## APPENDIX B: LSPA Historical Timeline

### The Past

Founded in the 1890's

Earliest known report of annual meeting is 1898

Subjects of those days

- Lake Level – the Sunapee Dam Corporation
- Sawmill pollution – logs in lake, sawdust
- Shoreline sanitary

1904 Became the Lake Sunapee Protective Corporation
Lake level – the Sunapee Dam Corporation (lobbying in Concord, lawsuits)

1907 Approximately 250 buildings on the lake

| | |
|---|---|
| Newbury | 110 |
| New London | 50 |
| Sunapee | 90 |

### The Teens to the '50's

Annual dues: $1.00

Subjects of those days

- Lake level
- Sanitary codes & enforcement (LSPC paid for sanitary inspection)
- Cottage break-ins (LSPC paid for patrols)
- Fish health and laws
- Boat speeds and noise
- Building cottages over the lake
- Excessive logging on Mt. Sunapee
- Pollution from steamboats
- Paying a bounty for new members!

### Coming of Age

1956 Strong emphasis on water quality begins

1957 Reorganized as a non-profit corporation

1958 Eliassen report on water quality
261 members
Class A designation won

1968 LSPA requests towns appropriate funds and hire health officers

1972 Cortell report
A major examination of the Lake's quality, sources of problems, recommendations for corrective actions

"1,000 members - LSPA hires full-time Executive Director"

## More Recent History '70's – '80's

1977 LSPA takes over responsibility for lighthouses

1985 Contract with University of NH to do water quality testing, analysis, interpretation
Solar powered lights installed in three lighthouses on Lake Sunapee

1988 *the Beacon* begins publication

1989 Shoreland protective ordinances
LSPA, towns, Regional Planning Commission work together to create and gain voter approval of these ordinances

## The '90's

1990 LSPA's first office opened
Shared space in Grevstad office in The Gallery, New London

1991 Regional water quality laboratory
Cooperative effort of LSPA, NH DES and Sunapee schools
First classes for youth cosponsored with the Montshire Museum of Science

1992 First expansion of staff beyond Executive Director
Managers of Water Quality and Public Awareness
Comprehensive study of LPA by management consultant: The Roche report

1993 First expansion into watershed – streams testing, coordination with other lakes
First testing of streams during snow melt
First LSPA classes in elementary schools
Board retreat commits to vision statement, establishes action teams to implement retreat commitments
Publication of first brochures, on LSPA and Boating on the lake

1994 Two new part time positions: Watershed Steward and Education Coordinator (now 5 part time employees)
Reconstruction of Burkehaven Lighthouse
Formation of Clean Stream Team with grant proposal for funds to clean up tributary streams (working with town and county conservation commissions, and regional planning group)
$25,000 awarded to LSPA to clean up four tributaries in Lake Sunapee watershed

1995 Two more educational brochures published, for a total of six
Door-to-door lakeshore public awareness and membership campaign

LSPA Watershed Protection Specialist was invited to participate in a State seminar on buffer zones hosted by NH DES

1997 LSPA Water Quality lab moves to Colby-Sawyer College
First "Celebrate Your Lakes" Day, held by LSPA and NH DES

1998 LSPA moves to Sunapee Harbor, with a visible and accessible office
LSPA celebrates its centennial
- Weekend-long Celebrate Your Watershed program
- Celebrate Your Lakes Day – huge and successful
- LSPA honored by Gov. Jeanne Shaheen, NH DES

LSPA receives $65,000 DES/EPA grant for watershed protection

1999 Centennial Fund (endowment) established
Marine Patrol Lake Watch program initiated to patrol and observe boater activity
Invasive species – milfoil and rock bass – become a larger concern
LSPA received a Non-point Source pollution grant for Beck Brook Runoff Reduction

## New Century

2000 LSPA launches Milfoil Prevention campaign
Weekend Launch Monitors hired to educate boaters and inspect boats
Weed Watch volunteers cover whole shoreline
NH DES conducted a plant survey in shallow waters (up to 20') of Lake Sunapee
Watershed Discovery Days (2) for Kearsarge Reg. Sch. Dist. children grades 1-5
LSPA received a grant for a new deionized, reverse osmosis water purification system in the lab at Colby Sawyer

2001 Invasive milfoil discovered in July in Georges Mills
Board retreat looks at future direction and leadership of LSPA
Sunapee Area Milfoil Attack Team formed (SAMAT)

2002 LSPA awarded another non-point source pollution grant to reduce road runoff into the lake
First watershed mailing; watershed map
LSYC auction raises $52,000 for LSPA
Kathleen Stowell prepares "Watershed Wonders" curriculum for KRSD 4th grade
First macroinvertebrate assessment (Blodgett Brook)

2003 Red Water Creek Alliance, with Ausbon Sargent Land Pres. Trust and others, protect 140 acre Red Water Creek wetland

Build-out analyzes completed by graduate students from Antioch of three areas within Sunapee watershed
Herrick Cove lighthouse helicopter-lifted for repair

2004 Colby-Sawyer Community and Environmental Studies program does Lake Inventory for LSPA
Lab moves to its own space in Ivey Science Center at Colby-Sawyer College

2005 Creation of the Sunapee Area Watershed Coalition (SAWC)
LSPA received a grant (Moose plate program) to a fund water quality protection effort
LSPA mission & vision statements updated
LSPA hosted NH's "Make a Splash" festival

2006 NH DES grant to support work of Sunapee Area Watershed Coalition
The newly created Scientific Advisory Committee (SAC) held its first meeting
Color logo was developed with trees to signify the importance of the Lake Sunapee watershed
LSPA received grant from the Wellborn Ecology Fund to explore environmental education content in K-8 curricula

2007 GLEON (Global Lake Ecological Observatory Network) buoy is designed by the Dartmouth student engineers with LSPA volunteers
LSPA teaches AIL course on Watersheds
LSPA purchases The Knowlton House in Sunapee Harbor
LSPA's website is upgraded.
The Navigation chart is updated.
GLEON buoy is launched

2008 LSPA receives two more important education grants (NH Charitable Foundation Wellborn Ecology Fund, NSF grant)
Cores of lake bottom sediment collected through the ice
SAWC Watershed Plan complete
Bathymetry done of Lake Sunapee
LSPA receives GIS grant
Invasive Milfoil confirmed in Sunapee Harbor
LSPA leads workshop on Stormwater Management
LSPA an official Field Station, moves into its new location at the Knowlton House
2008 Watershed Management Plan completed

2009 LSPA seeks legal advice on Wild Goose proposed boat launch site.
Web Design for Buoy Data began
LSPA holds Hearing before the DES Wetlands Board on Wild Goose

2010 LSPA is a partner in the NOAA Watershed Infrastructure Task Grant
LSPA continues appeals on WG Boat Launch state permits
SAC members conducted research on Lake Sunapee's tributaries, with flow meters and spring sampling
"Follow the Water" demonstration garden is installed
LSPA's G. Lizotte continues GIS analysis of the Sunapee Watershed
Bates Student completed her study of sediment cores from the lake bottom and correlation with Gloeo emergence
LSPA's K. Stowell conducts "No Student Left Indoors" teacher 3-day institute, with teacher ecology training and curriculum planning
LSPA SAC scientists held meeting at LSPA to begin INBRE mercury study

2011 NOAA Infrastructure Project results shared with Lake Sunapee watershed towns
For the 7th year, B. Lewis and R. Wood conduct winter in-lake water sampling and testing.
LSPA's Loon Committee, with LPC, deployed a loon raft in Lake Sunapee
Chandler Brook erosion solutions investigated by LSPA's Robert Wood
Citizen-scientists assist the Gloeo team in research
LSPA's K. Stowell brought Insects and Water Quality Classrooms Programs to local elementary schools
LSPA hosted the GLEON 13 Conference, an international group of limnologists, in which LSPA is a member
LSPA's school programs are extended, as are programs held at LSPA
Science displays are extended at LSPA including installation of a Wentz Microscope for public viewing of zooplankton
Lake Sunapee Aquatic plant and mussel survey completed
LSPA's WQ Lab continues to test samples for over 25 lakes, performing over 3200 tests

2012 LSPA acquires the adjacent lot to its Learning Center, to be used as an Outdoor Classroom
More exhibits installed
Major research in and around Lake Sunapee, including Gloeo, mercury in insects and fish and tributary flow and chemistry
Education Intern hired in addition to 2 Lab interns

2013 "Clean, Drain & Dry" campaign started on Lake Sunapee
LSPA creates new committees (Governance, Watershed)
Second loon raft floated on Lake Sunapee
LSPA joins four groups in the Stoney Brook Project to protect and conserve 145 acres off Chalk Pond Road which feeds into the lake

2014 First pair of nesting loons on the lake (in over 50 years)
Results of mercury study presented at Annual Meeting

An AIS rapid response plan was created to provide guidance if an invasive species is discovered in Lake Sunapee

2015 Solar panels were installed at LSPA
Ground Penetrating Radar (GPR) technology was used for the first time in Lake Sunapee to explore the lake bottom & sediments
New website launched (built on Squarespace platform)
Two loon chicks hatched on Lake Sunapee for the first time in at least 40 years

2016 LSPA received NH Fish & Game's Watershed Award for the "Trout in the Classroom" programs
GPR research continues
Lake Sunapee & LSPA chosen for National Science Foundation CNH Lake Project
Sediment samples collected from 8 locations to test for nutrients & metals

2017 Spectrophotometer acquired for LSPA's water quality lab
LSPA Strategic Plan updated
Stormwater Runoff Sediment Basin Project completed
LSPA received a grant from the Byrne Foundation to expand educational outreach programs
LSPA hosted a 4-dayWatershed Ecology Institute in partnership with NH Fish & Game, The Fells, USDA Forest Service and UNH Cooperative Extension
Received 319 Clean Water Act grant funding to update 2008 Watershed Management Plan

2018 LSPA joins the US Lighthouse Society
Midge Eliassen Fellowship established to support scientific research on Lake Sunapee
LSPA purchased a chloride meter for the water quality lab

2019 LSPA hosted a Cyano Summit to discuss cyanobacteria in NH and beyond
Third loon raft was floated on Lake Sunapee
LSPA hosted AIL class titled "Land & Water—The Connection"
LSPA launched its "Opening a New Door" capital campaign
Third pair of loons initiated a nest on Lake Sunapee
Food web study was conducted on the lake
LSPA participates in a meeting of researchers studying the use of robotics to learn more about water quality in Lake Sunapee

## APPENDIX C: Land Cover Methodology and Classification Schema

Passive Remote Sensing

Land cover data derived from passive remote sensing technology provides a representation of land surface characteristics such as densities or types of developed areas, agricultural lands, and natural vegetation types. Sensors record a range of the electromagnetic spectrum usually between the infrared and ultraviolet wavelengths. Images are made up of cells or pixels where each cell is usually assigned the predominating value ignoring other possible characteristics or recorded values. The size of each cell or pixel is based on the spatial resolution of the sensors used in a satellite or other platform used to record images. Spatial resolution is determined by the need or mission of a project when designing a remote sensing system and/or current limitations of sensor technology.

For this plan, a USGS Landsat 8 cloud free image, taken in May 2018, was used to classify land cover which has a spatial resolution of 30 meters (see Subwatershed Land Cover Table in this Appendix). Using the supervised classification method in ArcGIS Pro software (ESRI GIS product), training samples were created to better define the land cover classes using the most recent base map imagery within a 3000-foot buffer area of the Lake Sunapee watershed. Selection of training sample sites was based on local knowledge of surface features known by LSPA staff.

A Land cover classification schema file was created by LSPA and is based on the Land Cover Mapping Standards created by NH GRANIT staff at the UNH Earth Systems Research Center (refer to Classification Schema Table in this Appendix). Thirteen primary land cover classes were used that LSPA felt best represent the dominant land features of the watershed.

Active Remote Sensing

Light Detection and Ranging (LiDAR) data is a type of remote sensing technology that emits light and then records how the light backscatters off a surface. It is one of three common active sensing technologies, the other two being RADAR and SONAR. LiDAR data is used mainly to produce detailed topographic models of land surfaces and objects.

LSPA used 2016 LiDAR data from NH GRANIT to create a digital elevation model used to define subwatershed basins and the perimeter and area of the 13 named waterbodies that lie within the watershed.

Tributaries

Using 2016 LiDAR data obtained from NHGRANIT, stream channels were defined from a flow accumulation raster and then converted to vector file. The stream/drainage network was created by selecting cells with greater than 150,000 upstream cells flowing into them. Edits were made to correct flow direction where it crossed beneath roads via bridges or through culverts.

Roads

Based on spatial resolution limitations, paved and unpaved road areas were removed before analyzing the satellite image to better define this land cover classification. Road area lengths and widths were derived from 2019 NH GRANIT data file and from additions made by LSPA where private driveways extended 200 or more feet.

Adjustments

Some subwatershed boundary areas were adjusted using LSPA knowledge of known or likely existing locations of stormwater conveyance structures (primarily road culverts) that altered flow direction from one basin to another. LSPA recognizes that due to the nature of topography in some areas and continually alteration of the terrain from land use activities, subwatersheds identified herein may not be entirely accurate.

Some perimeters of lakes and ponds were altered at the confluences of tributaries and drainage outlets by LSPA to create smoother transitions.

