Bare Hill Pond Watershed Management Committee
Town of Harvard
Harvard, MA 01451

August 20, 2011

Conservation Commission
Town of Harvard
Town Hall
Harvard, MA 01451

Re: 2011 Report and Fall 2011 Drawdown Plans

Dear Commissioners:

On behalf of the Bare Hill Pond Watershed Management Committee, we are pleased to submit our annual report under our current Order of Conditions. As discussed in January, we engaged Wendy Gendron to visit the Pond for several visits to investigate the questions asked by the Commission in March. Her reports are attached and she will be available to answer questions at the September 1 meeting.

This has been another busy year for the Committee as it works to improve the collection of information regarding the draw down, monitors the overall health of the Pond and its watershed, engage in outreach and education activities to encourage best management practices by watershed residents and users, and seeks to reduce invasive species and phosphorous in the Pond. As discussed in our last update at the Conservation Commission in the Spring, we are proceeding with permitting activities to determine whether to proceed with Town Beach excavation activities, and have been working with Rich Nota to ensure the completion of the remaining punch list items for the stormwater treatment project.

Drawdown Observations

The focus of this meeting is to address the basic question raised by Paul Willard last March, to provide additional data and information, and to describe our proposed drawdown plan. Paul Willard asked if we could provide professional confirmation that the drawdown was not harming the ecosystem and was helping the Pond. We believe the answer is strait forward and clear. Attached as Appendixes A, B and C are Wendy Gendron's reports of her visits last year to measure water quality, and then this Spring and this Summer to tour the Pond to address the questions raised in March. One of the concerns for example, that received the most attention, was the question of whether the drawdown was actually promoting invasive species, such as phragmites. In fact, the species that is re-emerging is a native plant, and while it may be viewed as a recreational nuisance, it is not a non-native invasive species. Other questions were how was the water quality doing, was the draw down having a positive impact on native plants and habitat overall, a negative impact on native species and habitate and was it harming the upstream or downstream wetlands.

As noted in Ms. Gendron's reports, the drawdown is having what we believe is a positive, restorative effect on the watershed as follows:

- The 2010 Report, which was furnished last March, notes an improvement in water quality in several respects. Phosphorous levels have declined in a number of locations from the excessive levels measured by the EPA in 1998 since we initiated the activity in 2001. Because these readings preceded the stormwater BMP project, we believe this is potentially the result of the washing out of phosphorous from the upper level of sediment and the dilution of effect of the drawdown. This is a key improvement because the reduction of phosphorous is what is most likely to stave off eutrophication which would lead to oxygen depletion, fish kills, algal blooms, anerobic bacteria growth, etc. which would be the most significant risk facing the Pond if no action was taken. Ms. Gendron noted that secci disk readings have improved as well. This is consistent with our own secci disk readings. This year in June and July we consistently had 6.5 foot readings in the morning, before sediments were stirred up by wind and traffic, and they declined following a 2 week period of limited rainfall at the end of July to 5.5 feet in August. The 5.5 feet readings were typically the high end of readings 10 years ago.

- Ms. Gendron's Spring and Summer reports also note, we believe, a healthy and vibrant Pond. We were fortunate to have Jim Breslauer join us for her second visit. We believe that the reports confirm the following:

    - The Pond continues to have significant presence of invasive aquatic species; although the species have shifted to fanwort from milfoil in many locations.

    - While there is a continued presence of invasive species that warrants management, the overall biovolume in the water column has declined. What appears to have occurred is that there is now a greater number of bottom growing species, typically native plants, which use less of the water column, but cover the bottom and provide habitat for other watershed residents. We see this as a positive change. Based on observations, the extent of invasive species growth was significantly less this year than last year. Ms. Gendron suggests that this may be due to differences in the growing seasons. Last year we a particularly bad year on most lakes and ponds with an early warm spring. This year was a cool, late spring, and the growing season was shorter. I toured the Pond in mid-August and still found significantly less milfoil and fanwort reaching the surface than in prior years. There continues to be much less in the draw down zone than in the deeper zones.

    - In the upstream wetlands, there is an increase in seed bearing plants, and an increase in the diversity of the plants. While seed bearing plants, such as grasses may be viewed as a nuisance, they appear to be native. At the same time, when samples of plants were taken on June 18 a wider diversity of native plants, rather than a single invasive plant was found in the locations sampled.

  - In July we visited the downstream wetlands too. A variety of native sedge and grasses were observed below the dam and there was healthy growth below the outflow of the pump indicated that the risk of washout was being managed by the rocks placed below the pipe.

- In July, the EPA staff also visited Bare Hill Pond to examine its health and watershed. I have asked them for a copy of their findings. We understand this is the same team that prepared the 1998 TDML report on the Pond that resulted in the Pond being designated as endangered. We will provide the data as soon as we receive it from the EPA.

- In the Spring, I attended a meeting sponsored by the Town of Concord Conservation Commission on mussel ecology. Sean F. Werle, presented his data on mussel surveying. After he spoke I showed him our mussel photos and discussed our mussel survey protocol. He indicated that the mussels we have in Bare Hill Pond were Eastern Eliptia mussels.-- one of the most prevalent and more hardy species in Massachusetts. He indicated that they do move with the waterflow, unless trapped in rocks, that they are not endangered, and that unlike what we had thought, live throughout the Pond bottom at all depths. He did not believe the draw down would pose a risk to their population given that they would be living throughout the Pond and because we had evidence of reproduction.

- Jeff Ritter continues to conduct springtime Frog Counts. This year they continued to hear choruses of peepers and continued to confirm a resurgence of pickerel frogs. They also went out in May and heard the early presence of bullfrogs. He continues to question whether the presence of blue heron on the Pond could be having an impact on the frog population. There have been reports that frog observations in developed shorelines have decreased. The frog counts are conducted in wetland areas and conservation land.

- With regard to reptiles, I conducted a turtle survey in the upstream wetlands on a morning in early May. During a 30 minute period, I observed approximately 30 turtles (one has to approach very quietly in the kayak) in the sedges and on logs. Most of the turtles were painted turtles; although I regularly see snapping turtles during egg laying season and during the summer. This year there were a number of reports that water snakes were more common. They are typically sunning themselves in the morning. At our outreach and education event, several folks were concerned they were "black mocassins". I asked the snake expert to identify them from a photo and he confirmed they were common northern watersnakes, which are not poisonous, but which are also not friendly if handled or disturbed. An increase in snake populations in the residential areas could also explain a decrease in frog observations in shorelines with homes.

- Rick Dickson continues to pursue invasive waterchestnut plants with support from the Pond Committee water chestnut pulls. Last year he used the harvester to take out 4 loads of waterchestnut plants in Clapps Brook area. When he started 4 years ago it was 64 loads. This year there were not enough plants to even use the harvester. The water chestnut pull and Rick's personal efforts have cleared the Pond again although a few plants were found outside the Clapps Brook area and he encourages all of us to be vigilant and to pull any plants we see. This is an amazing success story.

In summary, we believe the draw down is having a positive effect, that its effect is incremental in nature, as expected, and that as a result allows for the restoration of the habitat as native species replace invasive species. We are particularly pleased to see a trend in the reduction of phosphorous.

Drawdown Plan

In 2008-9, we proposed and took a year off from pumping after several incremental years of improvement. The result in the Summer of 2009 was a significant resurgence of invasive species growth. In 2009-10, we conducted a 6 foot drawdown which had a solid freeze and it appeared at the time to have had a beneficial reduction in invasive plants as noted in that year's report. It was also, however, an excellent and early growing season and while the Pond did not worsen that year, as a result of the draw down we believe, it also did not significantly improve. As noted above, the 2010-11 drawdown, coupled with the shorter growing season has reduced the invasive species now further although there is still invasive species prevalence in many areas of the Pond that need to be controlled, including, for example, the Town beach, Great South Bay, and to the left of Thurston's cove (facing the Pond).More importantly, the water quality data show that the draw down is our best short term strategy for the reduction of phosphorous and that we are making significant gains and avoiding eutrophication risk.

Ms. Gendron confirmed in March that because the efficacy of drawdowns is uncertain due to weather and length of the freeze, weather alone is as likely to provide the equivalent of taking a year off from pumping. For this reason, given that we are not observing negative habitat impacts, we recommend continuing the drawdown this year and deferring a year off. We anticipate this might continue until we achieve the right equilibrium of phosphorous levels and invasive growth. This is also consistent with the recommendation of the 2002 ENSR Report filed with our first Notice Of Intent.

Our proposal for this year is to follow last year's drawdown protocol (with one modification). Under that protocol, which was coordinated with the Rowing Association last year, we initiated with a gravity drawdown the week of September 19. We deferred starting the pump until October 15 to maintain Pond height, and then limited the pumping reduction to 4 feet until October 28th. At that time pumping would then continue to a 5 foot level, when we could conduct a mussel survey. Provided we continue to see mussels at the same prevelance, we would continue the pumping to 6.5 feet unless there is a freeze or we reach the November 30. The one change we are proposing this year is that if we receive the permits to conduct the excavation this December at the Beach, including the Order of Conditions, that we would continue to pump to 7 feet to enable that work to proceed. As in prior years, the rate of drawdown would not exceed 2” per day per the Order of Conditions.

As in prior years, we would initiate the refill on or before February 1, 2011 following notice to the Commission and the abutters. Because snowmelt timing is variable and is important to timely refilling of the Pond, our experience indicates that deferring the refill beyond February 1 is unwise to ensure the habitat is restored for amphibians, fish and reptiles.

We appreciate the time the Commission has take, and the effort made to understand, and help manage the project. We look forward to the meeting on September 1.

Sincerely,

Bruce A. Leicher
Chair, Bare Hill Pond Watershed Management Committee

Cc: Conservation Commission Members
Pond Committee Members
Selectmen

Attachment A

Aquatic Restoration Consulting, LLC
18 Sunset Drive
Ashburnham, MA 01430
Phone: 508-397-0033

Bare Hill Pond Watershed Management Commission
Tom Gormley
Town of Harvard
99 Ann Lee Road
Harvard, MA 01451

Dear Mr. Gormley,
This report provides a summary of the watershed, in-lake and plant survey data collected in 2010.

