



COMPREHENSIVE MANAGEMENT PLAN for LAKE AGAWAM



PREPARED FOR:

Village of Southampton
Village Board of Trustees
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Southampton, NY 11968

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Comprehensive Management Plan for Lake Agawam

**Village of Southampton
23 Main Street
Southampton, New York 11968**

Village Board of Trustees

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Board of Trustees of the Village of Southampton,
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1.0 INTRODUCTION

This document is a Comprehensive Management Plan for Lake Agawam, prepared at the request of the Village of Southampton Board of Trustees, by Nelson, Pope & Voorhis (NP&V), environmental and planning consultants to the Village of Southampton. This report provides a framework for improvements to Lake Agawam, developed through public input, review of literature and analysis of issues and opportunities for recommendations, in a framework that outlines actions, responsibilities, costs and schedule to ensure effective implementation.

1.1 Geographic Context

Lake Agawam is a 60 acre body of water located in the Village of Southampton, Suffolk County, New York. The lake is a focal point within the Village, lying centrally within the Village boundaries and extending from the west part of the Village downtown business district, south of Jobs Lane, to the Southampton Bathing Corporation along Gin Lane, south of which is the Atlantic Ocean. The north side of Lake Agawam is bounded by Agawam Park, and the water body is readily visible from Jobs Lane, Pond Lane, and Gin Lane, thus establishing its prominence as an important feature in the Village. A map depicting the lake and its context within the Village is provided as **Figure 1**, and a figure illustrating the lake and key geographic features is provided as **Figure 2**. *[All figures are contained in a separate section at the end of this report.]*

Figure 3 illustrates a 2004 aerial photograph of the surface watershed contributing area to Lake Agawam. The watershed area lies mostly within the Village of Southampton; however, the northern part of the watershed includes portions in the Town of Southampton, specifically the hamlets of North Sea and Tuckahoe.

1.2 Physical Characteristics

Like a number of other lakes in Southampton Village and along the south shore of Southampton Town, Lake Agawam was likely a basin created as a result of glacial meltwater traversing from the moraines and outwash plains to the north, south to the Atlantic Ocean. The lake was likely once connected to the ocean, but littoral drift along the south shore has created an east-west trending barrier beach which separates many similar water bodies from the ocean. Lake Agawam is now a freshwater body, and the only connection to the ocean is an outflow pipe used to relieve lake water levels by controlled release to the ocean through a manually operated valve.

1.3 Historic Context and Cultural Importance

Lake Agawam has played an important role in the history of the Village. The lake has historically been used mostly for recreation including sailing, boating, fishing and ice skating, and has been a source of enjoyment for Village residents since Village incorporation in 1894 and before.



Local resident accounts indicate the construction of new homes on the lake in 1882 (Memories of Southampton by Marion McKeever Thompson contained in Southampton Long Island 1640/1965, 325th Anniversary, 1965). Photographs generously provided by the Southampton Historical Museum and Research Center depict piers north of the Dune Church and the lake being used for small boat sailing. Celebrations and events, and boat landings along the lake were evident in the 1890's through the early 1900's. The lake was used by residents for row and sail boat transportation to go out at night and travel to the village or the beach. Other accounts recall Captain Pyrrhus Concer, who sailed an antique catboat ferry that carried people back and forth from the village to the beach (Treyor, unpublished manuscript, 1932). **Appendix A** of this report provides a photographic account of the importance of Lake Agawam and its historical context within the community; photographs were provided by the Southampton Historical Museum and Research Center located at 17 Meetinghouse Lane, Southampton. Agawam Park is and has been used for summer concerts and recreational enjoyment. Over time, the lake front has been developed with private residences with the exception of those noted stretches along Agawam Park, Pond Lane and Gin Lane. As a result, many Village residents now share their rear yards with the lake shore.

1.4 Identification of Issues of Concern

Water quality problems in Lake Agawam began in 1954, when fish kills provided evidence of depleted oxygen levels. There have been several notable fish kills in recent decades that have been a source of aesthetic and emotional impact, noted as follows:

- *July 20, 1954* - Many carp, white perch and bullheads killed in July by oxygen depletion (Oxygen as low as 0.5 ppm at 7' depth)
- *June 1981* - Fish kill; 225,000 fish died.
- *June 15, 2000* - Hundreds of white perch found dead, and firefighters used 4 pumper trucks to aerate the lake.
- *Fall 2005* - Fish kill due to cyanobacteria bloom.

Fish kills are generally preceded by algae blooms which occur as phytoplankton feed on excess nutrients (typically nitrogen and phosphorous) caused by groundwater and/or stormwater influx. The biological decomposition which occurs after an algae bloom uses up oxygen in the water, resulting in hypoxic conditions which cause fish kills. Hypoxic conditions can also occur as a result of long periods of stagnation (lack of mixing) during warm weather, when the water does not readily retain oxygen. Algae blooms have been documented on Lake Agawam and have been a primary cause of oxygen depletion with resulting impacts to the lake. Current concerns which are addressed by this study include:

- Stormwater discharge
- Groundwater outflow
- Pet waste management
- Waterfowl populations
- Fertilization and runoff
- Shoreline and buffer management
- Sediment accumulation and resuspension



Recommendations are provided to address these and other issues to assist in implementing the plan for improvements to Lake Agawam.

1.5 Purpose of Study

The purpose of this study is to address water quality problems of Lake Agawam, in order to improve the environmental health of the lake, and restore its prominence as a recreational and cultural resource. The study will raise the awareness of the lake and problems which confront it, and will provide a basis for actions by various levels of government to implement measures to improve water quality and aesthetics. An important part of the study is to include public input and participation, in order to gain the full benefit of available local knowledge and information, and to provide a platform for consensus building. The Lake Agawam Conservation Association has played a vital role in the dissemination of information, and their interest, input and commitment to improving Lake Agawam is acknowledged and appreciated.

The Comprehensive Management Plan will assemble all available information to date, so that it will form a comprehensive baseline of data and information for use in tracking the implementation of recommendations and lake improvements. It is the purpose of this study to provide an action plan for the lake's future, by identifying projects, preliminary budgets, funding sources, responsibilities and a tentative schedule for improvements.

1.6 Jurisdictional Entities

There are several jurisdictional entities which will play key roles in implementing improvements to Lake Agawam. The Village Board of Trustees of the Village of Southampton has commissioned this study, which is funded by the Village Board in concert with the Lake Agawam Conservation Association. The Village Board is committed to implementing improvements for the health of the lake, and has played a vital role in increasing public education and in taking actions to remedy water quality concerns. To date, the Village Board has been engaged in a number of activities to improve Lake Agawam. These include:

- Prior funding of water quality studies by Southampton College
- Installation of bubblers to add oxygen to the water
- Installation of additional stormwater recharge facilities within the watershed
- Public information and outreach through televised Village Board meetings
- Mailing a brochure on buffers to owners of lakefront property and Village residents

The current Village Board has taken a keen interest in ensuring that a meaningful plan which results in actual improvements to the lake is implemented; this Comprehensive Management Plan for Lake Agawam is the result of that commitment. The Village of Southampton was incorporated from the Town of Southampton in 1894, giving the Village jurisdiction over land use within the corporate boundaries of the Village. The Village's primary role is to ensure that the areas surrounding the lake result in reduced influx of pollutants to the lake. This will occur through public education, direct actions and legislative initiatives for those aspects of Lake Agawam that can be addressed through the jurisdiction of the Village Board.



The Village of Southampton Zoning Board of Appeals (ZBA) has legislative powers to review and approve applications for development and land use within certain setbacks of Village defined wetlands. This authority is granted under Chapter 116 Article IIIA of the Village code, and establishes setbacks of 200 feet for sanitary systems, 150 feet for structures and 125 for landscape limitations. Regulated activity occurring within these setbacks requires a permit from the ZBA. The Board has taken initiatives to reduce fertilizer dependent landscaping and increase and maintain natural buffers adjacent to Lake Agawam and other lakes, ponds and wetlands in the Village, as well as ensuring that development retains and recharges stormwater and conforms to required setbacks to the greatest extent practicable. The ZBA will continue to play a vital role in ensuring that land use within the required setback areas is reasonably controlled through their current authority, and does not cause adverse impacts to Lake Agawam or other Village wetlands.

The Town of Southampton plays a key jurisdictional role with respect to Lake Agawam. The Board of Trustees of the Freeholders and Commonalty of the Town of Southampton, referred to as the Town Trustees, are the stewards of the lake itself. The Town Trustees gain this jurisdiction through the Dongan Patent of 1686, a King's grant through his General Governor Thomas Dongan, which granted the Board of Trustees access, rights and stewardship of common underwater land and marshland within the Town. The Dongan Patent also guarantees every Town Freeholder the right to access and use this land and its resources. The Town Trustees have engaged in lake improvement activities in the past, including: removal of 5,000 pounds of carp in 2004; and, installation of four (4) bubblers at the south end of the lake. The Town Trustees have been actively involved with public outreach associated with this study by addressing the Village Board during public information meetings, and have provided input during the course of it's preparation. The Town Trustees control the parking area for the Southampton Bathing Corporation at the south end of the lake, and are encouraged through this study to explore parking lot improvements to provide more effective public access, aesthetic and environmental qualities and stormwater runoff control.

