

DRAFT  
WATERSHED MANAGEMENT PLAN  
LAKE BOON  
HUDSON & STOW, MASSACHUSETTS

DATE SUBMITTED: OCTOBER 29, 2002

PREPARED BY:

LEE LYMAN, PRESIDENT  
LYCOTT ENVIRONMENTAL, INC.  
600 CHARLTON STREET  
SOUTHBRIDGE, MASSACHUSETTS 01550  
(508) 765-0101 FAX (508) 765-1352



**WATERSHED MANAGEMENT PLAN  
LAKE BOON  
HUDSON & STOW, MASSACHUSETTS**

**Introduction**

For the past several decades the residents of Lake Boon through the Lake Boon Commission and various associations have worked diligently to preserve, protect and restore Lake Boon to an aesthetically pleasing and healthy condition.

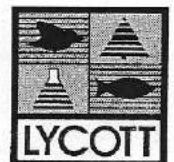
Various studies have been conducted on Lake Boon which include:

- Diagnostic/Feasibility Study by the Massachusetts Department of Water Pollution Control & Notini and Morrison in 1981
- Diagnostic/Feasibility Study in 1987 by Camp, Dresser & McKee in association with IEP, Inc.
- A Nutrient and Limnological Investigation of Lake Boon by Environmental Science Services, Inc., in 1999.
- TMDL of Phosphorus, Lake Boon (Boons Pond) Hudson and Stow, MA (MA 82011), by the Commonwealth of Massachusetts, October 24, 2001.
- Lake Boon Wildlife Habitat Study 2000 by Environmental Science Services, Inc. in 2000.
- Lake-Level Drawdown Study by Lycott Environmental, Inc., in 2000/2001.
- Lake-Level Drawdown Well Impact Report by Lycott Environmental, Inc., in 2000/2001.

**Problem Statement**

The primary focus of Lake Boon has been on the reduction of the excessive, invasive aquatic plant growth and periodic algal blooms. As indicated in the studies that have been undertaken, a two-pronged approach should be implemented for (1) in-lake management, and (2) watershed management of Lake Boon.

During 2002 the initial in-lake management program for the invasive aquatic plants in Basins 2, 3 & 4 of Lake Boon, more specifically Fanwort (*Cabomba caroliniana*) and Variable Milfoil (*Myriophyllum heterophyllum*), was undertaken with the herbicide Sonar® (active ingredient fluridone). Continued in-lake management will need to be undertaken to maintain the invasive plant growth at an acceptable level.



## Watershed Management Goals

Prior to the 2002 aquatic plant management program, Lake Boon was listed on the list of impaired water bodies/Massachusetts 303d list for Nuisance Aquatic Plants.

The lake currently has elevated levels of phosphorus (TMDL MA82011 report p. 13). One of the goals of this watershed management plan is to reduce the phosphorus loading to Lake Boon by approximately 112 kg per year (366 kg/yr. less 254 kg/yr). By reducing the phosphorus entering Lake Boon, the water clarity should improve and algal blooms should be reduced.

| Source               | Current TP Loading (kg/yr) | Target TP Load Allocation kg/yr) |
|----------------------|----------------------------|----------------------------------|
| Direct Precipitation | 10                         | 10                               |
| Groundwater          | 24                         | 16                               |
| Septic Systems       | 117                        | 80                               |
| Dry weather runoff   | 8                          | 5                                |
| Wet weather runoff   | 204                        | 141                              |
| Internal Release     | 3                          | 2                                |
| <b>Total Inputs</b>  | <b>366</b>                 | <b>254</b>                       |

A secondary goal of the watershed management plan is to implement structural measures to preclude sediment buildup in Lake Boon and associated nutrient loading to the lake.

This management plan focuses on the identification and actions considered for implementation in Lake Boon and its watershed. The watershed management plan together with the educational brochure to be provided to lake and watershed residents and municipal agencies, will outline actions that can be taken to reduce the sediment loading, nutrient loading, and phosphorus loading in Lake Boon.

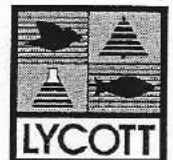
## Watershed Characteristics

There is some discrepancy in the delineation of the watershed for Lake Boon between the Camp, Dresser & McKee study of 1987 and the Environmental Science Services (ESS) study of 1999. The Camp, Dresser & McKee study indicates that the watershed is 1690 acres. The most recent TMDL report prepared by the Commonwealth of Massachusetts is based on this acreage. The Environmental Science Services (ESS) study of 1999, eliminated the White Lake area due to lack of significant influence, and divided the watershed into sub-basins, for a watershed of 1076 acres. An area in the military reservation was also eliminated (see enclosed maps – Attachment A).

According to the TMDL report by the State, the land uses of the watershed are as follows: Forest 54%, Residential 23%, Water 15% and Other 8%.

Generally speaking, Lake Boon is 163 acres with a maximum depth of 23 feet and an average depth of 10.7 feet. However, each of the basins has a different average depth (see enclosed map from the ESS study – Attachment B).

A wildlife habitat study of Lake Boon was conducted by ESS in 2000. While this study was primarily focused on lake-level drawdown and its impact on wildlife habitat, the information contained in the study is valuable. The enclosed tables indicate the amphibians, reptiles and mammal species observed in or around Lake Boon (Attachment C).



Aquatic plant growth in Lake Boon has been mapped during the previous studies that were undertaken. As a result of the excessive plant growth that was present in Lake Boon up until 2002, Lake Boon was listed on the Massachusetts 303d list for Nuisance Aquatic Plants. Enclosed is a map from the 1999 ESS study indicating the aquatic plant coverage along with a pre- and post-treatment map provided by Lycott as a result of the herbicide treatment to Lake Boon during 2002 (see Attachment D).

The diagnostic/feasibility studies that were undertaken included water quality sampling. The ESS study (Section 3.3.3 Hydrologic and Nutrient Loading, pp. 15 - 20) and the TMDL report (Wasteload Allocations, Load Allocations and Margin of Safety, pp. 13 -14) used the water quality data to model the lake's nutrient budget, hydrology budget and watershed contribution. As indicated in the ESS study, the water flow into Lake Boon comes from three sources: surface water, groundwater and direct precipitation. "Estimated average water input to Lake Boon from surface water, groundwater and direct precipitation is 2.48, 0.91, and 0.56 cfs, respectively, for a total annual flow of 3.95 cfs." (ESS 1999 study Table 10 - Attachment E)

Since Basins 3 & 4 were historically wetlands, there is a substantial nutrient loading in the sediments and the water is very shallow. As a result, aquatic plant growth will continue to proliferate. Dredging these two basins might be considered in the future as indicated in the ESS study and TMDL report. The ESS study evaluated the sediment in two locations of Lake Boon (see attached ESS 1999 study Table 7 - Attachment F).

The initial step is to profile the sediments and analyze the soil in various locations in accordance with the Massachusetts dredge criteria to determine where and how much soil can be disposed of after removal. The fees are discussed in the TMDL report.

The majority of the residents around Lake Boon acquire domestic water from shallow wells or well points. A significant portion of the hydrology budget is derived from groundwater. Lycott conducted a Lake-Level Drawdown Well Impact Report during 2000/2001 and determined that 40 - 50 wells would be adversely affected with a 24" drawdown, and 50 - 100 wells with a 40" drawdown. Since many residents depend on the lake's head pressure/water elevation for domestic water supply, lake-level drawdown of Lake Boon has been delayed until the private water supply issues are addressed.

The Towns of Stow and Hudson should continue to evaluate the domestic water supply issues so that lake-level drawdown can be implemented in the future.

The land use of the area around Lake Boon was studied by ESS in 1999. A summary of the land use by sub-watershed basins is included as Attachment G. As indicated in the TMDL report, the Metropolitan Area Planning Council published two reports entitled A Management Program for Lake Boon and the Lake Boon Summary Report in 1979 (MAPC 1979 a,b), which addressed land use and zoning issues and nutrient inputs from run off and septic systems (TMDL, pg. 14). These reports should be reviewed and the zoning of the watershed should be assessed by the LBC and Planning Boards. Previous studies have also addressed the development of criteria to regulate the conversion of summer homes to year-round residences. Implementation

Both the ESS study and TMDL report clearly indicate the goals to be implemented. The residents that have dwellings along the shoreline of Lake Boon and in the watershed can help preserve and protect the water quality of Lake Boon and its watershed. Methods to protect the lake and reduce the phosphorus loading will be provided in an educational brochure. These items are as follows





Steps that can be taken to prevent excessive phosphorus from entering Lake Boon:

- Check household product labels for phosphorus content.
- Utilize low-phosphorus or phosphorus-free lawn fertilizers.
- Set up vegetated buffer zones
- Don't feed waterfowl
- Maintain septic systems
- Reduce sediment loading
- Prevent erosion of soils

Household Products:

Although the Massachusetts Legislature passed a law requiring that only non-phosphorus detergents be sold in Massachusetts, many products do contain varying levels of phosphorus. Please check the labels on the household products you use to be certain that they contain low phosphorus levels, especially products that are used to wash vehicles. The water used to wash vehicles can be washed into a local tributary or storm drain and into the lake.

Lawn Fertilizers:

The quest for a "perfect lawn" can pose several threats to the life of the lake. A closely-cropped lawn that slopes down to the water's edge does little to trap phosphates in the storm water runoff from driveways and roads.

Many lawns are over treated with fertilizers. While fertilizers can provide lush, green lawns, they contain nutrients, such as phosphorus, that can also help create a green lake.

Lawn Care Recommendations:

Use of phosphorus-free or low-phosphorus fertilizers, available for lawns and gardens, is recommended to reduce the nutrients entering the lake from surface-water runoff.

Do not fertilize before a rainstorm.

Avoid over application of fertilizers.

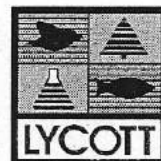
Avoid fertilizing during the summer. Turf grass demand for nutrients is low at this time of the year.

Keep vegetable gardens small and limit the use of fertilizers.

Read labels to determine correct application amount.

If you use a lawn care company, find one that uses Integrated Pest Management (IPM). Lawn care professionals that use IPM are focused on chemical treatments to specific pests and their areas of infestation.

