

WATER QUALITY STUDIES

~~July 2001~~

**Lake Nabnasset Nuisance Aquatic Vegetation
Management Program**

included the western portion of the lake, within Shipley Swamp area, at the confluence of Blue Brook and Nabnasset Lake, and at random points throughout the central portion and lake shoreline. In situ water quality measurements included temperature and dissolved oxygen; observational measurements included secci dish depth and presence or absence of submerged aquatic vegetation. LEC collected water samples which were sent to an independent laboratory for nitrate, ammonia and total phosphorus analysis (Table 2).

4.2 Sampling Results

4.2.1 Water Quality

The collected data (Table 1) demonstrate that Nabnasset Lake exhibits typical stratification patterns in areas with greater than a six (6) feet watercolumn. The clarity of the water was average, with a photic zone depth of four feet or greater (maximum depth of light penetration was 12 feet 2 inches), and the dissolved oxygen level revealed a concentration on average of slightly below saturation, approximately 85%.

Table 1: Water Characteristics at Sampling Stations on Nabnasset Lake.

Sampling Station	Temperature	Dissolved Oxygen	predicted oxygen	% of saturation	Depth	Secchi Dish Depth
1	25.5	7	8.1919	85.45026184	7'3"	5'3"
2	25	6.5	8.271	78.58783702	5'8"	4'10"
3	25.6	7.9	8.17608	96.62332071	6	5'4"
4top	26.4	7	8.04952	86.96170703	1	10'3"
4 bottom	17.4	7.5	9.47332	79.1697103	18'	
5	25.7	7	8.16026	85.78158049	10	10'
6	26.5	6.5	8.0337	80.90917012	5'7"	4'5"
7 top	26.6	7.4	8.01788	92.29372353	1	10'3"
7 bottom	15.2	3	9.82136	30.54566781	25'	10'
8top	26.1	7.5	8.09698	92.62712765	1	
8 bottom	25.8	6	8.14444	73.66989013	6	
9 top	26.7	8.5	8.00206	106.2226477	4'	4'
9 bottom	26.3	9	8.06534	111.5886001	4'	4'
10 top	26.4	7.9	8.04952	98.14249794	12'3"	12'2"
10 bottom	22.2	4	8.71396	45.90335508		
11 top	27.1	8	7.93878	100.7711512		1 6'1"
11 bottom	25.2	9	8.23936	109.231785	7'3"	
Average				85.55764904		

LEC collected water samples to determine nutrient concentrations at each of the sampling stations within the lake (Table 2). Independent analyses have been completed on Nabnasset Lake for the past four years, 1997 through 2000 (Carr Research Laboratory (2000) and Menzie and Cura Associates, Inc. (1997 through 1999), Table 3). Levels of nitrogen (as nitrate and ammonium) in the lake have been consistent/variable over the past three years. Nitrate concentrations in 2001 were 1.5-2 times higher than those observed for the same season in 1998 and 1999. Due to high reporting limits for phosphorous and ammonium, it was not possible to determine the limiting nutrient in Nabnasset Lake this summer. The two historical studies, however, reveal some variability in the limiting nutrient in the lake as evidenced by N:P ratios. In general, an N:P ratio of less than 12.5 indicates nitrogen limitation, while an N:P ratio of more than 12.5 indicates phosphorous limitation. In 2000, Carr Research Lab cited nitrogen as limiting (N:P=8.93), while Menzie and Cura cited phosphorus as limiting in 1998 and 1999 (N:P=71-147). The variation in results may be due

to annual fluctuations. Notwithstanding the varying results in the past studies, both analyses of Nabnasset Lake cited increased nutrient loading and resulting increased vegetative growth. The vegetative growth has taken the form of macrophytic biomass or algae, which function in accordance with seasonal climatic patterns.

Table 2: Surface Water Nutrient Concentrations at Sampling Stations on Nabnasset Lake, Late Summer 2001 (7/31/01). Samples were analyzed by Groundwater Analytical, Inc., Buzzards Bay, MA.