The Town of Southampton has also prepared an overall Stormwater Management Program (SWMP) which includes the Village of Southampton in accordance with the New York State Department of Environmental Conservation (NYSDEC) Stormwater Phase II regulations. These regulations were established in 2003 (and updated in May 2008), and require that municipalities in proximity to certain water bodies obtain permit coverage under the program for stormwater discharges from Municipal Separate Storm Sewer Systems (MS4s). The Town and the Village as regulated MS4s prepared a SWMP which includes the development of public outreach programs on stormwater impacts, evaluation of best management practices for municipal operations (i.e., road salting, street sweeping, roadway drainage design, etc.), mapping of existing stormwater outfalls and drainage features, and establishing a program for review of construction sites for proper erosion controls and stormwater containment and local implementation of the construction stormwater permits. The SWMP also established a schedule for implementation of the first cycle of the program (March 2003 - March 2008) and required the preparation of annual reports on the implementation of the program to the NYSDEC.



Under the SWMP, the Town retained a stormwater manager that has sought grants and identified potential stormwater improvements in the Village of Southampton. Under the second cycle of the program (May 2008 – January 2013), the Town will be required to update the SWMP to meet the new General Permit (GP-0-08-002) requirements. Conformance to the SWMP will be required on an ongoing basis, and coordination with the Town of Southampton to ensure conformance to the multi-year improvement programs is critical.

Additionally under the NYSDEC Stormwater Phase II Program, General Permits are also required for stormwater discharges from construction activities which involve more than 1-acre of disturbance in areas which may contribute to a receiving water body. The General Permit (identified as SPDES GP-0-08-001), requires the preparation of a Stormwater Pollution Prevention Plan (SWPPP) designed to ensure proper erosion control and stormwater control measures are implemented during the construction period and that the post construction stormwater management system is properly designed and maintained. The SWPPP must be submitted for review by the local municipality prior to filing of a Notice of Intent for coverage under the General Permit prior to commencing the activity and a Notice of Termination when activities are complete with NYSDEC.

NYSDEC typically regulates activities within 100 feet of State designated freshwater wetlands under the statutory authority of Article 24 of the NYSECL and the enabling regulations of 6NYCRR Part 663. This jurisdiction applies to other lakes, ponds and wetlands in the Village; however, for Lake Agawam this authority does not exist and as of 1991, all permitting activities lie with the Village ZBA. **Appendix B** contains a letter from the NYSDEC indicating the freshwater wetland permit authority for Lake Agawam as delegated to the Village of Southampton pursuant to the enabling regulations of 6NYCRR Part 665.

The Suffolk County Department of Health Services (SCDHS) is an agency which regulates subdivision of land and density of land use under Article 6 of the Suffolk County Sanitary Code (SCSC) for the purpose of ensuring that properly designed and installed sanitary systems or sewage treatment are in place for land use projects, and to ensure that excess nitrogen loading does not occur from sanitary waste. SCDHS reviews and acts on subdivision applications and permits to construct sanitary systems. In addition, the SCDHS Board of Review considers sanitary transfer credit applications. This agency is important in ensuring groundwater and surface water protection from sanitary discharge.



2.0 LITERATURE SEARCH

There are a significant number of studies, reports and news items which are important for consideration in the development of the Comprehensive Management Plan for Lake Agawam. This section is intended to identify the programs, studies, reports and references that have been reviewed with respect to water quality, past management efforts and future recommended efforts. **Appendix C** includes a review of both news items and research studies, which are the product of a data mining effort to compile a comprehensive reference list of information related specifically to Lake Agawam. Resources and information were compiled by reviewing Village and office resource files for past studies which may have contained recommendations for Lake Agawam, as well as by meeting with Town of Southampton officials, NYSDEC, SUNY Southampton education/research professionals, and community representatives. The overall review and resulting information have been considered and utilized in development and evaluation of management recommendations. Applicable information from these studies, reports and references are briefly summarized below and identified in **Appendix C**.

The earliest known ecological study on Lake Agawam was a fish inventory performed by the NYS Conservation Department (presently known as NYSDEC) in July 1938, which identified the presence of largemouth bass, rock bass, white perch and carp in the lake (**NYSCD, 1938**). The inventory also noted that carp were overly abundant and the fish were being seined out in an attempt to reduce their population in the lake. A second fish inventory conducted by NYS Conservation Department in July 1954 noted the presence of brown bullhead (catfish) and banded killifish in addition to white perch and carp (**NYSCD, 1954**). The inventory further reported a hypoxic event followed by a fish kill on July 20th, 1954, just a few days after the fish inventory was conducted. Fish population control measures (poisoning) were slated to be conducted by the Town of Southampton that same fall, but control measures were not performed due to a September hurricane event which flooded Lake Agawam. The 1970 fish inventory noted the common presence of pumpkinseed in addition to white perch, European carp, and an abundant brown bullhead population (**NYSCD, 1970**). The 1982 fish inventory had similar results, but with largemouth bass also being observed (**NYSDEC, 1982**). A NYSDEC permit was issued in April 2003 to remove carp with the intention of balancing nuisance and recreational game fish (**NYSDEC, 2004**). In July 2003, a NYSDEC fish stocking permit was also issued to increase largemouth bass populations in the lake (**NYSDEC, 2003**). In 2007, the NYSDEC indicated that no fish are presently stocked in Lake Agawam, as it contains naturally reproducing populations of largemouth bass, bluegill, pumpkinseed, white perch, carp and brown bullhead (**NYSDEC, 2007**).

Fish kills within the lake were reported in multiple articles within the New York Times in 1981 and 2000 (**NY Times, 1981a, 1981b; Wright, 2000**). In 1984, a local newspaper reported a wetland improvement project in the southwest corner of the lake which involved the removal of extensive water lily vegetation. Efforts to improve the condition of Lake Agawam sparked up again in 2002 with a discussion on the general needs of the lake published in The Southampton Press (**Wright, 2002**). A proposal for gunderbooms and storm drain filters was put forth in 2002 with Hildreth's Department Store pledging their support.



The SCDHS conducted sediment monitoring within Lake Agawam to assess whether sediment traps installed by the Village had a significant impact on metal concentrations in bottom sediments of the lake (SCDHS, 2003). Baseline sediment samples from 2000 were compared with samples collected in 2003 and determined that metal levels were consistent with other freshwater sediments in Suffolk County and posed no threat to public health. No significant volatile organic compounds were detected in the samples. The report concluded that it was unclear whether the sediment traps had made a significant impact on metal concentrations, as it could take more than ten years before sediment contamination levels significantly changed. The SCDHS recommended that the traps be inspected and maintained regularly, but that no further sediment sampling be considered until at least 2008.

The health of Lake Agawam is a public concern and the distasteful green color of overly enriched and polluted Lake Agawam waters even became a topic of discussion on David Patrick Columbia's New York Social Diary (2006). In 2007, the installation of Solarbees for aeration of the lake was pushed for by local residents to combat algal problems, and the removal of carp was again considered (Wright, 2007). The Town of Southampton indicated their dedication of stormwater fund money to conduct outfall and infrastructure mapping as well as install new catch basins and leaching pools to protect three of the Village's ponds. Also in 2007, Professor Christopher Gobler expressed his concern regarding the bubblers which were installed within Lake Agawam, as their circulation of water could potentially cause more harmful conditions by promoting the growth of toxic cyanobacteria (Hamptons.com, 2007). In the Fall 2007 issue of The Village News, the Town's plan for stormwater retention in the Lake Agawam watershed was reported and NP&V was retained, with funding from the Village and the newly formed Lake Agawam Conservation Association, to prepare a comprehensive management plan for the lake.

No water quality monitoring had been known to occur in Lake Agawam until 2003, when Professor Christopher Gobler, Ph.D., of Southampton College (currently State University of New York, Southampton and Stony Brook) began conducting a preliminary assessment of water quality in the lake with weekly sampling conducted from April through August. Measured parameters included dissolved oxygen, temperature, salinity, chlorophyll *a*, nutrients, water clarity, coliform bacteria, cyanobacteria and bottom sediment sampling. Preliminary results indicated extremely high levels of nutrients and bacteria were entering the lake from storm drains (Gobler, 2003). The final report, released in May 2004, concluded the lake was a biologically stressed, hypereutrophic ecosystem which experienced high algal growth, varying levels of bacteria and low levels of oxygen (hypoxia) along the lake bottom in summer months.