Do not dump yard waste into the wetlands, water or along the shoreline of the lake—this is illegal and it contributes nutrients to the lake.



### Vegetated Buffer Zones:

Lake Boon has a diverse fisheries and wildlife habitat, which includes a variety of birds, ducks, herons, swans, muskrats, fish, frogs and turtles.

While waterfowl can be aesthetically pleasing, feeding waterfowl is greatly discouraged. Waterfowl move from one water body to another, often carrying plant fragments or seeds. In addition to the threat of aquatic plant infestations, the defecation (by waterfowl or other animals) in the lake and along the shoreline increases the nutrient and bacterial loading.

### Wildlife recommendations:

- Do not feed any wildlife. They will become dependent on humans for food rather than eating the diet nature intended.
- Do not disturb or approach wildlife; use binoculars or cameras with zoom lenses for closer observation.
- Turtles are not toys! Even the big snapping turtles, deserve respect.
- When fishing, practice a catch-and-release, and be certain to remove remnants of monofilament line, as it is hazardous to wildlife.

### Maintain Septic Systems:

A failed septic system can contribute a significant nutrient loading to the lake, not to mention the increased bacterial problems.

The LBC and Boards of Health are encouraged to implement a septic system inspection program. Septic systems should be evaluated and pumped at least every 2 – 3 years depending on usage and the size of the household. Any septic system that begins to show signs of failure should be repaired or replaced.

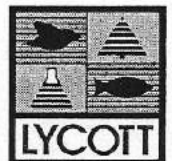
### Sediment Loading:

There are a number of ways in which sedimentation and the resulting increase of nutrients enters the water column. Buildup of sediment in the lake eventually leads to more shallow water, greater light penetration and increased aquatic plant growth.

### Soil Particles:

Soil particles, especially those organic in nature (such as loam), contain varying amounts of nutrients. When soil particles enter the water column, they can carry a significant source of nutrients. Precautions should be taken to preclude soil erosion.

Adding sand/fill to beach areas in or near the lake is considered an activity/alteration, which requires authorization from the local conservation commission. While the establishment of beach areas is desirable for some residents, only washed sand should be used. Please realize that every cubic yard of sand placed in the lake, will eventually need to be removed from the lake.



### Roadway Runoff:

Roadway runoff can be a major source of sedimentation buildup and nutrient loading. Efforts should be made to capture as much runoff as possible and remove it from the watershed.

Catch basins with sumps that are cleaned periodically can effectively capture these soil particles.

Runoff from impervious surfaces, such as driveways, can also be a source of nutrients and sedimentation as a result of periodic sanding. It is recommended that spring sweeping of driveways be undertaken, as well as street sweeping operations by the Towns of Hudson and Stow.

### Storm Drains:

Whatever is left on the street today may be washed in the lake tomorrow. When it rains, storm drains collect runoff from the street and carry it into the lake along with any petroleum products, transmission oil, radiator coolant, or phosphate-loaded detergents from washing cars.

Storm drains are designed to collect storm water runoff. They should not be used to dump automotive or household waste products, leaves, sand or litter.

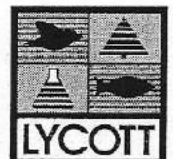
### Hazardous Materials:

To prevent contamination of the water in Lake Boon from hazardous materials, the following is recommended:

- Store gas powered equipment and hazardous materials in a safe, secure area.
- Dispose of paint and solvents in a responsible manner; never pour them down the drain, into storm sewers or on the ground.
- Latex paint can be dried out in a well-ventilated area, then put in the trash.
- Let used paint thinner settle. Once it separates, pour off the clear liquid for reuse. Let the solid residue dry out in a well-ventilated area, then put in the trash. These materials are highly flammable.
- Used motor oil should be taken to a service station or auto parts store for recycling. Many municipalities have hazardous waste recycling days.

Boating - Aquatic plants are easily transported from one water body to another. It only takes one or two fragments to introduce an aquatic plant into a water body. The residents and visitors to Lake Boon need to use extreme caution in cleaning/removing plants from boats and trailers when entering and disembarking. All plant material needs to be removed and properly disposed of, so that it does not wash into Lake Boon or any other water body.

Surveys - The lake residents and/or professional consultant should continue to inventory and map the aquatic plant growth in Lake Boon on an annual basis. Invasive aquatic plants should be managed at an early stage to preclude their proliferation.



Monitoring programs - The LBC and lake residents should remain involved in the Department of Environmental Management (DEM) and U-Mass Watershed Watch Partnership and stormwater monitoring program. Lake Boon has been chosen as a pilot watershed stewardship program. This will certainly aid in educating the towns, residents, and association members and begin a long-term program to gather data for the preservation of Lake Boon. The Town of Stow has received a 319 Nonpoint Source Pollution grant from the State. The implementation of this grant and the resulting structures should considerably reduce the sediment buildup and nutrient loading to Lake Boon.

A schedule for the implementation of the applicable activities needs to be established by the LBC and LBQAT in accordance with the attached Action Plan (Attachment H).

wtrshdmgmt.drf





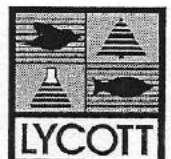
## References

Environmental Science Services, Inc., March 31, 1999. A Nutrient and Limnological Investigation of Lake Boon, Hudson/Stow, Massachusetts.

Environmental Science Services, Inc., 2000. Lake Boon Wildlife Habitat Study 2000.

Commonwealth of Massachusetts Executive Office of Environmental Affairs, Bob Durand, Secretary; Massachusetts Department of Environmental Protection, Lauren A. Liss, Commissioner; Bureau of Resource Protection, Cynthia Giles, Assistant Commissioner; Division of Watershed Management, Glenn Haas, Director, October 24, 2001. Draft Total Maximum Daily Load of Phosphorus for Lake Boon, (Boons Pond), Hudson and Stow, MA (MA 82011).

Commonwealth of Massachusetts, Department of Environmental Protection. 2001. Massachusetts Volunteers Guide for Surveying a Lake Watershed and Preparing an Action Plan.





Attachment A  
Watershed Maps



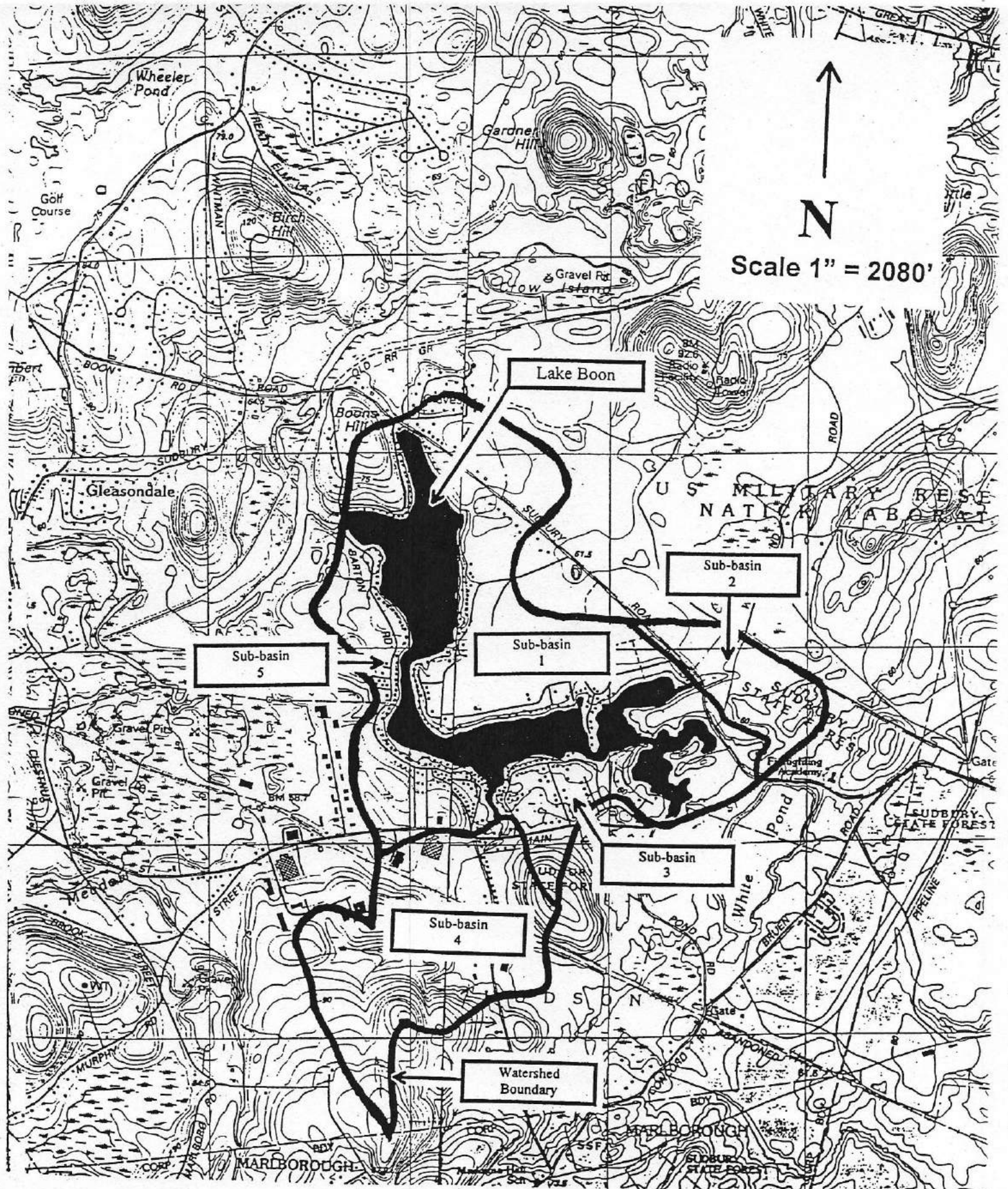

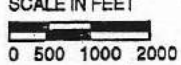


Figure 1. Watershed and watershed sub-basins for Lake Boon, Hudson/Stow, Massachusetts.

