Appendix A

pH Impairments at Messer Pond

BASE FLOW, LLC

Appendix A – pH Impairments at Messer Pond

In addition to impairments related to phosphorus and sediment, Messer Pond has failed to meet water quality standards for pH in recent years. Some pond and tributary samples collected under the Volunteer Lake Assessment Program (VLAP) have had pH results that were below the lower recommended threshold (i.e. below 6.5; NHDES recommended range per NHDES Env-Wq 1703.18 is 6.5 to 8.0 for Class B waters). Note that a pH value less than 7.0 is considered more acidic, values greater than 7.0 are considered more basic, and 7.0 is considered neutral.

As part of this study, Base Flow performed some cursory studies on pH impairments in New Hampshire for similarly sized lakes in the Dartmouth – Lake Sunapee Region. Results showed that out of 26 similarly sized lakes in the region, 10 (including Messer Pond) were impaired for pH. The list of those lakes is provided below.

Table 1. Dartmouth – Lake Sunapee Region Lakes Similar in Size to Messer Pond, with pH Impairments (NHDES 2012)

Lake, Town	Size (Ac)
Canaan Street Lake, Canaan	290.1
Kilton Pond, Grafton	66.1
Stocker Pond, Grantham	75.1
Messer Pond, New London	71.5
Todd Lake, Newbury	167.2
Baptist Pond, Springfield	83.1
Perkins Pond, Sunapee	156.2
Kezar Lake, Sutton	169.4
Halfmoon Pond, Washington	75.0
Ashuelot Pond, Washington	366.9

The observation of low pH values in water bodies is a common issue for ponds in the Northeast, particularly in locations where there is much low-buffering capacity granite bedrock . Acidic rain falling on soil with low buffering capacity is a potential cause. The local environment also contributes: the surrounding woodlands have many conifers and the soil is acidic. So, increased disturbance of soil and increased flushing of soil into the pond might increase acidity.

Road salt runoff and decomposition of organic matter are other potential sources. At Messer Pond, there are a number of wetland complexes associated with Nutter and County Road Brooks, which are most likely acting as sinks for natural organic material. Overtime these wetlands are providing a means for the decomposition of that organic material. This natural process is typical of certain types of wetlands and carbonic acid is a byproduct of this decomposition. The stream flows passing through both brooks and these associated wetlands would be a conduit for the transport of decomposed material and carbonic acid to the pond.

Other anthropogenic-related causes of lower pH surface water within the watershed are suspected as well. The wetland associated with Brown's Brook is believed to be highly influenced by stormwater runoff from I-89. This wetland is thought to be 'newer', and in the process of breaking down much more

organic matter compared to a natural wetland that has had thousands of years to form, and is thus, producing more carbonic acid and decomposition byproducts. Some of the lowest pH values in the Messer Pond sampling data set were found at Browns Brook. And finally, the Hurricane of 1938 lead to mass tree falls in the area. We know that an unknown amount of logs cut from those fallen trees exist on the pond bottom, as storage of logs in local ponds as a means of preservation was a practice used during storm recovery efforts (Smith, 2006). Reports of periodic emergence of logs on the pond surface is common, going back to the early 1980s, and most likely well before that. In June, 2015, the NHDES published a report regarding acid rain and potential impacts to lakes and ponds. That report can be found at this location:
http://des.nh.gov/organization/commissioner/pip/publications/wd/documents/r-wd-15-5.pdf.

References

New Hampshire Code of Administrative Rules, Env-Wq 1700.
http://des.nh.gov/organization/commissioner/legal/rules/documents/env-wq1700.pdf

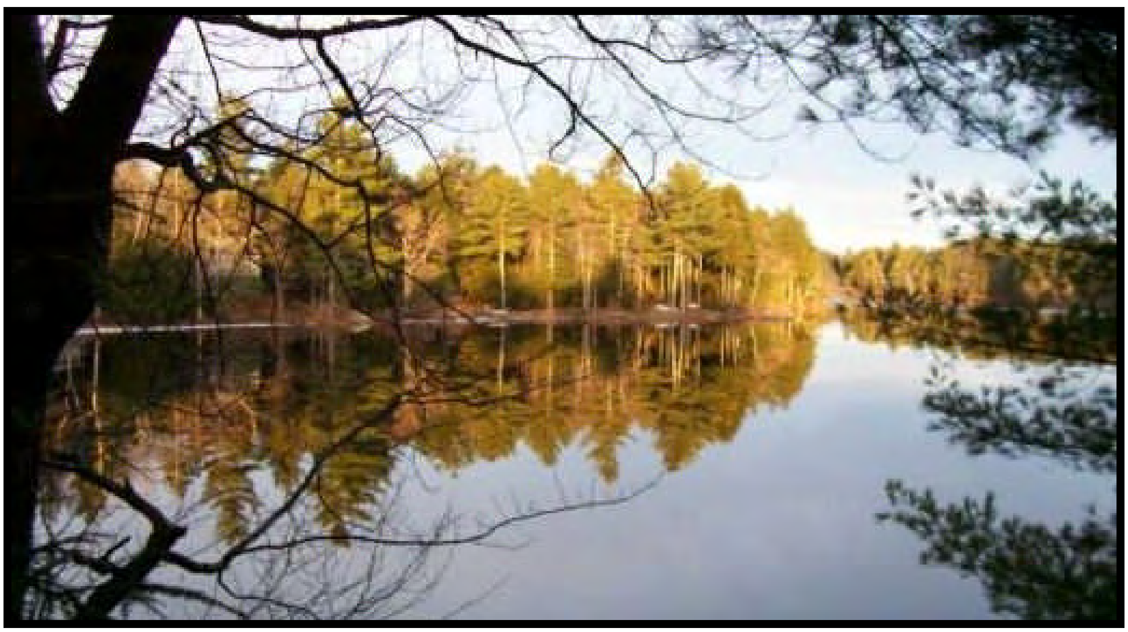
NHDES 2012. 2012, Draft 303(d) List. Surface Water Quality Assessment Program. April 20, 2012. Found at: http://des.nh.gov/organization/divisions/water/wmb/swqa/

Appendix B

CLD Consulting Engineers, Inc.

Messer Pond Watershed Study

Messer Pond
Watershed Study



Prepared by

CLD CONSULTING ENGINEERS

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May 8, 2008

I. GENERAL INFORMATION

The Messer Pond Watershed area is approximately 1,334 acres in size. The surface area of Messer Pond is approximately 69 acres in size. Large areas within the watershed are forested and the predominant land use within the watershed is residential development. There is some agricultural use that consists of grazing land for cows and some outdoor fenced in fields where horses are pastured but the number of animals grazing within the watershed is not overly significant. Messer Pond is a relatively shallow body of water that is in the range of twenty feet at the deepest spot and averages about nine feet deep. A portion of Interstate 89 crosses through the watershed of Messer Pond approximately 700 feet south of the Pond. About 5,465 linear feet of interstate 89 crosses through the watershed, including both lanes of I-89 (each considered a road) plus secondary and local roads. There are about 62,600 linear feet of roads that are within this watershed. The entire watershed area including Messer Pond, its sub-watershed areas, streams, roads, and topography can be viewed on the attached Messer Pond Watershed Map at a scale of 1 inch = 500 ft.

Historically, development immediate to Messer Pond started on the south side along Forest Acres Road. These homes began as cottages along the shoreline. Over time these cottages have been converted, remodeled, or replaced as year-round primary residences. Additional homes have been built and land continues to be developed along both sides of Forest Acres Road. Beginning in the 1980's, land subdivision and residential development had progressed along the north side of the Pond and further up in the watershed north of the Pond. Increases in impermeable surfaces result in increases in runoff which in turn puts more water in channels and streams.

Three major streams flow directly into Messer Pond as well as several smaller seasonal streams and runoff channels. The largest stream, County Road Brook, flows in from the northwest and runs through the largest sub-watershed area. This sub-watershed area is approximately 605.5 acres in size. This sub-watershed (Sub-watershed #1 on the Messer Pond Watershed Map) is probably the oldest in terms of the residential development within the watershed. After collecting runoff in the developed upland areas of Burpee Hill, County Road Brook flows through about 3,500 feet of wetlands before it reaches Messer Pond. This is by far the largest wetland area within the entire watershed. The plants of the extensive wetland areas that the County Road Brook flows through before entering the open water of Messer Pond provide, at times, a natural filtering for sediment removal and absorption of nutrients. This stream has many smaller tributary streams, seasonal streams, and runoff channels flowing into it. This sub-watershed area also has the most residential development and number of roads contrasted to the other Messer Pond sub-watersheds.

A Water Quality sampling program has been ongoing in Messer Pond since 1996. The Volunteer Lake Assessment Program (VLAP) has been sampling five locations within the Pond. These locations are: Browns' Brook inlet; Nutter Brook inlet; County Road Brook inlet at the point of open water within the pond; the deep spot; and at the outlet of the pond.

II. WATERSHED CHARACTERISTICS & WATER QUALITY

The Messer Pond Watershed is classified as a smaller watershed as it relates to watersheds with a receiving pond or lake. It is a sub-watershed at the headwaters within the large Merrimack River Watershed. Currently the development characteristics would most likely place this watershed under the term of a rural watershed but the potential for further residential development could move it into the class of an urban watershed. A rural watershed is one where the majority of development within the watershed is residential and the collective impermeable surface area is 10% or less. An accurate estimate of total impermeable surface area as a percentage of the total watershed area is beyond the scope of this study and no estimates were found in the research on this watershed. A very rough estimate is that impermeable surfaces make up to about 6% of the total watershed area.

All of the residential development within the watershed is served by individual on-site septic systems with the exception of the Highland Ridge Condominium development. Highland Ridge is tied into the New London Municipal Sewer System. Homes in the Burpee Hill area, those along and off of Knights Hill, and homes north of both Burpee Hill and Knights Hill are served by community water provided by the Springfield New London Water Precinct. All other homes are served by individual wells.

Most of the roads within the watershed are on sloping terrain. Winter maintenance of these roads generally includes sand application. At times a low percentage salt mixture is included with the sand application on some of the steeper roads away from open water bodies. The New Hampshire DOT maintains I-89. The section of I-89 within the Messer Pond Watershed is one of the higher elevation sections of I-89, and winter temperatures and snow and icing conditions require salt as a deicing agent. According to Alan Hanscom, the District Two NHDOT Engineer, “Salt applications are limited to what is necessary to provide a safe highway for motorists. Sand use on I-89 is generally limited to on and off ramps, with lesser amounts being applied to the main line during extended storms.”