## Watershed Sampling

We conducted dry weather sampling of the tributary downstream of Pond Road (BHP-T1) on June 9, 2010. We collected a surface grab sample from BHP-T1 and sent it to Berkshire Enviro Labs for total phosphorus (TP), dissolved phosphorus (DP) and total suspended solids (TSS) analysis. We also recorded in-situ measurements of temperature, dissolved oxygen (DO), pH and specific conductivity. We observed no measurable flow at the other planned sampling locations described below and, therefore, we did not collect samples or perform in-situ analyses at these locations. Table 1 provides a summary of the results.

Wet weather sampling of the tributary was conducted on April 27, 2010. Four other locations were sampling during this wet weather event. These locations are:

| | |
|---|---|
| BHPBS-1 | Behind School - Parking lot runoff |
| BHPBS-2 | Behind School - Detention basin outlet |
| BHP-SFP | Soccer field drainage pipe discharging to tributary |
| BHP-T1 | Tributary downstream of Pond Road, downstream of soccer field pipe confluence |
| BHPSF-1 | Soccer field behind fence at baseball diamond - small buried pipe discharge |

In-situ measurements of temperature, DO, pH and specific conductivity were recorded at all but one location (BHPSF-1). The flow at sample location BHPSF-1 was very low and the drainage channel did not contain enough water to immerse the sampling equipment. We collected grab samples at all locations which were sent to Berkshire Enviro Labs for analysis of TP, DP and TSS. Table 1 summarizes these results. A total of 0.18 inches of precipitation was measured at the Fitchburg Airport during this rain event.

**Table 1. Bare Hill Pond Watershed Sampling Results 2010.**

| Weather Condition | Station | Date | Time | Temp (C ) | DO (mg/L) | pH (SU) | Spec Cond (us/cm) | TP (mg/L) | DP (mg/L) | TSS (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|
| Dry | BHP-T1 | 6/9/2010 | 13:15 | 14.1 | 8.6 | 7.7 | 423 | 0.025 | 0.011 | 1.0 |
| Wet | BHP-T1 | 4/27/2010 | 16:30 | 10.2 | 9.9 | 8.5 | 273 | 0.556 | 0.065 | 136 |
| | BHPBS-1 | 4/27/2010 | 16:07 | 12.0 | 8.8 | 8.0 | 105 | 1.293 | 0.150 | 344 |
| | BHPBS-2 | 4/27/2010 | 16:12 | 11.8 | 8.8 | 7.7 | 1075 | 0.041 | 0.022 | 6 |
| | BHP-SFP | 4/27/2010 | 16:44 | 8.5 | 10.2 | 7.8 | 750 | 0.022 | 0.018 | <1 |
| | BHPSF-1 | 4/27/2010 | 16:25 | no in-situ sample | | | | 0.063 | 0.030 | 26 |

Conductivity in the dry weather tributary sample was higher than the wet weather sample. This suggests a possible dilution effect of dissolved ions under wet weather conditions. However, this is difficult to confirm without additional data. DO and pH were higher under wet conditions.

TP, DP and TSS were substantially lower under dry conditions at BHPT-1. Overall, concentrations of TP and DP were greatest at BHPBS-1 (parking lot runoff), with the tributary sample containing the second highest concentrations. These values are typical of stormwater runoff in developed areas. The tributary provides a larger flow volume and is therefore suspected to generate the highest load of all locations sampled. TSS concentrations were also highest at these locations and suggest higher sediment loading.

TP and DP concentrations downstream of the detention basin and from the soccer field were relatively low. It should be noted that this rain event was a passing, but intense thunderstorm. It may take a longer duration storm to accurately assess the loading from the vegetated and retention areas. Additional data from several different wet weather events are needed to accurately assess loading from these areas..

## In-Lake Sampling

Dry weather in-lake sampling was conducted on June 21, 2010. In-situ water depth profiles measurements of temperature, DO, pH and specific conductivity were recorded at two locations: shallow south basin BHP-1 and deep hole in the north basin BHP-2. These data are presented in Table 2. Figure 1 provides a graphical representation of temperature and DO data.

The temperature and DO profiles suggest that the lake began to thermally stratify in June. The metalimnion (middle transitional layer) appears at 10 feet. DO rapidly declines at around eight feet, with concentrations less than 2.0 mg/L at 16 feet. DO values above 5-6 mg/L are desirable for fish. The surface pH level is neutral to slightly basic at the surface and becomes more acidic with water depth. Specific conductivity is within a desirable range, values above 200 us/cm can be indicative of elevated dissolved pollutants and high productivity. Surface and mid depth values at these two stations were comparable.

**Table 2. Bare Hill Pond Water Depth Profiles**

| 6/21/2010 | BHP-1 | | | |
|---|---|---|---|---|
| Depth (ft) | Temp (C ) | DO (mg/L) | pH (SU) | Spec Cond (us/cm) |
| 0 | 25.9 | 8.5 | 8.6 | 141 |
| 2 | 25.9 | 8.6 | 8.3 | 141 |
| 4 | 25.9 | 8.6 | 8.2 | 141 |
| 6 | 24.8 | 8.9 | 8.1 | 140 |
| 8 | 23.9 | 8.6 | 8.0 | 140 |
| 10 | 21.6 | 8.0 | 7.9 | 139 |
| 12 | 20.9 | 5.7 | 7.6 | 139 |

| 6/21/2010 | BHP-2 | | | |
|---|---|---|---|---|
| Depth (ft) | Temp (C ) | DO (mg/L) | pH (SU) | Spec Cond (us/cm) |
| 0 | 25.1 | 8.5 | 8.6 | 136 |
| 2 | 25 | 8.6 | 7.8 | 137 |
| 4 | 24.9 | 8.7 | 7.7 | 136 |
| 6 | 24.1 | 8.7 | 7.7 | 136 |
| 8 | 23.1 | 8.6 | 7.6 | 136 |
| 10 | 20.3 | 6.4 | 7.5 | 135 |
| 12 | 19.2 | 4.8 | 7.4 | 135 |
| 14 | 16.7 | 3.4 | 7.3 | 136 |
| 16 | 14.6 | 1.5 | 7.2 | 136 |
| 18 | 12.6 | 0.9 | 7.1 | 139 |
| 20 | 11.8 | 0.3 | 6.9 | 155 |
| 22 | 11.3 | 0.2 | 6.8 | 188 |

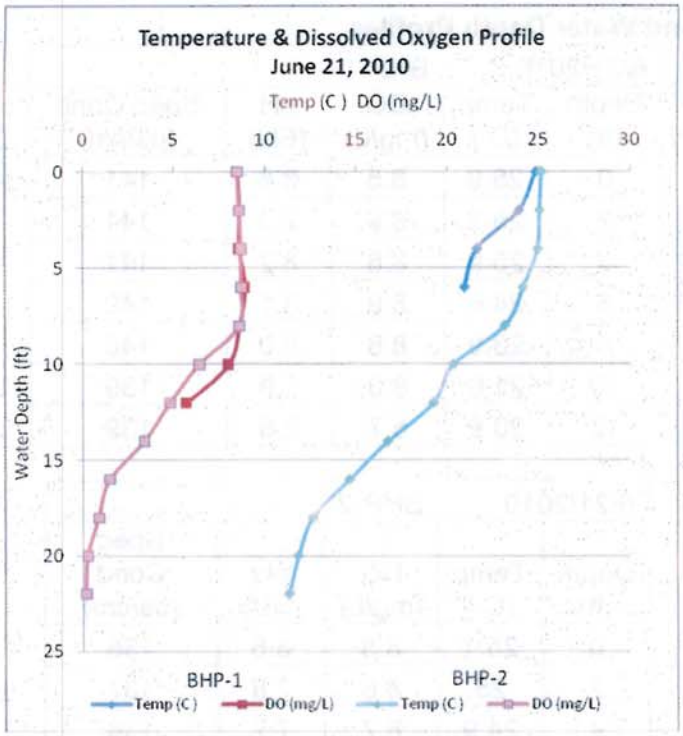



**Figure 1. Temperature and Dissolved Oxygen Profiles.**

Table 3 provides phosphorus and other water quality variables measured during the surveys. Overall, 2010 phosphorus concentrations are comparable to previous years and may be trending slightly lower. However it is difficult to assess given the limited sampling. Figure 1 shows the in-lake measured phosphorus at the deep location (BHP-2) for both surface and bottom samples. Secchi disk transparency in 2010 was comparable to 2004 and 2005 and was more desirable than 2007.

