Highlands Council
New Jersey

Warren County

New Jersey Highlands Council Meeting

Thursday, January 19, 2023

The Development of Site-Specific Harmful Algal Bloom (HAB) Management Plans

New Jersey Highlands Council Meeting

January 19, 2023

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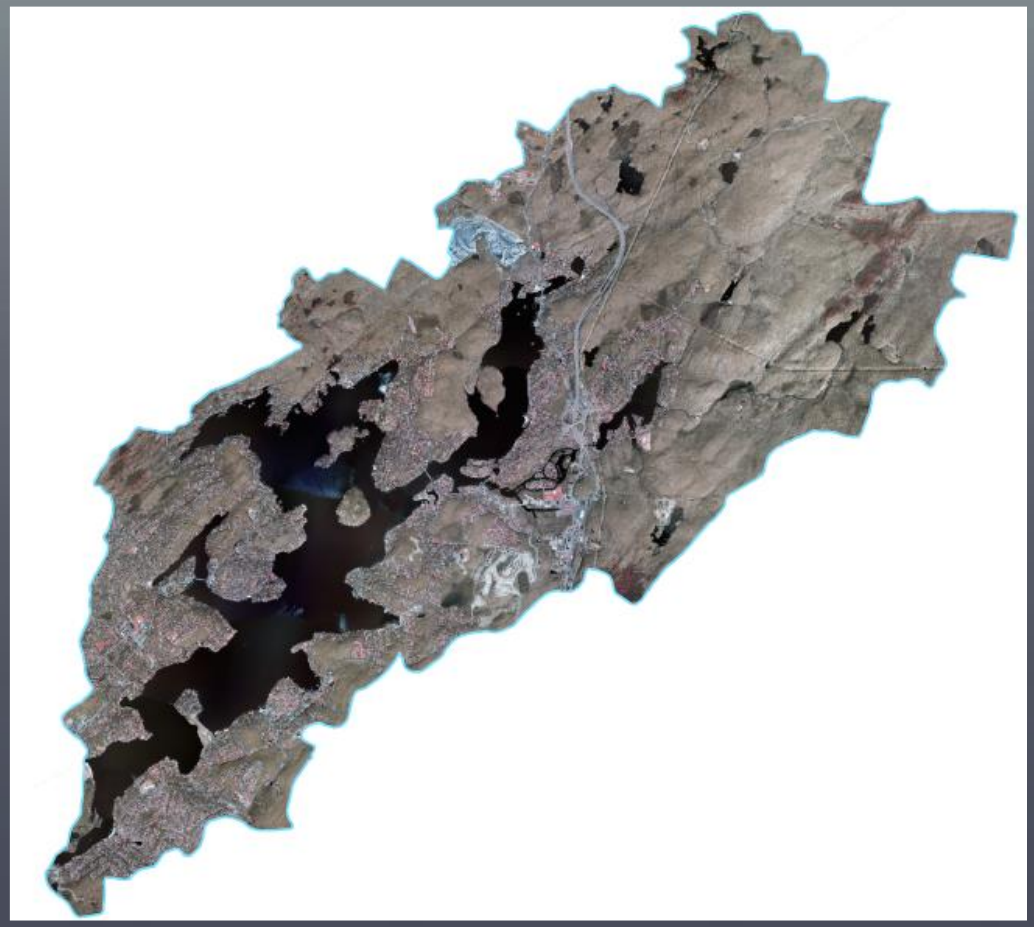
PRINCETON HYDRO

SCIENCE ENGINEERING DESIGN

Phase I Diagnostic / Feasibility Studies Section 314 of the Clean Water Act

- ✓ Collect a variety of site-specific in-lake and watershed-based data.
- ✓ Quantify the annual hydrologic and pollutant loads.
- ✓ Develop a holistic Management Plan that addressed both in-lake and watershed issues.