Sampling Station	Nitrate-N (mg/L)	Ammonium-N (mg/L)	Phosphorous (mg/L)
1	0.14	BRL	BRL
2	0.13	BRL	BRL
3	0.22	BRL	BRL
4	0.24	BRL	BRL
5	0.24	BRL	BRL
6	0.22	BRL	BRL
7	0.23	BRL	BRL
8	0.22	BRL	BRL
9	0.25	BRL	BRL
10	0.21	BRL	BRL
11	0.24	BRL	BRL
Average for 07/01	0.21	-	-

BRL indicates result is below reporting limit for analyte. Reporting limit is lowest value that can be reliably quantified under routine laboratory operating conditions. Reporting limit for ammonium was 0.4 mg/L; phosphorous 0.5-1 mg/L depending upon sample dilution and size.

Table 3: Average Surface Water Nutrient Concentrations in Nabnasset Lake in Late Summer of 1998 and 1999. Samples were analyzed by Menzie and Cura Assoc., Inc., Chelmsford, MA.

Date	Nitrate-N (mg/L)	Ammonium-N (mg/L)	Phosphate (mg/L)	N:P
08/98	0.14	0.03	0.005	71
07/99	0.10	0.06	0.002	147
08/00	0.01	.23	0.027	

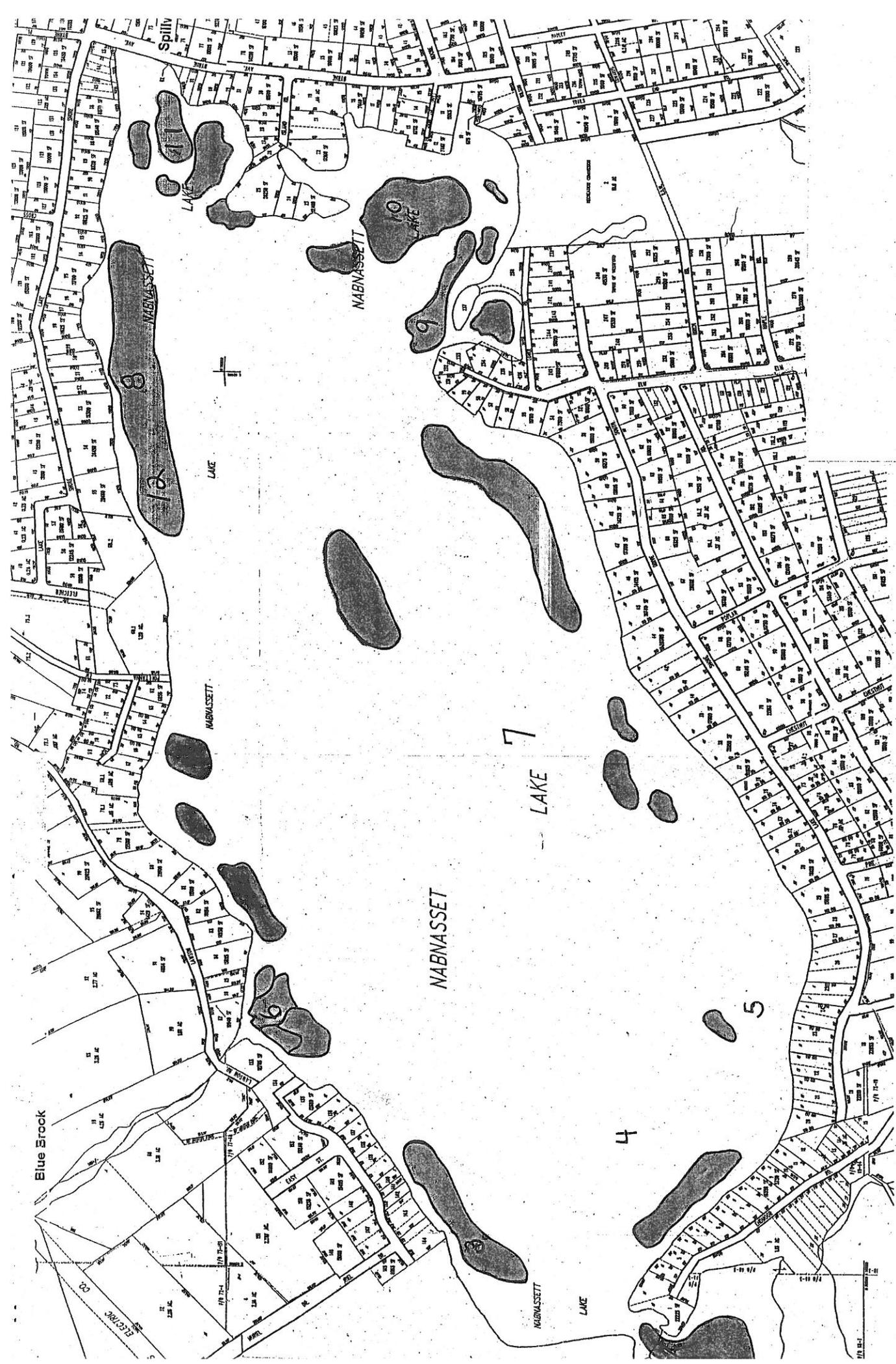
4.2.2

Aquatic Vegetation

Submerged aquatic vegetation was identified to species level where possible. Of the 20 dominant species identified, all are considered native vegetation (Table 4). One species of milfoil was identified adjacent to the confluence of Shipley Swamp and Nabnasset Lake, and though a positive identification was not possible due to the lack of flowering parts, the probability that the milfoil species is invasive Eurasian milfoil is not great. LEC has identified the milfoil to be either variable-leaf water milfoil (*Myriophyllum heterophyllum*) or low water milfoil (*Myriophyllum humile*), both of which are native, aggressive, plant species.

The presence of submerged aquatic vegetation was extensive along the perimeter of the lake. The majority of the shoreline was occupied by an assemblage of submerged aquatic vegetation. A steeply sloping shelf characterized the areas absent of submerged aquatic vegetation. In general, the northern shore of the lake contained extensive beds