NEWFOUND LAKE WATERSHED MANAGEMENT PLAN IMPLEMENTATION: PHASE II

A through I Summary Addendum Report to

The New Hampshire Department of Environmental Services

Submitted by

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Executive Summary

The Newfound Lake Watershed is a 61,000-acre (~95 sq. mi.) region that includes 4,451-acre Newfound Lake, classified as a High Quality Water by the NH Department of Environmental Services (DES). Working with several partner organizations and supported by EPA Section 319 funding, the Newfound Lake Region Association (NLRA) completed *Every Acre Counts: The Newfound Watershed Master Plan* in October 2009 to provide a comprehensive, watershed-wide approach to maintaining clean water in Newfound Lake and its tributaries (see http://newfoundlake.org/index.php/resources/publications).

The Newfound Watershed principally contains some or all of five rural communities (Alexandria, Bridgewater, Bristol, Groton and Hebron) with a year-round population of roughly 5,000 and seasonal population in the 10,000-15,000 person range. In addition to rich cultural history and resources, the Watershed contains some of the most pristine and highly diverse habitat in the State.

The terrain is roughly 83 percent forested and very steep, ranging in elevation from 3,120 feet above mean sea level (msl) at the summit of Mt. Cardigan to ~586 feet msl at the Lake. The steep slopes and thin soils create "flashy" runoff conditions where an inch of rain over the watershed raises the Lake level nearly one foot within 24 hours, with an extremely high potential for destructive erosion of exposed soil, roadways and river banks.

The main threat to water quality comes from stormwater runoff, particularly during increasingly-frequent extreme storm events. Managing stormwater in a rural setting that lacks centralized government requires grass-roots capacity and action based on objective and accurate information, practical examples, and non-structural methods such as land-use regulations. The project team's approach has included collecting and sharing environmental data; working with local Planning Boards to support shared community visions of clean water, healthy forests and rural character; and educating stakeholders about stormwater management options through large-scale collaborative projects, public workshops, and publications.

Building on the findings of *Every Acre Counts*, our desired project outcome statement from our Full Proposal for this phase of the project, dated November 10, 2011 is:

Our desired outcome for this project is sustainable, watershed-scale stewardship to maintain Newfound's High Quality Water status. The primary measure of success is maintaining Newfound Lake's oligotrophic status and median phosphorus concentration of 4 micrograms / liter.

During this reporting period, two substantial (~$35,000+ and $54,000+) stormwater mitigation projects were completed; over 1,000 acres of high-value land was conserved; one town (Groton) actively engaged our planning team for land-use zoning and Master Plan revisions; three towns (Alexandria, Bristol and Hebron) requested various analyses and information for land-use planning; hundreds of people, including local youth, engaged in educational programs through our on-lake Newfound Eco-Tours and local workshops; our ability to publish water quality and other data on our web site and the amount of information posted grew; we completed a watershed-wide analysis and prioritization of stormwater Best Management Practices (BMPs) for implementation by Town and State road agents; we completed extensive, credible and compelling land-use maps and reports for local decision makers; the organization received a

steadily increasing number of queries from the public about how to control erosion and prevent stormwater pollution; our strategy for developing sustainable grass-roots stewardship ethic gained momentum; and NLRA's organizational capacity and financial stability continued to improve.

Key findings from this report include the following:

- While public opinion indicates a unified valuation of clean water and healthy forests, local land use policy and regulations dictate a suburban development pattern that is contrary to public perceptions of future conditions. In addition, there is little to no enforcement capacity of existing regulations in any of the watershed towns.

- Collaborative projects with towns, summer camps and homeowner associations have helped reduce stormwater pollution and built positive relationships. These projects are long (years) and expensive ($10's of thousands). The projects that the NLRA has helped facilitate have had measureable water quality and public education benefits, and are relatively manageable with our limited resources. Beginning in 2015, the NLRA will adopt the SOAK up the Rain approach to engage landowners within 250' of surface water in efforts to reduce their stormwater impacts. Our initiative will also be informed by the Youth Conservation Corps program successfully established by the Acton-Wakefield Watershed Alliance.

- Watershed-scale modeling of benefits provided by BMPs was performed, with focus on improvements along public roads (i.e. culverts and drainage ditches). Extensive modeling was also performed to quantify the value of riparian bufer and wetland functions on protecting clean water (ecosystem services). Reasonable scenarios of development and forest harvesting were modeled to predict the impact on water quality.

  Modeling results indicated that implementing the top 20 BMPs significantly reduces phosphorus loading in Newfound Lake at a reasonable cost. More strikingly, the estimated value of the ecosystem services is in the $40,000,000 range. The clear conclusion is that protecting our natural water quality systems, principally riparian buffer and wetland functions, is orders-of-magnitude more effective than degrading them through development and replacing them with man-made BMPs.

- Residential growth averages one percent (1%) per year for the past decade, including the Great Recession. Projecting this conservative rate into the future yields increases in watershed housing by 15% to 30% over a 15- to 30-year time span. Using a realistic, watershed-specific framework of development patterns indicates that critical resources (aquifers, prime agricultural soil and scenic vistas) are highly vulnerable to permanent loss from development. An example of smart-growth development in the vicinity of the Fowler River valley aquifer in Alexandria and Bristol can be extrapolated to other areas and towns in the watershed.

- Ultimate success depends completely on the sustained presence of a critical mass of engaged property owners and voting residents shaping the public opinion on individual land use and town land-use policy, regulations, and enforcement. The NLRA's strategy to catalyze this reaction is to clearly and consistently communicate why stormwater is a problem and what individuals and towns can do about it. In addition to various print and

electronic media, public presentations and workshops, and collaborative projects, we have recently posted summary water quality data and stormwater mitigation project summaries on our web site. Our goal is to continuously improve our ability to communicate relevant and actionable information to all stakeholders in the Newfound watershed.

- Our strategy of bottom-up / top-down measures remains to be fully implemented, and we have learned that focusing too much effort on local Planning Boards as an organization may not be the most effective way to develop and adopt progressive land-use regulations and policy. Rather, engaging and building a critical mass of informed residential voting and taxpaying stakeholders to advocate for sustainable land use policy is needed to encourage and support local Boards in their policy development and decision making.

The November 10, 2011 Full Proposal that became the Grant Agreement for this project included 7 Objectives with 43 Tasks. Project Tasks were completed on budget and non-federal match exceeded project requirements. The results of implementing the second phase of *Every Acre Counts* follow.

Introduction

Background Information

The Phase II implementation actions completed during this project were based on recommendations from *Every Acre Counts*, a 30-month, $360,000+ regional environmental planning effort to protect the water resources of the Newfound Lake Watershed (Figure 1), and recommendations from the first phase of implementation presented in the report entitled Newfound Lake Watershed Management Plan Implementation: Phase I (October 2012).

Description of Project Area

Newfound Lake is located in the predominantly forested Newfound River Watershed in the western edge of New Hampshire's Lakes Region. The Lake drains south via the Newfound River through the Town of Bristol to the Pemigewasset River, which subsequently flows to the Merrimack River, reaching the Atlantic Ocean at Newburyport, Massachusetts. Newfound Lake's water level is controlled by a dam located at the southern end of the Lake and operated by the DES Dam Bureau. The Newfound watershed encompasses three HUCs: 010700010601 (Cockermouth River), 010700010602 (Hornet Cove), and 010700010603 (Sanborn Bay to Newfound River).

Newfound Lake is one of the deepest lakes in New Hampshire with a maximum depth of 182 feet. It is the fifth largest of New Hampshire's lakes. Major tributaries to the Lake include the Cockermouth and Fowler River systems, and wetland complexes that drain into Georges Brook to the north and Bog Brook to the west. The Newfound Watershed includes all of the Town of Hebron and portions of the Towns of Alexandria, Bridgewater, Bristol, Danbury, Dorchester, Groton, Orange, and Plymouth. Of these nine towns, most or all of five towns (Alexandria, Bridgewater, Bristol, Groton, and Hebron) represent the majority of the watershed. The hills and ridges that surround Newfound Lake and encompass the Watershed form a roughly 50-mile-long ridgeline ranging in elevation from 586 feet at the Lake outlet dam in Bristol to 3,120 feet at Mt. Cardigan's summit.

The combination of bedrock geology, thin soils and steep slopes causes rapid runoff during storm and snowmelt events. During these short-duration and high intensity runoff periods, rainfall and/or melt-waters tend to flow rapidly off the landscape and to concentrate in well-defined stream channels. This rapid runoff and concentrated flow erodes disturbed soil, adding sediment, phosphorus and other contaminants to streams, wetlands and ponds.

Threats to Water Quality and a Watershed Approach

Threats to water quality are principally related to stormwater runoff. Impacts from stormwater runoff have been well documented based on sampling and analysis of tributaries and Newfound Lake by University of New Hampshire – Center for Freshwater Biology (UNH-CFB) scientists and our many citizen volunteers. More focused sampling of culverts discharging directly to Newfound Lake by NLRA and the Town of Bristol detected concentrations of phosphorus, turbidity and Escherichia coliform bacteria (*E.coli*) orders of magnitude greater than baseline and in excess of DES water quality standards. Recently, both public (in 2009 and 2010) and private (in 2008) beaches have been temporarily closed due to elevated *E.coli* concentrations.

Rationale for Watershed Approach and Basis for Grant Funding

Because stormwater impacts are dispersed in their cause (multiple sources) and focused in their effect (adverse impacts to receiving water quality), and because forest and water resources cross municipal boundaries, a holistic, watershed-wide approach is required to address them. In the rural Newfound watershed, populations are dispersed among many small communities that have strong traditions of independent behavior. Additionally, while there is a shared principle of appreciating clean water and the surrounding landscape, zoning (where it exists) mandates a suburban development pattern, and enforcement of existing land-use regulations is essentially nonexistent.

Thus, a broad and sustained effort to engage local citizenry in pro-active water resource protection behavior is warranted. Based on the size of the watershed, the jurisdiction of multiple towns, the overall lack of local or centralized guidance and enforcement capacity and DES and the US Environmental Protection Agency (EPA) support of watershed-wide approaches to NPS threats, Section 319 (Clean Water Act) funding was the most viable approach to this project.

Project Objectives, Measures of Success, and Results

Project Objectives and Measures of Success from the November 2011 Full Proposal which formed the basis for our Grant Agreement (Appendix A) are in *italics* in this section. Project deliverables by Objective and Task are also included in Appendix A. Measures of Success are summarized after each Project Objective. How this project successfully addressed EPA Elements a through i is identified under Objective 4 of this report. Critical project deliverables required to make this a comprehensive planning document conducive to implementation are included in various Appendixes. Additional task verifications have been submitted to DES separately. Results for each Objective summarize highlights, what was most effective, and areas for improvement.

Objective 1: *Shared Environmental Planner to assist Watershed communities with land-use related implementation actions from the 2009 Newfound Watershed Master Plan.*

Measures of Success: One or more anti-degradation ordinances per year in up to five Watershed towns prepared for Town meeting.

Results: While the Town of Groton utilized planning support for their subdivision regulations, no watershed towns have yet adopted the anti-degradation ordinances targeted under this Objective. The amount of time requested of our planning team varied greatly by town, ranging from substantial (Groton) to none (Bridgewater). Maps showing property boundaries and natural resources were of universal interest to town planning boards, as well as the general public. Providing such maps has long been a priority of the project team, since from the beginning of this project it was clear that people most readily identify visually with their place in the watershed. Draft ordinances were requested by towns and provided on several occasions, but the prevailing public sentiment is against new rules of any kind, and those that address land-use in particular. Additionally, the idea of hiring a shared planner appears unpopular as towns consider the Regional Planning Commissions their primary resource.

We have concluded that Planning Boards need support and engagement from their fellow, voting citizens to direct their work and advocate through the rule-making process (including public hearings and Town meeting) for changes in land-use rules and policy to occur. We plan to focus our communications, education and outreach on building a more active local stewardship ethic by working more closely with non-Board citizens in the watershed towns in 2015 and beyond.

Objective 2: *Educate and motivate individuals, associations and towns to implement stormwater BMPs and measure results using Residential Loading Model. Create sustainable stewardship ethic of awareness and action to reduce stormwater impacts on water quality.*

Measures of Success: Two or more Towns, two or more Camps and one or more homeowner associations implement BMPs; BMPs evaluated using Residential Loading Model; Results reported on Water Watchdog web site and other public media.

Results: Our strategy for this Objective was to identify large-scale projects that typically required multi-party coordination. This strategy engages multiple stakeholders in the process and outcome, has larger positive impact on water quality, and is easier to manage then multiple projects of smaller size. Examples of our clearest measures of success are summarized below.

Cummings Beach Bristol, NH. This major stormwater treatment project was designed, permitted and constructed during a previous project phase. During the current phase, runoff from an uphill, off-site source deposited a total of roughly 7 - 10 cubic yards (10 – 15 tons) of sediment in the treatment system catch basins and swale. These materials were removed by Town of Bristol personnel, but the potential for continued sedimentation remained.

In late 2013 the NLRA contacted upgradient landowners, including two individuals and the Newfound Sands (NS) homeowner association, a development of roughly 40 homes on a 17.6-acre tract to discuss ways to reduce up-hill erosion and stormwater runoff. All contacted parties responded favorably to the idea of cooperating, with NS taking the lead in designing and constructing road and drainage improvements, primarily paving 700 ft. of steeply-sloping dirt road, constructing 603 ft. of paved and armored side ditches, and installing catch basins and closed drainage.

The project cost NS roughly $54,000 and was completed in November 2014. Modeling of the benefit from this work to sediment and nutrient reductions was performed by FB Environmental (FBE) in December 2014. Results indicate that these improvements will reduce sediment by 6 tons / yr., phosphorus by 5 lb./year and nitrogen by 10 lb./year. These reductions do not include impacts of paving the ~11,000 square feet of dirt road, as the model does not have a BMP for this action. Thus, the model reductions are expected to be lower than actual, although they compare well with empirical sediment removal data. A copy of the model output is included in Appendix B.

The Cummings Beach / NS project represents a substantial collaborative effort that reduced stormwater pollution to Newfound Lake, has engaged and educated a large number of people, and will continue to be a visible message about the means and value of stormwater management.

Stonegate Acres Association Hebron, NH. Stonegate Acres (Stonegate) is a 25-unit association of single-family homes located at the north end of Newfound Lake. Over a period of many years, runoff from State-owned North Shore Road flowed across the unpaved public access road, through inadequate ditching and directly discharged to Stone Gate's beach. As a result, the beach area has filled substantially, reducing usability and boat access (see photographs in Appendix C).

The NLRA initiated a stormwater mitigation project that involved representatives of Stone Gate, the Town of Hebron and the NHDOT. The design concept included improving drainage and infiltration of State road runoff, paving the public access road, installing a closed drainage system, and installing catch basins to reduce flow velocities and trap sediment. The project was driven by several Stonegate members, with the Town of Hebron voting to fund paving and drainage work at a cost of roughly $35,000. The project was completed in 2014. RLM modeling was not performed as road pavement is not included as a BMP option. However, based on the area paved, average slope and proximity to Newfound Lake, loading reductions are likely similar to Cummings Beach (see above).

Now that the sediment source has been mitigated, maintenance dredging is being considered by the residents to restore the Stonegate beach to its historical condition. This is another example of long-term, multi-party cooperation to address the combined threats of erosion and stormwater pollution.

Sleepy Hollow Association Hebron, NH. Sleepy Hollow is a 13-unit association of single-family homes located at the north end of Newfound Lake, roughly 1/4 mile west of the Stone Gate project. Over a period of many years, runoff from State-owned North Shore Road has added substantial sediment to an un-named brook that discharges at Sleepy Hollow's beach as well as overland flow that causes erosion at several locations. In addition, runoff from side ditches along an unpaved section of Town-owned George Rd. contributes sediment to the un-

named brook roughly 600 feet upstream of the Sleepy Hollow's waterfront. It appears likely that an historical forestry operation adjacent to the un-named brook and further uphill from George Rd. contributed substantial sediment loading before vegetation was re-established. As a result, the Sleepy Hollow beach area has filled substantially, reducing usability and boat access (see photographs in Appendix C).

The NLRA has been working with representatives of Sleepy Hollow, the Town of Hebron and the NHDOT to address this complex situation. The current design concept is to improve drainage and infiltration of State road runoff, and reinforce the side ditches along George Rd. The project has been delayed in part by NHDOT budget cuts and schedules, but has been identified as a priority in our watershed modeling report and will be pursued. Watershed modeling by FBE (see Objective 3) indicated that improving the George Rd. drainage and controlling this sediment source would produce the following annual reductions of stormwater contaminants:

- 0.8 ton / year sediment
- 1.2 lb./year phosphorus
- 1.6 lb./year nitrogen.

The estimated 10-year construction and maintenance cost for the recommended BMPs (FBE Site 37; armored ditch and vegetated shoulder) is $3,875. A copy of the FBE watershed modeling technical memorandum is provided in Appendix D**.**

Once the sediment source has been mitigated, maintenance dredging is being considered by the residents to restore the Sleepy Hollow beach to its historical condition. While progress on this project has been slower than desired, it remains a good example of long-term, multi-party cooperation to address the combined threats of erosion and stormwater pollution.

Newfound Lake Youth Camps

During a previous project phase, the NLRA worked closely with several summer camps (Berea, Pasquaney, Onaway, the Mayhew Program, and the Circle Program) to create site-specific stormwater management plans that could be implemented as part of summer youth programs and facility maintenance. The seven main youth camps in the watershed own ~750 acres and 12% of the lake shore. Two (Pasquaney and Onaway) have over a century of continuous operation, and all youth camps have introduced thousands of campers from multiple generations to the beauty of the watershed and a tradition of stewardship.

Two camps (Berea and Pasquaney) installed armored ditching and rain barrels, respectively. Camp Berea will need to monitor sediment clogging of their ditching, and Camp Pasquaney indicated that the rain barrels lacked capacity and inhibited drainage, so they were removed. The Circle Program, located on steep slopes with thin soils, is reportedly challenged by drainage and erosion problems, and will likely contact the NLRA for future assistance. Camp Onaway runoff has little to no impact on water quality due to current layout and drainage patterns, and the Mayhew Program has several potential drainage improvements that are expected to be included as part of their current capital campaign.

In general, the camps have little impact on water quality due to their excess of on-site infiltration capacity. Rather, their principal motivation for drainage improvements is more closely related to aesthetics, convenience and education. Outreach and education from NLRA to the camps related to stormwater mitigation have improved communications and relationships, leading to a higher level of financial support from several camps, as well as new project partnerships such as trail and informational signage construction at NLRA conservation properties. Future stormwater mitigation collaborations are anticipated as opportunities occur and needs arise.

The NLRA has provided reports and articles about all of these projects through our bi-annual Newsletter, periodic e-Newsletter, and frequent Facebook posts. In addition, we submitted articles to the local newspaper (Plymouth Record-Enterprise) that were typically published, and presented results annually to municipal budget committees. The underlying software developed during the Phase I Implementation project Water Watchdog web site (Drupal) was replaced with free and user-friendly technology to post summary project data for easy public access. See Appendix E for a summary memo of our methodology, and view stormwater project summaries on our web site at the link below**.** We plan to continue building our web-based data set of stormwater projects and water quality summaries.

Link to NLRA stormwater project web site:
http://newfoundlake.org/index.php/protect-the-lake-watershed/water-watch-dog/stormmap

In summary, stormwater mitigation projects require clear identification of a problem that is important to the landowner(s); that a practical and economic solution is available; the engagement of committed and influential stakeholders; substantial time (typically years) for design and implementation; and reliable and adequate funding, often via private/public and non-profit partnerships. It is important, and deeply rewarding, to see members of associations, camps, towns and the general public step up to leadership roles in project advocacy and management. Ultimately, this nurturing of local leaders is one of the greatest measures of success for meeting our overall project objective.

Objective 3: *Perform watershed-scale modeling to identify critical needs and locations for BMPs; use model for scenario planning and decision making at municipal level.*

Measures of Success: Robust, calibrated model, approved by DES, able to estimate pollution source loads for watershed and Lake assimilation capacity; up to six (6) selected subwatersheds undergo more detailed analysis and scenario planning ("what-if' analysis) to facilitate regulatory and structural BMP selection, prioritization, and funding. Test impact of existing and potential BMPs (e.g. Cummings Beach and unpaved road mitigation and management).

Results: Tasks related to this Objective were originally contracted with the University of New Hampshire (UNH). UNH submitted a draft report documenting development and calibration of a Lake Loading Response Model (LLRM), modeled large-scale effects of retaining or losing key ecosystem services (riparian buffers and wetlands), and in-lake impacts from several development and forest harvest scenarios. However, they were unable to complete the identification of specific pollutant sources that could be addressed by local municipalities to

meet Newfound's water quality goal and failed to meet critical project schedule requirements. Working with the DES during the summer of 2014, the NLRA terminated the contract with UNH and hired FBE to complete a "Non-point Source Watershed Survey and BMP Matrix" (Appendix D).

Following guidance from the NLRA and contractor Greenfire GIS, and using information from local road agents, the 2010 NLRA Culvert Study, and field reconnaissance, FBE personnel surveyed 79 locations along public roads and modeled 55 sites where erosion and stormwater runoff are most likely to impact water quality. Using the Region 5 model for individual sites and the calibrated LLRM model from UNH, FBE prioritized potential BMPs by pollutant load reduction and cost, and estimated in-lake water quality as a result of various BMP implementation scenarios.

Table 1 lists the benefits and costs to install recommended BMPs at the 55 sites identified and modeled by FBE, including estimated construction and total 10-year costs, amount of phosphorus removed, and cost per pound of phosphorus removed. A copy of the FBE report is provided in Appendix D. Highlights of Table 1 and the FBE report are summarized as follows:

- The LLRM predicts 3,496 lb/yr of phosphorus enters the lake annually under current conditions (no BMPs installed). See Figure 2 for phosphorus contributions from the principal land cover / land-use in the watershed (more discussion under Objective 4).

- Model results indicate that 445 pounds of phosphorus and 447 tons of sediment annually enter the lake from the 55 modeled sites.

- The top 20 sites annually contribute 358 pounds (80%) of phosphorus and 359 tons (80%) of sediment.

- Phosphorus loading has resulted in a 2005 - 2014 ten-year median in-lake phosphorus concentration of 3.5 parts per billion (ppb) at the reference location and 4.2 ppb using all lake sampling locations. Newfound's target phosphorus concentration is 4.0 ppb.

- Implementing BMPs at the top 20 sites reduces annual phosphorus loading by 10% (to 3,144 lb/yr) and in-lake phosphorus by 8% (from modeled 4.0 ppb to 3.7 ppb).

- Implementing BMPs at all 55 sites reduces annual phosphorus loading by 12% (to 3,060 lb/yr) and in-lake phosphorus by 10% (from modeled 4.0 ppb to 3.6 ppb).

- Estimated 10-year cost (includes design, construction and maintenance) for the top 20 sites is $134,610 for an average cost of $1,503/pound of phosphorus reduction. The estimated ten-year cost for all 55 sites is $328,300 for an average cost of $6,194/pound of phosphorus reduction. Note that not all phosphorus is removed by BMPs, thus estimated cost/pound removal is higher than calculated from the values in Table 1.

Clearly, the top 20 sites should be the focus of near-term remediation, based on the cost / benefit of phosphorus removal. Additional steps for road-related runoff should include ongoing efforts to stabilize drainage and road ditches, and to up-size culverts as part of routine maintenance to better handle larger storm events. In addition to the towns, the NHDOT needs to be more fully engaged in managing runoff from State-owned roads.

As part of the work to prepare the LLRM used by FBE, UNH estimated positive impacts and costs to improve culverts identified as high-priority for repair in the October 2012 Phase I of this project (2010 Culvert Study). Table 2 contains a detailed summary of the results of this analysis, with the following highlights:

- 42 culverts were identified in 12 of the 15 watershed sub-basins and modeled for the results of an assumed and standardized improvement. Note some overlap of sites with Table 1 is likely.

- The total area of improvements is roughly 13.4 acres resulting in roughly 70 lb/year of phosphorus removal.

- Estimated cost for all modeled work is $802,000, using standardized assumptions for costs (e.g. $19,000/BMP).

- The 10-year cost for phosphorus removal for road culvert improvements is estimated to be $1,400/lb.

Note that the average cost of phosphorus removal estimated by the UNH work is similar to the FBE findings.

Ecosystem Services - Value of Riparian Buffers and Wetlands on Water Quality

Part of the LLRM analysis was designed to evaluate the benefit of the ecosystem services provided by riparian buffer (RB) and wetland (WT) functions. This analysis was extended to estimate order-of-magnitude costs for man-made structures required to replace the services that RB and WF provide if they were lost due to poor land-use planning and development.

Table 3 indicates that the integrity of natural features such as riparian buffers and wetlands is required to maintain current water quality. Even with these functions intact, a reasonable growth scenario (30% increase in development and 10% forest clearing) under a "business-as-usual" lack of adequate land-use policy would result in a decrease in average lake clarity from 7.3 meters (m) to 4.9 m and an increase in average phosphorus concentration from 4.0 ppb to 8.5 ppb.

Under the reasonable growth scenario, with less than 90% of existing RB intact and all WT functions lost, average lake clarity would decline to 4.4 m and average phosphorus concentration would increase to 10.5 ppb. Note in Table 3 that estimated pre-development conditions indicate an average clarity of 10.6 m and average phosphorus concentration of 2.1 ppb.

Table 4 summarizes modeled results and the relative monetary value of phosphorus removal by RB and WT ecosystem services in 15 sub-basins. Highlights of Table 4 include the following:

- 153 lb/year of phosphorus is removed annually by RB functions, with an estimated value of $4,000,000 for man-made BMPs providing similar functions.

- 1,525 lb/year of phosphorus is removed annually by WT functions, with an estimated value of $40,000,000 for man-made BMPs providing similar functions.

- Combined, RB and WT functions (some overlap) remove 1,705 lb/year of phosphorus for a ecosystem services monetary value of approximately $44,000,000.

These ecosystem services provide substantial benefits at no cost to watershed towns and residents. In fact, they intrinsically provide multiple benefits (e.g. wildlife habitat, aesthetics, erosion control, flood prevention, and clean water). Clearly, protection of RB and WT functions is the best approach to maintaining clean water and healthy habitat.

The NLRA plans to share the results of FBE and UNH's work with each watershed town to allow them the opportunity to develop schedules and budgets for BMP implementation. Beginning in 2015, the NLRA Trustees have committed to implementing an alliance with the DES SOAK up the Rain program, informed by the Youth Conservation Corps program successfully developed by the Acton-Wakefield Watershed Alliance, to increase stormwater mitigation stewardship by landowners owning property within 250 ft. of Newfound Lake and its tributaries. Our overall objective is to continue implementing our bottom-up / top-down strategy of individual and municipal stormwater management.

Objective 4: *Complete EPA Element a - i gap analysis and summary report addendum for the 2009 Watershed Master Plan.*

Measures of Success: Review existing documents and Watershed Model output to create an addendum to Every Acre Counts that integrates EPA a through i key elements for watershed-based plans into the updated version of Every Acre Counts watershed master plan.

Results: This part of the summary addendum report is intended to satisfy the requirements of Objective 4. Using abbreviated EPA a through i criteria definitions (*in italics*), highlights of this analysis, including reference to relevant parts of this report, are summarized as follows:

a. *Identify sources that need to be controlled to maintain a median phosphorus concentration of 4.0 ppb*. All changes in land use from its natural state (building construction, roads, and forest harvesting) have the potential to adversely impact water quality. Areas of erosion and stormwater runoff associated with the watershed road network are a significant source of stormwater pollution. Property development and forest harvesting are the other two principal sources of stormwater pollution. See Objectives 2, 3 and 5 for additional details.

Figure 2 shows the principal land cover types and land uses in the watershed. The largest source of phosphorus is forest cover, which is not surprising considering roughly 89% of the watershed is forested. More importantly, on a normalized basis of phosphorus load per unit area, roads contribute roughly 37% more phosphorus than agricultural land, twice as much as developed property, and 15-times the phosphorus released by forested lands. Roads supply a disproportionately high source of phosphorus; are by definition accessible; are relatively easy to repair with existing technology; and their improvement reduces stormwater pollution while enhancing public safety. As such, they are a principal source targeted for stormwater control.

Our other priority for phosphorus reduction is developed property, principally within 250' of a water body. Such development is principally residential, and can be addressed with low-cost, relatively simple BMPs. In addition, opportunities to educate property owners about septic system maintenance will have complementary benefits for clean water. Further, by engaging individuals in the why and how of stormwater management, we look for added benefits at the town policy and governance level of watershed management.

In addition to road improvements and near-shore development BMPs, large-scale projects will also receive NLRA assistance on an as-requested and opportunistic basis.

b. *Estimate load reductions expected for the management measures described under paragraph (c) below*. Implementation of the 55 identified BMPs would reduce annual phosphorus loading by 12% from current conditions, and reduce in-lake phosphorus concentrations by 0.4 ppb (10%). Implementation of the top 20 identified BMPs would reduce annual phosphorus loading by 10% from current conditions, and reduce in-lake phosphorus concentrations by 0.3 ppb (8%). Improvements at 42 priority culverts (some overlap) would potentially remove an additional 72 lb of phosphorus. *These estimates assume unrealistic conditions of no future degradation of riparian buffer and wetland ecosystem services, a no-growth scenario for housing and population, and no further timber harvesting.* See Objective 3 for additional details.

c. *Describe management measures (structural and non-structural (e.g. BMPs and regulations)) required to achieve desired load reductions and water quality goal (4.0 ppb phosphorus).*

Key management measures identified in this report include:

- Implementing BMPs at the 55 sites modeled by FBE, starting with the top 20.
- Improving the 42 culverts within the 12 sub-basins identified by UNH.
- Protecting riparian buffers and wetlands via Town land-use regulations and policies and through the SOAK approach.
- Providing Towns and the public with maps, land-use analysis and recommendations.
- Providing ongoing outreach and education about why stormwater prevention is important, and how it can be addressed, at both the individual and Town level.
- Engaging local advocates to inform, motivate and support local Boards to develop and enforce effective land-use policy and regulations.

See Objectives 3, 5 and 6 for additional details**.**

d. *Estimate amounts of technical and financial resources and stakeholder commitment required to implement the plan.* The technical resources for most BMPs are likely within the means of watershed town highway departments and road agents. Most, if not all, BMPs will not require formal engineering design or certification by a licensed professional. Rather, they were selected to be implemented by Town Road Agents and properly-experienced contractors. See Objective 3 for additional details**.**

Table 5 lists critical project milestones and estimated costs. In total, 10-year estimates to implement structural and non-structural BMPs are in the $1,000,000 - $1,500,000 range. Estimated 10-year costs for phosphorus removal range from $1,400/lb. (culverts modeled by UNH) to $1,500/lb. (BMPs modeled by FBE). The financial resources for this work would be shared among towns, based on actual BMPs completed. Based on recent experience, these costs

(roughly $20,000 - $30,000/yr. if equally divided among the five watershed towns) will be seen as relatively high by town budget standards.

The stakeholder commitment and costs associated with non-structural BMPs (i.e. protecting ecosystem services such as wetlands and riparian buffers, developing and enforcing low-impact and sustainable land-use policies and guidance) are uncertain, but the benefits provided by ecosystem services are substantial (millions of dollars), and orders of magnitude less than the cost of building BMPs to replace them. We anticipate that commitment to protecting riparian buffer and wetland functions will grow as an outcome of our ongoing work, and that net costs for low-impact land-use policy will be negative as sustainable growth is expected to yield long-term positive economic benefit. See Objectives 5 and 6 for additional details.

e. *Information and education to enhance public understanding and engagement.*

Extensive information has been provided to the public throughout all three phases of this project. Information and education outlets and efforts have included: local media; NLRA electronic and printed newsletters; public workshops; meetings with local Planning and Select Boards; social media (web and Facebook); fact sheets and white papers; maps; site visits; collaborative stormwater prevention projects; conservation partnerships; presentations to local schools and social clubs; student internships; town budget requests and presentations; extensive technical reports; Newfound Eco-Tours (NLRA educational boat tours); and hands-on projects with schools and local youth.

Future emphasis will focus on the following:

- Delivering the land-use data and analysis from Objective 5 (Map Sets, Build-out analysis, and Fowler River watershed analysis) to Towns via individual reports and presentations, and to the public via our web site and newsletters, articles in the local paper, and public presentations. A critical goal is to more effectively engage voting residents of all watershed towns to support, encourage and advocate for effective land-use policy with the Planning Boards and fellow citizens. See Objective 5 for more details.

- The NLRA is planning on launching a SOAK up the Rain model of grass-roots stormwater prevention in 2015. The purpose is to identify properties within 250 feet of Newfound Lake or its tributaries for potential BMP installation using a cooperative approach that includes the property owners, paid and volunteer labor, with the NLRA as project coordinator. See Objective 6 for more details.

f. *Reasonably expeditious implementation schedule*.

Based on our experience and the scope of work recommended to implement BMPs and critical land-use policies, we estimate a 5- to 10-year implementation schedule to complete the most critical work identified in this report. Table 5 provides a summary of recommended structural and non-structural BMPs with estimated costs, responsible party for implementation, and a projected schedule for substantial completion.

g. *Interim implementation milestones*.

See Table 5.

h. *Load reduction measurement criteria*.

Load reduction measurement will be performed as part of our existing in-lake and tributary water quality monitoring programs. A running 10-year median value for in-lake phosphorus will be calculated annually for both the reference site and all established in-lake sampling locations. The results of the ongoing sampling and analysis will be compared to the project objective of a 4.0 ppb phosphorus concentration.

i. *Implementation effectiveness monitoring*.

Effectiveness monitoring will be performed by annually reviewing the running, in-lake, 10-year median phosphorus concentration following each sampling year. We will report our results to the watershed Towns, NHDES and NLRA constituency annually. We commit to working with our town, State and private-sector partners to take necessary and practical steps required to meet or exceed our target phosphorus concentration.

Objective 5: *Provide local Planning Boards and general public with maps and critical information using GIS Analysis and Reporting that Supports Land-use Planning, Strategic Communications, Education and Outreach.*

Measures of Success: Data-based policy documents that support Low-Impact Development, water quality protection, and eco-system scale land use planning and implementation.

Results: The project planning team (Dan Sundquist, GreenFire GIS; Steve Whitman, Jeffrey Taylor& Associates; Boyd Smith, NLRA Director) worked extensively with engaged watershed planning boards, most notably the Town of Groton, to improve land-use planning policies and guidelines that protect water quality. Planning Boards vary in their level of interest and engagement. While we have been responsive to all Planning Board requests, their engagement has been somewhat limited. Thus, production of useful, long-duration data such as maps and summary reports, has been a critical part of our work under this objective.

The capstone of Objective 5 and our greatest measure of success is a comprehensive natural-resource co-occurrence map set prepared for each town, a build-out analysis that predicts 15- and 30-year development, and a detailed study of the Fowler River watershed and aquifer that demonstrates the need for, and value of, conservation-oriented land-use planning. The Greenfire GIS technical report that contains this powerful and compelling information is provided in Appendix F**,** with highlights summarized below.

Map Set. Each map set shows natural resources and their co-occurrence across the watershed, thus identifying areas where development should be avoided or is already constrained. The maps are augmented by a detailed technical report that provides methodology and applications of the map data to a) identify high-value natural resources for conservation and protection, and b) identify areas of constraints to development. Combined, these focal points also identify where development could best fit with the *Every Acre Counts* watershed vision and achieve the overall desired project outcome.

Highlights of the GIS land cover and mapping analysis are presented in Table 6 and are summarized as follows:

- The watershed contains significant areas classified as high-quality habitat by the NH Fish and Game Department. The majority of Newfound's high-quality water comes from the more than 100 miles of headwater streams that originate in the uplands and flow through large, unfragmented forest blocks before reaching the larger drainage networks within the major valleys of the watershed.

- Twelve (12) critical natural resources were mapped (wetlands, riparian buffers, floodplains, aquifers, steep slopes (>25%), highly erodible soils, future well sites, wellhead protection areas, Wildlife Action Plan (WAP) Tier I, Tier II and special habitat types, and prime agricultural soils).

- Only a small portion (6% - 33%) of the above critical natural resources are permanently protected from development with conservation easements or as public lands. The highest percentages of protection (20% - 33%) apply to steep slopes, highly erodible soils, and the three listed WAP habitats, which are typically co-located at higher elevations with existing conservation or public land.

The mapping and co-occurrence analysis clearly indicate that large portions of the watershed are vulnerable to development in areas not well suited for growth, and that land-use policies and guidelines will be required in the near term to prevent degradation of environmental and economic conditions.

Build-out Analysis. The build-out analysis uses watershed data on land use and population growth to predict where development is most likely to occur in the 15- and 30-year timeframes. Highlights of the build-out analysis are summarized as follows:

- Building (primarily residential) in the watershed Towns has increased at a 1% / year average between 2000 and 2012, similar to the State-wide average**.** This conservative growth rate, which spans the Great Recession, was used to predict 15- and 30-year build outs.

- Lot size and development patterns were determined by analyzing 17 existing developments in the watershed. In general, building density is much higher at the south end of the lake (Bristol) and decreases to the north (Groton) and away from the lake (Alexandria).

- In 15 years, an additional 1,113 structures could be built, and in 30 years an additional 2,349 structures could be added. These predicted increases are 30% and 63%, respectively, over the 2010 baseline of 3,740 structures.

As summarized in Table 3, under current conditions and a reasonable scenario of 30% growth (30 years) and 10% forest clearing, if mitigating steps are not taken Newfound clarity is predicted to decrease from 7.3 m to 4.9 m, and average phosphorus concentration to increase from 4.0 ppb to 8.5 ppb. ***The critical mitigating measure to prevent this very undesirable outcome would be no net runoff from all changes in land use (structures, roads and forestry operations). That is, hydrology and nutrient transport would not be affected by changing land use from its natural state.***

Fowler River Watershed Analysis. The Fowler River watershed was selected for more detailed study and scenario planning related to the watershed build-out analysis for the following reasons:

- The Fowler River drainage area totals about 36 square miles, or 37% of the total Newfound Lake watershed.

- It contains a rural-to-urban land use continuum that matches the watershed-wide development character.

- Alexandria is predicted to have the largest share and a significant numerical increase in new construction based on the build-out model.

- Water quality sampling and analysis indicate that the Fowler River watershed contributes 48% of the total phosphorus load to Newfound Lake.

In addition, the largest aquifer in the watershed underlies the lower Fowler River valley and serves 3,327 residents of Bristol. The co-occurring open space and its related scenic value, and an unusually high concentration of rare, prime agricultural soil, makes this area incredibly valuable for careful stewardship and long-term protection from careless development.

Essentially, this portion of the Greenfire GIS report identifies where development will occur under the current regulatory structure, and clearly illustrates where predicted growth will encroach on the primary recharge area of the aquifer and the overlying prime agricultural soils. Our intention and hope is that all watershed towns will take active steps to guide future growth away from their most valuable and vulnerable resources that protect water quality, provide capacity for local food production, and create the aesthetic appeal of the region's much-desired rural character.

Objective 6: *Strategic Communications to Create Sustainable, Long-term Local Support and Action for Watershed-scale Water Quality Protection.*

Measures of Success: Adoption of Every Acre Counts in Bristol and Groton, adoption of one or more critical anti-degradation ordinances in at least 3 watershed towns by 2014.

Results: This has been the most difficult Objective to achieve our stated measures of success, in large part because the behavior of Town planning boards and the voting public is out of our control, and external groups have limited influence over town management decisions. While Groton has been well-engaged with our planning team, only Alexandria and Hebron have adopted *Every Acre Counts* in to their Town master plans during an earlier project phase. While the defined measures of success for Objective 6 have not yet been completely achieved, progress is being made based on increasing solicitations for assistance and questions about stormwater mitigation brought to the NLRA by town officials, homeowners associations, and residents and the collaborative projects in Bristol and Hebron discussed earlier in this report.

Our strategy for communications continues to focus on the **Why** and **How** of stormwater runoff control. We are continually seeking ways to make our message more compelling, consistent, focused, and action-oriented. Our guiding principles:

- **Why**. We craft our message around the answer to the question "what's in it for me?". Homeowners benefit by reducing erosion on their property and recharging their groundwater supplies, as well as maintaining clean water (especially waterfront property owners). Towns benefit by reducing costs from damage to infrastructure and by improving access and public safety during heavy rains and floods. Overall land-management that maintains the watershed's clean water and forested hills protects the quality of life and economic vitality of the region, a clear (but harder to recognize) benefit to all.

- **How**. We continually refer to the NHDES Homeowner's Guide to BMPs **http://des.nh.gov/organization/divisions/water/wmb/was/index.htm** for residents and businesses; have developed watershed-specific natural resource analysis and maps that identify sensitive habitats, most suitable areas to build, and constraints to development (see Objective 5); have published Fact Sheets and white papers for steep slopes, erodible soils and Low-Impact Development (see Appendix G); held public workshops and presentations to share information; and provided recommended priorities for BMPs that will improve infrastructure and reduce stormwater pollution (see Objective 3). *The NLRA's mission is to protect the water quality and economic vitality of the Newfound watershed, and we consistently carry this message to the public as part of our culture and daily operations.*

While we have been unable to make rapid progress in natural resource protection through the avenues of municipal land-use planning, a partnership led by the NLRA, the Forest Society, and the Lakes Region Conservation Trust has managed to conserve roughly 2,000 acres of high quality habitat, with a strong focus on water quality protection, since 2010. This partnership continues to become more effective at accelerating the pace of land conservation in the watershed, with current emphasis on large, upper elevation tracts that are the source of headwater streams.

It is clear that meeting Objective 6 will require both a long period of time and more involved local citizens that have the right to vote and shape decisions in the watershed towns. We are adjusting our strategy from a Planning Board focus to identifying voting residents, and encouraging them to become informed and effective advocates for low-impact development and sustainable land use within their towns. Coupled with the foundation established among town planning boards and our land conservation efforts, and the SOAK program informed by the Acton-Wakefield Watershed Alliance, we expect substantial progress over the coming years.

Objective 7*: Administration and Organizational Capacity to Develop and Sustain Grass-roots Watershed Protection.*

Measures of Success: Sustainable grass-roots support for the NLRA and Watershed Master Plan implementation. Sustainability of NLRA as leading advocate for Newfound Region anti-degradation policies and procedures. Local "Watershed Coalition" that advocates for land-use and other local controls to protect water quality.

Results: Critical results include continued membership of five watershed towns in NLRA; high level of credibility of Watershed team and project with local Boards and general public; celebration of NLRA's 43d anniversary in 2014; our two most successful fundraising years

(2013 and 2014); increasing the number of major donors by nearly 50% in 2013; and building an organizational structure with fully-staffed committees for key functions (Communications, Development and Membership, Programs, and Governance).

As noted previously, a town Board-based coalition that implements land-use regulations and policies has not been created. However, the number of people, associations and towns that have been directly engaged in stormwater mitigation has increased (e.g. Cummings Beach, Stonegate, Sleepy Hollow, and summer camp projects). Based on the growing number of inquiries the NLRA receives about stormwater problems, our sense is that broader awareness and increasing levels of action are becoming the social norm.

Conclusions and Recommendations

From our November 2011 Project Outcome Statement: *Our desired outcome for this project is sustainable, watershed-scale stewardship to maintain Newfound's High Quality Water status. The primary measure of success is maintaining Newfound Lake's oligotrophic status and median phosphorus concentration of 4 micrograms / liter.*

Based on the most recent 10-year median in-lake phosphorus concentration of 3.5 ppb at the reference site (4.2 ppb overall in-lake average), we continue to meet our primary measure of success. However, there are real and growing threats to Newfound's water quality that are yet to be addressed. Under reasonable rates of growth and land use, the lack of land-use planning and controls strongly suggests that water quality will decline substantially in the next 15 to 30 years. Predicted water quality degradation would seriously undermine the local economy and damage the Newfound region's unique quality of life. The incremental and relatively slow pace of environmental degradation makes it difficult to rally the public commitment required to prevent drastic and unwanted changes in the watershed.

The critical mitigating measure to prevent this very undesirable outcome would be no net runoff from all changes in land use (structures, roads and forestry operations). That is, hydrology and nutrient transport would not be affected by changing land use from its natural state.

Our strategy of bottom-up / top-down measures remains to be fully implemented, and we have learned that focusing too much effort on local Planning Boards as an organization may not be the most effective way to develop and adopt progressive land-use regulations and policy. Rather, engaging and building a critical mass of informed voting and taxpaying stakeholders to advocate for sustainable land use policy is needed to encourage and support local Boards in their policy development and decision making.

Substantial stormwater prevention projects that engage multiple stakeholders have been a successful approach to protecting water quality and educating and engaging the public and town officials in the stewardship required to maintain clean water and healthy forests for the long term. These projects require vision, local leadership, collaboration, persistence and funding. We plan to continue seeking opportunities for large-scale, impactful collaborations. The NLRA Trustees have also committed to a SOAK-based model to engage more waterfront property owners in stewardship of their land to prevent stormwater pollution, as well as to build

membership for the NLRA and increase the number of potential advocates for town-level planning.

There is a serious and substantial disconnect between the common visions and principles for the Newfound watershed and the individual and town actions required to achieve the vision. While this disconnect exists, Newfound's clean water, healthy forests and rural character are at risk from poorly planned development, failing transportation infrastructure and badly managed land use, including forestry activities. The NLRA will continue to seek compelling and action-oriented ways to engage and motivate key stakeholders to take steps that ensure the watershed will remain as healthy and breathtakingly beautiful for years to come.

Acknowledgements

The financial support provided for this work through the EPA, and the knowledge, expertise and commitment of our partners at DES have made this complex and ambitious project possible. In addition to the DES and EPA, we wish to thank the following members of the project team for their years of helpful engagement, professional expertise, and passion in support of *Every Acre Counts*: The University of New Hampshire-Center for Freshwater Biology (Bob Craycraft and Jeffrey Schloss); The Forest Society and GreenfireGIS (Dan Sundquist); Jeffrey A. Taylor & Associates (Steve Whitman); Plymouth State University (Brian Eisenhauer, June Hammond-Rowan, Mary Ann McGarry and the students of the Center for the Environment); the Newfound Area School District (Chris Duggan and Jim LaBaron for Awakening the Senses); the many contributors to technical reports included in *Every Acre Counts*, Volume II (with special thanks to Katie Callahan of the NH Fish & Game Department for early watershed GIS mapping); and the members and Trustees of the NLRA.

While the changes in land-use behavior required to permanently protect our clean water have not fully come to pass, we have learned that it is a slow process that requires patience, persistence, local leadership and vision, with positive examples that engage residents a major source of success. The products and outcomes created by the *Every Acre Counts* project team have laid an excellent foundation for long-term protection of the Newfound watershed.

The NLRA deeply appreciates having the opportunity, and the tools, to continue striving for the *Every Acre Counts* watershed vision.

Newfound Watershed Vision:

We envision a Newfound Watershed where quality of life and economic vitality continue to be fostered by stewardship and sustainable use of the Watershed's natural resources, where land uses and development are balanced with conservation, and where the current water quantity and water quality have been maintained.