SCIENCE
ENGINEERING
DESIGN

Watershed Implementation Plans

- Focus on the external (watershed) source of pollution.
- Directly linked to the lake's TMDL (total phosphorus)
- US EPA 9-element WIPs.
- For Lake Hopatcong, NJ a Restoration Plan was developed in 2006 and then revised / updated into a full WIP in 2021 (funding provided by the NJ Highlands Council).

Blooms at Lake Hopatcong, New Jersey (June 2019)

Four (revised to Five) Point Strategy

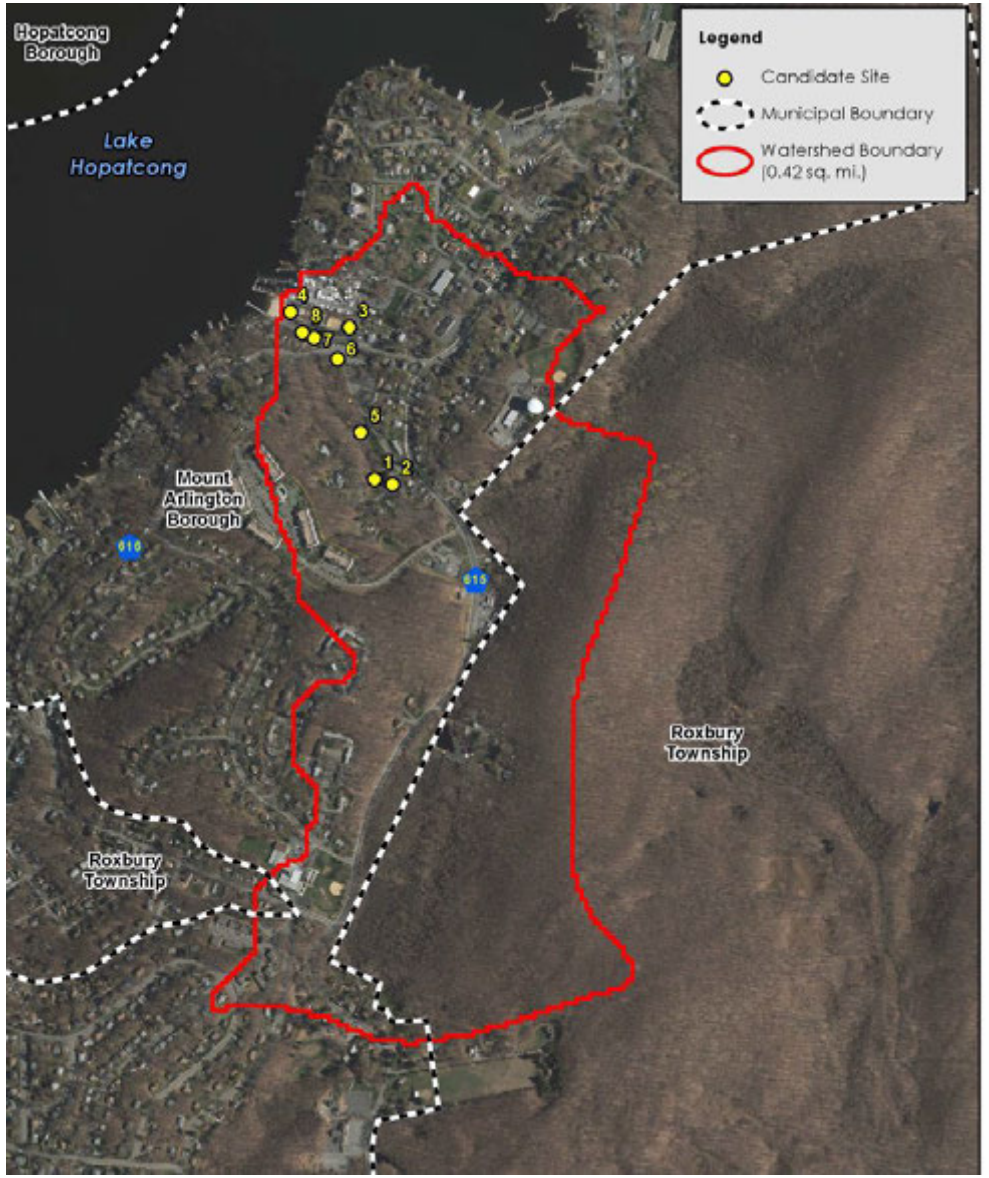
- ✓ Complete the revision of the Restoration Plan into a Watershed Implementation Plan for Lake Hopatcong (completed in early 2021, with funding provided by the NJ Highlands Council)
- ✓ **Near-Shore Demonstration Projects**
- ✓ **Beach / Cove Restoration Plans**
- ✓ Scientific Investigation on Lake Hopatcong to address issues of concern and origin of the HABs.
- ✓ Later added – initiate sewering the section of the watershed in the Township of Jefferson (Morris County)