Most of the developable land within the Messer Pond Watershed is sloping. The Watershed Map highlights areas with slopes of 20 percent or greater. Very few areas fall into the 20 percent or greater slope range. Most developed areas are in the 8 to 15 percent slope range. Impermeable road surfaces make up approximately 2 to 3 percent of the watershed area. The additional impermeable areas consist of homes, garages, barns, and driveways. In observing the residential development within the watershed, it was noted that there are many homes that have relatively large impermeable footprints. These areas include house roof surfaces, garage roofs, and drives that total over 5,400 square feet per house lot.

The older homes throughout the watershed tend to have large yard areas consisting of grass lawns. Newer homes immediate to Messer Pond, particularly on the north side of Messer Pond, have smaller lawn areas and tend to be on more wooded sites. Soils throughout the watershed vary in type but have some similar characteristics associated with their susceptibility to erosion. In general these soils are quite susceptible to erosion when disturbed or exposed with no vegetative cover. This is particularly true if you consider the slopes where these soils occur. There are essentially four types of soils in the watershed. Three are associated with glacial tills. The immediate ground surface and top layer subsoils are typically sandy loams. Some types tend to have a hardpan at depths of around 20 inches and have a low permeability below the pan layer. Low permeability soils leave more stormwater on the surface to runoff. Other types are poorly to somewhat poorly drained and tend to hold water close to the surface. The third type of soil has bedrock very close to the surface and, therefore, does not allow much in the way of infiltration. The fourth soil type is very poorly-drained wetland soils, wet on the surface most of the time. Developed sites, where the natural, wooded, pre-developed conditions are left intact wherever possible as a woodland buffer, have a lower potential for erosion. These sites are more capable of dispersing increased runoff from impervious surfaces back into the natural woodland.

Practices and methods for dealing with stormwater runoff have historically been to channel, collect, and divert concentrated stormwater runoff directly into brooks, streams, and water bodies. As a watershed becomes more developed, thus more impervious, these traditional approaches to manage stormwater runoff tend to cause greater negative impacts to the natural environment and particularly affect the receiving water bodies.

The Messer Pond Watershed Map that is attached highlights the stream networks (in blue) that run through the watershed down to Messer Pond. Many road sections within the watershed have road ditches that channel runoff away from the roads and developed areas toward these streams carrying the runoff and any other material that can be transported by water, in suspension, in solution, or dissolved, down along the stream paths toward Messer Pond. Heavier particles may settle out where velocities are low or the land flattens out. Finer soils, organic debris, nutrients, liquid petroleum-based products, and other liquids tend to travel down through the watershed until they reach Messer Pond. Increases in impermeable surfaces result in increases in runoff, which, in turn, puts more water in channels and streams. Greater water volume and increased velocity of flow in these streams and runoff channels erodes these channels carrying soils and riparian vegetation downstream ultimately depositing these materials in the receiving surface water body. Under heavy rains this water flows through these channels with relatively greater velocity, which increases the water’s ability to carry more material further down the watershed. It can carry material of greater mass and pick up soils deposited in the channels from previous rains moving the material further down through the watershed. Where runoff passes through wetlands, the wetlands can act as a filter trapping and removing particles; and the wetland plants can absorb nutrients, such as phosphorous and nitrogen, removing some material from the water.

Runoff that is not in a channel or stream can run over the land as sheet flow. This water has more contact with vegetation and the varying surface characteristics of the land. In this less-concentrated condition, the water will move slower and have a chance to seep into the soil being absorbed by grasses, plants, and trees. Some of the water will percolate down through the soil layers and either be held in the voids in the soil or build up as a saturated zone in the soil called the ground water table. Ground water moves in the soil similar to a stream moving down hill. Typically, the ground water travels in the soil down toward water bodies where it eventually combines with the surface water. This is called recharge. Particles and organic material in the water entering the soil are removed by soil filtering and the microbes in the soil can consume the organics. Some materials that are water soluble and in high concentrations may continue to be carried into the ground water and can actually be carried by the water to a surface water body. Contaminated effluent from septic systems, where the leaching portion of the septic system is very close to or sits in the ground water table, can actually contaminate the ground water. If it is close to a water body, it can carry contaminants and nutrients harmful to water quality into the water body through recharge.

<u>III. OBSERVATIONS AS NOTED FROM THE MPPA HOMEOWNER QUESTIONNAIRES</u>

The following is a summary of observations and concerns noted by homeowners around Messer Pond:

1. Many people expressed a concern for the build-up of sediment in the inlet area of Nutter Brook and sediment extending into the Messer Pond. Some feel it has moved further into the pond than observed in past years. Sediment was also observed on the uphill side of Forest Acres Road in Nutter Brook near the culvert. Over the past ten years it appears the shoreline area surrounding the Nutter Brook inlet has become shallower.
2. In the pond area adjacent to White Pine Lane and Little Cove Road, there is a lot of muck along the shoreline.
3. Aquatic plant growth seems to have increased. On the east end of the pond Watershield growth has increased in the last year. In general, plant growth has increased to a point that the pond appears shallower since the plants are growing up closer to the surface. Both the County Road end of the pond and the Bog Road end of the pond appears to be filling in with plants at a rapid rate.

   Plants are observable in much deeper water. More growth at the Nutter Brook inlet area. Increases in growth of Wild Celery, water lilies and Watershield. Also increases in northeast corner of pond and around Bog Road. outlet.
4. Concern for green lawns and use of fertilizer around the pond.
5. Concern for impact of septic systems.
6. Concerns for accumulation of sands and sediment coming off roads and accumulating in ditches, stream channels, and I-89.
7. Impact of runoff from Columbus Ave/Burpee Hill area as well as Knights Hill areas.
8. Concerns of the impact of new construction on the pond.
9. Areas along Forest Acres Road have wide sand shoulders.
10. What can be done to keep the pond from filling in?
11. What guidance can be given to homeowners on what to do and what not to do to help preserve the pond?
12. Concerns for turbidity in County Road Brook inlet.
13. Concerns relative to animal grazing in close proximity to runoff channels.

The above observations and areas of concern were also viewed by CLD. In the following sections we have attempted to discuss, address, and highlight these concerns and others we noted in our observations and investigations. Many issues are not simple to correct or have multiple-approach strategies to address one issue. A combination of several actions may be necessary to suspend or reverse the effects of increased runoff into Messer Pond.

The next section will discuss Impacts. It will detail potential sources of impacts, where they can occur, and their indicators.

IV. IMPACTS: POTENTIAL SOURCES, LOCATIONS, INDICATORS, AND EFFECTS ON THE WATER QUALITY OF MESSER POND

The Messer Pond Watershed consists of all the land that contributes water to Messer Pond. A Watershed Management Plan for Messer Pond is the development of a program to protect, maintain, and improve the water quality within the watershed and within Messer Pond. Defining potential sources of impacts to water quality, the location of those sources, the indicators warning of potential water quality impacts, as well as an understanding of the effects on the watershed environment and the water quality of Messer Pond are the first steps in developing a Watershed Management Plan. Due to the relatively shallow depth of the pond, Messer Pond is more susceptible to the process of eutrophication than a water body with significantly more depth. The rate of change of the pond can be most influenced by a program to manage the control of the input of sediment and nutrients into the pond.

A. The following are potential sources that can cause impacts to streams and ultimately Messer Pond:

1. Increased development within the watershed;
2. Development on steep slopes;
3. Concentrated road runoff, particularly in close proximity to streams and Messer Pond;
4. Concentrated runoff from individual home sites;
5. Ineffective erosion control during construction;
6. Large impermeable areas in close proximity to streams or Messer Pond;
7. Malfunctioning and improperly-located septic systems;
8. Agricultural runoff;
9. Use of excessive lawn fertilizers or use of lawn fertilizers in close proximity to surface water;
10. Exposed soils with no stabilization or vegetation on the surface;
11. Petroleum leakage;
12. Heavy land clearing;
13. Overuse of insecticides or herbicides in close proximity to water;
14. A high frequency of reoccurring major storm events.

B. Locations where potential sources can have the greatest effect on Messer Pond:

1. Shoreline areas immediate to existing and new shorefront homes (1st tier homes);
2. Access roads within the shoreland buffer – within 250 feet from the water's edge;
3. Second tier homes – homes on the uphill side of a road around the pond;

4. New developments within the watershed, including development roads, drainage features, and new home-site construction;
5. Roads, particularly steeper roads, anywhere in the watershed;
6. Grazing of animals close to streams.

C. Indicators warning of potential water quality impacts:

1. Sediment build up in streams;
2. Sediment build up in Messer Pond;
3. Excessive plant growth in Messer Pond;
4. Water samples in both streams and Messer Pond indicating any of the following: high conductivity, phosphorous, nitrates, turbidity, e-Coli;
5. Eroded ditches and swales;
6. Culvert washouts;
7. Foul odors in the vicinity of the pond;
8. Cloudy water, limited depth visibility;
9. Loss of fish populations;
10. Fish kills;
11. Sheen on water surface;
12. Reduced channel capacity to carry runoff – channel erosion;
13. Reduced culvert capacity – inlet-area erosion;
14. Lot erosion and loss of soil and site stability.

V. ROAD AND LOT RUNOFF and EROSION

A. Interstate 89

A site investigation of culvert-discharge areas along the north side of I-89 noted that many of the existing highway culverts have sediment build-up in the culvert pipes. These pipes do not appear to have been cleaned out in recent years. In many locations the sediments appear to be a mixture of sands and some silt. The sands are most likely from highway sanding. The easterly most culvert on I-89 west of Bog Road is Browns' Brook. The upper sub-watershed area south of I-89 (labeled as sub-watershed #3 on the attached map) has some large, open-field areas and the soils above and south of King Hill Road are fairly-dense, silty tills that are not very permeable. Excess fertilizers and any soil erosion will tend to get carried in runoff water down through this sub-watershed. The flow on the north side of I-89 does appear to get filtered through some wetland vegetation; but, under high runoff, the velocity and volume of flowing water appears to flush these areas and carry the sediments deposited under lower-flow conditions down toward Messer Pond.

The Nutter Brook culvert under I-89 also has sediment build-up in the culvert pipe. This material becomes a restriction that creates a higher velocity of flow in the culvert, and some of the sediment periodically gets washed out of the pipe and flows downstream. Nutter Brook probably is a receptor of a greater portion of the I-89 runoff. The stream channel characteristics north of I-89 indicate that, at times, this stream has some very high flows, which will increase the velocity of the flowing water. Immediate to the culvert discharge on the north side of the highway at the base of the road embankment is a pool that can collect sediment and, under certain flow conditions, appears to collect this material. If this pool is periodically cleaned out, perhaps with a hand shovel, the soil could be removed from the channel and raked into the vegetation in this immediate area away from the stream channel. A high build-up of soil in this pool will tend to get washed downstream under high runoff conditions. Once sediment is carried in the stream away from the immediate highway area much of the material will make its way down to the flatter reaches of Nutter Brook and into Messer Pond.