# 2018 Lake Sunapee Subwatershed Land Cover

| Schema Value[1] | Class Name[1] | Area measured in Hectares | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Baptist Pond | Bartlett Brook | Bell Cove Brook | Birch Grove | Blodgett Brook | Chalk Pond | Chandler Brook | Cunningham Brook | Dutchman Pond | Eagle Rock Brook | Hastings Creek | Herrick Cove | Herrick Cove | Jobs Creek | King Hill Brook | Little Lake Sunapee | Morgan Pond | Mountainview Lake | Muzzey Brook | Newbury Inlet Brook | Otter Pond Brook | Pike Brook | Red Water Creek | Rodgers Brook | Star Lake | LS Shoreland | LS Shoreland | LS Shoreland | LS Shoreland | TOTAL |
| 1120 | Residential Medium Density[2] | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 16.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5.0 | 0.0 | 1.8 | 6.5 | 30.5 |
| 1130 | Residential Low Density | 24.6 | 3.1 | 1.1 | 0.3 | 35.3 | 5.8 | 28.0 | 8.3 | 0.2 | 3.3 | 8.3 | 15.6 | 20.8 | 7.2 | 35.0 | 87.7 | 0.0 | 29.6 | 22.3 | 8.9 | 120.2 | 19.8 | 33.4 | 27.0 | 5.1 | 32.8 | 54.1 | 44.4 | 141.1 | 823.3 |
| 120 | Commercial | 1.2 | 0.3 | 0.4 | 0.1 | 1.0 | 0.0 | 7.0 | 0.3 | 0.0 | 0.4 | 0.2 | 1.0 | 2.0 | 0.0 | 0.5 | 4.1 | 0.0 | 2.3 | 0.9 | 2.3 | 14.6 | 0.3 | 1.2 | 1.8 | 0.0 | 2.5 | 1.8 | 5.9 | 9.7 | 61.5 |
| 144 | Paved Roads[3] | 15.1 | 1.6 | 1.0 | 0.4 | 6.9 | 0.9 | 8.1 | 2.1 | 0.0 | 1.9 | 3.3 | 9.9 | 14.4 | 1.9 | 6.5 | 27.2 | 0.0 | 6.9 | 4.4 | 3.7 | 46.3 | 3.7 | 8.0 | 7.2 | 1.5 | 5.9 | 7.2 | 13.7 | 21.0 | 230.7 |
| 1449 | Unpaved Roads[3] | 3.2 | 0.2 | 0.0 | 0.0 | 2.8 | 1.7 | 4.2 | 1.5 | 0.2 | 0.1 | 0.3 | 0.9 | 0.4 | 0.0 | 3.4 | 5.4 | 0.0 | 3.9 | 0.6 | 0.1 | 13.6 | 3.9 | 3.2 | 0.5 | 2.6 | 4.1 | 6.0 | 2.1 | 7.2 | 72.0 |
| 173 | Outdoor Recreation[4] | 0.0 | 0.0 | 0.0 | 0.0 | 29.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 9.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 6.7 | 0.0 | 4.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 49.6 |
| 178 | Maintained Open Areas | 5.5 | 0.6 | 0.5 | 0.1 | 6.6 | 2.2 | 30.2 | 5.5 | 0.0 | 0.0 | 1.2 | 4.9 | 4.3 | 1.2 | 11.7 | 8.3 | 0.3 | 1.6 | 2.7 | 0.8 | 14.7 | 4.2 | 4.3 | 3.1 | 8.4 | 4.8 | 2.7 | 8.2 | 9.3 | 147.9 |
| 211 | Row Crops | 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 | 6.1 | 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 | 6.1 |
| 212 | Hay/Pasture | 25.7 | 2.0 | 1.3 | 0.9 | 51.6 | 4.2 | 39.0 | 7.8 | 0.2 | 2.1 | 6.6 | 14.5 | 17.0 | 12.9 | 52.6 | 63.7 | 0.1 | 23.2 | 25.6 | 6.0 | 79.2 | 33.5 | 34.2 | 28.5 | 5.5 | 21.4 | 27.6 | 21.6 | 115.7 | 724.0 |
| | Pasture with Animals[5] | 24.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.0 | 2.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 13.0 | 0.0 | 0.0 | 0.3 | 14.3 | 0.0 | 0.0 | 0.0 | 0.2 | 55.7 |
| 400 | Forest | 269.3 | 143.0 | 133.3 | 26.9 | 283.0 | 82.5 | 469.8 | 53.3 | 23.8 | 10.1 | 7.8 | 30.1 | 37.2 | 41.5 | 142.9 | 556.8 | 149.3 | 226.1 | 95.4 | 114.7 | 467.6 | 158.8 | 157.1 | 17.8 | 203.6 | 166.2 | 63.4 | 263.4 | 65.5 | 4460.3 |
| 450 | Disturbed Forest | 194.3 | 11.2 | 6.3 | 0.5 | 102.9 | 11.6 | 139.6 | 20.8 | 5.3 | 6.4 | 13.9 | 39.2 | 66.7 | 56.8 | 220.5 | 318.2 | 40.0 | 57.4 | 82.2 | 15.8 | 352.1 | 202.6 | 95.0 | 37.8 | 127.4 | 55.8 | 96.3 | 46.2 | 147.4 | 2569.9 |
| 500 | Water | 0.5 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.9 | 0.0 | 0.0 | 2.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.4 | 0.2 | 0.3 | 0.8 | 6.2 |
| 610 | Forested Wetland | 28.6 | 1.5 | 0.4 | 0.1 | 47.1 | 1.7 | 8.0 | 4.1 | 2.6 | 0.8 | 1.9 | 3.4 | 11.2 | 1.9 | 26.2 | 65.7 | 3.2 | 30.9 | 7.6 | 2.6 | 57.5 | 29.1 | 39.3 | 8.1 | 14.1 | 19.0 | 26.3 | 12.6 | 36.3 | 491.8 |
| 620 | Open Wetland | 32.0 | 0.0 | 0.0 | 0.0 | 4.4 | 0.8 | 2.1 | 0.7 | 0.7 | 0.3 | 0.1 | 0.3 | 4.2 | 2.0 | 4.1 | 13.7 | 1.3 | 6.8 | 0.4 | 1.5 | 25.0 | 1.9 | 9.3 | 2.9 | 2.6 | 9.2 | 12.6 | 4.8 | 18.9 | 162.5 |
| 700 | Barren | 6.1 | 0.0 | 0.0 | 0.0 | 0.8 | 0.2 | 5.9 | 0.3 | 0.0 | 0.7 | 0.0 | 1.1 | 1.2 | 0.0 | 0.5 | 2.0 | 0.0 | 0.5 | 4.6 | 1.4 | 33.9 | 1.1 | 2.4 | 0.6 | 0.7 | 0.9 | 0.3 | 1.0 | 2.6 | 68.8 |
| | Total Area: | 630.2 | 163.4 | 144.3 | 29.3 | 571.9 | 111.6 | 743.2 | 104.9 | 32.9 | 26.1 | 43.7 | 122.9 | 181.4 | 125.4 | 509.8 | 1,178.2 | 194.2 | 390.1 | 246.6 | 157.9 | 1,240.2 | 465.7 | 387.5 | 139.6 | 385.8 | 327.9 | 298.4 | 426.0 | 582.1 | 9,961.0 |

**Notes:**

[1] Classification Schema is based on the NH GRANIT system - see Classification Schema Table in Appendix C

[2]Area removed from low density residential area and was calculated via ArcGIS Pro (via measurement tool) per LSPA knowledge of land use at time of assessment.

[3] Road width and length sourced from NH GRANIT.

[4] This class was based on identifying golf course greens.

[5] Area for this class was removed from Hay/Pasture class and was calculated via ArcGIS Pro (via measurement tool) per LSPA knowledge of land use at time of assessment.

## Classification Schema[1] for the 2018 Land Cover Assessment

| Value | Class Name | Definition |
|---|---|---|
| 1120 | Residential - Apartment & townhouses[2] | Medium density residential |
| 1130 | Residential single family[2] | Low density residential |
| 120 | Commercial[2] | |
| 140 | Transportation | Major transportation routes. |
| 144 | Road Transportation[2] | Roads |
| 1449 | Unpaved Roads[2] | |
| 173 | Outdoor Recreation[2] | Golf courses |
| 178 | Maintained Open Areas[2] | Lawns, frequently mowed fields |
| 211 | Row Crops | |
| 212 | Hay/Pasture | |
| 221 | Orchards | Fruit orchards. |
| 400 | Forest[2] | Primarily forested areas (includes all listed 400 land cover types except 450) |
| 412 | Beech/Oak | Forested stands comprising less than 25% coniferous basal area per acre. Beech/oak stands are deciduous stands comprising at least 30% beech and oak. |
| 414 | Paper Birch/Aspen | Forested stands comprising less than 25% coniferous basal area per acre. Paper birch/aspen stands are deciduous stands comprising at least 20% paper birch and aspen. |
| 419 | Other Hardwood | Forested stands comprising less than 25% coniferous basal area per acre. Other deciduous stands are deciduous stands not meeting either the beech/oak or paper birch/aspen criteria. |
| 421 | White/Red Pine | Forested stands comprising greater than 65% coniferous basal area per acre. White/red pine stands are coniferous stands in which white and red pine constitute a plurality of the coniferous basal area. |
| 422 | Spruce/Fir | Forested stands comprising greater than 65% coniferous basal area per acre. Spruce/Fir pine stands are coniferous stands in which white and red pine constitute a plurality of the coniferous basal area. |
| 423 | Hemlock | Forested stands comprising greater than 65% coniferous basal area per acre. Hemlock stands are coniferous stands in which white and red pine constitute a plurality of the coniferous basal area. |
| 424 | Pitch Pine | Forested stands comprising greater than 65% coniferous basal area per acre. Pitch pine stands are coniferous stands in which white and red pine constitute a plurality of the coniferous basal area. |
| 430 | Mixed Forest | Mixed stands are forested stands comprising greater than 25% and less than 65% coniferous basal area per acre. |
| 440 | Alpine | Alpine areas contain stunted vegetation, either hardwood or softwood (usually paper birch or spruce/fir), and occur just below tree line in the White Mountains. |
| 450 | Disturbed Forest[2] | Recently timber harvested forest areas or where tree cover has been thinned. |
| 500 | Water | Lakes, ponds, some rivers or any other open water feature. |
| 610 | Forested Wetland | Areas dominated by wetland characteristics defined by the U. S. Fish and Wildlife Service National Wetlands Inventory. |
| 620 | Open Wetland | Areas dominated by wetland characteristics defined by the U. S. Fish and Wildlife Service National Wetlands Inventory. |
| 630 | Tidal Wetland | Areas dominated by wetland characteristics defined by the U. S. Fish and Wildlife Service National Wetlands Inventory. |
| 700 | Barren (LSPA added) | Barren land primarily void of vegetation (Includes all 700 listed land cover types) |
| 710 | Disturbed | Gravel pits, quarries or other areas where the earth and vegetation have been altered or exposed. |
| 720 | Bedrock/Veg. | Exposed bedrock or ledge (usually in the mountains) that may have some forms of stunted vegetation growing in cracks or lichens growing on the surface rock. |
| 730 | Sand Dunes | Areas along the seacoast that are dominated by sand. |
| 790 | Other Cleared | Clear cut forest, old agricultural fields that are reverting to forest, etc. |
| 800 | Tundra | Areas dominated by short vegetation that occurs above tree line in the White Mountains (only mapped on Mt Washington). |

**Notes:**

[1]Classification Schema is based on the NH Land Cover Mapping Standard created by GRANIT staff at the Earth Systems Research Center (standards last revised on 24-June-2017). Red font color denotes classes used for the land cover assessment in the 2020 Lake Sunapee Watershed Management Plan.

[2]Class added by Lake Sunapee Protective Association.

# APPENDIX D: Z-test Results for Lake Sunapee Water Quality Deepwater Stations

$$Z = \frac{(\bar{X}_1 - \bar{X}_2)}{\sqrt{\sigma_{X_1}^2 + \sigma_{X_2}^2}}$$

Where

$X_1$ is the mean value of sample one

$X_2$ is the mean value of sample two

$\sigma_{x1}$ is the standard deviation of sample one divided by the square root of the number of data points

$\sigma_{x2}$ is the standard deviation of sample two divided by the square root of the number of data points

$|z| < 2$ indicates that distributions are the same

**Lake Sunapee Calculations**

| | TP (mg/l) | | | | | | | Z comparison with | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Date range | Station | Mean | SD | N | √N | SD/√N | $(SD/\sqrt{N})^2$ | 200 | 210 | 220 | 230 |
| 2009-2018 | 200 | 0.005067 | 0.001232 | 45 | 6.708204 | 0.000184 | 3.37374E-08 | x | 1.200918 | 0.756743 | -0.1266 |
| 2009-2018 | 210 | 0.004778 | 0.001042 | 45 | 6.708204 | 0.000155 | 2.41302E-08 | | x | -0.32523 | -0.89214 |
| 2009-2018 | 220 | 0.00486 | 0.00132 | 43 | 6.557439 | 0.000201 | 4.0511E-08 | | | x | -0.63885 |
| 2009-2018 | 230 | 0.005116 | 0.00227 | 43 | 6.557439 | 0.000346 | 1.19833E-07 | | | | x |

| | Chlor a (µg/l) | | | | | | | Z comparison with | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Date range | Station | Mean | SD | N | √N | SD/√N | $(SD/\sqrt{N})^2$ | 200 | 210 | 220 | 230 |
| 2009-2018 | 200 | 1.548444 | 0.599071 | 45 | 6.708204 | 0.089304 | 0.007975248 | x | -0.80319 | -0.57505 | -1.06332 |
| 2009-2018 | 210 | 1.681778 | 0.938721 | 45 | 6.708204 | 0.139936 | 0.01958215 | | x | 0.379574 | -0.04262 |
| 2009-2018 | 220 | 1.619535 | 0.560561 | 43 | 6.557439 | 0.085485 | 0.007307636 | | | x | -0.53603 |
| 2009-2018 | 230 | 1.689048 | 0.631988 | 42 | 6.480741 | 0.097518 | 0.009509734 | | | | x |

| | Secchi Transparency (m) | | | | | | | Z comparison with | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Date range | Station | Mean | SD | N | √N | SD/√N | $(SD/\sqrt{N})^2$ | 200 | 210 | 220 | 230 |
| 2009-2018 | 200 | 8.5265 | 1.063645 | 40 | 6.324555 | 0.168177 | 0.0282835 | x | -0.29756 | -0.01576 | 1.042037 |
| 2009-2018 | 210 | 8.597375 | 1.066761 | 40 | 6.324555 | 0.16867 | 0.028449455 | | x | 0.30278 | 1.370761 |
| 2009-2018 | 220 | 8.53 | 0.894716 | 38 | 6.164414 | 0.145142 | 0.021066216 | | | x | 1.153162 |
| 2009-2018 | 230 | 8.303514 | 0.804871 | 37 | 6.082763 | 0.13232 | 0.017508591 | | | | x |

## Table E-1. 2019 Land Cover Analysis (By LSPA)

| Schema Value[1] | LAND USE | BASIN AREAS | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Baptist Pond | Bartlett Brook | Bell Cove Brook | Birch Grove Brook | Blodgett Brook | Chalk Pond | Chandler Brook | Cunningham Brook | Dutchman Pond | Eagle Rock Brook | Hastings Creek | Herrick Cove North Bk | Herrick Cove South Bk | Jobs Creek | King Hill Brook | Little Lake Sunapee | Morgan Pond | Mountainview Lake | Muzzey Brook | Newbury Inlet Brook | Otter Pond Brook | Pike Brook | Red Water Creek | Rodgers Brook | Star Lake | LS Shoreland East | LS Shoreland North | LS Shoreland South | LS Shoreland West | TOTAL |
| | Class Name[1] | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | |
| | | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) |
| 1120 | Residential Medium Density[2] | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.25 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 16.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 5.00 | 0.00 | 1.75 | 6.50 | 30.50 |
| 1130 | Residential Low Density | 24.59 | 3.05 | 1.11 | 0.26 | 35.28 | 7.08 | 28.02 | 8.29 | 0.25 | 3.25 | 8.32 | 15.64 | 20.82 | 7.23 | 34.97 | 87.67 | 0.00 | 29.63 | 22.33 | 8.91 | 120.22 | 19.76 | 33.44 | 26.99 | 5.13 | 32.79 | 54.14 | 44.39 | 141.10 | 824.66 |
| 120 | Commercial | 1.15 | 0.26 | 0.37 | 0.09 | 0.96 | 0.62 | 6.96 | 0.32 | 0.00 | 0.41 | 0.20 | 1.00 | 2.02 | 0.04 | 0.49 | 4.11 | 0.00 | 2.25 | 0.85 | 2.27 | 14.56 | 0.34 | 1.19 | 1.85 | 0.00 | 2.46 | 1.75 | 5.92 | 9.69 | 62.11 |
| 144 | Paved Roads[3] | 15.06 | 1.59 | 1.01 | 0.45 | 6.92 | 0.87 | 8.10 | 2.14 | 0.00 | 1.89 | 3.28 | 9.89 | 14.40 | 1.86 | 6.48 | 27.16 | 0.00 | 6.90 | 4.36 | 3.73 | 46.32 | 3.73 | 8.02 | 7.25 | 1.55 | 5.86 | 7.16 | 13.75 | 20.95 | 230.66 |
| 1449 | Unpaved Roads[3] | 3.22 | 0.21 | 0.00 | 0.00 | 2.79 | 1.71 | 4.24 | 1.51 | 0.16 | 0.12 | 0.25 | 0.87 | 0.40 | 0.00 | 3.40 | 5.35 | 0.00 | 3.92 | 0.57 | 0.11 | 13.56 | 3.95 | 3.22 | 0.48 | 2.58 | 4.05 | 5.98 | 2.13 | 7.23 | 72.03 |
| 173 | Outdoor Recreation[4] | 0.00 | 0.00 | 0.00 | 0.00 | 29.47 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 9.28 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 6.70 | 0.00 | 4.14 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 49.59 |
| 178 | Maintained Open Areas | 5.53 | 0.60 | 0.46 | 0.13 | 6.55 | 2.17 | 30.16 | 5.52 | 0.00 | 0.02 | 1.24 | 4.89 | 4.27 | 1.24 | 11.72 | 8.34 | 0.25 | 1.56 | 2.69 | 0.85 | 14.73 | 4.23 | 4.31 | 3.06 | 8.42 | 4.80 | 2.68 | 8.18 | 9.28 | 147.89 |
| 211 | Row Crops | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 6.10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 6.10 |
| 212 | Hay/Pasture | 25.67 | 1.96 | 1.30 | 0.90 | 51.63 | 8.41 | 39.01 | 7.83 | 0.18 | 2.14 | 6.63 | 14.46 | 16.98 | 12.85 | 52.60 | 63.73 | 0.09 | 23.22 | 25.58 | 6.00 | 79.15 | 33.47 | 34.18 | 28.50 | 5.50 | 21.42 | 27.59 | 21.60 | 115.65 | 728.25 |
| | Pasture with Animals[5] | 24.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2.00 | 2.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 13.00 | 0.00 | 0.00 | 0.25 | 14.25 | 0.00 | 0.00 | 0.00 | 0.20 | 55.70 |
| 400 | Forest | 269.33 | 143.01 | 133.35 | 26.85 | 282.98 | 76.39 | 469.85 | 53.32 | 23.77 | 10.13 | 7.83 | 30.11 | 37.20 | 41.50 | 142.87 | 556.76 | 149.29 | 226.14 | 95.40 | 114.74 | 467.56 | 158.84 | 157.12 | 17.79 | 203.64 | 166.19 | 63.44 | 263.39 | 65.52 | 4454.27 |
| 450 | Disturbed Forest | 194.33 | 11.20 | 6.34 | 0.53 | 102.87 | 11.57 | 139.63 | 20.76 | 5.27 | 6.41 | 13.95 | 39.18 | 66.68 | 56.76 | 220.45 | 318.16 | 40.01 | 57.38 | 82.19 | 15.78 | 352.10 | 202.62 | 95.02 | 37.79 | 127.38 | 55.79 | 96.28 | 46.16 | 147.36 | 2569.95 |
| 500 | Water | 0.55 | 0.00 | 0.00 | 0.00 | 0.19 | 0.04 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.16 | 0.00 | 0.92 | 0.00 | 0.00 | 2.61 | 0.00 | 0.00 | 0.00 | 0.00 | 0.36 | 0.24 | 0.34 | 0.84 | 6.24 |
| 610 | Forested Wetland | 28.64 | 1.52 | 0.39 | 0.08 | 47.06 | 1.67 | 8.01 | 4.15 | 2.63 | 0.76 | 1.89 | 3.43 | 11.21 | 1.89 | 26.21 | 65.74 | 3.21 | 30.88 | 7.55 | 2.59 | 57.53 | 29.09 | 39.32 | 8.07 | 14.10 | 19.05 | 26.26 | 12.55 | 36.33 | 491.78 |
| 620 | Open Wetland | 32.02 | 0.01 | 0.01 | 0.00 | 4.41 | 0.84 | 2.11 | 0.73 | 0.65 | 0.31 | 0.11 | 0.28 | 4.25 | 2.02 | 4.06 | 13.65 | 1.30 | 6.78 | 0.45 | 1.52 | 24.99 | 1.88 | 9.27 | 2.89 | 2.57 | 9.16 | 12.60 | 4.81 | 18.85 | 162.54 |
| 700 | Barren | 6.11 | 0.00 | 0.00 | 0.00 | 0.75 | 0.19 | 5.90 | 0.28 | 0.00 | 0.69 | 0.01 | 1.12 | 1.19 | 0.00 | 0.46 | 2.04 | 0.00 | 0.51 | 4.61 | 1.41 | 33.86 | 1.06 | 2.45 | 0.55 | 0.72 | 0.94 | 0.33 | 0.99 | 2.60 | 68.76 |
| | **TOTAL** | **630.20** | **163.43** | **144.34** | **29.28** | **571.86** | **111.55** | **743.24** | **104.85** | **32.93** | **26.13** | **43.69** | **122.86** | **181.42** | **125.39** | **509.80** | **1,178.17** | **194.15** | **390.08** | **246.59** | **157.90** | **1,240.17** | **465.65** | **387.54** | **139.62** | **385.84** | **327.85** | **298.44** | **425.96** | **582.10** | **9,961.04** |

