Volume 2

Supporting Technical Products

The Newfound Watershed Master Plan

“It’s a place where you get the real sense of community, everybody knows everybody.”
Phil Twombly, Hebron

Volume 2 ~ Supporting Technical Products

Newfound Lake Tributary Assessment: Water/Phosphorus Budget - *University of New Hampshire Center for Freshwater Biology*

Newfound Lake Watershed Assessment – *University of New Hampshire Center for Freshwater Biology*

Geology of the Newfound Watershed – *Newfound Lake Region Association*

Wildlife Habitat in the Newfound Watershed – *New Hampshire Fish and Game Department*

Fish Species within the Newfound Watershed - *New Hampshire Fish and Game Department*

Native Brook Trout Study - *New Hampshire Fish and Game Department*

Forest Resources in the Watershed Communities – *New Hampshire Timberland Owners Association*

Strategic Conservation Efforts in the Newfound Watershed – *Society for the Protection of New Hampshire Forests*

Watershed Population and Housing Demographics – *Jeffrey H. Taylor and Associates*

Assessment of Master Plans and Land Use Regulations – *Jeffrey H. Taylor and Associates*

2007 Survey of Watershed Communities – *Plymouth State University Center for the Environment*

2009 Survey of Watershed Communities– *Plymouth State University Center for the Environment*

Oral Histories of Life in the Newfound Watershed – *Plymouth State University*

Math Lesson Worksheets – *Nancy Stock, Bridgewater Elementary School*

Map Resources

References and Additional Resources Available

- "Innovative Land Use Planning (*New Hampshire Department of Environmental Services*), including:
  - Permanent Stormwater Management (Low Impact Development)
  - Shoreland Protection: The Importance of Riparian Buffers
  - Erosion and Sediment Control During Construction
  - Steep Slopes and Ridgeline Protection
- Statewide Efforts that can Stimulate Stewardship
  - New Hampshire Water Resources Primer - *New Hampshire Department of Environmental Services*
  - New Hampshire Climate Action Plan - *New Hampshire Department of Environmental Services*
  - What's Our Water Worth? – *New Hampshire Lakes Association*
  - New Hampshire Stormwater Manual - *New Hampshire Department of Environmental Services*

Newfound Lake Tributary Assessment: Water/Phosphorus Budget

The Newfound Watershed Master Plan

NEWFOUND LAKE
TRIBUTARY ASSESSMENT

Water & Phosphorus Budget: October 2006 – September 2007

Prepared for:

NEWFOUND LAKE REGION ASSOCIATION

Prepared by:

UNH CFB

and

UNIVERSITY *of* NEW HAMPSHIRE
COOPERATIVE EXTENSION

Citation:
Craycraft, Robert C. and Jeffrey A. Schloss. July 2008. Newfound Lake Tributary Assessment, Water and Phosphorus Budget: October 2006 – September 2007. UNH Center for Freshwater Biology, UNH Cooperative Extension. University of New Hampshire. Durham, NH.

This work was funded by the New Hampshire Department of Environmental Services through a 319 Watershed Assistance Grant for High Quality Waters titled Newfound Lake Watershed Master Plan Development and Implementation.

Acknowledgements

The Newfound Lakes Region Association, in conjunction with the University of New Hampshire Center for Freshwater Biology and Cooperative Extension Water Resource Program, undertook an 18 month study of the Newfound Lake Watershed with the primary goal of identifying potential problem areas and providing recommendations to minimize future water quality impacts. The success of this project was the culmination of the assistance and guidance of numerous volunteers highlighted in Table 1 and the Newfound Lakes Region Association. Financial support for this project was provided

Table 1: Newfound Stream Volunteer Monitors (2006-2007).

Joe Allison	Ralph Donahue	Janet Towse
Vicki D'Alessandro	Kate Barrett	Bob Twombly
Dave Appeleton	Melinda Ryder	Betsy Twombly
Gene Banks	Dave Settele	Martha Twombly
Bill Bell	Boyd Smith	Phil Twombly
Joan Bell	Suzanne Smith	Linda Walsh
Carli Carrara		

through a monetary contribution from an anonymous donor within the Newfound Lake watershed. The Newfound Lakes Region Association, under the guidance of Deborah Johnson (former executive director), Boyd Smith (executive director) and Martha Twombly (program director), undertook the formidable task of coordinating this multi-site sampling effort, and assuring that samples and data were transferred to University of New Hampshire staff members on a timely basis. We also acknowledge Catherine Callahan, New Hampshire Fish and Game Geographical Information Specialist, who performed the Newfound Lake watershed delineations and who provided digital files that were used to generate the maps contained in this report, as well as Tim Carney, New Hampshire Department of Environmental Services Civil Engineer, who provided Newfound Lake Dam (outlet) discharge data and lake elevation data that were collected through the New Hampshire Department of Environmental Services Dam Bureau.

Jillian McCarthy, New Hampshire Department of Environmental Services Quality Assurance Coordinator, Vincint Perelli, New Hampshire Department of Environmental

Services Quality Assurance Manager, and Charles Porfert, Environmental Protection Agency New England Quality Assurance Officer, provided technical support and reviewed the Quality Assurance Project Plan that outlined the standard operating procedures used in this study. Steve Landry, New Hampshire Department of Environmental Services Project Coordinator, provided guidance and assistance with the development and implementation of the Newfound Watershed Master Plan initiative that will utilize the water quality data contained in this report in a watershed wide planning effort.

Laboratory space was provided by the University of New Hampshire College of Life Sciences and Agriculture while administrative support was provided by University of New Hampshire Cooperative Extension. Members of the University of New Hampshire Freshwater Biology Group laboratory and field team, who assisted in the collection and analysis of water quality samples include: John Baker, Robert Craycraft, Erin Cubly, Benjamin Ho, Karen Martel, Jennifer Thompson and Susan Wilderman.

Jeff Schloss, University of New Hampshire Cooperative Extension water resources specialist, provided guidance through the 18 month study period and provided editorial review of the summary report.

Executive Summary

Purpose and Objectives

The Newfound Lake watershed is located in the Towns of Alexandria, Bristol, Bridgewater, Danbury, Dorchester, Groton, Hebron, Plymouth and Orange. With continued development pressures facing local decision-makers in the nine towns, the need exists for scientifically based information that will provide support for proactive natural resource based planning within the Newfound Lake watershed. The New Hampshire Department of Environmental Services (DES), in conjunction with the Newfound Lake Region Association (NLRA), completed a phosphorus budget for Newfound Lake in 1992 (NLRA, 1996). The intent of the phosphorus budget was to provide a baseline data set that would be used for watershed planning. The 1992 Newfound Lake phosphorus budget identified a number of water quality measures that could be undertaken to minimize future water quality degradation, but lacked an implementation plan. The phosphorus budget that is summarized in this report was undertaken to identify potential threats to Newfound Lake that will guide the development of a Watershed Master Plan (WMP) as well as a series of educational workshops directed at helping local municipalities implement measures that protect natural resources and more specifically, protect water quality.

The Newfound Lake water/phosphorus budget is the first of two summary reports prepared by the University of New Hampshire Center for Freshwater Biology (CFB) as part of the WMP project that will focus on the Newfound Lake watershed, the current status of Newfound Lake and its tributaries, and measures that can be employed to minimize future water quality impacts. While this report emphasizes the stream inlets and the sources of water and phosphorus into the lake, the second report (due in April 2009) will include additional analyses and interpretation of the stream inputs as well as a detailed summary of the Newfound Lake water quality.

This intensive water quality monitoring project is part of a larger watershed master planning initiative that includes expertise in land-use and watershed planning, survey design and interpretation, education and outreach. The collective expertise of the professionals involved in this project will help educate the local municipal officials and will foster informed land-use planning decisions that will benefit future generations.

The core project team members for the Watershed Master Plan Project include:

- Robert Craycraft – University of New Hampshire Cooperative Extension and UNH Center for Freshwater Biology (water quality monitoring)
- Dr. Brian Eisenhauer – Plymouth State University Center for the Environment (social survey design and interpretation)
- Chris Duggan – Newfound Area School District (curriculum development and student engagement)
- Steve Landry – New Hampshire Department of Environmental Services Merrimack River Watershed Coordinator (development of watershed management plans)
- Boyd Smith – Newfound Lake Region Association Executive Director (project manager)

- Steve Whittman – Jeffrey H. Taylor and Associates (professional planner)

Scope

Water quality data were collected as part of the Newfound Lake water/phosphorus budget by both the CFB staff and by the Newfound Lake volunteer monitors between June 2006 and December 2007.

Tributary sampling was undertaken at twenty-three tributary sites and at the Newfound dam outlet (approximately ten feet upstream of the dam) at a sampling frequency that ranged from bi-weekly to weekly depending upon the sampling location and seasonal stream flow. Tributary data included the collection of temperature, specific conductivity, dissolved oxygen, pH, total phosphorus, stream flow and stream height (stage) measurements. The discharge, stream height (stage) and total phosphorus concentrations were used to develop the Newfound Lake water/phosphorus budget contained in this report.

Lake Monitoring

Supplemental 2007 in-lake water quality measurements included shoreline specific conductivity surveys, *E coli* bacteria and phosphorus samples while supplemental temperature, dissolved oxygen, total phosphorus, water clarity and microscopic plant "algal" abundance (measured as chlorophyll *a*) samples were collected at seven deeper and more centrally located sampling locations.

The complete accessory Newfound Lake dataset (unpublished data) will be discussed in detail in a subsequent water quality monitoring report scheduled for completion in April 2009. However, in-lake total phosphorus concentrations and deep water (hypolimnetic) dissolved oxygen concentrations from these data indicate that phosphorus re-circulation within the lake (internal nutrient loading) was negligible at the Newfound Lake sediment/water interface. Thus, when developing the Newfound water/phosphorus budget, the phosphorus loading values reported in this study are limited to external sources: atmospheric deposition (direct precipitation and windblown particles), stream inlets, non-channelized (diffuse) runoff and groundwater recharge.

Where does the water come from?

The Newfound Lake water/phosphorus budget was calculated over a twelve month period, from October 2006 – September 2007, that was characterized by above average precipitation that included heavy fall and spring rainfall (Figures 5 and 6). The Fowler River tributary inlet contributed 49.0% of the stream flow volume while the northwesterly Cockermouth River tributary inlet contributed 34.5% of the stream flow volume (Figure 9). The remaining tributary inlets collectively contributed 16.5% of the channelized stream flow volume. Like most New Hampshire lakes, the greatest volume of water entered Newfound Lake during the period of spring melt in March and April (Figure 7) during which heavy April 2007 rains also contributed to overland flow. Unusually heavy fall 2006 rainfall resulted in a second period of significant runoff between October and November. The largest volume of water exited Newfound Lake in April as spring melt rapidly recharged Newfound Lake and exceeded the lake's storage capacity. Heavy outflow, associated with the annual lake drawdown and coupled with heavy October rainfall, was also documented between October 2006 and January 2007.

Where does the phosphorus come from?

The dominant source of phosphorus entering Newfound Lake between October 2006 and September 2007 was from stream flow (74%) while contributions from atmospheric sources (12%), diffuse runoff (8%) and groundwater (6%) contributed significantly less phosphorus (Figure 10). Phosphorus entering Newfound Lake through stream flow closely mirrored the water inflow from the two larger tributaries with the Fowler River inlet contributing 47.98% of the phosphorus load followed by the Cockermouth River (18.81%). The remaining tributary inlets collectively contributed the remaining 33.21% phosphorus (Figure 12). The overall phosphorus load to Newfound Lake was low and characteristic of a pristine, heavily forested, New Hampshire watershed. However, both generalized and site-specific concerns exist and are detailed below as well as in the full technical report that follows.

Conclusions and Recommendations

The Newfound lake water/phosphorus budget results indicate that phosphorus primarily enters Newfound Lake as channelized stream flow while the quantitative data and the visual observations documented during the study period indicate that non-point source (NPS) pollution sources contribute to the phosphorus load. The Newfound Lake watershed is comprised of steep sloped areas that allow water to accelerate as it travels overland and it carries phosphorus and sediment particles down through the watershed and into Newfound Lake. The Newfound phosphorus budget indicates that there is an imbalance between the amount of phosphorus that comes into the lake and the amount of phosphorus that leaves the lake. Over 25% of the phosphorus that entered Newfound Lake between October 2006 and September 2007 (the period used to develop the phosphorus budget) was retained in the lake (Table 6). In other words, Newfound Lake tended to function as a large retention basin where phosphorus becomes "trapped" and accumulates over time in the bottom sediments. The total amount of phosphorus that was retained in Newfound Lake during study year totaled 1301.5 pounds (591.6 kilograms). The accumulation of phosphorus is part of the natural lake aging process, referred to as eutrophication, which occurs naturally over a geological time frame of thousands of years. However, the natural aging process can be accelerated through poorly planned land-use changes.

Many of the Newfound Lake tributary inlets are characterized by extensive bank-undercutting that reflects the erosive force of stream flow. However, extensive streamside (riparian) forests extend along most of the tributary inlets which help stabilize the stream banks and prevent excessive erosion. The retention of riparian forest cover is critical to the continued stability of the stream banks that prevent erosion and in return help protect water quality and protect critical fishery habitat. Healthy riparian buffers can also serve as travel corridors for upland wildlife species.

Future land-use planning efforts should consider minimizing the number of impervious surfaces such as road and out-buildings that tend to concentrate and accelerate overland water flow and thus increase the potential for erosion. Much of the

Newfound Lake watershed is steep sloped and is particularly susceptible to water quality problems due to the rapid runoff that is characteristic of the watershed. Thus, development and clearing of steep slopes should be carefully managed. Increases in impervious cover and the removal of natural forest canopy, associated with home site development, will alter the hydrology and can increase the discharge velocities of streams and the erosion potential of overland water flow. Impervious surfaces also reduce groundwater recharge and can result in atypically low in-stream water levels during summer low-flow (baseflow) periods.

The lack of in-stream flow can have adverse impacts on the local fishery and may also coincide with atypically low or dry dug wells for local residents. Efforts that foster the maintenance or replanting of shoreside “riparian” vegetation, and that minimize the channelization of water towards Newfound Lake and its stream inlets will help preserve the high water quality characteristics of the lake. The Newfound Lake Watershed Master Plan (in development) will be a good source of land use planning suggestions that balance the protection of natural resources, foster the retention of rural character, promote economic vitality and meet the needs of changing demographics and increasing population.

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Newfound Lake Watershed

Introduction

The quality of the Newfound Lake Watershed, the geographic area in which all water drains into Newfound Lake, is closely tied to water quality and quantity in Newfound Lake. Stated another way, a lake is a reflection of its watershed, and what occurs in that watershed can have significant impacts on whether the water quality improves, degrades or remains the same. As population growth occurs in our region and the resulting pressures from development and recreational use ensue, there is growing concern over the potential for degradation of lake water quality. The resulting symptoms of these impacts can include algal blooms, establishment of nuisance aquatic weeds, shoreline scums, declining fishery (as well as a decline in the lake's overall ecological integrity) and increased sedimentation. Of primary concern are the impacts of increased nutrient loading, caused by human activities in the watershed that result in accelerated plant growth (submerged and emergent vascular plants and algae) within the lake. Nutrients can come from many sources and include surface runoff resulting from precipitation upon the natural and developed areas of the lake's watershed (drainage basin). Additional nutrients are transported into the lake through stream inflow, groundwater, septic system effluent that leaches into groundwater and even from precipitation and dry fallout (dust particles). Activities within the watershed such as the construction of residential subdivisions result in removing or damaging vegetation, duff layers (leaf litter) and soils that, when left in an undisturbed and natural state, trap nutrients before they reach wetlands, streams, lakes and ponds. Roads, driveways and drainage ways increase channelized flow that tends to transport more runoff and nutrient laden materials through the watershed. Improper and unneeded fertilizer applications for agriculture and homeowner landscaping can also add to the nutrient load that reaches the lake.

Of the two nutrients most important to the growth of aquatic plants, nitrogen and phosphorus, it is generally observed that phosphorus is the more limiting to plant growth in lakes, and therefore the more important to monitor and control. Phosphorus is generally present in lower concentrations than nitrogen, and its sources arise primarily through human activity in a watershed. The total phosphorus discussed in this report includes dissolved phosphorus as well as phosphorus contained in or adhered to suspended particles such as sediment and plankton.

As little as 10 parts per billion of phosphorus in a lake can cause an algal bloom. Using a full Olympic swimming pool as an example, it would take 10 drops of water added to the approximately 130,000 gallons of water to equal 10 parts per billion. Extensive blooms will block sunlight and can depress oxygen levels in the water due to the death and subsequent microbial decomposition of plant and algal matter. Reduced oxygen concentrations can be detrimental to fish, plants and wildlife of the lake and can also result in the degradation of aesthetic quality due to events such as fish kills and accumulations of decaying material (muck) along the lake bottom. When the oxygen that is dissolved in the water becomes reduced below two milligrams per liter, phosphorus, the majority of which usually binds to the lake sediments and remains unreactive, can be released. Thus, it is important to obtain an understanding of the sources and amounts of phosphorus supplied to a lake from its watershed to control its input to the surface waters. The best method to achieve this is to conduct field sampling and derive a water and phosphorus budget – the focus of this study. The resulting information can be used as: a baseline to detect change over time, as a diagnostic tool to identify areas of concern within the Newfound Lake watershed which can then be the focus of mitigation, education and outreach efforts, and to develop science based policy to prevent future water quality degradation.

The Newfound Lake water / phosphorus budget is a component of a larger Watershed Master Planning project that will facilitate natural resource management at the watershed scale. Educational outreach efforts that evolve as part of this effort will involve numerous entities that include the NLRA, Jeffrey Taylor and Associates, the Lakes Region Planning Commission, Plymouth State University, DES, the University of New Hampshire and UNH Cooperative Extension, the watershed community, concerned citizens, the Newfound Area School District and local decision-makers.

Background Data

Newfound Lake Watershed

The Newfound Lake watershed encompasses the towns of Alexandria, Bristol, Bridgewater, Danbury, Dorchester, Groton, Hebron, Plymouth and Orange. Newfound Lake is located south of Plymouth and east of Mount Cardigan at a mean elevation of 179 meters (586 feet) above sea level. The Newfound River, which drains the lake, flows southerly through the Town of Bristol to the Pemigewasset River that forms the Merrimack River at its confluence with the Winnipesaukee River in Franklin (Table 2).

Table 2. Newfound Lake Summary Data

Latitude	43^{o}39'46"
Longitude	71^{o}46'31"
Lake Elevation	586 feet
Lake Area	4,451 acres
Maximum Depth	182 feet
Watershed Area	56,825 acres
Lake type	Natural with Dam
River Basin	Merrimack

Newfound Lake surface area and Watershed area were derived from 7.5 minute US Geological Survey mapping data that was digitized into a Geological Information System.

In the 1930s, Newfound Lake was artificially raised by a dam that is currently operated by the New Hampshire DES Dam Bureau. Newfound Lake is considered the deepest lake in New Hampshire with a maximum recorded depth of 55.5 meters (182 feet) and ranks fifth among the largest New Hampshire Lakes. The watershed is predominantly forested and includes two larger wetland complexes that drain into two of the larger streams: Georges Brook to the north and Bog Brook to the west. The watershed, delineated to the Newfound Lake Dam (outlet) at the Newfound River, totals 56,825 acres (Table 2 and Figure 1).

Geology and Topography

The bedrock geology of the Newfound Lake watershed, as typical of most New Hampshire watersheds, is predominantly granite and metamorphic rocks. Its topography is highly variable, with some of the flatter land located adjacent to the main stem of the Cockermouth and Fowler Rivers (Figure 2), and the Bog Brook tributary that is fed by a large meandering wetland complex. There is also flatter land around the perimeter of Newfound Lake, although steep sloped regions are interspersed and include "the Ledges" that is located northwest of Wellington State Park. Viewing the surrounding landscape, one sees hills and mountains in the distance that delineate the headwaters of Newfound Lake and the watershed divide with Mount Cardigan forming the highest land elevation of 3121 feet along the westerly watershed boundary. The bedrock geology and thin soils that do not retain much water, coupled with relatively steep slopes, cause the tributaries to experience rapid runoff during storm and snowmelt events. During these short-duration and high intensity runoff periods, rainfall and/or melt-waters tend to rapidly flow off the landscape and concentrate to form well-defined stream channels. The channels of many Newfound Lake tributary inlets are characterized by cobble and boulders as is expected in steep-sloped watersheds where finer materials are flushed downstream due to the erosive force of the water.

Figure 1: Newfound Lake Watershed (Generalized Landcover)

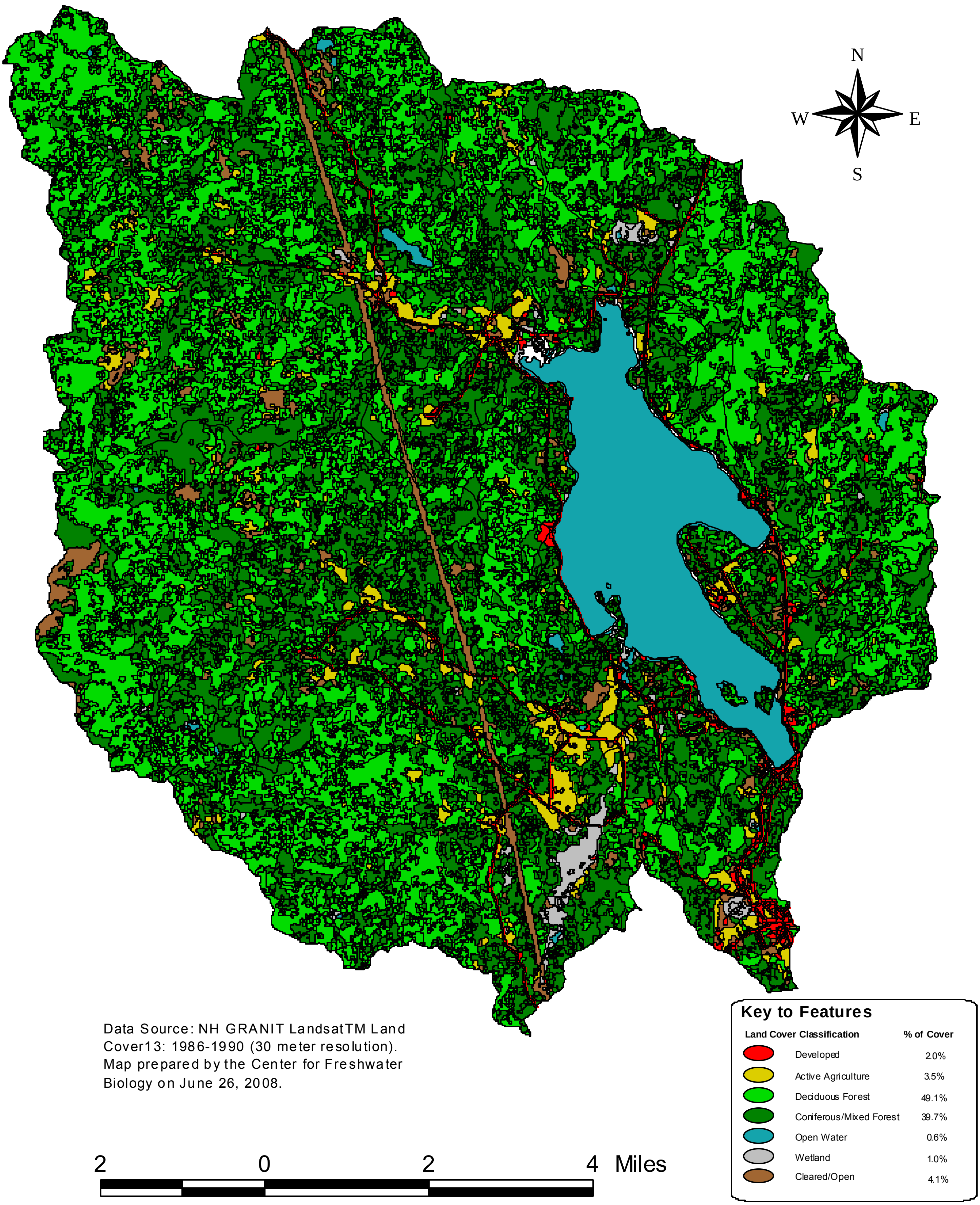
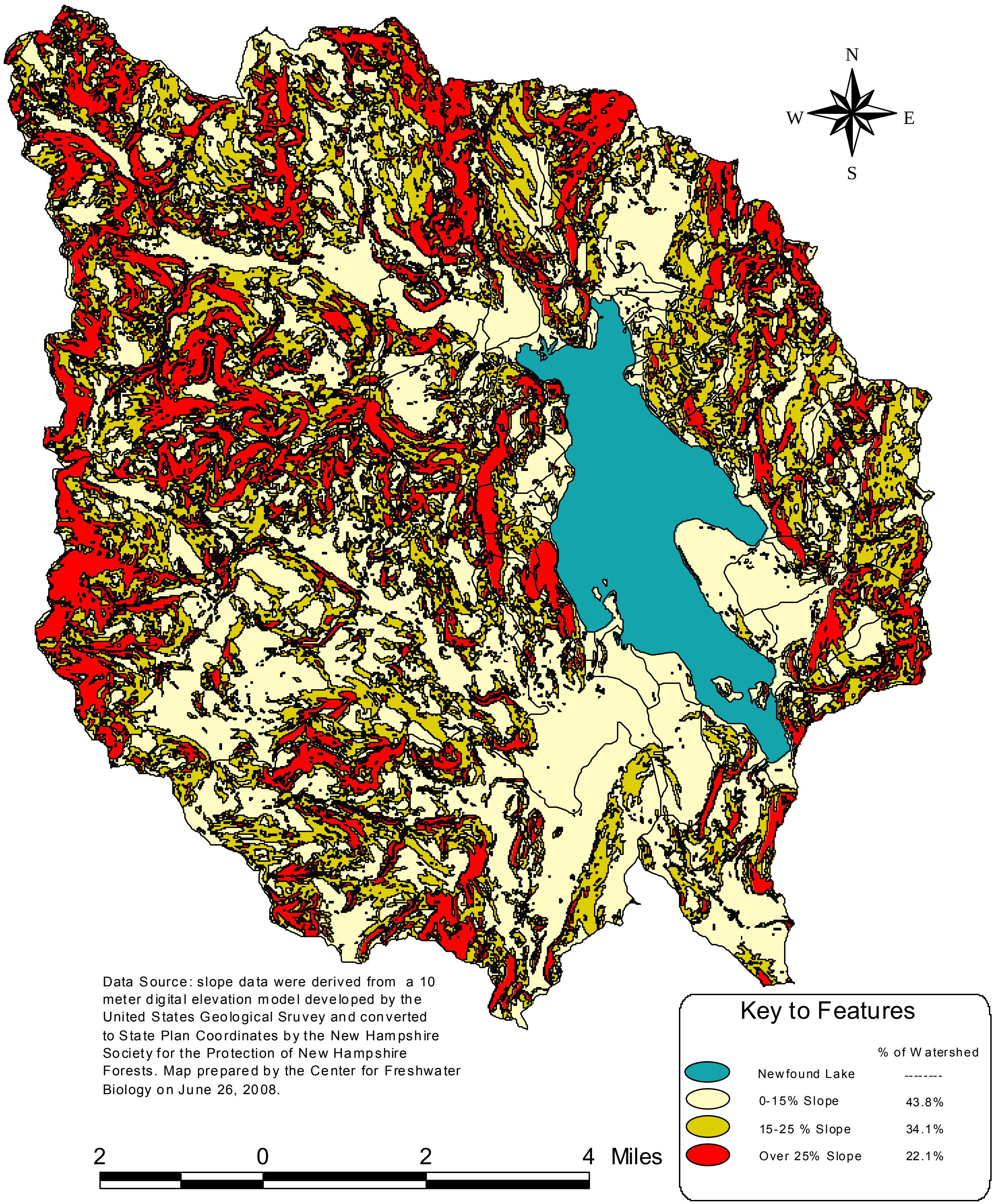


Figure 2. Newfound Lake Watershed (Slope)



Water and Phosphorus Budget Overview

While annual sampling of Newfound Lake has been ongoing through the New Hampshire Lakes Lay Monitoring Program since 1986, the primary emphasis of this report is the joint effort between the NLRA and the UNH CFB undertaken between June 2006 and December 2007. During this study period 1,481 total phosphorus samples were collected with 811 of these measurements collected between October 2006 and September 2007, the period of time chosen to develop the Newfound Lake annual (12 month) water / phosphorus budget.

The Newfound Lake hydrologic budget was determined by mass balance analysis of water inflow and outflow for hydrological year 2007 (October 2006 – September 2007). It is generally recommended to conduct a hydrologic analysis of forested watersheds starting at a period of high saturation following the spring runoff (April or May in our region; Hewlett 1982). However, sampling was not fully implemented at the 23 tributary inlet and tributary outlet sampling sites until September 2006 so that necessitated another strategy. The United States Geological Survey (USGS) hydrological year, October through September, was thus employed to develop the water and phosphorus budget for this study. It should be noted that the 2007 hydrological year was a wet year during which the measured precipitation over a twelve month period was nearly seven inches above average in some areas within the Newfound Lake watershed.

The Newfound Lake water budget is a sum of various water compartments and can be expressed as:

$$Qt + R + P + GWi = Qo + Ev + GWo$$

Where:

Qt =	Tributary inflow
R =	Overland runoff
P =	Precipitation
GWi =	Groundwater inflow
Qo =	Surface outflow
Ev =	Evapotranspiration
GWo =	Groundwater outflow

Figure 3. Newfound Lake Gauged Subwatersheds

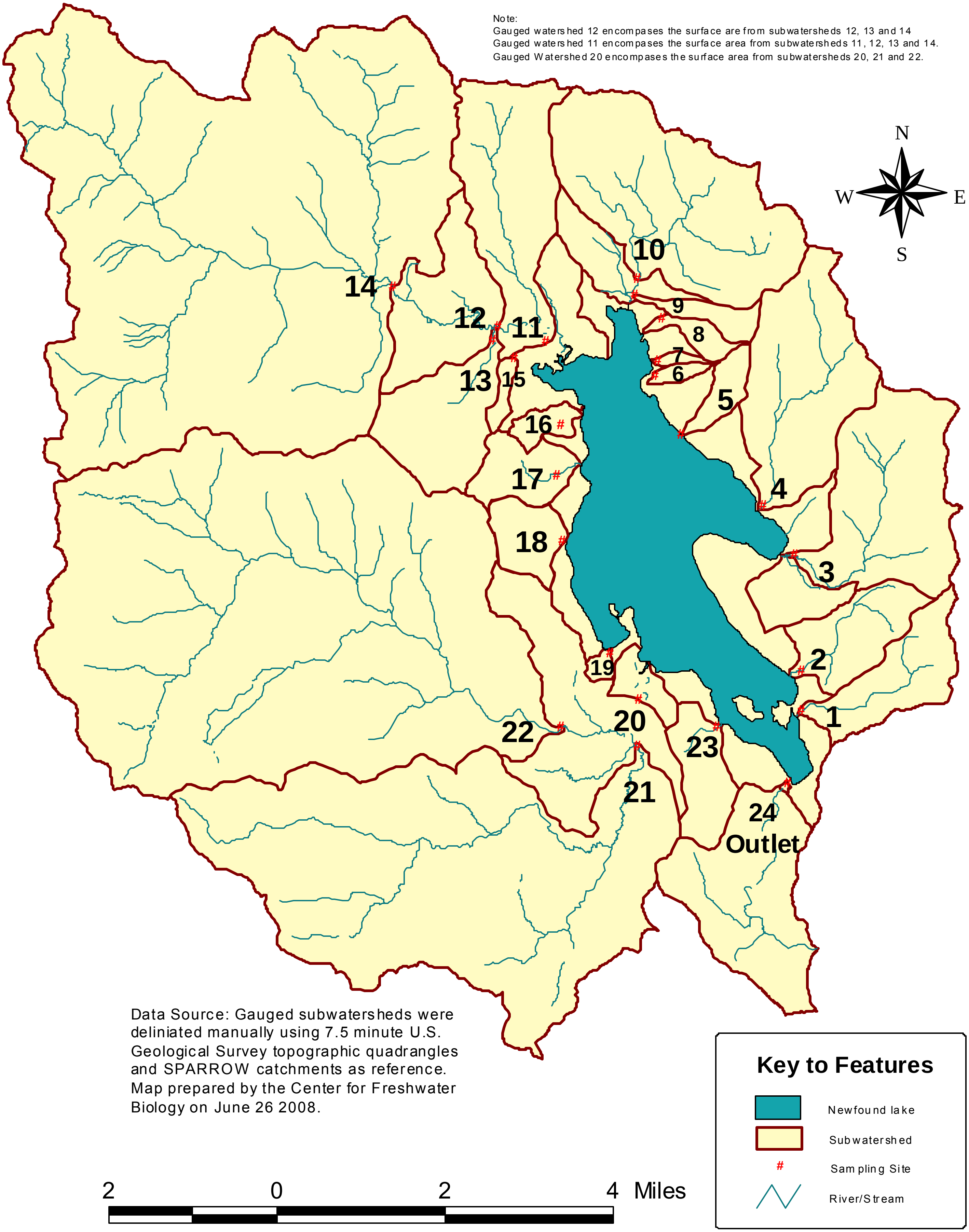
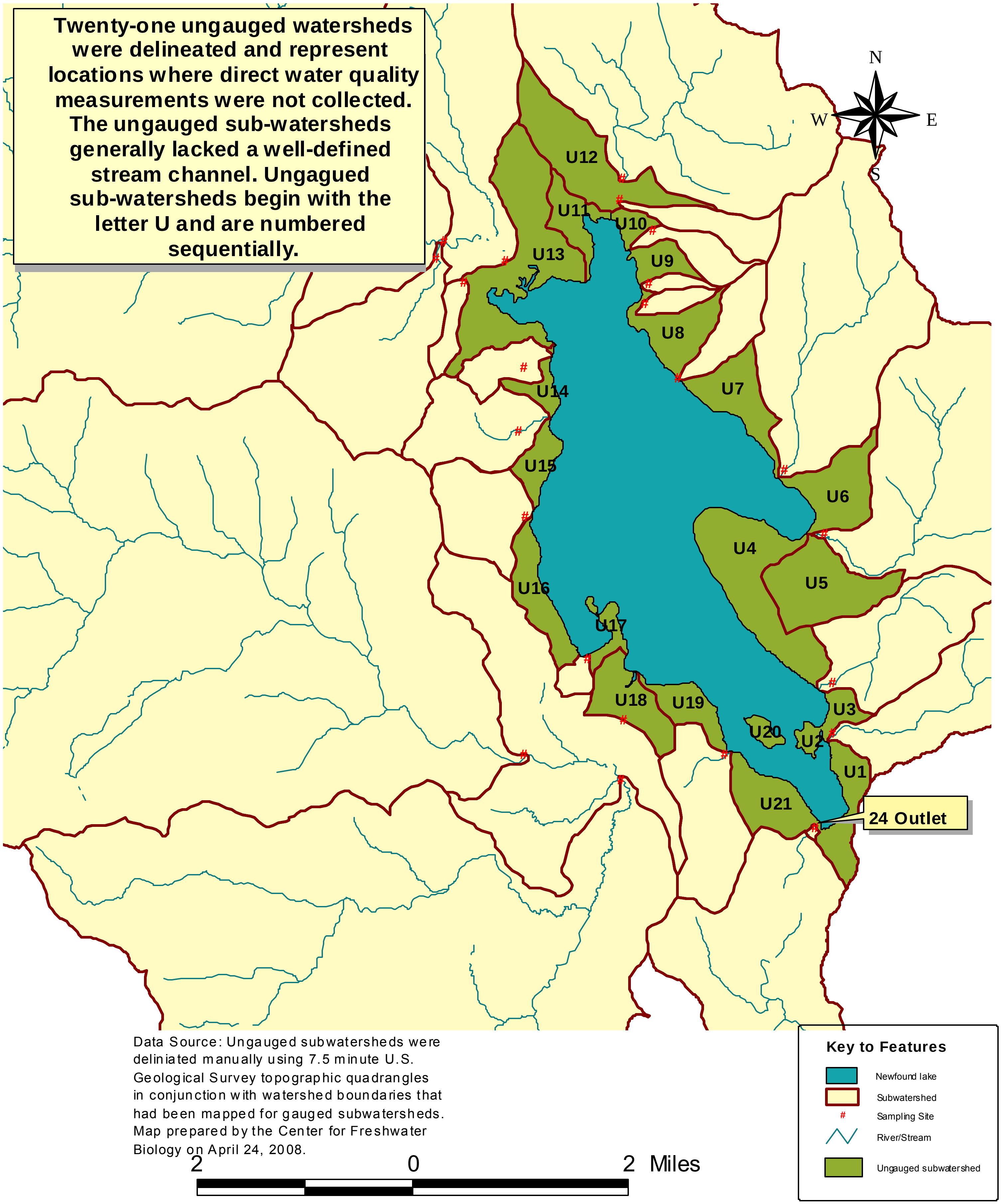


Figure 4. Newfound Lake Ungauged Subwatersheds



Data Source: Ungauged subwatersheds were deliniated manually using 7.5 minute U.S. Geological Survey topographic quadrangles in conjunction with watershed boundaries that had been mapped for gauged subwatersheds. Map prepared by the Center for Freshwater Biology on April 24, 2008.

Hydrologic Budget Modeling

Newfound Lake discharge values and total phosphorus loading values were modeled based upon data collected at 23 tributary inlet sites and the tributary outlet sites. A seasonal flow (based on seasonal base flow, rainfall degree, and resultant storm flows) integration approach was used to calculate daily flows and the results were summed for each month (this method is described in greater detail below in the “Tributary Sampling” section). This made the most of the substantial monitoring effort and prevented any anomalous or temporary high flow and phosphorus loading events from contributing any substantial bias (this is an improvement of the “mid-interval” time integration method as described in Monitoring Lake and Reservoir Restoration (1990)).

Sub-watershed Delineations

The Newfound Lake watershed was partitioned into two broad categories of overland runoff: 1) gauged sub-watersheds, where direct water quality measurements and stream discharge measurements were collected in well defined stream channels, and 2) ungauged watersheds, where direct water quality measurements were not collected and in most instances consisted of catchments that did not include a well defined stream channel. The Newfound gauged sub-watersheds (Figure 3) were delineated manually using 7.5' United States Geological Survey (USGS) topographic quadrangles and SPARROW catchments as reference. Ungauged sub-watersheds (Figure 4) were identified from a 10-meter digital elevation model (DEM) using the FLOW ACCUMULATION tool in the ArcGIS spatial analyst extension (ESRI, Redlands, CA). The 10-meter DEM originally created by the USGS, was projected to NH State Plane feet (NAD 83) by the Society for the Protection of New Hampshire Forests (February 2005).

Precipitation

Precipitation data were reviewed from four National Oceanic and Atmospheric Administration climatological sampling stations located in the vicinity that included Alexandria, Lakeport II (Laconia), Meredith and Plymouth (Table 3). Notice the substantial variation in monthly rainfall totals among the four stations. Anecdotal information from watershed residents, as well as personal observations made by CFB field team staff while conducting field sampling suggests that rainfall intensity and quantity within the watershed are highly variable. Based on a review of data collected at the gauged stream inlet sampling stations, rainfall data used to develop the hydrologic budget are based on the Alexandria weather station located within the Fowler River sub-

Table 3. Monthly precipitation comparison among climatological sampling stations (precipitation data are reported in inches)

	ALEXANDRIA 4	LAKEPORT 2	MEREDITH 3 NNE	PLYMOUTH
Latitude	**43°31'**	**43°33'**	**43°42'**	**43°46'**
Longitude	**71°48'**	**71°28'**	**71°28'**	**71°40'**
Elevation (feet)	**1160**	**500**	**830**	**540**
Time of observation	**0700 hrs**	**0700 hrs**	**2400 hrs**	
October-06	13.34	6.88	8.16	5.35
November-06	5.54	4.44	4.81	2.48
December-06	6.03	3.61	4.54	3.92
January-07	3.99	2.53	3.31	3.65
February-07	2.46	1.59	1.43	1.71
March-07	4.81	3.10	2.62	2.68
April-07	8.29	7.58	6.84	6.14
May-07	3.21	2.98	2.72	1.77
June-07	missing	2.83	2.46	2.18
July-07	5.79	4.38	3.70	no data
August-07	3.69	1.59	2.37	no data
September-07	4.07	2.80	3.48	no data
HY 2007 Total Rainfall	**61.22 ***	**44.31**	**46.44**	**---------**

Note: The Plymouth Climatological sampling station was removed from service in July 2007 and thus data gaps exist for July, August and September.
** the Alexandria precipitation total for HY 2007 does not include an estimated value for June-07.*

watershed and data collected at the Lakeport 2 sampling station in Laconia. The Alexandria station, located within the gauged Fowler River watershed and representing higher elevation conditions, should help approximate the rainfall within the westerly headwater region. Lakeport 2 precipitation data should approximate the rainfall in the lower elevation region and along much of the watershed located to the East of Newfound Lake. The monthly precipitation measured at the Alexandria and the Lakeport 2 climatological stations in hydrologic year 2007 (HY 2007) are depicted in Figures 5 and 6 while the long-term average monthly rainfall (1997 – 2007) is also displayed. The Hydrologic Year (HY) 2007 Lakeport 2 rainfall measured 44.31” relative to the long-term average of 44.73” measured over the past eleven years. On the other hand, the

Alexandria HY 2007 rainfall, excluding the June 2007 monthly total, measured 61.22" relative to the eleven year average of 54.42". The maximum HY 2007 monthly rainfall was documented in October 2006 at the Alexandria climatological station while the maximum monthly rainfall documented at the Lakeport II station occurred during the month of April 2007. All precipitation data were obtained from the National Oceanic and Administration (NOAA) National Climatic Data Center through the online TD-3200 database or as original station logs available online as PDF files.

Figure 5.

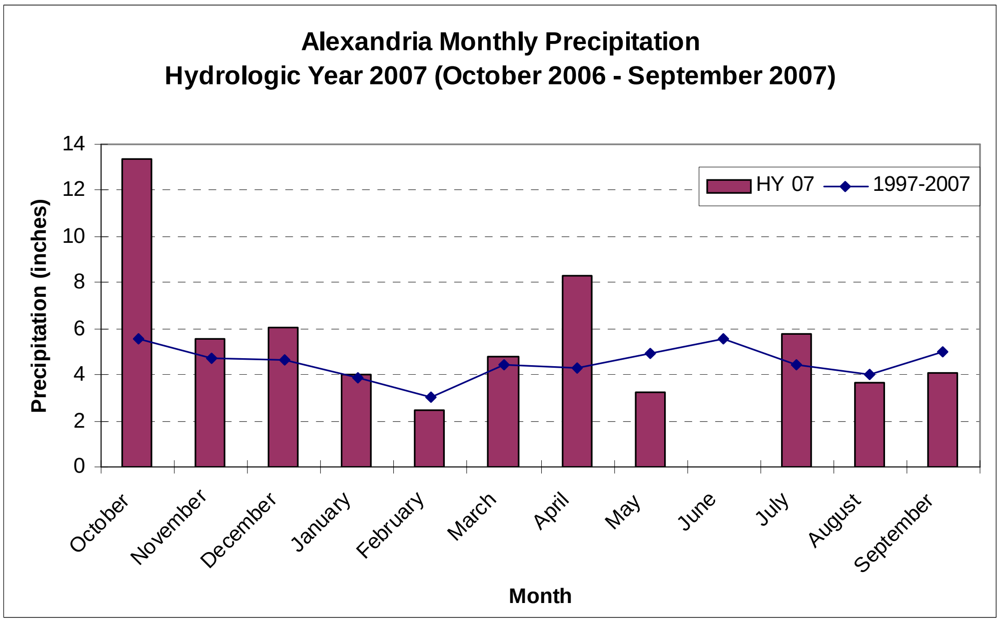
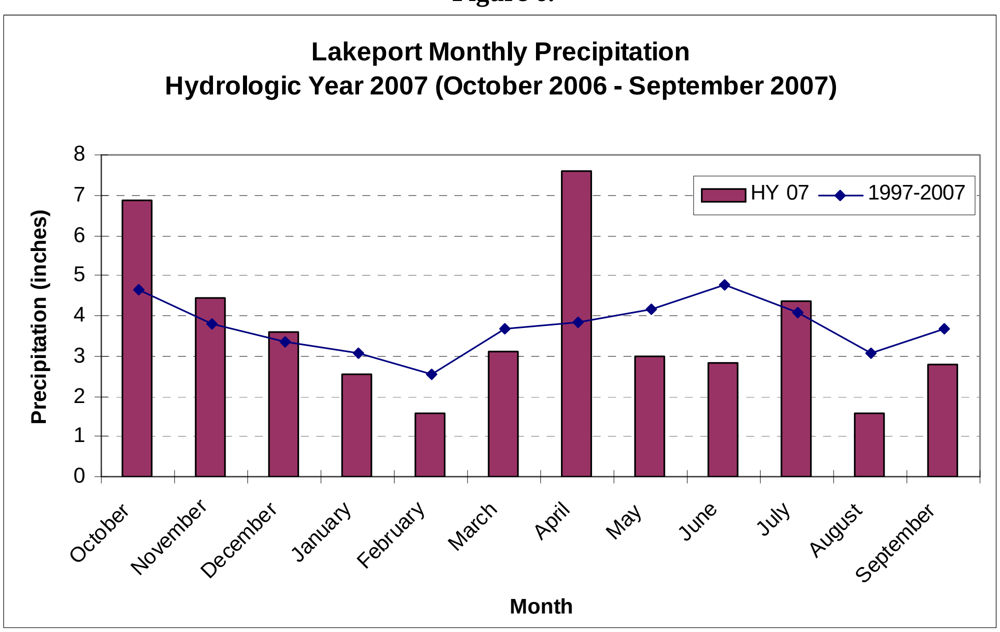


Figure 6.



Atmospheric (Direct Precipitation)

Precipitation directly on the lake (P) was derived by multiplying the monthly rainfall (in meters) by the surface area of the lakes (in square meters). The monthly precipitation values that were applied to the atmospheric deposition modeling were the average of the Lakeport II and the Alexandria monthly totals.

Atmospheric phosphorus loading is the result of precipitation, discussed in the introduction section, and dryfall. Atmospheric phosphorus loading was calculated by multiplying the over-lake precipitation (the average precipitation from the Alexandria and the Lakeport II sampling stations) by a phosphorus coefficient of .008 grams P per cubic meter that was used in two other studies: Hubbard Brook (Likens, 1977) and Squam Lake (Lewis et. al. 1976). The phosphorous coefficient of .008 grams P/m^3 was multiplied by the monthly rainfall to yield wetfall loading. Dry fall (from pollution, dirt and dust particles) was estimated as 20 percent of wetfall (Henson, 1977).

Groundwater

Groundwater inflow (Gwi) and outflow (Gwo) were not measured directly since our resources were limited and direct measurement tools such as pieziometers, ground penetrating radar and in-lake seepage meters are expensive and time consuming to employ. Groundwater inflow was instead estimated by comparing measured stream discharge in the gauged watersheds with predicted runoff that was obtained by multiplying the subwatershed area by the annual precipitation for that particular subwatershed. Each gauged subwatershed value was then multiplied by 52% to obtain the predicted runoff yield based on Knox and Nodenson (1955). Due to localized variations in precipitation throughout the watershed, the Fowler River subwatershed, where the Alexandria Climatological Sampling station is positioned, was ultimately used to derive the groundwater estimates since direct precipitation measurements were collected within the catchment. The Fowler River measured discharge (via staging) was 110.8% of the expected discharge yield and it was assumed that the additional 10.8% of unaccounted discharge was indicative of groundwater contributions. Based on this analysis, a groundwater estimate of 11% was used for this study. As there is a negligible altitude difference between the upper and lower lake areas groundwater inflow (GWi) was assumed to equal groundwater outflow (GWo) which has been a common assumption in past hydrological studies undertaken by both UNH and NH DES.

Water Balance: The difference between the total inflow and the total outflow for HY 2007 was 11,734,900 m^3 (5%; See Table 6 for inflow and outflow totals). *Note: one cubic meter is equivalent to 264 gallons.* In addition, the starting lake level was 0.27 feet lower than the lake level measured by the end of the study so there is a lake storage correction of 1,482,261 m^3. This was calculated by multiplying the lake level difference by the surface area of the lake. As there was a relatively small difference in lake level and the majority of the Newfound area has steep sloping shoreline this simple method was employed as opposed to trying to model the lake as an irregular cone. Thus, the total net difference between inflow and outflow is approximately 5.7% of extra outflow. This is quite acceptable as a model and measurement error given all of the complexities of this watershed study effort. However, this may also suggest that the groundwater outflow is actually a small amount greater than the inflow. For the purposes of this study, however, this groundwater outflow difference would not impact the results or interpretations of the data analysis.

Groundwater was not analyzed for phosphorus content directly as part of this study due to logistical issues associated with getting samples in a large geographic area that would be representative of the Newfound Lake drainage. A 1998 to 2000 study of Goose Pond, towns of Canaan and Hanover, New Hampshire, included the collection of phosphorus samples from shallow-wells immediately adjacent to Goose Pond that were used to calculate groundwater phosphorus loading in a similar study (Craycraft & Schloss, 2001). The groundwater phosphorus coefficient of .0057 milligrams per liter, derived for the Goose Pond study, was multiplied by the Newfound Lake monthly groundwater recharge values to estimate the Newfound groundwater phosphorus loading. The southern section of Newfound Lake is more developed than Goose Pond and thus the phosphorus coefficient of .0057 milligrams per liter might be considered a conservative (low) estimate for the southerly segment of Newfound Lake.

Evapotranspiration

Evaporation loss from the lake surface (Ev) was calculated by multiplying the lake's surface area by the monthly average pan evaporation recorded at Lakeport, NH for years 2006 and 2007 and using a pan coefficient multiplier of 0.77 (NOAA, 1982). The evapotranspiration data were obtained from the NOAA National Climatic Data Center.

Tributary Sampling

Staff gauges were installed at 20 tributary inlet sampling locations to monitor major water inflows (Qi) at areas that were accessible throughout the year while data were also collected at the Newfound Dam outlet (Qo) where a staff gauge had been installed as part of ongoing monitoring through the DES and the USGS (Table 4). Multiple sampling sites were implemented along the two larger tributary inlets, the Fowler River and the Cockermouth River, to track variations among sampling locations and to ensure that at least one site in each major tributary was wadeable during most streamflow conditions (Table 4). Tape measure (Keson Model OTR15M) readings were substituted for staff gauge readings at three of the larger tributaties where high discharge and rocky substrates necessitated an alternative to traditional staff gauge readings (Table 5). Tape measure readings were collected at a standard sampling location by lowering a weighted tape measure until the weight reached the surface of the water. The distance from the bridge to the surface of the stream was recorded to the nearest centimeter and served as a means to determine water depth (stage) and to calculate discharge. Thus, staging was conducted at a total of 23 tributary inlets (20 staff gauge sites and three tape measure sites).

Table 4. Newfound Lake Gauged Sampling Station Locations, Site Description and Sampling Rationale.

Study Streams	Site ID	Location: Latitude Longitude	Sampling Site Description	Stream Sampled in DES Study	Staff Gauge / Keson Survey Tape	Rationale/ Comments
Hemlock Brook	1	43°37’51.4” 71°44’09.3”	Junction of Sunset Drive and Route 3A.	Yes	Gauge	The Tributary sampling locations were selected to ensure all major sources of channelized flow entering and leaving Newfound Lake would be quantified in terms of discharge and phosphorus load. Discharge and phosphorus loading calculations in un-gauged sub-watersheds, where distinctive tributaries do not exist, were modeled using the areal phosphorus loading values from the most similar gauged watershed(s) to avoid errors that can arise when un-gauged watersheds are grouped or “lumped” into gauged watersheds.
Tilton Brook	2	43°38’15.8” 71°44’09.1”	Near Junction of Route 3A & Whittemore Pt. Road South.	Yes	Gauge	
Dick Brown Brook	3	43°39’28.4” 71°44’14.7”	Near Junction of Route 3A & Whittemore Pt. Road North.	Yes	Gauge	
Whittemore Brook	4	43°39’58.8” 71°44’41.8”	Near Junction of Route 3A, Paradise Road and Brook Road	Yes	Gauge	
Wilson Brook	5	43°40’43.0” 71°45’52.4”	Across from Favor Road at the Camp Pasquaney wooden walking bridge.	Yes	Gauge	
Yellow Brook	6	43°41’19.1” 71°46’14.5”	At junction of Onaway Point Road and Route 3A. Down Onaway Point Road as culvert passes under the road.	Yes	Gauge	
Post Office Brook	7	43°41’28.7” 71°46’11.7”	Adjacent to Merrill Road off of Route 3A.	Yes	Gauge	
Barn Brook	8	43°42’54.5” 71°46’08.7”	Off Route 3A next to address #49.	Yes	Gauge	
Cashman Brook	9	43°42’09.3” 71°46’31.8”	At junction of Cooper Road and Stony Brook Road	Yes	Gauge	
Georges Brook	10	43°42’19” 71°46’30”	At the junction of Cooper Road and Georges Brook	Yes	Survey Tape	
Cockermouth River (near lake)	11	43°41’39.9” 71°47’47.2”	At the junction of North Shore Road & the Cockermouth River	No	Gauge	
Cockermouth River (upstream)	12	43°41’49.4” 71°48’28.8”	At the intersection of Braley Road and the Cockermouth River	Yes	Gauge and Survey Tape	
Tannery Brook	13	43°42’40.7” 71°49’33.7”	Groton Road adjacent to the Hebron Public Safety Building	No	Gauge	
Cockermouth River (upstream)	14	43°42’14.1” 71°49’59.8”	Groton Road adjacent to the Groton Town Offices	No	Survey Tape	
Hebron Brook	15	43°41’29.7” 71°48’14.7”	Hebron Brook intersection with Cross Road.	Yes	Gauge	
Kendall Brook	16	43°40’48.6” 71°47’34.7”	Approximately 0.5 miles north of Camp Wicosutta. The stream is next to an house with an open field	Yes	Gauge	
Mason Brook	17	43°40’17.7” 71°47’38.2”	At Camp Wicosutta off of West Shore Road	Yes	Gauge	
The Ledges	18	43°39’36.1” 71°47’33.7”	At the Ledges condominium development off of West Shore Road	No	Gauge	
Wellington Brook	19	43°38’27.2” 71°46’52.6”	Near Bristol/Alexandria Town line & near trailhead parking. Down access road by Park Ranger Station	Yes	Gauge	
Fowler River	20	43°37’58.1” 71°46’28.1”	Fowler River at the intersection with West Shore Road.	Yes	Gauge	
Bog Brook	21	43°37’28.5” 71°46’29.0”	At the intersection of Fowler River Road and Bog Brook	No	Gauge and Survey Tape	

Study Streams	Site ID	Location: Latitude Longitude	Sampling Site Description	Stream Sampled in DES Study	Staff Gauge / Keson Survey Tape	Rationale/ Comments
Fowler River (upstream)	22	43°37’41.0” 71°47’34.4”	As the Fowler River intersects Fowler River Road	No	Survey Tape	see previous page
Black Brook	23	43°37’40.2” 71°45’22.7”	Junction of Brown’s Beach Road & West Shore Road	Yes	Gauge	
Newfound River	24	43°37’06.1” 71°44’20.8”	At the junction of West Shore Road and Old Route 3	Yes	Gauge	

During the ice-free season, weekly gauge height, or tape measure readings were collected by the NLRA volunteers while additional stream flow measurements and stream quality data were collected monthly by the CFB field team. Stream velocity measurements were obtained with a YSI/Sontek ADV flow meter by traversing the respective gauged stream channel and simultaneously collecting both depth and discharge measurements across the width of the stream. All stream velocity measurements were collected using the six-tenths method (the flow probe was positioned at six tenths the stream depth) which approximates the average velocity within the stream channel. Stream discharge and concurrent staff gauge measurements were used to develop rating curves that were subsequently used to calculate stream discharge volumes (Appendix B).

Supplemental Keson survey tape measurements were collected during high flow periods, when the staff gauges were fully submersed, at Site 12 (Cockermouth River) and Site 21 (Bog Brook). The tape measure readings were converted to staff gauge heights using standard regression analysis (Appendix C) and the calculated staff gauge heights were used in subsequent discharge calculations discussed above.

<u>Gauged sub-watersheds discharge calculations and water load</u>

Monthly tributary inflow for each gauged tributary was calculated by interpolation between the existing measurements. The intensity of sampling generally allowed for the measurement of base flow and storm event discharges for each month during the ice free season. Measured flow data from each of the gauged tributaries were partitioned into one of three "rain condition" discharges for that respective month as determined by recent precipitation that occurred within 24 hours to when the measurements were made: low (<.5 inches rainfall, moderate (0.5 inches precipitation to 0.99 inches) and high (>= 1" precipitation). The discharge estimate was generally based on at least two or more measured discharge values that were averaged. In the cases where only single measurements were available those measurements were checked against adjacent months for consistency. Daily flows, not directly measured, were estimated by applying a ”rain condition” discharge volume (characteristic of each individual tributary) to each day of the month. The sum of the estimated discharges is reported monthly for each gauged tributary. Any missing rain condition classes were derived for a given month using one of two methods that depended upon the availability of data and upon the recorded flow condition observations as described on the data sheets:

1) Discharge data were used from the abutting month where similar discharge patterns were documented for that season.
2) Discharge data from the previous year were examined for the similar time of the year, and weighted, to derive reasonable discharge values.

Due to lake level fluctuations and/or an insufficient number of discharge measurements, eight of the gauged streams were modeled based upon adjacent gauged tributaries that exhibited similar watershed characteristics and similar stream flow patterns (Table 5).

Table 5: Discharge Modeling of Gauged Tributaries

Site	Problem/deficiency	Corrective Action
3 Dick Brown Brook	Lake level interfered with staging during flood stage in 2006 and 2007.	Modeled discharge by multiplying the Whittemore Brook monthly discharge values by 1.018
7 Post Office Brook	Insufficient number of discharge data points	Modeled discharge by multiplying the Yellow Brook monthly discharge values by 0.588
8 Barn Brook	Insufficient number of discharge data points	Modeled discharge by multiplying the Cashman Brook monthly discharge values by 0.736
11 Cockermouth River	Lake level interfered with staging in 2006 and 2007	Modeled discharge by multiplying Site 12 Cockermouth River (the upstream Cockermouth River site) monthly discharge values by 1.115
14 Cockermouth River	Insufficient number of discharge data points	Modeled discharge by multiplying the Site 12 Cockermouth River (the downstream Cockermouth River site) monthly discharge values by 0.859
19 Wellington Brook	Lake level interfered with staging during flood stage in 2006 and 2007	Modeled discharge by multiplying the Ledges monthly discharge values by 0.1437
20 Fowler River	Lake level interfered with staging during the 2006 and 2007 sampling seasons.	Modeled discharge by multiplying the sum of the site 22 Fowler River and Site 21 Bog Brook (the two primary hydrologic sources to site 20 Fowler River) monthly discharge values by 1.0876
23 Black Brook	Lake level interfered with staging during flood stage in 2006 and 2007.	Modeled discharge by multiplying the Hemlock Brook monthly discharge values by 0.6503

Notes:

- The hydrologic modeling was based on choosing a similar gauged tributary and applying a corrective factor, derived from the difference in watershed area between the two sub-watersheds, to the calculated monthly discharge totals.
- All phosphorus loading calculations, used to derive the phosphorus budget, were based on site specific data collected at the tributaries summarized in Table 5.

Gauged sub-watershed phosphorus loading calculations

Daily total phosphorus loading values were also broken down into 24 hour rainfall classes as previously discussed. When total phosphorus data were missing for a particular class, data from the surrounding months of the same season were utilized during which similar total phosphorus characteristics had been observed. In general, the data from August and September 2006 were characteristic of dry summer conditions while data from October, November, December 2006 and January 2007 (through mid-month) were characteristic of a wet fall period during which coarse organic matter (i.e. leaf litter) was caught in the discharge. Data from late March, April and May 2007 were considered similar and characteristic of the spring runoff "high flow" period. Data from June, July, August and September were more characteristic of "low flow" periods while data from October and November 2007 were again characteristic of the "fall leaf senescence" period.

To avoid large total phosphors loading errors that could be associated with the use of any single total phosphorus value, high flow total phosphorus concentrations from the fall sampling period were averaged to better predict the phosphorus load during a significant (>= 1" rainfall) storm events in which large leaf debris and sediments tend to get caught in the "first flush" during the initial intense rainfall period and then the particle size tends to shift to smaller debris fragments and finer sediments as the storm tapers off and runoff velocity decreases. The general pattern observed in our water samples was an increase "spike" in particulate matter during peak rainfall and a gradual reduction in the particulate load as the intensity of the storm dissipated.

Ungauged sub-watershed runoff

Runoff volume (R) calculations were performed for twenty-one ungauged subwatersheds to best approximate the water load when direct measurements were unavailable. Phosphorus loading was modeled for each ungauged subwatershed as detailed below.

Ungauged sub-watershed runoff volume calculations

A standard runoff coefficient of 0.52 (*Knox and Nodenson 1955)*) was applied for the ungauged sub-watersheds that compose the Newfound drainage basin. The runoff coefficient was multiplied by the monthly rainfall totals measured at the Alexandria climatological sampling location to derive the total runoff volume (R) for each ungauged subwatershed.

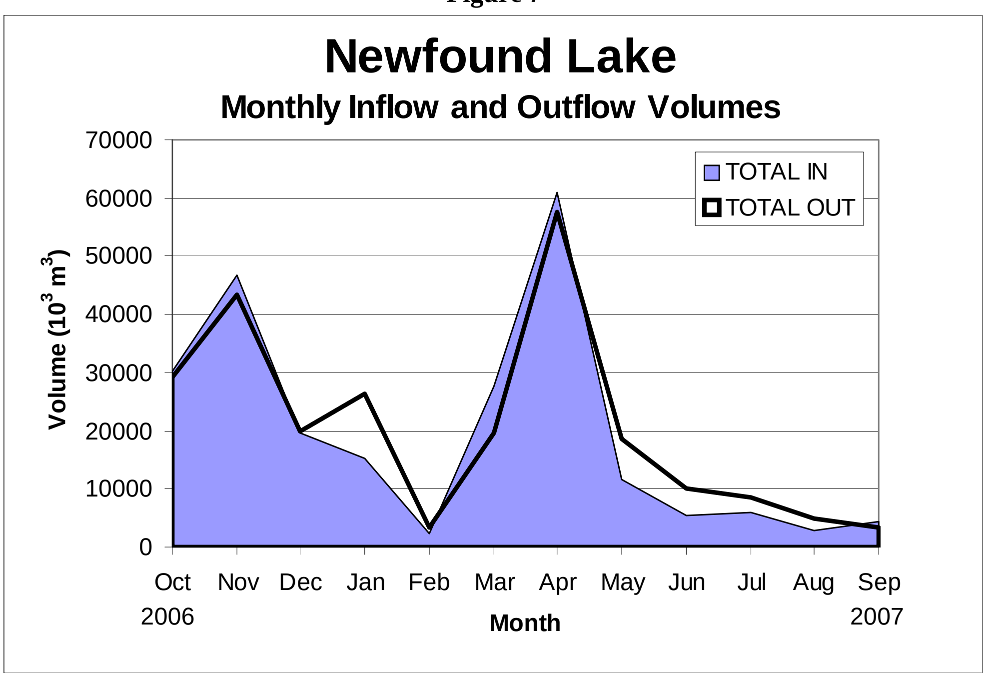
Ungauged sub-watershed phosphorus loading calculations

Land use classifications were derived for each gauged and each ungauged sub-watershed based upon the NH Geographically Referenced Analysis and Information Transfer System (NH GRANIT; UNH Complex Systems Research Center) LandCover data layer (2001). These data layers were divided into six generalized land cover classes: developed, agriculture, water, wetlands, open and forested. In each ungauged subwatershed, phosphorus coefficients (derived for gauged sub-watersheds in this study; refer to figure 13) were applied to each ungagued sub-watershed and multiplied by the number of hectares to yield the annual phosphorus load. Phosphorus coefficients were applied to ungauged sub-watersheds based upon similarities in the generalized land cover classes between gauged and ungauged sub-watersheds and proximity to similar sub-watersheds. To distribute this calculated annual phosphorus load over the hydrologic year of the study, the relative monthly precipitation percent was used to fractionalize the annual load into monthly estimates.

Hydrologic Budget for Study Year 2007: October 2006 – September 2007

The hydrologic budget, calculated as described above and summarized on a monthly basis, is presented in Table 6. In terms of mass balance, the difference between the annual inflow and the annual outflow was 5.7 percent. Given the size and complexity of the watershed this estimate seems very reasonable. Figure 7 graphically represents the monthly inflow/outflow volumes for Newfound Lake. As is typical to watersheds in our region, the greatest inflow typically occurs in March, April and May as the result of snowmelt and spring storms. The April 2007 inflow volume is slightly higher than one might expect during a "normal" year but can be explained by the atypically high April rainfall. Inflow did not always balance with outflow on a monthly basis as a result of wetland storage/release, lake level controls and model/measurement error. However, as stated above, the annual mass balance was off by less than 6 percent; the monthly discrepancies balanced out for the most part. The discrepancies between inflow and outflow were most obvious in January 2007, where outflow was significantly

Figure 7

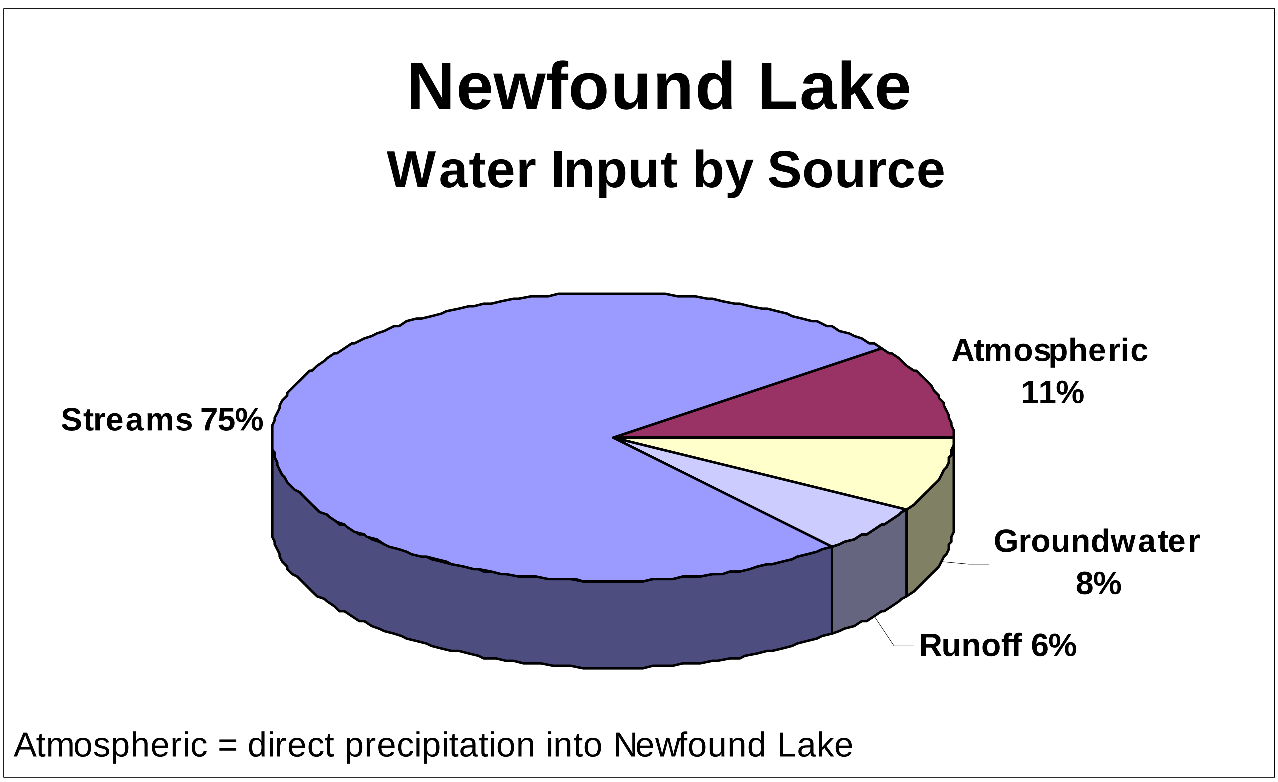


higher than inflow. This likely reflects conditions where frozen tributaries are providing reduced inflows while the lake level is lowered in anticipation of the spring runoff period. Inflow exceeded outflow during the month of March 2007 as would be expected when the lake recharged during the period of spring melt. October and November (2006) water inflow, and corresponding outflow, was also atypically high due to storm events during that period.

Where does the water come from?

Figure 8 depicts the relative water inflow by source type. The tributaries are the major water source to the lake and represent 75% of the inflow volume followed by direct precipitation (11%), groundwater inflow (8%) and surface runoff (6%). Of the subwatershed tributaries monitored during this study, the Fowler River tributary inlet contributed 49.0% of the channelized flow followed by the Cockermouth River that contributed 34.5% of the stream flow (Figure 9). The Fowler River and Cockermouth River subwatersheds compose 43.4% and 34.6% of the Newfound Watershed,

Figure 8



respectively, and the measured discharge volumes are closely related to the drainage areas. Georges Brook, Dick Brown Brook and Whittemore Brook collectively contribute 10.8% of the inflow while the remaining tributaries that include Wilson Brook, Cashman Brook, Hebron Brook and Barn Brook flow well during the period of spring melt and following heavy storm events but either dry up completely or become a series of isolated pools during the summer months. The latter tributaries collectively comprise 5.7% of the annual inflow.

Figure 9

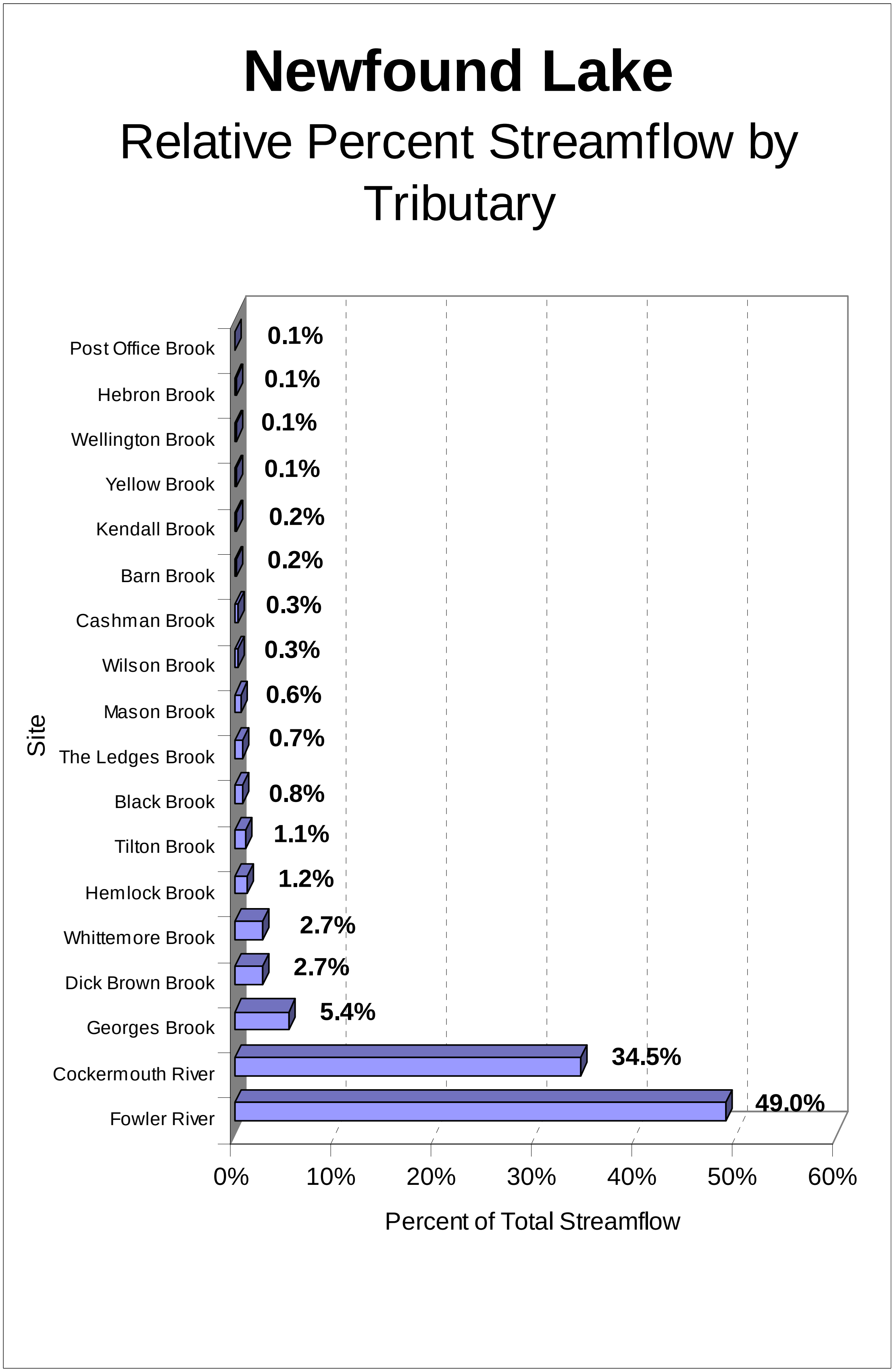

Newfound Lake
Relative Percent Streamflow by Tributary
Post Office Brook
Hebron Brook
Wellington Brook
Yellow Brook
Kendall Brook
Barn Brook
Cashman Brook
Wilson Brook
Mason Brook
The Ledges Brook
Black Brook
Tilton Brook
Hemlock Brook
Whittemore Brook
Dick Brown Brook
Georges Brook
Cockermouth River
Fowler River
0.1%
0.1%
0.1%
0.1%
0.2%
0.2%
0.3%
0.3%
0.6%
0.7%
0.8%
1.1%
1.2%
2.7%
2.7%
5.4%
34.5%
49.0%
Site
0%
10%
20%
30%
40%
50%
60%
Percent of Total Streamflow

Table 6

NEWFOUND LAKE HYDROLOGIC BUDGET

Water Year 2007 (October 2006 - September 2007)

units are water volume in 1000 cubic meters (10^3 m^3) (1 m^3 = 264 gallons)

	2006			2007									Total
	Oct	***Nov***	***Dec***	***Jan***	***Feb***	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Year**
Tributaries													
Hemlock Brook	227.0	321.5	276.6	289.0	4.1	368.3	451.1	113.0	32.1	19.4	4.1	21.4	2127.6
Tilton Brook	52.0	253.6	225.9	220.1	24.8	393.7	447.3	152.2	36.2	32.3	24.8	21.1	1884.0
Dick Brown Brook	290.3	1263.5	407.5	507.6	13.7	798.5	1110.8	222.8	81.5	97.9	13.7	23.6	4831.3
Whittemore Brook	285.2	1241.1	400.3	498.6	13.4	784.4	1091.1	218.9	80.0	96.2	13.4	23.2	4745.9
Wilson Brook	44.3	99.7	55.6	86.0	0.0	64.2	174.7	48.7	4.2	5.2	0.0	2.2	584.7
Yellow Brook	11.0	33.2	33.0	24.2	0.8	20.3	52.4	12.5	4.1	8.6	0.6	2.7	203.5
Post Office Brook	6.9	19.5	19.4	14.2	0.5	5.6	30.8	7.4	2.4	5.0	0.4	1.6	113.8
Barn Brook	50.2	87.6	18.5	49.5	0.0	64.9	95.7	5.9	0.0	0.0	0.0	0.0	372.3
Cashman Brook	68.2	119.0	25.1	67.2	0.0	133.4	130.1	8.0	0.0	0.0	0.0	0.0	551.0
Georges Brook	725.9	2729.4	585.2	1129.3	22.5	1130.0	2454.7	332.0	77.6	61.7	22.5	160.4	9431.2
Cockermouth River	8967.1	16766.0	2831.4	2669.7	155.2	8038.3	17337.4	2609.4	702.2	244.2	155.2	192.9	60669.0
Hebron Brook	16.5	55.6	10.8	20.5	0.5	0.5	56.5	4.7	2.5	0.4	0.5	0.9	169.7
Kendall Brook	29.4	61.9	15.4	28.1	0.7	47.8	80.2	11.3	3.6	2.7	0.7	1.3	283.1
Mason Brook	122.8	193.9	66.6	188.8	11.2	122.3	205.8	21.3	11.3	11.2	11.2	13.6	980.1
The Ledges Brook	77.2	241.5	36.8	64.0	7.4	324.5	459.7	47.5	16.1	9.5	7.4	13.8	1305.5
Wellington Brook	11.1	34.7	5.3	9.2	1.1	7.6	92.5	6.8	2.3	1.4	1.1	2.0	175.0
Fowler River	9724.5	15346.8	9399.7	5521.1	622.1	9892.8	25353.2	4690.2	2101.4	1532.1	622.1	1342.2	86148.2
Black Brook	147.6	209.1	179.9	187.9	2.7	239.5	293.4	73.5	20.8	12.6	2.7	13.9	1383.6
TRIBUTARIES TOTAL	**20857.2**	**39077.6**	**14593.1**	**11574.9**	**880.9**	**22436.7**	**49917.2**	**8585.9**	**3178.3**	**2140.4**	**880.6**	**1836.8**	**175959.4**
ATMOSPHERIC	**4625.2**	**2282.9**	**2205.1**	**1491.4**	**926.4**	**1809.4**	**3630.2**	**1415.9**	**1294.7**	**2326.3**	**1207.8**	**1571.5**	**24786.7**
GROUNDWATER (In)	**2294.3**	**4298.5**	**1605.2**	**1273.2**	**96.9**	**2468.0**	**5490.9**	**944.4**	**349.6**	**235.4**	**96.9**	**202.0**	**19355.5**
RUNOFF	**2440.1**	**1204.4**	**1163.3**	**786.8**	**488.7**	**954.6**	**1915.2**	**747.0**	**683.0**	**1227.3**	**637.2**	**829.1**	**13076.7**
TOTAL IN	**30216.8**	**46863.4**	**19566.7**	**15126.4**	**2393.0**	**27668.6**	**60953.4**	**11693.3**	**5505.6**	**5929.5**	**2822.4**	**4439.3**	**233178.4**
EVAPORATION	**627.0**	**398.1**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**1937.5**	**1962.1**	**2036.1**	**2127.7**	**1476.0**	**10564.5**
GROUNDWATER (Out)	**2294.3**	**4298.5**	**1605.2**	**1273.2**	**96.9**	**2468.0**	**5490.9**	**944.4**	**349.6**	**235.4**	**96.9**	**202.0**	**19355.5**
DISCHARGE (Dam)	**26363.2**	**38590.2**	**18410.3**	**25124.4**	**3205.1**	**17167.1**	**52130.3**	**15681.5**	**7657.9**	**6267.4**	**2623.7**	**1772.3**	**214993.3**
TOTAL OUT	**29284.6**	**43286.8**	**20015.6**	**26397.7**	**3302.0**	**19635.1**	**57621.2**	**18563.4**	**9969.6**	**8538.9**	**4848.3**	**3450.3**	**244913.3**

Phosphorus Budget for Hydrologic Year 2007: October 2006 – September 2007

The primary source of external phosphorus entering Newfound Lake was through stream flow (74%) while the atmospheric (12%), diffuse runoff (8%) and groundwater (6%) components contributed significantly less phosphorus (Figure 10). The maximum phosphorus inflow (predominantly stream flow) occurred during the month of April followed by heavy phosphorus loadings in November, October and March (Figure 11). A spring phosphorus maximum is generally associated with the spring thaw period during which significant stream flow results from melting snowpack coupled with intense storm events. The heavy spring runoff coincides with a period of minimal vegetative cover, as the summer foliage has not yet bloomed, increasing the probability that sediments and nutrients will make their way into Newfound Lake.

The 2007 Newfound Lake hydrologic year was unusual and included an atypically high period of rainfall in October 2006 (Figures 5 and 6). Leaf debris was documented in many of the fall 2006 water samples, including samples collected during periods of high discharge, and was partially responsible for the elevated fall phosphorus loading values. Periods of heavy precipitation can, as indicated above, provide a substantial phosphorus load to our lakes. Phosphorus loading can be exacerbated when improper land use practices destabilize the soils and increase the potential for the erosion of phosphorus laden sediments and debris.

Table 7

NEWFOUND LAKE PHOSPHORUS BUDGET

Water Year 2007 (October 2006 - September 2007)

units are Kilograms Phosphorus (Kg P)

	2006			2007									Total
	Oct	***Nov***	***Dec***	***Jan***	***Feb***	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Year**
Tributaries													
Hemlock Brook	4.32	5.67	2.40	2.55	0.02	4.99	6.06	0.99	0.17	0.10	0.02	0.10	27.38
Tilton Brook	1.22	3.97	2.80	3.39	0.11	2.07	3.25	0.77	0.16	0.13	0.10	0.11	18.09
Dick Brown Brook	7.79	34.89	4.40	1.73	0.06	6.43	16.02	1.22	0.39	1.81	0.13	0.20	75.05
Whittemore Brook	9.63	39.13	3.54	2.09	0.06	4.76	5.85	0.98	0.37	0.65	0.06	0.11	67.23
Wilson Brook	0.57	1.18	0.49	0.38	0.00	0.35	0.83	0.29	0.04	0.05	0.00	0.02	4.19
Yellow Brook	0.16	0.38	0.36	0.19	0.00	0.27	0.66	0.11	0.03	0.12	0.01	0.05	2.35
Post Office Brook	0.08	0.20	0.21	0.10	0.00	0.15	0.57	0.04	0.01	0.03	0.00	0.02	1.41
Barn Brook	0.91	0.60	0.12	0.20	0.00	1.18	0.76	0.03	0.00	0.00	0.00	0.00	3.81
Cashman Brook	0.63	0.76	0.06	0.31	0.00	2.24	1.78	0.03	0.00	0.00	0.00	0.00	5.81
Georges Brook	8.08	26.20	5.22	7.15	0.20	9.70	16.26	5.05	1.37	1.27	0.64	1.84	82.99
Cockermouth River	27.80	97.00	9.27	11.35	1.28	81.25	159.12	9.33	7.71	1.66	1.49	1.24	408.50
Hebron Brook	0.16	0.51	0.08	0.24	0.00	0.00	0.43	0.02	0.02	0.00	0.00	0.01	1.48
Kendall Brook	0.34	0.52	0.11	0.16	0.00	0.36	0.68	0.08	0.04	0.03	0.01	0.02	2.37
Mason Brook	1.83	1.41	0.40	0.96	0.05	1.32	2.59	0.13	0.05	0.04	0.05	0.12	8.95
The Ledges Brook	0.92	1.38	0.12	0.18	0.02	2.07	2.63	0.13	0.03	0.02	0.02	0.08	7.59
Wellington Brook	0.43	0.64	0.08	0.11	0.01	0.10	1.10	0.22	0.09	0.05	0.04	0.06	2.93
Fowler River	100.10	122.13	75.63	36.72	2.33	64.59	188.85	27.44	21.30	15.07	10.60	20.58	685.33
Black Brook	3.25	3.65	2.39	2.40	0.02	3.94	5.42	0.92	0.66	0.19	0.04	0.19	23.07
TRIBUTARIES (TOTAL)	**168.23**	**340.21**	**107.66**	**70.20**	**4.17**	**185.76**	**412.85**	**47.79**	**32.43**	**21.22**	**13.23**	**24.75**	**1428.50**
RUNOFF	**31.14**	**12.93**	**14.08**	**9.31**	**5.74**	**11.23**	**19.35**	**7.49**	**6.61**	**13.52**	**8.61**	**9.50**	**149.51**
ATMOSPHERIC	**44.40**	**21.92**	**21.17**	**14.32**	**8.89**	**17.37**	**34.85**	**13.59**	**12.43**	**22.33**	**11.59**	**15.09**	**237.95**
GROUNDWATER (IN)	**13.08**	**24.50**	**9.15**	**7.26**	**0.55**	**14.07**	**31.30**	**5.38**	**1.99**	**1.34**	**0.55**	**1.15**	**110.33**
TOTAL IN	**256.85**	**399.56**	**152.06**	**101.09**	**19.36**	**228.43**	**498.35**	**74.26**	**53.46**	**58.41**	**33.99**	**50.48**	**1926.29**
GROUNDWATER (OUT)	**13.08**	**24.50**	**9.15**	**7.26**	**0.55**	**14.07**	**31.30**	**5.38**	**1.99**	**1.34**	**0.55**	**1.15**	**110.33**
DISCHARGE (at Dam)	**133.13**	**221.25**	**91.13**	**168.59**	**10.21**	**57.61**	**271.08**	**58.81**	**54.95**	**32.49**	**10.23**	**4.55**	**1224.35**
TOTAL OUT	**146.21**	**245.75**	**100.28**	**175.84**	**10.77**	**71.68**	**302.38**	**64.19**	**56.94**	**33.83**	**10.78**	**5.70**	**1334.67**

Figure 10

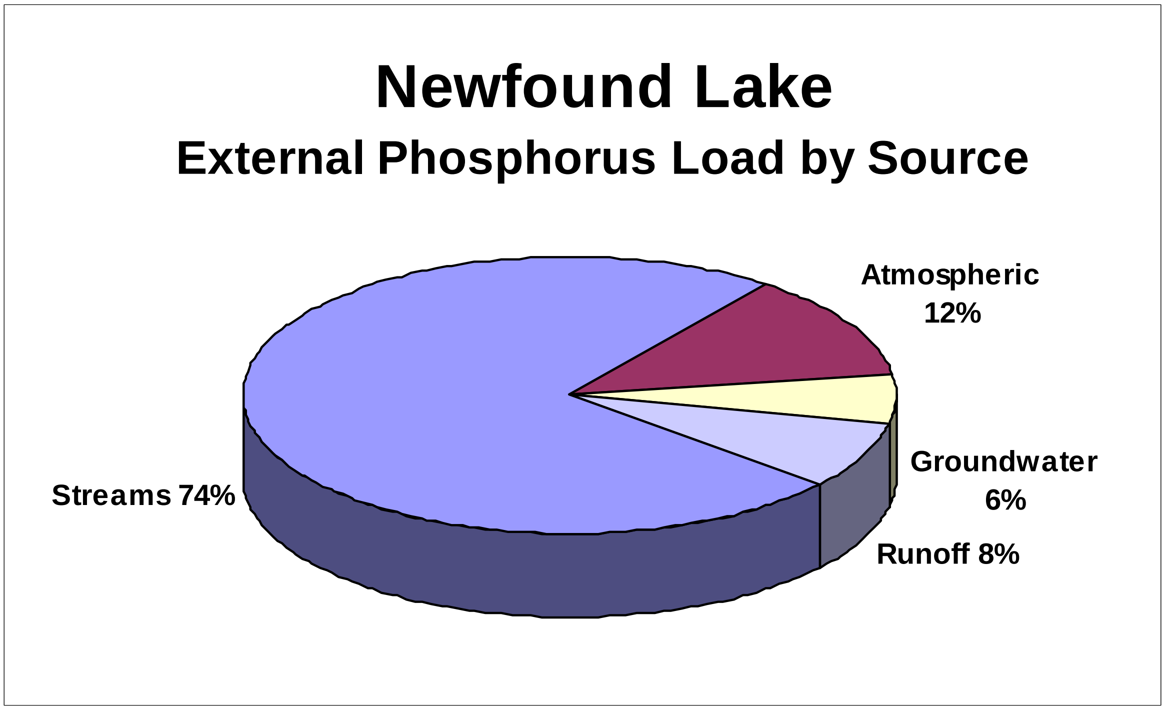
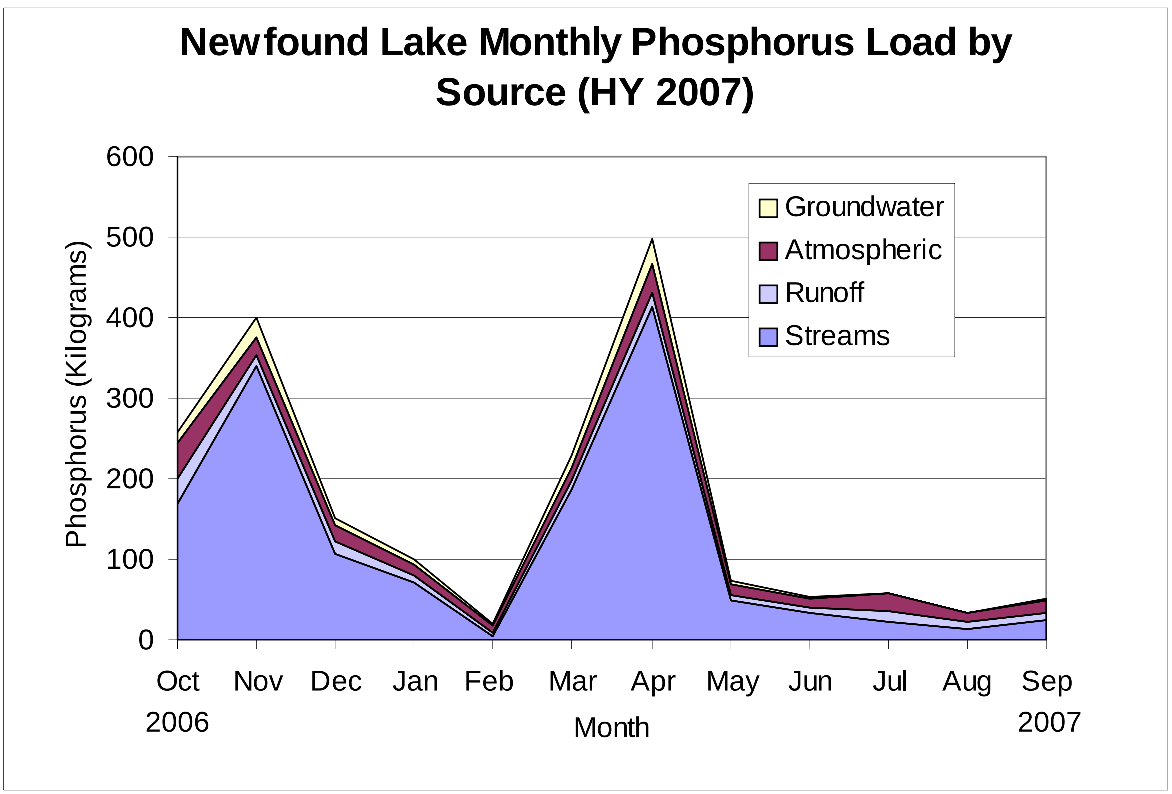


Figure 11



A breakdown of the yearly phosphorus loading from the Newfound Lake tributaries is illustrated in Figure 12. The Fowler River subwatershed accounted for 48.0% of the total yearly tributary loading during HY 2007 while the Cockermouth River accounted for an additional 18.8% of the phosphorus load. Three tributaries contributed significantly less phosphorus into Newfound Lake: Georges Brook (4.3%), Dick Brown Brook (3.6%) and Whittemore Brook (3.2%). None of the remaining tributaries individually contributed more than 1% of the annual phosphorus load (Figure 12).

While the data presented in Figure 12 are useful and provide an overview of the major phosphorus sources into Newfound Lake, the data can also be misleading due to large variations in subwatershed areas that will have an appreciable influence on the phosphorus loading values. The annual phosphorus loading values for this study ranged from 1.41 kilograms for the 18.38 hectare Post Office Brook subwatershed to 685.33 kilograms for the 9195.34 hectare Fowler River subwatershed (Table 8). A common practice used by hydrologists and natural resource professionals is to report phosphorus loading values as the phosphorus load per unit time per unit area; the areal phosphorus load. In essence, the areal phosphorus load normalizes the loading values by dividing the measured phosphorus for a particular tributary by the sub-watershed surface area.

The areal phosphorus load documented in the gauged Newfound Lake subwatersheds ranged from 0.033 kilograms per hectare per year (kg/ha/yr) to 0.117 kg/ha/yr (Figure 13 and Table 8). *One hectare is equivalent to 2.47 acres*. The highest areal phosphorus load was documented for the forested Wellington Brook subwatershed where fine particulate organic matter tended to be caught in the stream flow. All areal phosphorus loading values were relatively low and characteristic of relatively undeveloped New Hampshire watersheds.

Historical areal phosphorus loading values were developed for the Newfound Lake watershed for selected tributaries (Schloss 2001) based on tributary sampling conducted in 1992 by the DES (NLRA, 1996). The 1992 Newfound Lake areal phosphorus loading values for the Cockermouth River, Hemlock Brook and Tilton Brook subwatersheds were within approximately 25% of the values documented in the current study (Table 9). On the other hand, the areal phosphorus loads documented in the Black

Brook, Fowler River, Georges Brook, Wellington Brook and Whittemore Brook were more variable and, with the exception of the Wellington Brook areal phosphorus load, were higher in hydrologic year 1992. *However, care must be taken when comparing these two studies since the earlier effort was limited by budget and included the collection of significantly fewer total phosphorus data points that make the former study more prone to phosphorus loading over/underestimates. Methodological differences associated with the stream phosphorus loading calculations also existed between the two studies.*

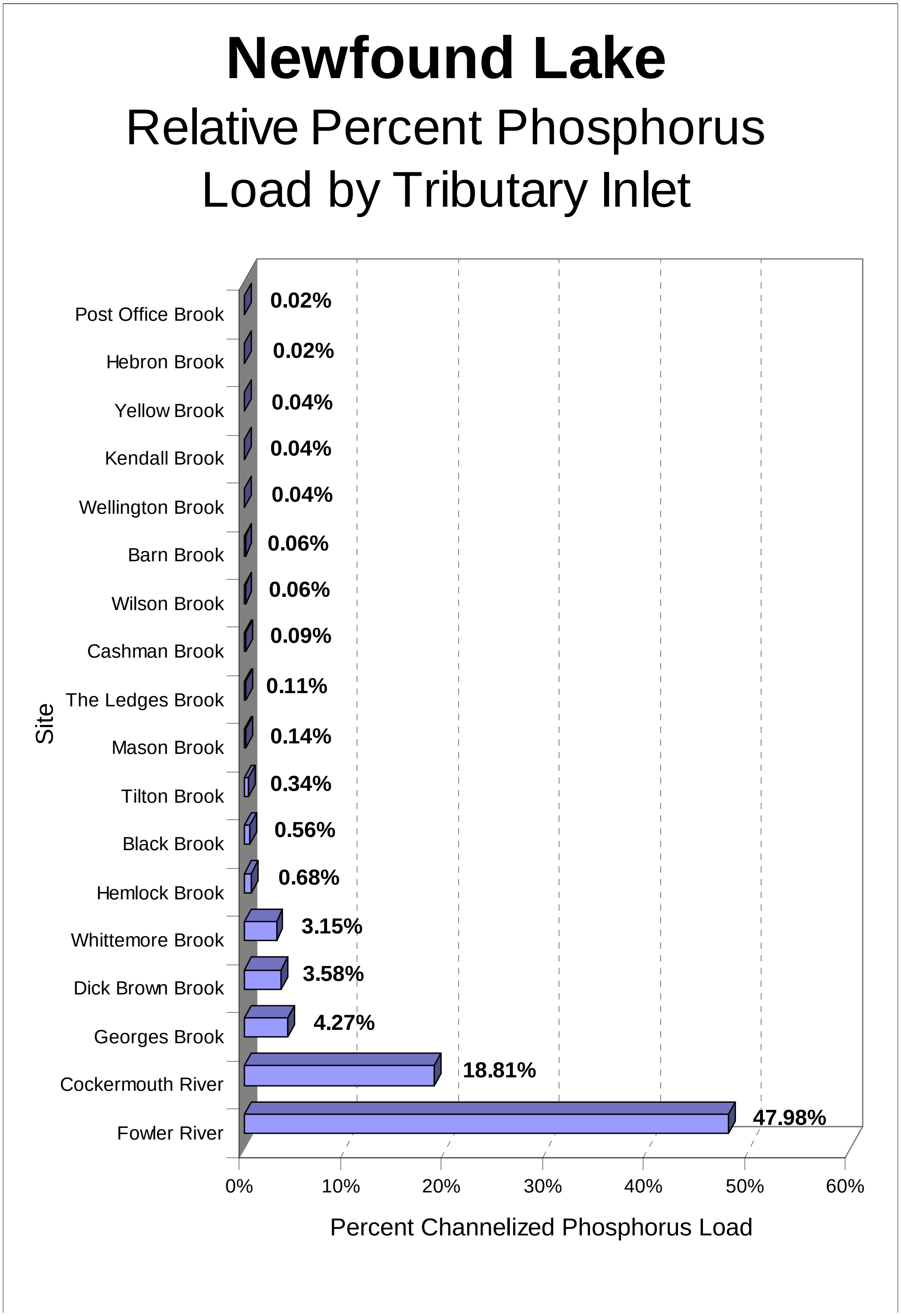
Putting the methodological differences aside, some of the findings were quite similar between the two studies and suggest the phosphorus loading in some streams may not have changed much over the 15 year period. On the other hand, some of the tributary loading values were higher in HY 1992, relative to 2007, and it is possible that short-term land clearing activities may have increased the phosphorus loading in select stream inlets during the early study. While beyond the scope of this study, an examination of local building permit records and possibly intent to cut records could provide insight into whether localized land clearing activities may have contributed to short-term water quality impacts in the early 1990s.

Focusing back on the current study, site-specific data documented in HY 2007 indicate that localized problems and areas of concern do exist. The forthcoming deep lake and shallow lake site assessment report will be instrumental in providing another analysis of lake trends and more detail of how the various tributaries impact the localized areas of the lake near their respective confluences.

While outside of our HY 2007 study period, heavy sedimentation into Black Brook was documented by the CFB field staff on June 26, 2006 and on July 13, 2006 during which the total phosphorus measured 91 *u*g/l and 49 *u*g/l respectively. These were the highest measurements documented among the 23 tributary inlet monitoring stations. Direct discharge measurements of 0.3220 m^3/sec and 0.9040 m^3/sec were collected on the respective "storm event" sampling dates. Heavy runoff during these high rainfall periods will naturally mobilize phosphorus into the lake, even under the most undisturbed conditions, but can also amplify water quality problems when the proper erosion control measures are not in place.

The following "conclusions and recommendations" section provides a synopsis of the study and identifies potential threats to Newfound Lake that can be mitigated through a proactive education and outreach effort and through long-term land use planning at the local level.

Figure 12.



Newfound Lake
Relative Percent Phosphorus Load by Tributary Inlet
Site
Post Office Brook
Hebron Brook
Yellow Brook
Kendall Brook
Wellington Brook
Barn Brook
Wilson Brook
Cashman Brook
The Ledges Brook
Mason Brook
Tilton Brook
Black Brook
Hemlock Brook
Whittemore Brook
Dick Brown Brook
Georges Brook
Cockermouth River
Fowler River
0.02%
0.02%
0.04%
0.04%
0.04%
0.06%
0.06%
0.09%
0.11%
0.14%
0.34%
0.56%
0.68%
3.15%
3.58%
4.27%
18.81%
47.98%
0%
10%
20%
30%
40%
50%
60%
Percent Channelized Phosphorus Load

Table 8: Annual Newfound Lake Phosphorus Loading by Gauged Subwatershed Hydrologic Year 2007 (October 2006-September 2007)

	Hemlock Brook	Tilton Brook	Dick Brown Brook	Whittemore Brook	Wilson Brook	Yellow Brook
TP Load (Kg/year)	27.38	18.09	75.05	67.23	4.19	2.35
TP Load %	1.97%	1.30%	5.39%	4.83%	0.30%	0.17%
Watershed %	1.57%	1.38%	3.69%	3.62%	0.42%	0.14%
Channelized Flow %	1.71%	1.50%	4.01%	3.94%	0.46%	0.15%
Watershed (Acres)	894.5	785.5	2095.6	2058.8	238.3	77.2
Areal P Load (Kg/ha/yr)	0.076	0.057	0.088	0.081	0.043	0.075
Watershed (hectares)	362.15	318.02	848.42	833.52	96.48	31.26

	Post Office Brook	Barn Brook	Cashman Brook	Georges Brook	Cockermouth River [1]	Hebron Brook
TP Load (Kg/year)	1.41	3.81	5.81	82.99	408.50	1.48
TP Load %	0.10%	0.27%	0.42%	5.96%	29.34%	0.11%
Watershed %	0.08%	0.30%	0.40%	5.33%	31.82%	0.18%
Channelized Flow %	0.09%	0.32%	0.44%	5.79%	34.56%	0.20%
Watershed (Acres)	45.4	168.8	229.2	3030.9	18080.4	105.1
Areal P Load (Kg/ha/yr)	0.076	0.056	0.063	0.068	0.056	0.035
Watershed (hectares)	18.38	68.34	92.79	1227.09	7320.00	42.55

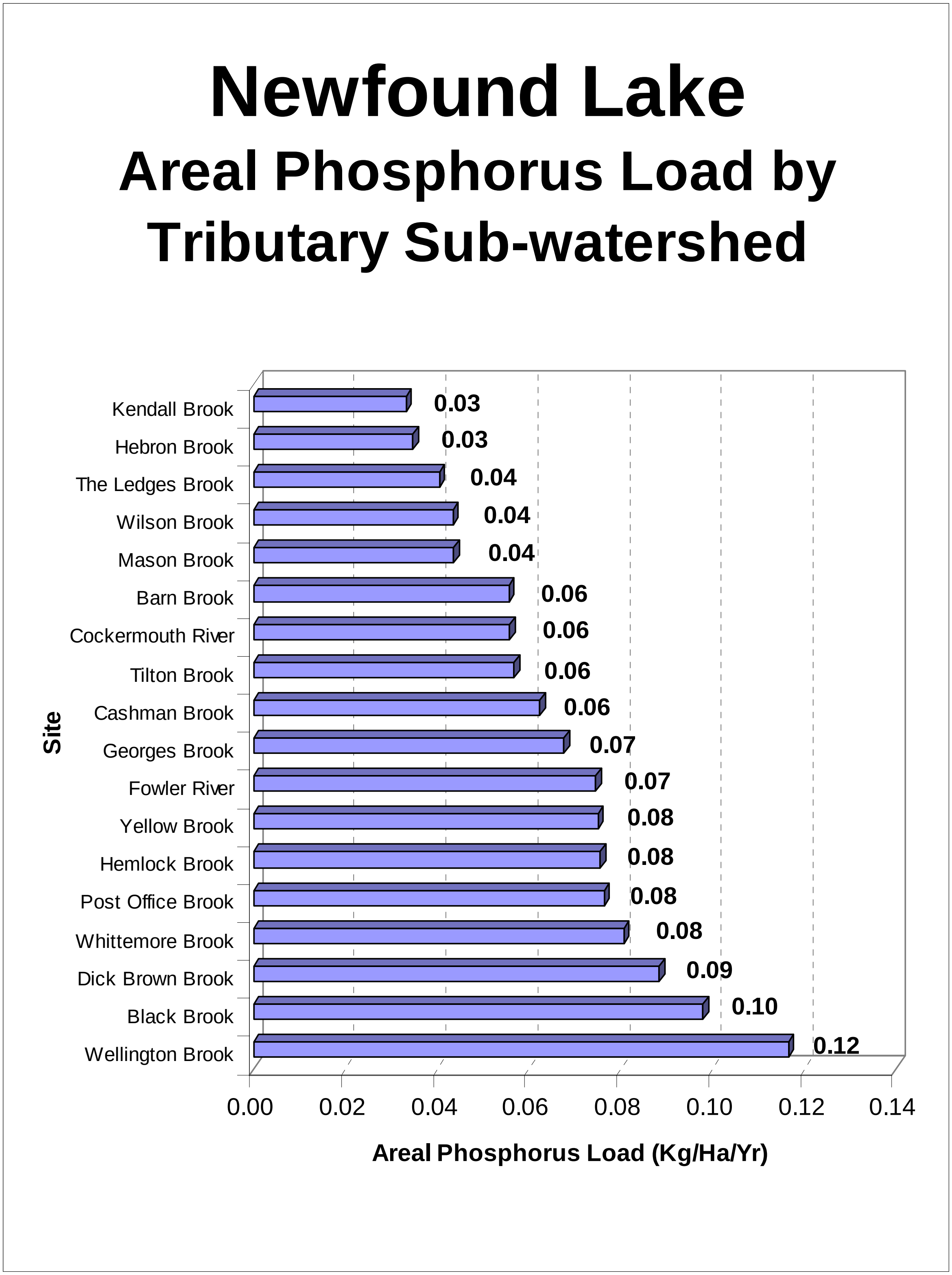
	Kendall Brook	Mason Brook	Ledges Brook	Wellington Brook	Fowler River [4]	Black Brook
TP Load (Kg/year)	2.37	8.95	7.59	2.93	685.33	23.07
TP Load %	0.17%	0.64%	0.55%	0.21%	47.06%	1.66%
Watershed %	0.31%	0.89%	0.81%	0.11%	39.97%	1.02%
Channelized Flow %	0.34%	0.97%	0.88%	0.12%	43.42%	1.11%
Watershed (Acres)	176.0	505.8	461.8	62.1	22712.5	581.7
Areal P Load (Kg/ha/yr)	0.033	0.044	0.041	0.117	0.075	0.098
Watershed (hectares)	71.26	204.78	186.96	25.14	9195.34	235.51

	Cockermouth River [2]	Cockermouth River [3]	Tannery Brook	Bog Brook	Fowler River [5]
TP Load (Kg/year)	472.98	312.32	14.41	298.02	272.22
TP Load %	33.97%	22.43%	1.04%	21.40%	19.55%
Watershed %	28.53%	24.52%	1.96%	14.00%	22.75%
Channelized Flow %	30.99%	26.63%	2.13%	15.21%	24.72%
Watershed (Acres)	16213.3	13931.1	1113	7954.1	12929.1
Areal P Load (Kg/ha/yr)	0.072	0.055	0.032	0.093	0.052
Watershed (hectares)	6564.09	5640.12	450.61	3220.28	5234.45

[1] Cockermouth River site near Newfound Lake (NLRA T11)
[2] Cockermouth River Site at Braley Road (NLRA T12)
[3] Cockermouth River Site in Groton (NLRA T14)
[4] Lower Fowler River Site (NLRA T20)
[5] Upper Fowler River Site (NLRA T22)

Refer to Table 4 and Figures 4 and 5 for additional sampling location data.

Figure 13.



Newfound Lake
Areal Phosphorus Load by Tributary Sub-watershed
Kendall Brook
Hebron Brook
The Ledges Brook
Wilson Brook
Mason Brook
Barn Brook
Cockermouth River
Tilton Brook
Cashman Brook
Georges Brook
Fowler River
Yellow Brook
Hemlock Brook
Post Office Brook
Whittemore Brook
Dick Brown Brook
Black Brook
Wellington Brook
0.03
0.03
0.04
0.04
0.04
0.06
0.06
0.06
0.06
0.07
0.07
0.08
0.08
0.08
0.08
0.09
0.10
0.12
Site
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
Areal Phosphorus Load (Kg/Ha/Yr)

Table 9. Newfound Lake, Hydrologic Year 1992 Areal Phosphorus Loading for select subwatersheds

Tributary	Areal Phosphorus Load HY 1992	Areal Phosphorus Load HY 2007 (current study)
Black Brook	0.209	0.098
Cockermouth River	0.071	0.056
Fowler River	0.137	0.075
Georges Brook	0.348	0.068
Hemlock Brook	0.100	0.076
Tilton Brook	0.063	0.057
Wellington Brook	0.048	0.117
Whittemore Brook	0.231	0.081

Note: The 1992 areal phosphorus loading values were calculated by Jeff Schloss (Schloss, 2001) based on data collected by the New Hampshire DES as part of the previous Newfound Lake hydrologic and phosphorus budget (NLRA, 1996)

Conclusions and Recommendations

The results of this study are intended to provide an overview of the current status of Newfound Lake's tributaries, to identify existing and potential problem areas within the watershed, and to identify possible threats to Newfound Lake water quality. The data are also intended to help the watershed residents become more aware of the potential for water quality problems and some actions that can be taken at the local level to make a positive difference. Everyone in the watershed has a stake in Newfound Lake. Some enjoy the lake and tributaries directly by participating in recreational opportunities including swimming, boating and fishing while others benefit indirectly through increased revenues associated with tourism and an expanded tax base associated with waterfront property.

While phosphorus loading into Newfound Lake was relatively low during the October 2006-September 2007 analysis period, increasing developmental pressures continue to pose a threat to our New Hampshire Lakes and often coincide with degraded water quality. The towns of Alexandria, Bristol, Bridgewater, Danbury, Dorchester, Groton, Hebron, Plymouth and Orange might consider adopting zoning that fosters natural resource conservation and concurrently minimizes water quality degradation. The Watershed Master Plan (in development) will be a good source of land use planning suggestions that balance the protection of natural resources, foster the retention of rural character, promote economic vitality and meet the needs of changing demographics.

Phosphorus loading into Newfound Lake is predominately from non-point pollution sources that is transported into the lake by its inlet streams. The highest phosphorus concentrations typically occur during the period of spring snowmelt but are augmented by excessive erosion during high-flow periods. The period of spring runoff coincides with minimal vegetative cover since trees and shrubs are just starting to bud, thus reducing the ability of vegetation to chemically remove nutrients (incorporate nutrients into plant material) or to physically filter pollutants out by slowing down the overland water flow.

Phosphorus loading is closely related to streamflow volumes, thus the greatest phosphorus and water load enters Newfound Lake through the Fowler River watershed. The Fowler River is well forested with a significant number of feeder streams. Bog Brook is the largest of these tributaries to the Fowler River and it is characterized by a substantial "bog" wetland complex. Such wetland complexes often function to purify water before reaching the lake (Schloss, 2000) and such wetlands also serve a vital function as flood control regulators that can store water in the wetland systems. Large wetland complexes can also function as critical wildlife habitat that can be adversely impacted by poorly planned residential and commercial development.

The Cockermouth River drains approximately 32% of the Newfound Lake watershed. Like the Fowler River, the Cockermouth River watershed is well forested and consists of numerous feeder streams that contribute to the total water volume and phosphorus loading.

The remaining 28.2% of the watershed comprises the majority of the Newfound Lake shoreline and includes numerous smaller tributaries. With the exception of the denser development around the shoreline of Newfound Lake where the forest cover is largely replaced with residential housing units and cleared lots, the Newfound watershed remains predominantly forested (88.8%). While natural environmental features including steep slopes, hydric soils/wetlands and a lack of existing road infrastructure pose constraints to development, municipalities and residents should recognize that environmental impacts result from poorly planned growth. For instance, the health of the headwater tributaries are highly susceptible to erosion due to steep slopes and rock outcrops. On the other hand, as one approaches Newfound Lake one may notice a reduction in riparian buffers in some areas that no longer provide optimal forage fish habitat that once existed when the shoreline areas were less developed (NLRA, 1996).

Steep Slopes create increased runoff water velocities, which cause increased sediment (and concurrent phosphorus) mobilization. The Newfound Lake watershed is comprised of an extensive network of feeder streams that are largely characterized by relatively steep-sloped watersheds that are highly susceptible to perturbation. Future land use management efforts should be directed towards maximizing riparian (shoreline) vegetation that will reduce the water velocity and that will both physically (i.e. filter) and chemically (i.e. plant uptake) remove nutrients. Slopes of 15% and greater compose 56.2% of the Newfound Lake watershed and characterize the headwaters of most tributary inlets (Figure 2). Steep sloped regions should be carefully managed to preserve vegetation and prevent soil erosion.

Riparian (shoreside) Buffers provide many natural functions that include the protection of water quality and the preservation and enhancement of in-stream and in-lake fishery and wildlife habitat. The New Hampshire Comprehensive Shoreland Protection Act (CSPA) regulates land clearing, development and fertilization activities within a 250 foot jurisdictional area adjacent to Newfound Lake and Spectacle Pond, as well as, adjacent to specified segments of the Cockermouth and Fowler Rivers. The CSPA should be consulted prior to removing any shoreside vegetation within 250 feet of the aforementioned water bodies. However, most of the steep sloped regions within the Newfound Lake watershed do not fall within the jurisdiction of the CSPA and thus it falls upon local municipalities and landowners to minimize unintended environmental impacts in steep sloped terrain.

When construction is undertaken, riparian cover should be maintained and diverted stormwater runoff should be directed towards vegetated regions where water will infiltrate the ground and minimize water quality impacts. Foresight should also be given to ensure that any implemented Best Management Practices (BMPs) are properly designed for the site-specific conditions and that a long-term maintenance plan, that includes regular inspections and corrective actions (when necessary), is followed.

Impervious surfaces such as roads, driveways, houses and out-buildings tend to concentrate, and accelerate overland waterflow, and thus increase the potential for sediment and phosphorus loading. Roads, homes and other structures cover the soil with impenetrable materials that reduce the natural infiltration and purification of water. Instead, the water often flows directly to the lake and tributaries as channelzied and/or sheet runoff which can carry with it a significant phosphorus load. Homeowners should consider implementing erosion control measures including check dams, daylighted culverts, plunge pools, water bars and vegetated buffers that will attenuate stormwater runoff from impervious surfaces. An inspection and long-term maintenance plan is a critical component of ensuring the long-term effectiveness of all erosion control measures. Again, the CSPA contains regulations that are in effect within 250 feet of Newfound Lake and the lower reaches of the Cockermouth and the Fowler Rivers.

Town officials should consider adopting a strategy to minimize water quality impacts associated with road construction. As the population grows, the road network will likely be improved. Improvements to existing roads and construction of new roads requires implementation of proper erosion control measures to minimize the adverse impacts to surface water and to minimize the expenses associated with long-term road maintenance. Drainage systems that were adequate for rough and semi-pervious gravel roads will not be able to handle the increased velocities and water volumes of paved roads; many more water turnouts and diversions will be required when roads are paved. The size of culvert may need to be increased to carry heavier storm flows. Road runoff should never go directly into the lake or any tributary but instead should be directed to a vegetated area that can reduce the velocity and increase infiltration.

Septic system effluent is laden with phosphorus and is thought to constitute a significant portion of the phosphorus reaching many of our New Hampshire lakes. Aging septic systems, along with the conversion of homes from seasonal to year round use (which increases the annual load), often exacerbate the problems. While the scope of this study did not measure the impacts of septic systems bordering the lake shore and the tributaries, modeling of the Squam Lake Watershed identified septic systems as one of the major phosphorus sources that occur during the dry summer season. For the Newfound watershed, any marginal systems will continue to pose a threat due to the well to excessively-drained soils around the lake and the close proximity of lakeshore homes to the lake. Septic systems have been shown to contribute a significant phosphorus load to Flint Pond (Hollis) where a combination of sandy soils, aging septic systems and conversions from seasonal to year round use existed. Even a well functioning septic system can contribute significant phosphorus load to the lake (Conner and Bowser, 1997). Thus, residents within the Newfound Lake watershed might consider installing low volume fixtures to limit the water used and thus reduce the phosphorus load to the lake. Local building codes could be amended to incorporate water-conserving appliances and fixtures. The NLRA might consider working with interested Towns to facilitate a timely septic tank inspection and pumping schedule that will facilitate a bulk-rate discount for watershed residents.

Stream bank undercutting and destabilization (Watershed-wide erosion concerns) - The Newfound watershed, as previously discussed, is characterized by steep slopes that accelerate water flow and in extreme cases scour substrate materials such as cobble and boulders during high flow periods. Evidence of extensive bank undercutting was observed in numerous tributaries (Figures 14 - 16). The figures also reflect the stabilizing capacity of the riparian vegetation and root systems, that are prevalent along most stream channels. Some might consider the root systems as natural "re-bar" that effectively stabilizes the shoreline and minimizes erosion into our New Hampshire streams and lakes. As previously discussed, the majority of the Newfound Lake watershed is forested and includes extensive riparian vegetation along the tributary network. Future conservation efforts should foster the retention of riparian vegetation and, when possible, the reestablishment of riparian vegetation in regions where it has been removed. Riparian cover not only minimizes the phosphorus and sediment loading into surface waters but it also enhances fishery habitat and provides travel corridors for wildlife species.

Figure 14. Whittemore Brook bank undercutting (August 30, 2007)

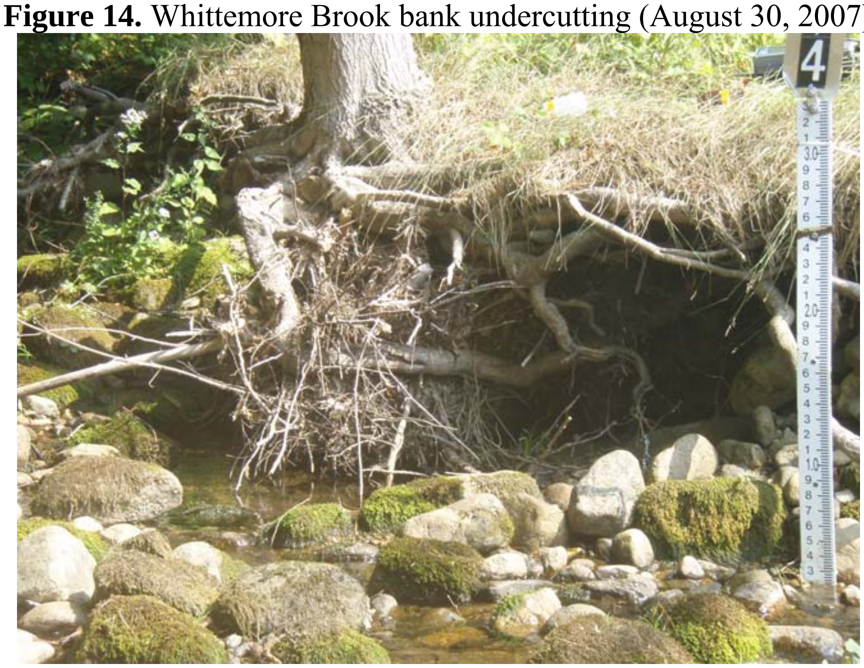


Figure 15. Cockermouth River (Site 12 Cockermouth) bank undercutting (Photographed August 17, 2007)

Figure 16. Fowler River (Site 22 Fowler) bank undercutting (Photographed August 17, 2007)

In-Lake Resources - In-lake and tributary sampling scheduled for 2008 will continue to characterize deep-water conditions while extensive near shore sampling that includes nutrient and *E coli* bactiera sampling will help assess the interplay between the stream inflow, land use, and lake water quality. Continued tributary monitoring will be conducted at the 24 core tributary sampling sites while accessory sampling of 12 tributary inlets will be undertaken at the Black Brook, Bog Brook, Cashman Brook, Cockermouth River, Dick Brown Brook, Fowler River, Georges Brook, Hemlock Brook, "the Mason Brook, Tilton Brook and Whittemore Brook to better understand of the relationship between land-use and stream water quality. Supplemental sampling of the 12 tributaries will include the collection of sodium and chloride (common constituents of winter sand/salt applications) as well as nutrients that include phosphate and nitrate.

A follow-up report will summarize the results of the supplemental sampling and an interpretive summary report will be completed in April 2009. The report will include additional comments and recommendations aimed at preserving both the in-stream and Newfound Lake water quality.

Generic Summary of Common Recommendations to Lakeshore and Streamside Residents:

- Encourage shoreside vegetation and protect wetlands - shoreside vegetation (what is known as **riparian vegetation**) and wetlands provide a protective buffer that "traps" pollutants before reaching the lake. These buffers remove materials both chemically (through biological uptake) and physically (settling materials out). As riparian buffers are removed and wetlands lost, pollutant materials are more likely to enter the lake and in turn, favor declining water quality. Shoreline vegetation grown tall will also discourage geese and shade the water reducing the possibility of aquatic weed recruitment.

- Limit fertilizer applications - fertilizers entering the lake can stimulate aquatic plant and algal growth and in extreme cases result in noxious algal blooms. Increases in algal growth tend to diminish water transparency and under extreme cases culminate in surface "scums" that can wash up on the shoreline and can also produce unpleasant smells as the material decomposes. Excessive nutrient concentrations also favor algal forms known to produce toxins which irritate the skin and under extreme conditions, are dangerous when ingested. Use low maintenance grasses such as fescues that require less nutrients and water to grow. After a lawn is established a single application of fertilizer in the late fall is generally more than adequate to maintain a healthy growth. Oftentimes a pH adjustment will do more good and release nutrients already in the soils.

- Limit organic matter loading - organic matter (leaves, grass clippings, etc.) are a major source of nutrients in the aquatic environment. As the vegetative matter decomposes nutrients are "freed up" and can become available for aquatic plant and algal growth. In general, we are not concerned with this material entering the lake naturally (leaf senescence in the fall) but rather excessive loading of this material as occurs when residents dump or rake leaf litter and grass clippings into the lake. This material not only provides large nutrient reserves which can stimulate aquatic plant and algal growth but also makes great habitat for leaches and other potentially undesirable organisms in swimming areas.

- Maintain Septic Systems - faulty septic systems are a big concern as they can be a primary source of water pollution around our lakes. Septic systems are loaded with nutrients and can also be a health threat when not functioning properly.

- Limit the loss of vegetative cover and the creation of impervious surfaces - A forested watershed offers the best protection against pollutant runoff. Trees and tall vegetation intercept heavy rains that can erode soils and surface materials. The roots of these plants keep the soils in place, process nutrients and absorb moisture so the soils do not wash out. Impervious surfaces (paved roads, parking lots, building roofs, etc.) reduce the water's capacity to infiltrate into the ground, and in turn, go through nature's water purification system. As water seeps into the soil, pollutants are removed from the runoff through absorption onto soil particles. Biological processes detoxify substances and/or immobilize substances. Surface water runoff over impervious surfaces also increases water velocities which favor the transport of a greater load of suspended and dissolved pollutants into your lake.

- Discourage the feeding ducks and geese – ducks and geese that are locally fed tend to concentrate around the known food source and can result in localized water quality problems. Waterfowl quickly process food into nutrients that are capable of stimulate microscopic plant "algal" growth. Ducks and Geese are also host to the parasite responsible for swimmers itch. While not a health threat, swimmers itch is very uncomfortable.

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NEWFOUND LAKE

TRIBUTARY ASSESSMENT (APPENDICES)

Water & Phosphorus Budget: October 2006 – September 2007

Prepared for:

Prepared by:

and

Newfound Lake Tributary Assessment
Water and Phosphorus Budget: October 2006 – September 2007

Final Report: July 2008

University of New Hampshire Center for Freshwater Biology and University of New Hampshire Cooperative Extension
38 Academic Way
Spaulding Hall Room G18
Durham NH 03824

Robert Craycraft

UNH CFB

UNIVERSITY *of* NEW HAMPSHIRE
COOPERATIVE EXTENSION

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APPENDIX A: 2006-2007 Newfound Tributary Data Listing

Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
CFB = Center for Freshwater Biology Field Team Data								
Vol = Volunteer Monitor Data								
CFB	1	Hemlock Brook	6/1/06	0.40	0.40	------	------	3.4
CFB	1	Hemlock Brook	6/8/06	0.73	0.75	------	------	7.8
CFB	1	Hemlock Brook	6/21/06	0.46	0.46	------	------	4.2
CFB	1	Hemlock Brook	6/26/06	0.80	0.80	------	------	------
Vol	1	Hemlock Brook	7/2/06	0.49	------	------	------	5.1
Vol	1	Hemlock Brook	7/12/06	0.39	------	------	------	5.1
CFB	1	Hemlock Brook	7/13/06	0.76	0.78	------	------	12.9
Vol	1	Hemlock Brook	7/20/06	0.37	------	------	------	4.5
Vol	1	Hemlock Brook	7/29/06	0.39	------	------	------	5.1
Vol	1	Hemlock Brook	8/13/06	0.25	------	------	------	4.7
CFB	1	Hemlock Brook	8/21/06	0.32	0.32	------	------	4.1
Vol	1	Hemlock Brook	8/22/06	0.28	------	------	------	4.3
Vol	1	Hemlock Brook	9/4/06	0.40	------	------	------	8.0
Vol	1	Hemlock Brook	9/11/06	0.25	------	------	------	3.9
CFB	1	Hemlock Brook	9/20/06	0.34	0.33	------	------	4.9
Vol	1	Hemlock Brook	10/3/06	0.40	------	------	------	5.9
Vol	1	Hemlock Brook	10/16/06	0.47	------	------	------	5.6
CFB	1	Hemlock Brook	10/17/06	0.44	0.44	------	------	3.2
Vol	1	Hemlock Brook	10/25/06	0.58	------	------	------	3.7
Vol	1	Hemlock Brook	11/5/06	0.51	------	------	------	3.4
Vol	1	Hemlock Brook	11/11/06	0.59	------	------	------	11.1
CFB	1	Hemlock Brook	11/14/06	0.88	0.88	------	------	15.8
CFB	1	Hemlock Brook	12/13/06	0.47	0.47	------	------	2.3
Vol	1	Hemlock Brook	12/29/06	0.55	------	------	------	3.1
Vol	1	Hemlock Brook	1/6/07	0.90	------	------	------	29.4
Vol	1	Hemlock Brook	1/13/07	0.57	------	------	------	5.1
CFB	1	Hemlock Brook	1/17/07	0.53	0.53	------	------	2.7
CFB	1	Hemlock Brook	3/13/07	------	------	------	------	------
CFB	1	Hemlock Brook	4/4/07	0.61	0.61	1.51	1.51	5.7
CFB	1	Hemlock Brook	4/11/07	0.51	0.51	------	------	13.1

APPENDIX A: 2006-2007 Newfound Tributary Data Listing

Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
CFB = Center for Freshwater Biology Field Team Data								
Vol = Volunteer Monitor Data								
Vol	1	Hemlock Brook	4/14/07	0.58	------	------	------	22.2
CFB	1	Hemlock Brook	4/18/07	0.92	0.92	1.41	1.41	11.7
Vol	1	Hemlock Brook	5/6/07	0.47	------	------	------	10.6
CFB	1	Hemlock Brook	5/17/07	0.54	0.54	1.52	1.53	6.9
Vol	1	Hemlock Brook	6/18/07	0.23	------	------	------	4.9
CFB	1	Hemlock Brook	6/20/07	0.25	0.25	1.61	1.62	3.9
Vol	1	Hemlock Brook	7/25/07	0.21	------	------	------	4.8
CFB	1	Hemlock Brook	8/2/07	0.06	0.06	------	------	4.9
CFB	1	Hemlock Brook	8/17/07	0.06	0.06	------	------	------
Vol	1	Hemlock Brook	8/24/07	Dry	------	------	------	------
CFB	1	Hemlock Brook	8/30/07	Dry	------	------	------	------
CFB	1	Hemlock Brook	9/11/07	0.30	0.30	------	------	3.5
Vol	1	Hemlock Brook	10/3/07	------	------	------	------	4.5
CFB	1	Hemlock Brook	10/24/07	0.40	0.40	------	------	9.0
Vol	1	Hemlock Brook	11/11/07	0.40	------	------	------	4.4
CFB	1	Hemlock Brook	11/15/07	0.80	0.80	------	------	78.2
Vol	1	Hemlock Brook	11/28/07	0.58	0.58	------	------	3.6
CFB	1	Hemlock Brook	12/11/07	0.40	0.40	------	------	4.5
CFB	2	Tilton Brook	6/1/06	------	------	------	------	3.6
CFB	2	Tilton Brook	6/8/06	1.05	1.05	------	------	9.8
CFB	2	Tilton Brook	6/21/06	0.68	0.68	------	------	5.1
CFB	2	Tilton Brook	6/26/06	1.19	1.19	------	------	21.4
Vol	2	Tilton Brook	7/2/06	0.69	------	------	------	6.0
Vol	2	Tilton Brook	7/12/06	0.58	------	------	------	2.8
CFB	2	Tilton Brook	7/13/06	1.06	1.06	------	------	18.0
Vol	2	Tilton Brook	7/20/06	0.58	------	------	------	5.1
Vol	2	Tilton Brook	7/29/06	0.68	------	------	------	6.5
Vol	2	Tilton Brook	8/13/06	0.49	------	------	------	10.8
CFB	2	Tilton Brook	8/21/06	0.52	0.52	------	------	4.8
Vol	2	Tilton Brook	8/22/06	0.50	------	------	------	4.7

APPENDIX A: 2006-2007 Newfound Tributary Data Listing

Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
Vol	2	Tilton Brook	9/4/06	0.50	------	------	------	4.1
Vol	2	Tilton Brook	9/11/06	0.48	------	------	------	3.5
CFB	2	Tilton Brook	9/20/06	0.50	0.50	------	------	4.9
Vol	2	Tilton Brook	10/3/06	0.50	------	------	------	10.0
Vol	2	Tilton Brook	10/16/06	0.51	------	------	------	6.2
CFB	2	Tilton Brook	10/17/06	0.53	0.53	------	------	3.8
Vol	2	Tilton Brook	10/25/06	0.70	------	------	------	6.4
Vol	2	Tilton Brook	11/5/06	0.75	------	------	------	4.2
Vol	2	Tilton Brook	11/11/06	0.87	------	------	------	3.9
CFB	2	Tilton Brook	11/24/06	1.25	1.25	------	------	20.7
CFB	2	Tilton Brook	12/12/06	0.69	0.68	------	------	3.1
Vol	2	Tilton Brook	12/29/06	0.78	------	------	------	4.7
Vol	2	Tilton Brook	1/6/07	1.29	------	------	------	38.6
Vol	2	Tilton Brook	1/13/07	0.79	------	------	------	3.7
CFB	2	Tilton Brook	1/17/07	0.80	0.80	------	------	4.4
CFB	2	Tilton Brook	3/13/07	------	------	------	------	------
CFB	2	Tilton Brook	4/4/07	0.88	0.87	------	------	4.2
CFB	2	Tilton Brook	4/11/07	0.75	0.75	------	------	4.5
Vol	2	Tilton Brook	4/14/07	0.89		------	------	10.6
CFB	2	Tilton Brook	4/18/07	1.50	1.50	------	------	12.5
Vol	2	Tilton Brook	5/6/07	0.79		------	------	5.2
CFB	2	Tilton Brook	5/17/07	0.82	0.82	------	------	4.7
Vol	2	Tilton Brook	6/17/07	0.59	------	------	------	4.5
CFB	2	Tilton Brook	6/20/07	0.55	0.56	------	------	4.3
Vol	2	Tilton Brook	7/25/07	0.55	------	------	------	4.4
CFB	2	Tilton Brook	8/2/07	0.58	0.58	------	------	3.2
CFB	2	Tilton Brook	8/17/07	0.58	0.58	------	------	3.0
Vol	2	Tilton Brook	8/24/07	------	------	------	------	5.9
CFB	2	Tilton Brook	8/30/07	0.42	0.42	------	------	4.1
CFB	2	Tilton Brook	9/11/07	0.56	0.56	------	------	4.7

CFB = Center for Freshwater Biology Field Team Data
Vol = Volunteer Monitor Data

APPENDIX A: 2006-2007 Newfound Tributary Data Listing

Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
CFB = Center for Freshwater Biology Field Team Data								
Vol = Volunteer Monitor Data								
Vol	2	Tilton Brook	10/3/07	0.50	------	------	------	7.0
CFB	2	Tilton Brook	10/24/07	0.68	0.68	------	------	4.8
Vol	2	Tilton Brook	11/11/07	0.66	------	------	------	3.6
CFB	2	Tilton Brook	11/15/07	1.30	1.30	------	------	74.1
Vol	2	Tilton Brook	11/28/07	0.86	0.86	------	------	3.3
CFB	2	Tilton Brook	12/11/07	0.68	0.68	------	------	4.9
CFB	3	Dick Brown Brook	6/1/06	1.26	1.27	------	------	4.5
CFB	3	Dick Brown Brook	6/8/06	1.73	1.74	------	------	12.8
CFB	3	Dick Brown Brook	6/21/06	1.47	1.47	------	------	7.0
CFB	3	Dick Brown Brook	6/26/06	1.80	1.80	------	------	24.3
CFB	3	Dick Brown Brook	7/13/06	2.06	2.08	------	------	23.6
Vol	3	Dick Brown Brook	7/24/06	0.44	0.48	------	------	9.8
Vol	3	Dick Brown Brook	8/1/06	0.82	0.86	------	------	12.2
Vol	3	Dick Brown Brook	8/10/06	0.70	0.71	------	------	5.9
Vol	3	Dick Brown Brook	8/19/06	0.66	0.64	------	------	4.6
CFB	3	Dick Brown Brook	8/21/06	0.80	0.80	------	------	5.6
Vol	3	Dick Brown Brook	8/25/06	0.76	0.77	------	------	5.8
Vol	3	Dick Brown Brook	9/1/06	0.72	0.73	------	------	------
Vol	3	Dick Brown Brook	9/7/06	0.71	0.72	------	------	4.3
Vol	3	Dick Brown Brook	9/14/06	0.70	0.69	------	------	4.5
CFB	3	Dick Brown Brook	9/20/06	0.80	0.80	------	------	6.5
Vol	3	Dick Brown Brook	9/22/06	0.72	0.71	------	------	5.4
Vol	3	Dick Brown Brook	9/29/06	0.86	0.88	------	------	13.0
Vol	3	Dick Brown Brook	10/14/06	0.85	0.86	------	------	8.7
CFB	3	Dick Brown Brook	10/17/06	0.74	0.74	------	------	3.6
Vol	3	Dick Brown Brook	10/26/06	1.01	1.00	------	------	5.3
Vol	3	Dick Brown Brook	11/2/06	1.10	------	------	------	6.1
Vol	3	Dick Brown Brook	11/10/06	1.12	1.10	------	------	6.6
CFB	3	Dick Brown Brook	11/14/06	1.60	1.60	------	------	14.1
Vol	3	Dick Brown Brook	11/30/06	0.76	0.78	------	------	22.1

APPENDIX A: 2006-2007 Newfound Tributary Data Listing

Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
CFB = Center for Freshwater Biology Field Team Data								
Vol = Volunteer Monitor Data								
CFB	3	Dick Brown Brook	12/12/06	0.75	0.76	------	------	5.7
Vol	3	Dick Brown Brook	12/21/06	0.71	0.72	------	------	4.1
Vol	3	Dick Brown Brook	1/5/07	0.84	0.86	------	------	3.0
Vol	3	Dick Brown Brook	1/12/07	0.89	0.88	------	------	4.0
CFB	3	Dick Brown Brook	1/17/07	0.74	0.74	------	------	3.4
Vol	3	Dick Brown Brook	1/25/07	------	------	------	------	3.2
Vol	3	Dick Brown Brook	2/8/07	0.70	------	------	------	4.0
CFB	3	Dick Brown Brook	3/13/07	0.64	0.64	------	------	4.4
Vol	3	Dick Brown Brook	3/30/07	1.02	1.00	------	------	6.7
CFB	3	Dick Brown Brook	4/4/07	1.00	1.02	------	------	5.3
CFB	3	Dick Brown Brook	4/11/07	0.80	0.82	------	------	4.2
Vol	3	Dick Brown Brook	4/17/07	2.48	2.50	------	------	32.4
CFB	3	Dick Brown Brook	4/18/07	2.60	2.60	------	------	12.5
Vol	3	Dick Brown Brook	5/11/07	1.39	1.40	------	------	3.6
CFB	3	Dick Brown Brook	5/17/07	1.36	1.36	------	------	7.1
Vol	3	Dick Brown Brook	6/1/07	1.16	1.18	------	------	5.4
CFB	3	Dick Brown Brook	6/20/07	0.23	0.23	------	------	4.2
Vol	3	Dick Brown Brook	6/27/07	1.12	1.13	------	------	3.8
Vol	3	Dick Brown Brook	7/12/07	1.14	1.16	------	------	9.0
Vol	3	Dick Brown Brook	7/25/07	1.12	1.13	------	------	27.9
CFB	3	Dick Brown Brook	8/2/07	0.96	0.98	------	------	23.8
CFB	3	Dick Brown Brook	8/17/07	0.84	0.84	------	------	4.0
Vol	3	Dick Brown Brook	8/24/07	1.40	1.40	------	------	4.2
CFB	3	Dick Brown Brook	8/30/07	0.66	0.66	------	------	5.3
CFB	3	Dick Brown Brook	9/11/07	0.58	0.58	------	------	6.4
Vol	3	Dick Brown Brook	9/19/07	0.74	0.76	------	------	3.6
Vol	3	Dick Brown Brook	9/28/07	0.73	0.74	------	------	14.2
Vol	3	Dick Brown Brook	10/12/07	1.50	------	------	------	360.4
CFB	3	Dick Brown Brook	10/24/07	0.76	0.76	------	------	10.8
Vol	3	Dick Brown Brook	10/30/07	0.71	0.72	------	------	5.8

APPENDIX A: 2006-2007 Newfound Tributary Data Listing

Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
CFB = Center for Freshwater Biology Field Team Data								
Vol = Volunteer Monitor Data								
CFB	3	Dick Brown Brook	11/15/07	1.80	1.80	------	------	111.5
Vol	3	Dick Brown Brook	11/29/07	0.90	------	------	------	4.1
Vol	3	Dick Brown Brook	12/7/07	0.70	------	------	------	3.0
CFB	3	Dick Brown Brook	12/11/07	0.72	0.72	------	------	7.7
CFB	4	Whittemore Brook	6/1/06	0.54	------	------	------	4.2
CFB	4	Whittemore Brook	6/8/06	1.18	1.18	------	------	11.3
CFB	4	Whittemore Brook	6/21/06	0.66	0.66	------	------	5.8
CFB	4	Whittemore Brook	6/26/06	1.46	1.46	------	------	21.9
Vol	4	Whittemore Brook	7/5/06	0.56	0.58	------	------	5.5
Vol	4	Whittemore Brook	7/12/06	0.45	0.42	------	------	4.0
CFB	4	Whittemore Brook	7/13/06	1.36	1.36	------	------	14.5
Vol	4	Whittemore Brook	7/19/06	0.49	0.49	------	------	5.7
Vol	4	Whittemore Brook	7/23/06	1.25	1.25	------	------	9.0
Vol	4	Whittemore Brook	7/31/06	0.51	0.52	------	------	6.1
Vol	4	Whittemore Brook	8/9/06	0.35	0.35	------	------	4.6
Vol	4	Whittemore Brook	8/16/06	-0.16	-0.16	------	------	4.4
CFB	4	Whittemore Brook	8/21/06	0.42	0.42	------	------	6.8
Vol	4	Whittemore Brook	8/23/06	0.00	0.00	------	------	4.0
Vol	4	Whittemore Brook	8/30/06	------	------	------	------	5.6
Vol	4	Whittemore Brook	9/7/06	0.29	0.29	------	------	3.1
CFB	4	Whittemore Brook	9/20/06	0.38	0.38	------	------	6.2
Vol	4	Whittemore Brook	9/21/06	0.30	0.30	------	------	3.9
Vol	4	Whittemore Brook	9/30/06	0.37	0.38	------	------	4.3
Vol	4	Whittemore Brook	10/10/06	0.34	0.36	------	------	4.1
CFB	4	Whittemore Brook	10/17/06	0.50	0.50	------	------	2.6
Vol	4	Whittemore Brook	10/25/06	0.82	0.80	------	------	4.8
Vol	4	Whittemore Brook	11/3/06	0.82	0.81	------	------	2.9
Vol	4	Whittemore Brook	11/10/06	1.10	1.20	------	------	5.7
CFB	4	Whittemore Brook	11/14/06	1.46	1.46	------	------	18.6
Vol	4	Whittemore Brook	11/22/06	0.78	0.80	------	------	4.7

APPENDIX A: 2006-2007 Newfound Tributary Data Listing

Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
Vol	4	Whittemore Brook	11/29/06	0.71	0.72	------	------	4.6
Vol	4	Whittemore Brook	12/6/06	0.76	0.78	------	------	3.0
CFB	4	Whittemore Brook	12/13/06	0.68	0.68	------	------	5.3
Vol	4	Whittemore Brook	12/19/06	0.63	0.64	------	------	5.2
Vol	4	Whittemore Brook	12/27/06	0.90	0.88	------	------	4.1
Vol	4	Whittemore Brook	1/4/07	0.78	0.79	------	------	3.6
CFB	4	Whittemore Brook	1/17/07	1.30	1.30	------	------	2.8
Vol	4	Whittemore Brook	1/22/07	------	------	------	------	5.2
Vol	4	Whittemore Brook	2/2/07	------	------	------	------	------
Vol	4	Whittemore Brook	2/22/07	------	------	------	------	------
Vol	4	Whittemore Brook	3/1/07	------	------	------	------	------
CFB	4	Whittemore Brook	3/13/07	------	------	------	------	------
Vol	4	Whittemore Brook	3/30/07	0.90	0.90	------	------	4.4
CFB	4	Whittemore Brook	4/4/07	0.97	0.97	------	------	4.0
Vol	4	Whittemore Brook	4/11/07	0.70	0.65	------	------	2.3
CFB	4	Whittemore Brook	4/18/07	1.38	1.38	------	------	9.4
Vol	4	Whittemore Brook	4/27/07	1.11	1.12	------	------	5.6
Vol	4	Whittemore Brook	5/2/07	0.78	0.77	------	------	3.6
Vol	4	Whittemore Brook	5/9/07	0.60	0.62	------	------	4.0
CFB	4	Whittemore Brook	5/17/07	0.78	0.78	------	------	5.0
Vol	4	Whittemore Brook	5/23/07	0.65	0.64	------	------	3.3
Vol	4	Whittemore Brook	5/30/07	0.46	0.46	------	------	4.9
Vol	4	Whittemore Brook	6/7/07	0.62	0.63	------	------	5.2
Vol	4	Whittemore Brook	6/14/07	0.49	0.51	------	------	4.1
CFB	4	Whittemore Brook	6/20/07	0.36	0.36	------	------	3.5
Vol	4	Whittemore Brook	6/28/07	0.36	0.36	------	------	3.7
Vol	4	Whittemore Brook	7/5/07	0.30	0.32	------	------	4.0
Vol	4	Whittemore Brook	7/12/07	0.61	0.62	------	------	9.8
Vol	4	Whittemore Brook	7/26/07	0.31	0.32	------	------	4.7
CFB	4	Whittemore Brook	8/2/07	0.25	0.26	------	------	5.0

CFB = Center for Freshwater Biology Field Team Data
Vol = Volunteer Monitor Data

APPENDIX A: 2006-2007 Newfound Tributary Data Listing

Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
Vol	4	Whittemore Brook	8/2/07	0.28	0.26	------	------	4.5
CFB	4	Whittemore Brook	8/17/07	0.28	0.28	------	------	3.6
Vol	4	Whittemore Brook	8/23/07	0.26	------	------	------	5.4
CFB	4	Whittemore Brook	8/30/07	0.24	0.24	------	------	4.1
Vol	4	Whittemore Brook	8/31/07	0.21	0.19	------	------	3.2
CFB	4	Whittemore Brook	9/11/07	0.38	0.38	------	------	4.1
Vol	4	Whittemore Brook	9/20/07	0.30	0.29	------	------	5.5
Vol	4	Whittemore Brook	9/28/07	0.28	0.29	------	------	5.2
Vol	4	Whittemore Brook	10/4/07	0.27	0.28	------	------	5.7
Vol	4	Whittemore Brook	10/15/07	0.46	0.48	------	------	9.7
CFB	4	Whittemore Brook	10/24/07	0.57	0.57	------	------	6.7
Vol	4	Whittemore Brook	10/31/07	0.60	0.65	------	------	6.8
CFB	4	Whittemore Brook	11/15/07	1.56	1.56	------	------	167.2
Vol	4	Whittemore Brook	11/21/07	0.68	0.66	------	------	3.9
Vol	4	Whittemore Brook	11/30/07	0.75	0.76	------	------	3.1
Vol	4	Whittemore Brook	12/5/07	------	------	------	------	3.1
CFB	4	Whittemore Brook	12/11/07	0.72	0.72	------	------	4.2
CFB	5	Wilson Brook	6/1/06	------	------	------	------	5.3
CFB	5	Wilson Brook	6/8/06	0.38	0.38	------	------	8.8
CFB	5	Wilson Brook	6/21/06	0.10	0.10	------	------	5.6
CFB	5	Wilson Brook	6/26/06	0.62	0.63	------	------	22.6
Vol	5	Wilson Brook	7/5/06	0.06	0.06	------	------	5.4
Vol	5	Wilson Brook	7/12/06	-0.10	------	------	------	6.3
CFB	5	Wilson Brook	7/13/06	0.46	0.46	------	------	12.1
Vol	5	Wilson Brook	7/19/06	-0.05	------	------	------	6.2
Vol	5	Wilson Brook	7/23/06	0.30	0.29	------	------	16.4
Vol	5	Wilson Brook	7/31/06	-0.10	------	------	------	5.8
Vol	5	Wilson Brook	8/9/06	------	------	------	------	6.5
Vol	5	Wilson Brook	8/16/06	-0.16	-0.16	------	------	6.1
CFB	5	Wilson Brook	8/21/06	-0.10	------	------	------	6.3

CFB = Center for Freshwater Biology Field Team Data
Vol = Volunteer Monitor Data

APPENDIX A: 2006-2007 Newfound Tributary Data Listing

Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
CFB = Center for Freshwater Biology Field Team Data								
Vol = Volunteer Monitor Data								
Vol	5	Wilson Brook	8/23/06	-0.10	-0.10	------	------	6.2
Vol	5	Wilson Brook	8/30/06	-0.10	-0.10	------	------	7.0
Vol	5	Wilson Brook	9/7/06	-0.16	------	------	------	------
CFB	5	Wilson Brook	9/20/06	-0.16	-0.16	------	------	7.1
Vol	5	Wilson Brook	9/21/06	-0.16	------	------	------	7.7
Vol	5	Wilson Brook	9/30/06	-0.16	-0.16	------	------	4.8
Vol	5	Wilson Brook	10/10/06	-0.16	-0.16	------	------	5.2
CFB	5	Wilson Brook	10/17/06	-0.02	-0.02	------	------	4.2
Vol	5	Wilson Brook	10/25/06	0.13	0.12	------	------	3.8
Vol	5	Wilson Brook	11/3/06	0.15	0.16	------	------	5.5
Vol	5	Wilson Brook	11/10/06	0.22	0.21	------	------	4.6
CFB	5	Wilson Brook	11/14/06	0.58	0.60	------	------	10.6
Vol	5	Wilson Brook	11/22/06	0.15	0.16	------	------	3.5
Vol	5	Wilson Brook	11/29/06	0.14	0.12	------	------	3.0
Vol	5	Wilson Brook	12/6/06	0.16	0.17	------	------	3.5
CFB	5	Wilson Brook	12/13/06	0.12	0.12	------	------	3.9
Vol	5	Wilson Brook	12/19/06	0.10	0.09	------	------	2.5
Vol	5	Wilson Brook	12/27/06	0.21	0.22	------	------	3.5
Vol	5	Wilson Brook	1/4/07	0.18	0.19	------	------	3.3
CFB	5	Wilson Brook	1/17/07	0.52	0.52	------	------	2.9
Vol	5	Wilson Brook	1/22/07	------	------	------	------	7.1
Vol	5	Wilson Brook	2/2/07	------	------	------	------	------
Vol	5	Wilson Brook	2/22/07	------	------	------	------	------
Vol	5	Wilson Brook	3/1/07	------	------	------	------	5.0
CFB	5	Wilson Brook	3/13/07	------	------	------	------	------
Vol	5	Wilson Brook	3/30/07	0.26	0.27	------	------	4.5
CFB	5	Wilson Brook	4/4/07	0.27	0.27	------	------	3.6
Vol	5	Wilson Brook	4/11/07	0.14	0.16	------	------	1.7
CFB	5	Wilson Brook	4/18/07	0.60	0.62	------	------	5.7
Vol	5	Wilson Brook	4/27/07	0.22	0.22	------	------	------

APPENDIX A: 2006-2007 Newfound Tributary Data Listing

Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
CFB = Center for Freshwater Biology Field Team Data								
Vol = Volunteer Monitor Data								
Vol	5	Wilson Brook	5/2/07	0.32	0.32	------	------	3.1
Vol	5	Wilson Brook	5/9/07	0.08	0.08	------	------	13.4
CFB	5	Wilson Brook	5/17/07	0.18	0.18	------	------	3.4
Vol	5	Wilson Brook	5/23/07	0.08	0.06	------	------	3.8
Vol	5	Wilson Brook	5/30/07	-0.15	-0.15	------	------	6.1
Vol	5	Wilson Brook	6/7/07	0.05	0.05	------	------	4.2
Vol	5	Wilson Brook	6/14/07	-0.15	-0.15	------	------	4.9
CFB	5	Wilson Brook	6/20/07	-0.12	-0.12	------	------	6.2
Vol	5	Wilson Brook	6/28/07	-0.15	-0.15	------	------	22.0
Vol	5	Wilson Brook	7/5/07	-0.15	-0.15	------	------	5.2
Vol	5	Wilson Brook	7/12/07	0.04	0.02	------	------	7.7
Vol	5	Wilson Brook	7/26/07	-0.15	------	------	------	5.2
CFB	5	Wilson Brook	8/2/07	Dry	------	------	------	------
Vol	5	Wilson Brook	8/2/07	Dry	------	------	------	6.6
CFB	5	Wilson Brook	8/17/07	Dry	------	------	------	------
Vol	5	Wilson Brook	8/23/07	Dry	------	------	------	
Vol	5	Wilson Brook	8/31/07	Dry	------	------	------	
CFB	5	Wilson Brook	9/11/07	-0.01	-0.01	------	------	11.6
Vol	5	Wilson Brook	9/20/07	Dry	------	------	------	
Vol	5	Wilson Brook	10/15/07	0.00	0.00	------	------	4.8
CFB	5	Wilson Brook	10/24/07	-0.10	-0.10	------	------	13.3
Vol	5	Wilson Brook	10/31/07	0.01	0.02	------	------	10.8
CFB	5	Wilson Brook	11/15/07	0.55	0.55	------	------	34.0
Vol	5	Wilson Brook	11/21/07	0.06	0.05	------	------	3.4
Vol	5	Wilson Brook	11/30/07	0.10	0.10	------	------	3.2
Vol	5	Wilson Brook	12/5/07	------	------	------	------	3.5
CFB	5	Wilson Brook	12/11/07	0.08	0.08	------	------	5.8
CFB	6	Yellow Brook	6/1/06	0.30	0.28	------	------	10.3
CFB	6	Yellow Brook	6/8/06	0.34	0.34	------	------	21.2
CFB	6	Yellow Brook	6/21/06	0.24	0.24	------	------	9.3

APPENDIX A: 2006-2007 Newfound Tributary Data Listing

Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
CFB = Center for Freshwater Biology Field Team Data								
Vol = Volunteer Monitor Data								
CFB	6	Yellow Brook	6/26/06	0.42	0.43	------	------	43.9
Vol	6	Yellow Brook	7/5/06	------	------	------	------	14.5
Vol	6	Yellow Brook	7/12/06	0.18	0.18	------	------	11.8
CFB	6	Yellow Brook	7/13/06	0.36	0.36	------	------	22.0
Vol	6	Yellow Brook	7/19/06	0.19	0.19	------	------	16.4
Vol	6	Yellow Brook	7/23/06	0.29	0.30	------	------	5.3
Vol	6	Yellow Brook	7/31/06	0.19	0.19	------	------	19.9
Vol	6	Yellow Brook	8/9/06	0.16	0.16	------	------	18.2
Vol	6	Yellow Brook	8/16/06	0.16	0.16	------	------	18.5
CFB	6	Yellow Brook	8/21/06	0.16	0.16	------	------	28.2
Vol	6	Yellow Brook	8/23/06	0.18	0.18	------	------	19.5
Vol	6	Yellow Brook	8/30/06	0.18	0.16	------	------	18.9
Vol	6	Yellow Brook	9/7/06	0.17	0.17	------	------	29.1
CFB	6	Yellow Brook	9/20/06	0.16	0.16	------	------	35.0
Vol	6	Yellow Brook	9/21/06	0.16	0.16	------	------	36.9
Vol	6	Yellow Brook	9/30/06	0.18	0.18	------	------	23.9
Vol	6	Yellow Brook	10/10/06	0.18	0.16	------	------	20.2
CFB	6	Yellow Brook	10/17/06	0.20	0.20	------	------	8.7
Vol	6	Yellow Brook	10/25/06	0.21	0.22	------	------	8.4
Vol	6	Yellow Brook	11/3/06	0.26	0.28	------	------	8.0
Vol	6	Yellow Brook	11/10/06	0.28	0.29	------	------	10.8
CFB	6	Yellow Brook	11/14/06	0.38	0.38	------	------	15.1
Vol	6	Yellow Brook	11/22/06	0.26	0.26	------	------	7.0
Vol	6	Yellow Brook	11/29/06	0.27	0.26	------	------	6.2
Vol	6	Yellow Brook	12/6/06	0.26	0.27	------	------	7.4
CFB	6	Yellow Brook	12/13/06	------	------	------	------	12.2
Vol	6	Yellow Brook	12/19/06	0.28	0.27	------	------	9.4
Vol	6	Yellow Brook	12/27/06	0.30	0.28	------	------	7.1
Vol	6	Yellow Brook	1/4/07	0.26	0.27	------	------	5.4
CFB	6	Yellow Brook	1/17/07	0.25	0.25	------	------	9.9

APPENDIX A: 2006-2007 Newfound Tributary Data Listing

Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
CFB = Center for Freshwater Biology Field Team Data								
Vol = Volunteer Monitor Data								
Vol	6	Yellow Brook	1/22/07	0.24	0.22	------	------	8.4
Vol	6	Yellow Brook	2/2/07	0.15	0.15	------	------	12.5
Vol	6	Yellow Brook	2/22/07	0.16	0.15	------	------	7.9
Vol	6	Yellow Brook	3/1/07	0.17	0.16	------	------	7.1
CFB	6	Yellow Brook	3/13/07	------	------	------	------	------
Vol	6	Yellow Brook	3/30/07	0.29	0.30	------	------	11.7
CFB	6	Yellow Brook	4/4/07	0.27	0.27	------	------	9.6
Vol	6	Yellow Brook	4/11/07	0.24	0.23	------	------	6.0
CFB	6	Yellow Brook	4/18/07	0.82	0.82	------	------	16.2
Vol	6	Yellow Brook	4/27/07	0.29	0.29	------	------	7.0
Vol	6	Yellow Brook	5/2/07	0.27	0.28	------	------	14.9
Vol	6	Yellow Brook	5/9/07	0.19	0.19	------	------	6.5
CFB	6	Yellow Brook	5/17/07	0.24	0.24	------	------	5.9
Vol	6	Yellow Brook	5/23/07	0.18	0.18	------	------	6.5
Vol	6	Yellow Brook	5/30/07	0.15	0.13	------	------	9.2
Vol	6	Yellow Brook	6/7/07	0.18	0.18	------	------	5.4
Vol	6	Yellow Brook	6/14/07	0.16	0.17	------	------	9.0
CFB	6	Yellow Brook	6/20/07	------	------	------	------	------
Vol	6	Yellow Brook	6/28/07	0.19	0.18	------	------	9.4
Vol	6	Yellow Brook	7/5/07	0.19	0.19	------	------	24.5
Vol	6	Yellow Brook	7/12/07	0.20	0.19	------	------	11.0
Vol	6	Yellow Brook	7/26/07	0.14	0.14	------	------	9.7
CFB	6	Yellow Brook	8/2/07	------	------	------	------	------
Vol	6	Yellow Brook	8/2/07	0.14	0.15	------	------	11.9
CFB	6	Yellow Brook	8/17/07	0.12	0.12	------	------	------
Vol	6	Yellow Brook	8/23/07	Dry	------	------	------	------
Vol	6	Yellow Brook	8/31/07	Dry	------	------	------	------
CFB	6	Yellow Brook	9/11/07	0.18	0.18	------	------	27.5
Vol	6	Yellow Brook	9/20/07	0.15	0.15	------	------	10.8
Vol	6	Yellow Brook	10/15/07	0.17	0.16	------	------	16.4

APPENDIX A: 2006-2007 Newfound Tributary Data Listing

Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
CFB = Center for Freshwater Biology Field Team Data								
Vol = Volunteer Monitor Data								
CFB	6	Yellow Brook	10/24/07	0.16	0.16	------	------	13.1
Vol	6	Yellow Brook	10/31/07	0.16	0.17	------	------	10.4
CFB	6	Yellow Brook	11/15/07	0.36	0.36	------	------	33.2
Vol	6	Yellow Brook	11/21/07	0.16	0.17	------	------	6.7
Vol	6	Yellow Brook	11/30/07	0.18	0.17	------	------	5.2
Vol	6	Yellow Brook	12/5/07	0.16	0.18	------	------	5.4
CFB	6	Yellow Brook	12/11/07	0.15	0.15	------	------	6.7
CFB	7	Post Office Brook	6/1/06	0.26	------	------	------	7.8
CFB	7	Post Office Brook	6/8/06	0.40	0.40	------	------	7.8
Vol	7	Post Office Brook	6/19/06	0.26	0.26	------	------	6.9
CFB	7	Post Office Brook	6/21/06	0.30	0.31	------	------	------
CFB	7	Post Office Brook	6/26/06	0.56	0.57	------	------	37.5
Vol	7	Post Office Brook	7/5/06	0.30	0.28	------	------	4.3
Vol	7	Post Office Brook	7/12/06	0.20	------	------	------	9.4
CFB	7	Post Office Brook	7/13/06	0.58	0.58	------	------	15.1
Vol	7	Post Office Brook	7/23/06	0.43	0.45	------	------	9.4
Vol	7	Post Office Brook	7/31/06	0.27	0.28	------	------	60.4
Vol	7	Post Office Brook	8/9/06	0.15	0.15	------	------	6.7
Vol	7	Post Office Brook	8/16/06	0.00	0.00	------	------	7.5
Vol	7	Post Office Brook	8/23/06	-0.20	-0.20	------	------	7.5
Vol	7	Post Office Brook	8/30/06	0.20	0.19	------	------	5.7
Vol	7	Post Office Brook	9/7/06	0.12	0.12	------	------	5.7
CFB	7	Post Office Brook	9/20/06	0.16	0.16	------	------	------
Vol	7	Post Office Brook	9/21/06	0.18	0.18	------	------	8.3
Vol	7	Post Office Brook	9/30/06	0.18	0.18	------	------	27.5
Vol	7	Post Office Brook	10/10/06	0.20	0.21	------	------	7.3
CFB	7	Post Office Brook	10/17/06	0.31	0.30	------	------	4.3
Vol	7	Post Office Brook	10/25/06	0.38	0.39	------	------	8.1
Vol	7	Post Office Brook	11/3/06	0.42	0.42	------	------	4.2
Vol	7	Post Office Brook	11/10/06	0.48	0.49	------	------	6.8

APPENDIX A: 2006-2007 Newfound Tributary Data Listing

Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
CFB = Center for Freshwater Biology Field Team Data								
Vol = Volunteer Monitor Data								
CFB	7	Post Office Brook	11/15/06	0.45	0.46	------	------	6.7
Vol	7	Post Office Brook	11/22/06	0.56	0.57	------	------	6.4
Vol	7	Post Office Brook	11/29/06	0.37	0.38	------	------	12.8
Vol	7	Post Office Brook	12/6/06	0.39	0.40	------	------	8.9
CFB	7	Post Office Brook	12/13/06	0.38	0.38	------	------	16.2
Vol	7	Post Office Brook	12/19/06	0.33	0.34	------	------	8.6
Vol	7	Post Office Brook	12/27/06	0.40	0.39	------	------	8.7
Vol	7	Post Office Brook	1/4/07	0.38	0.39	------	------	11.8
CFB	7	Post Office Brook	1/17/07	------	------	------	------	------
Vol	7	Post Office Brook	1/22/07	------	------	------	------	3.3
Vol	7	Post Office Brook	2/2/07	------	------	------	------	------
Vol	7	Post Office Brook	2/22/07	------	------	------	------	4.2
Vol	7	Post Office Brook	3/1/07	------	------	------	------	------
CFB	7	Post Office Brook	3/13/07	------	------	------	------	------
Vol	7	Post Office Brook	3/30/07	0.42	0.41	------	------	8.6
CFB	7	Post Office Brook	4/4/07	------	------	------	------	6.0
Vol	7	Post Office Brook	4/11/07	0.36	0.35	------	------	6.6
CFB	7	Post Office Brook	4/18/07	0.50	0.52	------	------	29.8
Vol	7	Post Office Brook	4/24/07	0.30	0.30	------	------	4.0
Vol	7	Post Office Brook	5/2/07	0.27	0.27	------	------	3.8
Vol	7	Post Office Brook	5/9/07	0.23	0.23	------	------	3.8
CFB	7	Post Office Brook	5/17/07	0.26	0.26	------	------	6.6
Vol	7	Post Office Brook	5/23/07	0.15	0.15	------	------	5.2
Vol	7	Post Office Brook	5/30/07	0.10	0.10	------	------	5.3
Vol	7	Post Office Brook	6/7/07	0.19	0.19	------	------	5.4
Vol	7	Post Office Brook	6/14/07	0.14	0.15	------	------	5.7
CFB	7	Post Office Brook	6/20/07	------	------	------	------	------
Vol	7	Post Office Brook	6/28/07	0.10	0.10	------	------	6.5
Vol	7	Post Office Brook	7/5/07			------	------	6.1
Vol	7	Post Office Brook	7/12/07	0.26	0.27	------	------	9.4

APPENDIX A: 2006-2007 Newfound Tributary Data Listing

Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
CFB = Center for Freshwater Biology Field Team Data								
Vol = Volunteer Monitor Data								
Vol	7	Post Office Brook	7/26/07	0.18	0.17	------	------	4.5
CFB	7	Post Office Brook	8/2/07	------	------	------	------	------
Vol	7	Post Office Brook	8/2/07	0.02	0.02	------	------	5.5
CFB	7	Post Office Brook	8/17/07	Dry	------	------	------	------
Vol	7	Post Office Brook	8/23/07	Dry	------	------	------	------
Vol	7	Post Office Brook	8/31/07	-0.10	------	------	------	7.5
CFB	7	Post Office Brook	9/11/07	0.18	0.18	------	------	14.9
Vol	7	Post Office Brook	9/20/07	0.14	0.15	------	------	11.6
Vol	7	Post Office Brook	10/15/07	0.19	0.18	------	------	9.2
CFB	7	Post Office Brook	10/24/07	0.16	0.16	------	------	9.7
Vol	7	Post Office Brook	10/31/07	0.26	0.26	------	------	9.5
CFB	7	Post Office Brook	11/15/07	0.46	0.46	------	------	29.7
Vol	7	Post Office Brook	11/21/07	0.28	0.29	------	------	4.4
Vol	7	Post Office Brook	11/30/07	0.28	0.27	------	------	4.0
Vol	7	Post Office Brook	12/5/07	------	------	------	------	4.7
CFB	7	Post Office Brook	12/11/07	0.32	0.32	------	------	8.2
CFB	8	Barn Brook	6/1/06	0.30	0.32	------	------	10.1
CFB	8	Barn Brook	6/8/06	1.40	1.40	------	------	11.2
CFB	8	Barn Brook	6/21/06	0.62	0.62	------	------	5.5
CFB	8	Barn Brook	6/26/06	1.24	1.24	------	------	18.2
Vol	8	Barn Brook	7/5/06	0.38	------	------	------	6.2
Vol	8	Barn Brook	7/12/06	0.26	------	------	------	4.5
CFB	8	Barn Brook	7/13/06	1.12	1.12	------	------	21.4
Vol	8	Barn Brook	7/20/06	0.26	0.26	------	------	6.9
Vol	8	Barn Brook	7/26/06	0.52	0.52	------	------	3.6
Vol	8	Barn Brook	8/3/06	0.26	0.26	------	------	5.9
Vol	8	Barn Brook	8/9/06	0.14	0.14	------	------	6.6
Vol	8	Barn Brook	8/16/06	0.12	0.12	------	------	14.7
Vol	8	Barn Brook	8/23/06	0.10	0.08	------	------	15.3
Vol	8	Barn Brook	8/31/06	0.10	0.10	------	------	7.7

APPENDIX A: 2006-2007 Newfound Tributary Data Listing

Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
CFB = Center for Freshwater Biology Field Team Data								
Vol = Volunteer Monitor Data								
Vol	8	Barn Brook	9/6/06	0.12	0.12	------	------	6.1
Vol	8	Barn Brook	9/13/06	0.10	0.10	------	------	8.5
CFB	8	Barn Brook	9/20/06	0.10	0.10	------	------	------
Vol	8	Barn Brook	9/21/06	0.10	0.10	------	------	8.8
Vol	8	Barn Brook	9/28/06	0.08	------	------	------	15.9
Vol	8	Barn Brook	10/4/06	0.16	------	------	------	10.0
Vol	8	Barn Brook	10/14/06	0.54	0.54	------	------	17.5
CFB	8	Barn Brook	10/17/06	0.36	0.36	------	------	3.6
Vol	8	Barn Brook	10/26/06	0.85	0.85	------	------	
Vol	8	Barn Brook	11/2/06	1.11	1.12	------	------	5.2
Vol	8	Barn Brook	11/10/06	1.04	1.05	------	------	3.8
CFB	8	Barn Brook	11/15/06	1.08	1.08	------	------	2.8
Vol	8	Barn Brook	11/15/06	1.10	1.10	------	------	1.7
Vol	8	Barn Brook	11/22/06	0.88	0.87	------	------	4.8
Vol	8	Barn Brook	11/29/06	0.82	0.82	------	------	5.1
Vol	8	Barn Brook	12/6/06	0.88	0.88	------	------	3.1
CFB	8	Barn Brook	12/13/06	0.80	0.80	------	------	3.5
Vol	8	Barn Brook	12/14/06	0.88	0.88	------	------	3.5
Vol	8	Barn Brook	12/20/06	0.70	0.70	------	------	3.1
Vol	8	Barn Brook	1/5/07	0.94	0.95	------	------	2.1
Vol	8	Barn Brook	1/9/07	1.20	1.22	------	------	2.6
CFB	8	Barn Brook	1/17/07	0.70	0.70	------	------	4.4
Vol	8	Barn Brook	1/23/07	------	------	------	------	------
Vol	8	Barn Brook	1/30/07	------	------	------	------	------
CFB	8	Barn Brook	3/13/07	------	------	------	------	------
Vol	8	Barn Brook	3/23/07	1.23	1.24	------	------	22.7
CFB	8	Barn Brook	4/4/07	1.08	1.08	------	------	4.1
CFB	8	Barn Brook	4/18/07	1.34	1.34	------	------	6.2
Vol	8	Barn Brook	5/4/07	0.90	0.90	------	------	2.8
Vol	8	Barn Brook	5/12/07	0.82	0.82	------	------	4.1

APPENDIX A: 2006-2007 Newfound Tributary Data Listing

Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
CFB	8	Barn Brook	5/17/07	0.98	0.98	------	------	3.4
Vol	8	Barn Brook	5/25/07	0.70	0.70	------	------	------
Vol	8	Barn Brook	5/31/07	0.38	0.38	------	------	6.6
Vol	8	Barn Brook	6/8/07	0.52	0.52	------	------	8.5
Vol	8	Barn Brook	6/15/07	0.32	0.32	------	------	6.6
CFB	8	Barn Brook	6/20/07	0.21	0.21	------	------	------
Vol	8	Barn Brook	6/29/07	0.24	0.24	------	------	16.3
Vol	8	Barn Brook	7/7/07	0.22	0.22	------	------	9.8
Vol	8	Barn Brook	7/13/07	0.32	0.32	------	------	5.6
Vol	8	Barn Brook	7/29/07	0.24	0.24	------	------	18.5
CFB	8	Barn Brook	8/2/07	------	------	------	------	------
Vol	8	Barn Brook	8/6/07	0.22	0.22	------	------	4.8
Vol	8	Barn Brook	8/12/07	0.22	0.22	------	------	13.2
CFB	8	Barn Brook	8/17/07	0.22	0.22	------	------	------
Vol	8	Barn Brook	8/24/07	0.22	0.22	------	------	17.5
Vol	8	Barn Brook	9/2/07	0.22	0.22	------	------	17.1
CFB	8	Barn Brook	9/11/07	------	------	------	------	------
Vol	8	Barn Brook	9/18/07	0.22	0.22	------	------	11.9
Vol	8	Barn Brook	9/26/07	0.22	0.22	------	------	21.1
Vol	8	Barn Brook	10/3/07	0.20	0.20	------	------	98.6
Vol	8	Barn Brook	10/10/07	0.20	0.20	------	------	42.0
Vol	8	Barn Brook	10/14/07	0.22	0.22	------	------	46.8
CFB	8	Barn Brook	10/24/07	0.34	0.34	------	------	------
Vol	8	Barn Brook	10/31/07	0.56	0.56	------	------	3.9
Vol	8	Barn Brook	11/8/07	0.62	0.62	------	------	10.4
CFB	8	Barn Brook	11/15/07	1.42	1.42	------	------	21.1
Vol	8	Barn Brook	11/19/07	0.78	0.78	------	------	7.9
Vol	8	Barn Brook	11/28/07	0.98	0.98	------	------	4.5
Vol	8	Barn Brook	12/4/07	------	------	------	------	5.1
CFB	8	Barn Brook	12/11/07	0.60	0.60	------	------	4.6

CFB = Center for Freshwater Biology Field Team Data
Vol = Volunteer Monitor Data

APPENDIX A: 2006-2007 Newfound Tributary Data Listing

CFB = Center for Freshwater Biology Field Team Data
Vol = Volunteer Monitor Data

Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
Vol	8	Barn Brook	12/30/07	0.98	1.00	------	------	2.6
CFB	9	Cashman Brook	6/1/06	0.58	0.58	------	------	90.1
CFB	9	Cashman Brook	6/8/06	1.01	1.01	------	------	10.0
CFB	9	Cashman Brook	6/21/06	0.68	0.69	------	------	6.4
CFB	9	Cashman Brook	6/26/06	1.32	1.32	------	------	32.3
Vol	9	Cashman Brook	7/5/06	0.64	------	------	------	5.1
Vol	9	Cashman Brook	7/12/06	0.50	0.50	------	------	137.9
CFB	9	Cashman Brook	7/13/06	1.12	1.12	------	------	17.8
Vol	9	Cashman Brook	7/20/06	0.56	0.56	------	------	5.2
Vol	9	Cashman Brook	7/26/06	0.64	0.64	------	------	3.6
Vol	9	Cashman Brook	8/3/06	0.56	0.56	------	------	2.9
Vol	9	Cashman Brook	8/9/06	------	------	------	------	3.7
CFB	9	Cashman Brook	8/15/06	Dry	------	------	------	------
Vol	9	Cashman Brook	8/16/06	Dry	------	------	------	5.7
Vol	9	Cashman Brook	8/23/06	Dry	------	------	------	4.8
Vol	9	Cashman Brook	8/31/06	Dry	------	------	------	18.6
Vol	9	Cashman Brook	9/6/06	Dry	------	------	------	4.5
Vol	9	Cashman Brook	9/13/06	Dry	------	------	------	88.2
CFB	9	Cashman Brook	9/20/06	0.52	0.52	------	------	------
Vol	9	Cashman Brook	9/21/06	Dry	------	------	------	12.2
Vol	9	Cashman Brook	9/28/06	Dry	------	------	------	93.1
Vol	9	Cashman Brook	10/4/06	0.58	------	------	------	5.8
Vol	9	Cashman Brook	10/13/06	0.70	0.70	------	------	8.6
CFB	9	Cashman Brook	10/17/06	0.59	0.59	------	------	3.2
Vol	9	Cashman Brook	10/26/06	0.74	0.74	------	------	
Vol	9	Cashman Brook	11/2/06	0.90	0.90	------	------	9.8
Vol	9	Cashman Brook	11/10/06	0.88	0.88	------	------	7.5
CFB	9	Cashman Brook	11/15/06	0.92	0.92	------	------	6.1
Vol	9	Cashman Brook	11/15/06	0.96	0.96	------	------	5.6
Vol	9	Cashman Brook	11/22/06	0.78	0.78	------	------	4.4

APPENDIX A: 2006-2007 Newfound Tributary Data Listing

Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
CFB = Center for Freshwater Biology Field Team Data								
Vol = Volunteer Monitor Data								
Vol	9	Cashman Brook	11/29/06	0.74	0.74	------	------	1.6
Vol	9	Cashman Brook	12/6/06	0.74	0.74	------	------	2.3
CFB	9	Cashman Brook	12/12/06	0.70	0.70	------	------	3.0
Vol	9	Cashman Brook	12/14/06	0.74	0.74	------	------	3.0
Vol	9	Cashman Brook	12/20/06	0.66	0.66	------	------	------
Vol	9	Cashman Brook	1/5/07	0.80	0.81	------	------	------
Vol	9	Cashman Brook	1/9/07	1.00	1.20	------	------	5.5
CFB	9	Cashman Brook	1/17/07	0.76	0.76	------	------	3.7
Vol	9	Cashman Brook	1/23/07	------	------	------	------	------
Vol	9	Cashman Brook	1/30/07	------	------	------	------	------
CFB	9	Cashman Brook	3/13/07	0.68	0.68	------	------	4.6
Vol	9	Cashman Brook	3/23/07	1.00	------	------	------	41.4
CFB	9	Cashman Brook	4/4/07	0.88	0.88	------	------	5.0
CFB	9	Cashman Brook	4/18/07	1.20	1.20	------	------	10.4
Vol	9	Cashman Brook	5/4/07	0.60	0.60	------	------	3.8
Vol	9	Cashman Brook	5/12/07	0.60	0.60	------	------	4.6
CFB	9	Cashman Brook	5/15/07	0.62	0.61	------	------	------
Vol	9	Cashman Brook	5/25/07	0.56	0.56	------	------	------
Vol	9	Cashman Brook	5/31/07	0.50	0.50	------	------	7.9
Vol	9	Cashman Brook	6/8/07	0.51	0.52	------	------	4.1
Vol	9	Cashman Brook	6/15/07	0.50	0.50	------	------	8.2
CFB	9	Cashman Brook	6/20/07	------	------	------	------	------
Vol	9	Cashman Brook	6/29/07	0.50	0.50	------	------	8.6
Vol	9	Cashman Brook	7/7/07	0.50	0.50	------	------	3.7
Vol	9	Cashman Brook	7/13/07	0.48	0.48	------	------	3.7
Vol	9	Cashman Brook	7/29/07	0.50	0.50	------	------	5.5
CFB	9	Cashman Brook	8/2/07	------	------	------	------	------
Vol	9	Cashman Brook	8/6/07	0.48	0.48	------	------	11.4
Vol	9	Cashman Brook	8/12/07	0.50	------	------	------	5.8
CFB	9	Cashman Brook	8/17/07	Dry	------	------	------	------

APPENDIX A: 2006-2007 Newfound Tributary Data Listing

Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
CFB = Center for Freshwater Biology Field Team Data								
Vol = Volunteer Monitor Data								
Vol	9	Cashman Brook	8/24/07	Dry	------	------	------	26.9
CFB	9	Cashman Brook	8/30/07	Dry	------	------	------	------
Vol	9	Cashman Brook	9/2/07	Dry	------	------	------	------
CFB	9	Cashman Brook	9/11/07	Dry	------	------	------	------
Vol	9	Cashman Brook	9/18/07	Dry	------	------	------	8.1
Vol	9	Cashman Brook	9/26/07	Dry	------	------	------	66.4
Vol	9	Cashman Brook	10/3/07	Dry	------	------	------	272.4
Vol	9	Cashman Brook	10/10/07	Dry	------	------	------	363.8
Vol	9	Cashman Brook	10/14/07	Dry	------	------	------	8.1
CFB	9	Cashman Brook	10/24/07	0.58	0.58	------	------	7.6
Vol	9	Cashman Brook	10/31/07	0.56	0.56	------	------	4.6
Vol	9	Cashman Brook	11/8/07	0.62	0.62	------	------	6.1
CFB	9	Cashman Brook	11/15/07	1.20	1.20	------	------	13.4
Vol	9	Cashman Brook	11/19/07	0.62	0.62	------	------	5.8
Vol	9	Cashman Brook	11/28/07	0.75	0.75	------	------	6.0
Vol	9	Cashman Brook	12/4/07	0.66	0.66	------	------	14.9
CFB	9	Cashman Brook	12/11/07	0.62	0.62	------	------	5.7
Vol	9	Cashman Brook	12/30/07	0.70	0.70	------	------	5.1
CFB	10	Georges Brook	6/1/06	------	------	------	------	4.0
CFB	10	Georges Brook	6/8/06	------	------	------	------	9.2
CFB	10	Georges Brook	6/21/06	------	------	4.91	------	17.8
CFB	10	Georges Brook	6/26/06	------	------	4.45	------	25.5
Vol	10	Georges Brook	7/4/06	------	------	------	------	9.3
Vol	10	Georges Brook	7/12/06	------	------	------	------	20.2
CFB	10	Georges Brook	7/13/06	------	------	4.47	4.46	17.4
Vol	10	Georges Brook	7/20/06	------	------	------	------	17.3
Vol	10	Georges Brook	7/26/06	------	------	------	------	8.9
Vol	10	Georges Brook	8/3/06	------	------	5.10	5.10	10.5
Vol	10	Georges Brook	8/9/06	------	------	------	------	16.4
CFB	10	Georges Brook	8/15/06	------	------	5.35	5.35	12.1

APPENDIX A: 2006-2007 Newfound Tributary Data Listing

Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
CFB = Center for Freshwater Biology Field Team Data								
Vol = Volunteer Monitor Data								
Vol	10	Georges Brook	8/16/06	------	------	5.31	5.29	14.0
Vol	10	Georges Brook	8/23/06	------	------	5.25	5.25	12.5
Vol	10	Georges Brook	8/31/06	------	------	5.80	5.40	11.9
Vol	10	Georges Brook	9/6/06	------	------	5.30	------	18.0
Vol	10	Georges Brook	9/13/06	------	------	5.35	5.35	12.2
CFB	10	Georges Brook	9/20/06	------	------	5.23	5.23	14.0
Vol	10	Georges Brook	9/21/06	------	------	5.22	------	12.2
Vol	10	Georges Brook	9/28/06	------	------	5.29	------	10.0
Vol	10	Georges Brook	10/4/06	------	------	4.95	------	11.4
Vol	10	Georges Brook	10/14/06	------	------	4.86	4.87	11.7
CFB	10	Georges Brook	10/17/06	------	------	4.96	4.96	10.3
Vol	10	Georges Brook	10/26/06	------	------	4.80	------	------
Vol	10	Georges Brook	11/2/06	------	------	4.58	4.58	7.5
Vol	10	Georges Brook	11/10/06	------	------	4.65	------	11.1
CFB	10	Georges Brook	11/15/06	------	------	4.64	4.63	8.7
Vol	10	Georges Brook	11/15/06	------	------	4.60	4.60	8.3
Vol	10	Georges Brook	11/22/06	------	------	4.80	------	8.9
Vol	10	Georges Brook	11/29/06	------	------	4.85	4.85	13.1
Vol	10	Georges Brook	12/6/06	------	------	4.84	4.84	9.5
CFB	10	Georges Brook	12/12/06	------	------	4.88	4.88	8.4
Vol	10	Georges Brook	12/14/06	------	------	4.83	4.83	8.7
Vol	10	Georges Brook	12/20/06	------	------	4.89	4.89	7.5
Vol	10	Georges Brook	1/5/07	------	------	4.80	------	6.3
Vol	10	Georges Brook	1/9/07	------	------	4.50	4.50	5.6
CFB	10	Georges Brook	1/17/07	------	------	4.60	4.60	7.1
Vol	10	Georges Brook	1/23/07	------	------	------	------	------
Vol	10	Georges Brook	1/30/07	------	------	------	------	------
CFB	10	Georges Brook	3/13/07	------	------	------	------	------
Vol	10	Georges Brook	3/23/07	------	------	------	------	10.8
CFB	10	Georges Brook	4/4/07	------	------	4.75	4.75	6.1

APPENDIX A: 2006-2007 Newfound Tributary Data Listing

Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
CFB = Center for Freshwater Biology Field Team Data								
Vol = Volunteer Monitor Data								
CFB	10	Georges Brook	4/18/07	------	------	4.54	4.53	7.0
CFB	10	Georges Brook	4/23/07	------	------	4.62	4.62	4.5
Vol	10	Georges Brook	5/4/07	------	------	4.80	4.80	8.6
Vol	10	Georges Brook	5/12/07	------	------	4.96	4.96	16.2
CFB	10	Georges Brook	5/15/07	------	------	------	------	13.8
CFB	10	Georges Brook	5/17/07	------	------	4.90	4.90	------
Vol	10	Georges Brook	5/25/07	------	------	4.96	4.96	------
Vol	10	Georges Brook	5/31/07	------	------	5.15	5.15	22.3
Vol	10	Georges Brook	6/8/07	------	------	4.94	4.97	15.7
Vol	10	Georges Brook	6/15/07	------	------	5.04	5.04	15.2
CFB	10	Georges Brook	6/20/07	------	------	5.27	5.28	17.0
CFB	10	Georges Brook	6/28/07	------	------	5.40	5.39	------
Vol	10	Georges Brook	6/29/07	------	------	5.35	5.35	17.8
Vol	10	Georges Brook	7/7/07	------	------	5.40	5.40	26.9
Vol	10	Georges Brook	7/13/07	------	------	4.97	4.97	21.4
Vol	10	Georges Brook	7/29/07	------	------	5.31	------	16.2
CFB	10	Georges Brook	8/2/07	------	------	------	------	19.1
Vol	10	Georges Brook	8/6/07	------	------	5.48	5.48	88.5
Vol	10	Georges Brook	8/12/07	------	------	5.28	5.26	12.7
CFB	10	Georges Brook	8/17/07	------	------	5.43	5.42	10.9
Vol	10	Georges Brook	8/24/07	------	------	5.46	5.47	------
CFB	10	Georges Brook	8/30/07	------	------	5.49	5.49	11.3
Vol	10	Georges Brook	9/2/07	------	------	5.45	5.45	9.3
CFB	10	Georges Brook	9/11/07	------	------	4.00	5.40	11.3
Vol	10	Georges Brook	9/18/07	------	------	5.14	5.16	12.7
Vol	10	Georges Brook	9/26/07	------	------	5.42	5.42	12.1
Vol	10	Georges Brook	10/3/07	------	------	5.45	5.45	7.3
Vol	10	Georges Brook	10/10/07	------	------	5.20	5.24	15.9
Vol	10	Georges Brook	10/14/07	------	------	4.90	4.90	20.2
CFB	10	Georges Brook	10/24/07	------	------	4.95	4.96	14.2

APPENDIX A: 2006-2007 Newfound Tributary Data Listing

Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
CFB = Center for Freshwater Biology Field Team Data								
Vol = Volunteer Monitor Data								
Vol	10	Georges Brook	10/31/07	------	------	4.89	4.87	8.0
Vol	10	Georges Brook	11/8/07	------	------	4.84	4.84	8.0
CFB	10	Georges Brook	11/14/07	------	------	4.92	4.92	5.4
Vol	10	Georges Brook	11/19/07	------	------	4.85	4.85	8.5
Vol	10	Georges Brook	11/28/07	------	------	4.69	4.68	7.2
Vol	10	Georges Brook	12/4/07	------	------	4.85	4.85	4.8
CFB	10	Georges Brook	12/11/07	------	------	4.90	4.91	6.6
Vol	10	Georges Brook	12/30/07	------	------	4.75	4.75	5.7
CFB	11	Cockermouth River (Near Lake)	6/1/06	2.35	2.35	------	------	13.4
CFB	11	Cockermouth River (Near Lake)	6/8/06	2.82	2.82	------	------	5.1
CFB	11	Cockermouth River (Near Lake)	6/21/06	2.52	2.52	------	------	6.2
CFB	11	Cockermouth River (Near Lake)	6/26/06	3.14	3.14	------	------	43.0
Vol	11	Cockermouth River (Near Lake)	7/5/06	1.00	------	------	------	4.3
Vol	11	Cockermouth River (Near Lake)	7/12/06	2.00	2.00	------	------	5.7
CFB	11	Cockermouth River (Near Lake)	7/13/06	------	------	------	------	28.5
Vol	11	Cockermouth River (Near Lake)	7/20/06	2.10	2.10	------	------	2.1
Vol	11	Cockermouth River (Near Lake)	7/26/06	1.88	1.88	------	------	3.6
Vol	11	Cockermouth River (Near Lake)	8/3/06	1.65	1.65	------	------	5.7
Vol	11	Cockermouth River (Near Lake)	8/9/06	1.60	1.60	------	------	3.0
CFB	11	Cockermouth River (Near Lake)	8/15/06	------	------	------	------	2.7
Vol	11	Cockermouth River (Near Lake)	8/16/06	1.50	1.50	------	------	5.1
Vol	11	Cockermouth River (Near Lake)	8/23/06	1.50	1.50	------	------	4.5
Vol	11	Cockermouth River (Near Lake)	8/31/06	1.50	1.50	------	------	3.7
Vol	11	Cockermouth River (Near Lake)	9/6/06	1.52	1.50	------	------	4.5
Vol	11	Cockermouth River (Near Lake)	9/13/06	1.48	1.48	------	------	5.2
CFB	11	Cockermouth River (Near Lake)	9/20/06	1.44	1.44	------	------	5.3
Vol	11	Cockermouth River (Near Lake)	9/21/06	2.40	------	------	------	5.4
Vol	11	Cockermouth River (Near Lake)	9/28/06	1.36	1.36	------	------	4.2
Vol	11	Cockermouth River (Near Lake)	10/4/06	1.60	1.60	------	------	3.7
Vol	11	Cockermouth River (Near Lake)	10/13/06	2.90	------	------	------	3.4

APPENDIX A: 2006-2007 Newfound Tributary Data Listing

Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
CFB = Center for Freshwater Biology Field Team Data								
Vol = Volunteer Monitor Data								
CFB	11	Cockermouth River (Near Lake)	10/17/06	1.59	1.58	------	------	2.2
Vol	11	Cockermouth River (Near Lake)	10/26/06	------	------	------	------	------
Vol	11	Cockermouth River (Near Lake)	11/2/06	1.90	1.90	------	------	5.4
Vol	11	Cockermouth River (Near Lake)	11/10/06	1.78	1.78	------	------	------
CFB	11	Cockermouth River (Near Lake)	11/15/06	2.06	2.06	------	------	4.5
Vol	11	Cockermouth River (Near Lake)	11/15/06	2.20	2.20	------	------	6.4
Vol	11	Cockermouth River (Near Lake)	11/22/06	1.49	1.50	------	------	3.6
Vol	11	Cockermouth River (Near Lake)	11/29/06	0.77	0.77	------	------	3.6
Vol	11	Cockermouth River (Near Lake)	12/6/06	1.10	1.09	------	------	3.5
CFB	11	Cockermouth River (Near Lake)	12/12/06	0.62	0.62	------	------	2.3
Vol	11	Cockermouth River (Near Lake)	12/14/06	0.52	0.52	------	------	3.9
Vol	11	Cockermouth River (Near Lake)	12/20/06	0.31	0.31	------	------	3.4
Vol	11	Cockermouth River (Near Lake)	1/5/07	0.82	0.82	------	------	2.1
Vol	11	Cockermouth River (Near Lake)	1/9/07	2.00	2.00	------	------	6.4
CFB	11	Cockermouth River (Near Lake)	1/17/07	------	------	------	------	------
Vol	11	Cockermouth River (Near Lake)	1/23/07	------	------	------	------	------
Vol	11	Cockermouth River (Near Lake)	1/30/07	------	------	------	------	------
CFB	11	Cockermouth River (Near Lake)	3/13/07	------	------	------	------	------
Vol	11	Cockermouth River (Near Lake)	3/23/07	1.14	------	------	------	13.8
CFB	11	Cockermouth River (Near Lake)	4/4/07	1.48	1.48	------	------	4.5
CFB	11	Cockermouth River (Near Lake)	4/18/07	------	------	------	------	11.5
Vol	11	Cockermouth River (Near Lake)	5/4/07	2.46	2.46	------	------	3.0
Vol	11	Cockermouth River (Near Lake)	5/12/07	2.39	2.39	------	------	4.0
CFB	11	Cockermouth River (Near Lake)	5/15/07	2.26	2.26	------	------	2.8
Vol	11	Cockermouth River (Near Lake)	5/25/07	2.40	2.40	------	------	------
Vol	11	Cockermouth River (Near Lake)	5/31/07	2.18	2.18	------	------	4.5
Vol	11	Cockermouth River (Near Lake)	6/8/07	2.34	2.34	------	------	4.4
Vol	11	Cockermouth River (Near Lake)	6/15/07	2.36	2.36	------	------	27.8
CFB	11	Cockermouth River (Near Lake)	6/20/07	2.26	2.26	------	------	4.6
Vol	11	Cockermouth River (Near Lake)	6/29/07	2.04	2.04	------	------	7.1

APPENDIX A: 2006-2007 Newfound Tributary Data Listing

Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
CFB = Center for Freshwater Biology Field Team Data								
Vol = Volunteer Monitor Data								
Vol	11	Cockermouth River (Near Lake)	7/7/07	1.92	1.92	------	------	8.1
Vol	11	Cockermouth River (Near Lake)	7/13/07	2.80	2.80	------	------	5.2
Vol	11	Cockermouth River (Near Lake)	7/29/07	2.04	2.04	------	------	7.1
CFB	11	Cockermouth River (Near Lake)	8/2/07	1.90	2.00	------	------	12.4
Vol	11	Cockermouth River (Near Lake)	8/6/07	1.78		------	------	11.0
Vol	11	Cockermouth River (Near Lake)	8/12/07	1.96	1.96	------	------	5.7
CFB	11	Cockermouth River (Near Lake)	8/17/07	1.86	1.88	------	------	4.4
Vol	11	Cockermouth River (Near Lake)	8/24/07	1.68	1.68	------	------	14.6
Vol	11	Cockermouth River (Near Lake)	9/2/07	1.58	1.58	------	------	7.0
CFB	11	Cockermouth River (Near Lake)	9/11/07	1.68	1.68	------	------	5.4
Vol	11	Cockermouth River (Near Lake)	9/18/07	1.78	1.78	------	------	5.3
Vol	11	Cockermouth River (Near Lake)	9/26/07	1.68	------	------	------	8.3
Vol	11	Cockermouth River (Near Lake)	10/3/07	1.68	1.68	------	------	11.4
Vol	11	Cockermouth River (Near Lake)	10/10/07	1.78	1.78	------	------	8.8
Vol	11	Cockermouth River (Near Lake)	10/14/07	2.16	2.16	------	------	
CFB	11	Cockermouth River (Near Lake)	10/23/07	1.73	1.73	------	------	7.1
Vol	11	Cockermouth River (Near Lake)	10/31/07	1.44	1.44	------	------	2.9
Vol	11	Cockermouth River (Near Lake)	11/8/07	1.05	1.05	------	------	3.1
CFB	11	Cockermouth River (Near Lake)	11/14/07	0.88	0.88	------	------	2.2
Vol	11	Cockermouth River (Near Lake)	11/19/07	1.38	1.38	------	------	4.0
Vol	11	Cockermouth River (Near Lake)	11/28/07	1.52	1.52	------	------	8.4
Vol	11	Cockermouth River (Near Lake)	12/4/07	------	------	------	------	------
Vol	11	Cockermouth River (Near Lake)	12/30/07	------	------	------	------	------
CFB	12	Cockermouth River (Upstream)	6/1/06	1.26	1.24	------	------	2.4
CFB	12	Cockermouth River (Upstream)	6/8/06	2.72	2.72	------	------	5.1
CFB	12	Cockermouth River (Upstream)	6/21/06	1.60	1.61	------	------	6.2
Vol	12	Cockermouth River (Upstream)	6/23/06	1.25	1.25	------	------	3.8
CFB	12	Cockermouth River (Upstream)	6/26/06	------	------	2.00	------	36.7
Vol	12	Cockermouth River (Upstream)	6/30/06	------	------	------	------	3.7
Vol	12	Cockermouth River (Upstream)	7/8/06	1.00	1.00	------	------	5.1

APPENDIX A: 2006-2007 Newfound Tributary Data Listing

Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
CFB = Center for Freshwater Biology Field Team Data								
Vol = Volunteer Monitor Data								
CFB	12	Cockermouth River (Upstream)	7/13/06	------	------	1.86	1.87	31.6
Vol	12	Cockermouth River (Upstream)	7/14/06	2.70	------	------	------	5.9
Vol	12	Cockermouth River (Upstream)	7/21/06	0.90	------	------	------	------
Vol	12	Cockermouth River (Upstream)	7/25/06	0.98	------	------	------	------
Vol	12	Cockermouth River (Upstream)	8/5/06	------	------	------	------	------
Vol	12	Cockermouth River (Upstream)	8/11/06	0.69	------	------	------	------
CFB	12	Cockermouth River (Upstream)	8/15/06	0.60	0.60	3.37	3.37	2.3
Vol	12	Cockermouth River (Upstream)	8/18/06	0.56	------	------	------	------
Vol	12	Cockermouth River (Upstream)	8/25/06	0.58	------	------	------	4.7
Vol	12	Cockermouth River (Upstream)	9/1/06	0.58	------	------	------	2.3
Vol	12	Cockermouth River (Upstream)	9/8/06	0.55	------	------	------	5.1
CFB	12	Cockermouth River (Upstream)	9/20/06	0.86	0.86	3.30	3.30	3.8
Vol	12	Cockermouth River (Upstream)	9/22/06	0.60	------	------	------	3.8
Vol	12	Cockermouth River (Upstream)	10/1/06	0.89	------	------	------	4.0
Vol	12	Cockermouth River (Upstream)	10/6/06	1.05	------	------	------	3.9
Vol	12	Cockermouth River (Upstream)	10/13/06	1.94	------	------	------	6.7
CFB	12	Cockermouth River (Upstream)	10/17/06	1.04	1.04	3.23	3.23	3.1
Vol	12	Cockermouth River (Upstream)	10/27/06	1.56	------	------	------	2.6
Vol	12	Cockermouth River (Upstream)	11/4/06	2.00	------	------	------	3.1
Vol	12	Cockermouth River (Upstream)	11/10/06	2.40	------	------	------	4.1
CFB	12	Cockermouth River (Upstream)	11/15/06	2.79	2.79	2.71	2.70	5.6
Vol	12	Cockermouth River (Upstream)	11/17/06	------	------	0.55	------	23.3
Vol	12	Cockermouth River (Upstream)	11/23/06	1.40	------	------	------	2.4
Vol	12	Cockermouth River (Upstream)	12/1/06	1.36	------	------	------	2.9
Vol	12	Cockermouth River (Upstream)	12/8/06	1.30	------	------	------	2.9
CFB	12	Cockermouth River (Upstream)	12/12/06	1.20	1.20	3.19	3.20	1.7
Vol	12	Cockermouth River (Upstream)	12/16/06	1.30	------	------	------	3.7
Vol	12	Cockermouth River (Upstream)	12/22/06	1.00	------	------	------	2.2
Vol	12	Cockermouth River (Upstream)	1/4/07	1.40	------	------	------	2.8
Vol	12	Cockermouth River (Upstream)	1/12/07	1.65	------	------	------	2.5

APPENDIX A: 2006-2007 Newfound Tributary Data Listing

Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
CFB = Center for Freshwater Biology Field Team Data								
Vol = Volunteer Monitor Data								
CFB	12	Cockermouth River (Upstream)	1/17/07	1.18	1.18	3.21	3.20	2.3
Vol	12	Cockermouth River (Upstream)	1/24/07	------	------	------	------	2.1
CFB	12	Cockermouth River (Upstream)	3/13/07	------	------	------	------	------
Vol	12	Cockermouth River (Upstream)	3/24/07	------	------	------	------	7.1
Vol	12	Cockermouth River (Upstream)	3/31/07	1.35	------	------	------	1.3
CFB	12	Cockermouth River (Upstream)	4/4/07	1.33	1.33	2.99	3.00	3.5
Vol	12	Cockermouth River (Upstream)	4/14/07	0.85	------	------	------	2.6
CFB	12	Cockermouth River (Upstream)	4/18/07	------	------	2.20	2.20	25.9
CFB	12	Cockermouth River (Upstream)	4/23/07	2.43	2.43	2.65	2.65	5.8
Vol	12	Cockermouth River (Upstream)	4/28/07	1.30	------	------	------	2.6
Vol	12	Cockermouth River (Upstream)	5/5/07	0.70	------	------	------	7.2
CFB	12	Cockermouth River (Upstream)	5/15/07	0.34	0.34	3.27	3.28	2.2
Vol	12	Cockermouth River (Upstream)	5/18/07	0.70	------	------	------	3.1
Vol	12	Cockermouth River (Upstream)	5/29/07	0.18	0.15	------	------	2.8
Vol	12	Cockermouth River (Upstream)	6/3/07	0.20	------	------	------	3.1
Vol	12	Cockermouth River (Upstream)	6/9/07	0.12	------	------	------	1.8
Vol	12	Cockermouth River (Upstream)	6/16/07	0.00	------	------	------	1.7
CFB	12	Cockermouth River (Upstream)	6/20/07	-0.14	-0.14	3.43	3.43	4.4
CFB	12	Cockermouth River (Upstream)	6/28/07	-0.23	-0.23	3.45	3.45	------
Vol	12	Cockermouth River (Upstream)	6/30/07	-0.23	------	------	------	4.6
Vol	12	Cockermouth River (Upstream)	7/8/07	-0.50	------	------	------	3.8
Vol	12	Cockermouth River (Upstream)	7/14/07	-0.16	------	------	------	3.5
Vol	12	Cockermouth River (Upstream)	7/26/07	-0.25	------	------	------	3.4
CFB	12	Cockermouth River (Upstream)	8/2/07	-0.24	-0.24	------	------	5.6
Vol	12	Cockermouth River (Upstream)	8/3/07	-0.46	------	------	------	8.2
Vol	12	Cockermouth River (Upstream)	8/10/07	-0.25	------	------	------	2.7
CFB	12	Cockermouth River (Upstream)	8/17/07	-0.26	-0.26	3.45	3.44	4.0
Vol	12	Cockermouth River (Upstream)	8/25/07	-0.50	------	------	------	------
CFB	12	Cockermouth River (Upstream)	8/30/07	-0.30	-0.30	------	------	6.6
Vol	12	Cockermouth River (Upstream)	8/31/07	-0.58	------	------	------	3.7

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Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
CFB = Center for Freshwater Biology Field Team Data								
Vol = Volunteer Monitor Data								
Vol	12	Cockermouth River (Upstream)	9/9/07	-0.58	------	------	------	3.6
CFB	12	Cockermouth River (Upstream)	9/11/07	-0.10	-0.10	------	------	3.5
Vol	12	Cockermouth River (Upstream)	9/22/07	-0.23	------	------	------	3.5
Vol	12	Cockermouth River (Upstream)	9/30/07	-0.52	------	------	------	5.3
Vol	12	Cockermouth River (Upstream)	10/6/07	-0.58	------	------	------	4.4
Vol	12	Cockermouth River (Upstream)	10/14/07	0.50	------	------	------	2.8
Vol	12	Cockermouth River (Upstream)	10/20/07	2.40	------	------	------	------
CFB	12	Cockermouth River (Upstream)	10/23/07	0.32	0.32	3.26	3.26	3.3
Vol	12	Cockermouth River (Upstream)	11/2/07	0.30	------	------	------	2.6
Vol	12	Cockermouth River (Upstream)	11/9/07	0.50	------	------	------	1.5
CFB	12	Cockermouth River (Upstream)	11/14/07	0.28	0.28	3.28	3.28	2.3
Vol	12	Cockermouth River (Upstream)	11/25/07	0.50	------	------	------	1.8
Vol	12	Cockermouth River (Upstream)	12/2/07	0.40	0.42	------	------	2.5
Vol	12	Cockermouth River (Upstream)	12/9/07	------	------	------	------	3.4
CFB	12	Cockermouth River (Upstream)	12/19/07	------	------	3.21	3.21	1.9
CFB	13	Tannery Brook	6/1/06	0.90	0.90	------	------	3.8
CFB	13	Tannery Brook	6/8/06	1.26	1.25	------	------	------
CFB	13	Tannery Brook	6/21/06	1.05	1.05	------	------	4.5
Vol	13	Tannery Brook	6/23/06	0.98	0.98	------	------	5.1
CFB	13	Tannery Brook	6/26/06	1.55	1.55	------	------	20.6
Vol	13	Tannery Brook	6/30/06	1.20	1.20	------	------	4.9
Vol	13	Tannery Brook	7/8/06	0.90	0.90	------	------	4.3
CFB	13	Tannery Brook	7/13/06	1.60	1.61	------	------	12.7
Vol	13	Tannery Brook	7/14/06	1.26	------	------	------	4.3
Vol	13	Tannery Brook	7/21/06	0.90	0.89	------	------	2.1
Vol	13	Tannery Brook	7/28/06	0.95	------	------	------	4.4
Vol	13	Tannery Brook	8/5/06	0.90	------	------	------	4.0
Vol	13	Tannery Brook	8/11/06	0.84	------	------	------	5.7
CFB	13	Tannery Brook	8/15/06	0.80	0.80	------	------	3.2
Vol	13	Tannery Brook	8/18/06	0.76	------	------	------	1.7

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Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
Vol	13	Tannery Brook	8/25/06	0.80	------	------	------	3.1
Vol	13	Tannery Brook	9/1/06	0.80	------	------	------	2.6
Vol	13	Tannery Brook	9/8/06	0.80	------	------	------	1.7
CFB	13	Tannery Brook	9/20/06	0.92	0.92	------	------	4.1
Vol	13	Tannery Brook	9/22/06	0.84	------	------	------	4.1
Vol	13	Tannery Brook	10/2/06	0.94	------	------	------	3.7
Vol	13	Tannery Brook	10/6/06	0.95	------	------	------	3.1
Vol	13	Tannery Brook	10/13/06	0.99	------	------	------	3.6
CFB	13	Tannery Brook	10/17/06	0.95	0.94	------	------	3.3
Vol	13	Tannery Brook	10/27/06	1.05	------	------	------	17.1
Vol	13	Tannery Brook	11/4/06	1.12	------	------	------	2.6
Vol	13	Tannery Brook	11/10/06	1.24	------	------	------	2.6
CFB	13	Tannery Brook	11/15/06	1.29	1.28	------	------	3.9
Vol	13	Tannery Brook	11/17/06	1.70	------	------	------	10.4
Vol	13	Tannery Brook	11/23/06	1.05	------	------	------	------
Vol	13	Tannery Brook	12/1/06	1.07	------	------	------	2.5
Vol	13	Tannery Brook	12/8/06	1.15	------	------	------	2.2
CFB	13	Tannery Brook	12/12/06	1.02	1.01	------	------	2.4
Vol	13	Tannery Brook	12/16/06	1.04	------	------	------	2.2
Vol	13	Tannery Brook	12/23/06	0.98	------	------	------	1.8
Vol	13	Tannery Brook	1/4/07	1.08	------	------	------	2.8
Vol	13	Tannery Brook	1/12/07	1.15	------	------	------	------
CFB	13	Tannery Brook	1/17/07	1.30	1.30	------	------	2.1
Vol	13	Tannery Brook	1/24/07	------	------	------	------	------
CFB	13	Tannery Brook	3/13/07	------	------	------	------	------
Vol	13	Tannery Brook	3/24/07	------	------	------	------	7.9
Vol	13	Tannery Brook	3/31/07	1.10	------	------	------	4.1
CFB	13	Tannery Brook	4/4/07	1.18	1.18	------	------	3.4
Vol	13	Tannery Brook	4/14/07	1.00	------	------	------	2.9
CFB	13	Tannery Brook	4/18/07	1.56	1.56	------	------	7.9

CFB = Center for Freshwater Biology Field Team Data
Vol = Volunteer Monitor Data

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Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
CFB = Center for Freshwater Biology Field Team Data								
Vol = Volunteer Monitor Data								
Vol	13	Tannery Brook	4/28/07	1.75	------	------	------	2.8
Vol	13	Tannery Brook	5/5/07	1.02	------	------	------	2.1
CFB	13	Tannery Brook	5/15/07	1.00	1.00	------	------	2.8
Vol	13	Tannery Brook	5/18/07	1.10	------	------	------	2.5
Vol	13	Tannery Brook	5/29/07	0.70	------	------	------	3.4
Vol	13	Tannery Brook	6/3/07	1.00	------	------	------	4.3
Vol	13	Tannery Brook	6/9/07	0.95	------	------	------	2.5
Vol	13	Tannery Brook	6/16/07	0.90	------	------	------	2.3
CFB	13	Tannery Brook	6/20/07	0.85	0.87	------	------	3.6
CFB	13	Tannery Brook	6/28/07	0.82	0.82	------	------	------
Vol	13	Tannery Brook	6/30/07	0.75	------	------	------	2.4
Vol	13	Tannery Brook	7/8/07	0.85	------	------	------	4.1
Vol	13	Tannery Brook	7/14/07	0.85	------	------	------	2.8
Vol	13	Tannery Brook	7/26/07	0.85	------	------	------	2.7
CFB	13	Tannery Brook	8/2/07	0.45	0.45	------	------	3.7
Vol	13	Tannery Brook	8/3/07	0.60	------	------	------	2.6
Vol	13	Tannery Brook	8/10/07	0.83	------	------	------	2.8
CFB	13	Tannery Brook	8/17/07	0.80	0.80	------	------	3.3
Vol	13	Tannery Brook	8/25/07	0.78	------	------	------	4.1
CFB	13	Tannery Brook	8/30/07	0.40	0.40	------	------	------
Vol	13	Tannery Brook	8/31/07	0.80	------	------	------	3.1
Vol	13	Tannery Brook	9/9/07	Dry	------	------	------	------
CFB	13	Tannery Brook	9/11/07	1.00	1.00	------	------	8.5
Vol	13	Tannery Brook	9/22/07	0.80	------	------	------	3.2
Vol	13	Tannery Brook	9/30/07	0.70	------	------	------	4.3
Vol	13	Tannery Brook	10/6/07	0.70	------	------	------	2.8
Vol	13	Tannery Brook	10/14/07	1.20	------	------	------	2.7
Vol	13	Tannery Brook	10/20/07	1.38	------	------	------	11.2
CFB	13	Tannery Brook	10/23/07	1.06	1.06	------	------	4.6
Vol	13	Tannery Brook	11/2/07	1.00	------	------	------	2.4

APPENDIX A: 2006-2007 Newfound Tributary Data Listing

Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
CFB = Center for Freshwater Biology Field Team Data								
Vol = Volunteer Monitor Data								
Vol	13	Tannery Brook	11/9/07	0.75	------	------	------	1.9
CFB	13	Tannery Brook	11/14/07	1.02	1.02	------	------	2.0
Vol	13	Tannery Brook	11/25/07	1.20	------	------	------	2.8
Vol	13	Tannery Brook	12/2/07	1.29	------	------	------	2.6
Vol	13	Tannery Brook	12/9/07	------	------	------	------	1.8
CFB	13	Tannery Brook	12/19/07	------	------	------	------	------
CFB	14	Cockermouth River (Upstream)	6/8/06	------	------	------	------	5.4
CFB	14	Cockermouth River (Upstream)	6/21/06	------	------	------	------	4.8
Vol	14	Cockermouth River (Upstream)	6/23/06	------	------	------	------	4.5
CFB	14	Cockermouth River (Upstream)	6/26/06	------	------	3.05	------	23.1
Vol	14	Cockermouth River (Upstream)	6/30/06	------	------	2.36	2.36	2.7
Vol	14	Cockermouth River (Upstream)	7/8/06	------	------	3.84	------	3.0
CFB	14	Cockermouth River (Upstream)	7/13/06	------	------	2.88	2.87	24.2
Vol	14	Cockermouth River (Upstream)	7/14/06	------	------	3.32	------	4.8
Vol	14	Cockermouth River (Upstream)	7/21/06	------	------	3.77	------	4.3
Vol	14	Cockermouth River (Upstream)	7/28/06	------	------	3.78	------	2.8
Vol	14	Cockermouth River (Upstream)	8/5/06	------	------	3.83	------	4.0
Vol	14	Cockermouth River (Upstream)	8/11/06	------	------	3.88	------	2.5
CFB	14	Cockermouth River (Upstream)	8/15/06	------	------	3.94	3.94	2.6
Vol	14	Cockermouth River (Upstream)	8/18/06	------	------	3.86	------	3.2
Vol	14	Cockermouth River (Upstream)	8/25/06	------	------	3.86	------	2.5
Vol	14	Cockermouth River (Upstream)	9/1/06	------	------	3.86	------	2.3
Vol	14	Cockermouth River (Upstream)	9/8/06	------	------	3.86	------	2.2
CFB	14	Cockermouth River (Upstream)	9/20/06	------	------	3.85	3.85	3.6
Vol	14	Cockermouth River (Upstream)	9/22/06	------	------	3.89	------	3.6
Vol	14	Cockermouth River (Upstream)	10/1/06	------	------	3.84	------	3.4
Vol	14	Cockermouth River (Upstream)	10/6/06	------	------	3.75	------	3.2
Vol	14	Cockermouth River (Upstream)	10/13/06	------	------	3.50	------	5.3
CFB	14	Cockermouth River (Upstream)	10/17/06	------	------	3.78	3.78	3.7
Vol	14	Cockermouth River (Upstream)	10/27/06	------	------	3.63	------	8.3

APPENDIX A: 2006-2007 Newfound Tributary Data Listing

Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
CFB = Center for Freshwater Biology Field Team Data								
Vol = Volunteer Monitor Data								
Vol	14	Cockermouth River (Upstream)	11/3/06	------	------	3.51	------	3.1
Vol	14	Cockermouth River (Upstream)	11/10/06	------	------	3.47	------	2.8
CFB	14	Cockermouth River (Upstream)	11/15/06	------	------	3.36	3.36	4.3
Vol	14	Cockermouth River (Upstream)	11/17/06	------	------	------	------	12.4
Vol	14	Cockermouth River (Upstream)	11/23/06	------	------	3.60	------	1.7
Vol	14	Cockermouth River (Upstream)	12/1/06	------	------	3.61	------	2.5
Vol	14	Cockermouth River (Upstream)	12/8/06	------	------	3.69	------	4.1
CFB	14	Cockermouth River (Upstream)	12/12/06	------	------	3.73	3.73	1.7
Vol	14	Cockermouth River (Upstream)	12/16/06	------	------	3.77	------	12.7
Vol	14	Cockermouth River (Upstream)	12/22/06	------	------	3.75	------	2.1
Vol	14	Cockermouth River (Upstream)	1/4/07	------	------	3.70	------	2.8
Vol	14	Cockermouth River (Upstream)	1/12/07	------	------	3.51	------	2.5
CFB	14	Cockermouth River (Upstream)	1/17/07	------	------	3.78	3.78	1.8
Vol	14	Cockermouth River (Upstream)	1/24/07	------	------	------	------	3.6
CFB	14	Cockermouth River (Upstream)	3/13/07	------	------	------	------	------
Vol	14	Cockermouth River (Upstream)	3/24/07	------	------	3.41	------	7.7
Vol	14	Cockermouth River (Upstream)	3/31/07	------	------	3.50	------	3.4
CFB	14	Cockermouth River (Upstream)	4/4/07	------	------	3.57	3.56	3.0
Vol	14	Cockermouth River (Upstream)	4/14/07	------	------	2.60	------	2.5
CFB	14	Cockermouth River (Upstream)	4/18/07	------	------	3.01	3.00	7.3
CFB	14	Cockermouth River (Upstream)	4/23/07	------	------	3.30	3.30	4.7
Vol	14	Cockermouth River (Upstream)	4/28/07	------	------	3.50	------	2.2
Vol	14	Cockermouth River (Upstream)	5/5/07	------	------	3.67	------	2.1
CFB	14	Cockermouth River (Upstream)	5/15/07	------	------	3.81	3.81	2.2
Vol	14	Cockermouth River (Upstream)	5/18/07	------	------	3.63	------	2.9
Vol	14	Cockermouth River (Upstream)	5/29/07	------	------	3.75	------	2.5
Vol	14	Cockermouth River (Upstream)	6/3/07	------	------	3.75	------	3.4
Vol	14	Cockermouth River (Upstream)	6/9/07	------	------	3.80	------	2.2
Vol	14	Cockermouth River (Upstream)	6/16/07	------	------	3.90	------	1.6
CFB	14	Cockermouth River (Upstream)	6/20/07	------	------	3.95	3.95	2.6

APPENDIX A: 2006-2007 Newfound Tributary Data Listing

Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
CFB = Center for Freshwater Biology Field Team Data								
Vol = Volunteer Monitor Data								
CFB	14	Cockermouth River (Upstream)	6/28/07	------	------	3.98	3.98	------
Vol	14	Cockermouth River (Upstream)	6/30/07	------	------	3.90	------	2.3
Vol	14	Cockermouth River (Upstream)	7/3/07	------	------	4.02	------	3.0
Vol	14	Cockermouth River (Upstream)	7/8/07	------	------	3.90	------	2.3
Vol	14	Cockermouth River (Upstream)	7/14/07	------	------	3.88	------	1.2
Vol	14	Cockermouth River (Upstream)	7/26/07	------	------	3.90	------	1.7
CFB	14	Cockermouth River (Upstream)	8/2/07	------	------	------	------	3.5
Vol	14	Cockermouth River (Upstream)	8/3/07	------	------	3.95	------	1.8
Vol	14	Cockermouth River (Upstream)	8/11/07	------	------	3.87	------	1.7
CFB	14	Cockermouth River (Upstream)	8/17/07	------	------	3.99	3.99	2.5
Vol	14	Cockermouth River (Upstream)	8/25/07	------	------	3.90	------	1.8
Vol	14	Cockermouth River (Upstream)	8/31/07	------	------	3.93	------	2.0
Vol	14	Cockermouth River (Upstream)	9/9/07	------	------	3.95	------	2.4
CFB	14	Cockermouth River (Upstream)	9/11/07	------	------	3.85	3.85	2.0
Vol	14	Cockermouth River (Upstream)	9/22/07	------	------	3.90	------	2.3
Vol	14	Cockermouth River (Upstream)	9/30/07	------	------	3.95	------	2.4
Vol	14	Cockermouth River (Upstream)	10/6/07	------	------	3.95	------	2.3
Vol	14	Cockermouth River (Upstream)	10/14/07	------	------	3.85	------	4.8
Vol	14	Cockermouth River (Upstream)	10/20/07	------	------	3.25	------	10.8
CFB	14	Cockermouth River (Upstream)	10/23/07	------	------	3.78	3.79	3.0
Vol	14	Cockermouth River (Upstream)	11/2/07	------	------	3.75	------	1.5
Vol	14	Cockermouth River (Upstream)	11/9/07	------	------	3.65	------	1.1
CFB	14	Cockermouth River (Upstream)	11/14/07	------	------	3.78	3.78	1.7
Vol	14	Cockermouth River (Upstream)	11/25/07	------	------	3.75	------	4.1
Vol	14	Cockermouth River (Upstream)	12/2/07	------	------	3.66	------	2.7
Vol	14	Cockermouth River (Upstream)	12/9/07	------	------	3.70	------	13.9
CFB	14	Cockermouth River (Upstream)	12/19/07	------	------	------	------	1.5
CFB	15	Hebron Brook	6/1/06	0.28	0.29	------	------	9.7
CFB	15	Hebron Brook	6/8/06	0.41	0.41	------	------	7.8
CFB	15	Hebron Brook	6/21/06	0.36	0.36	------	------	6.3

APPENDIX A: 2006-2007 Newfound Tributary Data Listing

Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
CFB = Center for Freshwater Biology Field Team Data								
Vol = Volunteer Monitor Data								
CFB	15	Hebron Brook	6/26/06	0.62	0.62	------	------	18.9
Vol	15	Hebron Brook	6/27/06	0.34	0.34	------	------	8.8
Vol	15	Hebron Brook	6/30/06	0.40	0.40	------	------	8.4
Vol	15	Hebron Brook	7/8/06	0.30	0.30	------	------	5.8
CFB	15	Hebron Brook	7/13/06	0.60	0.60	------	------	11.7
Vol	15	Hebron Brook	7/14/06	0.40	0.41	------	------	5.2
Vol	15	Hebron Brook	7/21/06	0.32	------	------	------	12.6
Vol	15	Hebron Brook	7/28/06	0.32	------	------	------	5.6
Vol	15	Hebron Brook	8/5/06	0.30	------	------	------	7.1
Vol	15	Hebron Brook	8/11/06	0.30	------	------	------	10.6
CFB	15	Hebron Brook	8/15/06	0.26	0.26	------	------	9.3
Vol	15	Hebron Brook	8/18/06	0.27	------	------	------	17.6
Vol	15	Hebron Brook	8/25/06	0.28	------	------	------	10.1
Vol	15	Hebron Brook	9/1/06	0.27	------	------	------	28.1
Vol	15	Hebron Brook	9/8/06	0.26	------	------	------	32.6
CFB	15	Hebron Brook	9/20/06	0.28	0.28	------	------	9.0
Vol	15	Hebron Brook	9/22/06	0.25	------	------	------	9.0
Vol	15	Hebron Brook	10/1/06	0.26	------	------	------	------
Vol	15	Hebron Brook	10/6/06	0.28	------	------	------	6.5
Vol	15	Hebron Brook	10/13/06	0.36	------	------	------	7.9
CFB	15	Hebron Brook	10/18/06	0.41	0.41	------	------	8.5
Vol	15	Hebron Brook	10/27/06	0.35	------	------	------	------
Vol	15	Hebron Brook	11/4/06	0.36	------	------	------	9.7
Vol	15	Hebron Brook	11/10/06	0.38	------	------	------	5.6
CFB	15	Hebron Brook	11/15/06	0.41	0.40	------	------	6.1
Vol	15	Hebron Brook	11/17/06	0.68	------	------	------	13.3
Vol	15	Hebron Brook	11/23/06	0.35	------	------	------	5.2
Vol	15	Hebron Brook	12/1/06	0.36	------	------	------	7.1
Vol	15	Hebron Brook	12/8/06	0.35	------	------	------	3.7
CFB	15	Hebron Brook	12/12/06	0.32	0.33	------	------	3.5

APPENDIX A: 2006-2007 Newfound Tributary Data Listing

Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
CFB = Center for Freshwater Biology Field Team Data								
Vol = Volunteer Monitor Data								
Vol	15	Hebron Brook	12/16/06	0.34	------	------	------	8.4
Vol	15	Hebron Brook	12/23/06	0.31	------	------	------	18.2
Vol	15	Hebron Brook	1/4/07	0.34	------	------	------	3.4
Vol	15	Hebron Brook	1/12/07	0.35	------	------	------	1.9
CFB	15	Hebron Brook	1/17/07	0.40	0.40	------	------	30.0
Vol	15	Hebron Brook	1/24/07	------	------	------	------	4.5
CFB	15	Hebron Brook	3/13/07	------	------	------	------	------
Vol	15	Hebron Brook	3/24/07	------	------	------	------	------
CFB	15	Hebron Brook	4/4/07	------	------	------	------	------
CFB	15	Hebron Brook	4/18/07	0.56	0.56	------	------	10.8
Vol	15	Hebron Brook	4/25/07	0.30	------	------	------	4.0
Vol	15	Hebron Brook	5/5/07	0.25	------	------	------	3.3
CFB	15	Hebron Brook	5/15/07	0.24	0.24	------	------	5.5
Vol	15	Hebron Brook	5/18/07	0.26	------	------	------	3.8
Vol	15	Hebron Brook	5/29/07	0.17	------	------	------	5.0
Vol	15	Hebron Brook	6/3/07	0.22	------	------	------	4.8
Vol	15	Hebron Brook	6/9/07	0.20	------	------	------	6.4
Vol	15	Hebron Brook	6/16/07	0.20	------	------	------	6.4
CFB	15	Hebron Brook	6/20/07	0.17	0.17	------	------	8.5
Vol	15	Hebron Brook	6/30/07	Dry	------	------	------	------
Vol	15	Hebron Brook	7/14/07	0.12	------	------	------	5.1
Vol	15	Hebron Brook	7/28/07	0.12	------	------	------	7.2
Vol	15	Hebron Brook	8/3/07	Dry	------	------	------	6.2
Vol	15	Hebron Brook	8/10/07	0.10	------	------	------	------
CFB	15	Hebron Brook	8/17/07	-0.14	------	------	------	------
Vol	15	Hebron Brook	8/25/07	Dry	------	------	------	------
Vol	15	Hebron Brook	8/31/07	Dry	------	------	------	------
Vol	15	Hebron Brook	9/9/07	Dry	------	------	------	------
CFB	15	Hebron Brook	9/11/07	0.22	0.22	------	------	13.8
Vol	15	Hebron Brook	9/22/07	Dry	------	------	------	------

APPENDIX A: 2006-2007 Newfound Tributary Data Listing

Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
CFB = Center for Freshwater Biology Field Team Data								
Vol = Volunteer Monitor Data								
Vol	15	Hebron Brook	9/30/07	Dry	------	------	------	------
Vol	15	Hebron Brook	10/6/07	Dry	------	------	------	------
Vol	15	Hebron Brook	10/14/07	0.15	------	------	------	7.4
Vol	15	Hebron Brook	10/20/07	0.30	------	------	------	11.0
CFB	15	Hebron Brook	10/24/07	0.21	0.21	------	------	8.2
Vol	15	Hebron Brook	11/2/07	0.15	------	------	------	6.3
Vol	15	Hebron Brook	11/9/07	0.20	------	------	------	4.1
CFB	15	Hebron Brook	11/15/07	0.46	0.46	------	------	15.8
Vol	15	Hebron Brook	11/25/07	0.20	------	------	------	3.9
Vol	15	Hebron Brook	12/2/07	0.26	------	------	------	3.1
Vol	15	Hebron Brook	12/9/07	------	------	------	------	2.9
CFB	15	Hebron Brook	12/19/07	------	------	------	------	5.8
CFB	16	Kendall Brook	6/1/06	0.86	0.85	------	------	10.5
CFB	16	Kendall Brook	6/8/06	1.19	1.19	------	------	14.7
CFB	16	Kendall Brook	6/21/06	1.11	1.11	------	------	16.2
CFB	16	Kendall Brook	6/26/06	1.44	1.44	------	------	28.9
CFB	16	Kendall Brook	7/13/06	1.54	1.54	------	------	16.7
Vol	16	Kendall Brook	7/24/06	1.20	1.18	------	------	10.7
Vol	16	Kendall Brook	8/1/06	0.98	0.98	------	------	13.8
Vol	16	Kendall Brook	8/10/06	1.06	1.06	------	------	------
CFB	16	Kendall Brook	8/15/06	1.04	------	------	------	11.3
Vol	16	Kendall Brook	8/19/06	1.05	1.05	------	------	17.1
Vol	16	Kendall Brook	8/25/06	1.06	1.06	------	------	13.4
Vol	16	Kendall Brook	9/1/06	1.05	1.05	------	------	------
Vol	16	Kendall Brook	9/7/06	1.01	1.02	------	------	13.8
Vol	16	Kendall Brook	9/14/06	1.01	1.00	------	------	17.4
CFB	16	Kendall Brook	9/20/06	1.04	1.04	------	------	13.1
Vol	16	Kendall Brook	9/22/06	1.02	1.02	------	------	17.2
Vol	16	Kendall Brook	9/29/06	1.14	1.15	------	------	23.1
Vol	16	Kendall Brook	10/14/06	1.10	1.10	------	------	11.0

APPENDIX A: 2006-2007 Newfound Tributary Data Listing

Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
CFB = Center for Freshwater Biology Field Team Data								
Vol = Volunteer Monitor Data								
CFB	16	Kendall Brook	10/16/06	1.26	1.26	------	------	10.2
Vol	16	Kendall Brook	10/20/06	1.13	1.14	------	------	6.4
Vol	16	Kendall Brook	11/2/06	1.30	1.32	------	------	6.8
Vol	16	Kendall Brook	11/10/06	1.18	1.19	------	------	6.4
CFB	16	Kendall Brook	11/15/06	1.22	1.22	------	------	6.4
Vol	16	Kendall Brook	11/30/06	1.10	1.09	------	------	7.4
CFB	16	Kendall Brook	12/12/06	1.12	1.11	------	------	4.7
Vol	16	Kendall Brook	12/21/06	1.08	1.07	------	------	6.0
Vol	16	Kendall Brook	1/5/07	1.13	1.14	------	------	5.3
Vol	16	Kendall Brook	1/12/07	1.17	1.18	------	------	3.7
CFB	16	Kendall Brook	1/17/07	1.20	1.20	------	------	9.5
Vol	16	Kendall Brook	1/25/07	------	------	------	------	4.8
Vol	16	Kendall Brook	2/8/07	------	------	------	------	------
CFB	16	Kendall Brook	3/13/07	------	------	------	------	------
Vol	16	Kendall Brook	3/30/07	1.20	1.20	------	------	5.4
CFB	16	Kendall Brook	4/4/07	1.16	1.16	------	------	5.7
Vol	16	Kendall Brook	4/17/07	1.60	1.70	------	------	12.6
CFB	16	Kendall Brook	4/18/07	1.50	1.48	------	------	7.0
Vol	16	Kendall Brook	5/4/07	1.10	1.09	------	------	5.6
CFB	16	Kendall Brook	5/15/07	1.06	1.06	------	------	7.4
Vol	16	Kendall Brook	6/1/07	1.00	1.01	------	------	9.0
CFB	16	Kendall Brook	6/20/07	0.76	0.76	------	------	11.1
Vol	16	Kendall Brook	6/27/07	0.67	0.68	------	------	10.5
Vol	16	Kendall Brook	7/12/07	0.91	0.90	------	------	13.8
Vol	16	Kendall Brook	7/25/07	0.69	0.69	------	------	9.9
CFB	16	Kendall Brook	8/2/07	0.00	0.00	------	------	13.5
CFB	16	Kendall Brook	8/17/07	0.68	0.68	------	------	------
Vol	16	Kendall Brook	8/24/07	0.68	0.68	------	------	14.8
CFB	16	Kendall Brook	8/30/07	0.76	0.76	------	------	------
CFB	16	Kendall Brook	9/11/07	0.78	0.78	------	------	29.5

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Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
CFB = Center for Freshwater Biology Field Team Data								
Vol = Volunteer Monitor Data								
Vol	16	Kendall Brook	9/19/07	0.68	0.68	------	------	8.3
Vol	16	Kendall Brook	9/28/07	0.70	------	------	------	------
Vol	16	Kendall Brook	10/12/07	1.05	1.06	------	------	20.8
CFB	16	Kendall Brook	10/24/07	1.02	1.02	------	------	12.8
Vol	16	Kendall Brook	10/30/07	1.05	1.04	------	------	10.2
CFB	16	Kendall Brook	11/15/07	1.34	1.34	------	------	22.0
Vol	16	Kendall Brook	11/29/07	1.05	1.06	------	------	4.6
Vol	16	Kendall Brook	12/7/07	------	------	------	------	4.0
CFB	16	Kendall Brook	12/19/07	------	------	------	------	------
CFB	17	Mason Brook	6/1/06	0.38	0.38	------	------	5.6
CFB	17	Mason Brook	6/8/06	0.62	0.62	------	------	7.3
CFB	17	Mason Brook	6/21/06	0.49	0.48	------	------	7.0
CFB	17	Mason Brook	6/26/06	0.92	------	------	------	44.6
CFB	17	Mason Brook	7/13/06	0.96	0.98	------	------	21.6
Vol	17	Mason Brook	7/24/06	0.48	0.48	------	------	6.3
Vol	17	Mason Brook	8/1/06	0.28	0.29	------	------	7.5
Vol	17	Mason Brook	8/10/06	0.22	0.22	------	------	6.1
CFB	17	Mason Brook	8/15/06	0.22	0.22	------	------	5.2
Vol	17	Mason Brook	8/19/06	0.18	0.18	------	------	4.7
Vol	17	Mason Brook	8/25/06	0.20	0.20	------	------	5.3
Vol	17	Mason Brook	9/1/06	0.20	0.20	------	------	4.4
Vol	17	Mason Brook	9/7/06	0.19	0.18	------	------	3.4
CFB	17	Mason Brook	9/14/06	0.20	0.19	------	------	2.8
Vol	17	Mason Brook	9/14/06	0.19	0.20	------	------	5.8
Vol	17	Mason Brook	9/22/06	0.18	0.18	------	------	3.5
Vol	17	Mason Brook	9/29/06	0.46	0.48	------	------	35.6
Vol	17	Mason Brook	10/14/06	0.34	0.35	------	------	16.0
CFB	17	Mason Brook	10/18/06	0.61	0.60	------	------	16.4
Vol	17	Mason Brook	10/26/06	0.42	0.41	------	------	3.5
Vol	17	Mason Brook	11/2/06	0.55	0.57	------	------	6.4

APPENDIX A: 2006-2007 Newfound Tributary Data Listing

Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
Vol	17	Mason Brook	11/10/06	0.51	0.52	------	------	5.0
CFB	17	Mason Brook	11/15/06	0.56	0.56	------	------	4.4
Vol	17	Mason Brook	11/30/06	0.38	0.39	------	------	6.4
CFB	17	Mason Brook	12/12/06	0.38	0.37	------	------	3.3
Vol	17	Mason Brook	12/21/06	0.34	0.33	------	------	4.5
Vol	17	Mason Brook	1/5/07	0.42	0.43	------	------	5.7
Vol	17	Mason Brook	1/12/07	0.45	0.46	------	------	6.1
CFB	17	Mason Brook	1/17/07	0.70	0.72	------	------	4.9
Vol	17	Mason Brook	1/25/07	------	------	------	------	3.6
Vol	17	Mason Brook	2/8/07	------	------	------	------	------
CFB	17	Mason Brook	3/13/07	------	------	------	------	------
Vol	17	Mason Brook	3/30/07	0.46	0.45	------	------	5.0
CFB	17	Mason Brook	4/4/07	0.47	0.46	------	------	4.4
Vol	17	Mason Brook	4/17/07	0.95	0.90	------	------	22.7
CFB	17	Mason Brook	4/18/07	0.72	0.72	------	------	13.4
Vol	17	Mason Brook	5/4/07	0.29	0.28	------	------	------
CFB	17	Mason Brook	5/15/07	0.26	0.26	------	------	7.1
Vol	17	Mason Brook	6/1/07	0.20	0.21	------	------	5.2
CFB	17	Mason Brook	6/20/07	0.10	0.10	------	------	4.6
Vol	17	Mason Brook	6/27/07	0.05	------	------	------	4.0
Vol	17	Mason Brook	7/12/07	0.14	0.15	------	------	4.4
Vol	17	Mason Brook	7/25/07	0.08	0.08	------	------	3.6
CFB	17	Mason Brook	8/2/07	------	------	------	------	3.2
CFB	17	Mason Brook	8/17/07	0.00	0.00	------	------	2.5
Vol	17	Mason Brook	8/24/07	0.05	------	------	------	2.9
CFB	17	Mason Brook	8/30/07	0.00	------	------	------	5.4
CFB	17	Mason Brook	9/11/07	0.25	0.25	------	------	35.1
Vol	17	Mason Brook	9/19/07	0.16	0.16	------	------	4.1
Vol	17	Mason Brook	9/28/07	0.14	------	------	------	12.1
Vol	17	Mason Brook	10/12/07	0.45	------	------	------	25.0

CFB = Center for Freshwater Biology Field Team Data
Vol = Volunteer Monitor Data

APPENDIX A: 2006-2007 Newfound Tributary Data Listing

Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
CFB = Center for Freshwater Biology Field Team Data								
Vol = Volunteer Monitor Data								
CFB	17	Mason Brook	10/24/07	0.30	0.30	------	------	4.6
Vol	17	Mason Brook	10/30/07	0.27	0.28	------	------	5.8
CFB	17	Mason Brook	11/15/07	0.66	0.66	------	------	40.2
Vol	17	Mason Brook	11/29/07	0.30	0.31	------	------	2.3
Vol	17	Mason Brook	12/7/07	------	------	------	------	1.9
CFB	17	Mason Brook	12/19/07	------	------	------	------	2.3
CFB	18	The Ledges	6/1/06	0.34	0.34	------	------	5.9
CFB	18	The Ledges	6/8/06	0.65	0.65	------	------	4.6
CFB	18	The Ledges	6/21/06	0.48	0.48	------	------	3.3
CFB	18	The Ledges	6/26/06	0.92	0.92	------	------	44.1
CFB	18	The Ledges	7/13/06	1.06	1.08	------	------	23.2
Vol	18	The Ledges	7/24/06	0.60	0.59	------	------	3.4
Vol	18	The Ledges	8/1/06	0.28	0.28	------	------	4.1
Vol	18	The Ledges	8/10/06	0.25	------	------	------	3.8
CFB	18	The Ledges	8/15/06	0.10	------	------	------	1.4
Vol	18	The Ledges	8/19/06	------	------	------	------	2.1
Vol	18	The Ledges	8/25/06	------	------	------	------	2.5
Vol	18	The Ledges	9/1/06	0.22	------	------	------	------
Vol	18	The Ledges	9/7/06	------	------	------	------	3.1
CFB	18	The Ledges	9/14/06	------	------	------	------	1.1
Vol	18	The Ledges	9/14/06	------	------	------	------	4.1
Vol	18	The Ledges	9/22/06	------	------	------	------	3.2
Vol	18	The Ledges	9/29/06	0.47	0.48	------	------	24.8
Vol	18	The Ledges	10/14/06	0.40	0.41	------	------	3.5
CFB	18	The Ledges	10/18/06	0.68	0.68	------	------	7.3
Vol	18	The Ledges	10/26/06	0.50	0.51	------	------	3.7
Vol	18	The Ledges	11/2/06	0.68	0.70	------	------	5.2
Vol	18	The Ledges	11/10/06	0.67	0.68	------	------	2.8
CFB	18	The Ledges	11/15/06	0.72	0.72	------	------	4.8
Vol	18	The Ledges	11/30/06	0.46	0.47	------	------	3.6

APPENDIX A: 2006-2007 Newfound Tributary Data Listing

Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
CFB = Center for Freshwater Biology Field Team Data								
Vol = Volunteer Monitor Data								
CFB	18	The Ledges	12/12/06	0.47	0.46	------	------	1.3
Vol	18	The Ledges	12/21/06	0.41	0.40	------	------	------
Vol	18	The Ledges	1/5/07	0.51	0.52	------	------	------
Vol	18	The Ledges	1/12/07	0.56	0.57	------	------	4.5
CFB	18	The Ledges	1/17/07	------	------	------	------	2.3
Vol	18	The Ledges	1/25/07	------	------	------	------	1.5
Vol	18	The Ledges	2/8/07	------	------	------	------	------
CFB	18	The Ledges	3/13/07	------	------	------	------	------
Vol	18	The Ledges	3/30/07	0.65	0.66	------	------	3.0
CFB	18	The Ledges	4/4/07	0.63	0.64	------	------	3.7
Vol	18	The Ledges	4/17/07	1.35	------	------	------	
CFB	18	The Ledges	4/18/07	1.16	1.16	------	------	8.7
CFB	18	The Ledges	4/23/07	0.70	0.69	------	------	2.8
Vol	18	The Ledges	5/4/07	0.53	0.54	------	------	1.9
CFB	18	The Ledges	5/15/07	0.50	0.50	------	------	3.8
Vol	18	The Ledges	6/1/07	0.40	0.42	------	------	2.3
CFB	18	The Ledges	6/20/07	0.20	0.20	------	------	1.6
Vol	18	The Ledges	6/27/07	0.25		------	------	2.0
Vol	18	The Ledges	7/12/07	0.25	0.26	------	------	3.0
Vol	18	The Ledges	7/25/07	0.22	0.22	------	------	1.0
CFB	18	The Ledges	8/2/07	------	------	------	------	1.9
CFB	18	The Ledges	8/17/07	-0.30	-0.30	------	------	------
Vol	18	The Ledges	8/24/07	0.25	------	------	------	3.6
CFB	18	The Ledges	8/30/07	------	------	------	------	------
CFB	18	The Ledges	9/11/07	0.52	0.52	------	------	16.5
Vol	18	The Ledges	9/19/07	0.25	0.26	------	------	3.3
Vol	18	The Ledges	9/28/07	0.24	------	------	------	2.4
Vol	18	The Ledges	10/12/07	0.85	0.87	------	------	23.9
CFB	18	The Ledges	10/24/07	0.50	0.50	------	------	4.5
Vol	18	The Ledges	10/30/07	0.56	0.57	------	------	3.7

APPENDIX A: 2006-2007 Newfound Tributary Data Listing

Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
CFB = Center for Freshwater Biology Field Team Data								
Vol = Volunteer Monitor Data								
CFB	18	The Ledges	11/15/07	1.12	1.12	------	------	13.0
Vol	18	The Ledges	11/29/07	0.66	0.65	------	------	2.4
Vol	18	The Ledges	12/7/07	------	------	------	------	1.2
CFB	18	The Ledges	12/19/07	------	------	------	------	------
CFB	19	Wellington Brook	6/1/06	0.81	0.81	------	------	33.0
CFB	19	Wellington Brook	6/8/06	1.09	1.08	------	------	15.2
CFB	19	Wellington Brook	6/21/06	0.98	0.98	------	------	22.7
CFB	19	Wellington Brook	6/26/06	1.04	1.04	------	------	29.4
CFB	19	Wellington Brook	7/13/06	1.32	1.32	------	------	19.1
Vol	19	Wellington Brook	7/27/06	0.68	0.68	------	------	25.8
Vol	19	Wellington Brook	8/4/06	1.00	1.00	------	------	50.3
Vol	19	Wellington Brook	8/12/06	0.62	0.62	------	------	39.7
CFB	19	Wellington Brook	8/15/06	0.60	0.60	------	------	48.7
Vol	19	Wellington Brook	8/19/06	0.60	0.60	------	------	64.0
Vol	19	Wellington Brook	8/25/06	0.60	0.60	------	------	49.4
Vol	19	Wellington Brook	9/1/06	0.60	0.60	------	------	42.8
Vol	19	Wellington Brook	9/10/06	0.60	0.60	------	------	46.1
Vol	19	Wellington Brook	9/16/06	0.64	------	------	------	44.0
CFB	19	Wellington Brook	9/20/06	0.65	0.65	------	------	57.4
Vol	19	Wellington Brook	9/23/06	0.60	------	------	------	54.8
Vol	19	Wellington Brook	9/30/06	0.69	------	------	------	54.9
Vol	19	Wellington Brook	10/7/06	0.64	------	------	------	------
Vol	19	Wellington Brook	10/17/06	0.70	------	------	------	------
CFB	19	Wellington Brook	10/18/06	0.71	0.71	------	------	38.8
Vol	19	Wellington Brook	10/22/06	1.02	------	------	------	------
Vol	19	Wellington Brook	10/27/06	0.80	------	------	------	------
Vol	19	Wellington Brook	11/5/06	0.66	------	------	------	18.0
Vol	19	Wellington Brook	11/11/06	0.68	------	------	------	12.2
CFB	19	Wellington Brook	11/15/06	0.76	0.76	------	------	13.6
Vol	19	Wellington Brook	11/27/06	0.62	------	------	------	16.4

APPENDIX A: 2006-2007 Newfound Tributary Data Listing

Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
CFB = Center for Freshwater Biology Field Team Data								
Vol = Volunteer Monitor Data								
Vol	19	Wellington Brook	12/4/06	0.70	------	------	------	13.1
CFB	19	Wellington Brook	12/12/06	0.61	0.61	------	------	16.0
CFB	19	Wellington Brook	1/17/07	0.60	0.60	------	------	12.2
CFB	19	Wellington Brook	3/13/07	------	------	------	------	------
CFB	19	Wellington Brook	4/18/07	2.12	2.12	------	------	11.1
CFB	19	Wellington Brook	4/23/07	1.59	1.59	------	------	12.7
Vol	19	Wellington Brook	4/26/07	0.80	------	------	------	14.5
Vol	19	Wellington Brook	5/6/07	0.86	------	------	------	40.2
Vol	19	Wellington Brook	5/11/07	0.68	------	------	------	26.6
CFB	19	Wellington Brook	5/15/07	0.82	0.82	------	------	36.1
Vol	19	Wellington Brook	5/24/07	0.85	------	------	------	27.5
Vol	19	Wellington Brook	6/4/07	0.66	------	------	------	26.3
Vol	19	Wellington Brook	6/12/07	0.67	------	------	------	26.8
CFB	19	Wellington Brook	6/20/07	0.78	0.78	------	------	36.3
Vol	19	Wellington Brook	6/29/07	0.52	------	------	------	55.7
Vol	19	Wellington Brook	7/8/07	0.56	------	------	------	39.6
Vol	19	Wellington Brook	7/14/07	0.52	------	------	------	27.5
Vol	19	Wellington Brook	7/26/07	0.60	------	------	------	38.1
Vol	19	Wellington Brook	8/3/07	0.50	------	------	------	29.9
Vol	19	Wellington Brook	8/10/07	0.52	------	------	------	28.5
CFB	19	Wellington Brook	8/17/07	0.48	0.48	------	------	------
Vol	19	Wellington Brook	8/25/07	0.48	------	------	------	67.3
Vol	19	Wellington Brook	9/7/07	------	------	------	------	38.7
CFB	19	Wellington Brook	9/11/07	0.60	0.60	------	------	17.8
Vol	19	Wellington Brook	9/23/07	0.50	------	------	------	------
Vol	19	Wellington Brook	9/28/07	0.56	------	------	------	47.3
Vol	19	Wellington Brook	10/5/07	0.50	------	------	------	27.2
Vol	19	Wellington Brook	10/16/07	0.78	------	------	------	56.2
CFB	19	Wellington Brook	10/24/07	0.56	0.56	------	------	43.6
Vol	19	Wellington Brook	10/30/07	0.58	------	------	------	24.1

APPENDIX A: 2006-2007 Newfound Tributary Data Listing

Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
CFB = Center for Freshwater Biology Field Team Data								
Vol = Volunteer Monitor Data								
Vol	19	Wellington Brook	11/11/07	0.55	------	------	------	24.3
CFB	19	Wellington Brook	11/15/07	0.80	0.80	------	------	30.4
Vol	19	Wellington Brook	11/21/07	0.55	------	------	------	15.5
CFB	19	Wellington Brook	12/19/07	------	------	------	------	------
CFB	20	Fowler River	6/1/06	3.00	3.01	------	------	9.1
CFB	20	Fowler River	6/8/06	------	------	------	------	13.0
CFB	20	Fowler River	6/21/06	3.20	3.20	------	------	13.7
CFB	20	Fowler River	6/26/06	------	------	------	------	24.7
CFB	20	Fowler River	7/13/06	------	------	1.90	1.89	34.3
Vol	20	Fowler River	7/27/06	------	------	------	------	9.3
Vol	20	Fowler River	8/4/06	3.06	3.06	------	------	13.4
Vol	20	Fowler River	8/12/06	2.24	2.24	------	------	11.1
CFB	20	Fowler River	8/15/06	2.16	2.16	2.88	2.88	8.3
Vol	20	Fowler River	8/17/06	2.12	------	2.95	------	10.3
Vol	20	Fowler River	8/25/06	1.70	------	2.95	------	
Vol	20	Fowler River	9/1/06	2.18	------	------	------	10.4
Vol	20	Fowler River	9/10/06	2.20	------	------	------	20.0
CFB	20	Fowler River	9/14/06	2.10	2.10	2.89	2.90	5.1
Vol	20	Fowler River	9/16/06	------	------	2.93	------	15.2
Vol	20	Fowler River	9/23/06	------	------	2.91	------	8.6
Vol	20	Fowler River	9/30/06	------	------	2.92	------	11.6
Vol	20	Fowler River	10/7/06	------	------	2.88	------	------
Vol	20	Fowler River	10/17/06	2.70	------	2.75	------	------
CFB	20	Fowler River	10/18/06	2.70	2.70	2.73	2.73	15.2
Vol	20	Fowler River	10/22/06	------	------	2.53	------	
Vol	20	Fowler River	10/27/06	2.36	------	2.89	------	
Vol	20	Fowler River	11/5/06	2.08	------	2.93	------	5.2
Vol	20	Fowler River	11/11/06	2.26	------	2.87	------	5.4
CFB	20	Fowler River	11/15/06	2.76	2.76	2.70	2.70	7.4
Vol	20	Fowler River	11/27/06	------	------	3.07	------	7.8

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Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
CFB = Center for Freshwater Biology Field Team Data								
Vol = Volunteer Monitor Data								
Vol	20	Fowler River	12/4/06	------	------	2.96	------	9.4
CFB	20	Fowler River	12/12/06	------	------	3.15	3.15	3.9
CFB	20	Fowler River	1/17/07	1.30	------	------	------	------
CFB	20	Fowler River	3/13/07	------	------	------	------	------
CFB	20	Fowler River	4/11/07	------	------	------	------	3.6
Vol	20	Fowler River	4/11/07	1.82	------	3.00	------	6.7
CFB	20	Fowler River	4/18/07	------	------	2.15	2.15	10.7
Vol	20	Fowler River	4/26/07	------	------	2.50	------	6.0
Vol	20	Fowler River	5/6/07	3.08	------	------	------	6.0
Vol	20	Fowler River	5/11/07	------	------	2.71	------	7.7
CFB	20	Fowler River	5/15/07	2.90	2.90	2.68	2.68	5.4
Vol	20	Fowler River	5/24/07	------	------	2.62	------	4.3
Vol	20	Fowler River	6/4/07	------	------	2.65	------	8.9
Vol	20	Fowler River	6/12/07	------	------	2.62	------	8.1
CFB	20	Fowler River	6/20/07	2.94	2.94	2.69	2.68	9.6
Vol	20	Fowler River	6/29/07	------	------	2.76	------	13.3
Vol	20	Fowler River	7/8/07	2.58	------	2.66	------	9.2
Vol	20	Fowler River	7/14/07	2.72	------	2.72	------	9.6
Vol	20	Fowler River	7/26/07	2.76	------	2.71	------	10.7
CFB	20	Fowler River	8/2/07	2.60	2.60	------	------	17.8
Vol	20	Fowler River	8/3/07	2.62	------	2.76	------	34.6
Vol	20	Fowler River	8/10/07	2.64	------	2.75	------	9.1
CFB	20	Fowler River	8/17/07	2.50	2.50	2.85	2.86	8.4
Vol	20	Fowler River	8/25/07	------	------	2.82	------	16.6
Vol	20	Fowler River	8/31/07	------	------	2.84	------	12.7
Vol	20	Fowler River	9/7/07	2.16	------	------	------	10.7
CFB	20	Fowler River	9/11/07	2.28	2.28	------	------	7.4
Vol	20	Fowler River	9/23/07	2.36	------	------	------	8.9
Vol	20	Fowler River	9/28/07	2.46	------	------	------	27.7
Vol	20	Fowler River	10/5/07	------	------	2.84	------	20.5

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Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
Vol	20	Fowler River	10/16/07	------	------	2.72	------	8.2
CFB	20	Fowler River	10/23/07	2.36	2.36	2.81	2.82	8.3
Vol	20	Fowler River	10/30/07	------	------	2.88	------	7.7
Vol	20	Fowler River	11/11/07	------	------	3.52	------	5.6
CFB	20	Fowler River	11/14/07	1.52	1.52	3.07	3.07	3.3
Vol	20	Fowler River	11/21/07	------	------	2.95	------	5.0
CFB	20	Fowler River	12/19/07	------	------	------	------	------
CFB	21	Fowler River (Bog Brk Drainage)	6/1/06	1.71	1.71	------	------	14.1
CFB	21	Fowler River (Bog Brk Drainage)	6/8/06	------	------	------	------	21.6
CFB	21	Fowler River (Bog Brk Drainage)	6/21/06	2.20	2.20	2.75	------	18.1
CFB	21	Fowler River (Bog Brk Drainage)	6/26/06	2.70	2.70	2.59	2.59	28.7
CFB	21	Fowler River (Bog Brk Drainage)	7/13/06	------	------	1.30	1.30	40.5
Vol	21	Fowler River (Bog Brk Drainage)	7/18/06	1.88	------	------	------	14.7
Vol	21	Fowler River (Bog Brk Drainage)	7/27/06	------	------	------	------	12.8
Vol	21	Fowler River (Bog Brk Drainage)	8/4/06	1.64	1.64	------	------	19.4
Vol	21	Fowler River (Bog Brk Drainage)	8/12/06	1.40	1.40	------	------	11.4
CFB	21	Fowler River (Bog Brk Drainage)	8/15/06	1.34	1.34	2.88	2.88	11.1
Vol	21	Fowler River (Bog Brk Drainage)	8/19/06	1.29	------	2.89	------	14.9
Vol	21	Fowler River (Bog Brk Drainage)	8/25/06	1.32	------	2.87	------	12.9
Vol	21	Fowler River (Bog Brk Drainage)	9/1/06	1.33	------	------	------	9.0
Vol	21	Fowler River (Bog Brk Drainage)	9/10/06	------	------	2.83	------	13.8
CFB	21	Fowler River (Bog Brk Drainage)	9/14/06	1.28	1.28	2.88	2.88	8.4
Vol	21	Fowler River (Bog Brk Drainage)	9/16/06	------	------	2.85	------	9.6
Vol	21	Fowler River (Bog Brk Drainage)	9/23/06	------	------	2.86	------	5.9
Vol	21	Fowler River (Bog Brk Drainage)	9/30/06	------	------	2.84	------	13.9
Vol	21	Fowler River (Bog Brk Drainage)	10/7/06	------	------	2.90	------	------
Vol	21	Fowler River (Bog Brk Drainage)	10/17/06	------	------	2.55	------	------
CFB	21	Fowler River (Bog Brk Drainage)	10/18/06	2.83	2.83	2.54	2.54	13.5
Vol	21	Fowler River (Bog Brk Drainage)	10/22/06	------	------	2.31	------	------
Vol	21	Fowler River (Bog Brk Drainage)	10/27/06	------	------	2.71	------	------

CFB = Center for Freshwater Biology Field Team Data
Vol = Volunteer Monitor Data

APPENDIX A: 2006-2007 Newfound Tributary Data Listing

CFB = Center for Freshwater Biology Field Team Data
Vol = Volunteer Monitor Data

Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
Vol	21	Fowler River (Bog Brk Drainage)	11/5/06	------	------	2.70	------	6.4
Vol	21	Fowler River (Bog Brk Drainage)	11/11/06	------	------	2.54	------	7.4
CFB	21	Fowler River (Bog Brk Drainage)	11/15/06	------	------	2.22	2.22	9.5
Vol	21	Fowler River (Bog Brk Drainage)	11/27/06	------	------	2.73	------	7.6
Vol	21	Fowler River (Bog Brk Drainage)	12/4/06	------	------	2.53	------	11.6
CFB	21	Fowler River (Bog Brk Drainage)	12/12/06	1.80	1.80	2.76	2.76	5.4
CFB	21	Fowler River (Bog Brk Drainage)	1/17/07	2.30	2.30	2.69	2.69	6.1
CFB	21	Fowler River (Bog Brk Drainage)	3/13/07	------	------	------	------	------
CFB	21	Fowler River (Bog Brk Drainage)	4/11/07	1.82	1.82	2.80	2.80	6.2
Vol	21	Fowler River (Bog Brk Drainage)	4/11/07	------	------	2.73		9.1
CFB	21	Fowler River (Bog Brk Drainage)	4/18/07	------	------	1.74	1.74	19.0
CFB	21	Fowler River (Bog Brk Drainage)	4/23/07	------	------	2.03	2.03	9.2
Vol	21	Fowler River (Bog Brk Drainage)	4/26/07	------	------	2.34	------	9.5
Vol	21	Fowler River (Bog Brk Drainage)	5/6/07	------	------	2.72	------	7.6
Vol	21	Fowler River (Bog Brk Drainage)	5/11/07	------	------	2.71	------	10.7
CFB	21	Fowler River (Bog Brk Drainage)	5/15/07	1.60	1.60	2.84	2.83	8.5
Vol	21	Fowler River (Bog Brk Drainage)	5/24/07	------	------	2.53	------	5.8
Vol	21	Fowler River (Bog Brk Drainage)	6/2/07	------	------	2.77	------	13.7
Vol	21	Fowler River (Bog Brk Drainage)	6/12/07	------	------	2.74	------	7.8
CFB	21	Fowler River (Bog Brk Drainage)	6/20/07	1.35	1.35	2.91	2.91	11.2
CFB	21	Fowler River (Bog Brk Drainage)	6/28/07	1.18	1.18	2.93	2.93	------
Vol	21	Fowler River (Bog Brk Drainage)	6/29/07	------	------	2.89	------	15.2
Vol	21	Fowler River (Bog Brk Drainage)	7/8/07	------	------	2.86	------	13.7
Vol	21	Fowler River (Bog Brk Drainage)	7/14/07	------	------	2.84	------	11.1
Vol	21	Fowler River (Bog Brk Drainage)	7/26/07	------	------	2.84	------	14.1
CFB	21	Fowler River (Bog Brk Drainage)	8/2/07	------	------	------	------	15.1
Vol	21	Fowler River (Bog Brk Drainage)	8/3/07	------	------	2.89	------	16.3
Vol	21	Fowler River (Bog Brk Drainage)	8/10/07	------	------	2.86	------	9.2
CFB	21	Fowler River (Bog Brk Drainage)	8/17/07	1.18	1.18	2.98	2.98	14.7
Vol	21	Fowler River (Bog Brk Drainage)	8/25/07	------	------	2.91	------	15.5

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Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
CFB = Center for Freshwater Biology Field Team Data								
Vol = Volunteer Monitor Data								
CFB	21	Fowler River (Bog Brk Drainage)	8/30/07	0.94	0.96	2.98	2.98	14.7
Vol	21	Fowler River (Bog Brk Drainage)	8/31/07	------	------	2.86	------	18.3
Vol	21	Fowler River (Bog Brk Drainage)	9/7/07	------	------	2.94	------	15.1
CFB	21	Fowler River (Bog Brk Drainage)	9/11/07	1.43	1.43	2.87	2.88	9.6
Vol	21	Fowler River (Bog Brk Drainage)	9/23/07	------	------	2.89	------	11.6
Vol	21	Fowler River (Bog Brk Drainage)	9/28/07	------	------	2.84	------	5.3
Vol	21	Fowler River (Bog Brk Drainage)	10/5/07	------	------	2.90	------	16.6
CFB	21	Fowler River (Bog Brk Drainage)	10/13/07	2.06	2.06	2.75	2.76	10.2
Vol	21	Fowler River (Bog Brk Drainage)	10/16/07	------	------	2.74	------	12.3
Vol	21	Fowler River (Bog Brk Drainage)	10/30/07	------	------	2.53	------	9.6
Vol	21	Fowler River (Bog Brk Drainage)	11/11/07	------	------	2.75	------	6.7
CFB	21	Fowler River (Bog Brk Drainage)	11/14/07	1.40	1.40	2.88	2.88	7.5
Vol	21	Fowler River (Bog Brk Drainage)	11/21/07	------	------	2.75	------	6.8
CFB	21	Fowler River (Bog Brk Drainage)	12/19/07	------	------	2.79	2.80	3.8
CFB	22	Fowler River (Upstream)	6/1/06	------	------	------	------	3.4
CFB	22	Fowler River (Upstream)	6/8/06	------	------	------	------	6.2
CFB	22	Fowler River (Upstream)	6/21/06	------	------	3.97	------	7.1
CFB	22	Fowler River (Upstream)	6/26/06	------	------	3.75	------	23.2
CFB	22	Fowler River (Upstream)	7/13/06	------	------	3.11	3.13	24.8
Vol	22	Fowler River (Upstream)	7/27/06	------	------	------	------	4.3
Vol	22	Fowler River (Upstream)	8/4/06	------	------	------	------	12.0
Vol	22	Fowler River (Upstream)	8/12/06	------	------	------	------	2.1
CFB	22	Fowler River (Upstream)	8/15/06	------	------	4.20	4.19	2.5
Vol	22	Fowler River (Upstream)	8/19/06	------	------	------	------	3.0
Vol	22	Fowler River (Upstream)	8/25/06	------	------	4.18	------	3.7
Vol	22	Fowler River (Upstream)	9/1/06	------	------	4.24	------	5.1
Vol	22	Fowler River (Upstream)	9/10/06	------	------	4.10	------	5.8
CFB	22	Fowler River (Upstream)	9/14/06	------	------	4.18	4.18	2.3
Vol	22	Fowler River (Upstream)	9/16/06	------	------	4.33	------	4.6
Vol	22	Fowler River (Upstream)	9/23/06	------	------	4.22	------	6.4

APPENDIX A: 2006-2007 Newfound Tributary Data Listing

Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
CFB = Center for Freshwater Biology Field Team Data								
Vol = Volunteer Monitor Data								
Vol	22	Fowler River (Upstream)	9/30/06	------	------	3.86	------	8.9
Vol	22	Fowler River (Upstream)	10/7/06	------	------	4.06	------	------
Vol	22	Fowler River (Upstream)	10/17/06	------	------	3.60	------	------
CFB	22	Fowler River (Upstream)	10/18/06	------	------	3.59	3.59	9.5
Vol	22	Fowler River (Upstream)	10/22/06	------	------	3.57	------	------
Vol	22	Fowler River (Upstream)	10/27/06	------	------	3.95	------	------
Vol	22	Fowler River (Upstream)	11/5/06	------	------	3.93	------	5.1
Vol	22	Fowler River (Upstream)	11/11/06	------	------	3.85	------	3.0
CFB	22	Fowler River (Upstream)	11/15/06	------	------	3.66	3.66	4.4
Vol	22	Fowler River (Upstream)	11/27/06	------	------	3.98	------	3.1
Vol	22	Fowler River (Upstream)	12/4/06	------	------	3.87	------	4.1
CFB	22	Fowler River (Upstream)	12/12/06	------	------	4.02	4.02	2.0
CFB	22	Fowler River (Upstream)	1/17/07	------	------	3.84	3.84	2.2
CFB	22	Fowler River (Upstream)	3/13/07	------	------	------	------	------
CFB	22	Fowler River (Upstream)	4/11/07	------	------	4.05	4.05	2.6
Vol	22	Fowler River (Upstream)	4/11/07	------	------	3.96		3.5
CFB	22	Fowler River (Upstream)	4/18/07	------	------	3.48	3.49	8.1
CFB	22	Fowler River (Upstream)	4/23/07	------	------	3.51	3.50	8.1
Vol	22	Fowler River (Upstream)	4/26/07	------	------	3.77	------	3.7
Vol	22	Fowler River (Upstream)	5/6/07	------	------	3.96	------	4.1
Vol	22	Fowler River (Upstream)	5/11/07	------	------	3.94	------	5.5
CFB	22	Fowler River (Upstream)	5/15/07	------	------	4.10	4.10	3.9
Vol	22	Fowler River (Upstream)	5/24/07	------	------	3.97	------	4.4
Vol	22	Fowler River (Upstream)	6/2/07	------	------	4.56	------	3.5
Vol	22	Fowler River (Upstream)	6/12/07	------	------	3.95	------	4.4
CFB	22	Fowler River (Upstream)	6/20/07	------	------	4.19	4.19	3.1
CFB	22	Fowler River (Upstream)	6/28/07	------	------	4.23	4.23	------
Vol	22	Fowler River (Upstream)	6/29/07	------	------	4.20	------	2.6
Vol	22	Fowler River (Upstream)	7/8/07	------	------	4.15	------	3.6
Vol	22	Fowler River (Upstream)	7/14/07	------	------	5.15	------	5.0

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Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
CFB = Center for Freshwater Biology Field Team Data								
Vol = Volunteer Monitor Data								
Vol	22	Fowler River (Upstream)	7/26/07	------	------	4.16	------	4.4
CFB	22	Fowler River (Upstream)	8/2/07	------	------	------	------	5.3
Vol	22	Fowler River (Upstream)	8/3/07	------	------	4.30	------	5.2
Vol	22	Fowler River (Upstream)	8/10/07	------	------	4.38	------	4.4
CFB	22	Fowler River (Upstream)	8/17/07	------	------	4.27	4.27	3.4
Vol	22	Fowler River (Upstream)	8/25/07	------	------	4.19	------	4.1
CFB	22	Fowler River (Upstream)	8/30/07	------	------	4.21	4.21	4.7
Vol	22	Fowler River (Upstream)	8/31/07	------	------	4.80	------	4.7
Vol	22	Fowler River (Upstream)	9/7/07	------	------	4.13	------	3.6
CFB	22	Fowler River (Upstream)	9/11/07	------	------	------	------	5.0
Vol	22	Fowler River (Upstream)	9/23/07	------	------	4.15	------	5.1
Vol	22	Fowler River (Upstream)	9/28/07	------	------	4.13	------	4.8
Vol	22	Fowler River (Upstream)	10/5/07	------	------	4.15	------	20.4
CFB	22	Fowler River (Upstream)	10/13/07	------	------	4.03	4.03	4.9
Vol	22	Fowler River (Upstream)	10/16/07	------	------	4.30	------	4.4
Vol	22	Fowler River (Upstream)	10/30/07	------	------	3.98	------	4.0
Vol	22	Fowler River (Upstream)	11/11/07	------	------	4.12	------	4.4
CFB	22	Fowler River (Upstream)	11/14/07	------	------	4.05	4.05	2.1
Vol	22	Fowler River (Upstream)	11/21/07	------	------	3.97	------	2.3
CFB	22	Fowler River (Upstream)	12/19/07	------	------	------	------	------
CFB	23	Black Brook	6/1/06	0.90	0.90	------	------	25.0
CFB	23	Black Brook	6/8/06	1.26	1.26	------	------	17.1
CFB	23	Black Brook	6/21/06	1.08	1.08	------	------	14.8
CFB	23	Black Brook	6/26/06	1.20	1.20	------	------	91.8
Vol	23	Black Brook	7/2/06	0.89	------	------	------	11.2
Vol	23	Black Brook	7/12/06	0.55	------	------	------	13.9
CFB	23	Black Brook	7/13/06	1.86	1.84	------	------	49.3
Vol	23	Black Brook	7/20/06	0.79	------	------	------	13.0
Vol	23	Black Brook	7/29/06	0.36	------	------	------	11.6
Vol	23	Black Brook	8/13/06	0.29	------	------	------	13.2

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Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
CFB = Center for Freshwater Biology Field Team Data								
Vol = Volunteer Monitor Data								
CFB	23	Black Brook	8/15/06	0.27	0.27	------	------	8.6
Vol	23	Black Brook	8/22/06	0.30	------	------	------	10.7
Vol	23	Black Brook	9/4/06	0.39	------	------	------	13.2
Vol	23	Black Brook	9/11/06	0.29	------	------	------	332.9
CFB	23	Black Brook	9/14/06	0.28	0.28	------	------	5.9
Vol	23	Black Brook	10/3/06	0.41	------	------	------	10.3
Vol	23	Black Brook	10/16/06	0.48	------	------	------	40.7
CFB	23	Black Brook	10/18/06	1.14	1.16	------	------	16.3
Vol	23	Black Brook	10/25/06	0.75	------	------	------	6.7
Vol	23	Black Brook	11/5/06	0.58	------	------	------	6.9
Vol	23	Black Brook	11/11/06	0.70	------	------	------	11.5
CFB	23	Black Brook	11/14/06	1.18	1.16	------	------	42.2
CFB	23	Black Brook	12/13/06	0.52	0.52	------	------	6.4
Vol	23	Black Brook	12/29/06	0.69	------	------	------	7.5
Vol	23	Black Brook	1/6/07	1.28	------	------	------	32.1
Vol	23	Black Brook	1/13/07	0.68	------	------	------	8.5
CFB	23	Black Brook	1/17/07	------	------	------	------	7.9
CFB	23	Black Brook	3/13/07	------	------	------	------	9.7
CFB	23	Black Brook	4/4/07	0.80	0.80	------	------	10.2
Vol	23	Black Brook	4/14/07	0.98	------	------	------	27.1
CFB	23	Black Brook	4/18/07	2.18	2.18	------	------	20.1
CFB	23	Black Brook	4/23/07	------	------	------	------	------
Vol	23	Black Brook	5/6/07	0.50	------	------	------	13.6
CFB	23	Black Brook	5/15/07	0.78	0.78	------	------	11.4
Vol	23	Black Brook	6/17/07	0.80	------	------	------	56.2
CFB	23	Black Brook	6/20/07	0.82	0.82	------	------	10.4
Vol	23	Black Brook	7/25/07	0.65	------	------	------	11.6
CFB	23	Black Brook	8/2/07	0.50	0.50	------	------	22.2
CFB	23	Black Brook	8/17/07	0.40	0.40	------	------	14.2
Vol	23	Black Brook	8/24/07	0.30	------	------	------	22.7

APPENDIX A: 2006-2007 Newfound Tributary Data Listing

Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
CFB = Center for Freshwater Biology Field Team Data								
Vol = Volunteer Monitor Data								
CFB	23	Black Brook	8/30/07	0.30	0.30	------	------	16.1
CFB	23	Black Brook	9/11/07	0.32	0.32	------	------	11.3
Vol	23	Black Brook	10/3/07	0.37	------	------	------	13.5
CFB	23	Black Brook	10/23/07	0.56	0.56	------	------	9.7
Vol	23	Black Brook	11/11/07	0.50	0.50	------	------	6.9
CFB	23	Black Brook	11/14/07	------	------	------	------	6.8
Vol	23	Black Brook	11/28/07	0.85	0.86	------	------	8.9
CFB	23	Black Brook	12/19/07	------	------	------	------	------
CFB	24	Newfound River (Outlet)	6/1/06	6.04	6.03	------	------	3.0
CFB	24	Newfound River (Outlet)	6/8/06	6.28	6.28	------	------	4.8
CFB	24	Newfound River (Outlet)	6/21/06	6.20	6.21	------	------	4.9
CFB	24	Newfound River (Outlet)	6/26/06	6.00	------	------	------	5.0
Vol	24	Newfound River (Outlet)	7/2/06	5.98	------	------	------	2.7
Vol	24	Newfound River (Outlet)	7/12/06	5.70	------	------	------	4.6
CFB	24	Newfound River (Outlet)	7/13/06	6.36	6.38	------	------	5.9
Vol	24	Newfound River (Outlet)	7/20/06	5.80	------	------	------	3.5
Vol	24	Newfound River (Outlet)	7/29/06	5.39	------	------	------	5.9
Vol	24	Newfound River (Outlet)	8/13/06	5.28	------	------	------	4.4
CFB	24	Newfound River (Outlet)	8/21/06	5.22	5.22	------	------	6.2
Vol	24	Newfound River (Outlet)	8/22/06	5.20	------	------	------	3.7
Vol	24	Newfound River (Outlet)	9/4/06	5.29	------	------	------	10.8
Vol	24	Newfound River (Outlet)	9/11/06	5.29	------	------	------	4.6
CFB	24	Newfound River (Outlet)	9/14/06	5.12	5.12	------	------	2.8
Vol	24	Newfound River (Outlet)	10/3/06	5.28	------	------	------	4.8
Vol	24	Newfound River (Outlet)	10/16/06	5.39	------	------	------	6.0
CFB	24	Newfound River (Outlet)	10/18/06	3.36	3.36	------	------	3.3
Vol	24	Newfound River (Outlet)	10/25/06	5.80	------	------	------	6.1
Vol	24	Newfound River (Outlet)	11/5/06	5.05	------	------	------	6.6
Vol	24	Newfound River (Outlet)	11/11/06	5.28	------	------	------	5.3
CFB	24	Newfound River (Outlet)	11/14/06	5.20	5.20	------	------	5.3

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Source	Site Number	Site Name	Date	Gauge Height replicate 1 (feet)	Gauge Height replicate 2 (feet)	Keson Tape from Bridge to water replicate 1 (meters)	Keson Tape from Bridge to water replicate 2 (meters)	Total Phosphorus (ppb)
CFB = Center for Freshwater Biology Field Team Data								
Vol = Volunteer Monitor Data								
CFB	24	Newfound River (Outlet)	12/13/06	4.16	4.16	------	------	4.3
Vol	24	Newfound River (Outlet)	12/29/06	4.50	------	------	------	5.6
Vol	24	Newfound River (Outlet)	1/6/07	4.50	------	------	------	7.8
Vol	24	Newfound River (Outlet)	1/13/07	4.70	------	------	------	4.3
CFB	24	Newfound River (Outlet)	1/17/07	4.30	4.30	------	------	9.1
CFB	24	Newfound River (Outlet)	3/13/07	3.46	3.46	------	------	3.5
CFB	24	Newfound River (Outlet)	4/4/07	4.94	4.96	------	------	3.4
Vol	24	Newfound River (Outlet)	4/14/07	4.85	------	------	------	
CFB	24	Newfound River (Outlet)	4/18/07	6.70	6.70	------	------	7.0
Vol	24	Newfound River (Outlet)	5/6/07	6.09	------	------	------	4.3
CFB	24	Newfound River (Outlet)	5/15/07	5.90	5.90	------	------	3.2
Vol	24	Newfound River (Outlet)	6/18/07	6.00	------	------	------	10.1
CFB	24	Newfound River (Outlet)	6/20/07	5.98	5.96	------	------	4.0
Vol	24	Newfound River (Outlet)	7/25/07	5.88	------	------	------	4.0
CFB	24	Newfound River (Outlet)	8/2/07	------	------	------	------	7.3
CFB	24	Newfound River (Outlet)	8/17/07	5.56	5.56	------	------	3.0
Vol	24	Newfound River (Outlet)	8/24/07	5.37	------	------	------	2.7
CFB	24	Newfound River (Outlet)	8/30/07	5.36	5.36	------	------	2.6
CFB	24	Newfound River (Outlet)	9/11/07	5.30	5.30	------	------	2.0
Vol	24	Newfound River (Outlet)	10/3/07	5.38	------	------	------	3.1
CFB	24	Newfound River (Outlet)	10/23/07	5.36	5.36	------	------	4.2
Vol	24	Newfound River (Outlet)	11/11/07	------	------	------	------	8.7
CFB	24	Newfound River (Outlet)	11/14/07	1.52	1.52	------	------	3.5
Vol	24	Newfound River (Outlet)	11/28/07	------	------	------	------	4.0
CFB	24	Newfound River (Outlet)	12/11/07	4.34	4.34	------	------	5.1

Appendix B: Newfound Tributary Rating Curves

Note: Rating curves are presented on the following pages while the rating curve equations for Hemlock Brook, Cockermouth River, Bog Brook and the Fowler River are provided below. Raw discharge data collected between June 2006 and December 2007 are included at the end of this section.

Hemlock Brook (Site 1)
(high flow periods) $-0.195461 + 0.5250195 * \text{gauge height} + 1.0486436 * (\text{gauge height} - 0.48286)\hat{}^{2}$
(low flow periods) $-0.005258 + 0.0620757 * \text{gauge height}$

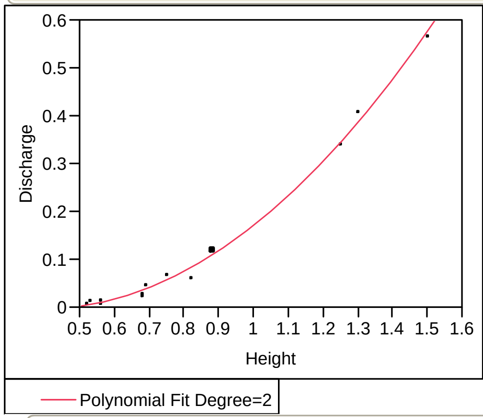
Cockermouth River (Site 12)
$-1.255872 + 1.716489 * \text{gauge height} + 0.8163421 * (\text{gauge height} - 1.298)\hat{}^{2}$

Bog Brook (Site 21)
$13.334273 - 4.5953904 * \text{Tape} + 3.3883907 * (\text{Tape} - 2.69571)\hat{}^{2}$

Fowler River (Site 22)
$29.483992 - 7.1434956 * \text{Tape} + 20.481736 * (\text{Tape} - 3.928331)\hat{}^{2} - 45.88054 * (\text{Tape} - 3.92833)\hat{}^{3}$

Tilton Brook Rating Curve

Bivariate Fit of Discharge By Height



Polynomial Fit Degree=2

Discharge = -0.252346 + 0.4083418*Height + 0.4724344*(Height-0.82462)^2

Summary of Fit

RSquare	0.99588
RSquare Adj	0.995056
Root Mean Square Error	0.012937
Mean of Response	0.129854
Observations (or Sum Wgts)	13

Analysis of Variance

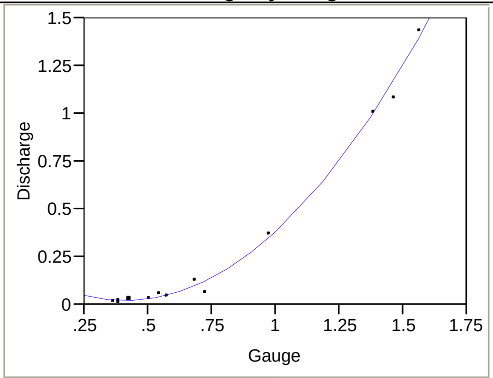
Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	0.40455584	0.202278	1208.532
Error	10	0.00167375	0.000167	**Prob > F**
C. Total	12	0.40622959		<.0001*

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	-0.252346	0.012752	-19.79	<.0001*
Height	0.4083418	0.018785	21.74	<.0001*
(Height-0.82462)^2	0.4724344	0.047148	10.02	<.0001*

Whittemore Brook Rating Curve (high flow)

Bivariate Fit of Discharge By Gauge



Polynomial Fit Degree=2

Discharge = -0.408366 + 0.7274727 Gauge + 1.0351096 (Gauge-0.76308)^2

Summary of Fit

RSquare	0.995341
RSquare Adj	0.994409
Root Mean Square Error	0.037308
Mean of Response	0.328523
Observations (or Sum Wgts)	13

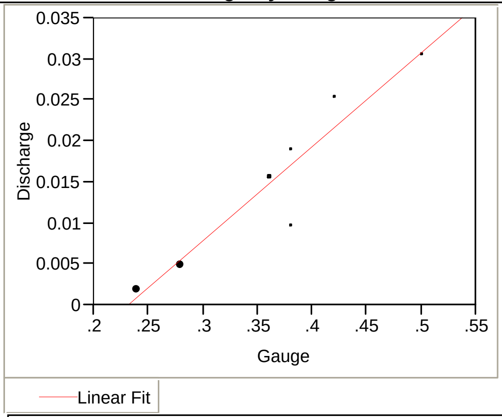
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	2.9735239	1.48676	1068.137
Error	10	0.0139192	0.00139	Prob > F
C. Total	12	2.9874431		<.0001

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	-0.408366	0.023387	-17.46	<.0001
Gauge	0.7274727	0.040975	17.75	<.0001
(Gauge-0.76308)^2	1.0351096	0.089633	11.55	<.0001

Bivariate Fit of Discharge By Gauge



Linear Fit

Discharge = -0.026652 + 0.1145962 Gauge

Summary of Fit

RSquare	0.887531
RSquare Adj	0.865038
Root Mean Square Error	0.003852
Mean of Response	0.015257
Observations (or Sum Wgts)	7

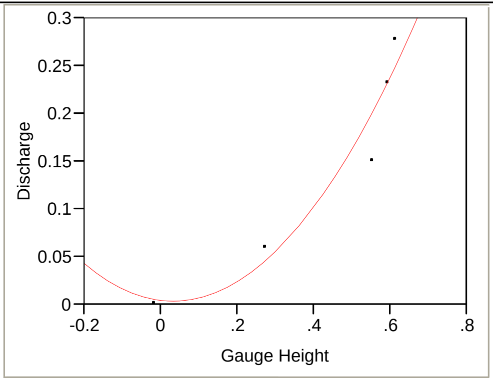
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.00058532	0.000585	39.4568
Error	5	0.00007417	0.000015	Prob > F
C. Total	6	0.00065950		0.0015

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	-0.026652	0.006829	-3.90	0.0114
Gauge	0.1145962	0.018244	6.28	0.0015

Bivariate Fit of Discharge By Gauge Height



Polynomial Fit Degree=2

Polynomial Fit Degree=2

Discharge = -0.112703 + 0.5340824 Gauge Height + 0.7285506 (Gauge Height-0.4)^2

Summary of Fit

RSquare	0.93308
RSquare Adj	0.86616
Root Mean Square Error	0.042173
Mean of Response	0.14406
Observations (or Sum Wgts)	5

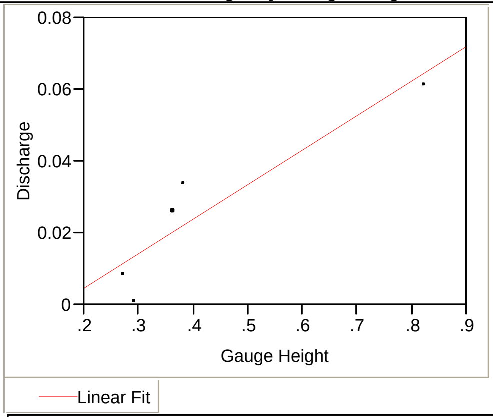
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	0.04959725	0.024799	13.9432
Error	2	0.00355708	0.001779	Prob > F
C. Total	4	0.05315433		0.0669

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	-0.112703	0.078709	-1.43	0.2885
Gauge Height	0.5340824	0.125398	4.26	0.0510
(Gauge Height-0.4)^2	0.7285506	0.513767	1.42	0.2919

Bivariate Fit of Discharge By Gauge Height



Linear Fit

Discharge = -0.014829 + 0.0962938 Gauge Height

Summary of Fit

RSquare	0.845426
RSquare Adj	0.793902
Root Mean Square Error	0.010751
Mean of Response	0.026
Observations (or Sum Wgts)	5

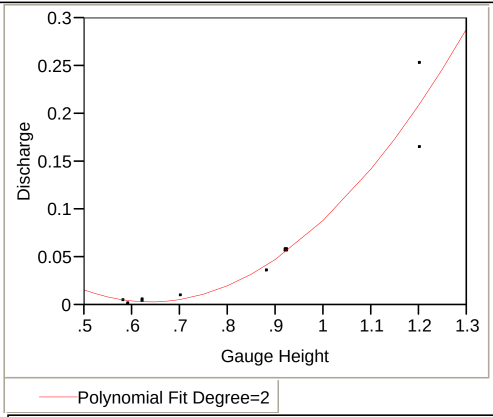
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.00189641	0.001896	16.4082
Error	3	0.00034673	0.000116	Prob > F
C. Total	4	0.00224314		0.0271

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	-0.014829	0.011167	-1.33	0.2762
Gauge Height	0.0962938	0.023772	4.05	0.0271

Bivariate Fit of Discharge By Gauge Height



Polynomial Fit Degree=2

Discharge = -0.161434 + 0.2261154 Gauge Height + 0.6533685 (Gauge Height-0.81222)^2

Summary of Fit

RSquare	0.938239
RSquare Adj	0.917652
Root Mean Square Error	0.025652
Mean of Response	0.059011
Observations (or Sum Wgts)	9

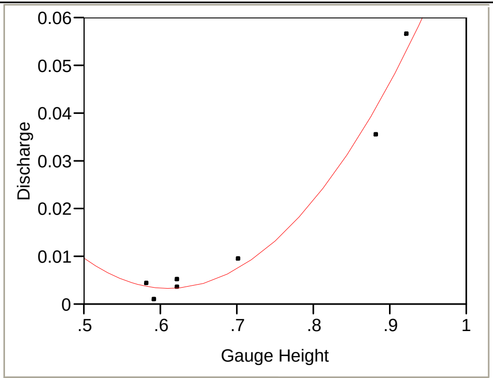
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	0.05997957	0.029990	45.5742
Error	6	0.00394826	0.000658	Prob > F
C. Total	8	0.06392783		0.0002

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	-0.161434	0.034436	-4.69	0.0034
Gauge Height	0.2261154	0.050553	4.47	0.0042
(Gauge Height-0.81222)^2	0.6533685	0.227231	2.88	0.0282

Bivariate Fit of Discharge By Gauge Height



Polynomial Fit Degree=2

Discharge = -0.057939 + 0.0932774 Gauge Height + 0.5161692 (Gauge Height-0.70143)^2

Summary of Fit

RSquare	0.978809
RSquare Adj	0.968214
Root Mean Square Error	0.003781
Mean of Response	0.016343
Observations (or Sum Wgts)	7

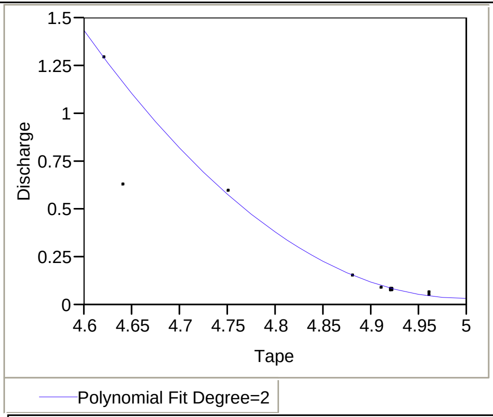
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	0.00264157	0.001321	92.3809
Error	4	0.00005719	0.000014	Prob > F
C. Total	6	0.00269876		0.0004

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	-0.057939	0.011631	-4.98	0.0076
Gauge Height	0.0932774	0.019667	4.74	0.0090
(Gauge Height-0.70143)^2	0.5161692	0.165367	3.12	0.0355

Bivariate Fit of Discharge By Tape



Polynomial Fit Degree=2

Discharge = 14.642592 - 2.9732524 Tape + 8.8513057 (Tape-4.83)^2

Summary of Fit

RSquare	0.999258
RSquare Adj	0.998886
Root Mean Square Error	0.01554
Mean of Response	0.329171
Observations (or Sum Wgts)	7

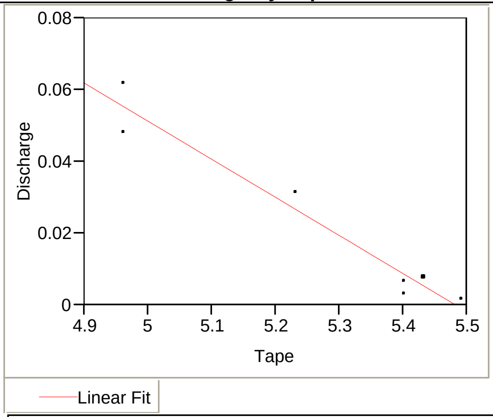
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	1.3001851	0.650093	2691.828
Error	4	0.0009660	0.000242	Prob > F
C. Total	6	1.3011511		<.0001

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	14.642592	0.318365	45.99	<.0001
Tape	-2.973252	0.064442	-46.14	<.0001
(Tape-4.83)^2	8.8513057	0.575895	15.37	0.0001

Bivariate Fit of Discharge By Tape



Linear Fit

Discharge = 0.5824084 - 0.1062479 Tape

Summary of Fit

RSquare	0.954569
RSquare Adj	0.945482
Root Mean Square Error	0.005692
Mean of Response	0.022786
Observations (or Sum Wgts)	7

Analysis of Variance

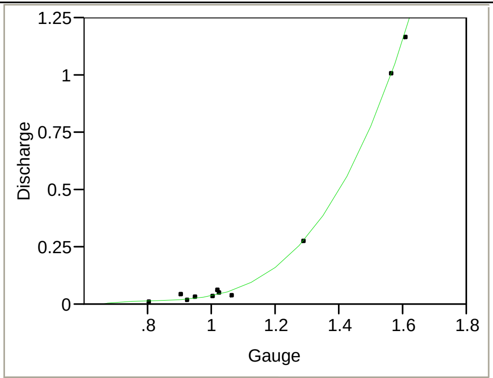
Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.00340400	0.003404	105.0559
Error	5	0.00016201	0.000032	Prob > F
C. Total	6	0.00356601		0.0002

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	0.5824084	0.054641	10.66	0.0001
Tape	-0.106248	0.010366	-10.25	0.0002

Tannery Brook Rating Curve

Bivariate Fit of Discharge By Gauge



Polynomial Fit Degree=3

Polynomial Fit Degree=3

Discharge = -0.582862 + 0.6011531 Gauge + 1.9635449 (Gauge-1.10091)^2 + 2.2668187 (Gauge-1.10091)^3

Summary of Fit

RSquare	0.999018
RSquare Adj	0.998597
Root Mean Square Error	0.015794
Mean of Response	0.244005
Observations (or Sum Wgts)	11

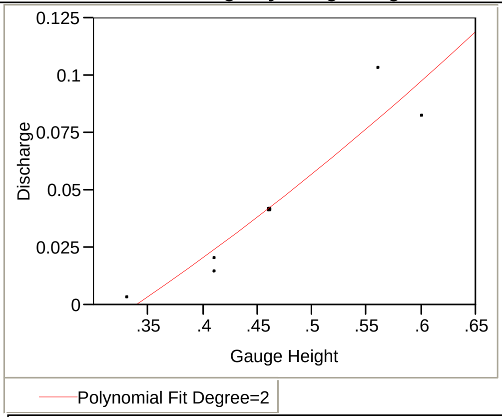
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	3	1.7760647	0.592022	2373.237
Error	7	0.0017462	0.000249	Prob > F
C. Total	10	1.7778109		<.0001

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	-0.582862	0.062651	-9.30	<.0001
Gauge	0.6011531	0.059263	10.14	<.0001
(Gauge-1.10091)^2	1.9635449	0.144706	13.57	<.0001
(Gauge-1.10091)^3	2.2668187	0.462837	4.90	0.0018

Bivariate Fit of Discharge By Gauge Height



Polynomial Fit Degree=2

Discharge = -0.128495 + 0.3698815 Gauge Height + 0.1942502 (Gauge Height-0.46167)^2

Summary of Fit

RSquare	0.892289
RSquare Adj	0.820481
Root Mean Square Error	0.017027
Mean of Response	0.043933
Observations (or Sum Wgts)	6

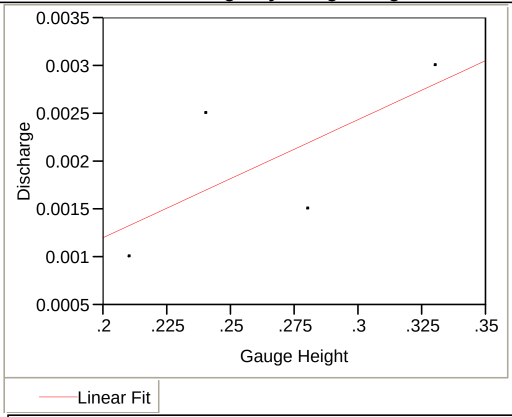
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	0.00720549	0.003603	12.4261
Error	3	0.00086980	0.000290	Prob > F
C. Total	5	0.00807529		0.0354

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	-0.128495	0.035343	-3.64	0.0359
Gauge Height	0.3698815	0.077529	4.77	0.0175
(Gauge Height-0.46167)^2	0.1942502	0.964398	0.20	0.8533

Bivariate Fit of Discharge By Gauge Height



Linear Fit

Discharge = -0.001272 + 0.0123457 Gauge Height

Summary of Fit

RSquare	0.493827
RSquare Adj	0.240741
Root Mean Square Error	0.000795
Mean of Response	0.002
Observations (or Sum Wgts)	4

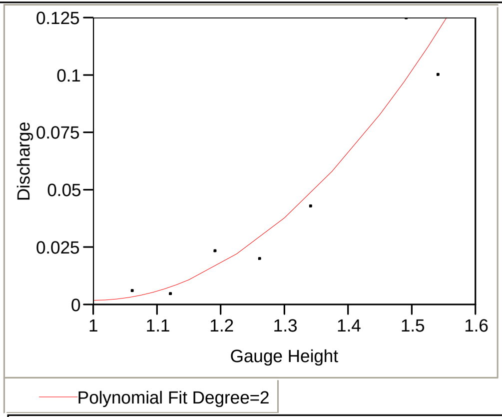
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.00000123	0.0000012	1.9512
Error	2	0.00000127	0.0000006	Prob > F
C. Total	3	0.0000025		0.2973

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	-0.001272	0.002376	-0.54	0.6460
Gauge Height	0.0123457	0.008838	1.40	0.2973

Bivariate Fit of Discharge By Gauge Height



Polynomial Fit Degree=2

Discharge = -0.259457 + 0.2285572 Gauge Height + 0.4007999 (Gauge Height-1.28571)^2

Summary of Fit

RSquare	0.909546
RSquare Adj	0.864318
Root Mean Square Error	0.017579
Mean of Response	0.045714
Observations (or Sum Wgts)	7

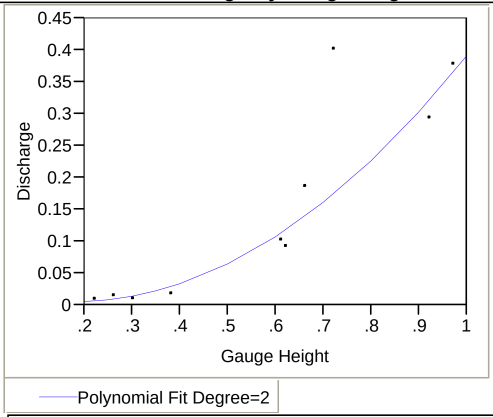
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	0.01242886	0.006214	20.1106
Error	4	0.00123605	0.000309	Prob > F
C. Total	6	0.01366491		0.0082

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	-0.259457	0.051824	-5.01	0.0075
Gauge Height	0.2285572	0.041446	5.51	0.0053
(Gauge Height-1.28571)^2	0.4007999	0.299276	1.34	0.2515

Bivariate Fit of Discharge By Gauge Height



Polynomial Fit Degree=2

Discharge = -0.160238 + 0.4426113 Gauge Height + 0.5689019 (Gauge Height-0.566)^2

Summary of Fit

RSquare	0.972325
RSquare Adj	0.9631
Root Mean Square Error	0.026128
Mean of Response	0.121956
Observations (or Sum Wgts)	9

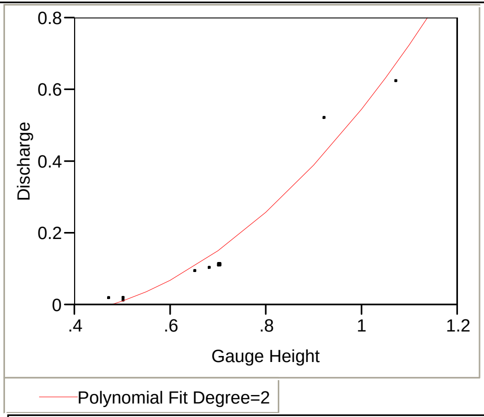
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	0.14390917	0.071955	105.4003
Error	6	0.00409607	0.000683	Prob > F
C. Total	8	0.14800524		<.0001

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	-0.160238	0.021425	-7.48	0.0003
Gauge Height	0.4426113	0.03391	13.05	<.0001
(Gauge Height-0.566)^2	0.5689019	0.156853	3.63	0.0110

Bivariate Fit of Discharge By Gauge Height



Polynomial Fit Degree=2

Discharge = -0.490501 + 0.9148801 Gauge Height + 1.2203795 (Gauge Height-0.68625)^2

Summary of Fit

RSquare	0.961709
RSquare Adj	0.946393
Root Mean Square Error	0.056102
Mean of Response	0.186088
Observations (or Sum Wgts)	8

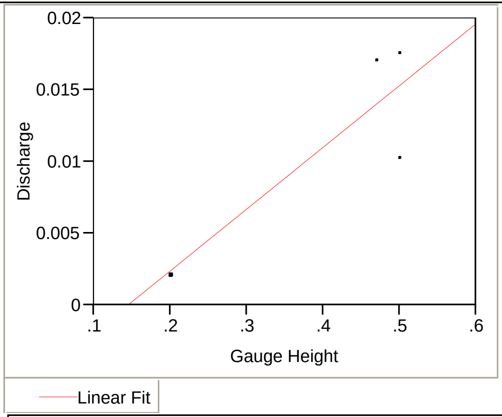
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	2	0.39524641	0.197623	62.7897
Error	5	0.01573691	0.003147	Prob > F
C. Total	7	0.41098333		0.0003

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	-0.490501	0.078467	-6.25	0.0015
Gauge Height	0.9148801	0.128637	7.11	0.0009
(Gauge Height-0.68625)^2	1.2203795	0.566125	2.16	0.0836

Bivariate Fit of Discharge By Gauge Height



Linear Fit

Discharge = -0.006308 + 0.0430742 Gauge Height

Summary of Fit

RSquare	0.747413
RSquare Adj	0.62112
Root Mean Square Error	0.004468
Mean of Response	0.011675
Observations (or Sum Wgts)	4

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.00011814	0.000118	5.9181
Error	2	0.00003993	0.000020	Prob > F
C. Total	3	0.00015807		0.1355

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	-0.006308	0.007723	-0.82	0.4998
Gauge Height	0.0430742	0.017706	2.43	0.1355

APPENDIX B: 2006-2007 Newfound Tributary Discharge Data

Station Number	Site Name	Date	Time 24:00 hr	Measured Discharge (cms)
1	Hemlock Brook	6/20/07	10:00	0.0005
1	Hemlock Brook	9/11/07	9:00	0.0081
1	Hemlock Brook	12/11/07	10:05	0.0143
1	Hemlock Brook	10/17/06	9:40	0.0208
1	Hemlock Brook	10/24/07	9:42	0.0208
1	Hemlock Brook	8/21/06	14:43	0.0266
1	Hemlock Brook	6/1/06	10:00	0.0368
1	Hemlock Brook	12/13/06	10:30	0.0391
1	Hemlock Brook	4/11/07	16:17	0.0819
1	Hemlock Brook	4/4/07	9:30	0.1769
1	Hemlock Brook	11/15/07	9:28	0.2598
1	Hemlock Brook	11/14/06	11:52	0.3110
1	Hemlock Brook	4/18/07	10:15	0.6345
2	Tilton Brook	8/21/06	15:44	0.0065
2	Tilton Brook	9/11/07	9:25	0.0065
2	Tilton Brook	10/17/06	10:15	0.0123
2	Tilton Brook	6/20/07	10:50	0.0135
2	Tilton Brook	12/11/07	10:40	0.0223
2	Tilton Brook	10/24/07	10:00	0.0268
2	Tilton Brook	12/12/06	15:30	0.0452
2	Tilton Brook	5/17/07	------	0.0598
2	Tilton Brook	4/11/07	15:55	0.0667
2	Tilton Brook	4/4/07	10:20	0.1172
2	Tilton Brook	11/24/06	12:35	0.3393
2	Tilton Brook	11/15/07	10:05	0.4070
2	Tilton Brook	4/18/07	10:47	0.5650
3	Dick Brown Brook	10/17/06	10:47	0.0223
3	Dick Brown Brook	6/20/07	------	0.0257
3	Dick Brown Brook	9/11/07	9:43	0.0312
3	Dick Brown Brook	12/11/07	11:10	0.0335
3	Dick Brown Brook	9/20/06	16:38	0.0393
3	Dick Brown Brook	10/24/07	10:50	0.0945
3	Dick Brown Brook	12/12/06	15:15	0.1355
3	Dick Brown Brook	4/11/07	15:27	0.1977
3	Dick Brown Brook	4/4/07	10:45	0.4488
3	Dick Brown Brook	11/14/06	13:07	1.1329
3	Dick Brown Brook	11/15/07	11:40	1.1631
3	Dick Brown Brook	6/1/06	11:00	0.1012
3	Dick Brown Brook	4/18/07	11:09	1.7434
4	Whittemore Brook	9/11/07	10:10	0.0096
4	Whittemore Brook	6/20/07	10:45	0.0155
4	Whittemore Brook	9/20/06	16:05	0.0189
4	Whittemore Brook	8/21/06	17:20	0.0253
4	Whittemore Brook	10/17/06	11:20	0.0305
4	Whittemore Brook	10/24/07	11:45	0.0432
4	Whittemore Brook	6/1/06	12:10	0.0552
4	Whittemore Brook	12/11/07	11:50	0.0608

APPENDIX B: 2006-2007 Newfound Tributary Discharge Data

Station Number	Site Name	Date	Time 24:00 hr	Measured Discharge (cms)
4	Whittemore Brook	12/13/06	11:15	0.1263
4	Whittemore Brook	4/4/07	11:18	0.3678
4	Whittemore Brook	4/18/07	11:50	1.0056
4	Whittemore Brook	11/14/06	13:50	1.0802
4	Whittemore Brook	11/15/07	11:05	1.4319
5	Wilson Brook	10/17/06	12:03	0.0009
5	Wilson Brook	4/4/07	12:15	0.0598
5	Wilson Brook	11/15/07	11:45	0.1502
5	Wilson Brook	11/14/06	14:53	0.2319
5	Wilson Brook	4/18/07	12:30	0.2775
6	Yellow Brook	6/1/06	13:24	0.0008
6	Yellow Brook	12/13/06	12:30	0.0018
6	Yellow Brook	4/4/07	12:33	0.0084
6	Yellow Brook	11/15/07	12:07	0.0259
6	Yellow Brook	11/14/06	15:40	0.0337
6	Yellow Brook	4/18/07	13:00	0.0612
7	Post Office Brook	6/1/06	13:44	0.0001
7	Post Office Brook	4/18/07	13:15	0.0323
8	Barn Brook	6/1/06	14:03	0.0007
8	Barn Brook	11/15/07	12:42	0.0558
8	Barn Brook	4/18/07	13:32	0.0973
9	Cashman Brook	10/17/06	13:13	0.0008
9	Cashman Brook	12/11/07	13:15	0.0034
9	Cashman Brook	6/1/06	14:24	0.0042
9	Cashman Brook	5/15/07	14:22	0.0050
9	Cashman Brook	12/12/06	14:50	0.0093
9	Cashman Brook	4/4/07	13:11	0.0353
9	Cashman Brook	11/15/06	14:25	0.0564
9	Cashman Brook	11/15/07	13:05	0.1643
9	Cashman Brook	4/18/07	13:53	0.2524
10	Georges Brook	9/20/06	14:32	0.0313
10	Georges Brook	10/17/06	13:38	0.0480
10	Georges Brook	10/24/07	12:55	0.0617
10	Georges Brook	11/14/07	15:15	0.0742
10	Georges Brook	5/15/07	14:45	0.0808
10	Georges Brook	12/11/07	13:37	0.0866
10	Georges Brook	6/1/06	14:50	0.1073
10	Georges Brook	12/12/06	14:20	0.1498
10	Georges Brook	4/4/07	13:25	0.5930
10	Georges Brook	11/15/06	14:47	0.6260
10	Georges Brook	4/23/07	10:15	1.2909
11	Cockermouth River (Near Lake)	8/15/06	16:00	0.0320
12	Cockermouth River (Upstream)	6/28/07	11:24	0.0810
12	Cockermouth River (Upstream)	8/15/06	14:32	0.1918
12	Cockermouth River (Upstream)	9/20/06	12:45	0.3660
12	Cockermouth River (Upstream)	10/17/06	14:55	0.5151
12	Cockermouth River (Upstream)	11/14/07	13:15	0.5389

APPENDIX B: 2006-2007 Newfound Tributary Discharge Data

Station Number	Site Name	Date	Time 24:00 hr	Measured Discharge (cms)
12	Cockermouth River (Upstream)	10/23/07	13:21	0.6340
12	Cockermouth River (Upstream)	5/15/07	12:49	0.7470
12	Cockermouth River (Upstream)	12/12/06	9:00	0.8728
12	Cockermouth River (Upstream)	11/15/06	12:31	5.3487
12	Cockermouth River (Upstream)	4/23/07	11:12	7.5543
13	Tannery Brook	8/15/06	14:10	0.0060
13	Tannery Brook	9/20/06	12:13	0.0134
13	Tannery Brook	10/17/06	16:34	0.0274
13	Tannery Brook	5/15/07	12:23	0.0301
13	Tannery Brook	10/23/07	14:35	0.0334
13	Tannery Brook	6/1/06	15:37	0.0384
13	Tannery Brook	11/14/07	14:40	0.0456
13	Tannery Brook	12/12/06	10:30	0.0574
13	Tannery Brook	11/15/06	13:17	0.2703
13	Tannery Brook	4/18/07	14:40	1.0020
13	Tannery Brook	7/13/06	14:10	1.1601
14	Cockermouth River (Upstream)	8/15/06	15:19	0.1304
14	Cockermouth River (Upstream)	9/20/06	11:21	0.2831
14	Cockermouth River (Upstream)	11/14/07	14:03	0.3732
14	Cockermouth River (Upstream)	10/17/06	15:51	0.4926
14	Cockermouth River (Upstream)	10/23/07	13:50	0.4973
14	Cockermouth River (Upstream)	5/15/07	13:32	0.6068
14	Cockermouth River (Upstream)	12/12/06	9:45	0.7496
14	Cockermouth River (Upstream)	4/23/07	12:01	7.4735
15	Hebron Brook	12/12/06	11:00	0.0030
15	Hebron Brook	10/18/06	14:25	0.0143
15	Hebron Brook	6/8/06	14:39	0.0201
15	Hebron Brook	11/15/07	13:35	0.0411
15	Hebron Brook	7/13/06	12:47	0.0821
15	Hebron Brook	4/18/07	15:35	0.1030
16	Kendall Brook	12/12/06	11:30	0.0044
16	Kendall Brook	5/15/07	11:18	0.0057
16	Kendall Brook	10/16/06	13:59	0.0197
16	Kendall Brook	6/8/06	14:02	0.0231
16	Kendall Brook	11/15/07	13:47	0.0426
16	Kendall Brook	7/13/06	12:23	0.0999
16	Kendall Brook	4/18/07	15:50	0.1246
17	Mason Brook	8/15/06	12:07	0.0085
17	Mason Brook	10/24/07	14:27	0.0092
17	Mason Brook	5/15/07	10:58	0.0141
17	Mason Brook	12/12/06	11:45	0.0172
17	Mason Brook	6/8/06	13:27	0.0914
17	Mason Brook	10/18/06	13:35	0.1014
17	Mason Brook	11/15/07	14:11	0.1856
17	Mason Brook	6/26/06	12:13	0.2930
17	Mason Brook	7/13/06	12:04	0.3772
17	Mason Brook	4/18/07	16:11	0.4009

APPENDIX B: 2006-2007 Newfound Tributary Discharge Data

Station Number	Site Name	Date	Time 24:00 hr	Measured Discharge (cms)
18	The Ledges	10/24/07	14:48	0.0102
18	The Ledges	12/12/06	14:00	0.0170
18	The Ledges	5/15/07	10:45	0.0175
18	The Ledges	6/8/06	12:51	0.0926
18	The Ledges	10/18/06	13:00	0.1013
18	The Ledges	4/23/07	12:52	0.1087
18	The Ledges	6/26/06	11:42	0.5194
18	The Ledges	7/13/06	11:35	0.6220
18	The Ledges	11/15/07	14:37	0.2795
19	Wellington Brook	5/15/07	10:24	0.0025
19	Wellington Brook	12/12/06	13:45	0.0052
19	Wellington Brook	10/18/06	8:34	0.0090
19	Wellington Brook	11/15/07	14:58	0.0239
19	Wellington Brook	4/23/07	13:10	0.0350
19	Wellington Brook	6/8/06	12:25	0.0357
19	Wellington Brook	6/26/06	11:25	0.0394
19	Wellington Brook	7/13/06	11:12	0.1109
21	Fowler River (Bog Brk Drainage)	6/28/07	15:42	0.0722
21	Fowler River (Bog Brk Drainage)	9/14/06	14:13	0.0972
21	Fowler River (Bog Brk Drainage)	8/15/06	9:01	0.1182
21	Fowler River (Bog Brk Drainage)	11/14/07	11:13	0.1713
21	Fowler River (Bog Brk Drainage)	9/11/07	11:55	0.2325
21	Fowler River (Bog Brk Drainage)	5/15/07	------	0.3932
21	Fowler River (Bog Brk Drainage)	12/12/06	13:00	0.5108
21	Fowler River (Bog Brk Drainage)	10/13/07	11:08	0.7046
21	Fowler River (Bog Brk Drainage)	4/11/07	14:05	0.7202
21	Fowler River (Bog Brk Drainage)	6/21/06	10:13	0.8623
21	Fowler River (Bog Brk Drainage)	10/18/06	9:52	0.9944
21	Fowler River (Bog Brk Drainage)	6/26/06	10:30	1.4380
21	Fowler River (Bog Brk Drainage)	11/15/06	9:18	3.7945
21	Fowler River (Bog Brk Drainage)	4/23/07	13:25	5.5708
22	Fowler River (Upstream)	6/28/07	16:07	0.0805
22	Fowler River (Upstream)	9/14/06	13:20	0.1253
22	Fowler River (Upstream)	9/11/07	12:35	0.2831
22	Fowler River (Upstream)	11/14/07	11:48	0.4648
22	Fowler River (Upstream)	5/15/07	9:24	0.5374
22	Fowler River (Upstream)	10/13/07	11:45	0.6038
22	Fowler River (Upstream)	12/12/06	12:30	0.6677
22	Fowler River (Upstream)	4/11/07	14:41	0.8798
22	Fowler River (Upstream)	6/21/06	10:00	1.4775
22	Fowler River (Upstream)	6/8/06	11:30	4.0174
22	Fowler River (Upstream)	11/15/06	8:30	4.6787
22	Fowler River (Upstream)	6/26/06	------	4.9950
22	Fowler River (Upstream)	10/18/06	10:37	7.2777
22	Fowler River (Upstream)	4/23/07	14:17	11.9281
23	Black Brook	9/11/07	11:30	0.0031
23	Black Brook	5/15/07	------	0.0079

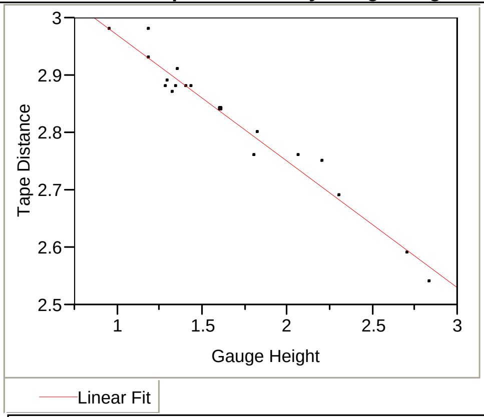
APPENDIX B: 2006-2007 Newfound Tributary Discharge Data

Station Number	Site Name	Date	Time 24:00 hr	Measured Discharge (cms)
23	Black Brook	10/23/07	10:24	0.0158
23	Black Brook	11/14/07	10:47	0.0171
23	Black Brook	12/13/06	9:15	0.0241
23	Black Brook	10/18/06	11:30	0.2142
23	Black Brook	6/8/06	10:20	0.2578
23	Black Brook	11/14/06	10:30	0.3142
23	Black Brook	6/26/06	9:06	0.3220
23	Black Brook	7/13/06	10:06	0.9040

Appendix C: Conversion from Keson Tape Measurements to Staff Gauge Heights

Bog Brook (Site 21)
Cockermouth River (Site 12) – Pre-ice conditions
Cockermouth River (Site 12) – Post-ice conditions

Bivariate Fit of Tape Distance By Gauge Height



Linear Fit

Tape Distance = 3.1903426 - 0.2203186 Gauge Height

Summary of Fit

RSquare	0.96256
RSquare Adj	0.96022
Root Mean Square Error	0.024387
Mean of Response	2.822778
Observations (or Sum Wgts)	18

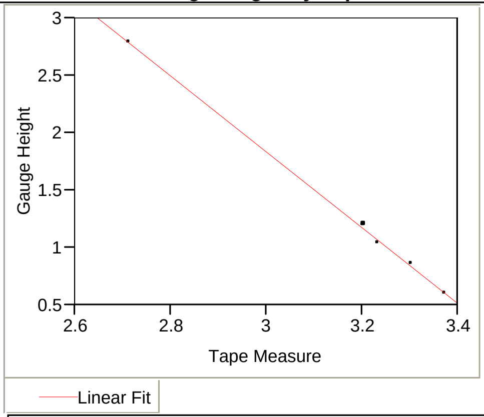
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.24464542	0.244645	411.3552
Error	16	0.00951569	0.000595	Prob > F
C. Total	17	0.25416111		<.0001

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	3.1903426	0.019013	167.80	<.0001
Gauge Height	-0.220319	0.010863	-20.28	<.0001

Bivariate Fit of Gauge Height By Tape Measure



Linear Fit

Gauge Height = 11.749252 - 3.3052662 Tape Measure

Summary of Fit

RSquare	0.999225
RSquare Adj	0.998967
Root Mean Square Error	0.027747
Mean of Response	1.298
Observations (or Sum Wgts)	5

Analysis of Variance

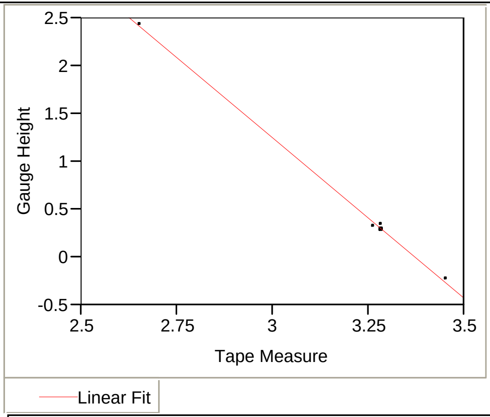
Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	2.9789704	2.97897	3869.4
Error	3	0.0023096	0.00077	Prob > F
C. Total	4	2.9812800		<.0001

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	11.749252	0.168472	69.74	<.0001
Tape Measure	-3.305266	0.053135	-62.20	<.0001

Cockermouth River Staff Gauge to Keson Tape Conversion (post-ice formation)

Bivariate Fit of Gauge Height By Tape Measure



Linear Fit

Gauge Height = 11.30745 - 3.3540987 Tape Measure

Summary of Fit

RSquare	0.998613
RSquare Adj	0.998151
Root Mean Square Error	0.044491
Mean of Response	0.628
Observations (or Sum Wgts)	5

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	4.2763417	4.27634	2160.382
Error	3	0.0059383	0.00198	Prob > F
C. Total	4	4.2822800		<.0001

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	11.30745	0.230625	49.03	<.0001
Tape Measure	-3.354099	0.072162	-46.48	<.0001

APPENDIX D: Newfound gauged sub-watershed land use catagories

Tributary	Site Number	Watershed Size (acres)	Developed Class (acres)	Agricultural Class (acres)	Forest Class (acres)	Water Class (acres)	Wetland Class (acres)	Open Class (acres)
Hemlock Brook	1	894.5	5.87	8.03	856.17	0.00	0.00	24.43
Tilton Brook	2	785.5	48.31	15.90	691.22	0.07	0.00	29.97
Dick Brown Brook	3	2095.6	17.08	66.24	1954.26	15.45	7.62	34.92
Whittemore Brook	4	2058.8	10.16	56.95	1961.65	0.00	4.21	25.84
Wilson Brook	5	238.3	0.95	1.48	235.70	0.15	0.00	0.00
Yellow Brook	6	77.2	2.20	1.54	72.30	1.05	0.00	0.12
Post Office Brook	7	45.4	3.76	5.03	36.63	0.00	0.00	0.00
Barn Brook	8	168.8	2.00	0.00	166.68	0.11	0.00	0.00
Cashman Brook	9	230.2	4.65	0.00	224.37	0.00	0.00	0.20
Georges Brook	10	3031.9	43.60	45.91	2839.04	5.22	78.64	18.50
Cockermouth River (lower)	11	18080.4	200.32	604.41	16240.65	94.75	58.22	882.06
Hebron Brook	15	105.1	1.12	1.02	98.72	0.00	0.00	4.22
Kendall Brook	16	176.0	8.84	2.01	159.27	0.41	3.81	1.66
Mason Brook	17	505.8	8.49	17.99	459.71	0.00	0.48	19.13
Ledges Brook	18	461.8	49.92	5.50	406.44	0.00	0.00	0.16
Wellington Brook	19	62.1	1.90	0.00	59.38	0.82	0.00	0.00
Fowler River (lower)	20	22712.5	276.29	945.18	20088.68	60.06	359.79	982.50
Black Brook	23	581.7	42.00	6.47	504.25	0.26	10.84	17.88
Cockermouth River (Hebron)	12	16213.3	169.77	461.06	14650.17	88.36	35.99	807.96
Tannery Brook	13	1113.0	29.01	38.79	990.47	0.40	0.00	54.34
Cockermouth River (Groton)	14	13931.1	112.39	315.97	12685.33	87.90	27.77	701.74
Bog Brook	21	7954.1	111.47	271.88	6959.33	10.08	333.02	268.33
Fowler River (upper)	22	12929.1	99.59	330.87	11855.64	16.88	16.08	610.05

Tributary	Site Number		Developed Class (%)	Agricultural Class (%)	Forest Class (%)	Water Class (%)	Wetland Class (%)	Open Class (%)
Hemlock Brook	1		0.7%	0.9%	95.7%	0.0%	0.0%	2.7%
Tilton Brook	2		6.2%	2.0%	88.0%	0.0%	0.0%	3.8%
Dick Brown Brook	3		0.8%	3.2%	93.3%	0.7%	0.4%	1.7%
Whittemore Brook	4		0.5%	2.8%	95.3%	0.0%	0.2%	1.3%
Wilson Brook	5		0.4%	0.6%	98.9%	0.1%	0.0%	0.0%
Yellow Brook	6		2.8%	2.0%	93.7%	1.4%	0.0%	0.2%
Post Office Brook	7		8.3%	11.1%	80.7%	0.0%	0.0%	0.0%
Barn Brook	8		1.2%	0.0%	98.7%	0.1%	0.0%	0.0%
Cashman Brook	9		2.0%	0.0%	97.5%	0.0%	0.0%	0.1%
Georges Brook	10		1.4%	1.5%	93.6%	0.2%	2.6%	0.6%
Cockermouth River (lower)	11		1.1%	3.3%	89.8%	0.5%	0.3%	4.9%
Hebron Brook	15		1.1%	1.0%	93.9%	0.0%	0.0%	4.0%
Kendall Brook	16		5.0%	1.1%	90.5%	0.2%	2.2%	0.9%
Mason Brook	17		1.7%	3.6%	90.9%	0.0%	0.1%	3.8%
Ledges Brook	18		10.8%	1.2%	88.0%	0.0%	0.0%	0.0%
Wellington Brook	19		3.1%	0.0%	95.6%	1.3%	0.0%	0.0%
Fowler River (lower)	20		1.2%	4.2%	88.4%	0.3%	1.6%	4.3%
Black Brook	23		7.2%	1.1%	86.7%	0.0%	1.9%	3.1%
Cockermouth River (Hebron)	12		1.0%	2.8%	90.4%	0.5%	0.2%	5.0%
Tannery Brook	13		2.6%	3.5%	89.0%	0.0%	0.0%	4.9%
Cockermouth River (Groton)	14		0.8%	2.3%	91.1%	0.6%	0.2%	5.0%
Bog Brook	21		1.4%	3.4%	87.5%	0.1%	4.2%	3.4%
Fowler River (upper)	22		0.8%	2.6%	91.7%	0.1%	0.1%	4.7%

APPENDIX E: Newfound ungauged sub-watershed land use catagories and phosphorus coefficients

Ungauged subwatershed	Total Area (acres)	Developed Class (acres)	Agriculture Class (acres)	Forest Class (acres)	Water Class (acres)	Wetland Class (acres)	Open Class (acres)
ug 1	200.00	68.93	0.00	115.95	1.19	0.00	8.92
ug 2	35.00	0.00	0.00	24.64	8.00	0.00	0.00
ug 3	73.70	7.00	3.44	42.25	3.75	0.00	14.36
ug 4	544.70	58.89	45.01	365.28	25.71	0.00	36.55
ug 5	404.00	35.37	17.24	321.65	0.00	0.00	29.66
ug 6	277.90	25.94	2.41	224.18	5.77	0.00	15.66
ug 7	236.10	23.29	0.00	198.38	3.59	0.00	2.00
ug 8	207.70	11.82	6.54	175.51	5.17	0.00	3.49
ug 9	97.40	6.70	13.92	71.25	0.84	0.00	2.20
ug 10	52.50	6.23	0.00	39.05	2.04	0.00	2.86
ug 11	142.00	7.15	3.47	115.53	5.96	0.00	7.98
ug 12	478.00	13.63	28.27	400.29	5.22	0.00	30.53
ug 13	668.30	40.39	13.13	500.82	17.18	27.57	59.93
ug 14	74.60	2.85	0.00	60.17	5.03	2.44	3.61
ug 15	117.50	11.64	7.22	85.21	8.25	4.81	0.00
ug 16	216.10	28.52	8.34	167.26	5.16	0.00	6.02
ug 17	54.60	1.36	0.00	35.51	10.52	4.68	0.00
ug 18	231.30	37.14	16.29	123.57	18.38	16.82	17.08
ug 19	143.70	27.59	0.10	92.25	9.40	6.75	7.57
ug 20	36.30	0.00	0.00	24.07	8.70	1.10	0.00
ug 21	232.60	35.76	5.56	166.53	3.59	1.75	19.33

Ungauged subwatershed		Developed %	Agriculture %	Forest %	Water %	Wetland %	Open %	Areal P Load (kg/ha/yr)	HY 2007 (P Load) (kg)
ug 1		35.4%	0.0%	59.5%	0.6%	0.0%	4.6%	0.098	7.9
ug 2		0.0%	0.0%	75.5%	24.5%	0.0%	0.0%	0.075	1.1
ug 3		9.9%	4.9%	59.7%	5.3%	0.0%	20.3%	0.098	2.9
ug 4		11.1%	8.5%	68.7%	4.8%	0.0%	6.9%	0.098	21.6
ug 5		8.8%	4.3%	79.6%	0.0%	0.0%	7.3%	0.075	12.3
ug 6		9.5%	0.9%	81.8%	2.1%	0.0%	5.7%	0.075	8.4
ug 7		10.2%	0.0%	87.3%	1.6%	0.0%	0.9%	0.081	7.7
ug 8		5.8%	3.2%	86.7%	2.6%	0.0%	1.7%	0.076	6.4
ug 9		7.1%	14.7%	75.1%	0.9%	0.0%	2.3%	0.098	3.9
ug 10		12.4%	0.0%	77.8%	4.1%	0.0%	5.7%	0.098	2.1
ug 11		5.1%	2.5%	82.5%	4.3%	0.0%	5.7%	0.068	3.9
ug 12		2.9%	5.9%	83.8%	1.1%	0.0%	6.4%	0.068	13.2
ug 13		6.1%	2.0%	76.0%	2.6%	4.2%	9.1%	0.056	15.1
ug 14		3.8%	0.0%	81.2%	6.8%	3.3%	4.9%	0.098	3.0
ug 15		9.9%	6.2%	72.7%	7.0%	4.1%	0.0%	0.098	4.7
ug 16		13.2%	3.9%	77.7%	2.4%	0.0%	2.8%	0.098	8.6
ug 17		2.6%	0.0%	68.2%	20.2%	9.0%	0.0%	0.075	1.7
ug 18		16.2%	7.1%	53.9%	8.0%	7.3%	7.4%	0.098	9.2
ug 19		19.2%	0.1%	64.2%	6.5%	4.7%	5.3%	0.098	5.7
ug 20		0.0%	0.0%	71.1%	25.7%	3.2%	0.0%	0.075	1.1
ug 21		15.4%	2.4%	71.6%	1.5%	0.8%	8.3%	0.098	9.2

APPENDIX F: LakePort 2 Evaporation Data (October 2006 - September 2007)

Month/Year	Pan Evaporation (inches)
Oct-06	1.78
Nov-06	1.13
May-07	5.50
Jun-07	5.57
Jul-07	5.78
Aug-07	6.04
Sep-07	4.19

APPENDIX G: Newfound River (Dam Outlet) daily data listing

Site Latitude Longitude Elevation (feet) Time of observation	ALEXANDRIA 4 43°31' 71°48' 1160 0700 hrs Precipitation (inches)	LAKEPORT 2 43°33' 71°28' 500 0700 hrs Precipitation (inches)	MEREDITH 3 NNE 43°42' 71°28' 830 2400 hrs Precipitation (inches)	PLYMOUTH 43°47' 71°39' 660 0700 hrs Precipitation (inches)	Newfound median daily lake level (feet)	Newfound median daily lake stage (feet)	Newfound dishcarge at the Dam Outlet (CMS)
10/1/06	0.00	0.00	0.62	0.02	586.99	4.50	1.086
10/2/06	2.01	0.65	0.00	0.56	587.14	4.54	1.213
10/3/06	0.00	0.00	0.00	0.01	587.17	4.55	1.247
10/4/06	0.00	0.01	0.30	0.02	587.18	4.56	1.282
10/5/06	0.21	0.28	0.00	0.22	587.23	4.57	1.317
10/6/06	0.00	0.00	0.00	0.00	587.20	4.57	1.317
10/7/06	0.00	0.00	0.00	0.00	587.20	4.56	1.282
10/8/06	0.00	0.00	0.00	0.00	587.20	4.56	1.282
10/9/06	0.00	0.00	0.00	0.00	587.20	4.56	1.282
10/10/06	0.00	0.00	0.00	0.00	587.19	4.58	1.353
10/11/06	0.00	0.00	0.30	0.00	587.13	5.12	3.871
10/12/06	1.72	1.65	1.42	1.42	587.32	5.14	3.985
10/13/06	0.00	0.00	0.00	0.03	587.41	5.38	5.477
10/14/06	0.00	0.00	0.00	0.00	587.37	5.61	7.103
10/15/06	0.00	0.00	0.00	0.00	587.29	5.58	6.879
10/16/06	0.00	0.00	0.00	0.00	587.21	5.55	6.661
10/17/06	0.00	0.00	0.52	0.00	587.13	5.50	6.301
10/18/06	1.37	0.89	0.70	1.08	587.25	5.53	6.516
10/19/06	0.04	0.05	0.00	0.11	587.30	5.70	7.788
10/20/06	0.34	0.14	1.72	0.63	587.36	6.17	11.855
10/21/06	2.72	0.73	0.02	0.19	588.14	6.83	18.541
10/22/06	0.04	0.00	0.05	0.00	588.08	6.86	19.175
10/23/06	1.32	0.72	0.61	0.39	587.97	6.99	20.727
10/24/06	0.07	0.04	0.00	0.12	587.87	6.94	20.124
10/25/06	0.00	0.00	0.00	0.00	587.67	6.83	18.541
10/26/06	0.00	0.00	0.00	0.00	587.29	6.73	17.677
10/27/06	0.00	0.00	0.00	0.00	587.09	6.84	18.940
10/28/06	0.34	0.31	1.90	0.38	586.95	6.79	18.360
10/29/06	3.14	1.41	0.00	0.11	587.94	7.33	25.041
10/30/06	0.02	0.00	0.00	0.06	587.90	7.32	24.910

APPENDIX G: Newfound River (Dam Outlet) daily data listing

Site Latitude Longitude Elevation (feet) Time of observation	ALEXANDRIA 4 43°31' 71°48' 1160 0700 hrs Precipitation (inches)	LAKEPORT 2 43°33' 71°28' 500 0700 hrs Precipitation (inches)	MEREDITH 3 NNE 43°42' 71°28' 830 2400 hrs Precipitation (inches)	PLYMOUTH 43°47' 71°39' 660 0700 hrs Precipitation (inches)	Newfound median daily lake level (feet)	Newfound median daily lake stage (feet)	Newfound dishcarge at the Dam Outlet (CMS)
10/31/06	0.00	0.00	0.00	0.00	587.63	7.25	23.993
11/1/06	0.00	0.00	0.00	0.00	587.39	7.04	21.339
11/2/06	0.10	0.19	0.39	0.31	587.17	6.91	19.765
11/3/06	0.21	0.11	0.00	0.02	587.05	8.45	41.772
11/4/06	0.00	0.00	0.00	0.00	586.98	7.67	29.708
11/5/06	0.02	0.00	0.00	0.00	586.88	5.99	10.207
11/6/06	0.00	0.00	0.00	0.00	586.76	5.93	9.683
11/7/06	0.00	0.00	0.00	0.00	586.67	5.90	9.425
11/8/06	0.17	0.06	1.22	0.02	586.57	5.90	9.425
11/9/06	1.91	2.01	0.45	1.32	586.90	6.19	12.044
11/10/06	0.00	0.00	0.00	0.00	587.03	6.31	13.214
11/11/06	0.00	0.00	0.00	0.00	586.98	6.24	12.526
11/12/06	0.00	0.00	0.48	0.00	586.91	6.16	11.761
11/13/06	0.53	0.42	0.10	0.07	586.96	6.21	12.237
11/14/06	0.36	0.51	0.76	0.49	587.02	6.28	12.917
11/15/06	0.48	0.08	0.02	0.08	587.13	6.80	18.476
11/16/06	0.04	0.00	0.20	0.00	587.05	6.74	17.791
11/17/06	1.55	1.02	1.02	0.09	587.15	7.15	22.713
11/18/06	0.00	0.00	0.00	0.00	587.42	7.25	23.993
11/19/06	0.00	0.00	0.00	0.00	587.28	7.12	22.333
11/20/06	0.00	0.00	0.00	0.00	587.13	7.03	21.220
11/21/06	0.00	0.00	0.00	0.00	587.06	6.22	12.333
11/22/06	0.00	0.00	0.00	0.00	586.93	6.17	11.855
11/23/06	0.00	0.00	0.00	0.00	586.79	6.08	11.019
11/24/06	0.00	0.00	0.00	0.00	586.65	5.99	10.207
11/25/06	0.00	0.00	0.00	0.00	586.57	5.92	9.598
11/26/06	0.00	0.00	0.00	0.00	586.45	5.86	9.088
11/27/06	0.00	0.00	0.00	0.00	586.36	5.70	7.788
11/28/06	0.00	0.00	0.10	0.01	586.31	5.67	7.556
11/29/06	0.17	0.04	0.07	0.07	586.21	5.65	7.403

APPENDIX G: Newfound River (Dam Outlet) daily data listing

Site Latitude Longitude Elevation (feet) Time of observation	ALEXANDRIA 4 43°31' 71°48' 1160 0700 hrs Precipitation (inches)	LAKEPORT 2 43°33' 71°28' 500 0700 hrs Precipitation (inches)	MEREDITH 3 NNE 43°42' 71°28' 830 2400 hrs Precipitation (inches)	PLYMOUTH 43°47' 71°39' 660 0700 hrs Precipitation (inches)	Newfound median daily lake level (feet)	Newfound median daily lake stage (feet)	Newfound dishcarge at the Dam Outlet (CMS)
11/30/06	0.00	0.00	0.00	0.00	586.14	5.63	7.253
12/1/06	0.01	0.00	1.75	0.11	586.11	5.61	7.103
12/2/06	2.08	1.49	0.00	1.34	586.57	5.80	8.589
12/3/06	0.00	0.00	0.00	0.00	586.65	5.86	9.088
12/4/06	0.00	0.00	0.00	0.00	586.66	5.86	9.088
12/5/06	0.00	0.00	0.00	0.00	586.60	5.81	8.672
12/6/06	0.00	0.00	0.00	0.00	586.52	5.77	8.346
12/7/06	0.00	0.00	0.06	0.00	586.43	5.73	8.026
12/8/06	0.11	0.00	0.00	0.12	586.43	5.72	7.947
12/9/06	0.00	0.00	0.00	0.00	586.27	5.66	7.479
12/10/06	0.00	0.00	0.00	0.00	586.19	5.64	7.326
12/11/06	0.00	0.00	0.05	0.00	586.12	5.61	7.103
12/12/06	0.00	0.00	0.00	0.00	586.04	5.61	7.103
12/13/06	0.70	0.00	0.25	0.00	585.99	5.60	7.026
12/14/06	0.24	0.16	0.00	0.18	585.94	5.59	6.953
12/15/06	0.00	0.00	0.00	0.00	585.92	5.33	5.149
12/16/06	0.01	0.00	0.06	0.00	585.92	5.33	5.149
12/17/06	0.00	0.00	0.00	0.00	585.88	5.32	5.083
12/18/06	0.00	0.00	0.00	0.00	585.87	5.32	5.083
12/19/06	0.00	0.00	0.00	0.00	585.83	5.31	5.021
12/20/06	0.00	0.00	0.00	0.00	585.80	5.30	4.956
12/21/06	0.00	0.00	0.00	0.00	585.79	5.12	3.871
12/22/06	0.00	0.00	0.20	0.00	585.76	5.10	3.758
12/23/06	0.90	0.83	1.38	0.89	585.95	5.29	4.894
12/24/06	0.65	0.48	0.00	0.53	586.20	5.61	7.103
12/25/06	0.00	0.00	0.12	0.00	586.22	5.64	7.326
12/26/06	0.54	0.44	0.40	0.38	586.27	5.70	7.788
12/27/06	0.32	0.00	0.00	0.07	586.32	5.75	8.184
12/28/06	0.01	0.00	0.00	0.00	586.30	5.73	8.026
12/29/06	0.00	0.02	0.00	0.00	586.26	5.69	7.712

APPENDIX G: Newfound River (Dam Outlet) daily data listing

Site Latitude Longitude Elevation (feet) Time of observation	ALEXANDRIA 4 43°31' 71°48' 1160 0700 hrs Precipitation (inches)	LAKEPORT 2 43°33' 71°28' 500 0700 hrs Precipitation (inches)	MEREDITH 3 NNE 43°42' 71°28' 830 2400 hrs Precipitation (inches)	PLYMOUTH 43°47' 71°39' 660 0700 hrs Precipitation (inches)	Newfound median daily lake level (feet)	Newfound median daily lake stage (feet)	Newfound dishcarge at the Dam Outlet (CMS)
12/30/06	0.00	0.00	0.27	0.00	586.22	5.63	7.253
12/31/06	0.46	0.19	0.00	0.30	586.18	5.58	6.879
1/1/07	0.77	0.35	0.92	0.37	586.16	5.57	6.805
1/2/07	0.00	0.28	0.00	0.42	586.23	5.63	7.253
1/3/07	0.00	0.00	0.00	0.00	586.22	5.62	7.176
1/4/07	0.00	0.00	0.00	0.00	586.21	4.82	2.330
1/5/07	0.00	0.00	0.04	0.00	586.25	4.84	2.422
1/6/07	0.29	0.31	0.53	0.44	586.42	5.85	9.003
1/7/07	0.79	0.00	0.00	0.40	586.65	6.18	11.951
1/8/07	0.71	0.36	1.01	0.60	586.72	6.64	16.672
1/9/07	0.41	0.59	0.00	0.62	586.92	7.07	21.679
1/10/07	0.00	0.00	0.00	0.00	586.88	7.01	20.971
1/11/07	0.00	0.00	0.00	0.00	586.72	6.82	18.708
1/12/07	0.00	0.00	0.00	0.00	586.60	6.64	16.672
1/13/07	0.07	0.00	0.02	0.03	586.50	6.54	15.584
1/14/07	0.01	0.03	0.12	0.00	586.40	6.41	14.222
1/15/07	0.32	0.12	0.44	0.13	586.33	6.31	13.214
1/16/07	0.39	0.36	0.00	0.48	586.27	6.25	12.622
1/17/07	0.00	0.00	0.00	0.00	585.85	5.83	8.836
1/18/07	0.00	0.00	0.00	0.00	586.03	5.78	8.425
1/19/07	0.00	0.05	0.09	0.00	586.00	5.70	7.788
1/20/07	0.19	0.03	0.11	0.11	585.95	5.65	7.403
1/21/07	0.00	0.00	0.00	0.00	585.87	5.51	6.372
1/22/07	0.00	0.00	0.03	0.00	585.81	5.53	6.516
1/23/07	0.04	0.04	0.00	0.04	585.77	5.94	9.770
1/24/07	0.00	0.00	0.00	0.00	585.73	5.73	8.026
1/25/07	0.00	0.00	0.00	0.00	585.72	5.20	4.339
1/26/07	0.00	0.00	0.00	0.00	585.68	------	------
1/27/07	0.00	0.00	0.00	0.00	585.64	------	------
1/28/07	0.00	0.01	0.00	0.00	585.61	------	------

APPENDIX G: Newfound River (Dam Outlet) daily data listing

Site Latitude Longitude Elevation (feet) Time of observation	ALEXANDRIA 4 43°31' 71°48' 1160 0700 hrs Precipitation (inches)	LAKEPORT 2 43°33' 71°28' 500 0700 hrs Precipitation (inches)	MEREDITH 3 NNE 43°42' 71°28' 830 2400 hrs Precipitation (inches)	PLYMOUTH 43°47' 71°39' 660 0700 hrs Precipitation (inches)	Newfound median daily lake level (feet)	Newfound median daily lake stage (feet)	Newfound dishcarge at the Dam Outlet (CMS)
1/29/07	0.00	0.00	0.00	0.00	585.60	------	------
1/30/07	0.00	0.00	0.00	0.00	585.58	------	------
1/31/07	0.00	0.00	0.00	0.01	585.57	------	------
2/1/07	0.00	0.00	0.00	0.00	585.55	------	------
2/2/07	0.00	0.00	0.31	0.00	------	------	------
2/3/07	0.37	0.32	0.00	0.30	------	------	------
2/4/07	0.00	0.00	0.00	0.00	585.20	------	------
2/5/07	0.00	0.00	0.00	0.00	585.18	------	------
2/6/07	0.00	0.00	0.00	0.00	585.18	------	------
2/7/07	0.00	0.00	0.00	0.00	585.16	------	------
2/8/07	0.00	0.00	0.00	0.00	585.15	------	------
2/9/07	0.00	0.00	0.00	0.02	585.13	------	------
2/10/07	0.00	0.00	0.00	0.00	585.12	------	------
2/11/07	0.00	0.00	0.00	0.00	585.10	------	------
2/12/07	0.00	0.00	0.00	0.00	585.10	------	------
2/13/07	0.00	0.00	0.00	0.00	585.39	------	------
2/14/07	0.31	0.25	1.12	0.25	585.17	------	------
2/15/07	1.73	0.98	0.00	1.14	585.18	------	------
2/16/07	0.00	0.00	0.00	0.00	585.15	------	------
2/17/07	0.00	0.00	0.00	0.00	585.14	------	------
2/18/07	0.00	0.00	0.00	0.00	585.13	------	------
2/19/07	0.00	0.00	0.00	0.00	585.10	------	------
2/20/07	0.00	0.00	0.00	0.00	585.10	------	------
2/21/07	0.00	0.00	0.00	0.00	585.39	------	------
2/22/07	0.00	0.00	0.00	0.00	585.38	------	------
2/23/07	0.05	0.04	0.00	0.00	585.37	------	------
2/24/07	0.00	0.00	0.00	0.00	585.34	------	------
2/25/07	0.00	0.00	0.00	0.00	585.34	------	------
2/26/07	0.00	0.00	0.00	0.00	585.33	------	------
2/27/07	0.00	0.00	0.00	0.00	585.33	------	------

APPENDIX G: Newfound River (Dam Outlet) daily data listing

Site Latitude Longitude Elevation (feet) Time of observation	ALEXANDRIA 4 43°31' 71°48' 1160 0700 hrs Precipitation (inches)	LAKEPORT 2 43°33' 71°28' 500 0700 hrs Precipitation (inches)	MEREDITH 3 NNE 43°42' 71°28' 830 2400 hrs Precipitation (inches)	PLYMOUTH 43°47' 71°39' 660 0700 hrs Precipitation (inches)	Newfound median daily lake level (feet)	Newfound median daily lake stage (feet)	Newfound dishcarge at the Dam Outlet (CMS)
2/28/07	0.00	0.00	0.00	0.00	585.32	------	------
3/1/07	0.00	0.00	0.00	0.00	585.31	------	------
3/2/07	0.39	0.32	1.00	0.27	585.31	------	------
3/3/07	1.50	0.96	0.10	0.55	585.39	------	------
3/4/07	0.03	0.04	0.00	0.00	585.38	------	------
3/5/07	0.00	0.00	0.00	0.03	585.38	------	------
3/6/07	0.00	0.00	0.00	0.00	585.35	------	------
3/7/07	0.00	0.00	0.00	0.00	585.35	------	------
3/8/07	0.00	0.00	0.00	0.00	585.33	------	------
3/9/07	0.00	0.00	0.00	0.00	585.33	------	------
3/10/07	0.00	0.00	0.04	0.00	585.33	------	------
3/11/07	0.06	0.00	0.03	0.07	585.32	4.54	1.213
3/12/07	0.00	0.00	0.00	0.00	585.32	4.62	1.499
3/13/07	0.00	0.00	0.00	0.00	585.32	4.65	1.614
3/14/07	0.00	0.00	0.02	0.00	585.33	4.67	1.692
3/15/07	0.13	0.01	0.05	0.10	585.20	4.72	1.880
3/16/07	0.10	0.05	0.38	0.04	585.33	5.24	4.582
3/17/07	1.79	1.12	0.64	0.86	585.80	5.92	9.598
3/18/07	0.21	0.15	0.00	0.17	585.83	5.91	9.510
3/19/07	0.04	0.00	0.00	0.00	585.82	5.89	9.340
3/20/07	0.01	0.01	0.00	0.02	585.81	5.93	9.683
3/21/07	0.00	0.00	0.00	0.00	585.80	5.66	7.479
3/22/07	0.00	0.01	0.02	0.00	585.79	5.84	8.921
3/23/07	0.00	0.00	0.00	0.01	585.85	5.35	5.279
3/24/07	0.00	0.00	0.18	0.00	585.98	5.72	7.947
3/25/07	0.30	0.24	0.00	0.20	586.12	5.65	7.403
3/26/07	0.00	0.00	0.16	0.00	586.20	6.64	16.672
3/27/07	0.25	0.19	0.00	0.36	586.33	6.54	15.584
3/28/07	0.00	0.00	0.00	0.00	586.57	6.21	12.237
3/29/07	0.00	0.00	0.00	0.00	586.67	7.92	33.389

APPENDIX G: Newfound River (Dam Outlet) daily data listing

Site Latitude Longitude Elevation (feet) Time of observation	ALEXANDRIA 4 43°31' 71°48' 1160 0700 hrs Precipitation (inches)	LAKEPORT 2 43°33' 71°28' 500 0700 hrs Precipitation (inches)	MEREDITH 3 NNE 43°42' 71°28' 830 2400 hrs Precipitation (inches)	PLYMOUTH 43°47' 71°39' 660 0700 hrs Precipitation (inches)	Newfound median daily lake level (feet)	Newfound median daily lake stage (feet)	Newfound dishcarge at the Dam Outlet (CMS)
3/30/07	0.00	0.00	0.00	0.00	586.65	6.02	10.476
3/31/07	0.00	0.00	0.00	0.00	586.68	6.03	10.563
4/1/07	0.00	0.00	0.03	0.00	586.66	6.01	10.385
4/2/07	0.31	0.31	0.43	0.22	586.68	6.03	10.563
4/3/07	0.21	0.14	0.05	0.06	586.78	6.10	11.201
4/4/07	0.11	0.11	0.85	0.17	586.80	6.13	11.481
4/5/07	1.08	0.98	0.40	0.86	586.83	6.14	11.574
4/6/07	0.04	0.01	0.00	0.10	586.79	6.07	10.926
4/7/07	0.00	0.00	0.00	0.00	586.77	5.75	8.184
4/8/07	0.00	0.00	0.00	0.00	586.73	5.70	7.788
4/9/07	0.00	0.00	0.00	0.02	586.68	5.64	7.326
4/10/07	0.00	0.00	0.00	0.00	586.68	5.35	5.279
4/11/07	0.00	0.00	0.00	0.00	586.67	5.34	5.214
4/12/07	0.00	0.00	0.89	0.00	586.67	5.35	5.279
4/13/07	1.28	0.91	0.00	0.97	586.71	5.71	7.867
4/14/07	0.00	0.01	0.00	0.00	586.68	5.70	7.788
4/15/07	0.00	0.00	0.77	0.00	586.69	5.71	7.867
4/16/07	2.58	2.18	2.22	2.17	587.07	6.00	10.297
4/17/07	1.22	2.16	0.32	0.84	588.52	8.23	38.204
4/18/07	0.73	0.24	0.07	0.39	588.93	8.67	45.510
4/19/07	0.00	0.04	0.01	0.00	588.99	8.72	46.388
4/20/07	0.00	0.00	0.00	0.00	588.99	8.76	47.068
4/21/07	0.00	0.00	0.00	0.00	588.97	8.71	46.190
4/22/07	0.00	0.00	0.00	0.00	588.83	8.64	45.000
4/23/07	0.00	0.00	0.00	0.00	588.67	8.43	41.432
4/24/07	0.00	0.00	0.00	0.00	588.53	8.26	38.657
4/25/07	0.00	0.00	0.00	0.00	588.33	7.96	33.984
4/26/07	0.00	0.00	0.00	0.00	588.04	7.60	28.716
4/27/07	0.01	0.03	0.28	0.00	587.84	7.39	25.839
4/28/07	0.43	0.21	0.12	0.22	587.95	5.82	8.754

APPENDIX G: Newfound River (Dam Outlet) daily data listing

Site Latitude Longitude Elevation (feet) Time of observation	ALEXANDRIA 4 43°31' 71°48' 1160 0700 hrs Precipitation (inches)	LAKEPORT 2 43°33' 71°28' 500 0700 hrs Precipitation (inches)	MEREDITH 3 NNE 43°42' 71°28' 830 2400 hrs Precipitation (inches)	PLYMOUTH 43°47' 71°39' 660 0700 hrs Precipitation (inches)	Newfound median daily lake level (feet)	Newfound median daily lake stage (feet)	Newfound dishcarge at the Dam Outlet (CMS)
4/29/07	0.07	0.18	0.12	0.04	587.98	5.86	9.088
4/30/07	0.22	0.07	0.28	0.08	588.03	5.91	9.510
5/1/07	0.33	0.28	0.00	0.19	588.11	5.98	10.119
5/2/07	0.06	0.02	0.00	0.02	588.10	5.94	9.770
5/3/07	0.00	0.00	0.00	0.00	588.07	5.91	9.510
5/4/07	0.00	0.00	0.00	0.00	588.02	5.84	8.921
5/5/07	0.00	0.00	0.00	0.00	587.98	5.57	6.805
5/6/07	0.00	0.00	0.00	0.00	587.95	5.54	6.587
5/7/07	0.00	0.00	0.00	0.00	587.91	5.51	6.372
5/8/07	0.00	0.00	0.00	0.00	587.88	5.48	6.160
5/9/07	0.00	0.00	0.00	0.00	587.84	5.45	5.953
5/10/07	0.00	0.00	0.00	0.00	587.82	5.41	5.678
5/11/07	0.00	0.00	0.24	0.03	587.81	5.13	3.928
5/12/07	0.36	0.27	0.00	0.21	587.85	5.15	4.044
5/13/07	0.00	0.00	0.00	0.00	587.84	5.14	3.985
5/14/07	0.00	0.00	0.00	0.00	587.81	5.11	3.812
5/15/07	0.00	0.03	0.15	0.03	587.80	5.10	3.758
5/16/07	0.32	0.40	0.73	0.20	587.81	5.11	3.812
5/17/07	0.92	0.64	0.03	0.45	587.92	5.19	4.279
5/18/07	0.22	0.01	0.11	0.02	587.96	5.24	4.582
5/19/07	0.17	0.42	0.24	0.12	587.91	5.92	9.598
5/20/07	0.25	0.41	0.80	0.11	587.94	5.45	5.953
5/21/07	0.42	0.35	0.00	0.34	588.07	5.53	6.516
5/22/07	0.00	0.00	0.00	0.00	588.07	5.53	6.516
5/23/07	0.00	0.00	0.00	0.00	588.04	5.51	6.372
5/24/07	0.00	0.00	0.00	0.00	588.00	5.49	6.230
5/25/07	0.00	0.00	0.00	0.00	587.96	5.45	5.953
5/26/07	0.00	0.00	0.00	0.00	587.93	5.42	5.746
5/27/07	0.00	0.00	0.00	0.00	587.85	5.38	5.477
5/28/07	0.14	0.14	0.14	0.00	587.82	5.35	5.279

APPENDIX G: Newfound River (Dam Outlet) daily data listing

Site Latitude Longitude Elevation (feet) Time of observation	ALEXANDRIA 4 43°31' 71°48' 1160 0700 hrs Precipitation (inches)	LAKEPORT 2 43°33' 71°28' 500 0700 hrs Precipitation (inches)	MEREDITH 3 NNE 43°42' 71°28' 830 2400 hrs Precipitation (inches)	PLYMOUTH 43°47' 71°39' 660 0700 hrs Precipitation (inches)	Newfound median daily lake level (feet)	Newfound median daily lake stage (feet)	Newfound dishcarge at the Dam Outlet (CMS)
5/29/07	0.00	0.00	0.00	0.00	587.77	5.34	5.214
5/30/07	0.00	0.00	0.00	0.00	587.74	4.81	2.285
5/31/07	0.02	0.01	0.28	0.05	587.72	4.81	2.285
6/1/07	------	0.19	0.03	0.21	587.76	4.81	2.285
6/2/07	------	0.00	0.02	0.00	587.76	4.81	2.285
6/3/07	------	0.15	0.22	0.00	587.78	4.81	2.285
6/4/07	------	0.45	1.17	0.20	587.81	4.81	2.285
6/5/07	------	1.06	0.40	0.58	587.92	5.62	7.176
6/6/07	------	0.04	0.00	0.08	587.97	5.63	7.253
6/7/07	------	0.00	0.00	0.00	587.92	5.60	7.026
6/8/07	------	0.00	0.00	0.00	587.89	5.11	3.812
6/9/07	------	0.00	0.10	0.00	587.87	5.10	3.758
6/10/07	------	0.04	0.00	0.17	587.86	5.10	3.758
6/11/07	------	0.00	0.02	0.00	587.86	5.09	3.701
6/12/07	------	0.54	0.09	0.48	587.88	4.84	2.422
6/13/07	------	0.04	0.11	0.03	587.89	4.85	2.468
6/14/07	------	0.00	0.00	0.00	587.89	4.85	2.468
6/15/07	------	0.00	0.00	0.00	587.89	4.85	2.468
6/16/07	------	0.00	0.00	0.00	587.87	4.85	2.468
6/17/07	------	0.00	0.00	0.00	587.89	4.84	2.422
6/18/07	------	0.00	0.00	0.01	587.88	4.84	2.422
6/19/07	------	0.00	0.00	0.00	587.84	4.83	2.375
6/20/07	------	0.00	0.01	0.00	587.83	4.83	2.375
6/21/07	------	0.02	0.04	0.02	587.81	4.82	2.330
6/22/07	------	0.02	0.02	0.06	587.78	4.81	2.285
6/23/07	------	0.04	0.00	0.26	587.78	4.81	2.285
6/24/07	------	0.00	0.00	0.00	587.74	4.79	2.195
6/25/07	------	0.00	0.22	0.01	587.71	4.79	2.195
6/26/07	------	0.24	0.00	0.02	587.70	4.78	2.151
6/27/07	------	0.00	0.01	0.00	587.68	4.78	2.151

APPENDIX G: Newfound River (Dam Outlet) daily data listing

Site Latitude Longitude Elevation (feet) Time of observation	ALEXANDRIA 4 43°31' 71°48' 1160 0700 hrs Precipitation (inches)	LAKEPORT 2 43°33' 71°28' 500 0700 hrs Precipitation (inches)	MEREDITH 3 NNE 43°42' 71°28' 830 2400 hrs Precipitation (inches)	PLYMOUTH 43°47' 71°39' 660 0700 hrs Precipitation (inches)	Newfound median daily lake level (feet)	Newfound median daily lake stage (feet)	Newfound dishcarge at the Dam Outlet (CMS)
6/28/07	------	0.00	0.00	0.05	587.67	4.77	2.107
6/29/07	------	0.00	0.00	0.00	587.66	4.68	1.731
6/30/07	------	0.00	0.00	0.00	587.62	4.67	1.692
7/1/07	0.00	0.01	0.00	------	587.58	4.67	1.692
7/2/07	0.00	0.00	0.00	------	587.55	4.66	1.652
7/3/07	0.00	0.00	0.00	------	587.51	4.65	1.614
7/4/07	0.00	0.00	0.13	------	587.48	4.65	1.614
7/5/07	0.42	0.21	0.16	------	587.48	4.65	1.614
7/6/07	0.00	0.00	0.06	------	587.48	4.65	1.614
7/7/07	0.04	0.03	0.00	------	587.47	4.64	1.575
7/8/07	0.27	0.15	0.17	------	587.47	4.64	1.575
7/9/07	0.24	0.07	------	------	587.47	4.64	1.575
7/10/07	0.91	1.16	------	------	587.55	4.65	1.614
7/11/07	0.21	0.00	------	------	587.57	4.65	1.614
7/12/07	0.50	0.53	------	------	587.64	4.66	1.652
7/13/07	0.00	0.00	2.52	------	587.63	4.67	1.692
7/14/07	0.00	0.00	0.00	------	587.62	4.67	1.692
7/15/07	0.00	0.00	0.00	------	587.61	4.66	1.652
7/16/07	0.63	0.55	0.00	------	587.62	4.64	1.575
7/17/07	0.00	0.00	0.00	------	587.61	4.64	1.575
7/18/07	0.57	0.09	0.66	------	587.60	4.64	1.575
7/19/07	0.33	0.12	------	------	587.65	4.65	1.614
7/20/07	1.47	1.40	------	------	587.88	4.73	1.936
7/21/07	0.00	0.00	------	------	587.92	5.64	7.326
7/22/07	0.00	0.00	------	------	587.82	5.62	7.176
7/23/07	0.11	0.00	------	------	587.73	5.59	6.953
7/24/07	0.00	0.01	------	------	587.70	4.83	2.375
7/25/07	0.00	0.00	------	------	587.69	4.82	2.330
7/26/07	0.00	0.00	------	------	587.67	4.82	2.330
7/27/07	0.00	0.00	------	------	587.65	4.81	2.285

APPENDIX G: Newfound River (Dam Outlet) daily data listing

Site Latitude Longitude Elevation (feet) Time of observation	ALEXANDRIA 4 43°31' 71°48' 1160 0700 hrs Precipitation (inches)	LAKEPORT 2 43°33' 71°28' 500 0700 hrs Precipitation (inches)	MEREDITH 3 NNE 43°42' 71°28' 830 2400 hrs Precipitation (inches)	PLYMOUTH 43°47' 71°39' 660 0700 hrs Precipitation (inches)	Newfound median daily lake level (feet)	Newfound median daily lake stage (feet)	Newfound dishcarge at the Dam Outlet (CMS)
7/28/07	0.02	0.00	------	------	587.62	4.81	2.285
7/29/07	0.07	0.05	------	------	587.61	4.81	2.285
7/30/07	0.00	0.00	------	------	587.58	4.80	2.240
7/31/07	0.00	0.00	------	------	587.55	4.80	2.240
8/1/07	0.00	0.00	0.00	------	587.53	4.79	2.195
8/2/07	0.00	0.00	0.00	------	587.51	4.53	1.179
8/3/07	0.00	0.00	0.00	------	587.49	4.53	1.179
8/4/07	0.00	0.00	0.00	------	587.48	4.52	1.146
8/5/07	0.00	0.00	0.00	------	587.45	4.51	1.113
8/6/07	0.00	0.00	0.52	------	587.42	4.51	1.113
8/7/07	0.52	0.18	0.00	------	587.44	4.51	1.113
8/8/07	1.21	0.26	0.78	------	587.49	4.51	1.113
8/9/07	0.48	0.51	0.00	------	587.55	4.52	1.146
8/10/07	0.00	0.00	0.00	------	587.53	4.52	1.146
8/11/07	0.00	0.00	0.00	------	587.52	4.52	1.146
8/12/07	0.00	0.00	0.03	------	587.50	4.51	1.113
8/13/07	0.00	0.00	0.02	------	587.50	4.51	1.113
8/14/07	0.00	0.00	0.00	------	587.48	4.45	0.924
8/15/07	0.00	0.00	0.01	------	-------	-------	-------
8/16/07	0.01	0.00	0.58	------	587.41	4.42	0.835
8/17/07	0.29	0.32	0.00	------	587.42	4.42	0.835
8/18/07	0.00	0.00	0.00	------	587.40	4.42	0.835
8/19/07	0.00	0.00	0.00	------	587.35	4.41	0.807
8/20/07	0.00	0.00	0.00	------	587.32	4.41	0.807
8/21/07	0.00	0.00	0.00	------	587.30	4.41	0.807
8/22/07	0.00	0.00	0.00	------	587.27	4.40	0.778
8/23/07	0.00	0.00	0.00	------	587.25	4.40	0.778
8/24/07	0.05	0.01	0.01	------	587.25	4.40	0.778
8/25/07	0.08	0.01	0.11	------	587.24	4.40	0.778
8/26/07	0.51	0.02	0.00	------	587.28	4.40	0.778

APPENDIX G: Newfound River (Dam Outlet) daily data listing

Site Latitude Longitude Elevation (feet) Time of observation	ALEXANDRIA 4 43°31' 71°48' 1160 0700 hrs Precipitation (inches)	LAKEPORT 2 43°33' 71°28' 500 0700 hrs Precipitation (inches)	MEREDITH 3 NNE 43°42' 71°28' 830 2400 hrs Precipitation (inches)	PLYMOUTH 43°47' 71°39' 660 0700 hrs Precipitation (inches)	Newfound median daily lake level (feet)	Newfound median daily lake stage (feet)	Newfound dishcarge at the Dam Outlet (CMS)
8/27/07	0.00	0.00	0.00	------	587.27	4.40	0.778
8/28/07	0.00	0.00	0.00	------	587.25	4.40	0.778
8/29/07	0.00	0.00	0.00	------	587.24	4.40	0.778
8/30/07	0.00	0.00	0.28	------	587.23	4.41	0.807
8/31/07	0.54	0.28	0.03	------	587.24	4.41	0.807
9/1/07	0.00	0.16	0.00	------	587.22	4.40	0.778
9/2/07	0.00	0.00	0.00	------	587.16	4.39	0.750
9/3/07	0.00	0.00	0.00	------	587.15	4.38	0.723
9/4/07	0.00	0.00	0.00	------	587.14	4.38	0.723
9/5/07	0.00	0.00	0.00	------	587.09	4.37	0.696
9/6/07	0.00	0.00	0.00	------	587.06	4.36	0.670
9/7/07	0.00	0.00	0.00	------	587.05	------	------
9/8/07	0.00	0.00	0.00	------	587.03	------	------
9/9/07	0.07	0.01	1.45	------	587.08	4.36	0.670
9/10/07	1.44	0.53	0.45	------	587.15	------	------
9/11/07	0.55	0.10	0.77	------	587.19	4.36	0.670
9/12/07	0.62	1.28	0.01	------	587.23	4.37	0.696
9/13/07	0.00	0.00	0.00	------	587.24	4.37	0.696
9/14/07	0.00	0.00	0.00	------	587.22	4.37	0.696
9/15/07	0.72	0.29	0.73	------	587.29	4.39	0.750
9/16/07	0.44	0.18	0.00	------	587.34	4.38	0.723
9/17/07	0.00	0.00	0.00	------	587.32	4.38	0.723
9/18/07	0.00	0.00	0.00	------	587.32	4.37	0.696
9/19/07	0.00	0.00	0.00	------	587.31	4.37	0.696
9/20/07	0.00	0.00	0.00	------	587.31	4.37	0.696
9/21/07	0.00	0.00	0.00	------	587.30	4.37	0.696
9/22/07	0.00	0.00	0.00	------	587.28	4.37	0.696
9/23/07	0.00	0.00	0.00	------	587.30	4.37	0.696
9/24/07	0.00	0.00	0.00	------	587.26	4.35	0.644
9/25/07	0.00	0.00	0.00	------	587.24	4.34	0.619

APPENDIX G: Newfound River (Dam Outlet) daily data listing

Site Latitude Longitude Elevation (feet) Time of observation	ALEXANDRIA 4 43°31' 71°48' 1160 0700 hrs Precipitation (inches)	LAKEPORT 2 43°33' 71°28' 500 0700 hrs Precipitation (inches)	MEREDITH 3 NNE 43°42' 71°28' 830 2400 hrs Precipitation (inches)	PLYMOUTH 43°47' 71°39' 660 0700 hrs Precipitation (inches)	Newfound median daily lake level (feet)	Newfound median daily lake stage (feet)	Newfound dishcarge at the Dam Outlet (CMS)
9/26/07	0.00	0.00	0.00	------	587.25	4.34	0.619
9/27/07	0.00	0.00	0.03	------	587.24	4.35	0.644
9/28/07	0.17	0.25	0.04	------	587.30	4.34	0.619
9/29/07	0.06	0.00	0.00	------	587.30	4.34	0.619
9/30/07	0.00	0.00	0.00	------	587.26	4.33	0.594

Newfound Lake Watershed Assessment

The Newfound Watershed Master Plan

Newfound Lake Watershed Assessment (2007 & 2008)

Prepared for

The People of the Newfound Lake Watershed, The Every Acres Counts Project Team, and The New Hampshire Department of Environmental Services

Prepared by:

UNH CFB

and

UNIVERSITY of NEW HAMPSHIRE
COOPERATIVE EXTENSION

CFB Project Number: 2009-05-DES-01
May, 2009

Citation:

Craycraft, Robert C. and Jeffrey A. Schloss. 2009. Final Report: Newfound Lake Water Quality Assessment. May 2009. UNH Center for Freshwater Biology, UNH Cooperative Extension. University of New Hampshire. Durham, NH. CFB Report # 2009-05-DES-01.