**Table 3. Bare Hill Pond In-lake Water Quality Data.**

| Station | Date | Time | TP (mg/L) | DP (mg/L) | TSS (mg/L) | Secchi (ft) |
|---|---|---|---|---|---|---|
| 2S | 9/16/2004 | 11:01 | 0.022 | 0.016 | | 12 |
| 2B | 9/16/2004 | 11:04 | 0.046 | 0.014 | | |
| 1S | 9/16/2004 | 8:59 | 0.022 | 0.022 | | |
| 1B | 9/16/2004 | 9:01 | 0.022 | 0.022 | | |
| 2S | 10/4/2005 | 12:50 | 0.040 | 0.019 | | 10.8 |
| 2B | 10/4/2005 | 13:11 | 0.032 | 0.022 | | |
| 1S | 10/4/2005 | 12:25 | 0.027 | 0.019 | | 8.7 (bottom) |
| 1B | 10/4/2005 | 12:29 | 0.032 | 0.022 | | |
| 2S | 11/3/2005 | 12:50 | 0.035 | 0.029 | | 11 |
| 2B | 11/3/2005 | 13:06 | 0.032 | 0.024 | | |
| 1S - Duplicate | 11/3/2005 | 11:25 | 0.024 | 0.024 | | |
| 1S | 11/3/2005 | 11:25 | 0.029 | 0.024 | | |
| 1B | 11/3/2005 | 11:29 | 0.051 | 0.024 | | |
| BHP-BK | 8/28/2007 | 9:30 | <0.010 | <0.010 | | |
| BHP-2S | 8/28/2007 | 13:14 | 0.024 | 0.015 | | 6.5 |
| BHP-2B | 8/28/2007 | 13:15 | 0.377 | 0.259 | | |
| BHP-1S-DUP | 8/28/2007 | 12:11 | 0.024 | <0.010 | | |
| BHP-1S | 8/28/2007 | 12:10 | 0.031 | 0.01 | | 4.5 (bottom) |
| BHP-1B | 8/28/2007 | 12:12 | 0.039 | 0.016 | | |
| BHP-2S | 9/7/2007 | 14:01 | 0.093 | 0.074 | | 5.8 |
| BHP-2B | 9/7/2007 | 14:02 | 0.292 | 0.197 | | |
| BHP-1S | 9/7/2007 | 13:10 | 0.091 | 0.086 | | 4.5 (bottom) |
| BHP-1B | 9/7/2007 | 13:11 | 0.092 | 0.069 | | |
| BHP-2S | 9/20/2007 | 9:30 | 0.029 | <0.010 | | 6.5 |
| BHP-2B | 9/20/2007 | 9:32 | 0.079 | 0.037 | | |
| BHP-1S | 9/20/2007 | 9:10 | 0.037 | 0.018 | | 4.8 (bottom) |
| BHP-1B | 9/20/2007 | 9:11 | 0.037 | <0.010 | | |
| 2S | 8/30/2009 | 15:15 | 0.011 | NA | <5 | |
| 2B | 8/30/2009 | 15:00 | 0.054 | NA | 51 | |
| 2S | 6/21/2010 | 19:15 | 0.019 | 0.015 | 1 | 11.8 |
| 2B | 6/21/2010 | 19:15 | 0.147 | 0.047 | 14 | |
| 1S | 6/21/2010 | 18:48 | 0.022 | 0.015 | 0.5 | 11.5 |

NA = not available, problem with laboratory analysis
"Bottom" indicates the Secchi disk reached the pond bottom
2S = Deep hole surface sample; 2B = Deep hole bottom sample; 1S = shallow surface sample

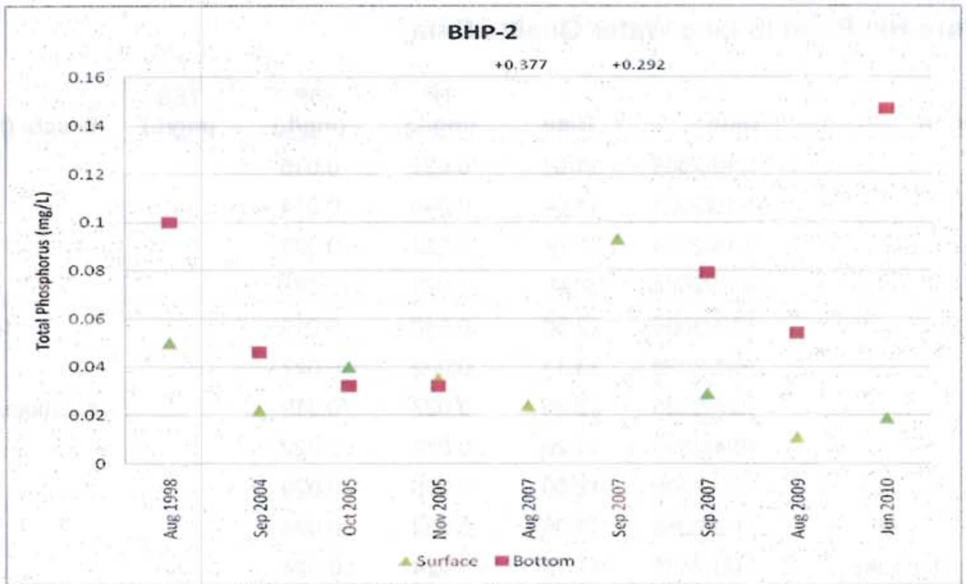



**Figure 1. Bare Hill Pond (BHP-2) Surface and Bottom Phosphorus**

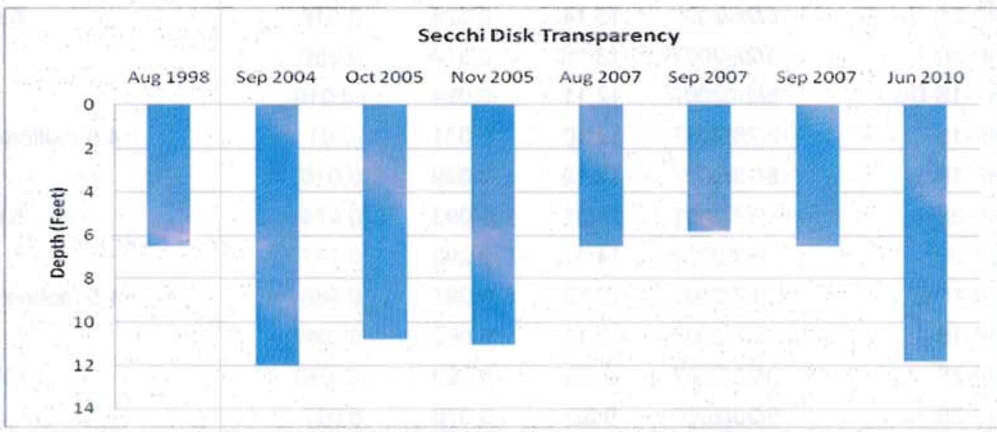



**Figure 2. Bare Hill Pond (BHP-2) Secchi Disk Transparency**

## Plant Survey

We conducted a plant survey on September 11, 2010 after all mechanical and hand harvesting activities ceased for the season. We used the same methods employed during the previous surveys conducted in 1998, 2001, 2004 and 2007. We mapped pond aquatic vegetation along the five transects (A through E) established in 1998. Each transect was divided into a series of observation points and were located using Global Positioning System (GPS). There was some error associated with the GPS but these positions were matched as closely as possible for each survey. The latitude and longitude position of each sample point was recorded. A total of 52 points were assessed during the survey.

These plant surveys focused on macroscopic fully submerged (e.g., milfoil), floating-leaved (e.g., pond lily), and/or free floating plants (e.g., duckweed). At each transect point, we recorded the percent cover of all plants, the percent biovolume (as measured by the amount of the water column filled with plants) using a semi-quantitative (0-5) ranking system. A rank of 0 represented 0% cover/biovolume. A rank of 1 corresponded to 1 - 25% cover/biovolume; 2 = 26 - 50%; 3 = 51 - 75%; 4 = 76 - 99; and 5 = 100%. Species observed in each transect were identified and assigned a percent of composition of all species present. Water depth and sediment type (boulders, rocks, muck, etc.) were also be recorded at each transect point. These data are presented in Table 3.

A detailed comparison of pre and post extended drawdown analysis was performed in 2007 on the plant cover and biovolume rank data to determine the efficacy of drawdown concurrent with harvesting for plant biomass and cover control. The 2007 report concluded:

> Data collected as part of this investigation suggest that winter water level drawdowns and plant harvesting are likely affecting plant biovolume and species composition. Plant biovolume decreased when comparing all three pre-treatment surveys (1998, 2001, and 2004) to the 2007 post treatment survey. The decrease in biovolume corresponds to a decrease in the percent frequency of occurrence of variable milfoil, especially in depths less than 6 ft. Over time, the increase in frequency of occurrence of stonewort and water nymph in 2007, both low growing plants that forms dense mats and occupy less of the water column, may explain the change in biovolume at shallower depths (2-6 ft). Hence, winter level drawdowns are likely contributing to the lower prevalence of milfoil in this zone and an overall drop in plant biovolume.

2010 data are comparable to 2007, although no statistical analysis was performed. Figures 2 and 3 provide a transect point summary for plant cover and biovolume for both the 2010 and 2007 survey and demonstrate similar conditions. Figures 4-6 provide a graphical representation of survey water depth, plant cover and biovolume for all survey years.

Plant composition in 2010 was also similar to 2007, with stonewort, Robbins pondweed, fanwort and water nymph encountered most frequently (Figure 7). Fanwort is likely out competing milfoil especially at the deeper depths. The frequency of occurrence data suggests that milfoil is becoming less abundant and fanwort, stonewort and water nymph are increasing. Water nymph and stonewort are low growing species. Fanwort, however, is a nuisance non-native species in the northeast. The majority of the fanwort was encountered at water depths greater than five feet.

**Table 3. Bare Hill Pond Macrophyte Survey Data 2010**

| Point | Water Depth (ft) | Total Depth (ft) | Sediment Type | Cover | Bio-volume | Mhe | Cca | Pro | Cde | Nod | alg | Nfl | Nsp | Nva | Utr | Bsc | Psp | Pot | Spa |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A-1 | 3 | >6.0 | M | 5 | 3 | | 5 | | | 15 | | | 5 | | 20 | 5 | | 50 | |
| A-2 | 3 | >6.0 | M | 5 | 2 | | 5 | 5 | 5 | | | | | 30 | 10 | 10 | 10 | 25 | |
| A-3 | 3 | >6.0 | M | 5 | 2 | | 20 | | | | | | 10 | | 40 | 30 | | | |
| A-4 | 3.5 | >6.0 | M | 3 | 1 | | | | | | | 40 | 10 | 10 | 40 | | | | |
| A-5 | 3.5 | >6.0 | M | 1 | 1 | | | | | | | 90 | 10 | | | | | | |
| A-6 | 4 | >7.5 | M | 1 | 1 | | | | | | | 90 | 10 | | | | | | |
| A-7 | 4.5 | 10 | M | 3 | 1 | | | | | 10 | | 90 | | | | | | | |
| A-8 | 5.5 | >11 | M | 3 | 1 | | | | | | | 100 | | | | | | | |
| A-9 | 8 | >11 | M | 1 | 1 | | | | | | 100 | | | | | | | | |
| A-10 | >11 | >11 | M | 1 | 1 | | | | | | 100 | | | | | | | | |
| A-11 | >11 | >11 | M | 0 | 0 | | | | | | | | | | | | | | |
| A-12 | 6 | 6.5 | C/S | 1 | 1 | 50 | 50 | | | | | | | | | | | | |
| A-13 | 4 | 4 | R/S | 0 | 0 | | | | | | | | | | | | | | |
| B-1 | 2.5 | 3 | S/R | 1 | 1 | | | | | | | | 10 | | | | | | 90 |
| B-2 | 4 | >6.0 | M | 5 | 1 | | | | | | | 10 | 70 | | | 20 | | | |
| B-3 | 4.5 | >6.0 | M | 4 | 1 | | | | | | | 40 | 50 | 10 | | | | | |
| B-4 | 4.5 | >6.0 | M | 5 | 1 | | | | | 10 | | 30 | 50 | | | 10 | | | |
| B-5 | 4.5 | >6.0 | M | 5 | 1 | | | | | 10 | | 50 | 30 | | | 10 | | | |
| B-6 | 4.5 | >6.0 | M | 5 | 1 | | | | | | | 50 | 50 | | | | | | |
| B-7 | 4.5 | >6.0 | M | 5 | 1 | | | | | 10 | | 50 | 30 | | | 10 | | | |
| B-8 | 4.5 | >6.0 | M | 5 | 1 | | | | | 10 | | 70 | 10 | | | 10 | | | |
| B-9 | 4.5 | >6.0 | M | 5 | 1 | | | 5 | | 10 | | 20 | 15 | 5 | | 5 | | 5 | 5 |
| B-10 | 4.5 | >6.0 | M | 1 | 1 | | | | | 50 | | | | 35 | | 5 | | | 10 |