Data from 2003 also indicated that harmful toxins produced by cyanobacteria were present in Lake Agawam, with the highest levels being observed from late July through October (Gobler, 2004). Cyanobacteria are a common family of blue green algae which are typically associated with over-enriched eutrophic and poorly flushed waters. There are several potentially toxic subspecies of these algae capable of producing harmful cyanotoxins, such as hepatoxins (e.g. microcystin) which target the liver. The abundance of these toxins in aquatic ecosystems has serious implications for wildlife and human health, as multitudes of sicknesses and even deaths have been associated with the consumption of contaminated water. Nutrient loading combined with warm temperatures is known to increase algal blooms in summer months, and is therefore also thought to increase the potential growth of harmful varieties of cyanobacteria in poorly



flushed waters (**Gobler, 2007**). A warning of harmful cyanobacteria algal blooms was posted at Lake Agawam by the Board of Trustees in August 2004 to inform the public of these hazards.

Additional sampling in 2004 was aimed at identifying the drivers of cyanobacterial growth (**Gobler et al., 2007**) and the dominance of microcystin-producing *Microcystis sp.* blooms during summer were linked to nutrient saturated conditions and suppression of mesozooplankton grazing. Bloom decline was associated with nutrient limitation, which reduced growth rates and toxin production by *Microcystis* and in turn may have permitted zooplankton to graze cells (**Gobler et al., 2007**). Part of a larger study among New York and the Lower Great Lakes Ecosystems finds that microcystin toxins are the most common cyanobacterial toxin encountered in the region, with nearly 60% of samples containing detectable levels of microcystins (**Boyer, 2007**).

A four year study of 20 lakes throughout Suffolk County was undertaken by Professor Gobler to assess the presence of toxic cyanobacteria blooms in recreational areas and the factors which are associated with promoting these blooms (**Gobler, 2007**). While the majority of the lakes studied had levels below the threshold considered to be a low recreational risk by the World Health Organization (WHO), Lake Agawam was identified as a lake which posed moderate-to-high risks to human health for recreation at various times during the study. The guidelines established for municipalities by the WHO for microcystin concentrations in natural water bodies are $1 \mu\text{L}^{-1}$ for drinking water supplies, 2 to $4 \mu\text{L}^{-1}$ for low recreational risk, and $20 \mu\text{L}^{-1}$ for moderate recreational risk. Water quality samples obtained from 2005 revealed an average annual microcystin concentration of $5.30 \pm 1.19 \mu\text{L}^{-1}$ in Lake Agawam, with concentrations ranging from 0.567 to $11.8 \mu\text{L}^{-1}$ over the summer months. High risk concentrations are indicated to be cyanobacteria mats which can form near the shore, and are to be avoided. A warning was posted at Lake Agawam in August 2004 to notify the public of precautions to take during harmful cyanobacteria algal bloom events to reduce the risk of illness.

As toxic blue green algae blooms are associated with stagnant, eutrophic waters, the following two approaches should be tested as methods for reducing the occurrence and risk of toxic cyanobacteria blooms in afflicted lake systems (**Gobler, 2007**):



Photo: Chris Gobler, MSRC

1. Install water circulators to push surface dwelling cyanobacteria to the bottom of the lake, potentially preventing bloom occurrence; and
2. Target the reduction of primary sources of nutrients into Lake Ronkonkoma in conjunction with monitoring to assess the relation of nutrient loads on algal blooms.



As part of an ongoing study (**Davis & Gobler, 2007**), additional water quality sampling was conducted weekly to biweekly from May through November 2007 in Lake Agawam by Professor Gobler's laboratory (**Harke et al., 2008**). In addition to sampling, an attempt was made to assess the relative sources and quantities of nutrients flowing into Lake Agawam using data collected from June through October 2007 (**Harke et al., 2008**). Nutrient sources for the lake were determined to be a large storm drain at the northwest corner of the lake, benthic fluxes of nutrients from bottom sediment, groundwater, atmospheric deposition and surface runoff from adjacent land uses. Among these sources, groundwater, stormwater and benthic sediments were found to be the greatest contributors of pollutants to the lake. Although groundwater appears to be a large contributor of nutrients to the lake, remediation of groundwater provides a challenge both from the standpoint of potential sewerage and maintenance/upgrade of existing sanitary systems. Control of additional density increases within the watershed should be carefully monitored and limited where possible. Given the challenge of groundwater remediation, **Harke et al.** suggest that remediation tactics to reduce the nutrient loads may best be focused on sediment dredging and diversion of stormwater runoff.



3.0 INVENTORY OF WATERSHED/LAND USE CONDITIONS

The following section describes the current conditions of the Lake Agawam Watershed and land use within the watershed.

3.1 Watershed Area

The Lake Agawam surface watershed area encompasses approximately 1,145 acres within the Village of Southampton, as well as portions in the Town of Southampton, specifically the hamlets of North Sea and Tuckahoe (**Figure 1**). The northernmost point of the watershed is located just south of the intersection of Majors Path and Henry Avenue. The watershed is more particularly described by the following:

Beginning at the intersection of Ox Pasture Road and First Neck Road, heading southwest approximately 150 feet, heading south along the west side of First Neck Road approximately 1,000 feet, before heading southeast approximately 800 feet to the east side of First Neck Road, before heading southwest approximately 300 feet, before heading southeast approximately 1,400 feet to Dune Road, before heading east approximately 880 feet, before heading south approximately 150 feet, before heading northeast approximately 700 feet to the east side of Atlantic Avenue, before heading north approximately 200 feet along the east side of Atlantic Avenue, before heading northeast approximately 850 feet along the beach line, before heading north approximately 720 feet south of Gin Lane, before heading northwest approximately 770 feet to the west side of South Main Street, before heading northeast approximately 690 feet to south of Foster Crossing, before heading northwest approximately 780 feet to north of Foster Crossing, before heading northeast approximately 3,100 feet to just south of Hampton Road, before heading northwest approximately 2,500 feet to Pulaski Road, before heading north approximately 630 feet to Powell Road, before heading northwest approximately 1,500 feet to County Road 39, before heading northwest approximately 1,000 feet to east of North Main Street, before heading west approximately 1,200 feet to west of North Main Street, before heading northwest approximately 1,200 feet, before heading northwest approximately 1,400 feet to just east of Majors Path, before heading southwest approximately 1,000 feet just south of Henry Road and east of County Road 38, before heading south approximately 1,800 feet to north of State Route 27, before heading southwest approximately 260 feet, before heading southeast approximately 400 feet, before heading south approximately 1,700 feet to Windward Way, before heading southeast approximately 1,300 feet to just north of White Street, before heading south approximately 2,100 feet to Montauk Highway between Breese Lane and Vahradian Lane, before heading southeast approximately 750 feet to west of First Neck Lane, before heading south approximately 750 feet, before heading southeast approximately 450 feet, before heading south approximately 700 feet to just north of Ox Pasture Road, then bearing southwest approximately 250 feet to the commencing position at the intersection of Ox Pasture Road and First Neck Road.

3.2 Topography

Topography within the watershed is illustrated in **Figure 4** with a Digital Elevation Model obtained from USGS. As illustrated, topography generally decreases from north to south. Within the northern portion of the watershed, areas of higher relief exist closer to the boundaries of the watershed while the center of the watershed has a lower relief. Topography within the remainder of the watershed shows the general downslope trend of the land surface toward the lake.



3.3 Soils

Soils within the watershed can be generally described as soils of the Bridgehampton-Haven association, which are deep, nearly level to strongly sloping, well drained to moderately well drained, moderately coarse textured and medium-textured soils found on moraines. Specific soil types within the watershed are illustrated in **Figure 5**. Bridgehampton soils (BgA, Bm) and Haven soils (HaA, HaB, He) are predominant within the watershed, and are characterized by the larger soil association described above.

Areas within the center of the watershed generally display the highest soil diversity. Riverhead soils (RdA, RdB) and Plymouth-Carver soils (PIB, PIC) are the predominant soils within the center of the watershed. Riverhead soils are generally deep, well-drained, moderately coarse textured soils. Plymouth-Carver soils are generally deep, excessively drained, coarse-textured soils. Other soils found within the watershed consist of Berryland mucky sand (Bd), Cut and Fill Land, gently sloping (CuB), Dune Land (Du), Fill Land, sandy (Fs), Urban Land (Ur), and Walpole sandy loam (Wd).

3.4 Subdrainage Areas

In total, fourteen subdrainage areas were identified within the Lake Agawam watershed, and are illustrated in **Figure 6**. The subdrainage areas were delineated using Digital Elevation Model data from USGS and the Spatial Analyst extension in ArcView. It should be noted that these areas are based upon topography only. Generally, the larger drainage areas are located within the northern portion of the watershed, while the smaller areas are located within the southern portion of the watershed.

3.5 Hurricane Hazard Areas

Information regarding areas within the watershed that would be affected by hurricanes was obtained from FEMA. Sea, Lake, and Overland Surges from Hurricanes (SLOSH) data, which determines which areas will be most impacted by varying categories of hurricanes, is illustrated in **Figure 7**.