The Need for Beach / Marina (Near-Shore) Restoration Plans

- ✓ Beach Management Plans (Beach MP) focused more on short-term improvements in water quality during the "high summer season," defined as the period between Memorial Day and Labor Day Holiday weekends.
- The Beach MP should be flexible , can vary from year to year and will focus more on issues with cyanotoxins / aesthetics.

Memorial Beach and Park, Mt. Arlington, Morris County, NJ

- Watershed Assessment.
- Bathymetric Assessment of Memorial Pond.
- Hydrologic and Pollutant Assessment for the Beach.
- Identify in-lake, in-pond, streambank and watershed projects for implementation.
- Proposed monitoring phycocyanin.
- Funds provided by the NJ Highlands Council.



Hydrologic and Pollutant Budgets

- Glen Brook is the main source of water entering the Memorial beach area (left).
- Pollutant budget analysis for the Memorial beach drainage area (right).

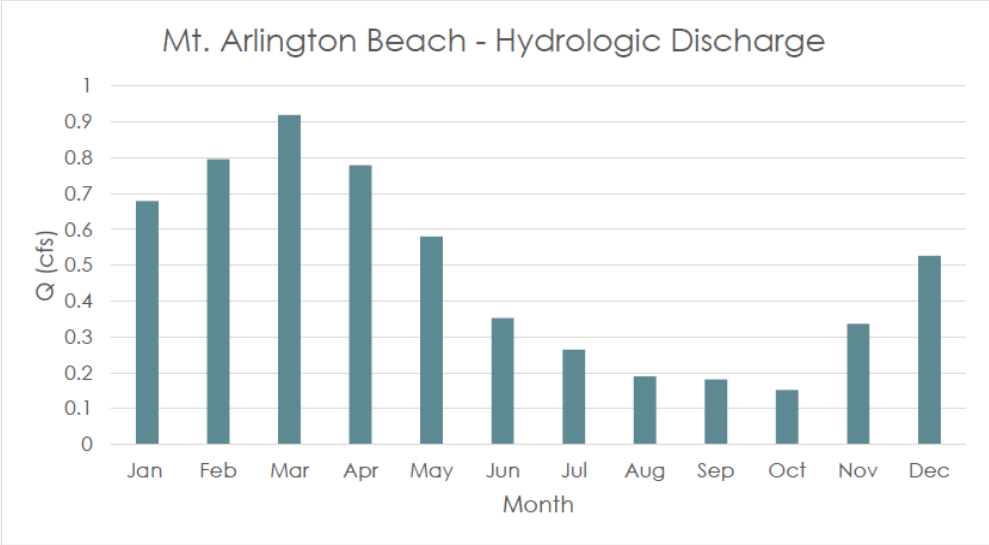


Figure 2.2: Glen Brook discharge.

Table 2.1: Annual nutrient and sediment load (source areas).

Sources	TN (kg)	TP (kg)	TSS (kg)
Deciduous Forest	112.1	9.0	11214.0
Developed, Open Space	100.0	5.0	10002.9
Woody Wetlands	0.0	0.0	0.0
Developed, Low Intensity	49.1	4.8	6459.3
Developed, Medium Intensity	17.0	1.7	2433.4
Developed, High Intensity	4.0	0.4	628.0
Total	**282.2**	**20.9**	**30737.6**

Table 1.1: Causes and sources of pollution within the Memorial Beach / Park study area.