October 6, 2009

FIGURE 1 – Newfound Lake Watershed Locus
A through I Summary Addendum Report
December 2014

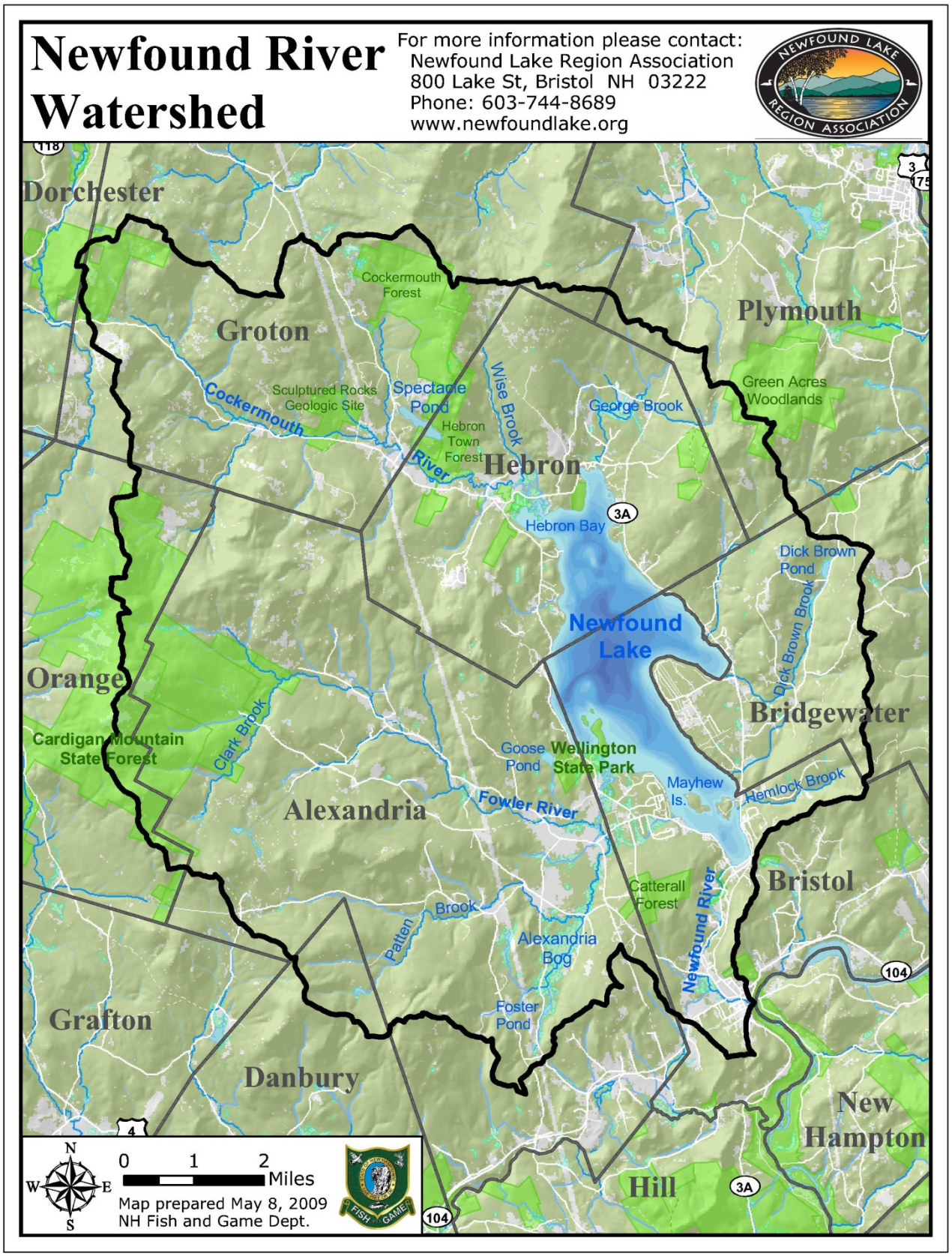
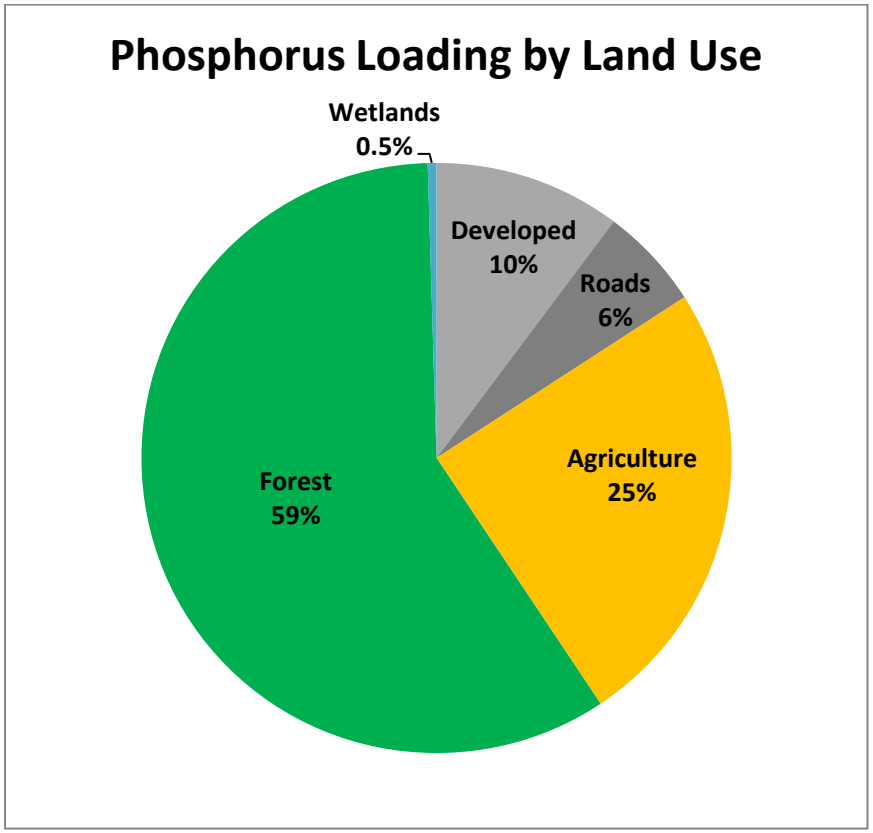


FIGURE 2 – Land Cover Types and Phosphorus Loading
A through I Summary Addendum Report
December 2014



P-load intensity

Land cover	**P-load, lb/ha-yr**	**Rank**
Developed	0.307051	3
Roads	0.632436	1
Agriculture	0.456672	2
Forest	0.046348	4
Wetlands	0.026149	5

Land Use Summary	**Hectares**	**Acres**	**% Area**
Residential	456	1,127	2.1
Roads	101	250	0.5
Fields and Crops	815	2,014	3.8
Forest	19,116	47,236	88.7
Wetland/Scrub/Cleared	1053	2,602	4.9
TOTAL	**21,541**	**53,228**	**100**

1 Hectare=2.471 acres

Data from FB Environmental (Appendix D) and GreenfireGIS (Appendix F)

Overall Priority	Site #	Site Description	Town	Recommendations	Sediment (t/yr)	P (lbs/yr)	N (lbs/yr)	BMP Cost Estimate (Labor and Materials Only)	BMP Annual Maintenance Cost Estimate	10-yr Cost
1	20	Rankin Road	Bridgewater	Need road engineer to assess	179.5	179.5	359.0	$16,000	$350	$19,500
2	67	Ditch culvert, Sculpture Rocks Rd	Groton	Vegetate ditch, armor ditch with stone, reshape ditch, install check dams, fix road shoulder	40.8	40.8	81.6	$5,550	$250	$8,050
3	74	Pike Hill Rd	Hebron	Armor ditch with stone, armor areas where seeps enter ditch and stabilize back walls	13.3	13.3	26.6	$1,625	$100	$2,625
4	56	Orange Rd, parallel to stream	Groton	Grade road, add new surface material to road, add riprap where it diverts into stream	21.8	21.8	43.5	$3,940	$500	$8,940
5	90	Bog Rd north of Cross Rd	Alexandria	Vegetate hillside slope eroding to gullies, install ditch with check dams and turnouts	16.9	16.9	33.8	$4,500	$275	$7,250
6	68	Ditch culvert, North Groton Rd	Groton	Armor ditch with stone, reshape ditch, install turnouts or check dams	9.8	9.8	19.6	$3,000	$125	$4,250
7	99	Hillside seeps/ditch erosion on Pike Hill Rd south of Wade Hill and north of New 18	Hebron	Armor ditch with stone, stabilize/armor were seeps enter ditch from Hillside	12.1	12.1	24.3	$3,500	$225	$5,750
8	85	North Groton Rd shoulder and bank slumping into stream	Groton	Riprap or stabilization geo web with hydro seeding to stabilize Rd shoulder/streambank	10.2	10.2	20.4	$3,500	$250	$6,000
9	100	Ditch erosion at stream crossing north of high meadows Rd	Bridgewater	Armor ditch with stone, install turnouts	6.1	6.1	12.3	$3,000	$200	$5,000
10	84	North Groton Rd streambank undercutting/slumping	Groton	Streambank stabilization	20.4	20.4	40.8	$12,000	$500	$17,000
11	26	Stream crossing- Shem Valley Rd	Alexandria	Armor ditch with stone, reshape ditch, add new surface material to road, add to buffer	6.8	6.8	13.6	$3,820	$200	$5,820
12	29	Stream crossing and ditches to SC109- Brock Hill Rd	Bridgewater	Armor ditch with stone, install turnouts before crossing into woods with plunge pool, install ditch	6.4	6.4	12.8	$4,763	$275	$7,513
13	50	Ditch culvert and stream crossing at Dick Brown Rd	Bridgewater	Armor culvert inlet/outlet, armor ditch with stone, reshape ditch, install turnouts	2.4	2.4	4.8	$2,525	$200	$4,525

Overall Priority	Site #	Site Description	Town	Recommendations	Sediment (t/yr)	P (lbs/yr)	N (lbs/yr)	BMP Cost Estimate (Labor and Materials Only)	BMP Annual Maintenance Cost Estimate	10-yr Cost
14	11	Multiple gullies along road to stream	Alexandria	Armor ditch with stone, reshape ditch. Install ditch to reduce sediment into stream	3.4	2.4	7.0	$2,413	$225	$4,663
15	97	Shore Rd beach (north end) gullies	Bristol	Armor and install detention basin/settling basin at outlet, redirect flow away from beach	1.4	1.4	2.8	$540	$275	$3,290
16	22	Stream Crossing- Cream Hill Rd	Alexandria	Armor inlet/outlet, add new surface material to road, create ditch and better turnouts	2.3	2.3	4.3	$3,085	$275	$5,835
17	82	Severe gully erosion and road erosion - Sculptured Rocks Rd	Groton	Add new surface material to road, reshape (crown) road, grade road and pitch away from stream, vegetate shoulder	1.7	1.7	3.4	$1,860	$250	$4,360
18	92	Washburn Rd stream crossing	Alexandria	Vegetate road shoulder and stabilize shoulder at culvert, install ditch with turnouts, check dams and plunge pool. Stabilize ditch with rock	1.8	1.8	3.6	$3,450	$275	$6,200
19	96	Culvert outlet at Shore Rd beach	Bristol	Armor outlet with rock and create detention area or redirect flow away from beach and lake	0.6	0.6	1.1	$540	$200	$2,540
20	103	South of site 50- Dick Brown Rd shoulder gully into stream	Bridgewater	Armor inlet/outlet, install ditch and armor with stone	1.2	1.2	2.6	$3,500	$200	$5,500
21	98	Stream crossing Pike Hill Rd (north of Rd gradient site 13)	Hebron	Armor inlet, vegetate and stabilize shoulder	0.6	0.5	1.1	$1,325	$200	$3,325
22	94	Burns Hill at Thissel Rd- ditch culvert near DC0113	Alexandria	Armor inlet and stabilize slumping or road shoulder, fix turnouts, install detention basin	0.3	0.3	0.7	$2,744	$275	$5,494
23	89	Shoulder erosion into stream with gullies- Brook Rd	Alexandria	Add to buffer, pitch road away from stream toward existing ditch and stabilize	0.2	0.2	0.5	$3,280	$175	$5,030
24	83	Sculptured rocks Rd. gully erosion next turn off	Groton	Reshape ditch, armor ditch with stone, build-up and add new surface material to road, reshape road & grade road	14.8	14.8	29.6	$3,085	$250	$5,585
25	104	Ditch to cross culvert turnout (gulley) Brock Hill Rd	Bridgewater	Install ditch and armor with stone. Create better turnout to prevent sediment from entering stream.	23.5	23.5	47.1	$6,050	$300	$9,050
26	91	Lakeview Heights down slope from Rd gradient site 7	Alexandria	Reshape (crown) road, grade road, install ditch on east side o road to cross culvert or turnout	8.5	8.5	16.9	$4,960	$200	$6,960

Overall Priority	Site #	Site Description	Town	Recommendations	Sediment (t/yr)	P (lbs/yr)	N (lbs/yr)	BMP Cost Estimate (Labor and Materials Only)	BMP Annual Maintenance Cost Estimate	10-yr Cost
27	27	Washburn Rd at end	Alexandria	Downstream ditch needs check dams and rock to slow flow and collect sediment, vegetate ditch, install turnouts and add rock/level spreader at end, vegetate shoulder upstream to stabilize inlet near Rd	5.3	5.3	10.6	$2,675	$200	$4,675
28	4B	Shem Valley Rd end	Alexandria	Armor ditch with stone, reshape ditch	3.9	3.9	7.8	$2,100	$200	$4,100
29	79	Stream crossing- Gove and Welton Falls Rd	Alexandria	Vegetate shoulder, add to buffer/ allow to naturally re-vegetate/don't mow, create ditch and turnout and stabilize	2.6	2.6	4.2	$2,325	$250	$4,825
30	49	Stream crossing on West Shore Rd at the Ledges Condos	Alexandria	Add to buffer, don't mow to bank, remove pavement around culvert on road shoulder and add permeable surface, direct water to buffers instead of into stream	1.2	1.2	2.4	$2,220	$100	$3,220
31	101	Ditch erosion to cross culvert into stream and erosion from Dick Brown Rd into stream	Bridgewater	Vegetate/stabilize road shoulder, install ditch & armor with stone	1.3	1.3	2.5	$2,475	$125	$3,725
32	24	Wicum Rd/Route 3A culvert to lake	Bristol	Armor inlet/outlet, armor ditch with stone and allow to vegetate	1.3	1.3	2.6	$1,725	$200	$3,725
33	102	Crossing on Dick Brown Rd- north of new 21	Bridgewater	Armor outlet, install ditch and turnout to direct water away from crossing, reshape (crown) road to get water into ditch	1.5	1.5	3.1	$3,130	$125	$4,380
34	81	Road erosion (Sculptured Rocks Rd)	Groton	Add new surface material to roadway, reshape (crown) road, grade road	1.2	1.2	2.3	$1,004	$250	$3,504
35	4A	Shem Valley Rd - end	Alexandria	reshape and stabilize shoulder and create turnout away from stream, add to buffer, reseed bare soil and thinning grass	1.3	1.3	2.6	$3,560	$125	$4,810
36	9	Stream Crossing- Bailey Rd	Hebron	Add to buffer, investigate upstream sediment and erosion	1.2	1.2	2.4	$4,800	$100	$5,800
37	87	George Rd- first crossing on unpaved portion from 3A	Hebron	Armor ditch with stone or vegetate shoulder, reshape shoulder, reshape ditch	0.8	0.8	1.6	$1,625	$225	$3,875
38	88	Stream bank erosion on Rd adjacent to stream-Brook Road	Alexandria	Add new surface material to road, reshape (crown) road, vegetate shoulder, add to buffer, pitch road away from stream to a ditch and detention basin	1.6	1.6	3.1	$5,130	$275	$7,880

Overall Priority	Site #	Site Description	Town	Recommendations	Sediment (t/yr)	P (lbs/yr)	N (lbs/yr)	BMP Cost Estimate (Labor and Materials Only)	BMP Annual Maintenance Cost Estimate	10-yr Cost
39	95B	Shore Rd beach in Bristol	Bristol	install curbing along edge of road and direct flow into a retention area to the south of the beach or into a catchbasin	1.3	1.1	2.2	$4,250	$175	$6,000
40	66	Ditch culvert, George Rd	Hebron	Enlarge culvert, vegetate ditch or armor with stone, reshape ditch	0.8	0.8	1.8	$2,250	$225	$4,500
41	2	Shem Valley Rd bridge on way to AMC lodge	Alexandria	Armor ditch with stone, reshape ditch, install proper turnout with plunge pool	0.3	0.3	0.5	$975	$125	$2,225
42	86	Groton Rd upstream of SC031	Hebron	Armor road shoulder with riprap or other stabilization method, add to buffer	0.4	0.4	0.8	$1,790	$125	$3,040
43	7	Lakeview Heights Rd- approaching crossing	Alexandria	Install ditch or reshape and vegetate road shoulder	0.8	0.8	1.6	$4,210	$225	$6,460
44	95A	Shore Rd beach in Bristol	Bristol	stabilize road shoulder, stabilize culvert outlet and install rock basin	0.3	0.3	0.5	$740	$175	$2,490
45	63	Stream crossing outlet of Newfound Lake	Bridgewater	Stabilize foot path to prevent gully on beach (upstream), infiltration steps, stabilize gullies on downstream side of crossing and vegetate	0.2	0.2	0.6	$1,300	$250	$3,800
46	10	Stream crossing- Mt. Cardigan Rd at hodgdon Rd	Alexandria	Reshape shoulder and stabilize or install ditch and turnout	0.1	0.1	0.3	$1,000	$125	$2,250
47	60	Stream crossing at corner of Town Pound Rd and Foster Pond Rd (outlet of Foster Pond)	Alexandria	Remove winter sand, redirect outlet of CB away from stream, stabilize shoreline erosion on Foster Pond Rd. - Insert rock?	0.1	0.1	0.2	$7,050	$300	$10,050
48	21	Stream crossing-Groton Rd	Hebron	Vegetate shoulder	3.4	3.4	6.8	$500	$100	$1,500
49	70	Range Rd site, steep slope with gully erosion	Hebron	Add new surface material to road, grade road - Pitch to ditch and cross culvert to wooded buffer	3.8	3.8	7.8	$5,040	$225	$7,290
50	8	Stream crossing-Brook Rd	Alexandria	Establish buffer, add to buffer	0.9	0.9	1.7	$960	$100	$1,960
51	72	Favor Rd/Rte 3A culvert (lakeside/downstream side of 3A)	Hebron	Armor ditch with stone, vegetate shoulder to stabilize south side of Pasaquay Rd	1.9	1.6	3.3	$1,350	$225	$3,600
52	1	Stream crossing, downstream pull off access area- North Shore Rd	Hebron	Stabilize foot path with infiltration steps, install runoff diverter or waterbar, add to buffer, stabilize parking area with stone	2.1	2.1	4.3	$2,823	$500	$7,823
53	93	Washburn Rd- Fire Dept. site and stream crossing	Alexandria	Shoreline stabilization, add to buffer, remove built-up winter sand in parking lot	0.2	0.2	0.3	$1,784	$125	$3,034
54	14	Ditch culvert, Sculptured Rocks Rd	Groton	Replace culvert with box culvert or large embedded culvert, or armor downstream side	0.0	0.0	0.0	$1,500	$100	$2,500

Overall Priority	Site #	Site Description	Town	Recommendations	Sediment (t/yr)	P (lbs/yr)	N (lbs/yr)	BMP Cost Estimate (Labor and Materials Only)	BMP Annual Maintenance Cost Estimate	10-yr Cost
55	15	Ditch culvert, North Groton Rd	Groton	Armor outlet or replace with larger culvert/box culvert. Culvert currently perched - some erosion downstream.	0.0	0.0	0.0	$1,000	$100	$2,000

TOTALS Top 20 Sites	Sediment (t/yr)	P (lbs/yr)	N (lbs/yr)	BMP Cost Estimate (Labor and Materials Only)	BMP Annual Maintenance Cost Estimate	10-yr Cost
Sum:	359	358	718	$83,110	$5,150	$134,610
Average:	18	18	36	$4,156	$258	$6,731

Source: FBEnvironmental, November 2014 (see Appendix D).

TOTALS All 55 Sites	Sediment (t/yr)	P (lbs/yr)	N (lbs/yr)	BMP Cost Estimate (Labor and Materials Only)	BMP Annual Maintenance Cost Estimate	10-yr Cost
Sum:	447	445	892	$175,845	$11,925	$295,095
Average:	8	8	16	$3,197	$217	$5,365

TABLE 2 - Results
of BMP Construction on Priority Watershed Culverts
A through I Summary Addendum Report
December 2014

Model Basin #	Subshed Name	No. of Impacted Ciulverts	Area of Road and ROW impacted (acres)	Pre-BMP Subshed Load (kg TP/yr)**	P Reduction by BMP (kg TP)**	% Load Reduction**	BMP Cost Estimate	Annual BMP Maint. Cost	10 yr Cost per Kilo TP Removed ($/kg)
BASIN 1	Hemlock Brook	1	0.367	31	0.720	0.02	$19,000	$250	$2,986
BASIN 2	Tilton Brook	2	0.734	32	1.440	0.04	$38,000	$500	$2,986
BASIN 3	Dick Brown Brook	1	0.367	97	0.720	0.01	$19,000	$250	$2,986
BASIN 4	Whittemore Brook	0	NA	NA	NA	NA	NA	NA	NA
BASIN 5	Georges Brook	2	0.734	132	1.440	0.01	$38,000	$500	$2,986
BASIN 6	Cashman Brook	1	0.184	7	0.420	0.06	$19,000	$250	$5,119
BASIN 7	Cockermouth River	10	3.488	827	7.110	0.01	$190,000	$2,500	$3,024
BASIN 8	Mason Brook	1	0.184	33	0.640	0.02	$23,000	$250	$3,984
BASIN 9	Ledges Brook	0	NA	NA	NA	NA	NA	NA	NA
BASIN 10	Wilson/Yellow/Post Office/Barn Brooks	0	NA	NA	NA	NA	NA	NA	NA
BASIN 11	Hebron/Kendell Brooks*	3	0.734	11	0.360	0.03	$57,000	$750	$17,917
BASIN 12	Fowler River	10	3.488	675	7.110	0.01	$190,000	$2,500	$3,024
BASIN 13	Bog Brook	3	1.102	410	2.160	0.01	$57,000	$750	$2,986
BASIN 14	Black Brook	1	0.367	37	0.720	0.02	$19,000	$250	$2,986
BASIN 15	Ungauged shoreline subsheds	7	1.652	279	9.110	0.03	$133,000	$1,750	$1,652
	Totals:	**42**	**13.402**		**31.95**		**$802,000**	**$10,500**	
								Median=	**$2,986**

Notes:

1. NA= No road drainages were prioritized as in need of repair
2. *- Wellington Brook is part of this modeled basin but no road culvert drainages were deemed in high need of mitigation
3. **- Load reported is pre-attenuation load to be consistent and comparable to DES and EPA NPS program procedures for BMP reduction calculations
4. 1 kg ~ 2.2 lb

5. Analysis performed by UNH-CFB, 2013 - 2014.

TABLE 3 – Newfound Lake LLRM Modeling Scenario Summary
A through I Summary Addendum Report – December 2014

(Analysis performed by UNH-CFB, 2013 – 2014)

Comparison of Current Conditions and LLRM Modeled Scenarios with at least 90% Riparian Buffers Maintained								
		Pre-Development	**Current Conditions**	**Loggging 10% cut**	**Loggging 20% cut**	**Loggging 30% cut**	**30 Year Growth**	**30 Year Growth & 10% cut**
Loading								
Watershed Load TP	KG/YR	866	**1585**	2341	3099	3856	2643	3440
Septic Systems	KG/YR	0	**131**	131	131	131	161	161
Total Load TP	KG/YR	992	**1915**	2671	3428	4186	3002	3799
Percent Increase (Decrease)	%	-48		39	79	119	57	98
In-Lake								
Predicted in-lake TP mean	ppb	2.1	**4.0**	5.5	6.9	8.2	6.7	8.5
Predicted Chlorophyl a mean	ppb	1.0	**2.0**	2.6	3.2	3.9	3.2	4
Predicted Peak Chlorophyll	ppb	2.7	**5.4**	7.4	9.4	11.3	9.1	11.7
Predicted Secchi Depth mean	m	10.6	**7.3**	6.2	5.5	5.0	5.5	4.9
Predicted Secchi Maximum	m	14.3	**11**	9.3	8.3	7.5	8.3	7.4

Comparison of Current Conditions and LLRM Modeled Scenarios with less than 90% Riparian Buffers Maintained								
		Current Conditions w/buffers	**Current Conditions**	**Loggging 10% cut**	**Loggging 20% cut**	**Loggging 30% cut**	**30 Year Growth**	**30 Year Growth & 10% cut**
Loading			**Adequate Riparian Buffers Not Maintained for >90% of stream corridors**					
Watershed Load TP	KG/YR	**1585**	1718	2543	3372	4200	2804	3661
Septic Systems	KG/YR	**131**	131	131	131	131	161	161
Total Load TP	KG/YR	**1915**	2048	2873	3701	4530	3163	4020
Percent Increase (Decrease)	%		7	50	93	137	65	110
In-Lake								
Predicted in-lake TP mean	ppb	**4.0**	4.4	5.9	6.9	8.9	7.1	9.0
Predicted Chlorophyl a mean	ppb	**2.0**	2.1	2.8	3.2	4.2	3.3	4.2
Predicted Peak Chlorophyll	ppb	**5.4**	5.9	8.0	9.4	12.2	9.7	12.4
Predicted Secchi Depth mean	m	**7.3**	7.0	5.9	5.5	4.8	5.4	4.8
Predicted Secchi Maximum	m	**11**	10.5	8.9	8.3	7.2	8.1	7.2

Comparison of Current Conditions and LLRM Modeled Scenarios with loss of wetland functions								
		Current Conditions w/wetlands	**Current Conditions**	**Loggging 10% cut**	**Loggging 20% cut**	**Loggging 30% cut**	**30 Year Growth**	**30 Year Growth & 10% cut**
Loading			**Wetlands removed and replaced with low density development**					
Watershed Load TP	KG/YR	**1585**	2835	3144	4075	5145	3309	3986
Septic Systems	KG/YR	**131**	131	131	131	131	161	161
Total Load TP	KG/YR	**1915**	3164	3473	4404	5474	3665	4345
Percent Increase (Decrease)	%		65	81	130	186	91	127
In-Lake								
Predicted in-lake TP mean	ppb	**4.0**	7.0	7.1	8.8	10.7	8.4	9.9
Predicted Chlorophyl a mean	ppb	**2.0**	3.3	3.3	4.1	4.9	3.9	4.6
Predicted Peak Chlorophyll	ppb	**5.4**	9.5	9.7	12.1	14.8	11.4	13.6
Predicted Secchi Depth mean	m	**7.3**	5.4	5.4	4.8	4.4	5.0	4.6
Predicted Secchi Maximum	m	**11**	8.1	8.1	7.2	6.6	7.5	6.9

Comparison of current conditions and LLRM Modeled Scenarios with less than 90% Buffer and wetland function loss								
		Current Conditions w/wetlands &buffers	Current Conditions	Loggging 10% cut	Loggging 20% cut	Loggging 30% cut	30 Year Growth	30 Year Growth & 10% cut
			Forest Cover Converted to Scrub					
Loading			Adequate Riparian Buffers Not Maintained for >93% of stream corridors					
			Wetlands removed and replaced with low density development					
Watershed Load TP	KG/YR	**1585**	2978	3397	4402	5509	3309	4231
Septic Systems	KG/YR	**131**	131	131	131	131	161	161
Total Load TP	KG/YR	**1915**	3307	3727	4731	5510	3668	4590
Percent Increase (Decrease)	%		73	95	147	188	92	140
In-Lake								
Predicted in-lake TP mean	ppb	**4.0**	7.3	7.6	9.5	11.4	8.4	10.5
Predicted Chlorophyl a mean	ppb	**2.0**	3.5	3.6	4.4	5.3	3.9	4.8
Predicted Peak Chlorophyll	ppb	**5.4**	10.0	10.4	13.0	15.8	11.5	14.4
Predicted Secchi Depth mean	m	**7.3**	5.3	5.2	4.7	4.2	5.0	4.4
Predicted Secchi Maximum	m	**11**	8.0	7.8	7.1	6.3	7.5	6.6

TABLE 4 - Ecosystem Services Calculations
A through I Summary Addendum Report
December 2014

		Current Conditions	With and Without Riparian Buffer (RB)				With and Without Wetlands Functions (WT)				With and Without RB andWT Functions			
Model Basin #	Subshed Name	TP Runoff Load (kg/yr)	TP Runoff w/out RB (kg/yr)	TP Runoff Rdctn. from RB (kg/yr)	TP Runoff Rdctn. from RB (%)	Est.cost for equivalent RB BMP**	TP Runoff w/out WT (kg/yr)	TP Runoff Rdctn. from WT (kg/yr)	TP Runoff Rdctn. from WT (%)	Est.cost for equivalent WT BMP**	TP Runoff without RB and WT (kg/yr)**	TP Runoff Rdctn. from RB and WT (kg/yr)	TP Runoff Rdctn. from RB and WT Services (%)	Est.cost for equivalent RB and WT BMP***
BASIN 1	Hemlock Brook	27	28.6	1.6	5.9%	$42,222	38.6	11.6	43.0%	$306,112	40.7	13.7	50.7%	$361,529
BASIN 2	Tilton Brook	18.5	20.1	1.6	8.6%	$42,222	25.7	7.2	38.9%	$190,001	27.9	9.4	50.8%	$248,057
BASIN 3	Dick Brown Brook	75.9	81	5.1	6.7%	$134,584	120.2	44.3	58.4%	$1,169,033	127.3	51.4	67.7%	$1,356,395
BASIN 4	Whittemore Brook	62.9	67.8	4.9	7.8%	$129,306	71.9	9	14.3%	$237,501	77.4	14.5	23.1%	$382,641
BASIN 5	Georges Brook	82.7	89.6	6.9	8.3%	$182,084	141.6	58.9	71.2%	$1,554,312	151.8	69.1	83.6%	$1,823,480
BASIN 6	Cashman Brook*	5.9	5.9	0	0.0%	$0	6.5	0.6	10.2%	$15,833	6.5	0.6	10.2%	$15,833
BASIN 7	Cockermouth River	429.7	472.6	42.9	10.0%	$1,132,088	832	402.3	93.6%	$10,616,295	832	402.3	93.6%	$10,616,295
BASIN 8	Mason Brook	21.7	23.4	1.7	7.8%	$44,861	21.8	0.1	0.5%	$2,639	23.5	1.8	8.3%	$47,500
BASIN 9	Ledges Brook*	17.7	17.7	0	0.0%	$0	25.4	7.7	43.5%	$203,195	25.4	7.7	43.5%	$203,195
BASIN 10	Wilson/Yellow*/Post Office*/Barn Brooks	11.5	11.5	0	0.0%	$0	12.3	0.8	7.0%	$21,111	13.3	1.8	15.7%	$47,500
BASIN 11	Hebron*/Kendell/Wellington Brooks	6.9	6.9	0	0.0%	$0	11.2	4.3	62.3%	$113,473	12.9	6	87.0%	$158,334
BASIN 12	Fowler River	649.5	714.4	64.9	10.0%	$1,712,646	1187.9	538.4	82.9%	$14,207,838	1295.9	646.4	99.5%	$17,057,850
BASIN 13	Bog Brook	297.7	319	21.3	7.2%	$562,086	574.2	276.5	92.9%	$7,296,559	610.1	312.4	104.9%	$8,243,924
BASIN 14	Black Brook	23.1	25	1.9	8.2%	$50,139	56.6	33.5	145.0%	$884,032	60.7	37.6	162.8%	$992,226
BASIN 15	Ungauged shoreline subsheds	152.4	152.4	0	0.0%	$0	282.6	130.2	85.4%	$3,435,848	282.6	130.2	85.4%	$3,435,848
	Totals:	**1883**	**2036**	**153**		**$4,032,239**	**3409**	**1525**		**$40,253,781**	**3588**	**1705**		**$44,990,606**

Notes:

1. *-indicates these tributaries do not currently have adequate buffer width for greater than 90% of their stream corridors
2. ** - Indicates TP runoff with no RB or WF
3. ***- based on median value of construction cost estimates from road stabilization and infiltration/diversion BMP modeling analysis of $26,389 per kilogram TP /yr. Range was $14,599-$158,333.
4. 1kg ~ 2.2 pounds
5. Analysis performed by UNH-CFB, 2013 - 2014.

TABLE 5 – Estimated BMP Implementation Costs and Timeline
A through I Summary Addendum Report
December 2014

BMP	TYPE (1)	EST. COST (2)	RESPONSIBLE PARTY	SCHEDULE (3)
Annually Update in-Lake Median Phosphorus Concentration	NS	$5,000	NLRA	Ongoing
Provide Land-Use Data, Analysis and Recommendations to Towns	NS	$500	NLRA	2015
Initiate Water Watchdog Program	NS	$5,000	NLRA	2015
Provide Ongoing Outreach and Education	NS	$10,000	NLRA	2015
Recruit Local Land-Use Policy Advocates	NS	$5,000	NLRA	2015
Implement Top 20 Sites Identified in FBE Report	S	$134,610	TOWNS	2020
Improve 42 Culverts Identified by UNH	S	$802,000	TOWNS	2025
Adopt Land-Use Regulations and Policies (no net runoff, riparian buffer, wetlands and steep slope protection)	NS	$1,000 / Town	TOWNS	2025
Fully Implement Water Watchdog Program (5-10 projects / year)	S	$10,000 / Yr.	NLRA	2020
Implement Remaining 35 Sites Identified in FBE Report	S	$193,690	TOWNS	2025
Identify and Implement Major Collaborative and Coordinated Stormwater Projects (Towns, Camps and Homeowner Associations)	S	$25,000+/- Project	NLRA AND ENGAGED PARTIES	Ongoing

NOTES:

1. S = Structural and NS = Non-Structural BMP
2. Cost Estimates are order-of-magnitude, except Structural BMPs, which are +/- 10% to 50%. All estimates in 2014 dollars.
3. Schedule represents estimated date for substantial completion.

TABLE 6 - Status of Resource Protection in the Newfound Lake Watershed - 2014
A through I Summary Addendum Report
December 2014

Municipality	Land Area (Ac)	Wetlands	Riparian Buffer	Floodplains	Aquifer	Steep Slopes	Highly Erodilble	Future Well	Wellhead Protection	NHWAP Tier 1	NHWAP Tier 2	Special Habitat Types	Prime Ag Soils	Prime Forest Soils
Alexandria	22,084	737	1,054	350	1,637	4,323	14,671	596	3,015	6,017	4,040	9,321	755	19,107
Bridgewater	5,322	315	197	55	95	877	2,709	9	401	0	3	938	443	4,860
Bristol	2,473	226	91	127	385	252	1,009	30	950	502	241	391	452	2,105
Danbury	855	57	30	0	0	192	486	0	0	477	87	766	0	686
Groton	10,672	159	610	171	530	2,838	8,508	107	0	7,920	261	3,089	114	9,927
Hebron	11,392	432	486	259	785	2,530	8,067	265	344	6,138	292	2,318	300	10,331
Orange	2,057	1	111	0	0	933	1,869	0	0	1,954	631	1,798	0	1,574
Plymouth	1,469	43	47	0	0	551	1,240	0	0	83	62	588	0	507
Watershed Total	**56,326**	**1,970**	**2,626**	**961**	**3,432**	**12,497**	**38,559**	**1,007**	**4,710**	**23,091**	**5,618**	**19,210**	**2,065**	**49,098**
Percent of Watershed		**3.5%**	**4.7%**	**1.7%**	**6.1%**	**22.2%**	**68.5%**	**1.8%**	**8.4%**	**41.0%**	**10.0%**	**34.1%**	**3.7%**	**87.2%**
Total Acres Conserved		**Acres of Resource Conserved In Each Municipality**												
Alexandria	4,583	39	169	0	22	1,271	3,337	15	458	767	1,040	2,928	32	4,226
Bridgewater	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bristol	322	79	7	21	60	4	64	3	255	157	32	47	39	280
Danbury	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Groton	1,837	57	98	1	13	582	1,622	3	0	1,411	149	640	0	1,484
Hebron	1,675	103	94	107	211	515	1,262	73	0	1,716	82	434	57	1,315
Orange	1,456	1	46	0	0	760	1,339	0	0	1,208	477	1,406	0	992
Plymouth	151	0	0	0	0	87	146	0	0	0	59	133	0	6
Watershed Total	**10,024**	**279**	**415**	**129**	**306**	**3,220**	**7,770**	**95**	**713**	**5,258**	**1,838**	**5,587**	**127**	**8,304**
		279.2												
Percent Conserved		**Percent of Resource Conserved In Each Municipality**												
Alexandria	20.8%	5.3%	16.1%	0.0%	1.3%	29.4%	22.7%	2.6%	15.2%	12.7%	25.7%	31.4%	4.2%	22.1%
Bridgewater	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Bristol	13.0%	34.9%	7.6%	16.9%	15.6%	1.4%	6.3%	11.5%	26.8%	31.2%	13.1%	11.9%	8.5%	13.3%
Danbury	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Groton	17.2%	35.7%	16.1%	0.4%	2.5%	20.5%	19.1%	2.6%	0.0%	17.8%	57.1%	20.7%	0.0%	14.9%
Hebron	14.7%	23.9%	19.3%	41.2%	26.8%	20.4%	15.6%	27.6%	0.0%	28.0%	28.0%	18.7%	19.0%	12.7%
Orange	70.8%	100.0%	42.0%	0.0%	0.0%	81.5%	71.6%	0.0%	0.0%	61.8%	75.5%	78.2%	0.0%	63.0%
Plymouth	10.3%	0.0%	0.4%	0.0%	0.0%	15.8%	11.8%	0.0%	0.0%	0.0%	95.8%	22.6%	0.0%	1.2%
Percent Protected	**17.8%**	**14.2%**	**15.8%**	**13.4%**	**8.9%**	**25.8%**	**20.2%**	**9.4%**	**15.1%**	**22.8%**	**32.7%**	**29.1%**	**6.2%**	**16.9%**

Notes:
1. **Analysis performed by GreenfireGIS (see Appendix F).**

Appendix A ~ Grant Agreement (June 20, 2012)

Jeff Marcoux

The State of New Hampshire

Department of Environmental Services

Thomas S. Burack, Commissioner

Celebrating 25 Years of Protecting New Hampshire's Environment

June 1, 2012

APPROVED G & C
DATE 6/20/2012
ITEM # 176

His Excellency, Governor John H. Lynch
and The Honorable Council
State House
Concord, NH 03301

REQUESTED ACTION

Authorize the Department of Environmental Services to enter into an agreement with the Newfound Lake Region Association, Bristol NH, (VC #156100) in the amount of $64,698 to complete the *Newfound Lake Watershed Master Plan Implementation Phase II: Watershed Stewardship Project*, effective upon Governor and Council approval through December 31, 2014. 100% Federal Funds.

Funding is available in the account as follows:

	FY 2012
03-44-44-442010-7602-072-500575	$64,698

Dept. Environmental Services, Surface Water Quality PPG, Grants-Federal

EXPLANATION

The Department of Environmental Services issued a Request For Proposals (RFP) for the 2012 Watershed Assistance and Restoration Grants program. The proposal process is a two-part process involving pre-proposals, and full proposals. Twenty-one pre-proposals were received. The pre-proposals were ranked based on the criteria included in the RFP: water quality benefits; commitment of local support; clarity of project outcomes; tasks matching goals; and, overall quality of the proposal. The eleven highest ranking organizations were invited to attend an interview with DES staff to further discuss the proposed project. Based on results of the interview and available federal grant funding levels, seven projects were selected to submit comprehensive full project proposals. Based on the review of the full proposals, all seven were selected to receive funding. Please see Attachment B for a list of project rankings and review team members.

The DES Watershed Assistance Section focuses on the reduction of nonpoint source (NPS) pollution. NPS pollution occurs when rainfall, snowmelt, or irrigation water runs over land or through the ground, transporting materials which are then deposited into rivers, lakes, and coastal waters, or introduced into the groundwater. Pollutants can include chemicals, sediments, nutrients, and toxics. These materials can have harmful effects on drinking water supplies, recreation, fisheries, and wildlife. Land development or changes in land use can also cause NPS pollution by disrupting the natural hydrology of

a water body, increasing impervious surfaces, and contributing to the loss of aquatic habitat. Watershed Assistance programs address NPS pollution by managing land use and drainage on a watershed scale.

Through previous phases of this project, Newfound Lake Region Association (NLRA) developed a watershed master plan which identified threats to water quality in the 63,150-acre Newfound River Watershed, and began implementing corrective actions. Identified threats to water quality include phosphorus, sediment, and *E, coli* bacteria pollution caused by stormwater runoff. Newfound Lake is currently a high quality waterbody, but long-term monitoring indicates declining clarity and water quality at two deep water sampling stations, and violations of *E. coli* and phosphorus standards from culvert discharges. Additionally, under-developed local land-use ordinances and a lack of enforcement capacity create an increasing threat that unregulated development practices will harm water quality.

This phase of implementation of the watershed master plan will build the local stewardship ethic required to maintain current high-quality conditions. This will be accomplished through several strategic actions. NLRA will enlist the assistance of professional planners to work cooperatively with the watershed towns to develop anti-degradation ordinances. NLRA will also continue working on building local understanding of pollution issues through outreach and communication with watershed stakeholders. This phase of the project will also include updates and expansion of the information contained in the Newfound watershed master plan, and development of watershed maps to help visually convey important information to stakeholders. NLRA will also use accepted predictive models to plan and prioritize best management practice construction to reduce pollutant loading in the watershed. Success will be evaluated through documentation of: municipal adoption of watershed master plan recommendations; implementation of best management practices; completion of plan updates; and completion of other deliverables as detailed in the Grant Agreement.

The total project costs are budgeted at $123,298. DES will provide $64,698 (52%) of the project costs through a federal grant and the Newfound Lake Region Association will provide the remaining costs through cash and in-kind services. A budget breakdown is provided in Attachment A. As required by Section 319 of the Clean Water Act, federal funds provided to this project must be matched by a local, state, or private share of at least 40 percent. In the event that Federal Funds become no longer available, General Funds will not be requested to support this program.

The agreement has been approved by the Office of the Attorney General as to form, execution, and content. We respectfully request your approval.

Thomas S. Burack, Commissioner

GRANT AGREEMENT

Subject: Newfound Lake Watershed Master Plan Implementation Phase II: Watershed Stewardship.

The State of New Hampshire and the Contractor hereby mutually agree as follows:

GENERAL PROVISIONS

1. IDENTIFICATIONS AND DEFINITIONS

1.1 State Agency Name Department of Environmental Services		**1.2 State Agency Address** 29 Hazen Drive Concord, NH 03301	
1.3 Grantee Name Newfound Lake Region Association		**1.4 Grantee Address** 800 Lake Street Bristol, NH 03222	
1.5 Effective Date Upon G&C approval	**1.6 Completion Date** December 31, 2014	**1.7 Audit Date** N/A	**1.8 Grant Limitation** $64,698
1.9 Grant Officer for State Agency Eric Williams, Watershed Assistance Section Supervisor		**1.10 State Agency Telephone Number** 603-271-2358	
1.11 Grantee Signature		**1.12 Name & Title of Grantee Signor** Boyd Smith, Executive Director	
1.13 Acknowledgment: State of New Hampshire, County of GRAFTON On 4/11/2012, before the undersigned officer, personally appeared the person identified in block 1.12., or satisfactorily proven to be the person whose name is signed in block 1.11., and acknowledged that s/he executed this document in the capacity indicated in block 1.12.			
1.13.1 Signature of Notary Public or Justice of the Peace (Seal)		LINDA M. BOLTE, Notary Public My Commission Expires May 16, 2012	
1.13.2 Name & Title of Notary Public or Justice of the Peace			
1.14 State Agency Signature(s) Thomas S. Burack		**1.15 Name/Title of State Agency Signor(s)** Thomas S. Burack, Commissioner	
1.16 Approval by Attorney General's Office (Form, Substance and Execution) **By:** **Attorney, On:** 6/1/2012			
1.17 Approval by the Governor and Council **By:** **On:** / /			

2. **SCOPE OF WORK.** In exchange for grant funds provided by the state of New Hampshire, acting through the agency identified in block 1.1 (hereinafter referred to as "the State"), pursuant to RSA 21-O, the Grantee identified in block 1.3 (hereinafter referred to as "the Grantee"), shall perform that work identified and more particularly described in the scope of work attached hereto as EXHIBIT A (the scope of work being referred to as "the Project").

3. **AREA COVERED.** Except as otherwise specifically provided for herein, the Grantee shall perform the Project in, and with respect to, the state of New Hampshire.

4. **EFFECTIVE DATE; COMPLETION OF PROJECT.**

4.1 This Agreement, and all obligations of the parties hereunder, shall become effective on the date in block 1.5 or on the date of approval of this Agreement by the Governor and Council of the State of New Hampshire whichever is later (hereinafter referred to as "the Effective Date").

4.2 Except as otherwise specifically provided for herein, the Project, including all reports required by this Agreement, shall be completed in ITS entirety prior to the date in block 1.6 (hereinafter referred to as "the Completion Date").

5. **GRANT AMOUNT; LIMITATION ON AMOUNT; VOUCHERS; PAYMENT.**

5.1 The Grant Amount is identified and more particularly described in EXHIBIT B, attached hereto.

5.2 The manner of, and schedule of payment shall be as set forth in EXHIBIT B.

5.3 In accordance with the provisions set forth in EXHIBIT B, and in consideration of the satisfactory performance of the Project, as determined by the State, and as limited by subparagraph 5.5 of these general provisions, the State shall pay the Grantee the Grant Amount. The State shall withhold from the amount otherwise payable to the Grantee under this subparagraph 5.3 those sums required, or permitted, to be withheld pursuant to N.H. RSA 80:7 through 7-c.

5.4 The payment by the State of the Grant amount shall be the only, and the complete, compensation to the Grantee for all expenses, of whatever nature, incurred by the Grantee in the performance hereof, and shall be the only, and the complete, compensation to the Grantee for the Project. The State shall have no liabilities to the Grantee other than the Grant Amount.

5.5 Notwithstanding anything in this Agreement to the contrary, and notwithstanding unexpected circumstances, in no event shall the total of all payments authorized, or actually made, hereunder exceed the Grant limitation set forth in block 1.8 of these general provisions.

6. **COMPLIANCE BY GRANTEE WITH LAWS AND REGULATIONS.** In connection with the performance of the Project, the Grantee shall comply with all statutes, laws, regulations, and orders of federal, state, county, or municipal authorities which shall impose any obligations or duty upon the Grantee, including the acquisition of any and all necessary permits.

7. **RECORDS AND ACCOUNTS.**

7.1 Between the Effective Date and the date seven (7) years after the Completion Date the Grantee shall keep detailed accounts of all expenses incurred in connection with the Project, including, but not limited to, costs of administration, transportation, insurance, telephone calls, and clerical materials and services. Such accounts shall be supported by receipts, invoices, bills and other similar documents.

7.2 Between the Effective Date and the date seven (7) years after the Completion Date, at any time during the Grantee's normal business hours, and as often as the State shall demand, the Grantee shall make available to the State all records pertaining to matters covered by this Agreement. The Grantee shall permit the State to audit, examine, and reproduce such records, and to make audits of all contracts, invoices, materials, payrolls, records or personnel, data (as that term is hereinafter defined), and other information relating to all matters covered by this Agreement. As used in this paragraph, "Grantee" includes all persons, natural or fictional, affiliated with, controlled by, or under common ownership with, the entity identified as the Grantee in block 1.3 of these general provisions.

8. **PERSONNEL.**

8.1 The Grantee shall, at its own expense, provide all personnel necessary to perform the Project. The Grantee warrants that all personnel engaged in the Project shall be qualified to perform such Project, and shall be properly licensed and authorized to perform such Project under all applicable laws.

8.2 The Grantee shall not hire, and it shall not permit any subcontractor, subgrantee, or other person, firm or corporation with whom it is engaged in a combined effort to perform such Project, to hire any person who has a contractual relationship with the State, or who is a State officer or employee, elected or appointed.

8.3 The Grant officer shall be the representative of the State hereunder. In the event of any dispute hereunder, the interpretation of this Agreement by the Grant Officer, and his/her decision on any dispute, shall be final.

9. **DATA: RETENTION OF DATA; ACCESS.**

9.1 As used in this Agreement, the word "data" shall mean all information and things developed or obtained during the performance of, or acquired or developed or obtained during the performance of, or acquired or developed by reason of, this Agreement, including, but not limited to, all studies, reports, files, formulae, surveys, maps, charts, sound recordings, video recordings, pictorial reproductions, drawings, analyses, graphic representations, computer programs, computer printouts, notes, letters, memoranda, papers, and documents, all whether finished or unfinished.

9.2 Between the Effective Date and the Completion Date the Grantee shall grant to the State, or any person designated by it, unrestricted access to all data for examination, duplication, publication, translation, sale, disposal, or for any other purpose whatsoever.

9.3 No data shall be subject to copyright in the United States or any other country by anyone other than the State.

9.4 On and after the Effective Date all data, and any property which has been received from the State or purchased with funds provided for that purpose under this Agreement, shall be the property of the State, and shall be returned to the State upon demand or upon termination of this Agreement for any reason, whichever shall first occur.

9.5 The State, and anyone it shall designate, shall have unrestricted authority to publish, disclose, distribute and otherwise use, in whole or in part, all data.

10. **CONDITIONAL NATURE OF AGREEMENT.**

Notwithstanding anything in this Agreement to the contrary, all obligations of the State hereunder, including without limitation, the continuance of payments hereunder, are contingent upon the availability or continued appropriation of funds, and in no event shall the State be liable for any payments hereunder in excess of such available or appropriated funds. In the event of a reduction or termination of those funds, the State shall have the right to withhold payment until such funds become available, if ever, and shall have the right to terminate this Agreement immediately upon giving the Grantee notice of such termination.

11. **EVENT OF DEFAULT; REMEDIES.**

11.1 Any one or more of the following acts or omissions of the Grantee shall constitute an event of default hereunder (hereinafter referred to as "Events of Default"):

11.1.1 failure to perform the Project satisfactorily or on schedule; or

11.1.2 failure to submit any report required hereunder; or

11.1.3 failure to maintain, or permit access to, the records required hereunder; or

11.1.4 failure to perform any of the other covenants and conditions of this Agreement.