There are several other smaller culvert pipes that discharge from I-89 along the north side of the highway at the base of the highway embankment. These concrete pipes also have sediment build-up in the pipe. Some of the pipes are practically buried at their outlet end due to sediment. It is recommended that the NHDOT District 2 Office in Enfield be contacted with a request to maintain these culverts. Alan Hanscom, District engineer, would be the person to contact; and the contact should include a written request.

The use of road salt around lakes and ponds is a topic of much discussion. Due to the specific, localized, winter-weather conditions along this particular section of I-89, salt is a necessary safety measure. Based on the Oct. 17, 1997, State Inter-department Memo written by Alan Hanscom, this highway section probably receives more salt application than sand; but both materials are used along this section of highway. The State has researched the use of other materials as an alternative to salt but as of this time no product has been found to be as effective for deicing. Currently, Canada seems to be most active in researching alternative approaches to the use of road salt. In our immediate area, sand application with low-salt content or no salt content is the alternative to concentrated-salt application. Area towns have defined no-salt zones immediate to some of the lakes and ponds; and, in those areas, straight sand is applied. The Eastman Community has experimented with and is using a by-product of rock crushing, the finer stone particles (stone dust). They have attempted an approach where less material is applied than with the use of sand.

Possibly planting salt-tolerant vegetation adjacent to highways and grading to allow runoff to sheet off highways might reduce salt being carried along drainages and into waterways. Salt, typically, is water soluble and mixes quite readily in moving water so it can be carried through stream channels through a basin and into the receiving water bodies.

Browns' Brook 42" Culvert Outlet on the Downhill Side of I-89

Nutter Brook 48" Culvert Outlet on the Downhill Side of I-89

I-89 Underdrain Pipe Showing Some Sediment

A Partially-buried Section of Concrete Culvert Pipe on the Downhill Side of I-89

B. Forest Acres Road

Stormwater runoff sheds off of Forest Acres Road through a combination of shallow ditches and, in some areas, sheet flow. Observations in April of 2008 as well as in the Fall of 2007 noted significant sand along much of the road shoulder areas. Forest Acres Road has many sections where the shoulders are quite broad. Some of the road ditches flow directly to the stream channels at culvert crossings. The Town of New London has created some small sediment basins between the stream crossings and the adjacent road ditches. These basins are effective in collecting sand and sediment. Any and all stormwater treatment and collection devices and components require periodic maintenance, particularly after major storm events. At this time the Town Highway Department does not have the staffing and time to maintain all these elements on a regular basis.

CLD has spoken with New London Public Works Director, Richard Lee, in regards to approaches to dealing with the stormwater runoff along roads in the Messer Pond Watershed. Roads, typically, in the past were constructed with road runoff channels and culverts that concentrated the runoff and conveyed this runoff directly to stream channels. Mr. Lee understands and has attended many recent workshops that address stormwater runoff. He is currently attempting to incorporate these innovative approaches to create an updated strategy to address stormwater issues. In general the approach today is to disperse runoff where possible and not concentrate the flows. Modifying existing drainage patterns and systems along existing roads is a challenge. Several catch basins with sumps for collecting sediment have been added along the road upstream of local culvert crossings. These do collect sediment and require periodic removal of the sediment. The Town does have equipment for removing sediment from these basins.

The Forest Acres Road shoulders were observed in the fall of 2007. The road ditches were shallow and contained a lot of sand. The Town's maintenance program includes grading the road in the spring and grading out the road ditches. In so doing, sand is removed from the ditches and this soil is trucked away. By doing this maintenance in the spring, sand built up from winter road sanding can be removed and the spring ditch grading can allow for vegetation to grow on the shoulders. The sediment basins installed by the Town are also cleaned out in the spring. Mr. Lee has begun a program of adding "knit pac or hard pac," a mixture of crushed stone and the stone dust to the road as part of the road grading program. This is a good way of creating a stronger, firmer road surface that is less susceptible to deterioration of the surface from road traffic. Applying more of this material as a surface treatment and compacting it with a vibratory roller will strengthen the road surface and result in less sand being washed from the road surface by stormwater.

The paving of Forest Acres Road was asked of Richard Lee, but he indicated there was no budgeting for this. This was discussed in a letter Mr. Lee wrote to the MPPA. Paving the road presents other problems associated with runoff.

The existing, broad-road shoulder sections of sand and gravel are not necessary along Forest Acres Road. These sections could be planted with grass or ground cover to help stabilize the shoulders and act more as filter strips. In CLD's discussions with Mr. Lee, CLD asked how the MPPA could help with these road problems. One suggestion included some volunteer assistance from MPPA in the spring. After grading of the road and shoulders and cleaning out the road ditches, the MPPA could help in the shoulder and ditch areas. The Town could provide the soil, seed and mulch. The MPPA could assist by raking out the soil in these shoulder areas and in the ditches and spread out fresh topsoil. The MPPA could also seed the areas to promote vegetative growth. The MPPA could provide additional assistance by cleaning out the small sediment basins after major rain events. These basins are about three to four feet in diameter and have stone check dams along the outlet side. This material can be shoveled out by hand and placed outside the ditch flow line with arrangements to be made for pick up by the Town. If MPPA would consider participating in this collaborative approach, a meeting with the Town, arranged through Richard Lee and Jessie Levine, would be required to discuss specifics and details to successfully implement this strategy.

Clearly, sediment from Forest Acres Road reaches the Pond and has an added impact to the Pond.

The following is an outline of measures that can be applied to the Forest Acres Road area and also applies to problem areas along other roadways:

1. Clean out and periodically remove accumulated sand from ditches and shoulders;
2. Vegetate swales and ditches and vegetate shoulder prior to ditch;
3. Vegetate shoulder areas between road surface and culvert headwall;
4. Extend culvert pipes further into stream channel to allow for more effective headwall or sloped outlet grading;
5. Use upslope diversions, turnouts and level spreaders on individual properties;
6. Hard-pac road surface that is compacted with roller;
7. Install stone check dams in road ditches;
8. Use sediment basins off road prior to stream discharge of runoff. Homeowners could assist in cleaning out these areas and reseeding.
9. Add check dams prior to runoff discharge to existing streams;
10. Reduce contributing runoff volume;
11. Slow down the flow;
12. Where possible, direct road runoff into adjacent wooded areas with level spreaders to disperse flow back into forest mat. Use stone check dams along swale to level spreader.

To Vegetate, consider:

Grasses: nurse grasses with rye, rye grain, redtop for initially binding the soil;
Legumes: clover, flat pea, bird's foot trefoil;
Seeding Times: prior to mid-June, mid-August to mid-September;
Mulch all areas with hay;
Use straw mats on steeper slopes;
Bioengineered planting for structural stability of soils;
Wildflower cover.

<u>Photos along Forest Acres Road</u>

Large Areas of Sand Covered by Leaves in the Fall

A Broad Sandy Shoulder Could be Loamed and Seeded for Vegetative Growth

Photos along Forest Acres Road

Additional Wide-shoulder Areas along Forest Acres Road that are Currently Sand with Very Little Vegetative Growth

<u>Photos along Forest Acres Road</u>

Broad Shoulders of Sand and Gravel

Shallow Runoff Ditches of Sand and Gravel

<u>Photos along Forest Acres Road</u>

Examples of Shallow Road Ditches Consisting of Sand and Gravel

Photos along Forest Acres Road

A Shallow Road Ditch and Broad Shoulder Consisting of Sand

Photos along Forest Acres Road

Broad Shoulders of Sand and Gravel

Shallow Road Swale with Lots of Sand and Very Little Vegetation

Photos along Forest Acres Road

Shallow Road Swale with Lots of Sand and Very Little Vegetation

Road Runoff Areas Consisting Mainly of Sand and Gravel with Little or No Vegetation

<u>Photos along Forest Acres Road</u>

Shallow Road Swales Filled with Sand

C. County Road

County Road is a Town road maintained by the New London Public Works (NLPWD). The section of County Road from the intersection of Knights Hill Road down to the low point in County Road at the County Road Brook culvert is one of the steepest sections of road in the Messer Pond Watershed. The heavy rains of 2006 eroded the easterly side down much of this hill. The road ditch was scoured and portions of the pavement undermined. This area has been repaired with stone rip-rap placed in the ditch and sections of pavement replaced. Sand applied during the winter on County Road does wash down into the road ditches and ultimately can wash into the County Road Brook and adjacent wetland areas. These road ditches should be periodically cleaned out as well as the sediment-collection basin on the east side of the road part way down the hill toward the County Road Brook crossing. Where possible, runoff could be periodically dispersed into wooded areas as runoff flows down the hill. Although this hill is steep, winter salt application should be limited since the majority of the road runoff does currently drain into the wetlands and stream on the Messer Pond side of County Road. Without periodic maintenance of these road ditches, sediment catch basin and sediment build-up areas, the sediments get flushed all the way down the hill and into the County Road Brook. The Messer Pond Protective Association, as part of a Watershed Protection Plan, should notify the NLPWD of these concerns and may want to monitor conditions along County Road such that when sediment accumulation is observed, the NLPWD can be notified.

D. Rocky Ridge

This is a new subdivision that should have open-space buffers and stormwater detention and treatment as part of the design. Temporary stabilization and erosion control during construction of both roads and individual lot development is of concern due to its location in the watershed. Peter Stanley from the Town of New London should be inspecting this project during construction to make sure erosion control practices are being maintained. Downstream monitoring of streams and intermittent channels should be done periodically to determine if erosion controls are effective. Current New London subdivision regulations with proposed amendments relating to low-impact approaches to land subdivision provide a good control on minimizing the erosion and stormwater impacts from new development. The concern today is the follow through of these requirements relating to the development on the individual lot level. Amending the local zoning regulations to require proper approaches to minimizing off-site runoff, incorporating low-impact approaches, and requiring the implementation of best-management practices (BMP's) for individual lots is an important component for watershed management. Approaches to low-impact development for individual lots must be regulated at the building permit level.

Article XIV, the Steep Slope Overlay District, of the New London Zoning Regulations does address individual lot development on steep slopes. No building, drive, septic system, or roads are allowed on slopes over 25%. Individual house lot development is allowed on slopes of 15% to 25% with an Erosion and Sedimentation Control Plan approved by the Selectmen prior to issuing a building permit.

E. Woodland Trace

The following are observations of road conditions and runoff channels along Woodland Trace Road as observed in April of 2008.