2019 Land Cover Analysis performed by LSPA

May 2018 Landsat8 cloud free image used for analysis

[1] Classification Schema is based on NH GRANIT system - see tab

[2] Area removed from low density residential area and was calculated via ArcGIS Pro per LSPA knowledge

[3] Road width and length from NH GRANIT

[4] Golf course greens (if no greens known then area is added to Maintained Open Areas)

[5] Area removed from Hay/Pasture area and was calculated via ArcGIS Pro per LSPA knowledge

## Table E-2. 2019 Land Cover With Adjustments Representating 10-Year Buildout

| Schema Value[1] | LAND USE | BASIN AREAS | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Baptist Pond | Bartlett Brook | Bell Cove Brook | Birch Grove Brook | Blodgett Brook | Chalk Pond | Chandler Brook | Cunningham Brook | Dutchman Pond | Eagle Rock Brook | Hastings Creek | Herrick Cove North Bk | Herrick Cove South Bk | Jobs Creek | King Hill Brook | Little Lake Sunapee | Morgan Pond | Mountainview Lake | Muzzey Brook | Newbury Inlet Brook | Otter Pond Brook | Pike Brook | Red Water Creek | Rodgers Brook | Star Lake | LS Shoreland East | LS Shoreland North | LS Shoreland South | LS Shoreland West | TOTAL |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | |
| | Class Name[1] | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) |
| 1120 | Residential Medium Density[6] | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2.24 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 34.73 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 13.10 | 0.00 | 3.47 | 8.91 | 62.44 |
| 1130 | Residential Low Density | 76.85 | 4.68 | 2.06 | 0.30 | 93.68 | 14.95 | 48.85 | 23.23 | 3.67 | 6.45 | 13.80 | 26.63 | 39.40 | 28.65 | 129.46 | 166.64 | 9.63 | 77.57 | 56.99 | 18.98 | 252.26 | 107.72 | 79.46 | 34.76 | 38.13 | 76.25 | 86.34 | 85.69 | 188.81 | 1791.88 |
| 120 | Commercial | 1.10 | 0.26 | 0.37 | 0.09 | 0.86 | 0.61 | 6.95 | 0.30 | 0.00 | 0.38 | 0.18 | 1.65 | 2.00 | 0.03 | 0.45 | 3.92 | 0.00 | 2.14 | 0.87 | 2.26 | 14.05 | 0.33 | 1.12 | 1.81 | 0.00 | 2.43 | 1.57 | 5.54 | 9.41 | 60.66 |
| 144 | Paved Roads[7] | 15.06 | 1.59 | 1.01 | 0.45 | 6.92 | 0.87 | 8.10 | 2.14 | 0.00 | 1.89 | 3.28 | 9.89 | 14.40 | 1.86 | 6.48 | 27.16 | 0.00 | 6.90 | 4.36 | 3.73 | 46.32 | 3.73 | 8.02 | 7.25 | 1.55 | 5.86 | 7.16 | 13.75 | 20.95 | 230.66 |
| 1449 | Unpaved Roads[7] | 3.22 | 0.21 | 0.00 | 0.00 | 2.79 | 1.71 | 4.24 | 1.51 | 0.16 | 0.12 | 0.25 | 0.87 | 0.40 | 0.00 | 3.40 | 5.35 | 0.00 | 3.92 | 0.57 | 0.11 | 13.56 | 3.95 | 3.22 | 0.48 | 2.58 | 4.05 | 5.98 | 2.13 | 7.23 | 72.03 |
| 173 | Outdoor Recreation[4] | 0.31 | 0.00 | 0.00 | 0.00 | 26.44 | 0.03 | 1.11 | 0.00 | 0.00 | 0.00 | 0.00 | 0.12 | 0.04 | 0.01 | 0.55 | 7.98 | 0.00 | 0.06 | 0.20 | 0.17 | 0.76 | 5.39 | 0.24 | 3.98 | 0.08 | 0.14 | 0.17 | 0.06 | 0.83 | 48.66 |
| 178 | Maintained Open Areas | 4.39 | 0.55 | 0.40 | 0.10 | 5.98 | 1.76 | 28.14 | 4.04 | 0.00 | 0.02 | 1.02 | 3.92 | 3.77 | 0.95 | 9.37 | 7.45 | 0.25 | 1.41 | 2.12 | 0.68 | 12.12 | 3.49 | 3.38 | 2.74 | 6.73 | 3.93 | 2.15 | 6.80 | 7.32 | 124.95 |
| 211 | Row Crops | 0.88 | 0.03 | 0.07 | 0.02 | 0.99 | 0.15 | 1.18 | 0.28 | 0.08 | 0.01 | 0.05 | 0.43 | 0.90 | 0.09 | 5.01 | 3.17 | 0.05 | 0.56 | 0.34 | 0.37 | 3.29 | 0.22 | 0.55 | 0.14 | 0.60 | 1.41 | 1.10 | 1.13 | 2.05 | 25.14 |
| 212 | Hay/Pasture | 23.86 | 1.90 | 1.26 | 0.89 | 43.35 | 7.50 | 36.89 | 6.34 | 0.15 | 1.89 | 5.61 | 13.02 | 14.61 | 10.73 | 42.38 | 54.24 | 0.09 | 20.27 | 21.61 | 5.78 | 66.65 | 26.39 | 29.14 | 26.61 | 4.85 | 18.76 | 24.22 | 19.34 | 101.41 | 629.74 |
| | Pasture with Animals[5] | 22.31 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.80 | 1.72 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 10.95 | 0.00 | 0.00 | 0.23 | 12.57 | 0.00 | 0.00 | 0.00 | 0.18 | 49.75 |
| 400 | Forest | 238.60 | 142.02 | 132.53 | 26.84 | 250.94 | 71.03 | 455.20 | 46.13 | 21.09 | 8.12 | 6.08 | 26.37 | 30.48 | 33.38 | 109.12 | 506.81 | 141.57 | 190.76 | 81.10 | 105.84 | 400.81 | 125.20 | 130.96 | 16.27 | 181.61 | 128.68 | 50.85 | 230.39 | 53.54 | 3942.32 |
| 450 | Disturbed Forest | 177.94 | 10.73 | 6.29 | 0.52 | 89.97 | 10.28 | 134.82 | 16.63 | 4.72 | 5.65 | 11.46 | 33.64 | 58.37 | 46.38 | 176.57 | 283.82 | 38.07 | 49.93 | 67.94 | 14.55 | 309.57 | 162.65 | 83.19 | 34.12 | 120.54 | 45.56 | 82.56 | 40.14 | 126.06 | 2242.66 |
| 500 | Water | 0.55 | 0.00 | 0.00 | 0.00 | 0.13 | 0.04 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.16 | 0.00 | 0.92 | 0.00 | 0.00 | 2.61 | 0.00 | 0.00 | 0.00 | 0.00 | 0.36 | 0.24 | 0.34 | 0.83 | 6.17 |
| 610 | Forested Wetland | 27.37 | 1.44 | 0.36 | 0.08 | 45.04 | 1.63 | 7.57 | 3.48 | 2.40 | 0.67 | 1.85 | 3.13 | 9.90 | 2.12 | 23.24 | 61.73 | 3.20 | 28.56 | 6.33 | 2.51 | 53.19 | 24.29 | 37.05 | 7.82 | 13.39 | 17.35 | 23.39 | 11.46 | 33.66 | 454.20 |
| 620 | Open Wetland | 31.91 | 0.01 | 0.01 | 0.00 | 4.12 | 0.84 | 2.08 | 0.55 | 0.61 | 0.26 | 0.10 | 0.28 | 4.25 | 2.01 | 3.39 | 13.20 | 1.30 | 6.60 | 0.40 | 1.52 | 24.23 | 1.51 | 9.21 | 2.86 | 2.55 | 9.07 | 12.38 | 4.78 | 18.52 | 158.57 |
| 700 | Barren | 5.87 | 0.00 | 0.00 | 0.00 | 0.66 | 0.14 | 5.87 | 0.22 | 0.00 | 0.67 | 0.01 | 1.11 | 1.19 | 0.00 | 0.39 | 1.81 | 0.00 | 0.48 | 3.76 | 1.41 | 29.84 | 0.77 | 1.99 | 0.55 | 0.66 | 0.90 | 0.33 | 0.96 | 2.39 | 61.97 |
| | **TOTAL** | **630.20** | **163.43** | **144.34** | **29.28** | **571.86** | **111.55** | **743.24** | **104.85** | **32.89** | **26.13** | **43.69** | **122.85** | **181.42** | **126.21** | **509.82** | **1,178.17** | **194.15** | **390.07** | **246.59** | **157.90** | **1,240.18** | **465.65** | **387.55** | **139.62** | **385.84** | **327.86** | **298.44** | **425.96** | **582.10** | **9,961.81** |

Stone Env. 10 Year Buildout Estimates based on zoning type/regulations and potential developable land

May 2018 Landsat8 cloud free image used for analysis

[1] Classification Schema is based on NH GRANIT system - see tab

[2] Area removed from low density residential area and was calculated via ArcGIS Pro per LSPA knowledge

[3] Road width and length from NH GRANIT

[4] Golf course greens (if no greens known then area is added to Maintained Open Areas)

[5] Area removed from Hay/Pasture area and was calculated via ArcGIS Pro per LSPA knowledge

[6] Residential Medium Density Calculated from percentages based off of LC2018 data

[7] Paved and Unpaved Roads unchanged from LC2018 data. Need to determine a ratio of how many more paved/unpaved roads would be come with increased residential/commercial development

## Table E-3. 2019 Land Cover With Adjustments Representating Half Buildout

| Schema Value[1] | LAND USE | BASIN AREAS | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Baptist Pond | Bartlett Brook | Bell Cove Brook | Birch Grove Brook | Blodgett Brook | Chalk Pond | Chandler Brook | Cunningham Brook | Dutchman Pond | Eagle Rock Brook | Hastings Creek | Herrick Cove North Bk | Herrick Cove South Bk | Jobs Creek | King Hill Brook | Little Lake Sunapee | Morgan Pond | Mountainview Lake | Muzzey Brook | Newbury Inlet Brook | Otter Pond Brook | Pike Brook | Red Water Creek | Rodgers Brook | Star Lake | LS Shoreland East | LS Shoreland North | LS Shoreland South | LS Shoreland West | TOTAL |
| | Class Name[1] | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | |
| | | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) |
| 1120 | Residential Medium Density[6] | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2.86 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 46.41 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 18.15 | 0.00 | 4.54 | 10.41 | 82.35 |
| 1130 | Residential Low Density | 109.42 | 5.69 | 2.65 | 0.32 | 130.08 | 19.86 | 61.84 | 32.54 | 5.81 | 8.44 | 17.22 | 33.49 | 50.99 | 42.01 | 188.37 | 215.86 | 15.63 | 107.45 | 78.59 | 25.26 | 334.57 | 162.55 | 108.15 | 39.60 | 58.71 | 103.34 | 106.41 | 111.44 | 218.56 | 2394.83 |
| 120 | Commercial | 1.06 | 0.26 | 0.37 | 0.09 | 0.80 | 0.61 | 6.94 | 0.29 | 0.00 | 0.37 | 0.17 | 2.06 | 1.99 | 0.02 | 0.42 | 3.81 | 0.00 | 2.07 | 0.88 | 2.25 | 13.73 | 0.32 | 1.07 | 1.78 | 0.00 | 2.41 | 1.46 | 5.31 | 9.23 | 59.77 |
| 144 | Paved Roads[7] | 15.06 | 1.59 | 1.01 | 0.45 | 6.92 | 0.87 | 8.10 | 2.14 | 0.00 | 1.89 | 3.28 | 9.89 | 14.40 | 1.86 | 6.48 | 27.16 | 0.00 | 6.90 | 4.36 | 3.73 | 46.32 | 3.73 | 8.02 | 7.25 | 1.55 | 5.86 | 7.16 | 13.75 | 20.95 | 230.66 |
| 1449 | Unpaved Roads[7] | 3.22 | 0.21 | 0.00 | 0.00 | 2.79 | 1.71 | 4.24 | 1.51 | 0.16 | 0.12 | 0.25 | 0.87 | 0.40 | 0.00 | 3.40 | 5.35 | 0.00 | 3.92 | 0.57 | 0.11 | 13.56 | 3.95 | 3.22 | 0.48 | 2.58 | 4.05 | 5.98 | 2.13 | 7.23 | 72.03 |
| 173 | Outdoor Recreation[4] | 0.51 | 0.01 | 0.00 | 0.00 | 24.54 | 0.05 | 1.79 | 0.00 | 0.00 | 0.00 | 0.00 | 0.19 | 0.07 | 0.02 | 0.89 | 7.16 | 0.00 | 0.09 | 0.33 | 0.27 | 1.23 | 4.57 | 0.39 | 3.88 | 0.13 | 0.23 | 0.28 | 0.10 | 1.34 | 48.07 |
| 178 | Maintained Open Areas | 3.68 | 0.52 | 0.36 | 0.08 | 5.62 | 1.50 | 26.88 | 3.11 | 0.00 | 0.01 | 0.88 | 3.31 | 3.45 | 0.76 | 7.90 | 6.90 | 0.25 | 1.33 | 1.77 | 0.57 | 10.49 | 3.03 | 2.81 | 2.54 | 5.67 | 3.39 | 1.81 | 5.93 | 6.09 | 110.65 |
| 211 | Row Crops | 1.42 | 0.04 | 0.11 | 0.02 | 1.61 | 0.25 | 1.92 | 0.46 | 0.13 | 0.01 | 0.08 | 0.70 | 1.45 | 0.14 | 4.33 | 5.14 | 0.08 | 0.92 | 0.54 | 0.60 | 5.33 | 0.36 | 0.90 | 0.23 | 0.97 | 2.29 | 1.79 | 1.83 | 3.33 | 37.00 |
| 212 | Hay/Pasture | 22.73 | 1.85 | 1.23 | 0.88 | 38.18 | 6.94 | 35.57 | 5.41 | 0.13 | 1.74 | 4.98 | 12.12 | 13.13 | 9.40 | 36.01 | 48.32 | 0.09 | 18.43 | 19.14 | 5.65 | 58.86 | 21.98 | 26.00 | 25.44 | 4.45 | 17.10 | 22.11 | 17.93 | 92.53 | 568.33 |
| | Pasture with Animals[5] | 21.26 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.68 | 1.55 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 9.67 | 0.00 | 0.00 | 0.22 | 11.52 | 0.00 | 0.00 | 0.00 | 0.16 | 46.05 |
| 400 | Forest | 219.44 | 141.41 | 132.02 | 26.83 | 230.97 | 67.70 | 446.08 | 41.65 | 19.41 | 6.87 | 4.99 | 24.04 | 26.29 | 28.31 | 88.09 | 475.67 | 136.76 | 168.71 | 72.19 | 100.29 | 359.20 | 104.23 | 114.65 | 15.32 | 167.88 | 105.30 | 43.00 | 209.81 | 46.08 | 3623.18 |
| 450 | Disturbed Forest | 167.72 | 10.44 | 6.26 | 0.52 | 81.93 | 9.48 | 131.82 | 14.05 | 4.37 | 5.18 | 9.91 | 30.19 | 53.19 | 39.91 | 149.22 | 262.41 | 36.85 | 45.29 | 59.05 | 13.77 | 283.05 | 137.73 | 75.82 | 31.83 | 116.27 | 39.18 | 74.01 | 36.39 | 112.79 | 2038.64 |
| 500 | Water | 0.55 | 0.00 | 0.00 | 0.00 | 0.09 | 0.04 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.16 | 0.00 | 0.92 | 0.00 | 0.00 | 2.61 | 0.00 | 0.00 | 0.00 | 0.00 | 0.36 | 0.24 | 0.34 | 0.83 | 6.12 |
| 610 | Forested Wetland | 26.58 | 1.40 | 0.34 | 0.08 | 43.77 | 1.60 | 7.30 | 3.07 | 2.26 | 0.61 | 1.82 | 2.94 | 9.09 | 2.27 | 21.38 | 59.23 | 3.19 | 27.11 | 5.56 | 2.47 | 50.48 | 21.31 | 35.63 | 7.66 | 12.94 | 16.29 | 21.61 | 10.77 | 32.00 | 430.78 |
| 620 | Open Wetland | 31.84 | 0.01 | 0.01 | 0.00 | 3.94 | 0.84 | 2.07 | 0.44 | 0.59 | 0.22 | 0.09 | 0.28 | 4.24 | 2.01 | 2.97 | 12.92 | 1.30 | 6.48 | 0.36 | 1.52 | 23.76 | 1.29 | 9.17 | 2.84 | 2.54 | 9.02 | 12.25 | 4.76 | 18.32 | 156.09 |
| 700 | Barren | 5.72 | 0.00 | 0.00 | 0.00 | 0.60 | 0.11 | 5.86 | 0.18 | 0.00 | 0.66 | 0.01 | 1.10 | 1.19 | 0.00 | 0.36 | 1.66 | 0.00 | 0.46 | 3.22 | 1.41 | 27.33 | 0.59 | 1.71 | 0.55 | 0.62 | 0.88 | 0.33 | 0.93 | 2.26 | 57.74 |
| | **TOTAL** | **630.20** | **163.43** | **144.34** | **29.28** | **571.86** | **111.55** | **743.25** | **104.85** | **32.87** | **26.13** | **43.69** | **122.85** | **181.42** | **126.72** | **509.82** | **1,178.16** | **194.15** | **390.07** | **246.59** | **157.90** | **1,240.18** | **465.64** | **387.55** | **139.62** | **385.83** | **327.86** | **298.44** | **425.96** | **582.09** | **9,962.29** |