**Table 3 (continued). Bare Hill Pond Macrophyte Survey Data 2010**

| Point | Water Depth (ft) | Total Depth (ft) | Sediment Type | Cover | Bio-volume | Mhe | Cca | Pro | Cde | Nod | alg | Nfl | Nsp | Nva | Utr | Bsc | Psp | Pot | Spa |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C-1 | 4.7 | 5.5 | S/M | 5 | 4 | | 95 | 5 | | | | | | | | | | | |
| C-2 | 6.5 | 7.5 | M | 4 | 2 | 10 | 40 | 20 | 20 | 10 | | | | | | | | | |
| C-3 | 7.5 | 10 | M | 4 | 2 | | 20 | 80 | | | | | | | | | | | |
| C-4 | 8.5 | >10 | M | 3 | 1 | 10 | 50 | 10 | 30 | | | | | | | | | | |
| C-5 | >11 | >11 | M | 0 | 0 | | | | | | | | | | | | | | |
| C-6 | >11 | >11 | M | 1 | 1 | | 100 | | | | | | | | | | | | |
| C-7 | >11 | >11 | M | 1 | 1 | | 100 | | | | | | | | | | | | |
| C-8 | 9.3 | 9.4 | R/S | 2 | 2 | 20 | 75 | 5 | | | | | | | | | | | |
| D-1 | 3 | 3.5 | S | 4 | 1 | | | | | 10 | | | | | | | | | 90 |
| D-2 | 4 | >6.0 | M | 4 | 1 | 10 | | | | 30 | | | | | | 60 | | | |
| D-3 | 4.5 | 6 | M | 5 | 1 | | | | | | | 90 | | 10 | | | | | |
| D-4 | 4 | 7 | M | 5 | 1 | | | | | | | 60 | | 10 | | | | | 30 |
| D-5 | 4.5 | 6 | M | 5 | 1 | | 10 | 20 | | | | 40 | 15 | 5 | | 10 | | | |
| D-6 | 4.5 | >6.0 | M | 5 | 1 | | | 10 | | 10 | | 40 | 20 | | | 20 | | | |
| D-7 | 5 | >7.0 | M | 5 | 1 | | | 30 | | | | 40 | | | | 30 | | | |
| D-8 | 5 | >7.0 | M | 5 | 1 | | | 30 | | | | 50 | 20 | | | | | | |
| D-9 | 5.5 | >7.5 | M | 5 | 1 | | | 40 | | | | 50 | 10 | | | | | | |
| D-10 | 5.5 | >7.5 | M | 5 | 1 | | | 40 | | | | 40 | 20 | | | | | | |
| D-11 | 6 | >7.0 | M | 5 | 1 | | | 70 | | | | 10 | 10 | | 10 | | | | |
| D-12 | 6.5 | >8.0 | M/C | 4 | 2 | | | 100 | | | | | | | | | | | |
| D-13 | 9 | 9.1 | S | 5 | 2 | 5 | 50 | 15 | 30 | | | | | | | | | | |

**Table 3 (continued). Bare Hill Pond Macrophyte Survey Data 2010**

| Point | Water Depth (ft) | Total Depth (ft) | Sediment Type | Cover | Bio-volume | Mhe | Cca | Pro | Cde | Nod | alg | Nfl | Nsp | Nva | Utr | Bsc | Psp | Pot | Spa |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E-1 | 4 | 4 | R/C | 1 | 1 | | | 100 | | | | | | | | | | | |
| E-2 | 4.5 | 4.5 | R/C | 1 | 1 | | | 100 | | | | | | | | | | | |
| E-3 | 5 | 5.5 | M | 4 | 2 | | 10 | 30 | | | | 60 | | | | | | | |
| E-4 | 6 | >8.0 | M | 4 | 2 | 30 | 60 | 10 | | | | | | | | | | | |
| E-5 | 6 | 8 | M | 4 | 3 | 20 | 50 | 20 | | | | | | | 10 | | | | |
| E-6 | 7 | >9.0 | M | 4 | 2 | | 40 | 60 | | | | | | | | | | | |
| E-7 | 8 | >11 | M | 4 | 2 | | 100 | | | | | | | | | | | | |
| E-8 | 10 | >10.0 | M | 3 | 2 | | 100 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | | Frequency of occurrence | | 15 | 37 | 42 | 8 | 23 | 4 | 44 | 38 | 15 | 12 | 27 | 2 | 6 | 10 |

Legend:

alg – filamentous algal mats

Bsc – *Brasenia schreberi* (watershield)

Cca – *Cabomba caroliniana* (fanwort)

Cde - *Ceratophyllum demersum* (coontail)

Mhe – *Myriophyllum heterophyllum* (variable-leaf milfoil)

Nfl – *Nitella flexilis* (stonewort)

Nsp - *Najas sp.* (waternymph)

Nod – *Nymphaea odorata* (white-flower waterlily)

Nva – *Nuphar variegata* (yellow-flower waterlily)

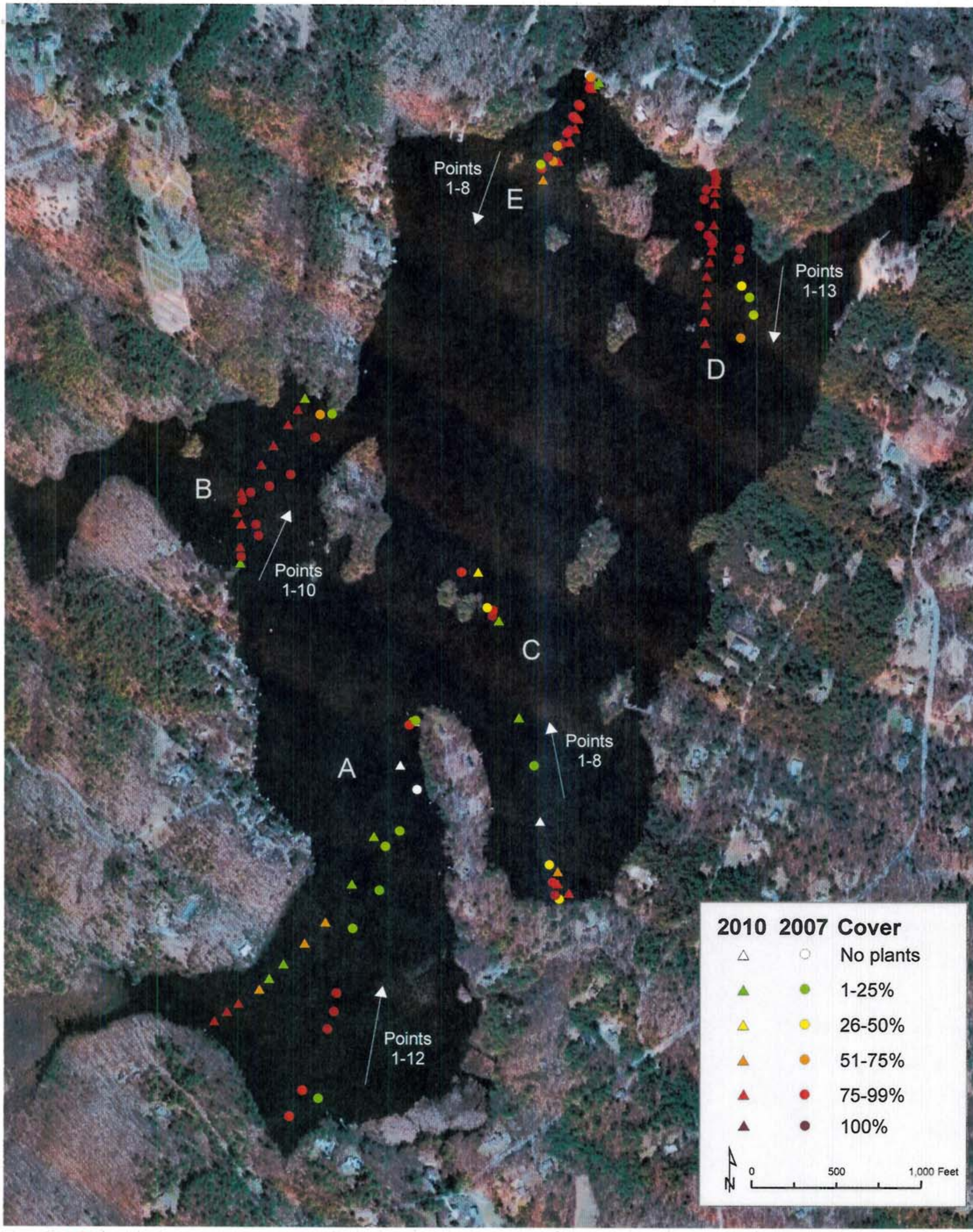
Psp - *Potamogeton spirillus* (spiral pondweed)