Funding for this project was provided in part by a Watershed Assistance Grant from the NH Department of Environmental Services with Clean Water Act Section 319 funds from the U.S. Environmental Protection Agency.

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ACKNOWLEDGEMENTS

The Newfound Lakes Region Association (NLRA), in conjunction with the University of New Hampshire Center for Freshwater Biology (CFB) and Cooperative Extension Water Resource Program, undertook an extensive two year sampling effort on Newfound Lake and select tributary inlets with the primary goals of better characterizing the current condition of Newfound Lake, identifying potential problem areas around the lake and providing recommendations to minimize future water quality impacts. This report builds upon the findings of a Newfound Lake Tributary Assessment (Craycraft and Schloss, 2008) that characterized the water and phosphorus load into Newfound Lake. The success of this project was the culmination of the assistance and guidance of numerous volunteers highlighted in Table 1. The NLRA, under

Table 1: Newfound Lake Volunteer Monitors (2007 & 2008).

Joe Allison	Ralph Donahue	Jean Fay
Dick Beyer	Lynn Egsgard	Ron West
Nancy Dineen	Bill Fay	

the guidance of Boyd Smith (executive director) and Martha Twombly (program director), undertook the formidable task of coordinating this multi-site sampling effort, assuring that samples and data were transferred to University of New Hampshire staff members on a timely basis and helping coordinate the use of the NLRA pontoon boat during CFB field team visits. We also acknowledge Catherine Callahan, New Hampshire Fish and Game Geographical Information Specialist, who performed the Newfound Lake watershed delineations and Dan Sundquist of the Society for the Protection of New Hampshire Forests who provided the map of topography and lake bathymetry included in this report..

Jillian McCarthy, New Hampshire Department of Environmental Services (DES) Quality Assurance Coordinator, Vincint Perelli, New Hampshire DES Quality Assurance Manager, and Charles Porfert, Environmental Protection Agency (EPA) New England Quality Assurance Officer, provided technical support and reviewed the Quality Assurance Project Plan (QAPP) that outlined the standard operating procedures used in this study. Steve Landry, New Hampshire DES Merrimack Watershed Supervisor, provided guidance and assistance with the development and implementation of the Newfound Watershed Master Plan (WMP) initiative that will utilize the water quality data contained in this report in a watershed wide planning effort.

Laboratory space was provided by the University of New Hampshire College of Life Sciences and Agriculture while administrative support was provided by University of New Hampshire Cooperative Extension. Members of the University of New Hampshire CFB laboratory and field team, who assisted in the collection and analysis of water quality samples include: Robert Craycraft, Erin Cubly, William Finley, Benjamin Ho, Gabrielle Hodgman, Lejla Kadic, Jennifer Thompson and Susan Wilderman.

Jeff Schloss, University of New Hampshire Cooperative Extension water resources specialist, provided guidance during the two year study period and provided editorial review of the summary report. Michelle Daley, University of New Hampshire Water Resource Research Center, reviewed and provided constructive comments regarding the sodium and chloride data collected through this project.

EXECUTIVE SUMMARY

Purpose and Objectives

The Newfound Lake watershed is located in the Towns of Alexandria, Bristol, Bridgewater, Danbury, Dorchester, Groton, Hebron, Plymouth and Orange. With continued development pressures facing local decision-makers in the nine towns, the need exists for scientifically-based information that will provide support for proactive natural resource based planning within the Newfound Lake watershed.

The Newfound Lake watershed assessment is the second of two summary reports prepared by the University of New Hampshire Center for Freshwater Biology as part of the Watershed Master Plan that focuses on the Newfound Lake watershed, the current status of Newfound Lake and its tributaries, and discusses measures that can be employed to minimize future water quality impacts. This report largely focuses on in-lake water quality. However, data from select stream inlets are also discussed and information from the previous Newfound Lake water/phosphorus budget (Craycraft and Schloss, 2008) including more extensive analysis and interpretation of the steam water quality and quantity with an emphasis on the phosphorus load into Newfound Lake, is also referenced in this report when appropriate.

This intensive water quality monitoring project is a component of the larger watershed master planning initiative that relies on expertise in land-use and watershed planning, survey design and interpretation, education and outreach. The collective expertise of the professionals involved in this project will help educate local municipal officials and will foster informed land-use planning decisions that will benefit future generations.

The core project team members for the Watershed Master Plan Project include:

- Robert Craycraft – University of New Hampshire Cooperative Extension and UNH Center for Freshwater Biology (water quality monitoring)
- Dr. Brian Eisenhauer – Plymouth State University Center for the Environment (social survey design and interpretation)
- Chris Duggan – Newfound Area School District (curriculum development and student engagement)
- Steve Landry – New Hampshire Department of Environmental Services Merrimack River Watershed Coordinator (development of watershed management plans)
- Boyd Smith – Newfound Lake Region Association Executive Director (project manager)
- Steve Whittman – Jeffrey H. Taylor and Associates (professional planner)

Scope

The Newfound Lake watershed assessment, conducted between July 23, 2007 and September 25, 2008, was designed to complete a series of independent, but interrelated objectives that will provide local decision makers and the public with a better understanding of the impacts of development, population growth, and land use change on the Newfound Lake and its drainage basin (watershed). The Newfound Lake Watershed Master Plan and Implementation Grant includes the following tasks that are being integrated into the WMP to allow local officials to make decisions based upon sound scientific data:

- Completed an 18-month Newfound Lake Water/Phosphorus Budget: completed and summarized in a complimentary report (Craycraft and Schloss, 2008)
- Conducted water quality sampling at seven "deep" sampling stations.
- Conducted near-shore water quality sampling at thirty shallow sampling stations.
- Conducted artificial substrate sampling, that mimics growth on rocks and lake bottom debris, at three in-lake sampling stations and one site located in the Fowler River.
- Conducted bottom sediment (benthic) core sampling at twenty three lake and stream sampling stations
- Conducted paired watershed sampling in twelve selected stream inlets.

Lake Aging (Eutrophication) Overview

A common concern among New Hampshire lakefront property owners is a perceived increase in the density and abundance of aquatic plants in the shallows, increases in the amount of microscopic plant "algae" growth (detected as greener water), and water transparency decreases collectively known as eutrophication. Eutrophication is a natural process that takes place on a geological time frame of thousands of years, during which lakes progress from clear pristine lakes to green, nutrient enriched lakes. Much like the fertilizers applied to our lawns, nutrients that enter our lakes stimulate plant growth and culminate in greener (and in turn, less clear) waters. Some lakes age at a faster rate than others due to naturally occurring attributes: watershed area relative to lake area, slope of the land surrounding the lake, soil type, mean lake depth, etc. Since our New Hampshire lakes were created during the last ice-age, which ended about 12,000 years ago, we should have a natural continuum of lakes ranging from pristine to nutrient enriched.

Deep Sampling Site Water Quality Assessment

The overall condition of each of the Newfound Lake deep sampling stations is excellent based on a review of the 2007 and 2008 water quality data. The water transparency ranged from 18.0 to 37.1 feet during the study period while the amount of microscopic plant growth was generally low and well below nuisance concentrations. Total phosphorus (nutrient) concentrations were also low while the dissolved oxygen concentrations (necessary for a self-sustaining cold water fishery) were high throughout the water column for all but the southernmost sampling location, Site 2 Mayhew, located south of Mayhew Island (Appendix C). The overall condition of Newfound Lake remained excellent and was characteristic of a relatively young, oligotrophic lake, although there was a clear difference between the Mayhew sampling station and the remaining Newfound Lake sites.

The Mayhew Site, the only site located south of Mayhew Island, was characterized by the lowest dissolved oxygen concentrations near the lake bottom (Appendix C). This likely restricted the cold water fishery to other areas of Newfound Lake during the summer and fall months. Likewise, the water clarity was shallower (Figure 7), the amount of algal (microscopic plant) growth was higher (Figure 6) and the total phosphorus (nutrient) concentrations were higher (Appendix B). The Mayhew site is located in the most developed segment of Newfound Lake and might be reflecting localized nutrient inputs associated with a more intense level of residential development (Figure 1). As indicated above, the overall water quality is excellent but the Mayhew sampling site is exhibiting the early symptoms of nutrient enrichment that are not evident at the other Newfound Lake sampling sites.

Shallow Sampling Site Water Quality Assessment

Near-shore Water Quality Sampling

The near-shore water quality was generally excellent and was characterized by low total phosphorus and low levels of *E. coli* bacteria (Appendix D). However, a notable exception existed on September 30, 2008 that included bacteria "spikes" near the major tributary inlets, the Cockermouth River and the Fowler River (Appendix D), following a period of heavy rainfall. *E. coli* spikes near the tributary inlets are a reminder that the large catchments extending well into Alexandria and Groton may act as conduits for pollutant transport that could significantly impact the Newfound Lake water quality.

Total phosphorus concentrations were generally low at the Newfound Lake near-shore sampling sites with the exception of the Hebron Marsh sampling stations where the total phosphorus concentrations tended to be higher (Appendix D). Hebron Marsh is a shallow area characterized by macroscopic plant (weed) growth and a finer and more organic lake bottom composition. Hebron Marsh is an example of a localized region of Newfound Lake that appears to have naturally transitioned into a more nutrient enriched state.

Artificial Substrate (Periphyton) Sampling

The near-shore periphyton sampling, which integrates multi-week water quality, indicated the forested "reference" site exhibited the least amount of algae growth among sampling stations. On the other hand, the Hebron Site, near the Hebron brook tributary, included the highest measured periphyton concentration following a heavy storm event period (Figure 15). The periphyton data are a reminder that short-term nutrient loading can locally stimulate near-shore algal growth and that water quality threats exist and could be exacerbated by poorly thought out land use conversions that increase the sediment and phosphorus load into Newfound Lake.

Near-rshore Bottom Sediment (Benthic) Core Sampling

Benthic sediment sampling indicates the more organic sediments generally contained more phosphorus (Figure 19). Visual observation suggested that the more organic sediments in and around Hebron Marsh, The Newfound Marina channel and Georges Brook (Figure 18 and Table 10), were associated with areas of increased aquatic plant growth. Erosion of fertile upland soils (forest soils, agricultural soils or duff layer from disturbed sites) may stimulate aquatic plant growth if they reach Newfound Lake. The displacement of upland soils will not only adversely impact the Newfound Lake water quality, but will also result in the loss of soil fertility and reduce the capacity to regenerate the forest and promote the growth of agricultural crops in the watershed.

Paired Watershed (Stream Assessment)

The paired watershed (stream) total phosphorus and turbidity concentrations spiked during an August 11, 2008 storm event and suggest storm water management and erosion control measures are important to protecting in-lake and in-stream water quality (Appendix H). Soluble reactive phosphorus (the dissolved phosphorus fraction) was low on all sampling dates and suggests that significant phosphorus is associated with particulate debris (i.e. sediment and vegetation) that enters the lake during high flow and storm event periods. Cashman Brook and Black Brook were characterized by sodium and chloride (constituents of road salt) concentrations that were significantly higher than the concentrations documented at the other sampling locations (Figure 21). Dick Brown Brook and Tilton Brook are also characterized by elevated salt concentrations relative to abutting streams, drained by similarly sized watersheds (Figure 21 and Table 11). Elevated sodium and chloride concentrations have been correlated to the amount of paved roadway (Daley et al, submitted) and may be associated with local road salt applications.

Long-Term Water Quality Trends

A review of twenty three years of water quality sampling in Pasquaney Bay indicates a long-term trend of decreasing water clarity since 1986 (Figure 28). The amount of algal (microscopic plant) growth exhibits a trend of increasing concentrations in both Pasquaney Bay and south of Mayhew Island since 1986 (Figures 29 and 30). Thus, while the overall water quality remained excellent in Newfound Lake, there are signs that the water quality has been degraded over time (even at the deep centrally located reference stations) and may be influenced by land use changes within the Newfound Lake watershed.

Conclusions and Recommendations

One may consider the saying, “a lake is a reflection of its watershed,” which ties lake and stream quality to watershed wide land use patterns. A watershed-wide effort is essential to the preservation of the exceptional Newfound Lake and tributary water quality that is characteristic of the region. Short-term and localized water quality variations, identified through the extensive Newfound Lake and tributary sampling and discussed previously, are a reminder that threats exist within the watershed. If these threats are ignored, they will ultimately have an adverse impact on the Newfound Lake and stream quality.

Many Newfound Lake tributary inlets are characterized by extensive bank-undercutting associated with the erosive force of stream flow. Elevated turbidity and total phosphorus concentrations documented during intense storm events reflect the displacement of sediments from the stream bank and upland sources. On a more positive note, extensive streamside (riparian) forests extend along most of the tributary inlets which help stabilize the stream banks, prevent excessive erosion and in turn protect water quality and critical fishery habitat. Healthy riparian buffers can also serve as travel corridors for upland wildlife species. Streamside vegetative buffer requirements, that fall under the jurisdiction of the comprehensive shoreland protection act (CSPA), are currently limited to the lower reaches of the Cockermouth and Fowler Rivers (DES, November 2008). Municipalities should consider establishing local vegetative buffer requirements for the other streams in the watershed to foster environmentally friendly development.

Future land-use planning efforts should consider minimizing the percentage of impervious surfaces, such as roads and out-buildings, that tend to concentrate and accelerate overland water flow and thus increase the potential for erosion. Much of the Newfound Lake watershed is steep sloped and is particularly susceptible to water quality problems due to the rapid runoff. Increases in impervious cover and the removal of natural forest canopy, associated with home site development, can alter the natural hydrology and can increase the discharge velocities of streams and the erosion potential of overland water flow. Rainwater that runs over the impervious surface and the associated developed areas can also pick up pollutants such as pet waste and lawn fertilizers that may enter water courses and adversely impact water quality. Impervious surfaces also reduce groundwater recharge and can result in atypically low in-stream water levels during summer low-flow (summer base flow) periods. The lack of in-stream flow can have adverse impacts on the local fishery and may also coincide with atypically low or dry dug wells for local residents. Municipalities might consider incorporating low impact development (LID) principals into their subdivision, site plan and zoning ordinances that will help retain natural hydrology and that will protect water quality. Recent publications by the DES, New Hampshire Stormwater Manual Volume 2: Post-Construction Best Management Practices Selection and Design (DES, 2008) and Innovative Land Use Planning Handbook (DES, 2008) discuss LID principles and provide model ordinances and regulations that can assist communities in their environmental planning efforts.

Municipalities might want to consider creating, reviewing or amending their storm water management regulations that provide temporary and permanent storm water management requirements. Strong stormwater management requirements can simultaneously protect water quality and reduce highway maintenance costs associated with inadequately engineered storm water management measures. Municipalities might also consider measures such as conservation subdivision design standards, which direct growth to areas of a land parcel most suitable for development and direct growth away from more environmentally sensitive areas (i.e. lakes and ponds, rivers, wetlands and steep slopes).

The Watershed Master Plan is a good source of land use planning suggestions for those seeking further land use planning suggestions. The Watershed Master Plan was developed with a mind towards balancing the protection of natural resources, fostering the retention of rural character, promoting economic vitality and meeting the needs of changing demographics and increasing population.

NEWFOUND LAKE AND ITS WATERSHED

Introduction

The Newfound Lake Watershed, the geographic area in which all water drains into Newfound Lake, is closely tied to water quality and quantity in Newfound Lake. Stated another way, a lake is a reflection of its watershed; what occurs in the watershed can have significant impacts on whether the water quality improves, degrades or remains the same. As population growth occurs in our region and the resulting pressures from development and recreational use ensue, there is growing concern over the potential for degradation of lake water quality. The resulting symptoms of these impacts can include algal blooms, establishment of nuisance aquatic weeds, shoreline scums, declining fishery (as well as a decline in the lake's overall ecological integrity) and increased sedimentation. Of primary concern are the impacts of increased nutrient loading caused by human activities in the watershed that result in accelerated plant growth (submerged and emergent vascular plants and algae) within the lake. Nutrients can come from many sources and include surface runoff resulting from precipitation upon the natural and developed areas of the lake's watershed (drainage basin). Additional nutrients are transported into the lake through stream inflow, groundwater, septic system effluent that leaches into groundwater and even from precipitation and dry fallout (dust particles). Activities within the watershed, such as the construction of residential subdivisions, result in removing or damaging vegetation, duff layers (leaf litter) and soils that, when left in an undisturbed and natural state, trap nutrients before they reach wetlands, streams, lakes and ponds. Roads, driveways and drainage ways increase channelized flow that tends to transport more runoff and nutrient laden materials through the watershed. Improper and unneeded fertilizer applications for agriculture and homeowner landscaping can also add to the nutrient load that reaches the lake.

Of the two nutrients most important to the growth of aquatic plants, nitrogen and phosphorus, it is generally observed that phosphorus is the more limiting to plant growth in lakes, and therefore the more important to monitor and control. Phosphorus is generally present in lower concentrations than nitrogen, and its sources arise primarily through human activity in a watershed. The total phosphorus discussed in this report includes dissolved phosphorus as well as phosphorus contained in or adhered to suspended particles such as sediment and plankton.

As little as 10 parts per billion of phosphorus in a lake can cause an algal bloom. Using a full Olympic swimming pool as an example, it would take 10 drops of water added to the approximately 130,000 gallons of water to equal 10 parts per billion. Extensive blooms will block sunlight and can depress oxygen levels in the water due to the death and subsequent microbial decomposition of plant and algal matter. Reduced oxygen concentrations can be detrimental to fish, plants and wildlife of the lake and can also result in the degradation of aesthetic quality due to events such as fish kills and accumulations of decaying material (muck) along the lake bottom. When the oxygen, dissolved in the water over the sediments, becomes reduced below two milligrams per liter, phosphorus, the majority of which usually binds to the lake sediments and remains unreactive, can be released. Thus, it is important to obtain an understanding of the sources and amounts of phosphorus supplied to a lake from its watershed in order to control its input to the surface waters. The best method to achieve this is to conduct field sampling and derive a water and phosphorus budget which has been reported in a previous report (Craycraft and Schloss, 2008). The information summarized in this report builds upon the Newfound Lake water and phosphorus budget and characterizes the water quality conditions within Newfound Lake, and also includes supplemental stream sampling that will help better characterize the condition of select Newfound Lake sub-watersheds. The 2007 and 2008 water quality monitoring continued to emphasize the collection of total phosphorus measurements while additional measurements, highlighted and discussed in Table 2, were also collected to better assess current conditions.

The comprehensive water quality sampling approach outlined in this report is a component of a larger Watershed Master Planning project that will facilitate natural resource management at the watershed scale. Educational outreach efforts that evolve as part of this effort will involve numerous entities that include the NLRA, Jeffrey Taylor and Associates, Plymouth State University, NH DES, the University of New Hampshire and UNH Cooperative Extension, the Newfound Area School District, the watershed community, concerned citizens, and local decision-makers.

Table 2: Primary sampling parameters and sampling rationale

Sampling Parameters	Rationale
Total Phosphorus	Phosphorus (P) tends to be the limiting nutrient in lakes. Total phosphorus is the sum of phosphorus in all its forms (dissolved or particulate) and can be used to determine a lake's trophic (nutrient enrichment) state. Quantifying the phosphorus load is of paramount importance in lake management and is highly correlated to the amount of microscopic plant growth that can be measured as chlorophyll *a*.
Soluble Reactive Phosphorus	Soluble reactive phosphorus (SRP) is a dissolved fraction of the total phosphorus and the SRP is readily available for algal growth. Soluble reactive phosphorus is formed naturally through the decomposition of organic matter but can also be associated with fertilizer applications and septic system effluent.
Turbidity	Turbidity reflects the amount of particulate matter suspended in the water column and can also help determine the areas within the Newfound watershed where sediment erosion is the greatest concern. Turbidity can also be used as a surrogate for "total phosphorus" loading into Newfound Lake since phosphorus tends to attach to sediment particles and is also part of organic debris that enter Newfound Lake. Turbidity will also serve as an indicator of areas within the watershed where sediment erosion is of the greatest concern.
Temperature	Temperature is correlated to what types of aquatic organisms can survive in the lake and the streams. Temperature variations can also reflect differences in the amount of (shoreside) riparian cover in the Newfound Lake sub-watersheds and may also be correlated with the amount of impervious surface (surfaces that do not allow water infiltration such as roofs, roads, etc.
Light	Sunlight is a necessary component to the photosynthetic activity of both aquatic and terrestrial plants. The amount of light penetration can influence the amount of aquatic vascular plant and algal growth. Much like terrestrial plants, many aquatic species require high light levels to successfully grow, reproduce and flourish.
Specific Conductivity	Specific Conductivity, the capacity of water to carry an electrical current, provides insight into local geological variations among the sampling stations, as well as provides insight into regions where road salt runoff, nutrient runoff, etc. might be impacting the water quality. Specific conductivity is highly correlated with sodium and chloride concentrations and thus is a good surrogate measurement of road salt runoff.

Sampling Parameters	Rationale
Total Alkalinity	Alkalinity is a measure of the water's capacity to neutralize acids. The alkalinity is generally low in New Hampshire Lakes and provides insight into the susceptibility of Newfound Lake to acid precipitation.
pH	pH is an indicator of the acidity of the lakewater, influences nutrient availability from the sediments and impacts the fitness and distribution of aquatic organisms.
Dissolved Oxygen	Dissolved oxygen concentrations are essential for a healthy fishery and are also associated with the eutrophication (lake aging) process. During the summer months, deep north temperate lakes stratify into three distinct zones; an upper warm water zone (epilimnion), a zone of rapid temperature decrease (thermocline/metalimnion) and a deep cold water zone (hypolimnion). During the summer months, the zones are partitioned and oxygen is not readily replenished to the bottom waters. Oxygen deprived (anoxic) conditions, near the lake bottom, are commonly associated with more nutrient enriched lake that may also be experiencing internal nutrient loading, a process by which nutrients are "released" from the sediments into the water column.
Carbon Dioxide	Carbon Dioxide is a by-product of microbial decomposition and can build-up in the deeper areas of Newfound Lake during the summer stratification period. When dissolved in the water, carbon dioxide is in equilibrium with carbonic acid which can naturally impact the lake acidity (pH) during the course of the day as well as among the thermal layers in the water column.
Secchi Disk Transparency	Water transparency integrates the impacts of sediments, microscpic plant "algal" cells, colored water and detrital (decomposing) debris that are flushed into the lake. The Secchi Disk transparency measurements provide water transparency data that can be compared among sampling locations and among years to assess the spatial and temporal variation.
Chlorophyll *a*	Chlorophyll a serves as a good estimator of microscopic plant "algal" biomass. Generally speaking, the greener the water, the more microscopic plant/chlorophyll *a* in the water column. The collection and analysis of chlorophyll samples are relatively simple and provide insight into the trophic condition of Newfound Lake.

Sampling Parameters	Rationale
True Color	True color is a measure of the natural color of the water after particulate debris has been filtered out. For instance, wetland systems tend to be darkly stained and when they enter the lake can also result in more tea stained waters can have a significant impact on the water clarity, particularly in localized areas of the Newfound Lake watershed where considerable wetland drainage exists. True color measurements provide insight into the causes of water transparency variations as well as insight into the seasonal variations in the amount of wetland drainage into Newfound Lake.
Escerichia coli (E. coli)	*E. coli* is an indicator bacteria that is used to screen for fecal contamination in lake and streams. *E. coli* samples were collected in this project to screen for problem near-shore areas around the periphery of Newfound Lake.
Sodium and Chloride	Sodium and Chloride are constituents of road salt and can become elevated in more developed watersheds where increased salt applications occur. Sodium and chloride are closely correlated with Specific Conductivity measurements and this study will examine those relationships within the Newfound Lake watershed.
Nitrate	Nitrates are commonly associated with septic effluent and fertilizer applications. Assessment of nitrate concentrations will assist in the screening for potential problem areas in select Newfound Lake tributary inlets.
Percent Organic Matter	The amount, or percent, of organic matter along the lakebottom can have an impact on whether aquatic vascular plants can successfully colonize and flourish in a particular area of the lake. A more organic rich benthos can also be associated with elevated phosphorus concentrations that can become available to stimulate algal and aquatic vascular plant growth.
Periphyton Chlorophyll *a*	Chorophyll *a* is the photosynthetic pigment found in plants and algae. Aquatic plant and algal growth are limited by the amount of in-lake nutrients, most notably phosphorus, and thus the chlorophyll *a* pigment concentrations can serve a surrogate for nutrient inputs over time as chlorophyll is the response parameter to nutrient condition. Many New Hampshire residents have expressed a concern that the amount of attached algae (periphyton) growth has increased on rocks around the periphery of New Hampshire's lakes and ponds.

BACKGROUND DATA

Newfound Lake Watershed

The Newfound Lake watershed encompasses all or part of the towns of Alexandria, Bristol, Bridgewater, Danbury, Dorchester, Groton, Hebron, Plymouth and Orange. Newfound Lake is located south of Plymouth and east of Mount Cardigan at a mean elevation of 179 meters (586 feet) above sea level. The Newfound River, which drains the lake, flows southerly through the Town of Bristol to the Pemigewasset River that forms the Merrimack River at its confluence with the Winnipesaukee River in Franklin (Table 3). In the 1930s, Newfound Lake was artificially raised by a dam that is currently operated by the New Hampshire DES Dam Bureau. Newfound Lake is considered the deepest lake in New Hampshire with a maximum recorded depth of 55.5 meters (182 feet) and ranks fifth among the largest New Hampshire Lakes. The watershed is predominantly forested and includes two larger wetland complexes that drain into two of the larger streams: Georges Brook to the north and Bog Brook to the west. The watershed, delineated to the Newfound Lake Dam (outlet) at the Newfound River, totals 56,825 acres (Table 3 and Figure 1).

Table 3. Newfound Lake Summary Data

Latitude	43°39'46"
Longitude	71°46'31"
Lake Elevation	586 feet
Lake Area	4,451 acres
Maximum Depth	182 feet
Watershed Area	56,825 acres
Lake type	Natural with Dam
River Basin	Merrimack

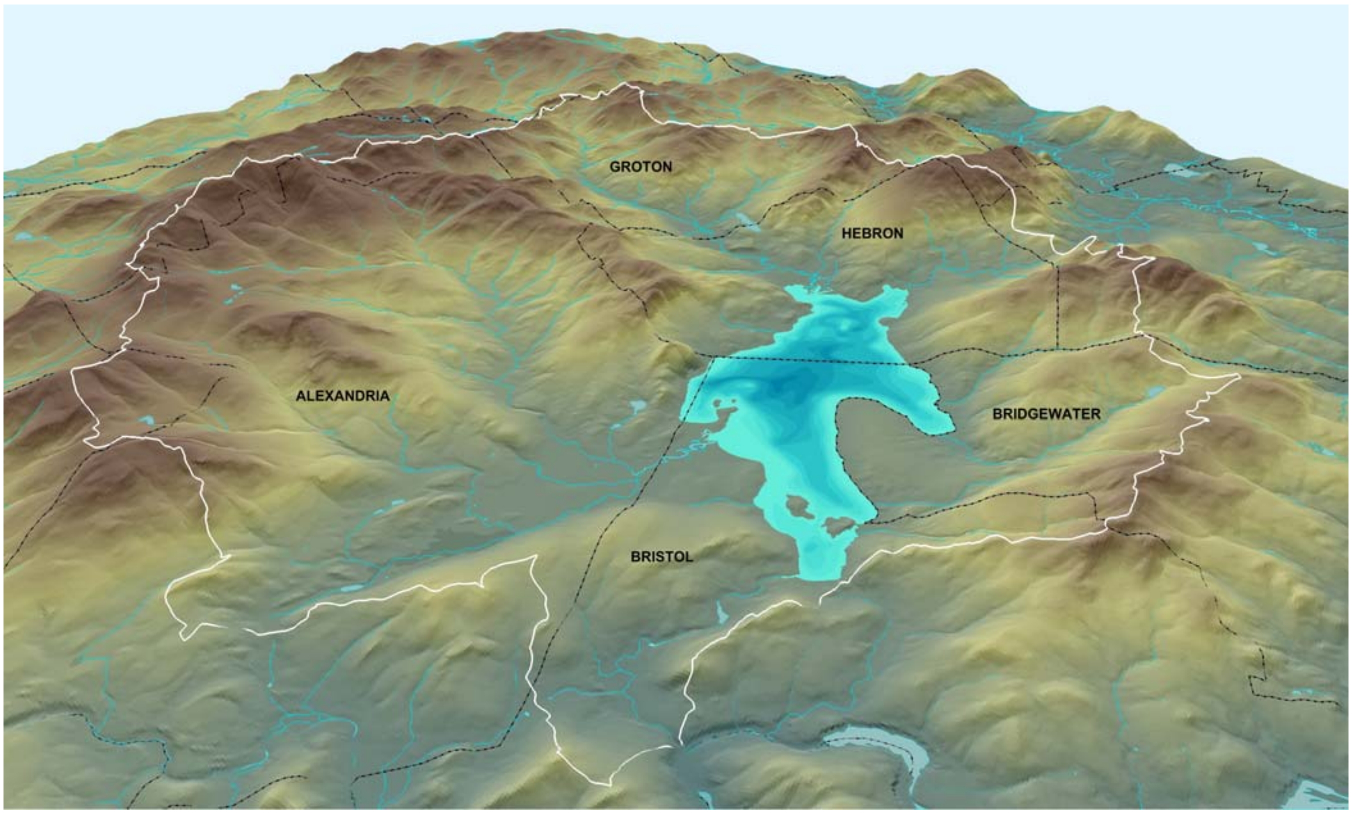
Newfound Lake surface area and Watershed area were derived from 7.5 minute US Geological Survey mapping data that was digitized into a Geological Information System.

Geology and Topography

The bedrock geology of the Newfound Lake watershed, as typical of most New Hampshire watersheds, is predominantly granite and metamorphic rocks. Its topography is highly variable, with some of the flatter land located adjacent to the main stems of the Cockermouth and Fowler Rivers (Figure 1), and the Bog Brook tributary that is fed by a large meandering wetland complex. There is also flatter land around the perimeter of Newfound Lake, although steep sloped regions are interspersed and include "the Ledges" located northwest of Wellington State Park. Viewing the surrounding landscape, one sees hills and mountains in the distance that delineate the headwaters of Newfound Lake and the watershed divide with Mount Cardigan forming the highest land elevation of 3155 feet along the westerly watershed boundary. The bedrock geology and thin soils that do not retain much water, coupled with relatively steep slopes, cause the tributaries to experience rapid runoff during storm and snowmelt events.

During these short-duration and high intensity runoff periods, rainfall and/or melt-waters tend to rapidly flow off the landscape and concentrate to form well-defined stream channels. The channels of many Newfound Lake tributary inlets are characterized by cobble and boulders as is expected in steep-sloped watersheds where finer materials are flushed downstream due to the erosive force of the water.

Figure 1. Shaded Relief map of the Newfound Lake Watershed



Source: Society for the Protection of NH Forests

Newfound Lake Bathymetry

The Newfound Lake bathymetry refers to the depth contours characteristic of the lake, much like the topographic contours of the Newfound Lake watershed. The deepest point of the lake is located east of "the Ledges" well away from the shoreline while a second deep basin, over 120 feet deep, is located in the more northerly section of Newfound Lake (Figure 1). Some of the larger areas of continuous shallow water are located in Hebron Marsh and near the outflows of the two largest tributary inlets: the Cockermouth and Fowler Rivers. A shallow, and relatively sandy strip, runs from the Fowler River south to Mayhew Island on the southwest side of the lake. While shallower than the other deep basins, a third basin of approximately 60 feet is located south of Mayhew Island. The Newfound bathymetry, coupled with coves and bays, partitions the lake in such a way that local watershed influences (i.e. differences in the amount of development or forest-cover) may influence water quality differently among sampling locations.

UNDERSTANDING LAKE AGING (EUTROPHICATION)

A common concern among New Hampshire lakefront property owners is a perceived increase in the density and abundance of aquatic plants in the shallows, increases in the amount of microscopic plant “algae” growth (detected as greener water), and water transparency decreases; what is known as **eutrophication**. Eutrophication is a natural process by which all lakes age and progress from clear pristine lakes to green, nutrient enriched lakes on a geological time frame of thousands of years. Much like the fertilizers applied to our lawns, nutrients that enter our lakes stimulate plant growth and culminate in greener (and in turn less clear) waters. Some lakes age at a faster rate than others due to naturally occurring attributes: watershed area relative to lake area, slope of the land surrounding the lake, soil type, mean lake depth, etc. Since our New Hampshire lakes were created during the last ice-age, which ended about 10,000 years ago, we should have a natural continuum of lakes ranging from extremely pristine to very enriched.

Classification criteria are often used to categorize lakes into what are known as **trophic states**, in other words, levels of lake plant and algae productivity or “greenness” Refer to Table 4 below for a summary eutrophication parameters used to assess water quality through the CFB.

Table 4: Eutrophication Parameters and Trophic Categorization

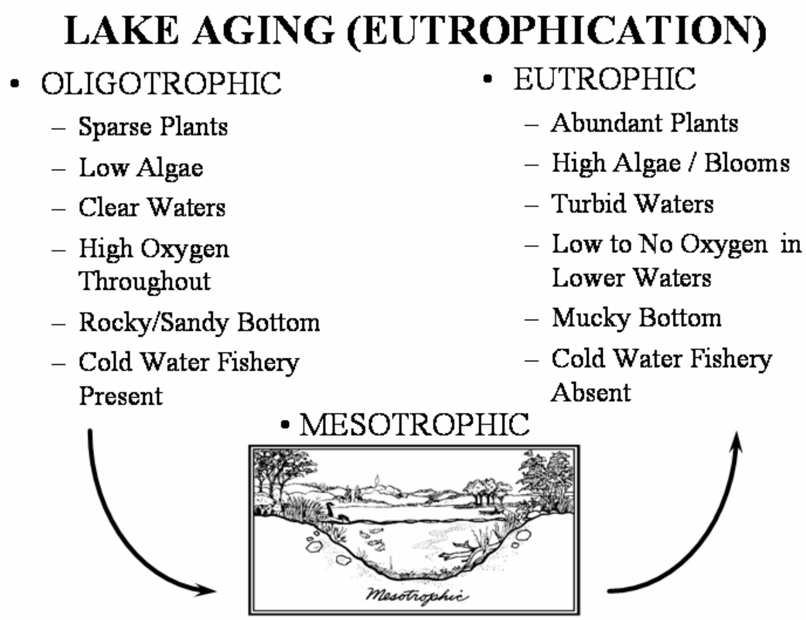
Parameter	Oligotrophic “pristine”	Mesotrophic “transitional”	Eutrophic “enriched”
Chlorophyll a (*ug*/l) *	<3.0	3.0-7.0	>7.0
Water Transparency (meters) *	>4.0	2.5-4.0	<2.5
Total Phosphorus (*ug*/l) *	<15.0	15.0-25.0	>25.0
Dissolved Oxygen (saturation) #	high to moderate	moderate to low	low to zero
Macroscopic Plant (Weed) Abundance	low	moderate	high

*** Denotes classification criteria employed by Forsberg and Ryding (1980).**
 # Denotes dissolved oxygen concentrations near the lake bottom.

Oligotrophic lakes are considered “unproductive” pristine systems and are characterized by high water clarities, low nutrient concentrations, low algae concentrations, minimal levels of aquatic plant “weed” growth, and high dissolved oxygen concentrations near the lake bottom. **Eutrophic** lakes are considered “highly productive” enriched systems characterized by low water transparencies, high nutrient concentrations, high algae concentrations, large stands of aquatic plants and very low dissolved oxygen concentrations near the lake bottom. **Mesotrophic** lakes have qualities between those of oligotrophic and eutrophic lakes and are characterized by moderate water transparencies, moderate nutrient concentrations, moderate algae growth, moderate aquatic plant “weed” growth and decreasing dissolved oxygen concentrations near the lake bottom (Figure 2).

Is a pristine, oligotrophic, lake “better than” an enriched, eutrophic, lake? Not necessarily! As indicated above, lakes will naturally exhibit varying degrees of productivity. Some lakes will naturally be more susceptible to eutrophication than others due to their

Figure 2



natural attributes and in turn have aged more rapidly. This is not necessarily a bad thing as our best bass fishing lakes tend to be more mesotrophic to eutrophic than oligotrophic; an ultra-oligotrophic lake (extremely pristine) will not support a very healthy cold water fishery. However, human related activities can augment the aging process (what is known as cultural eutrophication) and result in a transition from a pristine system to an enriched system in tens of years rather than the natural transitional period that should take thousands of years. Cultural eutrophication is particularly a concern for northern New England lakes where large tracts of once forested and agricultural lands are being developed.

The DES is currently working on formalizing aquatic life use nutrient criteria to determine whether lakes are impaired based upon the ability to support aquatic life. The draft

DES criteria for an oligotrophic lake are < 8.0 micrograms per liter (*u*g/l) for total phosphorus and < 3.3 *u*g/l for chlorophyll *a*. Data collected through the Newfound Lake Watershed Assessment (2007 & 2008) and collected by the Newfound Lake volunteer monitors and CFB (1986-2006), indicate Newfound Lake is best classified as an Oligotrophic Lake based upon the draft DES aquatic life use nutrient criteria.

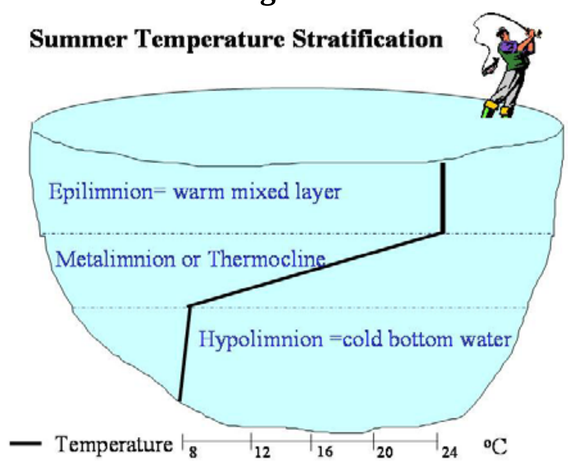
DISCUSSION OF LAKE AND STREAM MONITORING MEASUREMENTS

The section below details the important concepts involved for the various testing procedures used in the **New Hampshire Lakes Lay Monitoring Program**. Certain tests or sampling performed at the time of the optional **Center for Freshwater Biology** field trip are indicated by an asterisk (*).

Thermal Stratification in the Deep Water Sites

Lakes in New Hampshire display distinct patterns of temperature stratification, that develop as the summer months progress, where a layer of warmer water (the **epilimnion**) overlies a deeper layer of cold water (**hypolimnion**). The layer that separates the two regions characterized by a sharp drop in temperature with depth is called the **thermocline** or **metalimnion** (Figure 3). Some shallow lakes may be continually mixed by wind action and will never stratify. Other lakes may only contain a developed epilimnion and metalimnion.

Figure 3



Water Transparency

Secchi Disk depth is a measure of the water transparency. The deeper the depth of Secchi Disk disappearance, the more transparent the lake water; light penetrates deeper if there is little dissolved and/or particulate matter (which includes both living and non-living particles) to absorb and scatter it.

In the shallow areas of many lakes, the Secchi Disk will hit bottom before it is able to disappear from view (what is referred to as a "Bottom Out" condition). Thus, Secchi Disk measurements are generally taken over the deepest sites of a lake. Transparency values greater than 4 meters are typical of clear, unproductive lakes while transparency values less than 2.5 meters are generally an indication of highly productive lakes. Water transparency values between 2.5 meters and 4 meters are generally considered indicative of moderately productive lakes.

Chlorophyll *a*

The chlorophyll *a* concentration is a measurement of the standing crop of phytoplankton and is often used to classify lakes into categories of productivity called trophic states. **Eutrophic** lakes are highly productive with large concentrations of algae and aquatic plants due to nutrient enrichment. Characteristics include accumulated organic matter in the lake basin and lower dissolved oxygen in the bottom waters. Summer chlorophyll *a* concentrations average above 7 mg m^3 (7 milligrams per cubic meter; 7 parts per billion). **Oligotrophic** lakes have low productivity and low nutrient levels and average summer chlorophyll *a* concentrations that are generally less than 3 mg m^3. These lakes generally have cleaner bottoms and high dissolved oxygen levels throughout. **Mesotrophic** lakes are intermediate in productivity with concentrations of chlorophyll *a* generally between 3 mg m^3 and 7 mg m^3. Testing is sometimes done to check for **metalimnetic algal populations**, algae that layer out at the thermocline and generally go undetected if only epilimnetic (point or integrated) sampling is undertaken. Chlorophyll concentrations of a water sample collected in the thermocline is compared to the integrated epilimnetic sample. Greater chlorophyll levels of the point sample, in conjunction with microscopic examination of the samples (see Phytoplankton section below), confirm the presence of such a population of algae. These populations should be monitored as they may be an early indication of increased nutrient loading into the lake.

Turbidity

Turbidity is a measure of suspended material in the water column such as sediments and planktonic organisms. The greater the turbidity of a given water body the lower the Secchi Disk transparency and the greater the amount of particulate matter present. Turbidity is measured as nephelometric turbidity units (NTU), a standardized method among researchers. Turbidity levels are generally low in New Hampshire reflecting the pristine condition of the majority of our lakes and ponds. Increasing turbidity values can be an indication of increasing lake productivity or can reflect improper land use practices within the watershed which destabilize the surrounding landscape and allow sediment runoff into the lake.

While Secchi Disk measurements will integrate the clarity of the water column from the surface waters down to the depth of disappearance, turbidity measurements are collected at discrete depths from the surface down to the lake bottom. Such discrete sampling can identify layering algal populations (previously discussed) that are undetectable when measuring Secchi Disk transparency alone.

Dissolved Color

The dissolved color of lakes is generally due to dissolved organic matter from **humic substances**, which are naturally-occurring polyphenolic compounds leached from decayed vegetation. Highly colored or "stained" lakes have a "tea" color. Such substances generally do not threaten water quality except as they diminish sunlight penetration into deep waters.

Increases in dissolved watercolor can be an indication of increased development within the watershed as many land clearing activities (construction, deforestation, and the resulting increased run-off) add additional organic material to lakes. Natural fluctuations of dissolved color occur when storm events increase drainage from wetlands areas within the watershed. As suspended sediment is a difficult and expensive test to undertake, both dissolved color and chlorophyll information are important when interpreting the Secchi Disk transparency

Dissolved color is measured on a comparative scale that uses standard chloroplatinate dyes and is designated as a color unit or ptu. Lakes with color below 10 ptu are very clear, 10 to 20 ptu are slightly colored, 20 to 40 ptu are lightly tea colored, 40 to 80 ptu are tea colored and greater than 80 ptu indicates highly colored waters. Generally the majority of New Hampshire lakes have color between 20 to 30 ptu.

Total Phosphorus (TP)

Of the two "nutrients" most important to the growth of aquatic plants, nitrogen and phosphorus, it is generally observed that phosphorus is the more limiting to plant growth, and therefore the more important to monitor and control. Phosphorus is generally present in lower concentrations, and its sources arise primarily through human related activity in a watershed. Nitrogen can be fixed from the atmosphere by many bloom-forming blue-green bacteria, and thus it is difficult to control. The total phosphorus includes all dissolved phosphorus as well as phosphorus contained in or adhered to suspended particulates such as sediment and plankton. As little as 10 parts per billion of phosphorus in a lake can cause an algal bloom.

Generally, in the more pristine lakes, phosphorus values are higher after spring melt when the lake receives the majority of runoff from its surrounding watershed. The nutrient is used by the algae and plants which in turn die and sink to the lake bottom causing surface water phosphorus concentrations to decrease as the summer progresses. Lakes with nutrient loading from human activities and sources (agriculture, logging, sediment erosion, septic systems, etc.) will show greater concentrations of nutrients as the summer progresses or after major storm events.

Soluble Reactive Phosphorus (SRP) *

Soluble reactive phosphorus is a fraction of the (total) phosphorus that consists largely of orthophosphate, the form of phosphorus that is directly taken up by algae and that stimulates growth. Soluble reactive phosphorus is obtained by filtering a water sample through a fine mesh filter, generally a 0.45 micron membrane filter, which effectively removes the particulate matter from the sample. Soluble reactive phosphorus concentrations are thus less than, or equal to, the measured total phosphorus concentrations for a water sample.

Soluble reactive phosphorus typically occurs in trace concentrations while applications of fertilizers as well as septic system effluent can be associated with elevated concentrations. Knowledge of both the total phosphorus and the soluble reactive phosphorus is important to understanding the sources of phosphorus into a lake and to understanding the lake's response to the phosphorus loading. For instance, a lake experiencing soluble reactive phosphorus runoff from a fertilized field may exhibit immediate water quality decline (i.e. increased algal growth) while lakes experiencing elevated total phosphorus concentrations associated with sediment washout may not exhibit clear symptoms of increased nutrient loading for years.

Streamflow *

Streamflow, when collected in conjunction with stream cross-section information, is a measure of the volume of water traversing a given stream stretch over a period of time and is often expressed as cubic meters per second. Knowledge of the streamflow is important when determining the amount of nutrients and other pollutants that enter a lake. Knowledge of the streamflow in conjunction with nutrient concentrations, for instance, will provide the information necessary to calculate phosphorus loading values and will in turn be useful in discerning the more impacted areas within a watershed.

pH *

The pH is a way of expressing the acidic level of lake water, and is generally measured with an electrical probe sensitive to hydrogen ion activity. The pH scale has a range of 1 (very acidic) to 14 (very "basic" or alkaline) and is logarithmic (i.e.: changes in 1 pH unit reflect a ten times difference in hydrogen ion concentration). Most aquatic organisms tolerate a limited range of pH and most fish species require a pH of 5.5 or higher for successful growth and reproduction.

Alkalinity

Alkalinity is a measure of the buffering capacity of the lake water. The higher the alkalinity value, the more acid that can be neutralized. Typically lakes in New Hampshire have low alkalinities due to the absence of carbonates and other natural buffering minerals in the bedrock and soils of lake watersheds.

Decreasing alkalinity over a period of a few years can have serious effects on the lake ecosystem. In a study on an experimental acidified lake in Canada by Schindler, gradual lowering of the pH from 6.8 to 5.0 in an 8-year period resulted in the disappearance of some aquatic species, an increase in nuisance species of algae and a decline in the condition and reproduction rate of fish. During the first year of Schindler's study the pH remained unchanged while the alkalinity declined to 20 percent of the pre-treatment value. The decline in alkalinity was sufficient to trigger the disappearance of zooplankton species, which in turn caused a decline in the "condition" of fish species that fed on the zooplankton.

The analysis of alkalinity employed by the **CFB** includes use of a dilute titrant allowing an order of magnitude greater sensitivity and precision than the standard method. Two endpoints are recorded during each analysis. The first endpoint (gray color of dye; pH endpoint of 5.1) approximates low level alkalinity values, while the second endpoint (pink dye color; pH endpoint of 4.6) approximates the alkalinity values recorded historically, such as NH Fish and Game data, with the methyl-orange endpoint method.

The average alkalinity of lakes throughout New Hampshire is low, approximately 6.5 mg per liter (calcium carbonate alkalinity). When alkalinity falls below 2 mg per liter the pH of waters can greatly fluctuate. Alkalinity levels are most critical in the spring when acid loadings from snowmelt and run-off are high, and many aquatic species are in their early, and most susceptible, stages of their life cycle.

Specific Conductivity *

The specific conductance of a water sample indicates concentrations of dissolved salts. Leaking septic systems and deicing salt runoff from highways can cause high conductivity values. Fertilizers and other pollutants can also increase the conductivity of the water. Conductivity is measured in **micromhos** (the opposite of the measurement of resistance **ohms**) per centimeter, more commonly referred to as micro-Siemans (*u*S). Specific conductivity implies the measurements are standardized to the equivalent room temperature reading as conductivity will increase with increasing temperature.

Sodium and Chloride *

Low levels of sodium and chloride are found naturally in some freshwater and groundwater systems while high sodium and chloride concentrations are characteristic of the open ocean and are elevated in estuarine systems as well. Elevated sodium and chloride concentrations in freshwater or groundwater systems, that exceed the natural baseline concentrations, are commonly associated with the application of road salt. Sodium and particularly chloride are highly mobile and, relatively speaking, move into the surface and groundwater relatively unimpeded. Sodium and chloride concentrations can become elevated during periods of heavy snow pack melt when the salts are flushed into surface waters and have also been observed in elevated concentrations during the summer months when low flow conditions concentrate the sodium and chloride.

Road salt runoff is known to adversely impact roadside vegetation as is oftentimes evidenced by bleached (discolored) leaves and needles and in more extreme instances dead trees and shrubs. The United States Environmental Protection Agency (EPA) has set the standard for protection of aquatic life, both plants and animals, at 230 milligrams per liter (mg/l). The EPA has also established a secondary maximum contaminant level of 250 mg/l for both sodium and chloride, predominantly for taste, while the sodium advisory limit for persons with hypertention is 20 mg/l

Dissolved Oxygen and Free Carbon Dioxide *

Oxygen is an essential component for the survival of aquatic life. Submergent plants and algae take in carbon dioxide and create oxygen through **photosynthesis** by day. **Respiration** by both animals and plants uses up oxygen continually and creates **carbon dioxide**. Dissolved oxygen profiles determine the extent of declining oxygen concentrations in the lower waters. High carbon dioxide values are indicative of low oxygen conditions and accumulating organic matter. For both gases, as the temperature of the water decreases, more gas can be dissolved in the water.

The typical pattern of clear, unproductive lakes is a slight decline in hypolimnetic oxygen as the summer progresses. Oxygen in the lower waters is important for maintaining a fit, reproducing, cold water fishery. Trout and salmon generally require oxygen concentrations above 5 mg per liter (parts per million) in the cool deep waters. On the other hand, carp and catfish can survive very low oxygen conditions. Oxygen above the lake bottom is important in limiting the release of nutrients from the sediments and minimizing the collection of undecomposed organic matter.

Bacteria, fungi and other **decomposers** in the bottom waters break down organic matter originating from the watershed or generated by the lake. This process uses up oxygen and produces carbon dioxide. In lakes where organic matter accumulation is high, oxygen depletion can occur. In highly stratified eutrophic lakes the entire hypolimnion can remain unoxygenated or **anaerobic** until fall mixing occurs.

The oxygen peaks occurring at surface and mid-lake depths during the day are quite common in many lakes. These characteristic **heterograde oxygen curves** are the result of the large amounts of oxygen, the by-product of photosynthesis, collecting in regions of high algal concentrations. If the peak occurs in the thermocline of the lake, metalimnetic algal populations (discussed above) may be present.

Indicator Bacteria *

Certain disease causing organisms, pathogenic bacteria, viruses and parasites, can be spread through contact with polluted waters. Faulty septic systems, sewer leaks, combined sewer overflows and the illegal dumping of wastes from boats can contribute fecal material containing these pathogens. Typical water testing for pathogens involves the use of detecting coliform bacteria. These bacteria are not usually considered harmful themselves but they are relatively easy to detect and can be screened for quickly. Thus, they make good surrogates for the more difficult to detect pathogens.

Total coliform includes all coliform bacteria that arise from the gut of animals or from vegetative materials. **Fecal coliform** are those specific organisms that inhabit the gut of warm blooded animals. Another indicator organism **Fecal streptococcus** (sometimes referred to as **enterococcus**) also can be monitored. The ratio of fecal coliform to fecal strep may be useful in suggesting the type of animal source responsible for the contamination. In 1991, the State of

New Hampshire changed the indicator organism of preference to *E. coli* which is a specific type of fecal coliform bacteria thought to be a better indicator of human contamination. The new state standard requires Class A “bathing waters” to be under 88 organisms (referred to as colony forming units; cfu) per 100 milliliters of lakewater.

Ducks and geese are often a common cause of high coliform concentrations at specific lake sites. While waterfowl are important components to the natural and aesthetic qualities of lakes that we all enjoy, it is poor management practice to encourage these birds by feeding them. The lake and surrounding area provides enough healthy and natural food for the birds and feeding them stale bread or crackers does nothing more than import additional nutrients into the lake and allows for increased plant growth. As birds also are a host to the parasite that causes "swimmers itch", waterfowl roosting areas offer a greater chance for infestation to occur. Thus while leaving offerings for our feathered friends is enticing, the results can prove to be detrimental to the lake system and to human health.

NEWFOUND LAKE WATER QUALITY MONITORING: 2007 AND 2008

The WMP project is part of a pro-active effort dedicated to assisting local decision makers in their long-term planning efforts. The in-lake and tributary monitoring components of this project provide the watershed communities with quantitative baseline data that have identified potential problems and areas of concern that can be mitigated through education/outreach efforts in combination with long-term land use planning initiative directed at controlling pollutant runoff into Newfound Lake. The primary pollutant of concern is phosphorus (the lake stressor variable) in the context of how it will impact lake productivity as measured by chlorophyll concentration (lake reaction variable) while supplemental near-shore bacteria sampling will provide insight into public health concerns. Supplemental anion and cation data (i.e. sodium and chloride) will augment the assessment of impaired tributary reaches. All data collected through this project will assist in the creation of the Watershed Management Plan.

The water quality monitoring effort is designed to complete a series of independent, but interrelated objectives that will provide a better understanding of the impacts of development, population growth, and land use change on the Newfound Lake watershed. Water quality monitoring results are discussed by task in the following section:

- 18-month Newfound Lake Water/Phosphorus Budget - completed and summarized in a companion report (Craycraft and Schloss, 2008)
- Conduct In-lake water quality sampling to assist in trend detection and water quality assessment.
- Conduct Near-shore water quality surveys to screen for potential problem areas and assess near-shore water quality conditions.
- Implement periphyton (attached algae) sampling to integrate water quality impacts over time and help determine whether localized water quality variations exist.
- Conduct benthic (lake sediment) core sampling to determine the extent of sediment phosphorus variations among sampling locations.
- Perform a paired watershed study of select tributary inlets to characterize land-use impacts on minimally developed watersheds

Extensive details of the project's sampling design and methods can be found in the Newfound Lake Watershed Assessment Quality Assurance Project Plan (Schloss and Craycraft, 2006).

In-Lake (Reference) Sampling Sites

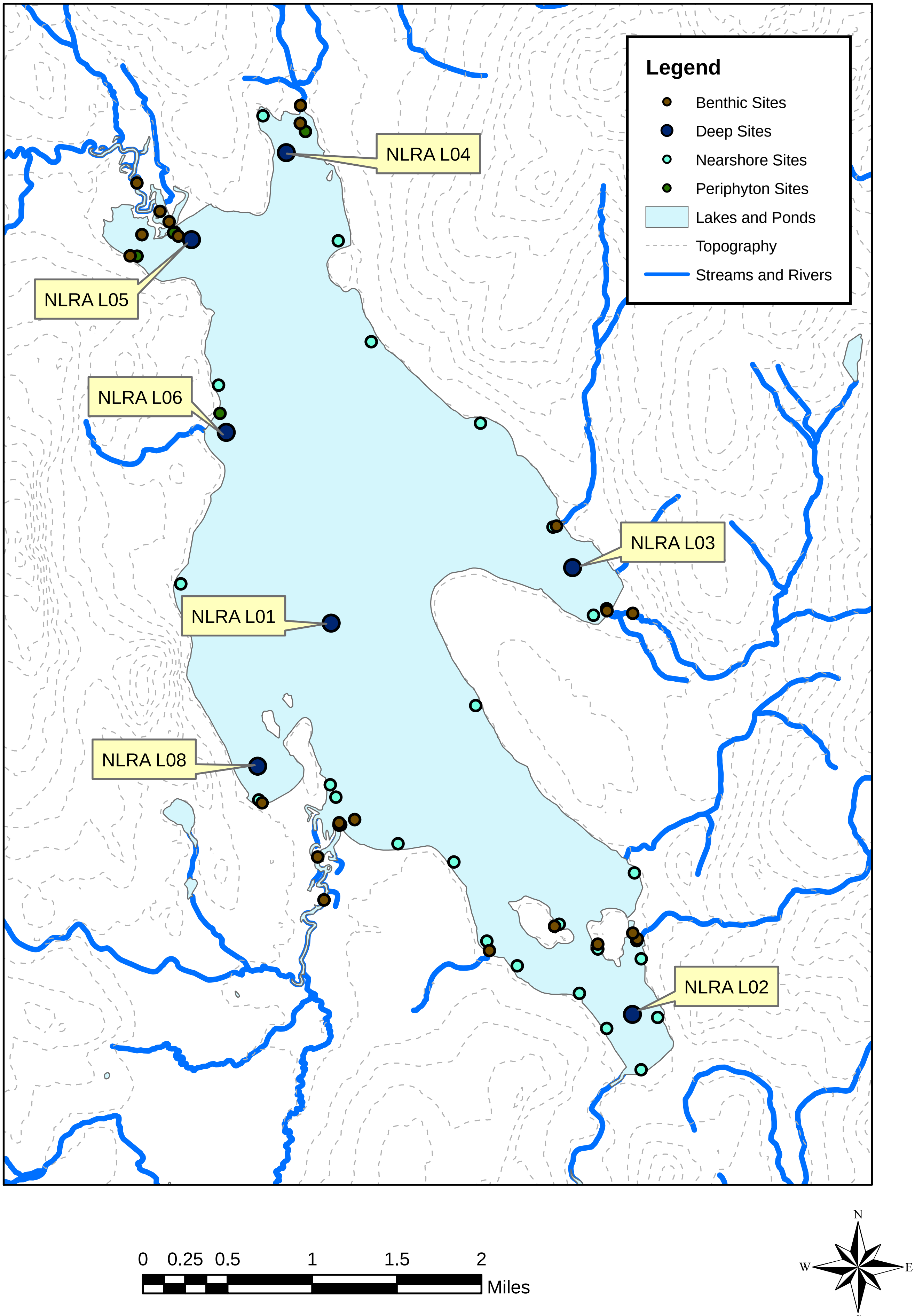
Choice Of Deep In-Lake Sampling Stations

Seven in-lake sampling locations were selected that had been included in past sampling efforts for Newfound Lake undertaken by the CFB and the NH LLMP (LLMP). Historical data have been documented in the annual volunteer monitoring reports provided since 1986 (LLMP, 1986-2006). The seven sampling sites are positioned at deeper points around Newfound Lake and reflect localized water quality variations found among the more centrally located sampling stations in both the open waters, and more confined basins (Table 5 and Figure 4). The monitoring of the seven in-lake sampling locations will also provide for insight into the differences and similarities among the sites that could be important when considering future remedial actions for the lake, as well as, the susceptibility of the seven Newfound Lake sampling stations to water quality degradation. Furthermore, during the period of thermal stratification, sampling locations such as L01 Deep and L02 Mayhew can effectively function as two "independent lakes" where the chemical, physical and biological characteristics vary between sampling locations.

Table 5. Newfound Lake Study Sites

Lake Sites	Site ID	Location: Latitude Longitude	Sampling Site Description / Rationale
Deep	NLRA L01	43°39'24.7" 71°46'24.5"	Near the deepest point in Newfound Lake, reflects the overall condition of Newfound Lake
Mayhew	NLRA L02	43°37'24.5" 71°44'16.5"	Southern Lake basin with heavy first-tier lakeshore development that might impact water quality.
Pasquaney Bay	NLRA L03	43°39'41.8" 71°44'42.1"	Sampling station located in Pasquaney Bay where watershed runoff might impact local water quality.
Loon Island	NLRA L04	43°41'49.3" 71°46'43.8"	Sampling station located in the northeasterly bay. Water quality will reflect sub-watershed inputs.
Cockermouth	NLRA L05	43°41'22.5" 71°47'24.0"	Sampling station located in the northwesterly bay that is "fed" by the Cockermouth River. Water quality will reflect the Cockermouth River drainage and other local watershed inputs.
Beachwood	NLRA L06	43°40'23.3" 71°47'09.1"	Sampling station located along the westerly shoreline.
Follansbee Cove	NLRA L08	43°38'40.7" 71°46'55.6"	Sampling location located in a westerly basin located near Wellington state park. Water quality reflects the sub-watershed inputs.

Figure 4. Newfound Lake Deep Sites



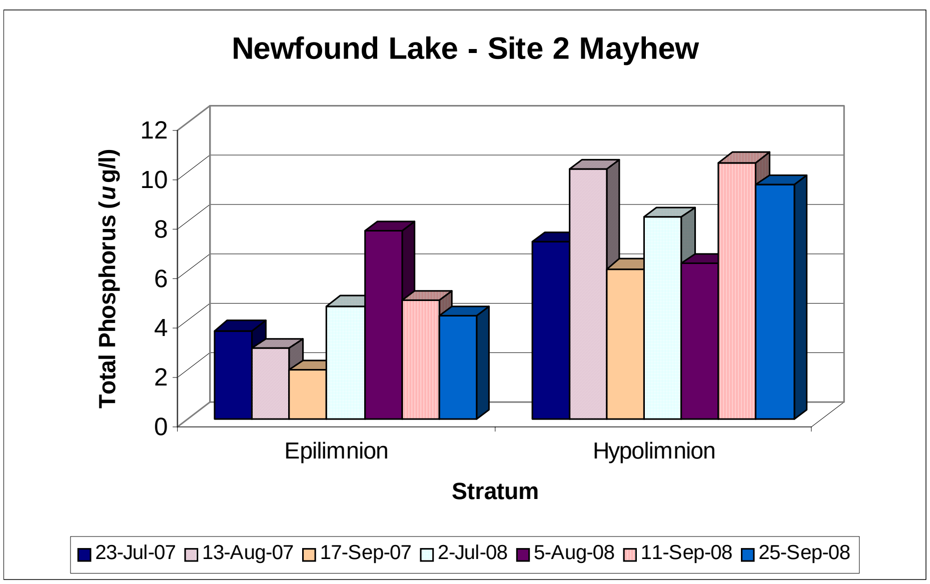
In-Lake Sampling Results

The Newfound Lake water quality data were variable among sampling locations as well as variable among sampling dates. The following section reports on the July 23, 2007 through September 25, 2008 water quality data that were collected by the UNH CFB field team. This section includes a brief discussion of the water quality monitoring results for each analytical water quality parameter followed by a summary of the water quality results.

Total Phosphorus

Total phosphorus concentrations were low at all sampling sites and the composite epilimnetic samples ranged from 2.0 to 7.6 micrograms per liter (*u*g/l) among seven sampling dates during the summers of 2007 and 2008 (Appendix B). Deep water (hypolimnetic) phosphorus samples were also low and ranged from 2.2 to 10.4 *u*g/l among the seven sampling locations (Appendix B). The hypolimnetic total phosphorus concentrations documented at Site L02 Mayhew were generally higher than the corresponding surface water (composite) samples (Figure 5). All epilimnetic total phosphorus concentrations were below 8 *u*g/l that is considered the DES aquatic life threshold for an oligotrphic lake.

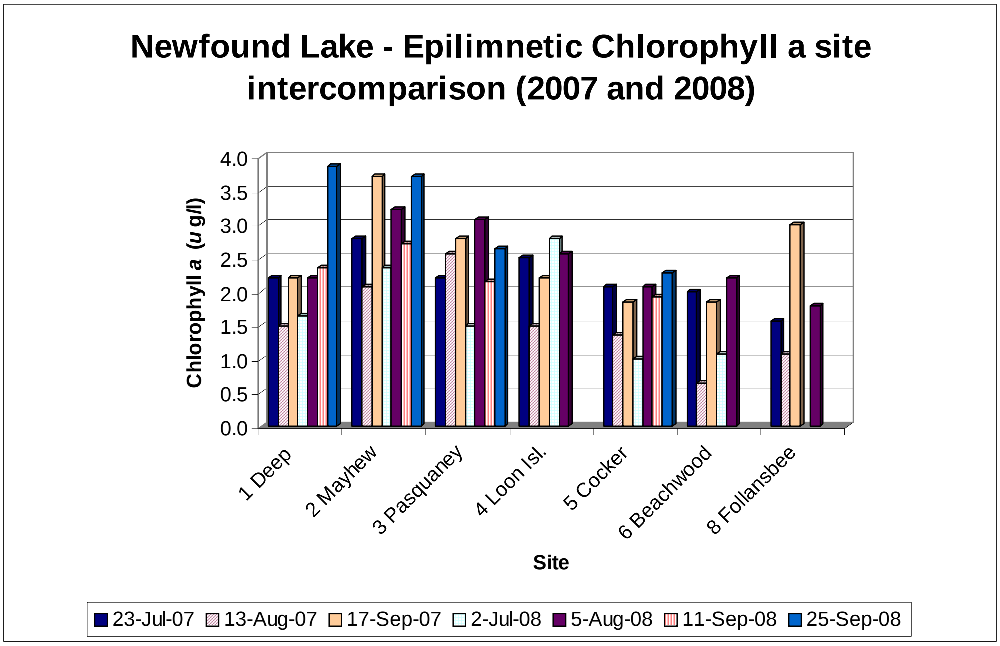
Figure 5.



Chlorophyll *a*

Chlorophyll *a* concentrations were variable among sampling dates and ranged from 0.6 to 3.9 micrograms per liter (*u*g/l) while most values remained below 3.0 *u*g/l (Figure 6). The chlorophyll *a* concentrations documented at Site L02 Mayhew were generally the highest concentrations measured among the sampling stations (Figure 6). The chlorophyll *a* concentrations generally fell below 3.3 *u*g/l that is considered the DES aquatic life threshold for an oligotrophic lake. Chlorophyll *a* concentrations sometimes exceeded the concentration of 3.3 *u*g/l at Site L02 Mayhew (Figure 6).

Figure 6.



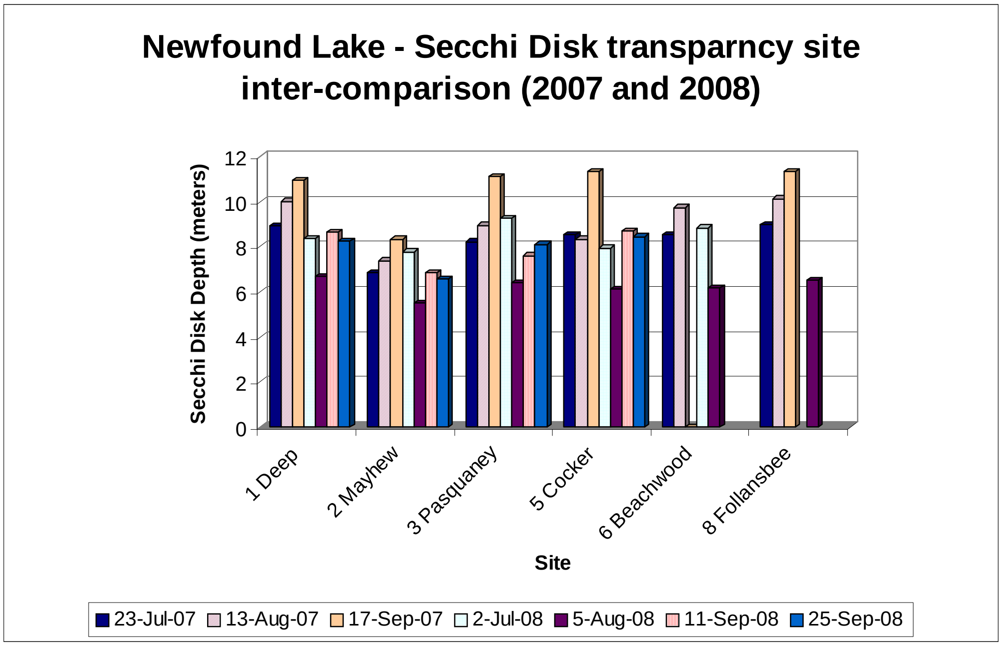
Secchi Disk Transparency

Secchi Disk transparency ranged from 18.0 feet (5.5 meters) to 37.1 feet (11.3 meters) and varied among sampling dates (Figure 7). The shallowest water transparency measurements were documented at Site L02 Mayhew on all sampling dates. *Note: Site 4 Loon Island was removed from the Secchi Disk transparency comparison due to the shallowness of the site and the Secchi Disk resting on the lakebottom before disappearing from view.*

Dissolved Oxygen

The dissolved oxygen concentrations generally remained above 5 milligrams per liter (mg/l) which is commonly considered the minimum oxygen concentrations required for the successful growth and reproduction of the coldwater fishery (Appendix C). The single exception was documented at Site L02 Mayhew where the bottom water (hypolimnetic) oxygen concentrations were near or below 5 mg/l by August 13, 2007 and near or below 5 mg/l by August 5, 2008. Sampling in September (2007 and 2008) revealed that the L02 Mayhew dissolved oxygen concentrations became reduced below 5 mg/l in the hypolimnion and that the dissolved oxygen concentrations were decreasing in the metalimnion as well (Appendix C).

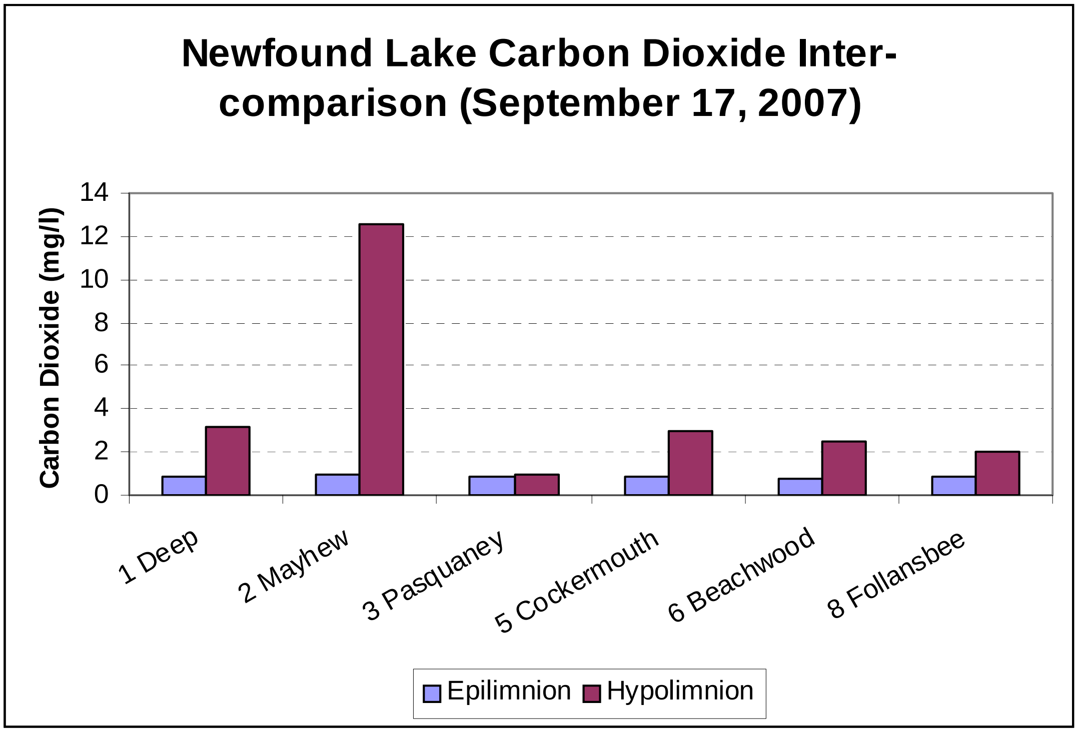
Figure 7.



Carbon Dioxide

Carbon dioxide concentrations were consistently low in the surface waters and increased with depth as one would expect. Higher carbon dioxide concentrations near the lake bottom are commonly associated with the decomposition of organic matter by microbes and the corresponding respiration (production of the carbon dioxide by-product). The highest carbon dioxide concentrations were consistently documented near the lake bottom of Site L02 Mayhew and correspond to the lower dissolved oxygen concentrations in the southerly basin. Figure 8 provides a visual representation of the late season (late August – early October) pattern of carbon dioxide concentrations among sampling stations.

Figure 8.



Total Alkalinity

Total alkalinity measurements ranged from 2.0 to 4.6 and averaged 3.3 milligrams per liter (mg/l). While low, the Newfound Lake alkalinity remained capable of neutralizing acid inputs and avoiding large pH (acidity) swings that can be toxic to aquatic organisms.

pH

The pH measurements varied from 5.9 to 7.4 in the surface waters (epilimnion) during the study period and generally exhibited a decrease in pH with depth. The most acidic water was documented near the lake bottom, in the hypolimnion, where a pH minimum of 5.5 units was logged. Carbonic acid, a natural acid that forms when carbon dioxide dissolved in the lake water, is common among New Hampshire lakes.

Specific Conductivity

Specific conductivity measurements were low and ranged from 32.0 to 43.0 micro-Siemans per centimeter (*u*S/cm) among the six sampling stations and among sampling dates. The highest specific conductivity measurement of 43.0 *u*S/cm was documented near the lakebottom of Site L02 Mayhew on September 25, 2008 and was most likely caused by some nutrient flux off of the sediments. The elevated elevated specific conductivity corresponded to low dissolved oxygen concentrations near the lake bottom.

Water Quality Summary

The water quality remained high at all Newfound Lake sampling Stations in both 2007 and 2008 and the data were characteristic of a high quality water body. A comparison among the seven Newfound Lake sampling stations indicates that the southerly sampling station, Site L02 Mayhew, is characterized by lower water transparency, higher chlorophyll *a*, higher total phosphorus concentrations as well as declining late season dissolved oxygen concentrations in the deep, hypolimnetic and metalimnetic, waters. The data indicate that the southern sampling station is more nutrient enriched than the sampling stations to the north and may reflect the influence of a higher level of watershed development in the southern segment of Newfound Lake. While the L02 Mayhew sampling station was clearly the most nutrient enriched amount the deep sampling locations, the water quality conditions were characteristic of an oligotrophic lake that is approaching more nutrient enriched, mesotrophic, status. Continued water quality monitoring of the Newfound Lake deep sites is recommended to continue to track both short-term and longer-term trends. Future sampling should include:

- Continued weekly to bi-weekly epilimnetic chlorophyll *a* and dissolved color sampling at the seven historical sampling stations. Secchi Disk transparency measurements should also be collected during each site visit.
- Implementation of bi-weekly epilimnetic total phosphorus sampling at each of the seven historical sampling stations.
- Implementation of hypolimnetic total phosphorus sampling at Site L02 Mayhew during the months of July, August and September.
- Continued collection of late season (mid-August/September) dissolved oxygen and metalimnetic chlorophyll *a* samples at each of the historical sampling sites.

Near-shore Water Quality Survey Data

Choice of Near-shore Sampling Stations

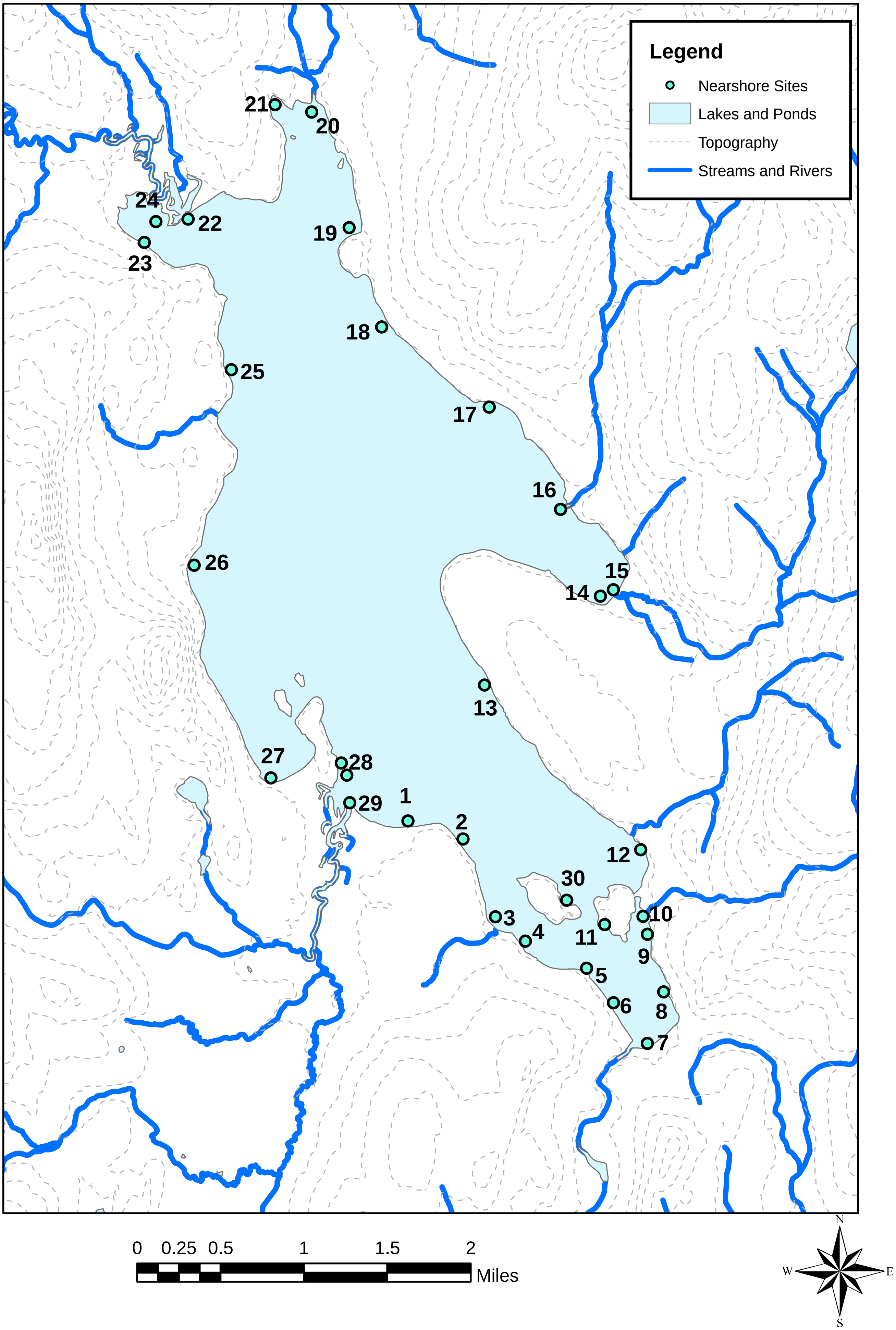
Thirty near-shore sampling stations were selected to correspond to locations that are most susceptible to water quality variations, such as areas proximal to tributary inlets and areas near more intensive land use, as well as a series of reference sampling locations that reflect minimal levels of human (anthropogenic) influence (Table 6 and Figure 9). The near-shore sampling approach included the collection of samples during the spring, summer and fall as well as a pair of samples collected before and after the Fourth of July weekend. The near-shore sampling locations were positioned approximately 150 to 300 feet offshore to provide an assessment of the collective influence of watershed inputs and to identify general variations that were evident around Newfound Lake such as differences between sites in Hebron Marsh, sites south of Mayhew Island and sites located in Pasquaney Bay. While the near-shore samples may provide insight into the influence of localized land use practices, the data were not designed to single out the influence of septic effluent, fertilizer application, tributary runoff, etc.

The near-shore water quality sampling effort emphasized the collection of three primary parameters to address the amount nutrient (total phosphorus), fecal contamination (*E. coli*) and salts (Specific Conductivity).

Table 6: Newfound Lake near-shore sampling stations

Site ID	Location: Latitude dd:mm:ss	Location: Longitude dd:mm:ss	Sampling Site Description
NLRA-S01	43 38 16.9	71 45 56.0	Approximately 150 feet offshore near Camp Wallomut. Old camps are located near the shoreline.
NLRA-S02	43 38 11.3	71 45 32.3	Approximately 200 feet offshore near numerous camps.
NLRA-S03	43 37 47.0	71 45 18.3	Approximately 300 feet offshore near the Black Brook tributary inlet. Numerous shoreline cottages exist.
NLRA-S04	43 37 39.4	71 45 05.4	Approximately 300 feet from the shore near Manor Estates Beach.
NLRA-S05	43 37 31.0	71 44 39.0	Approximately 150 feet from Cummings Beach and "Bungalow" Village.
NLRA-S06	43 37 20.2	71 44 27.4	Approximately 100 feet offshore with houses along the shoreline.
NLRA-S07	43 37 07.5	71 44 12.8	Approximately 100 feet offshore east of the outlet near the southern beach.
NLRA-S08	43 37 23.6	71 44 05.8	Approximately 150 feet offshore near Lakeshore Road and a dense cluster of shoreline cottages.
NLRA-S09	43 37 41.6	71 44 12.8	Approximately 150 feet offshore and receiving drainage from the Red Fox condominiums.
NLRA-S10	43 37 47.2	71 44 14.7	Approximately 75 feet from the mouth of Hemlock Brook.
NLRA-S11	43 37 44.6	71 44 31.2	Pikes Point at the mouth of the cove. Several cottages are located in the cove with a fairly well vegetated shoreline.
NLRA-S12	43 38 08.0	71 44 15.7	Approximately 100 feet from a forested shoreline with scattered near-shore cottages.
NLRA-S13	43 38 59.4	71 45 23.1	Approximately 100 feet from the shore and northwest of a community beach.
NLRA-S14	43 39 27.2	71 44 33.2	Near a beach and some cottages that include some older "second tier" (across the street) cottages.
NLRA-S15	43 39 29.2	71 44 27.6	Approximately 75 feet from the Whittemore Brook tributary inlet.
NLRA-S16	43 39 54.3	71 44 50.4	Off Paradise Pint, mouth of the tributary with numerous cottages and a community beach just north of the inlet.
NLRA-S17	43 40 26.2	71 45 21.2	Approximately 200 feet from shore and near the Whipowill condominiums.
NLRA-S18	43 40 51.2	71 46 07.6	Approximately 200 feet from shore between the Pasquaney and Moglis Camps. The shoreline is predominantly forested and is a “reference” site.
NLRA-S19	43 41 22.2	71 46 21.7	Some shorefront residential development north of Onaway Point.
NLRA-S20	43 41 58.3	71 46 37.9	Central location in Sanborn Bay cove that includes a beach and residential development. The site is in the middle of a *Sparganium* bed and is influenced by Georges Brook.
NLRA-S21	43 42 00.6	71 46 53.7	Approximately 200 feet offshore of Sleepy Hollow.
NLRA-S22	43 41 24.8	71 47 31.1	Approximately 100 feet from the mouth of the Cockermouth River
NLRA-S23	43 41 17.5	71 47 50.0	Approximately 250 feet offshore on the southern side of Hebron Marsh
NLRA-S24	43 41 24.0	71 47 45.0	Approximately 200 feet offshore on the northern side of Hebron Marsh
NLRA-S25	43 40 37.8	71 47 12.4	Approximately 150 feet from the shore. A forested “reference” site with a couple of scattered cottages.
NLRA-S26	43 39 36.7	71 47 28.3	Approximately 200 feet from the Ledges tributary inlet and approximately 40 feet from the Ledges beach.
NLRA-S27	43 38 30.3	71 46 55.1	Approximately 100 feet from the culvert and 200 feet from Wellington Beach. The site represents a composite influence of the inlet, beach and nearby cottages.
NLRA-S28	43 38 35.0	71 46 24.8	Approximately 100 feet offshore from the public boat launch ramp.
NLRA-S29	43 38 22.6	71 46 21.1	Mouth of the Fowler River.
NLRA-S30	43 37 52.2	71 44 47.6	Approximately 75 feet offshore of the Mayhew Island beach.

Figure 9. Newfound Lake Near-Shore Sites



Near-shore Sampling Results

The Newfound Lake water quality data were oftentimes similar among sampling locations as well as variable among sampling dates although some notable differences (discussed below) were documented. The following section reports on the September 13, 2007 through September 30, 2008 water quality data that were collected by the UNH CFB field team.

Total Phosphorus

Total phosphorus concentrations ranged from < 2.0 micrograms per liter (*u*g/l) to 15.7 *u*g/l during the study period. The total phosphorus concentrations were generally highest at the Hebron Marsh sampling stations, Sites NLRA S23 and NLRA S24, and likely reflect the natural conditions of this shallower region of Newfound Lake. Short-term phosphorus spikes were also documented at a sampling site off the Fowler River tributary inlet (S29) on June 10, 2008 and September 30, 2008 and likely reflect the influence of the Fowler River during higher discharge periods. Visual observations made by the CFB field team indicated that aquatic vegetation, the genus *Sparganium*, was matted down for hundreds of yards south of the Fowler River indicating the flow path of the Fowler River. Based upon visual observations, one could deduce the influence of the Fowler River extends well into Newfound Lake during high discharge periods. The near-shore total phosphorus concentrations documented in Newfound Lake in 2007 and 2008 were generally similar to the deep, open water samples measured during that time span.

Escerichia coli (E. coli)

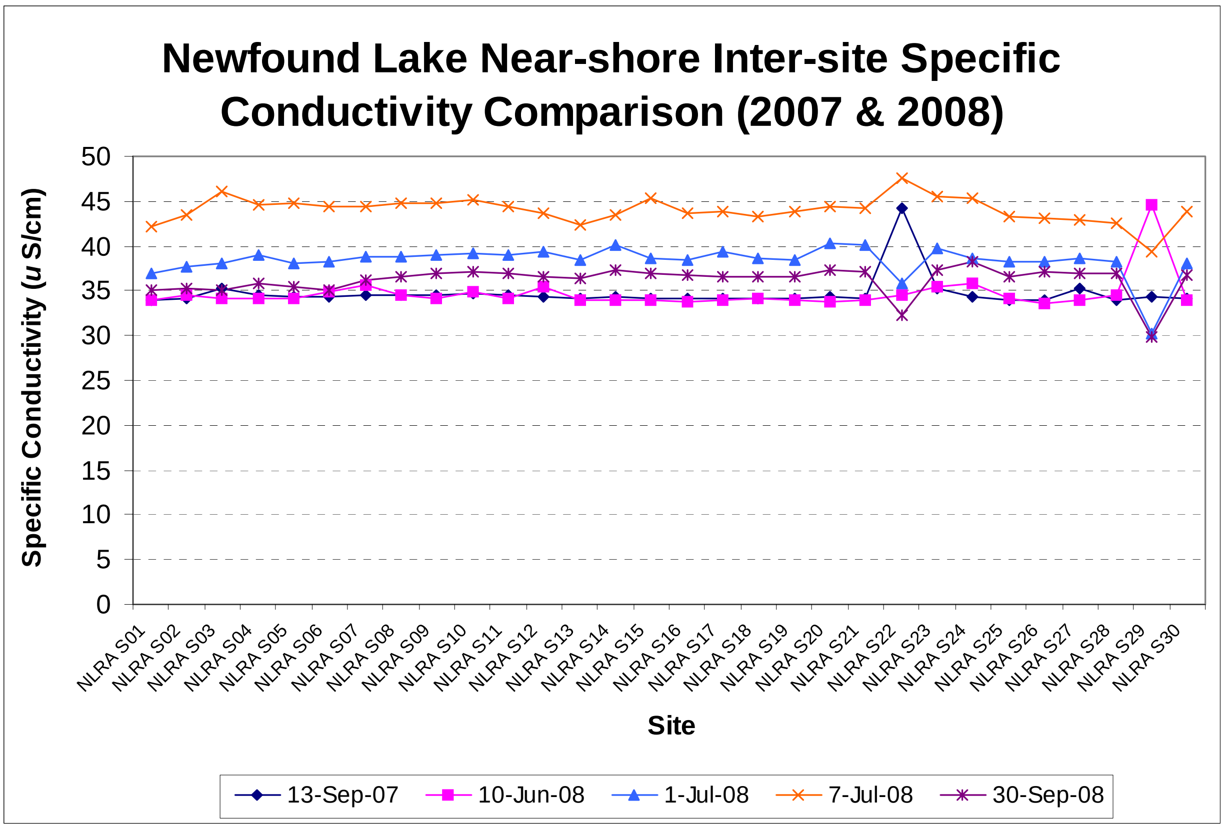
Escherichia coli data ranged from < 1 to 86 colony forming units per 100 milliliters (CFU/100 ml) during the study period. Furthermore, the *E. coli* counts were consistently below the New Hampshire DES threshold of 88 CFU/100 ml considered the state standard for contact recreation. The *E. coli* counts were highly variable among sampling dates and among sampling sites (Appendix D). The lowest bacteria counts were documented on July 7, 2008, after the fourth of July weekend, while the July 1, 2008 (pre July 4 weekend) were also some of the lower values documented during the study period. Water quality sampling on September 13, 2007, following a period of heavy rainfall the previous week (Appendix E), included *E. coli* "spikes" at sites near the mouths of the Cockermouth River (Site NLRA S22) and the Fowler River (Site NLRA S29). *E. coli* counts documented along the southwesterly shoreline were also elevated on September 13, 2007 relative to most sampling sites. Site NLRA S29 also experienced *E. coli* spikes on June 10, 2008 and September 30, 2008 while site NLRA S22 spiked on September 30, 2008. The September 30 sampling date followed a three day period of heavy rainfall (Appendix E) and included the two highest *E.*

coli measurements of 86 CFU/100ml (NLRA S22) and 72 CFU/100ml (NLRA S29) that were documented during the 2007/2008 study period.

<u>Specific Conductivity</u>

Specific Conductivity measurements ranged from 29.9 to 47.5 microsiemans per centimeter (*u*S/cm) during the study periods. Specific conductivity measurements were highest at all but Site NLRA S29 (the mouth of the Fowler River) on July 7, 2008 and tended to be lowest at most sampling locations on June 10, 2008 (Figure 10). The sampling locations near the mouths of the Cockermouth (NLRA S22) and the Fowler River (NLRA S29) tended to exhibit the greatest deviation relative to measurements recorded at the other sampling locations on a particular sampling date.

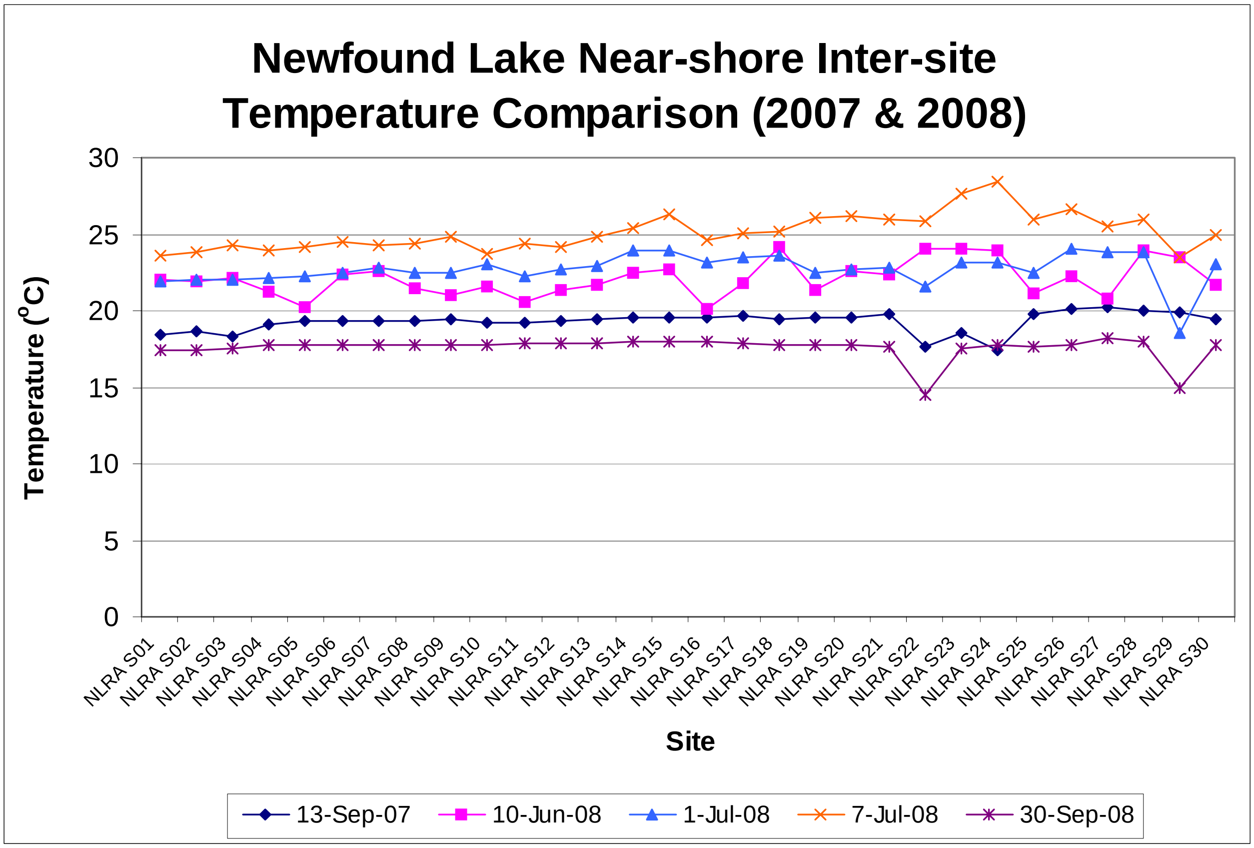
Figure 10



Temperature

Temperature measurements ranged from 14.5°C to 28.4°C during the study period. The temperature measurements were generally highest at each of the sampling stations on July 7, 2008 and were generally lowest on September 30, 2008 (Figure 11). The sites located at the outflows of the Cockermouth (NLRA S22) and the Fowler (NLRA S29) Rivers exhibited some of the larger discrepancies relative to temperature measurements documented at the other sampling locations. The highest temperature measurements were documented at the shallow and embayed Hebron Marsh sampling sites (NLRA S23 and S24) on July 7, 2008.

Figure 11



Water Quality Summary

Ambient water quality data collected as part of the near-shore sampling component of the project generally exhibited excellent water quality among the thirty sampling stations. Water quality variations were documented among sampling dates and some of the higher *E. coli* measurements were documented on September 30, 2008 following a period of heavy rainfall and indicate that the tributary inlets, particularly the Fowler and Cockermouth Rivers, serve as a conduit for pollutants (in this case *E. coli*) to make their way into Newfound Lake. Data collected as part of the previous Newfound Lake phosphorus/water budget (Craycraft and Schloss, 2008) and during the tributary sampling component of this report, reaffirm that short-term pollutant pulses occur and illustrate the linkage between the watershed area that extends miles away from the lake, and the quality of Newfound Lake.

Water quality data collected both before and after the July 4 weekend (July 1, 2008 and July 7, 2008) did not document short-term water quality impacts that are sometimes associated with periods of heavy use. The post-July 4 weekend data collected on July 7, 2008 included lower *E. coli* concentrations relative to the concentrations collected on July 1, 2008.

Water quality data collected along the more densely populated shoreline, south of Mayhew Island, were high and were generally similar to the water quality measurements documented in other areas of Newfound Lake. Total phosphorus concentrations remained low on all occasions south of Mayhew Island while short term *E. coli* spikes were documented but did not exhibit a general pattern among sampling dates and remained well below problematic levels.

Total phosphorus samples were typically higher in the shallow Hebron Marsh (sites NLRA S23 and S24) relative to the other near-shore sampling sites and reflected the progression of this localized region of Newfound Lake to a more nutrient enriched, meso/eutrophic, state. The Hebron Marsh is a good example of an area of Newfound Lake where a more organic rich (mucky) lakebottom has been colonized by aquatic vascular plants that flourish late in the summer months. To a lesser extent, one may observe some increased aquatic vegetation in the shallows near the inlet of Georges Brook although the near-shore phosphorus samples collected near Georges Brook (NLRA S20) were significantly lower than those documented in Hebron Marsh.

Periphyton (Attached Algae) Sampling

<u>Choice of Periphyton Sampling Locations</u>

Near-shore periphyton samples (Figures 12 & 13 and Appendix G) were positioned at seven sampling locations around the periphery of Newfound Lake (Table 7 and Figure 14) to provide a highly sensitive means to investigate Newfound Lake's productivity response to near-shore nutrient loading during the summer months. Unlike water column samples that represent a "snapshot" of the lake conditions, the periphyton samplers integrate the longer-term (two week to one month periods) over which attached algal growth responds to nutrient inputs and physical fluctuations such as temperature variations and light penetration. Many residents have expressed concerns that the amount of slimy coating one finds on rocks around the periphery of the lake has increased over time and the periphyton samplers provide a standardized method to quantify growth variations both spatially and temporally.

Figure 12. Periphyton Samplers pending deployment (June 16, 2008)

Figure 13. Periphyton Sampler deployed near Hemlock Brook (June 16, 2008)

Periphyton samplers were positioned near major tributary inlets that include the Cockermouth River, Fowler River, Georges Brook and Hemlock Brook while additional samplers were positioned in the more nutrient enriched Hebron Marsh as well as in a "reference" location along a predominantly forested shoreline, P-03 Beachwood (Table 7). The in-lake Cockermouth River, Fowler River and the Georges Brook samplers were vandalized during the study period and the results discussed in this report will be limited to the remaining sampling locations.

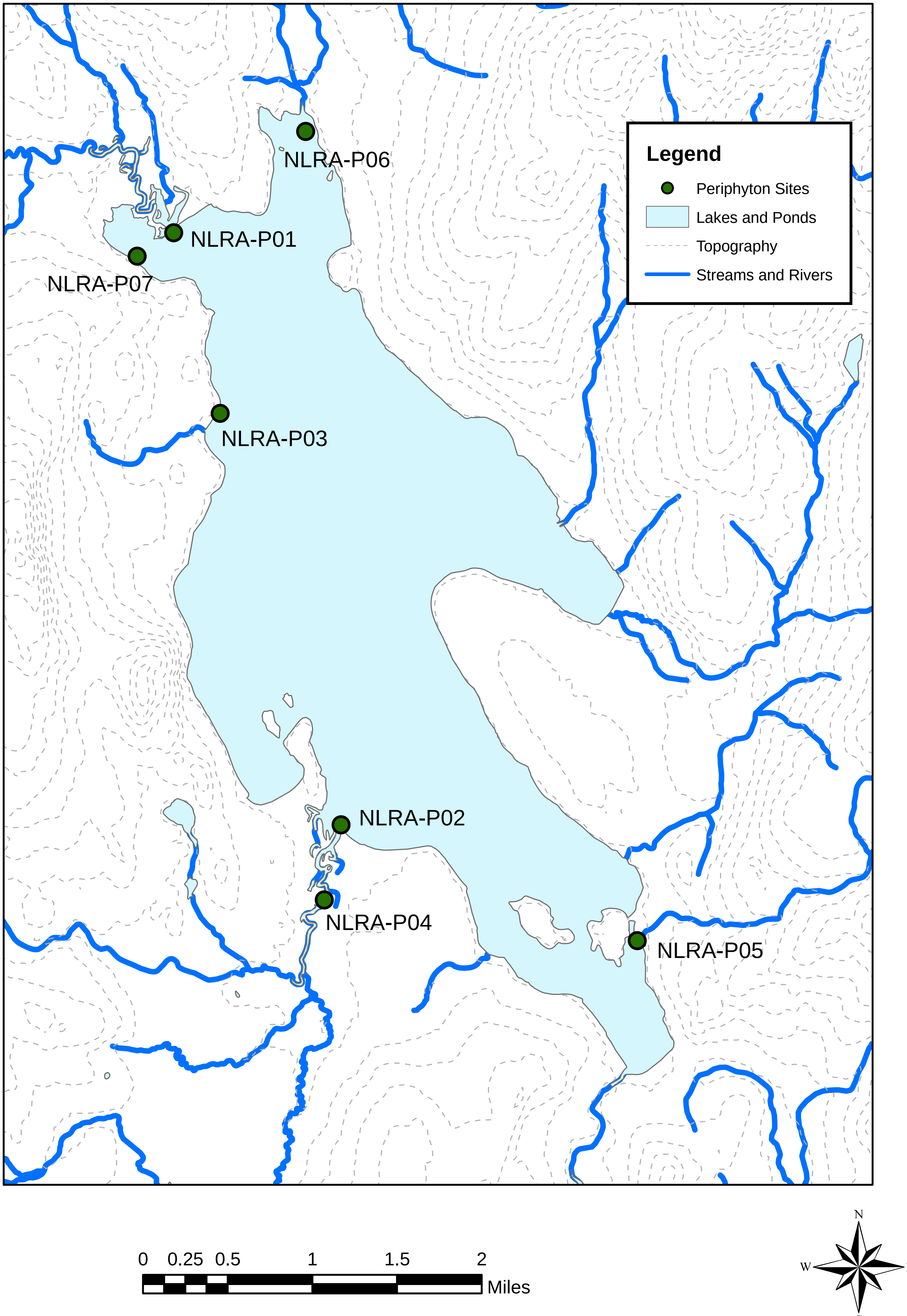
The functional (non-vandalized) periphyton samplers were initially deployed on June 12, 2008 (Site P-04 Fowler) and on June 16, 2008 (Sites P-03 Beachwood, P-05 Hebron and P-07 Hemlock) and were first sampled on July 22, 2008 following the formation of a natural biofilm and subsequent periphyton growth. Samplers were submersed to depths of approximately 4.5 feet

(P-04), 3.0 feet (P-05) and 4.5 feet (P-3 and P-07). Absolute sample depth varied based on lake level fluctuations that were characteristic of the summer months. A combination Onset temperature/light logger collected data at 15 minute increments that was used to determine the impact of light and temperature variation on the amount of periphyton growth.

Table 7. Near-shore Periphyton Sampling Locations and Sampling Rationale.

Site ID	Latitude dd:mm:ss	Longitude dd:mm:ss	Sampling site description / Rationale
NLRA-P01	43 41 24.6	71 47 31.6	Site located at the mouth of the Cockermouth River to assess the response to nutrient loading from the Cockermouth River sub-watershed. *Sampler vandalized.*
NLRA-P02	43 38 22.7	71 46 20.3	Site located at the mouth of the Fowler River to assess the response to nutrient loading from the Fowler River sub-watershed. *Sampler vandalized.*
NLRA-P03	43 40 29.1	71 47 11.8	Near-shore site north of the Beachwood development that is drained by a forested, near-reference, watershed.
NLRA-P04	43 37 59.6	71 46 27.4	Fowler River (approximately 1000 yards upstream) to document the difference in water quality in the embayed region, relative to the mouth of the River. The upstream sampling will help assess the potential for short-term nutrient loading during heavy storm events.
NLRA-P05	43 37 47.2	71 44 14.7	Site located near the mouth of Hemlock Brook to assess the response to nutrient loading from the Hemlock Brook sub-watershed.
NLRA-P06	43 41 55.8	71 46 35.7	Site located approximately 500 yards from the mouth of Georges Brook to assess the response to nutrient loading from the Georges Brook sub-watershed. The site is characterized by some macrophyte growth including patches of Sparganium. *Sampler vandalized.*
NLRA-P07	43 41 47.1	71 47 47.1	Site located in Hebron Marsh to document the periphyton response to the more nutrient enriched (relatively speaking) section of Newfound Lake. Hebron March is characterized by emergent vegetation and Eutricularia along the lake bottom.

Figure 14. Newfound Lake Periphyton Sites



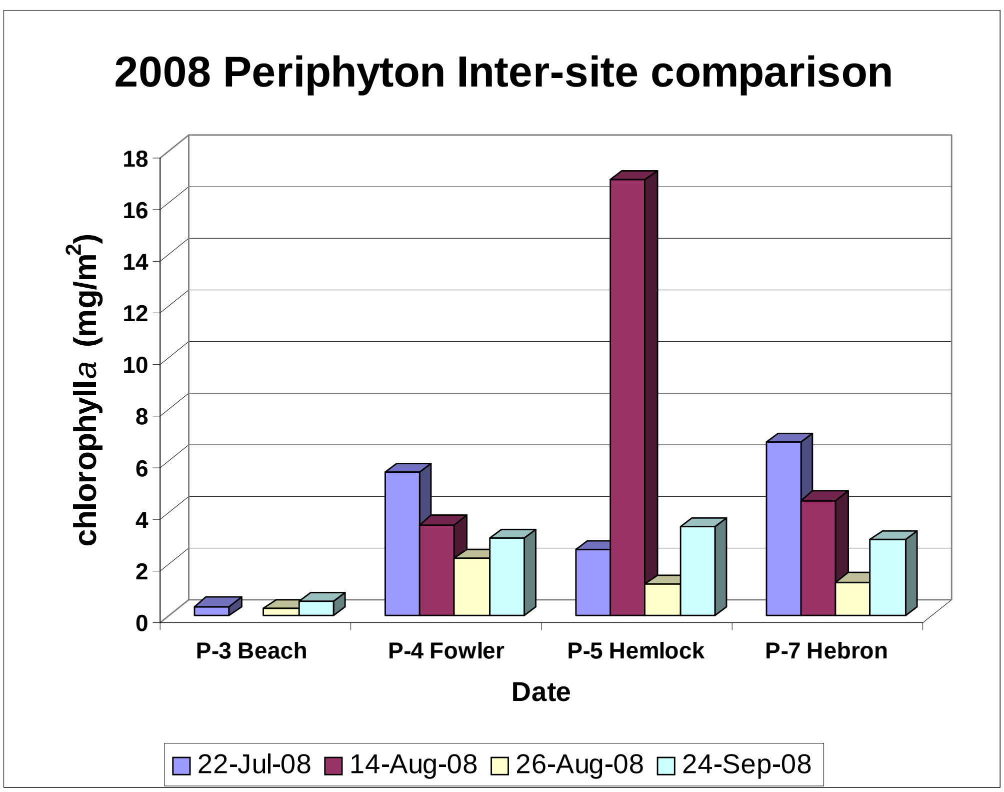
Periphyton Sampling Results

Periphyton Chloropyll *a*

Periphyton chlorophyll *a* was used to determine the amount of growth on each of the four intact periphyton samplers and the results are reported as milligrams per square meter (mg/m^2). The periphyton chlorophyll *a* results were obtained for July 22, 2008, August 14, 2008, August 26, 2008 and September 24, 2008 by scraping a known area of the periphyton sampler and retaining the growth for subsequent analysis. Appendix F provides images of the growth visually observed on each of the four samplers on the four sampling dates. Note: the P-03 Beachwood sampler was damaged and no data were collected for that site on August 14, 2008.

The P-03 Beachwood "reference" sampling site consistently exhibited the least amount of algal growth when compared to the other sampling sites (Figure 15). The site exhibiting the maximum amount of growth was variable among sampling dates with each of the Upper Fowler, P-04, Hemlock, P-05, and Hebron, P-07, exhibiting the maximum amount of growth on a given sampling date (Figure 15). The single greatest amount of periphyton growth was documented at site P-05 Hemlock on August 14, 2008 at which time the amount of periphyton growth reached 16.88 mg/m^2. The August 14 sampling date followed a period of intense rainfall and the Hemlock periphyton sampler included visible sediment depositional materials that were likely flushed into Newfound Lake during the high flow period.

Figure 15



Temperature

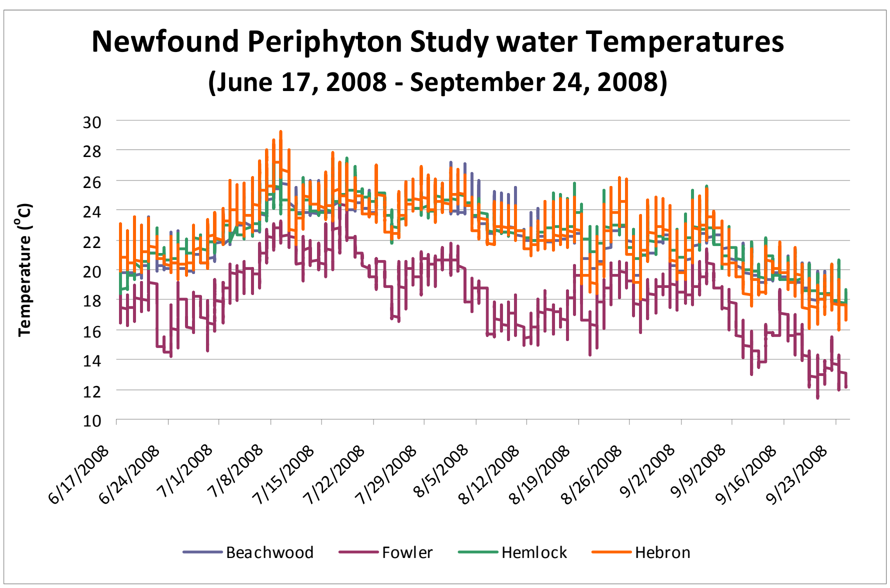
Water temperatures loggers attached to each of the periphyton samplers recorded temperature data at 15 minute increments. Water temperatures ranged from 11.4 °C to 29.3°C between June 17 and September 24, 2008. The temperature measurements documented at Site P-04 Fowler were significantly lower than the temperature measurements documented at the remaining sampling stations, Sites P-03 Beachwood, P-05 Hebron and P-07 Hemlock (Figure 16). Median temperature values were calculated for each deployment period (i.e. the period during which the periphyton growth occurred) and the results indicated that the warmest temperature for a given sampling period varied among Sites P-3 Beachwood, P-5 Hebron and P-7 Hemlock which were all characterized by warm water relative to the P-3 Fowler River sampling station (Table 8).

Table 8: 2008 Peripyton Sampler Water Temperature Summary Statistics by Sampling Period: mean, (median), minimum and maximum

Sample Period	P-3 Beachwood	P-4 Fowler	P-5 Hebron	P-7 Hemlock
June 17 – July 22	22.9°C (23.4°C) (range: 19.5 – 28.3)	19.3°C (19.5°C) (range: 14.2 – 24.9)	23.1°C (23.5°C) (range: 18.4– 28.0)	23.3°C (23.5°C) (range: 19.4 – 29.3)
July 22 – Aug 14	-------	18.3 °C (18.4°C) (range: 15.0 – 21.8)	23.7°C (23.8°C) (range: 21.7– 26.7)	23.7°C (23.8°C) (range: 20.9 – 27.0)
Aug 14 – Aug 26	22.2°C (22.1°C) (range: 19.9 – 25.4)	17.8°C (17.9°C) (range: 14.3 – 20.5)	22.9°C (22.8°C) (range: 21.0– 25.8)	22.3°C (22.4°C) (range: 18.4 – 26.2)
Aug 26 – Sept 24	20.5°C (20.3°C) (range: 17.6 – 25.2)	16.5°C (16.5°C) (range: 11.4 – 21.4)	20.7°C (20.8°C) (range: 17.7– 25.6)	20.5°C (20.2°C) (range: 16.0 – 25.4)

Note: P-3 Beachwood sampler not deployed between July 22 and July 31, 2008.

Figure 16.



Light

Light measurements, documented between June 17, 2008 and September 24, 2008, were collected to discern relative differences in light penetration among sampling locations (Table 9). The light measurements documented during the study period were most intense at Site P-3 Beachwood followed by Site P-5 Hebron while the measurements documented at P-7 Hemlock Brook and P-4 Fowler were less intense and were similar over the course of the study period (Table 9).

Table 9: 2008 Periphyton Sampler Light Intensity Summary Statistics

# reading in respective categories	Site P-3 Beachwood	Site P-4 Fowler	Site P-5 Hebron	Site P-7 Hemlock
> 1000 LUX	4385	4100	4299	4174
> 5000 LUX	2965	2417	2942	2607
> 10000 LUX	2112	1694	2040	1632
Median LUX	2411	1679	1970	1905
# Measurements	8621	8626	8625	8624

Note: the data summary data were collected at 15 minute intervals between June 17, 2008 (00:00 hr) and July 22, 2008 (10:15hr) and between August 1, 2008 (00:00 hr) and September 24, 2008 (10:00 hr). The P-3 Beachwood sampler was out of service between July 22 August 1, 2008. Samples logged during the periphyton sample collection period, when the sampler was out of the water, were selectively removed from the analysis. Thus, the minor discrepancy in sample size among sampling location.

Water Quality Summary

The "reference" Beachwood periphyton samples exhibited the least amount of algal growth even though the Beachwood periphyton sampler was exposed to some of the higher temperatures and higher light intensity that would favor increased periphyton growth. On the other hand, the lowest temperature and light intensity was documented at the Fowler River sampling site where the amount of periphyton growth was significantly higher than at the Beachwood site. The Hemlock and Hebron sampling stations exhibited, generally speaking, similar temperatures relative to the Beachwood site and light levels near or below that of the Beachwood site. Based purely on the physical, light and temperature data, one would expect the growth at both the Hemlock and Hebron sites to be near or below that of Beachwood. However, both Hemlock and Hebron were characterized by significantly more periphyton growth than was documented at the Beachwood Site.

The data suggest that localized and short-term and longer-term nutrient fluxes are impacting the periphyton growth at the Hemlock and Hebron sampling stations. The greatest amount of periphyton growth was documented at the Hemlock site (located approximately 75 feet from the Mouth of Hemlock Brook) on August 14, 2008 following a period of atypical rainfall and heavy watershed runoff. The growth response, documented at Hemlock Brook, suggests a significant amount of short-term nutrient loading stimulated the growth. Silt and coarser sand grains were also clearly visible on the Hemlock periphyton sampler that suggested an atypically heavy sediment load that was associated with the storm event. Interestingly, total phosphorus samples collected in Newfound Lake at or near the Hemlock site, during the study period of 2007 and 2008, were consistently low and near the concentrations documented at or near the Beachwood sampling site.

The results suggest that the Hemlock periphyton sampler growth responded to short-duration nutrient loading events that were not captured during standard ambient water quality sampling. Current and previous total phosphorus sampling at and near the Hebron (Hebron Marsh) and the Fowler (Fowler River) sampling sites have typically been higher that those documented at the Beachwood sampling site. Thus, the elevated periphyton growth at the latter sampling sites, relative to the Beachwood site, is not surprising.

Benthic (Bottom Sediment) Core Sampling

Choice of Benthic Core Sampling Stations

Benthic substrate composition can reflect sediment and organic matter loading from watershed sources and may be correlated to the ability of aquatic vascular plants, including nuisance exotic species such as variable water milfoil, to colonize locations around Newfound Lake. The benthos can serve as a nutrient sink and, under some conditions, a source of internal nutrient loading. The collection of benthic sediment samples and the characterization of the substrate composition was undertaken to provide a better understanding of the potential for future aquatic plant growth and to help ascertain whether particular areas of the lake are more susceptible to water quality problems, having been exposed to a greater degree of sediment and nutrient loading. Sediment cores were collected at 22 locations around the periphery of Newfound Lake and in the channels of the larger tributary inlets (Table 10 and Figure 17). The sampling locations collectively represent areas influenced by major tributary inlets, shallow marshy areas such as Hebron Marsh and locations distant from channelized nutrient runoff that are characterized by a forested shoreline (Table 10). Benthic sampling locations were positioned in close proximity to existing near-shore and tributary sampling sites where water chemistry and biology data were being collected.

Benthic Sampling Results

Benthic Phosphorus

Summer 2008 (July 29, August 14 and August 26) benthic phosphorus (dry weight) concentrations were highly variable among sampling sites and ranged from .010 grams phosphorus to Kilogram substrate (g/Kg) to 1.22 g/Kg. The lower phosphorus concentrations, such as those documented in a sandy Wellington Beach (Site NLRA-B22, 0.01 g/Kg) area and in the Fowler River south of West Shore Road (Site NLRA-B01, 0.015 g/Kg), were associated with sandier bottom substrates (Table 10 and Figure 18). On the other hand, finer benthic substrate composition typical of the Hebron Marsh sampling sites, that tended to be characterized by the highest phosphorus concentrations, ranged from 1.05 to 1.22 g/Kg (Table 10 and Figure 18).

Table 10: Benthic Core-sampling Locations

Site ID	Latitude dd:mm:ss	Longitude dd:mm:ss	Visual Assessment of Bottom Substrate Composition	Sampling Site Description
NLRA-B01	43 37 59.6	71 46 27.4	Predominantly sand	Site sampled in the Fowler River near the periphyton sampler located approximately 200 feet downstream of West Shore Road.
NLRA-B02	43 38 12.8	71 46 30.1	Predominantly sand	Site sampled in the Fowler River at the juntion of the marina and the Fowler River channel. Core collected in the center of the Fowler River channel.
NLRA-B03	43 38 23.3	71 46 21.0	Predominantly sand and some fine grained material	Site located in Newfound Lake approximately 100 feet from the river's mouth. Some scatter *Sparganium* in the immediate vicinity.
NLRA-B04	43 38 24.3	71 46 14.4	Predominantly sand	Site located approximately 500 feet from the mouth of the Fowler River southwest of the channel with the sand bar to the north.
NLRA-B05	43 37 44.1	71 45 17.2	Predominantly sand	Site located near the Black Brook tributary inlet.
NLRA-B06	43 37 47.7	71 44 14.4	Predominantly sand and fine grained material	Site located approximately 50 feet from the mouth of Hemlock Brook.
NLRA-B07	43 37 49.5	71 44 16.4	Predominantly sand and fine grained material	Site located approximately 100 feet from Hemlock Brook in an embayed area that has minimal Hemlock Brook influence.
NLRA-B08	43 37 46.1	71 44 31.2	Sand and fine grained material	Cove Site near NLRA-S11. Sample taken in a bed of Eriocolon.
NLRA-B09	43 37 51.6	71 44 49.6	Predominantly sand	Core collected at NLRA-S30 in the middle of a sandy beach.
NLRA-B10	43 39 27.8	71 44 16.5	Predominantly sand	Core collected in Dick Brown Brook immediately downstream of Route 3A.
NLRA-B11	43 39 28.6	71 44 27.4	Predominantly sand	Core collected at the mouth of Dick Brown Brook
NLRA-B12	43 39 54.6	71 44 48.9	Predominantly sand	Core collected at the mouth of Whittemore Brook approximately 50 feet from offshore of the tributary channel.
NLRA-B13	43 41 58.3	71 46 37.9	Predominantly sand with fine grained material	Core collected at Site NLRA-S20. Macrophytes, including *Sparganium*, were visible around the sampling site.
NLRA-B14	43 42 03.8	71 46 37.8	Fine grained material	Core collected at a more organic site in the Georges Brook channel between North Shore Road and Newfound Lake.
NLRA-B15	43 41 23.6	71 47 29.6	Predominantly sand	Core collected approximately 200 feet into Newfound Lake in the Cockermouth River Channel (between the navigation bouy markers).
NLRA-B16	43 41 28.0	71 47 33.5	Predominantly fine grained material	Core collected at the junction of the Cockermouth River and the Marina approximately 25 feet into the marina channel. Emergent and submergent vegetation characterized the sampling area.
NLRA-B17	43 41 31.2	71 47 37.4	Predominantly sand	Core collected in the Cockermouth River upstream of the intersection of the marina channel and the Cockermouth River channel.
NLRA-B18	43 41 39.9	71 47 47.2	Predominantly sand	Core collected at tributary site NLRA-S11 at North Shore Road.
NLRA-B19	43 41 17.5	71 47 50.0	Fine grained material	Core collected near the Hebron Marsh periphyton sampler (NLRA-P07) in the southern portion of the marsh. Emergent and submergent vegetation characterized the sampling area.
NLRA-B20	43 41 24.0	71 47 45.0	Fine grained material	Core collected in Hebron Marsh near the northern shoreline. Emergent and submergent aquatic vegetation characterized the sampling area.
NLRA-B21	43 37 51.6	71 44 49.6	Boulders, cobble and sand	Core collected in the vicinity of the Beachwood periphyton sampler and approximately 20-25 feet offshore.
NLRA-B22	43 38 29.4	71 46 53.7	Predominantly sand	Core collected in close proximity to the mouth of the Wellington Brook.

Figure 17. Newfound Lake Benthic Sites

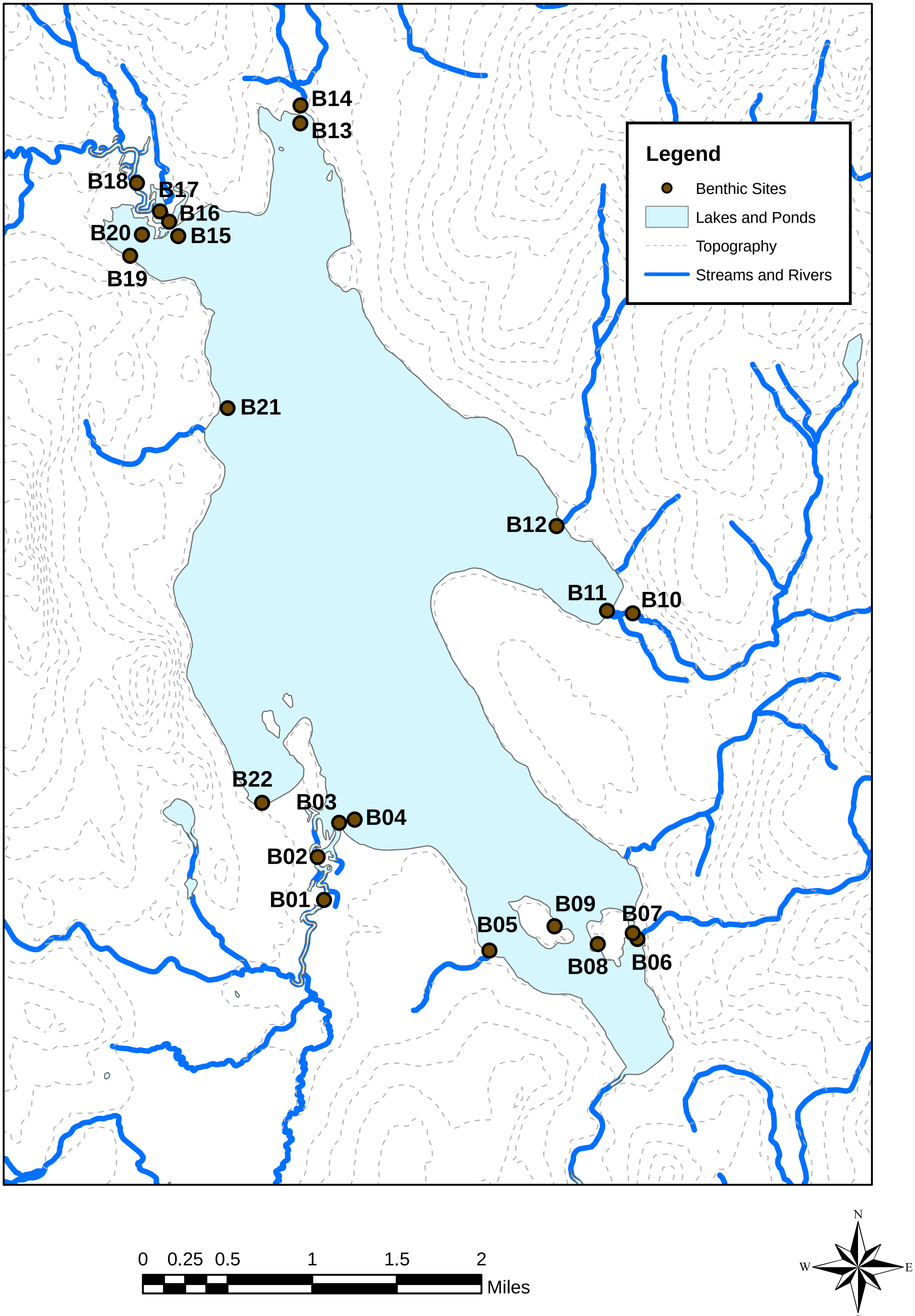
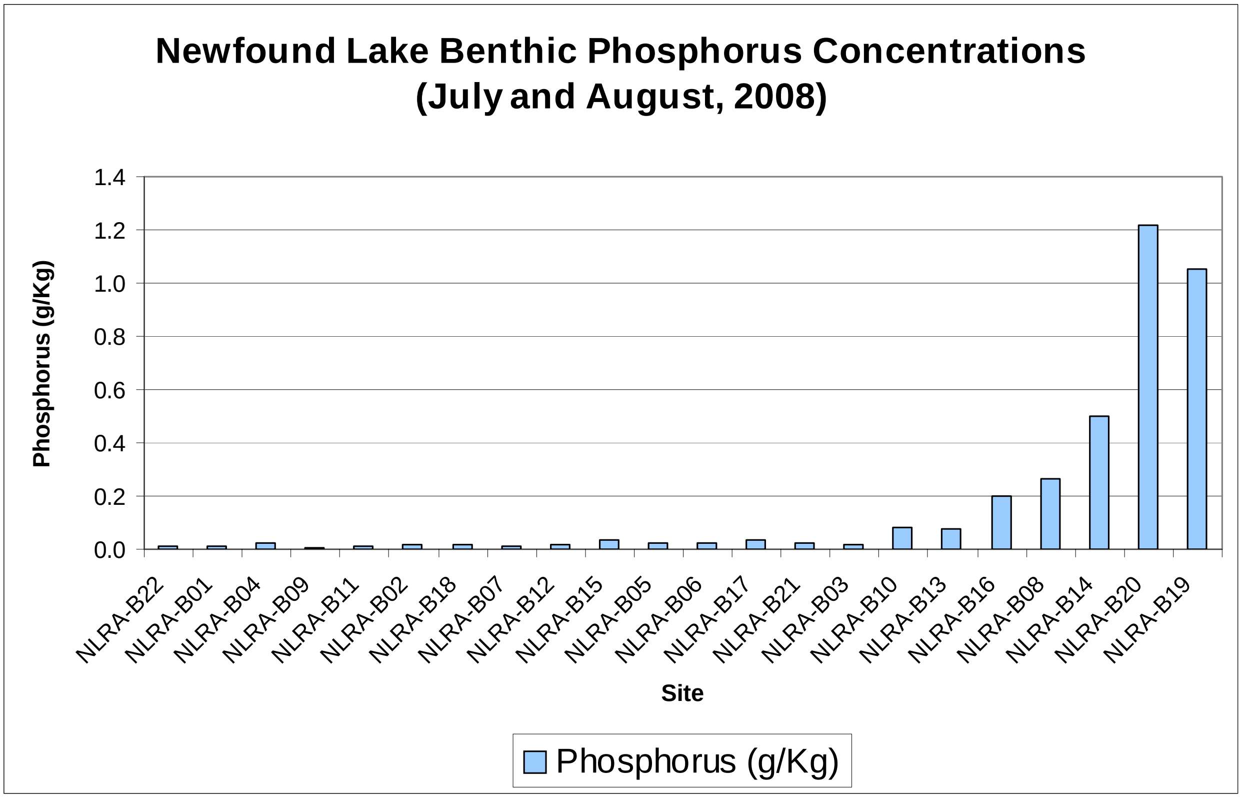


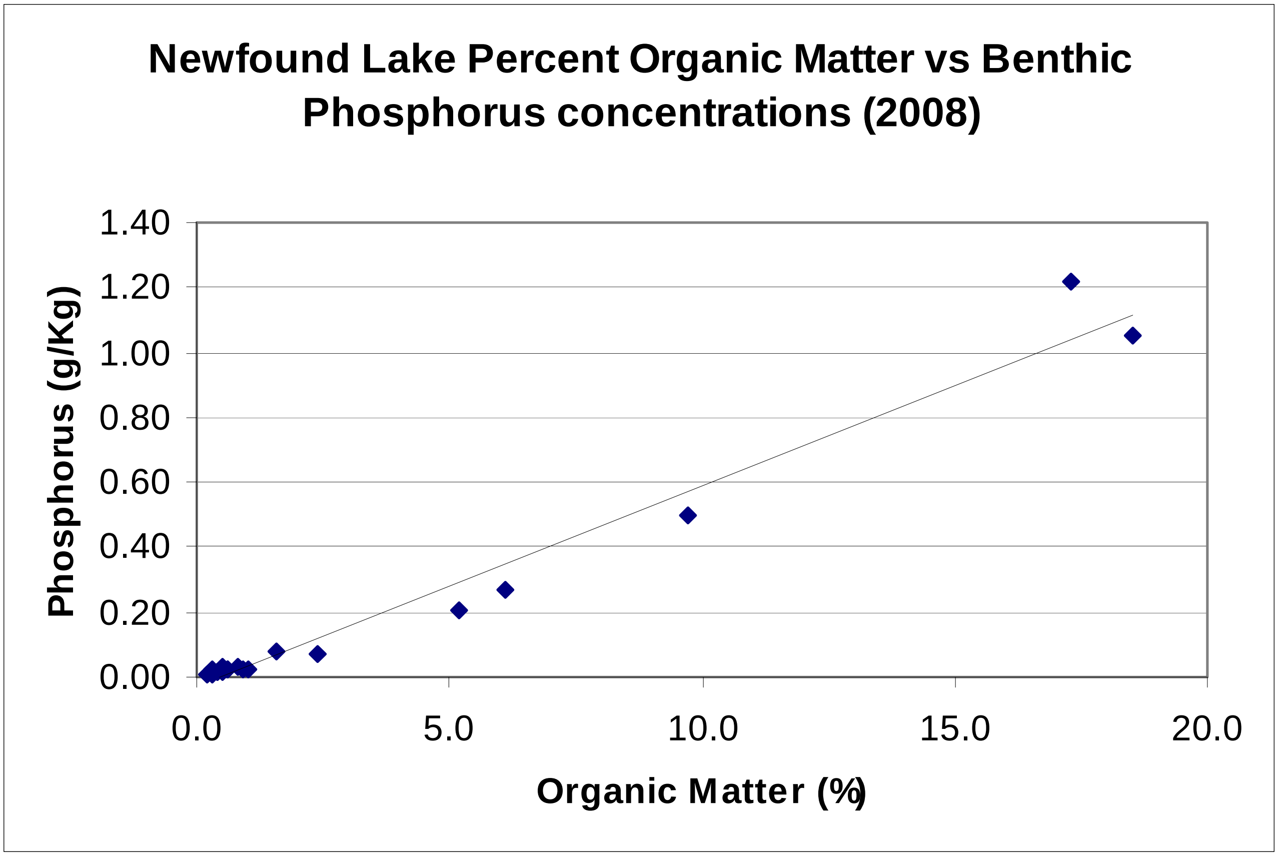
Figure 18



Benthic Percent Organic Matter

The composition of the benthic substrate was also highly variable in terms of the percent composition of organic matter. Organic matter collectively includes the decomposing and living debris that accumulates along the lake bottom including aquatic vascular plants, algal cells, twigs, leaves, decomposing animal remains, etc. The percent organic matter of the benthic substrate ranged from 0.2% to 18.5% among the twenty-two sampling sites. The organic composition of the benthic substrate tended to be lowest (<1%) in sandy shoreline areas and tended to be highest in the Hebron Marsh cove (17.3% - 18.5%). Based on visual observations, one tended to observe a decrease in the grain size of benthic materials as the percentage of organic matter increased. A simple relationship between the percent organic matter and benthic phosphorus concentration (Figure 19) indicates the pattern of increasing phosphorus contentration with increasing organic matter and, as was observed visually, with decreasing benthic grain size.

Figure 19



Water Quality Summary

The benthic sampling results, as indicated above, documented a clear correlation between the percent organic matter and the phosphorus content of the sediments. The more organic rich and phosphorus rich sediments were also the areas where aquatic vascular plants were sighted in greater abundance (i.e. B19 & B20 Hebron Marsh, B14 Georges Brook Channel and B16 Junction of Cockermouth River and Marina). The benthic sediment samples provide insight into the potential impacts of poorly planed development and land use activities in the uplands that could potentially destabilize the soils and result in additional sediment and the associated phosphorus loading. It is also worth noting that the finer soil particles, that tend to have the higher phosphorus content, are more likely to be displaced into the lake. Much like in the upland landscape, a host of aquatic plants take advantage of the finer and more organic sediments that are capable of supporting the colonization by both native and exotic aquatic plants.

Paired-watershed (Tributary Inlet) Study

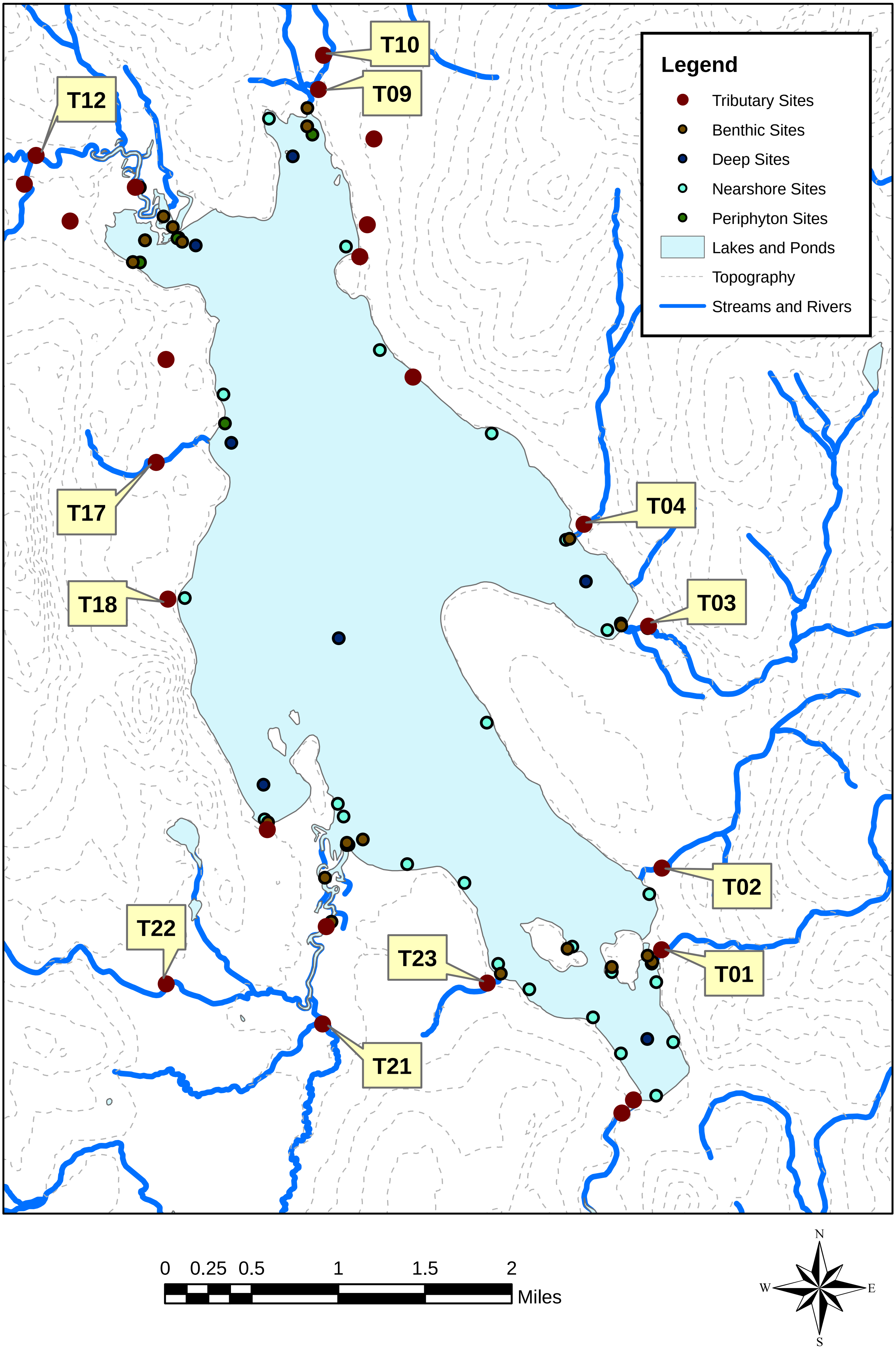
Choice of Paired-watershed Sampling Locations

Twelve stream sampling sites were selected for the paired-watershed sampling component of this study (Table 11 and Figure 20). The paired watershed approach involves sampling of both reference (minimally impaired) and impacted watersheds that that were selected based upon available land use data and previously collected water quality data (Craycraft and Schloss, 2008). The sites were selected from among twenty three stream inlet sites previously assessed during the Newfound Lake water/phosphorus budget (Craycraft and Schloss, 2008) and the selected streams represent a gradient of developed land use, 0.5 to 10.2%, based upon pre-existing geographical information system Thermatic Mapper land classification data (New Hampshire GRANIT, 2001). Some study streams were also selected based upon elevated specific conductivity (a surrogate for sodium and chloride runoff) values (Table 11). Rural communities, such as the Newfound Lake watershed community, can experience subtle water quality variations that are associated with differences in land use patterns. Knowledge of the relationships between land use and water quality interactions can be instrumental in helping local decision makers better understand the impacts of localized land use practices. The paired-watershed study expands upon the data collected as part of the Newfound Lake water/nutrient budget and includes the direct measurement of sodium and chloride (road salt constituents) concentrations and soluble reactive phosphorus concentrations which are readily available to stimulate algal plant growth. Nitrate and soluble reactive phosphorus concentrations were also measured to provide insight into potential variations in the application of local fertilizers, agricultural runoff and septic effluent. Total phosphorus, which includes both dissolved and particulate forms, was measured to track variations among watersheds and to provide additional insight into whether the phosphorus transported to the Newfound Stream network is in a dissolved or particulate form. Dissolved phosphorus may be an indication of septic effluent or excessive fertilizer application that are discharge into the surface waters while the total phosphorus can also be associated with periods of erosion that can transport nutrient laden soils into the Newfound tributaries and subsequently into Newfound Lake.

Table 11. Newfound Lake Study Streams.

Study Streams	Site ID	Location: Latitude Longitude	Sampling Location	Watershed Area (acres)	Developed (%)	Rationale for water quality monitoring and assessment
Hemlock Brook	NLRA T01	43°37'51.4" 71°44'09.3"	Junction of Sunset Drive and Route 3A.	894.5	0.7	Reference watershed located adjacent to the similarly sized Tilton Brook watershed.
Tilton Brook	NLRA T02	43°38'15.8" 71°44'09.1"	Near Junction of Route 3A & Whittemore Pt. Road South.	785.5	6.2	"degraded" watershed based on elevated conductivity
Dick Brown Brook	NLRA T03	43°39'28.4" 71°44'14.7"	Near Junction of Route 3A & Whittemore Pt. Road North.	2095.6	0.8	"degraded" watershed based on elevated conductivity
Whittemore Brook	NLRA T04	43°39'58.8" 71°44'41.8"	Near Junction of Route 3A, Paradise Road and Brook Road	2058.8	0.5	Reference watershed located adjacent to the similarly sized Dick Brown Brook watershed.
Cashman Brook	NLRA T09	43°42'09.3" 71°46'31.8"	At junction of Cooper Road and Stony Brook Road	230.2	2.0	"degraded" watershed based on elevated conductivity
Georges Brook	NLRA T10	43°42'19" 71°46'30"	At the junction of Cooper Road and Georges Brook	3031.9	1.4	Watershed fed by a large wetland complex..
Cockermouth River	NLRA T12	43°41'49.4" 71°48'28.8"	At the intersection of Braley Road and the Cockermouth River	16213.3	1.0	Extensively forested large watershed with scattered residential lots and fields.
Mason Brook	NLRA T17	43°40'17.7" 71°47'38.2"	At Camp Wicosutta off of West Shore Road	505.8	1.7	Predominantly forested watershed with a summer camp and grass field immediately upstream.
The Ledges	NLRA T18	43°39'36.1" 71°47'33.7"	At the Ledges condominium development off of West Shore Road	461.8	10.8	Predominantly forested watershed with a dense condominium development.
Bog Brook	NLRA T21	43°37'28.5" 71°46'29.0"	At the intersection of Fowler River Road and Bog Brook	7954.1	1.4	Watershed drained by an extensive wetland complex with scattered development
Fowler River	NLRA T22	43°37'41.0" 71°47'34.4"	As the Fowler River intersects Fowler River Road	12929.1	0.8	Extensively forested large watershed with scattered residential lots and cleared fields.
Black Brook	NLRA T23	43°37'40.2" 71°45'22.7"	Junction of Brown's Beach Road & West Shore Road	581.7	7.2	"degraded" watershed with elevated conductivity and turbidity spikes.

Figure 20. Newfound Lake Paired Watershed Sites



Paired Watershed Sampling Results

Rainfall

Rainfall totals were reviewed from the National Climatic Data Center climatological sampling station, Alexandria 4, located within the Newfound Lake watershed (latitude: 43:38, longitude: 71:48, elevation: 1160.1 feet). Rainfall quantities can be correlated to periods of heavy runoff and concurrent periods of heavy sediment erosion and are thus important to the interpretation of water quality data. The five tributary sampling dates included dry periods, minimal rainfall periods and a period of heavy rainfall and runoff (Table 12). Daily rainfall totals are reported for a two day period that captures the precipitation documented immediately prior to and during the sampling event. Rainfall data were collected at 7:00 AM each day and thus the best indicator of rainfall could be obtained by a review of the two day rainfall totals since most samples were collected in the later morning through the mid-afternoon.

Table 12. Alexandria 4 Climatological Sampling Station daily rainfall totals

Date *	Rainfall (Inches)	Sampling Date / Comments
4/9/2008	0.00	The April 9, 2008 sampling date is representative of the spring runoff period. Deep snowpack, a foot or more, remained on the ground on April 9, 2008.
4/10/2008	0.00	
5/22/2008	0.03	The May 22, 2008 sampling date is representative of the spring base flow period that followed periods of heavy runoff during the months of March and April.
5/23/2008	0.00	
8/11/2008	0.52	The August 11, 2008 sampling date is representative of an intense storm event. The sampling was conducted as the storm subsided and stream discharge was cresting at Black Brook, Fowler River, Cockermouth River, the Ledges and Mason Brook.
8/12/2008	1.48	
8/18/2008	0.00	The August 18, 2008 sampling date is representative of a return to base flow conditions following the intense August 11, 2008 storm event.
8/19/2008	0.43	
10/21/2008	0.00	The October 21, 2008 sampling date is representative of base flow conditions. Samples were collected prior to the rainfall event.
10/22/2008	0.93	

* Water quality samples were collected on the dates denoted by the **bold font**.

Total Phosphorus

Total phosphorus concentrations were variable among sampling dates and among sampling locations. The highest total phosphorus concentrations were consistenly measured at the sampling locations on August 11, 2008 during a high flow sampling period and reached a maximum concentration of 308.1 micrograms per liter (*u*g/l) in the Fowler River (Appendix H). Total phosphorus concentrations were significantly lower during both baseflow periods and spring runoff periods (April 9, 2008).

Soluble Reactive Phosphorus

Soluble reactive phosphorus concentrations were low during the study period and ranged from < 1.0 to 4.4 micrograms per liter (*u*g/l). Most sites were characterized by the highest soluble reactive phosphorus concentrations during the August 11, 2008 stormwater runoff period.

Turbidity

Turbidity measurements were generally low and were generally below one nephlometric turbidity unit (NTU). The highest turbidity measurements were consistently documented on August 11, 2008 for the sampling locations and included a maximum turbidity of 33.6 NTU measured at the Cockermouth River (NLRA T12) sampling station (Appendix H).

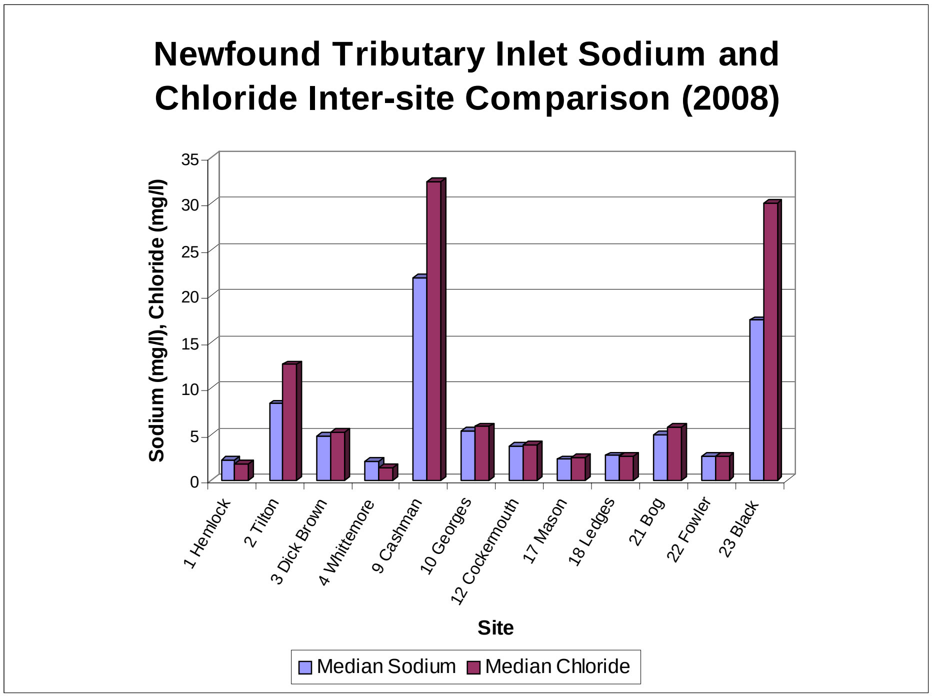
Discharge

Stream discharge volume was highest on August 11, 2008 and coincided with an intense period of rainfall the previous 24 hours. Discharge volumes were also elevated on April 9, 2008 and corresponded to a period of snow pack melt that recharged the tributary inlets (Appendix H). Discharge volumes were significantly lower during the dry sampling dates: May 22, August 18, 2008 and October 21, 2008 (Appendix H).

Sodium and Chloride

Sodium and chloride measurements were highly variable among sampling locations and among sampling dates (Appendix H). The median 2008 sodium and chloride concentrations documented in Cashman Brook and Black Brook were appreciably higher than values documented at the other sampling locations (Figure 21). An examination of similarly sized and adjacent watersheds indicated that the sodium and chloride concentrations in Dick Brown Brook and Tilton Brook were noticeably higher than levels documented in the less developed and adjacent Whittemore Brook and Hemlock Brooks (Table 11 and Figure 21). The sodium and chloride concentrations documented during the August 11, 2008 storm event were lowest at each of the sampling stations while sodium and chloride measurements documented during base flow (low flow) conditions in May tended to be appreciably higher.

Figure 21



Specific Conductivity

The specific conductivity results were highly correlated to the sodium and chloride concentrations (Figures 22 and 23) and followed the general pattern described for the

Figure 22

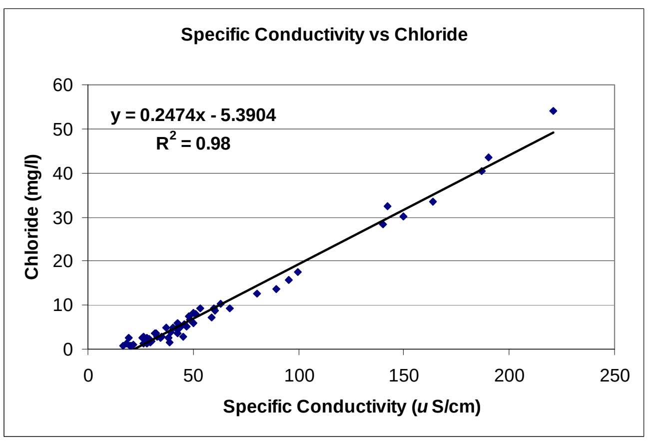
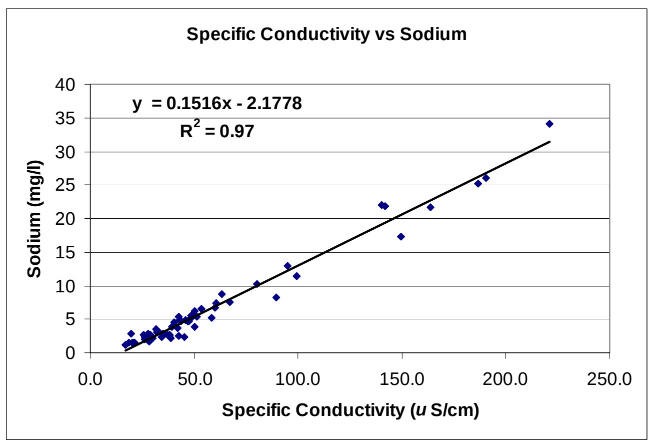


Figure 23

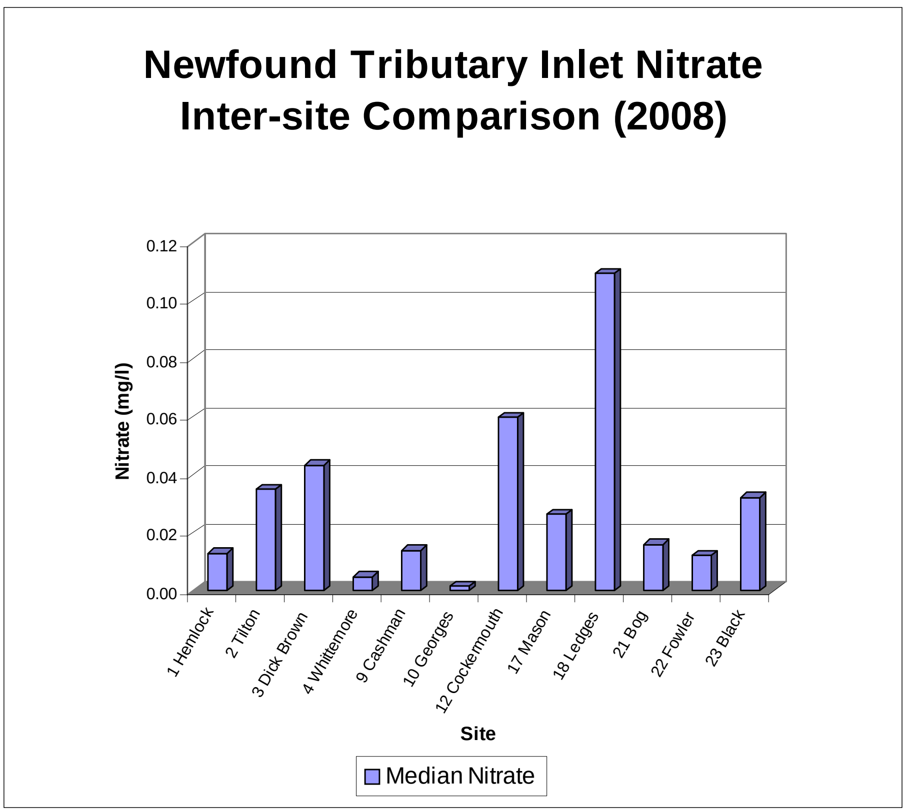


sodium and chloride data. The specific conductivity measurements exhibited a range of 16.7 micro-Siemans per centimeter (*u*S/cm) to 221.1 *u*S/cm during the study period.

Nitrate

To provide some general insight into the nitrate variation among sites, nitrate concentrations were compared and ranged from less than 0.03 milligrams per liter (mg/l) to 0.14 mg/l (Figure 24). Median nitrate concentrations were calculated for each sampling location and a comparison among sampling locations indicated that the highest median nitrate concentration occurred at the Ledges while the Cockermouth river also exhibited elevated nitrate concentrations. On the other hand, the median nitrate concentration documented at Georges Brook was the lowest documented among the sampling stations and was near detection limits. Nitrate concentrations documented at Tilton Brook and Dick Brown Brook were also higher than the corresponding values documented at the less developed, and adjacent, Hemlock Brook and Whittemore Brook watersheds.

Figure 24.



Water Quality Summary

While the Newfound Tributary water quality is generally excellent, storm event sampling during this study reaffirms the threat of phosphorus and sediment loading from upland sources. The August 11, 2008 sampling included turbidity and total phosphorus spikes that exceeded baseline levels by one to two orders of magnitude (Appendix H). Coupled with the high volume of water during the storm event sampling period, significant sediment and nutrient (phosphorus) entered the lake. The data suggest that the majority of the phosphorus entering Newfound Lake through the tributary network is in the form of particulate-bound phosphorus. Thus, measures that stabilize the uplands (i.e. retention of riparian buffers, minimizing impervious surfaces) will help minimize future water quality problems associated with runoff and nutrient loading.

The tributary inlets sampled during this study represent low density development patterns with the level of development ranging from 0.5 to 10.2 %. Sodium and chloride sampling conducted during the study period documented concentrations at the Cashman Brook, Black Brook, Tilton Brook and Dick Brown Brook that exceeded baseline levels. While this study did not identify a clear relationship between percent development and salt concentrations, Black Brook and Tilton Brook exhibit some of the higher levels of developed land in the watershed, 7.2 and 6.2% respectively, and they may be exhibiting the early signs of increased sodium and chloride loading associated with road salt applications. Research conducted through the University of New Hampshire Water Resource Research Center in the Lamprey River (coastal) watershed and the Ossipee River watershed has found a close relationship between percent road pavement or percent impervious surfaces as a predictor of spatial variation in both sodium and chloride (Daley et, al. submitted April 2009). Elevated sodium and chloride concentrations during base flow periods suggests that private well monitoring might be worth conducting in the future to quantify the salt concentrations in drinking water. Sampling of shallow wells may also provide soluble reactive phosphorus and nitrate information that will provide insight into nutrient loading associated with septic system effluent.

DETERMINING WATER QUALITY CHANGES AND TRENDS

Box and Whisker Plots

Quick Overview

A trend analysis for the L02 Mayhew and L03 Pasquaney sampling sites is included in this section using *box-and-whisker* plots that provide a visual representation of how the data are spread out and how much variation exists on an annual basis. The *box-and-whisker* plots also provide a summary of how your data have varied among years and a trendline has been inserted into the graphs to visualize the long-term water quality trend.

These plots illustrate how the data group together for a given year. The line in the “box” represents the sample median, the extent of the “box” represents a statistical range for comparison to another year, the “whiskers” show the boundaries of what could be considered the representative range of all the samples, and any points above or below the whiskers show atypical readings or “outliers” that represent an extreme condition or difference from that year’s data range. An algae bloom event may cause this type of outlier to occur in the chlorophyll data (high point) or Secchi disk clarity (low point).

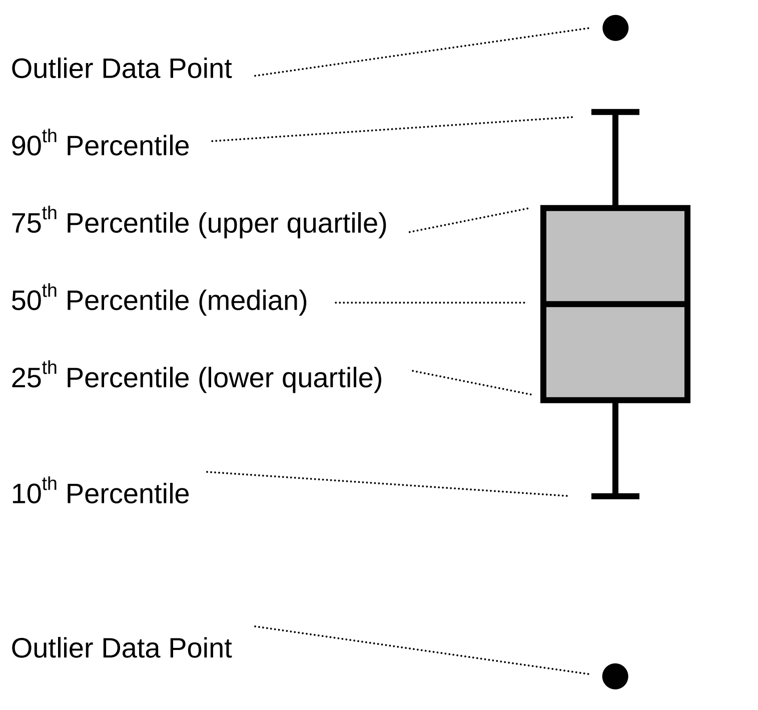
We recommend that each **NH LLMP** participating group plan on collecting weekly or biweekly measurements throughout the sampling season to ensure that enough data are available for this type of statistical analysis. We suggest that at least 8 data collections per year occur and generally set 10 measurements per year as a sampling effort goal per site.

The Details

In the sections below we further describe the use of the box and whisker plot for those that are interested on how they are determined and how they are interpreted:

The **box-and-whisker plot** is good at showing the **extreme values** and the range of middle values of your data (Figure 25). The box depicts the middle values of a variable, while the **whiskers** stretch to demonstrate the values between which 80% of the data points will fall. The filled circles then reflect the “outlier” data points that fall outside of the whiskers and reflect values that are atypically high or atypically low relative to the other data measured for a given year.

Figure 25. Sample Box and Whisker Plot



The box-and-whisker plots can be summarized as a graphic that displays the following important features of the data when they are arranged in order from least to greatest:

- Median (50th percentile) – the middle of the data
- Lower Quartile (25th percentile) – the point below which 25% of the data points are located.
- Upper Quartile (75th percentile) – the point below which 75% of the data points are located.
- 90th Percentile – the point below which 90% of the data points are located.
- 10th Percentile – the point below which 10% of the data points are located.
- Outlier Data points – data points that represent the upper 10% or the lowest 10% of the data collected for a specific year.

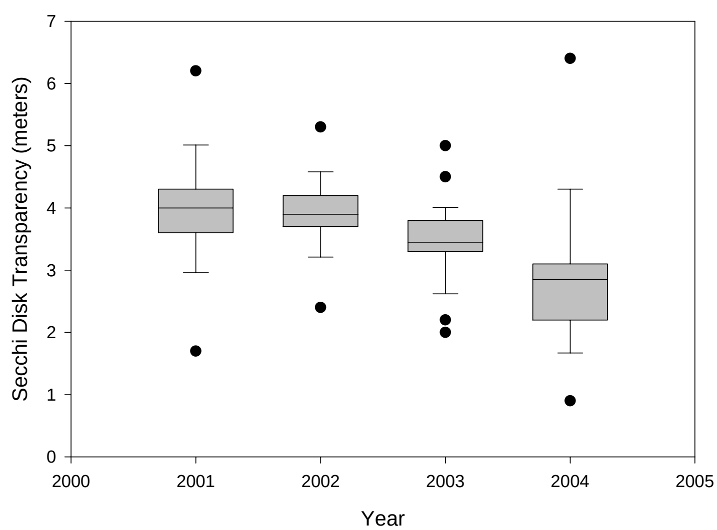
Note: A minimum number of data points is required to compute each feature documented above. At least three points are required to compute the Lower and the Upper Quartiles, five points are needed to compute the 10th percentile, and six points are needed to compute the 90th percentile. In the event that insufficient data points have been collected features will not be graphed due to the inability to reliably calculate the respective attribute.

Sample Box-and-Whisker Plot Interpretation

A sample *box-and-whisker* plot is depicted in Figure 26 and it provides an opportunity to assess the usefulness of this type of plot at interpreting water quality monitoring data. The imaginary data depicted in Figure 26 reflect the annual water transparency measurements between the years 2001 and 2004. As you can glean from Figure 26, the distribution of the water clarity measurements have shifted to less clear conditions between 2001 and 2004. The median values, as well as the upper and lower quartiles (what is represented by the gray shaded box) have gradually shifted to less clear conditions over the four year span. The data points that lie between the upper and lower quartiles reflect 50% of the data collected for a given year and can provide insight into whether or not the water quality data are varying significantly between or among years. In extreme cases, when the gray shaded regions do not overlap between successive years or among years, one can quickly determine that the data distribution is significantly different for those years where the middle data (gray shading) does not overlap. Such differences can reflect long-term trends or can be a reflection of extreme climatic conditions for a given year such as atypically wet or atypically dry conditions that can have a profound impact on water quality.

Figure 26.

Sample Lake - Site 1 Deep
Annual Secchi Disk Transparency Comparisions
Box and Whisker Plots: 2001-2004



Note: The number of outlier data points is dependant on the size of the dataset.

Additional evaluation of the data can include a review of the 10th and the 90th percentiles (the whiskers) that provide additional insight into the distribution of the data. In this case, the trends exhibited by the 10th and the 90th percentiles are following the pattern of decreasing Secchi Disk Transparency as is exhibited by boxes (gray shaded regions). Outlier data points that fall outside of the "whiskers" can also be insightful. Such extreme values can be an early indicator of coming trends or can be an early warning sign of potential water quality problems. For instance, when Secchi Disk transparency measurements occasionally become significantly reduced (i.e. shallower water) such phenomenon can be an indication of short-term water quality problems such as excessive sediment or an algal bloom. If such problems are not contended with, but are instead left unattended, the longer-term impact could result in an increase in the magnitude and frequency of the water transparency reductions that, in turn, would result in a decreasing trend as evidenced by a shift of the "Boxes" to shallower water transparencies. There might also be occasions when the Secchi Disk transparency outliers reflect atypically clear water clarity. Such outliers can be a sign that conditions are improving or, as is often the case, the water quality is responding to short-term climatic variations that can have a profound impact on the water quality data. For instance, the outlier data point of 6.4 meters that was documented in 2004 (Figure 26) is counter intuitive to the long term trend of decreasing water quality. Plausible explanations for such an anomaly could be due to short term overgrazing of algae by zooplankton (typical for moderate to highly productive lakes), an abrupt shift in climate that might have favored clearer water (cloudy days or cooler water) or perhaps there was some sort of human intervention, such as a fish stocking or lake treatment that would have resulted in clearer water claries.

Newfound Lake Long-term Trends

Newfound Lake Data

Water quality data have been collected annually at the L02 Mayhew and the L03 Pasquaney sampling sites since 1986 during which samples have been collected as early as May 22 and as late as October 21. The majority of the data have been collected between June 1 and September 15, among year, and the following trend analysis is based upon the June 1 – September 15 sampling period to ensure the results reflect variations among years rather than variations introduced by the timing of data collection. For instance, measurements collected in the spring and fall oftentimes differ appreciably from the summer samples. If the samples are not consistently collected during the same time period among years, the results might reflect the impact of seasonal water quality fluctuations that can mask the actual long-term trends. Samples have not been consistently collected prior to June or after September 15 in Newfound Lake. The long-term trend graphs are based on volunteer monitor data (1986-2008) and the 2007 and 2008 CFB data.

Newfound Secchi Disk Trends

The 23 year long-term Secchi Disk trend is stable for data collected at L02 Mayhew although significant variations are evident among years (Figure 27). On the other hand, the Secchi Disk transparency documented at L03 Pasquaney Bay (Figure 28) has decreased over the past 22 years (no data were collected in 1995). The Pasquaney Bay sampling site is located in a relatively isolated segment of Newfound Lake and may reflect localized land-use alterations along the shoreline or extending further into the watershed. Similar to the Mayhew Site, the Pasquaney Bay water quality has varied significantly among years. Such water transparency variations can be an indication of annual variations in rainfall that tend to have an impact on water quality. Many lakes experience less water clarity during heavy rainfall years relative to years with below average rainfall. Water transparency reductions during heavy rainfall years would tend to be exacerbated when land clearing and construction activities within the watershed do not follow proper erosion control practices and when development occurs on environmentally sensitive areas such as on steep slopes, immediately adjacent to Newfound Lake and adjacent to the stream inlets.

Figure 27.

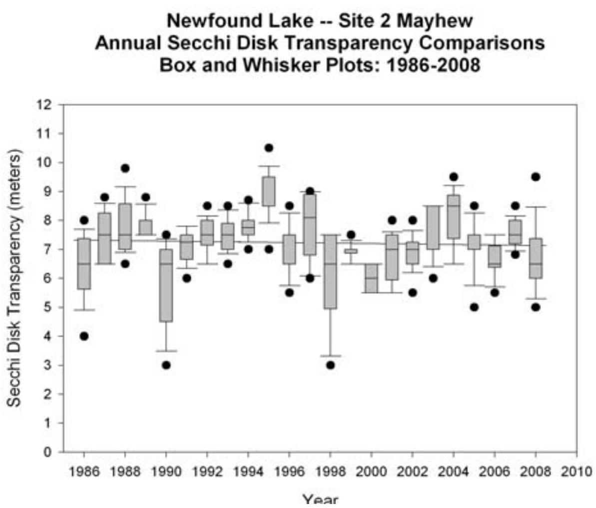
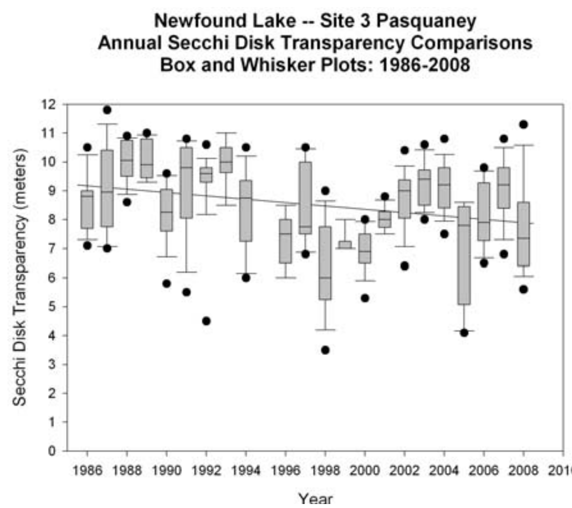


Figure 28.



<u>Newfound Lake Chlorophyll *a* Trends</u>

Sites L02 Mayhew and L03 Pasquaney both exhibit a gradual trend of increasing chlorophyll *a* concentrations over the 23 and 22 year periods, respectively (Figures 29 and 30). Similar to the annual Secchi Disk transparency graphs, the chlorophyll *a* graphs indicate a large degree of annual variation that may reflect fluctuations in rainfall among years, as well as, the influence of development that has the potential to increase the sediment and nutrient runoff into Newfound Lake.

Figure 29

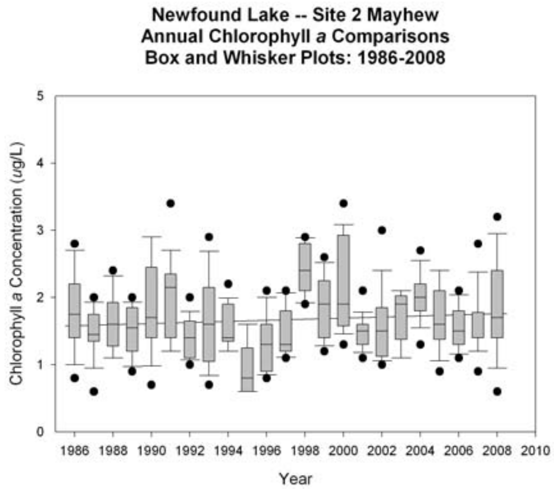
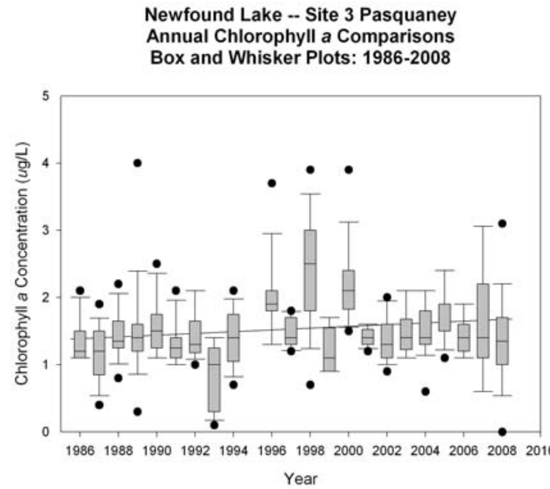


Figure 30



CONCLUSIONS AND RECOMMENDATIONS

Everyone in the watershed has a stake in Newfound Lake. Some enjoy the lake and tributaries directly by participating in recreational opportunities including swimming, boating and fishing while others benefit indirectly through increased revenues associated with tourism and an expanded tax base associated with waterfront property. This report highlights threats to the lake as well as action that can be taken by municipal officials and members of the public who are stewards of the lake and the surrounding uplands.

The overall condition of Newfound Lake, measured at open water deep sampling sites, is excellent and the lake is characterized by some of the clearer water in New Hampshire. However, upon closer examination, one will observe a gradient of clearer water north of Mayhew Island and less clear, greener and more nutrient enriched water south of Mayhew Island. Such variations in water quality can be naturally occurring but can also be a reflection of human activities. In the case of Newfound Lake, the more developed region is located south of Mayhew Island where the poorest (relatively speaking) water quality was documented.

Esherichia coli (E. coli)

Supplemental near-shore water quality sampling also documented localized water quality variations that were not evident from standard deep site sampling described above. Short-term *E. coli* bacteria spikes, an indicator of fecal contamination, were documented near the mouths of the Cockermouth and Fowler Rivers following periods of heavy rainfall. The larger stream inlets act as conduits that transport pollutants from the uplands into Newfound Lake and thus are areas where protective measures are warranted to maintain the high water quality. Sources of fecal contamination could be associated with natural wildlife activities near the stream channel or they may reflect fecal contamination from upland sources associated with septic effluent, livestock, pets, etc. While this study did not distinguish between the different sources, it is clear that poorly thought out land use alterations may have an adverse impact on the in-lake water quality through channelized and augmented watershed runoff.

Total Phosphorus

Total phosphorus (nutrient) concentrations were generally low around the lake periphery but did include periodic spikes near the major tributary inlets (Cockermouth and Fowler Rivers). Total phosphorus concentrations were also elevated at the Hebron Marsh sites and reflect a higher level of localized lake productivity. The Hebron Marsh is at a later stage of lake aging (eutrophication) relative to the remainder of Newfound Lake and is characterized by greater accumulations of organic matter along the lake bottom and elevated macroscopic plant growth. While Hebron Marsh represents a natural progression from a young to an older water body it is a reminder that shallow areas in Newfound Lake, particularly around the periphery of the lake, are susceptible to localized water quality degradation.

Periphyton (Attatched Algae)

Artificial substrate samplers reaffirm that Newfound Lake is susceptible to localized nutrient inputs and is characterized by water quality variations reflecting land cover and land use around the periphery of the lake. These periphyton substrate samplers integrate the longer-term impacts of nutrient runoff (2 week – 4 week periods) that can be overlooked when more typical "snapshot" water quality sampling is undertaken at a particular day and time. For instance, a reference sampling station located along a forested shoreline (P-3 Beachwood) was consistently characterized by less algal growth (a response to less nutrient loading) than the corresponding sampling location located near the Hemlock Brook (P-5) tributary inlet (Figures 31 and 32 and Appendix F).

Sediments

Sediment (benthic) core samples collected along the Newfound Lake bottom varied among sampling locations and exhibited a gradient of increasing phosphorus content as the sediments became more organic. It was also noted that aquatic plant growth tended to be more abundant in areas characterized by more organic and finer sediment relative to areas characterized by coarser grained material (i.e. sand) that is also low in phosphorus. The relationship between phosphorus content and organic matter should be a reminder of the threats associated with erosion of upland soils, both adjacent to the lake and that extend miles away, which can be channelized into the lake through its tributaries. The finer, nutrient laden organic sediments tend to settle out around the lake perimeter and favor the colonization of the shallows by aquatic plants. The loss of upland soils reduces soil fertility which has long-term implications related to agricultural and forest productivity in the watershed.

Figure 31. Site P-3 Beachwood (September 24, 2008)

Figure 32. Site P-5 Hemlock (September 24, 2008)

The greatest amount of tributary phosphorus loading documented among five sampling dates in 2008 occurred during an intense rainfall event on August 11. Such short-term nutrient loading events may be associated with increased periphyton growth, discussed above, around the periphery of Newfound Lake. The total phosphorus and turbidity spikes during high flow periods are a reminder that stormwater management and proper erosion control measures are important to protecting both the in-stream (tributary) and lake water quality. Consideration should be given to both short-term (during construction) and permanent stormwater management options that are capable of attenuating sediment, phosphorus and other pollutants before they discharge into the streams and subsequently into Newfound Lake.

Road Salt

Road salt constituents, sodium and chloride, were elevated above baseline levels in both Cashman Brook and Black Brook, suggesting anthropogenic (human) impacts. Data collected in the adjacent streams of the similarly sized Hemlock Brook and Tilton Brook watersheds, as well as the adjacent streams of the similarly sized Dick Brown Brook and Whittemore Brook watersheds, revealed differences in sodium and chloride concentrations. Interestingly, a recent analysis of data through the University of New Hampshire Water Resource Research Center has found a close relationship between percent road pavement and both sodium and chloride (Daley et, al. in Prep). Thus, it is possible that some variation in salt concentrations are associated with the quantity of paved surfaces in the stream catchments that receive road salt applications during the winter months. The United States Environmental Protection Agency (EPA) has set a chronic chloride threshold of 230 milligrams per liter (mg/l) for aquatic life impacts. While the current study did not include private well water sampling it is worth noting that the EPA recognizes the threat of sodium to patients with hypertension and requires public water suppliers to report sodium levels above 20 mg/l so physicians can advise patients with hypertension. Data collected through this study found a close correlation between both sodium and chloride and field specific conductivity measurements. Future specific conductivity measurements might serve as a low cost surrogate for documenting variations in salt concentrations among sampling locations both spatially and temporally.

Based on data collected as part of this study and data collected through the previous Newfound Lake water/phosphorus budget (Craycraft and Schloss, 2008), developmental pressures continue to pose a threat to our New Hampshire lakes and may coincide with degraded water quality. The Towns of Alexandria, Bristol, Bridgewater, Danbury, Dorchester, Groton, Hebron, Plymouth and Orange might consider proactively adopting zoning and regulations that foster natural resource conservation and that concurrently minimize water quality degradation.

Some General Considerations Include:

Steep Slopes create increased runoff water velocities, which cause increased sediment (and concurrent phosphorus) mobilization. Shoreline areas, such as the area near Follansbee Cove, are characterized by steep sloped terrain while the Newfound Lake watershed is comprised of an extensive network of feeder streams that are largely characterized by relatively steep-sloped sub-watersheds highly susceptible to perturbation. Future land use management efforts should be directed towards maximizing riparian (shoreline) vegetation, which will reduce the water velocity and will both physically (i.e. filter) and chemically (i.e. plant uptake) remove nutrients. Slopes of 15% and greater compose 56.2% of the Newfound Lake watershed and characterize the headwaters of most tributary inlets (Craycraft and Schloss, 2008). Steep sloped regions should be carefully managed to preserve vegetation and prevent soil erosion.

Riparian (shoreside) Buffers provide many natural functions that include the protection of water quality and the preservation and enhancement of in-stream and in-lake fishery and wildlife habitat. The New Hampshire Comprehensive Shoreland Protection Act (CSPA) regulates land clearing, development and fertilization activities within a 250 foot jurisdictional area adjacent to Newfound Lake and Spectacle Pond, as well as, specified segments of the Cockermouth and Fowler Rivers. The CSPA should be consulted prior to removing any shoreside vegetation within 250 feet of the aforementioned water bodies. However, most of the steep sloped regions are not regulated by the CSPA and thus it falls upon local municipalities and landowners to minimize unintended environmental impacts in steep-sloped terrain.

When construction is undertaken, riparian cover should be maintained and diverted stormwater runoff should be directed towards vegetated regions where water will infiltrate the ground and minimize water quality impacts. Foresight should also be given to ensure that any implemented Best Management Practices (BMPs) are properly designed for the site-specific conditions and that a long-term maintenance plan, that includes regular inspections and corrective actions (when necessary), is followed.

Impervious Surfaces such as roads, driveways, houses and out-buildings tend to concentrate, and accelerate overland waterflow, and thus increase the potential for sediment and phosphorus loading. Roads, homes and other structures cover the soil with impenetrable materials that reduce the natural infiltration and purification of water. Instead, the water often flows directly to the lake and tributaries as channelized and/or sheet runoff which can carry with it a significant phosphorus and sediment load. Homeowners should consider implementing erosion control measures including check dams, plunge pools, water bars and vegetated buffers that will attenuate stormwater runoff from impervious surfaces. Any existing pipes and culverts that bring concentrated flow directly to the shore should be daylighted and the water diverted or infiltrated. An inspection and long-term maintenance plan is a critical component of ensuring the long-term effectiveness of all erosion control measures. Again, the CSPA contains regulations that are in effect within 250 feet of the shorelines of Newfound Lake and the lower reaches of the Cockermouth and the Fowler Rivers.

Town officials should consider adopting a strategy to minimize water quality impacts associated with road construction. As the population grows, the road network will likely be improved. Improvements to existing roads and construction of new roads requires implementation of proper erosion control measures to minimize the adverse impacts to surface water and to minimize the expenses associated with long-term road maintenance. Drainage systems that were adequate for rough and semi-pervious gravel roads will not be able to handle the increased velocities and water volumes of paved roads; many more water turnouts and diversions will be required when roads are paved. The size of culverts may need to be increased to carry heavier storm flows. Road runoff should never go directly into the lake or any tributary but instead should be directed to a vegetated area that can reduce the velocity and increase infiltration.

Wetland Complexes are found within the Newfound watershed and include extensive wetland complexes in the Georges Brook and in the Bog Brook sub-watersheds. Wetland systems play a large role in mitigating flow and shunting nutrients but can also be highly susceptible to perturbation. Care needs to be taken when roads and driveways are improved so they do not interrupt these networks nor create excessive water loadings or sedimentation into these systems that can greatly reduce the wetland functionality as well as destroy critical wildlife habitat.

Septic System effluent is laden with phosphorus and is thought to constitute a significant portion of the phosphorus reaching many of our New Hampshire lakes. Aging septic systems, along with the conversion of homes from seasonal to year round use (which increases the annual load), often exacerbate the problems. While the scope of this study did not measure the impacts of septic systems bordering the lake shore and the tributaries, direct measurements of groundwater seepage in Mendums Pond (Schloss et al., 2009) identified septic systems as one of the major phosphorus sources that occur during the dry summer months. For the Newfound watershed, any marginal systems will continue to pose a threat due to the well to excessively-drained soils around the lake and the close proximity of lakeshore homes to the lake. Septic systems have been shown to contribute a significant phosphorus load to Flint Pond (Hollis) where a combination of sandy soils, aging septic systems and conversions from seasonal to year round use existed. Even a well functioning septic system can contribute significant phosphorus load to the lake (Conner and Bowser, 1997). Thus, residents within the Newfound Lake watershed might consider installing low volume fixtures to limit the water used and thus reduce the phosphorus load. Local building codes could be amended to incorporate water-conserving appliances and fixtures. The NLRA might consider working with interested Towns to facilitate a timely septic tank inspection and pumping schedule that will facilitate a bulk-rate discount for watershed residents.

Stream Bank Undercutting and Destabilization (Watershed-wide Erosion Concerns) The Newfound watershed, as previously discussed, is characterized by steep slopes that accelerate water flow and in extreme cases scour substrate materials such as cobble and boulders during high flow periods. Evidence of extensive bank undercutting was observed in numerous tributaries (Figures 33 - 35). The figures also reflect the stabilizing capacity of the riparian vegetation and root systems that are prevalent along most stream channels. Some might consider the root systems as natural "re-bar" that effectively stabilizes the shoreline and minimizes erosion into our New Hampshire streams and lakes. As previously discussed, the majority of the Newfound Lake watershed is forested and includes extensive riparian vegetation along the tributary network. Future conservation efforts should foster the retention of riparian vegetation and, when possible, the reestablishment of riparian vegetation in regions where it has been removed. Riparian cover not only minimizes the phosphorus and sediment loading into surface waters but it also enhances fishery habitat and provides travel corridors for wildlife species.

Figure 33. Whittemore Brook bank undercutting
(August 30, 2007)

The following pages contain some more generic recommendations for maintaining healthy lakes that can be copied and distributed to watershed residents to let them know what can be done to protect their valued water resources.

Figure 34. Cockermouth River (Site 12 Cockermouth) bank undercutting (Photographed August 17, 2007)

Figure 35. Fowler River (Site 22 Fowler) bank undercutting (Photographed August 17, 2007)

Recommendations for Healthy Lakeshore and Streamside Living

- Encourage shoreside vegetation and protect wetlands - shoreside vegetation (what is also known as **riparian vegetation**) and wetlands provide a protective buffer that "traps" pollutants before reaching the lake. These buffers remove materials both chemically (through biological uptake) and physically (settling materials out). As riparian buffers are removed and wetlands lost, pollutant materials are more likely to enter the lake and in turn, favor declining water quality. Shoreline vegetation grown tall will also discourage geese and shade the water reducing the possibility of aquatic weed recruitment.

- Limit fertilizer applications - fertilizers entering the lake can stimulate aquatic plant and algal growth and in extreme cases result in noxious algal blooms. Increases in algal growth tend to diminish water transparency and under extreme cases culminate in surface "scums" that can wash up on the shoreline and can also produce unpleasant smells as the material decomposes. Excessive nutrient concentrations also favor algal forms known to produce toxins which irritate the skin and under extreme conditions, are dangerous when ingested. Use low maintenance grasses such as fescues that require less nutrients and water to grow. After a lawn is established a single application of fertilizer in the late fall is generally more than adequate to maintain a healthy growth. Oftentimes a simple pH adjustment will do more good and release nutrients already in the soils.

- Limit organic matter loading - organic matter (leaves, grass clippings, etc.) are a major source of nutrients in the aquatic environment. As the vegetative matter decomposes nutrients are "freed up" and can become available for aquatic plant and algal growth. In general, we are not concerned with this material entering the lake naturally (leaf senescence in the fall) but rather excessive loading of this material as occurs when residents dump or rake leaf litter and grass clippings into the lake. This material not only provides large nutrient reserves which can stimulate aquatic plant and algal growth but also makes great habitat for leaches and other potentially undesirable organisms in swimming areas.

- Limit the loss of vegetative cover and the creation of impervious surfaces - A forested watershed offers the best protection against pollutant runoff. Trees and tall vegetation intercept heavy rains that can erode soils and surface materials. The roots of these plants keep the soils in place, process nutrients and absorb moisture so the soils do not wash out. Impervious surfaces (paved roads, parking lots, building roofs, etc.) reduce the water's capacity to infiltrate into the ground, and in turn, go through nature's water purification system. As water seeps into the soil, pollutants are removed from the runoff through absorption onto soil particles. Biological processes detoxify substances and/or immobilize substances. Surface water runoff over impervious surfaces also increases water velocities which favor the transport of a greater load of suspended and dissolved pollutants into your lake.

- Discourage the feeding ducks and geese – ducks and geese that are locally fed tend to concentrate around the known food source and can result in localized water quality problems. Waterfowl quickly process food into nutrients that are capable of stimulate microscopic plant "algal" growth. Ducks and Geese are also host to the parasite responsible for swimmers itch. While not a health threat, swimmers itch is very uncomfortable.

- Maintain Septic Systems - faulty septic systems are a big concern as they can be a primary source of water pollution around our lakes in the summer. Septic systems are loaded with nutrients and can also be a health threat when not functioning properly. Inspect your system on a timely basis and pump out the septic tank every three to five years depending on tank capacity and household water use.

Note: Consult materials such as those listed below, for further guidance on assessing and implementing corrective actions that can maintain or improve the quality of surface and subsurface (septic) runoff that may otherwise impact water quality.

- Pipeline: Summer 2008 Vol. 19, No. 1. Septic Systems and Source Water Protection: Homeowners can help improved community water quality. http://www.nesc.wvu.edu/pdf/WW/publications/pipline/PL_SU08.pdf
- Landscaping at the Water's Edge: an Ecological Approach. $20.00/ea University of New Hampshire Cooperative Extension Publications Center, Nesmith Hall, 131 Main Street, Durham NH 03824. www.extension.unh.edu/publications
- Integrated Landscaping: Following Nature's Lead. $20.00/ea University of New Hampshire Cooperative Extension Publications Center, Nesmith Hall, 131 Main Street, Durham NH 03824 www.extension.unh.edu/publications
- New Hampshire Department of Environmental Services fact sheet series (all topics) http://des.nh.gov/organization/commissioner/pip/factsheets/index.htm

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New Hampshire Department of Environmental Services. December 2008. New Hampshire Stormwater Manual Volume 3: Erosion and Sediment Controls During Construction. http://des.nh.gov/organization/divisions/water/stormwater/manual.htm

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Schloss, Jeffrey A., Robert C. Craycraft and Susan E. Wilderman. 2009. Final Report: Nutrient and Water Budget Mendums Pond Watershed Assessment. February 2009. UNH Center for Freshwater Biology, UNH Cooperative Extension. University of New Hampshire. Durham, NH. CFB Report # 2009-2-001.

APPENDIX A. Newfound In-lake Water Quality Sampling Data Summary: 2007 and 2008 (Task 6)

Site	Date	Depth (meters)	Start Time (hh:mm)	Finish Time (hh:mm)	Stratum	pH (std units)	Carbon Dioxide (mg/l)	Carbon Dioxide (replicate) (mg/l)	Alkalinity gray end pt. @ pH 5.1 (mg/l)	Alkalinity gray end pt. @ pH 5.1 (replicate) (mg/l)
1 Deep	7/23/2007	0.5	9:18	10:13	epilimnion	-----	1.1	-----	3.8	-----
1 Deep	7/23/2007	3.5	9:18	10:13	epilimnion	-----	-----	-----	-----	-----
1 Deep	7/23/2007	9.5	9:18	10:13	metalimnion	-----	1.0	-----	3.5	-----
1 Deep	7/23/2007	28.0	9:18	10:13	hypolimnion	-----	3.2	3.7	3.2	3.4
1 Deep	7/23/2007	0-7.0	9:18	10:13	epilimnion (composite "hose" sample)	-----	-----	-----	3.8	-----
1 Deep	8/13/2007	0.5	9:35	10:15	epilimnion	-----	1.0	-----	2.7	-----
1 Deep	8/13/2007	4.0	9:35	10:15	epilimnion	-----	1.1	-----	2.1	-----
1 Deep	8/13/2007	8.5	9:35	10:15	metalimnion	-----	0.9	-----	2.1	-----
1 Deep	8/13/2007	29.0	9:35	10:15	hypolimnion	-----	3.5	3.4	1.6	-----
1 Deep	8/13/2007	0-7.0	9:35	10:15	epilimnion (composite "hose" sample)	-----	-----	-----	2.0	-----
1 Deep	9/17/2007	0.5	9:40	10:30	epilimnion	-----	0.9	-----	3.4	-----
1 Deep	9/17/2007	6.0	9:40	10:30	epilimnion	-----	0.9	-----	3.4	-----
1 Deep	9/17/2007	13.5	9:40	10:30	metalimnion	-----	2.2	-----	2.9	-----
1 Deep	9/17/2007	29.0	9:40	10:30	hypolimnion	-----	3.2	-----	3.1	-----
1 Deep	9/17/2007	0-8.0	9:40	10:30	epilimnion (composite "hose" sample)	-----	-----	-----	3.0	-----
2 Mayhew	7/23/2007	0.5	14:16	14:55	epilimnion	-----	1.3	-----	3.8	-----
2 Mayhew	7/23/2007	3.5	14:16	14:55	epilimnion	-----	1.1	-----	3.5	-----
2 Mayhew	7/23/2007	7.0	14:16	14:55	metalimnion	-----	1.4	-----	-----	-----
2 Mayhew	7/23/2007	12.0	14:16	14:55	hypolimnion	-----	6.8	7.2	3.6	3.7
2 Mayhew	7/23/2007	0-6.0	14:16	14:55	epilimnion (composite "hose" sample)	-----	-----	-----	-----	-----
2 Mayhew	8/13/2007	0.5	17:55	18:20	epilimnion	-----	0.7	-----	2.2	-----
2 Mayhew	8/13/2007	3.0	17:55	18:20	epilimnion	-----	1.3	-----	2.3	-----
2 Mayhew	8/13/2007	8.5	17:55	18:20	metalimnion	-----	0.6	-----	2.4	-----
2 Mayhew	8/13/2007	15.5	17:55	18:20	hypolimnion	-----	11.3	-----	3.2	-----
2 Mayhew	8/13/2007	0-6	17:55	18:20	epilimnion (composite "hose" sample)	-----	-----	-----	2.7	-----
2 Mayhew	9/17/2007	0.5	14:30	15:00	epilimnion	-----	1.0	-----	3.3	-----
2 Mayhew	9/17/2007	5.0	14:30	15:00	epilimnion	-----	0.9	-----	3.4	-----
2 Mayhew	9/17/2007	11.0	14:30	15:00	metalimnion	-----	8.3	-----	4.3	-----
2 Mayhew	9/17/2007	14.5	14:30	15:00	hypolimnion	-----	12.6	12.2	5.0	-----
2 Mayhew	9/17/2007	0-8.0	14:30	15:00	epilimnion (composite "hose" sample)	-----	-----	-----	3.5	-----
3 Pasquaney	7/23/2007	0.5	13:13	13:53	epilimnion	-----	1.1	-----	3.5	-----
3 Pasquaney	7/23/2007	3.0	13:13	13:53	epilimnion	-----	1.0	-----	3.7	-----
3 Pasquaney	7/23/2007	6.5	13:13	13:53	metalimnion	-----	1.1	-----	3.3	-----
3 Pasquaney	7/23/2007	13.0	13:13	13:53	hypolimnion	-----	1.1	1.3	3.4	3.6
3 Pasquaney	7/23/2007	0-4.5	13:13	13:53	epilimnion (composite "hose" sample)	-----	-----	-----	3.8	-----
3 Pasquaney	8/13/2007	0.5	10:35	11:10	epilimnion	-----	0.7	-----	3.0	-----
3 Pasquaney	8/13/2007	4.0	10:35	11:10	epilimnion	-----	< 0.5	-----	3.1	-----
3 Pasquaney	8/13/2007	8.5	10:35	11:10	metalimnion	-----	0.6	-----	2.7	-----

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Site	Date	Depth (meters)	Start Time (hh:mm)	Finish Time (hh:mm)	Stratum	pH (std units)	Carbon Dioxide (mg/l)	Carbon Dioxide (replicate) (mg/l)	Alkalinity gray end pt. @ pH 5.1 (mg/l)	Alkalinity gray end pt. @ pH 5.1 (replicate) (mg/l)
3 Pasquaney	8/13/2007	12.3	10:35	11:10	hypolimnion	-----	0.7	-----	2.5	-----
3 Pasquaney	8/13/2007	0-7.0	10:35	11:10	epilimnion (composite "hose" sample)	-----	-----	-----	3.0	-----
3 Pasquaney	9/17/2007	0.5	13:30	13:50	epilimnion	-----	0.9	-----	3.3	-----
3 Pasquaney	9/17/2007	5.0	13:30	13:50	epilimnion	-----	1.0	-----	3.4	-----
3 Pasquaney	9/17/2007	12.0	13:30	13:50	hypolimnion	-----	1.0	-----	3.3	-----
3 Pasquaney	9/17/2007	0-8.0	13:30	13:50	epilimnion (composite "hose" sample)	-----	-----	-----	3.3	-----
4 Loon Island	7/23/2007	0.5	12:35	12:57	epilimnion	-----	1.1	-----	3.6	-----
4 Loon Island	7/23/2007	0-5.5	12:35	12:57	epilimnion (composite "hose" sample)	-----	-----	-----	3.4	-----
4 Loon Island	8/13/2007	0.5	15:25	15:55	epilimnion	-----	0.6	-----	2.8	-----
4 Loon Island	8/13/2007	3.0	15:25	15:55	epilimnion	-----	0.6	-----	2.5	-----
4 Loon Island	8/13/2007	5.5	15:25	15:55	metalimnion	-----	0.6	-----	2.6	-----
4 Loon Island	8/13/2007	0-6.0	15:25	15:55	epilimnion (composite "hose" sample)	-----	-----	-----	2.5	-----
4 Loon Island	9/17/2007	0.5	13:05	13:20	epilimnion	-----	1.2	-----	3.4	-----
4 Loon Island	9/17/2007	0-8.0	13:05	13:20	epilimnion (composite "hose" sample)	-----	-----	-----	3.3	-----
5 Cockermouth	7/23/2007	0.5	11:57	12:25	epilimnion	-----	1.1	-----	3.7	-----
5 Cockermouth	7/23/2007	0-6.0	11:57	12:25	epilimnion (composite "hose" sample)	-----	-----	-----	3.4	-----
5 Cockermouth	8/13/2007	0.5	14:20	15:15	epilimnion	-----	0.9	-----	4.0	-----
5 Cockermouth	8/13/2007	3.0	14:20	15:15	epilimnion	-----	0.8	-----	2.0	-----
5 Cockermouth	8/13/2007	9.0	14:20	15:15	metalimnion	-----	0.7	-----	3.0	-----
5 Cockermouth	8/13/2007	19.0	14:20	15:15	hypolimnion	-----	3.1	3.2	2.3	2.6
5 Cockermouth	8/13/2007	0-6.0	14:20	15:15	epilimnion (composite "hose" sample)	-----	-----	-----	3.0	-----
5 Cockermouth	9/17/2007	0.5	12:25	12:45	epilimnion	-----	0.9	-----	3.3	-----
5 Cockermouth	9/17/2007	5.0	12:25	12:45	epilimnion	-----	1.0	-----	3.3	-----
5 Cockermouth	9/17/2007	14.5	12:25	12:45	hypolimnion	-----	3.0	-----	3.2	-----
5 Cockermouth	9/17/2007	0-8.0	12:25	12:45	epilimnion (composite "hose" sample)	-----	-----	-----	3.3	-----
6 Beachwood	7/23/2007	0.5	11:10	11:47	epilimnion	-----	0.9	-----	3.7	-----
6 Beachwood	7/23/2007	9.0	11:10	11:47	metalimnion	-----	1.1	-----	3.6	-----
6 Beachwood	7/23/2007	15.5	11:10	11:47	hypolimnion	-----	2.8	-----	3.5	-----
6 Beachwood	7/23/2007	0-8.0	11:10	11:47	epilimnion (composite "hose" sample)	-----	-----	-----	3.6	-----
6 Beachwood	8/13/2007	0.5	16:10	16:40	epilimnion	-----	0.7	-----	2.6	-----
6 Beachwood	8/13/2007	3.0	16:10	16:40	epilimnion	-----	0.7	-----	2.7	-----
6 Beachwood	8/13/2007	8.0	16:10	16:40	metalimnion	-----	0.7	-----	3.1	-----
6 Beachwood	8/13/2007	16.5	16:10	16:40	hypolimnion	-----	1.0	-----	2.8	2.9
6 Beachwood	8/13/2007	0-6.0	16:10	16:40	epilimnion (composite "hose" sample)	-----	-----	-----	2.6	-----
6 Beachwood	9/17/2007	0.5	11:45	12:10	epilimnion	-----	0.8	-----	3.3	-----
6 Beachwood	9/17/2007	6.0	11:45	12:10	epilimnion	-----	0.7	-----	3.3	-----
6 Beachwood	9/17/2007	13.0	11:45	12:10	metalimnion	-----	1.4	-----	3.4	3.1
6 Beachwood	9/17/2007	14.5	11:45	12:10	hypolimnion	-----	2.5	-----	3.1	-----

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Site	Date	Depth (meters)	Start Time (hh:mm)	Finish Time (hh:mm)	Stratum	pH (std units)	Carbon Dioxide (mg/l)	Carbon Dioxide (replicate) (mg/l)	Alkalinity gray end pt. @ pH 5.1 (mg/l)	Alkalinity gray end pt. @ pH 5.1 (replicate) (mg/l)
6 Beachwood	9/17/2007	0-8.0	11:45	12:10	epilimnion (composite "hose" sample)	-----	-----	-----	3.3	-----
7 Fowler	7/23/2007	0.5	15:31	15:33	epilimnion	-----	-----	-----	-----	-----
7 Fowler	8/13/2007	0.5	17:40	17:41	epilimnion	-----	-----	-----	2.7	-----
8 Follensbee	7/23/2007	0.5	10:20	10:55	epilimnion	-----	0.9	-----	3.6	-----
8 Follensbee	7/23/2007	8.0	10:20	10:55	metalimnion	-----	1.1	-----	3.4	-----
8 Follensbee	7/23/2007	13.0	10:20	10:55	hypolimnion	-----	2.9	-----	3.3	-----
8 Follensbee	7/23/2007	0-6.5	10:20	10:55	epilimnion (composite "hose" sample)	-----	-----	-----	4.1	-----
8 Follensbee	8/13/2007	0.5	17:00	17:30	epilimnion	-----	0.7	-----	2.6	-----
8 Follensbee	8/13/2007	4.0	17:00	17:30	epilimnion	-----	1.1	-----	2.8	-----
8 Follensbee	8/13/2007	9.5	17:00	17:30	metalimnion	-----	0.9	-----	2.6	-----
8 Follensbee	8/13/2007	12.5	17:00	17:30	hypolimnion	-----	1.6	-----	2.2	-----
8 Follensbee	8/13/2007	0-7.5	17:00	17:30	epilimnion (composite "hose" sample)	-----	-----	-----	3.2	-----
8 Follensbee	9/17/2007	0.5	11:00	11:31	epilimnion	-----	0.9	-----	3.4	3.4
8 Follensbee	9/17/2007	6.0	11:00	11:31	epilimnion	-----	0.7	-----	3.2	-----
8 Follensbee	9/17/2007	13.5	11:00	11:31	hypolimnion	-----	2.0	-----	3.3	-----
8 Follensbee	9/17/2007	0-8.0	11:00	11:31	epilimnion (composite "hose" sample)	-----	-----	-----	3.3	-----
1 Deep	6/11/2008	0.5	12:30	13:29	epilimnion	------	------	-----	-----	-----
1 Deep	6/11/2008	4.5	12:30	13:29	metalimnion	------	------	-----	-----	-----
1 Deep	6/11/2008	30.0	12:30	13:29	hypolimnion	------	------	-----	-----	-----
1 Deep	6/11/2008	0-3.0	12:30	13:29	epilimnion (composite "hose" sample)	------	------	-----	-----	-----
2 Mayhew	6/11/2008	0.5	10:30	11:45	epilimnion	------	------	-----	-----	-----
2 Mayhew	6/11/2008	1.5	10:30	11:45	epilimnion	------	------	-----	-----	-----
2 Mayhew	6/11/2008	4.5	10:30	11:45	metalimnion	------	------	-----	-----	-----
2 Mayhew	6/11/2008	13.5	10:30	11:45	hypolimnion	------	------	-----	-----	-----
2 Mayhew	6/11/2008	0-3.0	10:30	11:45	epilimnion (composite "hose" sample)	------	------	-----	-----	-----
1 Deep	7/2/2008	0.5	10:48	11:36	epilimnion	------	1.5	1.2	2.9	3.1
1 Deep	7/2/2008	7.0	10:48	11:36	metalimnion	------	1.2	1.3	3.0	-----
1 Deep	7/2/2008	30.0	10:48	11:36	hypolimnion	------	3.9	3.5	2.9	3.0
1 Deep	7/2/2008	0-4.0	10:48	11:36	epilimnion (composite "hose" sample)	------	------	-----	3.0	-----
2 Mayhew	7/2/2008	0.5	9:45	10:28	epilimnion	------	1.1	-----	3.1	-----
2 Mayhew	7/2/2008	5.5	9:45	10:28	metalimnion	------	1.4	1.2	3.0	3.2
2 Mayhew	7/2/2008	13.0	9:45	10:28	hypolimnion	------	4.4	4.9	2.9	3.0
2 Mayhew	7/2/2008	0-3.5	9:45	10:28	epilimnion (composite "hose" sample)	------	------	-----	3.6	-----
3 Pasquaney	7/2/2008	0.5	11:50	12:24	epilimnion	------	1.2	-----	2.9	-----
3 Pasquaney	7/2/2008	7.5	11:50	12:24	metalimnion	------	1.5	1.6	2.7	3.2
3 Pasquaney	7/2/2008	13.5	11:50	12:24	hypolimnion	------	3.2	3.2	3.0	3.0
3 Pasquaney	7/2/2008	0-4.0	11:50	12:24	epilimnion (composite "hose" sample)	------	------	-----	2.9	-----
4 Loon Reef	7/2/2008	0.5	12:42	13:11	epilimnion	------	1.0	-----	3.2	-----

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Site	Date	Depth (meters)	Start Time (hh:mm)	Finish Time (hh:mm)	Stratum	pH (std units)	Carbon Dioxide (mg/l)	Carbon Dioxide (replicate) (mg/l)	Alkalinity gray end pt. @ pH 5.1 (mg/l)	Alkalinity gray end pt. @ pH 5.1 (replicate) (mg/l)
4 Loon Reef	7/2/2008	5.5	12:42	13:11	metalimnion	------	1.3	1.4	3.1	3.2
4 Loon Reef	7/2/2008	8.0	12:42	13:11	hypolimnion	------	1.8	1.9	3.1	3.1
4 Loon Reef	7/2/2008	0-3.5	12:42	13:11	epilimnion (composite "hose" sample)	------	------	-----	3.2	-----
5 Cockermouth	7/2/2008	0.5	13:25	14:10	epilimnion	------	1.1	-----	3.0	-----
5 Cockermouth	7/2/2008	6.0	13:25	14:10	metalimnion	------	2.0	1.9	3.4	3.2
5 Cockermouth	7/2/2008	17.5	13:25	14:10	hypolimnion	------	3.6	3.4	2.4	3.0
5 Cockermouth	7/2/2008	0-3.0	13:25	14:10	epilimnion (composite "hose" sample)	------	------	-----	3.3	-----
6 Beachwood	7/2/2008	0.5	14:32	15:00	epilimnion	------	1.0	-----	3.5	-----
6 Beachwood	7/2/2008	6.0	14:32	15:00	metalimnion	------	2.1	1.8	2.8	3.0
6 Beachwood	7/2/2008	16.5	14:32	15:00	hypolimnion	------	4.1	-----	2.9	-----
6 Beachwood	7/2/2008	0-3.0	14:32	15:00	epilimnion (composite "hose" sample)	------	------	-----	2.9	-----
1 Deep	8/5/2008	0.5	10:50	11:19	epilimnion	7.2	0.5	-----	3.2	-----
1 Deep	8/5/2008	8.5	10:50	11:19	metalimnion	7.1	1.0	-----	3.3	-----
1 Deep	8/5/2008	30.0	10:50	11:19	hypolimnion	6.4	2.5	-----	3.0	-----
1 Deep	8/5/2008	0-5.0	10:50	11:19	epilimnion (composite "hose" sample)	------	------	-----	3.4	-----
2 Mayhew	8/5/2008	0.5	10:00	10:31	epilimnion	7.1	0.5	-----	3.4	-----
2 Mayhew	8/5/2008	3.0	10:00	10:31	epilimnion	------	0.7	-----	3.3	-----
2 Mayhew	8/5/2008	8.5	10:00	10:31	metalimnion	6.5	3.5	-----	3.5	-----
2 Mayhew	8/5/2008	12.0	10:00	10:31	hypolimnion	6.2	6.0	-----	3.5	-----
2 Mayhew	8/5/2008	0-5.0	10:00	10:31	epilimnion (composite "hose" sample)	------	------	-----	3.2	-----
3 Pasquaney	8/5/2008	0.5	14:38	14:59	epilimnion	7.2	0.7	-----	3.0	-----
3 Pasquaney	8/5/2008	8.5	14:38	14:59	metalimnion	6.9	0.8	-----	3.3	-----
3 Pasquaney	8/5/2008	14.8	14:38	14:59	hypolimnion	5.5	3.9	-----	3.0	-----
3 Pasquaney	8/5/2008	0-6.5	14:38	14:59	epilimnion (composite "hose" sample)	------	------	-----	2.8	-----
4 Loon Reef	8/5/2008	0.5	13:47	14:17	epilimnion	7.1	0.7	-----	3.2	-----
4 Loon Reef	8/5/2008	6.8	13:47	14:17	epilimnion	6.9	0.8	1.0	3.4	3.3
4 Loon Reef	8/5/2008	0-7.0	13:47	14:17	epilimnion (composite "hose" sample)	------	------	-----	3.3	-----
5 Cockermouth	8/5/2008	0.5	13:12	13:37	epilimnion	------	0.6	-----	3.1	-----
5 Cockermouth	8/5/2008	9.0	13:12	13:37	metalimnion	6.8	1.1	-----	3.3	-----
5 Cockermouth	8/5/2008	15.0	13:12	13:37	hypolimnion	6.5	2.0	-----	3.0	-----
5 Cockermouth	8/5/2008	0-7.0	13:12	13:37	epilimnion (composite "hose" sample)	------	------	-----	3.3	-----
6 Beachwood	8/5/2008	0.5	12:09	12:33	epilimnion	7.2	1.1	-----	3.4	-----
6 Beachwood	8/5/2008	9.0	12:09	12:33	metalimnion	6.8	1.2	-----	3.2	-----
6 Beachwood	8/5/2008	13.8	12:09	12:33	hypolimnion	6.6	2.3	-----	3.1	-----
6 Beachwood	8/5/2008	0-7.0	12:09	12:33	epilimnion (composite "hose" sample)	------	------	-----	3.3	-----
8 Fallansbee	8/5/2008	0.5	11:28	11:55	epilimnion	7.1	0.8	-----	3.7	-----
8 Fallansbee	8/5/2008	8.5	11:28	11:55	metalimnion	6.9	1.1	-----	3.5	-----
8 Fallansbee	8/5/2008	14.0	11:28	11:55	hypolimnion	6.5	2.5	-----	3.5	-----

APPENDIX A. Newfound In-lake Water Quality Sampling Data Summary: 2007 and 2008 (Task 6)

Site	Date	Depth (meters)	Start Time (hh:mm)	Finish Time (hh:mm)	Stratum	pH (std units)	Carbon Dioxide (mg/l)	Carbon Dioxide (replicate) (mg/l)	Alkalinity gray end pt. @ pH 5.1 (mg/l)	Alkalinity gray end pt. @ pH 5.1 (replicate) (mg/l)
8 Fallansbee	8/5/2008	0-5.0	11:28	11:55	epilimnion (composite "hose" sample)	------	------	-----	4.0	-----
1 Deep	9/11/2008	0.5	12:08	13:16	epilimnion	6.8	1.2	-----	3.4	-----
1 Deep	9/11/2008	4.0	12:08	13:16	epilimnion	6.8	1.2	1.2	3.5	3.5
1 Deep	9/11/2008	11.0	12:08	13:16	metalimnion	6.7	2.6	-----	3.1	-----
1 Deep	9/11/2008	29.0	12:08	13:16	hypolimnion	6.3	4.1	3.8	3.2	-----
1 Deep	9/11/2008	0-9.0	12:08	13:16	epilimnion (composite "hose" sample)	------	------	-----	3.1	-----
2 Mayhew	9/11/2008	0.5	10:30	11:32	epilimnion	6.7	1.6	-----	3.5	-----
2 Mayhew	9/11/2008	3.0	10:30	11:32	epilimnion	6.7	1.5	-----	3.4	3.3
2 Mayhew	9/11/2008	9.0	10:30	11:32	metalimnion	6.7	1.4	-----	3.3	-----
2 Mayhew	9/11/2008	16.5	10:30	11:32	hypolimnion	6.0	13.0	-----	5.0	-----
2 Mayhew	9/11/2008	0-7.0	10:30	11:32	epilimnion (composite "hose" sample)	------	------	-----	3.3	-----
3 Pasquaney	9/11/2008	13.0	14:51	15:27	hypolimnion	6.4	2.8	-----	3.2	-----
3 Pasquaney	9/11/2008	0-9.0	14:51	15:27	epilimnion (composite "hose" sample)	------	------	-----	4.6	-----
5 Cockermouth	9/11/2008	0.5	13:33	14:32	epilimnion	6.8	1.1	-----	3.3	-----
5 Cockermouth	9/11/2008	5.0	13:33	14:32	epilimnion	6.9	1.1	-----	3.3	-----
5 Cockermouth	9/11/2008	11.0	13:33	14:32	metalimnion	6.6	2.3	-----	3.1	-----
5 Cockermouth	9/11/2008	19.0	13:33	14:32	hypolimnion	6.3	4.4	-----	3.5	-----
5 Cockermouth	9/11/2008	0-9.0	13:33	14:32	epilimnion (composite "hose" sample)	------	------	-----	3.8	-----
1 Deep	9/25/2008	13.0	13:35	14:32	metalimnion	6.5	4.7	-----	2.9	-----
1 Deep	9/25/2008	29.0	13:35	14:32	hypolimnion	6.2	5.4	-----	2.8	-----
1 Deep	9/25/2008	0-8.0	13:35	14:32	epilimnion (composite "hose" sample)	------	------	-----	3.0	-----
2 Mayhew	9/25/2008	0.5	12:13	13:06	epilimnion	7.1	1.1	-----	3.3	-----
2 Mayhew	9/25/2008	12.0	12:13	13:06	metalimnion	6.2	13.2	-----	4.1	-----
2 Mayhew	9/25/2008	15.0	12:13	13:06	hypolimnion	6.1	16.2	-----	4.8	-----
2 Mayhew	9/25/2008	0-8.0	12:13	13:06	epilimnion (composite "hose" sample)	------	------	-----	3.3	-----
3 Pasquaney	9/25/2008	12.0	15:59	16:43	metalimnion	6.5	3.7	-----	3.1	-----
3 Pasquaney	9/25/2008	13.5	15:59	16:43	hypolimnion	6.2	4.5	4.7	3.2	3.1
3 Pasquaney	9/25/2008	0-8.0	15:59	16:43	epilimnion (composite "hose" sample)	------	------	-----	3.2	-----
5 Cockermouth	9/25/2008	12.0	14:48	15:44	metalimnion	6.6	2.2	-----	3.1	-----
5 Cockermouth	9/25/2008	14.5	14:48	15:44	hypolimnion	6.5	3.5	-----	3.0	-----
5 Cockermouth	9/25/2008	0-8.0	14:48	15:44	epilimnion (composite "hose" sample)	------	------	-----	3.3	-----

APPENDIX A. Newfound In-lake Water Quality Sampling Data Summary: 2007 and 2008 (Task 6)

Site	Date	Depth (meters)	Alkalinity pink end pt. @ pH 4.6 (mg/l)	Alkalinity pink end pt. @ pH 4.6 (replicate) (mg/l)	Total Phosphorus (*u* g/l)	Total Phosphorus (replicate) (*u* g/l)	Turbidity (NTU)	Turbidity (replicate) (NTU)	Dissolved Oxygen (mg/l)	Dissolved Oxygen (replicate) (mg/l)	Chlorophyll *a* (*u* g/l)
1 Deep	7/23/2007	0.5	4.5	-----	-----	-----	0.5	0.6	-----	-----	1.6
1 Deep	7/23/2007	3.5	-----	-----	-----	-----	-----	-----	-----	-----	-----
1 Deep	7/23/2007	9.5	4.4	-----	3.1	-----	0.5	0.5	-----	-----	3.2
1 Deep	7/23/2007	28.0	4.1	4.2	2.7	-----	0.5	0.4	-----	-----	-----
1 Deep	7/23/2007	0-7.0	4.5	-----	3.2	-----	0.7	0.7	-----	-----	2.2
1 Deep	8/13/2007	0.5	3.2	-----	-----	-----	0.5	0.5	8.0	-----	1.0
1 Deep	8/13/2007	4.0	2.8	-----	-----	-----	0.2	0.3	-----	-----	-----
1 Deep	8/13/2007	8.5	2.6	-----	2.9	-----	1.3	0.6	-----	-----	3.0
1 Deep	8/13/2007	29.0	2.3	-----	4.1	-----	0.3	0.4	10.2	-----	-----
1 Deep	8/13/2007	0-7.0	2.2	-----	4.0	-----	0.4	0.4	-----	-----	1.5
1 Deep	9/17/2007	0.5	3.9	-----	-----	-----	0.2	0.2	-----	-----	2.1
1 Deep	9/17/2007	6.0	3.8	-----	-----	-----	0.4	0.7	-----	-----	-----
1 Deep	9/17/2007	13.5	3.5	-----	2.0	-----	0.2	0.3	-----	-----	3.3
1 Deep	9/17/2007	29.0	3.6	-----	2.2	-----	<0.2	0.2	8.2	-----	-----
1 Deep	9/17/2007	0-8.0	3.5	-----	3.9	-----	0.2	<0.2	-----	-----	2.2
2 Mayhew	7/23/2007	0.5	4.2	-----	-----	-----	1.0	0.8	-----	-----	2.8
2 Mayhew	7/23/2007	3.5	4.2	-----	-----	-----	1.2	1.0	-----	-----	-----
2 Mayhew	7/23/2007	7.0	-----	-----	4.6	-----	-----	-----	-----	-----	4.1
2 Mayhew	7/23/2007	12.0	4.2	4.2	7.2	6.5	1.0	1.3	-----	-----	-----
2 Mayhew	7/23/2007	0-6.0	-----	-----	3.6	3.4	-----	-----	-----	-----	2.8
2 Mayhew	8/13/2007	0.5	2.8	-----	-----	-----	0.4	0.3	7.9	-----	2.2
2 Mayhew	8/13/2007	3.0	2.9	-----	-----	-----	0.5	0.4	-----	-----	-----
2 Mayhew	8/13/2007	8.5	3.1	-----	5.4	-----	0.6	0.5	-----	-----	3.1
2 Mayhew	8/13/2007	15.5	3.8	-----	10.1	-----	-----	-----	2.3	-----	-----
2 Mayhew	8/13/2007	0-6	3.5	-----	2.9	-----	-----	-----	-----	-----	2.1
2 Mayhew	9/17/2007	0.5	3.9	-----	-----	-----	0.4	0.5	-----	-----	2.6
2 Mayhew	9/17/2007	5.0	3.9	-----	-----	-----	0.4	0.4	-----	-----	-----
2 Mayhew	9/17/2007	11.0	4.8	-----	5.7	-----	1.1	1.1	-----	-----	3.4
2 Mayhew	9/17/2007	14.5	5.6	-----	6.1	6.9	2.4	2.3	0.8	-----	-----
2 Mayhew	9/17/2007	0-8.0	4.0	-----	2.0	3.3	0.6	0.5	-----	-----	3.7
3 Pasquaney	7/23/2007	0.5	4.3	-----	-----	-----	1.0	0.8	-----	-----	1.9
3 Pasquaney	7/23/2007	3.0	4.3	-----	-----	-----	0.9	1.0	-----	-----	-----
3 Pasquaney	7/23/2007	6.5	4.1	-----	4.3	-----	0.6	0.6	-----	-----	3.1
3 Pasquaney	7/23/2007	13.0	4.6	4.5	3.5	-----	0.9	0.9	-----	-----	-----
3 Pasquaney	7/23/2007	0-4.5	4.8	-----	2.9	-----	0.4	0.2	-----	-----	2.2
3 Pasquaney	8/13/2007	0.5	3.6	-----	-----	-----	0.4	0.4	8.8	-----	1.3
3 Pasquaney	8/13/2007	4.0	3.6	-----	-----	-----	0.8	0.3	-----	-----	-----
3 Pasquaney	8/13/2007	8.5	3.2	-----	4.1	4.3	0.5	0.4	-----	-----	2.4

APPENDIX A. Newfound In-lake Water Quality Sampling Data Summary: 2007 and 2008 (Task 6)

Site	Date	Depth (meters)	Alkalinity pink end pt. @ pH 4.6 (mg/l)	Alkalinity pink end pt. @ pH 4.6 (replicate) (mg/l)	Total Phosphorus (*u* g/l)	Total Phosphorus (replicate) (*u* g/l)	Turbidity (NTU)	Turbidity (replicate) (NTU)	Dissolved Oxygen (mg/l)	Dissolved Oxygen (replicate) (mg/l)	Chlorophyll *a* (*u* g/l)
3 Pasquaney	8/13/2007	12.3	2.9	-----	6.1	-----	0.5	0.6	10.2	-----	-----
3 Pasquaney	8/13/2007	0-7.0	3.7	-----	2.7	2.9	0.3	0.2	-----	-----	2.6
3 Pasquaney	9/17/2007	0.5	3.9	-----	-----	-----	0.2	0.3	8.4	-----	1.7
3 Pasquaney	9/17/2007	5.0	3.8	-----	-----	-----	0.4	0.6	-----	-----	-----
3 Pasquaney	9/17/2007	12.0	3.6	-----	3.1	-----	0.4	0.3	7.2	-----	2.3
3 Pasquaney	9/17/2007	0-8.0	3.7	-----	3.3	-----	0.3	0.6	-----	-----	2.8
4 Loon Island	7/23/2007	0.5	4.1	-----	-----	-----	0.6	0.6	-----	-----	2.7
4 Loon Island	7/23/2007	0-5.5	4.4	-----	3.4	-----	0.3	0.4	-----	-----	2.5
4 Loon Island	8/13/2007	0.5	3.3	-----	-----	-----	0.4	0.5	8.5	-----	1.4
4 Loon Island	8/13/2007	3.0	3.0	-----	-----	-----	0.6	0.6	-----	-----	-----
4 Loon Island	8/13/2007	5.5	3.0	-----	4.1	-----	0.6	0.5	8.4	-----	2.2
4 Loon Island	8/13/2007	0-6.0	3.2	-----	3.5	-----	0.3	0.3	-----	-----	1.5
4 Loon Island	9/17/2007	0.5	3.9	-----	-----	-----	0.3	0.4	-----	-----	2.6
4 Loon Island	9/17/2007	0-8.0	3.8	-----	2.0	-----	0.3	0.3	-----	-----	2.2
5 Cockermouth	7/23/2007	0.5	4.3	-----	-----	-----	0.4	0.4	-----	-----	1.9
5 Cockermouth	7/23/2007	0-6.0	4.3	-----	3.0	-----	0.3	0.2	-----	-----	2.1
5 Cockermouth	8/13/2007	0.5	4.4	-----	-----	-----	0.4	0.4	8.3	-----	1.1
5 Cockermouth	8/13/2007	3.0	2.7	-----	-----	-----	0.3	0.6	-----	-----	-----
5 Cockermouth	8/13/2007	9.0	3.5	-----	3.7	-----	0.5	0.5	-----	-----	2.6
5 Cockermouth	8/13/2007	19.0	2.7	3.2	4.4	-----	0.5	0.3	10.1	-----	-----
5 Cockermouth	8/13/2007	0-6.0	3.6	-----	3.7	-----	0.3	0.5	-----	-----	1.4
5 Cockermouth	9/17/2007	0.5	3.9	-----	-----	-----	<0.2	<0.2	-----	-----	1.6
5 Cockermouth	9/17/2007	5.0	3.8	-----	-----	-----	0.2	0.2	-----	-----	-----
5 Cockermouth	9/17/2007	14.5	3.6	-----	3.8	-----	0.5	0.4	9.4	-----	3.2
5 Cockermouth	9/17/2007	0-8.0	3.8	-----	< 2.0	-----	0.2	0.3	-----	-----	1.9
6 Beachwood	7/23/2007	0.5	4.1	-----	-----	-----	0.4	0.4	-----	-----	1.8
6 Beachwood	7/23/2007	9.0	4.3	-----	4.7	-----	0.6	0.6	-----	-----	4.2
6 Beachwood	7/23/2007	15.5	4.3	-----	3.7	-----	0.6	0.6	-----	-----	-----
6 Beachwood	7/23/2007	0-8.0	4.4	-----	4.5	-----	0.3	0.5	-----	-----	2.0
6 Beachwood	8/13/2007	0.5	3.5	-----	-----	-----	0.4	0.2	8.1	-----	0.9
6 Beachwood	8/13/2007	3.0	3.2	-----	-----	-----	0.4	0.2	-----	-----	-----
6 Beachwood	8/13/2007	8.0	3.7	-----	3.0	-----	0.3	0.4	-----	-----	0.3
6 Beachwood	8/13/2007	16.5	3.3	3.3	4.5	-----	0.4	0.4	10.2	10.2	-----
6 Beachwood	8/13/2007	0-6.0	3.1	-----	3.6	-----	0.2	0.3	-----	-----	0.6
6 Beachwood	9/17/2007	0.5	3.8	-----	-----	-----	<0.2	<0.2	8.2	-----	1.7
6 Beachwood	9/17/2007	6.0	3.8	-----	-----	-----	0.3	0.3	-----	-----	-----
6 Beachwood	9/17/2007	13.0	3.9	3.6	3.1	-----	0.8	0.5	-----	-----	3.5
6 Beachwood	9/17/2007	14.5	3.6	-----	2.4	-----	0.2	0.2	12.4	-----	-----

APPENDIX A. Newfound In-lake Water Quality Sampling Data Summary: 2007 and 2008 (Task 6)

Site	Date	Depth (meters)	Alkalinity pink end pt. @ pH 4.6 (mg/l)	Alkalinity pink end pt. @ pH 4.6 (replicate) (mg/l)	Total Phosphorus (*u* g/l)	Total Phosphorus (replicate) (*u* g/l)	Turbidity (NTU)	Turbidity (replicate) (NTU)	Dissolved Oxygen (mg/l)	Dissolved Oxygen (replicate) (mg/l)	Chlorophyll *a* (*u* g/l)
6 Beachwood	9/17/2007	0-8.0	3.6	-----	3.2	-----	<0.2	0.2	-----	-----	1.9
7 Fowler	7/23/2007	0.5	-----	-----	4.5	-----	-----	-----	-----	-----	-----
7 Fowler	8/13/2007	0.5	3.2	-----	4.7	-----	0.6	0.5	-----	-----	1.8
8 Follensbee	7/23/2007	0.5	4.5	-----	-----	-----	0.6	0.4	-----	-----	2.1
8 Follensbee	7/23/2007	8.0	4.4	-----	2.7	-----	0.5	1.1	-----	-----	2.3
8 Follensbee	7/23/2007	13.0	4.2	-----	5.6	-----	0.5	0.8	-----	-----	-----
8 Follensbee	7/23/2007	0-6.5	4.9	-----	3.1	-----	0.4	0.5	-----	-----	1.6
8 Follensbee	8/13/2007	0.5	3.2	-----	-----	-----	0.3	0.3	7.9	8.0	0.8
8 Follensbee	8/13/2007	4.0	3.4	-----	-----	-----	0.3	0.3	-----	-----	-----
8 Follensbee	8/13/2007	9.5	3.3	-----	3.6	-----	0.4	0.4	-----	-----	2.7
8 Follensbee	8/13/2007	12.5	3.0	-----	4.3	-----	0.4	0.4	10.2	-----	-----
8 Follensbee	8/13/2007	0-7.5	3.6	-----	3.6	-----	0.2	0.2	-----	-----	1.1
8 Follensbee	9/17/2007	0.5	4.0	3.9	-----	-----	0.2	0.2	8.8	-----	2.9
8 Follensbee	9/17/2007	6.0	3.8	-----	-----	-----	0.4	0.3	-----	-----	-----
8 Follensbee	9/17/2007	13.5	3.6	-----	2.4	-----	0.6	0.5	11.6	-----	3.4
8 Follensbee	9/17/2007	0-8.0	4.0	-----	< 2.0	-----	0.2	0.2	-----	-----	3.0
1 Deep	6/11/2008	0.5	-----	-----	------	-----	------	------	------	-----	0.9
1 Deep	6/11/2008	4.5	-----	-----	2.6	-----	------	------	------	-----	0.9
1 Deep	6/11/2008	30.0	-----	-----	4.0	-----	------	------	------	-----	-----
1 Deep	6/11/2008	0-3.0	-----	-----	3.2	-----	------	------	------	-----	0.5
2 Mayhew	6/11/2008	0.5	-----	-----	------	-----	------	------	------	-----	1.1
2 Mayhew	6/11/2008	1.5	-----	-----	------	-----	------	------	------	-----	-----
2 Mayhew	6/11/2008	4.5	-----	-----	4.1	-----	------	------	------	-----	1.3
2 Mayhew	6/11/2008	13.5	-----	-----	6.8	-----	------	------	------	-----	-----
2 Mayhew	6/11/2008	0-3.0	-----	-----	7.1	-----	------	------	------	-----	1.1
1 Deep	7/2/2008	0.5	3.5	3.8	------	-----	0.2	0.2	8.2	8.4	1.1
1 Deep	7/2/2008	7.0	3.7	-----	7.0	-----	0.3	0.3	------	-----	1.7
1 Deep	7/2/2008	30.0	3.4	3.4	4.6	-----	0.3	0.3	10.8	-----	-----
1 Deep	7/2/2008	0-4.0	3.7	-----	4.0	4.4	0.4	0.2	------	-----	1.6
2 Mayhew	7/2/2008	0.5	3.6	-----	5.1	-----	<0.2	0.2	8.6	-----	2.6
2 Mayhew	7/2/2008	5.5	3.8	3.6	6.5	-----	0.4	0.4	------	-----	2.0
2 Mayhew	7/2/2008	13.0	3.4	3.6	8.2	-----	0.3	0.4	8.0	-----	
2 Mayhew	7/2/2008	0-3.5	4.4	-----	4.6	-----	0.3	0.3	------	-----	2.4
3 Pasquaney	7/2/2008	0.5	3.7	-----	------	-----	0.2	0.2	9.0	-----	1.1
3 Pasquaney	7/2/2008	7.5	3.5	3.7	5.3	-----	0.4	0.3	------	-----	1.6
3 Pasquaney	7/2/2008	13.5	3.4	3.5	8.6	-----	0.2	0.2	10.4	-----	-----
3 Pasquaney	7/2/2008	0-4.0	3.6	-----	5.0	-----	0.2	0.2	------	-----	1.5
4 Loon Reef	7/2/2008	0.5	3.7	-----	------	-----	0.2	0.3	8.6	-----	3.0

APPENDIX A. Newfound In-lake Water Quality Sampling Data Summary: 2007 and 2008 (Task 6)

Site	Date	Depth (meters)	Alkalinity pink end pt. @ pH 4.6 (mg/l)	Alkalinity pink end pt. @ pH 4.6 (replicate) (mg/l)	Total Phosphorus (*u* g/l)	Total Phosphorus (replicate) (*u* g/l)	Turbidity (NTU)	Turbidity (replicate) (NTU)	Dissolved Oxygen (mg/l)	Dissolved Oxygen (replicate) (mg/l)	Chlorophyll *a* (*u* g/l)
4 Loon Reef	7/2/2008	5.5	3.9	3.9	4.6	-----	0.3	0.3	------	-----	3.1
4 Loon Reef	7/2/2008	8.0	4.0	3.8	3.9	-----	0.4	0.3	9.4	-----	-----
4 Loon Reef	7/2/2008	0-3.5	4.0	-----	3.8	-----	0.3	0.2	------	-----	2.8
5 Cockermouth	7/2/2008	0.5	3.7	-----	------	-----	0.2	0.3	8.8	-----	0.9
5 Cockermouth	7/2/2008	6.0	3.9	3.6	5.7	-----	0.3	0.5	------	-----	1.3
5 Cockermouth	7/2/2008	17.5	3.4	3.6	3.1	-----	0.2	<0.2	10.4	-----	-----
5 Cockermouth	7/2/2008	0-3.0	3.9	-----	3.4	-----	<0.2	0.2	------	-----	1.0
6 Beachwood	7/2/2008	0.5	4.0	-----	------	-----	0.2	0.2	8.4	-----	1.3
6 Beachwood	7/2/2008	6.0	3.6	3.8	5.2	-----	0.4	0.3	------	-----	2.2
6 Beachwood	7/2/2008	16.5	3.6	-----	4.0	-----	0.4	0.4	10.4	-----	-----
6 Beachwood	7/2/2008	0-3.0	3.6	-----	3.3	-----	0.2	0.2	------	-----	1.1
1 Deep	8/5/2008	0.5	4.2	-----	------	-----	0.3	0.3	8.2	-----	3.7
1 Deep	8/5/2008	8.5	4.1	-----	10.3	-----	0.6	0.5	------	-----	4.6
1 Deep	8/5/2008	30.0	3.9	-----	3.3	-----	<0.2	<0.2	11.0	-----	------
1 Deep	8/5/2008	0-5.0	4.1	-----	3.8	-----	0.5	0.3	------	-----	2.2
2 Mayhew	8/5/2008	0.5	4.2	-----	------	-----	0.5	0.3	8.0	-----	1.7
2 Mayhew	8/5/2008	3.0	4.2	-----	------	-----	0.3	0.3	------	-----	-----
2 Mayhew	8/5/2008	8.5	4.3	-----	------	-----	0.7	0.6	------	-----	6.6
2 Mayhew	8/5/2008	12.0	4.4	-----	6.3	-----	0.5	0.5	6.0	-----	-----
2 Mayhew	8/5/2008	0-5.0	4.0	-----	7.6	-----	0.4	0.4	------	-----	3.2
3 Pasquaney	8/5/2008	0.5	3.9	-----	------	-----	0.2	<0.2	8.6	-----	2.5
3 Pasquaney	8/5/2008	8.5	4.0	-----	5.4	-----	0.3	0.4	------	-----	2.6
3 Pasquaney	8/5/2008	14.8	3.9	-----	6.4	-----	0.3	0.4	10.8	-----	-----
3 Pasquaney	8/5/2008	0-6.5	3.9	-----	7.3	-----	1.3	1.5	------	-----	3.1
4 Loon Reef	8/5/2008	0.5	4.0	-----	------	-----	0.3	0.3	9.0	-----	1.6
4 Loon Reef	8/5/2008	6.8	4.2	4.0	6.3	5.5	0.5	0.5	8.0	-----	1.4
4 Loon Reef	8/5/2008	0-7.0	4.2	-----	5.8	8.7	0.3	0.3	------	-----	2.6
5 Cockermouth	8/5/2008	0.5	3.9	-----	------	-----	0.4	0.3	8.0	-----	2.4
5 Cockermouth	8/5/2008	9.0	4.0	-----	8.9	-----	0.5	0.5	------	-----	3.1
5 Cockermouth	8/5/2008	15.0	4.2	-----	7.1	-----	0.4	0.4	10.2	-----	-----
5 Cockermouth	8/5/2008	0-7.0	4.1	-----	5.4	-----	0.3	0.3	------	-----	2.1
6 Beachwood	8/5/2008	0.5	4.3	-----	------	-----	0.4	0.4	8.2	-----	1.4
6 Beachwood	8/5/2008	9.0	4.0	-----	7.9	-----	0.4	0.3	------	-----	2.4
6 Beachwood	8/5/2008	13.8	3.8	-----	8.2	-----	0.4	0.4	10.0	-----	-----
6 Beachwood	8/5/2008	0-7.0	4.2	-----	6.1	-----	0.3	0.4	-----	-----	2.2
8 Fallansbee	8/5/2008	0.5	4.6	-----	------	-----	0.4	0.3	8.0	-----	1.9
8 Fallansbee	8/5/2008	8.5	4.3	-----	5.8	-----	0.5	0.4	-----	-----	4.4
8 Fallansbee	8/5/2008	14.0	4.5	-----	4.7	-----	0.5	0.4	10.2	-----	-----

APPENDIX A. Newfound In-lake Water Quality Sampling Data Summary: 2007 and 2008 (Task 6)

Site	Date	Depth (meters)	Alkalinity pink end pt. @ pH 4.6 (mg/l)	Alkalinity pink end pt. @ pH 4.6 (replicate) (mg/l)	Total Phosphorus (*u* g/l)	Total Phosphorus (replicate) (*u* g/l)	Turbidity (NTU)	Turbidity (replicate) (NTU)	Dissolved Oxygen (mg/l)	Dissolved Oxygen (replicate) (mg/l)	Chlorophyll *a* (*u* g/l)
8 Fallansbee	8/5/2008	0-5.0	4.8	-----	5.1	-----	0.5	0.5	-----	-----	1.8
1 Deep	9/11/2008	0.5	4.1	-----	------	-----	0.2	<0.2	8.4	-----	1.4
1 Deep	9/11/2008	4.0	4.3	4.0	------	-----	0.4	0.3	-----	-----	-----
1 Deep	9/11/2008	11.0	3.7	-----	5.1	-----	0.2	<0.2	-----	-----	1.6
1 Deep	9/11/2008	29.0	3.8	-----	3.5	-----	0.2	0.2	9.5	-----	-----
1 Deep	9/11/2008	0-9.0	3.8	-----	7.4	-----	0.2	0.2	-----	-----	2.4
2 Mayhew	9/11/2008	0.5	4.3	-----	------	-----	0.3	0.3	7.9	-----	2.4
2 Mayhew	9/11/2008	3.0	4.0	3.9	------	-----	0.3	0.5	-----	-----	-----
2 Mayhew	9/11/2008	9.0	3.8	-----	6.3	-----	0.4	0.3	-----	-----	2.1
2 Mayhew	9/11/2008	16.5	5.8	-----	10.4	-----	1.3	1.4	0.9	-----	-----
2 Mayhew	9/11/2008	0-7.0	4.0	-----	4.8	5.1	0.4	0.3	-----	-----	2.7
3 Pasquaney	9/11/2008	13.0	3.9	-----	6.7	-----	------	------	9.0	-----	-----
3 Pasquaney	9/11/2008	0-9.0	5.2	-----	4.5	-----	0.3	0.3	-----	-----	2.1
5 Cockermouth	9/11/2008	0.5	4.0	-----	------	-----	0.3	0.2	9.0	-----	1.6
5 Cockermouth	9/11/2008	5.0	4.0	-----	------	-----	<0.2	<0.2	-----	-----	-----
5 Cockermouth	9/11/2008	11.0	3.8	-----	3.5	-----	0.4	0.4	-----	-----	2.1
5 Cockermouth	9/11/2008	19.0	4.0	-----	------	-----	0.2	0.3	9.0	-----	-----
5 Cockermouth	9/11/2008	0-9.0	4.4	-----	3.4	-----	0.4	0.3	-----	-----	1.9
1 Deep	9/25/2008	13.0	3.4	-----	4.6	-----	<0.2	<0.2	-----	-----	1.1
1 Deep	9/25/2008	29.0	3.5	-----	3.8	-----	<0.2	0.2	9.4	-----	-----
1 Deep	9/25/2008	0-8.0	3.9	-----	4.2	-----	0.2	0.3	-----	-----	3.9
2 Mayhew	9/25/2008	0.5	3.7	-----	------	-----	0.2	0.3	9.4	-----	2.4
2 Mayhew	9/25/2008	12.0	4.8	-----	7.5	-----	1.1	1.2	-----	-----	1.4
2 Mayhew	9/25/2008	15.0	5.4	-----	9.5	8.3	1.6	1.7	0.8	-----	-----
2 Mayhew	9/25/2008	0-8.0	4.0	-----	4.2	3.9	0.3	0.3	-----	-----	3.7
3 Pasquaney	9/25/2008	12.0	3.8	-----	5.3	-----	0.2	0.2	-----	-----	1.8
3 Pasquaney	9/25/2008	13.5	3.7	3.6	4.3	-----	0.3	0.3	-----	-----	-----
3 Pasquaney	9/25/2008	0-8.0	3.7	-----	3.0	-----	0.2	0.3	-----	-----	2.6
5 Cockermouth	9/25/2008	12.0	3.7	-----	3.6	-----	0.4	0.3	-----	-----	1.8
5 Cockermouth	9/25/2008	14.5	3.8	-----	4.4	-----	0.3	0.3	9.2	-----	-----
5 Cockermouth	9/25/2008	0-8.0	3.9	-----	3.8	-----	0.2	0.2	-----	-----	2.3

APPENDIX A. Newfound In-lake Water Quality Sampling Data Summary: 2007 and 2008 (Task 6)

Site	Date	Start Time (hh:mm)	Stop Time (hh:mm)	Secchi Disk Transparency Shady Side w/o Scope black/white disk Reading #1 (meters)	Secchi Disk Transparency Shady Side w/o Scope black/white disk Reading #2 (meters)	Secchi Disk Transparency Shady Side w/o Scope black/white disk Reading #3 (meters)	Secchi Disk Transparency Shady Side with Scope black/white disk Reading #1 (meters)	Secchi Disk Transparency Shady Side with Scope black/white disk Reading #2 (meters)
1 Deep	7/23/2007	9:18	10:13	6.45	6.70	6.63	8.82	9.10
2 Mayhew	7/23/2007	14:16	14:55	4.90	5.00	5.20	6.80	6.80
3 Pasquaney	7/23/2007	13:13	13:53	5.70	5.80	5.75	8.25	8.30
4 Loon Island	7/23/2007	12:35	12:57	5.50	5.45	5.42	6.60	6.60
5 Cockermouth	7/23/2007	11:57	12:25	5.45	5.50	5.49	8.50	8.42
6 Beachwood	7/23/2007	11:10	11:47	5.97	6.10	5.95	8.61	8.49
8 Follansbee	7/23/2007	10:20	10:55	5.71	6.00	6.10	8.90	9.10
1 Deep	8/13/2007	9:35	10:15	7.80	7.75	7.70	10.05	9.95
2 Mayhew	8/13/2007	17:55	18:20	5.20	5.30	5.05	7.50	7.45
3 Pasquaney	8/13/2007	10:35	11:10	5.30	6.00	6.40	9.10	9.00
4 Loon Island	8/13/2007	15:25	15:55	7.15	6.70	6.35	8.60	8.60
5 Cockermouth	8/13/2007	14:30	15:15	5.60	6.40	5.95	8.20	7.95
6 Beachwood	8/13/2007	16:10	16:40	7.60	7.60	7.70	9.70	9.80
8 Follansbee	8/13/2007	17:00	17:30	6.80	6.85	6.90	10.20	10.15
1 Deep	9/17/2007	9:40	10:30	-----	-----	-----	10.80	11.00
2 Mayhew	9/17/2007	14:30	15:00	-----	-----	-----	8.30	8.40
3 Pasquaney	9/17/2007	13:30	13:50	-----	-----	-----	11.10	11.20
4 Loon Island	9/17/2007	13:05	13:20	-----	-----	-----	9.30	9.30
5 Cockermouth	9/17/2007	12:25	12:45	-----	-----	-----	11.30	11.30
6 Beachwood	9/17/2007	11:45	12:10	-----	-----	-----	-----	-----
8 Follansbee	9/17/2007	11:00	11:31	-----	-----	-----	11.30	11.30
2 Mayhew	6/11/2008	10:30	11:45	4.85	5.30	5.00	7.80	7.80
1 Deep	7/2/2008	10:48	11:36	6.20	6.15	6.10	8.50	8.30
2 Mayhew	7/2/2008	9:45	10:28	7.00	6.00	6.20	8.00	7.70
3 Pasquaney	7/2/2008	11:50	12:24				9.30	9.40
4 Loon Reef	7/2/2008	12:42	13:11				8.20	8.10
5 Cockermouth	7/2/2008	13:25	14:10				7.90	8.10
6 Beachwood	7/2/2008	14:32	15:00				8.50	8.90
1 Deep	8/5/2008	10:50	11:19	4.30	4.17	4.32	6.70	6.60
2 Mayhew	8/5/2008	10:00	10:31	4.65	4.70	4.75	5.60	5.35
3 Pasquaney	8/5/2008	14:38	14:59				6.30	6.60
4 Loon Reef	8/5/2008	13:47	14:17				6.00	6.10
5 Cockermouth	8/5/2008	13:12	13:37	4.20	4.25	4.30	6.10	6.09
6 Beachwood	8/5/2008	12:09	12:33				6.25	6.10
8 Fallansbee	8/5/2008	11:28	11:55	4.15	4.10	3.95	6.35	6.55

APPENDIX A. Newfound In-lake Water Quality Sampling Data Summary: 2007 and 2008 (Task 6)

Site	Date	Start Time (hh:mm)	Stop Time (hh:mm)	Secchi Disk Transparency Shady Side w/o Scope black/white disk Reading #1 (meters)	Secchi Disk Transparency Shady Side w/o Scope black/white disk Reading #2 (meters)	Secchi Disk Transparency Shady Side w/o Scope black/white disk Reading #3 (meters)	Secchi Disk Transparency Shady Side with Scope black/white disk Reading #1 (meters)	Secchi Disk Transparency Shady Side with Scope black/white disk Reading #2 (meters)
1 Deep	9/11/2008	12:08	13:16				8.62	8.63
2 Mayhew	9/11/2008	10:30	11:32				6.85	6.80
3 Pasquaney	9/11/2008	14:51	15:27				7.46	7.81
5 Cockermouth	9/11/2008	13:33	14:32				8.52	8.74
1 Deep	9/25/2008	13:35	14:32				8.20	8.20
2 Mayhew	9/25/2008	12:13	13:06				6.70	6.40
3 Pasquaney	9/25/2008	15:59	16:43				8.00	8.10
5 Cockermouth	9/25/2008	14:48	15:44				8.60	8.30

APPENDIX A. Newfound In-lake Water Quality Sampling Data Summary: 2007 and 2008 (Task 6)

Site	Date	Secchi Disk Transparency Shady Side with Scope black/white disk Reading #3 (meters)	Secchi Disk Transparency Sunny Side w/o Scope black/white disk Reading #1 (meters)	Secchi Disk Transparency Sunny Side w/o Scope black/white disk Reading #2 (meters)	Secchi Disk Transparency Sunny Side w/o Scope black/white disk Reading #3 (meters)	Secchi Disk Transparency Sunny Side with Scope black/white disk Reading #1 (meters)	Secchi Disk Transparency Sunny Side with Scope black/white disk Reading #2 (meters)
1 Deep	7/23/2007	8.80	6.03	6.05	5.99	8.20	8.50
2 Mayhew	7/23/2007	6.87	4.83	5.10	5.00	6.95	7.00
3 Pasquaney	7/23/2007	8.10	5.35	5.42	5.27	8.13	8.10
4 Loon Island	7/23/2007	6.60	5.90	6.20	6.10	6.80	6.80
5 Cockermouth	7/23/2007	8.61	4.74	4.82	4.71	7.65	7.52
6 Beachwood	7/23/2007	8.52	5.55	5.56	5.70	8.90	8.85
8 Follansbee	7/23/2007	8.90	5.92	5.93	5.91	8.25	8.26
1 Deep	8/13/2007	10.05	6.80	7.85	7.43	9.40	9.55
2 Mayhew	8/13/2007	7.20	4.80	5.00	5.00	6.40	6.30
3 Pasquaney	8/13/2007	8.70	6.65	6.80	6.90	8.75	8.85
4 Loon Island	8/13/2007	7.95	6.70	6.60	6.30	6.3 BO	6.3 BO
5 Cockermouth	8/13/2007	8.80	6.05	6.00	5.95	8.35	8.30
6 Beachwood	8/13/2007	9.70	5.95	6.50	7.10	8.50	8.69
8 Follansbee	8/13/2007	10.00	6.80	6.70	6.70	8.30	8.60
1 Deep	9/17/2007	11.00	-----	-----	-----	-----	-----
2 Mayhew	9/17/2007	8.30	-----	-----	-----	-----	-----
3 Pasquaney	9/17/2007	11.00	-----	-----	-----	-----	-----
4 Loon Island	9/17/2007	9.30	-----	-----	-----	-----	-----
5 Cockermouth	9/17/2007	11.40	-----	-----	-----	-----	-----
6 Beachwood	9/17/2007	-----	-----	-----	-----	10.60	10.50
8 Follansbee	9/17/2007	11.40	-----	-----	-----	-----	-----
2 Mayhew	6/11/2008	7.50	6.10	5.65	6.25	7.45	7.40
1 Deep	7/2/2008	8.25	7.40	7.50	7.30	8.50	8.55
2 Mayhew	7/2/2008	7.60	6.40	6.50	6.40	8.10	8.00
3 Pasquaney	7/2/2008	9.00				9.60	10.10
4 Loon Reef	7/2/2008	7.80				7.90	8.30
5 Cockermouth	7/2/2008	7.80				7.70	8.10
6 Beachwood	7/2/2008	9.10				8.00	8.20
1 Deep	8/5/2008	6.70	4.30	4.60	4.55	6.60	6.35
2 Mayhew	8/5/2008	5.55	4.10	3.70	3.90	5.20	5.35
3 Pasquaney	8/5/2008	6.30				5.75	5.85
4 Loon Reef	8/5/2008	6.35				6.80	6.15
5 Cockermouth	8/5/2008	6.15	4.70	4.60	4.30	5.70	5.90
6 Beachwood	8/5/2008	6.20				5.90	5.70
8 Fallansbee	8/5/2008	6.60	4.10	4.70	4.45	6.45	6.84

APPENDIX A. Newfound In-lake Water Quality Sampling Data Summary: 2007 and 2008 (Task 6)

Site	Date	Secchi Disk Transparency Shady Side with Scope black/white disk Reading #3 (meters)	Secchi Disk Transparency Sunny Side w/o Scope black/white disk Reading #1 (meters)	Secchi Disk Transparency Sunny Side w/o Scope black/white disk Reading #2 (meters)	Secchi Disk Transparency Sunny Side w/o Scope black/white disk Reading #3 (meters)	Secchi Disk Transparency Sunny Side with Scope black/white disk Reading #1 (meters)	Secchi Disk Transparency Sunny Side with Scope black/white disk Reading #2 (meters)
1 Deep	9/11/2008	8.60				7.75	7.61
2 Mayhew	9/11/2008	6.85				5.40	5.80
3 Pasquaney	9/11/2008	7.52				6.80	6.98
5 Cockermouth	9/11/2008	8.76				7.62	7.46
1 Deep	9/25/2008	8.30				7.80	7.70
2 Mayhew	9/25/2008	6.60				6.60	6.60
3 Pasquaney	9/25/2008	8.20				7.50	7.70
5 Cockermouth	9/25/2008	8.40				7.70	7.80

APPENDIX A. Newfound In-lake Water Quality Sampling Data Summary: 2007 and 2008 (Task 6)

Site	Date	Secchi Disk Transparency Sunny Side with Scope black/white disk Reading #3 (meters)	Secchi Disk Transparency Sunny Side with Scope black disk Reading #1 (meters)	Secchi Disk Transparency Sunny Side with Scope black disk Reading #2 (meters)	Secchi Disk Transparency Sunny Side with Scope black disk Reading #3 (meters)	Sky Condition	Lake Surface Condition	Wind Condition
1 Deep	7/23/2007	8.32	4.03	4.06	4.15	Cloudy	Ripples	Calm
2 Mayhew	7/23/2007	7.07	3.20	3.30	3.26	Cloudy	Ripples	Breezy
3 Pasquaney	7/23/2007	8.15	4.20	4.20	4.10	Cloudy	Waves	Breezy
4 Loon Island	7/23/2007	6.80	3.49	3.45	3.55	Cloudy	Ripples	Breezy
5 Cockermouth	7/23/2007	7.60	4.41	4.45	4.37	Cloudy	Waves	Breezy
6 Beachwood	7/23/2007	8.90	4.43	4.30	4.41	Cloudy	Waves	Breezy
8 Follansbee	7/23/2007	8.40	4.57	4.43	4.46	Cloudy	Waves	Breezy
1 Deep	8/13/2007	9.35	5.10	4.90	5.05	Cloudy	Ripples	Breezy
2 Mayhew	8/13/2007	6.70	4.00	3.70	3.65	Clear	Ripples	Breezy
3 Pasquaney	8/13/2007	9.15	4.50	4.90	4.51	Clear	Ripples	Breezy
4 Loon Island	8/13/2007	6.3 BO	4.20	4.40	4.45	Clear	Ripples	Gusty
5 Cockermouth	8/13/2007	8.30	4.15	4.00	4.20	Hazy	Ripples	Gusty
6 Beachwood	8/13/2007	8.45	5.20	5.40	5.20	Clear	Ripples	Gusty
8 Follansbee	8/13/2007	8.50	4.10	4.20	4.40	Clear	Waves	Windy
1 Deep	9/17/2007	-----	-----	-----	-----	Clear	Calm	Calm
2 Mayhew	9/17/2007	-----	-----	-----	-----	Clear	Ripples	Breezy
3 Pasquaney	9/17/2007	-----	-----	-----	-----	Clear	Ripples	Gusty
4 Loon Island	9/17/2007	-----	-----	-----	-----	Clear	Calm	Calm
5 Cockermouth	9/17/2007	-----	-----	-----	-----	Clear	Calm	Calm
6 Beachwood	9/17/2007	10.60	-----	-----	-----	Clear	Calm	Calm
8 Follansbee	9/17/2007	-----	-----	-----	-----	Clear	Calm	Calm
2 Mayhew	6/11/2008	7.35	2.90	3.00	3.80	Cloudy	Waves	Windy
1 Deep	7/2/2008	8.70	5.50	5.30	5.35	Clear	Ripples	Calm
2 Mayhew	7/2/2008	7.95	4.50	4.30	4.60	Overcast	Ripples	Calm
3 Pasquaney	7/2/2008	9.70				Cloudy	Ripples	Calm
4 Loon Reef	7/2/2008	8.40				Cloudy	Ripples	Calm
5 Cockermouth	7/2/2008	8.40				Cloudy	Ripples	Breezy
6 Beachwood	7/2/2008	8.40				Clear	Ripples	Breezy
1 Deep	8/5/2008	6.67	2.75	2.50	2.65	Cloudy	Ripples	Breezy
2 Mayhew	8/5/2008	5.34	2.30	2.20	2.25	Cloudy	Ripples	Breezy
3 Pasquaney	8/5/2008	6.05				Cloudy	Ripples	Breezy
4 Loon Reef	8/5/2008	6.30				Cloudy	Waves	Breezy
5 Cockermouth	8/5/2008	5.90	2.40	2.55	2.70	Cloudy	Waves	Breezy
6 Beachwood	8/5/2008	5.80				Cloudy	Ripples	Breezy
8 Fallansbee	8/5/2008	6.70	2.65	3.05	2.80	Cloudy	Ripples	Calm

APPENDIX A. Newfound In-lake Water Quality Sampling Data Summary: 2007 and 2008 (Task 6)

Site	Date	Secchi Disk Transparency Sunny Side with Scope black/white disk Reading #3 (meters)	Secchi Disk Transparency Sunny Side with Scope black disk Reading #1 (meters)	Secchi Disk Transparency Sunny Side with Scope black disk Reading #2 (meters)	Secchi Disk Transparency Sunny Side with Scope black disk Reading #3 (meters)	Sky Condition	Lake Surface Condition	Wind Condition
1 Deep	9/11/2008	7.64				Clear	Calm	Calm
2 Mayhew	9/11/2008	5.80				Clear	Calm	Calm
3 Pasquaney	9/11/2008	6.63				Clear	Calm	Calm
5 Cockermouth	9/11/2008	7.63				Clear	Ripples	Calm
1 Deep	9/25/2008	7.80				Hazy	Ripples	Breezy
2 Mayhew	9/25/2008	6.50				Overcast	Ripples	Breezy
3 Pasquaney	9/25/2008	7.90				Hazy	Ripples	Breezy
5 Cockermouth	9/25/2008	7.90				Hazy	Ripples	Breezy

APPENDIX A. Newfound Lake Near-Shore Sampling Data Summary: 2007 and 2008 (Task 7)

Site	Date	Time (hh:mm)	Depth (meters)	Total Phosphorus (u g/l)	Total Phosphorus (replicate) (u g/l)	E *coli* (CFU/100ml)	E *coli* (replicate) (CFU/100ml)	Temperature (^oC)	Temperature (replicate) (^oC)	Specific Conductivity (u S/cm)	Specific Conductivity (replicate) (u S/cm)
NLRA S01	9/13/2007	9:20	0.5	2.7	3.7	23	16	18.4	18.4	34.0	34.1
NLRA S02	9/13/2007	9:25	0.5	2.1	------	10	------	18.7	18.7	34.2	34.2
NLRA S03	9/13/2007	9:30	0.5	2.5	------	23	------	18.3	18.3	35.3	35.3
NLRA S04	9/13/2007	9:35	0.5	2.9	------	16	------	19.1	19.1	34.6	34.5
NLRA S05	9/13/2007	9:39	0.5	2.9	------	9	------	19.3	19.3	34.3	34.3
NLRA S06	9/13/2007	9:43	0.5	2.8	------	2	------	19.3	19.3	34.3	34.3
NLRA S07	9/13/2007	9:46	0.5	2.6	------	5	------	19.3	19.3	34.5	34.8
NLRA S08	9/13/2007	9:50	0.5	2.5	------	10	------	19.3	19.3	34.6	34.6
NLRA S09	9/13/2007	9:55	0.5	2.5	------	9	------	19.4	19.4	34.6	34.6
NLRA S10	9/13/2007	10:02	0.5	2.9	------	1	------	19.2	19.3	34.7	34.7
NLRA S11	9/13/2007	10:08	0.5	------	------	2	------	19.2	19.3	34.5	34.6
NLRA S12	9/13/2007	10:23	0.5	2.0	------	2	------	19.3	19.3	34.3	34.3
NLRA S13	9/13/2007	10:35	0.5	1.7	2.5	8	9	19.4	19.4	34.1	34.0
NLRA S14	9/13/2007	10:45	0.5	2.5	------	3	------	19.6	19.5	34.3	34.2
NLRA S15	9/13/2007	10:48	0.5	2.7	------	9	------	19.5	19.6	34.2	34.2
NLRA S16	9/13/2007	10:55	0.5	2.1	------	1	------	19.5	19.5	34.2	34.1
NLRA S17	9/13/2007	11:00	0.5	1.7	------	3	------	19.7	19.7	34.1	34.1
NLRA S18	9/13/2007	11:10	0.5	3.3	------	<1	------	19.4	19.5	34.2	34.2
NLRA S19	9/13/2007	11:15	0.5	1.9	------	3	------	19.5	19.6	34.2	34.2
NLRA S20	9/13/2007	11:24	0.5	2.0	------	5	------	19.6	19.7	34.4	34.6
NLRA S21	9/13/2007	11:29	0.5	2.5	------	2	------	19.8	19.8	34.2	34.2
NLRA S22	9/13/2007	11:40	0.5	2.7	------	18	------	17.6	17.4	44.3	46.0
NLRA S23	9/13/2007	11:47	0.5	5.8	------	5	------	18.5	18.5	35.3	35.3
NLRA S24	9/13/2007	11:52	0.5	10.6	------	2	------	17.4	17.4	34.3	34.3
NLRA S25	9/13/2007	12:00	0.5	2.1	------	2	------	19.8	19.8	34.0	34.0
NLRA S26	9/13/2007	12:16	0.5	2.2	------	3	------	20.1	20.1	34.0	33.9
NLRA S27	9/13/2007	12:24	0.5	1.7	------	1	------	20.2	20.2	35.2	35.1
NLRA S28	9/13/2007	12:35	0.5	2.0	------	<1	------	20.0	20.0	34.0	34.0
NLRA S29	9/13/2007	12:39	0.5	2.5	------	22	------	19.9	19.9	34.3	34.2
NLRA S30	9/13/2007	10:15	0.5	2.9	------	3	------	19.4	19.4	34.1	34.1
NLRA S01	6/10/2008	10:07	0.5	3.0	------	1	------	22.0	21.4	34.0	33.9
NLRA S02	6/10/2008	10:15	0.5	2.7	------	10	------	21.9	21.8	34.5	34.5
NLRA S03	6/10/2008	10:21	0.5	5.3	------	<1	------	22.1	22.1	34.1	34.1
NLRA S04	6/10/2008	10:27	0.5	5.0	------	9	------	21.2	21.4	34.2	34.5
NLRA S05	6/10/2008	10:35	0.5	3.0	------	17	------	20.2	20.6	34.2	34.6
NLRA S06	6/10/2008	10:43	0.5	2.9	------	32	------	22.4	22.3	34.9	34.9
NLRA S07	6/10/2008	10:47	0.5	2.4	------	6	------	22.6	22.7	35.7	35.1

APPENDIX A. Newfound Lake Near-Shore Sampling Data Summary: 2007 and 2008 (Task 7)

Site	Date	Time (hh:mm)	Depth (meters)	Total Phosphorus (*u* g/l)	Total Phosphorus (replicate) (*u* g/l)	E *coli* (CFU/100ml)	E *coli* (replicate) (CFU/100ml)	Temperature (°C)	Temperature (replicate) (°C)	Specific Conductivity (*u* S/cm)	Specific Conductivity (replicate) (*u* S/cm)
NLRA S08	6/10/2008	10:54	0.5	2.5	2.6	2	6	21.5	21.4	34.5	34.7
NLRA S09	6/10/2008	11:01	0.5	2.1	------	5	------	21.0	20.9	34.2	34.6
NLRA S10	6/10/2008	11:08	0.5	3.7	------	1	------	21.6	21.4	34.9	34.9
NLRA S11	6/10/2008	11:32	0.5	5.3	------	<1	------	20.6	20.5	34.1	34.1
NLRA S12	6/10/2008	11:44	0.5	2.6	------	1	------	21.4	21.6	35.5	35.7
NLRA S13	6/10/2008	11:53	0.5	3.1	------	3	------	21.7	21.9	33.9	34.2
NLRA S14	6/10/2008	12:08	0.5	1.9	------	<1	------	22.5	22.6	34.0	33.9
NLRA S15	6/10/2008	12:15	0.5	3.2	------	<1	------	22.7	22.8	33.9	34.0
NLRA S16	6/10/2008	12:21	0.5	4.3	------	1	------	20.1	20.0	33.7	33.9
NLRA S17	6/10/2008	12:30	0.5	5.2	------	<1	------	21.8	21.6	33.9	34.5
NLRA S18	6/10/2008	12:37	0.5	3.3	------	<1	------	24.2	23.9	34.1	34.3
NLRA S19	6/10/2008	12:47	0.5	2.1	------	<1	------	21.4	21.5	33.9	34.0
NLRA S20	6/10/2008	12:56	0.5	2.4	------	<1	------	22.6	22.5	33.8	33.8
NLRA S21	6/10/2008	13:02	0.5	3.9	------	<1	------	22.4	22.3	33.9	33.3
NLRA S22	6/10/2008	13:10	0.5	2.2	------	2	------	24.0	23.8	34.5	34.6
NLRA S23	6/10/2008	13:22	0.5	4.7	------	<1	------	24.0	23.7	35.5	35.2
NLRA S24	6/10/2008	13:27	0.5	5.3	------	3	------	23.9	23.7	35.8	35.6
NLRA S25	6/10/2008	13:39	0.5	3.2	4.7	<1	<1	21.1	------	34.1	34.6
NLRA S26	6/10/2008	13:50	0.5	5.4	------	<1	------	22.3	22.4	33.5	33.9
NLRA S27	6/10/2008	13:57	0.5	3.8	------	<1	------	20.8	20.8	33.9	33.5
NLRA S28	6/10/2008	14:12	0.5	3.2	------	2	------	23.9	23.6	34.6	33.9
NLRA S29	6/10/2008	14:33	0.5	10.9	------	29	------	23.5	23.4	44.5	44.9
NLRA S30	6/10/2008	11:23	0.5	3.2	------	15	------	21.7	21.6	34.0	33.7
NLRA S01	7/1/2008	10:06	0.5	4.3	------	1	------	21.9	21.9	37.0	37.2
NLRA S02	7/1/2008	10:14	0.5	4.7	------	4	------	22.0	22.0	37.7	37.6
NLRA S03	7/1/2008	10:19	0.5	5.5	------	<1	------	22.0	22.0	38.1	38.2
NLRA S04	7/1/2008	10:25	0.5	6.1	------	5	------	22.1	22.0	39.0	39.5
NLRA S05	7/1/2008	10:38	0.5	3.5	------	1	------	22.2	22.1	38.0	38.0
NLRA S06	7/1/2008	10:42	0.5	6.4	5.0	3	4	22.5	22.4	38.2	38.5
NLRA S07	7/1/2008	10:47	0.5	3.5	------	1	------	22.8	22.8	38.8	38.7
NLRA S08	7/1/2008	10:57	0.5	4.2	------	3	------	22.5	22.4	38.8	38.8
NLRA S09	7/1/2008	11:04	0.5	4.3	------	1	------	22.5	22.6	38.9	39.0
NLRA S10	7/1/2008	11:09	0.5	4.0	------	<1	------	23.0	23.1	39.1	39.3
NLRA S11	7/1/2008	11:18	0.5	4.2	------	<1	------	22.3	22.2	38.9	39.0
NLRA S12	7/1/2008	11:32	0.5	4.8	------	1	------	22.7	22.7	39.3	39.2
NLRA S13	7/1/2008	11:43	0.5	5.5	------	1	------	22.9	23.1	38.4	38.5
NLRA S14	7/1/2008	11:56	0.5	4.2	------	5	------	23.9	23.9	40.1	40.6

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Site	Date	Time (hh:mm)	Depth (meters)	Total Phosphorus (u g/l)	Total Phosphorus (replicate) (u g/l)	E *coli* (CFU/100ml)	E *coli* (replicate) (CFU/100ml)	Temperature (°C)	Temperature (replicate) (°C)	Specific Conductivity (u S/cm)	Specific Conductivity (replicate) (u S/cm)
NLRA S15	7/1/2008	12:00	0.5	4.1	------	2	------	23.9	23.9	38.6	38.8
NLRA S16	7/1/2008	12:07	0.5	5.6	------	2	------	23.1	23.1	38.5	38.6
NLRA S17	7/1/2008	12:12	0.5	4.8	------	2	------	23.5	23.4	39.4	40.0
NLRA S18	7/1/2008	12:21	0.5	4.2	------	<1	------	23.6	23.6	38.7	38.5
NLRA S19	7/1/2008	12:26	0.5	3.7	------	3	------	22.5	22.4	38.5	38.6
NLRA S20	7/1/2008	12:32	0.5	5.4	------	10	------	22.7	22.8	40.3	40.3
NLRA S21	7/1/2008	12:44	0.5	4.8	------	6	------	22.8	22.9	40.1	40.0
NLRA S22	7/1/2008	12:53	0.5	5.5	------	23	------	21.6	21.6	35.8	38.3
NLRA S23	7/1/2008	13:04	0.5	6.5	------	6	------	23.1	23.0	39.7	39.6
NLRA S24	7/1/2008	13:13	0.5	7.5	------	4	------	23.1	23.0	38.7	38.8
NLRA S25	7/1/2008	13:25	0.5	4.4	4.3	<1	<1	22.5	22.5	38.2	38.2
NLRA S26	7/1/2008	13:40	0.5	5.3	------	1	------	24.0	24.0	38.2	38.3
NLRA S27	7/1/2008	13:50	0.5	5.2	------	1	------	23.8	23.8	38.6	38.2
NLRA S28	7/1/2008	13:59	0.5	4.8	------	<1	------	23.8	23.9	38.3	38.3
NLRA S29	7/1/2008	14:07	0.5	4.0	------	3	------	18.5	18.5	30.3	31.2
NLRA S30	7/1/2008	11:27	0.5	4.4	------	8	------	23.0	23.1	38.1	38.1
NLRA S01	7/7/2008	10:20	0.5	6.7	------	<1	------	23.6	23.5	42.2	42.5
NLRA S02	7/7/2008	10:28	0.5	4.9	------	1	------	23.8	23.7	43.5	43.6
NLRA S03	7/7/2008	10:35	0.5	4.3	------	<1	------	24.3	24.3	46.0	45.8
NLRA S04	7/7/2008	10:43	0.5	4.0	------	1	------	23.9	23.8	44.5	44.6
NLRA S05	7/7/2008	10:50	0.5	4.5	------	<1	------	24.2	24.1	44.8	44.5
NLRA S06	7/7/2008	10:57	0.5	4.7	------	<1	------	24.5	24.4	44.4	44.5
NLRA S07	7/7/2008	11:04	0.5	3.7	------	<1	------	24.3	24.3	44.4	44.4
NLRA S08	7/7/2008	11:10	0.5	4.6	------	<1	------	24.4	24.4	44.8	44.5
NLRA S09	7/7/2008	11:18	0.5	6.0	------	<1	------	24.8	24.8	44.8	44.6
NLRA S10	7/7/2008	11:30	0.5	4.1	------	<1	------	23.7	23.6	45.1	45.2
NLRA S11	7/7/2008	11:40	0.5	4.7	------	2	------	24.4	24.5	44.4	44.2
NLRA S12	7/7/2008	12:01	0.5	3.9	------	2	------	24.2	24.2	43.6	43.5
NLRA S13	7/7/2008	13:21	0.5	3.6	------	<1	------	24.8	24.7	42.3	42.6
NLRA S14	7/7/2008	13:29	0.5	3.6	------	<1	------	25.4	25.5	43.5	43.6
NLRA S15	7/7/2008	13:35	0.5	4.3	------	5	------	26.3	26.2	45.4	44.9
NLRA S16	7/7/2008	13:43	0.5	6.0	4.3	1	1	24.6	24.5	43.6	43.7
NLRA S17	7/7/2008	13:51	0.5	4.6	------	7	------	25.1	25.1	43.8	43.8
NLRA S18	7/7/2008	14:01	0.5	3.9	------	<1	------	25.2	25.3	43.2	43.4
NLRA S19	7/7/2008	14:09	0.5	4.3	------	1	------	26.1	26.0	43.8	43.8
NLRA S20	7/7/2008	14:17	0.5	7.4	------	1	------	26.2	26.2	44.4	45.4
NLRA S21	7/7/2008	14:25	0.5	4.7	------	<1	------	26.0	26.1	44.2	44.1

APPENDIX A. Newfound Lake Near-Shore Sampling Data Summary: 2007 and 2008 (Task 7)

Site	Date	Time (hh:mm)	Depth (meters)	Total Phosphorus (*u* g/l)	Total Phosphorus (replicate) (*u* g/l)	E *coli* (CFU/100ml)	E *coli* (replicate) (CFU/100ml)	Temperature (°C)	Temperature (replicate) (°C)	Specific Conductivity (*u* S/cm)	Specific Conductivity (replicate) (*u* S/cm)
NLRA S22	7/7/2008	14:38	0.5	5.7	------	<1	------	25.8	25.7	47.5	47.2
NLRA S23	7/7/2008	14:58	0.5	10.8	------	<1	------	27.6	27.6	45.5	45.4
NLRA S24	7/7/2008	15:04	0.5	9.4	9.3	<1	------	28.4	28.3	45.3	45.2
NLRA S25	7/7/2008	15:18	0.5	4.6	------	1	------	25.9	25.9	43.2	43.1
NLRA S26	7/7/2008	15:30	0.5	4.1	------	<1	------	26.6	26.5	43.1	43.0
NLRA S27	7/7/2008	15:41	0.5	4.3	------	<1	------	25.5	25.4	43.0	43.0
NLRA S28	7/7/2008	15:54	0.5	6.0	------	<1	------	25.9	26.0	42.6	42.6
NLRA S29	7/7/2008	10:11	0.5	5.3	------	2	------	23.5	23.5	39.4	41.0
NLRA S30	7/7/2008	11:49	0.5	3.8	------	<1	------	24.9	25.0	43.9	43.5
NLRA S01	9/1/2008	10:25	0.5	15.7	------	------	------	19.7	19.6	34.8	34.9
NLRA S02	9/1/2008	10:32	0.5	10.0	------	------	------	18.4	18.4	34.2	34.3
NLRA S03	9/1/2008	10:43	0.5	11.9	------	------	------	18.6	18.6	36.4	36.3
NLRA S04	9/1/2008	10:53	0.5	5.8	5.6	------	------	19.2	19.3	36.1	36.1
NLRA S05	9/1/2008	11:05	0.5	3.8	------	------	------	19.7	19.8	36.0	36.0
NLRA S06	9/1/2008	11:16	0.5	4.0	------	------	------	19.8	19.9	35.9	35.8
NLRA S07	9/1/2008	11:26	0.5	3.8	------	------	------	19.8	19.9	36.5	36.4
NLRA S08	9/1/2008	11:35	0.5	3.8	------	------	------	20.0	20.0	36.0	35.9
NLRA S09	9/1/2008	11:43	0.5	4.3	------	------	------	20.1	20.1	36.1	36.1
NLRA S10	9/1/2008	11:51	0.5	5.1	------	------	------	20.1	20.1	36.1	36.1
NLRA S11	9/1/2008	12:03	0.5	4.2	------	------	------	20.5	20.6	35.2	35.9
NLRA S12	9/1/2008	12:26	0.5	6.1	------	------	------	20.5	20.5	36.5	36.6
NLRA S13	9/1/2008	12:43	0.5	3.4	------	------	------	19.8	19.9	35.2	35.2
NLRA S14	9/1/2008	------		------	------	------	------	------	------	------	------
NLRA S15	9/1/2008	------		------	------	------	------	------	------	------	------
NLRA S16	9/1/2008	------		------	------	------	------	------	------	------	------
NLRA S17	9/1/2008	------		------	------	------	------	------	------	------	------
NLRA S18	9/1/2008	------		------	------	------	------	------	------	------	------
NLRA S19	9/1/2008	------		------	------	------	------	------	------	------	------
NLRA S20	9/1/2008	------		------	------	------	------	------	------	------	------
NLRA S21	9/1/2008	------		------	------	------	------	------	------	------	------
NLRA S22	9/1/2008	------		------	------	------	------	------	------	------	------
NLRA S23	9/1/2008	------		------	------	------	------	------	------	------	------
NLRA S24	9/1/2008	------		------	------	------	------	------	------	------	------
NLRA S25	9/1/2008	------		------	------	------	------	------	------	------	------
NLRA S26	9/1/2008	------		------	------	------	------	------	------	------	------
NLRA S27	9/1/2008	------		------	------	------	------	------	------	------	------
NLRA S28	9/1/2008	13:02	0.5	3.9	------	------	------	20.3	20.4	35.2	35.2

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Site	Date	Time (hh:mm)	Depth (meters)	Total Phosphorus (*u* g/l)	Total Phosphorus (replicate) (*u* g/l)	E *coli* (CFU/100ml)	E *coli* (replicate) (CFU/100ml)	Temperature (°C)	Temperature (replicate) (°C)	Specific Conductivity (*u* S/cm)	Specific Conductivity (replicate) (*u* S/cm)
NLRA S29	9/1/2008	13:15	0.5	11.6	------	------	------	16.7	17.7	32.8	32.9
NLRA S30	9/1/2008	12:16	0.5	3.4	------	------	------	20.1	20.2	35.2	35.3
NLRA S01	9/30/2008	9:52	0.5	3.7	4.5	3	7	17.4	17.4	35.0	35.0
NLRA S02	9/30/2008	10:08	0.5	3.2	------	6	------	17.4	17.4	35.2	35.3
NLRA S03	9/30/2008	10:16	0.5	3.8	------	11	------	17.5	17.5	35.0	34.9
NLRA S04	9/30/2008	10:22	0.5	3.9	------	5	------	17.8	17.8	35.8	35.7
NLRA S05	9/30/2008	10:28	0.5	3.5	------	7	------	17.7	17.7	35.4	35.4
NLRA S06	9/30/2008	10:33	0.5	4.8	------	10	------	17.7	17.7	35.0	35.0
NLRA S07	9/30/2008	10:39	0.5	4.4	------	8	------	17.8	17.8	36.2	36.2
NLRA S08	9/30/2008	10:46	0.5	3.4	------	10	------	17.8	17.8	36.6	36.6
NLRA S09	9/30/2008	10:53	0.5	4.7	------	8	------	17.8	17.8	36.9	36.9
NLRA S10	9/30/2008	10:59	0.5	3.8	------	8	------	17.8	17.9	37.1	37.1
NLRA S11	9/30/2008	11:07	0.5	3.2	------	6	------	17.9	17.9	37.0	37.0
NLRA S12	9/30/2008	11:22	0.5	4.5	------	6	------	17.9	17.9	36.6	36.8
NLRA S13	9/30/2008	11:33	0.5	2.7	------	3	------	17.9	17.9	36.4	36.4
NLRA S14	9/30/2008	11:47	0.5	3.8	------	17	------	18.0	18.0	37.4	37.3
NLRA S15	9/30/2008	11:51	0.5	3.9	------	14	------	18.0	18.1	37.0	37.0
NLRA S16	9/30/2008	12:00	0.5	3.2	------	5	------	18.0	18.0	36.7	36.8
NLRA S17	9/30/2008	12:09	0.5	2.9	------	4	------	17.9	17.9	36.6	36.6
NLRA S18	9/30/2008	12:16	0.5	3.6	------	6	------	17.7	17.7	36.5	36.5
NLRA S19	9/30/2008	12:23	0.5	3.1	------	8	------	17.7	17.7	36.6	36.6
NLRA S20	9/30/2008	12:30	0.5	4.3	------	20	------	17.7	17.7	37.3	37.3
NLRA S21	9/30/2008	12:38	0.5	3.6	------	15	------	17.6	17.6	37.2	37.2
NLRA S22	9/30/2008	12:49	0.5	5.4	------	86	------	14.5	14.5	32.3	32.6
NLRA S23	9/30/2008	13:03	0.5	6.3	------	13	------	17.5	17.5	37.4	37.4
NLRA S24	9/30/2008	13:10	0.5	8.8	9.4	17	19	17.7	17.7	38.2	38.1
NLRA S25	9/30/2008	13:25	0.5	4.9	------	12	------	17.6	17.6	36.6	36.9
NLRA S26	9/30/2008	13:34	0.5	4.0	------	2	------	17.8	17.8	37.1	37.1
NLRA S27	9/30/2008	13:45	0.5	------	------	3	------	18.2	18.2	36.9	36.9
NLRA S28	9/30/2008	13:55	0.5	4.6	------	<1	------	18.0	18.0	37.0	37.0
NLRA S29	9/30/2008	14:07	0.5	7.6	------	72	------	14.9	14.8	29.9	29.9
NLRA S30	9/30/2008	11:15	0.5	3.6	3.9	6	------	17.8	17.8	36.7	36.2

APPENDIX A. Newfound Watershed Periphyton (attatched algae) Data Summary: 2008 (Task 9)

Site ID	Date	Start Time (hh:mm)	Stop Time (hh:mm)	Chlorophyll *a* periphyton (mg/m^2)	Chlorophyll *a* periphyton (replicate) (mg/m^2)	Temperature (^oC)	Temperature (replicate) (^oC)	Specific Conductivity @ 25^oC (u S/cm)	Specific Conductivity @ 25^oC (replicate) (u S/cm)
P-1 Cockermouth	7/22/2008	10:41	11:11	1.349	------	------	------	------	------
P-3 Beachwood	7/22/2008	11:33	12:04	0.372	------	24.6	24.6	39.6	39.6
P-4 Fowler	7/22/2008	15:10	15:32	5.567	5.618	20.0	20.0	49.1	49.3
P-5 Hemlock	7/22/2008	13:55	14:23	2.582	------	25.3	25.3	41.5	41.4
P-7 Hebron	7/22/2008	10:20	10:40	6.708	------	23.5	23.4	37.8	39.0
P-1 Cockermouth	8/14/2008	13:01	13:05	------	------	------	------	------	------
P-3 Beachwood	8/14/2008	11:25	11:40	------	------	22.5	22.5	35.3	35.4
P-4 Fowler	8/14/2008	15:08	15:30	3.538	------	17.9	17.8	30.0	30.1
P-5 Hemlock	8/14/2008	10:15	10:40	16.882	------	22.4	22.4	35.5	35.6
P-7 Hebron	8/14/2008	11:55	12:20	4.483	2.891	22.0	22.3	37.2	36.6
P-3 Beachwood	8/26/2008	10:37	10:55	0.301	------	20.9	20.9	35.4	35.3
P-4 Fowler	8/26/2008	15:55	16:17	2.224	2.018	18.3	18.3	48.7	48.7
P-5 Hemlock	8/26/2008	14:07	14:31	1.218	------	20.9	20.9	36.4	36.4
P-7 Hebron	8/26/2008	11:09	11:32	1.316	------	19.2	19.2	37.2	36.9
P-3 Beachwood	9/24/2008	11:09	11:33	0.566	------	18.2	18.2	35.6	35.6
P-4 Fowler	9/24/2008	14:17	14:39	2.986	------	14.0	14.0	49.3	49.2
P-5 Hemlock	9/24/2008	10:20	10:45	3.433	3.711	18.1	18.1	36.3	36.1
P-7 Hebron	9/24/2008	11:51	12:18	2.967	------	17.7	17.7	37.3	37.2

With the exception of the periphyton chlorophyll *a* samples, the data were collected at a standard sampling depth of 0.5 meters.