Causes and Sources of Pollution	Areas of Concern
Impervious Cover	Memorial Park parking lot / walkways Memorial Beach upper parking lot Memorial Beach lower parking lot Altenbrand Avenue
Steep Slopes	Altenbrand Avenue / Memorial Beach
Erosion	Glen Brook (Upper / Memorial Park) Glen Brook (Lower / Memorial Beach)
Pet Waste and/or Wildlife Management	Memorial Park Memorial Beach
Memorial Pond	Lack of shoreline buffer Steep / bare slopes Sedimentation / infilling of Pond
Glen Brook	Lack of shoreline buffer Eroding streambanks
Stormwater / Catch Basins	Memorial Park (Surrounding Memorial Pond) Memorial Beach upper parking lot Memorial Beach lower parking lot

Watershed Assessment

- Review of sites in need of stabilization / repair.
- General maintenance and routine clean outs.
- Sites that could benefit from green infrastructure.
- Minimize loss of soil / transport of sediments.

Table 3.1: Proposed Watershed Projects Summary

Site and Recommendations	Approximate Drainage Area (Acres)	Total P Removed (kg/yr) / (lbs/yr)	Total Suspended Solids Removed (kg/yr) / (lbs/yr)
Memorial Pond Biochar Floating Wetland Islands	187	2.80 / 6.17	-
Memorial Pond Shoreline Shoreline Buffer Enhancement / Plantings	+ / - 1	1.22 / 2.70	1,000 / 2,205
Memorial Pond Catch Basin Aqua-Guardian and Filter Media	+ / - 1	0.40 / .88	219 / 482
Memorial Beach Upper Lot Filterra Tree Box	+ / - 1	0.40 / 0.88	219 / 482
Memorial Beach Parking Lot MTD	215	3.8 / 8.38	10,500 / 23,148
Glen Brook (Downstream of Memorial Pond) Bank Stabilization Riparian Buffer	201	6.35 / 14.00	15,875 / 35,000
Glen Brook and Altenbrand Avenue Biochar	213	2.07 / 4.56	-
Glen Brook (Upstream of Memorial Beach) Vegetative Filter Strip	+ / - 1	0.10 / 0.22	146 / 322
Totals	**214**	**17.14 / 37.79**	**27,959 / 61.639**

Memorial Pond – stormwater pond

- Was dredged 2000 / 2001; removed approximately 1,000 cubic yards. Time to dredge again.
- Installed Biochar to remove phosphorus from the pond.
- Plan to conduct a shoreline stabilization project in 2023.
- Will use some NFWF grant funds to conduct an outlet / streambank stabilization project downstream.

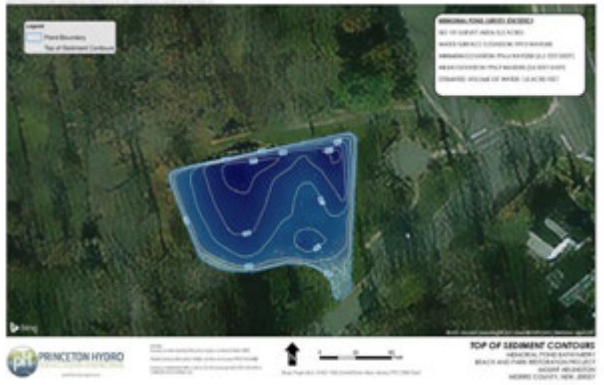


Table 1.2: Bathymetric Survey Statistics

Parameter	Statistic
Size of Survey Area	0.3 acres
Maximum Water Depth	5.5 feet
Mean Water Depth	3.0 feet
Estimated Volume of Water	1.0 acre-feet
Estimated Volume of Sediment	1,113.0 cubic yards
Mean Sediment Thickness	2.0 feet

