SURVEY REPORT

MILL POND BASELINE ASSESSMENT AND MANAGEMENT PLAN – WEST TISBURY, MA

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Prepared for:

Town of West Tisbury
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INTRODUCTION & POND DESCRIPTION

Based on concerns over accelerated sedimentation and increasing densities of aquatic vegetation within Mill Pond (West Tisbury, MA), the Town of West Tisbury, through their Conservation Commission, contracted Aquatic Control Technology, Inc. of Sutton, MA to perform a Baseline Assessment of the pond. The objective of the assessment was to document current/baseline morphometric, water quality, and vegetation growth conditions. These data were then to be used to evaluate potential near-term improvement options and outline some long-range management and maintenance strategies for the preservation of habitat diversity and passive recreational quality.

Mill Pond is a small 2.5 acre man-made impoundment of Mill Brook that was reportedly created sometime prior to the early 1800's to power a small family owned textile mill that made wool cloth called Satinet. The pond lies on the north/south axis just north of the Edgartown-West Tisbury Road, and directly west of the acting West Tisbury Police Station (see Figure 1 – Site Locus Map). The pond is fed via surface water flows from Mill Brook and direct run-off from its immediate watershed. Mill Brook originates some 3.5 miles to the north and west of the pond basin and supports three additional impoundments (Fisher Pond, Crocker Pond, and Priester Pond), which lie up gradient of Mill Pond along North Road. The primary flow of Mill Brook, however, is diverted via a man-made structure into two separate flows just south of Panhandle Road. The two created water conveyance channels then run along the extreme east and west borders of the extensive shrub swamp wetland immediately to the north of Mill Pond. The westerly inflow channel was created to provide flow into the small Parsonage Pond located just west of the intersection of Edgartown-West Tisbury Road and Vineyard Haven Road. However, at the point of a second diversion in the western channel, which is presumably intended to direct some water flow back to the Mill Pond, a sediment deposit has impeded the flow of water to Parsonage Pond. As a result all flow from Mill Brook currently flows through Mill Pond.

The pond's large earthen dam, which forms the basis for the Edgartown-West Tisbury Road, lies at the southern most end of the pond. The dam possesses two outlet structures located at the southeast and southwest limits of the pond. The primary outlet structure, located at the southeast corner, is comprised of two 4-5 ft. wide concrete spillways, which are controlled by multiple wooden flashboards. The flashboards appeared to provide sufficient control to allow complete draining of the pond. The secondary outlet, located in the southwest corner, flows uncontrolled through a large culvert under Edgartown-West Tisbury Road. Both flows remain separate as they flow south, where they eventually empty into Town Cove of Tisbury Great Pond.

Mill Pond has become quite shallow in recent years with a calculated average depth of just 1.7 ft. Despite it's current state, Mill Pond is an important feature to the environment and community alike. It provides valuable wildlife habitat, aesthetic value to the landscape, and important recreational opportunities in the form of fishing, non-motorized boating and wildlife viewing. Most ponds, especially man-made or enhanced ponds, require some level of management in order to maintain desirable conditions.

The following report will outline our field survey data as well as provide a discussion of the most appropriate and cost effective management strategies for Mill Pond.

SURVEY METHODS

The field survey data collection was performed on September 15, 2006 by two Aquatic Control Biologists. The survey consisted of five primary tasks, vegetation inventory and mapping, bathymetry (water depth) & unconsolidated sediment measurement and mapping, water quality sampling, critical wildlife habitat assessment and general site evaluation. The procedures followed for each of these tasks are outlined in the following sections.

The pond was accessed using a 12 ft. Jon Boat from a small clearing at the southeastern corner adjacent to the primary outlet structure.

Vegetation Mapping & Bathymetry and Sediment Measurements

The vegetation, sediment, and bathymetry data collection were performed at the same time, due to the similar operating procedures for each task. The above survey information was collected by first predetermining representative transect lines throughout the pond. Data sites were then chosen as points along each transect line and geo-spatially referenced using a Trimble™ Differential Global Positioning System (DGPS) (see Figure 2 – Data Point & Sample Collection Site Map) with an accuracy of +/- one meter. At each data point a flat weight was lowered on a measuring tape to gauge water depth. Sediment thickness was determined using a graduated steel rod. The rod was pushed, by hand, through the unconsolidated sediment layer to the hard inorganic refusal layer and the length of penetration was recorded. Vegetation samples were collected by dragging a long handled rake along the pond bottom. Dislodged vegetation was identified, at least to the genus level, and recorded. All the data collected was recorded under its corresponding data point and transect line and is presented in tabular format in Appendix B.

Water Sample Collection

Two water sampling stations were established, one located at the inlet end of the pond and the other was located directly adjacent to the pond's primary outlet structure (see Figure 2). A single surface grab (1.0 –2.0 ft. below the surface) sample was collected from each sample site on the day of the field data collection (9/15/06). The water samples were then analyzed by an independent MA DEP certified laboratory for a suite of common water quality parameters, which included: pH, total alkalinity, turbidity, total phosphorus, Kjeldal nitrogen, nitrate nitrogen, true and apparent color, and *E. coli* bacteria.

Field testing of temperature/dissolved oxygen profiles and Secchi disk transparency were also performed during the field survey. A composite water sample was also collected for identification of dominant species of phytoplankton and count by enumeration.

Wildlife Habitat Features

This task consisted of basic qualitative observation of the various resource areas associated with the pond and documenting actual wildlife utilization, if observed. Specific features potentially important to the area habitat value were also noted and classified by their typical habitat function. In addition to these field observations, rare and endangered species and pertinent fisheries information provided by the Town was also reviewed.

Aquatic Control's Senior Biologist, Keith Gazaille, met with interested Town officials following the completion of the field data collection to informally discuss initial impressions of the pond conditions and gather historic information regarding the pond, specific land use practices within the surrounding area, general pond uses, as well as the Town's particular management goals.

SURVEY FINDINGS

Even casual observations of Mill Pond are indicative of a eutrophic, fertile waterbody. The obvious eutrophic conditions are evidenced by abundant aquatic vegetation growth and limited water depths, which are observable through the growth of depth limited emergent plants throughout most portions of the pond. These qualitative observations along with more comprehensive quantitative data collection are outlined in the following section.

Mill Pond

Surface Area	2.5 ± acres
Average Water Depth	1.7-feet
Maximum Depth	7.0-feet
Average Sediment Thickness	2.8-feet
Approximate Water Volume	4.25 acre-feet
Qualitative Sediment Type	Organic Muck
Dominant Submersed Vegetation	Ribbon-leaf pondweed; Coontail, Nitella
Dominant Wetland/Shoreline Vegetation	Bur-reed; Water willow; rushes
Recommended Management Strategy	Mechanical sediment and vegetation removal

Water Quality

A single round of two surface grab water samples were collected during the field survey. One sample was taken from the inlet end of the pond (Site 1) and the other from the outlet end (Site 2). The samples were analyzed by a certified independent laboratory for a suite of common baseline water quality parameters.

TABLE 1 – WATER QUALITY SAMPLING RESULTS

Tested Parameters	Reported Units	Site 1 Results	Site 2 Results
pH	S.U.	6.0	5.87
Total Alkalinity	mg $CaCO_3$/l	6.1	6.4
Turbidity	NTU	0.90	0.86
Total Phosphorus	mg/l	0.055	0.041
Kjeldahl Nitrogen	mg/l	0.8	0.8
Nitrate Nitrogen	mg/l	0.60	0.33
True Color	Pt-Co	15	20
Apparent Color	Pt-Co	35	33
E. Coli	Org./100ml	270	60

Samples collected on 9/15/06

pH – The pH measurement scale ranges from 0-14, where zero is extremely acidic, seven is neutral, and 14 is the most basic. pH is related to the concentration of hydrogen ions (h^+) in solution, which can affect many different aspects of water chemistry. A range of about 5.5-8.5 S.U. is desired for maintaining a healthy fishery. Maintaining a stable pH ($\pm$ 1 S.U.) is also important as frequent variations can have adverse effects on water chemistry and resident fisheries. The results obtained from this sampling effort are, although at the low end of the range, still within desirable limits and not uncommon for ponds on Cape Cod and the Islands.

Total Alkalinity - Alkalinity is a measure of the buffering capacity of a waterbody against acid additions such as acid rain and pollution, which can be detrimental to wildlife populations. Total alkalinity measures the presence of carbonates, bicarbonates and hydroxides. Values below 20 mg/l typically illustrate that the pond may be susceptible to fluctuations in pH. Alkalinity levels are generally dependent upon the make up of the surficial geology of the geographic region; therefore, the glacial deposits of Cape Cod and the Islands, generally do not support high alkalinity levels. As a result, the relatively low alkalinity levels found in Mill Pond are naturally occurring and consistent with values for the region.