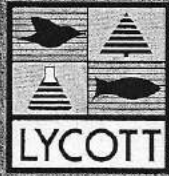
Map from ESS 1999 study



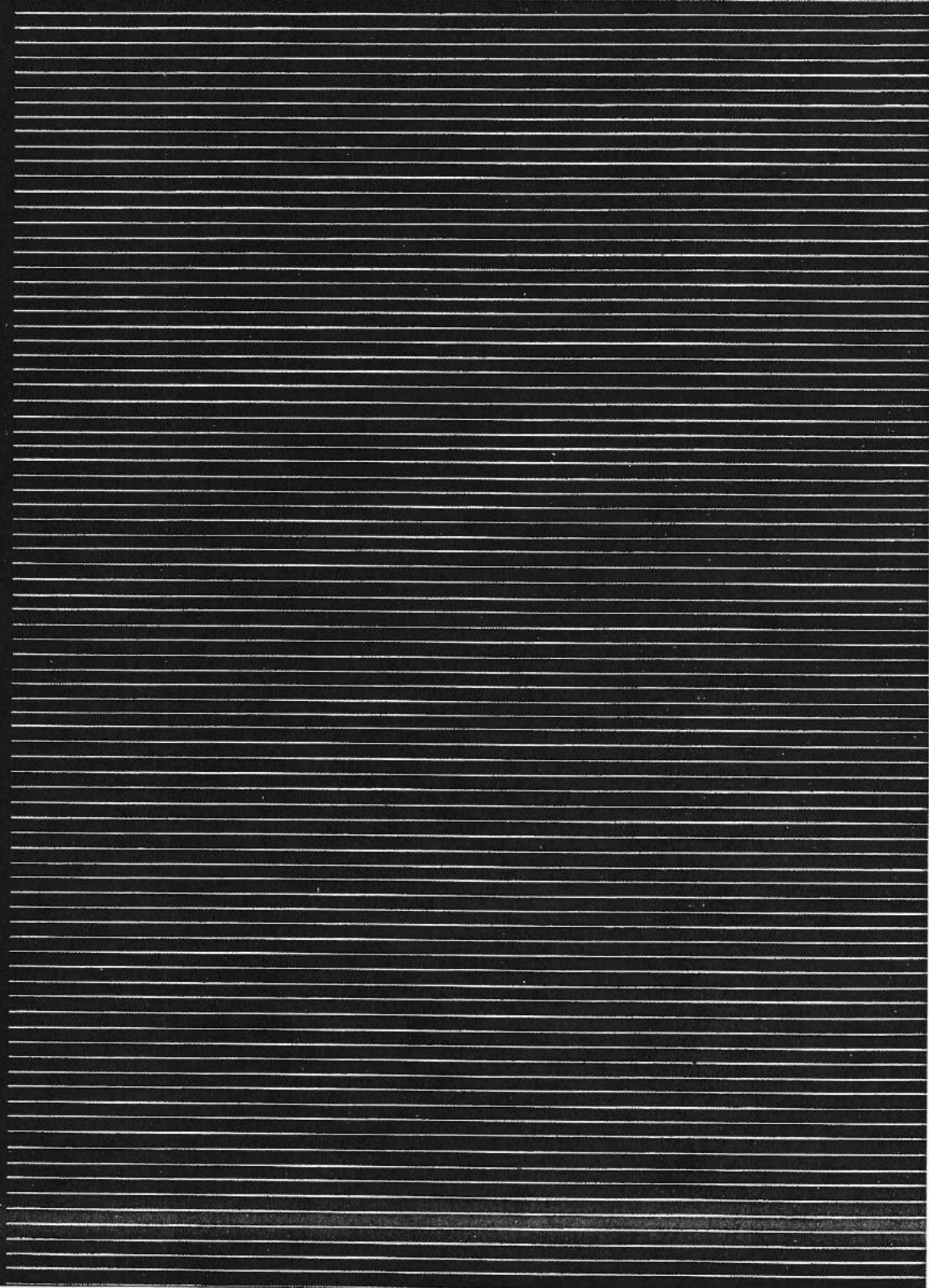
|   |   |   |  |                      |
|---|---|---|--|----------------------|
|  | <b>SCALE IN FEET</b><br> | <b>LAKE BOON</b><br>DIAGNOSTIC FEASIBILITY STUDY<br>TOWNS OF HUDSON AND STOW<br>MASSACHUSETTS | CAMP DRESSER &<br>MCKEE INC.<br>in association with<br>IEP, INC. | <b>FIGURE 2-2</b>    |
|   |   |   |  | <b>PUBLIC ACCESS</b> |

Camp, Dresser & McKee map used in the TMDL report 2001





Attachment B  
Bathymetry Map



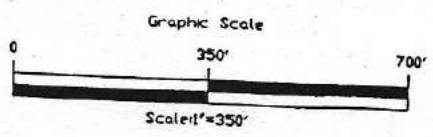
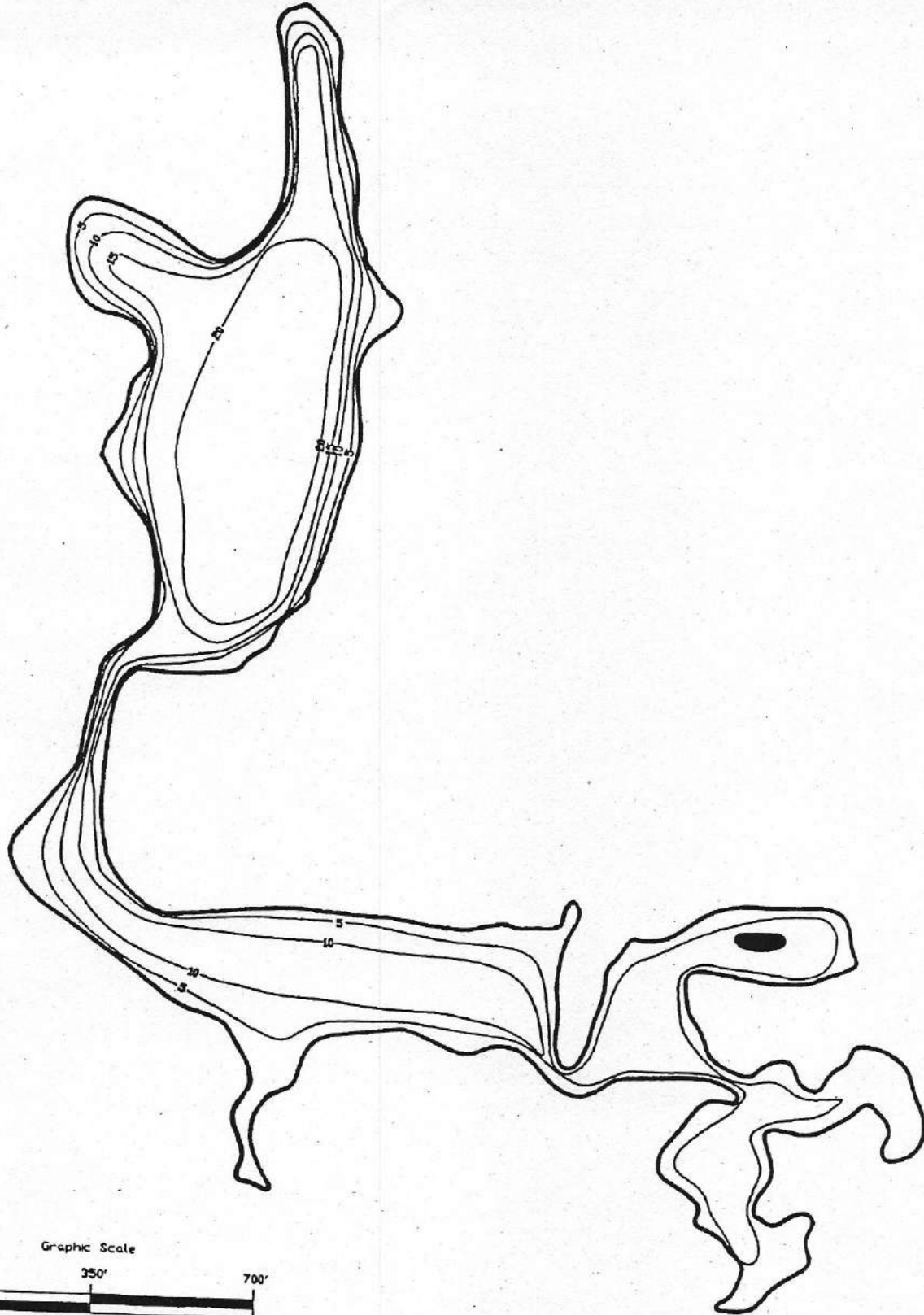


Figure:5

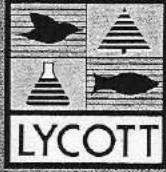
### Bathymetric Contours Lake Boon Hudson/Stow, Massachusetts

**ESS**  
ENVIRONMENTAL SCIENCE SERVICES, INC.  
200 University Street, Suite 200  
Bellingham, Massachusetts 01922  
(781) 421-0200  
ENVIRONMENTAL SCIENTISTS, ENGINEERS, AND PLANNERS

SCALE: AS SHOWN      Dwg. # L090\_R5  
DATE: January, 1999

Map from ESS 1999 study





Attachment C  
Wildlife Habitat

Table 1: List of Wetland Dependent Amphibians, Reptiles and Mammal Species Predicted by WETHings and Actual Species Observances

| Common Name                  | Scientific Nomenclature              | Species Observed on Site <sup>1</sup> |
|------------------------------|--------------------------------------|---------------------------------------|
| <b>Mammals</b>               |                                      |                                       |
| Beaver                       | <i>Castor canadensis</i>             |                                       |
| Muskrat                      | <i>Ondatra zibethicus</i>            | X                                     |
| Moose                        | <i>Alces alces</i>                   |                                       |
| Mink                         | <i>Mustela vison</i>                 |                                       |
| Masked shrew                 | <i>Sorex cinereus</i>                |                                       |
| Little brown myotis          | <i>Myotis lucifugus</i>              |                                       |
| Silver-haired bat            | <i>Lasiorycteris noctivagans</i>     |                                       |
| Eastern pipistrelle          | <i>Pipistrellus subflavus</i>        |                                       |
| Keen's myotis                | <i>Myotis keenii septentrionalis</i> |                                       |
| Small-footed myotis          | <i>Myotis leibii</i>                 |                                       |
| <i>Eastern Chipmunk</i>      | <i>Tamias striatus</i>               | X                                     |
| <i>Eastern Gray Squirrel</i> | <i>Sciurus carolinensis</i>          | X                                     |
| <i>White-tailed Deer</i>     | <i>Odocoileus virginianus</i>        | X                                     |
| <i>Eastern Mole</i>          | <i>Scalopus aquaticus</i>            | X                                     |
| <i>Common Raccoon</i>        | <i>Procyon lotor</i>                 | X                                     |
| <b>Reptiles</b>              |                                      |                                       |
| Northern water snake         | <i>Nerodia sipedon sipedon</i>       | X                                     |
| Common musk turtle           | <i>Sternotherus odoratus</i>         |                                       |
| Common snapping turtle       | <i>Chelydra serpentina</i>           | X                                     |
| Painted turtle               | <i>Chrysemys picta picta</i>         | X                                     |
| <b>Amphibians</b>            |                                      |                                       |
| Bullfrog                     | <i>Rana catesbeiana</i>              | X                                     |
| Northern spring peeper       | <i>Pseudacris crucifer</i>           | X                                     |
| Pickerel frog                | <i>Rana palustris</i>                | X                                     |
| <i>Eastern American toad</i> | <i>Bufo a. americanus</i>            | X                                     |
| <i>Wood frog</i>             | <i>Rana sylvatica</i>                | X                                     |

<sup>1</sup> Species marked with an X were observed on site during site visits conducted in May and June, 2000.