Use of Biochar

- Installed in some stormwater ponds
- After 3 months **TP** removal rates for the ponds were 67% and 81%.
- After 3 months **SRP** removal rates for the ponds were 76% and 97%.
- As the manufacturer stated, the longer the contact time, the higher the removal rate.
- After 7.5 months **TP** removal rates were 50% and **SRP** removal was 0%

Floating Wetland Islands

- Just planted (to the right).
- About 1 month after plants (to the left)

Memorial Pond Stabilization Project

- Steep slop exhibiting some erosion.
- Establish a vegetive shoreline buffer with native vegetation.
- Approximately 3,200 square feet of area that will be stabilized.
- The implementation of this work will be cover under an existing 319-grant.
- Scheduled to be conducted in spring 2023

RESTORATION SEED MIX (0.18 AC): SEED TO BE SOWN IN ALL PROPOSED ENHANCEMENT AREAS AT A RATE OF 20 POUNDS PER ACRE. METHOD OF APPLICATION TO BE DETERMINED DURING DESIGN.

BOTANICAL NAME:	SPECIES NAME:	SEEDING RATE (LBS PURE LIVE SEED/ACRE)	INDICATOR STATUS:	QUANTITY:
PANICUM CALDESTINUM	DEERTONGUE	4.77	FACW	23.9%
ELYMUS VIRGINICUS	VIRGINIA WILD RYE	4	FACW	20.0%
SCHIZACHYRIUM SCOPARIUM	LITTLE BLUE STEM	3.1	FACU	15.5%
CAREX VULPINOIDEA	FOX SEDGE	2.4	OBL	12.0%
CAREX LURIDA	LURID SEDGE	1	OBL	5.0%
CAREX SCOPARIA	BLUNT BROOM SEDGE	1	FACW	5.0%
CAREX LUPULINA	HOP SEDGE	0.9	OBL	4.5%
VERBENA HASTATA	BLUE VERVAIN	0.8	FACW	4.0%
HELIOPSIS HELIANTHOIDES	OXEYE SUNFLOWER	0.4	FACU	2.0%
CINNA ARUNDINACEA	WOOD REEDGRASS	0.3	FACW	1.5%
ASCLEPIAS INCARNATA	SWAMP MILKWEED	0.2	OBL	1.0%
JUNCUS EFFUSUS	SOFT RUSH	0.2	OBL	1.0%
EUPATORIUM PERFOLIATUM	BONESET	0.1	FACW	0.5%
HELENIUM AUTUMNALE	COMMON SNEEZEWEED	0.1	FACW	0.5%
ZIZIA AUREA	GOLDEN ALEXANDERS	0.1	FAC	0.5%
SYMPHYOTRICHUM NOVAE-ANGLIAE	NEW ENGLAND ASTER	0.08	FACW	0.4%
SYMPHYOTRICHUM PUNICEUS	PURPLESTEM ASTER	0.08	-	0.4%
DOELLINGERIA UMBELLATA	PARASOL WHITETOP	0.08	FACW	0.4%
MONARDA FISTULOSA	WILD BERGAMOT	0.08	FACU	0.4%
PENTHORUM SEDOIDES	DITCH STONECROP	0.08	OBL	0.4%
PYCNANTHEMUM TENUIFOLIUM	NARROWLEAF MOUNTAINMINT	0.08	FAC	0.4%
SCIRPUS CYPERINUS	WOOLGRASS	0.08	OBL	0.4%
LOBELIA SIPHILITICA	GREAT BLUE LOBELIA	0.06	FACW	0.3%
SOLIDAGO RUGOSA	WRINKLELEAF GOLDENROD	0.02	FAC	0.1%

LIVE STAKES (0.03 AC): TO BE INSTALLED ALONG STREAM BANKS WITH AN AVERAGE SPACING OF 3 FEET ON CENTER IN GROUPS OF LIKE SPECIES.

