English Brook Watershed Assessment

Warren County Soil and Water Conservation District

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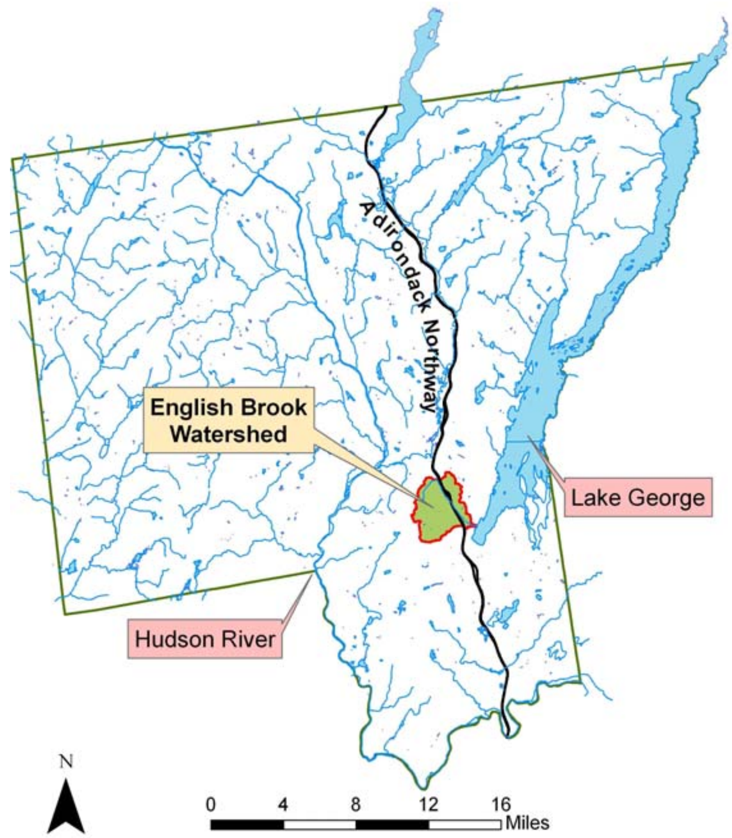
Introduction and Background

There are over 160 streams which enter Lake George contributing approximately 55% of the lake's water budget. The quality of these streams is a direct result of the lands which drain to them (their watersheds). To understand a stream system and its overall health and quality, one needs to look upland to see what is occurring within that watershed. As forested lands become developed, there is often a change in how the land reacts to precipitation events. If those developments are not well designed, then there can be significant increases in the volume of water which runs off into the local stream. The quality of this water is also often changed, as runoff picks up pollutants and carries them to the receiving stream as well. These changes modify the characteristics of the waterbody that they drain to, and ultimately the waterbodies below them.

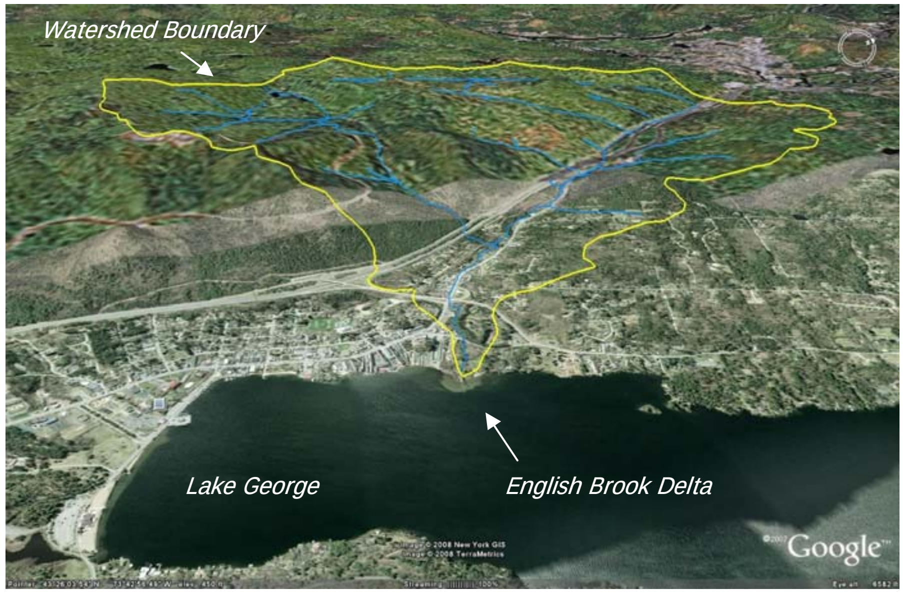


The focus of this study is the English Brook watershed, primarily located in the Town of Lake George. English Brook is one of the largest tributaries to Lake George, and has exhibited changes over time in relation to its water quality and the volume of sediment that it carries into Lake George. Many of the larger streams in the Lake George Basin exhibit deltas at their outlets, as a result of in-stream sediment settling out when it reaches the lake. The English Brook delta has increased dramatically over the past 50 years, largely beginning with the construction of Interstate 87 (the Adirondack Northway) and subsequent development of the watershed which continues today. The English Brook delta is perhaps the most widely known delta in Lake George, at over 60,000 cubic yards in size. In the summer, boaters often get caught on this delta, as the water is usually only one or two feet deep over the sediment at a location of over three hundred feet into the lake.

In late 2007, the Warren County Soil and Water Conservation District (District) began an evaluation process to identify water quality impacts to the brook coming from within the English Brook watershed. Issues such as stormwater runoff, streambank erosion, onsite septic system issues, forestry and logging practices were looked at in the following study. The District conducted this watershed assessment with the intent of determining major issues within the watershed which contribute to the delta growth and reduced water quality, and to identify opportunities to remediate these issues. The outcome is a document which is intended to serve as a guideline for restoration and improvements within this watershed. These improvements would be intended to slow the English Brook delta growth, and to improve the water quality and ecology of the brook and Lake George.

Stream and Watershed Characteristics

A. Location



The English Brook watershed encompasses 5,323 acres (approximately 8.3 square miles) and drains to the southern basin of Lake George. The watershed is located in two townships: the Town of Lake George (80% of the watershed) and the Town of Warrensburg (20% of the watershed up in the headwaters). The brook outlets just north of the village line in Lake George on the Lochlea Estate property. Although the stream system comprises many small tributaries, English Brook has two primary branches; the Main Branch and the Big Hollow Branch (USGS Lake George Quadrangle). The Main Branch is approximately 6.9 miles from the source up off of Somerville Road to its outlet in Lake George. The Big Hollow branch is the other main component stream of English Brook, adding another 2.5 miles to the brook's linear mileage. In all, there are eleven separate tributaries of English Brook which total approximately 13.4 miles.

The highest elevation in the watershed is located at the source of the Big Hollow branch at an elevation of 1,900 feet above mean sea level. The elevation at the source of the Main Branch is 1,400 feet located on Somerville Road in the Town of Warrensburg. From its source, the Main Branch flows slightly northeast from the Town of Warrensburg into the Town of Lake George, and turns south where it meets the edge of NYS Route 9. As the brook continues to the South, it runs adjacent to New York State Route 9 through the Town of Lake George for approximately three miles (from Somerville Road to Exit 22 of the Adirondack Northway), and finally to its outlet in Lake George just north of the Village. The Big Hollow Branch of English Brook runs down the north side of Prospect Mountain, under the

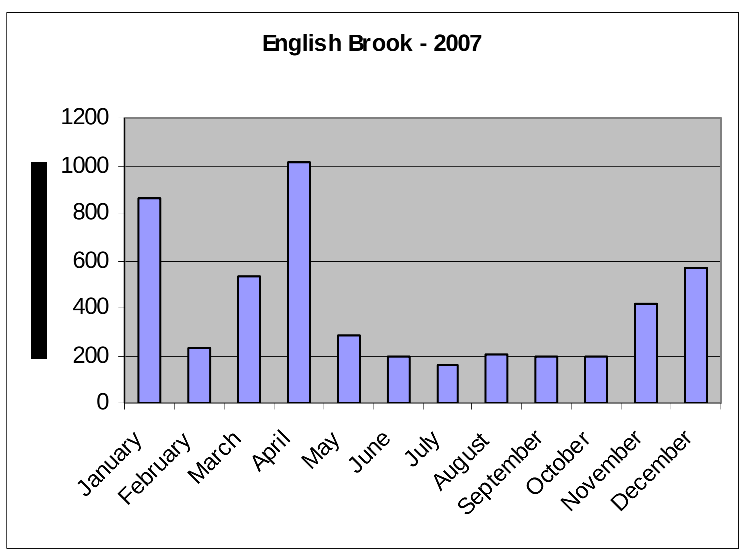


Figure 1. Monthly flows for English Brook in millions of gallons. Eichler 2008

Northway, and then joins the Main Branch at the intersection of Big Hollow Road and State Route 9 in the Town of Lake George. The elevation at the mouth of the brook on Lake George is 320 feet, giving the brook an overall elevation change of almost 1,600 feet.

B. Hydrology

The English Brook Watershed is one of the largest sub-watersheds of the Lake George Basin. As mentioned above, it has a drainage area of approximately 8 square miles and is a part of the greater Lake George Watershed which encompasses 233 square miles. Lake George outlets at its northern end into the LaChute River in Ticonderoga, which ultimately flows into Lake Champlain.

English Brook is a fourth order stream ranging from approximately two feet in width at its headwaters to approximately 20 feet in width as it enters Lake George. It contributes approximately four tenths of one percent (0.4%) of the water entering Lake George. Volumes calculated for 2007 indicate an average of 4,861,000,000 gallons of water pass the sampling station annually (Eichler, 2008). English Brook is the fourth largest tributary to Lake George by volume, after Northwest Bay Brook in Hague (#1), Hague Brook in Hague (#2), and Indian Brook in Bolton (#3). As recorded in the months of January to September of 2007 English Brook passes 13.2 million gallons per day (mgd) which is approximately half of Northwest Bay Brook's 24.7 MGD, but similar to Indian Brook at 13 mgd, and Hague Brook which is 12.6 mgd.

C. Stream Ecology *(provided by the Lake George Waterkeeper Program)*

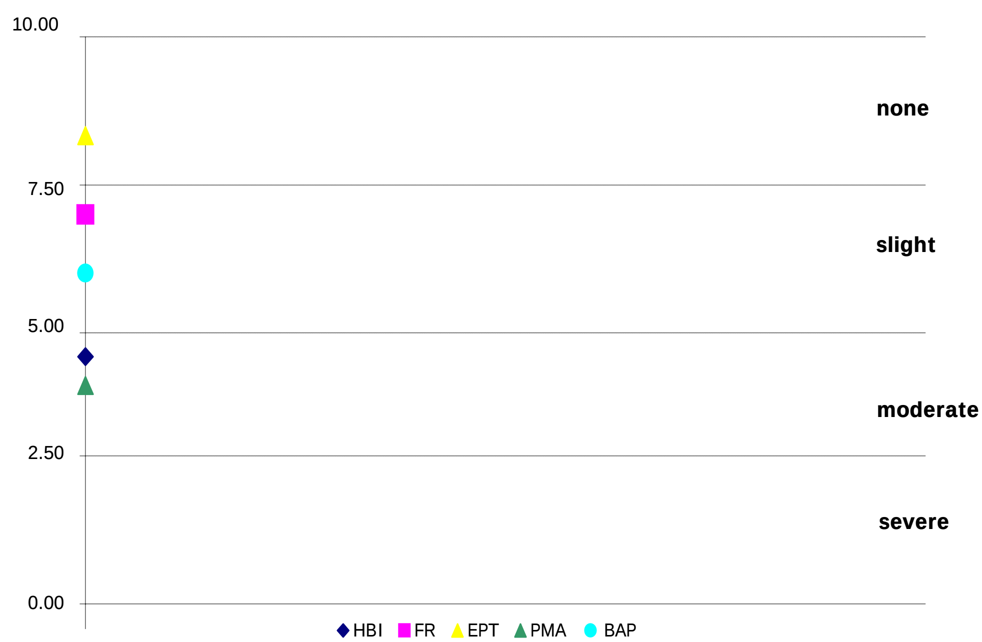


Figure 2. Water Quality Score for English Brook downstream of Route 9N on Sept. 10, 2007.