of the aquatic vegetation, while the southern littoral zone was situated at a steeper gradient, and likewise contained scattered patches of submerged aquatic vegetation. Upland of the lake edge, the northern shoreline was occupied by either manicured lawns, or extensive decking or retaining walls in place of native vegetation. One of the few areas on the northern shoreline devoid of submerged aquatic vegetation was downgradient from a naturally vegetated bank dominated by a shrub community of sweet pepperbush (*Clethra alnifolia*). Natural vegetation along the shoreline decreases the rate of surface water runoff to the lake, and inhibits erosion from the banks of the lake. Both of these processes, surface

Nabnasset Lake Westford, MA



SEPT. 2002 - WATER QUALITY

Table 2. Field-measured water quality data for Nabnasset Lake, September 2002.
Sites sampled included in-pond (Site 7s), the outlet tributary (Site 8) and the outlet from Shipley Swamp (Site 2).
Sampling locations are illustrated in Figure 1.

Site	Date	Temperature (Celsius)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	Turbidity (NTU)	pH (SU)	Conductivity (µmhos/cm)	Flow (cfs)	Secchi Depth (feet)
2	9/11/02	25.5	7.5	90.0	3.6	7.1	323	4.0	N/A
7S	9/11/02	24.2	9.1	109.2	0.5	8.1	316	N/A	9.0
8	9/11/02	25.0	7.8	93.0	1.1	7.6	319	1	N/A

N/A = Not applicable

Table 3. Laboratory analyzed water quality data for Nabnasset Lake, September, 2002.

Sample ID	Date	Total Kjeldahl Nitrogen (mg/L)	Nitrite Nitrogen (mg/L)	Nitrate Nitrogen (mg/L)	Ammonia (mg/L)	Total Phosphorus (mg/L)	Dissolved Phosphorus (mg/L)	Alkalinity (mg/L)
Site 2	9/11/02	<0.3	<0.01	0.03	0.1	0.03	0.03	30
Site 8	9/11/02	0.5	<0.01	0.04	0.2	0.04	0.04	28
Site 7S	9/11/02	0.5	<0.01	0.03	0.1	0.03	0.02	30

Table 4. Dissolved oxygen and temperature profile data for Nabnasset Lake at sampling station 7. September 2002. Sampling locations are illustrated in Figure 1.