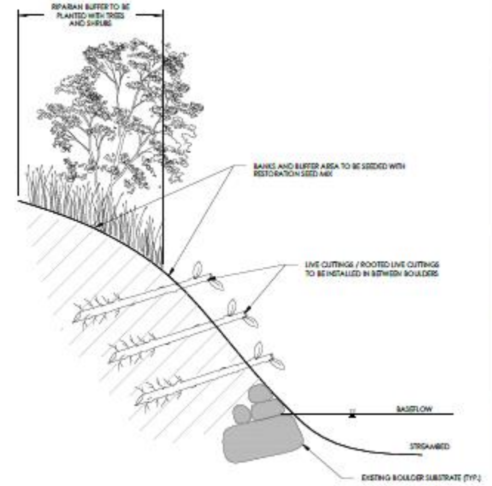
BOTANICAL NAME:	SPECIES NAME:	PLANTING TYPE:	INDICATOR STATUS:	QUANTITY:
CORNUS AMOMUM	SILKY DOGWOOD	3'-4' LIVE STAKE	FACW	25
CORNUS SERICEA	RED OSIER DOGWOOD	3'-4' LIVE STAKE	-	25
VIBURNUM DENTATUM	ARROWWOOD	3'-4' LIVE STAKE	FAC	25
VIBURNUM LENTAGO	NANNYBERRY	3'-4' LIVE STAKE	FAC	50

TREES AND SHUBS (.15 AC): SHRUBS TO BE SPACED EIGHT (8) FEET ON CENTER STAGGERED IRREGULARLY, IN GROUPS OF LIKE SPECIES. TREES TO BE SPACED TEN (10) FEET ON CENTER STAGGERED IRREGULARLY, IN GROUPS OF LIKE SPECIES.

BOTANICAL NAME:	SPECIES NAME:	PLANTING TYPE:	INDICATOR STATUS:	QUANTITY:
BETULA NIGRA	RIVER BIRCH	2 GALLON, 24-36"	FACW	4
LIQUIDAMBAR STYRACIFLUA	SWEETGUM	2 GALLON, 24-36"	FAC	4
PHOTINIA PYRIFOLIA	RED CHOKEBERRY	1 GALLON, 18-24"	FACW	12
PHYSOCARPUS OPULIFOLIUS	COMMON NINEBARK	1 GALLON, 18-24"	FACW	10
PLATANUS OCCIDENTALIS	AMERICAN SYCAMORE	2 GALLON, 24-36"	FACW	8
QUERCUS PALUSTRIS	PIN OAK	2 GALLON, 24-36"	FACW	8
ILEX VERTICILLATA	WINTERBERRY	1 GALLON, 18-24"	FACW	10
VIBURNUM DENTATUM	ARROWWOOD	1 GALLON, 18-24"	FAC	15
VIBURNUM LENTAGO	NANNYBERRY	1 GALLON, 18-24"	FAC	10

LAWN RESTORATION SEED MIX (AS NEEDED): TO BE SOWN OVER ALL DISTURBED AREAS NOT SPECIFIED TO RECIVE SPECIALIZED SEED MIXES.

BOTANICAL NAME:	SPECIES NAME:	SEEDING RATE (LBS PURE LIVE SEED/ACRE)	INDICATOR STATUS:	QUANTITY:
FESTUCA BREVIPILA	HARD FESCUE	120	-	63.0%
LOLIUM PERENNE	PERENNIAL RYEGRASS	30	FACU	16.0%
POA PRATENSIS	KENTUCKY BLUEGRASS	40	FACU	21.0%



A RIPARIAN ZONE ENHANCEMENT DETAIL
NOT TO SCALE

CALL BEFORE YOU DIG!
NEW JERSEY LAW REQUIRES
3 WORKING DAYS NOTICE FOR CONSTRUCTION PHASE AND 10 WORKING DAYS IN DESIGN STAGE - STOP CALL
NEW JERSEY ONE CALL SYSTEM, INC.
REFERENCE NEW JERSEY TITLE 48, CHPT. 2, ARTICLE 9
1-800-272-1000

PROJECT NOTES

1. PLANS ARE REFERENCED TO NAD83 STATE PLANE NEW JERSEY, FEET (FIPS 2900).
2. EXISTING SITE INFORMATION, AND EDGE OF WATER LIMITS INFORMATION WAS DIGITIZED BASED ON AN AERIAL IMAGE FROM MICROSOFT BING SHOT IN 2021. PRINCETON HYDRO DOWNLOADED THE IMAGE IN JUNE 2021.