In order to get a better understanding of the stream's water quality, looking at indicator species of macro invertebrates (water bugs) can be of significant value. Generally, cleaner streams have more pollutant intolerant organisms and are diverse. To gain an understanding of English Brook's aquatic community, kick net samples were collected by the Lake George Waterkeeper Stream Assessment Program on September 10th, 2007. Samples were taken from below Route 9N in English Brook. One hundred macro invertebrates were collected and analyzed. Several indexes were used and results were tabulated and graphed. According to the data it appears that the

Biological Assessment Profile (BAP), which is indicative of overall water quality, indicates that the stream is slightly impacted (Keppler 2007). This impact derives from water quality degradation resulting from stormwater inputs from the highways and developed areas. For more information on the Lake George Waterkeeper's stream ecology and monitoring program, contact Dawn Keppler at 668-5913.

Index		Score
HBI	Hilsenhoff Biotic Index	4.60
FR	Family Richness	7.00
EPT	% Ephemeroptera, Plecoptera, Tricoptera	8.33
PMA	Percent Model Affinity	4.11
*BAP	Biological Assessment Profile	6.01
	*average and representative of overall water quality	

Figure 3. Water Quality Index Scores

D. Water Quality

English Brook is classified by the New York State Department of Environmental Conservation (NYS DEC) in the most recent 2000 Lake Champlain Basin Waterbody Inventory and Priority Waterbodies List as a "AA Special" stream, potentially suitable for drinking water. However, English Brook is also listed as a 303(d) waterbody on the NYS Department of Environmental Conservation's Priority Waterbodies List. This listing describes English Brook as an impaired stream from pollutants including silt/sedimentation due to urban stormwater runoff and erosion. Additionally, this study calls for further investigation and implementation of a restoration strategy. This watershed assessment is a major step in that process.

Historic and Recent Water Quality Studies (provided by Darrin Freshwater Institute)

Historical water quality data for English Brook is limited. Fuhs (1972) recorded flow and water chemistry at 1 to 2 week intervals from July 1970 thru July 1971, but this station lacked continuous flow records so loadings could not be calculated. A continuous recording station was established for flow and periodic water quality sampling between 1981 and 1983 as part of the National Urban Runoff Program (Sutherland et al., 1983). This station was located between Route 9N and the lake, and both baseflow and storm event based data collection was included in this program.

At that time, English Brook was reported to be impacted by land development with slightly higher levels of total phosphorus, chlorides, total suspended sediments, lead and nitrate-nitrogen than "natural" (un-impacted) tributaries. Baseflow total phosphorus levels were reported to average 4 ug P/l.

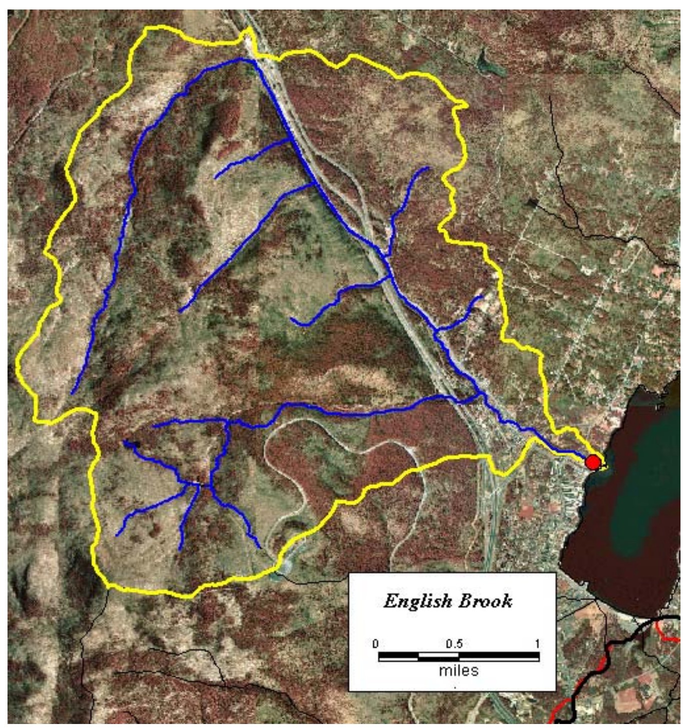


Figure 4. Map of English Brook drainage (yellow line) with historical sample collection site marked by a red circle.

The English Brook drainage is estimated to contribute 188.4 kg/yr of phosphorus to Lake George or 3.6% of the total annual loading of P to the lake. In June of 2002 through 2005, the main channel of English Brook just downstream of its crossing Route 9N was instrumented with a level recorder to generate a continuous flow record and periodic baseflow and storm flow water quality samples were collected.

Samples were analyzed for pH, conductivity, suspended solids, nitrate, sulfate, calcium and chloride. This project was underwritten by the FUND for Lake George and conducted by the NYSDEC. In 2005 and 2006, the station was maintained by NYSDEC for flow only with no water chemistry samples collected. In 2007, the Lake George Watershed Conference through a Department of State grant to the Darrin Fresh Water Institute continued the operation of this station with semi-monthly baseflow water quality testing and stormwater runoff event based data collections during major runoff events. All samples are analyzed for pH, conductivity, suspended solids, soluble reactive phosphorus, total soluble phosphorus, total phosphorus, total nitrogen, nitrate, sulfate, chloride, soluble reactive silica, and major cations (calcium, magnesium, sodium and potassium).

The water chemistry of English Brook is characteristic of tributaries draining developed areas within the Lake George basin (Figure 5).

	pH (s.u.)	Conductivity (umhos/cm)	Total Suspended Solids (mg/L)	Nitrate-N (mg/L)	Sulfate-S (mg/L)	Calcium (mg/L)	Chloride (mg/L)
Mean	**7.55**	**283.3**	**1.8**	**0.30**	**2.54**	**16.6**	**58.0**
SD	**0.27**	**123.9**	**3.3**	**0.33**	**0.40**	**8.5**	**19.1**

Figure 5. English Brook baseflow mean values for 2002 – 2004 for selected analytes (Sutherland, pers. comm.)

English Brook carries more than 33 metric tons (73,000 pounds) annually of suspended sediment to Lake George, which is responsible for current delta growth. Average suspended solids levels for baseflow in 2002 through 2004 were 1.8 ± 3.3 (SD) mg/l. Chemically, English Brook is more alkaline (higher pH) and has more dissolved minerals than are typically observed in streams draining into Lake George. Chloride concentration and specific conductance of English Brook waters average 4 times the levels present in Lake George, which is reflective of chloride applications from de-icing operations. Nitrate levels are also substantially higher in English Brook than in most streams entering Lake George, and can exceed lake levels by a factor of ten. The primary contributor to this condition is considered to be substantial stormwater runoff from developed areas, coupled with naturally higher nitrate levels found in forested watersheds.

English Brook has also been identified as one of the tributaries to Lake George with elevated levels of calcium (mean concentration 16.6 mg/l). Elevated levels are based on comparison to the concentration of calcium in the waters of Lake George (11.5 mg/l). This group of tributaries may create “microzones” where they mix with the waters of Lake George, creating conditions where calcium levels are high enough to support zebra mussel colonization. Sources of calcium may include weathering of naturally occurring mineral deposits within the watershed or anthropogenic (human induced) sources. Human sources include sites for deicing salt storage or application, concrete production or storage operations, wastewater discharges, mining or mineral extraction, etc. Longitudinal testing of specific conductance in English Brook may identify potential sources of calcium, salts and specific conductance.

E. Soils in the Watershed

Knowing soil types and their characteristics is important for land use changes, development, and restoration activities. As an example, very sandy soils are not conducive to septic systems as they would drain quicker that needed for the soil to properly treat the effluent. In contrast, soils with high clay content can have a considerable impact on stream clarity if they are exposed by land clearing practices and erode offsite.

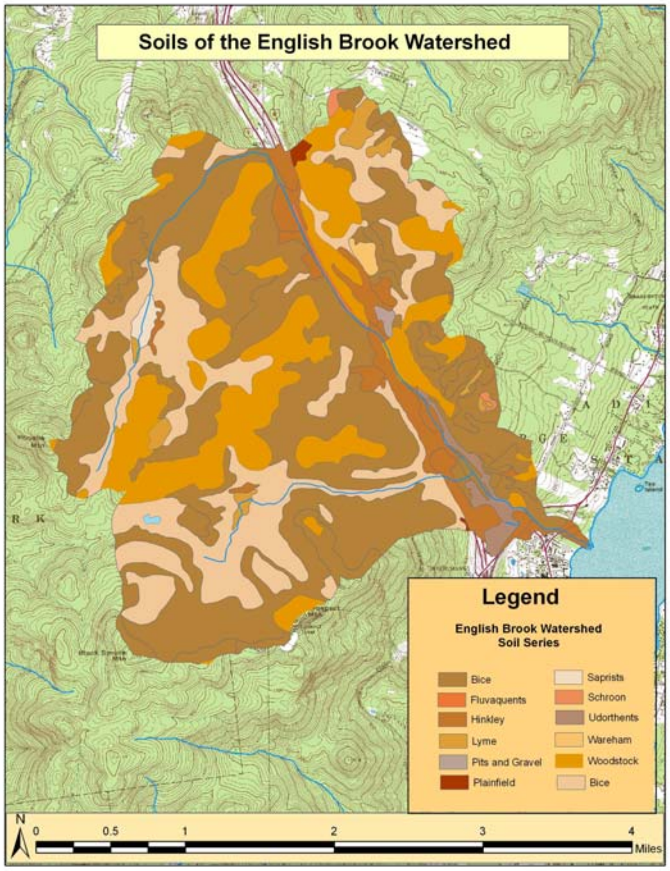


Figure 6. Soils of the English Brook Watershed

To identify soil types in the English Brook watershed, the watershed boundary was superimposed onto a Geographic Information System soils layer developed from the United States Department of Agriculture Soil Survey created in 1986. Brief descriptions of the primary soil types in the English brook watershed are discussed herein to summarize some of the potential concerns with land uses and water quality. Detailed information and maps are available in the Warren County Soil Survey through the Warren County SWCD office. Soils information may also be found online at the USDA Soil Survey Site: http://websoilsurvey.nrcs.usda.gov/app/.