Stone Env. Half Buildout Estimates based on zoning type/regulations and potential developable land

May 2018 Landsat8 cloud free image used for analysis

[1] Classification Schema is based on NH GRANIT system - see tab

[2] Area removed from low density residential area and was calculated via ArcGIS Pro per LSPA knowledge

[3] Road width and length from NH GRANIT

[4] Golf course greens (if no greens known then area is added to Maintained Open Areas)

[5] Area removed from Hay/Pasture area and was calculated via ArcGIS Pro per LSPA knowledge

[6] Residential Medium Density Calculated from percentages based off of LC2018 data

[7] Paved and Unpaved Roads unchanged from LC2018 data. Need to determine a ratio of how many more paved/unpaved roads would be come with increased residential/commercial development

## Table E-4. 2019 Land Cover With Adjustments Representating Full Buildout

| Schema Value[1] | LAND USE | BASIN AREAS | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Baptist Pond 1 | Bartlett Brook 2 | Bell Cove Brook 3 | Birch Grove Brook 4 | Blodgett Brook 5 | Chalk Pond 6 | Chandler Brook 7 | Cunningham Brook 8 | Dutchman Pond 9 | Eagle Rock Brook 10 | Hastings Creek 11 | Herrick Cove North Bk 12 | Herrick Cove South Bk 13 | Jobs Creek 14 | King Hill Brook 15 | Little Lake Sunapee 16 | Morgan Pond 17 | Mountainview Lake 18 | Muzzey Brook 19 | Newbury Inlet Brook 20 | Otter Pond Brook 21 | Pike Brook 22 | Red Water Creek 23 | Rodgers Brook 24 | Star Lake 25 | LS Shoreland East 26 | LS Shoreland North 27 | LS Shoreland South 28 | LS Shoreland West 29 | TOTAL |
| | Class Name[1] | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) | Area (Ha) |
| 1120 | Residential Medium Density[6] | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 4.46 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 76.81 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 31.29 | 0.00 | 7.32 | 14.31 | 134.19 |
| 1130 | Residential Low Density | 194.25 | 8.32 | 4.18 | 0.39 | 224.89 | 32.64 | 95.65 | 56.80 | 11.36 | 13.62 | 26.12 | 51.33 | 81.16 | 76.79 | 341.77 | 344.05 | 31.26 | 185.28 | 134.86 | 41.62 | 548.92 | 305.35 | 182.86 | 52.20 | 112.28 | 173.88 | 158.67 | 178.48 | 296.01 | 3965.00 |
| 120 | Commercial | 0.97 | 0.26 | 0.37 | 0.09 | 0.64 | 0.60 | 6.91 | 0.25 | 0.00 | 0.33 | 0.14 | 3.12 | 1.96 | 0.01 | 0.36 | 3.51 | 0.00 | 1.89 | 0.91 | 2.23 | 12.90 | 0.30 | 0.96 | 1.72 | 0.00 | 2.37 | 1.16 | 4.70 | 8.77 | 57.43 |
| 144 | Paved Roads[7] | 15.06 | 1.59 | 1.01 | 0.45 | 6.92 | 0.87 | 8.10 | 2.14 | 0.00 | 1.89 | 3.28 | 9.89 | 14.40 | 1.86 | 6.48 | 27.16 | 0.00 | 6.90 | 4.36 | 3.73 | 46.32 | 3.73 | 8.02 | 7.25 | 1.55 | 5.86 | 7.16 | 13.75 | 20.95 | 230.66 |
| 1449 | Unpaved Roads[7] | 3.22 | 0.21 | 0.00 | 0.00 | 2.79 | 1.71 | 4.24 | 1.51 | 0.16 | 0.12 | 0.25 | 0.87 | 0.40 | 0.00 | 3.40 | 5.35 | 0.00 | 3.92 | 0.57 | 0.11 | 13.56 | 3.95 | 3.22 | 0.48 | 2.58 | 4.05 | 5.98 | 2.13 | 7.23 | 72.03 |
| 173 | Outdoor Recreation[4] | 1.02 | 0.01 | 0.00 | 0.00 | 19.62 | 0.10 | 3.59 | 0.01 | 0.00 | 0.00 | 0.00 | 0.38 | 0.13 | 0.04 | 1.78 | 5.05 | 0.00 | 0.19 | 0.66 | 0.54 | 2.46 | 2.43 | 0.78 | 3.62 | 0.26 | 0.45 | 0.56 | 0.20 | 2.69 | 46.56 |
| 178 | Maintained Open Areas | 1.82 | 0.43 | 0.25 | 0.04 | 4.70 | 0.83 | 23.60 | 0.70 | 0.00 | 0.01 | 0.53 | 1.72 | 2.63 | 0.28 | 4.09 | 5.46 | 0.25 | 1.10 | 0.86 | 0.30 | 6.24 | 1.84 | 1.30 | 2.01 | 2.92 | 1.97 | 0.95 | 3.68 | 2.91 | 73.40 |
| 211 | Row Crops | 2.85 | 0.08 | 0.21 | 0.05 | 3.22 | 0.50 | 3.84 | 0.91 | 0.25 | 0.03 | 0.15 | 1.40 | 2.91 | 0.29 | 2.55 | 10.29 | 0.17 | 1.83 | 1.09 | 1.21 | 10.67 | 0.73 | 1.80 | 0.46 | 1.95 | 4.58 | 3.58 | 3.66 | 6.66 | 67.91 |
| 212 | Hay/Pasture | 19.80 | 1.74 | 1.16 | 0.86 | 24.74 | 5.47 | 32.13 | 2.98 | 0.07 | 1.34 | 3.34 | 9.78 | 9.27 | 5.95 | 19.42 | 32.91 | 0.08 | 13.65 | 12.69 | 5.29 | 38.57 | 10.49 | 17.82 | 22.38 | 3.39 | 12.79 | 16.64 | 14.26 | 69.41 | 408.42 |
| | Pasture with Animals[5] | 18.52 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.35 | 1.09 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 6.33 | 0.00 | 0.00 | 0.20 | 8.78 | 0.00 | 0.00 | 0.00 | 0.12 | 36.40 |
| 400 | Forest | 169.56 | 139.80 | 130.69 | 26.82 | 178.96 | 59.01 | 422.31 | 29.97 | 15.06 | 3.62 | 2.15 | 17.96 | 15.37 | 15.13 | 33.31 | 394.59 | 124.22 | 111.28 | 48.98 | 85.84 | 250.83 | 49.61 | 72.19 | 12.85 | 132.12 | 44.42 | 22.57 | 156.23 | 26.64 | 2792.09 |
| 450 | Disturbed Forest | 141.11 | 9.68 | 6.18 | 0.51 | 60.99 | 7.38 | 124.01 | 7.34 | 3.47 | 3.96 | 5.88 | 21.21 | 39.70 | 23.06 | 77.99 | 206.65 | 33.70 | 33.19 | 35.91 | 11.76 | 214.01 | 72.84 | 56.62 | 25.87 | 105.16 | 22.58 | 51.73 | 26.63 | 78.21 | 1507.34 |
| 500 | Water | 0.55 | 0.00 | 0.00 | 0.00 | 0.00 | 0.04 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.15 | 0.00 | 0.92 | 0.00 | 0.00 | 2.61 | 0.00 | 0.00 | 0.00 | 0.00 | 0.36 | 0.23 | 0.33 | 0.81 | 6.00 |
| 610 | Forested Wetland | 24.52 | 1.28 | 0.28 | 0.08 | 40.48 | 1.54 | 6.59 | 2.00 | 1.90 | 0.47 | 1.75 | 2.46 | 6.96 | 2.65 | 16.55 | 52.73 | 3.17 | 23.33 | 3.58 | 2.35 | 43.43 | 13.53 | 31.93 | 7.25 | 11.78 | 13.54 | 16.96 | 8.99 | 27.67 | 369.77 |
| 620 | Open Wetland | 31.66 | 0.01 | 0.01 | 0.00 | 3.48 | 0.84 | 2.02 | 0.15 | 0.52 | 0.13 | 0.08 | 0.28 | 4.24 | 1.99 | 1.89 | 12.19 | 1.30 | 6.18 | 0.28 | 1.52 | 22.53 | 0.70 | 9.07 | 2.79 | 2.51 | 8.88 | 11.90 | 4.70 | 17.78 | 149.64 |
| 700 | Barren | 5.32 | 0.00 | 0.00 | 0.00 | 0.44 | 0.03 | 5.81 | 0.09 | 0.00 | 0.63 | 0.01 | 1.09 | 1.19 | 0.00 | 0.25 | 1.28 | 0.00 | 0.41 | 1.83 | 1.41 | 20.80 | 0.13 | 0.97 | 0.55 | 0.53 | 0.83 | 0.33 | 0.88 | 1.92 | 46.73 |
| | **TOTAL** | **630.21** | **163.43** | **144.34** | **29.28** | **571.87** | **111.54** | **743.25** | **104.85** | **32.81** | **26.13** | **43.68** | **122.84** | **181.42** | **128.04** | **509.84** | **1,178.16** | **194.15** | **390.06** | **246.59** | **157.90** | **1,240.18** | **465.63** | **387.55** | **139.62** | **385.83** | **327.86** | **298.44** | **425.96** | **582.09** | **9,963.55** |

Stone Env. Full Buildout Estimates based on zoning type/regulations and potential developable land

May 2018 Landsat8 cloud free image used for analysis

[1] Classification Schema is based on NH GRANIT system - see tab

[2] Area removed from low density residential area and was calculated via ArcGIS Pro per LSPA knowledge

[3] Road width and length from NH GRANIT

[4] Golf course greens (if no greens known then area is added to Maintained Open Areas)

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[6] Residential Medium Density Calculated from percentages based off of LC2018 data

[7] Paved and Unpaved Roads unchanged from LC2018 data. Need to determine a ratio of how many more paved/unpaved roads would be come with increased residential/commercial development

## APPENDIX F: Septic System Survey Methodology

Initial research was conducted during the winter/early spring of 2019 to determine how much information was already available regarding septic system ages around Lake Sunapee. After searching NHDES's Subsurface "OneStop" database we found that roughly 46% of the properties were missing data, possibly due to the house being built before 1986 or not being entered into the system electronically. Requests for archived data can be made but there is a two-week turnaround and a fee associated with this service. We decided it would be more cost-effective to move forward with the development and delivery of a septic system survey.

A septic system survey was sent to 498 properties within 250 feet of waterbodies in the Lake Sunapee Watershed that are not on town sewer. This survey was mailed the second week of September in hopes that it reached mailboxes in time for EPA's Annual SepticSmart week (September 16-20, 2019). Participants had the option to mail the completed survey back to LSPA or to fill it out online. As an extra incentive, we offered a raffle drawing for (1) $100 gift certificate to a local restaurant if participants included their name and address on the survey and completed it by October 1, 2019. A second incentive was provided in the form of a septic tank pumping discount from a local septic service company. Unfortunately, only a few people contacted Byron's Septic Service by the suggested deadline; however, they are honoring the discount through August 2020 so hopefully survey participants will still take advantage of this offer.

An email was sent on September 25 to LSPA's "General Interest" email list as a reminder to complete the survey (email addresses were not provided on original lists from the towns) This caused a little confusion as six responses came from people who were not within 250 feet of a waterbody (but still in the watershed), even though the email specified that requirement. These responses were not included in the septic system analysis. Otherwise the reminder email was helpful as 11 more responses came in from properties on the original mailing list.

A few additional completed surveys came in after October 1—they were not included in the raffle drawing but were included in the final results of the survey. A total of 70 surveys were mailed to LSPA and the rest were filled out online. Twenty-one percent (21%) returned them anonymously while 79% included their name and/or address (a few people only included town or mailing address but they were listed in our database).

On the paper survey form we neglected to include an "N/A" option for question #9 (see survey form) for systems less than 20 years old. If that question was left blank on the paper form, it was entered as "N/A" unless otherwise noted.