Water Depth (meters)	Dissolved Oxygen (mg/L)	Temperature (°C)
0.0	9.1	24.2
1.0	9.1	24.2
2.0	9.1	24.0
3.0	9.1	23.8
4.0	9.1	23.7
5.0	9.1	23.7
6.0	7.0	21.4
7.0	5.0	20.8
8.0	0.4	15.3

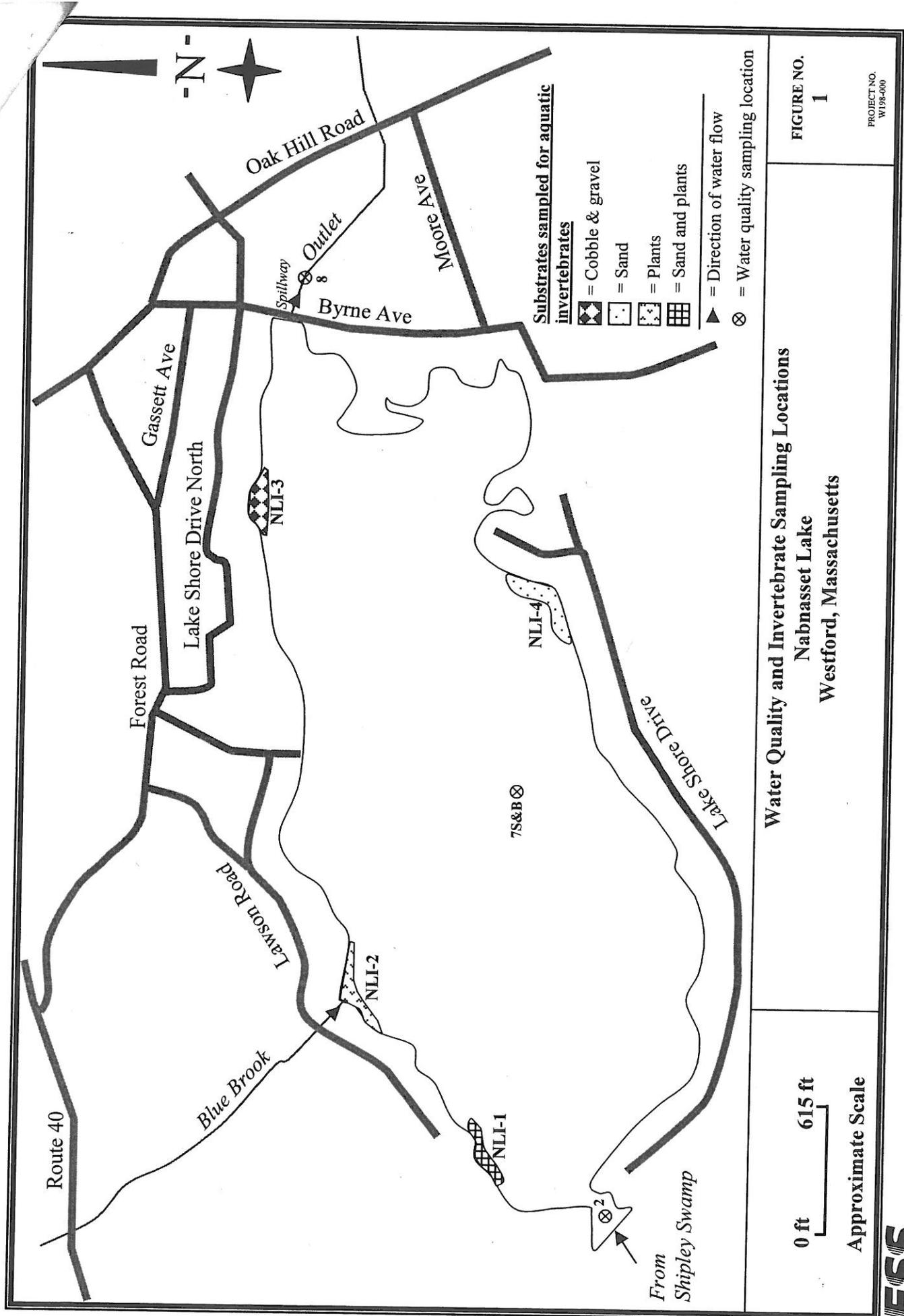


FIGURE NO.
1

PROJECT NO.
W198-000



AUGUST, 2004 WATER
QUALITY.

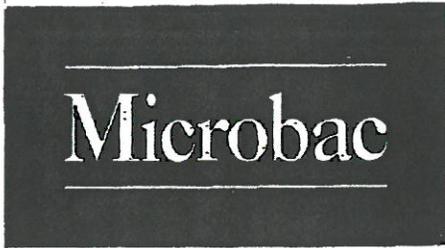
Table 1. Laboratory Data for Nabnasset Lake, 2004.