APPENDIX A. Newfound Watershed Periphyton (attatched algae) Data Summary: 2008 (Task 9)

Dissolved Oxygen (mg/l)	Dissolved Oxygen (replicate) (mg/l)	Dissolved Oxygen (% saturation)	Dissolved Oxygen (replicate) (% saturation)	Total Phosphorus (*u* g/l)	Total Phosphorus (replicate) (*u* g/l)	Chlorophyll *a* (*u* g/l)	Chlorophyll *a* (replicate) (*u* g/l)
------	------	------	------	3.8	------	1.6	------
8.5	8.4	101.6	101.2	2.9	------	1.3	------
8.0	8.1	88.2	88.6	10.4	10.3	2.6	------
8.5	8.4	103.0	102.6	3.2	------	1.4	------
8.6	8.6	101.1	101.4	7.4	------	2.6	------
------	------	------	------	6.0	------	------	------
------	------	------	------	3.5	------	1.8	------
------	------	------	------	16.8	------	0.5	------
------	------	------	------	6.1	------	1.3	------
------	------	------	------	7.2	------	1.8	------
------	------	------	------	2.9	------	3.6	------
------	------	------	------	11.1	------	1.6	------
------	------	------	------	5.8	------	4.5	------
------	------	------	------	8.7	------	4.9	------
------	------	------	------	4.1	------	1.9	------
------	------	------	------	8.7	------	1.6	1.1
------	------	------	------	4.1	------	1.9	------
------	------	------	------	5.9	------	2.1	------

APPENDIX A. Newfound Lake Benthic (lake sediment) Data Summary: 2008 (Task 10)

Site ID	Date	Time (hh:mm)	Depth (meters)	Temperature (^oC)	Temperature (replicate) (^oC)	Dissolved Oxygen (mg/l)	Dissolved Oxygen (replicate) (mg/l)	Dissolved Oxygen (% saturation)	Dissolved Oxygen (replicate) (% saturation)
NLRA-B01	7/31/2008	14:17	0.5	------	------	------	------	------	------
NLRA-B02	7/31/2008	13:01	0.5	------	------	------	------	------	------
NLRA-B03	7/31/2008	11:55	0.5	------	------	------	------	------	------
NLRA-B04	7/31/2008	10:25	0.5	------	------	------	------	------	------
NLRA-B05	8/26/2008	9:45	0.1	21.1	21.1	8.8	8.8	98.4	99.1
NLRA-B06	8/14/2008	10:09	0.5	------	------	------	------	------	------
NLRA-B07	8/26/2008	10:25	0.5	21.2	21.2	8.9	8.8	99.7	99.4
NLRA-B08	8/26/2008	10:57	0.5	21.5	21.5	8.9	8.9	100.2	100.7
NLRA-B09	8/26/2008	11:25	0.5	21.3	21.4	8.8	8.7	99.1	98.4
NLRA-B10	8/26/2008	17:14	0.1	15.6	15.6	9.8	9.8	98.9	98.8
NLRA-B11	8/26/2008	12:17	0.5	21.4	21.5	8.9	8.8	101.6	99.6
NLRA-B12	8/26/2008	12:55	0.5	21.2	21.3	9.1	9.0	102.0	101.6
NLRA-B13	8/26/2008	13:35	0.5	19.5	19.5	9.1	9.1	98.8	99.1
NLRA-B14	8/26/2008	14:06	0.5	19.2	19.0	7.1	7.1	77.1	76.6
NLRA-B15	8/14/2008	13:30	0.5	19.7	19.7	------	------	------	------
NLRA-B16	8/14/2008	14:59	0.5	18.5	18.7	------	------	------	------
NLRA-B17	8/14/2008	14:17	0.5	15.9	15.9	------	------	------	------
NLRA-B18	8/26/2008	16:30	0.5	16.9	16.8	9.2	9.2	94.6	94.9
NLRA-B19	8/14/2008	12:17	0.5	22.0	22.3	------	------	------	------
NLRA-B20	8/14/2008	12:45	0.5	23.0	23.3	------	------	------	------
NLRA-B21	8/14/2008	11:25	0.5	20.9	20.9	8.9	8.9	99.7	100.0
NLRA-B22	8/26/2008	15:01	0.5	21.2	21.4	8.9	8.9	99.6	100.1

APPENDIX A. Newfound Lake Benthic (lake sediment) Data Summary: 2008 (Task 10)

Specific Conductivity @ 25°C (*u* S/cm)	Specific Conductivity @ 25°C (replicate) (*u* S/cm)	Total Phosphorus (*u* g/l)	Percent Organic mater (%)	Percent Organic matter (replicate) (%)	Benthic Total Phosphorus (g/Kg)	Benthic Total Phosphorus (replicate) (g/Kg)
------	------	11.8	0.3	------	0.01465	------
------	------	11.6	0.4	------	0.01944	------
------	------	4.6	1.0	------	0.02028	------
------	------	3.7	0.3	------	0.02372	------
36.7	36.8	9.5	0.6	------	0.02119	------
------	------	------	0.6	------	0.02089	------
36.6	36.6	5.8	0.5	------	0.01455	------
36.3	36.3	6.2	6.1	------	0.26630	------
35.9	35.8	5.2	0.3	------	0.00549	------
69.0	68.8	7.1	1.6	------	0.08122	------
36.0	36.0	11.2	0.3	------	0.01239	------
37.5	36.5	------	0.5	------	0.02013	------
35.1	35.4	5.1	2.4	------	0.07511	------
56.2	56.8	18.4	9.7	------	0.49936	------
31.3	31.1	19.4	0.5	------	0.03357	------
33.8	34.0	9.3	5.2	------	0.20270	------
28.6	28.8	7.0	0.8	------	0.03296	------
52.7	52.7	4.5	0.4	------	0.01797	------
37.2	36.6	6.1	18.5	------	1.05166	------
39.2	37.5	7.2	17.3	17.0	1.21625	1.20808
35.4	35.3	2.9	0.9	------	0.02411	------
35.4	35.2	------	0.2	------	0.01024	------

APPENDIX A. Newfound Watershed Tributary (Paired-Watershed) Data Summary: 2008 (Task 5)

Sample Name	Sampling Date	Collection Time (hh:mm)	Depth (meters)	Chloride (mg Cl/l)	Chloride replicate (mg Cl/l)	Nitrate (mg NO^3/l)	Nitrate replicate (mg NO^3/l)	Sulfate (mg S/l)	Sulfate replicate (mg S/l)	Sodium (mg Na/l)	Sodium replicate (mg Na/l)	Potassium (mg K/l)	Potassium replicate (mg K/l)	Magnesium (mg Mg/l)
1 Hemlock Brook	09-Apr-08	11:50	0.1	1.73	------	0.05	------	1.44	------	2.09	------	0.31	------	0.47
1 Hemlock Brook	22-May-08	14:23	0.1	2.85	------	0.01	------	1.49	------	2.92	------	0.49	------	0.68
1 Hemlock Brook	11-Aug-08	14:54	0.1	0.96	------	0.01	------	1.06	------	1.59	------	0.33	------	0.25
1 Hemlock Brook	18-Aug-08	15:31	0.1	1.46	------	0.02	------	1.19	------	2.23	------	0.45	------	0.57
1 Hemlock Brook	21-Oct-08	15:01	0.1	4.88	------	<.003	------	1.43	------	2.62	------	0.55	------	0.75
2 Tilton Brook	09-Apr-08	12:22	0.1	12.56	------	0.04	------	1.58	------	10.28	------	0.60	------	0.63
2 Tilton Brook	22-May-08	14:03	0.1	17.62	------	0.03	------	2.69	------	11.43	------	0.75	------	1.02
2 Tilton Brook	11-Aug-08	14:45	0.1	6.35	------	0.01	------	1.29	------	5.54	------	0.51	------	0.53
2 Tilton Brook	18-Aug-08	15:18	0.1	9.16	------	0.08	------	1.65	------	7.58	------	0.62	------	0.66
2 Tilton Brook	21-Oct-08	14:43	0.1	13.53	------	<.003	------	2.53	------	8.31	------	0.77	------	1.15
3 Dick Brown Brook	09-Apr-08	12:50	0.1	4.82	4.70	0.07	0.05	1.32	1.41	4.68	4.66	0.34	0.33	0.50
3 Dick Brown Brook	22-May-08	13:38	0.1	9.26	------	0.04	------	1.45	------	6.71	------	0.56	------	0.74
3 Dick Brown Brook	11-Aug-08	14:18	0.1	2.79	------	0.02	------	1.16	------	3.15	------	0.43	------	0.45
3 Dick Brown Brook	18-Aug-08	14:46	0.1	5.19	------	0.06	------	1.23	------	4.77	------	0.49	------	0.61
3 Dick Brown Brook	21-Oct-08	14:15	0.1	7.10	------	0.02	------	1.32	------	5.19	------	0.62	------	0.85
4 Whittemore Brook	09-Apr-08	13:08	0.1	0.87	------	0.03	------	1.15	------	1.44	------	0.25	------	0.38
4 Whittemore Brook	22-May-08	13:19	0.1	2.06	------	<.003	------	0.95	------	2.20	------	0.41	------	0.47
4 Whittemore Brook	11-Aug-08	14:02	0.1	0.86	------	<.003	------	0.90	------	1.53	------	0.37	------	0.40
4 Whittemore Brook	18-Aug-08	14:28	0.1	1.32	------	0.02	------	0.91	------	2.07	------	0.45	------	0.49
4 Whittemore Brook	21-Oct-08	13:47	0.1	1.90	------	<.003	------	0.89	------	2.13	------	0.52	------	0.67
9 Cashman Brook	09-Apr-08	13:33	0.1	28.20	------	<.003	------	1.30	------	21.97	------	0.45	------	0.58
9 Cashman Brook	22-May-08	12:27	0.1	54.18	------	0.09	------	1.57	------	34.20	------	0.91	------	1.04
9 Cashman Brook	11-Aug-08	13:39	0.1	10.18	------	0.01	------	0.82	------	8.81	------	0.42	------	0.43
9 Cashman Brook	18-Aug-08	13:34	0.1	32.36	------	0.05	------	1.05	------	21.81	------	0.74	------	0.75
9 Cashman Brook	21-Oct-08	13:25	0.1	43.47	------	0.01	------	1.12	------	26.13	------	1.05	------	1.02
10 Georges Brook	09-Apr-08	13:55	0.1	5.82	------	<.003	------	1.12	------	5.32	------	0.23	------	0.34
10 Georges Brook	22-May-08	12:48	0.1	8.23	------	0.01	------	0.83	------	6.16	------	0.30	------	0.60
10 Georges Brook	11-Aug-08	13:25	0.1	3.52	------	<.003	------	0.77	------	3.58	------	0.28	------	0.30
10 Georges Brook	18-Aug-08	13:52	0.1	4.91	------	<.003	------	0.65	------	4.61	------	0.30	------	0.35
10 Georges Brook	21-Oct-08	13:01	0.1	8.02	------	0.01	------	0.78	------	5.46	------	0.42	------	0.55
12 Cockermouth River	09-Apr-08	14:25	0.1	2.29	------	0.06	------	1.03	------	2.65	------	0.25	------	0.34
12 Cockermouth River	22-May-08	11:49	0.1	6.80	------	0.10	------	1.23	------	5.18	------	0.54	------	0.54
12 Cockermouth River	11-Aug-08	12:30	0.1	0.66	------	0.02	------	0.74	------	1.11	------	0.50	------	0.19
12 Cockermouth River	18-Aug-08	12:36	0.1	3.89	------	0.11	------	1.01	------	3.83	------	0.49	------	0.42
12 Cockermouth River	21-Oct-08	12:33	0.1	4.61	------	0.05	------	1.12	------	3.72	------	0.50	------	0.58
17 Mason Brook	09-Apr-08	14:59	0.1	2.51	------	0.06	------	1.69	------	2.28	------	0.38	------	0.58
17 Mason Brook	22-May-08	11:28	0.1	2.61	------	0.02	------	1.14	------	2.60	------	0.46	------	0.76

APPENDIX A. Newfound Watershed Tributary (Paired-Watershed) Data Summary: 2008 (Task 5)

Sample Name	Sampling Date	Collection Time (hh:mm)	Depth (meters)	Chloride (mg Cl/l)	Chloride replicate (mg Cl/l)	Nitrate (mg NO^3/l)	Nitrate replicate (mg NO^3/l)	Sulfate (mg S/l)	Sulfate replicate (mg S/l)	Sodium (mg Na/l)	Sodium replicate (mg Na/l)	Potassium (mg K/l)	Potassium replicate (mg K/l)	Magnesium (mg Mg/l)
17 Mason Brook	11-Aug-08	12:03	0.1	1.50	------	0.03	------	1.00	------	1.76	------	0.44	------	0.58
17 Mason Brook	18-Aug-08	12:15	0.1	1.62	------	0.03	------	1.00	------	2.12	------	0.47	------	0.67
17 Mason Brook	21-Oct-08	12:14	0.1	2.73	------	<.003	------	1.12	------	2.32	------	0.55	------	1.06
18 The Ledges	09-Apr-08	15:25	0.1	1.32	------	0.05	------	1.14	------	1.77	------	0.26	------	0.53
18 The Ledges	22-May-08	11:01	0.1	5.99	------	0.14	------	1.52	------	3.79	------	0.49	------	0.90
18 The Ledges	11-Aug-08	11:44	0.1	2.63	------	0.03	------	1.05	------	2.82	------	0.39	------	0.57
18 The Ledges	18-Aug-08	11:55	0.1	2.65	------	0.12	------	1.37	------	2.67	------	0.41	------	0.75
18 The Ledges	21-Oct-08	11:52	0.1	3.52	------	0.11	------	1.39	------	2.59	------	0.45	------	0.97
21 Bog Brook	09-Apr-08	16:24	0.1	5.12	------	0.02	------	0.94	------	4.94	------	0.38	------	0.41
21 Bog Brook	22-May-08	10:00	0.1	9.33	------	0.01	------	1.03	------	6.56	------	0.49	------	0.57
21 Bog Brook	11-Aug-08	11:07	0.1	3.55	------	0.02	------	0.82	------	3.20	------	0.57	------	0.30
21 Bog Brook	18-Aug-08	10:45	0.1	5.79	------	0.02	------	0.77	------	4.89	------	0.61	------	0.44
21 Bog Brook	21-Oct-08	10:48	0.1	7.42	------	0.01	------	1.00	------	4.78	------	0.57	------	0.60
22 Fowler River	09-Apr-08	17:06	0.1	2.61	------	0.05	------	1.10	------	2.80	------	0.25	------	0.25
22 Fowler River	22-May-08	10:29	0.1	3.69	------	0.01	------	0.99	------	3.05	------	0.35	------	0.33
22 Fowler River	11-Aug-08	10:41	0.1	1.24	------	0.02	------	0.75	------	1.53	------	0.49	------	0.13
22 Fowler River	18-Aug-08	11:18	0.1	2.62	------	0.01	------	0.99	------	2.66	------	0.34	------	0.38
22 Fowler River	21-Oct-08	11:13	0.1	2.83	------	<.003	------	1.12	------	2.37	------	0.36	------	0.43
23 Black Brook	09-Apr-08	15:39	0.1	15.81	15.68	0.11	0.06	1.44	1.27	12.87	12.86	0.57	0.56	0.56
23 Black Brook	22-May-08	9:05	0.1	40.47	40.31	0.04	0.04	1.19	1.17	25.19	25.39	0.86	0.90	1.06
23 Black Brook	11-Aug-08	9:55	0.1	8.71	8.82	0.02	0.04	0.89	0.91	7.35	7.29	0.62	0.61	0.51
23 Black Brook	18-Aug-08	10:05	0.1	33.43	34.14	0.03	0.08	0.83	0.88	21.64	21.86	0.58	0.94	0.73
23 Black Brook	21-Oct-08	10:09	0.1	30.09	30.58	0.03	0.03	0.93	0.92	17.36	17.54	1.10	1.06	1.30

APPENDIX A. Newfound Watershed Tributary (Paired-Watershed) Data Summary: 2008 (Task 5)

Sample Name	Sampling Date	Collection Time (hh:mm)	Magnesium replicate (mg Mg/l)	Calcium (mg Ca/l)	Calcium replicate (mg Ca/l)	Soluble Reactive Phosphorus (*u* g/l)	Soluble Reactive Phosphorus replicate (*u* g/l)	Total Phosphorus (*u* g/l)	Total Phosphorus replicate (*u* g/l)	Temperature (^{o}C)	Temperature replicate (^{o}C)	Specific Conductivity @ 25^{o}C (*u* S/cm)
1 Hemlock Brook	09-Apr-08	11:50	------	2.56	------	1.0	------	3.2	------	2.7	2.7	27.6
1 Hemlock Brook	22-May-08	14:23	------	4.26	------	< 1.0	------	2.9	------	9.9	9.8	35.1
1 Hemlock Brook	11-Aug-08	14:54	------	2.44	------	1.3	------	18.5	------	15.2	15.2	21.3
1 Hemlock Brook	18-Aug-08	15:31	------	4.04	------	1.5	------	6.1	------	16.8	16.8	29.5
1 Hemlock Brook	21-Oct-08	15:01	------	4.53	------	3.0	------	6.1	------	7.5	7.4	37.2
2 Tilton Brook	09-Apr-08	12:22	------	4.55	------	< 1.0	------	3.7	------	3.1	3.1	80.2
2 Tilton Brook	22-May-08	14:03	------	6.33	------	< 1.0	------	7.2	------	9.6	9.5	99.6
2 Tilton Brook	11-Aug-08	14:45	------	4.25	------	1.4	------	13.3	------	15.2	15.2	48.8
2 Tilton Brook	18-Aug-08	15:18	------	5.41	------	1.2	------	6.3	------	16.4	16.4	67.4
2 Tilton Brook	21-Oct-08	14:43	------	7.16	------	< 1.0	------	3.1	------	8.4	8.4	89.5
3 Dick Brown Brook	09-Apr-08	12:50	0.49	3.73	3.60	< 1.0	------	4.9	------	3.2	3.2	43.7
3 Dick Brown Brook	22-May-08	13:38	------	4.40	------	1.0	------	4.0	------	10.4	10.3	60.0
3 Dick Brown Brook	11-Aug-08	14:18	------	3.89	------	1.4	------	18.7	------	15.7	15.7	32.6
3 Dick Brown Brook	18-Aug-08	14:46	------	4.28	------	1.1	------	6.7	------	17.4	17.3	46.9
3 Dick Brown Brook	21-Oct-08	14:15	------	5.63	------	1.5	------	5.2	------	7.8	7.8	58.5
4 Whittemore Brook	09-Apr-08	13:08	------	2.31	------	1.5	------	4.5	------	3.6	3.6	20.2
4 Whittemore Brook	22-May-08	13:19	------	2.82	------	< 1.0	------	5.3	------	9.8	9.8	29.7
4 Whittemore Brook	11-Aug-08	14:02	------	3.57	------	2.3	------	10.7	------	15.5	15.5	20.7
4 Whittemore Brook	18-Aug-08	14:28	------	3.63	------	1.9	------	8.8	------	17.4	17.4	26.3
4 Whittemore Brook	21-Oct-08	13:47	------	4.35	------	2.0	------	5.2	------	7.7	7.7	30.2
9 Cashman Brook	09-Apr-08	13:33	------	4.52	------	1.0	------	4.0	------	4.0	3.9	140.3
9 Cashman Brook	22-May-08	12:27	------	6.13	------	1.6	------	3.8	------	10.0	9.9	221.1
9 Cashman Brook	11-Aug-08	13:39	------	3.83	------	2.2	------	21.1	------	15.9	15.8	63.1
9 Cashman Brook	18-Aug-08	13:34	------	5.41	------	2.0	------	5.1	------	17.2	17.2	142.1
9 Cashman Brook	21-Oct-08	13:25	------	6.87	------	1.4	------	4.3	------	8.4	8.4	190.4
10 Georges Brook	09-Apr-08	13:55	------	2.61	------	< 1.0	------	4.1	------	1.6	1.5	42.8
10 Georges Brook	22-May-08	12:48	------	4.42	------	2.0	------	15.3	------	13.5	13.5	50.3
10 Georges Brook	11-Aug-08	13:25	------	3.48	------	1.3	------	12.8	------	16.3	16.3	31.6
10 Georges Brook	18-Aug-08	13:52	------	4.21	------	< 1.0	------	11.7	------	20.3	20.2	40.4
10 Georges Brook	21-Oct-08	13:01	------	4.48	------	1.2	------	7.8	------	7.8	7.8	51.1
12 Cockermouth River	09-Apr-08	14:25	------	2.42	------	< 1.0	------	5.5	------	4.2	4.2	29.1
12 Cockermouth River	22-May-08	11:49	------	4.11	------	1.1	------	3.6	------	10.2	10.2	48.4
12 Cockermouth River	11-Aug-08	12:30	------	2.80	------	2.7	------	258.1	------	15.0	14.9	16.7
12 Cockermouth River	18-Aug-08	12:36	------	4.23	------	< 1.0	------	3.5	------	17.2	17.1	39.1
12 Cockermouth River	21-Oct-08	12:33	------	4.54	------	< 1.0	------	2.9	------	8.4	8.3	42.1
17 Mason Brook	09-Apr-08	14:59	------	4.39	------	< 1.0	------	4.3	------	4.1	4.1	34.5
17 Mason Brook	22-May-08	11:28	------	5.02	------	1.6	------	6.7	------	9.6	9.6	38.4

APPENDIX A. Newfound Watershed Tributary (Paired-Watershed) Data Summary: 2008 (Task 5)

Sample Name	Sampling Date	Collection Time (hh:mm)	Magnesium replicate (mg Mg/l)	Calcium (mg Ca/l)	Calcium replicate (mg Ca/l)	Soluble Reactive Phosphorus (*u* g/l)	Soluble Reactive Phosphorus replicate (*u* g/l)	Total Phosphorus (*u* g/l)	Total Phosphorus replicate (*u* g/l)	Temperature (^{o}C)	Temperature replicate (^{o}C)	Specific Conductivity @ 25^{o}C (*u* S/cm)
17 Mason Brook	11-Aug-08	12:03	------	4.68	------	1.7	------	38.3	------	15.6	15.5	28.6
17 Mason Brook	18-Aug-08	12:15	------	5.53	------	1.1	------	4.9	------	17.0	17.0	38.8
17 Mason Brook	21-Oct-08	12:14	------	6.36	------	1.1	------	4.0	------	8.9	8.9	45.4
18 The Ledges	09-Apr-08	15:25	------	3.35	------	< 1.0	------	3.2	------	4.2	4.2	28.0
18 The Ledges	22-May-08	11:01	------	4.90	------	1.2	------	3.4	------	10.4	10.4	50.1
18 The Ledges	11-Aug-08	11:44	------	4.08	------	1.5	------	34.8	------	15.3	15.3	19.6
18 The Ledges	18-Aug-08	11:55	------	4.82	------	< 1.0	------	2.1	------	17.7	17.7	38.4
18 The Ledges	21-Oct-08	11:52	------	5.66	------	< 1.0	------	2.5	------	9.1	9.1	42.8
21 Bog Brook	09-Apr-08	16:24	------	3.10	------	1.4	------	8.9	------	3.9	3.9	42.9
21 Bog Brook	22-May-08	10:00	------	4.06	------	1.4	------	9.8	------	12.4	12.5	53.5
21 Bog Brook	11-Aug-08	11:07	------	3.48	------	4.4	------	98.1	------	15.5	15.5	32.1
21 Bog Brook	18-Aug-08	10:45	------	4.11	------	1.0	------	13.7	------	17.5	17.5	45.9
21 Bog Brook	21-Oct-08	10:48	------	4.34	------	1.2	------	6.9	------	6.9	6.8	47.7
22 Fowler River	09-Apr-08	17:06	------	1.46	------	< 1.0	------	6.9	------	4.5	4.4	28.1
22 Fowler River	22-May-08	10:29	------	2.69	------	1.1	------	3.5	------	10.5	10.6	32.1
22 Fowler River	11-Aug-08	10:41	------	2.11	------	3.5	------	308.1	------	14.9	14.9	18.3
22 Fowler River	18-Aug-08	11:18	------	2.22	------	1.0	------	4.5	------	17.1	17.1	25.7
22 Fowler River	21-Oct-08	11:13	------	3.02	------	1.2	------	4.5	------	6.8	6.7	26.2
23 Black Brook	09-Apr-08	15:39	0.56	5.05	5.14	2.0	------	18.2	18.6	4.5	4.4	95.2
23 Black Brook	22-May-08	9:05	1.15	9.00	8.92	2.0	2.6	8.6	9.7	9.8	9.7	186.9
23 Black Brook	11-Aug-08	9:55	0.51	5.02	5.29	3.5	3.6	182.6	160.6	15.7	15.6	60.4
23 Black Brook	18-Aug-08	10:05	0.93	8.85	9.10	2.2	2.0	10.2	10.1	16.0	15.9	163.6
23 Black Brook	21-Oct-08	10:09	1.26	8.50	8.28	1.7	1.8	8.4	8.6	6.7	6.7	149.7

APPENDIX A. Newfound Watershed Tributary (Paired-Watershed) Data Summary: 2008 (Task 5)

Sample Name	Sampling Date	Collection Time (hh:mm)	Specific Conductivity @ 25°C replicate (u S/cm)	Turbidity (NTU)	Turbidity replicate (NTU)	pH (std units)	pH replicate (std units)	Gauge Height (feet)	Gauge Height (feet)	Discharge (m^3/sec)
1 Hemlock Brook	09-Apr-08	11:50	27.7	0.2	0.4	6.5	6.6	0.78	0.78	0.422
1 Hemlock Brook	22-May-08	14:23	35.2	< 0.2	< 0.2	7.1	7.1	0.28	0.28	0.012
1 Hemlock Brook	11-Aug-08	14:54	21.2	1.1	1.2	-----	-----	0.98	0.98	0.589
1 Hemlock Brook	18-Aug-08	15:31	29.6	0.2	0.2	6.7	6.8	------	------	------
1 Hemlock Brook	21-Oct-08	15:01	37.3	0.2	< 0.2	7.0	7.0	0.26	0.26	0.011
2 Tilton Brook	09-Apr-08	12:22	80.1	0.2	< 0.2	6.6	6.6	1.08	1.08	0.219
2 Tilton Brook	22-May-08	14:03	100.1	< 0.2	< 0.2	7.0	7.1	0.58	0.58	0.013
2 Tilton Brook	11-Aug-08	14:45	49.1	0.9	0.8	-----	-----	1.24	1.24	0.336
2 Tilton Brook	18-Aug-08	15:18	67.2	0.2	0.2	6.8	6.9	0.78	0.78	0.067
2 Tilton Brook	21-Oct-08	14:43	89.2	< 0.2	< 0.2	6.9	6.9	0.66	0.66	0.030
3 Dick Brown Brook	09-Apr-08	12:50	43.9	0.4	0.4	6.6	6.6	1.28	1.28	0.658
3 Dick Brown Brook	22-May-08	13:38	61.4	0.2	0.5	6.8	6.9	0.78	0.78	0.074
3 Dick Brown Brook	11-Aug-08	14:18	32.6	1.9	1.6	-----	-----	1.96	2.00	0.889
3 Dick Brown Brook	18-Aug-08	14:46	46.4	0.7	0.5	6.9	6.9	------	------	0.195
3 Dick Brown Brook	21-Oct-08	14:15	58.4	0.2	0.2	6.9	6.9	0.66	0.66	0.074
4 Whittemore Brook	09-Apr-08	13:08	20.2	0.4	0.3	6.5	6.5	1.20	1.18	0.646
4 Whittemore Brook	22-May-08	13:19	29.9	0.2	< 0.2	6.9	6.8	0.64	0.64	0.073
4 Whittemore Brook	11-Aug-08	14:02	20.7	0.5	0.4	-----	-----	1.32	1.32	0.873
4 Whittemore Brook	18-Aug-08	14:28	26.3	0.7	0.6	6.9	6.9	0.82	0.82	0.192
4 Whittemore Brook	21-Oct-08	13:47	30.2	< 0.2	< 0.2	6.9	7.0	0.64	0.64	0.073
9 Cashman Brook	09-Apr-08	13:33	138.3	< 0.2	0.2	6.6	6.6	1.20	1.20	0.208
9 Cashman Brook	22-May-08	12:27	221.2	< 0.2	0.3	6.8	6.8	0.58	0.58	0.004
9 Cashman Brook	11-Aug-08	13:39	64.5	0.4	0.3	-----	-----	1.34	1.35	0.328
9 Cashman Brook	18-Aug-08	13:34	142.0	< 0.2	< 0.2	6.9	6.9	0.74	0.74	0.009
9 Cashman Brook	21-Oct-08	13:25	190.6	< 0.2	< 0.2	6.8	6.8	0.80	0.80	0.020
10 Georges Brook	09-Apr-08	13:55	42.8	0.2	0.3	6.3	6.3	4.59	4.59	1.505
10 Georges Brook	22-May-08	12:48	50.3	0.7	0.7	6.9	7.0	5.02	5.02	0.049
10 Georges Brook	11-Aug-08	13:25	32.0	1.2	0.7	-----	-----	4.44	4.45	2.738
10 Georges Brook	18-Aug-08	13:52	40.6	0.7	0.6	6.8	6.9	4.93	4.93	0.059
10 Georges Brook	21-Oct-08	13:01	51.2	0.4	0.4	6.7	6.8	4.93	4.94	0.067
12 Cockermouth River	09-Apr-08	14:25	29.3	1.0	1.1	6.3	6.3	2.74	2.75	2.875
12 Cockermouth River	22-May-08	11:49	48.4	0.2	0.2	6.6	6.6	3.30	3.30	0.070
12 Cockermouth River	11-Aug-08	12:30	16.6	33.6	34.2	-----	-----	1.48	1.46	30.748
12 Cockermouth River	18-Aug-08	12:36	39.2	0.2	< 0.2	6.6	6.6	3.23	3.23	0.112
12 Cockermouth River	21-Oct-08	12:33	42.1	0.2	< 0.2	6.6	6.6	3.30	3.30	0.070
17 Mason Brook	09-Apr-08	14:59	34.3	0.2	0.3	6.6	6.6	0.56	0.58	0.092
17 Mason Brook	22-May-08	11:28	38.5	0.3	0.3	6.9	6.9	0.22	0.22	0.005

APPENDIX A. Newfound Watershed Tributary (Paired-Watershed) Data Summary: 2008 (Task 5)

Sample Name	Sampling Date	Collection Time (hh:mm)	Specific Conductivity @ 25°C replicate (u S/cm)	Turbidity (NTU)	Turbidity replicate (NTU)	pH (std units)	pH replicate (std units)	Gauge Height (feet)	Gauge Height (feet)	Discharge (m^3/sec)
17 Mason Brook	11-Aug-08	12:03	26.1	2.4	2.3	-----	-----	0.98	0.98	0.371
17 Mason Brook	18-Aug-08	12:15	38.7	0.3	0.3	7.1	7.2	0.26	0.26	0.008
17 Mason Brook	21-Oct-08	12:14	45.5	0.2	< 0.2	7.0	7.0	0.24	0.24	0.006
18 The Ledges	09-Apr-08	15:25	27.9	0.5	0.4	6.7	6.7	0.92	0.92	0.418
18 The Ledges	22-May-08	11:01	50.1	< 0.2	0.2	7.0	7.0	0.31	0.31	0.007
18 The Ledges	11-Aug-08	11:44	19.7	2.1	1.9	-----	-----	1.30	1.28	1.135
18 The Ledges	18-Aug-08	11:55	38.5	0.4	0.3	7.1	7.1	0.40	0.40	0.011
18 The Ledges	21-Oct-08	11:52	42.8	< 0.2	< 0.2	7.2	7.2	0.36	0.36	0.009
21 Bog Brook	09-Apr-08	16:24	43.0	0.6	0.7	6.1	6.1	2.34	2.35	2.975
21 Bog Brook	22-May-08	10:00	53.6	0.7	0.7	6.6	6.6	2.83	2.83	0.390
21 Bog Brook	11-Aug-08	11:07	32.2	19.1	19.8	-----	-----	1.89	1.89	6.849
21 Bog Brook	18-Aug-08	10:45	45.9	0.7	0.6	6.4	6.4	2.78	2.78	0.583
21 Bog Brook	21-Oct-08	10:48	47.8	0.2	0.2	6.5	6.5	2.30	2.31	3.259
22 Fowler River	09-Apr-08	17:06	28.1	0.6	0.7	6.1	6.1	3.67	3.66	5.561
22 Fowler River	22-May-08	10:29	32.0	< 0.2	0.2	6.5	6.5	4.08	4.08	0.650
22 Fowler River	11-Aug-08	10:41	18.0	29.1	27.4	-----	-----	2.73	2.73	------
22 Fowler River	18-Aug-08	11:18	25.8	0.3	0.2	6.5	6.5	4.03	4.03	0.859
22 Fowler River	21-Oct-08	11:13	26.3	< 0.2	< 0.2	6.9	6.7	4.07	4.07	0.691
23 Black Brook	09-Apr-08	15:39	95.4	1.9	1.7	6.5	6.5	1.16	1.16	0.275
23 Black Brook	22-May-08	9:05	187.8	0.9	1.0	6.8	6.9	0.40	0.40	0.008
23 Black Brook	11-Aug-08	9:55	60.4	10.2	10.2	-----	-----	1.60	1.60	0.383
23 Black Brook	18-Aug-08	10:05	163.8	1.0	0.9	6.8	6.8	0.54	0.54	------
23 Black Brook	21-Oct-08	10:09	149.8	0.7	0.7	6.6	6.6	0.46	0.46	0.007

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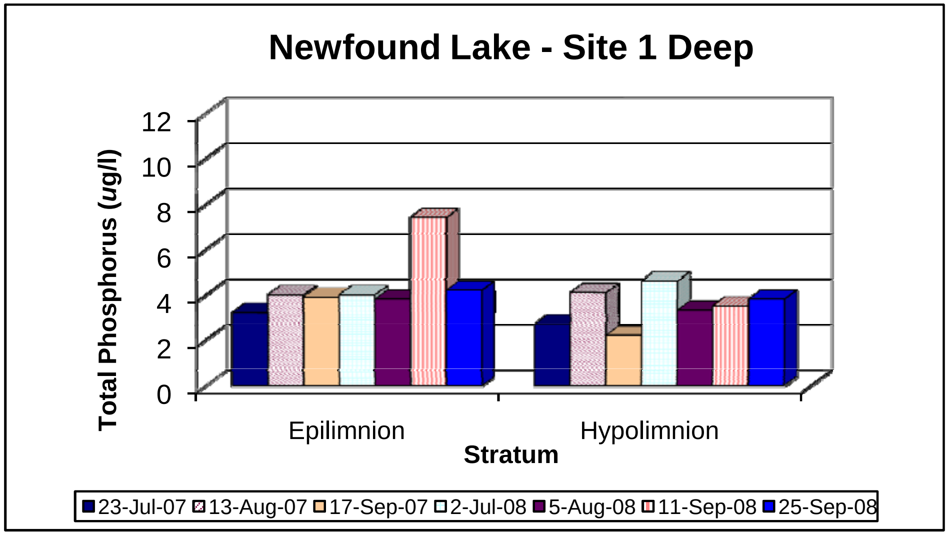
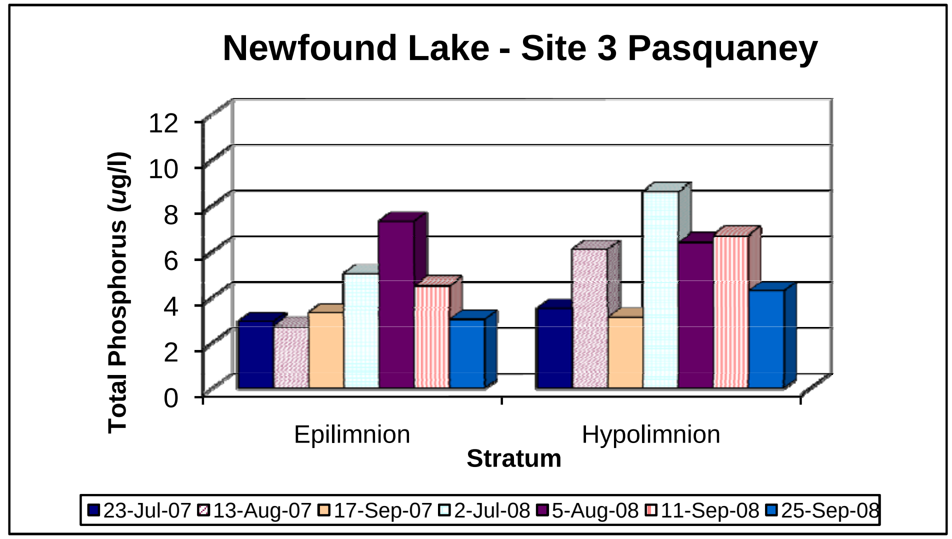
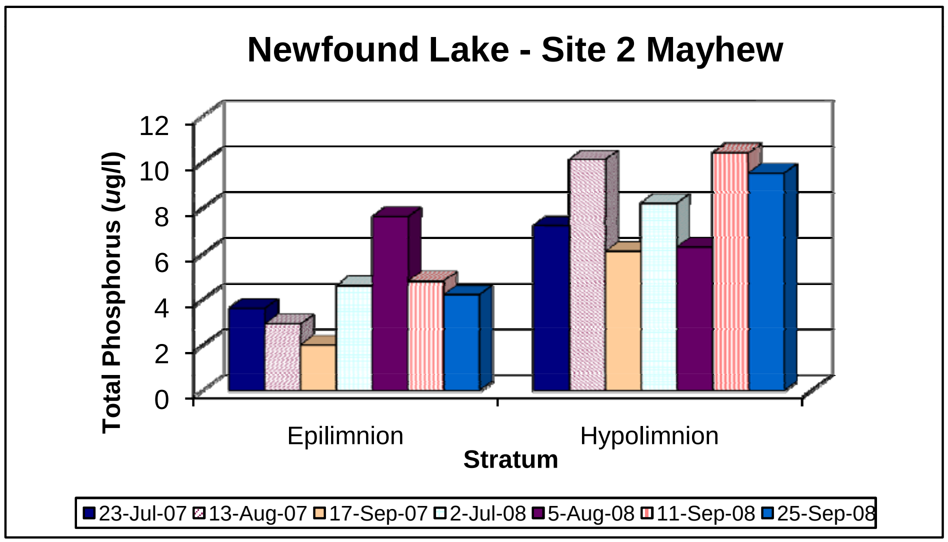
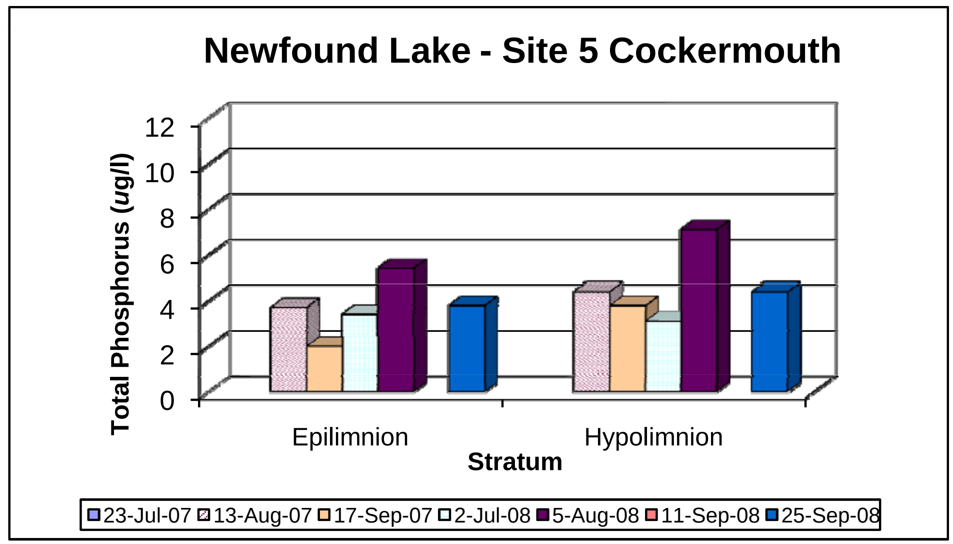
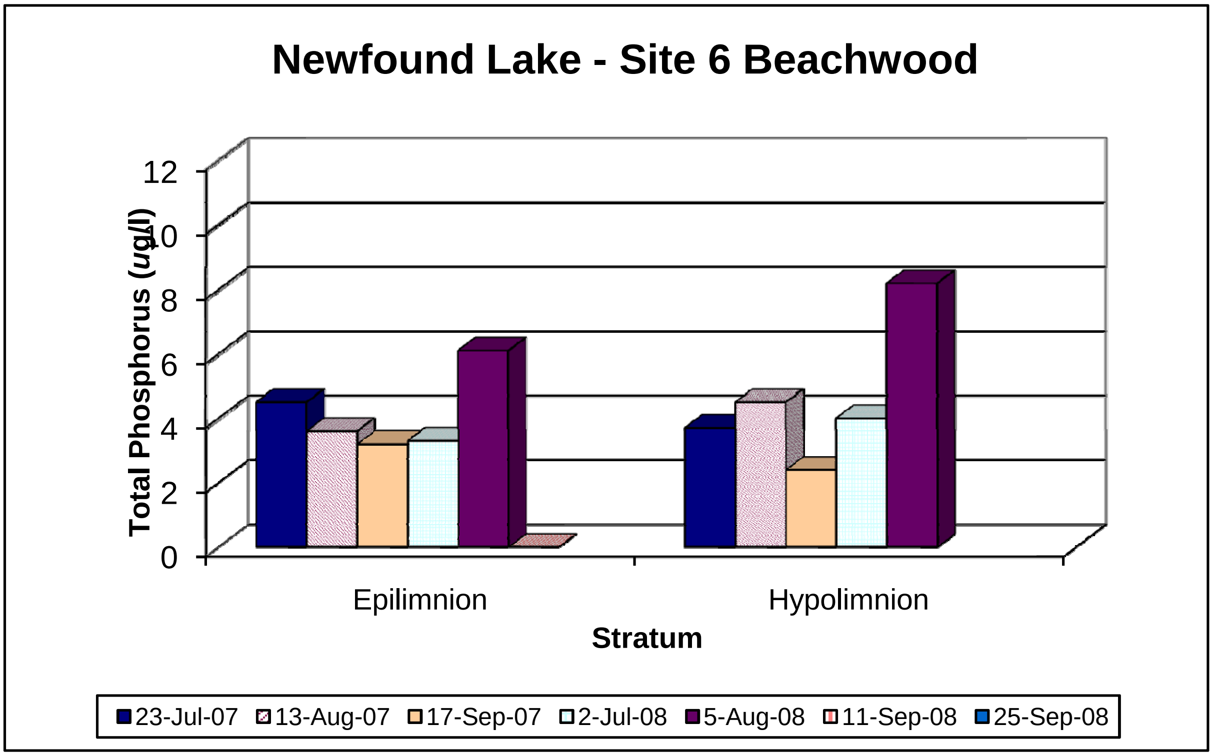
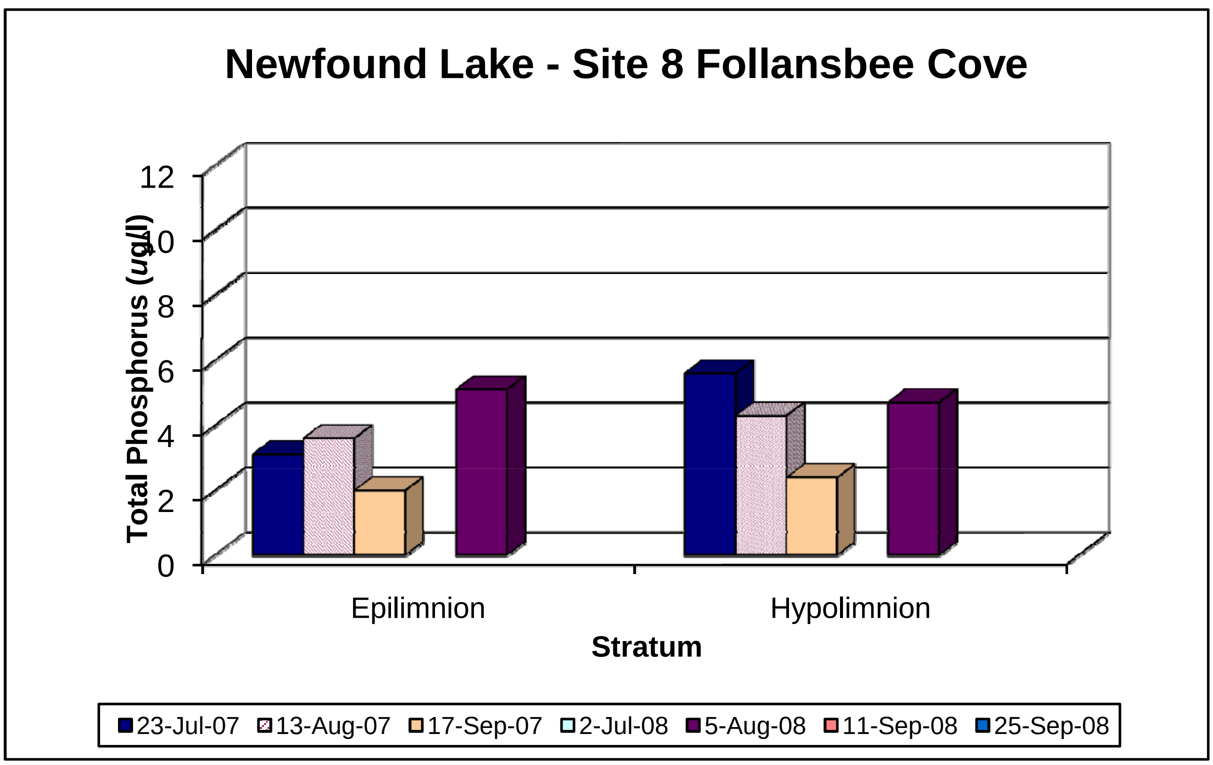

Newfound Lake - Site 1 Deep
Total Phosphorus (ug/l)
0
2
4
6
8
10
12
Epilimnion
Hypolimnion
Stratum
23-Jul-07
13-Aug-07
17-Sep-07
2-Jul-08
5-Aug-08
11-Sep-08
25-Sep-08


Newfound Lake - Site 3 Pasquaney
Total Phosphorus (ug/l)
0
2
4
6
8
10
12
Epilimnion
Hypolimnion
Stratum
23-Jul-07
13-Aug-07
17-Sep-07
2-Jul-08
5-Aug-08
11-Sep-08
25-Sep-08


Newfound Lake - Site 2 Mayhew
Total Phosphorus (ug/l)
0
2
4
6
8
10
12
Epilimnion
Hypolimnion
Stratum
23-Jul-07
13-Aug-07
17-Sep-07
2-Jul-08
5-Aug-08
11-Sep-08
25-Sep-08

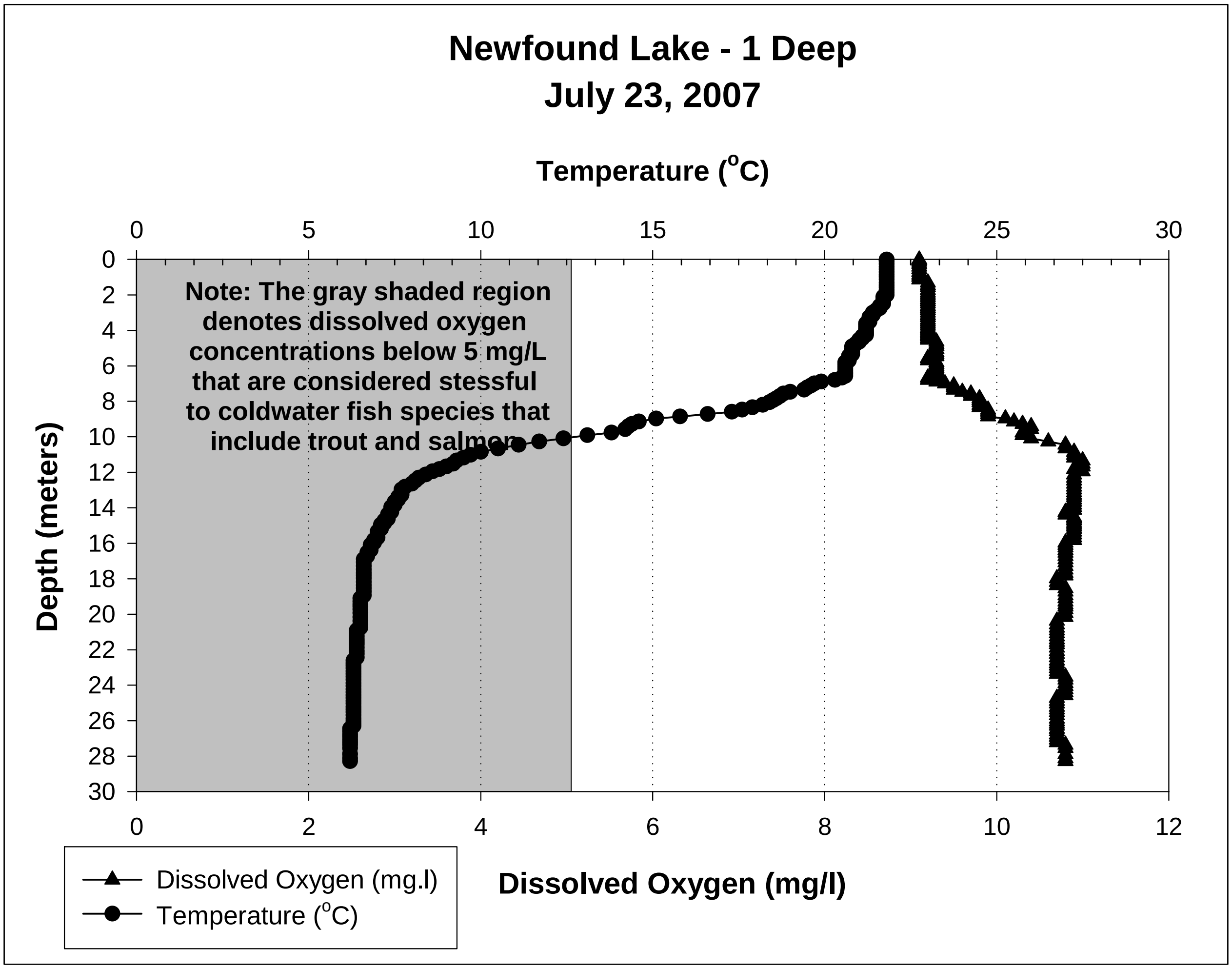

Newfound Lake - Site 5 Cockermouth
Total Phosphorus (ug/l)
0
2
4
6
8
10
12
Epilimnion
Hypolimnion
Stratum
23-Jul-07
13-Aug-07
17-Sep-07
2-Jul-08
5-Aug-08
11-Sep-08
25-Sep-08


Newfound Lake - Site 6 Beachwood
Total Phosphorus (ug/l)
0
2
4
6
8
10
12
Epilimnion
Hypolimnion
Stratum
23-Jul-07
13-Aug-07
17-Sep-07
2-Jul-08
5-Aug-08
11-Sep-08
25-Sep-08

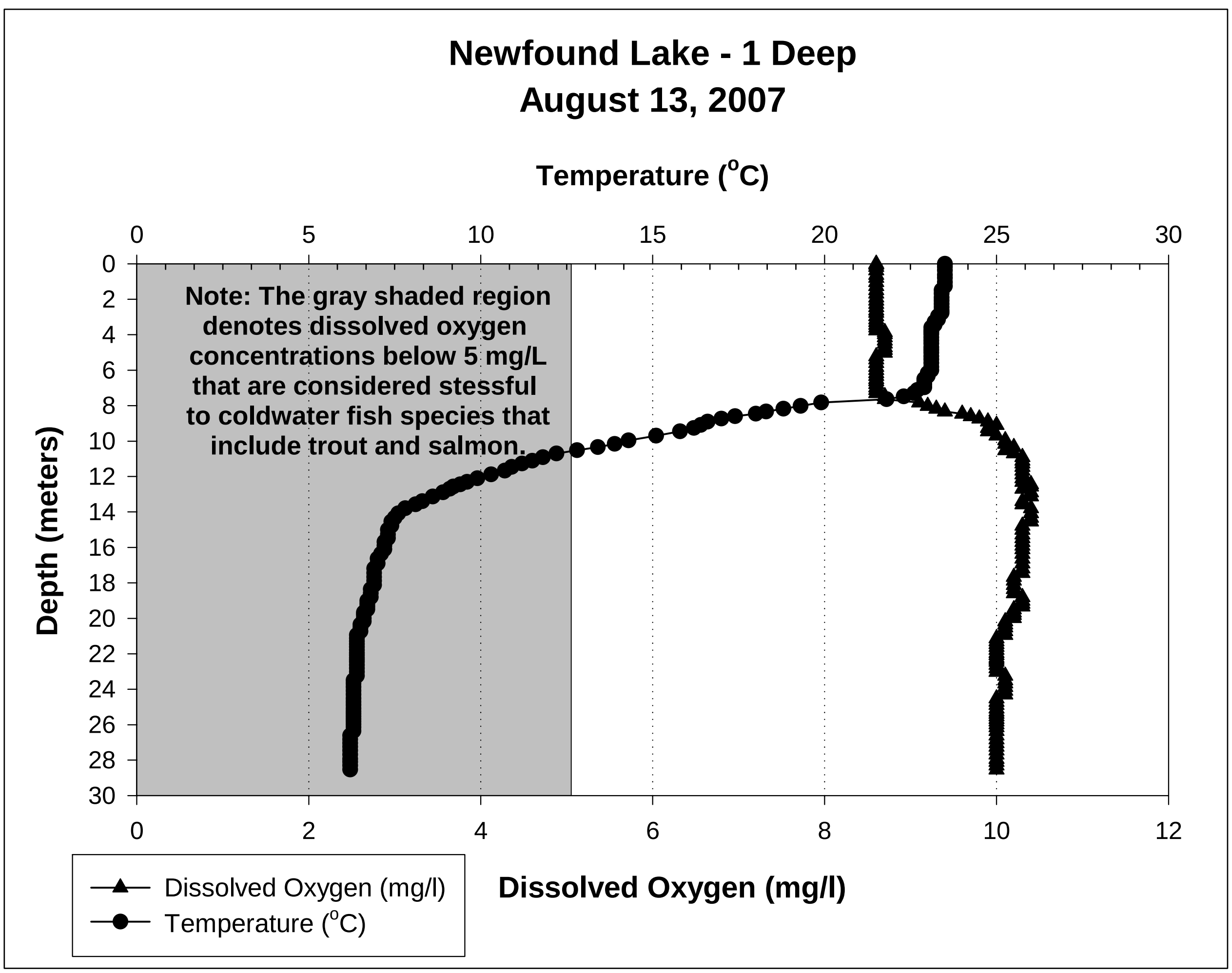

Newfound Lake - Site 8 Follansbee Cove
Total Phosphorus (ug/l)
0
2
4
6
8
10
12
Epilimnion
Hypolimnion
Stratum
23-Jul-07
13-Aug-07
17-Sep-07
2-Jul-08
5-Aug-08
11-Sep-08
25-Sep-08

APPENDIX C

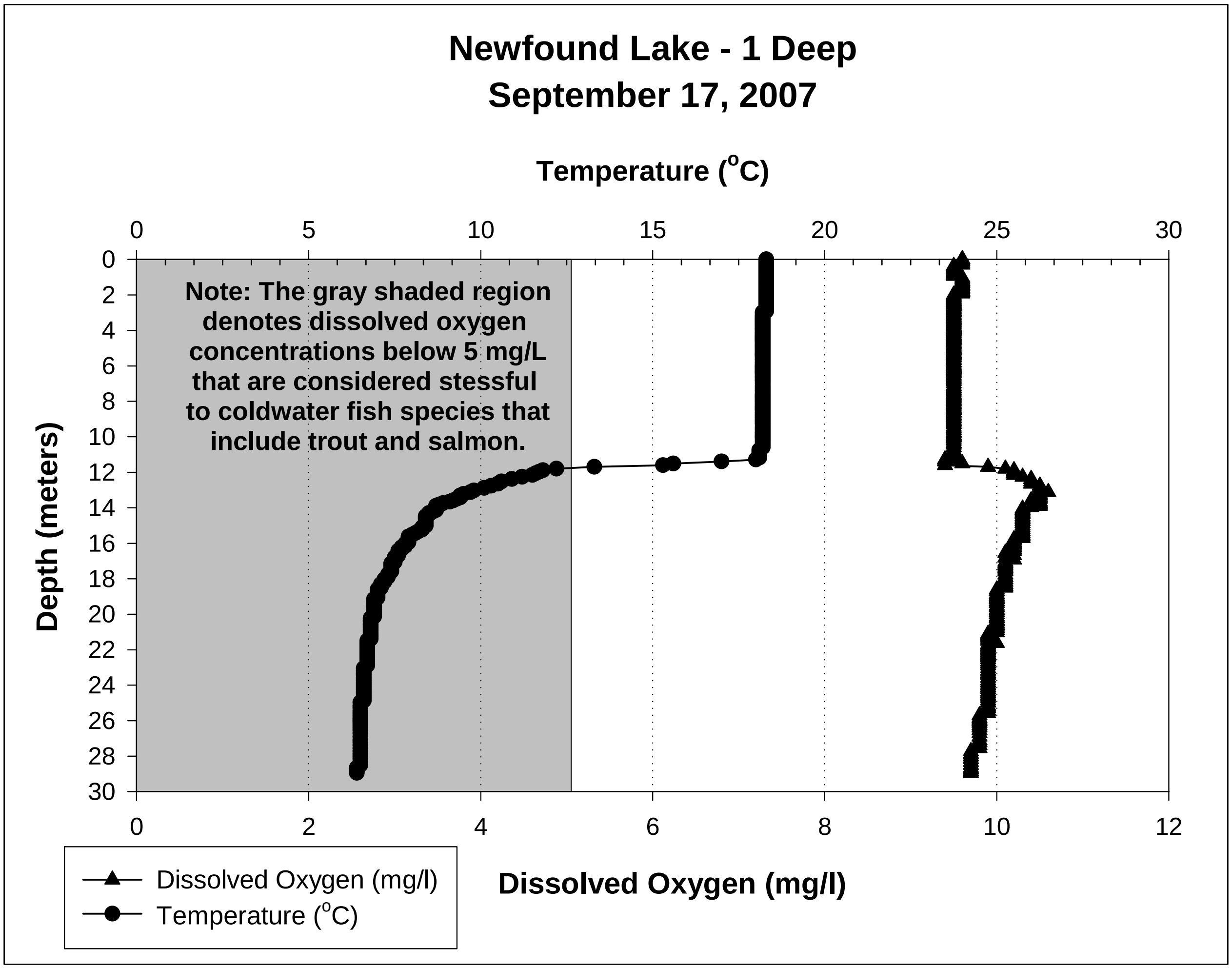
The following graphs illustrate the dissolved oxygen and temperature data collected at the Newfound Lake deep sampling stations between July 23, 2007 and September 25, 2008. Temperature and dissolved oxygen data were generally collected at twenty centimeter (0.2 meter) intervals from the surface down to the lake bottom. The temperature units are degrees Celsius (^oC) while the dissolved oxygen units are milligrams per liter (mg/l). The gray shaded region on the graphs represent dissolved oxygen concentrations stressful to coldwater fish species (dissolved oxygen concentrations less than 5 parts per million). *Notice the low dissolved oxygen concentrations near the lake bottom at Site L02 (2 Mayhew).*



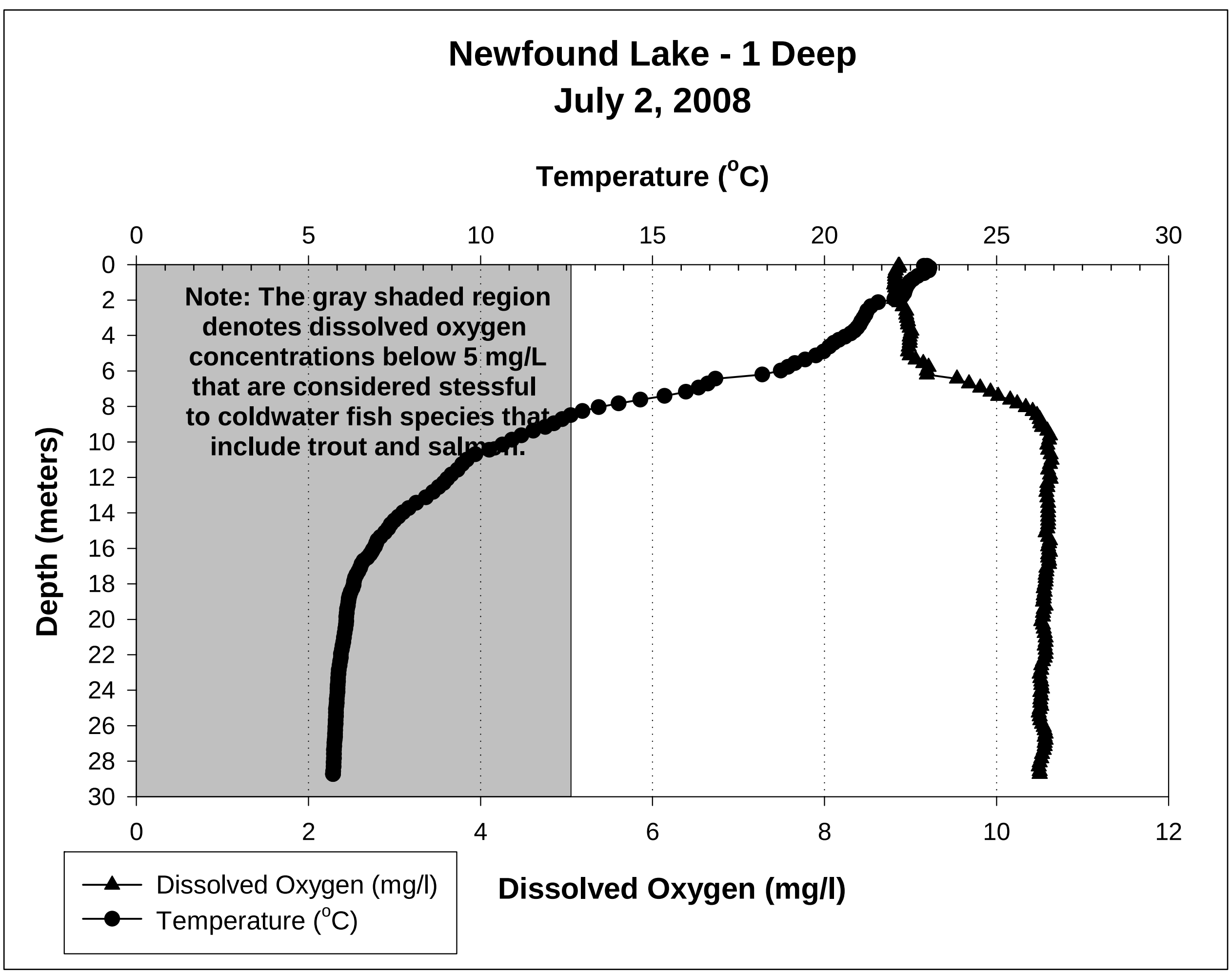
Newfound Lake - 1 Deep
July 23, 2007
Temperature (°C)
Note: The gray shaded region denotes dissolved oxygen concentrations below 5 mg/L that are considered stessful to coldwater fish species that include trout and salmon.
Depth (meters)
Dissolved Oxygen (mg/l)
Dissolved Oxygen (mg.l)
Temperature (°C)



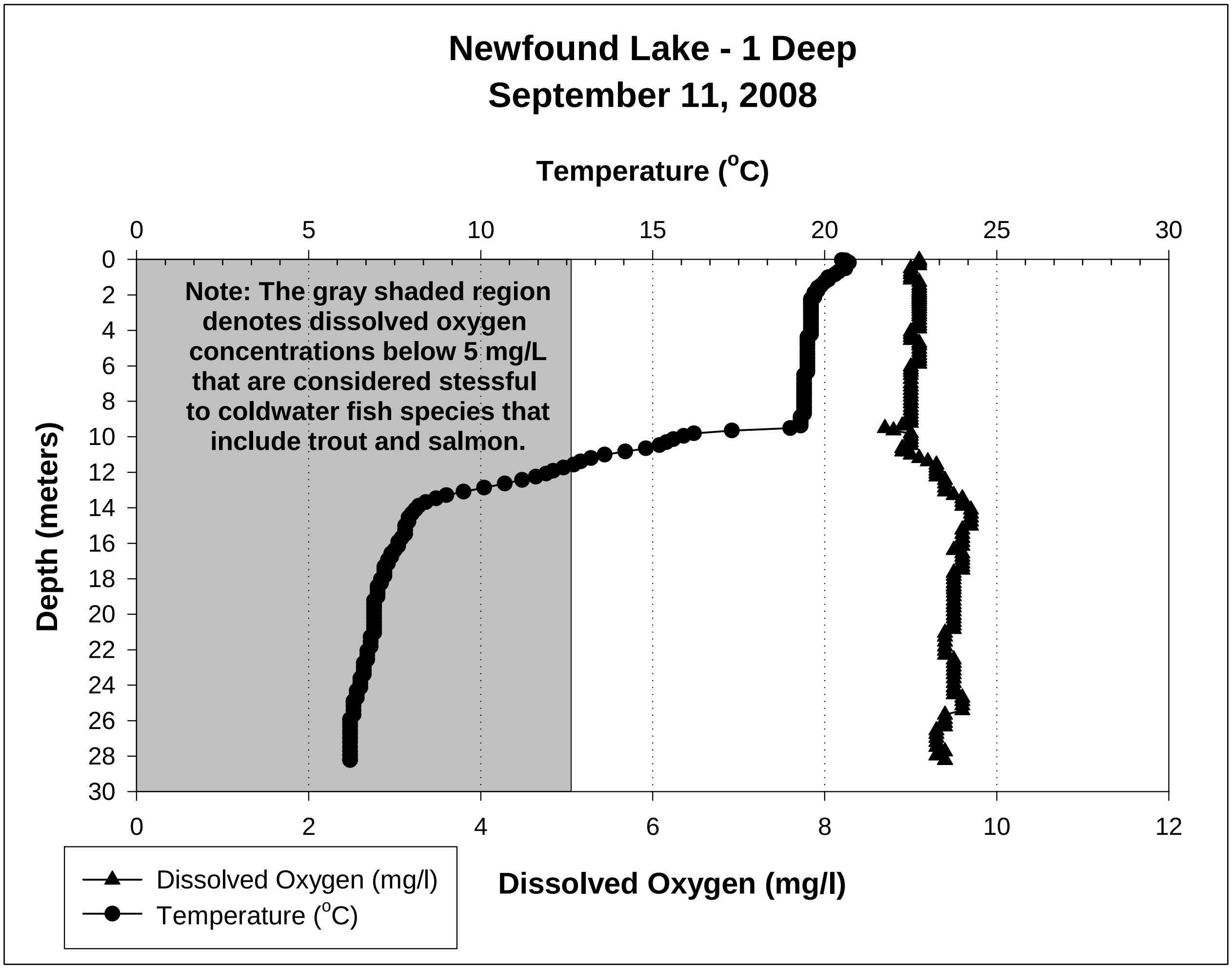
Newfound Lake - 1 Deep
August 13, 2007
Temperature (°C)
Note: The gray shaded region denotes dissolved oxygen concentrations below 5 mg/L that are considered stessful to coldwater fish species that include trout and salmon.
Depth (meters)
Dissolved Oxygen (mg/l)
Dissolved Oxygen (mg/l)
Temperature (°C)

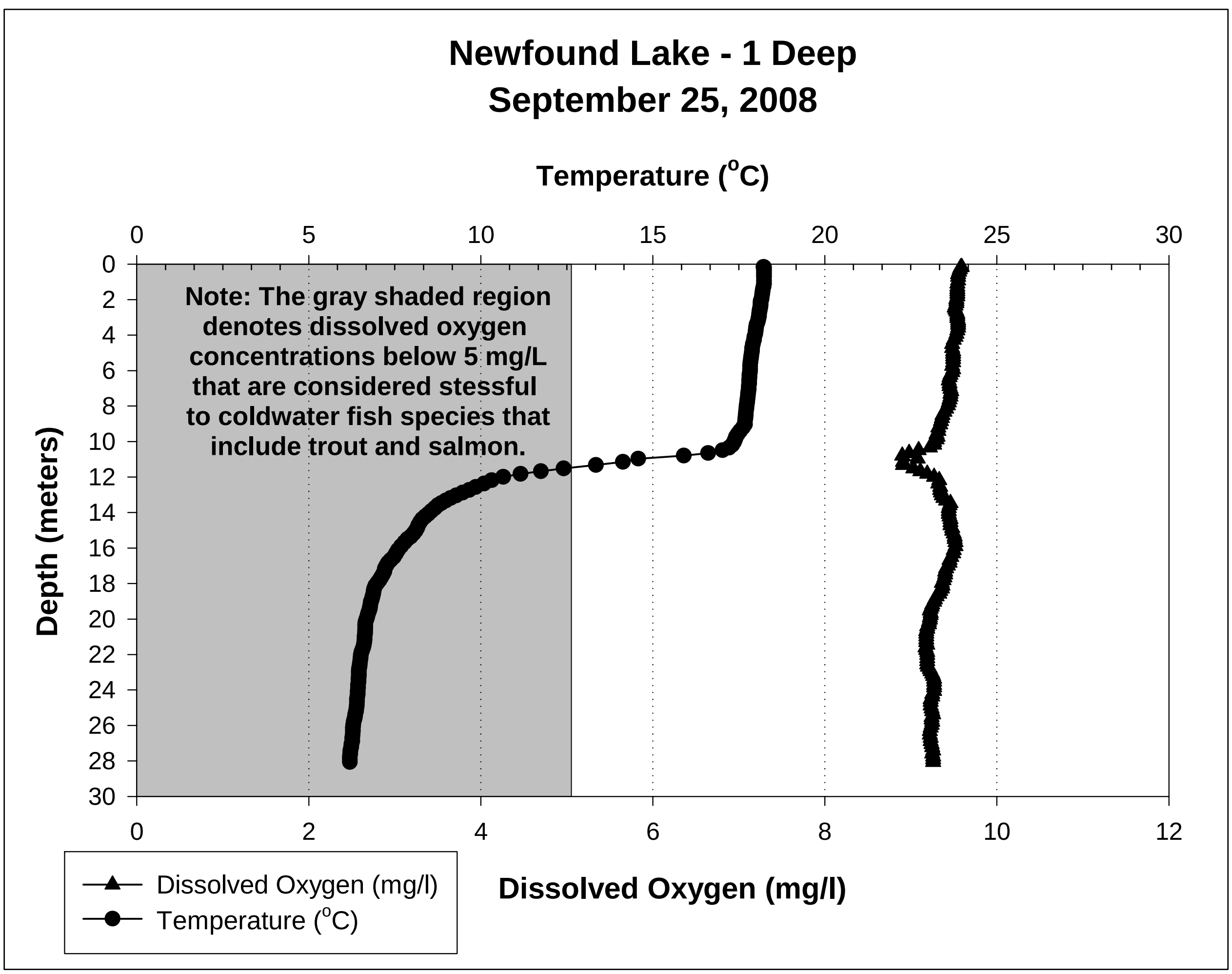


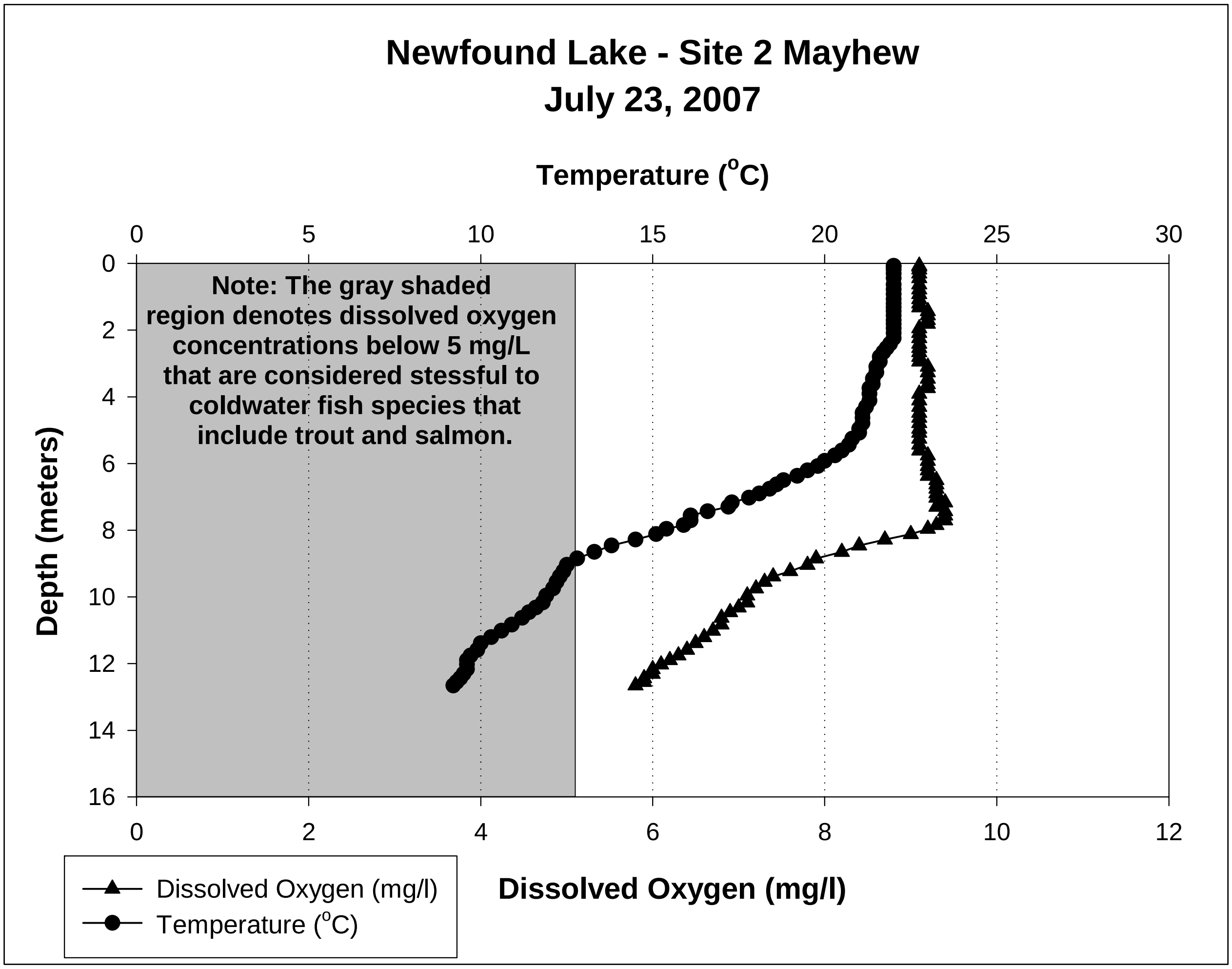
Newfound Lake - 1 Deep
September 17, 2007
Temperature (°C)
0 5 10 15 20 25 30
Depth (meters)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
Note: The gray shaded region denotes dissolved oxygen concentrations below 5 mg/L that are considered stessful to coldwater fish species that include trout and salmon.
0 2 4 6 8 10 12
Dissolved Oxygen (mg/l)
Temperature (°C)
Dissolved Oxygen (mg/l)

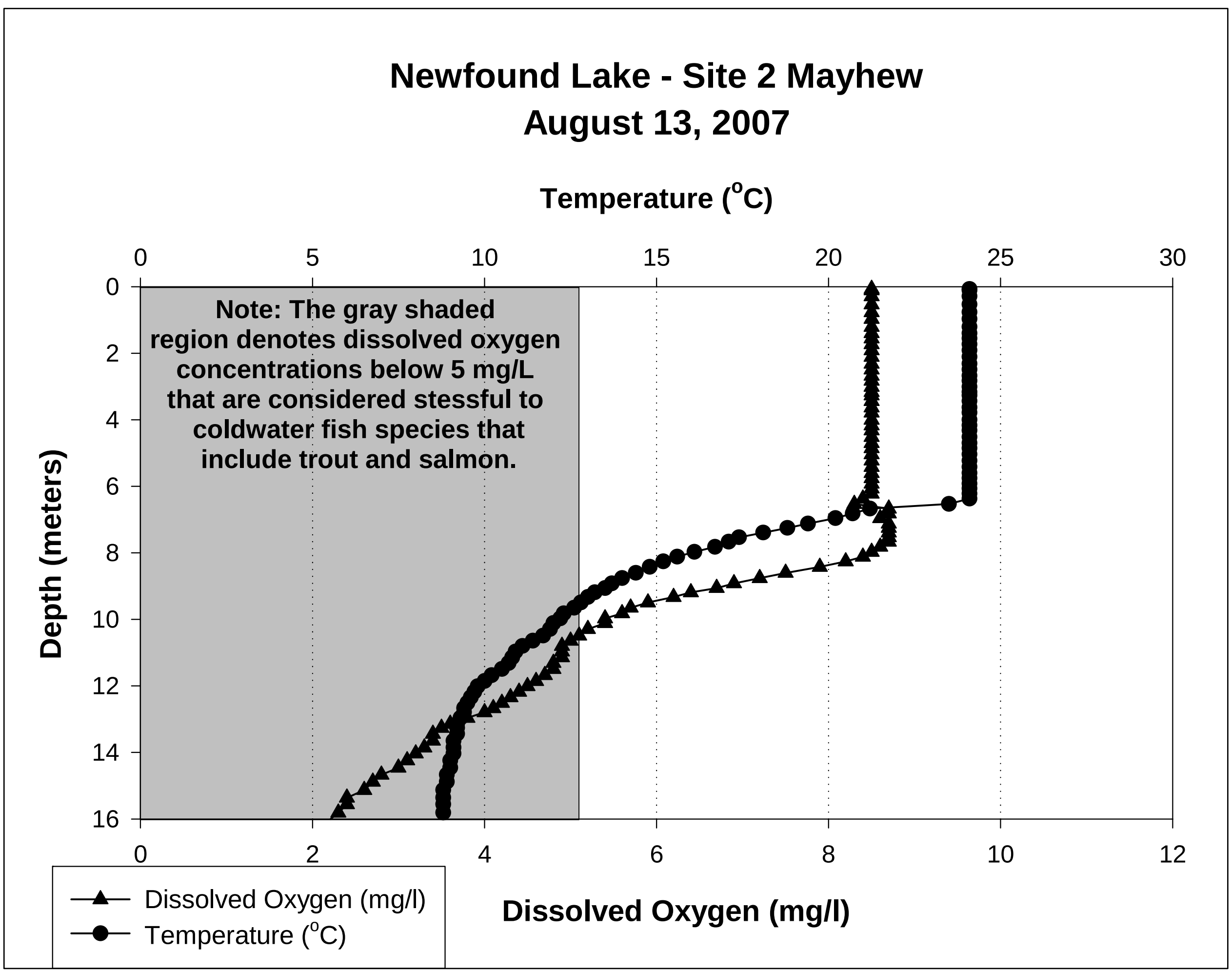


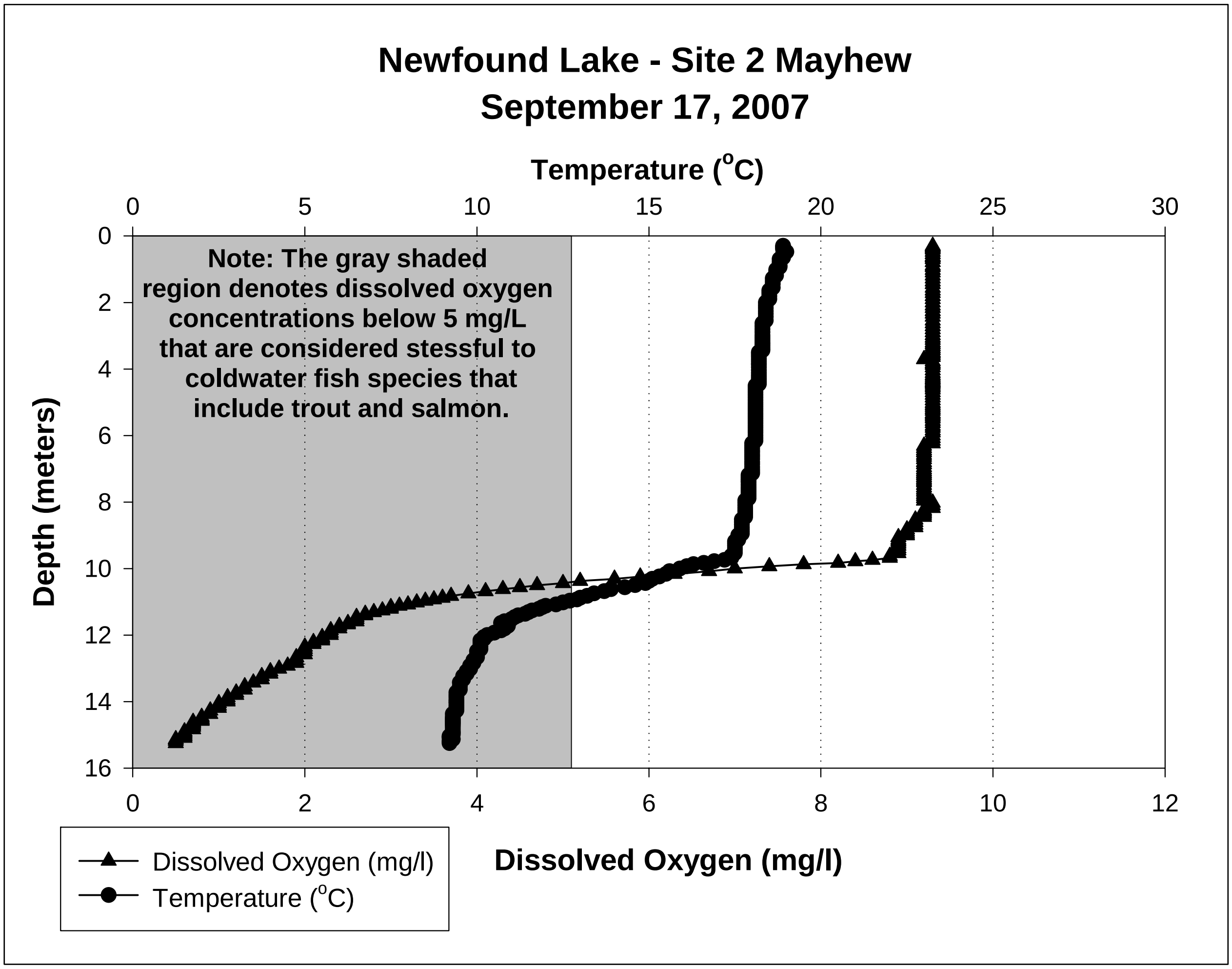
Newfound Lake - 1 Deep
July 2, 2008
Temperature (°C)
0 5 10 15 20 25 30
Depth (meters)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
Note: The gray shaded region denotes dissolved oxygen concentrations below 5 mg/L that are considered stessful to coldwater fish species that include trout and salmon.
0 2 4 6 8 10 12
Dissolved Oxygen (mg/l)
Temperature (°C)
Dissolved Oxygen (mg/l)

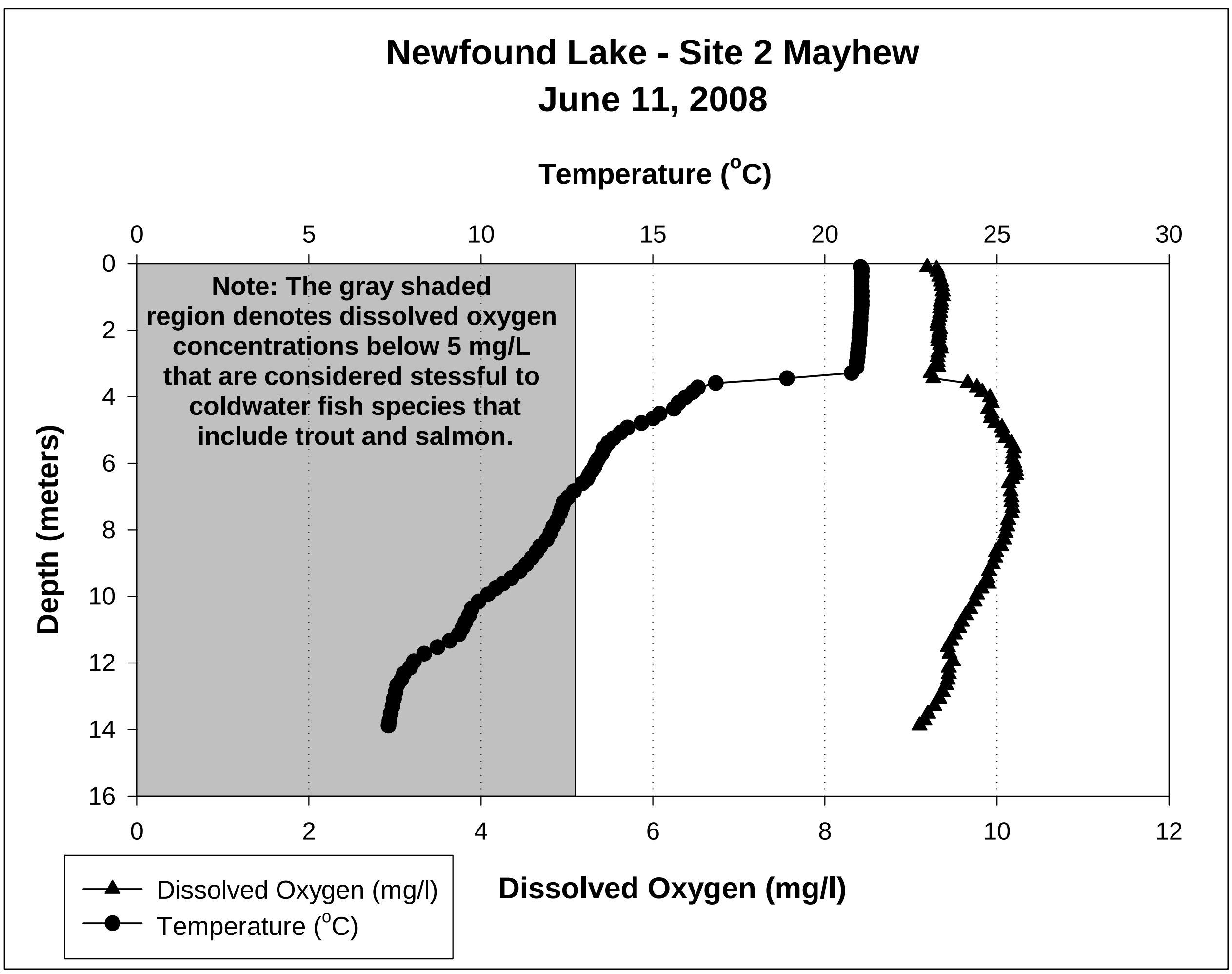

Newfound Lake - 1 Deep
September 11, 2008
Temperature (oC)
0
5
10
15
20
25
30
Depth (meters)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
Note: The gray shaded region denotes dissolved oxygen concentrations below 5 mg/L that are considered stessful to coldwater fish species that include trout and salmon.
0
2
4
6
8
10
12
Dissolved Oxygen (mg/l)
Temperature (oC)
Dissolved Oxygen (mg/l)

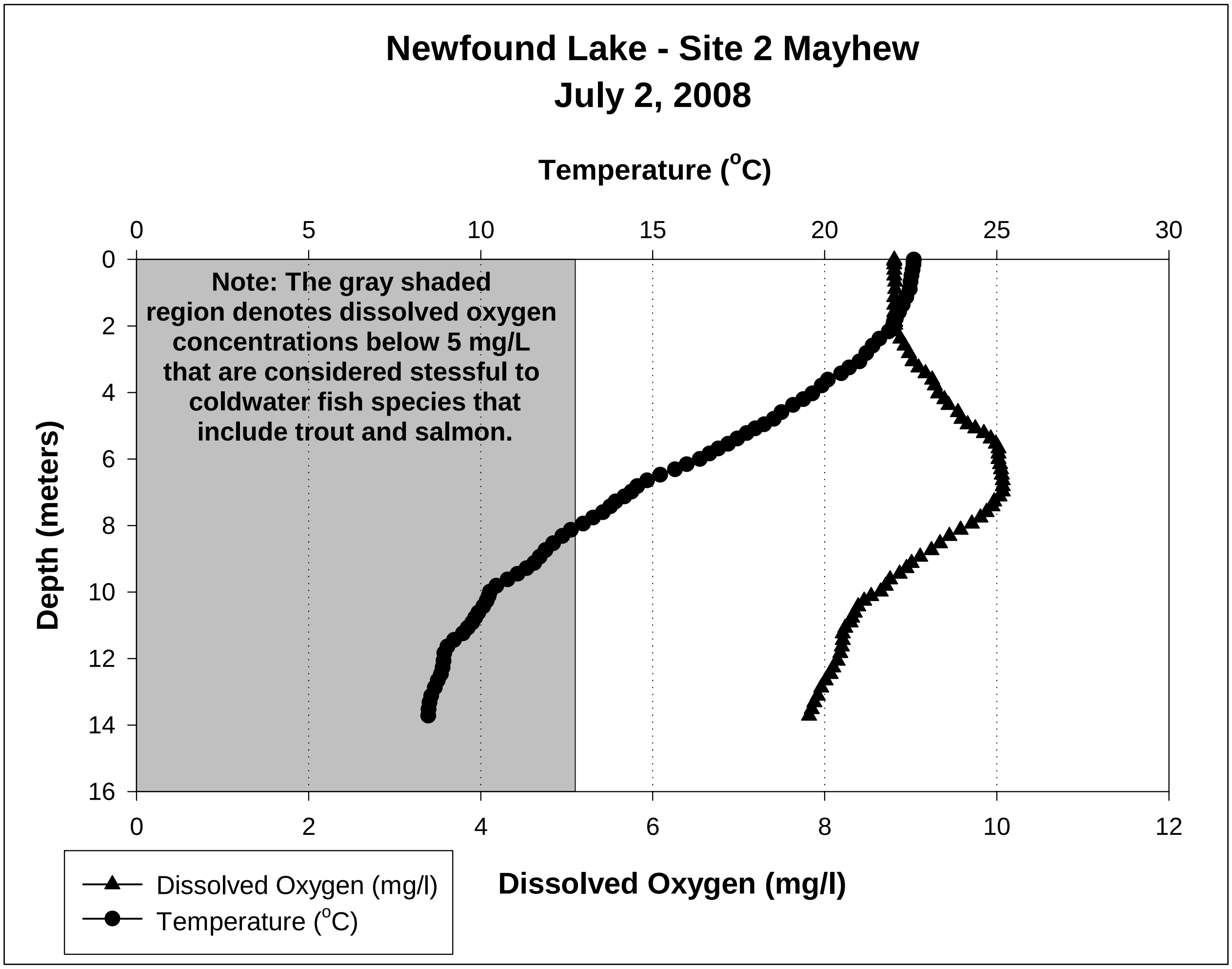

Newfound Lake - 1 Deep
September 25, 2008
Temperature (oC)
0
5
10
15
20
25
30
Depth (meters)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
Note: The gray shaded region denotes dissolved oxygen concentrations below 5 mg/L that are considered stessful to coldwater fish species that include trout and salmon.
0
2
4
6
8
10
12
Dissolved Oxygen (mg/l)
Temperature (oC)
Dissolved Oxygen (mg/l)

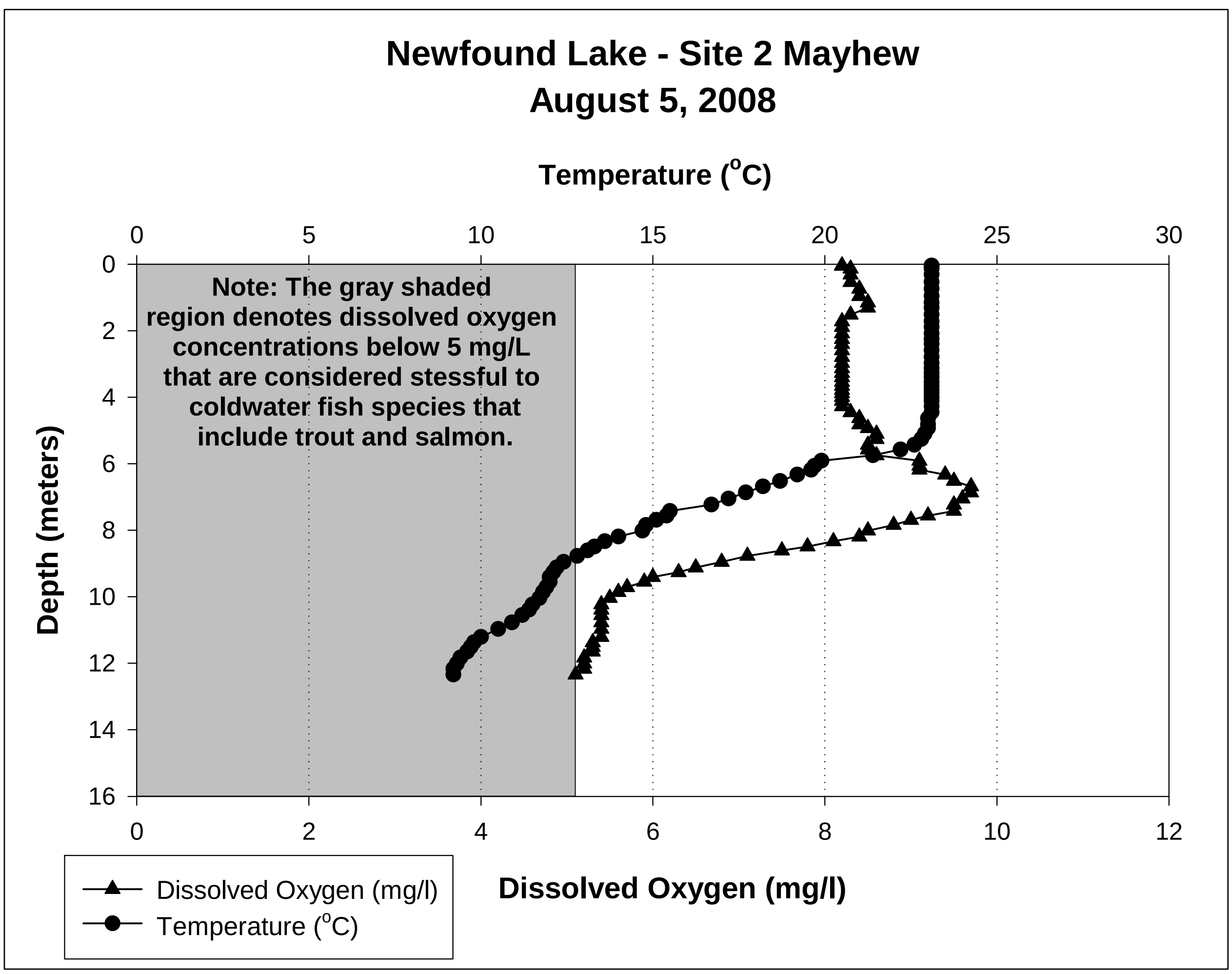

Newfound Lake - Site 2 Mayhew
July 23, 2007
Temperature (°C)
0
5
10
15
20
25
30
Note: The gray shaded region denotes dissolved oxygen concentrations below 5 mg/L that are considered stessful to coldwater fish species that include trout and salmon.
Depth (meters)
0
2
4
6
8
10
12
14
16
0
2
4
6
8
10
12
Dissolved Oxygen (mg/l)
Dissolved Oxygen (mg/l)
Temperature (°C)

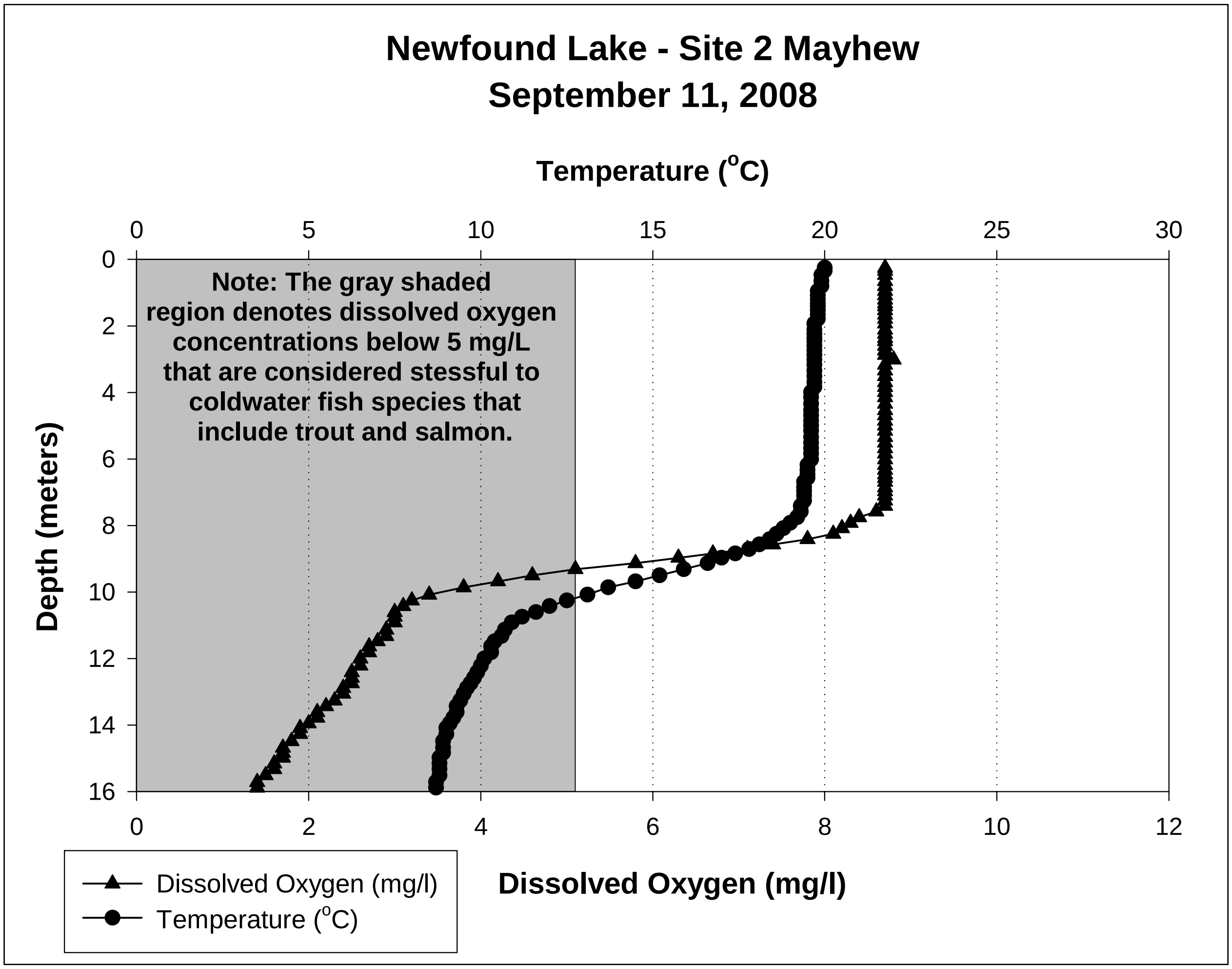

Newfound Lake - Site 2 Mayhew
August 13, 2007
Temperature (°C)
0
5
10
15
20
25
30
Note: The gray shaded region denotes dissolved oxygen concentrations below 5 mg/L that are considered stessful to coldwater fish species that include trout and salmon.
Depth (meters)
0
2
4
6
8
10
12
14
16
0
2
4
6
8
10
12
Dissolved Oxygen (mg/l)
Dissolved Oxygen (mg/l)
Temperature (°C)

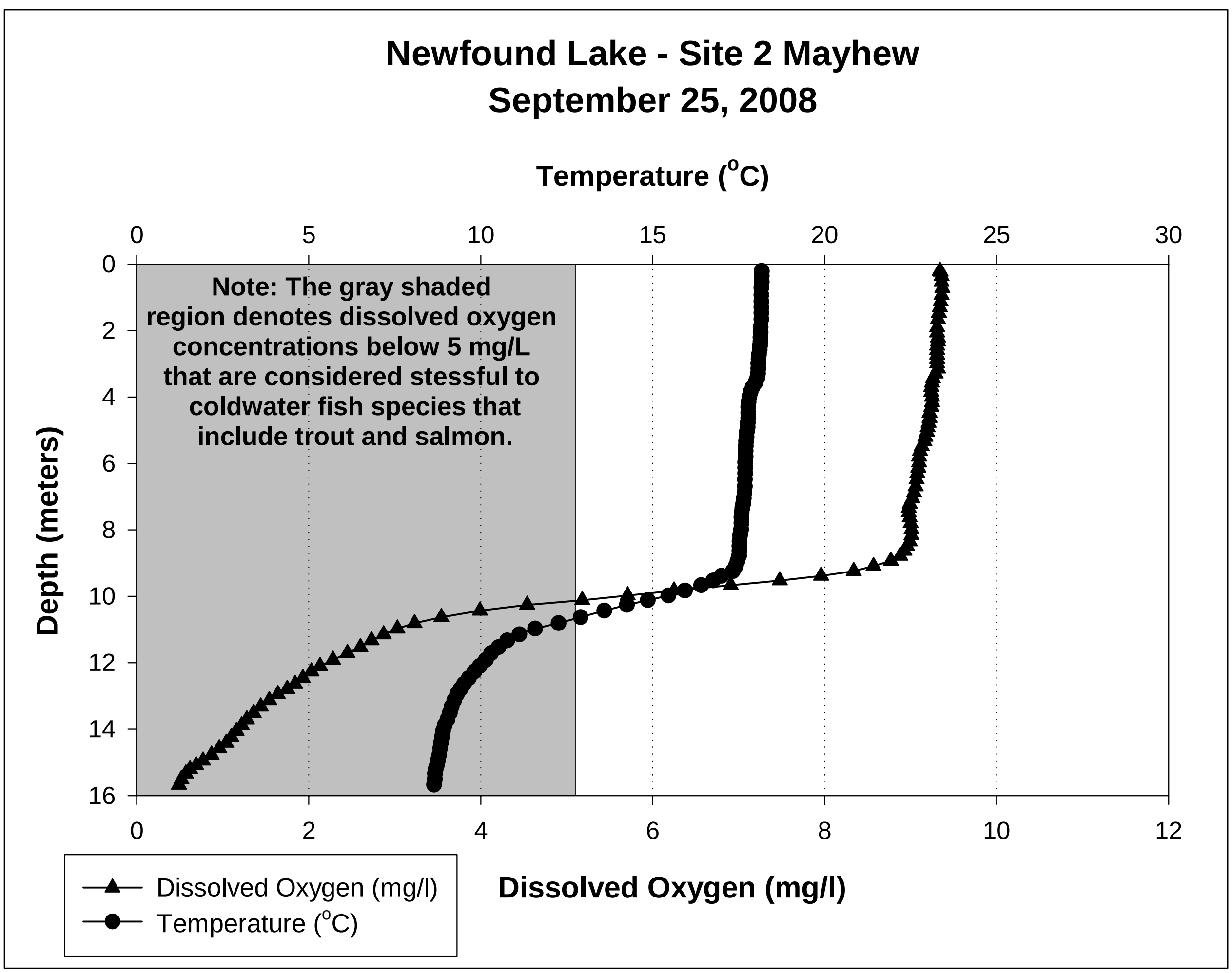

Newfound Lake - Site 2 Mayhew
September 17, 2007
Temperature (°C)
0
5
10
15
20
25
30
Note: The gray shaded region denotes dissolved oxygen concentrations below 5 mg/L that are considered stessful to coldwater fish species that include trout and salmon.
Depth (meters)
0
2
4
6
8
10
12
14
16
0
2
4
6
8
10
12
Dissolved Oxygen (mg/l)
Temperature (°C)
Dissolved Oxygen (mg/l)

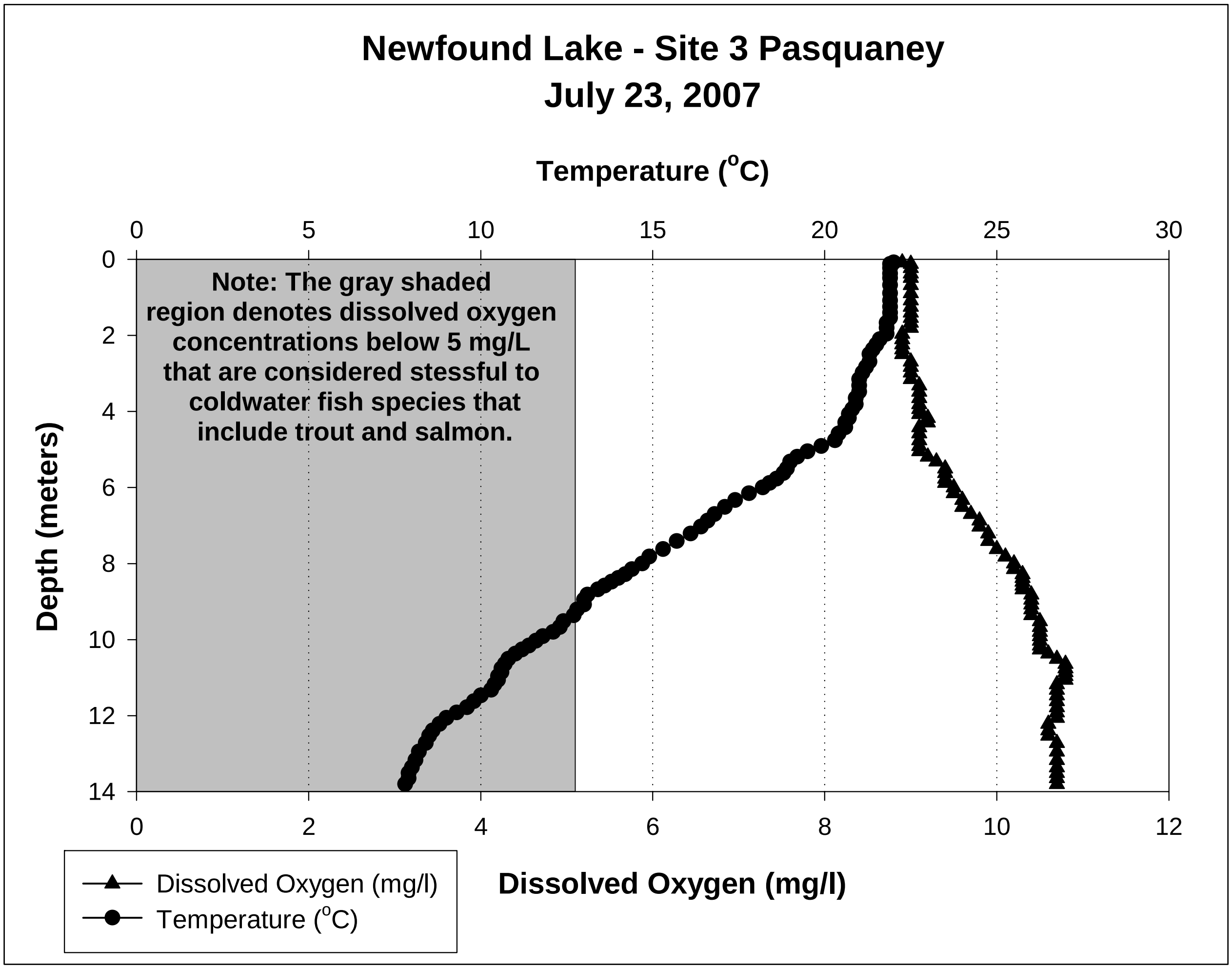

Newfound Lake - Site 2 Mayhew
June 11, 2008
Temperature (°C)
0
5
10
15
20
25
30
Note: The gray shaded region denotes dissolved oxygen concentrations below 5 mg/L that are considered stessful to coldwater fish species that include trout and salmon.
Depth (meters)
0
2
4
6
8
10
12
14
16
0
2
4
6
8
10
12
Dissolved Oxygen (mg/l)
Temperature (°C)
Dissolved Oxygen (mg/l)


Newfound Lake - Site 2 Mayhew
July 2, 2008
Temperature (°C)
0
5
10
15
20
25
30
Note: The gray shaded region denotes dissolved oxygen concentrations below 5 mg/L that are considered stessful to coldwater fish species that include trout and salmon.
Depth (meters)
0
2
4
6
8
10
12
14
16
0
2
4
6
8
10
12
Dissolved Oxygen (mg/l)
Temperature (°C)
Dissolved Oxygen (mg/l)

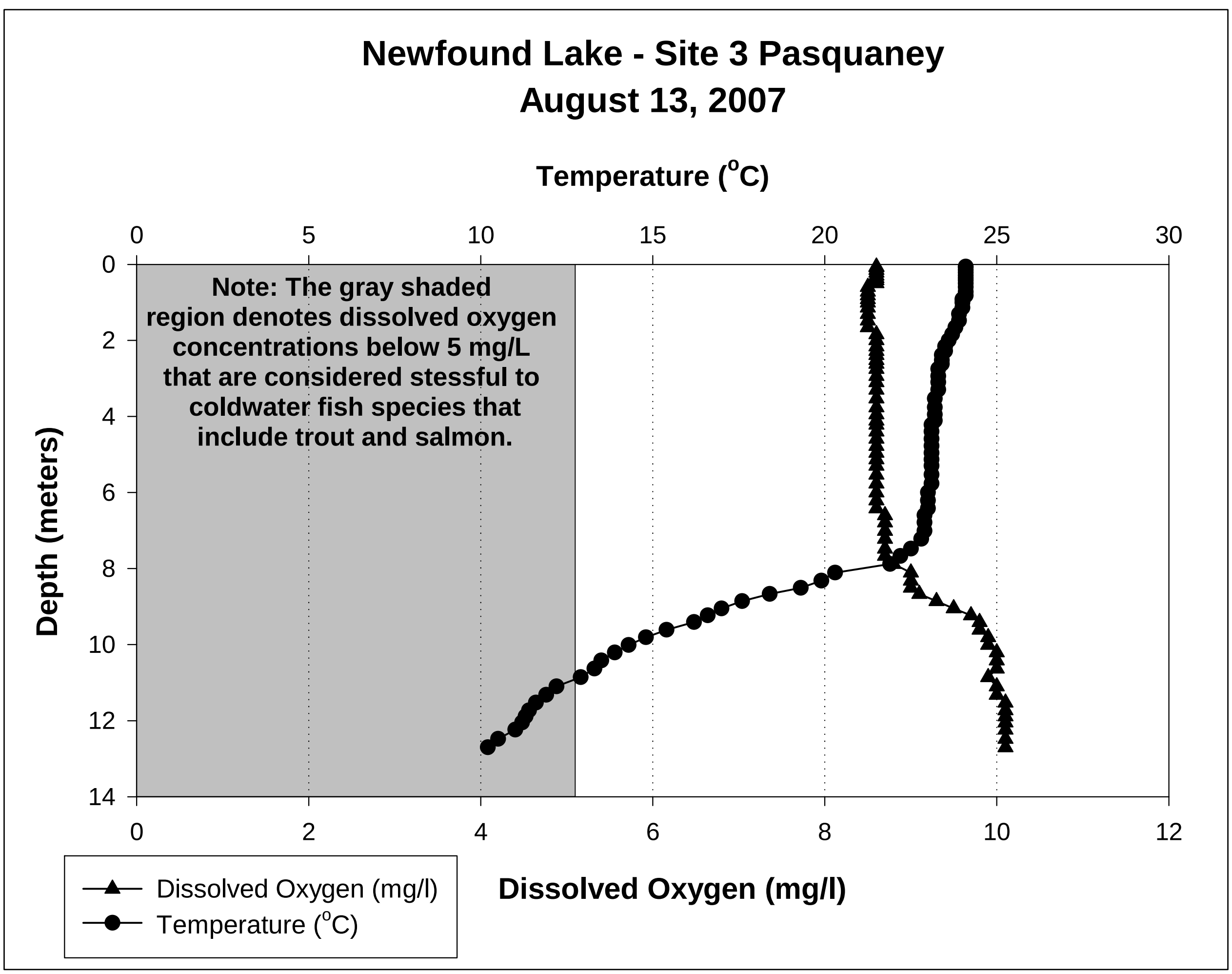

Newfound Lake - Site 2 Mayhew
August 5, 2008
Temperature (°C)
0
5
10
15
20
25
30
Note: The gray shaded region denotes dissolved oxygen concentrations below 5 mg/L that are considered stessful to coldwater fish species that include trout and salmon.
Depth (meters)
0
2
4
6
8
10
12
14
16
0
2
4
6
8
10
12
Dissolved Oxygen (mg/l)
Temperature (°C)
Dissolved Oxygen (mg/l)


Newfound Lake - Site 2 Mayhew
September 11, 2008
Temperature (oC)
0
5
10
15
20
25
30
Note: The gray shaded region denotes dissolved oxygen concentrations below 5 mg/L that are considered stessful to coldwater fish species that include trout and salmon.
Depth (meters)
0
2
4
6
8
10
12
14
16
0
2
4
6
8
10
12
Dissolved Oxygen (mg/l)
Temperature (oC)
Dissolved Oxygen (mg/l)

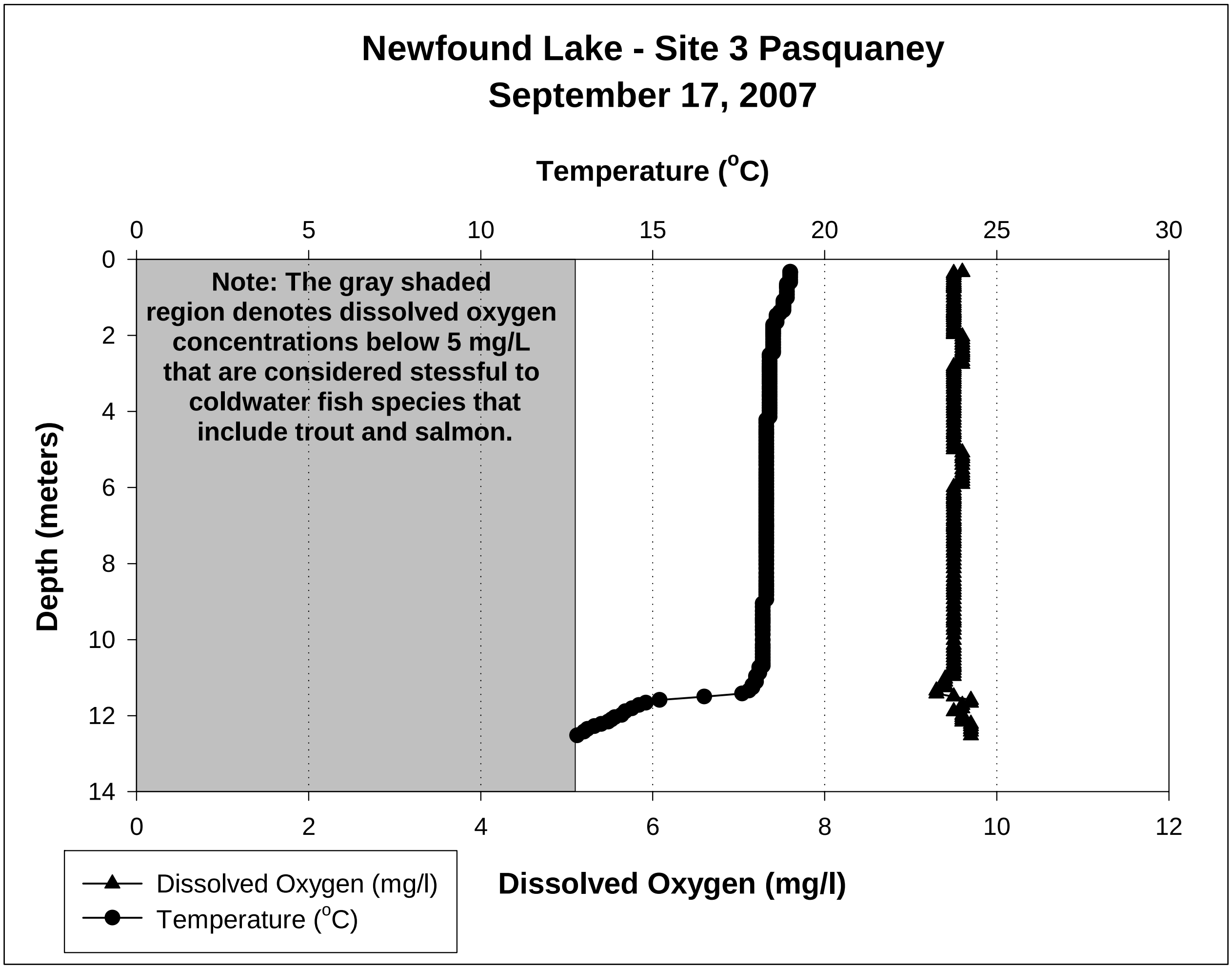

Newfound Lake - Site 2 Mayhew
September 25, 2008
Temperature (oC)
0
5
10
15
20
25
30
Note: The gray shaded region denotes dissolved oxygen concentrations below 5 mg/L that are considered stessful to coldwater fish species that include trout and salmon.
Depth (meters)
0
2
4
6
8
10
12
14
16
0
2
4
6
8
10
12
Dissolved Oxygen (mg/l)
Temperature (oC)
Dissolved Oxygen (mg/l)

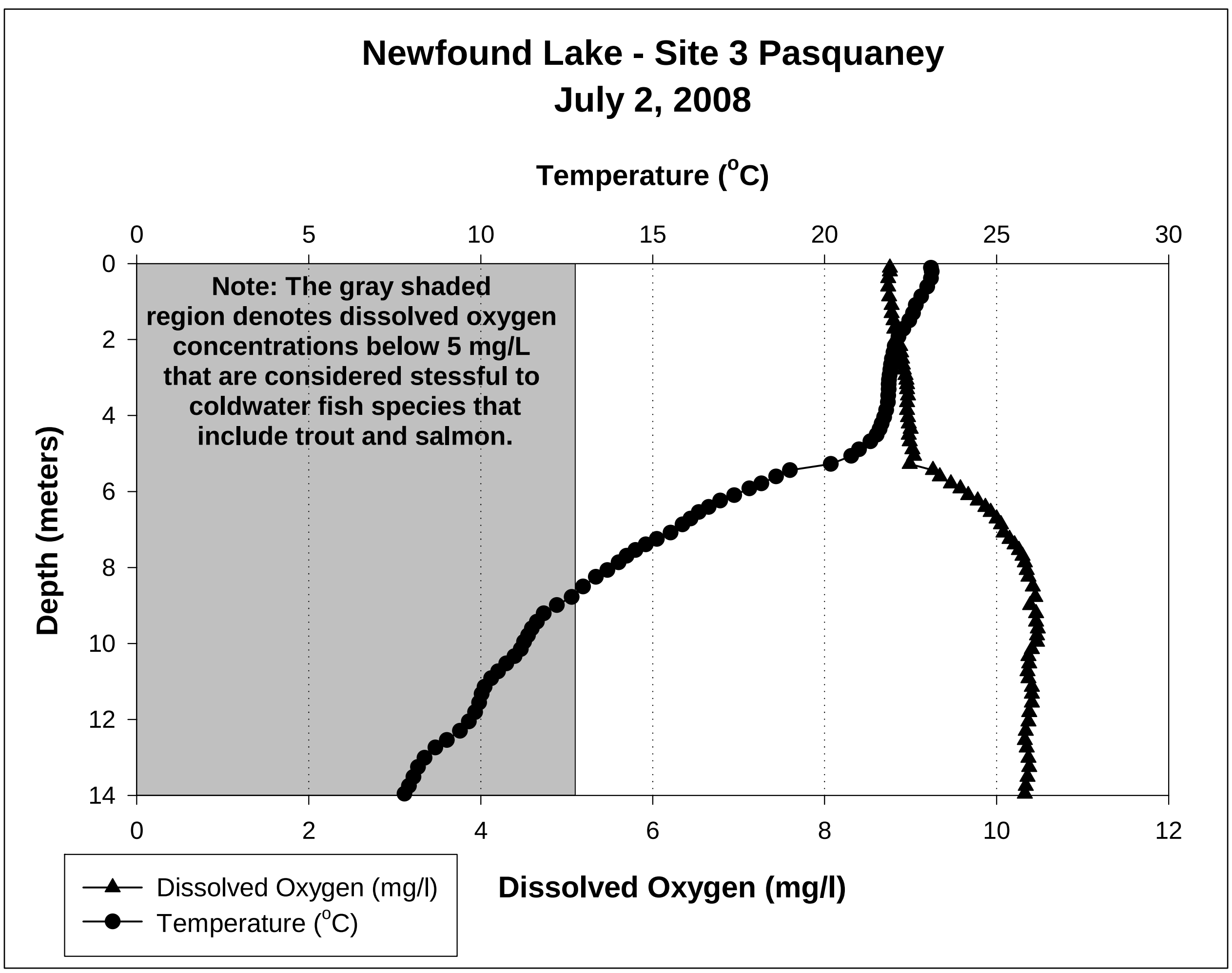


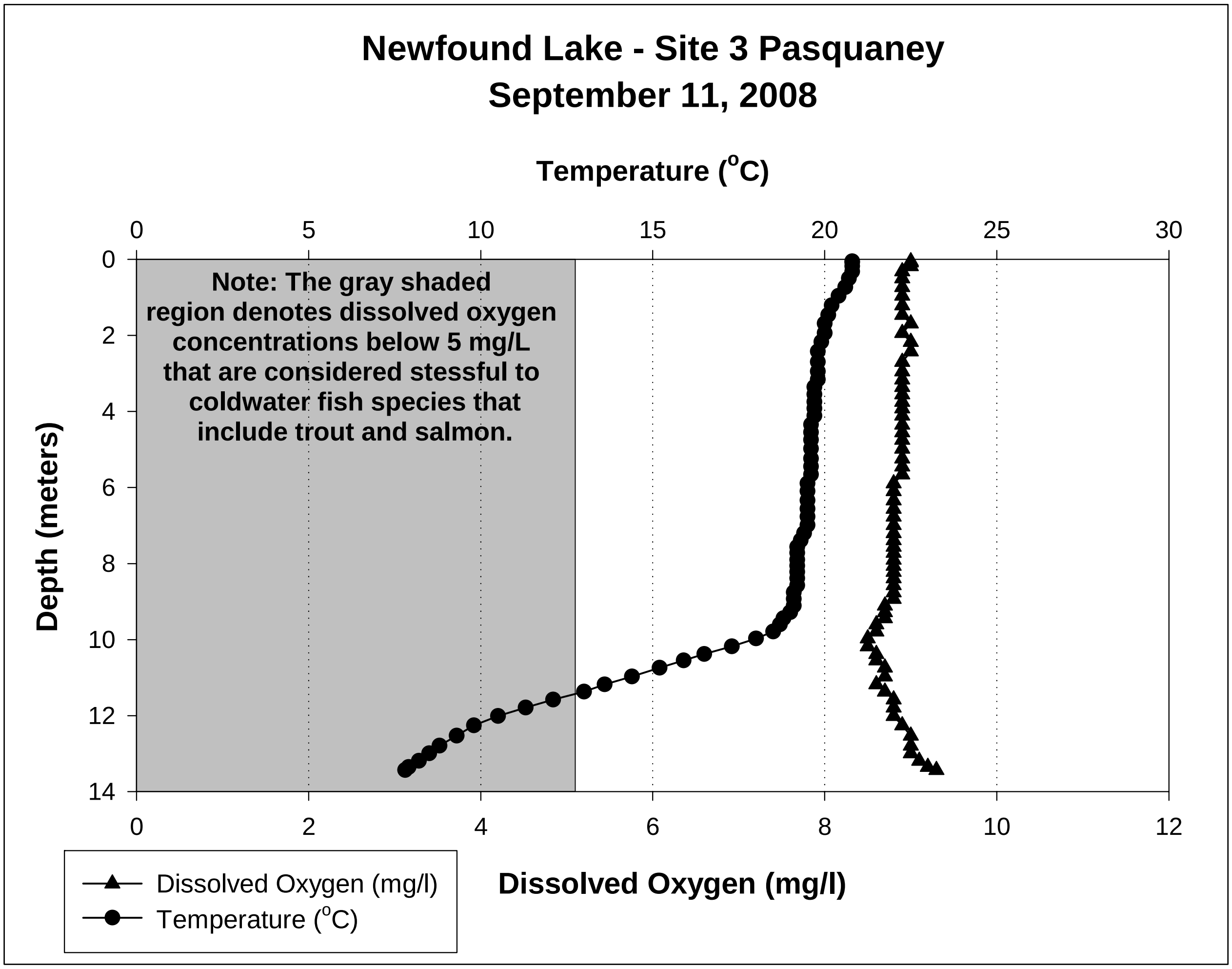
Newfound Lake - Site 3 Pasquaney
July 23, 2007
Temperature (oC)
0
5
10
15
20
25
30
Depth (meters)
0
2
4
6
8
10
12
14
Note: The gray shaded region denotes dissolved oxygen concentrations below 5 mg/L that are considered stessful to coldwater fish species that include trout and salmon.
0
2
4
6
8
10
12
Dissolved Oxygen (mg/l)
Temperature (oC)
Dissolved Oxygen (mg/l)

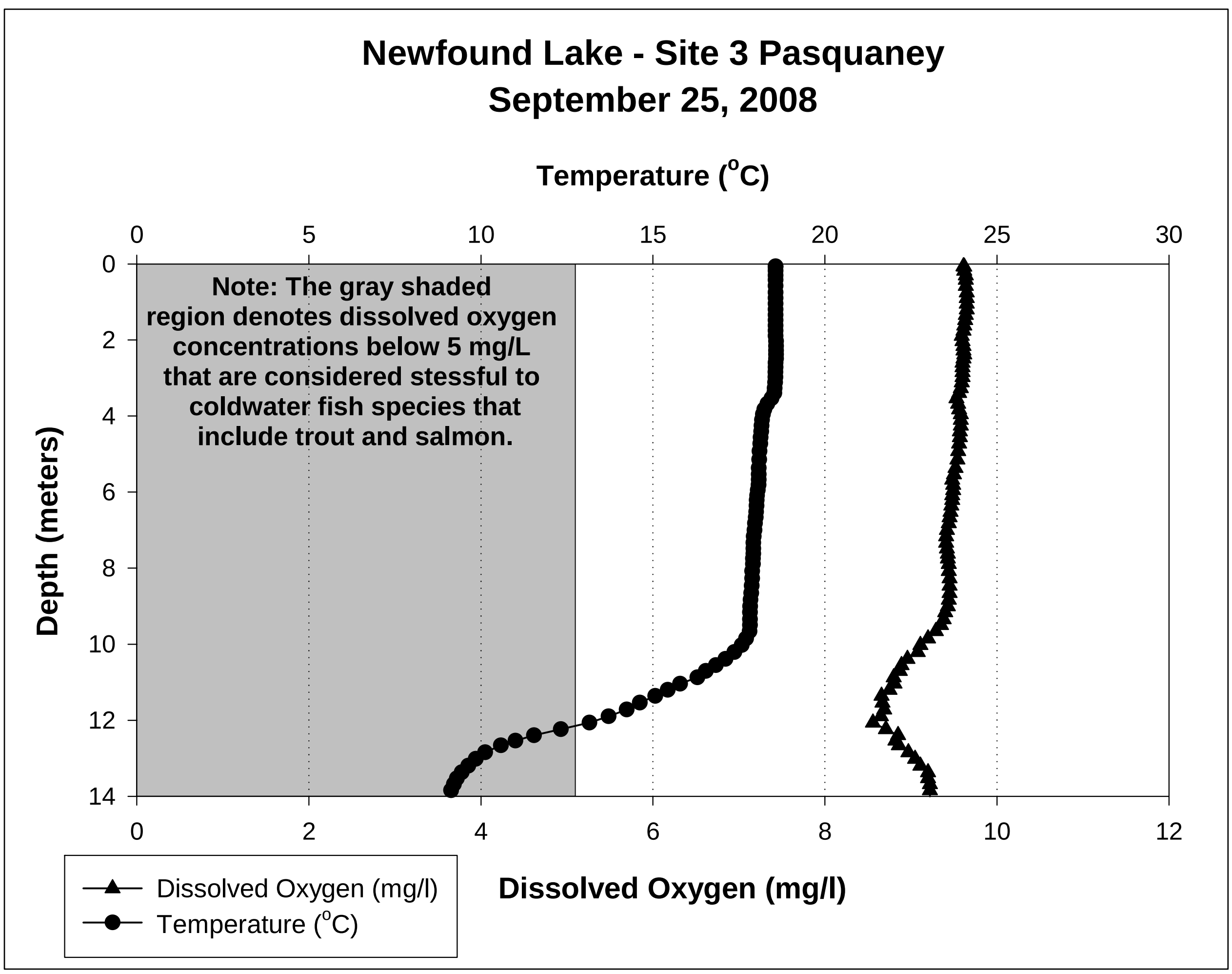


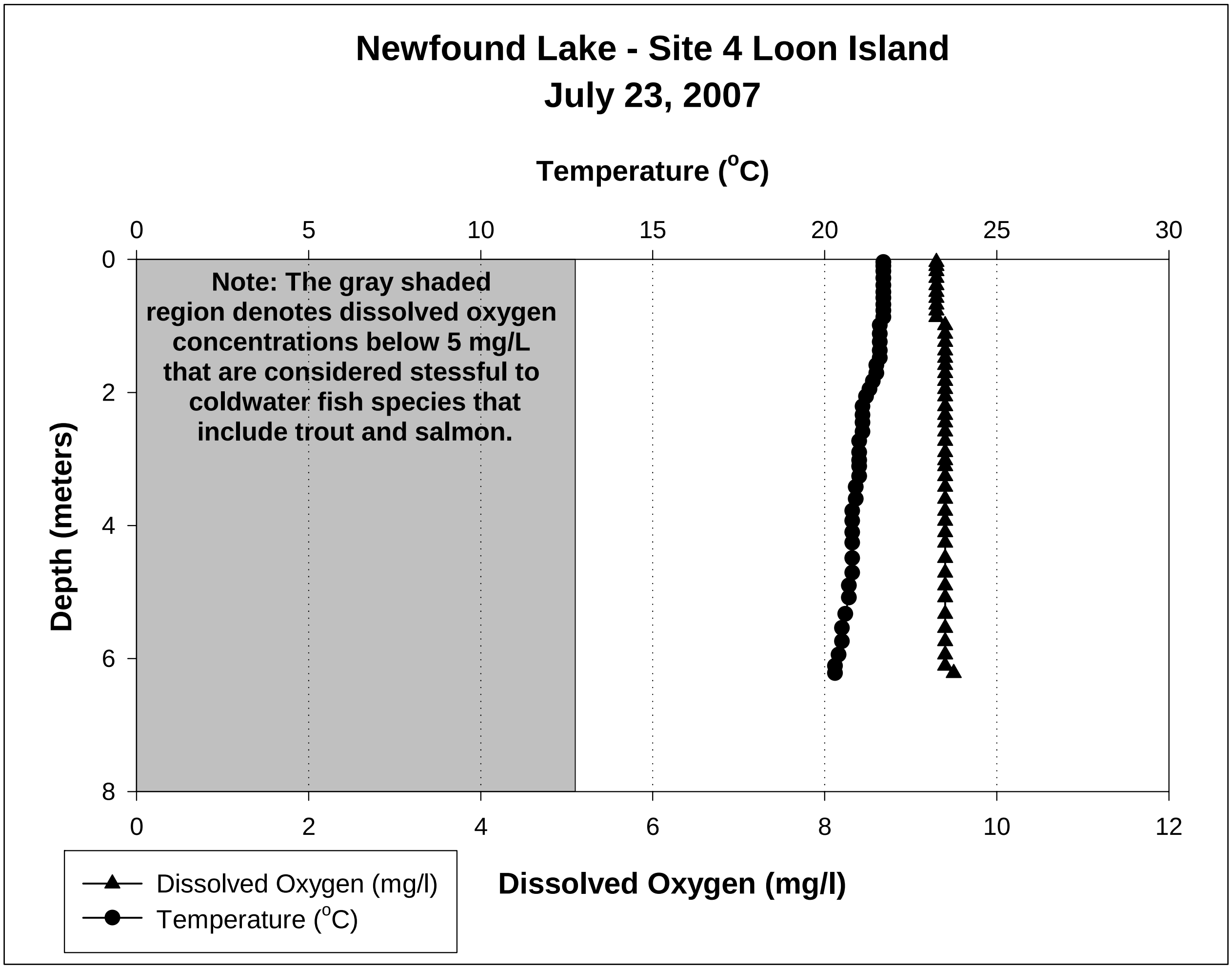
Newfound Lake - Site 3 Pasquaney
August 13, 2007
Temperature (oC)
0
5
10
15
20
25
30
Depth (meters)
0
2
4
6
8
10
12
14
Note: The gray shaded region denotes dissolved oxygen concentrations below 5 mg/L that are considered stessful to coldwater fish species that include trout and salmon.
0
2
4
6
8
10
12
Dissolved Oxygen (mg/l)
Temperature (oC)
Dissolved Oxygen (mg/l)

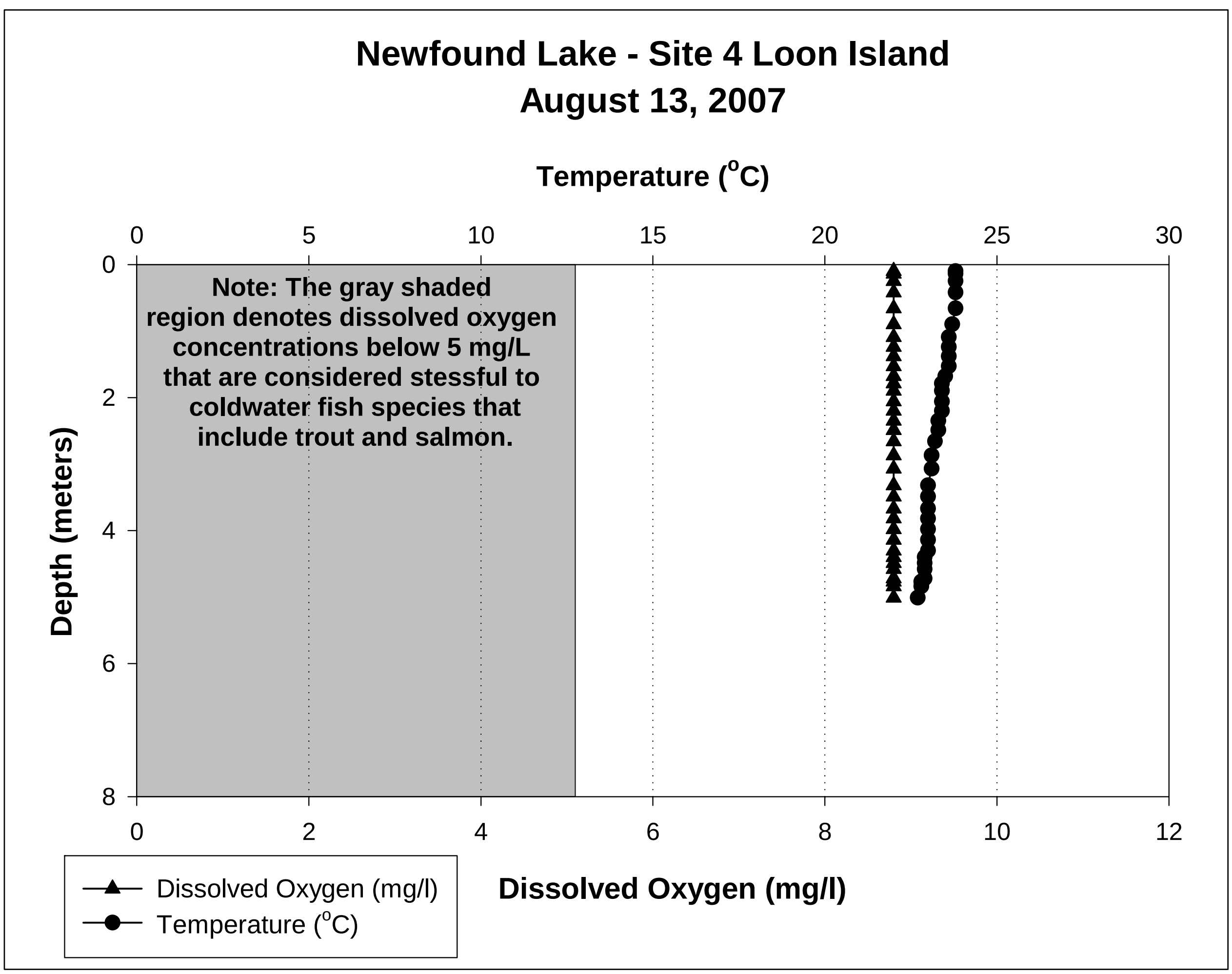

Newfound Lake - Site 3 Pasquaney
September 17, 2007
Temperature (oC)
0
5
10
15
20
25
30
Note: The gray shaded region denotes dissolved oxygen concentrations below 5 mg/L that are considered stessful to coldwater fish species that include trout and salmon.
Depth (meters)
0
2
4
6
8
10
12
14
0
2
4
6
8
10
12
Dissolved Oxygen (mg/l)
Temperature (oC)
Dissolved Oxygen (mg/l)

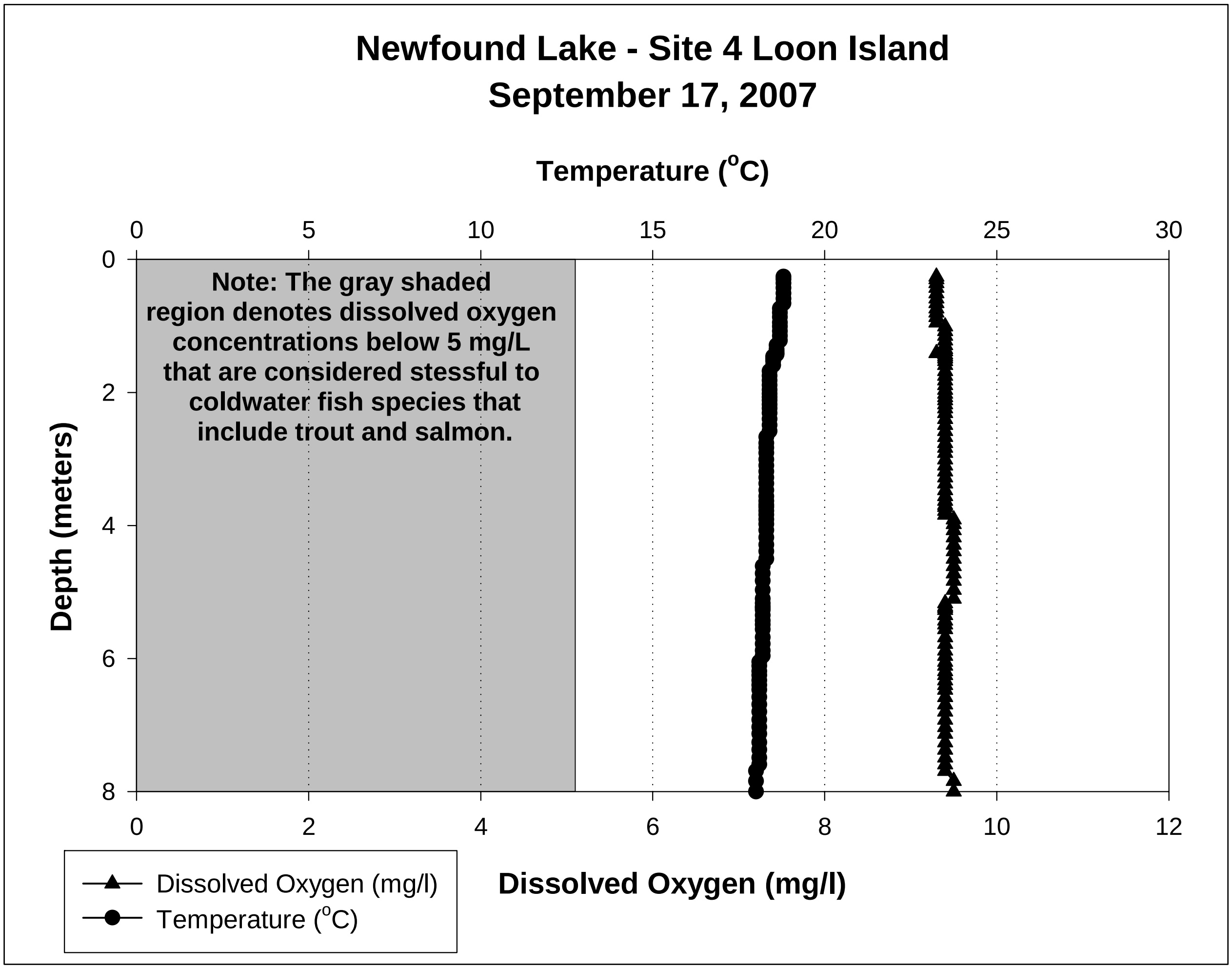

Newfound Lake - Site 3 Pasquaney
July 2, 2008
Temperature (oC)
0
5
10
15
20
25
30
Note: The gray shaded region denotes dissolved oxygen concentrations below 5 mg/L that are considered stessful to coldwater fish species that include trout and salmon.
Depth (meters)
0
2
4
6
8
10
12
14
0
2
4
6
8
10
12
Dissolved Oxygen (mg/l)
Temperature (oC)
Dissolved Oxygen (mg/l)


Newfound Lake - Site 3 Pasquaney
September 11, 2008
Temperature (oC)
Depth (meters)
Note: The gray shaded region denotes dissolved oxygen concentrations below 5 mg/L that are considered stessful to coldwater fish species that include trout and salmon.
Dissolved Oxygen (mg/l)
Temperature (oC)
Dissolved Oxygen (mg/l)

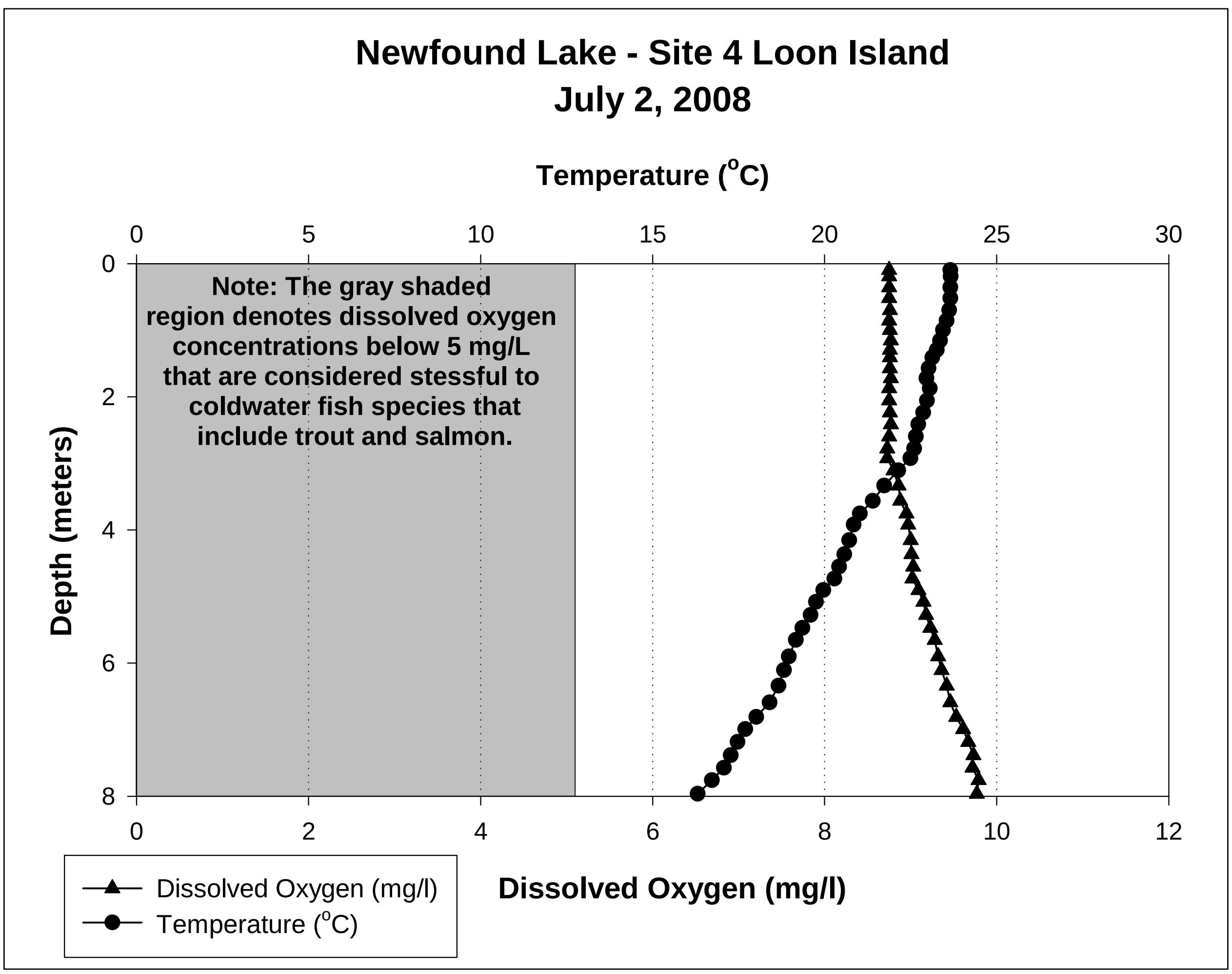

Newfound Lake - Site 3 Pasquaney
September 25, 2008
Temperature (oC)
Depth (meters)
Note: The gray shaded region denotes dissolved oxygen concentrations below 5 mg/L that are considered stessful to coldwater fish species that include trout and salmon.
Dissolved Oxygen (mg/l)
Temperature (oC)
Dissolved Oxygen (mg/l)


Newfound Lake - Site 4 Loon Island
July 23, 2007
Temperature (oC)
0 5 10 15 20 25 30
Note: The gray shaded region denotes dissolved oxygen concentrations below 5 mg/L that are considered stessful to coldwater fish species that include trout and salmon.
Depth (meters)
0 2 4 6 8
0 2 4 6 8 10 12
Dissolved Oxygen (mg/l)
Temperature (oC)
Dissolved Oxygen (mg/l)

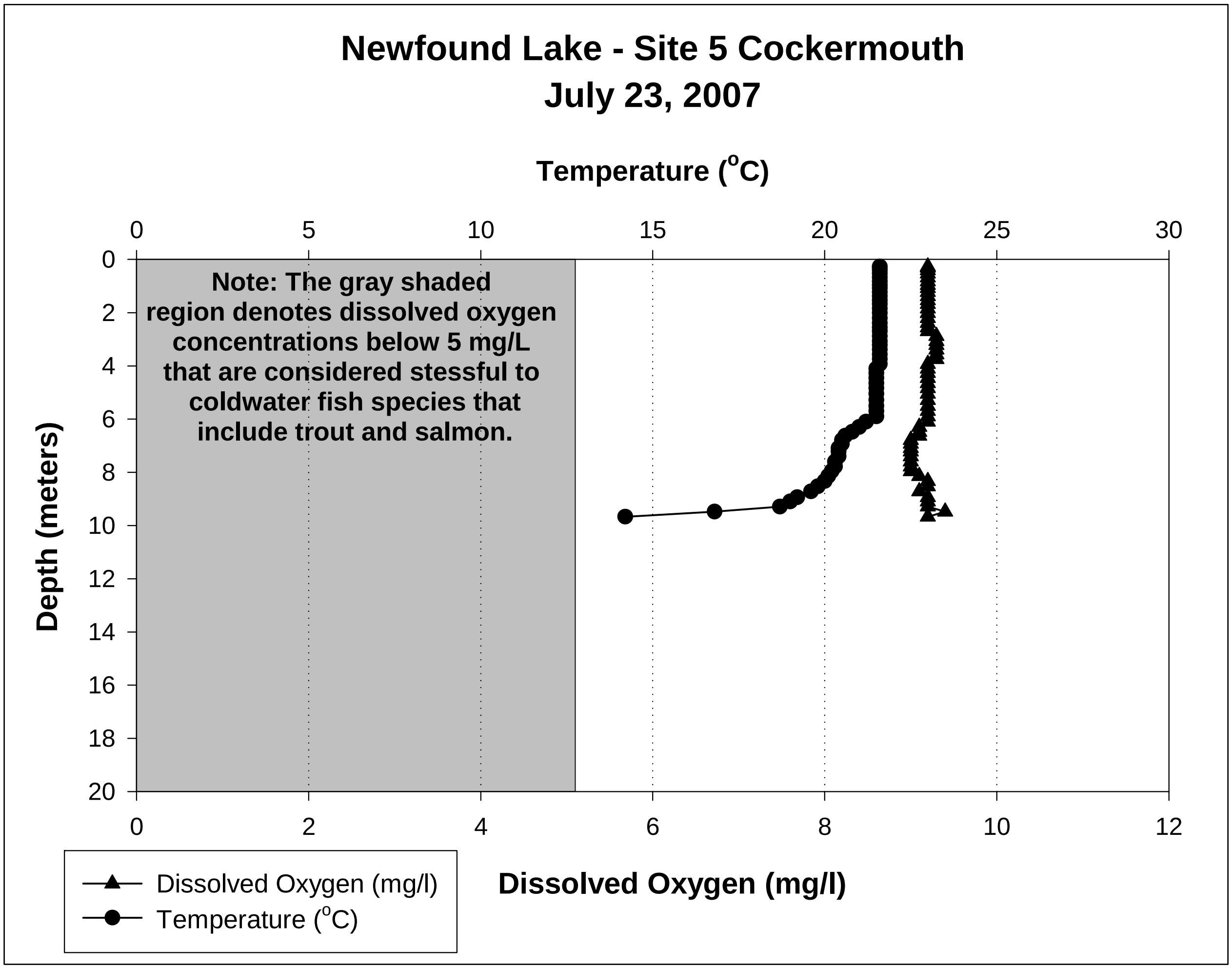

Newfound Lake - Site 4 Loon Island
August 13, 2007
Temperature (oC)
0 5 10 15 20 25 30
Note: The gray shaded region denotes dissolved oxygen concentrations below 5 mg/L that are considered stessful to coldwater fish species that include trout and salmon.
Depth (meters)
0 2 4 6 8
0 2 4 6 8 10 12
Dissolved Oxygen (mg/l)
Temperature (oC)
Dissolved Oxygen (mg/l)



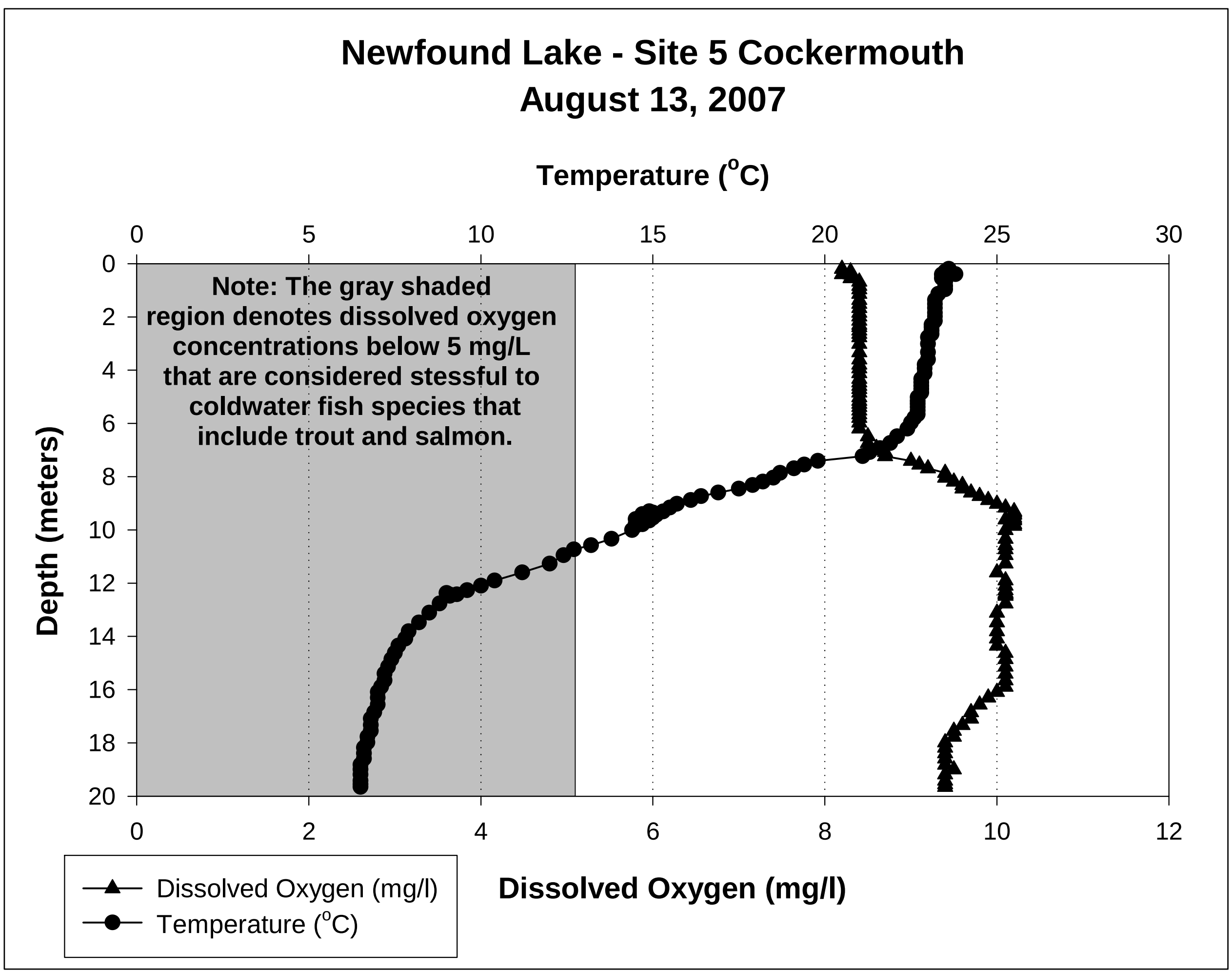
Newfound Lake - Site 4 Loon Island
September 17, 2007
Temperature (°C)
0 5 10 15 20 25 30
Note: The gray shaded region denotes dissolved oxygen concentrations below 5 mg/L that are considered stessful to coldwater fish species that include trout and salmon.
Depth (meters)
0 2 4 6 8
0 2 4 6 8 10 12
Dissolved Oxygen (mg/l)
Temperature (°C)
Dissolved Oxygen (mg/l)



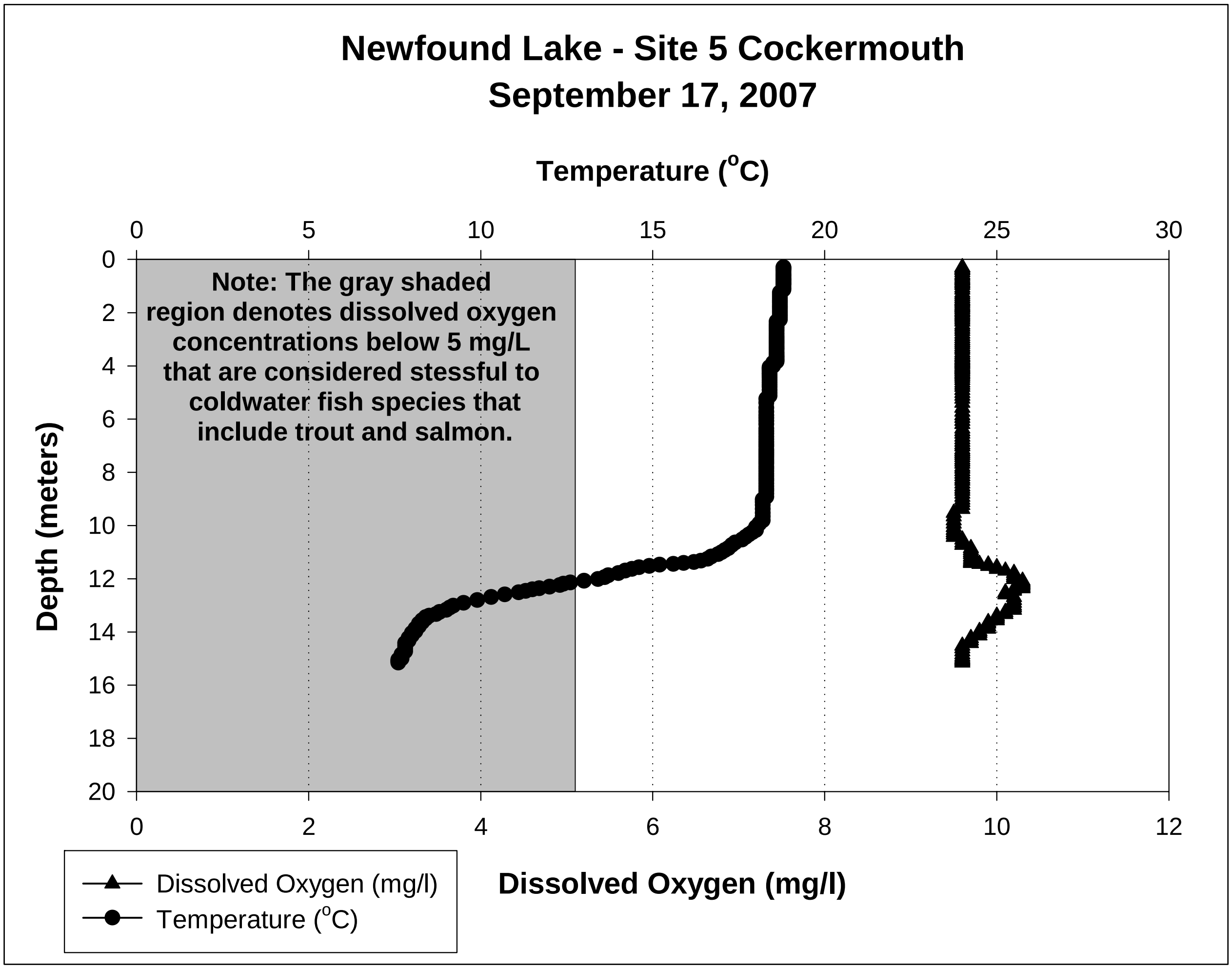
Newfound Lake - Site 4 Loon Island
July 2, 2008
Temperature (°C)
0 5 10 15 20 25 30
Note: The gray shaded region denotes dissolved oxygen concentrations below 5 mg/L that are considered stessful to coldwater fish species that include trout and salmon.
Depth (meters)
0 2 4 6 8
0 2 4 6 8 10 12
Dissolved Oxygen (mg/l)
Temperature (°C)
Dissolved Oxygen (mg/l)

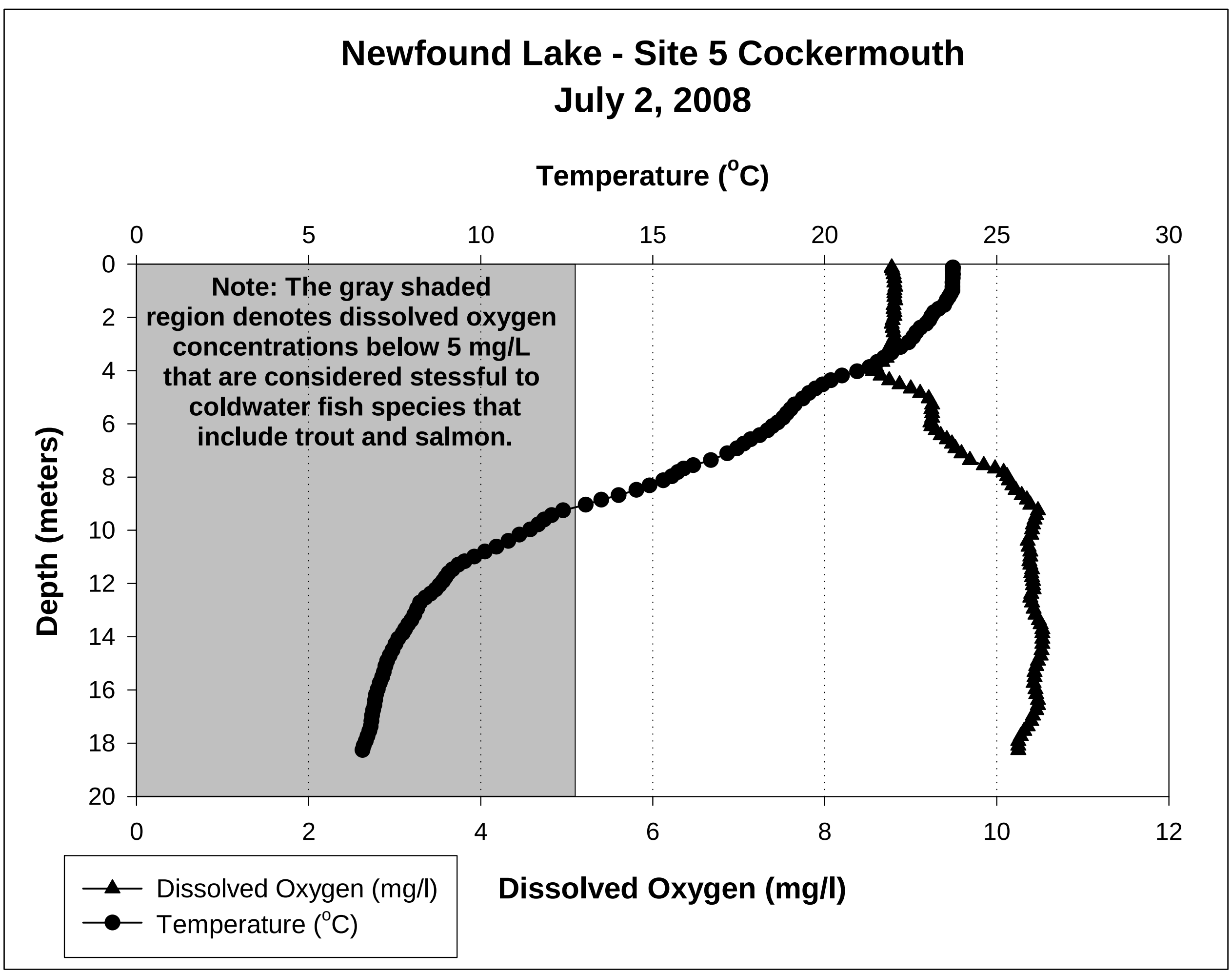


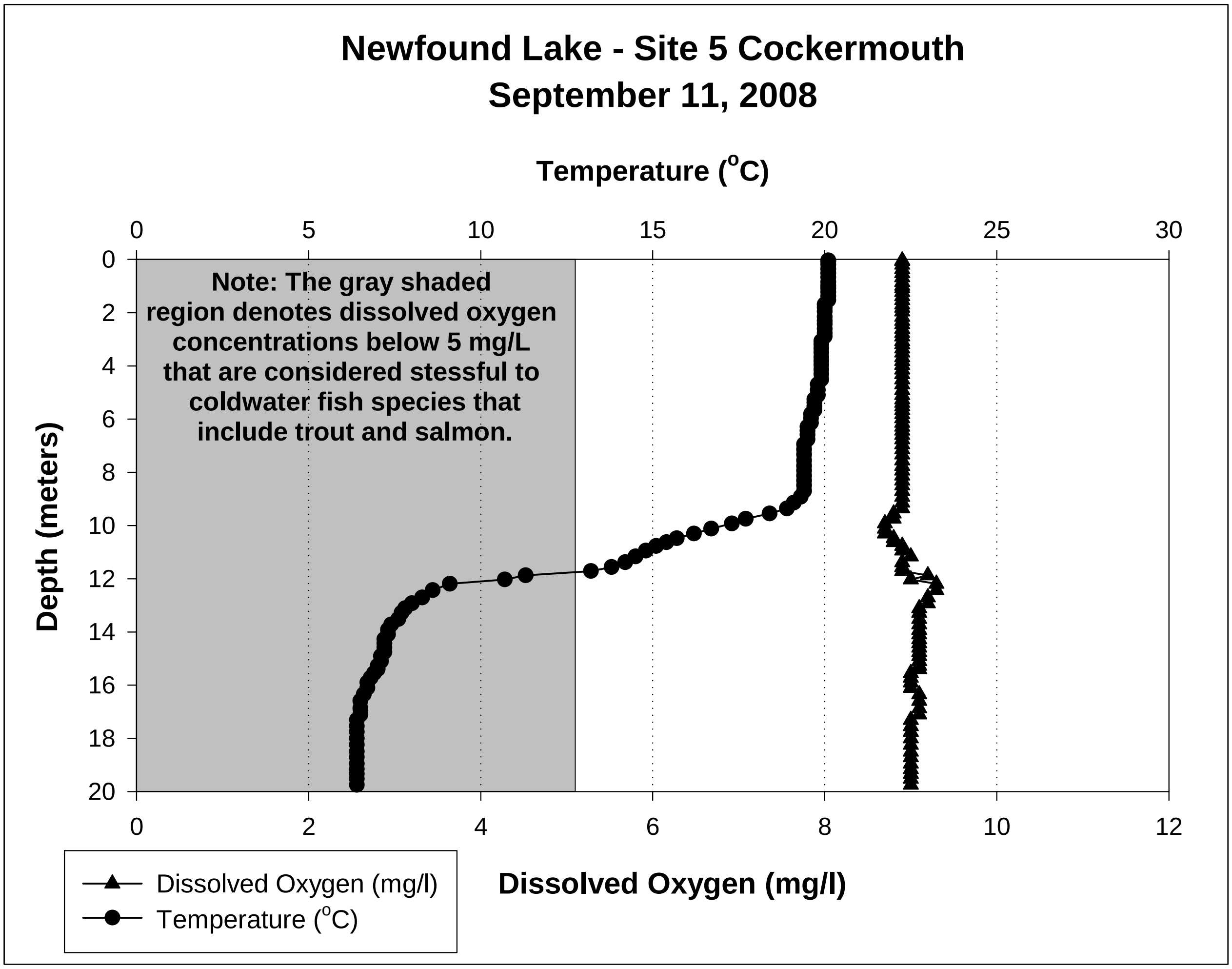
Newfound Lake - Site 5 Cockermouth
July 23, 2007
Temperature (°C)
0 5 10 15 20 25 30
Note: The gray shaded region denotes dissolved oxygen concentrations below 5 mg/L that are considered stessful to coldwater fish species that include trout and salmon.
Depth (meters)
0 2 4 6 8 10 12 14 16 18 20
0 2 4 6 8 10 12
Dissolved Oxygen (mg/l)
Temperature (°C)
Dissolved Oxygen (mg/l)

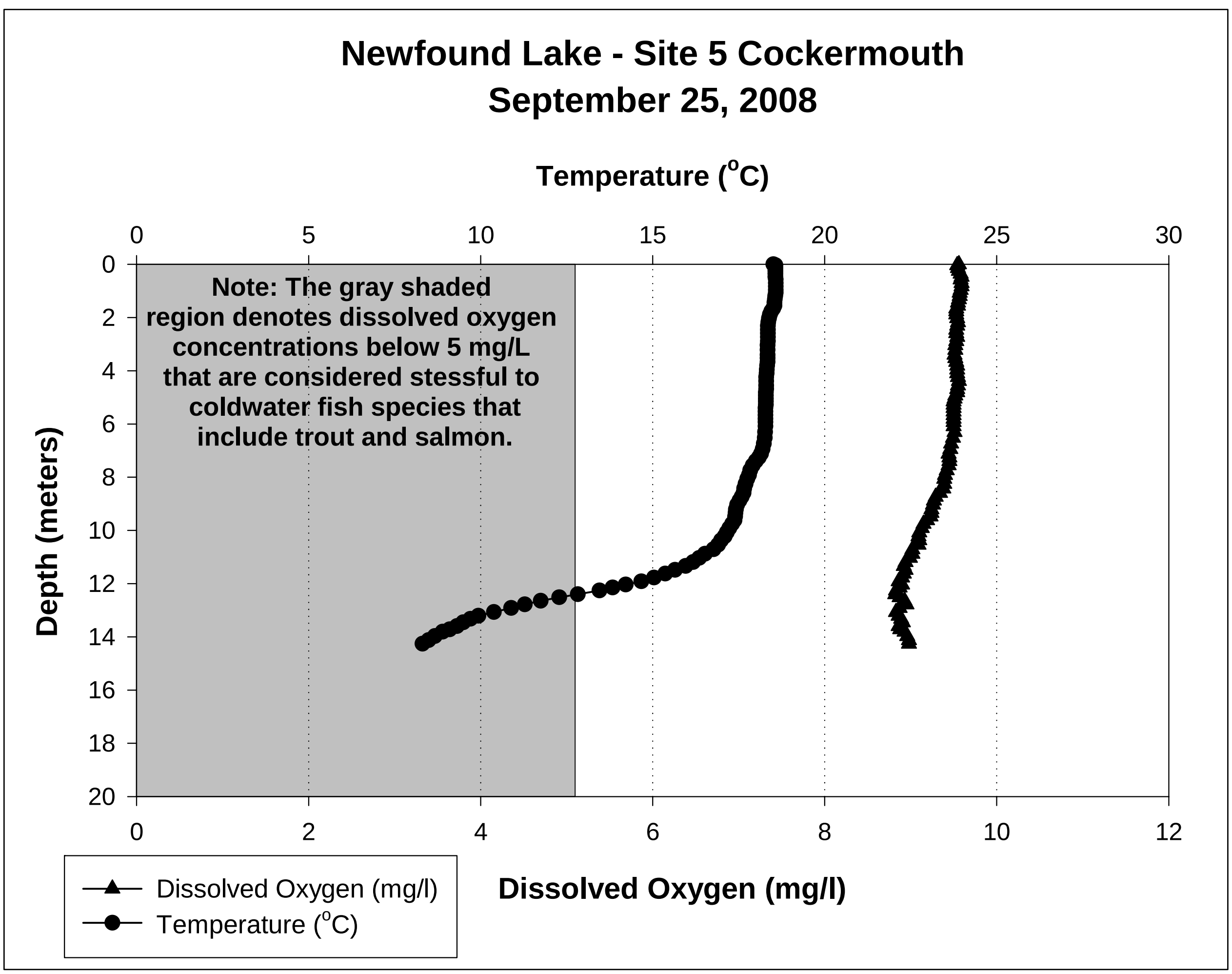


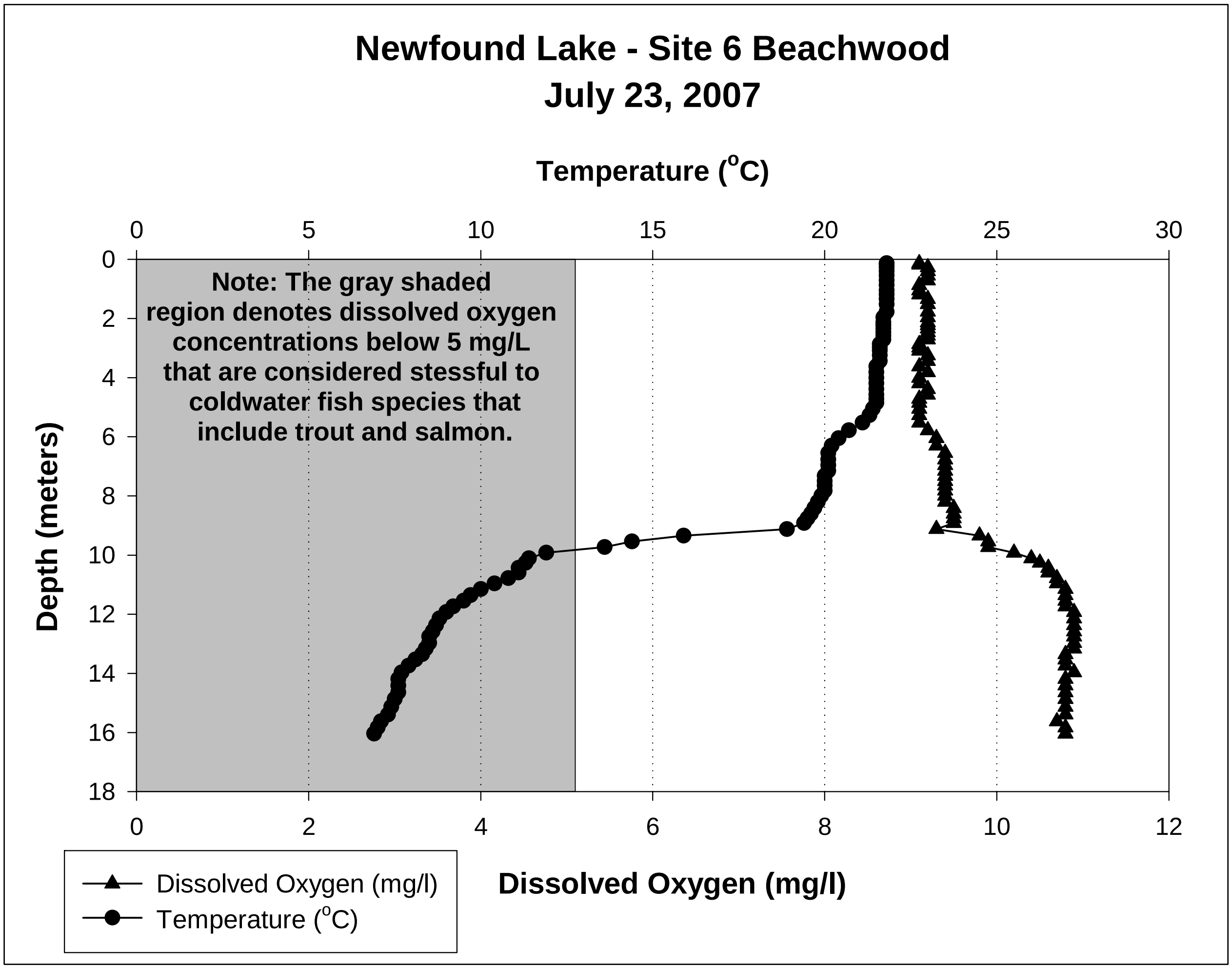
Newfound Lake - Site 5 Cockermouth
August 13, 2007
Temperature (°C)
0 5 10 15 20 25 30
Note: The gray shaded region denotes dissolved oxygen concentrations below 5 mg/L that are considered stessful to coldwater fish species that include trout and salmon.
Depth (meters)
0 2 4 6 8 10 12 14 16 18 20
0 2 4 6 8 10 12
Dissolved Oxygen (mg/l)
Temperature (°C)
Dissolved Oxygen (mg/l)


Newfound Lake - Site 5 Cockermouth
September 17, 2007
Temperature (oC)
0
5
10
15
20
25
30
Note: The gray shaded region denotes dissolved oxygen concentrations below 5 mg/L that are considered stessful to coldwater fish species that include trout and salmon.
Depth (meters)
0
2
4
6
8
10
12
14
16
18
20
0
2
4
6
8
10
12
Dissolved Oxygen (mg/l)
Temperature (oC)
Dissolved Oxygen (mg/l)

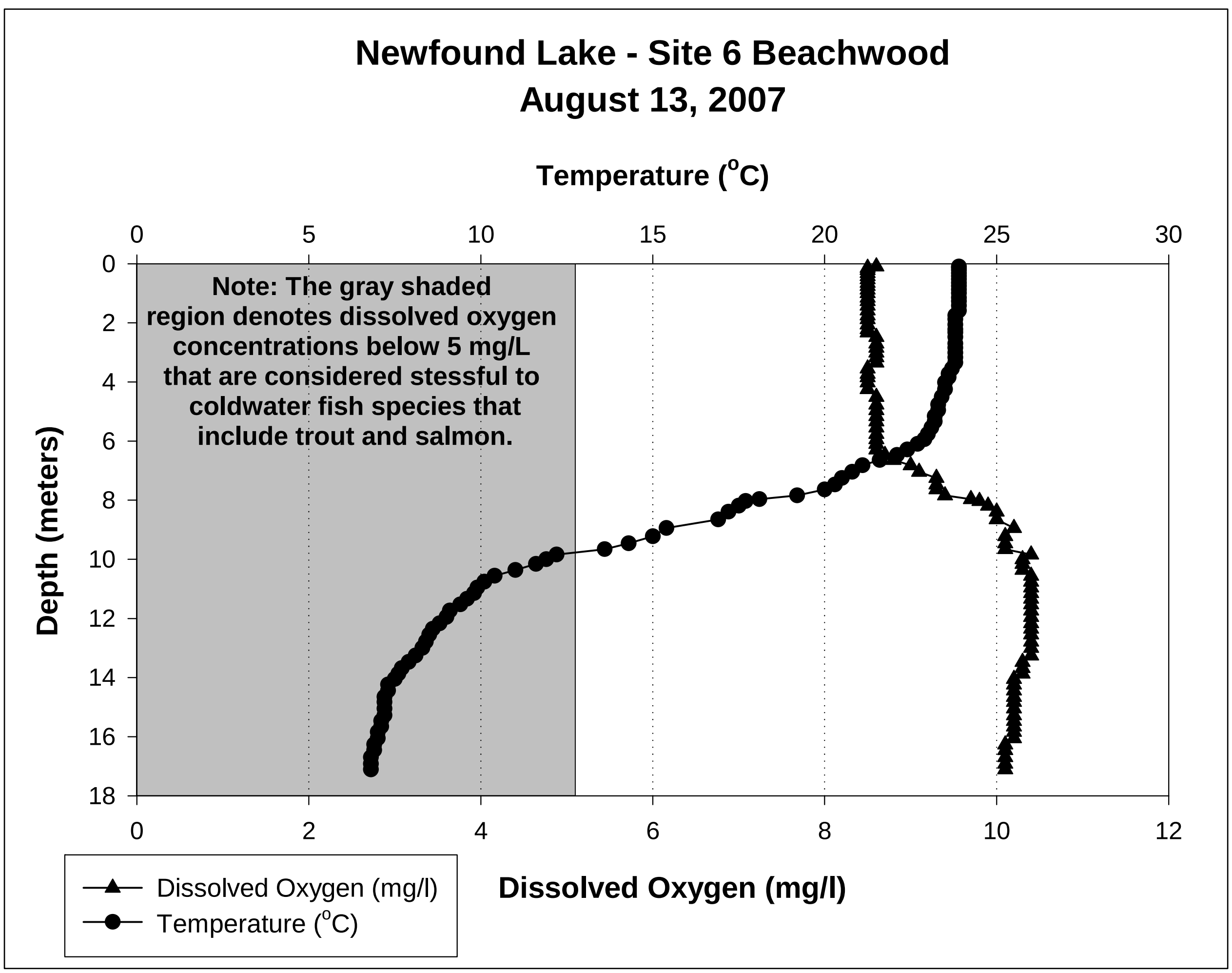

Newfound Lake - Site 5 Cockermouth
July 2, 2008
Temperature (oC)
0
5
10
15
20
25
30
Note: The gray shaded region denotes dissolved oxygen concentrations below 5 mg/L that are considered stessful to coldwater fish species that include trout and salmon.
Depth (meters)
0
2
4
6
8
10
12
14
16
18
20
0
2
4
6
8
10
12
Dissolved Oxygen (mg/l)
Temperature (oC)
Dissolved Oxygen (mg/l)


Newfound Lake - Site 5 Cockermouth
September 11, 2008
Temperature (oC)
0
5
10
15
20
25
30
Note: The gray shaded region denotes dissolved oxygen concentrations below 5 mg/L that are considered stessful to coldwater fish species that include trout and salmon.
Depth (meters)
0
2
4
6
8
10
12
14
16
18
20
0
2
4
6
8
10
12
Dissolved Oxygen (mg/l)
Temperature (oC)
Dissolved Oxygen (mg/l)

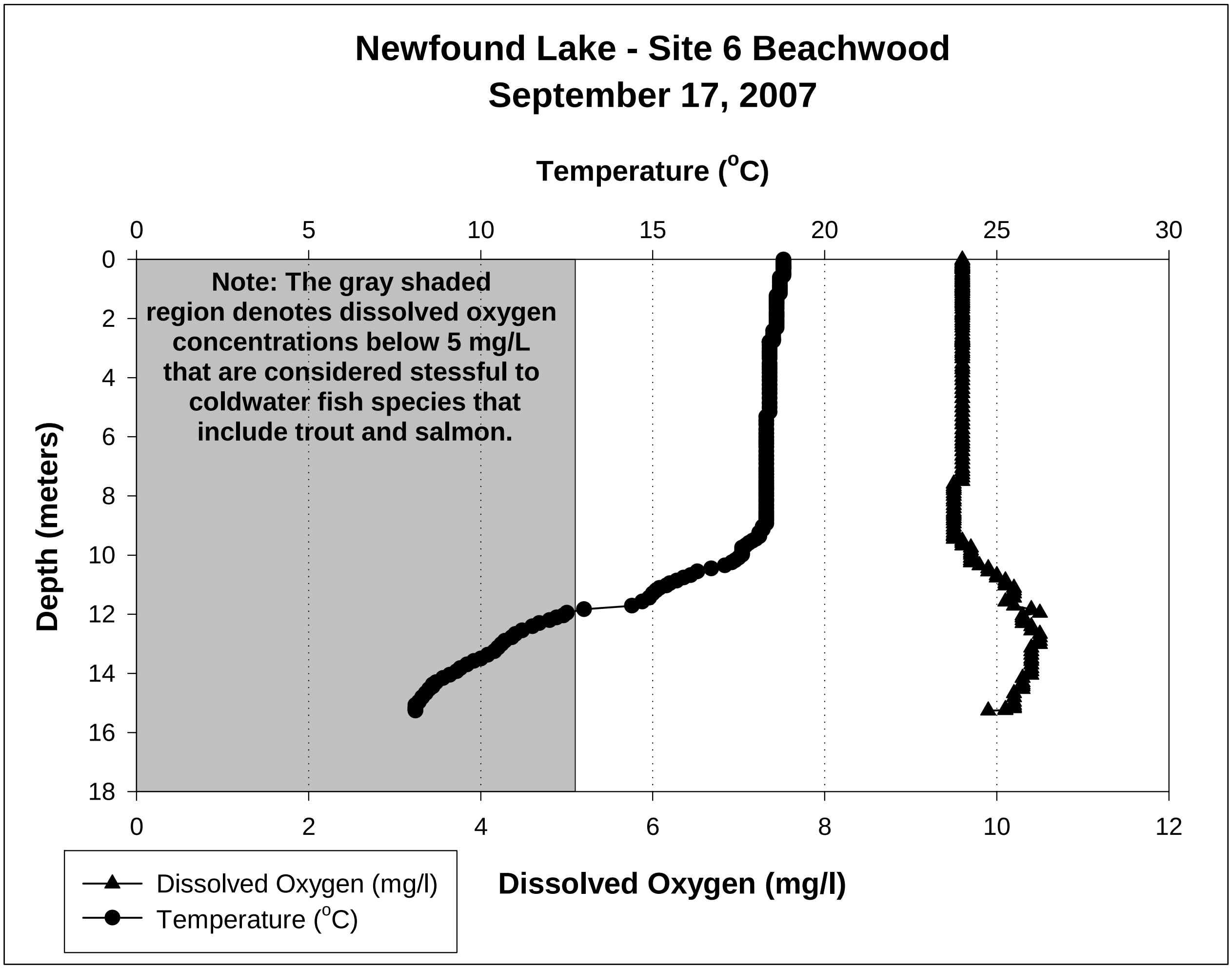

Newfound Lake - Site 5 Cockermouth
September 25, 2008
Temperature (oC)
0
5
10
15
20
25
30
Note: The gray shaded region denotes dissolved oxygen concentrations below 5 mg/L that are considered stessful to coldwater fish species that include trout and salmon.
Depth (meters)
0
2
4
6
8
10
12
14
16
18
20
0
2
4
6
8
10
12
Dissolved Oxygen (mg/l)
Temperature (oC)
Dissolved Oxygen (mg/l)

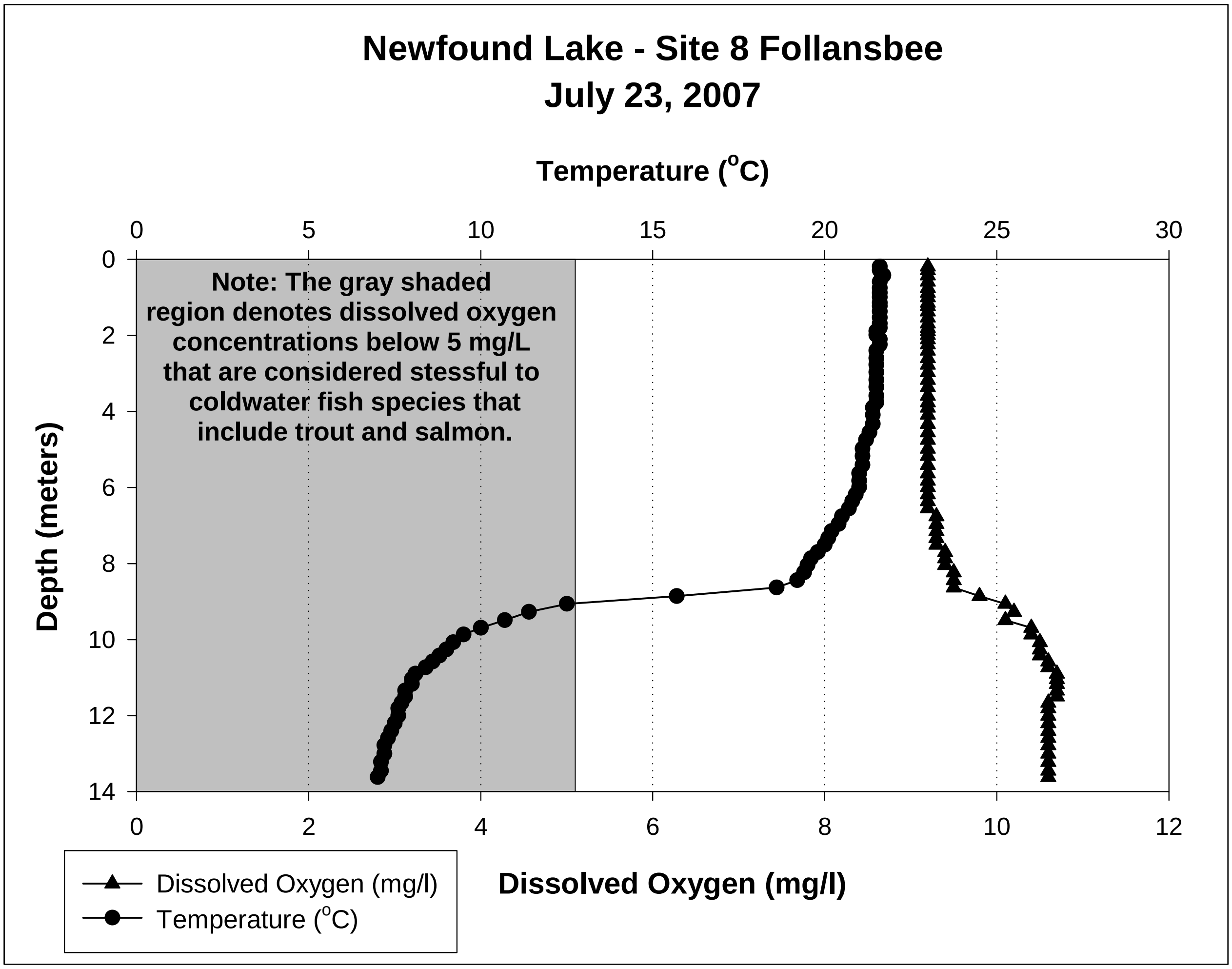


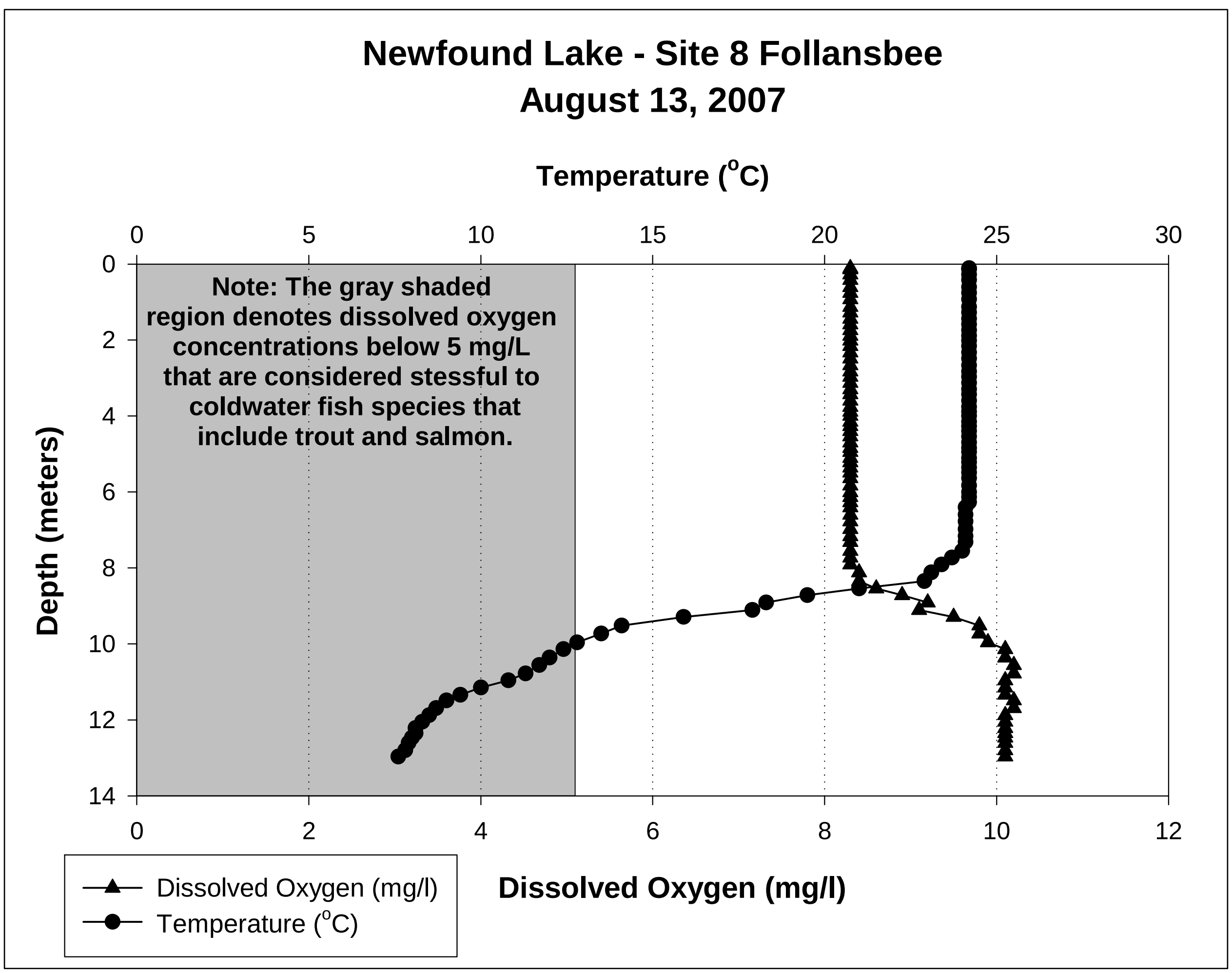
Newfound Lake - Site 6 Beachwood
July 23, 2007
Temperature (oC)
0
5
10
15
20
25
30
Note: The gray shaded region denotes dissolved oxygen concentrations below 5 mg/L that are considered stessful to coldwater fish species that include trout and salmon.
Depth (meters)
0
2
4
6
8
10
12
14
16
18
0
2
4
6
8
10
12
Dissolved Oxygen (mg/l)
Temperature (oC)
Dissolved Oxygen (mg/l)

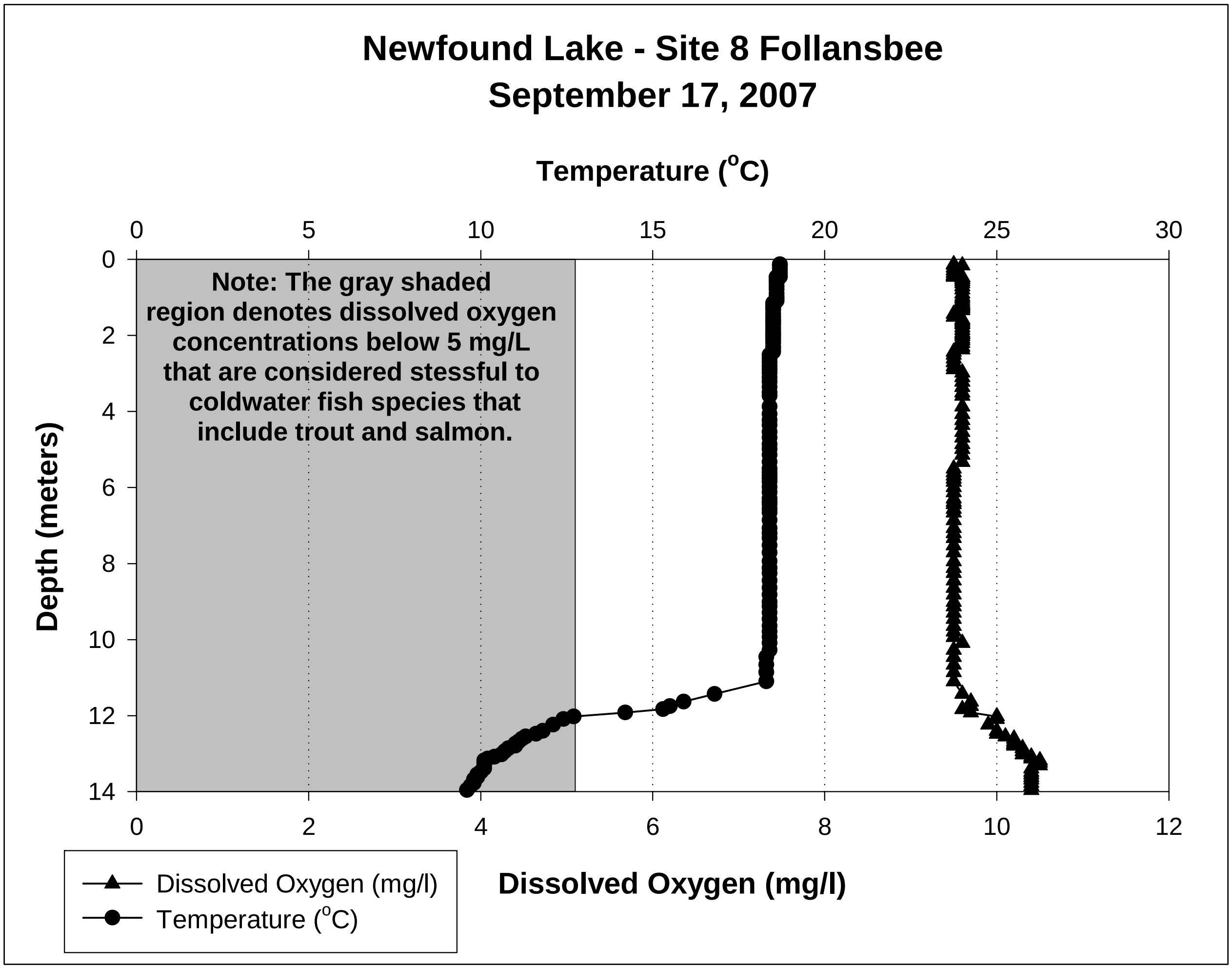


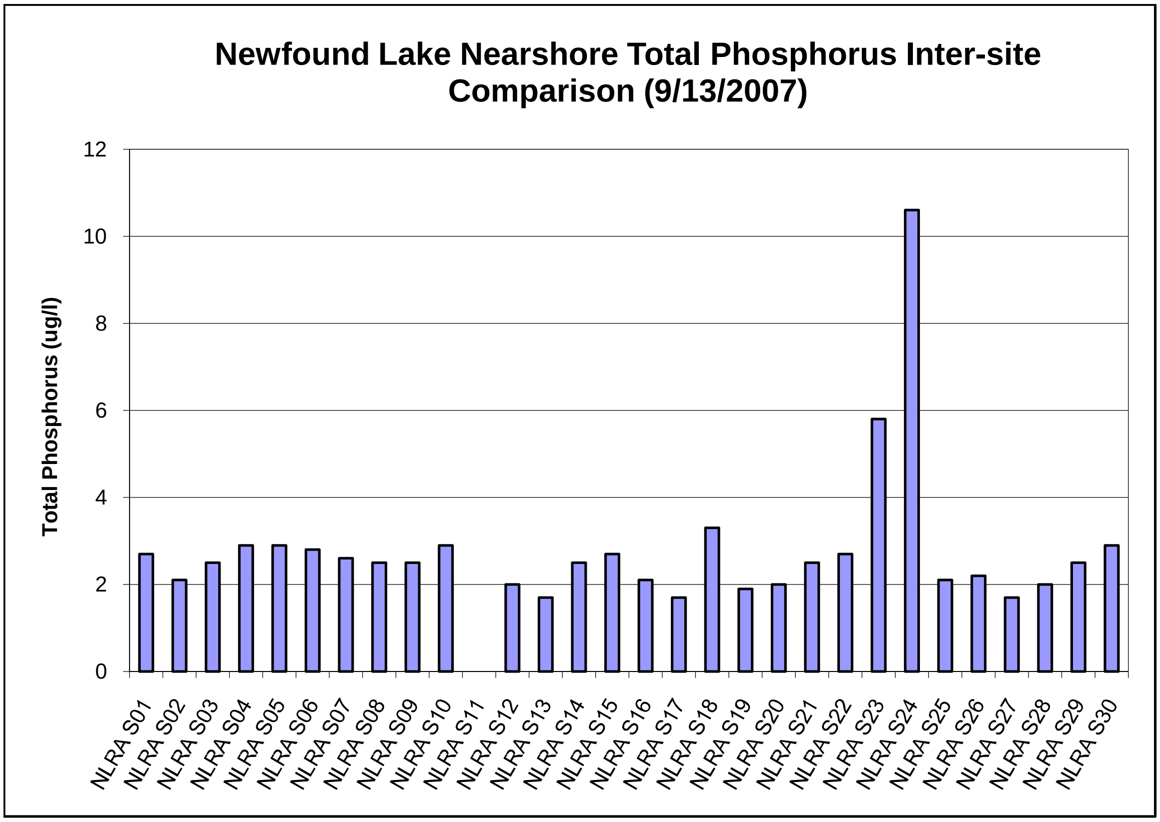
Newfound Lake - Site 6 Beachwood
August 13, 2007
Temperature (oC)
0
5
10
15
20
25
30
Note: The gray shaded region denotes dissolved oxygen concentrations below 5 mg/L that are considered stessful to coldwater fish species that include trout and salmon.
Depth (meters)
0
2
4
6
8
10
12
14
16
18
0
2
4
6
8
10
12
Dissolved Oxygen (mg/l)
Temperature (oC)
Dissolved Oxygen (mg/l)

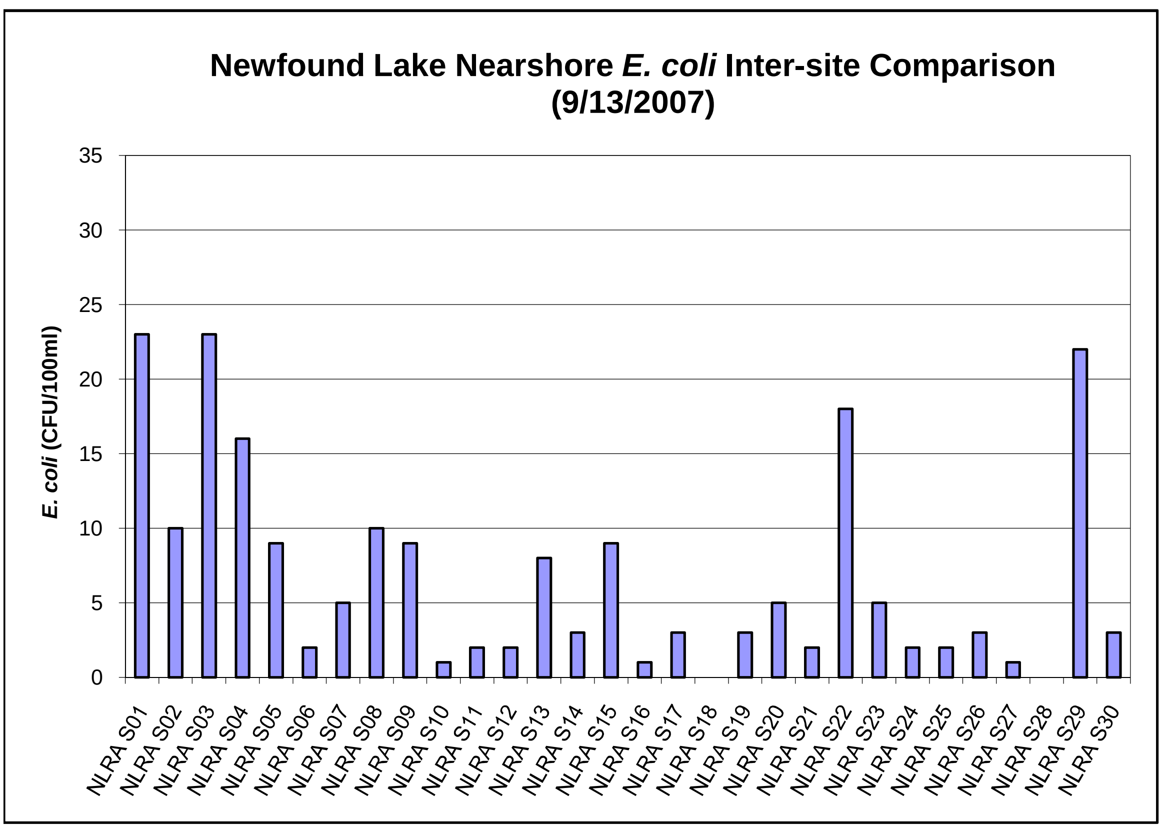

Newfound Lake - Site 6 Beachwood
September 17, 2007
Temperature (^oC)
0
5
10
15
20
25
30
Note: The gray shaded region denotes dissolved oxygen concentrations below 5 mg/L that are considered stessful to coldwater fish species that include trout and salmon.
Depth (meters)
0
2
4
6
8
10
12
14
16
18
0
2
4
6
8
10
12
Dissolved Oxygen (mg/l)
Temperature (^oC)
Dissolved Oxygen (mg/l)

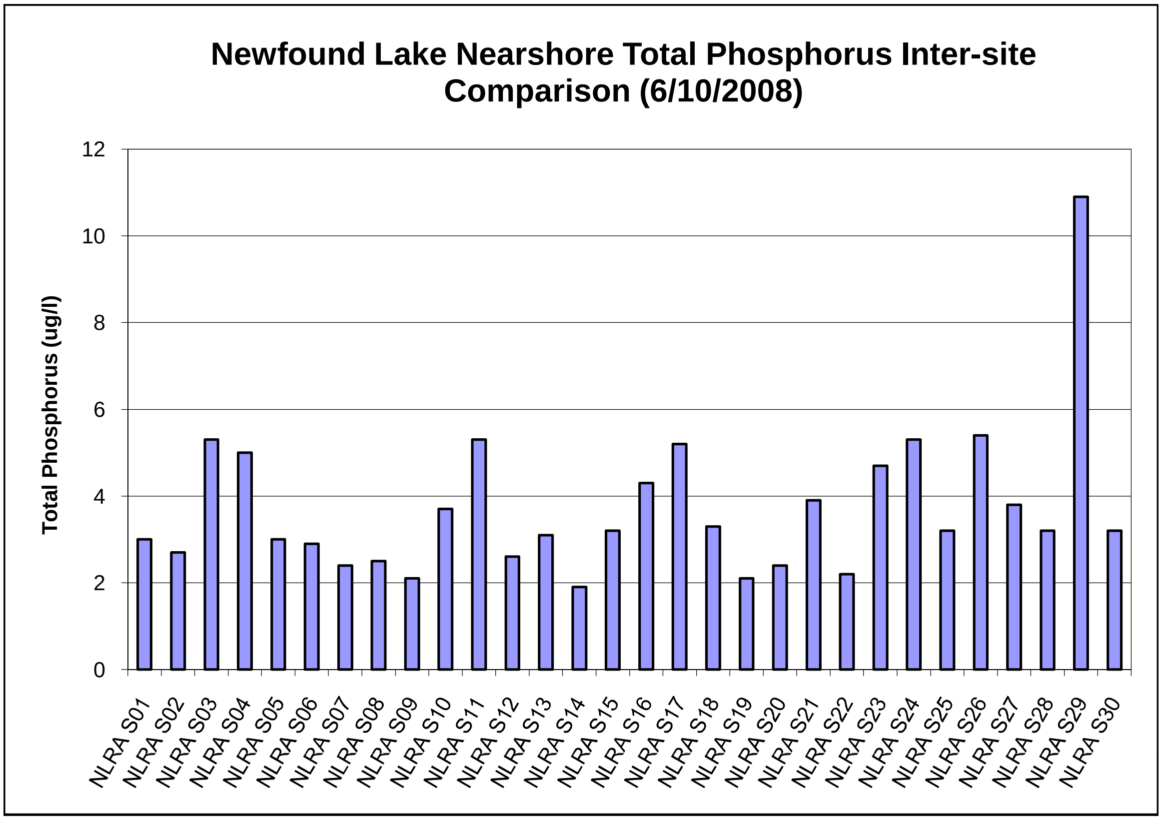

Newfound Lake - Site 8 Follansbee
July 23, 2007
Temperature (oC)
0 5 10 15 20 25 30
Depth (meters)
0 2 4 6 8 10 12 14
Note: The gray shaded region denotes dissolved oxygen concentrations below 5 mg/L that are considered stessful to coldwater fish species that include trout and salmon.
0 2 4 6 8 10 12
Dissolved Oxygen (mg/l)
Temperature (oC)
Dissolved Oxygen (mg/l)

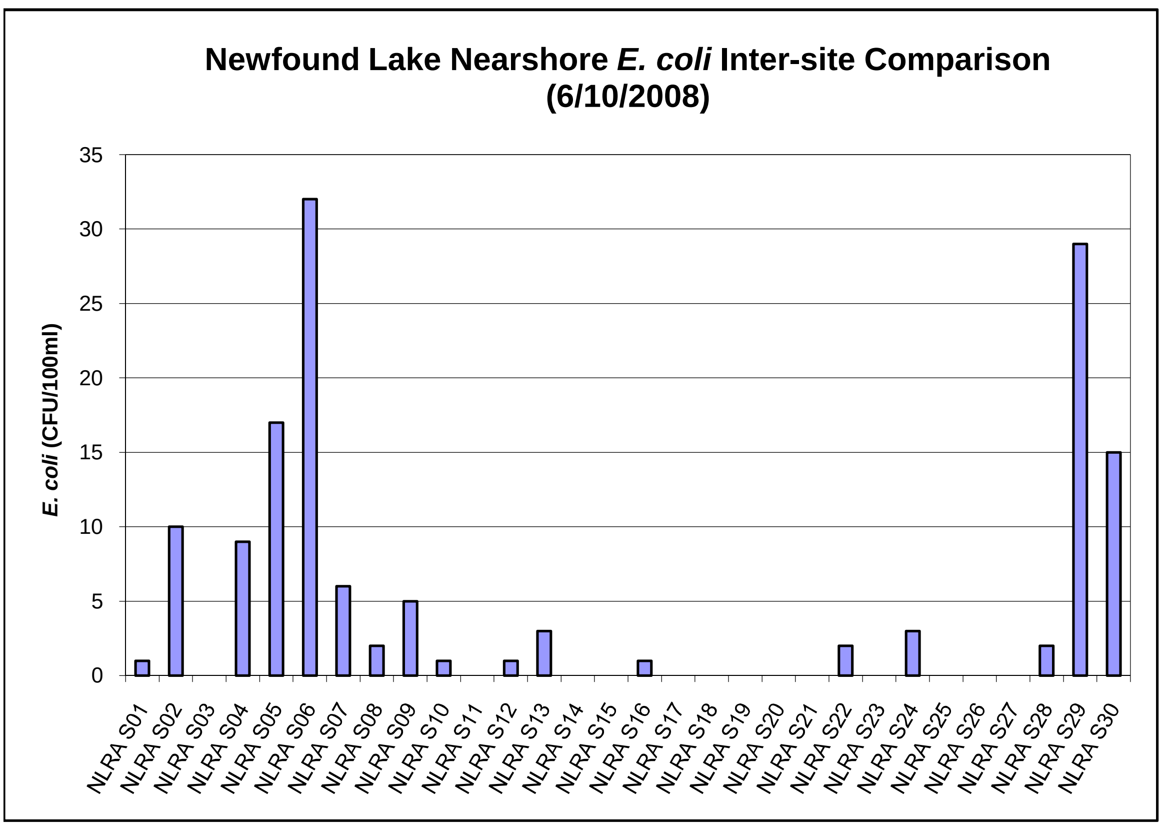

Newfound Lake - Site 8 Follansbee
August 13, 2007
Temperature (oC)
0 5 10 15 20 25 30
Depth (meters)
0 2 4 6 8 10 12 14
Note: The gray shaded region denotes dissolved oxygen concentrations below 5 mg/L that are considered stessful to coldwater fish species that include trout and salmon.
0 2 4 6 8 10 12
Dissolved Oxygen (mg/l)
Temperature (oC)
Dissolved Oxygen (mg/l)

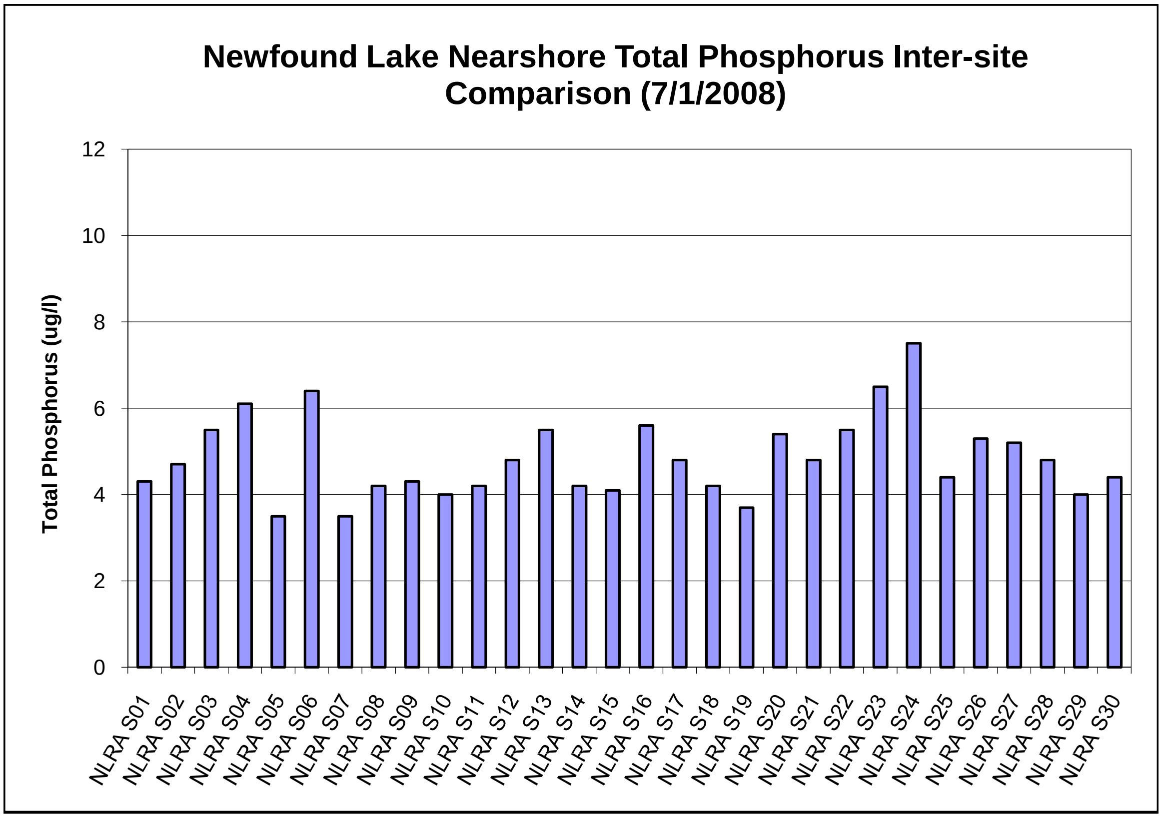

Newfound Lake - Site 8 Follansbee
September 17, 2007
Temperature (oC)
0
5
10
15
20
25
30
Note: The gray shaded region denotes dissolved oxygen concentrations below 5 mg/L that are considered stessful to coldwater fish species that include trout and salmon.
Depth (meters)
0
2
4
6
8
10
12
14
0
2
4
6
8
10
12
Dissolved Oxygen (mg/l)
Dissolved Oxygen (mg/l)
Temperature (oC)

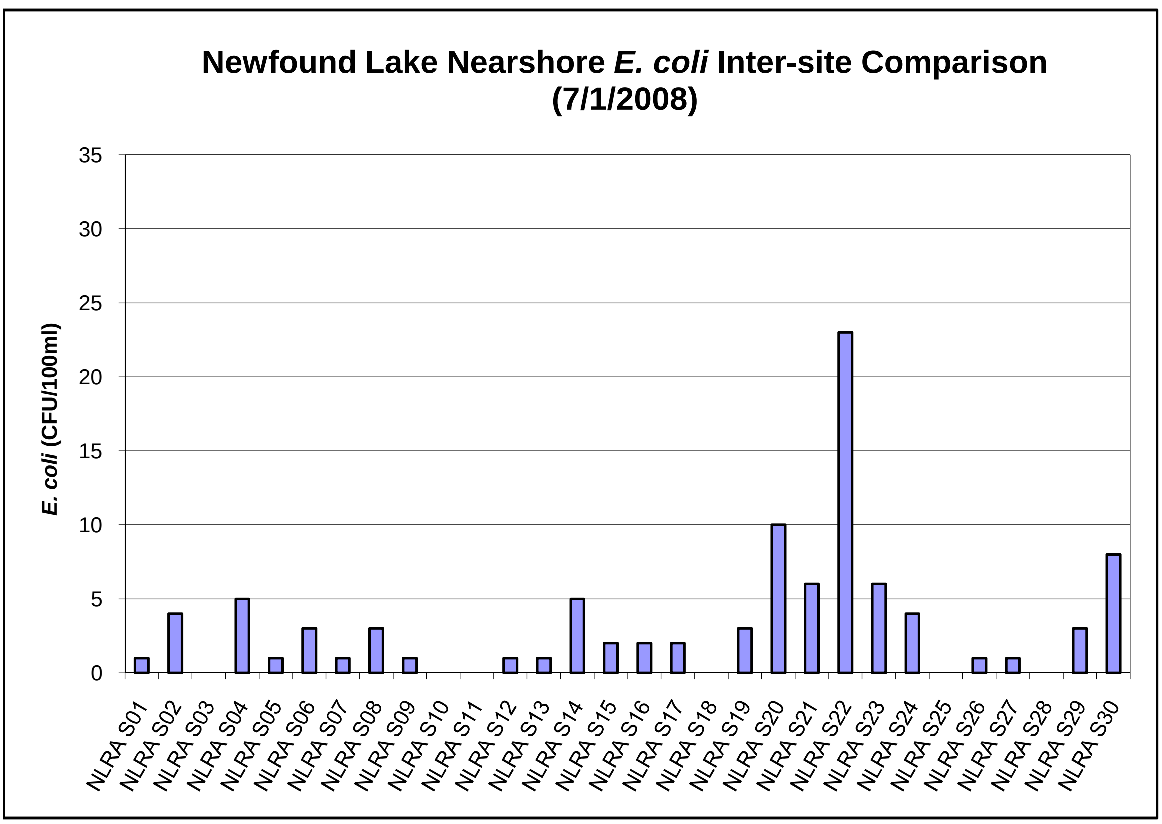

Newfound Lake Nearshore Total Phosphorus Inter-site Comparison (9/13/2007)
Total Phosphorus (ug/l)
0
2
4
6
8
10
12
NLRA S01
NLRA S02
NLRA S03
NLRA S04
NLRA S05
NLRA S06
NLRA S07
NLRA S08
NLRA S09
NLRA S10
NLRA S11
NLRA S12
NLRA S13
NLRA S14
NLRA S15
NLRA S16
NLRA S17
NLRA S18
NLRA S19
NLRA S20
NLRA S21
NLRA S22
NLRA S23
NLRA S24
NLRA S25
NLRA S26
NLRA S27
NLRA S28
NLRA S29
NLRA S30

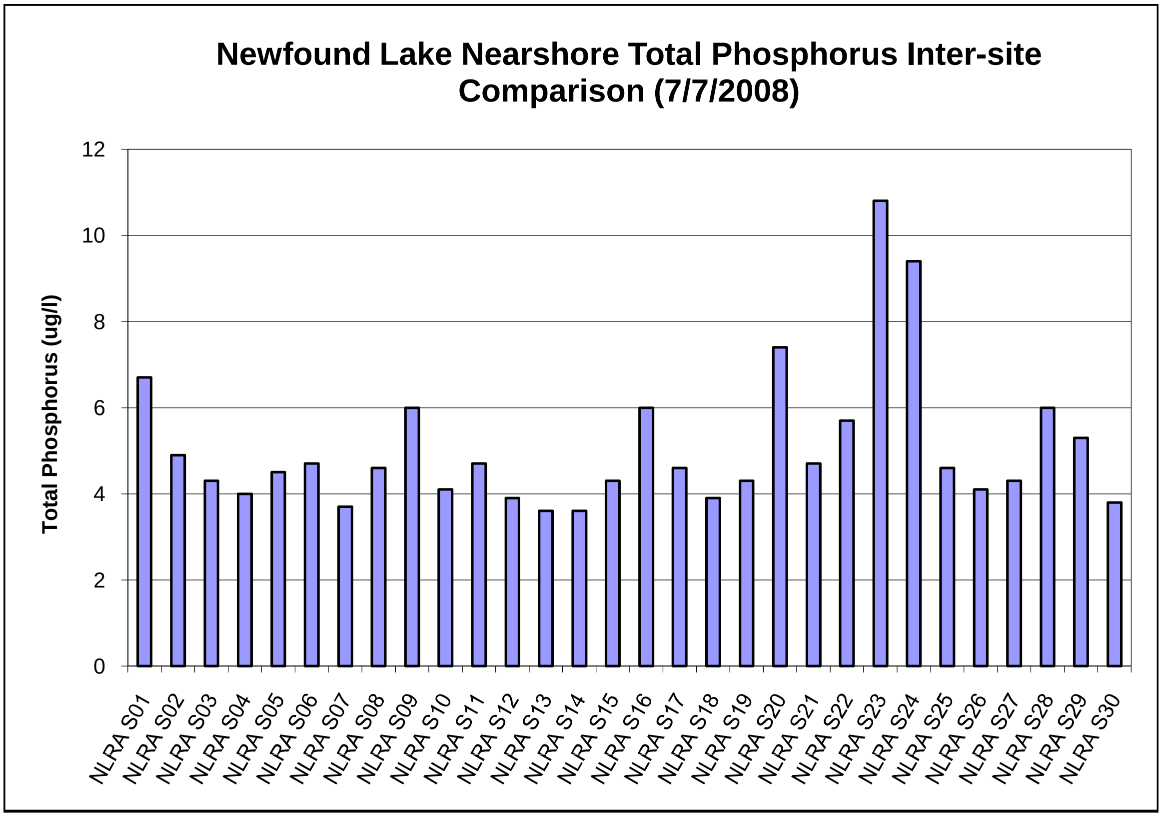

Newfound Lake Nearshore *E. coli* Inter-site Comparison (9/13/2007)
E. coli (CFU/100ml)
0
5
10
15
20
25
30
35
NLRA S01
NLRA S02
NLRA S03
NLRA S04
NLRA S05
NLRA S06
NLRA S07
NLRA S08
NLRA S09
NLRA S10
NLRA S11
NLRA S12
NLRA S13
NLRA S14
NLRA S15
NLRA S16
NLRA S17
NLRA S18
NLRA S19
NLRA S20
NLRA S21
NLRA S22
NLRA S23
NLRA S24
NLRA S25
NLRA S26
NLRA S27
NLRA S28
NLRA S29
NLRA S30

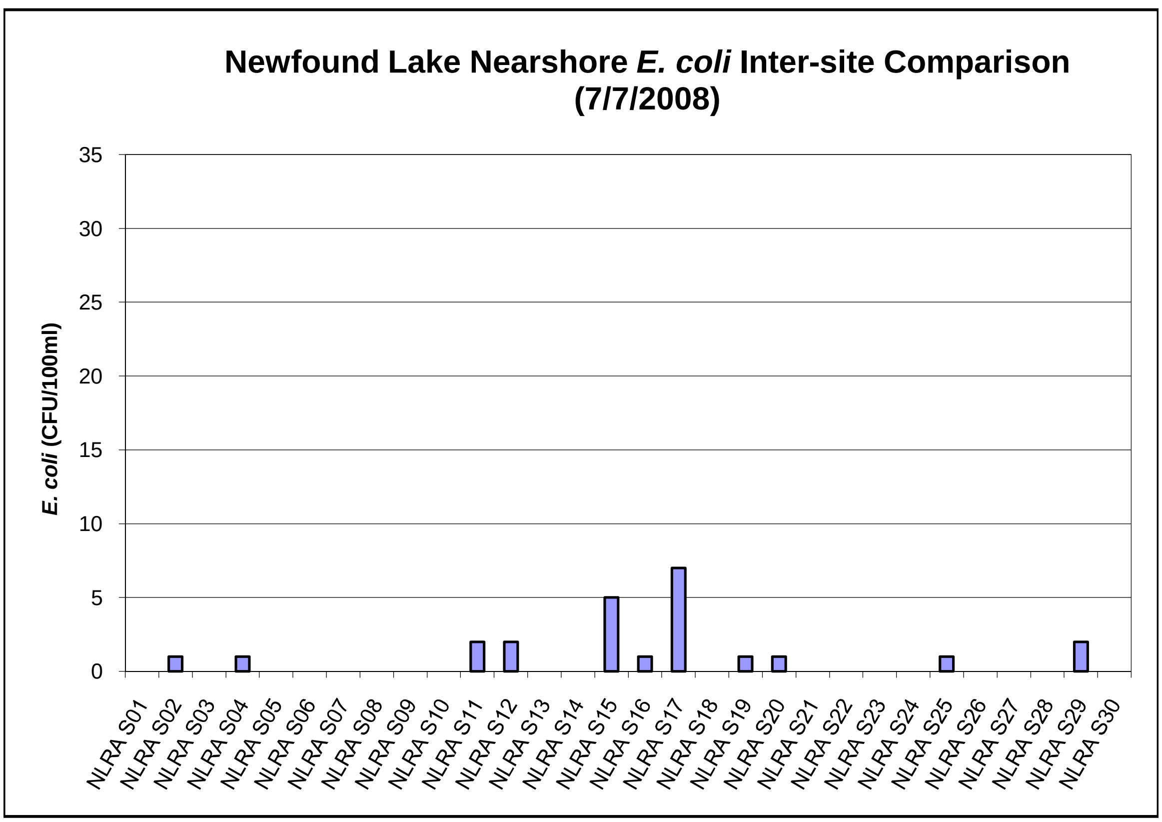

Newfound Lake Nearshore Total Phosphorus Inter-site Comparison (6/10/2008)
Total Phosphorus (ug/l)
0
2
4
6
8
10
12
NLRA S01
NLRA S02
NLRA S03
NLRA S04
NLRA S05
NLRA S06
NLRA S07
NLRA S08
NLRA S09
NLRA S10
NLRA S11
NLRA S12
NLRA S13
NLRA S14
NLRA S15
NLRA S16
NLRA S17
NLRA S18
NLRA S19
NLRA S20
NLRA S21
NLRA S22
NLRA S23
NLRA S24
NLRA S25
NLRA S26
NLRA S27
NLRA S28
NLRA S29
NLRA S30

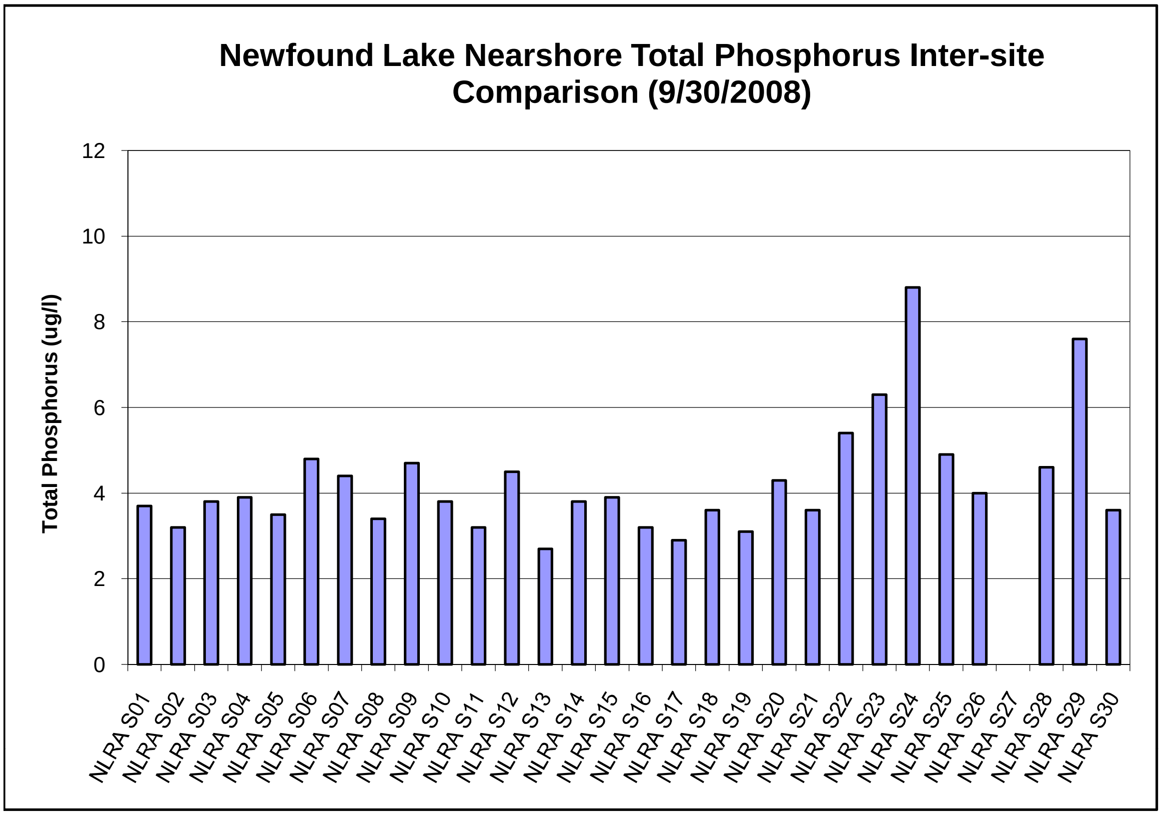

Newfound Lake Nearshore *E. coli* Inter-site Comparison (6/10/2008)
E. coli (CFU/100ml)
0
5
10
15
20
25
30
35
NLRA S01
NLRA S02
NLRA S03
NLRA S04
NLRA S05
NLRA S06
NLRA S07
NLRA S08
NLRA S09
NLRA S10
NLRA S11
NLRA S12
NLRA S13
NLRA S14
NLRA S15
NLRA S16
NLRA S17
NLRA S18
NLRA S19
NLRA S20
NLRA S21
NLRA S22
NLRA S23
NLRA S24
NLRA S25
NLRA S26
NLRA S27
NLRA S28
NLRA S29
NLRA S30

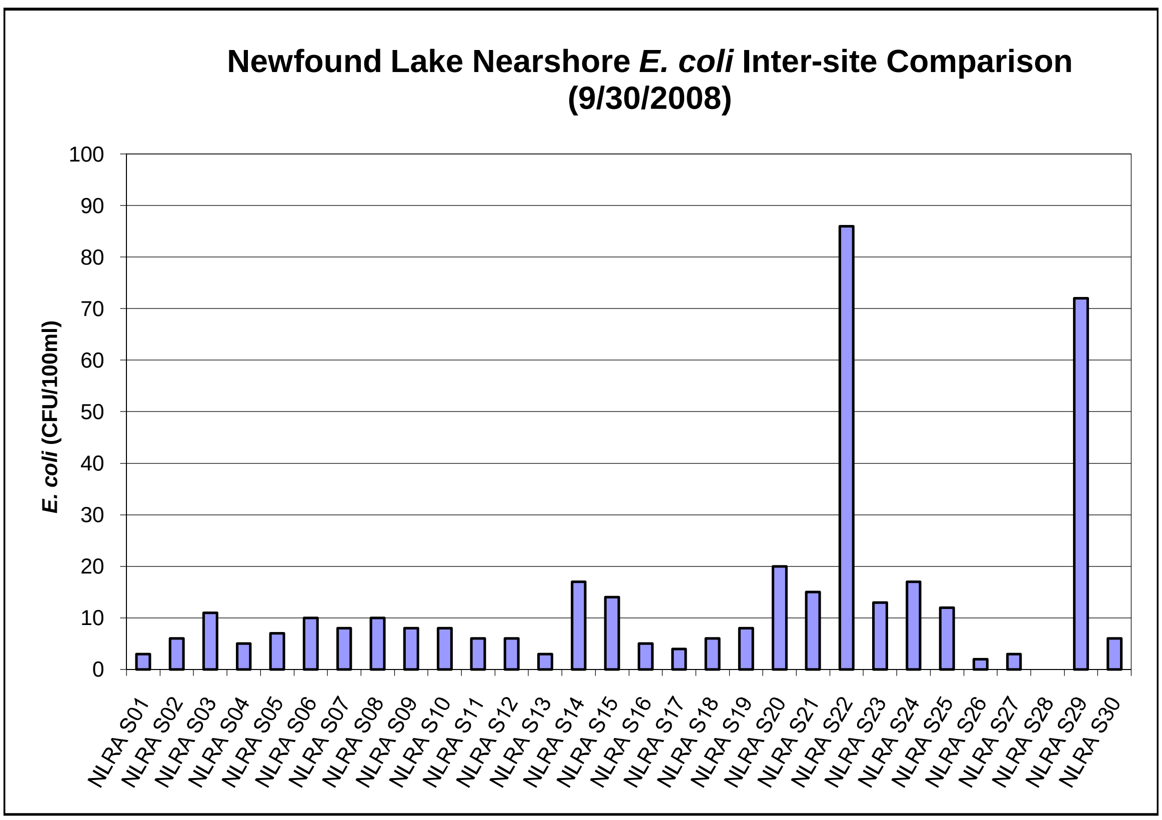

Newfound Lake Nearshore Total Phosphorus Inter-site Comparison (7/1/2008)
Total Phosphorus (ug/l)
0
2
4
6
8
10
12
NLRA S01
NLRA S02
NLRA S03
NLRA S04
NLRA S05
NLRA S06
NLRA S07
NLRA S08
NLRA S09
NLRA S10
NLRA S11
NLRA S12
NLRA S13
NLRA S14
NLRA S15
NLRA S16
NLRA S17
NLRA S18
NLRA S19
NLRA S20
NLRA S21
NLRA S22
NLRA S23
NLRA S24
NLRA S25
NLRA S26
NLRA S27
NLRA S28
NLRA S29
NLRA S30


Newfound Lake Nearshore *E. coli* Inter-site Comparison (7/1/2008)
E. coli (CFU/100ml)
0
5
10
15
20
25
30
35
NLRA S01
NLRA S02
NLRA S03
NLRA S04
NLRA S05
NLRA S06
NLRA S07
NLRA S08
NLRA S09
NLRA S10
NLRA S11
NLRA S12
NLRA S13
NLRA S14
NLRA S15
NLRA S16
NLRA S17
NLRA S18
NLRA S19
NLRA S20
NLRA S21
NLRA S22
NLRA S23
NLRA S24
NLRA S25
NLRA S26
NLRA S27
NLRA S28
NLRA S29
NLRA S30


Newfound Lake Nearshore Total Phosphorus Inter-site Comparison (7/7/2008)
Total Phosphorus (ug/l)
0
2
4
6
8
10
12
NLRA S01
NLRA S02
NLRA S03
NLRA S04
NLRA S05
NLRA S06
NLRA S07
NLRA S08
NLRA S09
NLRA S10
NLRA S11
NLRA S12
NLRA S13
NLRA S14
NLRA S15
NLRA S16
NLRA S17
NLRA S18
NLRA S19
NLRA S20
NLRA S21
NLRA S22
NLRA S23
NLRA S24
NLRA S25
NLRA S26
NLRA S27
NLRA S28
NLRA S29
NLRA S30


Newfound Lake Nearshore E. coli Inter-site Comparison (7/7/2008)
E. coli (CFU/100ml)
0
5
10
15
20
25
30
35
NLRA S01
NLRA S02
NLRA S03
NLRA S04
NLRA S05
NLRA S06
NLRA S07
NLRA S08
NLRA S09
NLRA S10
NLRA S11
NLRA S12
NLRA S13
NLRA S14
NLRA S15
NLRA S16
NLRA S17
NLRA S18
NLRA S19
NLRA S20
NLRA S21
NLRA S22
NLRA S23
NLRA S24
NLRA S25
NLRA S26
NLRA S27
NLRA S28
NLRA S29
NLRA S30


Newfound Lake Nearshore Total Phosphorus Inter-site Comparison (9/30/2008)
Total Phosphorus (ug/l)
0
2
4
6
8
10
12
NLRA S01
NLRA S02
NLRA S03
NLRA S04
NLRA S05
NLRA S06
NLRA S07
NLRA S08
NLRA S09
NLRA S10
NLRA S11
NLRA S12
NLRA S13
NLRA S14
NLRA S15
NLRA S16
NLRA S17
NLRA S18
NLRA S19
NLRA S20
NLRA S21
NLRA S22
NLRA S23
NLRA S24
NLRA S25
NLRA S26
NLRA S27
NLRA S28
NLRA S29
NLRA S30


Newfound Lake Nearshore *E. coli* Inter-site Comparison (9/30/2008)
E. coli (CFU/100ml)
0
10
20
30
40
50
60
70
80
90
100
NLRA S01
NLRA S02
NLRA S03
NLRA S04
NLRA S05
NLRA S06
NLRA S07
NLRA S08
NLRA S09
NLRA S10
NLRA S11
NLRA S12
NLRA S13
NLRA S14
NLRA S15
NLRA S16
NLRA S17
NLRA S18
NLRA S19
NLRA S20
NLRA S21
NLRA S22
NLRA S23
NLRA S24
NLRA S25
NLRA S26
NLRA S27
NLRA S28
NLRA S29
NLRA S30

Appendix E. Alexandria 4 Climatological Sampling Station Precipitation Data (2007 and 2008)

Date	Precipitation (inches)
7/1/2007	0.00
7/2/2007	0.00
7/3/2007	0.00
7/4/2007	0.00
7/5/2007	0.42
7/6/2007	0.00
7/7/2007	0.04
7/8/2007	0.27
7/9/2007	0.24
7/10/2007	0.91
7/11/2007	0.21
7/12/2007	0.50
7/13/2007	0.00
7/14/2007	0.00
7/15/2007	0.00
7/16/2007	0.63
7/17/2007	0.00
7/18/2007	0.57
7/19/2007	0.33
7/20/2007	1.47
7/21/2007	0.00
7/22/2007	0.00
7/23/2007	0.11
7/24/2007	0.00
7/25/2007	0.00
7/26/2007	0.00
7/27/2007	0.00
7/28/2007	0.02
7/29/2007	0.07
7/30/2007	0.00
7/31/2007	0.00
8/1/2007	0.00
8/2/2007	0.00
8/3/2007	0.00
8/4/2007	0.00
8/5/2007	0.00
8/6/2007	0.00

Date	Precipitation (inches)
9/1/2007	0.00
9/2/2007	0.00
9/3/2007	0.00
9/4/2007	0.00
9/5/2007	0.00
9/6/2007	0.00
9/7/2007	0.00
9/8/2007	0.00
9/9/2007	0.07
9/10/2007	1.44
9/11/2007	0.55
9/12/2007	0.62
9/13/2007	0.00
9/14/2007	0.00
9/15/2007	0.72
9/16/2007	0.44
9/17/2007	0.00
9/18/2007	0.00
9/19/2007	0.00
9/20/2007	0.00
9/21/2007	0.00
9/22/2007	0.00
9/23/2007	0.00
9/24/2007	0.00
9/25/2007	0.00
9/26/2007	0.00
9/27/2007	0.00
9/28/2007	0.17
9/29/2007	0.06
9/30/2007	0.00
4/1/2008	0.38
4/2/2008	0.15
4/3/2008	0.00
4/4/2008	0.00
4/5/2008	0.54
4/6/2008	0.01
4/7/2008	0.00

Date	Precipitation (inches)
5/1/2008	0.00
5/2/2008	0.00
5/3/2008	0.04
5/4/2008	0.38
5/5/2008	0.06
5/6/2008	0.00
5/7/2008	0.00
5/8/2008	0.08
5/9/2008	0.00
5/10/2008	0.00
5/11/2008	0.00
5/12/2008	0.00
5/13/2008	0.00
5/14/2008	0.00
5/15/2008	0.00
5/16/2008	0.00
5/17/2008	0.02
5/18/2008	0.01
5/19/2008	0.03
5/20/2008	0.03
5/21/2008	0.00
5/22/2008	0.03
5/23/2008	0.00
5/24/2008	0.03
5/25/2008	0.00
5/26/2008	0.00
5/27/2008	0.00
5/28/2008	0.05
5/29/2008	0.00
5/30/2008	0.00
5/31/2008	0.02
6/1/2008	0.06
6/2/2008	0.00
6/3/2008	0.00
6/4/2008	0.07
6/5/2008	0.11
6/6/2008	0.44

Date	Precipitation (inches)
7/1/2008	0.00
7/2/2008	0.00
7/3/2008	0.00
7/4/2008	0.00
7/5/2008	0.00
7/6/2008	0.00
7/7/2008	0.00
7/8/2008	0.00
7/9/2008	0.00
7/10/2008	0.15
7/11/2008	0.00
7/12/2008	0.00
7/13/2008	0.00
7/14/2008	0.16
7/15/2008	0.00
7/16/2008	0.00
7/17/2008	0.00
7/18/2008	0.00
7/19/2008	0.28
7/20/2008	0.09
7/21/2008	0.54
7/22/2008	0.61
7/23/2008	0.00
7/24/2008	1.09
7/25/2008	1.00
7/26/2008	0.00
7/27/2008	0.23
7/28/2008	0.00
7/29/2008	0.00
7/30/2008	0.00
7/31/2008	0.00
8/1/2008	0.40
8/2/2008	0.09
8/3/2008	1.69
8/4/2008	0.15
8/5/2008	0.00
8/6/2008	0.07

Date	Precipitation (inches)
9/1/2008	0.00
9/2/2008	0.00
9/3/2008	0.00
9/4/2008	0.00
9/5/2008	0.00
9/6/2008	0.03
9/7/2008	3.37
9/8/2008	0.00
9/9/2008	0.00
9/10/2008	0.67
9/11/2008	0.00
9/12/2008	0.00
9/13/2008	0.17
9/14/2008	0.61
9/15/2008	0.41
9/16/2008	0.00
9/17/2008	0.00
9/18/2008	0.00
9/19/2008	0.00
9/20/2008	0.00
9/21/2008	0.00
9/22/2008	0.00
9/23/2008	0.00
9/24/2008	0.00
9/25/2008	0.00
9/26/2008	0.00
9/27/2008	1.63
9/28/2008	1.25
9/29/2008	0.11
9/30/2008	0.00
10/1/2008	0.02
10/2/2008	0.42
10/3/2008	0.07
10/4/2008	0.02
10/5/2008	0.00
10/6/2008	0.00
10/7/2008	0.00

Appendix E. Alexandria 4 Climatological Sampling Station Precipitation Data (2007 and 2008)

Date	Precipitation (inches)
8/7/2007	0.52
8/8/2007	1.21
8/9/2007	0.48
8/10/2007	0.00
8/11/2007	0.00
8/12/2007	0.00
8/13/2007	0.00
8/14/2007	0.00
8/15/2007	0.00
8/16/2007	0.01
8/17/2007	0.29
8/18/2007	0.00
8/19/2007	0.00
8/20/2007	0.00
8/21/2007	0.00
8/22/2007	0.00
8/23/2007	0.00
8/24/2007	0.05
8/25/2007	0.08
8/26/2007	0.51
8/27/2007	0.00
8/28/2007	0.00
8/29/2007	0.00
8/30/2007	0.00
8/31/2007	0.54

Date	Precipitation (inches)
4/8/2008	0.00
4/9/2008	0.00
4/10/2008	0.00
4/11/2008	0.00
4/12/2008	0.59
4/13/2008	0.00
4/14/2008	0.00
4/15/2008	0.00
4/16/2008	0.00
4/17/2008	0.00
4/18/2008	0.00
4/19/2008	0.00
4/20/2008	0.00
4/21/2008	0.00
4/22/2008	0.00
4/23/2008	0.00
4/24/2008	0.05
4/25/2008	0.00
4/26/2008	0.00
4/27/2008	0.01
4/28/2008	0.19
4/29/2008	2.42
4/30/2008	0.83

Date	Precipitation (inches)
6/7/2008	0.57
6/8/2008	0.00
6/9/2008	0.09
6/10/2008	0.00
6/11/2008	0.53
6/12/2008	0.00
6/13/2008	0.00
6/14/2008	0.00
6/15/2008	0.56
6/16/2008	0.06
6/17/2008	0.03
6/18/2008	0.13
6/19/2008	0.00
6/20/2008	0.00
6/21/2008	0.00
6/22/2008	0.00
6/23/2008	2.38
6/24/2008	0.63
6/25/2008	0.05
6/26/2008	0.00
6/27/2008	0.06
6/28/2008	0.18
6/29/2008	1.32
6/30/2008	0.11

Date	Precipitation (inches)
8/7/2008	1.83
8/8/2008	0.18
8/9/2008	0.39
8/10/2008	0.00
8/11/2008	0.52
8/12/2008	1.48
8/13/2008	0.07
8/14/2008	0.00
8/15/2008	0.00
8/16/2008	0.00
8/17/2008	0.38
8/18/2008	0.00
8/19/2008	0.43
8/20/2008	0.00
8/21/2008	0.00
8/22/2008	0.00
8/23/2008	0.00
8/24/2008	0.00
8/25/2008	0.00
8/26/2008	0.00
8/27/2008	0.00
8/28/2008	0.00
8/29/2008	0.00
8/30/2008	0.00
8/31/2008	0.03

Date	Precipitation (inches)
10/8/2008	0.00
10/9/2008	0.16
10/10/2008	0.00
10/11/2008	0.00
10/12/2008	0.00
10/13/2008	0.00
10/14/2008	0.00
10/15/2008	0.00
10/16/2008	0.02
10/17/2008	0.37
10/18/2008	0.00
10/19/2008	0.00
10/20/2008	0.00
10/21/2008	0.00
10/22/2008	0.93
10/23/2008	0.05
10/24/2008	0.00
10/25/2008	0.00
10/26/2008	1.88
10/27/2008	0.00
10/28/2008	0.00
10/29/2008	0.53
10/30/2008	0.00
10/31/2008	0.00

APPENDIX F. Periphyton Substrate Sampler Growth

Figure: P-3 Beachwood July 22, 2008

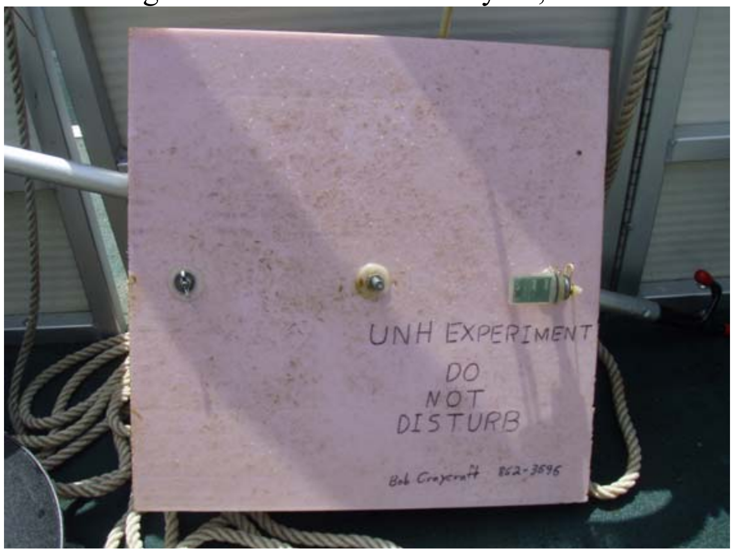


Figure: P-4 Fower July 22, 2008

Figure: P-5 Hemlock July 22, 2008

Figure: P-7 Hebron July 22, 2008

APPENDIX F. Periphyton Substrate Sampler Growth

Figure: P-3 Beachwood August 14, 2008

Missing Data: Periphyton sampler damaged during July 22 retrieval and had to re-establish biofilm before reinstituting sampling.

Figure: P-4 Fower August 14, 2008

Figure: P-5 Hemlock August 14, 2008

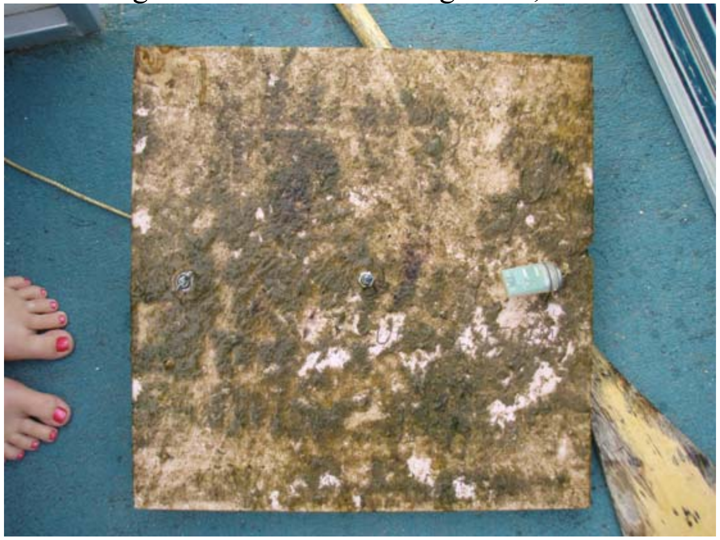
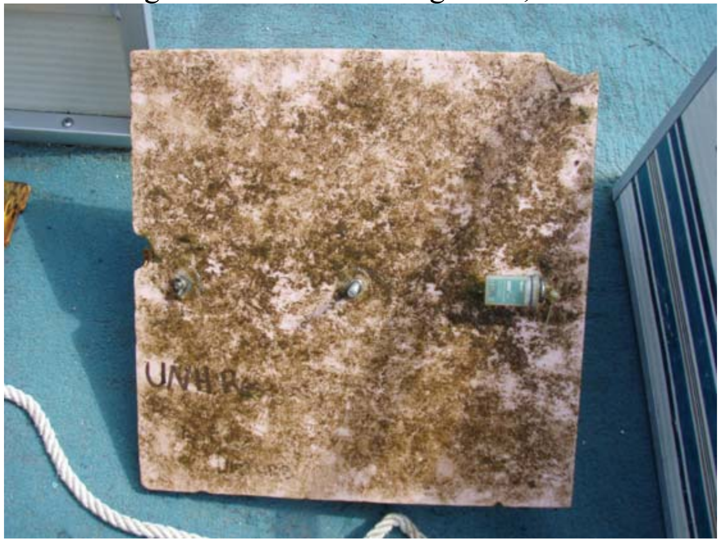


Figure: P-7 Hebron August 14, 2008



APPENDIX F. Periphyton Substrate Sampler Growth

Figure: P-3 Beachwood August 26, 2008

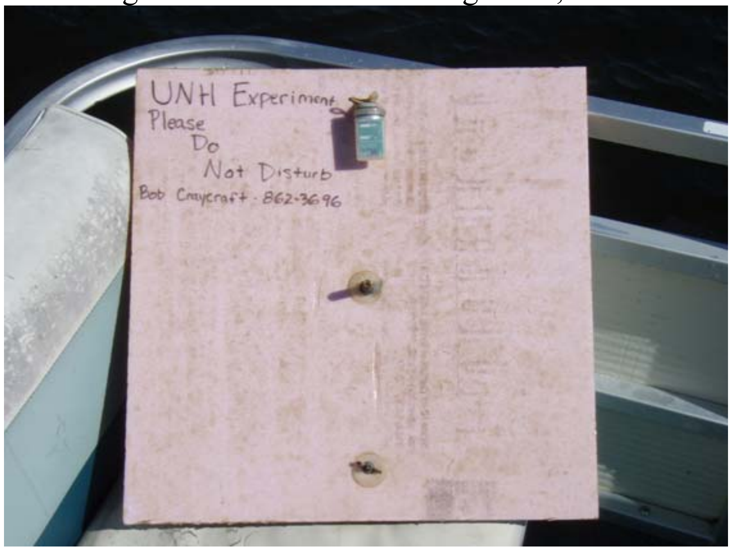


Figure: P-4 Fower August 26, 2008

Figure: P-5 Hemlock August 26, 2008

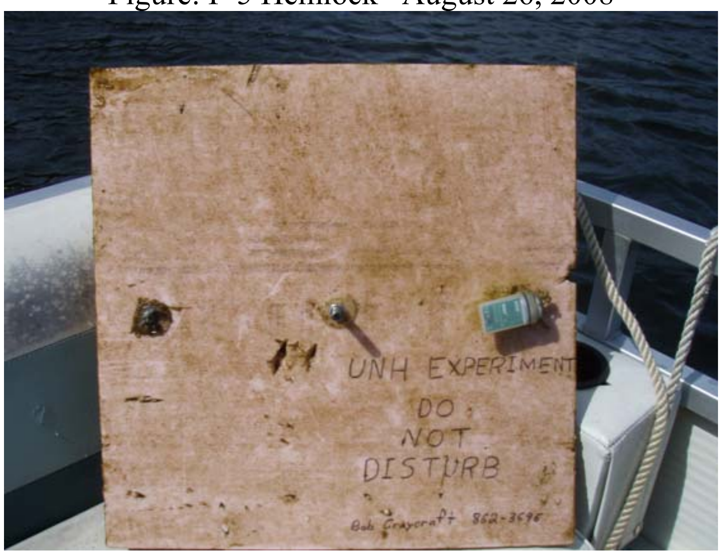


Figure: P-7 Hebron August 26, 2008

APPENDIX F. Periphyton Substrate Sampler Growth

Figure: P-3 Beachwood   September 24, 2008

Figure: P-4 Fower   September 24, 2008

Figure: P-5 Hemlock   September 24, 2008

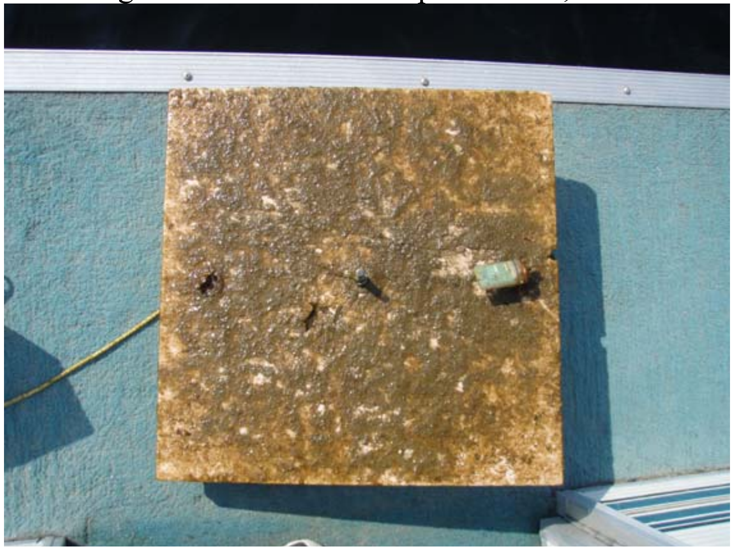
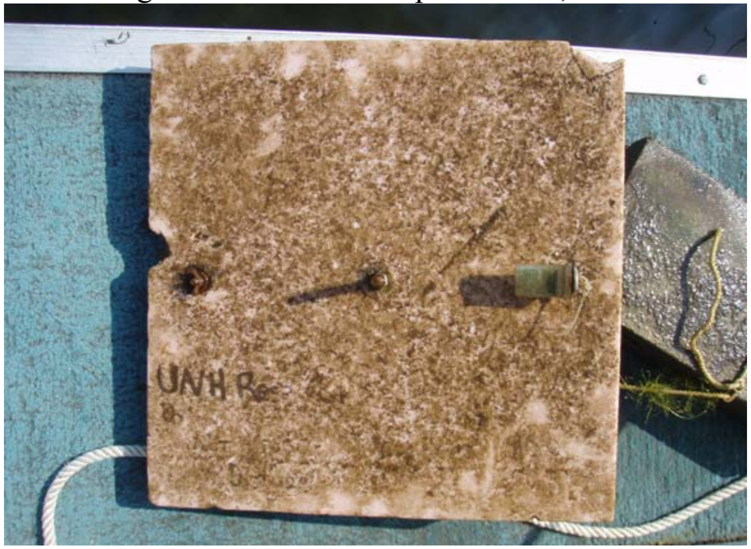


Figure: P-7 Hebron   September 24, 2008



Newfound Lake Artificial Substrate (periphyton) Sampler Components

(see photos on the subsequent pages for completed product)

Hardware/Components

- ½" x 3" wood cut to 18" length
- 1" thick (4 x 8 foot) pink Corning insulation cut to 18" x 18" squares
- 3" long ¼" diameter hex head bolts
- ¼" wing nuts
- 5" long x ¼" diameter stainless steel eye bolts (to affix the Hobo Onset light/temperature meters)
- 6" long x 3/8" diameter stainless steel eye bolts (to attach the anchor line to the buoyant samplers)
- nylon washers
- ¼" stainless steel washers
- 8" x 8" x 16" three hole cinder blocks (used as anchor weights)
- 10" x 10" x 10" one hole cinder blocks (used as anchor weights)
- nylon line rated for a 90 pound weight capacity (used as anchor line between the cinder block and the eye bolt)
- 4" zip ties to affix the Hobo Onset meters to the 4" eye bolts and to ensure the meters are positioned in the appropriate orientation (facing up to measure sunlight)
- thin nylon line to tether the Hobo Onset meters to the 4" eye bolts (to ensure that the samplers to not float away should the zip ties break)

General Notes (see photos on the following pages):

- The Corning insulation was attached to the wood frame using thee bolts (the 5" x 1/4" eye bolt, the 6" x 3/8" eye bolt and the 3" x ¼" hex bolt). The 3/8" eye bolt was positioned in the center of the sampler while the two remaining bolts were positioned 2" from the two edges of the sampler (one at each edge).
- A hex nut was recessed into the upper wood cross beam and a nylon washer was positioned between the upper and lower cross beams to avoid stressing the corning insulation when raising the samplers out of the water (the weight of the cinder block anchor is primarily born by the lower wood cross beam.
- The periphyton samplers were highly buoyant and while the three hole cinder blocks would "sink" the samplers, a second weight (cinder block) was generally attached to ensure that the samplers did not "walk" across the lake, due to wave action and turbulence, and end up submersed into deeper waters.
- In-lake periphyton samplers were submersed to depths of 1 to 1.5 meters. Natural lake level fluctuations had an influence on the daily sampler depth and it was important to consider submersing the samples to a sufficient depth that would avoid interference with boat props that may drive over the periphyton samplers.

- Periphyton samplers are retrieved using a standard boat hook that "catches" the anchor line while the wood cross beam frame protects the Corning insulation (growth substrate surface) from damage during sampler retrieval. The buoyancy of the periphyton sampler makes the rising of the sampler to the water surface but care must be taken once the sampler is raised out of the water. It was most effective to place one's hand under the lower wood beam, by the 3/8" eye bolt, and lift the sampler out of the water and place the sampler on the boat deck. All sampling was undertaken via a pontoon boat that provided a working platform and provided ample maneuvering space.

Figure 1. Front of Sampler with three bolts visible

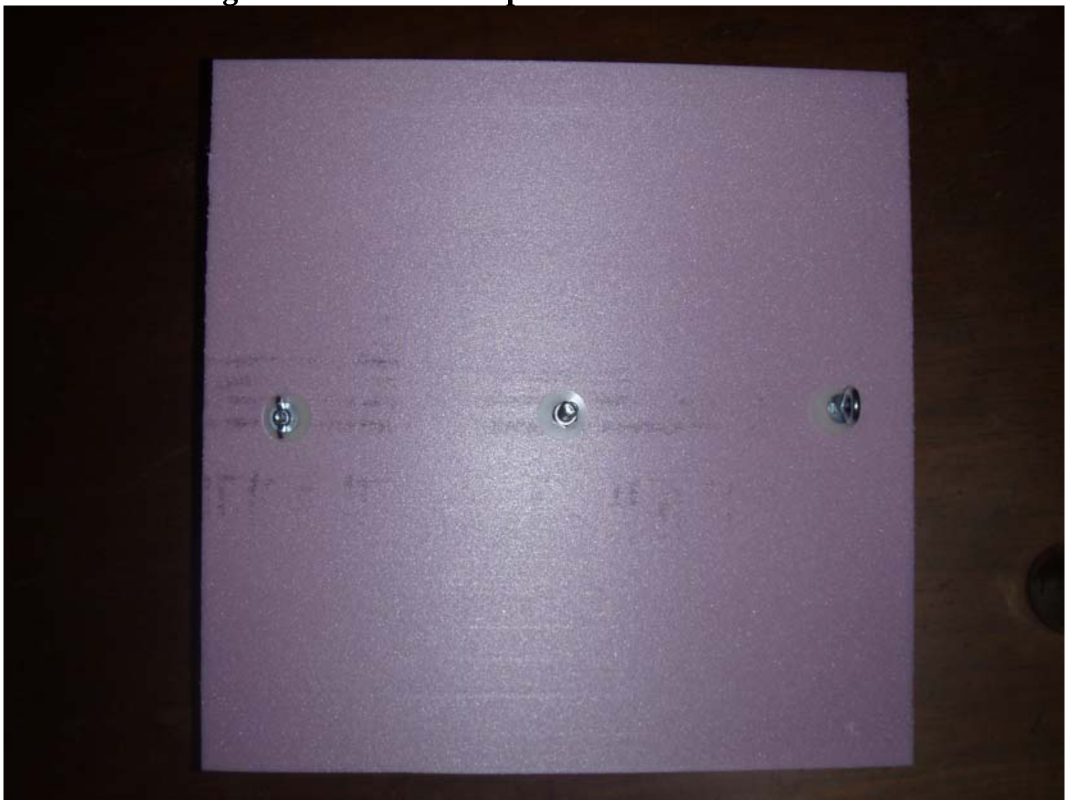


Figure 2. Underside of Sampler with Cross beams visible, eye bolt anchor hole visible and accessory bolts visible.

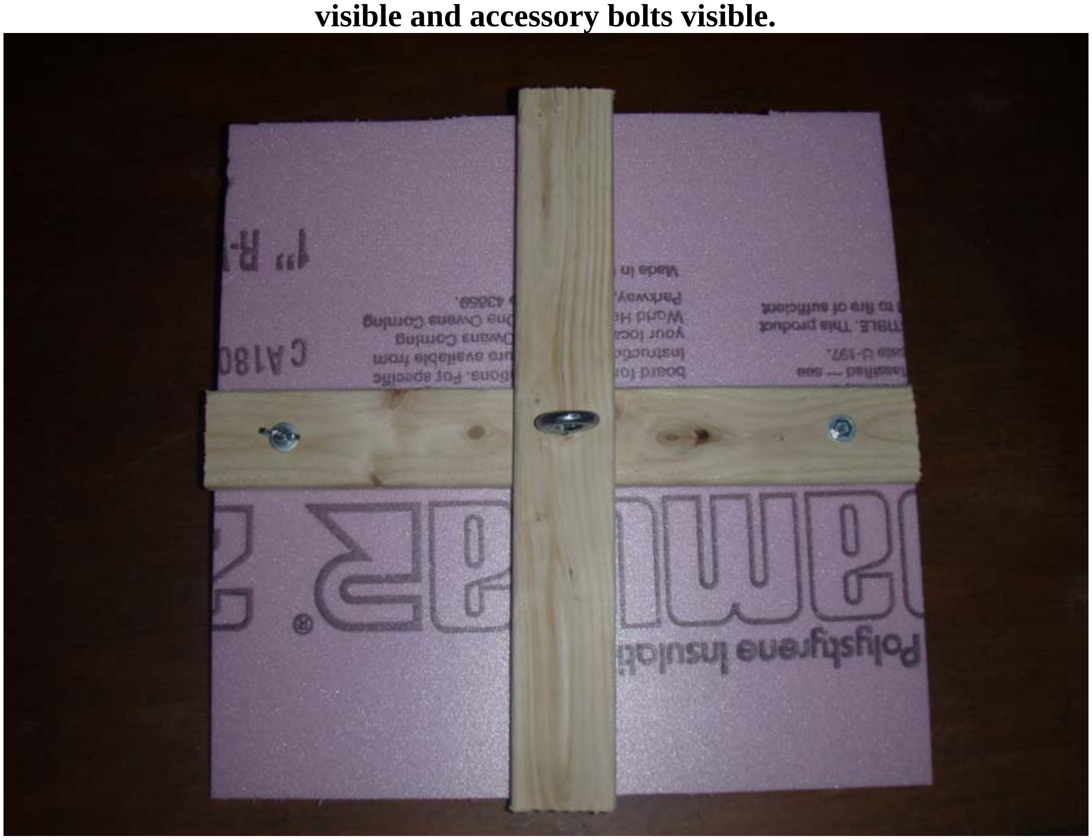
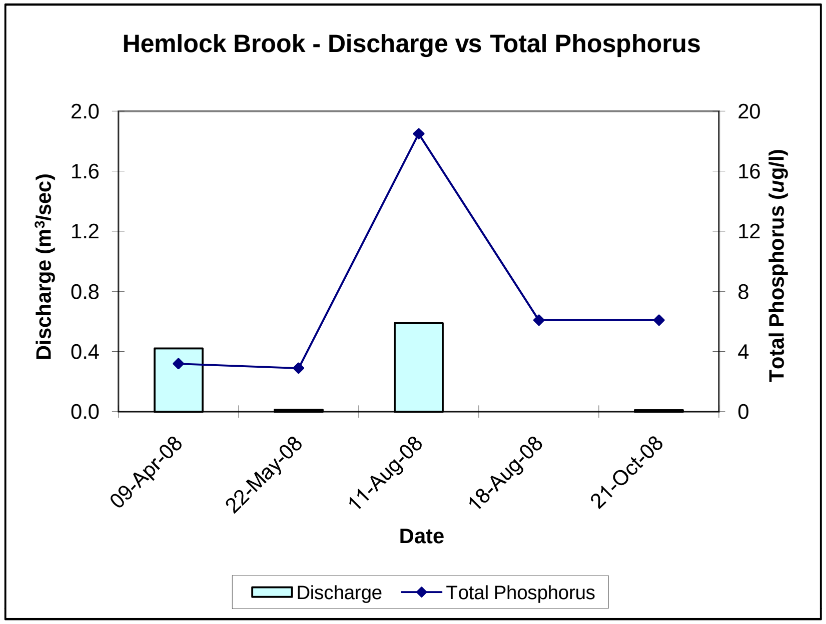
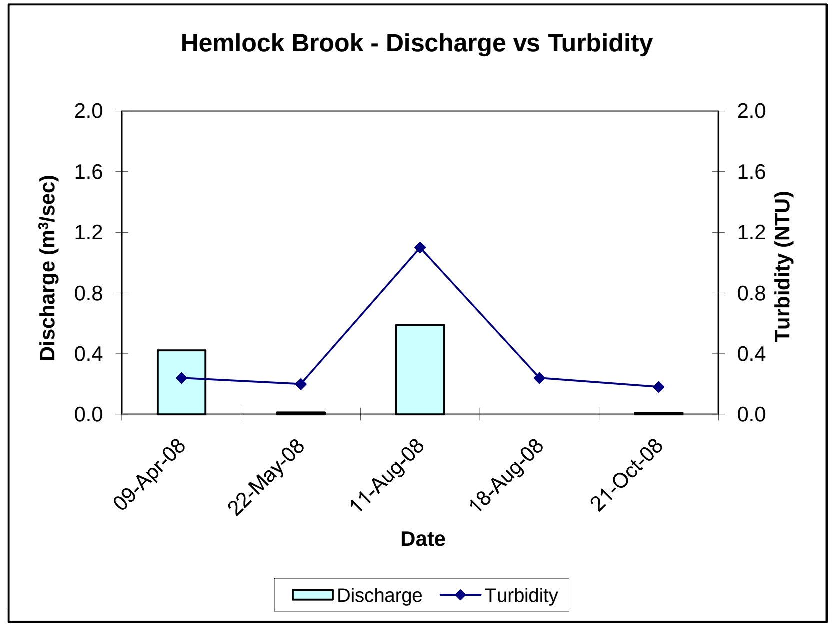
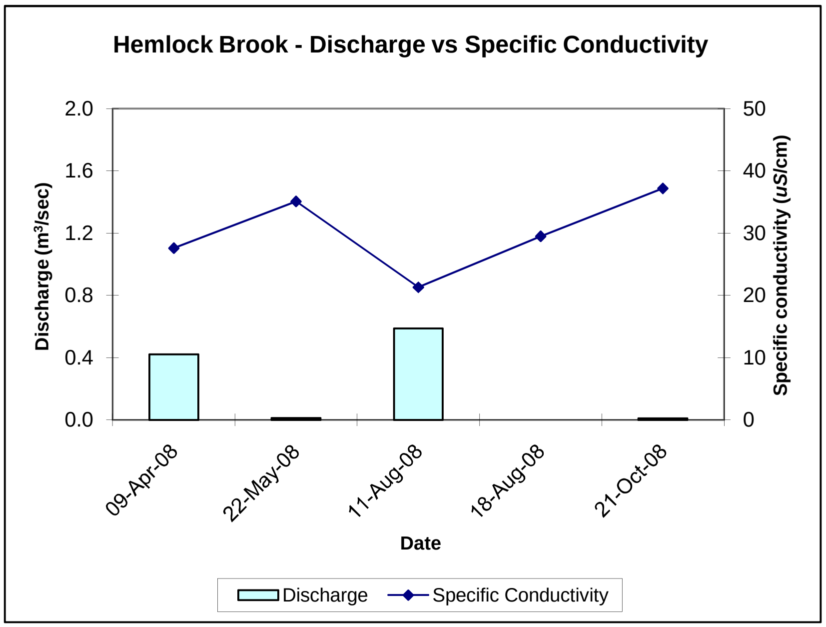


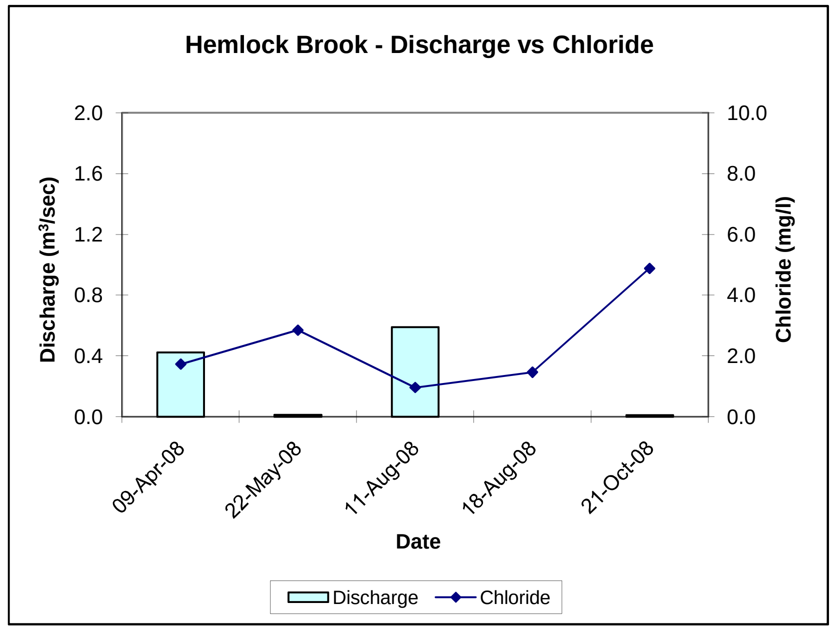
Figure 3. Artificial Substrate sampler being prepared for deployment. Note: the anchor line and cinder block is being attached and the Hobo Onset Temperature/Light meter is affixed to the 5” eye bolt on the right hand side of the sampler.

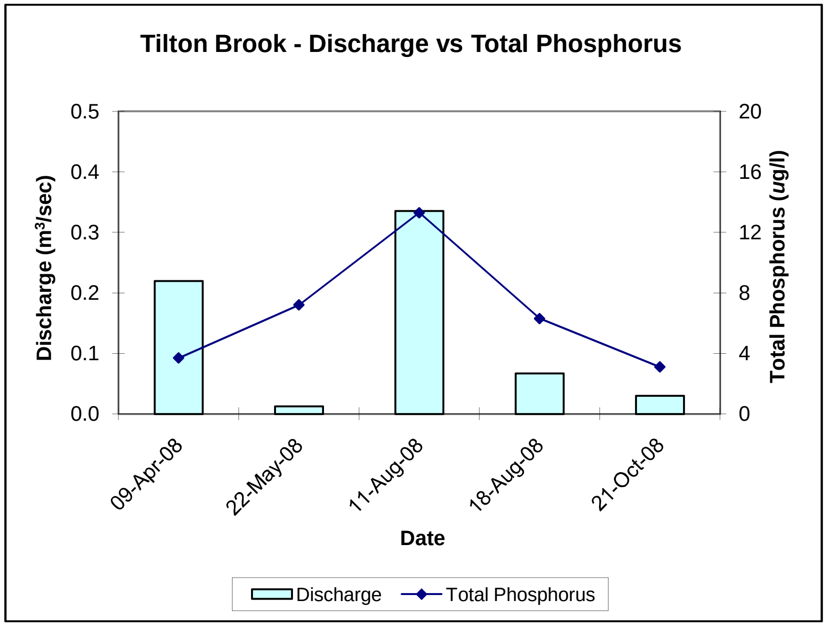
Figure 4. Periphyton Samplers awaiting deployment with Hobo Onset sensors attached.

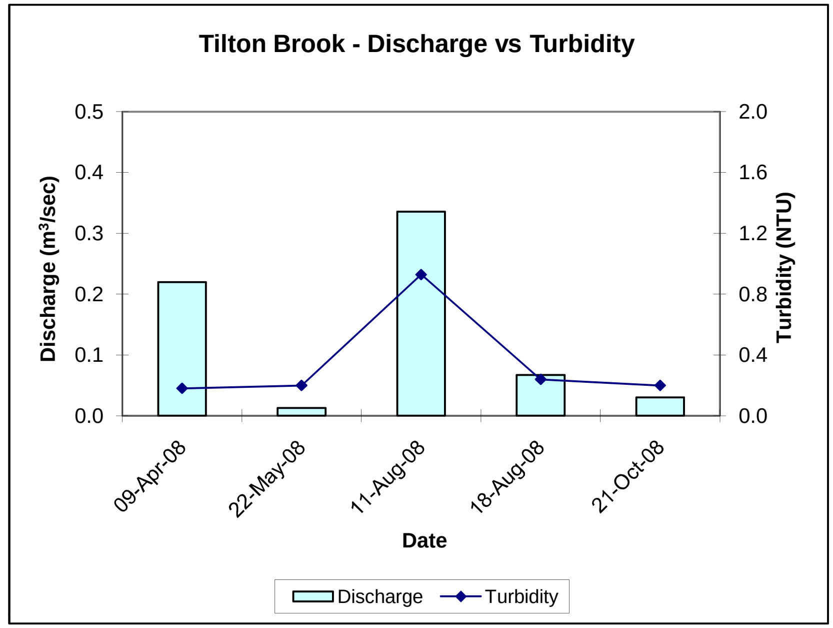

Hemlock Brook - Discharge vs Total Phosphorus
Discharge (m³/sec)
Total Phosphorus (ug/l)
2.0
1.6
1.2
0.8
0.4
0.0
20
16
12
8
4
0
09-Apr-08
22-May-08
11-Aug-08
18-Aug-08
21-Oct-08
Date
Discharge
Total Phosphorus

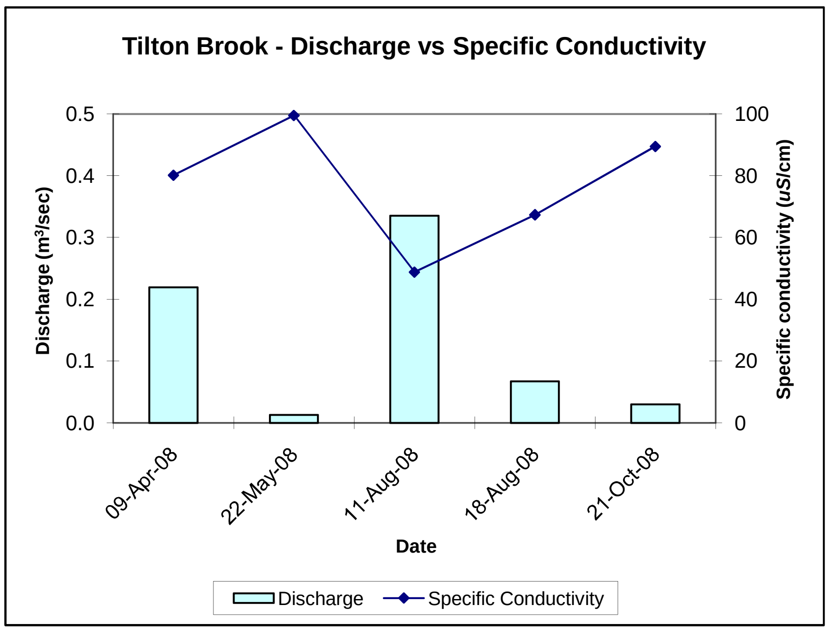

Hemlock Brook - Discharge vs Turbidity
Discharge (m³/sec)
Turbidity (NTU)
2.0
1.6
1.2
0.8
0.4
0.0
09-Apr-08
22-May-08
11-Aug-08
18-Aug-08
21-Oct-08
Date
Discharge
Turbidity

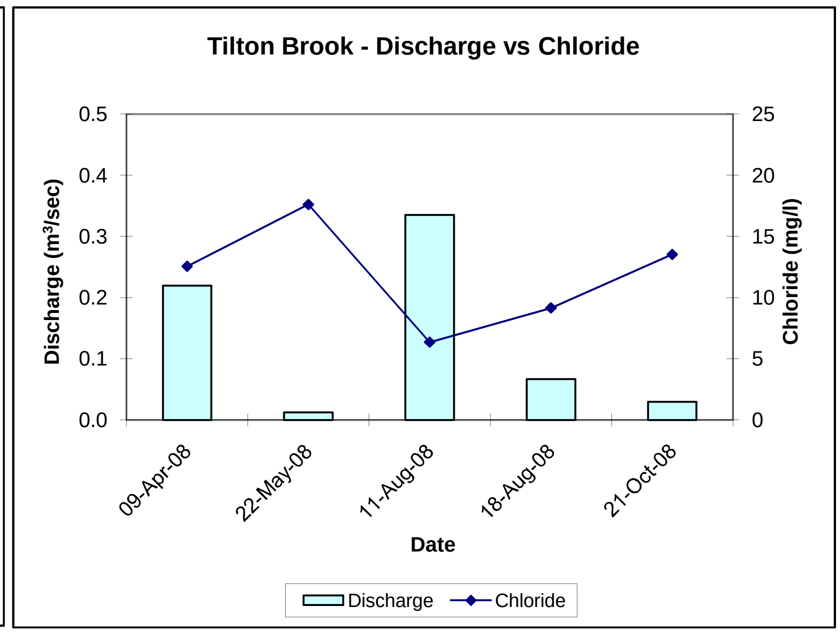

Hemlock Brook - Discharge vs Specific Conductivity
Discharge (m³/sec)
Specific conductivity (uS/cm)
2.0
1.6
1.2
0.8
0.4
0.0
50
40
30
20
10
0
09-Apr-08
22-May-08
11-Aug-08
18-Aug-08
21-Oct-08
Date
Discharge
Specific Conductivity

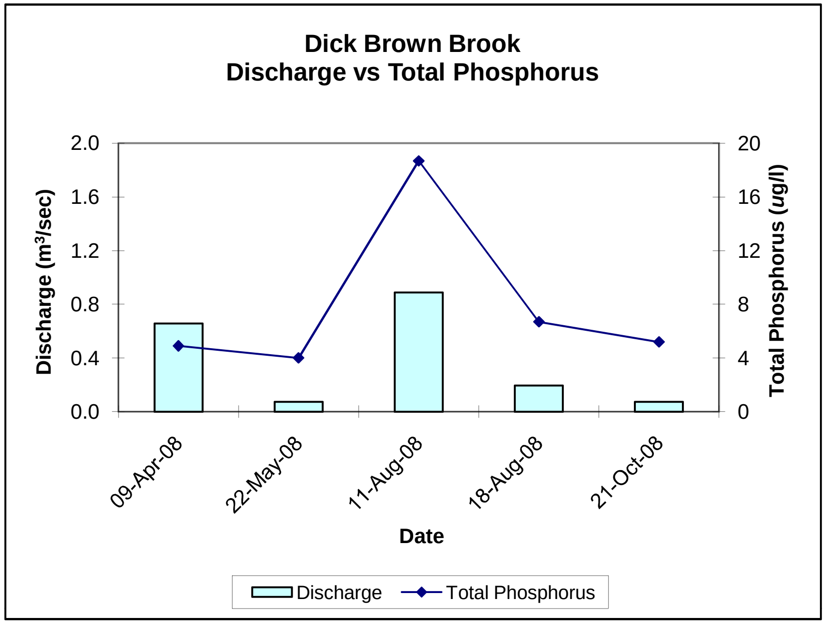

Hemlock Brook - Discharge vs Chloride
Discharge (m³/sec)
Chloride (mg/l)
2.0
1.6
1.2
0.8
0.4
0.0
10.0
8.0
6.0
4.0
2.0
0.0
09-Apr-08
22-May-08
11-Aug-08
18-Aug-08
21-Oct-08
Date
Discharge
Chloride

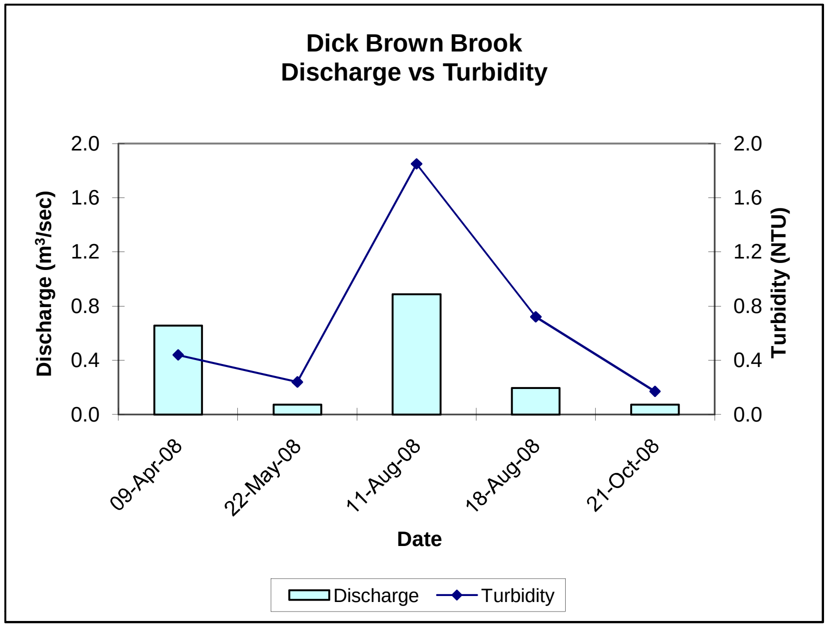

Tilton Brook - Discharge vs Total Phosphorus
Discharge (m³/sec)
Total Phosphorus (ug/l)
0.5
0.4
0.3
0.2
0.1
0.0
20
16
12
8
4
0
09-Apr-08
22-May-08
11-Aug-08
18-Aug-08
21-Oct-08
Date
Discharge
Total Phosphorus

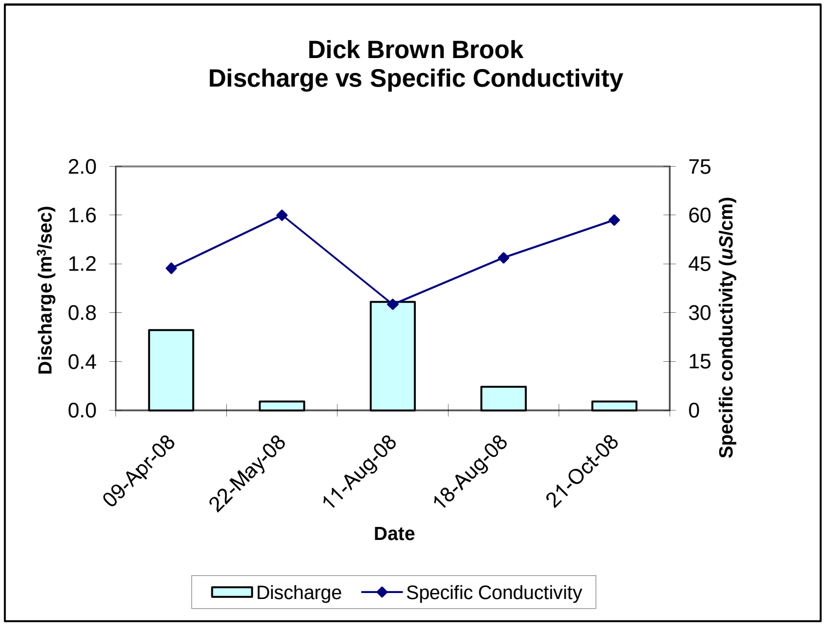

Tilton Brook - Discharge vs Turbidity
Discharge (m³/sec)
Turbidity (NTU)
0.5
0.4
0.3
0.2
0.1
0.0
2.0
1.6
1.2
0.8
0.4
0.0
09-Apr-08
22-May-08
11-Aug-08
18-Aug-08
21-Oct-08
Date
Discharge
Turbidity

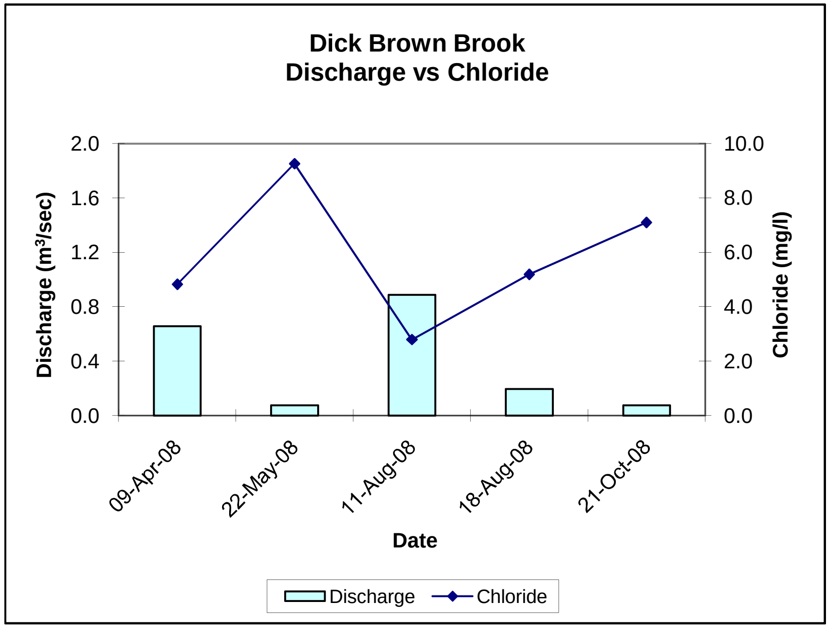

Tilton Brook - Discharge vs Specific Conductivity
Discharge (m³/sec)
Specific conductivity (uS/cm)
0.5
0.4
0.3
0.2
0.1
0.0
100
80
60
40
20
0
09-Apr-08
22-May-08
11-Aug-08
18-Aug-08
21-Oct-08
Date
Discharge
Specific Conductivity

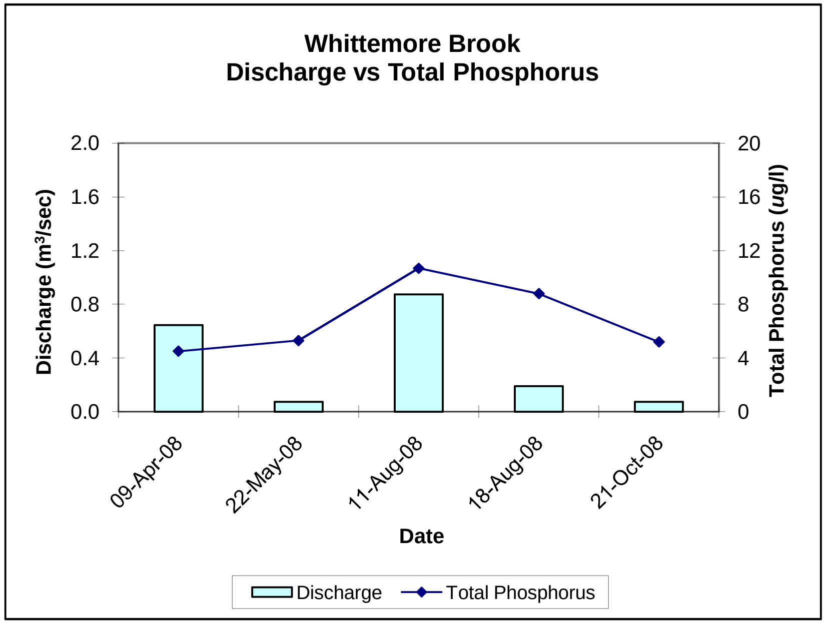

Tilton Brook - Discharge vs Chloride
Discharge (m³/sec)
Chloride (mg/l)
0.5
0.4
0.3
0.2
0.1
0.0
25
20
15
10
5
0
09-Apr-08
22-May-08
11-Aug-08
18-Aug-08
21-Oct-08
Date
Discharge
Chloride

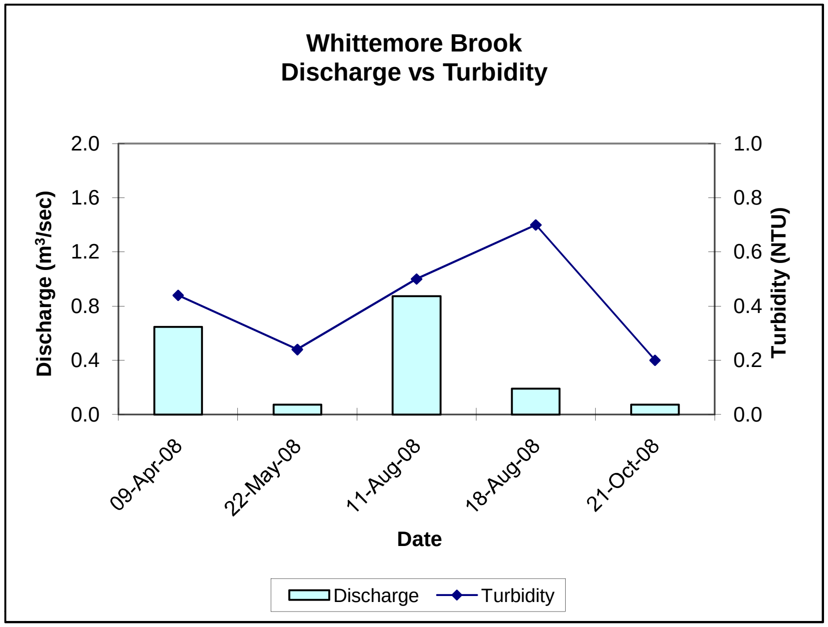

Dick Brown Brook
Discharge vs Total Phosphorus
Discharge (m³/sec)
Total Phosphorus (ug/l)
2.0
1.6
1.2
0.8
0.4
0.0
20
16
12
8
4
0
09-Apr-08
22-May-08
11-Aug-08
18-Aug-08
21-Oct-08
Date
Discharge
Total Phosphorus

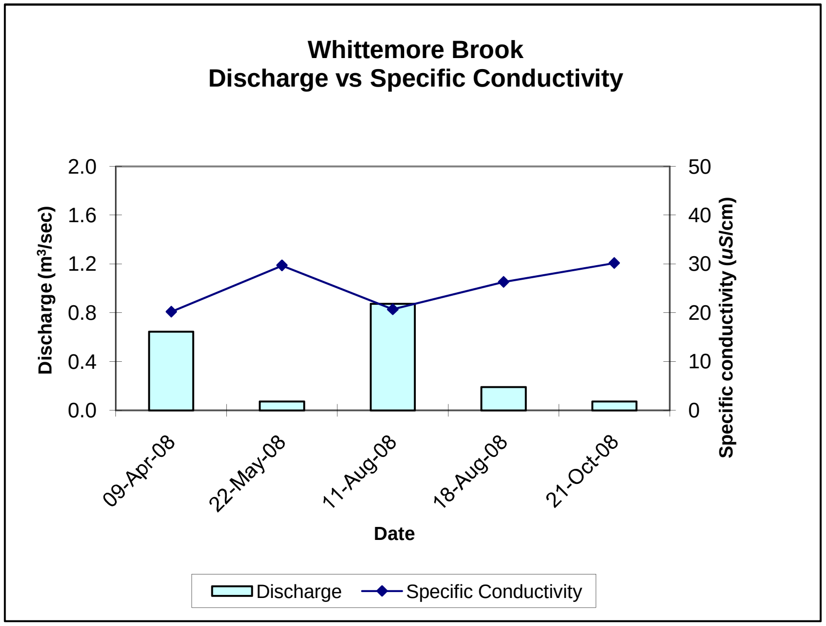

Dick Brown Brook
Discharge vs Turbidity
Discharge (m³/sec)
Turbidity (NTU)
2.0
1.6
1.2
0.8
0.4
0.0
09-Apr-08
22-May-08
11-Aug-08
18-Aug-08
21-Oct-08
Date
Discharge
Turbidity

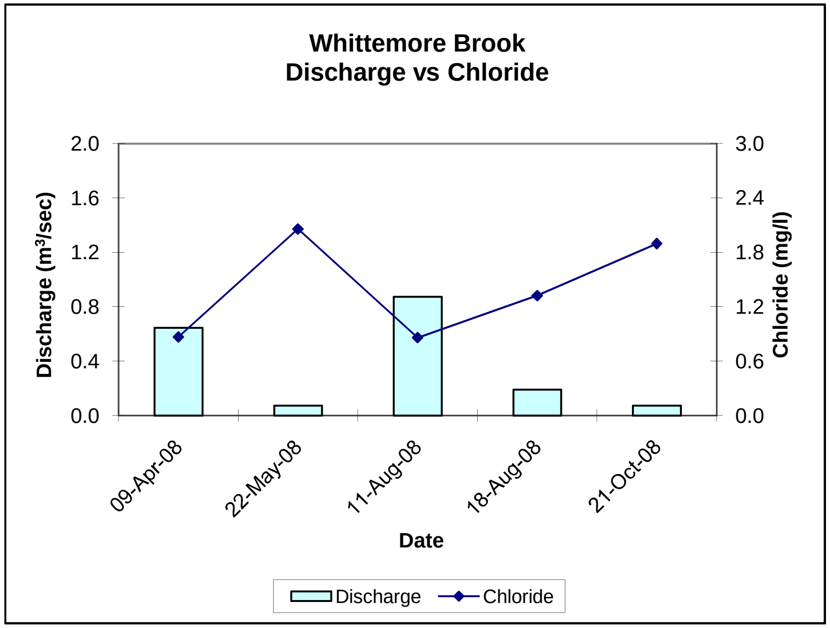

Dick Brown Brook
Discharge vs Specific Conductivity
Discharge (m³/sec)
Specific conductivity (uS/cm)
2.0
1.6
1.2
0.8
0.4
0.0
75
60
45
30
15
0
09-Apr-08
22-May-08
11-Aug-08
18-Aug-08
21-Oct-08
Date
Discharge
Specific Conductivity

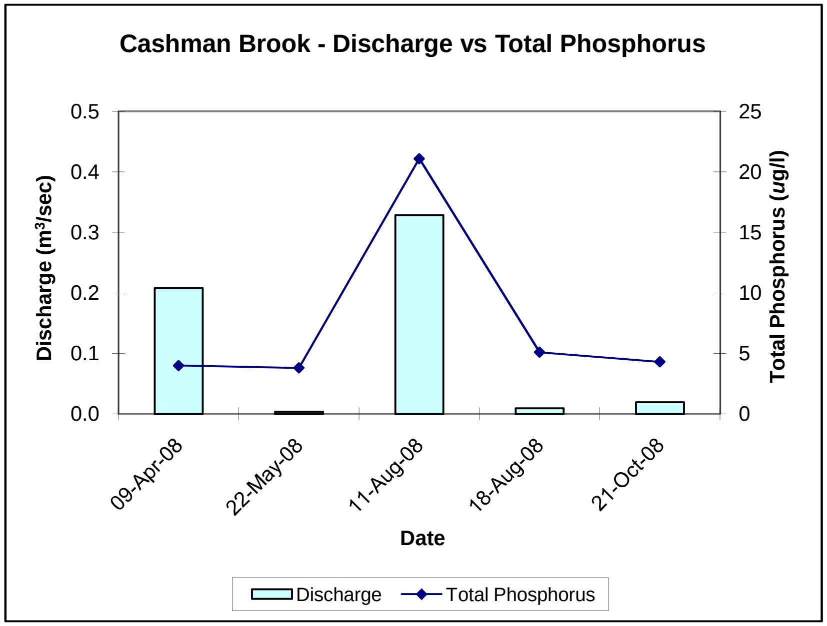

Dick Brown Brook
Discharge vs Chloride
Discharge (m³/sec)
Chloride (mg/l)
2.0
1.6
1.2
0.8
0.4
0.0
10.0
8.0
6.0
4.0
2.0
0.0
09-Apr-08
22-May-08
11-Aug-08
18-Aug-08
21-Oct-08
Date
Discharge
Chloride

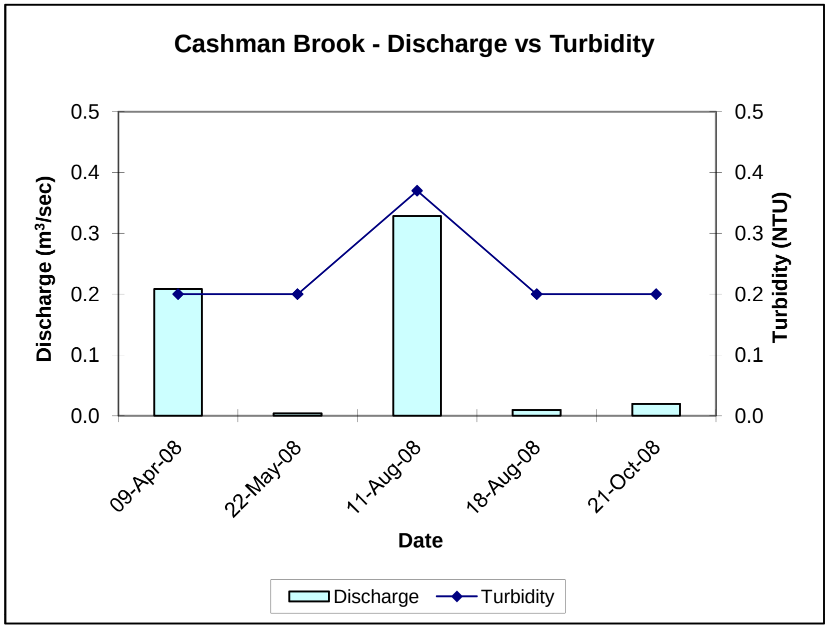

Whittemore Brook
Discharge vs Total Phosphorus
Discharge (m³/sec)
Total Phosphorus (ug/l)
2.0
1.6
1.2
0.8
0.4
0.0
20
16
12
8
4
0
09-Apr-08
22-May-08
11-Aug-08
18-Aug-08
21-Oct-08
Date
Discharge
Total Phosphorus

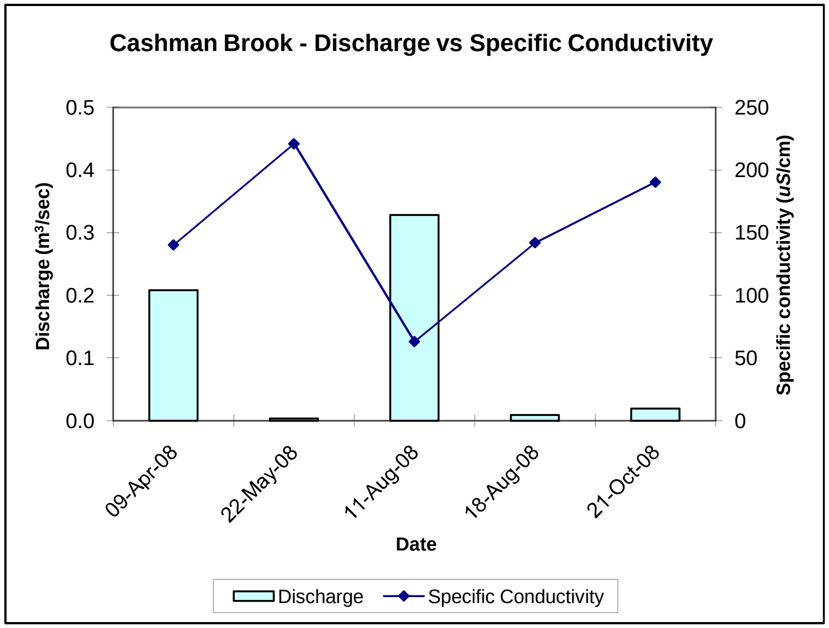

Whittemore Brook
Discharge vs Turbidity
Discharge (m³/sec)
Turbidity (NTU)
2.0
1.6
1.2
0.8
0.4
0.0
1.0
0.8
0.6
0.4
0.2
0.0
09-Apr-08
22-May-08
11-Aug-08
18-Aug-08
21-Oct-08
Date
Discharge
Turbidity

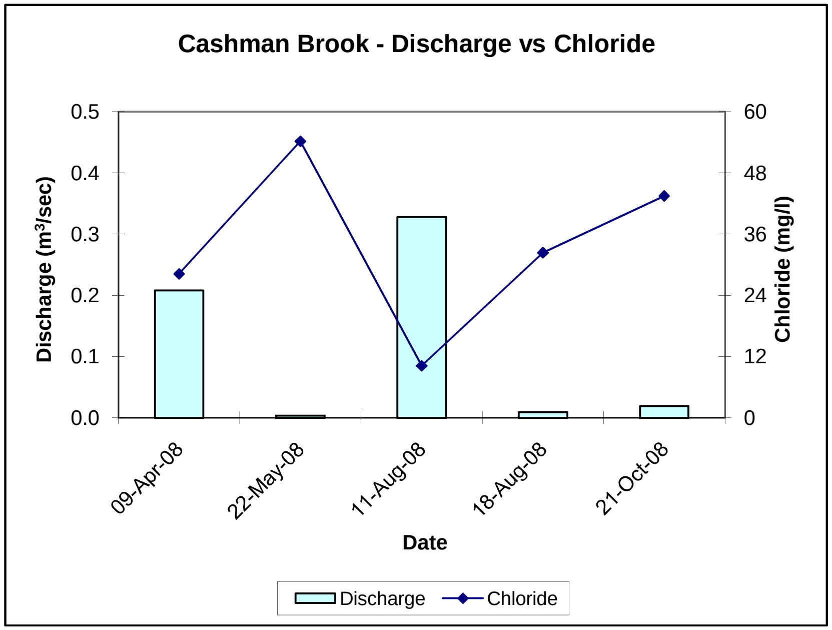

Whittemore Brook
Discharge vs Specific Conductivity
Discharge (m³/sec)
Specific conductivity (uS/cm)
2.0
1.6
1.2
0.8
0.4
0.0
50
40
30
20
10
0
09-Apr-08
22-May-08
11-Aug-08
18-Aug-08
21-Oct-08
Date
Discharge
Specific Conductivity

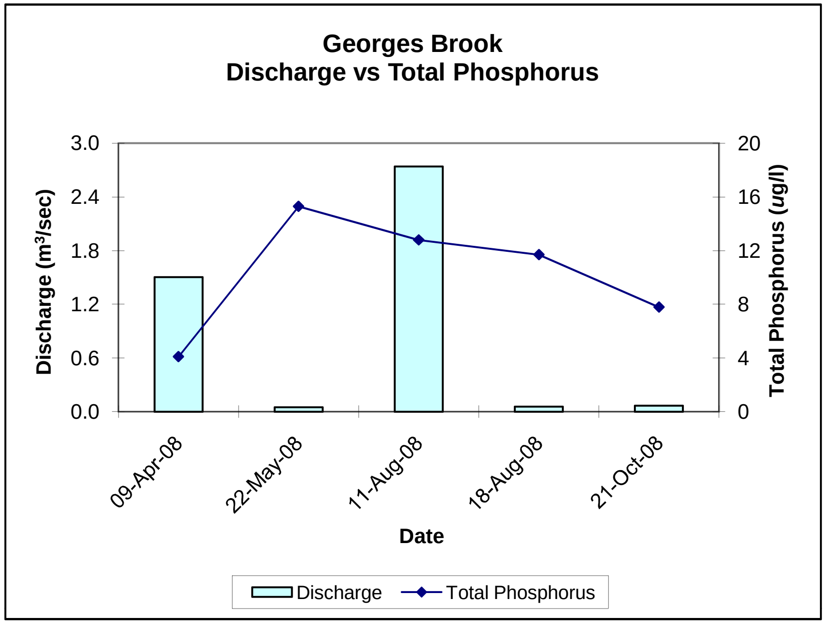

Whittemore Brook
Discharge vs Chloride
Discharge (m³/sec)
Chloride (mg/l)
2.0
1.6
1.2
0.8
0.4
0.0
3.0
2.4
1.8
1.2
0.6
0.0
09-Apr-08
22-May-08
11-Aug-08
18-Aug-08
21-Oct-08
Date
Discharge
Chloride

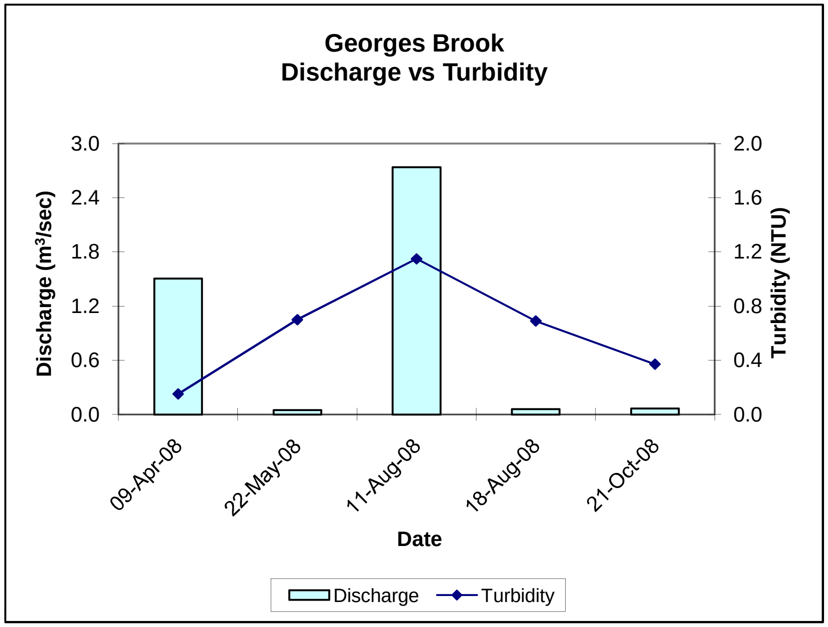

Cashman Brook - Discharge vs Total Phosphorus
Discharge (m³/sec)
Total Phosphorus (ug/l)
0.0
0.1
0.2
0.3
0.4
0.5
0
5
10
15
20
25
09-Apr-08
22-May-08
11-Aug-08
18-Aug-08
21-Oct-08
Date
Discharge
Total Phosphorus

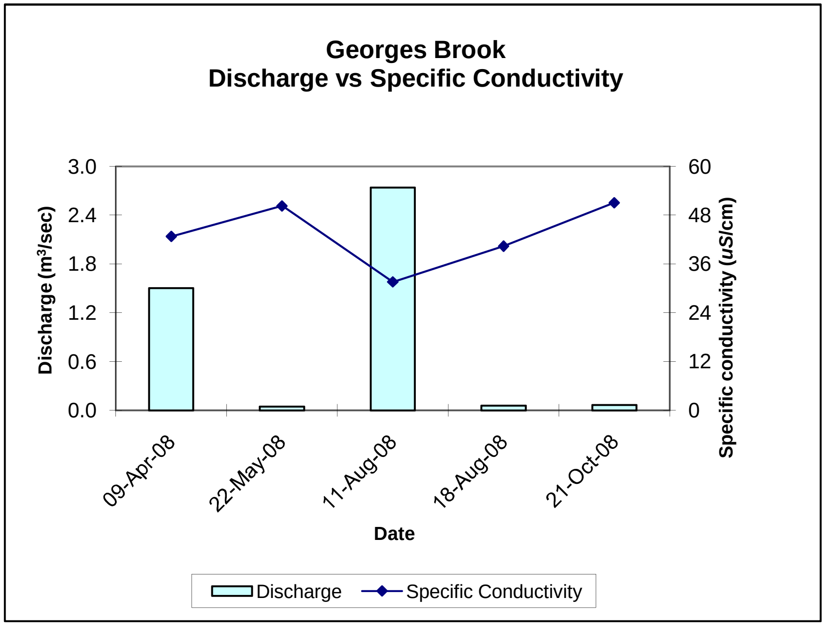

Cashman Brook - Discharge vs Turbidity
Discharge (m³/sec)
Turbidity (NTU)
0.0
0.1
0.2
0.3
0.4
0.5
09-Apr-08
22-May-08
11-Aug-08
18-Aug-08
21-Oct-08
Date
Discharge
Turbidity

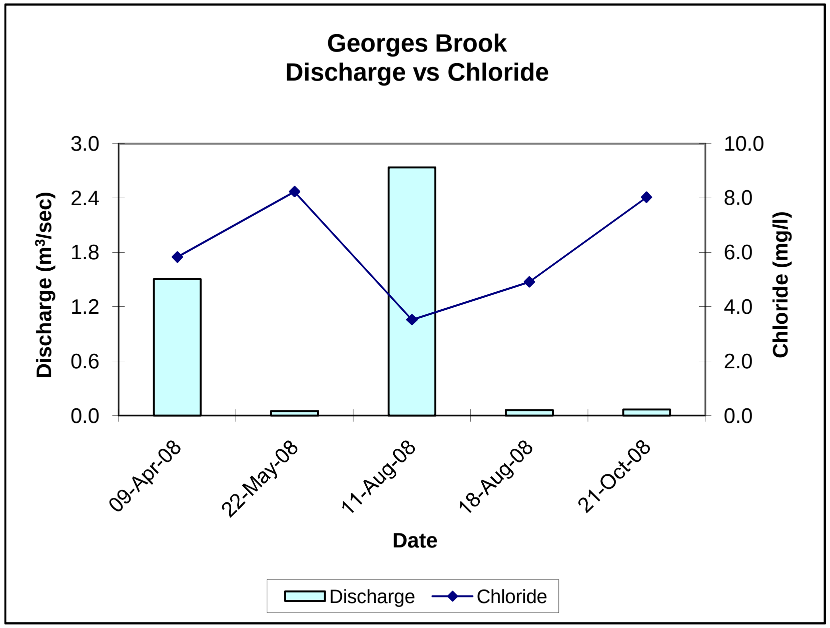

Cashman Brook - Discharge vs Specific Conductivity
Discharge (m³/sec)
Specific conductivity (uS/cm)
0.0
0.1
0.2
0.3
0.4
0.5
0
50
100
150
200
250
09-Apr-08
22-May-08
11-Aug-08
18-Aug-08
21-Oct-08
Date
Discharge
Specific Conductivity

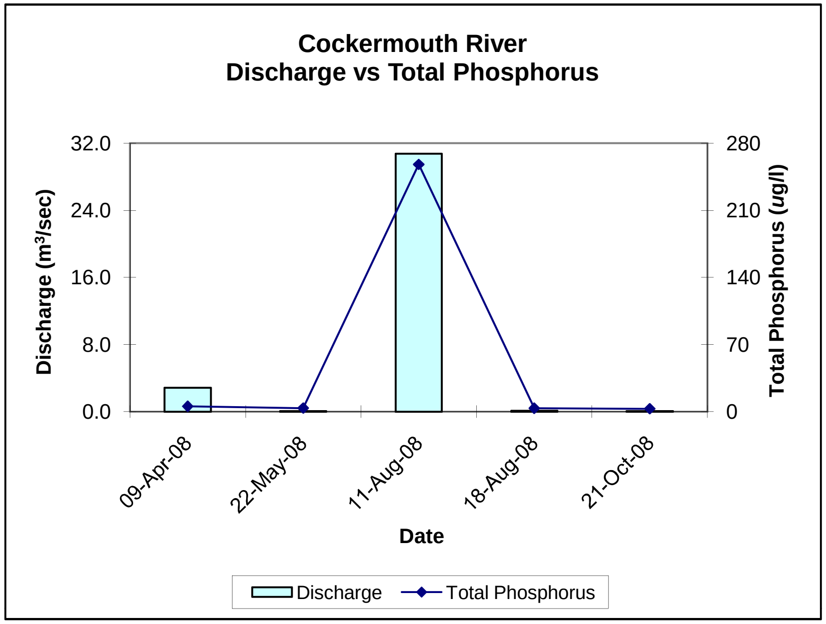

Cashman Brook - Discharge vs Chloride
Discharge (m³/sec)
Chloride (mg/l)
0.0
0.1
0.2
0.3
0.4
0.5
0
12
24
36
48
60
09-Apr-08
22-May-08
11-Aug-08
18-Aug-08
21-Oct-08
Date
Discharge
Chloride

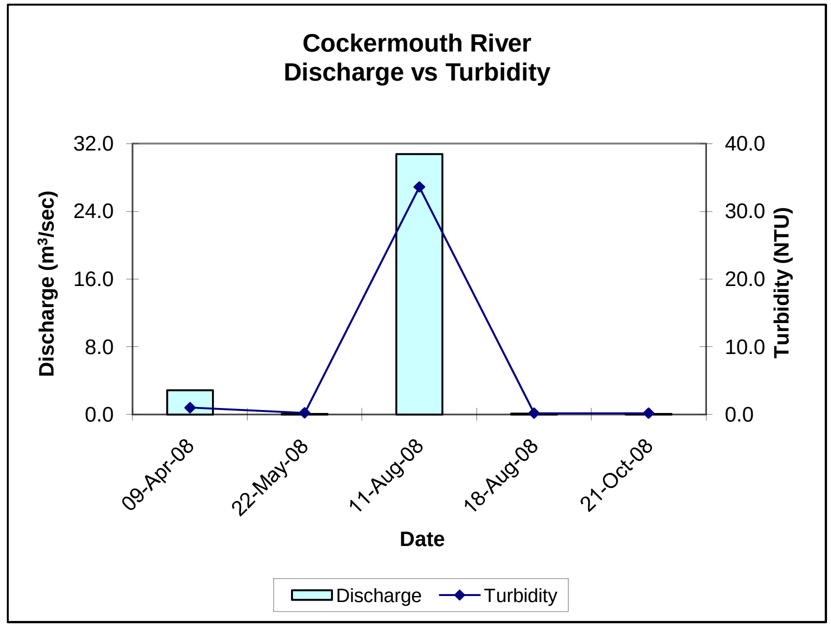

Georges Brook
Discharge vs Total Phosphorus
Discharge (m³/sec)
Total Phosphorus (ug/l)
3.0
2.4
1.8
1.2
0.6
0.0
20
16
12
8
4
0
09-Apr-08
22-May-08
11-Aug-08
18-Aug-08
21-Oct-08
Date
Discharge
Total Phosphorus

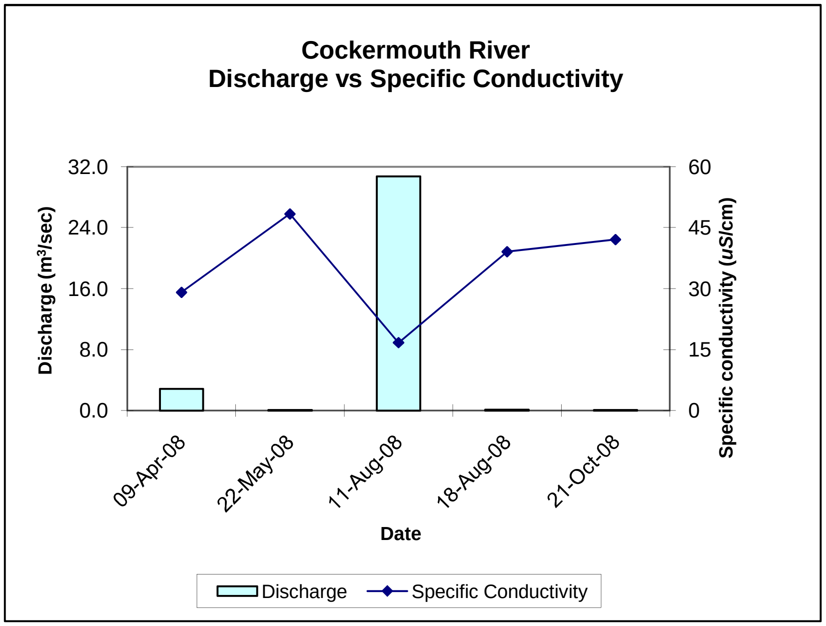

Georges Brook
Discharge vs Turbidity
Discharge (m³/sec)
Turbidity (NTU)
3.0
2.4
1.8
1.2
0.6
0.0
2.0
1.6
1.2
0.8
0.4
0.0
09-Apr-08
22-May-08
11-Aug-08
18-Aug-08
21-Oct-08
Date
Discharge
Turbidity

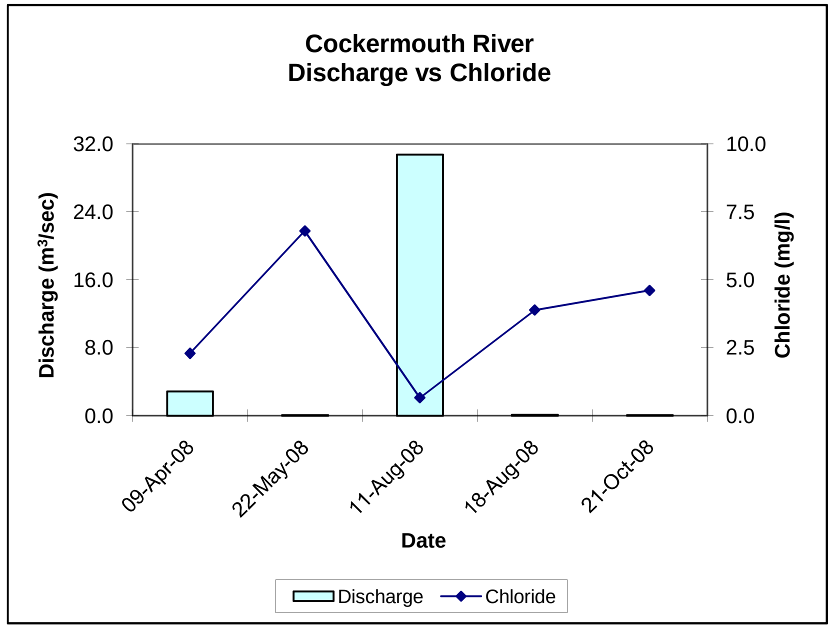

Georges Brook
Discharge vs Specific Conductivity
Discharge (m³/sec)
Specific conductivity (uS/cm)
3.0
2.4
1.8
1.2
0.6
0.0
60
48
36
24
12
0
09-Apr-08
22-May-08
11-Aug-08
18-Aug-08
21-Oct-08
Date
Discharge
Specific Conductivity

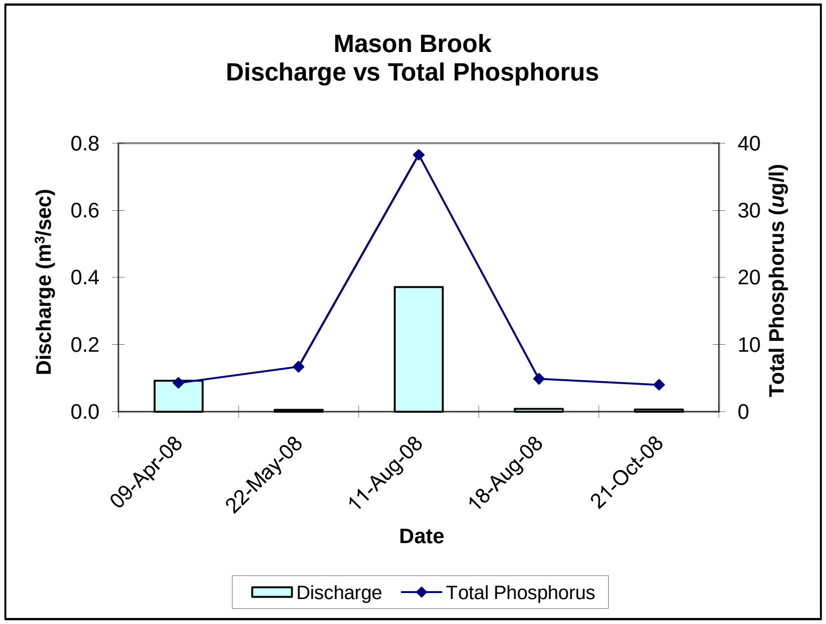

Georges Brook
Discharge vs Chloride
Discharge (m³/sec)
Chloride (mg/l)
3.0
2.4
1.8
1.2
0.6
0.0
10.0
8.0
6.0
4.0
2.0
0.0
09-Apr-08
22-May-08
11-Aug-08
18-Aug-08
21-Oct-08
Date
Discharge
Chloride

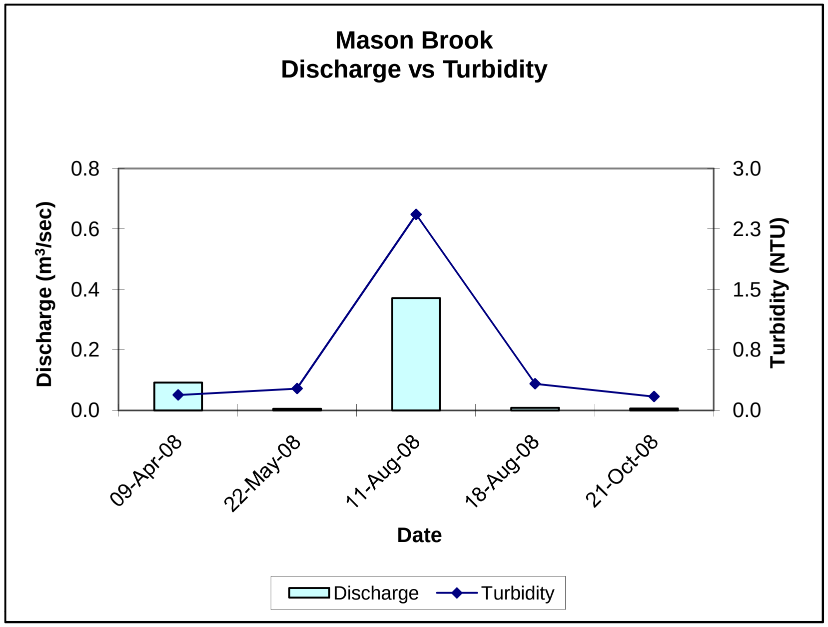

Cockermouth River
Discharge vs Total Phosphorus
Discharge (m³/sec)
Total Phosphorus (ug/l)
32.0
24.0
16.0
8.0
0.0
280
210
140
70
0
09-Apr-08
22-May-08
11-Aug-08
18-Aug-08
21-Oct-08
Date
Discharge
Total Phosphorus

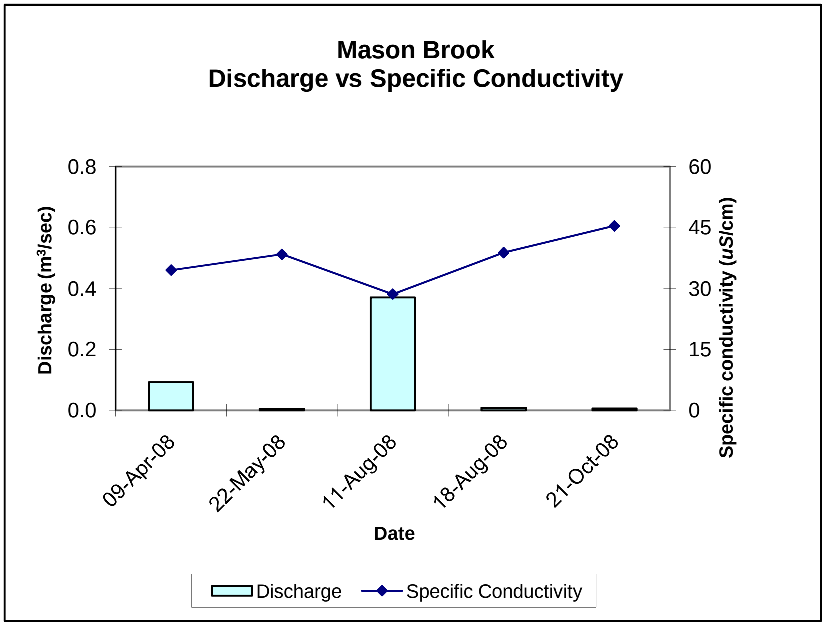

Cockermouth River
Discharge vs Turbidity
Discharge (m³/sec)
Turbidity (NTU)
32.0
24.0
16.0
8.0
0.0
40.0
30.0
20.0
10.0
0.0
09-Apr-08
22-May-08
11-Aug-08
18-Aug-08
21-Oct-08
Date
Discharge
Turbidity

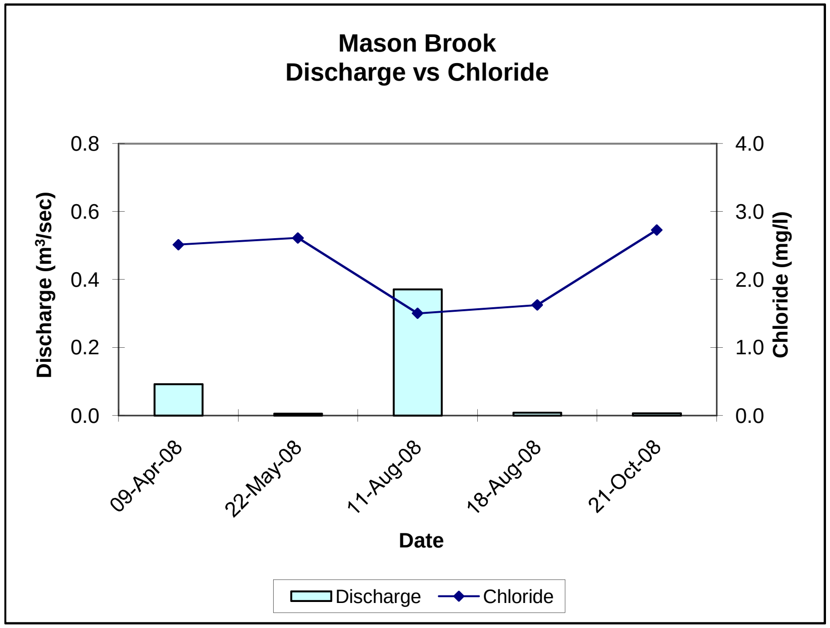

Cockermouth River
Discharge vs Specific Conductivity
Discharge (m³/sec)
Specific conductivity (uS/cm)
32.0
24.0
16.0
8.0
0.0
60
45
30
15
0
09-Apr-08
22-May-08
11-Aug-08
18-Aug-08
21-Oct-08
Date
Discharge
Specific Conductivity

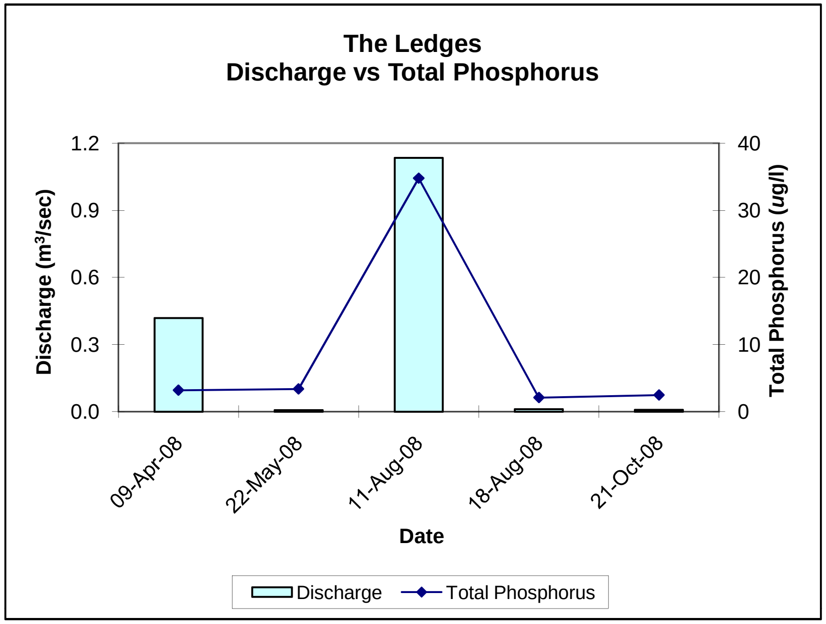

Cockermouth River
Discharge vs Chloride
Discharge (m³/sec)
Chloride (mg/l)
32.0
24.0
16.0
8.0
0.0
10.0
7.5
5.0
2.5
0.0
09-Apr-08
22-May-08
11-Aug-08
18-Aug-08
21-Oct-08
Date
Discharge
Chloride

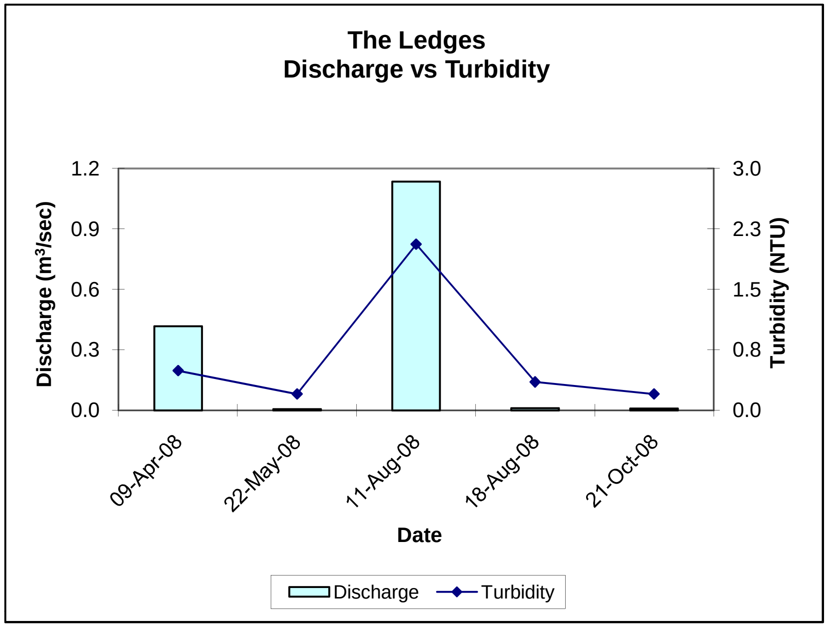

Mason Brook
Discharge vs Total Phosphorus
Discharge (m³/sec)
Total Phosphorus (ug/l)
0.8
0.6
0.4
0.2
0.0
40
30
20
10
0
09-Apr-08
22-May-08
11-Aug-08
18-Aug-08
21-Oct-08
Date
Discharge
Total Phosphorus

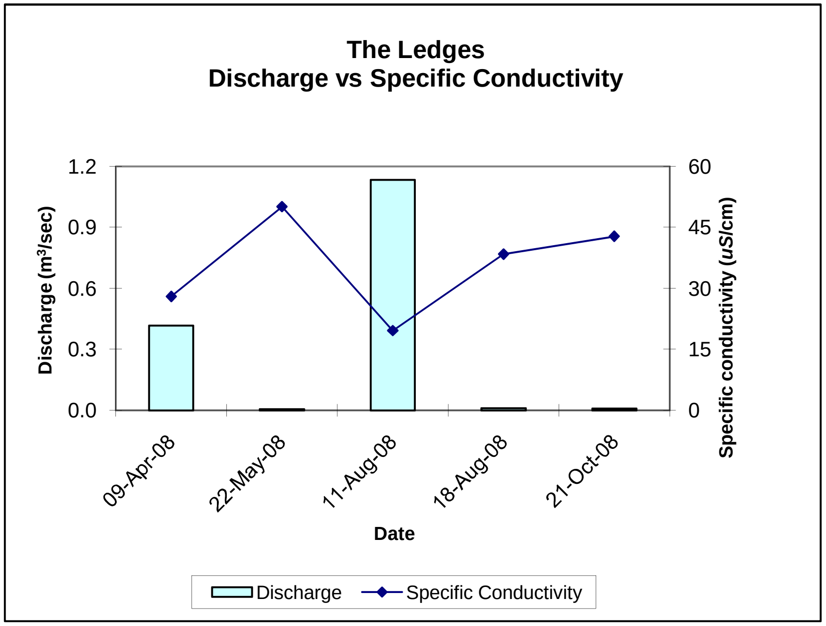

Mason Brook
Discharge vs Turbidity
Discharge (m³/sec)
Turbidity (NTU)
0.8
0.6
0.4
0.2
0.0
3.0
2.3
1.5
0.8
0.0
09-Apr-08
22-May-08
11-Aug-08
18-Aug-08
21-Oct-08
Date
Discharge
Turbidity

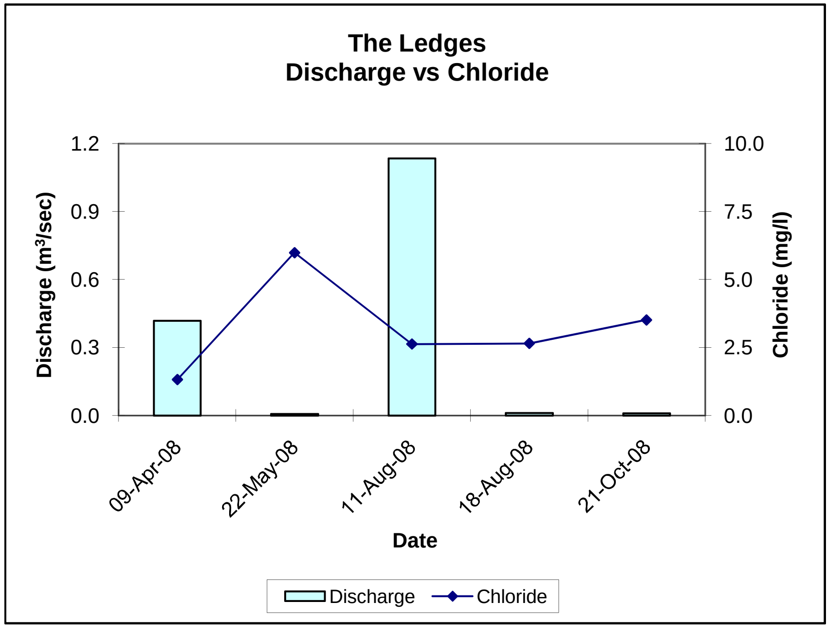

Mason Brook
Discharge vs Specific Conductivity
Discharge (m³/sec)
Specific conductivity (uS/cm)
0.8
0.6
0.4
0.2
0.0
60
45
30
15
0
09-Apr-08
22-May-08
11-Aug-08
18-Aug-08
21-Oct-08
Date
Discharge
Specific Conductivity

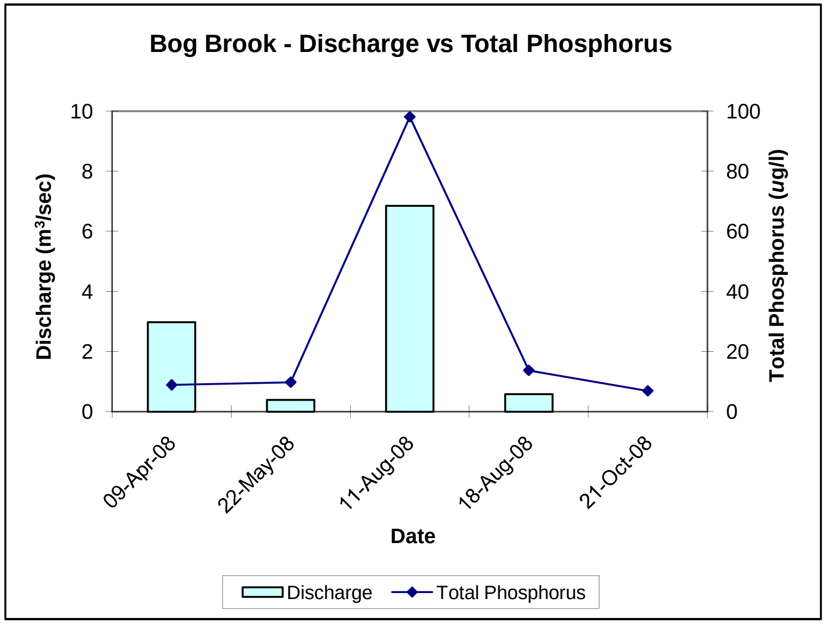

Mason Brook
Discharge vs Chloride
Discharge (m³/sec)
Chloride (mg/l)
0.8
0.6
0.4
0.2
0.0
4.0
3.0
2.0
1.0
0.0
09-Apr-08
22-May-08
11-Aug-08
18-Aug-08
21-Oct-08
Date
Discharge
Chloride

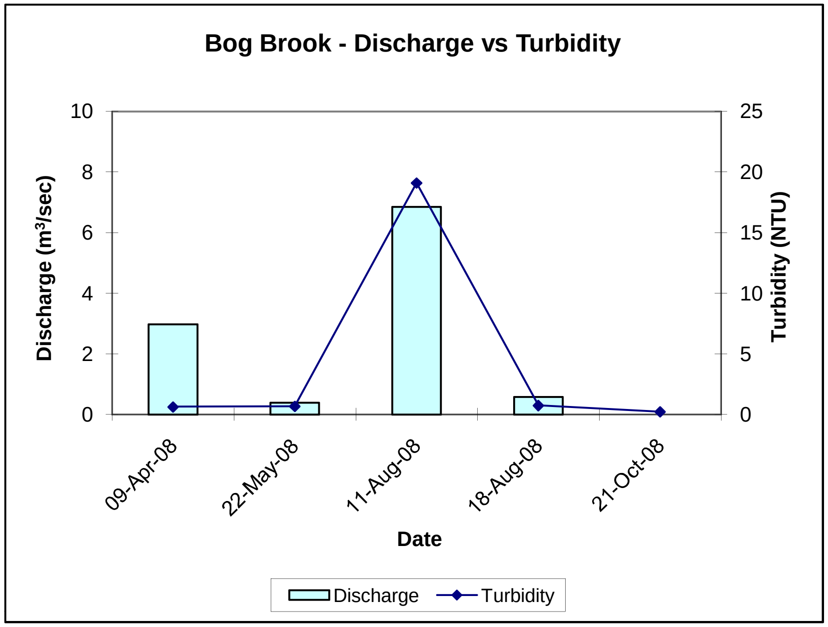

The Ledges
Discharge vs Total Phosphorus
Discharge (m³/sec)
Total Phosphorus (ug/l)
1.2
0.9
0.6
0.3
0.0
40
30
20
10
0
09-Apr-08
22-May-08
11-Aug-08
18-Aug-08
21-Oct-08
Date
Discharge
Total Phosphorus

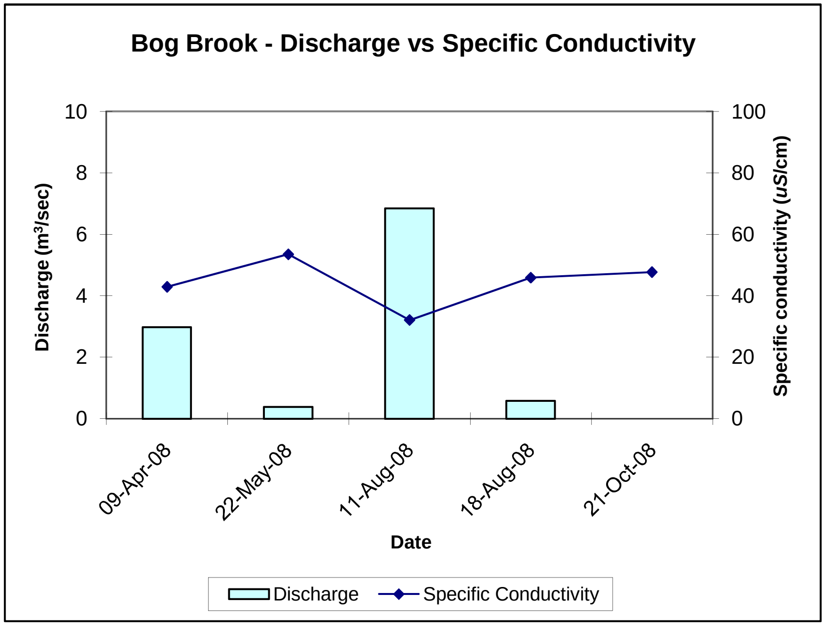

The Ledges
Discharge vs Turbidity
Discharge (m³/sec)
Turbidity (NTU)
1.2
0.9
0.6
0.3
0.0
3.0
2.3
1.5
0.8
0.0
09-Apr-08
22-May-08
11-Aug-08
18-Aug-08
21-Oct-08
Date
Discharge
Turbidity

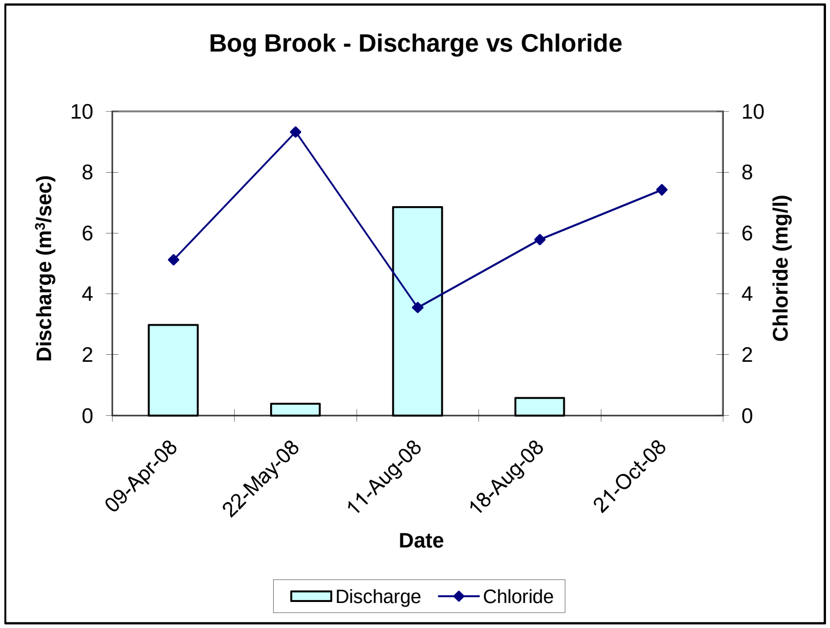

The Ledges
Discharge vs Specific Conductivity
Discharge (m³/sec)
Specific conductivity (uS/cm)
1.2
0.9
0.6
0.3
0.0
60
45
30
15
0
09-Apr-08
22-May-08
11-Aug-08
18-Aug-08
21-Oct-08
Date
Discharge
Specific Conductivity

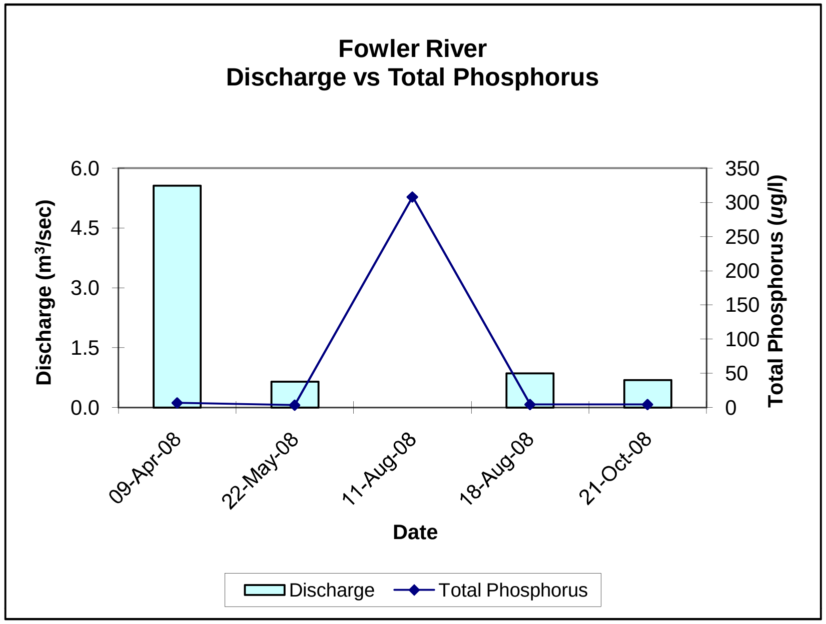

The Ledges
Discharge vs Chloride
Discharge (m³/sec)
Chloride (mg/l)
1.2
0.9
0.6
0.3
0.0
10.0
7.5
5.0
2.5
0.0
09-Apr-08
22-May-08
11-Aug-08
18-Aug-08
21-Oct-08
Date
Discharge
Chloride

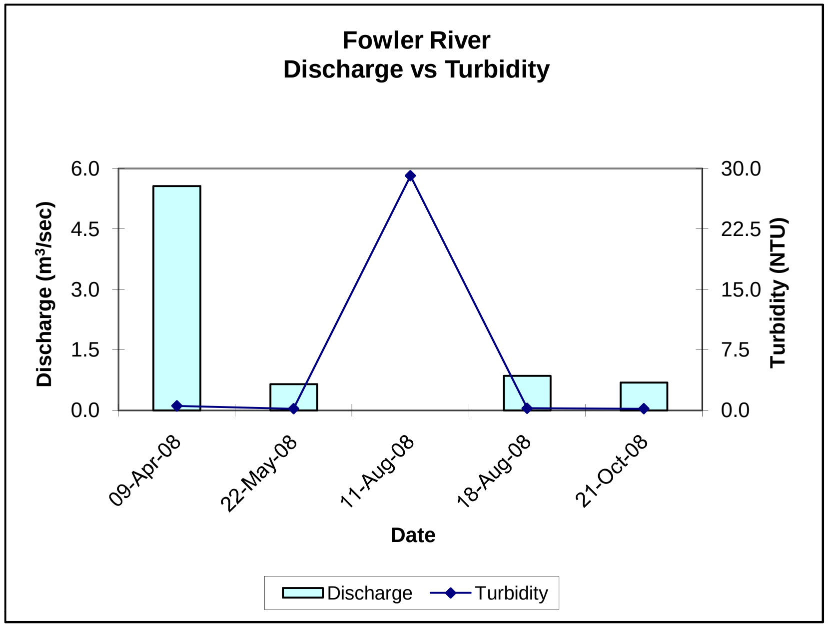

Bog Brook - Discharge vs Total Phosphorus
Discharge (m³/sec)
Total Phosphorus (ug/l)
10
8
6
4
2
0
100
80
60
40
20
0
09-Apr-08
22-May-08
11-Aug-08
18-Aug-08
21-Oct-08
Date
Discharge
Total Phosphorus

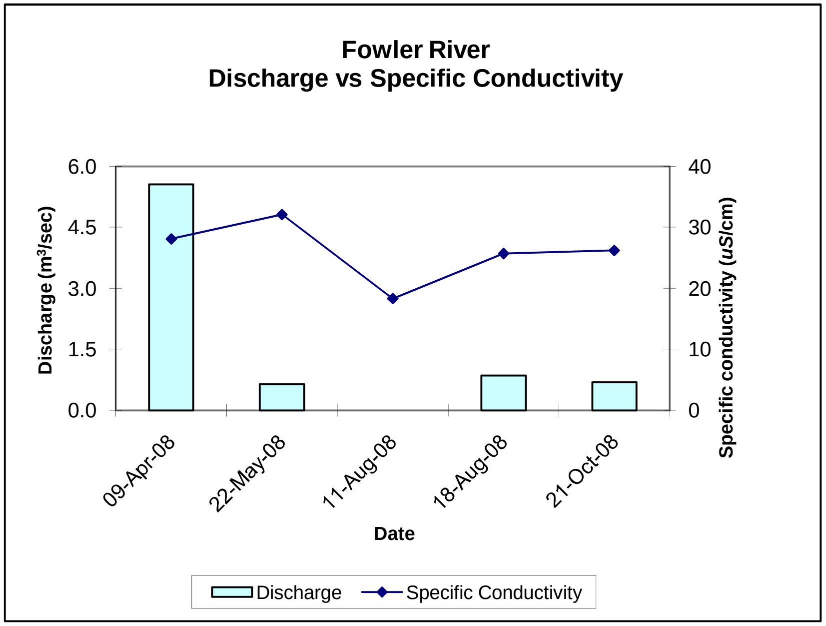

Bog Brook - Discharge vs Turbidity
Discharge (m³/sec)
Turbidity (NTU)
10
8
6
4
2
0
25
20
15
10
5
0
09-Apr-08
22-May-08
11-Aug-08
18-Aug-08
21-Oct-08
Date
Discharge
Turbidity

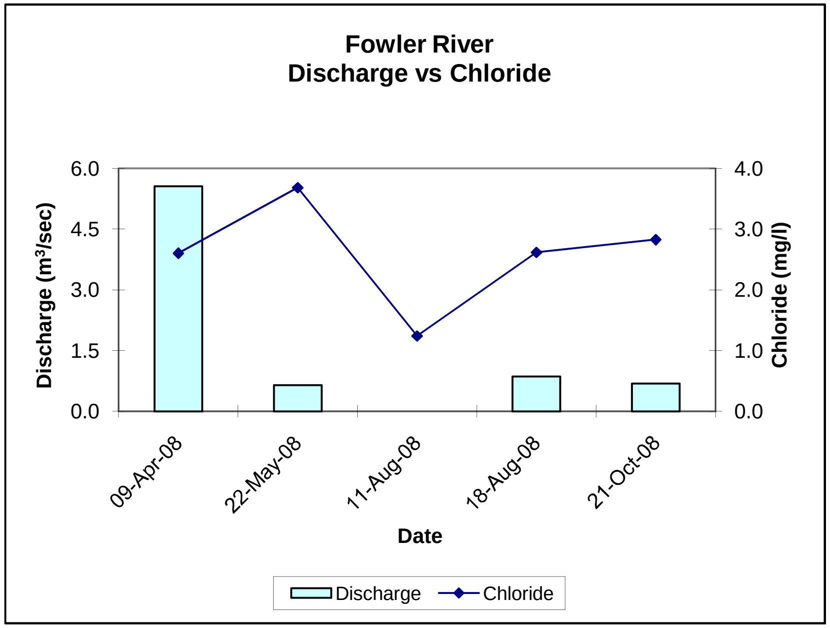

Bog Brook - Discharge vs Specific Conductivity
Discharge (m³/sec)
Specific conductivity (uS/cm)
10
8
6
4
2
0
100
80
60
40
20
0
09-Apr-08
22-May-08
11-Aug-08
18-Aug-08
21-Oct-08
Date
Discharge
Specific Conductivity

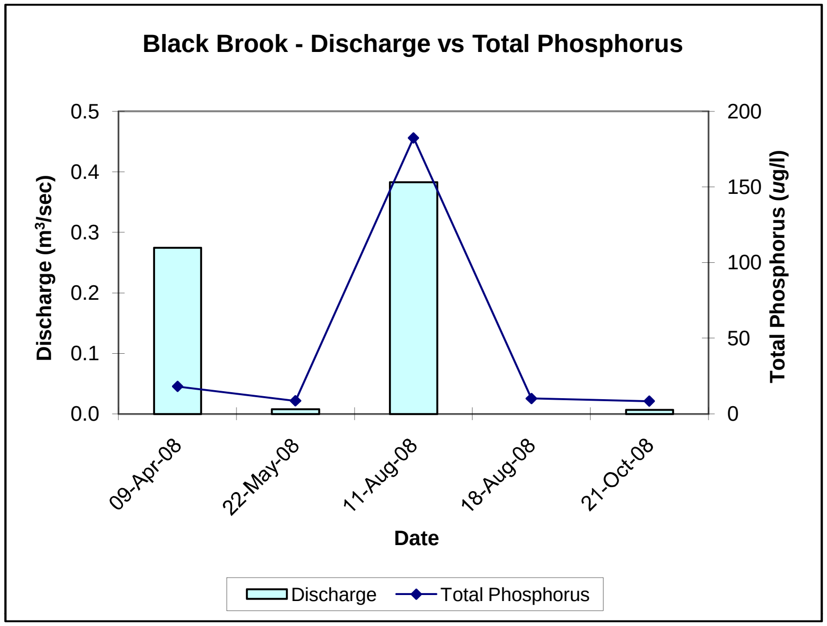

Bog Brook - Discharge vs Chloride
Discharge (m³/sec)
Chloride (mg/l)
10
8
6
4
2
0
10
8
6
4
2
0
09-Apr-08
22-May-08
11-Aug-08
18-Aug-08
21-Oct-08
Date
Discharge
Chloride

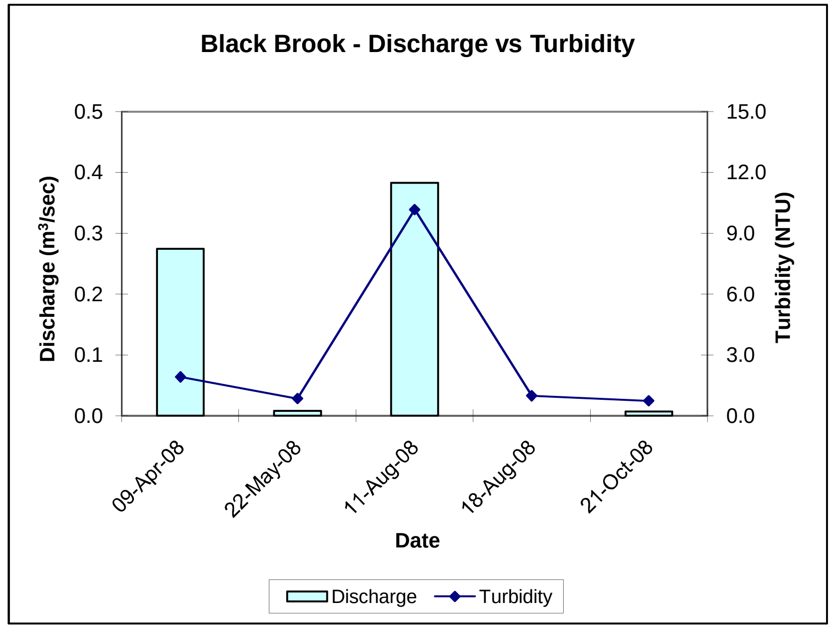

Fowler River
Discharge vs Total Phosphorus
Discharge (m³/sec)
Total Phosphorus (ug/l)
Date
09-Apr-08
22-May-08
11-Aug-08
18-Aug-08
21-Oct-08
Discharge
Total Phosphorus

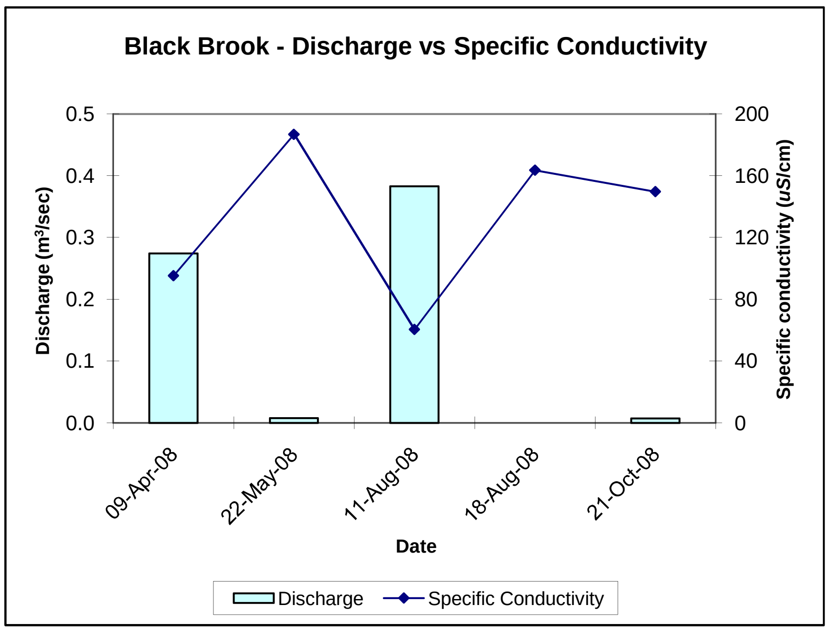

Fowler River
Discharge vs Turbidity
Discharge (m³/sec)
Turbidity (NTU)
Date
09-Apr-08
22-May-08
11-Aug-08
18-Aug-08
21-Oct-08
Discharge
Turbidity

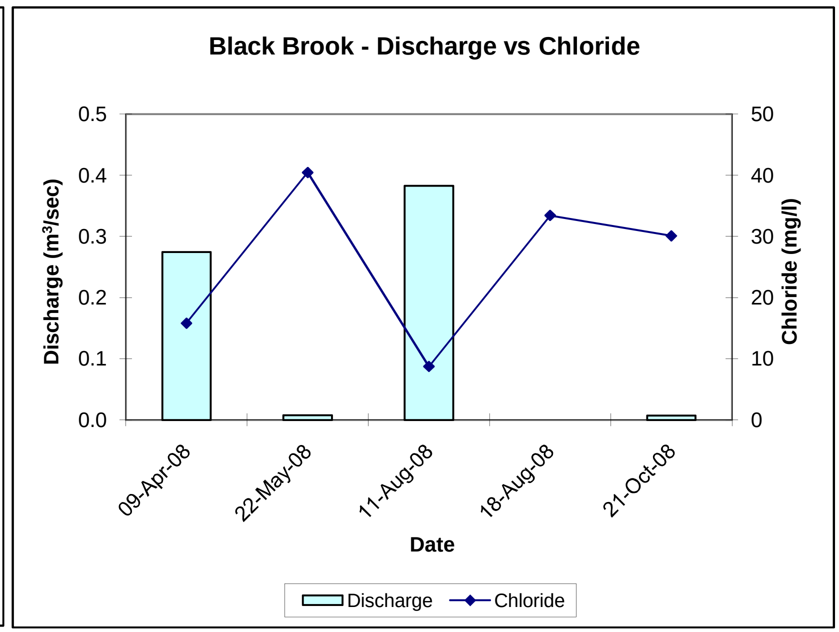

Fowler River
Discharge vs Specific Conductivity
Discharge (m³/sec)
Specific conductivity (uS/cm)
Date
09-Apr-08
22-May-08
11-Aug-08
18-Aug-08
21-Oct-08
Discharge
Specific Conductivity


Fowler River
Discharge vs Chloride
Discharge (m³/sec)
Chloride (mg/l)
Date
09-Apr-08
22-May-08
11-Aug-08
18-Aug-08
21-Oct-08
Discharge
Chloride


Black Brook - Discharge vs Total Phosphorus
Discharge (m³/sec)
Total Phosphorus (ug/l)
0.5
0.4
0.3
0.2
0.1
0.0
200
150
100
50
0
09-Apr-08
22-May-08
11-Aug-08
18-Aug-08
21-Oct-08
Date
Discharge
Total Phosphorus


Black Brook - Discharge vs Turbidity
Discharge (m³/sec)
Turbidity (NTU)
0.5
0.4
0.3
0.2
0.1
0.0
15.0
12.0
9.0
6.0
3.0
0.0
09-Apr-08
22-May-08
11-Aug-08
18-Aug-08
21-Oct-08
Date
Discharge
Turbidity


Black Brook - Discharge vs Specific Conductivity
Discharge (m³/sec)
Specific conductivity (uS/cm)
0.5
0.4
0.3
0.2
0.1
0.0
200
160
120
80
40
0
09-Apr-08
22-May-08
11-Aug-08
18-Aug-08
21-Oct-08
Date
Discharge
Specific Conductivity


Black Brook - Discharge vs Chloride
Discharge (m³/sec)
Chloride (mg/l)
0.5
0.4
0.3
0.2
0.1
0.0
50
40
30
20
10
0
09-Apr-08
22-May-08
11-Aug-08
18-Aug-08
21-Oct-08
Date
Discharge
Chloride

APPENDIX I. Newfound Lake Volunteer Monitor Data (1986-2008)

Site	Date	Secchi Disk Transparency (meters)	Chlorophyll *a* (*u* g/l)
2 Mayhew	6/26/86	5.5	2.6
2 Mayhew	7/4/86	6.5	1.8
2 Mayhew	7/8/86	8.0	1.2
2 Mayhew	7/15/86	7.0	2.8
2 Mayhew	7/22/86	7.5	1.4
2 Mayhew	7/29/86	7.5	1.9
2 Mayhew	8/5/86	4.0	2.2
2 Mayhew	8/12/86	6.0	------
2 Mayhew	8/19/86	6.5	1.6
2 Mayhew	8/26/86	5.5	0.8
2 Mayhew	9/2/86	6.0	1.7
2 Mayhew	6/16/87	8.5	1.1
2 Mayhew	6/24/87	6.5	1.4
2 Mayhew	7/1/87	7.5	1.5
2 Mayhew	7/7/87	6.5	2.0
2 Mayhew	7/14/87	7.5	1.9
2 Mayhew	7/21/87	6.5	1.6
2 Mayhew	7/29/87	7.5	1.4
2 Mayhew	8/5/87	6.5	1.9
2 Mayhew	8/12/87	8.0	1.3
2 Mayhew	8/18/87	8.8	0.6
2 Mayhew	8/25/87	7.5	1.4
2 Mayhew	9/1/87	8.5	1.5
2 Mayhew	6/14/88	8.0	1.8
2 Mayhew	6/22/88	7.0	1.2
2 Mayhew	6/28/88	7.5	1.1
2 Mayhew	7/6/88	7.0	1.4
2 Mayhew	7/13/88	8.5	1.1
2 Mayhew	7/20/88	8.8	1.6
2 Mayhew	7/28/88	7.8	1.4
2 Mayhew	8/3/88	9.0	1.3
2 Mayhew	8/11/88	9.8	1.6
2 Mayhew	8/17/88	7.5	1.6
2 Mayhew	8/24/88	7.5	2.3
2 Mayhew	9/1/88	6.5	2.4
2 Mayhew	9/6/88	7.0	2.3
2 Mayhew	6/14/89	8.8	1.0
2 Mayhew	6/20/89	8.0	------
2 Mayhew	6/27/89	8.0	1.1
2 Mayhew	7/4/89	7.5	1.3
2 Mayhew	7/13/89	7.5	1.6
2 Mayhew	7/18/89	7.5	2.0
2 Mayhew	7/25/89	8.0	0.9
2 Mayhew	8/1/89	8.0	1.7
2 Mayhew	8/9/89	8.0	1.3
2 Mayhew	8/15/89	8.0	1.8
2 Mayhew	8/23/89	8.0	1.9
2 Mayhew	8/29/89	7.5	1.5
2 Mayhew	9/5/89	8.5	1.9
2 Mayhew	6/18/90	6.5	1.5
2 Mayhew	6/26/90	7.3	1.3
2 Mayhew	7/5/90	7.0	1.8
2 Mayhew	7/11/90	6.5	2.9
2 Mayhew	7/17/90	7.0	1.5
2 Mayhew	7/24/90	6.5	1.1
2 Mayhew	7/31/90	7.5	0.7
2 Mayhew	8/8/90	3.7	2.9
2 Mayhew	8/15/90	3.0	2.9
2 Mayhew	8/21/90	4.0	1.8

Site	Date	Secchi Disk Transparency (meters)	Chlorophyll *a* (*u* g/l)
3 Pasquaney	7/4/86	8.9	1.9
3 Pasquaney	7/9/86	7.5	1.5
3 Pasquaney	7/16/86	8.0	2.1
3 Pasquaney	7/22/86	10.0	1.1
3 Pasquaney	7/29/86	8.8	1.2
3 Pasquaney	8/6/86	7.1	1.2
3 Pasquaney	8/13/86	7.7	1.1
3 Pasquaney	8/19/86	9.0	1.4
3 Pasquaney	8/26/86	10.5	1.1
3 Pasquaney	9/2/86	8.8	1.2
3 Pasquaney	6/18/87	9.0	0.9
3 Pasquaney	6/23/87	9.0	0.8
3 Pasquaney	7/2/87	7.0	1.6
3 Pasquaney	7/7/87	8.2	1.9
3 Pasquaney	7/14/87	7.1	1.6
3 Pasquaney	7/22/87	7.5	1.4
3 Pasquaney	7/29/87	8.9	1.4
3 Pasquaney	8/6/87	8.0	1.3
3 Pasquaney	8/12/87	10.0	0.4
3 Pasquaney	8/19/87	10.8	0.6
3 Pasquaney	8/27/87	11.8	0.9
3 Pasquaney	9/3/87	11.1	1.1
3 Pasquaney	6/14/88	9.9	0.8
3 Pasquaney	6/24/88	8.6	1.4
3 Pasquaney	6/28/88	9.5	1.2
3 Pasquaney	7/5/88	9.0	1.1
3 Pasquaney	7/12/88	10.2	1.8
3 Pasquaney	7/20/88	10.9	1.5
3 Pasquaney	7/26/88	9.7	1.3
3 Pasquaney	8/3/88	9.5	1.3
3 Pasquaney	8/9/88	10.7	2.0
3 Pasquaney	8/17/88	10.7	1.5
3 Pasquaney	8/23/88	10.8	1.3
3 Pasquaney	9/7/88	10.8	2.2
3 Pasquaney	10/31/88	11.3	------
3 Pasquaney	6/21/89	10.5	1.5
3 Pasquaney	6/30/89	11.0	1.2
3 Pasquaney	7/7/89	9.4	1.1
3 Pasquaney	7/13/89	10.9	1.7
3 Pasquaney	7/19/89	9.9	4.0
3 Pasquaney	7/26/89	9.9	1.4
3 Pasquaney	8/1/89	9.8	1.2
3 Pasquaney	8/9/89	9.3	0.3
3 Pasquaney	8/17/89	9.5	1.4
3 Pasquaney	8/23/89	10.8	1.7
3 Pasquaney	8/30/89	9.3	1.4
3 Pasquaney	9/6/89	10.8	1.5
3 Pasquaney	6/20/90	7.4	1.6
3 Pasquaney	6/27/90	9.0	1.5
3 Pasquaney	7/7/90	7.1	1.3
3 Pasquaney	7/11/90	8.8	1.8
3 Pasquaney	7/20/90	8.4	1.7
3 Pasquaney	7/25/90	9.6	1.1
3 Pasquaney	8/3/90	9.1	1.2
3 Pasquaney	8/10/90	9.5	2.5
3 Pasquaney	8/15/90	5.8	2.3
3 Pasquaney	8/22/90	7.8	1.5
3 Pasquaney	8/30/90	7.8	1.4
3 Pasquaney	9/5/90	8.1	1.1

APPENDIX I. Newfound Lake Volunteer Monitor Data (1986-2008)

Site	Date	Secchi Disk Transparency (meters)	Chlorophyll *a* (*u* g/l)
2 Mayhew	8/28/90	6.0	1.6
2 Mayhew	9/4/90	5.0	2.0
2 Mayhew	6/18/91	7.0	2.4
2 Mayhew	6/26/91	6.5	2.4
2 Mayhew	7/2/91	6.8	1.2
2 Mayhew	7/10/91	7.0	1.8
2 Mayhew	7/16/91	7.5	2.2
2 Mayhew	7/23/91	7.5	1.4
2 Mayhew	7/30/91	7.5	1.4
2 Mayhew	8/7/91	7.8	2.1
2 Mayhew	8/14/91	7.8	1.2
2 Mayhew	8/20/91	6.0	2.2
2 Mayhew	8/27/91	6.5	2.3
2 Mayhew	9/4/91	7.5	3.4
2 Mayhew	6/19/92	7.0	1.1
2 Mayhew	6/24/92	6.5	1.7
2 Mayhew	6/30/92	7.5	1.3
2 Mayhew	7/7/92	8.0	1.4
2 Mayhew	7/16/92	6.5	2.0
2 Mayhew	7/22/92	7.5	1.1
2 Mayhew	7/29/92	7.5	1.0
2 Mayhew	8/4/92	7.3	1.4
2 Mayhew	8/13/92	7.8	1.7
2 Mayhew	8/19/92	8.0	1.4
2 Mayhew	8/25/92	8.5	1.1
2 Mayhew	9/3/92	8.0	1.6
2 Mayhew	6/15/93	6.5	0.7
2 Mayhew	6/22/93	7.5	2.2
2 Mayhew	6/29/93	8.0	1.1
2 Mayhew	7/6/93	7.0	1.0
2 Mayhew	7/12/93	8.3	0.9
2 Mayhew	7/19/93	7.0	1.5
2 Mayhew	7/27/93	8.5	2.6
2 Mayhew	8/3/93	7.8	1.6
2 Mayhew	8/10/93	7.3	2.1
2 Mayhew	8/17/93	7.5	2.9
2 Mayhew	8/24/93	7.0	1.8
2 Mayhew	8/31/93	7.8	1.6
2 Mayhew	6/15/94	8.7	1.2
2 Mayhew	6/21/94	8.0	1.2
2 Mayhew	6/28/94	7.0	1.4
2 Mayhew	7/5/94	8.5	1.3
2 Mayhew	7/13/94	7.5	1.4
2 Mayhew	7/19/94	------	1.7
2 Mayhew	7/27/94	7.5	1.4
2 Mayhew	8/3/94	7.5	1.4
2 Mayhew	8/9/94	------	1.9
2 Mayhew	8/16/94	8.0	1.9
2 Mayhew	8/23/94	7.5	2.2
2 Mayhew	8/30/94	8.0	1.9
2 Mayhew	6/13/95	7.0	1.6
2 Mayhew	6/21/95	8.5	1.6
2 Mayhew	6/28/95	8.5	0.6
2 Mayhew	7/6/95	8.3	0.6
2 Mayhew	7/12/95	9.3	0.7
2 Mayhew	7/20/95	9.6	0.6
2 Mayhew	7/27/95	9.5	0.6
2 Mayhew	7/31/95	8.5	0.7
2 Mayhew	8/9/95	10.5	0.9

Site	Date	Secchi Disk Transparency (meters)	Chlorophyll *a* (*u* g/l)
3 Pasquaney	6/18/91	7.0	1.9
3 Pasquaney	6/25/91	5.5	1.3
3 Pasquaney	7/3/91	6.5	2.1
3 Pasquaney	7/11/91	------	1.1
3 Pasquaney	7/17/91	9.1	1.1
3 Pasquaney	7/25/91	10.5	1.2
3 Pasquaney	8/1/91	9.6	1.4
3 Pasquaney	8/9/91	10.8	1.1
3 Pasquaney	8/14/91	10.7	1.4
3 Pasquaney	8/20/91	10.0	1.3
3 Pasquaney	8/28/91	9.3	1.0
3 Pasquaney	9/4/91	10.1	1.0
3 Pasquaney	9/9/91	10.5	------
3 Pasquaney	6/19/92	4.5	1.1
3 Pasquaney	6/25/92	9.3	1.0
3 Pasquaney	7/5/92	9.6	2.1
3 Pasquaney	7/8/92	9.5	1.3
3 Pasquaney	7/17/92	9.7	1.5
3 Pasquaney	7/24/92	10.6	1.3
3 Pasquaney	7/29/92	9.1	1.1
3 Pasquaney	8/6/92	9.3	1.8
3 Pasquaney	8/13/92	10.0	1.2
3 Pasquaney	8/19/92	9.8	1.3
3 Pasquaney	8/27/92	9.8	1.2
3 Pasquaney	9/4/92	9.3	2.1
3 Pasquaney	9/11/92	9.7	1.6
3 Pasquaney	6/28/93	8.5	1.3
3 Pasquaney	7/5/93	------	1.4
3 Pasquaney	7/13/93	8.5	1.1
3 Pasquaney	7/19/93	9.5	1.4
3 Pasquaney	7/28/93	11.0	0.3
3 Pasquaney	8/4/93	10.0	0.9
3 Pasquaney	8/11/93	10.5	1.1
3 Pasquaney	8/19/93	10.0	1.2
3 Pasquaney	8/24/93	10.5	0.1
3 Pasquaney	8/30/93	11.0	0.8
3 Pasquaney	9/6/93	10.0	0.2
3 Pasquaney	9/13/93	10.0	0.3
3 Pasquaney	7/5/94	6.5	1.0
3 Pasquaney	7/14/94	6.0	1.3
3 Pasquaney	7/21/94	9.5	0.9
3 Pasquaney	7/29/94	10.5	0.7
3 Pasquaney	8/3/94	9.2	1.2
3 Pasquaney	8/11/94	------	1.8
3 Pasquaney	8/17/94	------	1.4
3 Pasquaney	8/24/94	8.5	1.4
3 Pasquaney	9/1/94	8.0	2.1
3 Pasquaney	9/6/94	9.0	1.6
3 Pasquaney	9/15/94	------	1.9
3 Pasquaney	10/9/94	------	2.1
3 Pasquaney	6/27/96	6.0	3.7
3 Pasquaney	7/3/96	6.8	2.1
3 Pasquaney	7/11/96	------	1.9
3 Pasquaney	7/17/96	6.0	1.8
3 Pasquaney	7/27/96	6.5	2.1
3 Pasquaney	8/3/96	8.0	1.3
3 Pasquaney	8/7/96	7.5	------
3 Pasquaney	8/15/96	7.5	2.2
3 Pasquaney	8/22/96	8.5	1.3

APPENDIX I. Newfound Lake Volunteer Monitor Data (1986-2008)

Site	Date	Secchi Disk Transparency (meters)	Chlorophyll *a* (*u* g/l)
2 Mayhew	8/16/95	9.5	1.1
2 Mayhew	8/29/95	8.5	1.4
2 Mayhew	9/5/95	8.5	1.1
2 Mayhew	6/6/96	7.0	0.9
2 Mayhew	6/12/96	8.5	1.3
2 Mayhew	6/20/96	7.5	0.8
2 Mayhew	7/1/96	7.5	1.6
2 Mayhew	7/8/96	7.5	1.6
2 Mayhew	7/13/96	8.0	1.9
2 Mayhew	7/18/96	5.5	0.9
2 Mayhew	7/26/96	6.0	1.3
2 Mayhew	8/2/96	6.5	2.1
2 Mayhew	8/19/96	7.5	0.9
2 Mayhew	7/18/97	6.8	1.3
2 Mayhew	7/24/97	7.7	1.1
2 Mayhew	7/31/97	8.9	1.3
2 Mayhew	8/6/97	9.0	1.2
2 Mayhew	8/27/97	8.5	1.8
2 Mayhew	9/5/97	6.0	2.1
2 Mayhew	9/17/97	8.0	1.7
2 Mayhew	7/7/98	3.0	2.8
2 Mayhew	7/21/98	4.6	2.4
2 Mayhew	8/3/98	6.0	2.9
2 Mayhew	8/18/98	7.5	1.9
2 Mayhew	9/1/98	7.5	2.4
2 Mayhew	9/11/98	6.5	2.1
2 Mayhew	9/17/98	7.5	1.8
2 Mayhew	7/9/99	7.0	1.4
2 Mayhew	7/16/99	7.0	1.4
2 Mayhew	7/23/99	6.5	2.2
2 Mayhew	7/30/99	7.0	1.2
2 Mayhew	8/6/99	7.0	2.4
2 Mayhew	8/13/99	7.0	1.9
2 Mayhew	8/20/99	7.0	2.0
2 Mayhew	9/6/99	6.5	1.9
2 Mayhew	9/11/99	7.5	2.6
2 Mayhew	9/18/99	2.0	3.0
2 Mayhew	9/24/99	3.0	2.4
2 Mayhew	10/3/99	4.5	2.9
2 Mayhew	10/8/99	4.5	------
2 Mayhew	5/16/00	4.7	2.6
2 Mayhew	5/30/00	5.0	2.3
2 Mayhew	6/18/00	6.0	1.6
2 Mayhew	6/23/00	6.5	1.3
2 Mayhew	6/30/00	6.0	1.9
2 Mayhew	7/7/00	5.5	2.0
2 Mayhew	7/13/00	6.5	1.8
2 Mayhew	7/20/00	6.5	1.9
2 Mayhew	7/26/00	6.5	1.5
2 Mayhew	8/11/00	5.5	3.4
2 Mayhew	8/18/00	5.5	3.0
2 Mayhew	8/23/00	5.5	3.0
2 Mayhew	9/1/00	6.0	1.5
2 Mayhew	9/8/00	5.5	2.4
2 Mayhew	9/14/00	6.0	2.9
2 Mayhew	9/27/00	5.0	3.1
2 Mayhew	6/9/01	5.5	2.1
2 Mayhew	6/18/01	7.5	1.4
2 Mayhew	6/25/01	5.8	1.6

Site	Date	Secchi Disk Transparency (meters)	Chlorophyll *a* (*u* g/l)
3 Pasquaney	8/28/96	8.0	1.9
3 Pasquaney	9/4/96	8.5	1.9
3 Pasquaney	5/29/97	6.0	0.6
3 Pasquaney	7/18/97	6.8	1.7
3 Pasquaney	7/24/97	7.5	1.3
3 Pasquaney	7/31/97	10.0	1.4
3 Pasquaney	8/6/97	10.5	1.2
3 Pasquaney	8/27/97	8.0	1.4
3 Pasquaney	9/5/97	7.5	1.8
3 Pasquaney	4/29/98	6.0	0.8
3 Pasquaney	6/24/98	5.5	2.1
3 Pasquaney	6/30/98	4.5	1.7
3 Pasquaney	7/6/98	3.5	3.9
3 Pasquaney	7/15/98	5.0	3.0
3 Pasquaney	7/21/98	5.7	2.8
3 Pasquaney	8/2/98	6.0	3.0
3 Pasquaney	8/3/98	6.0	2.1
3 Pasquaney	8/18/98	7.5	0.7
3 Pasquaney	8/25/98	7.5	1.6
3 Pasquaney	9/1/98	9.0	3.3
3 Pasquaney	9/11/98	8.5	2.5
3 Pasquaney	9/13/98	8.0	------
3 Pasquaney	9/18/98	8.5	2.7
3 Pasquaney	4/22/99	6.5	1.6
3 Pasquaney	5/9/99	8.0	2.0
3 Pasquaney	7/12/99	7.0	1.5
3 Pasquaney	7/18/99	7.0	1.1
3 Pasquaney	8/16/99	7.0	0.9
3 Pasquaney	8/25/99	7.0	1.7
3 Pasquaney	9/12/99	8.0	0.9
3 Pasquaney	5/16/00	4.5	2.1
3 Pasquaney	5/29/00	4.8	1.6
3 Pasquaney	6/28/00	7.5	1.9
3 Pasquaney	7/6/00	6.3	1.5
3 Pasquaney	7/11/00	6.5	2.0
3 Pasquaney	7/20/00	8.0	1.8
3 Pasquaney	7/28/00	6.9	1.6
3 Pasquaney	8/11/00	5.3	3.9
3 Pasquaney	8/18/00	7.2	2.6
3 Pasquaney	8/25/00	6.5	2.4
3 Pasquaney	9/1/00	6.6	2.2
3 Pasquaney	9/6/00	7.5	2.1
3 Pasquaney	9/14/00	7.9	2.4
3 Pasquaney	9/21/00	6.8	1.5
3 Pasquaney	6/15/01	7.5	1.3
3 Pasquaney	6/22/01	7.8	1.6
3 Pasquaney	6/29/01	8.0	1.4
3 Pasquaney	7/9/01	8.0	1.4
3 Pasquaney	7/20/01	7.8	1.2
3 Pasquaney	7/28/01	7.5	1.6
3 Pasquaney	8/19/01	8.2	1.3
3 Pasquaney	8/27/01	8.8	1.4
3 Pasquaney	9/3/01	8.5	1.5
3 Pasquaney	9/23/01	10.0	2.6
3 Pasquaney	10/1/01	7.8	2.7
3 Pasquaney	10/10/01	7.3	3.4
3 Pasquaney	10/17/01	7.0	2.8
3 Pasquaney	6/13/02	6.4	1.6
3 Pasquaney	6/21/02	9.2	1.3

APPENDIX I. Newfound Lake Volunteer Monitor Data (1986-2008)

Site	Date	Secchi Disk Transparency (meters)	Chlorophyll *a* (*u* g/l)
2 Mayhew	7/5/01	6.0	1.3
2 Mayhew	7/14/01	8.0	1.3
2 Mayhew	7/19/01	7.5	1.5
2 Mayhew	7/29/01	5.5	1.6
2 Mayhew	8/1/01	7.0	1.6
2 Mayhew	8/9/01	7.0	1.1
2 Mayhew	8/15/01	6.5	1.2
2 Mayhew	8/27/01	7.5	1.7
2 Mayhew	9/3/01	6.0	1.6
2 Mayhew	9/12/01	7.0	1.4
2 Mayhew	9/26/01	7.0	2.4
2 Mayhew	6/10/02	5.5	3.0
2 Mayhew	6/19/02	7.0	2.0
2 Mayhew	6/26/02	7.5	1.1
2 Mayhew	7/8/02	7.0	1.0
2 Mayhew	7/22/02	6.5	1.1
2 Mayhew	7/29/02	6.5	------
2 Mayhew	8/5/02	7.5	1.4
2 Mayhew	8/12/02	6.5	1.7
2 Mayhew	8/19/02	8.0	1.6
2 Mayhew	8/28/02	7.0	1.9
2 Mayhew	9/4/02	6.5	1.5
2 Mayhew	9/9/02	7.0	1.2
2 Mayhew	9/18/02	8.0	1.6
2 Mayhew	6/4/03	6.5	2.1
2 Mayhew	6/14/03	7.5	1.1
2 Mayhew	6/19/03	7.0	1.7
2 Mayhew	6/25/03	7.0	1.3
2 Mayhew	7/8/03	8.5	1.1
2 Mayhew	7/18/03	8.5	2.1
2 Mayhew	7/29/03	8.5	1.4
2 Mayhew	8/6/03	8.5	1.9
2 Mayhew	8/13/03	8.0	2.1
2 Mayhew	8/20/03	8.5	1.9
2 Mayhew	8/28/03	8.5	1.9
2 Mayhew	9/6/03	6.0	1.6
2 Mayhew	9/13/03	8.5	2.0
2 Mayhew	9/22/03	9.0	2.3
2 Mayhew	6/16/04	8.5	------
2 Mayhew	6/25/04	8.5	1.3
2 Mayhew	7/12/04	9.0	2.1
2 Mayhew	7/19/04	7.0	2.0
2 Mayhew	7/26/04	6.5	2.2
2 Mayhew	8/2/04	8.5	2.0
2 Mayhew	8/14/04	8.5	1.9
2 Mayhew	8/20/04	9.5	1.8
2 Mayhew	8/24/04	9.0	2.4
2 Mayhew	8/30/04	8.5	1.8
2 Mayhew	9/11/04	6.5	2.7
2 Mayhew	9/22/04	6.0	2.5
2 Mayhew	7/5/05	5.0	2.4
2 Mayhew	7/11/05	8.0	2.4
2 Mayhew	7/19/05	8.5	2.0
2 Mayhew	7/26/05	7.0	1.4
2 Mayhew	8/8/05	7.0	0.9
2 Mayhew	8/17/05	6.5	1.3
2 Mayhew	8/24/05	7.0	1.4
2 Mayhew	9/2/05	7.0	1.6
2 Mayhew	9/7/05	7.5	1.9
3 Pasquaney	6/28/02	8.2	1.1
3 Pasquaney	7/9/02	9.0	1.5
3 Pasquaney	7/16/02	7.5	1.3
3 Pasquaney	8/1/02	9.3	1.9
3 Pasquaney	8/9/02	8.0	1.2
3 Pasquaney	8/14/02	10.4	2.0
3 Pasquaney	8/23/02	9.4	1.1
3 Pasquaney	8/28/02	9.5	0.9
3 Pasquaney	9/4/02	8.8	------
3 Pasquaney	9/16/02	8.7	1.5
3 Pasquaney	9/24/02	8.9	1.6
3 Pasquaney	4/29/03	8.0	1.7
3 Pasquaney	5/5/03	7.7	2.0
3 Pasquaney	5/15/03	7.6	2.0
3 Pasquaney	6/11/03	9.4	1.1
3 Pasquaney	6/18/03	9.5	1.1
3 Pasquaney	6/25/03	8.0	1.5
3 Pasquaney	7/13/03	9.8	1.3
3 Pasquaney	7/31/03	10.6	1.2
3 Pasquaney	8/6/03	10.3	1.6
3 Pasquaney	8/12/03	8.4	2.1
3 Pasquaney	8/20/03	8.5	1.3
3 Pasquaney	8/26/03	8.5	1.7
3 Pasquaney	9/2/03	8.9	2.1
3 Pasquaney	9/9/03	9.5	1.4
3 Pasquaney	9/17/03	10.2	1.5
3 Pasquaney	9/23/03	9.6	1.6
3 Pasquaney	10/7/03	8.5	2.4
3 Pasquaney	10/14/03	8.4	2.7
3 Pasquaney	10/21/03	7.2	3.3
3 Pasquaney	4/19/04	8.5	1.5
3 Pasquaney	4/29/04	8.3	1.2
3 Pasquaney	5/5/04	7.9	1.5
3 Pasquaney	5/12/04	7.9	1.7
3 Pasquaney	6/6/04	8.3	1.3
3 Pasquaney	6/13/04	8.9	1.3
3 Pasquaney	6/22/04	8.5	1.4
3 Pasquaney	7/1/04	8.5	1.2
3 Pasquaney	7/7/04	8.0	2.1
3 Pasquaney	7/14/04	7.5	2.1
3 Pasquaney	7/27/04	8.4	0.6
3 Pasquaney	8/3/04	9.5	1.4
3 Pasquaney	8/10/04	9.8	1.4
3 Pasquaney	8/20/04	9.8	1.8
3 Pasquaney	8/27/04	9.8	1.4
3 Pasquaney	9/2/04	10.8	1.8
3 Pasquaney	9/8/04	9.9	2.1
3 Pasquaney	9/15/04	10.2	1.7
3 Pasquaney	9/22/04	9.5	2.6
3 Pasquaney	9/30/04	8.5	1.6
3 Pasquaney	5/27/05	8.0	1.1
3 Pasquaney	6/21/05	4.1	2.4
3 Pasquaney	6/29/05	4.2	2.4
3 Pasquaney	7/5/05	4.9	1.9
3 Pasquaney	7/13/05	5.6	1.6
3 Pasquaney	7/19/05	6.6	1.9
3 Pasquaney	7/29/05	8.2	1.5
3 Pasquaney	8/10/05	8.5	1.1
3 Pasquaney	8/19/05	8.3	1.3

APPENDIX I. Newfound Lake Volunteer Monitor Data (1986-2008)

Site	Date	Secchi Disk Transparency (meters)	Chlorophyll *a* (*u* g/l)
2 Mayhew	9/19/05	8.0	2.5
2 Mayhew	10/3/05	6.5	2.2
2 Mayhew	6/22/06	5.5	2.1
2 Mayhew	6/30/06	6.5	1.9
2 Mayhew	7/6/06	6.5	------
2 Mayhew	7/12/06	7.0	1.3
2 Mayhew	7/20/06	7.0	1.1
2 Mayhew	7/25/06	6.0	1.3
2 Mayhew	7/31/06	7.5	1.4
2 Mayhew	9/4/06	6.5	1.6
2 Mayhew	9/12/06	7.5	1.7
2 Mayhew	9/18/06	6.5	1.4
2 Mayhew	9/27/06	8.0	1.6
2 Mayhew	6/3/07	7.0	1.8
2 Mayhew	6/20/07	8.5	1.4
2 Mayhew	6/28/07	8.0	1.7
2 Mayhew	7/5/07	7.0	------
2 Mayhew	7/14/07	7.5	1.4
2 Mayhew	8/1/07	7.5	0.9
2 Mayhew	8/7/07	8.0	1.4
2 Mayhew	8/21/07	7.5	1.6
2 Mayhew	8/28/07	8.0	1.4
2 Mayhew	9/7/07	7.5	1.4
2 Mayhew	9/25/07	7.5	1.7
2 Mayhew	6/21/08	9.5	0.6
2 Mayhew	7/11/08	7.5	1.3
2 Mayhew	7/16/08	7.0	1.4
2 Mayhew	7/25/08	5.0	2.4
2 Mayhew	8/7/08	6.5	0.0
2 Mayhew	8/16/08	6.0	1.8
2 Mayhew	8/24/08	6.0	1.5
2 Mayhew	9/4/08	6.0	1.6

Site	Date	Secchi Disk Transparency (meters)	Chlorophyll *a* (*u* g/l)
3 Pasquaney	8/26/05	7.8	1.5
3 Pasquaney	9/2/05	8.6	1.9
3 Pasquaney	9/14/05	8.6	1.9
3 Pasquaney	9/25/05	8.2	2.2
3 Pasquaney	6/28/06	6.5	1.9
3 Pasquaney	7/4/06	7.2	1.6
3 Pasquaney	7/11/06	7.9	1.1
3 Pasquaney	7/19/06	7.5	1.2
3 Pasquaney	7/26/06	6.8	1.1
3 Pasquaney	8/4/06	9.3	1.2
3 Pasquaney	8/13/06	7.8	1.6
3 Pasquaney	8/22/06	9.2	1.9
3 Pasquaney	8/29/06	9.0	1.6
3 Pasquaney	9/5/06	9.6	1.3
3 Pasquaney	9/13/06	9.8	1.4
3 Pasquaney	9/22/06	9.8	1.4
3 Pasquaney	9/30/06	10.3	1.8
3 Pasquaney	10/7/06	9.9	1.4
3 Pasquaney	6/2/07	10.8	1.4
3 Pasquaney	6/10/07	10.5	0.6
3 Pasquaney	6/17/07	9.5	1.4
3 Pasquaney	6/25/07	8.9	------
3 Pasquaney	7/3/07	8.0	2.8
3 Pasquaney	7/10/07	7.3	1.2
3 Pasquaney	7/20/07	6.8	1.6
3 Pasquaney	7/26/07	9.0	5.4
3 Pasquaney	8/3/07	9.2	1.0
3 Pasquaney	8/10/07	9.8	1.1
3 Pasquaney	8/16/07	9.8	0.6
3 Pasquaney	8/24/07	9.8	1.4
3 Pasquaney	9/6/07	9.5	1.7
3 Pasquaney	9/17/07	9.5	1.3
3 Pasquaney	9/25/07	10.5	1.4
3 Pasquaney	6/8/08	10.5	1.0
3 Pasquaney	6/18/08	11.3	0.6
3 Pasquaney	6/26/08	8.5	1.0
3 Pasquaney	7/4/08	8.6	0.8
3 Pasquaney	7/13/08	7.0	1.7
3 Pasquaney	7/23/08	6.1	1.3
3 Pasquaney	7/30/08	6.3	1.2
3 Pasquaney	8/2/08	6.5	------
3 Pasquaney	8/12/08	5.6	1.9
3 Pasquaney	8/28/08	7.5	1.4
3 Pasquaney	9/11/08	7.2	1.6
3 Pasquaney	9/22/08	7.6	2.3

Geology of the Newfound Watershed

The Newfound Watershed Master Plan

Geology of the Newfound River Watershed
Boyd Smith, CPG
Spring 2009

Introduction

The physical setting of the Newfound River watershed is a rich and varied blend of healthy forests, diverse wildlife, rural communities and clear Newfound Lake. These features are framed by the subtle beauty of the hills and mountains that surround the lake, adding their infinite angles and shapes to the horizon. This contribution to *Every Acre Counts* is an overview of geologic processes that shaped the foundation of the watershed. The purpose is to summarize current hypotheses about NH bedrock geology, to lay the foundation for field investigations to confirm (or refute) these hypotheses, and to both challenge and reward the interested lay reader.