There are 24 different soil types identified in the English Brook watershed. The majority of soils (approx 3500 acres or nearly 66%) are in the Bice Series, which are typically a sandy loam and can be relatively steep and well drained. The second largest soil present is the Woodstock series which encompasses shallow excessively drained soils who slopes primarily range in the 8-15%. It can be comprised of scattered glacial till and is poorly suited for recreational and urban uses. There are very few areas with clay soils in the English Brook watershed or on the banks of the stream, which would tend to cause higher turbidity and water clarity issues in the brook. The highly sandy soils and lack of clay soils within the Lake George watershed are a significant factor in the water clarity within the tributaries and the lake itself.

These sandier soils within the watershed are not highly productive or nutrient rich, and as such can offer difficulties in re-establishment of vegetative cover following land clearing activities.

Due to these factors, re-establishment of vegetation can be a concern for development activities and improperly conducted logging practices within the watershed. An emphasis on Best Management Practices for erosion control should be a key factor when evaluating development proposals and logging activities in areas adjacent to the brook. Landowners and municipalities can acquire this information at no cost from the Warren County Soil and Water Conservation District. This information is available in both paper and digital formats, and can also be found at the District website at www.warrenswcd.org.

F. Land Use

Land use and land cover patterns in a watershed have a strong impact upon the quality and health of a stream system. Knowing the location and extent of development within a watershed is important in understanding possible contributions of contaminant loading. In general, as land gets developed, stream systems and overall health becomes diminished as stormwater runoff and other human impacts affect the quantity and quality of the contributing water.

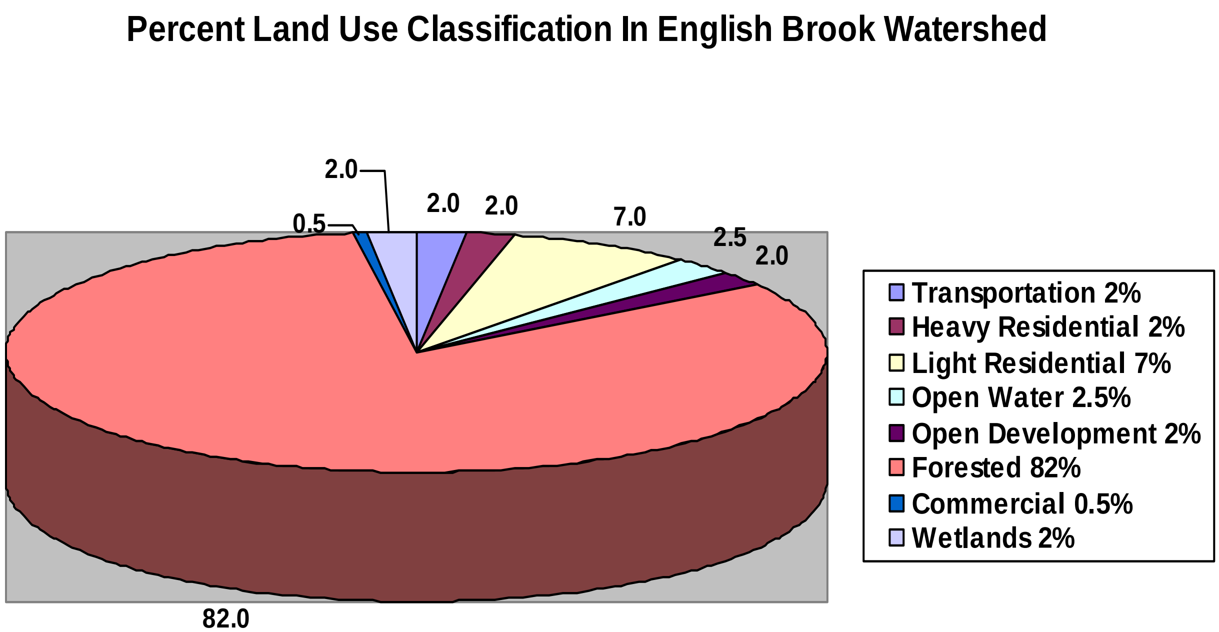


Figure 7. Percent land Use in the English Brook Watershed (Rath, 2008)

To understand the land use within the English Brook watershed, Geographic Information Systems and satellite imagery were used to review and analyze land use patterns, and develop a layer that illustrated various land uses in the English Brook watershed. Tax parcel data was also queried based on property classification and graphed to delineate the percent land use of commercial, low and high density development, open land, water, forested, wetland and transportation.

These land uses can best be described as:

- Transportation – Roads
- Heavy Residential – High Density Development
- Light Residential – Low Density Development
- Open Water – Water
- Open Developed – Grass, Cultivated, Sand
- Forested – Mixed Forest, Deciduous, Coniferous, scrub shrub
- Commercial - Impervious
- Wetlands – Wetlands

The graph shown in Figure 7 gives a fairly accurate snapshot in time regarding the land uses as of 2007 within the English Brook watershed. This information can be utilized for future land use trend analyses which would outline long-term changes in land use within the watershed.

G. Wetlands

Wetlands act like large sponges to slow down the transport of water allowing suspended solids to drop out and diminish the waters potential erosive force. Wetlands also have the ability to act as a natural flood control structures as well. Streams with healthy wetland systems are more naturally flow regulated, experience less flooding, and are much more ecologically complex.

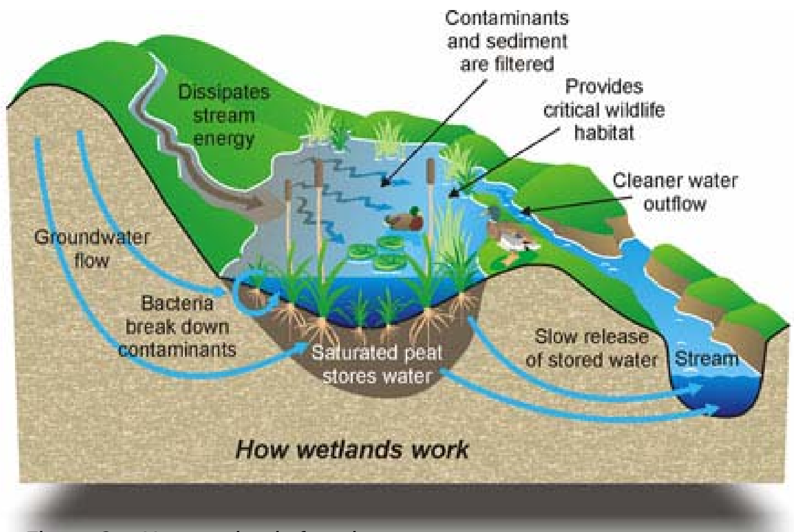


Figure 8. How wetlands function
Natural Resources Canada - http://geoscape.nrcan.gc.ca/aid e.php#images

The English Brook watershed has 245 acres of mapped Adirondack Park Agency regulated wetlands which represents approximately 5% of the entire watershed. At the headwaters of English Brook along Somerville Road, there is a 7.9 acre wetland complex which is in pristine condition and is undisturbed by development or logging activities. The remainder of the wetlands in the uplands portion of the watershed are in similar condition, and exhibit an abundance of plant species variety and little to no impacts from human activity.

H. Invasive Species in the Watershed

Lower down the stream corridor, the wetlands complexes are more linear in nature and generally run adjacent to the stream itself. These linear wetlands, stream corridors and road corridors adjacent to the stream are often heavily infested with Japanese Knotweed which is an invasive, non-native plant. This highly aggressive plant is prevalent throughout the lower Route 9 stream corridor and continues right down to the lake. In this area, it is currently considered beyond any cost-effective control mechanism currently available today. Knotweed is tremendously difficult to eradicate including both mechanical (cutting and digging) and chemical (herbicide) treatments. There are no plans to address this infestation along the stream or the roadway, although public awareness of this issue and funding to address it has been increasing dramatically over the past few years. Japanese Knotweed poses no human health risk, but rather poses ecological challenges in affected areas due to its rapid propagation and dense growth.

There are other isolated areas of invasive species within the watershed, including Phragmites (common reed), Purple Loosestrife, Tatarian Honeysuckle, Oriental Bittersweet and Garlic Mustard. These species are all identified by the Adirondack Park Invasive Plant Program (APIPP) as invasive and aggressive in their growth and expansion patterns. For more information on these species or APIPP's program, go to www.adkinvasives.com.

Water Quality Issues and Recommendations

The primary purpose of this study is to determine water quality issues and concerns within the English Brook watershed, and to identify and outline potential opportunities to address these issues. The principal sources of pollutants to the brook are stormwater runoff and streambank erosion, and a considerable amount of field investigation was undertaken to identify these issues within the watershed. In addition, a narrative is included describing logging activities within the watershed, as well as an overview of the current status of wastewater treatment in the watershed. The recommendations below are listed to serve as a guide to improve the quality of water flowing into English Brook and ultimately Lake George.

Stormwater Runoff

A significant concern in any highly developed area is stormwater runoff impacts to nearby waterbodies. Along roadways and parking lots, runoff is often channeled into drains and pipes, which most often outlet into a stream or a lake. Impervious surfaces such as roads, rooftops, and asphalt parking areas do not allow water from precipitation to infiltrate into the ground. As this water courses across these impervious surfaces, it can collect sediment, phosphorus, deicing materials (sand and salt), petrochemicals and other pollutants. During warmer months, this runoff can also be significantly warmer than the stream's water, causing thermal pollution which affects the stream's aquatic communities.

Drop Inlet at Exit 22 & Rt 9

These stormwater discharges are a major contributor to sedimentation/delta formation issues in the lake, and they can also have significant negative impacts to a stream's aquatic community. Calcium from road salt (if calcium chloride is used as a de-icing agent) can create habitats at the mouths of streams suitable towards zebra mussel colonization. Phosphorus transportation by sediments may create multiple problems including the eutrophication of waterbodies, which can create reductions in water quality and habitat for aquatic plants and animals.

Stormwater runoff poses additional challenges to the stream system directly, particularly related to its long-term stability. As land get developed, there is typically more water which runs off the land into nearby streams, often very quickly following a precipitation event. As such, this large volume of water entering a stream in a short period of time can cause an overwidening of the stream channel to accommodate the volume of water. These channel widening processes occur through accelerated streambank erosion, and ultimately more downstream deposition (deltas). Specific to English Brook, the relationship between stormwater runoff and delta growth is a significant concern.

Stormwater runoff is considered to be the largest water quality impact to English Brook, as well as the entire Lake George watershed. As such, this section focuses on the existing issues with stormwater runoff within the watershed, and offers recommendations for addressing these issues to improve English Brook.

English Brook Stormwater Overview

The main stem of English Brook parallels NYS Route 9 for more than three miles, often within a proximity of 20 feet or less to the bank of the brook. In a few areas, the bank of the brook is the retaining wall for the highway, leaving no buffer between the stream and the road at all. As Route 9 was built many decades ago, there was little if any consideration given to the roadway's runoff into the stream. In fact, the goal of highway design of that era was to get water off of the road as quickly as possible, very often outleting into a stream or lake directly.

The current geography of the brook in relation to the highway, while good for highway drainage purposes, poses difficulties in addressing stormwater pollutants. There is little available open space between the brook and the highway to construct remedial stormwater improvement measures. In addition to space constraints, there exists shallow bedrock in many areas and tight clay soils in others. These factors combined make for limited solutions along the Route 9 section north of the Village of Lake George. A listing of recommendations for this section of highway is included within this chapter.