<sup>2</sup> Species listed with common names in italics were observed to use habitat in or adjacent to Lake Boon, but were not predicted by WETHings, primarily because they are not considered to be wetland dependant.

ESS 1999 study



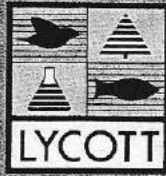
Table 2: Results of invertebrate sampling at Lake Boon, Stow/Hudson, Massachusetts.

| Taxa                                  | Site #1               |            | Site #2               |            | Site #3               |            | Site #4               |            | Site #5               |            |
|---------------------------------------|-----------------------|------------|-----------------------|------------|-----------------------|------------|-----------------------|------------|-----------------------|------------|
|                                       | Number of Individuals | Ranking    | Number of Individuals | Ranking    | Number of Individuals | Ranking    | Number of Individuals | Ranking    | Number of Individuals | Ranking    |
| Amphipoda (scuds)                     |                       |            |                       |            |                       |            |                       |            |                       |            |
| Talitridae                            |                       |            |                       |            |                       |            |                       |            |                       |            |
| <i>Hyalella</i> sp.                   | 12                    | Occasional | 11                    | Common     | 12                    | Common     | 10                    | Common     |                       |            |
| Isopoda                               |                       |            |                       |            |                       |            |                       |            |                       |            |
| Aeselliidae                           |                       |            |                       |            |                       |            |                       |            |                       |            |
| <i>Cnecidotea</i> sp.                 |                       |            | 4                     | Occasional |                       |            |                       |            |                       |            |
| Annelida (worms)                      | 1                     | Rare       |                       |            |                       |            | 1                     | Rare       |                       |            |
| Oligochaeta                           | 10                    | Occasional |                       |            |                       |            | 1                     | Rare       |                       |            |
| Mirandinia (leaches)                  |                       |            | 1                     | Rare       |                       |            |                       |            |                       |            |
| Trichoptera (caddisflies)             |                       |            |                       |            |                       |            |                       |            |                       |            |
| Leptoceritae                          |                       |            |                       |            |                       |            |                       |            |                       |            |
| <i>Leptocerus</i> sp.                 |                       |            |                       |            | 1                     | Rare       |                       |            |                       |            |
| Diptera (true flies)                  |                       |            |                       |            |                       |            |                       |            |                       |            |
| Chironomidae (midges)                 |                       |            | 4                     | Occasional | 2                     | Rare       | 3                     | Occasional | 5                     | Common     |
| Ephemeroptera (mayflies)              |                       |            |                       |            |                       |            |                       |            |                       |            |
| Ephemeroptera                         | 2                     | Rare       |                       |            | 2                     | Rare       | 8                     | Common     | 2                     | Occasional |
| Ephemeroptera                         |                       |            |                       |            |                       |            |                       |            |                       |            |
| Odonata (dragonflies and damselflies) |                       |            |                       |            |                       |            |                       |            |                       |            |
| Gomphidae                             |                       |            | 2                     | Rare       | 2                     | Rare       | 2                     | Rare       |                       |            |
| Lestidae                              |                       |            |                       |            | 12                    | Common     |                       |            |                       |            |
| Megaloptera (dobsonflies)             |                       |            |                       |            |                       |            |                       |            |                       |            |
| Corydalidae                           |                       |            |                       |            |                       |            | 1                     | Rare       | 1                     | Occasional |
| Mollusca (clams and snails)           |                       |            |                       |            |                       |            |                       |            |                       |            |
| Unionitidae                           |                       |            |                       |            |                       |            |                       |            |                       |            |
| <i>Anodonta</i> sp. (clam)            | 1                     | Rare       |                       |            |                       |            |                       |            |                       |            |
| Sphaeriidae (clam)                    | 20                    | Common     |                       |            | 5                     | Occasional |                       |            | 2                     | Occasional |
| Planorbidae (snail)                   |                       |            | 2                     | Rare       |                       |            |                       |            |                       |            |
| Physidae (snail)                      | 5                     | Rare       |                       |            | 2                     | Rare       |                       |            |                       |            |
| Vivipantidae (snail)                  |                       |            |                       |            | 2                     | Rare       |                       |            |                       |            |
| Ostracoda                             | 12                    | Occasional | 5                     | Occasional |                       |            | 3                     | Occasional |                       |            |
| Total Number of Individuals           | 63                    |            | 29                    |            | 40                    |            | 29                    |            | 10                    |            |
| Number of Taxa                        | 8                     |            | 7                     |            | 9                     |            | 8                     |            | 4                     |            |

Note: rankings are based on the following criteria:

- Rare: < 10% of sample
- Occasional: 10-25% of sample
- Common: 25-50% of sample
- Abundant: >50% of sample

ESS 1999 study



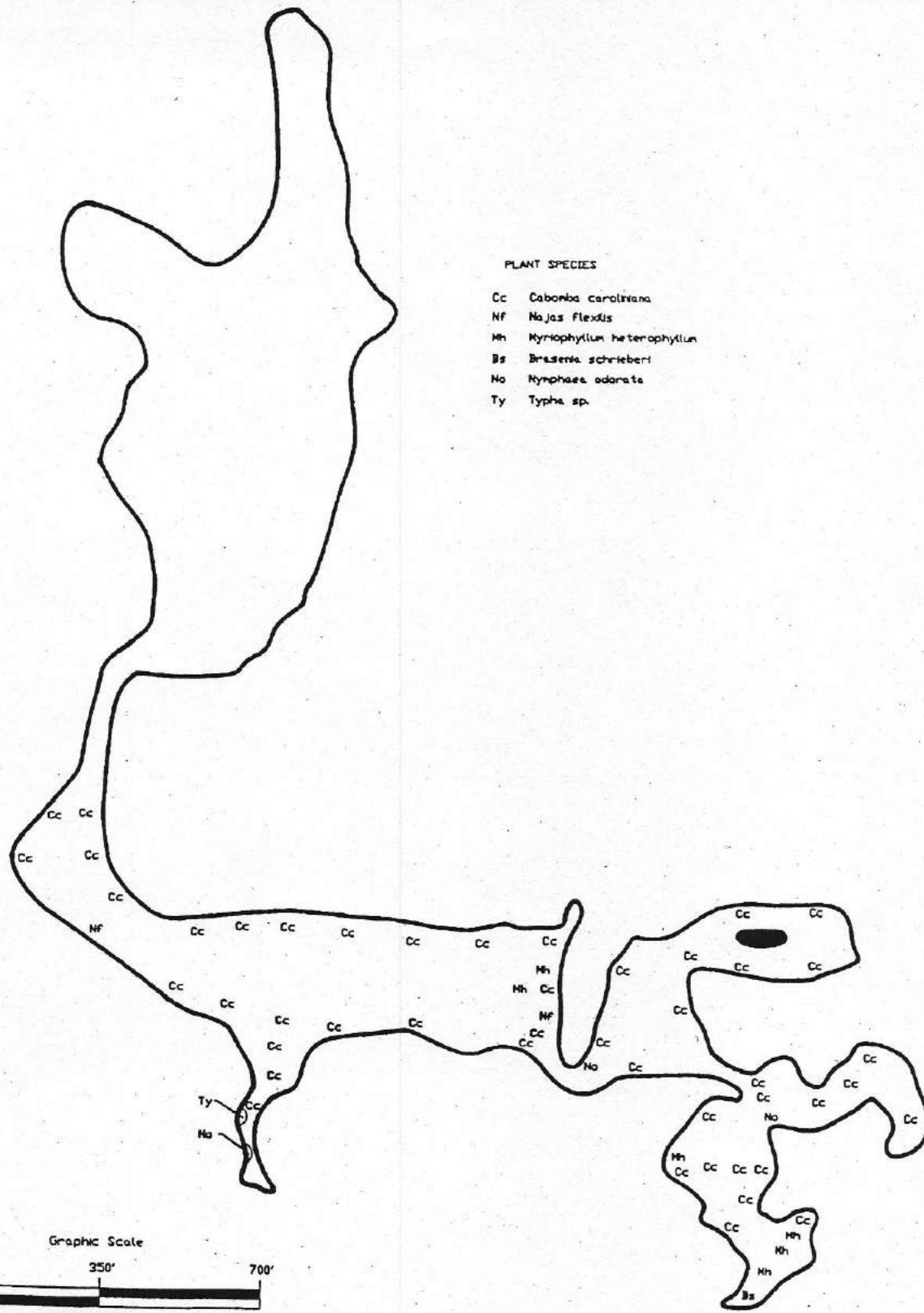
Attachment D  
Aquatic Vegetation Maps

NORTH

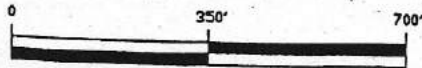


PLANT SPECIES

- Cc Cabomba caroliniana
- Nf Najas flexilis
- Mh Myriophyllum heterophyllum
- Bs Brasenia schrieberi
- No Nymphaea odorata
- Ty Typha sp.