The hills and ridges that surround Newfound Lake and encompass roughly 63,000 acres of land and water. The 50-mile ridgeline ranges in elevation from roughly 650 feet above mean sea level (msl) at the former Newfound Lake outlet to 3,155 feet msl at Mt. Cardigan's summit. Newfound Lake is roughly 7 miles long and 4 miles wide with an average depth of 90 feet and a maximum depth of 183 feet east of the Alexandria ledges. It is oriented northwest / southeast, generally parallel to the direction of glacial movement. Figure 1 depicts watershed topography and Newfound Lake bathymetry.

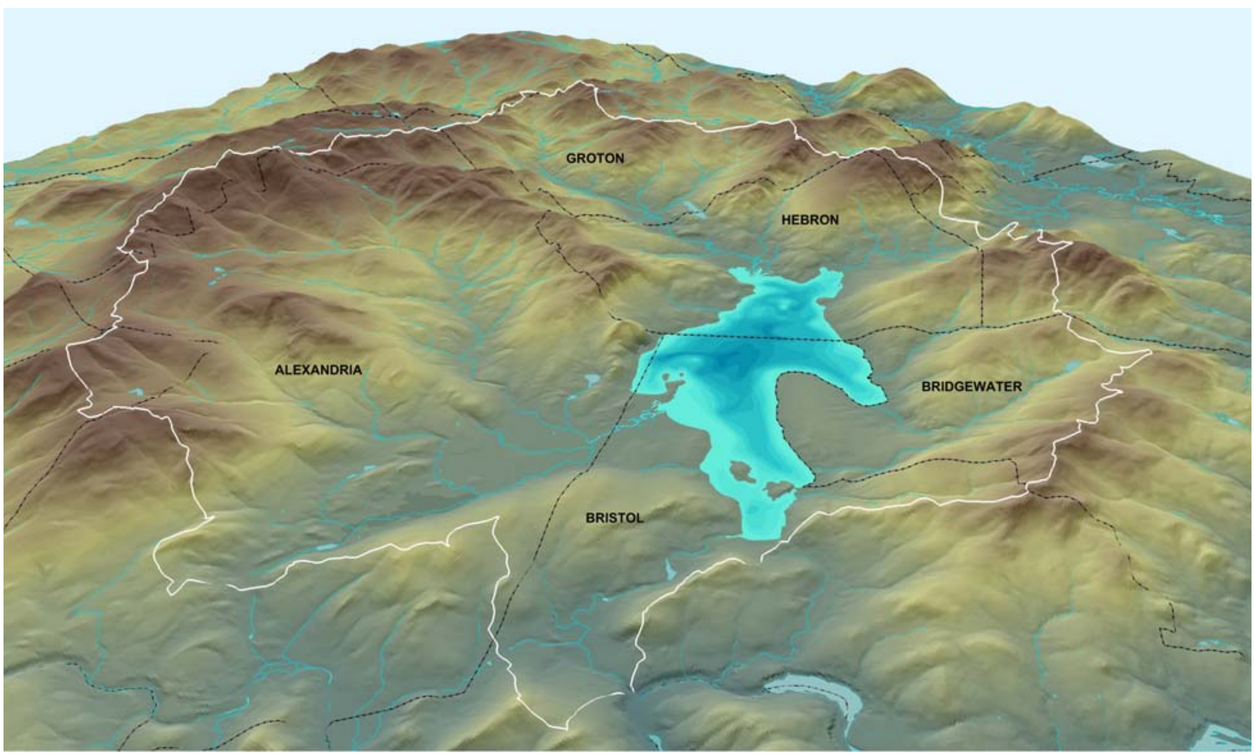


Figure 1. Shaded Relief Map of Newfound River Watershed (Society for Protection of NH Forests, September 2008 with funding from NH Department of Environmental Services)

Note the large range in elevation from the 3,155-foot msl summit of Cardigan to the ~565-foot msl lake surface - a maximum relief of ~2,500 feet - and the resulting steepness of much of the watershed. In fact, the fields in the lower valleys of the Fowler and Cockermouth Rivers present a remarkable contrast to the surrounding terrain.

Figure 2 shows the bedrock geology of the Newfound River watershed. There are many interesting features that reflect the complexity of the local bedrock and glacial geology, some of which are described herein with their approximate locations numbered on Figure 2. Of particular interest are the pegmatites with their abundant mica and feldspar deposits that supported the local economy from the early 1800s to the middle 1900s. The Alexandria Mica Mine (Location 1) was a major producer of mica in New Hampshire at a time when New England was the largest producer of mica in North America [1]. The Bristol graphite mine (Location 2) was reportedly worked by the Henry David Thoreau family to produce lead used in their pencil industry [2-5]. The Breck-Plankey Spring on Route 3A in Bristol (Location 3) provides water to hundreds of residents and visitors, while the Sculptured Rocks pot holes in Groton (Location 4) are a favorite summer swimming location (especially if you like really cold water).

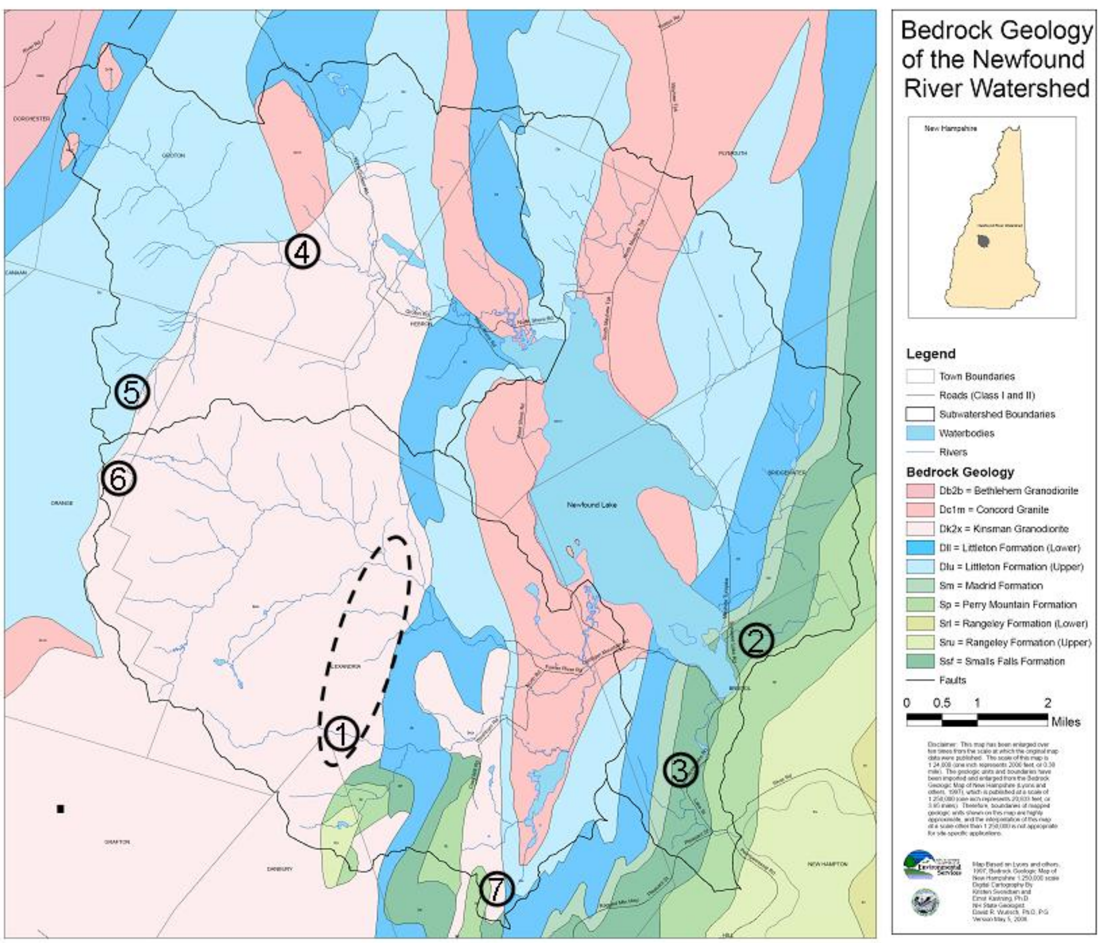


Figure 2. Bedrock Geology of the Newfound River Watershed (Dashed line encloses Alexandria Pegmatite Zone, circled numbers explained in text)

Many of these locations are open to the public, while the graphite and pegmatite mines are on private property and can only be accessed with the owner's permission. Always take great care when exploring old mines, as footing is treacherous and abandoned pits and shafts present great hazard.

Ages and dates of hundreds of millions of years will be used in this section as that is the scale on which Earth processes operate. It is hard for most people to comprehend such large numbers. Earth scientists put geologic events on a geologic time scale to convey their relative ages, and must connect sparse evidence from rock exposures to build and interpret a geologic history for the area.

Bedrock Geology

The Newfound watershed is located in the northern Appalachian Mountains. It lies within a geologic province referred to as the Central Maine Trough (CMT), a roughly 20 to 50 mile wide by 80 mile long region of central New Hampshire, that has a long and complex geologic history [6]. Figure 2 is derived from the Bedrock Geologic Map of NH [7], itself an evolving scientific work-in-progress built on investigations of New Hampshire geology which began in the mid-1800s.

The Appalachian Mountains, which extend 1,500 miles from northeastern Mississippi to western Newfoundland, were formed by three phases of mountain building that occurred over roughly 200 million years of continental collision between the ancestral North American and European / African tectonic plates. From oldest to most recent, these mountain-building events are known as the Taconian, Acadian and Alleghenian orogenies evidence of the Alleghenian is lacking in New Hampshire). Figure 3 is a schematic of the major tectonic phases of Appalachian mountain building (note that dates referenced in the text reflect a more current geologic time scale than that used on Figure 3).

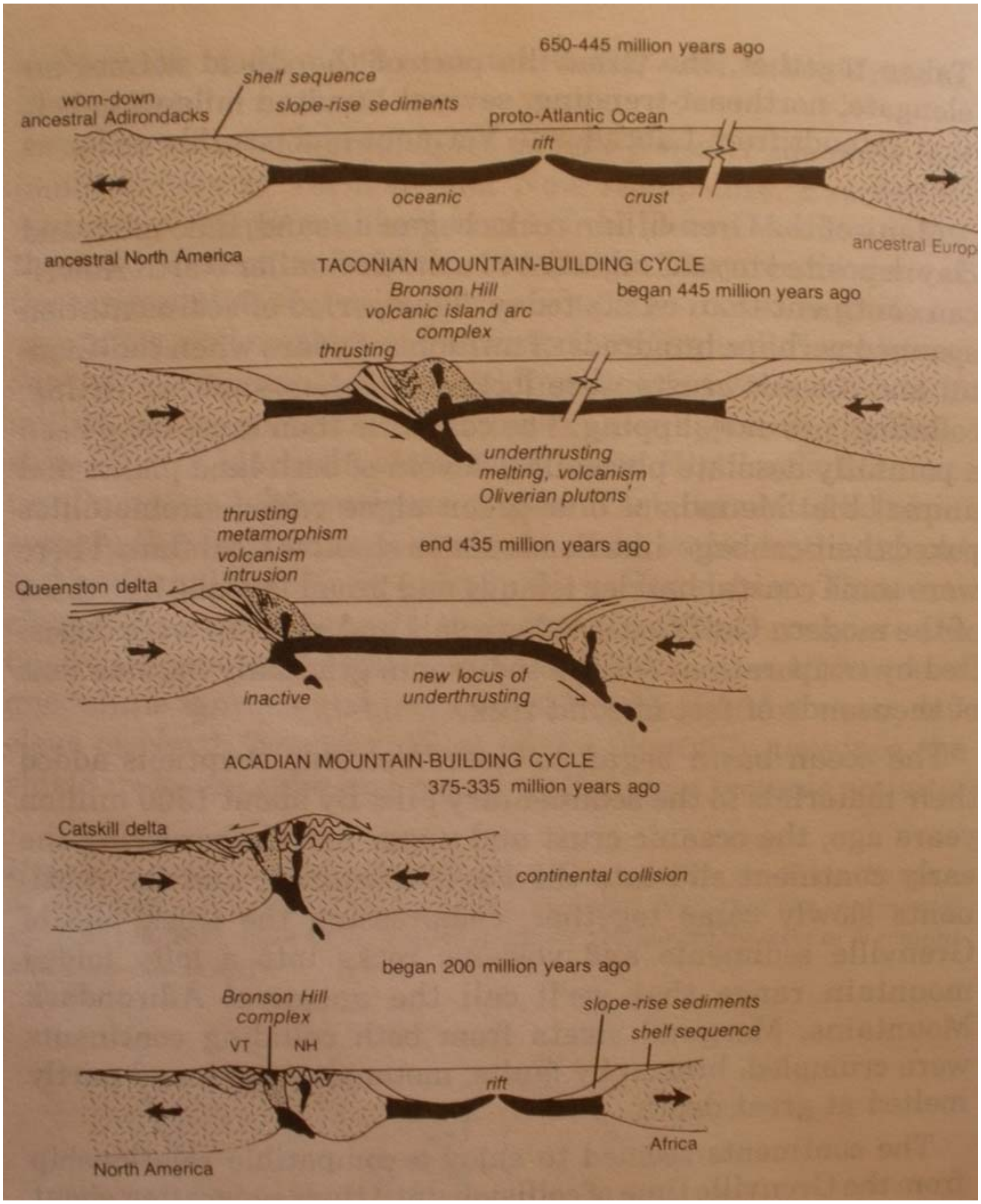


Figure 3. <u>Appalachian Mountain Building and Opening of Atlantic Ocean</u>
(After Van Diver [8], p. 28)

From 650 to 470 millions years ago (Ma), the east coast of the North American continent (NAC) was a passive tectonic margin where sediments and limestone deposits accumulated in a shelf/slope environment of the expanding Iapetus (or proto-Atlantic) Ocean. In the middle Ordovician period (around 470 ma), tectonic plate motion changed direction and the ocean basin began to close with east-directed subduction of the basaltic oceanic crust off shore of the NAC. Melting of the oceanic plate and overlying sediments generated magma which erupted, forming a volcanic island arc analogous to Japan. As these active volcanoes migrated slowly westward they eroded and shed their sediments to the intervening ocean basin. Basin closure initially compressed the continental and island-arc sediments into highly-deformed metamorphic rocks. As basin closure continued and compression intensified, slivers of the underlying mantle were added to the growing sediment pile - these slivers later became the serpentine and asbestos deposits of Vermont and Quebec. Over a period of roughly 10 million years known as the Taconic Orogeny, the volcanic island arc now known as the Bronson Hill Anticlinorium (BHA) was accreted to the NAC[8]. The BHA forms the highlands east of the Connecticut River in New Hampshire that extend northeasterly into Maine as the Boundary Mountains.

During the Silurian Period (443 to 417 Ma) the Iapetus Ocean continued to close while the mountains of the BHA eroded and shed their sediments both to the west and to a rapidly subsiding ocean basin to the east (the CMT). The eastern sediments became the Silurian-aged rocks now found to the east and south of Newfound Lake (Figure 2). These rocks, formed from a roughly 4-kilometer-thick pile of clastic and volcanic sediments [9] include (from oldest to youngest) the Lower Rangeley (SRl), Upper Rangeley (SRu), Perry Mountain (Spm), Smalls Falls (Ssf) and Madrid (Sm) Formations [6].

The proto-European / African continent approaching from the east added roughly one kilometer of flysch deposits that became the Devonian-aged (417 to 364 Ma) Littleton Formation [9], named for its type locality in Littleton, New Hampshire. Three units of the Littleton Formation are mapped in the watershed, being (from oldest to youngest) the Lower Member (Dll), the Upper Member (Dlu) and a Calcareous (calc-silicate) Member (Dlcs). The younger Devonian sediments overwhelmed deposition from the west, forming a sequence of deep-water sediments that overlapped the more shallow-water sediments of Silurian age [6], becoming the upper sequence now found in the CMT.

As the CMT continued to evolve the intervening sediments were further compressed, deformed and metamorphosed by intensifying pressure and heat. Deformation created enormous folds in the lithifying sediments, while increasing heat caused partial melting and generation of magmas that became intimately involved with the deformation process. The final part of Iapetus closure occurred between 400 and 385 ma [8], building mountains that rivaled the present-day Himalaya, home to 29,020-foot Mt. Everest.

At Himalyan elevations, crustal thickness during the Acadian orogeny likely exceeded 40 miles[10]. At these depths, heat from radioactive decay within the sediment pile as well as from sources deeper in the mantle allows rocks to become plastic and flow under tectonic stress and gravity. Central New Hampshire's complex geology can be explained as a series of nappe structures that migrated ("verged") westward and eastward from a line known as the "dorsal zone" [6] (see also [2, 9, 11-13]).

A nappe is essentially a large crustal fold that collapses to become reclined or recumbent. It is not uncommon for a nappe to be further transported in the direction of compression along a low-angle fault at its base. The geologic trace of the dorsal zone is identified by a series of metamorphosed serpentine deposits (soapstone - analogous to the Vermont serpentine belt), as well as verging directions of folds throughout New Hampshire. The dorsal zone is the location where the colliding continents ultimately came to rest, with the Lower Rangeley Formation representing the "root zone" or source of the nappes [6]. Lyons [9] noted that the Lower Rangeley Formation is likely the axis of the former ocean basin. This important rock unit is located immediately east of the Newfound watershed (Figure 2, SRl). Cross-section C-C' of the State Bedrock Map [7] gives a sense on the development and current map pattern of the dorsal zone and its nappes.

Figure 4 shows the evolution of nappes from early through late stages of deformation (D1 through D4) as proposed by Eusden and Lyons [14]. The horizontal line across the Present Day stage approximates the current land surface. Note that early-stage deformation (D1) is dominated by faults while during later-stage deformation (D2 – D4) plastic deformation (folding and nappe development) are accompanied my partial melting and magmatic intrusions.

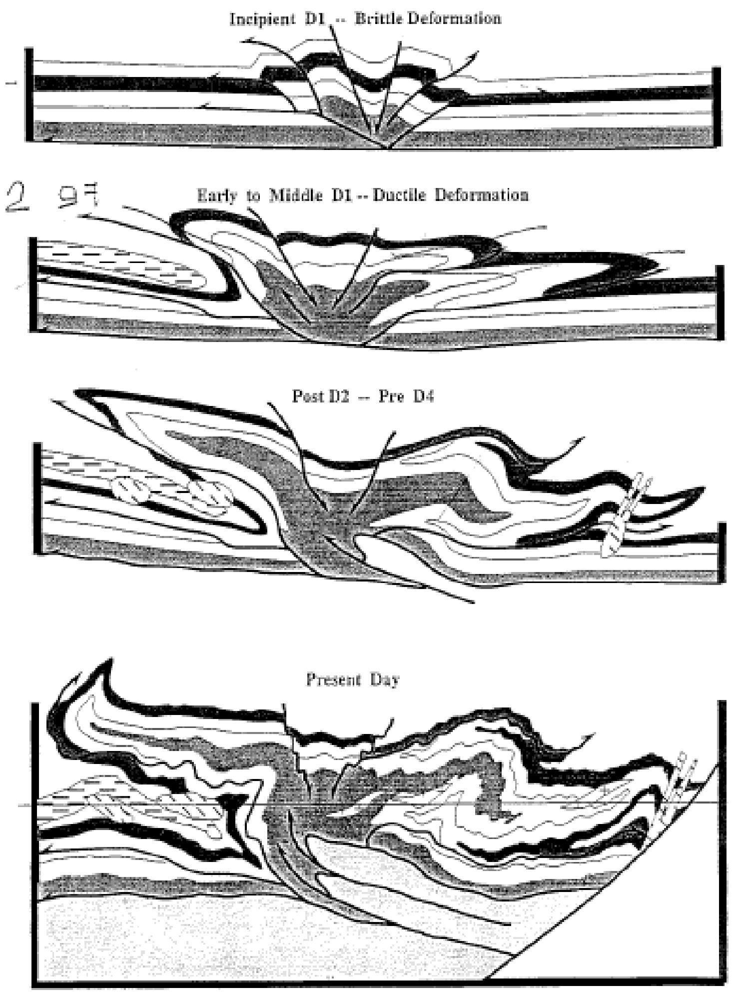


Figure 4. Proposed Evolution of New Hampshire's Acadian Nappes (after Fig. 6, Eusden and Lyons [14])

During nappe formation pressures and temperatures became high enough to melt metamorphic rocks, especially in the presence of fluids such as water and carbon dioxide. The Kinsman Granodiorite with its distinctive large, pale feldspar crystals (Dk2x of Fig.2) is prominent on the summit and eastern flanks of Mt. Cardigan. The Kinsman was created during late stages of the

Acadian orogeny (400 – 390 ma) [12] and was intimately involved with the nappe formation. Gravity studies[2] indicate that the Kinsman is a relatively thin (2 to 3 kilometer-thick) slab rather than a more deeply-rooted batholith. There is some debate about the amount of heat and material that formed the Kinsman as well as the Concord Granite (see below), suggesting that the Kinsman and Concord rocks did not originate solely as a result of melting of the enclosing metasediments [13]**,** but received input from a mantle source [9].

Late in the Kinsman's history, more volatile and less viscous portions of the melt were forced into the surrounding rock to slowly cool and form pegmatites. Newfound-area pegmatites are granitic intrusions distinguished by the unusually large size of their minerals. The eastern edge of the Kinsman Granodiorite in Alexandria contains a zone of abandoned pegmatite mines and prospects roughly ten miles long by one mile wide [1] (see Figure 2) From the late 1800s to the middle 1900s these pegmatites, as well as numerous others in Groton and Orange, were mined for mica and potash feldspar, providing a substantial source of cash to the local economy [15].

Detailed mapping for strategic minerals in the early 1940's indicates that the Alexandria pegmatites range in size from tens to hundreds of feet long and a few feet to tens of feet thick [1]. They are generally concordant with the foliation of the country rock, exclusively the Kinsman, and are often found in brecciated zones between the Kinsman and Littleton or along zones of tension evidenced by minor faulting and cross-cutting dikes[1]. The Alexandria Mica Mine (Figure 2, Location 1) is perhaps the best known of these historical mines. From its opening in 1883 by Mr. George Patten through its peak years of operation by General Electric, it produced some of the highest volumes of quality mica in the state.

The Concord Granite was injected into Newfound area rocks after the Acadian orogeny at roughly 365 Ma [9]. The Concord Granite cross-cuts the older Littleton Formation at the north end of Newfound Lake, but appears to be truncated by the Kinsman farther northwest in Groton (Fig. 2). This apparent contradiction could be the result of map patterns in a complex structure, where the much younger Concord Granite may have been generated by post-tectonic radioactive heating of the Kinsman and surrounding metasediments. As a result, it is intimately related to and controlled by the geometries of the older surrounding rocks. The Concord Granite underlies the lowlands filled by Newfound Lake, extending north to a low point (~880 msl) where Rte. 3A goes to Plymouth and south to another low point (~650 msl), a Newfound paleo-drainage (see Glacial Geology, below). Based on its presence in the lower elevations of the watershed it is likely that the Concord Granite is more susceptible to weathering than the surrounding rocks.

Roughly 335 Ma a final disturbance to the Appalachian Mountains called the Alleghenian orogeny occurred. However, evidence of the Alleghenian has not been definitively found in northern New England. More important to the bedrock history is the opening of the modern Atlantic Ocean, which began 180 – 200 Ma [8] with a series of rifts analogous to East Africa or the Mid-Atlantic Ridge. Remnants of a failed rift from this event can be seen in the distinctive coarse red sediments and dark brown basalt flows of the Connecticut River Valley along Rte. 86 in north-central Connecticut. As the Atlantic slowly widens the ancestral Appalachian Mountains continue to erode, shedding their former heights into the surrounding lowlands.

To reinforce a sense of time required for geologic processes and the challenge of reconstructing geologic events, periods of Appalachian mountain building are compared to erosion:

- Mountain Building "what we see": (470-460 Ma; Taconic) + (420-380 Ma; Acadian) = 50 million years.
- Erosion "what we don't see": (460-420) + (380 – present) + Mountain Building = 470 million years.

Today only the roots of the ancestral Appalachian Mountains remain, mantled by weathered rock, soil, vegetation and relatively sparse human development. The cliffs and summits that we view from our perspectives in the Newfound watershed are an ancient legacy of which we are but a fleeting part.

Glacial Geology

While the Earth has experienced numerous glacial events during its 4.6billion year history, to a great extent the past ~ 2 million years (Pleistocene epoch; 1.8 ma to 11,400 years before present (ybp)) shaped the landscape we see. During the Pleistocene, continental-scale glaciers formed at higher latitudes in North America and local glaciers developed in higher elevations such as the White Mountains. In southern New York and in the Midwest evidence of multiple Pleistocene glacial advances remains. In New Hampshire, only the most recent (Wisconsin) glaciation is recognized (although evidence of an earlier "Illinoian" advance is discussed under a "two-till theory").

During the late Wisconsin (roughly 35,000 to 11,150 ybp) an ice sheet thousands of feet thick advanced from Canada southeasterly across New Hampshire and extended as far as Long Island, NY. Glaciers move by plastic flow, advancing when more snow accumulates than melts and retreating when melting is greater than the snow accumulation rate. A tremendous amount of rock and sediment becomes entrained in the lower levels of a glacier. This material acts as a mega-scale abrasive, scratching and tearing at the land surface under the millions of tons of pressure exerted by the overlying ice.

Evidence of this abrasion can be seen at Cilley's Cave, where the ice plucked bedrock of the Littleton formation from the north shoulder of Mt. Cardigan, leaving a trail of tumbled boulders and voids (Figure 2, Location 5). Glacial striations (grooves) and boulder trains can be found on and near the summit of Mt. Cardigan (Figure 2, Location 6) and other areas of exposed bedrock. The orientations of glacial striae indicate the direction of ice movement; generally northwest to southeast across New Hampshire. The Concord Granite which underlies northwest-trending Newfound Lake was likely scoured and the pre-existing basin deepened by glacial action.

With the melting and retreat of the continental glaciers (roughly 21,000 – 10,000 ybp), enormous amounts of water were released that carried tremendous quantities of sediment down the major river drainages to the sea. Imagine the most powerful flood you have ever seen, and multiply it ten-fold by hundreds of years. Inspection of the carved pot holes of the Sculptured Rocks Geological Site (Figure 2, Location 4) helps illustrate the erosive effects of the sediments carried by the glacial melting. Where river valleys were obstructed by ice, sediment or bedrock, lakes ranging in areas from a few to hundreds of square miles formed at the margins of the retreating ice. Sediments transported by meltwater were deposited as deltas in glacial lakes and as sub-glacial and outwash deposits elsewhere. Today, many of these deposits are mined for sand and gravel.

Shortly after deglaciation, Newfound Lake was significantly larger and roughly 100 feet deeper than its current size, draining to the southwest via the tributary valley of Bog Brook in Alexandria [16] (elevation ~650 msl at Cross Road; Figure 2, Location 7). Test borings and seismic refraction surveys performed in the gently rolling fields of the lower Fowler and Cockermouth River valleys detected deposits of silt, fine to coarse sand and gravel over 100 feet thick [16]. These coarse sediments, saturated with ground water, form high-yielding aquifers with transmissivities greater than 8,000 square feet / day, which is why the Town of Bristol's water supply wells are located in the eastern Fowler River valley. The overlying well-drained valley soils also form some of the most productive agricultural lands in New Hampshire.

Conclusion

This brief and ambitious summary shows that the bedrock of the Newfound Lake watershed was formed during the Ordovician through Devonian Periods from sea floor sediments changed in to bedrock by the Iapetus (proto-Atlantic) Ocean closure. The resulting mountains and surrounding bedrock were subjected to weathering and erosion over hundreds of millions of years, most recently by late Wisconsin-age glaciation. The pegmatites, glacial pot holes, aquifers and surrounding hills that make our towns, forests and land so unique owe their existence to the processes of a long, complex and dynamic geologic history.

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Wildlife Habitat in the Newfound Watershed

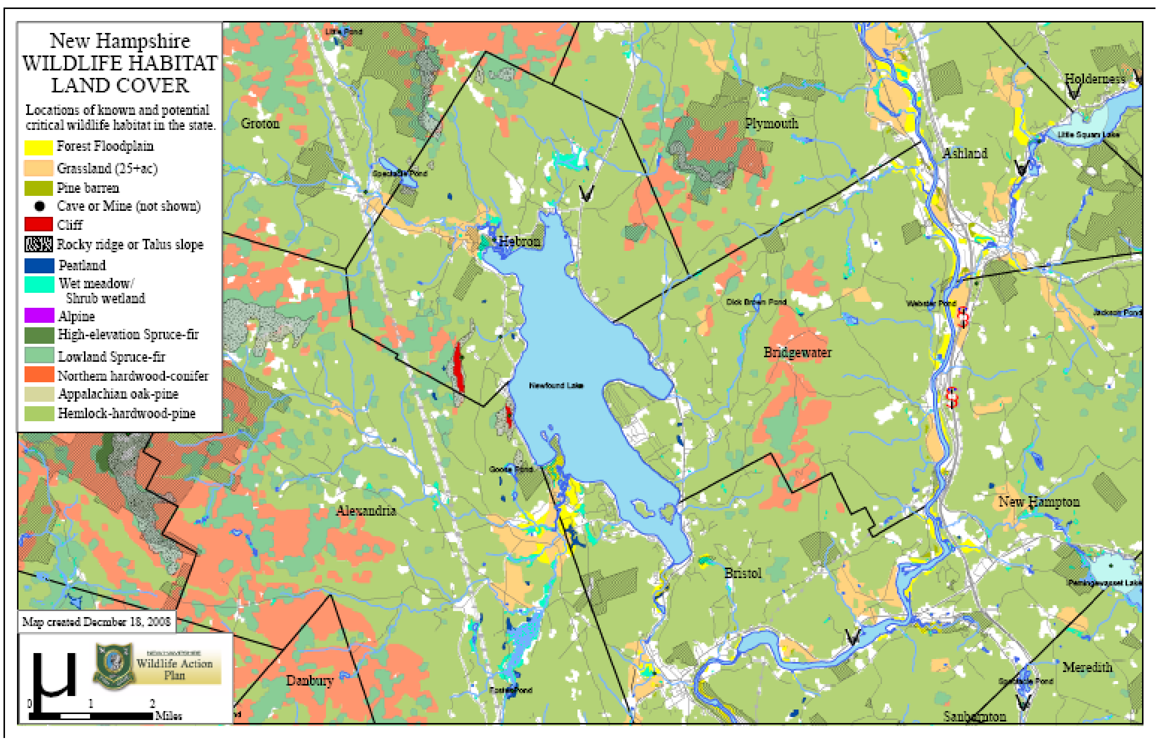
The Newfound Watershed Master Plan



Newfound Lake Region and New Hampshire's Wildlife Action Plan
By Lindsay Webb and Emily Brunkhorst,
NH Fish and Game Department, January 2009

New Hampshire's Wildlife Action Plan (WAP) is a blueprint to keep species from becoming endangered. The WAP is the most comprehensive wildlife and habitat assessment ever completed in New Hampshire. Completed in 2005 by NH Fish and Game Department staff and their conservation partners, the WAP provides New Hampshire landowners and conservationists with important tools for restoring and maintaining critical habitats and populations of the state's species of conservation and management concern. It pulls together a vast amount of data, analyzes much of it to assess how species and habitats are doing, and outlines key conservation strategies – ways to help conserve the wildlife and habitats that are most at risk in our state. It is a proactive effort to define and implement strategies that will help keep species off rare species lists, and in the process save taxpayers millions of dollars.

The WAP Wildlife Habitat Land Cover Map (Figure_) can be used in the Newfound Lake Watershed to broadly define habitat types.

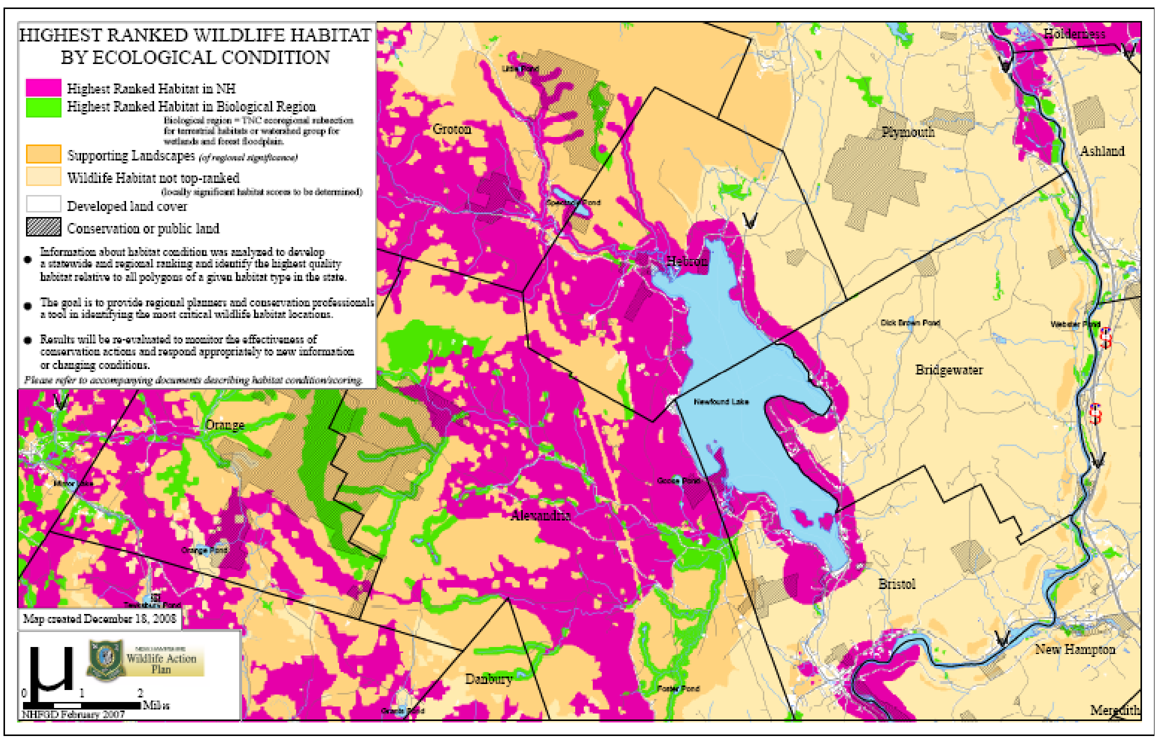


In general, this region has a large amount of hemlock-hardwood-pine forest. Other habitat types found in this region are northern hardwood-conifer, lowland spruce-fir, grasslands, cliffs, rocky ridge or talus slope, wet meadow/shrub wetlands, peatlands, and floodplain forests. Many common species use these habitats including white tailed deer, black bear, gray fox, and American crow, to name a few. The lowland spruce-fir habitat and dense hemlock forests should be checked for potential deer wintering areas which are critical for this common species to survive harsh winters. Using Appendix D of the

WAP, the habitats can help identify potential WAP wildlife species. WAP species are species that are in greatest need for conservation. Some WAP species are not yet imperiled in the state while others have the potential of going on the Threatened and Endangered List if the threats to their continued existence are not addressed. For example, the wetland and upland complexes throughout the watershed could provide ideal habitat for wood and spotted turtles. Newfound Lake provides habitat for numerous fish species including lake whitefish and round whitefish. Common loons also use the lake and its shoreland for habitat. The cliff habitat provides the opportunity for cliff dwelling species such as the peregrine falcon, which last nested there in 1927. An on the ground search will need to be done in order to confirm the presence of WAP species.

The WAP also identifies risks to both wildlife species and their habitats and offers strategies to address those needs. Loss of habitat due to development is one of the biggest threats to all habitats and species, but other threats such as recreation and energy communication infrastructure can also threaten lakes and cliffs. Recognizing and identifying these and other threats should be a priority for the decision makers within the Newfound Lake Region.

The WAP Highest Ranked Wildlife Habitat Map for the Newfound Lake Watershed is below in Figure _. The associated supporting landscape is critical to the health of the highest quality habitats.



The Newfound Lake Region has a significant amount of high ranking habitat with diverse biological factors, high landscape factors, and low human influence factors. This information can help prioritize conservation planning in the Newfound Lake Region. The map's geographic information system (GIS) information can also be re-ranked to focus on the Newfound Lake Watershed in order to provide a narrower scope of highest ranked wildlife habitat.

The NH Wildlife Action Plan is not a static document and the mapping information will be updated on a regular basis. The information, especially within the Highest Ranked Wildlife Habitat Map, is only as accurate as the current data. The Newfound Lake Watershed can continue to contribute to this data by reporting rare plants to New Hampshire Natural Heritage Bureau (http://www.nhdfl.org/natural-heritage-and-habitats) and WAP wildlife species to New Hampshire Fish and Game (www.wildnh.com). It is also useful to make sure all conservation and public lands are digitized in the New Hampshire Conservation GIS layer (http://www.granit.unh.edu). Future references to the New Hampshire Wildlife Action Plan should be using the most current updated version (New Hampshire Fish and Game: www.wildnh.com).

Fish Species within the Newfound Watershed

The Newfound Watershed Master Plan

Fish Species within the Newfound Lake Watershed

Newfound Lake is a popular year round fishery for New Hampshire anglers. Landlocked salmon, rainbow trout, lake trout and smallmouth bass are the species most primarily targeted during open water fishing seasons. The total number of bass tournaments, which are only authorized when permitted by the New Hampshire Fish and Game Department (NHFGD), have averaged below ten tournaments annually for the past ten years. Rainbow trout, lake trout, and yellow perch are most commonly targeted during the ice fishing season. A survey conducted during February and March of 1999 estimated that anglers spent over 7000 hours ice fishing on Newfound Lake.

The Newfound Lake Watershed contains twenty-two different fish species. Of these, six species have been identified as requiring special consideration in the New Hampshire Wildlife Action Plan (2006). This designation of a species of concern is based on population status, integral ecological function of a species, or the ability of a species to indicate a healthy aquatic ecosystem. For information regarding the current status of a particular species of concern or rationale as to why the species has this designation visit: http://www.wildlife.state.nh.us/Wildlife/Wildlife_Plan/WAP_pieces/WAP_App_A_Fish.pdf.

The presence of the round whitefish in Newfound Lake is of particular interest to natural resource managers in New Hampshire. Recent documentation suggests that populations of this species are only found in Newfound Lake, Lake Winnipesaukee and upper portions of the Connecticut River. While attempts to obtain information regarding the current status of these populations are ongoing at Newfound Lake, little information is available to describe the status of other populations. Documentation suggests the species is vulnerable to predation and competition with introduced fish species, acid deposition, degradation of spawning habitat, and poorly timed lake level fluctuations. The species is rarely targeted or caught by anglers, has a cylindrical body shape and most likely grows to a maximum size of approximately 20 inches in New Hampshire.

Table _ Documented Fish Species within the Newfound Lake Watershed

Species	Habitat	Designation	Species	Habitat	Designation
Blacknose Dace	R		Longnose Dace	R	
Brook Trout	L, R	**Species of Concern** Both stocked and self-sustaining game species	Margined Madtom	L	
Brown Bullhead	L	Self-sustaining game species	Rainbow Smelt	L	**Species of Concern**
Burbot	L, R	**Species of Concern**	Rainbow Trout	L, R	Stocked game species
Chain Pickerel	L	Self-sustaining game species	Redbreasted Sunfish	L	
Common Shiner	L, R		Rock Bass	L	
Creek Chub	R		Round Whitefish	L	**Species of Concern**
Fallfish	L, R		Slimy Sculpin	R	**Species of Concern**
Golden Shiner	L, R		Smallmouth Bass	L	Self-sustaining game species
Lake Trout	L	**Species of Concern** Self-sustaining game species	White Sucker	L, R	
Landlocked Salmon	L, R	Stocked game species	Yellow Perch	L	Self-sustaining game species

L=Found in Lake/Pond Habitats
R=Found in Riverine Habitats

Fisheries Management within the Newfound Lake Watershed

The mission of the Inland Fisheries Division of NHFGD is to use planning and science for effective management of New Hampshire's inland fisheries resources. The Inland Fisheries Division utilizes the Department's Strategic Plan (1998-2010) in conjunction with results from New Hampshire angler opinion and attitude surveys (1996 and 2004) to guide its programs. This ensures the division is addressing the needs of the State's inland fisheries resources as well as the recreational groups who utilize these resources.

Fisheries managers assess sport fish stocks through the use a variety of sampling methods. Typical monitoring includes surveys that examine forage fish biomass surveys, tributary spawning smelt surveys, angler surveys, and fall netting. These surveys assess growth and survival parameters which determine stocking rates and angling regulations.

Current quantitative data for aquatic communities within the rivers and streams of the Newfound Lake Watershed is limited. Information obtained through the monitoring component of The Eastern Brook Trout Joint Venture (EBTJV) is expected to become a valuable tool to predict wild brook trout (and presumably other fish species) presence in streams and rivers lacking fish community data. It is anticipated that this predictive analysis will help identify specific land use and landscape thresholds that may limit the ability of a species to persist. It is expected that this information in conjunction with other water quality models will be a valuable guidance tool for land use planners and for the prioritization of conservation efforts in the future.

In an effort to minimize disturbance to species listed on the state threatened and endangered species list, NHFGD personnel have the opportunity to review and comment on wetland dredge and fill permit applications filed with the New Hampshire Department of Environmental Services (NHDES) and aquatic herbicide applications filed with the New Hampshire Department of Agriculture. Permits that may impact fish and wildlife species within areas protected by the Comprehensive Shoreline Protection Act are also reviewed. These reviews include recommendations to NHDES staff that avoids risk and minimize impact to the species.

Lake Level Management Recommendations

Of primary concern regarding the current lake level management plan for Newfound Lake is the fall drawdown and its subsequent impacts to lake trout and round whitefish eggs. Fertilized eggs deposited upon the rocky shallows (in as little water as a few inches) from mid October to mid December may become exposed to open air or frozen within the ice when water levels continue to drop during and after spawning. This can lead to direct mortality of the eggs. These eggs require several months to incubate and develop before hatching. Over time, this impact may lead to serious population declines.

Lake trout and round whitefish are self-sustaining populations, these species are not stocked by the NHFGD and their survival is completely dependent on natural reproduction. Fall netting surveys and angler reports reveal the potential of Newfound Lake to produce trophy sized lake trout including the NH state record fish.

Sampling data from the past four years indicates that the round whitefish has seriously declined since a detailed survey examined the population in the 1960's. Information from other states suggests that fluctuating lake levels may have contributed to the decline of round whitefish populations. Fisheries resource managers would support a stable or increasing lake water level at Newfound Lake for the period October 15th through "ice-in". Since round whitefish and lake trout eggs generally hatch before spring, this strategy will still facilitate the preparations necessary to accommodate spring flooding events. This aspect of the lake level management is similar to former Newfound Lake level management plans in the 1970's and early 1980's and the current lake level strategy for Lake Winnipesaukee.

Newfound River Flow Recommendations

Flow stability and consistency are essential to resident fish species found in the Newfound River. The current flow management of this river consists of significant flow variability and periods with severe low water conditions. Typically, these low water conditions are observed during summer months. Stress upon coldwater fish populations is arguably the highest during summertime when water temperature is greatest. Reduced flow rate further amplifies this impact. The NHFGD recommends a flow management plan that provides a minimum of 100cfs flow at all times within the river. However, it is recognized that the hydrology of Newfound Lake (the source of the Newfound River) may not always provide for this minimum flow recommendation.

Maintaining Natural Features and Riparian Buffers in Watershed Tributaries

Rivers and streams and their adjacent riparian zones and floodplains are essential for fish and wildlife within the Newfound Lake Watershed. Access to spawning and feeding areas in conjunction with the ability to recolonize and disperse into new areas is essential for the survival of fish populations. Tributaries not only provide permanent habitat for resident fish species but some lake species depend on these streams and rivers for spawning and feeding migrations. Rainbow smelt, rainbow trout, brook trout, fallfish, suckers, and landlocked salmon ascend tributaries from Newfound Lake seasonally to spawn. Other fish species will follow the spawning fish into the tributaries and prey upon eggs as a seasonal food source. Spawning adults can be somewhat particular about specific substrate sizes in streams to spawn on. In general, fish will avoid areas impacted by excessive siltation and sedimentation. This can be a result of poorly designed stream crossings, impacts to riparian areas upstream, and erosion from adjacent developed areas.

Streams and rivers are dynamic features of a watershed and require much consideration when a new road or development is proposed. The removal of vegetation and an increase in impervious surfaces can dramatically increase runoff rates that enter a stream resulting from storm events. Increased runoff rates, especially in areas with removed vegetation, can scour bare soils and deposit silt, sand and other containments into streams. As sediment loads increase, significant alterations to the streambed may occur. Deep pools become shallow, and stream width increases. The natural streambed is buried under sediment and the macroinvertebrate community (a primary food source) can become altered as stream temperatures increase.

Stream erosion and deposition are natural functions of a stream's ability to transport sediment. Road crossing structures which focus on only the passage of water and neglect to incorporate sediment conveyance and aquatic organism passage can result in impacts to aquatic ecosystems spanning distances well away from the stream crossing location. Stream crossing structures that are undersized relative to the natural width and depth of a stream, especially those crossings that do not have natural substrate within them, tend to have high velocities compared to what is typical elsewhere in the stream.

Not only can these higher velocities reduce aquatic organism passage during periods of high flow, but also often create a scour pool immediately downstream. A scour pool can and often leads to the phenomenon called perching, in which the streambed is gradually eroded downstream of the crossing until the end of the culvert is well above the streambed, creating a waterfall at all but the highest flows. This condition limits fish from moving upstream through the culvert, especially as many fish species, and most other aquatic species, do not jump. Non-perched culverts may exhibit minimal water depth within the structure, which can restrict aquatic organism passage at low flows. Although properly designed stream crossings may require greater initial capitol costs, long term costs associated with maintenance and replacement are expected to be much less. In an effort to reduce costs associated with stream crossing structures, road planning should minimize the number of crossings or avoid crossing streams altogether.

The NHFGD recommends using the New Hampshire Stream Crossing Guidelines (2008) when a stream crossing structure is considered. This document provides direction to designers that promote structures that minimize impacts to aquatic ecosystems. Existing stream crossing structures throughout the Newfound Lake Watershed should be surveyed to determine areas where inappropriately sized crossing structures are creating excessive erosion or sedimentation. Crossing structures should also be analyzed for the ability to allow fish passage and the amount of habitat that would be reconnected if the crossing was improved. A database with this information would help prioritize areas if funding for replacement structures becomes available.

Allowing native vegetation to grow along streams, wetlands, ponds, and lakes is a cost effective management strategy for maintaining water quality and protecting wildlife habitat. Preventing development in these vegetated strips, or buffers, along aquatic habitats may avoid costly flood damage, wetland mitigation, and stream restoration projects. Riparian buffers provide many benefits to fish and wildlife. They help prevent sediment and pollutants from entering water bodies. Trees along the water's edge provide shade and reduce water temperatures. Fallen trees, branches, and leaves provide food for aquatic microorganisms, which form the base of the food chain that supports invertebrates, fish, and other aquatic wildlife. Fallen wood also improves fish habitat by providing cover, trapping sediment, and creating pools. Strips of native vegetation along streams and shorelines act as wildlife corridors and reduce the impacts of habitat fragmentation.

In general, the wider the buffer, the more environmental benefits that are provided. Recommended buffer widths usually range between 100 and 300 feet, depending on the desired level of protection. A 100 foot buffer will provide adequate water quality protection, but is not optimal for protecting fish habitat or wildlife corridors. Buffers of 300 feet or more provide the best protection for both water quality and habitat. Other factors to consider are the steepness of the terrain and land use in the surrounding watershed. For the best results, buffer protection should be applied to all aquatic habitats, including intermittent streams and small wetlands. Riparian buffer protection should be part of an overall plan to manage growth in a town or watershed, including other strategies such as limits on impervious surface and low impact development practices. Attached is a list of resources related to riparian buffers and developing town ordinances to protect them.

The NH Wildlife Action Plan acknowledges that shoreline development can limit the future expansion of a recovering population and act to reduce future carrying capacity of areas that currently support bald eagles. This species is a state threatened species protected by RSA 212-A, the New Hampshire Endangered Species Conservation Act. Shoreline development affects nesting, perching, roosting, and foraging by eagles, with direct and indirect effects on reproductive success and suitability of overwintering areas. The NH Wildlife Action Plan cites that one of the greatest ongoing habitat quality concerns for bald eagles is additional shoreline development on rivers and large lakes, especially in the Merrimack River watershed and Lakes Region areas. Every effort should be taken to preserve large trees, especially mature white pine, in order to preserve potential nest and roosting trees for bald eagle in the protected shoreland in this area.

Maintaining the Presence of Essential Aquatic Vegetation

Aquatic vegetation is vital for a wide and diverse range of fish and wildlife species. The sustainability of several fish species at several different life stages is intimately dependent on this habitat type. Aquatic vegetation, particularly when found in dense masses, is utilized for protection from predation, egg incubation, and feeding. Given the limited areas where aquatic vegetation can be found around the perimeter of Newfound Lake, shoreline property owners should attempt to limit disturbance to this lake habitat feature.

Aquatic vegetation is also instrumental in maintaining good water quality. When removed, the shoreline buffering capacity of aquatic vegetation on waves generated by wind and boat wakes is lost contributing to shoreline erosion (property damage) and higher levels of turbidity. Furthermore, when aquatic plants are removed from a system both existing and introduced nutrients become available for other organisms including several algal species. Significant available nutrients can lead to algal blooms which can create an objectionable scum on the water and in turn reduce water clarity. In some cases, certain algal types may reach concentrations which are toxic to humans, pets, and livestock. The removal of native vegetation is especially harmful as it leaves a void for non-native plant species to become established.

Native Brook Trout Study

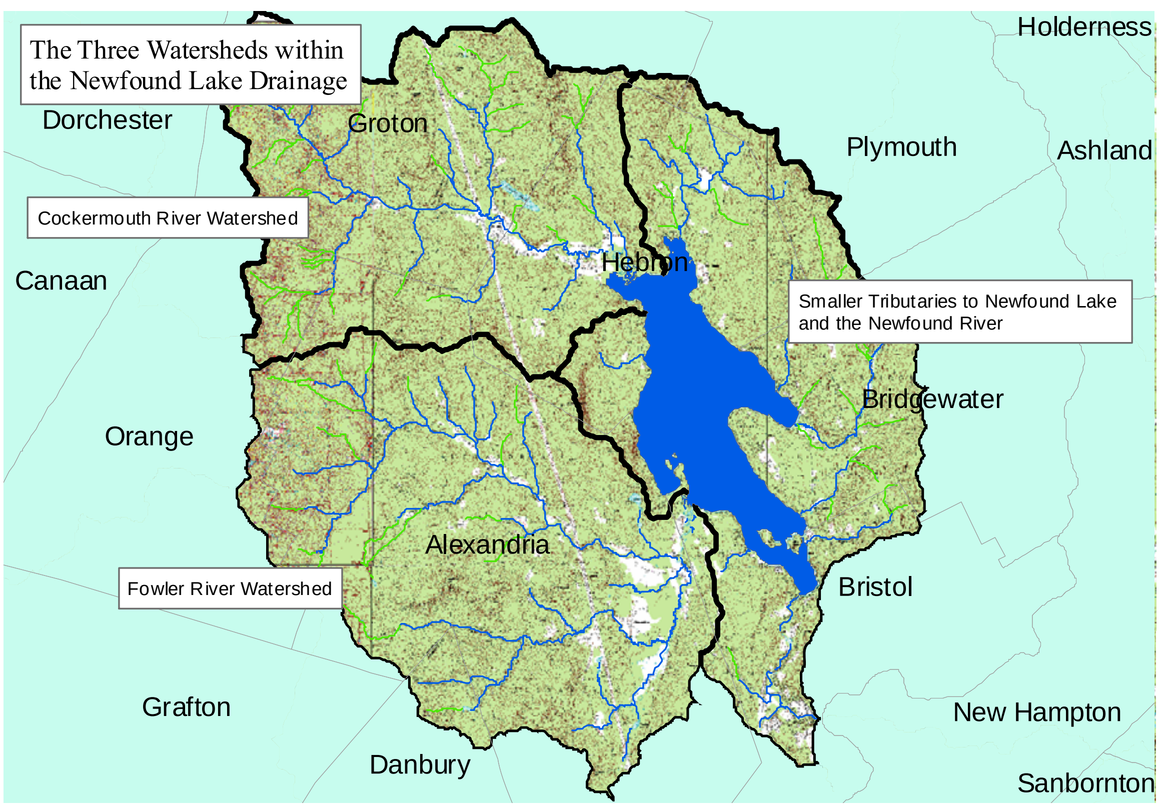
The Newfound Watershed Master Plan

Background

Brook trout are the only native stream dwelling trout species in New Hampshire, having a historic range that extended from Georgia to eastern Canada. It is believed that wild brook trout were once present throughout all watersheds in New Hampshire. Increased stream temperatures, changes to water chemistry, habitat fragmentation, increased rates of predation and competition, loss of spawning locations, and the loss of stream habitat complexity have led to reduced and isolated populations of wild brook trout both in New Hampshire and throughout the species native range in the eastern portions of the United States.

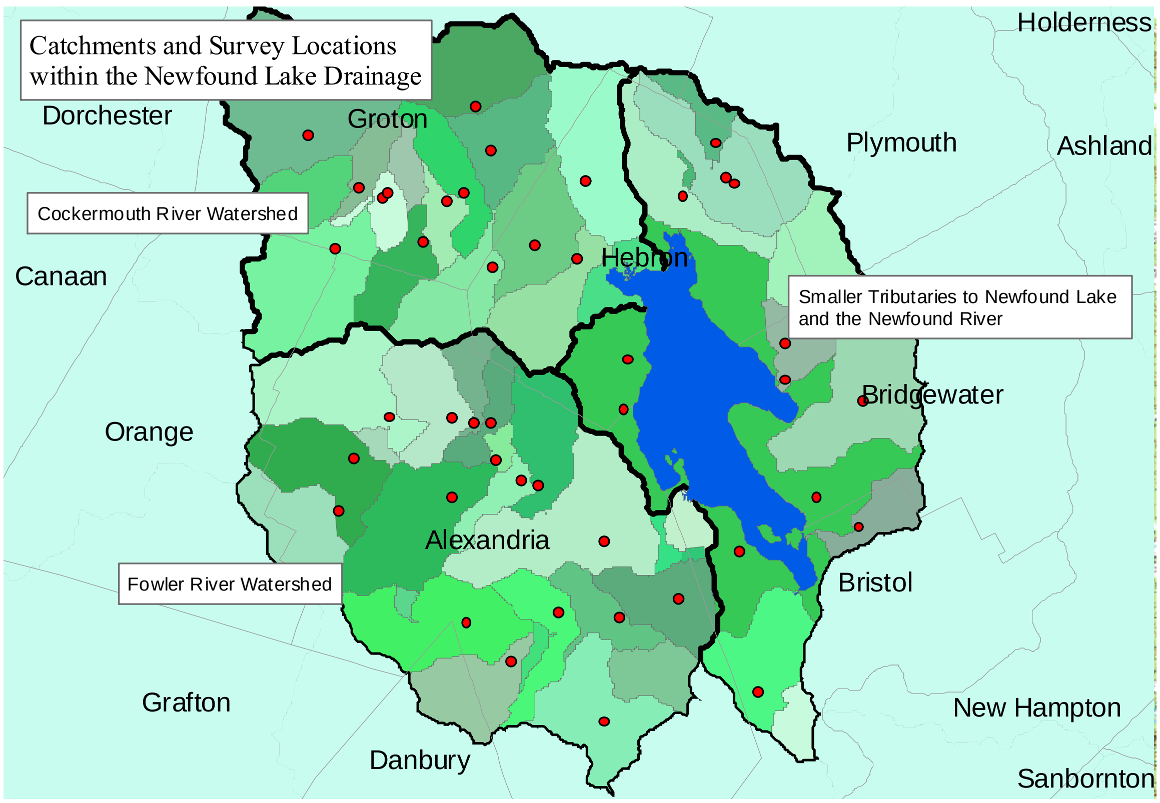
Recognizing the reduction in the distribution of wild brook trout, the Eastern Brook Trout Joint Venture (easternbrooktrout.org/) was established. This public and private partnership of state fish and wildlife agencies, federal natural resource agencies, academic institutions, and local conservation organizations is working to protect existing wild brook trout habitat, enhance and restore impacted habitat, and raise public awareness about their current status. These efforts will also benefit other native stream dwelling species, because brook trout serve as an indicator for healthy aquatic ecosystems. Fortunately, New Hampshire has more intact populations of brook trout (meaning more than 50% of a sub-watershed's habitat is occupied by wild brook trout) when compared to the southern portions of the species eastern U.S. range. However, information to quantitatively describe the status of brook trout populations in New Hampshire is limited.

To assess the status of brook trout within the Newfound Lake drainage, the New Hampshire Fish and Game Department (NHFGD), Pemigewasset Valley Trout



Unlimited, and the Newfound Lakes Region Association conducted electrofishing surveys during the summer of 2009. The scale used in the Eastern Brook Trout Joint Venture required that the Newfound Lake drainage be divided into three watersheds. These watersheds include: the Cockermouth River watershed, the Fowler River watershed, and a combination of the Newfound River and smaller tributaries that enter Newfound Lake.

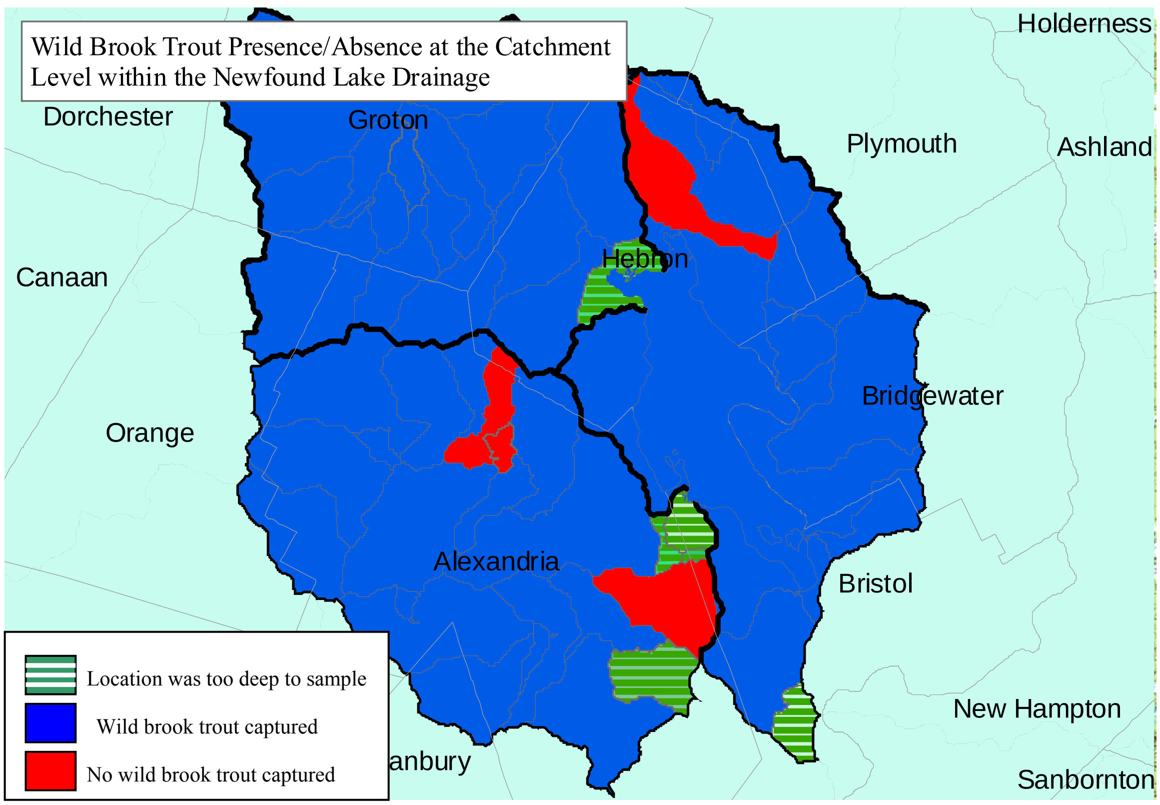
In order to summarize the status of wild brook trout populations within the three watersheds within the Newfound Lake drainage, each watershed was further broken down into smaller catchment drainages. Every catchment that had suitable depth for electrofishing was surveyed. Some catchments were not surveyed because depths were too great. In addition to length and weights of fish captured, information that described current brook trout habitat condition was collected.



Results

A total of 14 different species of fish were captured at 47 locations within the Newfound Lake drainage. Wild brook trout were the most dominant species found in the Cockermouth and Fowler watersheds while margined madtom were the most abundant species in the Newfound River watershed, though brook trout were the second most abundant species. Other species captured within the Newfound Lake drainage include: brown bullhead (hornpout), blacknose dace, burbot (cusk), creek chub, common shiner, fallfish, hatchery-reared brook trout, landlocked salmon, longnose dace, slimy sculpin, white sucker, and yellow perch. Of particular interest is the large abundance of wild landlocked salmon found in the Cockermouth River. These juvenile fish are believed to be the offspring of landlocked salmon that are routinely stocked into Newfound Lake as yearlings.

To explain the current status of wild brook trout at the watershed level, fish data from each catchment was assembled. Since there is over 120 miles of stream within these three watersheds that could not be completely surveyed, the assembled fish data from the catchments was used to illustrate a representative description for the entire watershed.

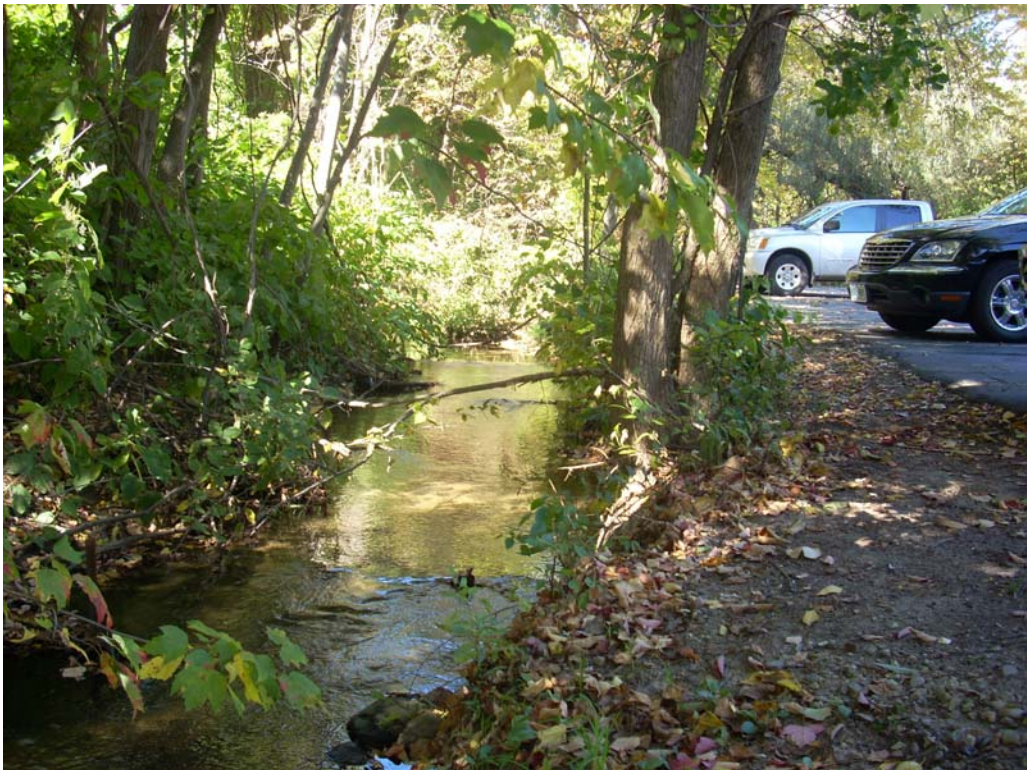


The surveys show that all three watersheds within the Newfound Lake drainage have intact populations of wild brook trout. Not only do these watersheds offer aquatic habitat suitable for wild brook trout, the overall magnitude of brook trout abundance is suspected to be unique for central New Hampshire and perhaps at the state level. Currently, wild brook trout are not necessarily rare in central New Hampshire, but the projected status of wild brook trout in this drainage is exceptionally good. Adjacent watersheds have suitable habitat for wild brook trout but not to the extent shown by the surveys in the Newfound Lake drainage.

Possible impacts to wild brook trout were recorded at every survey location. The lack of riparian vegetation as a result of logging, lawns, or adjacent road presence was the most common impact recorded. Subsequent increased erosion rates were observed at these locations. Perched culverts, livestock accessing streams, extensive stream bank armoring with riprap, washed out pavement entering the stream and litter were also noted in some locations.

The opportunity to protect intact populations of wild brook trout is uncommon, even in New Hampshire. Land conservation and guidance on land use practices are essential to protecting brook trout habitat. Wild brook trout populations and humans can coexist, but concerted efforts must be made to limit impacts to their habitat. Land and water use guidance should be given for streams of all sizes within a watershed as smaller streams are often used for spawning and nursery areas. Presumably minor human impacts to these streams can be additive throughout the watershed and create problems that are not readily apparent until further downstream. Land use practices do not necessarily have to be limited or halted in these areas; they may just have to occur in ways that minimize their impacts on brook trout and their habitats. The cost to restore a population of any species is always higher than the cost to protect them. Restoration actions require a great deal of effort and may not always guarantee self-sustaining populations would return.

Wild brook trout depend on cold, well-oxygenated water and access to a variety of aquatic habitat types. If streams become too warm and oxygen deprived, wild brook trout populations can be significantly impacted. This is often observed when land use practices remove shoreline vegetation that shade and cool streams. The presence of impoundments can slow water and allow the temperature to warm; altering aquatic habitat into something more desirable to non-native species (i.e. smallmouth bass). Stormwater discharged into streams from large sun-warmed impervious surfaces (i.e. large parking lots) can raise stream temperatures, as well as increase the amount of sediments and pollutants entering the stream.



Parking lots without riparian buffers or consideration of where stormwater is discharged can increase stream temperatures, sedimentation rates, and levels of hazardous materials.

When streams have increased sedimentation rates from anthropogenic causes, spawning gravel needed for brook trout reproduction is often covered or embedded. This reduces natural reproduction rates. Slower moving reaches of streams where excess sediments settle are often prone to widening; becoming warmer and shallower habitat not suitable for brook trout. Sedimentation can result from several different land use practices: stream crossings that are undersized increase stream velocities that amplify erosion and subsequent sedimentation rates; dirt roads that are constructed near streams with no riparian buffer that collapse or wash into streams; and impervious surfaces causing stormwater to discharge into streams at high velocities.

Road design that directs storm water runoff into streams increases erosion and sedimentation rates. This can alter stream habitat and cover spawning substrate, significantly impacting wild brook trout.

Wild brook trout are not often thought of as migratory fish and subsequently not often considered during roads design. However, radio telemetry studies by the NHFGD have shown larger wild trout can move over twenty miles in a single year. When crossings that alter stream flow and sediment transport are installed, impacts to stream habitat and migration can occur. Improperly sizes culverts that speed water flow often become perched overtime, making upstream passage difficult for many aquatic species. This can reduce access to spawning habitat or upstream refuge areas where water temperatures may be cooler. Under sized culverts may also act as a barrier that can isolate populations. If an isolated brook trout population is severely impacted by anchor ice in the winter or a flush of acidic water from spring run-off or storm events, then the affected area may not be able to repopulate. Genetic diversity is also a concern with isolated populations. The migratory needs of other fish species are represented by the presence of wild landlocked salmon in the Cockermouth River watershed. In the fall, adult landlocked salmon ascend lake tributaries to spawn. Juvenile landlocked salmon were captured over four miles upstream from the Cockermouth River's confluence with Newfound Lake.

Although stream crossings that consider sediment transport and fish passage in their design may cost more to design and install, overtime, these crossings are expected to have greater longevity and less maintenance costs. Additionally, the steep natural topography of several streams within the Newfound Lake drainage creates several falls and cascades that already potentially limit fish mobility. This increases the need for all stream crossings to be designed to allow for adequate fish passage.

Georges Brook-Hebron. Wild brook trout were found downstream of this culvert and no fish were found for the next 100 meters above the culvert. Road crossing design that does not incorporate fish movement can reduce fish dispersal. Opportunities for fish to repopulate an area or reach more desirable habitat has been reduced.

Local Strategies for the Conservation of Wild Brook Trout

Headwater Stream Protection

The level of protection for headwater streams varies by town and is usually accomplished through zoning ordinances, so local zoning ordinances should be reviewed to determine whether they provide sufficient protection. Best management practices for agriculture and silverculture should also be promoted among landowners who abut headwater streams. Local environmental stewards need to be attentive and vocal when projects are proposed within the watershed that could impact aquatic systems. The Comprehensive Shoreline Protection Act (RSA 483-B) already offers some regulatory protection for the Newfound River and lower portions of the Cockermouth and Fowler rivers. At a minimum, 100 feet (30 meters) of naturally vegetated buffers along all streams should be maintained. Preferably, vegetated buffers should be 300 feet (~100 meters). As buffer widths increase, more terrestrial species will use the wooded area as a travel corridor. Additionally, vegetation slows sediment and pollutant laden stormwater before it enters an aquatic system. Stormwater drainage designs that discharge directly into the stream should be avoided in favor of systems that filter stormwater into the ground. Maintaining larger riparian areas also allow for trees to fall into streams. The presence of large woody debris creates pools, cover, and complex habitat for fish species as well as bank stability.

Taking steps to protect headwater streams will prevent irreversible losses to New Hampshire's biodiversity as well as save countless dollars by protecting water quality and preventing flood damage. Therefore, communicating these protective measures to local policy makers is imperative.

Stream Crossing Inventories

Stream crossings should be evaluated within the Newfound Lake drainage to determine if they are degrading habitat and/or obstructing fish passage. Results of this crossing inventory in conjunction with fish survey data should be communicated to local road agents and the New Hampshire Department of Transportation so that stream crossing upgrade projects can be prioritized.

Public Outreach and Education

Educational programs should be developed to inform both children and adults about the importance of the link between the presence of wild brook trout populations and high water quality. Educators should emphasize the realization that environmental impacts caused by one person or one family in the Newfound Lake drainage could have a lasting effect on their neighbors downstream. The key is to stress the needs of wild brook trout, a species that is the essence of New Hampshire's rich heritage.

Photos from Surveys

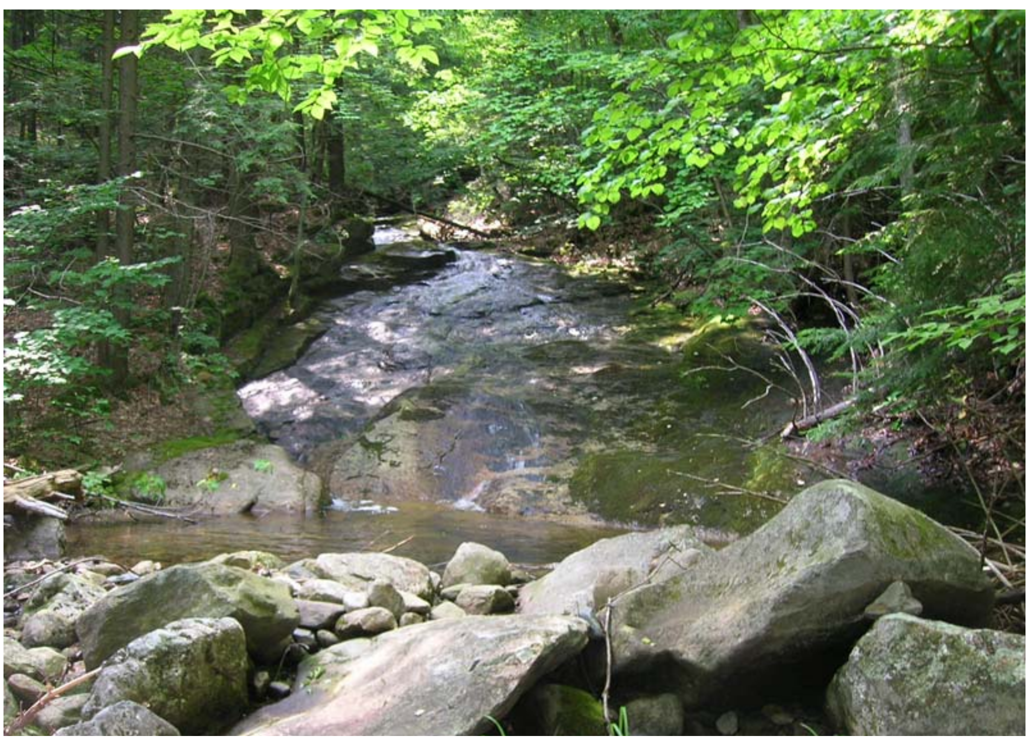
Lower Cockermouth River-Hebron. Large trees that are allowed to fall and remain in the river system provide cover and create pool features in an otherwise barren part of the river

Cockermouth River-Hebron. Wild brook trout

Bailey Brook-Alexandria. An example of a well forested riparian zone providing shade to a stream.

Cockermouth River-Hebron. Wild landlocked salmon juvenile

Unnamed Tributary to the Cockermouth River-Hebron. Long >50 meter chute. Wild young of the year brook trout were found in small pools within the chute. Wild brook trout were abundant above and below this area.



Headwaters of Punch Brook-Groton. Long >50 falls. Wild brook trout were abundant above and below this area.

Georges Brook-Hebron. Removal of essential riparian vegetation.

Patten Brook-Alexandria. Removal of essential riparian vegetation.

Forest Resources in the Watershed Communities

The Newfound Watershed Master Plan

Newfound Lake Region Forest Management

Jasen Stock, Executive Director
New Hampshire Timberland Owners Association
January 2009

Forestry and the forest products industry have, and continue to be, an important part of the history, culture, economy and environment in the Newfound Lake Watershed. Since settlement in the 1600 and 1700s, trees remain an important resource that provides lumber for building, firewood for heating, fiber for papermaking and for the generation of electricity. The history of timberland management and land use in the Watershed is not unique from what has occurred throughout New Hampshire. Settlement brought with it the removal of most timber for use as building materials and firewood for homes. This land clearing was also necessary for the development of agriculture (clearing for crop and pastureland). It is estimated that by the end of the 1800s, as much as eighty percent of New Hampshire's landscape was cleared. With the Civil War in the mid 1800s and westward expansion around the same time, many farms, homesteads, and, in some instances, entire communities were abandoned and in their place grew trees.

Current Use Land-Base and Taxation

Using current property tax data from the New Hampshire Department of Revenue Administration (NH DRA), 64% of all the acreage within the nine watershed communities is assessed as timberland or forestland in the Current Use tax assessment program. The amount of total forest cover is much greater because to qualify for the Current Use timber or forestland assessment the parcel must be greater than ten acres. But, using this data remains a good indicator of productive forestland as conducting a commercially viable timber sale on a parcel smaller than ten acres is difficult.

Within the Current Use tax assessment program, landowners can opt for an additional reduction in their tax assessment if their property has a management plan that has been developed and approved by a professional forester licensed in New Hampshire. Although the presence (or absence) of a management plan does not guarantee the timberland is being managed to its fullest potential, the fact a landowner took the time and made the financial investment to develop the plan is a good indicator that the property is being managed. Currently 47,216 acres within the nine watershed communities qualifies for this reduction.

In addition to their economic value, these lands also provide aesthetic and environmental benefits as well as recreational opportunities. Similar to the Current Use assessment reduction for management plans, landowners can also receive a reduction in their tax assessment if they agree to keep their land open for foot traffic and other non-motorized recreation. Currently 57,220 acres within the nine watershed communities receive this reduction, or 55% of all the land assessed under the Current Use program (farm and forest). It is safe to say a portion of these 57,220 acres also includes some of the 4,504 acres of agricultural land assessed under the Current Use program in these communities.

Forest Products Industry

The forests of the Newfound Watershed provide significant economic activity. Based on 2007 data published by the North East State Foresters Association, on average each acre of timberland annually provides $475 of economic activity; $252 from forest-based manufacturing value of shipments and $2 from Christmas tree and maple product production. The remaining $221 comes from forest-related recreation/tourism.

Multiplying the forest-based manufacturing value of shipments and Christmas tree and maple product production annual economic activity factors by all the acres within the watershed assessed as timberland or forestland in the Current Use program shows these lands annually generate $48.6 million in economic activity. The following is a rough breakdown of how the economic activity is distributed throughout the supply chain:

Forestry and Logging jobs

Not all individuals licensed as foresters under New Hampshire's forester licensing law actively practice forestry. If an individual has gone through the effort to maintain their license, there is a strong likelihood they have a career connected to forest or natural resource management. Based on the New Hampshire Joint Board of Licensure online roster of foresters licensed in New Hampshire, twenty-three individuals licensed to perform forestry reside in the watershed and abutting communities.

Understanding the number of individuals who derive their livelihood from the harvesting or transporting of forest products is more difficult since a segment of the logging and trucking community work seasonally or part-time. Using data from the New Hampshire Timberland Owners Association's (NH's landowner, logger and forest industry trade association) data base, currently 152 individuals in the watershed and abutting communities derive some portion of their livelihood from the harvesting or transporting timber.

Based on the 2006 New Hampshire Department of Resource Administration (NHDRA) timber tax data from the watershed communities this activity produced:

- 3.3 million board feet of softwood timber for lumber production,
- 1.9 million board feet of hardwood timber for lumber production,
- 28,863 tons of wood chips for electricity production,
- 7,003 tons of softwood pulp for paper manufacturing,
- 14,208 tons of hardwood pulp for paper manufacturing,
- 2,157 cords of firewood for home heating.

Wood Processing

New Hampshire law requires all wood processors (portable and stationary) to register with the New Hampshire Department of Resources and Economic Development (NH DRED). NH DRED's 2008 registry data shows 24 wood processors registered in the watershed and abutting communities. Ten of the processors are either portable chippers, portable sawmills or portable firewood processors while the remaining 14 are stationary sawmills. Stationary sawmills ranging from small firewood processors to the large sawmills, like the ones located outside the watershed on NH Rt. 25 in Rumney, are capable of processing as much as 25 million board feet of lumber annually and employing dozens of individuals.

In addition to sawmill jobs, there is currently one biomass (wood to energy) power plant operating in the Newfound Lake region - Bridgewater Power in Bridgewater. Based on 2002 data from the NH DRED report entitled, "Identifying and Implementing Alternatives to Sustain the Wood-Fired

Electricity Generating Industry in New Hampshire", this power plant consumes 229,320 tons of wood chips producing 15 megawatts of electricity annually. Based on the same data the Alexandria Power Plant (which is seeking to come back online sometime in 2009) will also produce approximately 15 megawatts of electricity. This same report estimates that for each megawatt of wood-fired energy capacity using forest-derived fuel, there is a direct annual economic impact of roughly $400,000 or $12,000,000 annually. But, some industry experts estimate that direct economic activity derived from these facilities will generate $18,000,000 in economic activity (wood purchases and payroll).

The forests within the watershed also produce pulp used in the papermaking process. Pulp wood grown in the watershed travels as far away as upstate New York and Western Maine. Based on timber tax records gathered by the NHDRA the watershed produced 21,211 tons of pulp wood.

In addition to direct economic activity, the forest management and wood processing activity also provides indirect economic activity. This includes money paid to communities in the form of timber and property taxes and economic activity generated from dollars circulating through the local economy. Because most of the work occurs locally, the indirect economic activity from this industry is significant. Based on NH DRED's 2002 report, the "economic multiplier" is 2.95 for timber harvesting and 3.83 for sawmilling, meaning for each dollar generated its economic benefit to the local economy can be multiplied 2.95 or 3.83 times.

In summary, forestry and the forest products industry have and continue to be an important part of the history, culture, economy and environment in the Newfound Lake region. The benefits of responsible forest management include healthier forests, wildlife habitat and water supply, recreational opportunities, and substantial economic value to the landowner and surrounding community. By understanding and caring for our forest lands we can expect to be rewarded with these benefits for years to come.

Strategic Conservation Efforts in the Newfound Watershed

The Newfound Watershed Master Plan

Holding the High Ground:

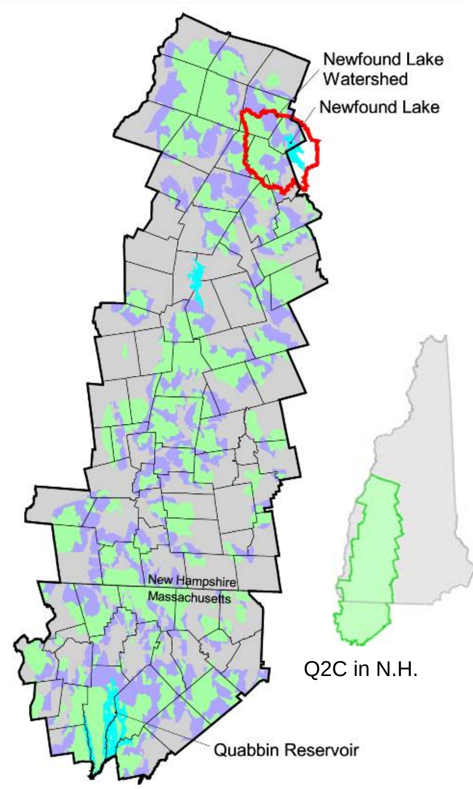
How much conserved land is enough in the Newfound Lake Watershed?

By Dan Sundquist, Research Director, Society for the Protection of NH Forests
January 2009

A drive around the Newfound Lake watershed, or a view from the water, is an experience of sunlight on pristine water lapping at the edges of forested hills. It is green almost everywhere we look to the horizon, the green summer of New Hampshire. Even in drab winter dress, rugged wildness is there for the eye to feed upon. But what assurances do we have that those qualities will remain into the future? As in many other attractive, changing communities in New Hampshire, the question being posed is how to balance growth and development with protection of the very natural and scenic resources that give places such as Newfound Lake its *genius loci*, or spirit of place. Inside that question is another: how much land conservation is enough?

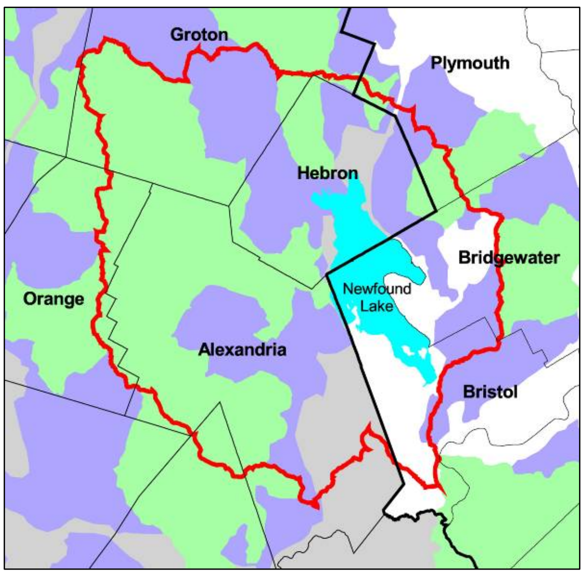
One way to answer that question is to understand *why* we conserve land, and then measure those goals against the landscape we care about. We protect land for wildlife habitat - both animals and plants, for its agricultural productivity and local food production, for the economic and ecologic values of unbroken forests, for the way it frames our view of the land, and perhaps most importantly for Newfound Lake and the nearly 140 miles of streams that feed it, for the sake of water quality. When we understand that all of the reasons given above are inextricably knitted together as a whole, we can see that the process of deciding where and what to conserve is a little more complicated than we might have thought.

The Forest Society and a broad group of local, state, and federal stakeholders has been grappling with this question of land conservation for the last few years in a 3,000-square-mile strategic planning area called the Quabbin-to-Cardigan corridor, or Q2C for short. This study area reaches from the southern edge of the White Mountains, follows the height of land between the Connecticut and Merrimack Rivers, all the way to the Quabbin Reservoir in north-central Massachusetts. Roughly 75% of the Newfound Lake watershed lies within this planning area. Recent geographic information system (GIS) mapping and analysis work to identify strategic conservation priority areas within the Q2C have brought the Newfound Lake region into sharper focus for expanded, collaborative conservation project planning.



The map at the right shows the entire Q2C planning area and its relationship to the Newfound Lake watershed (red), plus a series of conservation core focus areas (green) and supporting landscapes (lavender) that have been distilled from intensive analysis of more than twenty natural resource values identified by the Q2C stakeholder group. The core focus areas represent the highest priority for land conservation serving the Q2C vision: protecting large, intact forest blocks with significant embedded ecological features, as well as the supporting landscapes that work as buffers to further protect those values.

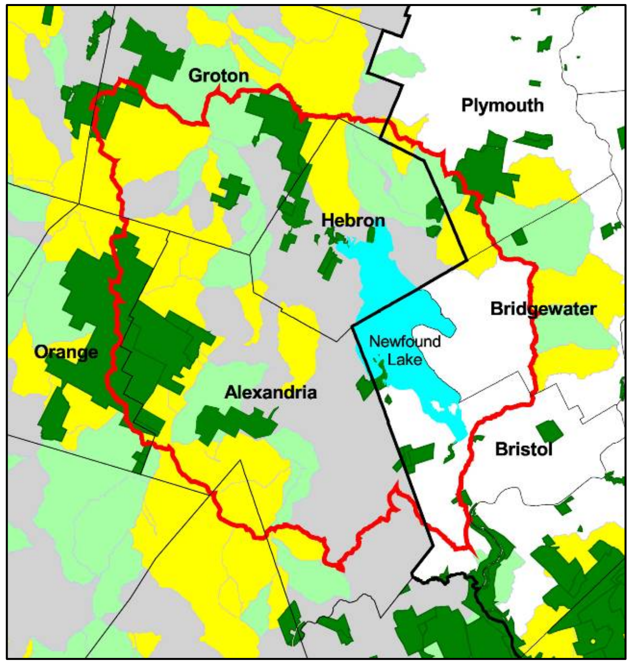
Each core focus area is delineated on-the-ground according to three inter-locking physical features: intact forest blocks, high quality stream watersheds, and N.H. *Wildlife Action Plan* habitat quality. These core areas represent the best-of-the-best strategic conservation options according to the Q2C vision, or about 20% of the total Q2C study area, thus guiding scarce conservation dollars to the right venues.



As the map on the left shows, Hebron, Groton, and Alexandria host extensive Q2C core focus areas and supporting landscapes within the Newfound watershed. Thanks to additional delineation of these areas in neighboring towns as part of the Q2C study, we can also see that parts of Plymouth, Bridgewater, Bristol and Danbury have important conservation focus areas which in effect create a "rampart" of high-value lands along the Newfound Lake watershed height of land.

Almost 28,000 acres, or 44% of the lake watershed is comprised of Q2C core focus areas; another 20,000 acres are important supporting landscapes. That means that *more than three-quarters of the entire watershed qualifies as top priority for land conservation according to the Q2C plan* – one of the nation's most scientific, cutting-edge regional forest conservation plans.

Going back to the importance of water quality to Newfound Lake and surroundings, let's look in more detail at the high quality stream watersheds that form part of the Q2C core focus areas. USGS mapped the recharge area for every stream tributary in the state as part of a New England region water quality modeling project in 2004 – nearly 7,300 in all in New Hampshire. While the intent of that study was to identify watersheds with nitrogen and phosphorous loading problems, we have "reverse-engineered" the data to tell us where the highest water quality is found. The **map to the right** shows the two highest ranked types of watersheds from that study. The yellow watersheds are near-pristine per U.S. EPA standards; the light green color shows watersheds with slightly greater population density, but also very high water quality. The dark green shapes represent existing protected lands.



Three towns harbor the lion's share of high quality stream watersheds in the Newfound Lake watershed: Alexandria with about 12,700 acres, Groton with more than 8,100 acres, and Hebron with nearly 5,200 acres. Together that amounts to 56% of the combined land area of the three towns within the watershed contributing high quality water into the Lake ecosystem! However, just 5,200 acres (20%) of the total 26,000 acres of high quality stream watersheds are protected to date. Breaking that total figure down, Alexandria is only 18% protected, Groton is 16%, and Hebron has no permanently protected high quality watersheds

Meanwhile, the Forest Society is busy working to protect more of these important watersheds on the Cardigan Highlands project, a major initiative that will conserve nearly 9,300 acres of working forest in Groton and Hebron. When completed, an additional 3,500 acres of the Newfound Lake watershed will be permanently protected, and of that area, 2,800 acres fall into high quality stream watersheds feeding the lake.

Scaling up our vision, the Cockermouth River in Groton and Hebron, and the Fowler River in Alexandria are the two primary inlet tributaries to Newfound Lake, contributing roughly 70% of the total tributary flow. The watersheds of these two rivers have their headwaters in the largely forested, high water quality stream networks to the north and west of the lake. While both tributaries show excellent physical check-ups in recent studies completed by the UNH Center for Freshwater Biology, it should be clear that protecting water quality in the high ground above Newfound Lake will pay dividends in water quality in the lake itself into the future. In addition, much of the high-quality surface water is co-located with the core focus area lands identified by the Q2C project.

The Q2C strategic plan is not intended to be a complete water resources protection plan for the Newfound Lake watershed, but it does provide an excellent, science-based foundation and early indicators for where land conservation can begin, in the short-term. Combined with the consensus-based approach to stewardship of the Newfound Lake environment articulated in this Watershed Master Plan, and solid water quality data, these efforts will result in maintaining and managing natural land cover in the headwaters of the lake tributaries.

Watershed Population and Housing Demographics

The Newfound Watershed Master Plan



Watershed Population and Housing Demographics

Newfound Lake Watershed Master Plan



August 2007

DRAFT

INTRODUCTION

The Newfound Lake Watershed is a rural area located in central New Hampshire's Lakes Region. Its 63,000 acres encompasses all, or parts, of nine towns. Five of the Watershed communities (Alexandria, Bridgewater, Bristol, Groton, and Hebron) account for 93% of the Watershed's area and 99% of its population. The Watershed has a year-round population of more than 4,500, distributed throughout the rural areas surrounding Newfound Lake. The arrival of the seasonal population during the summer months results in a doubling of the population for that portion of the year. If the year-round population growth continues without the appropriate tools in place, the impacts on the Watershed resources could be significant. Table _ displays the number of acres that each community contributes to the Watershed, and its share of the Watershed population.

Five of the Watershed communities (Alexandria, Bridgewater, Bristol, Groton, and Hebron) account for 93% of the Watershed area and 99% of the population in the Watershed.

Table_ Watershed Land Area and Population by Community - 2005

Town	% of Watershed	Acres (63,150 total)	Population in Watershed	% of Watershed Population
Alexandria	35.8	22,616	1030	23%
Bridgewater	8.4	5297	597	13%
Bristol	11.4	7212	1975	45%
Danbury	1.4	859	2	.05%
Dorchester	0 (rounding)	16	0	0%
Groton	18.0	11369	248	6%
Hebron	19.2	12151	539	12%
Orange	3.4	2141	12	.3%
Plymouth	2.4	1490	26	.6%

Source: New Hampshire Fish and Game Department, Catherine Callahan; US Census

So that the communities can prepare for the future, it is important that they understand how the population and housing characteristics have been changing within the Watershed. The population and housing characteristics are directly related to land use decisions, and these decisions contribute to the overall health and character of the Watershed. The well-being of the Watershed, in turn, effects the value of the region and its economic development.

The first half of this chapter focuses on the historical growth rate of the population, as well as the demographic composition relative to age and income and the potential for future population growth. The second half of the chapter provides information on the changing dynamics of the Watershed's housing supply. An overview is presented about total housing growth, changes in housing mix in terms of the types of housing units constructed, and the conversion of seasonal units to year-round units. Lastly, general information is presented about the employment and transportation resources in the Watershed.

POPULATION

Data from the 2000 Census and computer mapping software, geographic information systems (GIS), were used to calculate the location of the population and associated housing units within the Watershed. Once these percentages were established, they were also used to estimate historic and future Watershed population figures. The Watershed population is 29% of the total population in the nine town area.

The Watershed population is 29% of the total nine town population.

The majority of residents, 99%, are within the five towns of Alexandria, Bridgewater, Bristol, Groton, and Hebron. There are very few residents within the other four communities of Danbury, Orange, Dorchester, and Plymouth that reside within the Watershed boundaries. Table _ illustrates the total population in each community, the population for the portion of the community in the Watershed, and the percent of that community's population living within the Watershed.

Table_ Total Population by Town and by Watershed

Towns	Town Population 2005	Watershed Area Population 2005	% of Town Population in Watershed
Alexandria	1,472	1030	70%
Bridgewater	1,029	597	58%
Bristol	3,185	1975	62%
Danbury	1,179	2	0.20%
Dorchester	382	0	0%
Groton	496	248	50%
Hebron	539	539	100%
Orange	311	12	4%
Plymouth	6,387	26	0.40%
Total	*14,980*	*4,429*	

Source: NH Office of Energy and Planning

Population Change

Table _ illustrates the population change in the nine town region. In the 35 years from 1970 to 2005 the nine town region the Newfound Watershed is located within nearly doubled in year-round population, and as of 2007 likely exceeds 15,000 persons. This growth rate is even greater than that of the state as a whole, 78%, and Grafton County, 58%, during the same time period.

In the 35 years from 1970 to 2005 the nine town region the Newfound Watershed is located within nearly doubled in year-round population, and as of 2007 likely exceeds 15,000 persons.

Table _ Population Change of Nine Town Area 1970-2005

Towns	1970	2005	% Change 1970 - 2005
Alexandria	466	1,472	216%
Bridgewater	398	1,029	159%
Bristol	1,670	3,185	91%
Danbury	489	1,179	141%
Dorchester	141	382	171%
Groton	120	496	313%
Hebron	234	539	130%
Orange	103	311	202%
Plymouth	4,225	6,387	51%
Total	7,846	*14,980*	91%

Source: NH Office of Energy and Planning

The Watershed population figures were calculated using Census block data and mapping software that was able to approximate the watershed boundary. This provided an opportunity to select data just from the portions of the communities that fall within the Watershed. Table _ illustrates that during the same 35 year time period the Watershed's year-round population increased by 132%. This is an even greater rate of growth than the region and the state.

Table _ Population Change of the Watershed 1970-2005

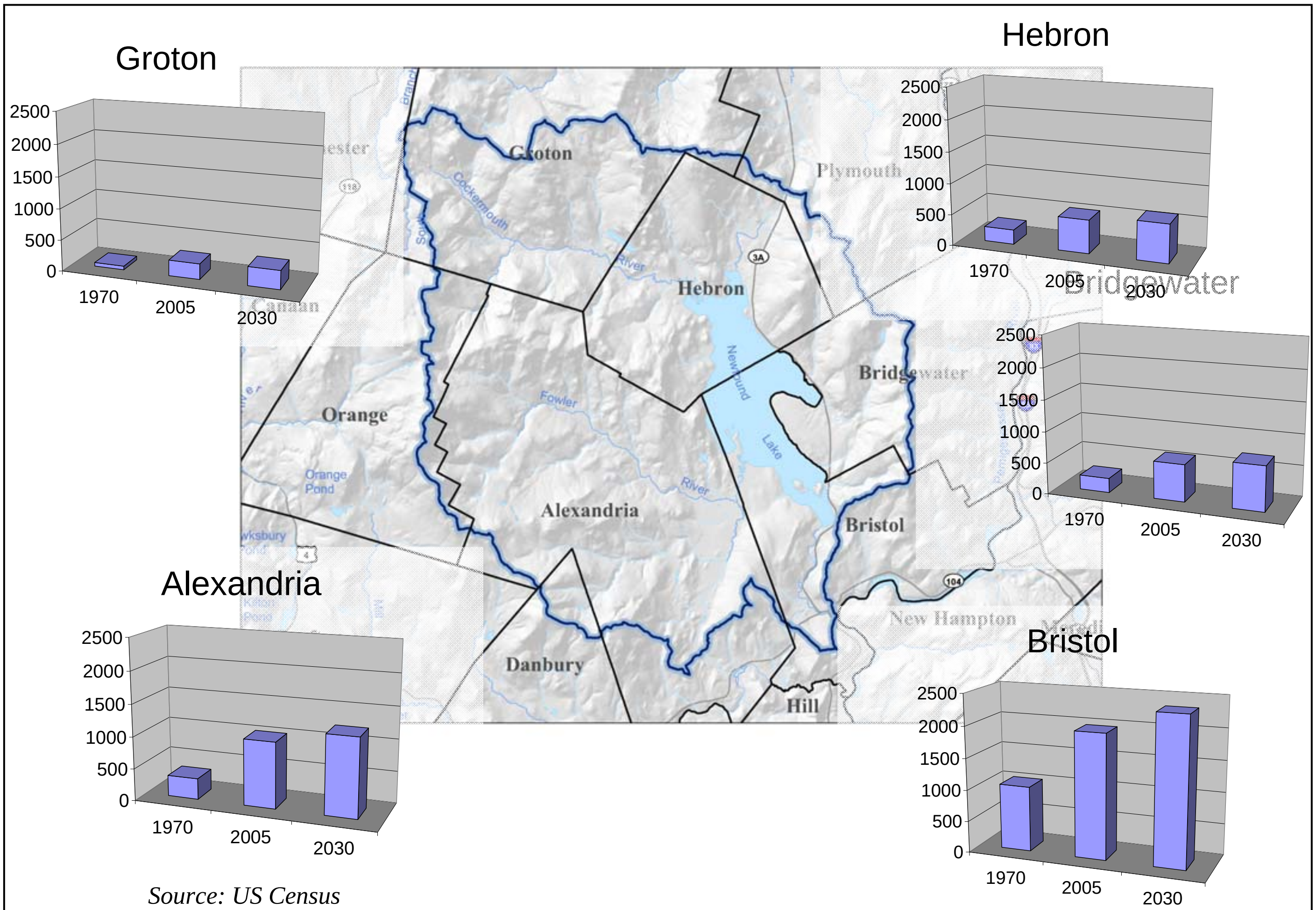
	Population of Watershed		
Watershed Area	1970	2005	% Change 1970 - 2005
Alexandria	326	1030	215%
Bridgewater	231	597	158%
Bristol	1035	1975	91%
Danbury	1	2	100%
Dorchester	0	0	0%
Groton	60	248	313%
Hebron	234	539	130%

Orange	4	12	200%
Plymouth	17	26	53%
Total	*1,908*	*4,429*	132%

From 1970 to 2005 the Watershed's year-round population increased by 132%. This is an even greater rate of growth than the region and the state.

Source: NH Office of Energy and Planning

Figure_ Population Change in the Watershed



Source: US Census

The seasonal population is another feature of the Newfound Watershed that makes it unique. Based on figures from the US Census for seasonal housing and average household size in the Watershed we can conservatively estimate that the seasonal population increases by an additional 3,600 persons. With the addition of other visitors and guests at camps, cottages, and local lodgings, the population in the Watershed

Land Use Implications:
Year-round and seasonal population growth create increasing pressure on the community and natural resources within the Watershed. However, increasing population also creates opportunities for increased economic opportunity. There is a need to balance these and other issues to protect the long-term health and sustainability of the Watershed for generations to come.

essentially doubles during the summer months.

Migration and Mobility

Within the Watershed 62% of residents lived in the same house in 2000 that they lived in in 1995. This was an increase in stability from the 1990 Census when only 53 % had been in the same house for at least five years. Of the new residents in 2000, 17% came from elsewhere in Grafton County.

> Within the watershed 48% of year-round residents are New Hampshire natives.

Within the watershed 48% of residents are New Hampshire natives. This represents a slight decrease from 1990 when 49% of watershed residents were New Hampshire natives, but is still higher than the County figure, 45%, and the State, 43%. The majority of watershed residents born outside of New Hampshire, 42%, are from the Northeast United States. Only 2% of Watershed residents were born outside of the continental United States.

Age

According to the 2000 Census, the average age within the Watershed is 43 years old. Bristol is on the lower end of the age spectrum with a median age of 38.5, and Hebron is at the upper end of the spectrum for the Watershed and the state with a median age of 50.

> Within the Watershed the average age is 43 years old.

According to the 2000 Census, the median age in New Hampshire is increasing. The median age, as of 2000, was 37.1 years in New Hampshire, and the median age in the U.S. was 35.3. The Newfound Watershed clearly has an older population overall. This may be a reflection of the higher number of retirees and that locate within the Watershed.

> ***Planning Implications:***
> An aging population will impact the Watershed differently over time. This aging population may require a different range of services from the communities, including smaller housing units, daytime activities, and assisted care facilities.

Household Structure

The Watershed has experienced changes in household structure, and the average household size in 2000 was 2.46 persons which is a decrease from the 1990 figure of 2.65 persons. Households in the Watershed are now smaller, and the number of single parent households and non-family households (i.e., roommates, cohabiting couples, and singles) have increased. The continued shrinking of household sizes is an ongoing trend nationwide as more people live alone, couples have fewer children, and the divorce rate increases. Table _ illustrates the change in average household size from 1990 to 2000.

> Households in the Watershed are now smaller, and the number of single parent households and non-family households have increased.

Table_ Average Persons Per Household

Location	1990	2000
Newfound Lake Watershed	2.65	2.46
Grafton County	2.51	2.38
New Hampshire	2.62	2.53

Source: 1990 and 2000 US Census

Table _ shows that the number of non-family households in the Watershed increased by 57% in the 1990s. This was a significant increase, and the largest increase of any household type in the Watershed. Non-Family Households also include single person households. In the Watershed these households have increased and now represent 30% of the year-round housing units in the watershed. The average Non-Family Household size in the Watershed is 1.48 persons.

Table_Non-Family Households

Location	Percent Change 1990-2000
Newfound Lake Watershed	57%
Grafton County	26%
New Hampshire	27.3%

Source: 1990 and 2000 US Census

> ***Planning Implications:***
> The main implication of shrinking household size is its effect on housing demand. As each housing unit holds fewer and fewer people, the number of housing units needed to accommodate the same number of people increases.

Education

As of 2000 approximately 87% of the population in the Watershed over the age of twenty-five were high school graduates or had continued on for additional schooling. On average 23% of the residents in the Watershed over the age of twenty-five completed a Bachelor's Degree or higher level of education.

As of 2000 approximately 87% of the population in the Watershed over the age of twenty-five were high school graduates or had continued on for additional schooling.

Table _ Level of Education

Location	Percent High School Graduate or Higher 2000	Percent of Bachelor's Degree or Higher 2000
Newfound Lake Watershed	87%	23%
Grafton County	88%	33%
New Hampshire	87%	29%

Source: 2000 US Census

The percent of Watershed residents that are high school graduates is very similar to both Grafton County and New Hampshire, but the number of college graduates in the Watershed is much lower overall. There is a significant range of educational attainment within the Watershed communities. Two communities in the Watershed were identified in the US Census as having 32% of their residents with a Bachelor's Degree or higher level of education. One community was identified as having only 8% of its residents with a Bachelor's Degree or higher level of education.

Income

The median household income in the Watershed was similar to the County in 1990 and slightly higher than the County in 2000. The median household income for the watershed actually represents a broad range of values with the highest median household income being $13,000 more than the lowest. A full range of income levels are present within the Watershed, as they are in other portions of New Hampshire.

The median household income in the Watershed was similar to the County in 1990 and slightly higher than the County in 2000.

Table _ Median Household Income

Location	Median Household Income 1990	Median Household Income 2000
Newfound Lake Watershed	$30,502	$43,217
Grafton County	$30,065	$41,962
New Hampshire	$36,329	$49,467

Source: 1990 and 2000 US Census

Poverty

Overall, fewer Watershed residents were considered to be living below the poverty level in 2000 than there were in 1990. The population of children (below 17 years of age) living below the poverty level decreased during this ten year period, but there was a slight increase in the number of seniors (75 years and older) living below the poverty level during this same time period. The US Census calculates poverty levels by setting income thresholds for households based on the number of family members and the number of children under the age of 18. If the family's total income is below their identified income threshold they are identified as being below the poverty level.

Overall, fewer watershed residents were considered to be living below the poverty level in 2000 than there were in 1990.

Table _ Population Living Below the Poverty Level

Location	% of Population Below Poverty Level - 1990	% of Population Below Poverty Level - 2000
Newfound Lake Watershed	8%	6%
Grafton County	10%	9%
New Hampshire	6%	7%

Source: US Census

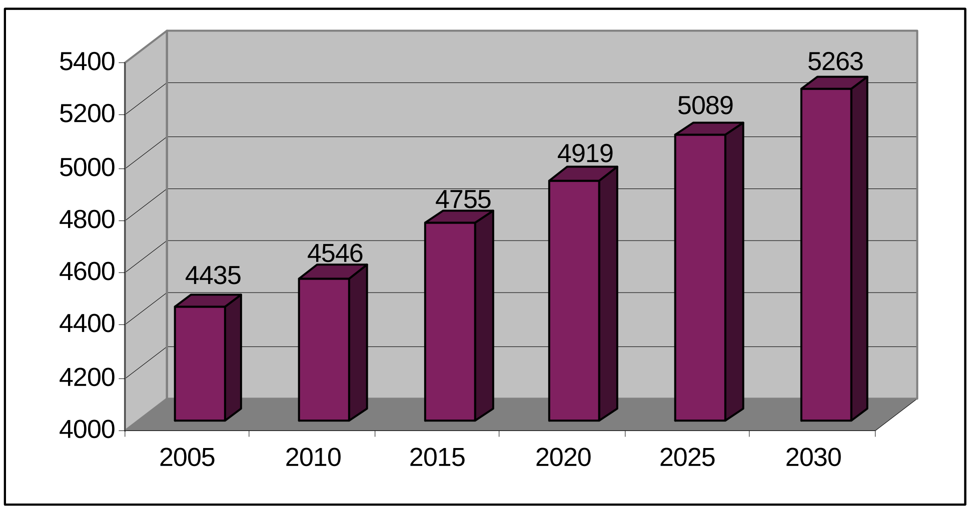
Future Population Growth

Methodology
The New Hampshire Office of Energy and Planning (NHOEP) has prepared population projections for New Hampshire since 1964. Local projections are highly dependent on the limits set by the county totals. The county projections are roughly based on long-term trends that occurred during the 1960 to 2000 period. The local projections are based on a community's historical share of its respective county's growth. Staff at the NHOEP and the regional planning commissions then evaluate the projections to make sure that the trends are likely for that community, or if some other external factors should be considered.

From 2005 to 2030 the Watershed population is expected to increase by 19%.

The projections prepared by NHOEP for the nine Watershed communities have been used to calculate Watershed population projections from the estimated 2005 population through 2030. This represents an average population growth of 3% every five years in the Watershed, and a 19% increase in the Watershed during this twenty-five year period. This is much lower than the rate of population growth, 132%, experienced in the Watershed from 1970 – 2005.

Figure _ Watershed Population Projections 2005 - 2030



Source: NH Office of Energy and Planning

If the current household size (2.46 persons) remains about the same in the Watershed, and the NHOEP population estimate is correct, the Watershed will need approximately 340 new year-round units by 2030. If the current household size continues to decline this could result in a need for even more units to accommodate the smaller households. If the current growth rate of 8.5% (2000-2005) continues, the watershed will likely see a much larger population than anticipated and a demand for nearly 1,000 year-round units by 2030.

HOUSING

The housing units in the Watershed account for 48% of the total number of housing units in the nine town region. This is greater than the percent of each community's population that is found within the Watershed, and is likely due to the higher percentage of seasonal units found in these areas around the Lake. Table _ illustrates the percent of each communities' housing stock that is within the Watershed. The housing situation in the Watershed is fairly complex because of the high percentage of seasonal units (45%) and the continued conversion of these units into year-round units.

> The housing situation in the Watershed is fairly complex because of the high percentage of seasonal units (45%), and their conversion to year-round units.

Table _ Estimated Number of Housing Units

Towns	Town Estimated Housing Units 2005	Watershed Area Estimated Housing Units 2005	% of Town Housing in Watershed	% of Watershed Housing Units
Alexandria	898	682	76%	18%
Bridgewater	921	682	74%	18%
Bristol	2,226	1,625	73%	43%
Danbury	670	2	0.30%	.05%
Dorchester	0	0	0%	0%
Groton	391	196	50%	5%
Hebron	583	583	100%	15%
Orange	143	7	5%	.2%
Plymouth	2,037	14	0.70%	.4%
Total	7,869	3,791		

Source: NH Office of Energy and Planning

All of Hebron's housing is within the Watershed, and four other communities (Alexandraia, Bridgewater, Bristol, and Groton) have a significant percentage of their housing located within the Watershed. The density of housing units is typically greater near the shoreline of Newfound Lake and less the further out into the Watershed one travels.

> ***Planning Implications:***
> The diversity of housing unit types and levels of affordability are a concern within the Watershed as we look into the future. The location and pattern of residential development within the Watershed also has the potential to impact both the communities and the natural resources in negative ways.

Housing Inventory and Housing Types

According to the US Census the number of housing units in the Watershed only increased by 1% from 1990 to 2000. This is because of the decrease in the number of mobile home units which masked the new housing units constructed during this time period. This replacement of mobile home units with single-family and multi-family units resulted in an increase of nearly 200 new housing units within the Watershed. A significant number of year-round housing units were also created by converted existing seasonal units. Table _ illustrates the change in housing units by type within the Watershed from 1990 to 2000.

According to the US Census the number of housing units in the Watershed only increased by 1% overall from 1990 to 2000.

Table _ Housing Units by Type

Type of Units	1990	% of Total	2000	% of Total	% Change
Total Units	3,352		3,433		1%
Single Family Units	2,544	75%	2,639	77%	4%
Multi-family Units	433	13%	530	15%	22%
Mobile Home & Other	375	11%	265	8%	-29%

Source: US Census

Planning Implications:
This reduction of mobile home units may represent some loss of affordable housing units within the Watershed. The regulatory analysis being completed as part of this Watershed Master Plan will need to examine the possibilities that exist for creating a range affordable housing opportunities within the Watershed.

Housing Occupancy and Tenure

From 1990 to 2000 the Watershed experienced a reduction in seasonal housing units overall. Some of the Watershed communities (Alexandria, Groton, and Hebron) actually saw an increase in seasonal units while others (Bridgewater and Bristol) saw large reductions. This illustrates the variable nature of this data across the Watershed. There was also a decrease in the vacancy rate created by units in the Watershed that are available for sale or rent and unoccupied.

From 1990 to 2000 the Watershed experienced a reduction in seasonal housing units overall, and an increase in year-round units.

The conversion of seasonal housing units, the decrease in the vacancy rate, and some new construction resulted in an increase of nearly 400 year-round housing units within the Watershed. Table _ illustrates the shift in housing by tenure and vacancy.

Table _ Housing Units in the Watershed 1990-2000

Units by Tenure & Vacancy	1990	%	2000	%	% Change
Total Units	3,394		3,425		1%
Occupied Units	1,477	43%	1,873	55%	27%
Owner Occupied	1,121	76%	1,438	77%	28%
Renter Occupied	356	24%	435	23%	22%
Vacant Units	1,917	56%	1,553	45%	19%
Vacant For Sale	58	3%	31	2%	-46%
Vacant For Rent	76	4%	22	1%	-71%
Vacant Seasonal	1,659	87%	1,446	93%	-13%

Source: US Census

The rate of increase in year-round housing units within the Watershed slowed slightly between 2000 and 2005, but still resulted in an increase of approximately 30 year-round units in the Watershed each year. It is very likely that this increase represents the continued conversion of seasonal units along with new construction.

Table _ Occupied Housing Units 2000-2005

Newfound Watershed	2000	2001	2002	2003	2004	2005	% Change 2000-2005
Occupied Housing Units	1,873	1,899	1,934	1,972	2,001	2,028	8%

Source: NH Housing Finance Authority

Planning Implications:
Many of the sites that are being converted from seasonal to year-round units in the Watershed are located in some of the more sensitive areas, adjacent to important natural resources. The conversion of units in these areas can increase the potential for long-term impacts by introducing year-round activity, but can create opportunities to address existing threats by upgrading waste treatment and other systems.

Residential Development Trends

From 1995 to 2005 an average of 66 building permits were awarded annually in the Watershed. Approximately 722 were awarded in total during this time period. This information is collected from the communities by New Hampshire Office of Energy and Planning (NHOEP). Usually, permits are valid for one year. Some permits never result in actual construction and in those cases the permit expires.

> From 1995 to 2005 an average of 66 building permits were awarded annually in the Watershed.

When expired permits are reported, NHOEP reduces the number of permits reported in the prior year. If the expired permits are never reported there is a possibility of double counting if a permit is re-issued, and the number of permits does not actually reflect the number of new units that were constructed. Building permit data is a useful tool that provides a sense of the rate of growth in the Watershed. This is especially true between Census counts. Table_ illustrates the number of permits awarded for each housing type in the Watershed from 1995 to 2005.

Table _ Building Permits in the Watershed

	1995-2005
Single Family	631
Multi-family	1
Mobile Home	90
Total	722

Source: NH Office of Energy and Planning

In the case of the Newfound Watershed the rate of permitting is lower for the entire watershed than it is for many New Hampshire communities to the south, and many of those located on other popular New Hampshire lakes.

> ***Planning Implications:***
> The location and design of development is more important to the health of the Watershed than the rate of growth alone.

EMPLOYMENT

Existing Conditions and Trends

The largest employers in the Watershed communities are generally located outside of the Watershed area, such as Freudenberg-NOK, Shop 'n Save, and the Newfound Area School District. Within the Watershed the largest employers are the municipalities, the Bridgewater Elementary School, and Shackett's Grocery. Many of the remaining employers are small, locally-owned businesses. There is also an increase in employment during the summer months when the many camps are open for operation, and other seasonal services are in demand.

> The largest employers in the Watershed communities are generally located outside of the Watershed area.

> ***Planning Implications:***
> Although the watershed is not home to one large employer supplying jobs to its residents, it is also not dependent on one business or employment sector for survival. The diversity of small locally owned businesses suits the Watersheds rural character, and provides greater stability to the Watershed economy.

Labor Force and Employment Trends

All of the Watershed communities, except Orange, fall within the Plymouth Labor Market Area as defined by the US Census. Orange is considered part of the Hartford-Lebanon VT-NH, Labor Market Area.

> The unemployment rate in the Watershed has been lower than the state, but higher than Grafton County.

Table _ indicates how the Watershed's unemployment rate compares to the Labor Market Area, County, state, and the nation. The unemployment rate in the Watershed has been lower than the state, but higher than Grafton County. The unemployment rate in the Watershed has increased since 1995 when it was only 2.5%.

Table _ Unemployment Rates in 2006

Area	Unemployment Rate
Watershed	3.3
Labor Market Area	3.2
Grafton County	2.9
New Hampshire	3.4
United States	4.6

Source: NH Employment Security

TRANSPORTATION

When analyzing the Watershed's demographics and growth rate, it is important to look at the transportation system that ties the communities together. Only one state route passes through the Watershed (NH Route 3A), but traffic counts have also been collected on several local roadways. The estimated average daily traffic counts for fourteen locations throughout the Watershed have been included in Table_ below. These counts indicate the total number of vehicles that are likely traveling on each roadway daily. This includes vehicles traveling in both directions on these two lane facilities.

Only one state route passes through the Watershed, but traffic counts have also been collected on several local roadways.

Table _ Annual Average Daily Traffic in the Watershed

Town	Location	1999	2000	2001	2004	2005	2006
Alexandria	West Shore Rd. @ Bristol Town Line	580				1100	
Alexandria	Washburn Road over Patten Brook	490				690	
Alexandria	Bailey Rd. over Bog Brook	310				330	
Bridgewater	NH Route 3A @ Hebron Town Line	2700				3100	
Bridgewater	Dick Brown Rd. over Clay Brook	200				320	
Bristol	NH Route 3A @ Newfound River Bridge	6400				7300	
Bristol	NH Route 3A @ Bridgewater Town Line		4200			4700	
Bristol	West Shore Rd. over Newfound River	2300				4300	
Bristol	West Shore Rd. @Fowler River Bridge	1300				1800	
Groton	North Groton Rd. @ Hebron Town Line		740				720
Groton	North Groton Rd. @ Cockermouth River		390				400
Groton	Sculptured Rocks Rd. over Atwell Brook		30				40
Hebron	North Shore Rd. over Cockermouth River			930		1100	
Plymouth	NH Route 3A @ Hebron Town Line	2700			3100		

Source: NH Department of Transportation

Planning Implications:
As population growth continues within the Watershed some of the local roadways will no longer be able to serve the increasing traffic volumes as well as they have. This is partially due to the geometry of many of these rural roadways, the increase in access points for roads and driveways, and the lack of infrastructure for other modes of travel such as bicycles and pedestrians.

Level of Service

New Hampshire Route 3A is the only state route in the Watershed, and therefore it is the only route that can easily be examined for its "Level of Service". A roadway's level of service rating indicates its overall condition and how well the facility can handle existing levels of use. According to the New Hampshire Department of Transportation's Ten Year Plan, Route 3A has no congestion issues in this area and the pavement condition for this two-lane state highway is considered good. This facility currently has a very high level of service, and is serving the region well. It is also important to recognize the importance of Route 104 to the south and Route 25 to the north. Both are east/west highways that provide access to Route 3A and the Watershed.

Route 3A has no congestion issues in this area, the pavement condition for this two-lane state highway is considered good, and it is serving the Watershed well.

Planning Implications:
As growth continues within the Watershed, and land use decisions are made along Route 3A and other roadways, more access points will likely be created. This could result in a higher number of locations for potential collisions, and will reduce the capacity of the roadways to handle the traffic volumes and serve the Watershed. Thoughtful land use regulations that manage access points could help reduce this threat.

Commuting Patterns

The average travel time to work for Watershed residents is 27 minutes based on information from the 2000 US Census, and the majority of workers commute to another New Hampshire community. The top locations workers reported commuting to include Bristol, Plymouth, Concord, Laconia, Meredith, Franklin, New Hampton, and Tilton. Table _ illustrates the commuting destinations of Watershed workers.

The average travel time to work for Watershed residents is 27 minutes, and the majority of workers commute to another New Hampshire community.

Table _ Commuting Destinations of Watershed Workers

Percent of Working Watershed Residents	
Working in community of residence	20%
Commuting to another NH community	75%
Commuting out-of-state	5%

Source: US Census

The distribution of commuters by mode of transportation in the Watershed is very similar to the state and national averages in all categories except carpooling and working from home. Overall, the majority of workers in the Watershed, 76%, commute to work alone using an automobile. It is understandable that the figures for public transportation would be lower than the national average, considering the lack of public transportation in the region compared to other regions of the U.S. that are more conducive to mass transit. Within the Watershed Hebron had the highest number of workers working from home at 14%.

Table _ Mode of Travel for Watershed Workers

Mode of Travel	*Percent of Watershed Workers*	*Percent of New Hampshire Workers*	*Percent of U.S. Workers*
Drove alone (car/truck/van)	76%	82%	76%
Carpooled (car/truck/van)	14%	10%	12%
Public Transportation	1%	1%	5%
Walked	3%	3%	3%
Other means	1%	1%	1%
Worked at home	6%	4%	3%
Mean Travel Time to Work	27 minutes	25 minutes	26 minutes

Source: US Census

Planning Implications:
There is a good percentage of carpooling and workers based at home or telecommuting within the Watershed. If these alternatives along with some form of public transportation could be encouraged further in the future this would have a very positive impact on the land use pattern within the Watershed, and would reduce the impact on the local and global environments.

CONCLUSION

It is clear from this demographic and growth assessment for the Watershed that the area is changing. This does not mean that the population is simply growing, which it is, but that the composition of this population is changing and will pose new challenges in the future. Overall, the population is aging, living together in smaller numbers, and shifting toward more year-round residency. The majority of the population and housing exists in the five communities of Alexandria, Bridgewater, Bristol, Groton and Hebron, but the four other Watershed communities contribute important upland areas. The majority of development within the Watershed is residential in nature, and this requires residents to travel outside of the Watershed for most services and employment opportunities.

The information gathered in this section of the Watershed Master Plan will be used in combination with the other sections to create implementation actions that ensure the long-term sustainability of the Watershed for generations to come.

Assessment of Master Plans and Land Use Regulations

The Newfound Watershed Master Plan

Assessment of Master Plans and Land Use Regulations

Newfound Lake Watershed Master Plan

November 2007

DRAFT

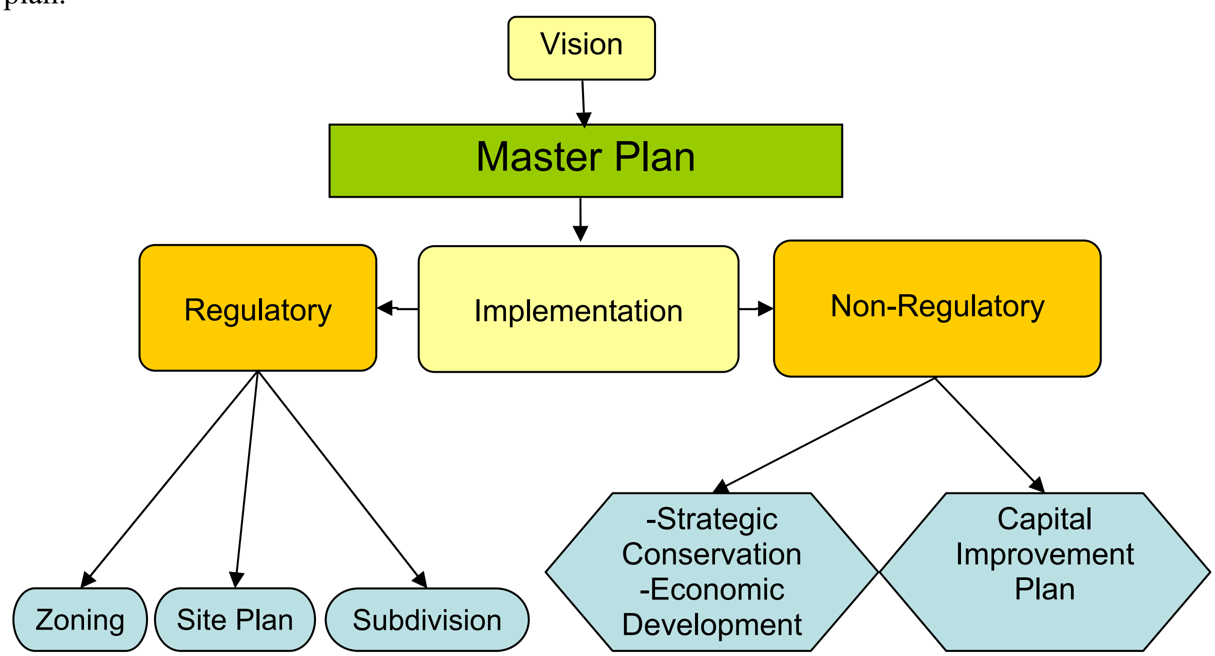
INTRODUCTION

This Watershed Master Plan includes an assessment of the existing master plan documents and the land use regulations in each of the nine Watershed towns. The reasons for conducting this assessment are to gain a better understanding of the level of planning and regulation that is currently taking place at the municipal level in the Watershed, to identify important tools that have been adopted locally, and to identify opportunities for new language and tools that may be adopted during future plan and regulation updates.

The purpose of this assessment is not to create an exact template for all plans and regulations within the Watershed, but rather to ensure that all nine communities are working toward a shared vision using whatever means they feel are most appropriate for their community. Any of the model language presented in the Watershed Master Plan will need careful review and adaptation to meet the needs and conditions found within individual communities.

A review of the existing master plan documents was the first step in this effort. This included a review of each plan's components with an emphasis on the vision statement and the future land use plan. It is important for all involved in this effort to know how each community has articulated its vision of the future, and how they believe future land use changes should be guided to reach their vision. We then reviewed each community's existing land use regulations to see if they are working to implement the vision and future land use plan for that town.

Legally, the master plan serves as the foundation for all land use regulations, and the regulations should help the community implement the vision contained in the master plan.



STATUS OF MASTER PLANNING IN THE WATERSHED

The majority of the master plans in the Watershed have been prepared since 2002. Although they differ somewhat in the extent of their inventory and the details of implementation, they all provide a clear sense of what the community would like to work toward from a land use perspective. This is critical information that can inform the Watershed Master Plan.

Throughout the nine Master Plans there is a clear understanding of what sets these communities apart, and how important it is to preserve their identities into the future. There is also a strong sense of stewardship and of the importance of protecting natural resources within the Watershed area. Many of the Master Plans also include some of the chapters recommended by the State of New Hampshire. Under NH RSA 674:2 only two chapters are required in a Master Plan. They are the Vision and Future Land Use chapters. The other recommended chapters include:

Hebron Village

-Transportation
-Community Facilities
-Economic Development
-Natural Resources
-Natural Hazards
-Recreation
-Utility and Public Service
-Cultural and Historic Resources
-Regional Concern
-Neighborhood Plan
-Community Design
-Housing
-Implementation

These chapters may be included in any combination based on the needs of the community. In future revisions of the community master plans it would be beneficial to this Watershed effort to see more detail on the condition and protection of natural resources, on future land use plans that consider the context of the Watershed, and on a Regional Concern chapter that reinforces the multi-town Watershed approach.

Table _ shows the age of each master plan, and the presence or absence of the Vision and Future Land Use sections required by New Hampshire statute.

Table _ Watershed Master Plan Dates and Details

Community	*Master Plan*	*Vision*	*Future Land Use Plan*
Alexandria	2007	√	√
Bridgewater	2006	√	√
Bristol	2002	√	√
Danbury	1985	X	√
Dorchester	1981	X	X
Groton	2007	√	√
Hebron	2005	√	√
Orange	2004	√	√
Plymouth	2006	√	√

√ = *included in the Master Plan*
X = *not included in the Master Plan*

A Vision for the Watershed

There is a great deal of similarity between the various Watershed communities' vision statements. All of the Master Plans identify the elements of their individual community's character, the importance of natural resource protection, and the need for balancing the various forces of growth and development into the future. The strong parallels between the various vision statements provide an assurance that the Newfound Watershed communities can join together to work toward a common vision.

The common vision that has been created for the Watershed communities states:

> *By the year 2020, we envision a watershed where quality of life and economic vitality are fostered by stewardship and sustainable use of the watershed's natural resources, land uses and development are balanced with conservation, and maintaining water quantity and quality is central to the efforts of the nine watershed communities.*
>
> *These have been achieved by…*

This vision was created during several public dialogues at Watershed meetings. In order to reach this vision a series of implementation actions must be developed during the preparation of this Watershed Master Plan. Then the identified actions must become priorities throughout the Watershed. Every resident, property owner, and visitor will necessarily have a role in the implementation of this vision in order for it to be fulfilled.

Existing Community Visions in the Watershed

The core elements of each community's vision have been summarized below:

Agricultural fields in Alexandria

Alexandria's vision reinforces the citizens' desire to preserve the rural character of the community while conserving natural resources, balancing development needs, and encouraging the use of land use policies and planning tools in order to work toward the vision. The vision also highlights concerns related to population increases in the future, and their potential impacts on the community.

Bridgewater's vision is to balance the preservation of its small town feel and natural resources with business development. The primary approach identified for accomplishing this is the strengthening of land use regulations.

Bristol's vision recommends safeguarding the rural qualities of the community by preserving the historic, natural, agricultural and forestry assets while creating well-designed, well-sited structures, addressing housing needs, and enhancing the economic vitality of the downtown.

Danbury does not have a specific vision statement, but the Goal Statements from the 1985 Master Plan serve a similar function (if they are still considered relevant by the residents today). In general they call for maintaining the uncrowded rural and village character, retaining agriculture and open space, protecting natural and historic resources, developing reasonable regulations, and maintaining an active role in local and regional land use planning activities.

Dorchester's 1981 Master Plan also lacks a vision statement, but the *Goals, Policies, and Objectives* section provides a fairly clear image of the community's desire to maintain rural character by protecting, improving, enhancing, and maintaining scenic, historic and natural areas (if they are still considered relevant by the residents today). The document also recommends protecting and maintaining watershed, wetland, and wilderness areas and keeping development away from natural and scenic resources.

Groton's vision recommends establishing a framework that reflects the will of the people and facilitates orderly growth and development while protecting the rural woodland characteristics of the town, promoting environmental protection, and creating opportunities for environmentally sensitive and aesthetically unobtrusive development.

Hebron's vision calls for remaining a small, friendly, rural community, but recognizes the need for affordable housing, protecting natural and historic resources, and encouraging small scale commercial businesses rather than large scale commercial or industrial activity.

Orange's vision states that the community should remain a rural residential community, protect natural and historic resources, and maintain its scenic beauty.

Plymouth's vision calls for responsible growth and community prosperity while preserving the rural characteristics and other qualities that residents and visitors value.

Future Land Use Considerations

The Future Land Use Plans that have been prepared in each of the local master plans appear to understand the complex web of resources that create each community. Each document also articulates the role of regulations in implementing the policy recommendations found in the Master Plan. This is good news and very important to the Watershed Master Planning effort. From a Watershed perspective it is important to view all nine future land use plans together as a cohesive whole. Together these municipal policies will determine future land use patterns in the Watershed, and how the impacts related to land use change will be mitigated to meet the objectives of the Watershed Vision.

Future Land Use Plans in the Watershed

Alexandria – This is a future land use plan that is based on the existing land use conditions and input expressed through the community survey (2005), and was designed to describe a desirable pattern of future development in Alexandria. Specific objectives are identified for the Village Center, the primary transportation corridor along NH Route 104, conservation/preservation areas, and the identified water resource protection areas. The future land use plan for Alexandria provides direction for future policy actions in the community, and stresses the importance of the natural and historic resources in the community. This information is very important to the health of the Watershed because Alexandria composes roughly 36 percent (22,600 acres) of the watershed area.

Bridgewater – The future land use plan recommends protecting the natural resources in Bridgewater, and reducing the impact of development on these resources. The plan also suggests fostering a village development pattern at a site to be identified along Route 3A, accommodating residential development using innovative development options such as open space cluster development, and creating voluntary design guidelines for all non-residential development.

Bristol - Bristol's present land use pattern provides a sharp contrast between the urban type of development found in the village area and a strongly rural pattern throughout the remainder of the town. The exception to this is the land area along the margins of Newfound Lake, where development patterns are denser. The future land use development in Bristol is limited by a variety of physical constraints' including steep slopes, wetlands, and floodplains. Otherwise development is expected to follow the existing zoning regulations. Bristol also included a Downtown Improvement Plan in the Master Plan that encourages the rehabilitation of the Downtown through a public/private partnership.

Danbury – The future land use plan calls for the continued use of the town center for a mixture of commercial and residential land uses, for future residential growth to be accommodated in areas of the community that are most suitable for development, and for the protection of identified conservation areas and environmental corridors. The plan even includes details on the types of land use regulations that would help discourage strip development and encourage a form of development that reflects Danbury's distinct rural character. The majority of the land in Danbury that falls within the watershed has been identified as being important for conservation.

Groton – According to the future land use plan residential development is expected to follow a pattern similar to that of the last two decades. In the future, though, it may fall under regulations that call for greater protection of surface water and ground water recharge areas, and the protection of areas considered important to preserving the rural/woodland character of Groton. Small unobtrusive home-based businesses are supported, and the desire for larger commercial/industrial development is dependent on the location. Forestry and agricultural activities are expected to continue and to be encouraged.

Hebron – Given the rural and generally hilly nature of Hebron, and the expressed wishes of the townspeople to maintain its rural character, low-density residential development is recommended in the future land use plan as the most appropriate land use pattern outside of the village area. The future land use plan also suggests that the town may want to revisit the minimum lots sizes currently being used, and, in order to protect the community's natural resources and scenic beauty, the plan recommends supporting zoning changes that would limit development in areas of steep slopes and in or near wetlands and floodplains.

Orange – The future land use plans states that a mix of residential uses, home businesses, agriculture and forestry activities will be encouraged throughout the town. Concern over the impact development may have on the natural environment and on the municipal budget is clearly stated.

Plymouth - The following settlement pattern is proposed in the future land use plan: mixed-use center in the downtown; moderate-density residential and civic-institutional uses adjacent to the downtown center; commercial and light industrial development in nodes along Route 3 north and Tenney Mountain Highway; surrounding countryside characterized by low density housing and a working landscape of forest and farms; a recreation area for four-season resort development; and the least accessible and most fragile areas left generally undeveloped. A very low density of development has been recommended for any of the remaining developable areas located in the portion of the community that falls within the Watershed.

Future Land Use Plans and Watershed Growth Projections

The Master Plans in the Watershed are in place to guide land use changes as the population grows. Based on the forecasts for population growth in the Watershed, the communities can plan on seeing a total of approximately 500 more year-round residents by 2020. These new residents will require housing units and non-residential services so **it is critical that the Master Plans are reinforced by regulations that will guide future development** toward the identified future land use plans and vision statements.

Population Projections for the Watershed Area

Towns	2005	2020	# Increase	% Increase
Alexandria	1029	1148	119	12%
Bridgewater	597	667	70	12%
Bristol	1978	2189	211	11%
Danbury	2	3	1	50%
Dorchester	0	0	0	0%
Groton	250	280	30	12%
Hebron	540	590	50	9%
Orange	12	14	2	17%
Plymouth	26	28	2	8%
Total	***4435***	***4919***	***484***	***11%***

Source: New Hampshire Office of Energy and Planning

Significant Master Plan Recommendations

The recommendations included in each of the nine master plans were reviewed against the Watershed Vision to see which are likely to help work toward the shared vision if they are implemented. The most significant recommendations were then grouped under the three main themes found in the Watershed Vision. A longer list of recommendations from each Master Plan can be found in Appendix _.

The three main Watershed Vision Themes are:

- Stewardship and Sustainable Use of the Watershed's Natural Resources

- Land Uses and Development are Balanced with Conservation
- Maintaining Water Quantity and Quality

Stewardship and Sustainable Use of the Watershed's Natural Resources

- Promote good forestry practices by requiring use of licensed foresters and registered loggers on timber harvests greater than five acres (*Bridgewater*)
- Consider adopting technology specific guidelines for the siting of windfarms (*Bridgewater*)
- Promote education and enforcement initiatives in Bridgewater related to Town and State regulations.(*Bridgewater*)
- Create a Town Beach on Newfound Lake. (*Bridgewater*)
- At the local level, The Conservation Commission has an obvious role to play in increasing public awareness of the town's natural assets and helping to educate the public about such approaches as conservation easements. The Planning Board should review the existing overlay districts to be sure they provide adequate protection for the most sensitive areas. (*Bristol*)
- Municipal authorities, business associations, private organizations and community leaders must work together to ensure the long-term health of the region's working landscape. Town ordinances should be friendly toward the agricultural and forest industries while encouraging the use of Best Management Practices. (*Bristol*)
- Establish a Rural Conservation District with large minimum lot sizes. (*Danbury*)
- The community should encourage the use of sound forest management practices. (*Danbury*)
- Adopt earth excavation regulations in accordance with RSA 155:E. (*Danbury*)
- The Conservation Commission should identify natural resources for restrictive action. (*Groton*)
- The Conservation Commission is also charged with developing a planning framework for the preservation of open spaces and woodlands while ensuring the viability of woodlands management activities. (*Groton*)
- Developing a program to encourage and improve forestry practices in the community. (*Dorchester*)
- Create a conservation commission to act as spokesperson for critical environmental areas. (*Dorchester*)
- Support sound forestry management practices. (*Hebron*)
- Adopt a lighting ordinance in conformity with the "Dark Sky" guidelines of the New Hampshire Office of Energy and Planning Technical Bulletin 16. (*Hebron*)
- Promote the preservation of open space land through conservation easements, gifts, and purchases. (*Orange*)
- Strategies to maintain and improve the continued economic viability of local agriculture and forest should continue to be supported. These include maintaining an adequate land base (e.g., through land conservation and land use regulations), maintaining and expanding economic incentives (e.g., current use), and allowing for value added production locally. (*Plymouth*)
- Protect and manage for sustainability the town's natural resources by:

    - Ensuring that the removal of sand, gravel, and other mineral resources does not permanently degrade the landscape, or adversely impact ground or surface waters;
    - Minimizing the loss of productive farm, forest and open land;
    - Guiding growth to priority development areas; and
    - Minimizing the impact of development to preserve the landscape. (*Plymouth*)
- Work with large landowners to identify alternatives to development; and use acquisition methods to protect important natural resources, especially environmentally sensitive areas. (*Plymouth*)
- Work with private conservation organizations to inventory wildlife habitat, including wildlife travel corridors, and to develop strategies for the preservation of that habitat. (*Plymouth*)
- Increase the public's awareness of its role in protecting natural resources and minimizing impacts on the natural environment. Provide information about appropriate water usage, non-point pollution sources (i.e., lawns, storm drains), maintenance of catch basins, sedimentation pools**,** waste disposal, invasive plants vs. native species, land protection options and other conservation issues. (*Plymouth*)
- Sustain forestlands as a renewable local resource. (*Plymouth*)

<u>*Land Uses and Development are Balanced with Conservation*</u>

- Establish ordinances and regulations designed to preserve and protect the rural character (*Alexandria*)
- Conduct an inventory of scenic resources and viewsheds within the community to guide the protection of key parcels within the identified scenic viewsheds. Provide guidelines for new development in these areas. (*Bridgewater*)
- Ensure that Bridgewater's regulations provide opportunities for a diverse mix of housing unit types that can accommodate the changing composition of Bridgewater's households. (*Bridgewater*)
- Work with developers to minimize the costs of living through quality housing design, energy efficient construction, and proximity to transportation options. (*Bridgewater*)
- Educate landowners about the benefits of leaving lands open to the public, and the liability protections provided by existing laws. (*Bridgewater*)
- One of the most effective ways to maintain the rural character of the town is through sensible zoning regulations. Commercial areas should be concentrated as much as possible, and preferably located close to the traditional village center. Zoning should allow for clustered residential development along with the preservation of open space. In addition, efforts to conserve our natural assets, to maintain the viability of agricultural lands and forests, and to enhance the natural systems that support life in Bristol, which are included later in this vision statement, all contribute to the effort to retain the rural character of the town. (*Bristol*)
- The community should guide growth in close proximity to existing community resources. (*Danbury*)
- Develop provisions for clustering development. (*Danbury*)

- Support zoning changes that would limit development in areas of steep slopes and in or near wetlands and floodplains. (*Hebron*)
- Determine the need for enhanced code enforcement services. (*Hebron*)
- Encourage land trusts, conservation groups, and private and municipal landowners to hold forests, shoreline, and open space for conservation and public recreational uses, as appropriate, and promote the use of conservation easements and restrictions for these purposes. (*Hebron*)
- Develop an Open Space Subdivision ordinance that would require developers to retain a significant portion of the development for open space/conservation easements. (*Hebron*)
- Review and update the Orange Zoning Ordinance and the Subdivison Regulations to ensure they foster the implementation of the Master Plan (*Orange*)
- Encourage additional creative site design to minimize development costs; allow for a mix of housing while preserving natural resources and open land; and, in appropriate instances, provide a density bonus to projects which include affordable housing units or permanent land preservation. (*Plymouth*)
- Encourage an integrated natural resource protection strategy that links the most environmentally sensitive areas of town to protect groundwater resources, surface waters, important wildlife habitat, softwood forests, farmland, recreation resource lands, and greenways through land acquisition/conservation, education, application of "best management practices," and/or "low-impact development" strategies. (*Plymouth*)
- Protect fragile resources and environmentally sensitive areas through land use regulations. At a minimum, such regulations shall:
    - Allow development on slopes of 15 to 25% only in accordance with strict standards to limit site disturbance and avoid erosion and sedimentation of surface waters;
    - Restrain the creation or the development of parcels that will result in development on steep slopes, wetlands, floodplain and/or natural heritage sites;
    - Require the designation of building envelopes (the area of a parcel where structures may be sited) and clustering of development;
    - Minimize the fragmentation of important agricultural land (including prime and statewide important soils), large softwood forest blocks and critical wildlife habitat;
    - Prevent the emission of excessive light, fumes, dust, odor, smoke and noise from all non-agricultural land uses; and
    - Explore land use regulations that clearly define areas unsuitable for development. (*Plymouth*)

Maintaining Water Quantity and Quality

- Develop construction and maintenance standards for the Highway Department and outside contractors to follow. (*Bridgewater*)
- While a good deal of federal and state legislation addresses such concerns as clean water and clean air, local awareness and concern play an important role in implementing this vision. The town should work closely with groups which are

devoted to the preservation of forests, rivers, etc. to assure that vital natural systems are preserved. (*Bristol*)

- Adopt and enforce more stringent setbacks from water bodies. (*Danbury*)
- Consider adopting a local septic system ordinance that includes design standards and inspection procedures. (*Danbury*)
- Preserving water quality by strictly enforcing state statutes on septic tank installations. (*Dorchester*)
- Using the *Comprehensive Shoreland Protection Act* as a guide, develop ordinances to protect the Cockermouth River, the major brooks (e.g. Cilley, Fretts, Wise, Tannery, and Georges/Bog Brooks) and wetlands. (*Hebron*)
- Prevent degradation of water resources by:
    - Evaluating current zoning setbacks from rivers and streams for adequacy, and make changes as deemed necessary;
    - Preventing potential adverse impacts to groundwater resources, including depletion and degradation of water quality, from groundwater extraction;
    - Ensuring that development within wellhead protection areas is carefully designed to prevent adverse impacts to groundwater supplies;
    - Requiring proper erosion control measures and storm water management during all development, including road construction and maintenance; and
    - Controlling road salt storage areas and snow dumps to prevent contamination of waters. (*Plymouth*)

STATUS OF LAND USE REGULATIONS IN THE WATERSHED

The existing land use regulations in each community were reviewed in order to better understand what is currently in place, how extensive the regulations are within the Watershed, and the likelihood that they will guide future changes toward the individual community visions and the Watershed vision. In many ways this review serves as both an inventory and an initial audit of how well the regulations will implement the master plans. Eight of the Watershed towns have a zoning ordinance in place. Alexandria, the one community that does not currently have zoning, does still regulate the subdivision of land, floodplain development, and earth excavation.

Hillside Development in Bridgewater

It is interesting to see the level of uniformity throughout the Watershed, and note which aspects of that uniformity are likely to work toward or against the Watershed vision. All of the towns have subdivision regulations in place, and five of the communities also have site plan review regulations. With the exception of some overlay districts, the majority of the Watershed falls under some form of a rural residential zoning district. As a result, most of the Watershed has a minimum lot size of 1-2 acres, and a minimum road frontage requirement of 150 to 200 feet. **This is potentially a very suburban pattern of development, and not one that matches the vision statements**. One exception to this is the Rural Residential District in Bridgewater, which notes the scenic, recreational, and environmental values of the land and calls for a lower density of development.

Some of the communities have adopted additional setbacks and performance criteria for land adjacent to surface waters and wetlands, but little has been done to address steep slope or ridgeline development. Most of the communities have a provision for open space cluster developments, but few provide suitable design guidelines or incentives to the developer. Some of the communities have also adopted other provisions including wetland ordinances, historic district regulations, a seasonal conversion ordinance, outdoor lighting regulations, impact fees, adult use ordinances, and telecommunications ordinances.

Some of the communities have also made a point of including a provision for the assessment of "regional impact." Having this provision in the land use regulations and regulatory checklists helps remind board members and applicants that any Planning Board may determine an application to be a development of regional impact according to NH RSA 36:54. This is a tool that may become more useful within the Watershed as each community begins to understand the potential impacts new development proposals may have on the shared resources within the Watershed.

Finally, this chapter of the Watershed Master Plan should help identify how effective the existing regulations are going to be in the future, what existing regulations may serve as examples for other portions of the Watershed, and what types of regulatory improvements would be beneficial to consider in the future.

Building Permits, Occupancy Permits and Enforcement

Currently, all of the Watershed communities require some form of building permit or land use permit for new structures. This is largely to help monitor the level of development activity in each community. Most of the enforcement duties related to these permits fall to the Boards of Selectmen, and in some instances an identified Health Officer working with the Selectmen. Two communities, Bristol and Plymouth, have professional code enforcement staff.

Bridgewater is the only community that requires an occupancy permit, but other communities in the Watershed have expressed interest in this practice. Occupancy permits are used to enforce the community's building and land use regulations. They often require an inspection to ensure that the structure is safe for occupancy, and occupancy is considered illegal without an approved occupancy permit.

Residential Units along the Shoreline of Newfound Lake

Community	Zoning Ordinance	Zones	Minimum Lot Size	Road Frontage	Lot Coverage Limits	Environmental Setback	Open Space Clustering	Excavation Regulations	Erosion/sediment Control
Alexandria	N/A	N/A	Minimum of two acres	Minimum road frontage of 150 feet	N/A	N/A	Cluster Housing Provision in Subdivision	Gravel Pit Regulations	In Subdivision regulations
Bridgewater	2004	General Residential District; Rural Residential District; Commercial District; Commercial/Industrial District	Minimum of two acres or five acres	Minimum road frontage of 150 feet to 300 feet	15% to 30% Maximum lot coverage	N/A	Allowed in Zoning with no additional density (no guidelines or performance criteria)	Basic regulations in the Zoning for areas within 100 feet of public ROW; RSA 155 E for all other commercial purposes.	N/A
Bristol	2007	Village Commercial District; Village Residential District; Downtown Commercial District; Corridor Commercial District; Rural District; Lake District; Industrial District; Pemigewasset Overlay District; Wetlands Conservation Overlay District; Historic Overlay District	Vary based on District from 10,000 square feet to two acre minimum	Vary based on District from 50 feet to 150 feet	Vary based on District from 100% in the Downtown Commercial District to a maximum of 10% impervious lot coverage in the Pemi Overlay	Primary structures and garages 100 feet from Pemigewasset reference line, and were existing preservation of the natural vegetative buffer within 150 feet of the river; All structures must be at least 50 feet from surface waters in Lake District; 50 feet from wetlands for all development unless a Special Use Permit is awarded	Allowed in Zoning, but lacking performance criteria	RSA 155 E	Erosion and siltation control requirements in Pemi Overlay District
Danbury	2006	Town wide Rural District with Village Overlay Districts	Vary based on District from one acre in the village to two acres elsewhere	Vary based on District from 100 feet to 200 feet	N/A	N/A	Cluster Residential Development in Zoning (50% as open space, and density bonus possibilities)	N/A	Stormwater Management and Erosion Control in Subdivision regulations

Community	Zoning Ordinance	Zones	Minimum Lot Size	Road Frontage	Lot Coverage Limits	Environmental Setback	Open Space Clustering	Excavation Regulations	Erosion/sediment Control
Dorchester	1991	Rural District	Minimum of two acres - not including wetland areas or slopes in excess of 20%	Minimum road frontage of 200; Lots over 15 acres require 400 feet of frontage	N/A	Buildings 75 feet from surface waters; no water or septic system within 100 feet of surface water bodies	Allowed in Zoning with no additional density (no guidelines)	N/A	In Subdivision regulations
Groton	2007	Rural Residential Development	Minimum lot size by soil classification or a minimum of two acres, whichever is greater	Minimum road frontage of 150 feet	N/A	N/A	N/A	N/A	In Subdivision Regulations
Hebron	2007	Common Historic District; Lake District; Rural District; Floodplain Overlay District; Wetlands Protection Overlay District	I acre in Village; 2 acres in the Lake and Rural Districts; (not including wetland areas or slopes in excess of 25%)	Minimum road frontage of 150 feet	30% Maximum for residential lots	Shore Setback - Buildings 50 feet from public waters; Wetland setback and buffer 50-150 feet	Permitted in the Lake and Rural Districts with no additional density	N/A	In Subdivision regulations
Orange	1991	Rural Residential District	Minimum of two acres; (not including wetland areas or slopes in excess of 15%)	Minimum road frontage of 200 feet	40% Maximum	N/A	Allowed in Zoning with no additional density (no guidelines or performance criteria)	Basic regulations in the Zoning for areas within 100 feet of public ROW; RSA 155 E for all other commercial purposes.	In Subdivision regulations
Plymouth	2006	Single Family Residential; Multi-Family Residential; Agricultural; Civic/Institutional; Village Commercial; Highway Commercial; Industrial and Commercial Development; Floodplain Development (overlay); Environmentally Sensitive (overlay); Airport (overlay)	No minimum lot size in the Village; .5 to 1 Acre minimum elsewhere	Vary based on District from 50 feet to 150 feet	Vary based on District from 100% in the Downtown and 50% elsewhere	In the Environmentally Sensitive Zone structures shall be setback 75 feet from the edge of the normal river channel or the mean high water line of the lake.	Open Space Residential Development in Zoning	RSA 155 E	In Subdivision regulations

Regulatory Models Within the Watershed

Within the Watershed several regulatory approaches that are used in some communities could serve as models to other communities, although they may need to be adapted to assist those communities as they strive to meet their own objectives. This is not to say that each of the examples below has been perfected, but rather that they are steps in the right direction towards addressing issues that all of the communities will be facing.

Diversity of Density

The communities of Bridgewater, Bristol, Hebron and Plymouth have all created a variety of zoning districts that relate to the characteristics in each portion of their community and the vision for that area of town. This is a more effective approach to reaching the vision than a "one size fits all" lot size requirement town-wide.

Open Space Cluster Regulations

Although most of the Watershed communities have provisions for the clustering of development, Danbury stands out as the most progressive example. The Danbury regulations require that fifty percent of the parcel be protected as common land (open space), and then provides a bonus unit incentive for developers. This ensures that the conservation area is significant, and provides a mechanism to promote this type of development to developers.

Environmental Setbacks

In Bristol and Hebron there are examples of specific setback requirements that reduce the impact of development activity on sensitive resources. These setback requirements also include provisions for natural vegetative buffers which filter stormwater, control erosion and provide critical wildlife habitat adjacent to surface waters.

Wetlands Overlay

Bristol has adopted an overlay district to reduce the impact of development on wetlands and their immediately adjacent uplands environments. Hebron has a similar ordinance going before the Town in 2008. These restrictions control the types of activities within wetland areas, and establish setback and buffering requirements for activities locating in close proximity to these critical resources.

Seasonal Conversion

The Town of Bridgewater has adopted an ordinance that assists it in monitoring the conversion of seasonal structures to year-round units. This is particularly important because many of the seasonal structures are older units that were not intended for intense year-round use. A primary concern is their septic systems, and the need to ensure that the system can accommodate the new levels of use.

Earth Excavation Regulations

Based on the authority of RSA 155:E for planning boards to regulate earth excavation regulations, Alexandria adopted an Earth Excavation ordinance and began working with local property owners to get existing and abandoned operations into compliance. Their annual review process has greatly reduced the number of abandoned and non-conforming operations within the community.

CONCLUSION

Moving forward as a Watershed it will be important to have a clear vision with detailed implementation actions that all of the communities can help work toward. Understanding the individual community visions within the Watershed, and the implementation tools that have been adopted locally was an important first step and the purpose of this *Assessment*. This information will be used to help inform the public, and to select areas that will need attention locally under future planning and implementation activities. This *Assessment* will also provide some baseline information on the level of planning and implementation in the Watershed, and a way to measure progress as more planning and implementation are accomplished in each of the Watershed communities. Selecting implementation actions that build on the work accomplished in each of the communities and leading the Watershed as a whole toward a common vision is central to the long-term health of the Newfound Lake region.

2007 Survey of Watershed Communities

The Newfound Watershed Master Plan

Understanding the Views of Residents to Guide the Creation of
Every Acres Counts: The Newfound Watershed Master Plan
Findings from a Watershed Community Survey

Prepared for

The People of the Newfound Lake Watershed, The Every Acres Counts Project Team, and The New Hampshire Department of Environmental Services

by

The Center for the Environment, Plymouth State University

Dr. Brian W. Eisenhauer
Associate Director
Center for the Environment
Plymouth State University

Dr. Joan M. Brehm
Assistant Professor of Sociology
Illinois State University

Danielle Ross
William H. Hopkins
Meghan Rodier
Jennifer Hill
Christian Weber
Center for the Environment
Plymouth State University

Dr. Richard Stedman
Assistant Professor of
Natural Resources
Cornell University

May, 2008

Plymouth State University
Center for the Environment
17 High Street, MSC #63
Plymouth, New Hampshire USA 03264
603.535.2497 bweisenhauer@plymouth.edu www.plymouth.edu/cfe

Plymouth State UNIVERSITY

Center for the Environment

I. Introduction and Statement of Purpose

The Newfound Lake watershed is a uniquely beautiful and rural watershed in New Hampshire that is home to residents of nine distinct towns. The watershed is valued for its beauty and as an essential economic resource in the region, and Newfound Lake itself has high scenic value and very good water quality at the present time. Like many regions of New Hampshire the Newfound Lake watershed is experiencing social and economic changes, including population growth and the related impacts on water quality. As a result it is a pivotal time for ensuring the long-term health and beauty of the watershed by developing a Watershed Master Plan for the Newfound Lake Region.

A watershed master plan is a non-binding, guiding document that can serve as a resource for town governments and residents of the watershed. A watershed master plan helps promote understanding of the shared resources in the region, and is often a key component of managing water resources on the watershed scale beyond town boundaries. The plan encourages the use of management tools within each subwatershed and community so that the water resource goals for the entire watershed are met. Watershed plans can work to improve water quality, balance development and conservation activities, manage recreational opportunities, maintain public health, encourage best management practices, and preserve the aesthetics of rivers and lakes. The Newfound Watershed Master Plan includes partnerships and collaboration between the public, local and state agencies, and local organizations.

Developing a watershed master plan is a complex process involving many areas of professional expertise and research, and many important tasks require an understanding of the social dynamics of issues within the watershed. Identifying residents' desires for the future through visioning processes, understanding concerns about management alternatives, and documenting the current understanding of best management practices are just a few examples of the ways watershed management plans necessitate an understanding of social factors to develop effective information and recommendations.

Surveys provide a form of public input that is used in most community planning processes in the United States (American Community Survey Data for Community Planning. 2006. Taeuber, Cynthia M. Trafford Publishing, New York). An excellent review of the use of surveys in community planning and other community-centered projects is published by and available through the Western Rural Development Center (http://wrdc.usu.edu/); specifically informative work for this project is *"Surveys as a Tool for Community Based Research."* (Dr. Stanley Guy. 2005. Chapter 1: Community Centered Research: A Primer. Utah State University Press. Logan, Utah.). Examples of surveys and their use in demographic data analysis are available at these sources, and examples from communities across the nation are also widely available on the internet.

To meet the need for social data in this planning project a random sample, scientific survey of residents of the Newfound Lake Watershed was conducted as part of the watershed plan development process. The development of the survey was a participatory action research process (Whyte, 1991; Wulfhorst et al in press) where the needs for the research and the topics to be examined to meet those needs were identified through extensive consultations and reviews with the Newfound Watershed Management Plan Project Team, including the non-profit organization the Newfound Lake Region Association (NLRA). The involvement of the NLRA was essential in the survey process, as watershed and river-based organizations represent a grassroots effort to facilitate citizens' involvement in protecting natural resources within a watershed. These place-based organizations take many different forms (Moore and Koontz, 2003) and are an increasingly common form of environmental action in the United States whether created by federal or state agencies (O'Neill, 2005) or citizens themselves. As of 2003 volunteers monitored watershed health in more than 700 programs in the U.S., and their activities involved more than 400,000 stakeholders (Fleming 2003). Research on the impacts of these organizations has indicated that watershed associations enhance the ability of communities to obtain funding and to implement watershed protection actions (Cline and Collins, 2003), and accordingly the NLRA, along with other project team members, were essential in questionnaire design.

Through consultation with the Newfound Watershed Master Plan project team and a review of relevant social science research specific goals for the Newfound Watershed Master Plan survey project were defined, and uses for the information were determined. The social science research was conducted to examine social factors relevant to efforts to maintain water quality, and the findings provide information for use in the development of the WMP and the design and delivery of education and outreach programs. The stages of the initial project to conduct as scientific survey of Newfound region community residents were defined as:

- Task 1: Literature review: Ground the study in existing works
- Task 2: Hire graduate and undergraduate student workers
- Task 3: Develop questionnaire; Consult with working group and Steve Whitman on content
- Task 4: Develop sampling frame; draw scientifically random sample
- Task 5: Print questionnaires, return envelopes, postcard reminders for survey administration
- Task 6: Administer survey using Tailored Design Method (multiple waves of mailings and other techniques to enhance response rates)
- Task 7: Enter survey data into Statistical Package for the Social Sciences
- Task 8: Data analysis
- Task 9: Write draft report
- Task 10: Write final report

This document will present salient findings in the following sequence:

I. Introduction and Statement of Purpose
II. Conceptual Context and Research Methods
III. Salient Findings - Survey of Community Members – Univariate Analyses
IV. Salient Findings - Survey of Community Members – Bivariate Analyses
V. Conclusions and Recommendations
VI. Appendices
   A. Research Instruments
   B. Tables Presenting Complete Data From All Questions in the Questionnaire
   C. Bar Charts Presenting Complete Data From All Questions in the Questionnaire
   D. Survey Results: Complete Bivariate Analyses

II. Conceptual Context and Research Methods

The survey of residents of the Newfound Lake Watershed is a scientifically designed survey project that has produced generalizable and usable information about residents' perceptions of issues in the watershed and desires for the future. The information was collected and analyzed to improve understanding of social dynamic of environmental and community issues in the region, and to provide the watershed master plan project team, local communities, residents, and NH DES with recommendations about how they might continue to work to protect water quality and the well-being of residents of the watershed. To achieve these goals the project used a multi-stage approach to design the research.

The initial stage of the project involved an extensive review of available information about watershed issues in New Hampshire. Press releases, newspaper articles, informal interviews with key informants, and peer-reviewed scholarly and professional research was reviewed to develop an understanding of the regional issues and to identify important considerations. This information provided a foundation for the design of the research, and frequent intensive consultations with project team members ensured that the research maintained a focus that results in findings that can be used in the watershed master planning process.

Once background information on the regional issues was collected a literature review of scholarly and professional works on watershed planning was conducted to determine key issues to be examined in the research. For example, social movement theory is a well-developed body of knowledge that offers insights into the technical needs frequently experienced by citizen based environmental groups involved in watershed planning (Burchfield, 2001; Brown, 1997). The results were used to further focus the inquiry by building on existent information about these groups and factors affecting their successful collaborations with communities. This effort helped ensure that the data collected was of maximum utility for the planning process, and was used to develop the self-administered questionnaires used in data collection. In the interests of space, time, and utility the literature review was used to design the research, but results are not presented as a separate section in this document.

Research Methods

The self-administered questionnaire survey was administered to property owners in eight towns in the watershed. Newfound Watershed encompasses all, or parts, of nine towns and samples drawn were based on demographic data from the US Census and on geographic location in relationship to Newfound Lake. Property owners in the Town of Dorchester were not included in the survey sample for two reasons 1) only sixteen acres of the town are located in the watershed and 2) no portion of Dorchester's population resides in the watershed. When developing the sample the goal was to target property owners whose actions had greater impact on the watershed and whose connections to the area were stronger, keeping in mind that decisions that affect the watershed are made at the town level. A portion of the sample, independent of town, was also drawn from a list of lakefront property owners. Ultimately the randomly selected sample included 1,945 property owners from towns in the watershed, with the specific sampling strategy in each community defined using the following information about the communities in the watershed.

Table 1._Watershed Land Area and Population by Community - 2005 and Samples Drawn from Community

Town	Acres in Watershed	% of Watershed Acres	Town Population	Population in Watershed	% of Watershed Population	Sampled Population
Alexandria	22,616	35.8	1,472	1,030	23	350
Bridgewater	5,297	8.4	1,029	597	13	70
Bristol	7,212	11.4	3,185	1,975	45	400
Danbury	859	1.4	1,179	2	0.05	100
Dorchester	16	0 (rounding)	382	0	0	0
Groton	11,369	18	496	248	6	230
Hebron	12,151	19.2	539	539	12	275
Orange	2,141	3.4	311	12	0.3	50
Plymouth	1,490	2.4	6,387	26	0.6	100
Lakefront						370
Total	**63,151**	**100**	**14,980**	**4,429**	**100**	**1,945**

Source: Newfound Lake Region Association; US Census; NH Office of Energy and Planning

To develop the sampling frame the research team worked with town halls to obtain lists of property owners from tax records. While the records are public, it was crucial to communicate with town administrators about the project in order to obtain these records electronically. In some cases this involved personal visits to town offices, and much dialogue. All towns were able to supply an electronic database with the exception of Orange, which did not have such a database but provided a hard copy of their records. Developing the list of lakefront property owners also involved visiting the town offices of Hebron, Bridgewater, Alexandria, and Bristol to view property maps. Using these maps it is possible to view the lot numbers of lakefront property and find the corresponding record in the electronic databases to develop the lakefront portion of the sample.

Once these records were obtained and identically formatted the samples were randomly selected from the resulting sampling frame; randomized numbers are assigned by excel, are sorted in numeric order, and the sample is drawn from the top of the list. The samples from each town and lakefront list were then combined and duplicates were removed and replaced by the next name on the list until a sample of 1,945 with no duplicates was created.

The survey was administered using a modified version of the Tailored Design Method (Dillman, 2000) that employed several techniques intended to enhance response rates; these included customizing letters, multiple waves of contacts with carefully timed reminders, providing information about the need for responses, as well as other techniques. The sampled population is sent a total of four contacts. Prior to sending the survey, a letter is sent that informs them about the project, the coming questionnaire, and the importance of their response. In about a week the second contact is sent. This includes the questionnaire, a cover letter with additional information about the project and confidentiality, and a postage paid return envelope for returning the questionnaire. A postcard is sent within the next two weeks as a gentle reminder to complete and mail in the questionnaire. A final letter reiterating the importance of responses that also contains a replacement questionnaire and return envelope are sent within one to two weeks of the reminder postcard.

A small proportion of the surveys sent to potential respondents from the original sample frame were returned as "undeliverable" due to inaccuracies in town records or other issues. In order to maintain our original sample size, the undeliverable surveys are replaced by the next names on the lists and the same modified version of the Tailored Design Method was implemented to deliver these surveys. Within the replacement surveys, seven were also undeliverable. Rather than repeating the process and holding up data collection, the original sample went from 1,945 to 1,938. Of the 1,938 questionnaires we sent, 794 were completed and returned for an overall response rate of 41%. The following chart breaks down the responses from each town and lakefront sample:

Table 2._Samples and Response Rates from Each Community in the Watershed.

Town	Sampled Population	Number of Responses	Response Rates (%)	Lakefront by Town	Total	% of Valid Responses
Alexandria	350	123	35.14	6	129	16.25
Bridgewater	70	33	47.14	24	57	7.18
Bristol	400	162	40.50	75	237	29.85
Danbury	100	23	23.00		23	2.90
Groton	230	77	33.48		77	9.70
Hebron	275	156	56.73	72	228	28.72
Orange	50	14	28.00		14	1.76
Plymouth	100	18	18.00		18	2.27
Lakefront	370	177	47.84			
Missing data		11			11	1.39
Undeliverable	7					
Total	**1,938**	**794**	**41**	**177**	**794**	100

Analyses of the questionnaire data were conducted using Statistical Package for the Social Sciences (SPSS). Descriptive statistics, bivariate analyses, and multivariate procedures are used to examine the results and to identify important findings that can be applied to achieve the goals of the project.

III. Research Questions Guiding the Survey Research

The following are the broad goals for the community survey segment of the Newfound Watershed Master Plan creation project:

- Identify residents' values for the watershed and desires for the future
- Determine residents' present understanding of stewardship principles
- Ascertain correlates of environmentally responsible behavior
- Identify perceived barriers to and benefits of adopting environmentally responsible behaviors
- Discern residents' level of trust in information sources and vectors of delivery
- Provide other useful information on specific issues relevant to the development of the watershed master plan

III. Salient Findings from the Survey of Watershed Residents – Section 1 – Univariate Analysis

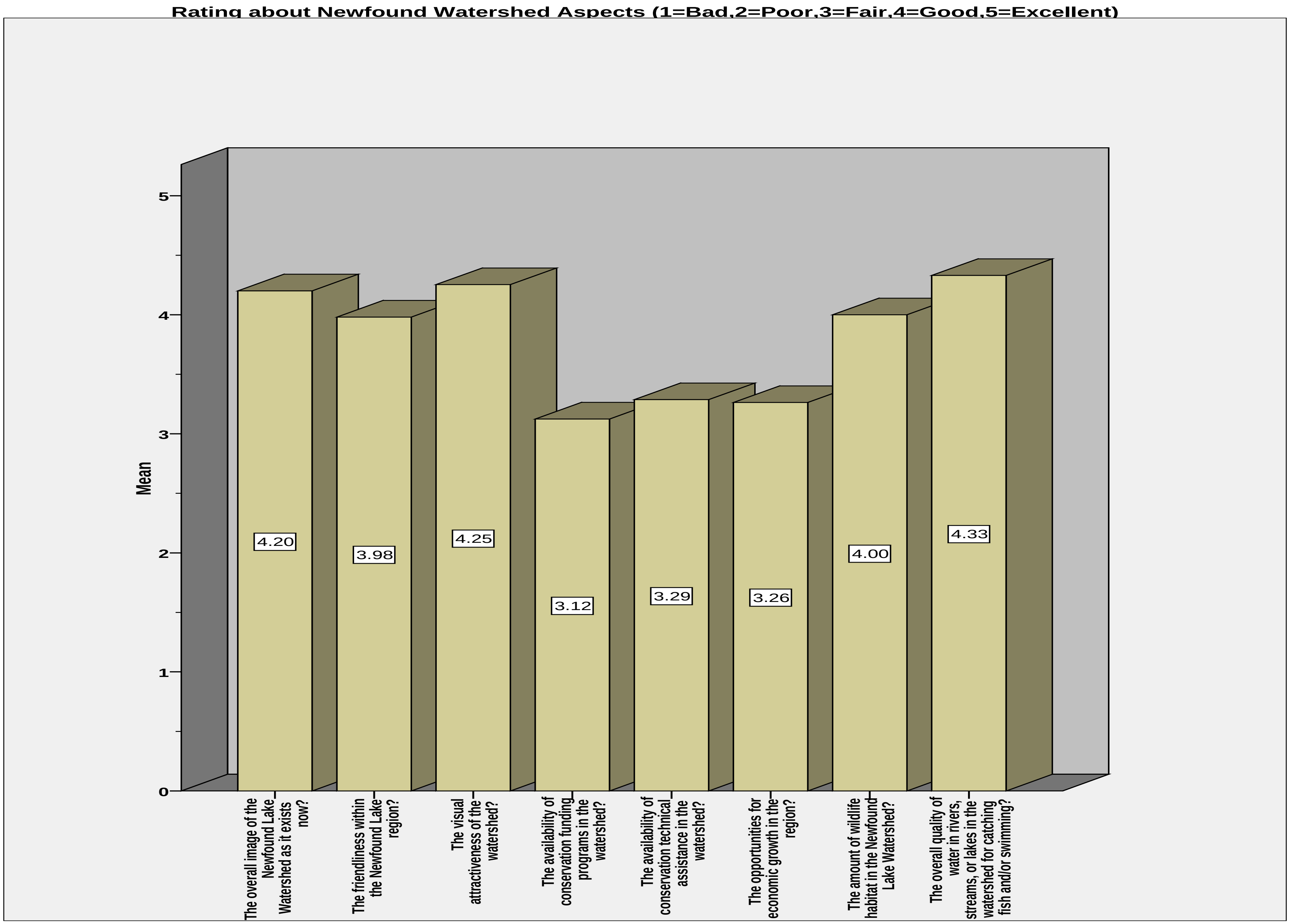
Using and interpreting this report

The first section of analyses highlights important findings from the survey data that are of particular use for the creation of watershed master plan by identifying residents' perceptions of issues and desires for the future. Complete results from the survey appear in both tabular and graphical summaries of response distributions to every question in the questionnaire in the appendices to this report.

Findings are presented in both tabular and graphical form, with key implications of the findings presented succinctly before the data. When interpreting the tables and charts in this section of the report it should be noted that several different forms of data presentation are used. First, charts are presented that can be used to analyze the numerical means of measures of respondents' attitudes towards several issues for comparative purposes. Most responses to these questions were measured on a numerical scale indicating a respondents' level of agreement with a specific assertion about an issue in the watershed, landowners' activities or potential future activities, or regulations. Other forms of questions are clearly presented. The responses to several questions identified as particularly informative are also presented in the findings from each section of the questionnaire after the means charts summarizing the response patterns as a whole. In tables representing data from a single question the column headers in the tables identify different forms of data analysis. The frequencies are simple counts of the number of responses. The percent column includes missing data, which are responses such as "don't know", "not applicable," or places where a respondent did not indicate an answer. The valid percent is the column of most use, as it indicates the distribution of responses with missing data removed from the analysis.

<u>Section I of the Questionnaire:</u>

The following is a bar chart indicates respondents' mean ratings (1= “Bad”; 5 = “Excellent) of specific aspects of the Newfound Lake Watershed related to the region’s identity and several conservation issues. The overall quality of water in rivers, streams, or lakes in the watershed for catching fish/or swimming was rated the highest out of all the visual and physical characteristics surveyed, with a mean of 4.33. This is a positive indication that the water quality in the lake is perceived as high. The second highest rated feature (mean = 4.25) was of the visual attractiveness of the Newfound Watershed, indicating that its rural character is valued and seen as visually attractive to its users. The lowest rated aspect of the watershed with (mean = 3.12) was the overall availability of conservation technical assistance. This indicates that residents feel the watershed is in need of conservation technical assistance, and presents opportunities for potential outreach and other activities to maintain water quality.



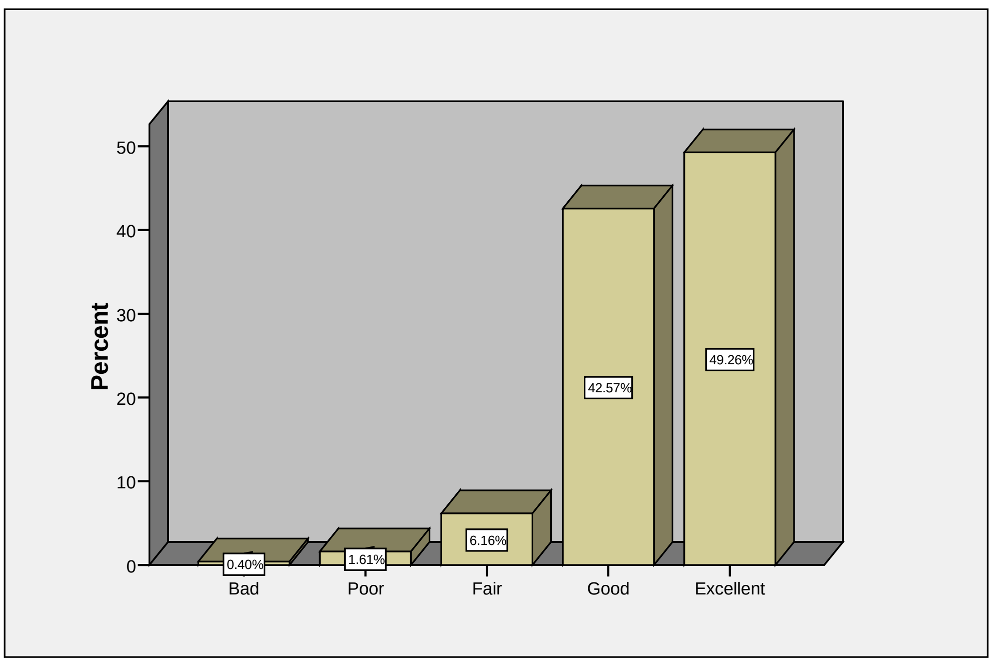
Rating about Newfound Watershed Aspects (1=Bad,2=Poor,3=Fair,4=Good,5=Excellent)
Mean
0
1
2
3
4
5
4.20
3.98
4.25
3.12
3.29
3.26
4.00
4.33
The overall image of the Newfound Lake Watershed as it exists now?
The friendliness within the Newfound Lake region?
The visual attractiveness of the watershed?
The availability of conservation funding programs in the watershed?
The availability of conservation technical assistance in the watershed?
The opportunities for economic growth in the region?
The amount of wildlife habitat in the Newfound Lake Watershed?
The overall quality of water in rivers, streams, or lakes in the watershed for catching fish and/or swimming?

Two questions in section one produced results that are especially noteworthy for the planning effort. The project has an explicit focus on water quality, and the last question in section one asked respondents to rate the overall quality of water in rivers, streams, or lakes in the watershed for catching fish/swimming, and the results are presented below in both tabular and graphical forms.

The overall quality of water in rivers, streams, or lakes in the watershed for catching fish and/or swimming?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Bad	3	.4	.4	.4
	Poor	12	1.5	1.6	2.0
	Fair	46	5.8	6.2	8.2
	Good	318	40.1	42.6	50.7
	Excellent	368	46.3	49.3	100.0
	Total	747	94.1	100.0	
Missing	Don't Know	39	4.9		
	Missing	8	1.0		
	Total	47	5.9		
Total		794	100.0		

The overall quality of water in rivers, streams, or lakes in the watershed for catching fish and/or swimming?



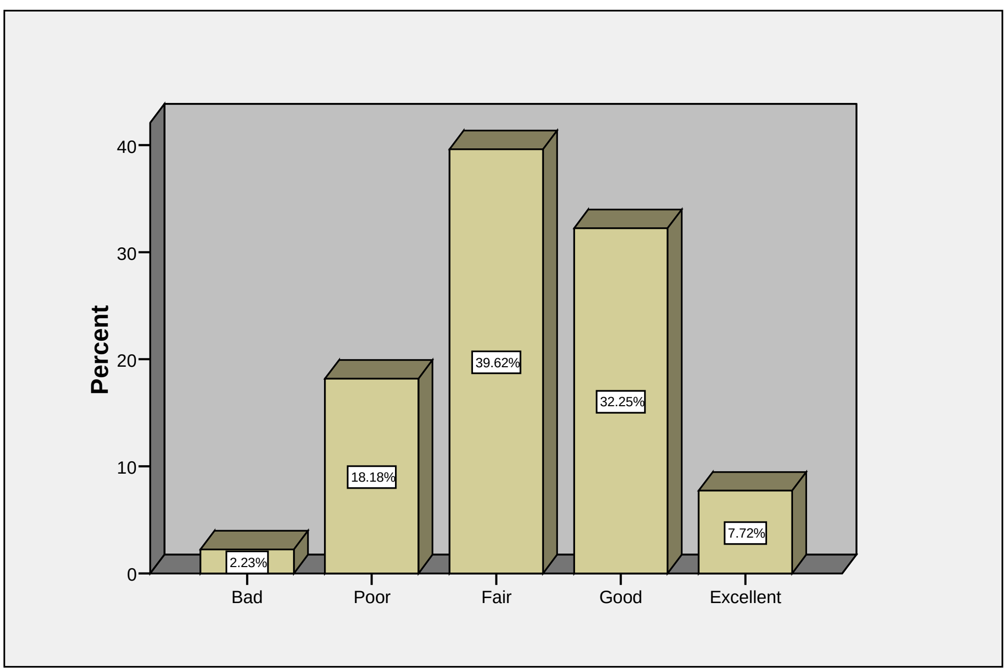
The results indicate that respondents' perceive that there is a very high water quality in the watershed, with few exceptions. This is an important factor for planning and outreach, as it is clear residents are aware that there the watershed has not suffered extensive negative impacts on water quality and may therefore be especially motivated to act proactively.

Another question in section one asked respondents to rate the opportunities for economic growth in the region, which is an important factor for consideration in the development of a master plan. The responses below indicate that respondents have very mixed perceptions of these opportunities, with a very even distribution of responses represented in the information below. Overall respondents feel primarily positive about these opportunities, but it is also an area of need in the region.

The opportunities for economic growth in the region?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Bad	13	1.6	2.2	2.2
	Poor	106	13.4	18.2	20.4
	Fair	231	29.1	39.6	60.0
	Good	188	23.7	32.2	92.3
	Excellent	45	5.7	7.7	100.0
	Total	583	73.4	100.0	
Missing	Don't Know	193	24.3		
	Missing	18	2.3		
	Total	211	26.6		
Total		794	100.0		

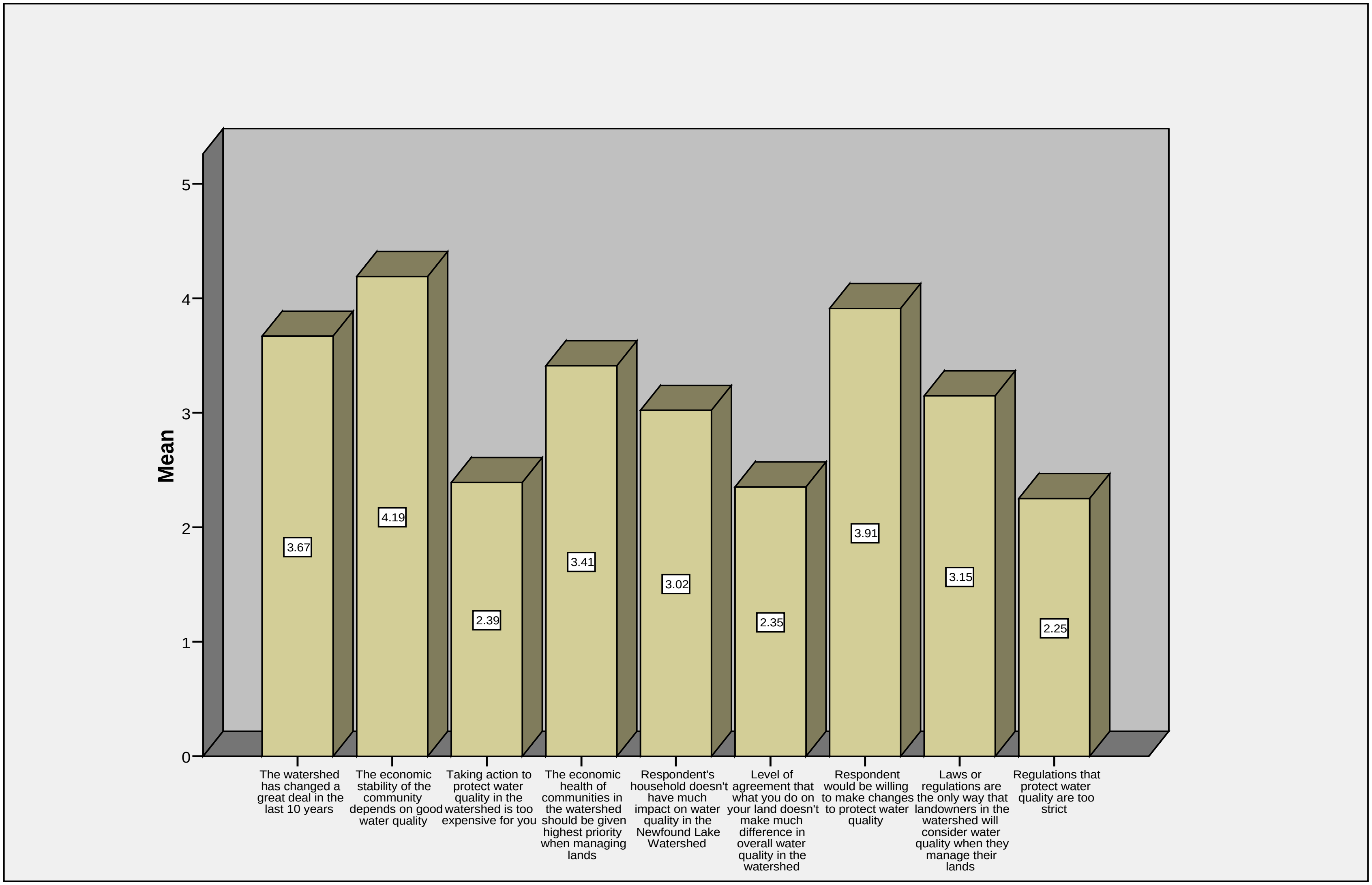
The opportunities for economic growth in the region?



Question 2 of the Questionnaire

The means chart on the next page shows respondents level of agreement with the specified statements about water quality and management option in the Newfound Lake Watershed. The highest level of agreement among respondents concerned the assertion that the economic stability of their community depends on good water quality. The level of agreement with that statement had an overall mean of 4.19. This indicates that people within the Newfound Watershed community recognize that it is vital to have good water quality conditions in order to have a stable community economy. In contrast to this positive perception of the importance of water quality, many people agreed with the statement, “what I do on my land doesn’t make much difference in overall water quality in the watershed.” This statement received the second highest level of agreement with a mean of 3.91. This is an indication that there are still many people not making the connection between the actions they take in their own back yard and the overall affect those actions have on the watershed. The lowest level of agreement (mean = 2.25) was regarding the statement, “laws or regulations are the only way that landowners in the watershed will consider water quality when they manage their lands.” This indicates that there are still many residents within the watershed that don’t feel laws and regulations are the only effective tools for stimulating environmentally responsible behavior change.

Respondents' Level of Agreement With Statements About the Newfound Lake Watershed

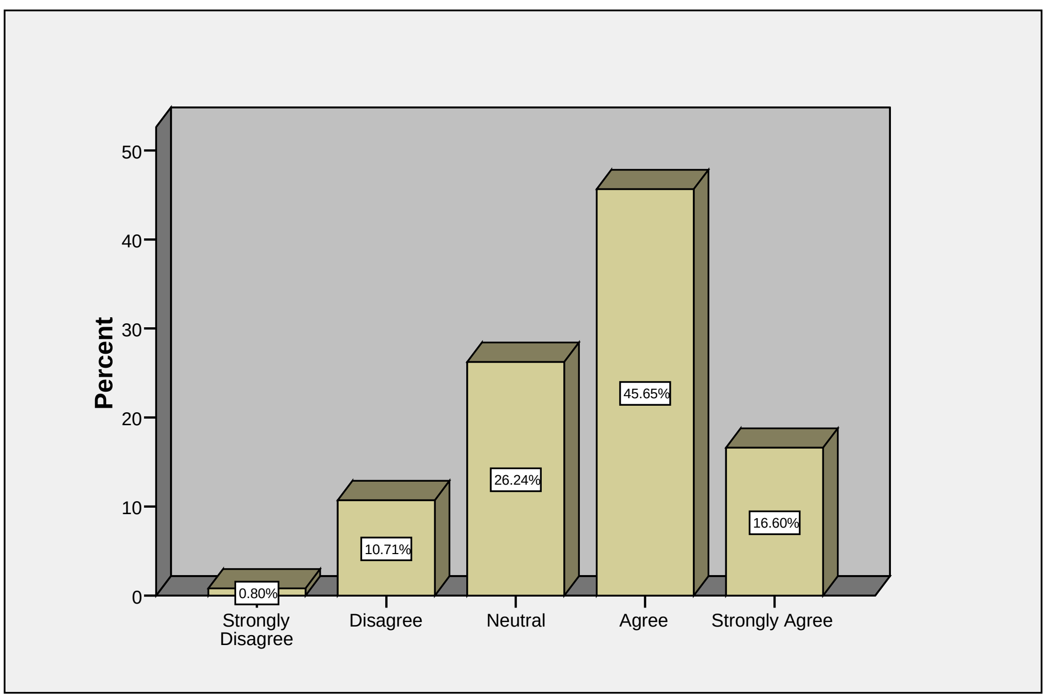


Several questions in section two of the questionnaire produced results that are especially noteworthy for the planning effort. The first asked respondents to indicate their level of agreement with the assertion that the watershed has changed a lot in the last 10 years, and the responses reported below indicate that most respondents agree there has been a great deal of change. As a result acceptance of planning efforts may be high among the general public due to their sensitivity to the need to shape some of the changes occurring.

The watershed has changed a great deal in the last 10 years

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	6	.8	.8	.8
	Disagree	80	10.1	10.7	11.5
	Neutral	196	24.7	26.2	37.8
	Agree	341	42.9	45.6	83.4
	Strongly Agree	124	15.6	16.6	100.0
	Total	747	94.1	100.0	
Missing	Don't Know	14	1.8		
	Not Applicable	1	.1		
	Missing	32	4.0		
	Total	47	5.9		
Total		794	100.0		

The watershed has changed a great deal in the last 10 years

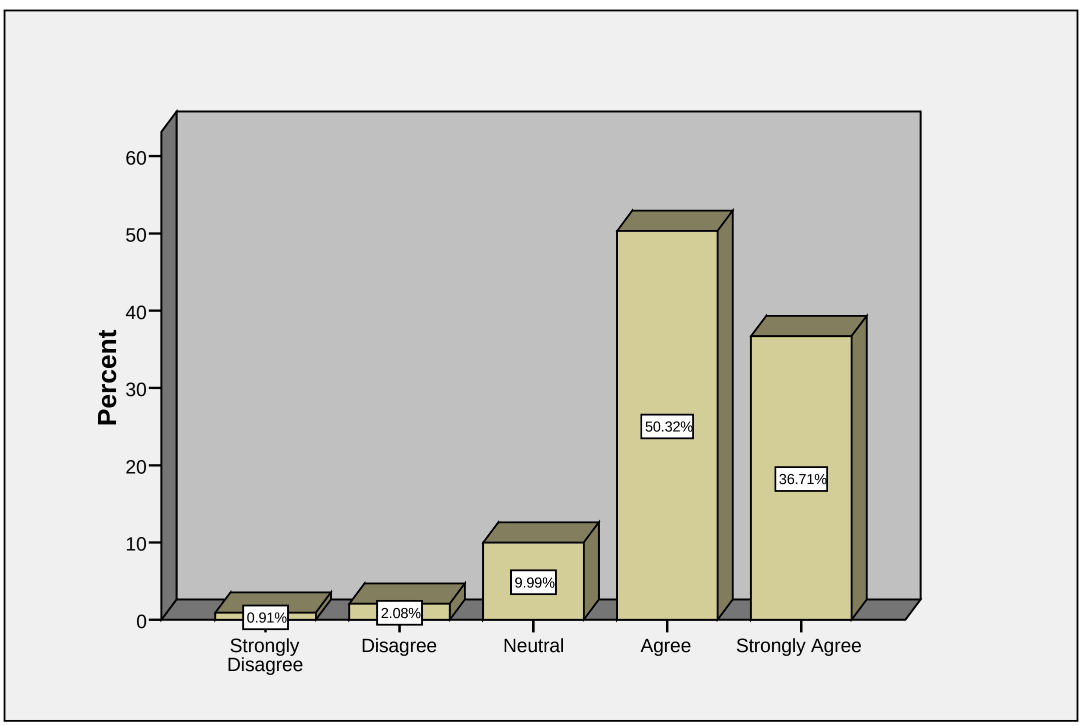


An important question in this section asked respondents to indicate their level of agreement with the assertion that the economic stability of their community depends on good water quality. As indicated in the tables and charts below, 87% of respondents agreed or strongly agreed with that assertion. These results suggest that emphasizing the water quality effects of management efforts in the watershed and connecting them explicitly with community economic well-being will have a positive effect on public perceptions of, and support for water quality protection activities.

The economic stability of the community depends on good water quality

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	7	.9	.9	.9
	Disagree	16	2.0	2.1	3.0
	Neutral	77	9.7	10.0	13.0
	Agree	388	48.9	50.3	63.3
	Strongly Agree	283	35.6	36.7	100.0
	Total	771	97.1	100.0	
Missing	Don't Know	4	.5		
	Missing	19	2.4		
	Total	23	2.9		
Total		794	100.0		

The economic stability of the community depends on good water quality

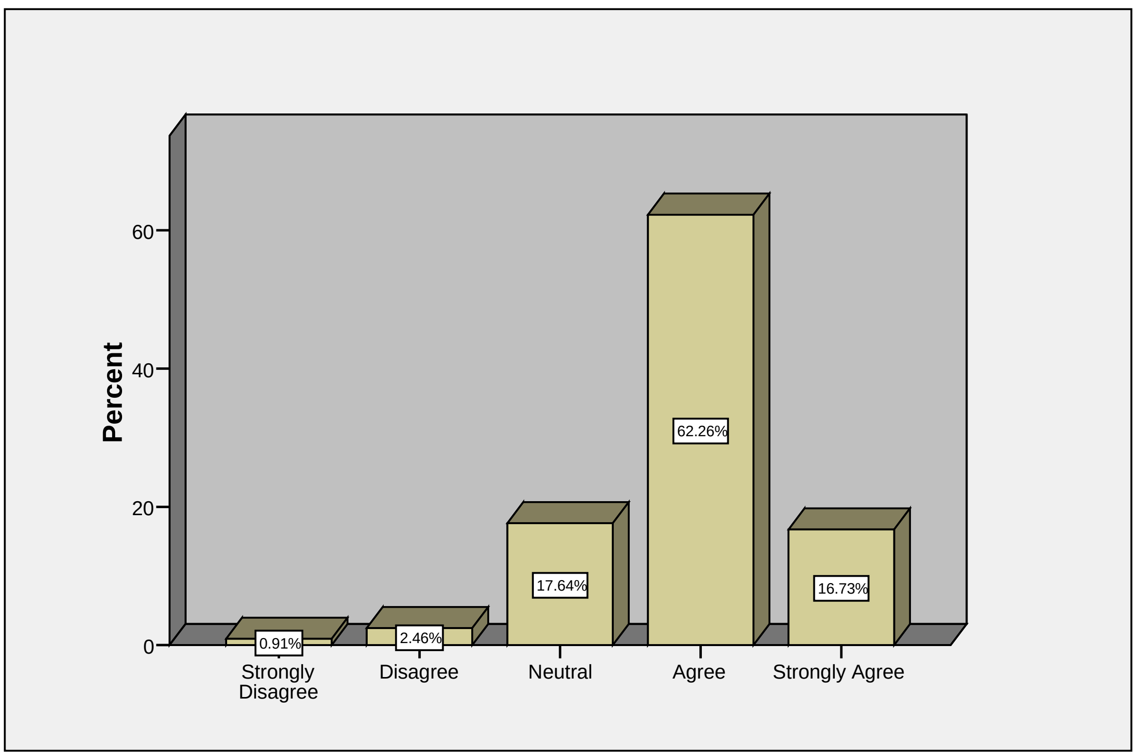


Respondents were also asked to indicate their level of agreement with the statement hat they would be willing to make changes to protect water quality. Seventy-nine percent of responses were in the positive, which is very encouraging for the likelihood of success in outreach and education efforts.

Respondent would be willing to make changes to protect water quality

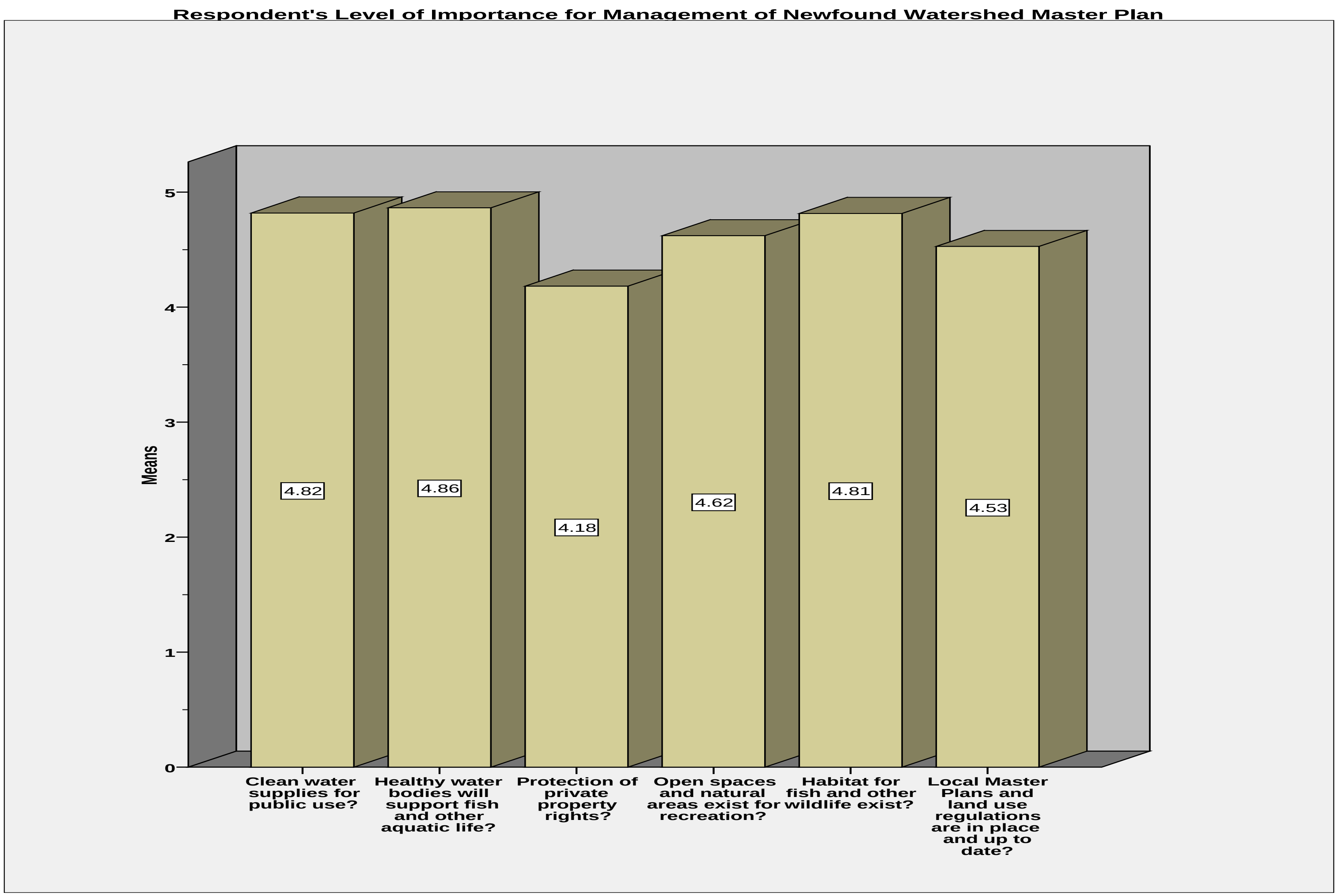
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	7	.9	.9	.9
	Disagree	19	2.4	2.5	3.4
	Neutral	136	17.1	17.6	21.0
	Agree	480	60.5	62.3	83.3
	Strongly Agree	129	16.2	16.7	100.0
	Total	771	97.1	100.0	
Missing	Missing	23	2.9		
Total		794	100.0		

Respondent would be willing to make changes to protect water quality



Question 3 of the Questionnaire

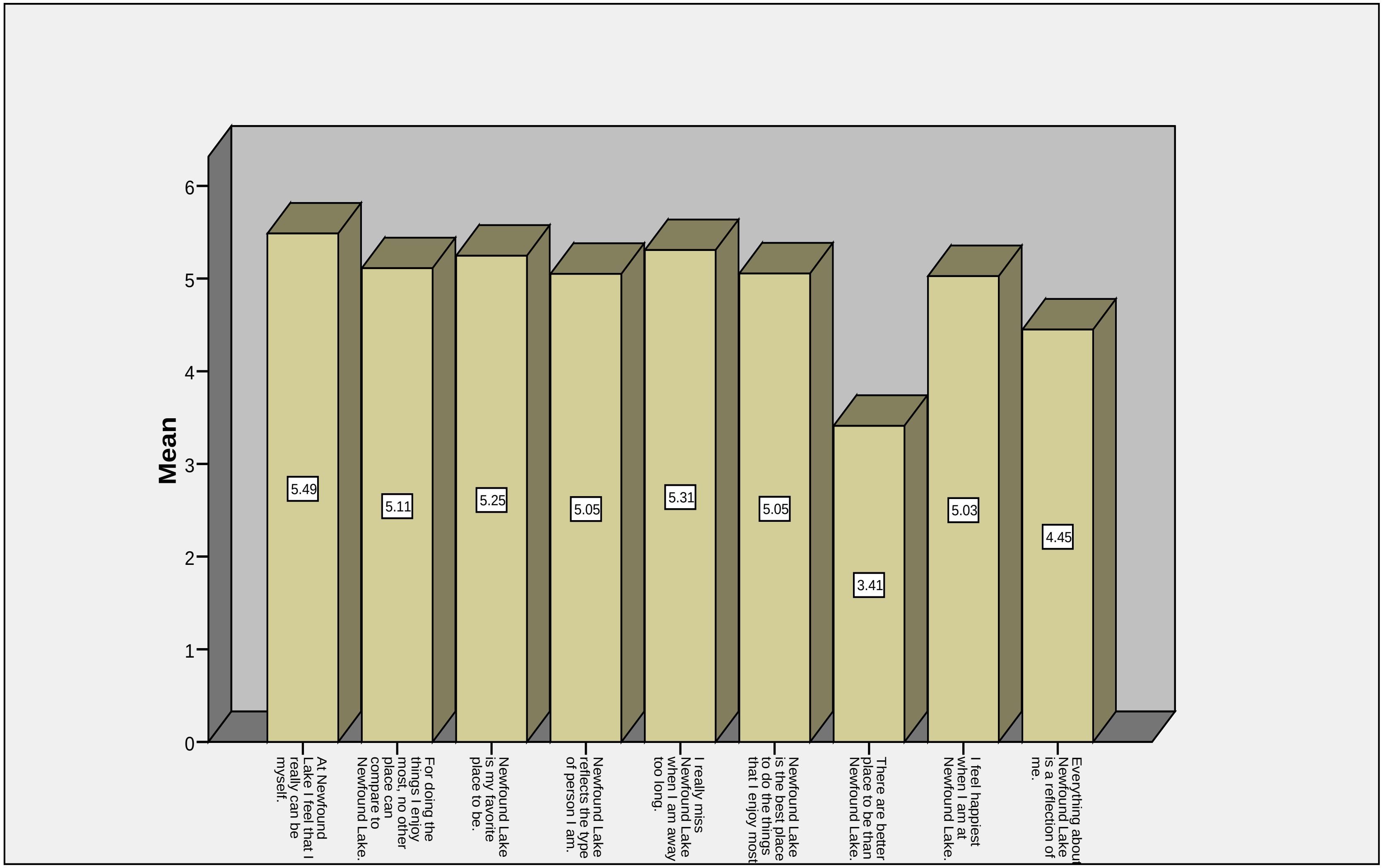
The bar chart below shows the level of importance that respondents place upon various management objectives (1 = not at all important; 5 = very important). The most agreed upon objective is that it is important for the new Newfound Watershed Master Plan to protect the healthy water bodies that will support fish and other aquatic life. Results also indicate it is very important to respondents that the Master Plan ensure that there are clean water supplies for public use.



<u>Question 4 of the Questionnaire</u>

The following bar chart displays respondents' level of agreement with how important each of the specific aspects of Newfound Lake are to them (1 = strongly disagree; 7 = strongly agree), and are used to measure respondents' strength of attachment to and sentiments about the lake. Most respondents agree that they feel like they can be themselves at Newfound Lake (mean = 5.49), which is important because many it speaks to how many respondents feel strongly attached to the place. That strength of attachment is also indicated by responses that show that respondents miss being around Newfound Lake when they are gone for a while (mean = 5.31). Overall respondents are strongly attached to the lake, and these measures will be used in subsequent analyses to determine the influence of attachment on a number of different issues and actions.

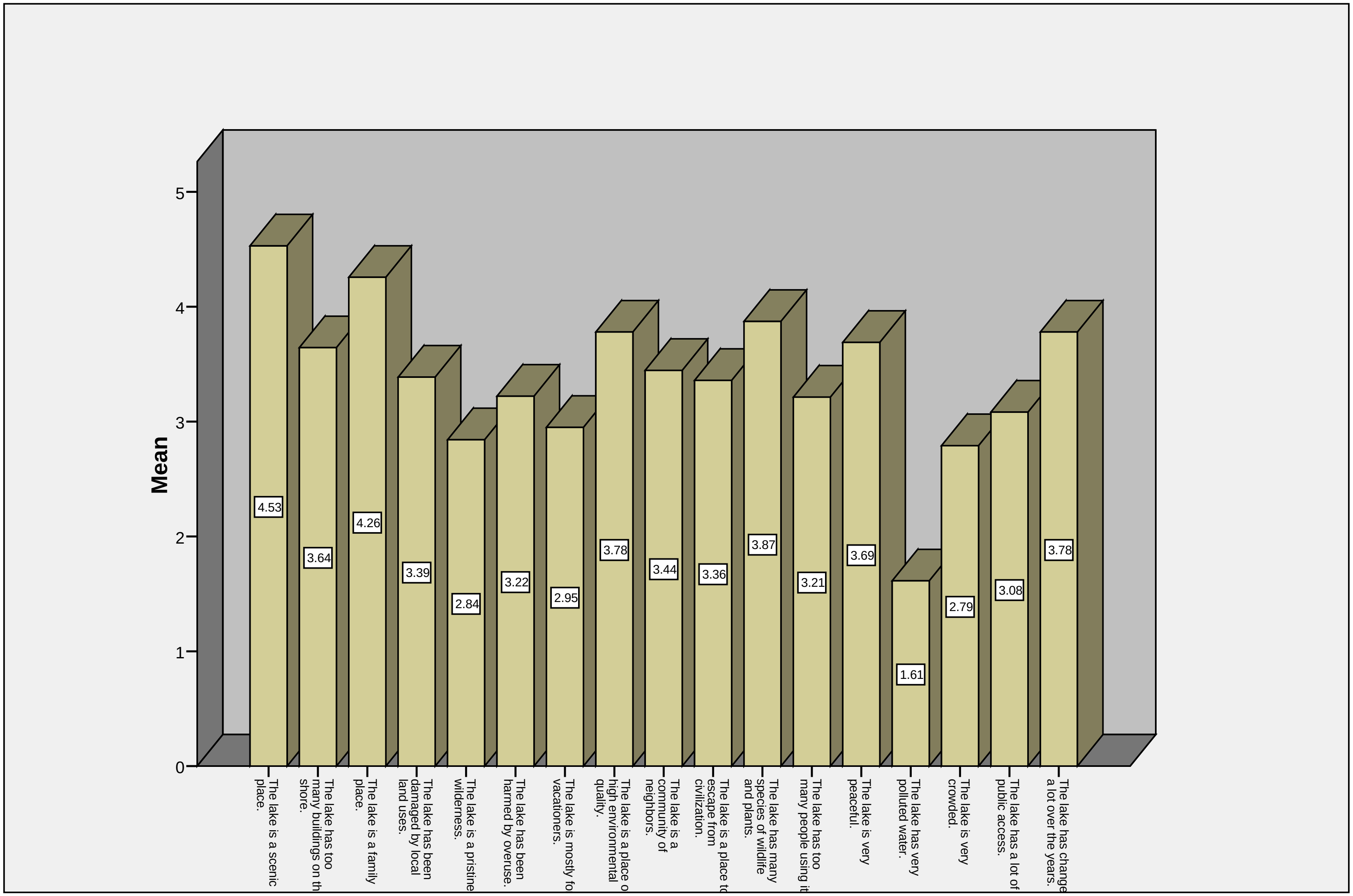
Respondents' Level of Agreement With Statements About How Important Newfound Lake is to Them



Question 5 of the Questionnaire

The following chart shows the overall mean of what kind of place people in the watershed see Newfound Lake as. The highest number of respondents said they saw Newfound Lake as a scenic place, and the statement received an overall mean response of 4.68. This is an indication that people in the watershed value the lake most for its scenic natural beauty, making it important to preserve into the future. The second highest mean level of agreement was regarding the claim that people feel Newfound Lake is a family place, and received an overall mean of 4.26. The statement that respondents had the lowest overall level of agreement with was that the lake has very polluted water (mean = 1.61). Other responses are of interest because they help understand residents' desires for the landscape in the future, and the means tables enables comparative analyses of respondents' sentiments about these issues.

Respondents Level of Agreement With Statement About What Kind of Place Newfound Lake is (1 = Strongly Disagree; 5 = Strongly Agree)



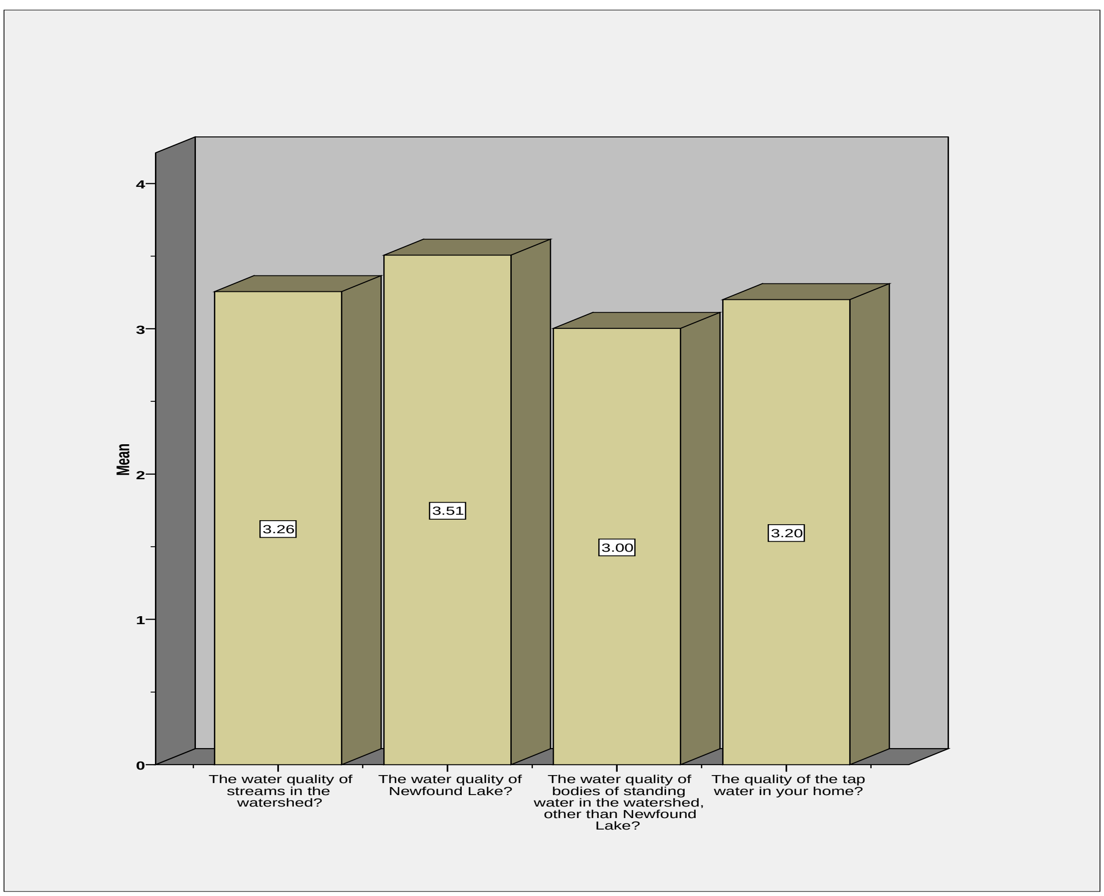
Questions 6 and 7 of the Questionnaire

Questions six and seven asked respondents how many people around the watershed they know on a first name basis, and how many of those people they consider close personal friends. These measures are not directly useful for developing a watershed master plan, but instead are dimensions of place attachment that can be used in analyses to better understand how it relates to a variety of opinions and activities. Accordingly results are not presented in this section of the report, however the distributions of responses to these questions are reported in the appendix.

Question 8 of the Questionnaire

The bar chart below represents respondents' overall mean ratings of the water quality of the various bodies of water identified in the questions. The chart indicates respondents' mean perceived levels of water quality (1=poor, 2=fair, 3=good & 4=excellent). Out of all the statements regarding water quality listed below, respondents overall mean was highest regarding the water quality of Newfound Lake (mean = 3.51). The second highest mean response (3.26) was regarding the water quality of streams in the watershed, indicating that many residents regard the water quality of streams highly as well.

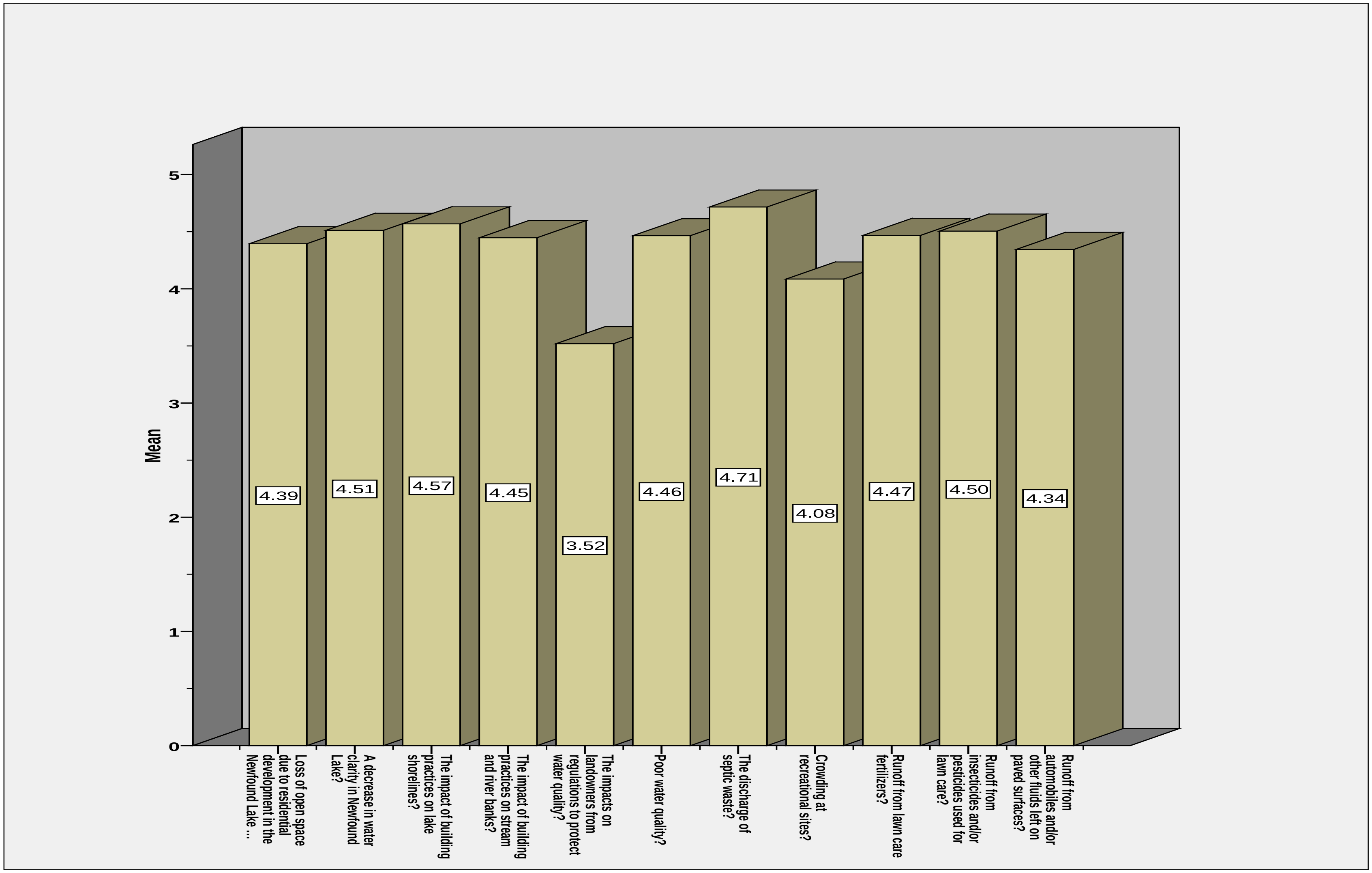
Rating Water Quality



Question 9 of the Questionnaire Part 1

The following bar chart displays how concerned people are regarding the specified issues about the Newfound Lake Watershed listed on the x-axis of the chart. The majority of issues seem to be of high concern to most respondents, however the issue that stood out as having the highest level of concern (with an overall mean of 4.71) was septic discharge. This indicates that people recognize that septic discharge can leak out and potentially pollute the watershed, and that those impacts are well understood and receive appropriate concern. The impacts of building practices on shorelines was also of particularly high concern to respondents.

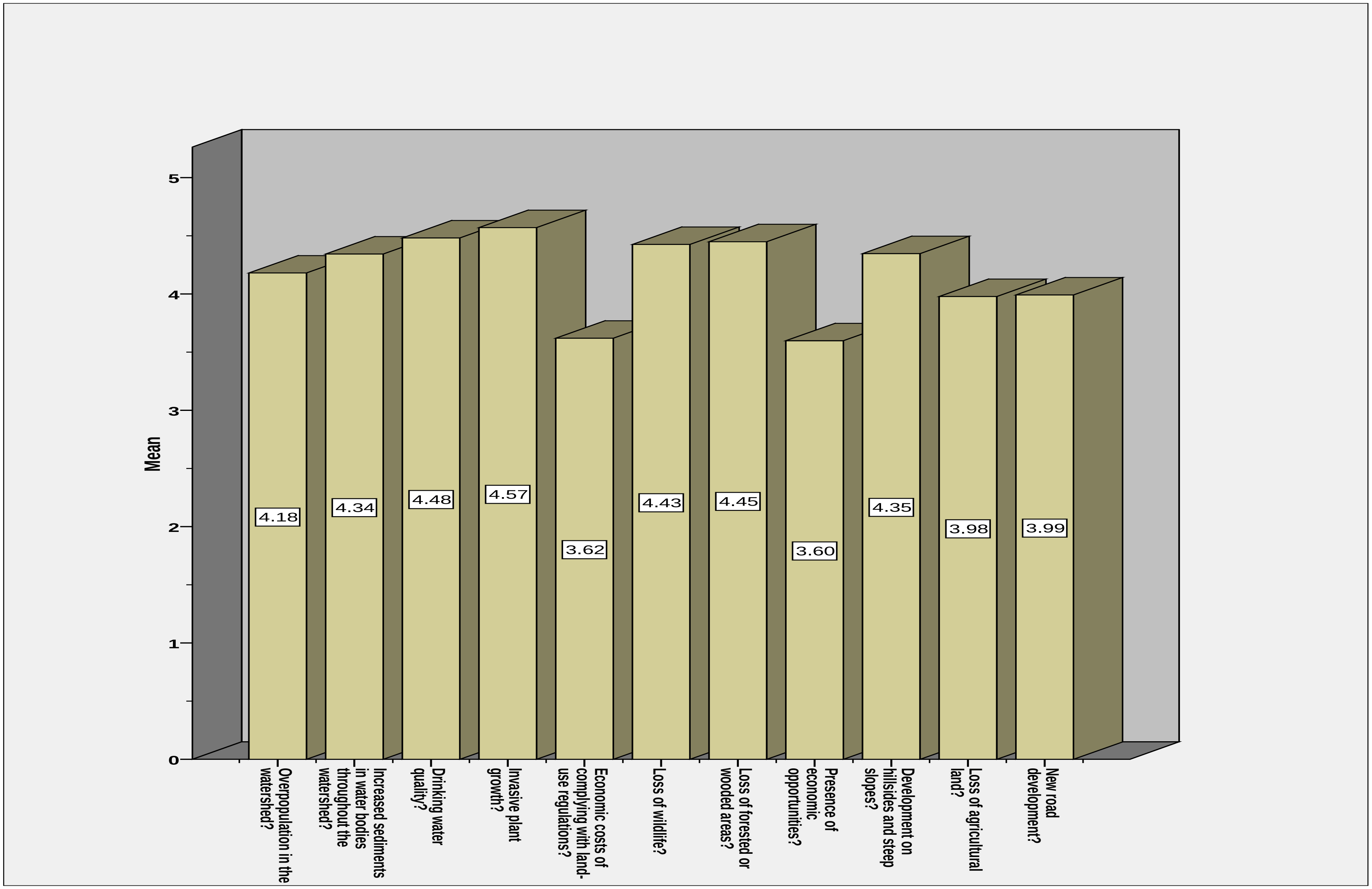
Level of Concern for issues about the Watershed (1=Not concerned at all. 3=Neutral. 5=Verv concerned)



Question 9 of the Questionnaire Part 2

The bar chart on the following page describes the level of concern for additional issues relating to the Newfound Watershed. The data indicates respondents' level of concern about specific issues on a scale of not concerned at all to very concerned, where 1=not concerned at all and 5=very concerned. In this second section of question nine the most issue of most concern to respondents was the presence of invasive plant species. This indicates that there is awareness of invasive species and their effects on native plant life and ecosystems that may well stem from DES and other outreach efforts. However the level of concern about invasive plant life had an overall mean of 4.57, and concern about that issue is not as high as concerns about septic system discharge (mentioned in part one of question nine) which was the issue of most concern to respondents (mean = 4.71). It is also noteworthy that respondents have a high level of concern about the loss of forested or wooded areas, which is a watershed protection issue that greatly affects the upper reaches of the watershed and should be highlighted as part of continuing efforts to break down the differences in perceived issues between residents with lakefront property and those in other parts of the watershed.

Level of Concern about Issues in the Watershed



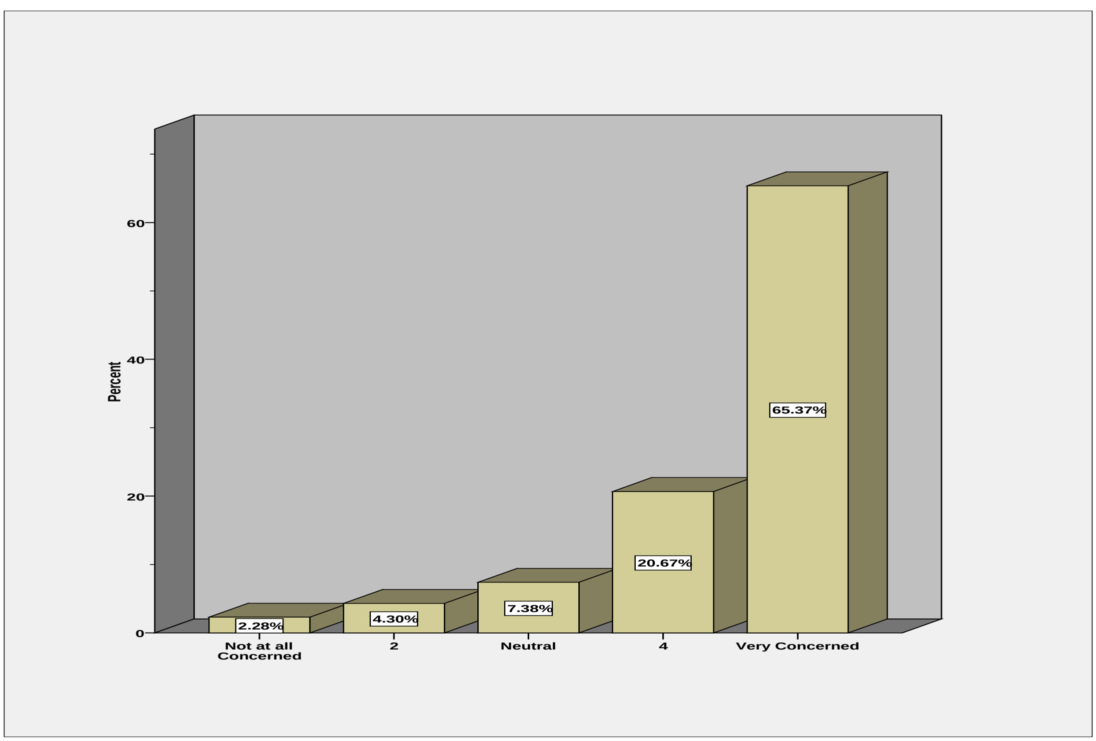
Several questions in section nine of the questionnaire are especially noteworthy for the watershed planning effort as they identify areas of particular concern to residents of the watershed or topics that are not well understood. The plan should address these issues explicitly to maximize its utility.

This project has a focus on water quality, and two questions asked respondents how concerned they were about water quality issues in the Newfound Lake Watershed. The first asked respondents to indicate their level of concern about poor water quality (in general) in the Newfound Lake Watershed, and the second asked respondents to indicate their level of concern about drinking water quality in the watershed. Responses to these questions appear in the tables and charts below.

How concerned are you about poor water quality?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Concerned	17	2.1	2.3	2.3
	2	32	4.0	4.3	6.6
	Neutral	55	6.9	7.4	14.0
	4	154	19.4	20.7	34.6
	Very Concerned	487	61.3	65.4	100.0
	Total	745	93.8	100.0	
Missing	Don't Know	18	2.3		
	Missing	31	3.9		
	Total	49	6.2		
Total		794	100.0		

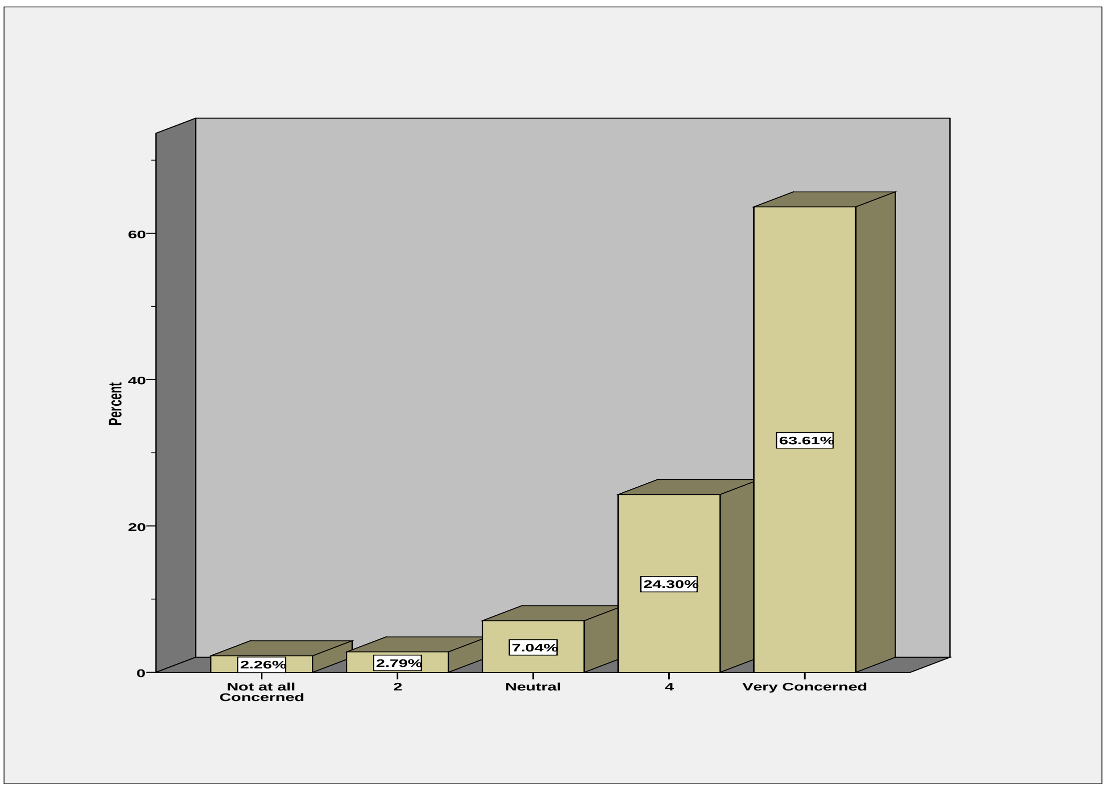
Level of Concern for Poor Water Quality



How concerned are you about drinking water quality?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Concerned	17	2.1	2.3	2.3
	2	21	2.6	2.8	5.0
	Neutral	53	6.7	7.0	12.1
	4	183	23.0	24.3	36.4
	Very Concerned	479	60.3	63.6	100.0
	Total	753	94.8	100.0	
Missing	Don't Know	17	2.1		
	Missing	24	3.0		
	Total	41	5.2		
Total		794	100.0		

Level of Concern for Drinking Water Quality



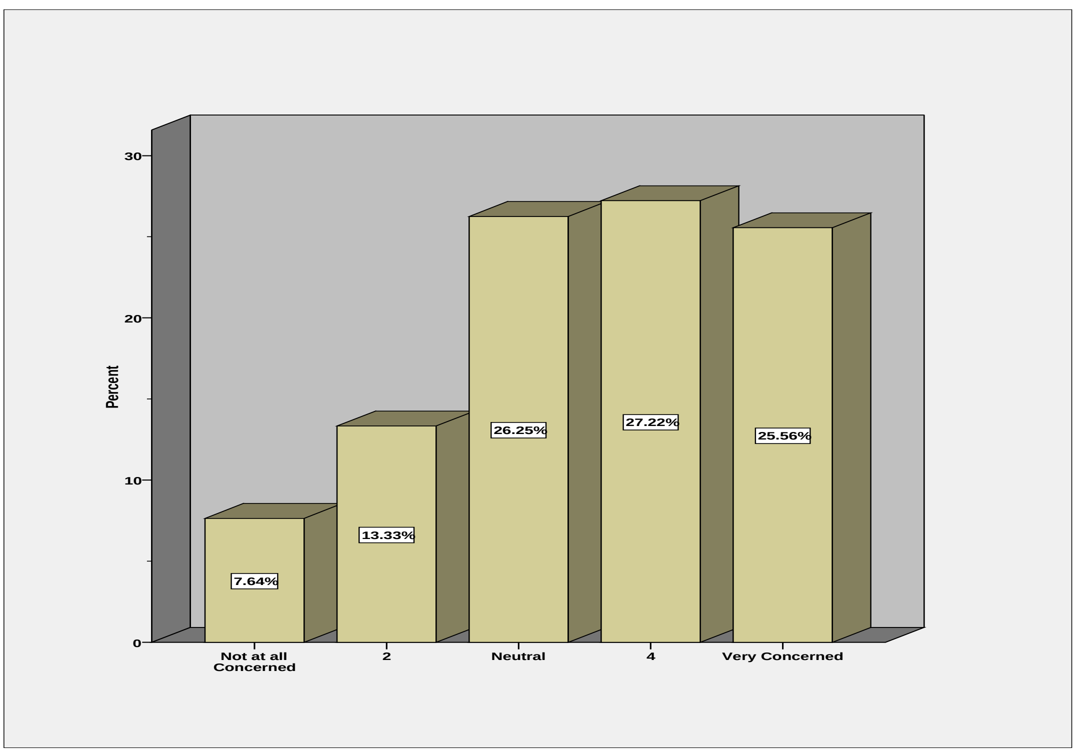
Responses to both questions indicate that water quality issues are of high concern to residents of the watershed, despite the data showing respondents perceive water quality to currently be high in water bodies in the watershed. The implications for the watershed plan and for the design of future communications is that the issue of water quality has high resonance within the watershed, and linking suggested actions with water quality benefits is a viable way to encourage the adoption of regulations and other means to protect water quality.

Two questions in section nine of the questionnaire asked respondents to indicate their level of concern about the impacts of environmental protection efforts on landowners. The first asked how concerned respondents were about the impacts on landowners from regulations to protect water quality, and the second specifically asked if respondents were concerned about the economic costs of complying with land use regulations.

How concerned are you about the impacts on landowners from regulations to protect water quality?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Concerned	55	6.9	7.6	7.6
	2	96	12.1	13.3	21.0
	Neutral	189	23.8	26.3	47.2
	4	196	24.7	27.2	74.4
	Very Concerned	184	23.2	25.6	100.0
	Total	720	90.7	100.0	
Missing	Don't Know	46	5.8		
	Missing	28	3.5		
	Total	74	9.3		
Total		794	100.0		

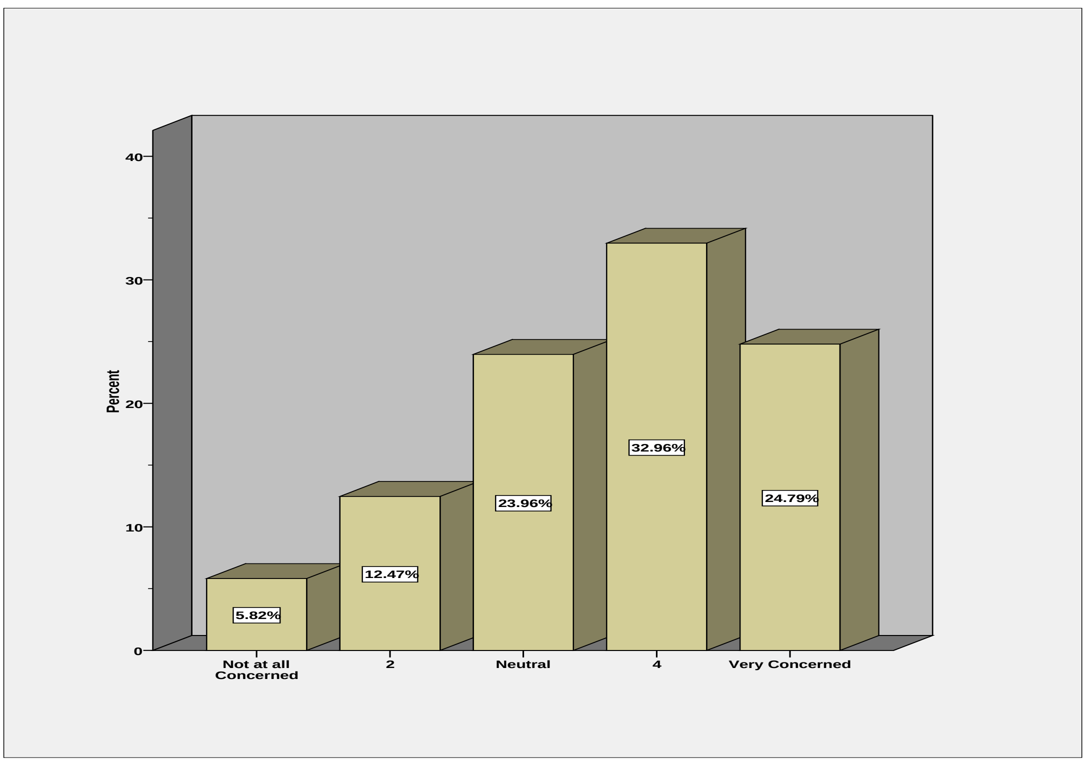
Level of Concern for the Impacts on Landowners From Regulations to Protect Water Quality



How concerned are you about economic costs of complying with land-use regulations?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Concerned	42	5.3	5.8	5.8
	2	90	11.3	12.5	18.3
	Neutral	173	21.8	24.0	42.2
	4	238	30.0	33.0	75.2
	Very Concerned	179	22.5	24.8	100.0
	Total	722	90.9	100.0	
Missing	Don't Know	44	5.5		
	Missing	28	3.5		
	Total	72	9.1		
Total		794	100.0		

Level of Concern for Economic Costs of Complying With Land-Use Regulations



The responses to these questions indicate that respondents do have high levels of concern about the impacts of these efforts, and clarify that when such measures are taken conscious and explicit efforts to mitigate impacts should be part of the implementation approaches designed. Such considerations are potentially political necessities for facilitating the adoption of the plan or its parts.

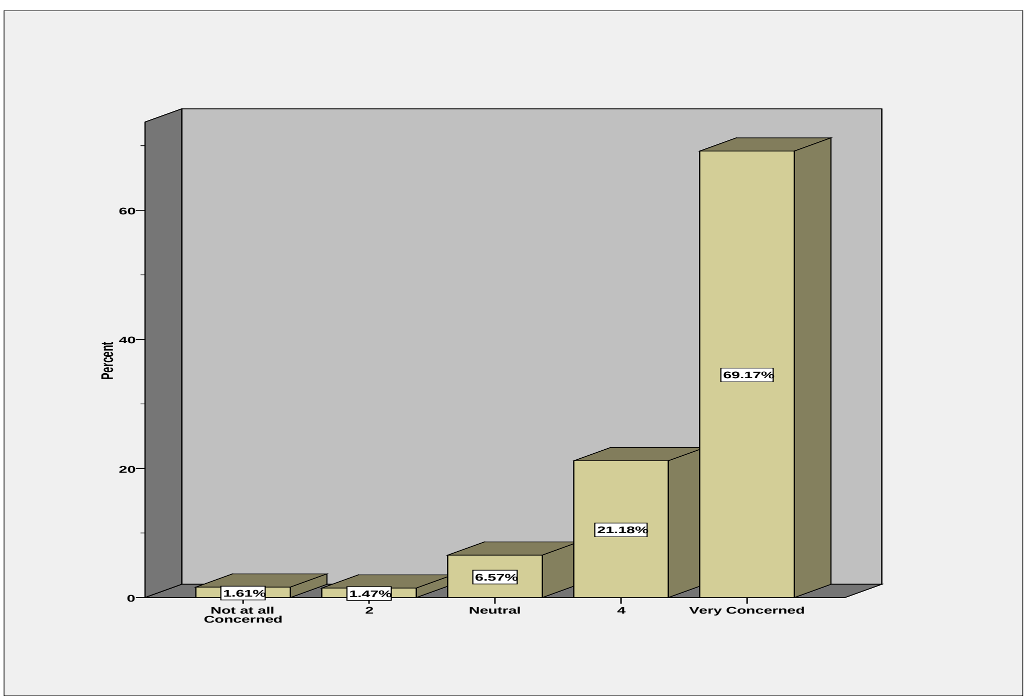
Two issues in this section of the questionnaire were of particularly high concern to respondents, and the complete responses to those questions are presented below to better clarify the distribution of responses to these questions, rather than simply the means. Readers of the report are encouraged to use the appendix to explore individual questions in this manner to provide more depth of understanding about response patterns than possible from comparisons of means.

Respondents have high levels of concern about the discharge of septic waste and the impacts of building practices on shorelines. Both are very important issues for water quality that deserve high levels of concern from residents of the region, and the results indicate that there is great agreement on these issues. As a result there is a high likelihood of success in efforts to encourage towns to implement recommendations from the plan that address these issues, as they are well understood by the public and of high concern.

How concerned are you about the impact of building practices on lake shorelines?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Concerned	12	1.5	1.6	1.6
	2	11	1.4	1.5	3.1
	Neutral	49	6.2	6.6	9.7
	4	158	19.9	21.2	30.8
	Very Concerned	516	65.0	69.2	100.0
	Total	746	94.0	100.0	
Missing	Don't Know	26	3.3		
	Missing	22	2.8		
	Total	48	6.0		
Total		794	100.0		

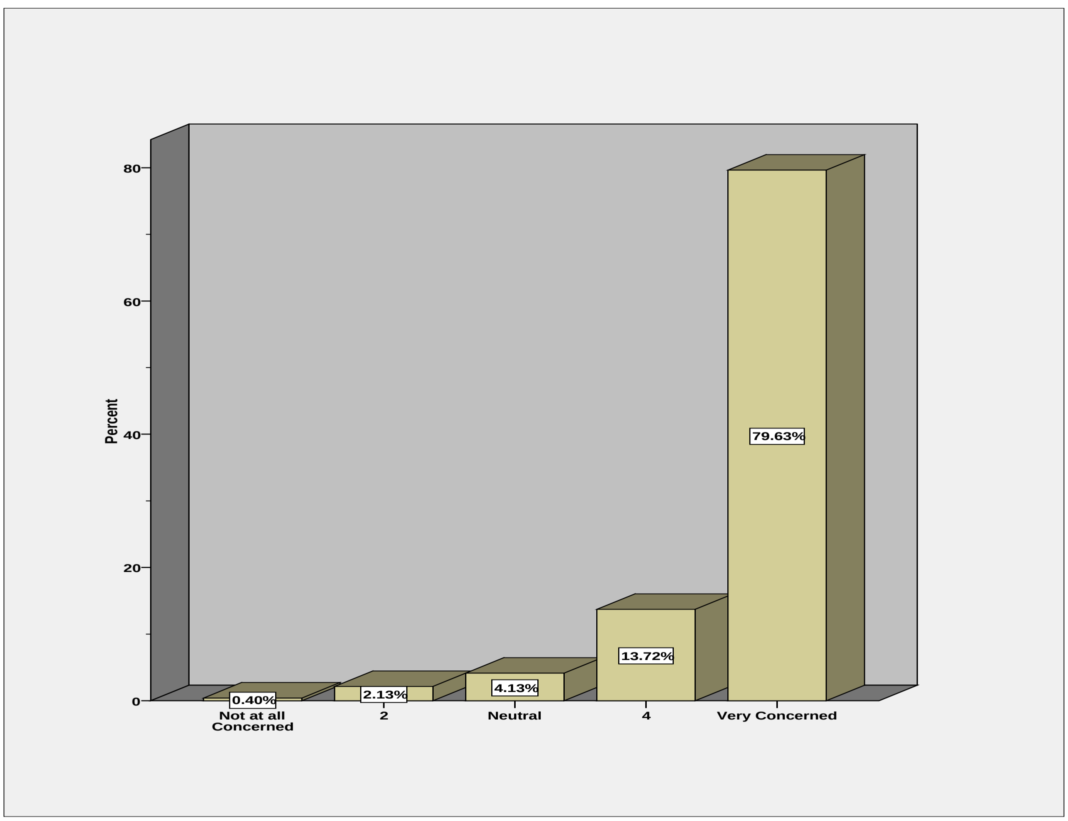
Level of Concern for the Impact of Building Practices on Lake Shorelines



How concerned are you about the discharge of septic waste?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Concerned	3	.4	.4	.4
	2	16	2.0	2.1	2.5
	Neutral	31	3.9	4.1	6.7
	4	103	13.0	13.7	20.4
	Very Concerned	598	75.3	79.6	100.0
	Total	751	94.6	100.0	
Missing	Don't Know	17	2.1		
	Missing	26	3.3		
	Total	43	5.4		
Total		794	100.0		

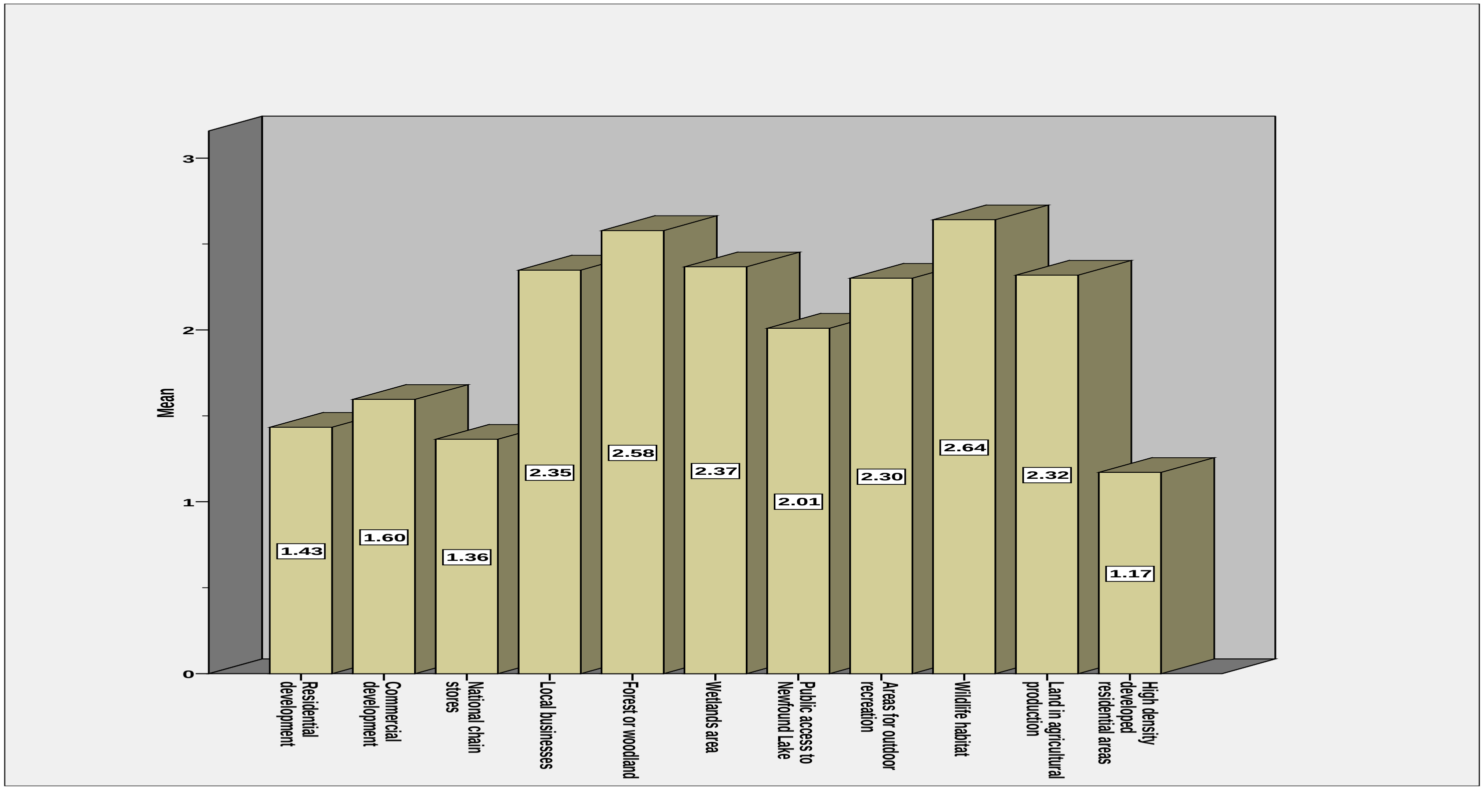
Level of Concern for the Discharge of Septic Waste



Question 10 of the Questionnaire

When asked to identify their desires for various land uses in the future of the watershed, the residents of the Newfound Lake Watershed responded that they would like to see more wildlife habitat, more forests and woodlands, and also more wetland areas in the watershed (1=less desired; 3=more desired). Clearly, it is the natural amenities that create desirability for the area among the vast majority of respondents. Results also indicate respondents would like to see less high density populated areas, as well as less national chain stores and residential development. Given other results, there is a distinct possibility that the benefits of high density housing for maintaining the rural character of an area identified as desirable by respondents are not well understood by residents of the watershed, as the responses are contradictory in some ways. Further education about these issues is likely warranted, and this and other areas will be essential to consider as the Newfound Watershed Master Plan is being developed and towns continue to explore the uses of zoning and other regulations to positively shape the nature and direction of growth.

What Respondents' Would Like to See in the Newfound Lake Watershed In the Future

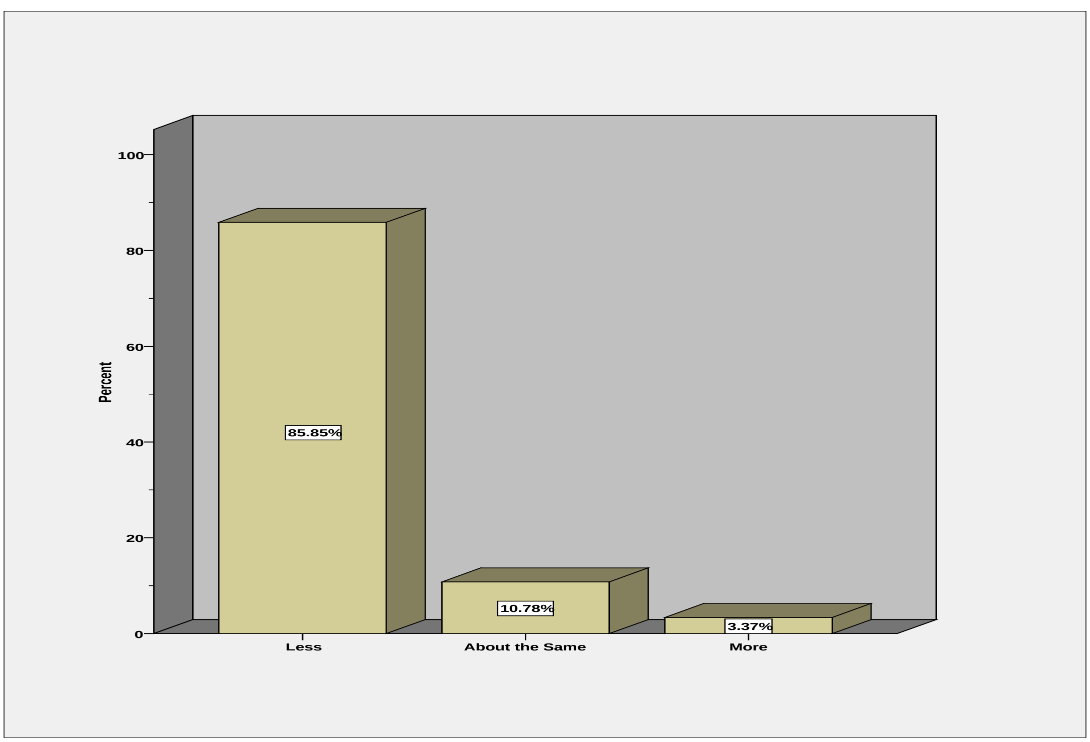


Question 10K asked respondents to identify whether they would like to see less, more, or about the same amount of high density developed residential areas in the Newfound Lake Watershed in the future, and the responses are important to highlight for the development and implementation of the watershed plan. The results below indicate that the vast majority of respondents do not desire the growth of this type of development in the watershed. This result is particularly interesting because responses to other measures designed to measure approval for efforts to shape development in a manner that maintain rural quality of life (and protect water quality) are strongly supported. After bivariate examinations of these responses the conclusion is simply that most respondents do not understand the positive impacts of high density development, and outreach and communication efforts should endeavor to help residents understand the connections between these complex issues more completely.

How much high density developed residential area would you like to see in the Newfound Lake Watershed in the future?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less	637	80.2	85.8	85.8
	About the Same	80	10.1	10.8	96.6
	More	25	3.1	3.4	100.0
	Total	742	93.5	100.0	
Missing	Don't Know	18	2.3		
	Missing	34	4.3		
	Total	52	6.5		
Total		794	100.0		

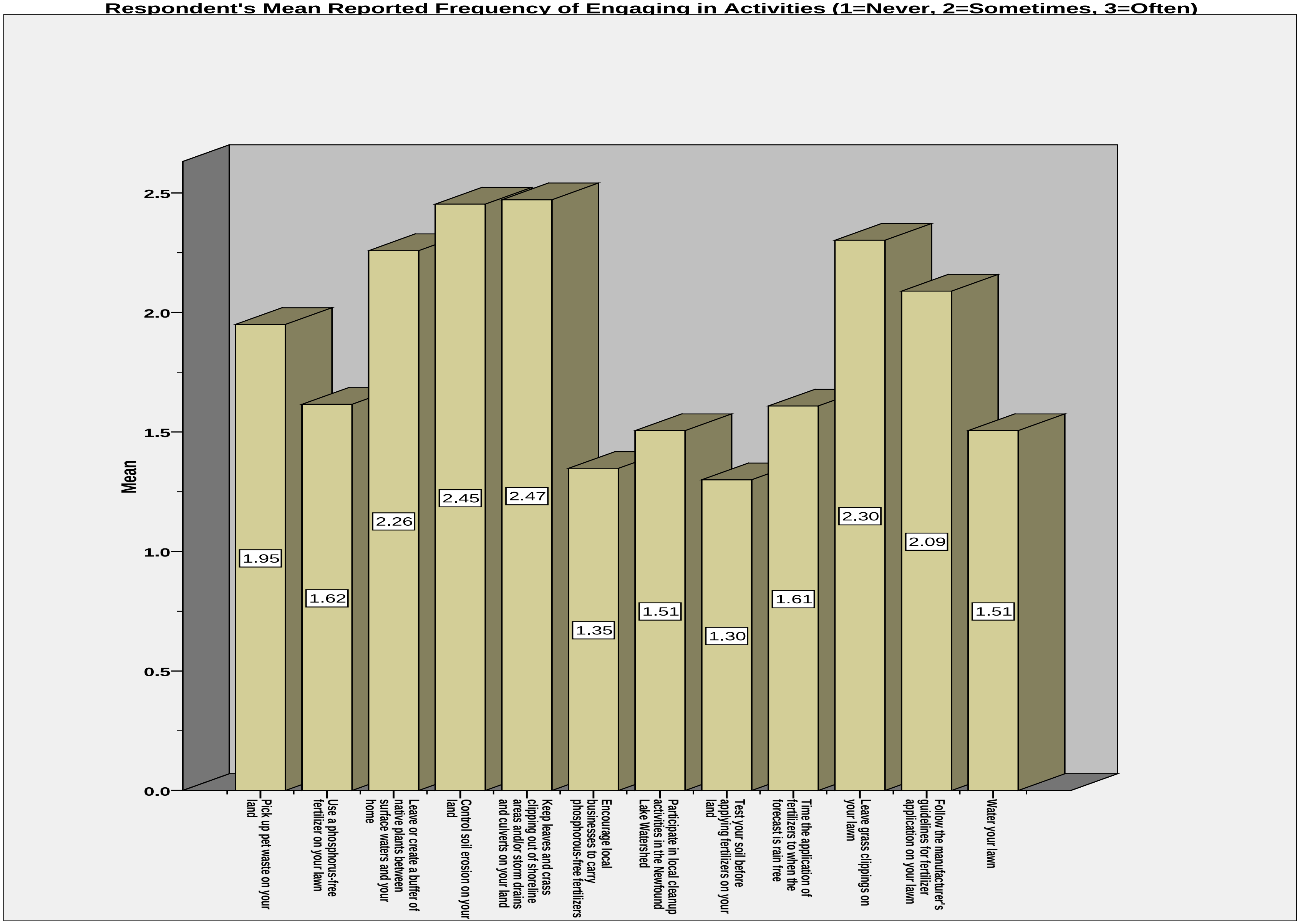
High Density Developed in Residential Areas in the Future



Question 11 of the Questionnaire

The following means chart represents respondents' level of activity in the specific actions identified, with 1 = "never" and 3 = "often". The averages give us a good idea about what activities people are performing on their lands in the Newfound Lake Watershed. The graph shows that the three most common activities to protect the environment that people are performing on their land are, leaving or creating a buffer of native plants between surface waters, keeping leaves and grass clipping from shoreline areas, and leaving their grass clippings on their lawn. The last question about watering the lawn is an inverse question, meaning that it not a beneficial environmental activity. It should be noted that there may be some means that are not fully accurate because there wasn't a "not applicable" box to check if a respondent did not have a pet or use fertilizer on their lawn (although respondents were encouraged to write such a response in the instructions given, few did). Since there was no box people may have checked the never box, instead of writing in that they do not own a pet or do not use fertilizer, so findings may be biased. The practical impacts for understanding the frequency of these behaviors are negligible, but the statistical impact is noted to inform interpretations of the data.

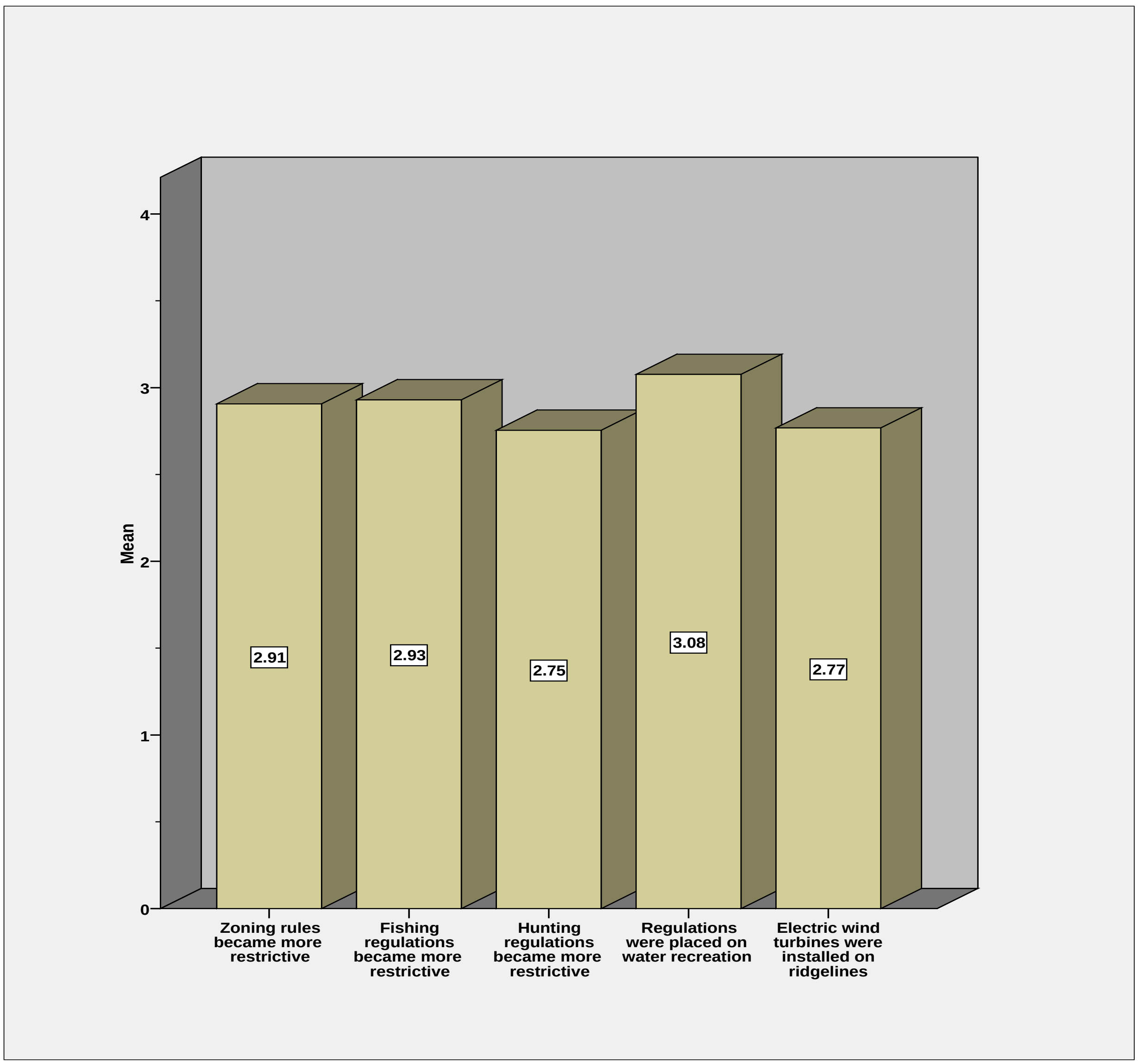
Respondent's Mean Reported Frequency of Engaging in Activities (1=Never, 2=Sometimes, 3=Often)



Question 12 of the Questionnaire

Section 12 asked respondents to indicate their level of concern about several potential regulation or land use changes in the watershed, and responses indicate residents would not favor the establishment of more regulations on their water recreation, or the creation of more restrictive fishing regulations in the region. Surprisingly, residents are relatively less concerned with electric wind turbines being installed on ridgelines or with hunting regulations, although it should be noted that all proposed actions are of relatively high concern. Overall the implications for the watershed plan are that as with many issues of regulation in New Hampshire, there are high levels of concern among citizens about how such changes may impact or restrict personal freedoms. As a result all actions should be directly and tangibly linked with the impacts on resources of concern to demonstrate justifications using issues of concern to residents.

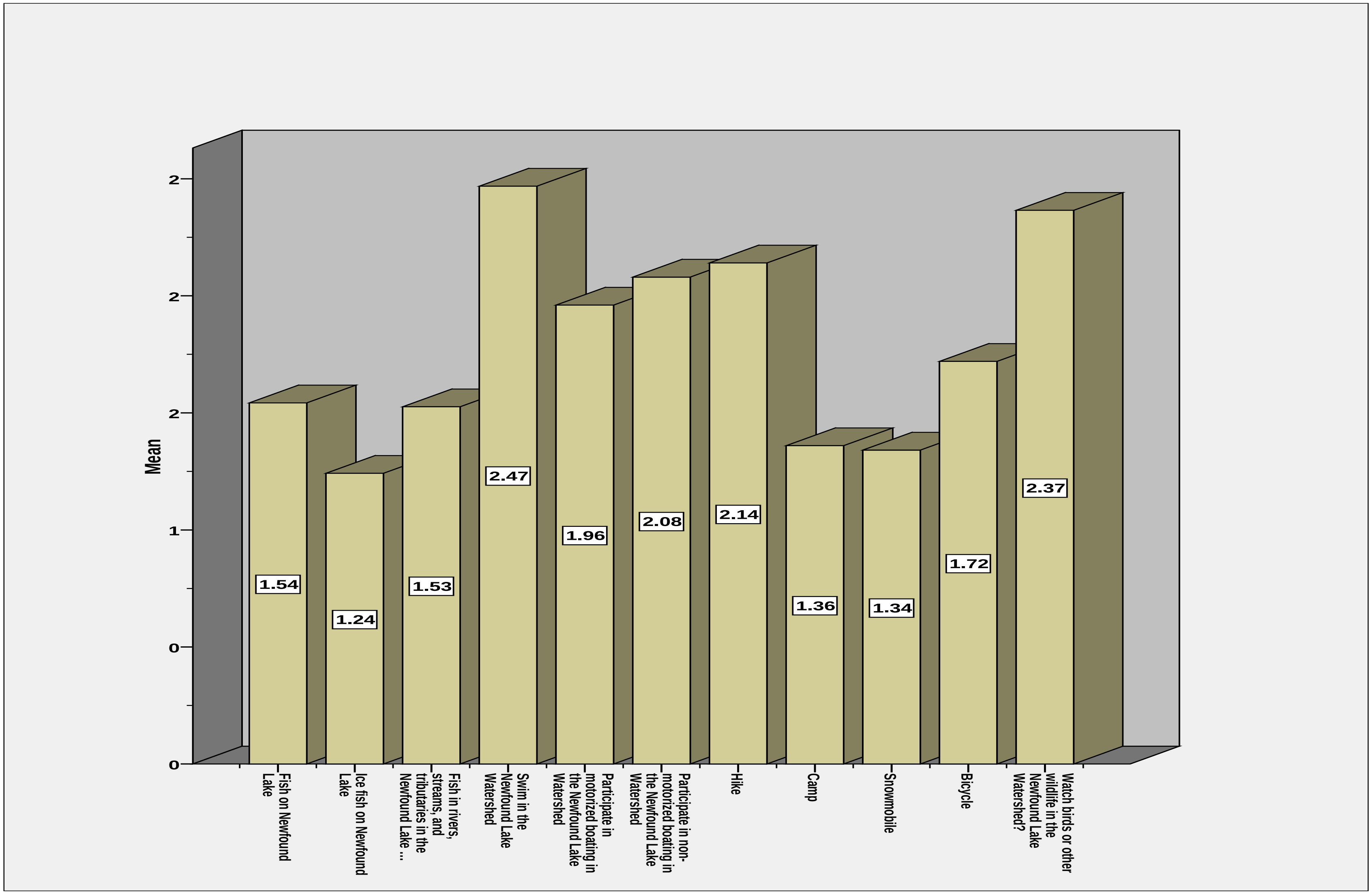
How Concerned people Are If Changes Are Made Within the Watershed



Question 13 of the Questionnaire Part 1

Information on the activities of outdoor and other selected activities of residents of the watershed was collected to better understand how people are connected to the landscape, and for use in subsequent analyses exploring how participation in these activities in related to perceptions of issues and a variety of other factors. Respondents were asked to indicate their frequency of participation in specific activities in the watershed (0 = “Never”; 1 = “Sometimes”; 3 = “Often”). The data collected is presented in two sets to facilitate the interpretation of the results. Responses indicate that the residents of the Newfound Lake Watershed enjoy swimming, watching birds and other wildlife and non-motorized boating as the most popular activities they engage in within the watershed. This is heartening for the region because the activities that the residents like to participate in are not harmful for the environment, and actually encourage its appreciation in many cases. As a whole responses reflect the important role of the landscape in the lives of residents of the watershed.

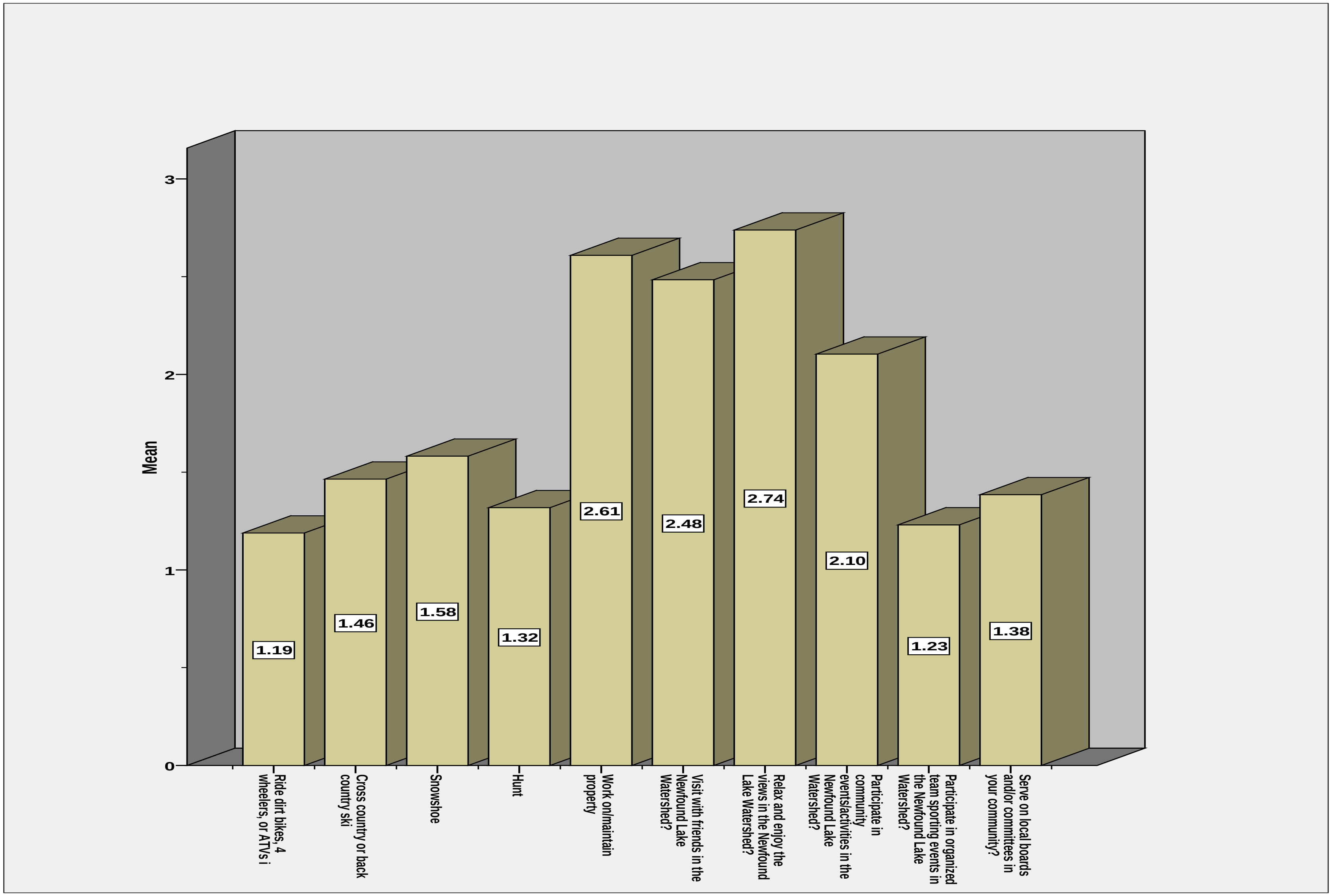
Participation in Activities Within the Newfound Lake Watershed



Question 13 of the Questionnaire Part 2

Some of the most popular activities among residents of Newfound Lake Watershed are to relax and enjoy the scenic views of their lake, along with working to maintain their property, and visiting with friends. In contract relatively few residents participate in hunting (which also may explain the low concern if hunting laws were changed in the Newfound area in question 12), organized sporting events in the community, or serving on boards and local committees.

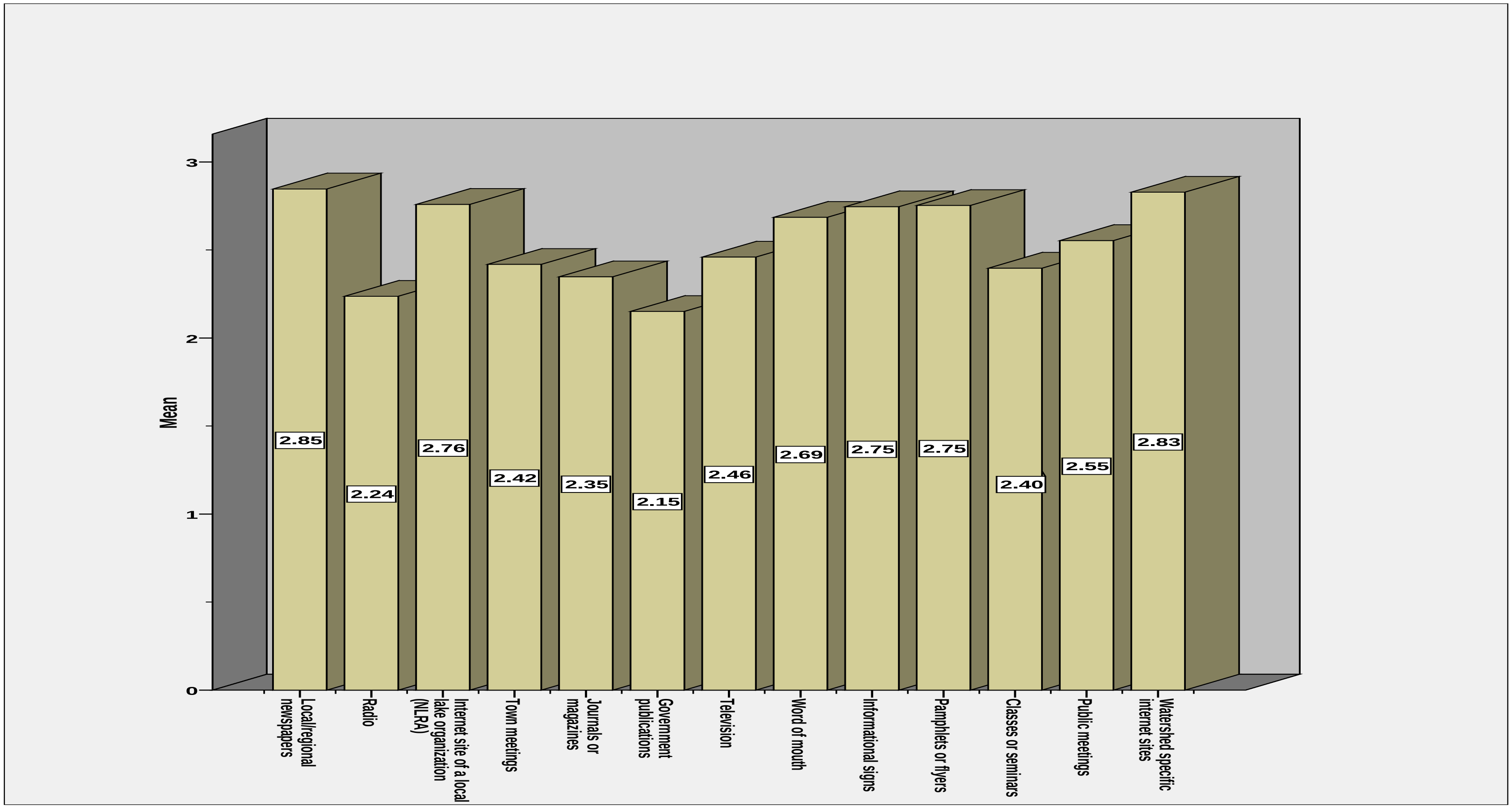
Participation in Activities Within the Newfound Lake Watershed



Question 15 of the Questionnaire

The chart below indicates the level of usefulness of sources about the Newfound Lake Watershed for respondents. The chart was graphed based on a scale of not at all useful to very useful, where 1=not useful at all and 4=very useful. The majority of respondents rated the local/regional newspapers as the most useful source of information (mean = 2.85). The source that received the lowest mean level of usefulness from respondents (2.15) was the government publications, indicating that relative to other information sources respondents don't feel the government publications are a useful source of information about the Newfound Lake Watershed.

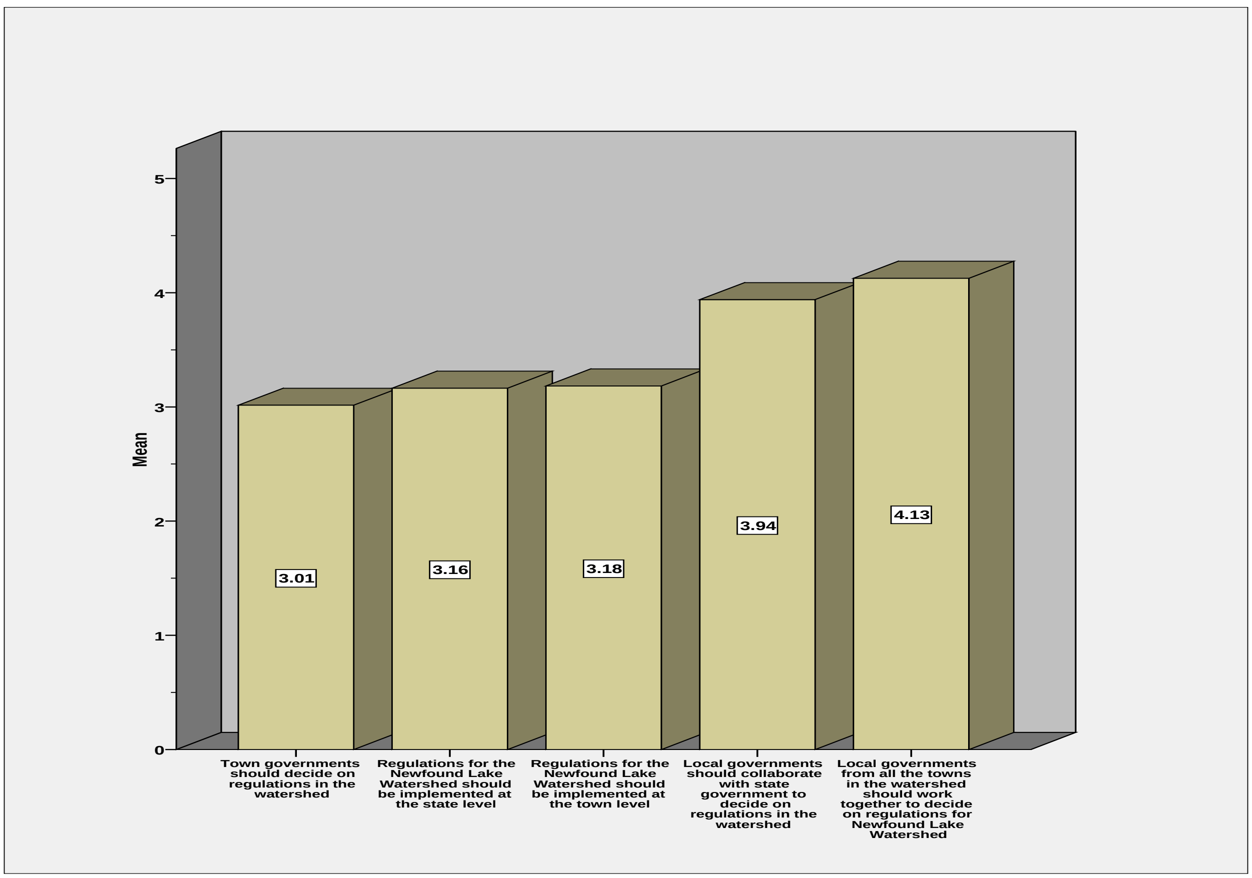
Usefulness of Informational Sources



Question 16 of the Questionnaire

The bar chart below indicates respondents level of agreement with how regulations should be determined and implemented within the Newfound Lake Watershed, and is of particular interest to the watershed plan because it conveys how residents feel changes of a regulatory nature should be enacted. Respondents' level of agreement with the appropriateness of specific approaches was measured using a scale of stronly disagree to strongly agree, where 1=strongly disagree, 3=neutral, and 5=strongly agree. The form of regulation and implementation that respondents agreed with most was having local governments from all the towns within the watershed work together to decide on regulations for the Newfound Lake Watershed.This indication received the highest mean level of agreement, 4.13. The fact that the majority of respondents surveyed from all the towns within the watershed are willing to see local governments from all the 9 towns that make up the watershed work together is encouragement for the future of the Newfound Watershed Master Plan implementation. The lowest level of agreement with how regulations should be decided and implemented was with plans in which individual town governments decide on regulations in the watershed by themselves (mean = 3.01). Many respondents recognize that in order for the Nefound Watershed to be successfully protected and a high quality of life maintained the local governments will need to work together. This information should be highlighted repeatedly in outreach and education efforts to encourage local governments to work with other communites, which their constituencies recognize is very important for the success of efforts to protect the watershed and its residents' quality of life.

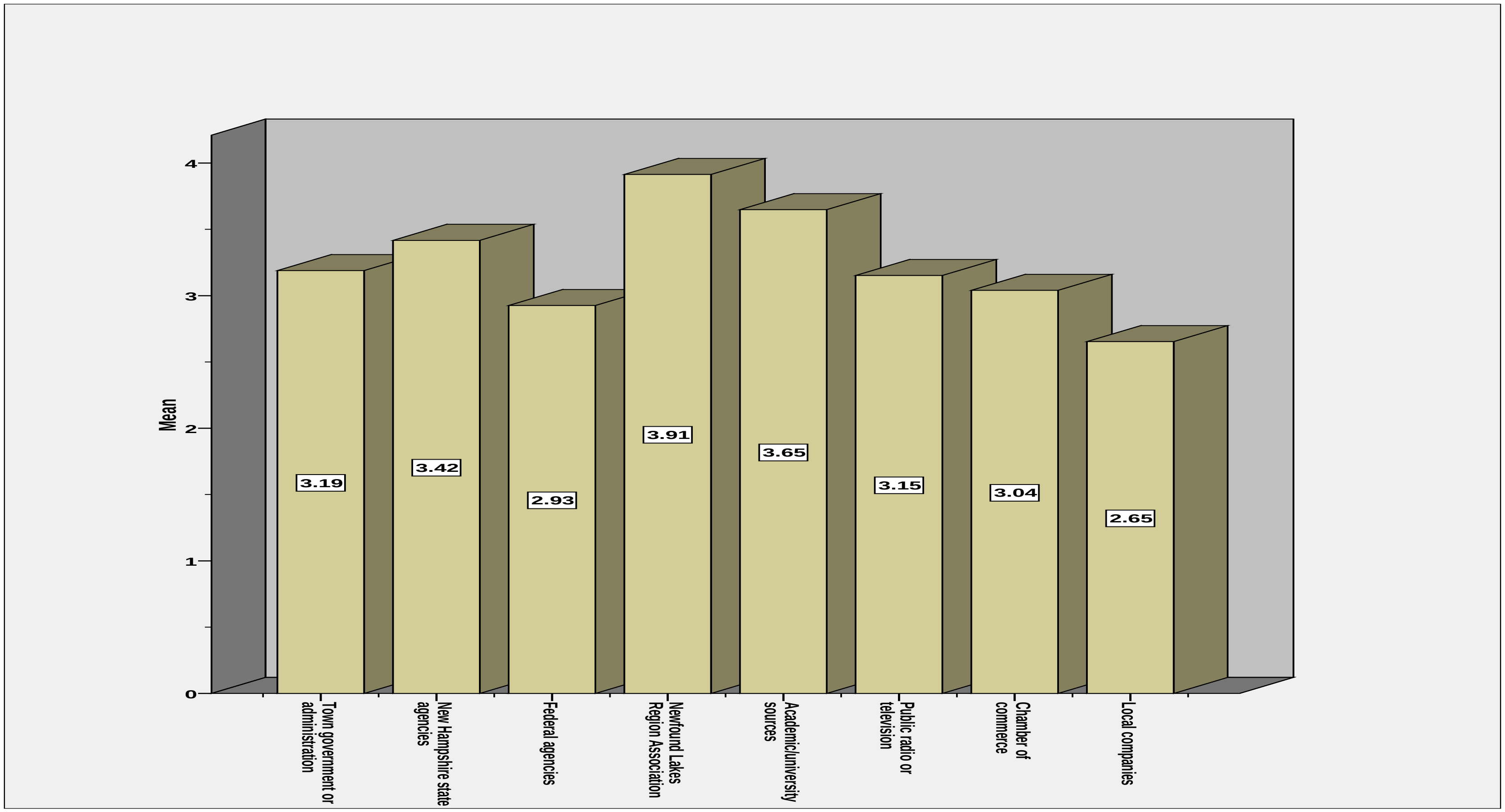
Level of Agreement on How Regulations Should be Determined and Implemented



Question 17 of the Questionnaire

The bar chart below indicates the level of trust in various sources of information about the Newfound Lake Region (1=no trust in a source, 3=neutral and 5=trust completely). The source that respondents trust most highly as a valid source of information was the Newfound Lake Region Association, that had an overall mean trust level of 3.91. The sorce of information that watershed respondents had the least amount of trust in was local companies (2.93).

Level of Trust About the Watershed in Informational Sources



Question 18 of Questionnaire – Background Characteristics (Demographics)

Demographic questions are asked to enable the identification of important relationships between attitudinal measures and demographic variables of importance for considering the equality of governance decisions. Demographic questions are used primarily in multivariate analysis, but can also help identify who did not respond to this survey. By looking at differences between the survey respondents and the overall population of the watershed, it is possible to extrapolate what opinions might be underrepresented from this report.

It is essential that towns and others using the report refer to the analyses of the differences in opinions across different demographic groups to be sensitive to issues of representation. As is typical with survey research respondents have higher average ages, incomes, and educational attainment then the general population. In addition the sample purposively included a high proportion of lakefront residents, and differences between lakefront and other property owners should be considered when interpreting the results as well. As a whole, response differences across categories of these variables are especially important for consideration.

The demographic section of this questionnaire asked about seasonality of residence, length of time living in or visiting the watershed, acreage of home lots, property maintenance contracting, membership in the NLRA, length of commute to work, income, views of economic dependence on the watershed, political orientation, birth year (used to derive age), gender, and level of education. By asking demographic questions, the analysis of responses was able to look at differences in response sets among groups, increasing the value of the collected data.

Which of the following best describes your residency in the Newfound Lake Watershed?

For many property owners in the watershed, the region is not their primary residence. The seasonal population has different impacts on the watershed and it is important to understand how their opinions and desires also differ from year round residence. The year round population in the Newfound Lake Watershed, based on 2005 census data, is about 4,500 people. During the summer months the population doubles. 46.7% of respondents were year round residents in the watershed, and 51.4% were not year round. This split accurately represents the actual composition of property owners in the watershed. A few respondents indicated that this question was not applicable to them, or no answer was given. It is reasonable to assume that a "not applicable" or missing response was because some respondents reside outside of the watershed altogether.

Seasonality of Residence

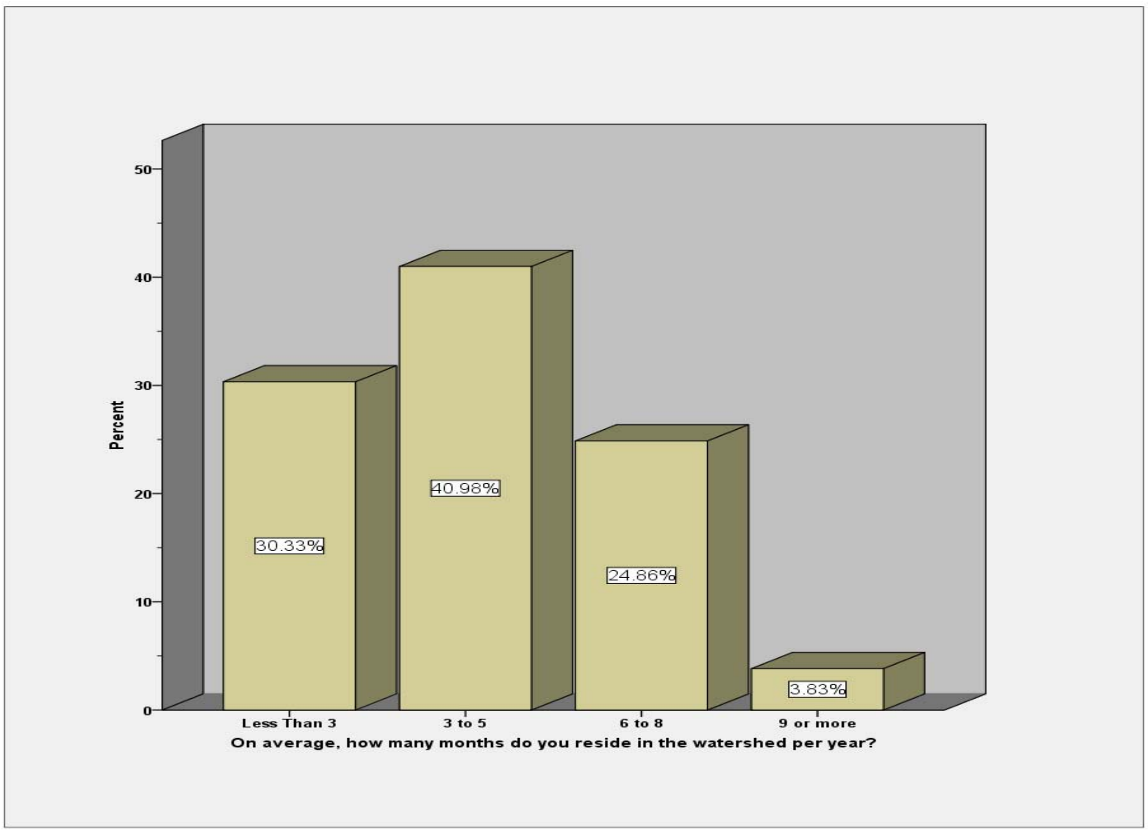
Which of the following best describes your residency in the Newfound Lake Watershed?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Year Round	371	46.7	48.6	48.6
	Not Year Round	392	49.4	51.4	100.0
	Total	763	96.1	100.0	
Missing	Not Applicable	3	.4		
	Missing	28	3.5		
	Total	31	3.9		
Total		794	100.0		

On average, how many months do you reside in the watershed per year?

There was a good deal of variance in the number of months respondents who were not year round residents indicated they spent in the watershed. 4.9% responded that they spend zero months in the watershed; as before this is likely a representation of those respondents that own property in one of the eight towns, but whose property is not in the watershed (woodlots, rental properties, etc.). 55.5% reported spending less than five months, but at least ½ a month, in the watershed during the year. The remaining 39.6% spend 5 to 10 months residing in the watershed. The amount of time seasonal residents spend in the watershed may significantly impact their values and desires for the watershed's future.

Months per Year for Seasonal Residents



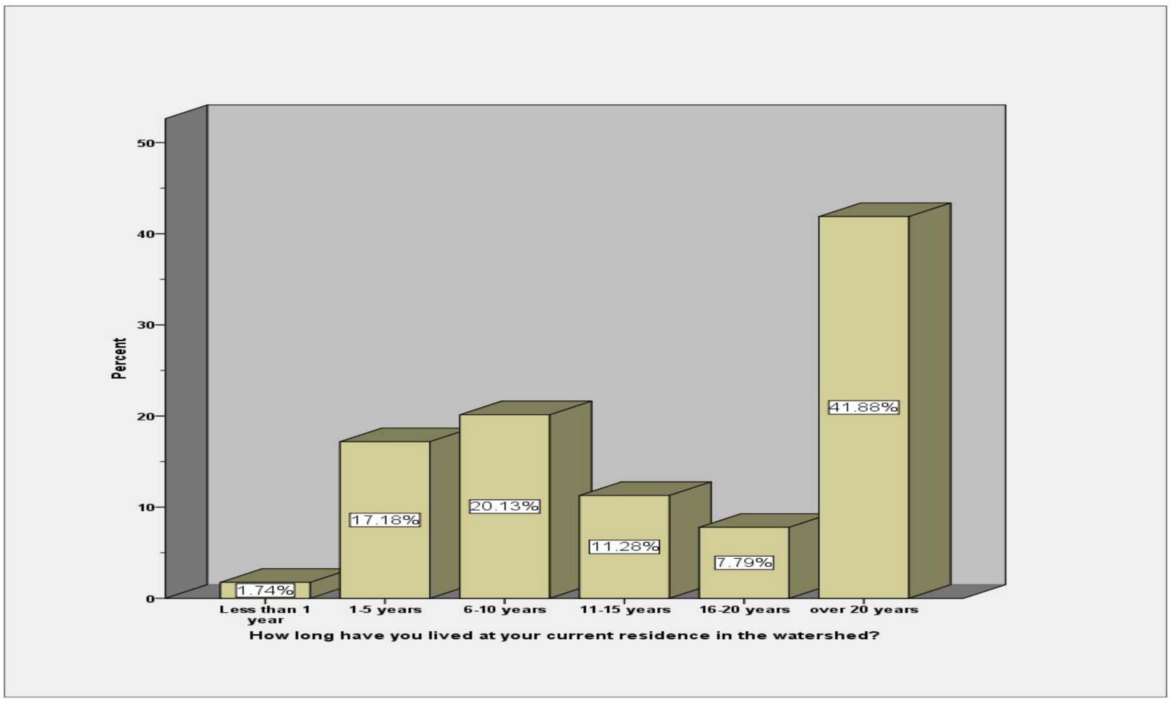
Months per Year

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 3	111	14.0	30.3	30.3
	3 to 5	150	18.9	41.0	71.3
	6 to 8	91	11.5	24.9	96.2
	9 or More	14	1.8	3.8	100.0
	Total	366	46.1	100.0	
Missing	System	428	53.9		
Total		794	100.0		

How long have you lived at your current residence in the watershed?

Communities in the watershed have experienced population growth and changes in housing characteristics in recent years. Housing characteristics are directly related to land use decisions, and these decisions contribute to the overall health and character of the watershed. The majority of the respondents indicated that they have lived in their current residence in the watershed for over 20 years (41.9%). Only 18.9% of respondents had been in their current residence for 5 years of less. The survey data may therefore reflect a highly stable population of home owners rather than a population for which the housing characteristics are changing.

Length of Residence



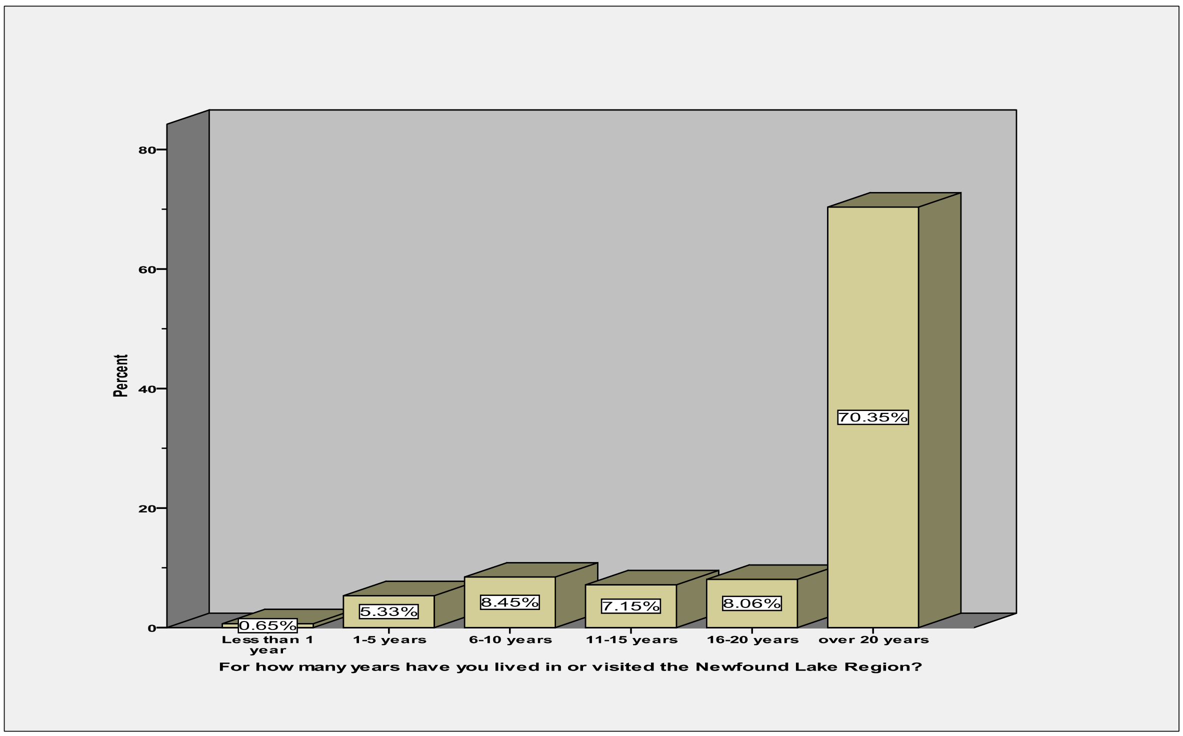
How long have you lived at your current residence in the watershed?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 1 year	13	1.6	1.7	1.7
	1-5 years	128	16.1	17.2	18.9
	6-10 years	150	18.9	20.1	39.1
	11-15 years	84	10.6	11.3	50.3
	16-20 years	58	7.3	7.8	58.1
	over 20 years	312	39.3	41.9	100.0
	Total	745	93.8	100.0	
Missing	Not Applicable	19	2.4		
	Missing	30	3.8		
	Total	49	6.2		
Total		794	100.0		

For how many years have you lived in or visited the Newfound Lake Region?

Respondents' sense of place and perceptions of the watershed may be influenced by their length of residence or how long they have been visiting the community, a common variable examined in research on social perceptions of community related variables. 70.4% of respondents indicated they have lived in, or visited the Newfound Lake Region for over 20 years. Only 6% of respondents had lived or visited the region for less than 5 years. The Newfound Lake Region continues to experience growth in year round and seasonal populations, but the majority of respondents were longtime residents or visitors.

Years Living in or Visiting the Region



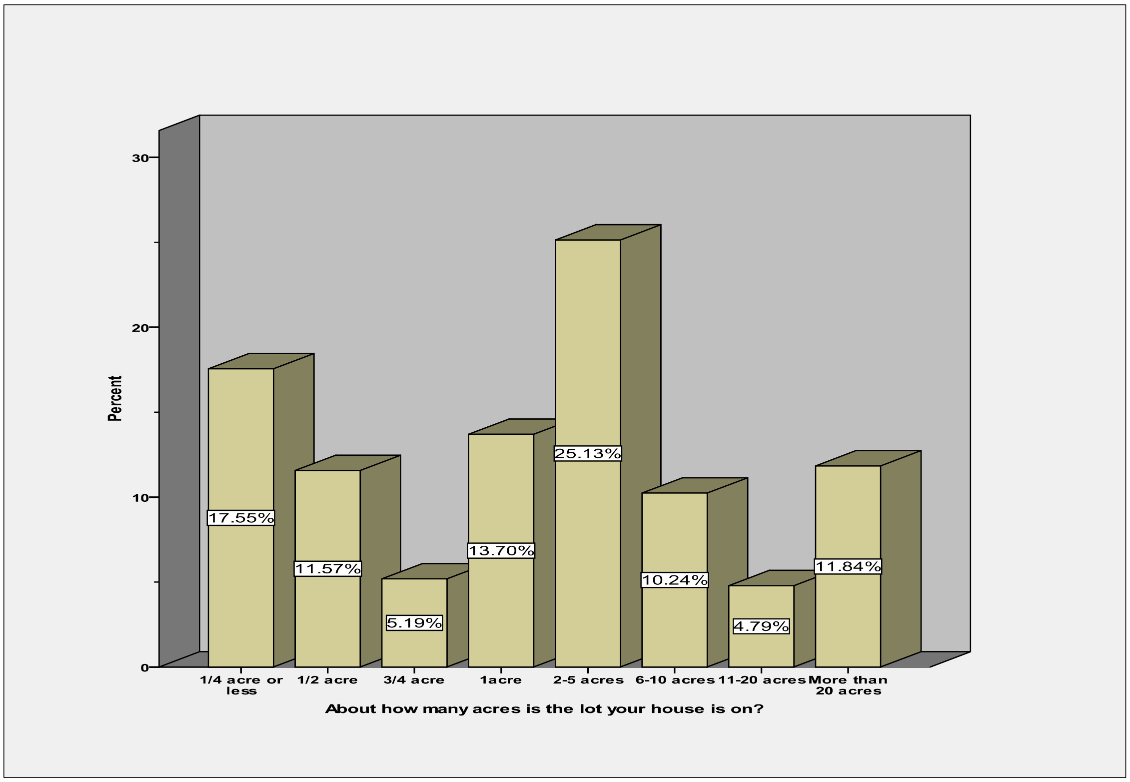
For how many years have you lived in or visited the Newfound Lake Region?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 1 year	5	.6	.7	.7
	1-5 years	41	5.2	5.3	6.0
	6-10 years	65	8.2	8.5	14.4
	11-15 years	55	6.9	7.2	21.6
	16-20 years	62	7.8	8.1	29.6
	over 20 years	541	68.1	70.4	100.0
	Total	769	96.9	100.0	
Missing	Not Applicable	2	.3		
	Missing	23	2.9		
	Total	25	3.1		
Total		794	100.0		

About how many acres is the lot your house is on?

Most frequent lot size for respondents was between two and five acres, but both very small (1/2 acre or less) and large (20 acres or more) lots were also quite frequent.

Percent of Respondents who Indicated that their Lot Size was Each of the Following Categories



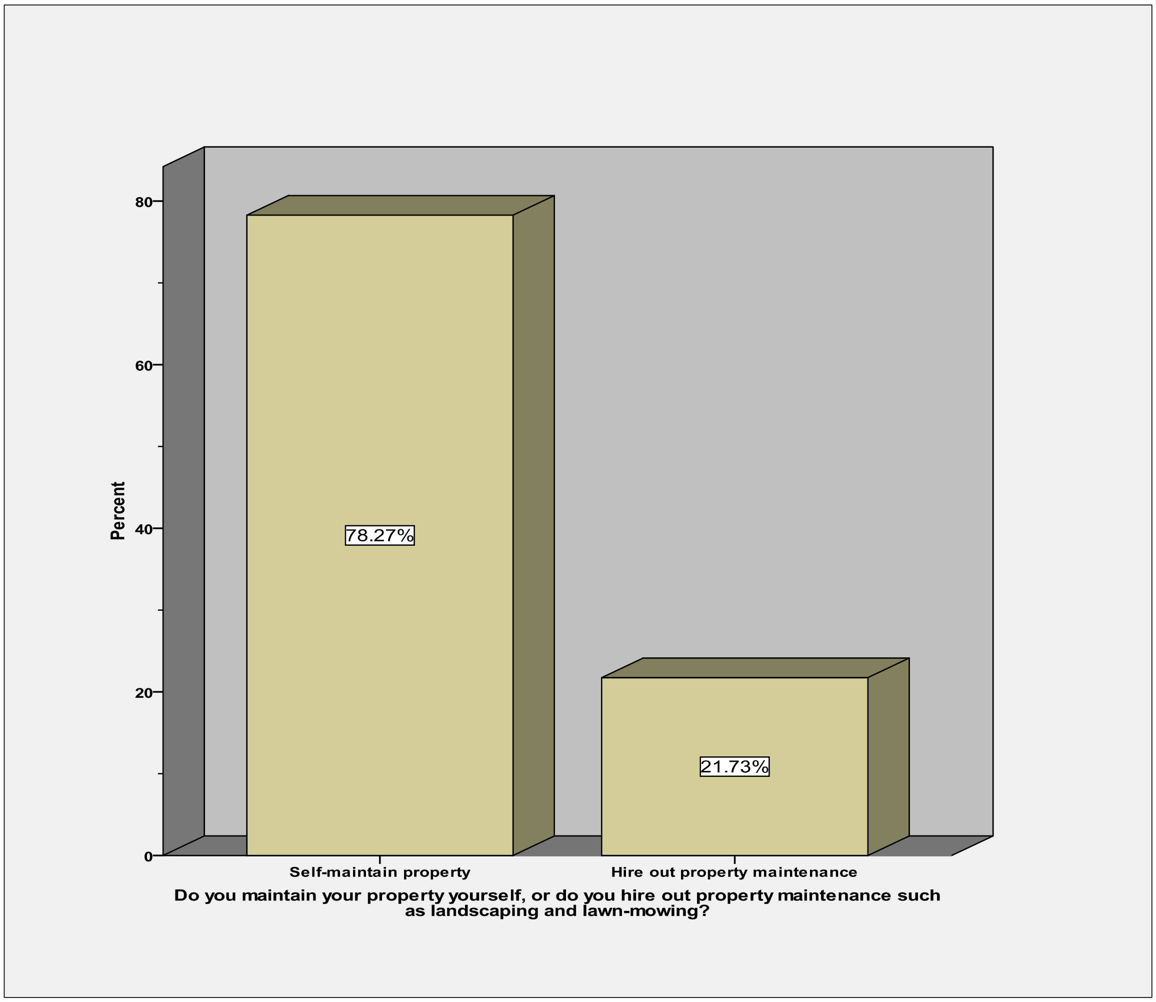
About how many acres is the lot your house is on?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1/4 acre or less	132	16.6	17.6	17.6
	1/2 acre	87	11.0	11.6	29.1
	3/4 acre	39	4.9	5.2	34.3
	1acre	103	13.0	13.7	48.0
	2-5 acres	189	23.8	25.1	73.1
	6-10 acres	77	9.7	10.2	83.4
	11-20 acres	36	4.5	4.8	88.2
	More than 20 acres	89	11.2	11.8	100.0
	Total	752	94.7	100.0	
Missing	Don't Know	1	.1		
	Not Applicable	6	.8		
	Missing	35	4.4		
	Total	42	5.3		
Total		794	100.0		

Do you maintain your property yourself, or do you hire out property maintenance such as landscaping and lawn-mowing?

A little more than one out of five respondents reported hiring out some or all of their property maintenance.

Percent of Respondents who Indicated that they Perform their Own Property Maintenance



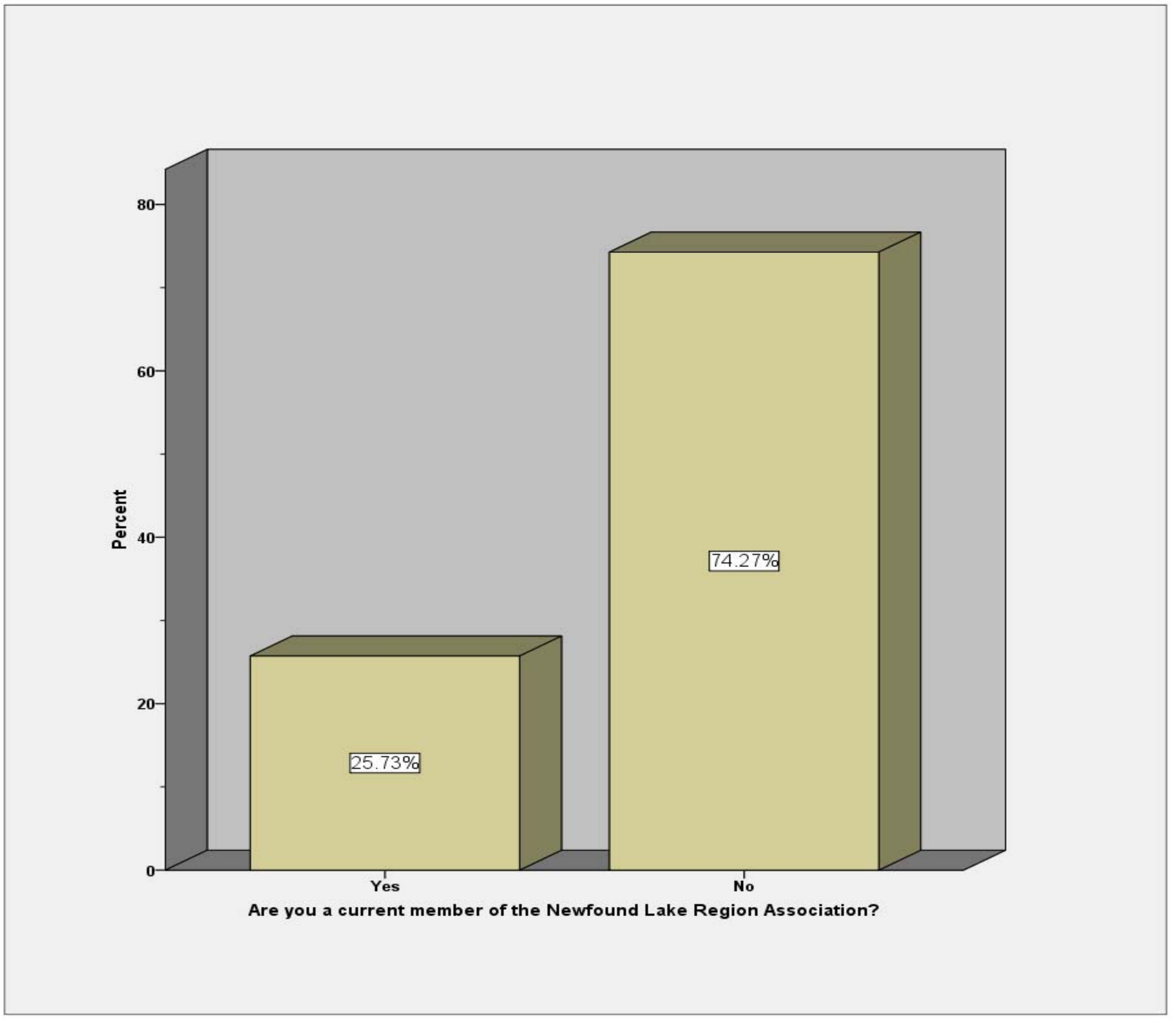
Do you maintain your property yourself, or do you hire out property maintenance such as landscaping and lawn-mowing?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Self-maintain property	587	73.9	78.3	78.3
	Hire out property maintenance	163	20.5	21.7	100.0
	Total	750	94.5	100.0	
Missing	Not Applicable	6	.8		
	Missing	38	4.8		
	Total	44	5.5		
Total		794	100.0		

Are you a current member of the Newfound Lake Region Association?

Roughly one out of four respondents are current members of the Newfound Lake Region Association.

NLRA Membership



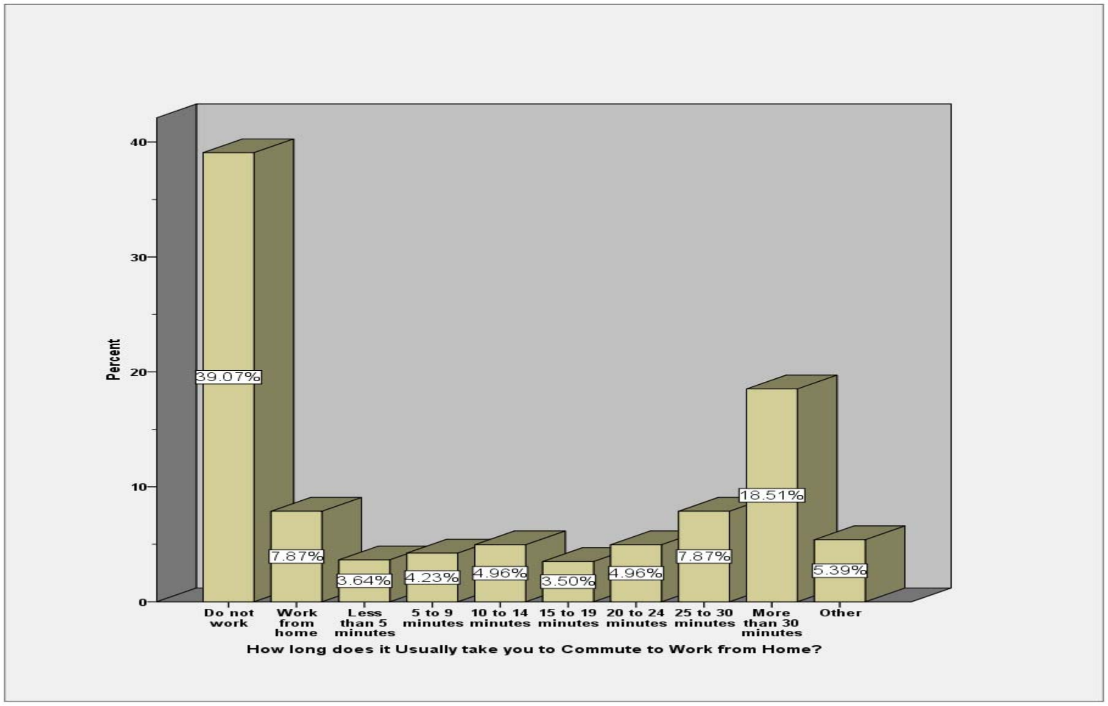
Are you a current member of the Newfound Lake Region Association?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	194	24.4	25.7	25.7
	No	560	70.5	74.3	100.0
	Total	754	95.0	100.0	
Missing	Missing	40	5.0		
Total		794	100.0		

How long does it take you to commute to work from home?

While almost half of respondents were retired, worked from home, or did not work, over one quarter, or about half of the working population of respondents, travel 25 minutes or more to get to work from home.

Length of Time it Takes to Commute to Work for Home

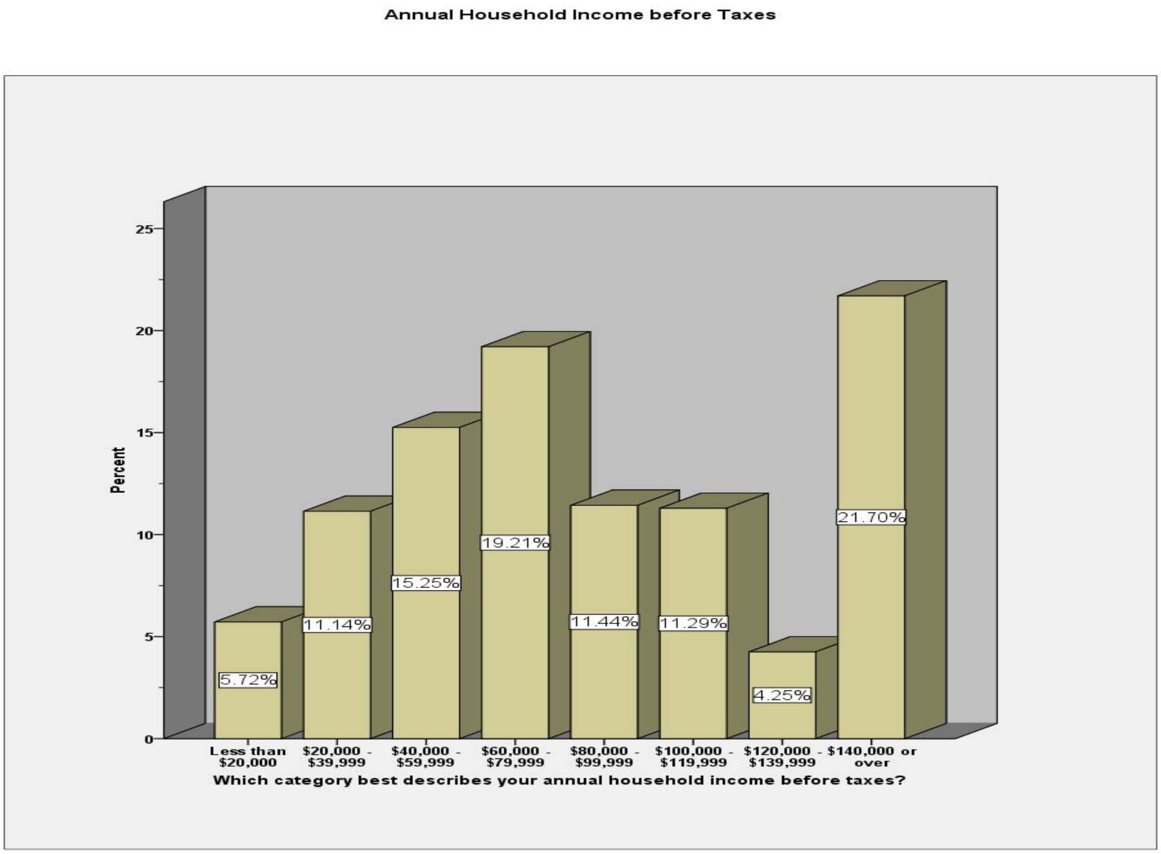


How long does it usually take you to commute to work from home?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Do not work	268	33.8	39.1	39.1
	Work from home	54	6.8	7.9	46.9
	Less than 5 minutes	25	3.1	3.6	50.6
	5 to 9 minutes	29	3.7	4.2	54.8
	10 to 14 minutes	34	4.3	5.0	59.8
	15 to 19 minutes	24	3.0	3.5	63.3
	20 to 24 minutes	34	4.3	5.0	68.2
	25 to 30 minutes	54	6.8	7.9	76.1
	More than 30 minutes	127	16.0	18.5	94.6
	Other	37	4.7	5.4	100.0
	Total	686	86.4	100.0	
Missing	Don't Know	1	.1		
	Not Applicable	16	2.0		
	Missing	91	11.5		
	Total	108	13.6		
Total		794	100.0		

Which category best describes your annual household income before taxes?

Based on 2000 US Census data, the median household income for the watershed is $43,217. The graph shows a typical bell curve trend for all income brackets but the highest. 21.7% of respondents reported annual household incomes of $140,000 or over, and the highest percent of respondents were in this bracket, which is likely a function of the over-representation of lakefront residents in the sample.



Which category best describes your annual household income before taxes?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than $20,000	39	4.9	5.7	5.7
	$20,000 - $39,999	76	9.6	11.1	16.9
	$40,000 - $59,999	104	13.1	15.2	32.1
	$60,000 - $79,999	131	16.5	19.2	51.3
	$80,000 - $99,999	78	9.8	11.4	62.8
	$100,000 - $119,999	77	9.7	11.3	74.0
	$120,000 - $139,999	29	3.7	4.3	78.3
	$140,000 or over	148	18.6	21.7	100.0
	Total	682	85.9	100.0	
Missing	Don't Know	1	.1		
	Not Applicable	1	.1		
	Missing	110	13.9		
	Total	112	14.1		
Total		794	100.0		

Do you feel your work or business is in some way economically dependent upon Newfound Lake?

People who view Newfound Lake as an important resource for their economic viability may have an increased awareness and stake in the long-term health of the lake. Only 13.2% of respondents indicated that their work or business was in some way dependent upon Newfound Lake. This may reflect the fact that 33.8% of respondents do not work, and others may travel outside the watershed to work.

Perception of Financial Dependence upon the Lake

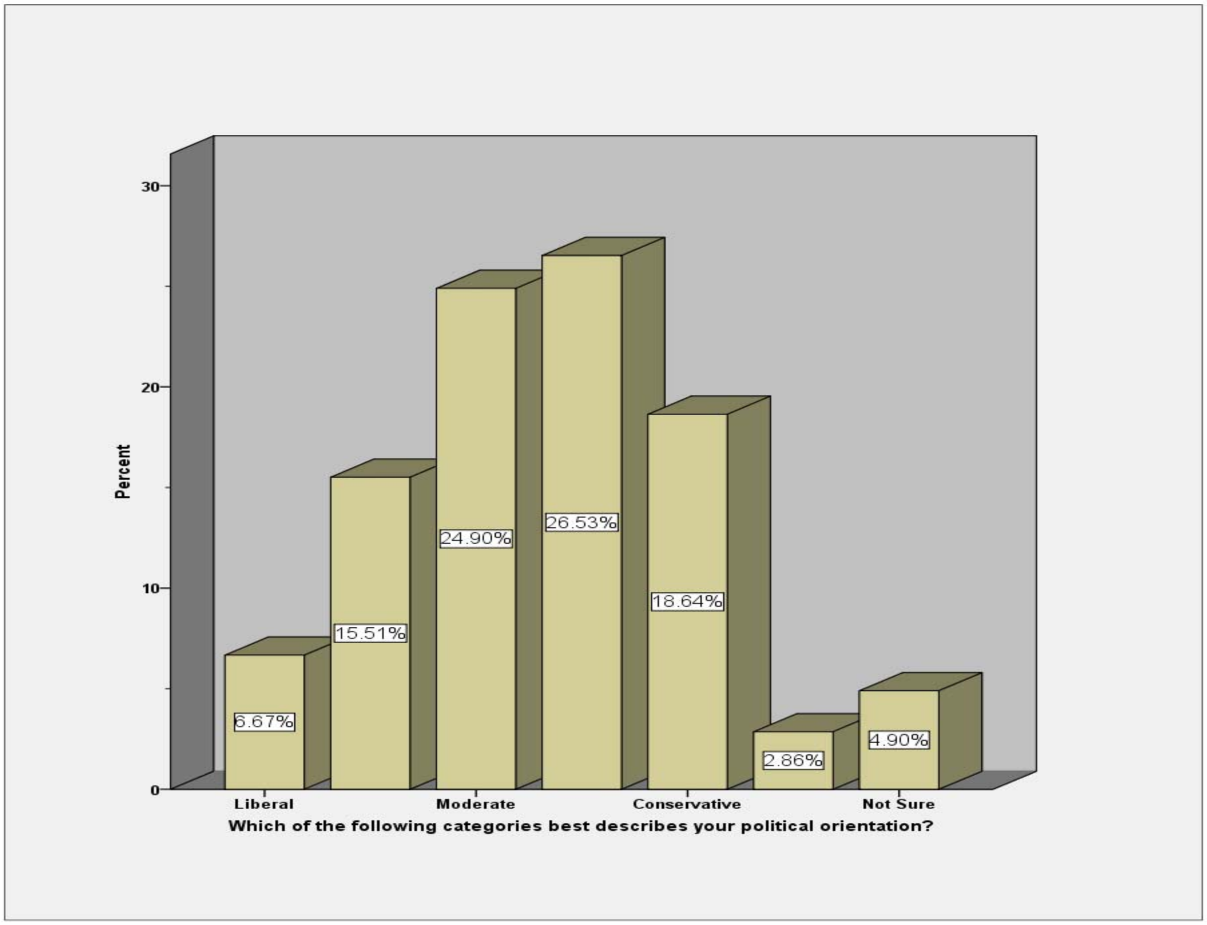
Do you feel your work or business is in some way economically dependent upon Newfound Lake?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	105	13.2	15.1	15.1
	No	591	74.4	84.9	100.0
	Total	696	87.7	100.0	
Missing	Not Applicable	29	3.7		
	Missing	69	8.7		
	Total	98	12.3		
Total		794	100.0		

Which of the following categories best describes your political orientation?

The majority of respondents indicated moderate to moderately conservative political orientation; together they account for over 50% of respondents. 18.6% of respondents were conservative in political orientation, while only 6.7% were liberal.

Political Orientation



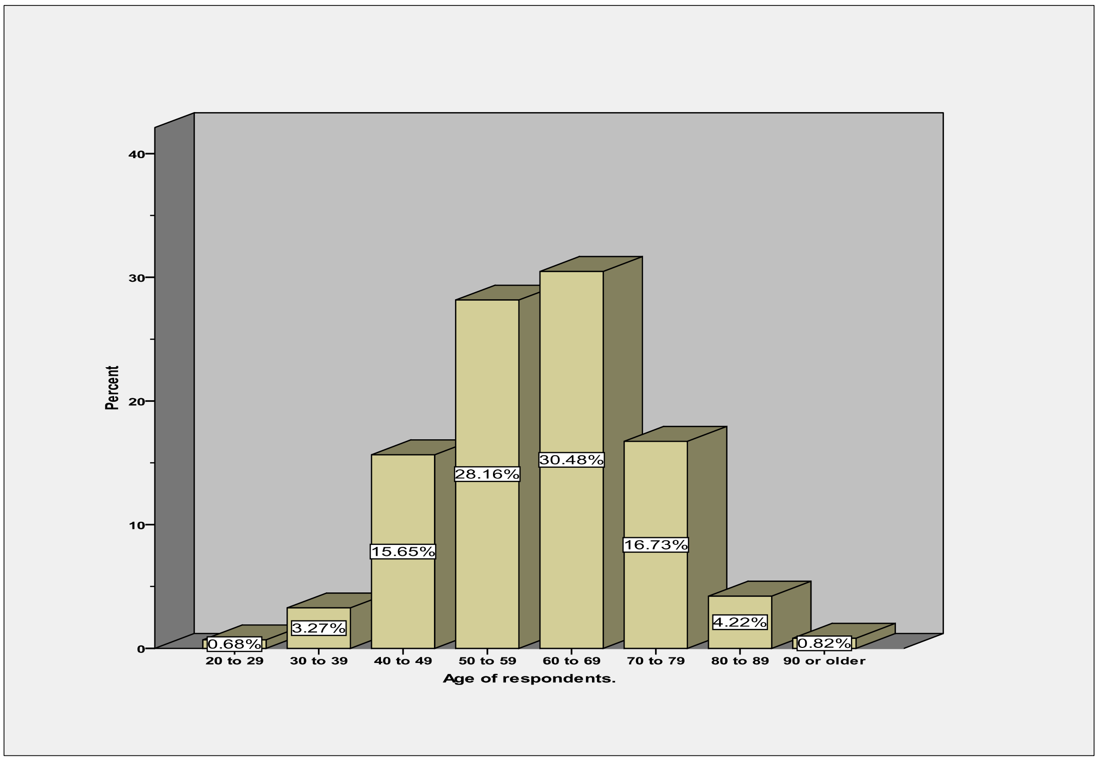
Which of the following categories best describes your political orientation?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Liberal	49	6.2	6.7	6.7
	Moderately Liberal	114	14.4	15.5	22.2
	Moderate	183	23.0	24.9	47.1
	Moderately Conservative	195	24.6	26.5	73.6
	Conservative	137	17.3	18.6	92.2
	Other	21	2.6	2.9	95.1
	Not Sure	36	4.5	4.9	100.0
	Total	735	92.6	100.0	
Missing	Don't Know	2	.3		
	Missing	57	7.2		
	Total	59	7.4		
Total		794	100.0		

In what year were you born?

Census data indicates that within the watershed the average age is 43 years old. The average age of survey respondents was 60 years old, and the age gap between respondents and census data is common in social research, as children under the age of 18 do not participate in household surveys but are counted in census data. However, this variance also likely reflects a slightly greater likelihood for older individuals to fill out this survey, and that factor should be considered using findings from bivariate analyses when interpreting survey results.

Age



Age Category

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	20 to 29	5	.6	.7	.7
	30 to 39	24	3.0	3.3	3.9
	40 to 49	115	14.5	15.6	19.6
	50 to 59	207	26.1	28.2	47.8
	60 to 69	224	28.2	30.5	78.2
	70 to 79	123	15.5	16.7	95.0
	80 to 89	31	3.9	4.2	99.2
	90 or older	6	.8	.8	100.0
	Total	735	92.6	100.0	
Missing	Missing	58	7.3		
	System	1	.1		
	Total	59	7.4		
Total		794	100.0		

<u>What is your gender?</u>

Male respondents outnumbered female by nearly 22%. This may in part be due to the sample frame. Sample was drawn using public property tax records, males were more often listed as property owners than females.

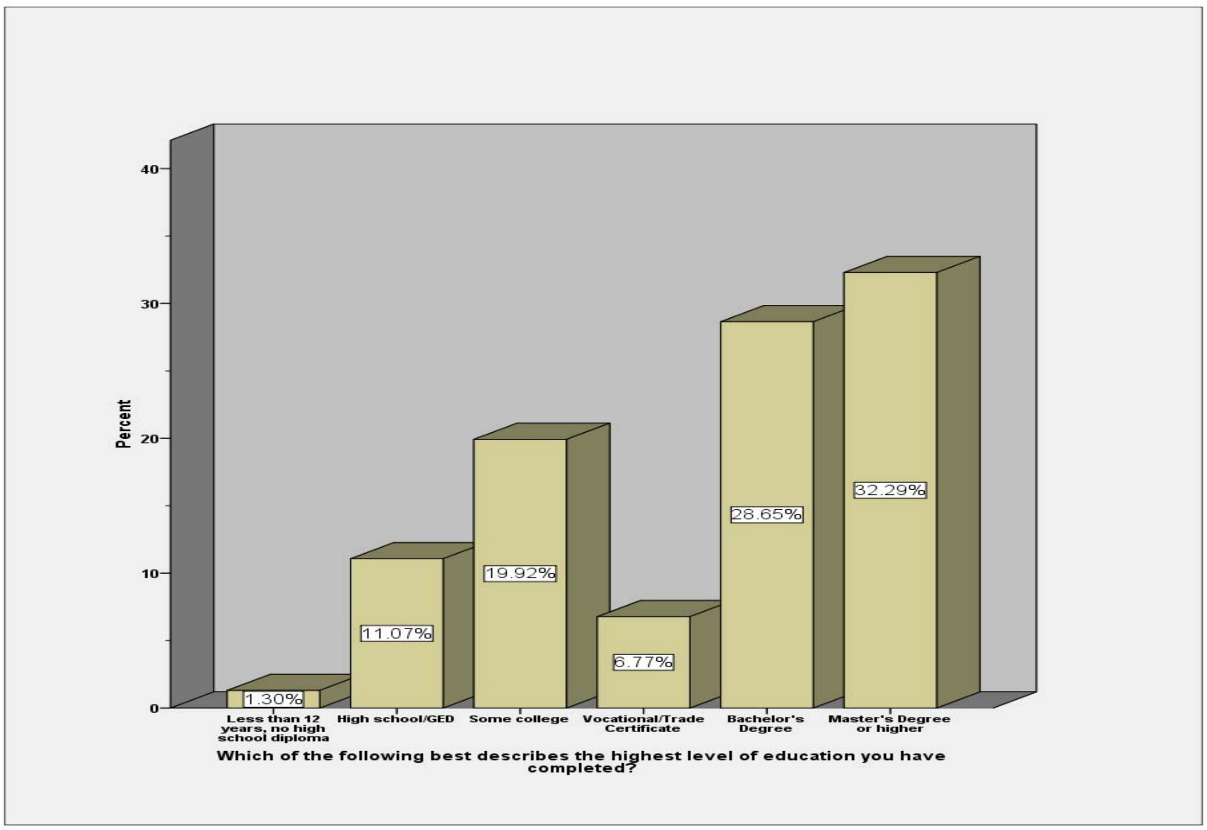
What is your gender?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	292	36.8	39.2	39.2
	Male	453	57.1	60.8	100.0
	Total	745	93.8	100.0	
Missing	Missing	49	6.2		
Total		794	100.0		

Which of the following best describes the highest level of education you have completed?

Census data from 2000 indicates that approximately 87% of the population in the watershed over the age of 25 were high school graduates or had continued on for additional schooling. Among survey respondents only 1.3% of respondents did not have a high school diploma. Respondents had typically completed high levels of education; 28.6% had completed bachelor’s degrees and 32.3% had completed master’s degrees or higher.

Education



Which of the following best describes the highest level of education you have completed?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 12 years, no high school diploma	10	1.3	1.3	1.3
	High school/GED	85	10.7	11.1	12.4
	Some college	153	19.3	19.9	32.3
	Vocational/Trade Certificate	52	6.5	6.8	39.1
	Bachelor's Degree	220	27.7	28.6	67.7
	Master's Degree or higher	248	31.2	32.3	100.0
	Total	768	96.7	100.0	
Missing	Not Applicable	1	.1		
	Missing	25	3.1		
	Total	26	3.3		
Total		794	100.0		

IV. Salient Findings from the Survey – Bivariate Analyses

The third series of analyses reported in the survey results section of this evaluation identifies important findings from bivariate analyses of the data collected, with key implications of the findings presented succinctly with the data. While all demographic questions were tested against each question, only selected statistically significant findings are reported here. Over one thousand statistically significant correlations between demographic variables, respondents' environmental values (measured using the New Ecological Paradigm (NEP) scale, an empirically tested and supported measurement tool), and a scale measuring the strength of respondents' attachment to Newfound Lake were found in analyses of the data. T-tests, ANOVA, and Pearson's Correlations were used to identify statistically significant correlations, and results that are of particular importance for the development of the watershed management plan and for understanding key issues in the watershed are presented. Further analyses of any relationships of interest for the project are available upon request. Tests of statistical significance, measures of strength of relationship, and theory and purpose guided analyses are the tools used to identify relationships of importance in the following section. Important points will be clarified so that a familiarity with statistical procedures will not be necessary to make sense of the analyses that follow, but a brief review of the meaning of statistical significance will be useful for users of this report.

Tests of statistical significance enable the identification of relationships between variables that are 95% or more likely to be true in the population in question (watershed residents), statistically speaking. If a relationship is "statistically significant" we are confident that it exists in the "real world". Tests of statistical significance do not signify a strong or weak relationship between variables per se, nor do they necessarily indicate a finding is of importance in and of itself. Instead, they identify relationships that, based on inferential statistical analyses, are generalizable from the sample and therefore worthy of consideration for their importance to project goals. Tests of statistical significance are combined with other analytic procedures that analyze the strength and direction of relationships to achieve analytic goals.

It should be noted that this report represents a first stage of social science analyses that provides understandable information that can be of great use as a reference for the creation of the watershed management plan and to towns and other interested parties engaged in efforts to address watershed issues. Analyses, including ones using sophisticated multivariate techniques, are on-going at the time of report production and key updates will be shared with the project team and other interested parties.

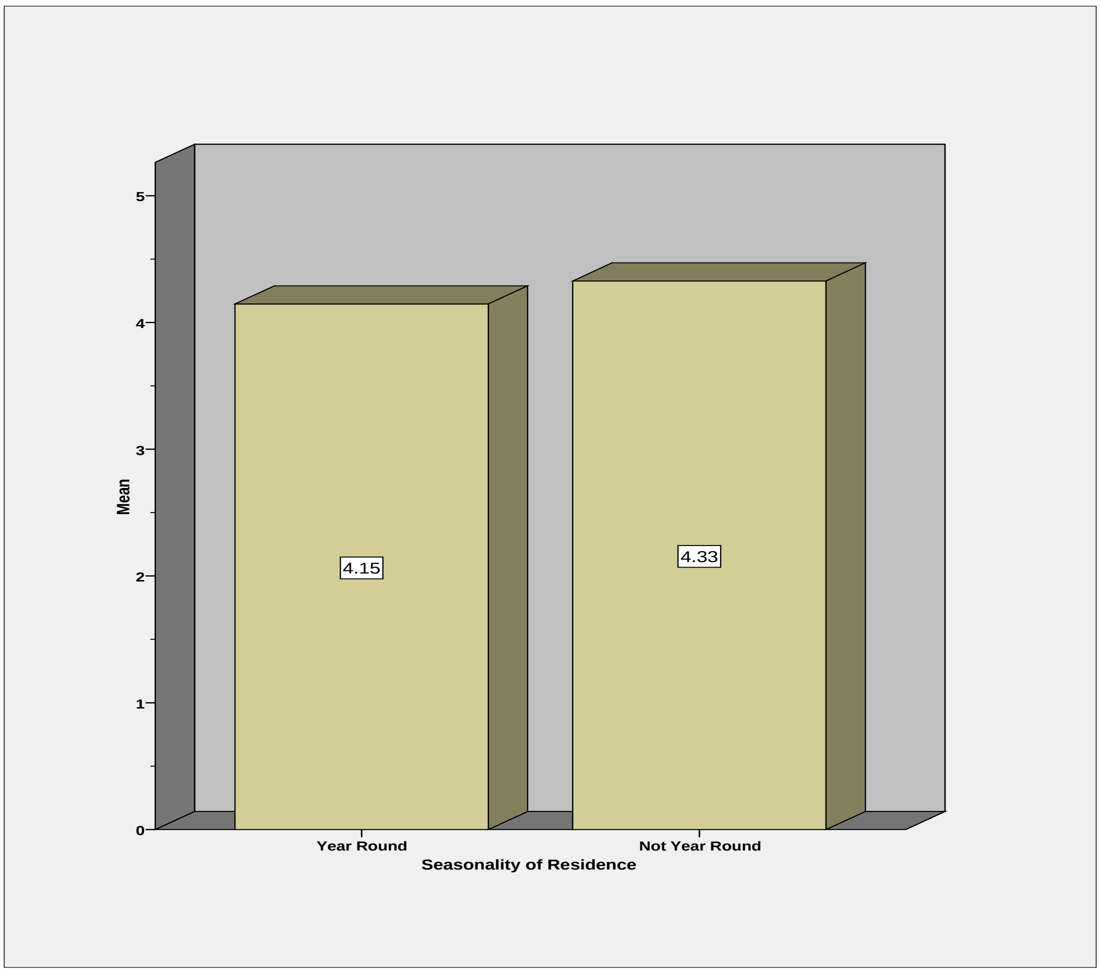
Dichotomous Variables: The Influences of Seasonal/Full-time Residency, Property Maintenance Responsibility, Membership in the NLRA, Gender, and Lakefront/Non-lakefront Property Ownership

The following demographic variables were dichotomous, meaning that valid responses were one of two categories. Statistical significance was measured at the 95% confidence level using T-tests. Year round versus seasonal residence, contracting of property maintenance, membership in the NLRA, gender, and whether the respondent owns lakefront property or not were each tested against each question in this study for significance.

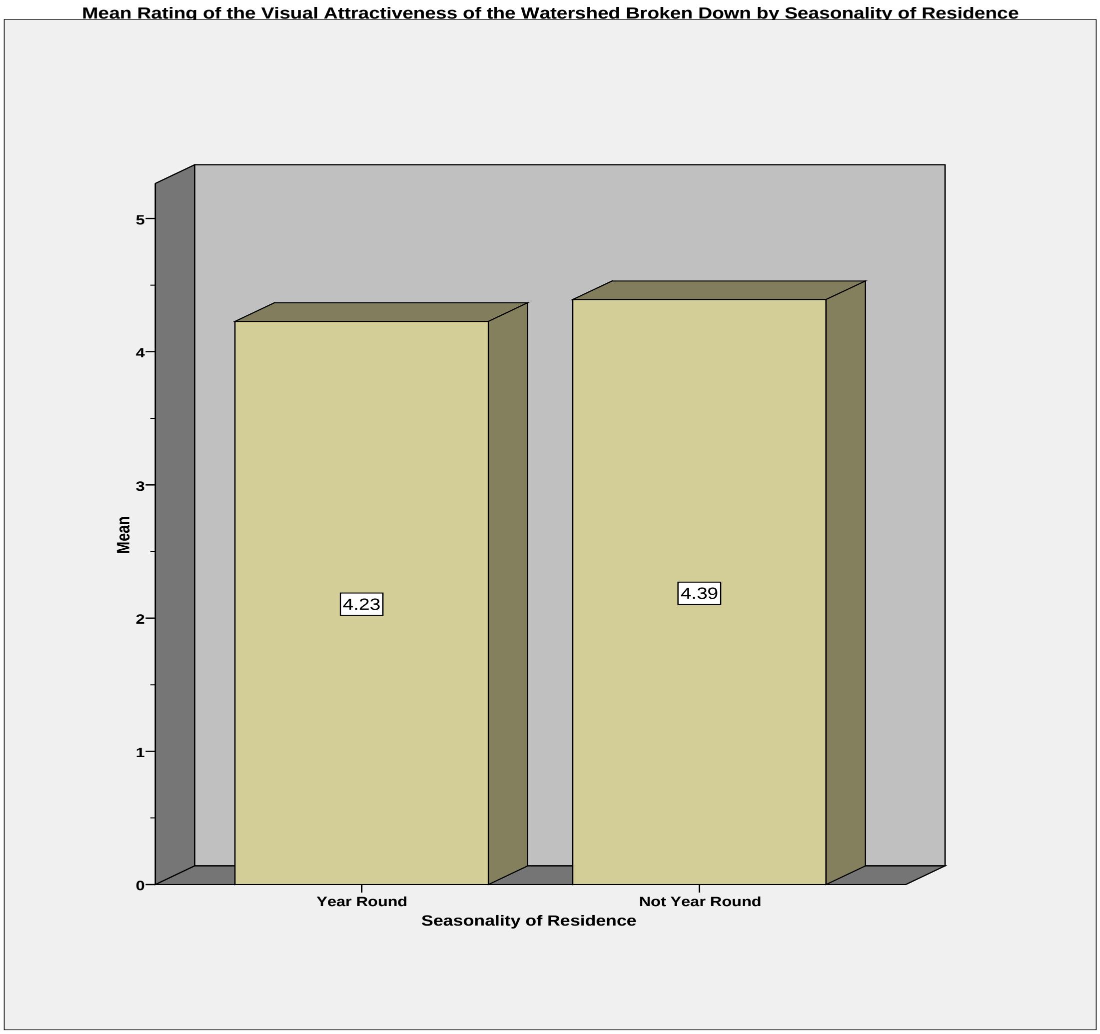
Full-time / Seasonal Residents: Key Differences

In searching for correlates of environmentally responsible behaviors, seasonality of residence was a clear factor. Year round residents indicated a higher awareness of human impacts, and reported more frequent participation in a number of environmentally responsible behaviors. This finding suggests a possible need for education focused on seasonal residents about their impacts on the watershed.