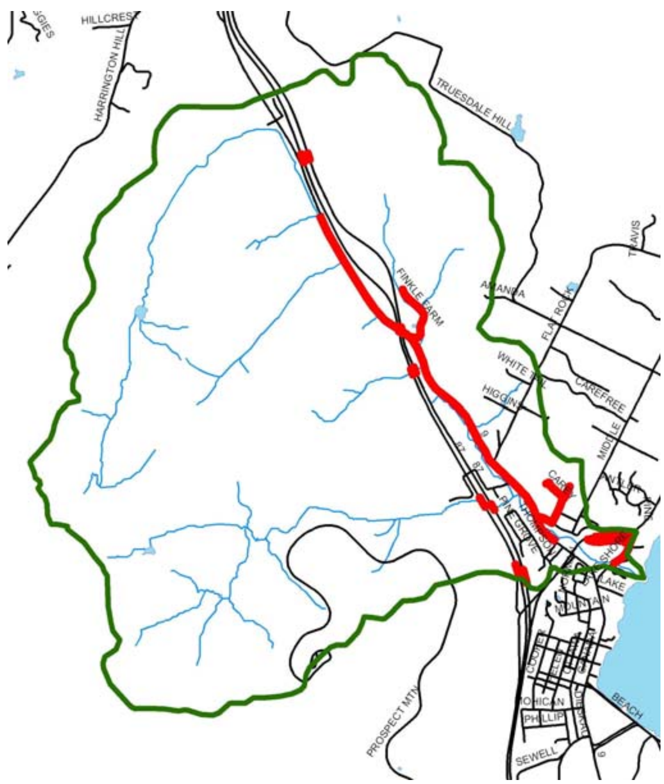


Figure 9. State and local road drainage which directly outlets into English Brook or a tributary is represented in red. The English Brook watershed boundary is in green.

Approximately three and one half miles upstream from the mouth of English Brook, the mainstem takes an abrupt turn away from NYS Route 9 and heads south-westward up the mountain, and runs along Somerville Road for approximately two and one half miles. Somerville Road is a seasonal dirt/stone road owned and maintained by the Town of Lake George. The road is significantly elevated above the brook along its length, with steep side slopes in a forested condition. As this road is essentially a cut and fill slope along a forested hillside, all drainage from this road slopes towards the creek. There are opportunities to address drainage issues on Somerville Road, which are also described in this chapter.

The secondary stem of English Brook is the Big Hollow Branch, which turns west off of the mainstem just north of the Village/Town line. A short section of unimproved roadway runs up to an old water supply reservoir known as Hubble Reservoir. This reservoir is on State Land, but the Village of Lake George owns the structure itself. This reservoir has been cleaned out three times in the past two decades, in an effort to capture in-stream sediment and reduce the sediment load to Lake George. Continuing upstream past the reservoir, an unmaintained access road runs parallel to the brook up towards the top of Prospect Mountain.

The sections which follow discuss more specifically the issues regarding stormwater runoff to English Brook, and outline recommendations and costs to address many of the key issues to the Brook.

Road De-icing Practices

One of the most significant issues in the English Brook watershed is the contribution of sediments and salts from roadways. Currently, there are approximately 23 lane miles of NYS highway in the English Brook Watershed, plus an additional 8.4 miles of local roads (see table below).

Average Salt and Sand Application Rates in the English Brook watershed

New York State roads

	Lane Miles	Pounds salt per lane mile	Total Lbs of Salt	
I87	15.5	250	3875	
Route 9	6.8	250	1700	
Route 9N	1	250	250	
	23.3	Lane Miles	5825	Lbs Per storm Event

Local roads (town uses 60% salt, 40% sand mix with similar application rates as DOT

	Lane Miles	Pounds salt per lane mile	Total Lbs of Salt	
Somerville Road	0.2	0	0	
Finkle Farm Road	0.8	150	114	
Flat Rock Road	2.4	150	358	
Big Hollow Road	0.2	150	30	
Hubble Road	2.4	150	358	
Maple Ave	2.5	150	369	
	8.40	Lane Miles	1,229	Lbs per storm event

Sand Application per land mile = 100 pounds

840 Lbs of sand per storm event

Total Salt Applied Per Storm = 7,054 pounds (3.5 tons)

Total Sand Applied Per Storm = 840 pounds (0.4 ton)

Figure 10. Average salt and sand applications in the English Brook Watershed compiled by Warren County SWCD

The New York State Department of Transportation (NYS DOT) winter road maintenance program historically utilized sand for its road de-icing activities. As English Brook is directly adjacent to NYS Route 9 for approximately three miles, a considerable amount of road sand historically would end up washing into the brook and adding to the delta. In the early 1990's, the NYSDOT began to add salt to the sand as their Lake George policies changed. By 1995 the DOT had turned to using only salt for deicing practices, using Sodium Chloride almost exclusively. Magnesium chloride is used on sporadic occasions as conditions warrant. According to Frank Komoroske, NYSDOT Resident Engineer for Warren County, the current average application rate of road salt by the NYSDOT is 250 lbs per lane mile per storm event.

There are a large number of drainage pipes and drainage channels which outlet directly into English Brook, with no means to reduce the pollutants contained in runoff from storm events. Highways and roadways require maintenance in the winter for safe travel, and these de-icing materials are applied at specified rates. The DOT has worked diligently to optimize their application of salt to their roadways using "state of the art" computer-controlled spreaders, which is a significant improvement from even a decade ago.

The Town of Lake George highway department utilizes both sand and salt within the watershed, with salt comprising approximately 60% of the mix and the remaining 40% as sand. The Town and Village of Lake George currently maintain good spreading equipment, although they are not as technologically advanced as the NYS DOT in their spreading systems. However, these municipalities both have aggressive street sweeping operations which clean the roadways in spring and summer, collecting many tons of sand off of the roadways and keeping it out of the streams.

The issue within the English Brook watershed, and indeed all of the Lake George Basin, is whether it is better to use salt or sand as de-icing agents and road traction material for winter storms. There is no universal standard for de-icing materials and practices among the various levels of government (local, county, state), and each public entity administers its own program based upon their local priorities.

Even among the environmental communities, there is little consensus regarding which de-icing practices are the most environmentally sound. Road sanding causes issues with in-stream sedimentation and delta buildup, while road salting causes increases in stream and lake salinity. In terms of their manifestations, the massive sand delta at English Brook (attributed partially to historical road sanding operations) has grown from almost nothing to over 60,000 cubic yards in the past 50 years. With regard to road salting, the Darrin Freshwater Institute has noted that Lake George sodium concentrations have more than doubled in the past 25 years, and continual increases will cause problems with individuals on sodium-restricted diets.

As for management of these impacts, sand is the easier of the two substances to manage. It can be captured in sediment traps and basins, and can be excavated from deltas. Salt is much more difficult to manage, as it goes into solution in water and cannot be retrieved in any cost-effective way. Considering factors including cost of the products, environmental damage, ongoing maintenance requirements, and suitability for use for different types of storm events (sleet, freezing rain, snow), there is no one product which stands clearly above the other.

Although the DOT and local highway departments are very aware of de-icing impacts upon the environment and water quality, their first and foremost priority is public safety. To keep these roadways safe for winter travel, the use of de-icing materials will continue long into the future.

Recommendations:

1. As this issue is very significant throughout the Lake George Basin, a study of current and potential alternative de-icing practices has been funded by NYS Senator Betty Little in 2008 to the Lake George Watershed Conference. This study will identify current practices, identify de-icing management issues and, and ultimately recommend opportunities for the future to help minimize their impacts upon Lake George and its tributaries. This study is expected to be complete in 2010. Until that time, it is expected that road de-icing practices and maintenance policies will continue under their current regimen.

2. Given the proximity of Route 9 to English Brook, the volume of drainage which directly discharges into the brook from Route 9 and the fact that stormwater retrofit systems do not effectively address chlorides (salts), this corridor would be an excellent demonstration corridor for testing of reduced salt applications. It is expected that the aforementioned study will address this as an opportunity.

Stormwater Outfall Mapping and Retrofit Recommendations

In 2007 and 2008 the Warren County Soil and Water District inventoried, GPS mapped, and photo catalogued all stormwater outfalls into English Brook along its entire length. District staff identified nearly 30 stormwater outfalls and drainage structures which enter English Brook, carrying stormwater from NYS Route 9, NYS Route 9N, Interstate 87, town roads and surrounding properties. Many of these sites have been selected for retrofit opportunities as outlined within this report. Prioritization of these drainages was determined by the nature of discharge, size of culvert outfall, area of impervious surface contributing, and any identified physical impacts to the stream channel.

There are several town roads within the watershed which drain to NYS Routes 9 and 9N, ultimately outleting through the state's drainage system. These roads are addressed separately from the state roads, and separate recommendations are included for local roads in this document.

It should be noted that although only a percentage of outfalls were labeled to be priority concerns with recommendations, if funding, technical staff, and municipal support were secured, significant improvements could be made to nearly all of the stormwater sub-drainage areas within the watershed. Following the mapping and cataloguing of each outfall, the surrounding site was assessed to determine opportunities to lessen the flow and/or improve the quality of runoff entering the brook from that discharge.

As noted in the "Soils" section of this report, most of the soils within the highway corridors are sands and sandy loams, which readily allow for the infiltration of storm water into the ground. As such, there are opportunities to use subsurface infiltration practices such as drywells and chambers to reduce flow volumes and pollutants which currently enter the brook. However, it must also be noted that there is a considerable amount of bedrock adjacent to the Route 9 corridor and surrounding areas, which limits the ability to undertake subsurface construction.

All systems recommended herein will require long-term maintenance, which is a major consideration in developing appropriate solutions. If these systems will not be maintained appropriately, there is little benefit to be gained through their installation. Prior to constructing any of these initiatives, it is imperative that all parties involved agree to the maintenance responsibilities.

Listed below are site specific recommendations for stormwater retrofit activities within the English Brook road corridors to help alleviate stormwater pollutants from entering the brook.

NYS Route 9 Stormwater Runoff

As mentioned earlier, NYS Route 9 runs parallel and adjacent to English Brook for approximately 3.2 miles, generally within 25 feet of the streambank. The road is primarily crowned (highest in the middle), with half of the highway draining towards the brook and the other half draining away. However, along much of the length, the stormwater runoff on the far side gets piped under Route 9 and outlets into the stream. Field analysis conducted by the SWCD showed that over 80% of the paved road surface along the adjacent section of Route 9 ends up flowing into English Brook, either through sheetflow through a narrow vegetated buffer or a direct discharge pipe into the stream. The remaining 20% appears to infiltrate into drainage swales which have no direct connection to the stream or culverts.

Along the NYS Route 9 corridor there is generally only 6 foot of soil depth or less to the water table. Also there are several locations where rock outcrop meets the edge of the road on the east side. Unfortunately, these two factors significantly limit the opportunities for stormwater retrofit initiatives along this highway corridor. These limitations were considered in the Route 9 stormwater recommendations. Most of the cost-effective stormwater improvements which could be implemented within the NYS Route 9 corridor are south of Finkle Farm Road, largely due to water table elevations, lack of bedrock, and available green space.