Many areas along Woodland Trace Road sheet drain into the surrounding woodland. This approach tends to disperse a lot of the runoff coming off the road surface. Although many home sites toward the end of Woodland Trace and off Surrey Lane have open cleared areas, the home sites appear to sheet drain yard runoff out into the wooded areas below. Sheet runoff does disperse water back out into the natural woodland buffer where vegetation and soils can absorb and infiltrate the water back into the ground. It appears that where road ditches concentrate road runoff from Woodland Trace Road, these ditches discharge and disperse the runoff back into wooded areas. Much less sand buildup from road sanding was observed along Woodland Trace Road than other roads in the watershed. It is important to maintain woodland buffers and provide methods for dealing with site runoff that disperses the runoff back into the natural areas to reduce erosion and minimize concentrated runoff flows.

F. Fieldstone Lane, Little Cove Road, and White Pine Lane

Fieldstone Lane, over much of its length, runs along the contour of the land. Seasonal and intermittent runoff channels in most areas run perpendicular to the road. Much of Fieldstone Lane, from the crown of the road to the south side, sheet drains off the road and into the field and woodland areas below the road on the south side. The crown toward the shoulder on the north side of the road drains into a road ditch that conveys road runoff to the road culvert inlet areas of the seasonal and intermittent streams that cross Fieldstone Lane. The road shoulders appear to be gravel. Observations in April of 2008 noted a significant amount of sand on the shoulders and road slopes and in the roadside drainage ditches. It is apparent that the heavy snow this past winter required many applications of sand on Fieldstone Lane, Little Cove Road, and White Pine Lane. All three roads have a heavy buildup of sand on the road shoulders, side slopes, and road ditches. Snow melt and spring runoff has carried the sand into the drainage ditches, into the seasonal and intermittent streams and into and through some of the culverts. In several locations, drive culverts and road-cross culverts are partially filled with sand and sediment. Finer particles get carried through these pipes and soil deposits can be observed in the streams and wetlands below these culverts adjacent to Messer Pond. Much of the sand built up along the road shoulders, road slopes, and swales could be collected and would fill several dump trucks. The sand in some areas has covered natural vegetation along the sides of these roads. Over time, the buildup of sand will smother and kill the vegetation under it. The decayed organic material from this vegetation will, during significant storms, wash away with some of the sand in the runoff and flow down toward Messer Pond to add sediment and nutrients to the pond environment. Removal of built-up sand is a major part of the maintenance of these roads. Mechanical sweeping of the roads and shoulders will help remove some of this material. Removal of sand from road ditches and areas beyond the gravel shoulders must be raked, graded, or scooped out with a machine or by hand. This is a time-consuming and labor-intensive process but beneficial to the removal of sediments that can ultimately deposit in the wetlands adjacent to Messer Pond or in the pond itself. Ideally, the road shoulders, sloped embankments, and road ditches should be vegetated. A possible approach to trapping sediment along the road ditches is to install small sediment basins or filter check dams to collect sediments before they flow further down toward Messer Pond. There are products out there today that can be utilized to create these sediment collection areas and live filters. Any and all of these approaches require periodic maintenance to remove built-up sand and sediment and maintain the vegetation.

G. Individual Lot Runoff

Runoff from individual lots contributes to the overall runoff into Messer Pond. Lots above roadways that direct site-related runoff down to the roadways increase the volume of runoff in road ditches. Typically, some of that runoff flows along the drives. There are areas along Forest Acres Road where ongoing erosion can be observed where the intersection of the drive runoff meets the road ditch. Reducing individual home-site runoff to road drainage systems will help reduce erosion and sediment transport along road ditches. In the Guidance Manual for Homeowners and Contractors, there is information on various approaches that can be applied to dealing with stormwater on individual home sites. These approaches can be incorporated on both existing home sites and new construction. Some of these features are landscaping elements that can enhance one's property.

Lakefront properties can also help reduce impacts to Messer Pond by dispersing runoff from impervious surfaces so they do not concentrate. Methods to infiltrate runoff are effective in reducing nutrient loading to the Pond. Reducing lawn areas particularly immediate to the Pond and creating vegetated plantings and riparian buffers is beneficial to the water quality of the Pond and will help reduce plant growth in the pond along the shoreline.

VI. DISCUSSION OF VLAP SAMPLING

The following comments are based on trends noted from a review of VLAP sampling from 1996 to 2007:

Increases in chlorophyll-a correlate with increased runoff.

High runoff deposits more nutrients into Messer Pond which results in greater plant and algae growth.

The best control for nutrient input is to implement runoff and stormwater management practices.

The flow of sediment and sand into Messer Pond and reducing off-site runoff can be controlled by dispersing localized runoff into woodland buffers.

Reduction in transparency can correlate with increased runoff carrying sediment, organic debris, and nutrients into the Pond.

Increased development is affecting the clarity of Messer Pond water. Also, sand carried off of roads immediate to Messer Pond and from I-89 is being carried into stream and runoff channels and under high runoff conditions is flushed down into Messer Pond. The visible signs are increased turbidity and decreased clarity. Controlling individual lot runoff can help reduce these problems.

Bottom sediments in Messer Pond are trapping nutrients and, when disturbed, release these nutrients into the water column.

Increased development in the watershed appears to be increasing the phosphorus concentration in the water in Messer Pond.

Winter applications of road salt, particularly on I-89, does make its way to Messer Pond. High conductivity levels also suggest the possibility of malfunctioning septic systems closer to Messer Pond.

Phosphorus may be naturally released from upstream wetlands under high runoff conditions. Due to reoccurring high levels in Browns' Brook and, at times, Nutter Brook, segmented stream sampling should be done to attempt to determine source locations.

Depleted dissolved oxygen levels in the lower layers of the Pond suggest a build up of organics on the Pond bottom and a potential to release in pond phosphorus. Reducing upstream sediment transport and input phosphorus should be a major component of a Stormwater Management Program.

VII. WATERSHED MANAGEMENT & PROTECTION

EPA's Center for Watershed Protection suggests a program of eight management tools for watershed management and protection. Each of the tools is an essential element in a comprehensive Watershed Management and Protection Program.

1. Land Use Planning

Effective Zoning and Planning Regulations address impervious cover and stormwater runoff. The Town of New London updated their Subdivision and Site Plan regulations to incorporate Low Impact Development Approaches (LID) that require runoff to be addressed at their sources. This may be addressed at the individual home site created by the subdivision process or immediate to the roadway created as part of a subdivision. Additional controls can be established through the zoning process. An ordinance can be developed that requires individual lot development to address the impacts of construction on existing lots of record as well as newly-created lots. CLD has worked with the Town of Newbury and has developed a Stormwater Ordinance that was approved by voters in Newbury in March, 2008. The New London Planning Board is reviewing this ordinance with possible plans to incorporate similar approaches within their ordinances.

Assisting in the development of such ordinances and supporting the approval and implementation of new land-use controls are ways to help reduce impacts to Lake and Pond water quality. Both New London Zoning Regulations and the State Shoreland Regulations also currently address the development of lots within the defined shoreland (250 ft. from mean high water under NHDES).

2. Land Conservation*

Five types of land may need to be conserved in a watershed:

- Critical habitats for plant and animal communities;
- Aquatic corridors along streams and shorelines;
- Hydrologic reserve areas that sustain a stream's hydrologic regime;
- Water-pollution hazards, including land uses or activities, that pose a high risk of pollution-spill potential. Conservation measures should exclude, restrict, or require setbacks for these uses.
- Cultural/ historical areas which are important to our sense of place.

A watershed manager must choose which of these natural and cultural areas must be conserved in a watershed in order to sustain the integrity of its aquatic and terrestrial ecosystems, and to maintain desired human uses from its waters. Each watershed should

* The Rapid Watershed Planning Handbook, Chapter 2, available at www.cwp.org

have its own land conservation strategy based on its management category, inventory of conservation areas, and land-ownership patterns.

The five conservation areas are not always clearly differentiated. Some of the natural areas may overlap among the conservation areas. For example, a freshwater wetland may serve as a critical habitat, be part of the aquatic corridor and also comprise part of the hydrologic reserve areas. However, the bulk of the most critical areas are covered in at least one of these five categories.

There are numerous techniques that can be used to conserve land which provide a continuum ranging from absolute protection to very limited protection. Some of the major land conservation techniques include:

- Land Acquisition;
- Conservation Easements;
- Regulate Land Alteration;
- Exclusion or Setback of Water Pollution Hazards;
- Protection within the Green Space of Open Space Designs;
- Landowner Stewardship;
- Public Sector Stewardship.

3. Aquatic Buffers*

The aquatic corridor, where land and water meet, deserves special protection in the form of buffers. A buffer can be placed along a stream or shoreline or around a natural wetland. A buffer has many uses and benefits. Its primary use is to physically protect and separate a stream, lake or wetland from future disturbance or encroachment. For streams, a network of buffers acts as a right-of-way during floods and sustains the integrity of stream ecosystems and habitats. Its functional importance in watershed protection merits some discussion on how they work and why they are important.

In some settings, buffers can remove pollutants travelling in stormwater or groundwater. Shoreline and stream buffers situated on flat soils have been found to be effective in removing sediment, nutrients, and bacteria from stormwater runoff and septic system effluent in a wide variety of settings (Desbonet et al., 1994). Buffers can also provide wildlife habitat and recreation. In many regions of the nation, the benefits of a buffer are amplified if it is managed in a forested condition.

Buffers are important because they make up an integral part of the watershed protection strategy and complement other programs and efforts to protect water quality.

4. Better Site Design*

Individual development projects can be designed to reduce the amount of impervious cover they create, and increase the natural areas they conserve. Many

* The Rapid Watershed Planning Handbook, Chapter 2, available at www.cwp.org

innovative site planning techniques have been shown to sharply reduce the impact of new development.

Cluster development designs minimize lot sizes within a compact developed portion of a property while leaving the remaining portion open. Clustered development creates protected open space that provides many environmental as well as market benefits. Cluster or open space development design typically keeps 30 to 80% of the total site area in permanent open space with much of the open space managed as natural area.

The key benefit of open space or cluster development is that it can reduce the amount of impervious cover created by a residential subdivision by 10 to 50% (CWP, 1998b; DE DNREC, 1997; Dreher and Price, 1994; Maurer, 1996; SCCCL, 1995). Clustering can also provide many community and environmental benefits. It can eliminate the need to clear and grade 35 to 60% of total site area and can reserve up to 15% of the site for active or passive recreation. This approach reduces the pressure to encroach on buffers and other natural areas. In addition, the ample open spaces within a cluster development provide a greater range of locations for more cost-effective stormwater runoff practices.