11.2 Upon the occurrence of any Event of Default, the State may take any one, or more, or all, of the following actions:

11.2.1 give the Grantee a written notice specifying the Event of Default and requiring it to be remedied within, in the absence of a greater or lesser specification of time, thirty (30) days from the date of the notice; and if the Event of Default is not timely remedied, terminate this Agreement, effective two (2) days after giving the Grantee notice of termination; and

11.2.2 give the Grantee a written notice specifying the Event of Default and suspending all payments to be made under this Agreement

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and ordering that the portion of the Grant Amount which would otherwise accrue to the grantee during the period from the date of such notice until such time as the State determines that the Grantee has cured the Event of Default shall never be paid to the Grantee; and

11.2.3 set off against any other obligation the State may owe to the Grantee any damages the State suffers by reason of any Event of Default; and

11.2.4 treat the agreement as breached and pursue any of its remedies at law or in equity, or both.

12. **TERMINATION.**

12.1 In the event of any early termination of this Agreement for any reason other than the completion of the Project, the Grantee shall deliver to the Grant Officer, not later than fifteen (15) days after the date of termination, a report (hereinafter referred to as the "Termination Report") describing in detail all Project Work performed, and the Grant Amount earned, to and including the date of termination.

12.2 In the event of Termination under paragraphs 10 or 12.4 of these general provisions, the approval of such a Termination Report by the State shall entitle the Grantee to receive that portion of the Grant amount earned to and including the date of termination.

12.3 In the event of Termination under paragraphs 10 or 12.4 of these general provisions, the approval of such a Termination Report by the State shall in no event relieve the Grantee from any and all liability for damages sustained or incurred by the State as a result of the Grantee's breach of its obligations hereunder.

12.4 Notwithstanding anything in this Agreement to the contrary, either the State or except where notice default has been given to the Grantee hereunder, the Grantee, may terminate this Agreement without cause upon thirty (30) days written notice.

13. **CONFLICT OF INTEREST.** No officer, member or employee of the Grantee and no representative, officer of employee of the State of New Hampshire or of the governing body of the locality or localities in which the Project is to be performed, who exercises any functions or responsibilities in the review or approval of the undertaking or carrying out of such Project, shall participate in any decision relating to this Agreement which affects his or her personal interests or the interest of any corporation, partnership, or association in which he or she is directly or indirectly interested, nor shall he or she have any personal or pecuniary interest, direct or indirect, in this Agreement or the proceeds thereof.

14. **GRANTEE'S RELATION TO THE STATE.** In the performance of this Agreement, the Grantee, its employees, and any subcontractor or subgrantee of the Grantee are in all respects independent contractors, and are neither agents nor employees of the State. Neither the Grantee nor any of its officers, employees, agents, members, subcontractors or subgrantees, shall have authority to bind the State nor are they entitled to any of the benefits, worker's compensation or emoluments provided by the State to its employees.

15. **ASSIGNMENT AND SUBCONTRACTS.** The Grantee shall not assign, or otherwise transfer any interest in this Agreement without the prior written consent of the State. None of the Project Work shall be subcontracted or subgranteed by the Grantee other than as set forth in Exhibit A without the prior written consent of the State.

16. **INDEMNIFICATION.** The Grantee shall defend, indemnify and hold harmless the State, its officers and employees, from and against any and all losses suffered by the State, its officers and employees, and any and all claims, liabilities or penalties asserted against the State, its officers and employees, by or on behalf of any person, on account of, based on, resulting from, arising out of (or which may be claimed to arise out of) the acts or omissions of the Grantee of Subcontractor, or subgrantee or other agent of the Grantee. Notwithstanding the foregoing, nothing herein contained shall be deemed to constitute a waiver of the sovereign immunity of the State, which immunity is hereby reserved to the State. This covenant shall survive the termination of this agreement.

17. **INSURANCE AND BOND.**

17.1 The Grantee shall, at its sole expense, obtain and maintain in force, or shall require any subcontractor, subgrantee or assignee performing Project work to obtain and maintain in force, both for the benefit of the State, the following insurance:

17.1.1 statutory worker's compensation and employees liability insurance for all employees engaged in the performance of the Project, and

17.1.2 comprehensive public liability insurance against all claims of bodily injuries, death or property damage, in amounts not less than $2,000,000 for bodily injury or death any one incident, and $500,000 for property damage in any one incident; and

17.2 The policies described in subparagraph 17.1 of this paragraph shall be the standard form employed in the State of New Hampshire, issued by underwriters acceptable to the State, and authorized to do business in the State of New Hampshire. Each policy shall contain a clause prohibiting cancellation of modification of the policy earlier than ten (10) days after written notice has been received by the State.

18. **WAIVER OF BREACH.** No failure by the State to enforce any provisions hereof after any Event of Default shall be deemed a waiver of its rights with regard to that Event, or any subsequent Event. No express waiver of any Event of Default shall be deemed a waiver of any provisions hereof. No such failure or waiver shall be deemed a waiver of the right of the State to enforce each and all of the provisions hereof upon any further or other default on the part of the Grantee.

19. **NOTICE.** Any notice by a party hereto to the other party shall be deemed to have been duly delivered or given at the time of mailing by certified mail, postage prepaid, in a United States Post Office addressed to the parties at the addresses first above given.

20. **AMENDMENT.** This agreement may be amended, waived or discharged only by an instrument in writing signed by the parties hereto and only after approval of such amendment, waiver or discharge by the Governor and Council of the State of New Hampshire.

21. **CONSTRUCTION OF AGREEMENT AND TERMS.** This Agreement shall be construed in accordance with the law of the State of New Hampshire, and is binding upon and inures to the benefit of the parties and their respective successors and assignees. The captions and contents of the "subject" blank are used only as a matter of convenience, and are not to be considered a part of this Agreement or to be used in determining the intent of the parties hereto.

22. **THIRD PARTIES.** The parties hereto do not intend to benefit any third parties and this Agreement shall not be construed to confer any such benefit.

23. **ENTIRE AGREEMENT.** This Agreement, which may be executed in a number of counterparts, each of which shall be deemed an original, constitutes the entire agreement and understanding between the parties, and supersedes all prior agreements and understandings relating hereto.

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Exhibit A
Scope of Services

The Newfound Lake Region Association (NLRA) shall perform the following tasks as described in the detailed proposal titled Newfound Lake Watershed Master Plan Implementation Phase II: Watershed Stewardship, submitted by the NLRA, dated November 10, 2011:

Objective 1: Shared Environmental Planner to assist Watershed communities with land-use related implementation actions from the 2009 Newfound Watershed Master Plan.
Measures of Success: One or more anti-degradation ordinances per year in up to five Watershed towns prepared for Town meeting.

Deliverable 1: Provide DES with copies of revised and new regulations, ordinances; meeting agendas, attendance, and meeting minutes.

Task 1: Conduct first of three regional meetings with Watershed Towns to provide outreach and education on planning and land-use regulations for water quality protection as identified in the Watershed Master Plan.
Task 2: Conduct second of three regional meetings with Watershed Towns to provide outreach and education on planning and land-use regulations for water quality protection as identified in the Watershed Master Plan.
Task 3: Conduct final regional meeting with Watershed Towns to provide outreach and education on planning and land-use regulations for water quality protection as identified in the Watershed Master Plan.
Task 4: Coordinate with the selected consultant to provide professional planning assistance to update existing or create new anti-degradation regulations and ordinances for Town approvals. This will include meetings with watershed planning boards to provide education and assistance on implementing the watershed master plan. Activities may include work on riparian and steep slope regulations for communities that have not acted on those items yet, low impact development regulations, aquifer, road standards and policies, pollutant loading regulations, and guidance on future land use planning for Master Planning.

- 4a: Scoping Phase of Local Ordinance Updates for 2013 Town Meeting.
- 4b: Drafting Phase of Local Ordinance Updates for 2013 Town Meeting.
- 4c: Scoping Phase of Local Ordinance Updates for 2014 Town Meeting.
- 4d: Drafting Phase of Local Ordinance Updates for 2014 Town Meeting.

Task 5: Conduct first Six-month period of project coordination and communication w/ project team including scheduling and attending team meetings, drafting and reviewing project correspondence, responding to queries from external stakeholders (e.g. Planning Boards) and project-specific invoicing.
Task 6: Conduct second Six-month period of project coordination and communication w/ project team including scheduling and attending team meetings, drafting and reviewing project correspondence, responding to queries from external stakeholders (e.g. Planning Boards) and project-specific invoicing.
Task 7: Complete final period of project coordination and communication w/ project team including scheduling and attending team meetings, drafting and reviewing project correspondence, responding to queries from external stakeholders (e.g. Planning Boards) and project-specific invoicing. .

Objective 2: Educate and motivate individuals, associations and towns to implement stormwater BMPs

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and measure results using Residential Loading Model. Create sustainable stewardship ethic of awareness and action to reduce stormwater impacts on water quality (EPA element "e").
Measures of Success: Two or more Towns, two or more Camps and one or more homeowner associations implement BMPs; BMPs evaluated using Residential Loading Model; Results reported on Water Watchdog web site and other public media.

Deliverable 2: Provide DES with copies of all documentation of BMP construction, and Residential Loading Model (RLM) or other applicable loading model summary with outputs.

Task 8: Complete first of four periods of communications, site visits, instruction on BMPs, pollutant loading models, and Water Watchdog requirements. Implement twelve individual BMPs, and then provide report on outcomes. If fewer than twelve BMPs are implemented, the report shall include discussion of obstacles to achieving that target.
Task 9: Complete second of four periods of communications, site visits, instruction on BMPs, pollutant loading models, and Water Watchdog requirements. Implement twelve individual BMPs, and then provide report on outcomes. If fewer than twelve BMPs are implemented, the report shall include discussion of obstacles to achieving that target.
Task 10: Complete third of four periods of communications, site visits, instruction on BMPs, pollutant loading models, and Water Watchdog requirements. Implement twelve individual BMPs, and then provide report on outcomes. If fewer than twelve BMPs are implemented, the report shall include discussion of obstacles to achieving that target.
Task 11: Complete final period of communications, site visits, instruction on BMPs, pollutant loading models, and Water Watchdog requirements. Implement twelve individual BMPs, and then provide report on outcomes. If fewer than twelve BMPs are implemented, the report shall include discussion of obstacles to achieving that target.

Objective 3: Perform watershed-scale modeling to identify critical needs and locations for BMPs; use model for scenario planning and decision making at municipal level.
Measures of Success: Robust, calibrated model, approved by DES, able to estimate pollution source loads for watershed and Lake assimilation capacity; up to six (6) selected subwatersheds undergo more detailed analysis and scenario planning ("what-if" analysis) to facilitate regulatory and structural BMP selection, prioritization, and funding. Test impact of existing and potential BMPs (e.g. Cummings Beach and unpaved road mitigation / management).

Deliverable 3: Provide DES with documentation of model calibration, sensitivity and predictive analysis; Lake assimilation capacity estimates; BMP prioritization / recommendations.

Task 12: Prepare drafts for NH DES review and submit SSPP for modeling and any additional monitoring.
Task 13: Calibrate annual pollution source loads for each subwatershed from nutrient water budget to STEPL or other appropriate method determined during SSPP process. Submit to NHDES for review and approval.
Task 14: Select best/most appropriate models or model combinations to predict Phosphorus, Secchi Disk, Chlorophyll-a and algal bloom possibility; for maintaining target Phosphorus as well as conducting what-if scenarios.
Task 15: Run models using incorporated planned BMPs to predict impact from implementation of

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practices.
Task 16: Work with SPNHF to create graphics and visuals of annual pollution loadings, build out consequences, and current and potential future water quality conditions for outreach programs and web site.
Task 17: Develop shoreline and tributary septic system survey.
Task 18: Conduct "Following the Flow" training for intensive Watershed NPS survey. The FTF training is the basis for the BMP site runoff assessment, provides a systems based approach to help focus/prioritize the specific areas to address with BMPs. Apply FTF training to Objective 2 BMPs as well as later BMP opportunities.
Task 19: Review and summarize Watershed NPS survey results (from model and field observations), prioritize problem sites.
Task 20: Develop a set of criteria or statistical analysis that can be used to determine whether the desired phosphorus loading is being achieved over time.
Task 21: Develop a monitoring component to existing LLMP program to evaluate the effectiveness of the implementation efforts over time.

Objective 4: Complete EPA Element a - i gap analysis and summary report addendum for the 2009 Watershed Master Plan.

Measures of Success: Review existing documents and Watershed Model output to create an addendum to Every Acre Counts that integrates EPA a through i key elements for watershed-based plans into the updated version of Every Acre Counts watershed master plan.

Deliverable 4: Provide DES with draft summary report addendum to Every Acre Counts watershed master plan as well as a finalized version incorporating review comments.

Task 22: Complete a gap analysis and use of Phase I and II implementation results to address EPA a through i requirements. Complete an addendum to the October 2009 Watershed Management Plan which brings the plan into full agreement with EPA a through i watershed plan elements.

Task 22a: Identify current and future pollution sources (EPA element "a") by coordinating with the University of New Hampshire (UNH) to model stormwater runoff (volume and peak flows for 2, 10, 25, 50, and 100 year storm) and annual sediment/pollution source loads for each subwatershed using Hydrocad, STEPL or other approved methods according to approved SSPP.

Task 22b: Estimate pollution reductions needed from current and future sources to achieve watershed protection goals (EPA element "b") by coordinating with UNH to run various scenarios of STEPL or other tools to develop stormwater runoff and pollutant load reduction estimates for BMPs installed throughout the watershed.

Task 22c: Generate a description of the BMPs that will need to be implemented to achieve the load reductions (EPA element "c") estimated under Task 22b (as well as to achieve other watershed goals identified in *Every Acre Counts)*, and an identification of the critical areas in which BMPs will be needed to implement the plan.

Task 22d: Generate and estimate of the amounts of technical and financial assistance needed, associated costs, and /or the sources and authorities that will be relied upon, to implement this plan (EPA element "d")

Task 22e: Develop a schedule for implementing the NPS management measures (BMPs) identified in *Every Acre Counts* that is realistic and achievable (EPA element "f")

Task 22f: Develop a set of interim, measurable milestones for determining whether BMPs and pollutant load reduction strategies are being implemented throughout the Newfound watershed (EPA element "g")

Task 22g: Develop a set of criteria that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made in support of the established water quality goal for Newfound Lake (EPA element "h"). Criteria within the plan may need revisions if progress toward the goal is

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not being achieved.

Objective 5: Provide local Planning Boards and general public with maps and critical information using GIS Analysis and Reporting that Supports Land-use Planning, Strategic Communications, Education and Outreach.
Measures of Success: Data-based policy documents that support Low-Impact Development, water quality protection, and eco-system scale land use planning and implementation

Deliverable 5: Provide DES with electronic copies of land-use maps, statistics and technical support used at public meetings and with project team (see Tasks below for detailed Verification materials). DES must approve materials prior to publication.

Task 23: Expand and update GIS database by generating detailed land cover/land use mapping for use in water quality modeling, including land-cover/land-use time series 2002 - 2010. Merge key soils characteristics and slope data.
Task 24: Coordinate GIS with other Tasks through team meetings (allow 3); meetings with Shared Planner (allow 1); meetings for water monitoring (allow 1); community outreach meetings with Shared Planner (allow 10). Verification includes documentation of meeting attendance.
Task 25: Output & update modeling parameter and water quality statistics at a subwatershed level; develop regional & community statistics; update current resource protection status. Verification includes digital copies of data and summary memorandum.
Task 26: Design & develop base maps and templates; expand and detail map sets for each of the five major Watershed communities (2 maps / set); document GIS processing, mapping and statistics in summary report.
Task 27: Conduct water quality/build-out analysis for Bristol and Alexandria. Generate development scenario on Fowler River aquifer. Assist with build-out community cost analysis. Verification includes digital copy of maps and documentation of meeting attendance.

Objective 6: Strategic Communications to Create Sustainable, Long-term Local Support and Action for Watershed-scale Water Quality Protection.
Measures of Success: Adoption of Every Acre Counts in Bristol and Groton, adoption of one or more critical anti-degradation ordinances in at least 3 watershed towns by 2014

Deliverable 6: Provide DES with copies of articles for local media; links to Web and FaceBook site updates; NLRA Newsletters; meeting attendance and minutes; links to Web site, documentation of Planning Board and Town Meeting decisions. All materials must be approved by DES prior to publication.

Task 28: Continue WMP Series in local paper. Submit at least two (2) feature articles in the first year of the project period for inclusion in the paper. Verification includes copies of articles submitted and/or published.
Task 29: Continue WMP Series in local paper. Submit at least two (2) feature articles in the second year of the project period for inclusion in the paper. Verification includes copies of articles submitted and/or published.
Task 30: Continue to utilize NLRA web and social networking sites for public education and outreach. Include reports, results and graphics from key project elements (e.g. modeling, land-use mapping, Water

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Watchdog).
Task 31: Include at least one project-related article in each issue of the NLRA eNewsletter (mailed to ~650 members and distributed locally twice during the first year of the project period)
Task 32: Include at least one project-related article in each issue of the NLRA eNewsletter (mailed to ~650 members and distributed locally twice during the second year of the project period)
Task 33: Sponsor at least one public presentation per year on the Plan implementation status and needs during the first year of the project period. Verification includes announcements, agendas, attendance list and meeting minutes.
Task 34: Sponsor at least one public presentation per year on the Plan implementation status and needs during the second year of the project period. Verification includes announcements, agendas, attendance list and meeting minutes.
Task 35: During the first year of the project period, continue development of an interactive, Web-based project information center hosted on NLRA web site. Use Drupal or similar technology to allow interactive content and database management. Verification includes link to operating site and summary report on methods and results.
Task 36: During the second year of the project period, continue development of an interactive, Web-based project information center hosted on NLRA web site. Use Drupal or similar technology to allow interactive content and database management. Verification includes link to operating site and summary report on methods and results.

Objective 7: Administration and Organizational Capacity to Develop and Sustain Grass-roots Watershed Protection.
Measures of Success: Sustainable grass-roots support for the NLRA and Watershed Master Plan implementation. Sustainability of NLRA as leading advocate for Newfound Region antidegradation policies and procedures. Local "Watershed Coalition" that advocates for land-use and other local controls to protect water quality.

Deliverable 7: Provide DES with copies of all project reports, and completed subcontractor agreements. DES must approve subcontractor agreements prior to execution.

Task 37: Complete first of four periods of project Management to include DES administrative and reporting requirements. Verification includes one (1) semi-annual report to DES and executed subcontractor agreements.
Task 38: Complete second of four periods of project Management to include DES administrative and reporting requirements. Verification includes one (1) semi-annual report to DES.
Task 39: Complete third of four periods of project Management to include DES administrative and reporting requirements. Verification includes one (1) semi-annual report to DES.
Task 40: Complete final period of project Management to include DES administrative and reporting requirements. Verification includes one (1) comprehensive final report to DES documenting project outcomes in compliance with DES and EPA requirements for Section 319 grant final reports.
Task 41: During the first year of the project period, build local watershed protection capacity by recruiting and retaining local leadership to develop and implement water resource protection policy. Build NLRA Board of Directors (ten or more members), financial strength (balanced budget) and local credibility (at least four watershed Towns members in NLRA). Develop and sustain local watershed coalition that represents at least 3 watershed towns in efforts to prevent NPS pollution. Submit annual reports for Watershed Towns, meet with Select and Planning Boards of at least 3 Watershed Towns at least once / year. Verification includes meeting agendas; attendance and minutes; copies of annual

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report submittals.
Task 42: During the second year of the project period, build local watershed protection capacity by recruiting and retaining local leadership to develop and implement water resource protection policy. Build NLRA Board of Directors (ten or more members), financial strength (balanced budget) and local credibility (at least four watershed Towns members in NLRA). Develop and sustain local watershed coalition that represents at least 3 watershed towns in efforts to prevent NPS pollution. Submit annual reports for Watershed Towns, meet with Select and Planning Boards of at least 3 Watershed Towns at least once / year. Verification includes meeting agendas; attendance and minutes; copies of annual report submittals

Additional Requirements of the Agreement

Quality Assurance
All project activities which are to be guided by a Quality Assurance document such as a Quality Assurance Project Plan (QAPP) or Site Specific Project Plan (SSPP) must **not** begin prior to DES/EPA approval of that QA document. In the event that sampling, modeling, or other such activities precede QA document approval, the data will not be considered valid, and the grantee will forfeit the ability to receive payment for those activities.

Outreach Materials
All materials produced for public distribution shall be reviewed and approved by DES prior to distribution and shall include the DES logo and the following citation: "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. Contracts with subcontractors, NLRA eNewsletter articles, meeting announcements, agendas, articles for local newspapers, web content, and other time sensitive materials shall be reviewed by DES within five business days. Technical reports, proposed ordinances and regulatory documents, addendum drafts to *Every Acre Counts*, and other documents requiring in depth, peer review shall be reviewed by DES within thirty days.

Operations and Maintenance
Management practices implemented as agreed upon in the scope of services of this grant agreement and with grant funds or matching funds under a Section 319 Watershed Grant, shall be properly operated and maintained for the intended purposes during the life span of the project. The life span of a project shall be determined by the Grantee, tailored to the types of practices expected to be funded in this project, and agreed upon by DES. The Grantee shall provide DES with an engineering estimate of the design life of the best management practice(s) (BMPs), or in the case of small-scale BMPs which do not have a design life estimation completed by an engineer, the design life of that practice shall be estimated to be ten years.

Operation includes the administration, management, and performance of non-maintenance actions needed to keep the completed practice safe and functioning as intended. Maintenance includes work to prevent deterioration of the practice, repairing damage, or replacement of the practice to its original condition if one or more components fail. The Grantee shall obtain written operation and maintenance (O&M) agreements from landowners of properties where BMPs are implemented. The Grantee shall assure that any O&M agreement or sub-award of Section 319 funds shall likewise include the same O&M requirements and conditions as this Agreement. Additionally, both EPA and DES reserve the right to periodically inspect a practice during the life span of the project to ensure that operation and maintenance are occurring. If it is determined that the participants are not operating and maintaining these practices in an appropriate manner, DES may request a refund for that practice supported by the grant.

Grantee Initials BPS
Date 4/12/12

Exhibit B
Contract Price and Method of Payment

All services shall be performed to the satisfaction of DES before payment is made. All payments shall be made upon receipt and approval of stated outputs and upon receipt of an associated invoice. Documentation of match costs (including the value of volunteer labor) shall be provided with each payment request. The final invoice shall include total match cost documentation of $58,600. Payment shall be made in accordance with the following schedule based upon completion of specific tasks described in Exhibit A (following page):

Grantee Initials BAS
Date 4/12/12

Upon completion and DES approval of Task 1	$667
Upon completion and DES approval of Task 2	$667
Upon completion and DES approval of Task 3	$667
Upon completion and DES approval of Task 4a	$2,500
Upon completion and DES approval of Task 4b	$3,000
Upon completion and DES approval of Task 4c	$2,500
Upon completion and DES approval of Task 4d	$3,000
Upon completion and DES approval of Task 5	$850
Upon completion and DES approval of Task 6	$850
Upon completion and DES approval of Task 7	$850
Upon completion and DES approval of Task 8	$2,000
Upon completion and DES approval of Task 9	$2,000
Upon completion and DES approval of Task 10	$2,000
Upon completion and DES approval of Task 11	$2,000
Upon completion and DES approval of Task 12	$1,000
Upon completion and DES approval of Task 13	$4,000
Upon completion and DES approval of Task 14	$2,500
Upon completion and DES approval of Task 15	$1,500
Upon completion and DES approval of Task 16	$500
Upon completion and DES approval of Task 17 and 18	$150
Upon completion and DES approval of Task 19	$1,100
Upon completion and DES approval of Task 20	$250
Upon completion and DES approval of Task 21	$250
Upon completion and DES approval of Task 22	$3,500
Upon completion and DES approval of Task 23	$1,800
Upon completion and DES approval of Task 24	$2,400
Upon completion and DES approval of Task 25	$900
Upon completion and DES approval of Task 26	$3,000
Upon completion and DES approval of Task 27	$2,700
Upon completion and DES approval of Task 28	$500
Upon completion and DES approval of Task 29	$500
Upon completion and DES approval of Task 30	$1,000
Upon completion and DES approval of Task 31	$500
Upon completion and DES approval of Task 32	$500
Upon completion and DES approval of Task 33	$500
Upon completion and DES approval of Task 34	$500
Upon completion and DES approval of Task 35	$2,000
Upon completion and DES approval of Task 36	$2,000
Upon completion and DES approval of Task 37	$1,000
Upon completion and DES approval of Task 38	$1,000
Upon completion and DES approval of Task 39	$1,000
Upon completion and DES approval of Task 40	$1,000
Upon completion and DES approval of Task 41	$1,000
Upon completion and DES approval of Task 42	$1,000
Upon completion and DES approval of Task 43	$1,597
Total	**$64,698**

Grantee Initials BBS
Date 4/12/12

Funding is provided through 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.

Exhibit C
Special Provisions

Subparagraph 1.7 of the General Provisions shall not apply to this Agreement.

Subparagraph 17.1.2 of the General Provisions shall be changed to read: comprehensive public liability insurance against all claims of bodily injuries, death or property damage, in amounts not less than $1,000,000 any one incident and $2,000,000 aggregate; and

Federal Funds paid under this agreement are from a Grant Agreement to the State from the US Environmental Protection Agency, Performance Partnership Grant under CFDA # 66.605. All applicable requirements, regulations, provisions, terms and conditions of this Federal Grant Agreement are hereby adopted in full force and effect to the relationship between this Department and the grantee. Additionally, the Grantee shall comply with the terms of the Federal Funding Accountability and Transparency Act (FFATA) by providing DES with their Data Universal Numbering System (DUNS) number.

In addition to the General Provisions, the following provisions as required by federal regulations apply to this Agreement

In addition to the General Provisions of Paragraph 1 through 23, the following provisions as required by federal regulations apply to this Agreement:

I) ***Nondiscrimination.*** The Grantee shall comply with 40 CFR part 7 which prohibits discrimination under any program or activity receiving EPA assistance on the basis of race, color, national origin, or gender, and 40 CFR part 12 which prohibits discrimination based on handicap.

II) ***Financial management.*** The Grantee shall comply with 40 CFR 31.20 and the specific standards regarding financial reporting, accounting records, internal control, budget control, allowable cost, source documentation, and cash management outlined therein.

III) ***Allowable costs.*** All costs charged to this Agreement shall be eligible, necessary, and reasonable for performing the tasks outlined in the approved project scope of services. The costs, including match, shall be incurred during the period of performance of the project, and shall be allowable, meaning that the costs must conform to specific federal requirements detailed in 40 CFR part 31.22; and OMB Circular A-87.

IV) ***Matching funds.*** All matching funds contributed by the Grantee shall conform to the same laws, regulations, and grant conditions as the federal funds in the Agreement and referenced in 40 CFR 31.24 and OMB Circular A-87.

V) ***Property Management.*** The Grantee shall comply with the property management and procedures detailed in 40 CFR 31.32 and 40 CFR 31.33.

Grantee Initials BPS
Date 4/12/12

VI) ***Debarrment and Suspension.*** The grantee shall comply with 40 CFR part 31.35. By signing and submitting the Agreement, the Grantee certifies that they have not been debarred or suspended by a government agency. The Grantee will not make any award or permit any award (subgrant or subcontract) at any tier to any party which is debarred or suspended or is otherwise excluded from or ineligible for participation in Federal assistance programs under Executive Order 12549, "Debarment and Suspension."

VII) ***Procurement.*** When purchasing goods or services with grant or match funds, the Grantee shall comply with procurement regulations as detailed in 40 CFR 31.36 which include procurement standards, competition, methods of procurement, contract cost and price, agency review, bonding requirements, and contract provisions.

a. Assignment of Subcontracts. The Contractor shall not assign, or otherwise transfer any interest in this contract without the prior written consent of the Contract Owner and the State.

b. Subcontracts. The Contractor shall:

i. Ensure that every subcontract includes provisions for compliance with Federal and State standards applicable to the contract;

ii. Ensure that every subcontract includes any clauses required by Federal statute and executive orders and their implementing regulations; and

iii. Ensure that subcontractors are aware of requirements imposed upon them by State and Federal statutes and regulations.

c. Payment to consultants. Grant payments to individual consultants retained by the Contractor (excluding overhead) are limited to the maximum daily rate for Level IV of the Executive Schedule (formerly GS-18). Maximum daily rates may change annually or more often. As of January 1, 2010, the limit is approximately $598 per day and $74.75 per hour. This amount does not include transportation and subsistence costs, in accordance with normal travel reimbursement practices. The Contractor may pay consultants more than this amount, but the excess amount shall not be paid with federal grant funds. Contracts with firms for services which are awarded using the procurement requirements in 40 CFR 31.36 are not affected by this limitation.

VIII) ***Participation by Disadvantaged Business Enterprises.*** The Grantee shall comply with the terms of 40 CFR Part 33 Subpart C, which requires that organizations conduct a competitive procurement process making a good faith effort to utilize goods and services provided by disadvantaged businesses.

IX) ***New Restrictions on Lobbying: Interim Final Rule.*** The Grantee shall comply with the terms of 40 CFR part 34 and OMB Circular A-87 which prohibit the use of federal grant funds to influence (or attempt to influence) a federal employee, and requires the submission of Standard Form LLL ("Disclosure of Lobbying Activities") if *non*federal funds have been used to influence (or attempt to influence) a federal employee.

X) ***Drug-Free Workplace.*** The Grantee shall comply with the terms of 40 CFR Part 36 which require that as a condition of the Agreement, certification that they maintain a drug-free workplace. By signing and submitting the Agreement, the Granteee certifies that he or she will not engage in the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance in conducting any activity associated with the Agreement.

XI) ***Bonding requirements.*** For construction or facility improvement contracts or subcontracts exceeding the simplified acquisition threshold (currently $100,000), the minimum requirements shall be as follows:

a. A bid guarantee from each bidder equivalent to five percent of the bid price. The "bid guarantee" shall consist of a firm commitment such as a bid bond, certified check, or other negotiable instrument accompanying a bid as assurance that the bidder will, upon acceptance of his bid, execute such contractual documents as may be required within the time specified.

b. A performance bond on the part of the contractor for 100 percent of the contract price. A "performance bond" is one executed in connection with a contract to secure fulfillment of all the contractor's obligations under such contract.

Grantee Initials BF

Date 4/12/12

c. A payment bond on the part of the contractor for 100 percent of the contract price. A "payment bond" is one executed in connection with a contract to assure payment as required by law of all persons supplying labor and material in the execution of the work provided for in the contract.

XII) ***Additional contract provisions.*** The Grantee shall comply with the following as applicable:

a. Comply with Executive Order 11246 of September 24, 1965, entitled "**Equal Employment Opportunity**," as amended by Executive Order 11375 of October 13, 1967, and as supplemented in Department of Labor regulations (41 CFR chapter 60). (All construction contracts awarded in excess of $10,000 by grantees and their subcontractors)

b. Comply with the **Copeland "Anti-Kickback" Act** (18 U.S.C. 874) as supplemented in Department of Labor regulations (29 CFR part 3). (All contracts and subcontracts for construction or repair)

c. Comply with Sections 103 and 107 of the **Contract Work Hours and Safety Standards Act** as supplemented by Department of Labor regulations (29 CFR part 5). (Construction contracts awarded by grantees and subcontractors in excess of $2,000, and in excess of $2,500 for other contracts which involve the employment of mechanics or laborers.)

d. Comply with all applicable standards, orders, or requirements issued under section 306 of the Clean Air Act (42 U.S.C. 1857(h)), section 508 of the Clean Water Act (33 U.S.C. 1368), Executive Order 11738, and Environmental Protection Agency regulations (40 CFR part 15). (Subcontracts in excess of $100,000)

e. Comply with mandatory standards and policies relating to energy efficiency which are contained in the State energy conservation plan issued in compliance with the Energy Policy and Conservation Act (Pub. L. 94–163, 89 Stat. 871).

XIII) ***Federal Funding Accountability and Transparency Act (FFATA).*** The Grantee shall comply with the terms of the FFATA by providing DES with their Data Universal Numbering System (DUNS) number, and all applicable Executive Compensation Data information as required under the FFATA.

Grantee Initials BBS

Date 4/12/12

Newfound Lake Region Association
Newfound Lake Watershed Master Plan Implementation Phase II: Watershed Stewardship

CERTIFICATE of AUTHORITY

I, William K. Weidman, Jr. Treasurer of the Newfound Lake Region Association (NLRA), do hereby certify that:

(l) I am the duly elected Treasurer;
(2) at the meeting held on November 5, 2011, the NLRA voted to accept DES funds and to enter into a contract with the Department of Environmental Services;
(3) The NLRA further authorized the Executive Director to execute any documents which may be necessary for this contract;
(4) This authorization has not been revoked, annulled, or amended in any manner whatsoever, and remains in full force and effect as of the date hereof; and
(5) The following person has been appointed to and now occupies the office indicated in (3) above:

Boyd Smith, Executive Director

IN WITNESS WHEREOF, I have hereunto set my hand as the Secretary of the NLRA, this 11th day of April 2012.

William K. Weidman, Jr. Treasurer (sign above)

STATE OF NEW HAMPSHIRE
County of Grafton

LINDA M. BOLTE, Notary Public
My Commission Expires May 16, 2012

On this the 11 day of April 2012, before me _____ (Notary Public) the undersigned officer, personally appeared William K. Weidman, Jr. who acknowledged himself to be the Treasurer of the NLRA being authorized so to do, executed the foregoing instrument for the purpose therein contained.

In witness whereof, I have set my hand and official seal.

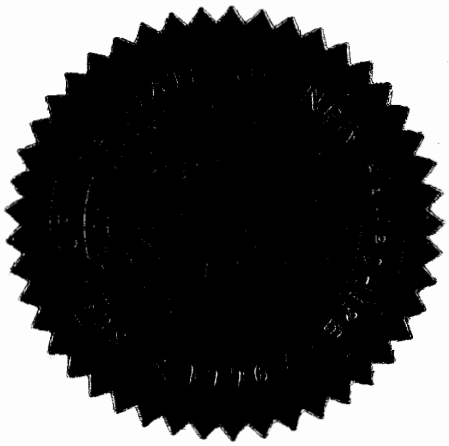
(Notary Public)

Commission Expiration Date:
(Seal)

State of New Hampshire
Department of State

CERTIFICATE

I, William M. Gardner, Secretary of State of the State of New Hampshire, do hereby certify that NEWFOUND LAKE REGION ASSOCIATION is a New Hampshire nonprofit corporation formed December 3, 1971. I further certify that it is in good standing as far as this office is concerned, having filed the return(s) and paid the fees required by law.



In TESTIMONY WHEREOF, I hereto set my hand and cause to be affixed the Seal of the State of New Hampshire, this 11th day of April A.D. 2012

William M. Gardner
Secretary of State

NEWFO-2 OP ID: VD

ACORD

CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY) 05/17/12

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(les) must be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER Melcher & Prescott-Plymouth PO Box 149 Plymouth, NH 03264 603-536-2440 603-536-4604	CONTACT NAME: PHONE (A/C, No, Ext): FAX (A/C, No): E-MAIL ADDRESS:

INSURER(S) AFFORDING COVERAGE	NAIC #
INSURER A : Cincinnati Insurance Company	10677
INSURER B :	
INSURER C :	
INSURER D :	
INSURER E :	
INSURER F :	

INSURED
Newfound Lake Region Assoc.
Attn: Boyd Smith
800 Lake Street
Bristol, NH 03222

COVERAGES CERTIFICATE NUMBER: REVISION NUMBER:

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	ADDL INSR	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS	
A	GENERAL LIABILITY X COMMERCIAL GENERAL LIABILITY CLAIMS-MADE X OCCUR GEN'L AGGREGATE LIMIT APPLIES PER: X POLICY PRO-JECT LOC	X		CPP0891875	07/09/11	07/09/14	EACH OCCURRENCE DAMAGE TO RENTED PREMISES (Ea occurrence) MED EXP (Any one person) PERSONAL & ADV INJURY GENERAL AGGREGATE PRODUCTS - COMP/OP AGG	$ 1,000,000 $ 100,000 $ 5,000 $ 1,000,000 $ 2,000,000 $ 2,000,000
	AUTOMOBILE LIABILITY ANY AUTO ALL OWNED AUTOS SCHEDULED AUTOS HIRED AUTOS NON-OWNED AUTOS						COMBINED SINGLE LIMIT (Ea accident) BODILY INJURY (Per person) BODILY INJURY (Per accident) PROPERTY DAMAGE (Per accident)	$ $ $ $
	UMBRELLA LIAB OCCUR EXCESS LIAB CLAIMS-MADE DED RETENTION $						EACH OCCURRENCE AGGREGATE	$ $
	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? Y/N (Mandatory in NH) If yes, describe under DESCRIPTION OF OPERATIONS below	N/A					WC STATU-TORY LIMITS OTH-ER E.L. EACH ACCIDENT E.L. DISEASE - EA EMPLOYEE E.L. DISEASE - POLICY LIMIT	$ $ $

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (Attach ACORD 101, Additional Remarks Schedule, if more space is required)
Operations: Conservation, preservation and education of Newfound Lake. New Hampshire Department of Environmental Services is listed as Additional Insured, per written contract between Insured and certificate holder, with respect to General Liability per Form GA 4078-Additional Insured Endorsement "Owners, Lessors, or Contractors, Scheduled Persons of Organization.

CERTIFICATE HOLDER

NHDENV1

NH Department of Environmental Services
P.O. Box 95
29 Hazen Drive
Concord, NH 03302-0095

CANCELLATION

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.

AUTHORIZED REPRESENTATIVE

H Thomas Vobe

CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY): 5/24/2012

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER	CONTACT NAME: Linda Bolte
Bristol Insurance Agency 800 Lake Street Bristol NH 03222	PHONE (A/C, No, Ext): (603) 744-5433 FAX (A/C, No): (603) 744-5436 E-MAIL ADDRESS: lbolte@byseinsurance.com

INSURER(S) AFFORDING COVERAGE	NAIC #
INSURER A: NHAR Work Comp	
INSURER B:	
INSURER C:	
INSURER D:	
INSURER E:	
INSURER F:	

INSURED
Newfound Lake Region Association 800 Lake Street Bristol NH 03222

COVERAGES **CERTIFICATE NUMBER:** CL1252401546 **REVISION NUMBER:**

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	ADDL INSR	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS	
	GENERAL LIABILITY						EACH OCCURRENCE	$
	☐ COMMERCIAL GENERAL LIABILITY						DAMAGE TO RENTED PREMISES (Ea occurrence)	$
	☐ CLAIMS-MADE ☐ OCCUR						MED EXP (Any one person)	$
							PERSONAL & ADV INJURY	$
	GEN'L AGGREGATE LIMIT APPLIES PER:						GENERAL AGGREGATE	$
	☐ POLICY ☐ PRO-JECT ☐ LOC						PRODUCTS - COMP/OP AGG	$
								$
	AUTOMOBILE LIABILITY						COMBINED SINGLE LIMIT (Ea accident)	$
	☐ ANY AUTO						BODILY INJURY (Per person)	$
	☐ ALL OWNED AUTOS ☐ SCHEDULED AUTOS						BODILY INJURY (Per accident)	$
	☐ HIRED AUTOS ☐ NON-OWNED AUTOS						PROPERTY DAMAGE (Per accident)	$
								$
	☐ UMBRELLA LIAB ☐ OCCUR						EACH OCCURRENCE	$
	☐ EXCESS LIAB ☐ CLAIMS-MADE						AGGREGATE	$
	☐ DED ☐ RETENTION $							$
A	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY Y/N						☐ WC STATU-TORY LIMITS ☐ OTH-ER	
	ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? ☐ (Mandatory in NH)	N/A		6S60UB-5B30602-9-12	4/7/2012	4/7/2013	E.L. EACH ACCIDENT	$ 500,000
	If yes, describe under DESCRIPTION OF OPERATIONS below						E.L. DISEASE - EA EMPLOYEE	$ 500,000
							E.L. DISEASE - POLICY LIMIT	$ 500,000

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (Attach ACORD 101, Additional Remarks Schedule, if more space is required)

CERTIFICATE HOLDER

NH Dept. of Environmental Services
29 Hazen Drive
PO Box 95
Concord, NH 03302-0095

CANCELLATION

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.

AUTHORIZED REPRESENTATIVE

Linda Bolte/LMB

Linda M Bolte

Attachment A
Budget Estimate

Budget Item	Grant Funding	Match	Total
Salaries & Wages	$27,108.00	$35,500.00	$62,608.00
Indirect Costs	$0.00	$5,920.00	$5,920.00
Travel and Training	$70.00	$0.00	$70.00
Contractual	$37,520.00	$17,180.00	$54,700.00
Construction	$0.00	$0.00	$0.00
Other (printing, postage, insurance, Etc.)	$0.00	$0.00	$0.00
Subtotals	**$64,698.00**	**$58,600.00**	**$123,298.00**
Total Project Cost			**$123,298.00**

Attachment B: Watershed Assistance and Restoration Grant Ranking

Organization	Project Name	Reviewer 'A'	Reviewer 'B'	Reviewer 'C'	Reviewer 'D'	Reviewer 'E'	Reviewer 'F'	Reviewer 'G'	Reviewer 'H'	Reviewer 'I'	Proposal Score	Interview Score	Total Score	Rank
Acton Wakefield Watersheds Alliance	Salmon Falls Headwaters Watershed - Based Management Implementation Project - Phase 2	93	96	90	81	93	94	86	94	77	804	1687	2491	1
Cobbetts Pond Improvement Association	Cobbett's Pond Restoration Plan Implementation II – Farmer Rd. & Horseshoe Rd. Area	90	86	77	72	69	89	73	73	54	683	1664	2347	2
Mirror Lake Protective Association	Mirror Lake Watershed - Stormwater Improvement Implementation Project	90	84	69	79	71	88	74	86	84	725	1421	2146	3
Newfound Lake Region Association	Newfound River Watershed Management Plan - Implementation Phase II	82	78	82	75	88	79	67	78	86	715	1358	2073	4
UNH Stormwater Center	Great Bay Municipal Bioretention Program	90	87	66	79	84	75	69	63	69	682	1321	2003	5
Rye, Town of	Implementation of the Parsons Creek Restoration Project - Phase 1	83	71	66	80	80	82	70	81	92	705	1200	1905	6
UNH Technology Transfer Center	College Brook Watershed Restoration: Chloride Reduction	81	70	74	77	68	83	61	59	59	632	1211	1843	7
Lakes Region Planning Commission	A Watershed Restoration Plan for Moultonborough Bay Inlet - Phase I	71	85	50	51	82	68	70	78	71	626	1182	1808	Not Selected
Granite Lake Association	Granite Lake Watershed Management Plan - Phase 1 Implementation	88	84	71	76	58	85	71	72	74	679	893	1572	Not Selected
Sunapee, Town of	Perkins Pond Watershed Planning and Stormwater Management Project	82	70	47	75	70	75	64	77	69	629	843	1472	Not Selected
Exeter, Town of	West Side Drive LID Stormwater Improvement Feasibility Analysis Phase 1	86	64	86	77	80	83	59	58	63	656	591	1247	Not Selected
Town of Meredith	Lake Waukewan Subwatershed Management Plan: Towards the Creation of a Lake Winnipesaukee Watershed Management Plan	90	57	60	69	68	79	54	78	72	627	Not selected	627	Not Selected
Manchester Water Department	Lake Massabesic Watershed Management Program Update	88	68	30	73	61	84	62	64	78	608	Not selected	608	Not Selected
South East Watershed Alliance	Nonpoint nutrient reduction in the lower Exeter / Swampscott watershed	85	71	60	75	55	71	57	66	64	604	Not selected	604	Not Selected
Green Mountain Conservation Group	Ossipee Watershed Master Plan ~ Phase I of III.	59	68	66	75	67	64	58	66	70	593	Not selected	593	Not Selected
Silver Lake Association	Mitigation of Run-Off from Breed Road into Silver Lake, Harrisville, NH	86	61	47	73	43	68	61	41	72	552	Not selected	552	Not Selected
The Nature Conservancy	Oyster Reef Restoration for Reducing Nitrogen in the Squamscott River at Great Bay Estuary	58	64	64	74	63	47	49	51	71	541	Not selected	541	Not Selected
Ashland, Town of	Squam River Watershed Plan	50	58	44	60	47	73	56	58	72	518	Not selected	518	Not Selected
University of New Hampshire	Mitigation of dissolved oxygen and chlorophyll impairments and sequestration and extraction of nitrogen in the tidal portion of the Oyster River using filtration capacity of native oysters	58	64	56	75	62	50	57	50	42	514	Not selected	514	Not Selected
Canaan, Town of	Canaan Street Lake Watershed Protection	81	75	42	40	39	54	47	48	25	451	Not selected	451	Not Selected
Nottingham, Town of	Pawtuckaway lake - Fernald Brook Area Remediation Plan	60	30	22	30	36	32	44	28	10	292	Not selected	292	Not Selected

Review Team Members

Name	Qualifications
Andy Chapman	11 years experience, Clean Lakes Program Coordinator, aquatic biologist, project management and coordination, lakes management expertise
Steve Landry	16 years experience, Merrimack Watershed Coordinator, aquatic biologist, project management, Merrimack watershed expertise
Rob Livingston	23 years experience, Nonpoint source pollution specialist, BMP, pollution source investigation expertise, Field training of local municipalities in watershed pollution source tracking and identification
Jeff Marcoux	7 years experience, Watershed Assistance Specialist, grant and contract expertise
Jillian McCarthy	7 years experience, Nonpoint source pollution specialist, quality assurance, and stormwater BMP expertise.
Barbara McMillan	12 years Watershed Assistance Outreach Coordinator, outreach and education expertise.
Sally Soule	13 years experience, Coastal Watershed Coordinator, project management, Coastal watershed expertise
Wendy Waskin	20+ years experience, Watershed Coordinator, budgeting, planning expertise
Eric Williams	23 years experience, Watershed Assistance Section Supervisor, environmental planner, general project management expertise, WAS section and 319 program supervisor.

Appendix B ~ Phosphorus Load Reduction Estimates from Newfound Sands

TECHNICAL MEMORANDUM

To: **Boyd Smith, Newfound Lake Region Association**

From: Cayce Dalton, FB Environmental

Subject: **Phosphorus Load Reduction Estimates from Newfound Sands and Cummings Beach BMPs at Newfound Lake**

Date: December 5, 2014

cc: Forrest Bell and Emily DiFranco, FB Environmental

att: ***Newfound Lake NPS Survey Results and BMP Matrix Spreadsheet***

This memo presents pollution reduction estimates for best management practices (BMPs) installed at Newfound Sands and Cummings Beach in Bristol, NH. These load reduction estimates were then inserted into the Lake Loading Response Model (LLRM) for Newfound Lake to create an updated set of model results. The work described below completes the scope of work between Newfound Lake Region Association and FB Environmental dated November 18, 2014.

Overview

Two important water quality BMPs were recently completed in the Newfound Lake watershed. In 2010, improvements were made at Cummings Beach, Bristol, NH, and in 2014, road and shoulder paving eliminated gully erosion along road in the Newfound Sands Condominium Association.

In November 2014, FB Environmental conducted a watershed survey, generated a prioritized list of BMPs each with an estimated cost and pollution load reduction estimate using the EPA Region 5 model. We then inserted these load reduction estimates into an existing nutrient loading model (LLRM) for Newfound Lake to reflect two possible scenarios of BMP installation. In this memo, the Region 5 model is used to estimate the effect of two BMPs already installed, and the lake model is updated to reflect those load reductions.

Pollution Reduction at Cummings Beach

The Cummings Beach BMP includes a vegetated infiltration basin, stormwater drainage and catchbasins, and erosion-preventing gravel steps to the water. These improvements are documented in a site plan from August 2010 by KV Partners of Manchester, NH (file name: *NLRA Cummings Site Plan Revised 8-9-10.pdf*), part of which is shown in Figure 1. Phosphorus reductions achieved through the BMP were estimated in early 2011 by the Newfound Lake Association (NRLA) and Steve Landry at NH DES Watershed Management Bureau. That load reduction estimate is described in a letter from NRLA to NH DES (file name: *Model-Summ Rpt-4Jan11.doc*). The letter outlines using the EPA Region 5 model, Urban Runoff / Extended Wet Detention component, to determine the pollution load reductions. Using conservative input assumptions, the **total phosphorus reduction**

for Cummings Beach was estimated at 1.2 kg/year. The input assumptions and methods were well documented, and upon review the estimate was accepted for use in the LLRM.