Pot – *Potamogeton* spp. (pondweeds)

Pro – *Potamogeton robbinsii* (Robbins pondweed)

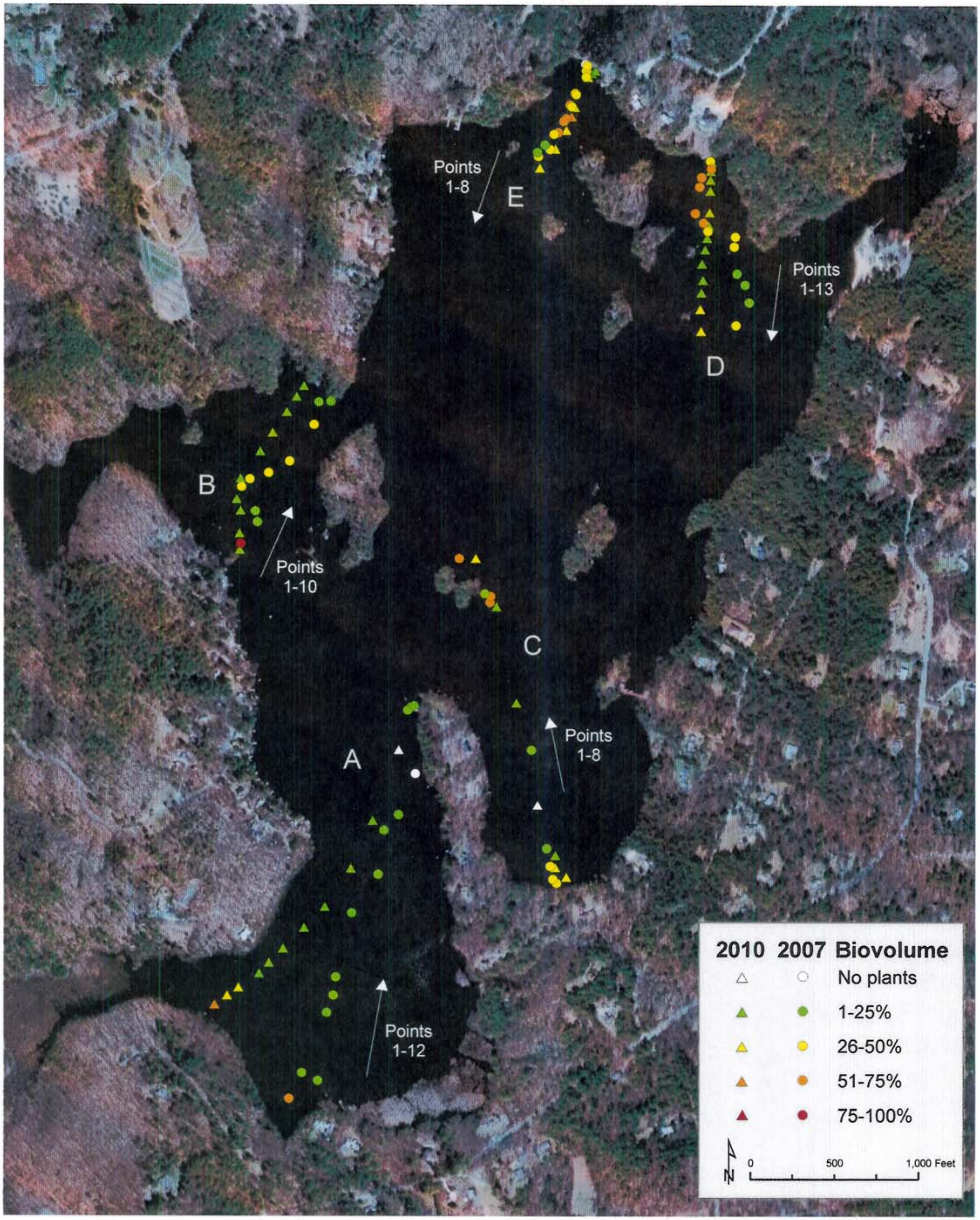
Spa – Sparganium sp. *(bur-reed)*

Utr – *Utricularia* spp. (bladderwort)