This was the first septic system survey that LSPA has sent out. Through this process we realized that future surveys should consider the following:

- Explain the difference between a pumping/tank inspection vs. having the whole system inspected (the lack of clarity may have caused some confusion with the original survey)
- Add a category for year-round residency (instead of just 6+ months)
- Change pumping frequency categories to: Less than 2 years; 3-5 years; 6-10 years

# September 2019 Septic System Survey

As you've probably heard, Lake Sunapee Protective Association (LSPA) is currently in the process of updating our **Watershed Management Plan (WMP) so that it satisfies all nine elements required by the EPA for a watershed-based plan**. The main goal of the new plan is to identify strategies to reduce current and future phosphorus loading into Lake Sunapee to avoid a decline in water quality. Based on computer modeling, it is estimated that nearly **10% of the phosphorus loading into Lake Sunapee comes from septic systems. (See illustration on reverse side for tips on being SepticSmart!)**

LSPA has been tasked with conducting a septic system survey (enclosed) to better understand the status of existing systems for all properties within 250 feet of waterbodies in the Lake Sunapee watershed that are not on town sewer. By participating in this survey, you will be eligible for group pumping discounts with a local septic service company. **Additionally, by providing your contact information you will be entered into a drawing for a (1) $100 gift certificate to The Refinery restaurant in Andover, NH.**


Did you know the EPA hosts an annual "SepticSmart" week in September (this year it's 9/16 - 9/20) to remind homeowners that septic systems can be a major source of pollutants into a waterway if they are not properly maintained? If a septic system malfunctions, due to improper care or age, untreated wastewater can seep into the ground and make its way to a nearby lake or pond, posing a threat to humans and animals. Additional nutrients will lead to an increase in unwanted plant and algae growth in a lake or pond which negatively affects water quality. Declines in water quality impacts recreational uses, local businesses and property values.

**<u>UPCOMING</u>: LSPA will be hosting a public meeting to update the general public about the WMP by the end of the year. The meeting time will be posted on our website (www.lakesunapee.org) and a summary of septic survey results will be included in the final plan (results are anonymous).**

**Questions? Contact us at 603-763-2210 or lspa@lakesunapee.org.**

LSPA
*Devoted to the Environmental Quality of the Lake Sunapee Watershed*

**Thank you for completing the enclosed survey!**

# Do Your Part. Be SepticSmart!


## Shield Your Field

Divert rain and surface water away and avoid parking vehicles and planting trees on your drainfield.

## Don't Overload the Commode

Don't flush diapers, wipes or other items meant for a trashcan down the toilet.

Toilet paper only

## Think at the Sink

Limit use of your garbage disposal and avoid pouring fats, grease, solids and harsh chemicals down the drain.

## Don't Strain Your Drain

Use water efficiently and stagger use of water-based appliances, such as your washing machine or dishwasher.

Drainfield

Septic Tank

Well

## Protect It and Inspect It

A typical septic system should be serviced every one to three years by a septic service professional.

## Pump Your Tank

Ensure your septic tank is pumped at regular intervals as recommended by a professional.

## Keep It Clean

If you are on a well, test your drinking water regularly to ensure it remains clean and free of contamination.

Groundwater Recharge

Aquifer

*2020 Lake Sunapee Watershed Management Plan*

EPA

830-F-180-03 | May 2018

# Mail survey back to LSPA or fill it out online at www.lakesunapee.org by October 1, 2019

1. What type of wastewater system is on your property (circle one)?
   **Septic (tank & leach field)  Cesspool (tank with holes)  Don't know**

2. How old is your wastewater system (circle one)?
   **1-10 years  10-20 years  >25 years  Not sure**

3. How many months is the property occupied per year, including rental use (circle one)?
   **<1 month  2-3 months  4-6 months  6+ month**

4. What's the average occupancy of this property (circle one)?
   **1-2 people  3-4 people  5-6 people  More than 6 people**

5. How often do you have your wastewater tank pumped & inspected (circle one)?
   **Every 1-2 years  Every 3-5 years  Every 6-10 years  Other_____**

6. Which of the following appliances do you use on a regular basis (circle all that apply)?
   **Washing Machine  Garbage Disposal  Dishwasher  Water Softener  Other_____**

7. Do you use phosphate free cleaning products in your house (i.e dishwashing liquid, surface cleaner)?
   **Yes  No**

8. Do you prevent trees/shrubs from growing on your leach field (to prevent premature aging of the system)?
   **Yes  No  N/A (no leach field)**

9. If your system is 20+ years or older, have you had it inspected within the last 5 years?
   **Yes  No**

10. How likely are you to have your system inspected after completing this survey (circle one)?
    **Definitely  Likely  Not Likely**

Name*: _____ Physical Address: _____

***Name/Address Optional - Anonymous surveys will not be entered into the drawing.**

**A wastewater tank pumping discount program ending November 1, 2019 is available through Byron's Septic. Email: cleanseptic@lakesunapee.org for more information.**

**If you are interested in getting your system inspected (ranges from $375-$450), visit http://www.lakesunapee.org/septic-systems (scroll to bottom) for a link to evaluators.**

## THANK YOU FOR PARTICIPATING IN THIS SURVEY!

**Mail survey to: LSPA, PO Box 683, Sunapee, NH 03782**

# APPENDIX G: Example of a Watershed Survey Datasheet Describing an Area of Concern

**Project: Lake Sunapee Protective Association** **Retrofit Summary Sheet**

ID#: 100

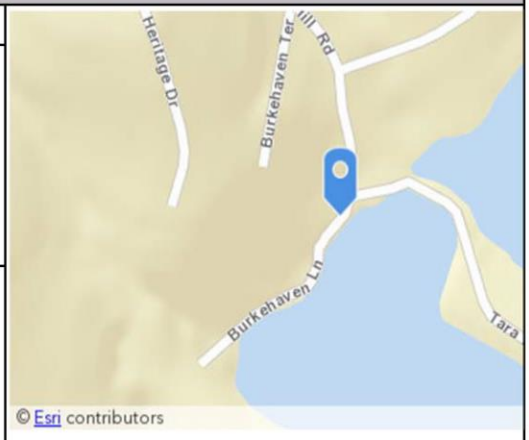
**Name:** Burkehaven Boat Works

**Concept Description:**

Significant stormwater runoff flows and sediment coming down hill from Burkehaven Hill Road, crossing street and draining at boat works. Additionally, flows off residential properties, accumulation of sediment on road and unmaintained infrastructure adjacent to boat works all considered to be a major source of sediment discharging to boat works boat slip area, as well as lake in general.

**Notes/Feasibility:**

Install check dams along ditch on Burkehaven Hill Road (Image 6). Potentially add 2 catch basins at bottom of road and send flow to existing culvert (Image 5). Upsize existing culvert that leads to swirler (Image 7). Maintain swirler and take advantage of swirler sump (approx. 4' deep, Image 3).




| GENERAL SITE INFORMATION | |
|---|---|
| **Site Contact Info:** | Town of Newbury |
| **Ownership:** | Public |
| **Land Use Type:** | Single Family Residential (<1 ac. lots), Commercial |
| **Land Use Detail:** | |
| **Existing BMP on Site?** | Yes |
| **Is site a hotspot?** | No |
| **Sources/pollutants:** | Sediment |
| **Soils:** | |
| **Use in Retrofit DA:** | Commercial Roof, Low-pitched Residential Roof |

| SIZING INFORMATION | |
|---|---|
| **Drainage Area (ac):** | |
| **Impervious Area (ac):** | |
| **Practice Area Available ($ft^2$):** | |
| **Existing Head Available?** | ~3-4' |

| RETROFIT DETAILS | |
|---|---|
| **Project Candidate:** | Yes |
| **New BMP / Retrofit Existing:** | New BMPs, Retrofit BMPs |
| **Proposed Retrofit Practice(s):** | Check dams, catch basins, upsize culvert, maintenance of existing BMP |
| **Non-Structural Controls:** | |
| **Non-Structural Other:** | |
| **Maintenance Burden:** | Moderate |

| Benefits: | | Conflicts: | |
|---|---|---|---|
| Storage: | No | Soils: | No |
| Water Quality: | Yes | Access: | No |
| Recharge: | No | Land Use: | No |
| Demonstration: | No | Utilities: | Unknown |
| Repair: | | Polluted: | |
| Reuse: | | High WT: | |
| | | Wetlands: | Yes |
| Other: | | Other: | |

**Assessed by:** gbolin_stone_env

**Date:** 05/30/2019 04:27 PM

Site ID: 100 Page **1** of **8**

# APPENDIX H: Stormwater Sites and Proposed BMPs, including prioritization methodology

BMP Priority Matrix Methodology

Through the field surveys, development of the Problem Area Datasheets (see Appendix G), and desktop evaluations to define and refine drainage areas and their respective characteristics, observations about each site were recorded, which were used to develop a draft "prioritization score" for each opportunity (refer to BMP Prioritization Table in this Appendix) relative to the following criteria:

- Existing environmental concerns – score was assigned based on the type(s) of problems present, with 1 point added for each of the following concerns presented by the site's current condition: water quality concerns; infrastructure vulnerability; localized drainage issues/flooding; stream bank or in-stream erosion, and directly connected impervious acreage greater than 0.25 acres. Although sites are generally anticipated to receive between 1 to 3 points, the maximum score a site can receive is 5.
- Environmental priority – relative environmental impact on nearest receiving water (i.e. lake, major tributary, minor tributary), and how active the problem area was during the site visit, with 1 representing the smallest impact and 5 representing the greatest impact.
- Constructability – relative ease with which a project could be implemented, including whether the recommended practice(s) could be constructed on publicly-owned land or with a willing landowner-partner, existing access to the site, and the amount of additional assessment and engineering design work that would be required to move the project to implementation. The maximum score a site can receive is 3, indicating a project that should move quickly and easily to implementation.
- Ease of operation – operational considerations, including amount and frequency of maintenance likely required, and whether maintenance activities will be straightforward to complete. The maximum score a site can receive is 3, indicating a project with infrequent maintenance needs that are easily completed.
- Phosphorus removal cost-benefit – qualitative evaluation of the cost per pound of phosphorus removed by each proposed BMP, where a score of 3 indicates a cost-benefit of <$10,000 / lb P removed, a score of 2 indicates a cost-benefit of $10,000-$100,000 / lb P removed, and a score of 1 indicates a cost-benefit of >$100,000 / lb P removed.
- Impervious treatment cost-benefit – evaluation of the cost per impervious acre treated by each proposed BMP, where a score of 3 indicates a cost-benefit of <$10,000 / impervious acre treated, a score of 2 indicates a cost-benefit of $10,000-$100,000 / impervious acre treated, and a score of 1 indicates a cost-benefit of >$100,000 / impervious acre treated.

The type of ownership of each project location, an initial indication of project cost, and the amount of additional engineering that will be needed for implementation are also presented in the matrix. These measures are not included currently in the score tabulated for each potential project, but are qualitatively scored as follows:

Estimated Implementation Cost “key”:

L less than $10,000
M $10,000-$50,000
MH $50,000-$150,000
H more than $150,000

Need for Additional Engineering “key”:

L Project can be implemented without formal engineering
M Project requires some amount of engineering design to ensure proper sizing
H Project requires full engineering

**Table H-1.** Drainage Area Assessment Summary and Cost-Benefit Screening



| Public (Town) /Private | Project ID | Site Name | Drainage Area Characteristics | | | | | Phosphorus Loading Estimates | | | Proposed BMPs, Implementation Costs, and Cost-Benefit | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Primary Soil HSG | Drainage Area (acres) | Impervious Area (acres) | Pervious Area (acres) | % Impervious | Estimated Total Base P Load (lbs/year) | Estimated Total P Load Post Treatment (lbs/year) | Estimated Total P Load Reduction (lbs/year) | Proposed BMP Type | BMP P Removal Efficiency (%) | BMP Construction Cost Estimate (2019 $) | BMP Design / Permitting Costs (2019 $) | Cost Adjustment Factor | Total Implementation Cost (2019 $) | Phophorus Removal Cost-Benefit ($/lb P removed) | Impervious Treatment Cost-Benefit ($/impervious acre managed) |
| New London | NL-01 | Bucklin Beach Swale | A | 0.31 | 0.21 | 0.10 | 69 | 1.08 | 0.38 | 0.70 | Bioretention | 65% | $2,000 | $500 | 1 | $2,500 | $3,500 | $11,700 |
| New London | NL-02 | Hastings Landing | C/D | 0.30 | 0.05 | 0.25 | 18 | 0.29 | 0.22 | 0.07 | Grass Swale | 25% | $14,000 | $3,500 | 1 | $17,500 | $243,000 | $320,500 |
| New London | NL-03 | Davis Hill Road Bank Stabilization | D | 38.44 | 1.80 | 36.64 | 5 | 11.01 | 11.01 | 0.64 | Bank Stabilization | N/A | $9,000 | $3,000 | 1 | $12,000 | $18,800 | $6,700 |
| Newbury | NW-01 | Chandler Brook Culvert | A/D | 2598.89 | 240.50 | 2358.39 | 9 | 1336.56 | 1336.56 | 2.50 | Culvert Replacement | N/A | $200,000 | $50,000 | 1 | $250,000 | $100,000 | $1,000 |
| Newbury | NW-02 | Newbury Police Department | A/D | 0.49 | 0.36 | 0.13 | 73 | 1.82 | 1.00 | 0.82 | Riparian buffer planting | 45% | $1,000 | $250 | 1 | $1,250 | $1,500 | $3,500 |
| Newbury | NW-03 | Pine Cliff Step Pool Conveyance | C/D | 4.41 | 0.71 | 3.70 | 16 | 3.77 | 1.13 | 2.64 | Regenerative Conveyance | 70% | $15,000 | $3,750 | 1 | $18,750 | $7,100 | $26,400 |
| Newbury | NW-04 | Highland Avenue | C/D | 0.03 | 0.01 | 0.02 | 33 | 0.06 | 0.04 | 0.02 | MSTD - Swirler | 30% | $15,000 | $3,750 | 1 | $18,750 | $1,073,800 | $1,657,000 |
| Newbury | NW-05 | Brats Cove Stormwater Improvements | C | 3.93 | 0.32 | 3.61 | 8 | 1.82 | 1.36 | 0.45 | Grass Swale | 25% | $4,000 | $1,000 | 1 | $5,000 | $11,000 | $15,500 |
| Newbury | NW-06 | Stream Canal at Lakewood Manor Road | B | 2.05 | 0.69 | 1.35 | 34 | 3.57 | 2.68 | 0.89 | Grass Swale | 25% | $2,000 | $500 | 1 | $2,500 | $2,800 | $3,600 |
| Newbury | NW-07 | Eroded Ditch Along Park 10 Road | B | 2.13 | 0.46 | 1.67 | 22 | 2.41 | 1.81 | 0.60 | Grass Swale | 25% | $4,000 | $1,000 | 1 | $5,000 | $8,300 | $10,800 |
| Newbury / Private | NW-08 | Mountain View Lake Drainage Channel | A | 1.29 | 0.56 | 0.73 | 43 | 2.87 | 1.15 | 1.72 | Infiltration Trench | 60% | $9,000 | $2,250 | 1 | $11,250 | $6,500 | $20,000 |
| NHDOT | DOT-01 | Rt. 11 BMP Improvements | B/D | 39.65 | 0.79 | 38.85 | 2 | 6.05 | 4.54 | 1.51 | Deep Sump Catch Basin | 25% | $5,000 | $1,250 | 2 | $12,500 | $8,300 | $15,800 |
| NHDOT | DOT-02 | Columbus Ave Swale Improvements | A/D | 33.92 | 5.26 | 28.67 | 15 | 28.00 | 21.00 | 7.00 | Grass Swale | 25% | $2,000 | $500 | 2 | $5,000 | $700 | $1,000 |
| NHDOT | DOT-03 | Route 114 Lakefront Vegetation | A | 43.59 | 1.01 | 42.58 | 2 | 7.35 | 4.04 | 3.31 | Riparian buffer planting | 45% | $1,000 | $250 | 2 | $2,500 | $800 | $2,500 |
| NHDOT | DOT-04 | Little Sunapee Lake Road Shoulder Improvements | B | 16.22 | 2.28 | 13.94 | 14 | 12.20 | 4.27 | 7.93 | Bioretention | 65% | $17,000 | $4,250 | 2 | $42,500 | $5,400 | $18,700 |
| NHDOT | DOT-05 | Poor Road and Lakeside Road Swale Improvements | C | 0.34 | 0.30 | 0.04 | 88 | 1.51 | 1.14 | 0.38 | Grass Swale | 25% | $12,000 | $3,000 | 2 | $30,000 | $79,300 | $100,000 |
| Private | PV-01 | Granliden Beach and Association | C/D | 0.52 | 0.09 | 0.43 | 17 | 0.46 | 0.34 | 0.11 | Grass Swale | 25% | $7,000 | $1,750 | 1.5 | $13,125 | $114,900 | $152,300 |
| Private | PV-02 | Lot 1 at Sunapee Mountain | C | 5.24 | 4.19 | 1.05 | 80 | 21.17 | 21.17 | 4.07 | Grass Swale & Bank Stabilization | N/A | $16,000 | $4,000 | 1.5 | $30,000 | $7,400 | $7,200 |
| Private | PV-03 | Mt. Sunapee Parking Garage | C | 14.54 | 0.62 | 13.91 | 4 | 3.89 | 2.14 | 1.75 | Riparian buffer planting | 45% | $1,000 | $250 | 1.5 | $1,875 | $1,100 | $3,000 |
| Private | PV-04 | Edgemont Swale | B | 0.37 | 0.22 | 0.14 | 61 | 1.12 | 0.84 | 0.28 | Grass Swale | 25% | $5,000 | $1,250 | 1.5 | $9,375 | $33,400 | $42,300 |
| Private | PV-05 | Bubba's Restaurant | A/D | 0.23 | 0.08 | 0.15 | 36 | 0.43 | 0.23 | 0.19 | Riparian buffer planting | 45% | $1,000 | $250 | 1.5 | $1,875 | $9,800 | $22,600 |
| Private | PV-06 | Hannaford | C | 2.14 | 1.83 | 0.31 | 85 | 9.24 | 5.08 | 4.16 | Wet pond/ Created Wetland | 45% | $24,000 | $6,000 | 1.5 | $45,000 | $10,800 | $24,600 |
| Private | PV-07 | Blodgetts Boat Launch | C | 0.28 | 0.09 | 0.19 | 31 | 0.45 | 0.40 | 0.04 | Stabilization | 10% | $3,000 | $750 | 1.5 | $5,625 | $125,000 | $64,400 |
| Private | PV-08 | Lakeside Landing Shoulder Vegetation | A/D | 13.12 | 0.92 | 12.20 | 7 | 5.26 | 2.89 | 2.37 | Riparian buffer planting | 45% | $1,000 | $250 | 1.5 | $1,875 | $800 | $2,000 |
| Springfield | SPR-01 | Stryker Road | B | 24.44 | 1.22 | 23.22 | 5 | 7.39 | 4.07 | 3.33 | Riparian buffer planting | 45% | $1,000 | $250 | 1 | $1,250 | $400 | $1,000 |
| Springfield | SPR-02 | Deer Hill Road | B | 571.00 | 45.70 | 525.30 | 8 | 258.07 | 258.07 | 3.50 | Bank Stabilization | N/A | $9,000 | $5,000 | 1 | $14,000 | $4,000 | $300 |
| Sunapee | SUN-01 | Garnet Street Stormwater Improvements | B | 0.57 | 0.41 | 0.15 | 73 | 2.09 | 1.57 | 0.52 | Deep Sump Catch Basin | 25% | $15,000 | $3,750 | 1 | $18,750 | $35,800 | $45,300 |
| Sunapee | SUN-02 | Sunapee Harbor Park | C | 15.77 | 2.59 | 13.18 | 16 | 13.76 | 10.32 | 3.44 | Grass Swale | 25% | $7,000 | $1,750 | 1 | $8,750 | $2,500 | $3,400 |
| Sunapee | SUN-03 | Paved Swale, Intersection of Lake Ave. & Burkehaven Hill Road | C | 14.50 | 2.05 | 12.46 | 14 | 10.97 | 8.23 | 2.74 | Grass Swale | 25% | $1,000 | $250 | 1 | $1,250 | $500 | $600 |
| Sunapee | SUN-04 | Dewey Beach Swale Improvements | D | 13.31 | 4.05 | 9.27 | 30 | 20.88 | 15.66 | 5.22 | Grass Swale | 25% | $4,000 | $1,000 | 1 | $5,000 | $1,000 | $1,200 |