Since streets are one of the biggest components of impervious cover created by car transport needs, headwater streets are built on a revised classification system where street width declines with decreasing average daily trips (much like headwater streams which decrease in size with decreasing drainage area). This is essential, since streets are a key source area for stormwater pollutants and do not allow the natural infiltration of water into the ground. By revisiting and changing some local subdivision codes many of the traditionally-accepted standards can be changed to address this issue.

Re-directing rooftop runoff over pervious surfaces before it reaches paved surfaces can decrease the annual runoff volume from a site by as much as 50% for medium to low density residential land uses (Pitt, 1987). This can significantly reduce the annual pollutant load and runoff volume being delivered to receiving waters and, therefore, can have a substantial benefit in reducing downstream impacts.

5. Erosion and Sediment Control

In New London, any new development to be proposed within the watershed should have a high degree of review and be subject to relatively stringent standards and regulations on the Town level. The latest New London subdivision regulations stress low impact development approaches (LID) and the inclusion of open-space buffers. A development's effect on drainage and runoff must address and be designed for no net increase in the rate and volume of runoff generated by the buildout of such a project. To meet these requirements, the impact of runoff must be applied to each proposed lot as well as the overall development project.

Currently in New London, Erosion Control Plans are required to be filed and approved before any building permit is issued on lot having a slope of 15 to 25%. No development is allowed on lots over 25% slope. State Shoreland and New London Zoning Regulations require the submission and approval of Erosion Control Plans for lot development within the shoreland buffer (250 ft from mean high water) before any construction can begin.

The attached "Guidance Manual for Homeowners and Contractors" discusses erosion controls and Best Management Practices (BMP's) for lot construction.

6. Stormwater Management & Treatment

There are many methods to apply to stormwater management and treatment. The general goals for stormwater are:

- Maintain groundwater recharge and quality;
- Reduce stormwater pollutant loads;
- Protect stream channels;
- Prevent overbank flooding;
- Safely convey extreme floods.

Stormwater practices are used to capture, store, treat, and infiltrate stormwater runoff. NHDES and EPA Stormwater web sites provide many sources and links to stormwater practices.

The "Guidance Manual for Homeowners and Contractors" provides information on handling stormwater. Throughout this report, suggestions have been provided for dealing with stormwater runoff.

7. Non-Stormwater Discharges

In the Messer Pond Watershed, key program elements can consist of establishing a program to inspect private septic systems, repair or replacement of failing systems, utilizing more advanced site septic controls, identifying and eliminating illicit connections and spill prevention.

8. Watershed Stewardship Programs[*]

There are six basic programs that should be considered to promote a greater watershed stewardship:

- Watershed Advocacy;
- Watershed Education;
- Pollution Prevention;
- Watershed Maintenance;
- Indicator Monitoring;
- Restoration.

Promoting Watershed advocacy is important because it can lay the foundation for public support and greater watershed stewardship. The MPPA serving as the watershed management organization is uniquely prepared to handle many critical stewardship programs, given their watershed focus, volunteers, low cost and ability to reach into

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[*] The Rapid Watershed Planning Handbook, Chapter 2, available at www.cwp.org

communities. The MPPA can be a forceful advocate for better land management and can develop broad popular support and involvement for watershed protection. Local government also has an important role to play in the watershed advocacy. In many watersheds, local governments create or direct the watershed management structure.

We must learn two things: that we live in a watershed and that we understand how to live within it. The design of watershed education programs that create this awareness is of fundamental importance. The four elements of watershed education are as follows:

- Watershed Awareness: raising basic watershed awareness through streamwalks, maps, reports, and informational meetings
- Personal stewardship: educating residents about the individual role they play in the watershed and communicating specific messages about positive and negative behaviors
- Professional training: educating the development community on how to apply the tools of watershed protection
- Watershed engagement: providing opportunities for the public to actively engage in watershed protection and restoration

For more information about pollution prevention, see NHDES Pollution Prevention Program Information on the NHDES web site.

Most watershed protection tools require maintenance if they are to properly function over the long run. Some of the most critical watershed "maintenance" functions include management of conservation areas and buffer networks, and maintenance of stormwater practice and septic systems.

An ongoing stewardship responsibility is to monitor key indicators to track the health of the watershed. The VLAP is an important aspect to the Stewardship program.

VIII. CONCERNS AND RECOMMENDATIONS

A program to address impacts from the potential sources noted in section IV of this report and one that addresses the concerns below would help maintain high water quality and reduce the rate of eutrophication in Messer Pond. Such a program should address minimizing input and impacts to Messer Pond through the 8 management tool approach.

A. Concerns with Sediment and Sand Transport from Road Runoff.

1. Sediments and sands carried off roadways, road shoulders, and road ditches and into culverts and transported down into runoff channels, streams, and, ultimately, Messer Pond have a significant impact to the water quality and pond depth of Messer Pond.
    - Sand applications from this past winter are piled up on the local roads within the watershed.
    - A significant build up of sand was noted on Forest Acres Road, Fieldstone Lane, Little Cove Road, and White Pine Lane.
    - Forest Acres Road has some very wide shoulder areas covered with sand, and the road ditches are thick with sand.
    - Runoff from snowmelt has carried sands down into road ditches partially filling culverts, and depositing sand in streams close to Messer Pond. Any significant spring rains will carry these soils farther down the watershed and into Messer Pond. Observations of local roads in some of the other area towns did not show as much sand buildup along road shoulders. Road sweeping will remove some of this sand, but there is a lot deposited on the shoulders, on the slope into the ditch areas and in the road ditches. Much of this material will either need to be cleaned out with a small machine or by hand raking. If these sands are not removed from the ditches and culverts, the soil will be carried out into the streams and wetlands adjacent to Messer Pond.
    - Many of the problems noted along and in Messer Pond collectively create impacts to the Water Quality of the Pond. Sediment from erosion carries nutrients, particularly phosphorous, that eventually makes its way to the Pond. Some natural processes work to adjust to these impacts and, in themselves, are a mechanism for removing nutrients. Natural wetlands are a filter that can remove sediment and nutrients, but increases in runoff can flush the wetlands and carry material into the Pond.
    - Flowing water can carry the constituents that create a chain reaction as they move into the pond. Reducing the impacts is a process that has many solutions and requires varied approaches.

2. Sediment carried in Nutter Brook down to the inlet area of the Pond is a major concern.
    - Sand, silt, and nutrients are moving further into the pond. The impact has resulted in several changes within the pond.
    - Sediment has formed a delta at the stream inlet.

- Some of the sediments are spreading beyond this immediate area and, dependent of internal pond currents, appears to be spreading further into the pond and out along the edge of the pond. This is creating shallower water along the edge of the pond that provides a growth medium richer in nutrients. Plants more adaptable to the shallow water are spreading along the edge of the pond. These plants take up nutrients and act as filters to both nutrients and sediment keeping more of these contaminants along the shallow edge of the pond. As these plants spread they become a problem to recreational use of the pond. Removal and control then becomes difficult. Thicker plants that periodically die off create more organics along the pond bottom resulting in more muck. As growth blocks sunlight from reaching the bottom of the pond and the organic build-up increases the dissolved oxygen along the bottom of the pond gets depleted sooner. This depletion can result in the release of bound up phosphorous in the bottom sediments.
- The organic decay of plants naturally occurs in lakes and ponds; it's an imbalance due to overgrowth that is of concern. The more erosion and sediment transport that can be controlled prior to entering the pond the less impact there will be in disrupting the balance and aging of the pond.

3. The impact from Browns' Brook is similar although not apparently as extensive. Lake currents do not appear to spread the incoming flow. The inlet area seems more isolated due to the shoreline shape and location on the pond.

4. Shoreline septic systems play a part that can influence growth along the shoreline of the pond. Older and/or improperly functioning septic systems close to the pond can affect the water quality. Setting up a program to inventory systems, where they are, and what they consist of, as well as information on tank pumping will provide a data base to assess potential impacts. Tanks should be pumped on a regular cycle somewhat dependent on use and occupancy. Some lake associations have set up a program to contract out pumping and pump multiple homes under one contract. This can result in a cost saving to homeowners. Examination of the tank and regular pumping can alert a homeowner to a problem before it becomes severe.

5. The County Road Brook inlet area is a concern. There were times when very turbid water was observed flowing under County Road. Flow in County Road Brook comes out of a large sub-watershed area. There was some question as to the exact sampling location in the Pond at this end. Is the sampling representative of the incoming flow? This sub-watershed area has a lot of impermeable areas. Also noted during a site walk with NHDES was a small horse farm just off the intersection of Columbus Ave. and Burpee Hill Road. Horses were observed grazing and feeding immediately along a runoff channel that flows through the fenced-in yard area. This channel eventually flows into County Road Brook. Sampling data does not show high levels of phosphorous as compared to those levels recorded at the Nutter Brook inlet. Due to the relatively-high volume of water that flows into the pond from County Road, there is a significant dilution factor. Are the phosphorous levels in