Although the NYS Department of Transportation does not utilize sand for de-icing operations, many of the drop inlets and outlet structures were heavily laden with sediment, debris and trash (bottles, cans, glass, etc) when inspected for this report. The sources of this sediment could be many, including shoulder erosion, de-icing materials from adjacent roads and properties, construction runoff, and others. As such, the recommendations for stormwater treatment include means to capture these pollutants. Where possible, infiltration of stormwater is added as a component to reduce flow volume and address dissolved pollutants which cannot be addressed through separation.

Recommendations:

1. Most of the structures on Route 9 which had sediment holding capacity were either filled to capacity or close to being so. These catch basins currently require maintenance cleanouts along the length of the highway to once again capture sediment and trash. Simply cleaning out the existing catch basins on a regular basis would be a good effort to minimize sedimentation to the brook.

2. There is a cross-culvert which drains a large amount of NYS Route 9 between markers 2110 and 2109. This is possible location for a small hydrodynamic separator or a catch basin with a large sump. If the flow in the ditch is moved east into the adjacent grassed area, there is potential opportunity to utilize infiltration chambers to reduce flow and address dissolved pollutant load, pending depth to water table assessment.
   Estimated Cost: $15,000 - $25,000

3. South of mile marker 2109, the vegetated roadside ditch on the east side of the highway becomes concrete and runs south for approximately 2.5 miles, broken by short sections of grass-lined ditch. All of this drainage system ultimately drains into English Brook through cross-culverts under NYS Route 9. Most of this section of highway is bordered by a significant bedrock outcrop on the east side and narrow vegetated buffer on the west side (stream side). As such, from mile marker 2108 down to mile marker 2102 (near Finkle Farm Road), there are few cost-effective stormwater retrofitting solutions that can be implemented for water quality improvement in this area. This section is approximately one-half mile long. Further investigation would be needed to advance any improvements at that location.
   Estimated Cost: Solution Yet To Be Determined

4. At approximately mile marker 2098 by Babe Mitchell Coffee, there is a drop inlet which takes in a significant distance of highway and outlets it into the brook. The grate was covered in trash, and the inlet was sediment laden. There is room at this location to install a hydrodynamic separator within the drainage pipe prior to it outleting into the stream. Estimated Cost: $15,000 – $25,000

Drop inlet along NYS Route 9 which is plugged with garbage and debris. These locations are excellent candidates for stormwater retrofits

5. Across the street from Flat Rock Road on Route 9 (west side) adjacent to the Custom Sealcoating property, there is a similar situation as described in recommendation #4 above. This outfall is fed from three drop inlets at the bottom of Flat Rock Road. The velocity and volume of water that this drainage carries is evident at the outfall. Although this is only an 18” culvert it has eroded a path 12 feet wide and nearly a hundred feet long to the streams edge. Over 50 cubic yards of soil have washed into the stream taking the grade down to boulder and rock. Flat Rock Road

stormwater should be dealt with prior to reaching Route 9, and this is addressed in the "Town Roads" section following. On Route 9, there is room for a hydrodynamic separator or deep sump catch basin at this location, and there might be opportunity for infiltration depending upon the available right-of-way. <u>Estimated Cost: $15,000 - $25,000</u>

6. Approximately 100 yards south of Adirondack Marine on Route 9 on the west side, there is another section of highway runoff which is conveyed via concrete ditch to a drop inlet which is culverted to English Brook. This site is much like recommendations #4 and #5, which has opportunity to install a separation system and perhaps infiltration. <u>Estimated Cost: $15,000 - $25,000</u>

7. Directly across from Hubble Lane on Route 9 there is a drop inlet which receives water from everything below Big Hollow Road, outleting directly into the brook via a blacktopped channel. The structure is completely filled with sand and debris, and needs a cleanout at a minimum and an upgrade if possible. This site is tight with water lines adjacent, so further study is merited to determine whether a new structure could be installed. If room was available, it would be similar to the above recommendations. <u>Estimated Cost: $20,000 - $30,000</u>

8. On the north side of the Interstate 87 onramp, there is a concrete drainage swale which collects several hundred yards of highway stormwater (up to Hubble Lane) and conveys it to the brook. This site is only approximately four to five feet above stream elevation, but there is considerable green space to install stormwater improvements such as hydrodynamic separators and perhaps flow diversions into the adjacent trees. <u>Estimated Cost: $20,000 - $30,000</u>

9. There is a 38"dia. concrete outfall just down stream of the exit 22 ramp off Interstate 87. This outfall has the capacity to pass significant volumes of water. Its drainage area includes two drop inlets on the south side of the exit ramp which are connected to the north side of the ramp by a culvert. This culvert accepts runoff through an asphalt swale that extends to the west side of I87 and encompasses a drainage area of approximately 60 acres. The concrete swale that runs the length of the onramp to I87 northbound should be reverted to a cobble/grass swale with earthen checkdams to allow water to infiltrate. The cobble swale would also reduce the velocity of the water and decrease its erosive force downstream. The drainage which ultimately comes to this point is complex and merits further study, as it is significant and has the capacity to discharge a large amount of stormwater into the brook. <u>Estimated Cost: To Be Determined</u>

Large stormwater outfall from Exit 22

Interstate 87 (Northway) Stormwater

Approximately four miles of I87 lies within the English Brook watershed. There are three lanes plus shoulders for both the northbound and southbound highways. This is a considerable amount of impervious surface, all of which drains off of the highway either into drop inlets and pipes, flows into a large vegetated swale between the highways, or flows off into the woods.

Drop inlets on I87 which drain directly down to NYS Route 9 and then into English Brook

Although there is significantly more highway surface from I87 than there is from Route 9, it does not impact English Brook as much as Route 9 does. This is primarily due to two factors: proximity to the brook and lack of concentrated flows entering drainage pipes.

The majority of I87 sheetflows off of the highway and into the vegetated roadbank adjacent to it. With the sandy soils that comprise much of the I87 corridor, most of the stormwater is infiltrated into the ground. There is little evidence of concentrated flows causing rilling and gullying on either the side slopes of the highways or in the center median, showing that flows are largely infiltrated prior to entering a drainageway or the brook itself.

During extended rainfall events, saturated ground conditions, and frozen ground conditions, stormwater does flow from the median into the I87 drainage pipes which then outlet down by English Brook. The precipitation events which cause flow into the median drainage system occur in the range of 10-15 times per year based upon field observations.

<u>Recommendations:</u>

1. The median and side slopes of I87 are maintained (mowed) on a regular basis during the summer and fall, primarily to keep down woody vegetation. If the frequency of mowing was reduced, it would allow the grasses to grow longer and thicker, creating a much better buffer to slow and infiltrate stormwater. Lesser mowing would also create less soil erosion, as the large tractor-mowers tear up the sod on the steeper side slopes.

2. In the median between the north and southbound lanes, several small earthen berms could be constructed very easily across the center of the swale. These earthen check dams would act to slow down and infiltrate stormwater that would otherwise reach the drop inlet structure and flow in a pipe down towards English Brook.

3. Meet with NYS DOT to determine if the direct discharges from the I87/Route 9 overpass could be handled within the I87 corridor instead of being a discharge down to Route 9.

NYS Route 9N Stormwater

One of the largest stormwater culverts in the watershed can be found along Rt. 9N in Lake George on the north side of English Brook. This culvert is 36" in diameter Stormwater from exit 22 and lower Hubble Lane enters two drop inlets at the base of Lower Hubble Lane. From there it is channeled under the road and picks up one more drop inlet before going to its outlet on the edge of the brook. Route 9N collects stormwater from all of Lower Hubble Lane and a large portion of the Exit 22 offramp as well. Hubble Lane stormwater is addressed separately in the "Town Roads" section.

Outfall at the Lochlea Estate from Route 9N

Recommendations:
To improve the stormwater coming from this area, an open area adjacent to the current culvert outlet on the bank has been identified as a possible treatment area. The installation of a large (probably offline) hydrodynamic separator and associated infiltration chambers or similar could be placed in this location. It appears there would be minimal to no UFPO impact as overhead utilities are run on the other side of the road. This project would likely involve working on private property from the Lochlea Estate, which would need to be determined prior to any official movement on this solution. Also, this pipe shows evidence of flowing during non-storm events, suggesting inflow issues. If this is the case, this would need to be addressed prior to any infiltration component was added.
Estimated Cost: $100,000 - $200,000

Town of Lake George Roadway Stormwater

Somerville Road

The headwaters of the English Brook lie at the top of what is referred to as the Somerville Branch of the stream. Somerville Road is an unimproved gravel Town of Lake George road that runs parallel to the stream for over two miles. For a seasonally maintained road, Somerville is in fairly good condition. However, there are numerous areas along its length which exhibit drainage problems, erosion, and offsite sedimentation. The second mile of Somerville Road has no development on it, and it simply acts as a seasonal access to the top of the mountain. The Town of Lake George has attempted to abandon and close this road in the past, but local landowners objected and the Town was required to keep it open. Re-grading of this road, adding new item 4 and gravel, replacement of eroded culverts and maintenance of ditches would clearly help to amend many of the concerns along this branch before it meets Route 9.
Estimated Cost: $30,000 - 50,000

Big Hollow Road

The Big Hollow Brach of English Brook is 2.5 miles in length and is north of the summit of Prospect Mountain. Big Hollow Road begins at Route 9 and is paved for approximately 100 yards, and then runs as a gravel road under the Northway through a massive culvert, continuing on for another 300 yards up the mountain to Hubble Reservoir. The Town of Lake George maintains Big Hollow road up to the reservoir, but above the reservoir the road becomes a jeep/ATV trail which is not regularly maintained by any entity. The land which the road is on is owned by NY State, although the reservoir and access road maintained by the Town of Lake George. The access road has been maintained regularly by the Town highway department, primarily as access to Hubble Reservoir for cleanout purposes. The primary concerns with Big Hollow Road result from the ATV and jeep trail above the reservoir. These trails are not maintained and cross the brook in a number of locations. As the property is state land and used for recreation as apparent by the ATV worn tracks, District staff found culverts that are washed out, eroded, crushed or in some cases gone altogether. Management of this property is through the Lake George Wild Forest Unit Management Plan, and ATV trails and recreational issues are discussed in this plan. Once the plan is finalized (2009 expected), it is hoped that action will take place by DEC to better control these activities. In the shorter term, the town-maintained access road to the reservoir is in need of drainage improvements, and could greatly benefit from re-grading to keep this road from eroding into the brook.
<u>Estimated Cost: $10,000 for access road improvements, $30,000 for upland road and culvert improvements on state land</u>

Lower Hubble Lane

Hubble Lane runs downhill for its entire length of over 500 feet where it intersects with NYS Route 9N. Hubble Lane has no stormwater infrastructure aside from paved swales, and stormwater flows along its length and enters a drop inlet at the intersection of Route 9N. This road has plenty of opportunity to install drywells along the roadside to capture and infiltrate a significant portion of the stormwater runoff from this roadway. Preliminary estimates show that six separate drywells (three per side) would accommodate stormwater from most storm events. The Town of Lake George highway department has successfully installed such systems on Birch Avenue and Michelli Drive in the Town, and could do so here as well. Soil test pits would need to be conducted prior to moving ahead to ensure good soils for these projects. Also, there is a gas line on the south side of the road which would have to be accounted for.
<u>Estimated Cost: $20,000 - $30,000</u>


