Roseland Lake Management Plan

Executive Summary

Roseland Lake is a natural lake located in Woodstock, Connecticut. Roseland Lake does not meet Connecticut Water Quality Standards due to nutrient enrichment, eutrophication and biological indicators. Algae blooms are common. The potential for cyanobacteria blooms are of particular concern because two miles downstream of Roseland Lake water is withdrawn for use as a public drinking water supply.

The Eastern Connecticut Conservation District (ECCD), supported by its project partners, collected water quality and other data to determine where the nutrients supporting the Roseland Lake algae blooms are originating. The purpose of this research was to determine whether the main source of nutrients are from the upper watershed or in-lake sources, or both. The over-arching goal of the Roseland Lake Management Plan is to address the nutrient enrichment of the lake and to eliminate potentially harmful algae blooms and to restore surface water conditions in compliance with Connecticut Water Quality Standards.

Background

Water quality data from Roseland Lake dates back to the 1930s. The data suggests an acceleration of nutrient enrichment in the lake due to diversified human activity in the watershed. In 2009, ECCD prepared a Muddy Brook and Little River Water Quality Improvement Plan that included a recommendation to study where the nutrients impacting water quality in Roseland Lake were originating.

Muddy Brook and Mill Brook are the main tributaries to the lake. Little River begins at the lake outlet of Roseland Lake. The United States Geological Survey (USGS) conducted a study in the watershed from 1981-1983 documenting the nutrient and sediment concentrations in Muddy Brook, Mill Brook and Little River. Of particular note was the presence of high concentrations of sediments entering into Roseland Lake from Muddy Brook.

In 2015 – 2016, ECCD collected and analyzed water samples from Muddy Brook, Mill Brook and Little River, using the same locations as those used by USGS for its study. Additional sampling sites were selected at upstream locations in Muddy Brook and Mill Brook, and select tributaries to those streams were also sampled. The purpose of the assessment was to determine if nutrient and sediment runoff increased, decreased or was the same as the found in the USGS study, and to track down specific regions of the watershed where future watershed improvements would be most needed and most effective to restore water quality conditions. Roseland Lake was also monitored as part of this study.

Funding for this project was provided in part by CT DEEP through the US EPA Clean Water Act § 319 nonpoint source pollution grant program. Additional funding for this project was provided by the Town of Putnam Water Pollution Control Authority. Water testing fees were waived by the CT Department of Public Health Drinking Water Division for samples analyzed at the Dr. Katherine A. Kelley State Public Health Laboratory (DPH lab) in Rocky Hill. CT DEEP provided water quality data, Quality Assurance Protocol Plan review, modeling guidance and technical grant management assistance. Volunteers involved with The Last Green Valley Water Quality Monitoring Program assisted with water sample

collection and data management. Dr. Mauri Pelto of Nichols College installed river stage rulers and determined flow curves. Staff from the Windham County office of the USDA Natural Resources Conservation Service provided guidance on agriculture best management practices. CME Associates and Dr. Richard Canavan were hired as project consultants.

Process

Water quality data was collected from Roseland Lake ten times between May 2015 and July 2016. Each sampling event took place over the deep part of the lake and included a depth profile of temperature, dissolved oxygen, pH, conductivity and turbidity, as well as a secchi disk reading. After determining the depth to the thermocline, a discrete depth sampler was used to collect water samples from the thermocline and the bottom of the lake. A grab water sample was also obtained at 0.5 meters. Water samples were analyzed for Alkalinity, Total Phosphorous, ortho-Phosphorus, Total Nitrogen, NO_X, Nitrite nitrogen (NO_2-N), and Ammonia-N. Nitrate nitrogen (NO_3-N), Organic nitrogen and Total Kjeldahl nitrogen (TKN) values were determined by calculation by the lab. Surface samples were also analyzed for Chlorophyll a concentrations. Wet chemistry analysis was performed at the University of Connecticut Center for Environmental Science and Engineering (UCONN CESE) laboratory in Storrs, CT. Depth profiles and secchi disk readings were also conducted at the northern and southern ends of the lake. In June, July, August and September 2015, a grab sample from the surface was collected and brought to Northeast Laboratory in Berlin, CT for algae identification and enumeration.

Stream water samples were also collected and analyzed. A total of fifteen sampling sites were selected. The same Muddy Brook, Mill Brook and Little River sites surveyed by USGS in the 1980s were included. Twelve other monitoring sites were selected to bracket water quality changes within the upper watershed. The samples from the sites closest to Roseland Lake were analyzed at the UCONN CESE lab, where lower detection limits were available for certain parameters. Peckham Brook samples were also analyzed at the UCONN CESE lab after the first sample set indicated high nutrients. Samples were analyzed for Total Phosphorus (TP), ortho-Phosphorus (ortho-P), Total Nitrogen (TN), NO_X, Nitrite nitrogen (NO2-N), Ammonia-N and Total Suspected Solids (TSS). Nitrate nitrogen (NO3-N), organic nitrogen (Org-N) and Total Kjeldahl nitrogen (TKN) values were determined by calculation.