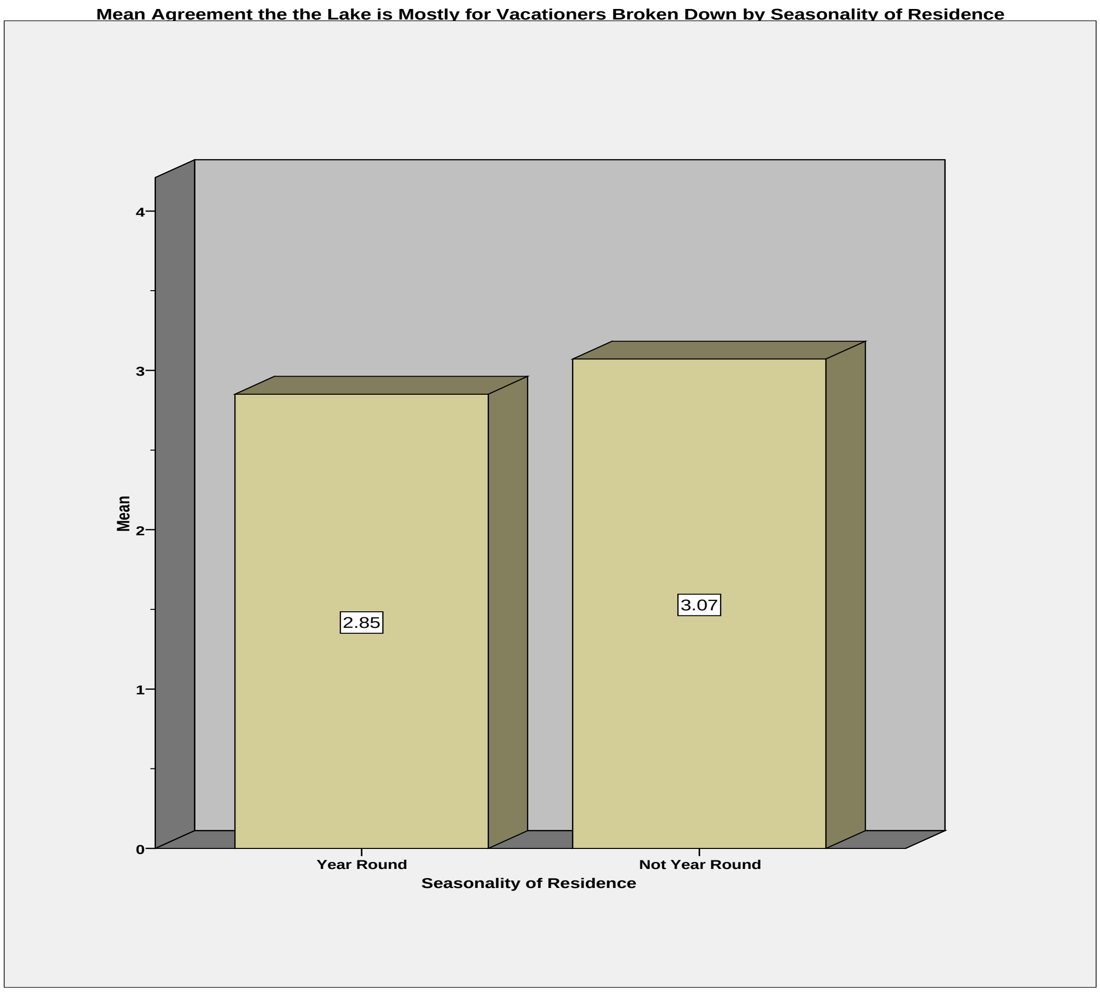
Mean Rating of the Overall Image of the Area Broken Down by Seasonality of Residence



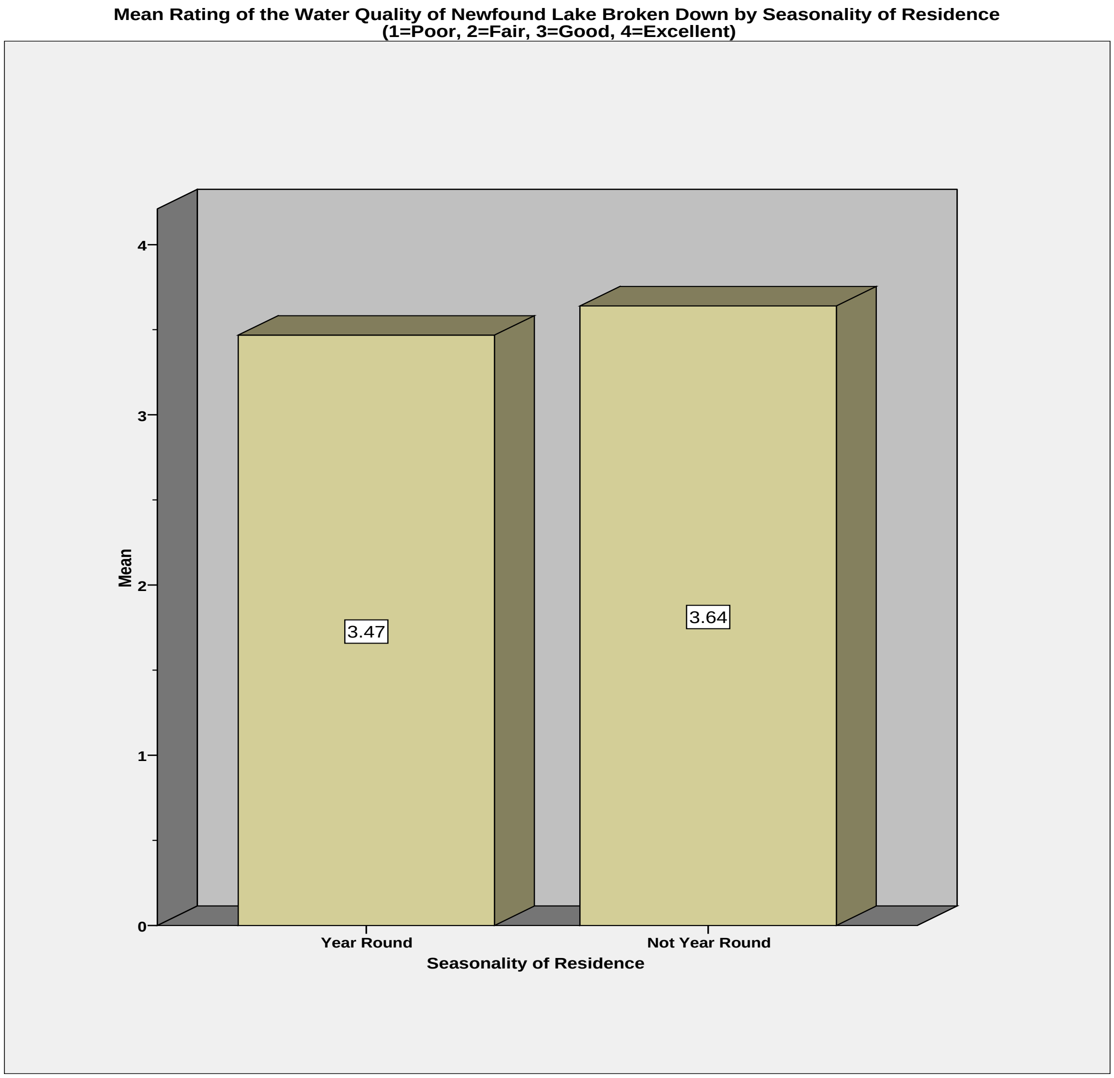
Most residents, regardless of seasonality rated the overall image of the area very positively; year round residents of the Newfound region generally rated the overall image of the area slightly lower than did seasonal residents.



The visual attractiveness of the watershed was also considered slightly more positive by seasonal residents.

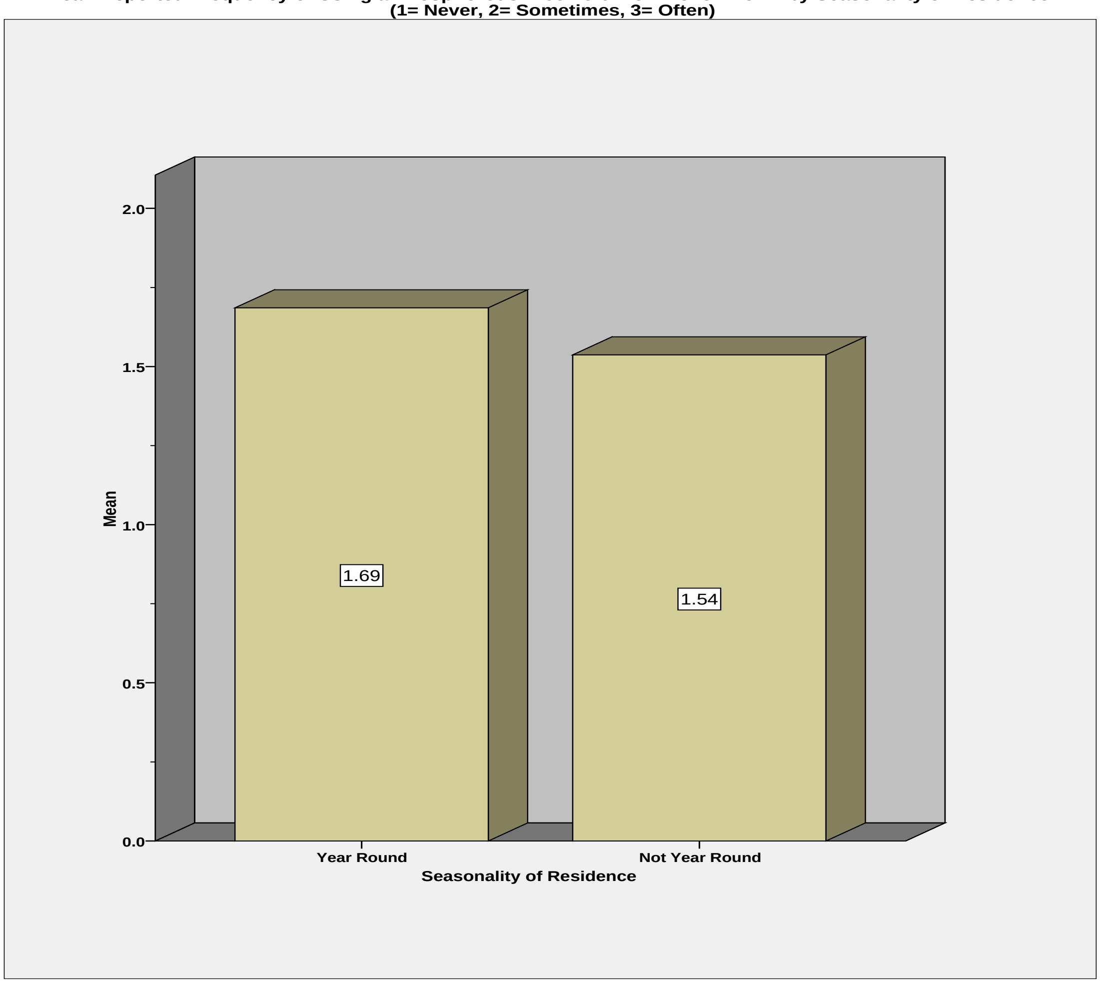


Not surprisingly, seasonal residents were more likely to agree that the lake is mostly for vacationers. Mean responses fell on either side of neutral, with seasonal residents tending slightly toward agreement, and year round residents tending slightly toward disagreement.



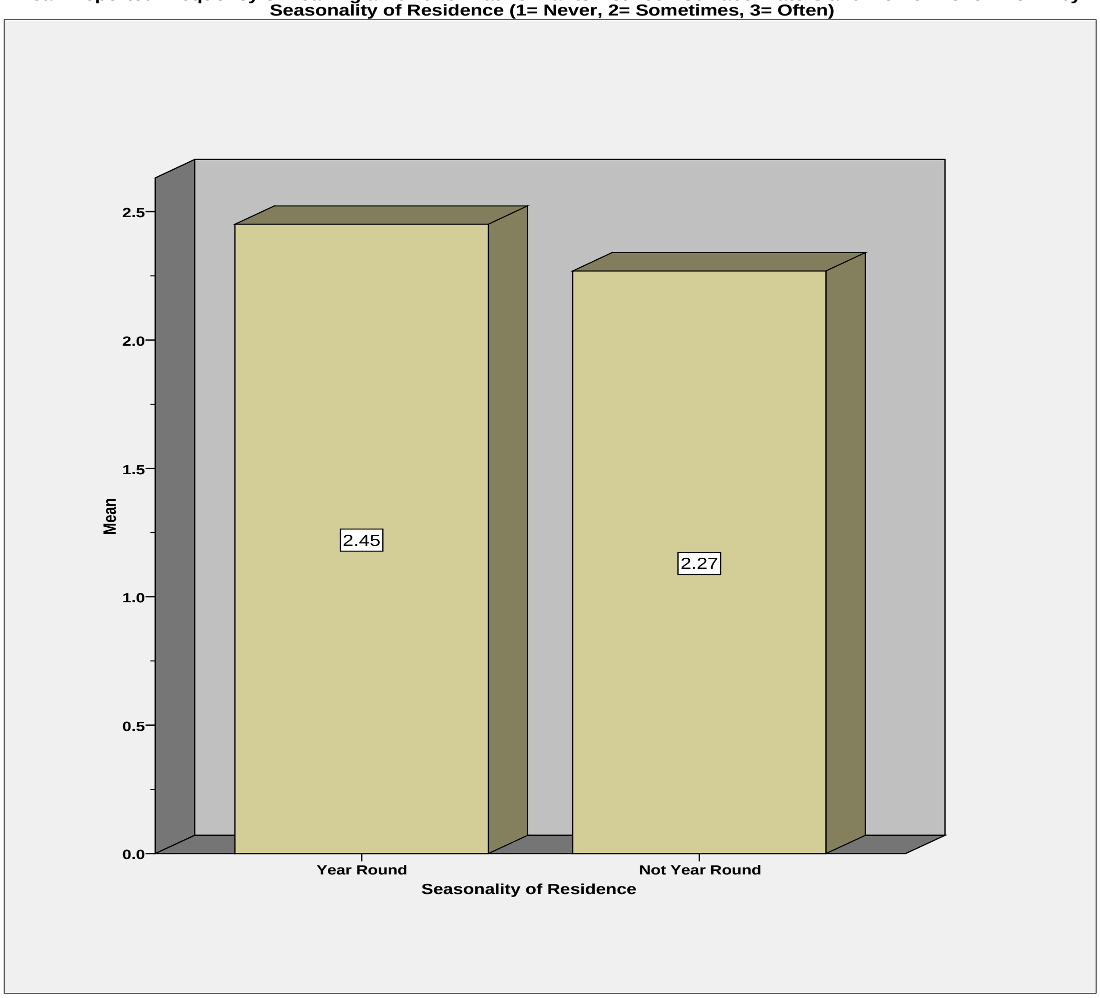
Seasonal residents generally had a more positive view of the water quality of Newfound Lake than did year round; year round residents were more likely to identify water as "Good" while seasonal residents overwhelmingly tended to identify the water quality as "Excellent".

Mean Reported Frequency of Using a Phosphorous Free Fertilizer Broken Down by Seasonality of Residence
(1= Never, 2= Sometimes, 3= Often)



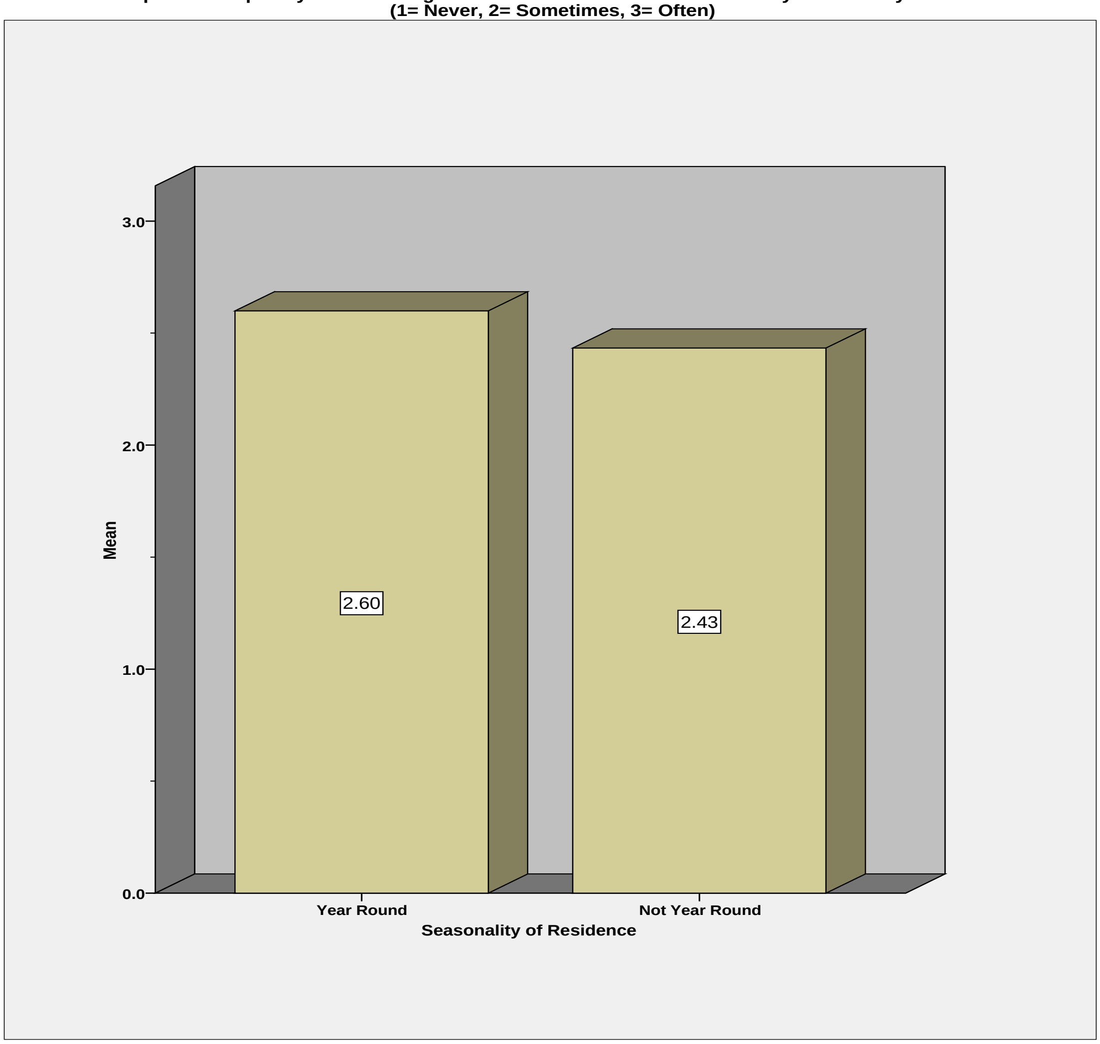
Year round residents reported the use phosphorous free fertilizers more frequently than did seasonal.

Mean Reported Frequency of Leaving a Buffer of Native Plants Between Surface Waters and Home Broken Down by Seasonality of Residence (1= Never, 2= Sometimes, 3= Often)



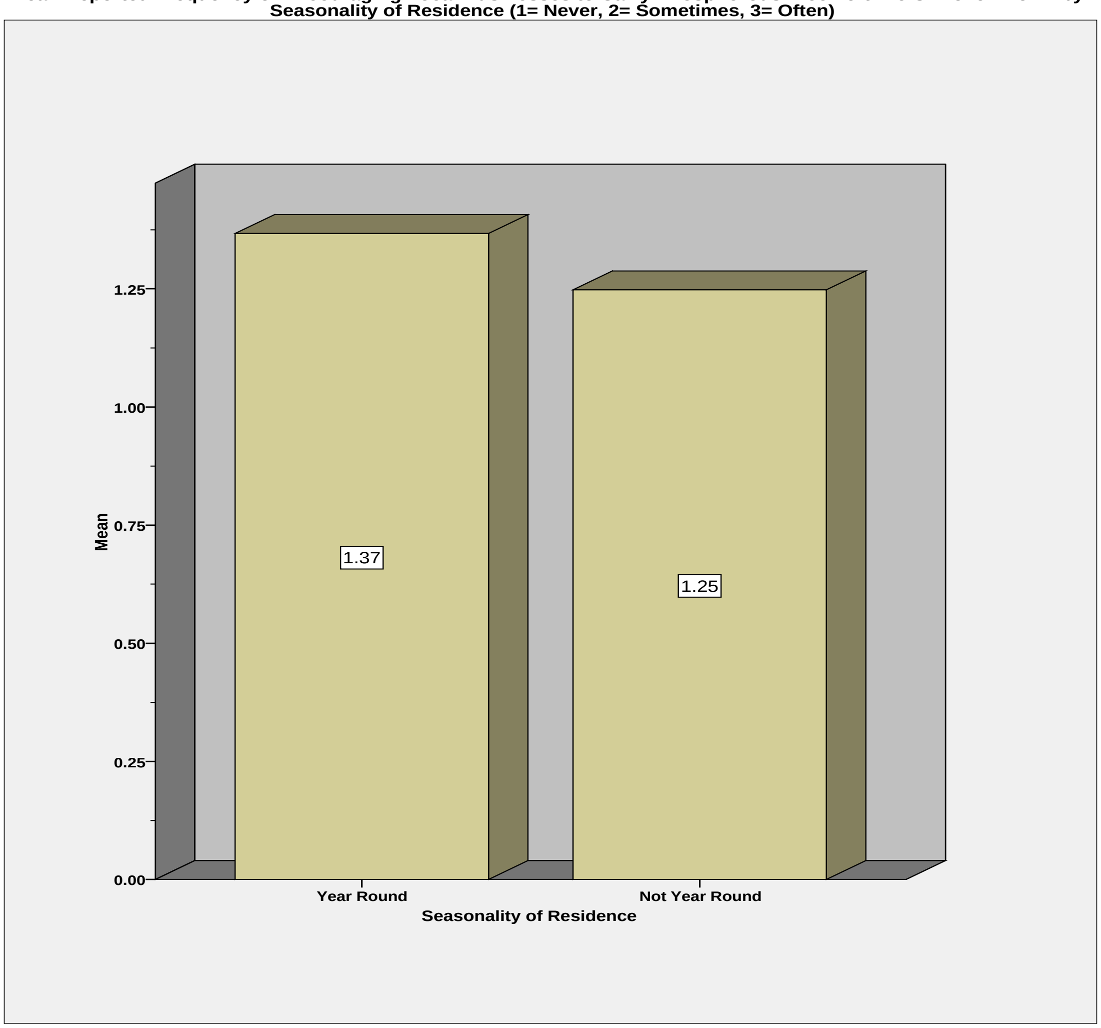
Seasonal residents were less likely to report that they had left a barrier of native plants between surface waters and their homes.

Mean Reported Frequency of Controling Soil Erosion on Land Broken Down by Seasonality of Residence
(1= Never, 2= Sometimes, 3= Often)



Year round residents reported attempting to control soil erosion more frequently on the average than did seasonal.

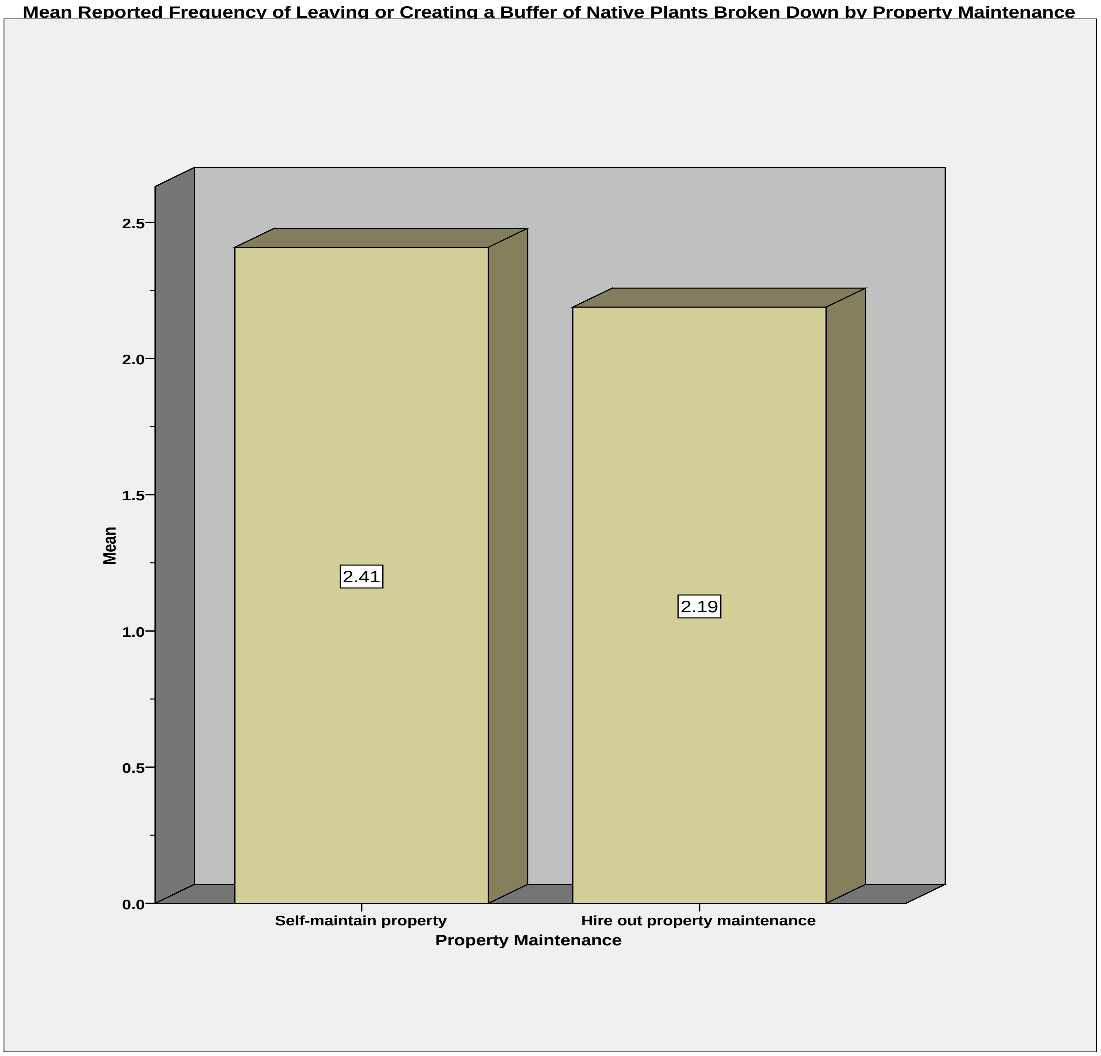
Mean Reported Frequency of Encouraging Local Businesses to Carry Phosphorous Free Fertilizers Broken Down by Seasonality of Residence (1= Never, 2= Sometimes, 3= Often)



While encouragement to local businesses to carry phosphorus free fertilizers was altogether infrequent, year round residents were slightly more likely to have reported doing so.

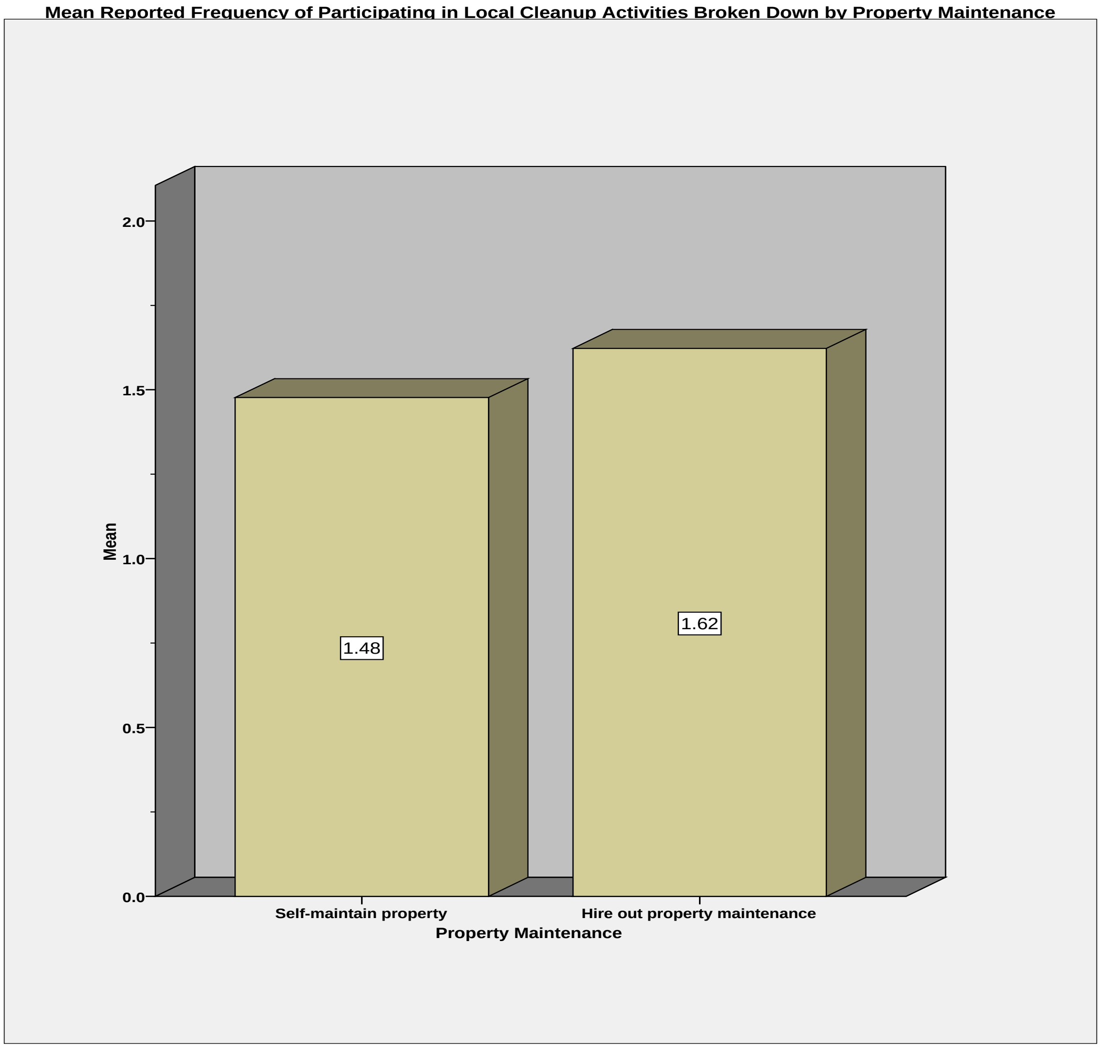
Property Maintenance: Key Differences

While those who hired out property maintenance were more likely to participate in local cleanup activities, but were less likely to be attentive to nutrient runoff prevention measures on their own land.



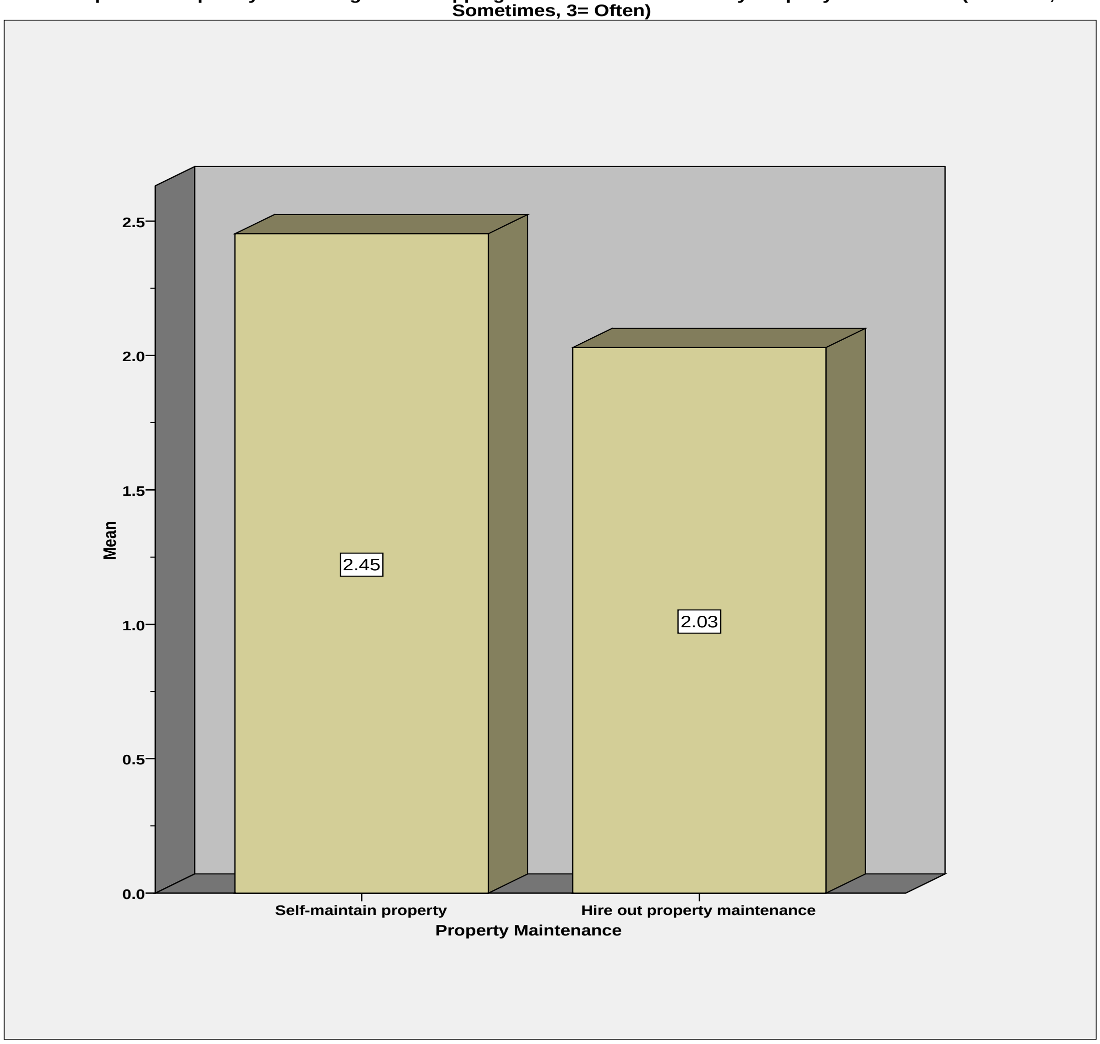
Those who maintain their own property were more likely to report having created or left a buffer of native plants between their homes and surface waters.

Those who hire out property on the average report less frequently that they had tried to control soil erosion around their homes.



Despite lower reported frequency of environmental practices around their homes, those who hire out their property maintenance were more likely to report having taken part in local cleanup activities.

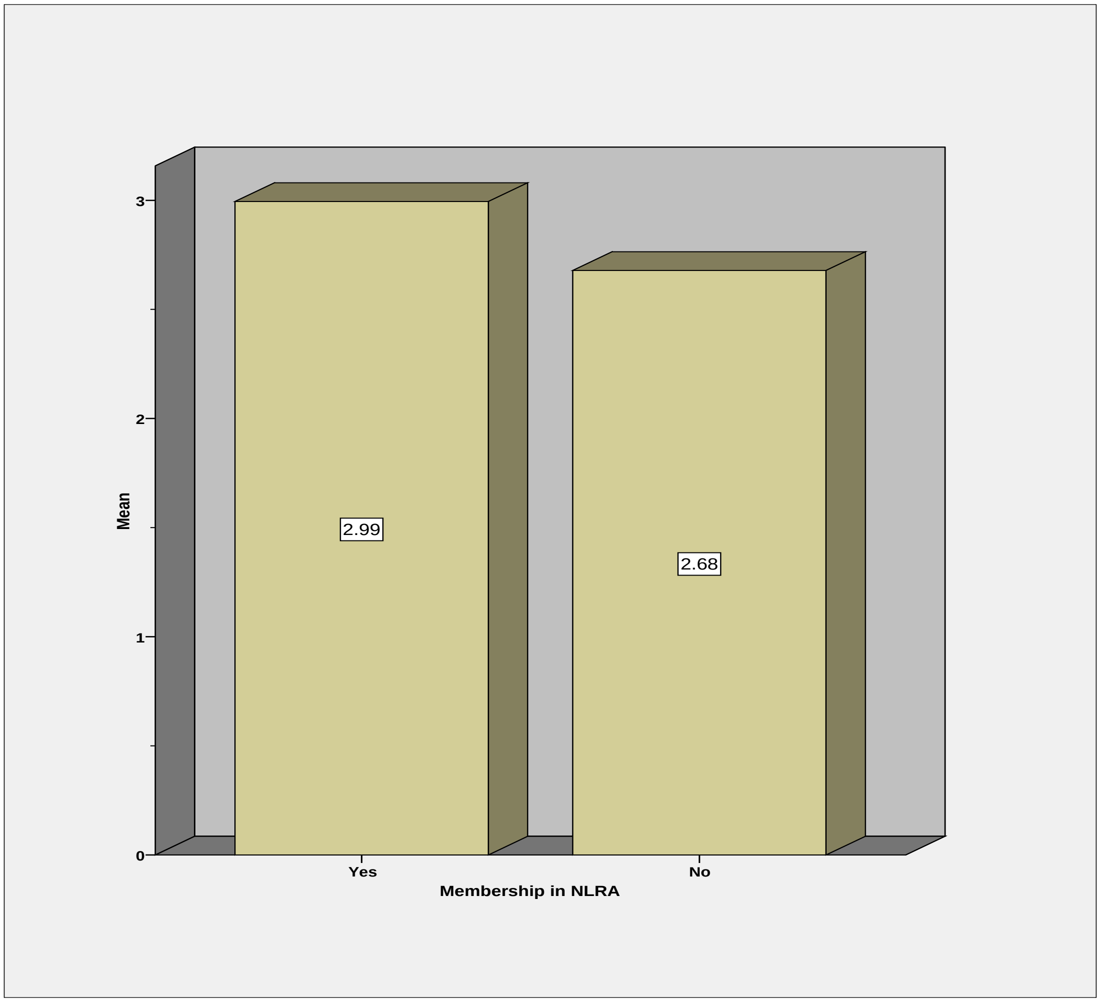
Mean Reported Frequency of Leaving Grass Clipping on Lawn Broken Down by Property Maintenance (1= Never, 2= Sometimes, 3= Often)



Those who reported hiring out their property maintenance, were slightly les likely to report leaving grass clippings on their lawns frequently.

Newfound Lake Region Association Members: Differences from the General Public
NLRA members had, as might be expected, a fairly different response set on a number of questions than the remainder of the sample, few of these response differences were surprising enough to report. The level of concern if electric wind turbines were installed on ridgelines however was somewhat higher; indicating, that NLRA members possible value the natural beauty of the area above possible overall environmental benefits.

Mean Reported Concern if Electric Wind Turbines Were Installed on Ridgelines Broken Down by NLRA Membership

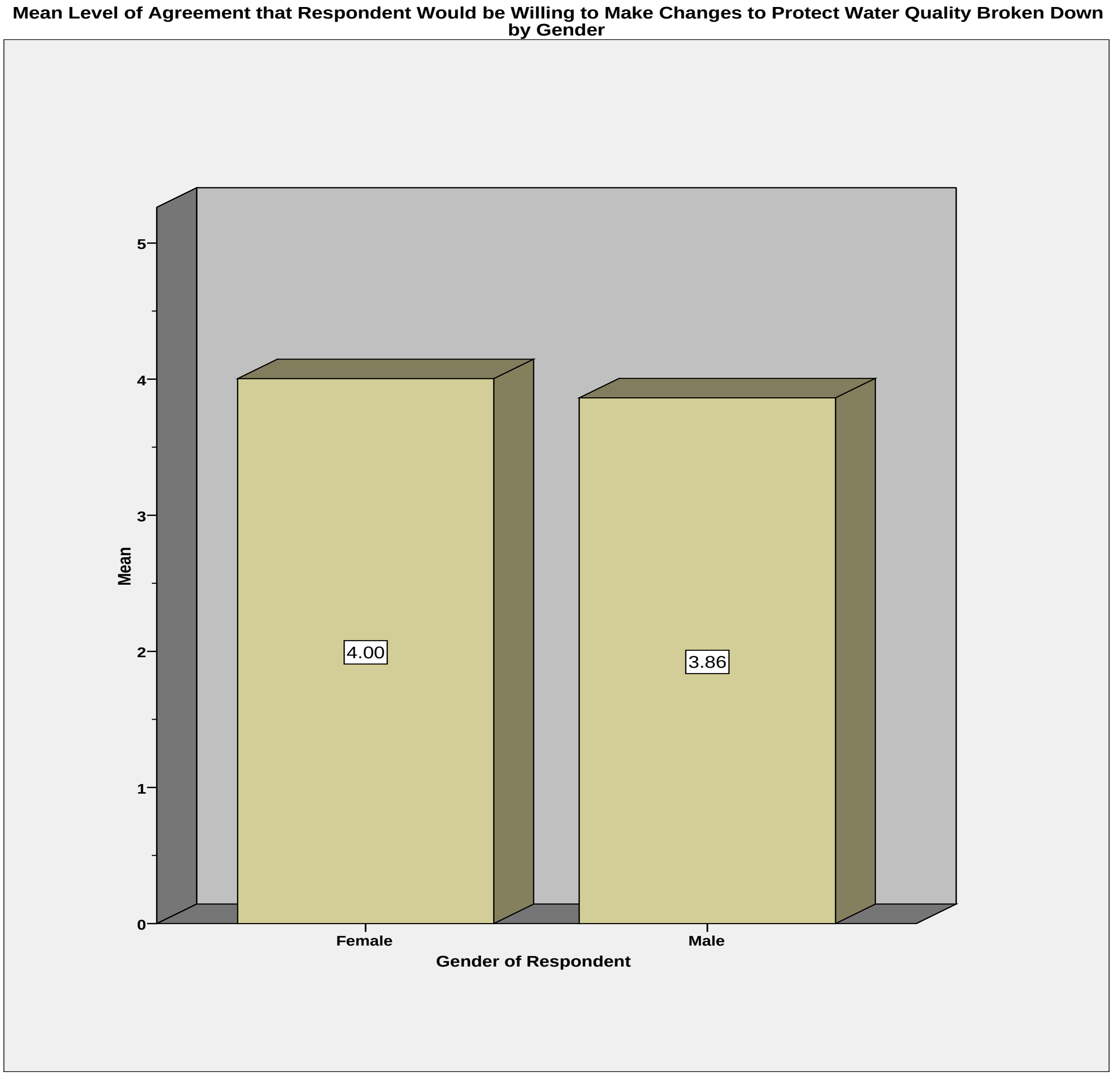


NLRA members indicated a slightly higher than average level of concern if electric wind turbines were installed on ridgelines.

Gender Differences in Responses:
Overall, females tended to respond with slightly more concern for environmental quality issues, felt that they had more impact on the watershed, and showed more willingness to change behaviors than males; however statistically significant differences in reported behaviors were very rare. Males and females also had differences of opinion generally in reference to the level at which regulations should be implemented, with women being more likely to favor the town level, and men the state.

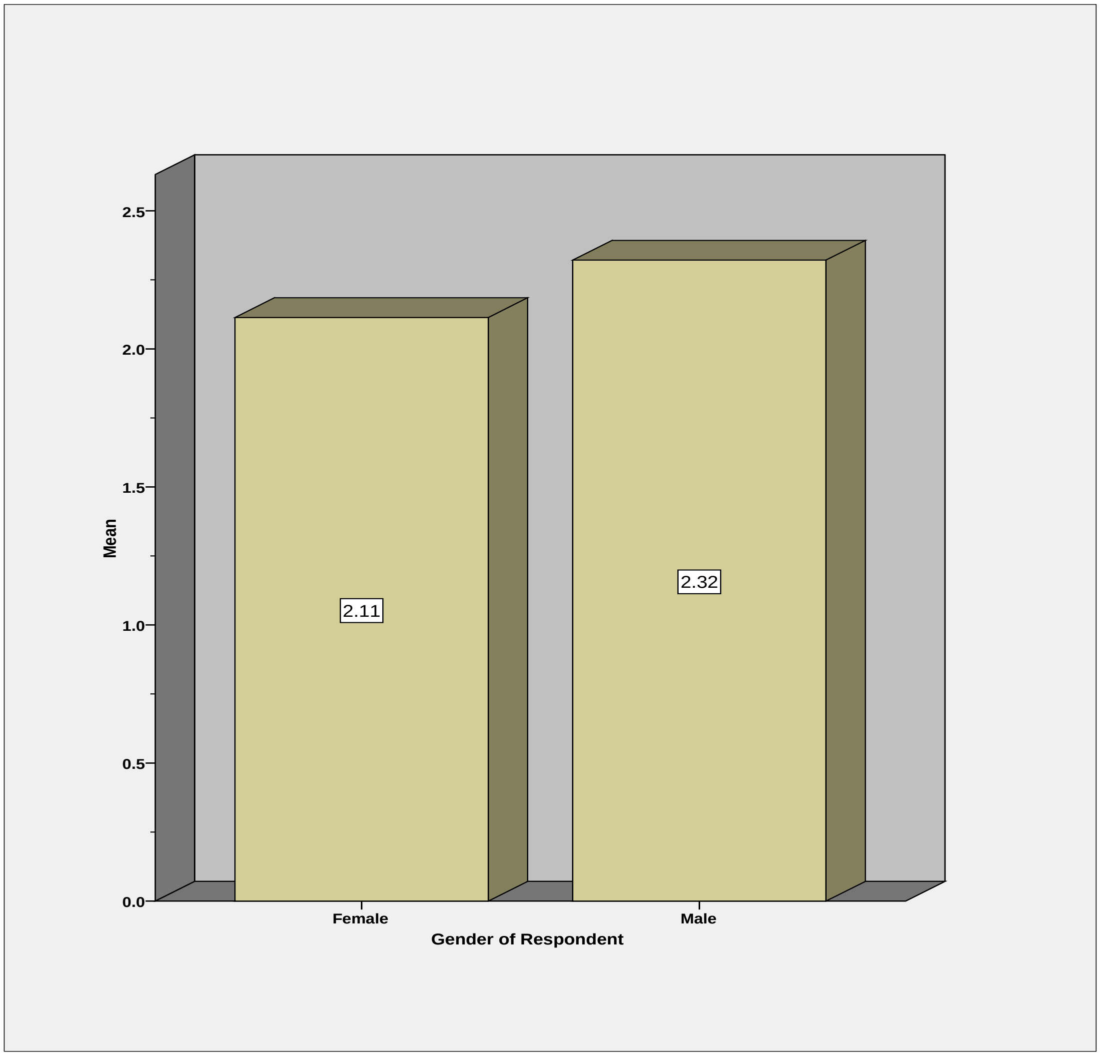
Women on the average agreed slightly more that the economic stability of the community depends on good water quality.

Women on the average disagreed more with the statement that their household does not have much impact on the watershed. Men averaged slightly above neutral (very slight agreement), women slightly below (very slight disagreement).



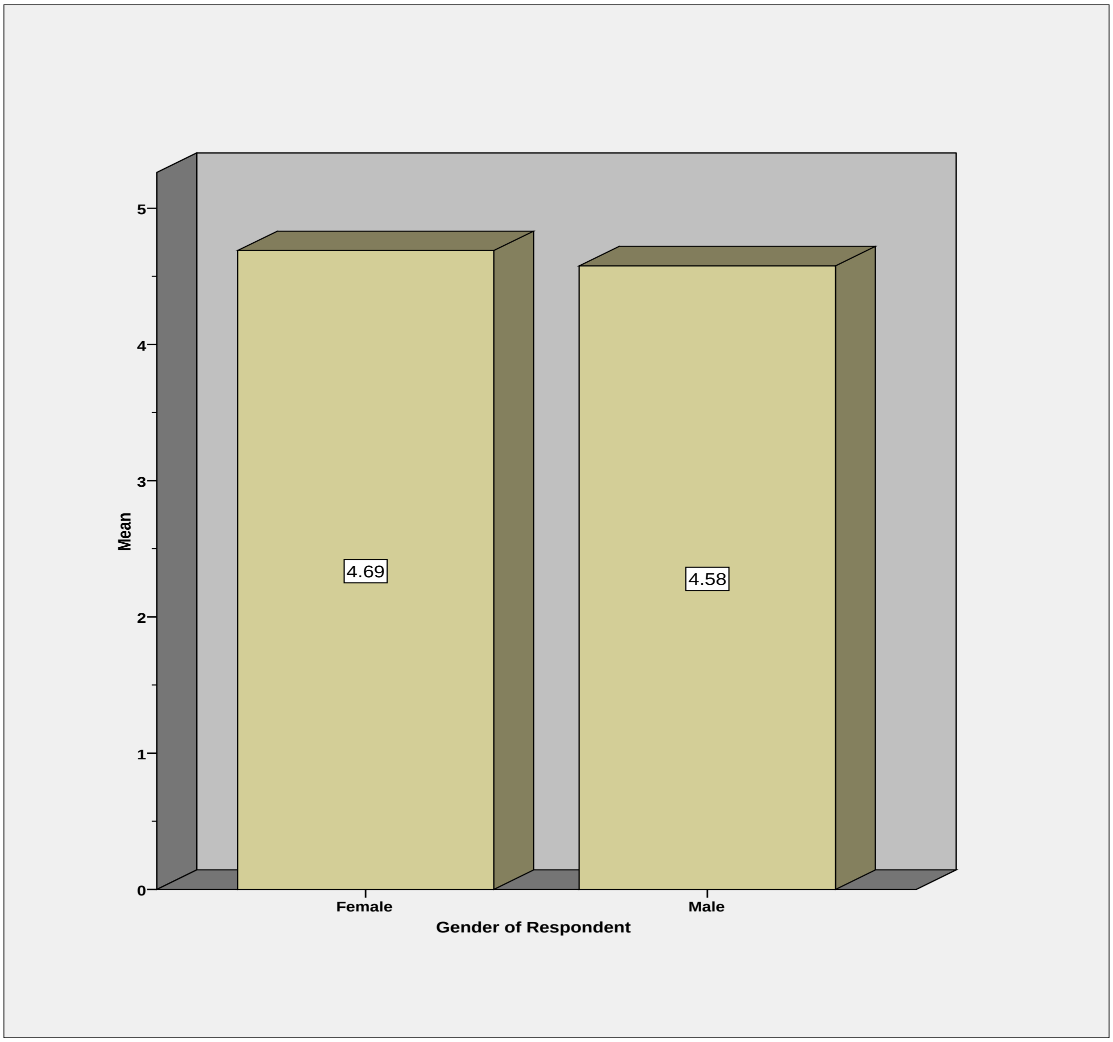
Women agreed slightly more that they would be willing to make changes to protect water quality on average than did men.

Mean Level of Agreement that Laws Protecting Water Quality are too Strict Broken Down by Gender



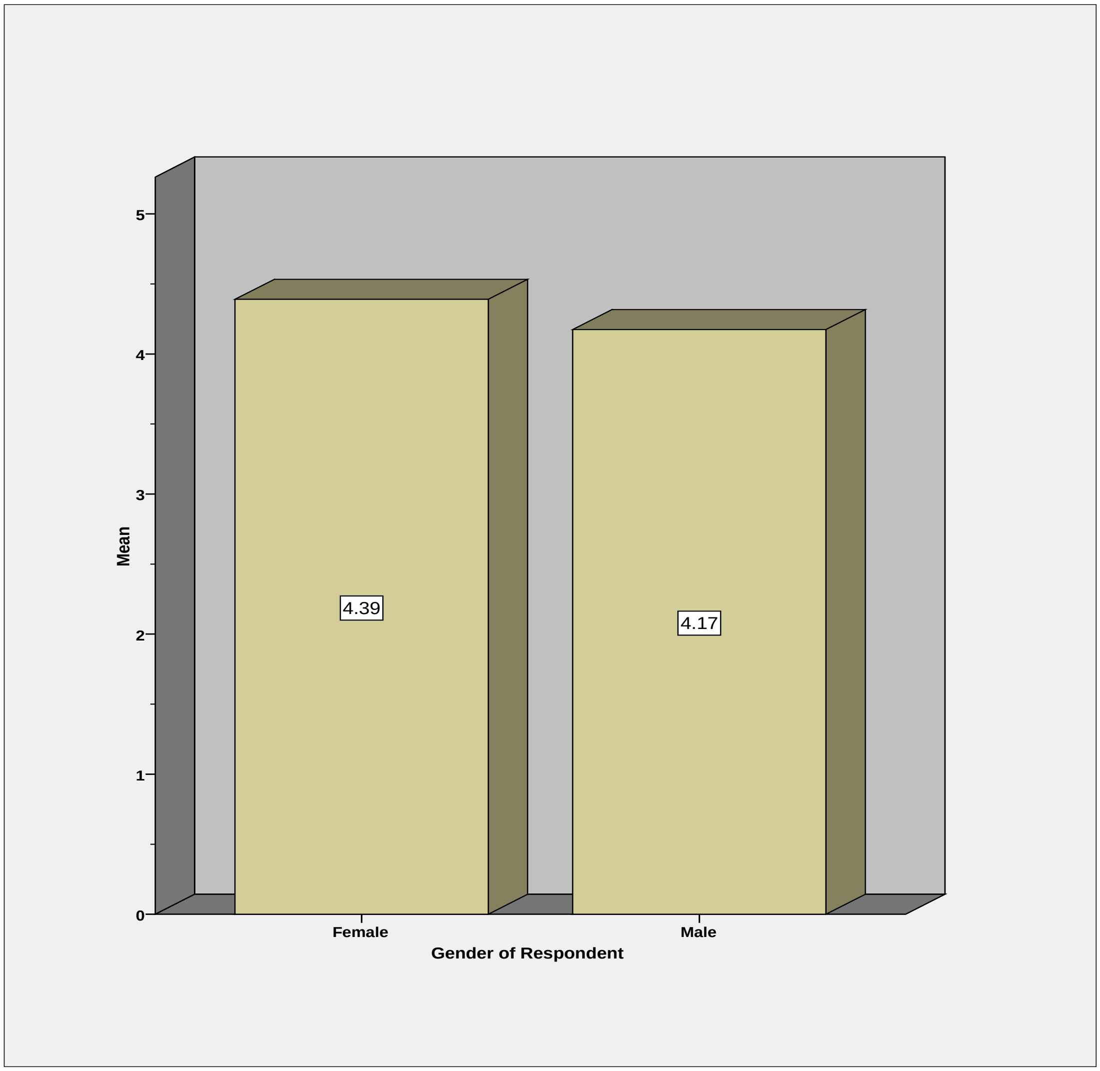
While both men and women generally indicated that they did not feel regulations protecting water quality are too strict, women exhibited this belief to a slightly higher degree on the average.

Mean Level of Importance that Open Spaces and Natural Areas Exist for Recreation Broken Down by Gender



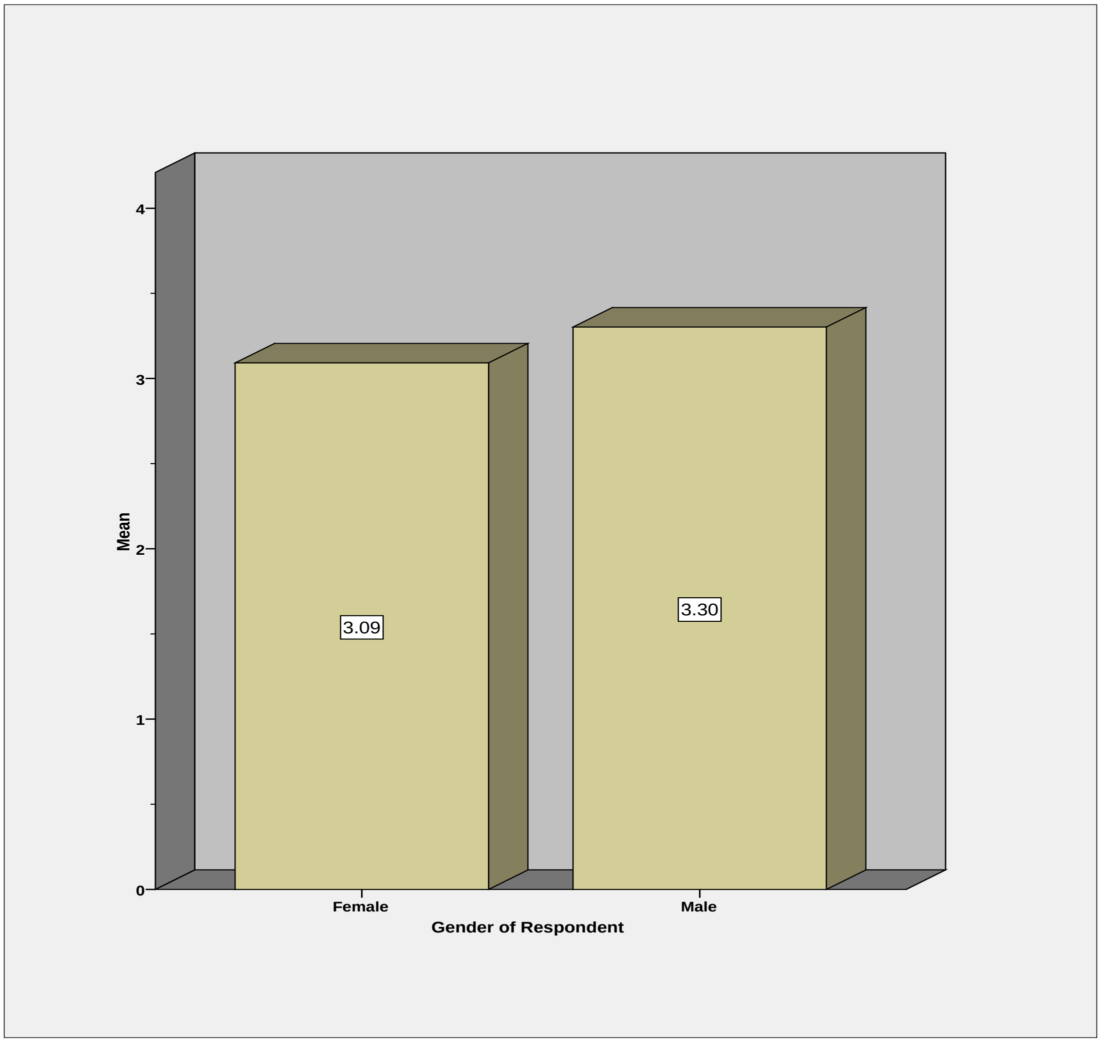
As with many environmental beliefs, women placed greater importance on the existence of open spaces and natural areas than men.

Mean Level of Agreement that the Lake is a Family Place Broken Down by Gender



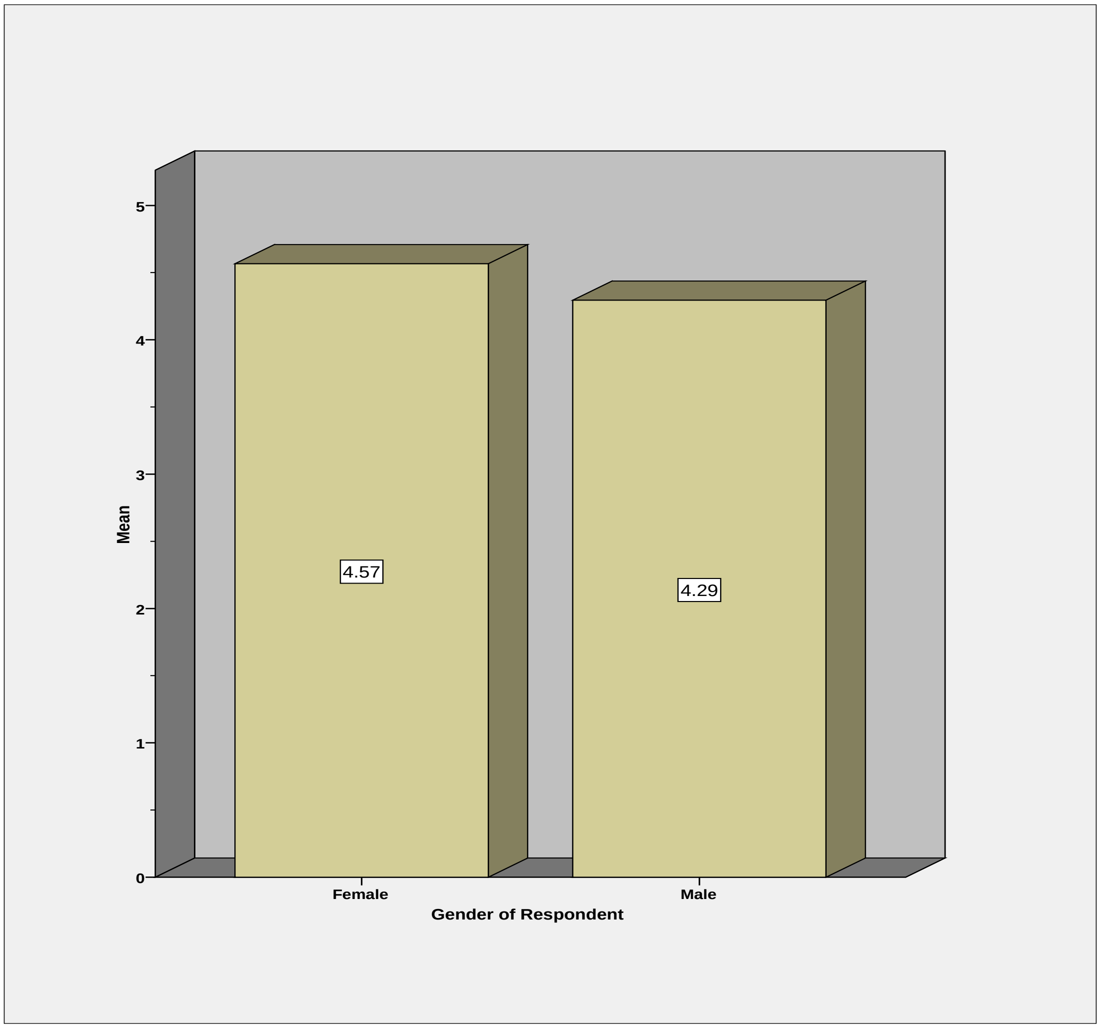
Women on the average agreed more that Newfound Lake is a family place than men.

Mean Rating of Tap Water in Respondent's Home Broken Down by Gender (1=Poor, 2=Fair, 3=Good, 4=Excellent)



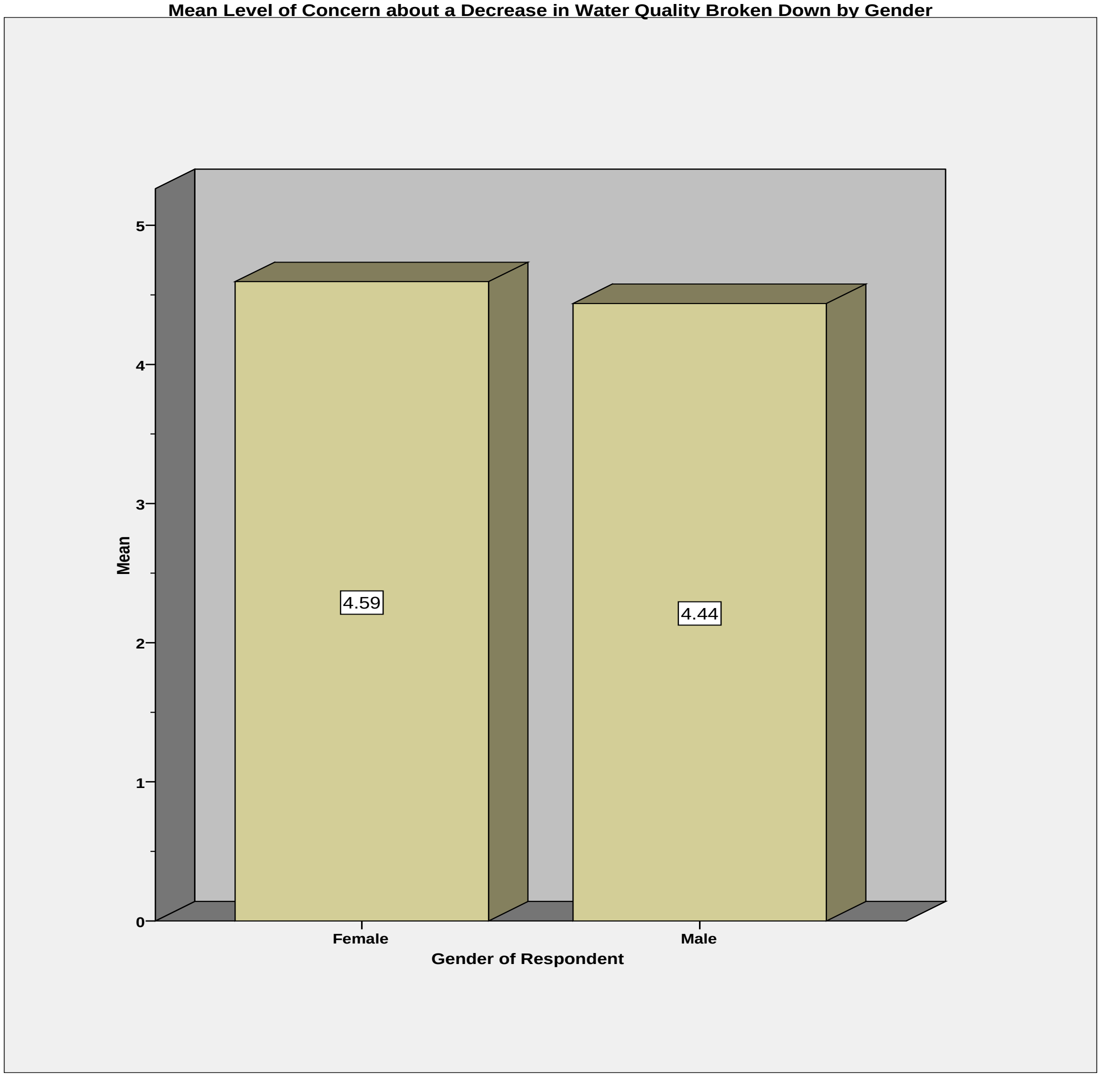
Women rated the tap water in their homes slightly lower than their male counterparts.

Mean Level of Concern about Loss of Open Space due to Residential Development Broken Down by Gender



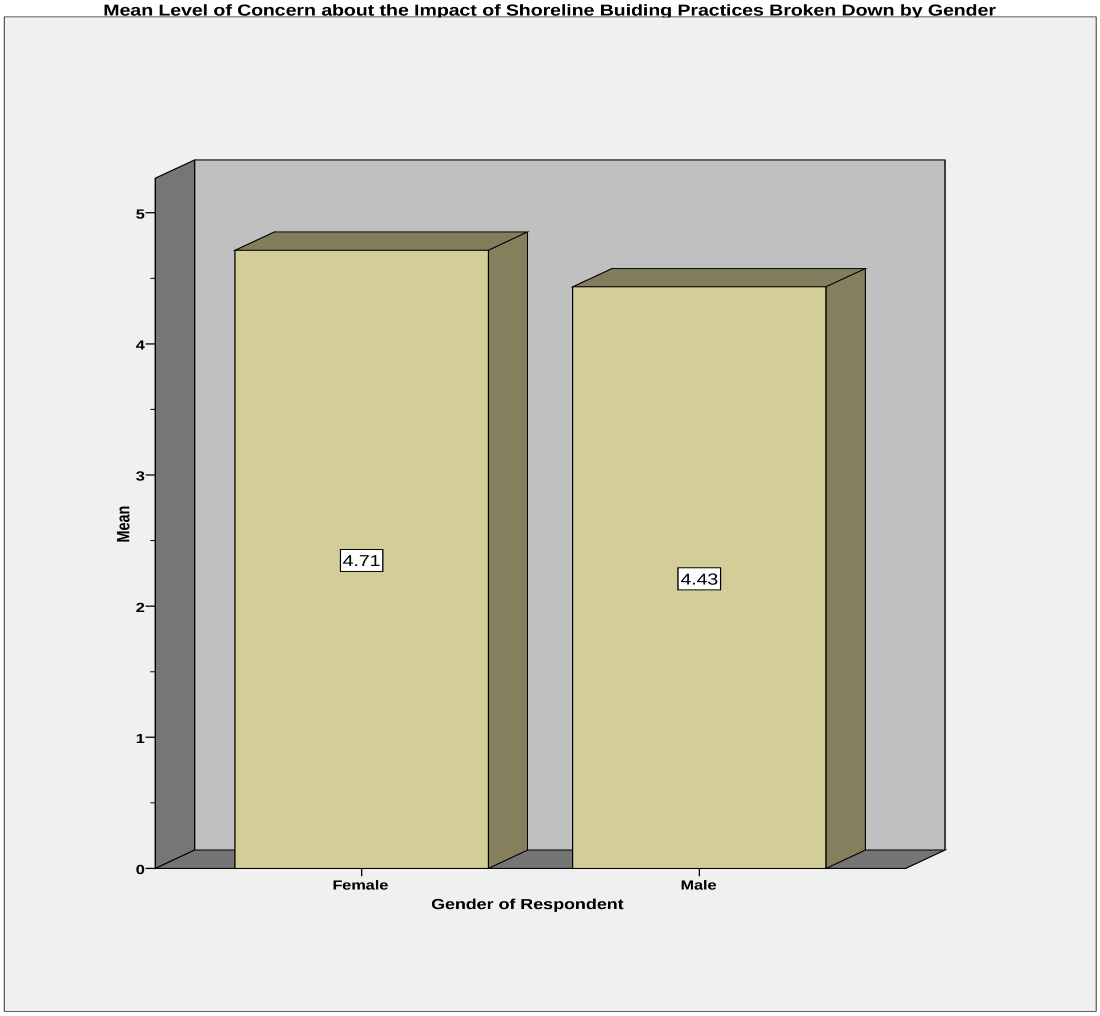
Female respondents indicated slightly more concern for loss of open space than male respondents.

Mean Level of Concern about a Decrease in Water Quality Broken Down by Gender



Females indicated a slightly higher average level of concern for potential decreases in water quality than males.

Mean Level of Concern about the Impact of Shoreline Buiding Practices Broken Down by Gender

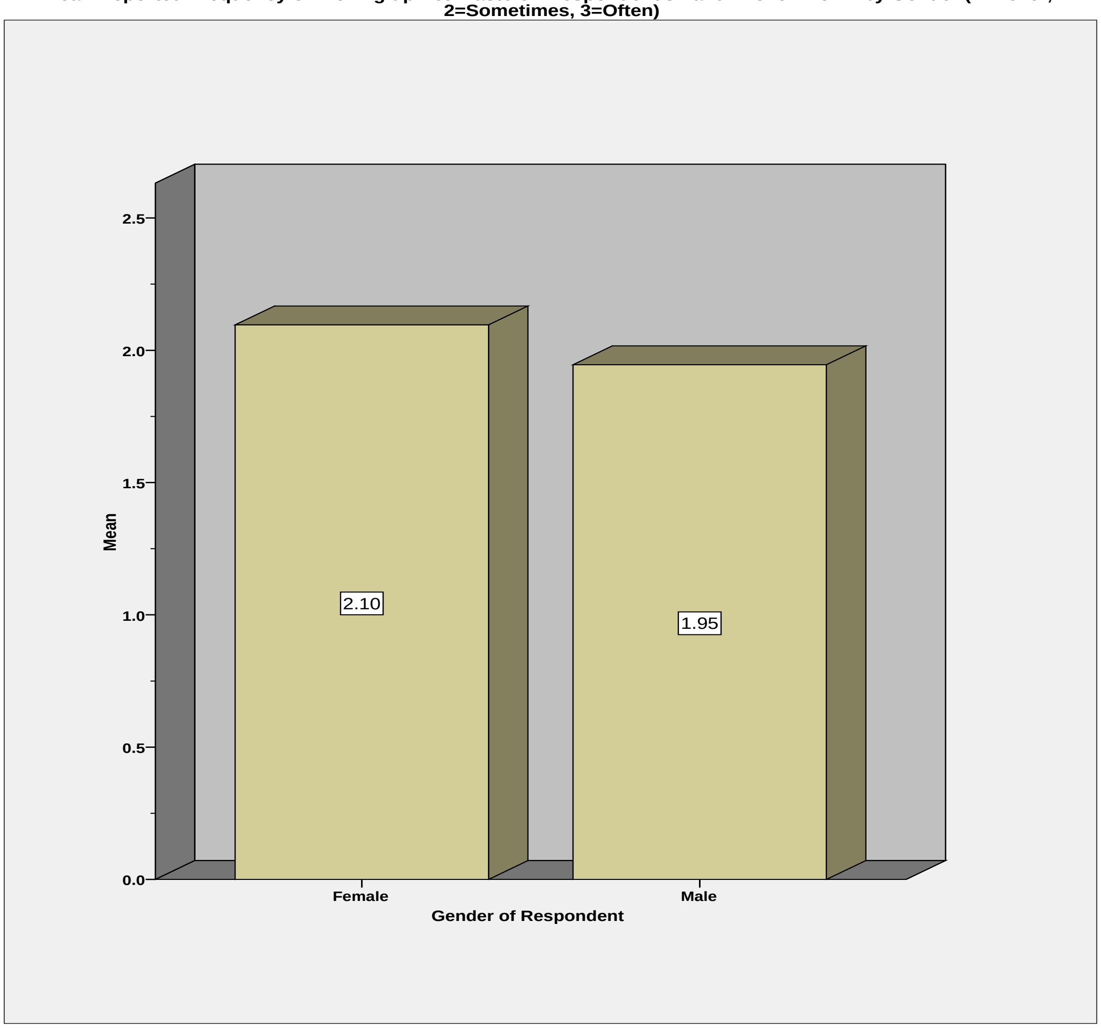


Women showed greater mean level of concern for the impacts of shoreline building practices.

Mean Level of Concern about Discharge of Septic Waste Broken Down by Gender

Discharge of septic waste was of slightly greater concern on the average to women than men.

Mean Reported Frequency of Picking up Pet Waste on Respondent's Land Broken Down by Gender (1=Never, 2=Sometimes, 3=Often)

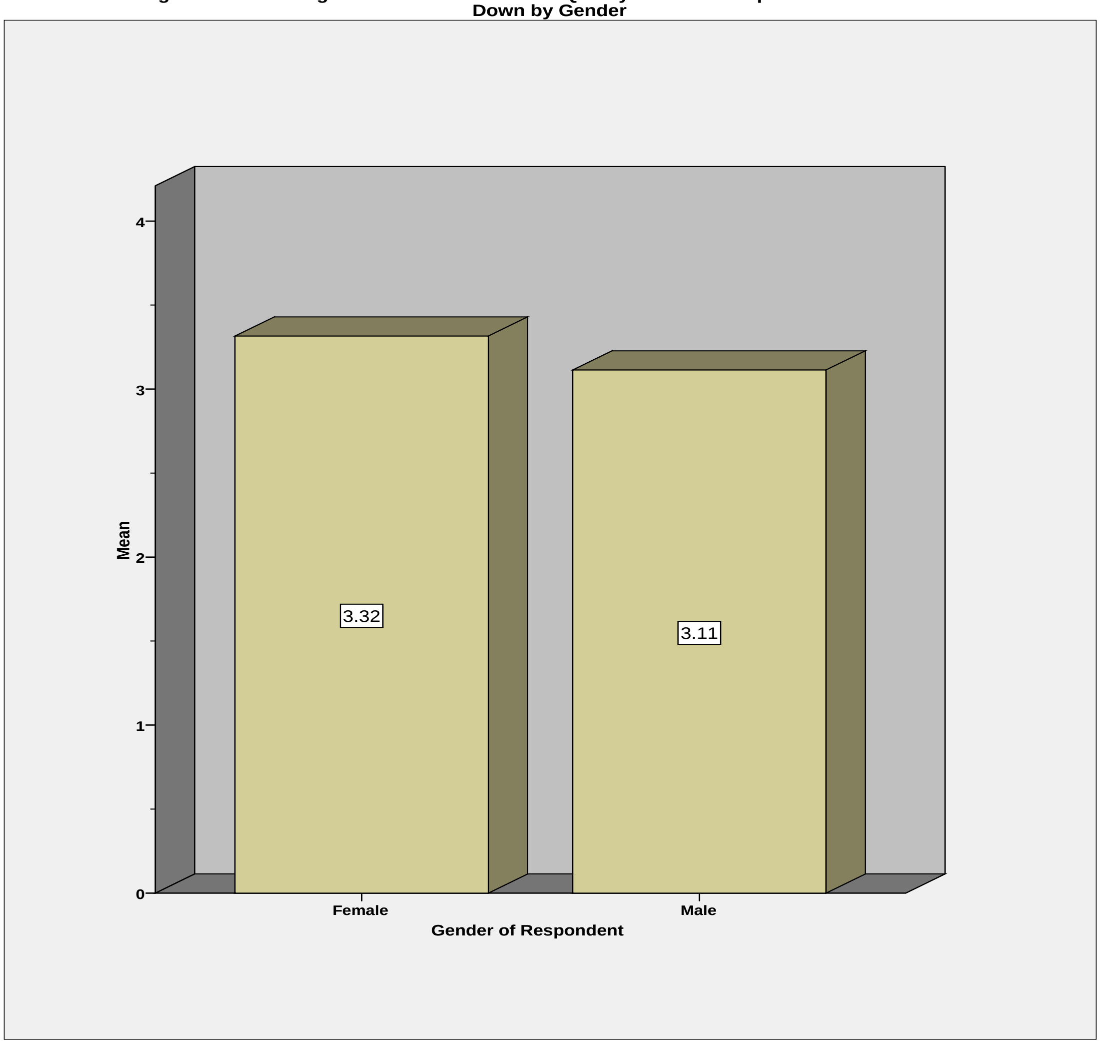


The only significant and relevant difference in reported environmentally responsible behaviors between males and females existed in the cleaning up of pet waste; which on the average women reported doing slightly more often than men.

Mean Level of Agreement that Regulations to Protect Water Quality Should be Implemented at the State Level Broken Down by Gender

Men on the average tended to agree that regulations to protect the watershed should be implemented at the state level, while women on the average responded with slightly lower levels of agreement.

Mean Level of Agreement that Regulations to Protect Water Quality Should be Implemented at the Town Level Broken Down by Gender

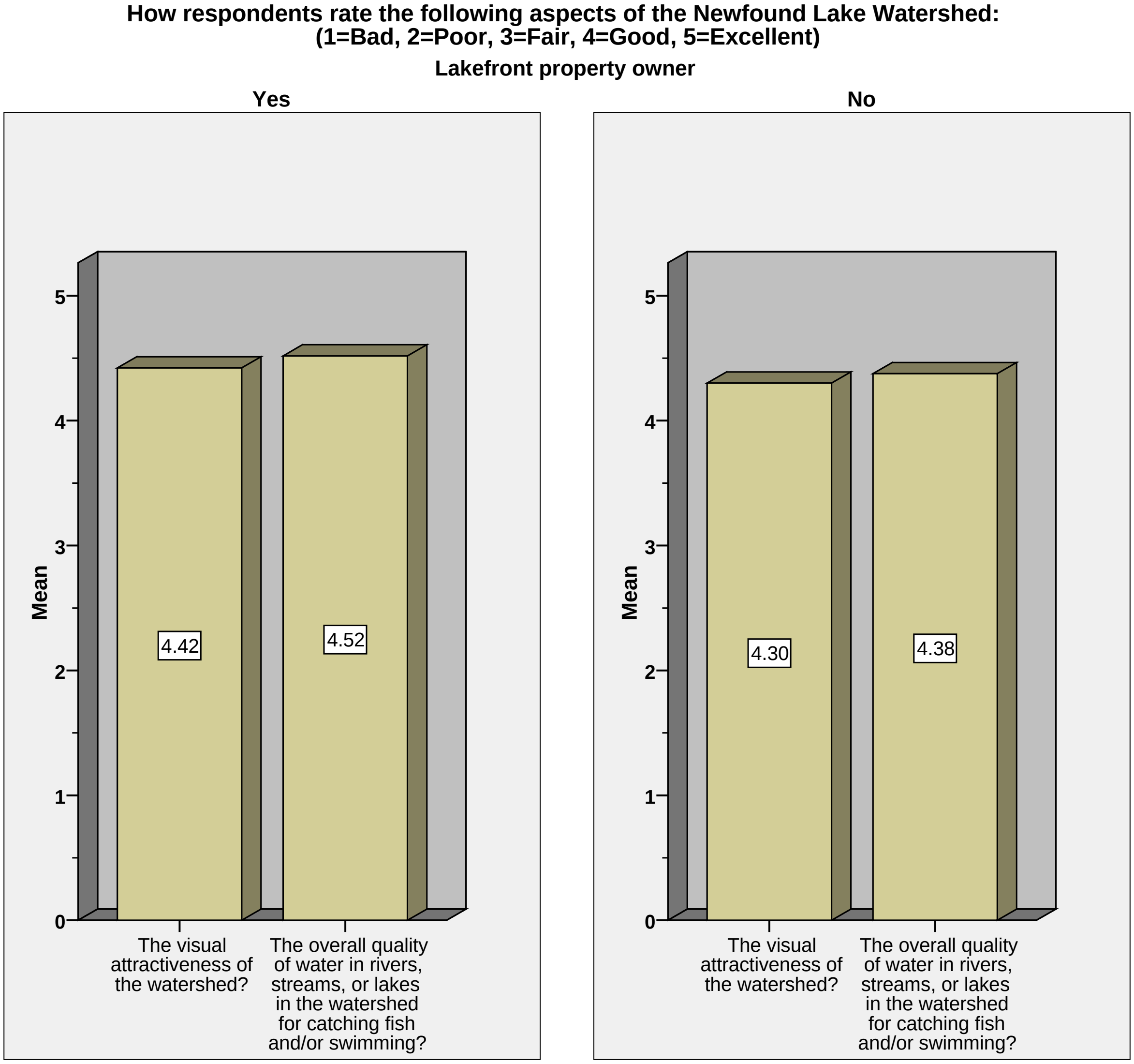


Women agreed slightly more than men on the average that the town level is the right one for regulations to protect water quality.

T-test analyses of differences between values and desires of lakefront and non-lakefront property owners

Statistical analyses were preformed to determine if significant differences were present between lakefront and non-lakefront property owners. Certain sources of non-point source degradation, which pose significant threats to water quality in the Newfound Lake Watershed, may be best mitigated with varying approaches to these two factions. For example shore land erosion and runoff is more crucial to address around the lake while the improper discharge of urban runoff through storm drains is pertinent throughout the watershed. Ideas to protect the resources in the watershed have included stewardship of natural resources through education and technical assistance, and improved regulations and enforcement; to be effective, it is important identify differences between property owners and adapt these goals for varying locations. The charts below report statistically significant differences between the mean responses of lakefront and non-lakefront property owners for each section of the survey – only statistically significant findings are reported. This series of analyses were conducted using t-tests for equality of means.

Significant relationships between how lakefront and non-lakefront property owners rated the visual attractiveness of the watershed and the overall quality of water in rivers, streams, or lakes for catching fish and/or swimming existed. In both cases lakefront property owners rated the watershed as it exists now more favorably.



Levels of agreement with statements about the watershed were statistically significant different for lakefront and non-lakefront property owners. Lakefront property owners more strongly agreed with the following statements about the watershed:

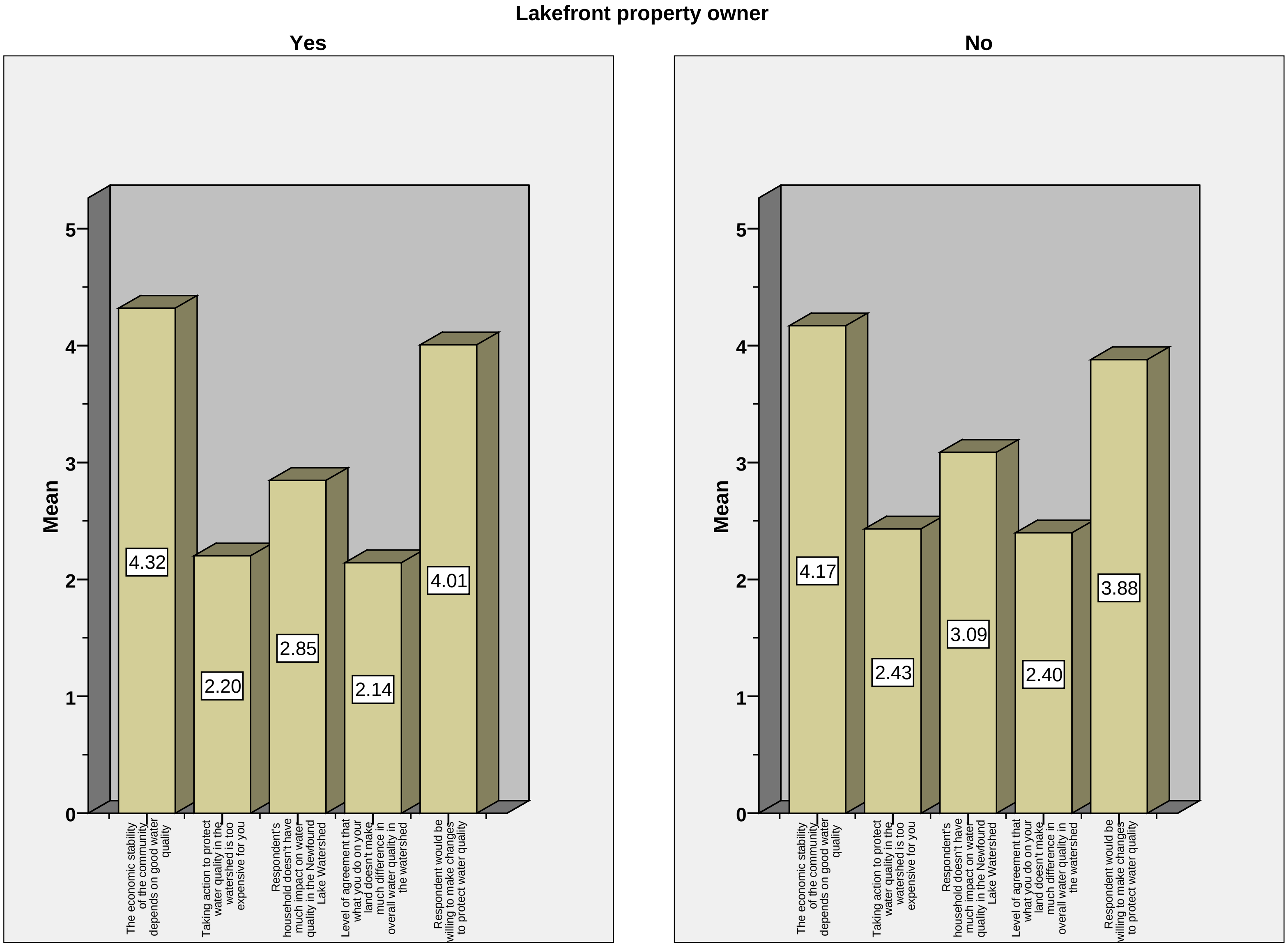
- The economic stability of my community depends on good water quality.
- I would be willing to make changes to protect water quality.

There were lower levels of agreement amongst lakefront property owners with the following statements:

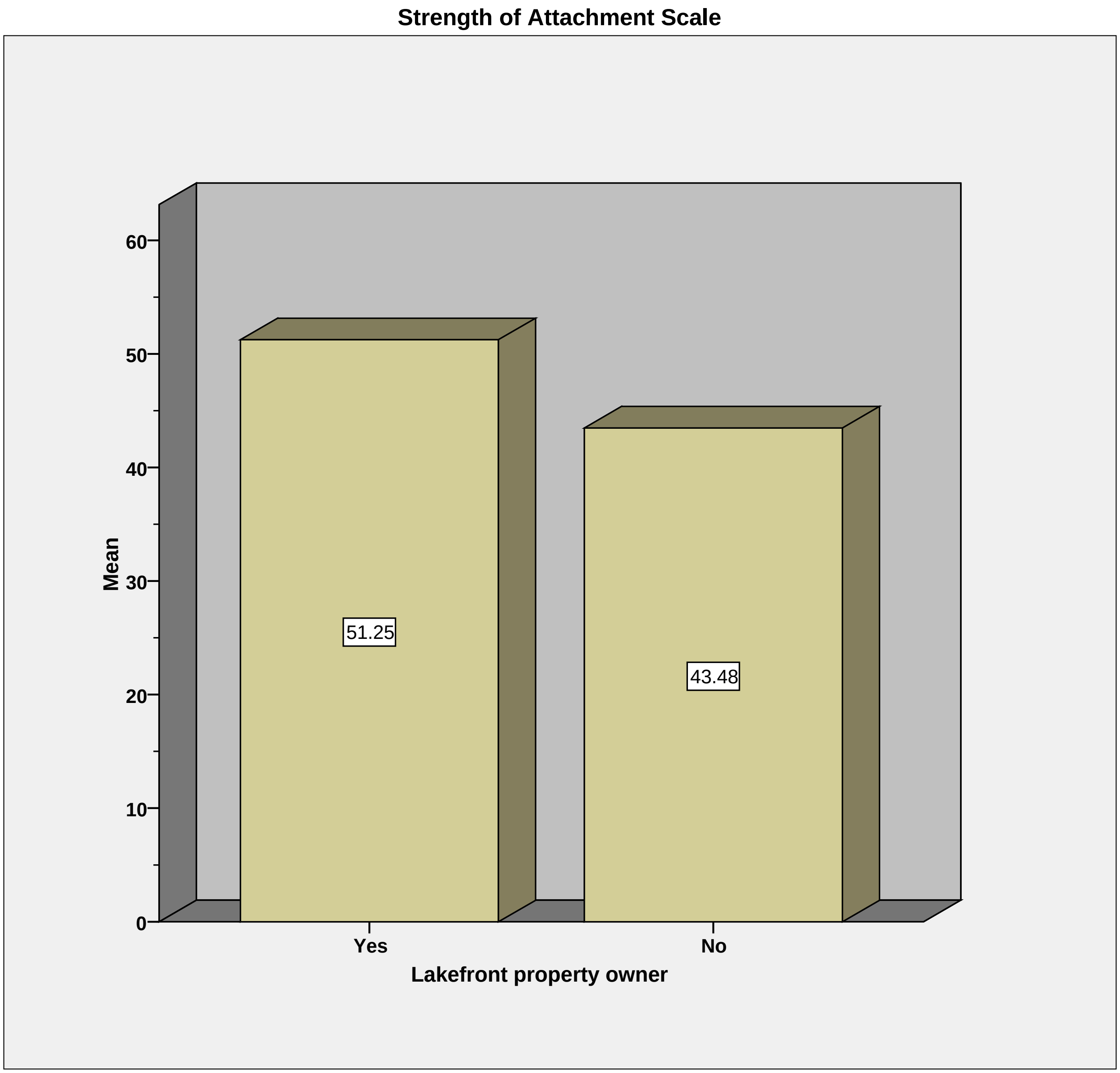
- Taking action to protect water quality in the watershed is too expensive for me.
- My household doesn't have much impact on water quality in the Newfound Lake Watershed.
- What I do on my land doesn't make much difference in overall water quality in the watershed.

These differences highlight a higher awareness amongst lakefront property owners in regards to their impact on water quality and a greater willingness to make changes despite cost.

Respondent's level of agreement with the following statements about the Newfound Lake Watershed: (1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly Agree)



The strength of attachment to the region is based on a scale of 9 – 63; 9 being the weakest and 63 being the strongest. The mean strength of attachment amongst lakefront property owners was 51.25 and the mean for non-lakefront property owners was 43.48, a statistically significant difference. Strength of attachment can often translate into higher levels of stewardship and environmentally responsible behavior.



Levels of agreement with many statements about what kind of place Newfound Lake is, were statistically significant different for lakefront and non-lakefront property owners. Lakefront property owners more strongly agreed with the following statements about the lake:

The lake …

- Is a scenic place.
- Is a family place.
- Is a place of high environmental quality.
- Is a place to escape from civilization,
- Is very peaceful.
- Has a lot of public access.

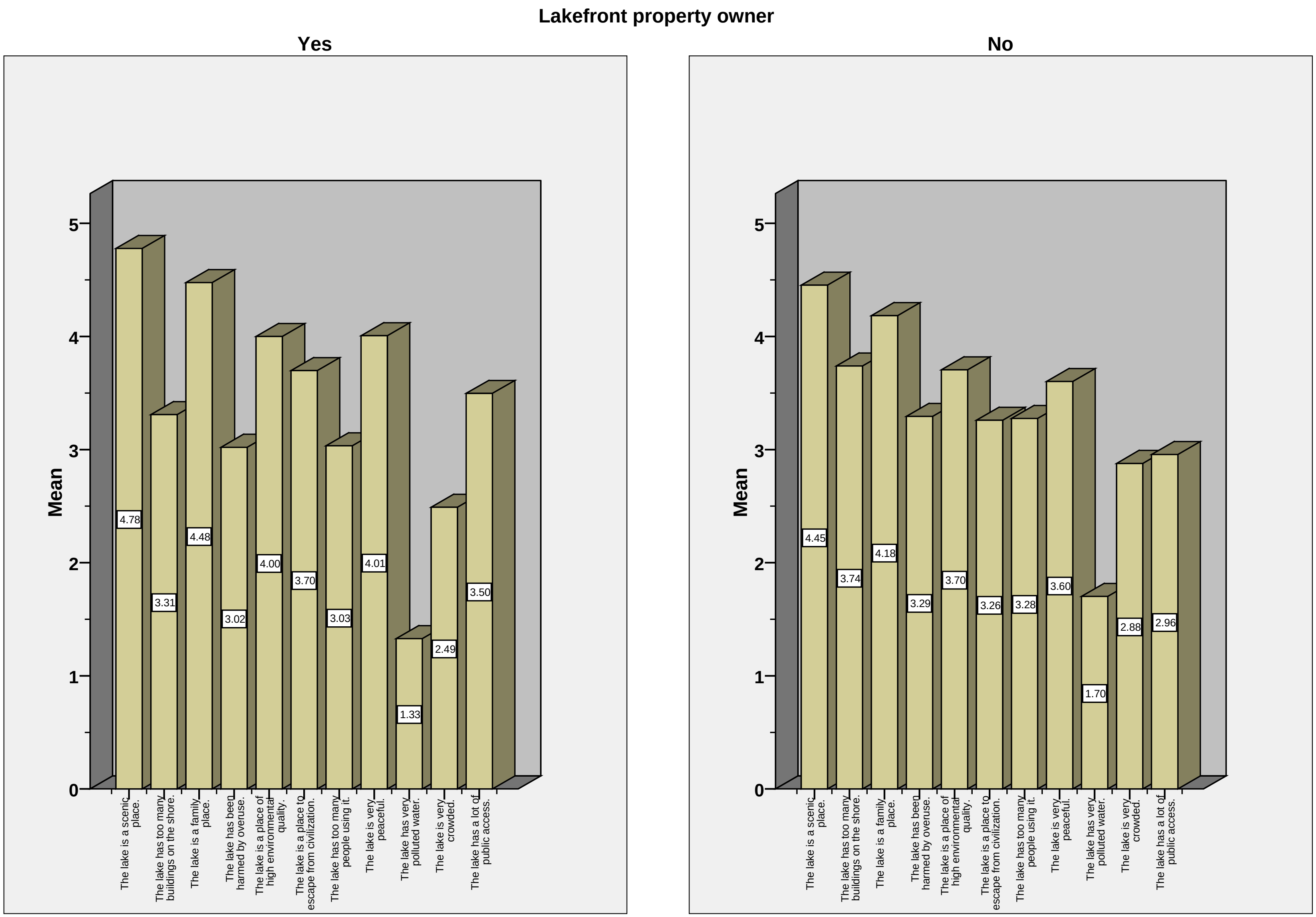
There were lower levels of agreement amongst lakefront property owners with the following statements:

The lake…

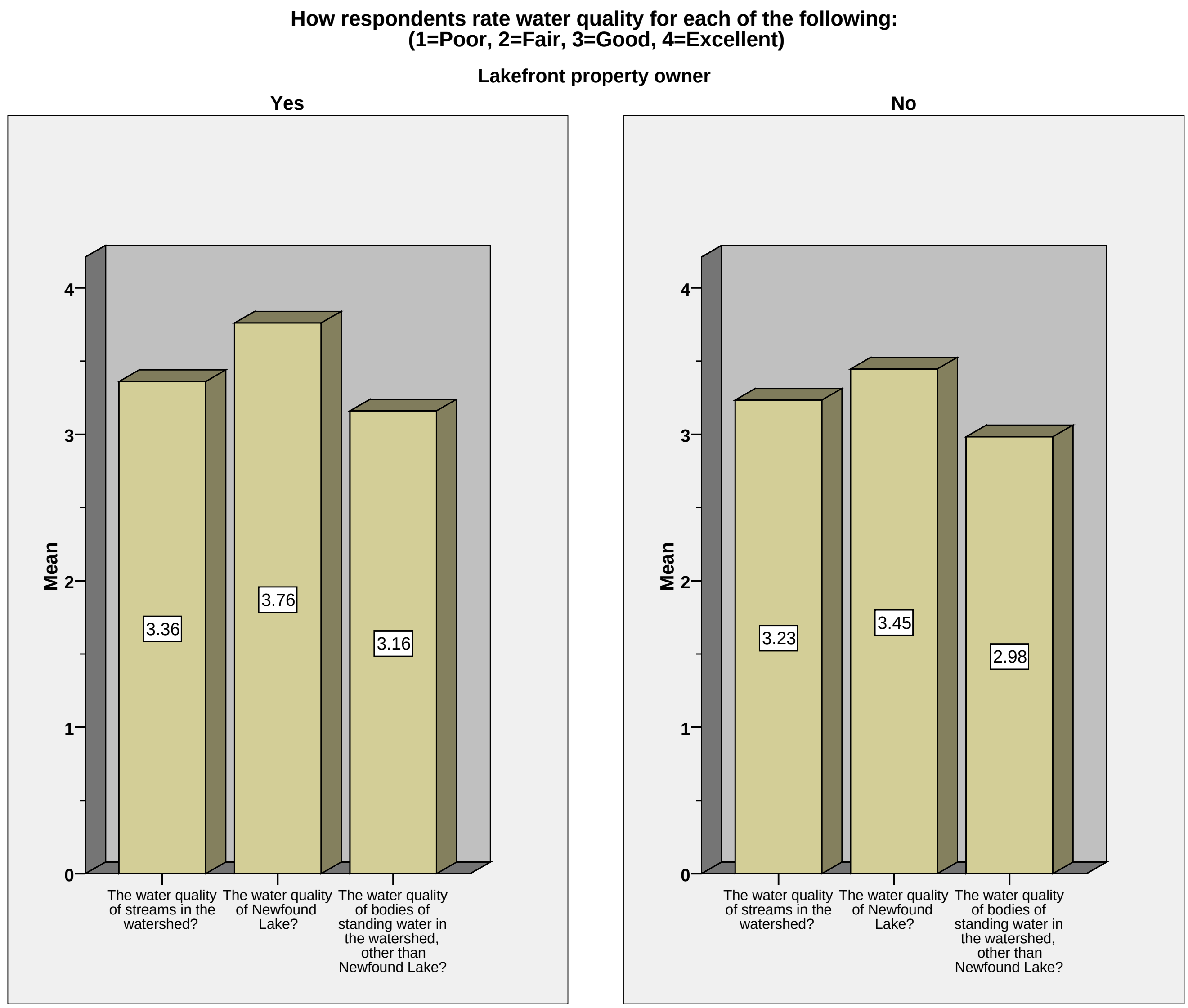
- Has too many buildings on the shore.
- Has been harmed by overuse.
- Has too many people using it.
- Has very polluted water.
- Is very crowded.

The differences in means highlight important differences in how lakefront and non-lakefront property owners view the lake. Lakefront property owners appear to view the lake as a retreat; the bivariate demographic section shows that lakefront property owners are more seasonal than non-lakefront. It is important to note that non-lakefront property owners had a mean response of 2.96 to the statement, "The lake has a lot of public access," meaning there was a lot of disagreement with the statement. Lakefront owners agreed less with statements that pertain to overuse, crowding, and degradation.

Respondent's level of agreement with statements about Newfound Lake:
(1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly Agree)



Lakefront property owners rate water quality of streams in the watershed, Newfound Lake, and bodies of standing water significantly higher than non-lakefront property owners. Lakefront property owners consistently rate quality of the region higher than non-lakefront owners.

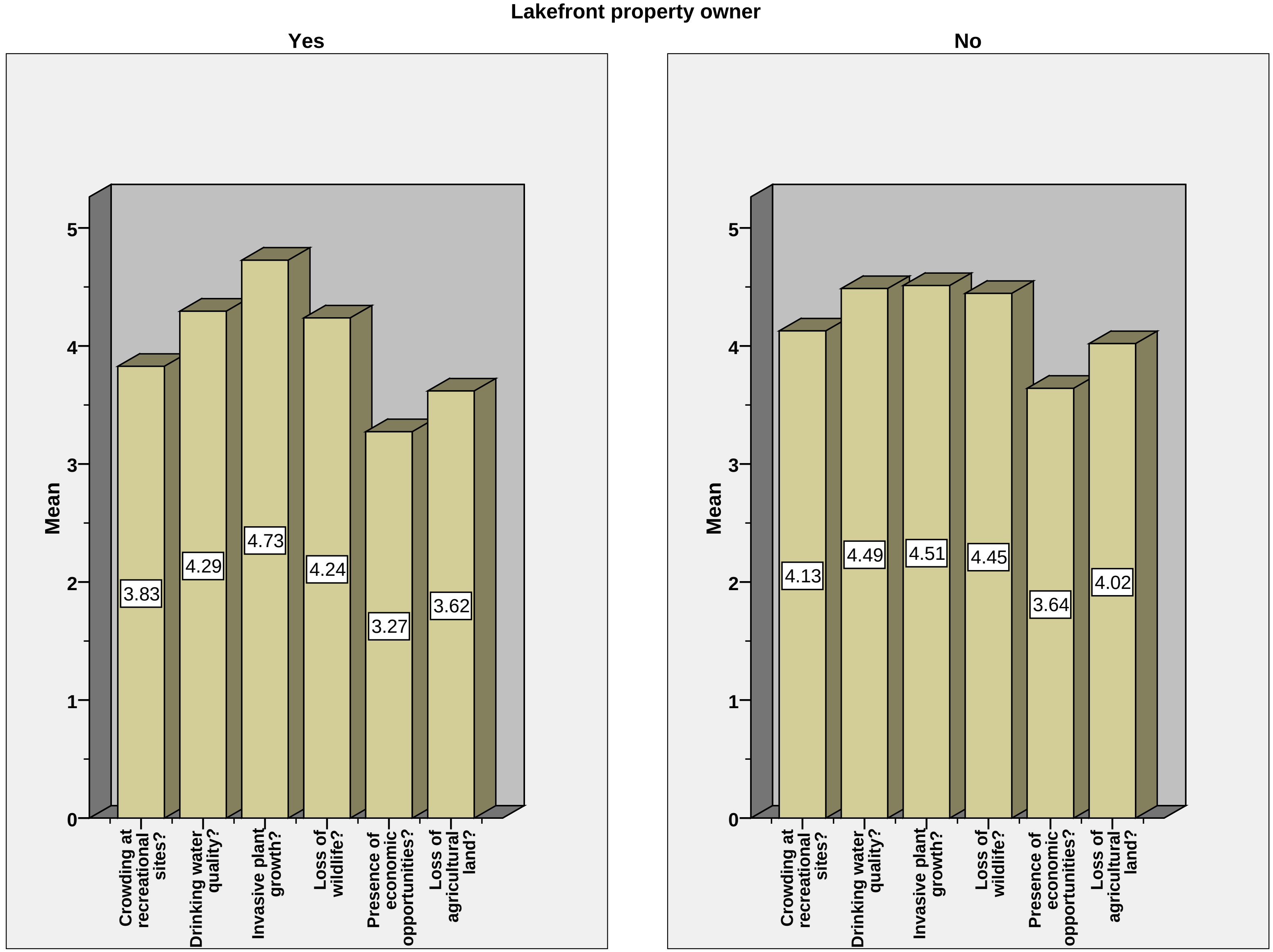


There were some statistically significant differences in the levels of concern with certain issues in the watershed. Non-lakefront property owners are more concerned than lakefront owners with the following issues:

- Crowding at recreational sites
- Drinking water quality
- Loss of wildlife
- The presence of economic opportunities
- Loss of agricultural land

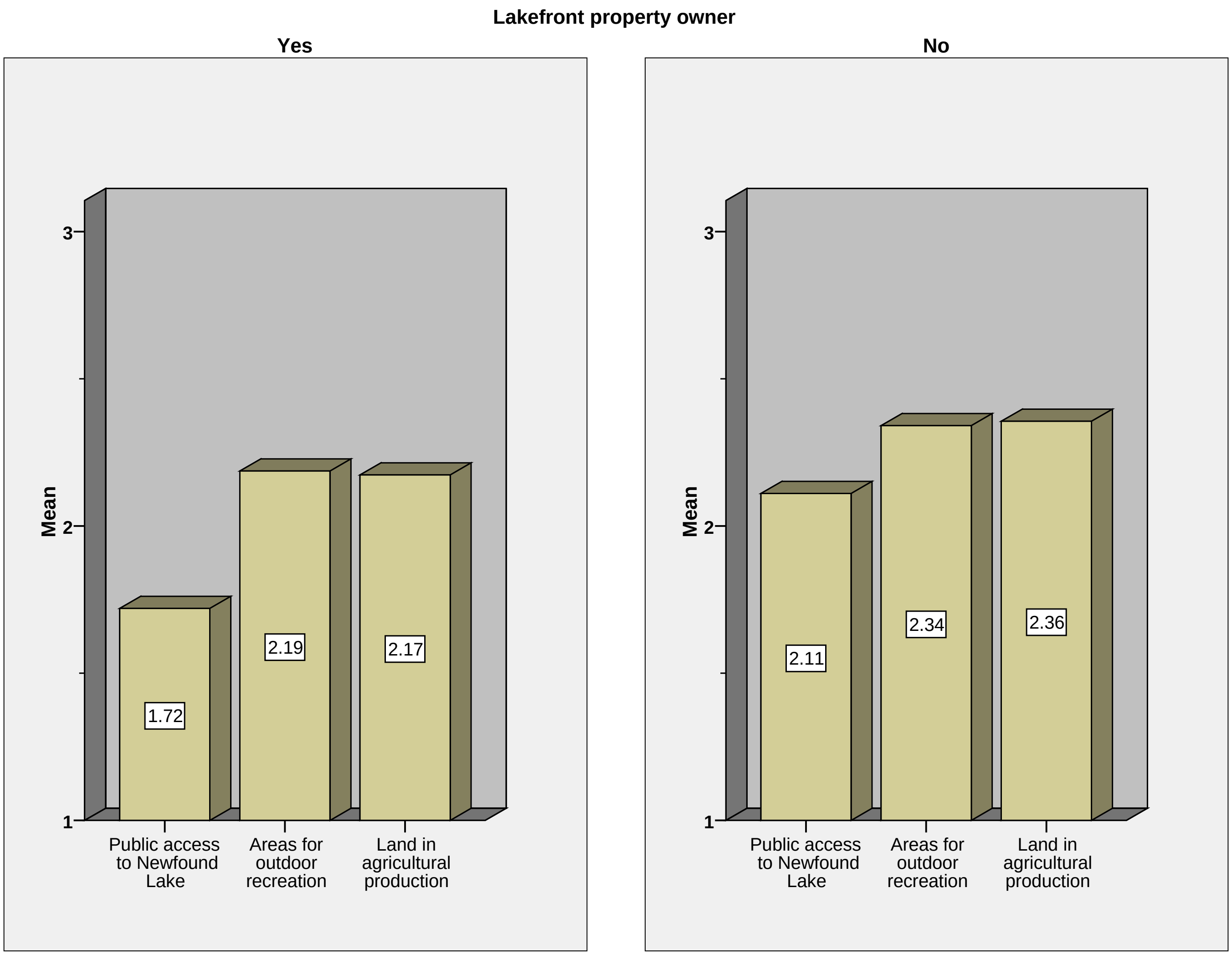
Lakefront property owners were more concerned with invasive plant growth than non-lakefront.

Respondents' levels of concern about the following issues in the Newfound Lake Watershed: (1=Not at all Concerned to 5=Very Concerned)

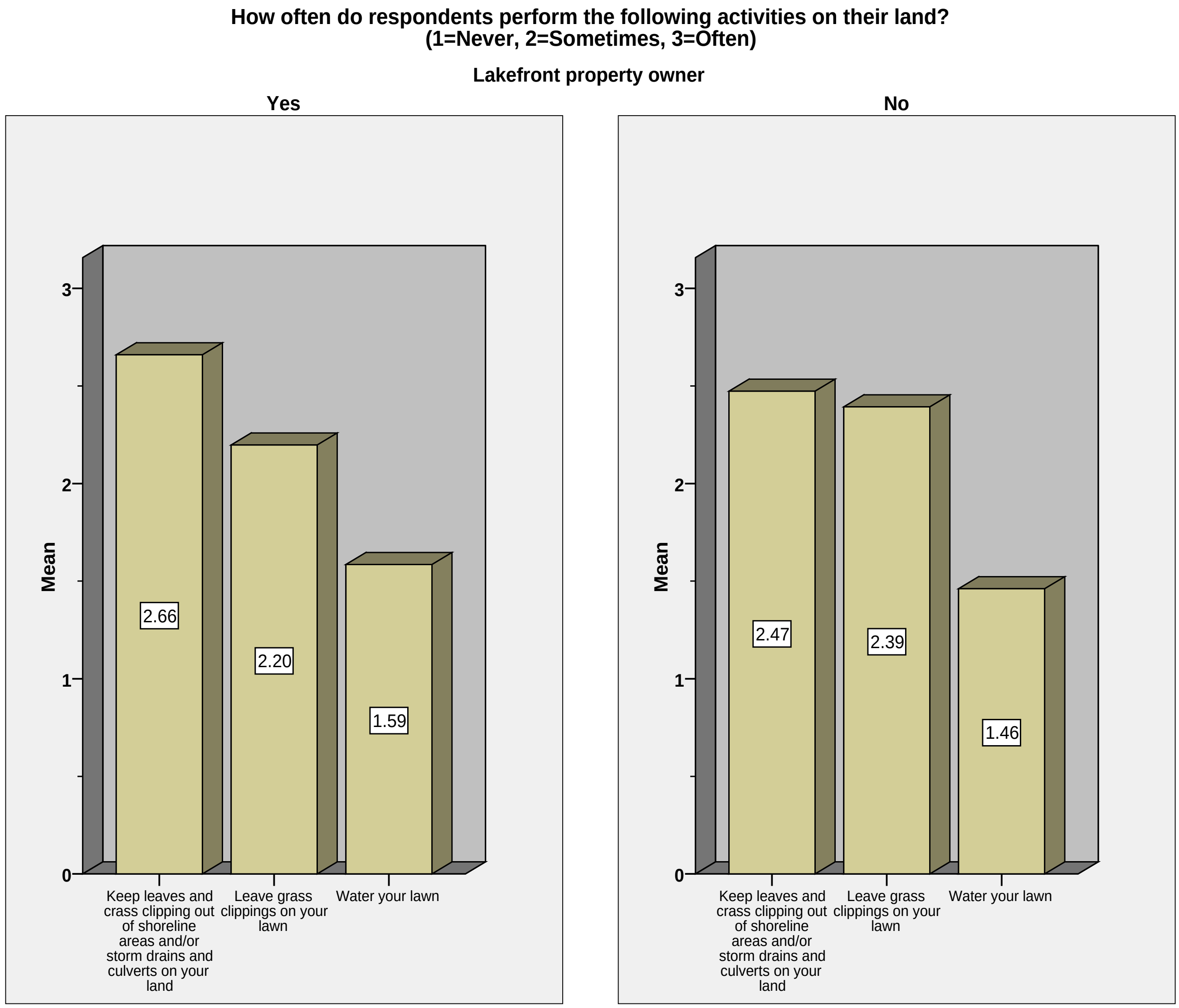


Non-lakefront property owners indicated a greater desire to see more public access to Newfound Lake, more areas for outdoor recreation, and more land in agricultural production than the lakefront property owners. Lakefront property owners may be more satisfied with their access to the lake and their recreational opportunities than the non-lakefront population. Due to the seasonality of the lakefront population, agricultural land may be of less importance.

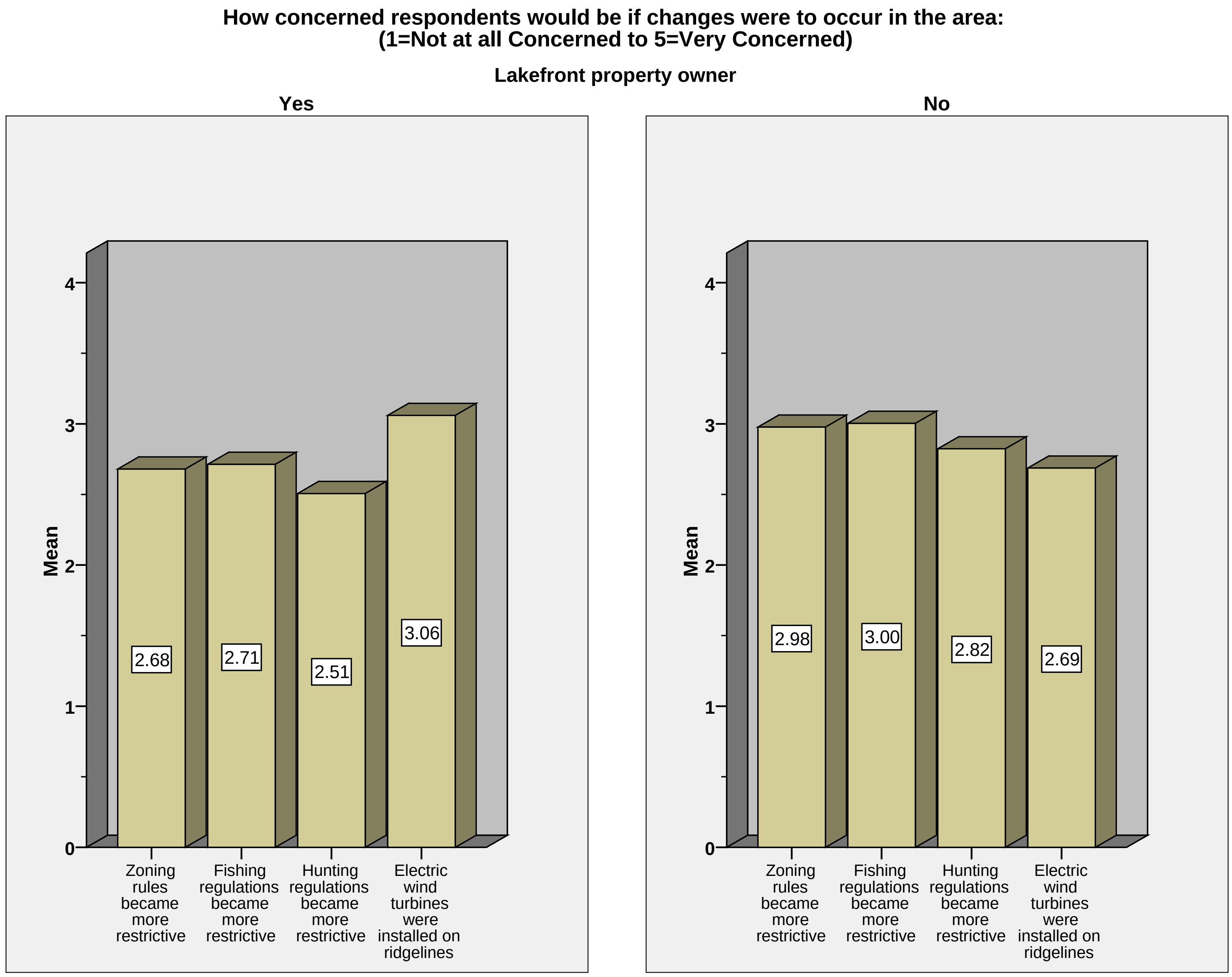
In the future, how much of the following land uses would respondents like to see in the watershed? (1=Less, 2=About the Same, 3=More)



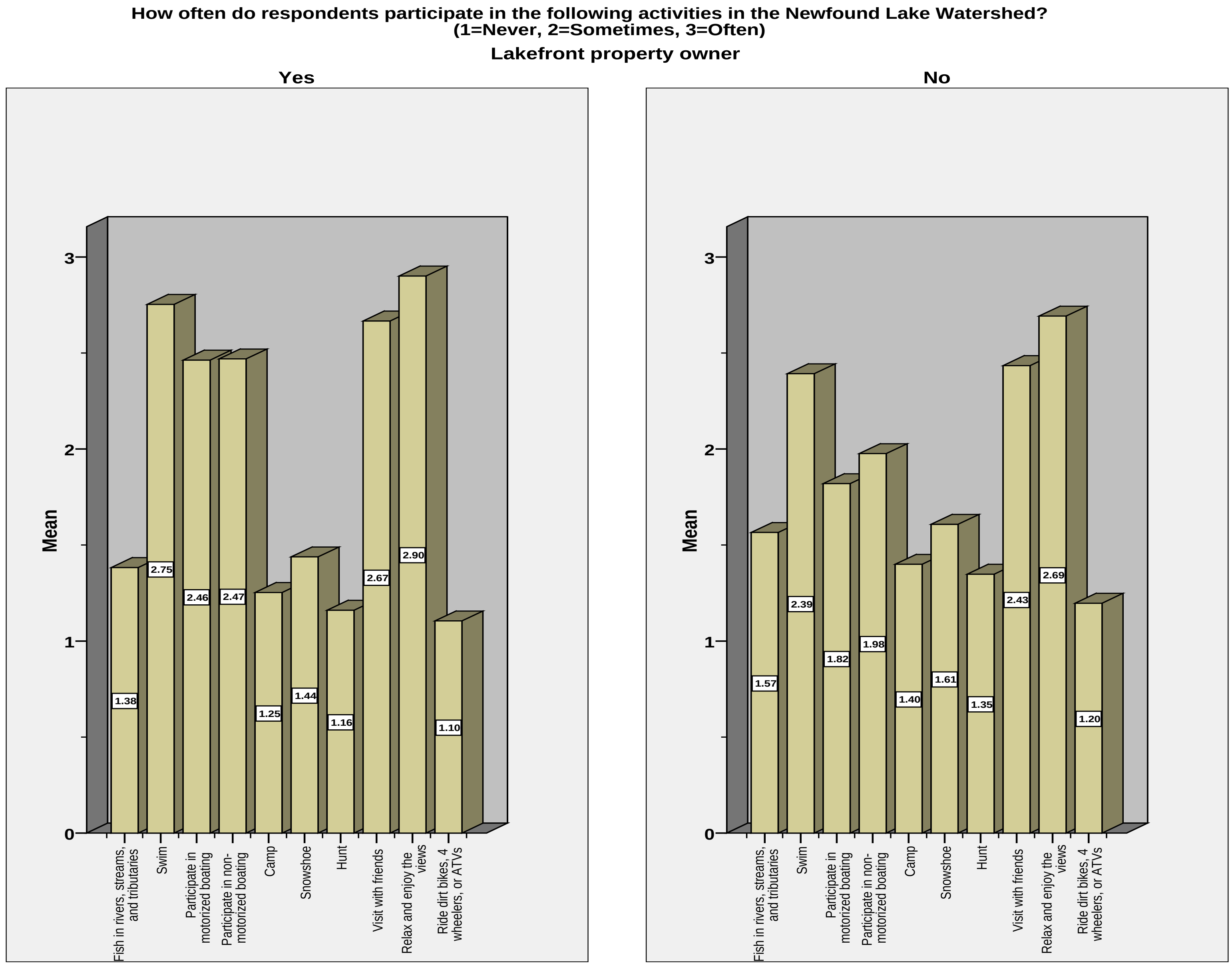
Lakefront property owners reported keeping leaves and grass clippings out of shoreline areas and/or storm drains and culverts more often than non-lakefront owners. Using the language "shoreline" in the question may have primed lakefront owners to respond performing this activity more often. Non-lakefront property owners leave grass clippings on their lawn more often and water their lawns less.



Non-lakefront property owners are more concerned with zoning rules, fishing regulations, and hunting regulations becoming more restrictive but less concerned with the prospect of electric wind turbine installation on ridgelines than lakefront property owners. Lakefront property owners may be more concerned with wind turbine installation because of the impact they have on views.


How concerned respondents would be if changes were to occur in the area:
(1=Not at all Concerned to 5=Very Concerned)
Lakefront property owner
Yes
No
Mean
0
1
2
3
4
2.68
2.71
2.51
3.06
2.98
3.00
2.82
2.69
Zoning rules became more restrictive
Fishing regulations became more restrictive
Hunting regulations became more restrictive
Electric wind turbines were installed on ridgelines

There were numerous differences in how often lakefront and non-lakefront property owners report participating in certain activities. These activities have very different impacts on the watershed. For example lakefront property owners participate in motorized and non-motorized boating activities more often and non-lakefront property owners participate in dirt biking, 4wheeling, or ATV riding more often. Boating has a greater impact on water bodies and the non-lakefront population participates in activities more often that have greater impacts on forest land.

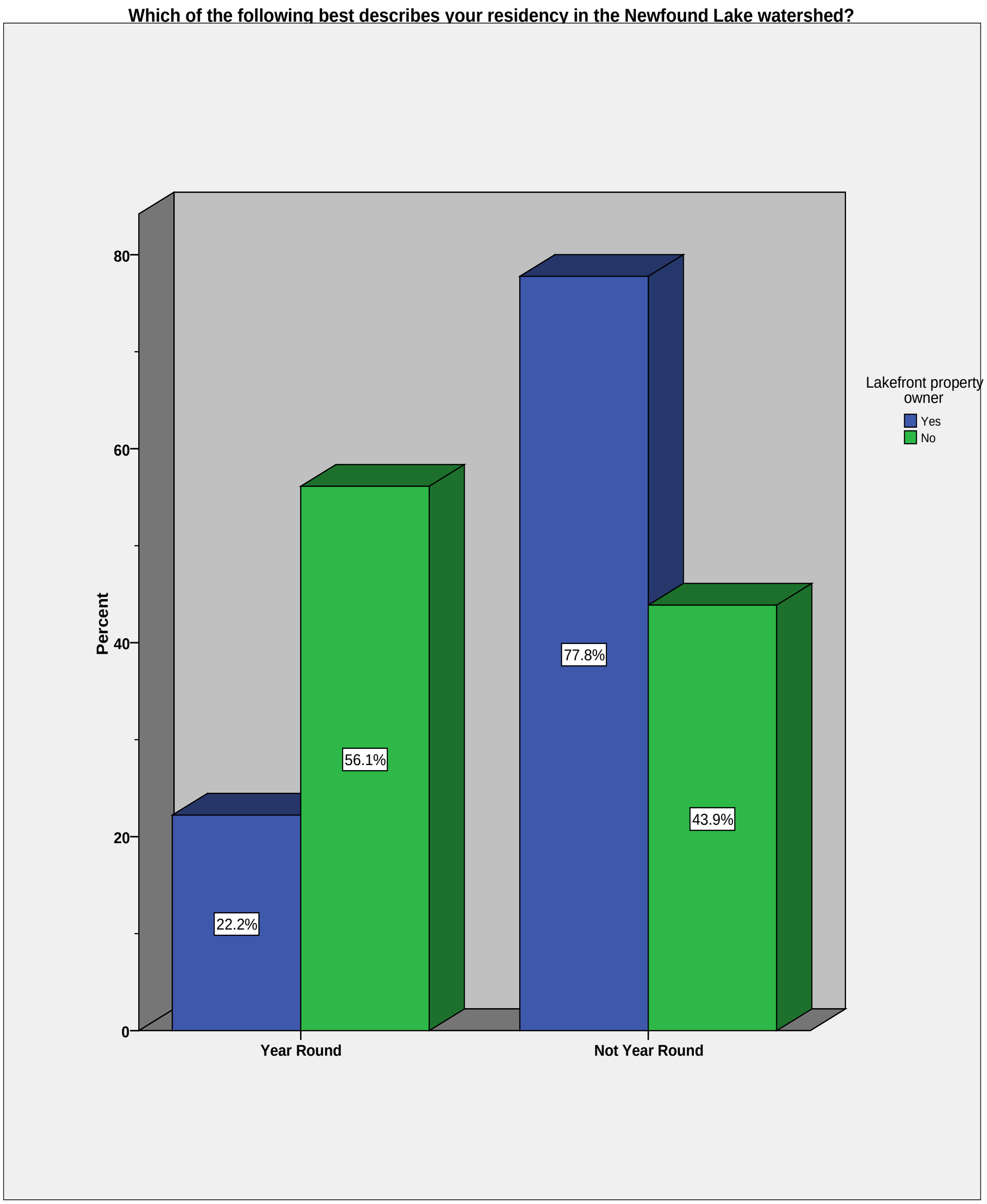

How often do respondents participate in the following activities in the Newfound Lake Watershed?
(1=Never, 2=Sometimes, 3=Often)
Lakefront property owner
Yes
No
Mean
0
1
2
3
1.38
2.75
2.46
2.47
1.25
1.44
1.16
2.67
2.90
1.10
1.57
2.39
1.82
1.98
1.40
1.61
1.35
2.43
2.69
1.20
Fish in rivers, streams, and tributaries
Swim
Participate in motorized boating
Participate in non-motorized boating
Camp
Snowshoe
Hunt
Visit with friends
Relax and enjoy the views
Ride dirt bikes, 4 wheelers, or ATVs

The non-lakefront property owners had a higher environmental values mean score.

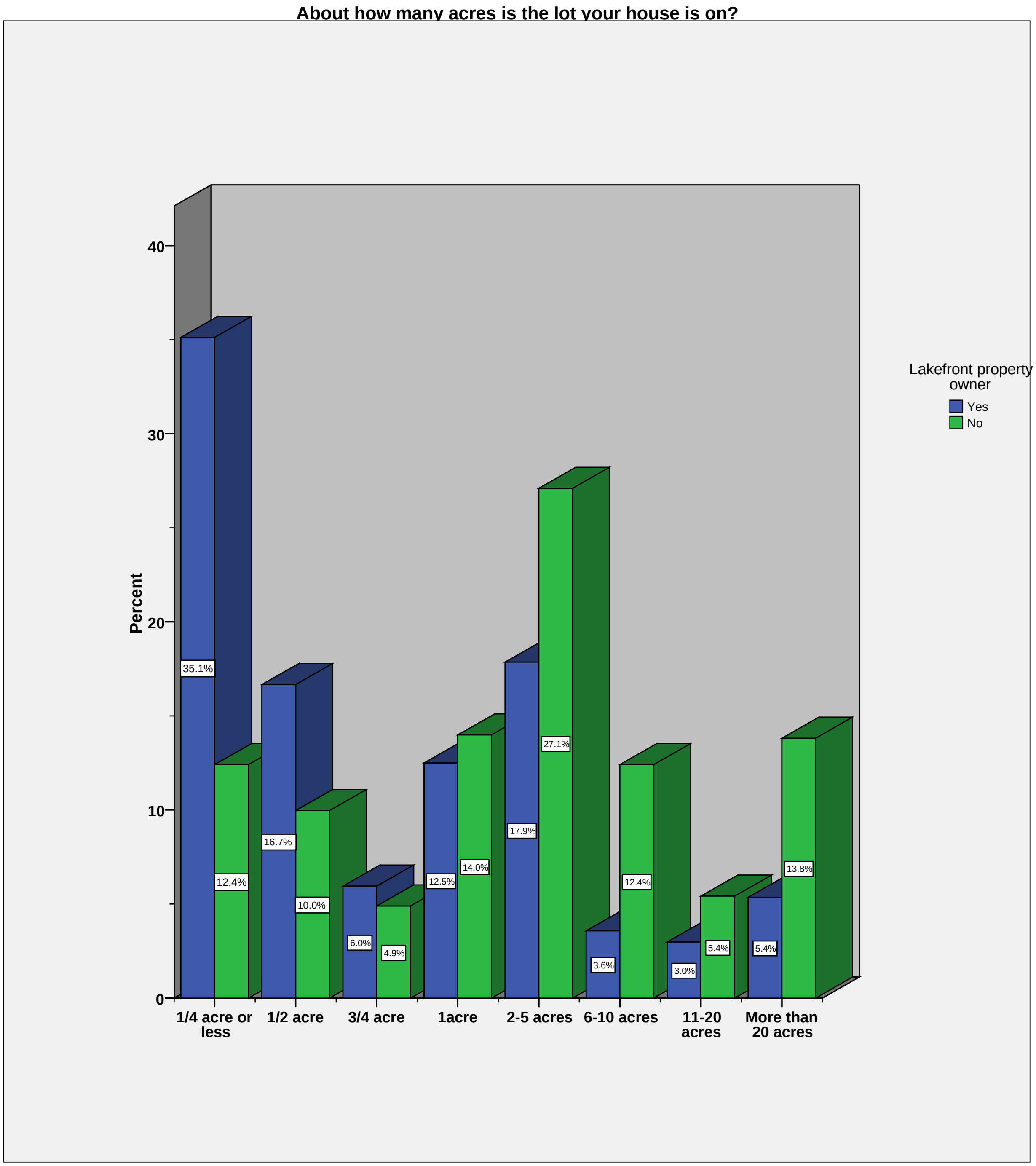
Lakefront property owners indicated that radio and television were less useful source for acquiring information about the watershed. During the summer months it may be important to use other means to distribute information.

Non-lakefront property owners agree more with the assertions that town governments should decide on regulations and that regulations should be implemented at the town level as well.

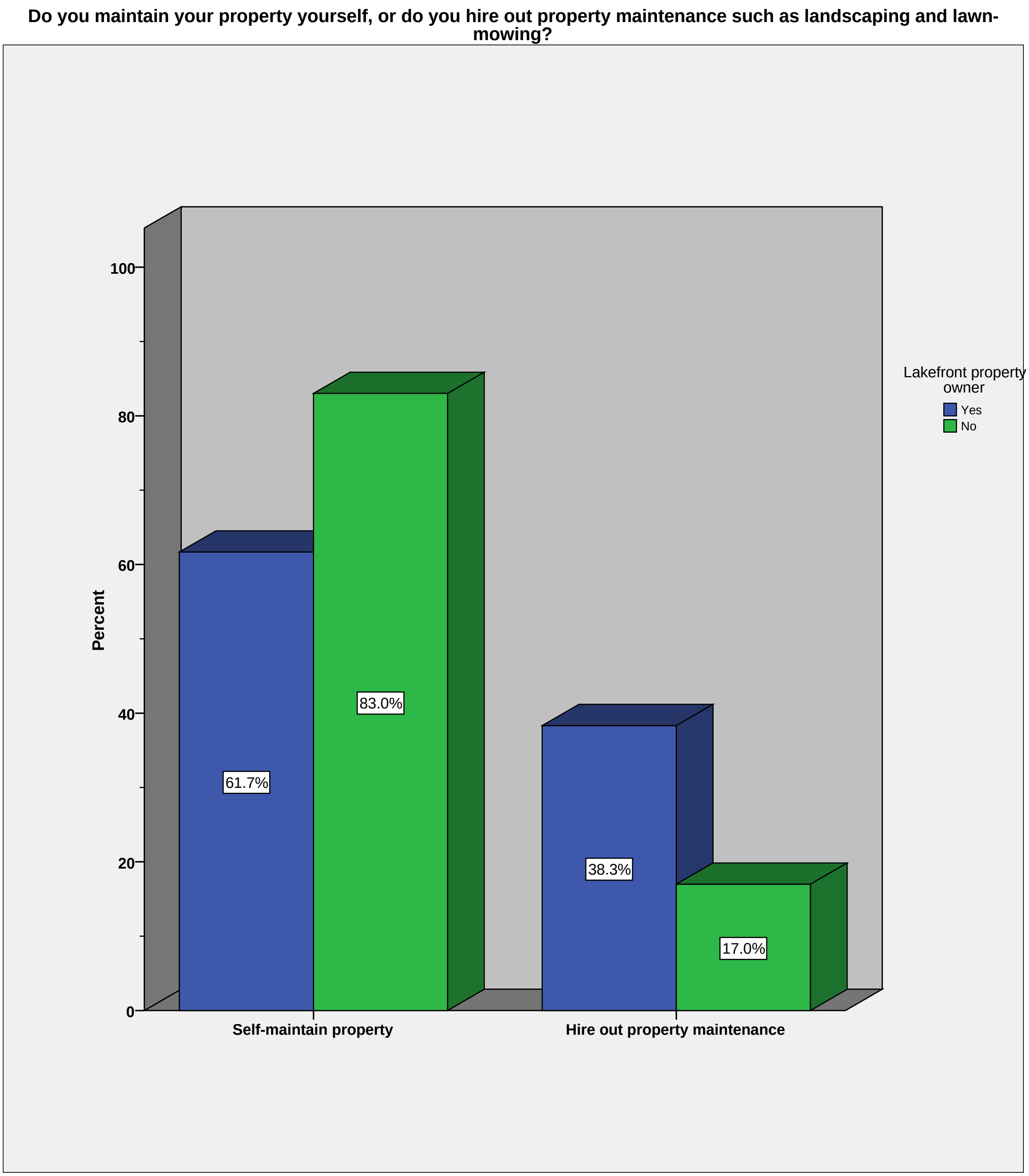
77.8% of the lakefront property owners were not year round residence, compared to only 43.9% of non-lakefront property owners. The seasonality of residence is reflected in the way lakefront property owners valued the watershed as a place to escape and relax. Many differences between the two populations in their values and desires for the watershed may reflect their residence status which.



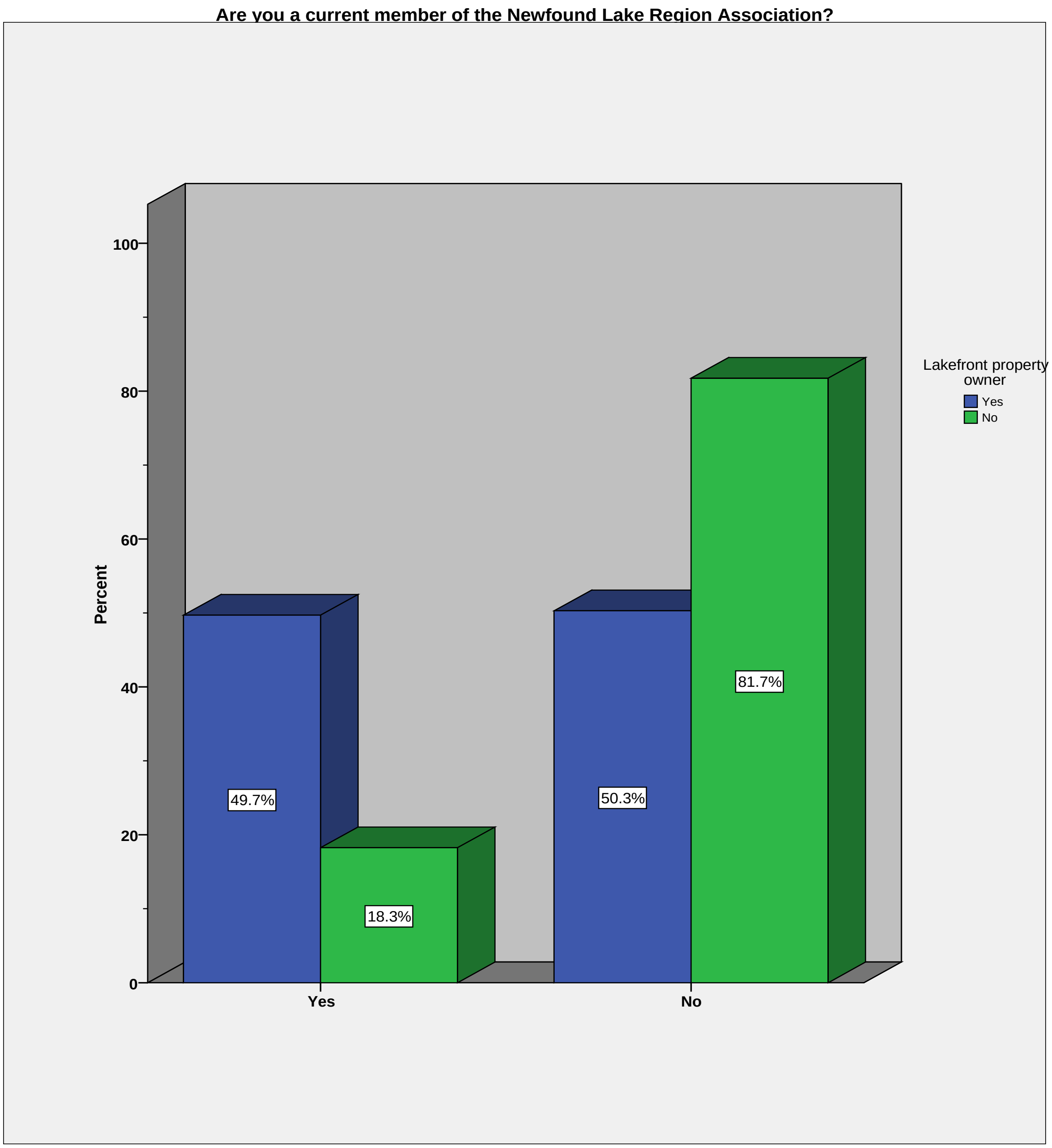
Lakefront properties are generally smaller in comparison to non-lakefront properties. Despite having smaller house lots, lakefront property owners agreed less with statements about crowding at the lake.



Lakefront property owners were more likely to hire out property maintenance. Although this may support local businesses, it may also mean that the property owners are unaware of the types of fertilizers and lawn care practices being used.

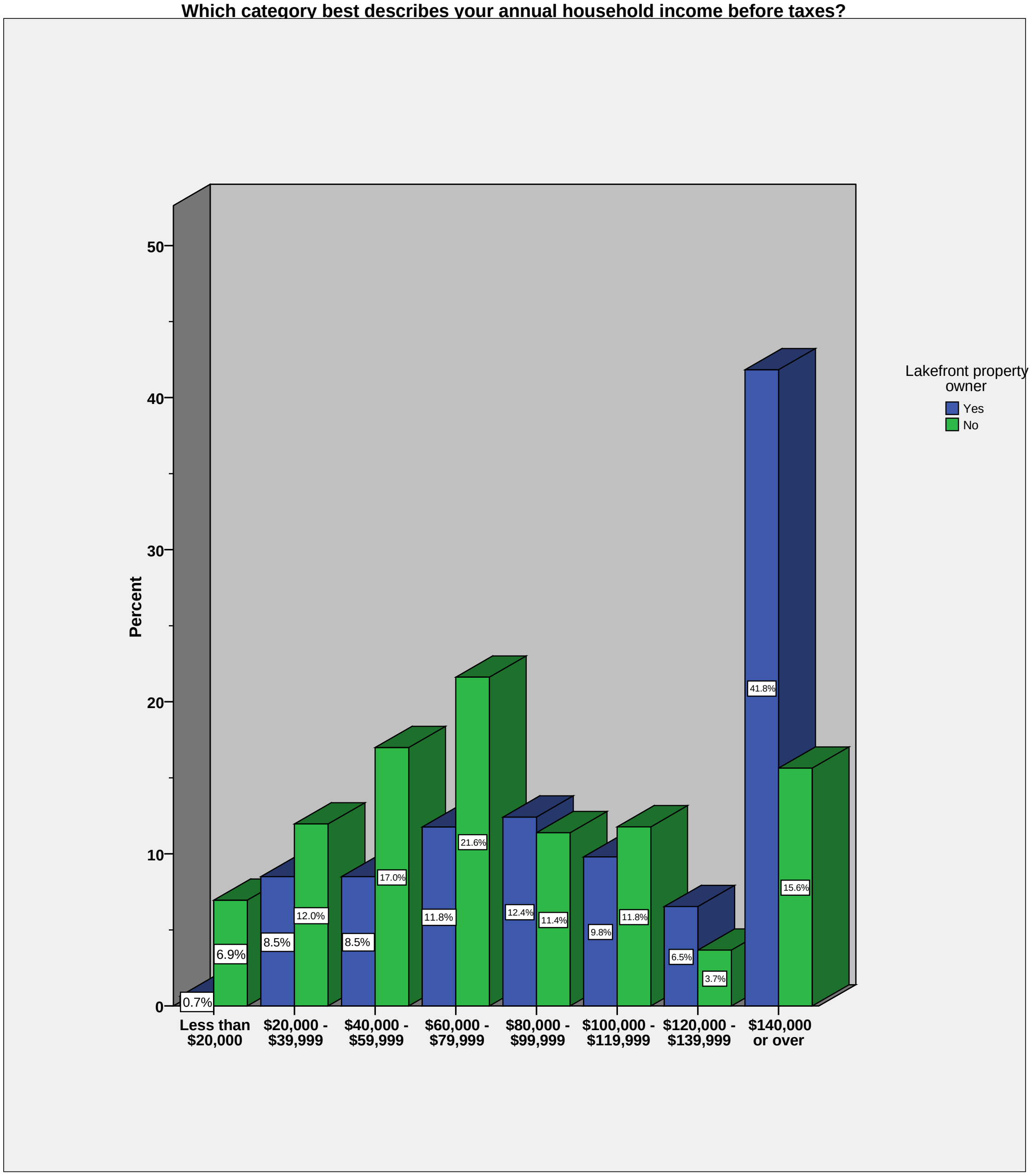


49.7%, nearly half, of lakefront property owners reported being members of the NLRA; only 18.3% of non-lakefront property owners are members. The NLRA could play an important role in outreach and education to lakefront property owners, especially in regards to the master plan.



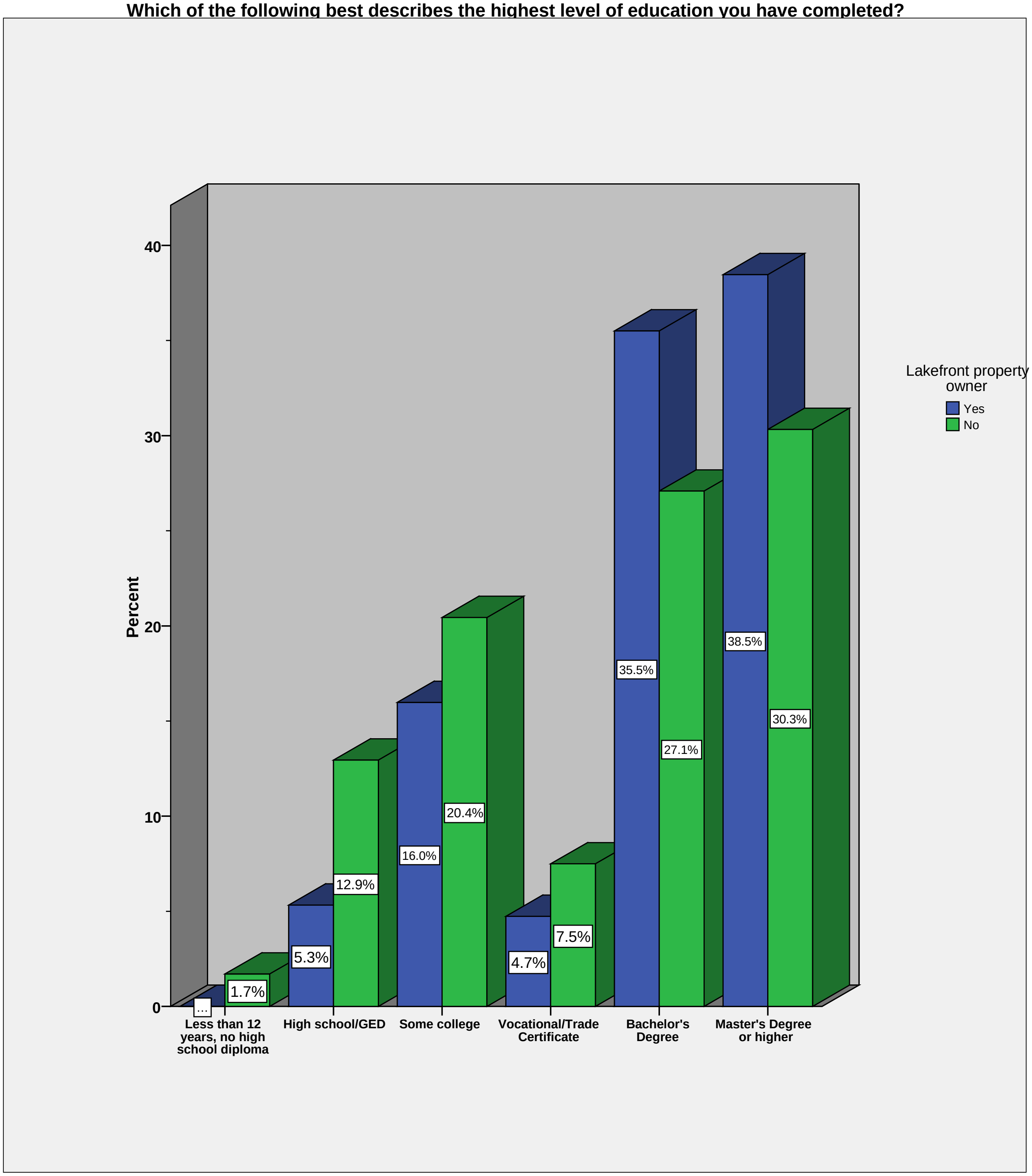
Lakefront property owners reported higher annual household incomes than non-lakefront owners, which is typically the case in lake communities.

Which category best describes your annual household income before taxes?



Lakefront property owners also had completed higher levels of education.

Which of the following best describes the highest level of education you have completed?



Analyses of Multiple Category Nominal Variables: The Influences of Duration of Residence, Duration of Association, Lot Size, Educational Attainment, and Town of Residence

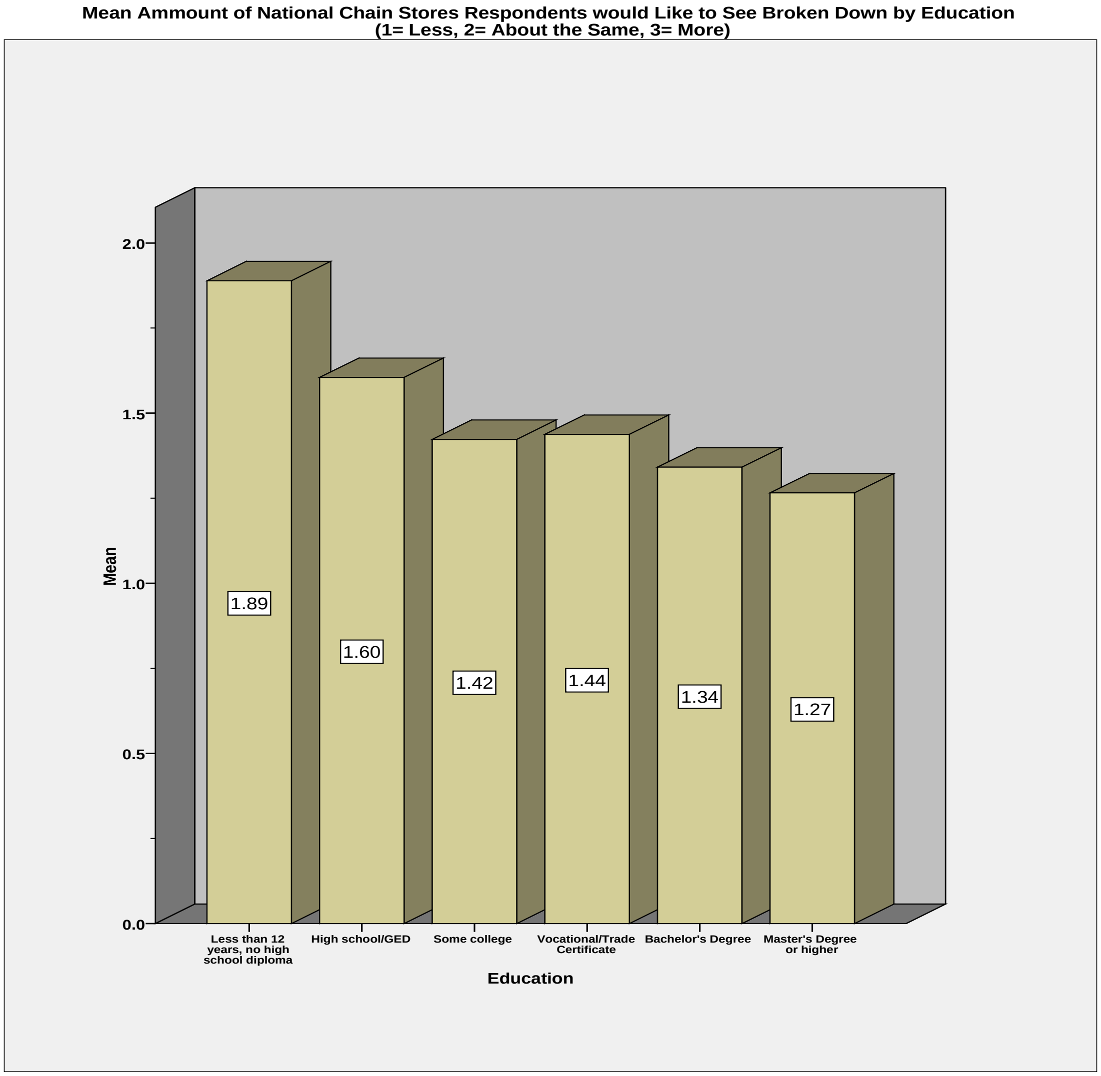
For variables which are not measured on continuous scales because of unequal categories or because of the nature of the subject matter ANOVA was used to test statistical significance in differences in responses across groups. ANOVA allows for detection of differences in response sets across multiple categories of a factor (variable) believed to be influential on responses.

While analyses were conducted to determine differences in responses according to respondents' number of years living in the watershed, number of years they visited the watershed, lot size, education, and by their town of residence for the sake of relevance and brevity only education and differences across towns are discussed graphically.

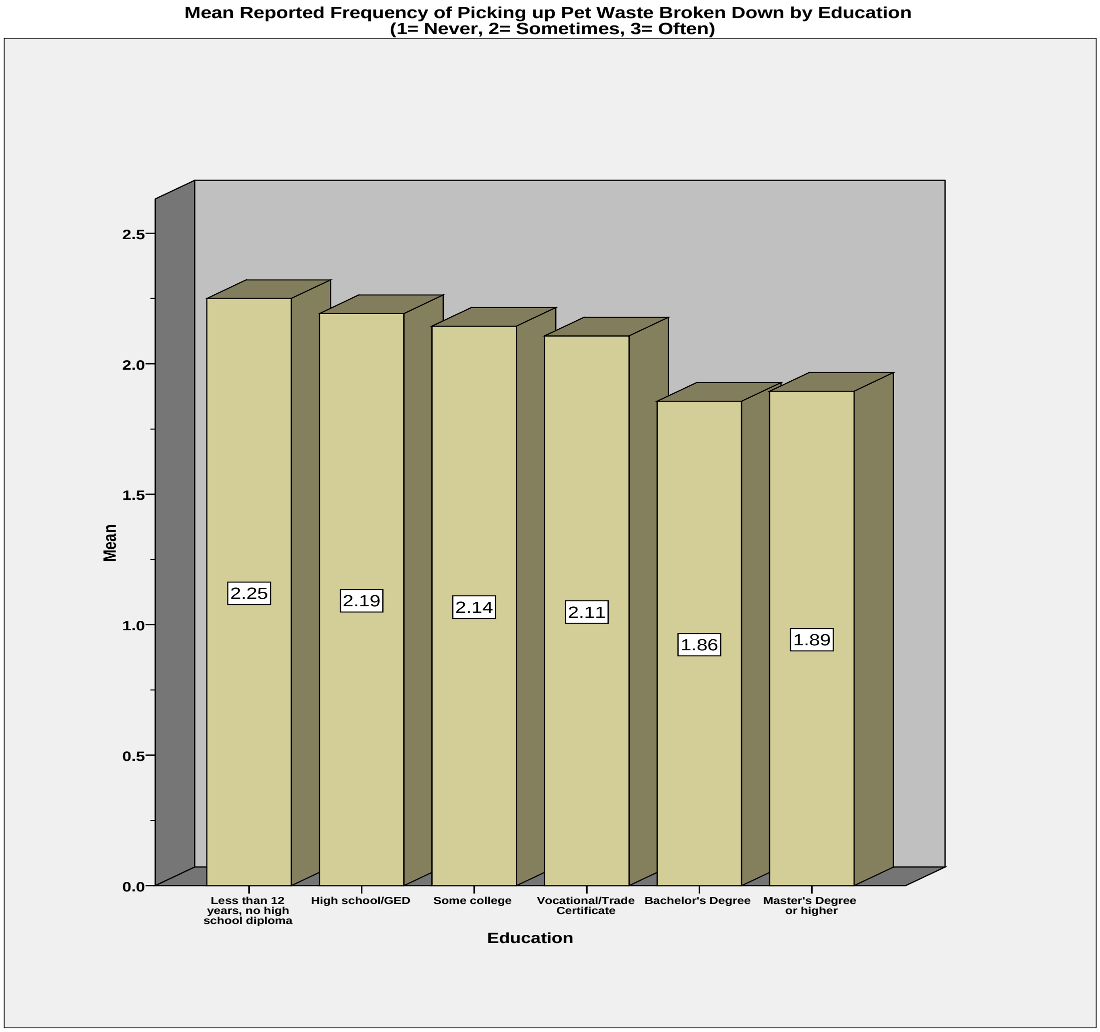
Length of exposure variables (lived or visited) correlated with many of the same questions as seasonality, in addition, questions which referred directly to long term changes in the watershed, naturally showed differences by these variables in expected and predictable patterns. Lot size in the watershed showed few relationships not exhibited by income.

Differences Across Education Levels:

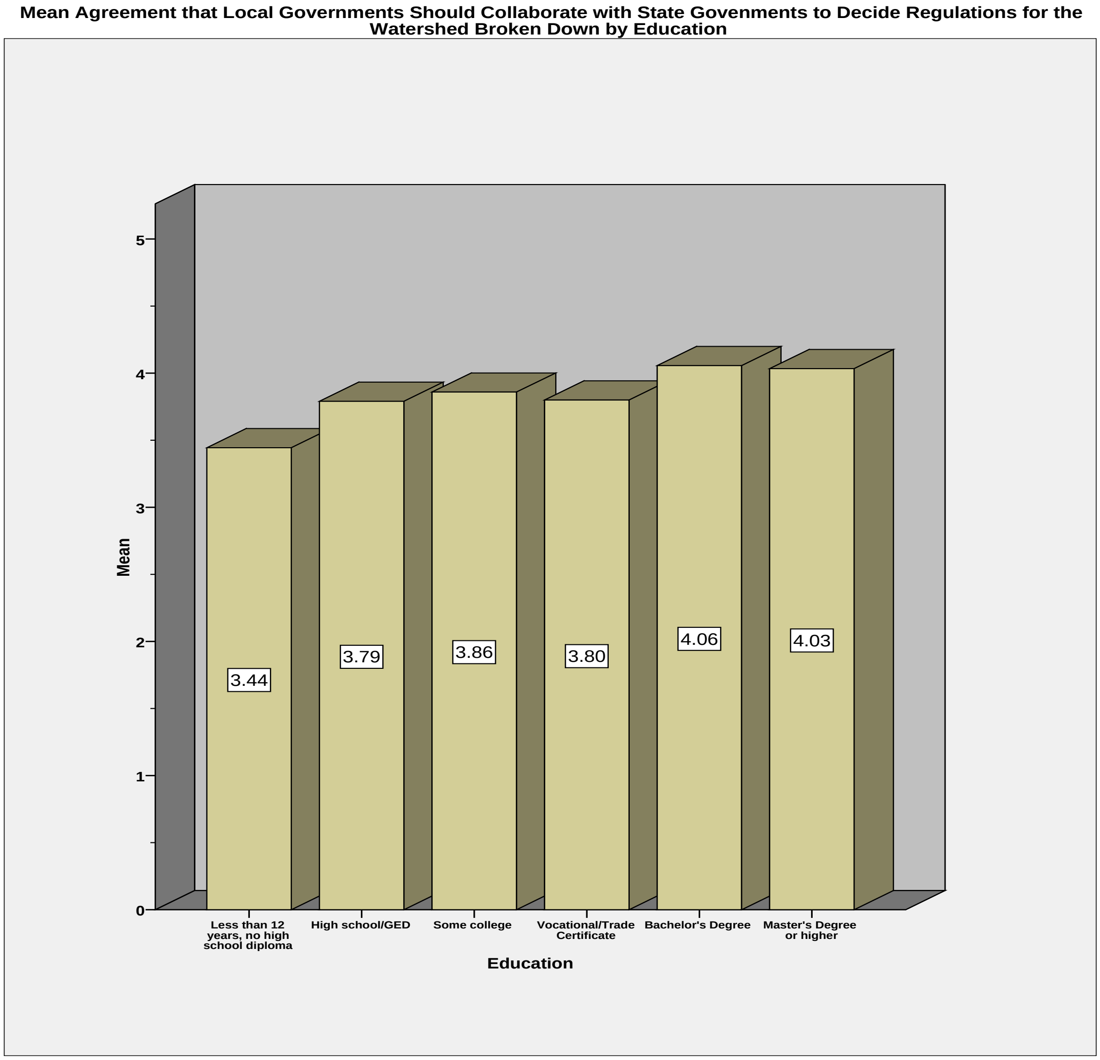
Education level is analyzed for its relationships with responses to other questions as a non-scale variable as it is not always accurately represented as equally spaced categories, (for instance, a "vocational or trade certificate" is not always indicative of a higher level of education than "some college"). Educational correlations are discussed as scales, frequently disregarding inverse columns for "some college" and "vocational or trade certificate"; the two responses for the sake of discussion are treated as roughly equivalent educational levels.



While there was agreement among most residents that they would like to see less national chain stores in the region, these views grew stronger with higher levels of education.

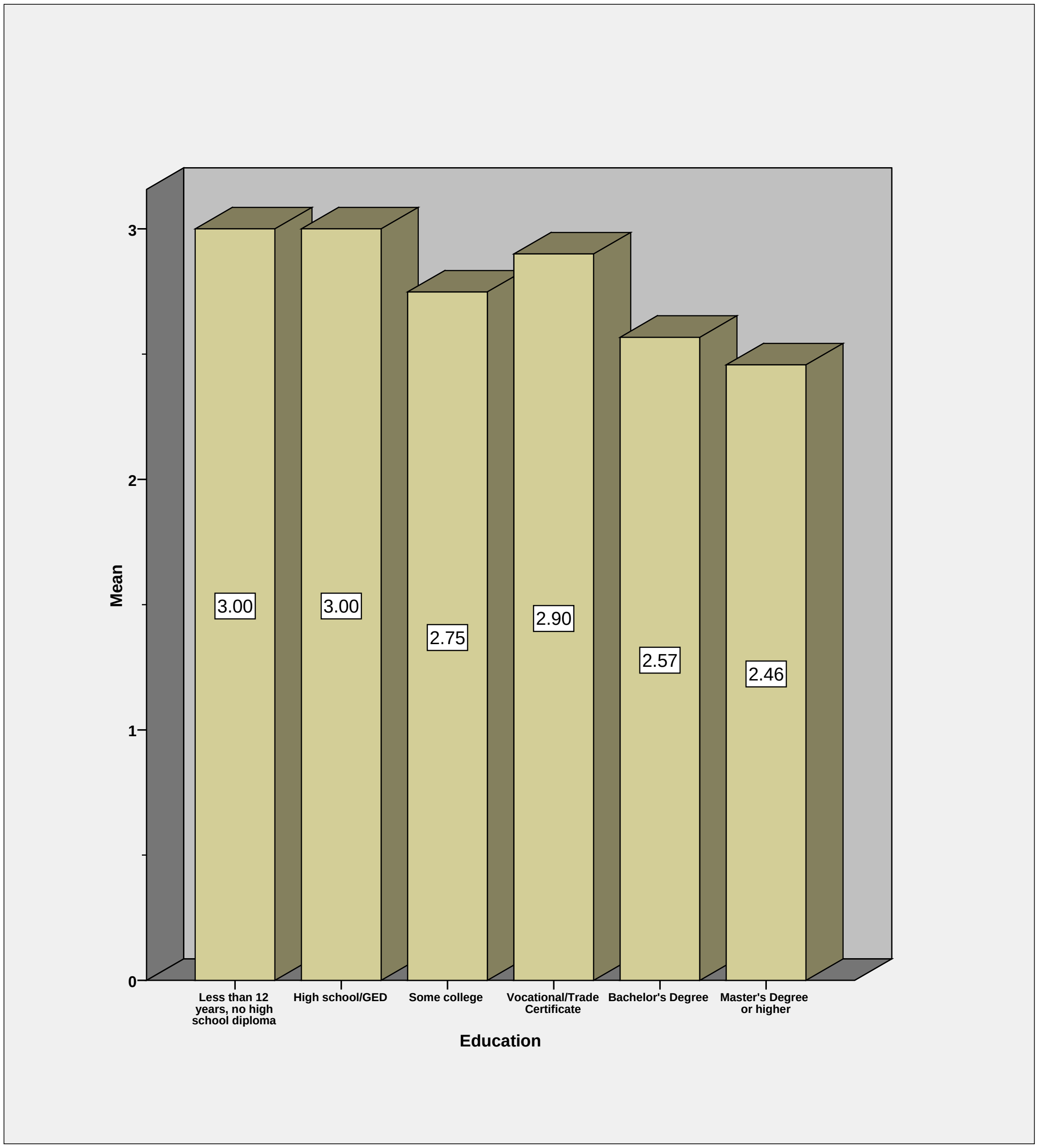


Those who have attained a higher level of education on the average reported that they less frequently picked up pet waste than those who have not attained that level of education.



As level of education increased, so did mean agreement that local and state governments should collaborate to decide regulations for the watershed.

Mean Level of Trust in Information from Local Businesses Broken Down by Education



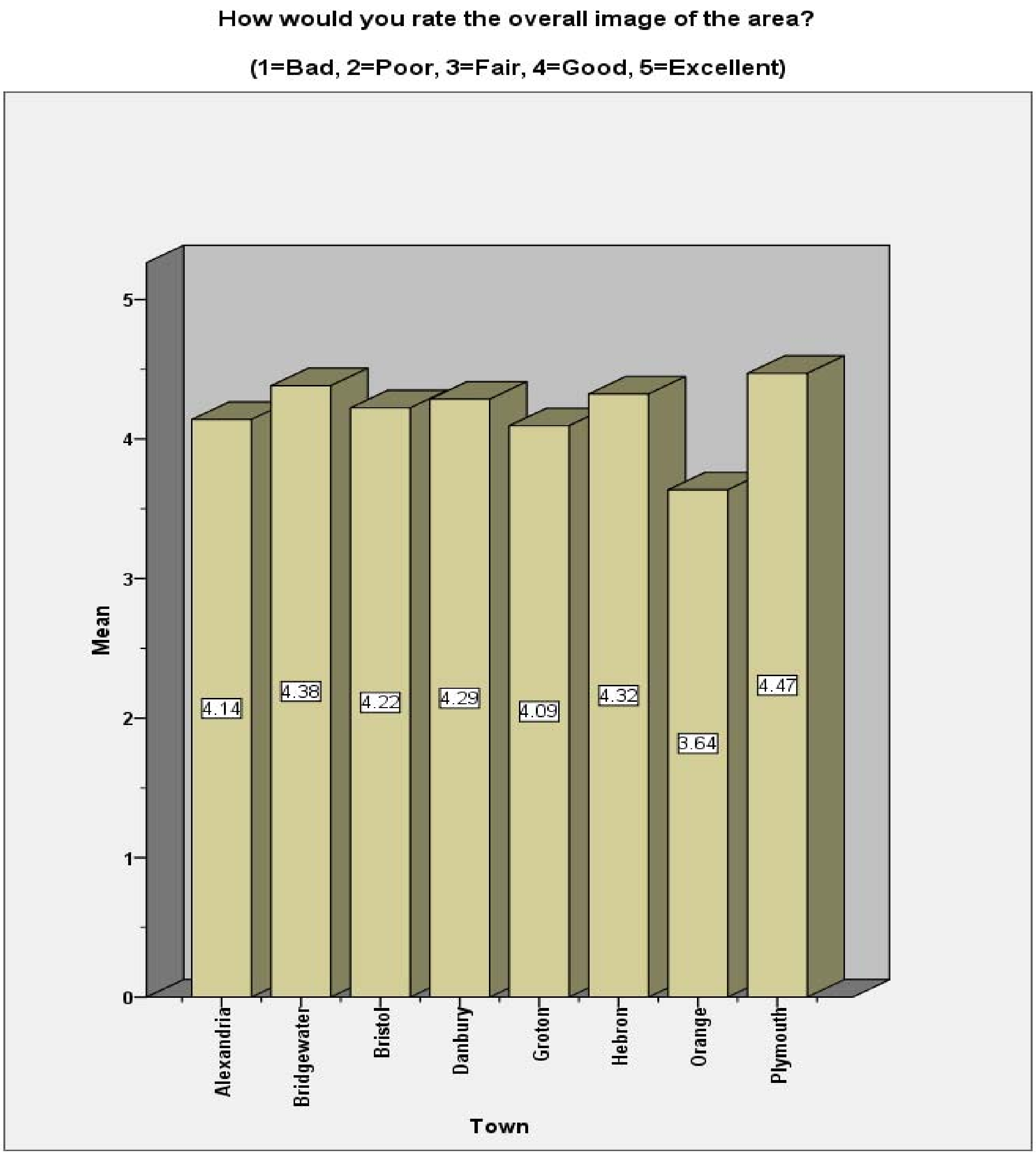
Mean level of trust in local businesses as a source of information decreased as level of education increased.

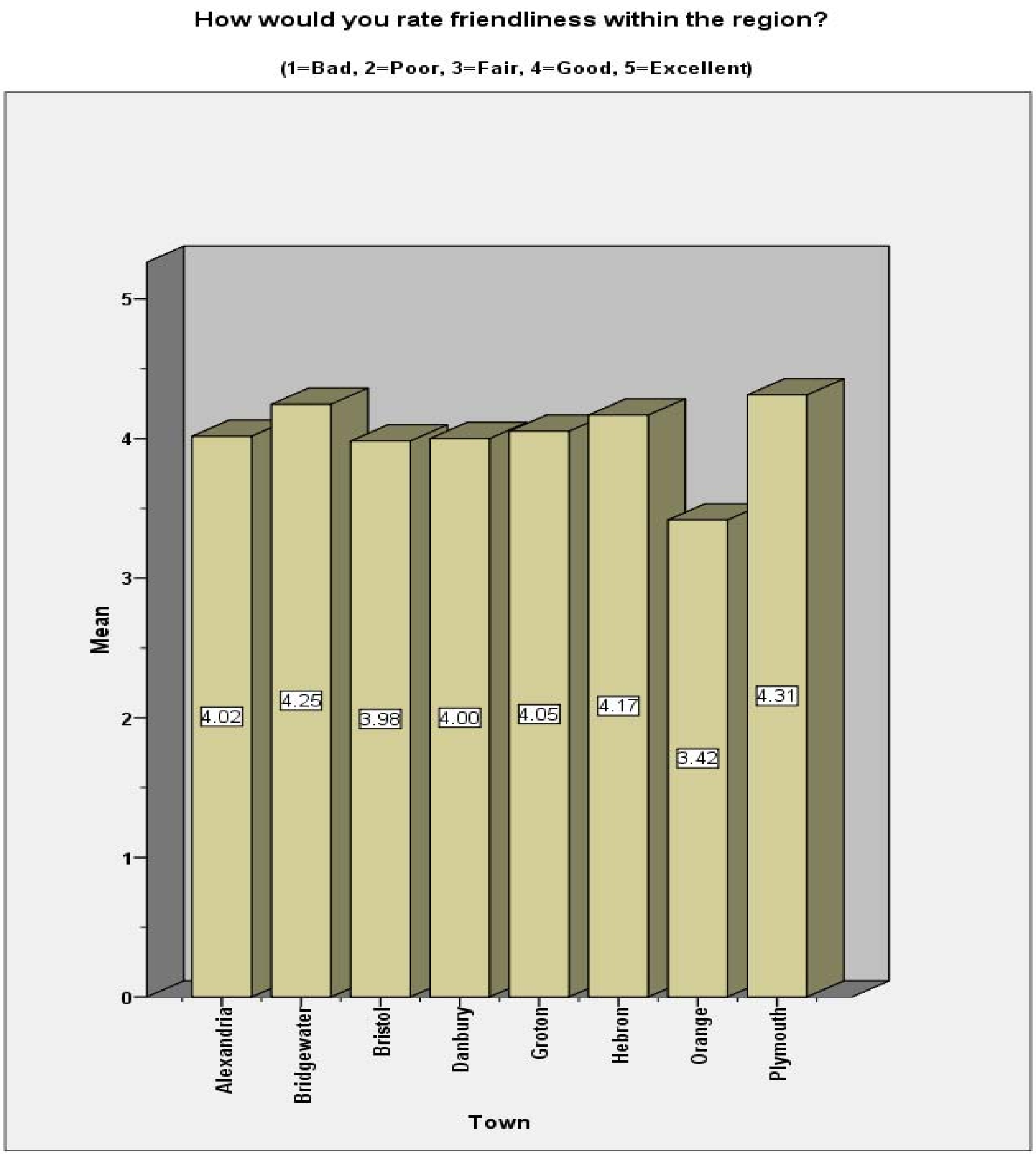
Differences Between Residents in Different Towns in the Newfound Lake Watershed

Analysis of variance procedures were performed to determine if significant differences existed in the views, opinions, and desires of residents of different towns in the watershed. These procedures compare the responses of respondents from the eight towns. This is important because the concerns and desires of residents may differ greatly because of each town's unique characteristics.

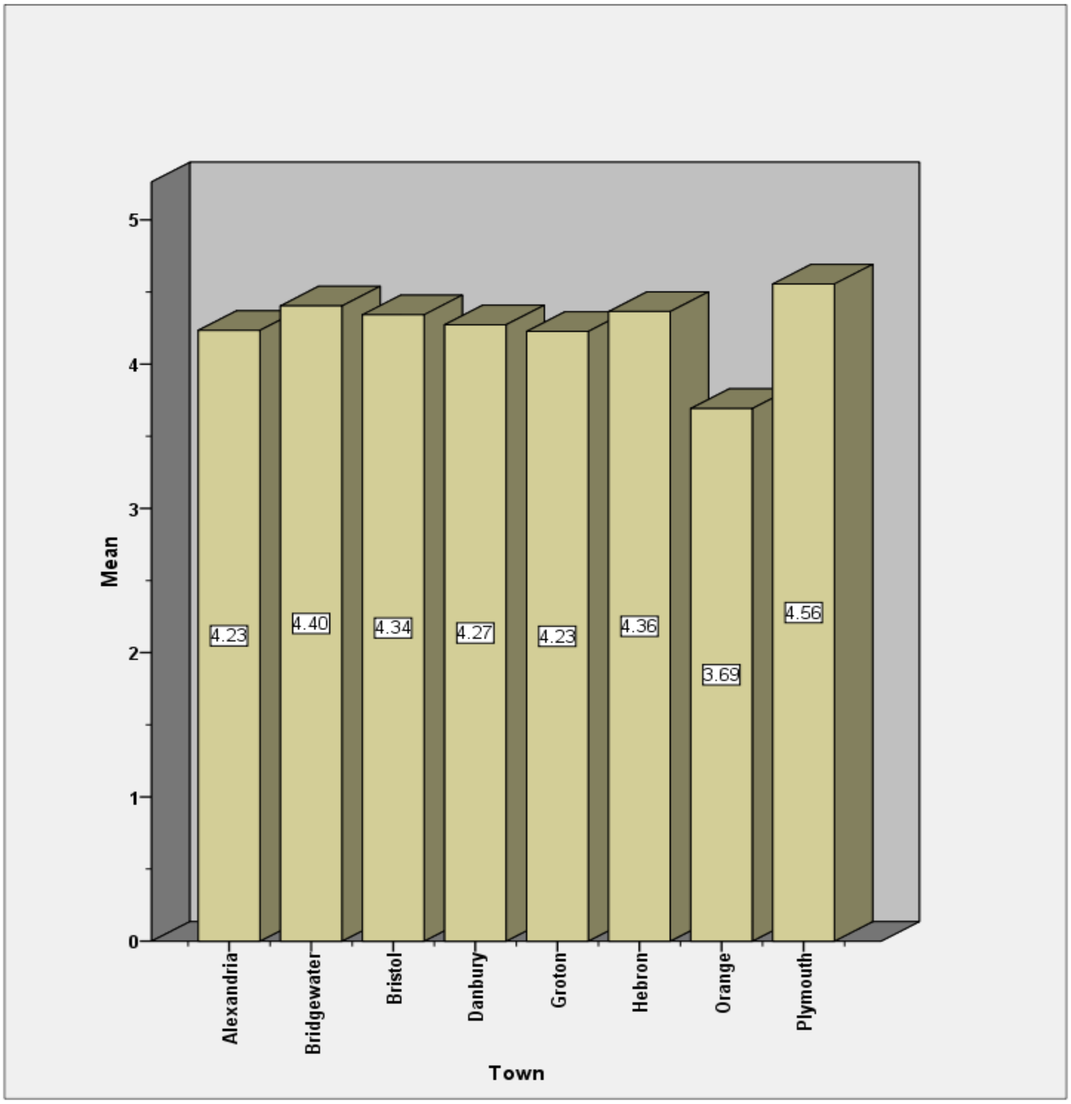
The results from ANOVA showed that for many variables significant differences were present between each town, but an additional statistical test of significance did not show that many of these relationships were likely to be true in the population in the watershed. The results that are shown are the variables for which there was a significant difference between towns and one town differed from the rest, but the relationship is not significant to the level that we can assume it exists in the population. We also indicate when this is the case; the relationships are 95% or more likely to be true in the population.

The respondents from the town of Orange rated aspects of the Newfound Lake Watershed as it exists now significantly different than respondents from the other towns. The mean of responses was lower for Orange respondents. The following three graphs represent the variables for which Orange differed.

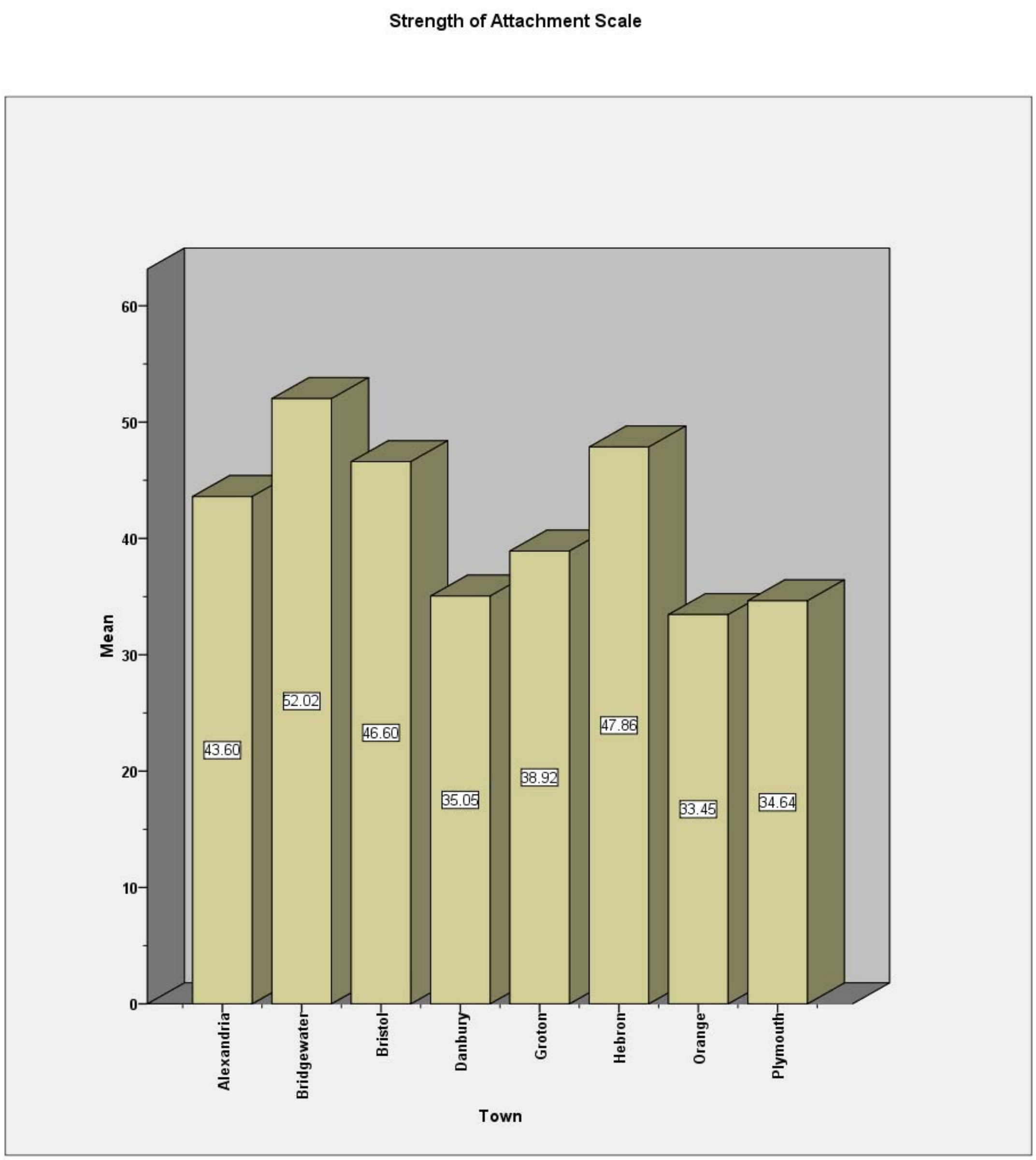



How would you rate friendliness within the region?
(1=Bad, 2=Poor, 3=Fair, 4=Good, 5=Excellent)
Mean
0
1
2
3
4
5
4.02
4.25
3.98
4.00
4.05
4.17
3.42
4.31
Alexandria
Bridgewater
Bristol
Danbury
Groton
Hebron
Orange
Plymouth
Town

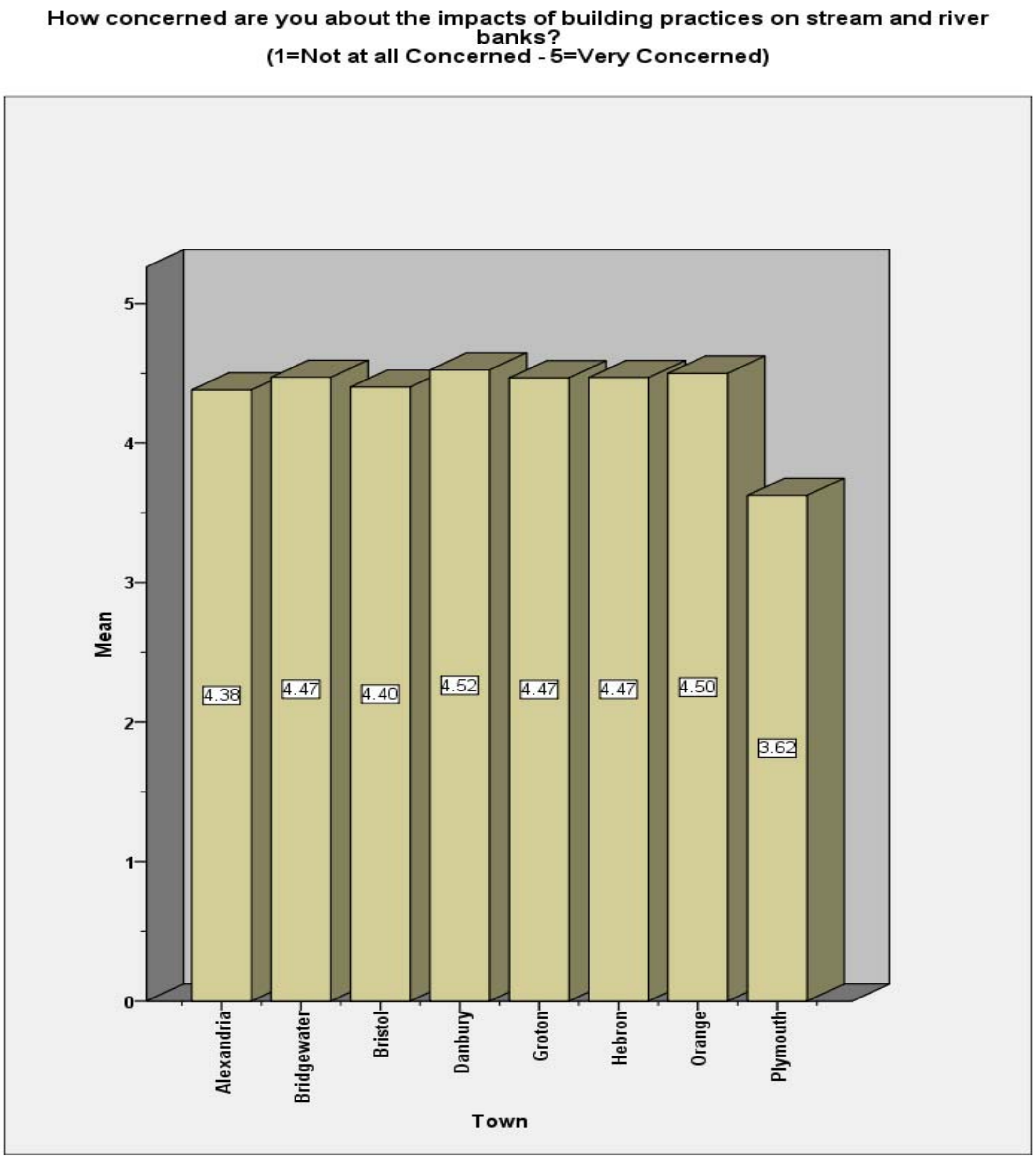
How would you rate the visual attractiveness of the watershed?
(1=Bad, 2=Poor, 3=Fair, 4=Good, 5=Excellent)



There was significant variance in the strength of attachment for respondents in each town. This relationship is also likely to exist in the population. Alexandria and Bridgewater were significantly different from all the other towns.

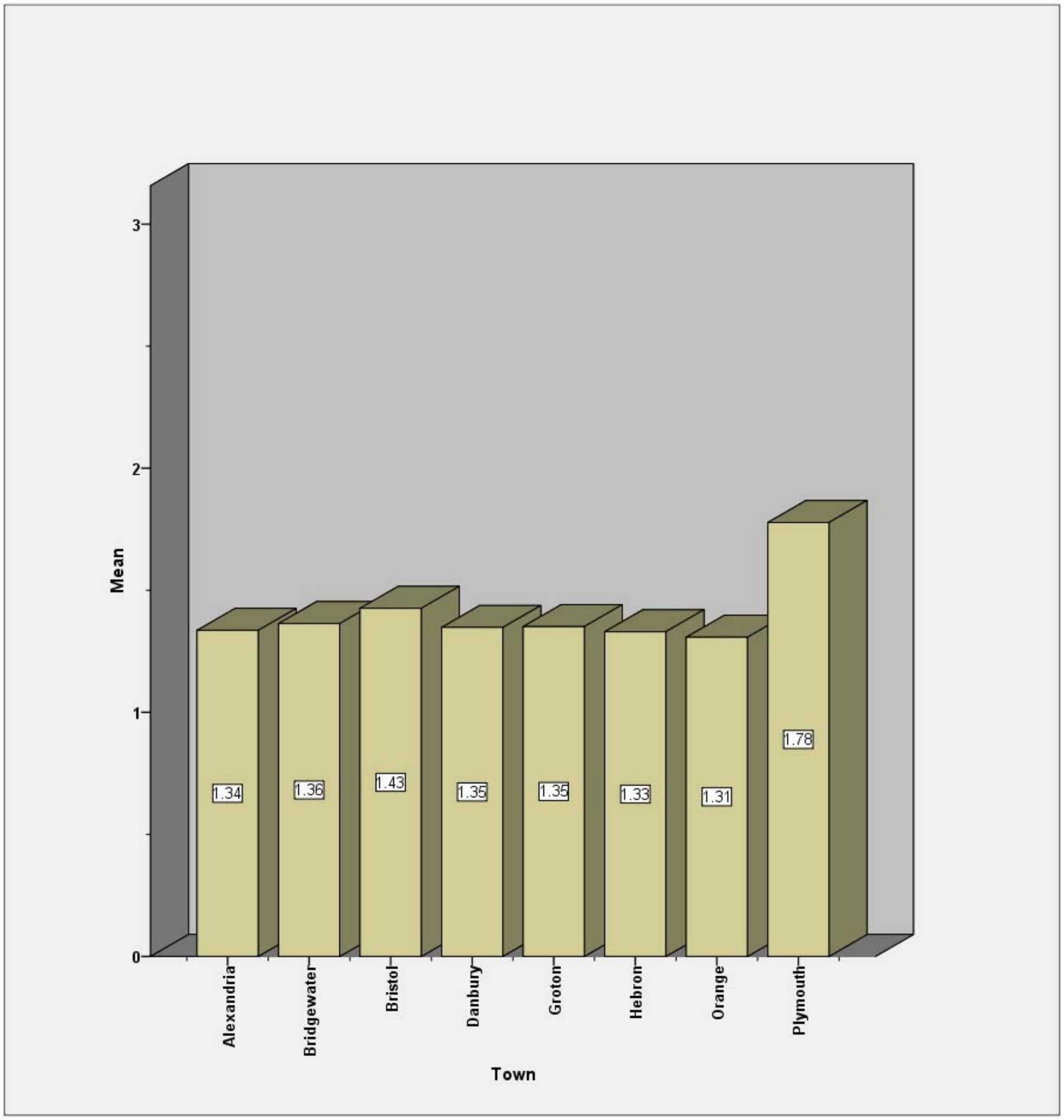


The town of Plymouth differed significantly from the other towns in how concerned respondents were about the impacts of building practices on stream and river banks. The mean of responses was lower for Plymouth respondents.

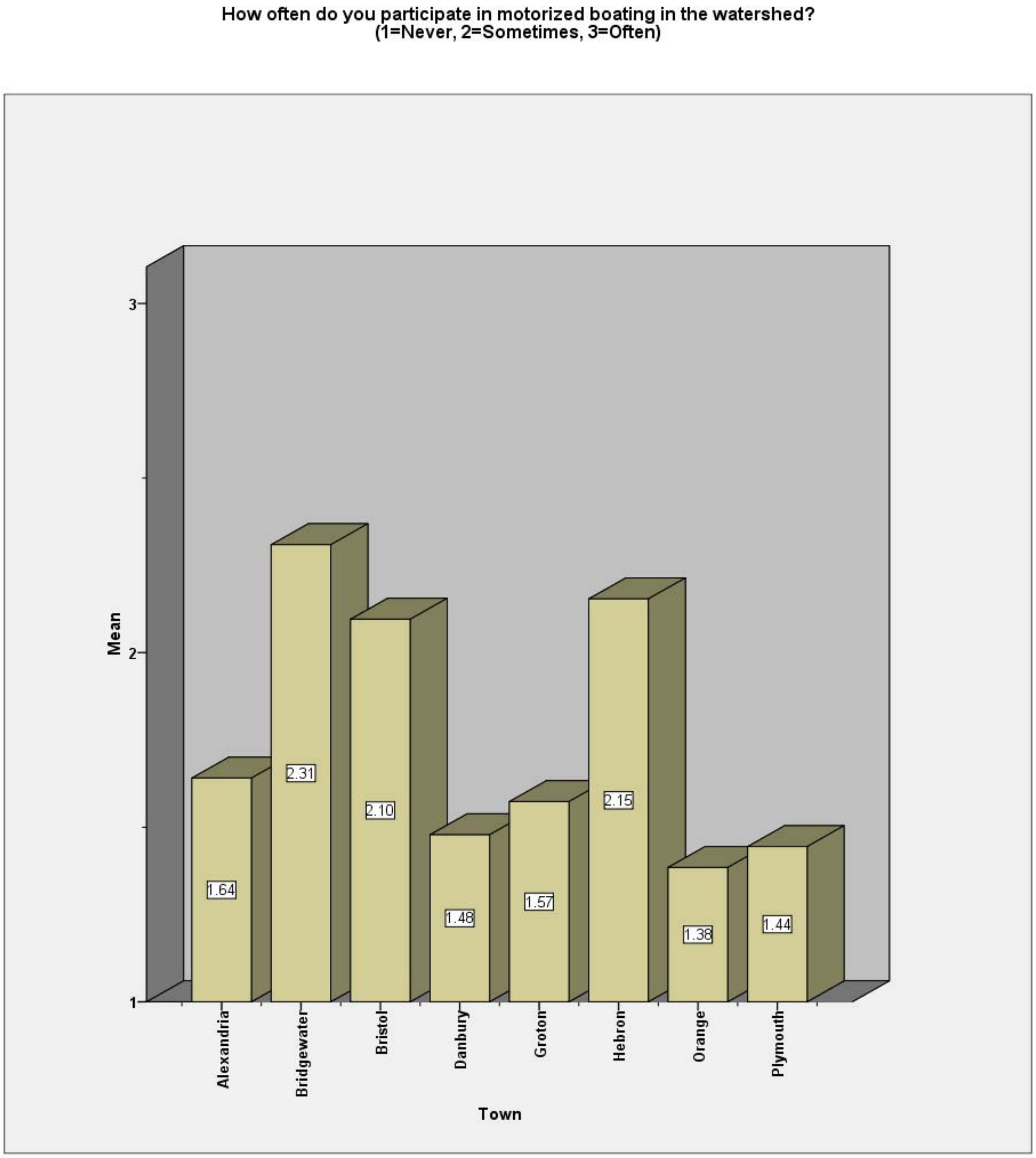


The town of Plymouth differed from all the other towns in how much respondents reported wanting national chain stores in the watershed in the future. The mean of responses was higher for Plymouth respondents.

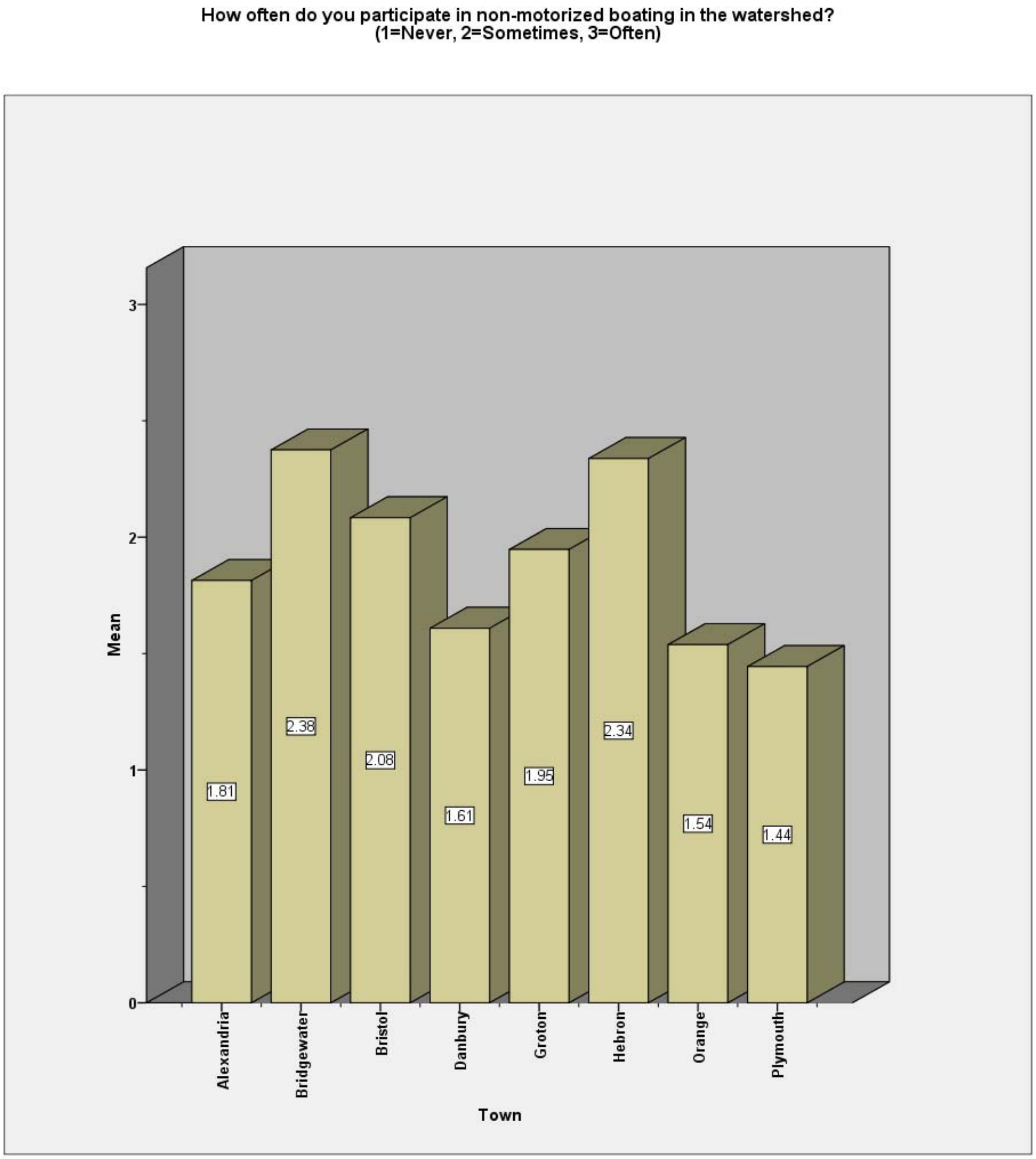
Would you like to see less, more, or about the same amount of national chain stores in the Newfound Lake Watershed in the future?
(1=Less, 2=About the Same, 3=More)



There was a significant difference in the mean of responses from the towns for how often they participate in motorized boating in the watershed. Bridgewater, Bristol, and Hebron were statistically different from the other towns. Respondents indicated that they participate in motorized boating more than respondents from the other towns. This relationship is likely to exist in the entire watershed population.

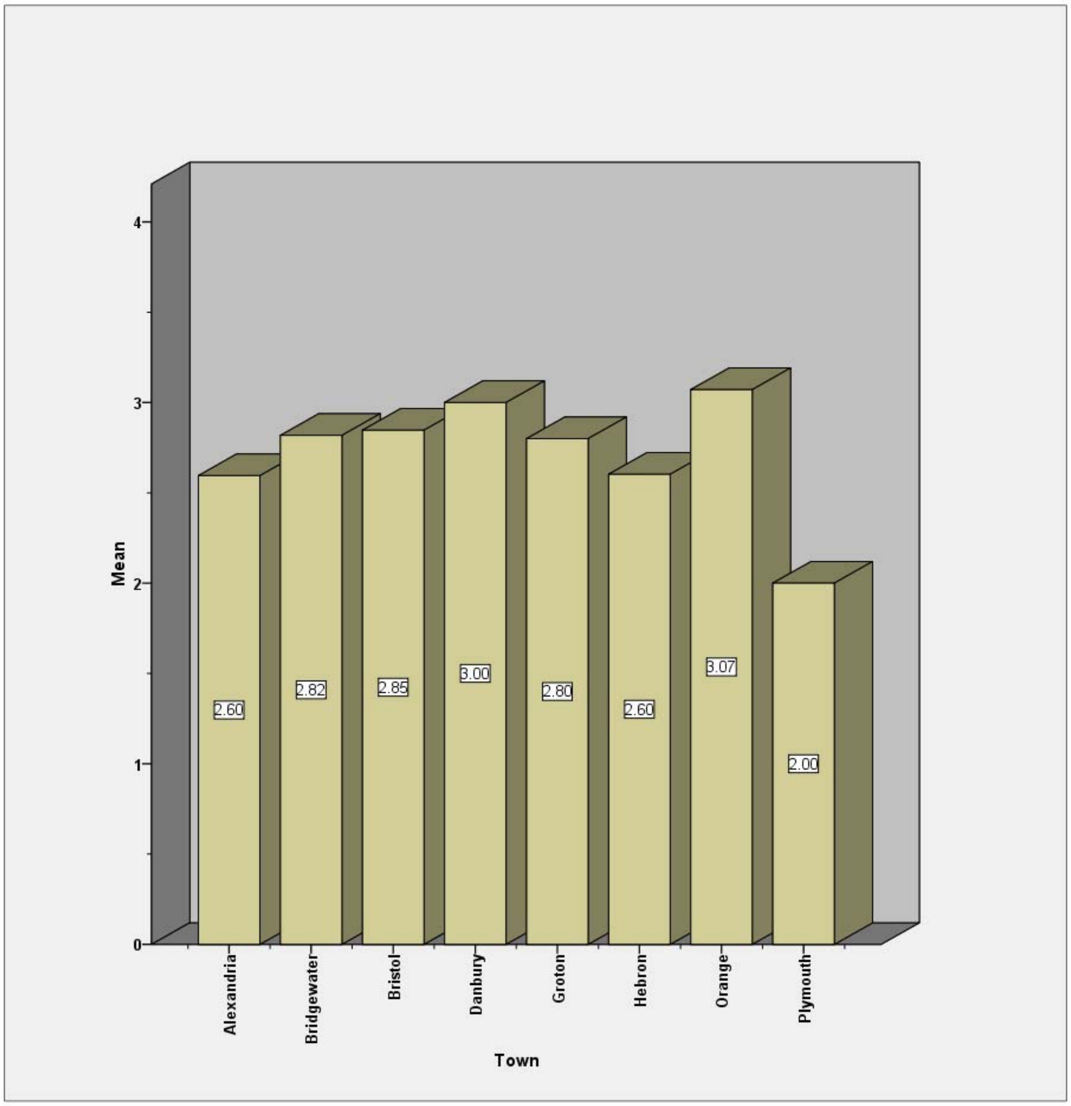


There was also a significant difference between towns in how often respondents report participating in non-motorized boating in the watershed. This relationship is likely to exist in the population.

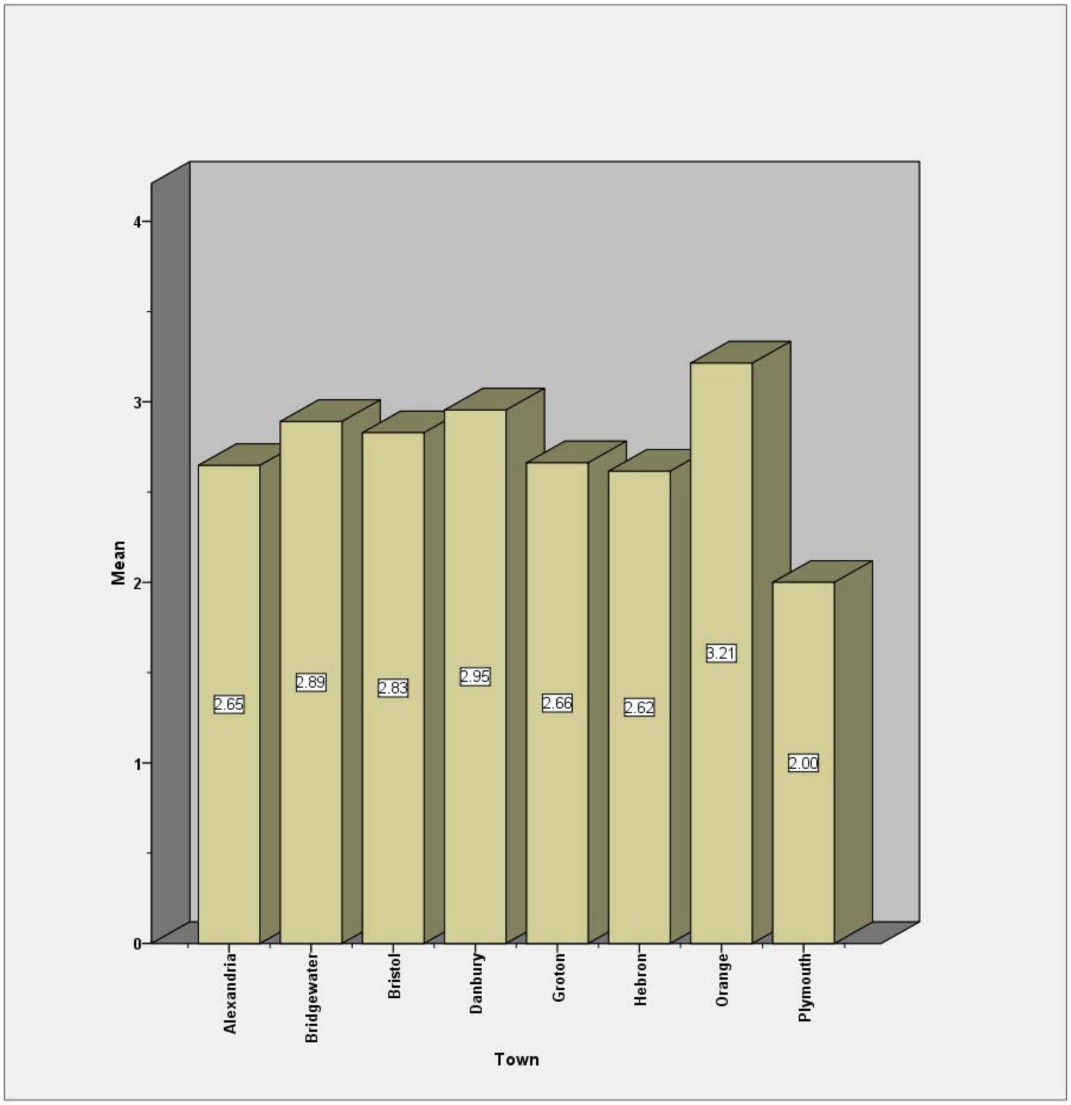


Plymouth respondents differed significantly from respondents in the other towns for how useful they thought informational signs and pamphlets or flyers were for acquiring information about the Newfound Lake Watershed. In both cases Plymouth respondents rated these sources as less useful than respondents from the other towns.

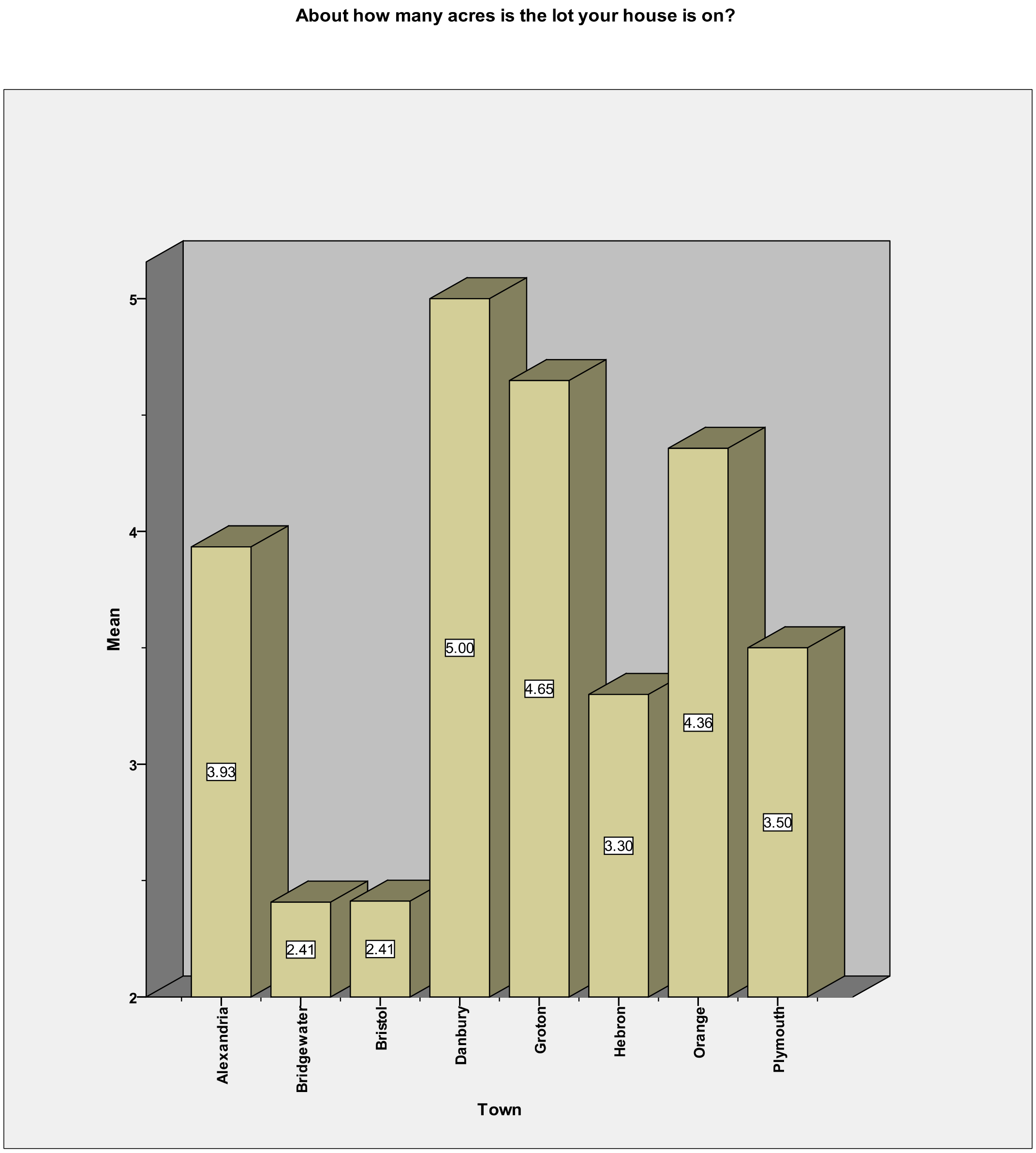
How useful are informational signs for acquiring information about the watershed?
(1=Not at all Useful, 2=Somewhat Useful, 3=Useful, 4=Very Useful)



How useful are pamphlets of flyers for acquiring information about the watershed?
(1=Not at all Useful, 2=Somewhat Useful, 3=Useful, 4=Very Useful)



There was a significant difference in the lot sizes of house between the towns in the watershed. This relationship is likely to exist in the population. Bridgewater and Bristol respondents reported having much smaller house lots than the other towns. Lakefront property owners also reported having smaller lot sizes than non-lakefront, and Bristol and Bridgewater have a large amount of lakefront properties.



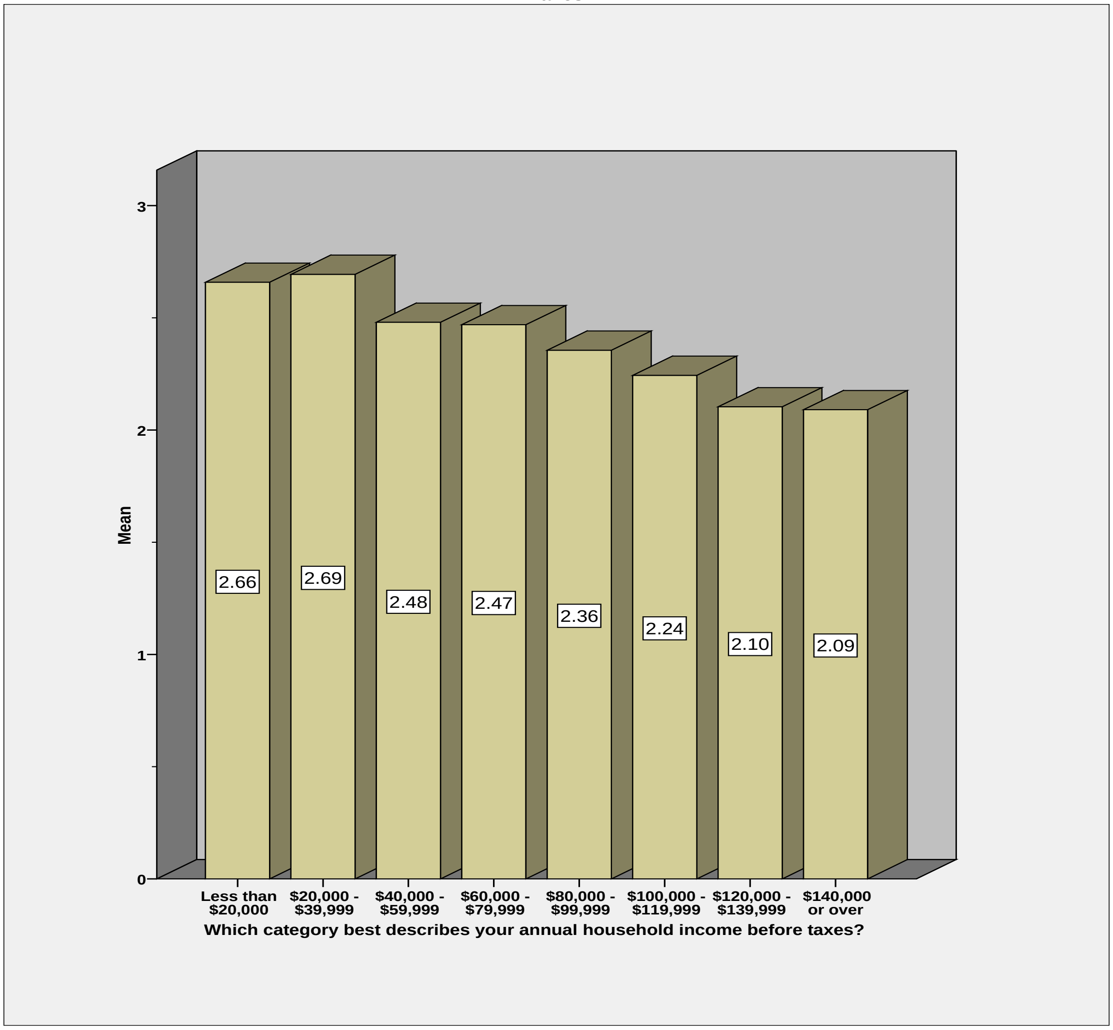
Multiple Category Scaled Variables: The Influences of Income, Age, Political Orientation, Time of Residency in the Watershed Each Year, the Strength of Respondents' Environmental Values, and the Strength of Respondents' Attachment to Newfound Lake

Demographic and other variables that are continuous and are measured with equal categories were tested for their relationships with variables of interest using tests of statistical significance to determine generalizability and Pearson's r to analyze correlations. Relationships between key questions and the variables of age, income, respondent's political orientation (measured on a continuum from liberal to conservative), the number of months per year a respondent resides in the watershed (for seasonal residents), the strength of environmental values, and the strength of respondents' attachment to the lake were analyzed in this manner.

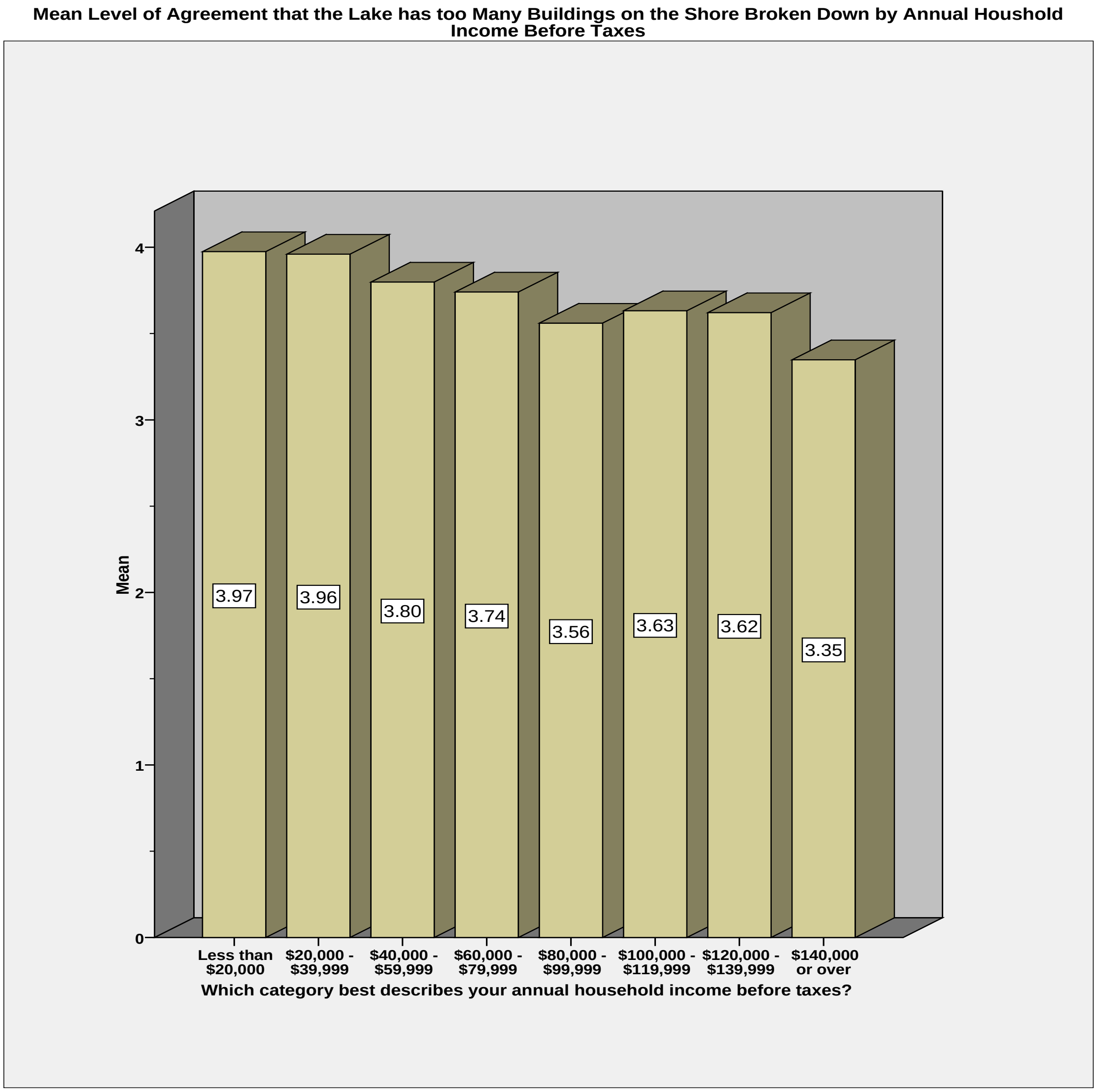
Income

Differences in responses by income may indicate barriers to environmentally responsible behaviors or financial influences on opinions and social currents, and are important for identification to ensure the watershed plan is representative of all constituencies. These differences are important for town officials and others to consider when interpreting survey results, as respondents to the survey represent higher average incomes than are present in the watershed. General trends amongst different income groups showed decreased environmental concern and improved views of the current status of environmental conditions in the region among higher income respondents. Regulation concerns and concerns about costs are also displayed to ensure that this decision making process is fully informed of how household income might effect views and behaviors. Findings repeatedly confirm that those with higher household income generally have a slightly more positive view of the current environmental quality of the lake and watershed. Many questions in which income seemed to correlate show inconsistent patterns with outliers in one or more income bracket; however, general trends are discussed.

Mean Level of Agreement that Taking Action is Too Expensive Broken Down by Annual Houshold Income Before Taxes

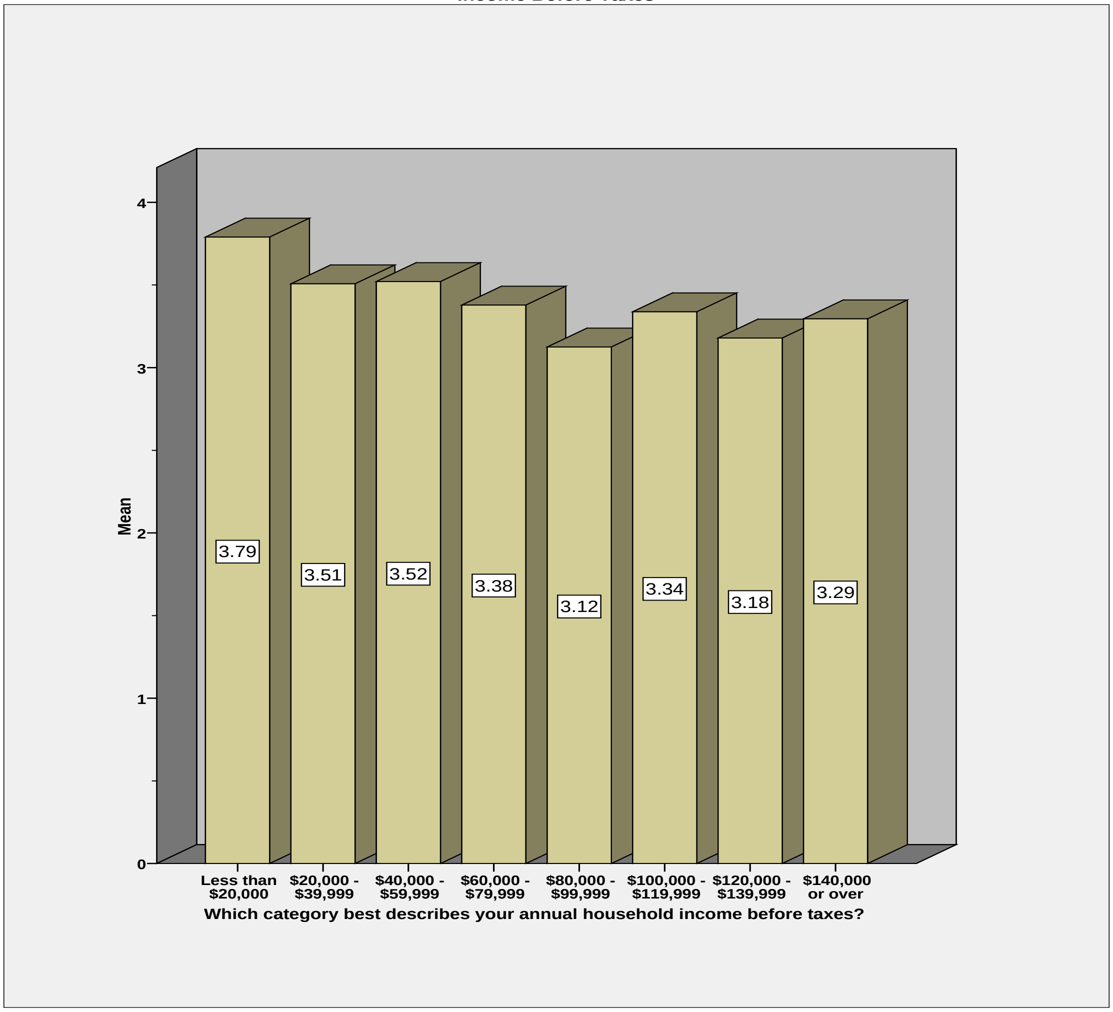


The view that taking action to protect water quality is too expensive, was more prominent among lower income brackets, although generally, the idea was responded to with slight disagreement across the board.

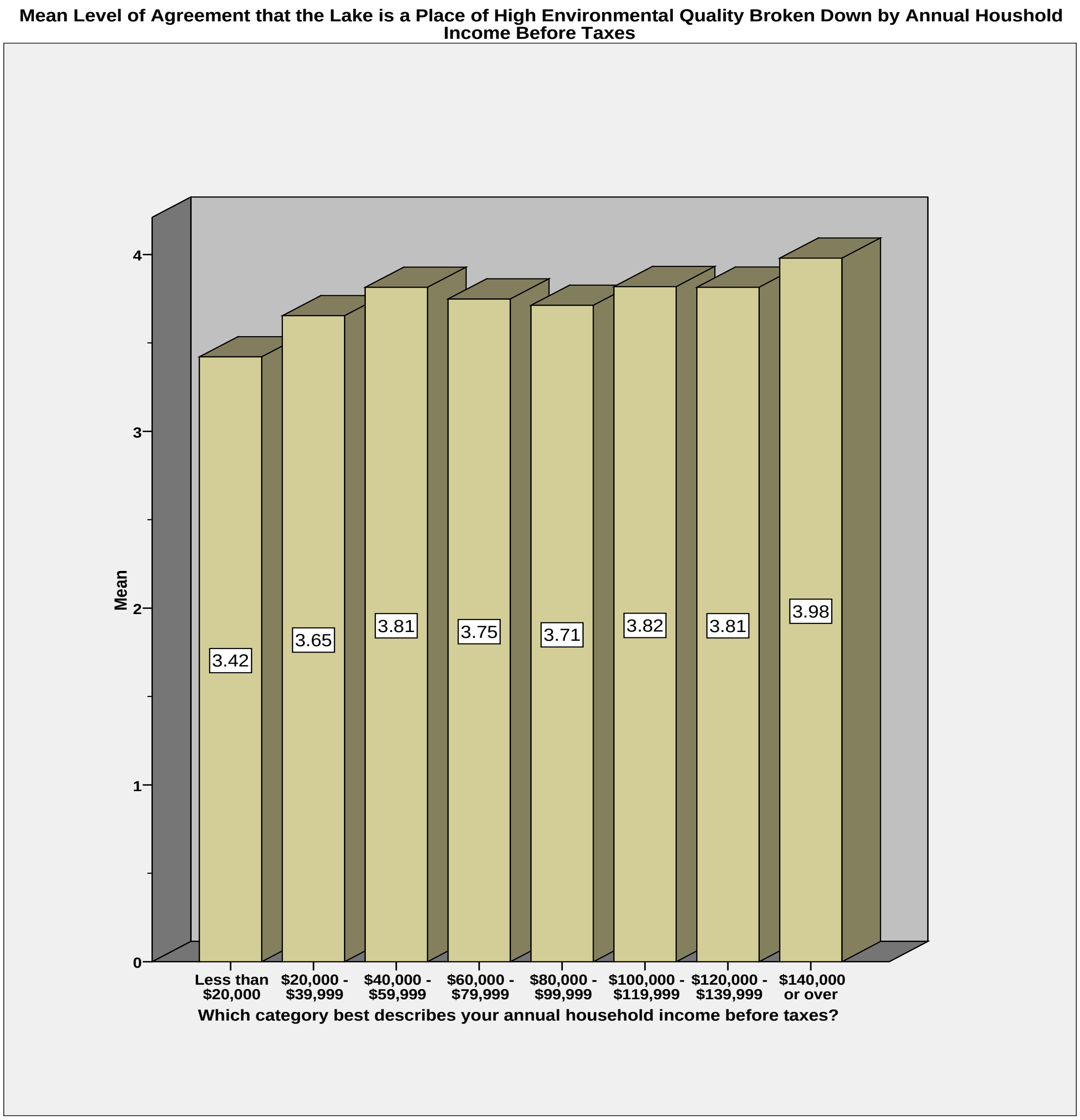


Those of higher income generally responded with less agreement that the lake has too many buildings on the shore.

Mean Level of Agreement that the Lake has been Damaged by Local Land Uses Broken Down by Annual Houshold Income Before Taxes

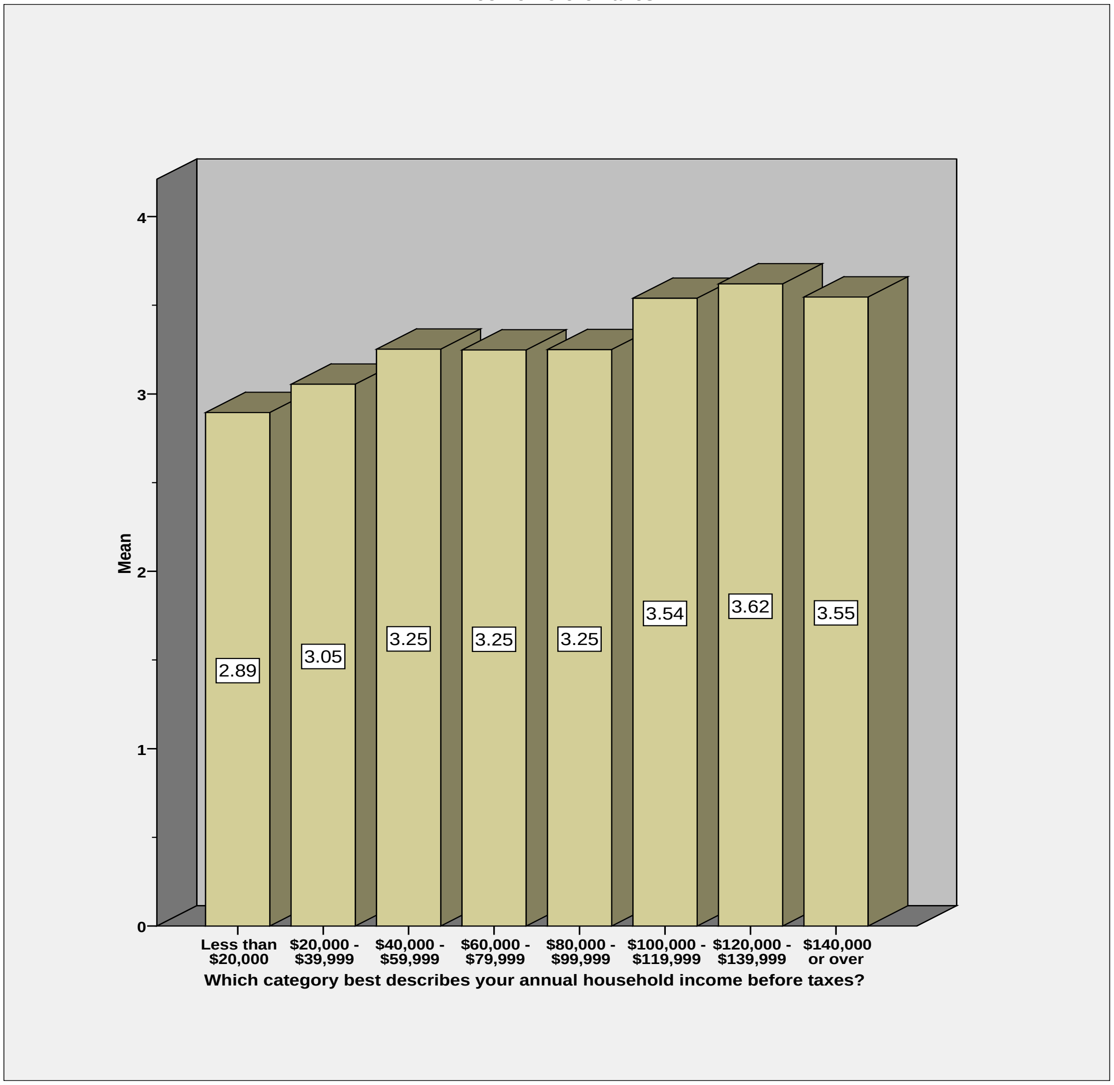


There was a general but inconsistent trend for individuals of lower household income to agree more strongly that the lake has been damaged by local land uses.



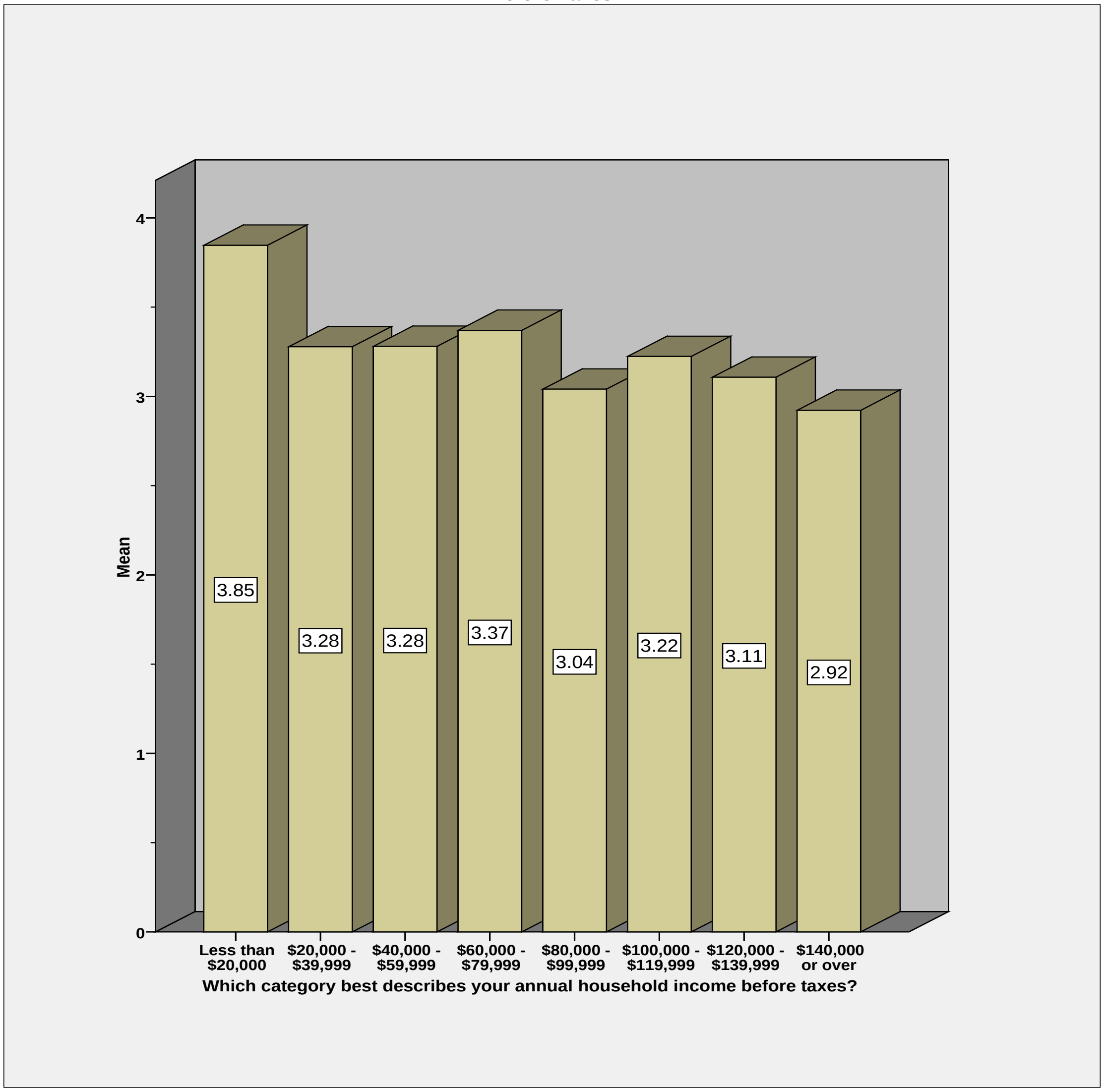
Mean agreement that the lake is a place of high environmental quality went up slowly with household income.

Mean Level of Agreement that the Lake is a Place to Escape from Civilization Broken Down by Annual Houshold Income Before Taxes

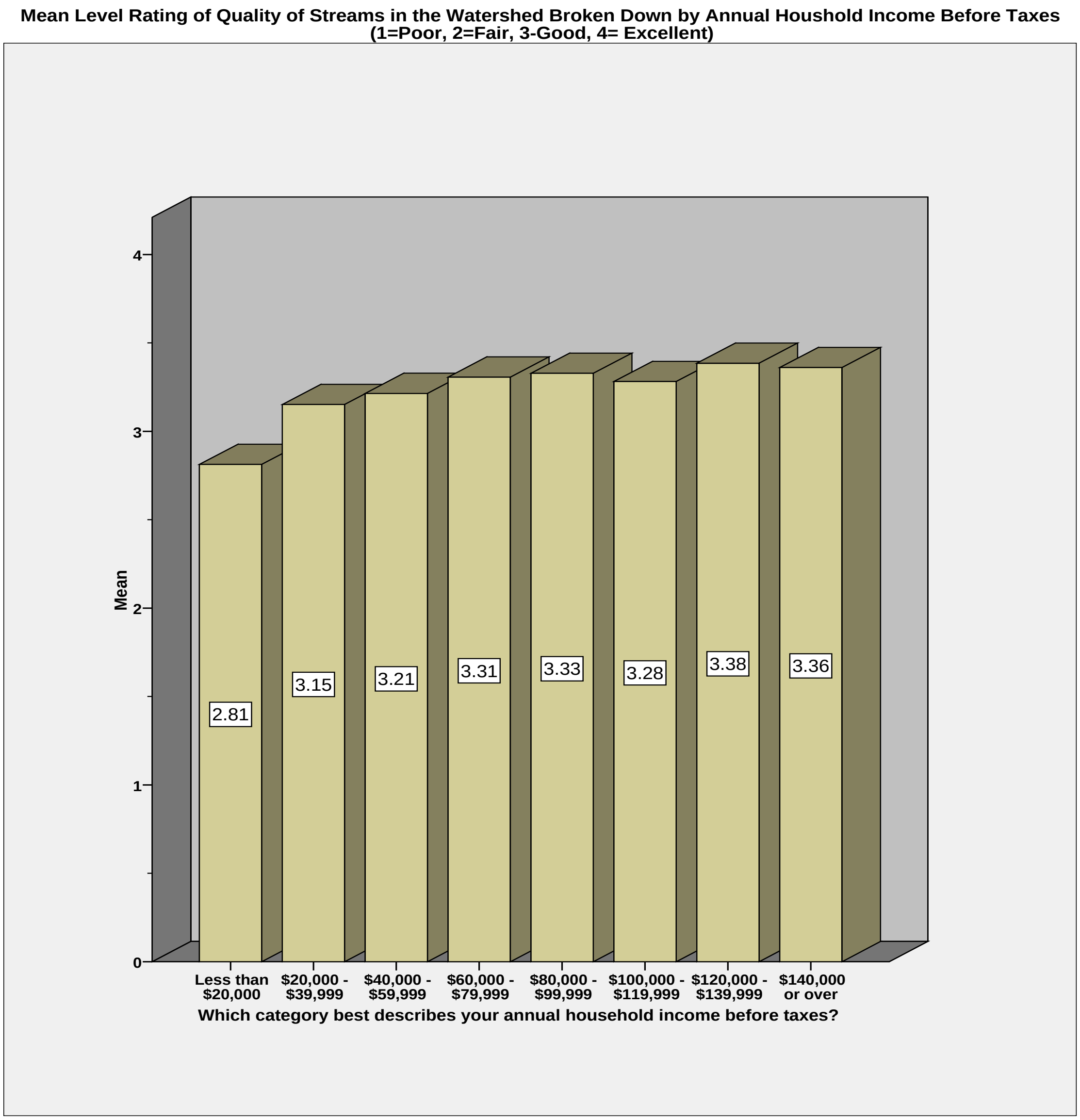


On the average, agreement that the lake is a place to escape civilization went up with household income.

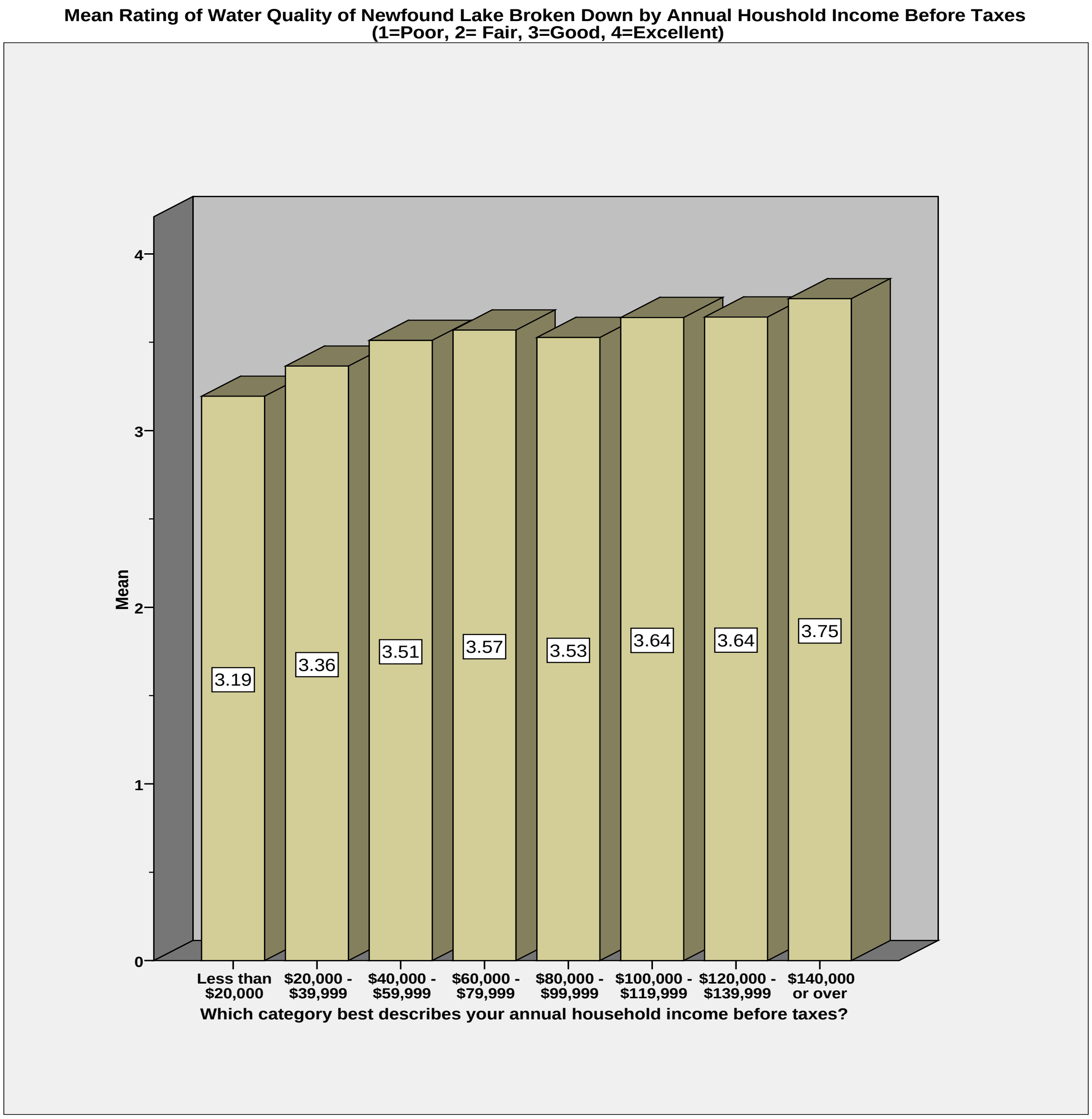
Mean Level of Agreement that the Lake has Too Many People Using it Broken Down by Annual Houshold Income Before Taxes



Generally, those with lower total household income were more likely to agree that the lake has too many people using it.

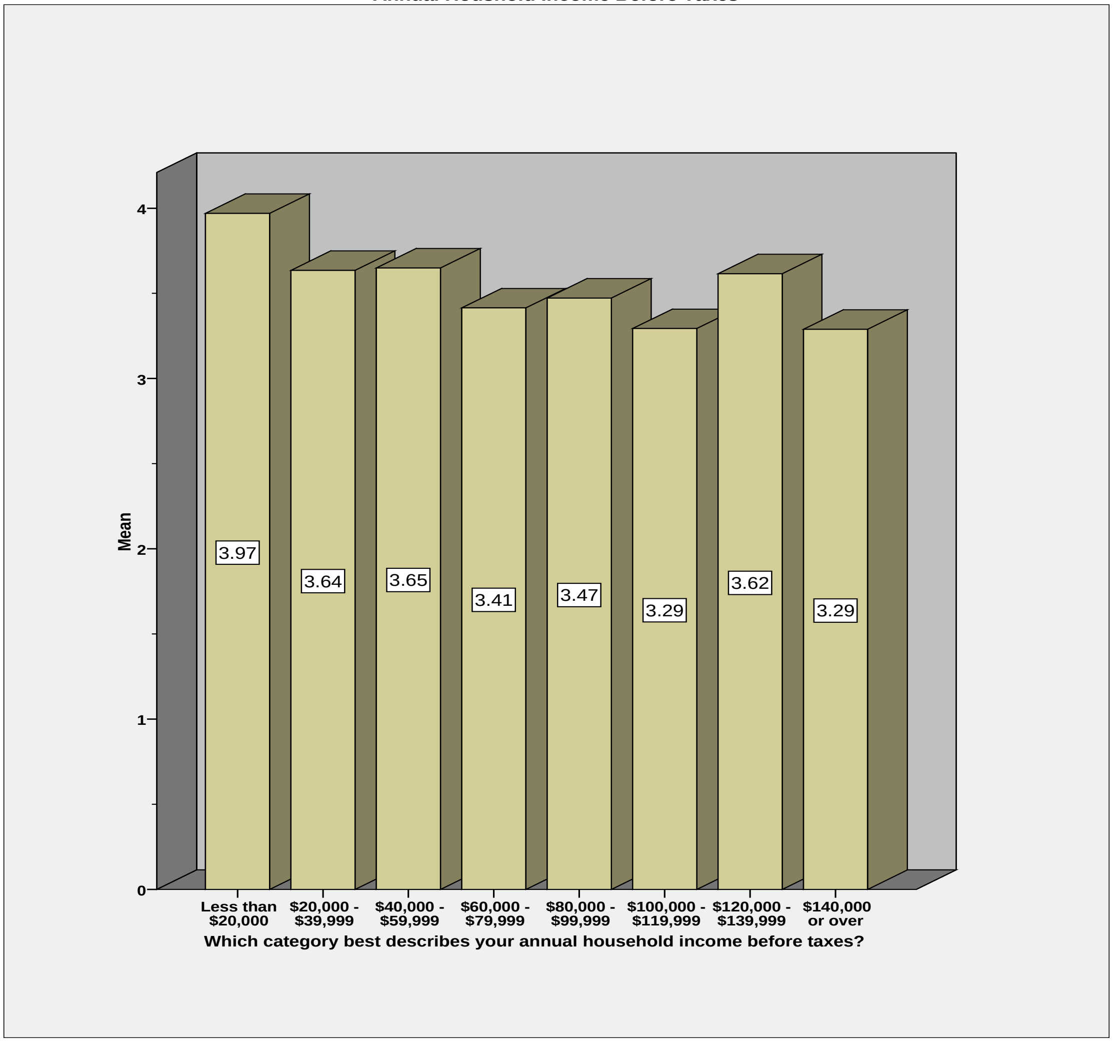


Those with higher total household income one the average rated water quality of streams in the watershed as well as the lake itself higher than those with lower household income.



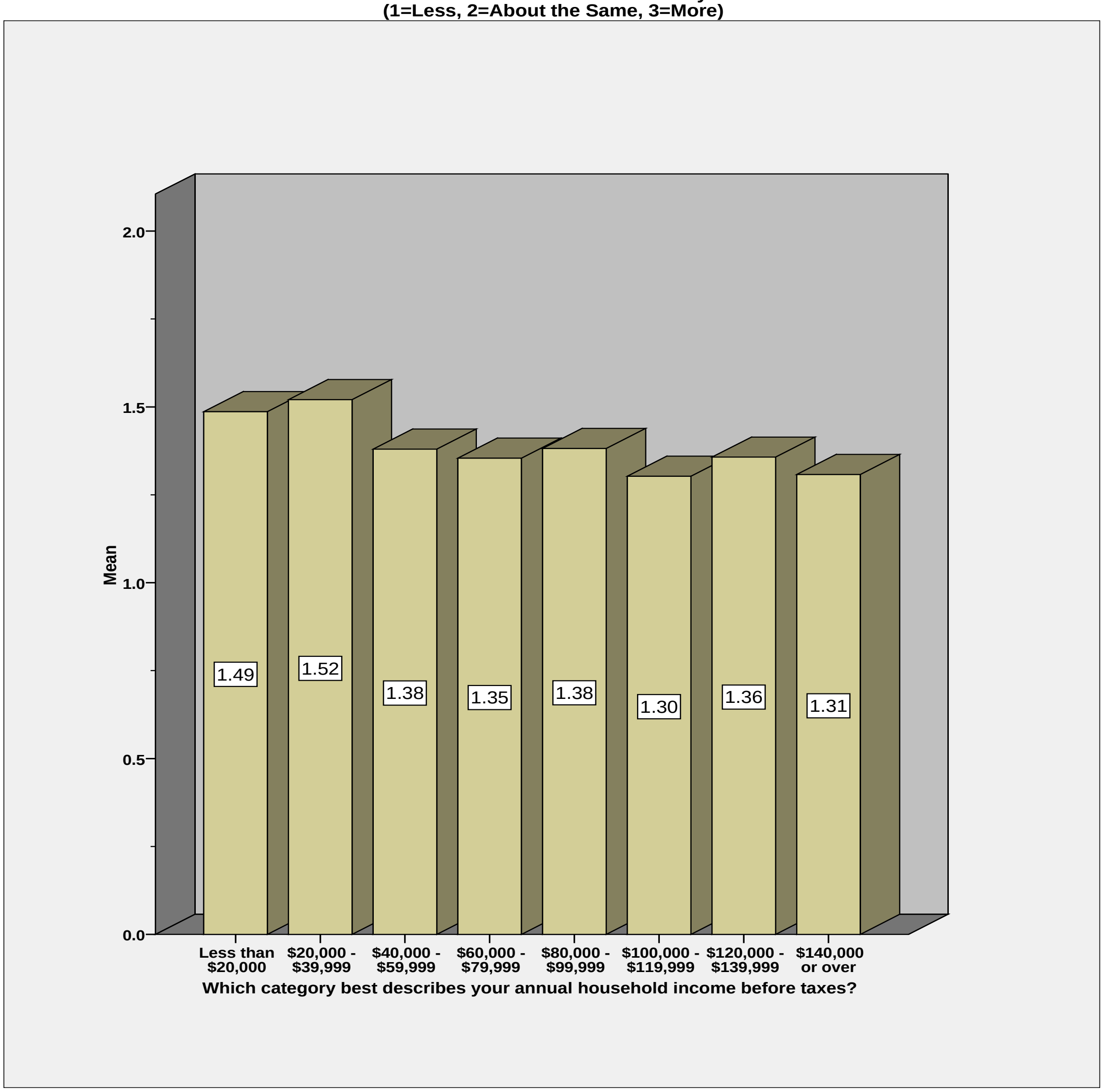
The water quality of the lake is viewed more positively, on the average, by those with higher income.

Mean Level of Concern about the Impacts on Landowners from Regulations to Protect Water Quality Broken Down by Annual Houshold Income Before Taxes



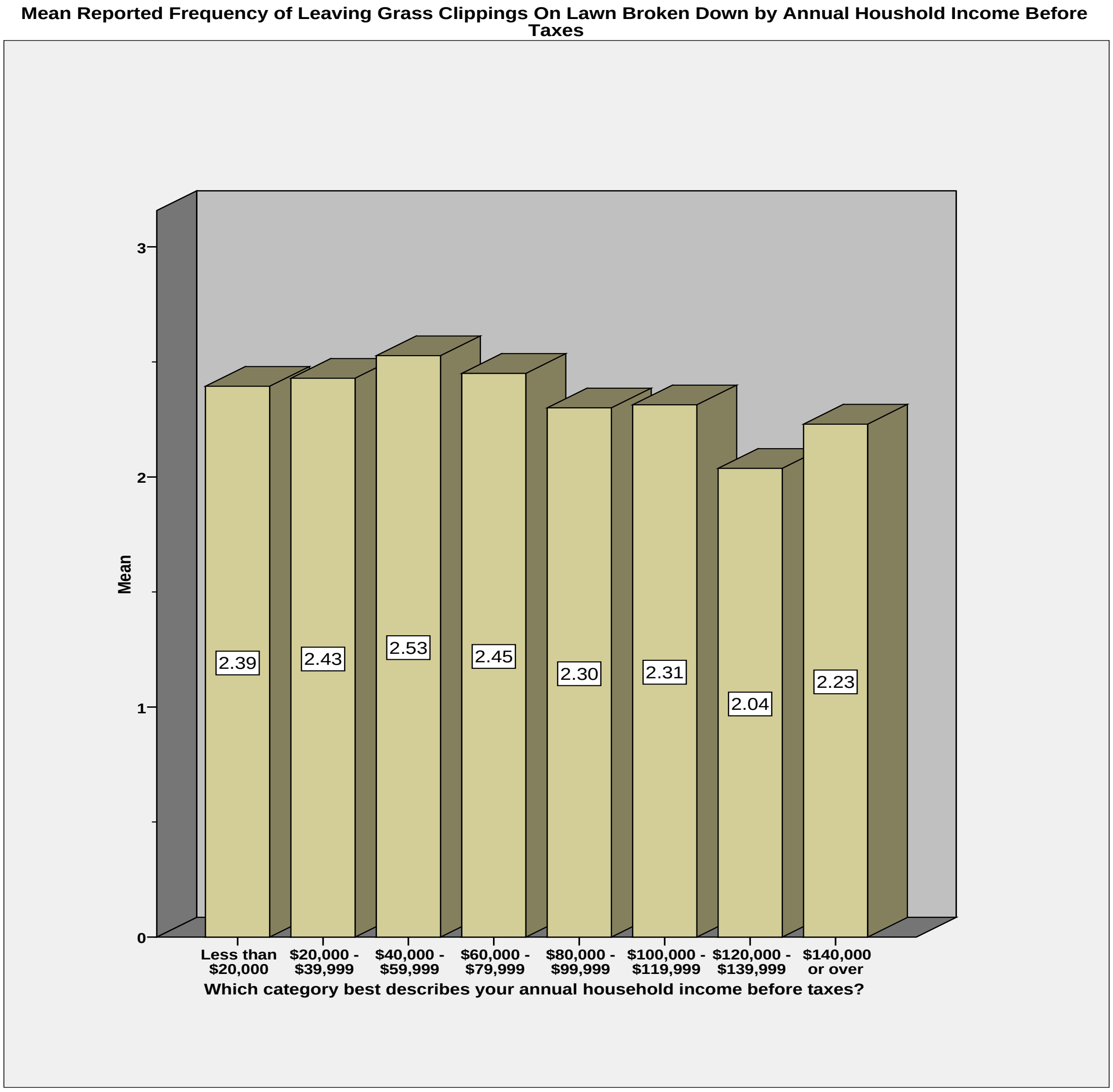
Individuals of lower income showed a greater mean level of concern about the impacts of regulations on landowners.

Mean Desired Future Land Use for National Chain Stores Broken Down by Annual Houshold Income Before Taxes
(1=Less, 2=About the Same, 3=More)



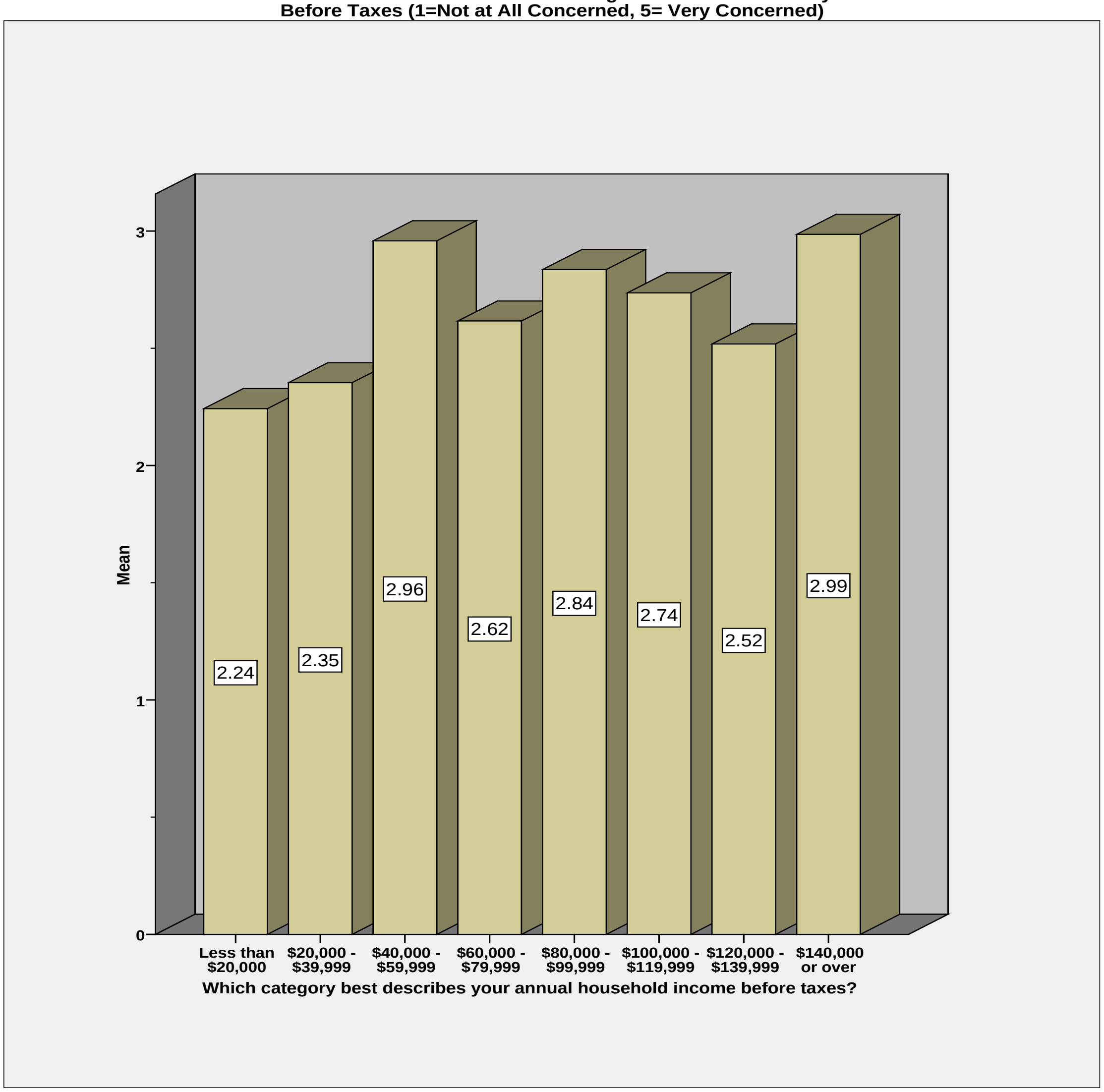
The general trend shows average desired land use for national chain stores going down as income increases, and further analyses indicate that this is possibly a primary function of education, and not income, as income correlates with education, and education showed a very strong correlation to this question.

Further analyses of this relationship indicate that education is likely a spurious variable creating a correlation between income and desires for more national chain stores. Given that average response by income shows relatively small changes, but that within most income groups education seems to correlate to these responses, it is likely that income is not the primary factor in this correlation, but rather is a factor more directly connected to education, which does seem to have a direct effect on desired land use for national chain stores.

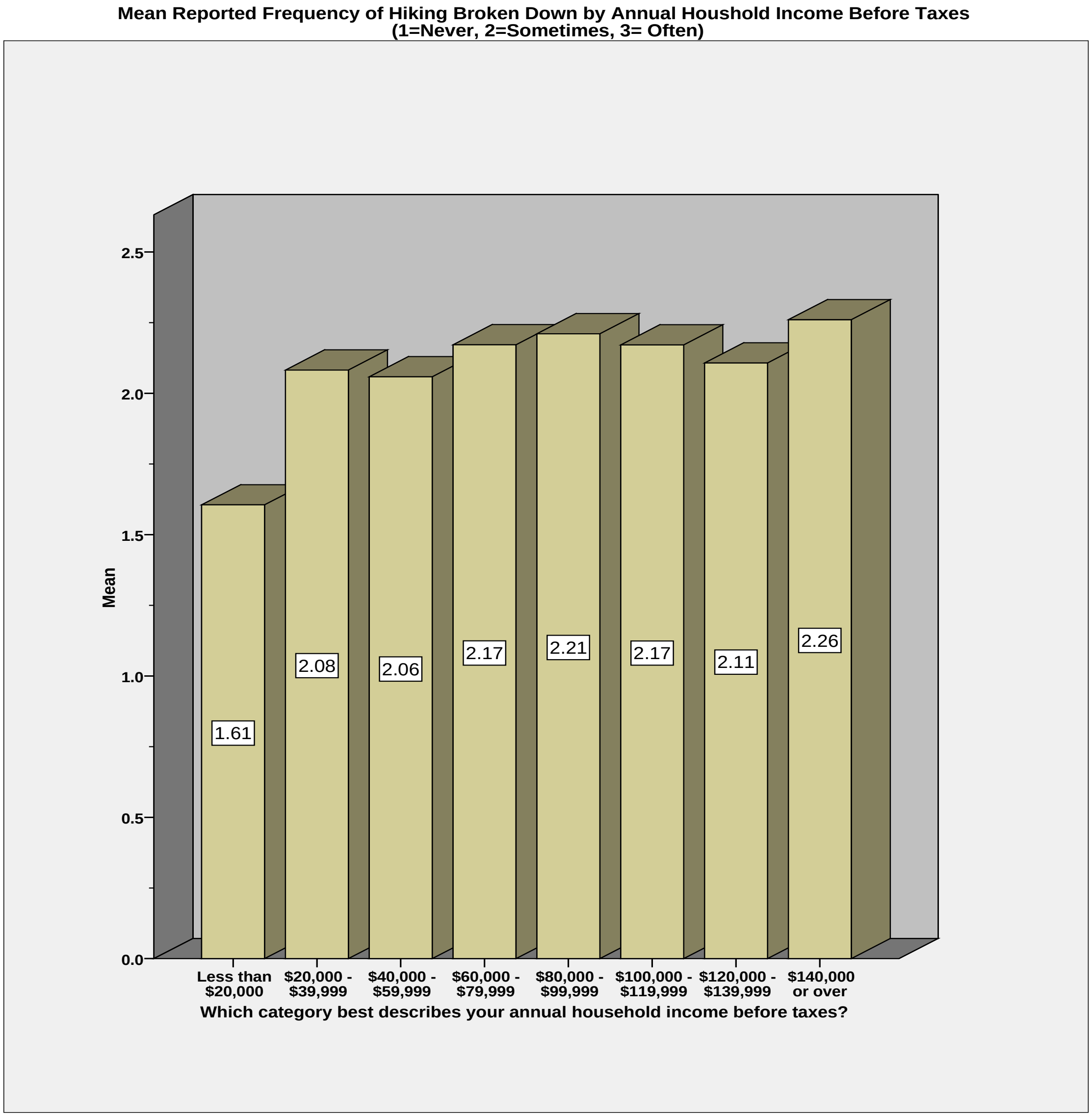


Most relationships between reported environmentally responsible behaviors and income showed only a few consistent patterns; among those was a general trend among lower household income individuals to be more likely to leave grass clipping on the lawn. Picking up pet waste and encouraging local businesses to carry phosphorous free fertilizers showed similar patterns, with slightly more reported environmentally responsible behaviors among lower income individuals.

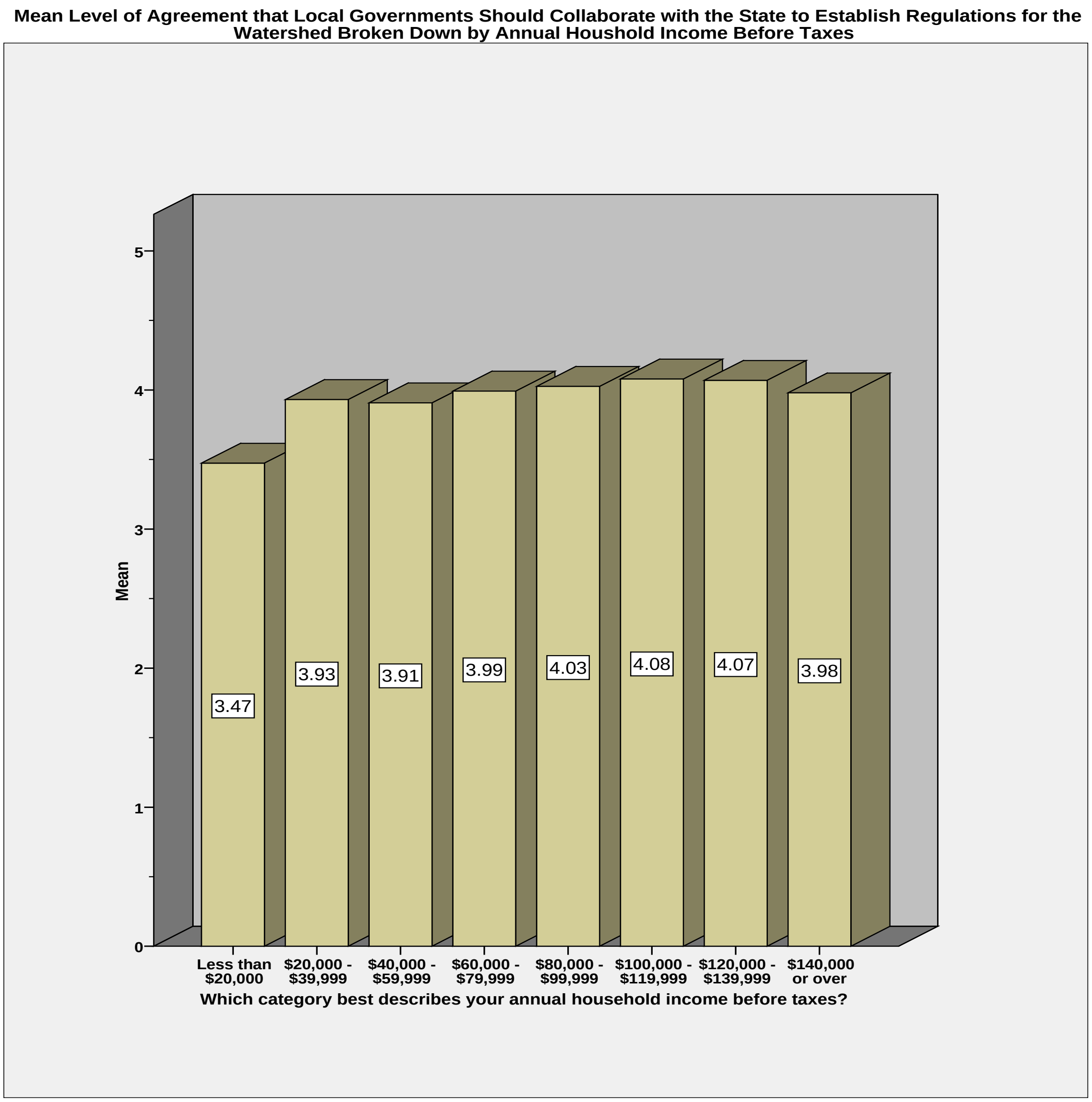
Mean Level of Concern if Wind Turbines Were Installed on Ridgelines Broken Down by Annual Houshold Income Before Taxes (1=Not at All Concerned, 5= Very Concerned)



General trend was for higher income respondents to show a greater level of concern at the prospect of electric wind turbines on ridgelines.



Respondents with higher household incomes tended to report hiking more often.

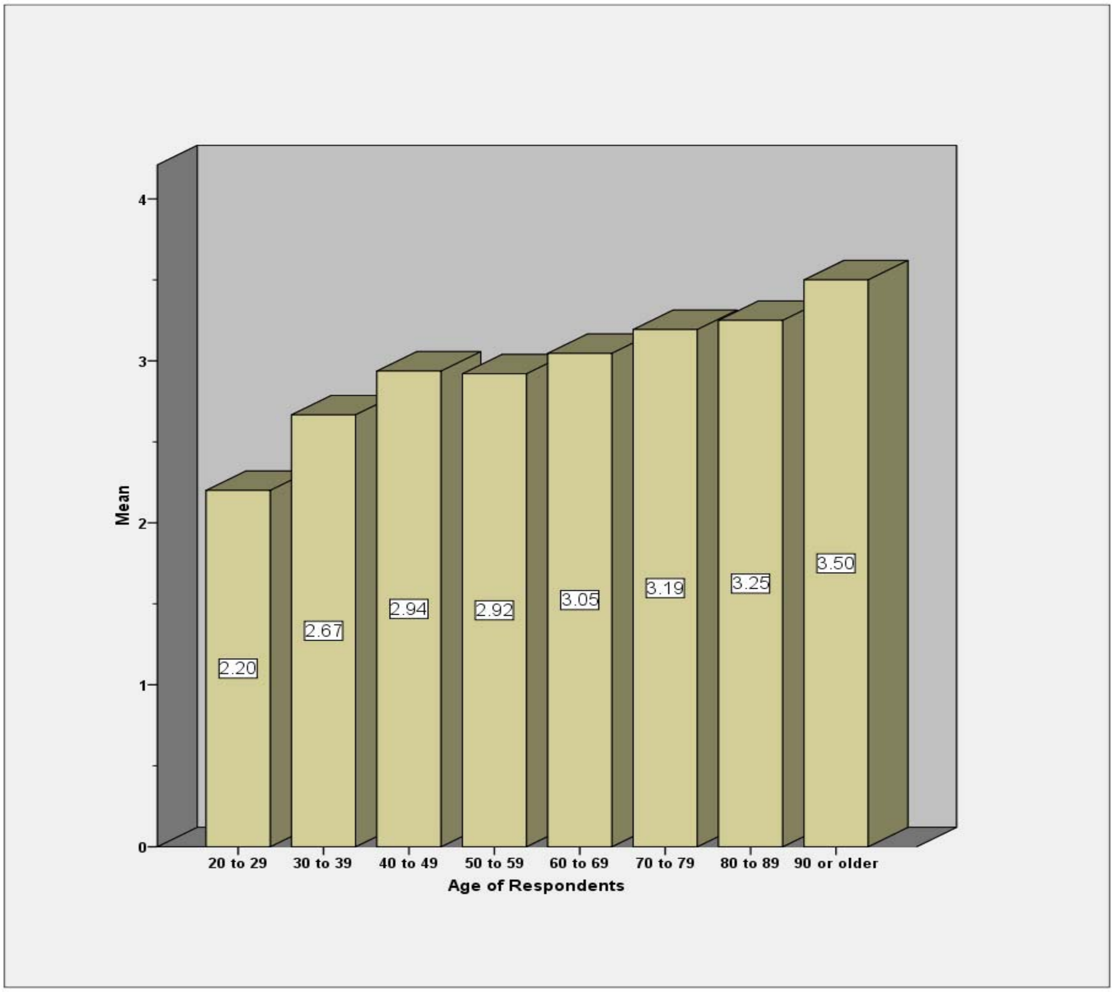


As household income increased, so did mean agreement that local governments should collaborate with the State to establish regulations to protect water quality.

Age of Respondents: Key Differences

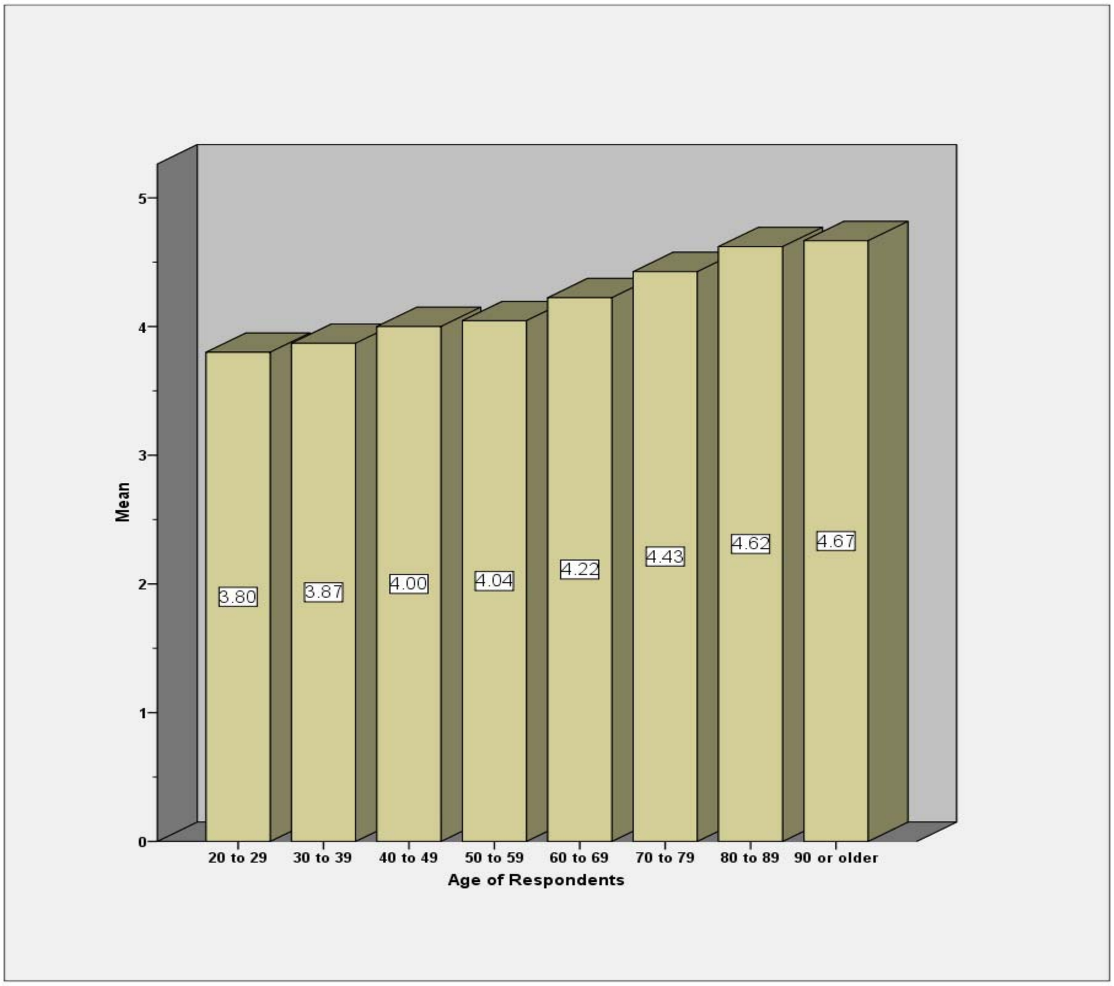
Age of respondents showed a number of correlations with responses. Selected questions were chosen primarily for relevance to project objectives.

Mean Level of Agreement that Respondent's Household does not have Much Impact on the Watershed Broken Down by Age



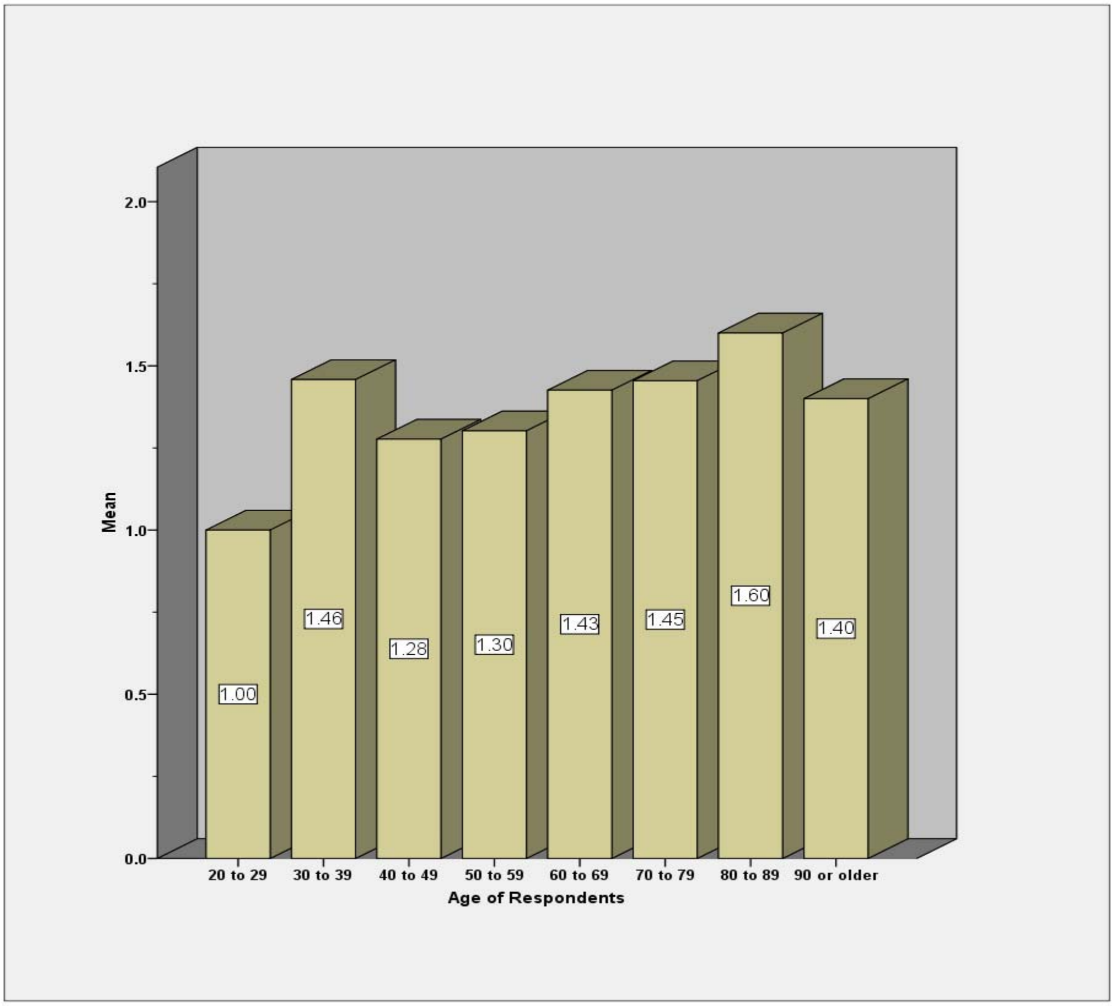
Older respondents were more likely to agree that their household did not have much impact on water quality. Younger respondents generally responded with disagreement.

Mean Level of Importance of Protection of Private Property Rights Broken Down by Age



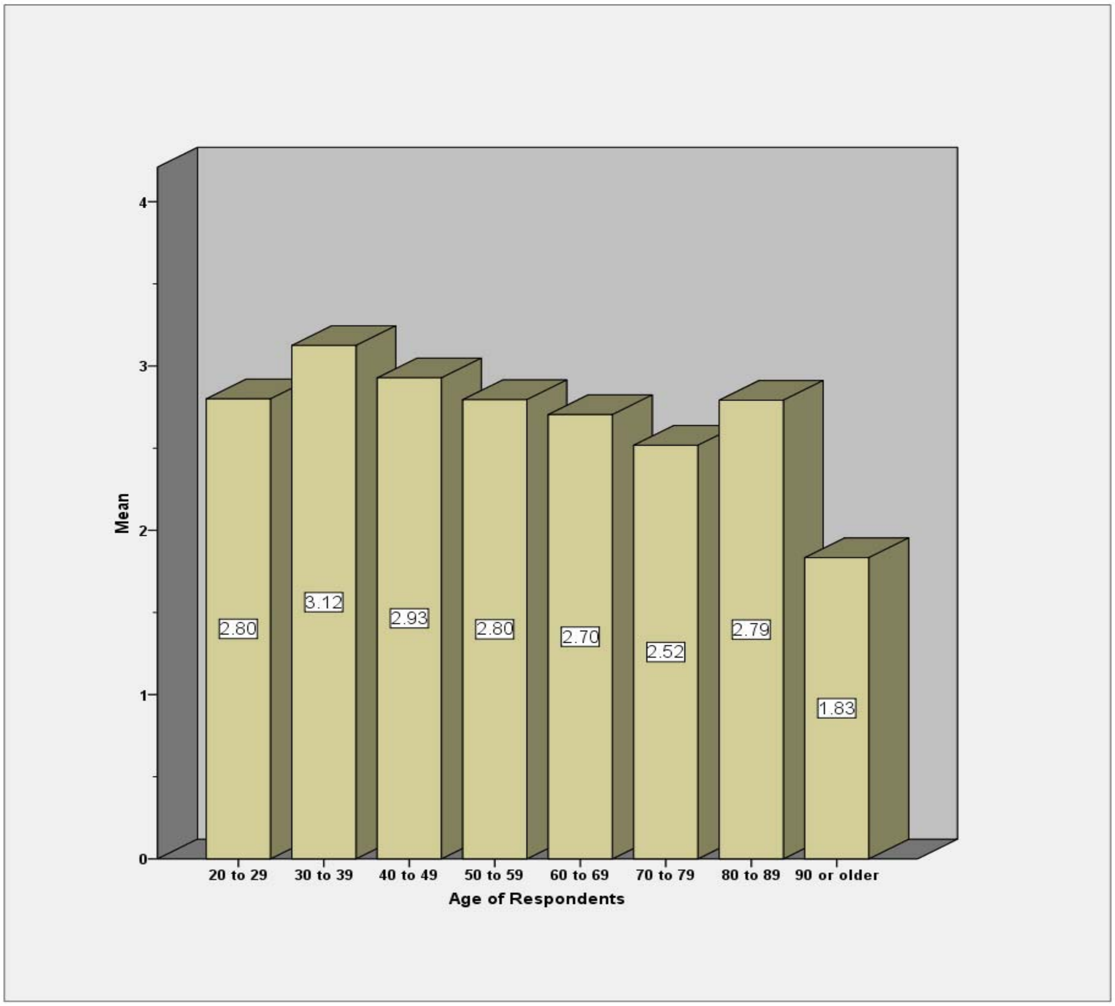
Older respondents showed a higher level of concern about protecting private property rights in general than younger respondents.

Mean Desired Land Use for National Chain Stores Broken Down by Age (1=Less, 2= About the Same, 3=More)



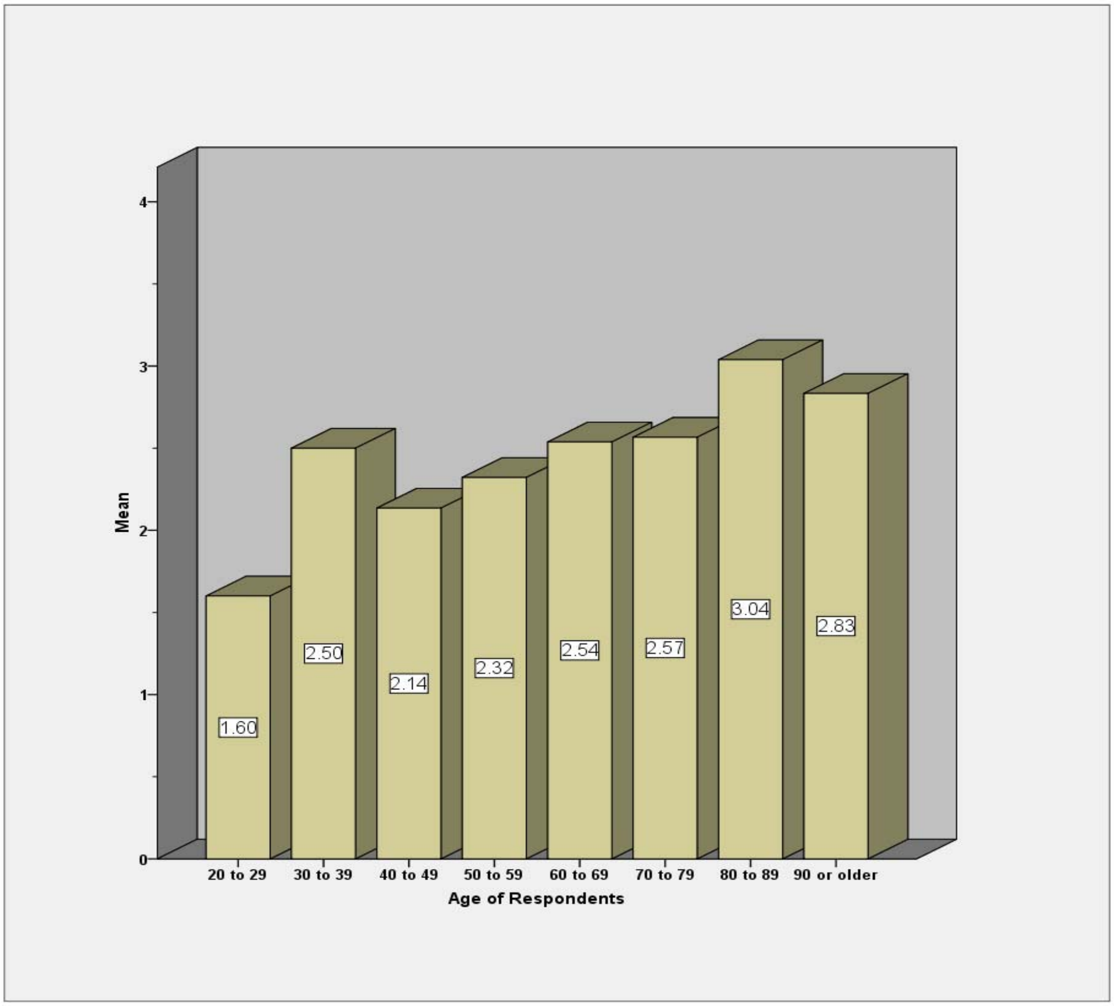
While correlation was not consistent, in general younger respondents were more firmly against national chain stores as a perspective land use than older respondents. Please note that only five respondents were in the 20 to 29 age range, all five responded that they would like to see less national chain stores.

Mean Predicted Level of Usefullness of NLRA Website Broken Down by Age (1=Not at all Useful, 2=Somewhat Useful, 3=Useful, 4=Very Useful)



Older respondents were generally less likely to see an NLRA website as useful, watershed specific internet site, in the same section followed a similar trend.

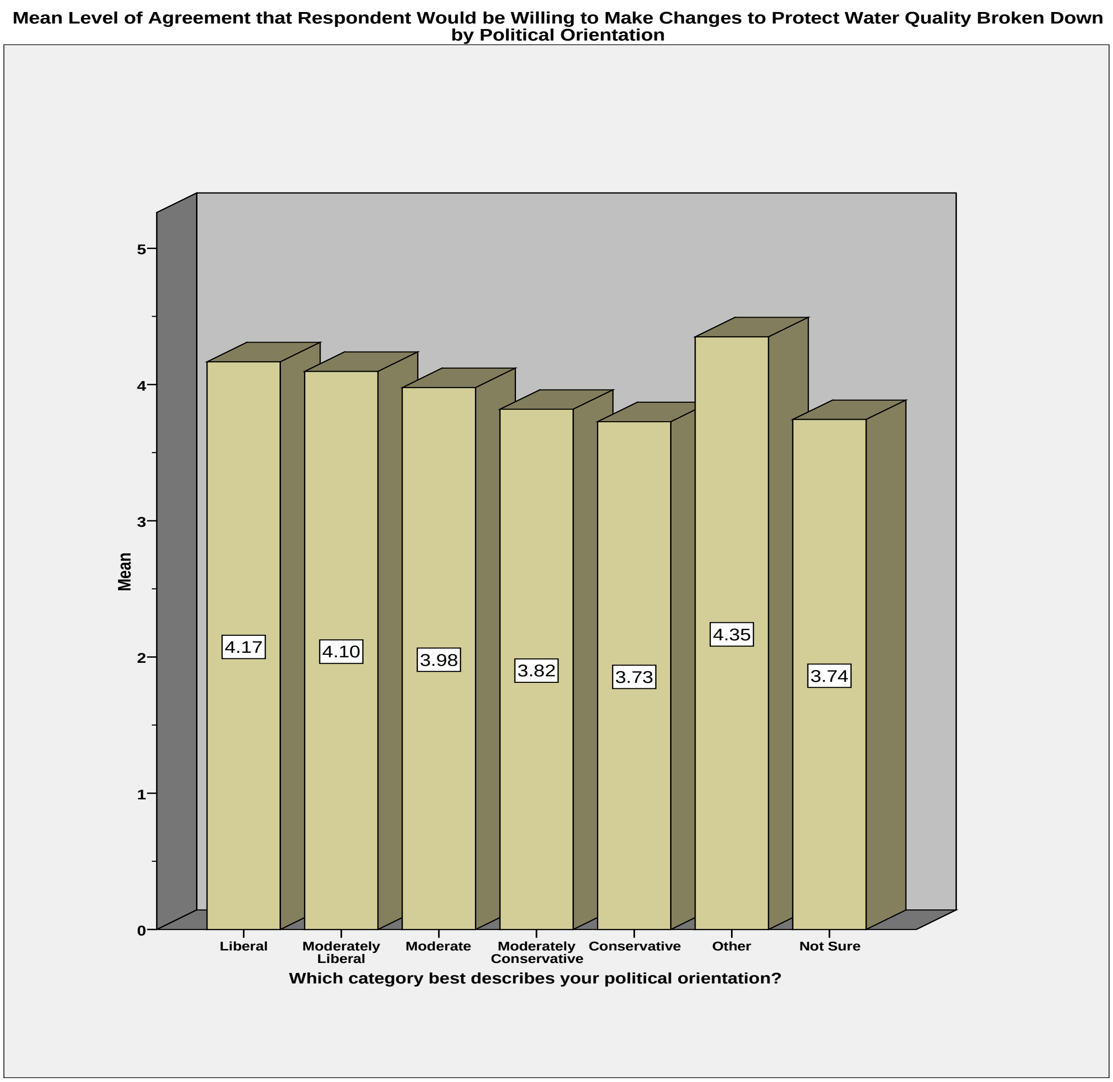
Mean Predicted Level of Usefullness of Town Meetings Broken Down by Age (1=Not at all Useful, 2=Somewhat Useful, 3=Useful, 4=Very Useful)



Younger respondents were less likely to see town meetings as useful, public meetings followed a similar trend.

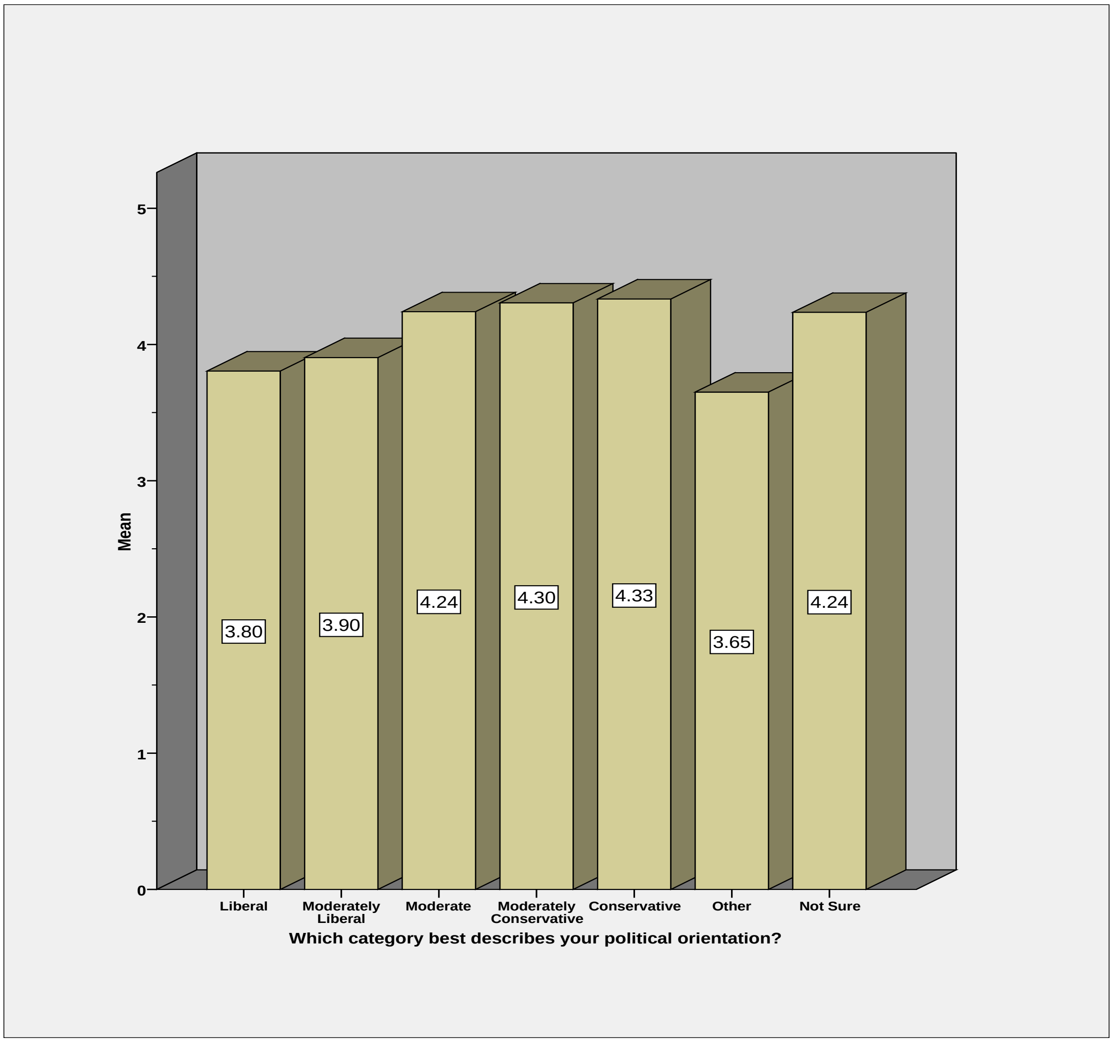
Political Orientation

Respondents' self identified political orientation correlated to number of questions including respondents' perceived environmental status of the lake, respondents' willingness to change and be regulated to protect environmental quality, their trust in sources of information, and beliefs about the level at which regulations should be implemented. Please note that the final two columns indicate "other" and "not sure" for political orientation, and are therefore not part of the scaled liberal – conservative continuum.



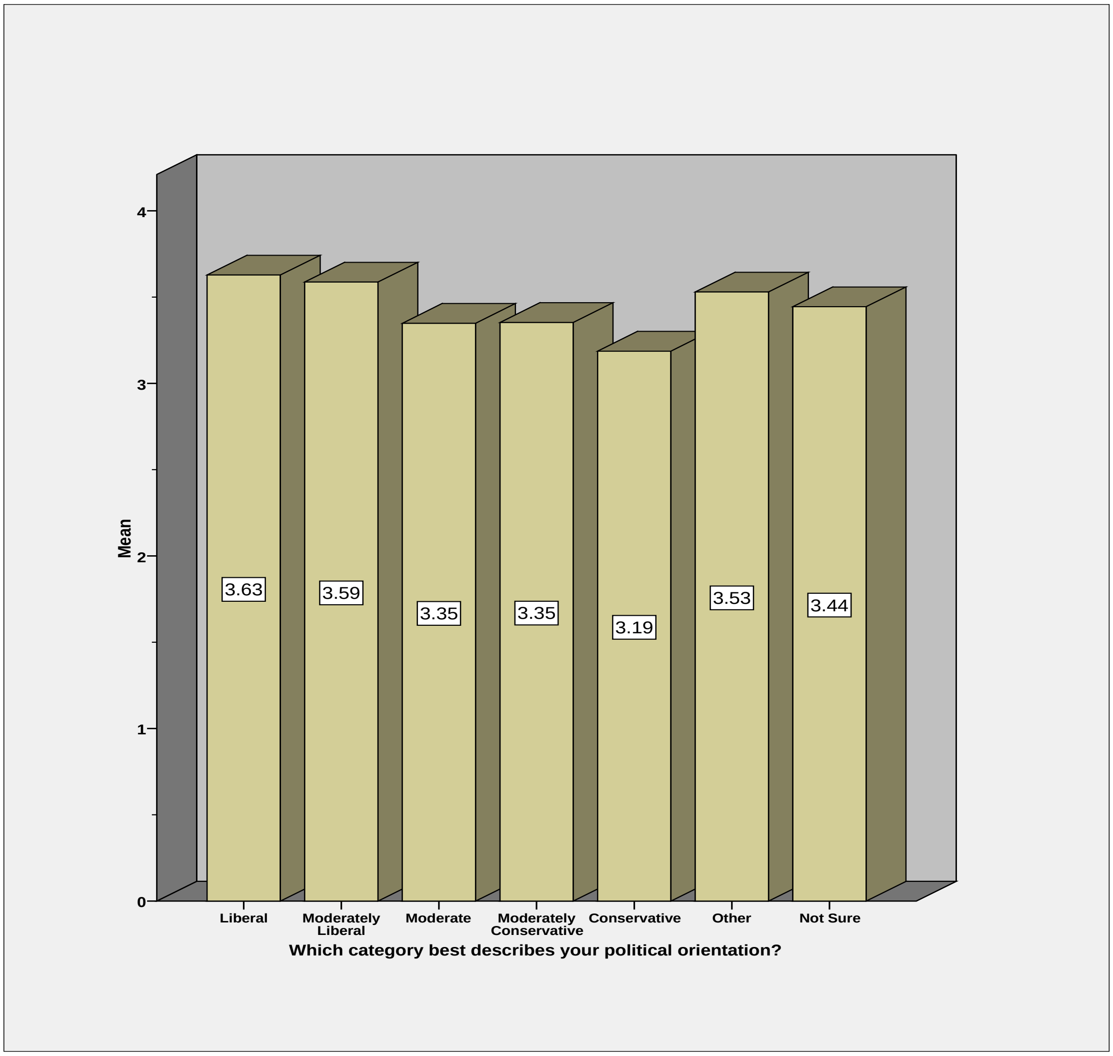
Generally, as political persuasion moves toward conservative willingness to make changes to protect water quality decreases.

Importance of Protecting Private Property Rights in the Watershed Broken Down by Political Orientation



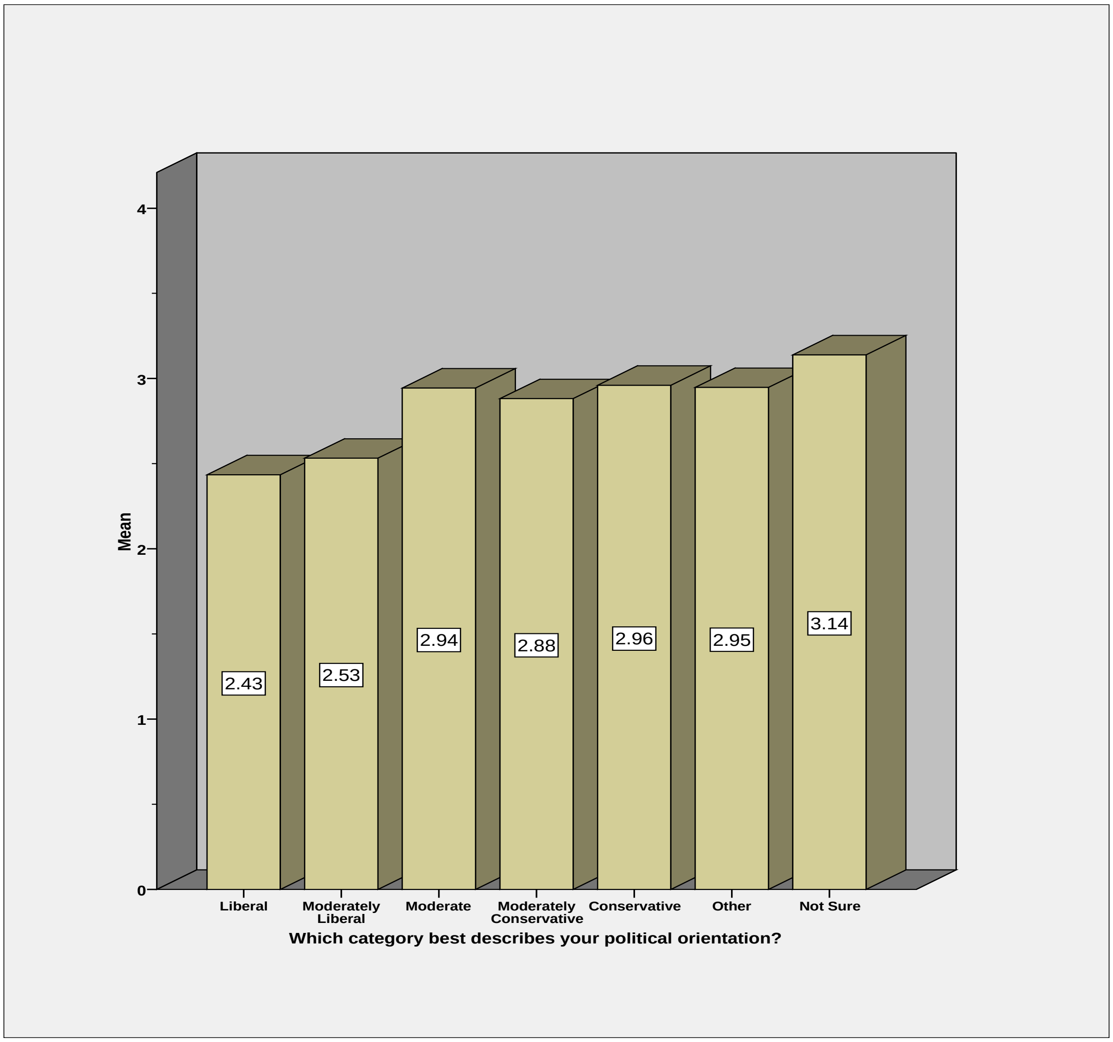
Those who identified themselves as more liberal placed less importance on the protection of private property rights.

Mean Level of Agreement that the Lake has been Damaged by Local Land Uses Broken Down by Political Orientation



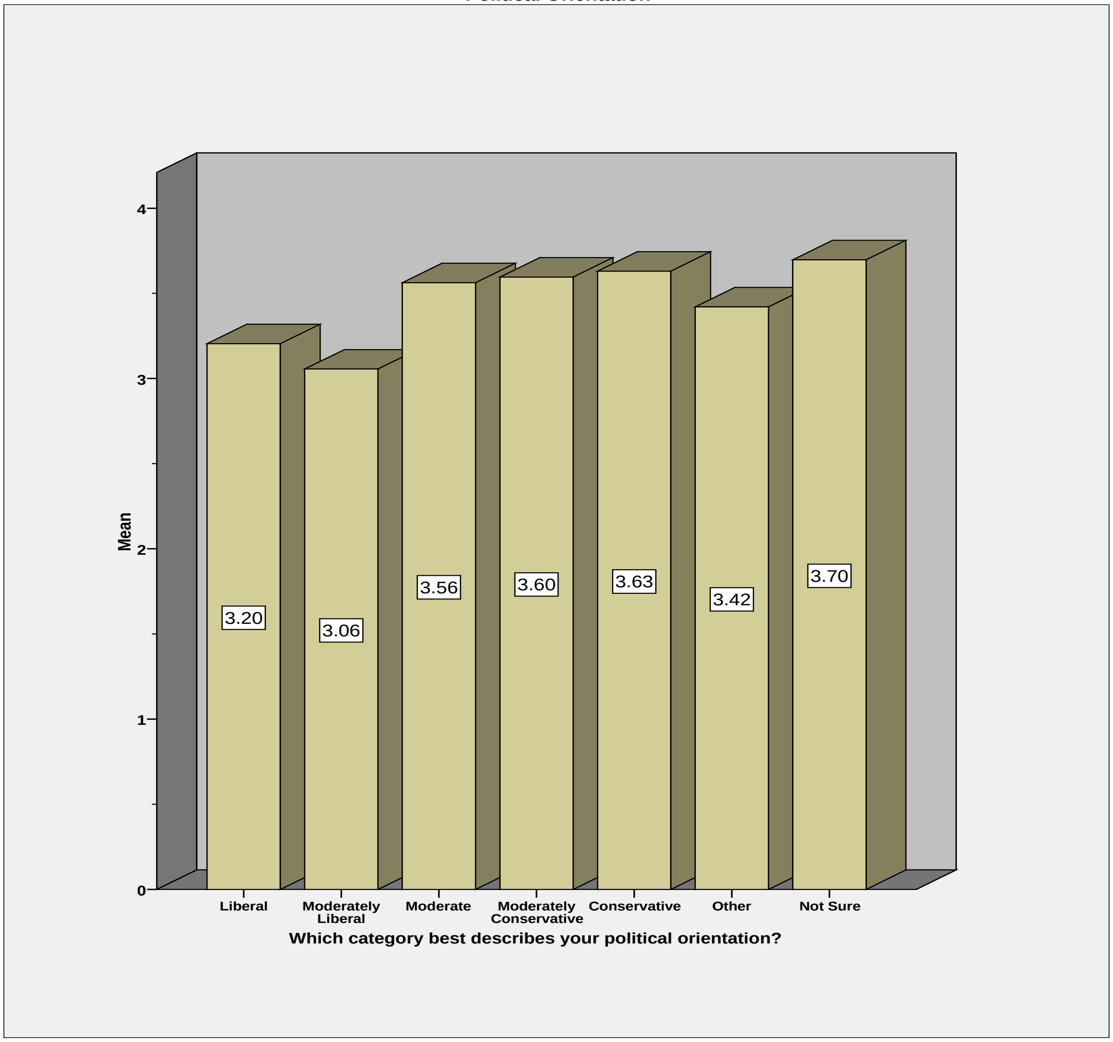
Mean responses indicate a tendency for those who identified themselves as liberal to view the watershed as more damaged by local land uses.

Mean Level of Agreement that the Lake is a Pristine Wilderness Broken Down by Political Orientation



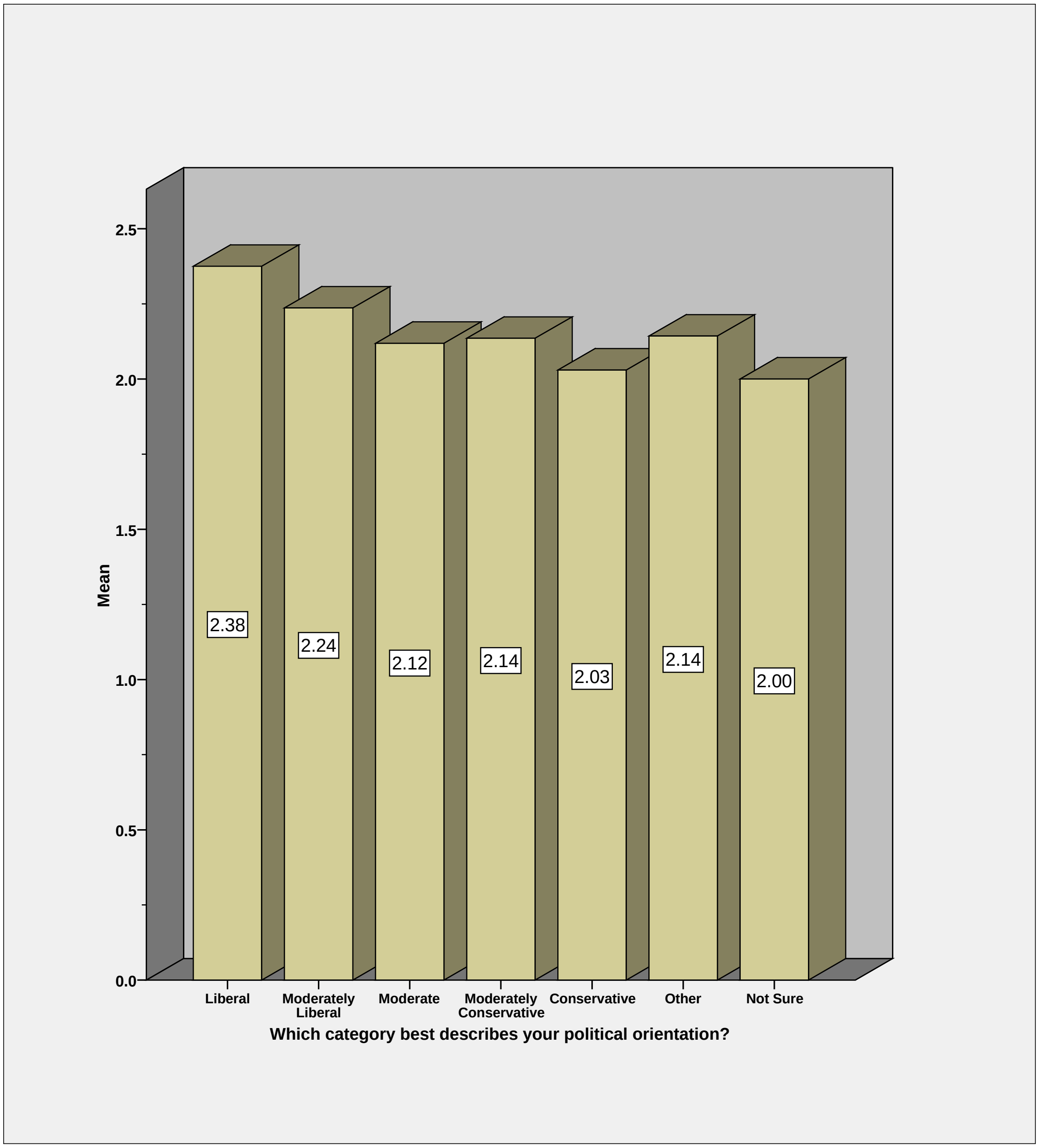
Those who identified themselves as conservative tended to agree more that the lake is a pristine wilderness.

Mean Level of Concern about Impacts on Landowners from Regulations to Protect Water Quality Broken Down by Political Orientation

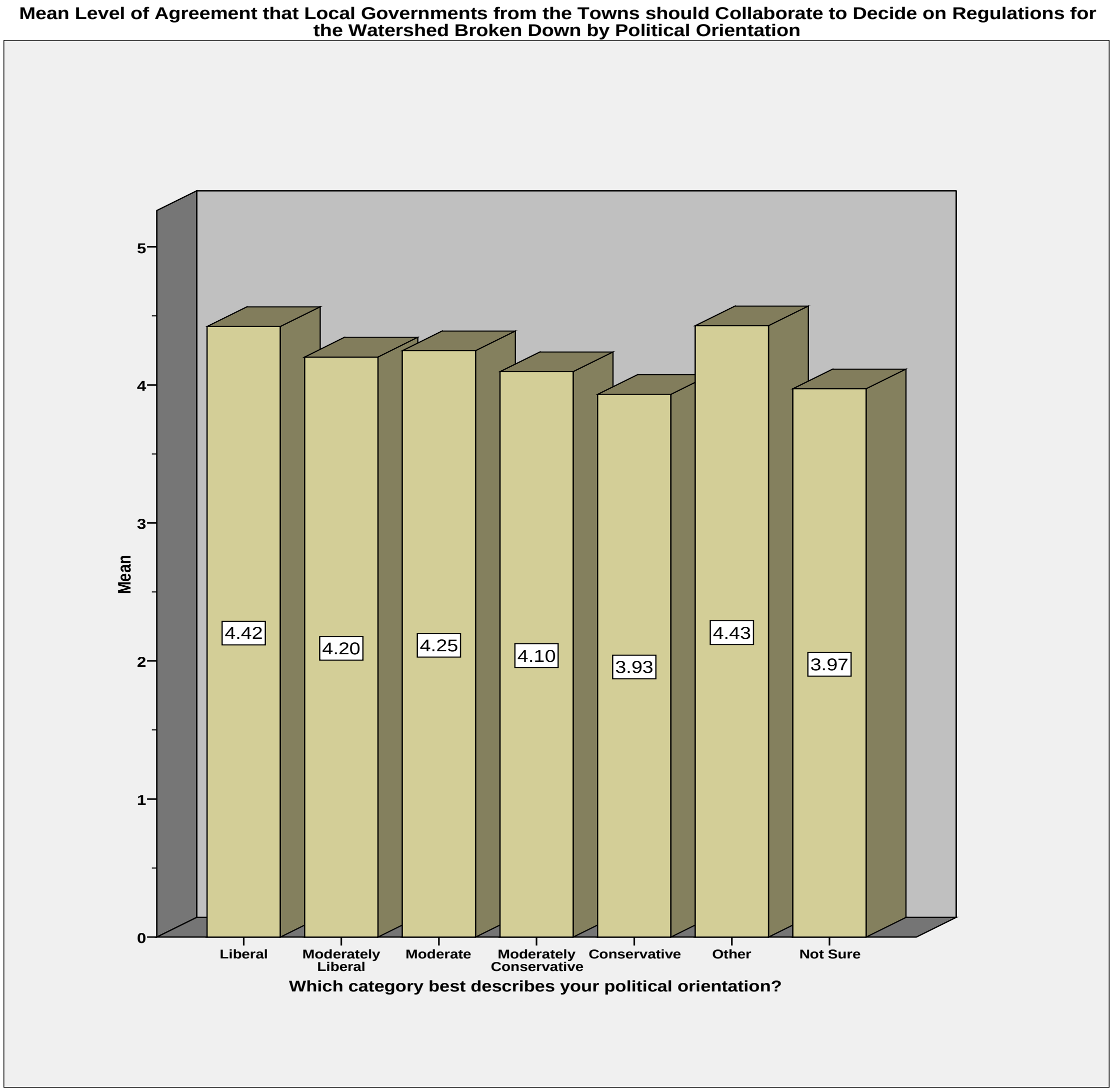


Those who identified themselves as conservatives indicated greater mean levels of concern about impact on landowners from regulations to protect water quality.

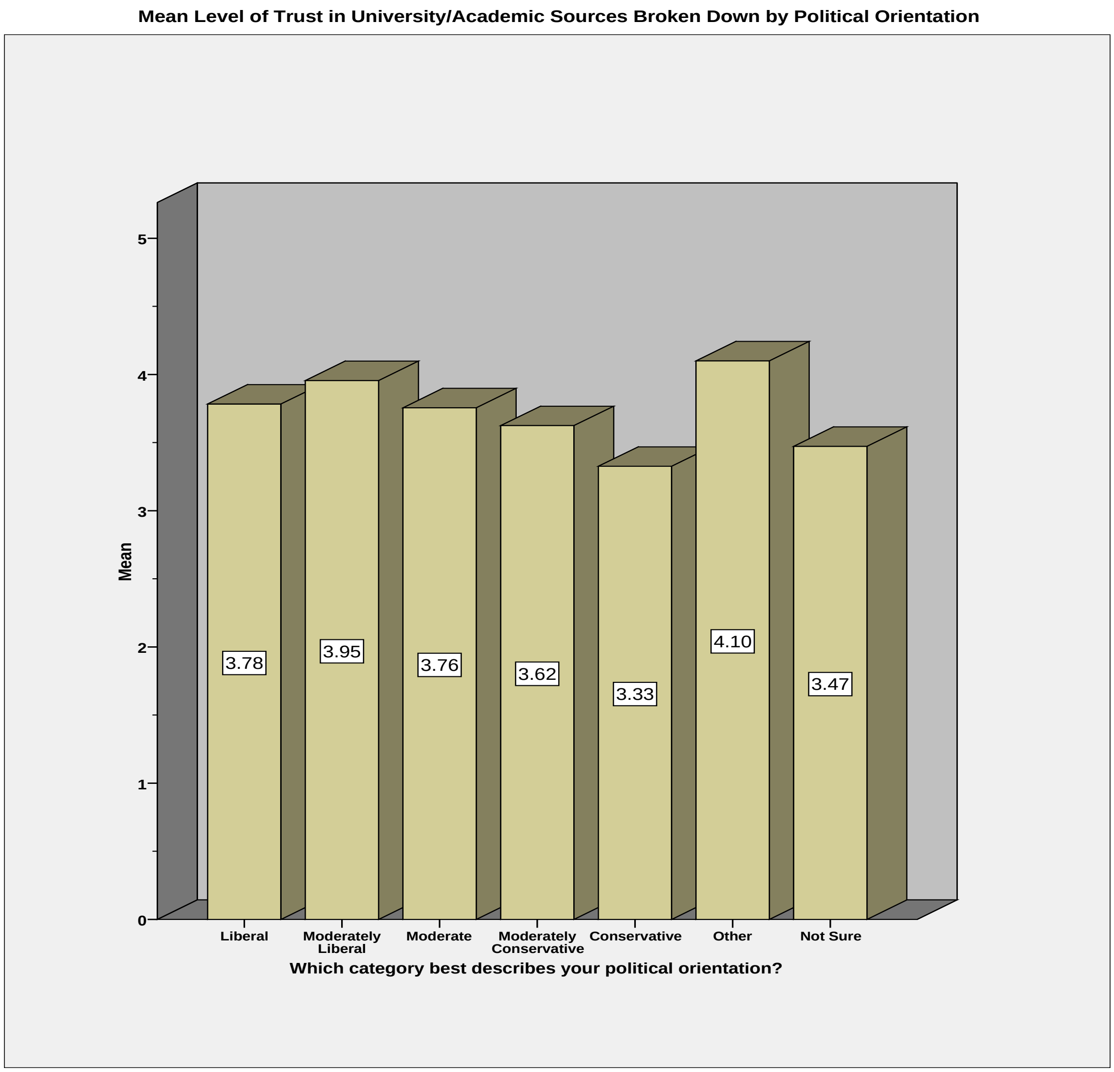
Mean Reported Frequency of Hiking Broken Down by Political Orientation (1= Never, 2= Sometimes, 3- Often)



Those who identified themselves as liberal tended to report hiking more frequently.



Those who identified themselves as liberals tended to agree more that local governments should collaborate to decide regulations for the watershed.



Generally speaking those who identified themselves as conservative indicated a lower level of trust in academic sources than those who identified themselves as moderately liberal or liberal.

Pearson's Correlations between Respondents' Environmental Values and Responses to Questionnaire Items

The strength of relationships between respondents' environmental values (measured using the New Ecological Paradigm (NEP) scale, a long-standing, empirically tested and verified tool that rates the strength of environmental values) and responses to questionnaire items was conducted to determine if respondents' environmental values influence perceptions of the watershed and willingness to change in order to mitigate environmental degradation. The following charts show statistically significant relationships, ones where there is confidence that the relationship between environmental values and other variables exists in the general population of the watershed. Pearson's Correlations (r) also indicate the direction of the relationship between variables. Negative Pearson's Correlations indicate that as values increase, it correlates with a decrease in the measure of the other variable; a positive correlation indicates that as values increase the measure of the other variable also increases. The NEP scale ranges from 15 – 75, 15 being the lowest and 75 being the highest level of environmental values. The strength of the relationships is indicated in the chart with asterisk. One asterisk indicates a weak relationship and two indicate a moderate to strong relationship.

There were significant negative relationships between environmental values and how respondents rated aspects of the watershed as they exist now; as a respondent's level of environmental values increased, their agreement with the following statements about the watershed decreased. Those with higher environmental values have a more negative perception of the watershed as it exists now.

Correlations

		NEP Environmental Values Scale
The overall image of the Newfound Lake Watershed as it exists now?	Pearson Correlation	-.155**
	Sig. (2-tailed)	.000
	N	687
The visual attractiveness of the watershed?	Pearson Correlation	-.095*
	Sig. (2-tailed)	.013
	N	684
The availability of conservation funding programs in the watershed?	Pearson Correlation	-.257**
	Sig. (2-tailed)	.000
	N	251
The availability of conservation technical assistance in the watershed?	Pearson Correlation	-.161**
	Sig. (2-tailed)	.007
	N	282
The amount of wildlife habitat in the Newfound Lake Watershed?	Pearson Correlation	-.121**
	Sig. (2-tailed)	.003
	N	623
The overall quality of water in rivers, streams, or lakes in the watershed for catching fish and/or swimming?	Pearson Correlation	-.180**
	Sig. (2-tailed)	.000
	N	671

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

There were negative and positive correlations with environmental values and statements about the watershed. Higher environmental values correlated with more willingness to make changes to protect water quality despite costs or having strict regulations enforced. They also correlated with a greater sense of having an impact on the watershed and the importance of water quality to the economy.

Correlations

		NEP Environmental Values Scale
The watershed has changed a great deal in the last 10 years	Pearson Correlation	.285**
	Sig. (2-tailed)	.000
	N	669
The economic stability of the community depends on good water quality	Pearson Correlation	.175**
	Sig. (2-tailed)	.000
	N	689
Taking action to protect water quality in the watershed is too expensive for you	Pearson Correlation	-.194**
	Sig. (2-tailed)	.000
	N	687
The economic health of communities in the watershed should be given highest priority when managing lands	Pearson Correlation	-.124**
	Sig. (2-tailed)	.001
	N	689
Respondent's household doesn't have much impact on water quality in the Newfound Lake Watershed	Pearson Correlation	-.190**
	Sig. (2-tailed)	.000
	N	687
Level of agreement that what you do on your land doesn't make much difference in overall water quality in the watershed	Pearson Correlation	-.256**
	Sig. (2-tailed)	.000
	N	687
Respondent would be willing to make changes to protect water quality	Pearson Correlation	.364**
	Sig. (2-tailed)	.000
	N	690
Laws or regulations are the only way that landowners in the watershed will consider water quality when they manage their lands	Pearson Correlation	.249**
	Sig. (2-tailed)	.000
	N	691
Regulations that protect water quality are too strict	Pearson Correlation	-.372**
	Sig. (2-tailed)	.000
	N	684

**. Correlation is significant at the 0.01 level (2-tailed).

There was a significant positive correlation with environmental values and opinions about how certain objective are for the management of the watershed. As environmental values increased, the importance of ensuring clean water, healthy water for aquatic life, and open spaces for recreation also increased. Ensuring the protection of private property rights was negatively correlated; as in the previous question, people with high environmental values are less opposed to regulations to protect the watershed.

Correlations

		NEP Environmental Values Scale
Clean water supplies for public use?	Pearson Correlation	.176**
	Sig. (2-tailed)	.000
	N	690
Healthy water bodies will support fish and other aquatic life?	Pearson Correlation	.255**
	Sig. (2-tailed)	.000
	N	693
Protection of private property rights?	Pearson Correlation	-.257**
	Sig. (2-tailed)	.000
	N	684
Open spaces and natural areas exist for recreation?	Pearson Correlation	.144**
	Sig. (2-tailed)	.000
	N	688
Habitat for fish and other wildlife exist?	Pearson Correlation	.319**
	Sig. (2-tailed)	.000
	N	688
Local Master Plans and land use regulations are in place and up to date?	Pearson Correlation	.271**
	Sig. (2-tailed)	.000
	N	677

**. Correlation is significant at the 0.01 level (2-tailed).

High environmental values correlated positively with statements about Newfound Lake that pertain to degradation such as, “The lake has been damaged by local land uses.” Negative correlations were with positive statements about the lake such as, “The lake is a pristine wilderness.” Once again, those with higher values are prone to having more negative perceptions of the watershed.

Correlations

		NEP Environmental Values Scale
The lake has too many buildings on the shore.	Pearson Correlation	.384**
	Sig. (2-tailed)	.000
	N	685
The lake has been damaged by local land uses.	Pearson Correlation	.399**
	Sig. (2-tailed)	.000
	N	670
The lake is a pristine wilderness.	Pearson Correlation	-.130**
	Sig. (2-tailed)	.001
	N	675
The lake has been harmed by overuse.	Pearson Correlation	.376**
	Sig. (2-tailed)	.000
	N	676
The lake has too many people using it.	Pearson Correlation	.349**
	Sig. (2-tailed)	.000
	N	680
The lake is very peaceful.	Pearson Correlation	-.121**
	Sig. (2-tailed)	.002
	N	679
The lake has very polluted water.	Pearson Correlation	.097*
	Sig. (2-tailed)	.011
	N	682
The lake is very crowded.	Pearson Correlation	.256**
	Sig. (2-tailed)	.000
	N	678
The lake has a lot of public access.	Pearson Correlation	-.083*
	Sig. (2-tailed)	.031
	N	683
The lake has changed a lot over the years.	Pearson Correlation	.242**
	Sig. (2-tailed)	.000
	N	676

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

More negative perceptions of the water quality of streams, the lake, other water bodies, and tap water were also correlated with higher environmental values.

Correlations

		NEP Environmental Values Scale
The water quality of streams in the watershed?	Pearson Correlation	-.105*
	Sig. (2-tailed)	.012
	N	571
The water quality of Newfound Lake?	Pearson Correlation	-.165**
	Sig. (2-tailed)	.000
	N	666
The water quality of bodies of standing water in the watershed, other than Newfound Lake?	Pearson Correlation	-.116*
	Sig. (2-tailed)	.019
	N	412
The quality of the tap water in your home?	Pearson Correlation	-.096*
	Sig. (2-tailed)	.016
	N	635

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Higher environmental values were positively correlated with levels of concern with many issues in the watershed. As environmental values increased, the level of concern about land use issues, water quality, and overpopulation also increased. Regulations and the cost of complying with them were once again negatively correlated.

Correlations

		NEP Environmental Values Scale
Loss of open space due to residential development in the Newfound Lake Watershed?	Pearson Correlation	.442**
	Sig. (2-tailed)	.000
	N	685
A decrease in water clarity in Newfound Lake?	Pearson Correlation	.260**
	Sig. (2-tailed)	.000
	N	659
The impact of building practices on lake shorelines?	Pearson Correlation	.430**
	Sig. (2-tailed)	.000
	N	672
The impact of building practices on stream and river banks?	Pearson Correlation	.414**
	Sig. (2-tailed)	.000
	N	655
The impacts on landowners from regulations to protect water quality?	Pearson Correlation	-.130**
	Sig. (2-tailed)	.001
	N	648
Poor water quality?	Pearson Correlation	.226**
	Sig. (2-tailed)	.000
	N	668
The discharge of septic waste?	Pearson Correlation	.279**
	Sig. (2-tailed)	.000
	N	674
Crowding at recreational sites?	Pearson Correlation	.300**
	Sig. (2-tailed)	.000
	N	668
Runoff from lawn care fertilizers?	Pearson Correlation	.358**
	Sig. (2-tailed)	.000
	N	658
Runoff from insecticides and/or pesticides used for lawn care?	Pearson Correlation	.378**
	Sig. (2-tailed)	.000
	N	663
Runoff from automobiles and/or other fluids left on paved surfaces?	Pearson Correlation	.411**
	Sig. (2-tailed)	.000
	N	669
Overpopulation in the watershed?	Pearson Correlation	.372**
	Sig. (2-tailed)	.000
	N	677

Increased sediments in water bodies throughout the watershed?	Pearson Correlation	.349**
	Sig. (2-tailed)	.000
	N	629
Drinking water quality?	Pearson Correlation	.236**
	Sig. (2-tailed)	.000
	N	677
Invasive plant growth?	Pearson Correlation	.208**
	Sig. (2-tailed)	.000
	N	653
Economic costs of complying with land-use regulations?	Pearson Correlation	-.133**
	Sig. (2-tailed)	.001
	N	647
Loss of wildlife?	Pearson Correlation	.376**
	Sig. (2-tailed)	.000
	N	671
Loss of forested or wooded areas?	Pearson Correlation	.413**
	Sig. (2-tailed)	.000
	N	671
Development on hillsides and steep slopes?	Pearson Correlation	.422**
	Sig. (2-tailed)	.000
	N	666
Loss of agricultural land?	Pearson Correlation	.350**
	Sig. (2-tailed)	.000
	N	664
New road development?	Pearson Correlation	.359**
	Sig. (2-tailed)	.000
	N	644

**. Correlation is significant at the 0.01 level (2-tailed).

Environmental values were negatively correlated with how much respondents wanted to see certain land uses. As environmental values increases, respondents wanted less commercial and residential development. Values were positively correlated with wanting more natural habitats and land in agricultural production.

Correlations

		NEP Environmental Values Scale
Residential development	Pearson Correlation	-.320**
	Sig. (2-tailed)	.000
	N	681
Commercial development	Pearson Correlation	-.250**
	Sig. (2-tailed)	.000
	N	677
National chain stores	Pearson Correlation	-.239**
	Sig. (2-tailed)	.000
	N	686
Local businesses	Pearson Correlation	-.097*
	Sig. (2-tailed)	.011
	N	684
Forest or woodland	Pearson Correlation	.279**
	Sig. (2-tailed)	.000
	N	690
Wetlands area	Pearson Correlation	.299**
	Sig. (2-tailed)	.000
	N	669
Wildlife habitat	Pearson Correlation	.275**
	Sig. (2-tailed)	.000
	N	680
Land in agricultural production	Pearson Correlation	.152**
	Sig. (2-tailed)	.000
	N	643
High density developed residential areas	Pearson Correlation	-.137**
	Sig. (2-tailed)	.000
	N	664

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

There were some positive correlations with environmental values and how often a person performed certain activities on their land, but as was not before the validity of some of the questions form this section is uncertain. One question from section 11 of the questionnaire which is surprisingly not positively correlated with environmental values is how often respondents participate in local lake cleanup activities – and the validity is not questioned in this case. Despite more negative impressions of the watershed and Newfound Lake, higher environmental values in this case did not translate to taking action more often.

Correlations

		NEP Environmental Values Scale
Use a phosphorus-free fertilizer on your lawn	Pearson Correlation	.094*
	Sig. (2-tailed)	.031
	N	527
Leave or create a buffer of native plants between surface waters and your home	Pearson Correlation	.103**
	Sig. (2-tailed)	.009
	N	633
Keep leaves and crass clipping out of shoreline areas and/or storm drains and culverts on your land	Pearson Correlation	.118**
	Sig. (2-tailed)	.003
	N	633
Test your soil before applying fertilizers on your land	Pearson Correlation	.106*
	Sig. (2-tailed)	.017
	N	513
Time the application of fertilizers to when the forecast is rain free	Pearson Correlation	.108*
	Sig. (2-tailed)	.017
	N	494
Leave grass clippings on your lawn	Pearson Correlation	.154**
	Sig. (2-tailed)	.000
	N	626

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Environmental values were significantly negatively correlated with concerns about changes in regulations and wind turbines. As values increased the concern with more restrictive regulation and wind turbine installation decreased.

Correlations

		NEP Environmental Values Scale
Zoning rules became more restrictive	Pearson Correlation	-.288**
	Sig. (2-tailed)	.000
	N	669
Fishing regulations became more restrictive	Pearson Correlation	-.206**
	Sig. (2-tailed)	.000
	N	664
Hunting regulations became more restrictive	Pearson Correlation	-.182**
	Sig. (2-tailed)	.000
	N	665
Regulations were placed on water recreation	Pearson Correlation	-.351**
	Sig. (2-tailed)	.000
	N	673
Electric wind turbines were installed on ridgelines	Pearson Correlation	-.133**
	Sig. (2-tailed)	.001
	N	654

**. Correlation is significant at the 0.01 level (2-tailed).

Environmental values were positively correlated with participating in community events/activities and serving on local board and/or committees. Although there was not a correlation between values and participating in local lake cleanup activities, as the level of environmental values increased so did how often the respondent participated in these activities. Because high values have also correlated with lower perceptions of the watershed, people with higher environmental values may get more involved in these activities to try to affect changes.

Correlations

		NEP Environmental Values Scale
Fish in rivers, streams, and tributaries in the Newfound Lake Watershed	Pearson Correlation	.093*
	Sig. (2-tailed)	.014
	N	686
Participate in motorized boating in the Newfound Lake Watershed	Pearson Correlation	-.130**
	Sig. (2-tailed)	.001
	N	693
Hike	Pearson Correlation	.134**
	Sig. (2-tailed)	.000
	N	693
Snowmobile	Pearson Correlation	-.103**
	Sig. (2-tailed)	.007
	N	692
Bicycle	Pearson Correlation	.075*
	Sig. (2-tailed)	.049
	N	690
Watch birds or other wildlife in the Newfound Lake Watershed?	Pearson Correlation	.219**
	Sig. (2-tailed)	.000
	N	687
Cross country or back country ski	Pearson Correlation	.124**
	Sig. (2-tailed)	.001
	N	693
Snowshoe	Pearson Correlation	.143**
	Sig. (2-tailed)	.000
	N	691
Participate in community events/activities in the Newfound Lake Watershed?	Pearson Correlation	.094*
	Sig. (2-tailed)	.014
	N	689
Serve on local boards and/or committees in your community?	Pearson Correlation	.087*
	Sig. (2-tailed)	.023
	N	687

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Environmental values were positively correlated with how useful information sources are for all sources but town meetings. The moderate to strong correlations are shown.

Correlations

		NEP Environmental Values Scale
Local/regional newspapers	Pearson Correlation	.108**
	Sig. (2-tailed)	.004
	N	702
Radio	Pearson Correlation	.122**
	Sig. (2-tailed)	.001
	N	686
Internet site of a local lake organization (NLRA)	Pearson Correlation	.165**
	Sig. (2-tailed)	.000
	N	692
Journals or magazines	Pearson Correlation	.101**
	Sig. (2-tailed)	.008
	N	688
Word of mouth	Pearson Correlation	.118**
	Sig. (2-tailed)	.002
	N	695
Informational signs	Pearson Correlation	.114**
	Sig. (2-tailed)	.003
	N	693
Classes or seminars	Pearson Correlation	.176**
	Sig. (2-tailed)	.000
	N	691
Public meetings	Pearson Correlation	.119**
	Sig. (2-tailed)	.002
	N	685
Watershed specific internet sites	Pearson Correlation	.206**
	Sig. (2-tailed)	.000
	N	669

**. Correlation is significant at the 0.01 level (2-tailed).

Environmental values were positively correlated with levels of agreement that regulations in the watershed should be determined and implemented at the state level as well as assertions that state and local governments from all towns should collaborate to make decisions.

Correlations

		NEP Environmental Values Scale
Regulations for the Newfound Lake Watershed should be implemented at the state level	Pearson Correlation	.104**
	Sig. (2-tailed)	.006
	N	688
Local governments should collaborate with state government to decide on regulations in the watershed	Pearson Correlation	.153**
	Sig. (2-tailed)	.000
	N	700
Local governments from all the towns in the watershed should work together to decide on regulations for Newfound Lake Watershed	Pearson Correlation	.157**
	Sig. (2-tailed)	.000
	N	703

**. Correlation is significant at the 0.01 level (2-tailed).

Environmental values were negatively correlated with the level of trust in town government and administration, which may be why higher environmental values also correlated with agreement that the state should be involved in regulations. There were positive correlations with trust in other sources.

Correlations

		NEP Environmental Values Scale
Town government or administration	Pearson Correlation	-.091*
	Sig. (2-tailed)	.019
	N	665
Newfound Lakes Region Association	Pearson Correlation	.150**
	Sig. (2-tailed)	.000
	N	673
Academic/university sources	Pearson Correlation	.267**
	Sig. (2-tailed)	.000
	N	668
Public radio or television	Pearson Correlation	.171**
	Sig. (2-tailed)	.000
	N	667
Local companies	Pearson Correlation	-.099*
	Sig. (2-tailed)	.011
	N	669

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Environmental values were related to some demographic variables. Because of the coding of data, the direction of the relationship is not always unclear and the results are explained to prevent confusion.

Correlations

		NEP Environmental Values Scale
Which of the following best describes your residency in the Newfound Lake Watershed?	Pearson Correlation	-.128**
	Sig. (2-tailed)	.001
	N	684
For how many years have you lived in or visited the Newfound Lake Region?	Pearson Correlation	.076*
	Sig. (2-tailed)	.046
	N	688
How long does it usually take you to commute to work from home?	Pearson Correlation	.083*
	Sig. (2-tailed)	.041
	N	613
Which category best describes your annual household income before taxes?	Pearson Correlation	-.165**
	Sig. (2-tailed)	.000
	N	615
Which of the following categories best describes your political orientation?	Pearson Correlation	-.265**
	Sig. (2-tailed)	.000
	N	660
In what year were you born?	Pearson Correlation	-.135**
	Sig. (2-tailed)	.001
	N	659
What is your gender?	Pearson Correlation	-.150**
	Sig. (2-tailed)	.000
	N	668
Which of the following best describes the highest level of education you have completed?	Pearson Correlation	-.076*
	Sig. (2-tailed)	.047
	N	689

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

- Respondents that were year round residence had higher environmental values.

- As the length of time respondents had lived in or visited the region increased, the level of environmental values increased.
- As a respondent’s commute from home increases, their level of environmental values also increased.

- As a respondent’s annual household income increased, their level of environmental values decreased.

- As respondents’ political orientation progressed from liberal to conservative, their level of environmental values decreased.

- As age increased, the level of environmental values decreased.

- Females had higher environmental values than males.

- As the level of education completed increased, the level of environmental values decreased.

<u>Pearson's Correlations between the Strength of Attachment Scale and Responses to Questionnaire Items</u>

The strength of relationships between variables and respondents' strength of attachment to Newfound Lake (measured using the place attachment scale that was a statistical combination of responses to the questions in section 4 of the questionnaire) were examined to determine if the level of attachment influences perceptions of the watershed and willingness to change in order to mitigate environmental degradation despite specific barriers. The following charts show statistically significant relationships. Pearson's Correlation also indicates the direction of the relationship between variables. Negative Pearson's Correlations indicate that as values increase, it correlates with a decrease in the measure of the other variable; a positive correlation indicates that as values increase the measure of the other variable also increases. The attachment scale ranges from 9 – 63, 9 being the lowest and 63 being the highest level of attachment. The strength of the relationships is indicated in the chart with asterisk. One asterisk indicates a weak relationship and two indicate a moderate to strong relationship.

Strength of attachment corresponded positively with how respondents rated aspect of the Newfound Lake Watershed as it exists now. As attachment increased the ratings of the watershed increased. Respondents with higher levels of attachment rate the watershed more favorably.

Correlations

		Strength of Attachment Scale
The overall image of the Newfound Lake Watershed as it exists now?	Pearson Correlation	.241**
	Sig. (2-tailed)	.000
	N	715
The friendliness within the Newfound Lake region?	Pearson Correlation	.286**
	Sig. (2-tailed)	.000
	N	712
The visual attractiveness of the watershed?	Pearson Correlation	.277**
	Sig. (2-tailed)	.000
	N	710
The availability of conservation funding programs in the watershed?	Pearson Correlation	.236**
	Sig. (2-tailed)	.000
	N	263
The availability of conservation technical assistance in the watershed?	Pearson Correlation	.185**
	Sig. (2-tailed)	.001
	N	292
The opportunities for economic growth in the region?	Pearson Correlation	.084*
	Sig. (2-tailed)	.049
	N	544
The overall quality of water in rivers, streams, or lakes in the watershed for catching fish and/or swimming?	Pearson Correlation	.262**
	Sig. (2-tailed)	.000
	N	695

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Attachment to the area correlated negatively with agreement with statements that regulations and cost are barriers to taking action to protect water quality. Stronger attachment corresponds with greater perceived impact on the watershed and more willingness to make changes.

Correlations

		Strength of Attachment Scale
The economic stability of the community depends on good water quality	Pearson Correlation	.342**
	Sig. (2-tailed)	.000
	N	726
Taking action to protect water quality in the watershed is too expensive for you	Pearson Correlation	-.131**
	Sig. (2-tailed)	.000
	N	729
The economic health of communities in the watershed should be given highest priority when managing lands	Pearson Correlation	.170**
	Sig. (2-tailed)	.000
	N	725
Respondent's household doesn't have much impact on water quality in the Newfound Lake Watershed	Pearson Correlation	-.241**
	Sig. (2-tailed)	.000
	N	727
Level of agreement that what you do on your land doesn't make much difference in overall water quality in the watershed	Pearson Correlation	-.185**
	Sig. (2-tailed)	.000
	N	727
Respondent would be willing to make changes to protect water quality	Pearson Correlation	.284**
	Sig. (2-tailed)	.000
	N	729
Laws or regulations are the only way that landowners in the watershed will consider water quality when they manage their lands	Pearson Correlation	.103**
	Sig. (2-tailed)	.005
	N	729
Regulations that protect water quality are too strict	Pearson Correlation	-.177**
	Sig. (2-tailed)	.000
	N	719

**. Correlation is significant at the 0.01 level (2-tailed).

Attachment correlated positively with how important respondents felt certain objects are for the management of the watershed.

Correlations

		Strength of Attachment Scale
Clean water supplies for public use?	Pearson Correlation	.179**
	Sig. (2-tailed)	.000
	N	727
Healthy water bodies will support fish and other aquatic life?	Pearson Correlation	.125**
	Sig. (2-tailed)	.001
	N	731
Open spaces and natural areas exist for recreation?	Pearson Correlation	.168**
	Sig. (2-tailed)	.000
	N	727
Habitat for fish and other wildlife exist?	Pearson Correlation	.118**
	Sig. (2-tailed)	.001
	N	727
Local Master Plans and land use regulations are in place and up to date?	Pearson Correlation	.305**
	Sig. (2-tailed)	.000
	N	715

**. Correlation is significant at the 0.01 level (2-tailed).

Attachment correlated positively with the level of agreement respondents had with statements about Newfound Lake that were positive and correlated negatively with statements that claimed the lake was overcrowded and degraded.

Correlations

		Strength of Attachment Scale
The lake is a scenic place.	Pearson Correlation	.455**
	Sig. (2-tailed)	.000
	N	715
The lake has too many buildings on the shore.	Pearson Correlation	-.154**
	Sig. (2-tailed)	.000
	N	707
The lake is a family place.	Pearson Correlation	.472**
	Sig. (2-tailed)	.000
	N	692
The lake has been damaged by local land uses.	Pearson Correlation	-.078*
	Sig. (2-tailed)	.039
	N	696
The lake is a pristine wilderness.	Pearson Correlation	.320**
	Sig. (2-tailed)	.000
	N	700
The lake has been harmed by overuse.	Pearson Correlation	-.118**
	Sig. (2-tailed)	.002
	N	699
The lake is mostly for vacationers.	Pearson Correlation	-.253**
	Sig. (2-tailed)	.000
	N	706
The lake is a place of high environmental quality.	Pearson Correlation	.389**
	Sig. (2-tailed)	.000
	N	705
The lake is a community of neighbors.	Pearson Correlation	.378**
	Sig. (2-tailed)	.000
	N	705
The lake is a place to escape from civilization.	Pearson Correlation	.496**
	Sig. (2-tailed)	.000
	N	702
The lake has many species of wildlife and plants.	Pearson Correlation	.274**
	Sig. (2-tailed)	.000
	N	707
The lake has too many people using it.	Pearson Correlation	-.184**
	Sig. (2-tailed)	.000
	N	703
The lake is very peaceful.	Pearson Correlation	.475**
	Sig. (2-tailed)	.000
	N	702

The lake has very polluted water.	Pearson Correlation	-.303**
	Sig. (2-tailed)	.000
	N	708
The lake is very crowded.	Pearson Correlation	-.319**
	Sig. (2-tailed)	.000
	N	704
The lake has a lot of public access.	Pearson Correlation	.229**
	Sig. (2-tailed)	.000
	N	710

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Strength of attachment correlated positively with then number of people respondents knew and considered close friends in the watershed. This variable may increase their attachment to the area.

Correlations

		Strength of Attachment Scale
How many people around the watershed do you know on a first name basis?	Pearson Correlation	.127**
	Sig. (2-tailed)	.001
	N	711
How many of these people would you consider close personal friends?	Pearson Correlation	.184**
	Sig. (2-tailed)	.000
	N	710

**. Correlation is significant at the 0.01 level (2-tailed).

Strength of attachment correlated positively with how respondents rate water quality in the watershed.

Correlations

		Strength of Attachment Scale
The water quality of streams in the watershed?	Pearson Correlation	.172**
	Sig. (2-tailed)	.000
	N	590
The water quality of Newfound Lake?	Pearson Correlation	.344**
	Sig. (2-tailed)	.000
	N	686
The water quality of bodies of standing water in the watershed, other than Newfound Lake?	Pearson Correlation	.182**
	Sig. (2-tailed)	.000
	N	434

**. Correlation is significant at the 0.01 level (2-tailed).

Strength of attachment correlated positively with how concerned respondents were about certain issues in the watershed. As attachment increased the concern about sources of pollution, water quality, and land use increased.

Correlations

		Strength of Attachment Scale
Runoff from lawn care fertilizers?	Pearson Correlation	.124**
	Sig. (2-tailed)	.001
	N	682
Runoff from insecticides and/or pesticides used for lawn care?	Pearson Correlation	.104**
	Sig. (2-tailed)	.007
	N	685
Increased sediments in water bodies throughout the watershed?	Pearson Correlation	.077*
	Sig. (2-tailed)	.048
	N	654
Drinking water quality?	Pearson Correlation	.074*
	Sig. (2-tailed)	.049
	N	700
Invasive plant growth?	Pearson Correlation	.187**
	Sig. (2-tailed)	.000
	N	675
Loss of forested or wooded areas?	Pearson Correlation	.075*
	Sig. (2-tailed)	.049
	N	694
Development on hillsides and steep slopes?	Pearson Correlation	.117**
	Sig. (2-tailed)	.002
	N	685

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

There was a negative correlation between attachment and how much respondents wanted to see certain land uses in the future. As attachment increased, respondents desire to have more public access to the lake, land in agricultural production, and high density residential areas decreased. A positive correlation existed with the desire for more forest or woodland.