Generally, areas within approximately 100 feet of the lake will be affected by Category 1 and greater hurricanes. Areas within approximately 200 feet of the lake will be affected by Category 2 hurricanes and greater. Areas which are affected by Category 3 hurricanes and greater vary in distance from the lake, and seem to be dependent upon topography. Areas which are affected by Category 5 hurricanes and greater also vary surrounding the lake, but extend as far north as just south of the intersection of White Street and Windmill Lane.



3.6 Groundwater

Groundwater elevation is illustrated in **Figure 8** and ranges from 0 to 3.8 feet above sea level (asl). Groundwater elevation generally increases from south to north. Depth to groundwater within the watershed is illustrated in **Figure 9**. The depth to groundwater ranges from 0 feet asl in the southern portion of the watershed to 36 feet asl in the northernmost portion of the watershed. Generally, depth to groundwater is less in the center of the watershed, while areas towards the boundaries of the watershed and in the northern portion have a greater depth to groundwater.

3.7 Land Use

Land use within the watershed area is comprised of eleven categories. The most prevalent land use within the watershed consists of Residential use, which encompasses approximately 45.42 percent of the watershed. Roadway use and Commercial use follow Residential use in terms of magnitude, which encompass 12.31 percent and 12.11 percent of the watershed, respectively. Agricultural, Community Service, Vacant uses and the lake each encompass approximately 7 percent of the watershed. Finally, Public Service, Recreation and Entertainment, Wild, Conservation and Public Parks, and Unknown uses each encompass less than 2 percent of the watershed. **Table 1** below details the acreages and percents of land use for each category.

TABLE 1
LAND USES WITHIN THE LAKE AGAWAM WATERSHED

Land Use Type	Area (Acres)	Percent
Agricultural	80.51	7.03
Commercial	138.67	12.11
Community Service	89.65	7.83
Lake	64.76	5.66
Public Service	23.75	2.07
Recreational & Entertainment	5.93	0.52
Residential	520.08	45.42
Road	140.96	12.31
Vacant	74.84	6.53
Wild, Forested, Conservation Lands & Public Parks	5.42	0.47
Unknown	0.60	0.05
Total	1,145.16	100.00



3.8 Zoning

Figure 12 illustrates zoning within the watershed. Fifteen zoning categories are represented within the watershed boundary, and consist of residential zoning, commercial zoning, and industrial zoning. The area within the watershed is dominated by residential zoning. Zoning surrounding the lake itself is entirely residential, with the majority of the zoning consisting of R-120. Generally, areas near the boundary of the watershed are residentially zoned. Commercial zoning primarily occurs within the interior of the watershed, and consists of OD – Office District, VB – Village Business District, and HB – Highway Business District. Two areas of industrial zoning occur within the watershed, which consist of LI – Light Industrial and LI40 – Light Industrial (40,000 sq. ft. lots). These areas are located within the northern portion of the watershed and both are surrounded by business and commercial zoning.

3.9 Publicly Owned Lands

Publicly owned lands within the watershed consist of both Town-owned and Village-owned lands, which are illustrated in **Figure 13**. Only a small portion of the land within the watershed is publicly owned. The Town owns two parcels used for recreation in the northern portion of the watershed, one vacant parcel along State Route 27A, one parcel used for institutional purposes near the eastern boundary of the watershed, on low density residential use adjacent to the northern end of the lake, and Lake Agawam itself. Village-owned lands include three commercial parcels to the north of the lake, several institutional parcels to the north of the lake, several vacant parcels north of the lake, and a park adjacent to the north end of the lake.

3.10 Stormwater Inventory

Stormwater infrastructure within the watershed was inventoried in May 2008 by Safi Sammi, a Village intern. NP&V coordinated the data sheets and gathering of information completed during the internship. The results of the inventory are depicted in **Figure 10**, which illustrates the locations of each structure as well as the structure type. The survey included observations on condition and maintenance needs associated with observed structures.

In total, 140 catch basins were identified within the watershed. Three areas in particular have large concentrations of catch basins. The first area occurs just north of the lake along State Route 27A. The second area occurs on North Main Street between Layton Avenue and the Long Island Railroad. The final concentration of catch basins occurs along North Sea Road between Miller Road and Valorie Road. It is expected that the first grouping of catch basins drains to the Lake, while the second and third grouping provide for direct recharge. In total, 36 catch basins are in need of maintenance or repair.

Two areas of significant flooding were identified during the stormwater inventory. The first area is located at the southern boundary of the watershed, while the second area is located at the intersection of Cameron Street and South Main Street. Two areas of overland flow were also identified within the watershed, both of which are located on the north side of Dune Road at the bulkhead at the southern end of the Lake.



4.0 Inventory of Lake Conditions

The following section describes both historical and current conditions of the lake.

4.1 Shoreline Vegetation Inventory

An inventory of the vegetation within the lake and within a 100 foot buffer, or riparian area, surrounding the lake was performed by NP&V in November of 2007. Five vegetation categories were identified within the lake and its riparian area, which are illustrated in **Figure 14**. Areas of lawn predominantly surround the lake, with the exception of the pavement which dominates the southernmost buffer of the lake. In total, 17.1 acres (67.2 percent) of lawn is located within the 100 foot riparian area surrounding the Lake. Common reed (*Phragmites australis*), is an invasive plant which currently encompasses approximately 0.9 acres (3.4 percent) of the riparian area along the lake's edges. Comparatively, native vegetation catalogued along the shoreline made up approximately 1.4 percent of the buffer area and included native assemblages of wetland plants, such as sedges, rushes, willow and sweet pepperbush. Other vegetation totaled 12.3 percent of the riparian buffer and included wooded areas as well as areas of lower shoreline vegetation where native species were highly mixed with invasive species, such as porcelainberry. Additionally, a small area of denuded shoreline on the west side of the lake, where all vegetation had been physically removed, totaled approximately 0.1 acres (0.3 percent of the buffer area). Within the lake, aquatic water lily vegetation was only observed in two areas of the lake during the November inventory, along the western shoreline and along the southwestern corner of the lake.

TABLE 2
LAND COVER WITHIN 100 FEET OF LAKE AGAWAM

Land Cover Type	Area (Acres)	Percent
Lawn	17.1	67.2
Pavement	3.7	14.6
Other Vegetation	3.1	12.3
Phragmites	0.9	3.4
Native Vegetation	0.4	1.4
Buildings	0.2	0.8
Denuded	0.1	0.3
Total	25.4	100.00

4.2 Bathymetry and In-Lake Features

Bathymetry of the lake is depicted in **Figure 14** and was obtained from soundings performed by NP&V in November 2007. Depth within the lake ranges from 0 to 10 feet. Gradual sloping along the lake bottom is greatest near the shoreline and the bathymetry remains more constant near the center of the lake.



Fountains and bubblers which had both been installed within the lake were also inventoried by NP&V in November 2007 (**Figure 14**). GPS coordinates were obtained for locating the bubblers. Three fountains were identified within the northern portion of the lake, and are maintained by the Village for aeration of the lake, as well as for aesthetic purposes. Sixteen bubblers were located within the lake during the December survey. Six of the bubblers were grouped in the northern portion of the lake, three within the middle of the Lake, and seven in the southern end of the lake.

4.3 Inlets and Outlets

Stormwater inputs and outfalls within the lake are illustrated in **Figures 10** and **14**. Inlets generally result from direct flow into the lake from the surrounding watershed. Holes located in the bulkhead along the southern shoreline of the lake also contribute runoff directly to the lake. Four outfalls were identified by NP&V in November 2007 within the lake. Three of these are stormwater outfalls are located on the northern shoreline of the lake. The fourth pipe structure is an outlet located at the southeast corner of the lake and solely serves as an overflow conveyance that can be manually opened to discharge lake water to the Atlantic Ocean when water levels within the lake become too high. The main stormwater outfalls are considered a single storm drain at the northwest corner of the lake, which contains two outflow openings that both release water during rain fall events. This structure is a large pipe which extends up Windmill Lane to North Sea Road and collects runoff within the upper and lower reaches of the watershed, for discharge to the lake. The exact alignment and limit of this conveyance system, as well as connected catch basins is not clear at this time. Water quality sampling was conducted at these outflow pipes in 2007 by Professor Gobler's laboratory group (**Harke et. al., 2008**) and is further discussed in **Section 6.1**.

4.4 Waterfowl

Canada geese have been observed both in the lake and in the area surrounding the lake. Feces as a result of Canada geese are a known pollutant to freshwater systems, as the feces result in additional nitrogen inputs to the lake. Excess nutrients such as nitrogen within freshwater systems can cause harmful algal blooms (HAB's) which are a known problem in Lake Agawam (**Gobler 2007**).



5.0 PUBLIC PARTICIPATION

5.1 Public Input

The Southampton Village Board of Trustees requested a proposal from NP&V to prepare the Comprehensive Management Plan for Lake Agawam. NP&V, as environmental planning consultant to the Village, had been involved with the study of the lake through meetings with the Trustees and community members, and reports to the Board at public board meetings for several years prior to this study. During the course of discussions, owners of property in the Village interested in Lake Agawam formed the Lake Agawam Conservation Association (LACA) which includes interested stakeholders with lakefront property and members of the Southampton Bathing Corporation. On the date that the Village Board accepted the proposal for preparation of this plan (September 12, 2007), the Lake Agawam Conservation Association had been involved and was sufficiently organized and committed to the project to pledge monetary assistance for the study. The study commenced and the LACA has been involved since that time.