Lower Hubble Lane

Flat Rock Road

Approximately 300 feet of Flat Rock Road drains down to NYS Route 9 with no existing drainage infrastructure except a paved ditch. At the lower section, Flat Rock Road is very steep and stormwater runoff is conveyed quickly to Route 9 and then to English Brook. There are opportunities on this roadway to install infiltration systems such as drywells, as described on

Lower Hubble Lane. Four separate drywell systems would successfully address most of the runoff from this road, eliminating it from the Route 9 system and English Brook.
Estimated Cost: $15,000 - $20,000

Finkle Farm Road

Finkle Farm Road is on the east side of Route 9 just south of the Northway overpass. It winds uphill to a private campground, and has unvegetated roadside ditches in its upper reaches. These ditches show signs of erosion and downstream sedimentation, and this sediment ends up in the Route 9 system and ultimately English Brook. These ditches could be re-graded, underlain with filter fabric, and rock lined to prevent erosion and piping of sediments below the stone. The town highway department has already addressed the lower section of this road, and just needs to continue these efforts further up the roadway.
Estimated Cost: $2,000 - 3,000

Upper Hubble, Carey, and Platt Roads

Carey and Platt Roads drain down to Upper Hubble Lane, which then flows to Route 9. There are multiple opportunities to address runoff from these roads, including improved ditching on Carey Road, turnouts on Platt Road, and infiltration systems on Hubble Lane. Specific sites would need to be selected and private property considerations taken into account, but it is likely that most of the stormwater runoff and road ditch erosion issues on these roads could be handled effectively.
Estimated Cost: $30,000 - $40,000

Stream Corridor Conditions

The primary function of rivers and streams is to convey water and sediment from uplands areas to their receiving waterbody. Streambank width, slope, and streambed characteristics are defining factors in a stream system and these variables affect how a stream functions within a watershed. These characteristics have a direct effect on the volume of water and sediment that a particular stream can carry.

Undercut banks along English Brook are numerous and provide a fairly significant volume of sediment to the brook and Lake George

Sediment being transported through streams is a natural process. However, development such as housing, infrastructure, logging and other such activities can have an influence on the amount of sediment and erosion that occur in a watershed. Various efforts have been and are currently underway to address these land use issues. However, as this sediment continues to be carried through the tributaries, it eventually settles out at the outlets of these streams creating numerous large deltas in Lake George. Deltas can impede fish migration, and act as bedding areas for nuisance aquatic species, hinder recreational activities, and negatively affect lakefront homeowners and their docks.

English Brook is one of the largest tributaries to Lake George, and maintains a network of over 13 miles of channel in its many branches. The headwaters of English Brook and its tributaries run through undisturbed forest, and are considered in a pristine condition. However, as in any channel, there are a number of locations even within these undisturbed areas which evidence undercut banks and minor streambank erosion. This is a natural process, and merits no restorative consideration.

Lower in the English Brook watershed, the surrounding land area becomes more developed with highways, residences, and commercial property. The stream also becomes more confined with retaining walls and fill-slope embankments which limit or eliminate the stream's ability to migrate naturally. Where English Brook runs adjacent to these developed corridors, there is concern for impacts to the stream from increased runoff and pollutants. The main stem of English Brook runs parallel to NYS Route 9 for over three miles, and the channel is relatively confined between the highway and the steep hillslope on the opposite side. In the last mile of English Brook, the channel is fully confined by properties on both sides, all of which is protected to a large degree against migration and erosion.

"Blowdown" of trees in English Brook is a common sight and a natural occurrence. However, situations like this can cause streams to erode their banks and overwiden, causing problems in the channel.

Warren County Soil and Water Conservation District staff have walked the main two branches of English Brook in their entirety, totaling almost ten miles. Throughout the stream walk, locations of streambank erosion, stormwater drainage pipes, and other issues were identified. Photographs were taken of points of concern along the stream, which were then located with a GeoXT Global Positioning System unit for mapping purposes.

English Brook and its tributaries have no large-scale streambank erosion sites, either resulting from natural or human-induced processes. There is evidence of a large number of past small bank failures along the NYS Route 9 corridor, but these have been armored with riprap and concrete retaining walls to protect the highway. From discussions with DOT, as these erosion sites are identified they are quickly addressed to minimize road travel and safety issues. Further up in the watershed away from Route 9, there once again are no large-scale bank failures which are clearly adding to the sedimentation of English Brook and ultimately Lake George. As such, it can be stated with confidence that large scale streambank failures are not a primary factor in the sedimentation of English Brook.

Although there are no large failing banks, what is observed throughout the watershed are very long stretches of stream which evidence smaller examples of erosion. These erosion sites are manifested in thousands of feet of undercut streambanks, sometimes up to three-feet deep under the overhanging vegetation. This undercutting of the banks is most clearly evident in the Route 9 section of English Brook, although it also exists in the undeveloped sections of the watershed to a somewhat lesser degree.

The challenges of addressing these sections of undercut bank are generally two-fold. Access to the site with equipment is often a problem, and even if the sites are accessible, the cost of undertaking a bank protection effort (armoring) generally well exceeds the benefit for the stream or water quality in general. In addition, English Brook's streambanks are largely gravel, sand, and cobble, which make vegetative stabilization efforts largely unsuccessful. When compounded by the overstory trees in most of the watershed, vegetative treatments are not a good candidate for streambank stabilization.

With these limitations, English Brook is a difficult watershed to undertake streambank protection measures for, aside from properties with existing stabilization structures (retaining walls, etc) which are a very minor portion of the stream system. Aside from a massive stream channel reconstruction effort throughout the lower 3 miles of stream channel (which the benefit would not seem to be close to the cost), there are only small opportunities for stream channel protection initiatives in the English Brook watershed.

Given the limited ability for sediment source control (bank protection), the only cost-effective remaining option to control sediment prior to reaching Lake George is in-stream sediment capture. The idea behind in-stream sediment capture is to slow the velocity of a stream and increase its capacity to hold sediment by widening and deepening the channel. Essentially, this creates a pond within the stream, which slows the velocity of the water and allows sediment and debris to drop out of suspension. These sediments which are captured in the pond do not get conveyed out to the delta in the lake, thereby significantly slowing the growth of the delta. This in-stream pond can then be cleaned out every one to three years (depending upon size and capacity), in a much more efficient, cost-effective, and environmentally sound manner than dredging a delta in a lake.

Hague Brook in-stream sediment pond on Lake George Land Conservancy property, created in 2007. This picture is taken one week following seeding. This basin collected more than 250 tons of sediment and debris in one year.

Within the English Brook tributary system, there is one existing in-stream pond (Hubble Reservoir) up on the Big Hollow Branch as described below. However, there is an opportunity to construct a new in-stream sediment pond on English Brook near its outlet on Lochlea Estate property which will capture streamflow from the entire watershed. Logistically, this location is feasible for both construction and long-term maintenance. However, this new pond would be on private property and would need the full consent and easements from the landowners to become a reality.

Recommendation:

In-Stream Sediment Pond at Lochlea Estate
Meet with Lochlea Estate representatives to discuss the viability of installing an in-stream sediment pond on English Brook, located approximately 100 feet above the outlet into Lake George. This basin would be fashioned much like the basin on Lake George Land Conservancy property on Hague Brook in the Town of Hague, constructed in 2007 (see picture). A field estimate on the probable dimensions of a sediment pond on English Brook would be approximately 7 feet deep by 45 feet wide by 100-150 feet long. An in-stream sediment pond of these dimensions would likely capture all cobble, gravel, and sands, plus a percentage of larger silts and debris.
Estimated Cost: The cost of construction of this basin varies widely depending upon municipal highway department assistance, but would likely be in the range of $25,000 - $50,000.

Hubble Reservoir

Hubble Reservoir is a small impoundment located on the Big Hollow tributary of English Brook off of Big Hollow Road in the Town of Lake George. It is a man-made reservoir with both a concrete and stone/mortar dam and concrete sidewalls, constructed in the mid 1900's for the purpose of providing drinking water to the Village of Lake George. The land that the reservoir is on is owned by New York State, but the dam structure and water rights are owned by the Village of Lake George. The reservoir is no longer in use as a water supply, however it is still in tact and remains in generally fair to good condition.

Cleaning out Hubble Reservoir in 1999

Once this reservoir was no longer utilized as a water supply, the regular sediment cleanouts were discontinued. As such, this reservoir has been accumulating in-stream sediment since that time. Historically, the sedimentation of reservoirs was simply a maintenance headache. Now, the fact that these reservoirs capture in-stream sediment is seen as a tremendous asset in helping to manage the growth of the deltas. With approximately 27% of the entire English Brook watershed flows into it Hubble Reservoir, it can be very effective at helping to slow the growth of the English Brook delta. As there is almost no development within that watershed, these sediments are from natural in-stream erosion processes.

In 1992, the Hubble Reservoir was cleaned out for the first time in many years, to have this reservoir act to catch sediment and keep it from adding to the delta. To excavate the sediments out of Hubble Reservoir, the stream must be diverted and the reservoir dewatered. This has been very difficult to do, without a permanent dewatering pipe to direct the flow into. As the land is owned by New York State, any new structures on the property must be included within an approved Unit Management Plan (UMP). A draft UMP for the Lake George Wild Forest is pending approval, and has been pending approval for the past four years. Included in this UMP is a provision for installing a permanent dewatering system for the reservoir, which will be installed upon final approval of that document by the Adirondack Park Agency and NYS DEC.

While the UMP is pending approval, in 2007 the Town of Lake George and Warren County SWCD worked to install a temporary piping system to route the stream around the reservoir during excavation. Following dewatering activities, over 1,400 cubic yards of sediment was then excavated and removed from the reservoir. This was a cooperative effort between the Warren County SWCD and the Town of Lake George, and funded through the Lake George Watershed Conference. By excavating as much sediment and material as possible from this basin (approximately 1,400 cubic yards in 2007, and 1,200 cubic yards in 1999), it once again has the capability of slowing flow and collecting in-stream sediment.