Sample ID	Date	Total Phosphorus (mg/L)	Dissolved Phosphorus (mg/L)	Nitrate Nitrogen (mg/L)	Total Kjeldahl Nitrogen (mg/L)
WQ-1	8/3/2004	0.04	0.02	0.89	0.61
WQ-2S	8/3/2004	0.01	0.01	1.00	<0.5
WQ-2B	8/3/2004	0.02	0.02	0.91	0.74

Sampling locations are illustrated in Figure 1.

JULY, 2005 WATER QUALITY.

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CERTIFICATE OF ANALYSIS

AQUATIC CONTROL TECHNOLOGY
11 JOHN ROAD
SUTTON, MA 01590-2509

Date Reported 7/28/2005
Date Received 7/12/2005
Sample ID 0507-00431
Invoice No. 97829
Cust # A031
Cust P.O. #

Subject NABNASSET LANE AND ISLAND POND SAMPLES REC'D 7/12/05

Sampled By: CLIENT Date 7/11/2005 Time

Table with columns: Test, Result, Date, Time, Tech, Method. Rows include pH, Alkalinity as CaCO3, Ammonia Nitrogen as N, Nitrate Nitrogen as N, Phosphorous as P, E. coli, and Temperature at Lab.

Sample Collected: 7/12/2005 12:00:00 AM
NABNASSET LAKE SITE #2 - OUTLET

Table with columns: Test, Result, Date, Time, Tech, Method. Rows include pH, Alkalinity as CaCO3, Ammonia Nitrogen as N, Nitrate Nitrogen as N, Phosphorous as P, E. coli.

Current State Certification IDs:
IN, C-MA-02; KY, #90138; ME, MA003; MA, M-MA003; RI, #00280; VT, listed



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JULY 2005 WATER QUALITY

Date: September 6, 2005

To: Dan Doherty; President, NLPA

From: Gerry Smith; President/Aquatic Biologist

Re: Results of Water quality Testing – Nabnasset Lake (2005)

The results for the two water samples collected on July 11th are attached for your review. Two samples were collected – one station at mid-lake and the second sample near the lake outlet. The samples were delivered to Microbac Laboratories in Marlborough, for analyses of selected chemical, nutrient and bacteria parameters. These test results are compared to test results from 2003. We were not contracted to collect or analyze water samples from last year.

- **pH & Alkalinity:** The pH of the lake water this July, was fairly similar to the pH readings taken in early August 2003. The pH at mid-lake and the outlet was 7.3 and 7.4, respectively. A pH range of generally 6.0 - 8.5 is desired to maintain a healthy fish population. The pH readings from the lake are close to neutral, which is a pH of 7.0. The alkalinity content measured this year is the same as 2003, at 22 mg/l. This alkalinity level indicates a moderate buffering capacity of the lake water to prevent substantial changes in pH, due to factors such as acid rain.
- **Ammonia N & Nitrate Nitrogen as N:** The ammonia level this year was the same at both sampling stations at <0.08 mg/l. This is a desirable, somewhat lower concentration that was found in 2003 of <0.2 mg/l. The lower value reported this year, reflects an increased limit of detection (ie; greater sensitivity), currently employed by the testing laboratory. The nitrate nitrogen concentration in 2005 was 1.0 mg/l or somewhat higher than the values of 0.62 and 0.60 mg/l found in 2003. We have no explanation for this change, especially since neither the ammonia content or the phosphorus concentration showed any increase in 2005. This single, somewhat elevated reading, is not cause for alarm, considering that other forms of nutrient levels in the lake were low.
- **Total Phosphorus as P:** Total phosphorus is typically the "limiting nutrient" in most fresh water systems or the nutrient found in least supply relative to the growth requirements of plants or algae. The concentration in July 2005 was the same as 2003, at <0.01 mg/l, which is a low and desirable reading. In ponds/lakes where total phosphorus is approximately 0.03 mg/l or greater, such waterbodies are more prone to potential algal blooms.
- **E. Coli Bacteria:** The E.Coli content was again low at < 10/ml. This is the same low content found in 2003.

The overall test results this year, were again favorable for Nabnasset Lake.

Thank you.