The LACA held a meeting in New York City on November 15, 2007, at which Mayor Mark Epley presented the resident group with information and an update on the study. The objectives and status of the study were discussed.

A presentation on the progress of the study to date was provided to the Board of Trustees at a public meeting on April 10, 2008. A PowerPoint Presentation was given by Charles J. Voorhis, CEP, AICP of NP&V, at which time, progress to date and preliminary recommendations were shared with the public. Included in the presentation was the following information:

- a summary of the Lake Agawam watershed;
- mapping including sub-drainage areas, depth to groundwater, hurricane inundation zones, aerial photography and land use;
- the results of an inventory of lake conditions (shoreline conditions, lake bathymetry, installed bubbler systems, inventoried lake vegetation, etc.); and
- Preliminary recommendations for the watershed area, the riparian buffer areas, and lake management recommendations for the water body itself.

The presentation was augmented with information provided by Dr. Chris Gobler, Ph.D., professor at the State University of New York (SUNY), Marine Science Research Center (MSRC) (Stony Brook and Southampton Campuses), who has been involved with graduate studies in the study of water quality in Lake Agawam since 2003. Dr. Gobler was in the process of completing an updated report on recent water quality and pollution source findings for the lake and provided a supplemental PowerPoint Presentation of their findings to date. Fred Havemeyer, Trustee of the Town of Southampton, attended and spoke at the meeting to provide input from the perspective of the Town Trustees. The presentation was followed by a question and answer period, and the video-recorded event was later televised on Channel 18 for further public information.



On May 2, 2008, Dr. Gobler and the MSRC hosted a Marine Science Symposium at the Southampton College Campus of SUNY at which he presented a summary of findings from the Lake Agawam water quality research. Representatives of NP&V were in attendance at this symposium.

The Lake Agawam Conservation Association held a member meeting on July 12, 2008, to update the membership on the status of the study and to gain further input to provide to the Village Board of Trustees and the consultant prior to finalization of the report. This input was incorporated to ensure participation of interested stakeholders.

The Village Board held a public meeting on July 10, 2008, at which NP&V presented the Draft Comprehensive Management for Lake Agawam for further public input and discussion. Input received during questions and answers at the meeting were further incorporated into the final report, as necessary. Similar to the April meeting, this event was televised for public information purposes.

5.2 Public Outreach

As a result of meetings conducted between NP&V and the Lake Agawam Conservation Association, a “Buffer Zone Kit” was prepared to educate land owners surrounding the lake. The kit includes a pamphlet created by NP&V, “An Owner’s Guide to Lake Agawam,” which contains basic information regarding the water quality of the lake, and what residents can do to improve the quality of the lake. Suggestions include native plantings within the 100 foot buffer zone surrounding the lake, reduction of lawn fertilization, and maintenance of septic systems. In addition to the pamphlet, a sign to delineate a “No Mow Zone” area on individual properties was designed by the LACA and is also included so that landscapers would not mow within the buffer zone. ‘An Owner’s Guide to Lake Agawam’ and ‘Buffer Zone’ signs, which were distributed to homeowners around the lake by Lake Agawam Conservation Association in June 2008. Information and status updates regarding the lake will continue to be provided to residents surrounding the lake.



6.0 ANALYSIS OF CONDITIONS

Two main issues were identified regarding the conditions of the lake. Problems regarding both surface water quality and groundwater quality have been identified within Lake Agawam and its watershed, and are further summarized below.

6.1 Surface Water Quality

Surface water quality has been studied extensively by Christopher J. Gobler, Ph.D. since 2003. His studies resulted in the identification of harmful cyanobacteria within the lake. Cyanobacteria are a common family of blue green algae which are typically associated with over-enriched, eutrophic and poorly flushed waters. There are several potentially toxic sub-species of these algae capable of producing harmful cyanotoxins, such as hepatoxins (e.g. microcystin) which target the liver, as well as neurotoxins (e.g. anatoxin-a) which target the neurological system. The abundance of these toxins in aquatic ecosystems has serious implications for wildlife and human health, as multitudes of sicknesses and even deaths have been associated with the consumption of contaminated water. Nutrient loading combined with warm temperatures is known to increase algal blooms in summer months, and is therefore also thought to increase the potential growth of harmful varieties of cyanobacteria in poorly flushed waters (**Gobler, 2007**). Dr. Gobler's water quality findings illustrate Lake Agawam exhibits levels of chlorophyll and nutrients (nitrogen and phosphorus) that deem it a hypereutrophic water body by EPA guidelines.

Sampling of Lake Agawam in 2004 was aimed at identifying the drivers of cyanobacterial growth (**Gobler et al., 2007**) and the dominance of microcystin-producing *Microcystis sp.* blooms during summer were linked to nutrient saturated conditions and suppression of mesozooplankton grazing. Bloom decline was associated with nutrient limitation, which reduced growth rates and toxin production by *Microcystis* and in turn may have permitted zooplankton to graze algal cells (**Gobler et al., 2007**).

A four year study of 20 lakes throughout Suffolk County was undertaken by Professor Gobler to assess the presence of toxic cyanobacteria blooms in recreational areas and the factors which are associated with promoting these blooms (**Gobler, 2007**). While the majority of the lakes studies had levels below the threshold considered to be a low recreational risk by the World Health Organization (WHO), Lake Agawam was identified as a lake which posed moderate-to-high risks to human health for recreation at various times during the study. The guidelines established for municipalities by the WHO for microcystin concentrations in natural water bodies are $1 \mu\text{L}^{-1}$ for drinking water supplies, 2 to $4 \mu\text{L}^{-1}$ for low recreational risk, and $20 \mu\text{L}^{-1}$ for moderate recreational risk. Water quality samples obtained from 2005 revealed an average annual microcystin concentration of $5.30 \pm 1.19 \mu\text{L}^{-1}$ in Lake Agawam, with concentrations ranging from 0.567 to $11.8 \mu\text{L}^{-1}$ over the summer months. High risk concentrations are indicated to be cyanobacteria mats which can form near the shore, and are to be avoided. A warning was posted at Lake Agawam in August 2004 to notify the public of precautions to take during harmful cyanobacteria algal bloom events to reduce the risk of illness.



As part of an ongoing study (**Davis & Gobler, 2007**), additional water quality sampling was conducted weekly to biweekly from May through November 2007 in Lake Agawam by Professor Gobler's laboratory (**Harke et al., 2008**). In addition to sampling, an attempt was made to assess the relative sources and quantities of nutrients flowing into Lake Agawam using data collected from June through October 2007 (**Harke et al., 2008**). Nutrient sources for the lake were determined to be a large storm drain at the northwest corner of the lake, benthic fluxes of nutrients from bottom sediment, groundwater, atmospheric deposition and surface runoff from adjacent land uses. Among these sources, groundwater, stormwater and benthic sediments were found to be the greatest contributors of pollutants to the lake.

Lake Agawam is not currently listed as a priority waterbody on the Final New York State 2006 Section 303(d) List of Impaired Waters Requiring a TMDL/Other Strategy¹. The 303(d) List identifies those waters that do not support appropriate uses and that may require development of a Total Maximum Daily Load (TMDL) or other restoration strategy to attain quality standards. At this time, development of the 2008 Section 303(d) List is in progress and the NYSDEC has indicated they will be conducting a reassessment of water quality conditions at Lake Agawam during the summer of 2008; until the Final 2008 list is approved by the USEPA, the 2006 Section 303(d) List is considered to be the most current List of Impaired/TMDL Waters.

The analysis that supports the 303(d) List is provided in a NYSDEC report entitled the Waterbody Inventory/Priority Waterbodies List (PWL) Report. The most recent NYSDEC Waterbody Inventory/Priority Waterbodies List Report for the Long Island region was published in April of 2002 and includes inventory and assessments for each waterbody in the area.

A March 2001 waterbody assessment prepared for Lake Agawam lists the lake as having minor impacts. The assessment identifies dissolved oxygen/oxygen demand and nutrients as the pollutants impacting lake water quality and which are suspected of stressing aquatic life support (see **Appendix D**). Urban runoff is listed as the suspected source of pollutants.

6.2 Groundwater Quality

As previously noted, groundwater quality is one of the greatest contributors of pollutants to the lake (**Harke et al. 2008**). Water quality data from two USGS monitoring wells (S-8836 and S-48441) within the watershed was consulted in order to gather information regarding groundwater quality. It should be noted that data from these wells is currently very limited. Even though well S-52652 is located in close proximity to the lake (approximately 440 feet to the north of the lake), only water level data was recorded from this well. Well S-8836 has 5 water quality samples which were collected in the 1970s. Results of analysis from these samples found low chlorides (no saltwater intrusion) and small but detectable nitrates (even for lab procedures in the 1970's which could not detect low concentrations). Nitrate values were found at concentrations in the range of 5.4–14 mg/L, where 10 mg/L is the drinking water standard, and pH values were found to be 5.3 to 6.1.