Turbidity - Turbidity is a relative measurement of the amount of suspended material in the water. It is measured through a process involving light diffraction of the pond sample as compared to a series of prepared samples. Turbidity values can range from less than one to thousands of units; however, values in most ponds and lakes rarely rise above 5 NTU. The Mill Pond values of <1.0 NTU indicate low suspended material, which is desirable.

Total Phosphorus – Phosphorus is generally considered to be the limiting nutrient for plant and algae growth in freshwater systems, with concentrations of 0.03 mg/l or greater being sufficient to stimulate nuisance algae blooms. Total phosphorus analyses measure both particulate and dissolved phosphorus. Particulate phosphorus is generally not immediately biologically available for algae growth. Although not alarmingly high, the mean total phosphorus level (0.048 mg/l) for this sampling effort is above the desired threshold. It is important to understand, however, that these sample results represent a mere "snap-shot" of the ever fluctuating phosphorus levels in Mill Pond. In order to establish a more meaningful baseline value, multiple sampling rounds would be required.

Although not statistically significant due to the small data set, an interesting trend can be observed in the nutrient (phosphorus & nitrogen) sample results. The phosphorus concentrations at the inlet end of the pond are noticeably higher than those obtained from the outlet sampling station. This may likely indicate that Mill Pond is acting as a nutrient sump. This means that the elevated non-point source nutrient inputs from up-gradient in the watershed are being removed from the water through various natural processes within the pond (i.e. organic sediment deposition, uptake by resident plant and algae growth, etc.), resulting in a net reduction in phosphorus in the watercourse. This is particularly important considering the fact that Mill Brook is a primary freshwater tributary of Tisbury Great Pond, and in turn further increases the importance of responsible management of the pond, as proper management and maintenance will likely enhance the ponds nutrient retention capabilities.

Nitrogen – Nitrogen exists in ponds and lakes in several forms. Kjeldahl nitrogen testing results are representative of the amounts of organic or biomass nitrogen and ammonium. Nitrate Nitrogen, however, is representative of the inorganic nitrogen form that is most readily usable by plants and algae. Nitrate nitrogen, in the presence of oxygen, is the breakdown product of ammonia, which is released during the decomposition of organic material. The nitrate results from the two sampling stations indicate elevated levels of nitrogen, as it is generally thought that inorganic nitrogen levels in excess of 0.30 mg/l are sufficient to support algae blooms. As with the phosphorus levels, the nitrate results showed a net reduction from the inlet station to the outlet station.

Equally important as the sheer amount of available nitrogen is the ratio of total nitrogen to total phosphorus (N:P). The ratio of nitrogen to phosphorus is important for determining how algae growth will be limited. Systems that have N:P ratios less than 10:1 are typically nitrogen limited and those that have ratios in excess of 15:1 are considered phosphorus limited. Like most freshwater systems, Mill Pond is phosphorus limited, as the N:P ratio was in excess of 25:1.

True Color/Apparent Color - Apparent color is the color of the unfiltered sample water that is caused by suspended and dissolved matter. True color is the color of the filtered sample water resulting from dissolved constituents only. Water color can effect light penetration and, as a result, can limit rooted plant and algae growth. The disparity between true and apparent color can indirectly indicate the amount of suspended material in the water and lead to conclusions about the influence of stormwater or incoming water quality. The results reported for these samples indicate that the color of the water is nearly equally caused by both substances in suspension and in solution. Overall both the true and apparent color values are low and within desirable limits.

***E. coli* Bacteria** – These bacterial analyses are used to determine the probability of some type of fecal contamination. *E. coli* is a bacterium present in the digestive tract of humans and animals and is therefore the most reliable indicator of recent fecal inputs. Typical *E. coli* standards for the protection of human health in fresh, "swimmable waters" are < 235 organisms/100 ml in any one sample. Therefore the results obtained from Site 1 (inlet) are elevated and above the aforementioned threshold. Like nitrogen and phosphorus, these results represent a moment in time of a continually fluctuating parameter; therefore, additional sampling would be required to establish whether or not this was a single sample anomaly or a more chronic/consistent baseline *E. coli* value. Also, it is impossible from this particular test to determine the source of the fecal contamination; consequently, the elevated levels could be the result of waterfowl or other animal waste inputs from the watershed. Light to moderate rain was experienced prior to and during the field survey and sample collection, resulting in elevated flows that may likely have influenced these and other sample results.

Dissolved Oxygen – The dissolved oxygen levels at the time of the field data collection were at the saturation point at the upper level of the water column, which is expected in ponds with normal plant and algae production. A reduction in dissolved oxygen was observed near the sediment water interface, which is likely the result of normal microbial breakdown of organic material and the subsequent Biological Oxygen Demand (BOD).

Secchi disk transparency was to the bottom in most areas of the pond. This level of transparency indicates low levels of suspended materials. The low levels of suspended materials is further reflected in the low turbidity values from the water quality sampling.

Algae Identification & Enumeration

Water samples were collected for microscopic identification and enumeration of planktonic or free-floating algae. The following table shows estimates of the dominant algal abundance at Mill Pond during the field survey in September of 2006. Samples were analyzed under 20X magnification in a Sedgewick-Rafter counting cell. The number of asterisks in each column represent the algal density (* present, ** common, *** abundant, **** very abundant).

TABLE 2 – MICROSCOPIC ALGAE COMPOSITION

ALGAE TAXON	9/15/06
Cyanophyta (Bluegreens)	
- *Gloeothece*	*
Chlorophyta (Greens)	
- *Clorococcum*	**
- *Closterium*	*
Bacillariophyta (Diatoms)	
- *Synedra*	*
- *Fragilaria*	*
- *Navicula*	
Chrysophyta & Pyrrhophyta	
- *Mallomonas*	
- *Peridinium*	
Algal Density Rank	2
Estimated Algal Cell Density	2,250 cells/ml

Water clarity was quite good during our inspection and no visible blooms of planktonic algae were observed. There was some benthic growth of filamentous algae observed, but no floating mats of algae were visible.

The planktonic algal density was low. Greens dominated the phytoplankton assemblage and the presence of some very small colonial bluegreens inflated the cell density numbers. Still, estimated algal cell densities were low and with the mix of planktonic algae seen in Mill Pond, cell densities would need to be well in excess of 10,000 cells/ml for visible algal blooms to be present.

The low algal density is likely due to the excessive vascular aquatic plant growth. Nutrients are probably utilized by the submersed and floating plant species, before they stimulate excessive algae growth.

Vegetation Distribution

The Pond has well-established populations of submersed and emergent vegetation. The vegetation growth throughout much of the pond averaged between 50%-90% bottom cover, with only small pockets of open water (see Figure 3 – Vegetation Distribution Map). The plant species found throughout the pond are listed in the following table:

TABLE 3 – DOMINANT AQUATIC PLANTS IN MILL POND (2006)

Scientific Name	Common Name	Field & Map Abbreviation	Plant Type	Distribution
Ceratophyllum demersum	Coontail	Cd	Submersed	Abundant – Growing at moderate to high densities throughout the southern half of the pond
Potamogeton pusilis	Thin-leaf Pondweed	Pp	Submersed	Common – Growing in shallow areas of the northern end of the pond
Potamogeton epihydrus	Ribbon-leaf Pondweed	Pe	Submersed	Abundant – most prevalent submersed plant throughout pond
Lemna minor	Duckweed	Lm	Floating	Sparse – Low densities found trapped in floating mats of submersed vegetation.
Nitella	Stonewort	Ni	Submersed Macro-Algae	Common – low to moderate density growth observed in most areas of the pond
---	Filamentous Algae	FA	Floating & Submersed Mats	Scattered/Common – most prevalent in areas with lower density submersed plant growth
Sparganium sp.	Bur-reed	S	Emergent	Common/Scattered – consisted of small isolated patches throughout shallower areas
Juncus sp	Rush	R	Emergent	Sparse – isolated growth along eastern shoreline

As a result of the extremely shallow water depths (<0.5 ft.) in the northern portion of the pond the density of the submersed growth was lower in that region than elsewhere, with an average areal coverage estimated in the range of 40%-50%. Although the shallow water depths in this region of the pond limited submersed plant densities, they facilitated widespread colonization by wetland/emergent growth, dominated by bur-reed and water willow.

The remaining two thirds of the pond harbored significantly greater densities of submersed vegetation, with scattered pockets of emergent bur-reed growth. Submersed vegetation densities in this area ranged between 70%-90% bottom cover. The dominant plant species were ribbon-leaf pondweed, coontail, and *Nitella*.