C:\Temp\transfer\2010 Data\2010BHPCover.mxd

**Bare Hill Pond Macrophyte Cover 2007 & 2010.**




C:\Temp\transfer\2010 Data\2010BHPBiomass.mxd

ARC

**Bare Hill Pond Macrophyte Biovolume 2007 & 2010.**

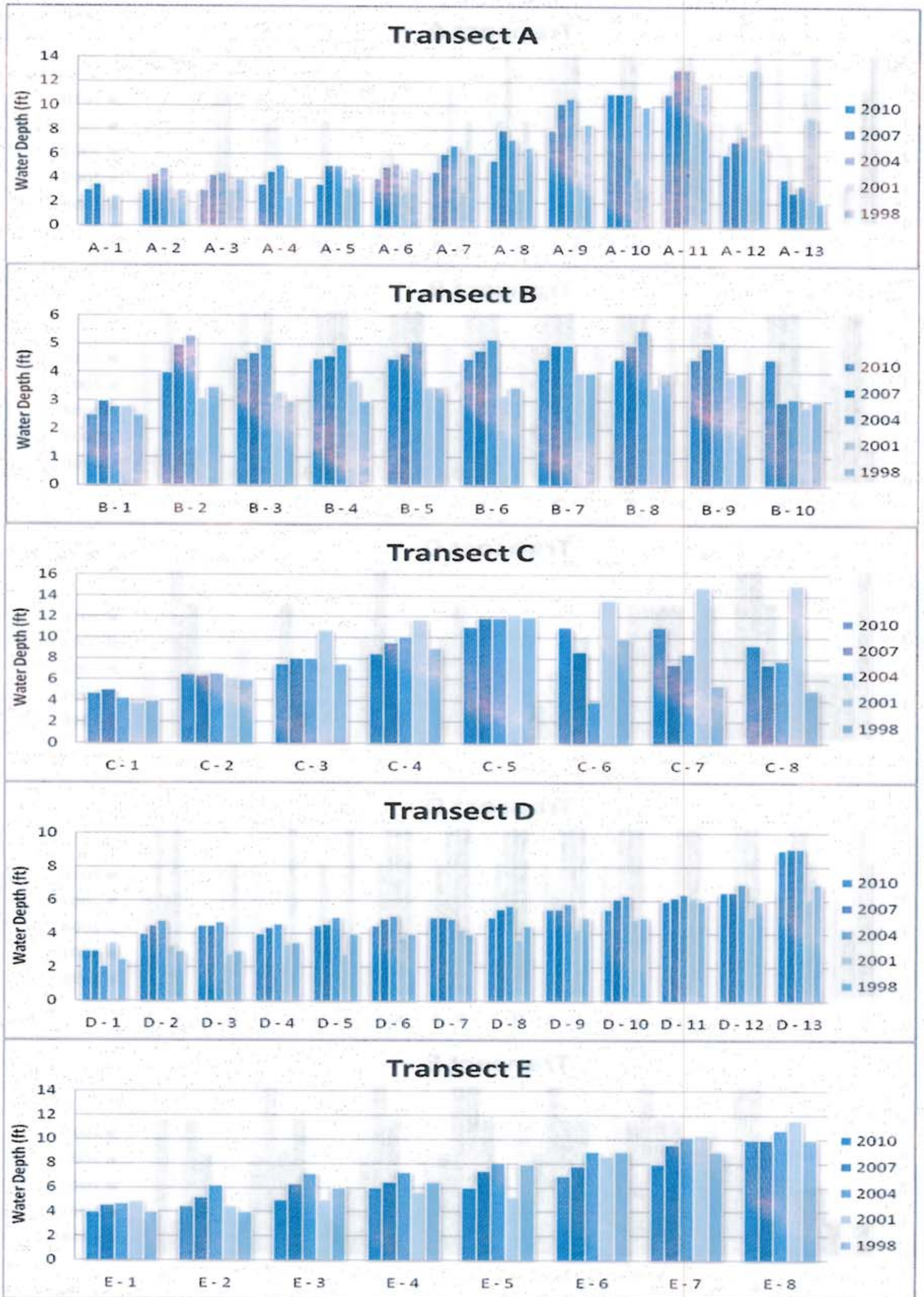



**Figure 4. Bare Hill Pond Plant Survey Transect-Point Water Depth.**

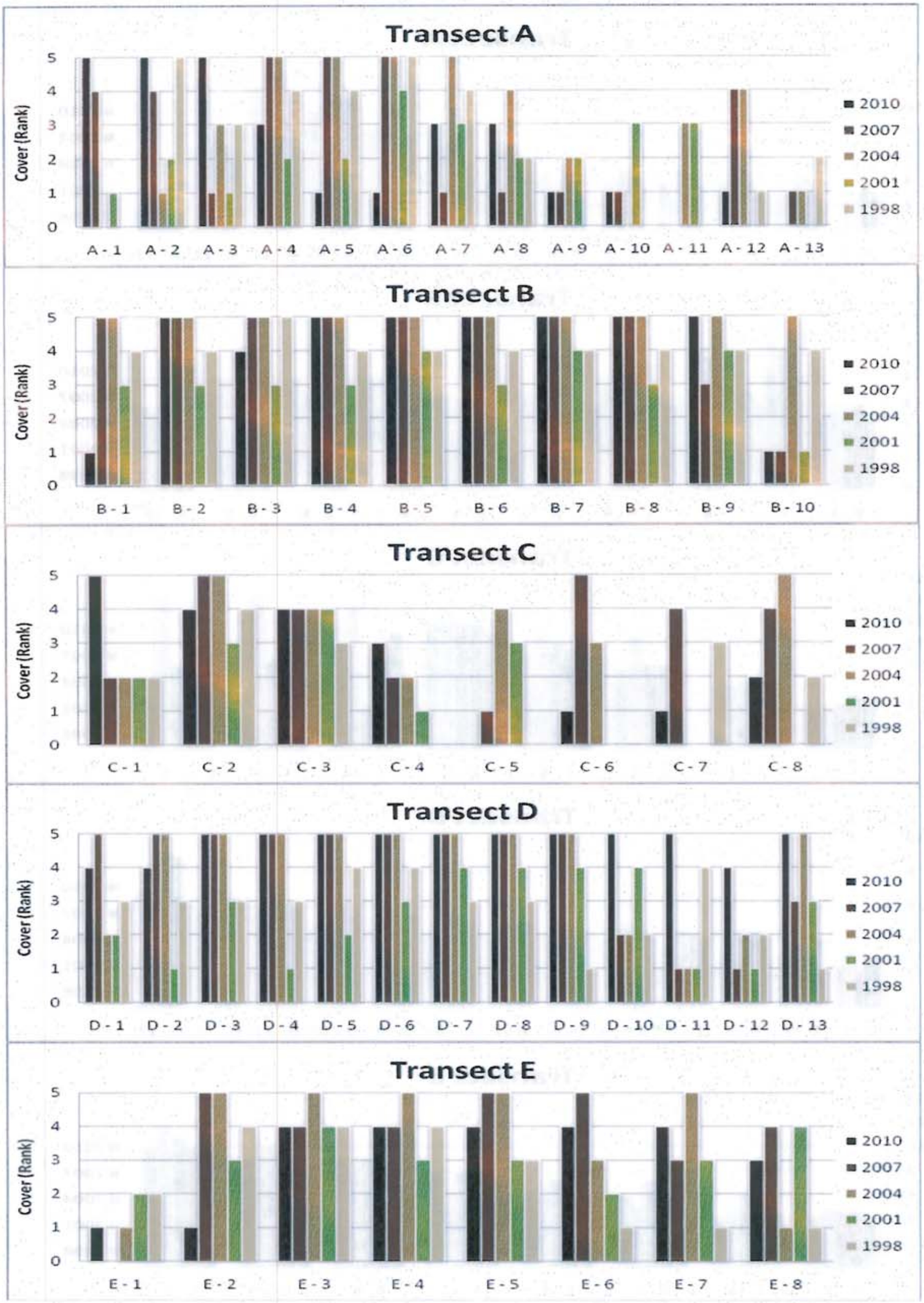



**Figure 5. Bare Hill Pond Macrophyte Cover.**

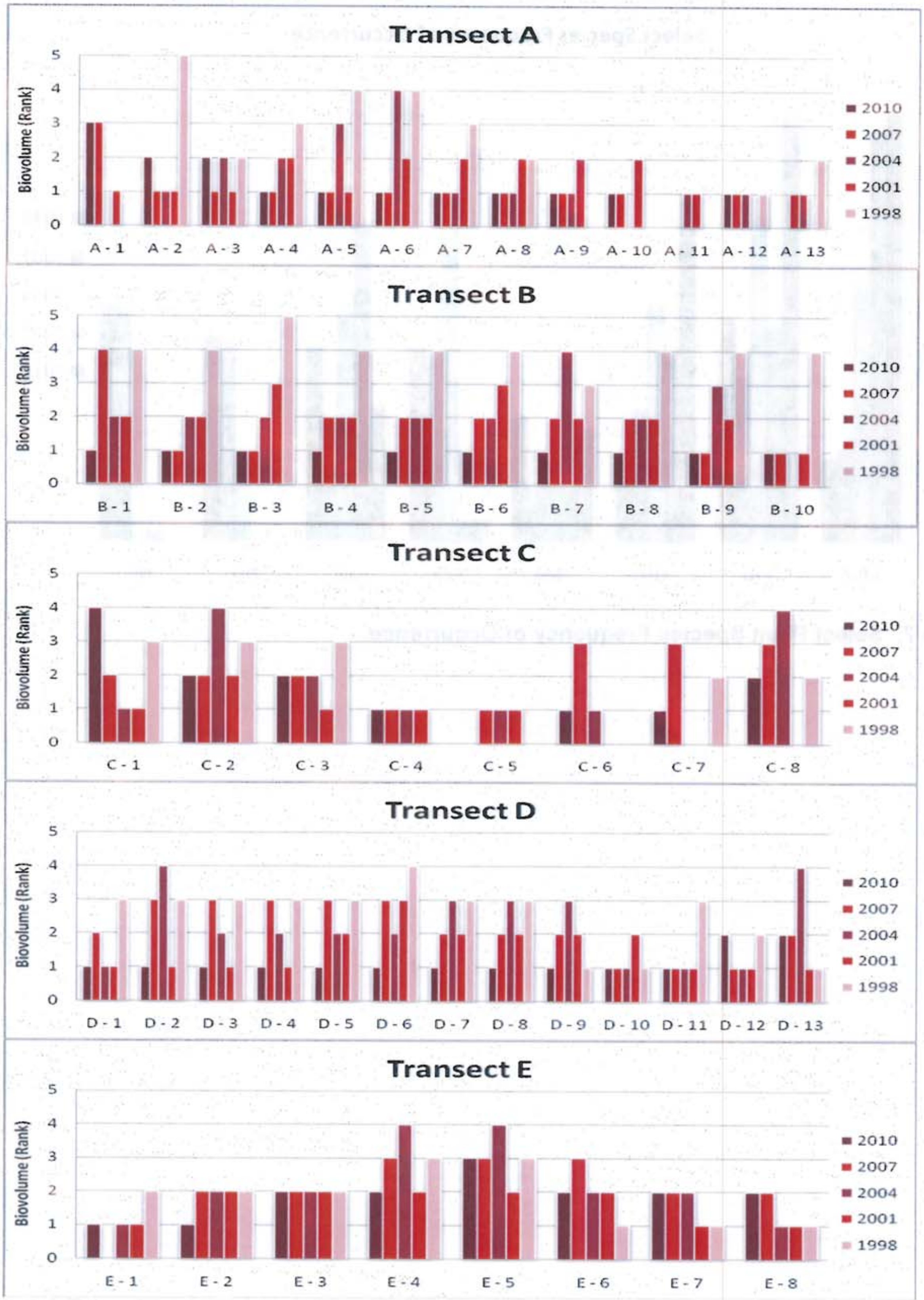



**Figure 6. Bare Hill Pond Macrophyte Biovolume.**

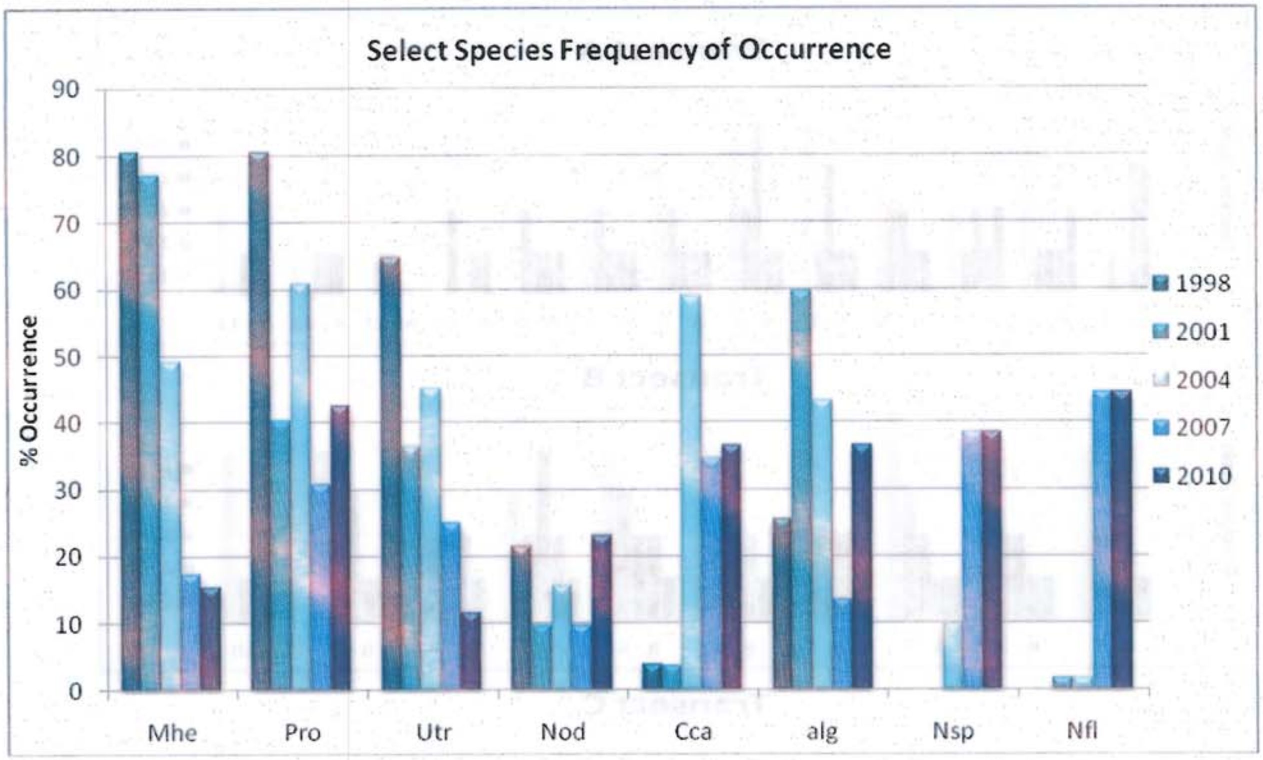



**Figure 7. Select Plant Species Frequency of Occurrence.**

Attachment B

Aquatic Restoration Consulting, LLC
18 Sunset Drive
Ashburnham, MA 01430
Phone: 508-397-0033

Bare Hill Pond Watershed Management Committee
Tom Gormley
Town of Harvard
99 Ann Lee Road
Harvard, MA 01451

Mr. Gormley,

On June 18, 2011 prior to the Bare Hill Pond Outreach Event, I accompanied Bruce Leicher, Deborah Pierce and Robert Judson on a boat tour to shoreline areas that were suspected to contain *Phragmites*, an aggressive non-native wetland plant. These areas included the southern and western cove areas that are well vegetated with emergent wetland plant species. We observed no *Phragmites* in these areas. These areas contained several native emergent species such as Pickerelweed (*Pontederia cordata*) and cattails (*Typha spp.*).