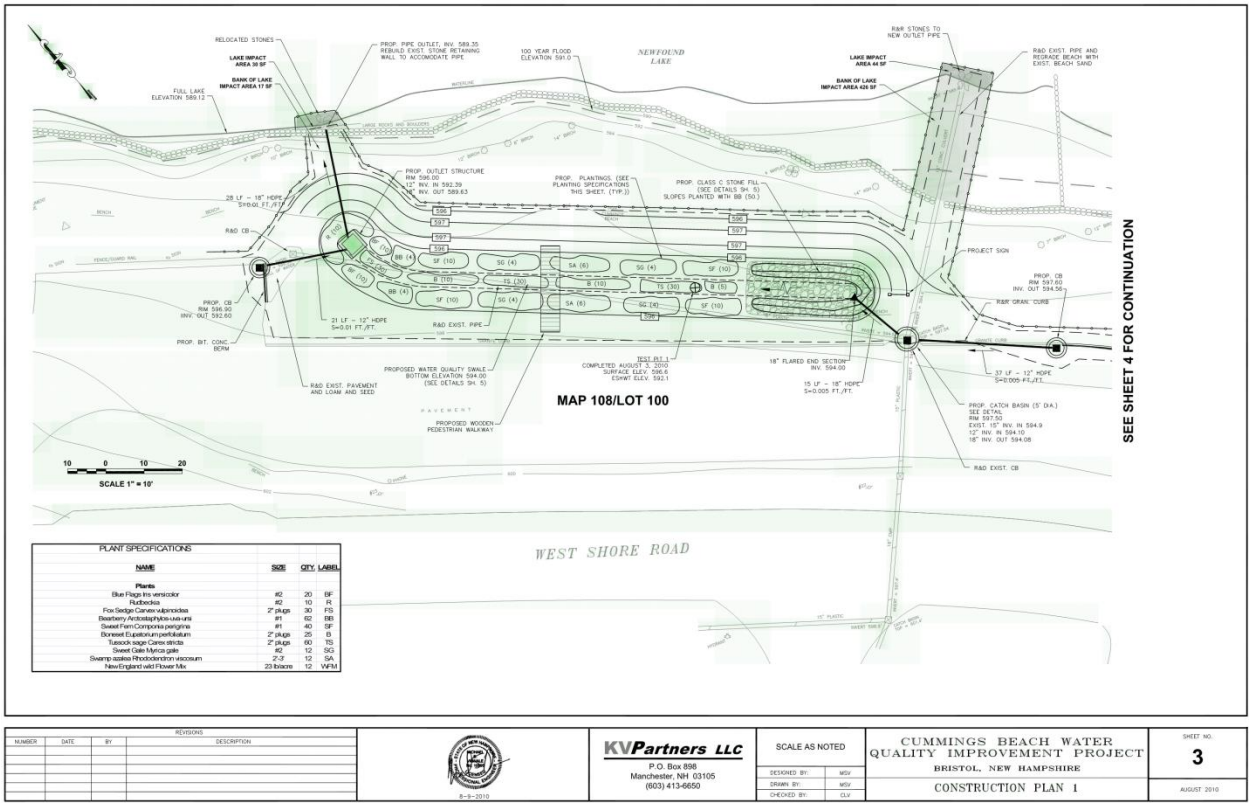


Figure 1: Selected page from the Cummings Beach BMP Construction Plan by KV Partners, August 2010.

Pollution Reduction at Newfound Sands

In 2014, a 700 foot length of road and a 603 foot length of road shoulder were paved in the Newfound Sands Condominium Association, 151 West Shore Road, Bristol, NH. This paving eliminated severe erosion along the Newfound Sands road near the entrance, which is across the street from Cummings Beach and the shore of Newfound Lake. In addition to correcting the erosion, the paved area now directs stormwater to either grassed swales or toward the Cummings Beach stormwater treatment area.

Figure 2: Two photos of the erosion prior to the paving improvements in the Newfound Sands Condominium Association roads. The photo on the left looks down to the lake, the photo on the right faces the opposite direction.

The EPA Region 5 model was used to estimate the load reduction achieved through the Newfound Sands BMP. Within the model, there is no road paving BMP, so the Gully Stabilization component was adopted. Pre-installation gully conditions were examined using Forrest Bell's letter with photos to NRLA on August 22, 2011, along with additional photos taken at the same time which are on file at FB Environmental. Two photos of the erosion are shown in Figure 2. These conditions were entered into the Region 5 model as follows:

- Soil type: "sandy loam"
- Top Width (ft): 2
- Bottom Width (ft): 0.5
- Depth (ft): 1
- Length (ft): 500
- Number of Years: 5
- BMP efficiency: 0.9

The Region 5 model returned the following results:

- Sediment Load Reduction (ton/year): 5.9
- Phosphorus Load Reduction (lb/year): 5.0
- Nitrogen Load Reduction (lb/yr): 10.0

Converting to metric units provides a **phosphorus reduction of 2.3 kg/year for Newfound Sands**.

To aid visualization, the sediment load reduction was converted to cubic yards. Using an estimated weight of loose earth[1] of 1200 kg/m^3 and converting units results in an equivalent of 5.8 cubic yards/year of sediment load eliminated.

The Region 5 calculations and all unit conversions for the Newfound Sands BMP are in the file: *Region5_model06_NewfoundSands_gullystabilization.xlsm*

Updating the Lake Loading Response Model to Reflect the BMPs

The above phosphorus load reductions, 1.2 kg/year for Cummings Beach and 2.3 kg/year for Newfound Sands, were entered into the LLRM for Newfound Lake. They were entered into the "ungaged drainage" basin, as described on the "Project Notes" tab of the spreadsheet. The model estimated a 1.2% reduction in the subwatershed phosphorus load, and a watershed-wide 0.1% reduction in phosphorus reaching the lake. The reduction in in-lake total phosphorus concentration was too small to be discernible at the level of precision shown in the original model. The results are summarized in Table 1. The LLRM model provided along with this memo is:
Newfound-Cal Shed Model Cummings NewfoundSands BMPs 3Dec2014.xls.

Table 1: Phosphorus load reduction estimates from the Lake Loading Response Model.

	Prior to BMPs	After BMPs	Reduction
Ungaged drainage phosphorus load (kg/year)	152.4	150.6	1.2%
Watershed Load phosphorus load (kg/year)	1585.4	1583.6	0.1%
In-lake estimated total phosphorus concentration (ppb)	4.03	4.03	not discernible

It is worth noting that the LLRM does not account for location within the watershed. In other words, the model cannot distinguish between a land use improvement that occurs next to the lake shore and one which occurs far upland, away from any streams, even though what happens at the lake or stream shore has a much greater effect on water quality. In addition, the Cummings Beach load reduction is stated as conservative by Steve Landry of NH DES, and the Newfound Sands load reductions calculated here are likewise intended to be fairly conservative. These combined factors suggest that the improvements made at Cumming Beach and Newfound Sands are more likely to be understated than overstated by the model. Furthermore, the lake model calculates average annual phosphorus concentration for the entire lake, and does not model localized or short-term effects in the lake. Localized water quality degradation in lakes is indeed possible, and these two improvements will certainly help protect the local water quality at Cummings Beach. Clearly, two BMPs which visibly reduce sediment load to the shoreline are real and valuable steps which help preserve the lake water quality.

[1] Source: http://www.engineeringtoolbox.com/earth-soil-weight-d_1349.html

Appendix C ~ Representative BMP Project Photographs

This Appendix contains selected photographs of representative stormwater mitigation projects planned, in progress, or completed as of December 2014. For more current information and an overview of the projects at each of the sites listed in Appendix C, refer to the NLRA web site at the link below.

Link to NLRA stormwater project web site:
http://newfoundlake.org/index.php/protect-the-lake-watershed/water-watch-dog/stormmap

Stormwater Mitigation Project Locus (Dec. 2013)

Camp Berea. BMP 3-6 armored swale; pre- and post BMP (May 2013)

Stonegate Acres. Preconstruction Drainage and Beach Erosion (April 2013)

Stonegate Acres. Post Construction (Summer 2014)

Sleepy Hollow. George Rd. Sediment Source, Beach Infilling (2013)

The Ledges. Site View and Swim Beach Infilling (Google Earth, April 2012)

Cummings Beach. Swale (pre/post clean out; Nov. 2013)

Cummings Beach. Erosion and Newfound Sands Runoff and Sediment Source (Nov. 2013)

Newfound Sands. Paving and Drainage Completed (November 2014)

Hebron Beach. Shoreline Erosion (Nov. 2013)

Whittemore Shores. Treatment Swale captures majority of site runoff (2012)

The Mayhew Program. Demonstrating roof runoff (2012)

The Mayhew Program. Runoff along pathway towards Lake, absorbed at beach (2012)

Appendix D ~ FBEnvironmental Watershed Survey Memo

TECHNICAL MEMORANDUM

To: **Boyd Smith, Newfound Lake Region Association**

From: Forrest Bell, FB Environmental

Subject: **Newfound Lake NPS Watershed Survey and BMP Matrix**

Date: November 14, 2014

cc: Emily DiFranco and Jennifer Jespersen, FB Environmental

att: ***Newfound Lake NPS Survey Results and BMP Matrix Spreadsheet; Updated LLRM (two BMP scenarios)***

This memo summarizes the results of the Newfound Lake Watershed Nonpoint Source (NPS) Survey and the process of creating the watershed Best Management Practice (BMP) matrix for calculating pollutant reductions and prioritizing identified BMP locations throughout the Newfound Lake Watershed. Upon completion of the survey and the matrix, the previously-completed Lake Loading Response Model (LLRM) was updated with the new BMP sites to estimate phosphorus load (kg/year) and in-lake concentration (ppb) reductions if all recommended BMPs were implemented. In addition, an assessment of the current water quality data and monitoring program was conducted. A summary of the findings of the LLRM and the water quality monitoring program assessment are also provided in this memo.

Watershed Survey (Task 15)

Beach erosion, inadequate shoreline buffers, poorly maintained roads, and winter sand inputs all contribute to the current state of the water quality in Newfound Lake. An important step in the watershed planning process is to "take stock" of potential sources of pollutants to a waterbody by conducting a thorough survey of the watershed. This survey provides a snapshot of potential sources and should be revisited every few years to assess progress and to identify new problem areas.

Prior to conducting the in-field NPS survey in the Newfound Lake Watershed, FB Environmental (FBE) staff conducted a desktop analysis of the Newfound Lake Watershed utilizing existing studies conducted by NLRA:

- Newfound Lake Road Gradient Survey
- 2010 Newfound Lake Preliminary Culvert Assessment
- A list of potential BMP locations provided to FBE by NLRA
- Additional Sites provided to FBE by contacting the Road Agents/Highway Departments of the 5 towns within the Newfound Lake Watershed.

Survey technical staff entered the field with a list of 80 potential NPS BMP locations to visit during the watershed survey. This prioritized list consisted of the "worst" 57 culverts (based on the culvert study scores given to each culvert identified in the study), 16 road gradient sites (these sites have a slope greater than 10%, and are within 75 feet of streams), and the six BMP sites FBE received from NLRA. Many of these sites were also referenced by the local Road Agents.

Obvious signs of erosion on Rankin Road in Bridgewater, NH (Site 20)

The actual watershed survey was conducted on October 21 and October 23, 2014. Efforts were made by survey staff to visit all the sites on the initial site list. During the survey, some could not be located or accessed and others were determined to be of low environmental impact and were excluded from the survey site list. While in the field, measurements were taken at each site to be used to calculate the pollutant load reduction that could be achieved through remediation. Pictures were taken and a detailed description of the site was documented on field sheets (a link will be provided to these pictures and documents). Recommendations for remediation were also made in the field.

The resulting Newfound Lake NPS survey site list includes a total of 55 identified NPS locations (Figure 1). These sites include:

- 4 BMP locations provided by NLRA
- 20 culvert study locations
- 6 road gradient problem sites (>10% slope within 75 ft. of streams)
- 25 new identified sites found in-field by survey technical staff

BMP site breakdown by Town is as follows. See Appendix A for Maps of identified sites by watershed Town.

- Alexandria (20 sites)
- Bridgewater (9 sites)
- Hebron (11 sites)
- Bristol (5 sites)
- Groton (10 sites)

Figure 1: Newfound Lake Identified Sites by Category

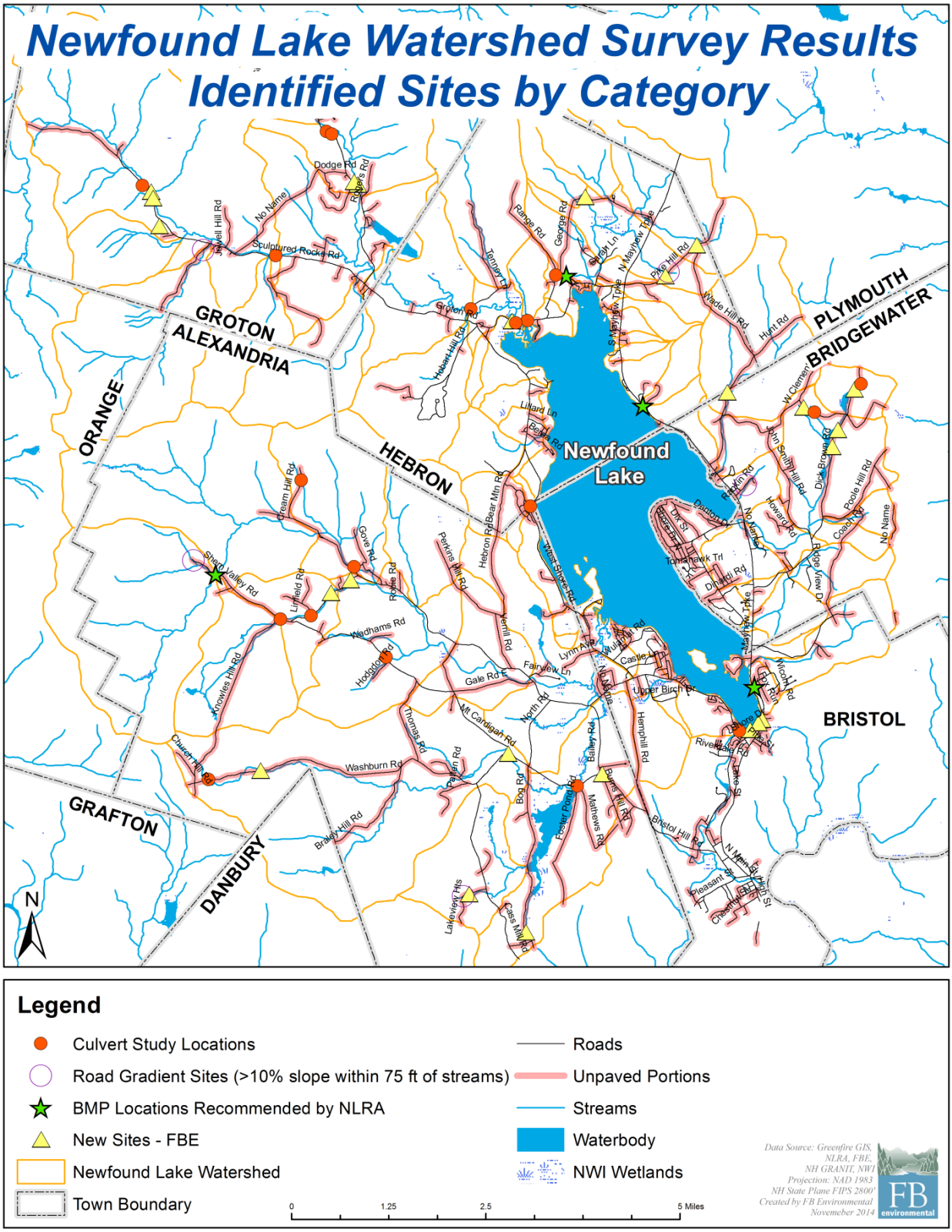
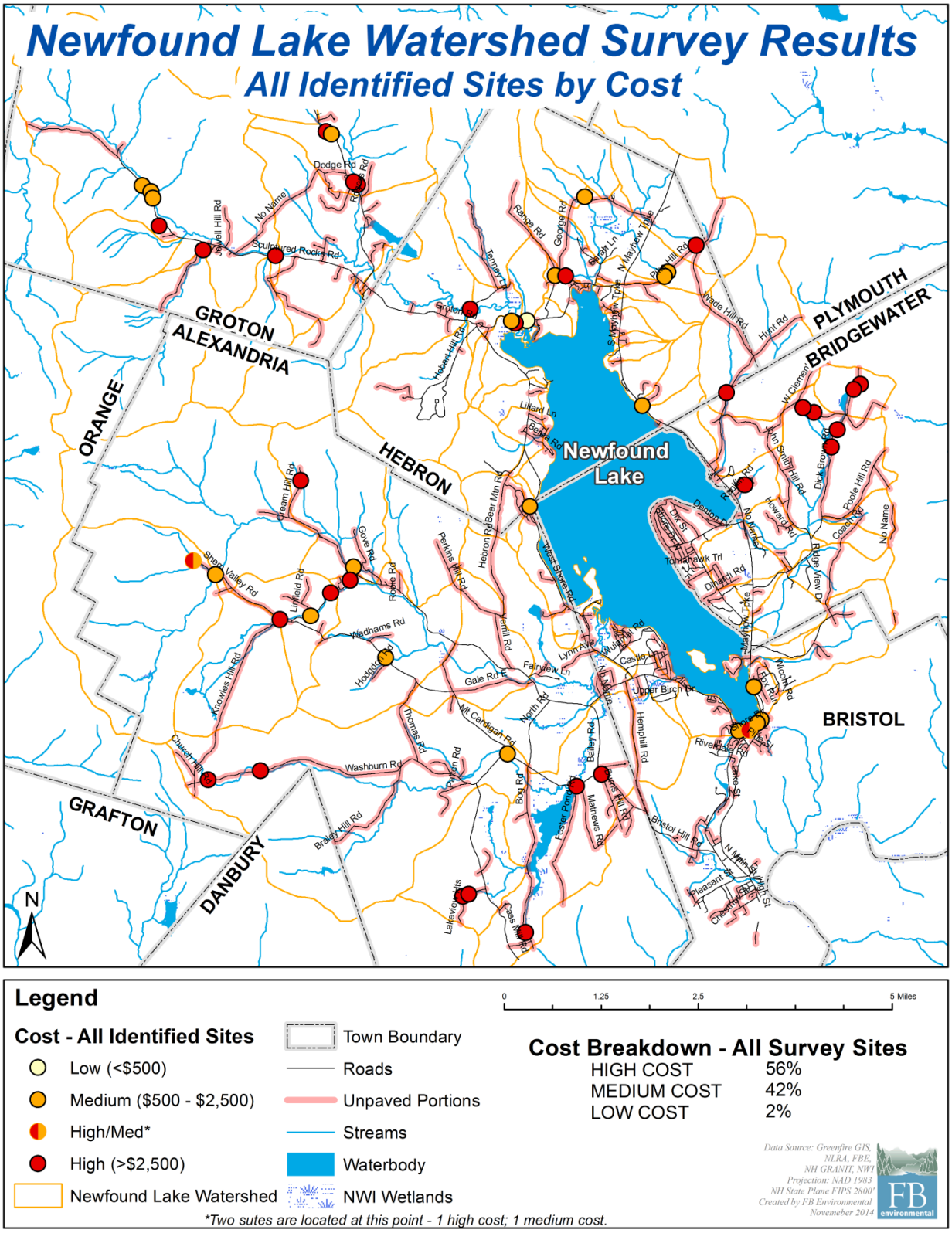


Figure 2: Newfound Lake Identified Site by Cost



Newfound Lake BMP Matrix (Task 19)

The results of the watershed survey were processed and assembled into a prioritized BMP matrix. This excel spreadsheet includes the location and description of each identified NPS site in the Newfound Lake Watershed, BMP recommendations for each site, the amount of sediment, phosphorus, and nitrogen that would be removed by implementing each BMP (based on the Region 5 model), and the estimated cost per site. The methods used for each step and for the prioritization of each site are described below. The full BMP matrix is provided as an attachment to this memo.

Obvious signs of erosion at the beach on Shore Road in Bristol, NH (Site 97)

EPA Region 5 Spreadsheet Model

The EPA Region 5 Model was used to calculate the reduction in pollutant load in response to the implementation of BMPs in the Newfound Lake watershed. The Region 5 Model provides a gross estimate of sediment and nutrient load reductions from the implementation of agricultural and urban BMPs. While it is recognized that this system has limitations, it does provide a uniform system of estimating relative pollutant loads.

As indicated above, measurements were collected at each identified site during the watershed survey in the Newfound Lake Watershed. The measurements document the area of any observed surface erosion or exposed/bare soil, the average dimensions of any gully erosion observed at each site (depth, width and length), and the height and lengths of eroded streambanks observed during the survey.

These measurements are used as inputs in the Region 5 Model to calculate the reduction in pollutant load expected if these eroded areas were addressed by installing the recommended BMP. By modeling results of pollutant reductions expected from addressing the 55 identified sites, we can estimate the total phosphorus load currently contributed by these selected locations throughout the watershed. Currently, 445 pounds of phosphorus and 447 tons of sediment enter Newfound Lake annually from these areas. Ideally, if all 55 problem sites identified in the 2014 watershed survey

were treated with BMPs, and all new development contained proper phosphorus controls, these annual phosphorous loadings would be significantly reduced. The top twenty BMP sites alone would remove approximately 358 pounds of phosphorus and 359 tons of sediment per year from entering the Lake. This would account for 80% of the total estimated phosphorus load per year contributed by all surveyed problem areas.

Estimated Cost for BMP implementation

Technical staff conducting the watershed survey also made in-field recommendations for each identified site in the watershed. Based on these recommendations, FBE was able to provide estimates of cost for each recommended BMP. Cost estimates were based roughly on the table below:

BMP Type	*Materials*	*Labor*	*Total*	*Reference*
Vegetated Buffer (20')	$ 400	$ 80	$ 480	*CCSWCD (2008). Table of Estimated Costs for Conservation Practices*
New Culvert (20' X18")	$ 500	$ 1,000	$ 1,500	*CCSWCD (2008). Table of Estimated Costs for Conservation Practices*
Gravel and grading (200' x 16')	$ 500	$ 860	$ 1,360	*CCSWCD (2008). Table of Estimated Costs for Conservation Practices*
Dripline/infiltration trench (18"x20'x8")	$ 150	$ 110	$ 260	*CCSWCD (2008). Table of Estimated Costs for Conservation Practices*
Rubber waterbar (16')	$ 320	$ 60	$ 380	*CCSWCD (2008). Table of Estimated Costs for Conservation Practices*
Grass-lined ditch (100')	$ 175	$ 400	$ 575	*CCSWCD (2008). Table of Estimated Costs for Conservation Practices*
Rock-lined ditch (100')	$ 350	$ 400	$ 750	*CCSWCD (2008). Table of Estimated Costs for Conservation Practices*
Ersion control mulch (30' x 30' x 4")	$ 350	$ 120	$ 470	*CCSWCD (2008). Table of Estimated Costs for Conservation Practices*
Plunge Pool	$1.25/sq. ft.	$75/hr	-	*Corespondence with J. Houle - University of NH Stormwater Center*
Guard Rail	$20/ Linear ft.	$75/hr	-	*Corespondence with J. Houle - University of NH Stormwater Center*
Retention Swales	$1.35/sq. ft.	$75/hr	-	*Corespondence with J. Houle - University of NH Stormwater Center*
Recycled Asphalt	$3.80/sq. ft.	$75/hr	-	*Corespondence with J. Houle - University of NH Stormwater Center*
Check dams & turnouts	$500-600 ea.	$75/hr	-	*Corespondence with J. Houle - University of NH Stormwater Center*
Paving (driveway)	$3.80/sq. ft.	$75/hr	-	*Corespondence with J. Houle - University of NH Stormwater Center*
Open-top Culvert	$ 100	$ 50	$ 150	*Estimate based on current lumber prices*
Retaining Walls	$40/sq. ft.	$75/hr	-	*Estimates from two landscaping companies for block/concrete walls: http://www.landscapingnetwork.com/walls/retaining-cost.html http://www.bahlerbrothers.com/blog/bid/111056/How-much-do-Retaining-Walls-Cost*
Concrete curbing	$15/linear foot	*Included in material*	-	

Estimates were also provided for annual maintenance cost for each BMP. The initial cost of the BMP was combined with the annual cost of each BMP over a ten year period (initial cost + (annual maintenance cost x 10 yrs)) to calculate a 10-year BMP cost for each site. This 10-year cost estimate was then used to determine the 10-year cost per lb. and per kg. of Phosphorus removed by each BMP per year.

Prioritization of BMPs

All surveyed sites were prioritized by two factors. First, priority was given to sites assessed as having a higher environmental impact to water quality. Second, sites were then sorted by cost per pound of phosphorus removed by the recommended BMP annually.

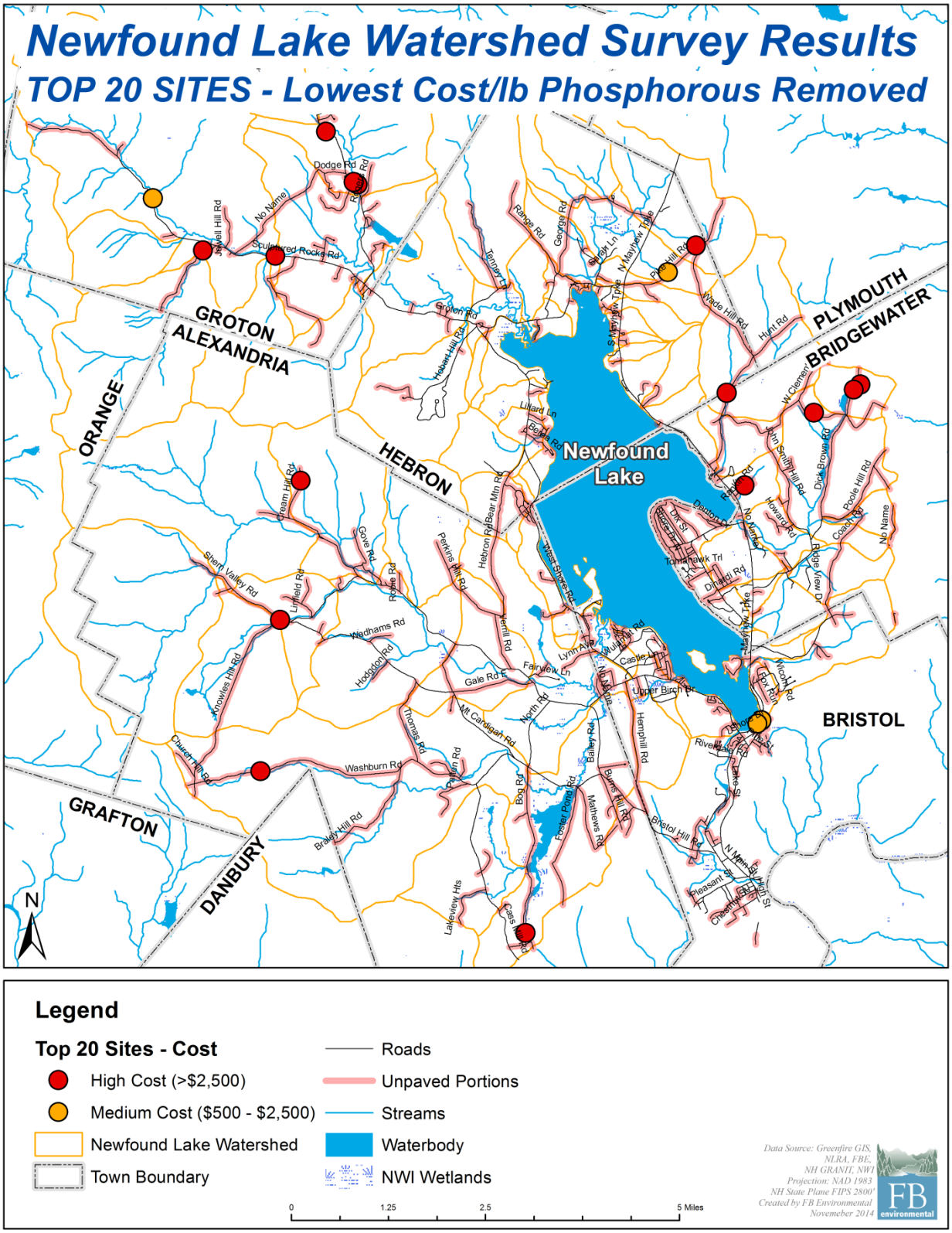
Top 20 BMP List

The top 20 BMPs from the prioritized list of all identified survey sites was extracted from the list and account for 80% of the total estimated P load per year contributed by all surveyed problem areas. On average, the top 20 BMPs will cost an estimated $1,503 per pound of phosphorus removed (Figure 3).

It is important to note that, while the focus of the BMP Matrix is on phosphorus, the treatment of stormwater will result in the reduction of many other kinds of harmful pollutants that could have a negative impact on these waters. These pollutants would likely include:

- Nutrients (e.g. nitrogen)
- Bacteria and viruses
- Heavy metals (cadmium, nickel, zinc)
- Petroleum products
- Road sand/salt

Figure 3: Top 20 Prioritized Sites from the Newfound Lake BMP Matrix



Phosphorus Load Reduction Goals (Task 20)

In addition to the phosphorus load reductions per site calculated using the Region 5 Model, these reductions were further evaluated using the Lake Loading Response Model (LLRM) previously developed by the University of New Hampshire, creating an estimate of the net effect on watershed phosphorus load (in kg/year) and in-lake TP concentration (ppb). In the first scenario, load reductions from the 20 highest priority BMPs were incorporated into the model, while in the second scenario all 55 recommended BMPs were incorporated. The updated LLRM for both scenarios is provided as an attachment to this memo.

Mathematically, the load reductions presented in the BMP matrix were subtracted from the total basin phosphorus load just prior to the basin attenuation step of the model, as described in the notes on the first tab in the LLRM spreadsheets. The BMPs, and thus the estimated load reductions, fell in seven of the fifteen basins used in the Newfound Lake LLRM under both scenarios. A summary of the results are as follows:

- The LLRM predicts a watershed phosphorus load of 1585.4 kg/year and an in-lake phosphorus concentration of 4.0 ppb under current conditions.
- By adding in the top 20 BMPs, the phosphorus load is reduced by 10% to 1425.8 kg/year and the in-lake phosphorus concentration is reduced 8% to 3.7ppb.
- By adding in all 55 BMPs, the phosphorus load is reduced by 12% to 1387.8 kg/year and the in-lake phosphorus concentration is reduced 10% to 3.6 ppb under the all-BMP scenario.

Monitoring Evaluation (Task 21)

A thorough review of the current monitoring program for Newfound Lake and its tributaries was conducted in November 2014.

The following project specific resources were reviewed as part of this task:

- NLRA website: http://newfoundlake.org/index.php/protect-the-lake-watershed/clean-water/water-quality-and-testing
- *Newfound Watershed Master Plan. Every Acre Counts: A Toolkit for our Future.* Volume I and Volume II. October 6, 2009.
- 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.
- Craycraft, Robert C. and Jeffrey A. Schloss. *Final Report: Newfound Lake Water Quality Assessment. 2014.* UNH Center for Freshwater Biology, UNH Cooperative Extension. University of New Hampshire. Durham, NH. CFB Report # 2014-LLMP 01.

Findings from the review indicate that Newfound Lake is a NHDES designated High Quality Waterbody with low levels of total phosphorus, high levels of dissolved oxygen, and excellent water clarity. The UNH Center for Freshwater Biology (CFB) has indicated that long-term monitoring of Newfound Lake is a high state-wide priority. Previous studies for Newfound Lake (above) have resulted in the collection of excellent baseline data for long-term monitoring in the Newfound Lake Watershed. The Newfound monitoring program is robust, beginning in 1986, with 28 years of data across eight lake sites, as well as 35 stream sites (including 24 "core sites") across eight subwatersheds and 16 rivers and streams. The UNH CFB is the primary lead for monitoring; conducting two monitoring events at each site with support from a well-established network of active volunteer monitors (23 monitors in 2012-2013) has helped support the robust lake and stream monitoring program. In addition, Newfound Lake has an active Lake Host Program, with volunteers actively monitoring the lake for aquatic invasive species.

The results of the 2008 Tributary Assessment and phosphorus modeling conducted by UNH CFB indicates that while water quality is excellent in Newfound Lake, there is clearly a North-South water quality gradient, with the poorest water quality at the southern end of the lake at the Mayhew Island site; also the area with the greatest development density, and a declining trend (decreasing clarity, increasing Chl-a) at Pasquaney Bay. The study also found that the streams that flow into Newfound Lake account for more than 74% of the external phosphorus load, and that 30% of the phosphorus entering the lake accumulates in the sediment. The Fowler River and Cockermouth River account for the greatest percentage of both stream flow and total phosphorus loading.

In their 2013 report, UNH CFB makes some excellent recommendations for monitoring at Newfound Lake:

- Conduct in-lake water quality sampling at historical deep sampling locations that will add to the long-term database, will facilitate continued trend detection and will continue to assess Newfound Lake's trophic status. Specifically:
    - Continued weekly to bi-weekly epiliminetic Chl-a and dissolved color sampling at the seven historical sampling stations. Secchi disk transparency measurements should also be collected during each visit.
    - Implement bi-weekly epilimentic TP sampling at each of the seven historical sampling stations.
    - Implement hypolimnetic TP sampling at Mayhew (Site L02) during July, August and September.
    - Continue collection of late season (mid-August/September) dissolved oxygen and metalimnetic Chl-a samples at each of the historical sampling sites.
- Conduct tributary sampling at pre-existing and expanded headwater sampling sites to document water quality variations among sampling locations and to screen for problem areas within the Newfound Lake watershed.
    - Collect tributary data during storm events.
    - Collect both turbidity and TP samples during each sampling event.

- Collect digital photographs of stream conditions to establish a visual record.
- Collect water samples in March/April to correspond with high flow periods associated with rapid snowpack melt.

<u>In addition to the UNH CFB recommendations, FB Environmental recommends the following:</u>

- Collect temperature and dissolved oxygen profiles during each of the weekly to bi-weekly visits at each of the seven primary lake monitoring stations.
- Conduct flow monitoring on the Newfound River to monitor lake levels (& drawdown) so that minimum recommended flows of 100 cfs are maintained to protect fish species of concern.
- Melt Sampling- Collect melt samples at targeted tributary sites with elevated specific conductivity (e.g CR U70, CR U80, DBB H03, FR H21, GB U10 and GB U20) from February through April on days when temperatures are above freezing and warm weather or spring rain have contributed to melting of any remaining snowpack (target 4-week period with high flow following ice-out). Parameters: Chloride
- Grab Sampling- Collect monthly baseflow and storm flow monitoring at targeted locations with elevated TP (e.g. CR H11, DBB U20, FR H21, GB U10) and specific conductivity (see above). Baseflow to be collected during dry weather conditions (no rain for 72 hours) with hand-held meter (specific conductance, temp, DO, pH and turbidity) and water sample (chloride, TP). Storm flow monitoring to be collected either by collecting grab samples, or using passive stormwater sampling devices that are pre-deployed at collection sites and fill when water rises to a determined level. Auto-samplers can be co-located with stilling wells and water level loggers to ascertain stream height and time that the sampler began to fill. Parameters (chloride, TP). Chloride data from grab samples can be used with specific conductivity readings to develop a specific conductivity-chloride model and regression. The benefit of the auto-samplers is that they will fill during heavy rains day or night. Volunteers have 48 hours to collect the samples.
- Continuous Monitoring- Data sondes and loggers may be deployed at strategic locations in rivers, streams and lakes to capture continuous (e.g., every 30 minutes) data on a number of parameters, including water temperature, dissolved oxygen, specific conductivity, turbidity, chlorophyll-a and algae abundance. Data such as this could be valuable to developing further understanding of water quality processes in the watershed. Install continuous monitoring data sondes at targeted locations in the Fowler River and Cockermouth River, and/or HOBO data loggers (U-24 and U-26) and stage level loggers. Install as early as possible in the spring, and retrieve as late in the fall as possible. Parameters: Temp, DO, specific conductance
- Biomonitoring- The Newfound Lake watershed is home to 22 fish species including an intact population of wild brook trout and six species of fish that require special consideration in the NH Wildlife Action Plan (WAP). Given that previous reports

indicate significant bank erosion within Newfound's tributaries, and high levels of turbidity at some of the stream sites, FBE suggests conducting benthic biomonitoring for macroinvertebrates at targeted stream stations on an ongoing basis (every 3- 5 years) in addition to a qualitative assessment of stream channel stability, geomorphology, in-stream wood and channel morphology. Fish monitoring should continue on a 5-year schedule.

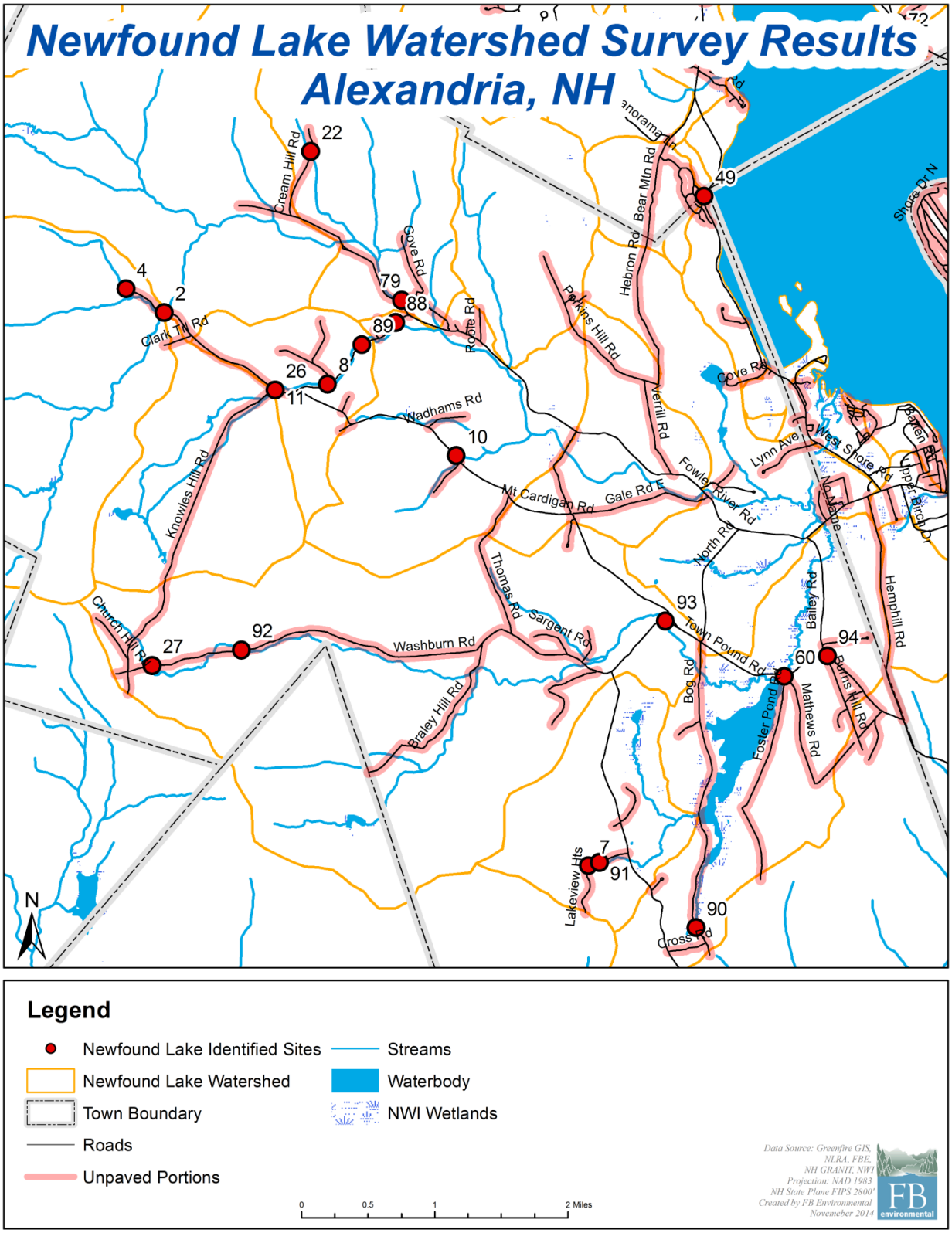
- Bioassessments- Conduct a physical habitat characterization at target stream sites, or within select subwatersheds to evaluate differences in stream and riparian habitat quality between monitoring locations. This may include a rapid habitat and geomorphic assessment.

Other Recommendations:

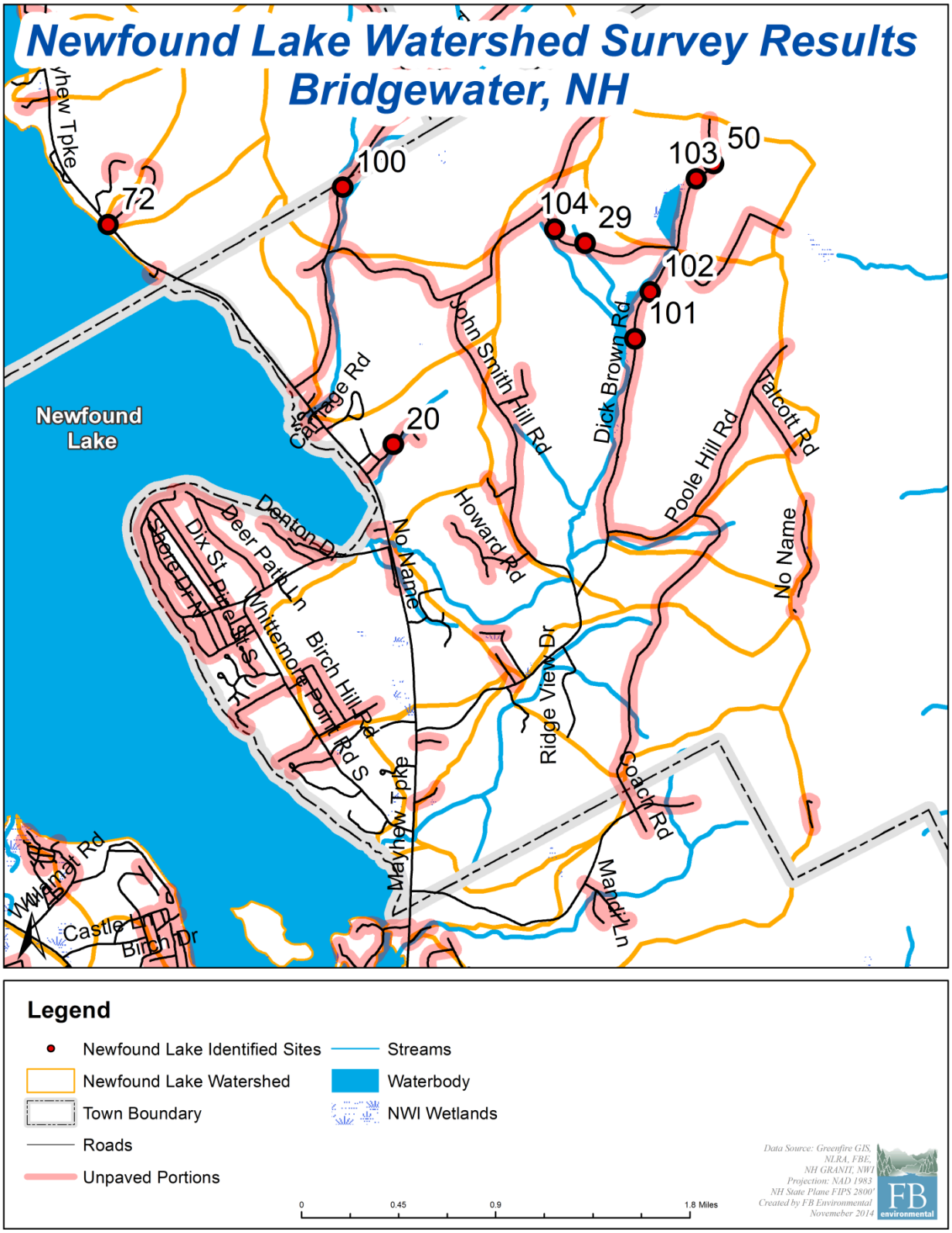
- Data Management- Create a common data base for all data that will allow NFLA to develop simple queries and reports of lake and stream data.
- BMP Monitoring- Work with the local municipalities or volunteers to ensure that BMPs (plunge pools, culverts, etc.) are functioning to prevent increased discharge to tributaries and the lake.
- Growth- Continue tracking growth rates in the watershed to determine how the watershed is changing over time, and how that may relate to changes in water quality.
- Septic Systems- Due to excessively drained soils in the watershed, and the close proximity of shoreland development, even marginal septic systems could have a significant impact on Newfound Lake. Consider conducting a septic system survey to assess the condition of these systems.
- Watershed Perspectives- Build upon previous citizen surveys by conducting a follow-up survey to the 2009 survey in 2019, and every 10 years thereafter.