In a warm-water fishery such as Mill Pond it is generally considered optimal, for fisheries habitat, to maintain vegetation cover in the range of 20%-40%. Therefore, the current level of vegetation growth can be considered excessive. Dense contiguous plant growth can have multiple adverse impacts to the "health" of an aquatic ecosystem. For example, fisheries size classes can become stunted by limited predator/prey interaction and water quality can deteriorate from a lack of water circulation. Drastic diurnal fluctuations in dissolved oxygen can also occur, which can also be detrimental to resident fish and wildlife. Area selective management of the in-pond vegetation is, therefore, desirable for the restoration and maintenance of a more balanced warm-water aquatic ecosystem.

Unconsolidated Sediment Distribution

Based on qualitative observations of the sediments attached to the sediment probe during the field survey, the unconsolidated sediments were classified as a combination of organic rich muck and inorganic sand or silt. This sediment type is typically high in nutrients and capable of supporting aquatic plant growth. Nutrient rich sediments are constantly added to an aquatic system by the annual decay of aquatic vegetation, algae and leaf litter. The unconsolidated sediment layer in Mill Pond is typical of a eutrophic waterbody suffering from excessive plant growth. The thickness of this layer ranged from 0.5 ft. to >4.0 ft. with the greatest volume of sediment located in the southeastern and northwester areas of the pond (see Figure 5 – Unconsolidated Sediment Thickness Map). The calculated average thickness of the unconsolidated sediment layer is 2.8 ft. A larger grain size or sand constituent was noted for the data points of transect A at the northern end of the pond. A higher degree of what was believed to be sand in the area of the inlets is probably the result of sediment deposition from the inlet waters. The heavier and larger sand grains settle out of suspension soon after entering the pond and the smaller and lighter silts and clay remain in suspension until flow velocities are further reduced upon entering the central and southern area of the pond; therefore, creating a distinct segregation of sediments based on grain size.

Wildlife Habitat Features

Mill Pond contains a variety of different habitat features that likely provide suitable nesting, basking, and/or perching sites for resident wildlife species. Wildlife utilization of this wetland resource is likely to be diverse, however, as was mentioned previously, the weather conditions at the time of the survey were less than optimal (moderate rain and wind) for the viewing of resident wildlife. As a result, very few species were observed during our visit. Based on the habitat characteristics observed in and around Mill Pond it is likely that it supports a variety of bird species, warm-water fish species, amphibians, and reptiles.

Biotic and abiotic habitat features of specific concern that were noted at Mill Pond, along with a brief discussion of their significance to the overall ecosystem, are provided in the following section.

Emergent Vegetation Growth - The pond contains a significant emergent plant community dominated by bur-reed, water willow, and various rush species. Fortunately, no non-native and/or invasive species were observed colonizing this relatively diverse native plant assemblage. The current emergent growth provides desirable nesting, and perching habitat for bird species such as waterfowl and other species that prefer freshwater wetland nest sites. The native emergent growth also provides escape cover for a variety of fish species and at certain times of the year can produce valuable forage, in the form of seeds, for waterfowl.

Deadfall Tree - A small deadfall tree was observed along the northwestern shoreline of the pond. Deadfall trees submerged and emergent within the littoral zone provide a number of potential uses for resident wildlife. Most frequently these trees provide basking sites for turtles as well as perching sites for bird species like the Great Blue Heron and the Double-Crested Cormorant.

The submerged portion of the tree provides excellent underwater structure that is particularly important to warm-water fish species. These areas are typically utilized as ambush sites for predatory species like Largemouth Bass.

Overhanging Vegetation - Much of the eastern and western shores support woody shoreline growth that have limbs overhanging the water surface. This overhanging vegetation provides perching sites for piscatory bird species like the Black-Crowned Night Heron, Belted Kingfisher, and/or Osprey. The overhanging vegetation also provides cover from predatory avian species to resident fish and amphibians.

"Edge" Habitat & Structure - Edge habitat is particularly important to predator/prey interaction. The transition area between vegetated areas and open water ("Edge") are important feeding areas for both wading bird species and predatory fish. The dense vegetation provides excellent escape cover and desirable juvenile fish nursery habitat. Because of the important role submersed aquatic vegetation plays in the balance of an aquatic ecosystem, any proposed management should focus on the enhancement of transitional zones and not the complete eradication of plant growth.

A review of the Natural Heritage and Endangered Species Program (NHESP) data-layers for rare and endangered species and habitat indicated the presence of both

Estimated wildlife habitat (WH 512) and Priority habitat (PH 1730). Correspondence with NHESP has indicated that the state-listed rare species of specific concern for these areas are the American Brook Lamprey (*Lampetra appendix*) and the Water-willow stem borer (*Papaipema sulphurata*). Due to the presence of these state-listed species any proposed pond restoration/management project will require NHESP review under the Massachusetts Endangered Species Act (MESA) to determine if the proposed activities would result in the disturbance of or "probable take" of either of these species.

The pond does support a warm-water fishery, as several sunfish and yellow perch were observed throughout the course of our survey. In addition to the resident warm-water fish species the state Division of Fish and Wildlife reportedly stocks the pond with various size classes of rainbow trout in the early spring of each year. These trout are no doubt stocked on a "put and take" basis, as the current condition of the pond is incapable of supporting cold-water fish species, such as trout, over the hot summer months.

The Town and MV Commission have also indicated that steps are currently being taken to restore Mill Brook and Mill Pond to a viable herring run and spawning area. Although water flows have been managed to provide optimal migration conditions and a suitable fish ladder has been seasonally installed to facilitate fish passage over the Mill Pond dam, utilization of the brook by herring has reportedly been minimal. The introduction of a recruitment herring population to Mill Pond in future years is also being investigated.

Mill Pond and its surrounding area contains suitable habitat characteristics for a variety of wildlife. The in-pond submersed vegetation cover is currently in excess of the range widely recommended for the maintenance of a "healthy" warm-water fishery and certainly exceeds what would be desirable for trout species and herring. Therefore, selective management of vegetation and the restoration of more suitable water depths will improve the overall habitat value of the system. In addition, efforts should be made to prevent the introduction of non-native aquatic and wetland species, as their invasive characteristics give them the ability to out-compete native plants species and spread rapidly. In many cases this results in the development of monotypic growth, reduced plant diversity, and a net loss in overall habitat value.

DISCUSSION OF MANAGEMENT OPTIONS

It is important when designing an aquatic management program to first identify the desired goal(s). This goal(s) should be consistent with the intended uses and natural functions of the waterbody and be realistically attainable. Selected management activities must also comply with environmental regulations that are put in place to preserve the pond's ecology and adjacent wetlands.

The primary objective of any active management at Mill Pond should be the restoration and maintenance of optimal fish and wildlife habitat value. In addition, the pond is reportedly used for common passive recreational activities such as shoreline fishing, wildlife viewing, natural aesthetics, etc. Therefore, the recommended management plan should incorporate tasks and goals that would mutually benefit all the potential uses of the pond.

In the following paragraphs we will discuss various management alternatives and provide insight and recommendations as to the best and most feasible techniques for the management of Mill Pond.

Watershed Management

Mill Pond has a large watershed area, which is not uncommon for impounded waterbodies. The bulk of the watershed area is comprised predominantly of undeveloped land and low density residential development. The relatively undisturbed nature of the watershed should be beneficial for limiting the introduction of nutrients and/or pollutants to the watercourse and the subsequent transport to Mill Pond.

Because no stormwater sampling or detailed watershed investigation was performed as part of the scope of this project, it is difficult to determine to what extent external nutrient loading from the watershed contributes the eutrophication of the pond. However, based on the size of the watershed and the pond basin to drainage basin ratio it can be assumed that in-pond water quality is highly influenced by land-use and management activities within the watershed. As is the case with all pond watershed situations it is important to limit potentially high risk land-uses (industrial, commercial, and even high use agricultural) as well as residential activities that might increase the level of nutrient transport to the pond (i.e. lawn fertilization, faulty septic systems, etc.).

It does appear that Mill Brook receives direct stormwater run-off from Panhandle Road. At the time of the survey transport of small particulate matter and other debris was evident where stormwater run-off from Panhandle Road is channeled directly into Mill Brook. The introduction of these and possible other pollutants (i.e. petroleum based substances) may have a contributing effect on the nutrient loading and sedimentation of the pond.

Prior to the implementation of any focused watershed management techniques, we recommend performing a more detailed investigation, inclusive of field confirmation of the watershed delineation and current land-uses. These data will provide additional insight into the potential watershed management issues facing the pond and how best to address them.

Improving water quality and in-pond conditions through watershed management is a slow and difficult process because there are likely multiple sources contributing to the overall nutrient load to the pond. Although significant reduction of in-pond vegetation growth is unlikely as a result of even large-scale watershed management, the implementation of generic watershed improvement measures or Best Management

Practices (BMP's) are always recommended. Additional BMP and watershed management information has been provided in Appendix C.