**Table H-1.** Drainage Area Assessment Summary and Cost-Benefit Screening



| Public (Town) /Private | Project ID | Site Name | Drainage Area Characteristics | | | | | Phosphorus Loading Estimates | | | Proposed BMPs, Implementation Costs, and Cost-Benefit | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Primary Soil HSG | Drainage Area (acres) | Impervious Area (acres) | Pervious Area (acres) | % Impervious | Estimated Total Base P Load (lbs/year) | Estimated Total P Load Post Treatment (lbs/year) | Estimated Total P Load Reduction (lbs/year) | Proposed BMP Type | BMP P Removal Efficiency (%) | BMP Construction Cost Estimate (2019 $) | BMP Design / Permitting Costs (2019 $) | Cost Adjustment Factor | Total Implementation Cost (2019 $) | Phophorus Removal Cost-Benefit ($/lb P removed) | Impervious Treatment Cost-Benefit ($/impervious acre managed) |
| Sunapee | SUN-05 | Garnet Street Driveway Improvements | D | 0.14 | 0.03 | 0.11 | 21 | 0.15 | 0.12 | 0.04 | Grass Swale | 25% | $4,000 | $1,000 | 1 | $5,000 | $130,200 | $170,300 |
| Sunapee | SUN-06 | Roadside Erosion by Dewey Beach | D | 1.20 | 0.20 | 1.00 | 17 | 1.06 | 0.37 | 0.69 | Bioretention | 65% | $2,000 | $500 | 1 | $2,500 | $3,600 | $12,600 |
| Sunapee | SUN-07 | Jobs Creek Bridge | C/D | 0.11 | 0.04 | 0.07 | 36 | 0.21 | 0.16 | 0.05 | Grass Swale | 25% | $4,000 | $1,000 | 1 | $5,000 | $95,600 | $122,600 |
| Sunapee | SUN-08 | 51 and 53 Westwood Road | B | 0.58 | 0.20 | 0.38 | 34 | 1.02 | 1.02 | 0.00 | No New BMP Proposed | 0% | $0 | $0 | 1 | $0 | N/A | $0 |
| Sunapee | SUN-09 | Jobs Creek Road | A/D | 11.13 | 2.71 | 8.42 | 24 | 14.08 | 10.56 | 3.52 | Grass Swale | 25% | $2,000 | $500 | 1 | $2,500 | $700 | $900 |
| Sunapee | SUN-10 | Hamel Brook Inlet Improvements | A/D | 1.28 | 0.20 | 1.08 | 16 | 1.08 | 1.08 | 0.45 | Culvert Replacement | N/A | $45,000 | $11,250 | 1 | $56,250 | $125,000 | $276,600 |
| Sunapee | SUN-11 | New Providence Road Swale | A/D | 5.69 | 1.09 | 4.60 | 19 | 5.73 | 4.30 | 1.43 | Grass Swale | 25% | $5,000 | $1,250 | 1 | $6,250 | $4,400 | $5,700 |
| Sunapee | SUN-12 | Morningside Drive and Hamel Road | B | 0.37 | 0.17 | 0.20 | 47 | 0.88 | 0.31 | 0.57 | Bioretention | 65% | $2,000 | $500 | 1 | $2,500 | $4,400 | $14,400 |
| Sunapee | SUN-13 | Burkehaven Boat Works | B/D | 2.73 | 0.33 | 2.40 | 12 | 1.78 | 1.33 | 0.44 | Grass Swale | 25% | $11,000 | $2,750 | 1 | $13,750 | $30,900 | $42,000 |
| Sunapee | SUN-14 | Lake Avenue at Georges Mill | C/D | 27.06 | 4.06 | 23.00 | 15 | 21.67 | 16.25 | 5.42 | Deep Sump Catch Basin | 25% | $5,000 | $1,250 | 1 | $6,250 | $1,200 | $1,500 |
| Sunapee | SUN-15 | Garnet Hill Road and Norcross Road | B | 16.64 | 2.00 | 14.64 | 12 | 10.84 | 3.79 | 12.44 | Bioretention + 2 Deep Sump Catch Basins | 65% | $20,000 | $5,000 | 1 | $25,000 | $2,000 | $12,500 |
| Sunapee | SUN-16 | Lake Sunapee Yacht Club | C | 1.00 | 1.00 | 0.00 | 100 | 5.04 | 3.78 | 1.26 | Deep Sump Catch Basin | 25% | $5,000 | $1,250 | 1 | $6,250 | $5,000 | $6,300 |

**Notes**

Cells shaded in **blue** indicate that the P load reduction was calculated based on the volume of soil/sediment stabilized and an average soil P concentration.

**Table H-2**. Proposed BMP Sites



| Site ID | Public (Town) /Private | Project ID | Site Name | Drainage Area Characteristics | | | | | Phosphorus Loading Estimates | | | Proposed BMPs, Implementation Costs, and Cost-Benefit | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Primary Soil HSG | Drainage Area (acres) | Impervious Area (acres) | Pervious Area (acres) | % Impervious | Estimated Total Base P Load (lbs/year) | Estimated Total P Load Post Treatment (lbs/year) | Estimated Total P Load Reduction (lbs/year) | Proposed BMP Type | BMP P Removal Efficiency (%) | BMP Construction Cost Estimate (2019 $) | BMP Design / Permitting Costs (2019 $) | Cost Adjustment Factor | Total Implementation Cost (2019 $) | Phophorus Removal Cost-Benefit ($/lb P removed) | Impervious Treatment Cost-Benefit ($/impervious acre managed) |
| 28 | New London | NL-01 | Bucklin Beach Swale | A | 0.31 | 0.21 | 0.10 | 69 | 1.08 | 0.38 | 0.70 | Bioretention | 65% | $2,000 | $500 | 1 | $2,500 | $3,500 | $11,700 |
| 33 | New London | NL-02 | Hastings Landing | C/D | 0.30 | 0.05 | 0.25 | 18 | 0.29 | 0.22 | 0.07 | Grass Swale | 25% | $14,000 | $3,500 | 1 | $17,500 | $243,000 | $320,500 |
| 106 | New London | NL-03 | Davis Hill Road Bank Stabilization | D | 38.44 | 1.80 | 36.64 | 5 | 11.01 | 11.01 | 0.64 | Bank Stabilization | N/A | $9,000 | $3,000 | 1 | $12,000 | $18,800 | $6,700 |
| 14 | Newbury | NW-01 | Chandler Brook Culvert | A/D | 2598.89 | 240.50 | 2358.39 | 9 | 1336.56 | 1336.56 | 2.50 | Culvert Replacement | N/A | $200,000 | $50,000 | 1 | $250,000 | $100,000 | $1,000 |
| 23 | Newbury | NW-02 | Newbury Police Department | A/D | 0.49 | 0.36 | 0.13 | 73 | 1.82 | 1.00 | 0.82 | Riparian buffer planting | 45% | $1,000 | $250 | 1 | $1,250 | $1,500 | $3,500 |
| 34 | Newbury | NW-03 | Pine Cliff Step Pool Conveyance | C/D | 4.41 | 0.71 | 3.70 | 16 | 3.77 | 1.13 | 2.64 | Regenerative Conveyance | 70% | $15,000 | $3,750 | 1 | $18,750 | $7,100 | $26,400 |
| 35 | Newbury | NW-04 | Highland Avenue | C/D | 0.03 | 0.01 | 0.02 | 33 | 0.06 | 0.04 | 0.02 | MSTD - Swirler | 30% | $15,000 | $3,750 | 1 | $18,750 | $1,073,800 | $1,657,000 |
| 36 | Newbury | NW-05 | Brats Cove Stormwater Improvements | C | 3.93 | 0.32 | 3.61 | 8 | 1.82 | 1.36 | 0.45 | Grass Swale | 25% | $4,000 | $1,000 | 1 | $5,000 | $11,000 | $15,500 |
| 101 | Newbury | NW-06 | Stream Canal at Lakewood Manor Road | B | 2.05 | 0.69 | 1.35 | 34 | 3.57 | 2.68 | 0.89 | Grass Swale | 25% | $2,000 | $500 | 1 | $2,500 | $2,800 | $3,600 |
| 102 | Newbury | NW-07 | Eroded Ditch Along Park 10 Road | B | 2.13 | 0.46 | 1.67 | 22 | 2.41 | 1.81 | 0.60 | Grass Swale | 25% | $4,000 | $1,000 | 1 | $5,000 | $8,300 | $10,800 |
| 17 | Newbury / Private | NW-08 | Mountain View Lake Drainage Channel | A | 1.29 | 0.56 | 0.73 | 43 | 2.87 | 1.15 | 1.72 | Infiltration Trench | 60% | $9,000 | $2,250 | 1 | $11,250 | $6,500 | $20,000 |
| 105 | NHDOT | DOT-01 | Rt. 11 BMP Improvements | B/D | 39.65 | 0.79 | 38.85 | 2 | 6.05 | 4.54 | 1.51 | Deep Sump Catch Basin | 25% | $5,000 | $1,250 | 2 | $12,500 | $8,300 | $15,800 |
| 31 | NHDOT | DOT-02 | Columbus Ave Swale Improvements | A/D | 33.92 | 5.26 | 28.67 | 15 | 28.00 | 21.00 | 7.00 | Grass Swale | 25% | $2,000 | $500 | 2 | $5,000 | $700 | $1,000 |
| 27 | NHDOT | DOT-03 | Route 114 Lakefront Vegetation | A | 43.59 | 1.01 | 42.58 | 2 | 7.35 | 4.04 | 3.31 | Riparian buffer planting | 45% | $1,000 | $250 | 2 | $2,500 | $800 | $2,500 |
| 26 | NHDOT | DOT-04 | Little Sunapee Lake Road Shoulder Improvements | B | 16.22 | 2.28 | 13.94 | 14 | 12.20 | 4.27 | 7.93 | Bioretention | 65% | $17,000 | $4,250 | 2 | $42,500 | $5,400 | $18,700 |
| 32 | NHDOT | DOT-05 | Poor Road and Lakeside Road Swale Improvements | C | 0.34 | 0.30 | 0.04 | 88 | 1.51 | 1.14 | 0.38 | Grass Swale | 25% | $12,000 | $3,000 | 2 | $30,000 | $79,300 | $100,000 |
| 8 | Private | PV-01 | Granliden Beach and Association | C/D | 0.52 | 0.09 | 0.43 | 17 | 0.46 | 0.34 | 0.11 | Grass Swale | 25% | $7,000 | $1,750 | 1.5 | $13,125 | $114,900 | $152,300 |
| 15 | Private | PV-02 | Lot 1 at Sunapee Mountain | C | 5.24 | 4.19 | 1.05 | 80 | 21.17 | 21.17 | 4.07 | Grass Swale & Bank Stabilization | N/A | $16,000 | $4,000 | 1.5 | $30,000 | $7,400 | $7,200 |
| 16 | Private | PV-03 | Sunnapee Moutain Garage | C | 14.54 | 0.62 | 13.91 | 4 | 3.89 | 2.14 | 1.75 | Riparian buffer planting | 45% | $1,000 | $250 | 1.5 | $1,875 | $1,100 | $3,000 |
| 21 | Private | PV-04 | Edgemont Swale | B | 0.37 | 0.22 | 0.14 | 61 | 1.12 | 0.84 | 0.28 | Grass Swale | 25% | $5,000 | $1,250 | 1.5 | $9,375 | $33,400 | $42,300 |
| 22 | Private | PV-05 | Bubba's Restaurant | A/D | 0.23 | 0.08 | 0.15 | 36 | 0.43 | 0.23 | 0.19 | Riparian buffer planting | 45% | $1,000 | $250 | 1.5 | $1,875 | $9,800 | $22,600 |
| 29 | Private | PV-06 | Hannaford | C | 2.14 | 1.83 | 0.31 | 85 | 9.24 | 5.08 | 4.16 | Wet pond/ Created Wetland | 45% | $24,000 | $6,000 | 1.5 | $45,000 | $10,800 | $24,600 |
| 37 | Private | PV-07 | Blodgetts Boat Launch | C | 0.28 | 0.09 | 0.19 | 31 | 0.45 | 0.40 | 0.04 | Stabilization | 10% | $3,000 | $750 | 1.5 | $5,625 | $125,000 | $64,400 |
| 30 | Private | PV-08 | Lakeside Landing Shoulder Vegetation | A/D | 13.12 | 0.92 | 12.20 | 7 | 5.26 | 2.89 | 2.37 | Riparian buffer planting | 45% | $1,000 | $250 | 1.5 | $1,875 | $800 | $2,000 |
| 24 | Springfield | SPR-01 | Stryker Road | B | 24.44 | 1.22 | 23.22 | 5 | 7.39 | 4.07 | 3.33 | Riparian buffer planting | 45% | $1,000 | $250 | 1 | $1,250 | $400 | $1,000 |
| x | Springfield | SPR-02 | Deer Hill Road | B | 571.00 | 45.70 | 525.30 | 8 | 258.07 | 258.07 | 3.50 | Bank Stabilization | N/A | $9,000 | $5,000 | 1 | $14,000 | $4,000 | $300 |
| 1, 2, 3 | Sunapee | SUN-01 | Garnet Street Stormwater Improvements | B | 0.57 | 0.41 | 0.15 | 73 | 2.09 | 1.57 | 0.52 | Deep Sump Catch Basin | 25% | $15,000 | $3,750 | 1 | $18,750 | $35,800 | $45,300 |
| 5 | Sunapee | SUN-02 | Sunapee Harbor Park | C | 15.77 | 2.59 | 13.18 | 16 | 13.76 | 10.32 | 3.44 | Grass Swale | 25% | $7,000 | $1,750 | 1 | $8,750 | $2,500 | $3,400 |
| 6 | Sunapee | SUN-03 | Paved Swale, Intersection of Lake Ave. & Burkehaven Hill Road | C | 14.50 | 2.05 | 12.46 | 14 | 10.97 | 8.23 | 2.74 | Grass Swale | 25% | $1,000 | $250 | 1 | $1,250 | $500 | $600 |
| 7 | Sunapee | SUN-04 | Dewey Beach Swale Improvements | D | 13.31 | 4.05 | 9.27 | 30 | 20.88 | 15.66 | 5.22 | Grass Swale | 25% | $4,000 | $1,000 | 1 | $5,000 | $1,000 | $1,200 |
| 9 | Sunapee | SUN-05 | Garnet Street Driveway Improvements | D | 0.14 | 0.03 | 0.11 | 21 | 0.15 | 0.12 | 0.04 | Grass Swale | 25% | $4,000 | $1,000 | 1 | $5,000 | $130,200 | $170,300 |