Appendix A – Newfound Lake Survey Site Maps by Town

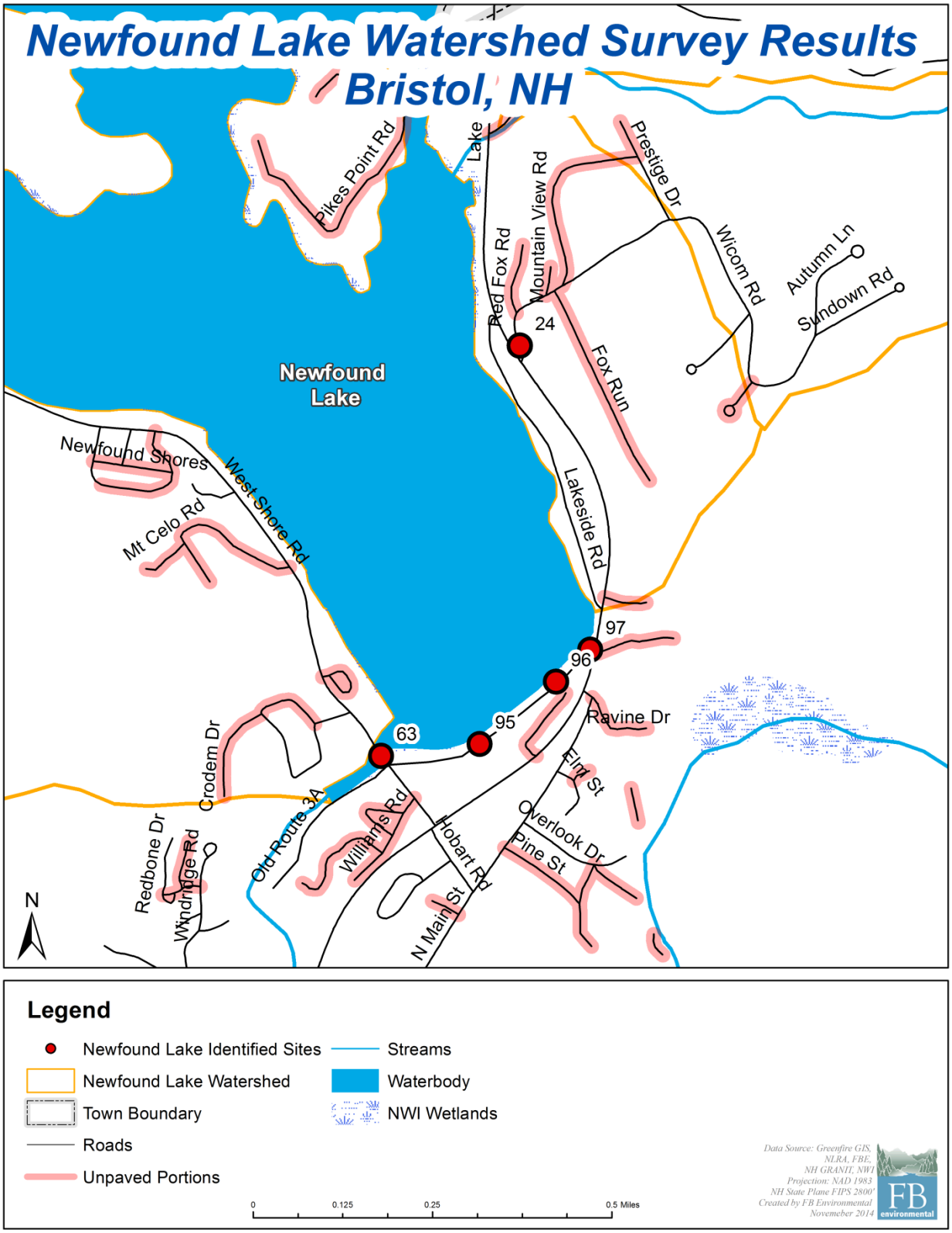
Alexandria


Newfound Lake Watershed Survey Results
Alexandria, NH
Cream Hill Rd
Cove Rd
Robie Rd
Hebron Rd
Bear Mtn Rd
Perkins Hill Rd
Merrill Rd
Clark Tln Rd
Knowles Hill Rd
Wadhams Rd
Mt Cardigan Rd
Gale Rd
Fowler River Rd
Lynn Ave
West Shore Rd
Shore Dr N
Barren Rd
Upper Birch Dr
North Rd
Thomas Rd
Sargent Rd
Church Hill Rd
Washburn Rd
Braley Hill Rd
Town Pound Rd
Bailey Rd
Hemphill Rd
Bog Rd
Foster Pond Rd
Mathews Rd
Barns Hill Rd
Lakeview Hts
Cross Rd
22
49
4
2
79
88
89
8
26
11
10
93
94
60
92
27
7
91
90
N
Legend
Newfound Lake Identified Sites
Newfound Lake Watershed
Town Boundary
Roads
Unpaved Portions
Streams
Waterbody
NWI Wetlands
0
0.5
1
2 Miles
Data Source: Greenfire GIS, NLRA, FBE, NH GRANIT, NWI
Projection: NAD 1983 NH State Plane FIPS 2800'
Created by FB Environmental
Novemeber 2014
FB environmental

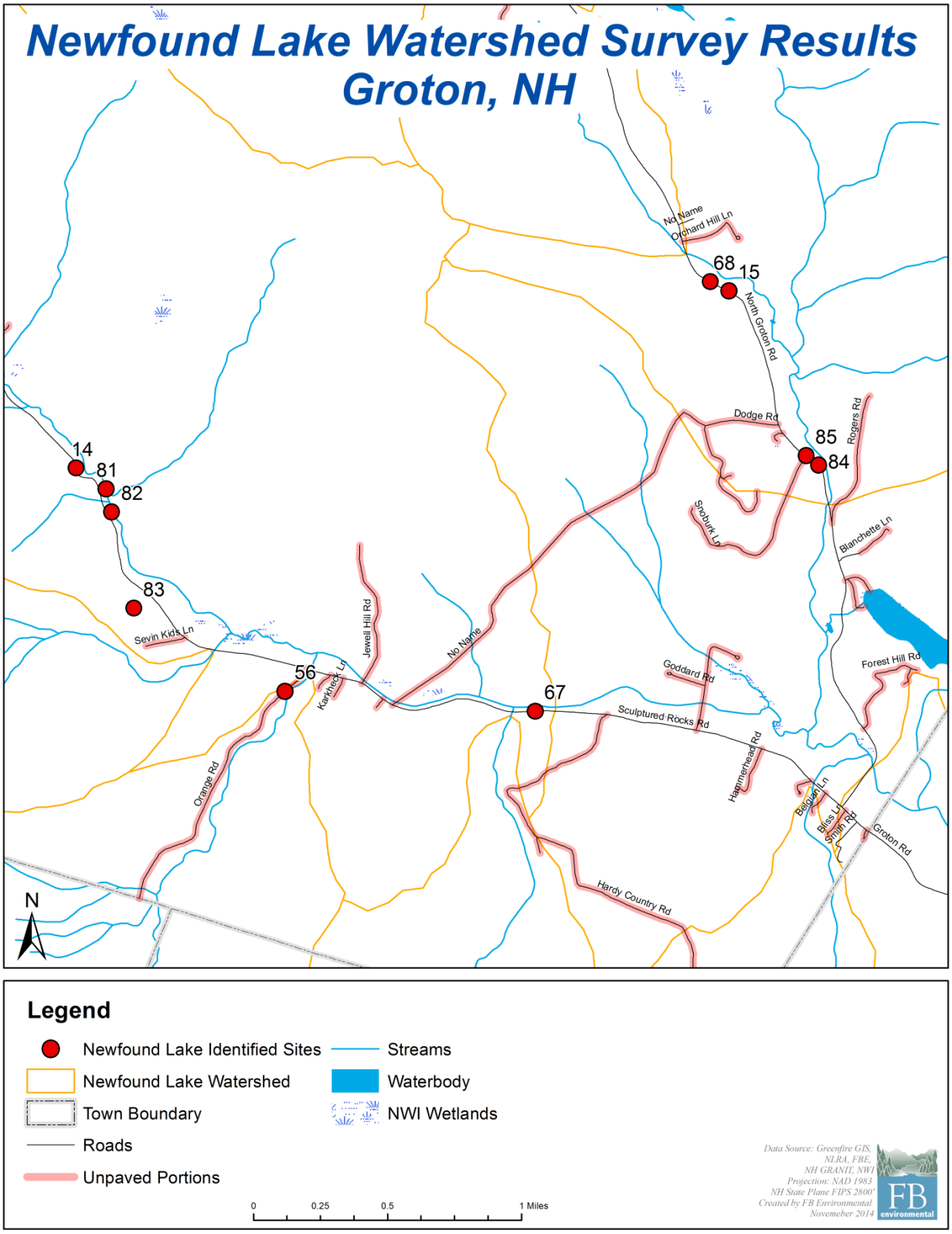
Bridgewater



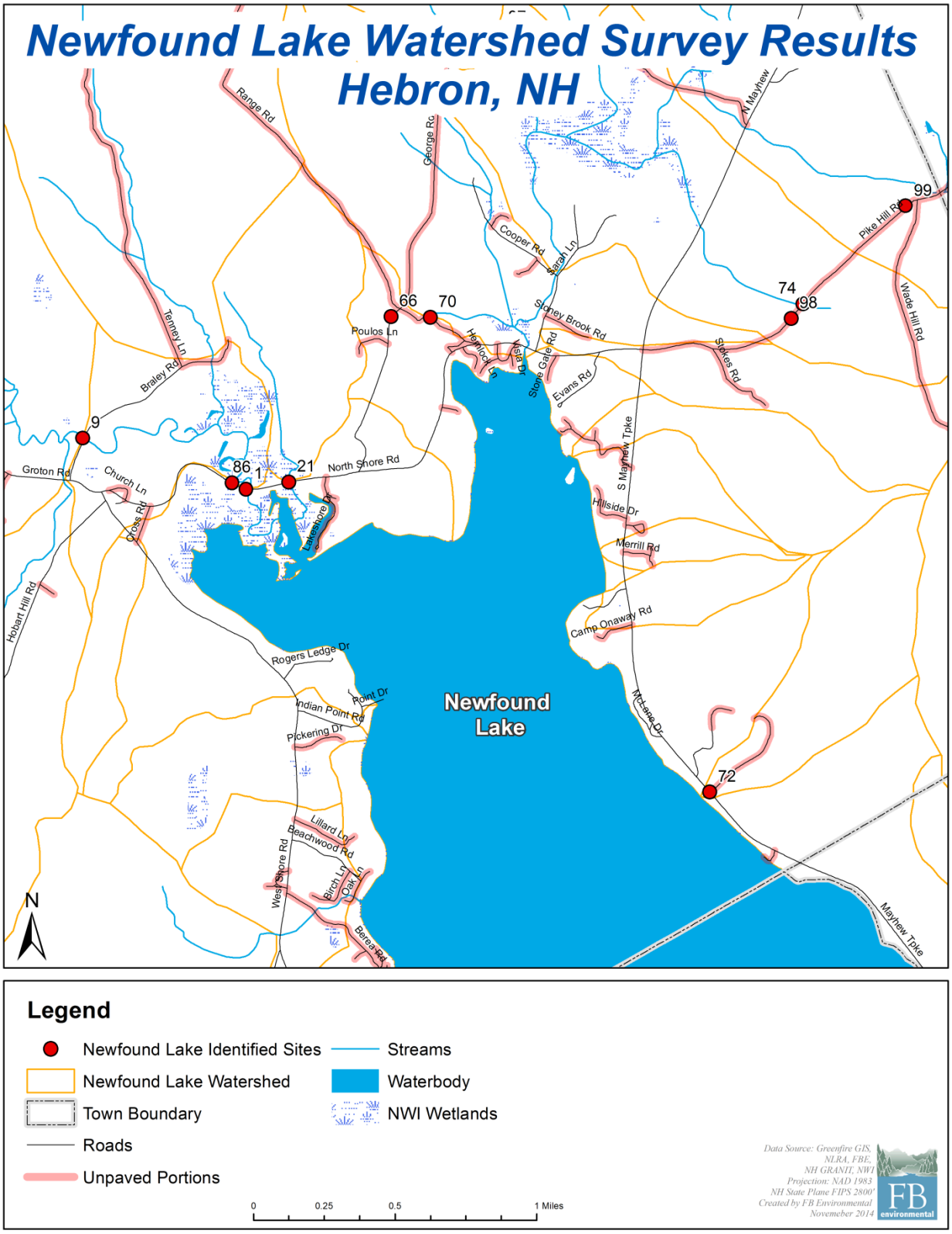
Bristol


Newfound Lake Watershed Survey Results
Bristol, NH
Pikes Point Rd
Lake
Prestige Dr
Mountain View Rd
Red Fox Rd
Wicom Rd
Autumn Ln
Sundown Rd
24
Fox Run
Newfound Lake
Newfound Shores
West Shore Rd
Mt Celo Rd
Lakeside Rd
97
96
95
63
Ravine Dr
Crodem Dr
Elm St
Old Route 3A
Williams Rd
Hobart Rd
Overlook Dr
Pine St
Redbone Dr
Windridge Rd
N Main St
N
Legend
Newfound Lake Identified Sites
Streams
Newfound Lake Watershed
Waterbody
Town Boundary
NWI Wetlands
Roads
Unpaved Portions
0
0.125
0.25
0.5 Miles
Data Source: Greenfire GIS, NLRA, FBE, NH GRANIT, NWI
Projection: NAD 1983 NH State Plane FIPS 2800'
Created by FB Environmental
Novemeber 2014
FB environmental

Groton


Newfound Lake Watershed Survey Results
Groton, NH
No Name
Orchard Hill Ln
68
15
North Groton Rd
Dodge Rd
Rogers Rd
85
84
14
81
82
83
Sevin Kids Ln
Jewell Hill Rd
Karlsheck Ln
No Name
56
67
Snoburt Ln
Blanchette Ln
Forest Hill Rd
Goddard Rd
Sculptured Rocks Rd
Hammerhead Rd
Belgian Ln
Bliss Ln
Smith Rd
Groton Rd
Orange Rd
Hardy Country Rd
N
Legend
Newfound Lake Identified Sites
Newfound Lake Watershed
Town Boundary
Roads
Unpaved Portions
Streams
Waterbody
NWI Wetlands
0
0.25
0.5
1 Miles
Data Source: Greenfire GIS, NLRA, FBE, NH GRANIT, NWI
Projection: NAD 1983 NH State Plane FIPS 2800'
Created by FB Environmental
Novemeber 2014
FB environmental

Hebron


Newfound Lake Watershed Survey Results
Hebron, NH
Newfound Lake
Range Rd
George Rd
Cooper Rd
Sarah Ln
N Mayhew
Pike Hill Rd
Wade Hill Rd
Stoney Brook Rd
Stokes Rd
Vista Dr
Stone Gate Rd
Evans Rd
Hemlock Ln
Poulos Ln
Tenney Ln
Braley Rd
Groton Rd
Church Ln
Cross Rd
North Shore Rd
Lakeshore Dr
S Mayhew Tpke
Hillside Dr
Merrill Rd
Camp Onaway Rd
McLane Dr
Hobart Hill Rd
Rogers Ledge Dr
Point Dr
Indian Point Rd
Pickering Dr
Lillard Ln
Beachwood Rd
West Shore Rd
Birch Ln
Oak Ln
Bereza Rd
Mayhew Tpke
66
70
74
98
99
9
86
1
21
72
N
Legend
Newfound Lake Identified Sites
Newfound Lake Watershed
Town Boundary
Roads
Unpaved Portions
Streams
Waterbody
NWI Wetlands
0
0.25
0.5
1 Miles
Data Source: Greenfire GIS, NLRA, FBE, NH GRANIT, NWI
Projection: NAD 1983 NH State Plane FIPS 2800'
Created by FB Environmental
Novemeber 2014
FB environmental

Appendix E ~ Web Site Data Posting Methodology

Appendix E ~ Web Site Data Posting Methodology
A through I Summary Addendum Report ~ December 2014
By Andrew Veilleux, NLRA Program Manager

Data Mapping Methodology

Online mapping is one of the most informative methods of sharing data gathered throughout the Watershed Master Plan. By representing water quality and BMP information on a map, viewers are given a location with picture/written explanations of the specific site. Many methods of mapping were explored for this data and the final decision was to utilize GoogleMaps. This mapping platform allows us to upload map layers of our own while also giving the option to create points and lines on the actual map. We were also given the opportunity to share information via pictures and text for each site. These factors, combined with the ability to host the map on our website, made this the best option for our organization. Note that this approached the more complex and sophistraced Drupal-based platform explored during the previous project phase.

Google Map Features:

-Hosted remotely for as long as we would like, though map will be displayed as long as we would like on newfoundlake.org

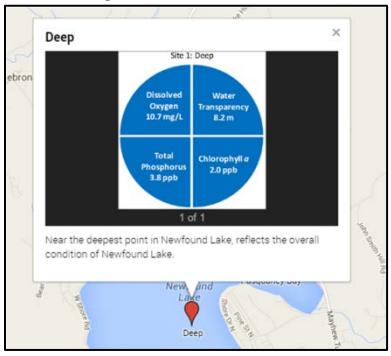
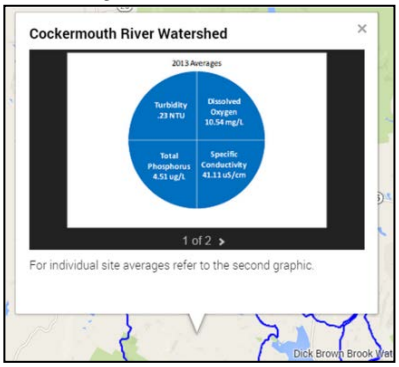
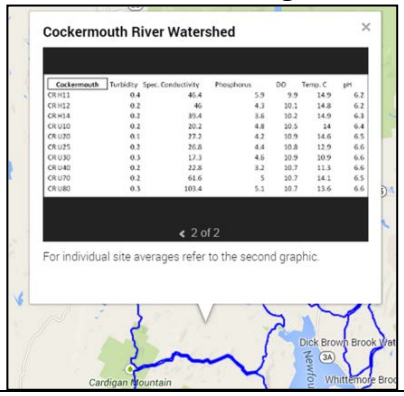
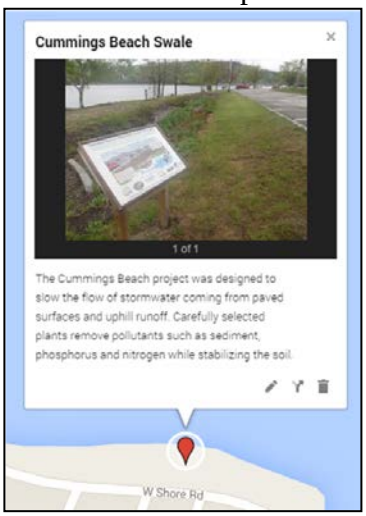
-Map can be customized, updated or edited at any time.

-Road Map or Satellite view

-Pictures and Text can be added to each individual point

-Custom map layers can be added (watershed boundary, tributary names, etc)

We will be sharing several interactive maps on our website including: Lake Water Quality Data, Tributary Water Quality Data, and Stormwater BMP Projects. Each map will display the Newfound Watershed with zoom and pan capabilities. The display can be either a road map or satellite image, lending itself to step-by-step directions to any site on a road and aerial views of every site. Using these base maps, points were placed on the map to represent each site. Graphics and text were chosen and inserted depending on the information we wished to be shared.

Lake Water Quality Map	Tributary Water Quality Map	Stormwater Map
-Displays marker at each sample site and another non-location dependant marker to display graphics and water quality standards -Pictures include a data graphic and may include a photo of the location. -Text describes why this location was chosen and explains the implications of the water quality data	-Displays marker at each sample site and another non-location dependant marker to display graphics and water quality standards -Pictures include a data graphic and will include several photos of the location.	-Displays marker at each project site. -Pictures include several photos of the project -Text describes why this BMP was chosen for the site and the implications (sediment and phosphorus modeling)
-Example of Graphic(s): Circle Quadrants 	-Example of Graphic(s): Circle Quadrants:  Individual Site Averages: 	-Example of Graphic (s): Site Photos and Explanation 
-Web Address: http://newfoundlake.org/index.php/protect-the-lake-watershed/clean-water/lake-sampling-site-map	-Web Address: http://newfoundlake.org/index.php/protect-the-lake-watershed/clean-water/trib-sampling-site-map	-Web Address: http://newfoundlake.org/index.php/protect-the-lake-watershed/water-watch-dog/stormmap

Appendix F ~ GreenFire GIS Technical Report

Newfound Lake Watershed Master Plan

GIS Technical Report

Prepared for the Newfound Lake Region Association

Prepared By

Dan Sundquist

GreenFire GIS Mapping & Analysis

December 2014

Funding for this project was provided in part by a grant from the NH Dept. of Environmental Services with funding from the US Environmental Protection Agency under Section 319 of the Clean Water Act

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or

info@NewfoundLake.org

Table of Contents

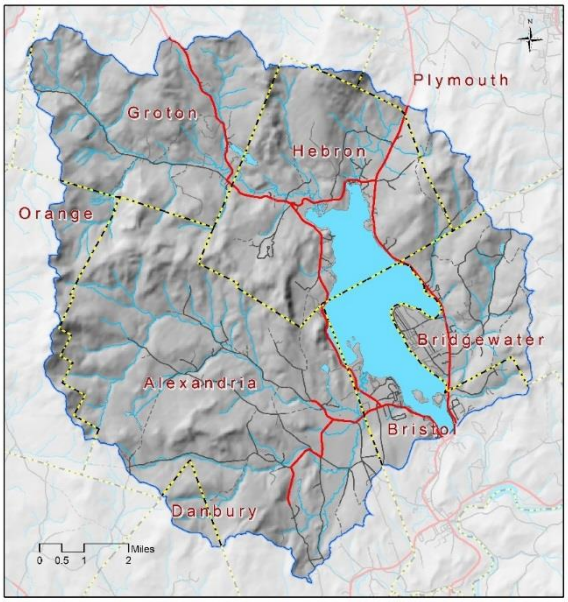
Executive Summary

Introduction

This report has been prepared in support of the Newfound Lake Watershed Master Plan as part of extensive GIS-based mapping and analysis performed in the course of the multi-year planning process. The information presented in the report covers two separate investigations:

- Mapping and analysis of a range of water quality-related natural resources has been conducted to identify those areas within the Newfound Lake watershed that are most suitable for future development and/or conservation; and,
- A "build-out analysis" for the Newfound Lake watershed that seeks to forecast development patterns and related water quality impacts within the watershed. This analysis included an example of local land-use planning with in-depth evaluation and recommendations for the Fowler River watershed, focusing on its high-yield aquifer and prime agricultural soils.

Study Area



The study area is the Newfound Lake watershed, a relatively small area compared to other lake watersheds in New Hampshire at a little more than 61,000 acres, or about 95 square miles in size. The watershed is defined by the topographical height of land surrounding the lake, and closes at the lake outlet at the dam in Bristol. The actual land area within the study area is 56,326 acres.

The map to the left shows the configuration of the watershed study area, and the municipalities included within the watershed. The topographic background illustrates the complex and often steep terrain found within the watershed. The land rises from a lake elevation of roughly 586', to the summit of Mt. Cardigan at about 3,120' which is part of the watershed boundary to the west of Alexandria.

Part 1: Resource Analysis & Co-Occurrence Mapping

Background

This study uses GIS technology to accomplish mapping and to perform statistical analysis of various features found in the maps. GIS relies upon digital versions of mapped data which are available from the state's geographic information data library at GRANIT, a program of the University of New Hampshire, as well as various state and federal agencies.

Twelve natural resource features were evaluated in this study. They can be grouped as follows, and are presented in this report in the following order:

- Surface Water Resources
- Drinking Water Resources
- Steep Slopes & Highly Erodible Soils
- Wildlife Habitat
- Prime Agricultural Soils & Most Productive Forest Soils

Highlights of Findings

A brief overview of the natural resources considered follows, with statistics on extent within the Newfound Lake watershed, and current protection status[1]. See the full report for more detailed information and mapping.

Surface Water Resources

Riparian Buffers are naturally vegetated corridors along streams and rivers that play a critical role in filtering sediment and nutrients before entering the water ecosystem. **Riparian buffers amount to 4.7% of the watershed, and are currently about 16% protected.**

Wetlands offer multiple benefits including flood water storage, biological purification, and important wildlife habitat for a number of species of plants and animals. **Wetlands cover 3.5% of the watershed, and are 14.2% protected.**

Floodplains provide flood water storage and transit, and are home to unique natural communities. **Floodplains involve 1.7% of the watershed, and are 13.4% protected.**

Drinking Water Resources

Sand & Gravel Aquifers underlie the Cockermouth and Fowler River valleys, and represent the most readily available groundwater supplies for public drinking water systems. **Aquifers cover 6.1% of the watershed, and are 8.9% protected.**

Favorable Gravel Well Sites with potential to provide uncontaminated water for future water supplies have been mapped by the N.H. Department of Environmental Services (NHDES) within the aquifer formations. **Future well sites on aquifers involve 1.8% of the watershed, and are 9.4% protected.**

Source Water Protection Areas around existing public water supplies have also been mapped by NHDES. The Bristol Water Works wellheads in the Fowler River aquifer currently serve more than 3,400 persons. **Collectively, source water protection areas cover 8.4% of the watershed, and are 15.1% protected.**

Steep Slopes & Highly Erodible Soils

Steep Slopes in this study are classified as greater than 25%, or a rise of one foot in a horizontal run of four feet. Slopes >25% are considered unbuildable, and if disturbed will rapidly erode, contributing

[1] Resources are considered to be protected if they are found on conservation and/or public land with legal agreements recorded to prevent development from affecting the resource.

significant sediment load to run-off. **Steep slopes >25% involve 22.2% of the watershed, and are 25.8% protected.**

Highly Erodible Soils have physical properties that make them prone to rapid erosion if disturbed, especially on steep slopes. **Highly erodible soils are widespread and common in the watershed at 68.5% of the land area, and are 20.2% protected at present.**

Wildlife Habitat

Wildlife Habitat Quality is a component of the N.H. Wildlife Action Plan (NHWAP) which has mapped areas statewide for intrinsic habitat quality and condition. Tier 1 areas are considered the best in the state; Tier 2 areas are best in the bio-region. **Tier 1 habitat zones cover 41% of the watershed, and are 22.8% protected. Tier 2 zones cover 10% of the watershed, and are 32.7% protected.**

Terrestrial Habitats of Concern in the Newfound Lake watershed include 9 of 16 habitat types mapped by the NHWAP. These are the least common habitat types, often found in small occurrences known as "patch habitats". **Grouped together, these habitats involve 34.1% of the watershed, and are 29.1% protected.**

Most Productive Farm & Forest Soils

Prime Agricultural Soils are rated by the National Resources Conservation Service (NRCS, formerly the Soil Conservation Service) as the most productive for croplands and forage production. **Prime agricultural soils are found on 3.7% of the watershed, and are 6.2% protected.**

Productive Forest Soils are also rated by NRCS for high-volume production of commercial timber species. **These soils are extensive within the watershed at 87.2% of land area, and are 16.9% protected.**

In summary, the Newfound watershed contains numerous high-value natural resources that are generally not well protected from development.

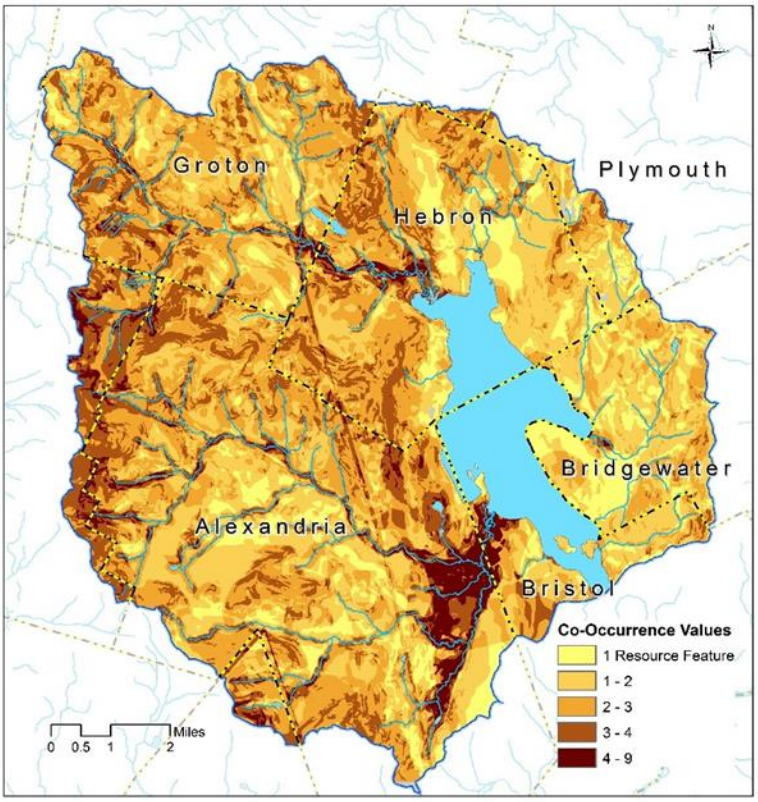
Co-Occurrence Mapping

The natural resources listed above have been combined in the GIS to produce a co-occurrence map that shows where one or more resource features are co-located, or are overlaid on one another. The map on the next page shows the results of that mapping exercise, with darker colors indicating where several resource features co-occur.

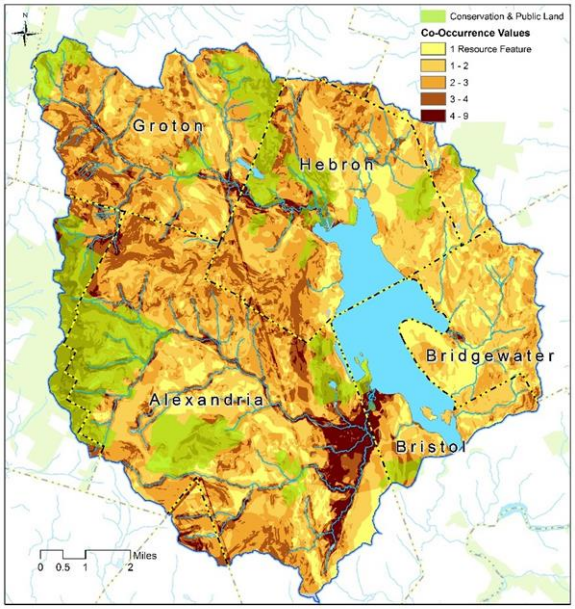
The areas with higher occurrences of natural resource features are important considerations for community planning for two reasons:

- Key resource features that provide eco-system services such as flood water storage and filtration, significant wildlife habitat, drinking water, and productive soils are high-priority for conservation; and,

- Resources that affect water quality in Newfound Lake and its tributary water courses such as steep slopes, highly erodible soils, and riparian buffers require recognition and stewardship in community development plans.



Resource Co-Occurrence Map



Resource Co-Occurrence Map

Statistical Analysis of Resource Analysis

The map to the left shows existing conservation and public lands (green) overlaid on the resource co-occurrence map. Using this data, the extent of each natural resource feature and its protection status has been determined for each of the five principal towns in the Newfound Lake watershed. Clearly, several areas of high importance in the co-occurrence map are not adequately protected. See **Section 4: Statistical Analysis** the main body of the report for the summary table and interpretation of the extent and protection status of the various natural resources considered in this study.

Part 2: Build-Out Analysis

Purpose

The purpose of conducting a build-out analysis is to predict with reasonable certainty how future development patterns are likely to occur in a given study area. Commonly used for community planning purposes, this build-out analysis addresses the entire Newfound Lake watershed by looking at historical development trends for entire towns within and outside the watershed, and land utilization within the watershed over time. Then, using realistic development constraints, the model systematically extrapolates those trends into various future time periods.

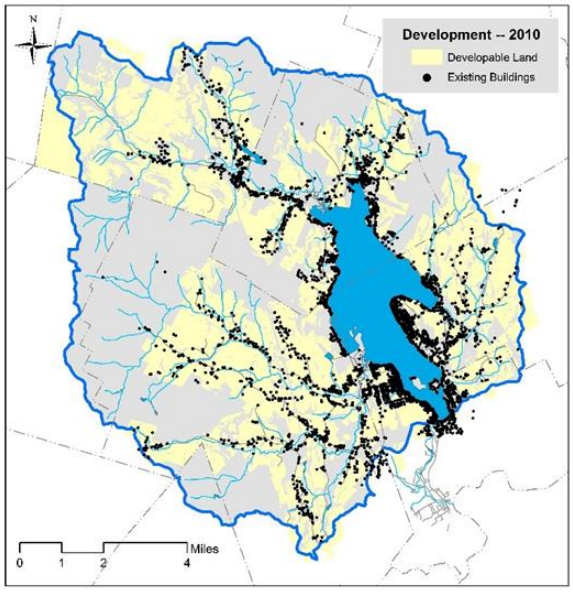
Methodology

A customized methodology for conducting a build-out analysis was designed for the Newfound Lake watershed due to the lack of local land use regulations such as zoning ordinances which determine lot sizes, frontage requirement, and density in some communities. This alternative approach used relies upon two sets of evaluation:

- Land considered **likely to develop** due to accessibility from existing roads and highways, constraints to development such as steep slopes, wetlands, floodplains, and utility rights-of-way, and/or current status as conserved land or land in institutional use; and,
- Prevailing patterns of recent subdivision and lot sizes which are used to assign varying densities of tract utilization for future development on land now undeveloped.

Using "multipliers" determined from the second analysis, undeveloped land deemed likely to develop in the future was "populated" with new housing using estimated growth rates and a utility in the GIS that generates a graphic representation of new development.

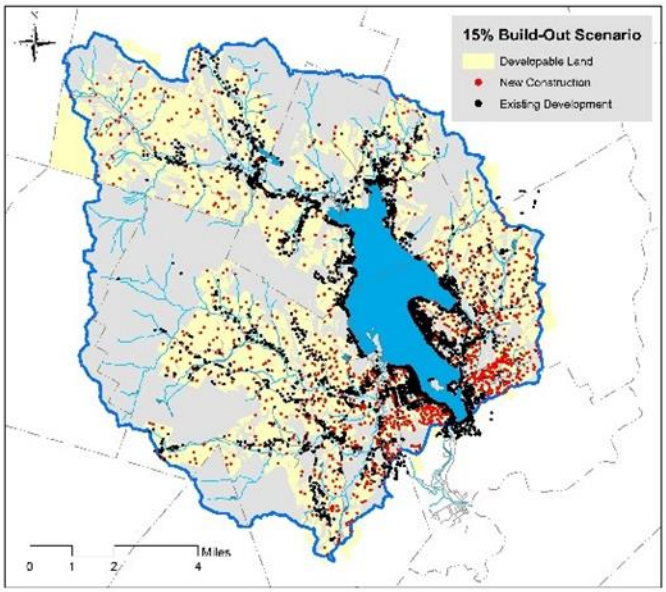
The map to the right shows a baseline inventory of existing buildings within the Newfound Lake watershed, based on 2010 high resolution aerial photography. The land most likely to develop is shown in the light yellow color.

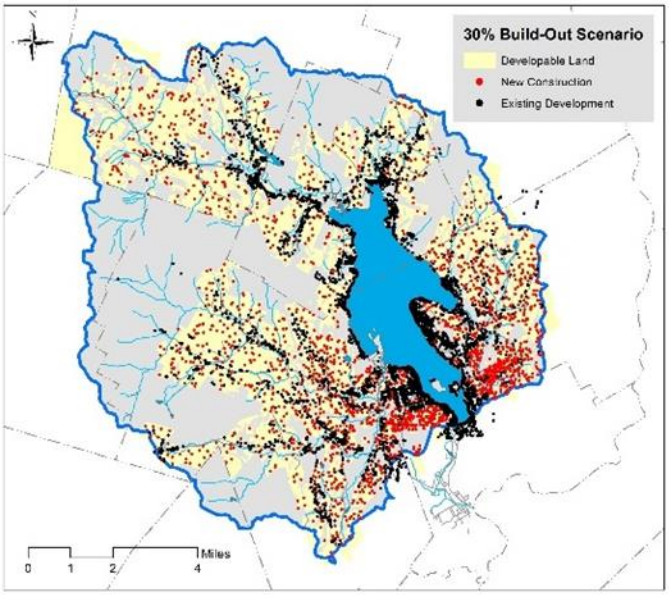


A total of 3,740 building are recorded in the map, with about 95% of those classified as residential buildings.

The maximum build-out determined by the model run would result in more than 8,000 new building units in the watershed, or 215% growth over the 2012 base of about 3,740 buildings identified in the 2010 aerial photography.

The two maps on the next page show the results of the build-out analysis for two stages of development: 15% and 30% total build-out, which have been selected for study since the two scenarios represent potential near-term future possibilities.





The red dots in each map show where new development is likely to occur given the inputs to the build-out analysis model. Density is higher at the southern end of the lake, in keeping with current densities and recent subdivision experience. Lower densities in the 5-acre and greater lot range extent into all other areas. **The 15% scenario would add about 1,100 new buildings – mostly new homes – or about 30% more than current baseline conditions, and the 30% scenario would add 2,340 new buildings, or about 63% over baseline.**

In terms of timeframe for each scenario, given the prevailing average annual 1% rate of growth in watershed over the past decade and a half, it would take about **15 years to reach the 15% build-out, and perhaps 30 years for the 30% build-out to occur** if the regional growth rate stays constant.

In both scenarios, the increase in impervious surfaces, lawns, etc., especially in the southern half of the lake watershed, will have obvious adverse effects on lake water quality if measures are not taken during design, construction and occupancy to avoid increased loading of sediment and nutrients.

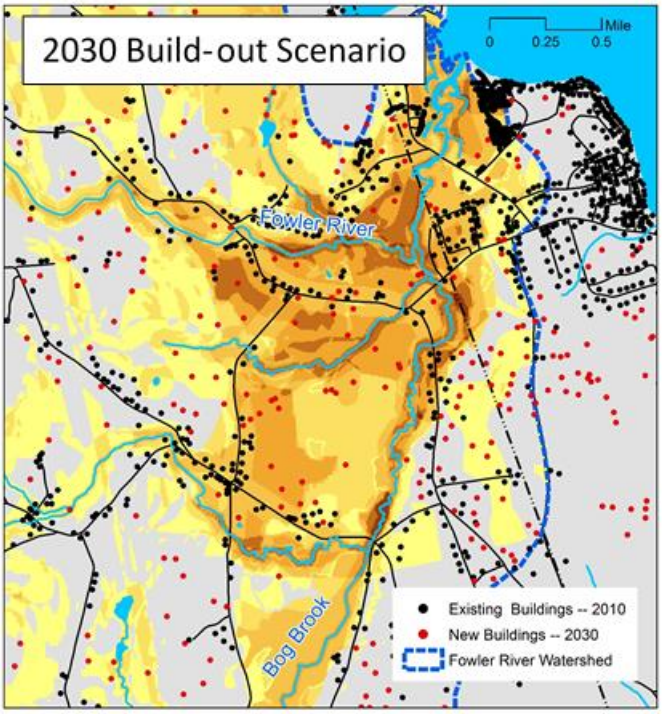
In summary, many of the watershed's most critical resources occur in more than one location, making large areas of land extremely sensitive to development. The analysis clearly indicates both areas that should be protected or very carefully developed, and areas where higher-impact development is more suitable.

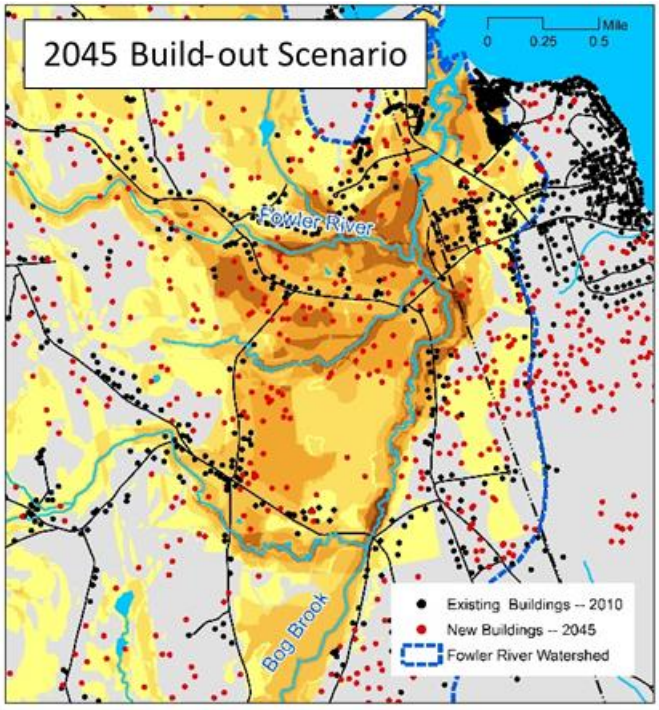
Fowler River Development Study

As part of the watershed-wide build-out analysis, a special study of the Fowler River and Bog Brook valley and aquifer area in Alexandria and Bristol has been made to investigate how the resource information considered in the co-occurrence mapping relates to development scenarios in that area. The area is readily apparent as a high-scoring feature in the co-occurrence mapping, and it contains easily developed land in the path of the next wave of new construction. It is also a critical groundwater recharge zone for the Bristol Water Works wellheads (see body of report for more information). The

method and recommendations from this analysis can be used as an example for other towns within the watershed.

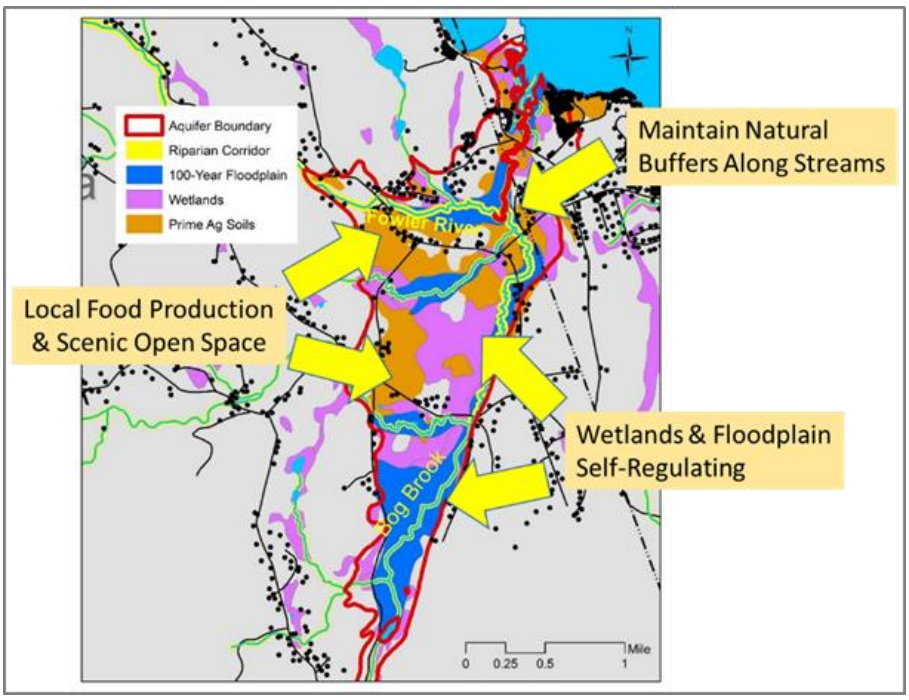
The maps below show development scenarios on the Fowler River aquifer area co-occurrence mapping near Newfound Lake for the 15% and 30% build-out scenarios (translated here for 2030 and 2045). The red dots are new development. Note the extensive development predicted on the aquifer itself which is defined by darker colors and along the river and its tributaries.





Various recommendations are presented in the report as an example of how communities can address this confluence of important natural resources in the context of planning for future development. However, a simple approach is illustrated on the nest page, where development constraints are identified (wetlands, floodplains), maintenance of natural filtration riparian buffers is emphasized, and prime agricultural soils are reserved for local food production and scenic farmland.

With this approach, development on the Fowler River aquifer can be limited and guided to the most suitable locations, while at the same time maximizing protection of water quality and clean drinking water for the existing Bristol Water Works and other potential water supply wells. **Using a similar approach to this analysis, communities can protect their critical resources and direct low-impact development through zoning, overlay districts, subdivision regulations, and conservation.**



Introduction

Background

This report has been prepared in support of the Newfound Lake Watershed Master Plan as part of extensive GIS-based mapping and analysis performed in the course of the planning process. Specifically, mapping and analysis of natural resources related to water quality maintenance and enhancement has been generated to investigate and identify those areas within the Newfound Lake watershed which result in adverse impacts to water quality if converted from currently stable environmental conditions. A separate mapping and analysis exercise addressed in this report seeks to forecast development patterns and related water quality impacts within the watershed.

The entire Newfound Lake watershed master plan, and other related studies can be reviewed the following link to the Newfound Lake Region Association website:

http://www.newfoundlake.org/index.php/protect-the-lake-watershed/publications

Study Purpose

The Newfound Watershed Master Plan (*Every Acre Counts*) studies are intended to provide a knowledge base for and guidance to local decision-makers from two perspectives: suitability of vacant land for development and land conservation priorities. By combining sound community planning with well-defined conservation priorities at community scale, both approaches can provide positive water quality benefits to Newfound Lake and to the long-term economic health of the region. This report is intended to supplement and amplify information found in mapping provided by the Newfound Lake Region Association (NLRA) to the five municipalities principally located within the Newfound Lake watershed: Alexandria, Bristol, Bridgewater, Groton, and Hebron. Each community is encouraged to utilize both the mapping and the analysis presented in this report to augment their local efforts at community planning, with emphasis on water quality and quantity, e.g., sufficient supply and flood-protection measures in both the stewardship of natural resources and thoughtful direction of future community growth. It is also important to recognize that the watershed itself should be viewed as a dynamic natural system, and that communities working cooperatively across municipal boundaries will have the greatest positive impact on the centerpiece of the watershed and its economy: Newfound Lake.

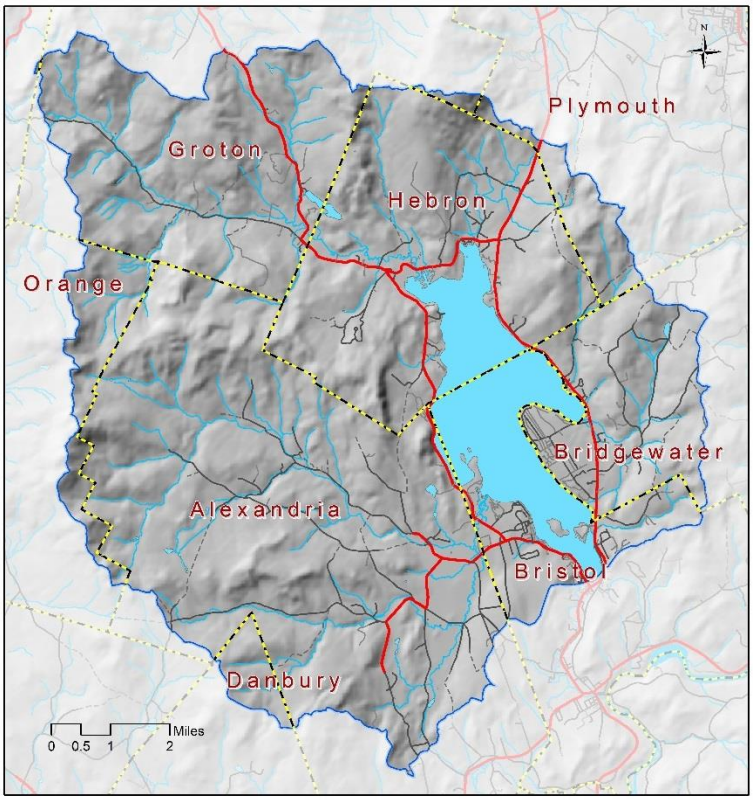
Study Area Definition

The study area is the Newfound Lake watershed, a relatively small region compared to other lake watersheds in New Hampshire at a little more than 61,000 acres[2], or about 95 square miles in size. The watershed is defined by the topographical height of land surrounding the lake, and closes at the outlet dam in Bristol. The actual land area within the study area is 56,326 acres. Alexandria has the largest share of the watershed with a little more than 22,000 acres, or about 39% of the land area. Hebron has the next largest share at about 11,400 acres, or 20% of the watershed, followed closely by Groton at 10,700 acres, or 19%. Bridgewater has about 5,300 acres in the watershed, and only a small portion of

[2] Previous studies of the Newfound Lake watershed used a watershed delineation based on the Newfound River drainage area. This report is based upon the land area of the watershed draining directly into the lake in order to conform to other water quality related studies conducted recently as part of the watershed master plan.

Bristol drains to the lake at about 2,500 acres. Small areas of the towns of Orange, Danbury, and Plymouth are also found within the watershed, all at the upper limits of the watershed.

The map below shows the configuration of the watershed study area, and the municipalities included within the watershed. The topographic background illustrates the complex and often steep terrain found within the watershed. The land rises from a lake elevation of roughly 586', to the summit of Mt. Cardigan at about 3,120' which is part of the watershed boundary to the west of Alexandria. Note also the drainages following the blue stream and river network, with local roads paralleling the drainage system in many locations.



Study Area

Report Organization

This report is divided into two major parts.

- **Part 1** addresses the mapping and analysis associated with the co-occurrence mapping of a range of important natural resource features within the watershed. The purpose of this analysis is to identify areas within the watershed that are important to consider when local communities are deciding suitability for future development and/or resource conservation priorities.
- **Part 2** is devoted to a "build-out" analysis for the entire watershed to illustrate probable development patterns over time. This analysis focuses primarily on new residential development since that has been the trend in recent decades. An in-depth analysis of the Fowler River watershed in Alexandria combines the resource information in Part 1 with predicted increase in

new development as an approach communities can take in guiding new development to the most suitable locations.

Both parts of this report discuss the study methodology and assumptions made in detail, as well as interpretation of the results of the study. Taken together, the two parts provide a knowledge base and powerful tools for community planning decisions, especially as related to maintaining and enhancing water quality in Newfound Lake and protecting the local economy.

Part 1: Co-Occurrence Mapping

Section 1: Overview of Natural Resources Considered

Twelve natural resource features were evaluated in this study. They can be grouped as follows, and are presented below in this order:

- Surface Water Resources
- Drinking Water Resources
- Steep Slopes & Highly Erodible Soils
- Wildlife Habitat
- Prime Agricultural Soils & Most Productive Forest Soils

This study uses GIS technology[3] to accomplish mapping and to perform statistical analysis of various features found in the maps. GIS relies upon digital versions of mapped data which are available from the state's geographic information data library at GRANIT, a program of the University of New Hampshire. Additional data has been provided by federal agencies, including the USGS and NRCS, as well as state agencies such as the N.H. Fish and Game Department and the N.H. Department of Environmental Services. Other data, such as tax parcel information, was obtained by from local municipalities. All data used in this study is the most current version available, as of this writing.

Surface Water Resources

Riparian Buffers

Riparian buffers zones are important wildlife habitat zones, and constitute the last and best line of defense in terms of maintaining water quality through filtration of stormwater moving overland to lakes, ponds, rivers and streams. This study uses a tiered buffer approach developed by the Center for Watershed Protection (CWP)[4] for all rivers and streams, adapted to the natural resources of the Newfound watershed. See the map to the right for extent and distribution of riparian corridors within the Newfound Lake watershed. Thicker lines indicate wider riparian buffers, based on CWP protocols (see below).

Riparian Buffers

It should be noted that the NH Wildlife Action Plan (NHWAP) uses a 300' buffer in its habitat

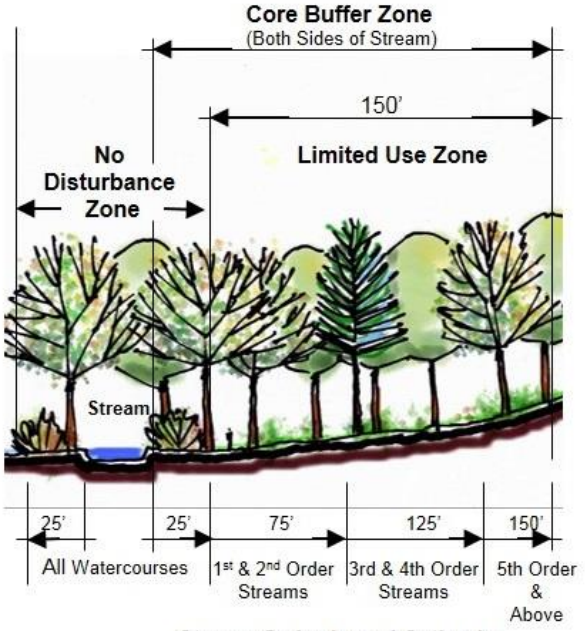
[3] GIS stands for Geographic Information Systems which uses digital versions of mapped data for mapping and selective processing within the GIS to study both the extent and distribution of mapped features and relationships among those features.