Samples from the upper watershed were analyzed at the CT DPH lab. Stream samples were analyzed for Total phosphorus, ortho-Phosphorus, NO_3-N, NO_2-N, TKN, and NH_3-N and TSS. Org-N, NO_X and Total Nitrogen were determined by calculation. The calculated TN values captured by the samples analyzed at the CT DPH laboratory were likely under-reported because the higher detection limit for certain nitrogen compounds caused values to be reported as non-detectable.

Stream sampling was structured to collect a pre-storm water sample while setting up a passive stormwater sampler at each location. Passive stormwater samplers were used to collect the first flush of stormwater off the land as the stream water level rose above the top of the sampler. A post-storm water sample was collected when the passive stormwater water samples were retrieved from the field. A multi-parameter probe was used to determine the water temperature, dissolved oxygen, pH, conductivity and turbidity in-situ at each sampling location before and after each storm event.

River stage rulers were installed and calibrated at select monitoring locations. Water pressure loggers were installed at the Muddy Brook #1, Mill Brook #1, Peckham Brook and Little River monitoring stations to capture changes in stream depth at hourly intervals.

Sediment samples were also collected from the bottom of Roseland Lake in the area beneath the summer anoxic zone. The summer anoxic zone was determined by the depth profile data obtained from the lake. The sediment samples were analyzed at Northeast Laboratory in Berlin, CT for Iron Bound Phosphorus, Loosely Sorbed Phosphorus, percent moisture and Total Phosphorus. Four sampling locations within the summer anoxic zone were selected randomly and the sediment samples were analyzed for their phosphorus make up.

Table 1: Stream sampling locations

Stream Name	Site number	Latitude	Longitude	Location of site upstream (US) or downstream (DS)
Mill Brook #1	Mill-01	41.939982	-71.957134	US Stone Bridge Road
Little River	LR-01	41.943235	-71.950128	US Stone Bridge Road
unnamed brook by baseball field	un-01	41.946759	-71.957662	DS Roseland Park Road
unnamed brook by golf course	un-02	41.953104	-71.958082	DS Roseland Park Road
Muddy Brook #1	MB-01	41.966200	-71.963645	US Roseland Park Road
North Running Brook	NRB-01	41.965876	-71.963948	US Muddy Brook Confluence
Muddy Brook #2	MB-02	41.966326	-71.963788	US North Running Brook
Peckham Brook	PB-01	41.974912	-71.964912	US Dugg Hill Road
May Brook	May-01	41.983886	-71.970218	US Woodstock Road
Muddy Brook #4	MB-04	41.983519	-71.98025	DS Woodstock Road
Gravelly Brook	GB-01	41.981385	-71.984580	US Cady Lane
English Neighborhood Brook	ENB-01	41.990895	-71.997685	US Route 169
Muddy Brook #5	MB-05	41.996299	-71.990017	US Route 197
Taylor Brook	TB-01	41.950344	-72.004466	US Pulpit Rock Road
Mill Brook #2	Mill-02	41.938115	-71.990322	DS New Sweden Road

Findings and Conclusions

Roseland Lake continues to experience hypereutrophic conditions periodically during the summer months. Conditions that favor cyanobacteria over other forms of true algae exist during those periods. Based on a comparison of data collected by ECCD in 2015-16 to samples collected by the United States Geological Survey in 1981-83, nutrients from upland sources have declined but continue to be substantial after storm events. Using morphometric and land use models to predict phosphorus annual loads to Roseland Lake, Dr. Richard Canavan calculated an approximate load of 2948 pounds of Total Phosphorus per year flowing into Roseland Lake. Mathematical modeling estimated the internal recycling load of phosphorus from in-lake legacy deposits as 300-600 lbs P/yr, about 10-16% of the annual load. However, since the release of these legacy deposits are limited to the summer growing season, they account for 21-55% of the load during summer and fall when anoxia in the bottom of the lake is most likely to occur.

In order to reduce nutrients that will lead to the eliminate HABs in Roseland Lake, a combination of watershed and in-lake practices will have to be implemented, evaluated and modified as necessary over time. Through watershed nutrient monitoring, local watersheds contributing the highest nutrient concentrations to the lake were determined. Those local watersheds should be targeted for implementing nutrient reduction strategies. In-lake monitoring, including lake sediment sampling and analysis, demonstrated that nutrients stored in the sediments beneath the lake are released in the hypolimnion during summer anoxic conditions and become available to cyanobacteria. Cyanobacteria can alter their buoyancy, allowing them to descend through the water column to the hypolimnion, to access this nutrient source during periods of high algae productivity. The data also demonstrates a loss in NO_3-N at the lake surface. Unlike other types of algae, cyanobacteria are capable of using atmospheric nitrogen when dissolved forms are limited. Several types of cyanobacteria produce toxins, a major concern since the public water supply water treatment facility downstream does not have the ability to filter out cyanotoxins.