Correlations

		Strength of Attachment Scale
Forest or woodland	Pearson Correlation	.075*
	Sig. (2-tailed)	.045
	N	712
Public access to Newfound Lake	Pearson Correlation	-.186**
	Sig. (2-tailed)	.000
	N	706
Land in agricultural production	Pearson Correlation	-.089*
	Sig. (2-tailed)	.021
	N	670
High density developed residential areas	Pearson Correlation	-.106**
	Sig. (2-tailed)	.005
	N	691

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Attachment correlated positively with how often respondents performed the following activities on their land. There was a negative correlation with how often they leave grass clippings on their lawns.

Correlations

		Strength of Attachment Scale
Pick up pet waste on your land	Pearson Correlation	.189**
	Sig. (2-tailed)	.000
	N	644
Use a phosphorus-free fertilizer on your lawn	Pearson Correlation	.108*
	Sig. (2-tailed)	.011
	N	550
Leave or create a buffer of native plants between surface waters and your home	Pearson Correlation	.079*
	Sig. (2-tailed)	.045
	N	652
Keep leaves and crass clipping out of shoreline areas and/or storm drains and culverts on your land	Pearson Correlation	.204**
	Sig. (2-tailed)	.000
	N	651
Participate in local cleanup activities in the Newfound Lake Watershed	Pearson Correlation	.153**
	Sig. (2-tailed)	.000
	N	684
Leave grass clippings on your lawn	Pearson Correlation	-.113**
	Sig. (2-tailed)	.004
	N	651
Follow the manufacturer's guidelines for fertilizer application on your lawn	Pearson Correlation	.117**
	Sig. (2-tailed)	.008
	N	505

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Attachment corresponded negatively with concern about zoning and hunting rules becoming more restrictive and positively with how concerned respondents would be if regulations were placed on water recreation or electric wind turbines were installed.

Correlations

		Strength of Attachment Scale
Zoning rules became more restrictive	Pearson Correlation	-.118**
	Sig. (2-tailed)	.002
	N	691
Hunting regulations became more restrictive	Pearson Correlation	-.085*
	Sig. (2-tailed)	.026
	N	690
Regulations were placed on water recreation	Pearson Correlation	.098**
	Sig. (2-tailed)	.009
	N	699
Electric wind turbines were installed on ridgelines	Pearson Correlation	.196**
	Sig. (2-tailed)	.000
	N	679

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

There were many positive correlations between attachment and how often respondents participated in activities in the watershed. The only negative correlation was with hunting.

Correlations

		Strength of Attachment Scale
Fish on Newfound Lake	Pearson Correlation	.158**
	Sig. (2-tailed)	.000
	N	717
Swim in the Newfound Lake Watershed	Pearson Correlation	.477**
	Sig. (2-tailed)	.000
	N	719
Participate in motorized boating in the Newfound Lake Watershed	Pearson Correlation	.402**
	Sig. (2-tailed)	.000
	N	716
Participate in non-motorized boating in the Newfound Lake Watershed	Pearson Correlation	.330**
	Sig. (2-tailed)	.000
	N	714
Hike	Pearson Correlation	.147**
	Sig. (2-tailed)	.000
	N	717
Bicycle	Pearson Correlation	.125**
	Sig. (2-tailed)	.001
	N	713
Watch birds or other wildlife in the Newfound Lake Watershed?	Pearson Correlation	.140**
	Sig. (2-tailed)	.000
	N	709
Hunt	Pearson Correlation	-.132**
	Sig. (2-tailed)	.000
	N	707
Work on/maintain property	Pearson Correlation	.145**
	Sig. (2-tailed)	.000
	N	714
Visit with friends in the Newfound Lake Watershed?	Pearson Correlation	.287**
	Sig. (2-tailed)	.000
	N	716
Relax and enjoy the views in the Newfound Lake Watershed?	Pearson Correlation	.307**
	Sig. (2-tailed)	.000
	N	714
Participate in community events/activities in the Newfound Lake Watershed?	Pearson Correlation	.238**
	Sig. (2-tailed)	.000
	N	712
Participate in organized team sporting events in the Newfound Lake Watershed?	Pearson Correlation	.121**
	Sig. (2-tailed)	.001
	N	717

Correlations

		Strength of Attachment Scale
Fish on Newfound Lake	Pearson Correlation	.158**
	Sig. (2-tailed)	.000
	N	717
Swim in the Newfound Lake Watershed	Pearson Correlation	.477**
	Sig. (2-tailed)	.000
	N	719
Participate in motorized boating in the Newfound Lake Watershed	Pearson Correlation	.402**
	Sig. (2-tailed)	.000
	N	716
Participate in non-motorized boating in the Newfound Lake Watershed	Pearson Correlation	.330**
	Sig. (2-tailed)	.000
	N	714
Hike	Pearson Correlation	.147**
	Sig. (2-tailed)	.000
	N	717
Bicycle	Pearson Correlation	.125**
	Sig. (2-tailed)	.001
	N	713
Watch birds or other wildlife in the Newfound Lake Watershed?	Pearson Correlation	.140**
	Sig. (2-tailed)	.000
	N	709
Hunt	Pearson Correlation	-.132**
	Sig. (2-tailed)	.000
	N	707
Work on/maintain property	Pearson Correlation	.145**
	Sig. (2-tailed)	.000
	N	714
Visit with friends in the Newfound Lake Watershed?	Pearson Correlation	.287**
	Sig. (2-tailed)	.000
	N	716
Relax and enjoy the views in the Newfound Lake Watershed?	Pearson Correlation	.307**
	Sig. (2-tailed)	.000
	N	714
Participate in community events/activities in the Newfound Lake Watershed?	Pearson Correlation	.238**
	Sig. (2-tailed)	.000
	N	712
Participate in organized team sporting events in the Newfound Lake Watershed?	Pearson Correlation	.121**
	Sig. (2-tailed)	.001
	N	717

**. Correlation is significant at the 0.01 level (2-tailed).

A positive correlation existed between strength of attachment and how useful respondents felt certain sources of information were.

Correlations

		Strength of Attachment Scale
Local/regional newspapers	Pearson Correlation	.122**
	Sig. (2-tailed)	.001
	N	705
Internet site of a local lake organization (NLRA)	Pearson Correlation	.204**
	Sig. (2-tailed)	.000
	N	697
Town meetings	Pearson Correlation	.144**
	Sig. (2-tailed)	.000
	N	697
Journals or magazines	Pearson Correlation	.142**
	Sig. (2-tailed)	.000
	N	695
Government publications	Pearson Correlation	.082*
	Sig. (2-tailed)	.030
	N	695
Television	Pearson Correlation	.125**
	Sig. (2-tailed)	.001
	N	691
Word of mouth	Pearson Correlation	.129**
	Sig. (2-tailed)	.001
	N	700
Informational signs	Pearson Correlation	.129**
	Sig. (2-tailed)	.001
	N	695
Pamphlets or flyers	Pearson Correlation	.217**
	Sig. (2-tailed)	.000
	N	698
Classes or seminars	Pearson Correlation	.171**
	Sig. (2-tailed)	.000
	N	697
Public meetings	Pearson Correlation	.210**
	Sig. (2-tailed)	.000
	N	688
Watershed specific internet sites	Pearson Correlation	.223**
	Sig. (2-tailed)	.000
	N	666

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Strength of attachment was positively correlated with agreement that towns should decide on and implement regulations for the watershed, and that all the towns in the watershed should work together.

Correlations

		Strength of Attachment Scale
Town governments should decide on regulations in the watershed	Pearson Correlation	.091*
	Sig. (2-tailed)	.017
	N	689
Regulations for the Newfound Lake Watershed should be implemented at the town level	Pearson Correlation	.085*
	Sig. (2-tailed)	.025
	N	691
Local governments from all the towns in the watershed should work together to decide on regulations for Newfound Lake Watershed	Pearson Correlation	.119**
	Sig. (2-tailed)	.002
	N	706

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Positive correlations existed between strength of attachment and how trustworthy respondents felt certain sources of information were.

Correlations

		Strength of Attachment Scale
Town government or administration	Pearson Correlation	.221**
	Sig. (2-tailed)	.000
	N	685
New Hampshire state agencies	Pearson Correlation	.131**
	Sig. (2-tailed)	.001
	N	695
Newfound Lakes Region Association	Pearson Correlation	.263**
	Sig. (2-tailed)	.000
	N	694
Academic/university sources	Pearson Correlation	.182**
	Sig. (2-tailed)	.000
	N	689
Chamber of commerce	Pearson Correlation	.206**
	Sig. (2-tailed)	.000
	N	686
Local companies	Pearson Correlation	.158**
	Sig. (2-tailed)	.000
	N	690

**. Correlation is significant at the 0.01 level (2-tailed).

There were significant correlations between strength of attachment and some demographic variables. Because of the coding of data, the direction of the relationship is not always unclear and the results are explained to prevent confusion.

Correlations

		Strength of Attachment Scale
Which of the following best describes your residency in the Newfound Lake Watershed?	Pearson Correlation	.147**
	Sig. (2-tailed)	.000
	N	709
On average, how many months do you reside in the watershed per year?	Pearson Correlation	.197**
	Sig. (2-tailed)	.000
	N	344
About how many acres is the lot your house is on?	Pearson Correlation	-.206**
	Sig. (2-tailed)	.000
	N	697
Do you maintain your property yourself, or do you hire out property maintenance such as landscaping and lawn-mowing?	Pearson Correlation	.169**
	Sig. (2-tailed)	.000
	N	694
Are you a current member of the Newfound Lake Region Association?	Pearson Correlation	-.275**
	Sig. (2-tailed)	.000
	N	701
Which category best describes your annual household income before taxes?	Pearson Correlation	.157**
	Sig. (2-tailed)	.000
	N	644
What is your gender?	Pearson Correlation	-.176**
	Sig. (2-tailed)	.000
	N	691
Which of the following best describes the highest level of education you have completed?	Pearson Correlation	.095*
	Sig. (2-tailed)	.011
	N	711

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

- Year round residents had lower levels of attachment than residents that were not year round.
- As the number of months respondents spent in the watershed increased, their level of attachment also increased.
- The smaller the lot a respondent’s house is on was, the stronger their attachment was.
- Respondents who hire out property maintenance had stronger attachment levels.
- Respondents who were members of the NLRA were more attached to the region.

- As annual household income increased, the strength of attachment increased.
- Females had higher attachment levels than men.
- As the level of education increased, the strength of attachment increased.

V. Conclusions—Observations, Conclusions, and Recommendations

The Newfound Lake Watershed is an area of unique natural beauty that has excellent environmental amenities and high water quality in both Newfound Lake and the surrounding areas. Like many other regions of New Hampshire the Newfound Lake Watershed is undergoing rapid and meaningful changes in land uses, some of which are related to population growth in the area. Many of these changes have the potential to impact water quality.

The environmental health of the region is essential to the well-being of communities and residents, however efforts to manage natural resources are complicated by the fact that there are nine distinct town governments acting independently in the watershed. Given the rapid changes in the watershed it is a pivotal time for ensuring the long-term health and beauty of the watershed by developing a Watershed Master Plan for the Newfound Lake Region, which can provide a common framework and reference for towns to use when planning for their futures as part of the larger watershed community.

A watershed master plan is a non-binding, guiding document that can serve as a resource for town governments and residents of the watershed. A watershed master plan helps promote understanding of the shared resources in the region, and is often a key component of managing water resources on the watershed scale beyond town boundaries. The Newfound Watershed Master Plan is being developed through partnerships and collaboration between the public, local and state agencies, and local organizations.

Developing a watershed master plan is a complex process involving many areas of professional expertise and research, and many important tasks require an understanding of the social dynamics of issues within the watershed. Identifying residents' desires for the future through visioning processes, understanding concerns about management alternatives, and documenting the current understanding of best management practices are just a few examples of the ways watershed management plans necessitate an understanding of social factors to develop effective information and recommendations.

This report presents the findings from an extensive survey of residents of the Newfound Watershed. A total of 1938 self-administered questionnaires were mailed, and a 41% response rate was obtained (n=794). These results are encouraging, and the survey has raised awareness of the effort and given residents an opportunity to express their views and desires for the future. Several results are of particular importance for understanding the views of residents for the region and for the creation of the watershed management plan, and this conclusion highlights those important points.

Key Findings

As a whole there are many encouraging findings for future efforts to protect water quality from the survey, and all conclusions below are based on the findings reported. Only very important findings and interpretations of their implications are presented here, and conclusions are organized by the research questions identified to guide this research. Readers of this report should be aware of the fact that as mentioned in the report, respondent demographics differ slightly from total demographics in the watershed as indicated by census data. As a result, when interpreting the data, users of this report should review the bivariate findings to be sensitive to these differences. We encourage users of this report to use the document and information as a reference resource for data on a variety of topics.

<u>Identify residents' values for the watershed and desires for the future</u>

- Residents perceive rapid changes in the watershed, which should be used as a precursor to encourage environmentally responsible behaviors and planning efforts. While this statement may be obvious, empirical support for assertions is a wise step when considering and developing public policy relevant documents. Many residents are strongly attached to the region, and these connections are a powerful motivator of environmentally responsible behaviors when it is clarified that efforts mitigate the negative impacts of some of the changes residents observe.
- Respondents have extremely positive sentiments about the watershed: an excellent overall image of the area, a strong belief in its visual attractiveness, and (somewhat surprisingly in NH) strong positive feelings about the "friendliness" of the region.
- Respondents express strong agreement that the economic stability of their community depends on good water quality. Publicizing and fostering these sentiments using normative framings (data from the survey about the widespread nature of this belief) would likely encourage environmentally responsible behaviors.
- Residents express very high levels of attachment to the region, and the strength of their attachment is strongly related to strong desires to protect water quality and natural resources in the watershed.
    - Communications should be designed to reflect their connections with a specific locale rather than an issue (i.e. protecting "Newfound" rather than "water quality").
    - Non-profits and communities should consider efforts to foster place attachment among residents, including citizen science efforts.
- When asked whether they would like to see less, more, or the same amount of various land uses in the watershed in the future residents expressed a desire for more wildlife habitat, forest or woodlands, more wetlands and agriculture, and more local businesses. These responses demonstrate a clear priority for natural resource conservation.
- In contrast, respondents expressed a desire for relatively less high density development, residential development, and national chain stores.
- Seasonal residents generally had a more positive view of the water quality of Newfound Lake than did year round residents.
- Lakefront residents are more seasonal than non-lakefront property owners and the concerns of each population seem to reflect this, as did how they view the watershed, and the activities in which they participate.
- As the level of education of respondents increases, mean opposition to national chain stores in the area grows stronger.
- Younger respondents expressed a strong desire for less national chain stores as a future land use, compared with older respondents.
- Stronger environmental values correlate with lower ratings of several aspects of the watershed– visual attractiveness, conservation funding and tech assistance, amount of wildlife, and quality of water.

- Respondents expresses moderate concern about the possibility of increasing regulations in the future, and such changes should be directly linked with their impacts on the values identified as important to residents of the watershed in this report when communications are developed.

<u>Determine residents' present understanding of stewardship principles</u>

- Perhaps most importantly, the data indicate that it is likely most respondents do not understand the potentially positive aspects of high density housing. This topic may be of special importance in the watershed master plan.
- When asked what objective are most important for the management of the watershed respondents indicated that clean water supplies for public use, healthy water bodies supporting fish and other aquatic life, and habitat for wildlife are of highest importance. These responses indicate a high level of interest in stewardship.
- Respondents' strength of concerns about various environmental contaminants in question nine indicate that a good deal of knowledge of important issues affecting environmental quality exists among watershed residents.
- When asked what environmentally responsible behaviors they perform on their land, responses from the community indicate a relatively high percentage of residents leave buffers at waterfronts, control erosion, and keep grass clippings out of drainages.
- In contrast, it is apparent that residents are relatively lax in their use of fertilizers (if they use them at all), so education on these efforts may be appropriate.
- Lakefront residents agree more strongly with statements about their own impacts on the watershed, and are more willing to make changes to protect water quality.
- Non-lakefront residents would like to see more public access to lake, more outdoor recreation areas, and more agricultural production than lakefront residents.
- Non-lakefront residents are less concerned about electric wind turbines being installed on ridgelines. Overall, the lakefront population appears to be more concerned with viewsheds, and the written comments indicate this concern as well.
- Lakefront property owners hire out maintenance more than non-lakefront property owners. The implication is that they may be unaware of the practices used by maintenance companies.
- Overall knowledge of these principles appears relatively high, but some specific principles are not well understood or are not frequently engaged in by respondents.

<u>Ascertain correlates of environmentally responsible behavior</u>

- The strength of their respondents' attachment to Newfound Lake is related to participation in many environmentally responsible behaviors.
  - Respondents with stronger attachments agree more strongly with statements that they have an impact on the watershed and are more willing to make changes and support regulations to protect water quality.
  - Respondents with stronger attachments give more importance to ensuring clean water, open space, wildlife habitat, and ensuring a Master Plan is up to date.
  - Respondents with stronger attachments have higher levels of concern with specific issues: runoff from lawn care fertilizer, insecticides, increased sediment, drinking water quality, invasive plant growth, loss of forest, and the development of hillsides.

    - Respondents with stronger attachments participate in many activities like picking up pet waste, using phosphorus-free fertilizer, leaving buffer of native plants, keeping leaves from shoreline and drains, and following guidelines from manufacturer when fertilizing.
- Year round residents indicated a higher awareness of human impacts, and reported more frequent participation in a number of environmentally responsible behaviors than seasonal.
- Overall, women tended to respond with slightly more concern for environmental quality issues, felt that they had more impact on the watershed, and showed more willingness to change behaviors than men.
- Generally, as political persuasion moves toward Conservative willingness to make changes to protect water quality decreases, and concern about impacts on landowners increases.
- Lakefront property owners are more willing to make changes to protect water quality, as they recognize the stewardship responsibilities associated with the locale of their ownership.

<u>Identify perceived barriers to and benefits of adopting environmentally responsible behaviors</u>

- Most encouragingly, overall respondents indicated a willingness to make changes to protect water quality.
- Most respondents do not feel that taking action to protect water quality is too expensive for them, so cost is not currently perceived as a significant barrier to behavioral change.
- Most respondents recognize that the economic stability of their community is dependent on good water quality, and economic well-being can be a significant benefit of efforts to protect water quality that may not be commonly recognized. Communications about efforts to protect water quality should make this connection explicit.
- Most respondents do not feel regulations to protect water quality are too strict.
- There are, however, some concerns about the economic costs of complying with land-use regulations.
- Respondents indicated that they feel there is only a "fair" amount of conservation funding programs and conservation technical assistance available in the watershed (means 3.12 and 3.29, respectively). Determining if this is a public relations issue or one related to the actual lack of existence of these programs is an important next step in using this information.
- Households with lower incomes expressed a greater mean level of concern about the impacts of regulations on landowners.
- Older respondents showed a higher level of concern about protecting private property rights in general than younger respondents.
- Overall, there are encouraging results that residents are willing to make changes, particularly if explicit connections between desired conditions and the need for such changes are clearly established.

<u>Discern residents' level of trust in information sources and vectors of delivery</u>

- The majority of respondents rated the local/regional newspapers as the most useful source of information.

- Watershed specific internet sites, local non-profits internet sites, pamplets or fliers, and informational signs were also identified as useful vectors for information delivery.
- The source that received the lowest mean level of usefulness from respondents was government publications, and radio and town meetings were also not rated as being highly useful.
- Older respondents did not respond as positively to the internet as a source of information, likewise younger respondents did not respond as positively to town or community meetings.
- More lakefront than non-lakefront respondents are members of NLRA, 50% of the lakefront prop owners surveyed were members. The implication is that the NLRA may be a very effective way to reach and educate this population.
- Respondents' level of trust in information about the Newfound Lake region from various sources was highest when the information comes from the Newfound Lakes Region Association.
- Academic and state government information sources are also considered trustworthy relative to other information sources about the watershed.
- Trust in academic sources varies strongly with political persuasion, with conservatives viewing them more skeptically.

<u>Provide other useful information on specific issues relevant to the development of the watershed master plan</u>

- Concerns in the watershed are highest about:
    - septic discharge
    - invasive plants
    - building practices on water bodies
    - lawn care runoff issues
    - water quality
    - loss of forested areas
    - loss of wildlife
    - development on steep slopes

  A watershed plan can provide a tool for towns to approach these issues of concern in an integrated, watershed-wide manner.
- Very few statistically significant differences exist across the responses from residents of different towns in the watershed, which is encouragement for all towns to work together for the common good of the watershed. The watershed plan can serve as an essential step in the process of developing these perspectives and relationships.
- Mean responses indicate a tendency for those who identified themselves as liberal and those having stronger environmental values to view the watershed as more damaged by local land uses.
- On the average, younger respondents felt that their household had more impact on the watershed than older.
- Lakefront residents are less concerned about zoning rules, fishing regulations, and hunting regulations being more restrictive than non-lakefront residents.
- Lakefront residents participate in swimming, motorized and non-motorized boating, visiting with friends, and relaxing and enjoying views more then their non-lakefront community peers. Non-lakefront property owners participate in fishing, camping, dirt

bike, 4wheel, or ATV riding, snowshoeing and hunting more than lakefront property owners. The implication is that the impacts these activities have on the watershed are very different, and outreach should be tailored to reach different populations

- Non-lakefront residents agree more strongly with assertions that town governments should decide on regulations and implemented at the town level than lakefront residents.
- Respondents with strong environmental values agreed more strongly that regulations for the watershed should be implemented at the state level, local governments should collaborate with state government to decide on regulations in the watershed, and all town governments in watershed should work together to decide on regulations.
- Respondents rate the current water quality in the watershed very highly, and seek to maintain it.
- There are several key points for the design of environmental communications:
    - There are findings from recent research about the importance of using normative framing when developing environmental communications to stimulate environmentally responsible behaviors that are reinforced by this work. Recent studies (Christakis and Fowler 2008; Goldstein, Cialdini, and Griskevicius 2008; Cialdini 2005; Cialdini 2003) has been conducted (some of it examining the effects of various message framings on hotel guests repeat use of towels, and other looking at smoking cessation efforts) that clarifies the power of framing messages in this particular manner. In multiple studies such framing resulted in significantly more participation in environmentally responsible behaviors than alternative message framing (Christakis and Fowler 2008; Goldstein, Cialdini, and Griskevicius 2008; Cialdini 2005; Cialdini 2003). Normative framing is the use of appeals employing descriptive and provincial norms to encourage behavioral change. Appeals employing descriptive norms (e.g., "the majority of guests reuse their towels") prove more effective than traditional appeals widely used by hotels that focus solely on environmental protection. Normative appeals are most effective when describing group behavior that occurs in the setting that most closely matches individuals' immediate situational circumstances (e.g., "the majority of guests in this room reuse their towels"), which are referred to as provincial norms.
    - To use this framing in messages, use the data from this report about what values are widely shared, what concerns are common, and what environmentally responsible behaviors residents engage in within the watershed.
    - It is also essential to directly link desired changes with the impacts they address, encouraging people to join others in their community.

The data clearly indicate that residents are concerned about rapid changes in the watershed, have good knowledge of stewardship principles, and are concerned about how future changes may affect the region in which they live. There is a strong desire to ensure the beauty of the region into the future, and to have communities work together to protect the watershed landscape. The watershed master plan is an essential step in the process of the long-term planning for and protection of the Newfound lake Watershed, and residents of the region and project partners are encouraged to use this resource to begin to develop an understanding of the human dimensions of many issues in the watershed. The data reported here was collected using social science research methods to design and conduct a scientific, random sample survey of watershed residents, and the conclusions and recommendations above represent one step in the process of developing a document, and more importantly a spirit, that can help communities and residents of the watershed protect the places and ways of life they cherish into the future.

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VII. Appendices

Appendix A: Research Instruments

The Opinions of Residents:
A Survey to Guide the Creation of
Every Acre Counts:
The Newfound Watershed Master Plan

NEWFOUND LAKE REGION ASSOCIATION

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

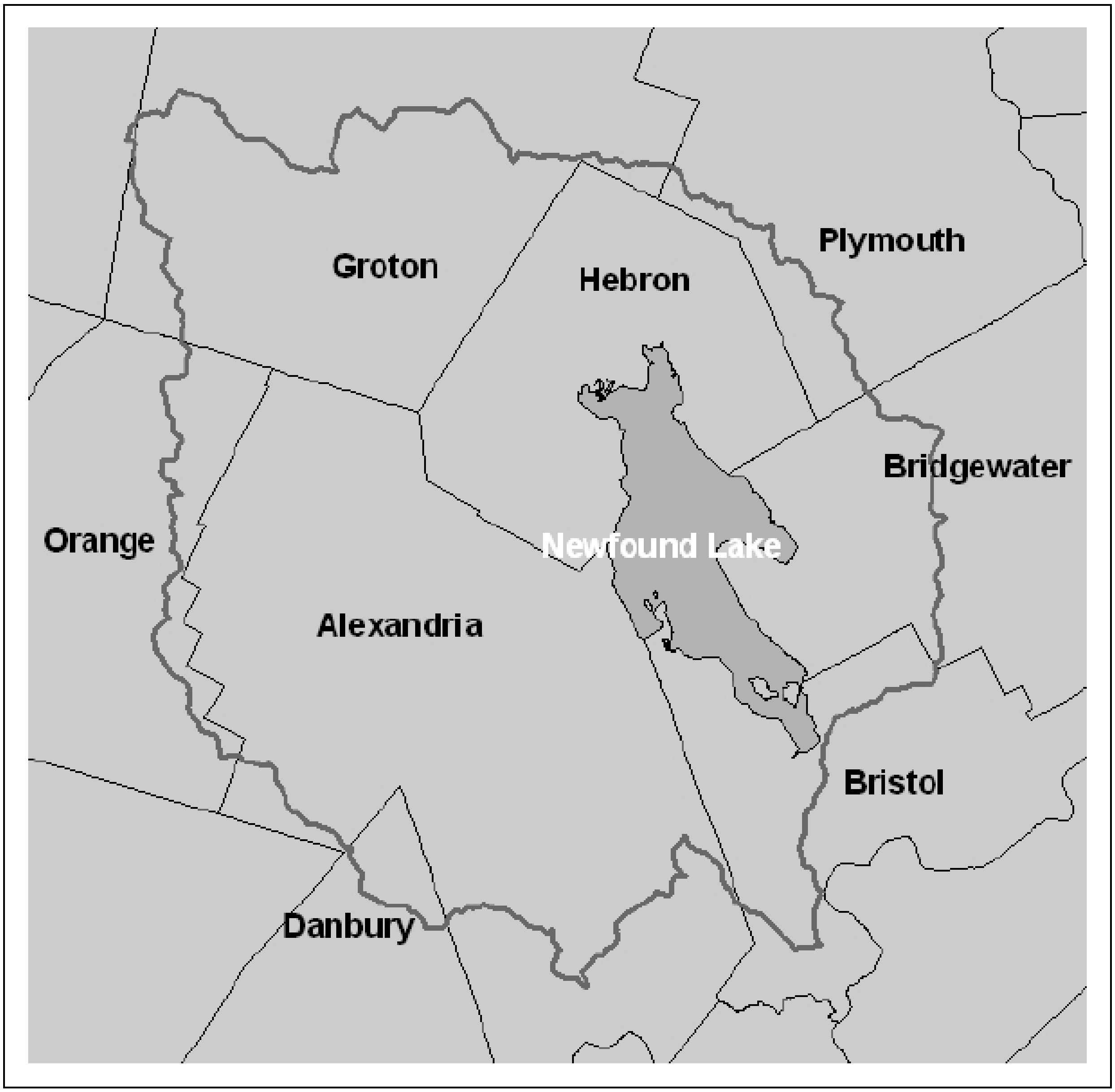
UNIVERSITY of NEW HAMPSHIRE Cooperative Extension

Plymouth State UNIVERSITY Center for the Environment

The Newfound Lake region is one of the crown jewels of New Hampshire, and the watershed is valued for its beauty and as an essential economic resource. This is a pivotal time for ensuring the long-term health and beauty of the watershed, and we need your opinions. Many agencies and organizations have committed to, and are participating in, the development of a Watershed Master Plan (WMP) for the Newfound Lake Region. The plan will provide useful information to communities in the watershed to help them ensure the high quality of life in the region into the future. This survey is your opportunity to contribute your opinions to the creation of the WMP.

*A **watershed** is the land area that drains into a specific body of water.*

The Newfound Watershed



The Newfound Lake Watershed (the entire area of land draining to Newfound Lake), like many in New Hampshire, is undergoing significant changes that will have lasting impacts on communities and residents of the region. To understand and plan for the impacts of these changes efficiently and effectively it is important to understand residents' opinions and their desires for the future. As a resident of one of the communities within the watershed we need your input to help guide the creation of the Newfound Watershed Master Plan.

Please take some of your valuable time to help in this important effort by answering each of the following questions by circling the response that best corresponds to your answer. The information collected will be used to develop a watershed plan to provide usable information to communities in the watershed to help them plan for the future.

If you encounter a question for which you do not know the answer, please indicate this by writing "DK" (for "don't know') in the margin next to that question. If you would like to explain any of your answers or make additional comments, please write that information legibly by the question that you are addressing.

Once you have completed the questionnaire, please place it in the reply envelope provided and drop it in the mail; no additional postage is necessary. ***Thank you!***

1. In your opinion, how would you rate the following aspects of the Newfound Lake Watershed as it exists now?

	Bad	Poor	Fair	Good	Excellent	Don't Know
A. The overall image of the area	1	2	3	4	5	DK
B. The friendliness within the region	1	2	3	4	5	DK
C. The visual attractiveness of the watershed	1	2	3	4	5	DK
D. The availability of conservation funding programs	1	2	3	4	5	DK
E. The availability of conservation technical assistance	1	2	3	4	5	DK
F. Opportunities for economic growth in the region	1	2	3	4	5	DK
G. The amount of wildlife habitat in the watershed	1	2	3	4	5	DK
H. The overall quality of water in rivers, streams, or lakes in the watershed for catching fish and/or swimming	1	2	3	4	5	DK

2. Please indicate your level of agreement with the following statements about the Newfound Lake Watershed.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
A. The watershed has changed a great deal in the last 10 years.	SD	D	N	A	SA
B. The economic stability of my community depends on good water quality.	SD	D	N	A	SA
C. Taking action to protect water quality in the watershed is too expensive for me.	SD	D	N	A	SA
E. When managing lands, the economic health of communities in the watershed should be given highest priority.	SD	D	N	A	SA
F. My household doesn't have much impact on water quality in the Newfound Lake Watershed.	SD	D	N	A	SA
G. What I do on my land doesn't make much difference in overall water quality in the watershed.	SD	D	N	A	SA
I. I would be willing to make changes to protect water quality.	SD	D	N	A	SA
J. Laws or regulations are the only way that landowners in the watershed will consider water quality when they manage their lands.	SD	D	N	A	SA
K. Regulations that protect water quality are too strict.	SD	D	N	A	SA

3. In your opinion, how important or unimportant are each of the following objectives for the management of the Newfound Lake Watershed?

	Not at all Important		Neutral		Very Important	Don't Know
A. Ensure clean water supplies for public use	1	2	3	4	5	DK
B. Ensure healthy water bodies that will support fish and other aquatic life	1	2	3	4	5	DK
C. Ensure the protection of private property rights	1	2	3	4	5	DK
D. Ensure that open spaces and natural areas exist for recreation	1	2	3	4	5	DK
E. Ensure that habitat for fish and other wildlife exist	1	2	3	4	5	DK
F. Ensure that local Master Plans and land use regulations are in place and up to date	1	2	3	4	5	DK

The following two questions ask specifically about Newfound Lake itself.

4. Please indicate your level of agreement with the following statements about how important *Newfound Lake* is to you.

	Strongly Disagree			Neutral			Strongly Agree
A. I feel that I really can be myself there.	1	2	3	4	5	6	7
B. For doing the things I enjoy most, no other place can compare to it.	1	2	3	4	5	6	7
C. It is my favorite place to be.	1	2	3	4	5	6	7
D. It reflects the type of person I am.	1	2	3	4	5	6	7
E. I really miss it when I am away too long.	1	2	3	4	5	6	7
F. It is the best place to do the things that I enjoy most.	1	2	3	4	5	6	7
G. There are better places to be than my lake.	1	2	3	4	5	6	7
H. I feel happiest when I am there.	1	2	3	4	5	6	7
I. Everything about it is a reflection of me.	1	2	3	4	5	6	7

5. What kind of place is *Newfound Lake*? (Please circle ONE response per line.)

The lake…	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
A. Is a scenic place.	SD	D	N	A	SA
B. Has too many buildings on the shore.	SD	D	N	A	SA
C. Is a family place.	SD	D	N	A	SA
D. Has been damaged by local land uses.	SD	D	N	A	SA
E. Is a pristine wilderness.	SD	D	N	A	SA
F. Has been harmed by overuse.	SD	D	N	A	SA
G. Is a place mostly for vacationers.	SD	D	N	A	SA
H. Is a place of high environmental quality.	SD	D	N	A	SA
I. Is a community of neighbors.	SD	D	N	A	SA
J. Is a place to escape from civilization.	SD	D	N	A	SA
K. Has many species of wildlife and plants.	SD	D	N	A	SA
L. Has too many people using it.	SD	D	N	A	SA
M. Is very peaceful.	SD	D	N	A	SA
N. Has very polluted water.	SD	D	N	A	SA
O. Is very crowded.	SD	D	N	A	SA
P. Has a lot of public access.	SD	D	N	A	SA
Q. Has changed a lot over the years.	SD	D	N	A	SA

6. How many people around the watershed do you know on a first name basis?

☐	☐	☐	☐	☐	☐
No one	1-5	6-10	11-20	21-50	More than 50

7. How many of these people would you consider close personal friends?

☐	☐	☐	☐	☐	☐
No one	1-5	6-10	11-20	21-50	More than 50

8. Overall, how would you rate water quality in each of the following?

	Poor	Fair	Good	Excellent	Don't Know
A. Streams in the watershed	☐	☐	☐	☐	☐
B. Newfound Lake	☐	☐	☐	☐	☐
C. Bodies of standing water in the watershed other than Newfound Lake	☐	☐	☐	☐	☐
D. The tap water in your home	☐	☐	☐	☐	☐

9. How concerned are you about each of the following issues in the Newfound Lake Watershed?

	Not at all Concerned	2	Neutral	4	Very Concerned	Don't Know
A. Loss of open space due to residential development	1	2	3	4	5	DK
B. A decrease in water clarity in Newfound Lake	1	2	3	4	5	DK
C. The impact of building practices on lake shorelines	1	2	3	4	5	DK
D. The impact of building practices on stream and river banks	1	2	3	4	5	DK
E. Impacts on landowners from regulations to protect water quality	1	2	3	4	5	DK
F. Poor water quality	1	2	3	4	5	DK
G. Discharge of septic waste	1	2	3	4	5	DK
H. Crowding at recreational sites	1	2	3	4	5	DK
I. Runoff from lawn care fertilizers	1	2	3	4	5	DK
J. Runoff from insecticides and/or pesticides used for lawn care	1	2	3	4	5	DK
K. Runoff from automobiles and/or other fluids left on paved surfaces	1	2	3	4	5	DK
L. Overpopulation in the watershed	1	2	3	4	5	DK
M. Increased sediments in water bodies throughout the watershed	1	2	3	4	5	DK
N. Drinking water quality	1	2	3	4	5	DK
O. Invasive plant growth	1	2	3	4	5	DK
P. Economic costs of complying with land-use regulations	1	2	3	4	5	DK
Q. Loss of wildlife	1	2	3	4	5	DK
R. Loss of forested or wooded areas	1	2	3	4	5	DK
S. The presence of economic opportunities	1	2	3	4	5	DK
T. Development on hillsides and steep slopes	1	2	3	4	5	DK
U. Loss of agricultural land	1	2	3	4	5	DK
V. New road development	1	2	3	4	5	DK

T. If you have any areas of concern related to your watershed that we did not ask about, please identify them: ______________________________

____

10. For each land use listed below please tell us whether you'd like to see less, more, or about the same of each in the Newfound Lake Watershed in the future?

	Less	About the Same	More	Don't Know
A. Residential development	☐	☐	☐	☐
B. Commercial development	☐	☐	☐	☐
C. National chain stores	☐	☐	☐	☐
D. Local businesses	☐	☐	☐	☐
E. Forests or woodlands	☐	☐	☐	☐
F. Wetlands	☐	☐	☐	☐
G. Public access to Newfound Lake	☐	☐	☐	☐
H. Outdoor recreation areas	☐	☐	☐	☐
I. Wildlife habitat	☐	☐	☐	☐
J. Land in agricultural production	☐	☐	☐	☐
K. High density developed residential areas	☐	☐	☐	☐

L. If there are other land uses you would like to comment on that we did not ask about, please let us know by identifying them: ____

____

11. Please indicate how often you perform the following activities on your land in the Newfound Lake Watershed.

	Never	Sometimes	Often
A. Pick up pet waste	☐	☐	☐
B. Use a phosphorus-free fertilizer on my lawn	☐	☐	☐
C. Leave or create a buffer of native plants between surface waters (lakes, streams) and my home	☐	☐	☐
D. Control soil erosion around my home	☐	☐	☐
E. Keep leaves and grass clippings out of shoreline areas and/or storm drains and culverts	☐	☐	☐
F. Encourage local businesses to carry phosphorous-free fertilizers	☐	☐	☐
H. Participate in local lake cleanup activities	☐	☐	☐
I. Test my soil before applying fertilizers	☐	☐	☐
J. Time the application of fertilizers when the forecast is rain free	☐	☐	☐
K. Leaving grass clipping on the lawn	☐	☐	☐
L. Following the manufacturer's guidelines for fertilizer application for my lawn	☐	☐	☐
M. Water my lawn	☐	☐	☐

12. Please indicate how concerned you would be if the following changes were to occur in your area:

	Not at all Concerned		Neutral		Very Concerned	Don't Know
A. Zoning rules became more restrictive	1	2	3	4	5	DK
B. Fishing regulations became more restrictive	1	2	3	4	5	DK
C. Hunting regulations became more restrictive	1	2	3	4	5	DK
D. Regulations were placed on water recreation	1	2	3	4	5	DK
E. Electric wind turbines were installed on ridgelines	1	2	3	4	5	DK

13. Please indicate how often you participate in the following activities in the Newfound Lake Watershed.

	Never	Sometimes	Often
A. Fishing on Newfound Lake (other than ice-fishing)	☐	☐	☐
B. Ice fishing on Newfound Lake	☐	☐	☐
C. Fishing in rivers, streams, and tributaries	☐	☐	☐
D. Swimming	☐	☐	☐
E. Boating (motorized)	☐	☐	☐
F. Boating (non-motorized)	☐	☐	☐
G. Hiking	☐	☐	☐
H. Camping	☐	☐	☐
I. Snowmobiling	☐	☐	☐
J. Bicycling	☐	☐	☐
K. Watching birds or other wildlife	☐	☐	☐
L. Dirt Bike, 4wheel, or ATV riding	☐	☐	☐
M. Cross country or back country skiing	☐	☐	☐
N. Snowshoeing	☐	☐	☐
O. Hunting	☐	☐	☐
P. Working on/maintaining property	☐	☐	☐
Q. Visiting with friends	☐	☐	☐
R. Relaxing and enjoying the views	☐	☐	☐
S. Community events/activities	☐	☐	☐
.T. Organized team sporting events	☐	☐	☐
U. Serve on local boards and/or committees	☐	☐	☐

14. Listed below are statements about the relationship between humans and the environment. For each one, please indicate whether you strongly agree, mildly agree, are unsure, mildly disagree, or strongly disagree with it.

	Strongly Disagree	Mildly Disagree	Unsure	Mildly Agree	Strongly Agree
A. We are approaching the limit of the number of people the earth can support.	SD	MD	U	MA	SA
B. Humans have the right to modify the natural environment to suit their needs.	SD	MD	U	MA	SA
C. When humans interfere with nature it often produces disastrous consequences.	SD	MD	U	MA	SA
D. Human ingenuity will insure that we do NOT make the earth unlivable.	SD	MD	U	MA	SA
E. Humans are severely abusing the environment.	SD	MD	U	MA	SA
F. The earth has plenty of natural resources if we just learn how to develop them.	SD	MD	U	MA	SA
G. Plants and animals have as much right as humans to exist.	SD	MD	U	MA	SA
H. The balance of nature is strong enough to cope with the impacts of modern industrial nations.	SD	MD	U	MA	SA
I. Despite our special abilities humans are still subject to the laws of nature.	SD	MD	U	MA	SA
J. The so-called "ecological crisis" facing humankind has been greatly exaggerated.	SD	MD	U	MA	SA
K. The earth is like a spaceship with very limited room and resources.	SD	MD	U	MA	SA
L. Humans were meant to rule over the rest of nature.	SD	MD	U	MA	SA
M. The balance of nature is very delicate and easily upset.	SD	MD	U	MA	SA
N. Humans will eventually learn enough about nature and now nature works to be able to control it.	SD	MD	U	MA	SA
O. If things continue on their present course, we will soon experience a major ecological catastrophe.	SD	MD	U	MA	SA

15. Please indicate how useful each of the following information sources would be to you to acquire information about the Newfound Lake Watershed?

	Not at all Useful	Somewhat Useful	Useful	Very Useful
A. Local/Regional Newspaper	☐	☐	☐	☐
B. Radio	☐	☐	☐	☐
C. Internet site of local lake organization (NLRA)	☐	☐	☐	☐
D. Town Meetings	☐	☐	☐	☐
E. Journals or Magazines	☐	☐	☐	☐
F. Government Publications	☐	☐	☐	☐
G. Television	☐	☐	☐	☐
H. Word of Mouth	☐	☐	☐	☐
I. Informational Signs	☐	☐	☐	☐
J. Pamphlets or Flyers	☐	☐	☐	☐
K. Classes or Seminars	☐	☐	☐	☐
L. Public meeting	☐	☐	☐	☐
M. Watershed specific internet site	☐	☐	☐	☐

N. If other sources of information not listed would be useful to you, please specify them: ____________________

____

16. Please indicate your level of agreement with the following assertions about how regulations in the watershed should be determined and implemented.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
A. Town governments should decide on regulations in the watershed.	SD	D	N	A	SA
B. Regulations for the Newfound Lake Watershed should be implemented at the state level.	SD	D	N	A	SA
C. Regulations for the Newfound Lakes Watershed should be implemented at the town level.	SD	D	N	A	SA
D. Local governments should collaborate with state government to decide on regulations in the watershed.	SD	D	N	A	SA
E. Local governments from all towns in the watershed should work together to decide on regulations for the Newfound Lake Watershed.	SD	D	N	A	SA

17. Please indicate your level of trust in information about the Newfound Lake Region from each of the following sources or groups.

	No Trust		Neutral		Trust Completely
A. Town Government or Administration	1	2	3	4	5
B. New Hampshire State Agencies	1	2	3	4	5
C. Federal Agencies	1	2	3	4	5
D. Newfound Lakes Region Association	1	2	3	4	5
E. Academic (University) Sources	1	2	3	4	5
F. Public Radio or Television	1	2	3	4	5
G. Chamber of Commerce	1	2	3	4	5
H. Local Companies	1	2	3	4	5

18. Background Characteristics.

The following questions will help us compare responses from people with differing background characteristics to identify important views and trends across different groups. Please remember that *all responses are completely confidential and cannot be linked with you as an individual.*

A. Which of the following best describes your residency in the Newfound Lake watershed?

☐ Year round
☐ Not year round → On average, how many months do you reside in the watershed per year? _________

B. How long have you lived at your current residence in the watershed?

☐ Less than 1 year
☐ 1-5 years
☐ 6-10 years
☐ 11-15 years
☐ 16-20 years
☐ over 20 years

C. For how many years have you lived in or visited the Newfound Lake Region?

☐ Less than 1 year
☐ 1-5 years
☐ 6-10 years
☐ 11-15 years
☐ 16-20 years
☐ over 20 years

D. About how many acres is the lot your house is on?

- ☐ ¼ acre or less
- ☐ ½ acre
- ☐ ¾ acre
- ☐ 1 acre
- ☐ 2-5 acres
- ☐ 6-10 acres
- ☐ 11-20 acres
- ☐ More than 20 acres

E. Do you maintain your property yourself, or do you hire out property maintenance such as landscaping and lawn-mowing?

☐ Self-maintain property ☐ Hire out property maintenance

F. Are you a current member of the Newfound Lakes Region Association?

☐ Yes ☐ No

G. How long does it usually take you to commute to work from home?

- ☐ Do not work
- ☐ Work from home
- ☐ Less than 5 minutes
- ☐ 5 to 9 minutes
- ☐ 10 to 14 minutes
- ☐ 15 to 19 minutes
- ☐ 20 to 24 minutes
- ☐ 25 to 30 minutes
- ☐ More than 30 minutes
- ☐ Other (please specify)______________________

H. Which category best describes your annual household income before taxes?

- ☐ Less than $20,000
- ☐ $20,000-$39,999
- ☐ $40,000-$59,999
- ☐ $60,000-$79,999
- ☐ $80,000-$99,999
- ☐ $100,000-$119,999
- ☐ $120,000-$139,999
- ☐ $140,000 or over

I. Do you feel your work or business is in some way economically dependent upon Newfound Lake?

☐ Yes ☐ No

J. Which of the following categories best describes your political orientation?

- ☐ Liberal
- ☐ Moderately liberal
- ☐ Moderate
- ☐ Moderately conservative
- ☐ Conservative
- ☐ Other
- ☐ Not Sure

K. In what year were you born? __________

L. What is your gender?

☐ Female ☐ Male

M. Which of the following best describes the highest level of education you have completed?

- ☐ Less than 12 years, no high school diploma
- ☐ High School/GED
- ☐ Some college
- ☐ Vocational/Trade Certificate
- ☐ Bachelor's Degree
- ☐ Master's Degree or higher

Thank you for your input. Please seal the completed questionnaire in the pre-addressed return envelope provided, and drop it in the mail.
No additional postage is necessary.

Funding for this project was provided in part by a grant form the NH Department of Environmental Services with funding from the US Environmental Protection Agency under Section 319 of the Clean Water Act.

Plymouth State UNIVERSITY
Center for the Environment

Center for the Environment
Plymouth State University
17 High Street, MSC #63
Plymouth, NH 03264-1595

XXXXXX
XXXXXX
XXXXXX

Dear XXXXXX,

The Newfound Lake region is one of the crown jewels of New Hampshire, and the watershed is valued for its beauty and as an essential economic resource. Like many areas in New England the Newfound Lake Watershed (the entire area of land draining to Newfound Lake) is undergoing significant changes that will have lasting impacts on communities and residents of the region.

To plan for the impacts of these changes efficiently and effectively it is important to understand residents' opinions and their desires for the future. As a resident of one of the communities within the watershed we need your input to plan for the future of our region.

This is a pivotal time to develop strategies to ensure the long-term health and beauty of the watershed. Many agencies and organizations are participating in the development of a Watershed Master Plan (WMP) for the Newfound Lake Region. The WMP will help communities address the important issues in our region by providing needed information for decision making. Your opinions are critical for the success of this process.

In about a week you will receive a questionnaire to provide information about your views and desires for our region. The questionnaire you receive will include directions and a postage paid return envelope for your convenience. All responses to the questionnaire will remain completely confidential, and no information that could identify any individual will be reported at any time, so please respond honestly and freely.

The final WMP is scheduled to be completed in 2009. We encourage you to monitor our progress through the Newfound Lake Region Association's website www.newfoundlake.org.

Thank you for your cooperation and participation in this important effort. This survey is being conducted by Dr. Brian W. Eisenhauer, on behalf of the WMP Project Team including the Center for the Environment at Plymouth State University. If you have any questions about this project, please feel free to contact Dr. Eisenhauer at his PSU office (603.535.2497.) or by e-mail (bweisenhauer@plymouth.edu). We look forward to hearing from you.

Sincerely,

Brian W. Eisenhauer, Ph.D.
Plymouth State University
Center for the Environment

NEWFOUND LAKE REGION ASSOCIATION

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

Plymouth State UNIVERSITY
Center for the Environment

UNIVERSITY of NEW HAMPSHIRE Cooperative Extension

Plymouth State University
Center for the Environment

Center for the Environment
Plymouth State University
17 High Street, MSC #39
Plymouth, NH 03264-1595

XXXXXX
XXXXXX
XXXXXX

Dear XXXXX,

The Newfound Lake Watershed is valued by residents for many reasons, including its beauty and economic value. Like many areas in New England the Newfound Lake Watershed (the entire area of land draining to Newfound Lake) is undergoing significant changes that will have lasting impacts on communities and residents of the region. Please help us plan for the future by taking some of your valuable time to share your opinions on important issues by completing the questionnaire enclosed.

This is a crucial time to ensure the long-term health and beauty of the watershed because many agencies and organizations are participating in the development of a Watershed Master Plan (WMP) for the Newfound Lake Region. The WMP will help communities address the important issues in our region by providing needed information for decision making, and in order for the WMP to useful it needs to be based on wide-spread input from residents. Your opinions are critical for the success of this process.

Findings from this research will guide the creation of the WMP, and the final WMP is scheduled to be completed in 2009. We encourage you to monitor our progress through the Newfound Lake Region Association's website www.newfoundlake.org.

Once your questionnaire has been returned your name will be deleted from our list so there will be no way to connect your responses to you individually. This ensures that your confidentiality will be protected. At the conclusion of this project the contact information database will be destroyed so that you will not receive any additional mailings from any source.

Thank you for your cooperation and participation in this important effort. This survey is being conducted by Dr. Brian W. Eisenhauer, on behalf of the Center for the Environment at Plymouth State University. If you have any questions about this project, please feel free to contact Dr. Eisenhauer at his PSU office (603.535.2497) or by e-mail (bweisenhauer@plymouth.edu). Thank you again for you assistance.

Sincerely,

Brian W. Eisenhauer, Ph.D.
Plymouth State University
Center for the Environment

Newfound Lake Region Association

New Hampshire Department of Environmental Services

Plymouth State University
Center for the Environment

University of New Hampshire
Cooperative Extension

NHCP RIVER & WATERSHED ORGANIZATIONS

NEEDS ASSESSMENT SURVEY

Date

Dear XXXXX,

Last week you received a questionnaire seeking your opinions about the future of the Newfound Lake Region. We are making this inquiry to gain information for inclusion in the Watershed Master Plan (WMP) being developed for the Newfound Lake Region.

If you have already completed and returned the questionnaire, please accept our sincere thanks. If not, please do so today. We are especially grateful for your help because it is only by asking people like you to share your opinions and ideas that we can develop a successful WMP to ensure the long-term health and beauty of Newfound Lake.

If you did not receive a questionnaire, or if it was misplaced, please contact us to request a copy. Thank you.

Brian W. Eisenhauer, Ph.D.
Center for the Environment, Plymouth State University
bweisenhauer@plymouth.edu, 603.535.2497

Center for the Environment
Plymouth State University
17 High Street, MSC #39
Plymouth, NH 03264-1595

XXXXX
XXXXX
XXXXX

Dear XXXXX,

About a month ago, we sent you a questionnaire looking for your input to help guide the creation and implementation of the watershed master plan for the Newfound Lake region. The plan will be an important resource that can be used by communities to make informed decisions about important issues, and it is important that we hear from you and other citizens to represent your views. If you have returned the survey recently we greatly appreciate it, but as of now our latest records indicate that the questionnaire has not yet been returned.

A large portion of those we surveyed have responded and added their input, explaining their feelings both positive and negative toward the region while expressing their desires for the future. We are contacting you now because we need responses from as many people as possible to ensure that our results are truly representative.

A few people have contacted us explaining that they no longer own property in the area, if this is the case, please let us know and we will take your name off our list. Others have had concerns that they do not spend time on Newfound Lake, or do not own property within the watershed. As an owner of property in one of the towns within the watershed, these issues will still affect you, so it is important for your voice to be heard.

When surveys are returned in the enclosed envelope your name is then deleted from our list. At that point we will no longer contact you or be able to connect you personally to your survey, so if you have returned your survey in your own envelope without a return address, please contact us so that we can remove your name from our list. Protecting your confidentiality is very important to us as well as to all of the organizations working on this project.

We hope to hear from you soon, but if for any reason you are unwilling or unable to respond, please return your blank questionnaire in the provided envelope so that we stop contacting you. Thank you for your help with this important project. If you have any questions about this project, please feel free to contact Dr. Eisenhauer at his PSU office (603.535.2497) or by e-mail (bweisenhauer@plymouth.edu). Thank you again for you assistance.

Sincerely,

Brian W. Eisenhauer, Ph.D.
Plymouth State University
Center for the Environment

Understanding the Views of Residents to Guide the Creation of Every Acres Counts: The Newfound Watershed Master Plan
Findings from a Watershed Community Survey
<u>Complete Appendices of Survey Results</u>

Prepared for

The People of the Newfound Lake Watershed, The Every Acres Counts Project Team, and The New Hampshire Department of Environmental Services

by

The Center for the Environment, Plymouth State University

Dr. Brian W. Eisenhauer
Associate Director
Center for the Environment
Plymouth State University

Dr. Joan M. Brehm
Assistant Professor of Sociology
Illinois State University

Danielle Ross
William H. Hopkins
Meghan Rodier
Jennifer Hill
Christian Weber
Center for the Environment
Plymouth State University

Dr. Richard Stedman
Assistant Professor of
Natural Resources
Cornell University

May, 2008

Plymouth State UNIVERSITY
Center for the Environment

17 High Street, MSC #63
Plymouth, New Hampshire USA 03264
603.535.2497 bweisenhauer@plymouth.edu www.plymouth.edu/cfe

This document is a reference developed to supplement the project report of findings from the random sample, scientific survey of residents of the Newfound Lake Watershed that presents the results for responses to all questions in the survey in both tabular and graph forms. The Newfound Lake watershed is a uniquely beautiful and rural watershed in New Hampshire that is home to residents of nine distinct towns. The watershed is valued for its beauty and as an essential economic resource in the region, and Newfound Lake itself has high scenic value and very good water quality at the present time. Like many regions of New Hampshire the Newfound Lake watershed is experiencing social and economic changes, including population growth and the related impacts on water quality. As a result it is a pivotal time for ensuring the long-term health and beauty of the watershed by developing a Watershed Master Plan for the Newfound Lake Region.

Developing a watershed master plan is a complex process involving many areas of professional expertise and research, and many important tasks require an understanding of the social dynamics of issues within the watershed. Identifying residents' desires for the future through visioning processes, understanding concerns about management alternatives, and documenting the current understanding of best management practices are just a few examples of the ways watershed management plans necessitate an understanding of social factors to develop effective information and recommendations.

Surveys provide a form of public input that is used in most community planning processes in the United States (American Community Survey Data for Community Planning. 2006. Taeuber, Cynthia M. Trafford Publishing, New York). An excellent review of the use of surveys in community planning and other community-centered projects is published by and available through the Western Rural Development Center (http://wrdc.usu.edu/); specifically informative work for this project is *"Surveys as a Tool for Community Based Research."* (Dr. Stanley Guy. 2005. Chapter 1: Community Centered Research: A Primer. Utah State University Press. Logan, Utah.). Examples of surveys and their use in demographic data analysis are available at these sources, and examples from communities across the nation are also widely available on the internet.

To meet the need for social data in this planning project a random sample, scientific survey of residents of the Newfound Lake Watershed was conducted as part of the watershed plan development process.

Research Methods

The self-administered questionnaire survey was administered to property owners in eight towns in the watershed. When developing the sample the goal was to sample property owners, keeping in mind that decisions that affect the watershed are made at the town level. A portion of the sample, independent of town, was also drawn from a list of lakefront property owners. Ultimately the randomly selected sample included 1,945 property owners selected at random from town records of property owners in the watershed.

A small proportion of the surveys sent to potential respondents from the original sample frame were returned as "undeliverable" due to inaccuracies in town records or other issues. In order to maintain our original sample size, the undeliverable surveys are replaced by the next names on the lists and the same steps were implemented to deliver these surveys. Within the replacement surveys, seven were also undeliverable. Rather than repeating the process and holding up data collection, the original sample went from 1,945 to 1,938. Of the 1,938 questionnaires sent, 794 were completed and returned for an overall response rate of 41%.

The data below is presented to serve as a reference for community members and others, and is in several forms. The first section presents tables and charts of the responses to all questions in the questionnaire. A great deal of time was also spent conducting detailed analyses of relationships between demographic and other variables of interest and attitudinal and perceptual measures, and the most important results are reviewed in the final report. Complete results from these analyses are available from the research team upon request, but are not included in the appendix due to space considerations.

Frequency Tables for All Questions

Questionnaire Section 1

Town

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Alexandria	129	16.2	16.5	16.5
	Bridgewater	57	7.2	7.3	23.8
	Bristol	237	29.8	30.3	54.0
	Danbury	23	2.9	2.9	57.0
	Groton	77	9.7	9.8	66.8
	Hebron	228	28.7	29.1	95.9
	Plymouth	18	2.3	2.3	98.2
	Orange	14	1.8	1.8	100.0
	Total	783	98.6	100.0	
Missing	Not Applicable	5	.6		
	Missing	6	.8		
	Total	11	1.4		
Total		794	100.0		

Lakefront property owner

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	177	22.3	22.7	22.7
	No	604	76.1	77.3	100.0
	Total	781	98.4	100.0	
Missing	Not Applicable	5	.6		
	Missing	8	1.0		
	Total	13	1.6		
Total		794	100.0		

The overall image of the Newfound Lake Watershed as it exists now?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Poor	4	.5	.5	.5
	Fair	76	9.6	9.9	10.4
	Good	421	53.0	54.7	65.1
	Excellent	268	33.8	34.9	100.0
	Total	769	96.9	100.0	
Missing	Don't Know	11	1.4		
	Missing	14	1.8		
	Total	25	3.1		
Total		794	100.0		

The friendliness within the Newfound Lake region?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Bad	5	.6	.7	.7
	Poor	8	1.0	1.0	1.7
	Fair	105	13.2	13.7	15.4
	Good	459	57.8	60.1	75.5
	Excellent	187	23.6	24.5	100.0
	Total	764	96.2	100.0	
Missing	Don't Know	15	1.9		
	Missing	15	1.9		
	Total	30	3.8		
Total		794	100.0		

The visual attractiveness of the watershed?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Bad	4	.5	.5	.5
	Poor	4	.5	.5	1.0
	Fair	70	8.8	9.1	10.2
	Good	362	45.6	47.2	57.4
	Excellent	327	41.2	42.6	100.0
	Total	767	96.6	100.0	
Missing	Don't Know	12	1.5		
	Missing	15	1.9		
	Total	27	3.4		
Total		794	100.0		

The availability of conservation funding programs in the watershed?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Bad	8	1.0	2.9	2.9
	Poor	63	7.9	23.2	26.1
	Fair	103	13.0	37.9	64.0
	Good	86	10.8	31.6	95.6
	Excellent	12	1.5	4.4	100.0
	Total	272	34.3	100.0	
Missing	Don't Know	512	64.5		
	Missing	10	1.3		
	Total	522	65.7		
Total		794	100.0		

The availability of conservation technical assistance in the watershed?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Bad	10	1.3	3.2	3.2
	Poor	50	6.3	16.2	19.4
	Fair	94	11.8	30.4	49.8
	Good	125	15.7	40.5	90.3
	Excellent	30	3.8	9.7	100.0
	Total	309	38.9	100.0	
Missing	Don't Know	473	59.6		
	Missing	12	1.5		
	Total	485	61.1		
Total		794	100.0		

The opportunities for economic growth in the region?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Bad	13	1.6	2.2	2.2
	Poor	106	13.4	18.2	20.4
	Fair	231	29.1	39.6	60.0
	Good	188	23.7	32.2	92.3
	Excellent	45	5.7	7.7	100.0
	Total	583	73.4	100.0	
Missing	Don't Know	193	24.3		
	Missing	18	2.3		
	Total	211	26.6		
Total		794	100.0		

The amount of wildlife habitat in the Newfound Lake Watershed?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Bad	4	.5	.6	.6
	Poor	14	1.8	2.0	2.6
	Fair	104	13.1	14.9	17.5
	Good	395	49.7	56.5	74.0
	Excellent	182	22.9	26.0	100.0
	Total	699	88.0	100.0	
Missing	Don't Know	83	10.5		
	Missing	12	1.5		
	Total	95	12.0		
Total		794	100.0		

The overall quality of water in rivers, streams, or lakes in the watershed for catching fish and/or swimming?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Bad	3	.4	.4	.4
	Poor	12	1.5	1.6	2.0
	Fair	46	5.8	6.2	8.2
	Good	318	40.1	42.6	50.7
	Excellent	368	46.3	49.3	100.0
	Total	747	94.1	100.0	
Missing	Don't Know	39	4.9		
	Missing	8	1.0		
	Total	47	5.9		
Total		794	100.0		

Questionnaire Section 2

The watershed has changed a great deal in the last 10 years

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	6	.8	.8	.8
	Disagree	80	10.1	10.7	11.5
	Neutral	196	24.7	26.2	37.8
	Agree	341	42.9	45.6	83.4
	Strongly Agree	124	15.6	16.6	100.0
	Total	747	94.1	100.0	
Missing	Don't Know	14	1.8		
	Not Applicable	1	.1		
	Missing	32	4.0		
	Total	47	5.9		
Total		794	100.0		

The economic stability of the community depends on good water quality

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	7	.9	.9	.9
	Disagree	16	2.0	2.1	3.0
	Neutral	77	9.7	10.0	13.0
	Agree	388	48.9	50.3	63.3
	Strongly Agree	283	35.6	36.7	100.0
	Total	771	97.1	100.0	
Missing	Don't Know	4	.5		
	Missing	19	2.4		
	Total	23	2.9		
Total		794	100.0		

Taking action to protect water quality in the watershed is too expensive for you

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	138	17.4	17.9	17.9
	Disagree	312	39.3	40.6	58.5
	Neutral	229	28.8	29.8	88.3
	Agree	70	8.8	9.1	97.4
	Strongly Agree	20	2.5	2.6	100.0
	Total	769	96.9	100.0	
Missing	Don't Know	4	.5		
	Missing	21	2.6		
	Total	25	3.1		
Total		794	100.0		

The economic health of communities in the watershed should be given highest priority when managing lands

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	33	4.2	4.3	4.3
	Disagree	131	16.5	17.0	21.3
	Neutral	191	24.1	24.8	46.2
	Agree	308	38.8	40.1	86.2
	Strongly Agree	106	13.4	13.8	100.0
	Total	769	96.9	100.0	
Missing	Missing	25	3.1		
Total		794	100.0		

Respondent's household doesn't have much impact on water quality in the Newfound Lake Watershed

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	77	9.7	10.1	10.1
	Disagree	227	28.6	29.6	39.7
	Neutral	131	16.5	17.1	56.8
	Agree	257	32.4	33.6	90.3
	Strongly Agree	74	9.3	9.7	100.0
	Total	766	96.5	100.0	
Missing	Not Applicable	2	.3		
	Missing	26	3.3		
	Total	28	3.5		
Total		794	100.0		

Level of agreement that what you do on your land doesn't make much difference in overall water quality in the watershed

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	172	21.7	22.4	22.4
	Disagree	370	46.6	48.2	70.6
	Neutral	61	7.7	7.9	78.5
	Agree	125	15.7	16.3	94.8
	Strongly Agree	40	5.0	5.2	100.0
	Total	768	96.7	100.0	
Missing	Not Applicable	2	.3		
	Missing	24	3.0		
	Total	26	3.3		
Total		794	100.0		

Respondent would be willing to make changes to protect water quality

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	7	.9	.9	.9
	Disagree	19	2.4	2.5	3.4
	Neutral	136	17.1	17.6	21.0
	Agree	480	60.5	62.3	83.3
	Strongly Agree	129	16.2	16.7	100.0
	Total	771	97.1	100.0	
Missing	Missing	23	2.9		
Total		794	100.0		

Laws or regulations are the only way that landowners in the watershed will consider water quality when they manage their lands

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	41	5.2	5.3	5.3
	Disagree	223	28.1	28.9	34.2
	Neutral	150	18.9	19.5	53.7
	Agree	279	35.1	36.2	89.9
	Strongly Agree	78	9.8	10.1	100.0
	Total	771	97.1	100.0	
Missing	Don't Know	1	.1		
	Missing	22	2.8		
	Total	23	2.9		
Total		794	100.0		

Regulations that protect water quality are too strict

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	132	16.6	17.3	17.3
	Disagree	374	47.1	49.1	66.4
	Neutral	217	27.3	28.5	94.9
	Agree	23	2.9	3.0	97.9
	Strongly Agree	16	2.0	2.1	100.0
	Total	762	96.0	100.0	
Missing	Don't Know	12	1.5		
	Missing	20	2.5		
	Total	32	4.0		
Total		794	100.0		

Questionnaire Section 3

Clean water supplies for public use?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Important	3	.4	.4	.4
	2	2	.3	.3	.6
	Neutral	9	1.1	1.2	1.8
	4	103	13.0	13.3	15.2
	Very Important	655	82.5	84.8	100.0
	Total	772	97.2	100.0	
Missing	Don't Know	3	.4		
	Missing	19	2.4		
	Total	22	2.8		
Total		794	100.0		

Healthy water bodies will support fish and other aquatic life?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	1	.1	.1	.1
	Neutral	6	.8	.8	.9
	4	94	11.8	12.1	13.0
	Very Important	675	85.0	87.0	100.0
	Total	776	97.7	100.0	
Missing	Missing	18	2.3		
Total		794	100.0		

Protection of private property rights?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Important	14	1.8	1.8	1.8
	2	30	3.8	3.9	5.8
	Neutral	128	16.1	16.8	22.5
	4	220	27.7	28.8	51.3
	Very Important	372	46.9	48.7	100.0
	Total	764	96.2	100.0	
Missing	Don't Know	7	.9		
	Missing	23	2.9		
	Total	30	3.8		
Total		794	100.0		

Open spaces and natural areas exist for recreation?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Important	4	.5	.5	.5
	2	11	1.4	1.4	1.9
	Neutral	36	4.5	4.7	6.6
	4	174	21.9	22.6	29.2
	Very Important	546	68.8	70.8	100.0
	Total	771	97.1	100.0	
Missing	Don't Know	1	.1		
	Missing	22	2.8		
	Total	23	2.9		
Total		794	100.0		

Habitat for fish and other wildlife exist?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Important	1	.1	.1	.1
	2	1	.1	.1	.3
	Neutral	12	1.5	1.6	1.8
	4	114	14.4	14.8	16.6
	Very Important	643	81.0	83.4	100.0
	Total	771	97.1	100.0	
Missing	Don't Know	1	.1		
	Missing	22	2.8		
	Total	23	2.9		
Total		794	100.0		

Local Master Plans and land use regulations are in place and up to date?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Important	9	1.1	1.2	1.2
	2	11	1.4	1.5	2.6
	Neutral	53	6.7	7.0	9.6
	4	177	22.3	23.4	33.0
	Very Important	508	64.0	67.0	100.0
	Total	758	95.5	100.0	
Missing	Don't Know	14	1.8		
	Missing	22	2.8		
	Total	36	4.5		
Total		794	100.0		

Questionnaire Section 4

At Newfound Lake I feel that I really can be myself.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	20	2.5	2.6	2.6
	2	14	1.8	1.8	4.5
	3	15	1.9	2.0	6.5
	Neutral	152	19.1	20.1	26.6
	5	135	17.0	17.8	44.4
	6	166	20.9	21.9	66.3
	Strongly Agree	255	32.1	33.7	100.0
	Total	757	95.3	100.0	
Missing	Don't Know	1	.1		
	Not Applicable	1	.1		
	Missing	35	4.4		
	Total	37	4.7		
Total		794	100.0		

For doing the things I enjoy most, no other place can compare to Newfound Lake.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	30	3.8	3.9	3.9
	2	27	3.4	3.5	7.5
	3	41	5.2	5.4	12.9
	Neutral	179	22.5	23.5	36.4
	5	132	16.6	17.3	53.7
	6	153	19.3	20.1	73.8
	Strongly Agree	200	25.2	26.2	100.0
	Total	762	96.0	100.0	
Missing	Don't Know	1	.1		
	Not Applicable	1	.1		
	Missing	30	3.8		
	Total	32	4.0		
Total		794	100.0		

Newfound Lake is my favorite place to be.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	32	4.0	4.2	4.2
	2	26	3.3	3.4	7.6
	3	35	4.4	4.6	12.2
	Neutral	148	18.6	19.4	31.7
	5	123	15.5	16.2	47.8
	6	172	21.7	22.6	70.4
	Strongly Agree	225	28.3	29.6	100.0
	Total	761	95.8	100.0	
Missing	Don't Know	1	.1		
	Not Applicable	1	.1		
	Missing	31	3.9		
	Total	33	4.2		
Total		794	100.0		

Newfound Lake reflects the type of person I am.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	33	4.2	4.4	4.4
	2	21	2.6	2.8	7.2
	3	28	3.5	3.7	10.9
	Neutral	190	23.9	25.3	36.2
	5	154	19.4	20.5	56.7
	6	163	20.5	21.7	78.4
	Strongly Agree	162	20.4	21.6	100.0
	Total	751	94.6	100.0	
Missing	Don't Know	1	.1		
	Not Applicable	1	.1		
	Missing	41	5.2		
	Total	43	5.4		
Total		794	100.0		

I really miss Newfound Lake when I am away too long.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	33	4.2	4.3	4.3
	2	18	2.3	2.4	6.7
	3	24	3.0	3.2	9.9
	Neutral	144	18.1	19.0	28.9
	5	150	18.9	19.8	48.6
	6	161	20.3	21.2	69.8
	Strongly Agree	229	28.8	30.2	100.0
	Total	759	95.6	100.0	
Missing	Don't Know	1	.1		
	Not Applicable	1	.1		
	Missing	33	4.2		
	Total	35	4.4		
Total		794	100.0		

Newfound Lake is the best place to do the things that I enjoy most.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	35	4.4	4.6	4.6
	2	26	3.3	3.4	8.0
	3	39	4.9	5.1	13.2
	Neutral	161	20.3	21.2	34.4
	5	168	21.2	22.2	56.6
	6	155	19.5	20.4	77.0
	Strongly Agree	174	21.9	23.0	100.0
	Total	758	95.5	100.0	
Missing	Don't Know	1	.1		
	Not Applicable	2	.3		
	Missing	33	4.2		
	Total	36	4.5		
Total		794	100.0		

There are better place to be than Newfound Lake.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	122	15.4	16.1	16.1
	2	142	17.9	18.8	34.9
	3	103	13.0	13.6	48.5
	Neutral	223	28.1	29.5	78.0
	5	77	9.7	10.2	88.2
	6	50	6.3	6.6	94.8
	Strongly Agree	39	4.9	5.2	100.0
	Total	756	95.2	100.0	
Missing	Don't Know	1	.1		
	Not Applicable	1	.1		
	Missing	36	4.5		
	Total	38	4.8		
Total		794	100.0		

I feel happiest when I am at Newfound Lake.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	29	3.7	3.8	3.8
	2	22	2.8	2.9	6.8
	3	36	4.5	4.8	11.5
	Neutral	210	26.4	27.8	39.3
	5	128	16.1	17.0	56.3
	6	175	22.0	23.2	79.5
	Strongly Agree	155	19.5	20.5	100.0
	Total	755	95.1	100.0	
Missing	Don't Know	1	.1		
	Not Applicable	1	.1		
	Missing	37	4.7		
	Total	39	4.9		
Total		794	100.0		

Everything about Newfound Lake is a reflection of me.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	48	6.0	6.4	6.4
	2	45	5.7	6.0	12.4
	3	48	6.0	6.4	18.8
	Neutral	290	36.5	38.6	57.3
	5	119	15.0	15.8	73.1
	6	107	13.5	14.2	87.4
	Strongly Agree	95	12.0	12.6	100.0
	Total	752	94.7	100.0	
Missing	Don't Know	1	.1		
	Not Applicable	1	.1		
	Missing	40	5.0		
	Total	42	5.3		
Total		794	100.0		

Questionnaire Section 5

The lake is a scenic place.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	6	.8	.8	.8
	Disagree	7	.9	.9	1.7
	Neutral	8	1.0	1.0	2.7
	Agree	302	38.0	39.1	41.8
	Strongly Agree	449	56.5	58.2	100.0
	Total	772	97.2	100.0	
Missing	Not Applicable	1	.1		
	Missing	21	2.6		
	Total	22	2.8		
Total		794	100.0		

The lake has too many buildings on the shore.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	9	1.1	1.2	1.2
	Disagree	85	10.7	11.2	12.3
	Neutral	212	26.7	27.8	40.2
	Agree	293	36.9	38.5	78.6
	Strongly Agree	163	20.5	21.4	100.0
	Total	762	96.0	100.0	
Missing	Not Applicable	1	.1		
	Missing	31	3.9		
	Total	32	4.0		
Total		794	100.0		

The lake is a family place.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	.1	.1	.1
	Disagree	9	1.1	1.2	1.3
	Neutral	60	7.6	8.0	9.4
	Agree	404	50.9	54.0	63.4
	Strongly Agree	274	34.5	36.6	100.0
	Total	748	94.2	100.0	
Missing	Don't Know	1	.1		
	Not Applicable	1	.1		
	Missing	44	5.5		
	Total	46	5.8		
Total		794	100.0		

The lake has been damaged by local land uses.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	5	.6	.7	.7
	Disagree	131	16.5	17.6	18.3
	Neutral	259	32.6	34.8	53.1
	Agree	261	32.9	35.1	88.2
	Strongly Agree	88	11.1	11.8	100.0
	Total	744	93.7	100.0	
Missing	Don't Know	11	1.4		
	Not Applicable	1	.1		
	Missing	38	4.8		
	Total	50	6.3		
Total		794	100.0		

The lake is a pristine wilderness.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	66	8.3	8.8	8.8
	Disagree	268	33.8	35.6	44.4
	Neutral	178	22.4	23.7	68.1
	Agree	191	24.1	25.4	93.5
	Strongly Agree	49	6.2	6.5	100.0
	Total	752	94.7	100.0	
Missing	Not Applicable	1	.1		
	Missing	41	5.2		
	Total	42	5.3		
Total		794	100.0		

The lake has been harmed by overuse.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	17	2.1	2.3	2.3
	Disagree	163	20.5	21.7	23.9
	Neutral	268	33.8	35.6	59.6
	Agree	249	31.4	33.1	92.7
	Strongly Agree	55	6.9	7.3	100.0
	Total	752	94.7	100.0	
Missing	Don't Know	6	.8		
	Not Applicable	1	.1		
	Missing	35	4.4		
	Total	42	5.3		
Total		794	100.0		

The lake is mostly for vacationers.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	49	6.2	6.5	6.5
	Disagree	262	33.0	34.7	41.1
	Neutral	146	18.4	19.3	60.4
	Agree	256	32.2	33.9	94.3
	Strongly Agree	43	5.4	5.7	100.0
	Total	756	95.2	100.0	
Missing	Don't Know	1	.1		
	Not Applicable	1	.1		
	Missing	36	4.5		
	Total	38	4.8		
Total		794	100.0		

The lake is a place of high environmental quality.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	7	.9	.9	.9
	Disagree	44	5.5	5.8	6.7
	Neutral	166	20.9	21.9	28.6
	Agree	441	55.5	58.1	86.7
	Strongly Agree	101	12.7	13.3	100.0
	Total	759	95.6	100.0	
Missing	Don't Know	1	.1		
	Not Applicable	1	.1		
	Missing	33	4.2		
	Total	35	4.4		
Total		794	100.0		

The lake is a community of neighbors.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	13	1.6	1.7	1.7
	Disagree	97	12.2	12.8	14.5
	Neutral	233	29.3	30.7	45.1
	Agree	360	45.3	47.4	92.5
	Strongly Agree	57	7.2	7.5	100.0
	Total	760	95.7	100.0	
Missing	Don't Know	2	.3		
	Not Applicable	1	.1		
	Missing	31	3.9		
	Total	34	4.3		
Total		794	100.0		

The lake is a place to escape from civilization.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	27	3.4	3.6	3.6
	Disagree	166	20.9	22.0	25.6
	Neutral	163	20.5	21.6	47.2
	Agree	318	40.1	42.1	89.3
	Strongly Agree	81	10.2	10.7	100.0
	Total	755	95.1	100.0	
Missing	Not Applicable	1	.1		
	Missing	38	4.8		
	Total	39	4.9		
Total		794	100.0		

The lake has many species of wildlife and plants.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	7	.9	.9	.9
	Disagree	23	2.9	3.0	4.0
	Neutral	133	16.8	17.5	21.5
	Agree	488	61.5	64.3	85.8
	Strongly Agree	108	13.6	14.2	100.0
	Total	759	95.6	100.0	
Missing	Don't Know	1	.1		
	Not Applicable	1	.1		
	Missing	33	4.2		
	Total	35	4.4		
Total		794	100.0		

The lake has too many people using it.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	16	2.0	2.1	2.1
	Disagree	172	21.7	22.7	24.8
	Neutral	277	34.9	36.5	61.3
	Agree	203	25.6	26.8	88.1
	Strongly Agree	90	11.3	11.9	100.0
	Total	758	95.5	100.0	
Missing	Don't Know	2	.3		
	Not Applicable	1	.1		
	Missing	33	4.2		
	Total	36	4.5		
Total		794	100.0		

The lake is very peaceful.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	28	3.5	3.7	3.7
	Disagree	61	7.7	8.1	11.8
	Neutral	152	19.1	20.2	32.0
	Agree	391	49.2	52.0	84.0
	Strongly Agree	120	15.1	16.0	100.0
	Total	752	94.7	100.0	
Missing	Don't Know	1	.1		
	Not Applicable	1	.1		
	Missing	40	5.0		
	Total	42	5.3		
Total		794	100.0		

The lake has very polluted water.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	389	49.0	51.0	51.0
	Disagree	279	35.1	36.6	87.7
	Neutral	69	8.7	9.1	96.7
	Agree	21	2.6	2.8	99.5
	Strongly Agree	4	.5	.5	100.0
	Total	762	96.0	100.0	
Missing	Don't Know	4	.5		
	Not Applicable	1	.1		
	Missing	27	3.4		
	Total	32	4.0		
Total		794	100.0		

The lake is very crowded.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	50	6.3	6.6	6.6
	Disagree	278	35.0	36.9	43.5
	Neutral	228	28.7	30.2	73.7
	Agree	158	19.9	21.0	94.7
	Strongly Agree	40	5.0	5.3	100.0
	Total	754	95.0	100.0	
Missing	Not Applicable	2	.3		
	Missing	38	4.8		
	Total	40	5.0		
Total		794	100.0		

The lake has a lot of public access.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	59	7.4	7.8	7.8
	Disagree	195	24.6	25.7	33.4
	Neutral	189	23.8	24.9	58.3
	Agree	262	33.0	34.5	92.8
	Strongly Agree	55	6.9	7.2	100.0
	Total	760	95.7	100.0	
Missing	Don't Know	1	.1		
	Not Applicable	1	.1		
	Missing	32	4.0		
	Total	34	4.3		
Total		794	100.0		

The lake has changed a lot over the years.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	5	.6	.7	.7
	Disagree	78	9.8	10.3	11.0
	Neutral	176	22.2	23.3	34.3
	Agree	302	38.0	39.9	74.2
	Strongly Agree	195	24.6	25.8	100.0
	Total	756	95.2	100.0	
Missing	Don't Know	6	.8		
	Not Applicable	1	.1		
	Missing	31	3.9		
	Total	38	4.8		
Total		794	100.0		

Questionnaire Section 6

How many people around the watershed do you know on a first name basis?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No one	38	4.8	4.9	4.9
	1-5	82	10.3	10.6	15.6
	6-10	93	11.7	12.1	27.7
	11-20	140	17.6	18.2	45.8
	21-50	204	25.7	26.5	72.3
	More than 50	213	26.8	27.7	100.0
	Total	770	97.0	100.0	
Missing	Missing	24	3.0		
Total		794	100.0		

Questionnaire Section 7

How many of these people would you consider close personal friends?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No one	139	17.5	18.1	18.1
	1-5	248	31.2	32.3	50.4
	6-10	174	21.9	22.7	73.0
	11-20	115	14.5	15.0	88.0
	21-50	74	9.3	9.6	97.7
	More than 50	18	2.3	2.3	100.0
	Total	768	96.7	100.0	
Missing	Don't Know	1	.1		
	Missing	25	3.1		
	Total	26	3.3		
Total		794	100.0		

Questionnaire Section 8

The water quality of streams in the watershed?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Poor	9	1.1	1.4	1.4
	Fair	54	6.8	8.6	10.0
	Good	337	42.4	53.4	63.4
	Excellent	231	29.1	36.6	100.0
	Total	631	79.5	100.0	
Missing	Don't Know	136	17.1		
	Missing	27	3.4		
	Total	163	20.5		
Total		794	100.0		

The water quality of Newfound Lake?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Poor	4	.5	.5	.5
	Fair	29	3.7	3.9	4.5
	Good	255	32.1	34.6	39.1
	Excellent	448	56.4	60.9	100.0
	Total	736	92.7	100.0	
Missing	Don't Know	33	4.2		
	Missing	25	3.1		
	Total	58	7.3		
Total		794	100.0		

The water quality of bodies of standing water in the watershed, other than Newfound Lake?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Poor	10	1.3	2.2	2.2
	Fair	81	10.2	17.8	20.0
	Good	262	33.0	57.5	77.4
	Excellent	103	13.0	22.6	100.0
	Total	456	57.4	100.0	
Missing	Don't Know	310	39.0		
	Missing	28	3.5		
	Total	338	42.6		
Total		794	100.0		

The quality of the tap water in your home?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Poor	39	4.9	5.5	5.5
	Fair	82	10.3	11.6	17.2
	Good	277	34.9	39.3	56.5
	Excellent	307	38.7	43.5	100.0
	Total	705	88.8	100.0	
Missing	Don't Know	58	7.3		
	Not Applicable	4	.5		
	Missing	27	3.4		
	Total	89	11.2		
Total		794	100.0		

Questionnaire Section 9

Loss of open space due to residential development in the Newfound Lake Watershed?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Concerned	17	2.1	2.2	2.2
	2	15	1.9	2.0	4.2
	Neutral	75	9.4	9.9	14.1
	4	196	24.7	25.9	40.0
	Very Concerned	454	57.2	60.0	100.0
	Total	757	95.3	100.0	
Missing	Don't Know	9	1.1		
	Missing	28	3.5		
	Total	37	4.7		
Total		794	100.0		

A decrease in water clarity in Newfound Lake?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Concerned	13	1.6	1.8	1.8
	2	19	2.4	2.6	4.4
	Neutral	56	7.1	7.7	12.1
	4	147	18.5	20.1	32.2
	Very Concerned	495	62.3	67.8	100.0
	Total	730	91.9	100.0	
Missing	Don't Know	39	4.9		
	Missing	25	3.1		
	Total	64	8.1		
Total		794	100.0		

The impact of building practices on lake shorelines?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Concerned	12	1.5	1.6	1.6
	2	11	1.4	1.5	3.1
	Neutral	49	6.2	6.6	9.7
	4	158	19.9	21.2	30.8
	Very Concerned	516	65.0	69.2	100.0
	Total	746	94.0	100.0	
Missing	Don't Know	26	3.3		
	Missing	22	2.8		
	Total	48	6.0		
Total		794	100.0		

The impact of building practices on stream and river banks?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Concerned	13	1.6	1.8	1.8
	2	16	2.0	2.2	4.0
	Neutral	60	7.6	8.2	12.2
	4	200	25.2	27.4	39.6
	Very Concerned	440	55.4	60.4	100.0
	Total	729	91.8	100.0	
Missing	Don't Know	41	5.2		
	Missing	24	3.0		
	Total	65	8.2		
Total		794	100.0		

The impacts on landowners from regulations to protect water quality?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Concerned	55	6.9	7.6	7.6
	2	96	12.1	13.3	21.0
	Neutral	189	23.8	26.2	47.2
	4	196	24.7	27.2	74.4
	Very Concerned	184	23.2	25.6	100.0
	Total	720	90.7	100.0	
Missing	Don't Know	46	5.8		
	Missing	28	3.5		
	Total	74	9.3		
Total		794	100.0		

Poor water quality?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Concerned	17	2.1	2.3	2.3
	2	32	4.0	4.3	6.6
	Neutral	55	6.9	7.4	14.0
	4	154	19.4	20.7	34.6
	Very Concerned	487	61.3	65.4	100.0
	Total	745	93.8	100.0	
Missing	Don't Know	18	2.3		
	Missing	31	3.9		
	Total	49	6.2		
Total		794	100.0		

The discharge of septic waste?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Concerned	3	.4	.4	.4
	2	16	2.0	2.1	2.5
	Neutral	31	3.9	4.1	6.7
	4	103	13.0	13.7	20.4
	Very Concerned	598	75.3	79.6	100.0
	Total	751	94.6	100.0	
Missing	Don't Know	17	2.1		
	Missing	26	3.3		
	Total	43	5.4		
Total		794	100.0		

Crowding at recreational sites?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Concerned	17	2.1	2.3	2.3
	2	34	4.3	4.6	6.9
	Neutral	145	18.3	19.5	26.4
	4	230	29.0	31.0	57.4
	Very Concerned	316	39.8	42.6	100.0
	Total	742	93.5	100.0	
Missing	Don't Know	24	3.0		
	Missing	28	3.5		
	Total	52	6.5		
Total		794	100.0		

Runoff from lawn care fertilizers?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Concerned	7	.9	1.0	1.0
	2	19	2.4	2.6	3.6
	Neutral	62	7.8	8.5	12.0
	4	195	24.6	26.6	38.7
	Very Concerned	449	56.5	61.3	100.0
	Total	732	92.2	100.0	
Missing	Don't Know	32	4.0		
	Missing	30	3.8		
	Total	62	7.8		
Total		794	100.0		

Runoff from insecticides and/or pesticides used for lawn care?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Concerned	8	1.0	1.1	1.1
	2	16	2.0	2.2	3.3
	Neutral	54	6.8	7.3	10.6
	4	191	24.1	25.9	36.4
	Very Concerned	469	59.1	63.6	100.0
	Total	738	92.9	100.0	
Missing	Don't Know	31	3.9		
	Missing	25	3.1		
	Total	56	7.1		
Total		794	100.0		

Runoff from automobiles and/or other fluids left on paved surfaces?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Concerned	8	1.0	1.1	1.1
	2	32	4.0	4.3	5.4
	Neutral	74	9.3	10.0	15.4
	4	232	29.2	31.3	46.6
	Very Concerned	396	49.9	53.4	100.0
	Total	742	93.5	100.0	
Missing	Don't Know	27	3.4		
	Missing	25	3.1		
	Total	52	6.5		
Total		794	100.0		

Overpopulation in the watershed?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Concerned	16	2.0	2.1	2.1
	2	41	5.2	5.5	7.6
	Neutral	104	13.1	13.8	21.4
	4	234	29.5	31.2	52.6
	Very Concerned	356	44.8	47.4	100.0
	Total	751	94.6	100.0	
Missing	Don't Know	18	2.3		
	Missing	25	3.1		
	Total	43	5.4		
Total		794	100.0		

Increased sediments in water bodies throughout the watershed?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Concerned	9	1.1	1.3	1.3
	2	23	2.9	3.3	4.6
	Neutral	50	6.3	7.2	11.8
	4	239	30.1	34.3	46.1
	Very Concerned	375	47.2	53.9	100.0
	Total	696	87.7	100.0	
Missing	Don't Know	64	8.1		
	Missing	34	4.3		
	Total	98	12.3		
Total		794	100.0		

Drinking water quality?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Concerned	17	2.1	2.3	2.3
	2	21	2.6	2.8	5.0
	Neutral	53	6.7	7.0	12.1
	4	183	23.0	24.3	36.4
	Very Concerned	479	60.3	63.6	100.0
	Total	753	94.8	100.0	
Missing	Don't Know	17	2.1		
	Missing	24	3.0		
	Total	41	5.2		
Total		794	100.0		

Invasive plant growth?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Concerned	4	.5	.6	.6
	2	13	1.6	1.8	2.3
	Neutral	38	4.8	5.2	7.6
	4	179	22.5	24.7	32.3
	Very Concerned	491	61.8	67.7	100.0
	Total	725	91.3	100.0	
Missing	Don't Know	29	3.7		
	Missing	40	5.0		
	Total	69	8.7		
Total		794	100.0		

Economic costs of complying with land-use regulations?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Concerned	42	5.3	5.8	5.8
	2	90	11.3	12.5	18.3
	Neutral	173	21.8	24.0	42.2
	4	238	30.0	33.0	75.2
	Very Concerned	179	22.5	24.8	100.0
	Total	722	90.9	100.0	
Missing	Don't Know	44	5.5		
	Missing	28	3.5		
	Total	72	9.1		
Total		794	100.0		

Loss of wildlife?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Concerned	11	1.4	1.5	1.5
	2	23	2.9	3.1	4.6
	Neutral	64	8.1	8.6	13.1
	4	205	25.8	27.4	40.6
	Very Concerned	444	55.9	59.4	100.0
	Total	747	94.1	100.0	
Missing	Don't Know	20	2.5		
	Missing	27	3.4		
	Total	47	5.9		
Total		794	100.0		

Loss of forested or wooded areas?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Concerned	8	1.0	1.1	1.1
	2	18	2.3	2.4	3.5
	Neutral	57	7.2	7.6	11.1
	4	217	27.3	29.1	40.2
	Very Concerned	446	56.2	59.8	100.0
	Total	746	94.0	100.0	
Missing	Don't Know	15	1.9		
	Missing	33	4.2		
	Total	48	6.0		
Total		794	100.0		

Presence of economic opportunities?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Concerned	43	5.4	6.0	6.0
	2	68	8.6	9.5	15.5
	Neutral	234	29.5	32.7	48.2
	4	211	26.6	29.5	77.7
	Very Concerned	160	20.2	22.3	100.0
	Total	716	90.2	100.0	
Missing	Don't Know	41	5.2		
	Missing	37	4.7		
	Total	78	9.8		
Total		794	100.0		

Development on hillsides and steep slopes?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Concerned	11	1.4	1.5	1.5
	2	21	2.6	2.8	4.3
	Neutral	100	12.6	13.5	17.8
	4	189	23.8	25.5	43.4
	Very Concerned	419	52.8	56.6	100.0
	Total	740	93.2	100.0	
Missing	Don't Know	31	3.9		
	Missing	23	2.9		
	Total	54	6.8		
Total		794	100.0		

Loss of agricultural land?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Concerned	30	3.8	4.1	4.1
	2	46	5.8	6.2	10.3
	Neutral	158	19.9	21.4	31.8
	4	209	26.3	28.4	60.1
	Very Concerned	294	37.0	39.9	100.0
	Total	737	92.8	100.0	
Missing	Don't Know	28	3.5		
	Missing	29	3.7		
	Total	57	7.2		
Total		794	100.0		

New road development?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Concerned	26	3.3	3.7	3.7
	2	35	4.4	4.9	8.6
	Neutral	148	18.6	20.8	29.4
	4	226	28.5	31.8	61.2
	Very Concerned	276	34.8	38.8	100.0
	Total	711	89.5	100.0	
Missing	Don't Know	27	3.4		
	Missing	56	7.1		
	Total	83	10.5		
Total		794	100.0		

Questionnaire Section 10

Residential development

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less	451	56.8	59.4	59.4
	About the Same	284	35.8	37.4	96.8
	More	24	3.0	3.2	100.0
	Total	759	95.6	100.0	
Missing	Don't Know	12	1.5		
	Missing	23	2.9		
	Total	35	4.4		
Total		794	100.0		

Commercial development

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less	412	51.9	54.4	54.4
	About the Same	243	30.6	32.1	86.5
	More	102	12.8	13.5	100.0
	Total	757	95.3	100.0	
Missing	Don't Know	17	2.1		
	Missing	20	2.5		
	Total	37	4.7		
Total		794	100.0		

National chain stores

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less	542	68.3	70.7	70.7
	About the Same	163	20.5	21.3	91.9
	More	62	7.8	8.1	100.0
	Total	767	96.6	100.0	
Missing	Don't Know	8	1.0		
	Missing	19	2.4		
	Total	27	3.4		
Total		794	100.0		

Local businesses

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less	51	6.4	6.7	6.7
	About the Same	395	49.7	51.7	58.4
	More	318	40.1	41.6	100.0
	Total	764	96.2	100.0	
Missing	Don't Know	7	.9		
	Missing	23	2.9		
	Total	30	3.8		
Total		794	100.0		

Forest or woodland

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less	9	1.1	1.2	1.2
	About the Same	300	37.8	39.2	40.3
	More	457	57.6	59.7	100.0
	Total	766	96.5	100.0	
Missing	Don't Know	5	.6		
	Missing	23	2.9		
	Total	28	3.5		
Total		794	100.0		

Wetlands area

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less	31	3.9	4.2	4.2
	About the Same	407	51.3	54.6	58.8
	More	307	38.7	41.2	100.0
	Total	745	93.8	100.0	
Missing	Don't Know	23	2.9		
	Missing	26	3.3		
	Total	49	6.2		
Total		794	100.0		

Public access to Newfound Lake

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less	150	18.9	19.7	19.7
	About the Same	450	56.7	59.2	78.9
	More	160	20.2	21.1	100.0
	Total	760	95.7	100.0	
Missing	Don't Know	14	1.8		
	Missing	20	2.5		
	Total	34	4.3		
Total		794	100.0		

Areas for outdoor recreation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less	39	4.9	5.2	5.2
	About the Same	448	56.4	59.3	64.4
	More	269	33.9	35.6	100.0
	Total	756	95.2	100.0	
Missing	Don't Know	10	1.3		
	Missing	28	3.5		
	Total	38	4.8		
Total		794	100.0		

Wildlife habitat

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less	10	1.3	1.3	1.3
	About the Same	263	33.1	34.7	36.0
	More	485	61.1	64.0	100.0
	Total	758	95.5	100.0	
Missing	Don't Know	12	1.5		
	Missing	24	3.0		
	Total	36	4.5		

Public access to Newfound Lake

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less	150	18.9	19.7	19.7
	About the Same	450	56.7	59.2	78.9
	More	160	20.2	21.1	100.0
	Total	760	95.7	100.0	
Missing	Don't Know	14	1.8		
	Missing	20	2.5		
	Total	34	4.3		
Total		794	100.0		

Land in agricultural production

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less	54	6.8	7.5	7.5
	About the Same	376	47.4	52.4	59.9
	More	288	36.3	40.1	100.0
	Total	718	90.4	100.0	
Missing	Don't Know	42	5.3		
	Missing	34	4.3		
	Total	76	9.6		
Total		794	100.0		

High density developed residential areas

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less	637	80.2	85.8	85.8
	About the Same	80	10.1	10.8	96.6
	More	25	3.1	3.4	100.0
	Total	742	93.5	100.0	
Missing	Don't Know	18	2.3		
	Missing	34	4.3		
	Total	52	6.5		
Total		794	100.0		

Questionnaire Section 11

Pick up pet waste on your land

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	262	33.0	38.3	38.3
	Sometimes	161	20.3	23.5	61.8
	Often	261	32.9	38.2	100.0
	Total	684	86.1	100.0	
Missing	Not Applicable	69	8.7		
	Missing	41	5.2		
	Total	110	13.9		
Total		794	100.0		

Use a phosphorus-free fertilizer on your lawn

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	346	43.6	59.3	59.3
	Sometimes	116	14.6	19.9	79.2
	Often	121	15.2	20.8	100.0
	Total	583	73.4	100.0	
Missing	Don't Know	12	1.5		
	Not Applicable	138	17.4		
	Missing	61	7.7		
	Total	211	26.6		
Total		794	100.0		

Leave or create a buffer of native plants between surface waters and your home

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	153	19.3	22.0	22.0
	Sometimes	139	17.5	20.0	42.0
	Often	404	50.9	58.0	100.0
	Total	696	87.7	100.0	
Missing	Don't Know	4	.5		
	Not Applicable	39	4.9		
	Missing	55	6.9		
	Total	98	12.3		
Total		794	100.0		

Control soil erosion on your land

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	83	10.5	11.4	11.4
	Sometimes	189	23.8	25.9	37.3
	Often	457	57.6	62.7	100.0
	Total	729	91.8	100.0	
Missing	Don't Know	3	.4		
	Not Applicable	13	1.6		
	Missing	49	6.2		
	Total	65	8.2		
Total		794	100.0		

Keep leaves and crass clipping out of shoreline areas and/or storm drains and culverts on your land

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	109	13.7	15.6	15.6
	Sometimes	121	15.2	17.4	33.0
	Often	467	58.8	67.0	100.0
	Total	697	87.8	100.0	
Missing	Don't Know	5	.6		
	Not Applicable	37	4.7		
	Missing	55	6.9		
	Total	97	12.2		
Total		794	100.0		

Encourage local businesses to carry phosphorous-free fertilizers

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	547	68.9	78.8	78.8
	Sometimes	81	10.2	11.7	90.5
	Often	66	8.3	9.5	100.0
	Total	694	87.4	100.0	
Missing	Don't Know	5	.6		
	Not Applicable	16	2.0		
	Missing	79	9.9		
	Total	100	12.6		
Total		794	100.0		

Participate in local cleanup activities in the Newfound Lake Watershed

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	426	53.7	58.4	58.4
	Sometimes	240	30.2	32.9	91.4
	Often	63	7.9	8.6	100.0
	Total	729	91.8	100.0	
Missing	Don't Know	1	.1		
	Not Applicable	8	1.0		
	Missing	56	7.1		
	Total	65	8.2		
Total		794	100.0		

Test your soil before applying fertilizers on your land

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	436	54.9	76.8	76.8
	Sometimes	92	11.6	16.2	93.0
	Often	40	5.0	7.0	100.0
	Total	568	71.5	100.0	
Missing	Don't Know	8	1.0		
	Not Applicable	153	19.3		
	Missing	65	8.2		
	Total	226	28.5		
Total		794	100.0		

Time the application of fertilizers to when the forecast is rain free

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	301	37.9	55.2	55.2
	Sometimes	125	15.7	22.9	78.2
	Often	119	15.0	21.8	100.0
	Total	545	68.6	100.0	
Missing	Don't Know	7	.9		
	Not Applicable	160	20.2		
	Missing	82	10.3		
	Total	249	31.4		
Total		794	100.0		

Leave grass clippings on your lawn

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	146	18.4	20.9	20.9
	Sometimes	156	19.6	22.4	43.3
	Often	395	49.7	56.7	100.0
	Total	697	87.8	100.0	
Missing	Don't Know	5	.6		
	Not Applicable	48	6.0		
	Missing	44	5.5		
	Total	97	12.2		
Total		794	100.0		

Follow the manufacturer's guidelines for fertilizer application on your lawn

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	184	23.2	34.4	34.4
	Sometimes	84	10.6	15.7	50.1
	Often	267	33.6	49.9	100.0
	Total	535	67.4	100.0	
Missing	Don't Know	5	.6		
	Not Applicable	173	21.8		
	Missing	81	10.2		
	Total	259	32.6		
Total		794	100.0		

Water your lawn

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	413	52.0	59.2	59.2
	Sometimes	232	29.2	33.2	92.4
	Often	53	6.7	7.6	100.0
	Total	698	87.9	100.0	
Missing	Don't Know	2	.3		
	Not Applicable	47	5.9		
	Missing	47	5.9		
	Total	96	12.1		
Total		794	100.0		

Questionnaire Section 12

Zoning rules became more restrictive

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Concerned	190	23.9	25.6	25.6
	2	116	14.6	15.6	41.2
	Neutral	168	21.2	22.6	63.8
	4	119	15.0	16.0	79.8
	Very Concerned	150	18.9	20.2	100.0
	Total	743	93.6	100.0	
Missing	Don't Know	27	3.4		
	Missing	24	3.0		
	Total	51	6.4		
Total		794	100.0		

Fishing regulations became more restrictive

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Concerned	175	22.0	23.7	23.7
	2	86	10.8	11.6	35.3
	Neutral	226	28.5	30.6	65.9
	4	111	14.0	15.0	80.9
	Very Concerned	141	17.8	19.1	100.0
	Total	739	93.1	100.0	
Missing	Don't Know	35	4.4		
	Missing	20	2.5		
	Total	55	6.9		
Total		794	100.0		

Hunting regulations became more restrictive

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Concerned	227	28.6	30.7	30.7
	2	88	11.1	11.9	42.6
	Neutral	198	24.9	26.8	69.3
	4	95	12.0	12.8	82.2
	Very Concerned	132	16.6	17.8	100.0
	Total	740	93.2	100.0	
Missing	Don't Know	35	4.4		
	Missing	19	2.4		
	Total	54	6.8		
Total		794	100.0		

Regulations were placed on water recreation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Concerned	159	20.0	21.1	21.1
	2	107	13.5	14.2	35.4
	Neutral	160	20.2	21.3	56.6
	4	152	19.1	20.2	76.9
	Very Concerned	174	21.9	23.1	100.0
	Total	752	94.7	100.0	
Missing	Don't Know	24	3.0		
	Missing	18	2.3		
	Total	42	5.3		
Total		794	100.0		

Electric wind turbines were installed on ridgelines

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Concerned	229	28.8	31.5	31.5
	2	117	14.7	16.1	47.5
	Neutral	147	18.5	20.2	67.7
	4	72	9.1	9.9	77.6
	Very Concerned	163	20.5	22.4	100.0
	Total	728	91.7	100.0	
Missing	Don't Know	48	6.0		
	Missing	18	2.3		
	Total	66	8.3		
Total		794	100.0		

Questionnaire Section 13

Fish on Newfound Lake

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	431	54.3	55.7	55.7
	Sometimes	264	33.2	34.1	89.8
	Often	79	9.9	10.2	100.0
	Total	774	97.5	100.0	
Missing	Missing	20	2.5		
Total		794	100.0		

Ice fish on Newfound Lake

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	615	77.5	79.6	79.6
	Sometimes	124	15.6	16.0	95.6
	Often	34	4.3	4.4	100.0
	Total	773	97.4	100.0	
Missing	Not Applicable	1	.1		
	Missing	20	2.5		
	Total	21	2.6		
Total		794	100.0		

Fish in rivers, streams, and tributaries in the Newfound Lake Watershed

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	441	55.5	57.5	57.5
	Sometimes	244	30.7	31.8	89.3
	Often	82	10.3	10.7	100.0
	Total	767	96.6	100.0	
Missing	Missing	27	3.4		
Total		794	100.0		

Swim in the Newfound Lake Watershed

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	78	9.8	10.0	10.0
	Sometimes	269	33.9	34.6	44.7
	Often	430	54.2	55.3	100.0
	Total	777	97.9	100.0	
Missing	Missing	17	2.1		
Total		794	100.0		

Participate in motorized boating in the Newfound Lake Watershed

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	293	36.9	37.9	37.9
	Sometimes	227	28.6	29.3	67.2
	Often	254	32.0	32.8	100.0
	Total	774	97.5	100.0	
Missing	Missing	20	2.5		
Total		794	100.0		

Participate in non-motorized boating in the Newfound Lake Watershed

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	194	24.4	25.1	25.1
	Sometimes	325	40.9	42.1	67.2
	Often	253	31.9	32.8	100.0
	Total	772	97.2	100.0	
Missing	Missing	22	2.8		
Total		794	100.0		

Hike

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	144	18.1	18.6	18.6
	Sometimes	380	47.9	49.0	67.6
	Often	251	31.6	32.4	100.0
	Total	775	97.6	100.0	
Missing	Missing	19	2.4		
Total		794	100.0		

Camp

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	544	68.5	70.9	70.9
	Sometimes	171	21.5	22.3	93.2
	Often	52	6.5	6.8	100.0
	Total	767	96.6	100.0	
Missing	Missing	27	3.4		
Total		794	100.0		

Snowmobile

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	578	72.8	74.8	74.8
	Sometimes	120	15.1	15.5	90.3
	Often	75	9.4	9.7	100.0
	Total	773	97.4	100.0	
Missing	Missing	21	2.6		
Total		794	100.0		

Bicycle

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	325	40.9	42.2	42.2
	Sometimes	327	41.2	42.4	84.6
	Often	119	15.0	15.4	100.0
	Total	771	97.1	100.0	
Missing	Missing	23	2.9		
Total		794	100.0		

Watch birds or other wildlife in the Newfound Lake Watershed?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	91	11.5	11.9	11.9
	Sometimes	313	39.4	40.8	52.7
	Often	363	45.7	47.3	100.0
	Total	767	96.6	100.0	
Missing	Missing	27	3.4		
Total		794	100.0		

Ride dirt bikes, 4 wheelers, or ATVs i

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	661	83.2	85.7	85.7
	Sometimes	69	8.7	8.9	94.7
	Often	41	5.2	5.3	100.0
	Total	771	97.1	100.0	
Missing	Missing	23	2.9		
Total		794	100.0		

Cross country or back country ski

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	474	59.7	61.2	61.2
	Sometimes	234	29.5	30.2	91.5
	Often	66	8.3	8.5	100.0
	Total	774	97.5	100.0	
Missing	Missing	20	2.5		
Total		794	100.0		

Snowshoe

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	405	51.0	52.4	52.4
	Sometimes	285	35.9	36.9	89.3
	Often	83	10.5	10.7	100.0
	Total	773	97.4	100.0	
Missing	Missing	21	2.6		
Total		794	100.0		

Hunt

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	592	74.6	77.5	77.5
	Sometimes	95	12.0	12.4	89.9
	Often	77	9.7	10.1	100.0
	Total	764	96.2	100.0	
Missing	Missing	30	3.8		
Total		794	100.0		

Work on/maintain property

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	45	5.7	5.8	5.8
	Sometimes	216	27.2	28.0	33.9
	Often	510	64.2	66.1	100.0
	Total	771	97.1	100.0	
Missing	Missing	23	2.9		
Total		794	100.0		

Visit with friends in the Newfound Lake Watershed?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	51	6.4	6.6	6.6
	Sometimes	289	36.4	37.4	44.0
	Often	433	54.5	56.0	100.0
	Total	773	97.4	100.0	
Missing	Missing	21	2.6		
Total		794	100.0		

Relax and enjoy the views in the Newfound Lake Watershed?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	19	2.4	2.5	2.5
	Sometimes	170	21.4	22.1	24.5
	Often	581	73.2	75.5	100.0
	Total	770	97.0	100.0	
Missing	Missing	24	3.0		
Total		794	100.0		

Participate in community events/activities in the Newfound Lake Watershed?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	111	14.0	14.4	14.4
	Sometimes	473	59.6	61.5	75.9
	Often	185	23.3	24.1	100.0
	Total	769	96.9	100.0	
Missing	Missing	25	3.1		
Total		794	100.0		

Participate in organized team sporting events in the Newfound Lake Watershed?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	629	79.2	81.4	81.4
	Sometimes	111	14.0	14.4	95.7
	Often	33	4.2	4.3	100.0
	Total	773	97.4	100.0	
Missing	Missing	21	2.6		
Total		794	100.0		

Serve on local boards and/or committees in your community?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	541	68.1	70.5	70.5
	Sometimes	163	20.5	21.3	91.8
	Often	63	7.9	8.2	100.0
	Total	767	96.6	100.0	
Missing	Missing	27	3.4		
Total		794	100.0		

Questionnaire Section 14

We are approaching the limit of the number of people the earth can support.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	68	8.6	9.0	9.0
	Mildly Disagree	138	17.4	18.3	27.2
	Unsure	166	20.9	22.0	49.2
	Mildly Agree	212	26.7	28.0	77.2
	Strongly Agree	172	21.7	22.8	100.0
	Total	756	95.2	100.0	
Missing	Missing	38	4.8		
Total		794	100.0		

Humans have the right to modify the natural environment to suit their needs.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	205	25.8	27.2	27.2
	Mildly Disagree	245	30.9	32.5	59.6
	Unsure	71	8.9	9.4	69.0
	Mildly Agree	208	26.2	27.5	96.6
	Strongly Agree	26	3.3	3.4	100.0
	Total	755	95.1	100.0	
Missing	Missing	39	4.9		
Total		794	100.0		

When humans interfere with nature it often produces disastrous consequences.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	39	4.9	5.1	5.1
	Mildly Disagree	106	13.4	14.0	19.1
	Unsure	58	7.3	7.7	26.8
	Mildly Agree	271	34.1	35.8	62.5
	Strongly Agree	284	35.8	37.5	100.0
	Total	758	95.5	100.0	
Missing	Missing	36	4.5		
Total		794	100.0		

Human ingenuity will insure that we do NOT make the earth unlivable.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	128	16.1	17.0	17.0
	Mildly Disagree	172	21.7	22.8	39.8
	Unsure	182	22.9	24.2	64.0
	Mildly Agree	197	24.8	26.2	90.2
	Strongly Agree	74	9.3	9.8	100.0
	Total	753	94.8	100.0	
Missing	Missing	41	5.2		
Total		794	100.0		

Humans are severely abusing the environment.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	42	5.3	5.5	5.5
	Mildly Disagree	79	9.9	10.4	16.0
	Unsure	62	7.8	8.2	24.2
	Mildly Agree	293	36.9	38.7	62.9
	Strongly Agree	281	35.4	37.1	100.0
	Total	757	95.3	100.0	
Missing	Missing	37	4.7		
Total		794	100.0		

The earth has plenty of natural resources if we just learn how to develop them.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	89	11.2	11.7	11.7
	Mildly Disagree	139	17.5	18.3	30.1
	Unsure	113	14.2	14.9	45.0
	Mildly Agree	261	32.9	34.4	79.4
	Strongly Agree	156	19.6	20.6	100.0
	Total	758	95.5	100.0	
Missing	Missing	36	4.5		
Total		794	100.0		

Plants and animals have as much right as humans to exist.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	36	4.5	4.7	4.7
	Mildly Disagree	85	10.7	11.2	15.9
	Unsure	54	6.8	7.1	23.0
	Mildly Agree	225	28.3	29.5	52.5
	Strongly Agree	362	45.6	47.5	100.0
	Total	762	96.0	100.0	
Missing	Missing	32	4.0		
Total		794	100.0		

The balance of nature is strong enough to cope with the impacts of modern industrial nations.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	289	36.4	38.2	38.2
	Mildly Disagree	231	29.1	30.6	68.8
	Unsure	122	15.4	16.1	84.9
	Mildly Agree	89	11.2	11.8	96.7
	Strongly Agree	25	3.1	3.3	100.0
	Total	756	95.2	100.0	
Missing	Missing	38	4.8		
Total		794	100.0		

Despite our special abilities humans are still subject to the laws of nature.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	7	.9	.9	.9
	Mildly Disagree	15	1.9	2.0	2.9
	Unsure	53	6.7	7.0	9.9
	Mildly Agree	303	38.2	40.2	50.1
	Strongly Agree	376	47.4	49.9	100.0
	Total	754	95.0	100.0	
Missing	Missing	40	5.0		
Total		794	100.0		

The so-called "ecological crisis" facing humankind has been greatly exaggerated.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	246	31.0	32.5	32.5
	Mildly Disagree	195	24.6	25.8	58.3
	Unsure	134	16.9	17.7	76.1
	Mildly Agree	124	15.6	16.4	92.5
	Strongly Agree	57	7.2	7.5	100.0
	Total	756	95.2	100.0	
Missing	Missing	38	4.8		
Total		794	100.0		

The earth is like a spaceship with very limited room and resources.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	58	7.3	7.7	7.7
	Mildly Disagree	126	15.9	16.7	24.3
	Unsure	106	13.4	14.0	38.4
	Mildly Agree	283	35.6	37.4	75.8
	Strongly Agree	183	23.0	24.2	100.0
	Total	756	95.2	100.0	
Missing	Not Applicable	1	.1		
	Missing	37	4.7		
	Total	38	4.8		
Total		794	100.0		

Humans were meant to rule over the rest of nature.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	279	35.1	36.9	36.9
	Mildly Disagree	219	27.6	28.9	65.8
	Unsure	95	12.0	12.5	78.3
	Mildly Agree	112	14.1	14.8	93.1
	Strongly Agree	52	6.5	6.9	100.0
	Total	757	95.3	100.0	
Missing	Missing	37	4.7		
Total		794	100.0		

The balance of nature is very delicate and easily upset.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	18	2.3	2.4	2.4
	Mildly Disagree	80	10.1	10.5	12.9
	Unsure	62	7.8	8.2	21.1
	Mildly Agree	307	38.7	40.4	61.5
	Strongly Agree	292	36.8	38.5	100.0
	Total	759	95.6	100.0	
Missing	Missing	35	4.4		
Total		794	100.0		

Humans will eventually learn enough about nature and how nature works to be able to control it.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	174	21.9	23.0	23.0
	Mildly Disagree	212	26.7	28.1	51.1
	Unsure	196	24.7	26.0	77.1
	Mildly Agree	152	19.1	20.1	97.2
	Strongly Agree	21	2.6	2.8	100.0
	Total	755	95.1	100.0	
Missing	Missing	39	4.9		
Total		794	100.0		

If things continue on their present course, we will soon experience a major ecological catastrophe.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	68	8.6	8.9	8.9
	Mildly Disagree	108	13.6	14.2	23.2
	Unsure	164	20.7	21.6	44.7
	Mildly Agree	231	29.1	30.4	75.1
	Strongly Agree	189	23.8	24.9	100.0
	Total	760	95.7	100.0	
Missing	Missing	34	4.3		
Total		794	100.0		

Questionnaire Section 15

Local/regional newspapers

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Useful	68	8.6	8.9	8.9
	Somewhat Useful	179	22.5	23.6	32.5
	Useful	304	38.3	40.0	72.5
	Very Useful	209	26.3	27.5	100.0
	Total	760	95.7	100.0	
Missing	Missing	34	4.3		
Total		794	100.0		

Radio

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Useful	210	26.4	28.3	28.3
	Somewhat Useful	249	31.4	33.5	61.8
	Useful	200	25.2	26.9	88.7
	Very Useful	84	10.6	11.3	100.0
	Total	743	93.6	100.0	
Missing	Missing	51	6.4		
Total		794	100.0		

Internet site of a local lake organization (NLRA)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Useful	94	11.8	12.6	12.6
	Somewhat Useful	179	22.5	23.9	36.5
	Useful	288	36.3	38.5	75.0
	Very Useful	187	23.6	25.0	100.0
	Total	748	94.2	100.0	
Missing	Don't Know	1	.1		
	Missing	45	5.7		
	Total	46	5.8		
Total		794	100.0		

Town meetings

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Useful	145	18.3	19.4	19.4
	Somewhat Useful	240	30.2	32.0	51.4
	Useful	252	31.7	33.6	85.0
	Very Useful	112	14.1	15.0	100.0
	Total	749	94.3	100.0	
Missing	Missing	45	5.7		
Total		794	100.0		

Journals or magazines

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Useful	138	17.4	18.6	18.6
	Somewhat Useful	282	35.5	38.0	56.5
	Useful	247	31.1	33.2	89.8
	Very Useful	76	9.6	10.2	100.0
	Total	743	93.6	100.0	
Missing	Missing	51	6.4		
Total		794	100.0		

Government publications

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Useful	185	23.3	24.9	24.9
	Somewhat Useful	312	39.3	42.0	66.9
	Useful	192	24.2	25.8	92.7
	Very Useful	54	6.8	7.3	100.0
	Total	743	93.6	100.0	
Missing	Missing	51	6.4		
Total		794	100.0		

Television

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Useful	139	17.5	18.8	18.8
	Somewhat Useful	245	30.9	33.1	51.9
	Useful	232	29.2	31.4	83.2
	Very Useful	124	15.6	16.8	100.0
	Total	740	93.2	100.0	
Missing	Missing	54	6.8		
Total		794	100.0		

Word of mouth

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Useful	81	10.2	10.8	10.8
	Somewhat Useful	235	29.6	31.3	42.1
	Useful	285	35.9	37.9	80.0
	Very Useful	150	18.9	20.0	100.0
	Total	751	94.6	100.0	
Missing	Not Applicable	1	.1		
	Missing	42	5.3		
	Total	43	5.4		
Total		794	100.0		

Informational signs

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Useful	47	5.9	6.3	6.3
	Somewhat Useful	247	31.1	33.0	39.3
	Useful	322	40.6	43.0	82.4
	Very Useful	132	16.6	17.6	100.0
	Total	748	94.2	100.0	
Missing	Missing	46	5.8		
Total		794	100.0		

Pamphlets or flyers

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Useful	54	6.8	7.2	7.2
	Somewhat Useful	232	29.2	30.9	38.1
	Useful	336	42.3	44.7	82.8
	Very Useful	129	16.2	17.2	100.0
	Total	751	94.6	100.0	
Missing	Missing	43	5.4		
Total		794	100.0		

Classes or seminars

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Useful	142	17.9	19.0	19.0
	Somewhat Useful	269	33.9	36.1	55.1
	Useful	222	28.0	29.8	84.9
	Very Useful	113	14.2	15.1	100.0
	Total	746	94.0	100.0	
Missing	Missing	48	6.0		
Total		794	100.0		

Public meetings

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Useful	105	13.2	14.2	14.2
	Somewhat Useful	224	28.2	30.3	44.5
	Useful	296	37.3	40.0	84.5
	Very Useful	115	14.5	15.5	100.0
	Total	740	93.2	100.0	
Missing	Missing	54	6.8		
Total		794	100.0		

Watershed specific internet sites

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Useful	91	11.5	12.7	12.7
	Somewhat Useful	149	18.8	20.8	33.5
	Useful	264	33.2	36.9	70.4
	Very Useful	212	26.7	29.6	100.0
	Total	716	90.2	100.0	
Missing	Don't Know	1	.1		
	Missing	77	9.7		
	Total	78	9.8		
Total		794	100.0		

Questionnaire Section 16

Town governments should decide on regulations in the watershed

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	85	10.7	11.5	11.5
	Disagree	188	23.7	25.4	36.8
	Neutral	148	18.6	20.0	56.8
	Agree	270	34.0	36.4	93.3
	Strongly Agree	50	6.3	6.7	100.0
	Total	741	93.3	100.0	
Missing	Don't Know	1	.1		
	Missing	52	6.5		
	Total	53	6.7		
Total		794	100.0		

Regulations for the Newfound Lake Watershed should be implemented at the state level

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	54	6.8	7.3	7.3
	Disagree	181	22.8	24.3	31.6
	Neutral	177	22.3	23.8	55.4
	Agree	248	31.2	33.3	88.7
	Strongly Agree	84	10.6	11.3	100.0
	Total	744	93.7	100.0	
Missing	Don't Know	1	.1		
	Missing	49	6.2		
	Total	50	6.3		
Total		794	100.0		

Regulations for the Newfound Lake Watershed should be implemented at the town level

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	67	8.4	9.0	9.0
	Disagree	163	20.5	22.0	31.0
	Neutral	141	17.8	19.0	50.0
	Agree	301	37.9	40.6	90.6
	Strongly Agree	70	8.8	9.4	100.0
	Total	742	93.5	100.0	
Missing	Don't Know	1	.1		
	Missing	51	6.4		
	Total	52	6.5		
Total		794	100.0		

Local governments should collaborate with state government to decide on regulations in the watershed

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	25	3.1	3.3	3.3
	Disagree	43	5.4	5.7	9.0
	Neutral	91	11.5	12.0	20.9
	Agree	377	47.5	49.7	70.6
	Strongly Agree	223	28.1	29.4	100.0
	Total	759	95.6	100.0	
Missing	Don't Know	1	.1		
	Missing	34	4.3		
	Total	35	4.4		
Total		794	100.0		

Local governments from all the towns in the watershed should work together to decide on regulations for Newfound Lake Watershed

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	23	2.9	3.0	3.0
	Disagree	31	3.9	4.1	7.1
	Neutral	68	8.6	8.9	16.0
	Agree	337	42.4	44.2	60.2
	Strongly Agree	304	38.3	39.8	100.0
	Total	763	96.1	100.0	
Missing	Don't Know	1	.1		
	Missing	30	3.8		
	Total	31	3.9		
Total		794	100.0		

Questionnaire Section 17

Town government or administration

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No Trust	67	8.4	9.1	9.1
	2	92	11.6	12.5	21.7
	Neutral	267	33.6	36.4	58.0
	4	263	33.1	35.8	93.9
	Trust Completely	45	5.7	6.1	100.0
	Total	734	92.4	100.0	
Missing	Don't Know	1	.1		
	Missing	59	7.4		
	Total	60	7.6		
Total		794	100.0		

New Hampshire state agencies

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No Trust	30	3.8	4.0	4.0
	2	72	9.1	9.7	13.7
	Neutral	250	31.5	33.6	47.2
	4	346	43.6	46.4	93.7
	Trust Completely	47	5.9	6.3	100.0
	Total	745	93.8	100.0	
Missing	Missing	49	6.2		
Total		794	100.0		

Federal agencies

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No Trust	77	9.7	10.4	10.4
	2	155	19.5	20.9	31.3
	Neutral	282	35.5	38.1	69.4
	4	200	25.2	27.0	96.4
	Trust Completely	27	3.4	3.6	100.0
	Total	741	93.3	100.0	
Missing	Don't Know	2	.3		
	Missing	51	6.4		
	Total	53	6.7		
Total		794	100.0		

Newfound Lakes Region Association

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No Trust	21	2.6	2.8	2.8
	2	19	2.4	2.6	5.4
	Neutral	148	18.6	19.9	25.3
	4	372	46.9	50.0	75.3
	Trust Completely	184	23.2	24.7	100.0
	Total	744	93.7	100.0	
Missing	Missing	50	6.3		
Total		794	100.0		

Academic/university sources

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No Trust	22	2.8	3.0	3.0
	2	40	5.0	5.4	8.4
	Neutral	214	27.0	29.0	37.4
	4	358	45.1	48.5	85.9
	Trust Completely	104	13.1	14.1	100.0
	Total	738	92.9	100.0	
Missing	Don't Know	2	.3		
	Missing	54	6.8		
	Total	56	7.1		
Total		794	100.0		

Public radio or television

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No Trust	44	5.5	6.0	6.0
	2	90	11.3	12.2	18.2
	Neutral	348	43.8	47.2	65.4
	4	222	28.0	30.1	95.5
	Trust Completely	33	4.2	4.5	100.0
	Total	737	92.8	100.0	
Missing	Don't Know	2	.3		
	Missing	55	6.9		
	Total	57	7.2		
Total		794	100.0		

Chamber of commerce

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No Trust	43	5.4	5.9	5.9
	2	126	15.9	17.2	23.0
	Neutral	349	44.0	47.5	70.6
	4	191	24.1	26.0	96.6
	Trust Completely	25	3.1	3.4	100.0
	Total	734	92.4	100.0	
Missing	Don't Know	2	.3		
	Missing	58	7.3		
	Total	60	7.6		
Total		794	100.0		

Local companies

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No Trust	97	12.2	13.1	13.1
	2	189	23.8	25.6	38.7
	Neutral	342	43.1	46.3	85.0
	4	99	12.5	13.4	98.4
	Trust Completely	12	1.5	1.6	100.0
	Total	739	93.1	100.0	
Missing	Don't Know	2	.3		
	Missing	53	6.7		
	Total	55	6.9		
Total		794	100.0		

Questionnaire Section 18

Which of the following best describes your residency in the Newfound Lake Watershed?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Year Round	371	46.7	48.6	48.6
	Not Year Round	392	49.4	51.4	100.0
	Total	763	96.1	100.0	
Missing	Not Applicable	3	.4		
	Missing	28	3.5		
	Total	31	3.9		
Total		794	100.0		

On average, how many months do you reside in the watershed per year?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	18	2.3	4.9	4.9
	0.5	4	.5	1.1	6.0
	0.75	2	.3	.5	6.6
	1	28	3.5	7.7	14.2
	1.5	9	1.1	2.5	16.7
	1.75	1	.1	.3	16.9
	2	42	5.3	11.5	28.4
	2.5	7	.9	1.9	30.3
	3	58	7.3	15.8	46.2
	3.5	8	1.0	2.2	48.4
	4	37	4.7	10.1	58.5
	4.5	7	.9	1.9	60.4
	5	36	4.5	9.8	70.2
	5.5	4	.5	1.1	71.3
	6	67	8.4	18.3	89.6
	6.5	1	.1	.3	89.9
	7	13	1.6	3.6	93.4
	8	10	1.3	2.7	96.2
	9	12	1.5	3.3	99.5
	10	2	.3	.5	100.0
	Total	366	46.1	100.0	
Missing	Not Applicable	376	47.4		
	Missing	52	6.5		
	Total	428	53.9		
Total		794	100.0		

How long have you lived at your current residence in the watershed?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 1 year	13	1.6	1.7	1.7
	1-5 years	128	16.1	17.2	18.9
	6-10 years	150	18.9	20.1	39.1
	11-15 years	84	10.6	11.3	50.3
	16-20 years	58	7.3	7.8	58.1
	over 20 years	312	39.3	41.9	100.0
	Total	745	93.8	100.0	
Missing	Not Applicable	19	2.4		
	Missing	30	3.8		
	Total	49	6.2		
Total		794	100.0		

For how many years have you lived in or visited the Newfound Lake Region?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 1 year	5	.6	.7	.7
	1-5 years	41	5.2	5.3	6.0
	6-10 years	65	8.2	8.5	14.4
	11-15 years	55	6.9	7.2	21.6
	16-20 years	62	7.8	8.1	29.6
	over 20 years	541	68.1	70.4	100.0
	Total	769	96.9	100.0	
Missing	Not Applicable	2	.3		
	Missing	23	2.9		
	Total	25	3.1		
Total		794	100.0		

About how many acres is the lot your house is on?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1/4 acre or less	132	16.6	17.5	17.5
	1/2 acre	87	11.0	11.6	29.1
	1.5	1	.1	.1	29.2
	3/4 acre	39	4.9	5.2	34.4
	1acre	103	13.0	13.7	48.1
	2-5 acres	189	23.8	25.1	73.2
	6-10 acres	77	9.7	10.2	83.4
	11-20 acres	36	4.5	4.8	88.2
	More than 20 acres	89	11.2	11.8	100.0
	Total	753	94.8	100.0	
Missing	Don't Know	1	.1		
	Not Applicable	6	.8		
	Missing	34	4.3		
	Total	41	5.2		
Total		794	100.0		

Do you maintain your property yourself, or do you hire out property maintenance such as landscaping and lawn-mowing?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Self-maintain property	587	73.9	78.3	78.3
	Hire out property maintenance	163	20.5	21.7	100.0
	Total	750	94.5	100.0	
Missing	Not Applicable	6	.8		
	Missing	38	4.8		
	Total	44	5.5		
Total		794	100.0		

Are you a current member of the Newfound Lake Region Association?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	194	24.4	25.7	25.7
	No	560	70.5	74.3	100.0
	Total	754	95.0	100.0	
Missing	Missing	40	5.0		
Total		794	100.0		

How long does it usually take you to commute to work from home?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Do not work	268	33.8	39.1	39.1
	Work from home	54	6.8	7.9	46.9
	Less than 5 minutes	25	3.1	3.6	50.6
	5 to 9 minutes	29	3.7	4.2	54.8
	10 to 14 minutes	34	4.3	5.0	59.8
	15 to 19 minutes	24	3.0	3.5	63.3
	20 to 24 minutes	34	4.3	5.0	68.2
	25 to 30 minutes	54	6.8	7.9	76.1
	More than 30 minutes	127	16.0	18.5	94.6
	Other	37	4.7	5.4	100.0
	Total	686	86.4	100.0	
Missing	Don't Know	1	.1		
	Not Applicable	16	2.0		
	Missing	91	11.5		
	Total	108	13.6		
Total		794	100.0		

Which category best describes your annual household income before taxes?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than $20,000	39	4.9	5.7	5.7
	$20,000 - $39,999	76	9.6	11.1	16.9
	$40,000 - $59,999	104	13.1	15.2	32.1
	$60,000 - $79,999	131	16.5	19.2	51.3
	$80,000 - $99,999	78	9.8	11.4	62.8
	$100,000 - $119,999	77	9.7	11.3	74.0
	$120,000 - $139,999	29	3.7	4.3	78.3
	$140,000 or over	148	18.6	21.7	100.0
	Total	682	85.9	100.0	
Missing	Don't Know	1	.1		
	Not Applicable	1	.1		
	Missing	110	13.9		
	Total	112	14.1		
Total		794	100.0		

Do you feel your work or business is in some way economically dependent upon Newfound Lake?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	105	13.2	15.1	15.1
	No	591	74.4	84.9	100.0
	Total	696	87.7	100.0	
Missing	Not Applicable	29	3.7		
	Missing	69	8.7		
	Total	98	12.3		
Total		794	100.0		

Which of the following categories best describes your political orientation?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Liberal	49	6.2	6.7	6.7
	Moderately Liberal	114	14.4	15.5	22.2
	Moderate	183	23.0	24.9	47.1
	Moderately Conservative	195	24.6	26.5	73.6
	Conservative	137	17.3	18.6	92.2
	Other	21	2.6	2.9	95.1
	Not Sure	36	4.5	4.9	100.0
	Total	735	92.6	100.0	
Missing	Don't Know	2	.3		
	Missing	57	7.2		
	Total	59	7.4		
Total		794	100.0		

What is your gender?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	292	36.8	39.2	39.2
	Male	453	57.1	60.8	100.0
	Total	745	93.8	100.0	
Missing	Missing	49	6.2		
Total		794	100.0		

Which of the following best describes the highest level of education you have completed?

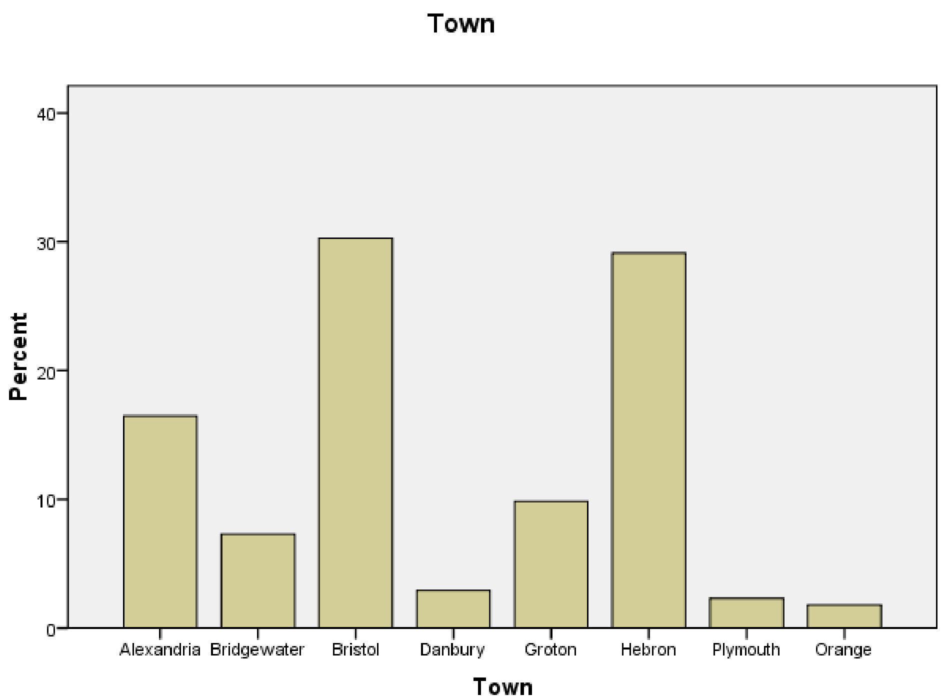
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 12 years, no high school diploma	10	1.3	1.3	1.3
	High school/GED	85	10.7	11.1	12.4
	Some college	153	19.3	19.9	32.3
	Vocational/Trade Certificate	52	6.5	6.8	39.1
	Bachelor's Degree	220	27.7	28.6	67.7
	Master's Degree or higher	248	31.2	32.3	100.0
	Total	768	96.7	100.0	
Missing	Not Applicable	1	.1		
	Missing	25	3.1		
	Total	26	3.3		
Total		794	100.0		

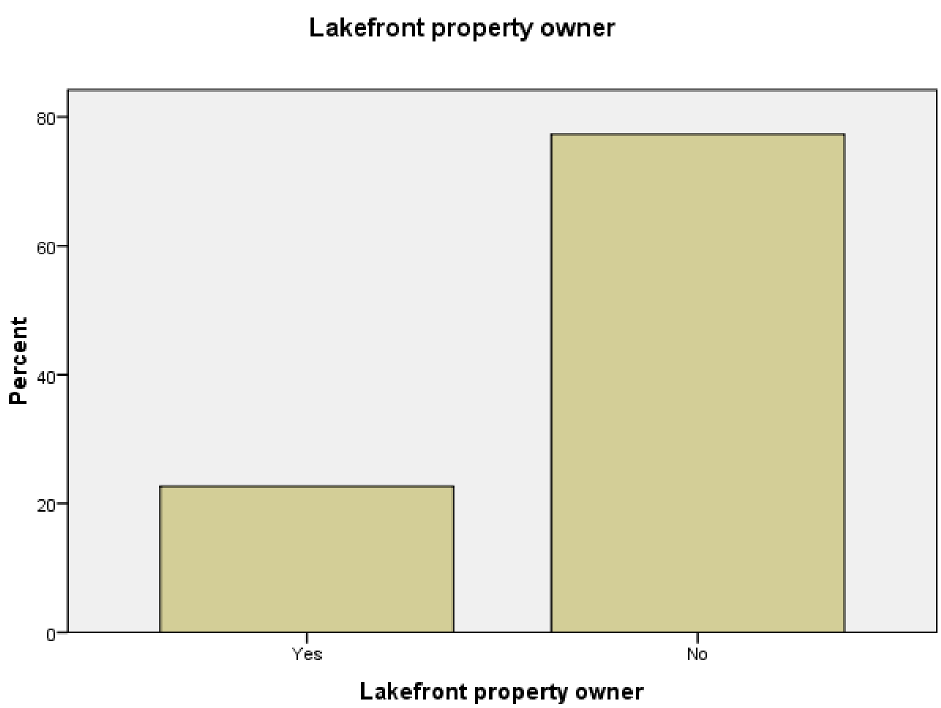
Age of Respondent

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	21-40	39	4.9	4.9	4.9
	41-60	342	43.1	43.1	48.0
	61-80	321	40.4	40.4	88.4
	81 and over	92	11.6	11.6	100.0
	Total	794	100.0	100.0	

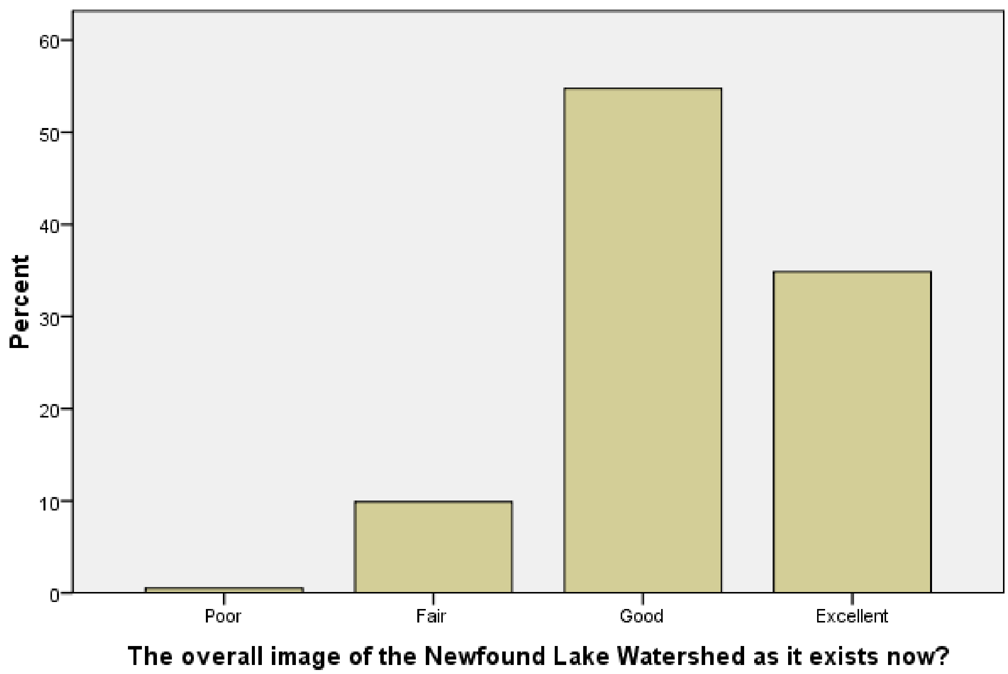
Bar Charts for All Questions

Questionnaire Section 1

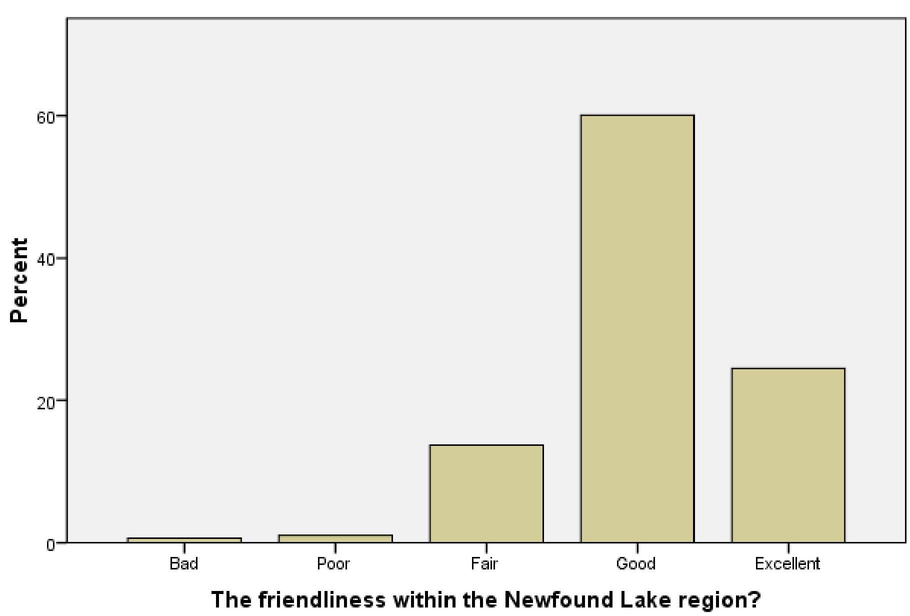




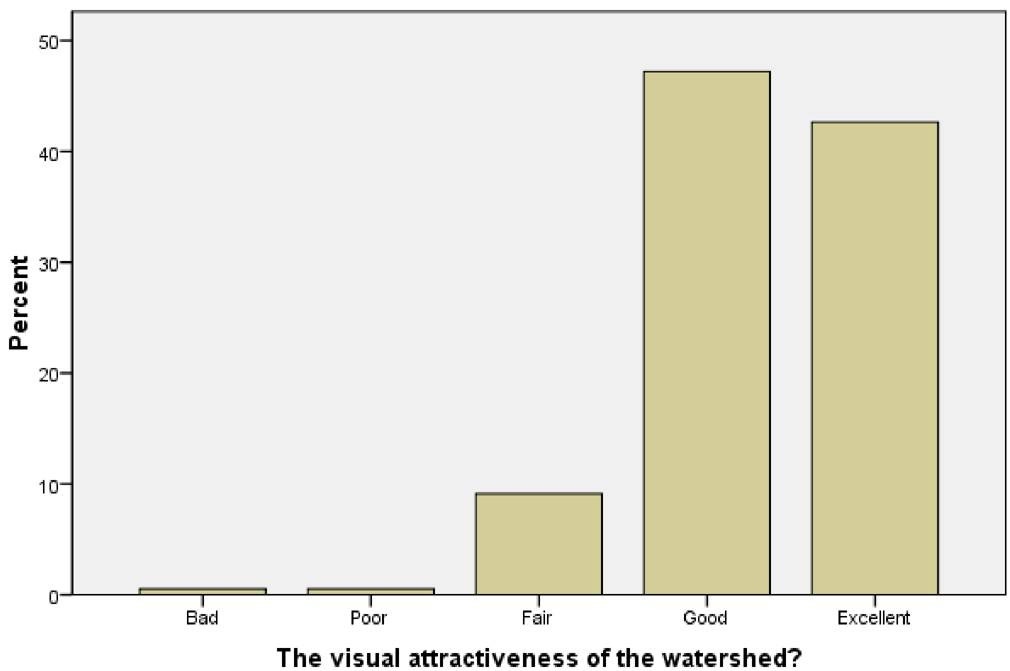
The overall image of the Newfound Lake Watershed as it exists now?



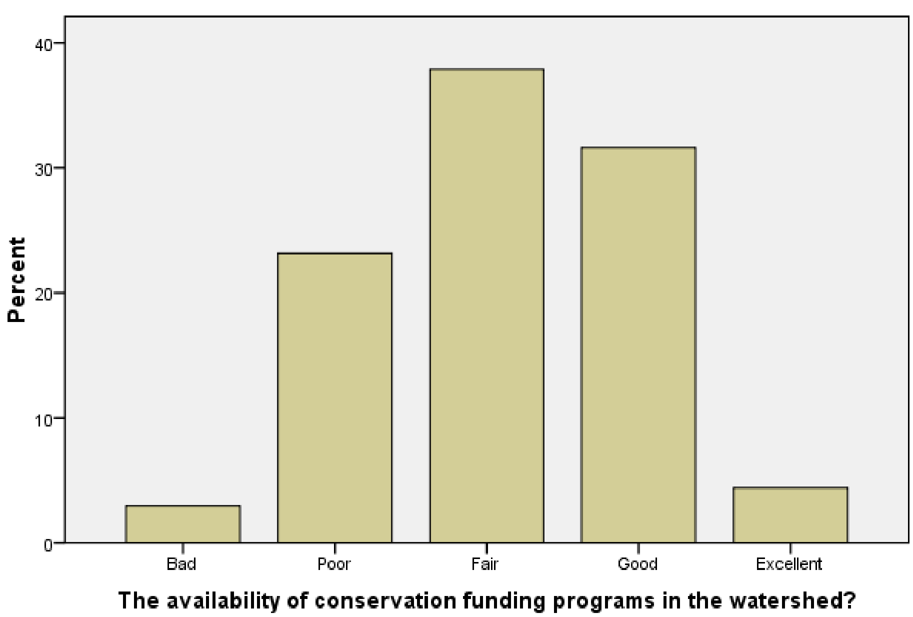
The friendliness within the Newfound Lake region?



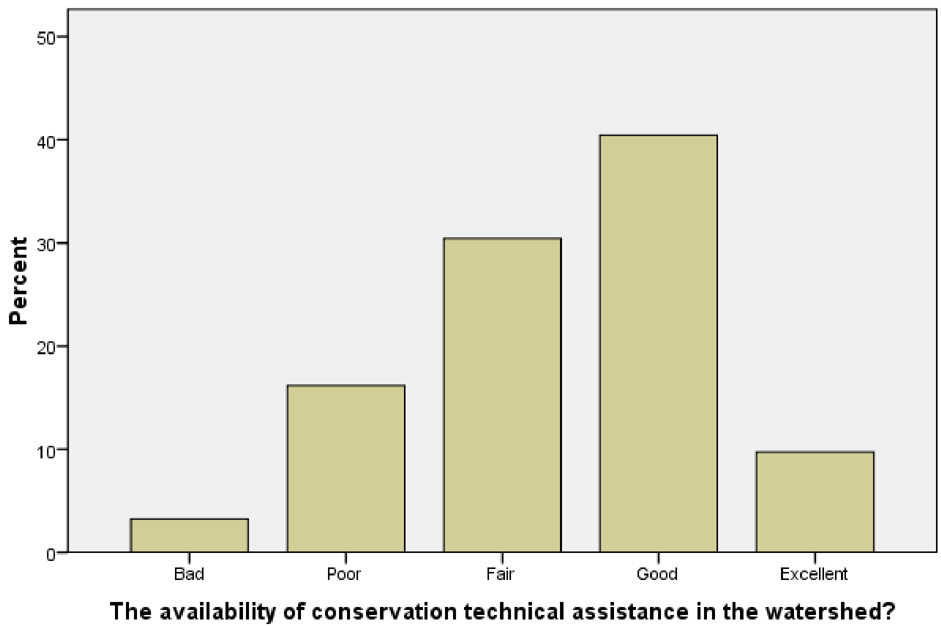
The visual attractiveness of the watershed?



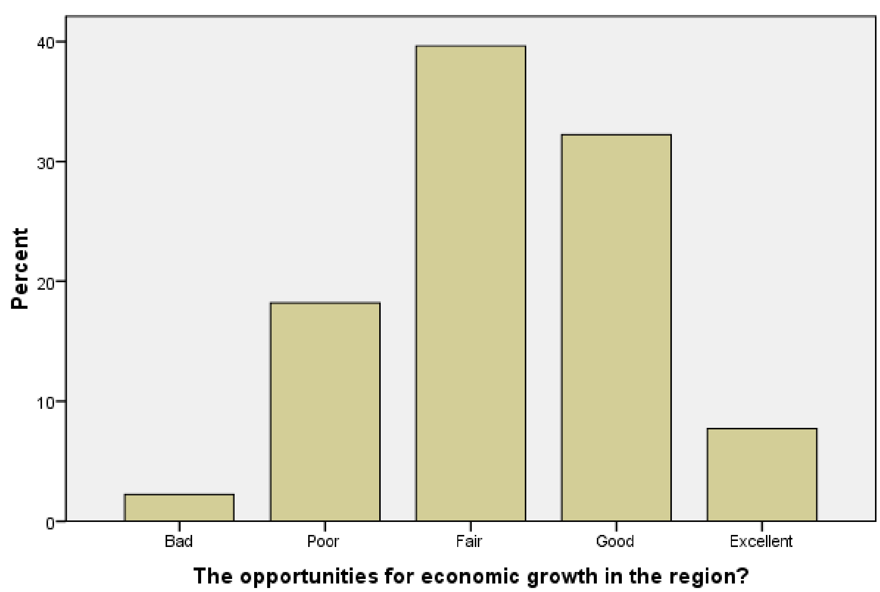
The availability of conservation funding programs in the watershed?



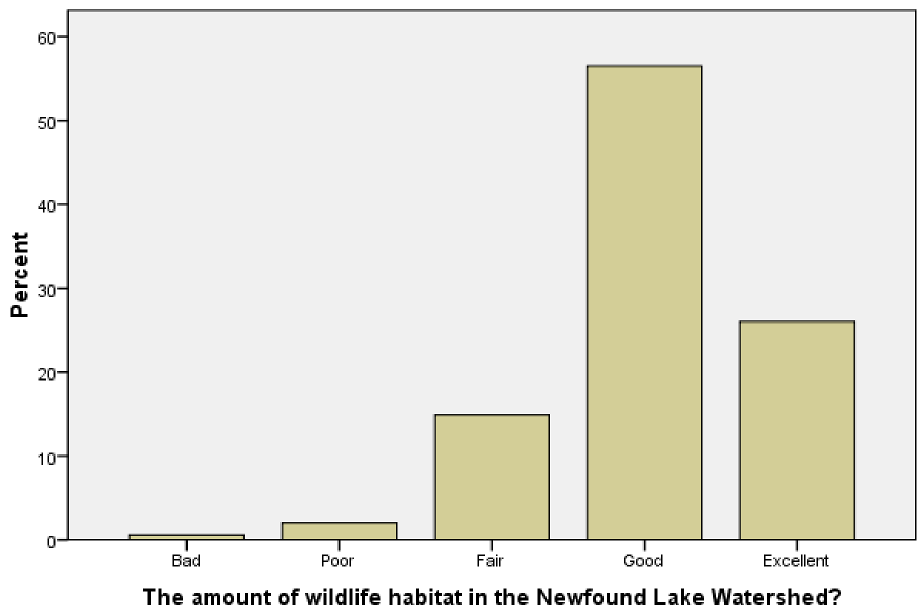
The availability of conservation technical assistance in the watershed?



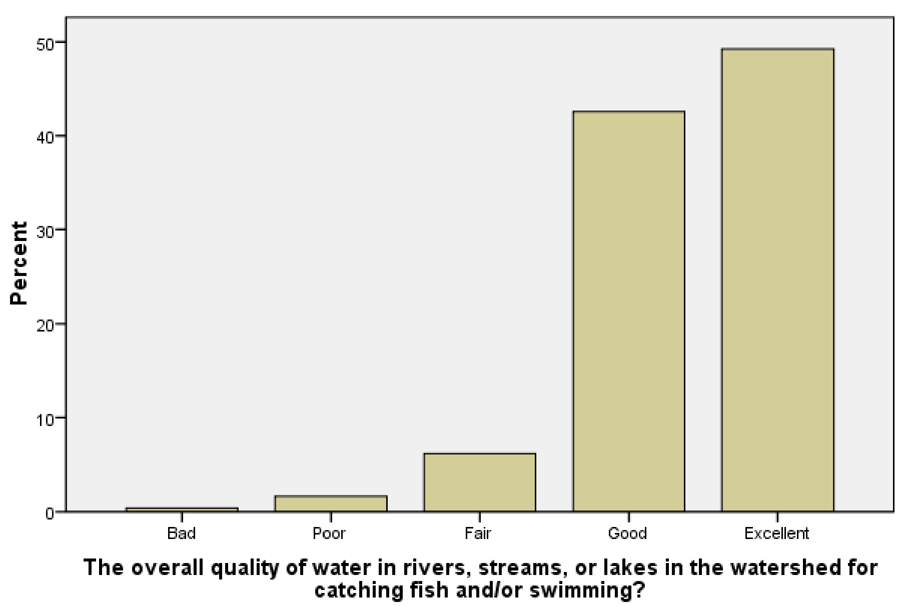
The opportunities for economic growth in the region?



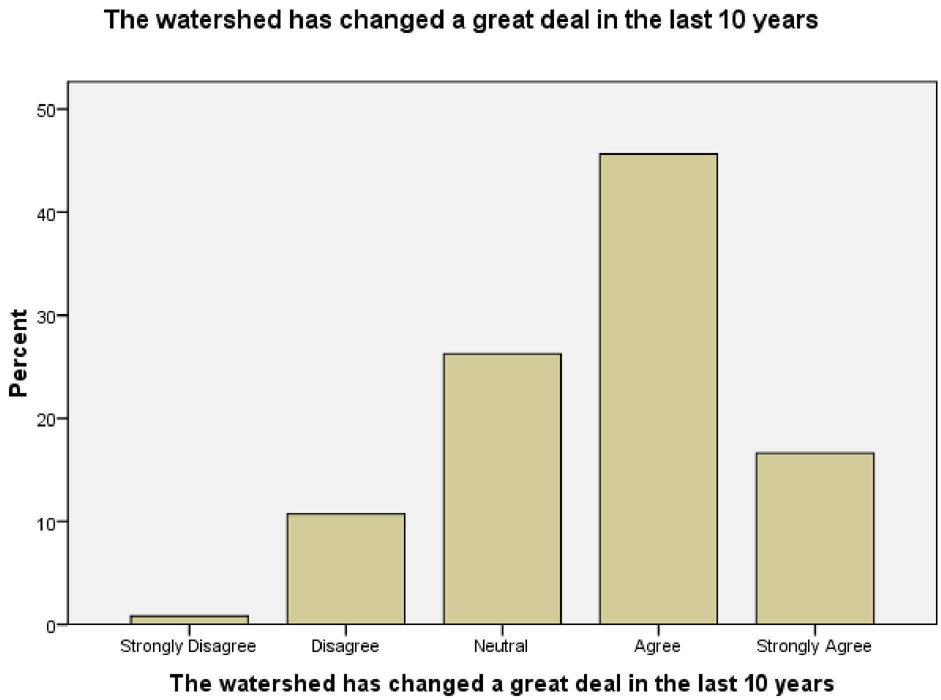
The amount of wildlife habitat in the Newfound Lake Watershed?

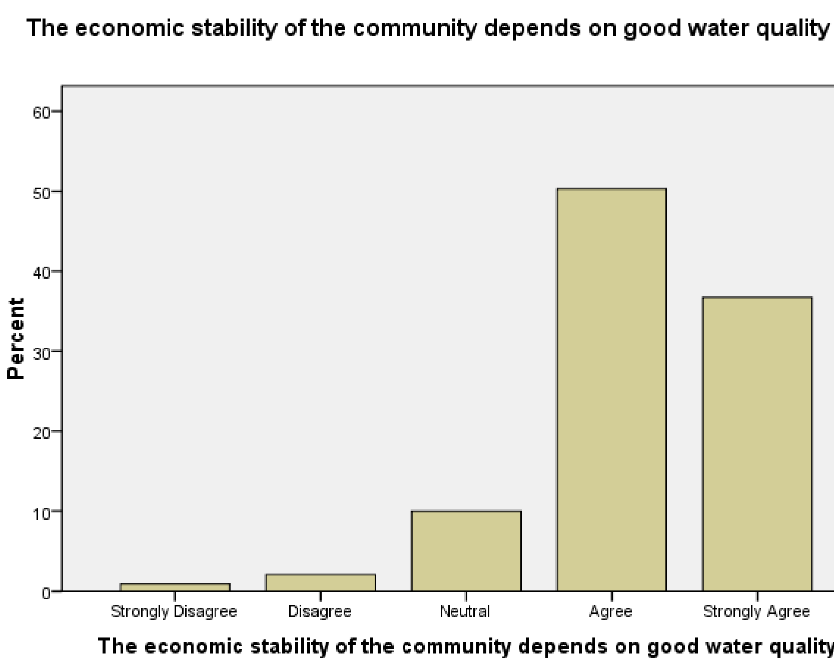


The overall quality of water in rivers, streams, or lakes in the watershed for catching fish and/or swimming?

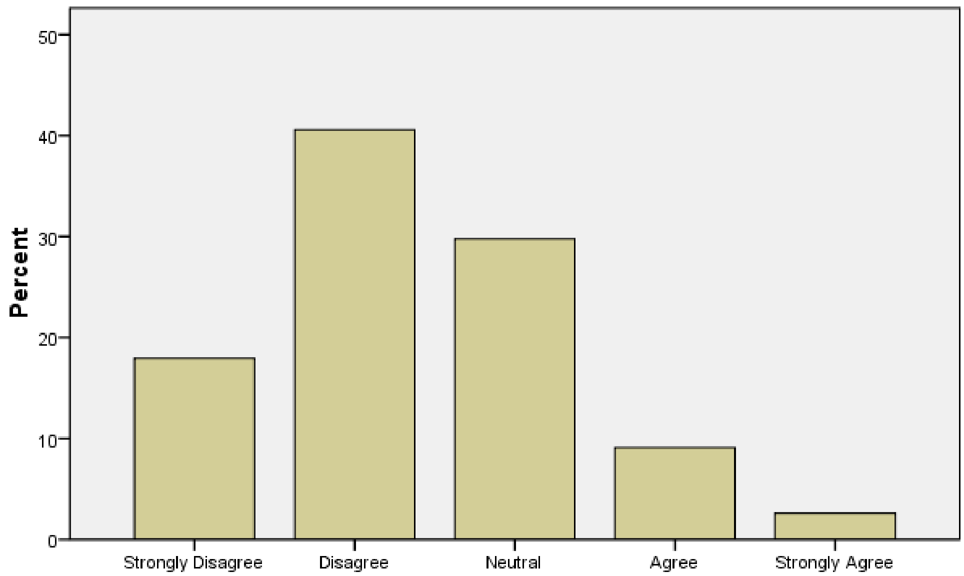


Questionnaire Section 2



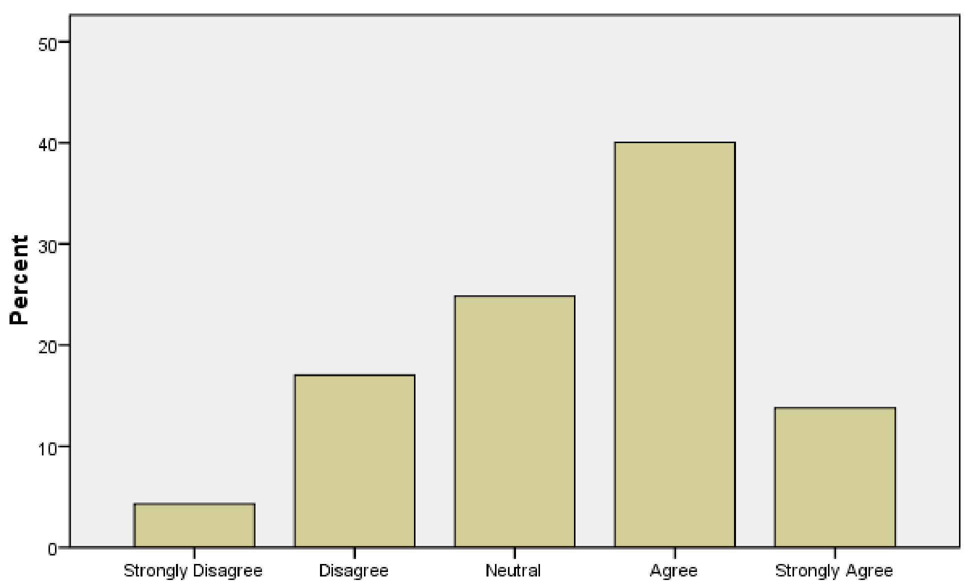


Taking action to protect water quality in the watershed is too expensive for you

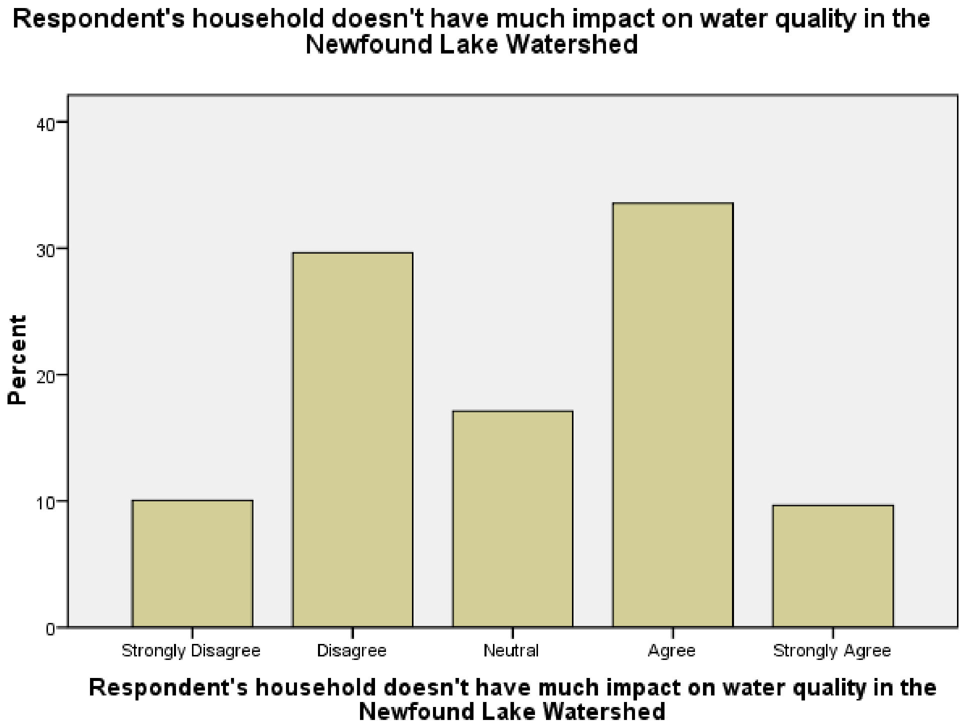


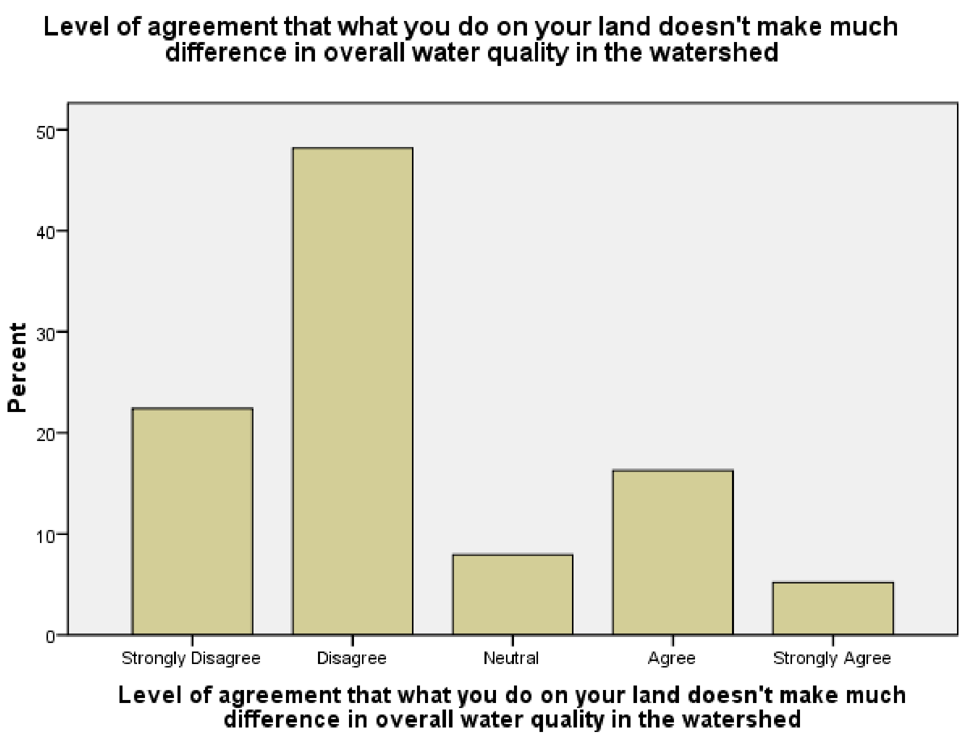
Taking action to protect water quality in the watershed is too expensive for you

The economic health of communities in the watershed should be given highest priority when managing lands

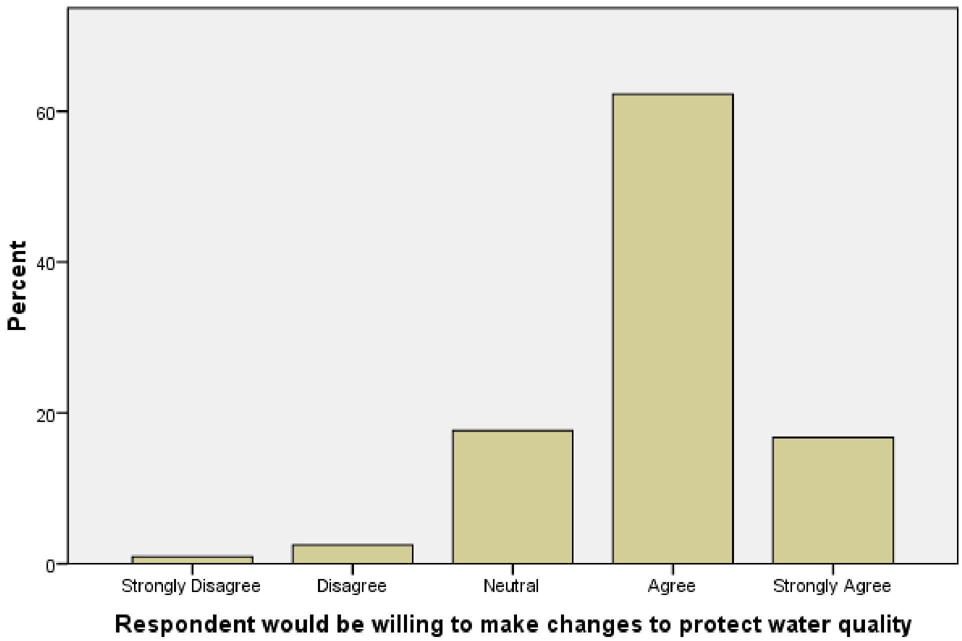


The economic health of communities in the watershed should be given highest priority when managing lands

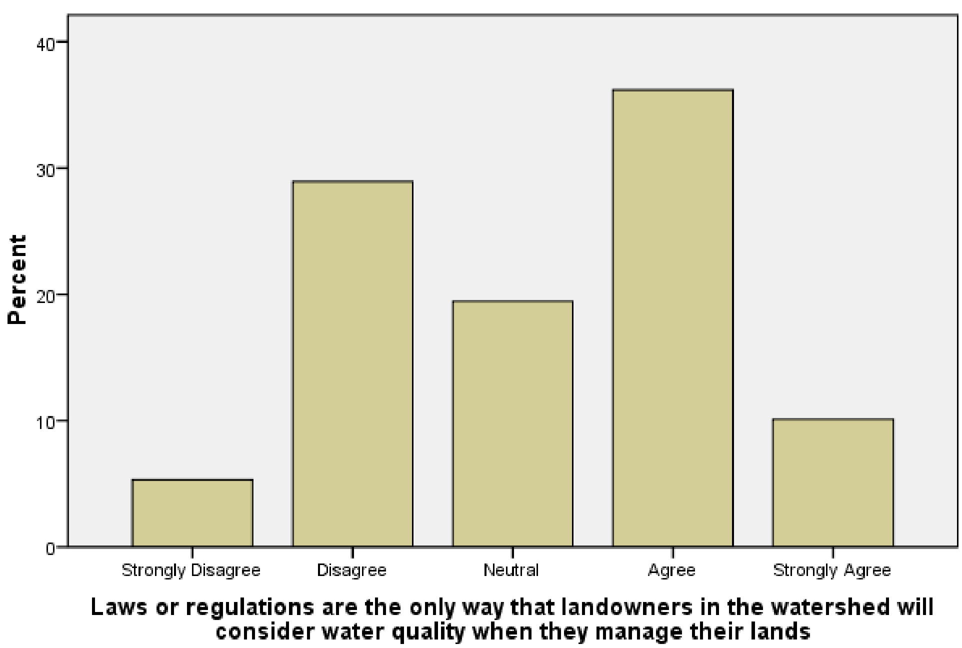

Respondent's household doesn't have much impact on water quality in the Newfound Lake Watershed
Percent
40
30
20
10
0
Strongly Disagree
Disagree
Neutral
Agree
Strongly Agree
Respondent's household doesn't have much impact on water quality in the Newfound Lake Watershed


Level of agreement that what you do on your land doesn't make much difference in overall water quality in the watershed
Percent
50
40
30
20
10
0
Strongly Disagree
Disagree
Neutral
Agree
Strongly Agree
Level of agreement that what you do on your land doesn't make much difference in overall water quality in the watershed

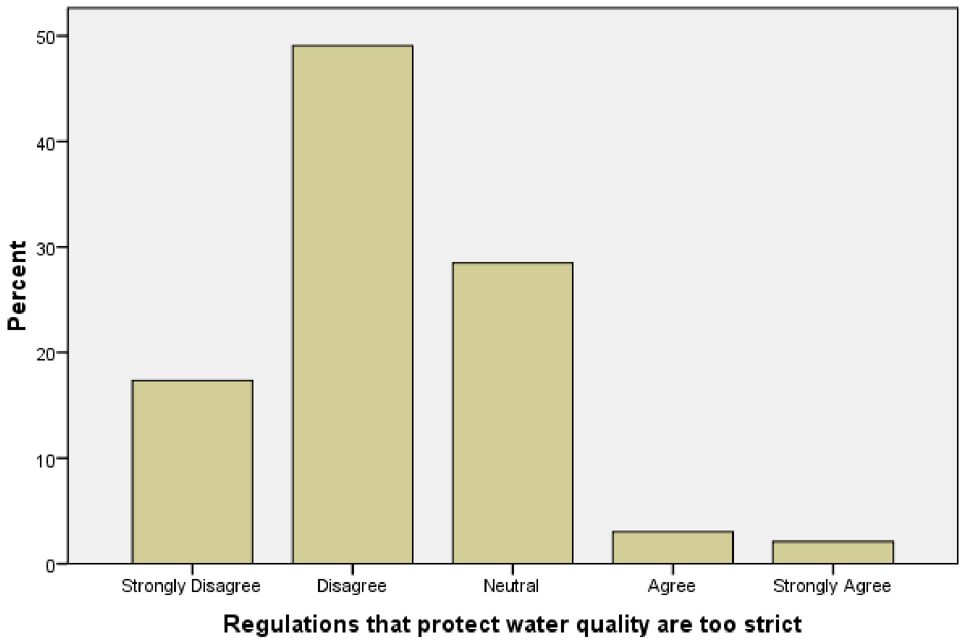
Respondent would be willing to make changes to protect water quality



Laws or regulations are the only way that landowners in the watershed will consider water quality when they manage their lands

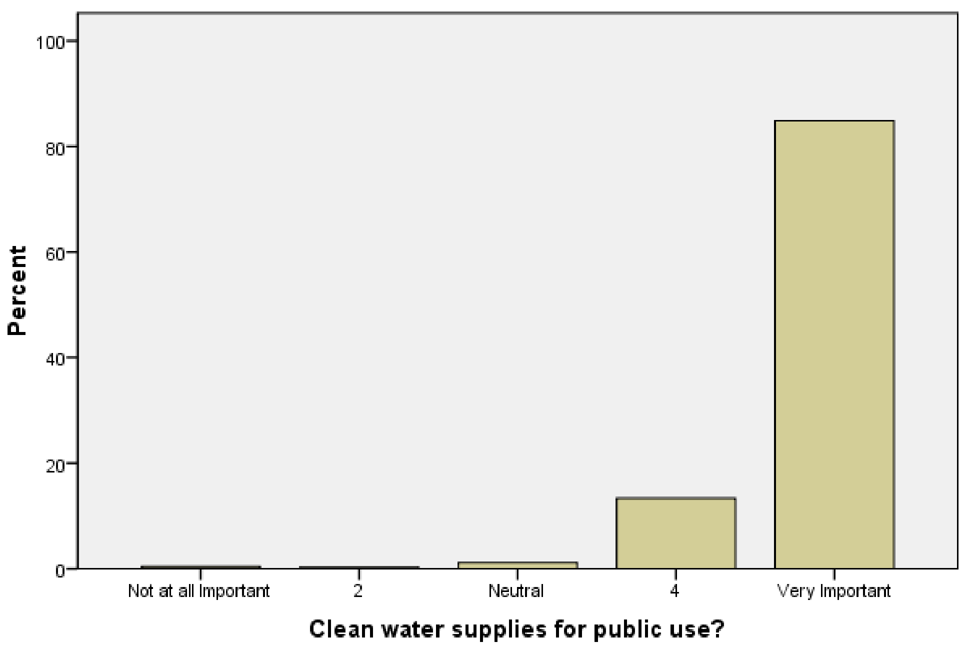


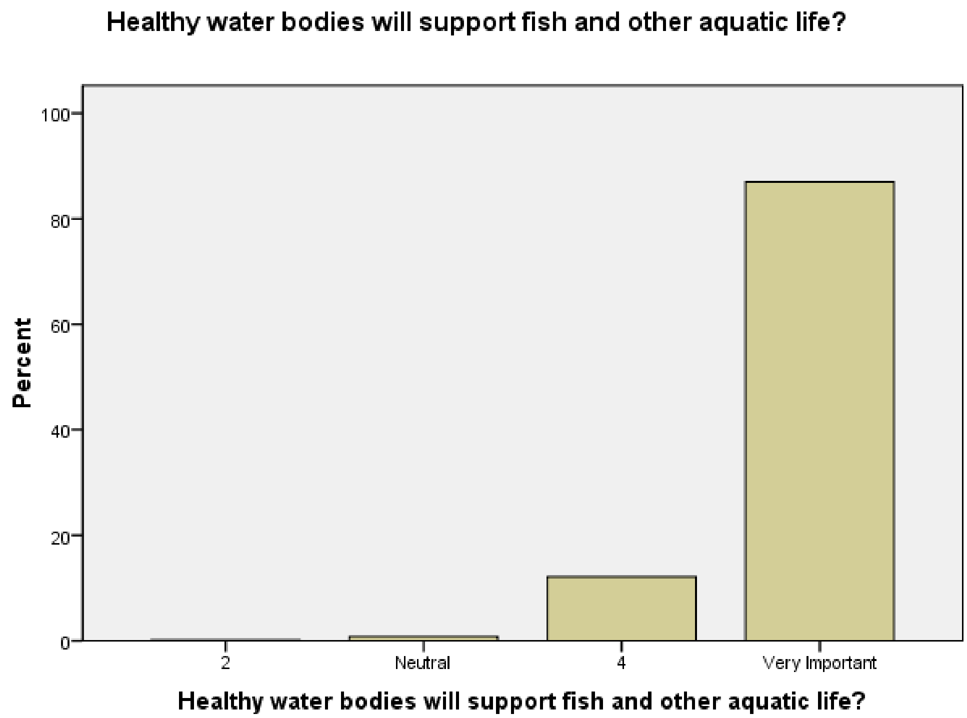
Regulations that protect water quality are too strict

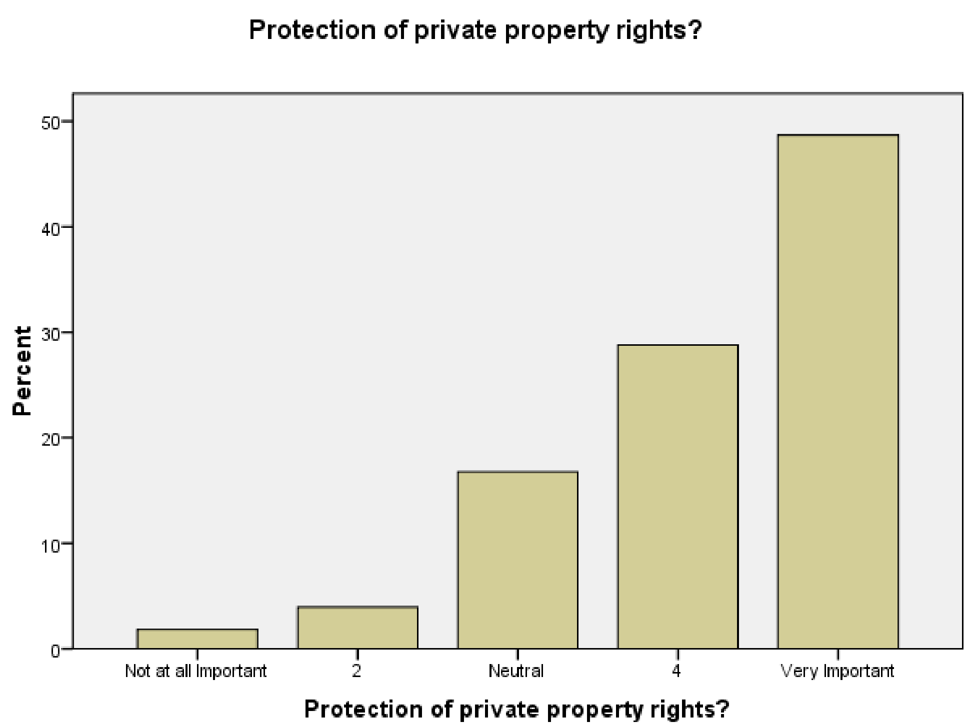


<u>Questionnaire Section 3</u>

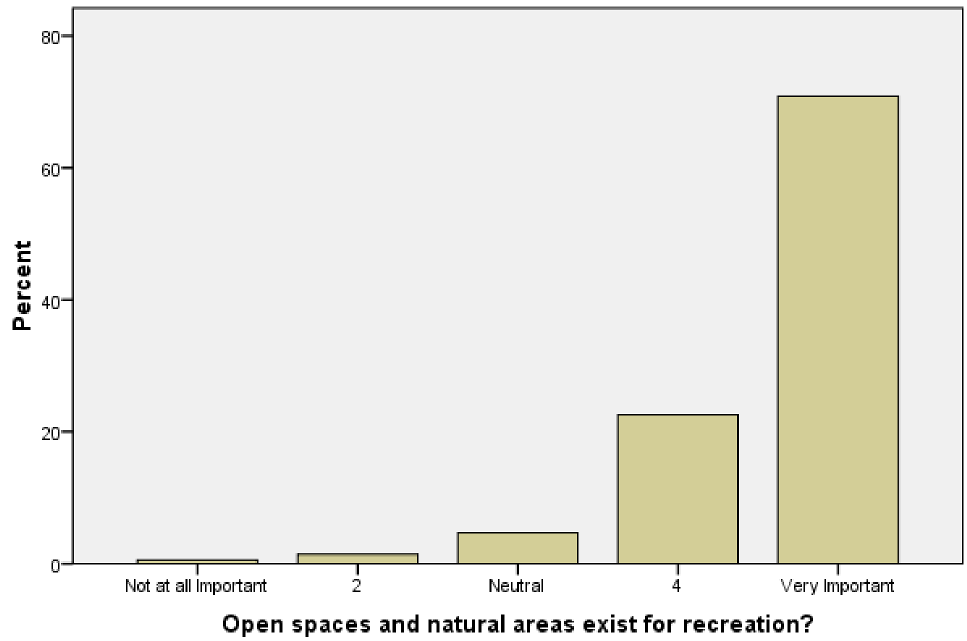
Clean water supplies for public use?



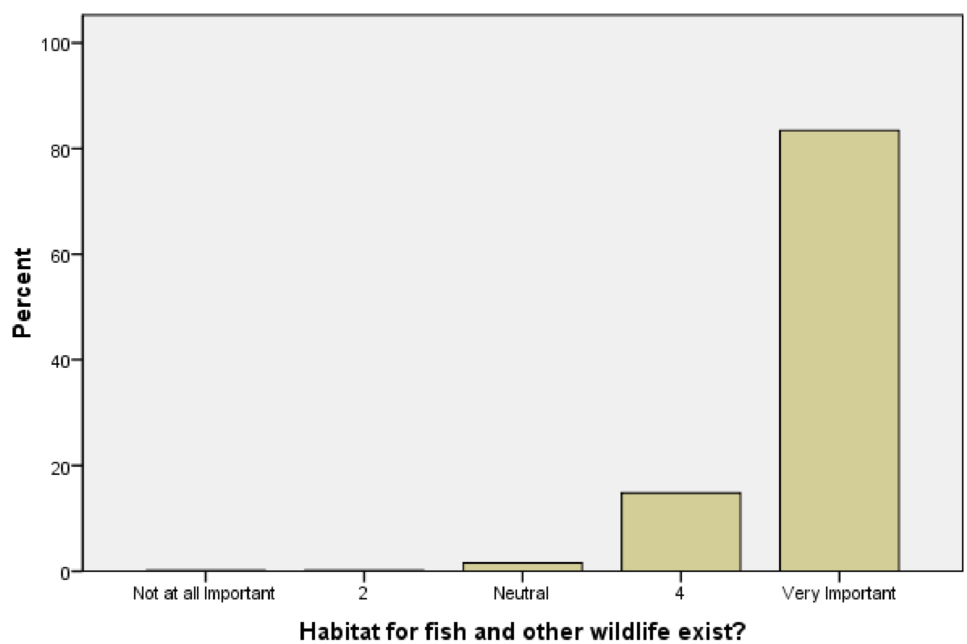

Healthy water bodies will support fish and other aquatic life?
Percent
100
80
60
40
20
0
2
Neutral
4
Very Important
Healthy water bodies will support fish and other aquatic life?

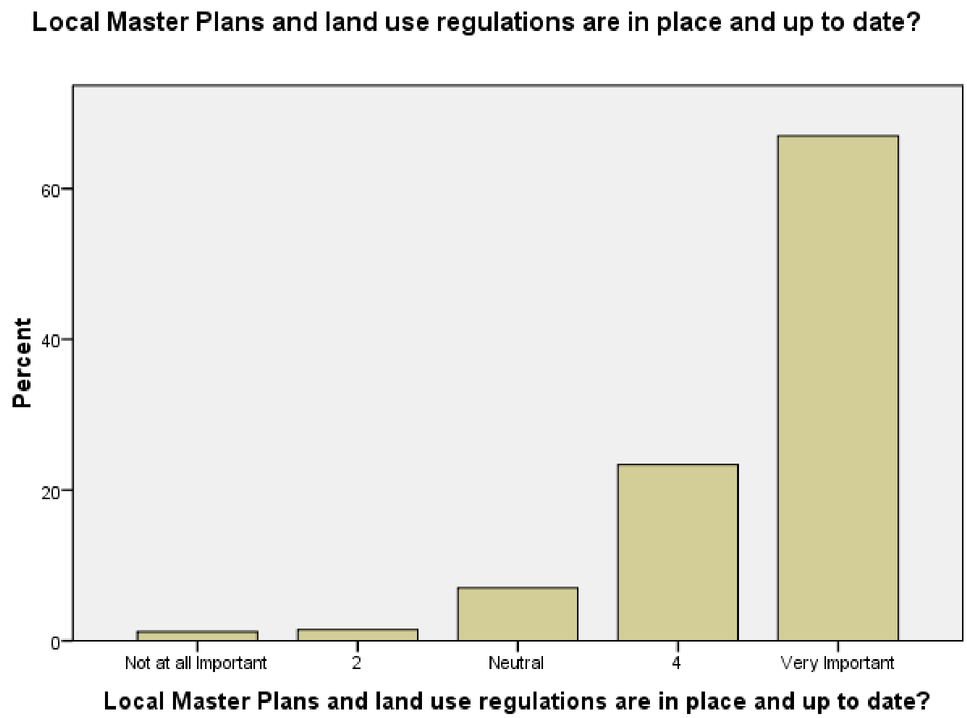

Protection of private property rights?
Percent
50
40
30
20
10
0
Not at all Important
2
Neutral
4
Very Important
Protection of private property rights?

Open spaces and natural areas exist for recreation?



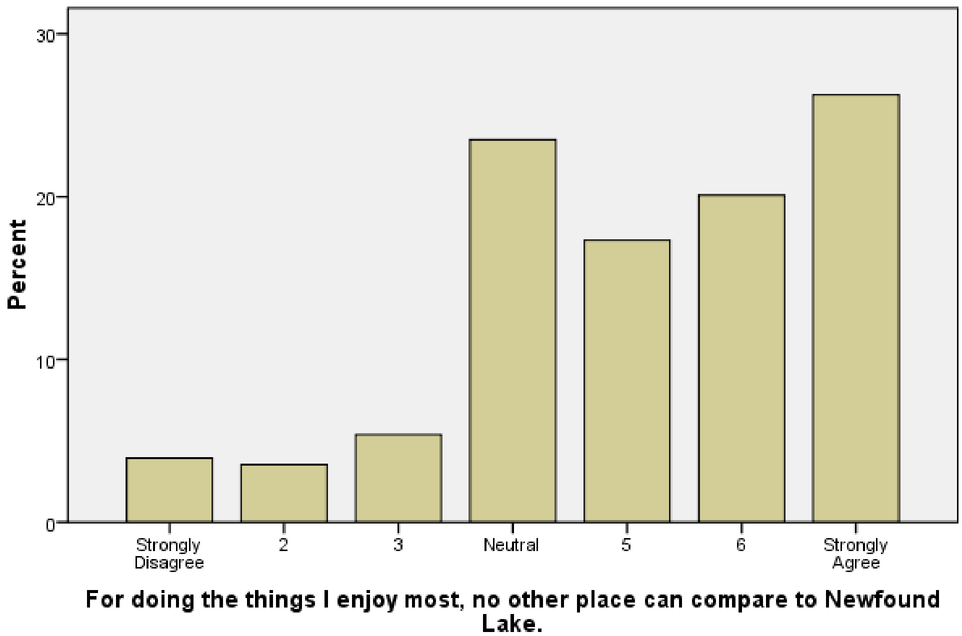
Habitat for fish and other wildlife exist?



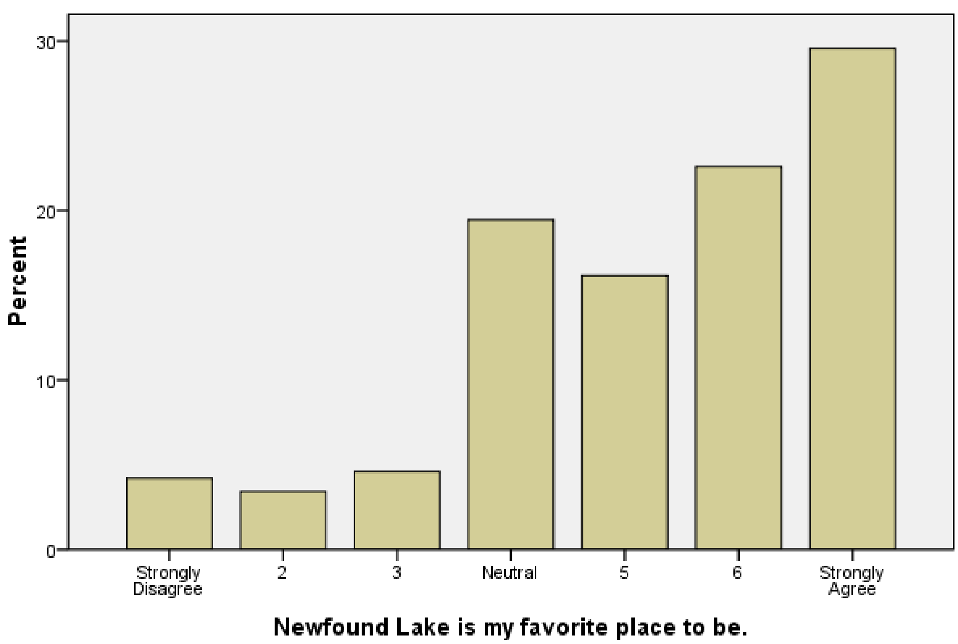


Questionnaire Section 4

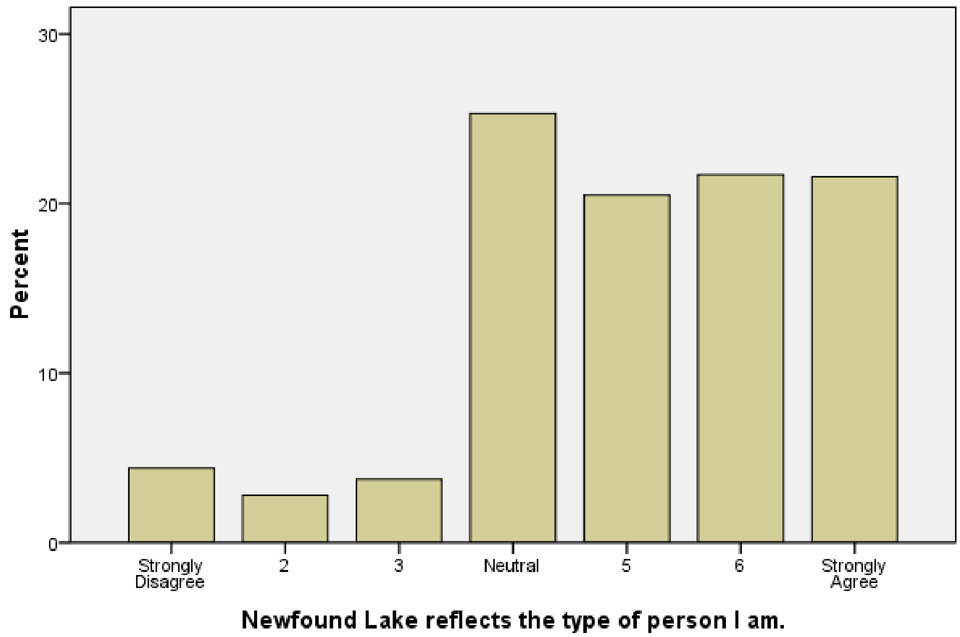
For doing the things I enjoy most, no other place can compare to Newfound Lake.



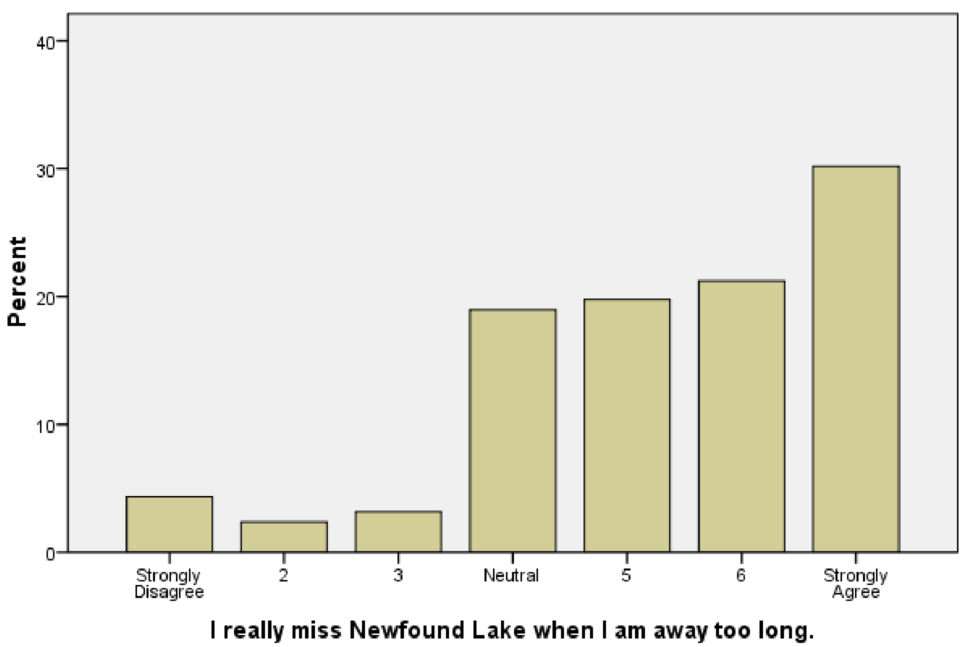
Newfound Lake is my favorite place to be.



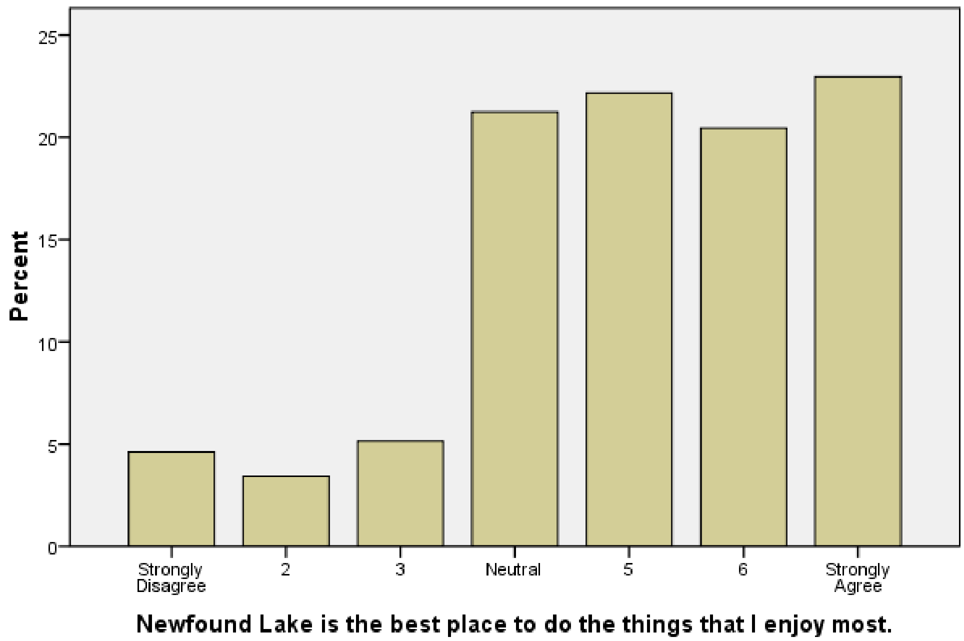
Newfound Lake reflects the type of person I am.



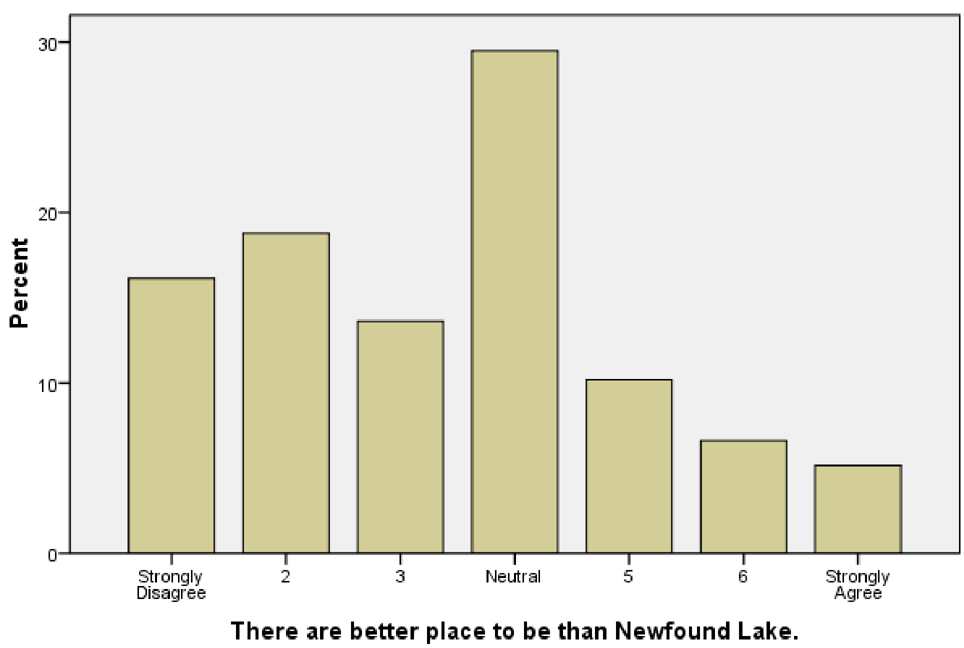
I really miss Newfound Lake when I am away too long.



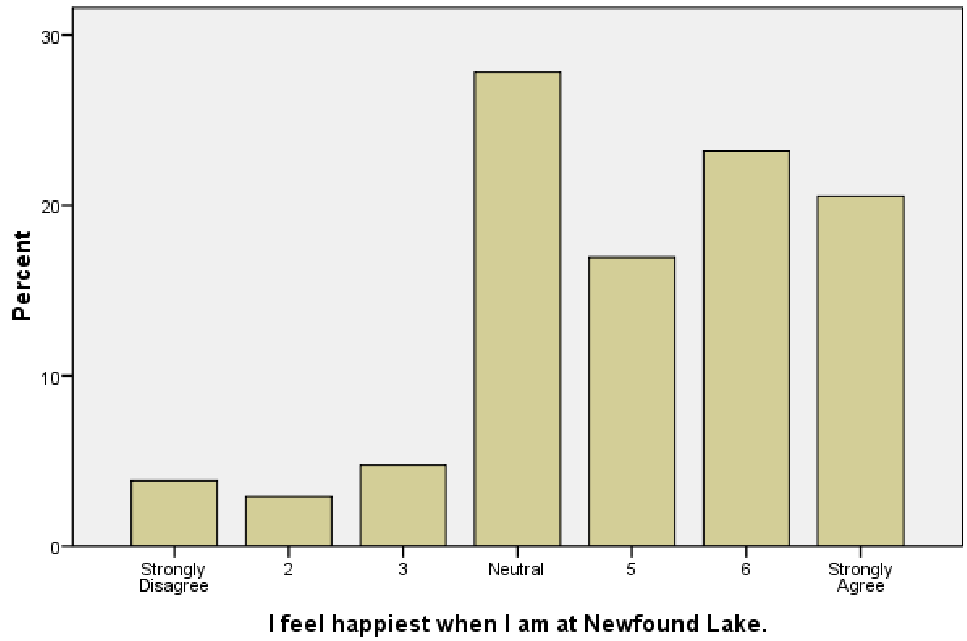
Newfound Lake is the best place to do the things that I enjoy most.



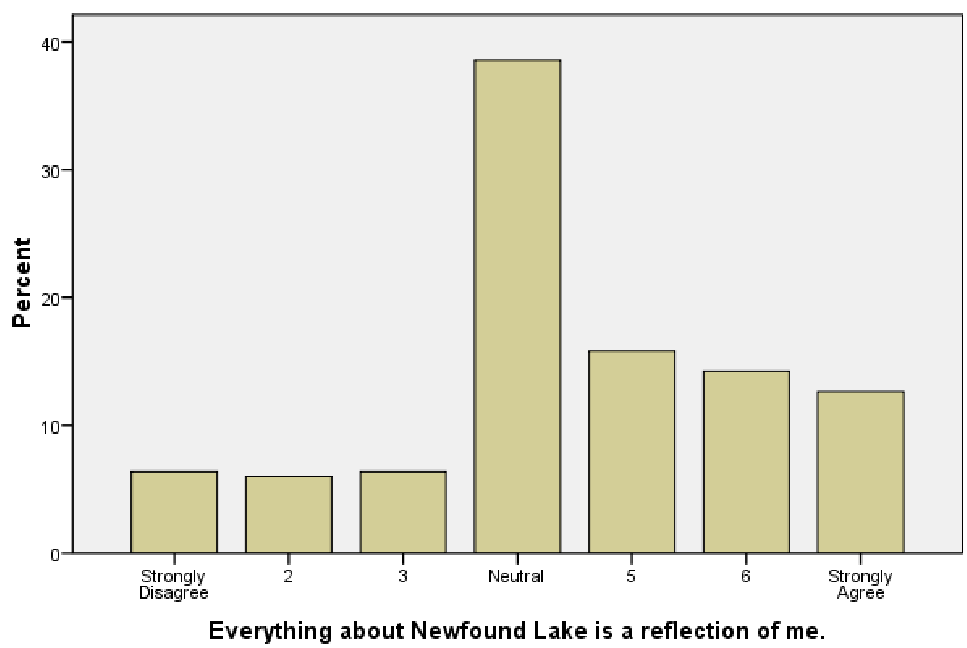
There are better place to be than Newfound Lake.



I feel happiest when I am at Newfound Lake.

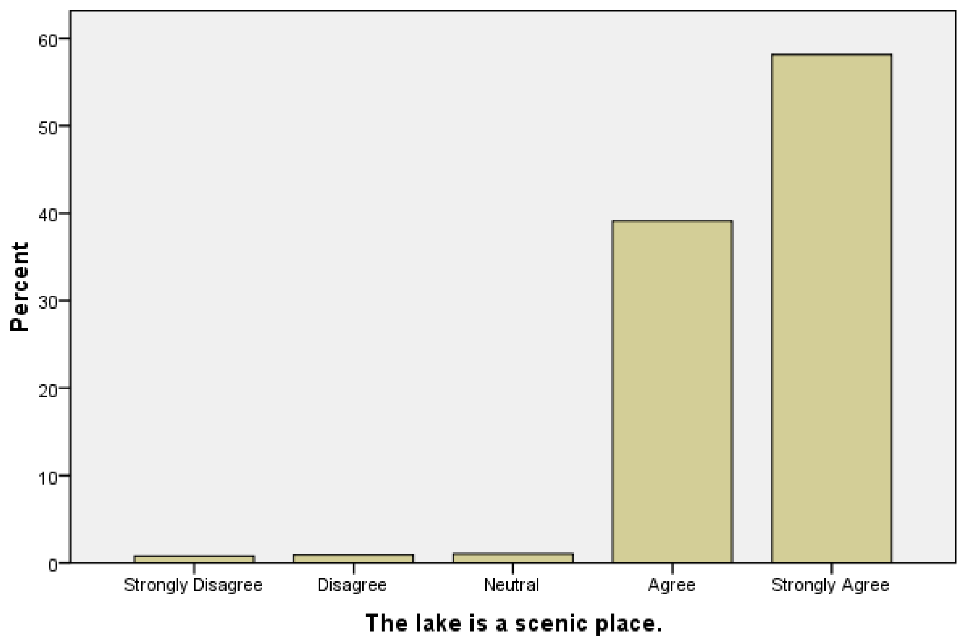


Everything about Newfound Lake is a reflection of me.

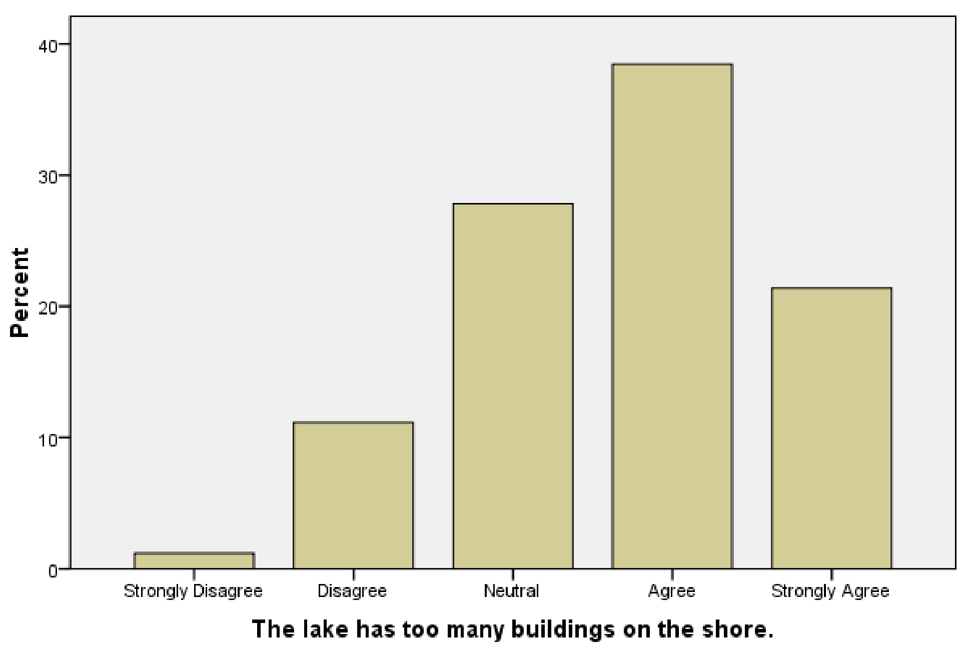


Questionnaire Section 5

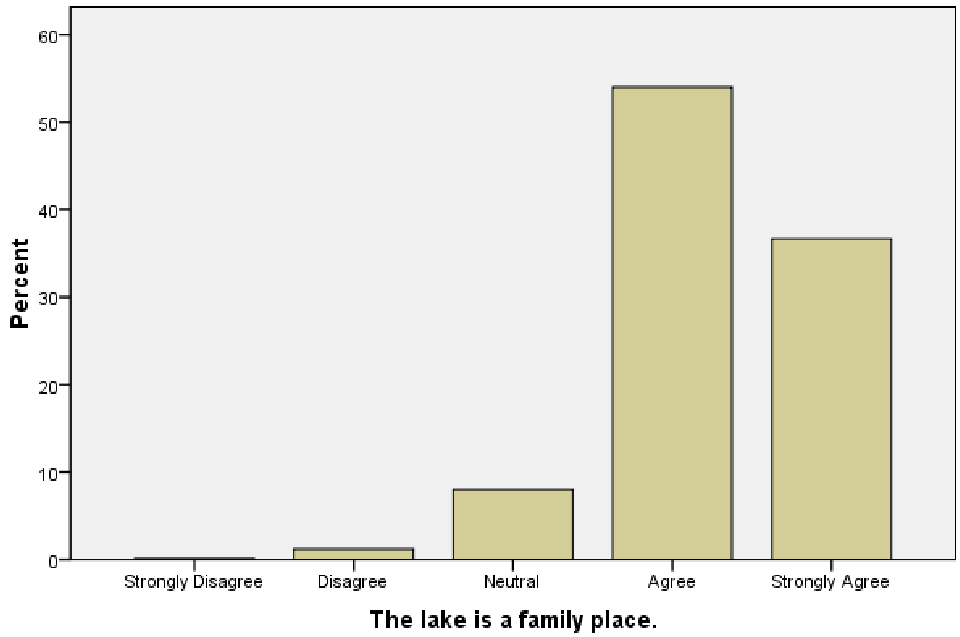
The lake is a scenic place.



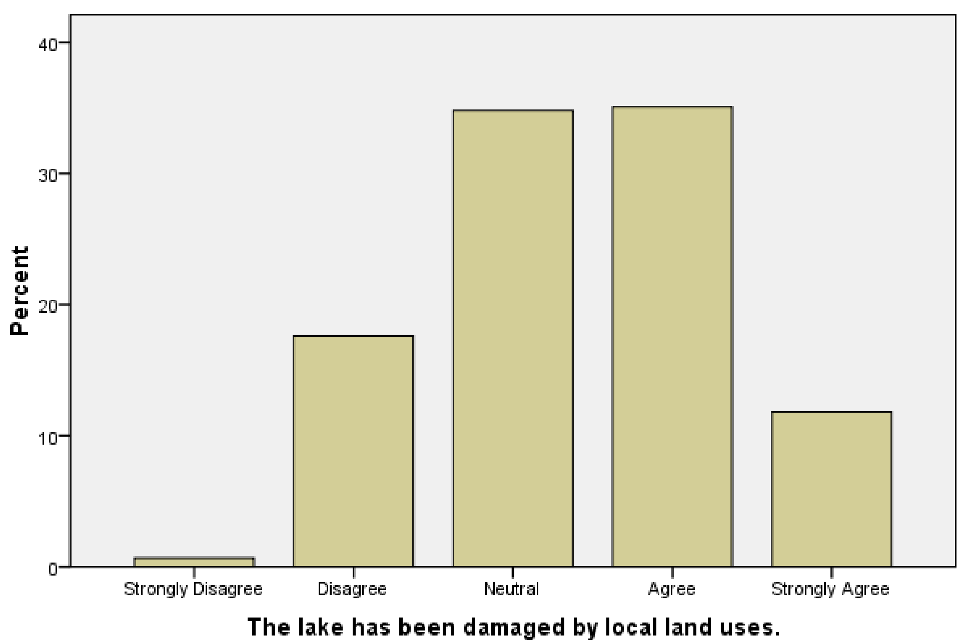
The lake has too many buildings on the shore.



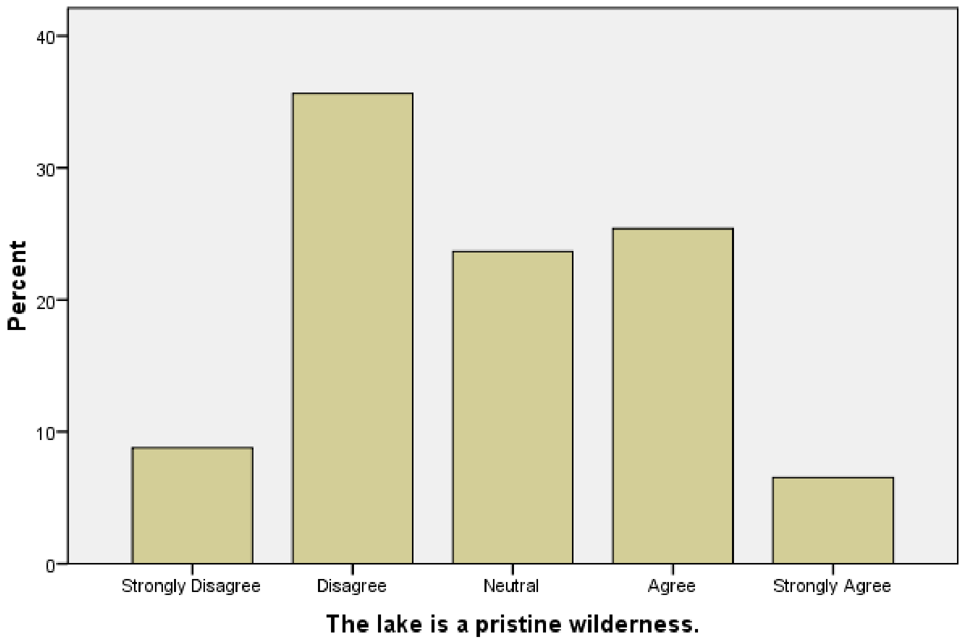
The lake is a family place.



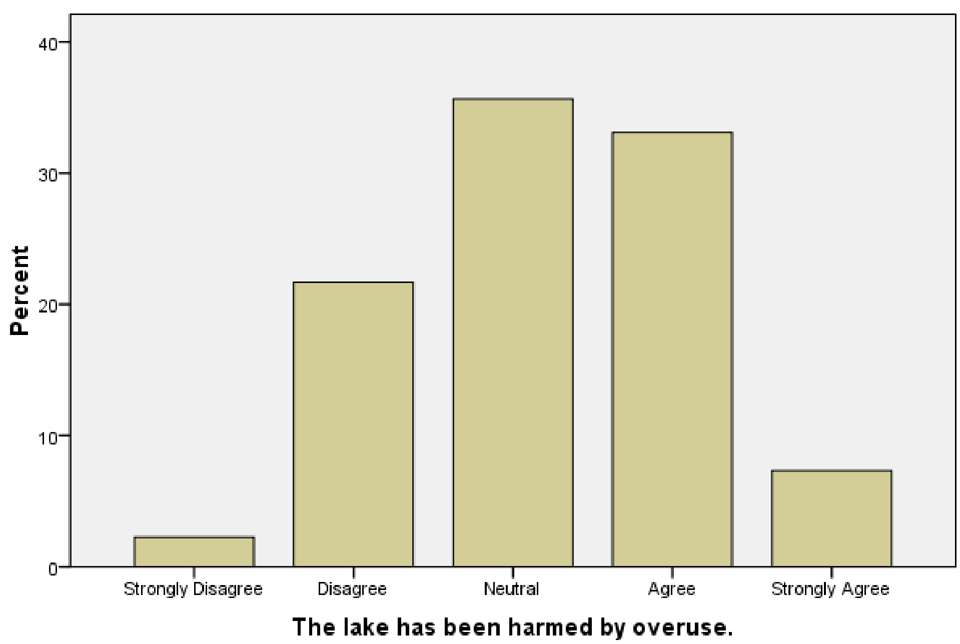
The lake has been damaged by local land uses.



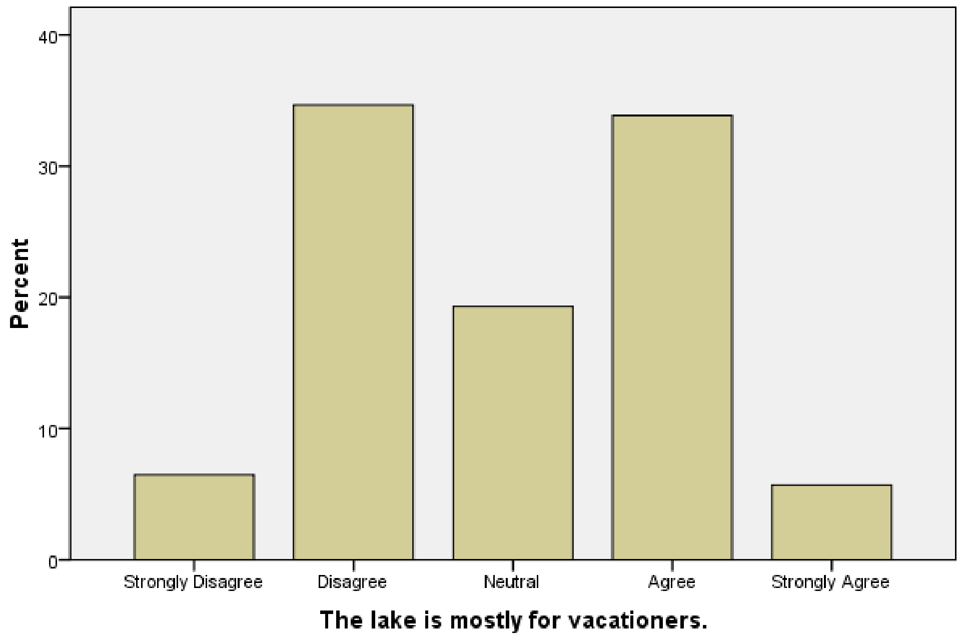
The lake is a pristine wilderness.



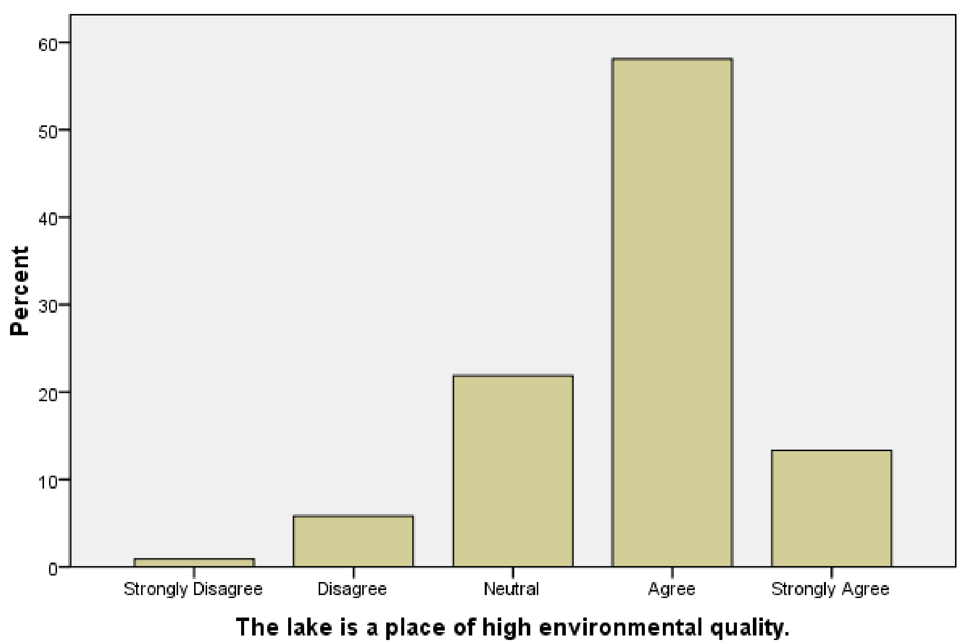
The lake has been harmed by overuse.



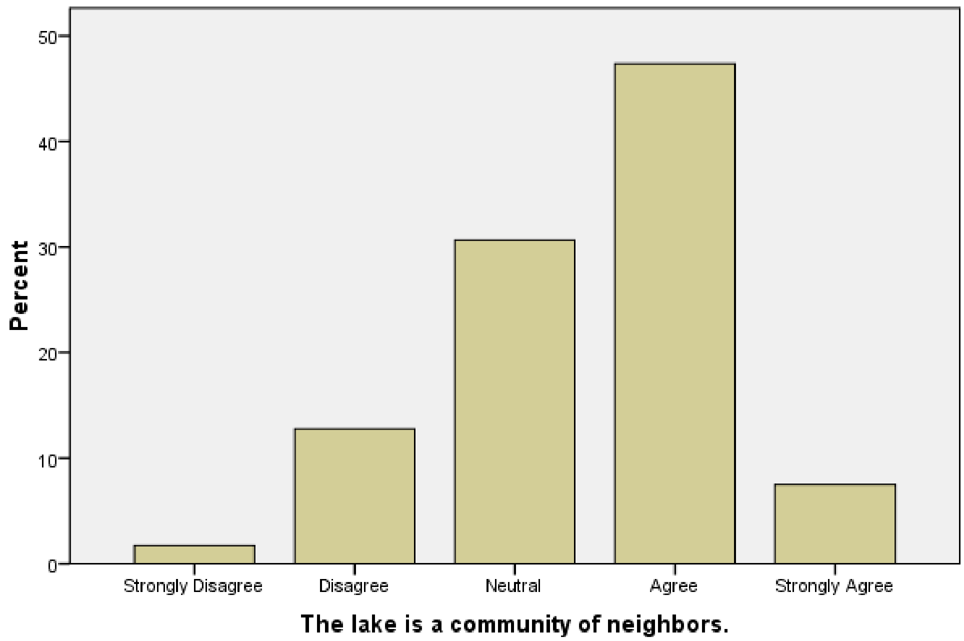
The lake is mostly for vacationers.



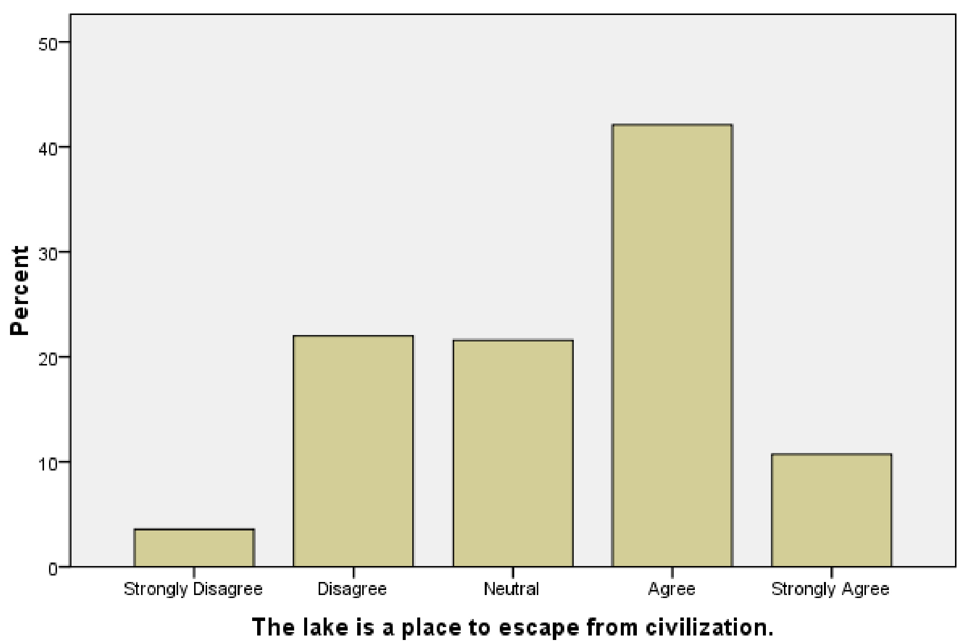
The lake is a place of high environmental quality.



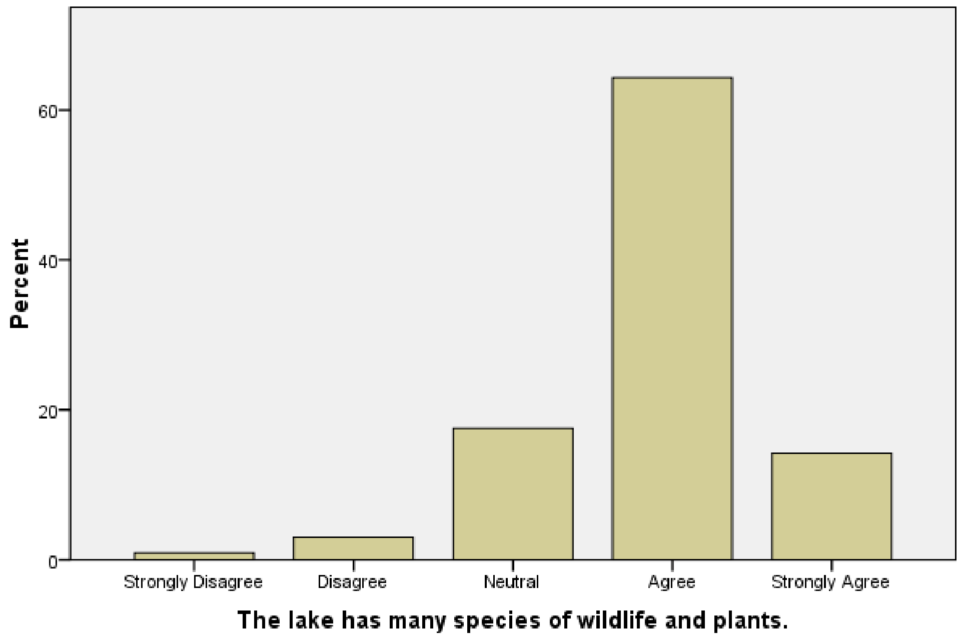
The lake is a community of neighbors.



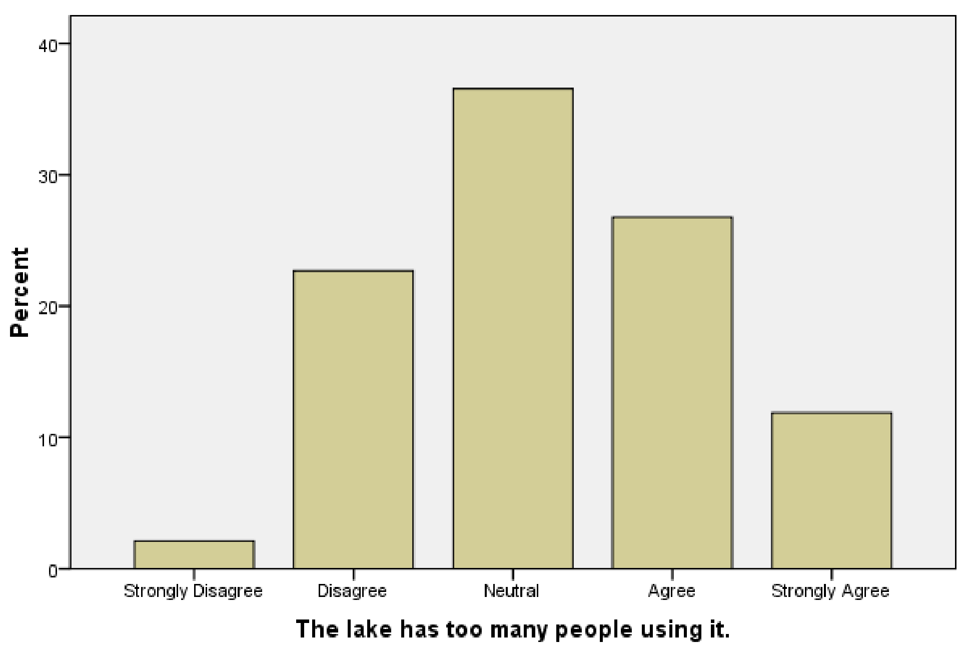
The lake is a place to escape from civilization.



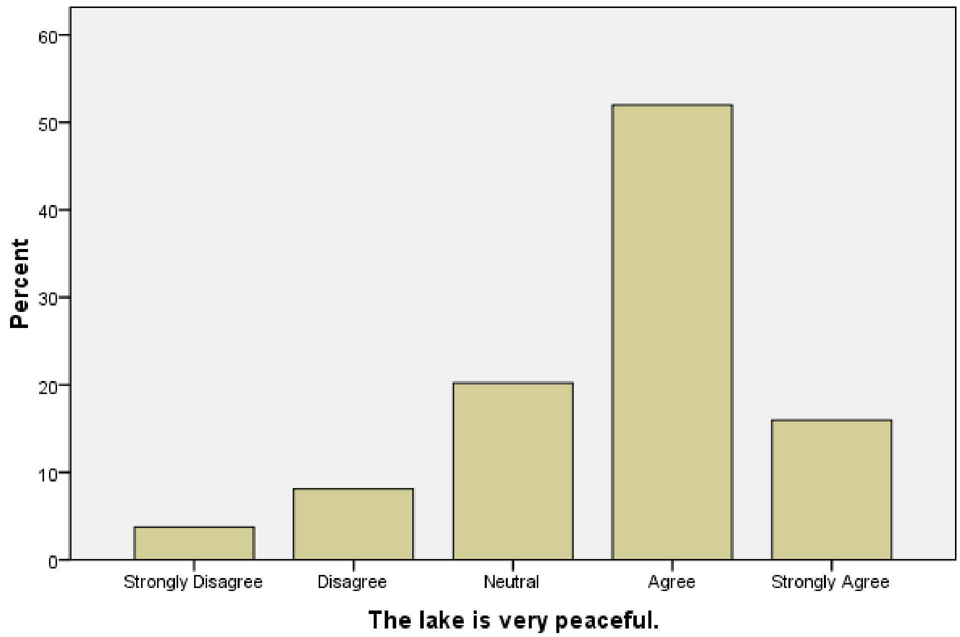
The lake has many species of wildlife and plants.



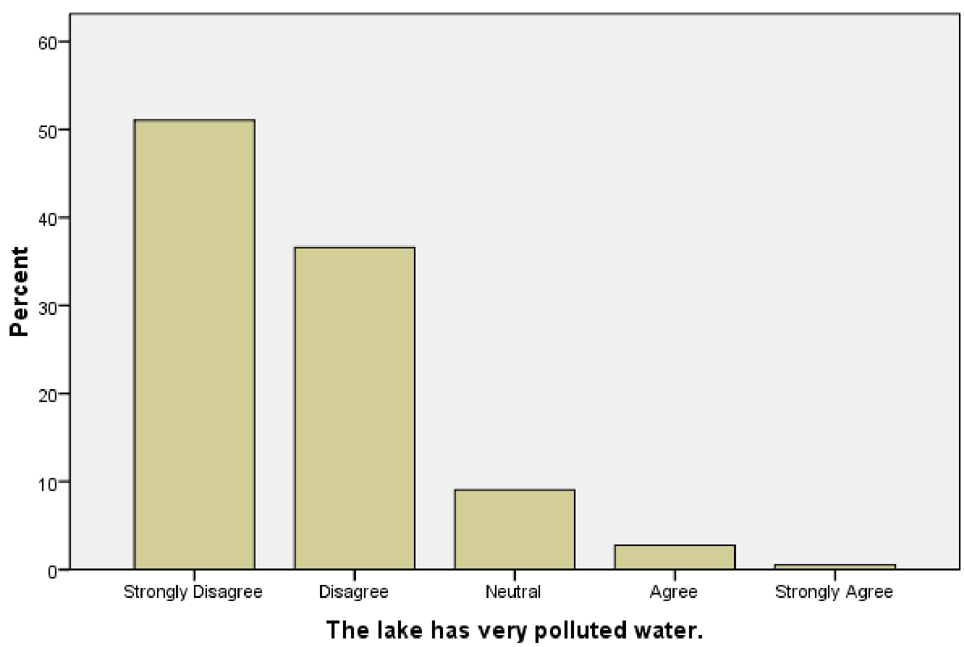
The lake has too many people using it.



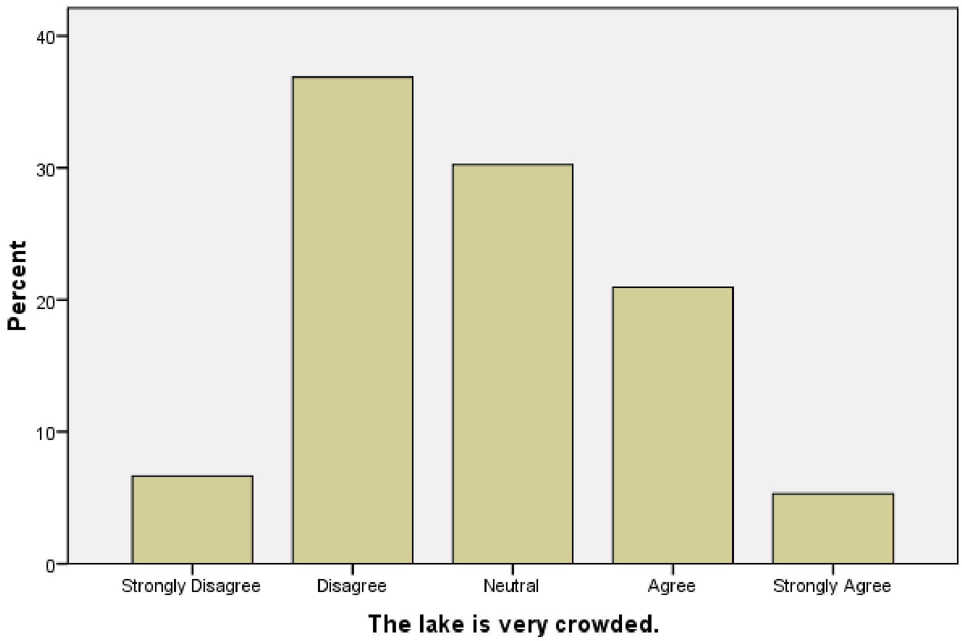
The lake is very peaceful.



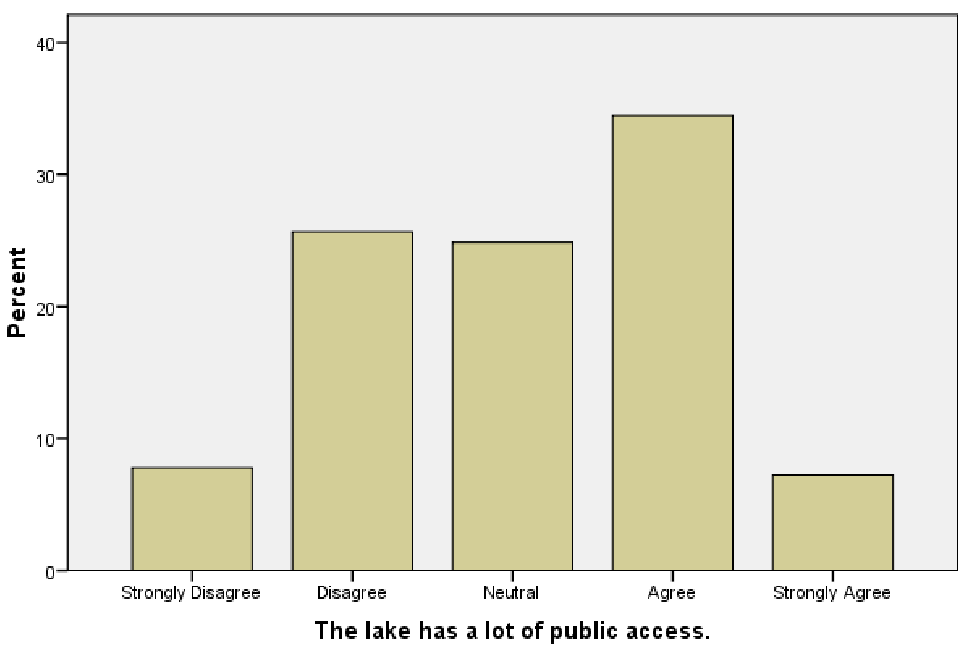
The lake has very polluted water.



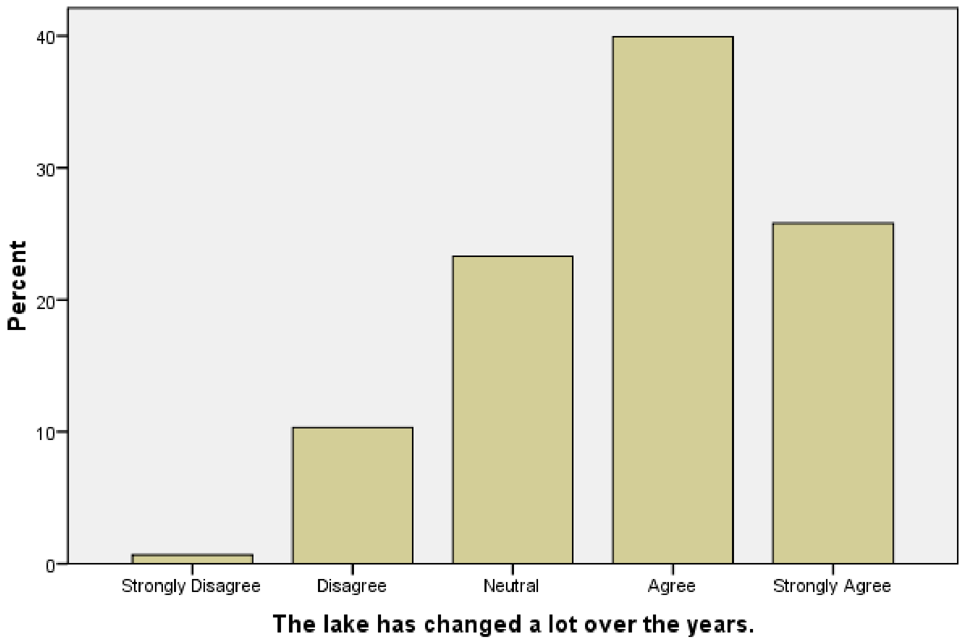
The lake is very crowded.



The lake has a lot of public access.

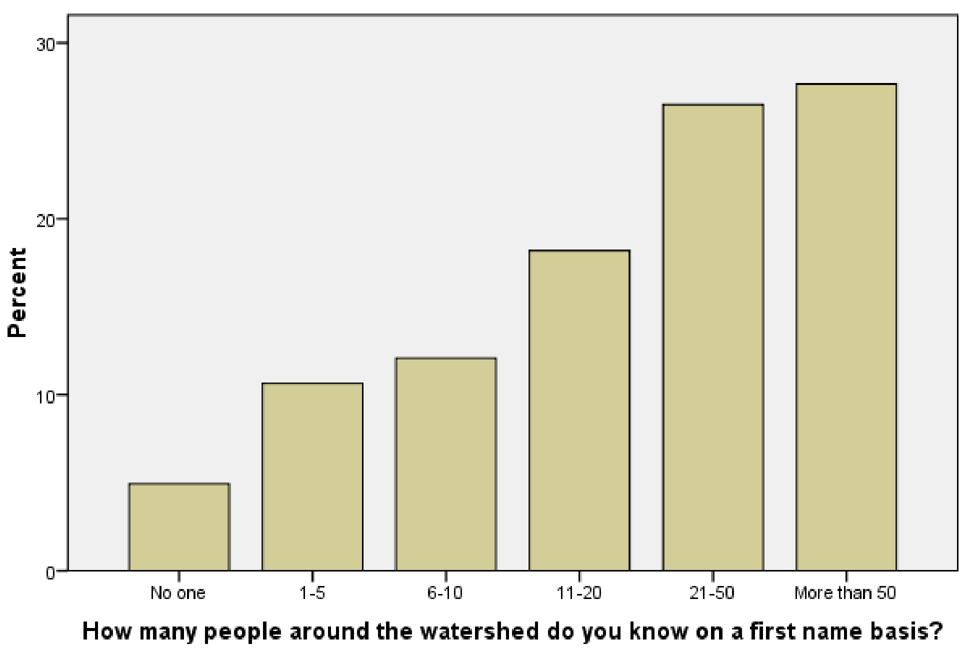


The lake has changed a lot over the years.

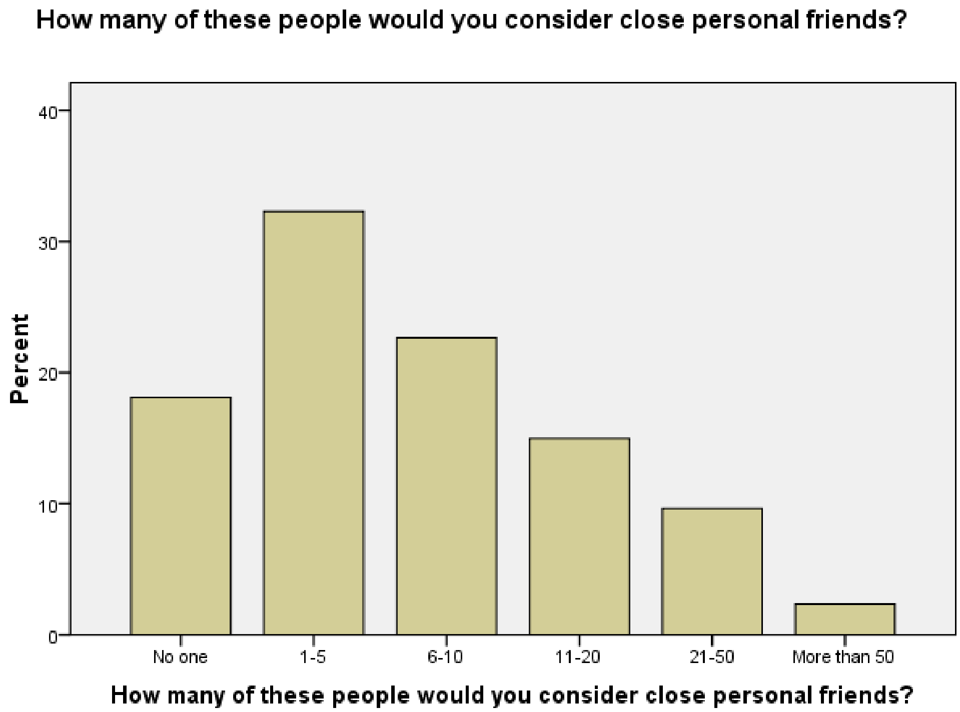


<u>Questionnaire Question 6</u>

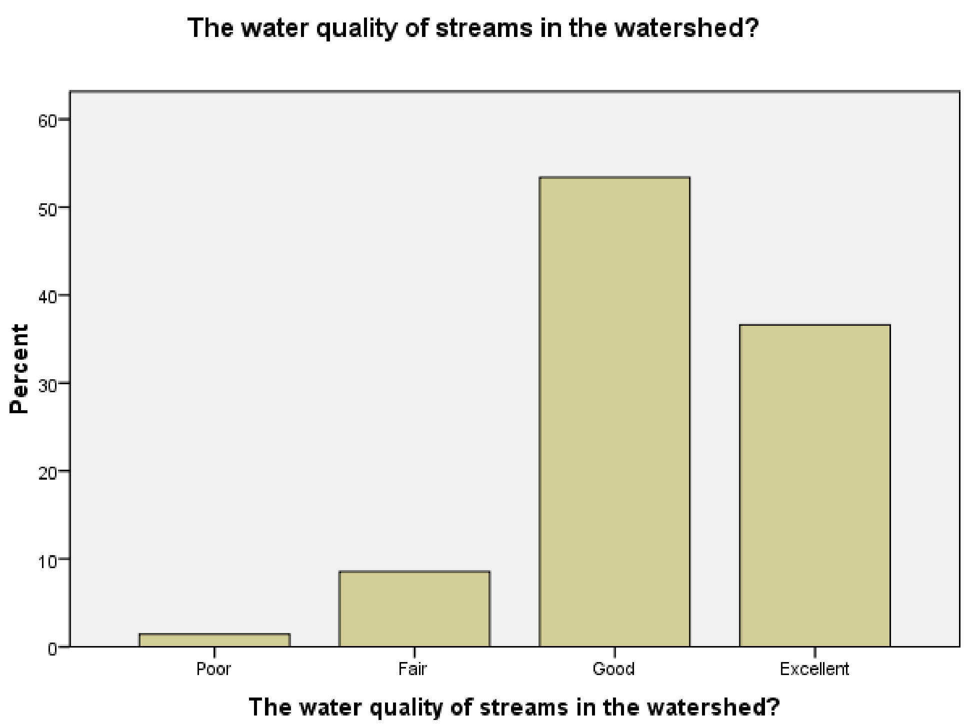
How many people around the watershed do you know on a first name basis?



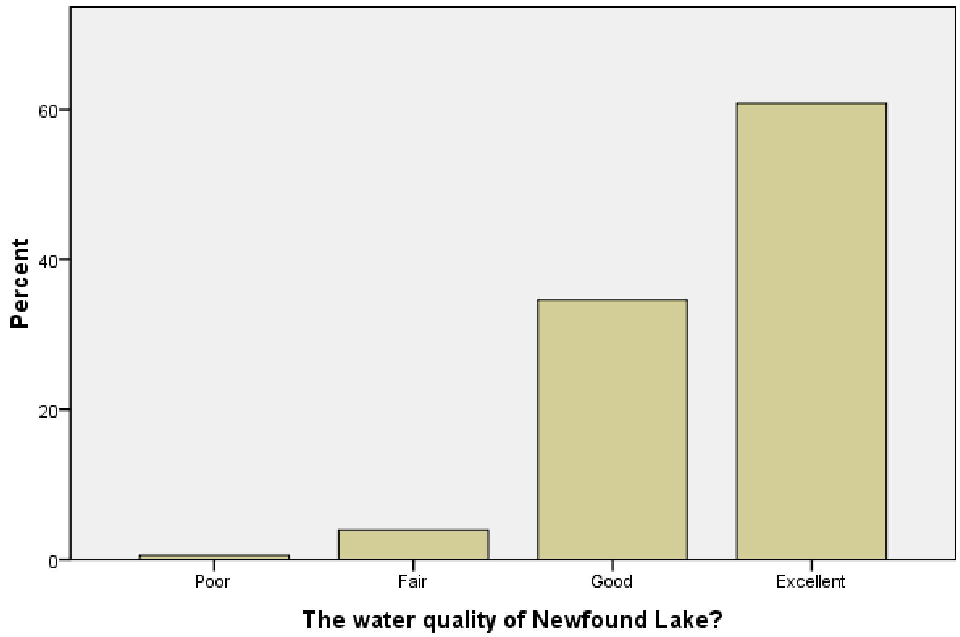
Questionnaire Question 7



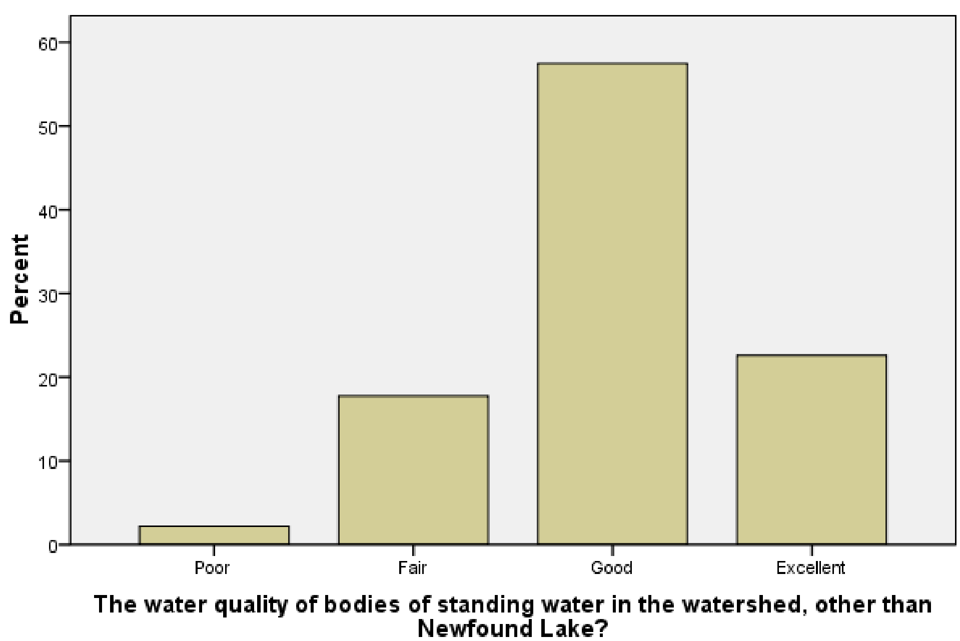
Questionnaire Section 8

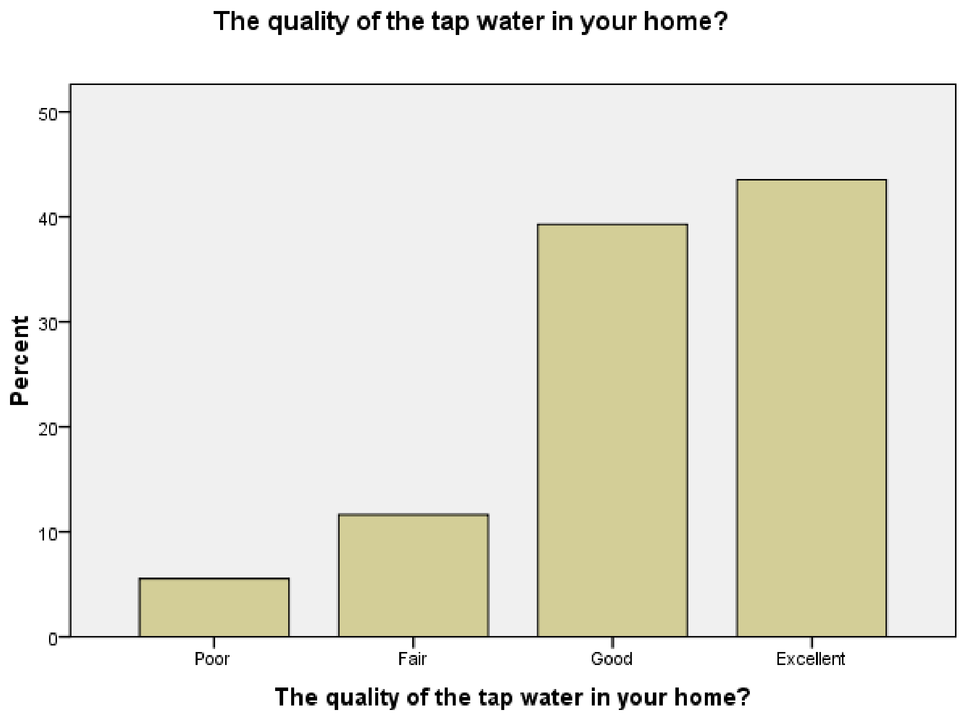


The water quality of Newfound Lake?

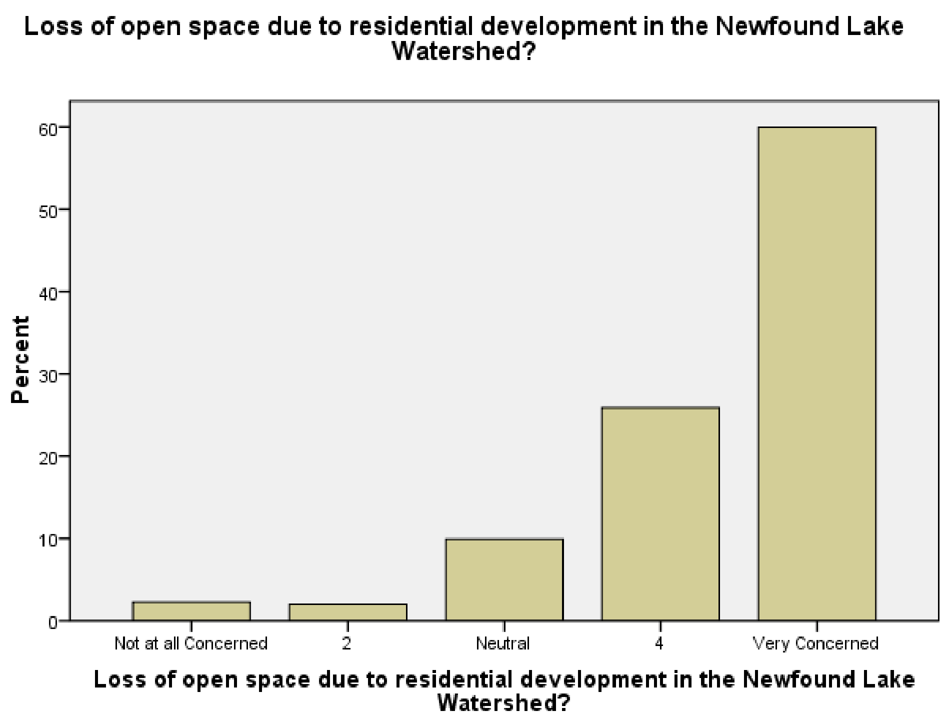


The water quality of bodies of standing water in the watershed, other than Newfound Lake?

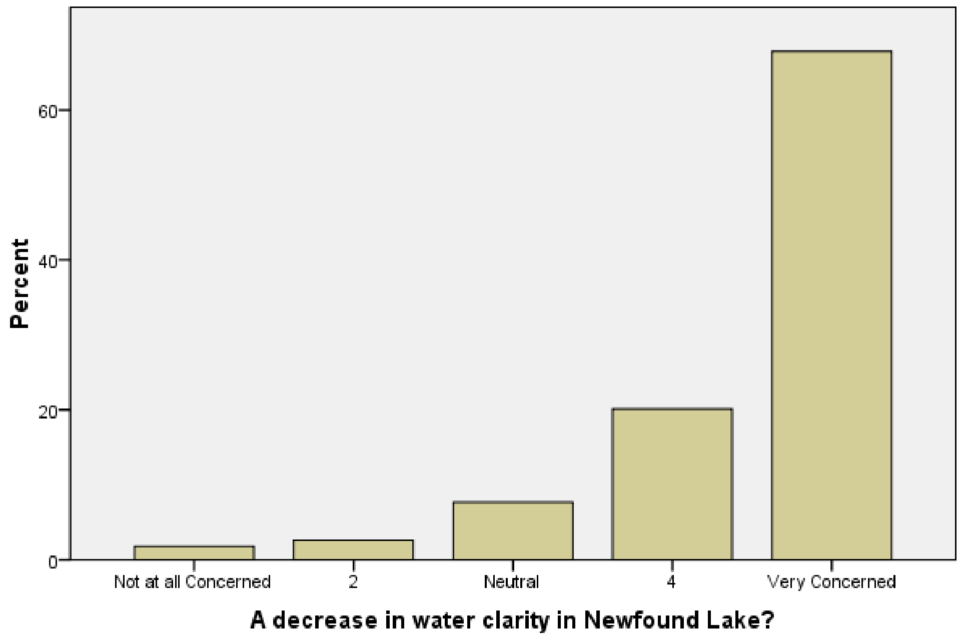




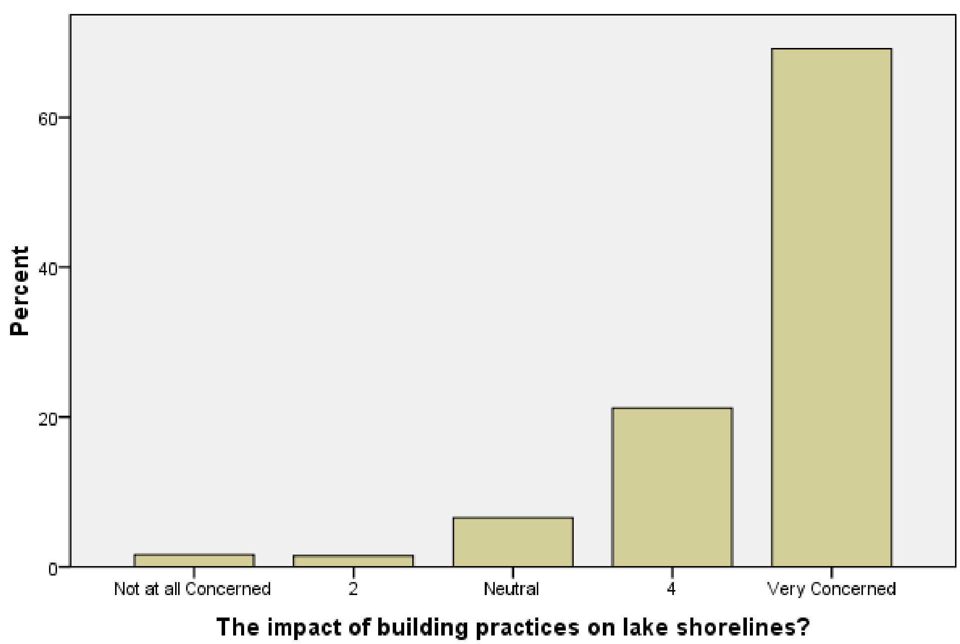
Questionnaire Section 9



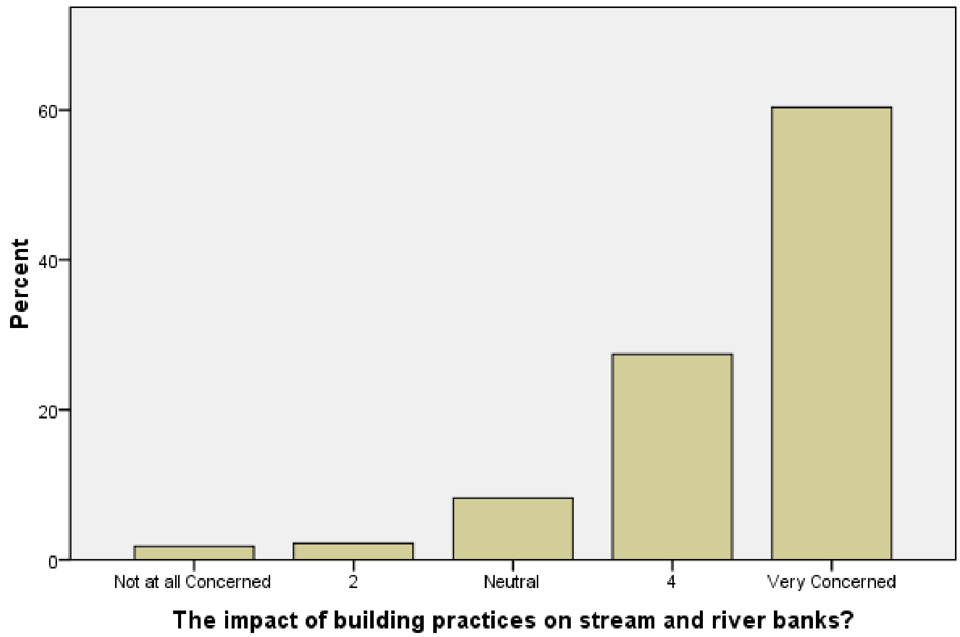
A decrease in water clarity in Newfound Lake?



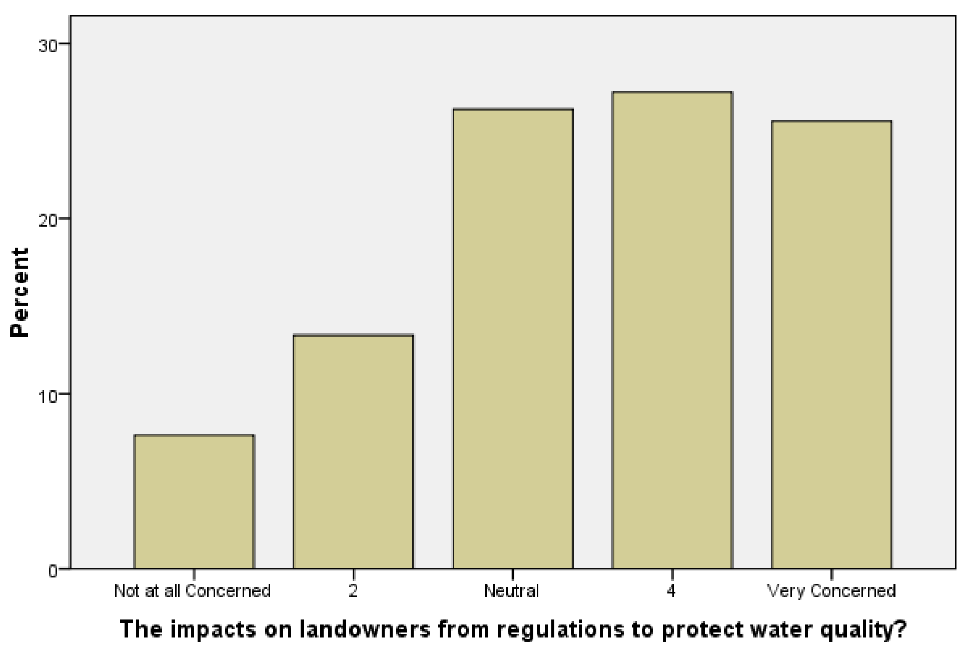
The impact of building practices on lake shorelines?



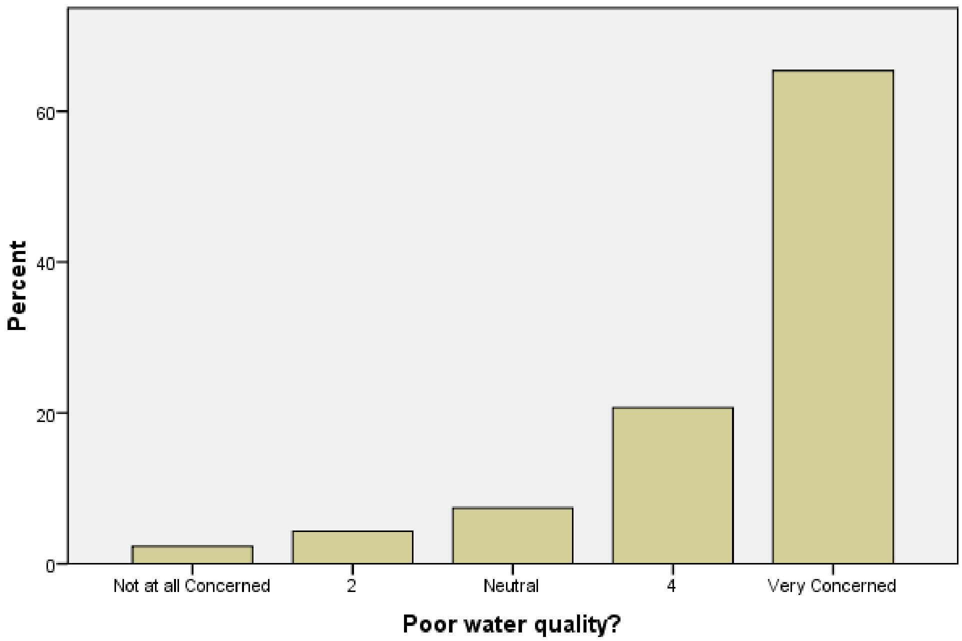
The impact of building practices on stream and river banks?



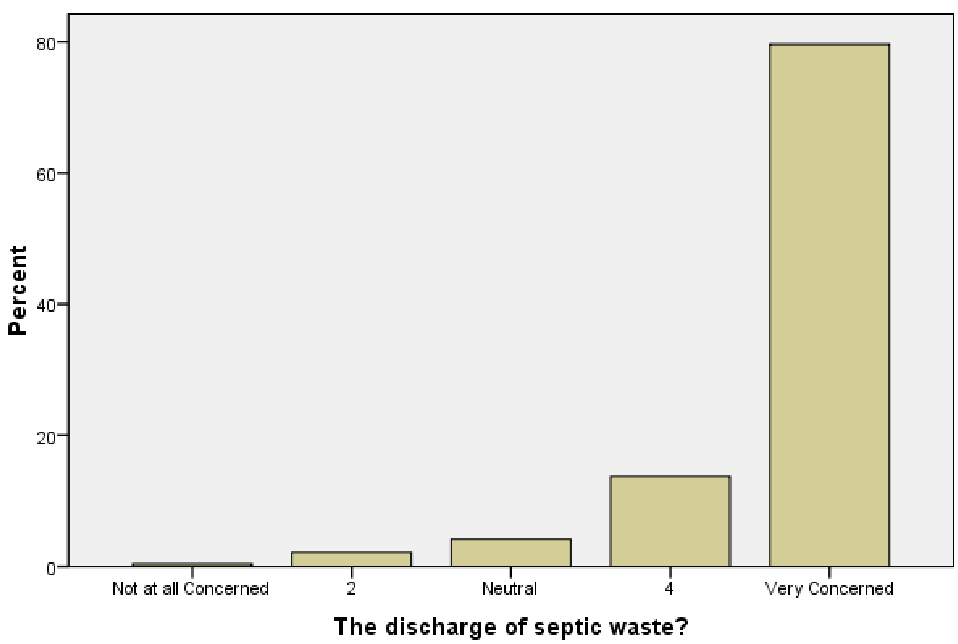
The impacts on landowners from regulations to protect water quality?



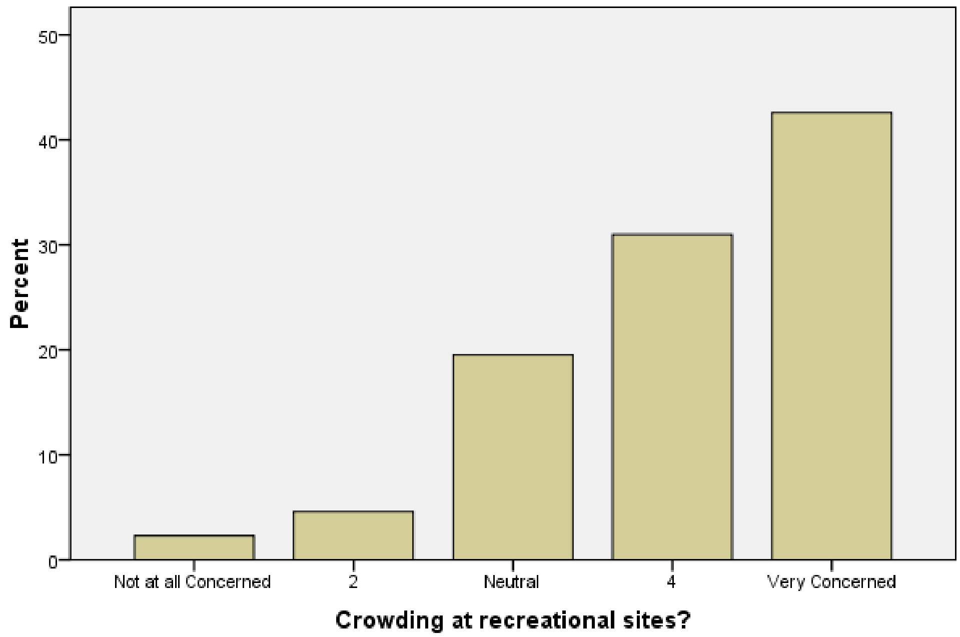
Poor water quality?



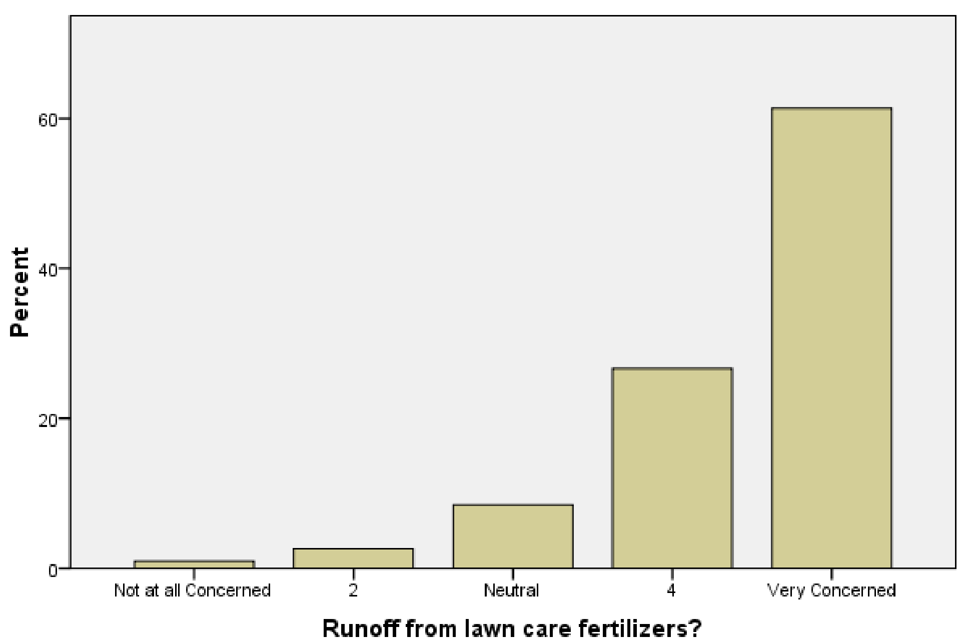
The discharge of septic waste?



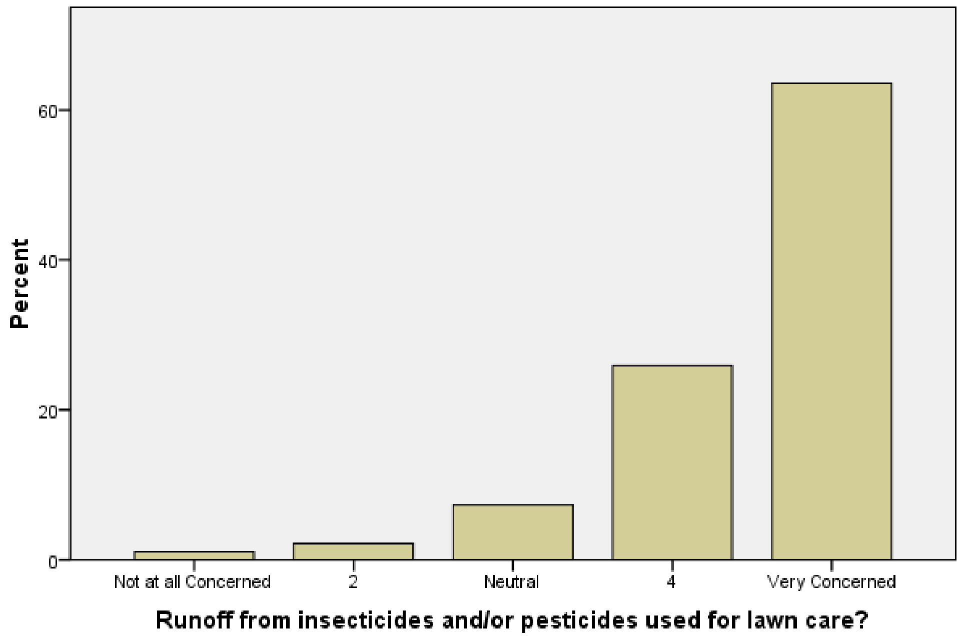
Crowding at recreational sites?



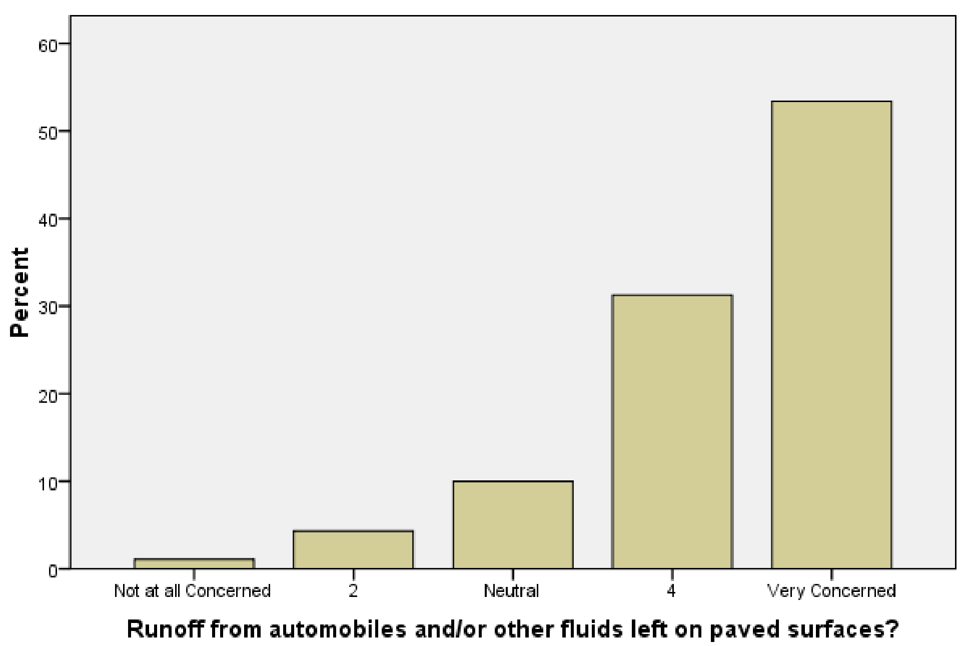
Runoff from lawn care fertilizers?



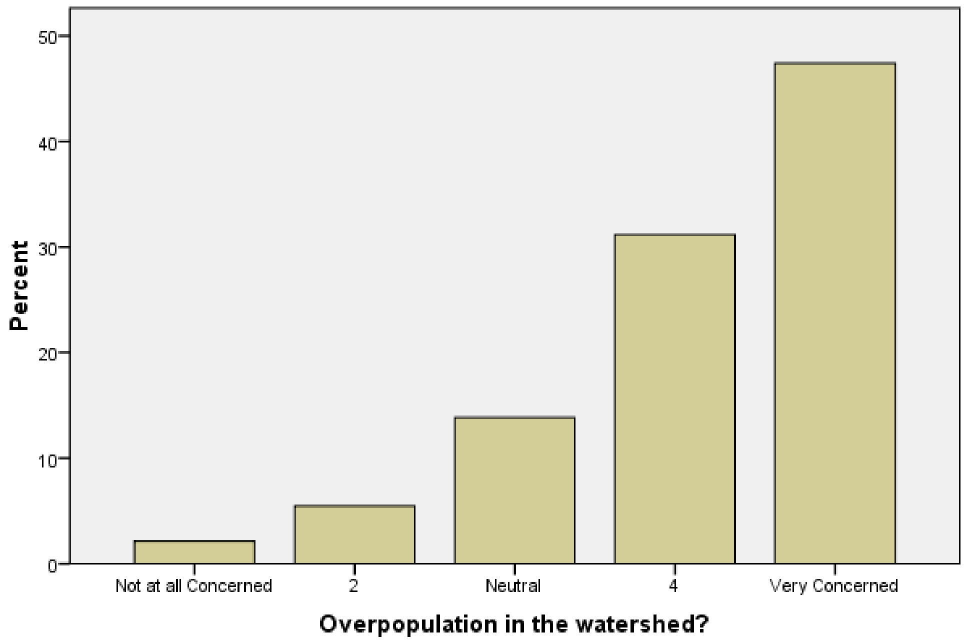
Runoff from insecticides and/or pesticides used for lawn care?



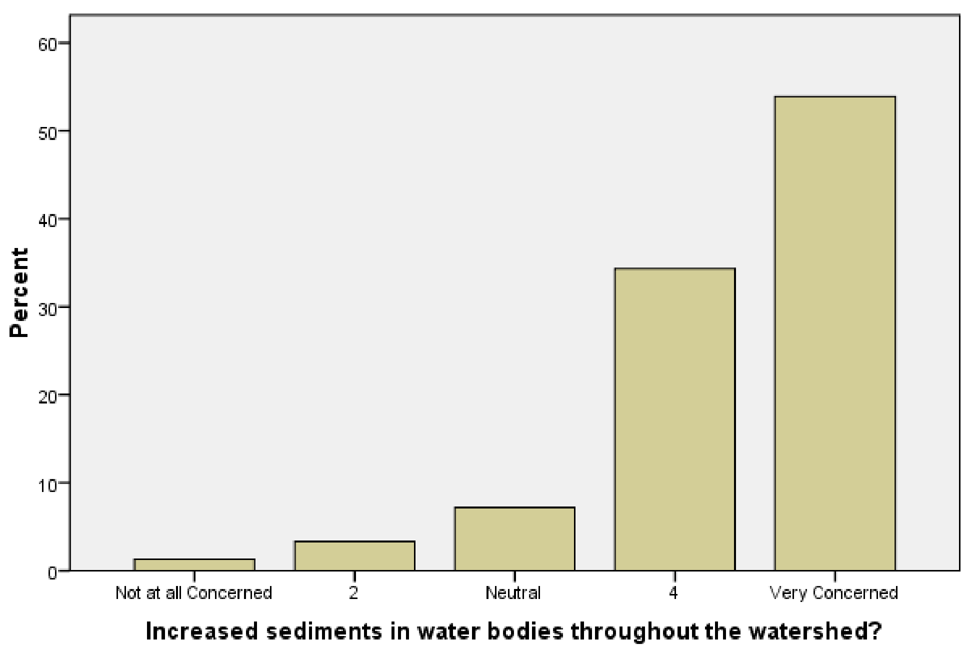
Runoff from automobiles and/or other fluids left on paved surfaces?



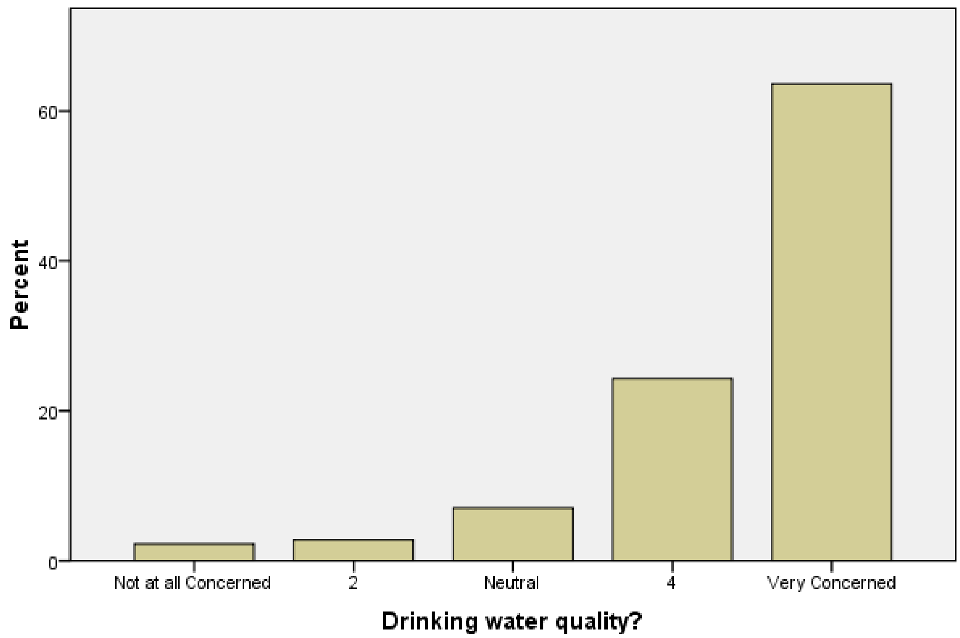
Overpopulation in the watershed?



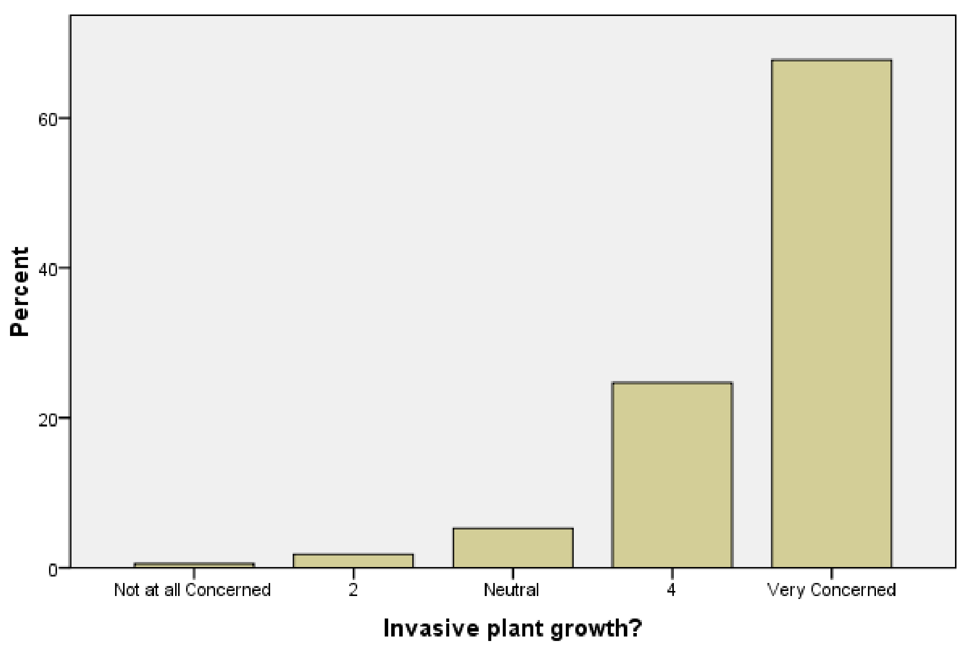
Increased sediments in water bodies throughout the watershed?

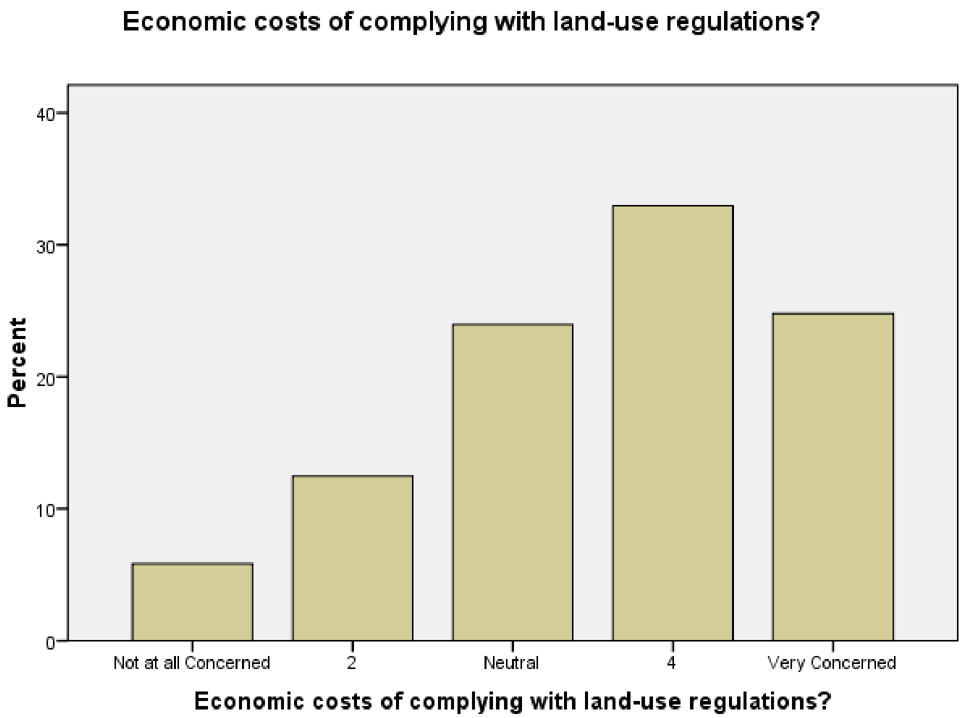


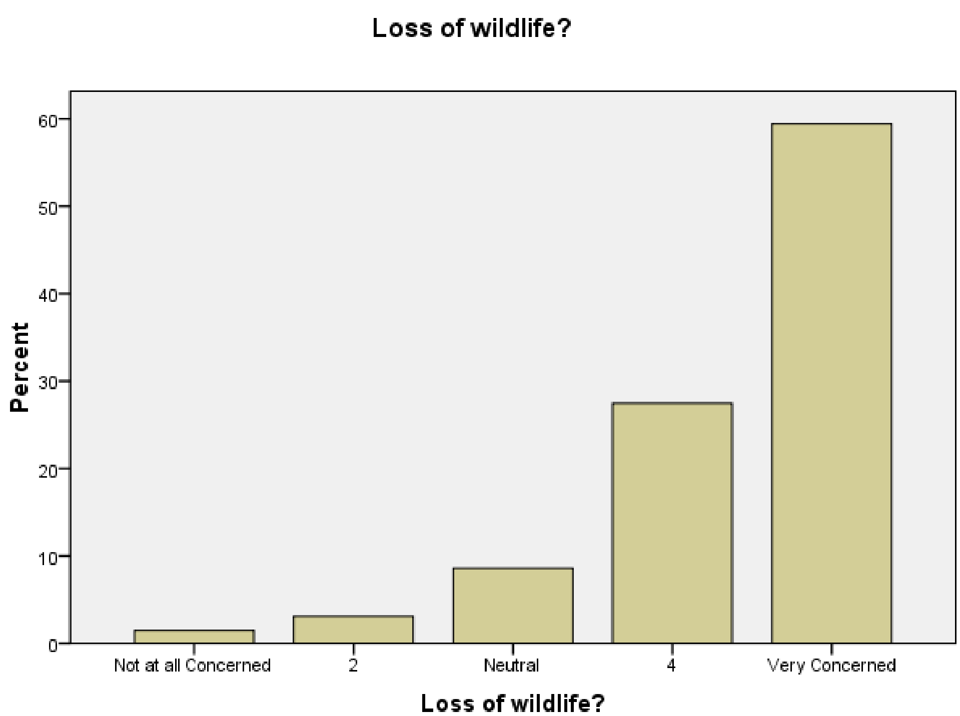
Drinking water quality?

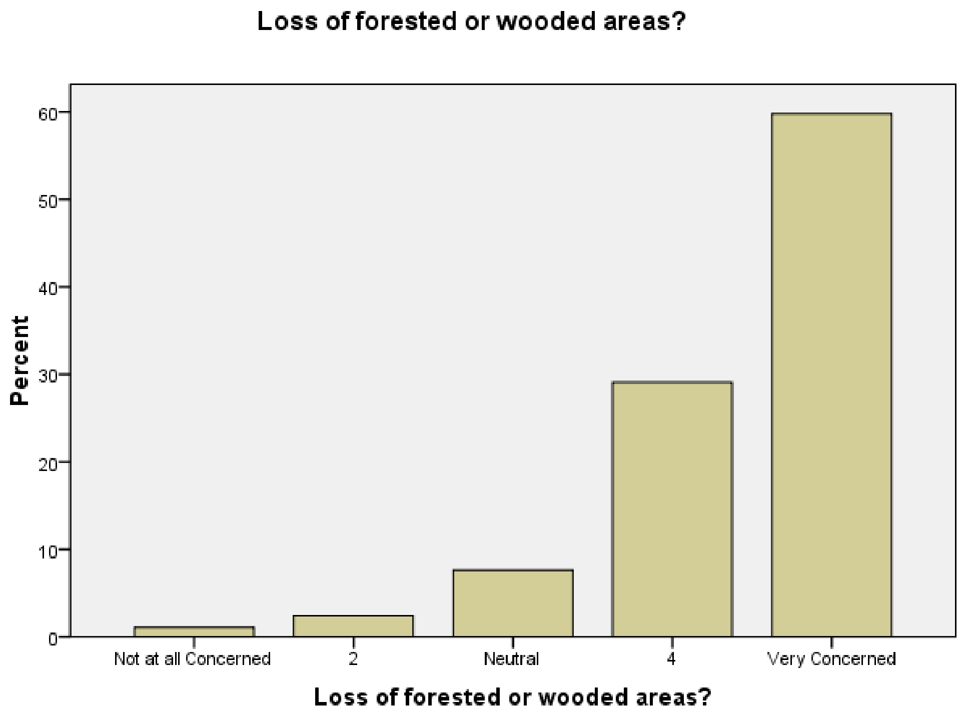


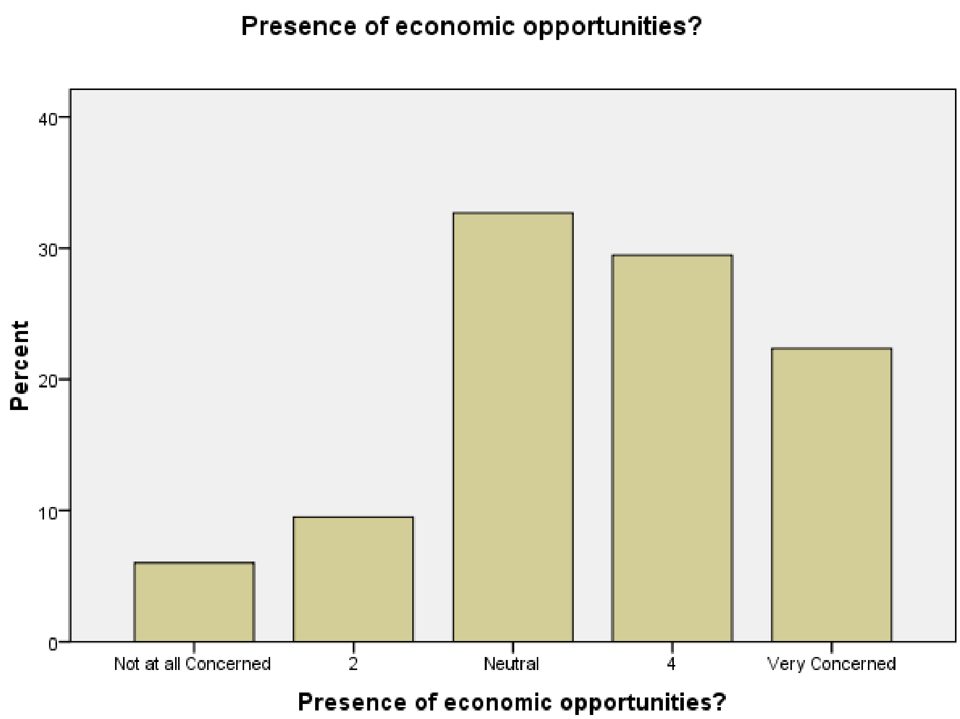
Invasive plant growth?



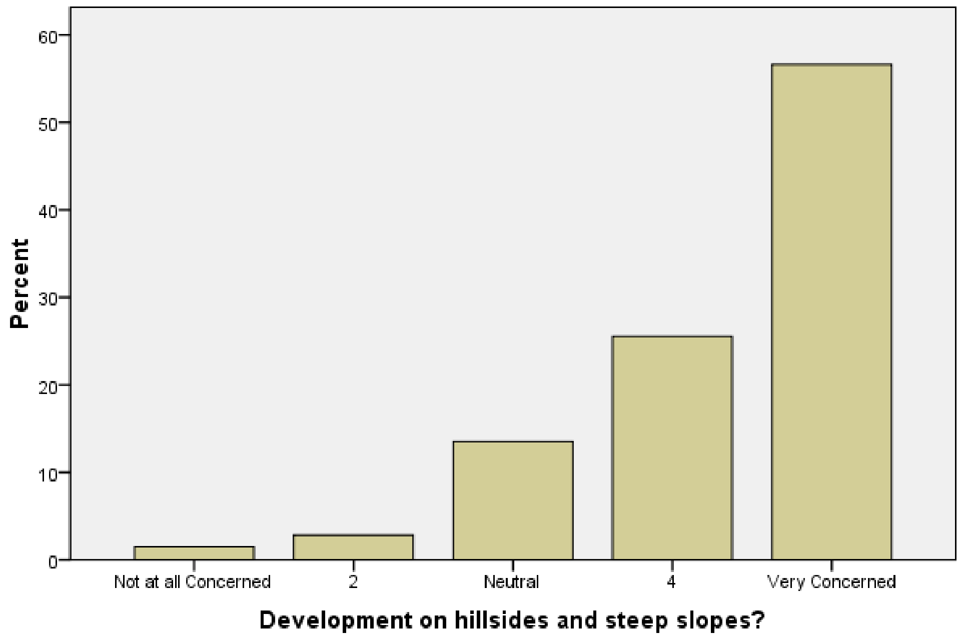

Economic costs of complying with land-use regulations?
Percent
40
30
20
10
0
Not at all Concerned
2
Neutral
4
Very Concerned
Economic costs of complying with land-use regulations?


Loss of wildlife?
Percent
60
50
40
30
20
10
0
Not at all Concerned
2
Neutral
4
Very Concerned
Loss of wildlife?

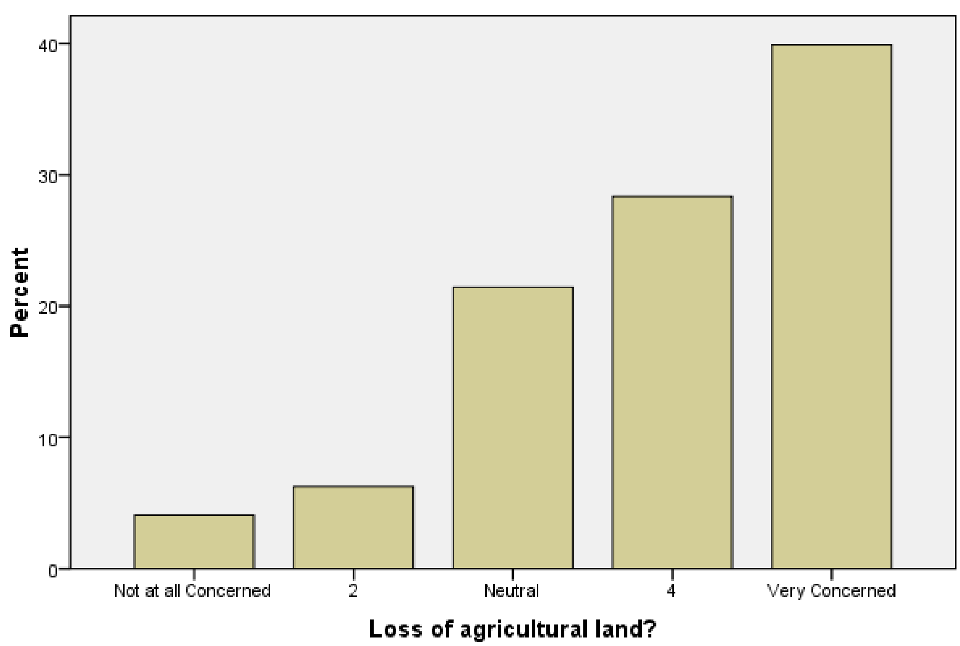

Loss of forested or wooded areas?
Percent
60
50
40
30
20
10
0
Not at all Concerned
2
Neutral
4
Very Concerned
Loss of forested or wooded areas?

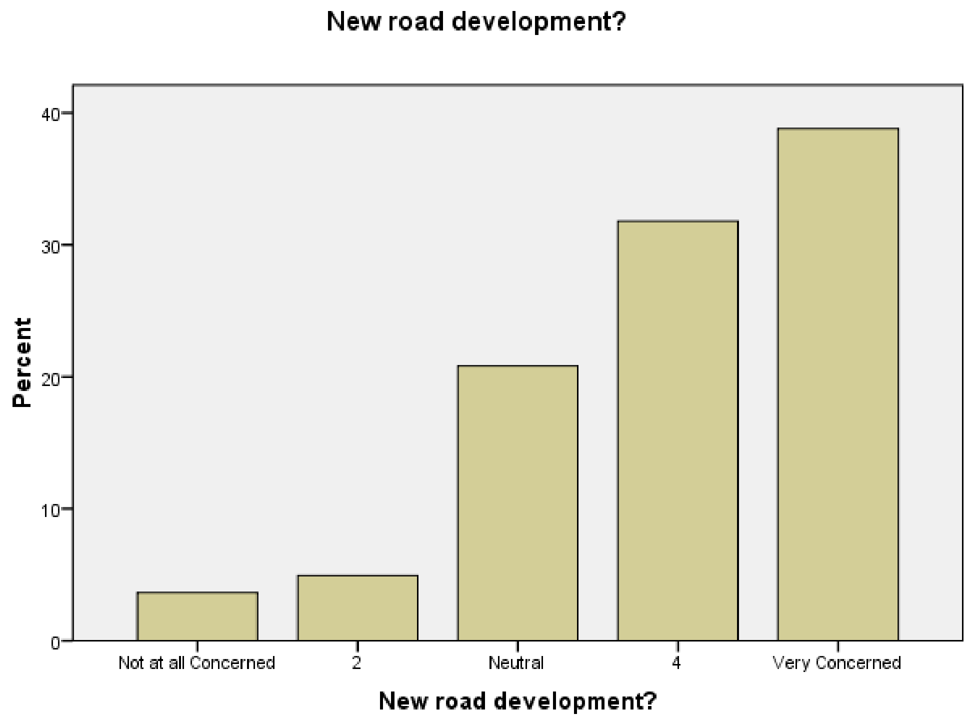

Presence of economic opportunities?
Percent
40
30
20
10
0
Not at all Concerned
2
Neutral
4
Very Concerned
Presence of economic opportunities?

Development on hillsides and steep slopes?

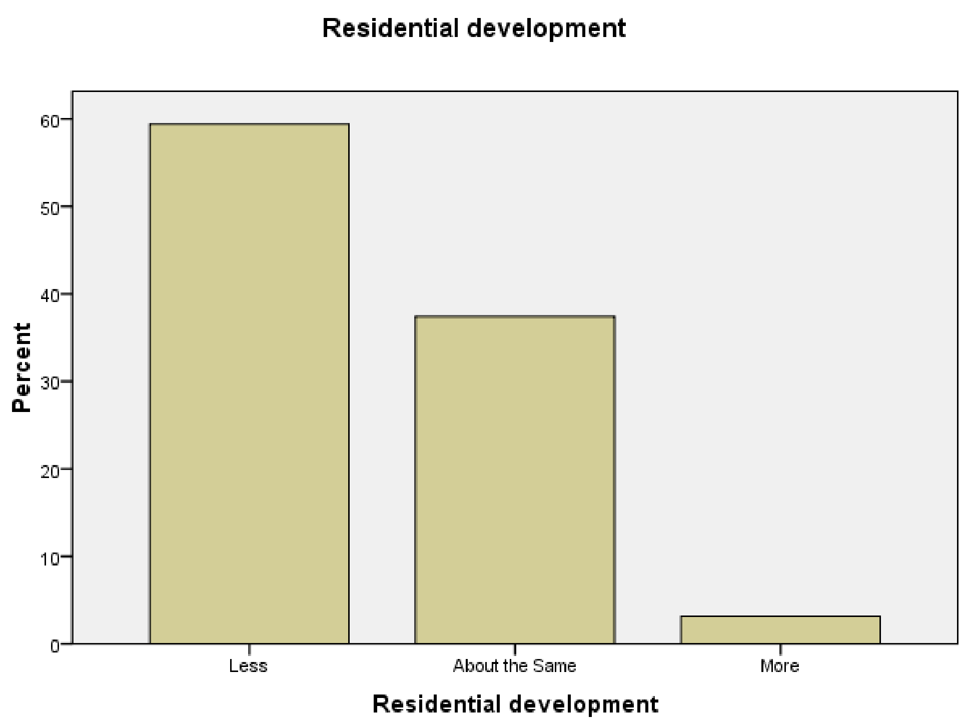


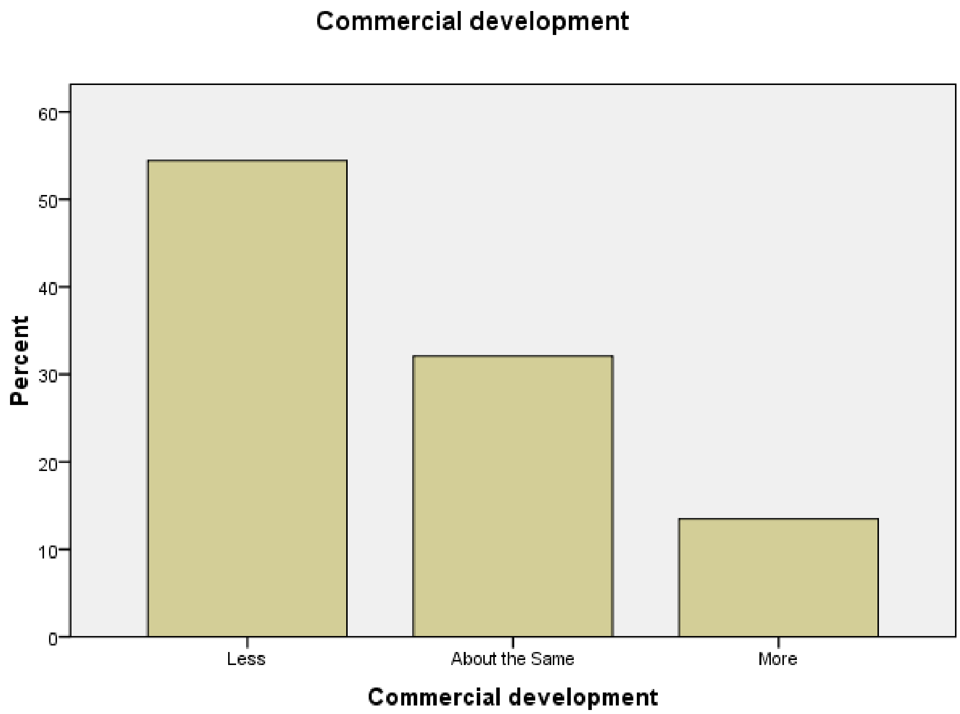
Loss of agricultural land?

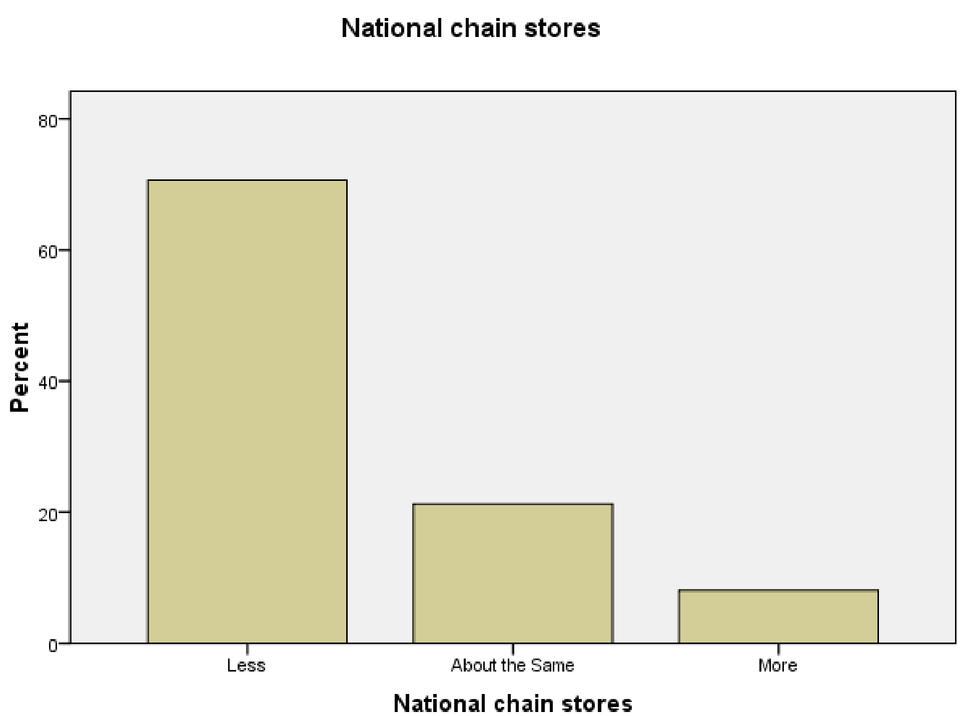




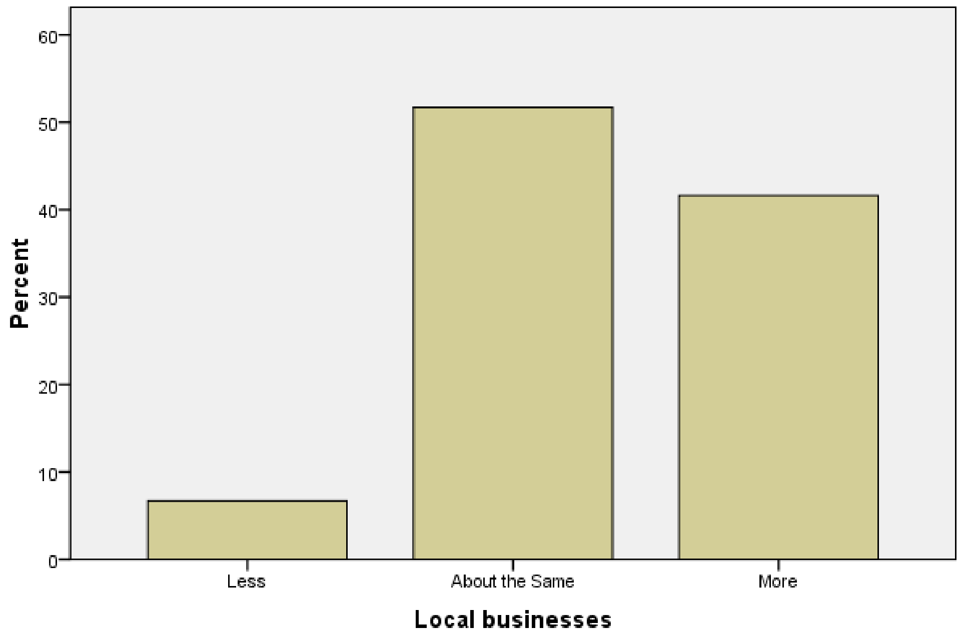
__Questionnaire Section 10__



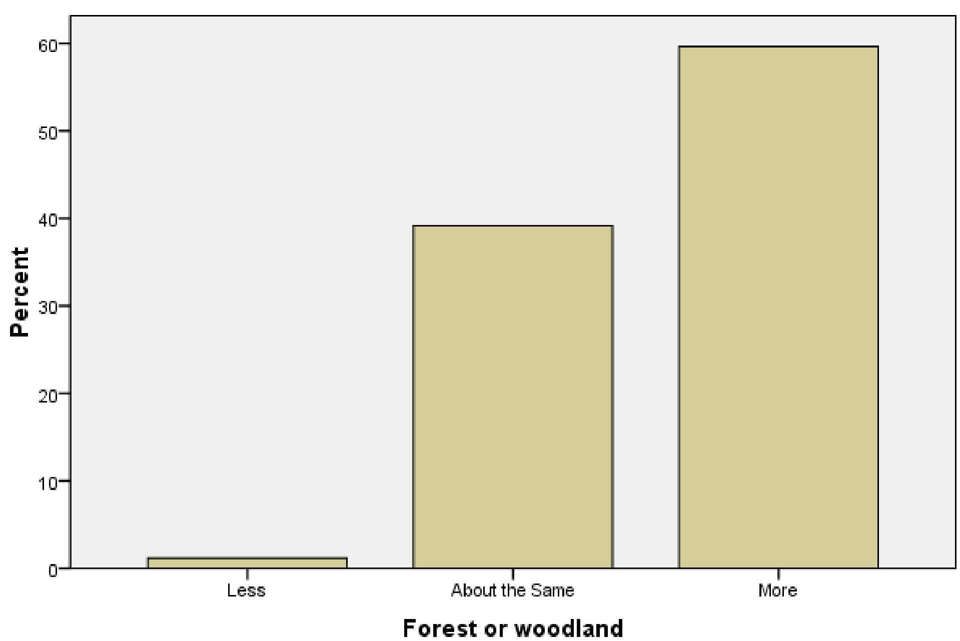

Commercial development
60
50
40
30
20
10
0
Percent
Less
About the Same
More
Commercial development


National chain stores
80
60
40
20
0
Percent
Less
About the Same
More
National chain stores

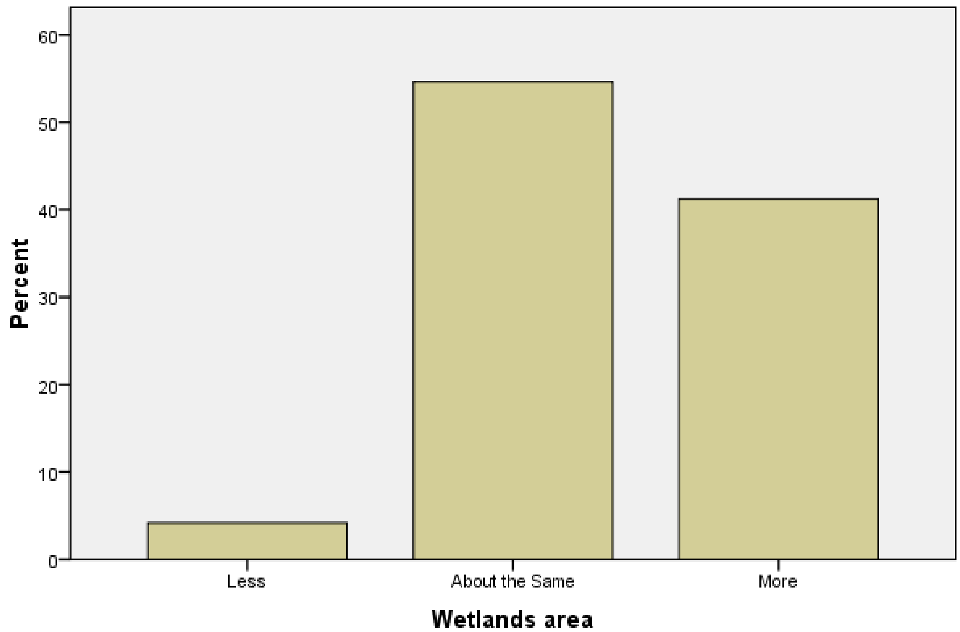
Local businesses



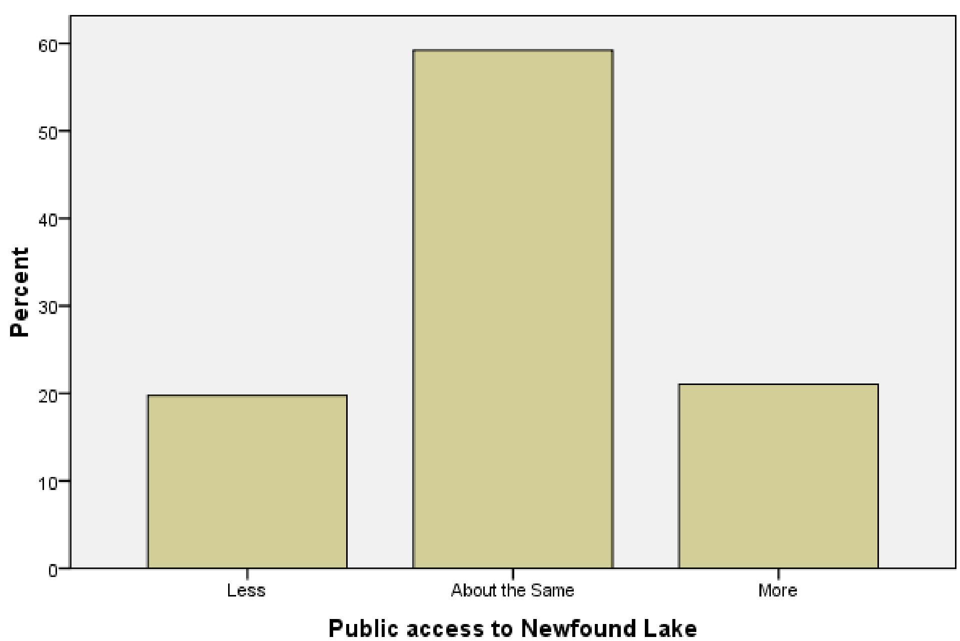
Forest or woodland



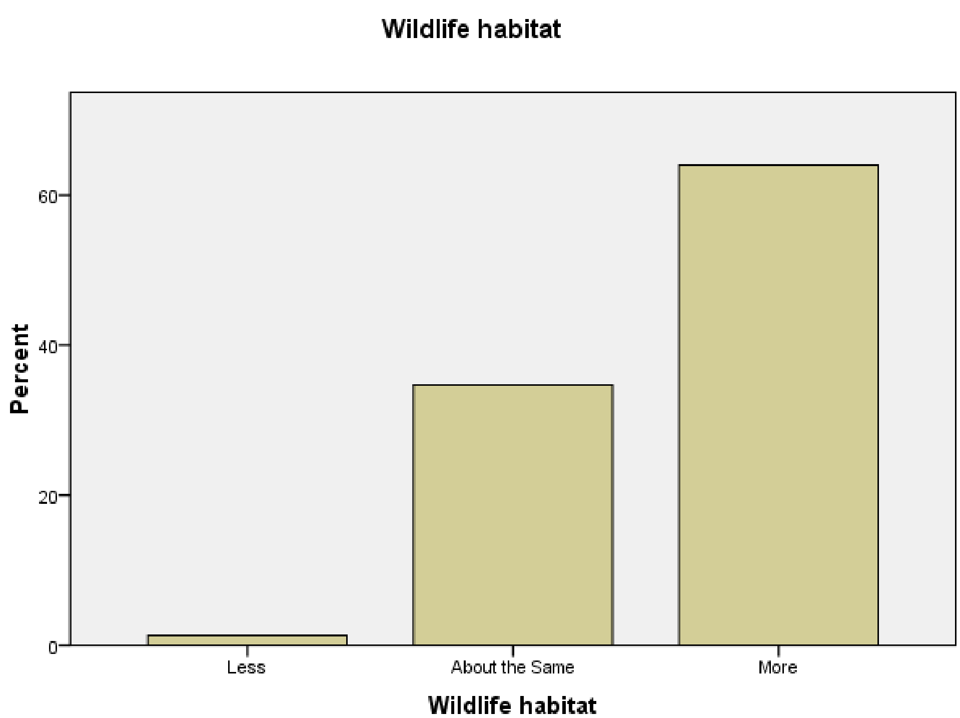
Wetlands area

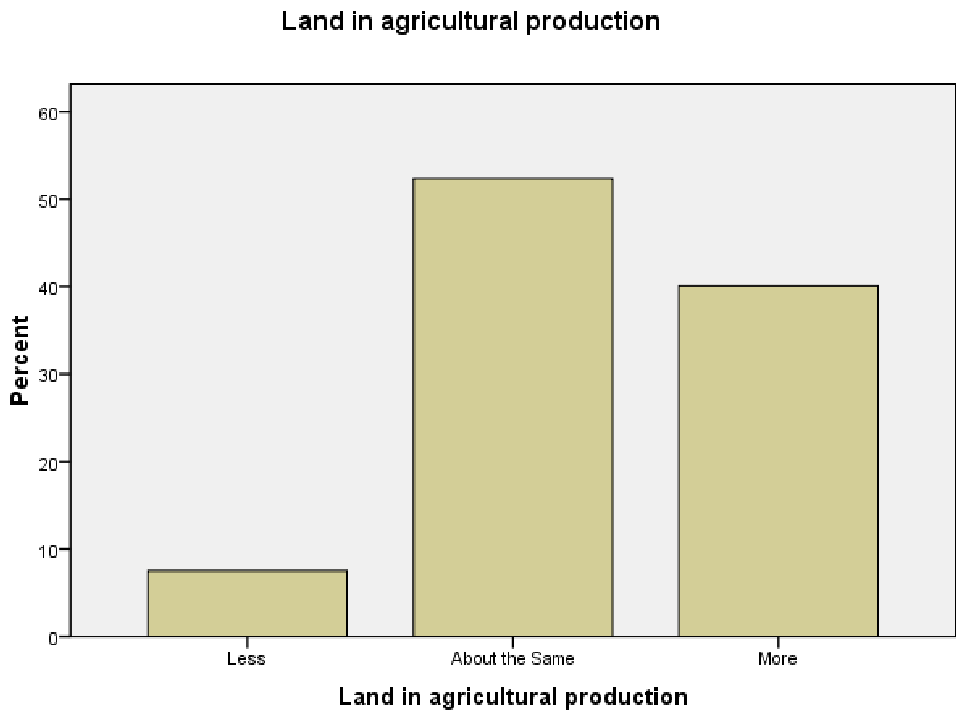


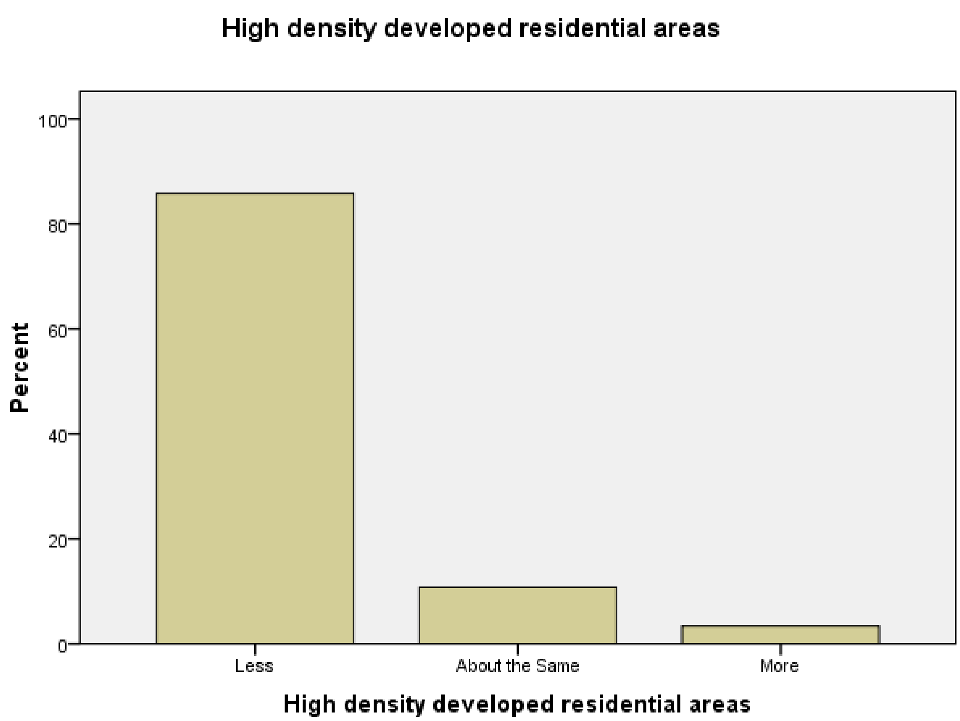
Public access to Newfound Lake



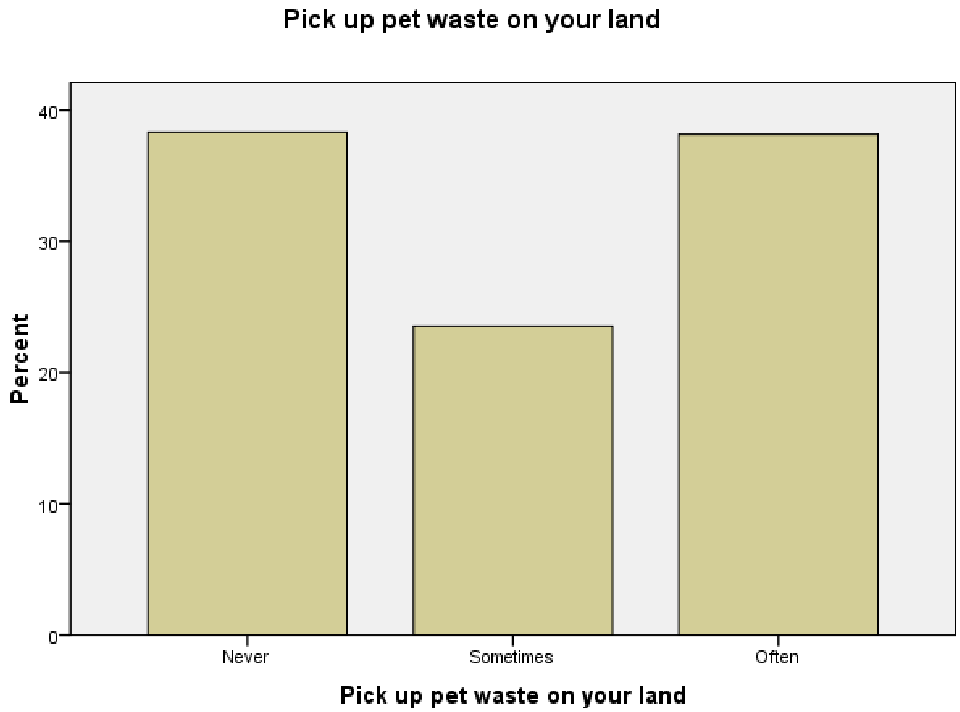

Areas for outdoor recreation
Percent
60
50
40
30
20
10
0
Less
About the Same
More
Areas for outdoor recreation

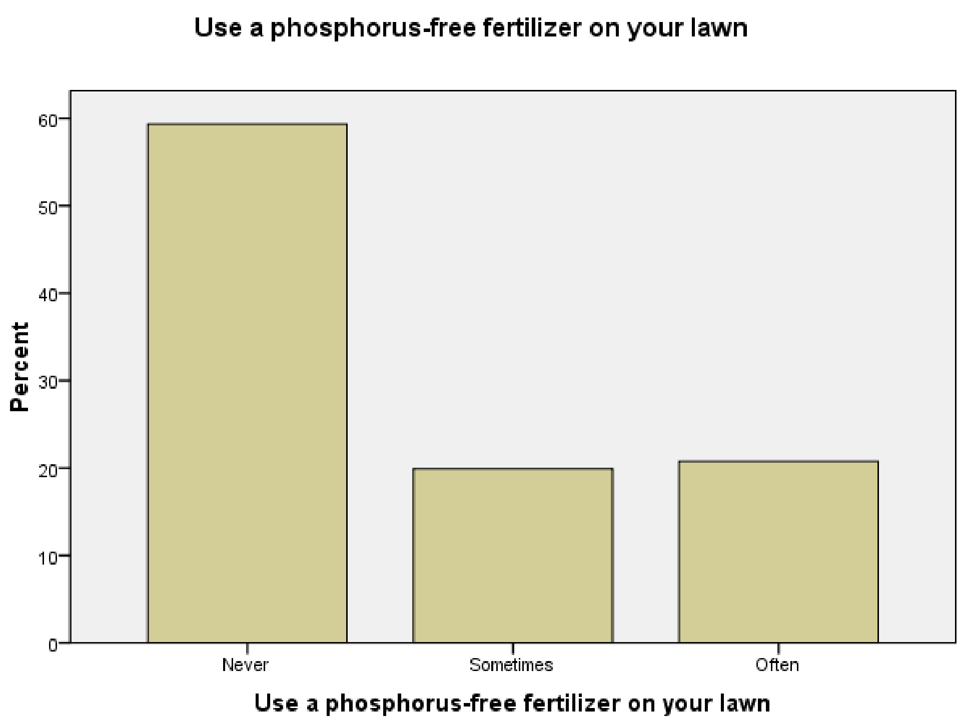

Wildlife habitat
Percent
60
40
20
0
Less
About the Same
More
Wildlife habitat


Land in agricultural production
Percent
60
50
40
30
20
10
0
Less
About the Same
More
Land in agricultural production

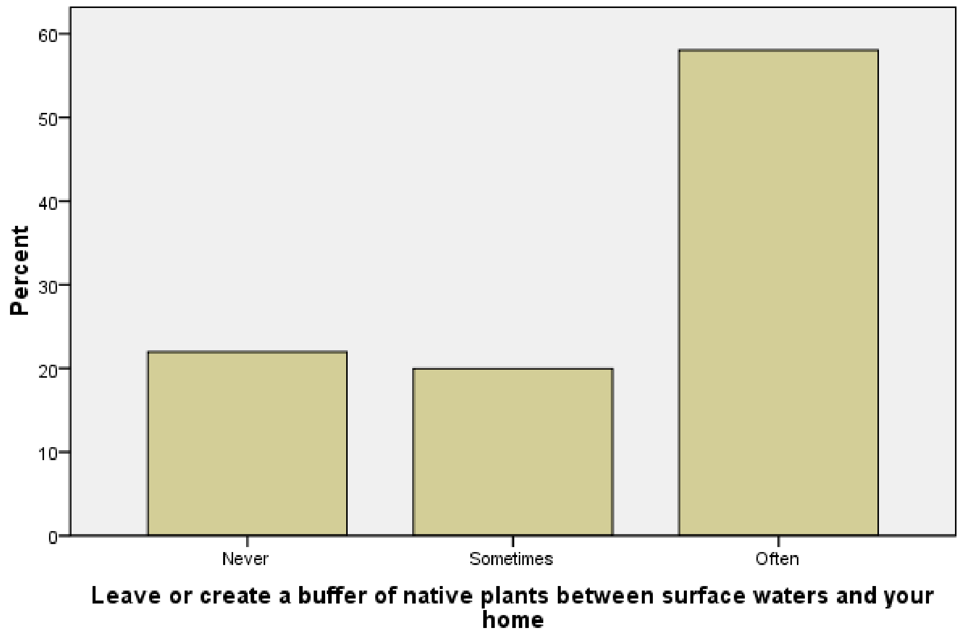

High density developed residential areas
Percent
100
80
60
40
20
0
Less
About the Same
More
High density developed residential areas

Questionnaire Section 11

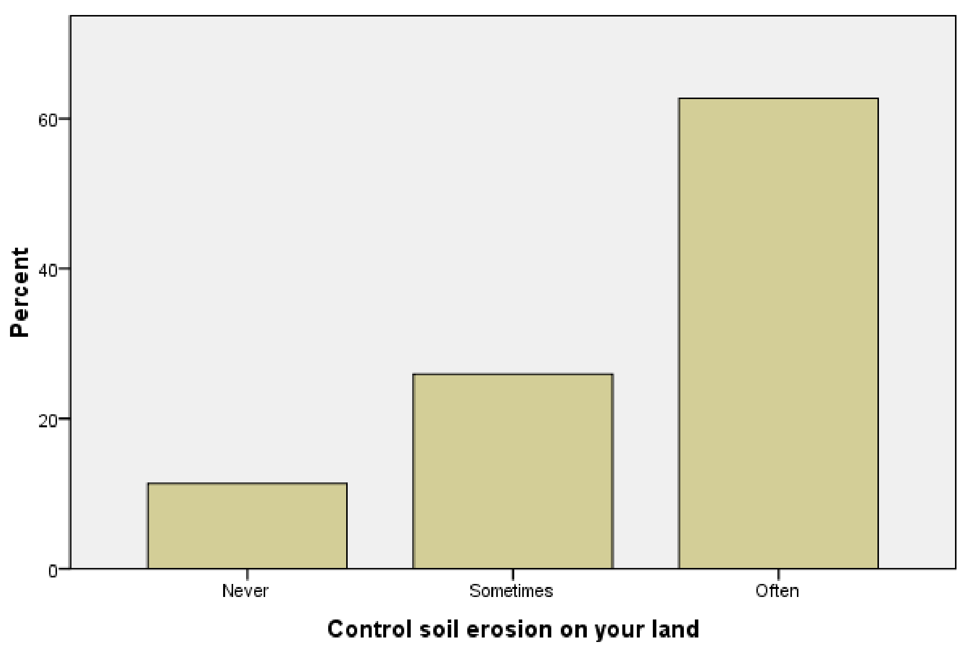


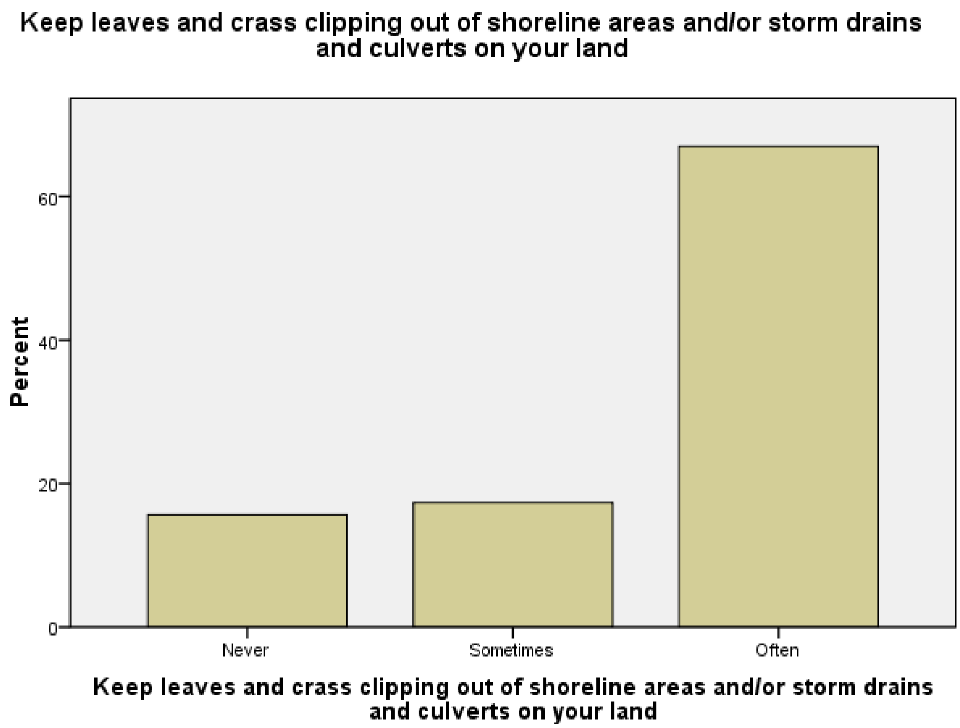


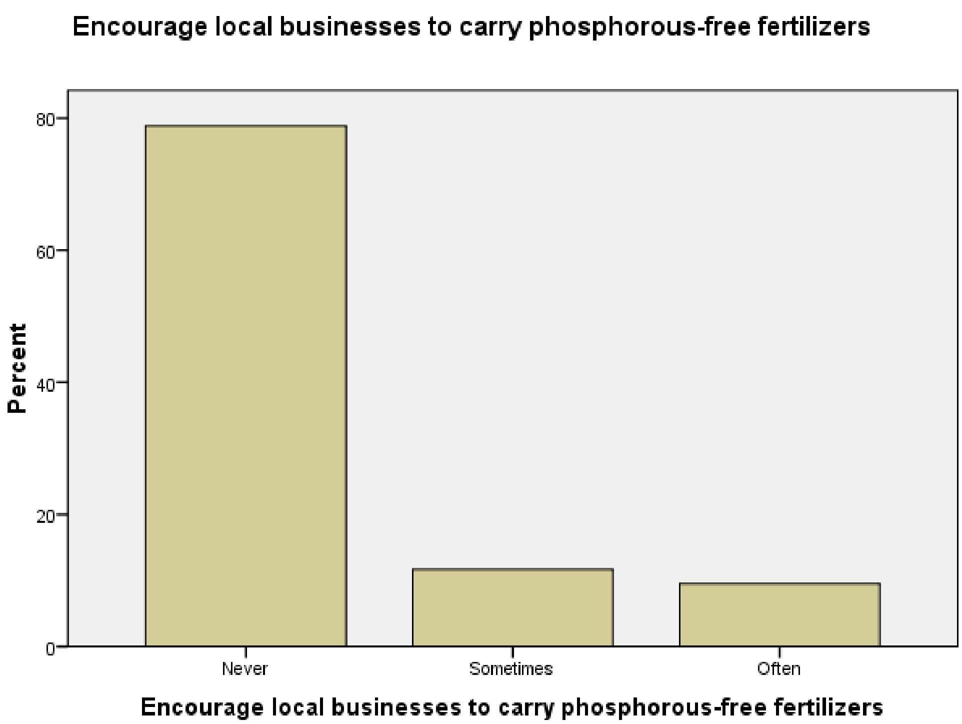
Leave or create a buffer of native plants between surface waters and your home



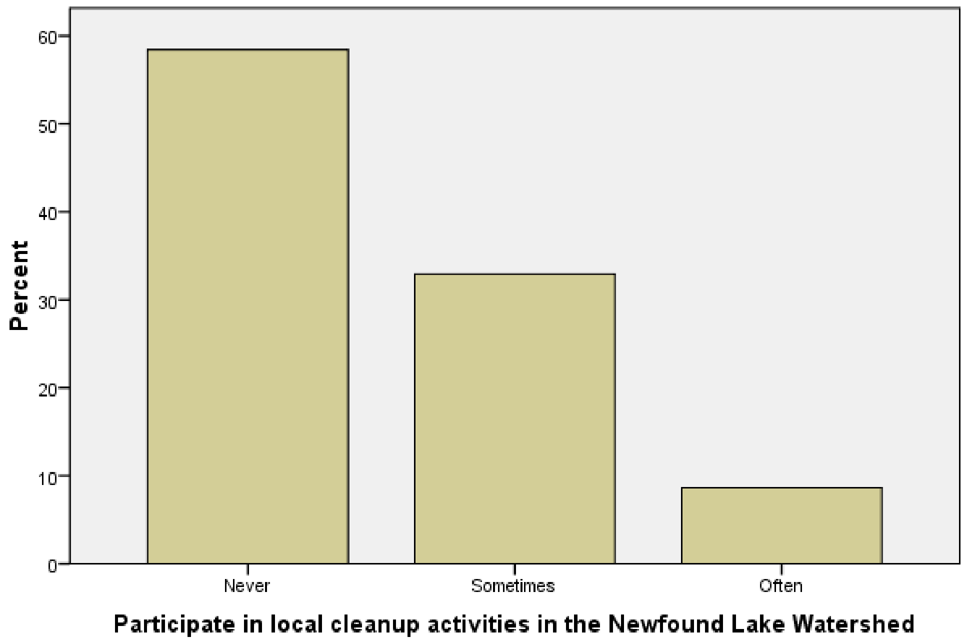
Control soil erosion on your land



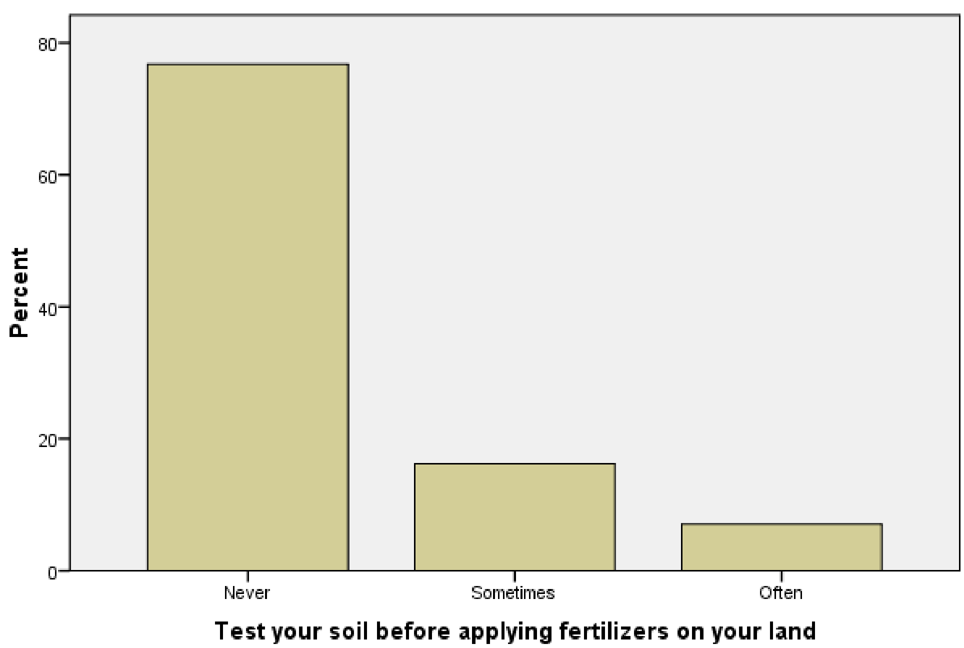

Keep leaves and crass clipping out of shoreline areas and/or storm drains and culverts on your land
Percent
0
20
40
60
Never
Sometimes
Often
Keep leaves and crass clipping out of shoreline areas and/or storm drains and culverts on your land


Encourage local businesses to carry phosphorous-free fertilizers
Percent
0
20
40
60
80
Never
Sometimes
Often
Encourage local businesses to carry phosphorous-free fertilizers

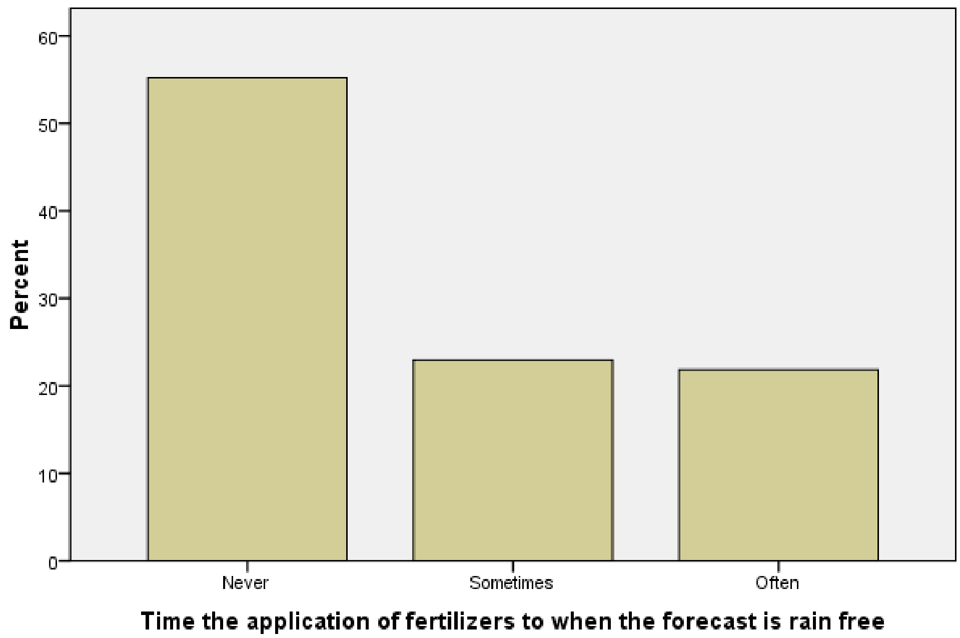
Participate in local cleanup activities in the Newfound Lake Watershed



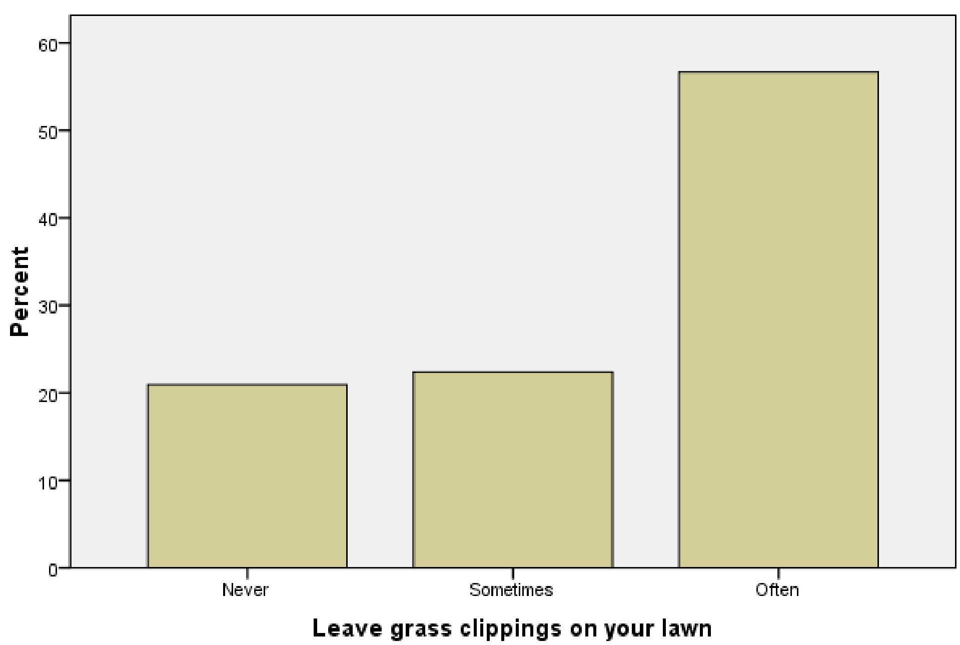
Test your soil before applying fertilizers on your land



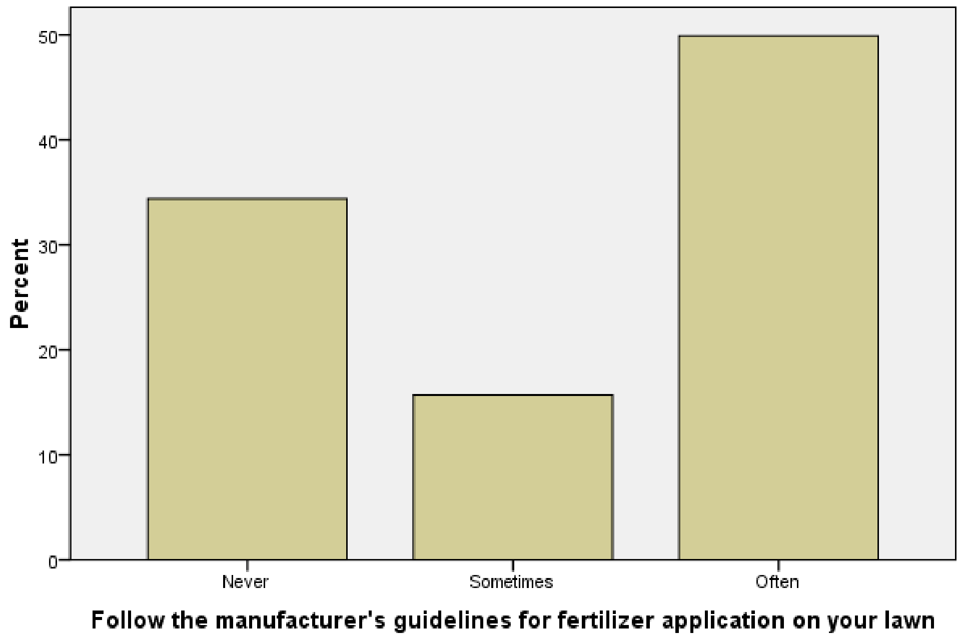
Time the application of fertilizers to when the forecast is rain free



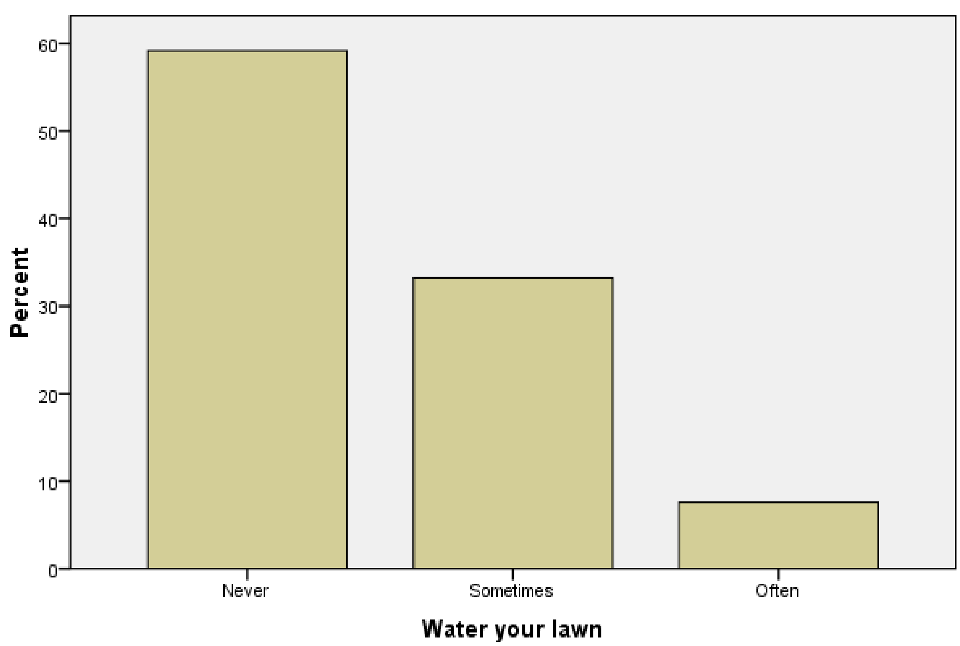
Leave grass clippings on your lawn



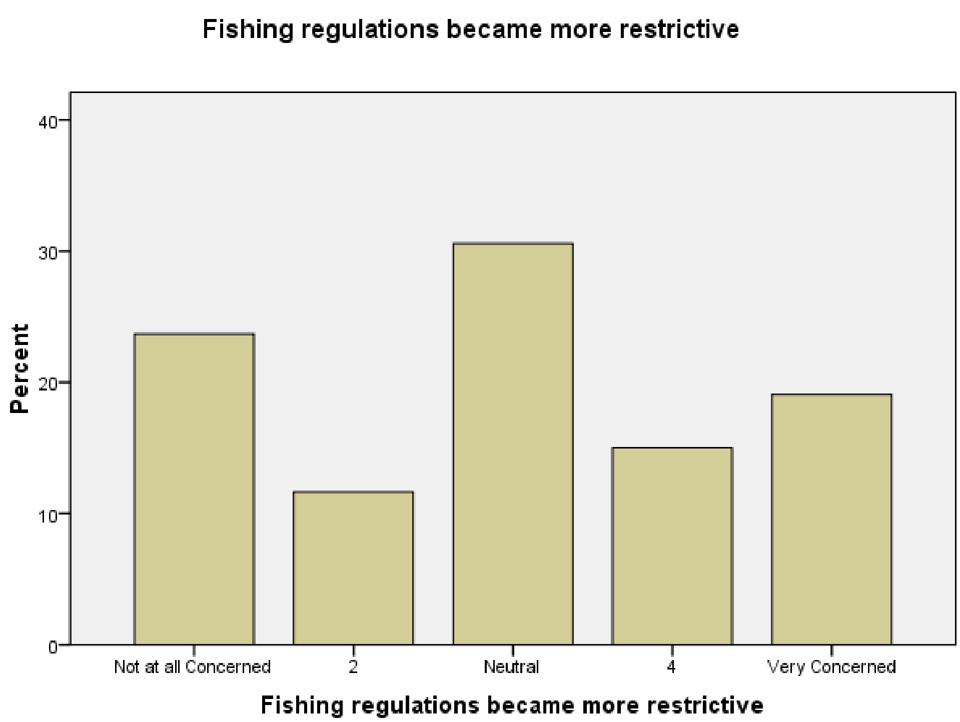
Follow the manufacturer's guidelines for fertilizer application on your lawn

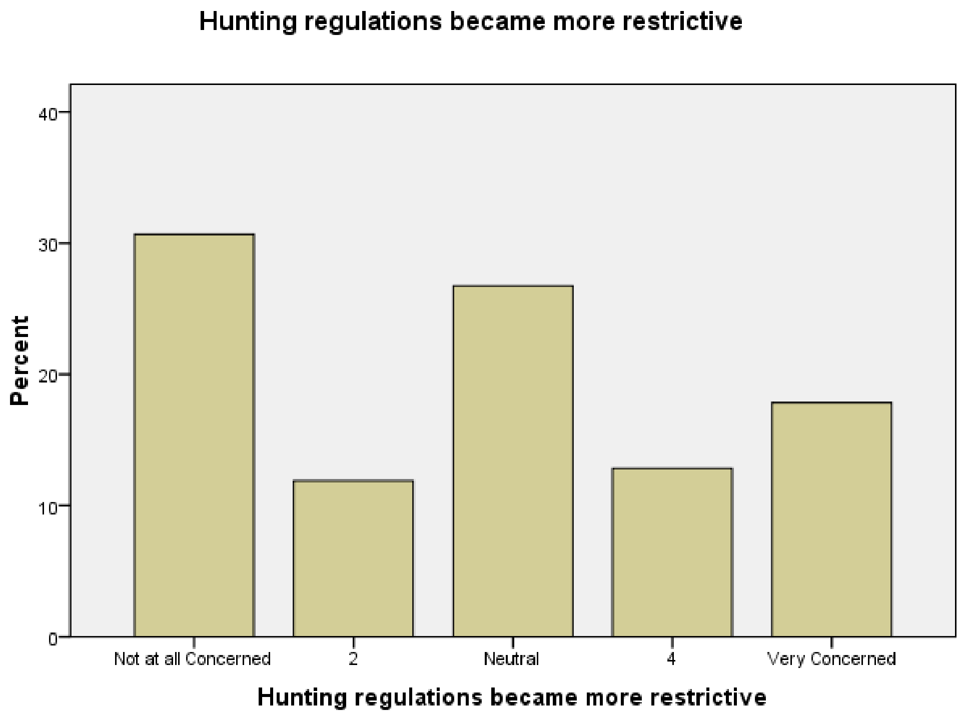


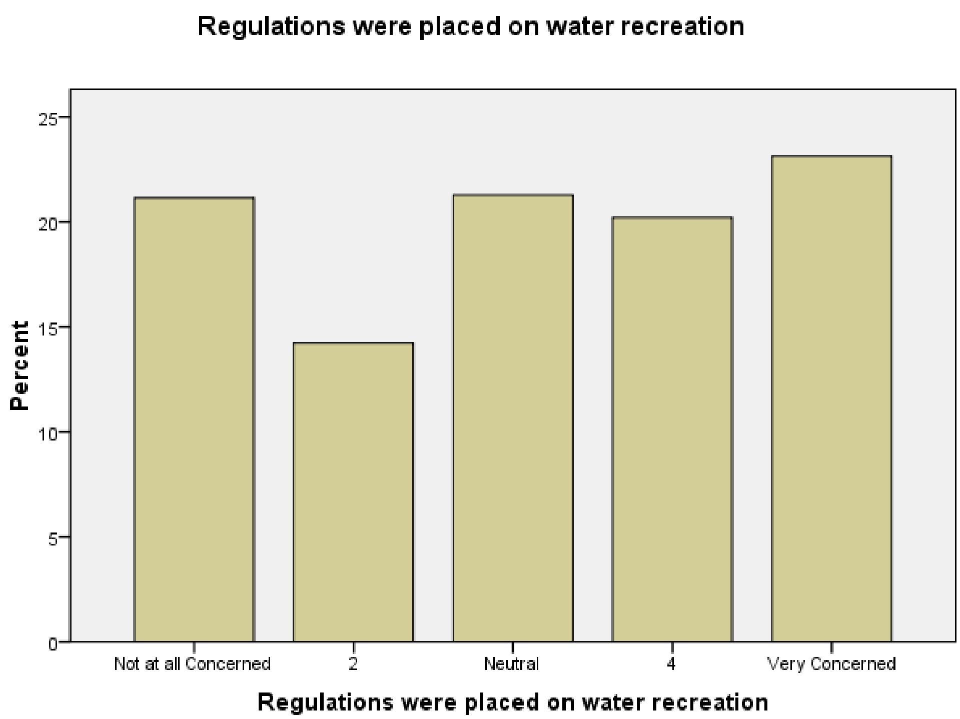
Water your lawn

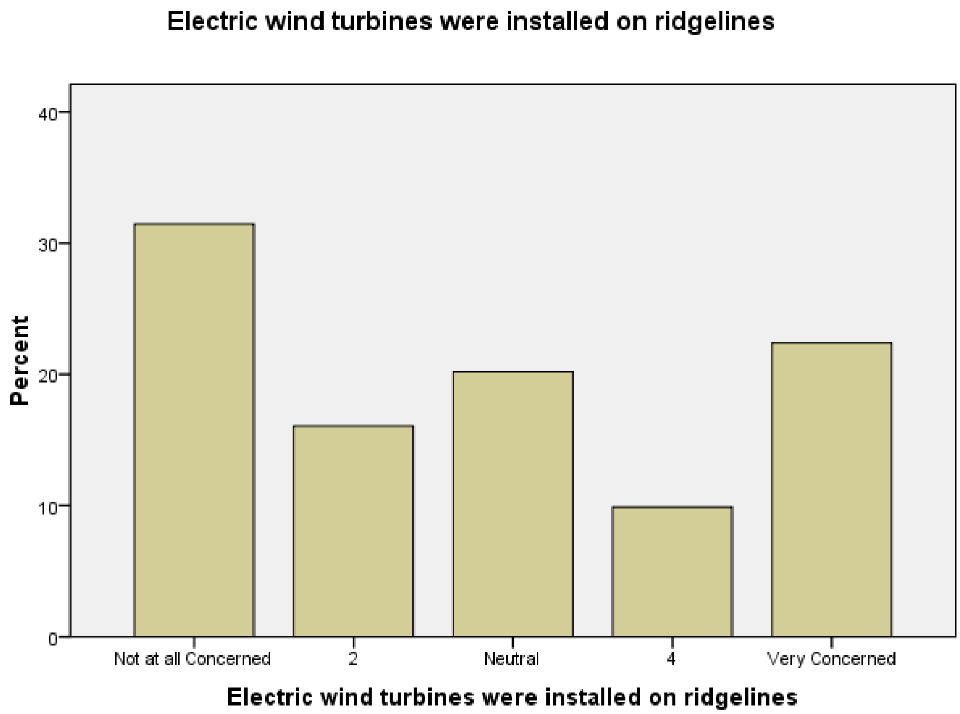


Questionnaire Section 12

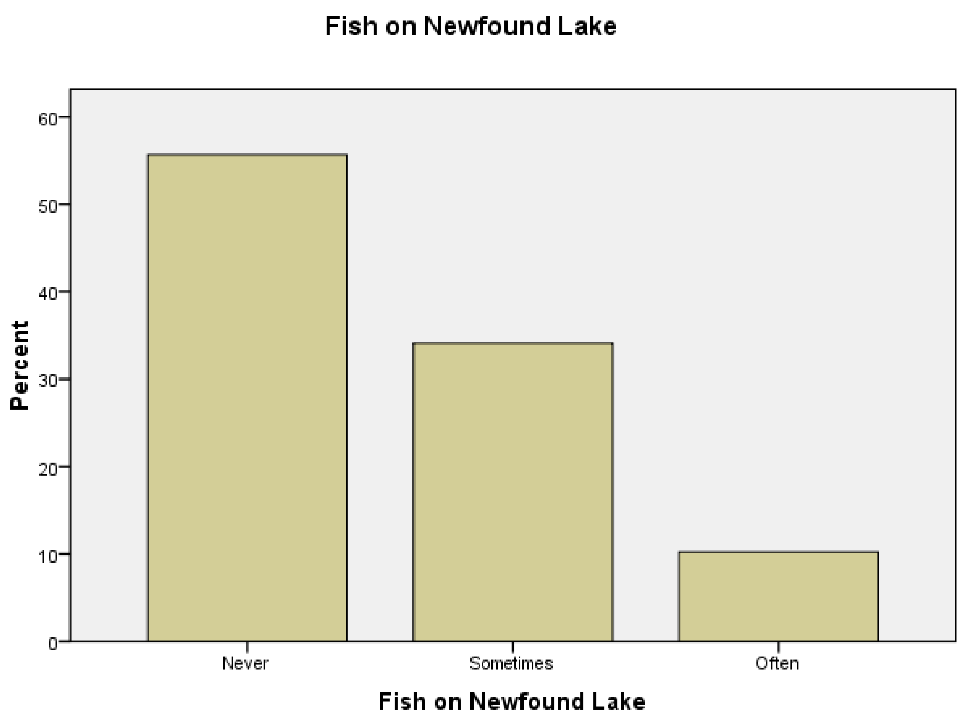



Hunting regulations became more restrictive
Percent
40
30
20
10
0
Not at all Concerned
2
Neutral
4
Very Concerned
Hunting regulations became more restrictive

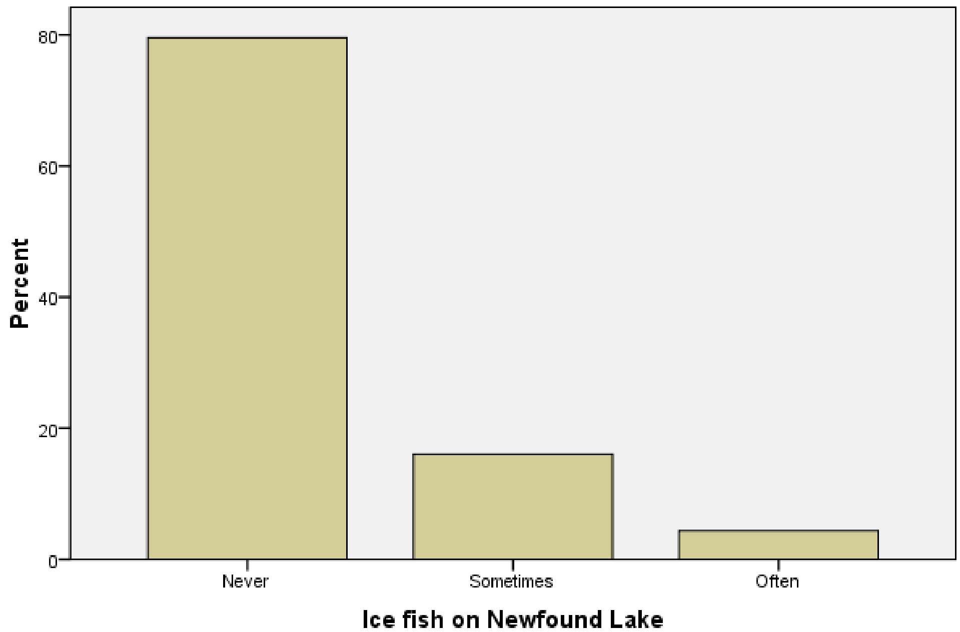

Regulations were placed on water recreation
Percent
25
20
15
10
5
0
Not at all Concerned
2
Neutral
4
Very Concerned
Regulations were placed on water recreation



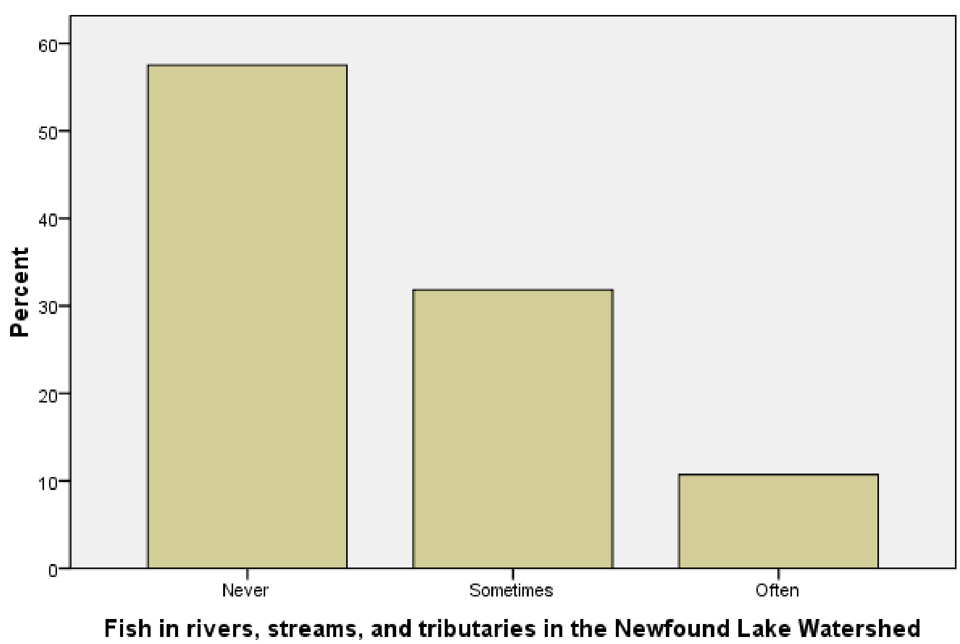
Questionnaire Section 13



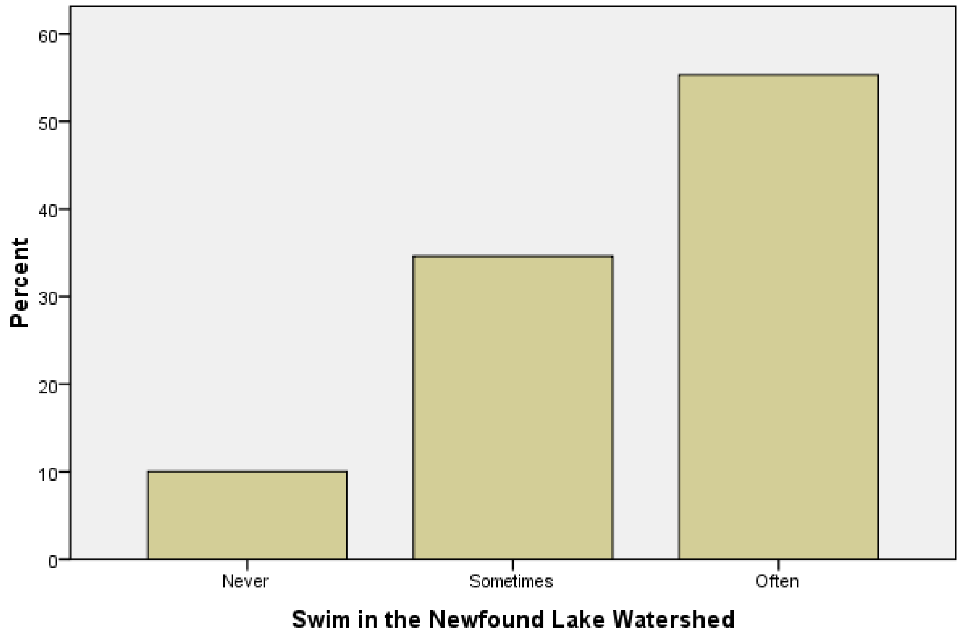
Ice fish on Newfound Lake



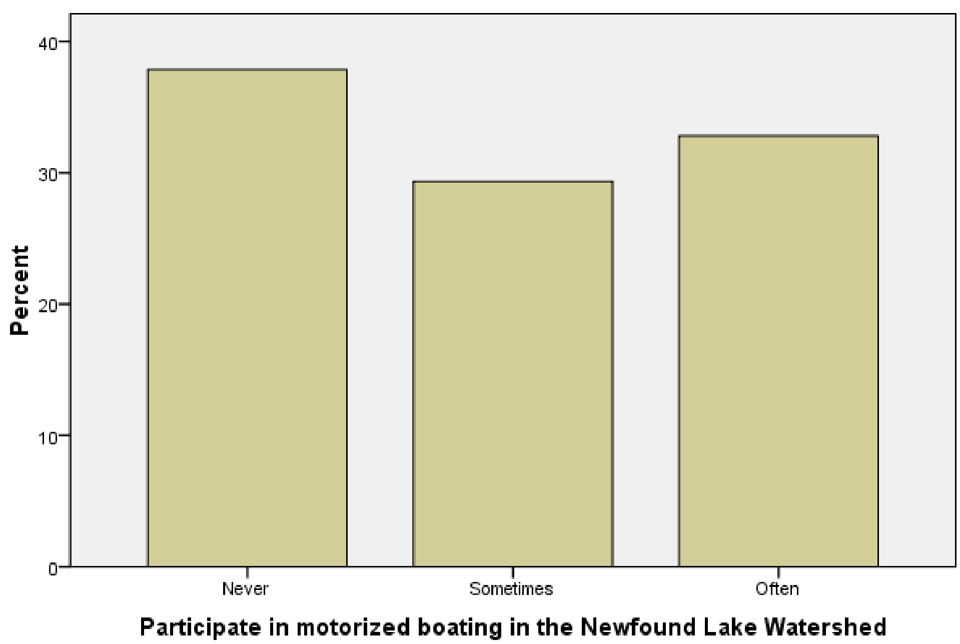
Fish in rivers, streams, and tributaries in the Newfound Lake Watershed



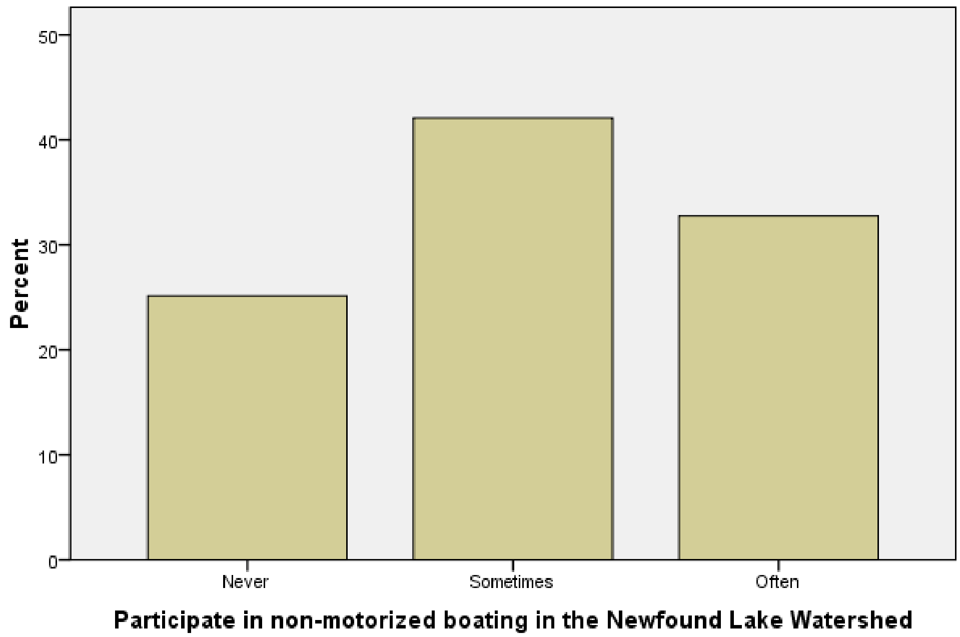
Swim in the Newfound Lake Watershed



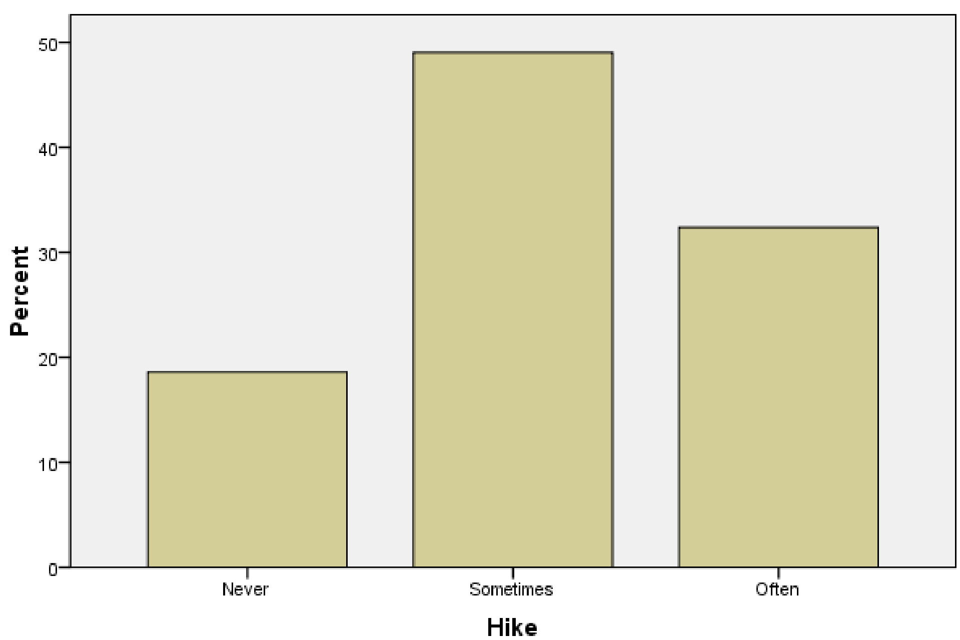
Participate in motorized boating in the Newfound Lake Watershed



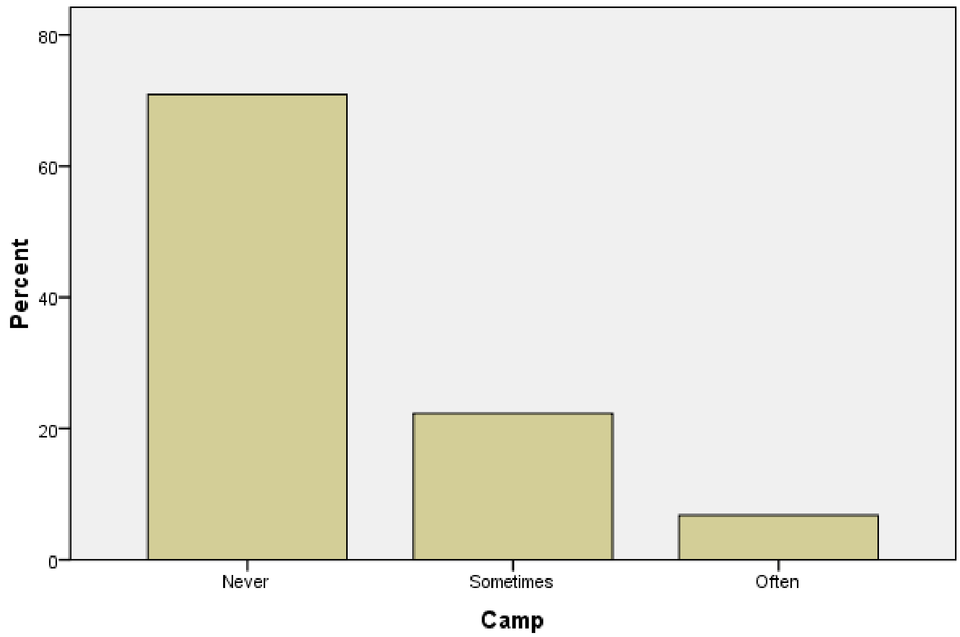
Participate in non-motorized boating in the Newfound Lake Watershed



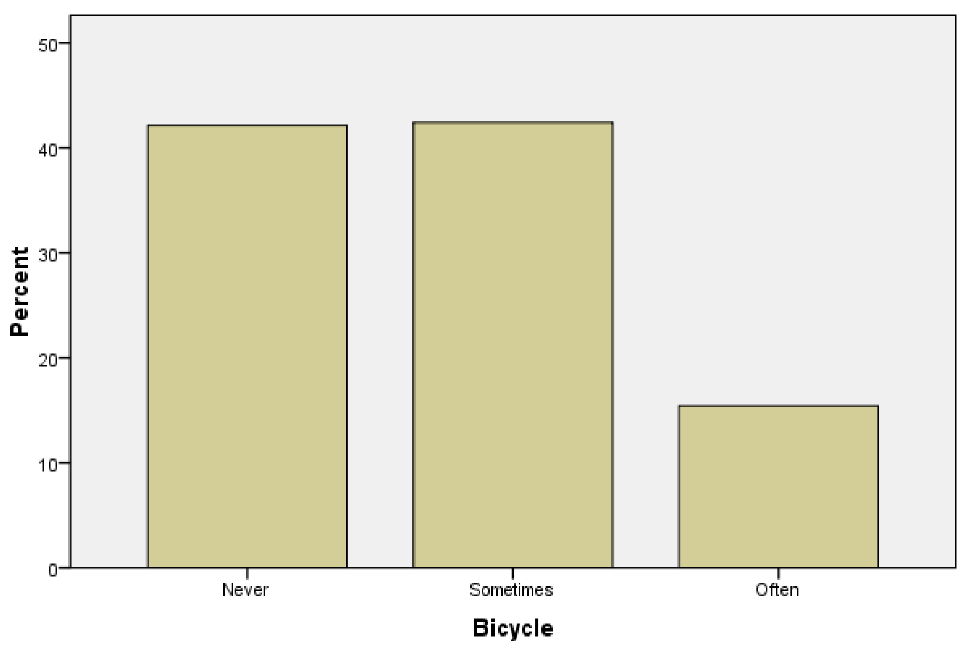
Hike



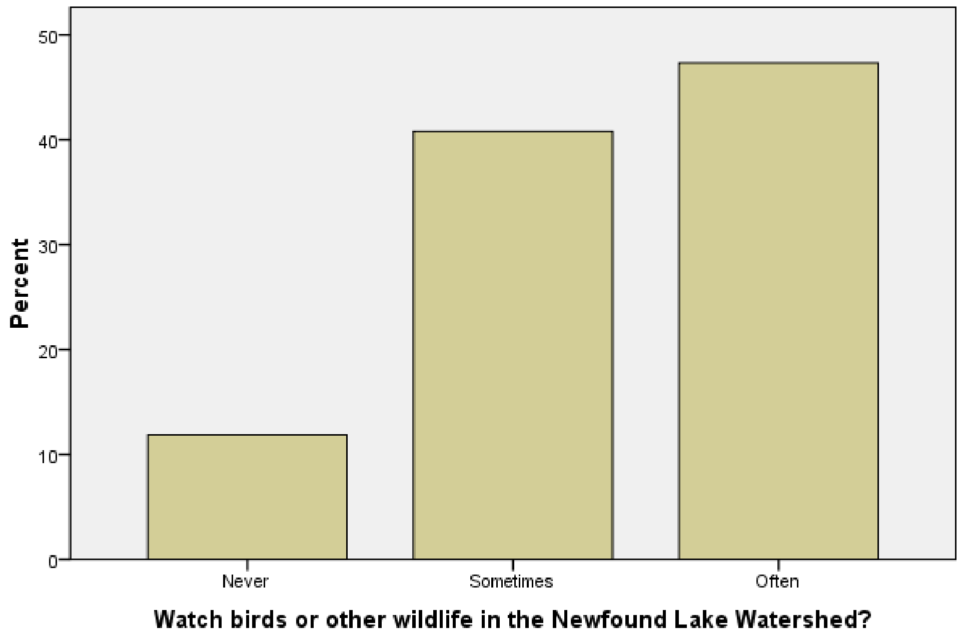
Camp



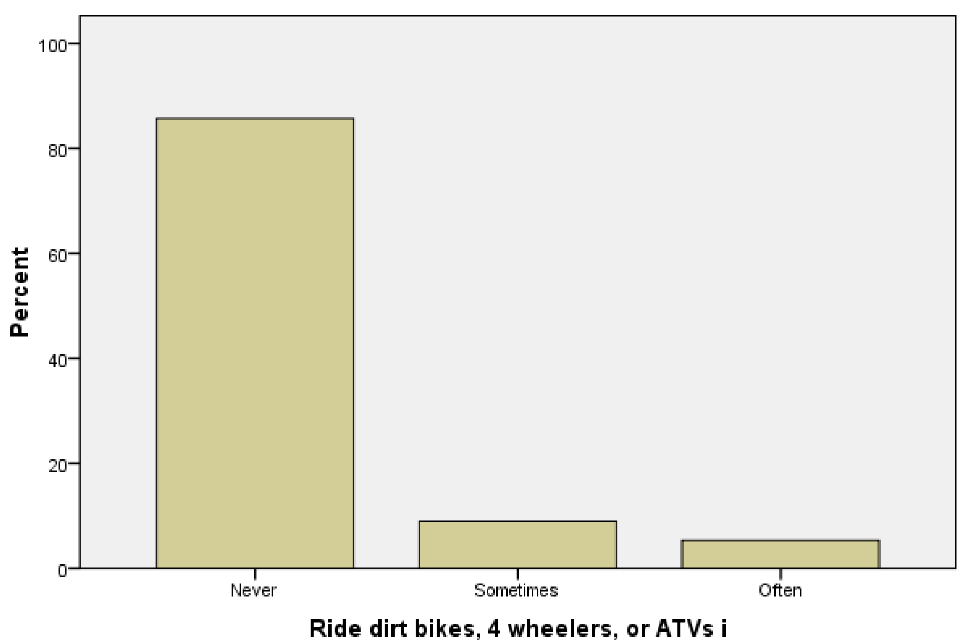
Bicycle



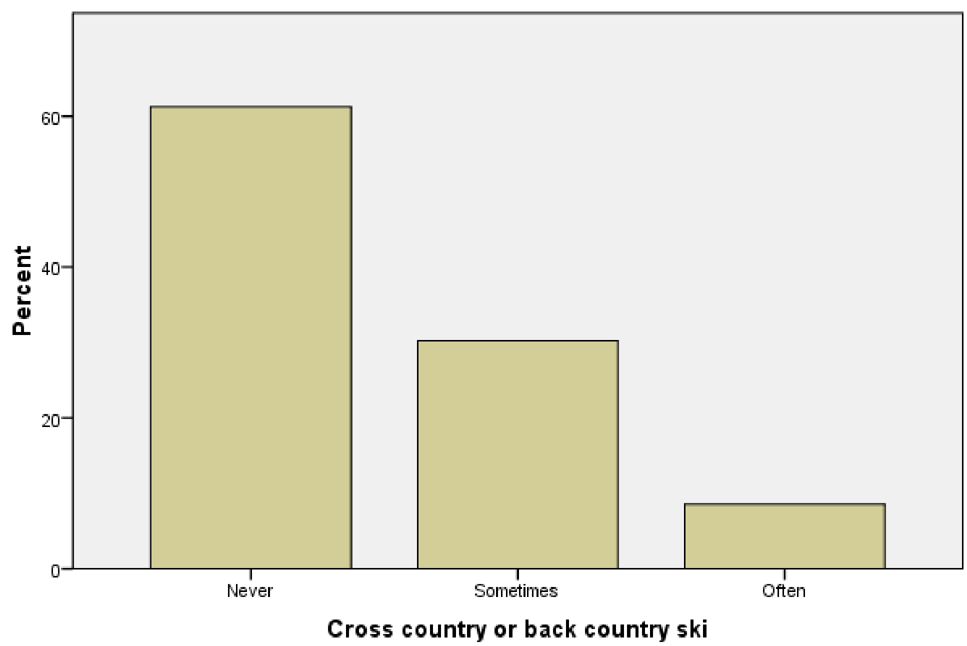
Watch birds or other wildlife in the Newfound Lake Watershed?