¹ Section 303(d) refers to Section 303(d) of the Federal Clean Water Act which requires states to periodically assess and report on the quality of waters in their state.



Well S-48441 has 24 water quality samples which were collected between 1973 and 1998. Results from analysis of these samples indicates medium to low chlorides, which tended to decrease with time. Sulfate results mirror the same trend as the chlorides. It should be noted that sulfate is not an EPA listed contaminant, but is a secondary contaminant (<http://www.epa.gov/safewater/contaminants/unregulated/sulfate.html>). The EPA considers the Maximum Contaminant Level (MCL) for sulfates to be 250 mg/L and the highest measured value was 87.5 mg/L from the 24 water quality samples. Samples analyzed from 1981-1998 were analyzed for Volatile Organic Carbon's (VOC's) which were not found. The highest nitrate value recorded from these samples was 32 mg/l (filtered), and was found on August 28, 1974. Samples measured after 1976 averaged much lower concentrations than the values measured earlier. All values recorded during 1977 and later were collected and analyzed by SCDHS; values from prior to 1977 were collected and analyzed by USGS. As previously stated, the drinking water standard for nitrate is 10 mg/L. Typical pH values recorded ranged from 5.6 to 7.0, with a mode of 6.1. It is interesting to note that the sample analyzed in 1973 found 53 pCi/L (picoCuries per liter), which is greatly above the 5 pCi/L MCL listed in the EPA's drinking water contaminant list (<http://www.epa.gov/safewater/contaminants/index.html>).



7.0 RECOMMENDATIONS

The following section provides recommendations for improving water quality within the lake and within the watershed in consideration of the extensive body of information gathered for this report. Recommendations are divided into sections including: Shoreline Improvements which address primarily Riparian (buffer) areas; Stormwater Improvements which address primarily watershed area improvements; Lake Aeration and Water Quality Improvements which primarily address lake management; and Water Quality Monitoring and research. A major emphasis of this study is education of residents, stakeholders and visitors that enjoy the lake and have a deep desire to improve the aesthetic and ecological characteristics of Lake Agawam. Recommendations are further examined in **Section 8.0**, which provides an action plan identifying responsible entities, project timing (short term and long term), potential funding and preliminary costs to implement the recommendations of this report.

7.1 Shoreline Improvements

Riparian (Buffer) Area Recommendations

- Control waterfowl populations through management practices.
 1. Discourage lawns fronting lake shore areas.
 2. Discourage feeding of waterfowl populations.
- Encourage homeowners to remove fertilizer dependent vegetation and establish native planting areas.
 1. Naturalized meadow, woodland and shrub planting areas intercept and filter stormwater and reduce fertilizer/nutrient input.
 2. Village laws encourage natural plantings within 125 feet of wetlands through ZBA issued wetland permits.
 3. Place shade trees near shore that will provide soil stability, biological uptake and shading of surface water to maintain lower water temperatures allowing higher dissolved oxygen levels.
- Remove invasive vegetation in favor of natural habitat areas under controlled re-vegetation restoration programs.
- Examine municipally owned lakefront areas for improvement opportunities (control direct stormwater overflow from paved surfaces in close proximity to the lake; establish lake front walking trails in areas where public access can be provided; provide public education and interpretive signage in appropriate lakefront areas).
 1. Consider installation of a drainage swale and subsurface detention along Pond Lane in connection with pedestrian walks, landscape improvements and sitting areas for lake enjoyment.
 2. Consider potential for invasive species removal, stormwater control and lake front walking trails for Gin Lane area at south and southeast part of the lake.



3. Work cooperatively with the Town Trustees to improve the Gin Lane and Bathing Corporation parking area by reducing pavement, installing a “rain garden” along the shoreline, installing a low sill bulkhead along the southern shoreline (to retain parking capacity), subsurface drainage improvement, pedestrian circulation/traffic calming and providing aesthetic improvements through landscaping (see **Figure 14** for example).
- Provide educational opportunities in form of pamphlets, newsletters, web site information and other media tools through the Village of Southampton and the Lake Agawam Conservation Association (see **Appendix E**).
 - Examine potential for removal of existing hardened shorelines; discourage expansion of new hardened shoreline structures.

7.2 Stormwater and Watershed Improvements

Watershed Area Recommendations

- Intercept and recharge stormwater runoff in higher elevations of the watershed.
 1. Install more street catch basins such as is being done on Hill Street.
 2. Examine Village/Town owned land opportunities for recharge facilities such as Windmill Lane.
 3. Coordinate with Town (Walter Bundy) on Grants and stormwater Phase II implementation.
 4. Consider maximum stormwater retention and on-site recharge for any site plans and subdivisions in the watershed area; ensure compliance with SPDES GP 0-08-001.
 5. Review Village parking areas for potential subsurface stormwater detention installation in connection with parking lot improvement plans.
- Continue to maintain catch basins and leaching pools on a regular basis by removing accumulated sediment.
- Continue to maintain roads on a regular basis through street sweeping to reduce potential for sediments to accumulate and/or enter the lake.
- Explore potential for sewerage in areas of the watershed with commercial downtown development and shallow depth to groundwater.
- Encourage homeowners to regularly inspect and maintain sanitary systems in high groundwater areas and elsewhere in the watershed.
- Encourage and enforce when appropriate, upgrade of malfunctioning sanitary systems.



- Ensure appropriate land use density within the Village and the watershed area for Lake Agawam, through coordination with SCDHS on the implementation of Article 6 of the SCSC; sanitary credit transfers to the Lake Agawam watershed area should be reviewed and limited based on nitrogen load.
- Encourage and facilitate “pick up after your pet” practices
 1. Educational pamphlets, Village newsletter and public information media.
 2. Install dispensers in Village parks and key areas for convenience.

7.3 Lake Aeration and Water Quality Improvements

Lake Management Recommendations

- Provide equipment to improve dissolved oxygen levels in the lake.
 1. Maintain and install forced air bubblers to further the coverage already achieved by this cooperative Town/Village effort.
 2. Consider discontinuing fountains in favor of bubblers, particularly during algae blooms.
- Improve fish populations in the lake favoring native fish assemblages.
 1. Stock bass, perch and bluegill fish assemblages, if necessary. [*Naturally reproducing populations of largemouth bass, bluegill, pumpkinseed, white perch, carp and brown bullhead currently exist in lake (NYSDEC, 2007)*].
 2. Remove or reduce carp populations in the lake, as necessary, ensuring that harvested fish are managed in a manner that considers public health and safety.
- Maintain, but don't expand areas of aquatic vegetation on the west side of the lake; such vegetation provides fish habitat, food source and shading.
- Examine wetland biological treatment options for north end of lake near stormwater outfall
- Examine potential for removal of organically enriched surface sediments from the lake bottom in order to reduce the release of nutrients into the water column.

7.4 Water Quality Monitoring and Research

- Continue water quality monitoring to determine effectiveness of implementation of management recommendations and track trends in water quality.
- Continue monitoring for cyanotoxins levels and associated ecological-based studies (e.g. chemical, physical and biological factors) to further elucidate the factors which promote the presence of these toxins.
- Implement an adaptive management approach for Lake Agawam as the understanding of cyanotoxins is expanded, and strive to improve water quality while minimizing health risks to humans and animals.



8.0 ACTION PLAN FOR LAKE IMPROVEMENTS

The following implementation matrix (**Table 3**) is designed to provide a framework for improvements to Lake Agawam through implementation of an effective Comprehensive Management Plan. This strategy essentially consists of a schedule of specific activities, capital projects and policy or legislative actions that need to be enacted and implemented in order to ensure adequate management of the watershed in accordance with the recommendations set forth in **Section 7.0**.

Lake Agawam lies within multiple governmental jurisdictions, and each agency is responsible for a different type of activity that affects the watershed or directly affects the water body. This Management Plan is designed to facilitate inter-governmental coordination and cooperation among these agencies so as to ensure that all actions work to the benefit of the watershed. The purpose of this section is to identify the sphere of jurisdiction exercised by each relevant agency, as well as to identify the specific actions that each agency can take to help implement the recommendations set forth in **Section 7.0**.

The matrix is divided into the same four sub-sections as the recommendations. *Section 8.1* of the action plan matrix identifies Shoreline Improvements which should be implemented by the parties responsible for the lands surrounding the shoreline. These parties consist of Town, Village, SCDHS and surrounding residents. Educational materials have already been provided to residents regarding appropriate plantings within the buffer zone. As the Town is responsible for the roadway along the southern shoreline of Lake Agawam, it will be up to the Town to improve the parking area and implement the recommended low sill bulkhead. This Plan provides concepts and recommendations to assist the Town in this important endeavor. Permits from the Town Trustees and the Village Zoning Board of Appeals will be required for the installation of the shoreline modifications on the south side of the lake.