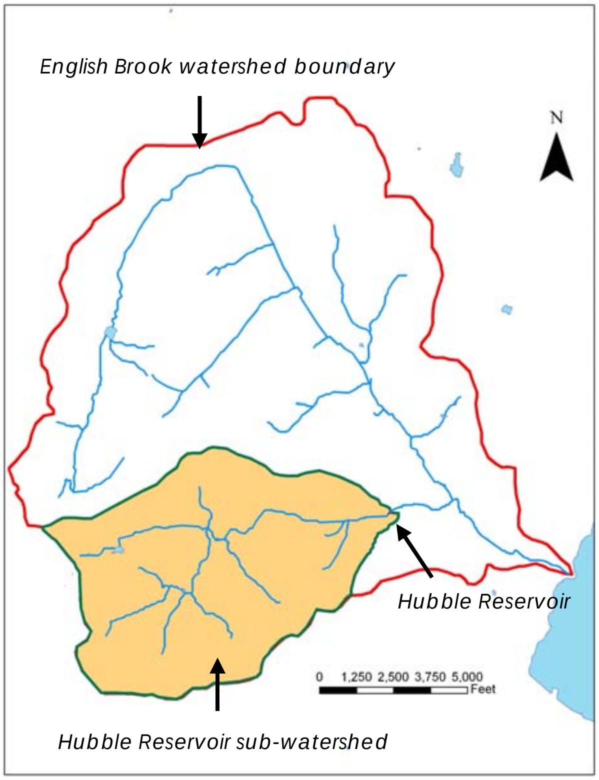


Figure 11. Hubble Reservoir watershed, which captures about 27% of the overall English Brook watershed area

Town of Lake George Highway Superintendent Hoddy Ovitt overseeing the removal of more than 1,400 cubic yards of sediment, leaves and debris from Hubble Reservoir in 2007

The Warren County SWCD works with the highway departments throughout the Warren County side of the Lake George watershed to manage this and other reservoirs on a regular basis. Through the cooperative efforts of the agencies, organizations and municipalities around Lake George, these Reservoir and Sediment Basin Programs have been successful in capturing and removing almost 10,000 tons of sediment (approximately 700 large dump truck loads) before it reaches the lake. Clearly, maintenance of this basin prevents significant amount of sediment from reaching Lake George in general. Coupled with upland measures of protection this program has proven to be a proactive and cost effective way to slow the growth of deltas in Lake George. With continued maintenance these sediment basins and reservoir retention basins can keep excess sediment from reaching Lake George, protecting water quality, habitat, and recreational uses. All of the information and reports completed on sediment basins can be found at the Warren County Soil and Water Conservation District web site at www.warrenswcd.org.

Recommendations:

1. Ensure that the permanent dewatering provisions included for Hubble Reservoir are still included in the final Unit Management Plan for the Lake George Wild Forest, and provide follow-up with DEC and APA as necessary.

2. Develop a consistent funding stream and clean out this reservoir every 3-5 years as necessary, as the reservoir reaches 75% capacity.

3. Once approved, design and install permanent dewatering structures for the reservoir and fix the broken sluice gate and valve stem in the dam.

4. With the proposed new Dam Regulations in NYS, an inspection of Hubble Dam will be required by a licensed engineer, likely by 2015 or sooner. This dam does have evidence of signs of ageing, and an inspection of this structure should be conducted for public safety in general. Estimated Costs: $50,000

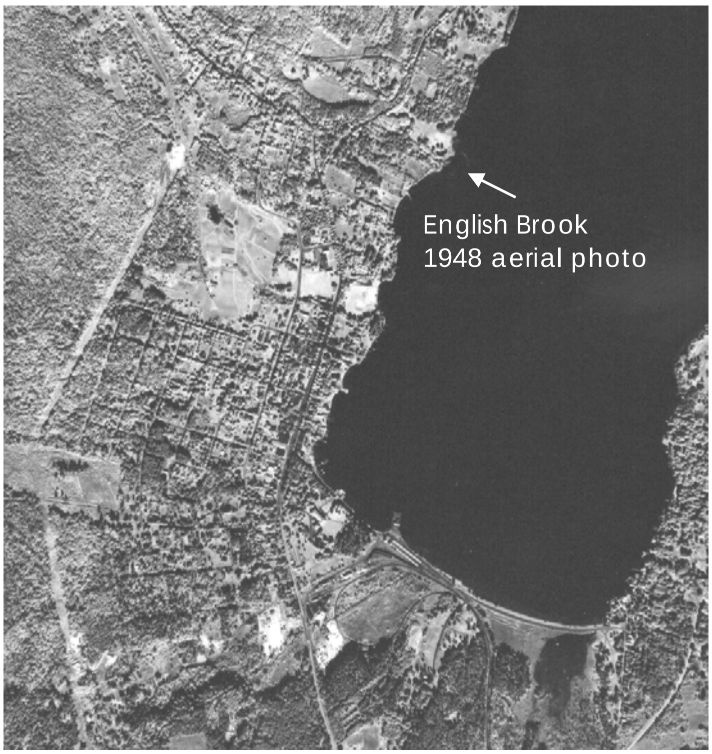
English Brook Delta

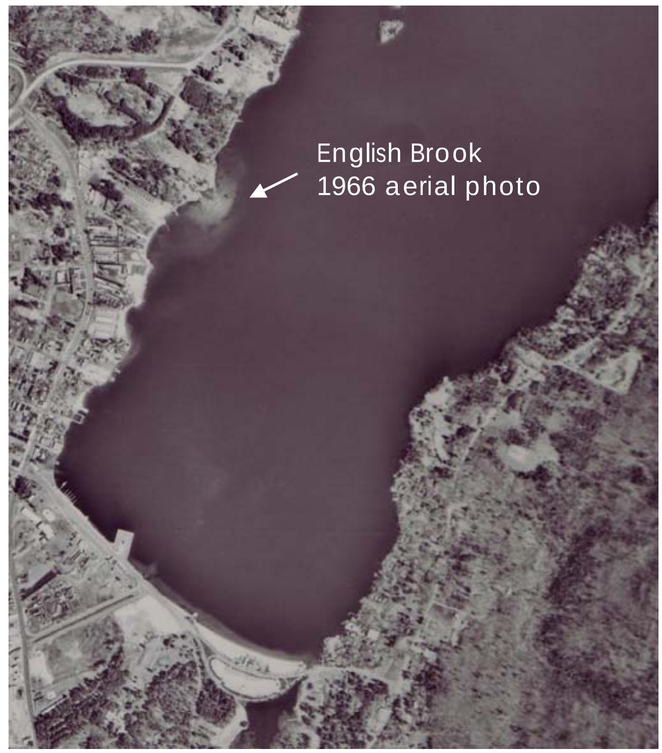
English Brook Delta in Lake George – 2007
Photo: Post Star Newspaper

Delta formation is a natural process that occurs over time as streams erode and downcut within their watersheds, transporting and depositing sediments into lakes at their outlets. However, this process can be greatly accelerated by human-induced factors including land and roadway development, improper logging activities, road de-icing practices, and any other activity which adds sediment to a stream system. When this occurs, these sediments manifest themselves as fast-growing deltas at the lakeshore, reducing water depths which affect boat navigation, docking, swimming, and general access to the lake.

This accelerated delta growth is epitomized in the English Brook delta. The delta at the mouth of English Brook in Lake George has grown significantly over the past 50 years, tremendously exceeding geologic rates. In 1980, State University of New York College of Environmental Science and Forestry studied various environmental challenges within the Lake George watershed through the National Urban Runoff Program (NURP). With the help of historic aerial photographs taken over the course of 30 years over repeated flight paths, the researchers were able to accurately evaluate the changes in the size of the English Brook delta. According to their findings, in 1948, for all practical purposes, there was essentially no delta at the mouth of English Brook. Looking at the adjacent 1966 aerial photo, there is a very clear and considerably sized delta at the outlet to English Brook.

Much of the massive growth of the delta during the late 1960's has been attributed to the construction of the Adirondack Northway (Interstate 87) which runs right through the heart of the watershed and within 200 feet of English Brook for almost three miles. Construction of this





Interstate preceded the Clean Water Act (1973) and there was little consideration given to erosion control, water quality issues, or sedimentation of waterways.

More recently, a comprehensive Generic Environmental Impact Statement (GEIS) was commissioned by the Lake George Association undertaken by Earth Tech Incorporated, called the "Lake George Deltas Sediment Management/Shoreline Restoration Project (2002). This document outlines the needs and requirements to undertake a delta removal effort for seven deltas in Lake George, with English Brook being by far the largest at 60,572 cubic yards. This document is available on the Lake George Association's website, and contains considerable information on the delta issue in Lake George.

In addition to in-lake delta impacts, these in-stream materials including cobble, gravel and sand don't always make it all the way to the lake, and settle out at flatter points within the stream. This has been occurring at the Lochlea Estate just above the outlet of English Brook for many years. The result is a stream channel which has aggraded (higher streambed elevation) to the point where the channel's capacity is significantly less than required to handle the flow. The outcome of this aggradation is that the stream floods out of the channel much more frequently and causes damage to surrounding structures and property. Dredging of the channel will temporarily restore the capacity, but ultimately these dredged areas will fill in once again with sediment. To combat these issues, the Lochlea Estate has dredged the channel and also built small earthen berms to contain the stream during higher flow events.

Channel aggradation on the Lochlea Estate property. The channel elevation has been increasing as over time, leading to localized flooding issues

The state of the English Brook delta and its exponential growth over the last 50 years are primary driving forces behind this watershed assessment initiative. Most parties agree that the English Brook delta is not a natural condition for the brook and for Lake George, and should be mitigated through removal to some degree. This will be a very costly and time consuming initiative and funds for a project such as this have yet to be identified. However, prior to any delta removal initiative, upland restoration and protection work should be undertaken to minimize future growth of this delta. The initiatives outlined in this report are intended to help accomplish this goal.

Recommendations:

1. The first priority is to control the growth of the delta by implementing upland protection and improvement measures, many of which are outlined in this report. It is unlikely that any concerted effort or public funding will be expended prior to significant efforts upstream. These efforts will likely take at least five years to fully implement, but is highly variable based upon available public and private funding.

2. Following substantial efforts within the watershed to reduce in-stream sedimentation, then site specific dredging plans should be put together to advance the full or partial removal of the English Brook delta through a dredging operation. It is the opinion of the Warren County SWCD that a mechanical dredging operation (as opposed to hydraulic) would be the most cost and time-effective for the English Brook delta. This is based upon available working land area, delta composition, site logistics, and experience.

Stream Buffers

Vegetative buffers can have a significant impact on the health of the waterbody. Not only do they catch physical debris such as trash from nearby roads but also sand, salt, fertilizers and oils. Tall trees and shrubs provide shade for the stream which will keep it cooler and thereby increase its ability to hold oxygen. This will have an impact on the species of fish and macro invertebrates the stream can sustain. The Lake George region is well known for its spawning brook trout and smelt runs, and the quality of a stream’s buffer from development directly affects the stream’s water quality and the organisms that thrive in those streams.

Within the English Brook watershed, stream buffers are seen as a key factor to help mitigate runoff from roadways. The NYS Route 9 corridor, running parallel to English Brook for three miles, has very limited buffers to help filter and infiltrate stormwater runoff and pollutants. The average buffer width between the stream and Route 9 is approximately 15 feet, with as much as 50 feet in some sections and as little as 0 feet (retaining wall) in others.

Vegetated buffer between NYS Route 9 and English Brook. Buffers average approximately 15 feet wide in this highway corridor

Typically, the stream buffer along Route 9 consists of a moderately dense and unmanaged grasses (creeping red fescue, perennial ryegrass), and occasional bushes and small trees. These buffers slope towards the stream and have few areas of depression or internal drainage to slow overland flow through the buffer. The lowest section of English Brook (last one-mile or so) is primarily developed along the streambank, with many banks of the brook held up with retaining wall or riprap. When compared to typical standards and recommended widths for effective stream buffers, this three-mile section of grass buffer is not seen as highly effective in reducing pollutants from stormwater runoff. It is however, considerably better than the long sections of concrete swale along the roadway which directly discharge into the brook with no filtering through vegetation or other means.