The following list describes a selection of some commonly implemented Best Management Practices,:

Limit impervious area – Impervious areas such as driveways, buildings and roads interfere with the natural absorption and filtering (percolation) of stormwater through soils. Limiting impervious areas will reduce flow volumes and mitigate plug flow of nutrients into the watercourse.

Minimize contaminant exposure – Regulating the use of potentially hazardous chemicals and other nutrient sources on properties surrounding the waterbody will lessen the exposure to potential contamination of the waterbody and watercourse alike.

Control of fertilization, pet & yard wastes – It is important to encourage the proper processing of pet & yard wastes as well as the modification of fertilization practices and other activities which introduce nutrients to the watershed (i.e. car washing). In addition, establishing practices to limit nuisance non-migratory waterfowl, such as no feeding and other deterrents, can also eliminate a significant source of nutrients to the waterbody.

Land Management – Controlling and/or minimizing the introduction of land uses that have the potential to negatively impact the pond, such as, industrial and even agricultural uses will further limit potential sources of external nutrients and contaminants. Equally important to land management is the preservation of natural woodland areas to help prevent increases in nutrient loading and the natural processing of storm water.

Street Cleaning – Frequent cleaning of roadways in the watershed and maintenance of catch basins will promote cleaner stormwater runoff.

Buffer Strips – Vegetated buffer strips of grass and/or shrubs can act as a biofilter to mediate nutrients from non-point sources before they enter the waterbody.

Catch Basins/Grease & Grit Traps
Detention Basins
Infiltration systems – These more complicated watershed/storm water management techniques generally address point source runoff from drainage systems, construction or other areas with the elevated potential to introduce high levels of nutrients. The installation, improvement and/or updated design of these systems can significantly reduce the nutrient load of stormwater inflow.

Constructed Wetlands – The construction of simulated wetlands in areas of high stormwater flow can act as settling/detention basins and help to replicate the natural processing of nutrients from runoff that typically occurs within unaltered natural wetland systems.

These more involved nutrient transport mitigation strategies (catch basins/grease & grit traps, detention basins, infiltration systems, and constructed wetlands) are more difficult to implement because they require ownership of large portions of the watershed. General watershed management practices are always wise to implement if possible.

Physical Techniques

Physical management strategies generally utilize an alteration to the physical environment to eliminate, control, or reduce nuisance aquatic vegetation populations. Several accepted methods are available and have been widely implemented; however, each technique has its particular application. Therefore, like any other management strategy, the feasibility, efficacy and potential adverse impacts should be investigated prior to use in a management program.

Benthic Vegetation Barriers - The use of bottom weed barriers (i.e. Aquatic Weed Net™ or Palco™) are effective for small dense patches of nuisance vegetation, but are not cost effective or feasible for large areas. Weed barriers are expensive to install and maintain at ~ \$1.00 \$1.25/ft^2 (1 acre expanse would cost in the range of \$43,560 - \$54,450 material & installation). Semi-annual maintenance to retrieve, clean and re-deploy the barriers would be expensive and time consuming. Also covering expansive areas of the pond bottom may also have detrimental impacts on invertebrates or other types of wildlife.

Winter Drawdown - Drawdown for the control of nuisance aquatic vegetation involves the lowering of the pond's water level during the fall and winter of the year to expose nuisance vegetation infestations. Exposing aquatic plant species to the elements for long periods of time (>6-8 weeks) facilitates desiccation and freezing of the plants and their root systems.

Drawdown is not a feasible management alternative at Mill Pond due to the contiguous plant growth and the shallow bottom contours of the pond. In order to expose all the areas of dense vegetation and achieve any degree of success it would be necessary to drain all of the water out of the pond, leaving insufficient water to sustain resident fish and wildlife populations.

Hand-Pulling/Harvesting - Hand-Pulling or hand-harvesting is an effective low-impact, non-chemical alternative to controlling a variety of unwanted vegetation species. Because hand-pulling is labor intensive on a large scale it is best suited for very low plant densities (<500 stems/acre). The current vegetation growth in Mill Pond is far too dense and widespread to be effectively or feasibly managed through manual hand-harvesting.

Biological Controls

There has been a good deal of research done on stem boring weevils (*Euhrychiopsis lecontei*) for the control of invasive Eurasian watermilfoil (*Myriophyllum spicatum*). The results of their introduction to milfoil infestations have been mixed. These weevils are exclusively for the control of Eurasian watermilfoil and therefore not applicable to the management of the native plant assemblage found in Mill Pond.

Leaf eating beetles (*Galerucella* sp.) and root eating beetles (*Hylobius sp*.) have also been studied for their impacts to purple loosestrife (*Lythrum salicaria*). Reportedly these insects have been released at several sites throughout the northeast with promising results. Fortunately the emergent and adjacent wetland plant communities associated with Mill Pond do not currently support the growth of non-native and invasive purple loosestrife.

Triploid (sterile) grass carp have also been used for the management of submersed vegetation in various parts of the country. However, in the state of Massachusetts grass carp cannot be legally introduced for any purpose.

Mechanical Techniques

Mechanical control techniques have proven useful in controlling nuisance aquatic vegetation. These techniques, mechanical harvesting and Hydro-Raking, benefit from area selective management and where the waterbody's morphological characteristics (i.e. depth, outlet structure, flow rates, etc.) deter the use of other techniques.

Mechanical Hydro-Raking - The mechanical Hydro-Rake can best be described as a "floating backhoe" with a York Rake attachment. The barge is paddle wheel driven to facilitate operation in shallow water (<2 feet) and it can effectively work to depths of about 10-12 feet. The Hydro-Rake is most effective at removing plants with well defined root systems, such as emergent species. It works from the water, thereby avoiding damage to sensitive shoreline habitat and property. This machine "rakes" the upper sediment layer collecting plants and their attached root systems.

In the case of Mill Pond the hydro-rake would be best suited for the removal of dense submersed and emergent growth throughout the pond. The selective removal of designated areas of growth will create a greater amount of valuable open water habitat, increase water circulation, improve the aesthetic quality of the area, and reduce the amount of vegetative biomass available for annual decomposition. The machine is capable of area selective management, making it possible for the removal of specific stands of growth and even specific portions of a particular infestation. This feature is particularly attractive for the management of Mill Pond, because small designated areas of plant growth can be preserved to serve as valuable fish and wildlife habitat. The removal of the vegetative biomass may subsequently cause a reduction in the dissolved nutrients/phosphorus levels that are derived from decaying organic material. Not to mention the removal of the plant root systems will likely provide multiple seasons of plant control.

Although Hydro-Raking is potentially a viable option for the area selective control of the excessive plant growth, the current bathymetry most likely precludes machine access to a large portion of the pond. In addition, the removal of plant material through mechanical Hydro-Raking does not address the existing accumulation of unconsolidated sediment, which undoubtedly contributes to the dense and widespread growth of rooted plants. The Hydro-Rake is an inefficient tool for the removal of bottom sediments on the scale that is required in Mill Pond; therefore, this technique is likely not the most appropriate initial management strategy, but is certainly well suited for future maintenance of desirable in-pond conditions.

Mechanical Harvesting - Mechanical cutting or harvesting on the other hand is not a recommended management technique. Mechanical harvesters have large cutting heads that cut the vegetation off just above the bottom of the pond. This technique is generally used for the control of plants that propagate exclusively through seed production. The method is to remove the vegetative portion of the plant before it has an opportunity to produce seeds. However, some of dominant plant species present in Mill Pond are perennial plants that re-grow each year from the same root system; therefore, cutting the plants and leaving the root system would provide little if any long-term control. It has been our experience that due to the rapid growth rate of many aquatic plant species multiple cuttings are often required for even season long control, thereby significantly reducing the cost effectiveness of a harvesting project. Not to mention that, like mechanical Hydro-Raking, the current water depths limit machine access to a large portion of the pond.

Chemical (Herbicide) Treatment

Chemical treatment is often the most cost-effective and least disruptive means of nuisance aquatic vegetation control. Chemical treatment offers both species and area specific control, and often a longer duration of control of certain plant species. Because the Hydro-Rake is unlikely able to access all areas of the pond requiring some level of plant control, chemical treatment may be better suited to provide a short-term reduction of plant growth. The use of herbicides as a short-term or maintenance technique will reduce overall management costs and likely result in less impact to the aquatic system over the long-term.

Reward (Diquat) - When selecting the appropriate herbicide for a particular project it is necessary to take many outside variables into consideration. For instance, in the case of Mill Pond the two most influential factors in determining the proper herbicide are the potential for high water flows through the system and the types of vegetation that would be targeted for control. After considering all of the variables it was determined that Reward® (active ingredient diquat) is best suited for the control of the dominant plant species, ribbon-leaf pond and coontail. Reward is quickly absorbed into target plants and is therefore not as severely impaired by the flushing of high flows. It has a relatively low level of mobility in the water column allowing for area specific application, and it is extremely effective on all of the dominant submersed plants present in the pond.