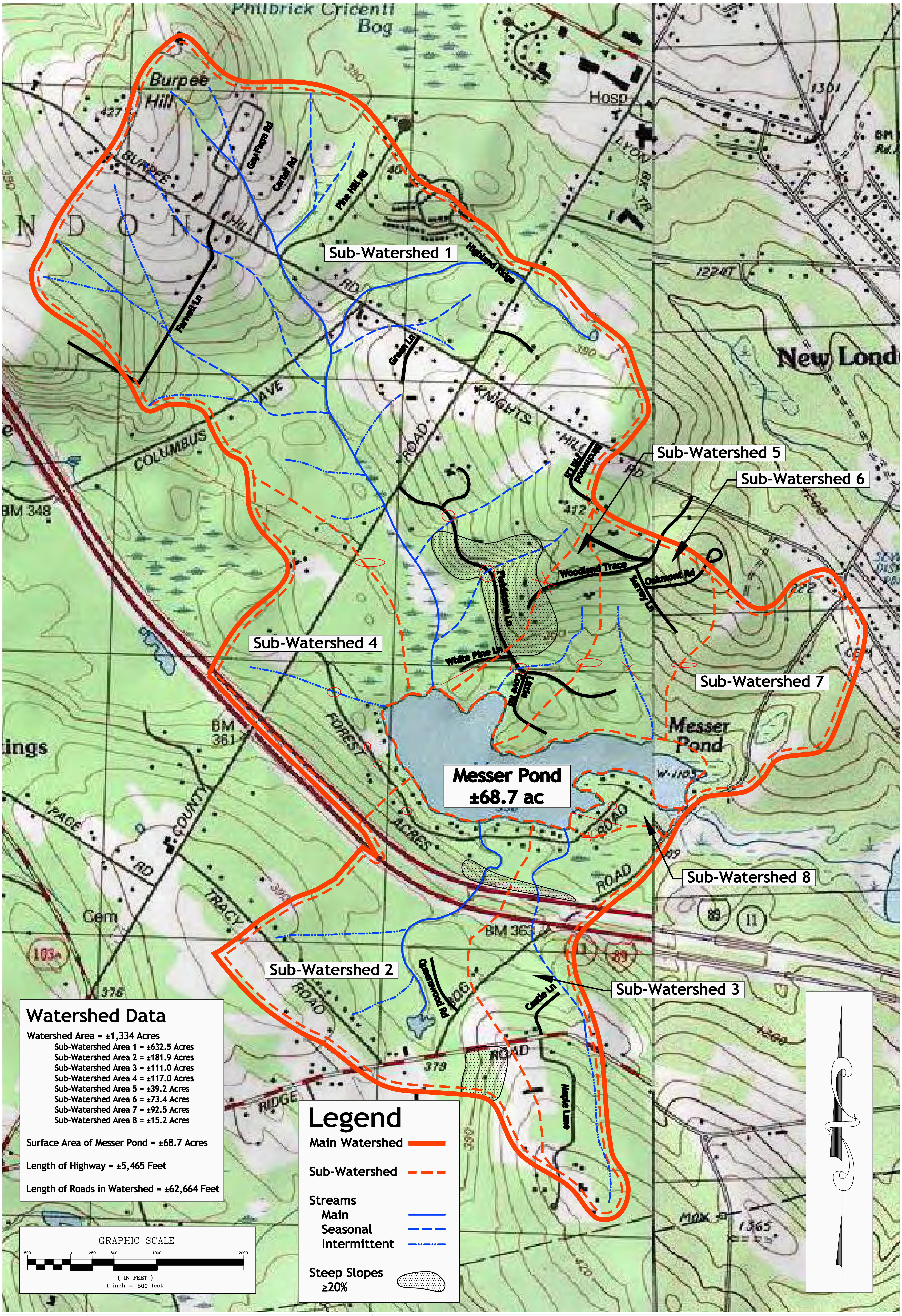
County Road Brook more regularly occurring? The 3500 ft. of wetland that County Road Brook flows thru may reduce the phosphorous loading; but, if that is the case, we would not expect to see the high-turbidity levels that were visually observed the day we met with NHDES staff this fall. Bracketed sampling during both rain events and dry-weather flow in Browns' Brook, Nutter Brook, and County Road Brook can help better understand the source locations, variations in contaminant concentrations, and how they are influenced by rain events.

B. Watershed Management Objectives

1. Address the sand buildup on local roads, particularly those roads immediate to the pond, including Forest Acres Road, Fieldstone Lane, Little Cove Road, and White Pine Lane. Sands from road sanding are washing into culverts, restricting their capacity, and under high-runoff conditions, the sediment is flushed out into streams and runoff channels. The sand chokes out vegetation, reduces the capacity of runoff channels, and once in the pond, it fills in the pond. Sand in the pond covers existing vegetation that decays under the sand providing nutrients for new plant growth. The new growth may be a different species of plant that is more adaptable to the sand base and shallower depth. Continuous movement of sediment and trapped organics into the pond creates a dynamic condition that promotes the aging of the pond.
2. Work with the Town of New London and the New London Public Works Director to develop methods for the removal and collection of road sand to get it out of the runoff path. Also remove sand piles left after snowmelt along roadways and at end of road locations. Consider vegetating areas along the sides of roads and provide methods for sediment collection. This requires periodic removal of the builtup sands. The vegetation acts as a filter to help remove sand immediate to the area of application. Small sediment basins with check dams of stone or living filters of compost material can be used as permanent collection points for removing sand from the runoff flow. These features do need to be cleaned out after major storm events.
3. Educate Homeowners to methods and approaches for dispersing site runoff and Best Management Approaches to reducing erosion and impacts from Stormwater Runoff. Maintain wooded buffers around individual properties where runoff can be dispersed into the natural woodland buffer. There are methods in the Guidance Manual for Homeowners and Contractors that can be applied to both existing home sites as well as new construction.
4. Educate Homeowners to the proper operation of their septic systems. Develop a database of existing system types, locations, and pumping cycles. Older systems sitting in the groundwater table can cause both groundwater and surface water pollution. Systems in close proximity to the edge of a stream or surface water are apt to impact those water bodies.
5. Develop riparian buffers along and between house sites and the edge of Messer Pond. Educate homeowners to proper shoreland management and riparian buffer approach.

6. Contact NHDOT and request that they clean out I-89 culverts so that these pipes can flow freely.
7. Maintain the lake monitoring program and add stream sampling locations. Bracket (isolate stream sections by sampling above and below areas suspect for nutrient input) streams where nutrient levels are above ambient to help determine sources of nutrient input.
8. Observe stream conditions during different times of the year and after major rain events to help define problem areas.
9. Develop a Watershed Management Plan for the pond that incorporates the following:

    - Defines known problem areas;
    - Includes continued monitoring;
    - Provides a priority system for addressing known problems;
    - Includes an action plan;
    - Educates homeowners to concerns, corrective actions, and the do's and don'ts for runoff and stormwater management;
    - Allows for working with town officials to help solve problems;
    - Has a land-use component supported by local regulations;
    - Has an active, erosion-control program and includes the maintenance of erosion-control features;
    - Incorporates land-conservation practices;
    - Addresses any illicit discharges;
    - Provides for riparian buffers to streams and the Pond;
    - Researches web sites for current approaches to watershed management, i.e., EPA's Stormwater Programs, the Center for Watershed Protection, (www.cwp.org), (www.stormwatercenter.net).



DATE:	APRIL 2008
SCALE:	1" = 500'
PROJECT #:	07-0236
DRAWING #:	Presentation

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Messer Pond Watershed

PROJECT LOCATION:
New London
New Hampshire

Appendix C

Compilation of Messer Pond History

MESSER POND HISTORY

Originally the town was called Heidelberg. On June 25, 1779 the name was changed to New London. A warrant was issued and Mr. Samuel Messer was authorized to call a meeting to choose town officers. Mr. Messer called a meeting for August 3, 1779 in which 13 voters met at Squires home on Messer Hill, which is now Knights Hill Road, to elect officers and conduct business. Messer Pond was named after Samuel Messer who was the first selectman of the town and who owned land down to the pond. [1]

The Hurricane of '38 was an important time in the history of the pond. On September 21, the largest lumber program in the town's history took place. During the hurricane, 20 million board-feet of lumber and 10,000 cords of wood were leveled. Total cost exceeded $100,000.[2] The New London Selectmen did not want to use Lake Sunapee, Little Sunapee or Pleasant Lake for storing the logs. (These were prime recreational water bodies and tourist attractions as well as drinking water sources for those living on those lakes). Otter Pond (Georges Mills) and Todd Pond (Bradford) were the largest receiving stations.[3] Messer Pond (New London) and Gile Pond (Sutton) were considered "smaller" bases. 10,000 cords of wood were stored in Messer Pond.[4] A report on salvaging the lumber after the hurricane stated that 700,000,000 feet or more of white pine must be logged and either put in ponds, lakes or rivers or sawn and struck before July 1939. The idea was to store the wood in water, which would extend the handling period for 5-6 years for future use.[5] Unfortunately, there is no evidence that any of the timber stored in Messer Pond was ever retrieved to be used for building or other use. Much of the tannin on the bottom of the pond is a result of loosened bark from the wood stored in the pond. You can see the eye bolts in rocks along the shore where the booms were hooked to bring the logs to the pond and saw mill near the pond.

The Cricenti family acquired the pond property and subsequently sold it to Forest Kimball in the mid 1950's. Mr. Kimball developed a lot plan and registered it in Concord. One of Forest Kimball's children built a log cabin on the pond in 1957 (no heat or electricity). Under a 1958 Zoning Act, Mr. Kimball was allowed to develop the property without directives. There were 49 lots on the plan. Lots on the Forest Acres side of the pond were put up for sale. A road was build behind the Haskell cabin. In 1962, the road, now Forest Acres Road (originally called Messer Pond road) was required to brought up to minimum standards.

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[1] History of Messer Pond, Karen Haskell, May 1, 1996. Prior to that, maps identify Messer Pond as Bog Pond, probably because it is located off of Bog Road.

[2] Ibid.

[3] Speaker, Nov. 1938

[4] "There is sufficient timber within a 3-mile radius of each of these places to fill them to the limit." Speaker, Jan. 1939. I could find no verification that the actual number of logs was 10,000. TBB

[5] Report of the Foresters and Lumbering Subcommittee, New Hampshire Disaster Emergency Board, Owen Johnson Chairman.

As early as 1957 some water testing was being conducted on water bodies in New London. Bad bacteria was found in Lake Sunapee in 1957. As a result, higher water quality standards were urged. The town announced that the testing would be extended to Messer Pond as well as all brooks in New London in 1964.[6] The purpose was to determine if, where, and when pollution of our waters was occurring. However, per the 1964 Town Report this did not occur due to inadequate funding and low water levels.[7] In 1965, the Town report indicated that Messer Pond and Otter Pond were included in the water testing program. The purpose of these tests was to ensure the safety of drinking water as well as for swimming. It did not cite Messer Pond specifically, but did indicate that a brook from Clark Pond at Kind Hill Road was high in cloriform and exceeded Class A limits.

In 1968, the Town of New London's Water Pollution Control Program was augmented with a town financed physical inspection of all waste disposal systems on the New London shore of Lake Sunapee.[8] In 1969 the Report of the Town Health Officer discussed the results of the septic survey on Lake Sunapee. The problem was faulty septic systems. Many problems were corrected or were in the process of being corrected. This was a big issue since residents on Lake Sunapee use the lake water for their drinking water.[9] The report also noted that specimens of water for bacteriological examination were also taken from strategic points on Pleasant Lake and Messer Pond as well as bacteriological testing. Otter Pond had high cloriform levels.[10] [11]

In the late 1960's into the 1970's the town concentrated on protecting the drinking water in the New London area. Per Bob and Sandy Brown there was a time when residents on Messer Pond used the pond water for drinking water. The town focused on water treatment facilities for the town and concern over septic systems and their impact on the water. There were various engineering reports on water supply alternatives and treatment plants for the town of New London. None of them mentioned Messer Pond. It does not seem that anyone now uses Messer Pond for drinking water!! In 1972 the Health Officer reported that inspection of sewer systems is a time-consuming burden. He recommended that homeowners consult with the town before they build.[12] In 1973, the Town expressed general concern

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[6] 1963 New London Town Report, p. 74.