[4] Centers for Watershed Protection at http://cwp.org/. Adapted from the *Architecture of Urban Stream Buffers*, Article 39, Watershed Protection Techniques. 1 (4): 155 – 163.

modeling. This distance helps to ensure adequate wildlife movement corridors along water features, which are often home to unique natural communities. The 300' buffer is not included in the CWP riparian buffer layer, but is included in the NHWAP **habitat quality** data discussed below, and it is also found in the wildlife habitat **connectivity** data to a large degree. Thus, both concerns – water quality and wildlife habitat – are well represented in this study.

The CWP tiered buffer model is based on stream order[5], with a buffer of 75' for order 1 and 2, 125' for order 3 and 4, and 150' for stream order 5 and above (typically larger rivers). The 150' buffer is also applied to all lakes and ponds. Recent scientific studies show that these distances are more than adequate for maintaining water quality if kept in a natural land cover condition. However, wildlife corridors along riparian buffers needs to be wider, on the order of 300'.

The graphic below shows how the CWP tiered buffer concept works. Note that the intent is to maintain a 25' no disturbance zone on either side of a watercourse. The limited use zone extending out to 150' in the case of higher order watercourses is also intended as a natural stormwater "filter strip", but may be devoted to light human uses such as trails, natural recreation areas, and timber harvests.



Stream Order-based Setbacks

Riparian buffers account for about 2,600 acres, or 4.7%, of the study area, and are about 16% protected presently.

[5] Headwater streams highest in the watershed are Order 1; where two Order 1 streams combine, the watercourse becomes Order 2. Two Order 2 streams combine to make Order 3, and so forth down gradient.

Wetlands

Wetlands

Wetlands are delineated for this study using hydric soils – poorly-drained and very poorly drained soils – based on mapping from the NRCS. Both soils types are strong indicators of jurisdictional wetlands per state and federal regulations. The term jurisdictional indicates that State and Federal laws regulating wetland uses and impacts exist, providing some level of protection from development. While our approach does not specify **wetland types**, this is addressed to a large degree in the habitat data also used in this planning process. See **Special Wildlife Types** below for more information.

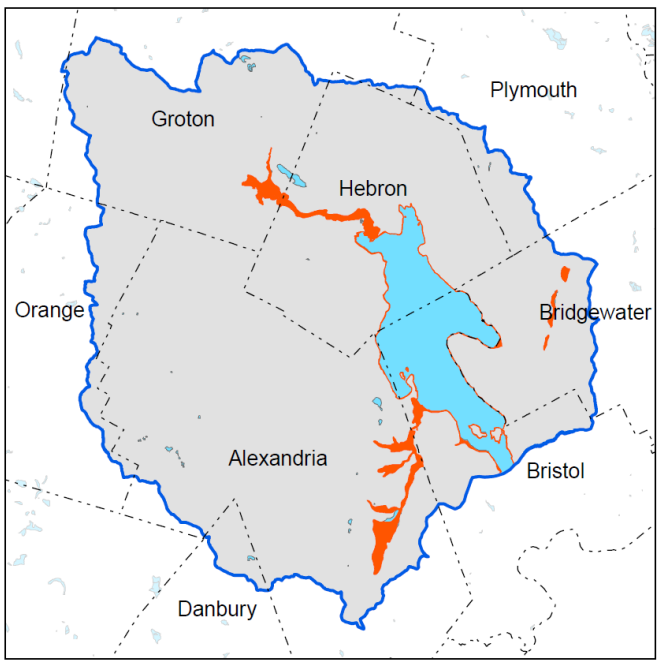
Wetlands are important natural features in conservation planning not only for their many habitat values but also for maintaining water quality as "natural filters", and for floodwater storage.

The map above displays hydric soils in the study area. Note how the pattern of wetlands across the study area is somewhat concentrated in certain areas, especially associated with watercourses such as the Fowler River and the Cockermouth River. Compare the wetlands map with the riparian buffers map above.

Wetlands are total about 1,970 acres, or 3.5% of the study area, and are currently about 14% protected.

Floodplains

The map to the right displays the location of all 100-year floodplain areas in the Newfound Lake watershed, as determined by floodplain insurance mapping originally developed by USGS. Typically 100-year floodplains are found in close association with larger streams and rivers such as the Fowler River and Cockermouth River. A series of wetlands along Dick Brown Brook in Bridgewater form a complex of wetlands that also serve as natural flood storage areas. Note that the lake itself is subject to water level fluctuations, and most shoreline margins fall into the floodplain category.



Floodplains

Since floodplains provide critical eco-system services in terms of flood water management, as well as providing habitat opportunities for unique natural communities and wildlife corridors, maintaining natural land cover and conditions within them is an important conservation priority.

Floodplains are cover about 960 acres, or 1.7% of the study area, and are about 13% protected.

Drinking Water Resources

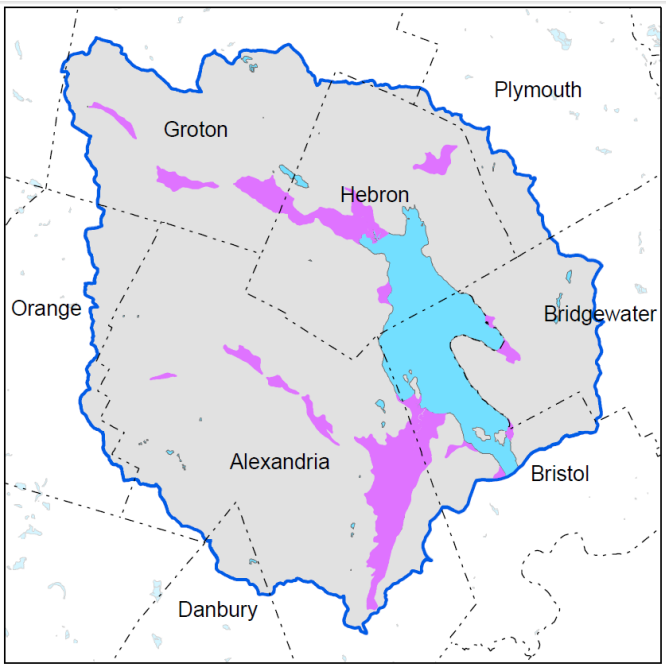
Sand & Gravel Aquifers

Extensive sand and gravel aquifers exist in New Hampshire, and within the study area, as a result of sediment deposition in major river valleys following the last glacial age. As opposed to bedrock aquifers, these surficial deposits represent one of the most important groundwater resources in the state, and have been developed for high-yield municipal water wells in many communities. The entire land surface overlying the aquifers represents a ***primary recharge zone*** with obvious implications for groundwater quality and quantity depending upon land cover and land uses occurring on this recharge zone.

Due to the nature of materials and the thickness of an aquifer, some areas indicate greater potential flow (transmissivity) of groundwater water to a well, and therefore a greater water supply productivity. These zones are also most prone to the rapid movement of contaminants that find their way into the groundwater, and therefore retaining natural land cover and non-commercial/industrial land uses is important.

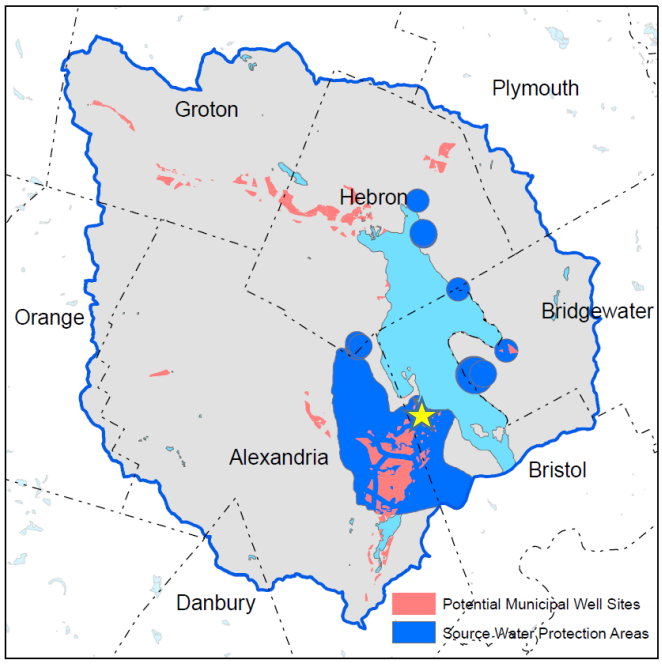
The map to the right shows the aquifer zones in pink. Note the large formations in the Fowler River and Cockermouth River valleys. Other smaller aquifers exist in the Georges Brook area of Hebron, in several locations immediate to the Newfound Lake shore, and along tributaries of the Fowler River. See also the mapping and discussion on **drinking water resources** below.

Aquifer recharge zones are involve about 3,400 acres or 6.1% of the study area, and are currently about 9% protected.



Aquifers

Favorable Gravel Well Sites



Drinking Water Protection

The N.H. Department of Environmental Services (NHDES) has mapped areas of sand and gravel aquifers statewide that have the potential to provide municipal water supplies. The mapping and analysis removes all areas representing a contamination risk (roads, known and potential contamination threats such as gasoline stations, landfills, etc.). It also focuses on those portions of the aquifers thought to have sufficient transmissivity and groundwater recharge to provide a reliable water supply.

The areas shown in pink in the map to the left are those portions of the aquifer that may be suitable to provide water supply at a sustainable minimum of 75 gallons per minute, subject to confirmation by a hydro-geologic engineering study.

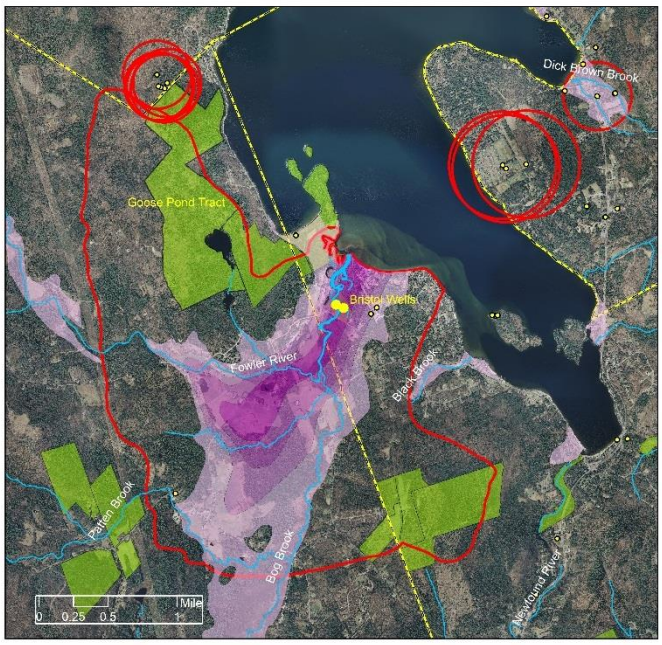
Favorable gravel well sites account for about 1,000 acres, or 1.8% of the watershed land area, and are about 9% protected.

Source Water Protection Areas

The **Drinking Water Protection** map above also shows **source water protection areas** (public drinking water supplies), typically wells, along with a large source water protection zones (blue color) delineated by the NHDES. There are seven public water supply sources in the Newfound Lake watershed classified by NHDES as active community water supplies. One of those is the Bristol Water Works with wells near the Fowler River (see **yellow star** in map). The others are private water supply services to residential and commercial developments.

The Bristol Water Works serves a total of 3,327 persons according to the most recent data from NHDES, and another 490 persons depend upon the remaining six private community water supplies. Note the large size of the source water protection area associated with the Bristol wellheads; it has been delineated by NHDES according to calculations of surface water recharge to the Fowler River groundwater aquifer zone from which Bristol pumps water. Note also the extensive, high-transmissivity areas favorable for future high-yielding wells trending southwest of the Bristol wells.

While the NHDES does not require municipalities to permanently protect drinking water supply zones (except for a small sanitary radius), the **best approach to ensure drinking water supply and quality in the long term is to maintain these zones in natural land cover**, and to limit development within the zones, particularly land uses with a high risk of contaminant release or extensive impermeable surfaces.



In addition to maintaining clean drinking water, locating suitable future water supplies is a difficult, costly, and uncertain endeavor should existing wells become contaminated.

The figure to the left illustrates the source water protection area associated with the Bristol water supply wells in more detail. The wells are shown as **yellow dots** and the wellhead protection zone is outlined in red. The wellhead protection zones for water supply wells at The Ledges residential area are represented as circles to the north end of the Bristol protection zone, and other community water supply protection zones are found across the lake at Whittemore Point.

The Fowler River aquifer formation feeding the wells appears in pink/purple colors, with the darker colors being areas with higher transmissivity. The green areas are conservation and public lands which serve to protect the natural land cover of the source water protection area. Note that the majority of the area within the source water protection area is not currently protected. The recent conservation of the 400+ acre Goose Pond Tract (green area north of the aquifer) adds significantly to the protected upland surface water flows into the Fowler River aquifer. **However, note that none of the land overlying the aquifer is protected.**

For a more detailed look at the Fowler River aquifer and related natural resources, see the **Fowler River Development Study** in **Part 2** of this report.

NHDES source water protection areas total about 4,700 acres, or 8.4% of the study area, and are about 15% protected at present.

Steep Slopes & Highly Erodible Soils

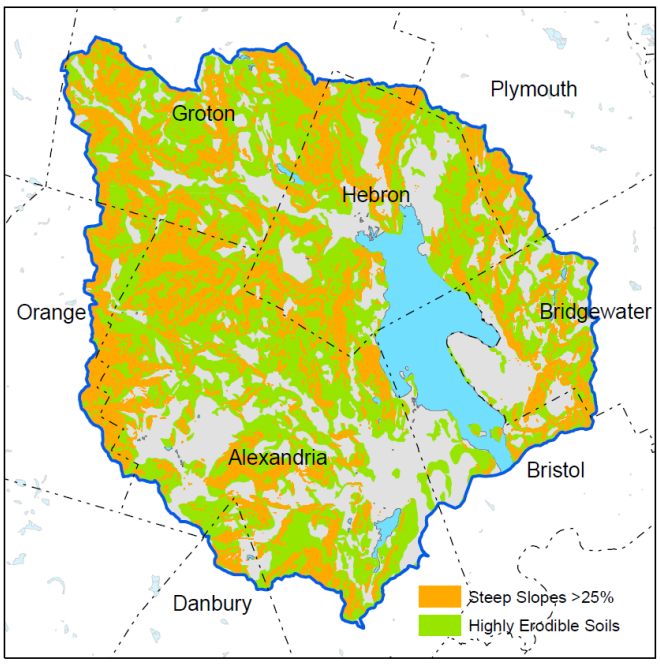
Steep Slopes

It is a widely accepted community planning standard that slopes in excess of 25% gradient are not buildable due to limitations and elevated risks of severe land disturbance from siting roads and buildings. Slopes in the range of 15% to 25% are deemed a cautionary zone, and require careful engineering design to mitigate impacts, especially stormwater runoff and erosion.

Steep slope areas are also home to unique natural communities in certain places where nutrients have accumulated in pockets, or where cliffs and talus slopes have formed. Such formations also offer den sites for a number of wildlife species, and are important winter sunning sites for bobcats.

Slopes in excess of 25% gradient are shown in orange in the map to the right. Note that much of the terrain within the Newfound Lake watershed is classified as steep slopes and is also associated with highly erodible soils (see below). **Approximately 22% of the watershed has slopes greater than 25%**, and as can be seen in the map, these areas are extensively distributed all across the watershed with the exception of the river valley bottoms along the Fowler River and Cockermouth River, and two or three areas in Hebron, Bristol and Bridgewater.

Steep slope areas cover about 12,500 acres, or 22.2% of the watershed land area, and are currently about 26% protected.



Steep Slopes & Highly Erodible Soils

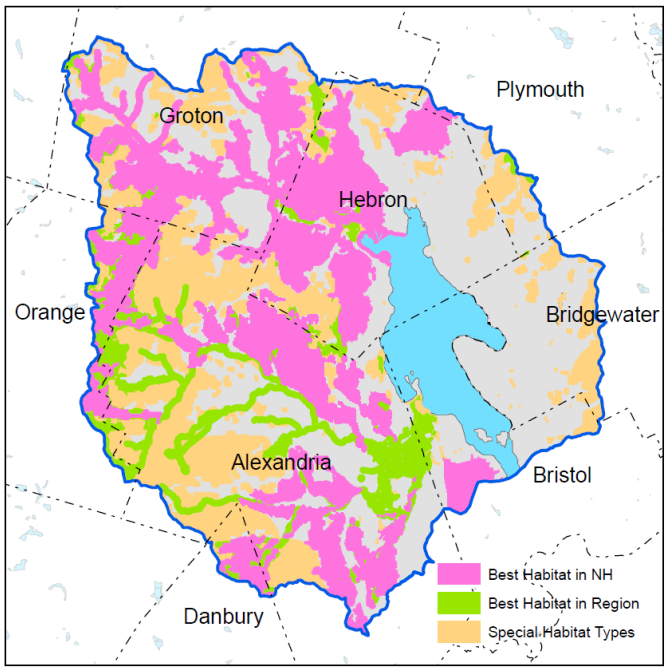
Highly Erodible Soils

The NRCS has rated soils for erosion potential as part of a national program to identify highly erodible soils requiring special management. These soils are known to erode rapidly and extensively if disturbed, due to their physical properties and slope conditions. Highly erodible soils are of great importance to water quality as they may cause adverse impacts from sediment and nutrient loading in lakes, ponds, and streams. **About 68% of the watershed has highly erodible soil conditions.**

Of special concern are lands where steep slopes and highly erodible soils are both present. The map above shows slopes greater than 25% overlaid on the highly erodible soils. These areas should be of high priority for land conservation to preserve the natural land cover and ensure that headwater streams are not impacted by erosion. Limiting or prohibiting development on steep slopes through land use regulations (zoning, subdivision regulations, road design standards, etc.).

The coincidence of steep slopes and highly erodible soils totals about 12,000 acres watershed-wide, and is found on about 95% of all steep slope areas shown in the map. The coincidence of steep slopes and highly erodible soils amounts to about 21% of the entire study area, but is just 26% protected.

Wildlife Habitat



NHWAP Habitat Types & Quality

Wildlife Habitat Quality

The N.H. Fish and Game Department has extensively studied[6] habitat types and condition stateside in order to help set conservation priorities that support their programs. The New Hampshire Wildlife Action Plan (NHWAP) has classified aggregate habitat types by relative condition and quality statewide in three tiers:

- **Tier 1** represents the best habitat statewide;
- **Tier 2** represents the best habitat in the several biological regions found across the state; and,
- **Tier 3** is designated as supporting landscapes that act as a buffer to protect the integrity of the first two tiers.

The map above displays these the top two tiers according to the 2010 update of the NHWAP, with pink showing Tier 1 areas and green showing Tier 2. Extensive Tier 1 habitat areas are found west and north of Newfound Lake, largely due to the undeveloped nature of the area and large, unfragmented blocks of forest. Tier 2 areas are typically associated closely with Tier 1 designation and certain stream networks of high habitat quality which account for the aquatic habitat component of the NHWAP model and mapping; note the Tier 2 areas associated with the Fowler River drainage in Alexandria.

Much of the study area did not qualify for any tier, largely due to the more developed nature of the land, especially in portions of Bridgewater and Bristol. Note that Tier 3 supporting landscapes are not mapped here; instead a composite of wildlife habitat types has been substituted for scoring purposes in the co-occurrence mapping (see **Section 2** below). However, no Tier 3 areas are found in the eastern half of the watershed, so no significant data has been eliminated by not mapping Tier 3 in those communities.

Tier 1 habitat areas cover about 23,100 acres, or 41% of the watershed land area, and are about 23% protected. Tier 2 areas add another 5,600 acres, or 10% of the watershed land area, and are about 33% protected.

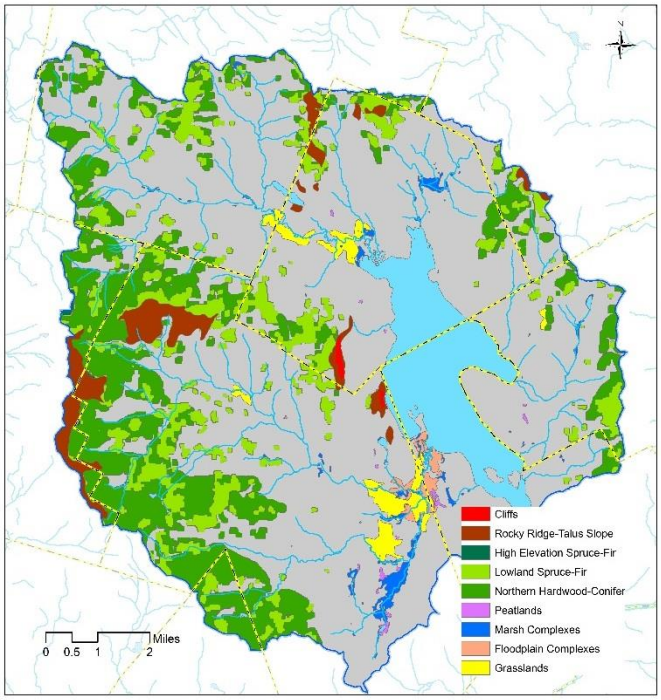
Special Habitat Types

The light orange areas of the map above include several specific wildlife habitats of concern due to scarcity or unusual value. This zone is comprised of nine distinct habitat types, three of which are

[6] NH Wildlife Action Plan: http://www.wildlife.state.nh.us/Wildlife/wildlife_plan.htm

forest habitat types not common in the watershed. Others, such as cliff and talus slopes, are rare statewide and involve relatively small number of occurrences and land area. Taken together, these habitats can be thought of as "patch habitats" within the watershed. Areas not within the habitat type mapping are either widespread "matrix habitats" or are developed.

The map to the right displays the location of these nine special habitat types present in the watershed. Some habitat types overlap one another, e.g., rocky ridge-talus slopes are intermixed with the three forest habitat types, but they are arranged in the map to best show extent and location.



NHWAP Habitat Types

Note how the three forest types tend to occupy the higher elevation around the watershed rim, and how cliffs and talus communities are associated with steeper terrain. On the other hand, grasslands, wetlands, and floodplains follow the river valleys at lower elevation.

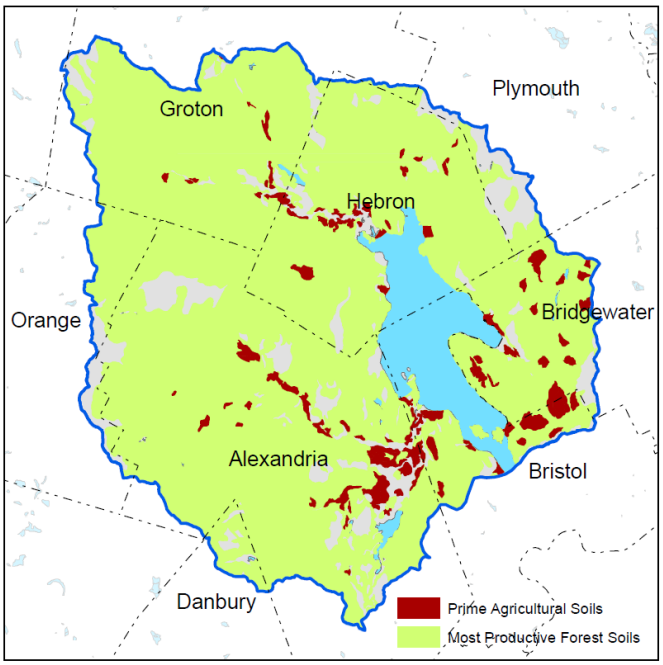
The table below summarizes the nine special habitat types by extent and protection status, arranged in rank order from least common within the watershed to more common. Note the low levels of conservation for several habitat types with relatively low percentage of land cover in the watershed. In addition, aquatic habitat types associated with water quality enhancement (floodplain communities, marsh complexes, and peatlands) are not well protected in the watershed.

Habitat Type	Total Acres	Percent of Watershed	Acres Protected	Percent Protected
Cliffs	59	0.1%	11	19.3%
Peatlands	111	0.2%	8	7.2%
High Elevation Spruce-Fir Forest	322	0.6%	322	100.0%
Floodplain Complexes	409	0.7%	69	16.8%
Marsh Complexes	715	1.3%	59	8.3%
Grasslands	1,105	2.0%	89	8.1%
Rocky Ridge-Talus Slopes	1,771	3.1%	950	53.7%
Lowland Spruce-Fir Forest	6,763	12.0%	1,563	23.1%
Northern Hardwood-Conifer Forest	10,033	17.8%	3,347	33.4%

For more detailed descriptions of these habitat types and their ecological importance see: http://www.wildlife.state.nh.us/Wildlife/Wildlife_Plan/habitat_types.htm

Most Productive Farming & Forest Soils

Prime Agricultural Soils



Productive Soils

New Hampshire's most productive agricultural soils are scarce statewide, comprising only about 6.5% of the state's land area, and typically occurring in small and scattered pockets of soil.

The 6.5% figure above relates to two NRCS classes of agricultural soils: prime agricultural soils (the best soils), and soils of statewide significance (second tier but also productive), at 3.5% and 3%, respectively. Prime soils and soils of statewide importance are shown in brown in the map to the left.

Some of these soils are currently being farmed, notably in the Fowler River Valley, where farmland contributes significantly to the scenic quality of the community. Others are associated with existing grass meadows which provide important wildlife habitat for certain species. Several areas with prime agricultural soils are already developed for non-farm land uses, as in Bristol and Bridgewater. It is important to consider the potential for future local food production as one of several conservation priorities in the watershed.

Prime agricultural soils account for about 2,100 acres, or 3.7% of the watershed, of which only about 6% is currently protected.

Most Productive Forest Soils

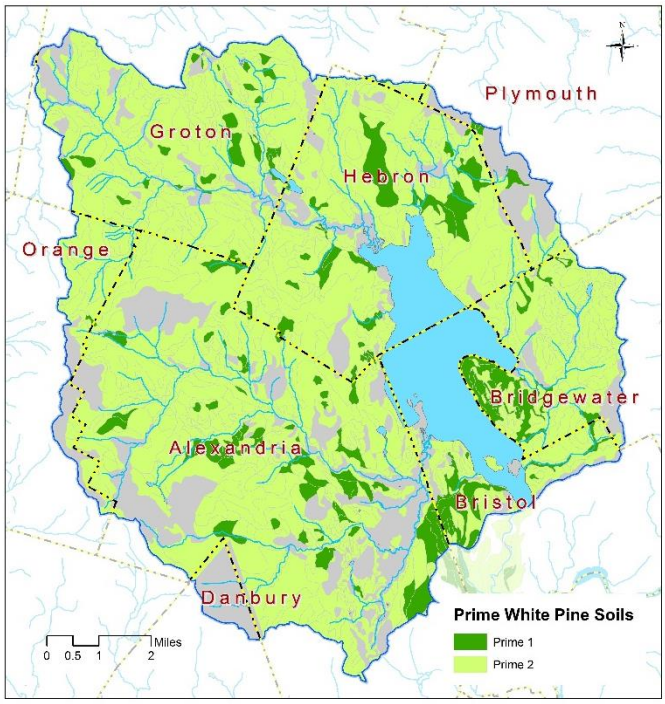
Economic forestry in another resource-related aspect of the Newfound Lake watershed. The area is heavily forested, and timber harvests represent a significant, sustainable income for both landowners and those working in the forest products industry in New Hampshire.

The relative productivity of forest soils is an important consideration for both economic forestry and ecological significance since productive soils tend to exhibit more diverse natural communities.

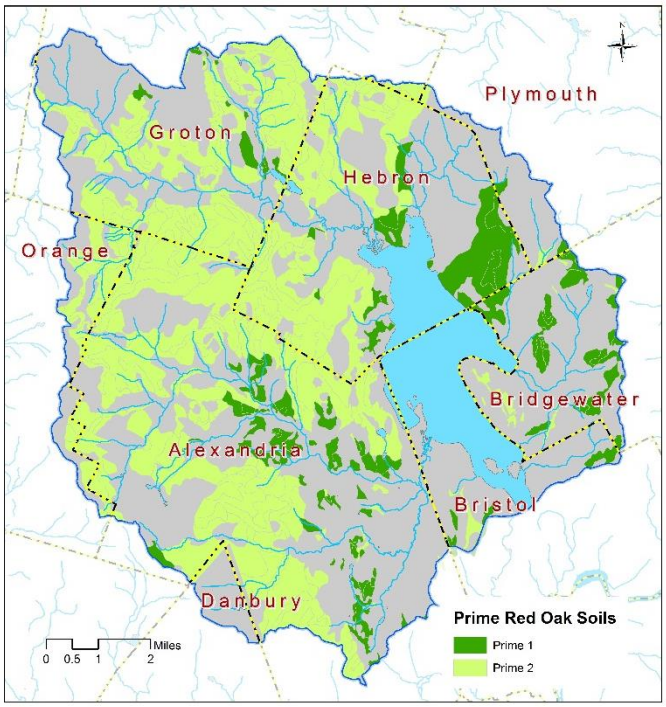
This study uses the NRCS **site index rating** for production of wood volume on soils, supplemented with other site considerations. Two valuable commercial forest tree species are rated: white pine and red oak.

Classifications are assigned based on volume of wood that can be expected in a 50 year time period. Prime 1 soils can be considered the very best timber-producing soils in the area; Prime 2 soils are also important, with timber volume estimates about 20% lower than Prime 1.

The previous map (**Productive Soils**) merges the Prime 1 and 2 soils for both white pine and red oak into a single resource feature for purposes of co-occurrence mapping (see light green color). The two maps below provide more detail on the extent and distribution of Prime 1 and 2 forest soils for white pine and red oak separately.



Most Productive Forest Soils: White Pine



Most Productive Forest Soils: Red Oak

Note that the locations of Prime 1 soils differs somewhat from map to map, but that large areas within the watershed area rated Prime 2 for both species.

Prime forest soils cover about 49,000 acres, or 87% of the study area, and are currently about 17% protected.

Section 2: Co-Occurrence Mapping

Methodology

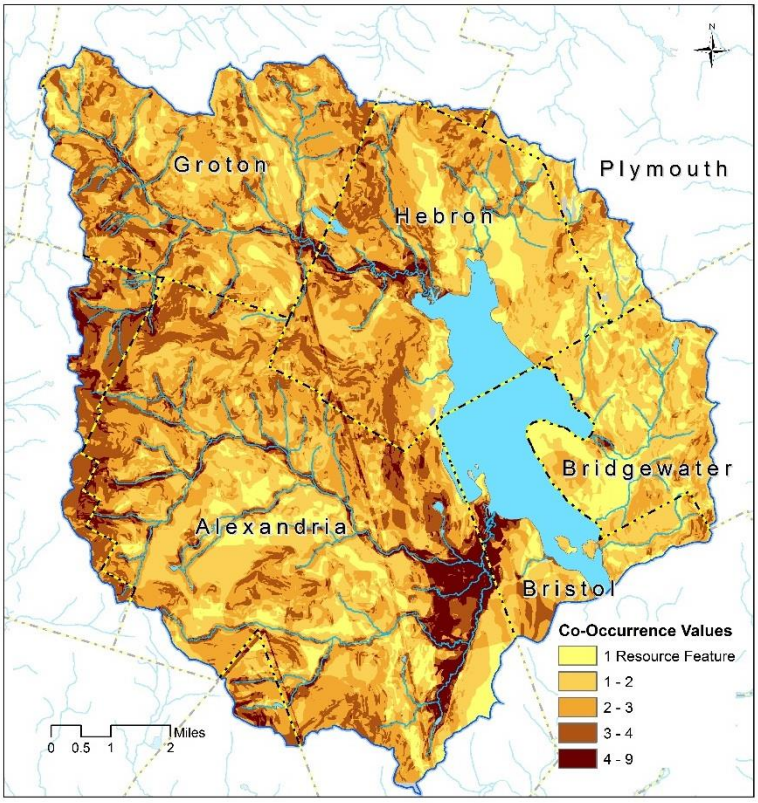
As described in the previous section of the report, twelve natural resource map datasets[7] have been factored into the co-occurrence mapping analysis of the Newfound Lake watershed. The purpose of the co-occurrence analysis and mapping is to identify areas where several resource features share the same location, or are "co-located", indicating constraints to development and/or high-priority conservation values for consideration in community planning, depending upon the resources present.

[7] The transmission line right-of-way traversing Groton and Alexandria is also a factor in the co-occurrence map due to building constraints, but is not detailed in this report.

Each of the twelve natural resource datasets has been merged to remove internal classifications since this analysis uses a simple additive approach without regard to relative important values[8]. For example, the two tiers in the NHWAP habitat quality data count as a single feature, and all the habitat types in the NHWAP data are merged into a single entity. In more sophisticated co-occurrence mapping, each aspect of a resource dataset would be weighted by local decision-makers, and final appearance of the map would be significantly different (see comments on developing a "shared vision" community plan at the end of this report). Therefore, the additive approach should be viewed as general and conservative.

Each resource dataset was assigned a value of "1", and all twelve datasets were processed in the GIS (by adding the layers) to generate a co-occurrence map. The map below shows the result of the scoring in a map with a color gradient from light to dark colors. Darker colors indicate areas of higher aggregate values, and therefore higher priority for conservation versus new development.

The GIS processing involves a geographically-referenced grid with each grid cell measuring 30'x30', or a resolution of about 1/5th of an acre. Close inspection of the mapped data shows this grid at the edges of some features. This resolution is appropriate to regional-scale mapping and analysis.



Resource Co-Occurrence Map

Interpretation

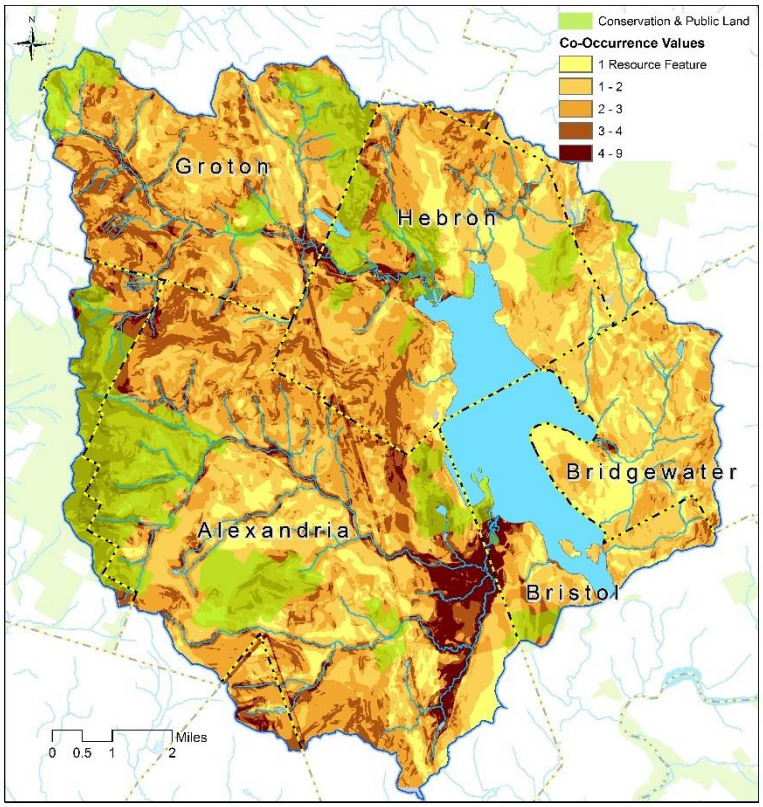
Most evident in the co-occurrence map of natural resource features is the Fowler River valley in Alexandria, and Bristol. A review of the various natural resources highlighted in the previous section of this report gives an idea of which factors are aggregating to produce the darker color in that area – with water quality related features chief among them: floodplain, aquifer, wetlands, riparian buffers, drinking water protection areas, and future water supplies. Prime agricultural soils and wildlife habitat values are also significant in this area. The situation is similar, but geographically more limited in the Cockermouth River valley.

[8] Community conservation commissions are encouraged to expand and refine this analysis by engaging in a consensus-built version of the co-occurrence mapping using weighted values decided by community participants in a special voting process.

Middle to high co-occurrence values also are found in the high elevation areas in western Alexandria and Groton, and along the height of land separating the Fowler River and Cockermouth River watersheds (the so-called “Spruce Ridge”).

The eastern portion of the watershed has conspicuously lower co-occurrence values, especially parts of Hebron, Bridgewater and Bristol. It is important to recognize that this does not mean there are no natural resources worthy of conservation, nor that there are no constraints to development. The scale of the various data used in the mapping and analysis is broad and somewhat coarse, so at the community-scale significant features likely exist that warrant stewardship. Also, the NHWAP habitat quality data used in this study is statewide in its analysis and ranking; a closer analysis of the eastern watershed at regional scale would no doubt discover wildlife habitat values not present in the statewide study. Finally, with regard to water quality in Newfound Lake, the tributaries flowing into the lake along the eastern shore are all contributors of phosphorus(and other nutrients), and at community scale have elevated importance for riparian and wetland protection.

To assess how well the natural resource features considered in the analysis are currently protected, the map to the right shows the co-occurrence values overlaid with conservation and public lands in green. The green color is somewhat transparent, so the darker colors of the co-occurrence map can be seen, giving an idea of where high-value resources are conserved. The high-elevation areas shared by Alexandria and the town of Orange to the west are fairly well protected at present, as are lands along the border of Groton and Hebron. Resources in the Fowler River and Cockermouth River valleys are not well protected, nor is the high ground (Spruce Ridge) separating those two watersheds. The higher value areas in the western portion of Groton also not currently well-protected.



Resource Co-Occurrence Map

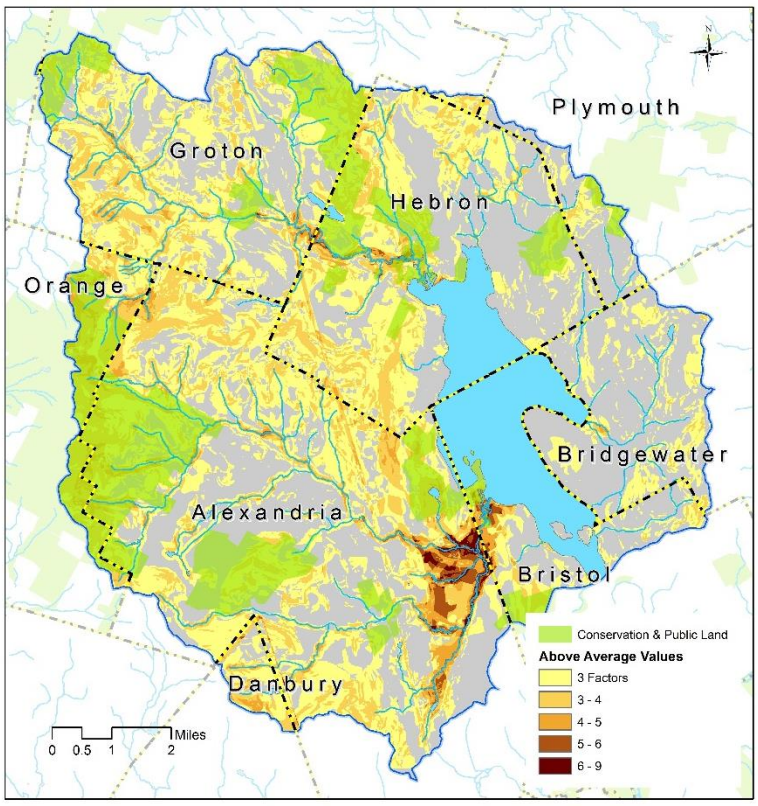
The Fowler River valley area is addressed in more detail in **Part 2** of this report as part of the build-out analysis for the watershed. See also the summary of resource protection by community in **Part 1: Section 4** of this report.

Section 3: Delineating High-Priority Conservation Focus Areas

Methodology

With a study area of more than 56,326 acres, and varied natural resource co-occurrence values across the entire watershed, it is helpful to further refine the co-occurrence mapping to delineate areas with higher priority for conservation. These areas are also typically less suitable or totally unsuitable for future development.

A simple approach is to identify those areas of the co-occurrence map that are "above average" aggregate value. The average value for all scoring cells (value > 0) in the map is 2.8; however it is not possible to map 2.8 since the co-occurrence values are based on whole integers. Therefore, the average value is rounded up to 3. The map below shows all resource co-occurrence values of 3 or higher.



High-Value Resource Co-Occurrence Map

Interpretation

Note the dramatic difference between this map and the previous co-occurrence map. The gray color indicates areas with only one or two resource features, while the color gradient from yellow to brown zeroes in on the higher-value areas (co-occurrence value of 3 and higher). The Fowler and Cockermouth River valleys display higher scoring, as does the height of land separating these two rivers in northern Alexandria. The darker colors in the Fowler River valley clearly highlight the importance of this area. This map is useful in making strategic decisions with regard to building suitability and conservation priorities, at both the watershed scale, and within each community. Note that additional high-value resources will likely be identified by community-scale studies.

Section 4: Statistical Analysis

Summary of Resource Protection

In making decisions important to community planning and/or conservation planning at community-scale, considering the existing level of resource protection is often critical. **Table 1** (below) summarizes the area of each resource feature, as well as the current level of permanent protection, for each community and for the watershed as a whole. All known conservation transactions have been included in the analysis, most recently the Goose Pond tract in Alexandria. The statistics will change as more land comes under permanent protection; for example, Hebron will see a dramatic change when the so-called Green Acres Woodlands conservation easement tract in the northern portion of town is consummated.

Interpretation

The following are highlights-oriented interpretations of the data in **Table 1**.

- Bridgewater has no land conserved within the Newfound Lake watershed. While the town's land area represents only about 10% of the entire watershed, natural resource features exist in Bridgewater that are critical to water quality in the lake, including wetlands, riparian buffers, steep slopes and highly erodible soils.

- Several natural resource features amount to relatively small percentages of the watershed land area. These include wetlands, riparian buffers, floodplains, aquifers, drinking water protection zones, future water supply areas, and prime agricultural soils. Note that while these features involve small land areas, the level of protection is also very low, generally less than 15%. Most of these features are also critical to maintaining water quality.

- The overall level of resource protection within the Newfound Lake watershed is relatively low at about 18%. At community-scale, the percentages range from 13% in Bristol to about 21% in Alexandria.

- Inspection of the percent of resource conserved in each town shows a wide range of levels of protection; many are less than 20% despite the fact that the resource area itself is quite large, e.g., aquifers and high quality wildlife habitat in Alexandria, or highly erodible soils in Hebron and Groton.

The natural question when looking at resource protection figures is: *How much is enough?*. The answer is: *It depends*. One perspective is to consider how critical a particular resource is to the eco-system services[9] provided for human use. Drinking water is an obvious critical factor, and the importance with regard to the Bristol water supplies has been discussed above. Prime agricultural soils may not seem important at this time given the state of farming in New Hampshire, but sound planning at a community level would reserve this resource for future food production and ancillary benefits such as scenic values. Finally, when thinking about water quality, several resource features deserve elevated attention,

[9] "Eco-system services" are community benefits provided by natural systems functioning at peak performance, such as clean water from forested watersheds, flood storage in floodplains and wetlands, etc..

including protection of riparian buffers (**probably the single most important tool in maintaining water quality**), wetlands, floodplains, aquifer areas, and steep slopes with highly erodible soils. Protection of these critical resources will yield the greatest benefits.

See **Table 1** on the following page.

Table 1

Status of Resource Protection in the Newfound Lake Watershed -- 2014

Municipality	Land Area (Ac)	Wetlands	Riparian Buffer	Floodplains	Aquifer	Steep Slopes >25%	Highly Erodilble Soils	Future Well Sites	Wellhead Protection Areas	NHWAP Tier 1	NHWAP Tier 2	Special Habitat Types	Prime Ag Soils	Prime Forest Soils
Alexandria	22,084	737	1,054	350	1,637	4,323	14,671	596	3,015	6,017	4,040	9,321	755	19,107
Bridgewater	5,322	315	197	55	95	877	2,709	9	401	0	3	938	443	4,860
Bristol	2,473	226	91	127	385	252	1,009	30	950	502	241	391	452	2,105
Danbury	855	57	30	0	0	192	486	0	0	477	87	766	0	686
Groton	10,672	159	610	171	530	2,838	8,508	107	0	7,920	261	3,089	114	9,927
Hebron	11,392	432	486	259	785	2,530	8,067	265	344	6,138	292	2,318	300	10,331
Orange	2,057	1	111	0	0	933	1,869	0	0	1,954	631	1,798	0	1,574
Plymouth	1,469	43	47	0	0	551	1,240	0	0	83	62	588	0	507
Watershed Total	**56,326**	**1,970**	**2,626**	**961**	**3,432**	**12,497**	**38,559**	**1,007**	**4,710**	**23,091**	**5,618**	**19,210**	**2,065**	**49,098**
Percent of Watershed		**3.5%**	**4.7%**	**1.7%**	**6.1%**	**22.2%**	**68.5%**	**1.8%**	**8.4%**	**41.0%**	**10.0%**	**34.1%**	**3.7%**	**87.2%**
	Total Acres Conserved	**Acres of Resource Conserved In Each Municipality**												
Alexandria	4,583	39	169	0	22	1,271	3,337	15	458	767	1,040	2,928	32	4,226
Bridgewater	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bristol	322	79	7	21	60	4	64	3	255	157	32	47	39	280
Danbury	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Groton	1,837	57	98	1	13	582	1,622	3	0	1,411	149	640	0	1,484
Hebron	1,675	103	94	107	211	515	1,262	73	0	1,716	82	434	57	1,315
Orange	1,456	1	46	0	0	760	1,339	0	0	1,208	477	1,406	0	992
Plymouth	151	0	0	0	0	87	146	0	0	0	59	133	0	6
Watershed Total	**10,024**	**279**	**415**	**129**	**306**	**3,220**	**7,770**	**95**	**713**	**5,258**	**1,838**	**5,587**	**127**	**8,304**
		279.2												
	Percent Conserved	**Percent of Resource Conserved In Each Municipality**												
Alexandria	20.8%	5.3%	16.1%	0.0%	1.3%	29.4%	22.7%	2.6%	15.2%	12.7%	25.7%	31.4%	4.2%	22.1%
Bridgewater	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Bristol	13.0%	34.9%	7.6%	16.9%	15.6%	1.4%	6.3%	11.5%	26.8%	31.2%	13.1%	11.9%	8.5%	13.3%
Danbury	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Groton	17.2%	35.7%	16.1%	0.4%	2.5%	20.5%	19.1%	2.6%	0.0%	17.8%	57.1%	20.7%	0.0%	14.9%
Hebron	14.7%	23.9%	19.3%	41.2%	26.8%	20.4%	15.6%	27.6%	0.0%	28.0%	28.0%	18.7%	19.0%	12.7%
Orange	70.8%	100.0%	42.0%	0.0%	0.0%	81.5%	71.6%	0.0%	0.0%	61.8%	75.5%	78.2%	0.0%	63.0%
Plymouth	10.3%	0.0%	0.4%	0.0%	0.0%	15.8%	11.8%	0.0%	0.0%	0.0%	95.8%	22.6%	0.0%	1.2%
Percent Protected	**17.8%**	**14.2%**	**15.8%**	**13.4%**	**8.9%**	**25.8%**	**20.2%**	**9.4%**	**15.1%**	**22.8%**	**32.7%**	**29.1%**	**6.2%**	**16.9%**

Part 2: Build-Out Analysis

Introduction

Purpose

The purpose of conducting a build-out analysis is to predict with reasonable certainty how future development patterns are likely to occur in a given study area. Commonly used for community planning purposes, this build-out analysis addresses the entire watershed by looking at historical development trends and land utilization over time, and then systematically extrapolating those trends into various future time periods using locally-estimated development rates.

Reader Orientation

The following description of the build-out analysis involves several stages of data development which in turn require several assumptions and steps that must be explained in some detail. The narrative in **Section 1 i**ncludes discussion of the following:

- The process used to determined land most suitable and likely to develop within the Newfound Lake watershed;
- The results of mapping existing development baseline conditions using aerial photography;
- Analysis of 17 recent subdivisions in several communities to better understand local land utilization and typical lot sizes and densities;
- Application of the build-out analysis model watershed-wide with an emphasis on new residential development on suitable tracts of land; and,
- Extrapolation of recent growth trends and rates in the watershed communities to predict the probable timeframe for various development scenarios.