Section 8.2 of the matrix identifies an action plan for Stormwater and Watershed Improvements. Stormwater improvements are already underway, with production of 'An Owner's Guide to Lake Agawam' and 'Buffer Zone' signs, which were distributed to homeowners around the lake by Lake Agawam Conservation Association in June 2008. The Village of Southampton is also applying for a Transportation Enhancement Program Grant with the goal of improving stormwater infrastructure at two key locations within the Lake Agawam watershed (Windmill Lane and the Lake Agawam parking lot).

Section 8.3 focuses on Lake Aeration and Water Quality Improvements, encompassing sediment, vegetation and fish management strategies for improved water quality and aquatic habitat, including reducing the occurrence of harmful algal blooms. A warning sign for harmful cyanobacteria algal blooms was posted at Lake Agawam by the Board of Trustees in August 2004. This sign should remain for as long as problem persists.

Section 8.4 outlines water quality monitoring and research strategies which should be aggressively pursued until such a time when the water quality of the lake has been shown to be restored to pristine levels. After such a time, monitoring of the lake should be maintained to ensure high water quality. Monitoring and research should be continued by Dr. Chris Gobler and



associated lab members at SUNY Southampton, who have been studying the lake system for several years. Grants to continue this monitoring and research through Village, Town, State, and Federal funding should be strongly considered.



TABLE 3
LAKE AGAWAM ACTION PLAN MATRIX

No.	Recommendation	Type of Action	Responsible Entity	Short-Long Term/ Tentative Schedule	Funding Sources	Possible Vendors	Public Budget/ Product
8.1 Shoreline Improvements							
<u>Riparian (Buffer) Area Recommendations</u>							
1.	Control waterfowl populations through management practices.						
1a.	- Discourage lawns fronting lake shore areas.	Education; Individual Implementation	Village; Residents	Short Term/ Immediate & Ongoing	1, 3, 4, 5, 6, 8 & 9	Village; Consultant; Printer	\$10,000 per yr*/ Literature-Web
1b.	- Discourage feeding of waterfowl populations.	Education; Individual Implementation	Village; Residents	Short Term/ Immediate & Ongoing	1, 3, 4, 5, 6, 8 & 9	Village; Consultant; Printer	\$10,000 per yr*/ Literature-Web
2.	Encourage homeowners to remove fertilizer dependent vegetation and establish native planting areas.						
2a.	- Naturalized meadow, woodland and shrub planting areas intercept and filter stormwater and reduce fertilizer/nutrient input.	Education; Permit; Private Implementation	Village ZBA; Residents	Short Term/ Immediate & Ongoing	1, 3, 4, 5, 6, 8 & 9	Landscape Contractors	Private Funds/ Buffer Plantings
2b.	- Village laws encourage natural plantings within 125 feet of wetlands through ZBA-issued wetland permits.	Education; Permit; Private Implementation	Village ZBA; Residents	Short Term/ Immediate & Ongoing	1, 3, 4, 5, 6, 8 & 9	Landscape Contractors	Private Funds/ Buffer Plantings
2c.	- Place shade trees near shore that will provide soil stability, biological uptake and shading of surface water to maintain lower water temperatures and allow higher dissolved oxygen levels.	Education; Permit (if necessary); Private Implementation	Village ZBA; Residents	Short Term/ Immediate & Ongoing	1, 3, 4, 5, 6, 8 & 9	Landscape Contractors	Private Funds/ Tree Plantings
3.	Remove invasive vegetation in favor of natural habitat areas under controlled re-vegetation restoration programs.						
4.	Examine municipally owned lakefront areas for improvement opportunities (control direct stormwater overflow from paved surfaces in close proximity to the lake; establish lake front walking trails in areas where public access can be provided; provide public education and interpretive signage in appropriate lakefront areas).						
4a.	- Consider installation of a drainage swale and subsurface detention along Pond Lane in connection with pedestrian walks, landscape improvements and sitting areas for lake enjoyment.	Direct Government Action	Village of Southampton	Long Term/ 5-10 years	1, 3, 4, 5, 6, 8 & 9	Village; Consultant; Highway Department; Contractors	\$500,000/ Stormwater Management and Aesthetics
4b.	- Consider potential for invasive species removal, stormwater control and lake front walking trails for Gin Lane area at south and southeast part of the lake.	Direct Government Action	Village of Southampton	Long Term/ 5-10 years	1, 3, 4, 5, 6, 8 & 9	Village; Consultant; Highway Department; Contractors	\$350,000/ Biological Productivity and Aesthetics/Views



No.	Recommendation	Type of Action	Responsible Entity	Short-Long Term/Tentative Schedule	Funding Sources	Possible Vendors	Public Budget/Product
4c.	- Work cooperatively with the Town Trustees to improve the Gin Lane and Bathing Corporation parking area by reducing pavement, installing a “rain garden” along the shoreline, installing a low sill bulkhead along the southern shoreline (to retain parking capacity), installing subsurface drainage improvements, pedestrian circulation/traffic calming and providing aesthetic improvements through landscaping (see Figure 14 for example).	Direct Government Action	Town Trustees Town of Southampton	Intermediate Term	Capital Budget And/or Grants 1, 3, 4, 5, 6, 8 & 9	Town; Consultant; Highway Department; Contractors	\$650,000/ Stormwater; Pedestrian/Traffic Improvements; Aesthetics; Shoreline Stabilization
5.	Provide educational opportunities in form of pamphlets, newsletters, web site information and other media tools through the Village of Southampton and the Lake Agawam Conservation Association (see Appendix E).	Education	Village; Town; Non-Profit LACA	Short Term/ Immediate & Ongoing	Non-Profit Donations 1, 3, 4, 5, 6, 8 & 9	Village; Consultant; Printer	\$10,000 per yr*/ Literature-Web Information
6.	Examine potential for removal of existing hardened shorelines; discourage expansion of new hardened shoreline structures.	Direct Government; Education; Permit; Private Implementation	Village Education/Permit; Town Beach Club	Short & Intermediate Term; Immediate & Ongoing	1, 3, 4, 5, 6, 8 & 9	Construction Contractors	Dependent Upon Specific Project
8.2 Stormwater and Watershed Improvements							
<u>Watershed Area Recommendations</u>							
7.	Intercept and recharge stormwater runoff in higher elevations of the watershed.	Direct Government Action	Village Trustees; Town of Southampton	Short, Intermediate & Long Term	2, 3, 4, 6, 7, 8 & 9	Drainage Contractors	Dependent Upon Specific Project
7a.	- Install more street catch basins along Hill Street, and other streets where feasible.	Direct Government Action	Village Trustees	Completed	Capital Budget 2, 3, 4, 6, 7, 8 & 9	Drainage Contractor	\$160,000/ Drainage Retention
7b.	- Examine Village/Town owned land opportunities for recharge facilities such as Windmill Lane and Nugent Street; the west side of Windmill Lane; and north of Bowden Square.	Government Action	Village Trustees; Town of Southampton	Intermediate Term; Grant Pending	2, 3, 4, 6, 7, 8 & 9	Drainage Contractor	\$1,900,000/ Drainage Retention
7c.	- Coordinate with Town (Walter Bundy) on Grants and stormwater Phase II implementation.	Government Action	Village Trustees; Town of Southampton	Short Term; Immediate & Ongoing	2, 3, 4, 6, 7, 8 & 9	Village Personnel & Consultants	Dependent Upon Specific Project
7d.	- Consider maximum stormwater retention and on-site recharge for any site plans and subdivisions in the watershed area; ensure compliance with SPDES GP 0-08-001.	Legislative Review	Village Planning Board & ZBA	Short Term; Immediate & Ongoing	2, 3, 4, 6, 7, 8 & 9	Village Personnel & Consultants	Private Expenditure/ Drainage Retention
7e.	- Review Village parking areas for potential subsurface stormwater detention installation in connection with parking lot improvement plans.	Government Action	Village Trustees	Intermediate Term/ 3-5 years	2, 3, 4, 6, 7, 8 & 9	Drainage Contractors	\$1,000,000/ Drainage Retention
8.	Maintain catch basins and leaching pools on a regular basis by removing accumulated sediment.	Maintenance	Village Highway Department	Short Term; Immediate & Ongoing	Annual Budget 2, 3, 4, 6, 7, 8 & 9	Highway Department Personnel	\$10,000 per yr; Approx. Prorated/ Sediment Control
9.	Maintain roads on a regular basis through street sweeping to reduce potential for sediments to accumulate and/or enter the lake.	Maintenance	Village Highway Department	Short Term; Immediate & Ongoing	Annual Budget 2, 3, 4, 6, 7, 8 & 9	Highway Department Personnel	\$10,000 per yr; Approx. Prorated/ Sediment Control