We feel that Reward herbicide treatment is a viable option for the short-term control of excessive plant growth. By targeting a maximum of 60%-80% of the heaviest submersed plant growth at the southern end of the pond, open water area can be increased to provide more desirable habitat value. A single Reward treatment performed in the late spring (i.e. May/June period) of the year, when the plants are immature (not at full biomass) will not only provide season long control, but will also reduce the level of sedimentation derived from the annual decomposition of aquatic plant material. Reward, however, is a contact herbicide, killing only the vegetative portion of plant; therefore, annual or biennial (once every two years) treatment may likely be required to maintain desirable conditions.

AquaPro (Glyphosate) – The control of the existing emergent bur-reed growth in the central portions of the pond could be selectively controlled with a glyphosate based aquatic herbicide. AquaPro is a systemic, foliar active herbicide, which means that the active ingredient controls both the vegetative portion of the plant and the roots and is only active when it comes in direct contact with vegetation foliage. It has no activity in surrounding soil or water, so the potential for non-target impacts is further reduced. This property allows for very area selective management.

The translocation of the herbicide is partly dependent upon the plant's movement of starch to its root structures; therefore, treatment with AquaPro is most effective later in the growing season (August) when plants are preparing to over-winter by moving carbohydrate reserves down into their roots. Due to the fact that the herbicide must be in contact with the exposed plant foliage for proper control to occur, it may be necessary to perform a second follow-up treatment to insure that targeted control is achieved.

Because AquaPro is a systemic herbicide, a single season of treatment will generally provide multiple years of control. The selective control of the bur-reed growth in the central portions of the pond, while at the same time preserving desirable shoreline emergent growth, will limit the spread of this expanding plant community. Therefore, proper management of these selected stands of growth will promote the proper balance and distribution of the emergent zone. As with the submersed plant growth, reduction of the emergent plants will reduce sedimentation rates derived from annual plant decomposition.

Dredging

The removal of nutrient rich sediments and the subsequent deepening of waterbodies is sometimes used to control rooted aquatic vegetation. When utilizing dredging as a vegetation control method there are two primary objectives. The first is to remove the organic nutrient rich sediment to eliminate an internal source of nutrients, and the second, is to increase the depth of the water to a minimum of 8-10 ft., which is typically sufficient depth to preclude adequate light from penetrating to the pond bottom. By changing these morphological features of the pond the area that can be colonized by rooted vegetation is reduced. It is also important to understand that dredging does not always eliminate nuisance aquatic vegetation problems, therefore, requiring additional in-pond management activities to maintain adequate control. Dredging of Mill Pond would be designed to optimize and enhance the ponds features through the removal of sediment in selected areas, while leaving other pond areas undisturbed.

Mill Pond would undoubtedly benefit from a dredging project. The pond has a considerable layer of unconsolidated sediment and very shallow water depths; however, in order to achieve the recommended depths of 8-10 ft. over a substantial portion of the pond, a significant portion of the ponds hard packed refusal layer (sand, gravel, and/or clay) would need to be removed. Removal of the accumulated unconsolidated sediment alone would require a significant time and financial commitment and the additional removal of a portion of the ponds consolidated refusal layer would further add to that commitment.

The two most commonly used methods of sediment removal are conventional dredging and hydraulic or suction dredging. Hydraulic dredging consists of a floating barge that is equipped with a rotary auger and a large pumping system. The auger digs and suspends the soft sediment component of the pond bottom so that it can be pumped through a pipeline, as a sediment water slurry, to a nearby containment basin. The containment basin allows the sediments and other suspended particles to settle out of the water column to the bottom. Following this process the water is decanted off the top of the basin and returned to the pond, leaving the sediment behind.

The construction of a detention basin adequate to hold the volume of removed sediment would require a significant amount of space in close proximity to the removal area (generally within a 0.25-0.50 mile). A dredging project of only two acres in Mill Pond would require a detention basin of approximately 1.5-2.0 acres and a volume of at least 40,000 cubic yards. In addition to requiring the construction of a large detention basin suction dredging is also limited to the removal of the soft unconsolidated sediment only. The advantage to this technique is that it does not require complete dewatering of the pond, and therefore imposing, significantly less impacts to adjacent wetlands and resident fish and wildlife. Although perhaps operationally possible, it is unlikely that suction dredging is the most feasible and cost effective sediment removal strategy for use at Mill Pond.

Conventional dredging on the other hand, involves the use of traditional excavation equipment after the pond has been dewatered. Excavation equipment enters the dewatered pond basin and removes bottom sediments until the desired depths are achieved. When designing such a dredging project often times the most complicated task is the complete dewatering of the waterbody and the diversion of the inlet waters. There are many different ways a pond can be drained. In the case of Mill Pond, it appears that the current flashboard controls will allow simple gravity dewatering, which consists of merely removing all of the boards to enable the impounded water to flow downstream until the pond is drained.

To facilitate a dredging project following dewatering measures must be taken to prevent the pond from filling back up. This is typically accomplished by the timing of the project (mid to late summer when flow rates are often at there lowest) and by diverting the inlet water around the pond basin. In waterbodies that have small watershed areas, and therefore less potential for high flows, refilling can often be avoided by the timing of the project and a simple pumping system to drawdown head waters when they threaten to overflow into the pond. When dealing with waterbodies that have large watershed areas and minimum downstream flows, like Mill Pond, more comprehensive diversion measures must be considered. In the case of Mill Pond it may be necessary to construct a diversion ditch around the pond or a wooden diversion channel to accommodate the significant volume of water that routinely flows through the system as well as elevated storm flows. When diverting normal flows around the pond basin using a diversion ditch it is not uncommon to experience a significant amount of erosion and scouring of the disturbed sediments. This is a concern because increased turbidity can have impacts on the remaining fish and wildlife populations as well as an increased potential for accelerated sedimentation downstream. Therefore, lining the ditch with gravel, or constructing a wooden conveyance channel should mitigate the potential for erosion and the associated negative impacts. In the case of Mill Pond conventional or dry dredging is likely the more feasible and cost effective strategy.

Dredging is a feasible and likely the most recommended long-term management alternative for Mill Pond. Dredging is the only technique that will address, at least in part, both the excessive growth of rooted vegetation and the significant accumulation of sediment. Dredging is certainly the only technique that can appreciably restore the pond's water depths. Although dredging is likely the best initial management strategy under the current pond conditions, it does not come without potentially significant non-target environmental impacts and multiple design and operational hurdles. In addition to potential undesirable impacts and the obvious project design considerations, dredging carries with it a complex multi-tiered permitting process with local, state and federal agencies, not to mention potentially cost prohibitive operational expenses. We would anticipate that the design and permitting expenses alone for a conventional dredging project of this size would range between $20,000-$30,000. The actual operational costs depend on the amount of material removed, but reasonable unit cost estimates may run between $20-$30 per cubic yard of material removed. Therefore, removal of an average of ~5.0 ft of sediment over approximately 2.5 acres of the pond would generate approximately 20,000 cu-yds of removed spoils. The total operational dredging cost at a rate of $20-$30 /cu-yd. would be in the range of $400,000-$600,000. Costs may also run higher, depending upon certain permit conditions and other complicating factors, such as restrictions on the disposal of the removed sediments and trucking distance to the final disposal site.

SUMMARY

Mill Pond is significantly impacted by dense aquatic vegetation growth and shallow water depths resulting from the accumulation of unconsolidated organic sediments. The dense vegetation, if left unmanaged, will continue to degrade water quality, impact the pond's fish and wildlife populations, and further contribute to the already seemingly accelerated sedimentation/filling in of the pond. The pond management plan for Mill Pond should, therefore, focus on the area selective removal accumulated organic sediments, as this internal nutrient source and resulting alteration of the ponds morphology likely contribute significantly to the current unbalanced growth of aquatic vegetation and algae. The restoration of water depths in Mill Pond will not only improve in-pond habitat and recreational values, but should also enhance the waterbodies possible nutrient retention capabilities, which will further protect Tisbury Great Pond from undesirable nutrient loading.

Although dredging is the primary recommended in-pond management strategy, future sediment and vegetation management is likely to be required post-dredging. Possible alternatives for the maintenance of desirable in-pond conditions may include mechanical Hydro-Raking and chemical treatment or an integration of both techniques. Regardless of whether active in-pond management is required post-dredging some level of on-going monitoring should occur following the implementation of any large scale management project. Monitoring may be the most important facet of an ongoing program as it allows for the early detection of possible management issues and the timely implementation of pointed, small scale, low-impact management strategies.