Graphic Scale



Scale 1"=350'

**Figure 9**  
**Dominant Aquatic Plant Distribution**  
**Lake Boon**  
**Hudson/Stow, Massachusetts**

**ESS**

ENVIRONMENTAL SCIENCE SERVICES, INC.  
 688 Worcester Street, Suite 540  
 Woburn, Massachusetts 02458  
 (781) 938-9999

ENVIRONMENTAL SCIENTISTS, ENGINEERS, AND PLANNERS

SCALE: AS SHOWN  
 DATE: January, 1999

Fig. # 1090\_19

Map from ESS 1999 study



NORTH



PERCENT COVER

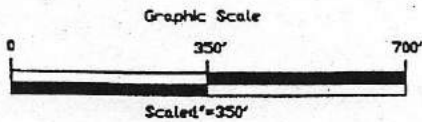
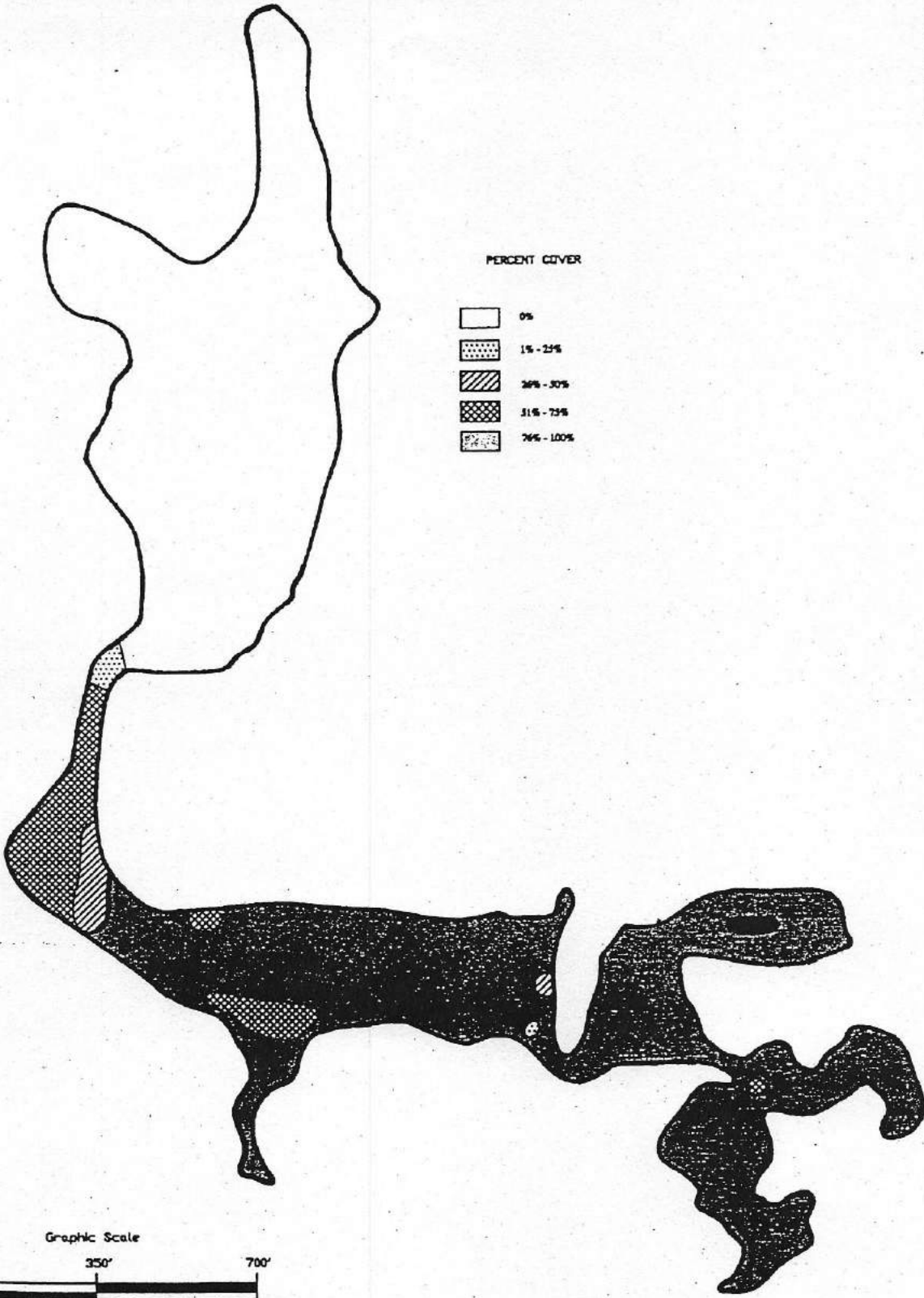
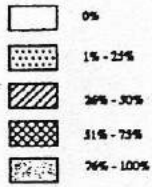


Figure:10

**Percent Plant Cover  
Lake Boon  
Hudson/Stow, Massachusetts**

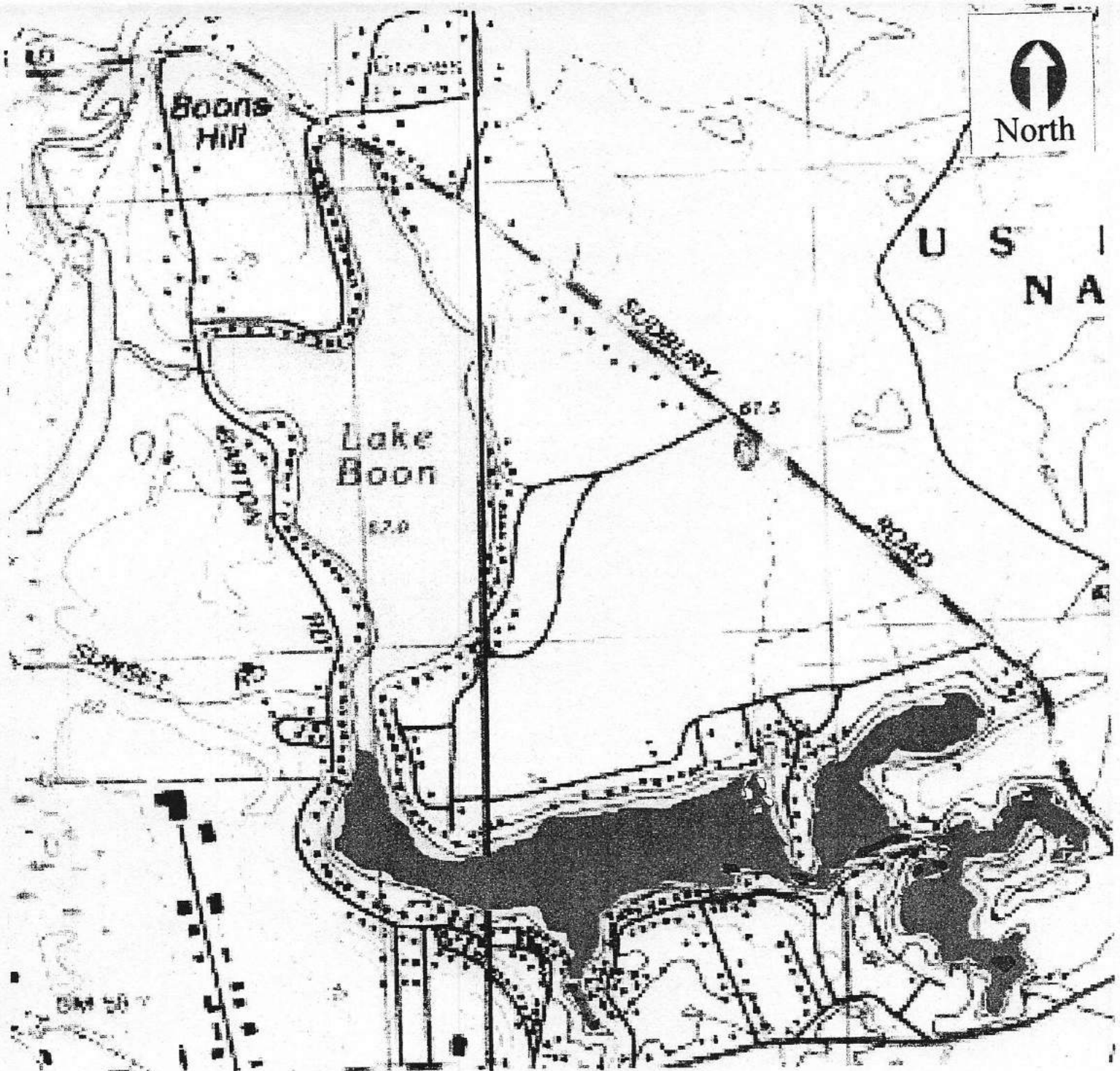
**ESS**

ENVIRONMENTAL SCIENCE SERVICES, INC.  
201 Vancouver Street, Suite 500  
Woburn, Massachusetts 01890  
(781) 938-6000  
ENVIRONMENTAL SCIENCE, ENGINEERING, AND PLANNING