[7] 1964 New London Town Report, p.72-74.

[8] 1968 New London Town Report, p.73.

[9] 1969 New London Town Report, p.76.

[10] 1970 New London Town Report, p.69.

[11] I interviewed Donald Bent who was the Health Officer for several years. He told me that on Messer Pond there was one septic system that was not up to code and should have been changed, but that the owner had pull with the town and nothing was done. He did not say and I was reluctant to ask which one it was. Otherwise there was no record of results of the Messer Pond's septic survey.

[12] 1972 New London Town Report, p.57.

about septic systems (not Messer Pond specific).[13] There was a survey done on Messer Pond in August 1975.[14] Local procedures concerning septics were formalized on May 29, 1977 (Septic plan approval before having a septic put in). Residents on lakes were urged to monitor their septic systems. In 1980 all the wells on Messer Pond as well as Lake Sunapee, Little Sunapee, and Pleasant Lake were tested during July, August, and September. They were also inspected visually. No results were given.[15]

In 1979, soil erosion and agricultural waste roadbank sites were identified on Messer Pond. Never found anything else about this.

In the 1960's Bruce Haskell requested that Messer Pond be stocked with fish. The State granted the request and stocked the pond with large-mouthed bass. During the period 1979-1989 there was an annual fishing derby on Messer Pond each March for the Boy Scouts. Plaques were given for the largest fish caught. In 2011 and 2012, MPPA stocked the pond with rainbow and brown trout. To this day, Messer Pond is a favorite fishing spot. For the past several years, New London Elementary School has brought students to Messer Pond for ice fishing in the winter.

I interviewed Bob and Sandy Brown because they have been on the pond since at least the early 1970's. Bob recalled that in the late 1970's or early 1980's a beaver dam near a chicken farm on Tracy Road broke and all kinds of debris and chicken poop came down near what is now the Bowie's residence on Forest Acres. It was Oz Peter's home at the time and apparently he was quite upset as it was in his yard and into the water. My interview with the town Health Officer did not produce any recollection of the event and I found no official record of it.

A 1972 Ecological Study of Lake Sunapee found that Herrick Cove had high salt content of 425 per million apparently attributable to road salt on I-89. I-89 constructed some time after 1969 and before this study.

In 1995, the Town of New London, in conjunction with the late Jody Connor from NH DES, approached several Messer Pond residents to form a protective association for the pond. At that time, only the Forest Acres side of the pond was developed. The Messer Pond Protective Association was formed in May 1996 to serve, promote, and preserve the recreational and natural resource interest of the pond and the adjoining areas. Monthly water quality monitoring began that year. Members were also given guidance on the care and pumping out of septic systems. The Association also became involved in further development initiatives on the pond by attending New London Planning Board meetings and the Association joined the New Hampshire Lakes Association. In 1997, the Town of New London received a

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[13] 1973 New London Town Report, p.64.

[14] 1975 Town Report, p.65 **I have not yet found a copy of that survey. Still need to check with the New London Planning Board.**

[15] 1980 New London Town Report

proposal for a subdivision on the north side of the pond. That subdivision was approved in 1998 with Bob Bell. In 2007, the town approved another subdivision off Bog Road by Harry Snow. That is the Rocky Ridge development. The second house in that subdivision is being built in 2015. They have waterfront property but are precluded from have docks due to the wetlands.

In 2011, MPPA became a 501(c)(3) non-profit corporation.

Since the Association was established, it has expanded its water protection efforts and instituted the following programs:

1996: Weed Watch Program
1996: Joined NH DES Volunteer Lake Assessment Program
2007: Lake Host™ Program
2008/2009: Messer Pond Clean Up Days
2009: Septic Pump Out discount program—MPPA participants get a discount for being on a regular septic pump out program
2008: Contract with CLD Engineering to conduct a Watershed Evaluation
2013: Keep New London Presentable Program—MPPA volunteers pick up trash on County Road from Burpee Hill to Tracy Road
2014: town approved posting of a sign identifying boundary of Messer Pond Watershed

Appendix D

Messer Pond Depth/Bathymetric Maps

For fishing regulation information, please refer to the NHFGD Freshwater Fishing Digest.

Contact: NHFGD Region 2 (Lakes Region), New Hampton
E-mail: reg2@wildlife.nh.gov Phone: 603-744-5470

MESSER POND
New London

FISHERY: **ACRES:** 72

TROPHIC LEVEL: MESO

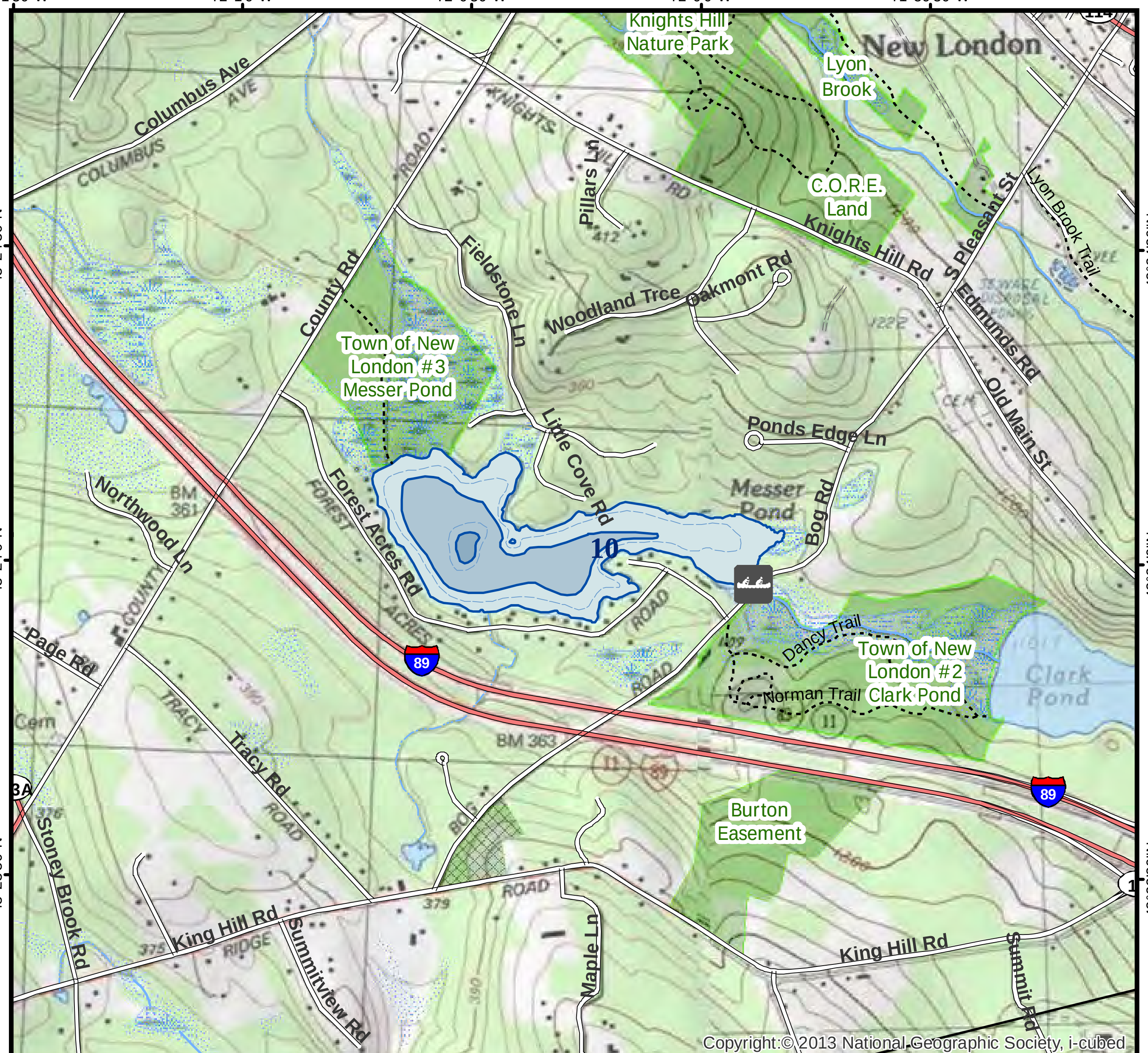
AVG. DEPTH: 8 **MAX. DEPTH:** 25

SPECIES:

ADDITIONAL INFO:

ACCESS: cartop

Please contact NH Dept of Safety, Marine Patrol for info. on water body/boat/motor restrictions: (603) 293-2037 www.nhmarinepatrol.com



Public Water Access site

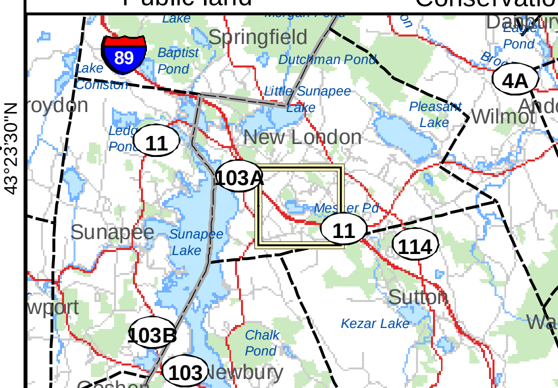
- Canoe/cartop
- Shorebank
- Ramp
- Bathymetric contour (feet)

Bathymetry provided by the NH Department of Environmental Services, Watershed Mgt Bureau

- Town boundary
- Primary Route
- Road or Street
- Trail or other
- Stream or Shoreline
- Surface Water
- Wetland
- Conservation or Public land
- Restricted Access Conservation