The following specific management activities are suggested for consideration or inclusion in the development of a long-term management plan for Mill Pond.

- Reduce the amount of vegetation growing throughout the pond. The most appropriate techniques are dredging, mechanical Hydro-Raking, or chemical treatment. Hydro-Raking and chemical treatment are only short-term solutions under the current conditions.

- Implement annual or biannual monitoring and sampling program to document the rate of regrowth and identify the possible introduction of exotic and invasive vegetation species. Water sampling to establish baseline water quality values and identify seasonal nutrient fluctuations to aid in the timing of appropriate management measures.

- Implement Best Management Practices to address the sources and/or transport of external nutrients from the ponds surrounding watershed.

- Perform more detailed watershed investigation in order to determine potential watershed management concerns and establish baseline data that will potentially aid in the development of specific management alternatives.

An estimated cost summary for various management techniques follows. We encourage you to contact us if you have any questions or would like to discuss possible alternatives to the recommended techniques.

COST SUMMARY

TABLE 4 – MULTI-YEAR COST ESTIMATES FOR FEASIBLE MANAGEMENT OPTIONS

Feasible Management Options	***Estimated Cost Range***			
	Permitting & Design	***Year 1 (2007)***	***Year 2 (2008)***	***Year 3 (2009)***
▪ Mechanical Hydro-Raking for the short-term/maintenance removal of undesirable vegetation growth and accumulated organic debris.	$2,500-$3,000[1]	$44,500-$51,000[2]	----	$33,000-$40,000[2]
▪ Area selective short-term control of excessive emergent and submersed vegetation growth with Reward and Rodeo herbicides.	$2,500-$3,000[1, 3]	$5,000-$5,500	$4,500-$5,000	$4,250-$4,500
▪ Comprehensive dredging project in order to restore water depth and limit rooted vegetation growth.	$20,000-$30,000[4]	$400,000-$600,000[5]	$5,000-$6,000[6]	$5,000-$8,000[6, 7]

1 - Cost includes our preparation & filing of the necessary NOI application and supporting information as well as our attendance at one public hearing. Expenses consist of direct reimbursable costs such as filing fees, certified mailing, copying, etc…and typically do not exceed an additional $500-$1,000.

2 – The cost of a local contractor to handle the required shore-based operations (loading, trucking, and disposal of the removed materials) are not included in the figures provided. Although these costs will vary based on the contractor selected, we generally advise our clients to assume 50%-70% of the actual Hydro-raking costs for budgeting purposes.

3 – The application of pesticides to Massachusetts waters requires an additional site specific permit called a License to Apply Chemicals issued by the MA DEP – Office of Watershed Management. This permit must be filed on an annual basis. The cost for preparation, filing, and all associated fees is $250/year.

4 – Although Aquatic Control has considerable experience with dredging, a project of this magnitude would benefit from an environmental/engineering firm to complete the final project design and permitting phase.

5 – This operational cost is an estimate based on typical unit costs for the dredging of associated sediment volume. Actual costs may vary significantly based on possible permit conditions and unforeseen operational complications. Also due to the relative scarcity of organic loam on the island, the operational dredging costs could possibly be partially off-set by the sale of the dredge spoils to the selected dredging contractor for future processing into saleable loam.

6 – Following a dredging project of this size some level of post-dredging monitoring will likely be required by the permitting agencies. This cost estimate is based on what we would expect to be the minimum level of follow-up assessment.

7 – Because it is unlikely that a sufficient areal percentage of the pond will be able to be deepened adequately to preclude the growth of rooted vegetation, some level of vegetation management may be required as soon as two years post-dredging. For this reason we have included the expense of some small scale area selective chemical treatment in year three.

APPENDIX A

Figure 1 – Site Locus Map
Figure 2 – Data Point & Sample Collection Site Map
Figure 3 – Vegetation Distribution Map
Figure 4 – Bathymetry Map
Figure 5 – Unconsolidated Sediment Thickness Map
Figure 6 – MA DEP Wetland Resource Area Delineations

2006 Mill Pond Baseline Assessment

Site Locus Map

West Tisbury, MA

FIGURE:	SURVEY DATE:	MAP DATE:
1	9/15/06	11/10/06

Legend:

0 1,000 2,000 4,000 Feet

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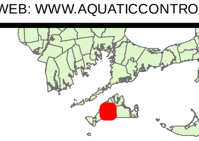

2006 Mill Pond Baseline Assessment

Data Point and Sample Collection Site Map

West Tisbury, MA

FIGURE:	SURVEY DATE:	MAP DATE:
2	9/15/06	11/10/06

Legend:

Water sample collection sites

a1-f6 - DGPS recorded data points

0 60 120 240 Feet

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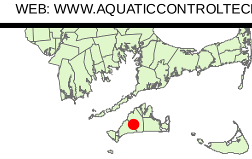
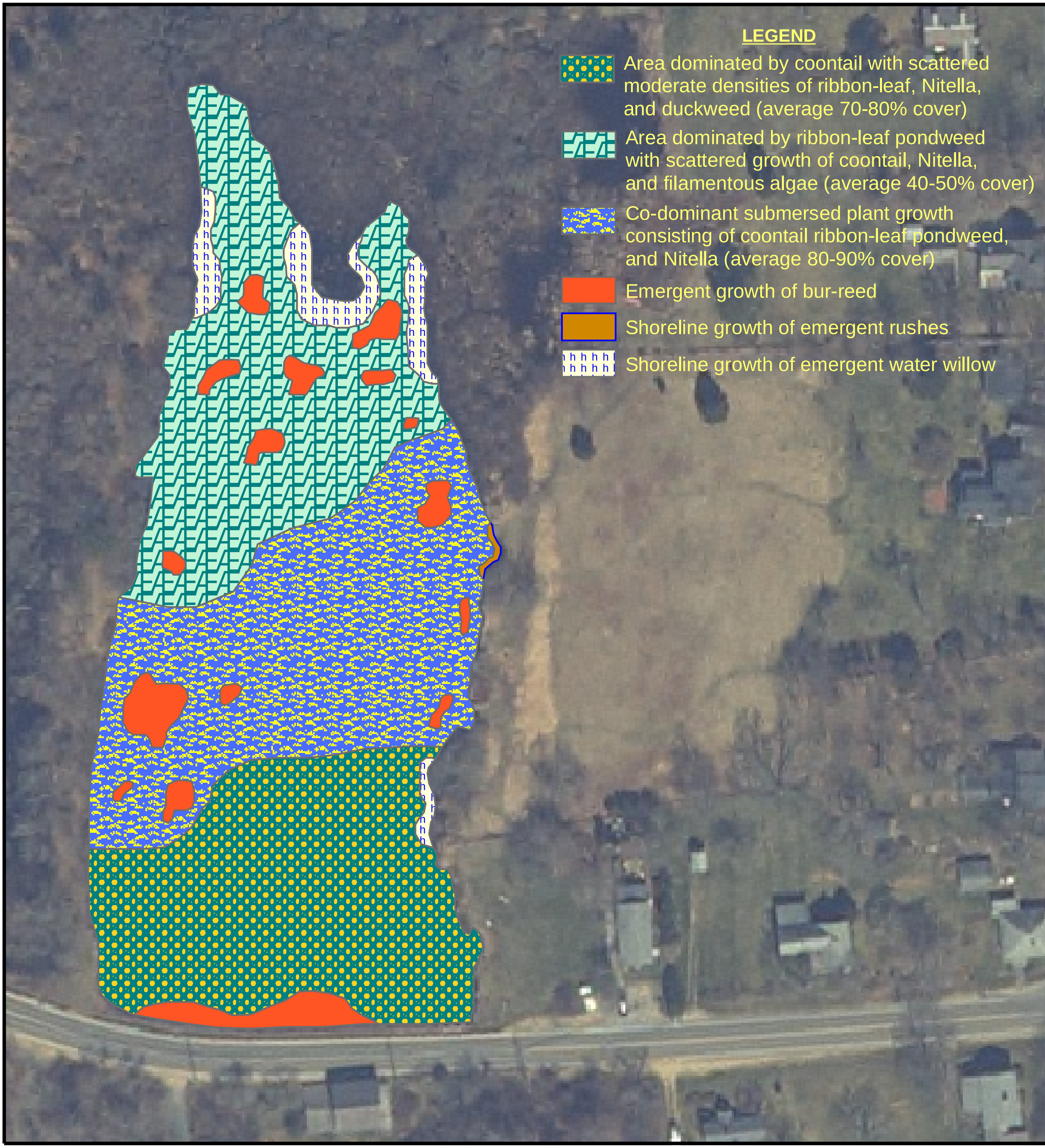