SCALE: AS ABOVE  
DATE: January, 1999

Fig. # 1000\_10





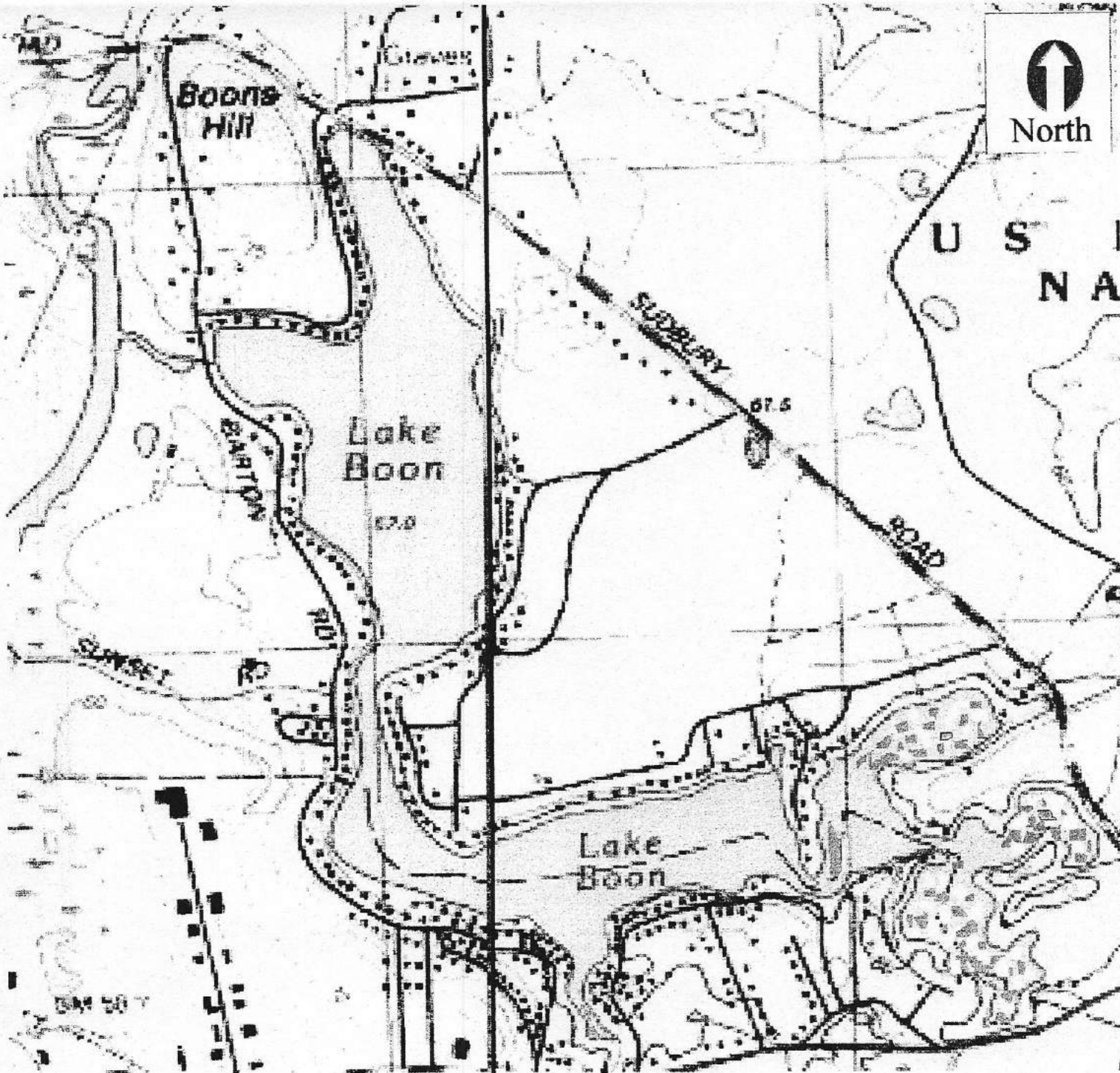
**Lake Boon, Hudson & Stow, MA**  
**6/2/2002 Pre-Treatment Aquatic Vegetation Survey**

Fanwort

Variable Milfoil

Bigleaf Pondweed





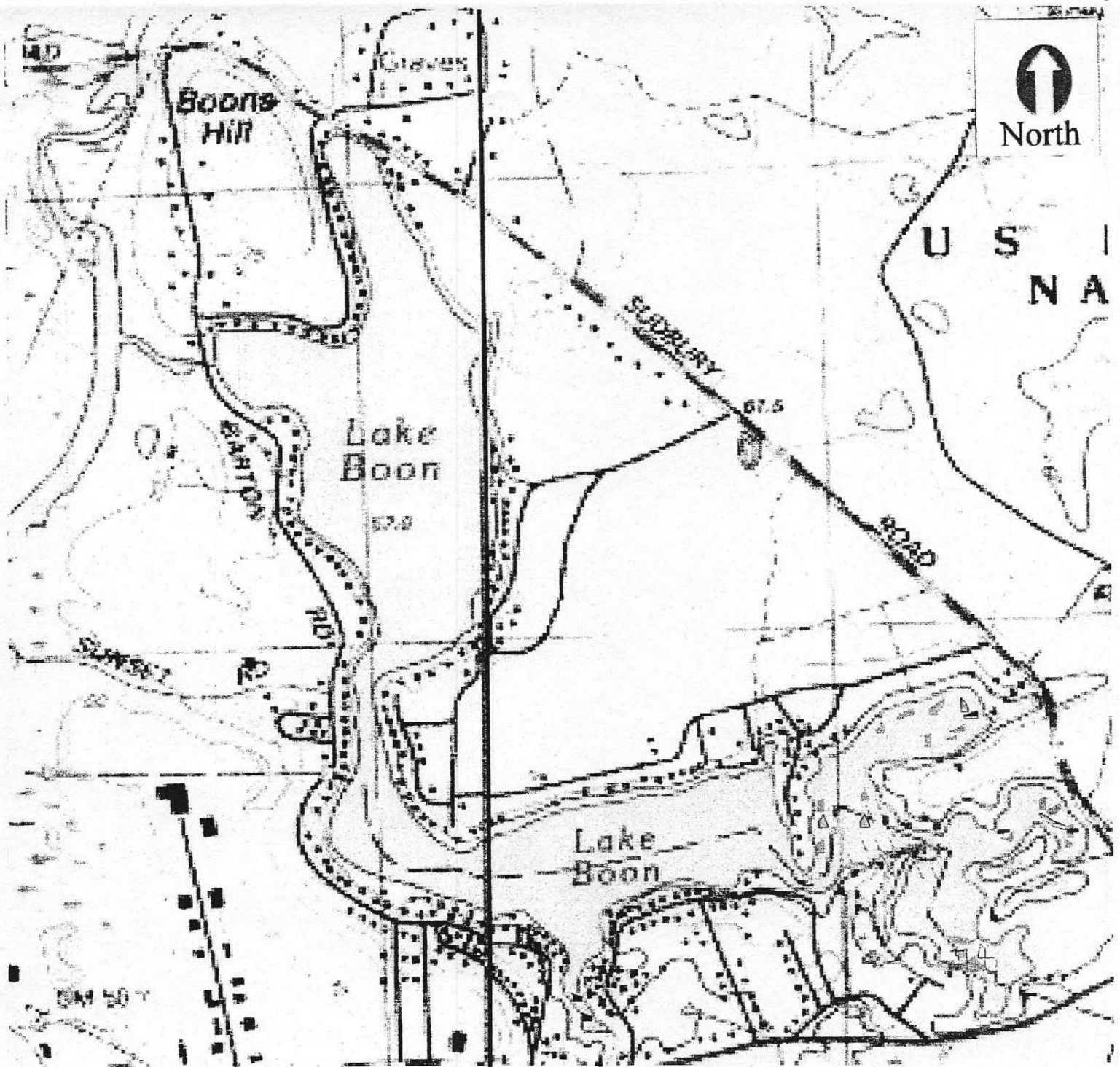
### Lake Boon, Hudson & Stow, MA

### 6/2/2002 Pre-Treatment Aquatic Vegetation Survey

- |             |             |
|-------------|-------------|
| Watershield | Bladderwort |
| Lilies      | Algae       |





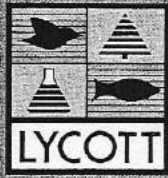


## Lake Boon, Hudson & Stow, MA

### 7/5/2002 Post-Treatment Aquatic Vegetation Survey

|             |                  |                   |
|-------------|------------------|-------------------|
| Fanwort     | Bladderwort      | Algae             |
| Watershield | Fern Pondweed    | Bigleaf Pondweed  |
| Lilies      | Variable Milfoil | Floating Pondweed |





Attachment E  
Hydrology



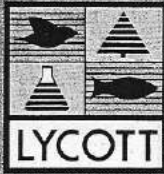
Table 10. Annual hydrologic (water) loading to Lake Boon determined through modeling

| Source                 | (cfs) | Load<br>(m3/min.) | (%)   | Notes                                  |
|------------------------|-------|-------------------|-------|--|
| Direct Precipitation   | 0.56  | 0.95              | 14.1  | Peak of 35 cfs likely for 2-year storm |
| Ground Water Inseepage | 0.91  | 1.55              | 23.1  |  |
| Surface Water          | 2.48  | 4.21              | 62.7  |  |
| Dry Weather*           | 0.48  | 0.86              | 12.8  |  |
| Wet Weather*           | 2.00  | 3.35              | 49.9  |  |
| Total Annual           | 3.95  | 6.71              | 100.0 |  |

\* Subset of surface water total

|                |                         |
|----------------|-------------------------|
| Watershed Area | 4,354,572 square meters |
| Lake Boon Area | 651,567 square meters   |
| Volume         | 2,114,010 cubic meters  |
| Mean Depth     | 3.24 meters             |
| Maximum Depth  | 6.70 meters             |
| Detention Time | 219 days (0.600 years)  |
| Flushing Rate  | 1.67 times/year         |
| Response Time  | 160 - 266 days          |

Table from ESS 1999 study



Attachment E  
Sediment Sampling

Table 7. Results of sediment sampling in Lake Boon conducted on August 20, 1998  
 Samples were collected from locations corresponding to Figure 7

| Parameter               | Units | Results | Detection Limit |
|-------------------------|-------|---------|-----------------|
| Solids, Total           | %     | 10      | NA              |
| Solids, Total Volatile  | %     | 6       | NA              |
| Moisture                | %     | 90      | NA              |
| Nitrogen, Total Kjeldal | mg/kg | 8,500   | 1,250           |
| Phosphorus, Total       | mg/kg | <40     | 40              |
| Oil and Grease          | mg/kg | 518     | 313             |
| <b>Particle Size</b>    |       |         |                 |
| Sand + (>53 um)         | %     | 0       | NA              |
| Coarse Silt (20-53 um)  | %     | 0       | NA              |
| Medium Silt (5-20 um)   | %     | 0       | NA              |
| Fine Silt (2-5 um)      | %     | 6.1     | NA              |
| Clay (<2 um)            | %     | 93.9    | NA              |
| <b>Metals, Total</b>    |       |         |                 |
| Arsenic                 | mg/kg | 28      | 13              |
| Cadmium                 | mg/kg | <3      | 3               |
| Chromium                | mg/kg | 17      | 13              |
| Copper                  | mg/kg | 30      | 13              |
| Lead                    | mg/kg | 145     | 32              |
| Mercury                 | mg/kg | <0.08   | 0.08            |
| Nickel                  | mg/kg | 17      | 13              |
| Zinc                    | mg/kg | 158     | 32              |