Bruce pointed out a plant that may have spread in these coves since the extended drawdown period was initiated. Several of these plants were removed and later identified using dichotomous keys as bur-reed (*Sparganium sp*.). The species level identification is difficult at this time of year due to the lack of flowers or fruits. There are several species of bur-reed native to northeastern lakes, ponds and marshes and some can achieve nuisance densities in their native habitat. Bur-reed can spread by rhizomes (underground stems) or seeds. Since an increase in seed producing plants is often a result of winter water level drawdowns; I am not surprised if there is a measurable increase in this species within Bare Hill Pond. Bur-reed is a sedge that provides important ecological functions in lakes, wetlands and ponds by providing food and cover for wildlife and waterfowl. I will be sure to collect specimens later in the summer to more precisely identify the plant.

It was a pleasure attending the Outreach Event and look forward to assisting the Committee with continuing improvements and outreach activities for Bare Hill Pond.

Sincerely,

WC Gendron

Wendy C. Gendron, CLM

Attachment C

Aquatic Restoration Consulting, LLC
18 Sunset Drive
Ashburnham, MA 01430
Phone: 508-397-0033

July 30, 2011

Bare Hill Pond Watershed Management Committee
Tom Gormley
Town of Harvard
99 Ann Lee Road
Harvard, MA 01451

Mr. Gormley,

On July 16, 2011 I accompanied Bruce Leicher and Harvard Conservation Commission Member James Breslauer on a boat tour covering most of the northern, western and southern shoreline of the Bare Hill Pond. We also inspected the wetland immediately downstream of the dam outlet. The purpose of the visit was to observe areas not previously surveyed during the formal plant survey and to look for obvious signs of impairment to the plant community assumed to be or likely attributable to the drawdown.

The shoreline contained a variety of emergent wetland species and, according to Bruce; these species were at higher densities than previous years. Some species encountered included bur-reed (*Sparganium sp*.), rush (*Juncus sp.*), cattail (*typha sp*.) and several sedges and grasses. We did not see any *Phragmites*, a species of concern by residents. We did see small patches of purple loosestrife (*Lythrum salicaria)* along the shoreline which is also an introduced aggressive wetland plant. Many people like purple loosestrife because of its showy purple flowers. In fact, this plant was introduced to America as a garden plant and has spread uncontrolled. The patches of this plant along Bare Hill Pond are small and should be hand pulled before the species colonizes larger areas. It can create large monotypic stands which reduce plant diversity. One should not assume that the appearance of this species is linked to the drawdown because it could have been present prior as this species spreads extremely easily colonizing a wide range of habitats from lake shores, along roadways, ditches and residential perennial gardens.

Submerged aquatic plants were far less dense than observed in September of previous years. I pointed out the drawdown target species, fanwort (*Cabomba caroliniana*) and variable milfoil (*Myriophyllum heterophyllum*), and several native species that have increased over the past years in the drawdown zone, stonewort: (*Nitella flexilis*) and waternymph (*Najas sp*.). We also observed those species whose abundance has remained relatively consistent, pondweeds (*Potamogeton spp*.), bladderwort (*Utricularia spp*.), watershield (*Brasenia schreberi*), water lilies (*Nymphaea odorata* and *Nuphar variegatum*) and several others. I suspect that the reduced plant density is the result of a successful winter drawdown and a late start to the growing season. The volunteers were hand pulling water chestnut (*Trapa natans*) while we were there. Bruce explained that water chestnut densities are much lower than in past years. Controlling this aggressive species is difficult and the successful work performed by volunteers continues to show the Committees' commitment to the health of the pond.

The wetland immediately downstream of the dam was thick with vegetation. We did not walk into the wetland, but observations from the dam suggest that the hydrology of the wetland is not impacted by the winter water level drawdown. There was no observable scouring or erosion to suggest the process of dewatering is impacting the area. The scour protection downstream of the pump house is functioning properly and does not appear to need any maintenance.

We did not observe any deleterious impacts of the drawdown to the pond. Although some residents are concerned about the increase in emergent wetland plants, this increase typically supports species diversity. The adjacent wetlands are fully vegetated and dominated by native species and appear unimpacted by the drawdown. Bare Hill Pond will likely always contain dense vegetation due to its shallow morphometry. However, the submerged species currently occupying much of drawdown zone are less intrusive to recreation and provide a more diverse plant assemblage than prior to the drawdown when these areas were dominated by invasive fanwort and variable milfoil. Overall I do not see any reason to discontinue the drawdown.

As an aside, although it was not the purpose of our survey, we observed several painted turtles, a great blue heron and several young of the year largemouth bass.

It was a pleasure to accompany Bruce and Jim on the pond plant inspection and was very nice to see so many volunteers working hard to remove water chestnut. I look forward to assisting the Committee with continuing improvements and outreach activities for Bare Hill Pond.

Sincerely,

W. C. Gendron

Wendy C. Gendron, CLM
Aquatic Ecologist/Owner

Attachment D

Amphibian Monitoring 2011 Bare Hill Pond

Two frog counts were conducted in the late spring of this year, using a slightly different protocol from past years, in order to determine whether there were significantly greater numbers of amphibians, or if there were a broader diversity of amphibian species than previously observed.

On April 24th at 9 pm two groups of frog monitors spread out around the pond and monitored frogs in five locations. Air temperature was 62 degrees, winds light, skies partly cloudy, with no precipitation. Locations monitored included the town well head on Pond Road, Bowers Brook, the dam on Willow Road, Clapp's Brook, and Sprague Swamp. Spring peepers were abundant, in loud chorus everywhere across the pond watershed. We note that this date is on the late side of the peeper mating season, and our results indicate that we have not lost any spring frog population due to recent pond water level management activities. In addition to the peepers, there were also reports of large numbers of pickerel frogs, though not enough to be considered a full chorus. This finding seems to indicate that the pickerel frog resurgence reported two years ago is now stabilized, with a supportable population in residence.

On May 22nd at 8:45 pm, another monitoring session occurred, in an effort to find other species of frogs beyond the peepers and pickerels. The same locations around the pond were monitored, and the weather was 50 degree air temp, winds calm, light mist, with some ambient human noise (which disturbs the frogs in their native habitat). We heard relatively more pickerel frogs than in April, and rather fewer peepers, which is expected. More importantly, we heard two bullfrogs, in different locations, indicating a rather early start to the mating of bullfrogs this year. Typically, bullfrogs are most active in late June and July, during peak air and water temperatures.

We are left to ponder whether the presence of the two blue herons on the pond this year is causing the frog population to be reduced, or if the bullfrog population is mating earlier due to the presence of the local herons. We will continue to monitor the amphibian population closely in order to determine the answer to that question and to determine whether biological diversity on Bare Hill Pond is increasing. Clearly, the absolute number of frogs on the pond is increasing relative to our baseline period of 2004.