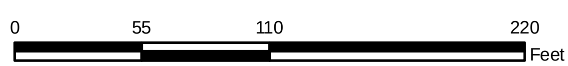


2006 Mill Pond Baseline Assessment

Vegetation Distribution Map

West Tisbury, MA

FIGURE:	SURVEY DATE:	MAP DATE:
3	9/15/06	11/10/06



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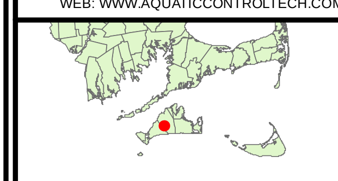

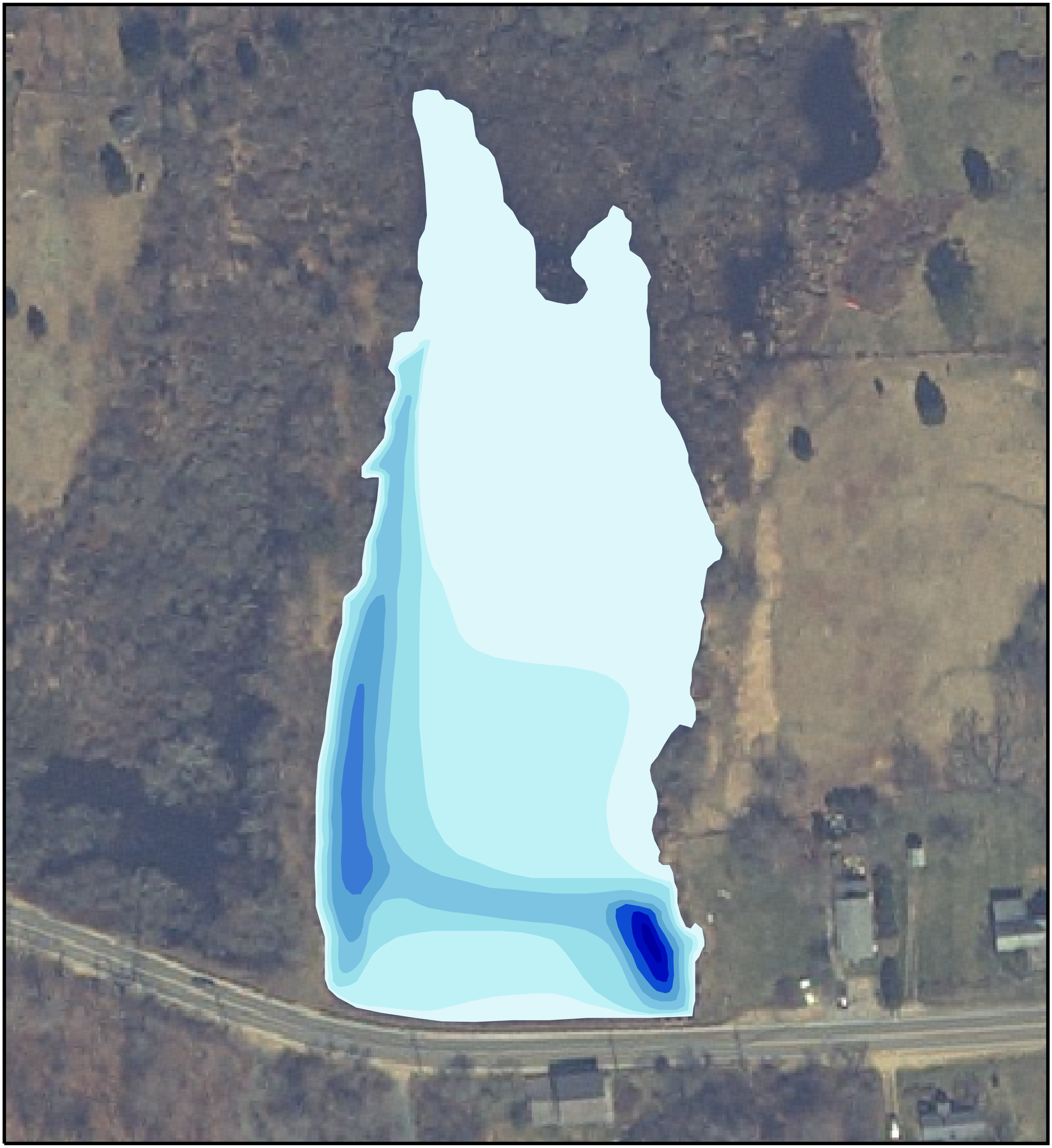

2006 Mill Pond Baseline Assessment

Bathymetry Map

West Tisbury, MA

FIGURE:	SURVEY DATE:	MAP DATE:
4	9/15/06	11/10/06

Legend:

- 0-1 FT.
- 1-2 FT.
- 2-3 FT.
- 3-4 FT.
- 4-5 FT.
- 5 FT.
- 5-6 FT.
- 6-7 FT.
- 7 FT.

0 50 100 200 Feet

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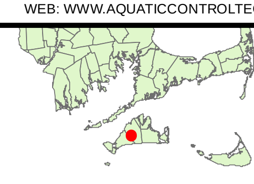

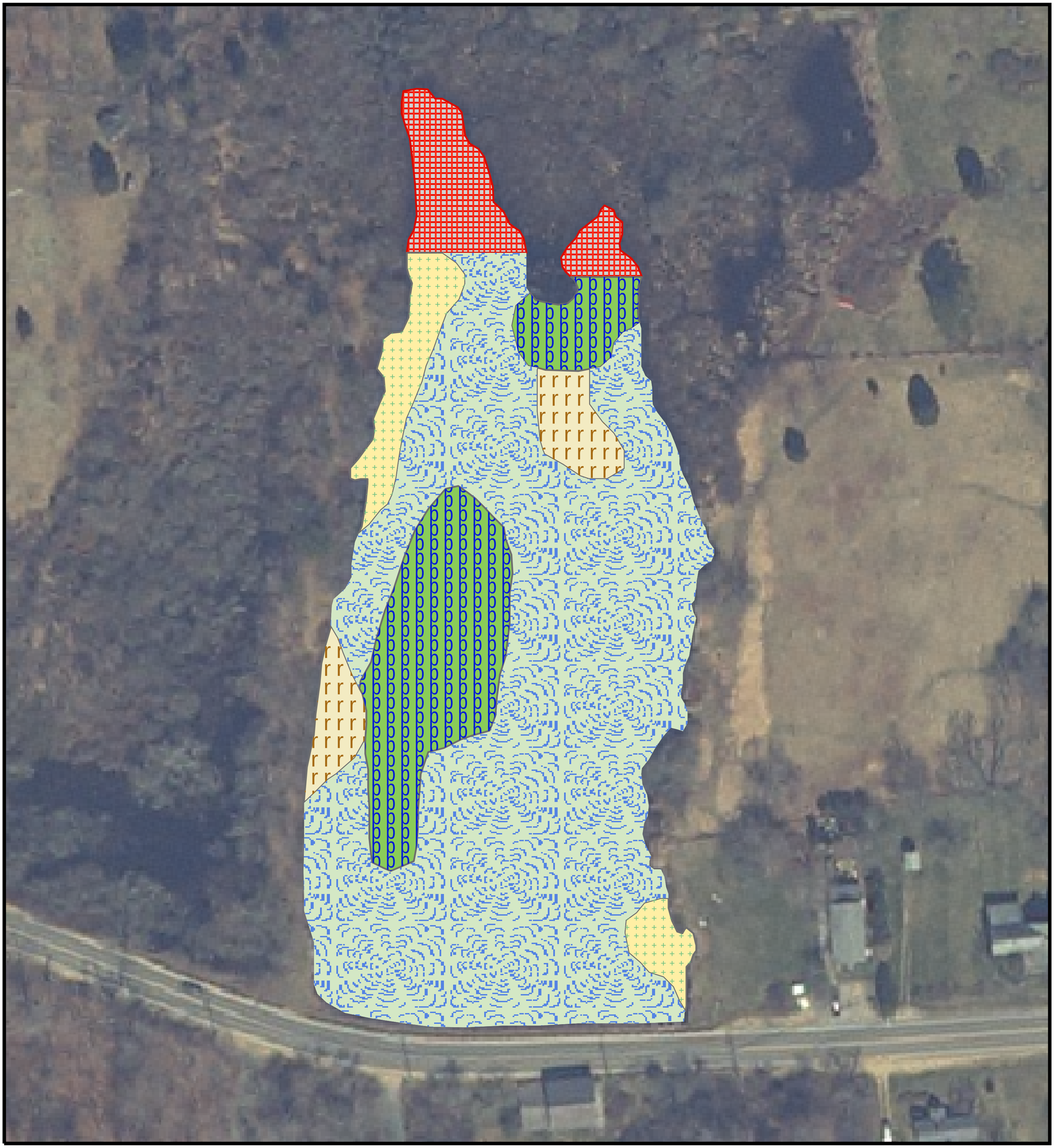

2006 Mill Pond Baseline Assessment

Unconsolidated Sediment Thickness Map

West Tisbury, MA

FIGURE:	SURVEY DATE:	MAP DATE:
5	9/15/06	11/10/06

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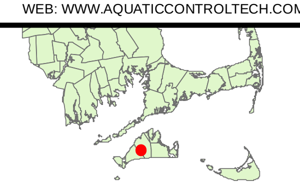