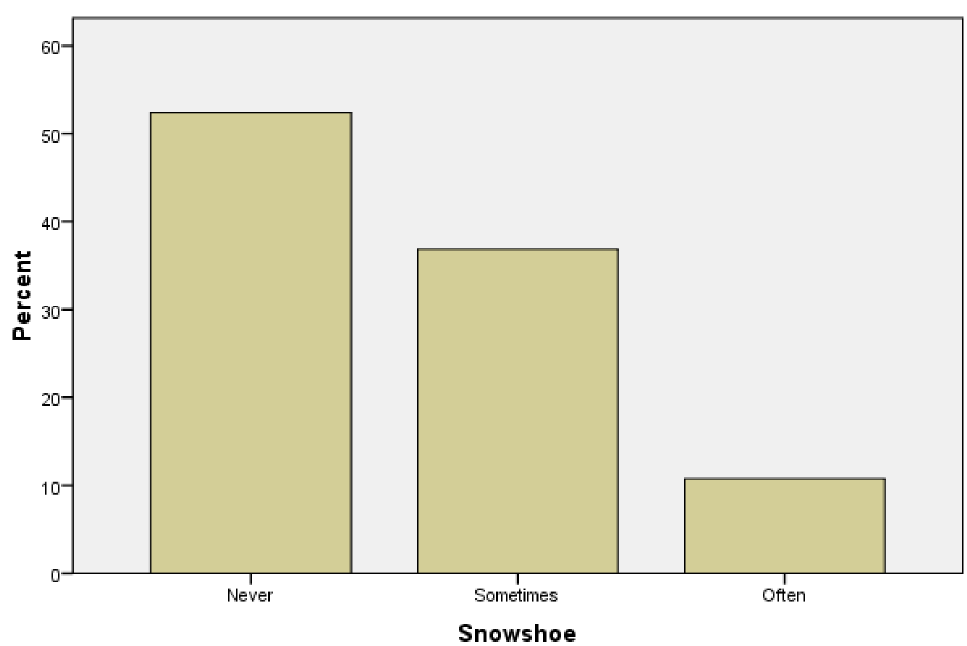
Ride dirt bikes, 4 wheelers, or ATVs i

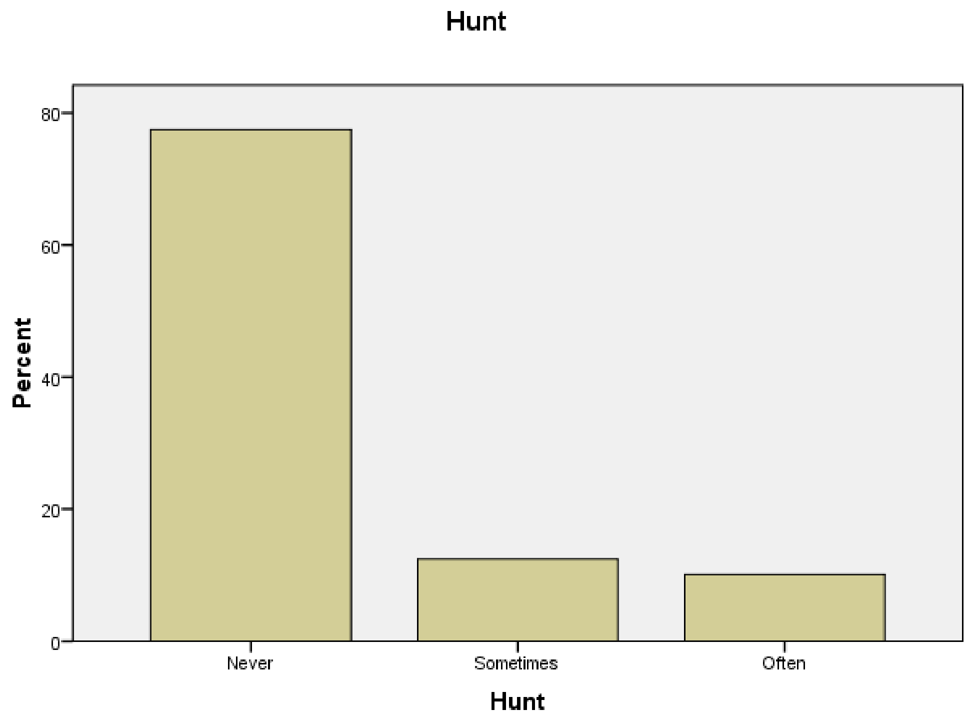


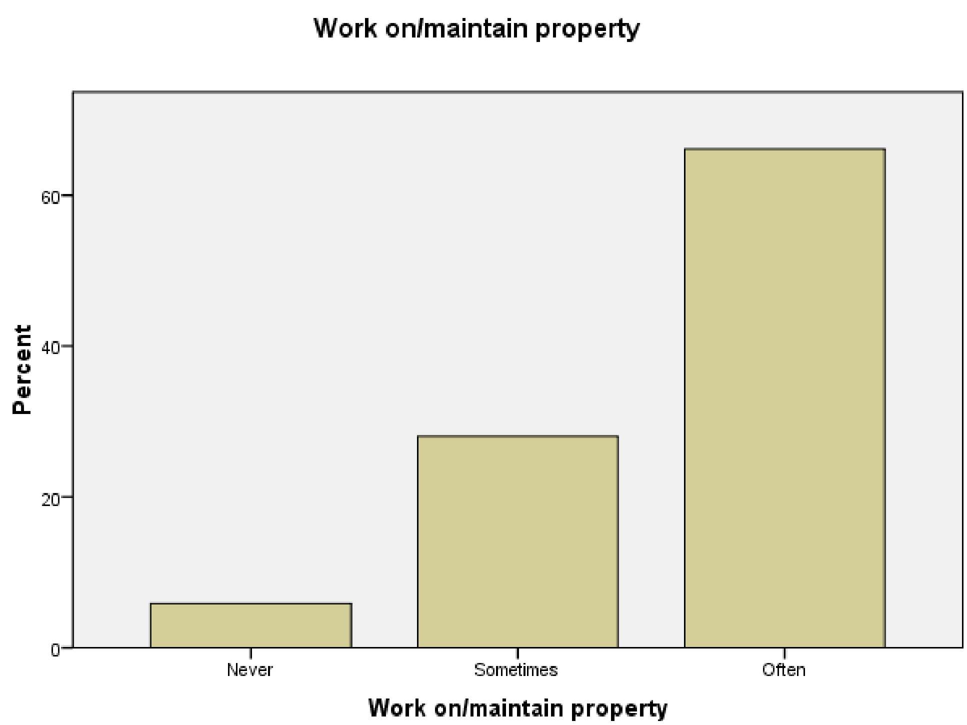
Cross country or back country ski



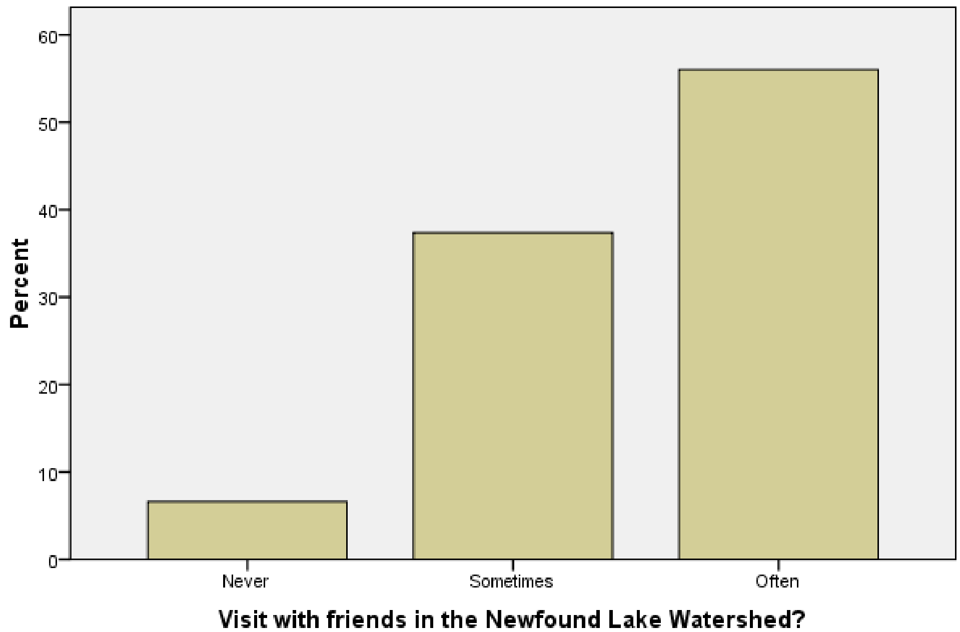
Snowshoe



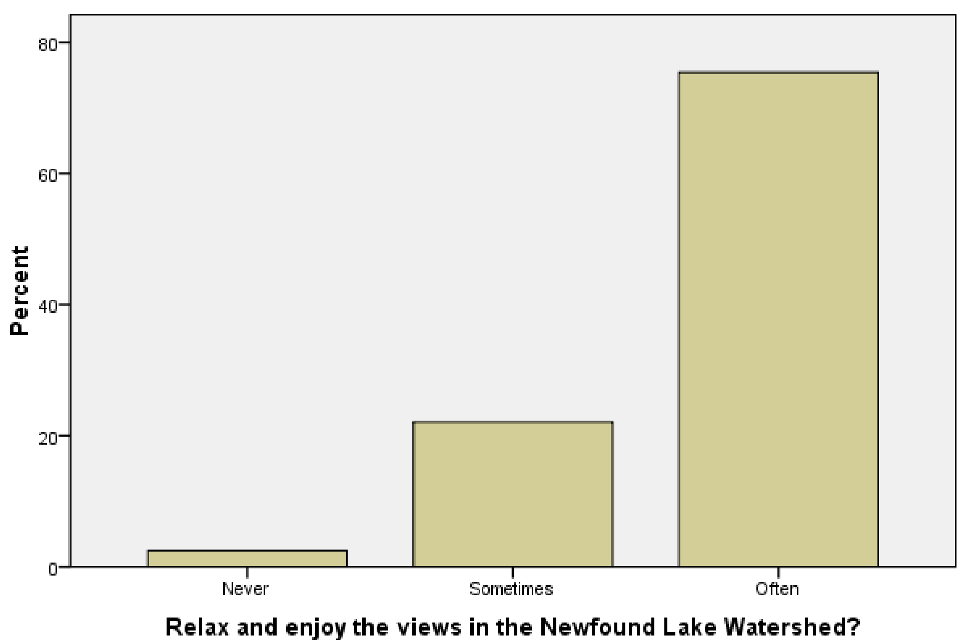

Hunt
80
60
40
20
0
Percent
Never
Sometimes
Often
Hunt


Work on/maintain property
60
40
20
0
Percent
Never
Sometimes
Often
Work on/maintain property

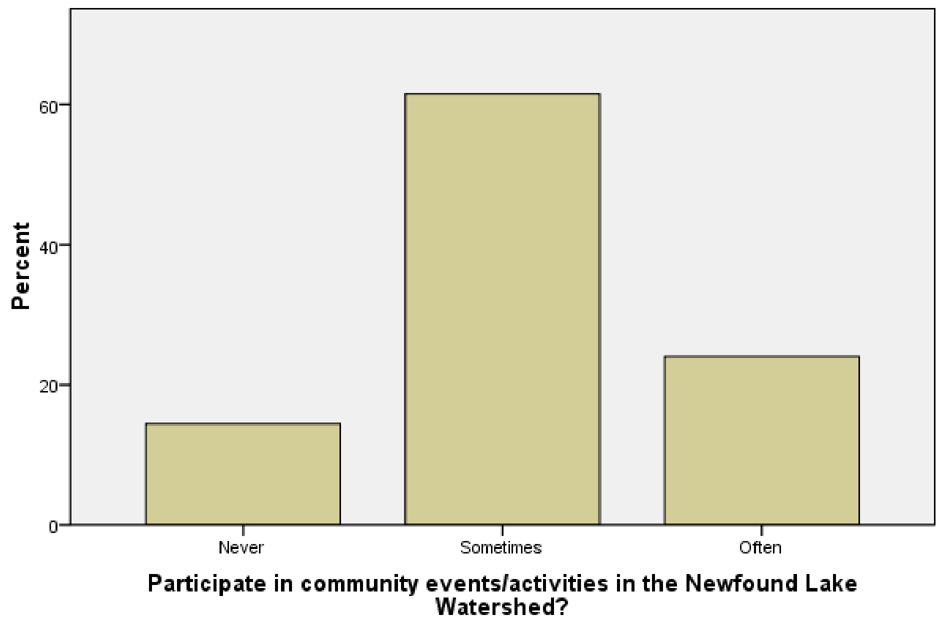
Visit with friends in the Newfound Lake Watershed?



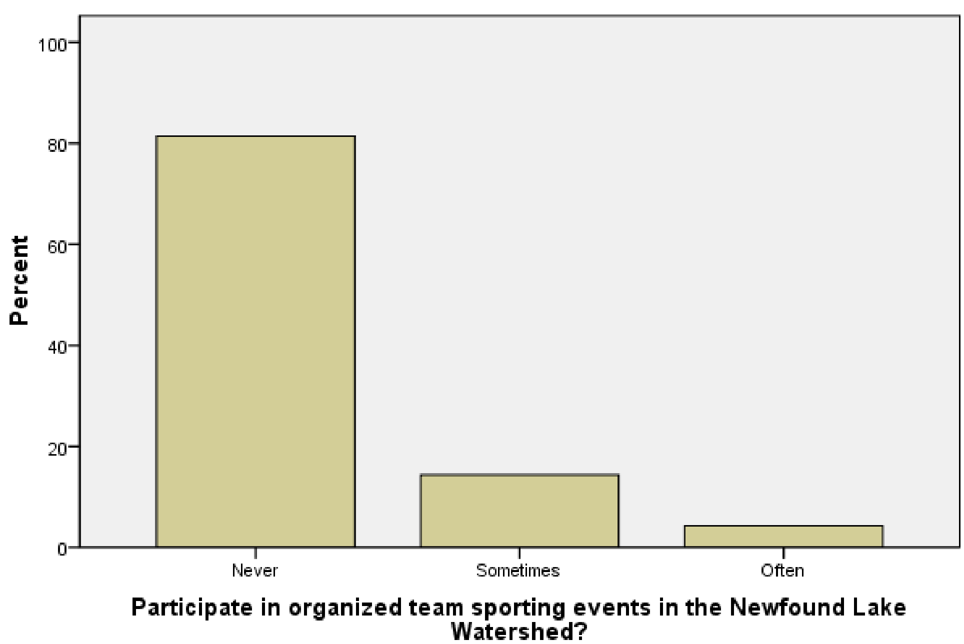
Relax and enjoy the views in the Newfound Lake Watershed?

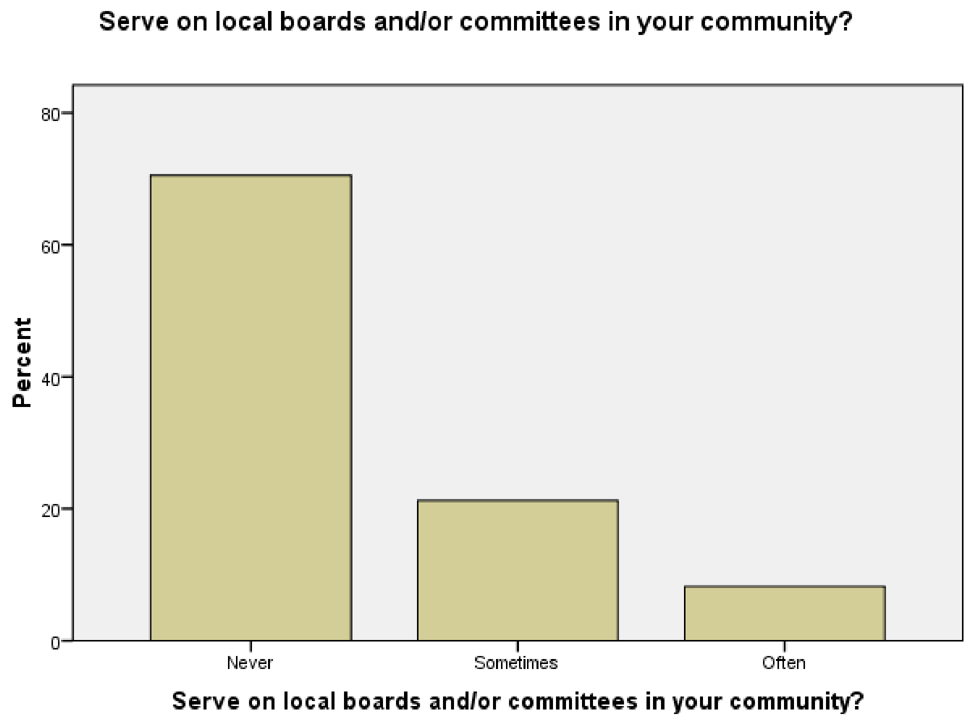


Participate in community events/activities in the Newfound Lake Watershed?

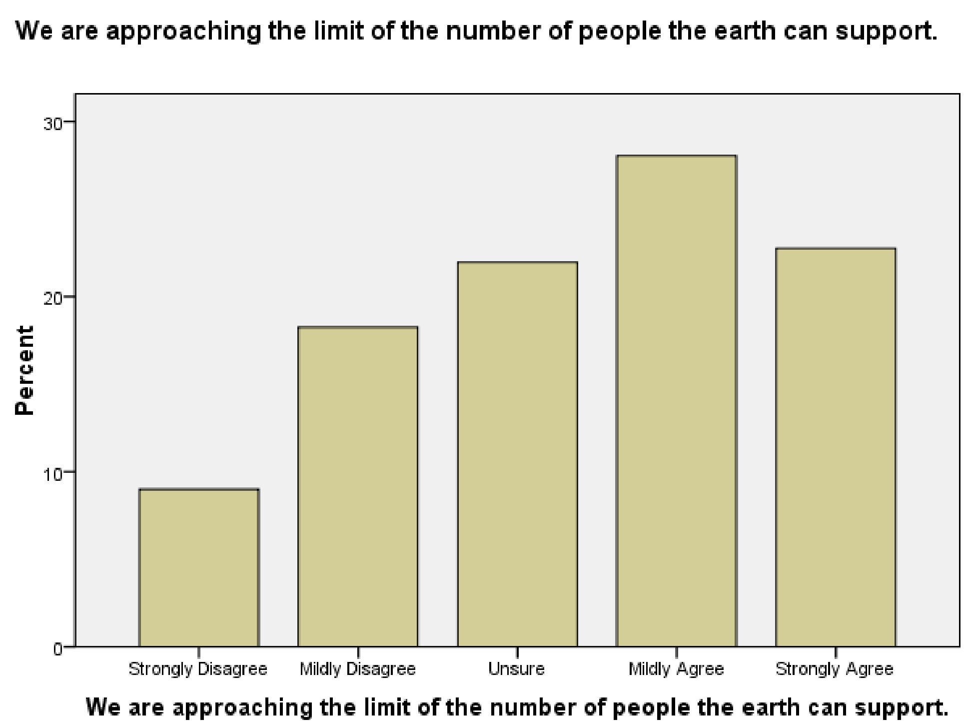


Participate in organized team sporting events in the Newfound Lake Watershed?

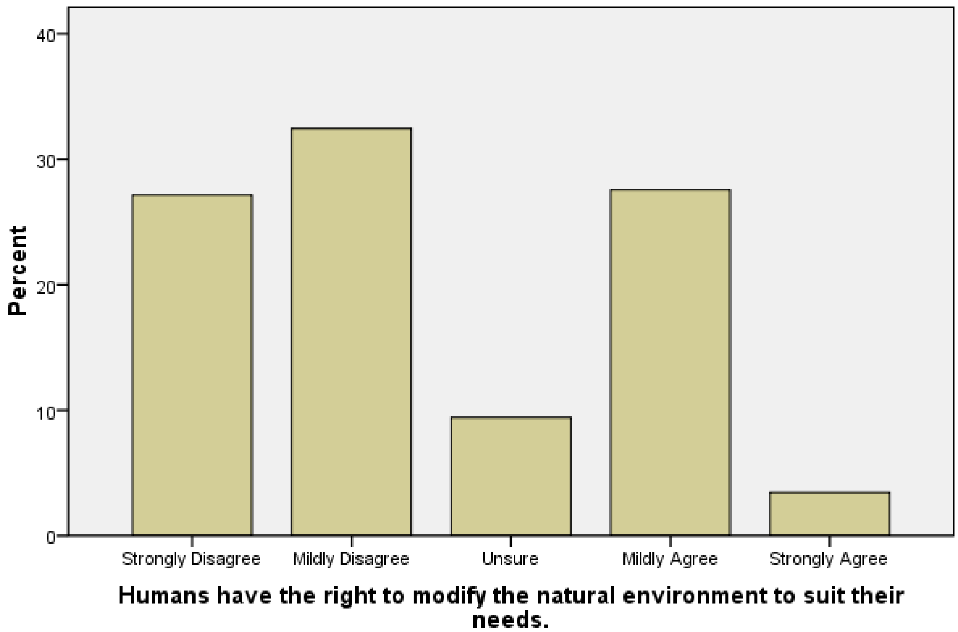




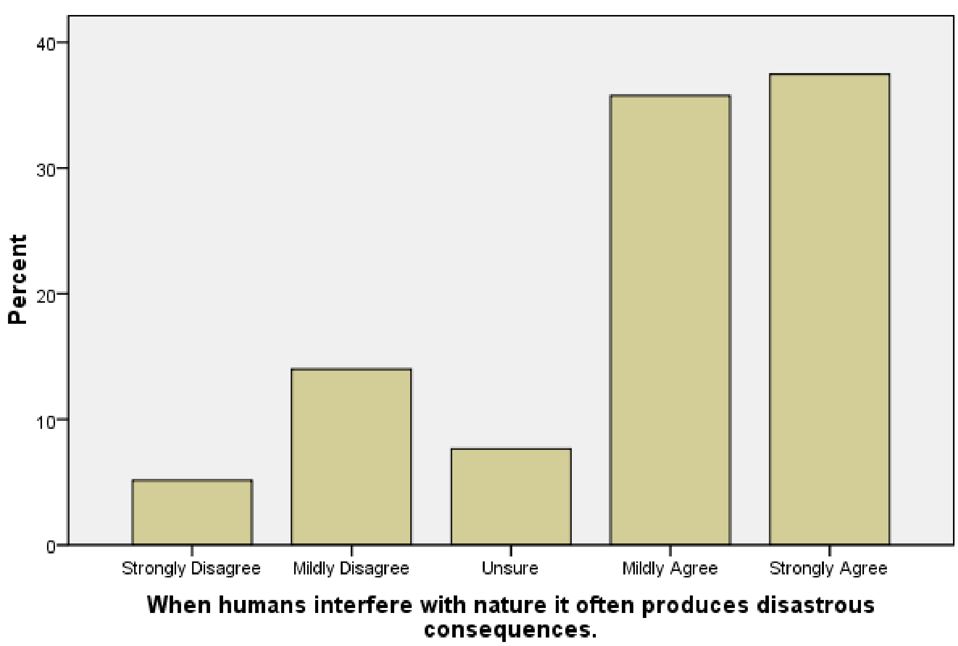
Questionnaire Section 14



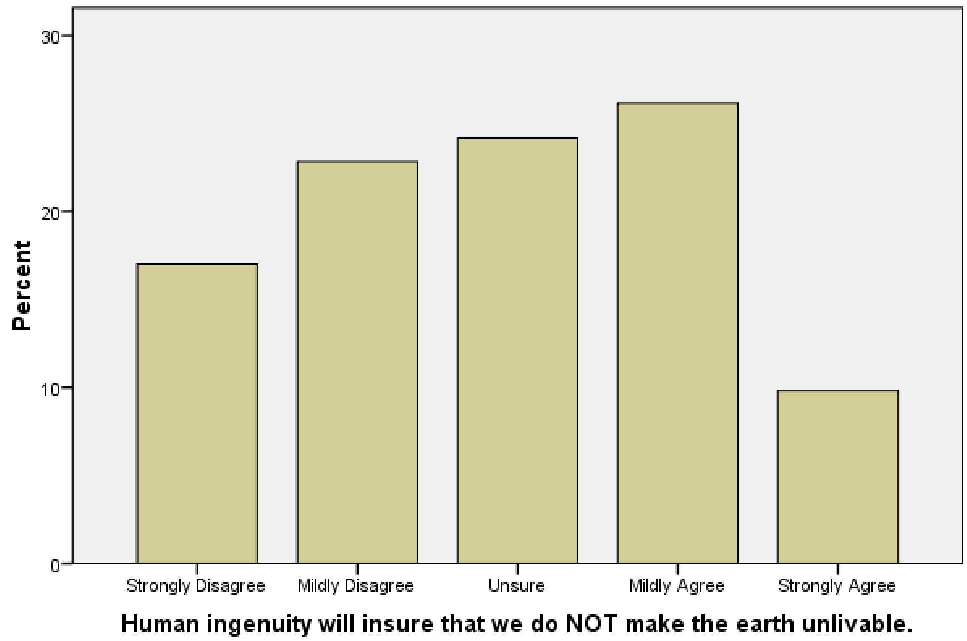
Humans have the right to modify the natural environment to suit their needs.



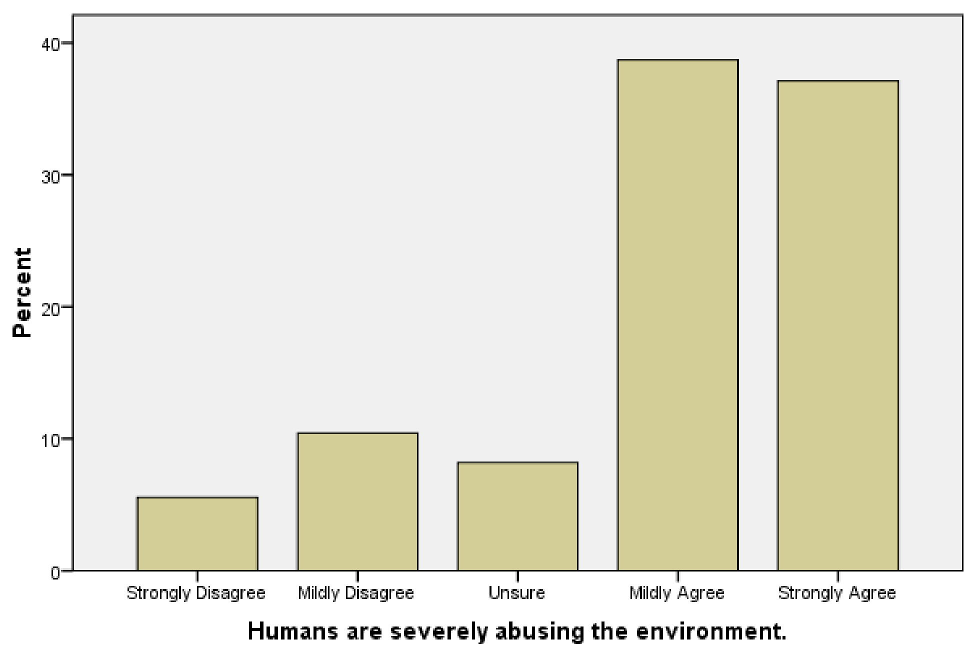
When humans interfere with nature it often produces disastrous consequences.

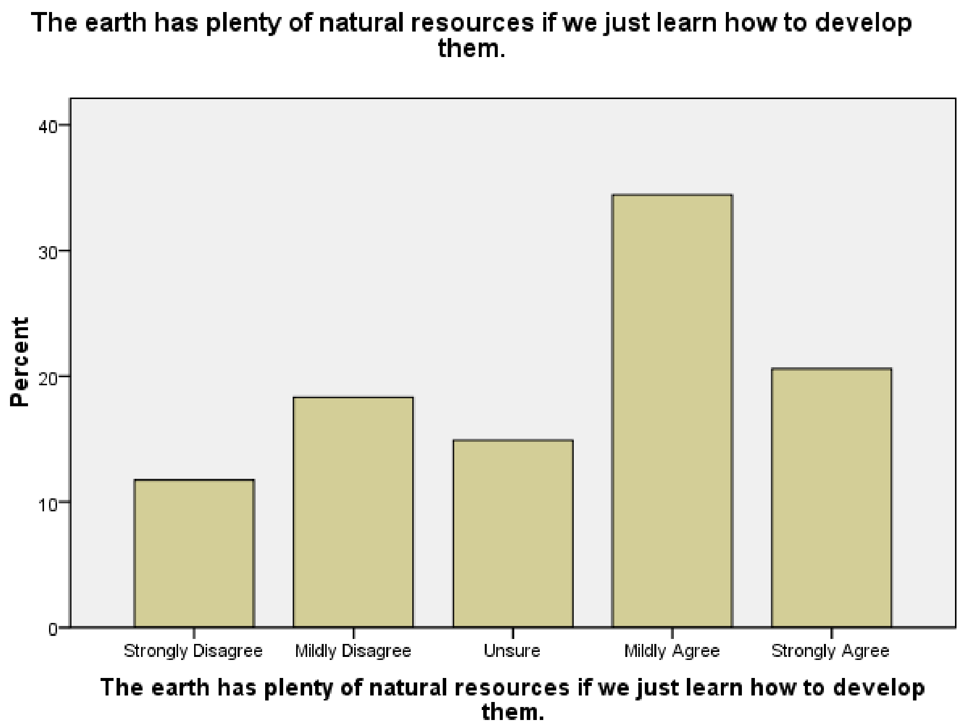


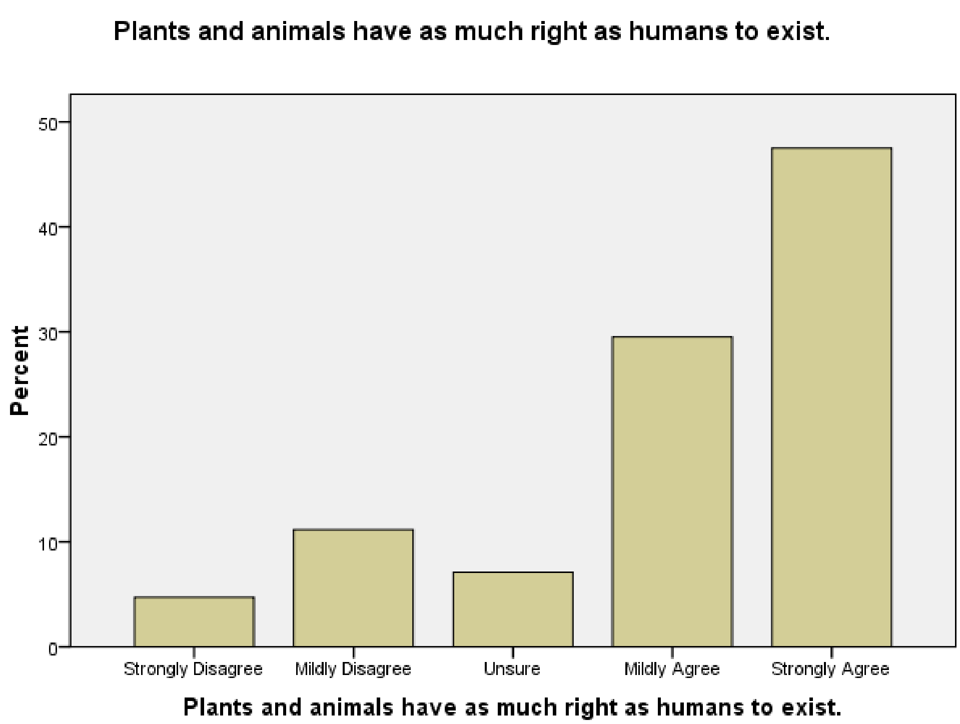
Human ingenuity will insure that we do NOT make the earth unlivable.



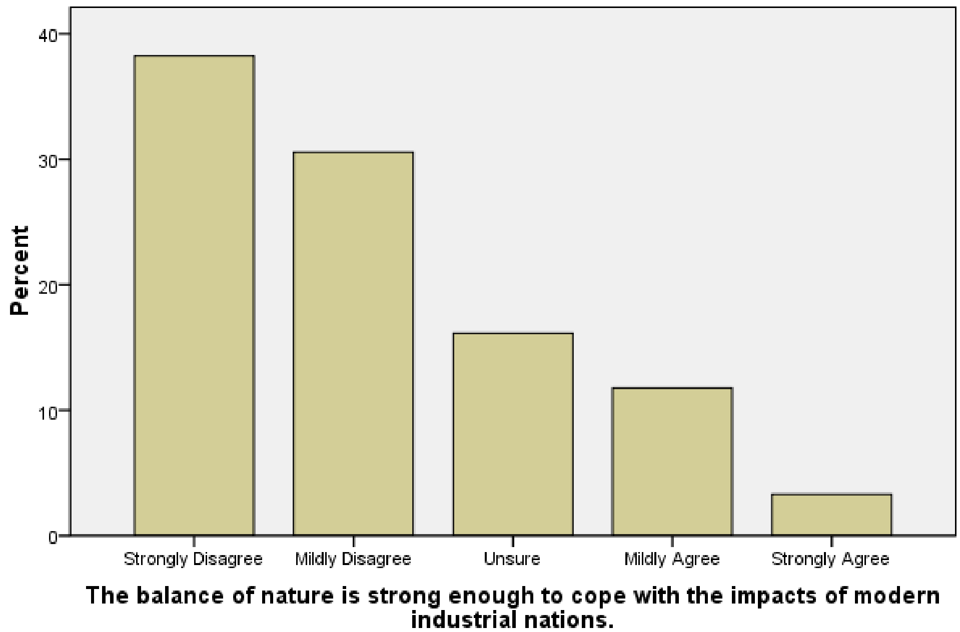
Humans are severely abusing the environment.



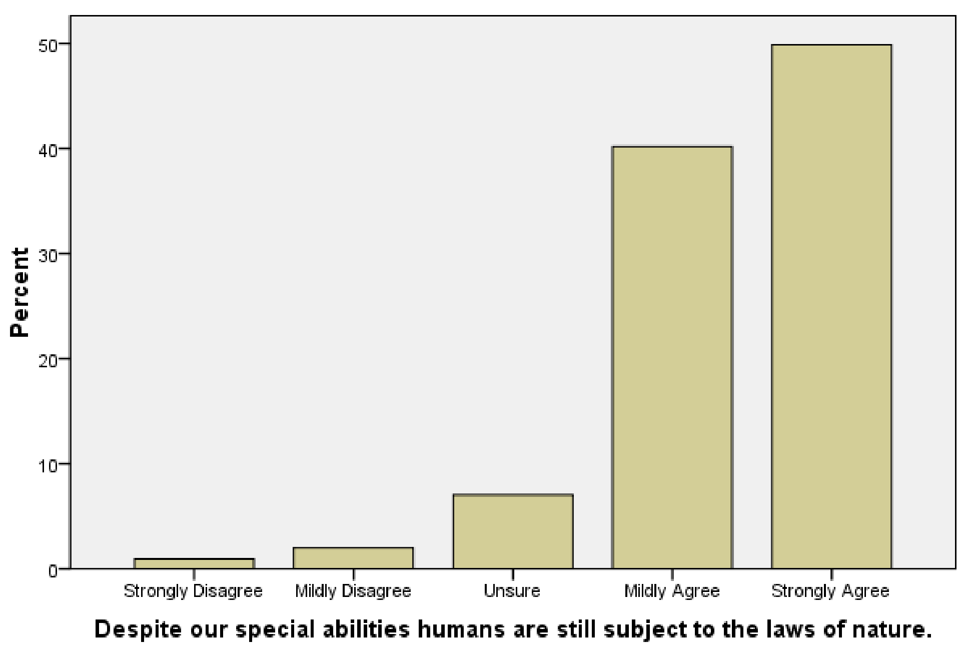

The earth has plenty of natural resources if we just learn how to develop them.
Percent
0
10
20
30
40
Strongly Disagree
Mildly Disagree
Unsure
Mildly Agree
Strongly Agree
The earth has plenty of natural resources if we just learn how to develop them.


Plants and animals have as much right as humans to exist.
Percent
0
10
20
30
40
50
Strongly Disagree
Mildly Disagree
Unsure
Mildly Agree
Strongly Agree
Plants and animals have as much right as humans to exist.

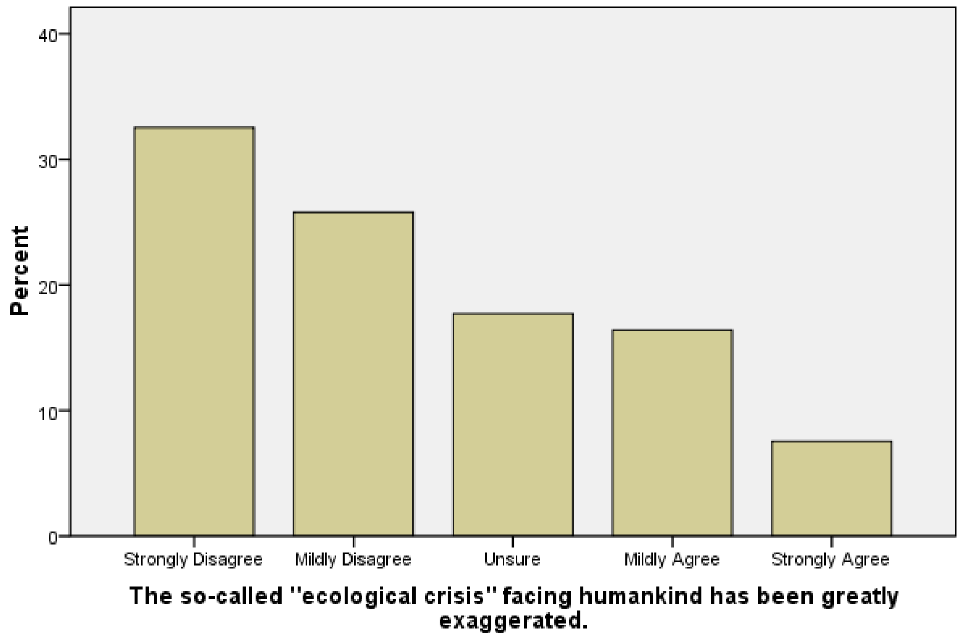
The balance of nature is strong enough to cope with the impacts of modern industrial nations.



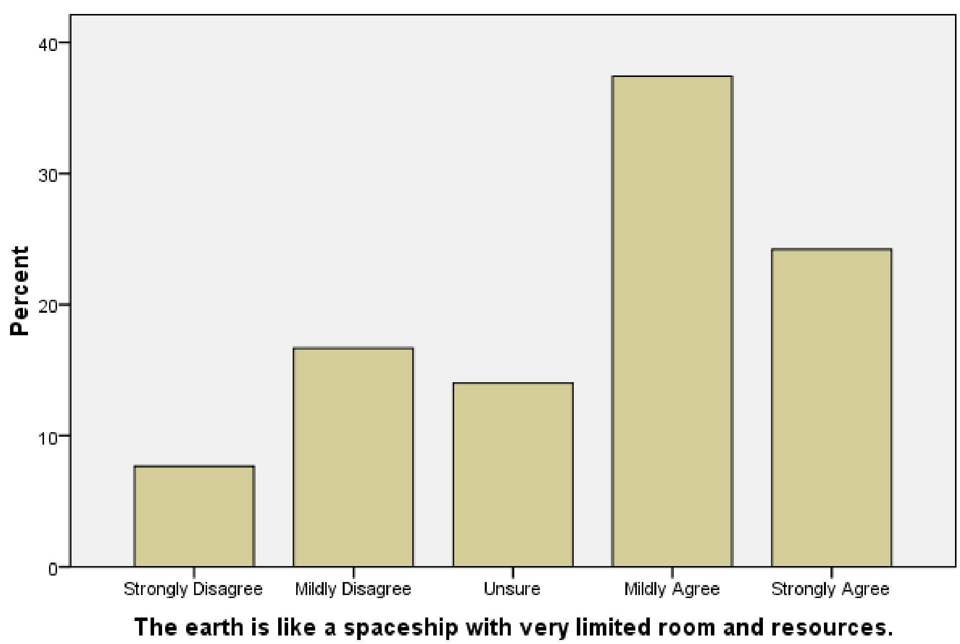
Despite our special abilities humans are still subject to the laws of nature.



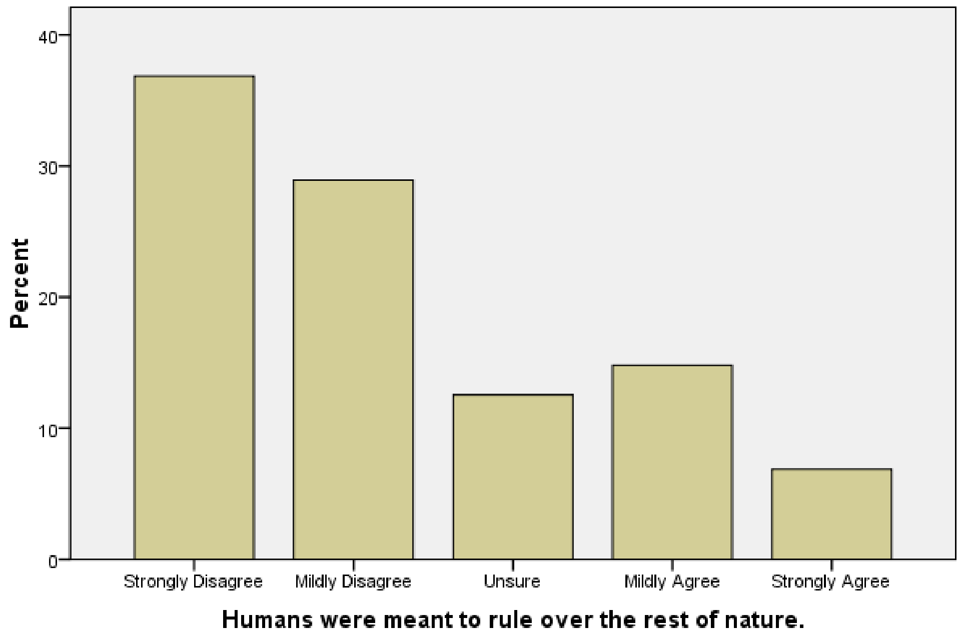
The so-called "ecological crisis" facing humankind has been greatly exaggerated.



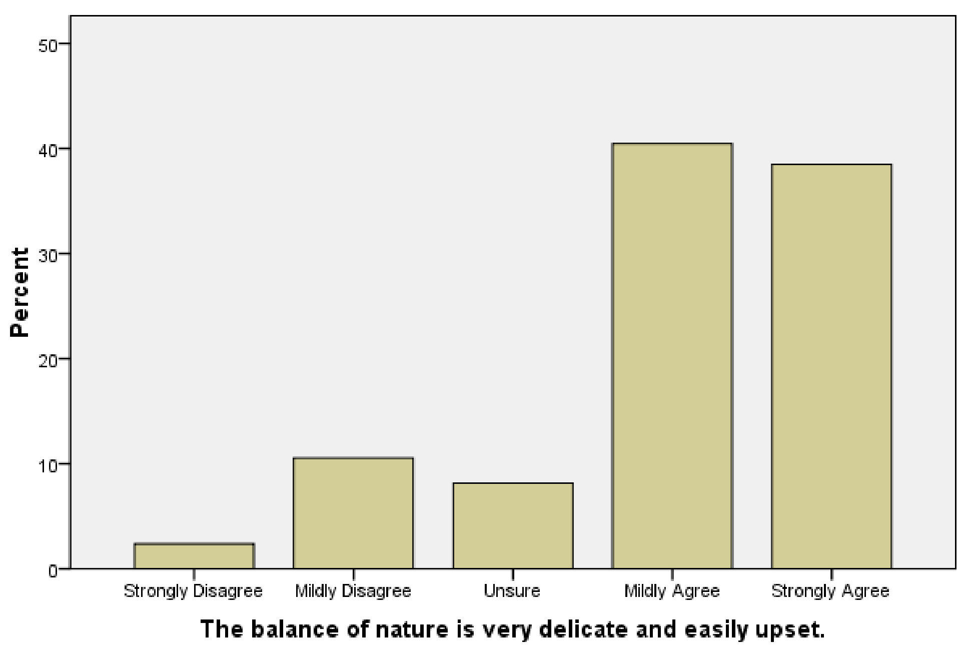
The earth is like a spaceship with very limited room and resources.



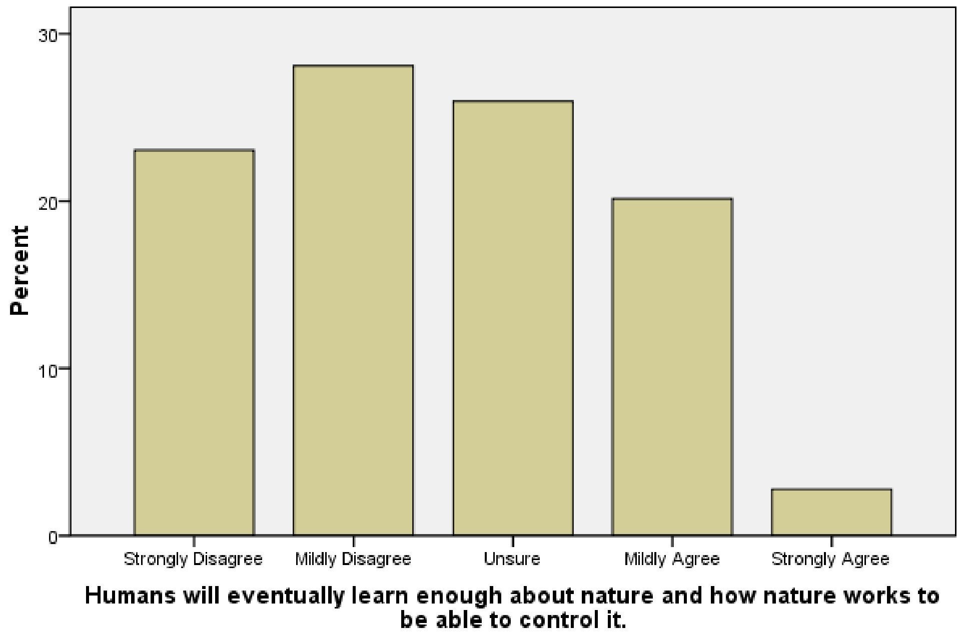
Humans were meant to rule over the rest of nature.



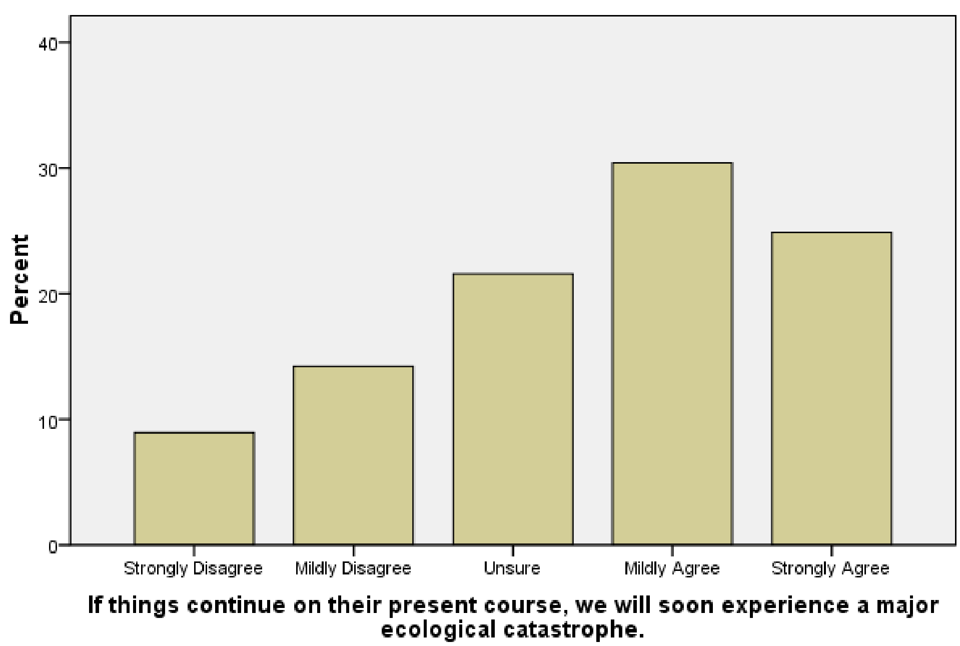
The balance of nature is very delicate and easily upset.



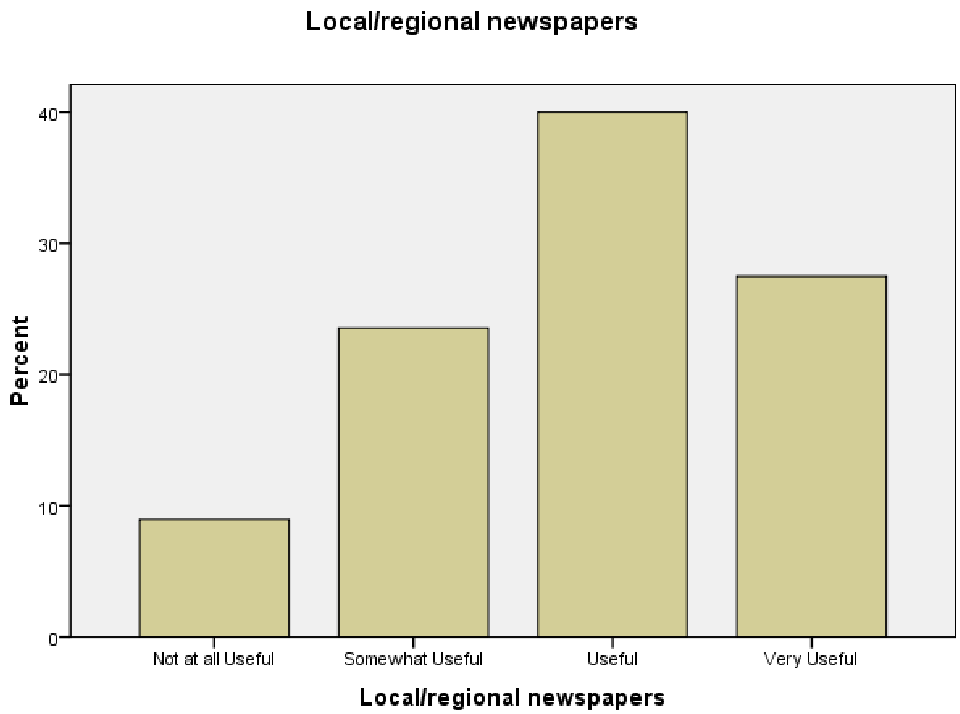
Humans will eventually learn enough about nature and how nature works to be able to control it.

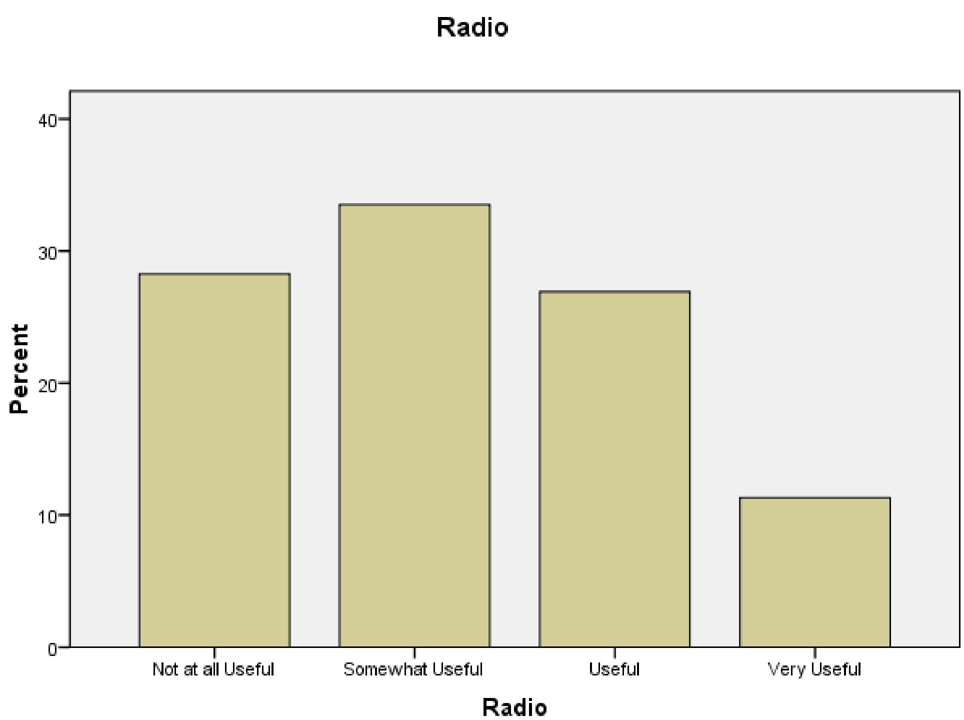


If things continue on their present course, we will soon experience a major ecological catastrophe.

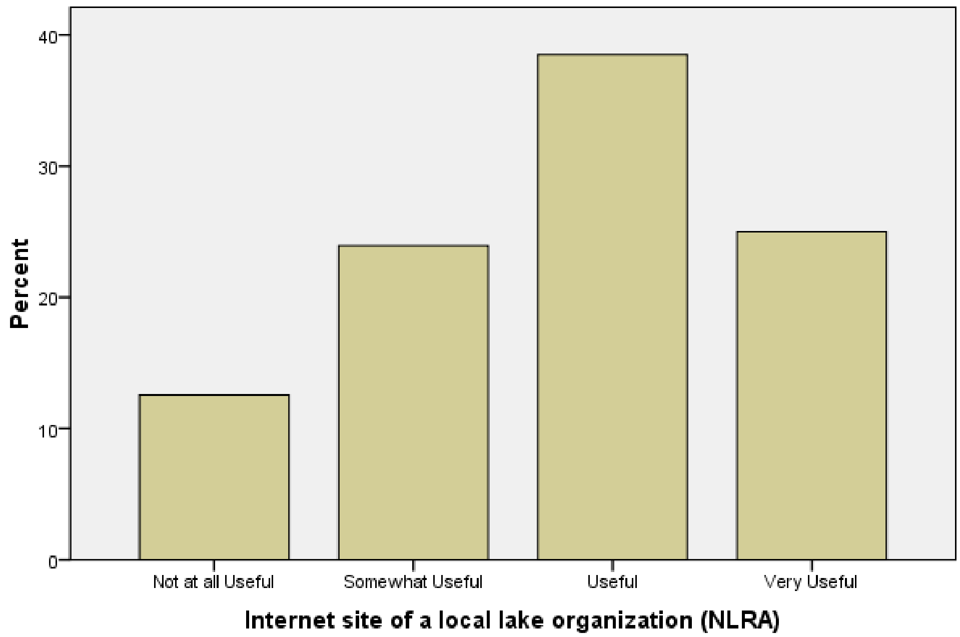


Questionnaire Section 15

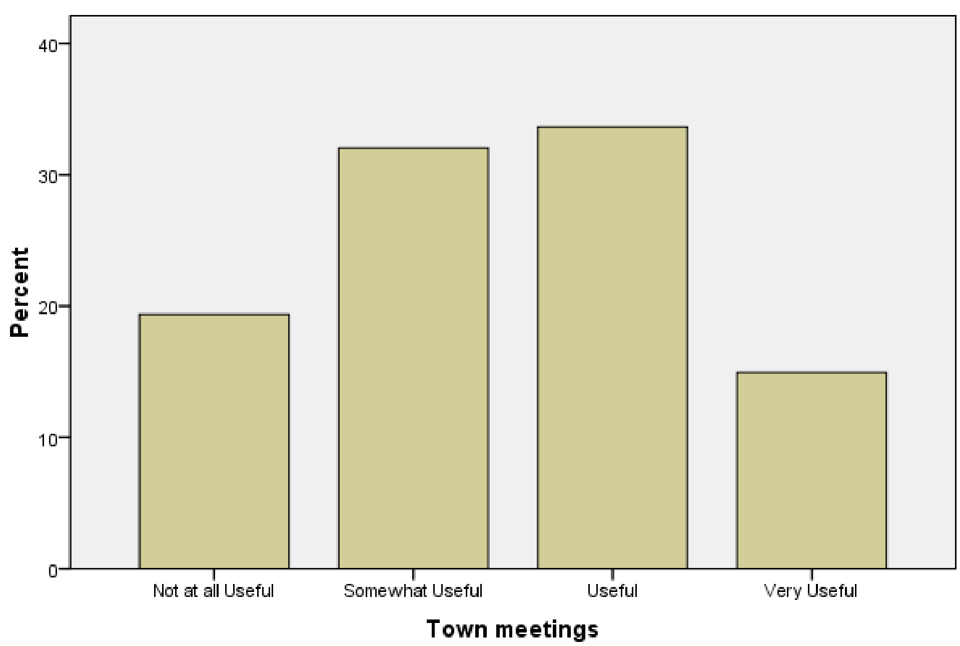


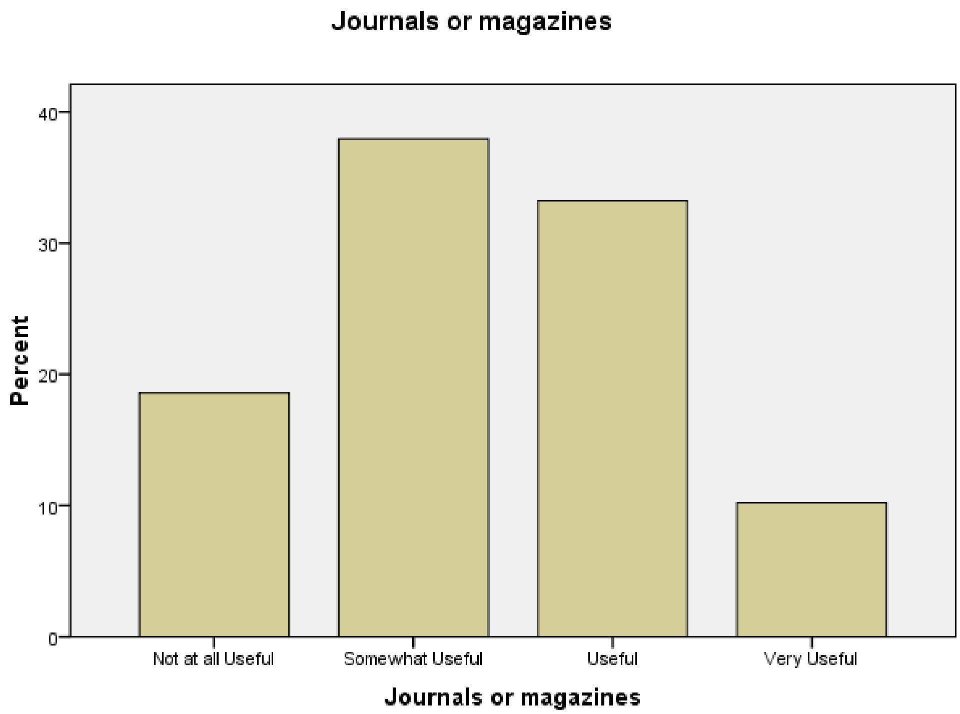


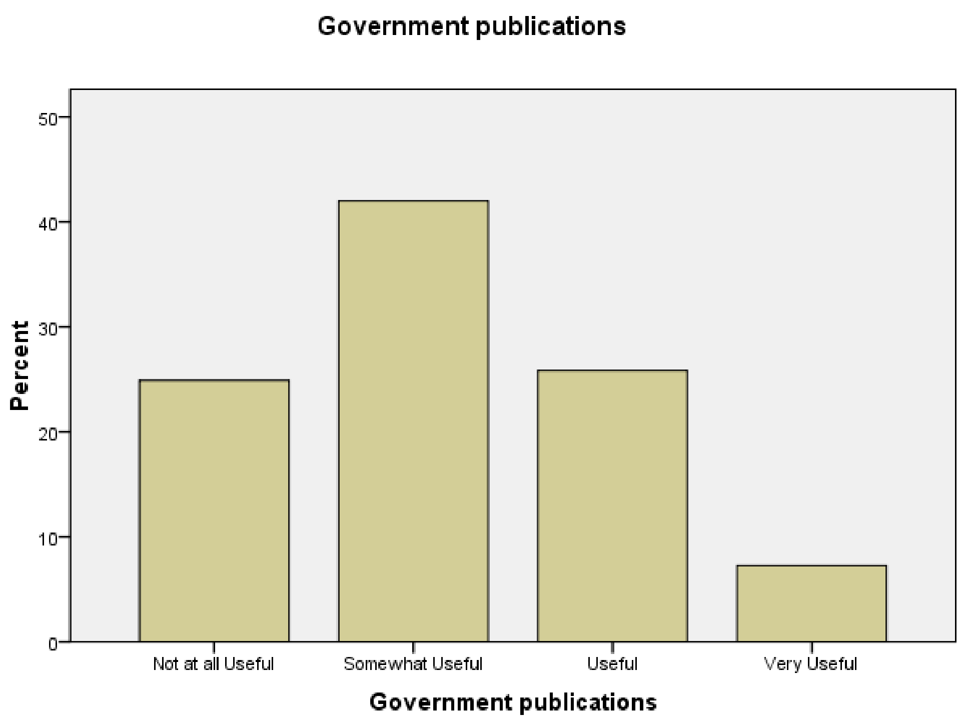
Internet site of a local lake organization (NLRA)



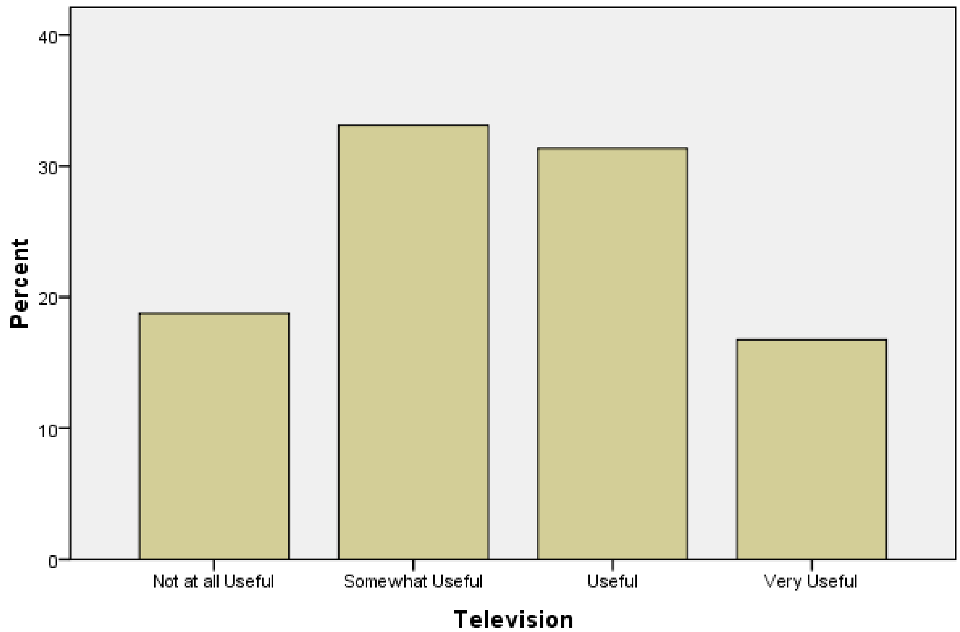
Town meetings



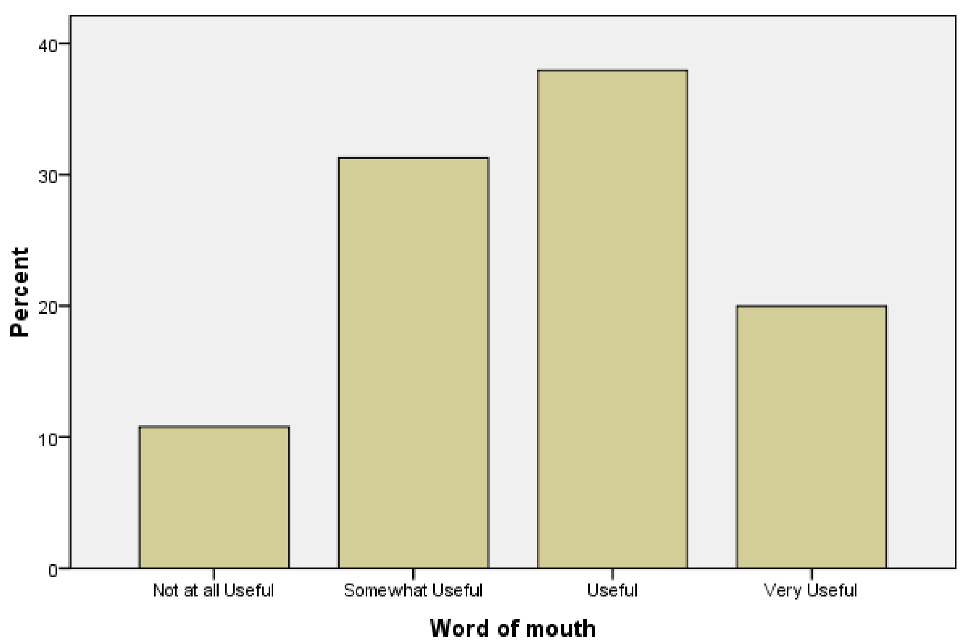

Journals or magazines
Percent
40
30
20
10
0
Not at all Useful
Somewhat Useful
Useful
Very Useful
Journals or magazines


Government publications
Percent
50
40
30
20
10
0
Not at all Useful
Somewhat Useful
Useful
Very Useful
Government publications

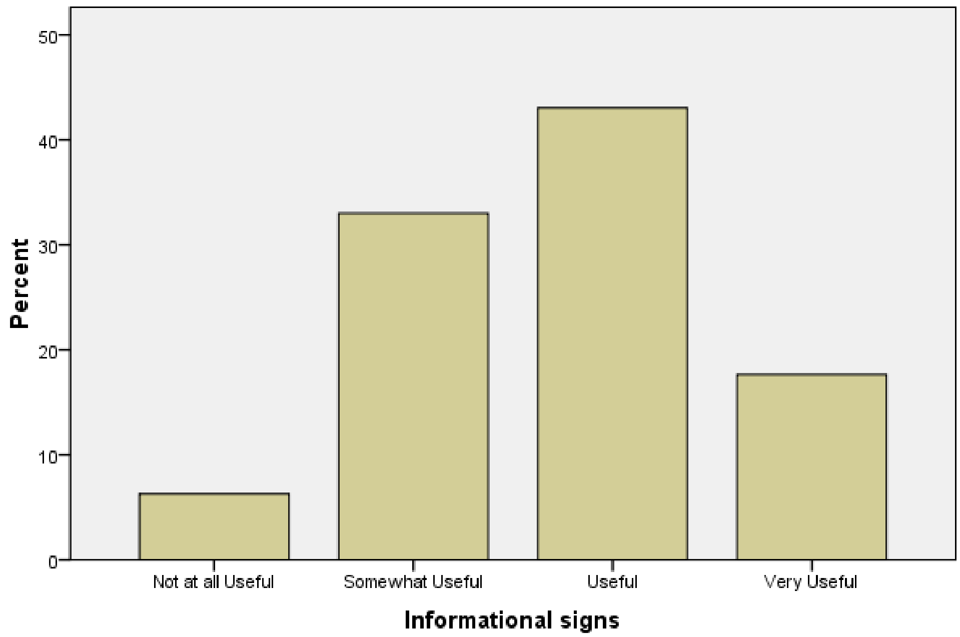
Television



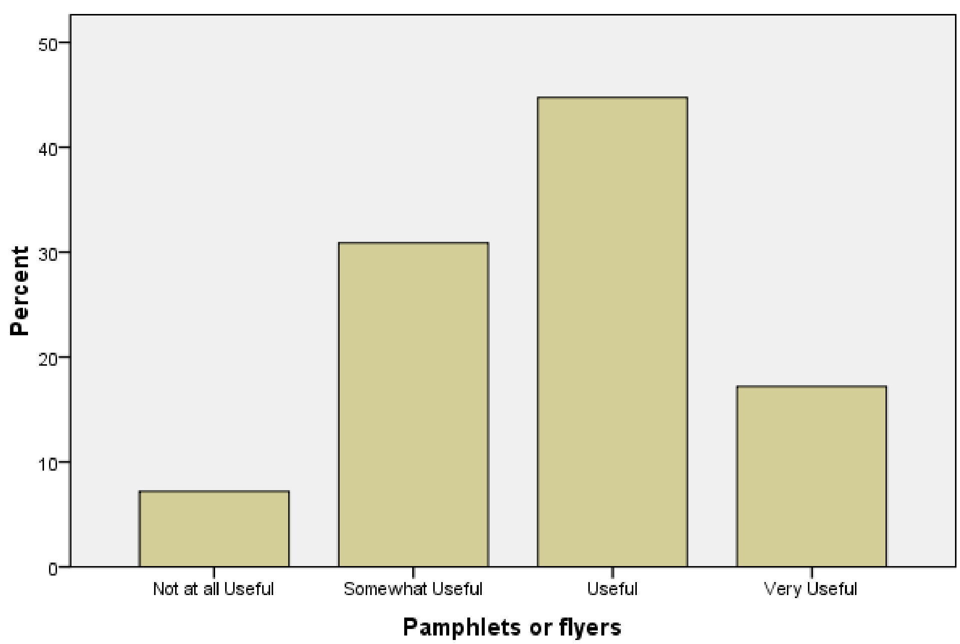
Word of mouth



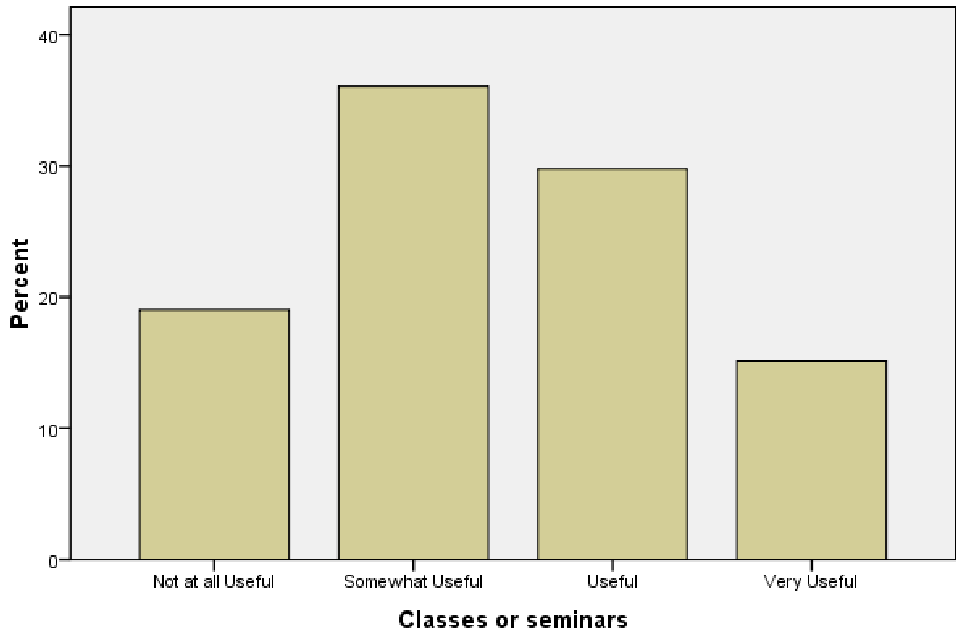
Informational signs



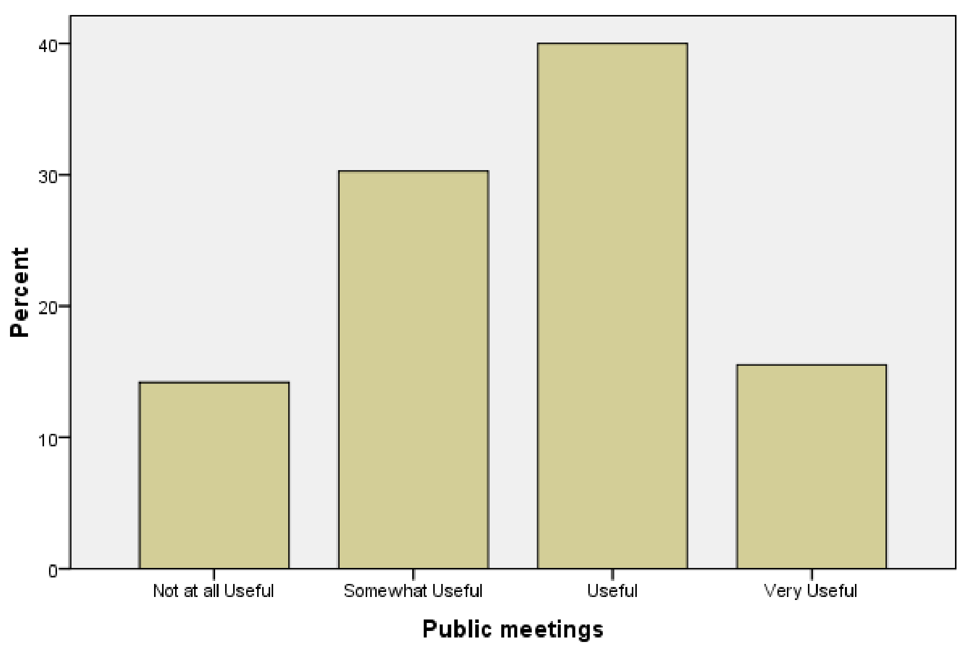
Pamphlets or flyers



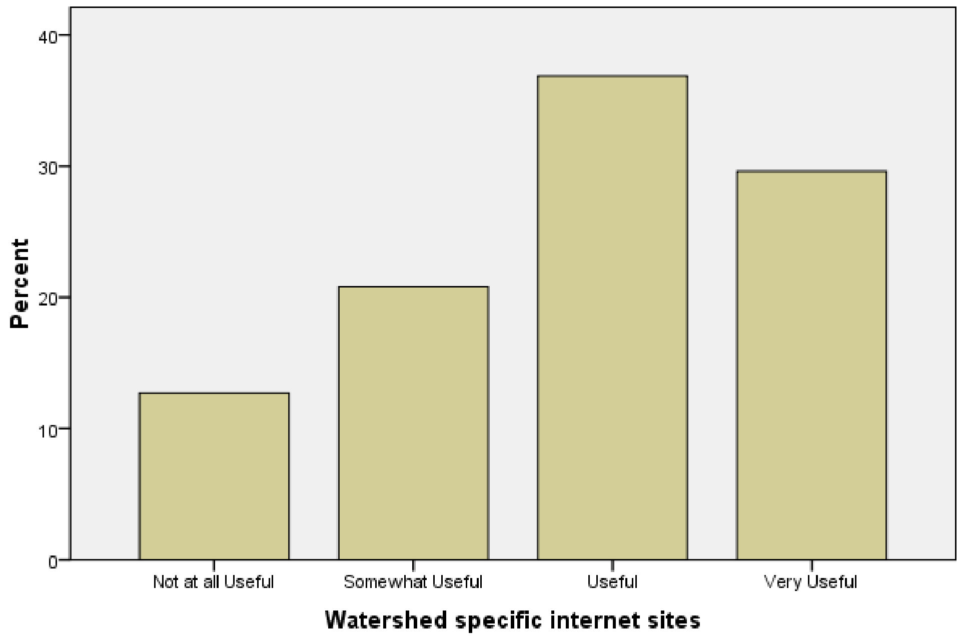
Classes or seminars



Public meetings

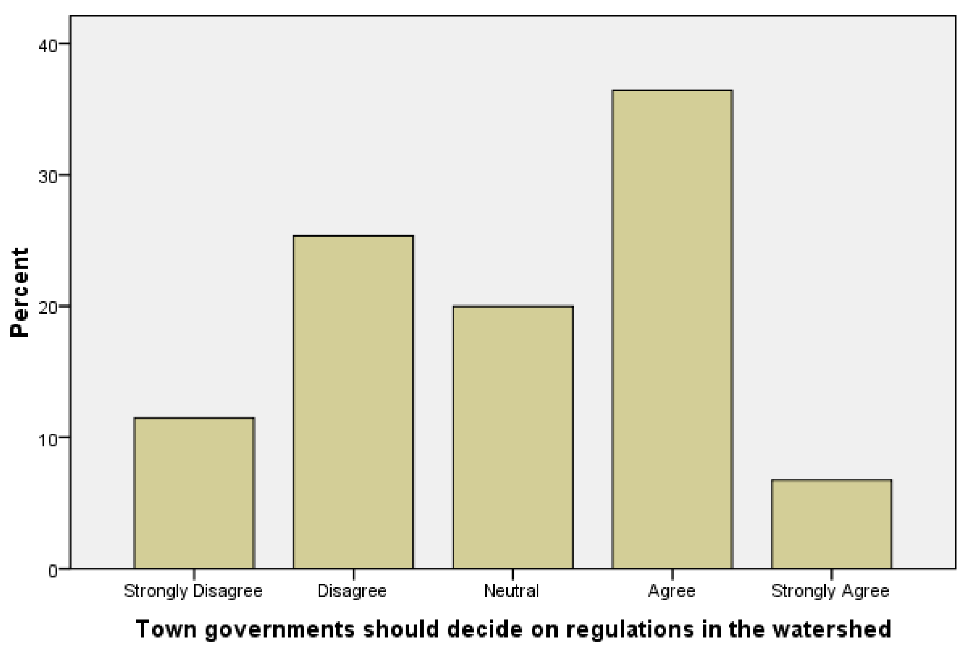


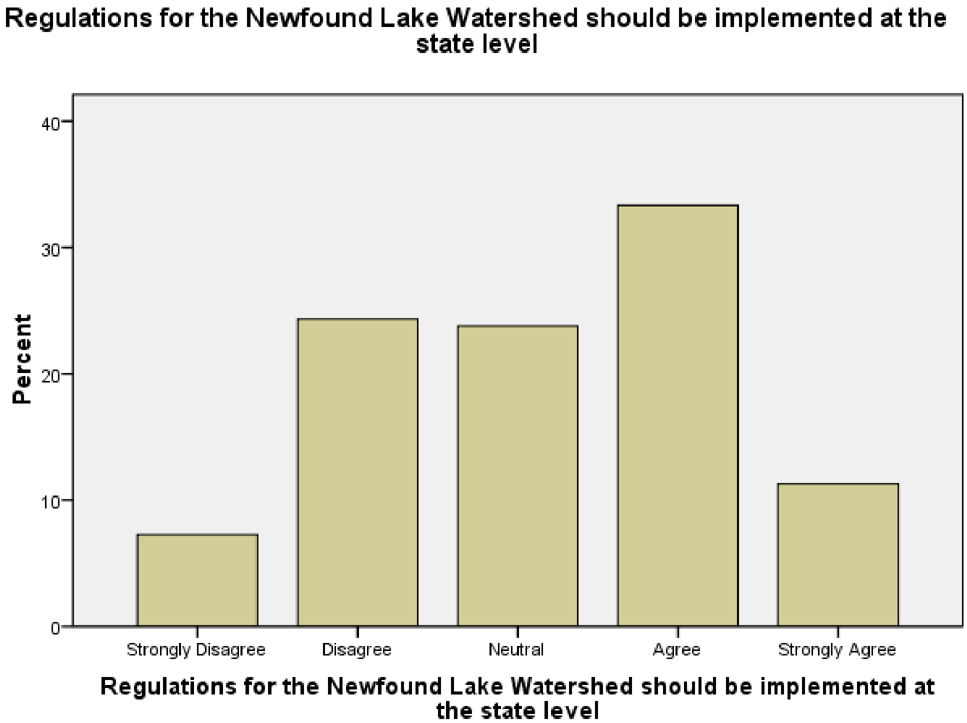
Watershed specific internet sites

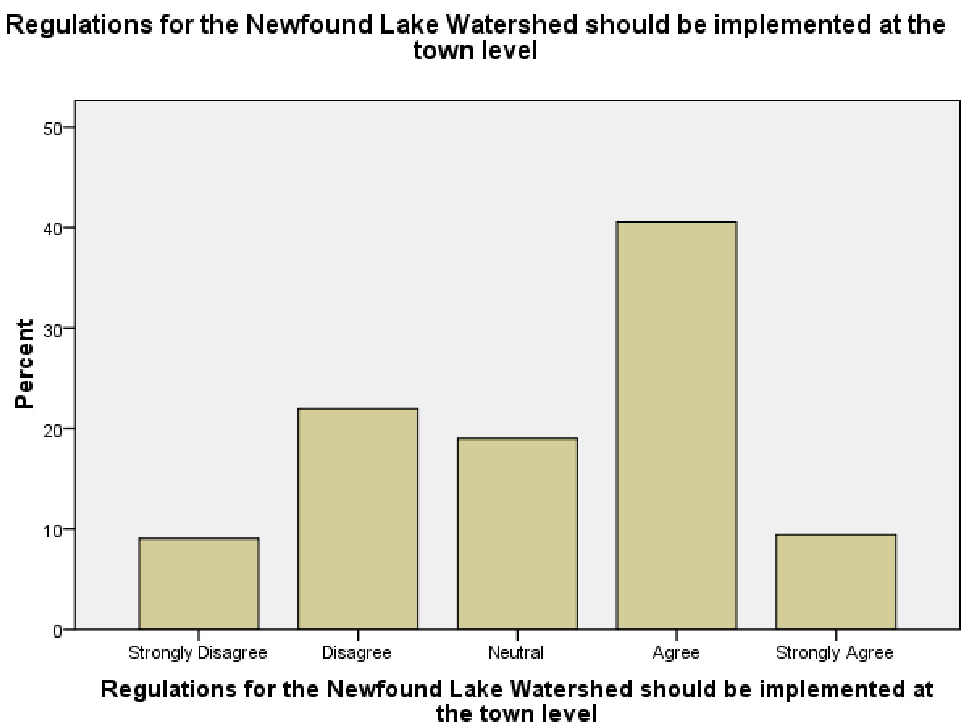


Questionnaire Section 16

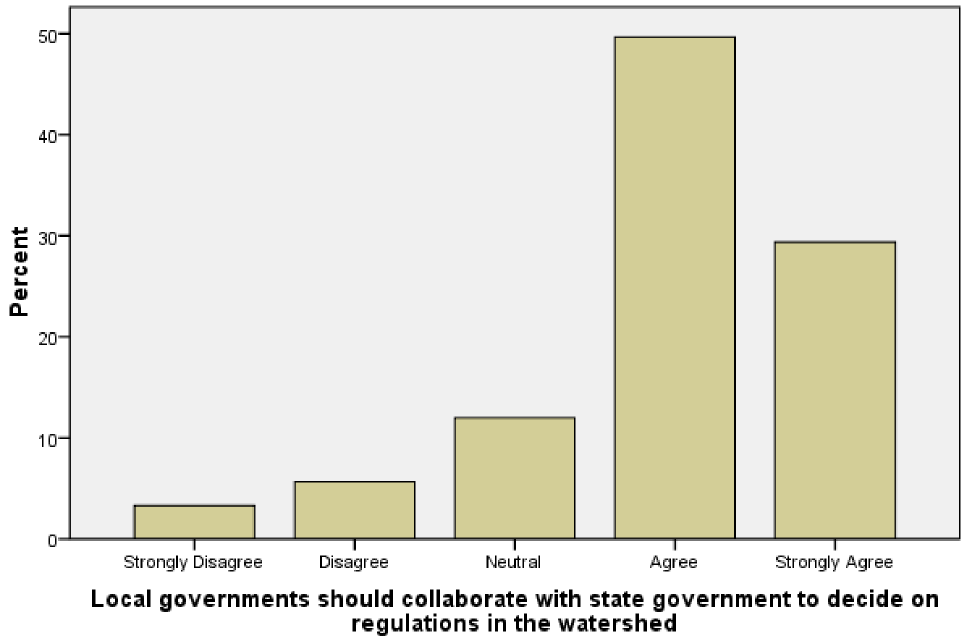
Town governments should decide on regulations in the watershed



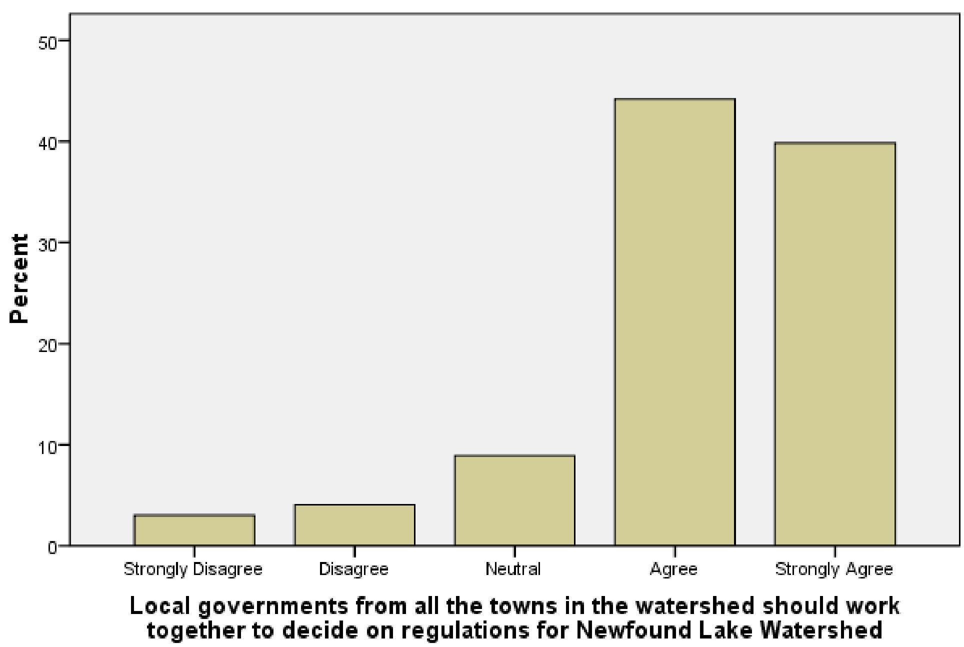

Regulations for the Newfound Lake Watershed should be implemented at the state level
Percent
0
10
20
30
40
Strongly Disagree
Disagree
Neutral
Agree
Strongly Agree
Regulations for the Newfound Lake Watershed should be implemented at the state level


Regulations for the Newfound Lake Watershed should be implemented at the town level
Percent
0
10
20
30
40
50
Strongly Disagree
Disagree
Neutral
Agree
Strongly Agree
Regulations for the Newfound Lake Watershed should be implemented at the town level

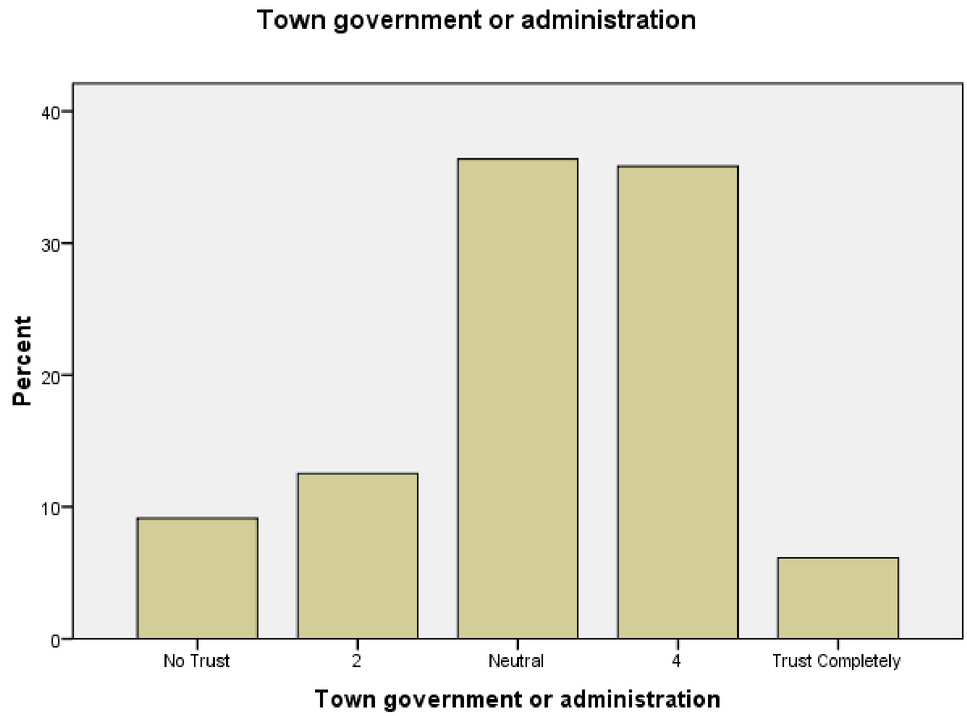
Local governments should collaborate with state government to decide on regulations in the watershed

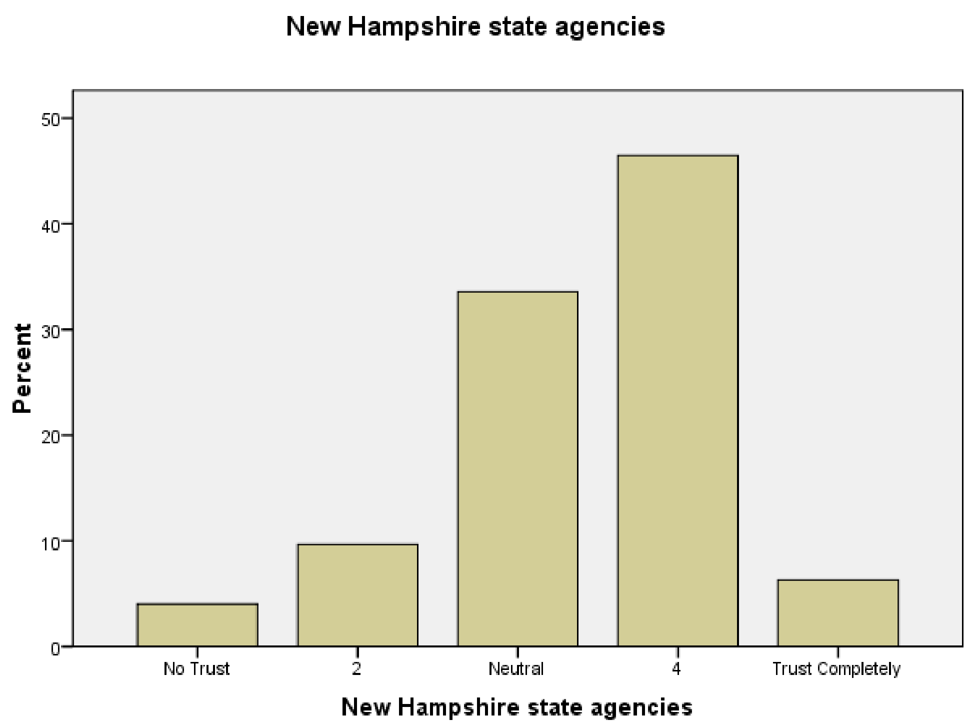


Local governments from all the towns in the watershed should work together to decide on regulations for Newfound Lake Watershed

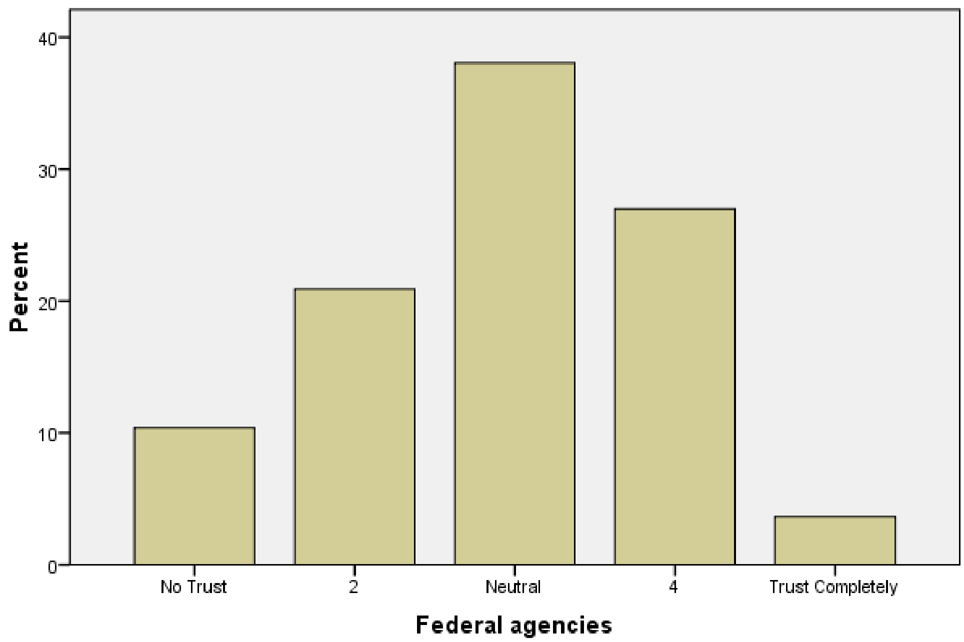


Questionnaire Section 17

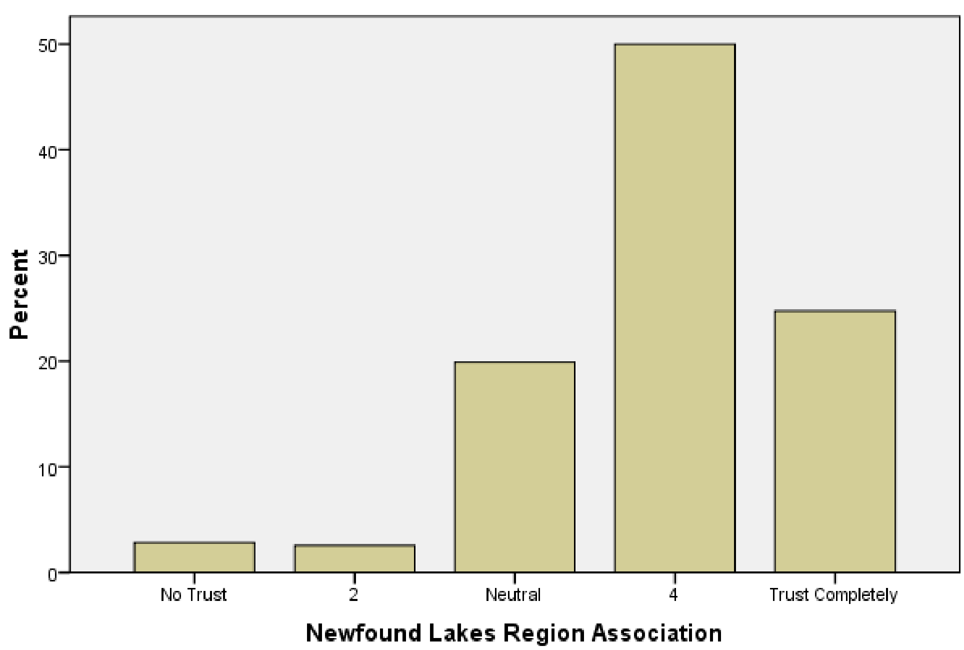




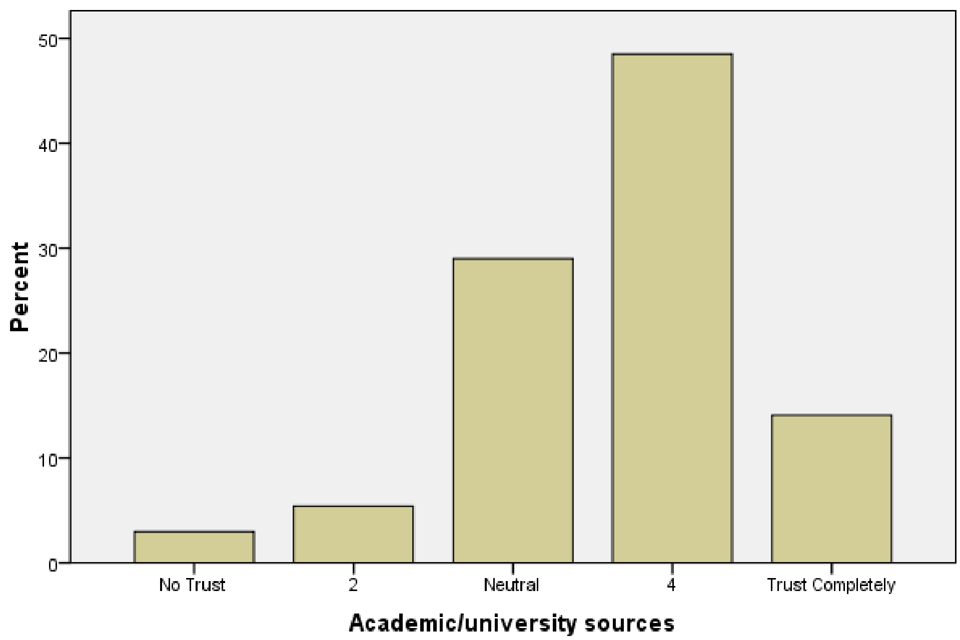
Federal agencies



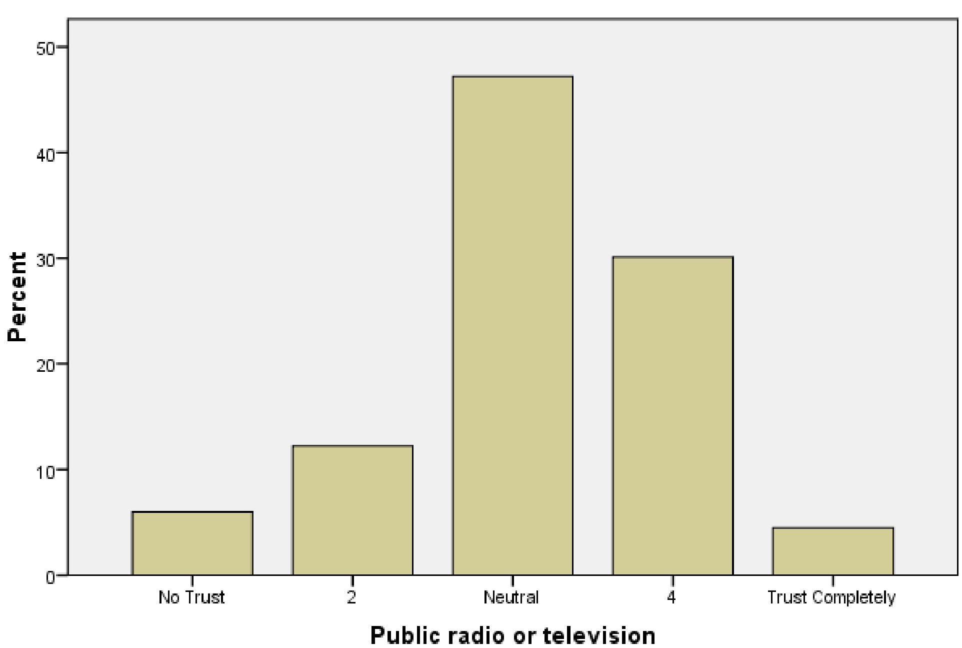
Newfound Lakes Region Association

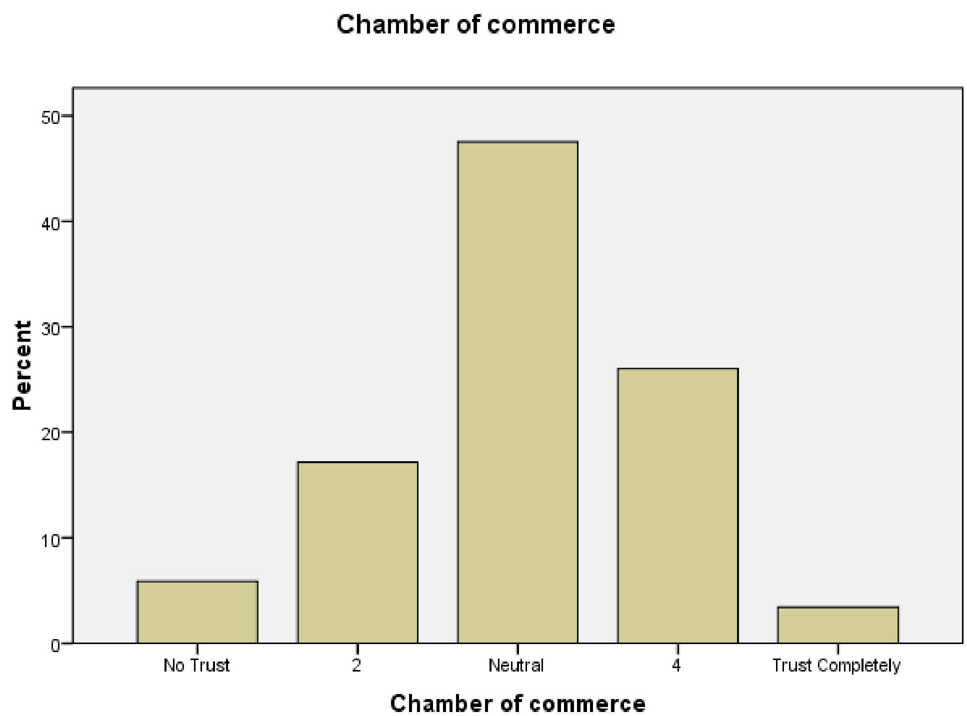


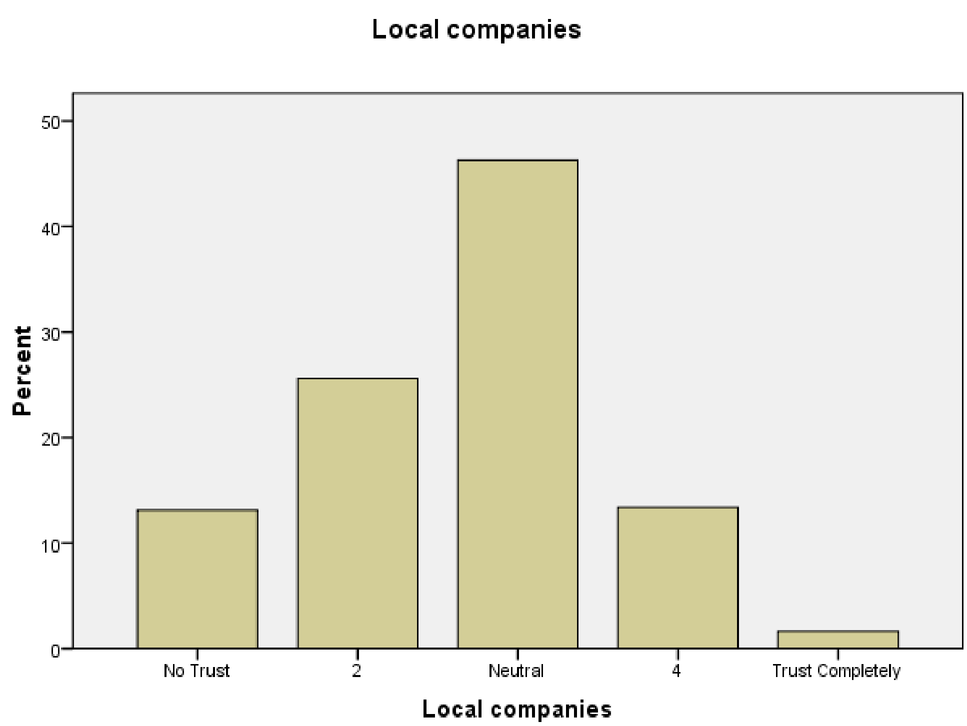
Academic/university sources



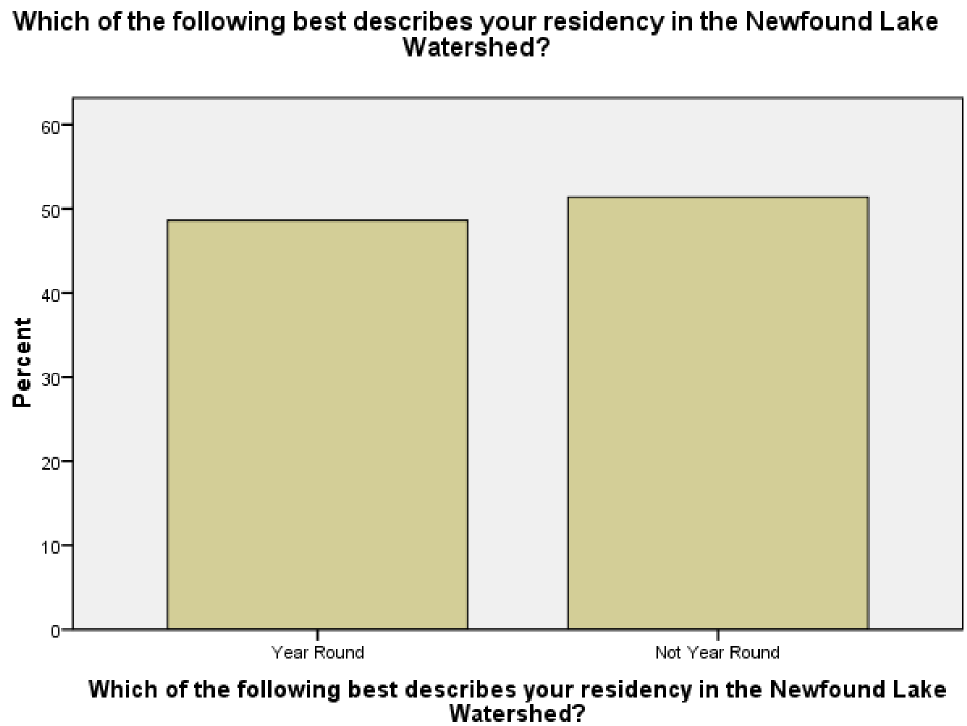
Public radio or television

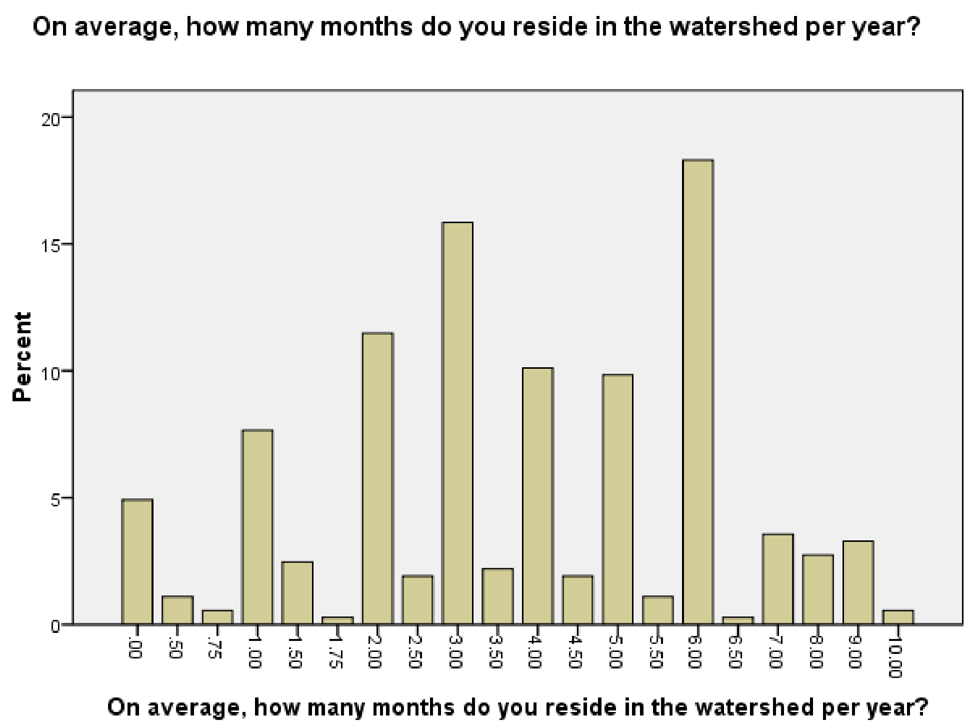



Chamber of commerce
Percent
50
40
30
20
10
0
No Trust
2
Neutral
4
Trust Completely
Chamber of commerce

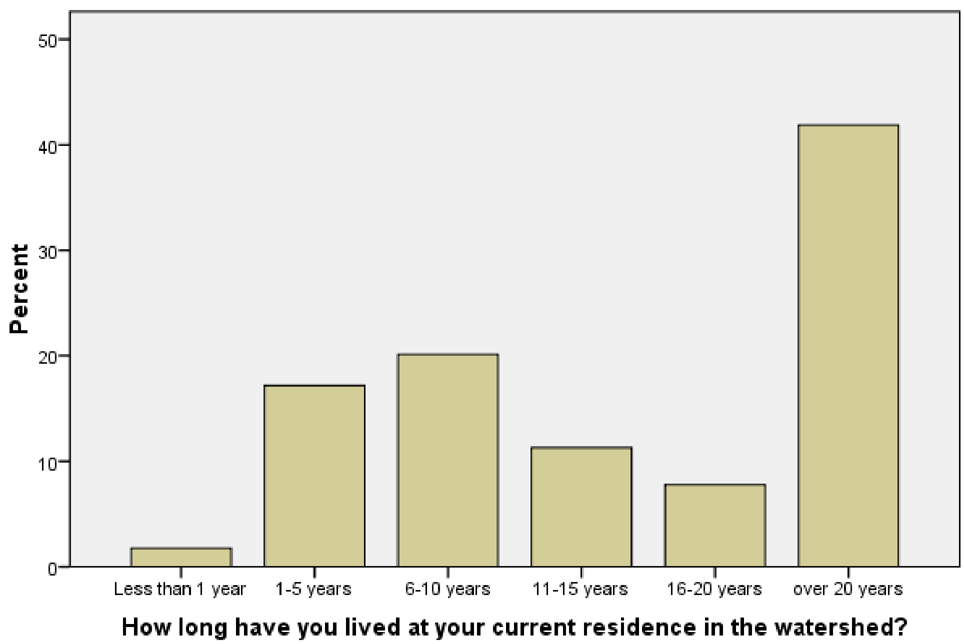

Local companies
Percent
50
40
30
20
10
0
No Trust
2
Neutral
4
Trust Completely
Local companies

Questionnaire Section 18

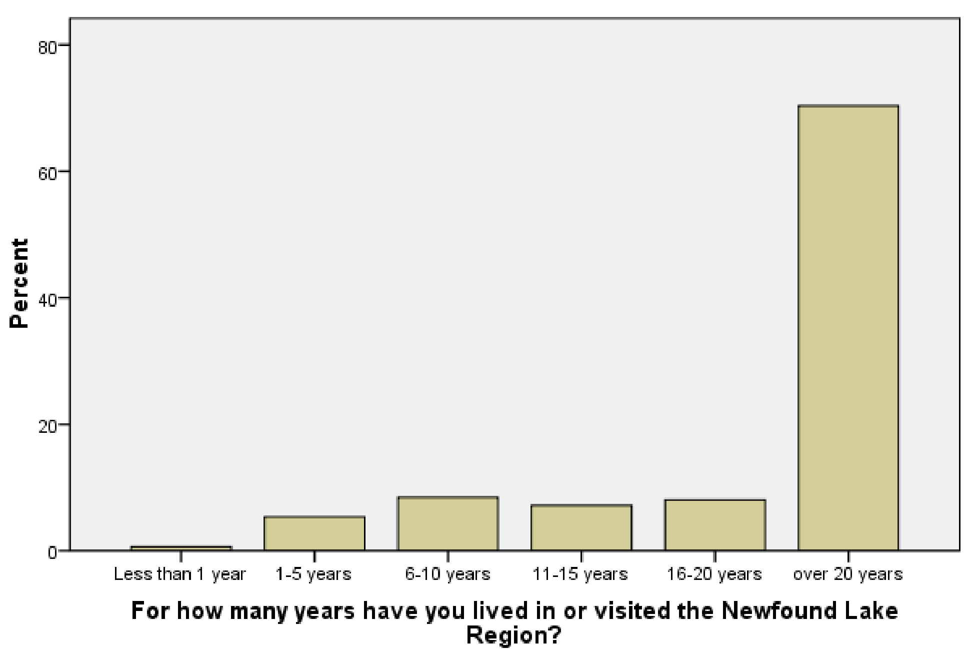


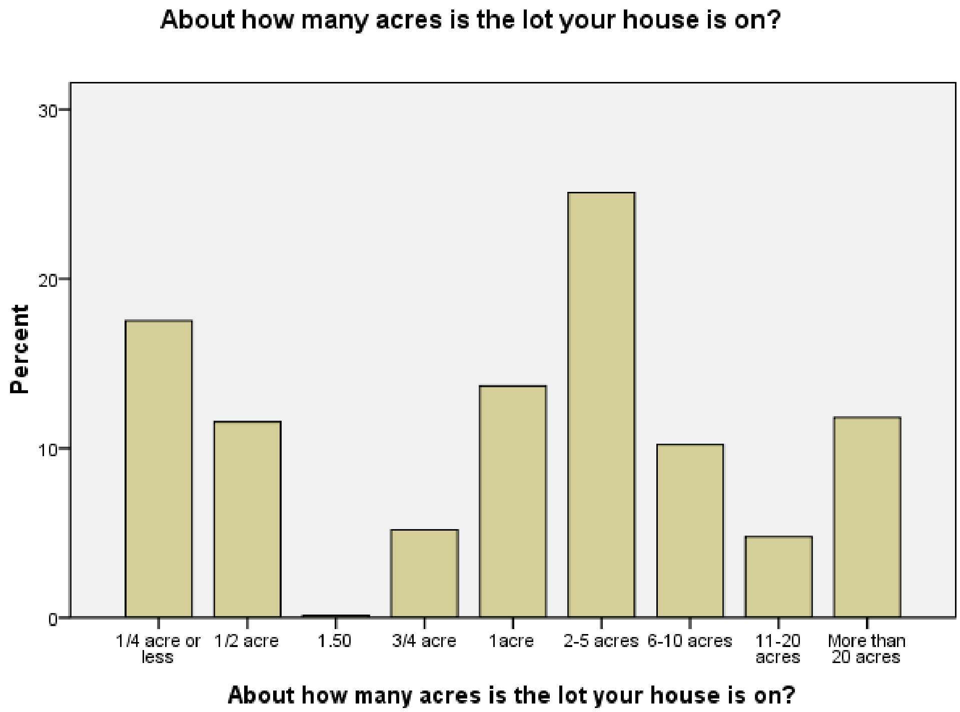


How long have you lived at your current residence in the watershed?

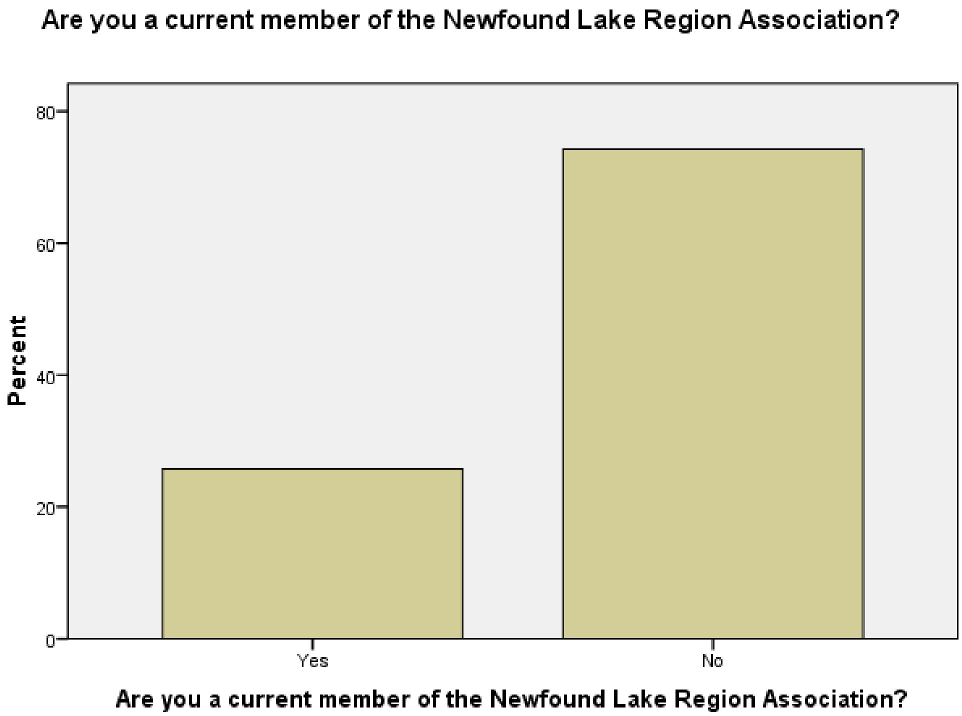


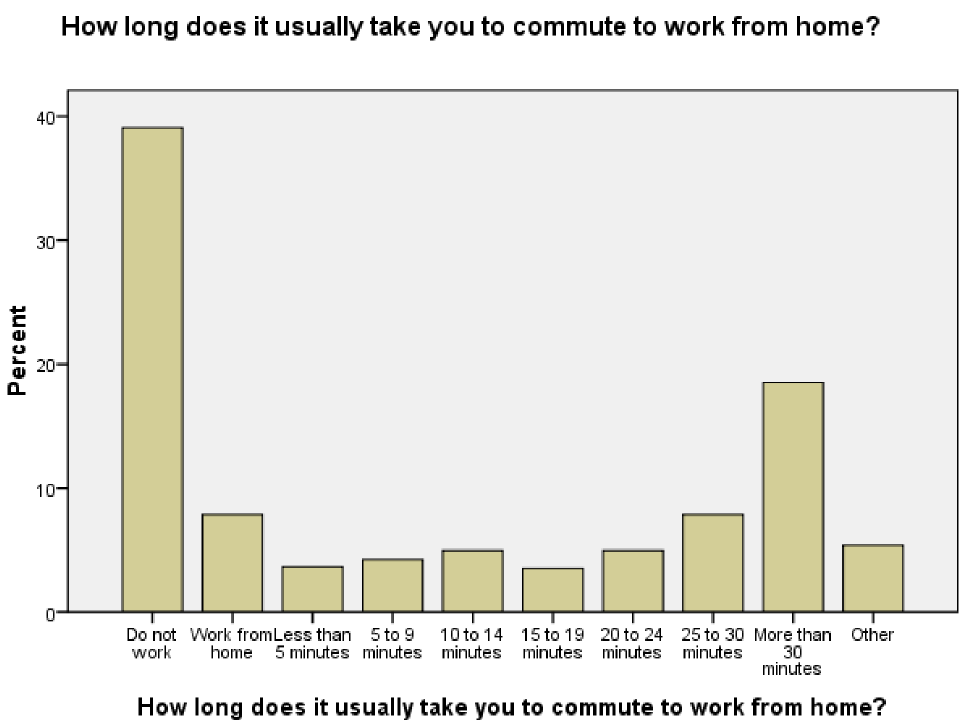
For how many years have you lived in or visited the Newfound Lake Region?



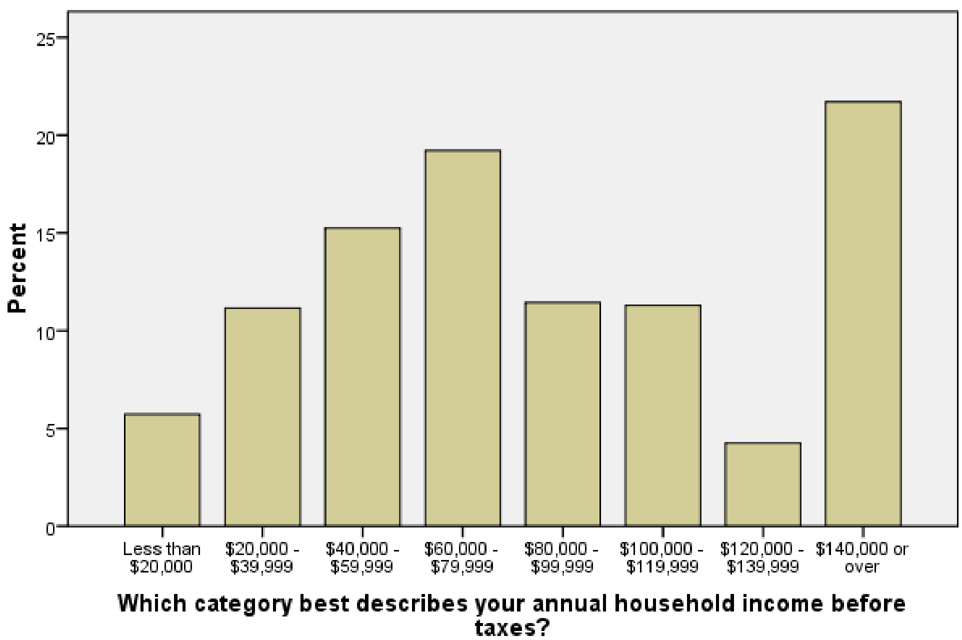

About how many acres is the lot your house is on?
Percent
30
20
10
0
1/4 acre or less
1/2 acre
1.50
3/4 acre
1acre
2-5 acres
6-10 acres
11-20 acres
More than 20 acres
About how many acres is the lot your house is on?


Do you maintain your property yourself, or do you hire out property maintenance such as landscaping and lawn-mowing?
Percent
80
60
40
20
0
Self-maintain property
Hire out property maintenance
Do you maintain your property yourself, or do you hire out property maintenance such as landscaping and lawn-mowing?

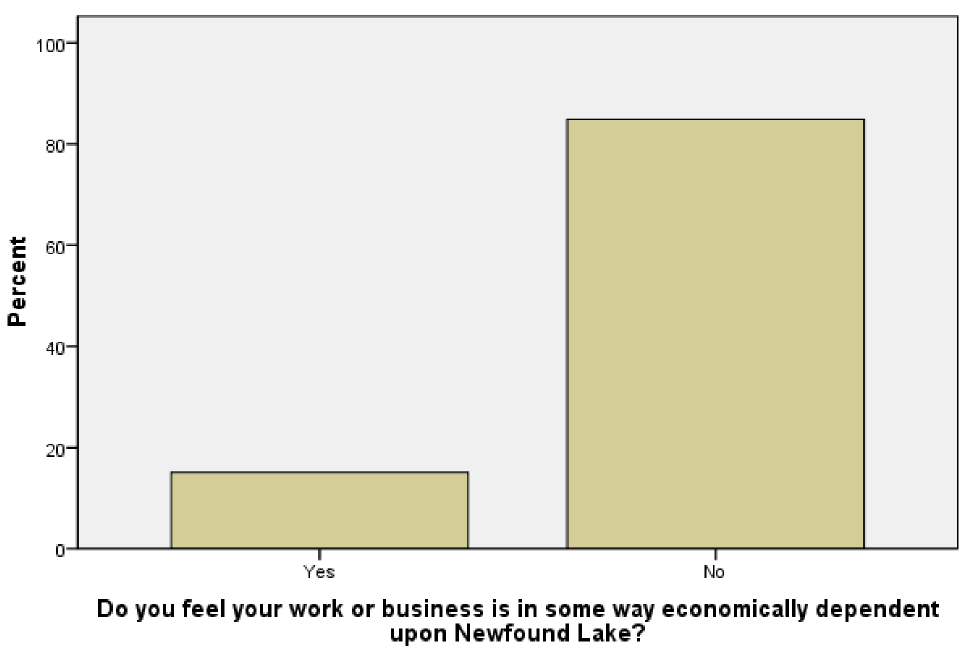

Are you a current member of the Newfound Lake Region Association?
Percent
80
60
40
20
0
Yes
No
Are you a current member of the Newfound Lake Region Association?


How long does it usually take you to commute to work from home?
Percent
40
30
20
10
0
Do not work
Work from home
Less than 5 minutes
5 to 9 minutes
10 to 14 minutes
15 to 19 minutes
20 to 24 minutes
25 to 30 minutes
More than 30 minutes
Other
How long does it usually take you to commute to work from home?

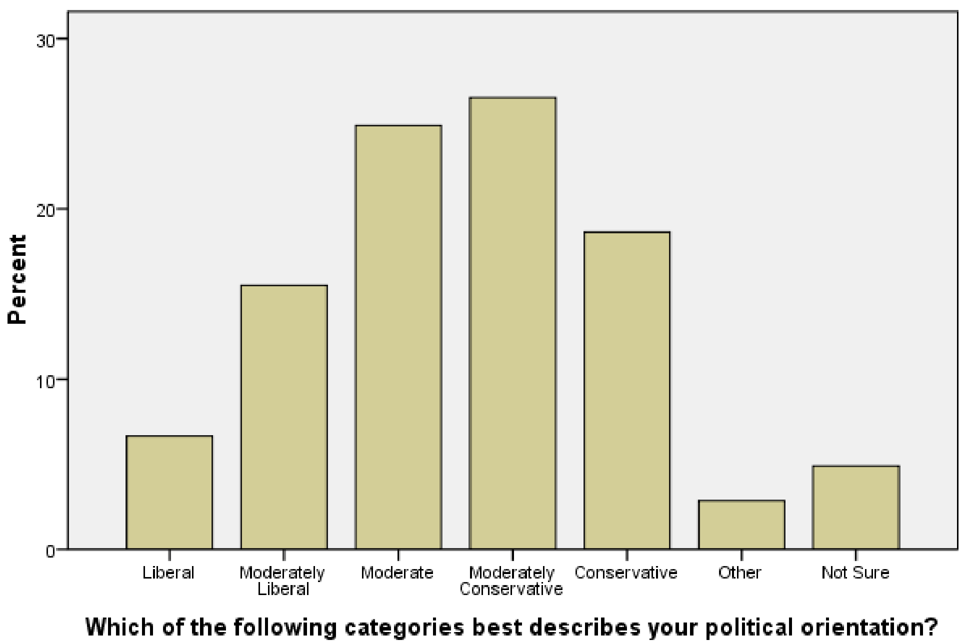
Which category best describes your annual household income before taxes?



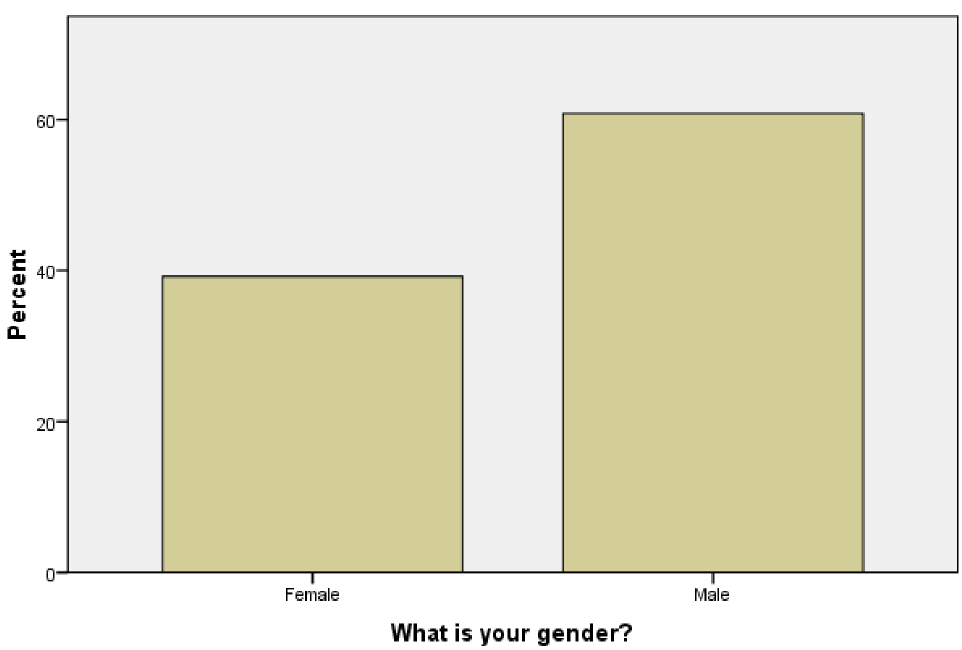
Do you feel your work or business is in some way economically dependent upon Newfound Lake?



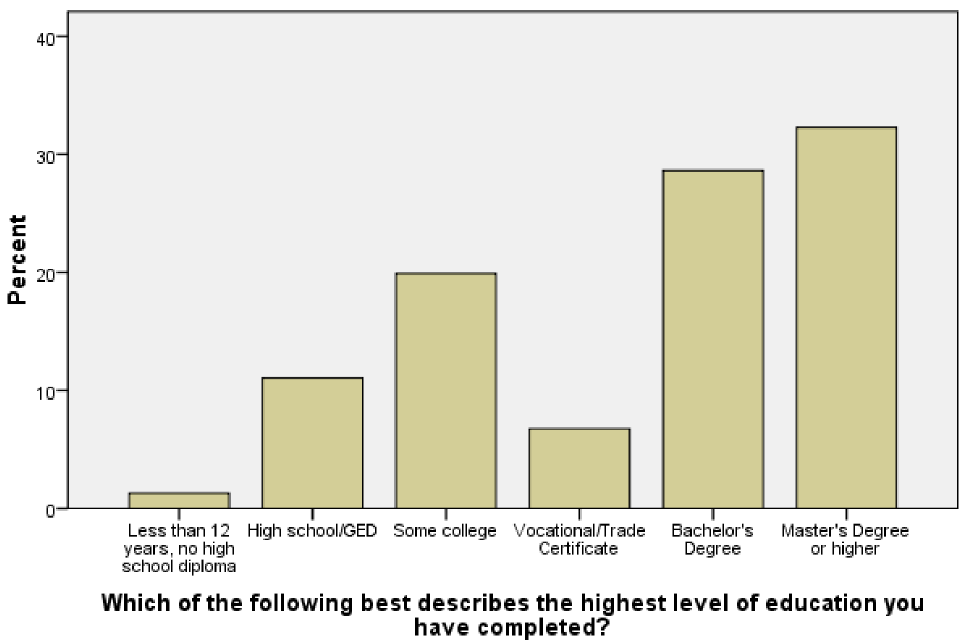
Which of the following categories best describes your political orientation?

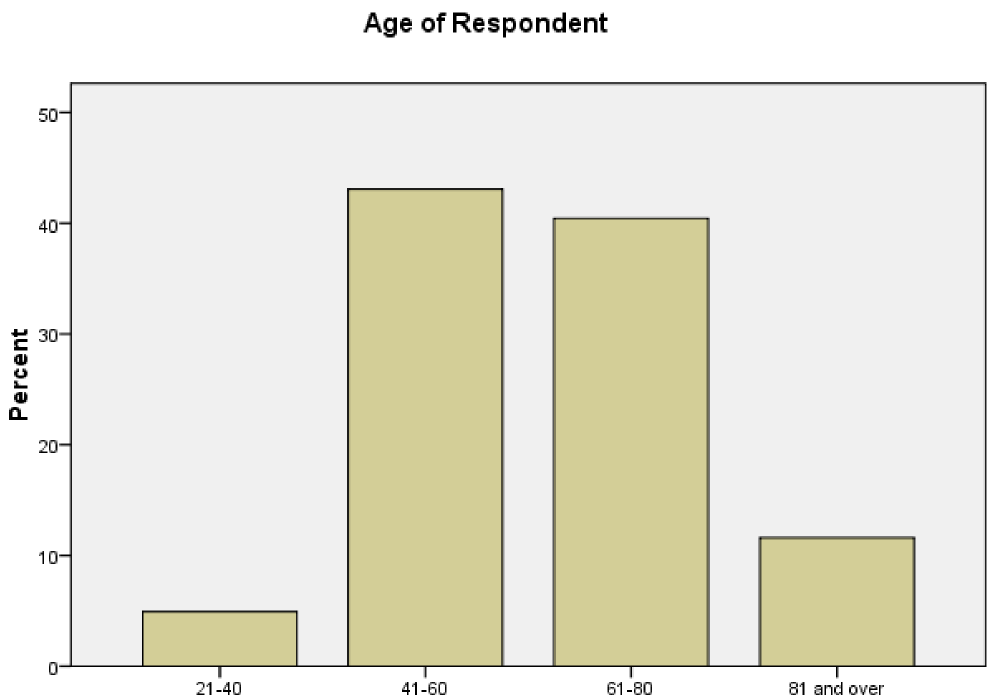


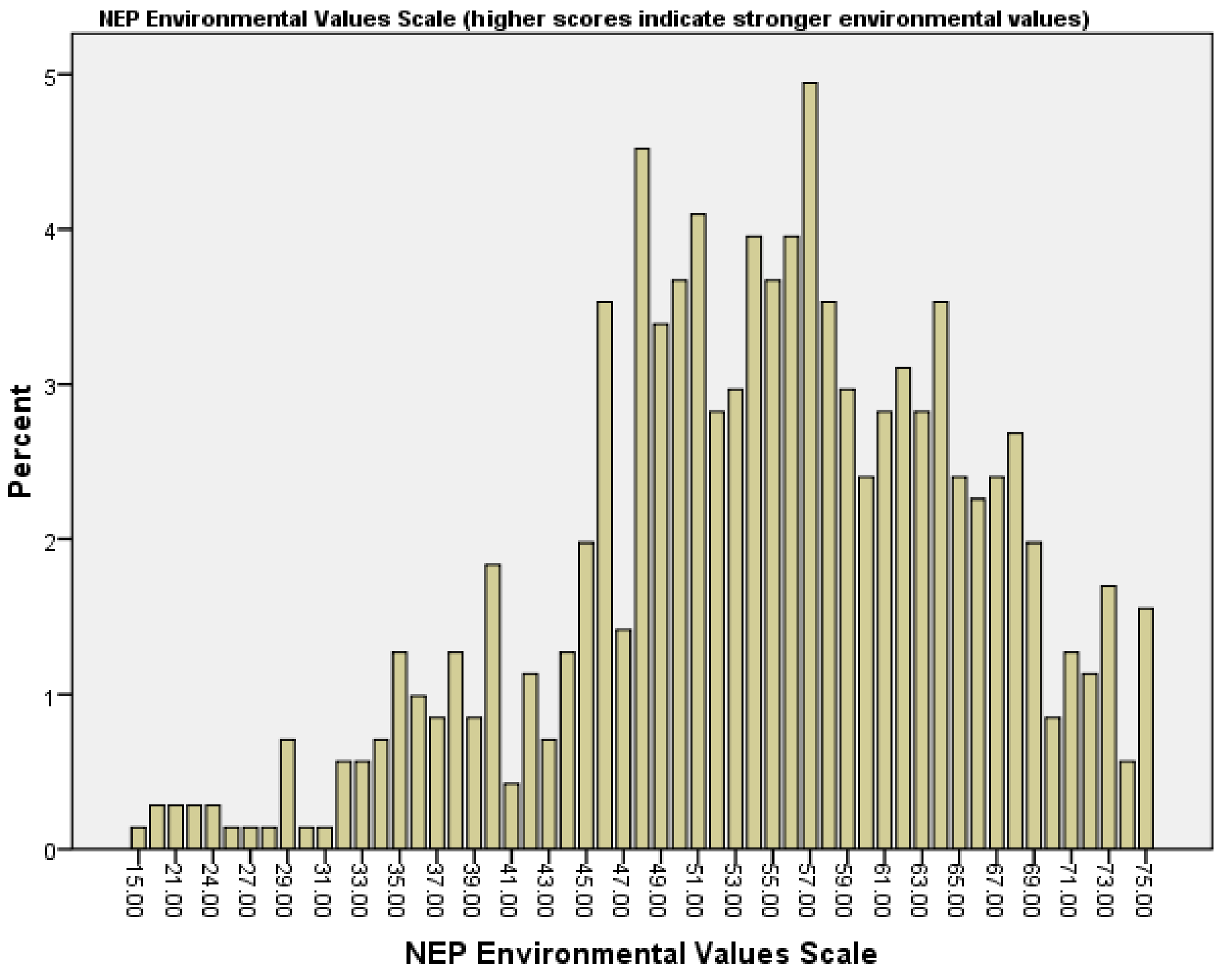
What is your gender?



Which of the following best describes the highest level of education you have completed?

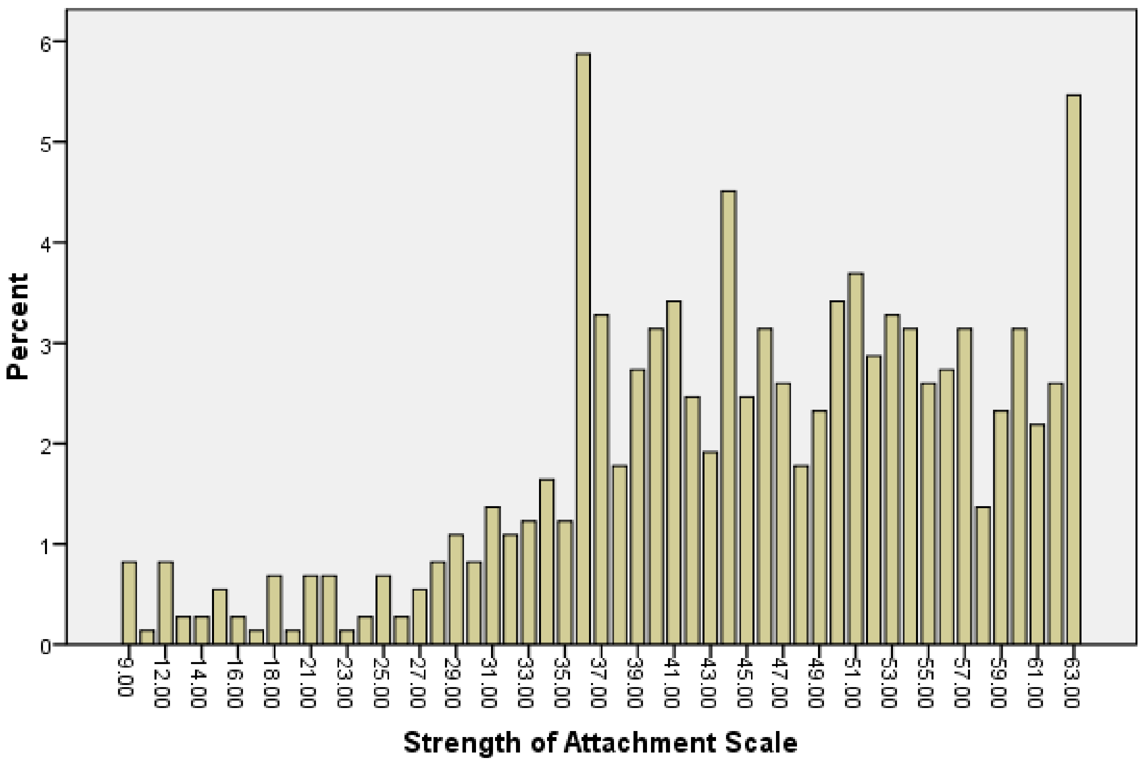



Age of Respondent
Percent
50
40
30
20
10
0
21-40
41-60
61-80
81 and over



NEP Environmental Values Scale (higher scores indicate stronger environmental values)
Percent
0
1
2
3
4
5
15.00
21.00
24.00
27.00
29.00
31.00
33.00
35.00
37.00
39.00
41.00
43.00
45.00
47.00
49.00
51.00
53.00
55.00
57.00
59.00
61.00
63.00
65.00
67.00
69.00
71.00
73.00
75.00
NEP Environmental Values Scale

Strength of Attachment Scale



Appendix: Questionnaire

The Opinions of Residents:
A Survey to Guide the Creation of
Every Acre Counts:
The Newfound Watershed Master Plan

NEWFOUND LAKE REGION ASSOCIATION

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

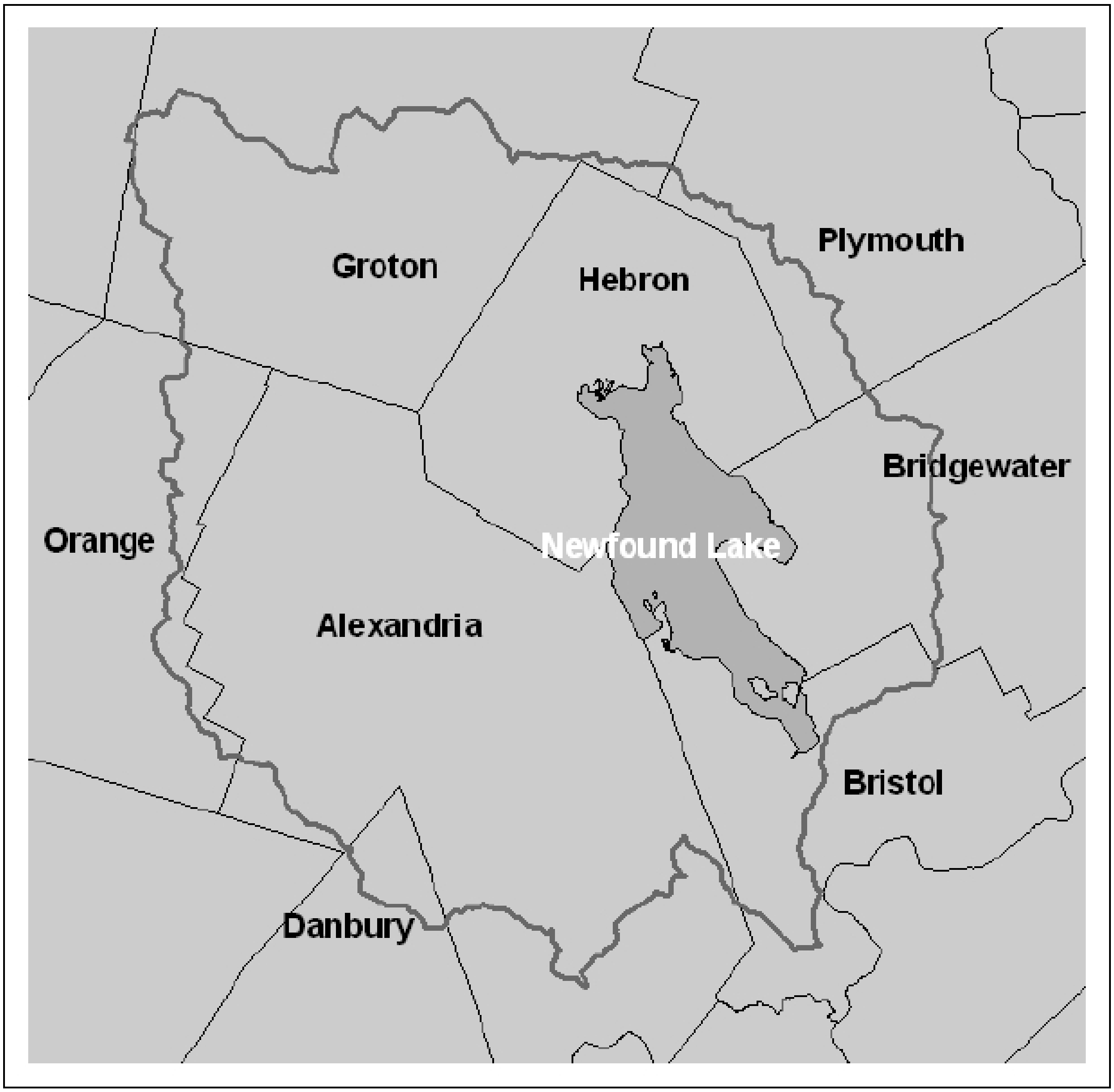
UNIVERSITY of NEW HAMPSHIRE Cooperative Extension

Plymouth State UNIVERSITY Center for the Environment

The Newfound Lake region is one of the crown jewels of New Hampshire, and the watershed is valued for its beauty and as an essential economic resource. This is a pivotal time for ensuring the long-term health and beauty of the watershed, and we need your opinions. Many agencies and organizations have committed to, and are participating in, the development of a Watershed Master Plan (WMP) for the Newfound Lake Region. The plan will provide useful information to communities in the watershed to help them ensure the high quality of life in the region into the future. This survey is your opportunity to contribute your opinions to the creation of the WMP.

*A **watershed** is the land area that drains into a specific body of water.*

The Newfound Watershed



The Newfound Lake Watershed (the entire area of land draining to Newfound Lake), like many in New Hampshire, is undergoing significant changes that will have lasting impacts on communities and residents of the region. To understand and plan for the impacts of these changes efficiently and effectively it is important to understand residents' opinions and their desires for the future. As a resident of one of the communities within the watershed we need your input to help guide the creation of the Newfound Watershed Master Plan.

Please take some of your valuable time to help in this important effort by answering each of the following questions by circling the response that best corresponds to your answer. The information collected will be used to develop a watershed plan to provide usable information to communities in the watershed to help them plan for the future.

If you encounter a question for which you do not know the answer, please indicate this by writing "DK" (for "don't know') in the margin next to that question. If you would like to explain any of your answers or make additional comments, please write that information legibly by the question that you are addressing.

Once you have completed the questionnaire, please place it in the reply envelope provided and drop it in the mail; no additional postage is necessary. ***Thank you!***

1. In your opinion, how would you rate the following aspects of the Newfound Lake Watershed as it exists now?

	Bad	Poor	Fair	Good	Excellent	Don't Know
A. The overall image of the area	1	2	3	4	5	DK
B. The friendliness within the region	1	2	3	4	5	DK
C. The visual attractiveness of the watershed	1	2	3	4	5	DK
D. The availability of conservation funding programs	1	2	3	4	5	DK
E. The availability of conservation technical assistance	1	2	3	4	5	DK
F. Opportunities for economic growth in the region	1	2	3	4	5	DK
G. The amount of wildlife habitat in the watershed	1	2	3	4	5	DK
H. The overall quality of water in rivers, streams, or lakes in the watershed for catching fish and/or swimming	1	2	3	4	5	DK

2. Please indicate your level of agreement with the following statements about the Newfound Lake Watershed.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
A. The watershed has changed a great deal in the last 10 years.	SD	D	N	A	SA
B. The economic stability of my community depends on good water quality.	SD	D	N	A	SA
C. Taking action to protect water quality in the watershed is too expensive for me.	SD	D	N	A	SA
E. When managing lands, the economic health of communities in the watershed should be given highest priority.	SD	D	N	A	SA
F. My household doesn't have much impact on water quality in the Newfound Lake Watershed.	SD	D	N	A	SA
G. What I do on my land doesn't make much difference in overall water quality in the watershed.	SD	D	N	A	SA
I. I would be willing to make changes to protect water quality.	SD	D	N	A	SA
J. Laws or regulations are the only way that landowners in the watershed will consider water quality when they manage their lands.	SD	D	N	A	SA
K. Regulations that protect water quality are too strict.	SD	D	N	A	SA

3. In your opinion, how important or unimportant are each of the following objectives for the management of the Newfound Lake Watershed?

	Not at all Important		Neutral		Very Important	Don't Know
A. Ensure clean water supplies for public use	1	2	3	4	5	DK
B. Ensure healthy water bodies that will support fish and other aquatic life	1	2	3	4	5	DK
C. Ensure the protection of private property rights	1	2	3	4	5	DK
D. Ensure that open spaces and natural areas exist for recreation	1	2	3	4	5	DK
E. Ensure that habitat for fish and other wildlife exist	1	2	3	4	5	DK
F. Ensure that local Master Plans and land use regulations are in place and up to date	1	2	3	4	5	DK

The following two questions ask specifically about Newfound Lake itself.

4. Please indicate your level of agreement with the following statements about how important *Newfound Lake* is to you.

	Strongly Disagree			Neutral			Strongly Agree
A. I feel that I really can be myself there.	1	2	3	4	5	6	7
B. For doing the things I enjoy most, no other place can compare to it.	1	2	3	4	5	6	7
C. It is my favorite place to be.	1	2	3	4	5	6	7
D. It reflects the type of person I am.	1	2	3	4	5	6	7
E. I really miss it when I am away too long.	1	2	3	4	5	6	7
F. It is the best place to do the things that I enjoy most.	1	2	3	4	5	6	7
G. There are better places to be than my lake.	1	2	3	4	5	6	7
H. I feel happiest when I am there.	1	2	3	4	5	6	7
I. Everything about it is a reflection of me.	1	2	3	4	5	6	7

5. What kind of place is *Newfound Lake*? (Please circle ONE response per line.)

The lake…	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
A. Is a scenic place.	SD	D	N	A	SA
B. Has too many buildings on the shore.	SD	D	N	A	SA
C. Is a family place.	SD	D	N	A	SA
D. Has been damaged by local land uses.	SD	D	N	A	SA
E. Is a pristine wilderness.	SD	D	N	A	SA
F. Has been harmed by overuse.	SD	D	N	A	SA
G. Is a place mostly for vacationers.	SD	D	N	A	SA
H. Is a place of high environmental quality.	SD	D	N	A	SA
I. Is a community of neighbors.	SD	D	N	A	SA
J. Is a place to escape from civilization.	SD	D	N	A	SA
K. Has many species of wildlife and plants.	SD	D	N	A	SA
L. Has too many people using it.	SD	D	N	A	SA
M. Is very peaceful.	SD	D	N	A	SA
N. Has very polluted water.	SD	D	N	A	SA
O. Is very crowded.	SD	D	N	A	SA
P. Has a lot of public access.	SD	D	N	A	SA
Q. Has changed a lot over the years.	SD	D	N	A	SA

6. How many people around the watershed do you know on a first name basis?

☐ No one ☐ 1-5 ☐ 6-10 ☐ 11-20 ☐ 21-50 ☐ More than 50

7. How many of these people would you consider close personal friends?

☐ No one ☐ 1-5 ☐ 6-10 ☐ 11-20 ☐ 21-50 ☐ More than 50

8. Overall, how would you rate water quality in each of the following?

	Poor	Fair	Good	Excellent	Don't Know
A. Streams in the watershed	☐	☐	☐	☐	☐
B. Newfound Lake	☐	☐	☐	☐	☐
C. Bodies of standing water in the watershed other than Newfound Lake	☐	☐	☐	☐	☐
D. The tap water in your home	☐	☐	☐	☐	☐

9. How concerned are you about each of the following issues in the Newfound Lake Watershed?

	Not at all Concerned		Neutral		Very Concerned	Don't Know
A. Loss of open space due to residential development	1	2	3	4	5	DK
B. A decrease in water clarity in Newfound Lake	1	2	3	4	5	DK
C. The impact of building practices on lake shorelines	1	2	3	4	5	DK
D. The impact of building practices on stream and river banks	1	2	3	4	5	DK
E. Impacts on landowners from regulations to protect water quality	1	2	3	4	5	DK
F. Poor water quality	1	2	3	4	5	DK
G. Discharge of septic waste	1	2	3	4	5	DK
H. Crowding at recreational sites	1	2	3	4	5	DK
I. Runoff from lawn care fertilizers	1	2	3	4	5	DK
J. Runoff from insecticides and/or pesticides used for lawn care	1	2	3	4	5	DK
K. Runoff from automobiles and/or other fluids left on paved surfaces	1	2	3	4	5	DK
L. Overpopulation in the watershed	1	2	3	4	5	DK
M. Increased sediments in water bodies throughout the watershed	1	2	3	4	5	DK
N. Drinking water quality	1	2	3	4	5	DK
O. Invasive plant growth	1	2	3	4	5	DK
P. Economic costs of complying with land-use regulations	1	2	3	4	5	DK
Q. Loss of wildlife	1	2	3	4	5	DK
R. Loss of forested or wooded areas	1	2	3	4	5	DK
S. The presence of economic opportunities	1	2	3	4	5	DK
T. Development on hillsides and steep slopes	1	2	3	4	5	DK
U. Loss of agricultural land	1	2	3	4	5	DK
V. New road development	1	2	3	4	5	DK

T. If you have any areas of concern related to your watershed that we did not ask about, please identify them: ____________________

10. For each land use listed below please tell us whether you'd like to see less, more, or about the same of each in the Newfound Lake Watershed in the future?

	Less	About the Same	More	Don't Know
A. Residential development	☐	☐	☐	☐
B. Commercial development	☐	☐	☐	☐
C. National chain stores	☐	☐	☐	☐
D. Local businesses	☐	☐	☐	☐
E. Forests or woodlands	☐	☐	☐	☐
F. Wetlands	☐	☐	☐	☐
G. Public access to Newfound Lake	☐	☐	☐	☐
H. Outdoor recreation areas	☐	☐	☐	☐
I. Wildlife habitat	☐	☐	☐	☐
J. Land in agricultural production	☐	☐	☐	☐
K. High density developed residential areas	☐	☐	☐	☐

L. If there are other land uses you would like to comment on that we did not ask about, please let us know by identifying them: ____

____

11. Please indicate how often you perform the following activities on your land in the Newfound Lake Watershed.

	Never	Sometimes	Often
A. Pick up pet waste	☐	☐	☐
B. Use a phosphorus-free fertilizer on my lawn	☐	☐	☐
C. Leave or create a buffer of native plants between surface waters (lakes, streams) and my home	☐	☐	☐
D. Control soil erosion around my home	☐	☐	☐
E. Keep leaves and grass clippings out of shoreline areas and/or storm drains and culverts	☐	☐	☐
F. Encourage local businesses to carry phosphorous-free fertilizers	☐	☐	☐
H. Participate in local lake cleanup activities	☐	☐	☐
I. Test my soil before applying fertilizers	☐	☐	☐
J. Time the application of fertilizers when the forecast is rain free	☐	☐	☐
K. Leaving grass clipping on the lawn	☐	☐	☐
L. Following the manufacturer's guidelines for fertilizer application for my lawn	☐	☐	☐
M. Water my lawn	☐	☐	☐

12. Please indicate how concerned you would be if the following changes were to occur in your area:

	Not at all Concerned		Neutral		Very Concerned	Don't Know
A. Zoning rules became more restrictive	1	2	3	4	5	DK
B. Fishing regulations became more restrictive	1	2	3	4	5	DK
C. Hunting regulations became more restrictive	1	2	3	4	5	DK
D. Regulations were placed on water recreation	1	2	3	4	5	DK
E. Electric wind turbines were installed on ridgelines	1	2	3	4	5	DK

13. Please indicate how often you participate in the following activities in the Newfound Lake Watershed.

	Never	Sometimes	Often
A. Fishing on Newfound Lake (other than ice-fishing)	☐	☐	☐
B. Ice fishing on Newfound Lake	☐	☐	☐
C. Fishing in rivers, streams, and tributaries	☐	☐	☐
D. Swimming	☐	☐	☐
E. Boating (motorized)	☐	☐	☐
F. Boating (non-motorized)	☐	☐	☐
G. Hiking	☐	☐	☐
H. Camping	☐	☐	☐
I. Snowmobiling	☐	☐	☐
J. Bicycling	☐	☐	☐
K. Watching birds or other wildlife	☐	☐	☐
L. Dirt Bike, 4wheel, or ATV riding	☐	☐	☐
M. Cross country or back country skiing	☐	☐	☐
N. Snowshoeing	☐	☐	☐
O. Hunting	☐	☐	☐
P. Working on/maintaining property	☐	☐	☐
Q. Visiting with friends	☐	☐	☐
R. Relaxing and enjoying the views	☐	☐	☐
S. Community events/activities	☐	☐	☐
.T. Organized team sporting events	☐	☐	☐
U. Serve on local boards and/or committees	☐	☐	☐

14. Listed below are statements about the relationship between humans and the environment. For each one, please indicate whether you strongly agree, mildly agree, are unsure, mildly disagree, or strongly disagree with it.

	Strongly Disagree	Mildly Disagree	Unsure	Mildly Agree	Strongly Agree
A. We are approaching the limit of the number of people the earth can support.	SD	MD	U	MA	SA
B. Humans have the right to modify the natural environment to suit their needs.	SD	MD	U	MA	SA
C. When humans interfere with nature it often produces disastrous consequences.	SD	MD	U	MA	SA
D. Human ingenuity will insure that we do NOT make the earth unlivable.	SD	MD	U	MA	SA
E. Humans are severely abusing the environment.	SD	MD	U	MA	SA
F. The earth has plenty of natural resources if we just learn how to develop them.	SD	MD	U	MA	SA
G. Plants and animals have as much right as humans to exist.	SD	MD	U	MA	SA
H. The balance of nature is strong enough to cope with the impacts of modern industrial nations.	SD	MD	U	MA	SA
I. Despite our special abilities humans are still subject to the laws of nature.	SD	MD	U	MA	SA
J. The so-called "ecological crisis" facing humankind has been greatly exaggerated.	SD	MD	U	MA	SA
K. The earth is like a spaceship with very limited room and resources.	SD	MD	U	MA	SA
L. Humans were meant to rule over the rest of nature.	SD	MD	U	MA	SA
M. The balance of nature is very delicate and easily upset.	SD	MD	U	MA	SA
N. Humans will eventually learn enough about nature and now nature works to be able to control it.	SD	MD	U	MA	SA
O. If things continue on their present course, we will soon experience a major ecological catastrophe.	SD	MD	U	MA	SA

15. Please indicate how useful each of the following information sources would be to you to acquire information about the Newfound Lake Watershed?

	Not at all Useful	Somewhat Useful	Useful	Very Useful
A. Local/Regional Newspaper	☐	☐	☐	☐
B. Radio	☐	☐	☐	☐
C. Internet site of local lake organization (NLRA)	☐	☐	☐	☐
D. Town Meetings	☐	☐	☐	☐
E. Journals or Magazines	☐	☐	☐	☐
F. Government Publications	☐	☐	☐	☐
G. Television	☐	☐	☐	☐
H. Word of Mouth	☐	☐	☐	☐
I. Informational Signs	☐	☐	☐	☐
J. Pamphlets or Flyers	☐	☐	☐	☐
K. Classes or Seminars	☐	☐	☐	☐
L. Public meeting	☐	☐	☐	☐
M. Watershed specific internet site	☐	☐	☐	☐

N. If other sources of information not listed would be useful to you, please specify them: ______________________

____

16. Please indicate your level of agreement with the following assertions about how regulations in the watershed should be determined and implemented.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
A. Town governments should decide on regulations in the watershed.	SD	D	N	A	SA
B. Regulations for the Newfound Lake Watershed should be implemented at the state level.	SD	D	N	A	SA
C. Regulations for the Newfound Lakes Watershed should be implemented at the town level.	SD	D	N	A	SA
D. Local governments should collaborate with state government to decide on regulations in the watershed.	SD	D	N	A	SA
E. Local governments from all towns in the watershed should work together to decide on regulations for the Newfound Lake Watershed.	SD	D	N	A	SA

17. Please indicate your level of trust in information about the Newfound Lake Region from each of the following sources or groups.

	No Trust		Neutral		Trust Completely
A. Town Government or Administration	1	2	3	4	5
B. New Hampshire State Agencies	1	2	3	4	5
C. Federal Agencies	1	2	3	4	5
D. Newfound Lakes Region Association	1	2	3	4	5
E. Academic (University) Sources	1	2	3	4	5
F. Public Radio or Television	1	2	3	4	5
G. Chamber of Commerce	1	2	3	4	5
H. Local Companies	1	2	3	4	5

18. Background Characteristics.

The following questions will help us compare responses from people with differing background characteristics to identify important views and trends across different groups. Please remember that *<u>all responses are completely confidential and cannot be linked with you as an individual.</u>*

A. Which of the following best describes your residency in the Newfound Lake watershed?

- ☐ Year round
- ☐ Not year round → On average, how many months do you reside in the watershed per year? ________

B. How long have you lived at your current residence in the watershed?

- ☐ Less than 1 year
- ☐ 1-5 years
- ☐ 6-10 years
- ☐ 11-15 years
- ☐ 16-20 years
- ☐ over 20 years

C. For how many years have you lived in or visited the Newfound Lake Region?

- ☐ Less than 1 year
- ☐ 1-5 years
- ☐ 6-10 years
- ☐ 11-15 years
- ☐ 16-20 years
- ☐ over 20 years

D. About how many acres is the lot your house is on?

- ☐ ¼ acre or less
- ☐ ½ acre
- ☐ ¾ acre
- ☐ 1 acre
- ☐ 2-5 acres
- ☐ 6-10 acres
- ☐ 11-20 acres
- ☐ More than 20 acres

E. Do you maintain your property yourself, or do you hire out property maintenance such as landscaping and lawn-mowing?

☐ Self-maintain property ☐ Hire out property maintenance

F. Are you a current member of the Newfound Lakes Region Association?

☐ Yes ☐ No

G. How long does it usually take you to commute to work from home?

☐ Do not work ☐ Work from home ☐ Less than 5 minutes
☐ 5 to 9 minutes ☐ 10 to 14 minutes ☐ 15 to 19 minutes
☐ 20 to 24 minutes ☐ 25 to 30 minutes ☐ More than 30 minutes
☐ Other (please specify)______________________

H. Which category best describes your annual household income before taxes?

- ☐ Less than $20,000
- ☐ $20,000-$39,999
- ☐ $40,000-$59,999
- ☐ $60,000-$79,999
- ☐ $80,000-$99,999
- ☐ $100,000-$119,999
- ☐ $120,000-$139,999
- ☐ $140,000 or over

I. Do you feel your work or business is in some way economically dependent upon Newfound Lake?

☐ Yes ☐ No

J. Which of the following categories best describes your political orientation?

☐ Liberal ☐ Moderately liberal ☐ Moderate ☐ Moderately conservative ☐ Conservative
☐ Other
☐ Not Sure

K. In what year were you born? _________

L. What is your gender?

☐ Female ☐ Male

M. Which of the following best describes the highest level of education you have completed?

- ☐ Less than 12 years, no high school diploma
- ☐ High School/GED
- ☐ Some college
- ☐ Vocational/Trade Certificate
- ☐ Bachelor's Degree
- ☐ Master's Degree or higher

Thank you for your input. Please seal the completed questionnaire in the pre-addressed return envelope provided, and drop it in the mail.
No additional postage is necessary.

Funding for this project was provided in part by a grant form the NH Department of Environmental Services with funding from the US Environmental Protection Agency under Section 319 of the Clean Water Act.

2009 Survey of Watershed Communities

The Newfound Watershed Master Plan

Every Acre Counts

The Newfound Watershed Master Plan

A Report On The Second Community Survey

Photo By: Bill Hemmel - www.AerialPhotoNH.com

Prepared By The Center For The Environment, Plymouth State University

Dr. Brian W. Eisenhauer
Associate Director
Center For The Environment

Nicholas Stevenson
Timothy Sacco
Christian Weber

Project Partners:

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Introduction: Planning For The Future Of The Newfound Watershed

The Newfound Lake watershed (Figure 1) is a uniquely beautiful and rural watershed in New Hampshire that is home to residents of nine distinct towns. The watershed is valued for its beauty and as an essential economic resource in the region, and Newfound Lake itself has high scenic value and excellent water quality at the present time. Like many regions of New Hampshire the Newfound Lake watershed is experiencing many social and economic changes, including population growth and the related impacts on water quality. As a result it is a pivotal time for ensuring the long-term health and beauty of the watershed by developing a Watershed Master Plan for the Newfound Lake Region. This report presents the findings of a second, scientific random sample survey of property owners in communities in the watershed conducted to inform the creation of *Every Acre Counts: The Newfound Watershed Master Plan.*

The Newfound Watershed Master Plan identifies threats to our shared natural resources and specific implementation actions designed to protect them. It helps to promote an understanding of the shared resources in the region, and is a key component in managing those resources on a watershed scale, a scale that goes well beyond individual town boundaries. This plan is a pro-active step to protect what people value in the region that is more cost effective than restoration efforts would be in the future. The resulting *Every Acre Counts: The Newfound Watershed Master Plan* provides a comprehensive analysis of the Newfound Watershed and creates a "tool kit" of implementation actions and methods to maintain and improve the environmental quality of the Watershed into the future.

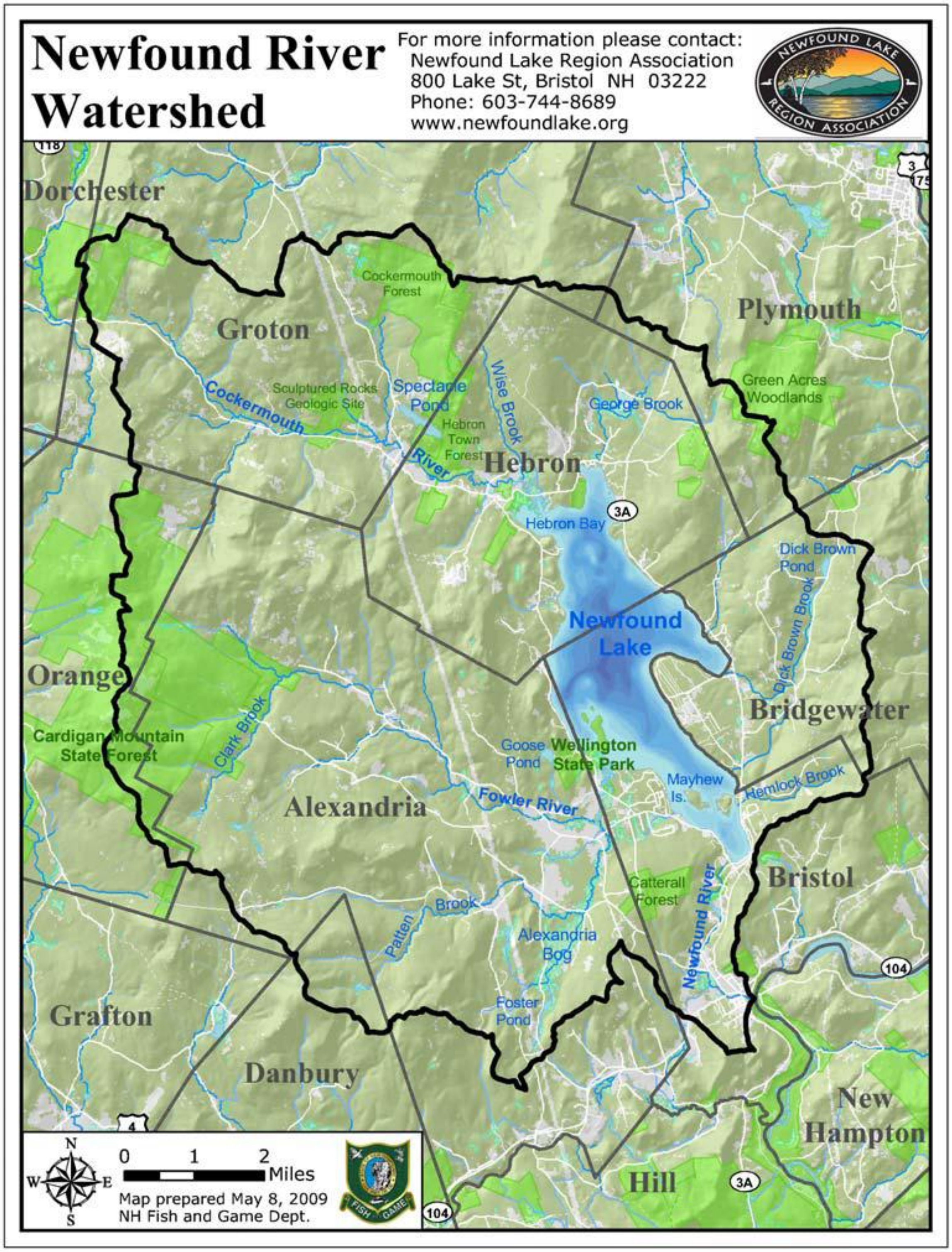
To be successful, a watershed master plan must incorporate the values and desires of residents and property owners. *Every Acre Counts* is designed to provide additional perspective to each of the local communities' efforts to help guide future planning and regulatory initiatives in the watershed as a whole. The consideration of property owners' values and desires in the findings in *Every Acre Counts: The Newfound Watershed Master Plan* will enhance towns' local master plans connections with residents and provide guidance for future implementation efforts to shape land use changes and proactively protect water quality that are grounded in local values. However these values are not static, and the plan is a living document that should be updated and amended as new information and resources become available.

> *To be successful, a watershed master plan must incorporate the values and desires of residents.*

Developing a watershed master plan is a complex process involving many areas of professional expertise and research, and many important tasks require an understanding of the social dynamics of issues within the watershed. Identifying residents' and property owners' desires for the future through visioning processes, understanding their concerns about management alternatives, and documenting the current understanding of best management practices are just a few examples of the ways watershed management plans necessitate an understanding of social factors to be effective.

To learn about the values and desires that need to be considered to guide the creation of *Every Acre Counts: The Newfound Watershed Master Plan* two scientific random sample surveys of property owners in communities in the watershed were conducted. The first survey was conducted in 2007, and the second in 2009. The surveys documented residents' and property owners' desires for the future of the region, perceptions of issues important to address in the watershed plan, and sentiments about possible recommendations made in the plan.

Figure 1. The Newfound Watershed.



Source: New Hampshire Fish and Game Department

Surveys provide a form of public input that is used in most community planning processes in the United States (American Community Survey Data for Community Planning. 2006. Taeuber, Cynthia M. Trafford Publishing, New York). An excellent review of the use of surveys in community planning and other community-centered projects is published by and available through the Western Rural Development Center (http://wrdc.usu.edu/); specifically informative work for this project is *"Surveys as a Tool for Community Based Research."* (Dr. Stanley Guy. 2005. Chapter 1: Community Centered Research: A Primer. Utah State University Press. Logan, Utah.).

Through consultation with the Newfound Watershed Master Plan project team, the project steering committee, and a review of relevant social science research specific goals for the *Every Acre Counts: The Newfound Watershed Master Plan* survey project were created. In addition, discussions with members of the project team identified specific uses for the information collected. The social science research was conducted to examine social factors relevant to efforts to maintain water quality, and the findings provide information for use in the development of the watershed master plan and the design and delivery of education and outreach programs.

The second survey project was designed to:

- Evaluate the watershed plan creation project
- Document property owners' perceptions of the importance of several goals for the plan
- Assess property owners' level of concern about specific issues addressed in the plan
- Determine property owners' support for regulatory measures that may be recommended in the plan
- Identify possible vectors for the delivery of information about the plan

Research Methods Used To Conduct The Survey

The self-administered questionnaire survey was administered to property owners in eight towns in the watershed. Newfound Watershed encompasses all, or parts, of nine towns and samples drawn were based on demographic data from the US Census and on geographic location in relationship to Newfound Lake. Property owners in the Town of Dorchester were not included in the survey sample for two reasons 1) only sixteen acres of the town are located in the watershed and 2) no portion of Dorchester's population resides in the watershed. Ultimately the randomly selected sample included 1,500 property owners from towns in the watershed, with the specific sampling strategy in each community defined using the following information about the communities in the watershed.

Table 1. Watershed Land Area, Size Of Population By Community (2005), And Samples Drawn From Each Community.

Town	Acres in Watershed	Percent of Watershed Acres	Town Population	Population in Watershed	Percent of Watershed Population	Sampled Population
Alexandria	22,616	35.8	1,472	1,030	23	330
Bridgewater	5,297	8.4	1,029	597	13	75
Bristol	7,212	11.4	3,185	1,975	45	379
Danbury	859	1.4	1,179	2	0.05	91
Dorchester	16	0 (rounding)	382	0	0	0
Groton	11,369	18	496	248	6	218
Hebron	12,151	19.2	539	539	12	260
Orange	2,141	3.4	311	12	0.3	47
Plymouth	1,490	2.4	6,387	26	0.6	100
Total	**65,151**	**100**	**14,980**	**4,429**	**100**	**1,500**

Source: Newfound Lake Region Association; US Census, NH Office of Energy and Planning.

To develop the sampling frame the research team worked with town halls to obtain lists of property owners from tax records. While the records are public, it was crucial to communicate with town administrators about the project in order to obtain these records electronically. In some cases this involved personal visits to town offices, and much dialogue. Once these records were obtained and identically formatted the samples were randomly selected from the resulting sampling frame. The samples from each town were then combined and duplicates were removed and replaced by the next name on the list until a sample of 1500 with no duplicates was created.

The survey was administered using a modified version of the Tailored Design Method (Dillman, 2009) that employed many techniques intended to enhance response rates including customizing letters, using multiple waves of contacts with carefully timed reminders, and providing clear information about the need for responses. The sampled population is sent a total of four contacts. First, prior to sending the survey, a letter is sent that informs them about the project, the coming questionnaire, and the importance of their response. In about a week a second contact is sent that includes the questionnaire, a cover letter with additional information about the project and confidentiality, and a postage paid return envelope for returning the questionnaire. The third contact consists of a postcard that is sent within the next two weeks as a reminder to complete and mail in the questionnaire. A final letter reiterating the importance of responses that also contains a replacement questionnaire and return envelope are sent two to three weeks after the reminder postcard.

A small proportion of the surveys sent to potential respondents from the original sample frame were returned as “undeliverable” due to inaccuracies in town records or other issues, and there were 46 of these cases. In order to maintain our original sample size, the undeliverable surveys were replaced and the same modified version of the Tailored Design Method was implemented to deliver these surveys. Within the replacement surveys, six were also undeliverable. In addition thirty-six more of the original sample mailings were returned as undeliverable late in the process due to an undocumented delay in the PSU mailroom. Rather than repeating the process and holding up data collection, the original sample went from 1,500 to 1,458. Of the 1458 questionnaires we sent to valid mailing addresses, 439 were completed and returned for an overall response rate of 30.1%.

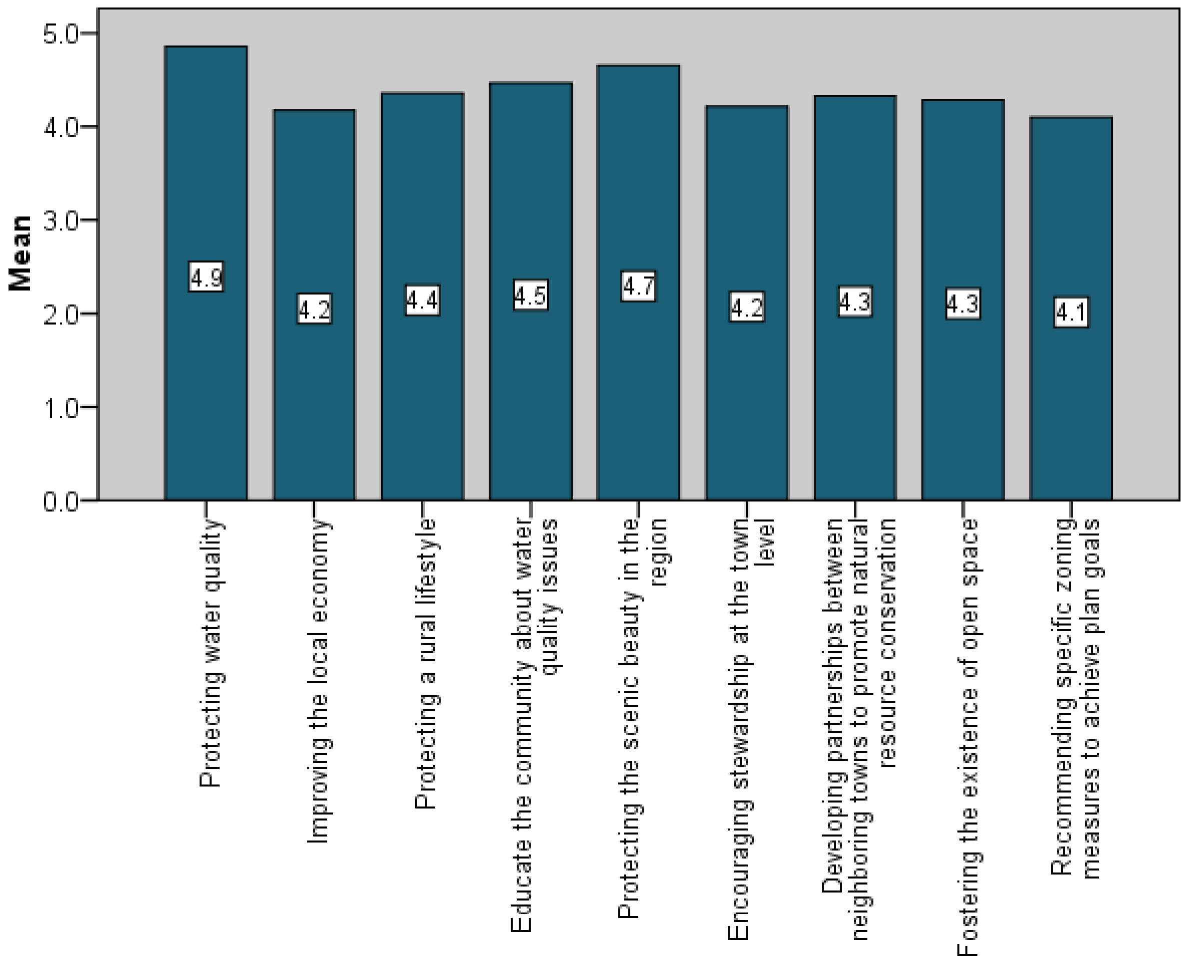
Analyses of the questionnaire data were conducted using Statistical Package for the Social Sciences (SPSS). Descriptive statistics, bivariate analyses, and multivariate procedures are used to examine the results and to identify important findings that can be applied to achieve the goals of the project.

This report presents key findings from the second survey of particular importance for the creation of *Every Acre Counts: The Newfound Watershed Master Plan* through the use of tables, charts, and by highlighting the most important findings. Complete information about the responses to all questions in the survey is provided in the appendix to this document, which presents tables and charts giving the complete responses to each question in the questionnaire. A copy of the questionnaire used in the survey appears at the end of this report and as the last section of the appendix.

<u>What Is Important? Goals For *Every Acre Counts: The Newfound Watershed Master Plan*</u>

A watershed master plan must provide guidance for achieving goals residents, property owners, and other stakeholders consider important. The first question in the second survey asked respondents to rate the importance of several specific goals in *Every Acre Counts: The Newfound Watershed Master Plan*. The chart below displays the mean level of importance of each specific goal in the plan as rated by respondents.

Figure 1. The Importance Of Specific Goals In *Every Acres Counts: The Newfound Watershed Master Plan* (1=”Not at All Important”; 5=”Very Important”).



The data indicate that respondents consider all the goals listed to be of high importance. These goals essentially represent the vision statement for *Every Acre Counts: The Newfound Watershed Master Plan*, so the high level of importance placed upon achieving them reinforces the appropriateness of the vision statement. While the overall perceived importance of all the goals listed is high, several important findings are evident:

- The goal in the plan considered most important by respondents is protecting water quality. It is also worthy of note that this is the goal with the least disagreement among respondents, with very strong and consistent rankings of its importance.

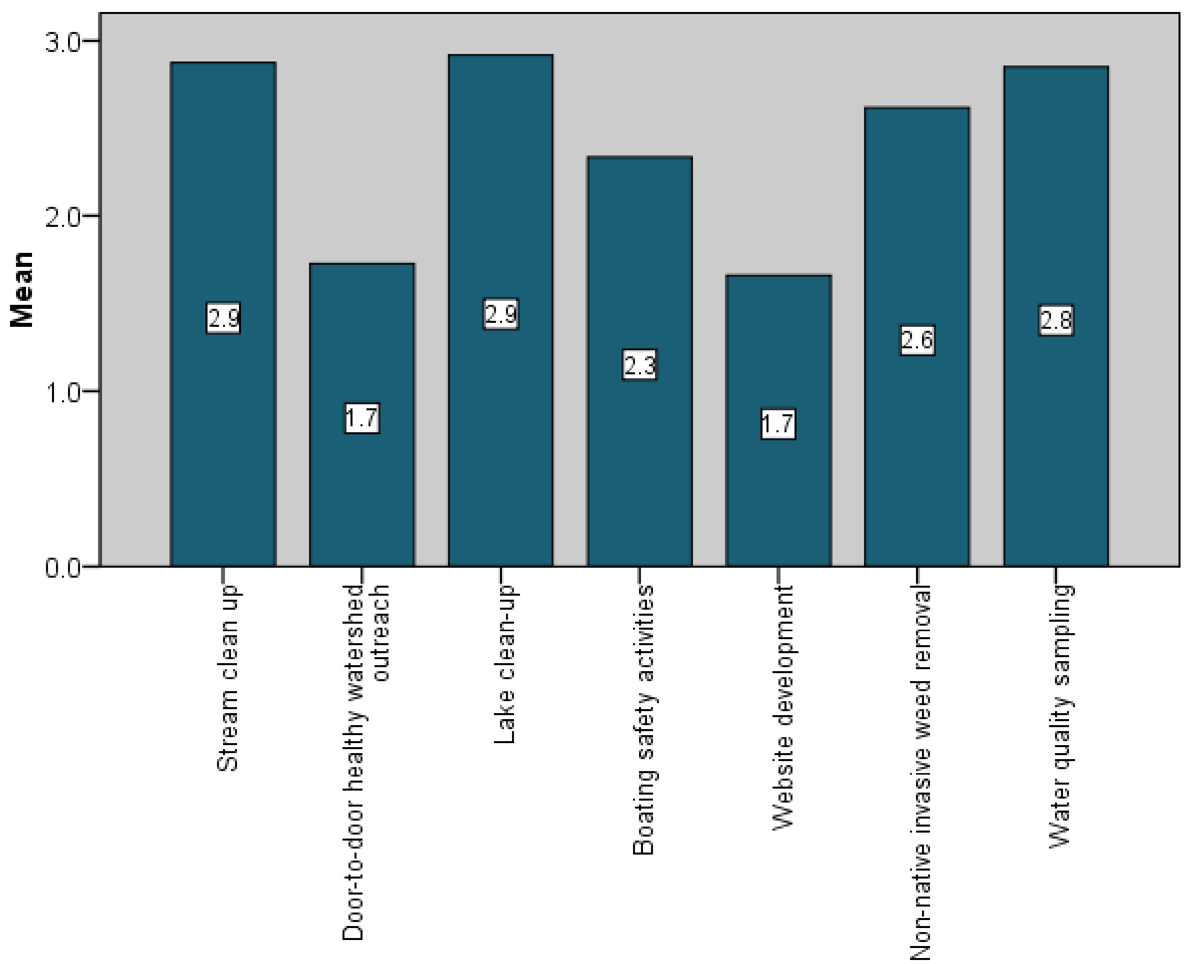
The goal in the plan considered most important by respondents is protecting water quality.

- The goal in the plan considered least important by respondents is recommending specific zoning measures to achieve plan goals. However, it is important to note that the importance of this goal was still perceived to be high. Recommending specific zoning measures was the most controversial goal of the plan, with the most variation among respondents' ratings of this goal's importance. Further statistical examination revealed that this variation is primarily due to a small percentage of respondents who are adamantly opposed to zoning.

How Can People Help? Volunteer Stewardship In The Watershed

To achieve the goals in a watershed plan citizens must become involved and active in diverse ways. Achieving a vision for the future of the region is not something that can be done by government officials and regulations alone. Volunteer stewardship activities are an important part of successful efforts to enact watershed plans in other areas. To help plan volunteer efforts in the Newfound watershed a question in the second survey asked respondents to indicate their willingness to participate in volunteer activities. The chart below presents the mean rating of willingness to participate in several volunteer activities.

Figure 2. Respondents' Willingness To Participate In Volunteer Stewardship Activities in the Newfound Watershed (1="Not Willing"; 5="Very Willing").



Considerable and consistent challenges face organizations relying on volunteers to achieve outcomes, and the data indicate that there is considerable variability in respondents' willingness to participate in the stewardship activities identified.

- Water quality sampling, lake clean-ups, and stream clean-ups are the volunteer stewardship activities in which respondents are most willing to participate.
- Web site development and door-to-door outreach are the activities in which respondents are least willing to participate.

This questionnaire item included an open ended "other" response space where respondents could write in any other volunteer stewardship activities in which they would be willing to participate. Content analysis techniques were used to analyze the comments provided and draw conclusions.

- The vast majority of the 78 comments given by respondents explained why they fell they are unable to participate in the volunteer stewardship activities.
    - 26 comments were made by respondents saying that they did not feel like they could participate because they are seasonal residents.
    - Another 21 comments were made explaining how they were unable to participate due to poor health.

  This information can be useful for developing information to encourage participation in volunteer programs. Considerations should be made to ensure volunteer options are provided that would be feasible for both seasonal residents and residents of poor health.
- 31 other comments were made by respondents identifying other potential volunteer activities, however no one activity was mentioned frequently enough (more than twice) to warrant the creation of its own category. Examples of activities mentioned include: monitor wildlife, educate fishermen about catch and release, be a neighborhood watchdog, and monitor loggers to prevent mud. For a detailed description of the content analysis and categories developed for question 5h please see the appendix to this document.

To achieve the goals in a watershed plan citizens must become involved and active in diverse ways.

As is consistent with other research on volunteer participation, the general pattern is that people are more willing to engage in volunteer activities that are outdoors, active, and have a social element than in activities that are indoors and more isolated. Activities that are consciously designed to build and foster a sense of place and place attachment are important components in efforts to build a consistent and long-term set of volunteer stewardship activities.

What's Changing In Our Backyard? Natural Resource Issues In The Watershed

The natural environment and the natural resources in the Newfound watershed are essential to the well-being of its residents and its economy. Protecting water quality is an important goal in the plan, and addressing concerns over phosphorous runoff pollution in the watershed is one example of the many complexities involved in protecting the natural resources valued by stakeholders. To identify what issues that may be addressed in *Every Acre Counts: The Newfound Watershed Master Plan* are most important to property owners a series of three questions asked them to indicate the importance of each of several environmental protection goals in the plan. Figures 3, 4, and 5 graphically illustrate the responses to these three questions below.

Figure 3. The Importance Of Protecting "Viewsheds" Throughout The Newfound Lake Watershed (1="Not at All Important"; 5="Very Important").

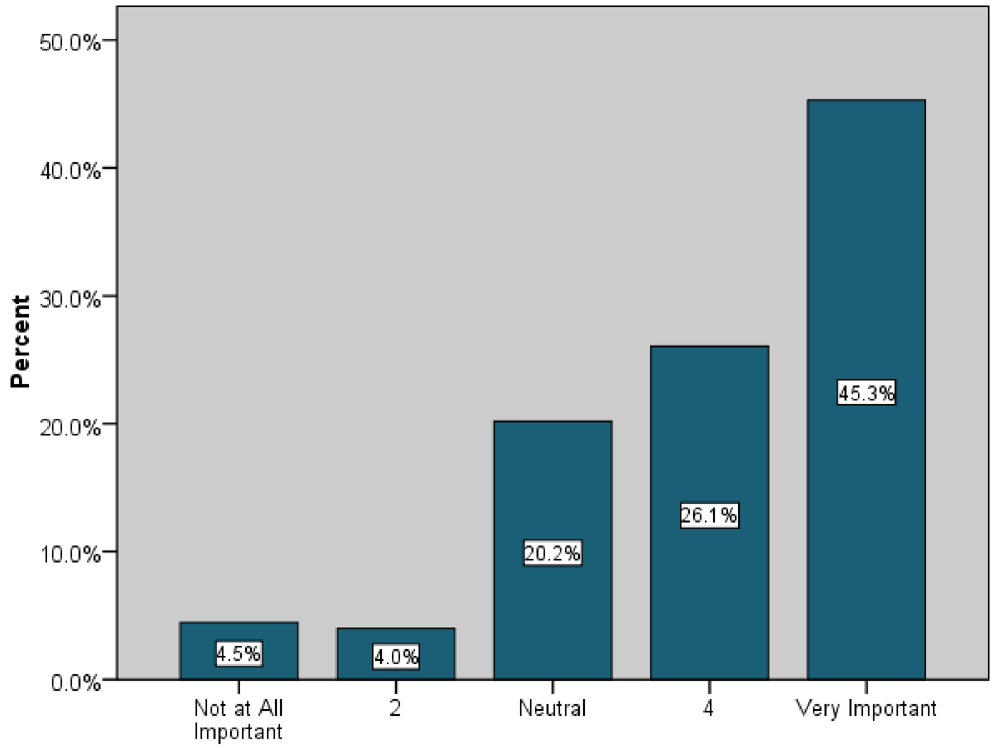


Figure 4. The Importance Of Reducing The Amount Of Salt Used On Public Roads To Protect Water Quality (1="Not at All Important"; 5="Very Important").

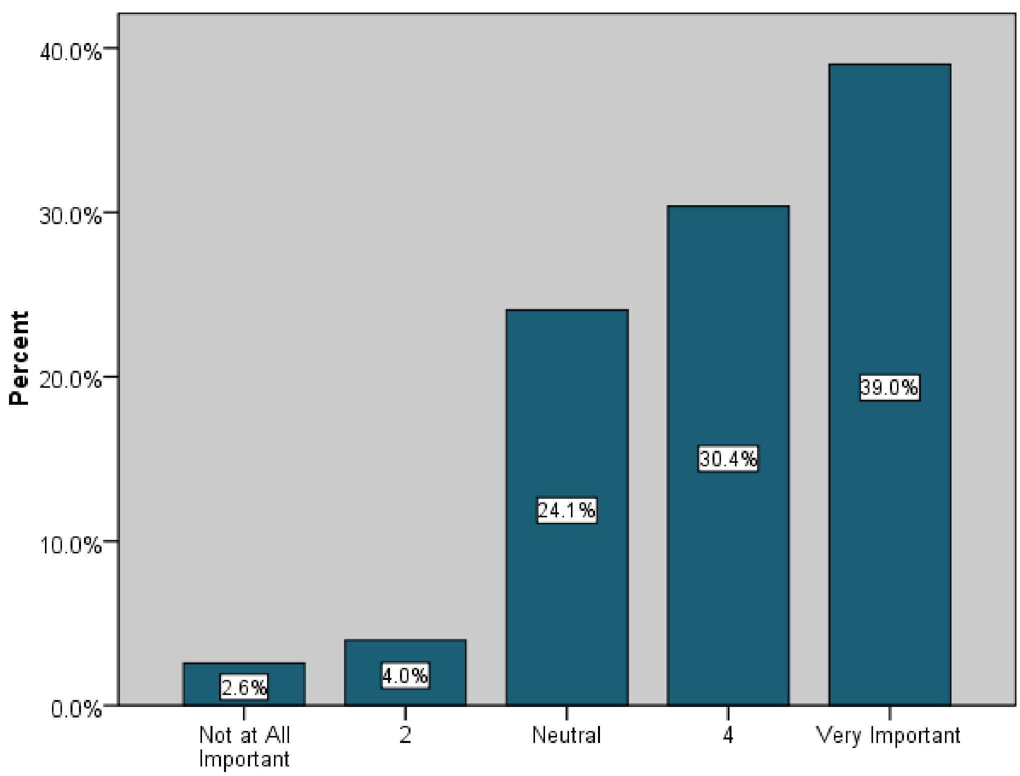
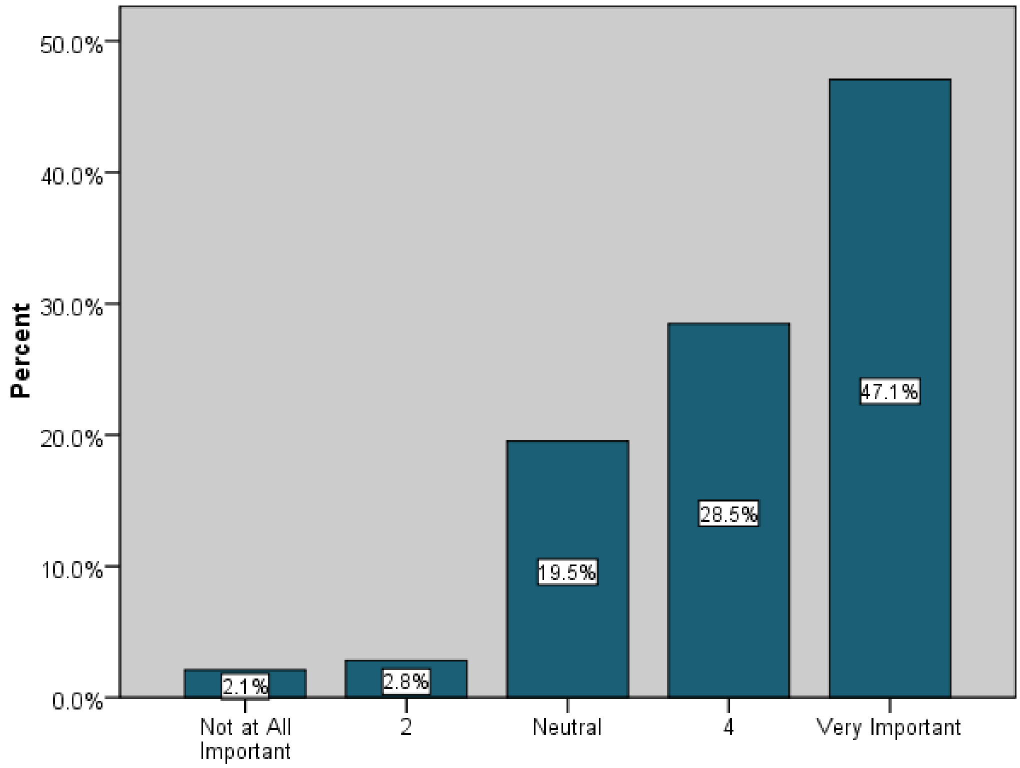
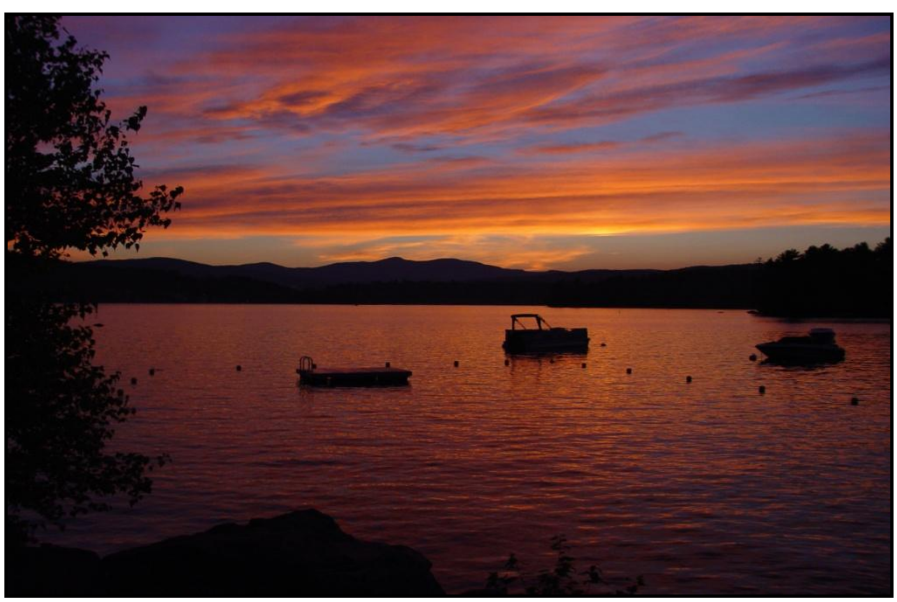


Figure 5. The Importance Of Increasing Town Support Of Non-Native Invasive Weed Prevention Programs (1=”Not at All Important”; 5=”Very Important”).

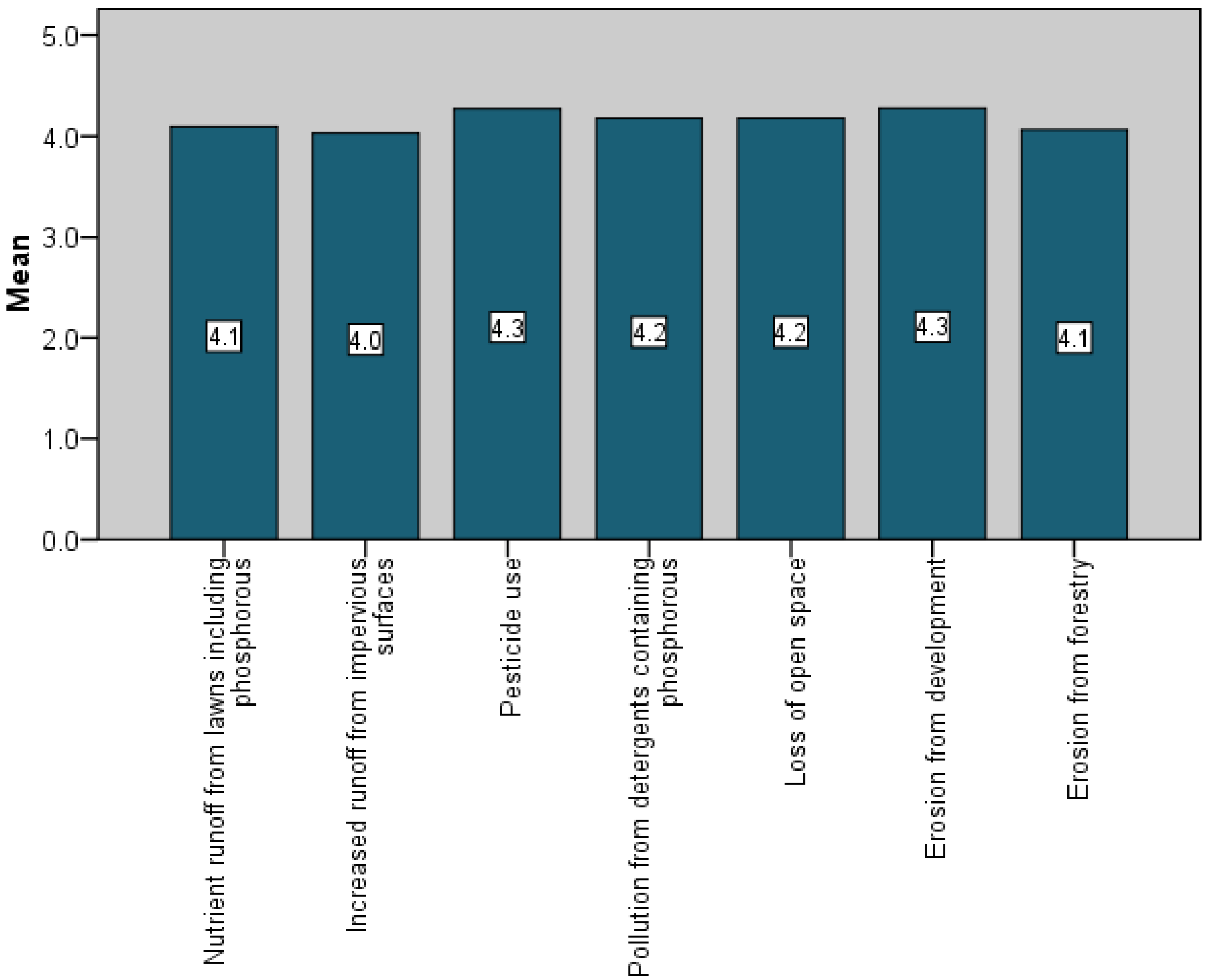


Protecting viewsheds, reducing the amount of salt used on public roads, and increasing town support of non-native invasive weed prevention programs were all of high importance to respondents, with little variation in responses. Of these three actions the perceived importance of increasing town support of invasive prevention programs was highest, but only slightly.



In addition to identifying the importance of the environmental protection goals, a second series of questions asked respondents to rank their level of concern about specific environmental issues. These issues have been identified by the watershed master plan project team through the process of interacting with citizens and hearing their concerns to create *Every Acre Counts: The Newfound Watershed Master Plan*. The following chart indicates the mean level of concern among respondents about each of the issues.

Figure 6. Levels of Concern About Specific Environmental Issues In The Newfound Watershed (1=”Not at All Concerned”; 5=”Very Concerned”).



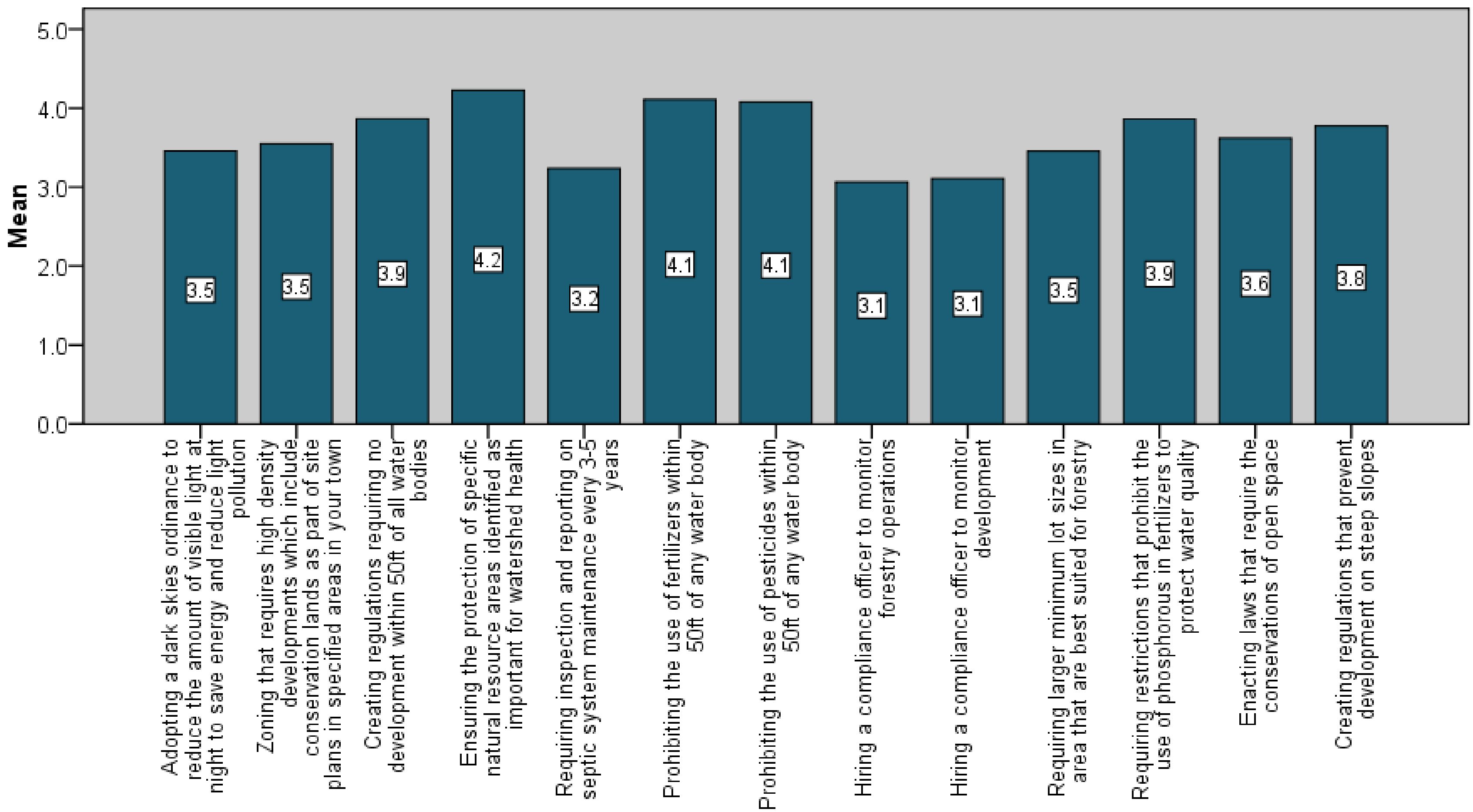
The data indicate that respondents have high levels of concern about all the issues identified, with little variation. Concerns are highest about erosion from development and pesticide use, and lowest about increased runoff from impervious surfaces.

Natural resources are highly valued by respondents, who support protecting them through the master plan.

What Should Be Done? Levels Of Support For Regulatory Measures

One of the most important parts of a watershed master plan are recommendations towns can follow to achieve the vision for the future of the region the plan represents. Some of the recommendations in a master plan are draft regulatory measures towns can use as examples to create their own ordinances to achieve their goals. To understand property owners' opinions about regulatory measures that may be recommended in *Every Acre Counts: The Newfound Watershed Master Plan* a question asked respondents to identify their level of support for each of several specific regulatory measures. The results presented in the figure below indicate respondents' mean level of support for each.

Figure 7. Support For Regulatory Measures That May Be Recommended As Part Of *Every Acre Counts: The Newfound Watershed Master Plan* (1="Do Not Support"; 5="Fully Support").



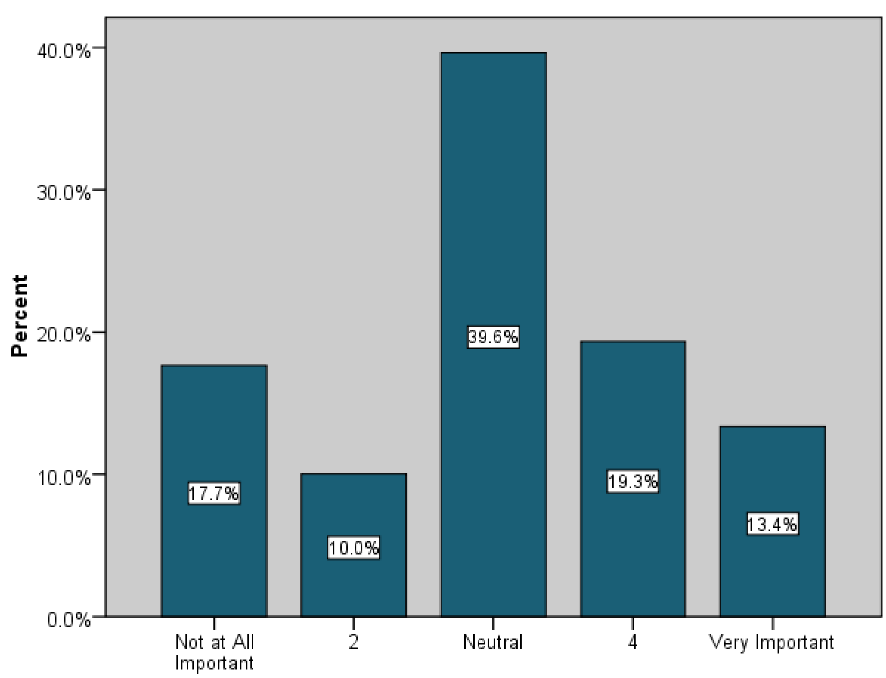
There is considerable variation in respondents' level of support for regulatory measures that may be recommended as part of *Every Acre Counts: The Newfound Watershed Master Plan*, but overall there is above neutral support for all the measures identified. The following results are especially important for the next steps in the master plan process as implementation begins.

- Respondents most strongly support "ensuring the protection of natural areas important for watershed health", "prohibiting the use of fertilizers within 50 feet of any water body", and "prohibiting the use of pesticides within 50 feet of any water body". Support for all these regulations is high. There is also very little variation among respondents in their support for the three regulations.
- It is important to note there is also high support for prohibiting the use of phosphorous in fertilizers.
- The least amount of support among respondents is for "requiring inspection and reporting on septic system maintenance every 3-5 years", and "hiring a compliance officer to monitor forestry".
- The most variation among respondents in their levels of support for possible regulations concerned compliance issues. These are especially controversial.
- As recommended in the first survey report, when choosing to enact relatively unsupported regulations it is important to make clear connections with desired outcomes publically and repeatedly.

Many respondents support regulations establishing a 50 foot buffer from water bodies that limits several activities that harm water quality.

Designing, drafting, and implementing regulatory measures is a complex technical process. It is common for municipalities of all sizes to employ the services of a professional planner and work collaboratively to complete these tasks. In *Every Acre Counts: The Newfound Watershed Master Plan* an important goal is to work collectively across town boundaries to achieve the plan's vision for the communities in the watershed. A question in the survey asked respondents to identify how important they believed it is to hire a professional planner to assist towns in the watershed with implementing *Every Acre Counts: The Newfound Watershed Master Plan*, and the results are presented in figure 8.

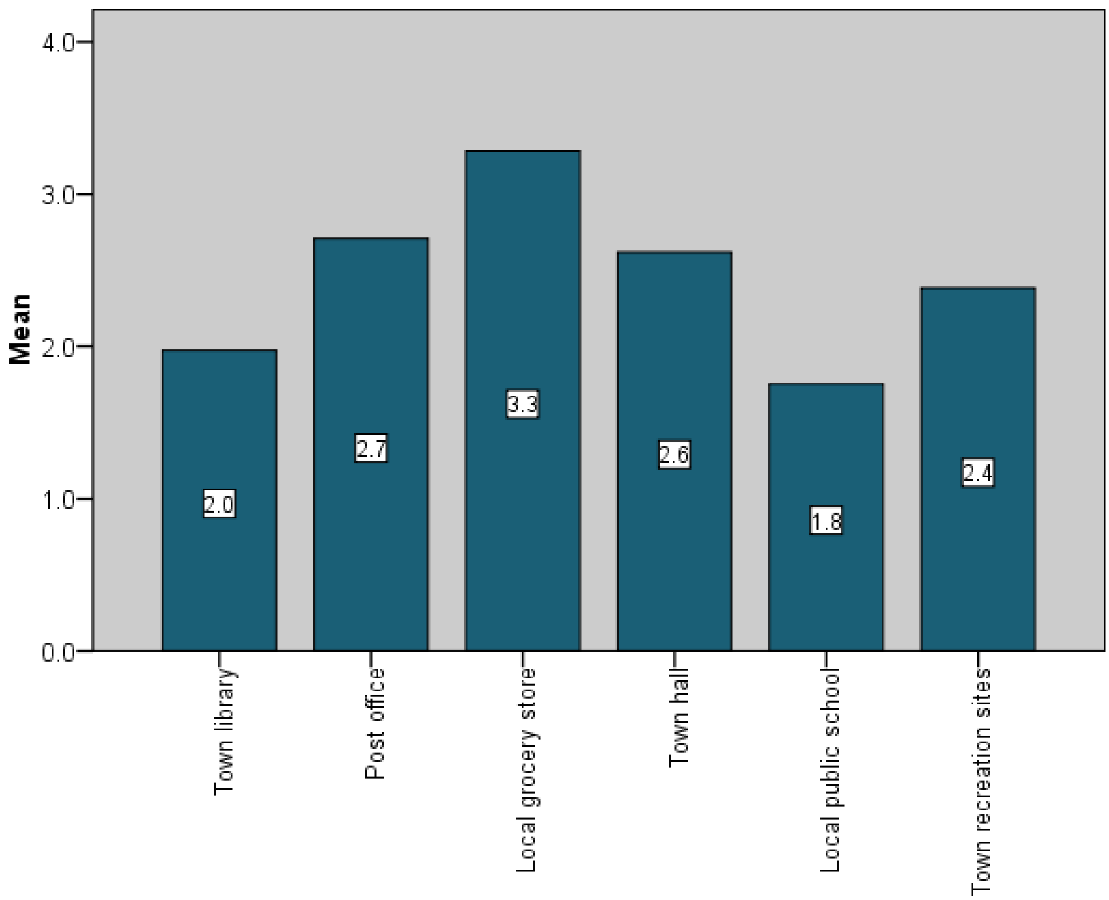
Figure 8. Importance Of Hiring A Professional Planner To Assist Towns With Watershed Plan Implementation (1="Not at all Important"; 5="Very Important").



How Can We Tell People About *Every Acre Counts: The Newfound Watershed Master Plan*?

An important goal of *Every Acre Counts: The Newfound Watershed Master Plan* is to create awareness of the project and its potential contributions to our communities so the plan can be used as a starting point for many activities. To determine how to best raise awareness of the plan a question in the survey asked property owners to identify how likely they would be to notice information about the plan in locations within their community. Figure 9 presents the mean rating of the likelihood respondents would notice planning information at specific local locations.

Figure 9. The Likelihood Respondents Will Notice Information About Watershed Planning At The Following Locations (1="Not Likely"; 5="Very Likely").



Question twelve included an open ended option where respondents could write in other places they would be likely to notice information about watershed planning. 113 comments were made and content analysis techniques were used to analyze these comments and draw conclusions.

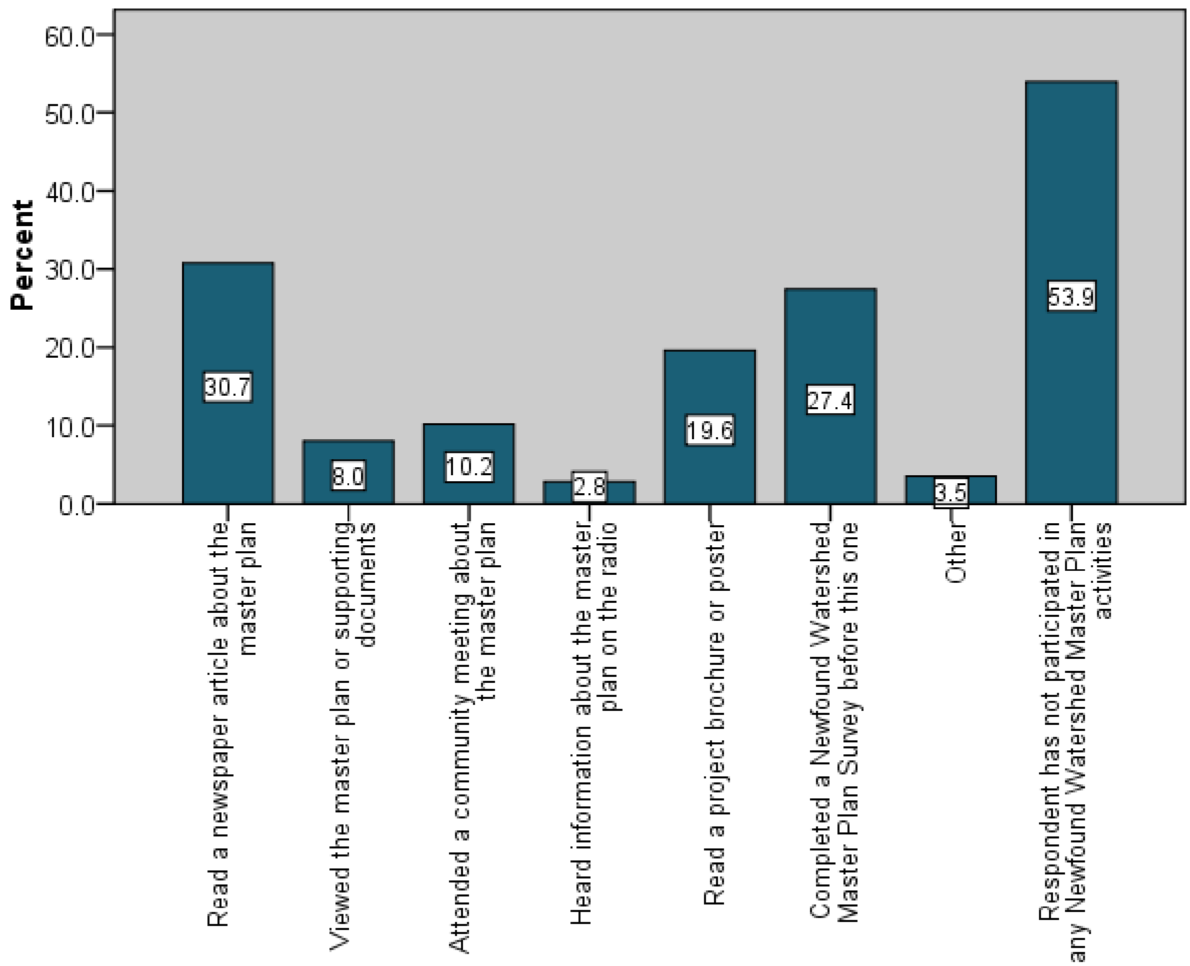
- The three locations most frequently mentioned were local business (23 comments), local newspaper (20 comments), and town transfer station (11 comments)
- The other 59 comments made listed several options such as mailings (10 comments), websites (8 comments), municipal buildings (7 comments), and parks/town beach (7 comments).

The data above clearly indicates the locations respondents' felt they are most likely to notice information about watershed planning. In addition to the locations identified above, it should also be noted that several respondents suggested posting information at town transfer stations.

Evaluating The *Every Acre Counts: The Newfound Watershed Master Plan* Project

Evaluating the *Every Acre Counts* project is essential for understanding its successes and challenges and for applying the ideas that worked well in this project in other efforts. A series of questions appearing throughout the questionnaire asked respondents if they were aware of the project, how they know of it, if they have participated, and how it has affected them. The chart below presents the percentage of respondents participating in various project activities.

Figure 10. Percentage of Respondents Participating In Newfound Watershed Master Plan Project Activities.



As a whole the survey evaluation results provide evidence that the *Every Acre Counts: The Newfound Watershed Master Plan* project is successful in meeting many of its goals. The complete results for evaluation questions appear in the appendix to this document, with the major conclusions reviewed below.

- 60.9% of respondents indicated they were aware of the development of the master plan prior to receiving the second survey.
- The vision statement is an important part of the watershed plan, and 38.4% of respondents asserted that they have seen or heard it.

- When asked to indicate how important or unimportant it is that their town participates in the Newfound watershed master plan process on a scale from 1 to 5 (with 1 being “Not at all important” and 5 being “Very important”), 80.3% of respondents rated it as “important” or” very important.” Only 6.1% of respondents asserted it was “unimportant” or “not at all important.”
- As indicated in figure 10, the plan has been well-publicized and a surprising number of respondents have participated in some plan related activity.
    - The majority of respondents, 53.8%, have participated in some Newfound Watershed Master Plan Activity.
    - 31.3% of respondents have read a newspaper article about the project, which was an important component of the communications aspect of it.
    - About 10% of respondents have read the draft plan and/or attended community meetings.
    - 19.5% of respondents have read a project brochure or poster.
    - 27.5% of respondents completed the first watershed master plan survey.
    - The questionnaire item asking respondents which master plan activities they have participated in also included an open ended response “option” where respondents could specify other activities they have participated in that were not identified in the questionnaire. Of the 11 comments made in this section 2 said that they had received master plan information through mailings and 2 said that they gained exposure to the master plan by working directly for the NLRA. No other comments were mentioned more than once.

The evaluation data from the survey provide evidence that The Newfound Watershed Master Plan project is successful in meeting its goals.

- Perhaps the most important evaluation question is simply how this exposure has affected people’s thinking about, and actions within, the watershed. Achieving behavioral change is difficult, but the survey results indicate that the project has had some very positive effects.
    - 53.9% of respondents asserted that exposure to the project affected their thinking about the watershed.
        - The question asking respondents if their exposure to master plan activities had affected their thinking requested that if the respondent answered “yes” they were asked to “please specify” how their thinking was affected in a provided space. 53 comments in total were provided for this section.
            - Most comments (30) made by respondents stated that their exposure to master plan activities increased their awareness.
            - Fifteen comments were made stating that the exposure has increased their support for the plan. For more information and a full list of the comment categories please see the appendix to this document.
    - 24.3% of respondents stated that exposure to the project has caused them to change their behavior in the watershed.
        - The question asking respondents if their exposure to master plan activities had changed their behavior in any way requested that if the respondents answered “yes” they were asked to “please specify” how their behavior was affected.

        - Of the total 29 comments made in this section, the most common response was that this exposure increased the respondent's agreement/support for the master plan, with 8 comments made.
        - Six comments were made stating that the respondent had changed their behavior to be more environmentally responsible.
        - Five comments stated that the respondent no longer uses fertilizers containing phosphorus.
        - Six comments were made stating that the respondent has experienced an increase in awareness of watershed health issues. For further information and a full list of comments please see the appendix to this document.
    - A final question asked if exposure to the project has positively or negatively affected the respondents' thinking about the need for *Every Acre Counts: The Newfound Watershed Master Plan*.
        - 54.3% of respondents said the exposure has positively affected their thinking about the need for the plan.
        - Only 4.5% of respondents claimed exposure has negatively affected their thinking.
        - 41.2% said exposure has not changed their thinking about the plan.

Who Responded To The Survey?

In order to best understand the uses and limitations of the survey data collected a series of questions asked about the characteristics of the respondent and their household. Asking about background characteristics enables two important analyses: First, the data can be evaluated and compared with census data to identify any potential biases stemming from who responded to the questionnaire. Second, responses to all questions can be analyzed using multivariate statistical analyses to identify how respondents' characteristics are related to patterns of responses. This information can be used to better understand responses to specific questions that may be affected by differences between who responded to the survey and the population of all property owners in towns in the watershed.

The text below highlights some of the key demographic findings from the survey. Complete tables and charts representing responses to all questions in the survey including responses to open-ended questions are in the appendix to this document.

- The majority of the survey's respondents, 57.5%, live within the Newfound Lake region year round. Twenty-one respondents classified themselves as landowners, but neither a season nor full-time resident.
- 97.1% own their property, and 0.7% rent their property.
- The majority of the respondents, 74%, live in single family homes. 6.5% reported living in condominiums, and 8.4% reported that they owned land in the region that did not include a residential building of any kind.
- 54.2% of respondents reported that they were registered voters in the Newfound Lake region.
- 21.6% of respondents reported serving on a town board or commission at some time.
- 19.8% report owning a business or being employed by a local business in the area.

Familiarity With The NLRA

One goal of *Every Acre Counts: The Newfound Watershed Master Plan* is to empower towns and other organizations to play an active role in maintaining watershed health. The Newfound Lakes Region Association (NLRA) has played a pivotal role in the project, and as part of the assessment of project efforts information was collected from respondents about their familiarity with the organization. This information can be used to help the organization better plan for its role in the future. Responses to the three questions respondents were asked about the NLRA are summarized below.

- 59.2% of respondents asserted they are familiar with the NLRA, and 40.8% said they were not familiar with the organization.
- Of those expressing a familiarity with the organization, 60.6% stated that they are familiar with the goals of the organization.
- Of those expressing a familiarity with the organization, 47.2% asserted that they are familiar with the organization's mission statement.

Overall these responses are very encouraging for the NLRA, as the data indicate they are well-known and understood by property owners in the watershed.

What Characteristics Are Related To The Opinions Expressed By Respondents?

In order to best understand the uses and limitations of the survey data multivariate statistical analyses were performed to identify how respondent characteristics are related to patterns of responses. This information can be used to better understand responses to specific questions that may be affected by differences between who responded to the survey and the population of all property owners in towns in the watershed.

Conducting these analyses is a very time consuming, complicated, and technical process and accordingly the complete procedures of data analyses and their results are not presented here. To present useful information for plan implementation the section below highlights important relationships between respondent's characteristics and responses to specific questions in the survey for consideration when working with the survey data.

Residential Status: Year Round Or Seasonal

The following section reports on differences in responses between seasonal and full-time residents.

> *There are many significant differences between seasonal and permanent residents' support for possible regulations, with permanent residents being less supportive of zoning.*

- Both groups support the watershed master plan project at similar levels, with few differences between them. For example, the majority of both year-round and seasonal residents reported that it was "Important" or "Very Important" that their town participates in the Watershed Master Plan process.
- There are several significant differences between the residential status of a respondent and their opinions on the goals of the Newfound Watershed Master Plan. Seasonal residents feel each goal is more important than

their full-time resident counterparts, and in particular place much more importance in the plan's goal to recommend specific zoning measures.

- Few differences exist between seasonal and full-time residents' willingness to engage in volunteer stewardship activities.
- Seasonal residents have higher levels of concern about all the environmental issues facing the Newfound watershed than full time residents.
- Understandably, there is a statistically significant relationship ($p<.001$) between a respondent's residential status and whether or not they owned or worked for a business in the area. Only three Seasonal residents reported owning or working for a business in the region.
- There was also a significant relationship ($p<.001$) between a respondent's residential status and what type of home they owned. Year-round residents are more likely to own single family residences than seasonal residents.
- There are many statistically significant relationships between the respondents' residential status and their opinions on various zoning regulations.
    - There is a statistically significant relationship ($p<.01$) between a respondent's residential status and their support for ensuring protection of specific natural resource areas that is identified in the Watershed Master Plan. Both groups consider such efforts important, but seasonal residents support them especially strongly.
    - There is also a statistically significant relationship ($p<.01$) between a respondent's residential status and their support for laws that require the conservation of open space, with seasonal residents being more supportive of such laws.
    - Finally, there are significant relationships between a respondent's residential status and their support for zoning requiring high density developments that include conservation land, requiring reporting on septic system maintenance, and requiring minimum lot sizes in areas best suited for forestry, with seasonal residents being more supportive of such measures.

Type of Property Owned In The Watershed

Differences in responses among those who own a single family home and those who live in other settings, such as apartments, condominiums, or those who simply own land in the watershed, are highlighted below.

- After running statistical tests, it can be concluded that there are few statistically significant relationships between the type of property the respondent owns or occupies and their opinions about many of the issues going on in the Newfound Lake region which they were asked about.
- There were a few exceptions to this, the most notable being the relationship between property owned or occupied and the respondents support for prohibiting the use of pesticides within 50 feet of any water body ($p<.01$), where single family home owners have lower levels of support for the measures.
- The other two relationships that proved to be statistically significant was the property owned or occupied by the respondent and their knowledge of the Newfound Lake Regional Association ($p<.001$) and also whether or not the respondent was a registered voter ($p<.001$). Respondents owning single family homes are more likely to know the NLRA and more likely to be registered voters, not surprisingly.
- Some variations amongst answers are noticeable between different property types owned or occupied by the respondents. The respondents who were included in the "None (own no property within the watershed)" and "Other" seemed to have more neutral feelings about a variety of issues, where respondents that owned or occupied properties like "Single family

homes" or "Condominiums" tend to have more variation and opinion in their support for issues going on in the area. In general respondents are in support of zoning regulations, with the exception of members of the "None" or "Other" residential categories, who tended to stay neutral on the topics.

- Single family homeowners are less supportive of putting a 50 foot buffer around bodies of water than other types of property owners.

Other Characteristics

In addition to the analyses described above responses to the survey were also statistically examined to determine what, if any, other demographic variables had relationships with responses to substantive questions about the master plan process. Whether a respondent was a registered voter, if they had served in local governance, if they rent or own their property, or if they are employed or own a business in the watershed were all variables examined to determine their relationships with responses to the survey. Very few differences exist amongst these categories, and the few findings of potentially important differences are highlighted below.

- There was no statistically significant relationship between a respondent's opinion on zoning regulations and whether or not that respondent was registered to vote in the Newfound Lake region.
- There is a statistically significant relationship ($p<.001$) between whether or not a respondent works for or owns a business in the Newfound Lake region and their support for hiring a compliance officer to monitor forestry operations. For the respondents that do work for or own their own business in the area, the majority are not in support of hiring a compliance officer.
- There were statistically significant relationships between the goals of the master plan and whether or not a respondent had ever served on a town board or commission. The most significant relationships were in the importance of retaining the rural lifestyle, and the importance of encouraging stewardship on the town level. In both cases respondents who have served on a town board or commission place more importance on the goal in the plan.

Overall there were relatively few significant differences among respondents. The existence of few differences is promising for the implementation of the master plan, as it indicates there is a great deal of agreement among the public about the issues facing the region and steps to take to address them.

As a whole there were relatively few differences across respondents with different characteristics, which is evidence of a shared vision for the region.

Conclusions

The survey results are very encouraging for the success of *Every Acre Counts: The Newfound Watershed Master Plan*. The second survey was conducted as part of the master plan project, and the random sample survey of close to 1500 property owners in communities in the watershed resulted in the receipt of close to 450 completed questionnaires, a response rate of 30.1%. This is excellent representation for a community planning survey, and the data can be useful for understanding property owners' desires and values when planning for the future of the region.

There is strong support for and awareness of the master plan process in the watershed. Respondents readily recognize the connections between environmental health, the economic opportunities in the region, and the well-being of residents. Accordingly they support efforts to protect natural resources, oftentimes even in the case of enacting zoning, which is a contentious issue in the region.

The data reported here and in the appendix have many applications, and the reports should be used as a reference guide in a wide variety of future planning and communication efforts. Several findings are especially important for the preparation of the final draft of *Every Acre Counts: The Newfound Watershed Master Plan* and the efforts to implement the document, and are highlighted below.

- The vast majority of respondents are very supportive of the plan and are aware of its creation. 61.3% of respondents indicated they were aware of the development of the master plan. When asked how important or unimportant it is that their town participates in the Newfound watershed master plan process, 80.3% of respondents rated it as "important" or" very important." Only 6.1% of respondents asserted it was "unimportant" or "not at all important."
- Respondents consider all the goals of the master plan listed to be of high importance. However, the goal in the plan considered most important by respondents is protecting water quality.
- Respondents are more willing, in general, to engage in volunteer activities that are outdoors, active, and have a social element. Volunteer coordinators should make efforts to develop and advertise volunteer programs that feature these elements.
- Respondents indicate a high level of concern for all the specific environmental issues asked about in this survey, with little variation in responses. Not surprisingly, concerns about invasive species are especially high. The connections between recommendations in the plan, actions recommended and taken, and the protections they create for natural resources should be a featured part of communications about these efforts.
- There is considerable variation in respondents' level of support for regulatory measures that may be recommended as part of *Every Acre Counts: The Newfound Watershed Master Plan*, but overall there is above neutral support for all the measures identified.
    - Respondents most strongly support "ensuring the protection of natural areas important for watershed health", "prohibiting the use of fertilizers within 50 feet of any water body", and "prohibiting the use of pesticides within 50 feet of any water body".
    - The least amount of support among respondents is for "requiring inspection and reporting on septic system maintenance every 3-5 years", and "hiring a compliance officer to monitor forestry".
    - The most variation among respondents in their levels of support for possible regulations concerned compliance issues. These are especially controversial and should be addressed accordingly.
- A lot of variance exists among responses concerning how important or unimportant it would be for towns to hire a professional planner to assist with plan implementation. 28% of respondents feel this is either "not at all important" or "unimportant", while 33% feel it is "important" or

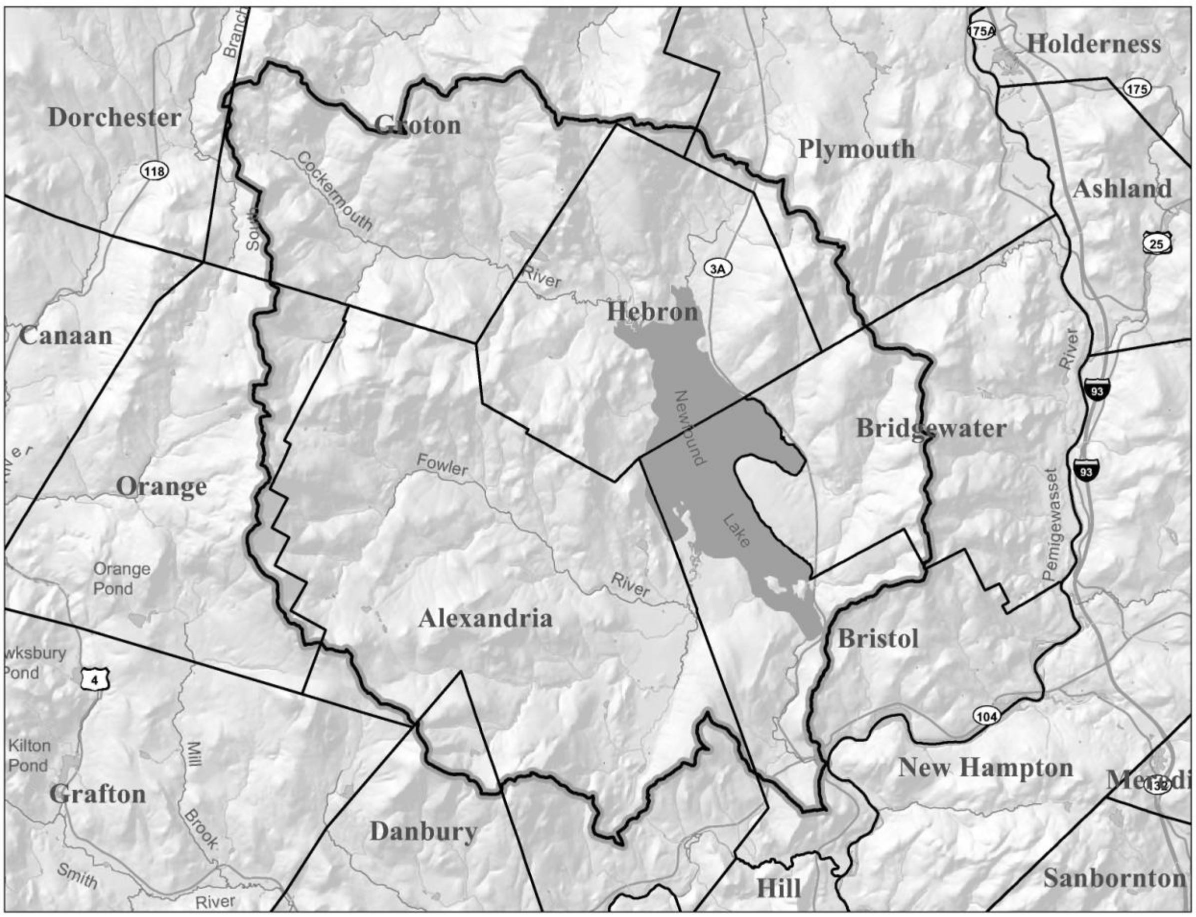
"very important", with the remainder of the responses being neutral. Clarifying the need for this activity is an essential part of engaging town in implementation, and communications about this need should be delivered to both decision makers and the general public.

- Statistical analyses indicate that only a few important variances among responses exist across groups of respondents with different characteristics.
  - Seasonal residents are far more supportive of zoning regulations and ensuring protection of specific natural resource areas, suggesting that any education and outreach efforts would be more successful if audience segmentation is considered.
  - Single family homeowners have less support for the use of 50 foot buffers from water bodies to regulate some activities than respondents residing in other housing.
  - Respondents who have served on town boards or commissions place more importance on the goals of retaining a rural lifestyle and encouraging stewardship at the town level than respondents who have not served in such a capacity.
- Most respondents are familiar with the NLRA (59.2%) and its goals.
- Data indicate that the *Every Acre Counts: The Newfound Watershed Master Plan* project is successful in meeting many of its goals.

Every Acre Counts

The Newfound Watershed Master Plan

A Second Community Survey to Inform the Plan's Creation



The Newfound Watershed

NEWFOUND LAKE REGION ASSOCIATION

Plymouth State UNIVERSITY
Center for the Environment

UNIVERSITY of NEW HAMPSHIRE
Cooperative Extension

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

The Newfound Lake region is one of the crown jewels of New Hampshire. The watershed is valued for its beauty and as an essential economic resource. Like other areas of New Hampshire the area is experiencing many changes. This is a critical time to plan to protect resources and economic opportunities in the region by helping towns coordinate their planning efforts.

To plan effectively we need your opinions. Many agencies, towns, and organizations are participating in the development of *Every Acre Counts: The Newfound Watershed Master Plan*. The plan will provide useful information to towns in the watershed to help them take steps to ensure the high quality of life valued by residents of the region exists in the future. In addition to documenting important social, economic, and environmental conditions in the watershed, the plan will make recommendations for town regulations and other actions that can be taken.

Please take some of your valuable time to let your town and the Newfound Watershed Master Plan project team know your opinions by circling the response that best fits your answer to each of the following questions. The information you share is completely confidential and will not be recorded or presented in any way that could link responses with the individuals who make them.

Thank you for your participation!

A watershed is the land area that drains to a specific body of water.
(Please see the cover for a map of the Newfound Lake Watershed)

1. Using a scale of 1 (NOT AT ALL IMPORTANT) to 5 (VERY IMPORTANT), please circle the number that best indicates how important you think each of the following goals is in *Every Acre Counts: The Newfound Watershed Master Plan*.

	Not at All Important		*Neutral*		*Very Important*	*Don't Know*
A. Protecting water quality	1	2	3	4	5	DK
B. Improving the local economy	1	2	3	4	5	DK
C. Protecting a rural lifestyle	1	2	3	4	5	DK
D. Educating the community about water quality issues	1	2	3	4	5	DK
E. Protecting scenic beauty in the region	1	2	3	4	5	DK
F. Encouraging stewardship at the town level	1	2	3	4	5	DK
G. Developing partnerships between neighboring towns in the watershed to promote natural resource conservation	1	2	3	4	5	DK
H. Fostering the existence of open space	1	2	3	4	5	DK
I. Identifying specific zoning measures towns can adopt to achieve watershed plan goals	1	2	3	4	5	DK

2. Prior to receiving this questionnaire, were you aware that a watershed master plan is being developed for the Newfound Lake region?

☐ Yes

☐ No *(Go to #3)*

2b. Have you seen or heard the vision statement in *Every Acre Counts: The Newfound Watershed Master Plan?*

☐ Yes

☐ No

3. How important or unimportant is it to you that your town participates in the Newfound watershed master plan process?

Not at all Important		*Neutral*		*Very Important*
1	2	3	4	5

4. How important or unimportant do you think it is for your town to hire a professional planner to assist with the implementation of *Every Acre Counts: The Newfound Watershed Master Plan*?

Not at all Important		*Neutral*		*Very Important*
1	2	3	4	5

Project participants are interested in what types of projects community members are willing to participate in to help implement Every Acre Counts: The Newfound Watershed Master Plan Plan.

5. Please circle the number that best indicates your willingness to participate in each of the stewardship volunteer activities listed below:

	Not Willing		*Maybe*		*Very Willing*	*Don't Know*
A. Stream clean-up	1	2	3	4	5	DK
B. Door-to-door outreach about ways to maintain a healthy watershed	1	2	3	4	5	DK
C. Lake clean-up	1	2	3	4	5	DK
D. Boating safety	1	2	3	4	5	DK
E. Web site development	1	2	3	4	5	DK
F. Non-native invasive weed removal (e.g. milfoil)	1	2	3	4	5	DK
G. Water quality sampling	1	2	3	4	5	DK

H. Other (Please specify any other stewardship volunteer activities in which you are willing to participate): ____

A "viewshed" is the area of land visible from a particular location. For example, your home's viewshed is the entire landscape visible from your property.

6. How important or unimportant do you feel it is to protect the "viewsheds" throughout the Newfound Lake watershed?

Not at all Important		*Neutral*		*Very Important*
1	2	3	4	5

7. How important or unimportant do you feel it is to reduce the amount of salt used on public roads to protect water quality?

Not at all Important		*Neutral*		*Very Important*
1	2	3	4	5

8. How important or unimportant do you feel it is to increase town support of non-native invasive weed prevention programs?

Not at all Important		*Neutral*		*Very Important*
1	2	3	4	5

9. Using a scale from 1 (NOT AT ALL CONCERNED) to 5 (VERY CONCERNED) please circle the number that best indicates how concerned you are about each of the following issues in the Newfound Lake watershed?

	Not at all Concerned		*Neutral*		*Very Concerned*	*Don't Know*
A. Nutrient runoff from lawns (including phosphorous)	1	2	3	4	5	DK
B. Increased runoff from impervious surfaces (e.g. roads, parking lots, roofs)	1	2	3	4	5	DK
C. Pesticide use	1	2	3	4	5	DK
D. Pollution from detergents containing phosphorous	1	2	3	4	5	DK
E. Loss of open space	1	2	3	4	5	DK
F. Erosion from development	1	2	3	4	5	DK
G. Erosion from forestry	1	2	3	4	5	DK

10. Using a scale of 1 (DO NOT SUPPORT) to 5 (FULLY SUPPORT) please circle the number that best indicates your level of support for the following regulatory measures that may be recommended as part of *Every Acre Counts: The Newfound Watershed Master Plan.*

	Do not Support		*Neutral*		*Fully Support*	*Don't Know*
A. Adopting a dark skies ordinance to reduce the amount of visible light at night and save energy	1	2	3	4	5	DK
B. Zoning requiring high density developments that include conservation lands as part of site plans in specified areas in your town	1	2	3	4	5	DK
C. Creating regulations requiring no development within 50 feet of all water bodies	1	2	3	4	5	DK
D. Ensuring the protecting of specific natural resource areas identified as important for watershed health	1	2	3	4	5	DK
E. Requiring inspection and reporting on septic system maintenance every 3-5 years	1	2	3	4	5	DK
F. Prohibiting the use of fertilizers within 50 feet of any water body	1	2	3	4	5	DK
G. Prohibit the use of pesticides within 50 feet of any water body	1	2	3	4	5	DK
H. Hiring a compliance officer to monitor forestry operations	1	2	3	4	5	DK
I. Hiring a compliance officer to monitor development	1	2	3	4	5	DK
J. Requiring larger minimum lot sizes in areas that are best suited for forestry	1	2	3	4	5	DK
K. Requiring restrictions that prohibit the use of phosphorus in fertilizers to protect water quality	1	2	3	4	5	DK
L. Enacting laws that require the conservation of open space	1	2	3	4	5	DK
M. Creating regulations that prevent development on steep slopes	1	2	3	4	5	DK

11. Which of the following *Every Acre Counts: The Newfound Watershed Master Plan* activities have you participated in? (Please mark all that apply)

- ☐ Read a newspaper article about the master plan
- ☐ Viewed the master plan or supporting documents on a Web site
- ☐ Attended a community meeting about the master plan
- ☐ Heard information about the master plan on the radio
- ☐ Read a project plan brochure or poster
- ☐ Completed a Newfound Watershed Master Plan Survey <u>before this one</u>
- ☐ Other (Please specify): ______________________________

- ☐ I have not participated in any Newfound Watershed Master Plan activities *(Go to #12)*

A. Has this exposure affected your thinking about the Newfound watershed?

- ☐ Yes (Please specify): ____
- ☐ No (please use the blank page on the back if additional space is needed)
- ☐ Not applicable

B. Has this exposure changed your behavior in the watershed in any way?

- ☐ Yes (Please specify): ____
- ☐ No (please use the blank page on the back if additional space is needed)
- ☐ Not applicable

C. Has this exposure positively or negatively affected your thinking about the need for *Every Acre Counts: The Newfound Watershed Master Plan*?

- ☐ It has positively affected my thinking about the need for the plan
- ☐ It has negatively affected my thinking about the need for the plan
- ☐ It has not changed my thinking about the need for the plan
- ☐ Not applicable

An important goal of Every Acre Counts: The Newfound Watershed Master Plan is to create awareness of the project and its potential contributions to our communities.

12. Please circle the number below that best indicates how likely or unlikely you would be to notice information about watershed planning at the following locations:

	Not Likely		Neutral		Very Likely	Don't Know
A. Town library	1	2	3	4	5	DK
B. Post office	1	2	3	4	5	DK
C. Local grocery store	1	2	3	4	5	DK
D. Town Hall	1	2	3	4	5	DK
E. Local public schools	1	2	3	4	5	DK
F. Town recreation sites (parks, etc.)	1	2	3	4	5	DK

G. Please indicate any other public areas that you would likely notice information about watershed planning: ____

13. Are you familiar with the Newfound Lake Regional Association (NLRA)?

- ☐ Yes →
- ☐ No *(Go to question 14)*

A. Are you familiar with the goals of the NLRA?
- ☐ Yes
- ☐ No

B. Are you familiar with the vision statement of the NLRA?
- ☐ Yes
- ☐ No

14. Are you a registered voter in the Newfound Lake region?
- ☐ Yes
- ☐ No

15. Have you ever served on any of your local town boards or commissions?
- ☐ Yes
- ☐ No

16. Are you employed by a business or do you own a business that operates in the Newfound Lake watershed?
- ☐ Yes
- ☐ No

17. Are you a year-round or seasonal resident of a town in the Newfound watershed?
- ☐ Year-round resident
- ☐ Seasonal resident
- ☐ Other (Please specify):____

18. What type of property do you currently own/occupy in the Newfound watershed?
- ☐ Single family home
- ☐ Condominium
- ☐ Mobile home
- ☐ Apartment
- ☐ Own land, no residential building on lot
- ☐ None (own no property within the watershed)
- ☐ Other (Please specify): ___________________

19. Do you rent or own your current property?
- ☐ Rent
- ☐ Own
- ☐ Other (Please specify): _____________________

<u>Thank you</u> for your input. Please seal the completed questionnaire in the pre-addressed return envelope provided, and drop it in the mail.

No additional postage is necessary.

Understanding the Views of Residents to Guide the Creation of Every Acres Counts: The Newfound Watershed Master Plan

Findings from the Second Watershed Community Survey

Complete Appendix of Survey Results

Prepared for

The People of the Newfound Lake Watershed, The Every Acres Counts Project Team, and The New Hampshire Department of Environmental Services

Prepared By The Center for the Environment, Plymouth State University

Dr. Brian W. Eisenhauer
Associate Director
Center for the Environment
Plymouth State University

Christian Weber
Nicholas Stevenson
Timothy Sacco
Center for the Environment
Plymouth State University

September, 2009

17 High Street, MSC #63
Plymouth, New Hampshire USA 03264
603.535.2497 bweisenhauer@plymouth.edu www.plymouth.edu/cfe

Contents

Introduction

This document is a reference to supplement the report of findings from the second random sample scientific survey of property owners in towns in the Newfound Lake Watershed. This report presents the results for responses to all questions in the survey in both tables and bar charts, and includes all written comments received as well.

The Newfound Lake watershed is a uniquely beautiful and rural watershed in New Hampshire that is home to residents of nine distinct towns. The watershed is valued for its beauty and as an essential economic resource in the region, and Newfound Lake itself has high scenic value and very good water quality at the present time. Like many regions of New Hampshire the Newfound Lake watershed is experiencing social and economic changes, including population growth and related impacts on water quality. As a result it is a pivotal time for ensuring the long-term health and beauty of the watershed by developing a Watershed Master Plan for the Newfound Lake Region.

To meet the need for social data in this planning project two random sample scientific surveys of residents of the Newfound Lake Watershed were conducted as part of the watershed plan development process.

Research Methods

The self-administered questionnaire survey was administered to property owners in eight towns in the watershed. When developing the sample the goal was to sample property owners, keeping in mind that decisions that affect the watershed are made at the town level. Ultimately the randomly selected sample included 1,500 property owners selected at random from town records of property owners in the watershed, and details of the distribution are in the second survey report.

A small proportion of the surveys sent to potential respondents from the original sample frame were returned as “undeliverable” due to inaccuracies in town records or other issues. In order to maintain our original sample size, the undeliverable surveys are replaced by the next names on the lists and the same steps were implemented to deliver these surveys. Within the replacement surveys, some were also undeliverable. Rather than repeating the process and holding up data collection, the original sample went from 1,500 to 1,458. Of the 1,458 questionnaires sent, 439 were completed and returned for an overall response rate of 30.1%.

The data below is presented to serve as a reference for community members and others, and is in several forms. The first section presents tables and charts of the responses to all questions in the second questionnaire. A great deal of time was also spent conducting detailed analyses of relationships between demographic and other variables of interest and attitudinal and perceptual measures, and the most important results are reviewed in the final report. Complete results from these analyses are available from the research team upon request, but are not included in the appendix due to space considerations.

We sincerely hope the data that follow are of use to citizens and decision makers as they plan for the future of the communities in the Newfound Lake Watershed.

Frequency Tables For All Questions In The Survey

Protecting water quality

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at All Important	3	.7	.7	.7
	2	1	.2	.2	.9
	Neutral	5	1.1	1.2	2.1
	4	35	8.0	8.2	10.4
	Very Important	381	86.8	89.6	100.0
	Total	425	96.8	100.0	
Missing	Don't Know	2	.5		
	Missing	12	2.7		
	Total	14	3.2		
Total		439	100.0		

Improving the local economy

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at All Important	10	2.3	2.4	2.4
	2	11	2.5	2.7	5.1
	Neutral	72	16.4	17.4	22.5
	4	123	28.0	29.8	52.3
	Very Important	197	44.9	47.7	100.0
	Total	413	94.1	100.0	
Missing	Don't Know	6	1.4		
	Missing	20	4.6		
	Total	26	5.9		
Total		439	100.0		

Protecting a rural lifestyle

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at All Important	6	1.4	1.4	1.4
	2	7	1.6	1.7	3.1
	Neutral	59	13.4	14.1	17.2
	4	111	25.3	26.6	43.8
	Very Important	235	53.5	56.2	100.0
	Total	418	95.2	100.0	
Missing	Don't Know	5	1.1		
	Missing	16	3.6		
	Total	21	4.8		
Total		439	100.0		

Educate the community about water quality issues

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at All Important	4	.9	.9	.9
	2	7	1.6	1.7	2.6
	Neutral	46	10.5	10.9	13.5
	4	103	23.5	24.3	37.8
	Very Important	263	59.9	62.2	100.0
	Total	423	96.4	100.0	
Missing	Don't Know	2	.5		
	Missing	14	3.2		
	Total	16	3.6		
Total		439	100.0		

Protecting the scenic beauty in the region

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at All Important	4	.9	.9	.9
	2	5	1.1	1.2	2.1
	Neutral	25	5.7	5.9	8.0
	4	80	18.2	18.9	27.0
	Very Important	309	70.4	73.0	100.0
	Total	423	96.4	100.0	
Missing	Don't Know	2	.5		
	Missing	14	3.2		
	Total	16	3.6		
Total		439	100.0		

Encouraging stewardship at the town level

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at All Important	8	1.8	2.0	2.0
	2	12	2.7	3.0	5.0
	Neutral	64	14.6	16.1	21.2
	4	113	25.7	28.5	49.6
	Very Important	200	45.6	50.4	100.0
	Total	397	90.4	100.0	
Missing	Don't Know	24	5.5		
	Missing	18	4.1		
	Total	42	9.6		
Total		439	100.0		

Developing partnerships between neighboring towns to promote natural resource conservation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at All Important	8	1.8	1.9	1.9
	2	7	1.6	1.7	3.6
	Neutral	54	12.3	13.0	16.7
	4	116	26.4	28.0	44.7
	Very Important	229	52.2	55.3	100.0
	Total	414	94.3	100.0	
Missing	Don't Know	10	2.3		
	Missing	15	3.4		
	Total	25	5.7		
Total		439	100.0		

Fostering the existence of open space

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at All Important	6	1.4	1.4	1.4
	2	17	3.9	4.1	5.5
	Neutral	55	12.5	13.2	18.8
	4	121	27.6	29.1	47.8
	Very Important	217	49.4	52.2	100.0
	Total	416	94.8	100.0	
Missing	Don't Know	9	2.1		
	Missing	14	3.2		
	Total	23	5.2		
Total		439	100.0		

Recommending specific zoning measures to achieve plan goals

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at All Important	24	5.5	5.9	5.9
	2	14	3.2	3.5	9.4
	Neutral	58	13.2	14.3	23.7
	4	118	26.9	29.1	52.8
	Very Important	191	43.5	47.2	100.0
	Total	405	92.3	100.0	
Missing	Don't Know	20	4.6		
	Missing	14	3.2		
	Total	34	7.7		
Total		439	100.0		

Respondent is aware of the development of the master plan

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	164	37.4	39.1	39.1
	Yes	255	58.1	60.9	100.0
	Total	419	95.4	100.0	
Missing	Missing	20	4.6		
Total		439	100.0		

Respondent has seen or heard master plan's vision statement

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	173	39.4	62.0	62.0
	Yes	106	24.1	38.0	100.0
	Total	279	63.6	100.0	
Missing	Not Applicable	134	30.5		
	Missing	26	5.9		
	Total	160	36.4		
Total		439	100.0		

Importance of town participation in the master plan process

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at All Important	15	3.4	3.6	3.6
	2	12	2.7	2.9	6.4
	Neutral	52	11.8	12.4	18.8
	4	108	24.6	25.7	44.4
	Very Important	234	53.3	55.6	100.0
	Total	421	95.9	100.0	
Missing	Not Applicable	1	.2		
	Missing	17	3.9		
	Total	18	4.1		
Total		439	100.0		

Importance of town hiring a professional planner to assist plan implementation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at All Important	74	16.9	17.7	17.7
	2	42	9.6	10.0	27.7
	Neutral	166	37.8	39.6	67.3
	4	81	18.5	19.3	86.6
	Very Important	56	12.8	13.4	100.0
	Total	419	95.4	100.0	
Missing	Don't Know	1	.2		
	Missing	19	4.3		
	Total	20	4.6		
Total		439	100.0		

Stream clean up

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Willing	86	19.6	23.2	23.2
	2	37	8.4	10.0	33.2
	Maybe	118	26.9	31.9	65.1
	4	66	15.0	17.8	83.0
	Very Williing	63	14.4	17.0	100.0
	Total	370	84.3	100.0	
Missing	Don't Know	31	7.1		
	Missing	38	8.7		
	Total	69	15.7		
Total		439	100.0		

Door-to-door healthy watershed outreach

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Willing	216	49.2	59.8	59.8
	2	62	14.1	17.2	77.0
	Maybe	54	12.3	15.0	92.0
	4	12	2.7	3.3	95.3
	Very Williing	17	3.9	4.7	100.0
	Total	361	82.2	100.0	
Missing	Don't Know	28	6.4		
	Missing	50	11.4		
	Total	78	17.8		
Total		439	100.0		

Lake clean-up

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Willing	91	20.7	25.2	25.2
	2	29	6.6	8.0	33.2
	Maybe	109	24.8	30.2	63.4
	4	70	15.9	19.4	82.8
	Very Williing	62	14.1	17.2	100.0
	Total	361	82.2	100.0	
Missing	Don't Know	34	7.7		
	Missing	44	10.0		
	Total	78	17.8		
Total		439	100.0		

Boating safety activities

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Willing	139	31.7	39.2	39.2
	2	52	11.8	14.6	53.8
	Maybe	81	18.5	22.8	76.6
	4	45	10.3	12.7	89.3
	Very Williing	38	8.7	10.7	100.0
	Total	355	80.9	100.0	
Missing	Don't Know	38	8.7		
	Missing	46	10.5		
	Total	84	19.1		
Total		439	100.0		

Website development

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Willing	219	49.9	62.9	62.9
	2	67	15.3	19.3	82.2
	Maybe	31	7.1	8.9	91.1
	4	18	4.1	5.2	96.3
	Very Williing	13	3.0	3.7	100.0
	Total	348	79.3	100.0	
Missing	Don't Know	41	9.3		
	Missing	50	11.4		
	Total	91	20.7		
Total		439	100.0		

Non-native invasive weed removal

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Willing	115	26.2	31.9	31.9
	2	42	9.6	11.7	43.6
	Maybe	98	22.3	27.2	70.8
	4	49	11.2	13.6	84.4
	Very Williing	56	12.8	15.6	100.0
	Total	360	82.0	100.0	
Missing	Don't Know	38	8.7		
	Missing	41	9.3		
	Total	79	18.0		
Total		439	100.0		

Water quality sampling

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Willing	95	21.6	26.0	26.0
	2	29	6.6	7.9	34.0
	Maybe	104	23.7	28.5	62.5
	4	72	16.4	19.7	82.2
	Very Williing	65	14.8	17.8	100.0
	Total	365	83.1	100.0	
Missing	Don't Know	32	7.3		
	Missing	42	9.6		
	Total	74	16.9		
Total		439	100.0		

Content Analysis Of Open-Ended Question Data:

Question number five, which asked respondents to indicate their willingness to volunteer for various stewardship activities in the watershed, included an open ended question "other" where respondents could write in any other volunteer stewardship activities in which they would be willing to participate (see questionnaire number 5h). Content analysis techniques were used to analyze the comments provided and develop meaningful categories and conclusions out of the responses. The categories, and number of comments fitting into their respective category, are presented below.

- I am unable to participate because I am a seasonal resident (26 comments)
- I am unable to participate because of health reasons (21 comments)
- I already volunteer (3 comments)
- Other activity (28 comments)
    - Many other activities where listed, however no one activity was mentioned frequently enough (more than twice) to warrant the creation of its own category. Examples of activities mentioned include: monitor wildlife, cartooning, educate fishermen about catch and release, be a neighborhood watchdog, pick up trash, serve on a town planning board, and monitor loggers to prevent mud.
- Total number of comments for question 5h: 78.

Importance of protecting the viewsheds throughout the Newfound Lake watershed

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at All Important	19	4.3	4.5	4.5
	2	17	3.9	4.0	8.5
	Neutral	86	19.6	20.2	28.6
	4	111	25.3	26.1	54.7
	Very Important	193	44.0	45.3	100.0
	Total	426	97.0	100.0	
Missing	Missing	13	3.0		
Total		439	100.0		

Importance of reducing the amount of salt used on public roads to protect water quality

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at All Important	11	2.5	2.6	2.6
	2	17	3.9	4.0	6.5
	Neutral	103	23.5	24.1	30.6
	4	130	29.6	30.4	61.0
	Very Important	167	38.0	39.0	100.0
	Total	428	97.5	100.0	
Missing	Missing	11	2.5		
Total		439	100.0		

Importance of increasing town support of non-native invasive weed prevention programs

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at All Important	9	2.1	2.1	2.1
	2	12	2.7	2.8	4.9
	Neutral	83	18.9	19.5	24.5
	4	121	27.6	28.5	52.9
	Very Important	200	45.6	47.1	100.0
	Total	425	96.8	100.0	
Missing	Missing	14	3.2		
Total		439	100.0		

Nutrient runoff from lawns including phosphorous

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Concerned	16	3.6	3.9	3.9
	2	19	4.3	4.7	8.6
	Neutral	66	15.0	16.3	24.9
	4	121	27.6	29.8	54.7
	Very Concerned	184	41.9	45.3	100.0
	Total	406	92.5	100.0	
Missing	Don't Know	15	3.4		
	Missing	18	4.1		
	Total	33	7.5		
Total		439	100.0		

Increased runoff from impervious surfaces

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Concerned	13	3.0	3.2	3.2
	2	26	5.9	6.4	9.5
	Neutral	68	15.5	16.6	26.2
	4	133	30.3	32.5	58.7
	Very Concerned	169	38.5	41.3	100.0
	Total	409	93.2	100.0	
Missing	Don't Know	13	3.0		
	Missing	17	3.9		
	Total	30	6.8		
Total		439	100.0		

Pesticide use

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Concerned	9	2.1	2.2	2.2
	2	17	3.9	4.1	6.3
	Neutral	47	10.7	11.4	17.6
	4	124	28.2	30.0	47.6
	Very Concerned	217	49.4	52.4	100.0
	Total	414	94.3	100.0	
Missing	Don't Know	9	2.1		
	Missing	16	3.6		
	Total	25	5.7		
Total		439	100.0		

Pollution from detergents containing phosphorous

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Concerned	9	2.1	2.2	2.2
	2	18	4.1	4.4	6.6
	Neutral	56	12.8	13.6	20.2
	4	139	31.7	33.8	54.0
	Very Concerned	189	43.1	46.0	100.0
	Total	411	93.6	100.0	
Missing	Don't Know	13	3.0		
	Missing	15	3.4		
	Total	28	6.4		
Total		439	100.0		

Loss of open space

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Concerned	18	4.1	4.3	4.3
	2	15	3.4	3.6	7.9
	Neutral	53	12.1	12.7	20.7
	4	127	28.9	30.5	51.2
	Very Concerned	203	46.2	48.8	100.0
	Total	416	94.8	100.0	
Missing	Don't Know	7	1.6		
	Missing	16	3.6		
	Total	23	5.2		
Total		439	100.0		

Erosion from development

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Concerned	9	2.1	2.1	2.1
	2	13	3.0	3.1	5.3
	Neutral	53	12.1	12.6	17.9
	4	127	28.9	30.3	48.2
	Very Concerned	217	49.4	51.8	100.0
	Total	419	95.4	100.0	
Missing	Don't Know	6	1.4		
	Missing	14	3.2		
	Total	20	4.6		
Total		439	100.0		

Erosion from forestry

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all Concerned	15	3.4	3.6	3.6
	2	21	4.8	5.1	8.7
	Neutral	70	15.9	16.9	25.5
	4	133	30.3	32.0	57.6
	Very Concerned	176	40.1	42.4	100.0
	Total	415	94.5	100.0	
Missing	Don't Know	10	2.3		
	Missing	14	3.2		
	Total	24	5.5		
Total		439	100.0		

Adopting a dark skies ordinance to reduce the amount of visible light at night to save energy and reduce light pollution

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Do not Support	65	14.8	16.4	16.4
	2	25	5.7	6.3	22.7
	Neutral	100	22.8	25.2	47.9
	4	74	16.9	18.6	66.5
	Fully Support	133	30.3	33.5	100.0
	Total	397	90.4	100.0	
Missing	Don't Know	27	6.2		
	Missing	15	3.4		
	Total	42	9.6		
Total		439	100.0		

Zoning that requires high density developments which include conservation lands as part of site plans in specified areas in your town

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Do not Support	57	13.0	15.2	15.2
	2	20	4.6	5.3	20.5
	Neutral	79	18.0	21.0	41.5
	4	88	20.0	23.4	64.9
	Fully Support	132	30.1	35.1	100.0
	Total	376	85.6	100.0	
Missing	Don't Know	41	9.3		
	Missing	22	5.0		
	Total	63	14.4		
Total		439	100.0		

Creating regulations requiring no development within 50ft of all water bodies

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Do not Support	52	11.8	12.8	12.8
	2	20	4.6	4.9	17.7
	Neutral	52	11.8	12.8	30.5
	4	72	16.4	17.7	48.2
	Fully Support	211	48.1	51.8	100.0
	Total	407	92.7	100.0	
Missing	Don't Know	16	3.6		
	Missing	16	3.6		
	Total	32	7.3		
Total		439	100.0		

Ensuring the protection of specific natural resource areas identified as important for watershed health

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Do not Support	16	3.6	3.8	3.8
	2	8	1.8	1.9	5.8
	Neutral	49	11.2	11.8	17.5
	4	114	26.0	27.4	45.0
	Fully Support	229	52.2	55.0	100.0
	Total	416	94.8	100.0	
Missing	Don't Know	9	2.1		
	Missing	14	3.2		
	Total	23	5.2		
Total		439	100.0		

Requiring inspection and reporting on septic system maintenance every 3-5 years

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Do not Support	74	16.9	18.5	18.5
	2	33	7.5	8.2	26.7
	Neutral	99	22.6	24.7	51.4
	4	87	19.8	21.7	73.1
	Fully Support	108	24.6	26.9	100.0
	Total	401	91.3	100.0	
Missing	Don't Know	23	5.2		
	Missing	15	3.4		
	Total	38	8.7		
Total		439	100.0		

Prohibiting the use of fertilizers within 50ft of any water body

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Do not Support	23	5.2	5.5	5.5
	2	17	3.9	4.1	9.6
	Neutral	46	10.5	11.0	20.6
	4	109	24.8	26.1	46.8
	Fully Support	222	50.6	53.2	100.0
	Total	417	95.0	100.0	
Missing	Don't Know	6	1.4		
	Missing	16	3.6		
	Total	22	5.0		
Total		439	100.0		

Prohibiting the use of pesticides within 50ft of any water body

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Do not Support	26	5.9	6.3	6.3
	2	14	3.2	3.4	9.6
	Neutral	48	10.9	11.6	21.2
	4	98	22.3	23.6	44.8
	Fully Support	229	52.2	55.2	100.0
	Total	415	94.5	100.0	
Missing	Don't Know	9	2.1		
	Missing	15	3.4		
	Total	24	5.5		
Total		439	100.0		

Hiring a compliance officer to monitor forestry operations

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Do not Support	90	20.5	23.3	23.3
	2	25	5.7	6.5	29.8
	Neutral	112	25.5	29.0	58.8
	4	76	17.3	19.7	78.5
	Fully Support	83	18.9	21.5	100.0
	Total	386	87.9	100.0	
Missing	Don't Know	34	7.7		
	Missing	19	4.3		
	Total	53	12.1		
Total		439	100.0		

Hiring a compliance officer to monitor development

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Do not Support	85	19.4	21.9	21.9
	2	33	7.5	8.5	30.3
	Neutral	101	23.0	26.0	56.3
	4	85	19.4	21.9	78.1
	Fully Support	85	19.4	21.9	100.0
	Total	389	88.6	100.0	
Missing	Don't Know	30	6.8		
	Missing	20	4.6		
	Total	50	11.4		
Total		439	100.0		

Requiring larger minimum lot sizes in area that are best suited for forestry

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Do not Support	56	12.8	14.4	14.4
	2	20	4.6	5.1	19.5
	Neutral	100	22.8	25.6	45.1
	4	101	23.0	25.9	71.0
	Fully Support	113	25.7	29.0	100.0
	Total	390	88.8	100.0	
Missing	Don't Know	35	8.0		
	Missing	14	3.2		
	Total	49	11.2		
Total		439	100.0		

Requiring restrictions that prohibit the use of phosphorous in fertilizers to protect water quality

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Do not Support	28	6.4	6.9	6.9
	2	23	5.2	5.7	12.7
	Neutral	69	15.7	17.1	29.8
	4	108	24.6	26.8	56.6
	Fully Support	175	39.9	43.4	100.0
	Total	403	91.8	100.0	
Missing	Don't Know	20	4.6		
	Missing	16	3.6		
	Total	36	8.2		
Total		439	100.0		

Enacting laws that require the conservations of open space

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Do not Support	50	11.4	12.2	12.2
	2	19	4.3	4.6	16.8
	Neutral	85	19.4	20.7	37.6
	4	112	25.5	27.3	64.9
	Fully Support	144	32.8	35.1	100.0
	Total	410	93.4	100.0	
Missing	Don't Know	15	3.4		
	Missing	14	3.2		
	Total	29	6.6		
Total		439	100.0		

Creating regulations that prevent development on steep slopes

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Do not Support	41	9.3	10.1	10.1
	2	22	5.0	5.4	15.5
	Neutral	72	16.4	17.7	33.3
	4	93	21.2	22.9	56.2
	Fully Support	178	40.5	43.8	100.0
	Total	406	92.5	100.0	
Missing	Don't Know	18	4.1		
	Missing	15	3.4		
	Total	33	7.5		
Total		439	100.0		

Read a newspaper article about the master plan

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Have not participated	293	66.7	69.3	69.3
	Have participated	130	29.6	30.7	100.0
	Total	423	96.4	100.0	
Missing	Don't Know	1	.2		
	Missing	15	3.4		
	Total	16	3.6		
Total		439	100.0		

Viewed the master plan or supporting documents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Have not participated	391	89.1	92.0	92.0
	Have participated	34	7.7	8.0	100.0
	Total	425	96.8	100.0	
Missing	Missing	14	3.2		
Total		439	100.0		

Attended a community meeting about the master plan

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Have not participated	382	87.0	89.9	89.9
	Have participated	43	9.8	10.1	100.0
	Total	425	96.8	100.0	
Missing	Missing	14	3.2		
Total		439	100.0		

Heard information about the master plan on the radio

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Have not participated	413	94.1	97.2	97.2
	Have participated	12	2.7	2.8	100.0
	Total	425	96.8	100.0	
Missing	Missing	14	3.2		
Total		439	100.0		

Read a project brochure or poster

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Have not participated	342	77.9	80.5	80.5
	Have participated	83	18.9	19.5	100.0
	Total	425	96.8	100.0	
Missing	Missing	14	3.2		
Total		439	100.0		

Completed a Newfound Watershed Master Plan Survey before this one

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Have not participated	308	70.2	72.5	72.5
	Have participated	117	26.7	27.5	100.0
	Total	425	96.8	100.0	
Missing	Missing	14	3.2		
Total		439	100.0		

Other

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Have not participated	410	93.4	96.5	96.5
	Have participated	15	3.4	3.5	100.0
	Total	425	96.8	100.0	
Missing	Missing	14	3.2		
Total		439	100.0		

Content Analysis Of Open-Ended Question Data:

Question number eleven, asking respondents which master plan activities they have participated in, included an open ended other option where respondents could specify other activities they have participated in that were not provided in question eleven. Content analysis was conducted to analyze these responses and form meaningful categories and conclusions. The categories and the number of responses fitting into those categories are presented below.

- Received mailing (2 comments)
- I have worked or supported the NLRA in the past (4 comments)
- Other exposure (5 comments)
  - Five other comments were provided and they are: water testing, guided boat tour, updates provided at Bridgewater town hall, through one on one conversations, and one person wrote “other”.
- Total number of comments for question 11other: 11.

Respondent has not participated in any Newfound Watershed Master Plan activities

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Have not participated	196	44.6	46.1	46.1
	Have participated	229	52.2	53.9	100.0
	Total	425	96.8	100.0	
Missing	Missing	14	3.2		
Total		439	100.0		

Exposure has affected respondent's thinking about the watershed

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	91	20.7	45.5	45.5
	Yes	109	24.8	54.5	100.0
	Total	200	45.6	100.0	
Missing	Not Applicable	200	45.6		
	Missing	39	8.9		
	Total	239	54.4		
Total		439	100.0		

Content Analysis Of Open-Ended Question Data:

Question 11a asked respondents if their exposure to master plan activities had affected their thinking. If the respondent answered “yes” they were asked to “please specify”. The responses were formed into meaningful categories that are presented below.

- Increased my awareness/knowledge (30 comments)
- Increased my support (15 comments)
- Increased my involvement (3 comments)
- Encouraged me to change my behavior (2 comments)

- Caused me to think negatively of the plan (2 comments)
- Other comments (4 comments)
  - These other comments did not warrant categories because they were not substantial.
- Total number of comments for question number 11a: 56.

Exposure has caused respondent to change their behavior in the watershed

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	148	33.7	75.9	75.9
	Yes	47	10.7	24.1	100.0
	Total	195	44.4	100.0	
Missing	Not Applicable	204	46.5		
	Missing	40	9.1		
	Total	244	55.6		
Total		439	100.0		

<u>Content Analysis Of Open-Ended Question Data:</u>

Question 11b asked the respondents if their exposure to master plan activities had changed their behavior in any way. If the respondents answered “yes” they were asked to “please specify”. The responses were analyzed using content analysis techniques to form meaningful categories and conclusions. The categories and number of responses are presented below.

- Increased my support (8 comments)
- Increased my awareness (6 comments)
- I changed my behavior to be more environmentally responsible (6 comments)
- I no longer use pesticides (3 comments)
- I no longer use fertilizers containing phosphorus (5 comments)
- I now think negatively about the plan (1 comment)
- We need a sewer plant (1 comment)
- Total number of comments for question 11b: 30.

Town library

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Likely	229	52.2	60.7	60.7
	2	23	5.2	6.1	66.8
	Neutral	46	10.5	12.2	79.0
	4	40	9.1	10.6	89.7
	Very Likely	39	8.9	10.3	100.0
	Total	377	85.9	100.0	
Missing	Don't Know	13	3.0		
	Missing	49	11.2		
	Total	62	14.1		
Total		439	100.0		

Post office

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Likely	136	31.0	35.0	35.0
	2	29	6.6	7.5	42.4
	Neutral	70	15.9	18.0	60.4
	4	78	17.8	20.1	80.5
	Very Likely	76	17.3	19.5	100.0
	Total	389	88.6	100.0	
Missing	Don't Know	10	2.3		
	Missing	40	9.1		
	Total	50	11.4		
Total		439	100.0		

Local grocery store

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Likely	78	17.8	19.9	19.9
	2	23	5.2	5.9	25.8
	Neutral	61	13.9	15.6	41.3
	4	125	28.5	31.9	73.2
	Very Likely	105	23.9	26.8	100.0
	Total	392	89.3	100.0	
Missing	Don't Know	9	2.1		
	Missing	38	8.7		
	Total	47	10.7		
Total		439	100.0		

Town hall

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Likely	132	30.1	33.9	33.9
	2	39	8.9	10.0	44.0
	Neutral	82	18.7	21.1	65.0
	4	73	16.6	18.8	83.8
	Very Likely	63	14.4	16.2	100.0
	Total	389	88.6	100.0	
Missing	Don't Know	10	2.3		
	Missing	40	9.1		
	Total	50	11.4		
Total		439	100.0		

Local public school

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Likely	248	56.5	66.8	66.8
	2	30	6.8	8.1	74.9
	Neutral	40	9.1	10.8	85.7
	4	23	5.2	6.2	91.9
	Very Likely	30	6.8	8.1	100.0
	Total	371	84.5	100.0	
Missing	Don't Know	13	3.0		
	Missing	55	12.5		
	Total	68	15.5		
Total		439	100.0		

Town recreation sites

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Likely	163	37.1	43.6	43.6
	2	38	8.7	10.2	53.7
	Neutral	55	12.5	14.7	68.4
	4	72	16.4	19.3	87.7
	Very Likely	46	10.5	12.3	100.0
	Total	374	85.2	100.0	
Missing	Don't Know	11	2.5		
	Missing	54	12.3		
	Total	65	14.8		
Total		439	100.0		

Content Analysis Of Open-Ended Question Data:

Question number twelve asked respondents how likely they would be to notice information about watershed planning at several listed locations. Respondents were also given the option to write in other where they would be likely to notice information about watershed planning. The responses were formed into meaningful categories and conclusions were made using content analysis techniques. The categories and number of responses are presented below.

- Local businesses (23 comments)
- Local paper (20 comments)
- Transfer station (11 comments)
- Mailings (10 comments)
- Website (8 comments)
- Municipal buildings (7 comments)
- Parks/Town beach (7 comments)
- Community TV (6 comments)
- Boat launch (4 comments)
- Downtown bulletin board (4 comments)
- Road side signs (3 comments)
- Churches (3 comments)
- Other (7 comments)
    - Other comments were made that either did not fit into meaningful categories or were not substantial. Example comments were: make a video, fairs or festivals, give to school kids to take home to parents, and I don’t read propaganda.
- Total number of comments for question 12g: 113.

Respondent is familiar with the Newfound Lake Regional Association

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	173	39.4	41.2	41.2
	Yes	247	56.3	58.8	100.0
	Total	420	95.7	100.0	
Missing	Missing	19	4.3		
Total		439	100.0		

Respondent is familiar with the goals of the NLRA

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	102	23.2	39.4	39.4
	Yes	157	35.8	60.6	100.0
	Total	259	59.0	100.0	
Missing	Not Applicable	150	34.2		
	Missing	30	6.8		
	Total	180	41.0		
Total		439	100.0		

Respondent is familiar with the vision statement of the NLRA

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	133	30.3	52.8	52.8
	Yes	119	27.1	47.2	100.0
	Total	252	57.4	100.0	
Missing	Not Applicable	153	34.9		
	Missing	34	7.7		
	Total	187	42.6		
Total		439	100.0		

Respondent is a registered voter in the Newfound Lake region

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	199	45.3	46.5	46.5
	Yes	229	52.2	53.5	100.0
	Total	428	97.5	100.0	
Missing	Missing	11	2.5		
Total		439	100.0		

Respondent has served on local town boards or commissions

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	337	76.8	78.4	78.4
	Yes	93	21.2	21.6	100.0
	Total	430	97.9	100.0	
Missing	Missing	9	2.1		
Total		439	100.0		

Respondent is employed by a business or owns a business that operates in the Newfound Lake watershed

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	84	19.1	19.4	19.4
	Yes	348	79.3	80.6	100.0
	Total	432	98.4	100.0	
Missing	Missing	7	1.6		
Total		439	100.0		

Year-round or seasonal resident of a town in the Newfound Lake watershed

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Year-round resident	244	55.6	56.7	56.7
	Seasonal resident	139	31.7	32.3	89.1
	Other	47	10.7	10.9	100.0
	Total	430	97.9	100.0	
Missing	Missing	9	2.1		
Total		439	100.0		

Content Analysis Of Open-Ended Question Data:

Question number seventeen asked respondents to indicate whether they are a year-round or a seasonal resident but also included an open ended "other" option. Responses were analyzed using content analysis techniques and the results and the total number of comments are presented below.

- I am a land owner (20 comments)
- I live at this home part time (11 comments)
- I no longer live in the area (6 comments)
- Other (13 comments)
    - Other comments were made that either did not fit into meaningful categories or were not substantial.
- Total comments for question number seventeen: 50.

Type of property owned/occupied in the Newfound watershed

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Single family home	320	72.9	74.4	74.4
	Condominium	29	6.6	6.7	81.2
	Mobile home	18	4.1	4.2	85.3
	Apartment	2	.5	.5	85.8
	Own land, no residential builing on lot	38	8.7	8.8	94.7
	None (own no property within the watershed	5	1.1	1.2	95.8
	Other	18	4.1	4.2	100.0
	Total	430	97.9	100.0	
Missing	Missing	9	2.1		
Total		439	100.0		

Content Analysis Of Open-Ended Question Data:

Question number eighteen asked respondents what type of property they currently own/occupy and included an "other (please specify)" option. The comments provided were analyzed using content analysis techniques to form meaningful categories and draw conclusions. The categories and number of comments are presented below.

- I am a land owner (7 comments)
- Building in progress (3 comments)
- Other (17 comments)
  - Other comments were made that either did not fit into meaningful categories or were not substantial. Examples include: office building, camp, rental, and barn.
- Total number of comments for question eighteen: 27.

Rent or own current property

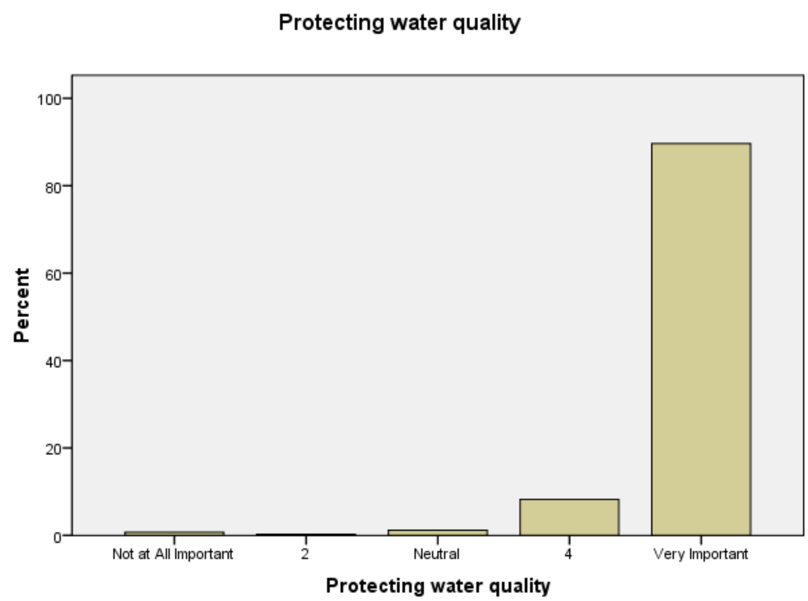
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Rent	3	.7	.7	.7
	Own	425	96.8	98.6	99.3
	Other	3	.7	.7	100.0
	Total	431	98.2	100.0	
Missing	Missing	8	1.8		
Total		439	100.0		

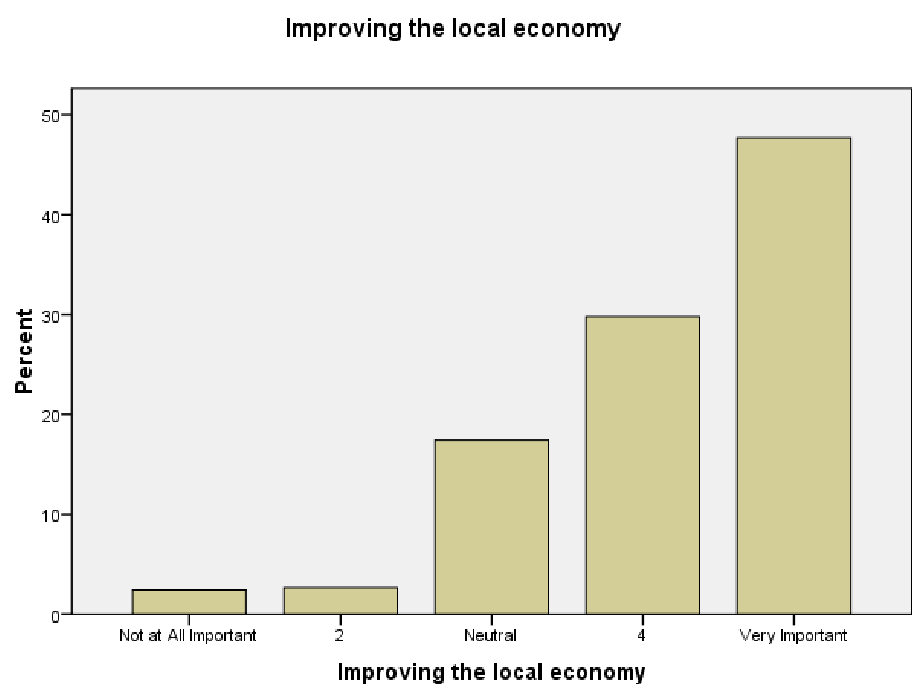
Content Analysis Of Open-Ended Question Data:

Question number nineteen asked respondent if they rent or own their current property and included an "other (please specify)" option. The comments provided were analyzed using content analysis techniques to form meaningful categories and draw conclusions. The categories and number of comments are presented below.

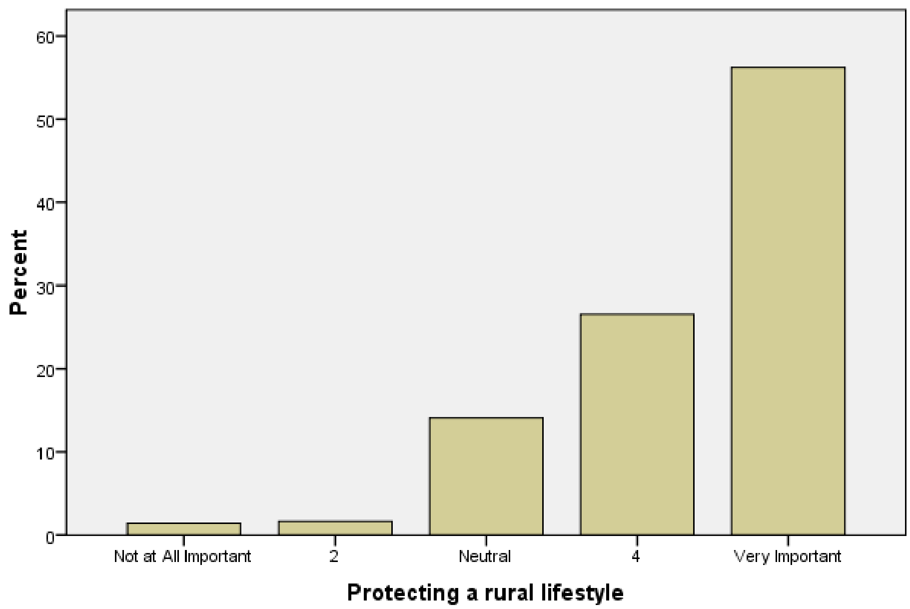
- Other (3 comments)
    - Other comments were made that either did not fit into meaningful categories or were not substantial.
- Total number of comments for question nineteen: 3.