**Table H-2**. Proposed BMP Sites

| Site ID | Public (Town) /Private | Project ID | Site Name | Drainage Area Characteristics | | | | | Phosphorus Loading Estimates | | | Proposed BMPs, Implementation Costs, and Cost-Benefit | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Primary Soil HSG | Drainage Area (acres) | Impervious Area (acres) | Pervious Area (acres) | % Impervious | Estimated Total Base P Load (lbs/year) | Estimated Total P Load Post Treatment (lbs/year) | Estimated Total P Load Reduction (lbs/year) | Proposed BMP Type | BMP P Removal Efficiency (%) | BMP Construction Cost Estimate (2019 $) | BMP Design / Permitting Costs (2019 $) | Cost Adjustment Factor | Total Implementation Cost (2019 $) | Phophorus Removal Cost-Benefit ($/lb P removed) | Impervious Treatment Cost-Benefit ($/impervious acre managed) |
| 10 | Sunapee | SUN-06 | Roadside Erosion by Dewey Beach | D | 1.20 | 0.20 | 1.00 | 17 | 1.06 | 0.37 | 0.69 | Bioretention | 65% | $2,000 | $500 | 1 | $2,500 | $3,600 | $12,600 |
| 11 | Sunapee | SUN-07 | Jobs Creek Bridge | C/D | 0.11 | 0.04 | 0.07 | 36 | 0.21 | 0.16 | 0.05 | Grass Swale | 25% | $4,000 | $1,000 | 1 | $5,000 | $95,600 | $122,600 |
| 12 | Sunapee | SUN-08 | 51 and 53 Westwood Road | B | 0.58 | 0.20 | 0.38 | 34 | 1.02 | 1.02 | 0.00 | No New BMP Proposed | 0% | $0 | $0 | 1 | $0 | N/A | $0 |
| 13 | Sunapee | SUN-09 | Jobs Creek Road | A/D | 11.13 | 2.71 | 8.42 | 24 | 14.08 | 10.56 | 3.52 | Grass Swale | 25% | $2,000 | $500 | 1 | $2,500 | $700 | $900 |
| 18 | Sunapee | SUN-10 | Hamel Brook Inlet Improvements | A/D | 1.28 | 0.20 | 1.08 | 16 | 1.08 | 1.08 | 0.45 | Culvert Replacement | N/A | $45,000 | $11,250 | 1 | $56,250 | $125,000 | $276,600 |
| 19 | Sunapee | SUN-11 | New Providence Road Swale | A/D | 5.69 | 1.09 | 4.60 | 19 | 5.73 | 4.30 | 1.43 | Grass Swale | 25% | $5,000 | $1,250 | 1 | $6,250 | $4,400 | $5,700 |
| 20 | Sunapee | SUN-12 | Morningside Drive and Hamel Road | B | 0.37 | 0.17 | 0.20 | 47 | 0.88 | 0.31 | 0.57 | Bioretention | 65% | $2,000 | $500 | 1 | $2,500 | $4,400 | $14,400 |
| 100 | Sunapee | SUN-13 | Burkehaven Boat Works | B/D | 2.73 | 0.33 | 2.40 | 12 | 1.78 | 1.33 | 0.44 | Grass Swale | 25% | $11,000 | $2,750 | 1 | $13,750 | $30,900 | $42,000 |
| 103 | Sunapee | SUN-14 | Lake Avenue at Georges Mill | C/D | 27.06 | 4.06 | 23.00 | 15 | 21.67 | 16.25 | 5.42 | Deep Sump Catch Basin | 25% | $5,000 | $1,250 | 1 | $6,250 | $1,200 | $1,500 |
| 104 | Sunapee | SUN-15 | Garnet Hill Road and Norcross Road | B | 16.64 | 2.00 | 14.64 | 12 | 10.84 | 3.79 | 12.44 | Bioretention + 2 Deep Sump Catch Basins | 65% | $20,000 | $5,000 | 1 | $25,000 | $2,000 | $12,500 |
| x | Sunapee | SUN-16 | Lake Sunapee Yacht Club | C | 1.00 | 1.00 | 0.00 | 100 | 5.04 | 3.78 | 1.26 | Deep Sump Catch Basin | 25% | $5,000 | $1,250 | 1 | $6,250 | $5,000 | $6,300 |

**Notes**

Cells shaded in **blue** indicate that the P load reduction was calculated based on the volume of soil/sediment stabilized and an average soil P concentration.

**Table H-3.** BMP Prioritization Table



| Project ID | Site Name | Primary Soil HSG | Existing Environmental Concerns (scale 1-5) | Environmental Priority (scale 1-5) | Constructability (scale 1-3) | Ease of Operation (scale 1-3) | P Removal Cost Effectiveness (Scale 1-3) | Imp. Treatment Cost Effectiveness (Scale 1-3) | Implementation Score | Public (Town) /Private | Estimated Implementation Cost | Need for Additional Engineering |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PV-03 | Sunapee Mountain Garage | C | 3 | 4 | 3 | 3 | 3 | 3 | 19 | Private | L | M |
| SPR-02 | Deer Hill Road | B | 4 | 4 | 2 | 3 | 3 | 3 | 19 | Springfield | M | M |
| NL-03 | Davis Hill Road Bank Stabilization | D | 4 | 3 | 3 | 3 | 2 | 3 | 18 | New London | M | H |
| NW-01 | Chandler Brook Culvert | A/D | 4 | 4 | 2 | 3 | 2 | 3 | 18 | Newbury | H | H |
| SPR-01 | Stryker Road | B | 4 | 3 | 2 | 3 | 3 | 3 | 18 | Springfield | L | L |
| SUN-09 | Jobs Creek Road | A/D | 4 | 3 | 3 | 2 | 3 | 3 | 18 | Sunapee | L | L |
| SUN-13 | Burkehaven Boat Works | B/D | 4 | 5 | 3 | 2 | 2 | 2 | 18 | Sunapee | M | M |
| NW-02 | Newbury Police Department | A/D | 2 | 3 | 3 | 3 | 3 | 3 | 17 | Newbury | L | L |
| DOT-02 | Columbus Ave Swale Improvements | A/D | 3 | 4 | 2 | 2 | 3 | 3 | 17 | NHDOT | L | M |
| PV-02 | Lot 1 at Sunapee Mountain | C | 3 | 4 | 2 | 2 | 3 | 3 | 17 | Private | M | H |
| PV-08 | Lakeside Landing Shoulder Vegetation | A/D | 2 | 4 | 2 | 3 | 3 | 3 | 17 | Private | L | L |
| SUN-02 | Sunapee Harbor Park | C | 3 | 3 | 3 | 2 | 3 | 3 | 17 | Sunapee | L | H |
| NL-01 | Bucklin Beach Swale | A | 2 | 3 | 3 | 3 | 3 | 2 | 16 | New London | L | M |
| DOT-03 | Route 114 Lakefront Vegetation | A | 2 | 3 | 2 | 3 | 3 | 3 | 16 | NHDOT | L | L |
| PV-06 | Hannaford | C | 4 | 4 | 2 | 2 | 2 | 2 | 16 | Private | M | H |
| SUN-03 | Paved Swale, Intersection of Lake Ave. & Burkehaven Hill Road | C | 2 | 3 | 3 | 2 | 3 | 3 | 16 | Sunapee | L | M |
| SUN-04 | Dewey Beach Swale Improvements | D | 2 | 3 | 3 | 2 | 3 | 3 | 16 | Sunapee | L | M |
| SUN-11 | New Providence Road Swale | A/D | 2 | 3 | 3 | 2 | 3 | 3 | 16 | Sunapee | L | M |
| SUN-14 | Lake Avenue at Georges Mill | C/D | 3 | 3 | 2 | 2 | 3 | 3 | 16 | Sunapee | L | H |
| SUN-15 | Garnet Hill Road and Norcross Road | B | 3 | 4 | 2 | 2 | 3 | 2 | 16 | Sunapee | M | H |
| SUN-16 | Lake Sunapee Yacht Club | C | 3 | 3 | 2 | 2 | 3 | 3 | 16 | Sunapee | L | H |
| NW-03 | Pine Cliff Step Pool Conveyance | C/D | 3 | 3 | 2 | 2 | 3 | 2 | 15 | Newbury | M | H |
| NW-05 | Brats Cove Stormwater Improvements | C | 3 | 3 | 3 | 2 | 2 | 2 | 15 | Newbury | L | M |
| NW-06 | Stream Canal at Lakewood Manor Road | B | 2 | 2 | 3 | 2 | 3 | 3 | 15 | Newbury | L | M |
| NW-07 | Eroded Ditch Along Park 10 Road | B | 3 | 3 | 2 | 2 | 3 | 2 | 15 | Newbury | L | M |
| SUN-06 | Roadside Erosion by Dewey Beach | D | 1 | 4 | 3 | 2 | 3 | 2 | 15 | Sunapee | L | M |
| SUN-07 | Jobs Creek Bridge | C/D | 3 | 4 | 3 | 2 | 2 | 1 | 15 | Sunapee | L | L |
| NW-08 | Mountain View Lake Drainage Channel | A | 2 | 2 | 3 | 2 | 3 | 2 | 14 | Newbury / Private | M | L |
| DOT-04 | Little Sunapee Lake Road Shoulder Improvements | B | 2 | 3 | 2 | 2 | 3 | 2 | 14 | NHDOT | M | M |
| PV-07 | Blodgett's Boat Launch | C | 1 | 4 | 3 | 3 | 1 | 2 | 14 | Private | L | M |
| NL-02 | Hastings Landing | C/D | 2 | 4 | 3 | 2 | 1 | 1 | 13 | New London | M | M |
| DOT-01 | Rt. 11 BMP Improvements | B/D | 2 | 3 | 1 | 2 | 3 | 2 | 13 | NHDOT | M | H |
| PV-05 | Bubba's Restaurant | A/D | 1 | 3 | 2 | 2 | 3 | 2 | 13 | Private | L | M |
| SUN-01 | Garnet Street Stormwater Improvements | B | 2 | 3 | 2 | 2 | 2 | 2 | 13 | Sunapee | M | H |
| SUN-12 | Morningside Drive and Hamel Road | B | 1 | 2 | 3 | 2 | 3 | 2 | 13 | Sunapee | L | M |
| DOT-05 | Poor Road and Lakeside Road Swale Improvements | C | 2 | 2 | 2 | 2 | 2 | 2 | 12 | NHDOT | M | M |
| PV-04 | Edgemont Swale | B | 2 | 3 | 1 | 2 | 2 | 2 | 12 | Private | L | M |
| SUN-10 | Hamel Brook Inlet Improvements | A/D | 2 | 4 | 2 | 2 | 1 | 1 | 12 | Sunapee | MH | M |
| PV-01 | Granliden Beach and Association | C/D | 2 | 3 | 2 | 2 | 1 | 1 | 11 | Private | M | M |
| NW-04 | Highland Avenue | C/D | 2 | 3 | 1 | 2 | 1 | 1 | 10 | Newbury | M | H |
| SUN-05 | Garnet Street Driveway Improvements | D | 1 | 3 | 2 | 2 | 1 | 1 | 10 | Sunapee | L | L |
| SUN-08 | 51 and 53 Westwood Road | B | N/A | N/A | N/A | N/A | N/A | N/A | N/A | Sunapee | L | N/A |

# APPENDIX I: Road Maintenance and Stormwater BMPs

## Road Maintenance

To minimize sediment and phosphorus transport from roadways into Lake Sunapee and its tributaries, stormwater control and treatment practices should be employed and routine maintenance of the roads and drainage systems should be performed.

A primary mechanism for the transport of phosphorus from paved roads is sheet flow washing of sediments. Sand that is applied in winter to paved roads is a major source of sediment load to down gradient streams and lakes. Best management practices for minimizing the sediment and phosphorus load from paved roads include:

- Minimize use of sand and salt during the winter;
- Remove sand from the streets prior to spring rain and ground thaw;
- Routine monitoring of and removal of sediments in stormwater catch basins.

Gravel roads are essentially impervious so precipitation quickly pools and flows to the edge of the road where it either infiltrates into surrounding soils or becomes channelized and flows along a roadside drainage ditch to the nearest surface water or topographic low point. The slope of the road and abutting land, the infiltration capacity and ground cover of the surrounding soil, and the intensity of the storm event are factors that determine the amount of sediment that is transported from gravel roads. Unfortunately these factors are generally established by the location and layout of the road. Through proper road maintenance and the incorporation of a system for treating the drainage, sediment loads associated with runoff from gravel roads can be managed.

As is the case for most potential pollution sources, control at the source is typically the easiest and most cost effective.

The following best management practices address gravel roads as the source of sediment loads through on-going maintenance:

- Evaluate and maintain the best cross-road pitch as is appropriate for the drainage conditions. It is important to pitch gravel roads to minimize runoff flow velocity and contact time, ponding, and erosion. A road center crown is appropriate when surrounding topography is flat enough to infiltrate sheet flow or roadside drainage ditches/swales exist that are adequate for the expected flow. Where possible, it is ideal to maintain a road grade and pitch that causes sheet flow to the area abutting the road where it can infiltrate in undisturbed soils. Pitching the road toward the upslope edge should be considered where downslope erosion is a concern. The ditch/swale along the upslope roadside must be adequately sized and reinforced to manage the concentrated channelized flow and the

discharge at the low topographic point must be capable of handling and treating the expected flow.

- Re-surface gravel roads as is needed to maintain the cross-road pitch, remove pot-holes, and maintain the road elevation as is needed for proper drainage. Crushed bank-run gravel or similar angular-grained material should be used for re-surfacing.
- When plowing, care must be taken to ensure the gravel is not disturbed.
- The edge of gravel roads must be graded such that water can freely flow to the abutting ditch/swale or ground surface. Improper grading along road shoulders can cause stormwater to channelize, erode abutting materials, and transport sediment from the road directly to a waterbody. Gravel that falls into drainage ditches and swales must be removed.
- Schedule maintenance to minimize potential erosion. Top coating should be performed after spring thaw and at a time when no or very little rain is predicted.
- Maintain vegetation in the ditch line to stabilize the ditch whenever it is feasible to do so. When mowing ditches, set mover at a minimum of 5 inches to avoid permanently damaging vegetation while maintaining the vegetative function of slowing water.
- Add rip-rap or similar material to unstable culverts that are either steep or cannot grow vegetation due to shading or soil conditions.

As runoff is channelized along roadside ditches, its potential to cause erosion and suspend sediment greatly increases. In order to minimize the sediment loads associated with drainage conveyance, it is important to understand the size and characteristics of the area draining to channel and properly engineer the channel and treatment practice for predicted storm volumes and peak rates. Refer to *Gravel Road Maintenance Manual, A Guide for Landowners on Camp and Other Gravel Roads*, MEDEP & Kennebec County Soil and Water Conservation District, April 2010, for information on proper gravel road construction and maintenance.

Routine inspections of the drainage along gravel roads are important for the identification of potential problems. Some problems with simple solutions such as a clogged culvert can cause major damage to a gravel road.