2006 Mill Pond Baseline Assessment

MA DEP Wetland Resource Area Delineations

West Tisbury, MA

FIGURE:	SURVEY DATE:	MAP DATE:
6	9/15/06	11/10/06

Legend:

SHRUB SWAMP

OPEN WATER

WOODED SWAMP DECIDUOUS

Wetland resource area delineations provided by June 2006 MA DEP Wetlands datalayer from MassGIS

0 150 300 600 Feet

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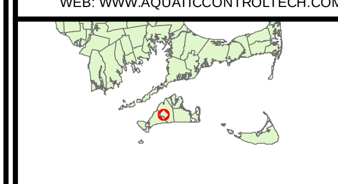


APPENDIX B

Vegetation Survey Data
Water Quality Analysis Lab Sheets

		9/15/06 Survey Data				
Transect	**Data Point**	**Water Depth**	**Sediment Thickness**	**Vegetation**	**Percent Vegetation Cover**	**Biomass Index**
A	1	0.3	4.0	Pe, S, Lm	50	4
A	2	0.2	3.0	Pe, S, Lm	100	4
A	3	0.3	3.5	Pe, Lm	50	4
A	4	0.3	2.0	Pe, S, Ni	75	4
A	5	0.4	1.5	S, Lm	5	4
B	1	0.6	2.5	Pe, Lm, Ni, Cd	100	4
B	2	0.6	3.5	Pe, Cd, Ni, FA	25	4
B	3	0.2	3.0	Pe, FA	25	3
B	4	0.2	3.5	Pe, FA, S, Pp	25	4
B	5	0.8	2.5	Pe, Cd, FA, Lm	75	4
B	6	3.5	6.5	Lm, FA, Cd	15	4
C	1	3.5	3.0	Pe, Lm, Cd, S	40	4
C	2	1.0	2.0	Pe, Cd, Ni	100	4
C	3	1.0	2.0	Cd, Pe, Ni, S, Lm	100	4
C	4	1.0	2.5	Pe, Cd, Ni, S, Lm	100	4
C	5	1.0	2.5	Cd, Ni, Pe, S	100	4
C	6	1.0	3.0	Cd, Pe, S	100	4
C	7	1.0	3.0	Cd, Pe, S, Ni	100	4
D	1	1.0	3.0	Cd, Pe, Lm, S	80	4
D	2	1.5	2.5	Cd, Pe, Ni	80	3
D	3	1.5	2.5	Cd, Ni	100	4
D	4	1.5	2.0	Cd, Pe, FA	100	4
D	5	1.5	1.5	S, Cd, Pe, Ni	100	4
D	6	3.0	1.0	S, FA, Lm	30	4
D	7	5.0	3.5	S, Cd, FA	30	4
E	1	5.5	2.5	FA, S, Lm	10	2
E	2	2.5	0.5	S, Cd, Pe, FA, Lm	100	4
E	3	1.5	3.0	Cd, Pe	100	4
E	4	1.5	2.5	Cd, Ni, Pe	75	4
E	5	1.5	2.5	Cd, Pe	40	4
E	6	1.0	3.0	Cd, Pe	60	4
F	1	7.0	5.0	Cd	40	3
F	2	2.0	3.0	Cd, Pe, Ni	100	4
F	3	1.5	2.5	Cd, Pe, S, Ni	100	4
F	4	1.5	2.5	Cd, Pe, S, Ni	100	4
F	5	2.0	2.5	Cd, S	50	3
F	6	4.0	3.0	Cd, S	50	3
	Averages	**1.7**	**2.8**		**68.38**	**3.81**

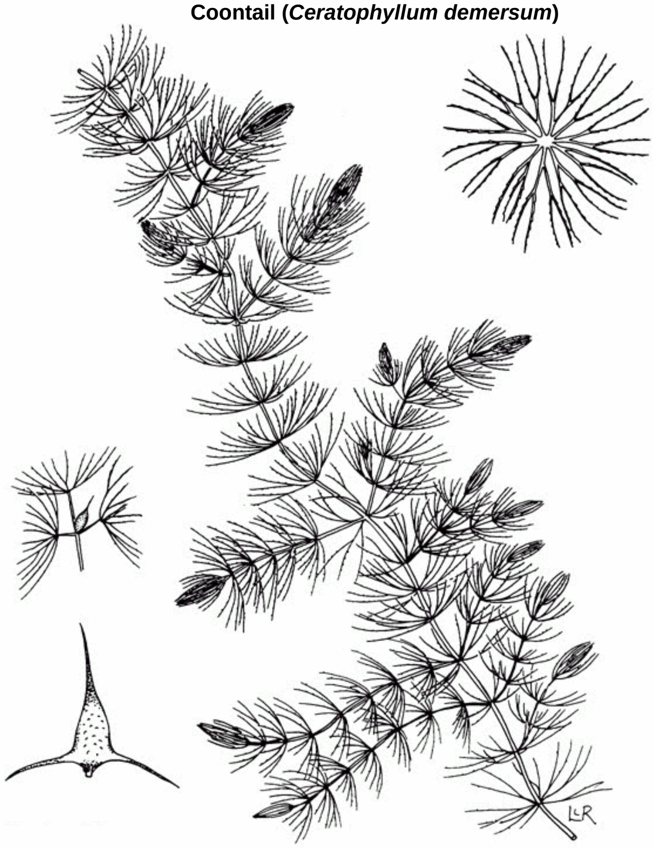
APPENDIX C

BMP – Best Management Practices Information

APPENDIX D

Mill Pond Dominant Plant Line Drawings

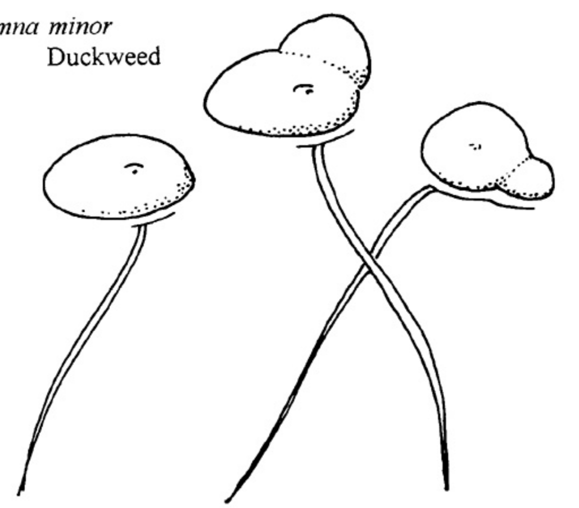
Coontail (*Ceratophyllum demersum*)



Thin-leaf Pondweed (*Potamogeton pusilis*)

Ribbon-leaf Pondweed (*Potamogeton epihydrus*)

Lemna minor
Duckweed



Nitella spp stonewort

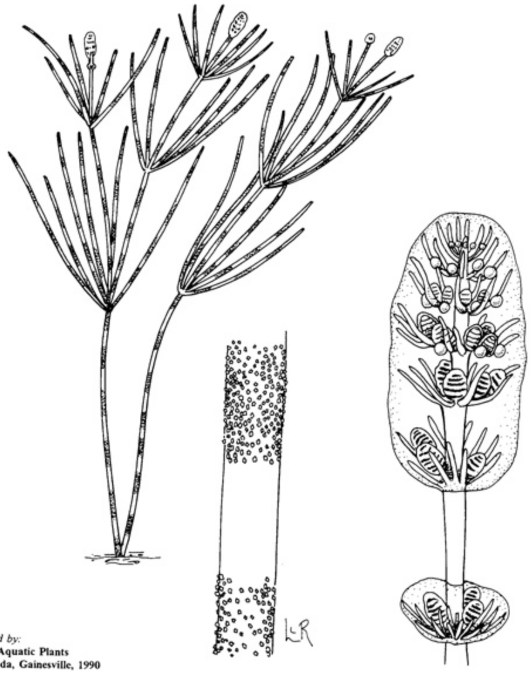


illustration provided by:
IFAS, Center for Aquatic Plants
University of Florida, Gainesville, 1990

Sparganium americanum
Bur-reed

illustration provided by:
IFAS, Center for Aquatic Plants
University of Florida, Gainesville, 1996

Juncus effusus
Soft rush