NA = not applicable

Table from ESS 1999 study





Attachment F  
Land Use

Table 1. Land use within each of the five watershed sub-basins within the Lake Boon watershed.

| Land Use           | Lake Boon<br>(acres) | Sub-Basin 1<br>(acres) | Sub-Basin 2<br>(acres) | Sub-Basin 3<br>(acres) | Sub-Basin 4<br>(acres) | Sub-Basin 5<br>(acres) | Total acres for<br>Watershed |
|--------------------|----------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------------|
| Industrial         | 0.0                  | 0.0                    | 0.0                    | 0.0                    | 16.4                   | 20.0                   | 36.4                         |
| Commercial         | 0.0                  | 0.0                    | 0.0                    | 0.0                    | 20.5                   | 6.7                    | 27.2                         |
| Residential        | 0.0                  | 109.3                  | 0.0                    | 56.9                   | 25.1                   | 61.8                   | 253.1                        |
| Agriculture        | 0.0                  | 5.1                    | 4.6                    | 5.1                    | 0.0                    | 0.0                    | 14.8                         |
| Forest             | 0.0                  | 205.2                  | 79.5                   | 50.3                   | 205.2                  | 43.3                   | 583.5                        |
| Water              | 161.0                | 0.0                    | 0.0                    | 0.0                    | 0.0                    | 0.0                    | 161.0                        |
| <b>Total Acres</b> | <b>161.0</b>         | <b>319.6</b>           | <b>84.1</b>            | <b>112.3</b>           | <b>267.2</b>           | <b>131.8</b>           | <b>1076.0</b>                |

Table from ESS 1999 study

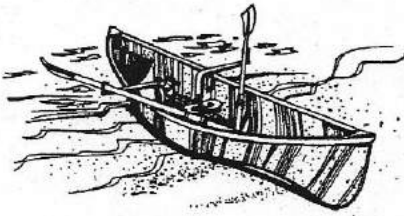




Attachment G  
Funding Resources



# Funding Opportunities and Resources



*The following funding opportunities and resources are available for lake watershed surveys and implementation of remediation measures. Contact agencies directly for details on grant applications and deadlines. Contact names, addresses, and telephone numbers may change. They are current up to the printing of this document. Check the agency/organization Web sites for the most up to date information.*

## State and Local Grants

### **Source: Massachusetts Department of Environmental Management**

DEM offers grants for a variety of conservation management projects including those that promote the preservation, protection, and public use of lakes, ponds, and shorelines of waterways. Applicants can include municipalities, non-profit organizations, and planning agencies. For more information, contact the individual grant contacts, or visit DEM's Grants Section Web site at <http://www.state.ma.us/dem/grants.htm>.

### **Lakes and Ponds Grant Program**

*Steve Asen (617) 973-8733*

Promotes a holistic approach to lake management based on scientific principles and emphasizes the integrated use of watershed management, in-lake management, pollution prevention, and education to provide long-term solutions to lake problems. Priority is given to lake districts, lake associations, and other active citizen groups, as well as to proposals that develop and enhance public access to the waterbody and public uses.

### **Greenways and Trails Demonstration Grants Program**

*Jennifer Howard (413) 586-8706 Ext. 18*

Greenways are corridors of land and water that protect and link a variety of natural, cultural, and recreational resources. Grant awards of \$1,000-\$5,000 may be given to municipalities, non-profit organizations, and regional planning agencies to support innovative projects which create and/or promote greenways and trail networks in Massachusetts.

### **MASS ReLeaf Grant Program**

*Edith Makra (617) 626-1466*

Fosters partnerships between business, government, and nonprofit groups to raise money for the planting and care of public trees. The program helps communities purchase trees for energy conservation, screening, community gateway or parking lot enhancement, or to offset urban pollution. The program also engages a network of community leaders, government officials, and corporate partners through educational and promotional events and projects. In addition, the program assures long-term tree survival by



emphasizing proper tree selection, planting, aftercare, and maintenance. Applicants can be municipalities and non-profit organizations that will plant trees on publicly accessible land. The grants require in-kind services such as planting and maintenance of trees. Up to \$5,000 in grant funds are available to each recipient.

#### **National Recreational Trails Act Grant Program**

*Peter Brandenburg (617) 973-8740*

Under the National Recreational Trails Act (NRTA) and the Intermodal Surface Transportation Act (ISTEA) of 1991, fuel tax revenues, generated by off-highway vehicles and backcountry camping, are used to fund trail projects conducted by private organizations, government agencies, and municipalities. Projects can include mitigation of erosion problems of trails that abut waterbodies.

#### **Forest Stewardship Planning and Project Grants for Town Forestlands**

*Susan Campbell (413) 256-1201*

Encourages landowners to practice long-term guardianship through development of management plans for woodlands. The program is designed to improve wildlife habitat and forest aesthetics, to protect soil and water resources, and to increase the potential for high-quality wood products. Grants are awarded to public and private organizations in three categories: landowner outreach projects that deliver a stewardship message, such as tours, workshops, demonstrations, and printed material; preparation of 10-year forest management plans and demonstration areas on town and conservation commission lands; and professional training and technical support to the forestry community for delivery of a stewardship message. Most grants range from \$500 to \$2,500.

#### **Urban Forest Planning and Education Grants**

*Warren Archey (413) 784-1829 Ext.33 or Edith Makra (617) 626-1466*

Assist communities and nonprofit groups in building support for long-term protection and management of community trees and forests. Grants are awarded to tree wardens and nonprofit groups to organize and develop projects with the involvement of local residents and educators. The USDA Forest Service provides the grants, which DEM administers with guidance from the Massachusetts Community Forestry Council. A maximum of \$10,000 is available per project.

#### **Rivers and Harbors Grant Program**

*Leslie Lewis (781) 740-1600*

A statewide program of matching grants from DEM's Office of Waterways to towns and municipalities for design and construction to address problems on coastal and inland waterways, lakes, and great ponds. Projects funded under the program include channel and harbor dredging; pier, wharf, bulkhead, seawall, revetment and jetty repairs; coastal erosion control and beach nourishment; inland flood control; river cleanup and streambank stabilization; and other water-related projects. The grants require a 25% local match for dredging, and 50% for all other types of projects. Because there are practical

limits to funding, projects requiring less than \$300,000 in state funds are preferred. The program also provides matching funds for the local cost share of U.S. Army Corps of Engineers projects within the Commonwealth.

**Source: Massachusetts Department of Fisheries, Wildlife, and Environmental Law Enforcement**

**Riverways Small Grants Program**

Patricia Sheppard (617) 626-1541

Promotes greenways along rivers and healthy stream flows by funding projects that restore rivers and their wildlife and fisheries habitats. Grants range from about \$3,000 to \$8,000. For more information, see the Web site at [www.state.ma.us/dfwele/river/riv\\_tac.htm](http://www.state.ma.us/dfwele/river/riv_tac.htm).

**Source: Massachusetts Department of Environmental Protection**

DEP's grant and loan programs include funds from the U.S. Environmental Protection Agency as authorized by the federal Clean Water Act (sections 604b, 104(b)(3) and 319(h) and from state appropriation (research and demonstration and loan programs for municipalities and homeowners). More detailed information can be found at DEP's Web site: [www.state.ma.us/dep/brp/wm/wmpubs.htm](http://www.state.ma.us/dep/brp/wm/wmpubs.htm) or by contacting DEP's Regional Service Centers: Northeast: (978) 661-7677; Southeast: (508) 946-2714; Central: (508) 792-7683; and Western: (413) 755-2124.

**Grants:**

**604b Water Quality Management Planning Grant Program** funds projects that combine elements of water supply protection and planning and water quality assessment, particularly addressing nonpoint source issues. Proposals should have a public outreach or technology transfer component. Eligible grant recipients include regional planning agencies, councils of governments, conservation districts, counties, and municipalities. A local match is not required, but is encouraged. Contact Gary Gonyea: (617) 556-1152.

**319(h) Nonpoint Source Grant Program** funds projects that prevent, control, and abate nonpoint source pollution. Projects must have a 40 % non-federal match of the total project cost, which can be cash or in-kind services performed as part of the approved project activities. Lake protection and restoration projects are eligible for funding if they meet the same criteria for remediating nonpoint source pollution. 319(h) projects typically receive \$20,000 - \$150,000. Lake and pond restoration projects will require additional funding from other sources to implement. Eligible recipients include any interested Massachusetts public or private organization. Contact Beth McCann: (617) 292-5901.

**Loan Programs:**

Northeast Region: Tom Mahin (978) 661-7660

Southeast Region: Dick Keith (508) 946-2784

Central Region: Paul Andersen (508) 767-2802

Western Region: Dierdre Cabral (413) 755-2148







### **Clean Water State Revolving Loan Fund (CWSRF) Program**

The Massachusetts State Revolving Fund for water pollution abatement projects provides low-cost funding to help municipalities comply with federal and state water quality requirements. The CWSRF Program is jointly administered by DEP's Division of Municipal Services and the Massachusetts Water Pollution Abatement Trust. CWSRF loans have the current subsidy level of 50% grant equivalency that approximates a no-interest loan. Loans are available for planning, design, and construction of structural water pollution abatement projects, nonpoint source pollution abatement projects, and stormwater remediation. Non-structural projects, such as planning projects for remediating nonpoint source problems, also are eligible for funding.

### **Community Septic Management Program**

Provides funds to homeowners with failing septic systems to comply with the Title 5 regulations. Communities can obtain loans for septic system planning and improvements.

### **Massachusetts Drinking Water State Revolving Fund (DWSRF) Program**

Provides loans to municipalities for engineering, design, and construction of drinking water projects that protect public health and strengthen compliance with federal and state drinking water regulations. The current subsidy level of 50% equivalency approximates a no-interest loan.