Bar Charts For All Questions In The Survey

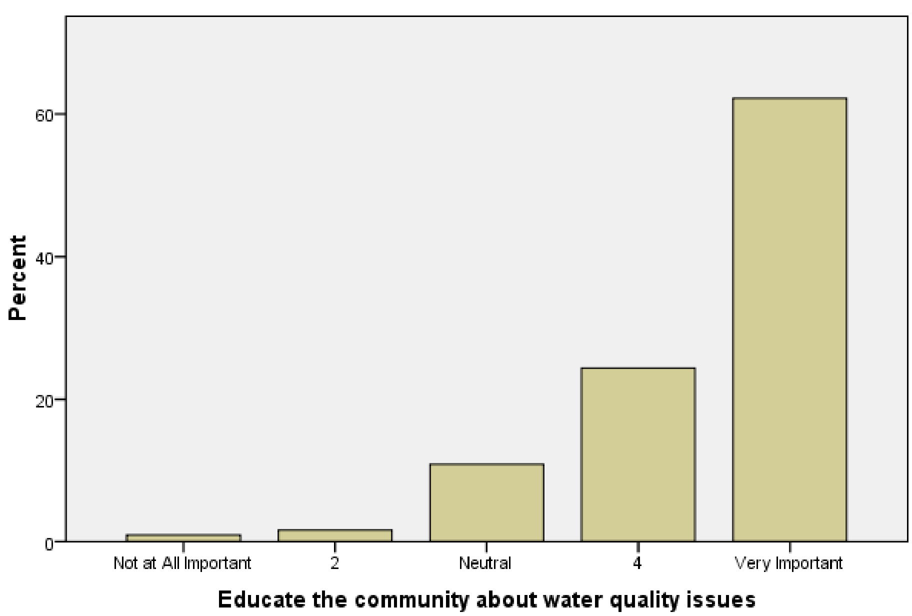




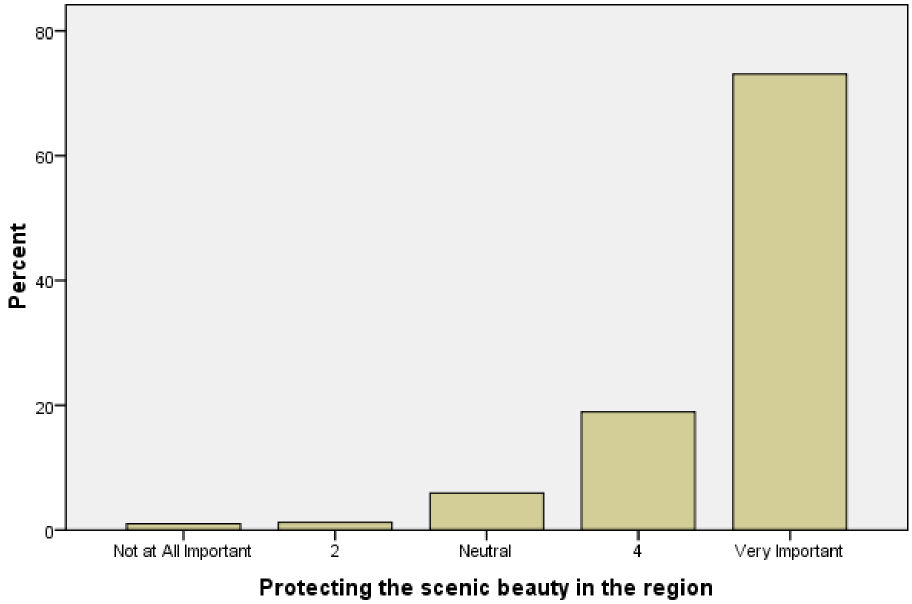
Protecting a rural lifestyle



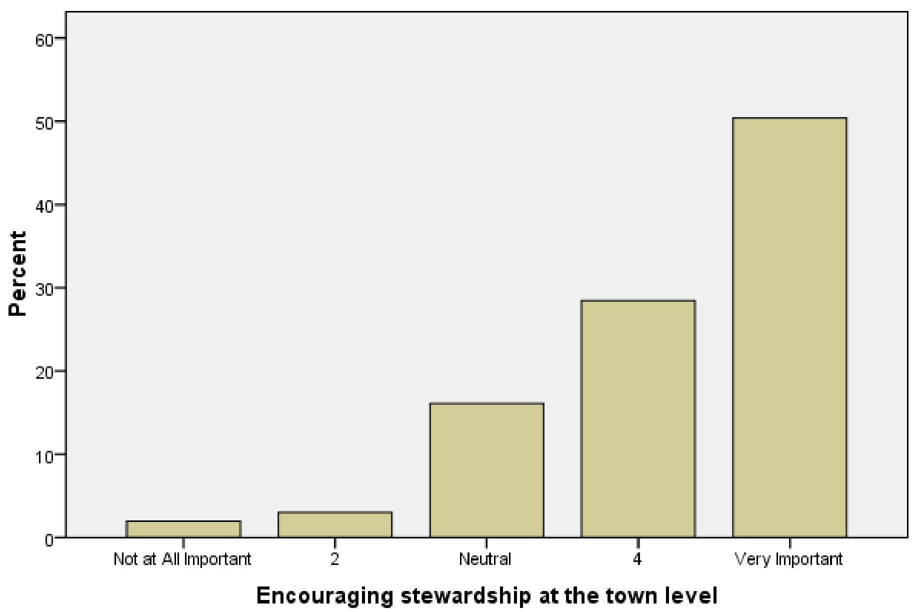
Educate the community about water quality issues



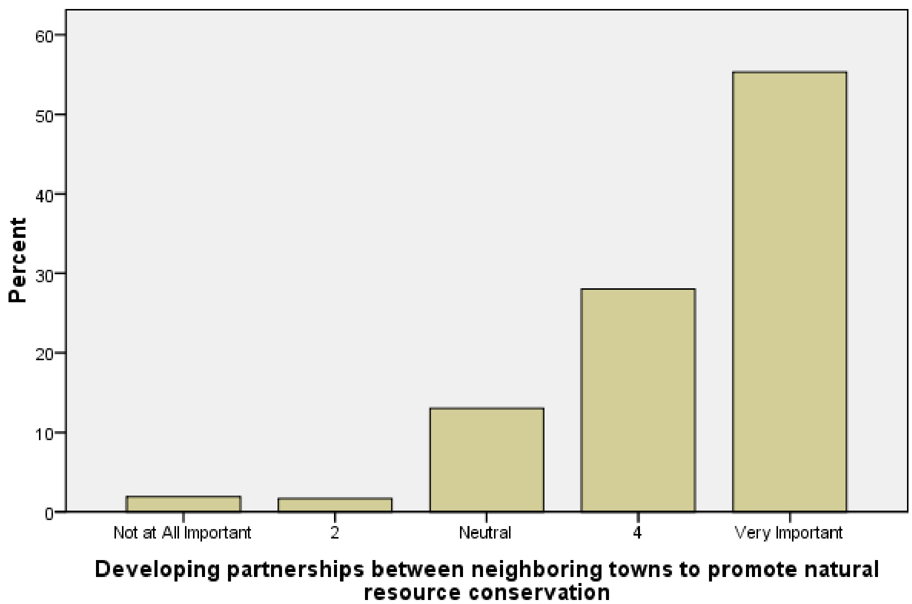
Protecting the scenic beauty in the region



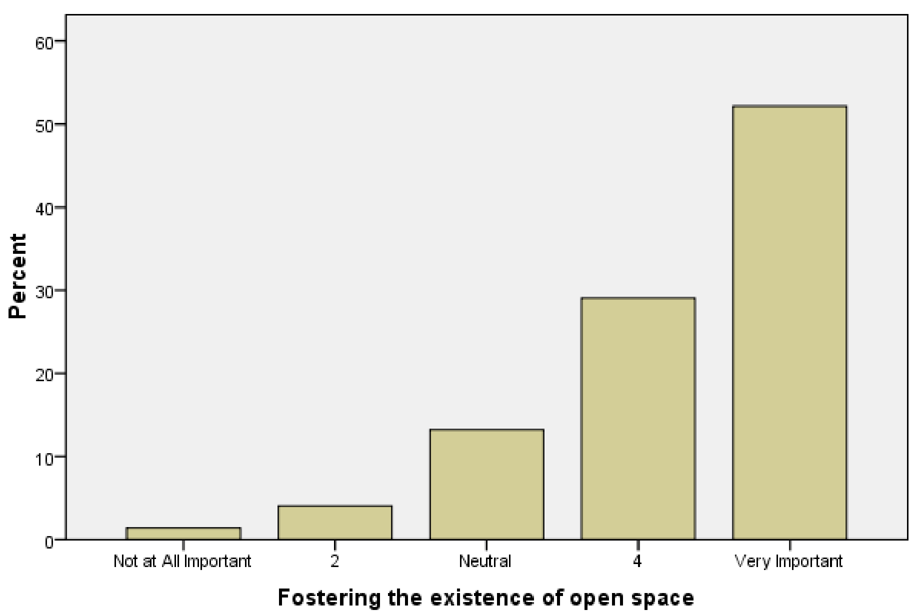
Encouraging stewardship at the town level



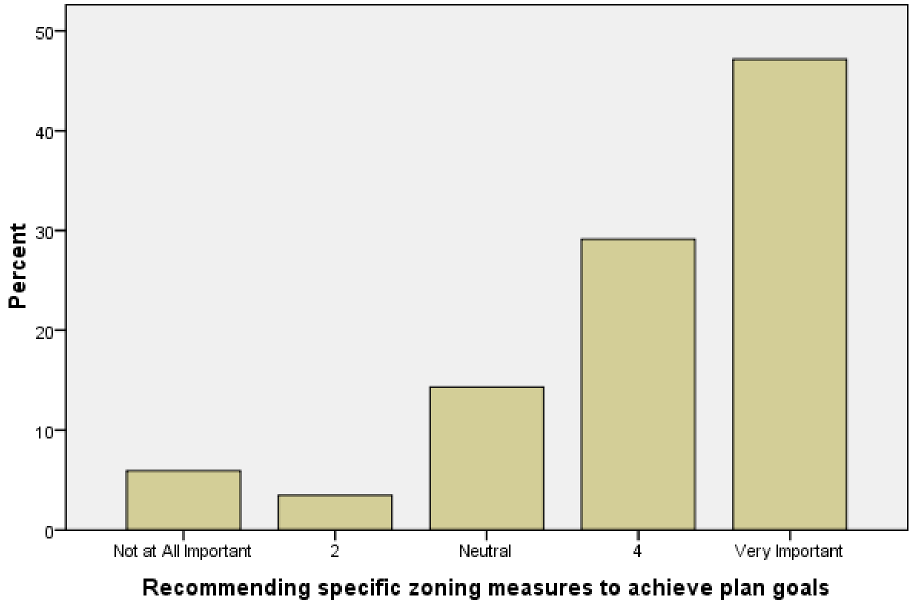
Developing partnerships between neighboring towns to promote natural resource conservation



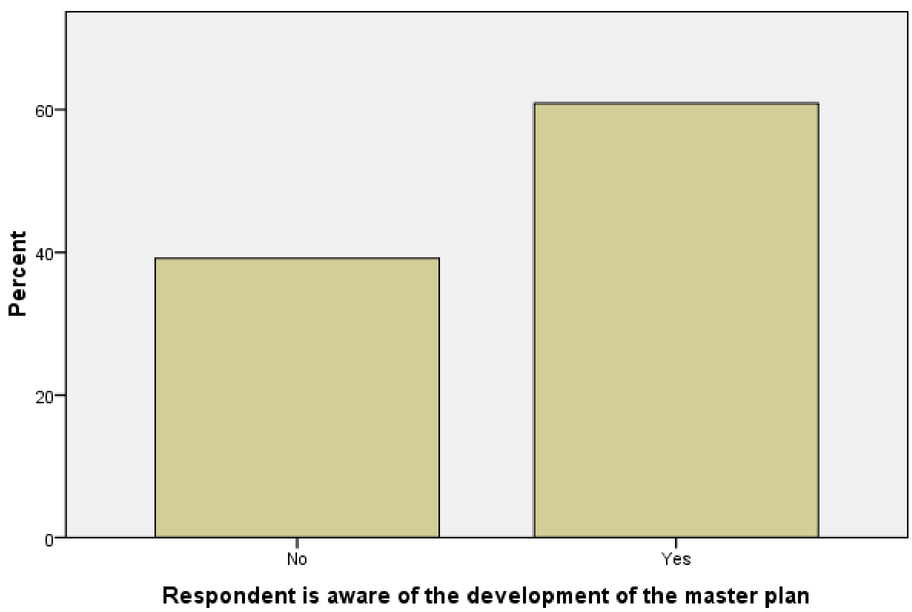
Fostering the existence of open space



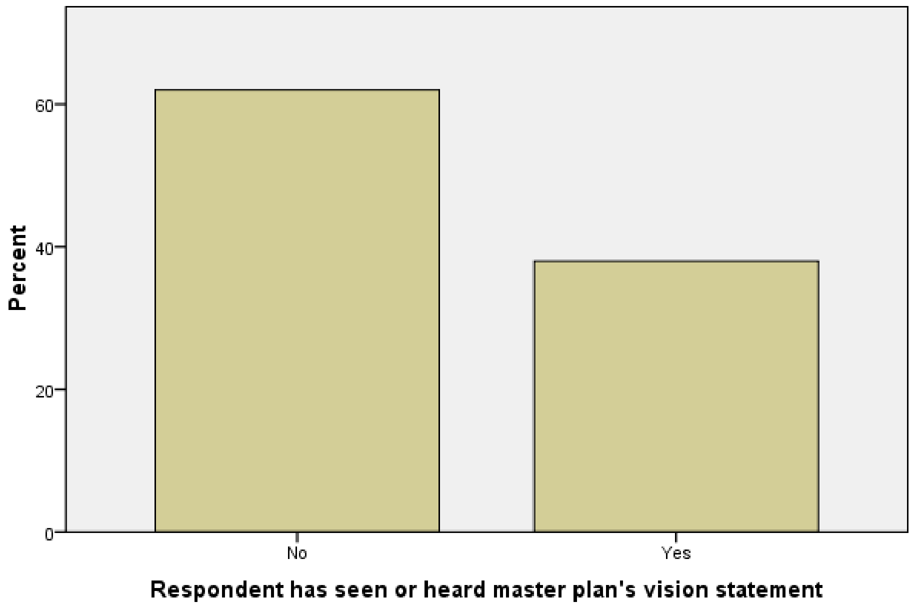
Recommending specific zoning measures to achieve plan goals



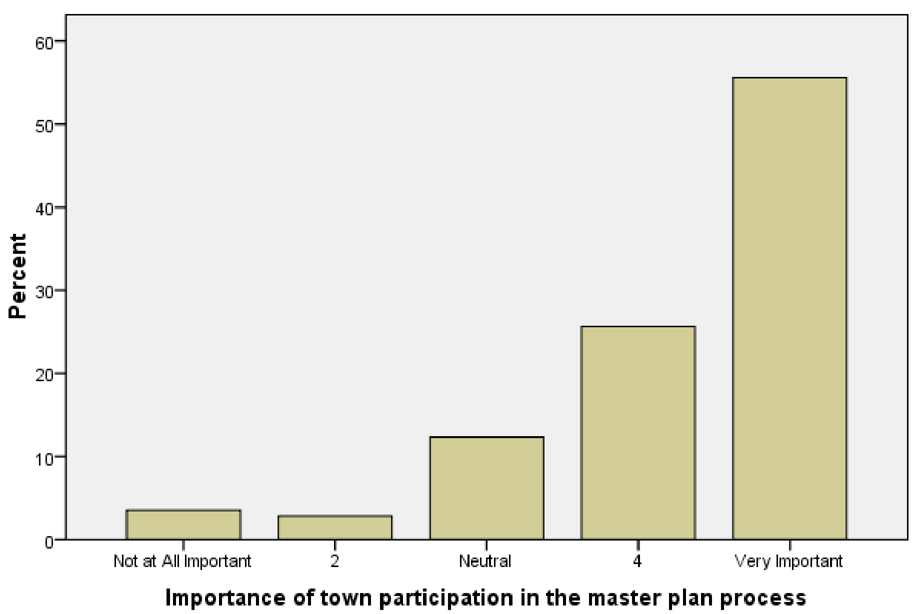
Respondent is aware of the development of the master plan



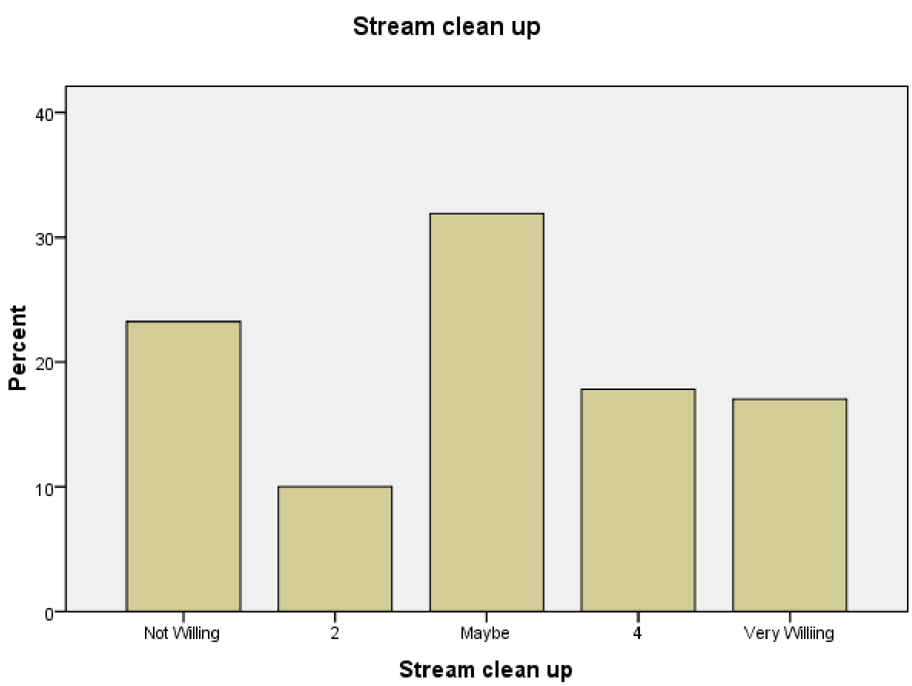
Respondent has seen or heard master plan's vision statement



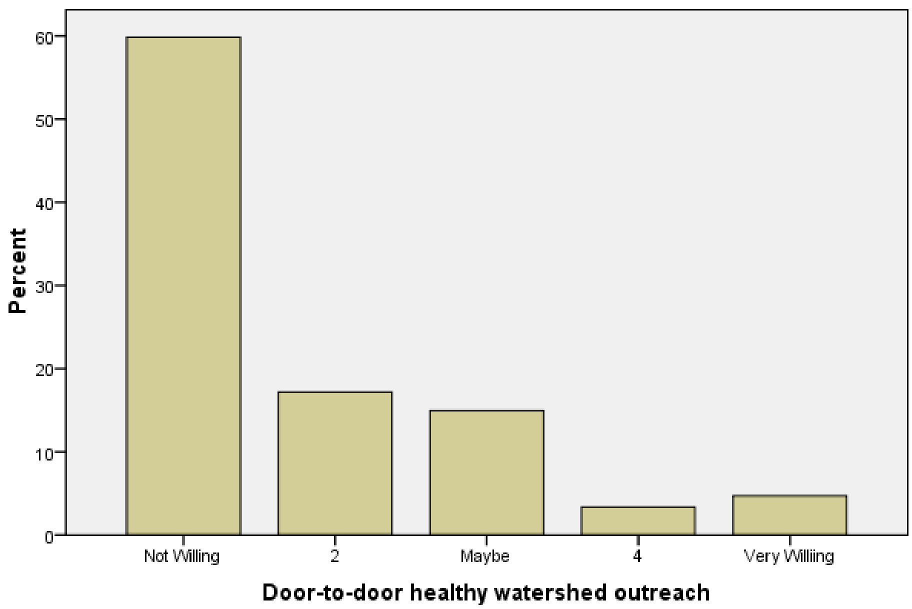
Importance of town participation in the master plan process



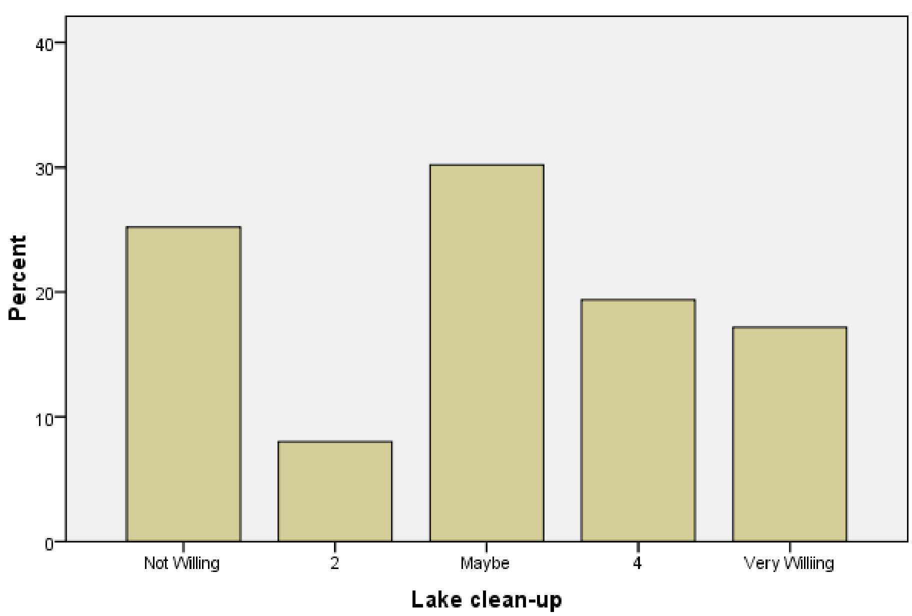

Importance of town hiring a professional planner to assist plan implementation
Percent
40
30
20
10
0
Not at All Important
2
Neutral
4
Very Important
Importance of town hiring a professional planner to assist plan implementation


Stream clean up
Percent
40
30
20
10
0
Not Willing
2
Maybe
4
Very Williing
Stream clean up

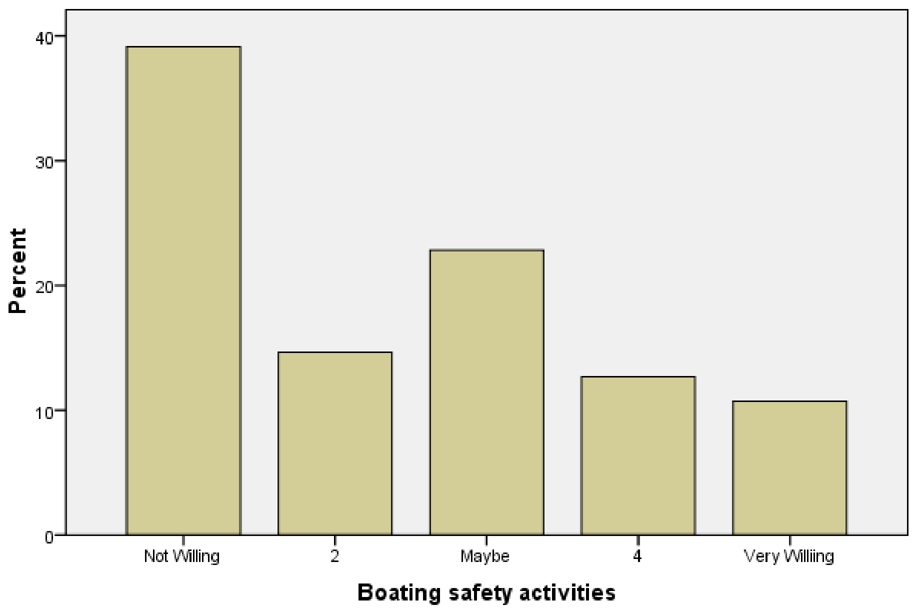
Door-to-door healthy watershed outreach



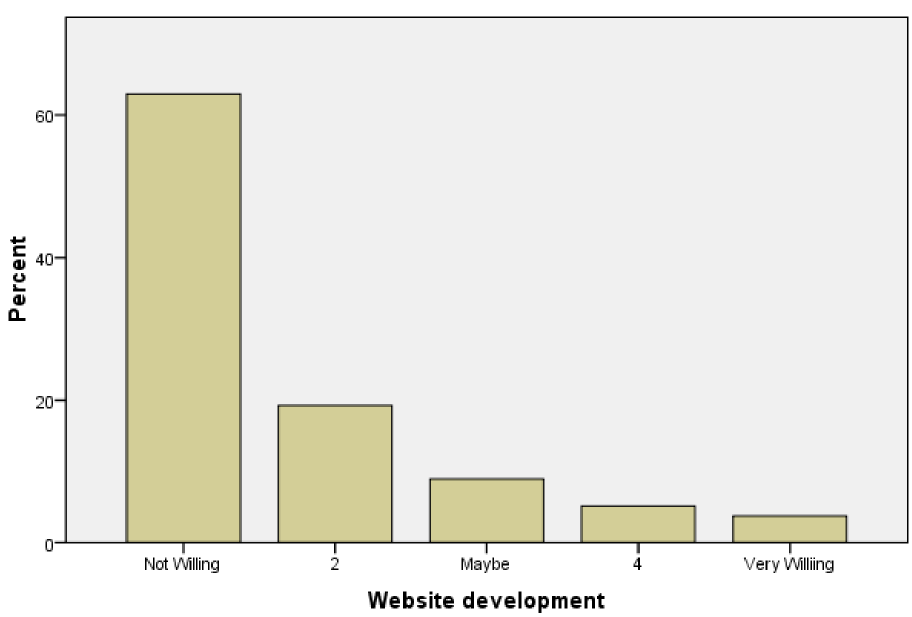
Lake clean-up



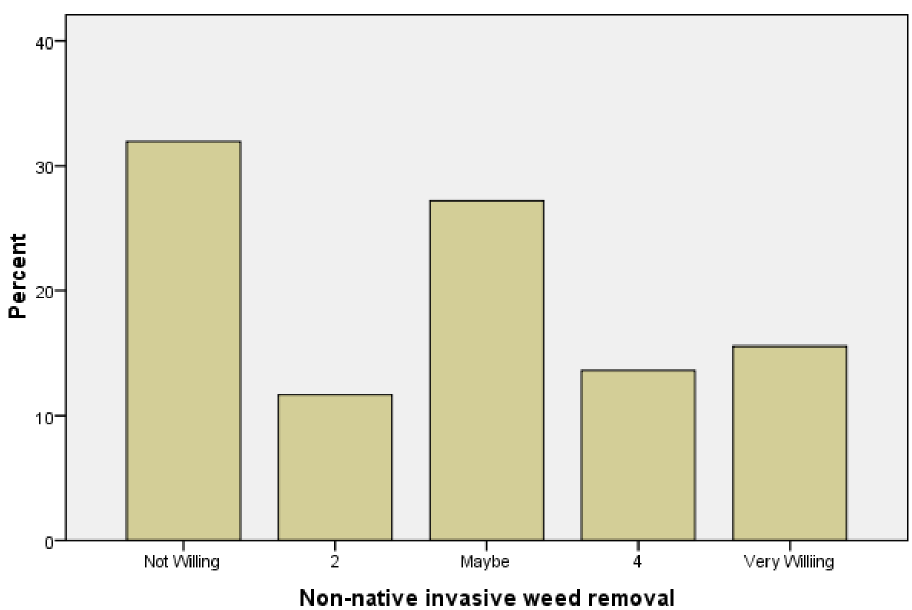
Boating safety activities



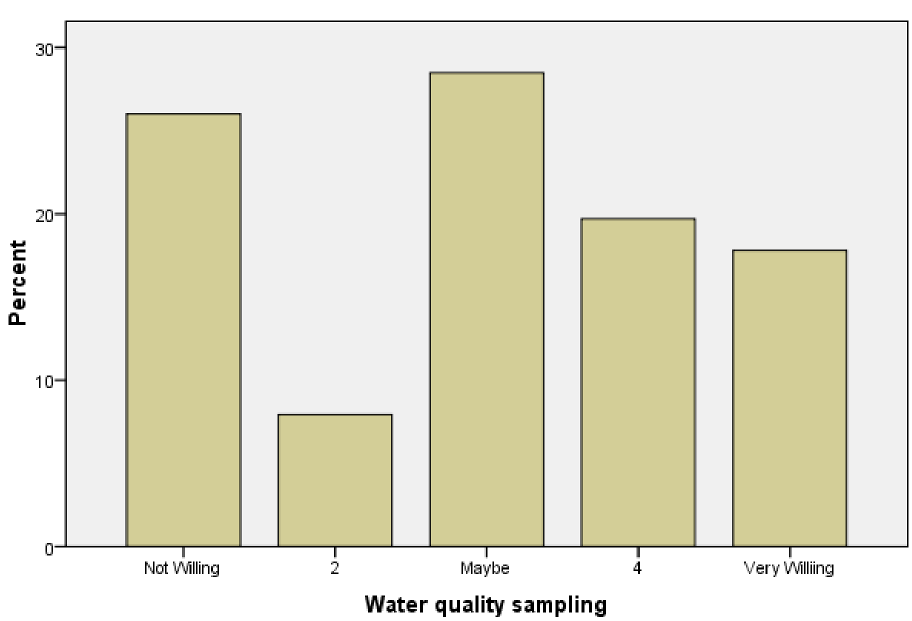
Website development

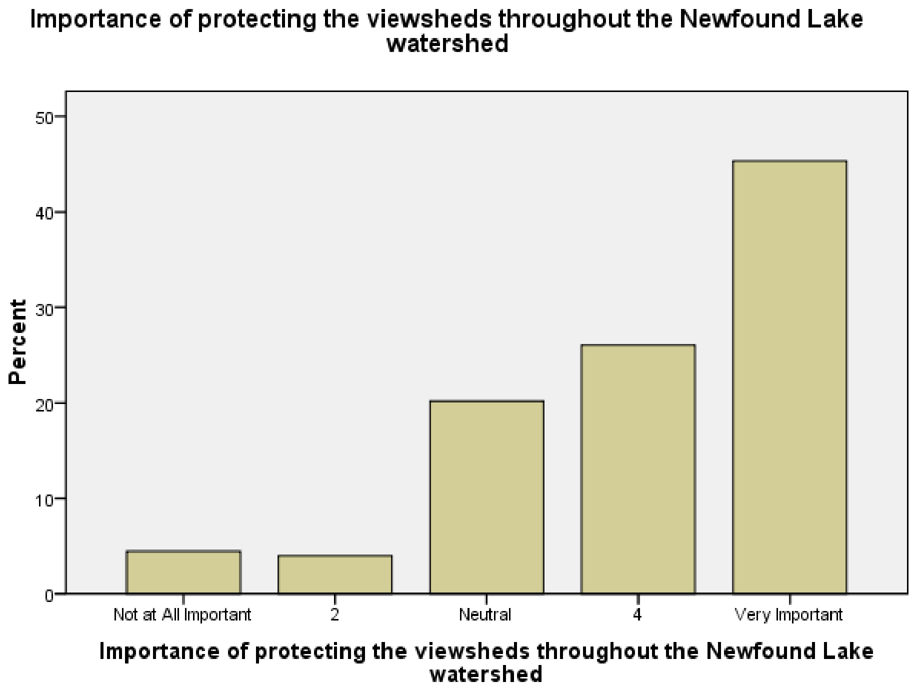


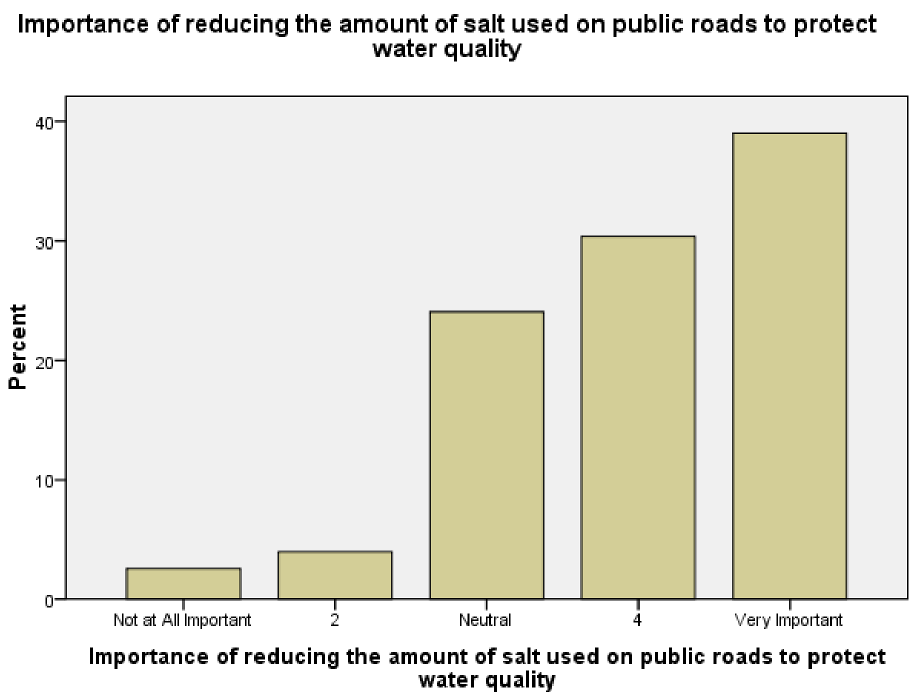
Non-native invasive weed removal



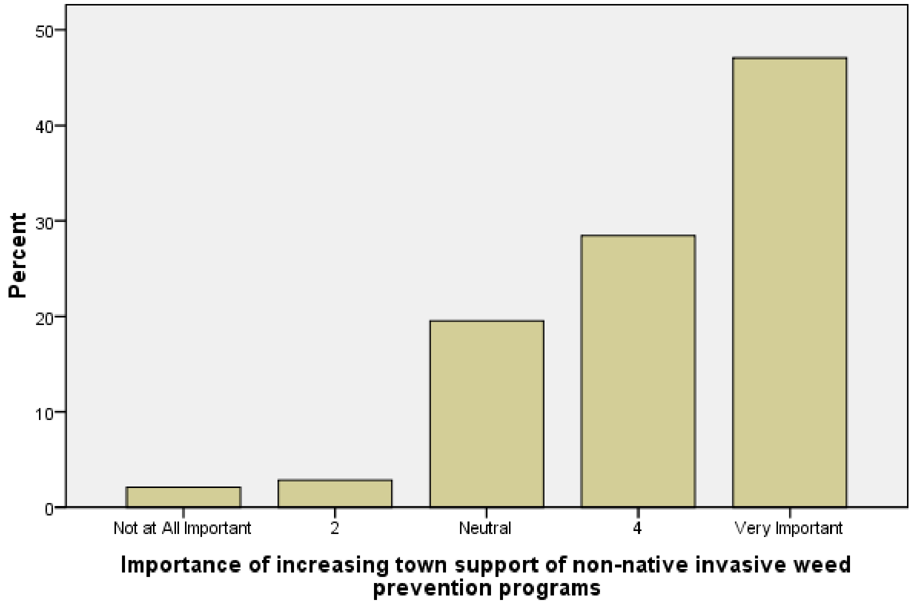
Water quality sampling



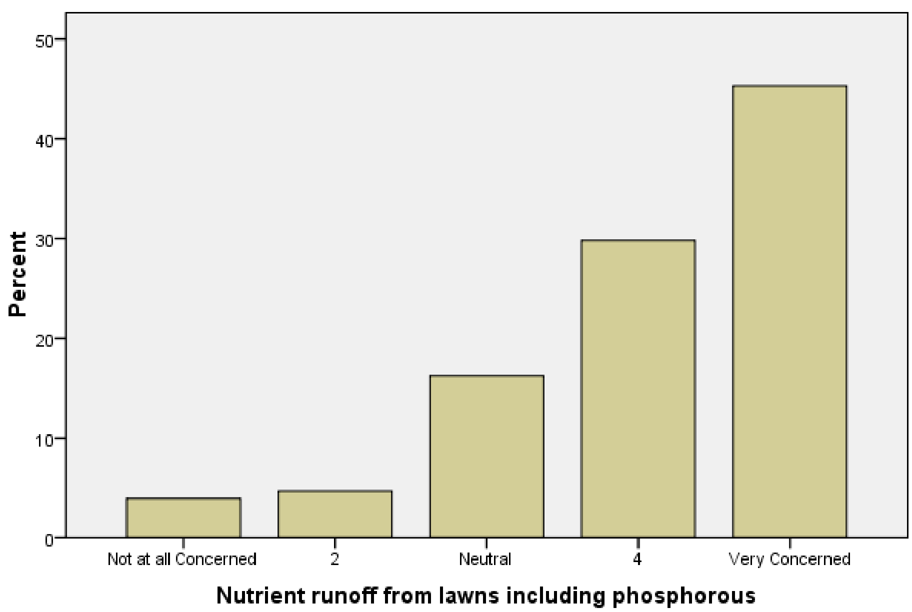

Importance of protecting the viewsheds throughout the Newfound Lake watershed
Percent
50
40
30
20
10
0
Not at All Important
2
Neutral
4
Very Important
Importance of protecting the viewsheds throughout the Newfound Lake watershed


Importance of reducing the amount of salt used on public roads to protect water quality
Percent
40
30
20
10
0
Not at All Important
2
Neutral
4
Very Important
Importance of reducing the amount of salt used on public roads to protect water quality

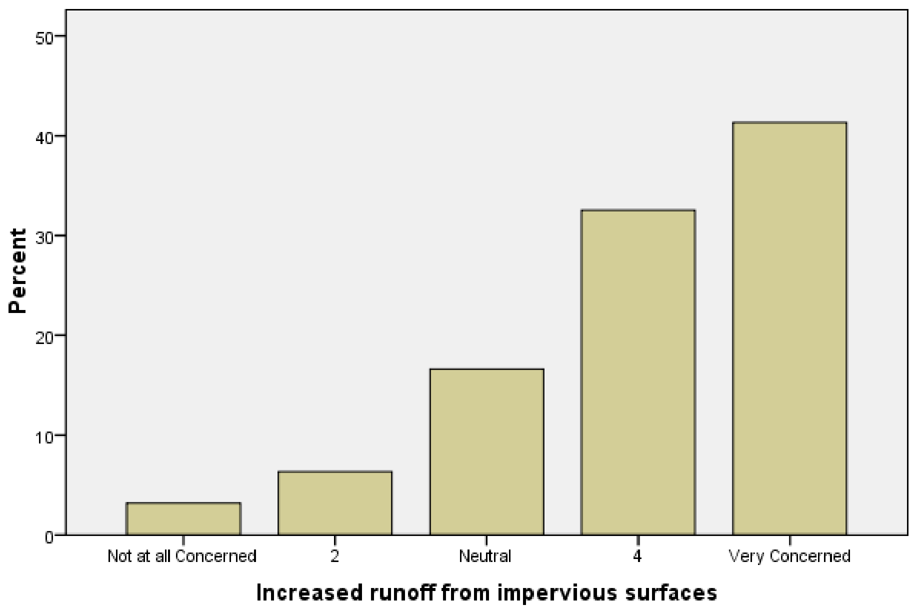
Importance of increasing town support of non-native invasive weed prevention programs



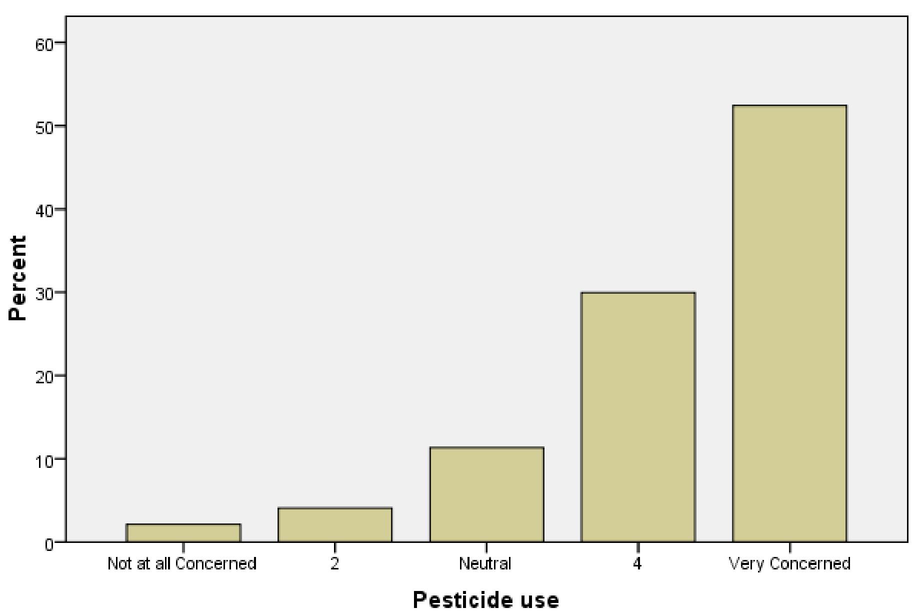
Nutrient runoff from lawns including phosphorous



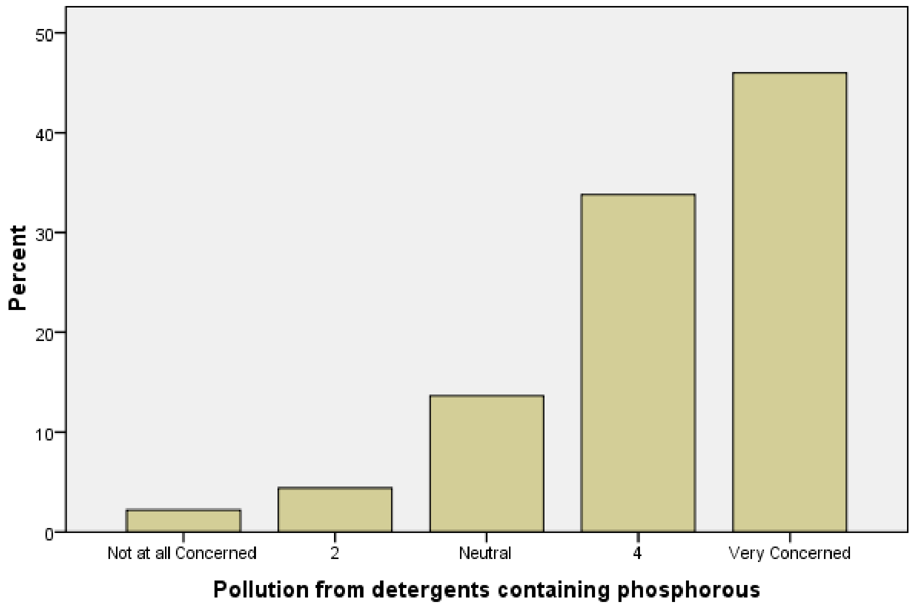
Increased runoff from impervious surfaces



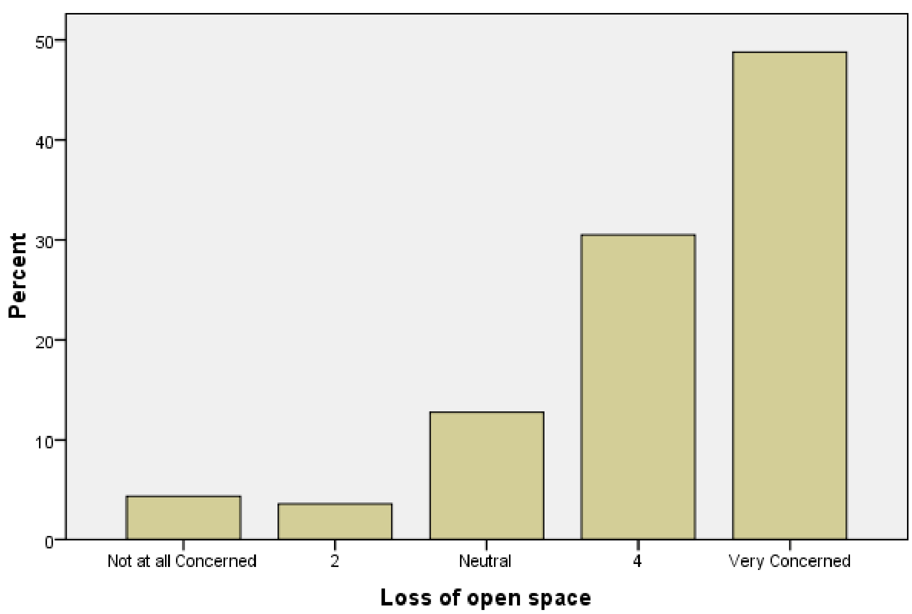
Pesticide use



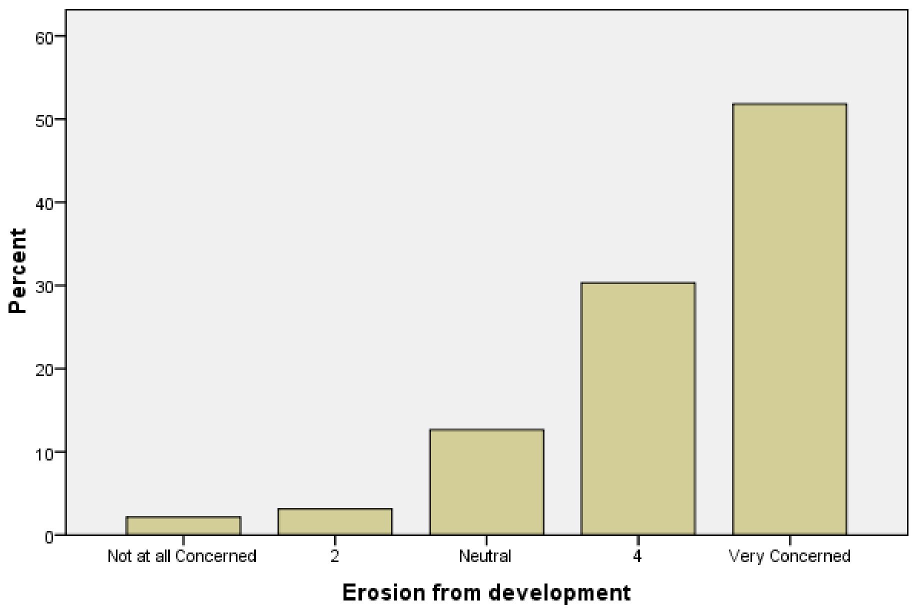
Pollution from detergents containing phosphorous



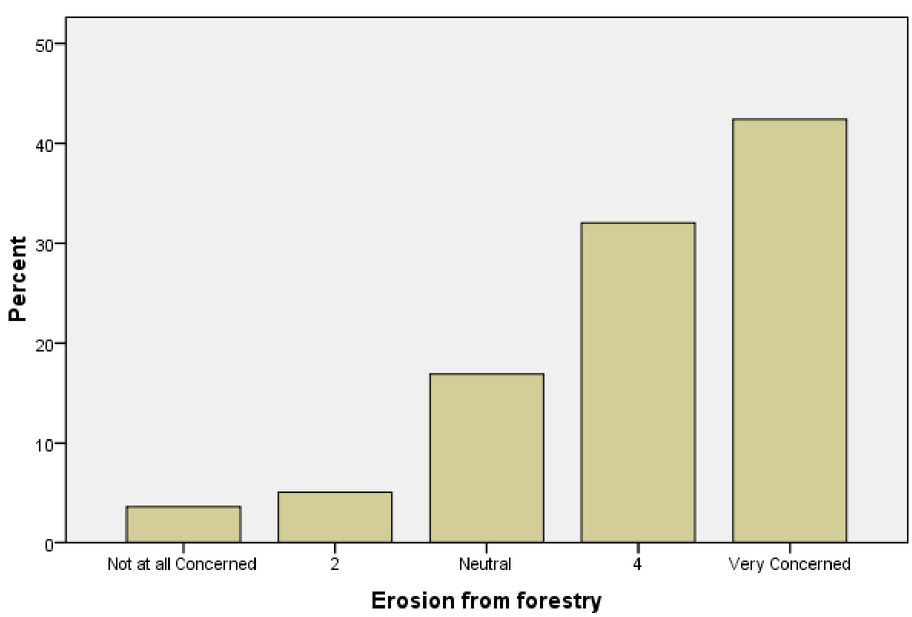
Loss of open space



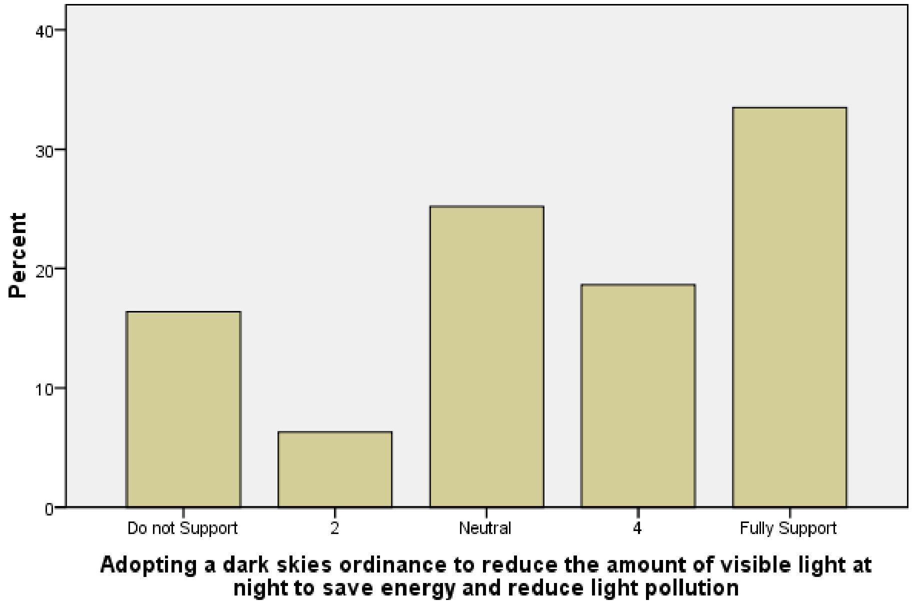
Erosion from development



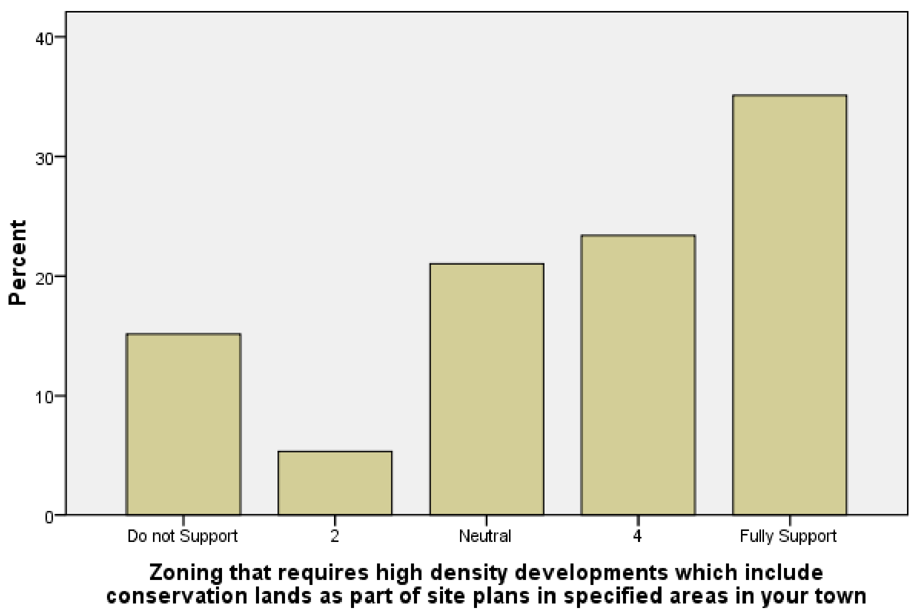
Erosion from forestry



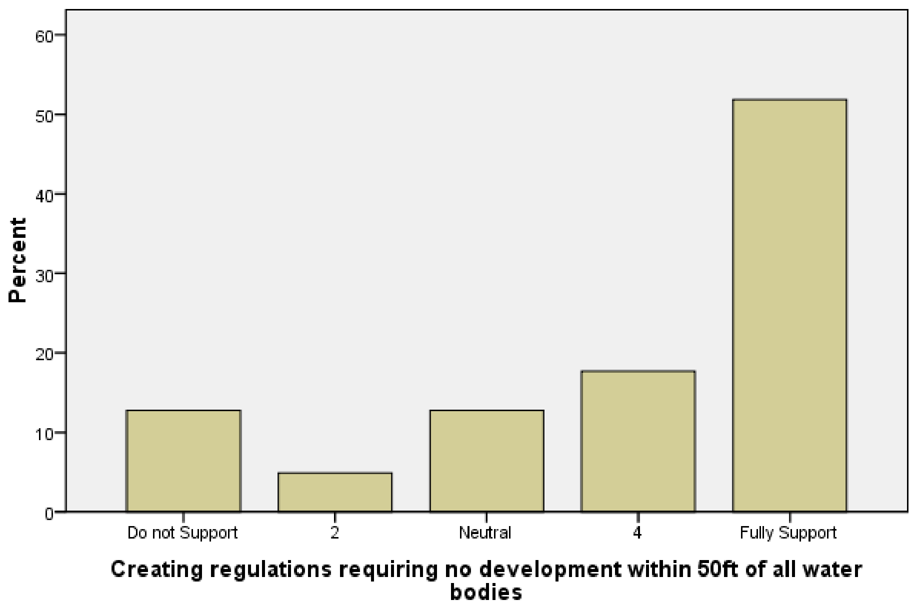
Adopting a dark skies ordinance to reduce the amount of visible light at night to save energy and reduce light pollution



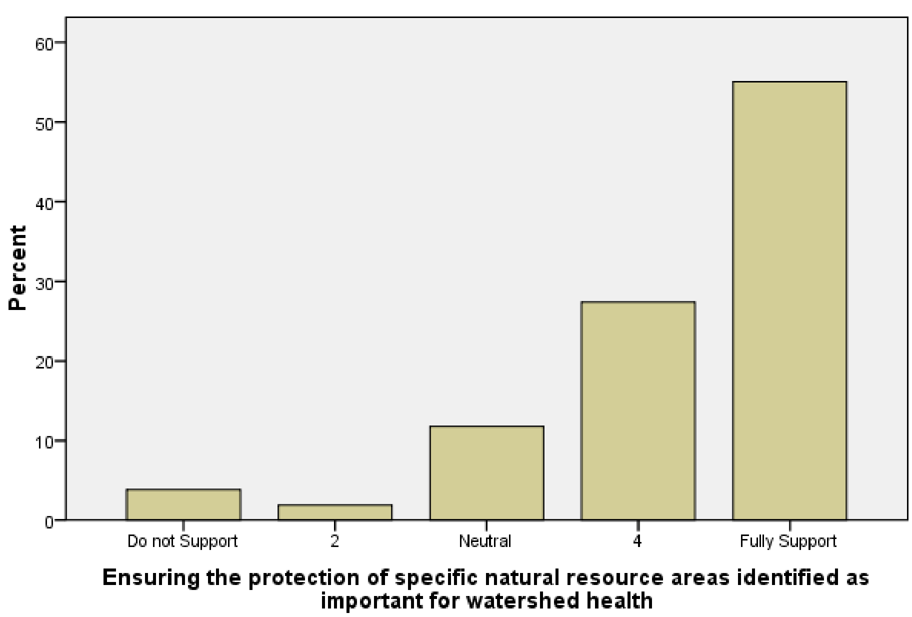
Zoning that requires high density developments which include conservation lands as part of site plans in specified areas in your town



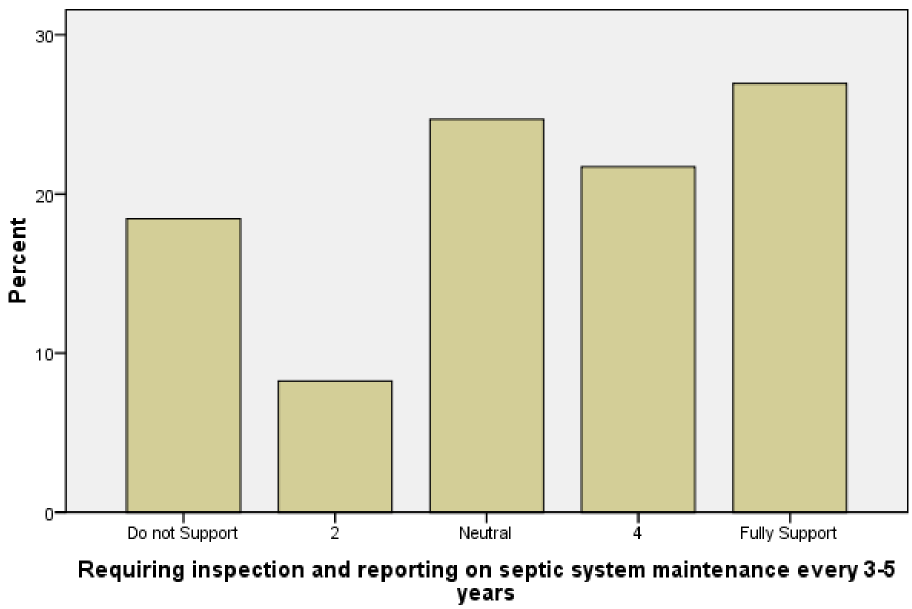
Creating regulations requiring no development within 50ft of all water bodies



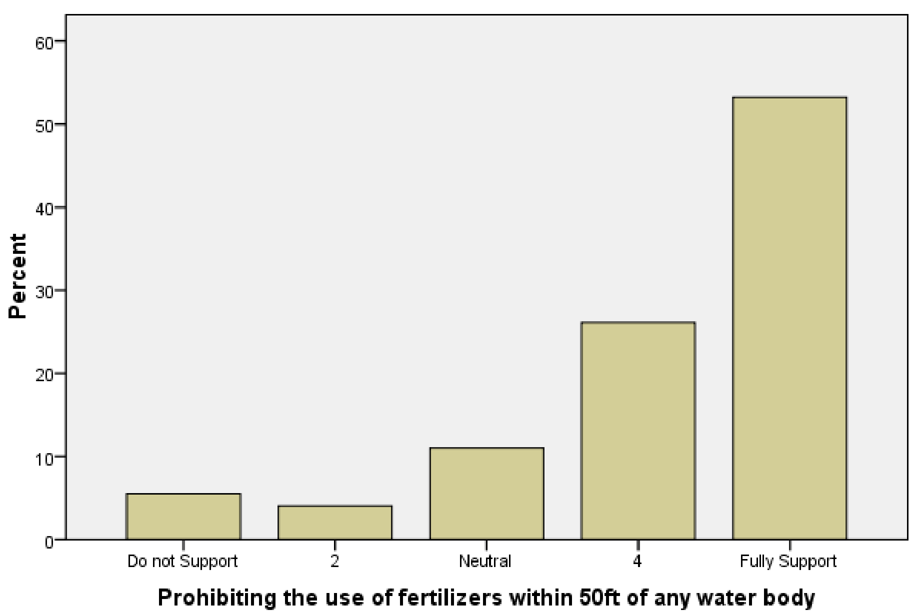
Ensuring the protection of specific natural resource areas identified as important for watershed health



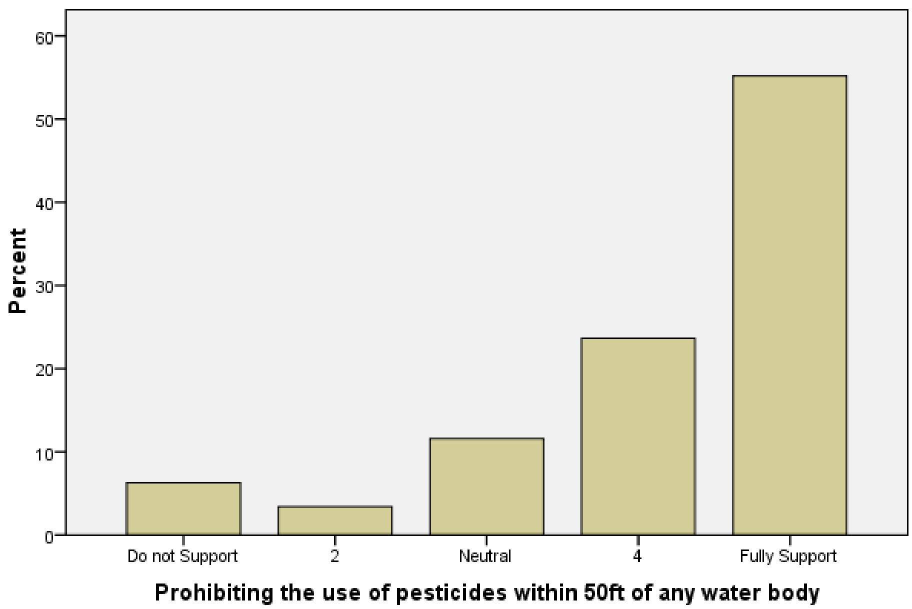
Requiring inspection and reporting on septic system maintenance every 3-5 years



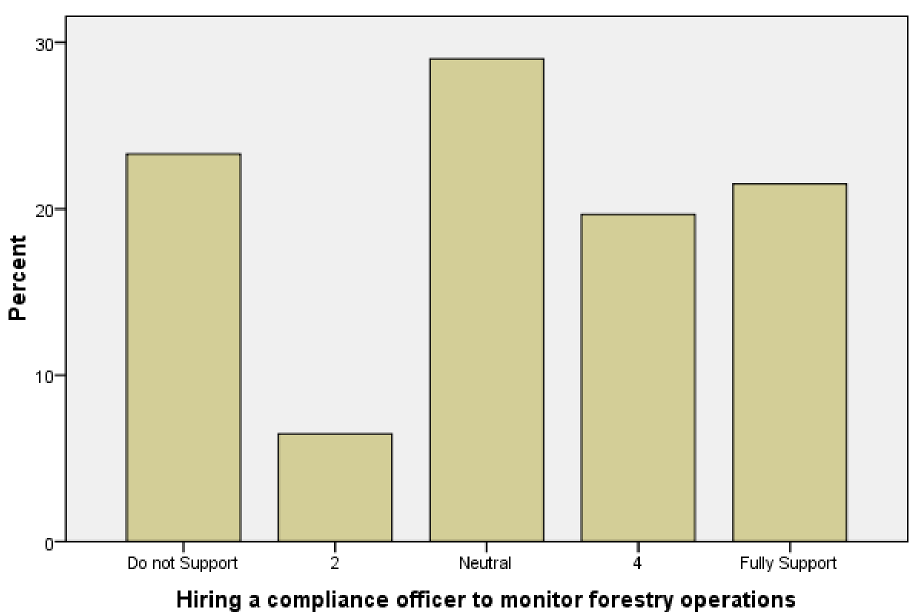
Prohibiting the use of fertilizers within 50ft of any water body



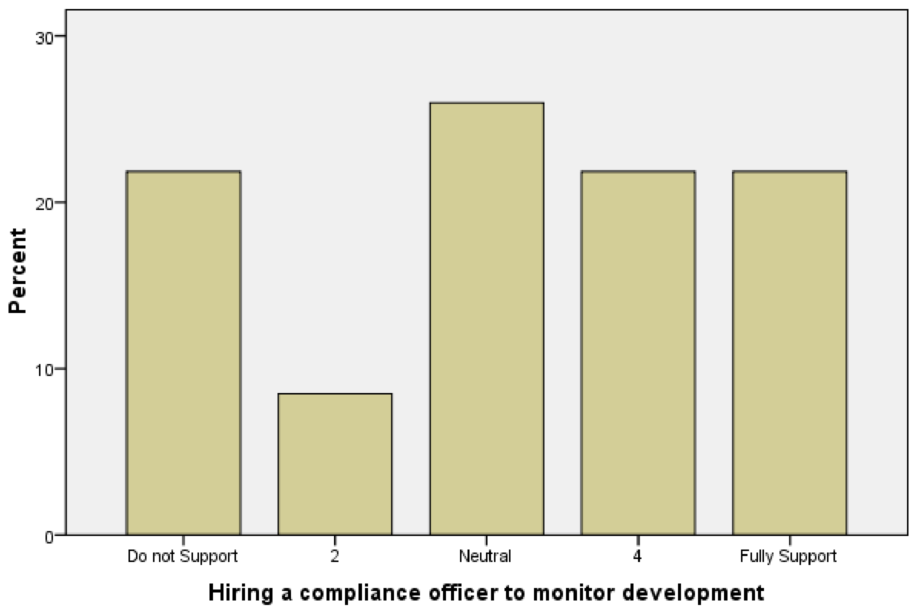
Prohibiting the use of pesticides within 50ft of any water body



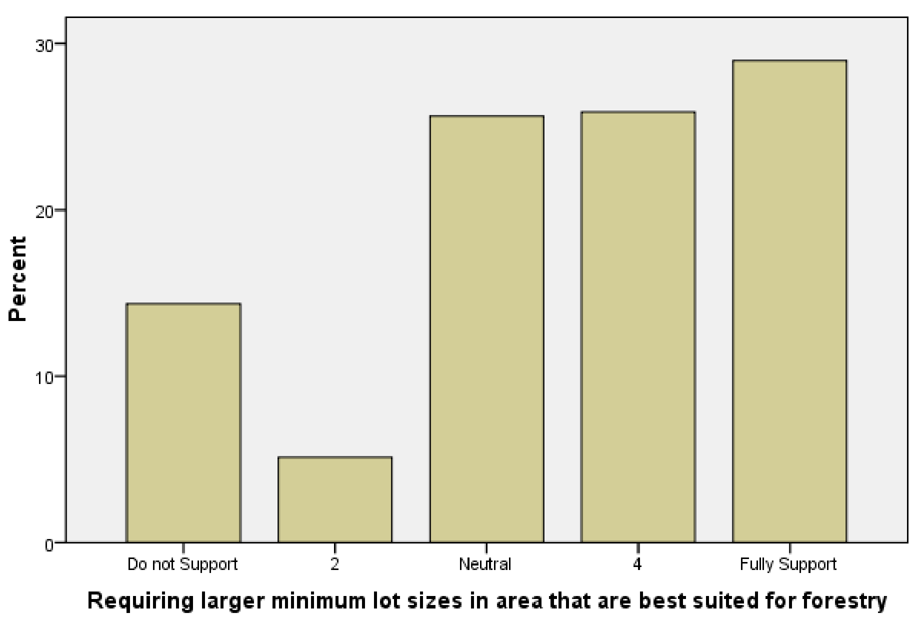
Hiring a compliance officer to monitor forestry operations



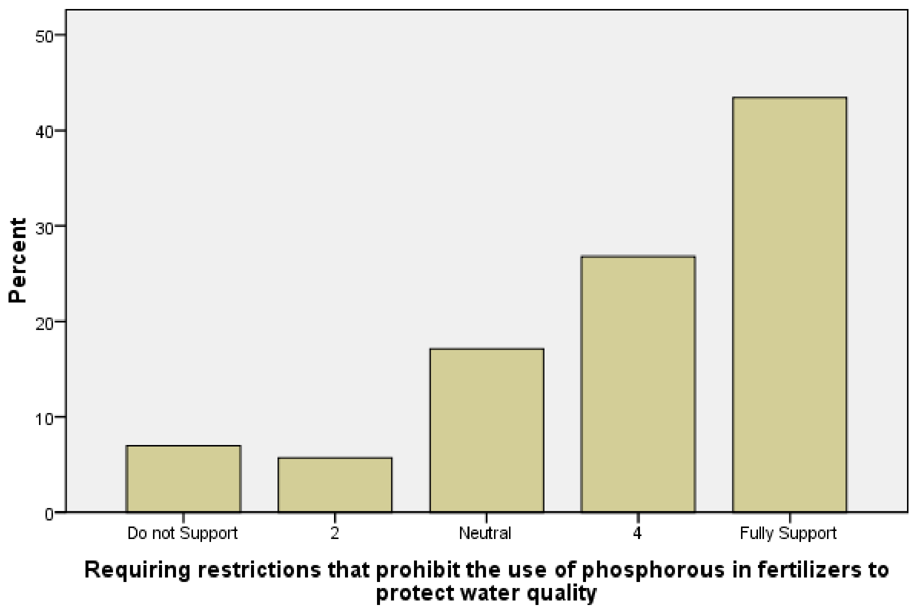
Hiring a compliance officer to monitor development



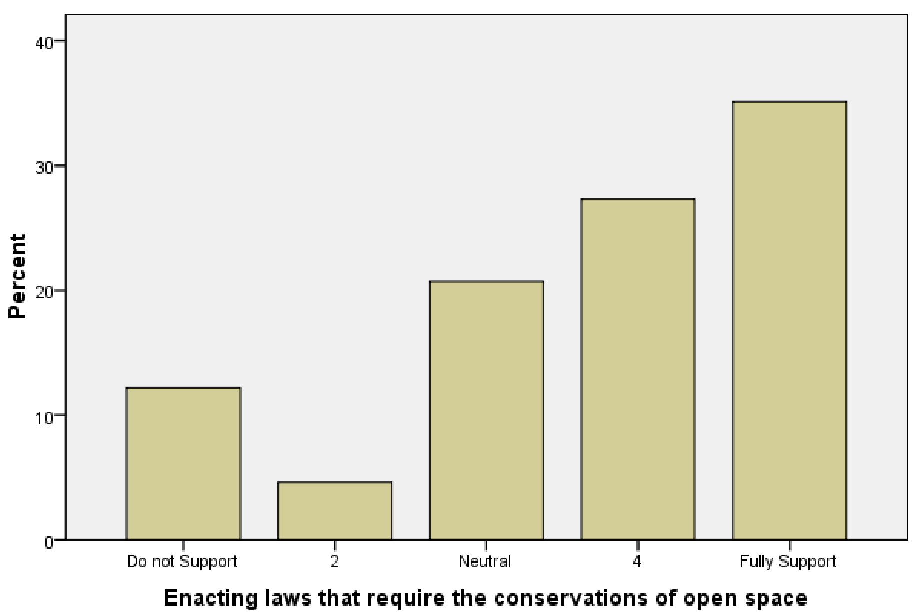
Requiring larger minimum lot sizes in area that are best suited for forestry

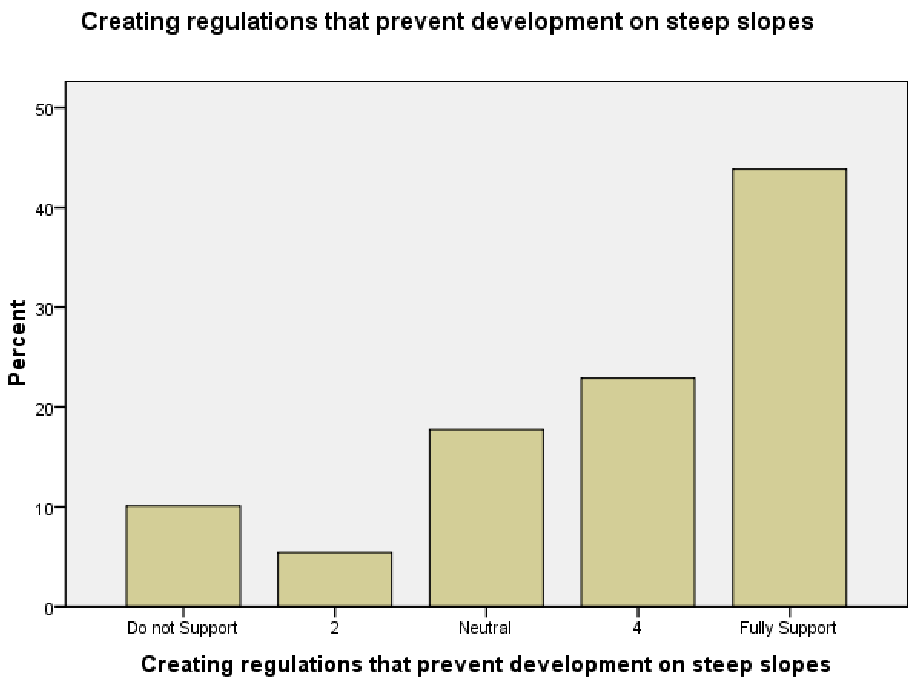


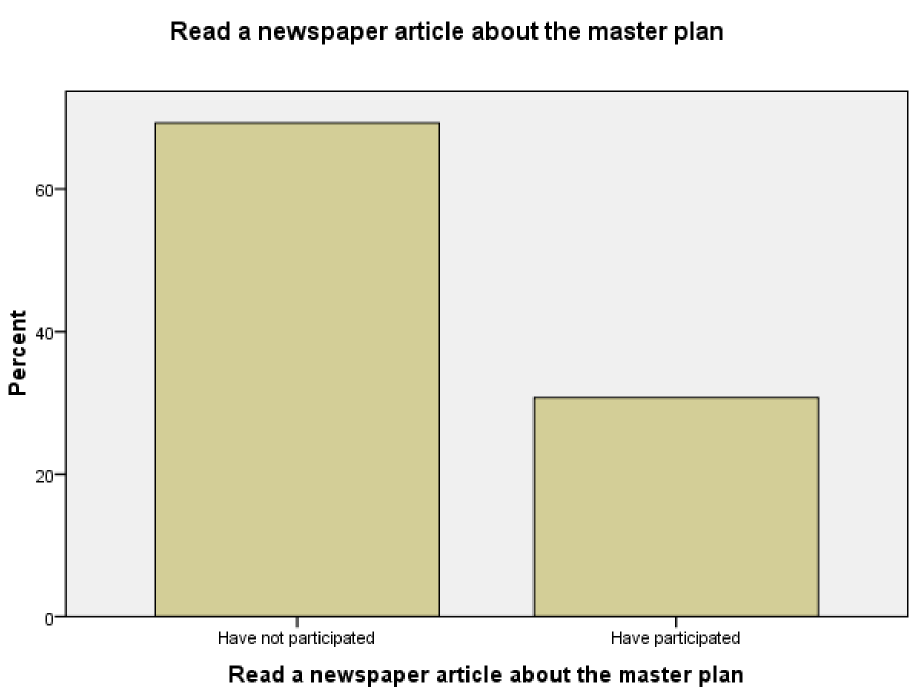
Requiring restrictions that prohibit the use of phosphorous in fertilizers to protect water quality



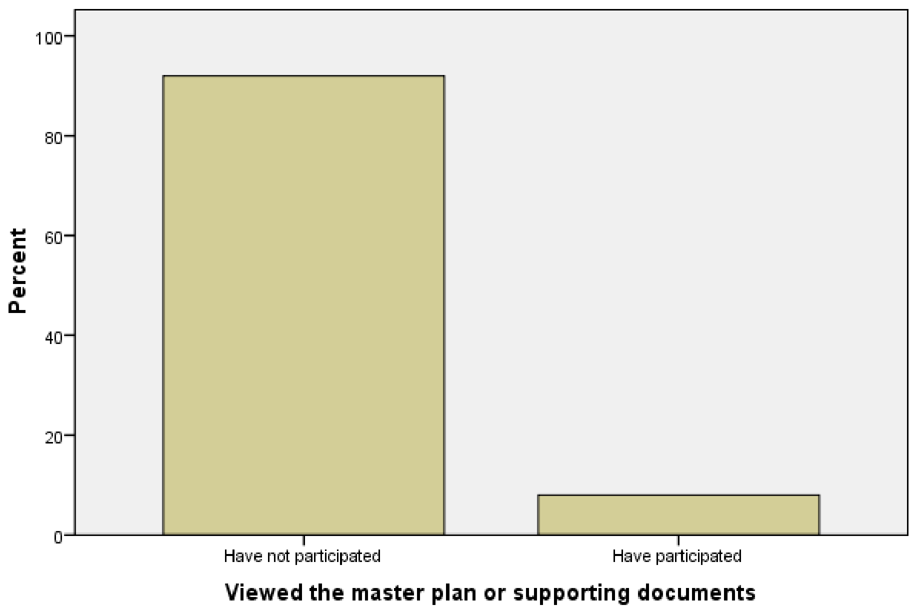
Enacting laws that require the conservations of open space



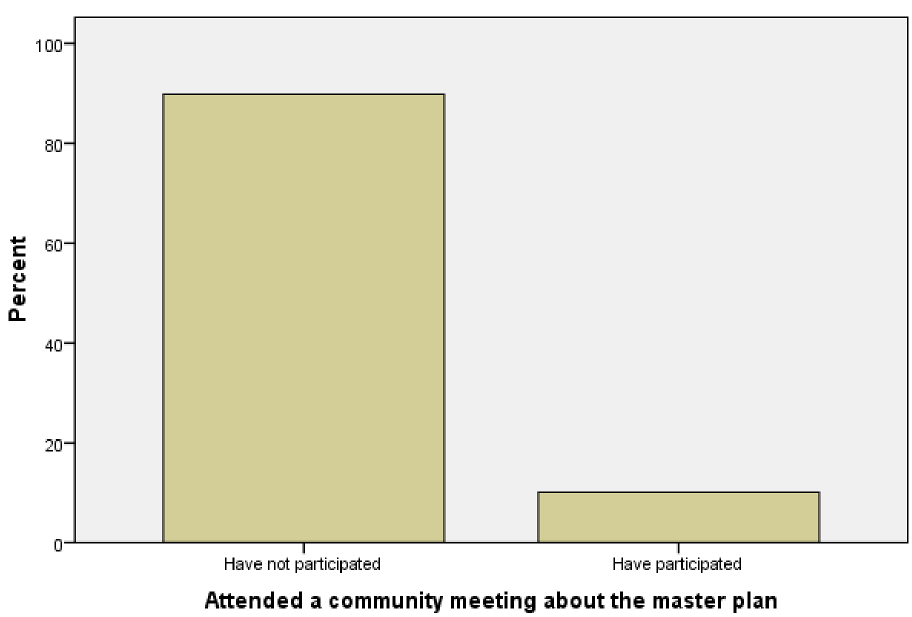

Creating regulations that prevent development on steep slopes
Percent
50
40
30
20
10
0
Do not Support
2
Neutral
4
Fully Support
Creating regulations that prevent development on steep slopes


Read a newspaper article about the master plan
Percent
60
40
20
0
Have not participated
Have participated
Read a newspaper article about the master plan

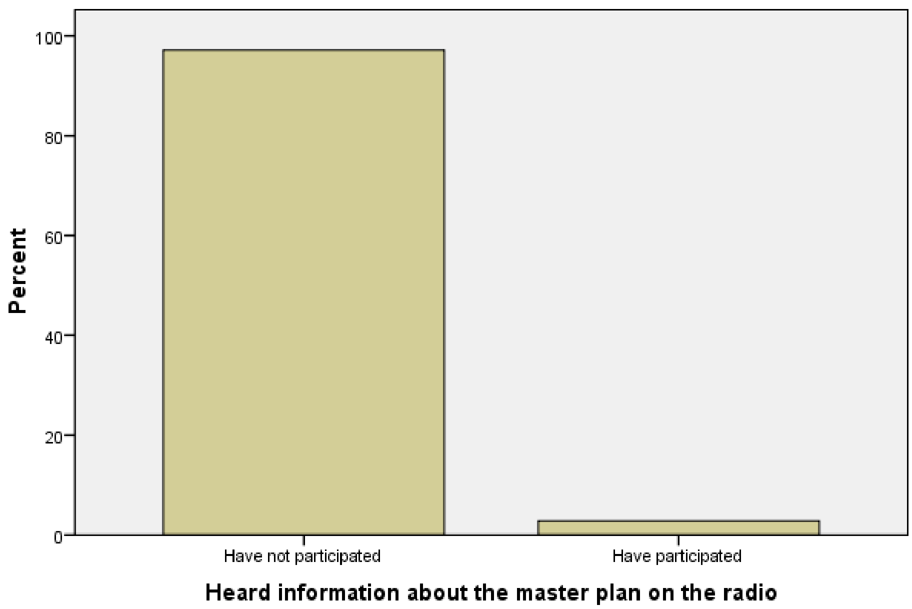
Viewed the master plan or supporting documents



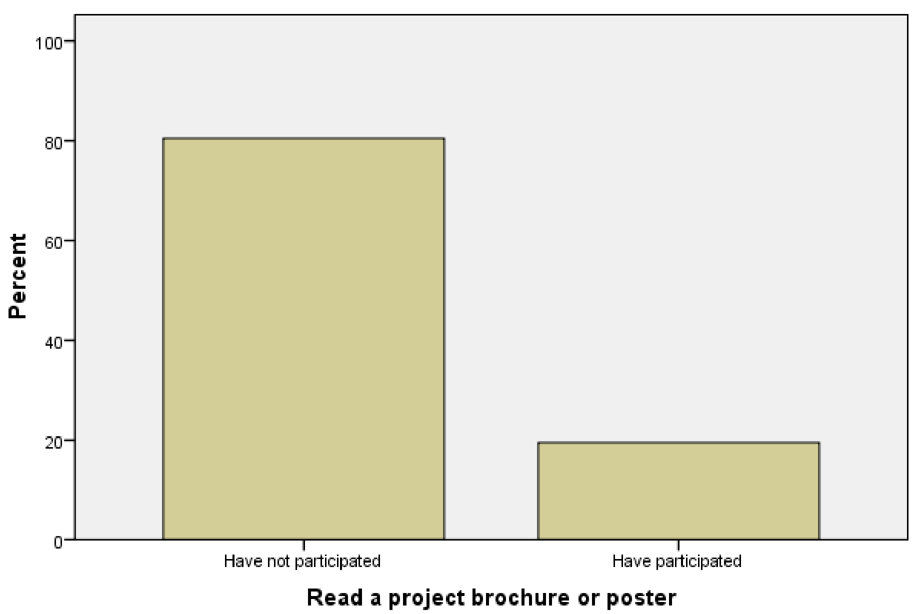
Attended a community meeting about the master plan



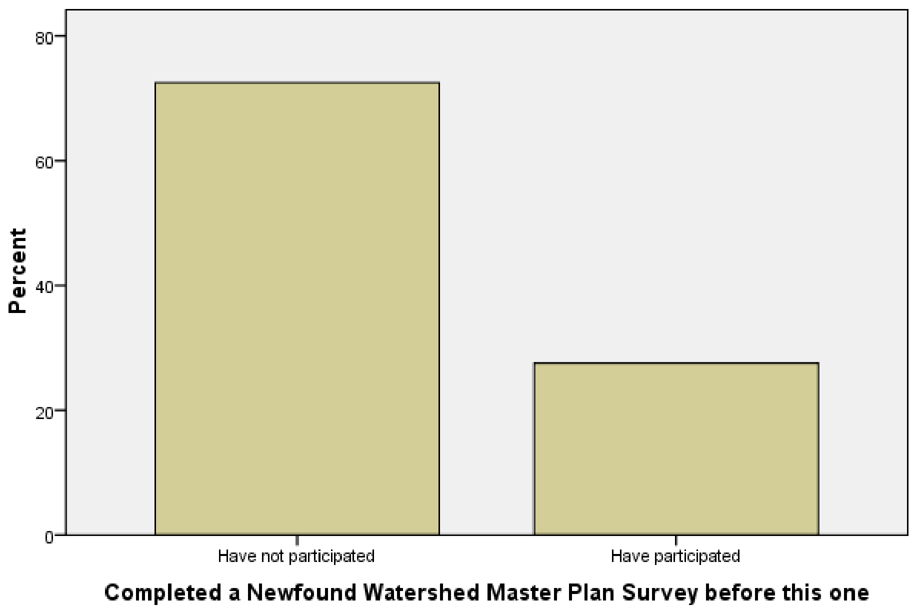
Heard information about the master plan on the radio



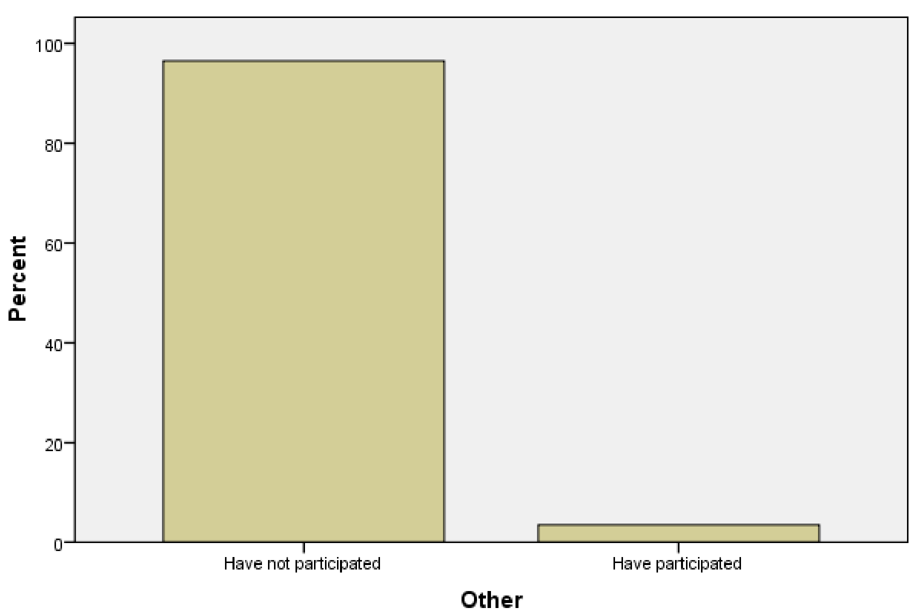
Read a project brochure or poster



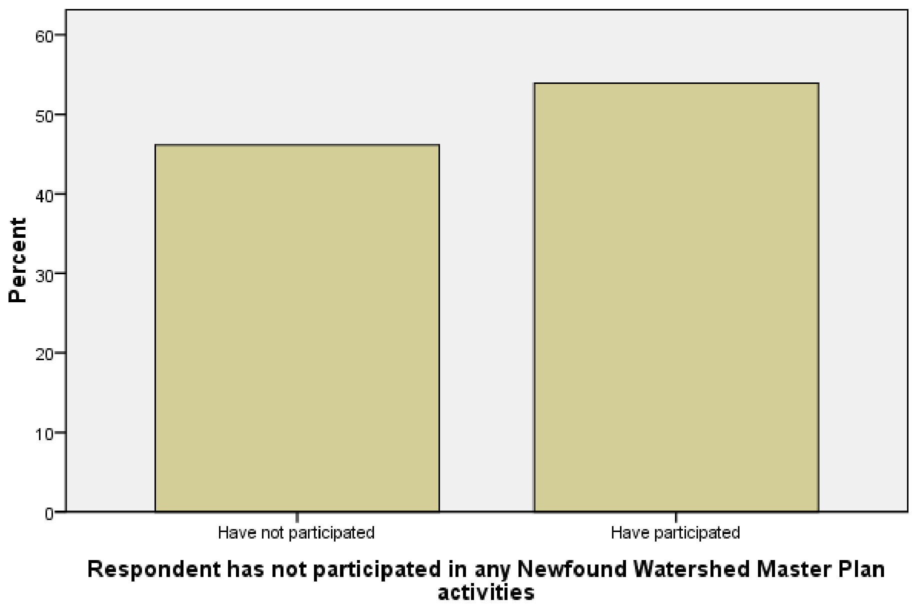
Completed a Newfound Watershed Master Plan Survey before this one



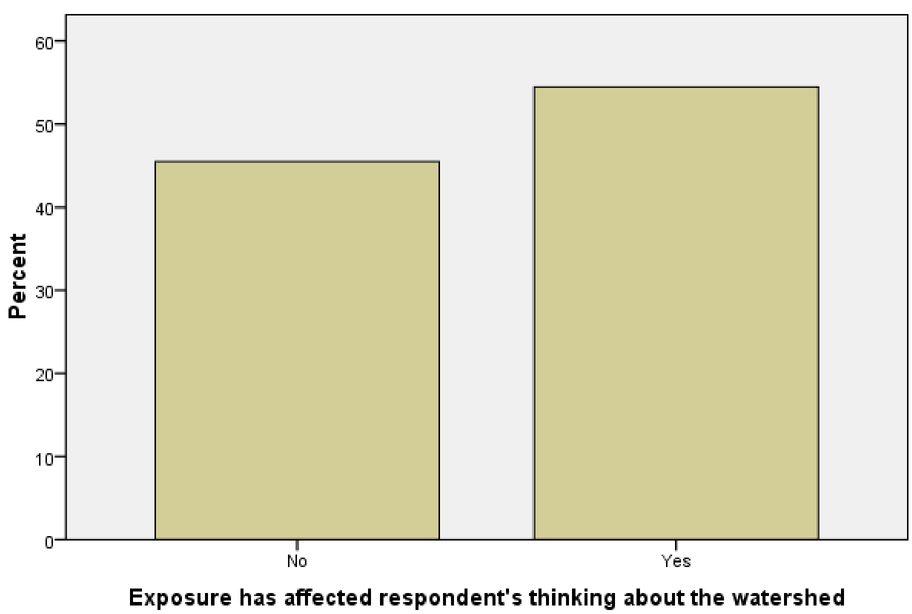
Other



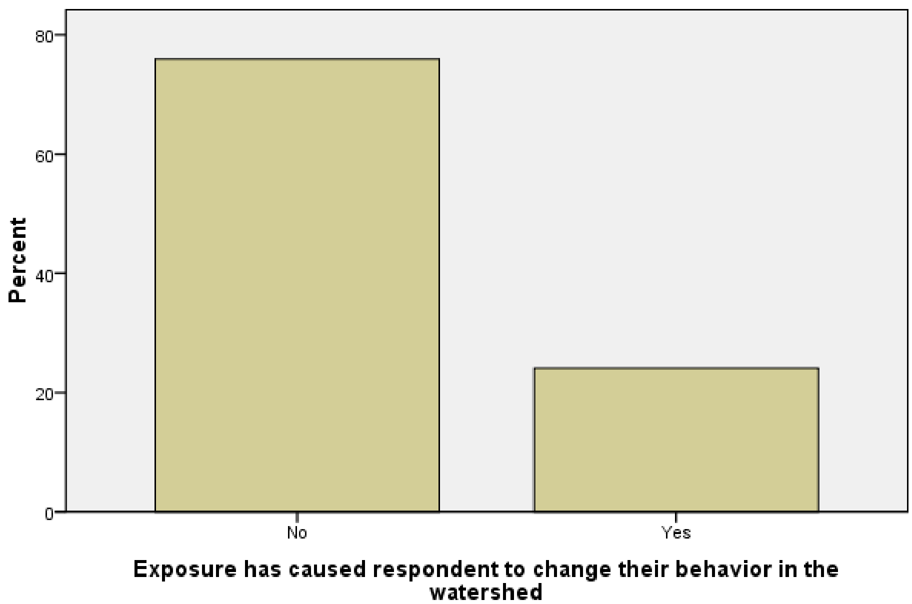
Respondent has not participated in any Newfound Watershed Master Plan activities



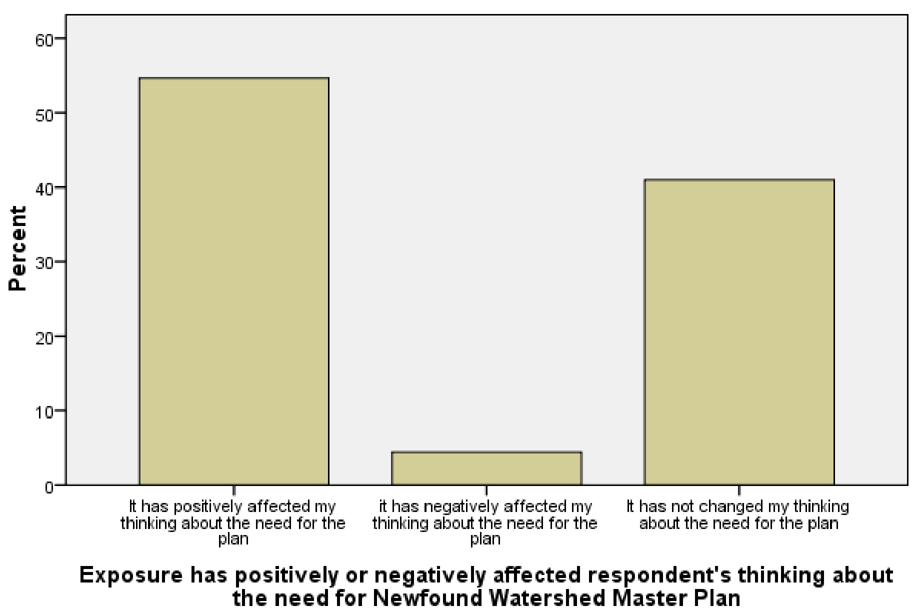
Exposure has affected respondent's thinking about the watershed

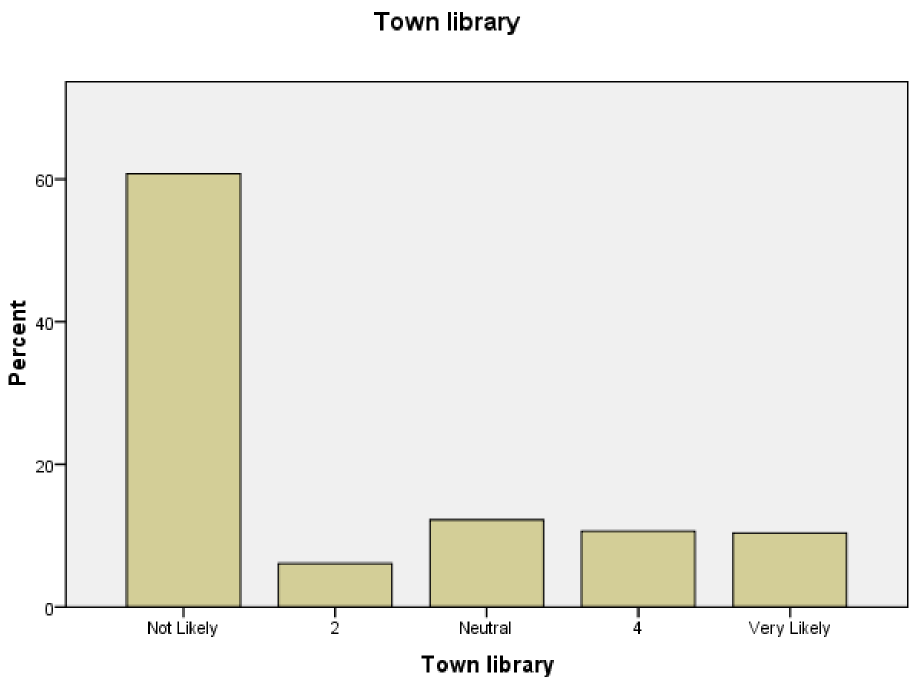


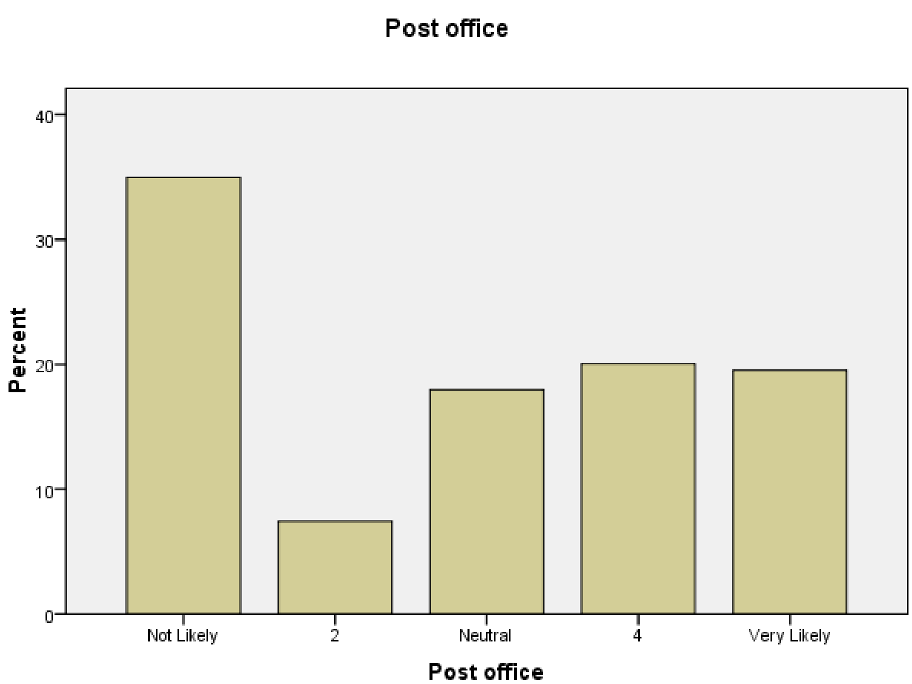
Exposure has caused respondent to change their behavior in the watershed



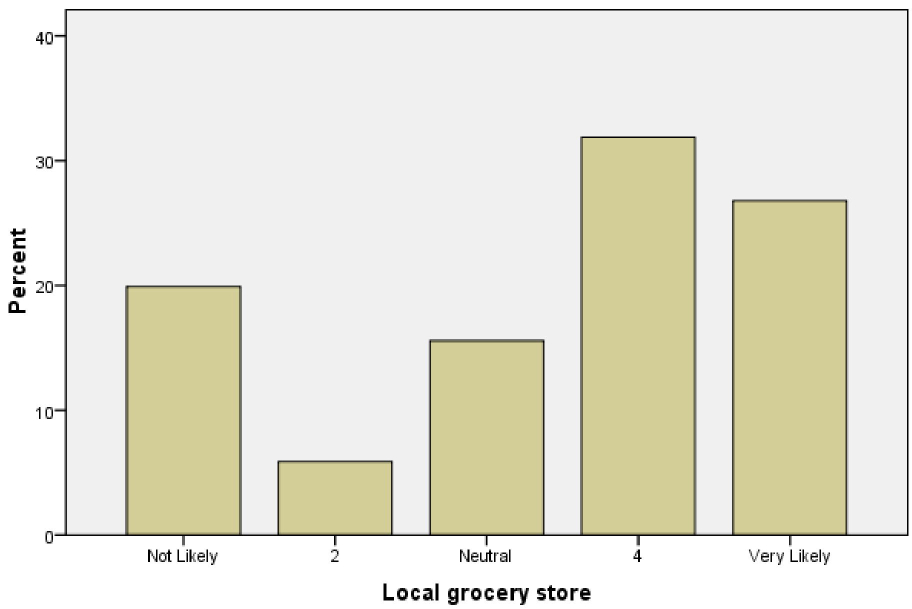
Exposure has positively or negatively affected respondent's thinking about the need for Newfound Watershed Master Plan



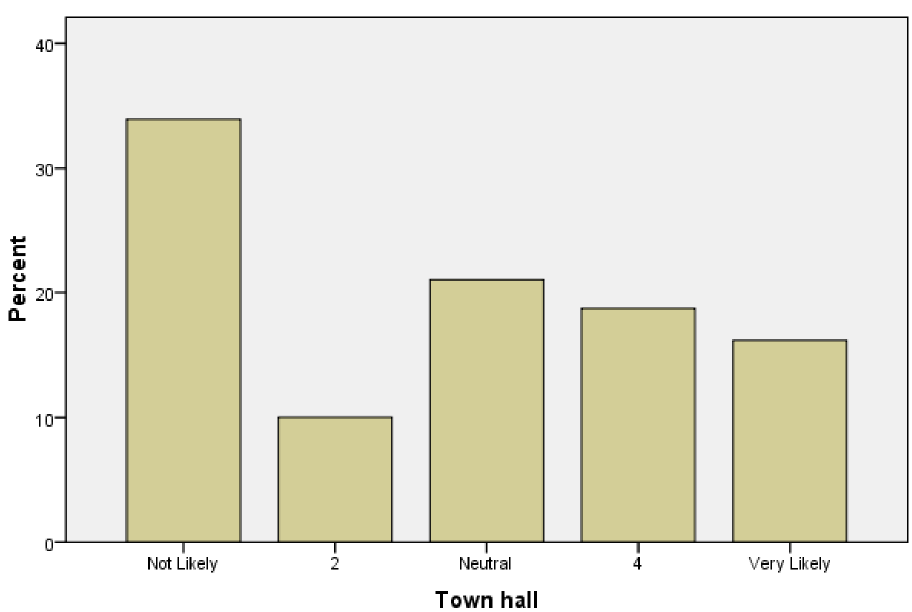

Town library
Percent
0
20
40
60
Not Likely
2
Neutral
4
Very Likely
Town library


Post office
Percent
0
10
20
30
40
Not Likely
2
Neutral
4
Very Likely
Post office

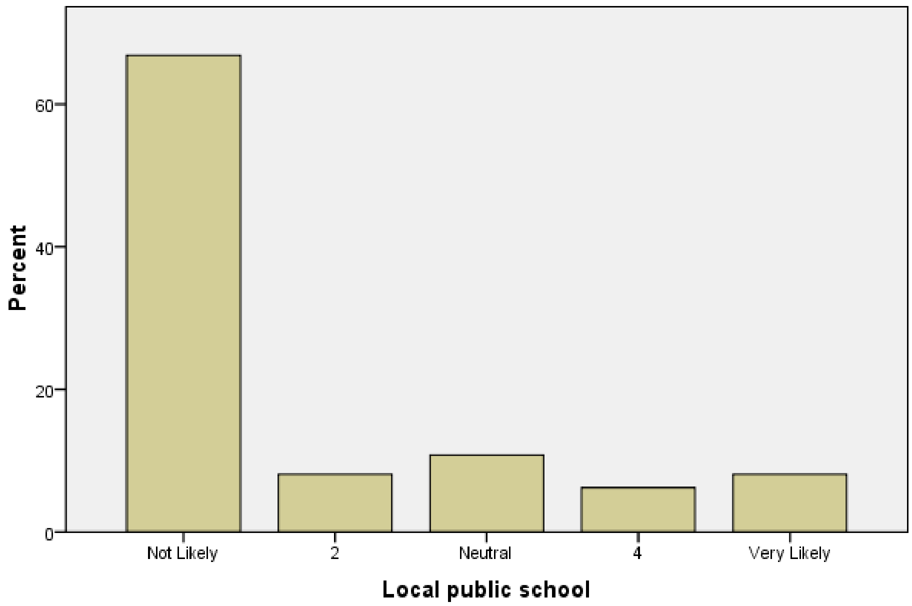
Local grocery store



Town hall

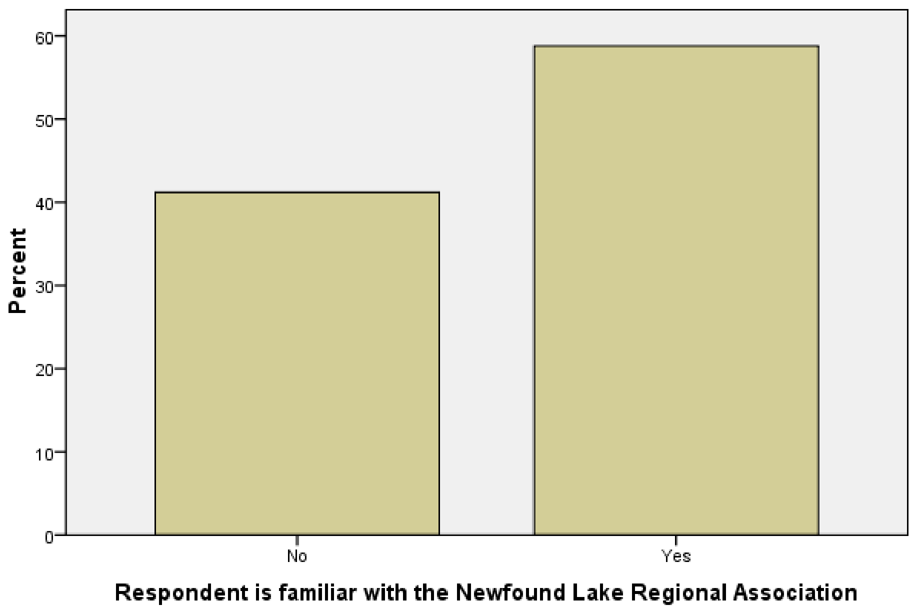


Local public school

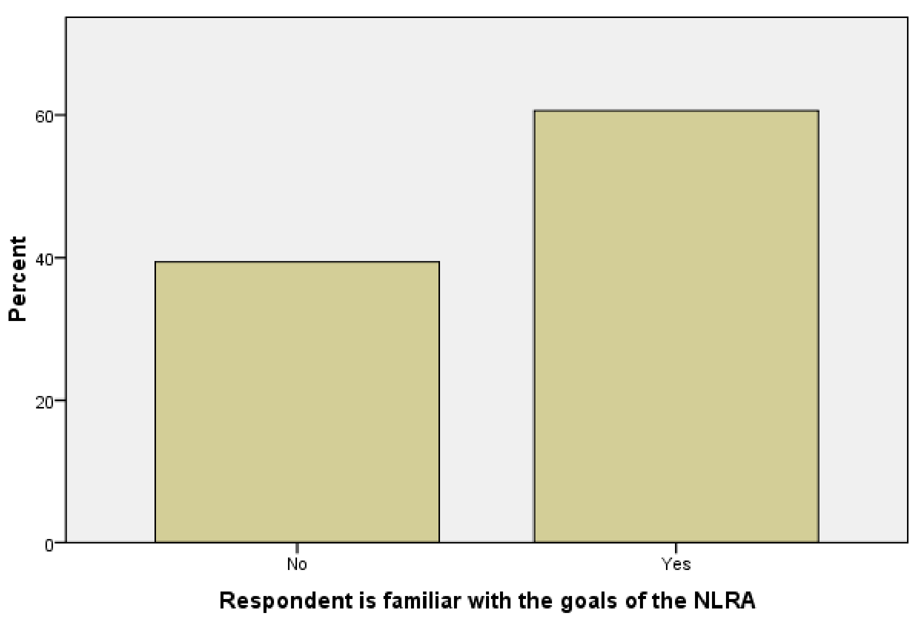


Town recreation sites

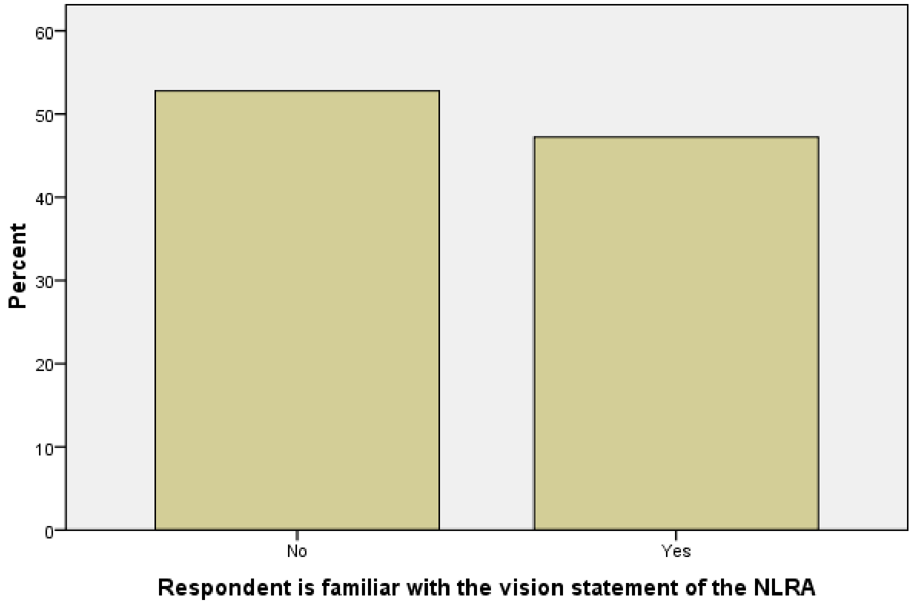
Respondent is familiar with the Newfound Lake Regional Association



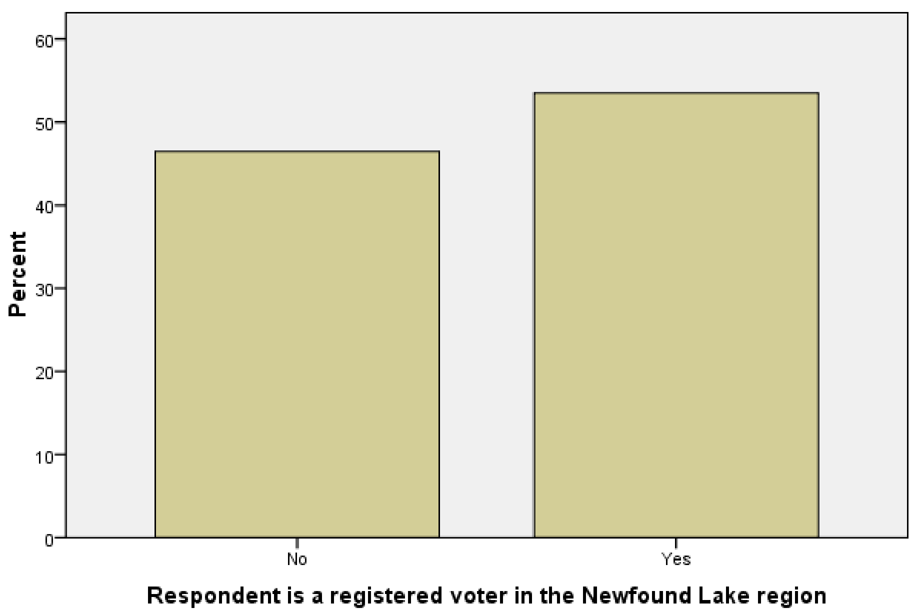
Respondent is familiar with the goals of the NLRA



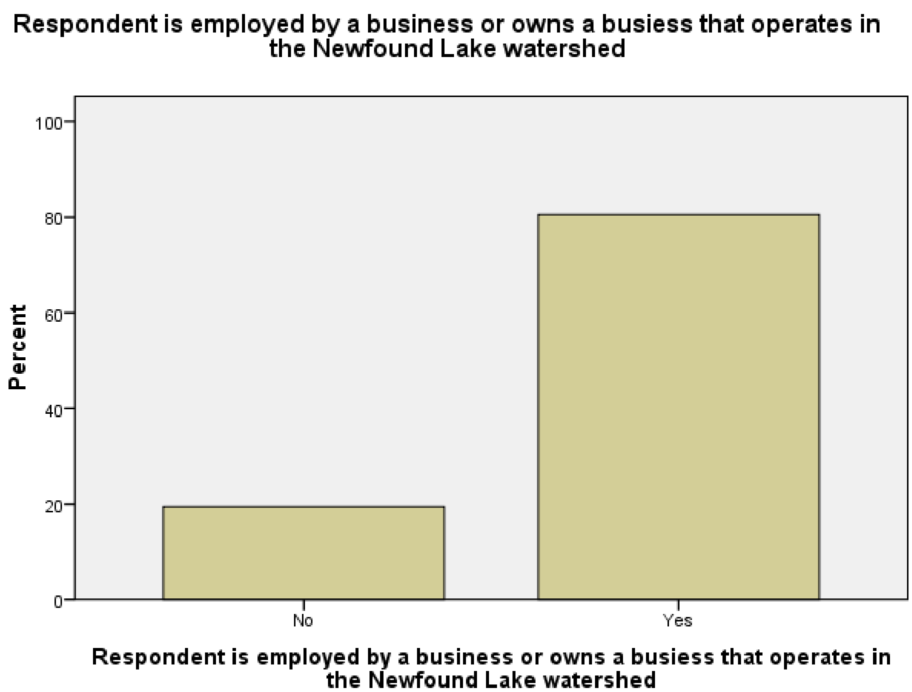
Respondent is familiar with the vision statement of the NLRA



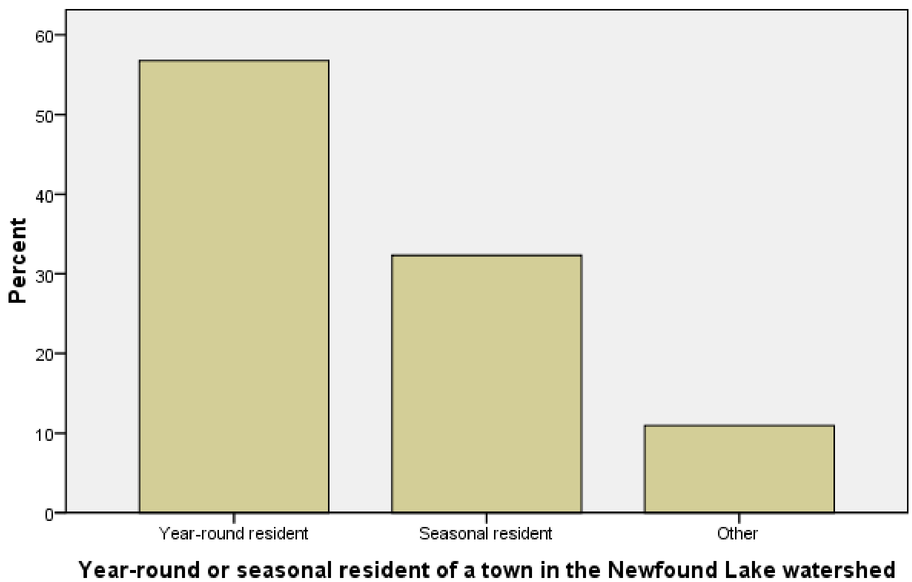
Respondent is a registered voter in the Newfound Lake region



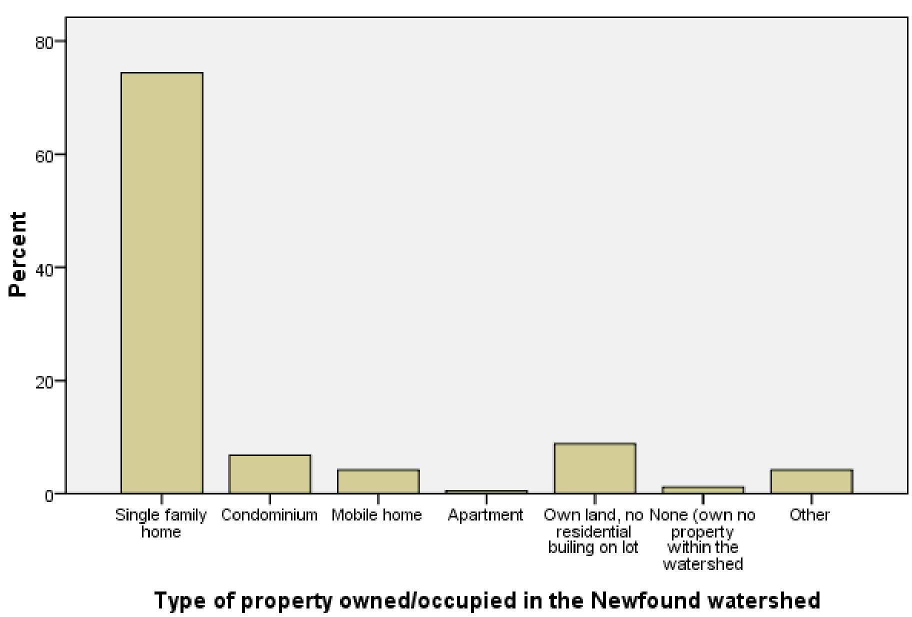

Respondent has served on local town boards or commissions
Percent
80
60
40
20
0
No
Yes
Respondent has served on local town boards or commissions

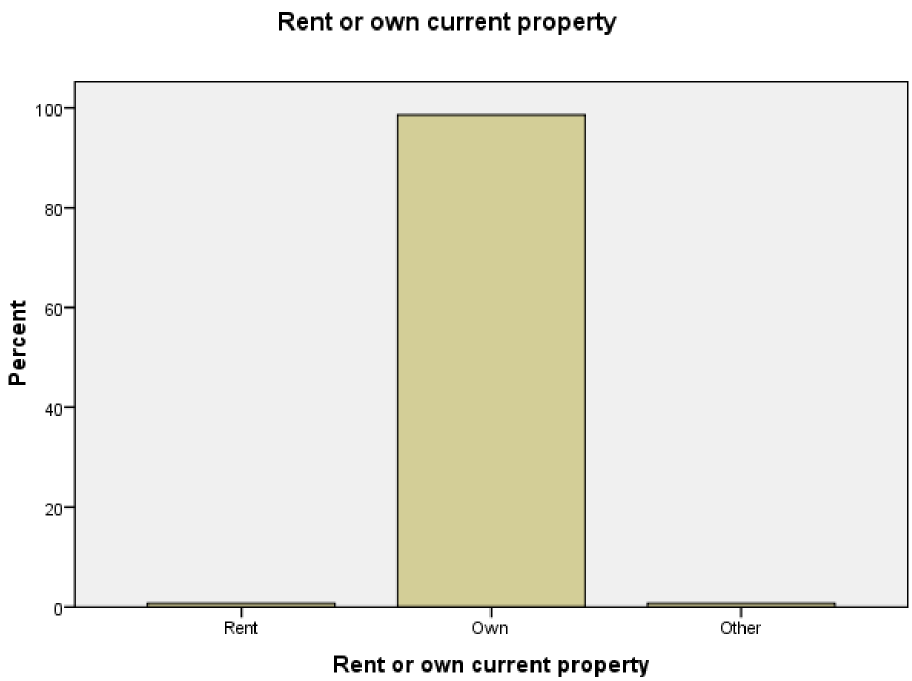

Respondent is employed by a business or owns a busiess that operates in the Newfound Lake watershed
Percent
100
80
60
40
20
0
No
Yes
Respondent is employed by a business or owns a busiess that operates in the Newfound Lake watershed

Year-round or seasonal resident of a town in the Newfound Lake watershed



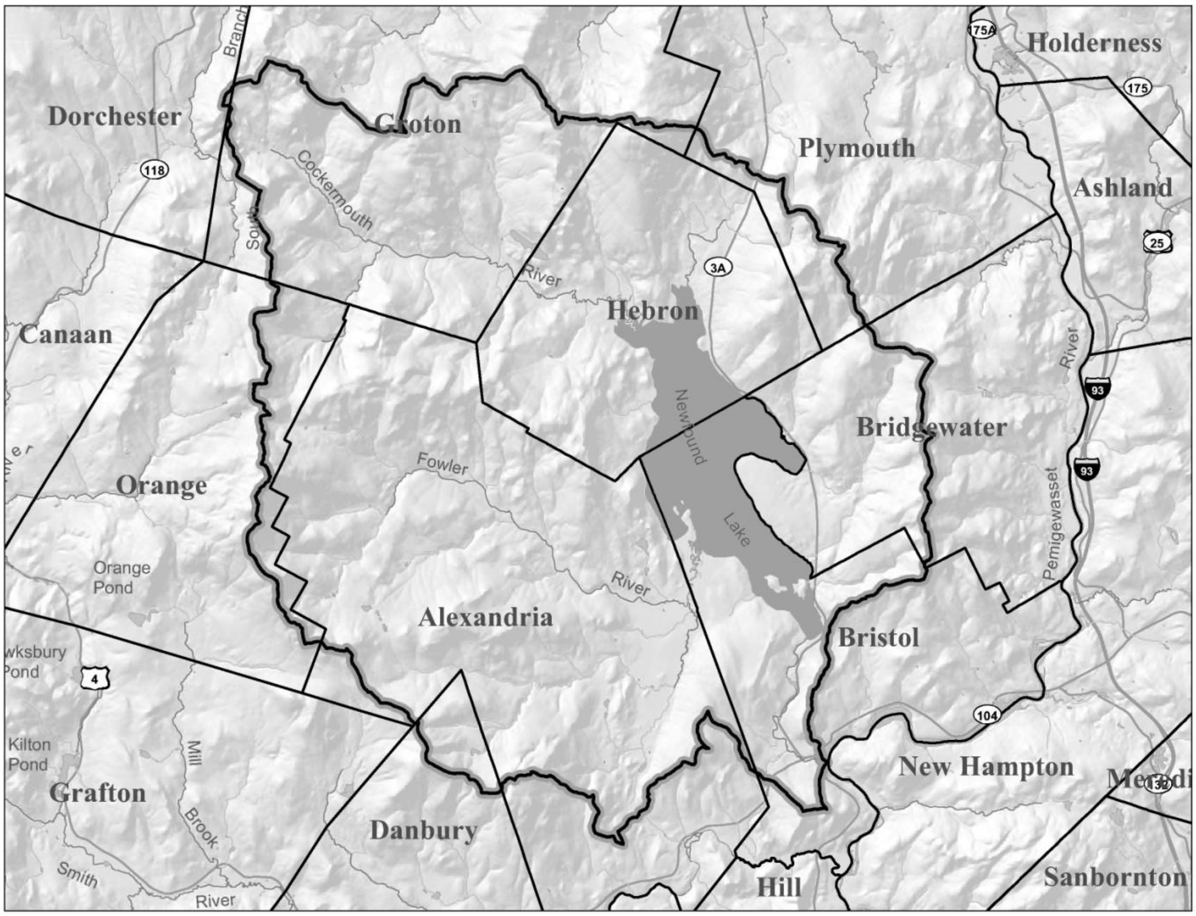
Type of property owned/occupied in the Newfound watershed




Rent or own current property
Percent
100
80
60
40
20
0
Rent
Own
Other
Rent or own current property

Every Acre Counts
The Newfound Watershed Master Plan

A Second Community Survey to Inform the Plan's Creation



The Newfound Watershed

The Newfound Lake region is one of the crown jewels of New Hampshire. The watershed is valued for its beauty and as an essential economic resource. Like other areas of New Hampshire the area is experiencing many changes. This is a critical time to plan to protect resources and economic opportunities in the region by helping towns coordinate their planning efforts.

<u>To plan effectively we need your opinions.</u> Many agencies, towns, and organizations are participating in the development of *Every Acre Counts: The Newfound Watershed Master Plan*. The plan will provide useful information to towns in the watershed to help them take steps to ensure the high quality of life valued by residents of the region exists in the future. In addition to documenting important social, economic, and environmental conditions in the watershed, the plan will make recommendations for town regulations and other actions that can be taken.

Please take some of your valuable time to let your town and the Newfound Watershed Master Plan project team know your opinions by circling the response that best fits your answer to each of the following questions. The information you share is completely confidential and will not be recorded or presented in any way that could link responses with the individuals who make them.

Thank you for your participation!

> *A watershed is the land area that drains to a specific body of water.*
> *(Please see the cover for a map of the Newfound Lake Watershed)*

1. Using a scale of 1 (NOT AT ALL IMPORTANT) to 5 (VERY IMPORTANT), please circle the number that best indicates how important you think each of the following goals is in *Every Acre Counts: The Newfound Watershed Master Plan*.

	Not at All Important		*Neutral*		*Very Important*	*Don't Know*
A. Protecting water quality	1	2	3	4	5	DK
B. Improving the local economy	1	2	3	4	5	DK
C. Protecting a rural lifestyle	1	2	3	4	5	DK
D. Educating the community about water quality issues	1	2	3	4	5	DK
E. Protecting scenic beauty in the region	1	2	3	4	5	DK
F. Encouraging stewardship at the town level	1	2	3	4	5	DK
G. Developing partnerships between neighboring towns in the watershed to promote natural resource conservation	1	2	3	4	5	DK
H. Fostering the existence of open space	1	2	3	4	5	DK
I. Identifying specific zoning measures towns can adopt to achieve watershed plan goals	1	2	3	4	5	DK

2. Prior to receiving this questionnaire, were you aware that a watershed master plan is being developed for the Newfound Lake region?

- ☐ Yes
- ☐ No *(Go to #3)*

2b. Have you seen or heard the vision statement in *Every Acre Counts: The Newfound Watershed Master Plan?*

- ☐ Yes
- ☐ No

3. How important or unimportant is it to you that your town participates in the Newfound watershed master plan process?

Not at all Important		*Neutral*		*Very Important*
1	2	3	4	5

4. How important or unimportant do you think it is for your town to hire a professional planner to assist with the implementation of *Every Acre Counts: The Newfound Watershed Master Plan*?

Not at all Important		*Neutral*		*Very Important*
1	2	3	4	5

Project participants are interested in what types of projects community members are willing to participate in to help implement Every Acre Counts: The Newfound Watershed Master Plan Plan.

5. Please circle the number that best indicates your willingness to participate in each of the stewardship volunteer activities listed below:

	Not Willing		*Maybe*		*Very Willing*	*Don't Know*
A. Stream clean-up	1	2	3	4	5	DK
B. Door-to-door outreach about ways to maintain a healthy watershed	1	2	3	4	5	DK
C. Lake clean-up	1	2	3	4	5	DK
D. Boating safety	1	2	3	4	5	DK
E. Web site development	1	2	3	4	5	DK
F. Non-native invasive weed removal (e.g. milfoil)	1	2	3	4	5	DK
G. Water quality sampling	1	2	3	4	5	DK

H. Other (Please specify any other stewardship volunteer activities in which you are willing to participate): ______________________________

A "viewshed" is the area of land visible from a particular location. For example, your home's viewshed is the entire landscape visible from your property.

6. How important or unimportant do you feel it is to protect the "viewsheds" throughout the Newfound Lake watershed?

Not at all Important		*Neutral*		*Very Important*
1	2	3	4	5

7. How important or unimportant do you feel it is to reduce the amount of salt used on public roads to protect water quality?

Not at all Important		*Neutral*		*Very Important*
1	2	3	4	5

8. How important or unimportant do you feel it is to increase town support of non-native invasive weed prevention programs?

Not at all Important		*Neutral*		*Very Important*
1	2	3	4	5

9. Using a scale from 1 (NOT AT ALL CONCERNED) to 5 (VERY CONCERNED) please circle the number that best indicates how concerned you are about each of the following issues in the Newfound Lake watershed?

	Not at all Concerned		*Neutral*		*Very Concerned*	*Don't Know*
A. Nutrient runoff from lawns (including phosphorous)	1	2	3	4	5	DK
B. Increased runoff from impervious surfaces (e.g. roads, parking lots, roofs)	1	2	3	4	5	DK
C. Pesticide use	1	2	3	4	5	DK
D. Pollution from detergents containing phosphorous	1	2	3	4	5	DK
E. Loss of open space	1	2	3	4	5	DK
F. Erosion from development	1	2	3	4	5	DK
G. Erosion from forestry	1	2	3	4	5	DK

10. Using a scale of 1 (DO NOT SUPPORT) to 5 (FULLY SUPPORT) please circle the number that best indicates your level of support for the following regulatory measures that may be recommended as part of *Every Acre Counts: The Newfound Watershed Master Plan*.

	Do not Support		Neutral		Fully Support	Don't Know
A. Adopting a dark skies ordinance to reduce the amount of visible light at night and save energy	1	2	3	4	5	DK
B. Zoning requiring high density developments that include conservation lands as part of site plans in specified areas in your town	1	2	3	4	5	DK
C. Creating regulations requiring no development within 50 feet of all water bodies	1	2	3	4	5	DK
D. Ensuring the protecting of specific natural resource areas identified as important for watershed health	1	2	3	4	5	DK
E. Requiring inspection and reporting on septic system maintenance every 3-5 years	1	2	3	4	5	DK
F. Prohibiting the use of fertilizers within 50 feet of any water body	1	2	3	4	5	DK
G. Prohibit the use of pesticides within 50 feet of any water body	1	2	3	4	5	DK
H. Hiring a compliance officer to monitor forestry operations	1	2	3	4	5	DK
I. Hiring a compliance officer to monitor development	1	2	3	4	5	DK
J. Requiring larger minimum lot sizes in areas that are best suited for forestry	1	2	3	4	5	DK
K. Requiring restrictions that prohibit the use of phosphorus in fertilizers to protect water quality	1	2	3	4	5	DK
L. Enacting laws that require the conservation of open space	1	2	3	4	5	DK
M. Creating regulations that prevent development on steep slopes	1	2	3	4	5	DK

11. Which of the following *Every Acre Counts: The Newfound Watershed Master Plan* activities have you participated in? (Please mark all that apply)

- ☐ Read a newspaper article about the master plan
- ☐ Viewed the master plan or supporting documents on a Web site
- ☐ Attended a community meeting about the master plan
- ☐ Heard information about the master plan on the radio
- ☐ Read a project plan brochure or poster
- ☐ Completed a Newfound Watershed Master Plan Survey <u>before this one</u>
- ☐ Other (Please specify): ______________________________

- ☐ I have not participated in any Newfound Watershed Master Plan activities *(Go to #12)*

A. Has this exposure affected your thinking about the Newfound watershed?

- ☐ Yes (Please specify): ____
- ☐ No (please use the blank page on the back if additional space is needed)
- ☐ Not applicable

B. Has this exposure changed your behavior in the watershed in any way?

- ☐ Yes (Please specify): ____
- ☐ No (please use the blank page on the back if additional space is needed)
- ☐ Not applicable

C. Has this exposure positively or negatively affected your thinking about the need for *Every Acre Counts: The Newfound Watershed Master Plan*?

- ☐ It has positively affected my thinking about the need for the plan
- ☐ It has negatively affected my thinking about the need for the plan
- ☐ It has not changed my thinking about the need for the plan
- ☐ Not applicable

An important goal of Every Acre Counts: The Newfound Watershed Master Plan is to create awareness of the project and its potential contributions to our communities.

12. Please circle the number below that best indicates how likely or unlikely you would be to notice information about watershed planning at the following locations:

	Not Likely		Neutral		Very Likely	Don't Know
A. Town library	1	2	3	4	5	DK
B. Post office	1	2	3	4	5	DK
C. Local grocery store	1	2	3	4	5	DK
D. Town Hall	1	2	3	4	5	DK
E. Local public schools	1	2	3	4	5	DK
F. Town recreation sites (parks, etc.)	1	2	3	4	5	DK

G. Please indicate any other public areas that you would likely notice information about watershed planning: ____

13. Are you familiar with the Newfound Lake Regional Association (NLRA)?

- ☐ Yes →
- ☐ No *(Go to question 14)*

A. Are you familiar with the goals of the NLRA?
- ☐ Yes
- ☐ No

B. Are you familiar with the vision statement of the NLRA?
- ☐ Yes
- ☐ No

14. Are you a registered voter in the Newfound Lake region?
- ☐ Yes
- ☐ No

15. Have you ever served on any of your local town boards or commissions?
- ☐ Yes
- ☐ No

16. Are you employed by a business or do you own a business that operates in the Newfound Lake watershed?
- ☐ Yes
- ☐ No

17. Are you a year-round or seasonal resident of a town in the Newfound watershed?
- ☐ Year-round resident
- ☐ Seasonal resident
- ☐ Other (Please specify):____

18. What type of property do you currently own/occupy in the Newfound watershed?
- ☐ Single family home
- ☐ Condominium
- ☐ Mobile home
- ☐ Apartment
- ☐ Own land, no residential building on lot
- ☐ None (own no property within the watershed)
- ☐ Other (Please specify): ________________

19. Do you rent or own your current property?
- ☐ Rent
- ☐ Own
- ☐ Other (Please specify): __________________

<u>Thank you</u> for your input. Please seal the completed questionnaire in the pre-addressed return envelope provided, and drop it in the mail.

No additional postage is necessary.

Oral Histories of Life in the Newfound Watershed

The Newfound Watershed Master Plan

To: The Newfound Watershed Master Plan
Brian Eisenhauer
June Hammond Rowan
From: Marcia Schmidt Blaine
Re: report on Oral History project
Date: January 2, 2008

In the fall of 2007, students in the New Hampshire and New England History class conducted interviews with 30 people who are in some way connected to the Newfound watershed region. Many references within the interviews show the deep connections between the people in the region. They value and wish to preserve the personality of the lake region. In this report, I have included the analyses students conducted after their interviews and after reading other interview transcripts, a CD with the interview transcripts, consent forms from each person interviewed, and a sampling of useful quotes from the transcripts that may be useful in your final report.

All of the interviewees appreciate the region they live in. They value the people in the region and, even when they disagree with their neighbors, believe that all are trying to do what they think is best. The controversy regarding the extension of sewerage lines to the lake is a perfect example. Each side strongly feels that their ideas will be most effective in keeping the lake clean. Most interviewees enjoy year-round outdoor activities and mentioned the thrill of seeing otters, mink, beaver, moose, red fox, and bear in their explorations of the area. While some trust the depth of the lake and the many springs that flow into the lake to protect it, most believe that varying degrees of increased regulation are necessary to preserve the area.

Almost without exception, the interviewees all listed growth as the greatest challenge facing the watershed region. It seems that for many the condominiums that sprang up in the 1990s awakened them to the threat of losing what they valued: the pristine beauty of the region. Many people suggested that what is needed is a regional approach. One interviewee, a member of a local select board, mentioned that there are now meetings of regional select boards. Yet, because of the authority granted town boards as opposed to some sort of larger geographic area, it's clear that much work must done on a town-by-town basis rather than the region. For some, this is quite frustrating. Residents worry about the loss of the rural nature of the area as the high ground is now being cleared and lake-view houses built. They fear that the region will eventually be caught in the Winnipesaukee effect with increased traffic, commercialization, and environmental degradation. At the same time, they do not want the area to suffer economically. They seek some sort of balance that will preserve the timelessness of the region. Is education alone enough to do this?

A note about the attachments:
1. Each entry in the sampling of quotes includes the interviewee's name, the date they were interviewed and, in parentheses, the name of the interviewer. Interviewees' birth years are also listed. Students interviewed people ranging in age from late teens to early

90s. Excerpts from the interviews that may be useful for your final report are on the CD (title: 'oral histories – excerpts') and paper.
2. There are two exceptions to the consent forms: the interviews of Mason Westfall and Richard Cowern. I have included their complete transcripts and excerpts of their transcripts in your documents but, without the consent forms, you cannot use their information in the report unless you obtain permission.
3. The student's papers are based on at least five interviews: two they conducted and three of their classmates. They were instructed to find a theme within the interviews and to focus on that. You will see from their titles that they have chosen many interesting avenues to pursue.

Every Acre Counts: Newfound Watershed Master Plan - Oral histories
Conducted by the New Hampshire and New England History class at Plymouth State University, Fall, 2007 under the direction of Prof. Marcia Schmidt Blaine

Bruce VanDerren, October 19, 2007 (Christine Celeta)
b. 1953.
[Most important issue facing the region] BV: making sure that the development is well planned…welcomed but incorporated with the watershed needs.
BV: I sense there's people who have the budget to buy a million dollar house have the budget to hire a lawyer and do what they want …. the towns don't have that kind of control. I think we've got to incorporate change in a way that preserves the sense of timelessness here.
BV: You know one minute you've got - you know a farm, and that's you know maybe for fifty years, and then it's a campground for light seasonal use. The next think you know, it's gonna be covered with trailers and traffic and it just goes to show that nobody understands "how did that happen?"…. I mean there's a way to find the middle ground.
BV: I'm a selectman of Bristol, and I can count on one hand the number of times our Selectboard has talked to the other Selectboards, so we just started having Selectman Summits….. trying to see if we can start a dialogue about how we can keep this place as nice as we want it to be, but I am concerned that you know within a couple miles of each other, we've got one town that has no zoning…. . I guess that's what concerns me is that as you go from one town to the other.

Helen Robinson, October 19, 2007 (Christine Celata)
B. 1930
HR: My father - bought property before I was born (laughs) in 1927 on Newfound Lake and he founded a boys', traditional boys camp which he, with my mother, ran until 1942 at which time he closed the camp because the war (pause) prevented him getting counselors and food and everything….and then, just by a crook of fate, he let someone stay in one of the cabins that the boys would traditionally stay in - just as a favor, and he could see the idea of converting the cottages into housekeeping cottages for families to rent. So, in 1942 or 3 it became what it is today and has been operating - with the same (laughs) - some of the same cabins that were put up in 1927 and added onto -electricity put in them, running water and screen porches…..so.
HR: it's physically beautiful and I think it's a little more off the beaten path.
HR: the answer I got was: everything in my life changes; this is the only thing that doesn't change.
HR: there are more boats, there are more houses on hills. Um, I notice there's a change in the, the lake it's still clean but there are plants growing on the bottom…. Not algae, I don't know what it is, but they get washed up on the beach…and they were never there before and I'm told that one reason we see it and…I row rowing shells so I go out and I look down and they said that the water that comes in from the Fowler River, which is that river kinda near Wellington State Park…. it comes in and because it brings silt with it, that's why plants are growing, see they dredged it so boats could get up there to the Marina.
HR:
Yeah, I honestly think that the State should have, everybody's crying about not having enough money and I honestly…yes the water belongs to people of the State, I understand that, but I think they should, they charge for people to go into Wellington to swim, why don't they charge for you to put your boat in?
Interviewer took photos of her photos – included at end of interview transcript.

Gordon "Buddy" MacDougall, November 7, 2007 (Patrick Leahy)
b. 1914 Native – b. in Hebron
GM: Newfound Lake is better than most of the other lakes around here, but still its going, it's soon going to lose its identity in a few years, can't help it. Every cottage that's built - every house that's built on Newfound Lake has to have a sewer system. Okay, so they have these experts that come around and lay out the sewerage system that gets okayed by the state, but down the road, ten years from now, these septic tanks that have been put in, whether its 500 gallons or whatever, unless they pump them out every two years or three years and keep the junk out of them, stuff that shouldn't be there, they're not going to operate efficiency, and will have floods and when we do, that stuff has one place, just one place, and that is Newfound Lake. No place else to go, because everything is downhill from here to Newfound Lake…. I would like to see a sewerage system around Newfound Lake, every damn cottage would have a system.
GM: Well one thing about Newfound Lake that it has got, it is, that is pretty darn good, that the fact its spring fed pretty much. It has some brooks, but mostly, and I know this because from being in Newfound Lake, you would be swimming along in the lake, the water would be fairly warm, and you would all the sudden hit a place that feels like ice water. You hit a spring, and its cold, yea, and I know this because I've swam in Newfound Lake, and been in it so much. The lake itself, has got these springs of cool water, I've got the affects of one of those right here. If you go over to my sink, and you turn on the cold water, it will only take a little bit for that water to come from my 200 foot well, which the water will be just as cold as it will in January as it will in August. You don't have to put any ice in it, it's beautiful. You try glass of this water; you won't find any better water in the state of New Hampshire.
GM: I traced that thing back up to Bungalow village, not in, but next to it, and there were these people who had this cottage, and they had trouble with their sewerage system, so they disconnected their pipes that went into the septic tanks, and ran it down into the brook that went down to the town beach.

Gillian Reise, November 5, 2007 (Kyle Clark)
b. 1979.
GR: GR: I remember canoeing out there a lot when I was a kid. Actually I guess we did kind of live on the lake. We owned Fowler River Marina its now the Newfound Boat Club; it's over on West Shore Road over by Wellington State Park. And we used to canoe from there. And we could go straight out to the lake. My parents actually built the marina; there was nothing there.
GM: [re: population growth] That's definitely helped with the lake building up. It's that we have businesses that have definitely improved, you know you have a lot more people. And you know a lot of people that love the area too. You know people coming is not negative because they love being here. So it's not like there coming up to trash the place, they're coming up because they really enjoy coming up and the lake.
GR: For us with businesses in this town if the lake wasn't there what would we have? What draw would we have to get people to come up here? Yeah it's still beautiful you got the mountains but that lake really does it for a lot of people.
GR: I've never been down there but years ago they tried to move a hotel with oxen. I mean it was like a long time ago…. from one side of the lake to the other and it feel right through…. I don't know if it was in the twenties I know it was way back. There's also a mail truck down there I guess there's a lot of boats because a friend of mine scuba dives; I never have but he said there a lot of stuff.
GR: and I'd say they all work together pretty well. If something happens everyone would be there to work together and try and figure out a solution rather than not care.
GR: I like to see a lot more businesses going in. You know maybe people study their demographic a little better. It's hard because summer this place is mobbed but then you get to

November and December and its like where is everyone? Well they are home because there is nothing up here. So it would be nice for there to be another draw to the area other then the lake. It would be nice to have more activities for people to do. I've been thinking about that for along time I don't know were to go with but I think it would be good to have more attractions in the area.

Larry Cushman, November 1, 2007 (Sierra Poole)
b. 1925
LC: Well ahh we like a, we liked the lake. … it was it was better before the summer people arrived. so that would be spring, spring fishing … up until say July. And then once … the tourists showed up, they make, although it is not terribly busy in comparison to say Winnipesauke,…it got busier. And … they were, I felt, they were fairly dangerous. They drank too much. They ran their boats too fast. Ahh, and so on. And, but then in the fall, when they were gone it would be nice again. But I think that this is almost a history that many of our lakes have….
LC: And man has a tendency to over do things and, and that does not usually do well for nature. Newfound has the same situation. They have a beautiful lake which for the most part is not terribly overly used. But I can remember what Newfound looked like thirty years ago, and…. Around Newfound what it looks like today, because it is just condominiums as far as you can see. And I know because I am a biologist and I know that water runs down hill, And all those people have toilets. Now they have septic systems, but a septic does not stop the water from flowing down hill.
LC: And what happen is most of this work is volunteer work. And you just do not get the numbers of people that are willing to … to put a certain amount of not only their time but their brain, their thoughts into where they live; most people just sort of leave this up [to] some body else - they don't know who but some body else.

David Switzer, November 2, 2007 (Katy Thurman)
b. 1934
DS: And Ambrose Adams and his brother and two other guys were the orchestra. They sat in the stern and all the *Stella Marion* people were dancing on there. And when that barge wasn't used for dancing, it was used for carrying cord-wood. Piles of, ya know, cord wood cut to probably three or four foot lengths. And then it did more with lumber, there were lumber mill—there were saw mills… or no, I don't want to say saw mills. There was a lot of lumber being ex—being cut down on Tenney Mountain by hand. And then they would bring the lumber, or the-- the trees down to the lake. They worked them all together into a group and they would have what was known as a log boom. So the outer logs surrounding this were all linked together. And so it was the steamers job to pull the log booms down the lake to the saw mills in Bristol, some of which ran off the river that runs through Bristol, the Newfound River.
DS: The boat [*Stella Marion*] was just a small boat about 14 feet, but on the weekend there was so much traffic on the lake going very, very fast that the waves made a, a, a distinctive pattern that was going this way and that way. So that if you were in a small boat you found yourself just bouncing around. So if, it was more fun to go out on the weekday.
DS: go out on the lake and go from north to south and look at the shores and see the amount of buildings, see the amount of construction, see the amount of development that has, I would say appeared in the last 6 years - which gives cause of concern, I think. Uh not so much I think because all towns, Bridgewater, Bristol, Hebron, and so forth all have requirements for the septic systems and things like that. But lakes can only hold so many people, I mean comfortably. I mean they can hold hundreds of people, but really I think, it could undermine the tourist business if - if it becomes too populated. And that brings up the question: whose gonna say that it's going to become too populated? They say, you know we talk about sprawl, we usually think of sprawl

outside of an urban area where big store developments are taking place, but there is lake sprawl too.
DS: about the Newfound lake? My favorite thing? I think when you're on the lake there are great views. Looking north and looking east, and to a certain extent looking west. And I think that is a positive thing…. a lot of people take the lake for granted. And uh, I mean - it's there and we - we don't think about it as something special because we're, we're so used to it.
Photo of the drawing of what's left of the Stella Marion at the end of the transcript.

Katie Foster, November 5, 2007 (Justin Foster)
Age 17
KF: There's increased tourism into the area which causes car pollution and brings in people who will liter and leave trash not only at the beaches but on roadsides and in the woods. At the beach alone, I see overflowing trashcans, people leaving their waste and I've even found trash in the water. Not only is this pollution hurting the environment but its hurting the people and the animals. The animals get sick from eating left over trash and then they die which depletes the beauty of the land even more.
KF: We really need to take the proper precautions to ensure the environments clean and to keep the lake region beautiful so people will want to come back and visit the lake. We need to keep it clean so it can become a popular tourist attraction.
KF: I really love the area and would hate to see it get hurt due to the fact that people are lazy and decided something superficial is more important than the land we've all made our lives on.

Laurence Sharp, October 9, 2007 (Mike Holt)
b. 1939
LS: Oh yea, we've had some floods. Only one forest fire that I can remember. Which wasn't big, it only consisted of probably twenty-five acres. We had to lug water over a mile with Indian tanks to put it out, so it was quite an event at the time. Anything else, we'd have a flood and wash the roads out, then put them back. Nothing weird, nobody got washed away or nothing.
In your opinion what are some of the most important issues facing this area?
[LS]: Well you know there is a lot of things to consider, water pollution, how many people can you have around, there is some instance timber harvesting, cut a lot clear cuts and create a lot of runoff, creates problems. A lot of different issues

Bill Drake, September 29, 2007 (Tami Melendy)
b. 1984
TM: How many boats do you think you work on in a given season?
BD: I would say we have at least 15,000 people in the data base at the Marina, customers wise. Any where in between some people have more than one boat so it can be up to 18,000 boats we see in a summer.
TM: How many other marinas are around the lake?
BD: There is only one other Marina, it's on the opposite side of the lake we are on. We don't really have too much competition with them.
BD: The only change I have notice in the past two years actually, was when we had the flood. Not last May but I think the May of 06 we had a huge flood and that messed up the lake for the whole summer. The sandbar was all sticks; it wasn't nice any sandy like it usually is. It is back to normal this year but, that is the only time I really noticed a significant change.

Jeff Shackett, September 25, 2007 (Tami Melendy)
b. 1975
JS: it has changed a lot in that I don't think that it is affordable for people to own, for local people to buy lake front property now. My parents sold our house about 15 years ago because the taxes were so high. The value of lake front property has just escalated so much I think that it has be come pretty hard for local people to actually own lake front property…. the demand for lake front property has escalated so much it has become unaffordable. I'm one of the more affluent people in the area and I can't afford to buy property on the lake so.
JS: My grandfather used to say we have three seasons here, July, August and winter and that's really the nature of my business. Certainty if it weren't for tourists I wouldn't be here, because I do so much business with them.
JS: I think it is important to keep these bodies of water accessible to everyone in the state not just the people who can afford to have water front property. I was a huge advocate for that but, I don't think the lake quality has suffered at all, I haven't heard that it has. You know, I go to Winnipesauke and I see the weeds growing up through the water and we don't have those here, thankfully not yet. I believe it is one of the cleanest bodies of water in the state if not the country.
JS: I can remember a flood when we were living over on the lake; my parents owned a cabin colony over on the other side of the lake. I think it was 1975, the front row of cottages that set on the edge of the lake were floating. My father had to sand bag them and tie them to trees so they wouldn't float off their foundations.
JS: if we were just to sewer the Bristol part of the lake, which is the scope of their project because it is being founded by the town of Bristol and the grant is being written by the town of Bristol. All that affluent or whatever would certainly end up down here, from the surrounding towns. I think if we could sewer the whole lake that might help but, I think that sewering this lake is a huge waste of money.
JS: Newfound is a huge watershed area. I think for every inch of rain we get it raises the Newfound Lake a foot. So, Newfound Lake, doesn't just, the quality of Newfound Lake doesn't just consist of the people who live directly on it or next to it. It has a huge watershed area, so what occurs in the pretty distant radius of the lake affects its quality.
Photo of Jeff Shackett included in the CD.

Marcia Morris, October 26, 2007 (Matthew Hunter)
b. 1958
MM: when I was little it had a much more rural feel to it, and I can remember - I don't know how old I was when - it must have been in the'80s, I think, there was like this big real-estate boom and these huge condominium developments started going in on the lake.
MM: It's all sort of more developed than I'd like, but I think the northern end of the lake is - we're very fortunate to have a number of conservation properties that have been put together and some land owners who um have a lot of fore front land and who take care of it very well, so that it remains a really beautiful kind of space. If you're kayaking out on the lake, which I do all the time, you know you see a lot of wood, wooded frontage and that's really, really nice on the northern part of the lake. The southern part of the lake obviously is you know little miniature cabins all over the place but - it's just a different nature of the beast.
MM: I didn't really understand but it was a beautiful, beautiful feeling of , you know, being under water and how beautiful it was to be under water. It was a very pleasant experience and I've never forgotten it. So that's a good way to bond with the lake over time!
MM: There's all these great events that happen and all of them are fun, and all of them help create a sense of community around the lake, which I really like.
Morris: I think everybody will tell you the same thing, it's kind of cliché. Smart Growth.
MM: I actually care a lot about the people who live in this area who have lived here for generations, many whom are not wealthy. I'm a little bit concerned about all these wealthy people

moving up from, you know, New York and New Jersey buying, building these mega mansions and stuff and how that's going to effect the older timers who were here, who don't have a little money. Their job base is shrinking, and I just want to make sure that this is a place where everybody can live and live productively.

Mary Hazelton, October 24, 2007 (Mike Holt)
b. 1945
MH: But we do end up on the lake sometimes if we take the canoes down the river from here. Right down on the edge of the field you can walk to the river and put the canoes in or the kayaks in. Sometimes we will go down the river and end up on the lake that way,
MH: Well, growth I think. I feel, I don't know if other people think it's an issue. But I think it's a shame seeing all the houses going up on the hillside. Just for the view and so on. It's a problem I think, they get a beautiful view, but everyone else has to see them.
MH: So you have to be maybe more aware of the fact that if your water is degrading because of too many people you have to do something about or people are not going to come. So it's kind of a balancing act.
MH: I'd like it to maintain a rural character.

Richard and Flora Braley, September 25, 2007
b. 1913, 1918
FB: So we, we would just slid down the road from up near Spectacle [?] Pond, down to where my folks lived in the Village.
EJG: So, you would go down a big hill….
RB: I use to go ice fishing on the lake in the winter. I had a bob house that we owned and we use to go down and fish….
FB: You had one big one. It weighed twenty-six pounds!...
FB: Things have grown up a lot. People use to keep all the road sides free of bushes that came up. And now they grew up and we don't have all the views that we had. When we moved up [in 1946], all those trees down there were not big like that. We could see right over on Tenney Hill and see the cattle in the pasture.

Doug Robertson, December 7, 2007 (Kyle Clark)
b. 1949
I learned to swim in Newfound when I was in early grade school, at Wellington beach.
DR: From when I was thirteen or fourteen to when I was in my mid twenties our family ran the Hillside Inn. Which is at the north end of the lake…. there was a big red barn…. That was run as an inn, as a resort and we ran it. Our family ran it for about thirteen fourteen years.
DR: Well how has it changed? Well one of the things that's changed which is really nice that's changed is there more sailing on the lake. Because when I was a kid there weren't until Peter Brown came around there was not a lot of sailing on Newfound Lake. People considered it too windy to sail on. A long time ago. But now there is more sailing going on which I think is a good thing. The thing that I don't think is good is that the size of the power boats has become so large that it's quite ridiculous. I mean I don't mind water skiing. You know boats that can pull a water skier. I don't mind powerful boats, a small boat. But they got some boats on the lake that are powerboats that are like offshore racers type boats that are fifty feet long.
DR: Let's see what else, what else has changed. The water is still, one thing that hasn't changed is the water is still beautiful and clear. That's really something that I value and treasure [pause] a lot.
DR: . I enjoy early morning over there when the lake is flat- you can go out and water ski and it's like glass, its really cool.

DR: We then went further up on the property we owned. I don't know if it still is but it was owned at the time by the resort. And up on the side of the mountain we found a spring. We found a spring by divining…. You ever see someone take a crocked stick, hold it between their hands. And when the stick goes down, there's water and when it doesn't there no water…. It's called a divining rod and the best sort are made out of apple. Well, that's something I can do is find water that way…. So I walked over the side of the hill up there and about a half mile up onto that hill. I came across a water source.
DR: much of the lake is fed by springs in the lake. And that's what keeps it purity. It's interesting to know that certain springs like the one I found on the hill, doesn't necessarily have to be in the lake. The aquifer was up there - the other thing that interesting is at the south end of the lake, there is actually a true artesian well.
DR: And so we cut a road up in there. Like a logging road. Pulled our backhoe and bulldozer up there along with some other fill and we dug this spring out.
DR: The other thing I that needs to be thought of is the amount of - How do I say it? It's looking at the lake from the aquifers that feed it. You have to look at what happening to those aquifers with all the construction are tapping into those too much.
DR: some of the hillsides are being stripped of their forestation so people can have better views. Those actions have consequences on the land. And people should be educated about that.

Joe Denning, October 2, 2007 (Sierra Poole)
b. 1942
SP: What do you know about the watershed?
JD: Not as much as I should. I find that, the more I look around the less I know. I don't think it's in trouble yet. But I think it could be. Right now it's pretty much uncontrolled growth. Particularly in the hills that surround the lake. I also understand that it is a very fast lake for water.
JD: We need to do things more regionally, and with that our Bristol selectman have started to regularly meet with other selectmen from other towns, to work on some regional issues to see what we've got. Hopefully, we can do something.
JD: It is hard to be connected, when we need to connect all of the time. That is the difference between a community and a successful community.

Mason Westfall, Fall, 2007 (Hillary Hyson)
b. 1938
HHH: What would you like to see done with the lake? Would you like this new watershed project to go through or do you have concerns about that?
MW: I don't have a problem with a project; what I have the biggest problem with that I've seen over the years is that we study things to death. And it's wonderful to identify problems and identify ways of perhaps solving problems but very seldom are solutions ever implemented. And if rules are established, very seldom are they enforced. So, when it gets to the point where monies need to be spent to make something happen the idea seems to get lost and that's sad. Because many of us realize what the things are that need doing and we say gee, it should you know, you should do this and try and educate the public as to what they should and shouldn't do. And most people are conscious and are going to do that anyways. But those that aren't, there's very little that can be done to make they do what they should, if they are doing what they aren't to do. But that's my biggest concern about a project like this, is that we can identify what's going on, good and bad and I think we need to accent those good things that are happening. The thing is follow up and see that something positive happens for the study I guess, that's what really important.

Edward ('Ned') Gordon, October 13, 2007 (Justin Foster)
b. 1948

NG: it's part of your life, something that's available to you at all times and you feel so fortunate to have it, it just adds to wealth of life to have a lake in your backyard.
NG: Bristol itself is a mill community and even though a good portion of the lake lies in Bristol, the town of Bristol itself really got its beginning because of the river that runs out of the lake and the river drops a couple of 100 of feet between the lake and the Pemigewasset, and in doing so it offered mill power, water power to mills and from the very beginning of the settlement of this area there were saw mills and grist mills in this area up until recent history which was a large part of manufacturing largely because the Newfound River, not because of the lake.
NG: … the concern that a lot of people have over the development of the lake. Not necessarily on the lake itself, but on the tributaries to the lake in the watershed. In particular there are very few land-use regulations in place in towns such as Groton and Alexandria. In those 2 towns in particular they have the most tributaries to the lake…. [O]ur whole quality of life is affected by it, so we have to protect it or we're going to pay the consequences.
NG: There are already lake quality issues simply due to the fact there is more users. You might go out there 10 years ago on a Saturday afternoon and see half a dozen boats and now you go out there on a Saturday afternoon and because all of the boats you have to be careful.

T. Holmes Moore, September 18, 2007 (Matt Hunter)
b. 1920
Hunter: What would you say, how have things changed in the past 50 years since you've been here over the course, having to do with the lake, the area itself.
Moore:
THM: So, you can get, that'll give you some kind of idea of the pressure that has been put on Newfound Lake from developers and one of the reasons that I'm really interested in helping NLRA is to - I know that you can't , you can't keep the lake from being developed, that's not possible. So I think that NLRA is a great organization to help control that growth, to protect the quality of that lake. The economic engine of the area, in the summer, is Newfound Lake. And if you just look at the development that has already taken place and that I'm sure will continue to take place, really needs to be controlled. I think that NLRA has in place a lot of the, the things that need to be in place in order to control that. And if NLRA can - NLRA in itself doesn't make decisions, but it can influence the select boards of the nine towns around the lake, in terms of their regulations, and help them in adopting regulations which are going to keep density down and not pollute the lake, and not decrease the water quality, which to my mind is taking away the economic livelihood of the place partly, not to mention the aesthetic things. So that's really why I'm helping NLRA, I think it's a really important thing to do.
THM: Well because I think the lake is the part of the economic engine of [the region], but that's sort of a side reason; [the] most [important] reason that I'd like to see the lake maintained is the quality. I would not like to see it become Coney Island or the Weirs. I'd like to see it have the character it has now - preserving the beauty of the lake and just making it possible for people to really enjoy that and enhance quality of like for people who live around the lake. It just makes a lot of sense to me to do that.
THM: Development [is the most important issue facing the region], I think that the developers are doing their job. They are in the business of making money and they will, I don't really want to run developers down but many of them don't care about the environment. They don't care about what they are destroying to make their developments to make money on it. I think that's the major, major problem that we face because even if you get back from the lake several miles there are things happening in the streams two or three miles away from the lake that have an impact on the lake. … It's really difficult for that guy who wants to have a nice lawn right there and waters it everyday, fertilizes it, puts the fertilizer in the lake, doesn't help the lake, so NLRA is the only agencies totally devoted to trying to keep that from happening. Got a huge job ahead of itself.

Victor Field, September 27, 2007 (Patrick Leahy)
b. 1948
VF: we have been in the past blessed being 20 years behind the times. It was a smaller area; it had a low profile and seemed to attract people who enjoyed a low profile. Which kept things more the same for longer, and we could look to other areas, and see things changing and know that it could take ten or fifteen years before that occurred here….
VF: the water doesn't care what town line it crosses, and it's not an infinite, and is in fact a finite, resource. The surface water can be contaminated and the ground water can be contaminated and other areas, if we work together smartly we can maintain a lifestyle we enjoy before we get in trouble, and also continue growth so that the people who rely on a different kind of economy can make a good living, but it takes bringing towns together, includes people currently in government or planning boards zoning, who are volunteer positions and other people who may wind up in those positions because people there now may in fact move and retire. …so it's a real concern to have everyone understand that we're not trying to undo a problem, we're trying to prevent one.
VF: In even like today with the thunder storm , when I'm coming down here, where there is construction, the roads that aren't paved, because of the construction, have huge rivers of brown running down into the lake, that is nutrient loading. And the people who are building those places, in the future, and it isn't just today's event, it will take a number of these storms, will wonder why they have so many weeds growing at the shore line. The reason is, its fertilized it, its nutrient loaded with top soil, off their construction site, and that's where the weeds are going to grow, cause it's rich soil. And when you drive around now, and they'll be out with the front end loaders scraping it clean because it's building up; it won't last long, but it's so intense, it's washing part of the hill down. Those are the kinds of things we want to go out as the lake association and talk to people about, and say did you know that, and the reason is, and you can help that slow down by, so its an educational purpose.
VF: the work that needs to be done, is up the hills, so it doesn't get to the water. Alexandria and Groton is one the most prime bio diverse pieces of environment of the state of New Hampshire. It is rich in diversity of plant and animal life. And that reason alone should be protected.
VF: … there are about 8,000 residents in that area. You don't need all 8,000 clearly, but you want to influence people, and it doesn't matter if they live on top of the mountain, or at the edge of the water. Their interests in fact are the same. Once they are all in the same boat, we will get somewhere if we all row together in the same direction. It's never easy, but it will be easier.

George and Marilyn Blaisdell, October 1, 2007 (Elizabeth Gagnon)
MB: Ice skating, you could see to the bottom, you know, even if you were far out.
GB: Yeh, if you get a freeze before the snow came and you went out skating about one hundred yards, you could look down fifteen feet and see every rock clears as day.
MB: There are parts I think that there are weeds growing. I don't think they're bad weeds but there is something growing in parts of it.
GB: …And you get a lot of beach traffic in the summer and yet you go into that lake and its still very, very, very clean. It's also most pristine and I think the lake association has something to do with that. Like Marilyn said people monitoring it and volunteering at the boat launch to make sure there aren't any weeds brought in. you know or basic plants brought in. also monitoring conditions on the lake. We have friends that do that every week. They are out there taking samples and monitoring, so that's good….
EJG: What are some of the most important issues facing the region today?
MB: I'd say too much growth or builders that want to build on land that wouldn't be appropriate. That would send run off down into the lake some people are building on very small [inaudible] of land and have to put their septic systems to close to the lake. So I think its important towns to be very strict and monitor that kind of thing….
GB: … But the controls make perfectly good sense, for the protection the lake and watershed….

GA:… people kind of look out for each other.

Al Faro, September 27, 2007 (Tami Melendy)
b.1961
AF: We would spend pretty much every weekend of the summer up here. It was kind of the big thing. I couldn't wait to get out of school all week to get, 3 o'clock on Friday afternoon, you know and wait for my dad to get home, pack the car and drive, forever again to get to where we wanted to go…
AF: It was just - look around. It was a great place, it was better for the kids to grow up; the ultimately it is the environment is just so much better up here.
AF: it was probably a half a mile you had to go through to get to the marina. It was really neat; you expected to see alligators coming off the side. It reminds, looking back of Africa or the Everglades or something like that, creature coming in, we never saw anything, but we hoped we did, but we never saw anything. It was just totally different; to have it part of the lake was amazing because it was so different. It was dirty and there was fuel in the water and I have not idea how it didn't get into the lake, it just seemed like when you go to that spot where you looked for, that is where it would start and when you got out of it into the lake it stopped, it was gone. It was clean, it was strange that it would separate like that, that is what I remember about going into there.
AF: That's another part why, I think myself and the boys both, as I get older and they were growing up didn't use the lake that much, because it was just so congested. It was packed, there was a lot of people out there, a lot of people that didn't care what they were doing out there as long as they were out there.
AF: I can remember at the lake, where my mom's house is, at the foot of the lake, you could walk out as far as you could walk and then some and it would just be sand, it would just be sand on the bottom of the lake. Now you walk out to you waist or you walk out ten or twelve feet and the bottom is kind of brown. I don't know if it is leaves or what, but we had leaves when I was growing up I'm sure we did, but they weren't there in the water, when you were getting in the water, so it is kind of silty and mushy on the bottom now, and it never was when I was a kid. So, I assume the impact the people around the lake have had, I think it must have something to do with the people, the more people that are there.
AF: Everything would have been different if I did not have the opportunities I had growing up, being up here in Bristol and at the lake. That's why I am who I am.

David Powden, October 3, 2007 (Katy Thurman)
b. 1936
DP: It's not as special as it used to be. To be point blank. But, uh, it was a wonderful town to be brought up in because everybody knew everybody else. They don't know that now. Umm, they uh, if you stole flowers out of the flower garden, then she would uh, tell your mother and then, we meet and correct you. we would be out at night until the street lights came on and we would go up to Roundtop and built forts and everything. We would have a wonderful time.
DP: (pause) Trying to get Bristol back on it's feet again - and… getting some people involved in the community, as far as selectmen and things like that. Having enough gumption to bite the bullet. Get lighting in the streets. Do the - get street lights for the streets. And stop talking about the mundane things, things that will take care of themselves anyway. Ever since we went into the building of the condominiums and everything else, Bristol has gone down the tubes. And it's - Bristol's still got the spark. There's a spark there, ya just got to fan it.
DP: once the condos came, there is two parts to Bristol now: Newfound lake part and the Bristol part. And you can understand the reason why Newfound lake wants everything, because all their condos and everything are right there, while Bristol is left out in dark. I want them to bring Bristol back in… they haven't made it yet.

DP: They're building major houses along the lake… if they don't stop building they are going to ruin the lake…. Because… they are building all along the mountains, and you know what happens to the surge. It all runs downhill. And they have to have room for their boats. So many boats on the lake and the lakes not that big.
DP: The lake actually made Bristol, but the water from the lake made Bristol. And Bristol used to be a real wonderful town. It had all sorts of mills, paper mills, clothing; they made scented toilet paper (laughs). They had tanning mills, they had - it was really active. And then it just goes down, down, down, down, down.

Ken Weidman, October 15, 2007 (Shea Daly)
b. 1939
KW: then it wasn't probably till - late '60s or maybe '70s, yeah maybe mid '70s, that people started to keep their cottages open year round and winterizing them and using them for snowmobiling, skiing or as a place to come in the winter. So that it - it - more and more people started using their cottage for that purpose; more and more of the roads would be plowed by the town. Originally the road where our cottage is wasn't plowed at all, because there was no one down there at the time, so it evolved into the more of a four season area around the lake that occurred very, very slowly. Now you go down onto that road and of the 50 lots down there, there is probably – 15, maybe 20m are now year-round homes - making their home there. A lot of people then converted their cottages as they got older - to year-round homes - putting foundations under them, moving them but basically keeping them pretty much in the same status they were in, which they were built and modifying them to some extent. Then I would say the phenomenon of the '90s came along and people started buying these little cottages and tearing them down and - not putting mcmansions on them but larger more expensive homes. There can't be anymore land on the lake so it is limited by its shoreline, so as people wanted to acquire these homes, it pushed the prices of the lots up…. Because the lake has been transformed to some degree of a lake that was a summer lake, very much family and now it is more and more year round and instead of people coming up in their Chevys, they come up in their Escalades. It's - the lake is populated with people from Massachusetts - where the economy is good down there. Fortunately it has not happened to the degree of other lakes like a Winnipesauke.
KW: there is the Shore Line Protection Act, which - that involves the development on the shore line so that's state and all of the towns have developed codes for monitoring and allowing building. But the problem is the towns are small and they don't have the initial resources to police their own codes. So most of the towns don't get a code enforcement officer, if they have a building inspector its part-time person and the level of expertise is not, is not very high. And there needs to be, in my opinion, collaboration of the towns, So that they can hire and share the cost between them to monitor the towns around the lake. How things get built, not in accordance to original plans and nothing is done.
KW: I suppose it's somewhat the whole watershed issue that is very political. I think the towns need to adopt stricter building codes is political or maybe the development in areas where the slope is too steep which hasn't stopped the strip logging that is occurring. Obviously if you build a house on the side of a – well, it happened here. We bought this lot and built on it, it was already cleared. But when it is cleared all the trees are taken away, when it rains it all washes down instead of getting absorbed when it was before so as that happens more and more its going to have an effect on the runoff and what's going down into the lake.
SD: What do you hope for the future of this area?
KW: Well I hope very much that it does not become a commercial area, that it be non-commercial with more responsible building codes adopted by various towns so that when an area in the watershed is developed that the first thing is done - it's developed in an ecological safe way, using cluster development, using techniques that will not destroy land. There is an awful lot that can be done.

KW: I think that it is easier for someone who lives on the lake to see the impact that the watershed has on the lake and understand the potential of invasive species getting into the lake running down or sediment and carcinogens that may get into the lake, having an impact because they are sitting there looking at it. So there is that population that is right around the lake. That is generally where the more expensive real estate is so there is probably an assumption that is where the wealth is, into the areas around the lake and the hills there are many permanent residents and people who have been born in the area or raising families in the area and their interest and priorities does not center around the lake. Although they use the lake and have boat and fish and use the lake every day. Selling the watershed plan to a town means you got to sell it to the people who live on the lake and the hill country…. Our interest is to sell this plan to all the towns to change their building codes to align with what the lake association is trying to accomplish. It has to be sold based upon the influence of the residents and you have to understand if I am sitting here and all of the sudden I change the topography of this so that the water is running off in a different course or I use turf builder it is not going to impact me it's going to impact the people down there. How do you sell that, there is different personalities.

John Stokoe, October 16, 2007 (Shea Daly)
b. 1935
JS: Actually, I think that the quality has maintained itself to be very, very pure. The - the lake, we have a - very active lake association as you know and the lake association monitors all the boats that come through Wellington State Park for exotic weeds and milfoil, etc. and I think that have been doing a very, very good job - as far as I know and as far as the lake association has stated. We have no milfoil in the lake, therefore in my particular area, the bottom of the lake is clear and I have a boat, powerboat, that is moored about 55 feet from shore in about 20 feet of water and on sunny day I could look out and I can see the bottom of the lake clear as a bell.
JS: Well uh there's been several incidences that I have been involved in on the lake, in a sense that, I am not sure the year but we had hurricane Floyd came through and I am not sure the date but in the '90s I believe, but I believe the figure was about 60 boats that were capsized or broke loose from the mooring buoys because the lake rose so fast - a couple of feet, that my particular power boat the bow chain was too short and when the water came it pulled the bow down subsequently flooding the boat and actually ruining it.
JS: a few issues ago in Yankee magazine, they had a big article on Newfound lake with a double page picture of the lake, which I said to my wife, we don't need this kind of publicity, let Newfound Lake be a silent partner here. But it is getting to be well known and well that's just the way things are going to go.
JS: Well, I know that in especially one area of Hebron, In Hebron, they have a very good zoning area I think, there was a bunch of trees cut down on the west side of West Shore Road but it was an area that was sloping and they wanted to put up condominiums on that area and housing and the town decided it was too much of a factor for erosion and things like that and they killed it and I think that if your town is strong and they have zoning and the rules apply, it doesn't have to be strict zoning but it at least has to have some kind of zoning to eliminate that kind of thing which could be very detrimental to the watershed.

James Freidline, October 27, 2007 (Gregg Vigliotti)
59 years old in December
JF: New Hampshire is a wonderful place. The diversity in the surroundings is amazing, you can hunt, ski, hike or just relax, plus it is a good place to raise a kid.
JF: At my uncle's place in Bristol, it was different. He had a boat on Newfound, nothing big by any means but it was a boat. I'd bring a friend up for the week and we would take the boat and row out to the middle and try and fish. We never caught anything 'cause we were fishing in the

wrong spots, but it was a real fun time, plus the lake was so big. We'd row for hours and it'd seem like we weren't even close to being in the middle.
JF: I guess in short the overall scenery drew me back to NH. Even the drive up here was beautiful, you couldn't beat it, this area is the best of New England in my opinion. If you're an outdoor buff then this is the place for you.
JF: so the woods used to be so huge that you could get lost real easy, but as time went on they got smaller and smaller. More houses started to be built across from the lake going into the woods and with that more roads to get to the houses.
JF: I forget when the condos went in around the lake in Bristol but those changed the scene a lot more than everything else. It changed the summer attitude a lot, bringing in a lot of people, mostly from Mass. Most of the people with the condos just came up for a little period time with rentals you know? They didn't have a huge connection to the place so the way it was treated changed during the summers.
JF: Sculptured Rocks is one of the most beautiful water flows I've seen in the north and it has stayed preserved … and is still pristine. The natural beauty that surrounds the area changes with the seasons and never gets old. I consider myself lucky to be able to live here near the lake and the mountains. I just hope the lake stays beautiful and pristine for ever.

Charlie Huntoon, November 1, 2007 (Gregg Vigliotti)
35 years old
Newfound: since childhood - fishing since growing up in area
CH: We spent a lot of time in the Newfound region because of the tributaries, especially for fly fishing; those are some of the best streams and creeks to fly fish….
I love fishing Newfound because it is so big and can be accessed at all corners of the lake really easily. You can fish all your life and never fish in the same spot if you're tried hard enough.
CH: it's THE lake to fish, at least to me.
CH: I live in this little cabin in Groton, it's a cool place, we have a bunch of land and our privacy so we can do what we want without being hassled. It's nice too because, don't get me wrong, I love the lake and I would love to be a little closer, but once you're within seven miles of the lake then things change and it gets a little less natural to me. The northern country in New Hampshire is still pretty wild if you live or go to the right place, but there's no sense living in a developed area when you can live 15 miles away from it and feel like you're actually in the wilderness.
CH: [CH is a fishing guide] I've started to notice a lot of erosion around a lot of the streams near Newfound Lake. The erosion is causing the streams and creeks to change their flow and this is definitely bad for everyone. Because the streams are changing it means the level of water is changed also. It doesn't keep the same height in certain areas as it used to because the streams are getting wider and wider as the access gets greater and greater.
CH: Things change when there are people coming to visit this area and stay for a short period of time. They don't put much effort in not leaving a trace…. I don't know if they don't realize that it will do great harm to the eco-system or if they just don't care. They probably just think that one person leaving a piece of trash won't harm anyone, but it adds up, especially when there's more and more tourists coming into the Newfound Region every summer.
CH: I think they are starting realize that if they keep adding on more condos and cutting down more land and being more lenient in boating regulations that they'll just end up shooting themselves in the foot. These people are businessmen but they also live in the region so they know what's at stake, they won't ruin it for themselves. It's the people who don't live in the region who own businesses that tend to scare me a little…. Because they don't really have a connection with the area except financially.

Lisa Carpenter, Fall, 2007 (Amy Carter)
91 years old (fall, 2007)

Property on Newfound in the family since 1895.
LC: to help preserve the lake, our property over there across the road, … protects the watershed since no one lives there. I forget how many acres protects and conserves the land and keeping it for the future generations benefit….
LC: every year we have a bruiser bass that lays its eggs at the end of our dock, you probably know all of this…. The female goes off the male patrols and protects even though he'd probably eat them given the chance… and … when you're swimming he'll come up and WHAM! Bumps into you…. we were amazed to see an otter sitting on the end of our dock one day with the beavers.
LC: and that otter is just a beautiful creature and that was the year that the lake never froze over and there were little patches of water so the otter would swim around. There was an eagle that commuted 8:30 am who flew around and was hoping to find a fish….
AC: Why did you become a member of the Newfound Lakes Region Association?
LC: Just because we're into the welfare of the lake particularly in keeping milfoil out. That's why we work so hard on it. We used to get up early in the morning and volunteer to check the boat going in Wellington Beach for milfoil coming in and out. Now they have a paid host; we got very interesting in the ecology of the lake. …
LC: there was a small house an original stage coach inn. Someone tried to move it across the ice, with oxen. I talked to a diver who took great delight in telling me it was still down there, you could see the curtains in the windows and all…. that was a joke of course. They got only to the edge of the lake and fell in. The whole place fell apart, but the oxen didn't fall….
LC: Well I don't think I ever expected to retire up here and as a summer resident, it's… you know just a few people. Now we just adore the … vicinity of the people year round. Having lived in D.C. and New York having the thrill of … calling the post office and having them know your voice on the phone is great….
LC: Strong feeling of home and family. I have a big sense to preserve it. I hope it lasts.

Richard Cowern, Fall, 2007 (Amy Carter)
b. 1933
Newfound since a boy - "about 1939"
Moved to Hebron 1966. Town selectman for Hebron.
RC: The Lake has changed a lot - a lot of rentals. Newfound Lake was the poor man's lake by my estimation. Not the wealthy, more blue-collar workers, the upper end of the blue collar workers. That has all changed: many more professional workers and successful business [people].
why do you care about the lake so much.
DC; I'd like it to stay pristine and also it's a huge resource. We don't have any bad growth, I think it's important….
RC: Pontoon boast were even larger when we had our marina. Salmon was great, everyone would come and someone opens the lake for commercial smelting and that ruined the population. The smallmouth bass gobbled up the fingerlings.
RC: In general people are very protective of the lake.
RC: My wife and I put on a show about some of the funny things that happened to us during our Marina days at the historical society.
RC: Zoning is snobbish not but probably is to a degree, you have to give up some to get a little a lot and you are giving up some of your rights as a land owner. But it preserves and protects the land for a long time. The state doesn't have enough people to enforce the rules, and you see violations everywhere, we need to be able to get enough people to investigate. People do what ever they want on the lake.
RC: Salt of the earth people around here, by in large good people. I mean we have our weirdoes but so does every town.

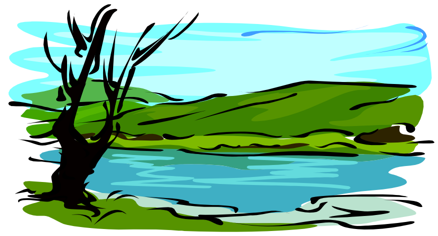
Sherwood Kidder, November 15, 2007 (William McNally)
b. 1931
SK: And we used to have floods 'cause there was a brook right near our camp there, near the gas station and everything. The flood waters would come down through there and they would wash out the bridge by the road, and that was it for a while for the road.
SK: the brook that currently runs down through the area is the same brook that was there at the time I am talking about, and it used to flood out the road way and things below. So the state put in a cement retaining wall, I don't know probably a several hundred feet from where it ran underneath the bridge and the road. And it ran up stream and contained a nice pond of water in there which was just great for fishing and swimming. I learned to swim in there. ["near where Auto Air Garage is today"]
SK: basically it was a core of natives that had been here a long time, you generation after generation, and you don't get that anymore, or you don't see much of that anymore.
SK: Well, see, growing up as a young lad here, I loved the winters because early in the fall I can remember quite clearly going out in back of the house and up on the slopes that crossed the brook where we cut small trees and things down and made ski trails.
SK: land is being developed now that wasn't even considered accessible in the past ya' know.

Phil and Betsy Twombly, October 11, 2007 (William McNally)
b. 1922, 1925 respectively
BT: Well, having come up here so much as a kid, I just got to really, really like the outdoors and the peace and quiet. And the lake, it is a beautiful and clear lake, you know, one of the clearest in the country, and it's a thing to satisfy what I feel the need of.
BT: people are discovering Newfound Lake and it is a really nice place to live so people are buying and building here and they always want to have a view so they are trying to build up on the top of the hill and cut a big safe and put up a big house and paint it white so you can see it from everywhere.
PT: we're trying to control growth as best we can through changes in our zoning bylaws which we have been aware of and keep track of…. we have tried to keep our ordinances set so that we don't have a huge amount of buildings on steep slopes. And which we are worried about erosion and runoff and …um because we are in a very tight valley with a sixty somewhat thousand acre watershed and we worry about fertilizers and septic system failures and so on.
PT: It's a place where you get the real sense of community, everybody knows everybody. Most all the folks are active with town meetings, we still have open town meetings and we also have a community breakfast once a month at the church. We have a historic society which has a monthly potluck supper, and we have a snowmobile club that has fund-raising dinners regularly. There's just a lot of really good things going on amongst the community folks and it is just good fun.
BT: We're getting together in a week or so for a party that is being given by a neighbor across the lake, and it's a story telling party. Everyone has to come prepared to tell a story.

Math Lesson Worksheets

The Newfound Watershed Master Plan

2.1 A Visit to the Newfound Lake Watershed



Name: ________________________

1. About how many people live in the Newfound Lake Watershed?

   _______between 100 – 200 ________between 1,000 – 10,000
   _______between 500 – 1,000 ________between 10,000 – 100,000

2. In 2005, about how many people drove on North Shore Road in Hebron per day?

   _______between 100 – 200 ________between 1,000 – 2,000
   _______between 500 – 1,000 ________between 10,000 – 100,000

3. Which town inside the watershed has the highest population in 2005?

   ____

4. About how many towns with a population the size of Hebron would it take to equal the town with the highest population in the watershed?

   ____

5. The average age within the watershed is _______________.

6. About what percent of the people living in Grafton County have a high school degree or higher? _______

7. The population of the watershed in the future will likely

   _______ go up
   _______ go down
   _______ remain the same

2.5 A Visit to the Newfound Lake Watershed

Name: ________________________

1. About how many times did you swim in Newfound Lake last summer?

    _______between 0-5 ________between 11-15
    _______between 6-10 ________more than 16

2. About how many times did you ride in a motor boat on Newfound Lake last summer?

    _______between 0-5 ________between 11-15
    _______between 6-10 ________more than 16

3. About how many times did you ride in a kayak on Newfound Lake last summer?

    _______between 0-5 ________between 11-15
    _______between 6-10 ________more than 16

You and your class answered the above questions. Collect data from your classmates for each question and place a tally mark from each student in the correct row.

Swim in lake	Tallies
0-5	
6-10	
11-15	
16+	

Motor boat rides	Tallies
0-5	
6-10	
11-15	
16+	

Kayak Trips	Tallies
0-5	
6-10	
11-15	
16+	

Make a prediction based upon the sample of data you collected. Do you think this data represents the water activity of all the residents living within the Newfound Lake watershed area? Explain

____

____

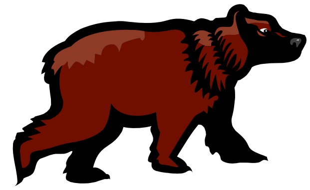
____

____

Practice:

4. What was the range of swimming trips? ___________________
5. What was the median number of swimming trips? _____________

2.6 A Visit to the Newfound Lake Watershed



Name: ________________________

Using the information found on page 1 of the *Demographic and Growth Assessment: Newfound Lake Watershed Master Plan* answer the following questions about the population of the communities in the watershed:

1. In which town would you find the largest number of people? _________________
   This is called the **maximum** number of this set of data.

2. In which town would you find the smallest number of people? ________________
   This is called the **minimum** number of this set of data.

3. What is the **range** of this set of data? ___________________
   Subtract the minimum from the maximum.

4. What is the **median** of this set of data? __________________

Using the same table, answer the following questions about the acres (amount of land) in the communities of the watershed:

1. In which town would you find the largest number of acres? _________________
   This is called the **maximum** number of this set of data.

2. In which town would you find the smallest number of acres? ________________
   This is called the **minimum** number of this set of data.

3. What is the **range** of this set of data? ___________________
   Subtract the minimum from the maximum.

4. What is the **median** of this set of data? __________________

Is the community with the most number of people also the community with the largest number of acres? _____________________

Explain why you think the data looks the way it does

____

____

____

2.8 A Visit to the Newfound Lake Watershed - Study Link

Name: ________________________

When people plan for the future, many pieces of information are used to determine if an area is growing in population. Below is a table of the average (mean) daily traffic on local roadways in the watershed. With this information, planners can see where people travel and what roads might need repair.

Town	Location	2004	2005	2006
Alexandria	West Shore Rd @ Bristol Town Line		1100	
Alexandria	Washburn Road over Patten Brook		690	
Alexandria	Bailey Rd over Bog Brook		330	
Bridgewater	NH Rt 3A @ Hebron Line		3100	
Bridgewater	Dick Brown Rd over Clay Brook		320	
Bristol	NH Rt 3A @ Newfound River Bridge		7300	
Bristol	NH Rt 3A @ Bridgewater Town Line		4700	
Bristol	West Shore Road over Newfound River		4300	
Bristol	West Shore Road @ Fowler River Bridge		1800	
Groton	North Groton Road @ Hebron Town Line			720
Groton	North Groton Road @ Cockermouth River			400
Groton	Sculptured Rocks Rd over Atwell Brook			40
Hebron	North Shore Road over Cockermouth River		1100	
Plymouth	NH Rt 3A @ Hebron Town Line	3100		

1. What is the maximum number of trips on one road for one day?

   ____

2. What is the minimum number of trips on one road for one day?

   ____

3. How many more cars travel on Bailey Road than Dick Brown Road each day?

   ____

4. Which towns have more than two roads that were measured for traffic?

   ____

5. Which two roads had the same amount of traffic?

   ____

6. Which road do you think is closest to your house?

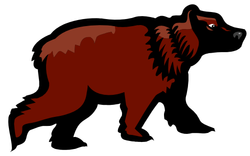
   ____

Practice:

7. 44+31=_________________ 8. 235-78=___________________

9. 480+29=________________ 10. 134-72=__________________

3.6 A Visit to the Newfound Lake Watershed



Name: ________________________

Use the *Demographic and Growth Assessment: Newfound Lake Watershed Master Plan* as a reference to answer the following questions.

1. In the 35 years from 1970 to 2005, the population of the nine towns making up the Newfound Watershed area doubled in size. If the population doubles from 2005 to 2040, what will the new population be?

(estimate)______________________________

Write the number model

____

2. According to the 2000 census, the average age of people living within the watershed was ______________________ years old. Hebron has a median age of 50 and Bristol has a median age of 38.5. In which town would you expect to find the most children living? __________________________

3. In the Newfound Lake watershed area, each house contains about 2 ½ people. How can this be possible?

____
____
____
____

4. How much has the median household income in New Hampshire increased from 1990 to 2000? ____

5. Most people in the watershed area drive cars/trucks/vans to work each day. About 14% of the people carpool and about 76% drive alone.

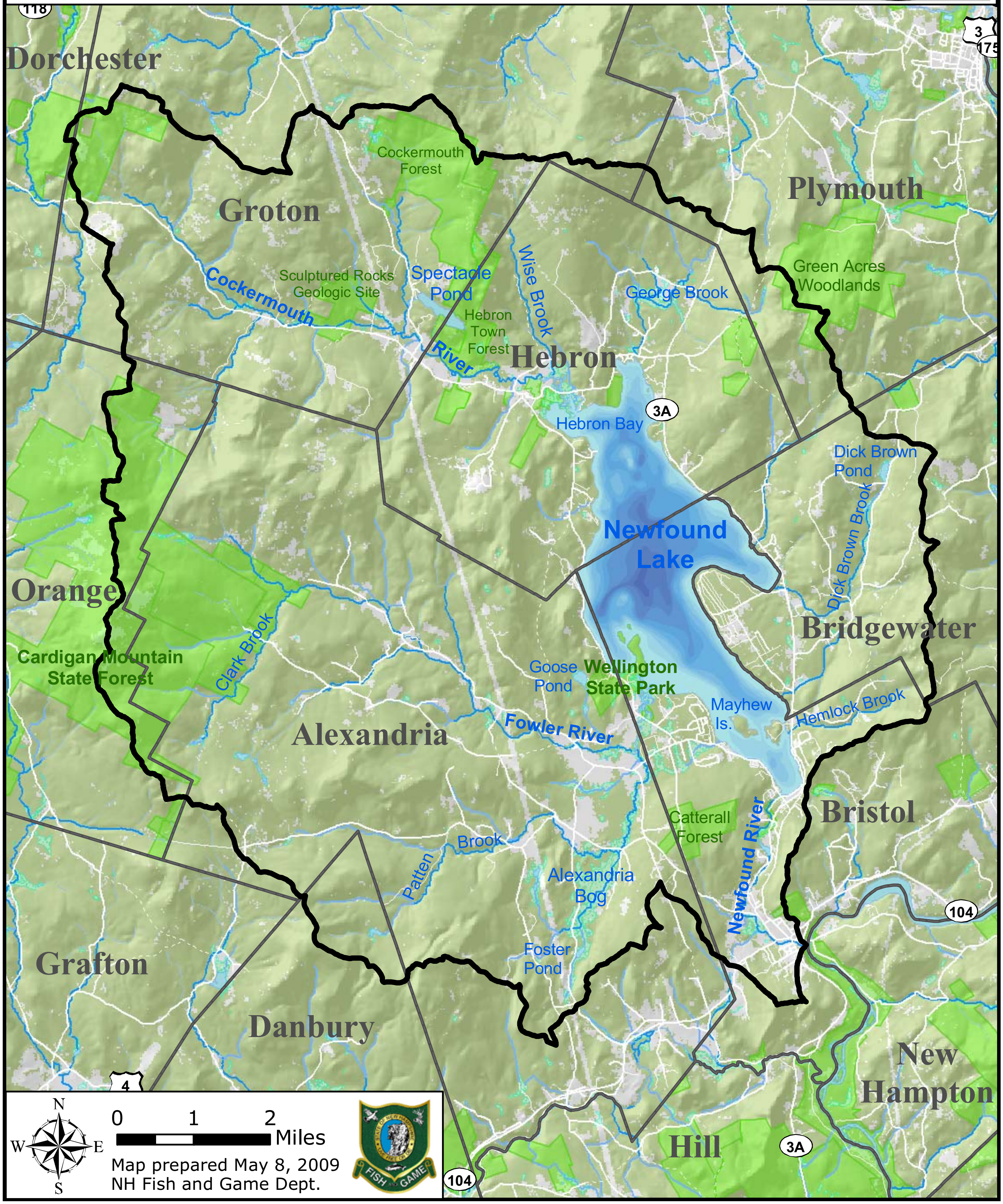
True or False About 60% more people drive alone than in carpools.

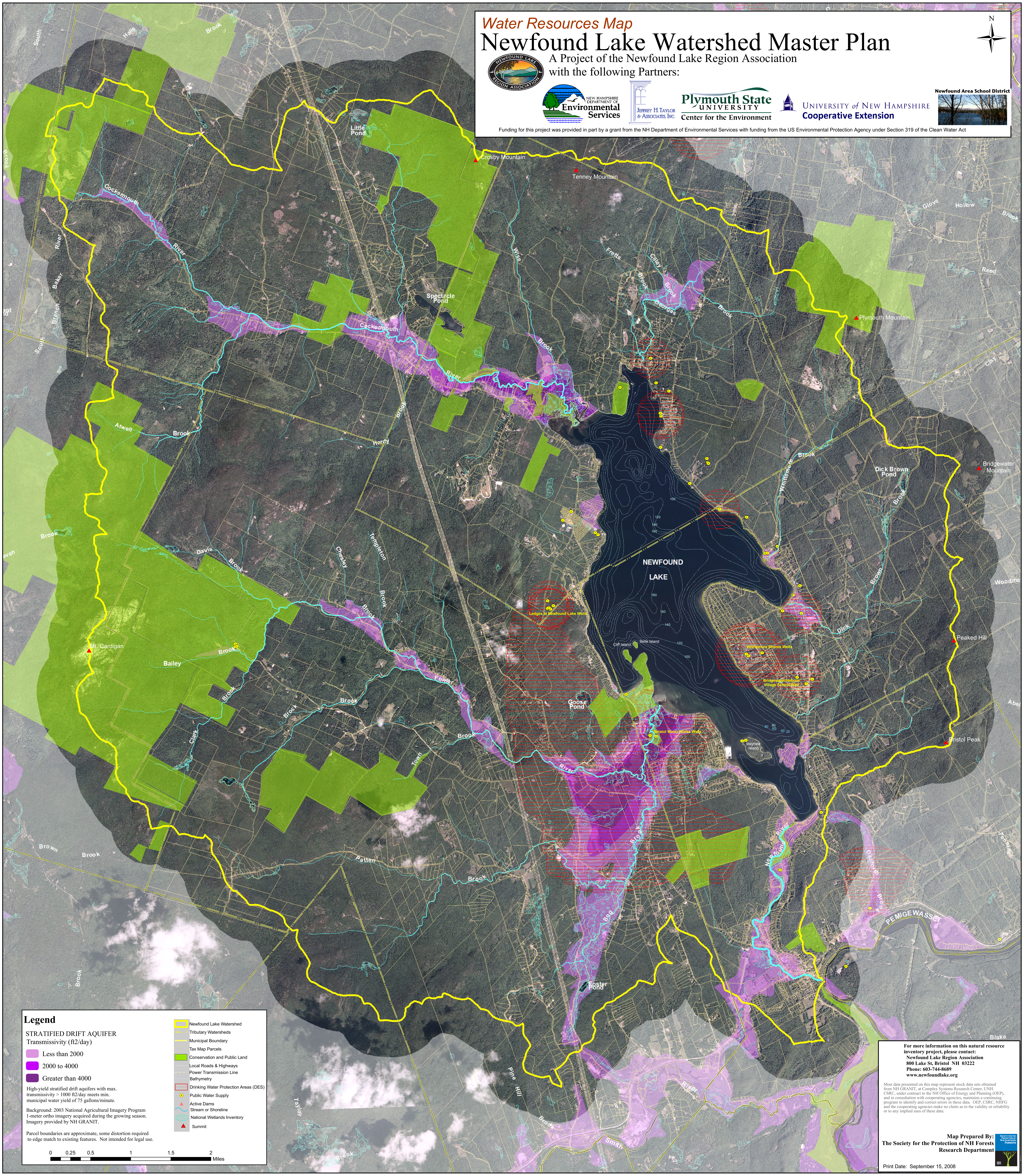
Map Resources

The Newfound Watershed Master Plan


Newfound River Watershed

For more information please contact:
Newfound Lake Region Association
800 Lake St, Bristol NH 03222
Phone: 603-744-8689
www.newfoundlake.org




Water Resources Map
Newfound Lake Watershed Master Plan
A Project of the Newfound Lake Region Association
with the following Partners:
Newfound Lake Region Association
New Hampshire Department of Environmental Services
Jeffrey H. Taylor & Associates, Inc.
Plymouth State University
Center for the Environment
University of New Hampshire
Cooperative Extension
Newfound Area School District
Funding for this project was provided in part by a grant from the NH Department of Environmental Services with funding from the US Environmental Protection Agency under Section 319 of the Clean Water Act
N
Crosby Mountain
Tenney Mountain
Little Pond
Spectacle Pond
Cockermouth River
Plymouth Mountain
Bridgewater Mountain
Dick Brown Pond
NEWFOUND LAKE
Mt. Cardigan
Bailey Brook
Goose Pond
Peaked Hill
Bristol Peak
Foster Pond
Ledges at Newfound Lake Wells
Bristol Water Works Wells
PEMIGEWASSET
Legend
STRATIFIED DRIFT AQUIFER
Transmissivity (ft2/day)
Less than 2000
2000 to 4000
Greater than 4000
High-yield stratified drift aquifers with max. transmissivity > 1000 ft2/day meets min. municipal water yield of 75 gallons/minute.
Background: 2003 National Agricultural Imagery Program 1-meter ortho imagery acquired during the growing season. Imagery provided by NH GRANIT.
Parcel boundaries are approximate, some distortion required to edge match to existing features. Not intended for legal use.
Newfound Lake Watershed
Tributary Watersheds
Municipal Boundary
Tax Map Parcels
Conservation and Public Land
Local Roads & Highways
Power Transmission Line
Bathymetry
Drinking Water Protection Areas (DES)
Public Water Supply
Active Dams
Stream or Shoreline
National Wetlands Inventory
Summit
0 0.25 0.5 1 1.5 2 Miles
For more information on this natural resource inventory project, please contact:
Newfound Lake Region Association
800 Lake St, Bristol NH 03222
Phone: 603-744-8689
www.newfoundlake.org
Most data presented on this map represent stock data sets obtained from NH GRANIT, at Complex Systems Research Center, UNH. CSRC, under contract to the NH Office of Energy and Planning (OEP), and in consultation with cooperating agencies, maintains a continuing program to identify and correct errors in these data. OEP, CSRC, NHFG and the cooperating agencies make no claim as to the validity or reliability or to any implied uses of these data.
Map Prepared By:
The Society for the Protection of NH Forests
Research Department
Society for the Protection of New Hampshire Forests
Since 1901
Print Date: September 15, 2008

References and Additional Resources Available

The Newfound Watershed Master Plan

2.1 Permanent (Post-Construction) Stormwater Management

RELATED TOOLS:

- Erosion and Sediment Control During Construction
- Landscaping
- Steep Slopes and Ridgeline Development

BACKGROUND AND PURPOSE

Stormwater runoff is water from rain or melting snow that does not soak into the ground. It flows over land from rooftops, paved areas and bare soil, and steep slopes and saturated vegetated areas. As it flows, stormwater runoff collects and transports pollutants including sediment and organic matter; pet waste; automobile fluids (oil, grease, gasoline, antifreeze); deicing products (road salt); pesticides and fertilizers; grass clippings, leaves and other yard waste; and cigarette butts and other litter.

While traditional stormwater management practices are designed to collect, detain, and divert water to the nearest surface water body or watercourse, time and experience have shown that this approach does not adequately address the cumulative hydrologic or water quality impacts of stormwater. Development creates impervious surfaces that prevent water from infiltrating through the underlying soil. Impervious and disturbed surfaces from development can cause changes to both water quality and hydrology, or the movement of water through the landscape.

Changes to water quality from increased impervious surface cover include increased pollutant loads, higher bacterial contamination, and higher temperatures. These changes can degrade fisheries, inhibit certain uses, such as swimming, and increase treatment costs for public water supplies. Hydrologic changes resulting from increased impervious area include increased volume and velocity of stormwater runoff entering receiving waters, reduced groundwater levels, more frequent high flows in streams during wet weather (i.e. “flashy” streams), reduced stream flows during dry weather, unnatural changes in stream channels and banks that reduce habitat quality, and more frequent and severe flooding.

Thus, an essential part of stormwater management is maintaining the natural hydrology of a site to the maximum extent possible. This is accomplished by limiting land disturbance as much as possible, slowing down the flow of stormwater to

Infiltration is the movement of water from the land surface into the soil. Infiltration occurs naturally in the undeveloped landscape as water, from rain or snowmelt, soaks into the ground, often using the roots of trees and other vegetation to travel through soil layers. Infiltration is important to replenish groundwater supplies, often used for drinking water, and for maintaining the volume of water flowing in streams and wetlands during dry weather. It is also important in treating stormwater to remove pollutants.

On an undeveloped site, the land has a natural rate of infiltration, also referred to as groundwater recharge, which is the volume of water that soaks into the ground and replenishes groundwater aquifers over a set period of time. This rate is dependent on a number of factors including type of soil, slope of the land, type of vegetation cover and depth to a confining layer, such as bedrock or the water table.

When that same site is developed, impervious surfaces, such as rooftops, roads, and driveways, block water on the land surface from soaking into the soil. This reduces the volume of water that infiltrates to recharge groundwater supplies and increases the amount of runoff from a site.

maintain peak flows and increase infiltration, and treating stormwater on-site to maintain and protect the quality of receiving waters. Non-traditional and non-structural methods, such as minimizing clearing and grading, maintaining natural flow paths, and disconnecting impervious surfaces, focus on prevention and reduction of stormwater volumes and pollutants at their source and help to maintain the natural hydrology of a site. These approaches are typically preferred where possible and may reduce the need for structural best management practices. For example, runoff can be diverted along existing land contours to localized low spots on a site where it will be retained, infiltrated or taken up by vegetation. Where natural vegetation is limited, areas can be constructed and planted with water tolerant vegetation, such as the creation of a bioretention area or rain garden, to provide similar treatment. If a lot is hilly, terraced slopes can slow the flow of runoff, while preservation or creation of wooded areas can effectively retain water on larger lots. Buffers of thick vegetation around surface water resources such as wetlands, lakes, ponds, or streams are considered among the most effective stormwater management practices. Since site disturbance has great influence over the hydrology of a site, the model stormwater ordinance presented here includes specific requirements and limits for site disturbance.

APPROPRIATE CIRCUMSTANCES AND CONTEXT FOR USE

Stormwater controls are recommended for all development sites. While state and federal permit requirements address the impacts of development on large sites, considerable development occurs on smaller sites that do not require permits from the U.S. Environmental Protection Agency (EPA) or New Hampshire Department of Environmental Services (DES). Yet these small-scale developments can have serious, cumulative impacts on water quality. To mitigate these effects, communities are encouraged to adopt a local stormwater management ordinance instituting stormwater controls for projects of all sizes and during all phases of development. This combination of local, state, and federal requirements will help to promote the long-term protection of water resources.

The model ordinance should satisfy EPA's requirements under Phase II of the National Pollutant Discharge and Elimination System (NPDES) for small municipal separate storm sewer systems (MS4, see margin note) to regulate land disturbances greater than one acre.

DES also regulates alteration of terrain activity disturbing greater than 100,000 square feet, or 50,000 square feet within the protected shoreland zone. The model presented here is intended to be at least as stringent as the DES requirements and does take into account the proposed changes to the DES requirements. However, because the model is a performance standard approach, it does not include all the technical specifications for specific types of best management practices that are contained within the DES rules. Every effort has been made to ensure that any technical specifications that are included in the

NPDES Stormwater Phase II requirements apply to municipalities located in or near an urbanized area as defined by U.S. Census (i.e., a central place (or places) adjacent to a densely settled surrounding territory that together have a residential population of at least 50,000 and an average density of at least 1,000 people per square mile). In New Hampshire, 45 communities must comply with Phase II requirements. However, the NPDES Construction General Permit, which applies to any construction activity disturbing more than 1 acre, applies statewide. See http://des.nh.gov/Stormwater for more information.

model are consistent with the DES requirements. In addition, in some areas, the model includes more stringent requirements and/or additional provisions not addressed by the DES program.

Stormwater management is necessary during all stages of site development including site planning and design, design review, construction, and post-construction permanent controls. The model language below is focused on post-construction stormwater management and assumes communities have adopted and will institute construction-phase stormwater management and sedimentation and erosion control requirements. Permanent stormwater management systems cannot be expected to function properly if adequate controls are not implemented during construction.

Construction-phase mitigation is not addressed in the model ordinance included in this chapter. Stormwater management controls instituted during construction are typically designed to be temporary, using methods such as silt fences, sediment basins, mulch, erosion control mats, berms, and check dams. Construction-phase requirements (also called sedimentation and erosion controls) deal primarily with preventing a build-up of sediments in on- and off-site surface waters, by controlling unstable soils. Alternatively, post-construction stormwater management measures are designed as permanent solutions to keep and treat water on-site.

LEGAL BASIS AND CONSIDERATIONS FOR NEW HAMPSHIRE

Stormwater management requirements are best addressed through a performance-based zoning ordinance. Zoning is the appropriate means for addressing stormwater for the purpose of "promoting the health, safety, or the general welfare of the community" (RSA 674:16) and "to assure proper use of natural resources" (RSA 674:17). A performance-based approach (authorized under RSA 674:21) allows the community to specify the desired outcome or performance required by any development activity without being overly prescriptive regarding the specific techniques or approaches used. A zoning ordinance is also the appropriate means for addressing several issues affecting stormwater management, such as lot usage, density, location of buildings, and vegetative cover.

Although many larger sites are subject to state and federal stormwater management requirements, a local zoning ordinance provides the municipality the authority to act independently from state and federal officials to address any problems on the site or local water quality impacts. In addition, many building lots are too small to be subject to federal or state stormwater regulations. A local zoning ordinance ensures that all development activity must comply with the stormwater management requirements, including projects not subject to state or federal regulations and individual building lots that are not subject to subdivision or site plan review. Stormwater management requirements that apply to an individual building site that does not go through subdivision or site plan review are enforceable at the building permit stage and by a code enforcement officer.

A zoning ordinance can also authorize the planning board to require a more detailed stormwater management plan for certain types of development, such as for larger developments, developments subject to subdivision and/or site plan review, or for developments near sensitive resources. Under this situation, the planning board will develop site plan and subdivision regulations specifying what information is required in a plan and establishing any additional requirements for such sites.

EXAMPLES AND OUTCOMES

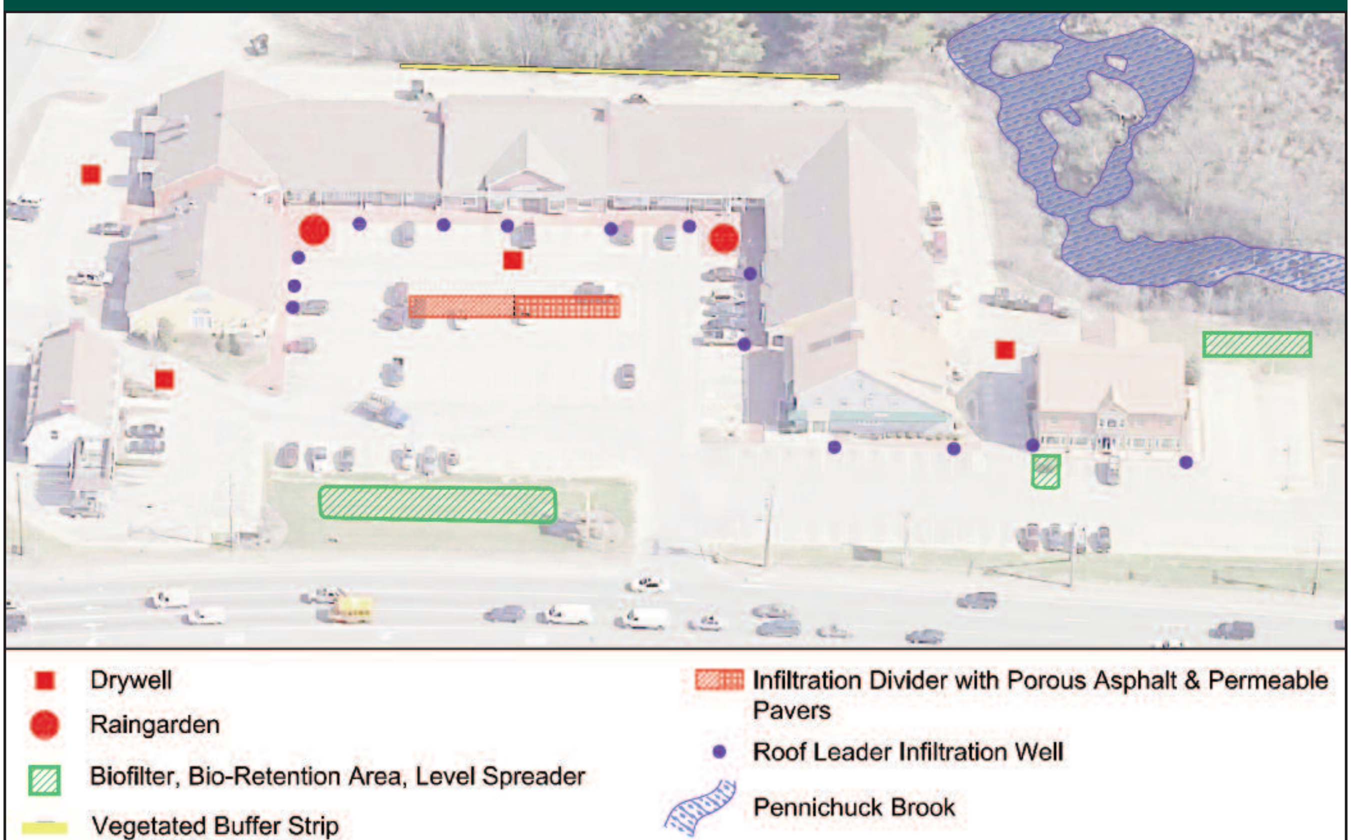
Nashua

The city of Nashua has a stormwater management ordinance that prefers runoff prevention measures and on-site stormwater treatment.

Merrimack

The Pennichuck Square redevelopment project used innovative stormwater practices to infiltrate runoff on a densely developed retail site. The project resulted in over 88 percent of the site's runoff being infiltrated and treated on-site where it had previously been piped untreated into Pennichuck Brook, Nashua's water supply. See Figure 2.1.1 for illustration.

FIGURE 2.1.1 Low Impact Development Redevelopment Plan: Pennichuck Square, Merrimack, NH



Comprehensive Environmental, Incorporated (www.pennichuck.com/raingardens/raingardens.htm)

Model Language and Guidance for Implementation

PERMANENT (POST-CONSTRUCTION) STORMWATER MANAGEMENT MODEL ORDINANCE

I. PURPOSE

To protect, maintain and enhance the public health, safety, environment, and general welfare by establishing minimum requirements and procedures to control the adverse affects of increased post-development stormwater runoff, decreased groundwater recharge, and non-point source pollution associated with new development and redevelopment.

II. AUTHORITY

The provisions of this Article are adopted pursuant to RSA 674:16, Grant of Power, RSA 674:17, Purposes of Zoning Ordinance, and RSA 674:21, Innovative Land Use Controls.

III. APPLICABILITY

The requirements of this Article shall apply to land disturbance, development, and/or construction activities in all zoning district(s).

IV. DEFINITIONS

Communities should review existing definitions sections prior to the adoption of any of the following definitions to avoid duplication or conflicting definitions.

Best Management Practice (BMP): Structural, non-structural and managerial techniques that are recognized to be the most effective and practical means to prevent and/or reduce increases in stormwater volumes and flows, reduce point source and non-point source pollution, and promote stormwater quality and protection of the environment.

Curve Number (CN): A numerical representation used to describe the stormwater runoff potential for a given drainage area based on land use, soil group, and soil moisture, derived as specified by the U.S. Department of Agriculture, Natural Resources Conservation Service (USDA/NRCS).

Developer: A person who undertakes or proposes to undertake land disturbance activities.

Development: For the purposes of this article, development refers to alterations to the landscape that create, expand or change the location of impervious surfaces or alters the natural drainage of a site.

Disconnected Impervious Cover: Impervious cover that does not contribute directly to stormwater runoff from a site, but directs stormwater runoff to on-site pervious cover to infiltrate into the soil or be filtered by overland flow so that the net rate and volume of stormwater runoff from the disconnected impervious cover is not greater than the rate and volume from undisturbed cover of equal area.

Drainage Area: Means a geographic area within which stormwater, sediments, or dissolved materials drain to a particular receiving waterbody or to a particular point along a receiving waterbody.

Effective Impervious Cover: Impervious cover that is not disconnected impervious cover.

Erosion: The detachment and movement of soil, rock, or rock fragments by water, wind, ice or gravity.

Impervious Cover: A structure or land surface with a low capacity for infiltration, including but not limited to pavement, roofs, roadways, and compacted soils, that has a Curve Number of 98 or greater.

Infiltration: The process by which water enters the soil profile (seeps into the soil).

Land Disturbance or Land Disturbing Activity: For the purposes of this Article, refers to any exposed soil resulting from activities such as clearing of trees or vegetation, grading, blasting, and excavation.

Owner: A person with a legal or equitable interest in a property.

Pervious Cover: A land surface with a high capacity for infiltration.

Recharge: The amount of water from precipitation that infiltrates into the ground and is not evaporated or transpired.

Redevelopment: The reuse of a site or structure with existing man-made land alterations. A site is considered a redevelopment if it has 35 percent or more of existing impervious surface, calculated by dividing the total existing impervious surface by the size of the parcel and convert to a percentage.

Regulated Substance: A “regulated substance” as defined in Env-Ws 421.03(f) or successor rule, Env-Wq 401.03(h).

Sediment: Solid material, mineral or organic, that is in suspension, is being transported, or has been moved from its site of origin by air, water or gravity as a product of erosion.

Sensitive Area: For the purpose this Article include lakes, ponds, perennial and intermittent streams, vernal pools, wetlands, and highly erodable soils.

Sheet flow: Runoff that flows or is directed to flow across a relatively broad area at a depth of less than 0.1 feet for a maximum distance of 100 feet in such a way that velocity is minimized.

Site: The lot or lots on upon which development is to occur or has occurred.

Stormwater: Water resulting from precipitation (including rain and snow) that runs off the land’s surface, is transmitted to the subsurface, or is captured by separate storm sewers or other drainage facility.

Stormwater Runoff: Water flow on the surface of the ground or in storm sewers, resulting from precipitation.

Total Impervious Cover: The sum of Disconnected Impervious Cover plus Effective Impervious Cover.

Undisturbed Cover: A natural land surface whose permeability has not been altered by human activity.

Vegetation: Is defined to include a tree, plant, shrub, vine or other form of plant growth.

Wellhead Protection Area: As defined in RSA 485-C:2, XVIII, the surface and subsurface area surrounding a water well or well field, supplying a public water system, through which contaminants are reasonably likely to move toward and reach such water well or well field.

V. STORMWATER MANAGEMENT PLAN

All developments disturbing greater than 20,000 square feet of area shall submit a permanent (post-construction) Stormwater Management Plan (SMP) with an application for subdivision or site plan review. The permanent SMP, which shall be prepared by a licensed New Hampshire, professional engineer, shall address and comply with the requirements set forth herein and as specified by the planning board.

Each community should decide whether it wants to require a separate management plan and, if so, what size development or disturbed area is subject to this requirement. A community might also decide to restrict the applicability of additional provisions from this model ordinance to larger developments or developments in more sensitive areas.

VI. PERMANENT STORMWATER MANAGEMENT REQUIREMENTS

All development activity must comply with the following provisions to reduce and properly manage stormwater post-construction:

A. Maximum effective impervious cover shall not exceed 10 percent of a site. Impervious cover may be disconnected from the stormwater drainage network, to reduce total effective impervious cover, through such techniques as infiltration or sheet flow over a pervious area.

As noted in the definitions, Effective Impervious Cover is different from Impervious Cover. For example, to comply with this section, a site that creates 50 percent impervious cover must provide ample opportunities to capture and infiltrate stormwater to reduce the amount of stormwater leaving the site to be equivalent to having just 10 percent impervious cover (i.e., the site has 10 percent effective impervious cover).

B. BMP techniques shall be used to meet the conditions below for control of peak flow and total volume of runoff, water quality protection, and maintenance of on-site groundwater recharge.

   1. Stormwater management practices shall be selected to accommodate the unique hydrologic and geologic conditions of the site.

   2. The use of nontraditional and/or nonstructural stormwater management measures, including site design approaches to reduce runoff rates, volumes, and pollutant loads, are preferred and shall be implemented to the maximum extent practical. Such techniques include, but are not limited to, minimization and/or disconnection of impervious surfaces; development design that reduces the rate and volume of runoff; restoration or enhancement of natural areas such as riparian areas, wetlands, and forests; and use of practices that intercept, treat, and infiltrate runoff from developed areas distributed throughout the site (e.g. bioretention, infiltration dividers or islands, or planters and raingardens). Applicants shall demonstrate why the use of nontraditional

An example of a site condition that should be factored into the stormwater management approach is soil type. The areas of a site with the best soils for infiltration should be preserved to maintain natural infiltration or set aside to be used for infiltrating stormwater generated elsewhere on the site.

Communities may wish to include a provision to require emergency shutdown and containment, particularly in commercial and industrial areas or in drinking water supply areas, as an added protection against contamination of surface waters or groundwaters.

The NHDES Alteration of Terrain program provides for exemptions to the above standards (5) and (6) for stormwater management systems that discharge stormwater from areas less than 0.5 acres and that do not and will not receive stormwater from a high-load area. The exemption is designed to encourage low impact development.

and/or nonstructural approaches are not possible before proposing to use traditional, structural stormwater management measures (e.g., stormwater ponds, vegetated swales).

3. The applicant shall demonstrate how the proposed control(s) will comply with the requirements of this ordinance, including the control of peak flow and total volume of runoff, protection of water quality, and recharge of stormwater to groundwater. The applicant must provide design calculations and other back-up materials necessary.

4. At the discretion of the planning board, stormwater management systems shall incorporate designs that allow for shutdown and containment in the event of an emergency spill or other unexpected contamination event.

5. Stormwater management systems shall not discharge to surface waters, ground surface, subsurface, or groundwater within 100 feet of a surface water within a water supply intake protection area.

6. Stormwater management systems shall not discharge within the setback area for a water supply well as specified in the following table:

Well Type	Well Production Volume (gallons per day)	Setback from Well (feet)
Private Water Supply Well	Any Volume	75
Non-Community Public Water Supply Well	0 to 750	75
	751 to 1,440	100
	1,441 to 4,320	125
	4,321 to 14,400	150
Community Public Water Supply Well	0 to 14,400	150
Non-Community and Community Public Water Supply Well	14,401 to 28,800	175
	28,801 to 57,600	200
	57,601 to 86,400	250
	86,401 to 115,200	300
	115,201 to 144,000	350
	Greater than 144,000	400

7. BMPs shall be designed to convey a minimum design storm event, as described in the table below, without overtopping or causing damage to the stormwater management facility.

Treatment Practice	Design Storm Event
Stormwater Pond	50-year, 24-hour storm
Stormwater Wetland	50-year, 24-hour storm
Infiltration Practices	10-year, 24-hour storm
Filtering Practices	10-year, 24-hour storm
Flow through Treatment Swales	10-year, 24-hour storm

C. Protection of natural hydrologic features and functions.

1. Site disturbance shall be minimized. Vegetation outside the project disturbance area shall be maintained. The project disturbance area shall be depicted on site plans submitted as part of the site plan review process. The project disturbance area shall include only the area necessary to reasonably accommodate construction activities. The applicant may be required to install construction fencing around the perimeter of the proposed project disturbance area prior to commencing land disturbance activities.

2. Soil compaction on site shall be minimized by using the smallest (lightest) equipment possible and minimizing travel over areas that will be revegetated (e.g., lawn areas) or used to infiltrate stormwater (e.g., bioretention areas). In no case shall excavation equipment be placed in the base of an infiltration area during construction.

3. Development shall follow the natural contours of the landscape to the maximum extent possible. A grading plan shall be submitted as part of the site plan review process showing both existing and finished grade for the proposed development.

4. Cut and fill shall be minimized. The maximum height of any fill or depth of any cut area, as measured from the natural grade, shall not be greater than 10 feet.

5. Any contiguous area of disturbance, not associated with the installation of a roadway, shall be limited to 20,000 square feet for residential development and to 100,000 square feet for other types of development. Contiguous areas of disturbance shall be separated by an area maintained at natural grade and retaining existing, mature vegetated cover that is at least 20 feet wide at its narrowest point.

> Communities may decide to allow a larger contiguous area of disturbance overall or in certain areas where appropriate, such as in areas zoned for larger-scale commercial or industrial use.

6. No ground disturbed as a result of site construction and development shall be left as exposed bare soil at project completion. All areas exposed by construction, with the exception of finished building, structure, and pavement footprints, shall be decompacted (aerated) and covered with a minimum thickness of six inches of non-compacted topsoil, and shall be subsequently planted with a combination of living vegetation such as grass, groundcovers, trees, and shrubs, and other landscaping materials (mulch, loose rock, gravel, stone).

7. Priority shall be given to maintaining existing surface waters and systems, including, but not limited to, perennial and intermittent streams, wetlands, vernal pools, and natural swales.

    a. Existing site hydrology shall not be modified so as to disrupt on-site and adjacent surface waters. The applicant must provide evidence that this standard can be achieved and maintained over time.

    b. Existing surface waters, including lakes, ponds, rivers, perennial and intermittent streams, wetlands, vernal pools, and natural swales, shall be protected by a 50 foot no disturbance, vegetated buffer.

The 50 foot buffer requirement under 7.b. is meant as a bare-minimum standard for communities that do not have more specific buffer requirements. While a 50 foot buffer will provide some water quality benefits, it will not be adequate in all situations (e.g., particularly steep slopes) or sufficient to meet all the natural resource protection goals of a community. Communities should determine whether a broader buffer requirement is appropriate for their community to provide additional water quality and other benefits, such as wildlife habitat and corridor protection and human recreation opportunities. Other chapters in this series, particularly those pertaining specifically to the protection of surface water resources and habitat, provide additional information on appropriate buffer widths and protections to achieve various natural resource protection goals.

c. BMPs shall not be located within the 50 foot no disturbance, vegetated buffer or within 50 feet of steep banks (greater than 15 percent slope).

d. Where roadway or driveway crossings of surface waters cannot be eliminated, disturbance to the surface water shall be minimized, hydrologic flows shall be maintained, there shall be no direct discharge of runoff from the roadway to the surface water, and the area shall be revegetated post-construction.

e. Stream and wetland crossings shall be eliminated whenever possible. When necessary, stream and wetland crossings shall comply with state recommended design standards to minimize impacts to flow and animal passage. (See NH Fish and Game Department, 2008.)

The NHDES Alteration of Terrain program provides for exemptions to the standards D.2, D.3, and D.4 for projects that directly discharge to a stream, waterbody, estuary, or tidal water and where the applicant has provided supporting off-site drainage calculations for the 10-year and 50-year, 24-hour storm showing that at a point immediately downstream from the project site the post-development peak flow rate from the site and the off-site contributing area does not exceed the pre-development peak flow rate at that point.

D. Post-development peak flow rates and total runoff volumes.

1. The applicant shall provide pre- and post-development peak flow rates. Any site that was wooded in the last five years must be considered undisturbed woods for the purposes of calculating pre-development peak flow rates.
2. The two-year, 24-hour post-development peak flow rate shall be (a) less than or equal to 50 percent of two-year, 24-hour storm pre-development peak flow rate or (b) less than or equal to the one-year, 24-hour storm pre-development peak flow rate.
3. The 10-year, 24-hour post-development peak flow rate shall not exceed the 10-year, 24-hour pre-development peak flow rate for all flows off-site.
4. The 50-year, 24-hour post-development peak flow rate shall not exceed the 50-year, 24-hour pre-development peak flow rate for all flows off-site.
5. Measurement of peak discharge rates shall be calculated using point of discharge or the down-gradient property boundary. The topography of the site may require evaluation at more than one location if flow leaves the property in more than one direction. Calculations shall include runoff from adjacent up-gradient properties.
6. An applicant may demonstrate that a feature beyond the property boundary is more appropriate as a design point.
7. The applicant shall provide pre- and post-development total runoff volumes. Any site that was wooded in the last five years shall be considered

undisturbed woods for the purposes of calculating pre-development total runoff volumes.

8. The post-development total runoff volume shall be equal to 90 to 110 percent of the pre-development total runoff volume (based on a two-year, 10-year, 25-year, and 50-year, 24-hour storms). Calculations shall include runoff from adjacent up-gradient properties.

E. Water Quality

1. If more than 35 percent of the total area of the site will be disturbed or the site will have greater than 10 percent effective impervious cover, the applicant shall demonstrate that their stormwater management system will:

   a. Remove 80 percent of the average annual load of total suspended solids (TSS), floatables, greases, and oils after the site is developed.

   b. Remove 40 percent of phosphorus.

2. Compliance with the recharge requirements under Section F, consistent with the pre-treatment and design requirements in Sections F.2 and F.3, shall be considered adequate to meet the treatment standards specified in VI.E.1.

3. Applicants not able to employ Section F must provide suitable documentation, including a pollutant loading analysis from an approved model, that the treatment standards specified in VI.E.1 will be met.

Depending on the existing water quality of downstream receiving waters, in particular if a waterbody is impaired or designated as an "outstanding resource water," development projects requiring an Alteration of Terrain Permit or a 401 Water Quality Certification from the state may be subject to more stringent pollutant removal requirements than specified in Sections E. 1. a. and b.

F. Recharge to Groundwater
Except where prohibited, stormwater management designs shall demonstrate that the annual average pre-development groundwater recharge volume (GRV) for the major hydrologic soil groups found on-site are maintained.

1. For all areas covered by impervious cover, the total volume of recharge that must be maintained shall be calculated as follows:

   a) REQUIRED GRV =
   (Total Impervious Cover) x (Groundwater Recharge Depth)

   Where Total Impervious Cover is the area of proposed impervious cover that will exist on the site after development.

   And where Groundwater Recharge Depth is expressed as follows:

USDA/NRCS Hydrologic Soil Group (HSG)	Groundwater Recharge Depth (inches)
A	0.40
B	0.25
C	0.10
D	not required

Example: Applicant proposes 30,000 square foot parking lot over C soils.

REQUIRED GRV = 30,000 X 0.10

REQUIRED GRV= 250 ft3

b. Where more than one hydrologic soil group is present, a weighted soil recharge factor shall be computed.

2. Pre-Treatment Requirements

a. All runoff must be pretreated prior to its entrance into the groundwater recharge device to remove materials that would clog the soils receiving the recharge water.

b. Pretreatment devices shall be provided for each BMP, shall be designed to accommodate a minimum of one-year's worth of sediment, shall be designed to capture anticipated pollutants, and be designed and located to be easily accessible to facilitate inspection and maintenance.

The use of below-ground pre-treatment devices should be discouraged because of the added difficulty in assessing their function and performing regular inspections and maintenance.

3. Sizing and design of infiltration (recharge) BMPs

a. All units shall be designed to drain within 72 hours from the end of the storm.

b. The floor of the recharge device shall be at least three feet above the seasonal high water table and bedrock.

c. Soils under BMPs shall be scarified or tilled to improve infiltration.

d. Infiltration BMPs shall not be located in areas with materials or soils containing regulated or hazardous substances or in areas known to DES to have contaminants in groundwater above ambient groundwater quality standards or in soil above site-specific soil standards.

This design requirement addresses concerns about infiltration BMPs contributing to mosquito problems. Requiring such facilities to drain within 72 hours will prevent mosquitoes from successfully breeding.

4. Infiltration may be prohibited or subject to additional pre-treatment requirements under the following circumstances:

a. The facility is located in a well-head protection area or water supply intake protection area; or

b. The facility is located in an area where groundwater has been reclassified to GAA, GA1 or GA2 pursuant to RSA 485-C and Env-Dw 901; or

c. Stormwater is generated from a "high-load area," as described under Section G.

G. Land Uses with Higher Potential Pollutant Loads

1. The following uses or activities are considered "high-load areas," with the potential to contribute higher pollutant loads to stormwater, and must comply with the requirements set forth in subsections 2, 3, and 4 below:

a. Areas where regulated substances are exposed to rainfall or runoff; or

b. Areas that typically generate higher concentrations of hydrocarbons, metals, or suspended solids than are found in typical stormwater runoff, including but not limited to the following:

i. Industrial facilities subject to the NPDES Multi-Sector General Permit (MSGP); not including areas where industrial activities do not occur, such as at office buildings and their associated parking facilities or in drainage areas at the facility where a certification of no exposure will always be possible [see 40CFR122.26(g)].

ii. Petroleum storage facilities.

iii. Petroleum dispensing facilities.

iv. Vehicle fueling facilities.

v. Vehicle service, maintenance and equipment cleaning facilities.

vi. Fleet storage areas.

vii. Public works storage areas.

viii. Road salt storage and loading facilities.

ix. Commercial nurseries.

x. Non-residential facilities having uncoated metal roofs with a slope flatter than 20 percent.

xi. Facilities with outdoor storage, loading, or unloading of hazardous substances, regardless of the primary use of the facility.

xii. Facilities subject to chemical inventory under Section 312 of the Superfund Amendments and Reauthorization Act of 1986 (SARA).

xiii. Commercial parking areas with over 1,000 trips per day.

c. If a high-load area demonstrates, through its source control plan, the use of best management practices that result in no exposure of regulated substances to precipitation or runoff or release of regulated substances, it shall no longer be considered a high-load area.

2. In addition to implementation of BMPs for designing site-specific stormwater management controls, uses included under subsection G.1 shall provide a stormwater pollution prevention plan (SWPPP, see margin note below), describing methods for source reduction and methods for pretreatment.

3. Infiltration of stormwater from high-load areas, except commercial parking areas, is prohibited. Infiltration, with appropriate pre-treatment (e.g., oil/water separation) and subject to the conditions of the SWPPP, is allowed in commercial parking areas and others areas of a site that do not involve potential "high-load" uses or activities (e.g., where a certification of "no exposure" under the MSGP will always be possible).

4. For high-load areas, except commercial parking areas, filtering and infiltration practices, including but not limited to, sand filters, detention basins,

Information on the Multi-Sector General Permit for commercial and industrial sites is available at http://cfpub.epa.gov/npdes/stormwater/swppp-msgp.cfm.

The uses listed under 1.b.ii – 1.b.xiii are generally not subject to the MSGP, unless associated with another use or specific activity that is covered under the MSGP. A municipality may decide not to regulate one or more of these types of uses, or to cover additional types of uses that may represent a threat to water quality in their community (e.g., auto recyclers/salvage yards; marina service areas).

Example Stormwater Pollution Prevention Plans (SWPPP) are available at http://cfpub.epa.gov/npdes/stormwater/swppp-msgp. cfm.

wet ponds, gravel wetlands, constructed wetlands, swales or ditches, may be used only if sealed or lined.

H. Parking

1. Snow may not be plowed to, dumped in, or otherwise stored within 15 feet of a wetland or waterbody, except for snow that naturally falls into this area. Snow storage areas shall be shown on the site plan to comply with these requirements.
2. At the discretion of the planning board, parking spaces may be allowed, or required, to be constructed of a pervious surface (i.e. grass, pervious asphalt, pervious pavers).
3. Infrequently used emergency access points or routes shall be constructed with pervious surfaces (i.e. grass, pervious asphalt, pervious pavers).

I. Redevelopment or Reuse

1. Redevelopment or reuse of previously developed sites must meet the stormwater management standards set forth herein to the maximum extent possible as determined by the planning board. To make this determination the planning board shall consider the benefits of redevelopment as compared to development of raw land with respect to stormwater.
2. Redevelopment or reuse activities shall not infiltrate stormwater through materials or soils containing regulated or hazardous substances.
3. Redevelopment or reuse of a site shall not involve uses or activities considered “high-load areas” unless the requirements under Section G. are met.

J. Easements

1. Where a site is traversed by or requires construction of a watercourse or drainageway, an easement of adequate width may be required for such purpose.
2. There shall be at least a ten foot wide maintenance easement path on each side of any stormwater management system element. For systems using underground pipes, the maintenance easement may need to be wider, depending on the depth of the pipe.

K. Performance Bond

1. To ensure that proposed stormwater management controls are installed as approved, a performance bond shall be provided as a condition of approval in an amount determined by the planning board.
2. To ensure that stormwater management controls function properly, a performance bond shall be required, as a condition of approval, which may be held after final certificate of occupancy is issued.

L. Operation and Maintenance Plan

1. All stormwater management systems shall have an operations and maintenance (O&M) plan to ensure that systems function as designed. This plan shall be reviewed and approved as part of the review of the proposed per-

manent (post-construction) stormwater management system and incorporated in the Permanent Stormwater Management Plan, if applicable. Execution of the O&M plan shall be considered a condition of approval of a subdivision or site plan. If the stormwater management system is not dedicated to the city/town pursuant to a perpetual offer of dedication, the planning board may require an applicant to establish a homeowners association or similar entity to maintain the stormwater management system. For uses and activities under Section G, the O&M plan shall include implementation of the Stormwater Pollution Prevention Plan (SWPPP).

2. The stormwater management system owner is generally considered to be the landowner of the property, unless other legally binding agreements are established.

3. The O&M plan shall, at a minimum, identify the following:
   a. Stormwater management system owner(s), (For subdivisions, the owner listed on the O&M plan shall be the owner of record, and responsibilities of the O&M plan shall be conveyed to the party ultimately responsible for the road maintenance, i.e. the Town should the road be accepted by the Town, or a homeowners association or other entity as determined/required under Section VI.L.1 above.)
   b. The party or parties responsible for operation and maintenance and, if applicable, implementation of the Stormwater Pollution Prevention Plan (SWPPP).
   c. A schedule for inspection and maintenance.
   d. A checklist to be used during each inspection.
   e. The description of routine and non-routine maintenance tasks to be undertaken.
   f. A plan showing the location of all stormwater management facilities covered by the O&M plan.
   g. A certification signed by the owner(s) attesting to their commitment to comply with the O&M plan.

4. Recording:
   a. The owner shall provide covenants for filing with the registry of deeds in a form satisfactory to the planning board, which provide that the obligations of the maintenance plan run with the land.
   b. The owner shall file with the registry of deeds such legal instruments as are necessary to allow the city/town or its designee to inspect or maintain the stormwater management systems for compliance with the O&M plan.

5. Modifications:
   a. The owner shall keep the O&M plan current, including making modifications to the O&M plan as necessary to ensure that BMPs continue to operate as designed and approved.

b. Proposed modifications of O&M plans including, but not limited to, changes in inspection frequency, maintenance schedule, or maintenance activity along with appropriate documentation, shall be submitted to the planning board for review and approval within thirty days of change.

c. The owner must notify the planning board within 30 days of a change in owner or party responsible for implementing the plan.

d. The planning board may, in its discretion, require increased or approve decreased frequency of inspection or maintenance or a change in maintenance activity. For a reduced frequency of inspection or maintenance, the owner shall demonstrate that such changes will not compromise the long-term function of the stormwater management system.

e. The planning board shall notify the owner of acceptance of the modified plan or request additional information within 60 days of receipt of proposed modifications. No notification from the planning board at the end of 60 days shall constitute acceptance of the plan modification. The currently approved plan shall remain in effect until notification of approval has been issued, or the 60 day period has lapsed.

M. Record Keeping

1. Parties responsible for the operation and maintenance of a stormwater management system shall keep records of the installation, maintenance and repairs to the system, and shall retain records for at least five years.

2. Parties responsible for the operation and maintenance of a stormwater management system shall provide records of all maintenance and repairs to the [______ *i.e. Code Enforcement Officer, Board of Selectmen*], during inspections and/or upon request.

N. Enforcement

When the responsible party fails to implement the O&M plan, including, where applicable, the SWPPP, as determined by the Code Enforcement Officer or Board of Selectmen, the municipality is authorized to assume responsibility for their implementation and to secure reimbursement for associated expenses from the responsible party, including, if necessary, placing a lien on the subject property.

VII. AUTHORIZATION TO ISSUE A SPECIAL USE PERMIT

A. Authority is hereby granted to the planning board, as allowed under RSA 674:21 II, to issue a special use permit to allow variations from the requirements and restrictions set forth in this section upon the request of the applicant provided the development design and proposed stormwater management approach satisfy the following conditions:

1. Such modifications are consistent with the general purpose and standards of this section and shall not be detrimental to public health, safety or welfare;

2. The modified design plan and stormwater management approach shall meet the performance standards under sections VI.D-VI.F of this ordinance; and

3. The modified design plan and stormwater management approach shall satisfy all state and/or federal permit requirements, as applicable.

Municipalities have the option of granting the planning board the authority to issue a special use permit (also known as a conditional use permit) as a means of giving the planning board and applicants greater flexibility to meet the requirements of this section. The advantage of allowing a special use permit option is that the planning board can work with an applicant to modify a plan when it is in the best interest of the community, while still ensuring compliance with the intent of the ordinance, without forcing the applicant to pursue a zoning variance.

VIII. ENGINEERING REVIEW

A. The applicant shall submit a fee, as determined by the planning board, with their application for subdivision or site plan review to cover the cost of outside engineering review of their proposed permanent post-construction stormwater management system(s), and the separate Permanent Post-Construction Stormwater Management Plan (SMP) and Stormwater Pollution Prevention Plan (SWPPP), if applicable.

B. Additional copies of all plans, engineering studies, and additional information as requested by the planning board describing the proposed permanent post-construction stormwater management system shall be provided as necessary to allow for a thorough outside engineering review.

REFERENCES

GENERAL STORMWATER AND ORDINANCE INFORMATION

City of Nashua, NH

The city of Nashua Land Use Code stormwater management and landscaping requirements were referenced in the development of this chapter. The code also contains language for recordkeeping requirements for O&M plans approved as part of a subdivision or site plan. In addition, the city's "Alternative Stormwater Management Methods Part 1 – Planning and Guidance" (March 2003) and "Alternative Stormwater Management Methods Part 2 – Designs and Specifications" (March 2003), prepared by Comprehensive Environmental Inc., are model resources for communities when reviewing proposed alternative stormwater management techniques. The city's Land Use Code is available on the city's website, www.ci.nashua.nh.us. The "Alternative Stormwater Management" resources are available on OEP's Resource Library under Low Impact Development, at http://nh.gov/oep/resourcelibrary/referencelibrary/l/ lowimpactdevelopment/index.htm.

Comprehensive Environmental Inc. (CEI)

CEI has prepared numerous publications designed to assist communities with developing stormwater management regulations. "Design Guidelines and Criteria for Stormwater Management" (November 2003) and "Appendix A: Stormwater Technical Design Criteria: To Achieve Phase II Stormwater Compliance and Promote Low Impact Development" both referenced in the development of this chapter. For more information refer to the CEI website at http://ceiengineers.com.

Jefferson County, Washington

Jefferson County stormwater management requirements for all types (scale) and phases of development provide a step-by-step process to help owners/developers understand the requirements. Several checklists and flowcharts could be adapted for use by New Hampshire municipalities. For more information, refer to the Jefferson County Department of Community Development website at www.co.jefferson.wa.us/commdevelopment.

Low Impact Development Center Inc.

The Low Impact Development Center Inc. develops and provides information to individuals and organizations dedicated to protecting the environment and water resources through proper site design techniques that replicate pre-existing hydrologic site conditions. For more information refer to the Low Impact Development Center Inc. website at www.lowimpactdevelopment.org.

National Low Impact Development Clearinghouse

The Clearinghouse is a website developed through a Cooperative Assistance Agreement under the US EPA Office of Water 104b(3) Program in order to provide a web-based clearinghouse that allows researchers, practitioners, and program managers to collaborate and efficiently disseminate and share information with local governments, states, builders, developers, stakeholders, and environmental groups. The administrative and technical information available through this clearinghouse will be useful to permit writers, local government officials, watershed managers, and stakeholders. Refer to the Clearinghouse website at www.lid-stormwater.net/clearinghouse/home.htm.

The Practice of Low Impact Development (LID)

"The Practice of Low Impact Development," (July 2003) prepared by NAHB Research Center Inc. for the U.S. Dept. of Housing and Urban Development, Office of Policy Development and Research, provides an overview of LID including a discussion and examples of LID. For a copy of this publication, refer to the publications page of the Housing and Urban Development website at http://www.huduser.org/ publications/destech/lowImpactDevl.html.

Town of Thornton, New Hampshire

The town of Thornton's Subdivision and Site Plan Regulations include stormwater management provisions referenced in the preparation of this chapter. Contact the town for a copy of the most current regulations.

Towns of Duxbury, Marshfield, and Plymouth, Massachusetts

The "Model Stormwater Management Bylaw" (December 31, 2004) prepared by Horsely Witten Group for the towns of Duxbury, Marshfield, and Plymouth, includes model bylaws, regulations, pollutant load calculations, and credits and incentives to support the implementation of municipal stormwater management controls. For more information, refer to the Horsely & Witten website at www.horsleywitten.com.

U.S. EPA Stormwater Management

U.S. EPA provides extensive information and resources for protecting water resources, including best management practices fact sheets for construction and post-construction stormwater management. For more information on techniques for the protection water and other resources refer to the US EPA website at www.epa.gov.

New Hampshire Stormwater Manuals

New Hampshire Department of Environmental Services. May 2002. *Innovative Stormwater Treatment Technologies Best Management Practices Manual*. www.des.nh.gov.

New Hampshire Department of Environmental Services. 2008. *New Hampshire Stormwater Management Manual: Volume 1 Antidegradation and Stormwater*.

New Hampshire Department of Environmental Services. 2008. *New Hampshire Stormwater Management Manual: Volume 2 Post Construction Best Management Practices: Selection and Design*.

New Hampshire Department of Environmental Services. 2008. *New Hampshire Stormwater Management Manual: Volume 3 Construction Phase Erosion and Sediment Controls*.

New Hampshire Fish and Game Department. September 2008. *New Hampshire Stream Crossing Guidelines*.

2.6 Shoreland Protection: The Importance of Riparian Buffers

RELATED TOOLS:

- Habitat Protection
- Permananent (Post-Construction) Stormwater Management
- Environmental Characteristics Zoning
- Density Transfer Credit

BACKGROUND AND PURPOSE

The purpose of this chapter is to provide municipalities with a model ordinance designed to promote shoreland and riparian protection.

The simplest and most effective way to protect streams, rivers, lakes and estuaries is to leave an area of undisturbed native vegetation adjacent to the water body. These undisturbed areas act as buffers by performing functions that protect water quality and enhance wildlife habitat. Preserving and restoring riparian buffers is essential to surface water quality protection.

There are a number of important guides, technical reports and scientific bulletins available to help New Hampshire municipalities better understand the importance of shoreland protection and the value of riparian buffers (see References).

Two of the key resources for municipal planners are *Buffers for Wetlands and Surface Waters: A Guidebook for New Hampshire Municipalities* and *Riparian Conservation: A Professional's Practical Guide to Financial Assistance and Program Support*.

Surface waters can be broadly classified as either lakes and ponds or rivers and streams. Streams are typically classified according to their *order (see the definition of Stream Order in Glossary)*. In general, streams of higher order are larger than those of lower order. Rivers are examples of higher order streams. The size of a stream is one parameter that can be used to determine the amount of protection or buffer size that is desired for the water body.

In New Hampshire, municipalities currently have four options to regulate development for shoreland and riparian purposes:

Option 1: They may rely solely on the state's Comprehensive Shoreland Protection Act (CSPA) to protect the specific types of surface water bodies that fall under the jurisdiction of the CSPA[1]; or

Option 2: They may elect to adopt regulations that extend protection to the streams and surface water bodies that are not covered by the CSPA; or

Option 3: The municipality may adopt more stringent regulations than the minimum standards of the CSPA as provided for under RSA 483-B:8; or

[1] RSA 483-B, Comprehensive Shoreland Protection Act (CSPA); Effective Date of Enactment: 1991. Revised: 2008.

Option 4: The municipality may elect to develop separate stream corridor (watershed) regulations to protect the riparian buffers along first, second and third order streams and rivers within the community leaving the CSPA or a more stringent local shoreland ordinance to regulate the lakes, ponds, and higher order streams and rivers within the community.[2]

[2] If a municipality desires to pursue this option, the following applicable provisions from this Model Ordinance should be considered: I, II, III, IV, V, VI, VII a, b, d. 3, e, g, VIII, XI, and X.

Four primary resources were used to develop the ordinance of this chapter; the three-zone riparian buffer system developed by the Center for Watershed Protection; the Standards of the CSPA where those standards are most effective in protecting shorelands; the recommendations recently proposed by the Senate Commission to Review the Effectiveness of the CSPA as they relate to this ordinance; and the DES Model Rule for the Protection of Water Supply Watersheds.

The model ordinance is designed to implement Option 3 above. It includes a provision to protect lower order streams and expands upon the buffers established by the CSPA.

The ordinance contains three basic components: (1) a shoreland protection overlay district and zoning map; (2) shoreland protection district standards; and (3) riparian buffer standards. It is drafted as a complete zoning ordinance amendment.

Buffers for wetlands, fire and farm ponds, beaver impoundments, and coastal shorelands are excluded from the model ordinance.

For the purposes of this chapter, the terms “shoreland” and “riparian” shall be used interchangeably to refer to anything connected or immediately adjacent to the shoreline or bank of a stream, river, pond, lake, bay, estuary or other similar body of water. The term “riparian buffer” shall refer to the naturally vegetated shoreline, floodplain or upland forest adjacent to a surface water body.

APPROPRIATE CIRCUMSTANCES AND CONTEXT FOR USE

THE FUNCTION AND CONFIGURATION OF BUFFERS

There are many types and sizes of riparian buffers. Within any given watershed, riparian buffers can be strips of grassy land leading to the water’s edge, thickly forested upland areas or floodplain areas that provide a transition zone between development areas and adjacent surface waters. Typically, these areas are managed to reduce the impacts of adjacent land use and to protect water quality by providing a buffer between upland development and the adjoining surface waters.

Most riparian buffers in New Hampshire consist predominately of forest vegetation. When left undisturbed and intact, these natural forest systems help to maintain clean water and healthy aquatic wildlife. Specifically, they serve to:

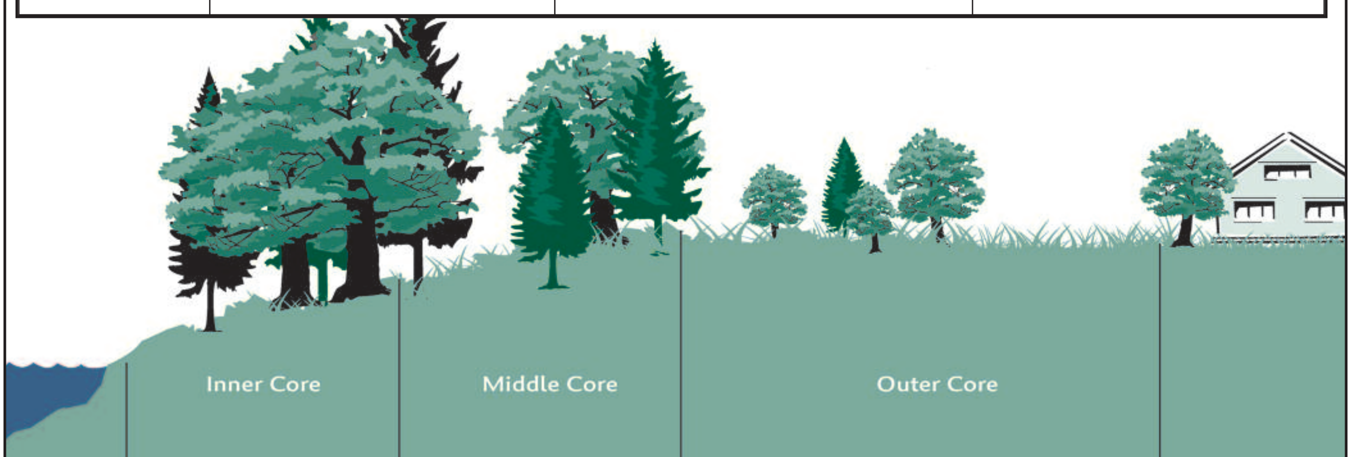
- Stabilize stream banks and shorelands with healthy root systems.
- Moderate the impact of heavy rains.
- Act as a natural filter, capturing sediment and pollutants from runoff.

- Protect people and property from flood damage by slowing and storing flood waters.
- Shade the shoreline and help to lower water temperatures. Cooler water holds more oxygen which is essential to aquatic animal species.
- Provide the organic matter that helps give soil the structural ability to hold oxygen and moisture. The duff layer (downed leaves, small twigs, and dead herbaceous vegetation) also moderates the impact of heavy rain, holds moisture, and can act as a natural mulch to prevent weed species.
- Increase property values by improving the appearance, beauty and aesthetics of the shoreland.
- Provide wildlife habitat on the shore with tree canopy, snags, and downed woody debris.
- Provide organic matter and woody material that falls into the water. The biomass that falls naturally into the water serves as food and habitat for the aquatic life in the water body.

The Center for Watershed Protection (CWP) has developed an effective three zone vegetated buffer model. The principles from that model have been adopted for the buffer strategy reflected in this model ordinance (see Figure 2.6.1). The CWP model consists of an inner core (closest to the water's edge), a middle core, and outer core.

Figure 2.6.1 The Three Cores of the Natural Riparian Buffer

Characteristics	Inner Core	Middle Core	Outer Core
Function	Protect the physical and ecological integrity of the shoreland	Provide distance between upland development and inner core	Prevent encroachment and filter backyard runoff.
Width	Minimum 25 feet from the reference line	Minimum 25 feet: first order streams; 50 feet: all other water bodies depending on stream order, slope, and floodplain	Minimum 25 feet
Vegetative Target	Undisturbed mature forest. Reforest if grass.	Managed forest, some clearing allowable.	Forest encouraged, but usually turfgrass.
Allowable Uses	**Very restricted** e.g., flood control, utility right of ways, footpaths, etc.	**Restricted** e.g., some recreational uses, some stormwater BMPs, bike paths, etc.	**Untrestricted** e.g., residential uses including lawn, garden compost, yard waste, most stormwater BMPs.
Target Pollutant Removal Rates	50% - 60% range	60% - 70% range	70% - 80% range



The inner core most closely matches the waterfront buffer in the CSPA. The middle and outer cores closely match the woodland buffer standards of the CSPA.

Inner Core: extends a minimum of 25 feet from the water's edge for 1st and 2nd order streams (about the distance of one to two mature trees) and 50 feet for lakes, ponds and 3rd and 4th order streams. The Inner Core serves to protect the physical and ecological integrity of the adjacent water ecosystem. A mature riparian forest is the desired vegetation because it provides multiple canopy layers, interwoven root systems, shade, leaf litter, woody debris, and erosion protection. Only limited tree cutting and very restricted uses such as access paths and utility rights of way should be allowed. No land clearing or impervious surfaces (except an access path) should be considered within this zone.

Middle Core: extends beyond the inner core to the beginning of the outer core, a minimum of 25 feet for 1st and 2nd order streams and a minimum of 50 feet for all other water bodies. The exact size of this zone will depend on stream order and slope. This zone is mainly composed of managed forest with some clearing allowed. This zone protects adjacent water quality and offers wildlife habitat. Fifty percent of this area can be allowed for structures, recreational use, stormwater best management practices (BMPs), and tree removal. The other fifty percent of this zone should remain in an undisturbed state.

Outer Core: extends a minimum 25 feet out from the middle core for 1st and 2nd order streams and 50 feet for lakes, ponds and all 3rd and 4th order streams. This zone is mainly composed of forest or turf and typically contains the yard, garden, or woods between a residential dwelling and the rest of the buffer. This zone traps sediment and consists of play areas, gardens, compost piles, and other common residential activities.

While many factors including slope, soil type, adjacent land use (including amount of impervious cover), floodplain, vegetation type, and watershed condition all influence buffer width, in most cases, the most commonly prescribed minimum buffer widths for use in water quality and habitat protection are 35 to 250 feet (Tjaden and Weber). Buffers of less than 35 feet have not been found to sustain long-term protection of aquatic communities.

A minimum 100-foot buffer width is recommended in *Buffers for Wetlands and Surface Waters: A Guidebook for New Hampshire Communities*, as a standard width for all surface waters and wetlands in New Hampshire (Chase, et al. 1997)

Even for narrow creeks or intermittent streams that run through residential neighborhoods or commercial developments, riparian buffers are important for sediment control and aquatic integrity. Protection of these smaller creeks and streams is particularly important because:

- they are numerous across the landscape;
- they feed larger streams and rivers – one of the best ways to protect larger rivers is to protect the small streams that flow into them; and
- they can be readily impacted by sedimentation, erosion and non-point source pollution.

LEGAL BASIS AND CONSIDERATIONS FOR NEW HAMPSHIRE

This chapter is being prepared at a time when sweeping changes have been recommended to the State of New Hampshire's Comprehensive Shoreland Protection Act (CSPA). These changes, adopted by the legislature during 2007, will help to improve the implementation of the CSPA at both the state and local level.

Under the current CSPA, municipalities may adopt land use ordinances (zoning, subdivision, site plan, etc.) to regulate protected shorelands within their boundaries. These ordinances can be more stringent than the minimum standards of the CSPA (see RSA 483-B:8, Municipal Authority). In fact, the CSPA encourages municipalities to adopt land use control ordinances designed to protect the shorelands of water bodies and water courses not subject to the CSPA. These other water bodies can include first and second order (headwater streams and tributaries), third order streams and rivers, lakes, and ponds, and other impoundments. In addition, municipalities may elect to enforce the provisions of the CSPA by issuing cease and desist orders, and by seeking injunctive relief or civil penalties as provided in RSA 483-B:18, III(a) and (b). One of the advantages of local enforcement is that any civil penalties and fines collected by the court, can be remitted to the treasurer of the municipality prosecuting violations, for use of the municipality. In order to enforce the provisions of the CSPA, however, municipalities must have a knowledgeable code enforcement officer on hand who understands and can apply the provisions of the act on a case by case basis.

The CSPA minimum standards are designed to overlay other state and municipal permitting programs. This means that state permitting programs such as Subsurface, Wetlands, and Alteration of Terrain as well as local building permits must ensure that any permits issued are in compliance with the CSPA.

Currently, the protected shoreland under the CSPA includes all land located within 250 feet of the reference line (see glossary for definition of reference line) of public waters and fourth order and higher streams.

Exemptions for forestry and agricultural activities are built into the CSPA and can be considered when establishing a local ordinance. The CSPA also provides an urban exemption for situations in which specialized urban conditions exist. This exemption requires the governing body to make a formal request to the Commissioner of DES to grant an exemption form the CSPA.

On July 1, 2005, the New Hampshire legislature established a "Commission to study the effectiveness of the CSPA." On November 30, 2006, the Commission's final report was released and in the spring of 2007, most of the Commission's recommendations were incorporated into house bills. The following summarizes the major proposed legislative changes that are important considerations in developing a local shoreland protection ordinance:

- The setback for primary structures to protected shoreland shall be at least 50 feet in all towns whether or not the municipality has an established lesser setback.

- The current methodology for measuring and maintaining the Natural Woodland Buffer (50 percent basal area removal/well distributed stand) would be replaced by establishing a waterfront buffer that extends 50 feet back from the reference line. Within the waterfront buffer there would be no root, rock, duff, or understory removals and no fertilizer or pesticide use. Tree cutting would be limited and would be managed in accordance with a grid and points system. Fifty percent of the area outside of permitted impervious surfaces would be left undisturbed.
- Impervious surfaces would be limited to 20 percent of the area within the protected shoreland. With mitigation, the impervious surface allowance could be up to 30 percent.
- The full protection of the CSPA would be extended to all third order and higher streams (including the Saco and Pemigewasset Rivers) as identified by the N.H. Hydrologic Database.

EXAMPLES AND OUTCOMES

There are many municipalities in New Hampshire that have developed regulations to protect shorelands and riparian buffers. The Office of Energy and Planning currently maintains a list of 48 communities within New Hampshire that have adopted local regulations for shoreland and riparian protection.

The model ordinance contained in this chapter provides municipalities with a new and effective tool for shoreland and riparian protection. Key provisions within the ordinance include:

- a 25 foot setback for primary structures from the reference line for first and second order streams;
- a 50 foot setback for primary structures from all third, fourth and higher order streams, lakes, ponds, and coastal estuaries;
- a 20 percent impervious surface limitation requirement for any portion of any lot located within the Shoreland Protection District. (see sidebar)
- The inclusion of Conditional Use Permit requirements for water-dependent structures, including but not limited to docks, piers, breakwaters, boathouses and marinas, etc. Many of these uses currently require planning board approval subject to both local site plan review and DES permits as applicable.
- Requirements for the submittal of a stormwater management plan for all earth moving or excavation activities on lots greater than one acre in size.
- Requirement for planning board approval of a selected clearing and landscape plan

Municipalities may wish to consider a 10 percent impervious surface limitation as studies show that there is a level (between 7 and 14 percent impervious surface) at which water quality and wildlife habitat become affected by urban characteristics, such as impervious surface. These results are similar to other studies, where measures of impervious surface of about 10 percent have been identified as the level at which stream quality decreases (Klein, 1979; Schueler, 1994; Booth and Reinelt, 1993).

Model Language and Guidance for Implementation

MODEL ORDINANCE FOR SHORELAND AND RIPARIAN PROTECTION

Shoreland Zoning Ordinance for the Municipality of ________________________

I. TITLE AND AUTHORITY

A. **Title:** This Ordinance shall be known as the "Shoreland Protection District of the City/Town of _________________, New Hampshire."

B. **Authority:** Pursuant to the authority granted by RSA 483-B:8, Municipal Authority; RSA 674:17 I., Purposes of Zoning Ordinances; and RSA 674:21 I., Innovative Land Use Controls this ordinance is hereby adopted by the Town/City of _______________, New Hampshire to protect the public health, safety, and general welfare.

II. PURPOSE

The purpose of this Ordinance is to establish regulations for the design of riparian buffers to protect the flowing streams and surface water bodies of the Town/City of _____________ to protect the water quality of these resources; to protect the Town/City of ___________'s riparian and aquatic ecosystems; and to provide for the environmentally sound use of the Town/City of ____________'s land resources.

III. FINDINGS

The City/Town of _____________, New Hampshire finds that shoreland protection and riparian buffers adjacent to flowing waters and surface water bodies provide numerous environmental benefits. Shoreland forested buffers serve to:

A. Restore and maintain the chemical, physical and biological integrity of the water resources;

B. Provide infiltration of stormwater runoff;

C. Remove pollutants delivered in stormwater runoff;

D. Reduce erosion and control sedimentation;

E. Stabilize lake and stream banks;

F. Maintain base flow of streams;

G. Contribute food and habitat for the aquatic ecosystem;

H. Moderate the temperature of near shore waters

I. Provide and enhance terrestrial wildlife habitat; and,

J. Enhance scenic value and recreational opportunities

Therefore, the City/Town of ______________, New Hampshire adopts this ordinance to protect and maintain the native vegetation along the shorelands of the community's water courses and surface waters by implementing standards for protection, use and development of these areas within the jurisdiction of the municipality.

IV. APPLICABILITY

A. **Shoreland Protection District.** The Shoreland Protection District of the City/Town of _________________, New Hampshire is an overlay district superimposed over the existing conventional zoning districts of the municipality. It includes within its boundary a protected shoreland on either side of all 1st, 2nd, 3rd and 4th order and higher rivers and streams, and a protected shoreland adjacent to all natural and impounded lakes and ponds and coastal estuaries (if applicable) located within the municipality. The Shoreland Protection District does not apply to wetlands, ephemeral streams, beaver impoundments, fire ponds, and farm ponds as defined in this ordinance. The Shoreland Protection District subject to this Ordinance shall be shown on the municipality's Official Shoreland Zoning Map, which is incorporated as part of this Ordinance.

B. **Official Shoreland Zoning Map.**

1. **Scale of Map.** The Official Shoreland Zoning Map shall be drawn at a scale of not less than 1 inch = 2,000 feet. District boundaries shall be clearly delineated and a legend indicating the symbols for each district shall be placed on the map.

A municipality may have a series of maps instead of one map depicting its shoreland protection district. The state's regional planning commissions are available to assist your municipality in preparing this map. A reliable source of stream location and stream order classification i.e. the identification of first, second, third and fourth and higher streams within your municipality is available from the New Hampshire Hydrography Dataset (NHHD) developed by Complex Systems Research Center, University of New Hampshire. The Final Report of the Commission reviewing the effectiveness of the CSPA recommends that the state adopt the NHHD for the purpose of identifying stream order.

Planning boards are encouraged to include in their site plan and subdivision regulations, requirements for the submittal of surveyed plans depicting the true location of the streams, rivers and other water bodies subject to this ordinance within the subject property. This plan information can then be used to supplement the NHHD data.

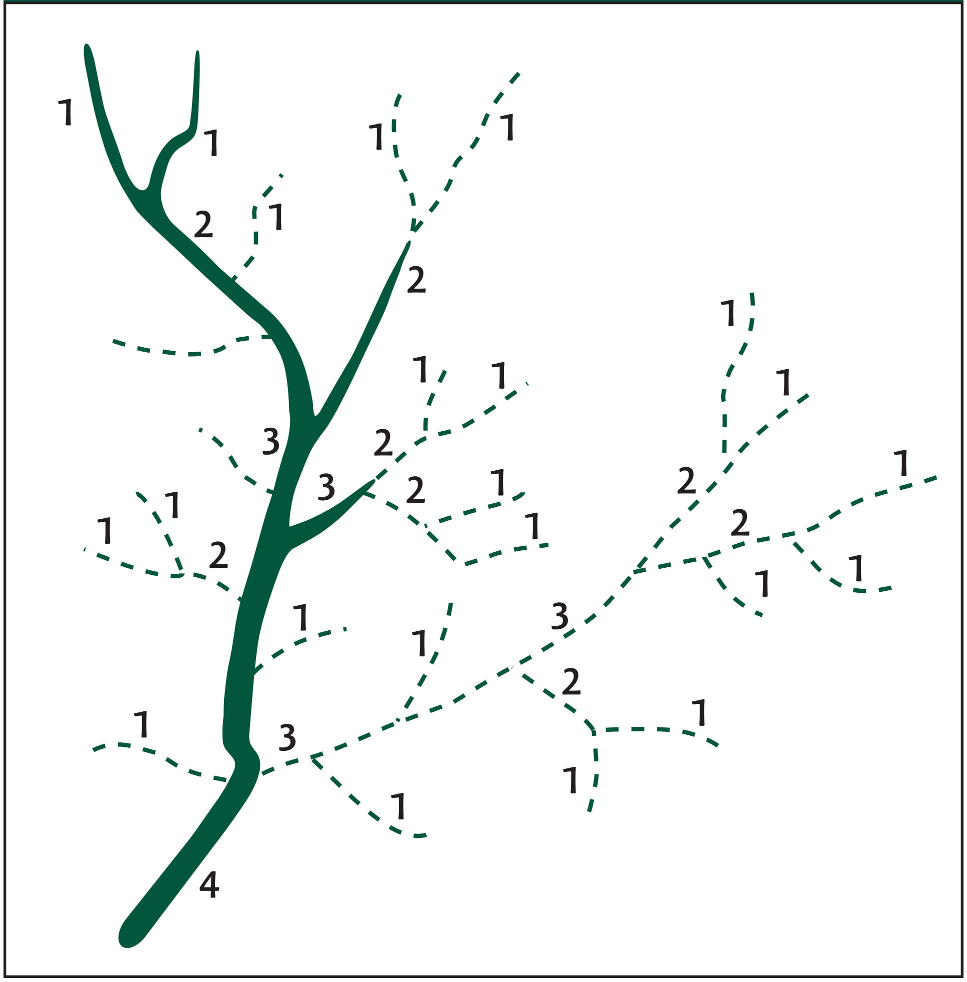
Other reliable mapping resources:

Stream Buffer Characterization Data and Maps; town specific maps that assess 150 and 300 buffer areas.
Online: www.nhep.unh.edu/resources/actions.htm

Buffer Data Mapper; demonstrates the land area impact of various buffer widths.
Online: http://mapper.granit.unh.edu/viewer.htm

2. **Certification of Official Shoreland Zoning Map.** The Official Shoreland Zoning Map shall be certified by signature of the municipal clerk and shall be located in the municipal planning office. In the event the municipality does not have a planning office, the municipal clerk shall be the custodian of the map.

Figure 2.6.2 Fourth Order Rivers: The Strahler Method



3. **Changes to the Official Shoreland Zoning Map.** If amendments are made to the Shoreland Protection District or other matters portrayed on the Official Shoreland Zoning Map, such changes shall be made on the map within 30 days after the amendment has been adopted by the municipality.

V. DISTRICT BOUNDARIES

A. **Definition of District Boundaries.** The district boundaries of the Shoreland Protection District shall encompass all land within a horizontal distance of 150 feet of the reference line of any 1st and 2nd order stream, and 250 feet of the reference line of any 3rd and 4th order stream and higher, lake, pond or coastal estuary as defined by this Ordinance.

B. **Interpretation of District Boundaries.** Where uncertainty exists as to the exact location of district boundary lines, the city/town code enforcement officer with the assistance of the N.H. Department of Environmental Services (DES) shall be the final authority as to boundary locations.

Municipalities are encouraged to incorporate specific written descriptions of district boundaries into this Ordinance so that disputes over boundaries are minimized. The Official Shoreland Zoning Map is only one of the primary tools in determining district boundaries. Other tools include actual field verification of the reference line. This is where the assistance of DES will be the most useful.

VI. DEFINITIONS

Accessory Structure or Use: A use or structure located on the same lot and customarily incidental and subordinate to the primary structure, including but not limited to paths, driveways, patios, any other improved surface, pump houses, gazebos, woodsheds, garages, or other outbuildings. A deck or similar extension of the primary structure or a garage attached to the primary structure by a roof or a common wall is considered part of the primary structure.

Base flow: The groundwater contribution to stream flow arising from submerged springs and seeps.

Beaver Impoundment: An area this is generally inundated most of the year as a result of flowing water impounded by a beaver dam. Beaver impoundments and the meadows that develop when the dams are not kept up and deteriorate are generally considered wetlands.

Best Management Practices (BMPs): A proven or accepted structural, non-structural, or vegetative measure the application of which reduces erosion or sedimentation, stabilizes stream channels, or reduces peak storm discharge, or improves the quality of stormwater runoff, or diminishes the quantity of stormwater runoff flowing to a single location by using multiple BMPs at separate and dispersed locations. BMPs also include construction site maintenance measures such as removing construction debris and construction waste from construction sites and disposing of debris and waste appropriately in order to reduce contamination of stormwater runoff.

Boat Slip: On water bodies over 10,000 acres, means a volume of water 25 feet long, 8 feet wide, and 3 feet deep as measured at normal high water and located adjacent to a structure to which a watercraft may be secured. On water bodies of 10,000 acres or less, a volume of water 20 feet long, 6 feet wide, and 3 feet deep as measured at normal high water mark and located adjacent to a structure to which a watercraft may be secured (RSA 482-A:2 VIII.).

Buffer: A vegetated area, including trees, shrubs and herbaceous vegetation, which exists or is established to protect a stream, river, lake, pond, reservoir, or coastal estuarine area.

Canopy: The more or less continuous vegetative cover formed by tree crowns in a wooded area.

Disturbed Area: An area in which natural vegetation is removed, exposing the underlying soil.

Ephemeral Stream: A drainage feature that carries only stormwater in direct response to precipitation with water flowing only during and shortly after large precipitation events. An ephemeral stream may or may not have a well defined channel, the aquatic bed is always above the water table, and stormwater runoff is the primary source of water. An ephemeral stream typically lacks the biological, hydrological, and physical characteristics commonly associated with the continuous or intermittent conveyance of water.

Estuaries: A tidal wetland whose vegetation, hydrology or soils are influenced by periodic inundation of tidal waters.

Farm Pond: A small, shallow (3-14 foot) artificial impoundment maintained for private recreational use, such as fishing or swimming, or to provide water for livestock, irrigation, or other agricultural uses. Such ponds may be addressed as part of an approved USDA Natural Resources Conservation Service conservation plan and as such do not need to be protected by this Ordinance.

Fire Pond: A small, naturally-occurring or artificially constructed water body designated and maintained for the purpose of providing water for fire suppression, characterized by large-vehicle access to the water's edge throughout the year and/or the presence of a dry hydrant. Typically such ponds have been identified or designated by the municipality's fire department as a fire pond.

First Order Streams: Are intermittent and perennial streams identified as either dashed lines or solid lines on the New Hampshire Hydrography Dataset (NHHD) or the most recent edition of USGS topographic maps, where mapped.

Forest Management: The application of scientific and economic principles to conserve forest resources and obtain forest benefits.

Great Pond: All natural bodies of fresh water situated entirely in the state having an area of 10 acres or more are state-owned public waters, and are held in trust by the state for public use; and no corporation or individual shall have or exercise in any such body of water any rights or privileges not common to all citizens of this state; provided, however, the state retains its existing jurisdiction over those bodies of water located on the borders of the state over which it has exercised such jurisdiction (RSA 271:20).

Ground Cover: Any herbaceous or woody plant which normally grows to a mature height of two feet or less, especially mat forming vegetation which stabilizes the soil.

Defining "First Order Streams" is perhaps the most difficult issue in developing this ordinance. This model ordinance defines first order streams as both intermittent and perennial streams because these streams are the most important headwater streams within a watershed. However, municipalities may elect to limit the application of this ordinance to "perennial" streams only. To accomplish this, intermittent streams would need to be excluded from the definition of first order streams. This would require revisions to the NHHD database, because intermittent streams are currently identified as first order streams in this database.

Headwater Streams: Intermittent streams and perennial streams of first and second order.

Impervious Surface: Any areas covered by material that impedes the infiltration of water into the soil. Examples of impervious surfaces include buildings, roofs, decks, patios, and paved, gravel, or crushed stone driveways, parking areas, and walkways.

Intermittent Streams: A well-defined channel that contains water for only part of the year, typically during winter and spring when the aquatic bed is below the water table. The flow may be heavily supplemented by stormwater runoff. An intermittent stream often lacks the biological and hydrological characteristics commonly associated with the conveyance of water. Intermittent streams (or portions thereof) are portrayed as dashed blue lines on a USGS topographic map, where mapped).

Lake: A natural or impounded inland body of fresh water. May also be called a pond or great pond. The terms lakes and ponds are commonly used interchangeably, however, a lake can be distinguished from a pond because a lake contains a thermocline layer while a pond does not.

Lot of Record: A legally created parcel, the plat (keep "or" here in case there is only a recorded metes and bounds description) description of which has been recorded at the registry of deeds for the county in which it is located.

Marina: A commercial waterfront facility whose principal use is the provision of public services such as the securing, launching, storing, fueling, servicing, repairing and sales of watercraft equipment and accessories.

Natural Vegetation: All existing live woody and herbaceous trees, shrubs, and other plants.

Natural Woodland Buffer: Is defined in the CSPA, RSA 483-B as a forested area consisting of various species of trees, saplings, shrubs, and ground covers in any combination and at any stage of growth.

Non-Conforming Lot: A single lot of record which, at the effective date of adoption or amendment of this Ordinance, does not meet the dimensional requirements of the district in which it is located.

Non-Conforming Structure: A structure which does not meet any one or more of the following dimensional requirements; setback, height, or lot coverage, but which is allowed solely because it was in lawful existence at the time this Ordinance or subsequent amendments take effect.

Non-Conforming Use: Use of buildings, structures, premises, land or parts therefore which is not permitted in the district in which it is situated, but which is allowed to remain solely because it was in lawful existence at the time this Ordinance or subsequent amendments take effect.

Mean High Water Level: See Reference Line definition.

Ordinary High Water Mark: Means the line on the shore, running parallel to the main stem of the river or stream, established by the fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the immediate bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas.

Perennial Streams: A stream that normally flows year round because it is sustained by groundwater discharge as well as by surface water. A perennial stream exhibits the typical biological, hydrological, and physical characteristics commonly associated with the continuous conveyance of water. Perennial streams (or portions thereof) are portrayed as solid blue lines on a USGS topographic map, where mapped.

Pond: Means a natural or impounded still body of water. The term is often used conterminously with "lake."

Primary Structure: A structure built for the support, shelter or enclosure of persons, animals, goods, or property of any kind, as well, as anything constructed or erected with a fixed location on or in the ground, exclusive of fences. The primary structure is central to the fundamental use of the property and is not accessory to the use of another structure on the same premises.

Protected Shorelands: The area subject to this Ordinance.

Public Waters: See CSPA, RSA 483-B:4, Definitions.

Reference Line: Defined in the CSPA, RSA 483-B and under this Ordinance as follows:

a. for natural fresh water bodies without artificial impoundments, the natural mean high water level as determined by the NH Department of Environmental Services;

b. for artificially impounded fresh water bodies with established flowage rights, the limit of the flowage rights, and for water bodies without established flowage rights, the waterline at full pond as determined by the elevation of the spillway crest;

c. for coastal waters, the highest observable tide line, which means a line defining the furthest landward limit of tidal flow, not including storm events, recognized by indicators such as the presence of a strand line of flotsam and debris, the landward margin of salt tolerant vegetation, or a physical barrier that blocks further flow of the tide;

d. for third and fourth order and higher rivers and streams, the ordinary high water mark; and

e. for first and second order streams, the extent of the defined channel.

Removal or Removed: Cut, sawed, pruned, girdled, felled, pushed over, buried, burned or otherwise destructively altered.

Riparian Area: The area of land adjacent to the shoreline or bank of a stream, river, pond, lake, bay, estuary, or other similar body of water.

Riparian Buffer: See Buffer definition.

Sapling: A young tree less than four inches (9.75 cm) in diameter (dbh) and less than 20 feet in height

Selected Clearing and Landscape Plan: A site plan drawn to scale depicting the lot boundaries, shoreland protection district boundaries, shoreline, reference line, all impervious surfaces, structures, septic and well systems, setback requirements, proposed view corridor, and existing and proposed trees and vegetation.

Setback: Horizontal distance from the reference line of a water body to the nearest part of a structure, road, parking space or other regulated object or area.

Shoreland: The area of land adjacent to the reference line of a stream, river, pond, lake, bay, estuary, or other similar body of water.

Shoreland Frontage: The average of the distances of the actual natural shoreline frontage and a straight line drawn between the property lines (RSA 483-B:4, Definitions).

Shoreline: The intersection of a specified plane of water with the beach or bank. It migrates with changes of the water level.

Shrub: A woody perennial, smaller than a tree, usually branching from the base with several main stems.

Stream ordering is a widely applied method for classifying streams. Its use in classification is based on the premise that the order number has some relationship to the size of the contributing area, to channel dimensions and to stream discharge (Strahler 1964). The most common method used in stream ordering is based on the Strahler Method. This method is applied by DES and GRANIT in classifying streams within the New Hampshire Hydrologic dataset. For more information about the Strahler Method, refer to Strahler, A.N., 1964. Part II. Quantitative geomorphology of drainage basins and channel networks, pp. 4-39 to 4-76. Chow, ed. Handbook of Applied Hydrology, McGraw-Hill, New York.

Stream Order: A classification system for streams based on stream hierarchy. The smaller the stream, the lower its numerical classification. For example, a first order stream does not have tributaries and normally originates from springs or seeps. At the confluence of two first order streams, a second order stream begins and at the confluence of two second order streams, a third order stream begins, et.seq.

Stream or River: A free-flowing body of water or segment or tributary of such water body (RSA 483:4, XVII.).

Structure: Anything built for the support, shelter or enclosure of persons, animals, goods or property of any kind, together with anything constructed or erected with a fixed location on or in the ground, exclusive of fences, and poles, wiring and other aerial equipment normally associated with service drops as well as guying and guy anchors. The term includes structures temporarily or permanently located, such as decks, patios, and satellite dishes.

Stormwater or Surface Water Runoff: Water that flows over the surface of the land as a result of rainfall or snow-melt. Surface water enters streams and rivers to become channelized stream flow.

Stormwater Management Plan: An analysis and plan designed in accordance with rules adopted by the DES under RSA 541-A for terrain alteration under RSA 485-A:17, to manage stormwater and control erosion and sediment, during and after construction.

Surface Waters: Those portions of waters of the state as defined by RSA 482-A:4, which have standing water or flowing water at or on the surface of the ground. This includes but is not limited to rivers, streams, lakes, ponds and tidal waters (Env-Wt 101.88).

Timber Harvesting: The cutting and removal of timber for the primary purpose of selling or processing forest products.

Tree: A woody perennial having a main stem.

USGS (United States Geological Survey) topographic map: A map that uses contour lines to represent the three-dimensional features of a landscape on a two-dimensional surface. Map scale: 1:24,000.

Water Body: Any pond, lake, river or stream.

Water Dependent Use or Structure: A use or structure that services and supports activities that require direct access to, or contact with the water, or both, as an operational necessity and that requires a permit under RSA 482-A, including but not limited to a dock, pier, breakwater, beach, boathouse, retaining wall, or launching ramp. Hydroelectric facilities, including, but not limited to, dams, dikes, penstocks, and powerhouses, shall be recognized as water dependent structures, however, these uses are exempt from the requirements of this Ordinance.

Wetlands: areas inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas (RSA 482-A:2).

VII. SHORELAND PROTECTION DISTRICT REGULATIONS

A. **Prohibited Water Pollution Hazards, Uses, Structures and Activities**

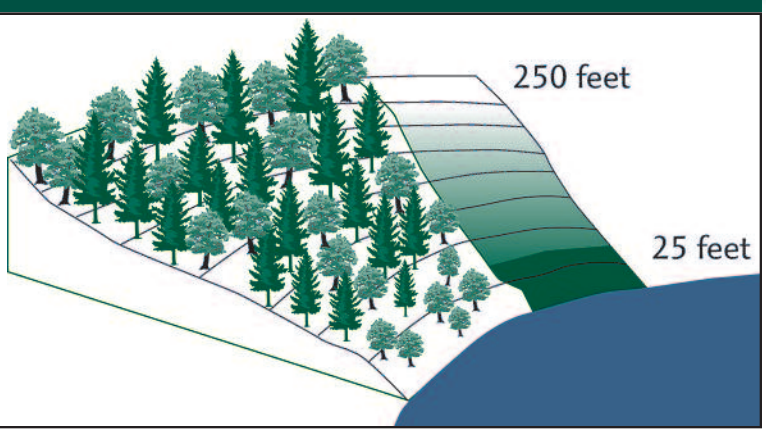
The following uses, structures and activities are prohibited within the Shoreland Protection District:

1. Establishment or expansion of salt storage yards, automobile junk yards and solid or hazardous waste facilities.
2. Establishment or expansion, dry cleaning establishments and automobile service/repair shops.
3. Laundry/car wash establishments not on municipal or public sewer.
4. Subsurface disposal of pollutants from sewage treatment facilities, other than on-site septic systems.
5. Storage of hazardous substances, including the use of road salt, de-icing chemicals, herbicides, pesticides, or fertilizer, (except limestone) within 50 feet of the reference line of any property. Fifty feet beyond the reference line, low phosphate, slow release nitrogen fertilizer or limestone may be used on areas that are already vegetated.
6. Bulk or temporary storage of chemicals above or below ground.

The following shoreland protection regulations are modeled after specific provisions of the CSPA (RSA 483-B) as applicable, the recommendations contained within the Final Report of the Commission to Review the Effectiveness of the CSPA, as well as the NH DES Model Rule for the Protection of Water Supply Watersheds. Some noted key provisions include a 25 foot setback for primary structures from the reference line of first and second order streams, a 50 foot setback for all other water bodies, a maximum impervious surface requirement of 20% of the lot area located within the shoreland protection district, and Conditional Use Permit requirements for water-dependent uses and structures. The riparian buffer requirements included within this ordinance are modeled after the three-stage riparian buffer design and buffer model ordinance favored by the journal Watershed Protection Techniques and developed by the Center for Watershed Protection, Elliot City, Maryland.

FIGURE 2.6.3 Fertilizer and Pesticide Restrictions

- No fertilizer or pesticide within 25' of the reference line.
- From 25 to 250 feet only low phosphate, slow release nitrogen.



Source: N.H. Department of Environmental Services

7. Bulk or temporary storage of petroleum products or hazardous materials above or below ground, excluding normal residential or business use of liquid petroleum products and heating fuels for on-premise use.

8. Sand and gravel excavations as defined in RSA 155-E.

9. Mining or the processing of excavated materials.

10. Any use or activity not expressly permitted.

B. **Permitted Uses, Structures and Activities**

All necessary state and local approvals and permits shall be obtained prior to the commencement of any activity within the Shoreland Protection District. The following uses, structures and activities are permitted within the Shoreland Protection District, subject to state and local approval:

Under the CSPA, development within the protected shoreland requires a permit from the Department of Environmental Services.

1. All permitted uses allowed within the municipality's underlying zoning district(s), except those uses expressly prohibited as listed above.

2. All primary structures shall be setback a minimum distance of 25 feet from the reference line of all first and second order streams , 50 feet of all third order and higher streams, lakes, ponds, and coastal estuaries as required by the CSPA.

3. All accessory structures shall be setback a minimum distance of 25 feet from the reference line of all streams, lakes, ponds and coastal estuaries.

4. Water-dependent structures, or any part thereof, built over, on or within adjacent public waters subject to the jurisdiction of RSA 483-B 9.2 c.shall be constructed only as approved by the DES, pursuant to RSA 482-A. All water-dependent uses or structures or parts thereof, built over, on or within the adjacent waters subject to this Ordinance shall be required to obtain a Conditional Use Permit from the planning board of the municipality in accordance with the requirements of subsection c) Conditional Uses below.

5. Other permitted uses within the Shoreland Protection District, subject to necessary local and state approval, include the following:

   a. Public water supply facilities, including water supply intakes, pipes, water treatment facilities, pump stations and disinfectant stations;

   b. Public water and sewage treatment facilities;

   c. Hydroelectric facilities, including, but not limited to dams, dikes, penstocks and powerhouses;

   d. Public utility lines and associated structures and facilities;

   e. Existing solid waste facilities, including the construction of accessory structures and other activities consistent with the operation of the facility and its solid waste permit, including filling, grading and installing monitoring wells and other drainage structures;

   f. Flood control structures; and,

   g. Public roads and public access facilities, including boat ramps.

C. **Conditional Uses**

The following Conditional Uses are permitted within the Shoreland Protection District, subject to all applicable local, state and federal regulations:

1. Marinas developed in accordance with the following requirements:

    a. Minimum shoreland frontage shall be 300 feet with an additional 25 feet of shoreland frontage per boat slip.

    b. Off street parking shall be provided at a rate of 500 square feet per boat slip.

    c. Submission of an environmental impact study including measures to mitigate potential negative impact on the adjacent waters, including but not limited to:

        i. Measures to prevent leakage or spills of fuels, lubricants, wastewater and other potential pollutants into the public waters;

        ii. Assurances that impact on wetlands and other related sensitive areas have been avoided.

    d. Submission of a site plan, that is consistent with local regulations, for review by the planning board which includes locations of rest rooms, buildings, parking areas and all related support facilities with assurances that these facilities shall be permanently available to the project.

    e. Receipt of a wetland permit from DES.

2. Water dependent uses and structures including, but not limited to, docks, wharves, boat ramps, etc. All water dependent uses and structures shall be approved as a Conditional Use Permit in accordance with the following requirements:

    a. The use is in keeping with the purpose and intent of this Ordinance.

    b. The least impacting route and methodology for the use have been selected as the best practicable alternative.

    c. Canopies and seasonal covers extend only over the boat slips and shall be removed during the non boating season.

D. **Minimum Lot Requirements**

1. The minimum size for new lots in areas dependent upon on-site subsurface wastewater systems shall be determined by either the municipality's underlying zoning district requirements or the soil type lot size determinations, as established by the DES under RSA 485-A and rules adopted to implement it.

2. The total number of residential units in the protected shoreland district, whether built on individual lots or grouped as cluster or condominium development, shall not exceed:

a. one unit per 150 feet of shoreland frontage; or

b. for any lot that does not have direct frontage, one unit per 150 feet of lot width as measured parallel to the shoreland frontage that lies between the lot and the reference line.

3. The total constructed, impervious surface area within any lot shall not exceed 20 percent of the area of the lot located within the shoreland protection district. In instances when the existing tree cover has been depleted, 25 percent impervious coverage may be granted in exchange for additional native tree and shrub planting within 50 feet of the reference line. This should be enforced through a deed restriction whereby the property owner agrees not to cut after the trees are planted.

E. **Subsurface Wastewater Disposal Facilities**
All new lots, including those in excess of five acres, any portion of which is located within the Shoreland Protection District, shall require subdivision approval by the DES Water Division, Subsurface Systems Bureau pursuant to RSA 485-A:29. All subsurface wastewater disposal facilities shall be in compliance with RSA 485-A:29 and 483-B.

F. **Erosion and Siltation**

1. New structures and all modifications to existing structures within the Shoreland Protection District shall be designed, constructed and maintained to prevent the release of surface runoff across exposed mineral soils.

2. All earth moving or excavation activities on lots greater than 1 acre in size either partially or wholly within the Shoreland Protection District, including the construction of new structures and modifications to existing structures shall be conducted in accordance with a stormwater management plan approved by the municipality's planning board. Such plan shall be designed in accordance with rules adopted by the DES under RSA 541-A for terrain alteration under RSA 485-A:17, to manage stormwater and control erosion and sediment, during and after construction. All erosion control measures shall be implemented before any earth disturbance occurs.

3. In new developments, on-site and non-structural stormwater management alternatives shall be preferred over larger facilities within the riparian buffer.

4. When constructing stormwater management facilities (i.e. BMPs), the area cleared shall be limited to the area required for construction, and adequate maintenance access only.

5. A permit under RSA 485-A:17, I. shall be required for developed, or subdivided land whenever there is a contiguous disturbed area exceeding 50,000 square feet that is either partially or wholly within the Shoreland Protection District.

G. **Riparian Buffer Requirements**

Riparian Buffer: Within the Shoreland Protection District, a riparian buffer of natural vegetation and trees shall be maintained or established within 75 feet of the reference line of all first and second order streams, and 150 feet of

The riparian buffer standards included in this ordinance are based upon the Center for Watershed Protection's Buffer Model Ordinance and as such these standards present the best technical guidance available to create and protect the most effective riparian buffers possible.

Also included are appropriate buffer standards from New Hampshire's CSPA and the Commission's recommendations where applicable. Municipalities should use these standards as a guide to adopt the most appropriate buffer requirements for their community considering such factors as existing site conditions, ease of enforcement, public acceptance, and the sensitivity and vulnerability of the water body to be regulated.

Municipalities are also encouraged to include a reference to these standards in their site plan and subdivision regulations and to add a checklist item or requirement that the location of all streams and water bodies be surveyed and accurately shown on site plans and subdivisions.

the reference line of all third and fourth and higher order streams, lakes, ponds and coastal estuaries. This riparian buffer is similar in terminology to the Natural Woodland Buffer under the CSPA.

To address areas containing steep slopes, the following formula recommended by the Center for Watershed Protection should be used to expand the riparian buffer widths as noted:

Percent Slope*	Width of Buffer
15%-17%	add 10 feet
18%-20%	add 30 feet
21%-23%	add 50 feet
> 24%	add 60 feet

*Percent slope shall be based on an average of the overall slope dividing the average vertical distance of the slope into the overall horizontal distance of the slope.

Source: Southern New Hampshire Planning Commission. Adapted from Center for Watershed Protection

Within the riparian buffer, the following management zones shall be maintained.

1. **Waterfront Zone:** The waterfront zone is located closest to the water's edge and serves to protect the physical and ecological integrity of the shoreland. This zone must be maintained in a natural state although a view corridor and a maximum 6 ft wide path to the water's edge may be established in accordance with an approved Selected Clearing and Landscape Plan. This zone extends a minimum distance of 25 feet from the reference line for 1st and 2nd order streams and a minimum distance of 50 feet from the reference line for all other water bodies. Allowable uses within the waterfront zone are restricted to flood control structures, utility rights of way, footpaths, road crossings such as bridges and culverts as required and water-dependent structures and uses where permitted under Section VII. b. and c. of this ordinance. Target sediment and pollutant removal rates are to be within 50 percent and 60 percent.

A minimum fixed buffer width of 10 meters or 33 feet is documented in the scientific literature as providing approximately 60 percent or greater sediment and pollutant removal while minimally protecting the adjacent water body (Source: Center for Watershed Protection).

Examples of Selective Clearing and Landscape Plans can be found in the following resources: *Vegetated Riparian Buffers and Buffer Ordinances,* Figure 2, pg. 12 and *Environmental Land Use Planning and Management,* John Randolph, Island Press, Figure 14.3, pg. 446, 2004.

Within the Waterfront Zone, the following additional prohibitions and limitations apply:

a. No mechanized logging, no clear cutting of trees, and no cutting or removal of vegetation and natural ground cover (including the duff layer) below 3 feet in height shall be permitted, except as provided by an approved Selected Clearing and Landscape Plan.

b. Restricted tree care involving the removal of dead, diseased, unsafe, or fallen trees, saplings, shrubs is permitted. All stumps and their root systems, stones, and duff shall be left intact in or on the ground.

c. A view corridor and path to the water's edge may be established in accordance with a Selected Clearing and Landscape Plan submitted to and approved by the planning board of the municipality. This plan shall include photographic documentation of the pre-existing riparian buffer. The view corridor shall not exceed 75 feet in width or one-third the width of the shoreline frontage, whichever is less. View corridors must also be in compliance with the CSPA, Natural Woodland Buffer requirements, RSA 483-B.

d. Preservation of dead and living trees that provide dens and nesting places for wildlife is encouraged.

e. Planting and reforesting efforts to restore native vegetation within this zone is encouraged.

2. **Middle Zone:** The middle zone begins at the outer edge of the waterfront zone extending out a minimum fixed distance of 25 feet for 1st and 2nd order streams and a minimum distance of 50 feet for all other water bodies. The overall width of the middle zone can vary depending upon stream order and slope. Target sediment and pollutant removal rates are to be within 60 to 70 percent. Forest management and limited tree clearing and removal are allowed within the middle zone as well as limited recreational uses, stormwater BMPs, paths, and other similar uses as permitted under Section VII. b. and c. of this ordinance. However, a minimum of 50 percent of the tree canopy within this zone shall remain in an undisturbed state. Overall tree canopy shall be managed through a Selective Clearing and Landscape Plan.

Within the middle zone, the following additional prohibitions and limitations apply:

a. Impervious surfaces on the portion of the lot within the shoreland protection district shall be limited to 20 percent subject to Section D. 3. of this ordinance.

b. No mechanized logging or clear cutting of trees and vegetation shall be permitted.

c. Limited tree removal and clearing, tree pruning, including the removal of dead, diseased, unsafe, or fallen trees, saplings, shrubs is permitted. All stumps and their root systems shall be left intact in the ground.

d. Fifty percent of this zone should remain in an undisturbed state.

A minimum fixed buffer width of 15 meters or 50 feet is documented in the scientific literature as providing greater than 60 percent sediment and pollutant removal while providing minimal general wildlife and avian habitat value. (Source: Center for Watershed Protection).

e. A view corridor and path to the water's edge may be established in accordance with a **Selected Clearing and Landscape Plan** approved by the planning board of the municipality. No more than 50 percent of the tree canopy within this zone may be removed as shown on the **Selected Clearing and Landscape Plan.**

f. Preservation of dead and living trees that provide dens and nesting places for wildlife is encouraged.

g. Planting and reforesting efforts to restore the native vegetation within this zone is encouraged.

3. **Outer Zone:** The function of the outer zone is to prevent encroachment into the inner and middle zones of the riparian buffer and to filter runoff from adjacent residential and commercial development. The outer zone begins at the outer edge of the middle zone extending out a minimum distance of **25 feet** for 1st and 2nd order streams and-a minimum distance of **50 feet** for all other water bodies. Target sediment and pollutant removal rates are to be within 70 to 90 percent.

A minimum fixed buffer width of 20 meters or 66 feet is documented in the scientific literature as providing 70% or greater sediment and pollutant removal while providing minimal general wildlife and avian habitat value. (Source: Center for Watershed Protection).

Within the outer zone, the following additional prohibitions and limitations apply:

a. Tree removal and clearing, tree pruning, including the removal of dead, diseased, unsafe, or fallen trees, saplings, shrubs is permitted in accordance with a Selected Clearing and Landscape Plan approved by the planning board of the municipality.

b. No more than 50 percent of the tree canopy within this zone may be removed as shown on the Selected Clearing and Landscape Plan.

c. Preservation of dead and living trees that provide dens and nesting places for wildlife is encouraged.

d. Planting and reforesting efforts to restore the natural vegetation within this zone is encouraged.

e. Impervious surfaces on the portion of the lot within the shoreland protection district shall be limited to 20 percent subject to Section D. 3. of this ordinance.

VIII. NON-CONFORMING LOTS, USES AND STRUCTURES

A. **General Purpose:** It is the intent of this Ordinance to promote the conforming use of land located within the Shoreland Protection District, except that non-conforming lots, structures and uses that existed before the effective date of this Ordinance or amendments thereto shall be allowed to continue, subject to the requirements as set forth in this section. Except as otherwise provided in this Ordinance, a non-conforming lot, use or structure shall not be permitted to become more non-conforming.

B. **Non-conforming Lots:** Non-conforming, undeveloped lots of record that are located within the Shoreland Protection District shall comply with the following restrictions, in addition to any other requirements of the municipality's zoning ordinance:

1. Except when otherwise prohibited by law, present and successive owners of an individual undeveloped lot may construct building or structure on it, notwithstanding the provisions of this Ordinance.
2. Conditions may be imposed which, in the opinion of the municipality's zoning board of adjustment as appropriate, more nearly meet the intent of this Ordinance, while still accommodating the applicant's rights.
3. Building on non-conforming lots of record also include but not limited to docks, piers, boathouses, boat loading ramps, walkways, and other water dependent structures, consistent with this Ordinance.

C. **Non-conforming Uses:** Existing uses which are non-conforming under this ordinance may continue until the use ceases to exist or the use is discontinued for a period of one year. An existing non-conforming use may not be changed to another non-conforming use; existing non-conforming uses shall be required to meet the requirements of this ordinance to the maximum extent possible.

D. **Non-conforming Structures:** Except as otherwise prohibited, non-conforming structures, erected prior to the effective date of this Ordinance or amendments thereto, located within the Shoreland Protection District may be repaired, renovated, or replaced in kind using modern technologies, provided the result is a functionally equivalent use. Such repair or replacement may alter the interior design or existing foundation, but no expansion of the existing footprint or outside dimensions shall be permitted. An expansion that increases the sewage load to an on-site septic system, or changes or expands the use of a septic system or converts a structure to condominiums or any other project identified under RSA 485-A:29-44 and rules adopted to implement it shall require DES approval. Between the primary building line and the reference line as shown on the following figure, no alteration shall extend the structure closer to the adjacent water body, except that the addition of a deck is permitted up to a maximum of 12 feet towards the reference line.

IX. RIPARIAN BUFFER MANAGEMENT, MAINTENANCE AND INSPECTION

These buffer markers should be designed and sold by the conservation commission of the municipality to property owners. Examples of tree markers can be obtained from the Town of Bow, N.H. and are shown in the Wetlands Protection chapter. Installation and cost of the markers should be the responsibility of the property owner.

A. It shall be the responsibility of every property owner within the Shoreland Protection District to manage and maintain the vegetation and natural conditions existing within the riparian buffer located on their property. Management includes specific limitations on the alteration of the natural conditions of these resources as specified by this Ordinance. To help property owners assume this responsibility, it shall be the duty of every property owner to secure and install markers every 50 feet on trees depicting the location of the riparian buffer on their property.

B. It shall be the responsibility of the planning board of the municipality to ensure that all plats and rights of way, prepared for recording, and site plans adopted by the planning board clearly:

1. show the extent of the riparian buffer on the subject property by metes and bounds;

2. label the riparian buffer, building setbacks as well as the inner core, middle core and outer core zones of the riparian buffer;

3. provide a note to reference the riparian buffer stating: "There shall be no clearing, grading, construction or disturbance of vegetation except as permitted by the planning board of the municipality"; and

4. provide a note to reference any protective covenants governing the riparian buffer area stating: "Any riparian buffer shown hereon is subject to protective covenants which may be found in the land records and which restrict disturbance and use of these areas.

C. It shall be the responsibility of the planning board of the municipality through aerial photography to inspect the integrity of the riparian buffer both annually and immediately following severe storms for evidence of sediment deposition, erosion, or concentrated flow channels and corrective actions taken to ensure the integrity and functions of the riparian buffer.

Procedures for conducting these inspections should be developed by the planning board and the municipality. This should also include obtaining photographic documentation of the integrity of the riparian buffer as part of the review and approval of stormwater management or selective clearing and landscape plans.

X. EXCEPTIONS

The following land uses are exempt from the provisions of this Ordinance:

A. Forest management not associated with shoreland development or land conversion, and conducted in compliance with RSA 227-J:9.

B. Forestry involving water supply reservoir watershed management.

C. Agriculture activities and operations as defined in RSA 21:34-a. (except animal feedlots) provided such activities and operations are conducted in accordance with best management practices (BMPs).

D. Temporary stream, stream bank, and other vegetation restoration projects, the goal of which is to restore the shoreline and riparian buffer to an ecologically healthy state.

E. Wildlife and fisheries management activities consistent with the State Wildlife Action Plan and applicable state laws.

F. The creation of foot path(s) to the water in accordance with an approved selective clearing and landscape plan and the construction of perched sandy beaches in accordance with a wetland permit issued by DES.

G. Other uses permitted by the DES or under Section 404 of the Clean Water Act. Notwithstanding the above, all except uses, structures or activities shall comply with all applicable best management practices and shall not diminish water quality as defined by the Clean Water Act. All excepted uses shall be located as far from the reference line as reasonably possible.

SUMMARY OF MODEL ORDINANCE

SHORELAND PROTECTION DISTRICT AND RIPARIAN BUFFER STANDARDS

SHORELAND PROTECTION DISTRICT

- **150** ft. for 1st and 2nd order streams and **250** ft. for all other water bodies.
- Establishment/expansion of salt storage yards, auto junk yards, solid waste and hazardous waste facilities, animal feedlot operations, dry cleaning establishments, automobile service/repair shops, laundry/car wash establishments not on municipal water or sewer, disposal or land application of biosolids, including septage, sewage sludge and animal manure are prohibited.
- Subsurface disposal of pollutants from sewage treatment facilities, other than on-site septic systems, storage or hazardous substances, including the use of road salt and de-icing chemicals are prohibited.
- Bulk or temporary storage of chemicals above or below ground, bulk or temporary storage of petroleum products or hazardous materials above or below ground, excluding normal residential or business use of liquid petroleum products and heating fuels for on-premise use are prohibited.
- Sand and gravel excavations as defined in RSA 155-E, mining or the processing of excavated materials, and any other use or activity not expressly permitted.
- No fertilizer, except limestone between the reference line and 50 feet. From 50 ft. landward of the reference line to 250 ft. only low phosphate, slow release nitrogen fertilizer may be used.

Impervious Surface Area Limitations:

- Total constructed, impervious surface area is limited to 20% of a lot either partially or wholly located within the shoreland protection district. This may be increased to 25% in exchange for additional native tree and shrub planting within 50 ft. of the reference line through a deed restriction.

Stormwater Management:

- All earth moving or excavation activities on lots greater than 1 acre in size either partially or wholly within the shoreland protection district, including the construction of new structures and modifications to existing structures must be conducted in accordance with an approved stormwater management plan per NH DES specifications under RSA 541-A for terrain alteration and RSA 485-A:17 to manage stormwater and control erosion and sediment, during and after construction.
- A permit is also required under RSA 485-A:17, I. for developed, or subdivided land whenever there is a contiguous disturbed area exceeding 50,000 square feet that is partially or wholly within the shoreland protection district.

RIPARIAN BUFFER STANDARDS

- **Waterfront Zone:** 25 ft. from reference line for 1st and 2nd order streams and 50 ft. for all other water bodies. The Waterfront Buffer must be maintained in a natural state, although a view corridor and path to the water's edge may be established in accord with an approved Selected.
- **Clearing and Landscape Plan.** No mechanized logging, no clear cutting of trees, and no cutting or removal of vegetation and natural ground cover (including the duff layer) below 3 feet in height is allowed, except as provided by this plan. Restricted tree care involving the removal of dead, diseased, unsafe, or fallen trees, saplings, shrubs is permitted. All stumps and their root systems, stones and duff shall be left intact in or on the ground.
- **Middle Core:** 25 ft. from reference line for 1st and 2nd order streams and 50 ft. for all other water bodies. Forest management and limited tree clearing and removal are allowed. No more than 50% of the tree canopy within this zone can be removed. Overall tree coverage is managed through a Selected Clearing and Landscape Plan.
- **Outer Core:** 25 ft. from the reference line for 1st and 2nd order streams and 50 ft. for all other water bodies. No more than 50% of the tree canopy within this zone may be removed. Tree removal and clearing, tree pruning, including the removal of dead, diseased, unsafe, or fallen trees, saplings, shrubs is permitted.
- **Selected Clearing and Landscape Plan:** This plan is required in order to establish a view corridor and path to the water's edge as well as document the pre-existing riparian buffer conditions on the lot. The view corridor shall not exceed 75 feet in width or one-third the width of the shoreline frontage, whichever is less. View corridors must also be in compliance with the CSPA, Natural Woodland Buffer requirements per RSA 483-B.

PRIMARY BUILDING LINE

- Primary structures must be set back at least **25** ft. from the reference line for 1st and 2nd order streams and **50** ft. for all other water bodies.

ACCESSORY STRUCTURES

- Accessory structures must be setback at least **25** feet from the reference line.

REFERENCE LINE

- For coastal waters = highest observable tide line
- For rivers = ordinary high water mark
- For natural fresh water bodies = natural mean high water level
- For artificially impounded fresh water bodies – water line at full pond

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2.8 Erosion and Sediment Control During Construction

RELATED TOOLS:

- Shoreland Protection
- Permanent (Post Construction) Stormwater Management
- Steep Slope and Ridgeline Protection

BACKGROUND AND PURPOSE

The development process typically involves the removal of vegetation, the alteration of topography, and the covering of previously vegetated surfaces with impervious cover such as roads, driveways, and buildings. These changes to the landscape may result in the erosion of soil and the sedimentation of water bodies as soil travels to streams, rivers, and lakes in water runoff during storms at an increased velocity due to the lack of vegetative cover. The removal of vegetative cover and its roots system compromise the ability of vegetation to stabilize soil, reduce the velocity of runoff, shield the soil surface from rain, and maintain the soil's ability to absorb water.

Specific erosion and sedimentation impacts related to the loss of vegetation, pollution of the water supply, and alteration of topography are:

1. **Streambank erosion caused by an increase in stormwater runoff.** Eroded material may affect aquatic habitats and alter aquatic species' life cycle events by increasing turbidity, changing the water temperature, and changing the depth of water bodies.
2. **Alteration of existing drainage patterns.** This may affect abutting properties and roads, as well as water bodies.
3. **Destabilization of steep slopes.** Removal of trees and other vegetation may lead to erosion of soil on steep slopes.
4. **Reduced potential for groundwater recharge** due to coverage by impervious surfaces or drainage control methods that take stormwater off-site.
5. **Runoff of chemicals into water supplies.** Petroleum and other chemicals on construction sites may be included in non-point pollution that drains to water supplies during storm events.
6. **Runoff of nutrients into water supplies.** Nitrogen and phosphorus concentrations in surface water bodies can be dramatically increased by increased stormwater runoff resulting in accelerated eutrophication and the proliferation of non-native aquatic plant species.

There are several structural and non-structural methods and management and planning techniques that may be used to control erosion and sedimentation during the site development process. These methods differ from permanent, or post construction techniques. Methods used during construction are meant to deal with the increased amount of erosion and sedimentation that occurs as a result of grading and other land disturbance short-term activities during construction, and are not designed to be permanently in place. These methods, despite their temporary nature, when properly installed can be effective in preventing the erosion and sedimentation that may occur during construction, including during storm events.

These methods include:

- Developing work zones by consulting with a building contractor during design.
- Within the work zones, establishing the phases of construction.
- Within the phases, developing the sequence of construction and methods to be used.
- Preparing a schedule for earth moving and building construction activities.
- Requiring a narrative of daily activities.
- When all of the above has been completed, creating an erosion and sediment control plan utilizing practices that will support the daily schedule of construction activities while preventing erosion and controlling sediment movement to water bodies.

These methods utilize one or more of the following techniques:

- Compost filter sock and mulching
- Vegetated buffer strips
- Grassed swales
- Detention ponds
- Constructed wetlands
- Stabilization of steep slopes
- Infiltration practices
- Phasing of the removal of vegetation
- Silt fence and haybale barriers
- Stone check dams
- Tree clearing plans during development
- Vegetated buffer requirements

A thorough discussion of the environmental, public health, and welfare justifications for regulating stormwater management is given in the "findings" section of model regulations.

APPROPRIATE CIRCUMSTANCES AND CONTEXT FOR USE

The following regulations are appropriate for use during the pre-construction, construction, and short-term post construction phases of a development project.

Although permanent post-construction techniques for erosion and sediment control are addressed in the Permanent (Post-Construction) Stormwater Management chapter, the two topics must be considered hand-in-hand in the sense that the implementation of low impact development techniques for permanent or post-construction stormwater management will also aid in the effectiveness of techniques used during construction. For example, by designing the site with a smaller area of impervious surface, and incorporating a number of smaller permanent stormwater management techniques, the effects of erosion and sedimentation during construction may be lessened through thoughtful design. Also, methods for erosion and sediment control during construction can sometimes be integrated into more permanent measures. For example, a mulch barrier may become integrated into a more permanent erosion and sedimentation control structure. Riparian buffers maintained during construction will remain after construction has been completed.

Land disturbance is also regulated at the federal and state levels (see below, Legal Basis and Considerations for New Hampshire), but the threshold level of disturbance at the state and federal levels may be higher than that of many projects a municipality may wish to regulate, because significant environmental damage can occur at levels of disturbance below the acreage thresholds regulated at the state level.

The model regulations included here propose that the regulations apply where a cumulative disturbed area exceeds 20,000 square feet, or in disturbed critical areas.

Materials provided by the EPA describing the Municipal Separate Storm Sewer System (MS4) program state that municipalities can regulate areas as small as 2,000 square feet. One of the requirements of the MS4 program is that municipalities develop regulations to control erosion and sedimentation of water bodies during construction.

LEGAL BASIS AND CONSIDERATIONS FOR NEW HAMPSHIRE

ENABLING STATUTES

RSA 674:44, Site Plan Review Regulations, subpart II, states: “The site plan review regulations which the planning board adopts may: a) Provide for the safe and attractive development or change or expansion of use of the site and guard against such conditions as would involve danger or injury to health, safety, or prosperity by reason of: (1) Inadequate drainage or conditions conducive to flooding of the property of another; (2) Inadequate protection for the quality of the groundwater; (3) Undesirable and preventable elements of pollution such as noise, smoke, soot, particulates, or any other discharge into the environment which might prove harmful to persons, structures, or adjacent properties;

RSA 674:36, Subdivision Regulations, part II, states: “The subdivision regulations which the planning board adopts may: (a) provide against such scattered or premature subdivision of land as would involve danger or injury to health, safety, or prosperity by reason of the lack of water supply, drainage … or necessitate the excessive expenditure of public funds for the supply of such services.”

STATE AND FEDERAL REQUIREMENTS

Federal law regulates small municipal separate storm systems, or MS4s, under Phase II of the National Pollutant Discharge and Elimination System (NPDES) for land disturbances greater than one acre. NPDES Stormwater Phase II applies to municipalities, or MS4s, that are located in or near an urbanized area as defined by U.S. Census adjacent to a densely settled surrounding territory that together have a residential population of at least 50,000 and an average density of at least 1,000 square people per square mile. Forty-five New Hampshire communities must comply with Phase II requirements, which include a requirement to adopt a local level erosion and sediment control regulation. The NPDES Construction General Permit, applies to any construction activity disturbing more than one acre. This requirement applies statewide. More information on the DES permit process can be found at www.des.nh.gov.

New Hampshire law protects surface and groundwater quality from degradation as a result of significant alteration of terrain and activities in or on the border of surface waters of the state. RSA 485-A:17, RSA 485-A:17 Water Pollution and Waste Disposal/Terrain Alteration requires a permit from DES when more than 100,000 square feet of contiguous land area is to be disturbed (or 50,000 square feet if within the protected shoreland as defined by the Comprehensive Shoreland Land Protection Act). Other relevant state level controls include timber harvesting and excavation permits. Although these state level permits will be referenced herein, this chapter deals primarily with regulation at the local level.

Despite these protections at the federal and state level, many construction projects disturb a smaller area than 50,000 square feet, and thus local protection is necessary.

EXAMPLES AND OUTCOMES

Many New Hampshire towns, including Exeter, Portsmouth, and East Kingston have developed erosion and control regulations that typically deal with requirements for erosion and sediment control during and after construction. Numerous examples can be found in the subdivision and site plan regulations of most towns. These regulations are not fully effective however, if the pre-application clearing of land is not addressed, and if inspection prior to, during, and after construction is not addressed, as well as issues of maintenance during construction and after storm events.

Some towns, such as Exeter, have developed regulations addressing pre-application land clearing or grading by requiring the pre-cleared condition to be the basis of the stormwater calculation for pre-development conditions. Some towns, such as Newton, have begun to require construction sequencing plans and/or development agreements that consist of a written agreement between the board and developer that covers pre-construction meetings and inspection, during construction meetings, post storm and post construction inspections, maintenance schedules, and bonding of erosion and sediment control measures.

Land excavations are addressed at the state level by RSA 155-A but may also be addressed by municipalities, which may develop local level regulations under the authority granted to them by the state.

The best regulations will be ineffective without accompanying methods referenced for enforcement. The reader is encouraged to consult RSA 676:15, 17, and the publication "Guide to District Court Enforcement of Local Ordinances and Codes, available from the NH Bar Association at www.nhbar.org/legal-links/Local-ordinances-and-codes-guides.asp.

Model Language and Guidance for Implementation

The following regulation is based on several existing models and handbooks, including those prepared by DES and the N.H. Association of Conservation Districts. Model language for pre-application land disturbance was derived from a presentation entitled "Storm Water Phase II-Developing Construction & Post Construction Programs Fees and Funding" given by attorney Stephen C. Buckley, Hodes, Buckley, McGrath & LeFevre, PA, in the spring of 2005 at a workshop hosted by the US EPA, Region 1.

MODEL SUBDIVISION AND SITE PLAN REGULATION

EROSION AND SEDIMENT CONTROL DURING CONSTRUCTION

I. TITLE AND AUTHORITY

A. **Title**
The title of this Site Plan and Subdivision Regulation for the Town/City of [NAME], shall be known as the "Erosion and Sediment Control During Construction."

B. **Authority**
This regulation is adopted pursuant to RSA 674:16, Grant of Power, RSA 674:17, Purposes of Zoning Ordinance, and RSA 674:21, Innovative Land Use Controls, Environmental Characteristics. The corresponding section of the Zoning Ordinance is found at section [_______].

Towns adopting these regulations should add a section to the zoning ordinance authorizing the adoption of stormwater regulations during construction based on the RSA sections listed above. The findings listed in this regulation should be considered for addition to the master plan natural resources chapter.

II. PURPOSE

Based on the findings above, the purpose of this regulation is to develop standards for design, installation, and maintenance of stormwater management measures during construction for the following reasons:

- To control the quantity and quality of runoff.
- To prevent soil erosion and sedimentation resulting from site construction and development.
- To prevent the pollution of runoff from construction sites.
- To protect natural resources including wildlife habitat.
- To protect other properties from damage that could be caused by erosion and sedimentation or the quantity or quality of runoff.
- To reduce public expenditures in maintenance of stormwater drainage systems such as removing sediment from systems, repairing or replacing failed systems, restoring degraded natural resources, and to prevent damage to town infrastructure caused by inadequate controls.

III. FINDINGS

The planning board has made the following findings concerning the need to address sediment and erosion control during construction.

A. **Land development alters hydrologic response.**
Land development projects and other land use conversions and their associated changes to land cover can alter the hydrologic response of local watersheds and increase stormwater runoff rates and volumes, which in turn increase flooding, stream channel erosion, and sediment transport and deposition, and decrease groundwater recharge by creating impervious surface such as pavement and buildings, and compacting pervious surfaces.

B. **Small storms account for 90 percent of runoff.**
Over 90 percent of runoff and associated pollutants loads result from very small storms, thus traditional methods of preparing stormwater control plans must be revisited take into consideration not only larger, less frequent storms, but also small storms to ensure that water supplies do not become polluted by these small storms and that designs for larger, less frequent storms resulting in large downstream flows can be reduced so as not to cause significant stream channel erosion and other environmental damage.

C. **Cumulative effects.**
The cumulative effects of several storms on a particular project, and the erosion and sediment contributions from several projects create a significant cumulative effect on water quality, hydrologic response of local watersheds, and alter or destroy wildlife habitat.

D. **Land development contributes to increased nonpoint source pollution.**
Land development projects and other land use conversions contribute to increased nonpoint source pollution and degradation of receiving waters due to the addition of petroleum products, fertilizers and pesticides, construction waste, and other substances to runoff from construction sites.

E. **Land development causes significant environmental damage to wildlife and wildlife habitat.**
Land development projects cause significant damage to trees and other wildlife habitat through compaction of soils due to construction vehicle traffic, stripping of vegetation during grading and other site preparation activities, and increased turbidity in water supplies that may damage the habitat of aquatic species.

F. **Stormwater runoff related to development adversely affects health, safety, welfare, and the environment.**
The impacts of stormwater runoff related to development can adversely affect public safety, public and private property, surface water supplies, groundwater resources, drinking water, aquatic and non-aquatic wildlife habitats, fish and other aquatic life, property values, and the potential for other uses of land and water.

G. **Best management practices can minimize adverse impacts.**
These adverse impacts can be controlled and minimized through the application of best management practices during construction activities, low impact

development practices post construction, and periodic inspections before, during and after construction to ensure that erosion and sediment control practices are functioning effectively.

H. **Federal law requires regulations to manage stormwater runoff from construction sites.**
Federal law requires small MS4 operators to develop, implement, and enforce a program to reduce pollutants in any storm water runoff from construction activities that result in a land disturbance of greater than or equal to one acre. Reduction of storm water discharges from construction activity disturbing less than one acre must be included in the program if that construction is part of a large common plan or development or sale that would disturb one acre or more.

It is therefore in the public interest of health, safety, welfare, and environmental protection to minimize the impacts associated with land development and to regulate stormwater runoff during construction in order to address the adverse impacts to public health, safety, welfare, and the environment detailed in the above section.

IV. APPLICABILITY

The requirements of this regulation shall apply to land disturbance, development, and or any construction activities in all zoning districts where the disturbance, development, or construction activity will disturb greater than 20,000 square feet or that is within a critical area as defined below.

V. DEFINITIONS

Best Management Practice (BMP): A proven or accepted managerial, structural, non-structural, or vegetative measure to prevent or reduce increases in stormwater volumes or flow; to reduce erosion, sediment, peak storm discharge, and point-source and non-point-source pollution; and to improve stormwater quality and protection of the environment.

Critical Areas: Disturbed areas of any size within 75 feet of stream, intermittent stream, bog, water body, or poorly or very poorly drained soils; disturbed areas of any size within 50 feet of a property line; disturbed areas exceeding 2,000 square feet in highly erodible soils; or disturbed areas containing slope lengths exceeding 25 feet on slopes greater than 15 percent.

Developer: Any person or legal entity that undertakes or proposes to undertake activities that cause land disturbance.

Development: Any activity involving land grading, or alteration of terrain or landscape, other than for agricultural purposes or silvicultural purposes where best management practices for agriculture or timber harvesting as defined by New Hampshire law are utilized.

Disturbed area: An area where the natural vegetation has been removed exposing the underlying soil or where vegetation has been covered by soil.

Drainage Area: A geographic area within which stormwater, sediments, or dissolved materials drain to a particular receiving waterbody or to a particular point along a receiving waterbody.

Effective Impervious Cover: Impervious surfaces that contribute to stormwater runoff leaving a site. Effective impervious cover can be reduced by capturing and directing stormwater runoff generated by the impervious surface to an on-site retention, treatment and infiltration management device or practice.

Erosion: The detachment and movement of soil or rock fragments by water, wind, ice, or gravity.

Highly Erodible Soils: Any soil with an erodibility class (K factor) greater than or equal to 0.43 in any layer or listed below or as found in Table 3-1 of the "Stormwater Management and Erosion and Sediment Control Handbook for Urban and Developing Areas in New Hampshire" Rockingham County Conservation District, 1992.

Impervious Surface: Land surface with a low capacity for soil infiltration, including but not limited to pavement, roofs, roadways, or other structures, paved parking lots, sidewalks, driveways (compacted gravel or paved) and patios. Total impervious surface cover shall be calculated by determining the total area of all impervious surfaces on a site as described above, regardless of whether the impervious surfaces are contiguous or non-contiguous.

Land Disturbance or Land Disturbing Activity: For the purposes of this regulation, refers to any exposed soil resulting from activities such as clearing of trees or vegetation, grading, blasting, and excavation.

Low Impact Development Techniques: Alternative designs for the treatment and management of stormwater that minimize disturbance to the natural drainage patterns on the landscape and require high standards for water quality discharge and recharge. These techniques include treatment of stormwater runoff on residential lots using low-maintenance methods such as vegetated swales, rain gardens and subsurface infiltration devices.

Openness Ratio: A ratio calculated by dividing a culvert's cross-sectional area by its length (OR = cross sectional area / length).

Owner: A person with a legal or equitable interest in a property.

Pervious Surface: Any material of structure on or above the ground that permits water to infiltrate into the underlying soil. Naturally pervious surfaces may become less pervious through the process of compaction.

Qualified Professional: A person knowledgeable in the principles and practice of stormwater management and erosion and sedimentation control, including Certified Professional in Erosion and Sediment Control (CPESC), Certified Professional in Storm Water Quality (CPSWQ), licensed soil scientist, licensed engineer, or someone with experience in the principles and practices of stormwater management and erosion and sedimentation control working under the direction and supervision of a licensed engineer and in consultation with a person qualified to construct a project as per design and in compliance with regulatory requirements.

Recharge: The amount of water from precipitation that infiltrates into the ground and is not evaporated or transpired.

Redevelopment: The reuse of a site or structure with existing man-made land alterations. A site which currently has 35 percent or more of existing impervious surface, calculated by dividing the total existing impervious surface by the size of the parcel and converted to a percentage before the project begins would be considered a redevelopment. [*Note: This definition is distinct from other requirements a town may have as to maximum impervious surface allowed in the completed project.*]

Regulated Substance: Oil, as defined pursuant to RSA 146-A or a substance listed in 40 CFR 302, with the following exclusions: ammonia, sodium hypochlorite, sodium hydroxide, acetic acid, sulfuric acid, potassium hydroxide, and potassium permanganate.

Sediment: Solid material, either mineral or organic, that is in suspension, is transported, or has been moved from its site of origin.

Sensitive Area: For the purposes of this regulation, lakes, ponds, perennial and intermittent streams, vernal pools, wetlands, floodplains, floodways and areas with highly erodible soils.

Sheet flow: Runoff that flows or is directed to flow across a relatively broad area at a depth of less than 0.1 feet for a maximum distance of 100 feet.

Site: The lot or lots upon which development is to occur or had occurred.

Stabilization: The condition in which all soil-disturbing activities at a site have been completed and a uniform, perennial vegetative cover with a density of 85 percent has been established or equivalent stabilization measures (such as the use of mulches or geotextiles) have been employed on all unpaved areas and areas not covered by permanent structures.

Stormwater: Water resulting from precipitation (including rain and snow) that runs off the land's surface, is transmitted to the subsurface, or is captured by separate storm sewers or other man-made or natural drainage facilities.

Stormwater runoff: The water from precipitation that is not absorbed, evaporated, or otherwise stored within the contributing drainage area.

Stream: Areas of flowing water that occur for sufficient time to develop and maintain defined channels but which may not flow during dry portions of the year. Includes but is not limited to all perennial and intermittent streams located on U.S. Geological Survey Maps.

Turbidity: A condition of water quality characterized by the presence of suspended solids and/or organic material.

Undisturbed Cover: A land surface that has not been significantly altered by human activity.

Vegetation: Is defined to include a tree, plant, shrub, vine, or other form of plant or fungal growth.

Water Supply Intake Protection Area: Designated protection area for a surface water intake used a source by a public water system.

Well Head Protection Area: As defined in RSA 485-C:2, the surface and subsurface area surrounding a water well or well field, supplying a public water system, through which contaminants are reasonably likely to move toward and reach such well or well field.

VI. CONSTRUCTION INSPECTIONS, PHASING, AND THE PLANNING PROCESS

A. **Inspections/Frequency.** Periodic inspections of stormwater management structures or techniques shall be conducted periodically by the town's engineering consultant or a qualified professional; the cost of such inspections shall be included in the escrowed funds paid by the developer for the purpose of reimbursement to the town for the payment of fees to town engineering and planning consultants reviews and inspections. At a minimum, inspections shall be conducted at the site prior to commencement of land clearing activities, after every storm event during construction, periodically during construction, at the completion of construction activities and removal of any temporary BMPs, and as specified thereafter in an agreed-upon inspection schedule proposed by the developer in consultation with either the contractor who will build the project or a consulting contractor and approved by the planning board and the planning board's consulting engineer, to insure that stormwater management structures or techniques are performing effectively.

B. **Inspections/documentation.** All inspections shall be documented and written reports prepared by the town's compliance officer or compliance consultant that contain the following information:

1. Date and location of the inspection.
2. Date of last storm event.
3. Whether construction is in compliance with the approved stormwater management plan.
4. Variations from approved construction specifications.
5. Photographic documentation of each erosion and sediment control BMP and any other site level techniques employed pursuant to this regulation, such as but not limited to seeding of fill piles, marking of root zone areas of trees, disposal of construction debris, and implementation of any state or federal level record-keeping or reporting procedures related to erosion and sediment control.
6. Recommended actions for replacement, repair, or substitution of BMPs, that are not functioning properly.

Copies of reports and labeled photographs shall be provided to the planning board.

C. **Phases of Inspection.** The schedule for inspections should include the following phases:

1. **Initial site inspection** prior to plan approval, which shall include a site walk by the developer or developer's engineer and contractor, the town's

consulting engineer and/or compliance officer, and a member of the planning board.

2. **Erosion control inspection t**o ensure erosion control techniques or structures have been properly installed, and are in accord with the developer's submitted plan.

3. **During and post-storm event inspection.** The town's consultant shall inspect the site during and within 48 hours after the first storm event and subsequent storm events to ensure that erosion and sediment control techniques and drainage structures are functioning properly.

4. **Stormwater management system inspection.** This inspection will include inspection of temporary measures to be employed only during construction, as well as semi-permanent and permanent measures designed to remain for some time period after construction is completed but which may be completed before all construction of the site is completed. The inspector will also note whether construction debris is being disposed of properly and whether other erosion and sediment control measures in addition to those in the approved plan must be instituted by the developer to protect water resources.

4. **Final inspection and storm performance inspection.** The town's consultant shall inspect the system after the system has been constructed and before the surety has been released. This inspection shall also evaluate the effectiveness of the system during and after the first actual storm. No surety will be released until the inspector certifies both the final inspection and the storm performance inspection.

D. **Phasing.** The developer shall submit a phasing plan to the planning board to be reviewed by the town's engineering consultant to ensure compliance with all applicable federal and state level laws and regulations pertaining to stormwater management. The phasing plan shall specify areas of the development to be completed in sequence and shall specify that all necessary infrastructure to support each phase shall be in place prior to the issuance of permits for certificates of occupancy for that phase.

E. **The Planning Process.** All developers must adhere to the four-step process as set forth below and demonstrate this in writing in developing their stormwater management plan during construction and thereafter.

Step 1: Planning. Plan the development to fit the existing site features, including topography, soils, drainage ways, and natural vegetation.

Step 2: Scheduling of Operations. Schedule grading and earthmoving operations to expose the smallest practical area of land for the shortest possible time.

Step 3: Soil Erosion Control. Apply soil erosion control practice and any other techniques as specified in the stormwater management plan to achieve the purposes set forth in this regulation.

Step 4: Inspections and Maintenance. Implement a thorough maintenance program and schedule inspections in conjunction with the town's consultant, to be reviewed by the planning board.

This section relates to federal law requirements for small MS4 operators to develop procedures to receive public input. Municipalities may wish to develop a standard form for such information.

VII. PROCEDURES FOR CONSIDERATION OF INFORMATION SUBMITTED BY THE PUBLIC

A. The planning board shall consider any information submitted by the public concerning the stormwater management plan or site conditions or erosion and sediment control measures before and during construction. The board shall develop a short form to allow citizens to submit information concerning these measures. The board shall consider such information at a properly noticed public hearing even if the application to which the information relates has already been closed. All such information shall be either submitted in writing or as testimony in a properly noticed public hearing.

VIII. DESIGN STANDARDS

A. **Strategies to Be Employed**
To ensure that all sources or soil erosion and sediment on the construction site are adequately controlled, the following strategies shall be employed:

1. **Minimize the areas of disturbed soil.** Limit site preparation activities such as grading and clearing to where they are absolutely necessary and consistent with the phasing plan and the daily schedule of construction activities.

2. **Maximize the protection and on-site use of native vegetation.** Protect all vegetation not intended for removal by adequately marking, fencing around the drip line of trees, protectively wrapping and temporarily transplanting as necessary.

3. **Reduce the time that soil is left disturbed.** Utilize construction management and by phasing; soil disturbed by construction activities shall be stabilized within 14 days of ceasing disturbance.

4. **Stabilize soil** with seeding and mulch as soon as possible after disturbance. Minimize soil disturbance between October 15 and May 1.

5. **Control water at upslope site perimeters.** Prevent stormwater from entering areas of disturbed soil from outside the site and from other parts of the site. Utilize diversion swales and vegetated strips to reduce the amount of water entering a construction site.

6. **Control water on-site.** On the site water must be controlled and kept to low velocities so that erosion is minimal. This can be achieved through immediate seeding and mulching or the application of sod, as well as the use of structural measures including silt fences, check dams, mulch filter socks, and mechanical tracking of hillsides.

7. **Control sediment on site.** Reduce the amount of sediment produced from areas of disturbed soils, and control the sediment produced on site through seeding and mulching and structural measures.

8. **Control sediment at the down slope site perimeters.** Prevent the off-site transport of all sediment produced on the construction site using vege-

tated strips, diversion dikes, and swales, sediment traps and basins, stabilized construction entrances, and silt fences or mulch filter socks.

9. **Utilize biological or recyclable materials.** To the extent possible, developers should utilize natural biological materials or recyclable materials as temporary measures that can remain on-site after the completion of construction such as mulch berms or other methods as opposed to silt fences, which must be removed and disposed after the completion of construction activities in order to reduce waste and reduce costs of removal.

B. **Design Standards**

The following standards shall be applied in planning for stormwater management and erosion control:

1. Stormwater management and erosion control designs shall not conflict with minimum N.H. Department of Environmental Services requirements for Alteration of Terrain or other environmental permits required.
2. Measures shall be designed and installed to control the post-development peak rate of runoff so that it does not exceed pre-development runoff for the two-year, 10-year, and 25-year/24-hour storm event and for additional storm event frequencies as specified in the design criteria of the N.H. Stormwater Management Manual.
3. Emergency spillways and down slope drainage facilities shall have capacity to accommodate a 100-year/24-hour storm.
4. All measures in the plan shall meet as a minimum the best management practices set forth in the N.H. Stormwater Management Manual.
5. Stormwater management practices shall be selected to accommodate the unique hydrologic and geologic conditions of the site.
6. The use of low impact development techniques are preferred to intercept, treat, and infiltrate runoff from developed areas distributed throughout the site, as are techniques that restore, enhance, or protect natural areas such as riparian areas, stream channels, wetlands, and forests.
7. Stormwater management systems shall not discharge to surface waters, ground surface, subsurface, or groundwater within 100 feet of surface water within a water supply intake protection area.
8. Any contiguous area of disturbance, not associated with the installation of a roadway, shall be limited to 20,000 square feet.
9. Contiguous areas of disturbance shall be separated by at least 20 feet of area maintained at natural grade and retaining existing, mature vegetated cover that is at least 20 feet wide at its narrowest point.
10. Roadway and driveway crossings over streams shall meet the following design criteria to accommodate high flows, minimize erosion, and support aquatic habitat and wildlife passage:
    a. Natural stream bottoms.

b. Sized for 1.2 times bank-full stream width, i.e. the width of the stream during the 1.5-year flow event.

c. Bridges and culverts shall have an openness ration of greater than or equal to 0.25 (calculated in meters) for perennial streams.

d. Passageways under roads shall be designed to maintain water velocity at a variety of flows that is comparable to flows in upstream and downstream segments of the natural stream.

e. Culverts shall have a trough or narrow channel in the bottom running the full length of the culvert to maintain sufficient water depth during low-flow periods to support fish passage.

f. Round culverts must be imbedded at least 25 percent.

The above section is intended to provide some overlap with the chapter on Permanent (Post-Construction) Stormwater Management given that the use of techniques designed for the construction phase may overlap with other techniques that remain after construction activities are completed.

In some cases, design of culverts or other wildlife crossings that may be impacted by temporary or permanent stormwater control methods will require the review of such practices by a wildlife biologist who can assess the site's wildlife habitat and recommend practices that will minimize the adverse impact of stormwater control methods on existing wildlife crossing areas. The town may wish to add a provision allowing this limited review and providing for reimbursement of this expense by the developer. Alternatively, the Conservation Commission may appropriately provide information on the natural resources inventory of a town as well as site-level characteristics.

IX. CONSTRUCTION SITE METHODS

A. **Responsibility of the applicant.** The applicant shall bear final responsibility for the installation, construction, inspection, and disposition of all stormwater management and erosion control measures required by the provisions of this regulation.

B. **Daily log of installations, inspections, modifications, rainfall, and repairs or reinstallations.** Construction site operators shall be responsible to ensure erosion and sedimentation control measures approved for the site are installed as designed. A daily log of erosion control measures, inspections, modifications required, rainfall events and erosion observed shall be submitted weekly to the town's engineering consultant, or public works department, or the planning board, at the discretion of the planning board.

C. **Estimate required.** A detailed estimate including unit pricing of temporary and permanent erosion control methods in a form acceptable to the planning board shall be submitted for review by the town's engineering consultant prior to any construction work.

D. **Construction site inspections.** In addition to the general inspections outlined above, the qualified professional serving as the town's consultant shall verify proposed limits of site disturbance and limits of tree removal, including the marking of root zones of trees to be retained, the location of temporary parking of construction vehicles, the location of stockpiles of construction materials, the location of earth stockpiles, and the proposed methods for daily removal of construction waste and debris from the site.

E. **Test upgradient and downgradient waters for turbidity levels**. Both to ensure they meet allowable state and federal standards and to compare these levels in order to evaluate sediment capture through the site.

F. **Pre-construction meeting.** A pre-construction meeting shall take place in which the applicant, town's consultant, site engineer, site contractor, road agent, and any other key town personnel as necessary attend to discuss the site, the development plans, and all aspects of site construction.

G. **Pre-winter meeting.** A pre-winter meeting shall be held not later than September 15 of each year prior to the acceptable completion of site work, in order that town staff, the applicant, the contractor, the site engineer, the town's consultant, and other involved parties specify measures to secure the site for the winter season.

H. **Documentation.** Copies of all required permits and permit applications relative to the site, such as Site Specific Permit, and the Stormwater Pollution Prevention Plan shall be provided to the planning board and shall be considered as necessary for any conditional approval.

I. **Installation of erosion and sediment control devices**. Erosion and sedimentation control devices shall be installed prior to site disturbance or tree removal that would create erosion and sediment control issues.

J. **Certification.** No building permit shall be issued by the town until the town's consultant has certified that the site construction has proceeded in accordance with stormwater management and erosion and sedimentation control standards, plans, and specifications, and that the relevant portion of the site has been reasonably stabilized, and until the town's consultant has certified that all utilities, drainage and stormwater management measures and roadway base course of paving have been satisfactorily installed on the site.

K. **Surety.** An estimate shall be developed for the construction period, which shall include all erosion control costs. The applicant may request periodic release of such surety for work completed and verified by the town's consultant. At the completion of the construction and final acceptance by the town, the applicant may request up to 85 percent of escrow funds. The remaining escrow shall be held for two years after the completion of construction and acceptance by the town at which time the town's consultant will certify all temporary erosion controls that should be removed have been removed and all permanent measures have been installed and are functioning and have been maintained as intended. The site engineer shall develop and submit a maintenance plan for permanent erosion control and sedimentation and an estimate of annual maintenance costs. The plan shall include any necessary easements or other legal documents necessary to allow periodic inspection for a period of two years after completion of the project. Upon receipt of the certification and maintenance plan and legal review of easements or other legal documents as described herein, the town shall release the remaining funds.

X. CONSTRUCTION PRACTICES

A. Natural vegetation shall be retained, protected or supplemented to the extent practical. The stripping of vegetation shall be done in a manner that minimizes soil erosion.

B. Excavation equipment shall not be placed in the base of an infiltration area during construction. Excavation or other construction vehicles shall not be placed in the root zone areas of trees to be retained during construction.

C. Construction equipment and materials shall be stored at a distance greater than 25 feet from drainage channels, streams, lakes or wetlands.

D. Onsite wastes generated during the course of construction, including, but not limited to discarded building materials, concrete truck washout, chemicals, litter, and sanitary waste shall be removed from the site daily to the extent feasible or at a regular interval as specified in the construction sequence and schedule of daily activities for the project and disposed of properly.

E. No ground disturbed as a result of site construction and development shall be left as exposed bare soil. All areas exposed by construction, with the exception of finished building, structure, and pavement footprints, shall be decompacted (aerated) and covered with a minimum thickness of six inches of non-compacted topsoil, and shall be subsequently planted with a combination of living vegetation such as grass, groundcovers, trees, and shrubs, and other landscaping materials such as mulch, loose rock, gravel or stone. Native, non-invasive species as defined or listed on the New Hampshire DES Shoreland Protection List of Native Shoreland and Riparian Buffers Plantings in New Hampshire.

XI. REQUIRED SUBMISSIONS IN STORMWATER MANAGEMENT PLANS FOR APPLICATION REVIEW

A. In addition to any information generally required by the town for subdivision or site plan application, the applicant must submit the following items to the planning board for review:

1. Existing and proposed conditions including the following elements

    a. Local map showing property boundaries.

    b. North arrow, scale, and date of plan and plan amendments.

    c. Surveyed property lines.

    d. Structures, roads, utilities, earth stockpiles, equipment storage, and stump disposal.

    e. Records of any timbering activities within the past five years.

    f. Topographic contours at two-foot intervals.

    g. Critical areas relating to natural resources as defined at a regional level, state level, or local level by a regional, state, or local level natural resource inventory.

    h. Stockpile areas, and staging areas.

i. Within the project area, within 400 feet of project boundary, and upgradient within the watershed or appropriate portions thereof, all surface waters, waterbodies, streams, intermittent streams, ephemeral streams, wetlands, vernal pools, and drainage patterns and watershed boundaries.

j. Identified wildlife corridors if referenced in a local, regional, or state level natural resources plan

k. Vegetation, including description of species.

l. Extent of the 100-year flood plain when applicable.

m. Soil information from a National Cooperative Soils Survey soil series map or a High Intensity Soil Map.

n. Easements or covenants.

o. Areas of soil disturbance or remediation areas.

p. Areas of cut and fill.

q. Areas of poorly or very poorly drained soils, including any portion to be disturbed or filled.

r. Location of all structural, non-structural, and vegetative stormwater management and erosion control BMPs.

s. Detail sheet showing each BMP.

t. Phasing plan.

u. Inspection schedule.

v. Construction schedule.

w. Earth movement and grading schedule.

x. Construction Erosion and Sediment Control Plan that complies with the provisions of this regulation.

y. An operations and maintenance plan.

z. Spill prevention plan and emergency management plan for spills of potentially hazardous materials.

aa. Surety.

bb. Identification of alternatives in the drainage system design that provide for contingencies during storm events, for instance, and alternative for water flow in case a critical culvert becomes blocked by debris.

cc. Design calculations for all temporary and permanent BMPs and a narrative description of each measure, its purpose, construction sequence, and installation timing.

dd. Drainage report with inclusion of more frequent small storms as well as traditional calculations.

ee. Landscaping Plan (unless required by other sections of the regulations).

ff. Notation of soil types (unless required by other sections of the regulations).

XII. PRE-CLEARING

The applicant shall provide pre and post development peak flow rates in stormwater calculations. Any site that was wooded in the last five years must be considered undisturbed woods for the purposes of calculating pre-development peak flow rates.

XIII. ENFORCEMENT

The planning board may pursue any remedies authorized in the New Hampshire Revised Statutes Annotated for non-compliance with the specifications of an approved plan including revocation of the recorded plan.

REFERENCES

EPA New England's NPDES Storm Water Permit Program Web Site. www.epa.gov/ne/npdes/stormwater/index.html.

EPA's Storm Water Phase II Menu of Best Management Practices. www.epa.gov/npdes/menuofbmps/menu.htm.

EPA Storm Water Phase II Compliance Assistance Guide. www.epa.gov/npdes/pubs/comguide.pdf.

Maryland Cooperative Extension. Understanding the Science Behind Riparian Forest Buffers: Effects on Water Quality: Effects of Riparian Buffers on Sediment, Nutrients, and other Pollutants. www.ext.vt.edu/pubs/forestry/420-151/420-151.html.

National Pollutant Discharge Elimination System (NPDES) Phase II: How to Select, Install, and Inspect Construction Site Erosion and Sediment control BMPs for NPDES Storm Water Permit Compliance" International Erosion Control Association. www.ieca.org and www.ieca.org/Chapter/northeast/northeasthome. asp

New Hampshire Association of Conservation Districts. 1997. Model Stormwater Management and Erosion Control Regulation.

N.H. Department of Environmental Services. 2008. *Stormwater Management Manual: Volume 1 Antidegradation and Stormwater; Volume 2 Post Construction Best Management Practices: Selection and Design; Volume 3 Construction Phase Erosion and Sediment Controls.*

N.H. Department of Resources and Economic Development. *BMPs for Erosion Control on Timber Harvesting Operations in New Hampshire.* www.nhdfl.org/info-plan-bureau/fi&p-waterqualitybmps.htm.

2.2 Steep Slope and Ridgeline Protection

RELATED TOOLS:

- Habitat Protection
- Erosion and Sedimentation Control During Construction

BACKGROUND AND PURPOSE

There are a number of issues associated with development on steep slopes, hillsides, and ridgelines. Foremost among them are health, safety, and environmental considerations that arise when planning development in steep areas. Another factor is the aesthetic quality of hillsides and ridgelines that can be lost when they are developed. New Hampshire residents and visitors place great value on the state's natural resources. Protecting hillsides and steep slopes from development helps to preserve those unique environmental qualities that people value. Furthermore, development on steep slopes can have an adverse effect on water quality as a result of increased erosion and sedimentation.

This chapter provides information on regulating both steep slopes and ridgelines. While the two subjects are closely related, the regulations for each usually have different emphasis. Steep slope regulations are frequently based on environmental considerations such as erosion and sedimentation controls, while ridgeline regulations have more emphasis on view protection. The model ordinance in this chapter contains a section that deals with steep slopes and one that deals with ridgelines.

APPROPRIATE CIRCUMSTANCES AND CONTEXT FOR USE

Since the beginning of steep slope regulation in the 1950s, there have been a variety of ways to approach the subject. In 1975, the authors of a report called *Performance Standards for Sensitive Lands* reviewed a total of 35 hillside and grading regulations, and found that the regulations could be classified in the following three categories (Thurow 1975):

1. **Slope/Density Provisions.** These reduce allowable densities on hillsides: the steeper the slope, the less the allowed density.
2. **Soil Overlays.** These provisions key development regulations to soil type, based on maps by the Natural Resource Conservation Service.
3. **The Guiding Principles Approach.** This approach creates hillside overlay districts to cover all hillside lands in a jurisdiction. A set of guiding principles is applied to all proposed development in these areas. These regulations are usually

flexible, allowing for tailoring of development to the characteristics of each site and encouraging innovative approaches to attain the desired end.

These approaches have all become popular because they reduce the negative impacts of hillside development. These impacts include excessive cuts and fills, unattractive slope scars, and erosion and drainage problems. A logical method for addressing these problems is to reduce the intensity of development as the grade of the slope increases. The implication of linking density limitations with steep slopes is that steeply sloped hillsides are inherently unsuited for development for reasons of public safety, erosion, aesthetics, or general environmental protection. Because this type of regulation does allow for some hillside development, property owners can retain some use of their land. Pairing slope/density regulations with grading regulations helps to ensure that those sites are developed as safely as possible.

In most cases, large-scale commercial development is discouraged in areas with steep slopes because of the difficulties associated with trying to provide level building and parking areas as well as safe access to the site. Drainage and stormwater runoff can also cause problems.

When developing regulations to govern development on steep slopes, hillsides, and ridgelines, it is important to collect as much data as possible to form the basis of the ordinance. In a 1996 publication, Robert Olshansky, an expert on hillside development outlined ten topics that should be considered prior to implementing a regulation. These ten topics, which are outlined below, can be used as a framework to build a solid justification for regulating steep slopes, hillsides, and ridgelines.

TOPOGRAPHY

Before the location and extent of steep slopes in a community can be determined, it is essential that the definition of a steep slope be determined. Many communities define steep slopes as having a grade of 15 percent or greater, meaning that the elevation increases by 15 feet over a horizontal distance of 100 feet.

SLOPE STABILITY

When considering slope stability, it is important to consider not only how stable the slope is prior to development, but also what effect the grading necessary for development would have on slope stability. On steep slopes, any change in the equilibrium, whether it is caused by natural phenomena such as heavy rains or earthquakes or human activities, can cause erosion or landslides. Development on very steep slopes disturbs far more than the building footprint: on a 30 percent slope, 250 feet would have to be graded in order to create a 100-foot wide pad for construction, assuming a maximum 2:1 (50 percent) steepness of cut and fill as specified in the Uniform Building Code.

DRAINAGE AND EROSION

Collecting data on drainage and erosion entails identifying major watersheds and drainage courses as well as areas that are prone to flooding. In addition, key facilities and structures downstream of hillside drainageways should be identified. Knowing where the water is likely to drain and what impacts changing existing patterns will have on the entire drainage system can help to prevent damage to buildings and loss of life in the event of a landslide. In addition, changing drainage patterns and increased sedimentation due to erosion can compromise water quality. All highly erodible soils should be identified.

INFRASTRUCTURE

Extending infrastructure to hilltop communities can be very difficult to engineer and construct, especially for water and sewer systems. Individual septic systems are especially difficult to construct and maintain on steep slopes, both because of the slopes and because the soils tend to be shallow and poorly drained. This makes septic systems on steep slopes prone to higher failure rates, which puts ground and surface water supplies at risk. In New Hampshire, no septic system may be placed on a slope greater than 33 percent; however, individual municipalities may implement stricter regulations, or develop inspection/maintenance programs. Roads, power lines, and telephone wires are also difficult and expensive to extend up steep slopes, and to maintain after construction.

ACCESS

Providing access roads and driveways to development on steep slopes can be especially challenging. The New Hampshire Department of Transportation recommends that driveways for commercial activities not exceed an 8 percent grade, and that driveways to residences not exceed 15 percent. Towns may set a lower threshold if they choose. In order to be safe, roads and driveways on steep areas tend to be longer and have more curves and switchbacks than roads and driveways on flatter terrain. This means that there are more impacts on the hillside, such as increased erosion and runoff, a higher potential for accidents, and difficulty for emergency vehicles to access the development.

AESTHETICS

In many of the steep slope ordinances reviewed during the preparation of this chapter, preserving a view was cited as one of the purposes for enacting the ordinance. Although this chapter treats steep slope and ridgeline/viewshed regulation separately, there is a good deal of overlap. When citing aesthetic reasons for implementing an ordinance, it is important to carefully document the rationale. This includes evaluating the extent and quality of views to the hills. In addition, it is important to identify any peaks or hillsides of special symbolic value to the community, to survey community values regarding appearance of hillsides and ridgelines, and to prepare maps of significant aesthetic resources. Taking photographs of the most important resources is another valuable tool that can be used, especially to convince the community that the ordinance is needed

One method for cataloging visual resources is to use the Visual Resource Management strategy developed by the United States Bureau of Land Management (BLM) for use on public lands (BLM Manual H-8410-1). This system analyzes the quality of the view, the sensitivity of the resource, and the impacts that development would have at different distances. This comprehensive approach allows resources to be ranked in the context of their surroundings. Individual communities may not want or need to go into the amount of detail described in the BLM manual. However, the process outlined in the manual does provide a good framework that communities can use to build their own natural resource inventories.

NATURAL QUALITIES

Documenting natural qualities or resources includes identifying and mapping vegetation communities and wildlife habitats, and identifying threats to these resources. Special attention should be paid to rare and endangered plant and animal species. Because of the difficulties associated with steep slope development, hillsides tend to be developed after development has occurred on flatter areas. Wildlife species often take refuge on undeveloped hillsides, even if it is not their native habitat, because their preferred habitats have been developed.

FIRE HAZARD

Fire can break out in many parts of New Hampshire, especially in the White Mountain National Forest. Since it is more difficult to control fires on hillsides than on flat areas, it is important to evaluate the frequency and causes of hillside wildfires, identify fuel reduction methods, and identify architectural and landscaping factors in fire safety. Attention must be paid to response times and access requirements for fire departments, as well as the evaluation of the tradeoffs between natural habitat preservation and fire hazards.

RECREATIONAL VALUES

Hills and mountains provide many popular and important recreational opportunities, including hiking, hunting, climbing, wildlife observation, and skiing. When developing ordinances, consideration of areawide needs and opportunities for wildland recreation as well as identification of possible trail and viewpoint locations are important factors. Locating possible access points to existing and potential recreational opportunities is also important.

OPEN SPACE

Providing open spaces can be a key component of hillside/steep slope regulations. Possible mechanisms for open space management include creating greenways, wildlife habitat preservation areas, and conservation areas.

LEGAL BASIS AND CONSIDERATIONS FOR NEW HAMPSHIRE

In New Hampshire, regulating development on steep slopes is authorized under RSA 674:16, the zoning Grant of Power, RSA 674:21, Innovative Land Use Controls, and 674:21, I (j), Environmental Characteristics Zoning. Although steep slopes and ridgelines are not specifically named in the RSA, they are generally considered to be environmental characteristics and are frequently found as overlay districts similar to wetland protection. According to the New Hampshire Office of Energy and Planning, there were 27 municipalities in the state that had steep slopes regulations as of January 2007. In addition to regulating steep slopes and ridgelines through zoning, some communities include site-specific standards in their subdivision and site plan regulations.

Master Plan

Communities interested in regulating development on steep slopes, hillsides, and ridgelines should address the subject in the natural resource or land use chapters of their master plans. In developing the plan, it will be helpful to study maps of various slope categories. Using the ten-point framework outlined in Section II, a strong case can be built for protecting steep slopes. If viewshed protection is a high priority, then communities should survey their resources using either the Visual Resource Management strategy developed by the United States Bureau of Land Management, or a similar tool.

EXAMPLES AND OUTCOMES

In the United States, the earliest known example of steep slope regulations was in Los Angeles, California in the early 1950s, when grading regulations were first implemented. These regulations were designed to protect lives and property from unengineered development of hillsides (Olshansky 1995). This type of ordinance has been very successful at addressing engineering problems on hillside developments.

In December 2005, the Lakes Region Planning Commission published *Regulating Development on Steep Slopes, Hillsides, and Ridgelines*, a comprehensive look at the history and rationale behind steep slope regulation, along with several case studies from the state of New Hampshire as well as a few examples from other states. Excerpts from some of the case studies are included below.

LYME, NEW HAMPSHIRE

The Lyme zoning ordinance has both a Steep Slopes Conservation District and a Ridgeline and Hillside Conservation District. The Steep Slopes Conservation District is defined as all areas where there is an elevation change of 20 feet or greater and the average slope is 20 percent or greater. The Ridgeline and Hillside Conservation is defined as those ridgeline and hillside areas which are visible from public waters or public roads located within the town at a distance on the USGS topographic map of a half-mile or more (measured in a straight line distance from the proposed area of development).

According to the town planner, the Steep Slopes Conservation District works smoothly for the most part. There are occasional difficulties associated with determining where the district should be applied, which are solved with a site visit. The town has faced some challenges in defining exactly what land falls in the Ridgeline and Hillside Conservation District. The town is working on a map that will show where the district falls.

SANBORNTON, NEW HAMPSHIRE

The minimum lot size in the steep slopes conservation district is six acres. However, the planning board can waive that requirement if at least 50 percent of the lot has a slope of less than 15 percent and there is at least one contiguous area of 40,000 square feet that has a slope of 15 percent or less. According to the town planner, this regulation has been in place for several years, and people who plan to subdivide land in the steep slope conservation district are accustomed to the regulations and therefore bring the proposed subdivision plans with lots drawn in accordance with the ordinance.

NORTH CAROLINA MOUNTAIN RIDGE PROTECTION ACT

Steep slope and hillside regulations are mostly found at the local level as part of either the zoning ordinance or subdivision regulations. One exception to this trend is the North Carolina Mountain Ridge Protection Act of 1983 (NC G.S. 113A-205-214). This state law restricts development on mountain ridges that have elevations of 3,000 feet and higher. As the basis for enacting the law, the North Carolina State Legislature found that:

The construction of tall or major buildings and structures on the ridges and higher elevations of North Carolina's mountains in an inappropriate or badly designed manner can cause unusual problems and hazards to the residents of and to visitors to the mountains. Supplying water to, and disposing of the sewage from, buildings at high elevations with significant numbers of residents may infringe on the ground water rights and endanger the health of those persons living at lower elevations. Providing fire protection may be difficult given the lack of water supply and pressure and the possibility that fire will be fanned by high winds. Extremes of weather can endanger buildings, structures, vehicles, and persons. Tall or major buildings and structures located on ridges are a hazard to air navigation and persons on the ground and detract from the natural beauty of the mountains.

According to a report from the Land-of-Sky Regional Council in North Carolina, this law has been mostly effective in controlling development on mountain ridges. However, many mountain communities in the state are currently searching for ways to protect land at lower elevations from development as well (Houck 2005).

Model Language and Guidance for Implementation

This model ordinance contains two sections: Steep Slopes Protection and a Visual Resource Protection District. Steep Slopes Conservation should be adopted as a component of the zoning ordinance that applies in all districts. The Visual Resource Protection District is an overlay district where the boundaries are determined through a visual resource inventory process.

STATUTORY AUTHORIZATION

A. RSA Title LXIV, Chapters 674:16, Grant of Power

B. 674:21, Innovative Land Use Controls

C. 674:21(j), Environmental Characteristics Zoning

D. 673:16, II; 676:4, I(g); and 674:44,V collectively authorize planning boards to collect fees from applicants to cover the costs of hiring outside experts to review subdivision applications and site plans.

MODEL ORDINANCE FOR STEEP SLOPE PROTECTION

TITLE: STEEP SLOPE PROTECTION

I. PURPOSE

The purpose of this ordinance is to reduce damage to streams and lakes from the consequences of excessive and improper construction, erosion, stormwater runoff, or effluent from improperly sited sewage disposal systems, and to preserve the natural topography, drainage patterns, vegetative cover, scenic views, wildlife habitats, and to protect unique natural areas.

II. DELINEATION

This ordinance shall apply to all areas with a slope greater than 15 percent, as shown on the town's steep slopes map, and where the proposed site disturbance is greater than 20,000 square feet.

Municipalities should consider the local political climate, the terrain, and the nature of typical development in determining the minimum area of disturbance that triggers the steep slopes ordinance. The 20,000 square feet minimum recommended here will trigger the ordinance for most single-family home construction on steep slopes.

III. DEFINITIONS

Erosion: The wearing away of the ground surface as a result of the movement of wind, water, ice, and/or land disturbance activities.

Sedimentation: The process by which sediment resulting from accelerated erosion has been or is being transported off the site of the land-disturbing activity or into a lake or natural watercourse or wetland.

Site Disturbance: Any activity that removes the vegetative cover from the land surface.

Slope: The degree of deviation of a surface from the horizontal, usually expressed in percent or degrees; rise over run.

Vegetative Cover: Grasses, shrubs, trees, and other vegetation which hold and stabilize soils.

IV. APPLICATION REQUIREMENTS

A. Uses that will cause more than one acre of site disturbance must show the area subject to site disturbance in two-foot contours.

B. An engineering plan will be prepared by a professional engineer that shows specific methods that will be used to control soil erosion and sedimentation, soil loss, and excessive stormwater runoff, both during and after construction.

C. A hydrology, drainage, and flooding analysis will be included that shows the effect of the proposed development on water bodies and/or wetlands in the vicinity of the project.

D. A grading plan for the construction site and all access routes will be prepared.

V. PERFORMANCE STANDARDS

All uses permitted in the underlying district will be a conditional use in the Steep Slope Conservation District and must meet the following conditions for approval:

A. The grading cut and fill should not exceed a 2:1 ratio.

B. Existing natural and topographic features, including the vegetative cover, will be preserved to the greatest extent possible. In the event that extensive amounts of vegetation are removed, the site shall be replanted with indigenous vegetation and shall replicate the original vegetation as much as possible.

C. No section of any driveway may exceed a 10 percent slope for residential subdivisions or 8 percent slope for nonresidential site plans.

D. No structure shall be built on an extremely steep slope (greater than 25 percent prior to site disturbance).

VI. ADMINISTRATION OF CONDITIONAL USE PERMITS

In addition to meeting the conditions set forth in this section, Conditional Use Permits shall be granted in accordance with the following pertinent procedures:

A. A Conditional Use Permit shall be granted by the planning board upon a finding that the proposed use is consistent with the intent of the ordinance and following receipt of a review and recommendation of the conservation commission and any other professional expertise deemed necessary by the board.

B. The applicant must demonstrate that no practicable alternatives exist to the proposal under consideration, and that all measures have been taken to minimize the impact that construction activities will have upon the district.

VII. COSTS

All costs pertaining to the consideration of an application, including consultants fees, on-site inspections, environmental impact studies, notification of interested persons, and other costs shall be borne by the applicant and paid prior to the planning board's final action.

MODEL ORDINANCE FOR RIDGELINES/HILLSIDES/VIEWSHED PROTECTION

TITLE: VISUAL RESOURCE PROTECTION DISTRICT

I. PURPOSE

The purpose of the Visual Resource Protection district is to protect the scenic and ecological resources associated with lands characterized by high elevations, steep slopes, and visual sensitivity in a manner that allows for carefully designed, low-impact development.

II. DELINEATION

The Visual Resource Protection District is an overlay district that will be defined by a visual resource inventory dated_____. The results of the visual resource strategy will be shown on the Visual Resource Map, which is hereby incorporated into this ordinance.

Each community will have unique visual resources. It is the responsibility of the community implementing this ordinance to complete and document a comprehensive visual resource inventory. A manual detailing the Bureau of Land Management's Visual Resource Management Strategy is available online: www.blm.gov/nstc/VRM 8410.html#Anchor-49575

III. DEFINITIONS

Design Guidelines: A set of guidelines defining parameters to be followed in a site or building design or development.

Site Disturbance: Any activity that removes the vegetative cover from the land surface.

Visual Impact: A modification or change that could be incompatible with the scale, form, texture or color of the existing natural or man-made landscapes.

Visual Resource Map: The map depicting the visually sensitive areas, as determined by the visual resource inventory.

Visual Resource Inventory: A system for minimizing the visual impacts of surface-disturbing activities and maintaining scenic values. The inventory consists of a scenic quality evaluation, sensitivity level analysis, and a delineation of distance zones.

IV. APPLICATION REQUIREMENTS

A. Uses that will cause more than 20,000 square feet of site disturbance must show the buildable area in two-foot contours.

B. An engineering plan will be prepared by a professional engineer that shows specific methods that will be used to control soil erosion and sedimentation, soil loss, and excessive stormwater runoff, both during and after construction.

C. A hydrology, drainage, and flooding analysis will be included that shows the effect of the proposed development on water bodies and/or wetlands in the vicinity of the project.

D. A grading plan for the construction site and all access routes will be prepared.

E. Architectural plans and renderings clearly depicting all proposed structures to scale and their location on the site in relation to the physical and natural features of the parcel, including the proposed grade of the building area and finished floor elevations. Drawings should clearly display building elevation and architectural design, including building materials, exterior colors and window fenestration. All structures proposed, including outbuildings and garages are to be shown.

F. A landscaping plan showing existing vegetation and proposed landscaping and clearing plans showing proposed type, size, and location of all vegetation to be preserved and/or installed, along with other landscaping elements such as gazebos, berms, fences, walls, etc. Special attention should be given to existing/proposed vegetation adjacent to buildings for visibility and screening purposes. A species list of existing vegetation and a plan for maintenance of the existing and proposed landscape should be included. Such a plan shall address specific measures to be taken to ensure the protection and survival, and if necessary, replacement of designated trees during and after the construction and/or installation of site improvements.

V. ADMINISTRATION OF CONDITIONAL USE PERMITS

Conditional Use Permits shall include the findings of an architectural review in accordance with the following pertinent procedures:

A. A Conditional Use Permit shall be granted by the planning board upon a finding that the proposed use is consistent with the intent of the ordinance and following receipt of a review and recommendation of the conservation commission and any other professional expertise deemed necessary by the board, such as a licensed architect.

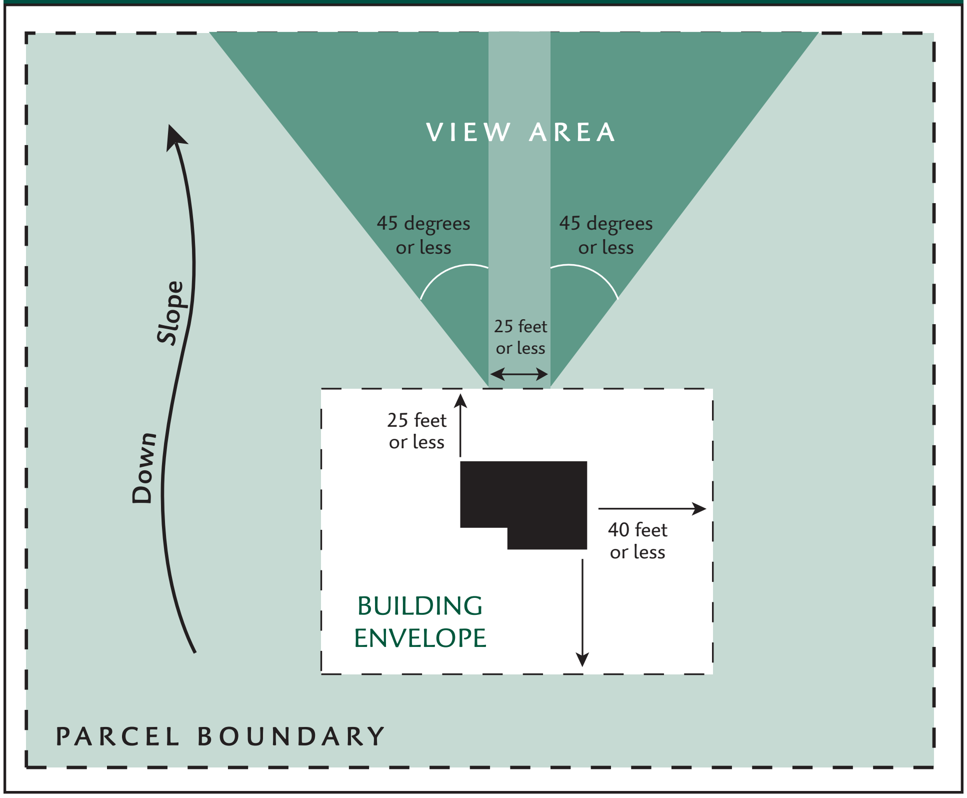
B. The applicant must demonstrate that no practicable alternatives exist to the proposal under consideration, and that all measures have been taken to minimize the impact that construction activities will have upon the district.

VI. DESIGN GUIDELINES

In order to reduce the visual impact of development in the Visual Resource Protection District, all proposed structures shall meet the following design guidelines:

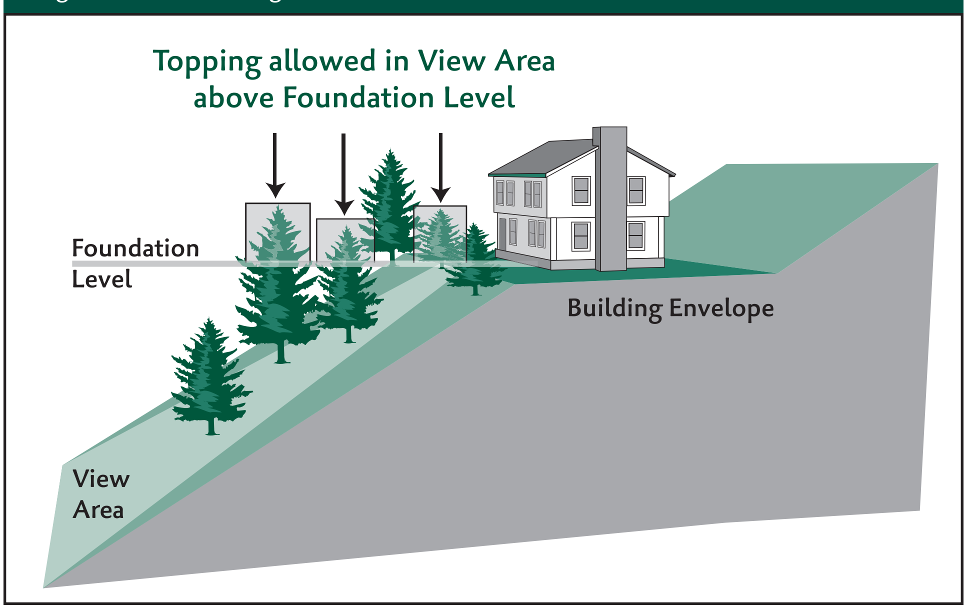
A. **Building Envelope:** The building envelope permitted in this district is a rectangle with an up-slope boundary 40 feet or less from the building, side boundaries 40 feet or less from each side of the building, and a down-slope boundary 25 feet or less from the building. Accessory structures shall be built within the building envelope. Building envelopes shall be at least 30 feet from property lines.

Figure 2.2.1 Building Envelope



B. **Clearing for views:** In order to develop a view, trees may be removed beyond the building envelope for a width of clear cutting not to exceed 25 feet and extending outward therefrom at an angle of 45 degrees or less on both sides, to a point down-slope where the tops of the trees are at the same elevation as the ground floor of the building.. The 25-foot opening may be at any point along the down-slope boundary.

Figure 2.2.2 Clearing for Views



C. Natural/neutral colors will be used.

D. Reflective glass will be minimized.

E. Only low level, indirect lighting shall be used. Spot lights and floodlights are prohibited.

F. No portion of any structure shall extend above the elevation of the ridgeline.

G. Structures shall use natural landforms and existing vegetation to screen them from view from public roads and waterways to the extent practicable.

H. Cuts and fills are minimized, and where practical, driveways are screened from public view.

I. Building sites and roadways shall be located to preserve trees and tree stands.

VII. COSTS

All costs pertaining to the consideration of an application, including consultants fees, on-site inspections, environmental impact studies, notification of interested persons, and other costs shall be borne by the applicant and paid prior to the planning board's final action.

REFERENCES

Bureau of Land Management. Manual H-8410-1 – Visual Resource Inventory. Washington, DC: U.S. Department of the Interior, Bureau of Land Management www.blm.gov/nstc/VRM/8410.html#Anchor-49575.

This manual provides a process for inventorying and prioritizing important visual resources. This, or another methodology, should always be employed when a community is contemplating a visual resource protection district.

Lakes Region Planning Commission. December 2005. *Regulating Development on Steep Slopes, Hillsides, and Ridgelines*. www.lakesrpc.org/steep%20slopes%20final.pdf.

The report explores the historical importance of steep slope regulation, outlines key development issues, and provides a variety of case studies designed to address safety, aesthetics, preservation of wildlife habitat, water quality protection and more.

Olshansky, Robert. September/October 1995. "Planning for Hillside Development" in *Environment & Development*, American Planning Association,

A short article that introduces the themes found in the 1996 PAS report of the same name.

Olshansky, Robert. 1996. *Planning for Hillside Development:* Planning Advisory Service Report No. 466, American Planning Association, Chicago.

A comprehensive study, building on the themes published in the 1995 article that discusses in depth the history and challenges of regulating hillside and steep slope development. The PAS report also provides excerpts from several of the ordinances and regulations reviewed for the study.

Thurow et al. 1975. *Performance Standards for Sensitive Lands*, Planning Advisory Service Nos. 307/308, American Planning Association.

This report was one of the first comprehensive looks at steep slope regulations.

Zoning Ordinances Reviewed:

Links to all of the New Hampshire ordinances listed here are available online from the Steep Slope Protection section of the New Hampshire Office of Energy and Planning Reference Library, nh.gov/oep/resourcelibrary/referencelibrary/s/steepslopeprotection/index.htm

Town of Antrim, NH

Town of Bath, NH

Town of Dublin, NH

Town of Enfield, NH

Town of Francestown, NH

Town of Hancock, NH

Town of Harrisville, NH

Town of Loudon, NH

Town of Lyme, NH

Town of New Ipswich, NH

Town of New London, NH

Town of Newbury, NH

Town of Northwood, NH

Town of Roxbury, NH

Town of Sanbornton, NH

Town of Sandwich, NH

Town of South Hampton, NH

Town of Stowe, Vermont
www.townofstowevt.org/images/photos/stowe_regs_8-29-05.pdf

City of Park City, Utah
www.parkcity.org/government/codesandpolicies/title_15_c_2_21.html

City of San Rafael, California
ordlink.com/codes/sanraf/_DATA/TITLE14/Chapter_14_12_HillsideDevelop.html

Town of Cortland, N.Y.
law.wustl.edu/landuselaw/ssprotection.htm

Sonoma County, California
municipalcodes.lexisnexis.com/codes/sonomaco (Article 26, Section 64)

Model Steep Slope Ordinance, Ten Towns Committee, N.J.
www.tentowns.org/10t/ordsteep.htm

North Carolina Mountain Ridge Protection Act of July 1983
www.cals.ncsu.edu/wq/lpn/statutes/nc/mountainridgeprotection.htm

Statewide Efforts that can Stimulate Stewardship in the Watershed

Two brand new research and policy reports on climate change and water resource management have been released by the State of New Hampshire. The content of the reports, which reinforce the importance of the NLRA's mission and this Watershed Master Plan, are summarized below. We hope you find these new tools and the political will they represent as exciting as we do!

New Hampshire Climate Action Plan, March 2009

On March 25, 2009, after a year of work with over 125 stakeholders and more than 200 citizen comments, the Governor's 29-member Climate Change Policy Task Force released the ***New Hampshire Climate Action Plan***. The goal of the Plan is to reduce greenhouse gas emissions while providing the greatest possible long-term economic growth to the citizens of New Hampshire. Key opportunities include:

- *Spurring growth* by investing money locally that currently goes to energy imports.
- *Creating jobs* by developing in-state renewable energy and green technology development and deployment opportunities.
- *Avoiding significant costs* by responding to changing climate conditions now, and avoiding the need to invest more heavily in New Hampshire's infrastructure, economy and citizen health in the future.

Central to meeting these goals is preserving our working forests, which support the forest products industry, tourism and outdoor recreation; provide priceless ecosystem services such as carbon sequestration and wildlife habitat; and protect our water quality and quantity. The full report is available on line from the NHDES at http://des.nh.gov/organization/divisions/air/tsb/tps/climate/action_plan/documents/032509_nhccptf_final_cap.pdf.

New Hampshire Water Resources Primer, December 2008

New Hampshire's economic well being, public health and quality of life depend on the sustainable management of our water resources. Whether it is used for drinking, manufacturing, recreation, waste assimilation or ecosystem health (or all of the above!), clean water is the cornerstone of our prosperity. The ***NH Water Resources Primer*** is the first document that covers all water-related topics of importance to New Hampshire policy makers and citizens. The full report is available on line from the NHDES at http://des.nh.gov/organization/divisions/water/dwgb/wrpp/documents/water_resources_primer.pdf.

What's Our Water Worth?

Surface waters are valuable both as a natural and economic resource. Residents, in-state property owners, and tourists spend money on water-based recreational activities, and waterfront property owners pay a purchase and tax premium to be located there. Public water utilities depend on surface waters to serve customers and businesses. People also place value on the enjoyment of great ponds and rivers, beyond any dollar figure that they are generally willing to pay to preserve them now and for the future. Business people start and keep businesses here in part because of access to water-based recreational activities. The full reports commissioned by the NH Lakes Association are available at:
http://www.nhlakes.org