The other main roadway which runs parallel to English Brook is Somerville Road, which is a gravel road maintained by the Town of Lake George. This road is elevated above English Brook and has a very steep side slope towards the brook. There is very little underbrush vegetation, as there is a significant canopy of mature trees along this corridor. Although the roadway could benefit from drainage improvements (as noted in the Stormwater section), the buffer along Somerville is in healthy condition and there is no need of additional vegetation or buffering along this stream corridor.

As can be seen in the Land Use Map included in this report, the large majority of the English Brook watershed is undeveloped and in a forested condition. Much of this land is very steep and not conducive to development, but there is still a considerable amount of land which is developable within the watershed. The protection of stream corridors through buffering is an important issue, and one that is currently being addressed by the Lake George Park Commission. The LGPC is currently in a regulatory development process to develop a stream corridor protection plan, which will likely result in regulated buffers along all stream corridors within the Lake George Basin. These buffers will affect new development, essentially regulating what activities are allowed within certain (undetermined as of yet) distances of a stream. These regulations will have a positive impact on protecting English Brook in the future.

District staff noted that a considerable amount of the stream banks were vegetated, and that in the more commercially developed areas the need to maximize parking, or utilize impervious surfaces is a main concern. These sections are the highest priority to preserve vegetative buffers. It was also observed that some landowners who border the stream could assist in the upkeep of its quality by leaving a naturally vegetated buffer strip which would increase water quality and possibly provide shading as mention above.

Recommendations:

1. Meet with NYS DOT to discuss their vegetation management program along the Route 9 corridor, and discuss options for improving their buffers along this highway.

2. Until the Lake George Park Commission stream corridor regulations go into effect, all development activities within 50 feet of the stream corridor should give consideration to buffers through the Town of Lake George Planning Board approval process.

3. As existing retaining walls fail (many are old and failing), these landowners must apply to NYS DEC for a stream disturbance permit to repair and improve the situation. These are excellent opportunities to improve upon the existing situation with buffers, vegetation, and improved structural solutions. The NYS DEC Division of Permits has been active in promoting improved streambank stabilization techniques in conjunction with the Warren County SWCD through their Article 15 General Permit.

Forestry and Logging Practices

Proper forest management has the ability to pair increased timber production with the health and quality of the stand. The use of Best Management Practices (BMP's) including proper road layout, installation of water bars and turnouts, and proper stream crossings are key to protect the local waterbodies within the watershed. Utilizing good silvicultural BMP's can not only minimize the impacts on the land and water, but actually increase profit from a timber harvest by reducing restoration costs of the forest land.

Utilizing a professional forester for the management of forest resources on a property is the best step to achieving a desired management goal. Forest Management may include managing for wildlife, timber, recreation, firewood or maple production. Professional foresters not only provide specific identification and knowledge of individual species and provide management strategies to maximize production and minimize impacts on the rest of the environment.

Historically, there were a number of logging activities undertaken in the English Brook watershed. These are evidenced by many old logging roads within the watershed, and confirmed by conversations with loggers that had done work on properties in the area. Logging on Somerville Road was noted as a major point of concern in the Jarrett-Martin, LLP Professional Engineering study conducted in February 2000. The Jarrett-Martin study reads, "Past and current logging practices that could have protected water quality in the Lake George watershed have not been fully implemented due to economic pressures, and no one agency has taken a strong stance on enforcement," (Jarrett-Martin). According to the study, poor maintenance of these logging access roads has been a cause for concern regarding water quality degradation, streambank erosion, and sediment deposition in Lake George. Currently, there are no log headers or active log roads which were found during this study in the English Brook watershed.

The lack of active logging roads found through this project's field assessments corresponds to the lack of permits applied for in the Town of Lake George. According to town records, there have been no recent major logging activities in the watershed in Lake George within the past few years. However, the logging ordinance for the Town of Lake George was adopted in 2003, so prior activities were not regulated or overseen by the town prior to that time. This ordinance describes how logging operations should be conducted utilizing Best management Practices, and suggests that the logger contact a professional forester or the Warren County SWCD to assist in the plans to minimize impacts on streams and wetlands. This ordinance is not always well known by smaller logging companies, and harvesting operations have been known to be undertaken without a town permit in place. The Town of Warrensburg does not have any logging ordinance on the records, and maintains no records of logging activities within the town.

Recommendations**:**

1. To increase awareness of the Town of Lake George ordinance, this information could be generated by the town to be included in Cornell Cooperative Extension's logger certification program. This program is subscribed to by most of the area's loggers.

2. All logging operations within the watershed should have plans and road layouts which should be reviewed and approved by the town's code enforcement officer and/or planning board. Significant logging operations should be reviewed by qualified personnel such as a professional forester or the Warren County Soil and Water Conservation District.
3. Once the Lake George Park Commission's new stream corridor regulations are in place, a major outreach and training effort should be undertaken to inform the logging community about how there rules will be administered.

4. The Town of Warrensburg should consider an ordinance requiring permits for logging operations over a certain size. This would help ensure that these activities, which can have a huge impact on water quality and wetlands if not conducted property, would receive a professional review at the local level.

Wastewater Management

According to 2007 tax parcel information, of the 349 parcels in Lake George portion of the watershed 187 are on public sewer and 162 parcels are noted as having private septic systems. In the Warrensburg portion of the watershed there are 31 parcels, only four of which have private septic systems. During the stream walks for this report, no direct discharges of illegal septic "overflow" pipes or to English Brook or any of its tributaries were identified. In addition, no obvious surface failures of septic systems into the brook were noted along properties bordering the stream as well, although a comprehensive search for these failures was not conducted. There are a few dozen residences located within 300 feet of the stream throughout the watershed which have small lot sizes and little available area for effective septic absorption fields. As such, the possibility that septic failures exist within the stream corridor merits consideration.

The Lake George sewer lines run north of the Village of Lake George on NYS Route 9 to Bradley Street, conveying septage to the Village treatment plant. This line captures most of the densely developed area around the lower Route 9 corridor in the watershed including most of Bradley Street, plus all of Maple Street and Cherry Street. It does not connect into the Thompson Road neighborhoods above Bradley Street. This sewer system addresses the majority of the developed area in the lower English Brook watershed, which is the only portion of the overall English Brook watershed which exhibits dense development.

There is no available data on the specific type or age of the septic systems in the stream corridor, and no proactive program exists to obtain that data or assess the condition of these systems. According to tax parcel data, many of the houses in the un-sewered areas are older, with a large percentage likely having been built more than 40 or 50 years ago. Generally, these systems consist of small septic tanks and seepage pits, particularly given the small lot size. In its past educational programs, the Warren County SWCD has found that a large percentage of residents on private septic systems are unfamiliar with their systems, which is most concerning because this indicates the likelihood of poor or no maintenance as well. With the factors of small lot size, age of the homes, and proximity to the stream, this un-sewered area should be considered a priority for evaluation of potential wastewater improvements.

Recommendations**:**

1. Meet with Reggie Burlingame, Village Wastewater Superintendent, regarding the history of wastewater treatment in the Bradley Street and Thompson Street area, and determine the likelihood of sewer extensions further into the developed areas and up the Route 9 corridor.

2. A targeted septic education program would be a valuable tool to educate landowners about the effects of untreated septic effluent can have on the environment and human health. A voluntary pumpout program in addition to septic education is an effective means to reduce non-point source pollutants through education and source reduction. The Warren County SWCD has successfully completed three of these programs (Brant Lake, Lake Luzerne and Loon Lake) in which landowners participated in a voluntary cost-shared septic pumpout program. Septic education materials are handed out and reviewed by SWCD staff, and a water conservation kit is provided to the homeowner as well. This voluntary program educates the participating landowners in what type of system they have, how it works, what condition their system is in and what to do if there is a problem.
   Estimated Costs: Depending on level of participation, participants can be reimbursed for as much as half of their total cost for pump out. Pump outs on average are approximately $180 for a 1500 gal tank.

Summary and Conclusions

English Brook is among the top five tributary streams to Lake George by volume, and as such, can have a major impact on the lake in terms of water quality and sedimentation. Currently, English Brook evidences the first or second largest sediment delta on Lake George (along with Hague Brook) at over 60,000 cubic yards. This Watershed Assessment was initiated to get a glimpse of the current state of the watershed, identify specific issues of water quality impairment, and provide recommendations to help address these issues.

There are without question signs of water quality degradation and other natural resource impacts within the English Brook watershed. This study looked primarily at stormwater runoff and stream corridor condition (streambank erosion), as these are the two primary factors which affect English Brook. Stormwater runoff is the single largest impact on the Brook as it relates to water quality, as identified in the 1983 NURP study, the 2000 Jarrett-Martin Study, and this assessment.

The uplands of English Brook are largely undeveloped, while the lower watershed towards the Village of Lake George is mostly built out with commercial development. In these lower reaches, the brook is largely confined between retaining walls of varying degrees of structural stability. The reasonably large percentage of developed land in the lower watershed is contributing a significant amount of untreated stormwater through the road network infrastructure. More than three and one half miles of NYS Route 9 and almost four miles of Interstate 87 are within the English Brook watershed, often very close to the brook. A significant amount of highway drains directly into the brook with little or no treatment, conveying road salts, sediment, trash and debris.
Although the NYS DOT utilizes only salt for de-icing on their road networks in the Lake George Basin, many of their roadside structures were partially or completely full of sediment. This sediment likely comes from erosion of the road shoulders, sanding of adjacent town roads, and unstabilized properties which drain to Route 9. Numerous opportunities exist to retrofit the drainage infrastructure on Route 9 to capture this sediment and trash seen within this study. These opportunities are identified and described in this report.

There are a considerable number of improvements within the road corridor and overall watershed which could be conducted to help protect English Brook, many of which are outlined in this report. These efforts could be a tremendous improvement to the quality of water which flows to the brook. However, it is unlikely that one of the primary sources of instream sediment – small undercut banks – can or will be addressed in the near future. There are miles of streambank which are slowly eroding and adding sediment to the stream system, largely during high flow events. Evidence of this erosion and sedimentation can be observed even in undeveloped areas simply by noting the turbidity (lack of clarity) in the water during these events. These small erosion processes are natural, and do not merit significant consideration for restoration. However, as uplands become developed in the future, it is imperative that stormwater runoff is controlled to minimize large increases in stream flow which can exacerbate these already unstable banks.

It is highly recommended that funding be sought to address the concerns mentioned throughout this document, working with the Lake George Watershed Conference, state funding agencies and lake-based conservation organizations such as the Lake George Association. The Town of Lake George highway department has been outstanding in constructing roadway and reservoir improvements to protect Lake George, and it is hoped that they will be a strong partner in this watershed as well. The Warren County SWCD is willing to help coordinate these efforts, both through grant writing, planning, and construction implementation once funding is achieved.

It is our conclusion that the English Brook watershed, while largely consisting of undeveloped land in the headwaters, is in significant need of improvements along the highway corridors and lower sections of stream. This conclusion is verified by the ongoing growth of the delta in Lake George, and the water quality declines seen in the brook over the years. A concerted effort between all involved partners will be required to affect a significant change in the watershed over the coming years, and the framework to achieve this already exists in the Lake George Watershed Conference. A final recommendation is to have the Conference convene a meeting among stakeholders in the watershed to discuss these findings and others, and to ultimately chart a cost-effective and achievable path for future protection and restoration efforts for this important tributary to Lake George.

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List of Figures