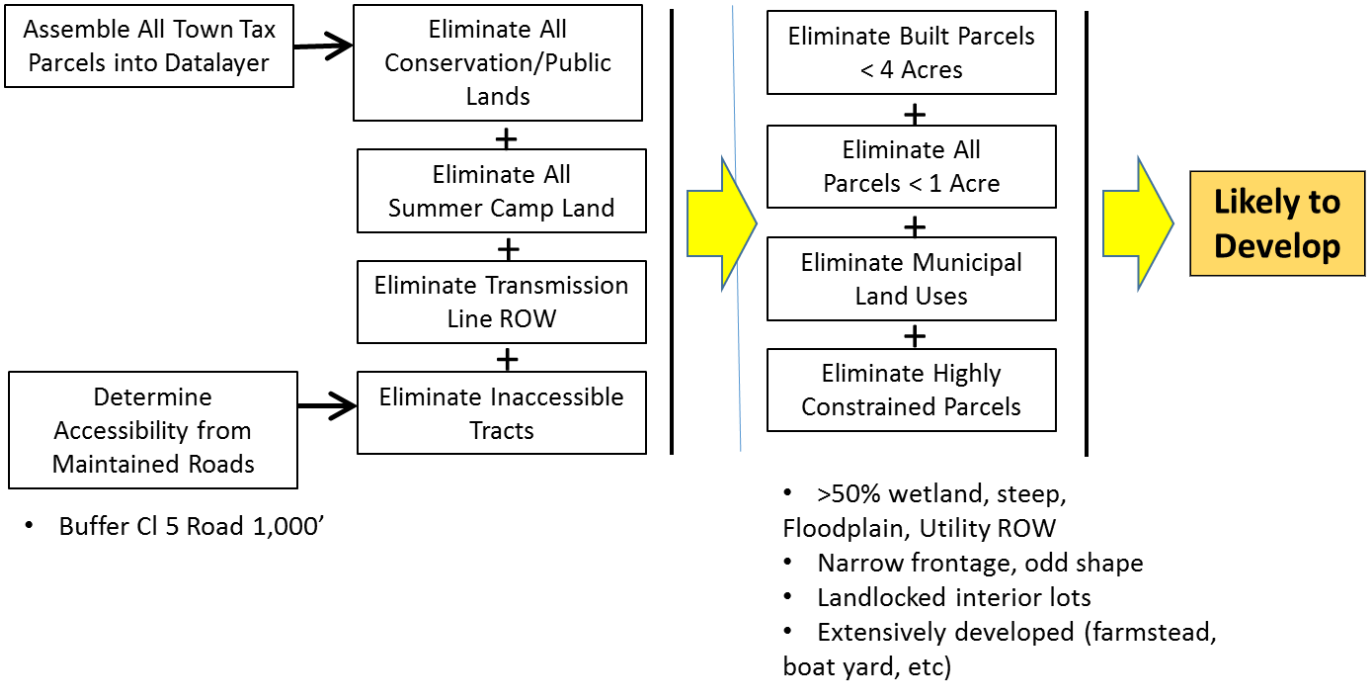
A more detailed look at the impact of predicted growth and development within the Fowler River aquifer area is presented in **Section 2** as a suggested community planning strategy that merges the insights gained in the co-occurrence mapping and the results of the build-out analysis.

Section 1: Approach Methodology

Determining Developable Land

Build-out analyses are typically tied to local land use regulations, especially zoning ordinances which define the allowed types of development and densities (minimum lot size, road frontage, etc.). However, due to the lack of such regulations in some of the watershed communities, another approach has been designed for this study that relies on an analysis of historical and recent land use, particularly the configuration of recent subdivisions, to arrive at various ratios of land area devoted to lot layouts versus road construction (see the discussion on “multipliers” below). Combined with knowledge of high-value natural resources and the desire to balance protection with development. This innovative, scientific and objective approach can be used to effectively guide local land use planning regulations, and future subdivision design.

Special consideration of certain land uses and constraints to development is also required to assure that development scenarios produced by the analysis are realistic. The chart below lays out the steps involved in creating a baseline of lands appropriate for future development, with an emphasis on the working concept that these lands are "most likely to develop". Actual development of vacant land is dependent upon landowner attitude and decisions, market conditions that drive new construction, and in many cases, support from the community in terms of local board reviews and approvals.



Note in the chart that several steps are necessary to identify the most likely and appropriate areas for future development. Accessibility from existing maintained local roads and highways is a key first step; this study assumes that land within 1,000' of existing roads and highways is most likely accessible for development. Given the limited road network in the Newfound Lake watershed and based on this criterion, large areas of some communities are not likely to develop and were removed from further study.

A second step eliminates tracts of land that are accessible but cannot be developed for various reasons (constraints). This includes all conservation and public land under permanent legal protection from development, and land associated with the major electric transmission line that traverses Groton and Alexandria. Several private summer camps for boys and girls exist in the northeast portion watershed, some with extensive tracts of land and waterfront. Development of these lands for other than camp purposes is deemed unlikely given the long history of these camps in the area.

The third step is to systematically eliminate tracts that cannot be developed without special exceptions. This study assumes that a buildable area of two acres is necessary for new construction; this is the typical minimum lot size specified in rural community zoning ordinances across New Hampshire. Therefore, all existing built tax lots less than four acres are removed from the baseline data as they cannot be subdivided to form a new two-acre parcel. There are small lots less than four acres scattered around the watershed that are currently undeveloped. These are included as buildable, but all

undeveloped tracts of less than one acre are eliminated due to the fact that they are unlikely to meet State septic system and well protection criteria.

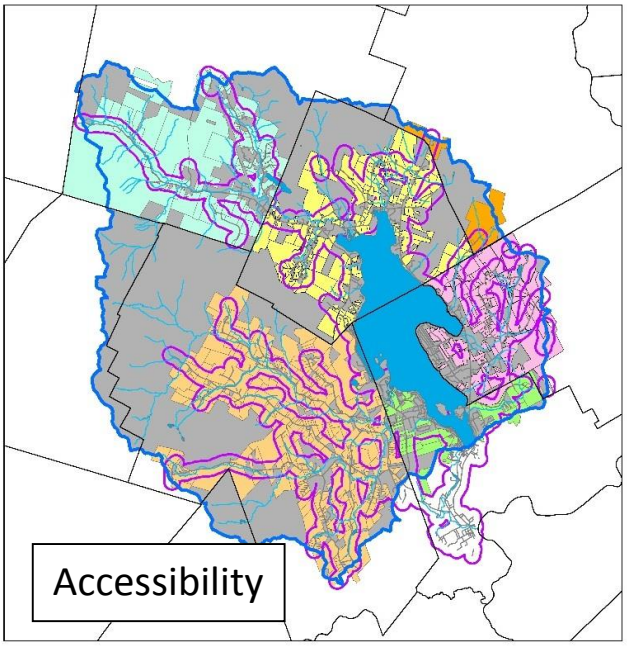
Fourth, all lands identified as municipally-owned have been removed, regardless of size or development status. In the final data selection and analysis step, some tax lots or portions of lots have been removed or modified due to the presence of severe constraints to development. These constraints have been applied as follows:

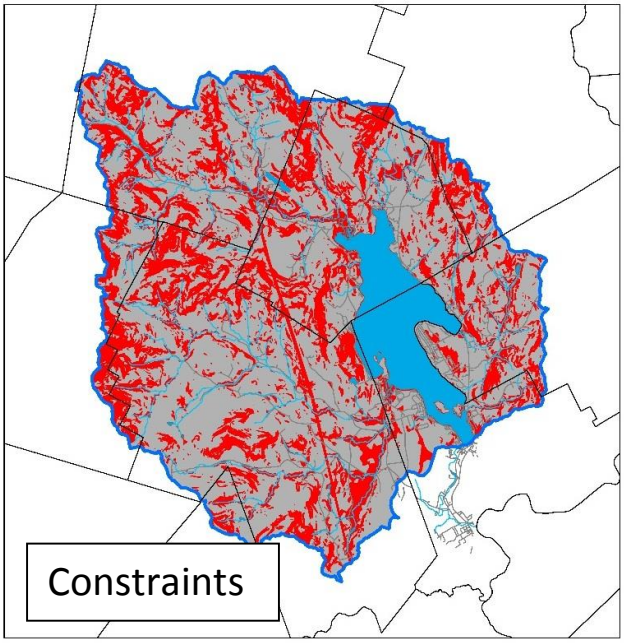
- Lots with greater than 50% area in wetlands, all floodplains, all steep slopes >25%, and/or all transmission line rights-of-way;
- Lots with very narrow road frontage and/ odd shapes that tend to preclude development;
- Landlocked interior lots with no apparent access; and,
- Lots that are already extensively developed such as farmstead complexes, boat yards, etc..

The **need** for these adjustments has been determined by close inspection of high-resolution aerial photography (NHDOT, 2010) to ascertain the range of lot configuration and utilization within the Newfound Lake watershed, augmented by sound community planning standards. The **goal** has been to determine those tracts of land which are reasonably most likely to develop over time.

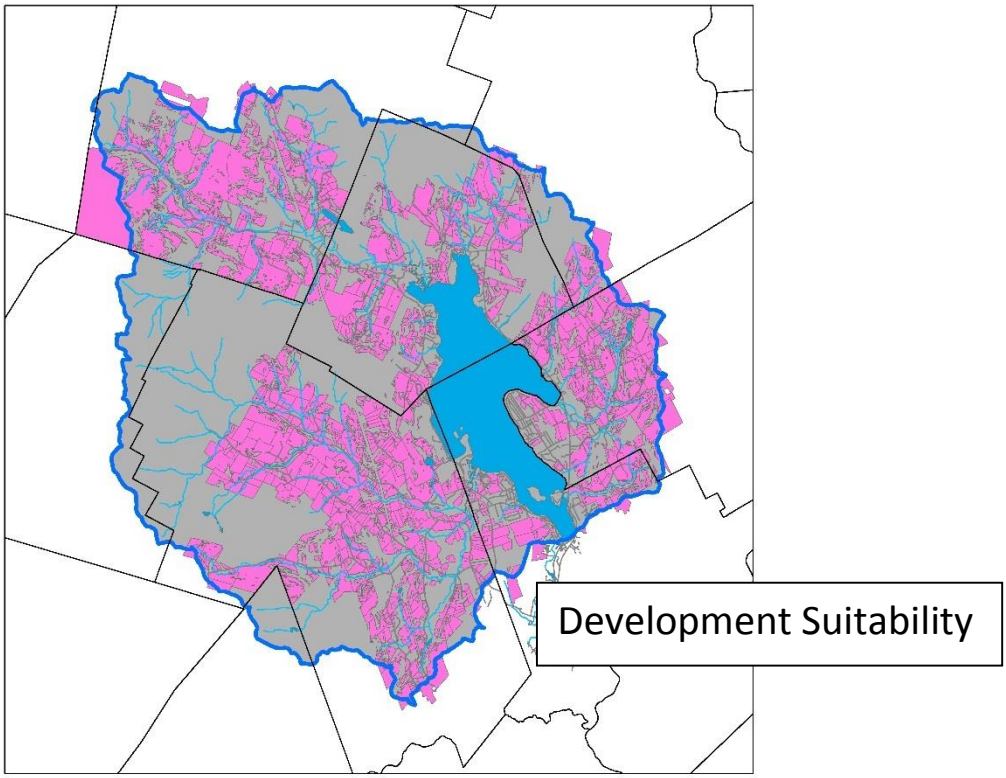
The map titled **Accessibility** below shows the result of applying the road accessibility factor to a composite of municipal tax maps within the watershed. Note that large areas of Alexandria, Groton, and Hebron "drop out" from further consideration for development as they are farther than 1,000' from a public road.

The second map titled **Constraints** gives an idea of the constraints to development mentioned above, with wetlands, floodplains, and steep slope areas merged into a single overlay. Note the north-south trending electrical transmission corridor that roughly bisects the watershed.





The **Development Suitability** map below shows the results of applying the constraints to development, plus elimination of lots not likely to develop. Some lots extend beyond the watershed boundary in this map as remainders, or in the case of Groton, due to interest in particular lots; in the next step of the build-out mapping process, these areas are shown only within the watershed. Using the criteria and rationale outlined above **the total land area suitable for development is 21,467 acres, or about 38% of the land area of the entire watershed.**



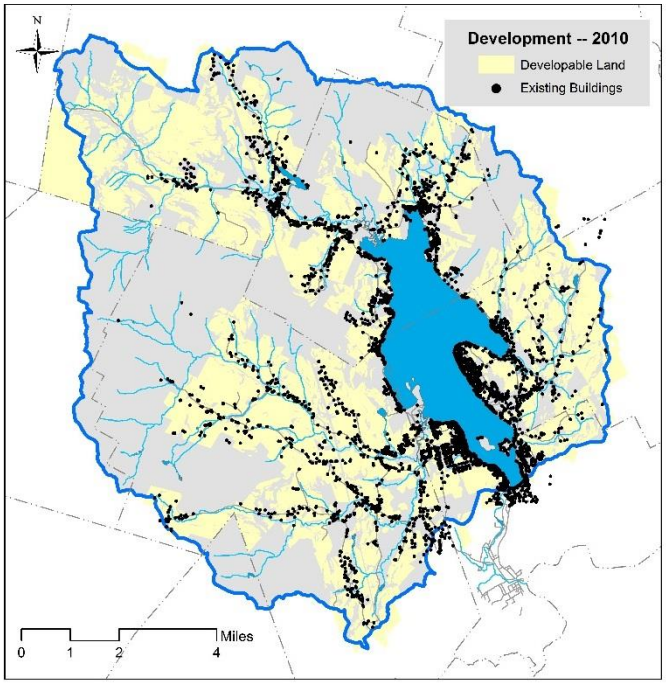
Section 2: Projecting Future Growth

Baseline Conditions

With the most likely to develop land area determined, the next step in the build-out analysis is to calculate the likely number of new residences to be constructed over a reasonable period of time. This study is limited to residential development because it is typical of most of the historical and recent growth within the watershed. Other land uses, particularly commercial and office developments exist within the watershed and provide a variety of services to residents of the area. However, the most recent development trends have been residential as growth moves outward from the well-established corridor along Route 3A in Bridgewater and in Bristol near the lake. Some limited service-related development (convenience stores, highway services, etc.) could occur in the future within the watershed, but will likely replace residential development predicted on certain tracts of land.

The first step in assessing historic and future growth patterns involved digital mapping of all visible **buildings**, observed using 2010 aerial photography[10]. Not all buildings are residential land uses; some are barns, outbuildings, commercial enterprises, and other non-residential land uses. Inspection of the aerial photography, and comparison with house-count data maintained by the N.H. Office of Energy and Planning, indicates that about 95% of all current buildings mapped are residential. Therefore, the following maps and discussion can be regarded simply as addressing residential development.

The map to the right displays the results of mapping all buildings existing in 2010, overlaid upon the land determined to be suitable for development, as discussed above. Note how development follows the road network outward from the lake, and is typically less dense as distance from the lake increases, and how the key model assumption (proximity to public roads) is supported by these data.



The 2010 building count shown on the Development -- 2010 map totals 3,740 buildings within the watershed.

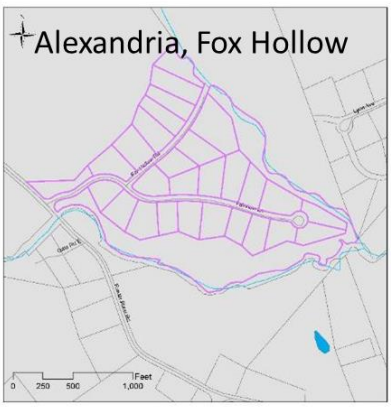
Modeling Regional Growth

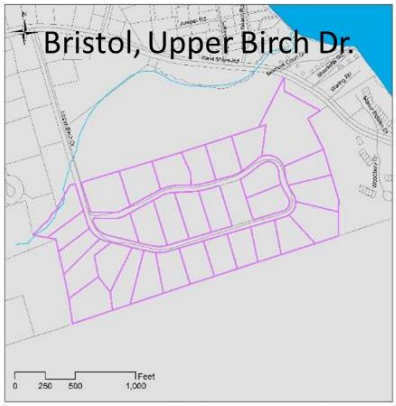
The final step in the build-out analysis was to decide on the most likely patterns of growth, and to calculate a "multiplier" that will reasonably predict the number of new residences likely on any given tract of land. To address both concerns, an analysis was made of various subdivisions within the watershed to build a database of typical lot sizes and building densities. The range of lot sizes and density of development is striking when moving along a continuum from older, more intensively developed areas with smaller lots at the south end of the lake (Bristol and Bridgewater), towards more rural settings away from the lake, e.g, in Alexandria and Groton, where larger lots are the norm.

The inset maps below show the variety of subdivision configurations and densities found. Note that the scale in each inset is the same in order to highlight the relative lot size differences.

[10] The aerial photography used is "leaf-off" imagery, which aids in identifying buildings under trees. However, buildings under conifers might not be visible, so the mapping conducted is approximate.

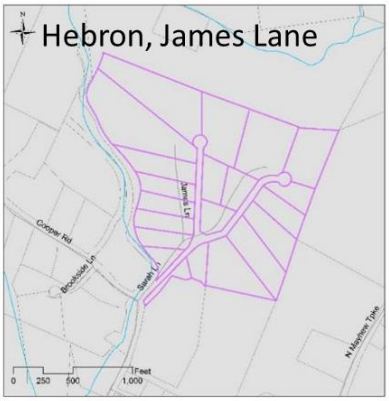
Average Lot Size: 1.3 Ac.

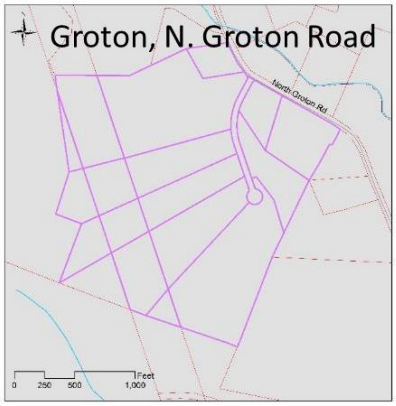




Average Lot Size: 1.7 Ac.

Average Lot Size: 3.0 Ac.





Average Lot Size: 13.1 Ac.

Table 2 below summarizes the results of the review of 17 different subdivisions in the five communities directly relating to Newfound Lake. Municipal tax maps were used to locate the subdivisions studied. There is significant variability evident within the table, but analyzing for average lot size, lot size range high to low, and land area devoted to internal road right-of-way does provide enough information to stratify the recent development trends from small lot developments to larger lot-size subdivisions.

Table 2

Municipality	Location	Total Tract Acres	ROW	Open Space Set Aside	Number of Lots	Average Lot Size	Lot Size Low	Lot Size High	Ratio ROW to Total Tract	Lot Layout Area
Alexandria	Fox Hollow/Farview	54.3	3.8	18.8	27	1.3	1	2.6	7.0%	93.0%
	Mountain View Drive	26.5	2.3		16	1.5	1.45	1.55	8.7%	91.3%
	Morrison Road	31.6	2.2		17	1.7	1	3.9	7.0%	93.0%
	Newfound Hills Road	70.9	0		12	5.9	5.2	8.2	0.0%	100.0%
	Mt. Cardigan Road	92.9	0		14	6.6	5	11	0.0%	100.0%
Bridgewater	Ridgeview Drive	49.2	3.2		10	4.5	2.1	5.7	6.5%	93.5%
	Meadowbrook/Ledgewood	80.8	10.42		30	2.7	1.25	5.65	12.9%	87.1%
Bristol	Upper Birch Drive	58.9	4.9		32	1.7	1.1	5	8.3%	91.7%
	Crodem Drive	17.9	1.35		9	1.8	1.1	2.3	7.5%	92.5%
Groton	Off North Groton Road	80.1	1.4		6	13.1	4.6	22.5	1.7%	98.3%
	Jewell Hill Road	110	2.7		17	5.5	5.5	10.5	2.5%	97.5%
	Beaver Pond Road	74.6	3.5		13	5.5	1.6	22.3	4.7%	95.3%
Hebron	Valley View/Eagle Ridge	275	11.3		29	8.9	1.5	27	4.1%	95.9%
	Stoney Brook Road	16.5	0.96		18	0.85	0.62	1.9	5.8%	94.2%
	Brookside Lane	14.8	0.23		6	2.4	1.7	4.8	1.6%	98.4%
	Smith Lane/James Lane	80.4	2.75	1.06	19	3	1.4	5.9	3.4%	96.6%
	North Mayhew Turnpike	51.1	0		7	7.3	1.9	10.7	0.0%	100.0%

The most intensively developed subdivisions typically are comprised of lots less than two acres, and often as low as about one acre. These are found at the south end of the lake. Larger lots are typical of subdivisions with frontage on existing roads and/or located further away from the lake. Land areas devoted to road rights-of-way were carefully measured in each specimen subdivision in order to understand local subdivision design trends. **This information is critical to determining the actual amount of land on any given tract that could be built-upon**. Some subdivision designs analyzed for this study made efficient use of roadway layouts, often in conjunction with larger lots, and therefore show less land taken up in roadways (on the order of 3% or less). Others are located on difficult terrain, with extensive complicated road systems to serve the lots in the subdivision, required more land for longer roadways (in the range of 9% to 13%). The entire frontage of two subdivisions was on existing roads, so no road construction was necessary.

Note also the range in **lot sizes** and **subdivision density**, which are a critical factors in conducting a build-out analysis. The Stoney Brook Road development in Hebron has 18 lots on about 16 acres of land, with an average lot size of 0.82 acre; this represents a very high density development. Similar densities are found in both older and more current developments in several locations around the shore of the lake, but the Hebron example is located at the more rural north end of the lake. A middle zone of density is found at approximately two to five acres per unit in several subdivisions, and lot sizes greater than 5 acres are common in subdivisions in more outlying areas.

To predict future **numerical development trends**, the build-out analysis requires a set of "multipliers" that reasonably reflects the typical number of residential units expected on vacant tracts of land at varying densities. Based on typical tract utilization for a range of subdivision densities determined above, the following table lists the break-points of lot size and available lot layout area used to finally "populate" developable land in the watershed (previously determined and discussed above) with potential new housing. Lower density developments with larger lots sizes are therefore assumed to have less land devoted to new road development. At the other end of the scale, the higher density subdivisions – ranging up to condominium-style developments – are assumed to have more land utilized for roads and in some cases parking.

Subdivision Density	Range of Lot Size Per Unit	Percent of Tract Available for Lot Layout
Low	> 5 Acres	97%
Medium	2 - 5 Acres	95%
High	1 - 2 Acres	93%
Very High	<1 Acre	90%

Determining Density

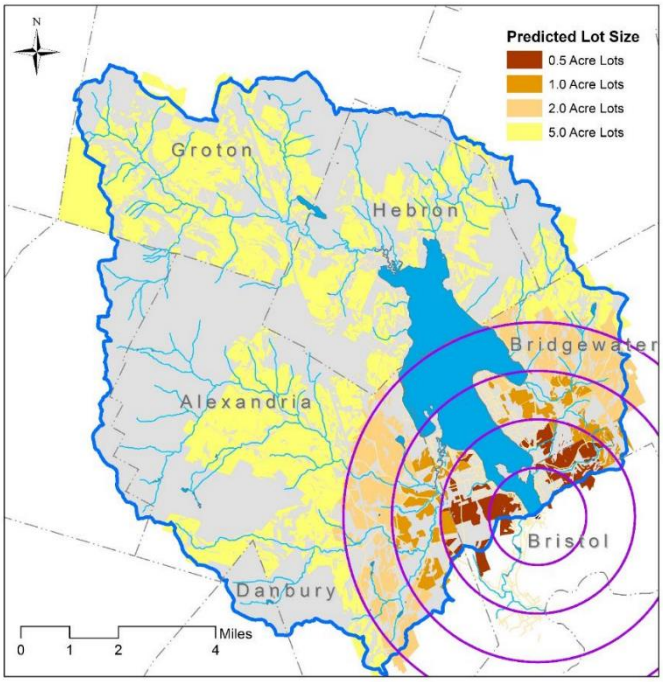
One last question must be answered before the build-out model can be run: **where in the watershed will certain subdivision densities be most likely to occur?** The clues to that pattern are found in the locations of the 17 subdivisions already discussed, and even more readily, by examining the municipal tax parcel mapping for the entire watershed.

One conclusion from examining the data and the land use patterns in the watershed is that it is unlikely that any significant new development will occur near the lake shore itself since it is already "built-out", and in fact has seen steady conversion of older, lower density residential tracts into higher density developments over the last two or three decades. New development ***could*** occur near the lake given the amenity value of the property, but for the purposes of this study it is assumed that this is not as likely as development in nearby locations around the lake.

A second observation is that the southern end of the lake, especially Bristol and Bridgewater, has seen subdivisions and development activity in the higher density ranges. This is true of older "camp lot" areas, and more recent subdivisions fairly near the lake shore. Bristol and Bridgewater are also the towns with services typically needed by denser development. There is also a significant echo of this development density in Hebron, at the north end of the lake in several small subdivisions clustered together.

Third, most of the more recent subdivisions in the areas away from the lake are larger lot sizes, typically in the 5 to 10 acres and greater range. This is most probably due to the prevailing market demand in the last couple of decades for year-round living arrangements, as well as preference for more rural home settings. Alexandria has seen several such low-density developments, especially in the southern portion of town abutting Bristol. Subdivisions in the same time period in Groton are also typically low-density

The map to the right displays the assumptions about predicted lot size and subdivision density that flow from this analysis. Again, to make numerical predictions of future development, a reasonable framework is necessary. The yellow-to-brown background in the map is the **land most likely to develop** as determined and discussed previously.



The four purple circles represent one-mile intervals from the foot of Newfound Lake; these distances correspond well to observed changes in historical and more recent subdivision lot densities evident in tax parcel mapping, and these areas are the most likely to experience "in-fill" development which converts lower density developed land into higher density utilization. Beyond the last circle, away from services and built-up areas around the lake, it is likely that larger lot sizes will be the norm.

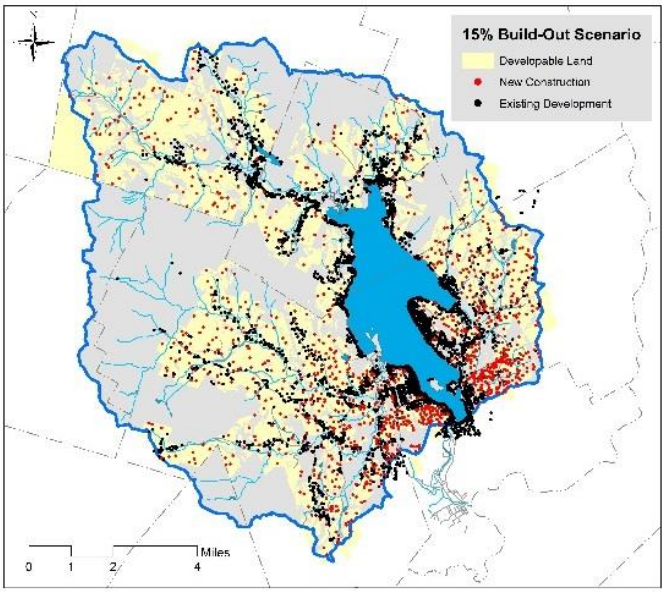
Section 3: Model Results

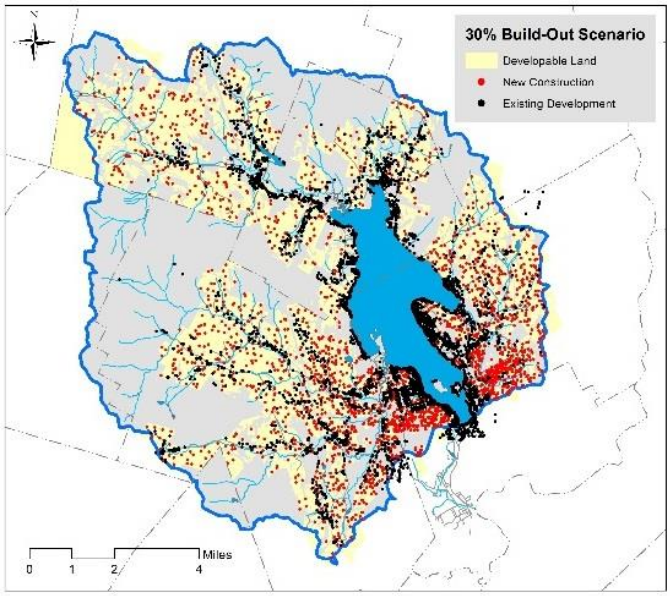
Predicted Change

With reasonable future land use assumptions decided, and all numerical parameters in place, the actual build-out model can be processed in the GIS using a function that randomly locates a mathematically-determined number of points (new homes) in each tract of developable land. The first pass in "populating" the vacant tracts results in the **maximum development** probable given the inputs; the second pass breaks this maximum down into percentages to better understand how incremental growth would play out across the Newfound Lake watershed.

Using the model parameters discussed above, the maximum build-out would result in more than 8,000 new building units in the watershed, or 215% growth over the base of about 3,740 buildings identified in the 2010 aerial photography. However, this prediction is a mathematical and theoretical artifact; it is not likely that full build-out will ever be achieved in the watershed. Earlier stages of likely development towards that maximum are better indicators of development patterns.

The maps on the next page show development at 15% and 30% of maximum build-out. Note how the density of red dots (new construction) increases near the south end of the lake, consistent with the predicted lot density assumptions reviewed above. The increase in impervious surfaces, lawns, etc., in this area will have significant adverse effects on lake water quality if measures are not taken during design, construction, and occupancy to avoid increased sediment and nutrient loading.





Probable Time Frame

A next logical question would be: how long will it take to meet the 15% and 30% scenarios? To answer the question, analysis of growth trends in the watershed is required. These trends are illustrated in the chart below and in **Table 3** which summarizes the changes in housing for the Newfound

Lake region communities for the period 2000 to 2012.[11] **Important note: the chart and the data in the table below reflect the total housing stock and growth trends for entire land area of the five municipalities listed both within and outside of the Newfound Lake watershed. However, these data are readily and reasonably used to predict growth given the large share of housing located within the watershed.**

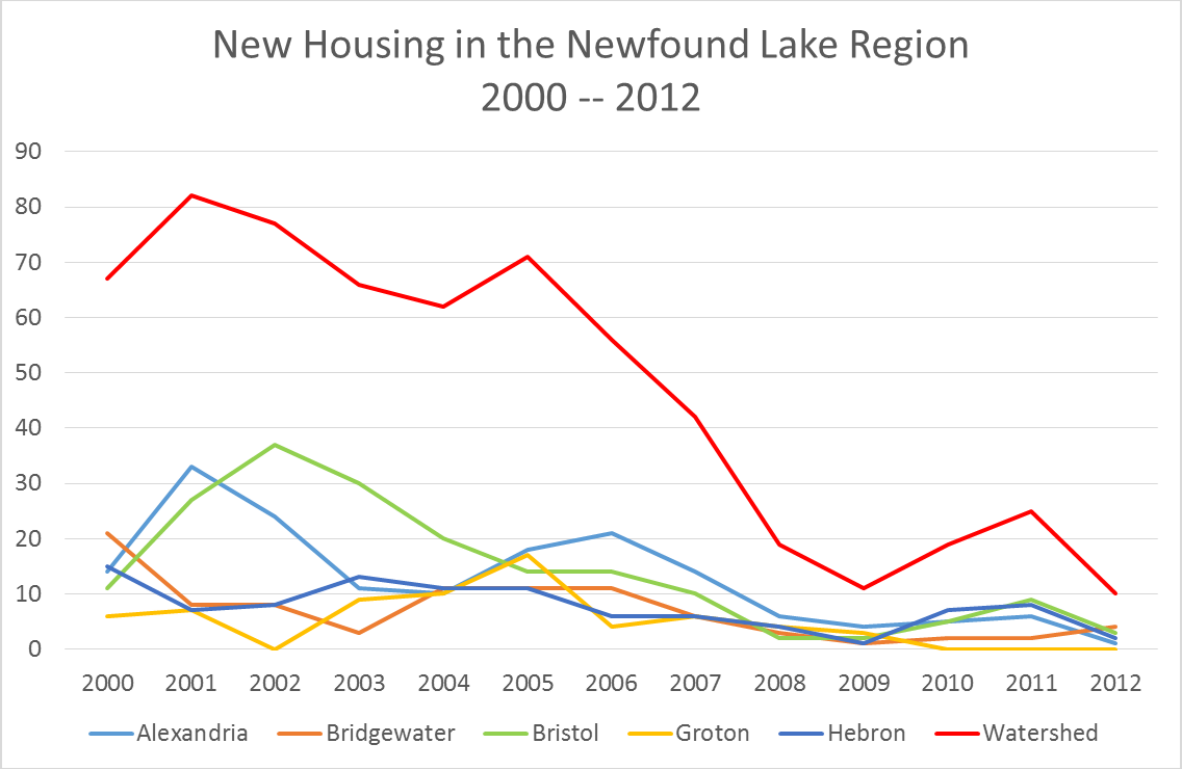


Table 3

Rates of Housing Change in Newfound Lake Watershed Communities 2000 - 2012

Municipality	2000 Total	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2012 Total	Percent Change
Alexandria	783	14	33	24	11	10	18	21	14	6	4	5	6	1	950	**21.3%**
Bridgewater	850	21	8	8	3	11	11	11	6	3	1	2	2	4	941	**10.7%**
Bristol	2,073	11	27	37	30	20	14	14	10	2	2	5	9	3	2,257	**8.9%**
Groton	342	6	7	0	9	10	17	4	6	4	3	NA	NA	NA	408	**19.3%**
Hebron	517	15	7	8	13	11	11	6	6	4	1	7	8	2	616	**19.1%**
	4,565	**67**	**82**	**77**	**66**	**62**	**71**	**56**	**42**	**19**	**11**	**19**	**25**	**10**	**5,172**	**13.3%**

The red line in the chart is the total new housing construction for the time period; the growth trends of the five principal municipalities around the lake are clustered below the watershed totals. Clearly, the effects of economic recession appears around the 2007 to 2008 period in both the chart and the summary, but new development typically follows boom-and-bust cycles, and these data represent a "snapshot in time". Using these data**, the average annual growth rate for the 2000 to 2012 period is about 1%**[12]. Therefore, the 15% build-out scenario would require about 15 years to reach given this

[11] Based on housing trends data published by the N.H. Office of Energy and Planning. Note that these figures are for the entire municipality, including areas outside the Newfound Lake watershed.

[12] This growth rate is also typical of the statewide change for the time period per N.H. Office of Energy and Planning data.

growth rate, and the 30% scenario could stretch out to 30 years. Beyond the 30-year horizon, the results of the build-out projections are too uncertain to predict.

The two tables below show the share of new housing predicted for each of the five communities for both the 15% and 30% development scenarios. Note that Alexandria – the municipality with the greatest developable land area and currently minimal zoning – shows the greatest potential for new construction both numerically and percentage-wise. Bristol and Bridgewater with higher density inputs into the model but less land area also are predicted to add significant new building development.

15% Development

Municipality	# New Buildings	Percent Share
Alexandria	382	34.3%
Bridgewater	245	22.0%
Bristol	277	24.9%
Groton	125	11.2%
Hebron	84	7.5%
	1,113	

30% Development

Municipality	# New Buildings	Percent Share
Alexandria	827	35.2%
Bridgewater	491	20.9%
Bristol	550	23.4%
Groton	281	12.0%
Hebron	200	8.5%
	2,349	

The 15% scenario results in a little more than 1,100 new housing units, or an increase of 30% over existing baseline, in a span of 15 years. The 30% scenario adds about 2,350 new units for an increase of 63% over existing baseline.

Section 4: Fowler River Development Study

Introduction

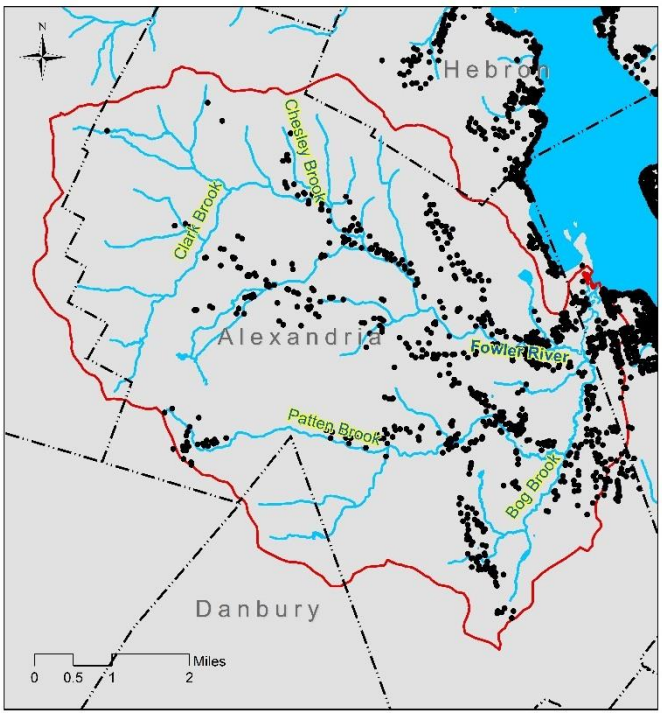
The Fowler River watershed has been chosen for more detailed study and scenario planning related to the build-out analysis for the following reasons:

- The Fowler River drainage area totals about 36 square miles, or 37% of the total Newfound Lake watershed;
- It contains a rural-to-urban land use continuum that matches the watershed-wide development character;
- As noted above, Alexandria is predicted to have the largest share and a significant numerical increase in new construction based on the build-out model; and, perhaps most importantly,
- Watershed master plan water quality measurements have shown that the **Fowler River watershed contributes 48% of total phosphorus loading to Newfound Lake based on existing conditions**.

Furthermore, as was noted in **Part 1** of this report, a number of natural resource features important to maintaining water quality and/or representing constraints to future development exist in the lower section of the Fowler River watershed. This alone should trigger more in-depth consideration of the

potential impacts of future development. It is hoped that this "cameo study" of the Fowler River will demonstrate a general process that communities surrounding Newfound Lake can use to assess both development and conservation priorities, arriving at a sound balance of both in the best interest of their personal and public property, of Newfound Lake, and of the local economy.

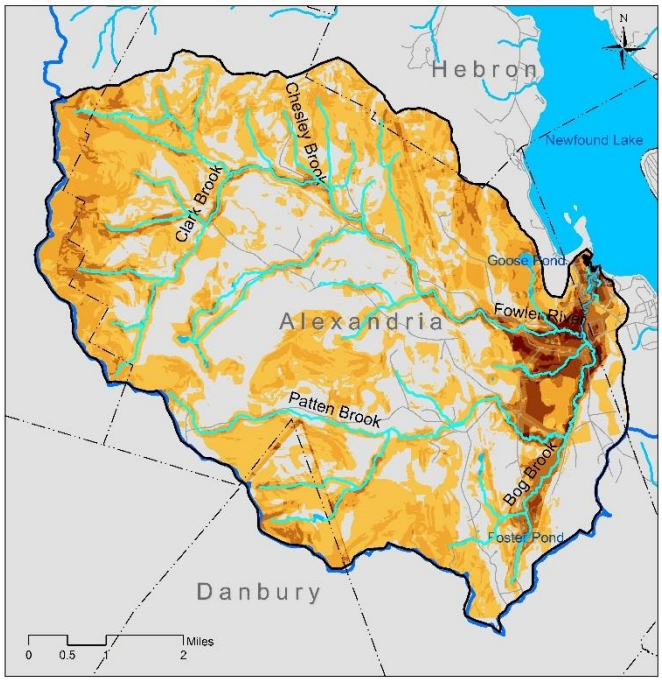
Study Area



The map to the left shows the Fowler River watershed and the limits of the study area for this analysis. This sub-watershed covers about 36 square miles, and is comprised of several smaller tributary stream watersheds. Clark Brook and Chelsey Brook are headwaters streams that join to form the Fowler River. Patten Brook and Bog Brook are significant tributaries that join the Fowler River near Newfound Lake. The black dots in the map are buildings mapped from 2010 aerial photography. **There are 940 buildings in the Fowler River watershed, totaling 99% of all housing in Alexandria, and about 25% of all buildings in the Newfound Lake watershed**.

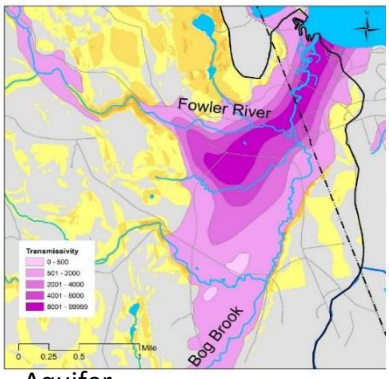
Focus Area

The map to the right shows the watershed co-occurrence mapping in the Fowler River watershed; the color gradient from light orange to dark brown represents the higher two-thirds of scores from the total co-occurrence mapping, with highest values evident in the lower portion of the Fowler River and along Bog Brook. The lack of color (gray) in much of Alexandria does not mean that there are no concerns there for water quality or future development; the selective use of the co-occurrence scores simply emphasizes those locations where priority considerations are most needed. The area with darker colors therefore is the focus area for the balance of this analysis.

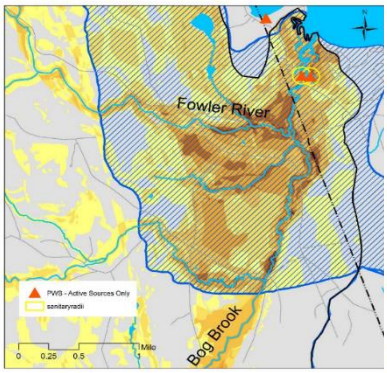


Review of Natural Resource Features

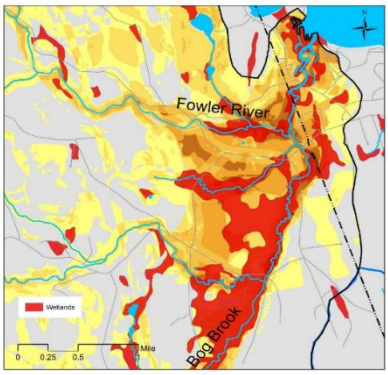
It is helpful to make a closer inspection of the key natural resource features that additively make the focus area significant. These are addressed in more detail in **Part 1** of this report, but are displayed in the following map series in greater detail. For illustration and brevity, only 6 of 12 resources are shown below, but all 12 are used in the analysis and mapping. Note how the features in each map appear again and again in the same focus area, overlaid on each other.



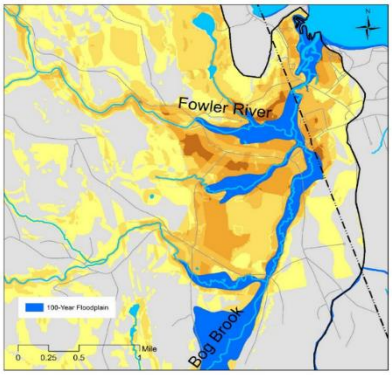
Aquifer



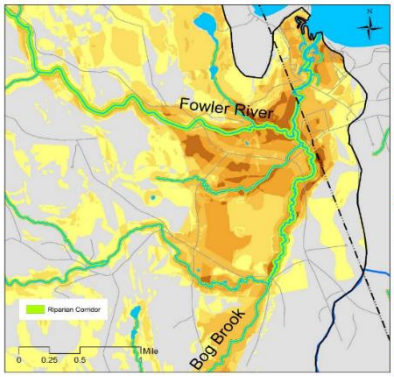
Drinking Water Protection



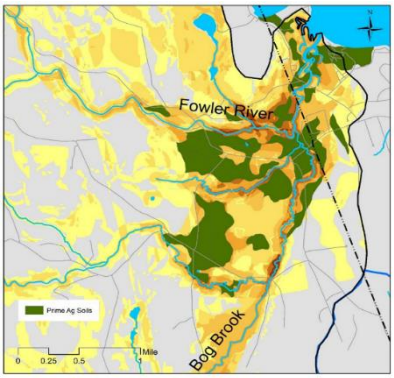
Wetlands



Floodplain

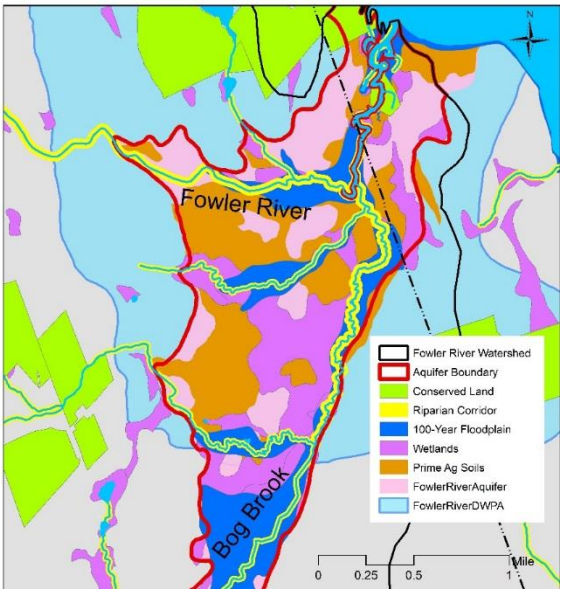


Riparian Buffers

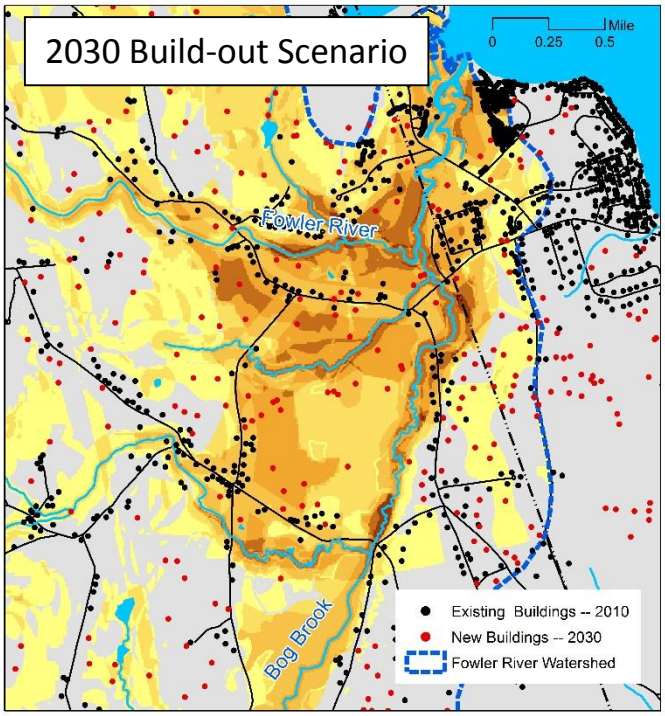


Prime Farmland Soils

The map to the right displays these six resource features overlaid on one another in the focus area to best show how the features cluster and interact. The bright green shapes are conservation and public lands; note how little of the Fowler River watershed is currently protected from development, especially within the aquifer area (red boundary).



Future Development Scenarios

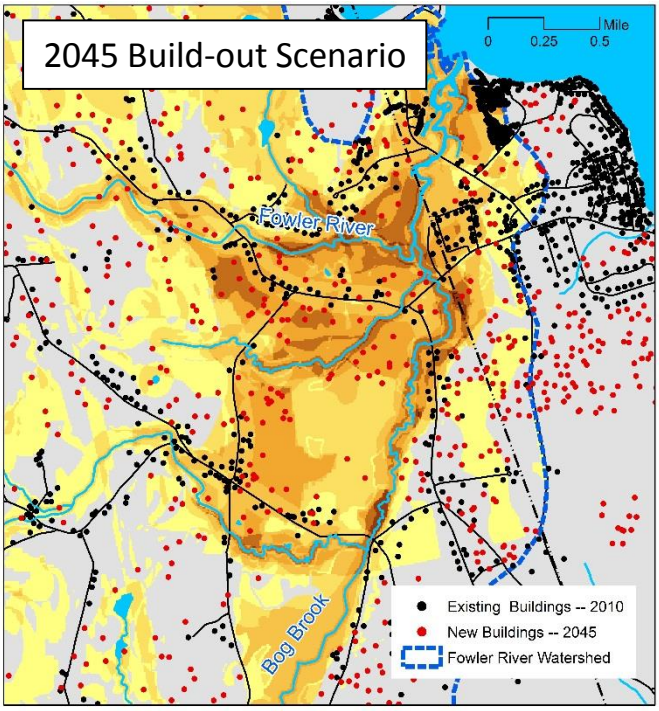


The map to the left shows the same area of the Fowler River study area, but returns to the color gradient scheme of the co-occurrence mapping which shows where more or less resource features are co-located.

The black dots are buildings mapped from the 2010 aerial photography. The red dots represent potential new development build-out by 2030 – just fifteen years from now (this is the 15% build-out scenario). Recall that the red dots do not precisely locate each new building, but rather are a graphic pattern of new construction determined by the build-out model.

For comparison, the map below shows the 30% build-out scenario, approximately 30 years from now (2045). In both scenarios, new construction has taken place on land currently undeveloped for residential land use. Note how the red dots scatter over much of the darker color tones in the co-occurrence mapping where multiple natural resources are found.