Recommendations for Further Actions

The Roseland Lake Management Plan includes actions items and a 5 year implementation schedule. The action items are divided into two sections, including practical and effective action items for nonpoint source pollution controls and in-lake techniques to manage eutrophication and aquatic algae. Nonpoint source controls are ongoing, but should continue and be expanded, especially in targeted locations. Options and strategies to manage accelerated eutrophication and cyanobacteria blooms in the lake need to be reviewed. Algaecide treatments utilized in the past to control cyanobacteria blooms will not be permitted going forward due to potential impacts to a non-target species of fresh water snail listed as a Special Concern species in the Connecticut Natural Diversity Data Base. Using data collected as research in preparing this plan, a Certified Lake Manager is needed to provide the guidance for practical and effective in-lake management strategies for nutrient management within Roseland Lake.

Refer to the 2018 Roseland Lake Management Plan for a complete outline of the recommendations. http://www.ConserveCT.org/Eastern

Table 2: List of Recommended Team Members with Suggested Responsibilities

Team Members	Responsibilities
Putnam WPCA	Work with a Certified Lake Manager to select in-lake management strategies to eliminate cyanobacteria blooms in Roseland Lake. Support efforts of other agencies or organizations working to reduce pollution sources impacting Roseland Lake. Initiate or support cyanobacteria bacteria monitoring. Utilize tools in the Roseland Lake Management Plan in future lake stewardship initiatives. Continue watershed inspections. Participate in the Roseland Lake/Little River Collaborative
Putnam Mayor/Board of Selectmen	Adopt Roseland Lake Management Plan and work with other town entities to implement the recommendations in the plan Work with the Town of Woodstock (others) to develop a Transfer of Development Rights program for preserving critical watershed land.
Putnam Town Administrator	Facilitate the formation of and participate in a Roseland Lake/Little River Healthy Watershed Collaborative
Putnam Board of Finance	Include watershed management funding in future funding cycles

Woodstock Board of Selectmen	Adopt Roseland Lake Management Plan and work with other town entities to implement the recommendations in the plan. Work with the Towns of Putnam to develop a Transfer of Development Rights program for preserving critical watershed land.
Woodstock Highway Department	Evaluate stormwater system and develop a plan to reduce impacts to Roseland Lake. Participate in the Roseland Lake/Little River Collaborative
Woodstock Board of Finance	Include watershed management funding, including open space funding, in future funding cycles.
Woodstock Planning and Zoning Commission	Review local regulations for compliance with PHC Section 19-13-B32-b Sanitation of Watersheds regulations.
Woodstock Town Planner	Incorporate relevant components of the Roseland Lake Management Plan into the Woodstock Plan of Conservation and Development. Participate in the Roseland Lake/Little River Collaborative
Woodstock Conservation Commission	Continue education and outreach effort on watershed protection issues. Participate in the Roseland Lake/Little River Collaborative
Woodstock Agricultural Commission	Promote agricultural best management practices and funding resources available to implement them. Participate in the Roseland Lake/Little River Collaborative
The Last Green Valley	Support for volunteer water quality monitoring; Promote easements for forest land owners; Promote Healthy Soil Initiative. Participate in the Roseland Lake/Little River Collaborative
Roseland Park Management	Intercept runoff from the park to reduce NPS. Participate in the Roseland Lake/Little River Collaborative
Eastern Connecticut Conservation District	Continue to seek grant funding to continue NPS reduction in the Roseland Lake Watershed. Participate in the Roseland Lake/Little River Collaborative
CT DEEP	National Pollution Detection and Elimination (NPDES) permitting for algaecide use, 319 and other grant administration; Lake management and water quality resource and support, technical programming support - water monitoring, TMDL, stormwater management, natural resources and open space acquisition and management; Participate in the Roseland Lake/Little River Collaborative
CT DPH	Continue to be an information resource on harmful algae blooms for water utilities Promote PHC Section 19-13-B32-b The Sanitation of Watersheds regulations in the towns with public drinking water watersheds. Participate in the Roseland Lake/Little River Collaborative

Northeast District Department of Health	Promote septic system maintenance Track down illicit discharges Participate in the Roseland Lake/Little River Collaborative
US EPA	Funding support for Non-point source pollution abatement projects
USDA NRCS	Funding support for agricultural producers Participate in the Roseland Lake/Little River Collaborative
Woodstock Open Space Land Acquisition and Farmland Preservation Committee	Cooperator on open space planning. Participate in the Roseland Lake/Little River Collaborative
Wyndham Land Trust	Cooperator on open space planning Participate in the Roseland Lake/Little River Collaborative
The New Roxbury Land Trust	Cooperator on open space planning Participate in the Roseland Lake/Little River Collaborative

The Roseland Lake Nutrients Modeling project was completed by the Eastern Connecticut Conservation District. The project was funded in part by the Connecticut Department of Energy & Environmental Protection through a United States Environmental Protection Agency Clean Water Act Section 319 Nonpoint Source Grant and the Town of Putnam Water Pollution Control Agency.