No.	Recommendation	Type of Action	Responsible Entity	Short-Long Term/Tentative Schedule	Funding Sources	Possible Vendors	Public Budget/Product
10.	Explore potential for sewerage in areas of the watershed with commercial downtown development and shallow depth to groundwater.	Government Action	Village Trustees	Intermediate Term/ 3-5 years	2, 3, 4, 6, 7, 8 & 9	Village Consultant; Consultants	\$75,000/ Sewage Treatment Feasibility Study
11.	Encourage homeowners to regularly inspect and maintain sanitary systems in high groundwater areas and elsewhere in the watershed.	Education	Village; Town; Non-Profit LACA	Short Term/ Immediate & Ongoing	Non-Profit Donations 2, 3, 4, 6, 7, 8 & 9	Village; Consultant; Printer	Private Funds/ Improved Sanitary System Function
12.	Encourage, and enforce when appropriate, upgrade of malfunctioning sanitary systems.	Education & Enforcement	Village; Town; Non-Profit LACA	Short Term/ Immediate & Ongoing	Non-Profit Donations 2, 3, 4, 6, 7, 8 & 9	Village; Consultant; Printer	Private Funds/ Improved Sanitary System Function
13.	Ensure appropriate land use density within the Village and the watershed area for Lake Agawam through coordination with SCDHS on the implementation of Article 6 of the SCSC; sanitary credit transfers to the Lake Agawam watershed area should be reviewed and limited based on nitrogen load.	Legislative	SCDHS & Village Trustees; Planning Board; ZBA	Short Term/ 1-3 years	Annual Budget 2, 3, 4, 6, 7, 8 & 9	Village Boards and Consultants	\$2,000 per yr/ Improved Coordination & Policy
14.	Encourage and facilitate “pick up after your pet” practices	Education & Government Action	Village Trustees & Town Trustees	Short Term/ 1-3 years	Annual Budget 2, 3, 4, 6, 7, 8 & 9	Village; Consultant; Printer	Dependent Upon Specific Project
14a.	- Educational pamphlets, Village newsletter and public information media.	Education & Government Action	Village Trustees	Short Term/ 1-3 years	Annual Budget 2, 3, 4, 6, 7, 8 & 9	Village; Consultant; Printer	\$10,000 per yr*/ Literature-Web
14b.	- Install dispensers in Village parks and key areas for convenience.	Education & Government Action	Village Trustees & Town Trustees	Short Term/ 1-3 years	Annual Budget 2, 3, 4, 6, 7, 8 & 9	ProPet.org; Poopaway.com; Curbappealsigns.co m	\$5,000 per yr/ Dispensers (\$500/station)
8.3 Lake Aeration and Water Quality Improvements							
<u>Lake Management Recommendations</u>							
15.	Provide water circulation equipment to improve dissolved oxygen levels in the lake.	Direct Government Action	Village Trustees & Town Trustees	Short & Intermediate Term; Immediate & Ongoing	Capital Budgets 3, 4, 6, 7 & 8	Water Circulator Contractor	Dependent Upon Specific Project
15a.	- Maintain and install forced air bubblers to improve dissolved oxygen levels and further the coverage already achieved by this cooperative Town/Village effort.	Direct Government Action	Village Trustees & Town Trustees	Short & Intermediate Term; Immediate & Ongoing	Capital Budgets 3, 4, 6, 7 & 8	Aquascape Designs, or similar	\$8,500/six units + install & yearly operating cost
15b.	- Consider discontinuing fountains in favor of bubblers, particularly during algae blooms.	Government Action Management Option	Village Trustees	Short Term/ 1-3 years	3, 4, 6, 7 & 8	N/A	No Cost/ Discontinuance of Practice
16.	Improve fish populations in the lake favoring native fish assemblages.	Direct Government Action	Village Trustees	Intermediate & Long Term	Capital Budget 3, 4, 6, 7 & 8	Village; Consultant	Dependent Upon Specific Project
16a.	- Stock bass, perch and bluegill fish assemblages, if necessary.	Direct Government Action; DEC Fish Stocking Permit	Village Trustees	Intermediate & Long Term	Capital Budget 3, 4, 6, 7 & 8	Obtain list of NYS- certified hatcheries from NYSDEC	\$5,000-12,000/yr Fish Stocking
16b.	- Remove or reduce carp populations in the lake, if necessary, ensuring that harvested fish are managed in a manner that considers public health and safety.	Direct Government Action; DEC Fish Control Permit	Village Trustees	Intermediate & Long Term	Capital Budget 3, 4, 6, 7 & 8	Commercial Fishermen/ SUNY MSRC Fish Bio-Assay	\$5,000/yr Carp Removal



No.	Recommendation	Type of Action	Responsible Entity	Short-Long Term/Tentative Schedule	Funding Sources	Possible Vendors	Public Budget/Product
17.	Maintain, but do not expand areas of aquatic vegetation on the west side of the lake; such vegetation provides fish habitat, food source and shading.	Government Action Management Option	Town Trustees	Short Term/Immediate	3, 4, 6, 7 & 8	N/A	N/A
18.	Examine wetland biological treatment options for north end of lake near stormwater outfall	Direct Government Action	Town Trustees	Long Term/5-10 years	3, 4, 6, 7 & 8	Consultant Design; Contractor Install	\$300,000/Wetland Treatment Area
19.	Evaluate potential for removal of organically enriched surface sediments from the lake bottom in order to reduce the release of nutrients into the water column.	Direct Government Action	Town Trustees	Long Term/5-10 years	3, 4, 6, 7 & 8	Consultant Design & Permits; Contractor Dredge & Disposal	\$500,000/Sediment Removal; Beneficial Reuse
8.4 Water Quality Monitoring and Research							
20.	Continue water quality and cyanobacteria monitoring to determine effectiveness of implemented management recommendations and to track trends in water quality.	Government Sponsored Research	Village Trustees & Town Trustees	Short Term/Immediate & Ongoing	SUNY MSRC; 3, 4 & 8	SUNY MSRC	\$17,500 per yr/Monitoring Data & Reports
21.	Continue associated ecological-based studies and research (e.g. chemical, physical and biological factors) to further elucidate the factors which promote the presence of cyanotoxins.	Government Sponsored Research	Village Trustees & Town Trustees	Short Term/Immediate & Ongoing	SUNY MSRC; 3, 4 & 8	SUNY MSRC	\$17,500 per yr/Monitoring Data & Reports
22.	Implement an adaptive management approach for Lake Agawam as the understanding of cyanotoxins is expanded, and strive to improve water quality while minimizing health risks to humans and animals.	Cooperative Effort	Town, Village, Research Institutions, LACA and Citizens	Long Term/5-10 years	3, 4 & 8	Consultant Assistance; SUNY MSRC	\$75,000/Lake Agawam Comprehensive Plan Update

Notes:

* \$5,000 per yr is combined educational budget for educational materials using consultant assistance for pamphlet design, printing and distribution, part of Village newsletters and web site maintenance.

All budget estimates are in current 2008 dollars, and do not account for inflation or increased costs which may occur over time.

Definition of Terms/Schedule: Short Term – 1-3 years Intermediate Term – 3-5 years Long Term – 5-10 years

Definition of Abbreviations: N/A - Not Applicable yr – Year SUNY MSRC – State University of New York Marine Sciences Research Center

List of potential funding sources to offset cost of implementing Agawam CMP and associated number abbreviation: Note that funding availability varies according to annual budget cycles and legislative action.

(1) NYS Office of Parks, Recreation and Historic Preservation Parks Development Grants under the EPA and LWCF- <http://www.nysparks.com/grants/>

(2) NYS Dept. of Transportation- Transportation Enhancements Program (TEP)- <https://www.nysdot.gov/portal/page/portal/programs/tep>

(3) NYS Dept. of State- Local Waterfront Revitalization Program (LWRP)- <http://www.nyswaterfronts.com/request.html>

(4) NYS Department of Environmental Conservation- Water Quality Improvement Program- <http://www.dec.ny.gov/pubs/4774.html>

(5) NYS Department of Environmental Conservation- Terrestrial Invasive Species Eradication Grant Program- <http://www.dec.ny.gov/animals/33358.html>

(6) NYS Environmental Facilities Corporation, *et al.*-NYS Water & Sewer Infrastructure Co-funding Initiative- <http://www.nycofunding.org/DotNetNuke/>

Note: NYS EFC provides financing and technical assistance. Funding sources vary and historically major sources have been the US Environmental Protection Agency’s Drinking Water State Revolving Fund (DWSRF) and Clean Water Revolving Fund (CWSRF)

(7) NYS Energy Research and Development Authority (NYSERDA)- Municipal Water and Wastewater Treatment Plan Programs (various)- <http://www.nyserda.org/Programs/Environment/muniwaterwwt.asp>

(8) NYS Department of State- Shared Municipal Services Incentive Program- For programs that achieve cost savings through shared services involving two or more municipalities-

<http://www.dos.state.ny.us/lgss/smsi/stateassistance.html>

(9) Suffolk County- Suffolk County Water Quality Protection and Restoration Program

Potential funding sources information provided by Jennifer Mesiano, Village Grants Coordinator.



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