#### ***Source: Massachusetts Environmental Trust***

The Trust is an environmental philanthropy established by the Massachusetts Legislature in 1988. The Trust funds and coordinates projects that encourage cooperative efforts to raise environmental awareness and support innovative approaches to protect and preserve natural resources, with a special focus on water and related land resources of the Commonwealth. There are a variety of grants available through the Trust with different applicant requirements and funding cycles. For more information, contact the Trust at (617) 727-0249, by e-mail at [env.trust@state.ma.us](mailto:env.trust@state.ma.us), or see the Web site at <http://www.agmconnect.org/maenvtr1.html>.

#### ***Source: Massachusetts Department of Food and Agriculture***

The Massachusetts Department of Food and Agriculture's Agricultural Environmental Enhancement Program (AEEP) provides funding to farmers to install a variety of water quality protection practices. Eligible practices include the installation of buffers, animal waste systems, pesticide storage facilities, fencing, culverts, seed and gutters. All farmers who actively farm five acres or more of land which could potentially impact a water resource are eligible. For more information on the program contact the coordinator, Susan Phinney, at (617) 626-1772.

## Federal Grants and Resources

*Source: U.S. Department of Agriculture,  
Natural Resources Conservation Services*

**Watershed Protection and Flood Prevention Program** works through local government sponsors to solve natural resource and related economic problems on a watershed basis. Projects include watershed protection, flood prevention, erosion and sediment control, water supply, water quality, fish and wildlife habitat enhancement, wetlands creation and restoration, and public recreation in watersheds of 250,000 or fewer acres. **Technical and financial assistance** is available for installation of improvement projects to protect, develop, and utilize land and water resources in small watersheds. Applicants can include a local or state agency, county, municipality, soil and water conservation district, flood prevention or flood control district, Indian Tribe or Tribal organization, or non-profit agency with authority to carry out, maintain, and operate watershed improvement works. Funds include cost sharing for 100% of flood prevention costs; and 50% of construction costs related to agricultural water management, recreation, and fish and wildlife. For more information, see the NRCS Web site at <http://www.nhq.nrcs.usda.gov>, or call the appropriate NRCS Field Office:

*State Headquarters* – (413) 253-4350

*Barnstable Field Office* (serving the Cape Cod, Dukes, and Nantucket Conservation Districts) – (508) 771-6476

*Greenfield Field Office* (serving the Franklin Conservation District) – (413) 772-0384 Ext.3

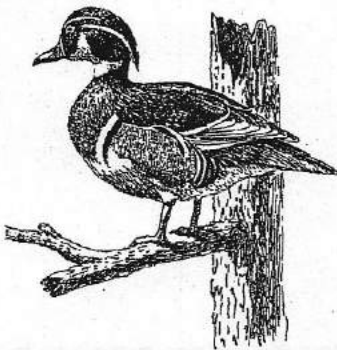
*Holden Field Office* (serving the Northeastern, Northwestern, and Southern Worcester Conservation Districts) – (508) 829-4477 Ext.3

*Northampton Field Office* (serving the Hampden and Hampshire Conservation Districts) – (413) 585-1000 Ext.3

*Pittsfield Field Office* (serving the Berkshire Conservation District) – (413) 443-6867 Ext.3

*West Wareham Field Office* (serving the Bristol, Norfolk, and Plymouth Conservation Districts) – (508) 295-5151 Ext.2

*Westford Field Office* (serving the Essex, Middlesex, and Suffolk Conservation Districts) – (978) 692-1904 Ext.3



**Environmental Quality Incentives Program (EQIP)** is a conservation grants program for farmers whose properties face serious threats to soil, water, and related natural resources. The program provides technical, financial, and educational assistance in designated priority areas such as watersheds, regions, or areas of special environmental sensitivity or having significant soil, water, or related natural resource concerns. These concerns include soil erosion, water quality and quantity, wildlife habitat, wetlands, and forest and grazing lands. The program pays for up to 75% of cost sharing expenses for conservation practices that improve and maintain the health of the natural resources in the area.

**Wetlands Reserve Program (WRP)** restores and protects wetlands on private property. WRP provides landowners with financial incentives to enhance wetlands in exchange for retiring marginal agricultural land. Landowners may sell a conservation easement or enter into a cost share restoration agreement.

Landowners and NRCS develop a plan for restoration and maintenance of the wetland. Applicant must be a landowner for at least one year and the land must be restorable and suitable for wildlife benefits. NRCS provides from 75 to 100% of the restoration costs depending on the easement and agreement with the landowner.

*Source: U.S. Department of Interior, U.S. Fish and Wildlife Service*

**The North American Wetlands and Conservation Act Grant Program** promotes long-term conservation of North American wetland ecosystems, the waterfowl and other migratory birds, fish, and wildlife that depend on that habitat. The program supports the acquisition, enhancement, and restoration of wetlands and wetlands-associated habitat. The program also encourages voluntary, public-private partnerships to conserve North American wetland ecosystems by creating an infrastructure and providing a source of funding. Funding is available for any individual or organization with a long-term wetlands conservation project for acquisition, restoration, and/or enhancement with the required 1:1 partnership match. There are two grants available under the Act. The **Standard Grants Program** funds projects that provide long-term conservation of wetlands and associated uplands through habitat protection, restoration, or enhancement. The funding cap is \$1 million per grant. The **Small Grants Program** gives priority to applicants who have never received an Act grant. The funding cap is \$50,000 per grant. For more information, see the U.S. Fish and Wildlife Web site at <http://www.fws.gov>.

*Source: U.S. Department of Transportation*

**Transportation Enhancement Act of the 21<sup>st</sup> Century funds for water quality projects.** The Planning and Conservation League (PCL), Heal the Bay and Rails-to Trails Conservancy developed an EPA sponsored document titled, "*Merging Currents: Transportation and Water Quality, a Guidebook for Funding Opportunities.*" This booklet explains how local agencies can apply for TEA21 (Transportation Enhancement Act of the 21<sup>st</sup> Century) funds for water quality projects that are impacted by transportation systems. While geared for California applicants, much of the information is applicable nationwide. PCL sells the booklet for \$15. They can be reached at:

PCL Foundation  
Publications Office  
926 J St. Suite 6112  
Sacramento, CA. 95816  
(916) 444-8726



## Private Trusts and Foundations

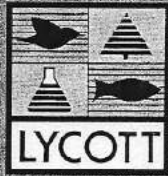
*Sweet Water Trust* is dedicated to the conservation of natural ecosystems and provides grants from its own endowment. It also may allocate grants from other foundation sources. The **Watershed Action Program** provides grants from \$1,000 to \$10,000 to non-profit organizations that support local action-



oriented projects to improve the ecological health and biotic integrity of local watershed ecosystems, particularly shoreline buffer zones and associated uplands where land and water meet. Types of projects eligible for funding include: acquisition of land or easements; assessment, maintenance, or improvement of water quality and quantity essential to aquatic ecosystem functions; and the prevention, removal, or control of exotic invasive species. Projects also may support good local planning; identify, map, and mitigate nonpoint sources of pollution; support conservation policy and advocacy regarding vernal pools, buffer zone areas, instream flow rates, anadromous fish migration, and dam removals; identify and map natural communities, habitat analysis, or ecological restoration. For more information, contact Sigrid Pickering, Watershed Action Program Director, at (617) 492-5998 or by e-mail at watersweet@aol.com.

*FishAmerica Foundation* provides grants for fishery improvement projects such as habitat improvement, streambank stabilization, aeration systems, silt removal, planting of trees and vegetation, hatchery construction and renovation, stocking and rearing fish, litter cleanups, and prevention and hands-on education. Non-profit organizations can apply with a letter of support from the appropriate state resource agency. For more information see the Foundation Web site at [http://www.asafishing.org/outreach/fish\\_america.htm](http://www.asafishing.org/outreach/fish_america.htm).





Attachment H  
Lake Boon Action Plan

## ATTACHMENT B

ACTION PLAN

| ITEM | TASK  | STATUS                      | COMMENT   |
|------|---|-----------------------------|---|
| 1    | Obtain 2002 DEM Lakes and Ponds Grant for Educational and Herbicide funding               | Complete                    | Up to \$25k State funds available for Education and Herbicides  |
| 2    | Apply for 319 Nonpoint Source Pollution Grant Program                                     | Complete<br>May 1, 2002     | To implement Watershed Controls as noted on Attachment C  |
| 3    | Hold Public Info Meeting & Public Hearing for Herbicides 2002                             | May 1, 2002                 | LBA, FLB seeking consensus for Herbicide Treatment & Introduce Watershed Management Plan                                      |
| 4    | Obtain funding from both Town Meetings  | May 2002                    | Funds for Lakes and Ponds grant allow for 319 Grant match   |
| 5    | Begin Herbicide Treatment   | On or after<br>May 16, 2002 | Pending ConCom's Approval May 7   |
| 6    | Develop a water quality monitoring program  | June - Dec 2002             | Volunteers Needed to begin implementation 2003  |
| 7    | Work with Lake Management Contractor to further develop Watershed Plan                    | July - Nov 2002             | Pending approval of contract with ACT   |
| 8    | Perform a nonpoint source watershed survey  | Fall 2002                   | To develop a list of problems in the watershed and prioritize them as goals to be fixed pending approval of State Application |
| 9    | Implement 319 Grant Tasks   | Summer 2002 -<br>2004       | Organizing Volunteers will begin before approval of grant - Town services all set   |
| 10   | Continue Education and Public Awareness   | Ongoing                     | Gazettes, newspapers, meetings, training, social events, etc.   |
| 11   | Adopt Covenant  | Nov 2002                    | LBA 2002 Annual Meeting   |
| 12   | Plan Exotic Weed Prevention Program   | Oct 2002                    | Train Volunteers to Identify Non-Native Weeds in Lake and on Boats / Trailers   |
| 13   | Continue to Evaluate Innovative Approaches, New Technologies for Long Term Weed Reduction | 2002 and beyond             | Ongoing Process   |
| 14   | Investigate & Apply for Other Sources of Funding  | 2002 and beyond             | Referenced in TMDL (also see "Buy a Bottle . . ." flyer for funding lab tests)  |