### Culvert Cleaning/Maintenance

There has been historic overtopping of roads throughout the watershed as a result of clogged or undersized culverts. Culvert blockage can cause water to pond on the upstream side of roads and potentially overtop the road during high flow events. The sediment and TP load from this type of event can be considerable, as well as its long-term impact to the stream morphology and associated aquatic habitat. Culverts should be inspected and cleaned at least seasonally, with more frequent cleaning prior to spring flow and during autumn leaf fall.

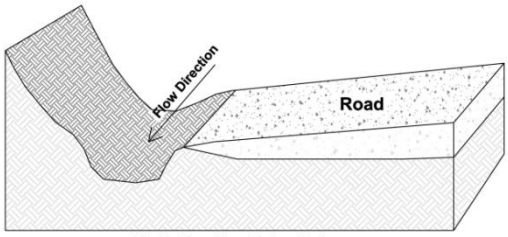
## Stormwater Management Practices

Paved and gravel roads are essentially impervious so during rain events water rapidly collects and flows to the nearest water conveyance channel or area where it can infiltrate to the ground. Road-side ditches have historically been built or were naturally created to rapidly drain stormwater to the nearest waterbody, but due to increased flooding, erosion, and contaminant transport associated with this practice, alternative techniques for managing road runoff are recommended. Minimizing the accumulation of channelized flow is the initial step toward controlling stormwater. This is accomplished by directing runoff to areas near the point of generation that are capable of natural infiltration. As greater amounts of runoff accumulates, the complexity of capturing, slowing, and treating the stormwater increases along with the costs. The New Hampshire Stormwater Manual (NHDES, 2008b) is a comprehensive resource for stormwater best management practices. As residential development, and road and driveway construction takes place in the Lake Sunapee watershed, it will be important that stormwater controls are implemented in accordance with this guidance document.

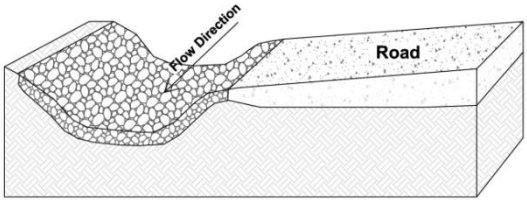
The following stormwater management practices are presented as examples of measures that could be employed in the Lake Sunapee watershed. These measures, as well as others that are described in the NH Stormwater Manual should be considered for existing sites and those that are discovered or developed in the future.

## Swales

Swales convey stormwater along roadsides to prevent water from ponding on, or flowing over the road. In many cases, road-side swales are ditches that have been created by channelized stormwater eroding a path of least resistance. The sediment and nutrient load associated with this type of drainage is considerable, as is the potential damage to the road integrity and abutting property. Properly designed swales provide a channel that is capable of conveying expected storm flow rates without erosion. Factors that need to be considered in the design of a road-side swale include topographic slope, drainage area, expected storm flow, swale dimensions, outlet control, base material and vegetation.



**High Erosion Potential**
**Narrow Roadside Ditch with Steep Side-Slope**



**Low Erosion Potential**
**Riprap Reinforced Swale**
**Widened with Lowered Side-Slopes**

The performance of swales can be improved and their potential contribution to sediment and nutrient loading reduced by increasing their depth and width, reinforcing with appropriately sized riprap, installing check dams (riprap) and step pools, and reducing their slope (cross-section and profile). Where feasible, infiltration trenches

should be considered in place of conveyance swales. Opportunities for swales to turn-out into areas with excess infiltration capacity should be assessed and utilized to convert channelized swale flow to sheet flow and infiltration.

### Culvert Inlet and Outlet Scour Protection

To reduce sediment and nutrient loading associated with erosion at culvert inlets and outlets, loose sediments should be routinely removed, the inlet and outlet pools should be reinforced with appropriately sized riprap, and headwalls should be installed. Inlet and outlet culvert areas are subject to concentrated flow velocities so the potential for erosion at these locations is considerable. By installing an energy-dissipation/sediment traps at locations where scour is likely due to high flow velocities, erosion can be mitigated. These pools are intended for use at the low point of swales and intermittent streams and stormwater drainage culverts, not perennial streams. The size of this type of pool is dependent upon the expected flow rates and the site conditions.

### Ditch Turnout Buffer

Ditch turn-out buffers are recommended to minimize erosion along roadside ditches where due to the grade of the road or the limitation of other stormwater control options, channelized flow is likely to cause erosion of the edge of the road or roadside ditch. Ditch turn-out buffers are designed to convert channelized flow into sheet flow by diverting ditch drainage into areas that slow the flow rates using check dams along a level channel and disperses the stormwater over a vegetated or forested area with a level spreader to allow for natural infiltration and plant update. For applications along gravel roads a sediment trap should be incorporated to ease maintenance operations.

### Vegetated Buffer

Vegetated buffers provide treatment for the ditch turnouts and are an effective BMP for areas where sheet flow can be maintained such as along roadway shoulders, parking lots, or at the edge of fields. Vegetated buffers are either natural undisturbed forested areas or areas where vegetation and uncompacted soil allow for plant uptake of nutrients and sheet flow infiltration. A sufficient flow path length across the buffer is necessary to ensure treatment is provided by the BMP. Design criteria are specified in the NH Stormwater Manual, Vol. 2, 4-3 (6) (NHDES 2008b).

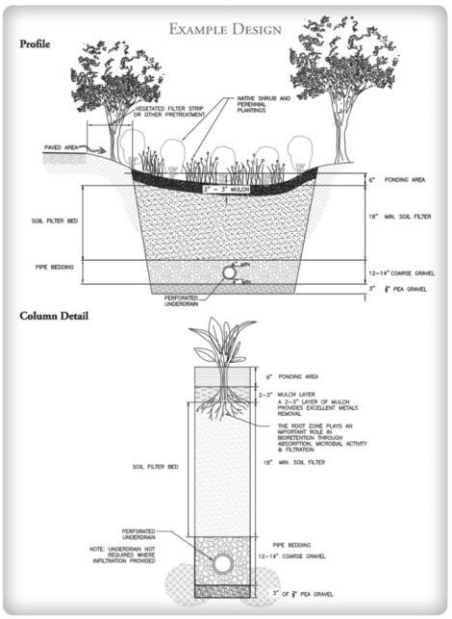
### Pervious Pavement / Pavers

Properly designed and constructed pervious asphalt pavement and pervious concrete pavers result in no direct runoff from these areas. The installation of pervious pavement/pavers is ideal where land area for runoff treatment is insufficient and the ability to infiltrate runoff before it

channelizes is limited. Factors that control the feasibility of this stormwater control option include the depth to groundwater, depth to bedrock, native soil permeability, topographic limitations, and expected traffic load. For optimal performance it is essential that pervious pavement / pavers are constructed in accordance with current design standards (http://www.unh.edu/unhsc/sites/unh.edu.unhsc/files/pubs_specs_info/unhsc_pa_spec_10_09.pdf).

### Bioretention System

Bioretention systems are shallow basins designed to infiltrate runoff thorough an engineered permeable soil material with sufficient vegetation to provide water treatment and plant uptake. Water treated with a bioretention system either infiltrates to the groundwater ("rain garden") or discharges via an underdrain system. Bioretention systems are vegetated to assist with the uptake of pollutants and to blend in with landscape aesthetics. Typically these systems are designed with a treatment capacity of the 10-year 24-hour storm. Pretreatment to remove settleable solids is required, as is a means to bypass flows greater than the design storm. Design criteria are specified in the NH Stormwater Manual, Volume 2 (NHDES, 2008b)(http://des.nh.gov/organization/commissioner/pip/publications/wd/documents/wd-08-20b.pdf). Example design shown here is from the NH Stormwater Manual.




Total suspended solids and total phosphorus removal from properly designed and installed bioretention systems is reported to be approximately 90% and 65%, respectively (NHDES 2008b). Installed costs for bioretention systems vary widely based on their size and site complexity. Systems could cost from $3,000 for very small simple systems, to over $35,000 for large systems.

### Timber Harvesting

Timber harvesting operations have considerable potential to cause soil erosion, runoff, and sediment and nutrient loading. The document, Best Management Practices for Erosion Control on Timber Harvesting Operations (NHDRED 2004) is available on-line at: http://www.nhdfl.org/library/pdf/Forest%20Protection/2004%20BMPs%20for%20Erosion%20Control.pdf

Loggers should be made aware by town officials that erosion control BMPs shall be followed during timber harvesting operations. Inspections by town officials or commission members should be performed to ensure BMPs are practiced and disturbance of soils, wetlands, and waterways are properly minimized. Hiring a forester or environmental consultant with a working

knowledge of forestry BMPs to conduct routine inspections during logging operations is an effective approach to control soil erosion, storm water runoff, and wetland disturbances.

### Agriculture / Field Management

Based on the land use delineation used to develop the TP loading model for this plan, approximately 1,815 acres within the Sunapee watershed are used for agricultural purposes. Most of this area appears to be used for hay or crop production. Nutrient loading from agricultural land can be managed through many methods including runoff controls and treatment, grazing area restrictions and setbacks, and manure application timing and buffers. Considerable information is available to assist with the management of nutrient loads from agricultural lands. The US Environmental Protection Agency has published a series of Nonpoint Source Management Fact Sheets (http://www.epa.gov/owow/nps/pubs.html#ag).

Fields that are maintained for uses such as sporting fields, golf courses, cemeteries, and parks typically have higher TP export due to fertilizer, grass clippings, animal/bird feces, and higher runoff rates due to soil compaction. Maintaining natural buffers around fields and providing treatment measures for channelized drainage from fields are critical in reducing the potential loading from fields. Treatment measures that are applicable to stormwater management from fields include infiltration techniques, treatment ponds and wetlands, and natural vegetated buffers.

It should be noted that these BMP categories are not exclusive, and often BMPs are designed to offer benefits from more than one broad category to maximize effectiveness. An example is a gravel wetland, which typically provides volume storage and a reduction in peak runoff flows downstream, while the presence of wetland plants and a subsurface gravel layer provides for filtering, denitrification (i.e. conversion of nitrate to nitrogen gas) and chemical sorption (UNHSC 2010).

| **Town & Zoning District / Ordinance Category** | **Goshen** | **New London** | | | | | | | | **Newbury** | | | **Springfield** | **Sunapee** | | | | | | | | **Sutton** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Rural Res.* | *R1 Public* | *R1 Septic* | *R2* | *Ag / Rural Res* | *Cons* | *Forest* | *Com* | *Inst* | *Business* | *Res* | *Shoreland* | *Rural Res.* | *Village Com.* | *Village Res.* | *Mixed I* | *Mixed II* | *Mixed III* | *Res* | *Rural Res* | *Rural lands* | *Rural Res.* |
| Subdivision minimum lot size (acres) | 2 | 0.46 | 2 | 2 | 4 | 10 | 25 | 0.23 | 2 | 2 | 2 | 0.1 | 1.5 | 0.5 | 0.5 | 0.5 | 1 | 1.5 | 1 | 1.5 | 3 | 2 |
| Slopes 15-25% allowed? | Sp. Exc. | Sp. Exc. | Sp. Exc. | Sp. Exc. | Sp. Exc. | Sp. Exc. | Sp. Exc. | Sp. Exc. | Sp. Exc. | Yes | Yes | Yes | Sp. Exc. | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Sp. Exc. |
| Slope 25% or more allowed? | No | No | No | No | No | No | No | No | No | No | No | No | Sp. Exc. | No | No | No | No | No | No | No | No | Sp. Exc. |
| Minimum road frontage (ft) | 175 | 100 | 150 | 150 | 200 | 200 | 400 | | 100 | 200 | 200 | | 200 | 75 | 75 | 75 | 75 | 100 | 75 | 100 | 150 | 250 |
| ROW setback (ft) | 50 | 25 | 25 | 25 | 30 | 50 | 50 | 30 | 25 | 30 | 30 | | 35 | 40 | 40 | 40 | 40 | 50 | 50 | 50 | 75 | 46 |
| Wetland setback (ft) | | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 75 | 75 | | 100 | | | | | | | | | |
| Minimum water frontage (ft) | | 200 | 200 | 200 | | 300 | | | 200 | | | 200 | | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 |
| Waterfront setback (ft) | | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 75 | 75 | 50 | 100 | 75 | 75 | 75 | 75 | 75 | 75 | 75 | 75 | 100 |
| Required open space (%) (pervious) | | | | | | | | | | | | 70 | | 20 | 40 | 20 | 50 | 60 | 50 | 60 | 70 | |
| Maximum lot density (acres per dwelling) | 2 | | | | | | | 0.23 | | | 2 | | 1.5 | 0.23 | 0.23 | 0.5 | 0.5 | 1.5 | 1 | 1.5 | 3 | 2 |
| Cluster minimum lot size (acres) | 12 | 5 | 5 | 5 | 5 | | | | | | | | 5 | | | | | | | | | 10 |
| Cluster open space requirement (%) | 65 | 33 | 33 | 33 | 33 | | | | | | | | | | | | | | | | | 30 |
| Existing of individual Stormwater Ordinance? | No | No | | | | | | | | No | | | No | No | | | | | | | | No |
| Considerations for Stormwater in Zoning Ordinance? | Zoning & Building Ordinance requires a stormwater management plan for specific development conditions in the Water Resources Protection District. | Zoning Ordinance has section regarding stormwater & erosion control including use of BMPs for specific disturbances in the Shoreland Overlay District; Land Subdivision Control Regulations has similar standards for stormwater and erosion control design. | | | | | | | | Zoning Ordinance includes section on stormwater management (Article 21), and erosion control and drainage (Section 6.16). | | | Zoning Ordinance includes encouragement of low impact development in stormwater control section (Section 6.90). | Zoning Ordinance has section regarding specifics for erosion & sediment control plans for specific disturbances in Shoreland Overlay District. | | | | | | | | Reference to erosion controls in Zoning & Building Ordinance (Article IX, E.6). |

Notes: Completed in 2019

| ID# | Town-Map#-Lot# | S | Year | No Structure | Shoreline Code | Buffer (1-5) | Bare Soil (1-3) | Distance (1-3) | Slope (1-3) | Total | Photo? | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | |
| 6 | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | |

KEY

**Shoreline:** B=Beach, R=Riprap/Retaining wall; N= Natural; D= Mostly or all docks; L= Mostly lawns; T= Trees, P= Plants, ST= Some trees

**Buffer:** 1= Excellent buffer (all natural vegetation, trees of mixed sizes and shrubs); 2=Good (some trees and shrubs, some bare areas); 3= Moderate (a few small trees, shrubs, some lawn); 4= Minimal (mostly lawns, some shrubs); 5= No buffer (all lawn/bare)

**Bare Soil:** 1= No exposed soil; 2= Minimal exposed soil; 3= Fair amount of exposed soil; 4= Large amounts of exposed soil

**Shoreline Erosion:** 1= No erosion visible; 2= Some erosion visible; 3=Moderate to severe shoreline erosion

**Distance:** 1= More than 150'; 2= 75-150'; 3= House/camp less than 75' from shore

**Slope:** 1= Little to no slope (3-8%); 2= Moderate slope (8-20%); 3= Steeply sloped (>20%)

**Total:** Total of all columns (Buffer to Slope)

## Appendix L. Land prices for parcels over 10 acres in Sunapee watershed on 1/20/2020

| Town | acres | hectares | current price | price/acre | price/hectare |
|---|---|---|---|---|---|
| Springfield | 37.1 | 15.0 | $125,000 | $3,367 | $8,321 |
| Springfield | 81.0 | 32.8 | $162,000 | $2,000 | $4,942 |
| New London | 11.5 | 4.7 | $459,000 | $39,913 | $98,627 |
| New London | 12.5 | 5.1 | $129,900 | $10,375 | $25,638 |
| Sunapee | 12.5 | 5.1 | $134,900 | $10,775 | $26,625 |
| Sunapee | 35.1 | 14.2 | $350,000 | $9,960 | $24,612 |
| Newbury | 126.7 | 51.3 | $750,000 | $5,918 | $14,623 |
| Newbury | 12.0 | 4.9 | $495,000 | $41,250 | $101,931 |
| Newbury | 10.1 | 4.1 | $89,000 | $8,812 | $21,775 |
| Newbury | 14.3 | 5.8 | $249,000 | $17,364 | $42,907 |
| Sutton | 75.0 | 30.4 | $590,000 | $7,867 | $19,439 |
| Goshen | 21.0 | 8.5 | $109,900 | $5,233 | $12,932 |
| | | | Average of all parcels > 10 acres: | $13,570 | $33,531 |
| | | | Average of parcels > 50 acres: | $5,261 | $13,001 |