Cleared
Forest
Contour
Building

Source: USGS



N

0 1,000 2,000 Feet

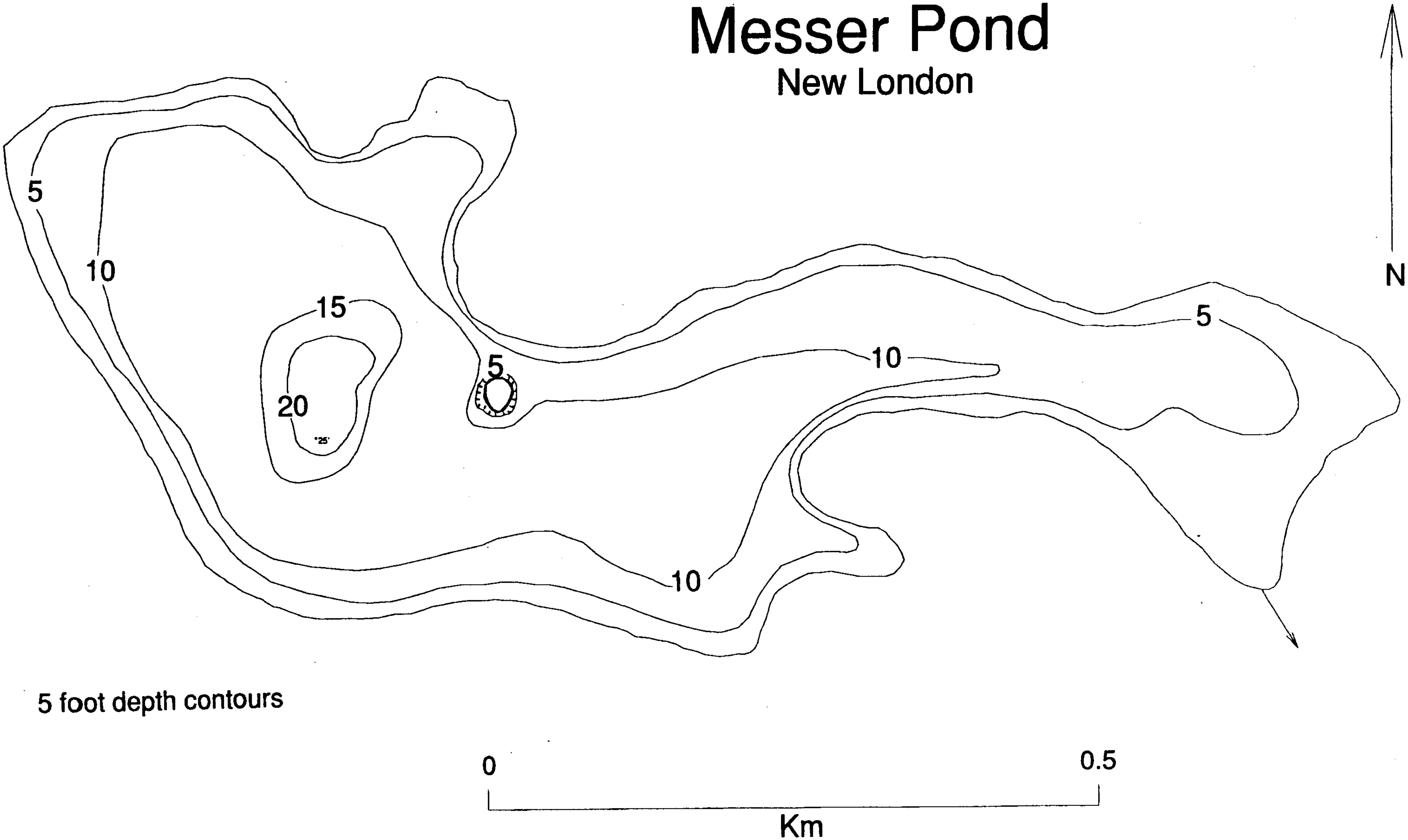
0 0.2 0.4 Miles

Most data presented on this map represent stock data sets obtained from NH GRANIT, Complex Systems Research Center, UNH. CSRC, NHOEP, NHFGD and the cooperating agencies make no claim as to the validity or reliability or to any implied uses of these data. NOT FOR NAVIGATION.

Directions: Rt 114 to S. Pleasant St, to Bog Rd

Messer Pond

New London



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Appendix E

Septic System Survey Results

Messer Pond

Watershed-Based Implementation Plan

Septic System Survey Results

Parcel Number	Address	Block	Lot	Records Found	Age of house	Age of system	Occupancy Rating (3 bdrms, 4, etc.)	Distance of system to water	House use (year-round/seasonal use)	How often pumped	Last time pumped
NewL-093-013-000	COUNTY ROAD	093	013	land							
NewL-105-002-000	82 LITTLE COVE ROAD	105	002	yes	2003	4/11/2003	3	130 feet	year round		
NewL-105-003-000	66 LITTLE COVE ROAD	105	003	yes	2002	3/26/2002	4	130 feet	year round		
NewL-105-004-000	58 LITTLE COVE ROAD	105	004	yes				150 feet	year round		
NewL-105-005-000	38 LITTLE COVE ROAD	105	005	yes	2005	6/23/2005	4	60 " to wetland/ 80' to pond	year round		
NewL-105-006-000	318 FIELDSTONE LANE	105	006	yes	not waterfront						
NewL-105-007-000	21 WHITE PINE LANE	105	007	no	2004	5/19/2004	3		year round		
NewL-105-008-000	63 WHITE PINE LANE	105	008	yes	1999	8/27/1999	4	160 feet	year round		
NewL-105-009-000	64 WHITE PINE LANE	105	009	yes	1999	8/27/1999	3	130 feet	year round		
NewL-105-011-000	101 FOREST ACRES ROAD	105	011	yes	2002	1/3/2002	3	80 feet to wetlands/far to pond	year round		
NewL-105-012-000	121 FOREST ACRES ROAD	105	012	yes but incomplete			3	62 line1,100 line 2	seasonal		
NewL-105-013-000	129 FOREST ACRES ROAD	105	013	no septic plans	1973/eby1985		3		seasonal		
NewL-105-014-000	143 FOREST ACRES ROAD	105	014	yes	1928/eby1962	1971	2	85 feet	year round	every 3 years	2012
NewL-105-015-000	153 FOREST ACRES ROAD	105	015	yes	1986	1986	4	100 feet	seasonal		
NewL-105-016-000	171 FOREST ACRES ROAD	105	016	yes	1950/eby1977	11/13/2001	3	75 feet	year round		
NewL-105-017-000	185 FOREST ACRES ROAD	105	017	yes	2005		4	110 feet	seasonal		
NewL-105-018-000	195 FOREST ACRES ROAD	105	018	yes	1964/eby1981		2	90 feet	seasonal		
NewL-105-019-000	203 FOREST ACRES ROAD	105	019	yes	1978/eby1987	1973?	2	90feet	seasonal		
NewL-105-020-000	217 FOREST ACRES ROAD	105	020	yes	1993	11/8/1993	3	130 feet	year round		
NewL-105-021-000	235 FOREST ACRES ROAD	105	021	yes	2005	7/29/2003	3	130 feet	seasonal		
NewL-106-004-000	533 FOREST ACRES ROAD	106	004	yes	1998	10/7/1998	3	160 feet	year round		
NewL-106-005-000	BEAVER POINT	106	005	land							
NewL-106-006-000	44 BEAVER POINT	106	006	yes	1962/eby1985		3	90 feet	year round but winter rental		
NewL-106-007-000	38 BEAVER POINT	106	007	no septic plans	1966/eyb1985		2		seasonal		
NewL-106-008-000	26 BEAVER POINT	106	008	no septic plans	1980/eyb1987		3		seasonal		
NewL-106-009-000	12 BEAVER POINT	106	009	yes	1984/eby1991	1979	2	90 feet	year round		
NewL-106-010-000	547 FOREST ACRES ROAD	106	010	no septic plans	1970/eby1987		3		seasonal		
NewL-106-011-000	316 BOG ROAD	106	011	no septic plans	1966/eby1977		2		not occupied for last year due to illness		
NewL-106-012-000	216 BOG ROAD	106	012	yes	1991/eyb1999	1991	4	130 feet	year round		
NewL-106-013-000	29 POND'S EDGE LANE	106	013	not bordering Messer Pond							
NewL-106-013-001	57 POND'S EDGE LANE	106	013-001	land							
NewL-106-013-002	85 POND'S EDGE LANE	106	013-002	land							
NewL-106-013-003	104 POND'S EDGE LANE	106	013-003	land							
NewL-106-016-000	FIELDSTONE LANE	106	016	land							
NewL-106-017-000	388 FIELDSTONE LANE	106	017	yes	2001	2001	3	111 feet	seasonal		
NewL-106-018-000	370 FIELDSTONE LANE	106	018	yes	2004	9/13/2004	4	60 ft. waiver from DES to allow	seasonal		
NewL-106-019-000	89 LITTLE COVE ROAD	106	019	yes	2002	12/10/2002	3		year round		
NewL-118-012-000	253 FOREST ACRES ROAD	118	012	incomplete		1/24/1997	3		seasonal		
NewL-118-013-000	273 FOREST ACRES ROAD	118	013	yes	2004	8/25/2004	3	135 feet	seasonal		
NewL-118-014-000	287 FOREST ACRES ROAD	118	014	yes	1991/eyb1995	1985/1990	4	130 feet	seasonal		
NewL-118-015-000	295 FOREST ACRES ROAD	118	015	yes	1966eby1996	6/20/2012	2	80 feet	seasonal	new	
NewL-118-016-000	305 FOREST ACRES ROAD	118	016	yes	2006	7/5/2006	2	125 feet	seasonal		
NewL-118-017-000	315 FOREST ACRES ROAD	118	017	yes	1994/eby2000	1994	3	110 feet	seasonal		
NewL-118-018-000	329 FOREST ACRES ROAD	118	018	no septic plans	1983/eby1989		2		year round		
NewL-118-019-000	FOREST ACRES ROAD	118	019	land							
NewL-118-020-000	357 FOREST ACRES ROAD	118	020	yes	1963/eby1985	2003	3	70 feet	year round	every 3 years	2011
NewL-118-021-000	387 FOREST ACRES ROAD	118	021	yes	1980/eby1995	1980	2	90 feet	seasonal		
NewL-118-022-000	395 FOREST ACRES ROAD	118	022	yes	1990/eby1997	1990	2	110 feet	year round		
NewL-119-001-000	BOG ROAD	119	001	land							
NewL-119-013-000	427 FOREST ACRES ROAD	119	013	no septic plans	1987/eby1993		2		year round		
NewL-119-014-000	449 FOREST ACRES ROAD	119	014	no			garage /workshop	trying to get permits to build	no conforming lot		
NewL-119-015-000	471 FOREST ACRES ROAD	119	015	yes	1977/eby1987	7/6/2007	3		seasonal		
NewL-119-016-000	477 FOREST ACRES ROAD	119	016	yes	1960/eby1981	7/21/2008	2	70 feet	seasonal		
NewL-119-017-000	FOREST ACRES ROAD	119	017	land							
NewL-119-018-000	FOREST ACRES ROAD	119	018	land							
NewL-119-019-000	565 FOREST ACRES ROAD	119	019	yes	1970/eby1983	1999	4	130 feet	seasonal		
NewL-119-020-000	575 FOREST ACRES ROAD	119	020	yes	1970/eby1983	6/1/2005	4	90 feet	seasonal		
NewL-119-021-000	583 FOREST ACRES ROAD	119	021	no septic plans	1940/eby1975		2		seasonal		