DATE	DESCRIPTION

REVISIONS

DATE

PRINCETON HYDRO
SCIENCE ENGINEERING DESIGN
1108 OLD YORK RD, SUITE 1
RINGOES, NEW JERSEY 08551
PHONE: 908.237.5660
PRINCETONHYDRO.COM

PROJECT NAME/LOCATION:
MEMORIAL PARK
RIPARIAN ENHANCEMENT PROJECT
BOROUGH OF MOUNT ARLINGTON
MORRIS COUNTY, NEW JERSEY

DRAWING NAME:
CONCEPTUAL RIPARIAN ZONE ENHANCEMENT PLANTING PLAN

DATE:	06/10/2021
PROJECT NO.:	1999.001
SCALE:	1"=20'
DRAWN BY:	CAS
CHECKED BY:	AEM

SHEET NO.
1 OF 1

Table 3.2: In-lake Restoration Prioritization and Summary

In-Lake Restoration Prioritization Table		
Restoration Measure	**Prioritization**	**Intended Results**
Biochar	High priority	Nutrient uptake
Aeration / Destratification	High priority	Maintenance of an oxic environment / reduction in nuisance plankton growth
Floating Wetland Islands	Medium priority	Nutrient uptake
Nutrient Inactivation	Low priority	Phosphorus reduction
Algaecides	As needed	Nuisance algae control
Nuisance Vegetation Control	As needed	Nuisance plant control

Memorial Beach, Nanobubble

Mt. Arlington (Nanobubble)

Sampling Date	Control	Aerated
25-May-22	42,905	13,125
22-Jun-22	20,484	18,710
2-Aug-22	88,495	67,820
24-Aug-22	260,641	234,444

Use of Algicides

- Conducted on an as needed basis.
- However, in New Jersey need to have a licensed applicator file for a permit and conduct the treatment.
- Prefer the use of an oxidizer (GreenClean) over a copper-based algicide.
- Oxidizer can breakdown cyanotoxins as well as kill algae.

Effectiveness of GreenClean

- Two near-shore GreenClean treatments; one at a beach (right) and one in an isolated cove (left).
- The cove treatment was more effective since it was separated from the main body of the lake.
- Also, used Biochar and PhosLock in the cove after the treatment.

Conclusions

- ✓ While a WIP has been recently updated for Lake Hopatcong and focuses on reducing TP load and complying with the TMDL, these are long-term goals.
- ✓ The Beach MP for Memorial Beach / Park focuses on short-term measures to minimize / avoid HABs in the Memorial beach area during the high summer season.
- ✓ A combination of in-lake / beach and watershed-based measures are required to address potential HAB events at Memorial Beach.

QUESTIONS?

Princeton Hydro, LLC
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THANK YOU!