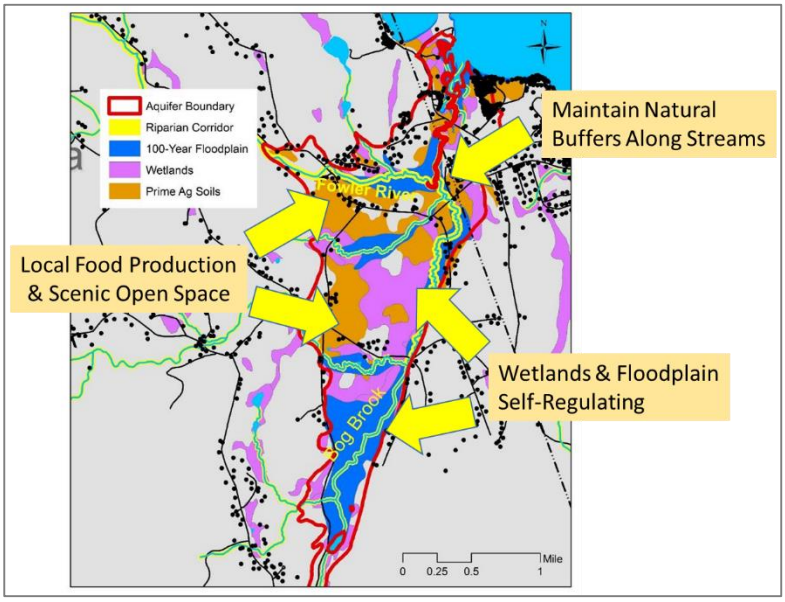
Wetlands and floodplains are automatically eliminated per the build-out model qualifications, hence the absence of red dots in some locations. However, note that considerable development is predicted on the aquifer, prime agricultural soils, within the Bristol Water Works wellhead protection area, and close to riparian buffers in this critical downstream segment of the Fowler River drainage.



Recommendations

Communities within the Newfound Lake watershed are encouraged to use the build-out analysis information provided in this report, in concert with separate mapping of the co-occurrence of various natural resources provided to each community that supplements this report, to conduct more in-depth community and conservation planning. The Fowler River development study presented here is one approach which can be replicated in other areas within the watershed, including the Cockermouth River valley in Groton and Hebron, the headwaters areas of Alexandria, and various sub- watersheds in Hebron and Bridgewater.

Understanding the importance of natural resource features as they relate to water quality in the lake and its tributaries, as well as constraints to development, can lead to relatively simple planning solutions useful to decision-makers in each community. Using the Fowler River and Bog Brook aquifer area as an example, the map below illustrates a few key points to guide development to the most suitable locations while simultaneously protecting water quality and other key natural resources.



The single most important resource feature in the Fowler River watershed is the aquifer, which provides drinking water to the Bristol Water Works, and a potentially excellent water supply for Alexandria's future growth. An overarching goal, therefore, would be to limit potential contamination sources and to prevent construction of impermeable surfaces (such as buildings, roads, and parking areas) as much as possible by keeping the land overlying the aquifer and within the aquifer recharge area in a natural condition.

Maintaining natural vegetation in riparian buffers along the river and streams is the most effective way to protect surface water quality. Wetlands and floodplains, which cover much of the aquifer area and are inter-connected with the riparian buffers, are self-protecting to a large degree because their use and development is regulated by State agencies.

The prime agricultural soils found over the aquifer offer an important choice to community decision-makers. On the one hand, the land is open and invites relatively easy development of roads and buildings. On the other hand, the high quality of the soil is unique in New Hampshire and the region, and warrants a long future perspective with local food production in mind. Keeping this land in farming will also help to preserve the excellent and prized scenic quality of the Fowler River valley that gives Alexandria much of its rural character. An alternative might be to work towards a balance of development and farm land preservation using clustered residential development and conservation

subdivisions that set aside a significant amount of farmland for the future, while also considering cumulative scenic quality.

Updating community master plans to reflect the findings of this and other Newfound Lake Watershed Master Plan studies is an important starting point for pro-active community planning. The natural resource data needed for updating town master plans is essentially complete, thanks to the watershed master plan process led by NLRA and its many partners. Each community can tailor their own "shared vision" using various group process consensus-building techniques[13], and the region-wide co-occurrence mapping can be refined and focused upon local values and priorities. The over-arching watershed master plan will continue to work as a unifying force in the region, while each community's vision defines the approach to local decisions that will affect both the quality of municipality and the economic benefits provided by clean water, healthy forests, and rural character of Newfound Lake for decades to come.

[13] For more information on how to start a "shared vision" community planning process, contact the Newfound Lake Region Association at 603-744-8689, or info@NewfoundLake.org

Appendix G ~ Fact Sheets and White Paper

Low Impact Development

Every Acre Counts Fact Sheet (May 2014)

What is a Low Impact Development?

According to the Environmental Protection Agency Low Impact Development (LID) is an approach to land development (or re-development) that works with nature to manage stormwater as close to its source as possible. LID employs principles such as preserving and recreating natural landscape features, minimizing effective imperviousness to create functional and appealing site drainage that treat stormwater as a resource rather than a waste product.

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 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 impacts of stormwater.

There are many LID practices that have been used to adhere to more ecological principles such as bioretention facilities, rain gardens, vegetated rooftops, rain barrels, and permeable pavements. By implementing LID principles and practices, water can be managed in a way that reduces the impact of built areas and promotes the natural movement of water within an ecosystem or watershed. Applied on a broad scale, LID can maintain or restore a watershed's hydrologic and ecological functions.

What is the Concern?

Changes to water quality from increased impervious surface cover include increased pollutant loads, higher bacterial contamination, and higher water temperatures. These changes can degrade fisheries, inhibit certain uses, such as swimming, and increase treatment costs for public water supplies. This is a concern for the water resources in the Newfound Watershed as well.

Increased impervious surfaces increase the volume and velocity of stormwater runoff entering receiving waters, reduce groundwater levels, and create more frequent high flows in streams during wet weather (i.e. “flashy” streams), create unnatural changes in stream channels and banks that reduce habitat quality, and are the cause of more frequent and severe flooding.

Therefore an essential part of stormwater management is maintaining the natural hydrology of a site to the maximum extent possible and LID practices assist with this. This is accomplished best by limiting land disturbance as much as possible, slowing down the flow of stormwater to minimize peak flows and increase infiltration, and treating stormwater on-site to maintain and protect the quality of receiving waters.

Regulatory Resources

Prior to adopting any new regulations it is good practice to review your Master Plan and be sure that such regulation is support in that policy document. If this issue has not been addressed this is an opportunity to do so, or to adopt *Every Acre Counts* as an amendment to the Master Plan. 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 zoning language available through the New Hampshire Department of Environmental Services 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.

Another alternative available to Watershed communities is to review your existing Site Plan Review and Subdivision Language and amend them as necessary to encourage or require Low Impact Development (LID). This may include site analysis requirements for the applicant that requires they document the site with both textual and graphic information early in the development review process. That allows for LID to be incorporated into the site design at the early stages of project conception, and the placement and function of LID facilities is not compromised.

LID provides each community in the Watershed with an opportunity to maintain and enhance green infrastructure while accommodating new development activity. These resources will assist local boards interested in evaluating their existing regulations and incorporating LID strategies:

This local code checklist can be used to evaluate existing regulations and identify changes that need to be made to encourage or require better stormwater management practices.
http://www.mapc.org/sites/default/files/LID_Local_Codes_Checklist.pdf

This handbook from Puget Sound provides a detailed perspective on integrating LID into local codes.
http://www.psp.wa.gov/downloads/LID_Guidebook/20120731_LIDguidebook.pdf

Additional Resources

For communities in the Watershed that are interested in a greater range of background documents and resources the following are recommended:

- DES Innovative Land Use Planning Techniques Handbook – http://des.nh.gov/organization/divisions/water/wmb/repp/innovative_land_use.htm
- The University of New Hampshire Stormwater Center – www.unh.edu/erg/cstev/
- EPA's National LID website – www.epa.gov/owow/nps/lid
- EPA New England Stormwater website – www.epa.gov/region1/topics/water/stormwater.html
- Center for Watershed Protection website – www.cwp.org
- Low Impact Development Center website – www.lowimpactdevelopment.org

If you are interested in other efforts to protect water quality in the Newfound Watershed, contact:

Newfound Lake Region Association
10 North Main St. Unit 1
Bristol, NH 03222
603-744-8689
info@Newfoundlake.org
www.Newfoundlake.org

Riparian Buffers

Every Acre Counts Fact Sheet (May 2014)

What is a Riparian Buffer?

A riparian buffer is an area of natural vegetation located adjacent to streams, lakes, ponds, and wetlands.

What is Their Purpose?

Riparian buffers provide the simplest, most effective and most economical way to protect clean water. These undisturbed areas act as buffers by performing critical functions that protect water quality and enhance wildlife habitat.

Riparian buffers slow and retain sediment, nutrients, pesticides, and other materials transported by surface runoff, and reduce the flow of nutrients and other pollutants to our surface waters. Woody vegetation in buffers provides food and cover for wildlife, and helps lower water temperatures by shading the waterbody. Also, root systems in healthy buffers increase the resistance of stream banks and shorelines to erosion caused by high water flows or waves. Riparian buffers can also be managed to provide timber, wood fiber, and horticultural products.

Riparian buffers provide numerous environmental benefits. Healthy riparian buffers:

A. Restore and maintain the chemical, physical and biological integrity of our clean water;

B. Provide stormwater infiltration capacity;

C. Remove pollutants from stormwater;

D. Reduce flooding, erosion and sedimentation;

E. Stabilize lake and stream banks;

F. Maintain base ("dry season") stream flow;

G. Contribute food and habitat to the ecosystem;

H. Moderate water temperature;

I. Provide and enhance wildlife habitat; and,

J. Enhance scenic value and recreational opportunities.

POTENTIAL IMPACTS FROM LAND DISTURBANCE ~ MITIGATED BY RIPARIAN BUFFERS:

1. **Destabilization of steep slopes.** Removal of trees and other vegetation may lead to erosion and slope failure.

2. **Alteration of existing drainage patterns.** May affect abutting properties, public roads, and water quality. Increased flooding and erosion.

3. **Stream bank erosion caused by an increase in stormwater runoff.** Erosion harms aquatic species and their habitats by increasing sediment loads.

4. **Reduced potential for groundwater recharge and water supply.** Impervious surfaces prevent rain and melting snow from soaking into the ground.

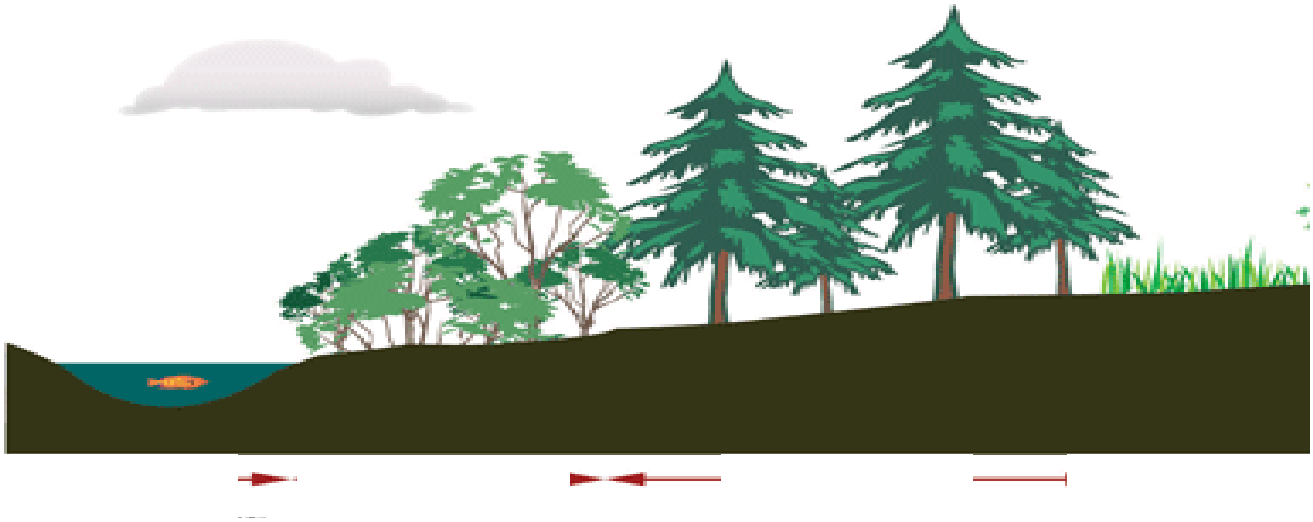
5. **Runoff of nutrients into surface waters.** Eroded sediments increase nutrients (nitrogen and phosphorus) in surface water, lowering oxygen levels, stressing native species and encouraging invasive species.

Where space allows, natural riparian buffers are the best means to protect water quality. As most residential projects fall beneath existing regulatory thresholds, and the larger projects are subject to a higher level of regulatory scrutiny, residential property owners should take voluntary steps to protect their riparian buffers.

Natural Buffers – The Best "Local Control"

A natural buffer is a strip of undisturbed native vegetation between a water resource and nearby development. Natural buffers protect biological, chemical, and physical qualities of surface and ground water. Using natural buffers when disturbing HEL is a practical approach to meeting existing state and federal water quality regulations while providing flexibility to the property owner and local authorities. Note that using a larger natural buffer may reduce the need for more intensive engineered controls, while a smaller buffer may make engineered controls more critical.

Schematic of Three-Tier Natural Buffer (explanation below)



WATER BODY

UNDISTURBED NATURAL ZONE (25-FT. MIN)

MANAGED FOREST ZONE (50-FT. MIN.)

STRUCTURE SETBACK ZONE (25-FT. MIN.)

Tiered Riparian Buffers ~ A Science-based Approach to Clean Water

The concept of a tiered riparian buffer was developed by the Center for Watershed Protection as a scientifically-based approach to protecting clean water and its habitat. The *Every Acre Counts* project team has adapted its use to the Newfound Watershed, and prepared maps and statistics that illustrate the location and extent of tiered riparian buffers in the five principal watershed towns. The three-tiers of a natural riparian buffer are illustrated above and summarized as follows:

- Zone 1 – The Undisturbed Natural Zone (UNZ) – minimum width of 25 feet from the top of the bank (i.e. high water mark). Protects physical and ecological integrity. Consists of mature riparian forest. Land use is highly restricted (footpaths and limited road / utility crossings).

- Zone 2 - The Managed Forest Zone (MFZ) – minimum width of 50 feet from edge of Undisturbed Natural Zone (may be wider to encompass 100-year floodplain, adjacent wetlands and steep slopes). Protects stream, provides buffer from upland development. Consists of mature forest with limited clearing for stormwater management, access and recreation.

- Zone 3 - The Structure Setback Zone (SSZ) – additional 25-foot setback beyond edge of Managed Forest Zone. Protects the buffer, allows typical residential uses (lawn, gardening, compost piles, etc.), however septic systems and new permanent structures are typically not allowed. Consists of (unfertilized) lawn, landscaped plantings, or natural meadow and forestland.

Regulatory Resources:

Recognizing that the simplest and most effective way to protect water quality is to leave an area of undisturbed native vegetation adjacent to the water body, the following regulatory approaches are recommended for consideration in the Newfound Watershed. Three options are presented along with model regulatory language:

Option 1 – Retaining a Uniform Natural Buffer

Option 2 – Language inserted in the Subdivision and/or Site Plan Review Regulations

Option 3 – A Tiered Buffer Approach

Option 1 – Retaining a Uniform Natural Buffer

This option includes the adoption of zoning language requiring a uniform 50 foot buffer along each side of all named and identified rivers/streams not already protected by the NH Shoreland Water Quality Protection Act or other Town Ordinance. Language can be adapted from the Tiered Buffer approach outlined in Option 3, but will most likely be focused only on the retention of natural vegetation. Sample language is provided below.

Riparian Buffer District.

The Riparian Buffer District of the 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 core buffer zone of shoreland on either side of all 1st, 2nd, 3rd, 4th order, and 5th and higher rivers and streams located within the municipality to supplement and expand upon the minimum requirements of the NH Shoreland Water Quality Protection Act.

The Riparian Buffer District requires a 50-foot-wide “no disturbance” zone along streams/rivers (25-ft.

minimum from both sides, top of bank) , and land uses are limited in the balance of the buffer. The "no disturbance" zone will be a riparian buffer of natural vegetation and trees that will be maintained or established within 50 feet of the reference line.

Option 2 – Language Inserted in the Subdivision and/or Site Plan Review Regulations

A second option for a community to consider is the inserting of riparian buffer requirements in the Subdivision and/or Site Plan Review Regulations to assist with the review of applications for resource-sensitive site design. This can be incorporated most likely in a section related to *Stormwater Management and Erosion Control*. The preservation and restoration of naturally vegetated riparian buffers is a critical stormwater management and erosion control strategy that should be required in erosion control plans.

Design Standards for Riparian Buffers.

A. A riparian buffer for a stream system shall consist of a forested strip of land extending along both sides of a stream and its adjacent wetlands or steep slopes. The riparian buffer width shall be adjusted to include contiguous sensitive areas, such as steep slopes and wetlands, where development or disturbance may adversely affect water quality, streams, wetlands, or other waterbodies.

B. The riparian buffer shall begin at the edge of the stream bank or water body.

C. The riparian buffer shall be composed of three distinct zones, with each zone having its own set of permitted and restricted uses:

1. Zone 1 – The Undisturbed Natural Zone (UNZ)

    1. Protects the physical and ecological integrity of the stream ecosystem.

    2. Begins at the edge of the stream bank of the active channel and extends 25 feet from the top of the bank plus any additional buffer width as specified in this section.

    3. Allowable uses within this zone are highly restricted to:

        1. Flood control structures

        2. Utility right of ways

        3. Footpaths

        4. Road crossings, where permitted.

    4. UNZ contains undisturbed natural vegetation.

2. Zone 2 - The Managed Forest Zone (MFZ)

    1. Protects key components of the stream and provides distance between upland development and the Streamside Zone.

    2. Begins at the outer edge of the UNZ and extends 50 feet

    3. Allowable uses within the MFZ must maintain the functional integrity of this zone and are restricted to:

        1. Biking or hiking paths

2. Stormwater management facilities, with the approval of _____ [jurisdiction].

3. Recreational uses as approved by _____ [jurisdiction].

4. Removal of mature tree cover (in conformance with the NH Shoreland Water Quality Protection Act)

4. Middle Zone requires the retention of the shrub layer and herbaceous ground cover to allow infiltration of run-off.

3. Zone 3 - The Structure Setback Zone (SSZ)

1. Provides an additional 25-foot setback beyond edge of Managed Forest Zone.

2.Protects the buffer, allows typical residential uses (lawn, gardening, compost piles, etc.), however septic systems and new permanent structures are typically not allowed.

3. Consists of (unfertilized) lawn, landscaped plantings, or natural meadow and forestland

Option 3 – A Tiered Buffer Approach

A Tiered Buffer approach which includes an overlay district superimposed over the existing conventional zoning districts of the municipality. It includes within its boundary a protected core buffer zone of shoreland on either side of rivers/streams. The core buffer zone is then widened where critical features exist (as represented on Page 2 of this document). The following model ordinance was adapted from the New Hampshire Innovative Planning Techniques Handbook available from the NH Department of Environmental Services to incorporate a tiered buffer approach for communities in the Newfound River Watershed.

Tiered-Riparian Buffer Ordinance

I. TITLE AND AUTHORITY

A. **Title:** This Ordinance shall be known as the "Tiered Riparian Buffer Ordinance of the 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 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 rivers and streams of the Town of _____ to protect the water quality of these resources; to protect the Town of _____'s riparian and aquatic ecosystems; to provide for the environmentally sound use of the Town of _____'s land resources; and to assist with the stewardship of the Newfound River Watershed.

The Town finds that 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 our clean water;

B. Provide stormwater infiltration capacity;

C. Remove pollutants from stormwater;

D. Reduce flooding, erosion and sedimentation;

E. Stabilize lake and stream banks;

F. Maintain base ("dry season") stream flow;

G. Contribute food and habitat to the ecosystem;

H. Moderate water temperature;

I. Provide and enhance wildlife habitat; and,

J. Enhance scenic value and recreational opportunities.

Therefore, the 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.

III. APPLICABILITY

A. **Riparian Buffer District.** The Riparian Buffer District of the 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 **Riparian Buffer Zone (RBZ)** on either side of all 1st, 2nd, 3rd 4th order, and 5th and higher rivers and streams located within the municipality. The RBZ is widened where critical features exist. This tiered buffer approach is based on the work of the Center for Watershed Protection .

All **RBZs** include a 25-foot-wide **Undisturbed Natural Zone (UNZ)** zone along both sides of regulated streams/rivers, and land uses are limited in the balance of the buffer. The UNZ shall be a riparian buffer of natural vegetation and trees that shall be maintained or established within 25 feet of the reference line (top of bank).

The following features are in addition to the UNZ, where applicable:

- The full extent of the **100 year floodplain** is added for flood storage and habitat value.
- **Wetlands** that extend beyond the UNZ or 100 year floodplain are added for their flood storage, water quality, and habitat functions.
- **Steep slopes** (25% or greater) that extend beyond the UNZ are added because of their potential to impact water quality if disturbed. This zone is limited to the first 100' of steep slope abutting the UNZ.

The Riparian Buffer District subject to this Ordinance shall be shown on the municipality's Official Riparian Buffer Zoning Map, which is incorporated as part of this Ordinance.

B. **Official Riparian Buffer District Map.**

1. **Scale of Riparian Buffer Zoning Map.** The Official Riparian Buffer District 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.

2. **Certification of Official Riparian Buffer Zoning Map.** The Official Riparian Buffer District 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.
3. **Changes to the Official Riparian Buffer Zoning Map.** If amendments are made to the Riparian Buffer District or other matters portrayed on the Official Riparian Buffer District Map, such changes shall be made on the map within 30 days after the amendment has been adopted by the municipality.

IV. DISTRICT BOUNDARIES

A. **Definition of District Boundaries.** The district boundaries of the Riparian Buffer District shall encompass the tiered buffer approach identified in Section IV. A of this Ordinance.

B. **Interpretation of District Boundaries.** Where uncertainty exists as to the exact location of district boundary lines, the Planning Board shall be the final authority as to boundary locations.

V. RIPARIAN BUFFER PROTECTION DISTRICT REGULATIONS

A. **Prohibited Water Pollution Hazards, Uses, Structures and Activities**
The following uses, structures and activities are prohibited within the Riparian Buffer District:

1. Establishment or expansion of salt storage yards, automobile junk yards and solid or hazardous waste facilities.
2. Establishment or expansion of dry cleaning establishments and automobile service/repair shops.
3. Laundry/car wash establishments not connected to municipal or public sewer.
4. Subsurface disposal of pollutants from sewage treatment facilities, other than residential 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 water body.
6. Bulk or temporary storage of chemicals (e.g. herbicides, pesticides, fertilizers) above or below ground.
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. Fertilizer or pesticide use in the 25 foot “no disturb” zone (50 feet under A.5 above). Fifty feet beyond the reference line, low phosphate, slow release nitrogen fertilizer or limestone may be used on areas that are already vegetated. Only low phosphate, slow release nitrogen fertilizer should be used elsewhere.
11. 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 Riparian Buffer District. The following uses, structures and activities are permitted within the Riparian Buffer District, subject to applicable state and local approval:

1. All permitted uses allowed within the municipality's underlying zoning district(s), except those uses expressly prohibited as listed above.
2. 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.

C. **Restrictions outside the UNZ but Within the RBZ**

a. Restricted tree care involving the removal of dead, diseased, unsafe, or fallen trees, saplings, shrubs is permitted. All stumps and their root systems shall be left in place (stumps may be gound down to grade), and stones and duff shall be left intact in or on the ground. Preservation of dead and living trees that provide dens and nesting places for wildlife is encouraged.

b. Planting and reforesting efforts to restore native vegetation within this zone is encouraged.

c. Forest management not associated with shoreland development or land conversion, and conducted in compliance with RSA 227-J:9 so as to not violate State water quality standards is exempt. See section VIII A of this ordinance.

d. Impervious surfaces on the portion of the lot within the Riparian Buffer District shall be limited to 10 percent of the lot area.

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**.

D. **Stormwater, Erosion and Siltation**

1. Stormwater runoff quantity and quality shall remain unchanged between pre- and post-development of all lots either partially or fully located within the Riparian Buffer District.
2. New structures and all modifications to existing structures within the Riparian Buffer District shall be designed, constructed and maintained to prevent the release of surface runoff from the property and to surface waters and wetlands.
3. All earth moving or excavation activities on lots located either partially or wholly within the Riparian Buffer 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 on projects that include at least 10,000 sq. ft. of disturbance .
4. In new developments, on-site, distributed and non-structural stormwater management alternatives shall be preferred over larger structural facilities within the riparian buffer.
5. When constructing stormwater management facilities, the area cleared shall be limited to the area required for construction, and adequate maintenance access only. Following construction, natural vegetation should be restored as much as possible, allowing room for maintenance needs.

VI. 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 Riparian Buffer 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 Riparian Buffer 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 includes but is 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 Riparian Buffer 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 Town and DES approval. Between the primary building line and the reference line, 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.

VII. RIPARIAN BUFFER MANAGEMENT, MAINTENANCE AND INSPECTION

A. It shall be the responsibility of every property owner within the Riparian Buffer 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 Undisturbed Natural Zone (UNZ), Managed

Forest Zone (MFZ) and Structure Setback Zone (SSZ) 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 to inspect the integrity of the riparian buffer both annually and immediately following severe storms during the first three years (or until vegetation is re-established) for evidence of sediment deposition, erosion, or concentrated flow channels and corrective actions taken to ensure the integrity and functions of the riparian buffer.

VIII. 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 to not violate State water quality standards. See "Good Forestry in the Granite State" manual (2nd Edition, December 2010, or most recent revision).

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) and do not violate State water quality standards.

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 and stable 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 excepted 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.

DEFINITIONS (Potential definitions for Towns to adopt as needed)

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.

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.

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.

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 (Perennial) 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, or the 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 CWQPA **(CORRECT TERM AND CONSISTENT USE)**, RSA 483-B:4, Definitions.

Reference Line: Defined in the CWQPA, 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 UPPER? 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 in body of this Ordinance.

Sapling: A young tree less than four inches (9.75 cm) in diameter (dbh) and less than 20 feet (6.3 m) in height

Selected Clearing and Landscape Plan: An accurate 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. Professionals certified to perform such work are recommended before approving regulated activities having moderate to significant potential impact.

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 typically 1:24,000 or larger for local land-use analysis, planning and regulation.

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).

Additional Resources:

NH Innovative Land Use Planning Techniques Handbook
http://des.nh.gov/organization/divisions/water/wmb/repp/innovative_land_use.htm

Center for Watershed Protection
http://www.cwp.org/

Guidance on erosion and sediment controls during construction:
NH Stormwater Manual Vol. 3 – Erosion and Sediment Controls During Construction:
http://des.nh.gov/organization/commissioner/pip/publications/wd/documents/wd-08-20c.pdf

NHDES Site for Stormwater Management for Homeowners (lots of great, practical information) and Residential Loading Model (spreadsheet to calculate your stormwater "footprint"):
http://des.nh.gov/organization/divisions/water/stormwater/stormwater-mgmt-homeowners.htm

NHDES Homeowner's Guide to Stormwater Management:
http://des.nh.gov/organization/commissioner/pip/publications/wd/documents/wd-11-11.pdf

If you are interested in other efforts to protect water quality in the Newfound Watershed, contact:

Newfound Lake Region Association
10 North Main St. Unit 1
Bristol, NH 03222
603-744-8689
info@Newfoundlake.org

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Steep Slopes

Every Acre Counts Fact Sheet (November 2011)

What are Steep Slopes?

Many communities define steep slopes as having grades of 15 % or more (elevation increases 15 feet every 100 horizontal feet). Some communities also define extremely steep slopes, with grades typically 25% or more.

What are the Issues Related to Steep Slopes?

Based on mapping by the Society for the Protection of NH Forests, more than half of the land in the Newfound Watershed (32,176 acres) has slopes of 15% or greater. Due to its steepness and size, one inch of rain in the watershed raises the water level in Newfound Lake by roughly ten inches within 24 hours of the rain event.

Development on steep slopes poses health, safety, and environmental challenges. The amount of polluted stormwater runoff increases, especially in areas of highly erodible land. Views of surrounding hills are degraded, reducing perceived and real values. In *Every Acre Counts*, protecting hillsides and steep slopes from development was identified as a priority because protecting healthy forests preserves water quality and the environment that supports our local economy.

Highly Erodible Soils

A Highly Erodible Land (HEL) designation indicates how susceptible soil is to erosion. HEL is very susceptible to erosion if disturbed, even in the 3%-8% slope range.

Land development typically removes vegetation, alters topography, and covers previously vegetated areas with impervious surfaces (roads, driveways, buildings and lawns). Development on steep slopes and HEL raises the threat of stormwater pollution because removing vegetation and roots weakens soil, increases the amount and velocity of runoff, exposes weakened soils to rain, and reduces the soil's ability to absorb water. Thus, removing vegetation increases soil erosion and sedimentation of water bodies.

Constructing access roads and driveways on steep slopes is technically and economically challenging and raises maintenance costs. The NH Department of Transportation recommends that commercial driveways not exceed an 8% grade and that residential driveways not exceed a 15% grade, but in some instances driveways this steep are still problematic. In addition, the amount of cut and fill required to meet grades on these slopes often disturbs an additional two to three times more land than a driveway in a flat area. This should be considered when selecting a building site.

Erosion and sedimentation impacts due to land disturbance:

1. **Destabilization of steep slopes.** Removal of trees and other vegetation may lead to erosion.

2. **Alteration of existing drainage patterns.** May affect abutting properties, public roads, and water quality. Can result in flooding and erosion.

3. **Stream bank erosion caused by an increase in stormwater runoff.** Erosion harmful to aquatic species and their habitats by increasing sediment loads.

4. **Reduced potential for groundwater recharge and water supply.** Impervious surfaces prevent rain and melting snow from soaking into the ground.

5. **Runoff of nutrients into surface waters.** Eroded sediments increase nutrients (nitrogen and phosphorus) in surface water, lowering oxygen levels, stressing native species and encouraging invasive species.

How to Protect Steep Slopes and Highly Erodible Lands

There are many practices that can be used to protect steep slopes by controlling erosion and sedimentation during site development. These temporary methods address the increased amount of erosion and sedimentation that occurs during construction. Despite their temporary nature, site development practices are critical for preventing the erosion and sedimentation that often occur during construction when the land has been freshly disturbed.

Each of the following examples assumes a moderate-sized home with driveway, on-site septic and drilled water supply well, built on a wooded two-acre lot. This scale of development typically disturbs between 10,000 – 20,000 square feet. Relative impacts and potential practices are outlined for each of the three examples.

Example 1 – Slope < 8%, soil stable, no surface water

- Low potential impact. Site development practices include: Site development and land-clearing plan (filed with Town), erosion and sediment control (mulch / seed exposed soil).

Example 2 – Slope 8-15%, soil moderately erodible, surface water present

- Moderate potential impact. Site development practices include: Site development and land-clearing plan (Planning Board approval required); construction phasing; erosion and sediment control (silt fence, hay bales etc.); drainage control (swales, detention ponds, check dams, infiltration basins); soil stabilization (mulch / seed, jute mats); minimum 50-foot undisturbed buffer around streams, ponds and wetlands.

Example 3 – Slope >15%, soil highly erodible, surface water present

- Significant potential impact. Site development practices include: Site development and land-clearing plan (Planning Board approval required); construction phasing; erosion and sediment control (silt fence, hay bales etc.); drainage control (swales, detention ponds, check dams, infiltration basins); soil stabilization (mulch / seed, jute mats); 100-foot to 300-foot undisturbed buffer around streams, ponds and wetlands.

In all three cases document the effectiveness of the practices using before and after photos, and by confirming soil stabilization has occurred.

Additional Resources

Additional resources for construction in sensitive areas include:

NHDES Guide on Steep slopes and Ridgeline Development:
http://des.nh.gov/organization/divisions/water/wmb/repp/documents/ilupt_chpt_2.2.pdf

NH Stormwater Manual Vol. 3 – Erosion and Sediment Controls During Construction:
http://des.nh.gov/organization/commissioner/pip/publications/wd/documents/wd-08-20c.pdf

The Web Soil Survey:
http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm

If you are interested in other efforts to protect water quality in the Newfound Watershed, contact:

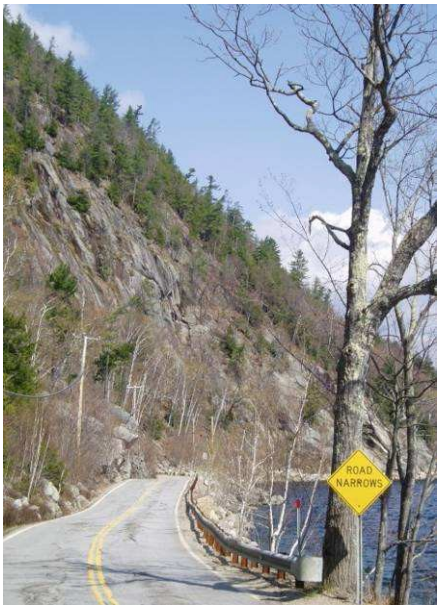
Newfound Lake Region Association
800 Lake St., Bristol, NH 03222
603-744-8689
info@Newfoundlake.org
www.Newfoundlake.org

A Guide to Steep Slopes and Highly Erodible Land

Created For Communities in the Newfound Watershed by the *Every Acre Counts* project team – April 2011 (Rev. December 2014)

Taken together, the combination of steep slopes and highly erodible land in the Newfound watershed creates a significant threat to water quality and infrastructure if land disturbance is not carefully and pro-actively managed. With nearly 90 miles of perennial streams and rivers; 2,250 acres of wetlands; 8,680 acres of high-quality surface water; and roughly 4,000 acres of aquifer area, soil erosion has a tremendous potential to damage our economy, environment, health and safety far beyond a disturbed area. The purpose of this document is to define steep slopes and Highly Erodible Land, summarize threats from improper land use in these sensitive areas, and provide recommendations and resources to local planners and developers to manage the threats.

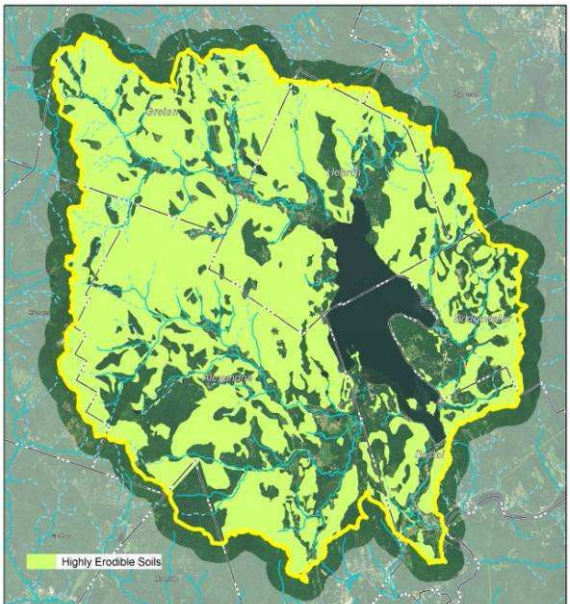
What are Steep Slopes?



Many communities define steep slopes as having grades of 15 % or more, meaning that the elevation increases by 15 feet over a horizontal distance of 100 feet. Some communities also define extremely steep slopes, with grades typically 25% or more. According to mapping by the Society for the Protection of NH Forests in 2010, more than half of the land in the Newfound watershed (32,176 acres) has a slope of 15% or greater. Due to its overall steepness, one inch of rain in the watershed raises the water level in Newfound Lake by roughly ten inches within 24 hours of the rain event.

Steep slope development poses unique health, safety, and environmental challenges. For example, adverse effects on water quality as a result of increased erosion and sedimentation, especially in areas of highly erodible land. In *Every Acre Counts: The Newfound Watershed Master Plan*, protecting hillsides and steep slopes from development was identified as a priority because it helps to preserve high water quality and the environment that supports the local economy.

Highly Erodible Land, Slopes Above 15%



What is Highly Erodible Land?

More than 50 percent of the land in the Newfound watershed has a slope of 15 percent or greater.

Highly Erodible Land (HEL) is an official soil rating of the Natural Resource Conservation Service (NRCS) aimed primarily at agricultural land management. The HEL rating indicates how susceptible soil is to erosion (high or potentially high). HEL is commonly located on steep to extremely steep slopes and are very susceptible to erosion if disturbed, even in the 3%-8% slope range.

Erosion and sedimentation impacts due to land disturbance:

1. **Destabilization of steep slopes.** Removal of trees and other vegetation may lead to erosion.

2. **Alteration of existing drainage patterns.** May affect abutting properties, public roads, and water quality. Can result in flooding and erosion.

3. **Stream bank erosion caused by an increase in stormwater runoff.** Erosion harmful to aquatic species and their habitats by increasing sediment loads.

4. **Reduced potential for groundwater recharge and water supply.** Impervious surfaces prevent rain and melting snow from soaking into the ground.

5. **Runoff of nutrients into surface waters.** Eroded sediments increase nutrients (nitrogen and phosphorus) in surface water, lowering oxygen levels, stressing native species and encouraging invasive species.

Land development typically involves removal of vegetation, alteration of topography, and covering of previously vegetated surfaces with impervious cover such as roads, driveways, and buildings. Development on steep slopes and HEL presents even more of an issue because removal of vegetative cover and its root system compromises 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. Thus, removal of vegetation leads to increased soil erosion and sedimentation of water bodies as soil is carried to streams, rivers, wetlands, and lakes.

Constructing access roads and driveways to development on steep slopes can be both technically and economically challenging while raising the cost of ongoing maintenance and risk of catastrophic failure. While the New Hampshire Department of Transportation recommends that commercial driveways not exceed an 8% grade and that residential driveways not exceed a 15% grade, these guidelines are exceeded in parts of all watershed communities. In addition, the amount of cut and fill required to meet grades disturbs an additional two to three times more land than a driveway in a flat area. As such, Towns should carefully consider impacts from access roads on steep slopes before approving a project.

Steep Slope Driveway Eroded by Uncontrolled Runoff

Stormwater Runoff to Newfound Lake from Upslope Residential Development

Regulatory Approaches for Managing Steep Slopes and Highly Erodible Land

Existing state and federal laws protect water quality from various sources of pollution, including sediment. Land disturbance is regulated at the federal and state levels, with federal permits required for disturbances of one (1) acre or more and state permits required for disturbance of 50,000 square feet or more when any portion of the disturbance is within the protected Shoreland; 100,000 square feet or more in upland areas; or in a wetland. In addition, a state permit is required if a project disturbs any area having a 25% or steeper land slope and is within 50 feet of any surface water.

Municipalities may wish to regulate smaller areas of site disturbance because significant environmental damage can occur at levels below the acreage thresholds regulated at federal and state levels. This is especially true in areas of steep slopes and/or HEL. The model steep slope regulation referenced in the "Additional Resources" section below proposes that the regulations apply where a cumulative disturbed area exceeds 20,000 square feet. *Every Acre Counts* recommends using a 10,000 square-foot threshold to reflect the nature of the majority of development activity anticipated in the Newfound watershed.

Regulatory approaches available to local communities include:

- Zoning ordinances that regulate development on steep slopes and HEL,
- Erosion and sediment control regulations,
- A variety of approaches in subdivision and site plan review regulations,
- An administrative process to review applications and inspect development projects,
- Making development permits, plans and approvals readily available for public review (e.g. on Town web site).

As planning, implementation and oversight are most effective at the local level, local authorities are well placed to adopt practical approaches that protect water quality from development impacts. By increasing transparency

and public knowledge of the application, permitting and planning processes, public awareness and support of good building practices will likely grow, resulting in reducing runoff to surface water and protecting its quality.

Some New Hampshire communities have developed both pre- and post-construction erosion and sediment control regulations. The State offers excellent guidance for planning and low-impact development (see Additional Resources at the end of this document). For regulations and guidance to be fully effective, they must address land clearing prior to construction and include requirements for inspection and maintenance. Some towns address this need by requiring the pre-cleared condition to be the basis of stormwater calculations for post-development conditions. Other towns have begun to require construction sequencing and/or development plans that consist of a written agreement between the board and developer that covers pre-construction meetings and inspection, construction meetings, post-storm and post-construction inspections, maintenance schedules, and bonding of erosion and sediment control measures. Note that even the best regulations will only be as effective as their accompanying methods of enforcement.

Steep Slopes, Highly Erodible Land and Water Resources

Stormwater Damage to NH Route 123 Alstead, NH

Much of the land in the Newfound watershed that is currently zoned for development is susceptible to rapid and damaging erosion. As the risk of environmental damage increases (e.g. slopes greater than 8%, presence of HEL, size of the disturbed area, proximity to water resources), so should the level of site planning and use of Best Management Practices (BMPs).

How to Protect Steep Slopes and Highly Erodible Lands

There are many structural (physical) and non-structural (administrative) BMPs that can be used to protect steep slopes by controlling erosion and sedimentation during site development. These temporary methods address the increased amount of erosion and sedimentation that occurs during construction. Despite their temporary nature, site development BMPs are critical for preventing the erosion and sedimentation that often occur during construction when the land has been freshly disturbed.

Development in the Newfound region is primarily conversion of seasonal structures to full-time use, construction of single-family homes, or construction of small subdivisions. Due to the ready availability of developable land, there is a growing potential for larger subdivisions with multiple house lots and extensive road and drainage infrastructure. As most residential projects fall beneath existing state and federal regulatory thresholds, and the larger projects are subject to a higher level of scrutiny, permitting and professional design, we have suggested some examples of how to address development of smaller lots and single-family homes.

Each of the following examples assumes a moderate-sized home with driveway, on-site septic and drilled water supply well, built on a wooded two-acre lot. This scale of development typically disturbs between 10,000 – 20,000 square feet. Relative impacts and potential BMPs are outlined for the following three examples:

Example 1 – Slope < 8%, soil stable, no surface water

- Low potential impact. BMPs include: Site development and land-clearing plan (filed with Town), erosion and sediment control (mulch / seed exposed soil).

Example 2 – Slope 8-15%, soil moderately erodible, surface water near by

- Moderate potential impact. BMPs include: Site development and land-clearing plan (Planning Board approval required); construction phasing; erosion and sediment control (silt fence, hay bales etc.); drainage control (swales, detention ponds, check dams, infiltration basins); soil stabilization (mulch / seed, jute mats); minimum 50-foot undisturbed buffer around streams, ponds and wetlands.

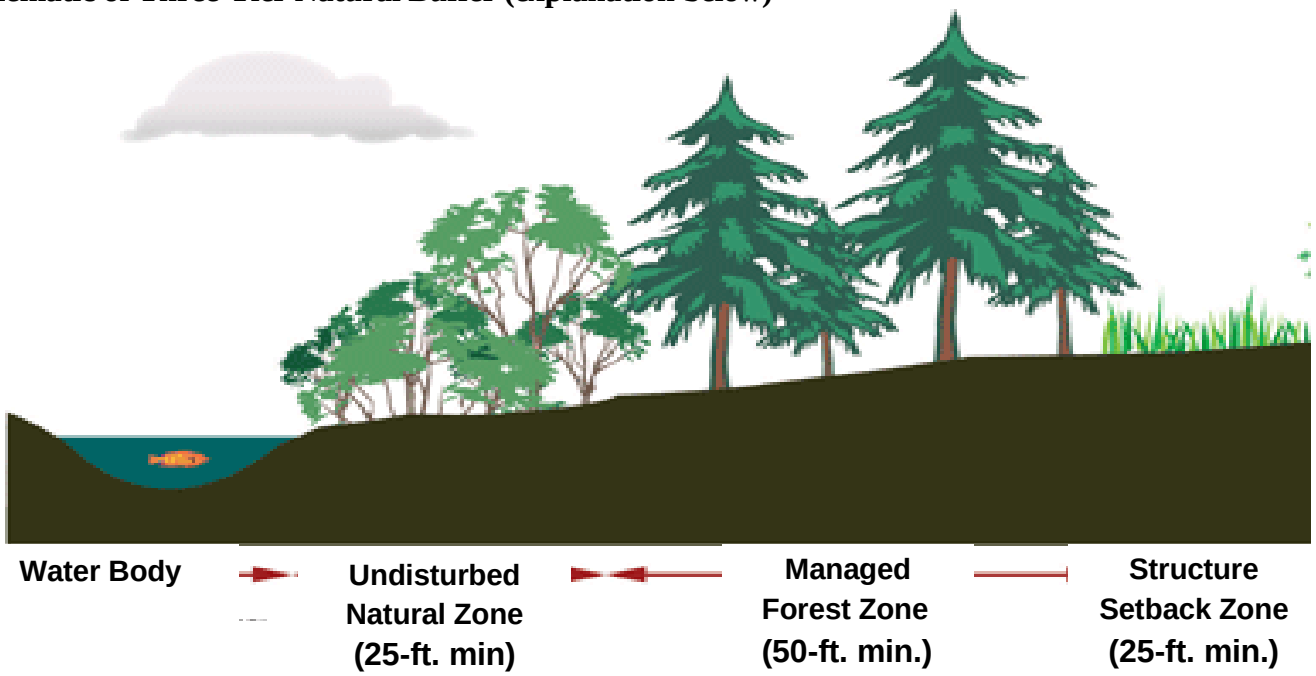
Example 3 – Slope >15%, soil highly erodible, surface water near by

- Significant potential impact. BMPs include: Site development and land-clearing plan (Planning Board approval required); construction phasing; erosion and sediment control (silt fence, hay bales etc.); drainage control (swales, detention ponds, check dams, infiltration basins); soil stabilization (mulch / seed, jute mats); 100-foot to 300-foot undisturbed buffer around streams, ponds and wetlands.

Natural Buffers – The Best "Local Control"

A natural buffer is a strip of undisturbed native vegetation between a water resource and nearby development. Natural buffers protect biological, chemical, and physical qualities of surface and ground water. Using natural buffers when disturbing HEL is a practical approach to meeting existing state and federal water quality regulations while providing flexibility to the property owner and local authorities. Note that using a larger natural buffer may reduce the need for more intensive engineered controls, while a smaller buffer may make engineered controls more critical.

Schematic of Three-Tier Natural Buffer (explanation below)



The above graphic indicates a three-tier natural buffer that provides an effective and efficient means to balance land use restrictions with habitat and infrastructure protections. The total buffer width should be at least 100 feet, and wider where needed to encompass adjacent wetlands, steep slopes or critical habitat areas. Buffers provide many valuable services, including flood protection and erosion control, pollutant removal, wetlands and habitat protection, natural stream channel migration and future greenways (see *Watershed Protection Techniques under* Additional Resources).

The three-tiers of a natural buffer are summarized as follows:

- The Undisturbed Natural Zone – minimum width of 25 feet from each side of stream. Protects physical and ecological integrity. Consists of mature riparian forest. Land use is highly restricted (footpaths and limited road / utility crossings).

- The Managed Forest Zone – minimum width of 50 feet from edge of Undisturbed Natural Zone (may be wider to encompass 100-year floodplain, adjacent wetlands and steep slopes). Protects stream, provides buffer from upland development. Consists of mature forest with limited clearing for stormwater management, access and recreation.

- The Structure Setback Zone – additional 25-foot setback beyond edge of Managed Forest Zone. Protects the buffer, allows typical residential uses (lawn, gardening, compost piles, etc.), however septic systems and new permanent structures not allowed. Consists of lawn, landscaped plantings, or natural meadow and forestland.

Where space allows, natural buffers are the best means to protect water quality. As space for buffers becomes less available, engineered structures may be required to meet water quality and quantity standards. As with all investments, the costs and benefits of various methods that meet local and state performance standards must be carefully assessed before the project is approved to be sure the outcome is favorable for all affected parties.

Additional Resources

Additional resources for construction in sensitive areas include:

NHDES Guide on Steep slopes and Ridgeline Development:
http://des.nh.gov/organization/divisions/water/wmb/repp/documents/ilupt_chpt_2.2.pdf

NH Stormwater Manual Vol. 3 – Erosion and Sediment Controls During Construction:
http://des.nh.gov/organization/commissioner/pip/publications/wd/documents/wd-08-20c.pdf

SSSNNE Order One soils manual: www.sssnne.org/nh-vt.pdf

The Soils Dictionary:
http://www.nh.nrcs.usda.gov/Soil_Data/soil_data_documents/datadict.pdf
http://www.nh.nrcs.usda.gov/

The Web Soil Survey:
http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm

The Architecture of Urban Stream Buffers
Watershed Protection Techniques, 1(4): 155-163

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For more information about *Every Acre Counts* or how you can be involved in protecting the Newfound Lake watershed, please contact:

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The Newfound Lake Region Association's mission is to protect Newfound Lake and its watershed. The Association - through education, programs and collaboration - promotes conservation and preservation of the region's natural, social and economic resources.