Appendix E Clapps Brook June 2011

Location
Ten 100' Segment Sites



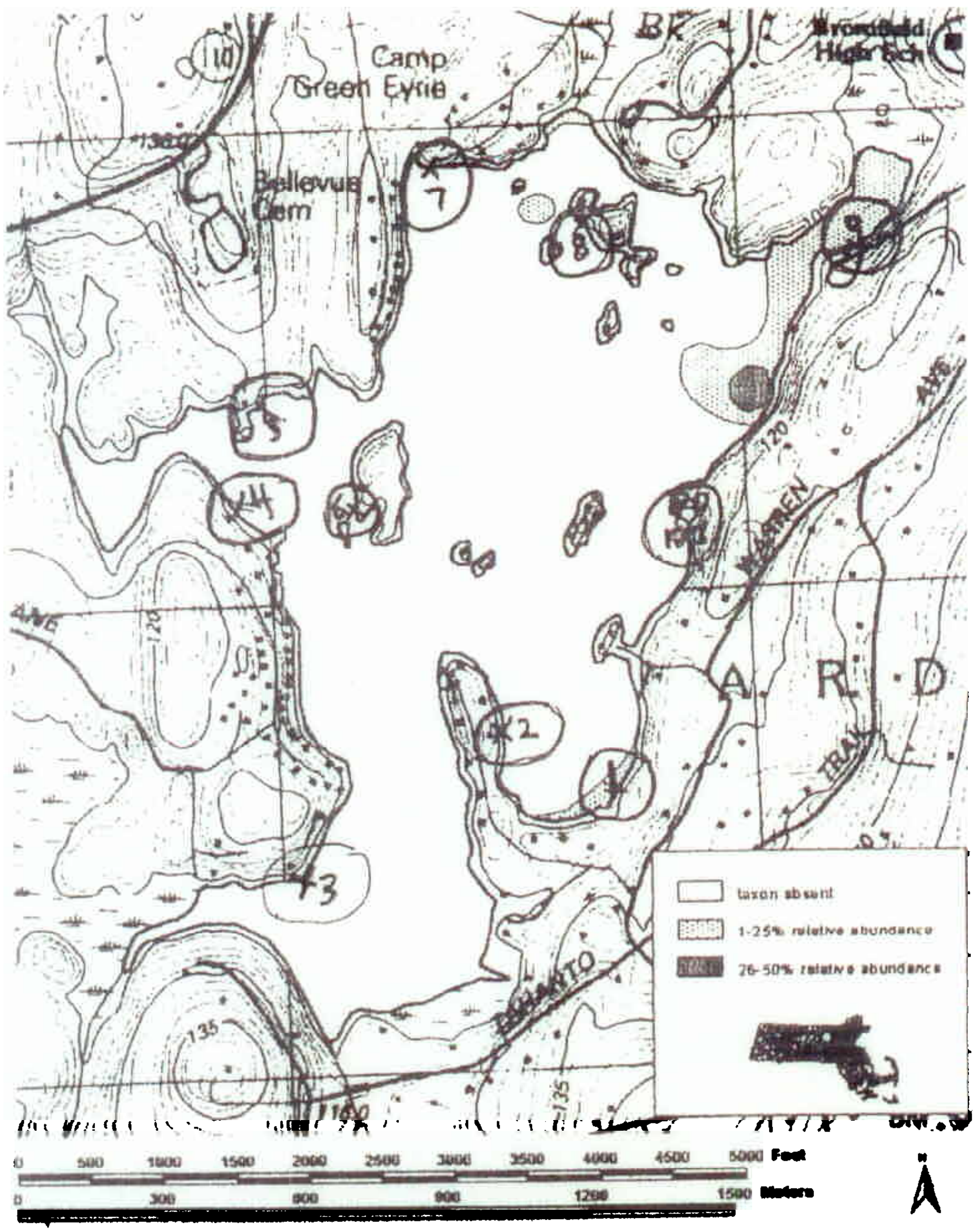


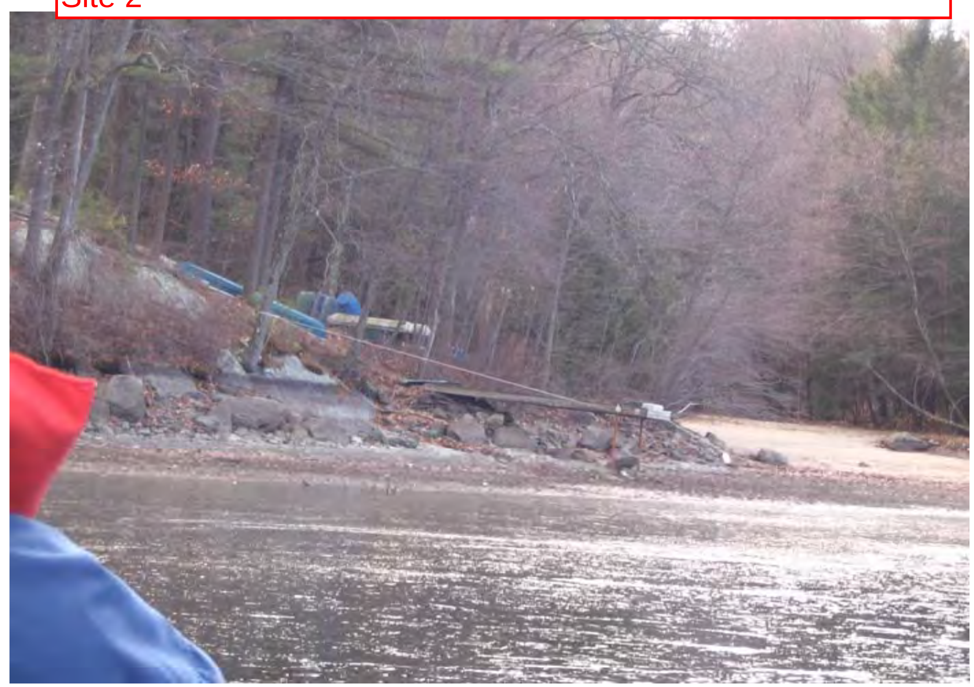

**Figure 5. Distribution and relative abundance of fanwort (*Cabomba caroliniana*) in Bare Hill Pond in October 2001, from data in Appendix A.**

Appendix F 100 Foot Photos

Site 1

Site 2

Great South Bay - Site 3



Site 1

Site 2

site 3

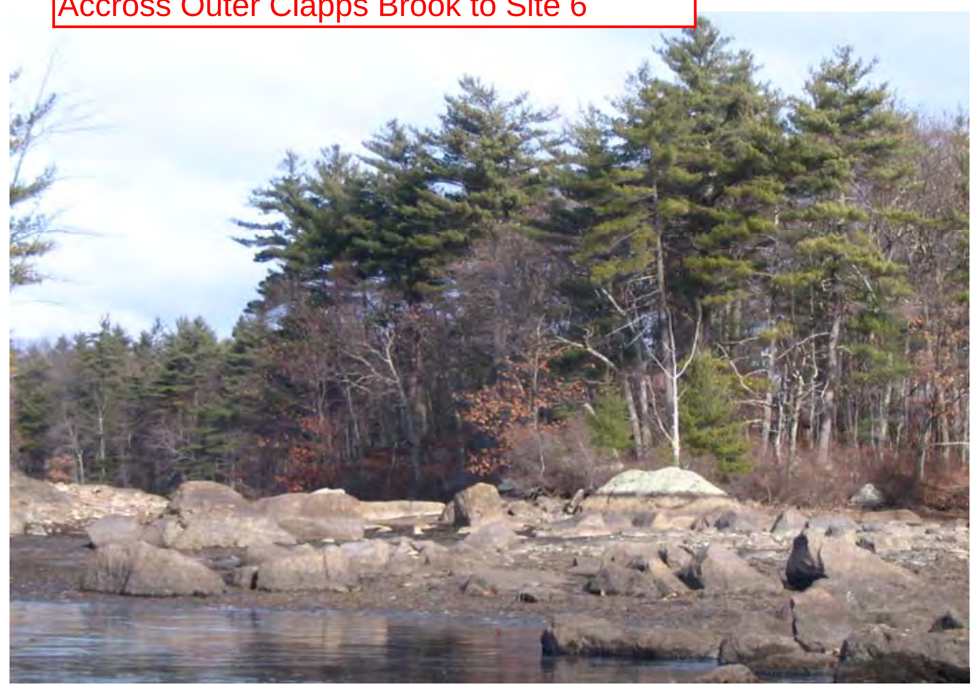
site 2

site 3

site 4 outer clapps brook

Accross Outer Clapps Brook to Site 6

Inner Great South Bay

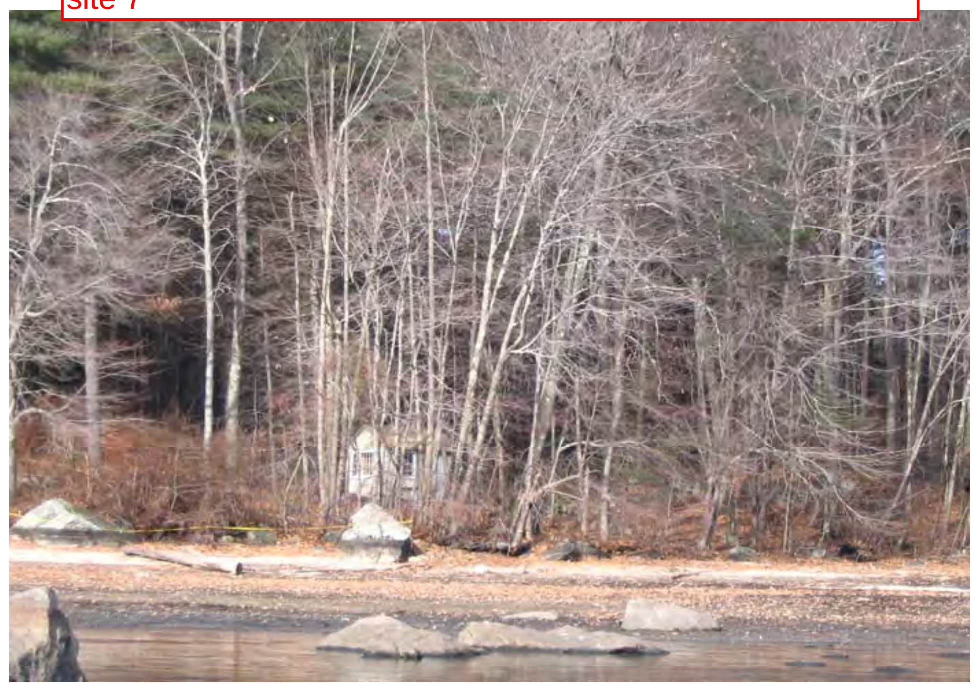


site 5 SW Ministers Island

sign at 6.5

site 7

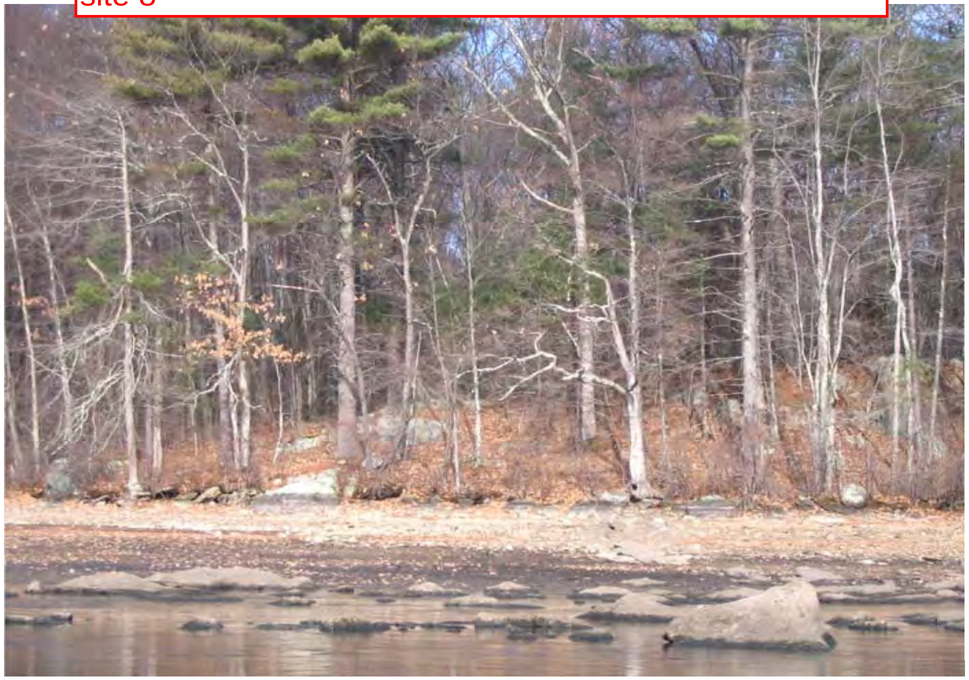

sign at 6.5



site 7

site 8

site 10



site 7

site 8

site 10

inner clapps brook

site 10

inner clapps brook

Photos taken from shore of Inner Clapps brook

More photos from Conservation Land on Inner Clapps Brook to see freezing

4 Photos of Site 9 Behind the Beach

Photos of stream near beach and of frozen invasives

Photo showing the effect of melting after a freeze lifting the invasives