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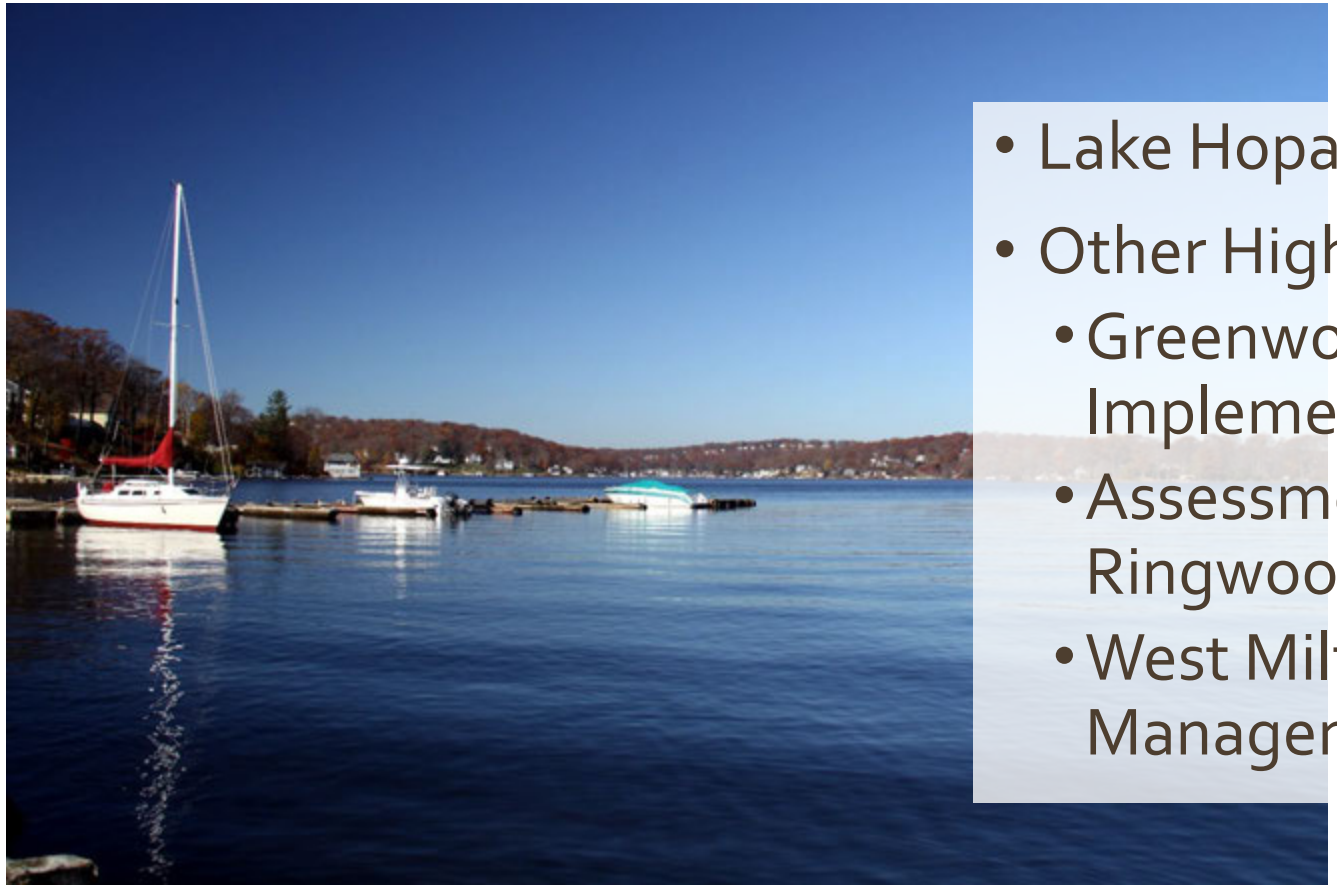
Replicating Water Quality Improvement Success in the Highlands



- Lake Hopatcong project is just one example.
- Other Highlands Council-funded plans:
  - Greenwood Lake Watershed Implementation Plan
  - Assessment of the Lakes and Watersheds of Ringwood Borough (completed)
  - West Milford Township Watershed Management Program (in progress)

Watersheds don't follow municipal boundaries.

Highlands Council
New Jersey

Ensuring Watershed Protection in the Highlands Region

- Request for Proposals to develop or update **Watershed Restoration and Protection Plans.**
- May propose evaluation and analysis of multiple watersheds or sub-watersheds.
- Plan will be framed around Environmental Protection Agency (EPA) identified 9 key elements critical for achieving improvements in water quality.
- Final deliverable to include complete plan, with associated maps and data tables
- Completed plans position respondents for implementation funding.

Multiple contracts may be awarded

Respondents to identify watershed(s) in need

12 months to complete

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