BRIDGEWATER SOURCE WATER PROTECTION PROJECT

02-04 SWT

June 30, 2005

PREPARED BY:

BRIDGEWATER WATER DEPARTMENT

PREPARED FOR:

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF RESOURCE PROTECTION

AND

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION 1

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This project has been financed partially with Federal Funds from the Environmental Protection Agency (EPA) to the Massachusetts Department of Environmental Protection (MADEP) under a Source Water Protection Grant.

The contents do not necessarily reflect the views and policies of EPA or MADEP, nor does the mention of trade names or commercial products constitute endorsement or recommendation for use.

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Section 1.0 Purpose of project

In 2002, the Town of Bridgewater was awarded a Source Water Protection (SWP) Grant by Massachusetts Department of Environmental Protection (MADEP) and the U.S. Environmental Protection Agency (EPA). The development of the material for this grant is consistent with the 2001 Bridgewater Master Plan and is coordinated with the recently completed Natural Resources Trust of Bridgewater (NRTB) Carver's Pond Management Plan. The grant work was designed to develop educational material specific to Carver's Pond and to provide an integrated view of the various and complex components that make up the study area.

The vulnerabilities of this resource were identified as potential impacts directly and indirectly to the wellfield and the treatment plant as well as the surface water. Some of these potential vulnerabilities were addressed in work conducted under a Wellhead Protection Grant. In June 2002, the Town of Bridgewater received a Wellhead Protection Grant through MADEP. Under that grant work, the town was able to implement both physical measures to ensure protection to the wellhead sites located throughout the town and technological advances through the development of GIS layers for use by the Water Department in their daily operation and long-term protection plans. The Town of Bridgewater chose to take a proactive approach for wellhead protection given the national alert for protection of water supplies and local property destruction to the iron removal facility that challenged the water supply security.

The 1,020 acre study area for this grant specifically addresses the Carver's Pond resource which consists of three components: Carver's Pond, the Zone II aquifer protection district and sub-watershed region of the Taunton River, as shown on Figure 1. Together, these three components represent the defined area of study which extends well beyond the boundaries of the pond, into the surrounding business and residential communities. The Zone II aquifer is determined by hydrologic study as the area of groundwater contribution to the wellfields while the sub-watershed collects surface water flow which is then directed towards Carver's Pond.

Carvers Pond is an approximately 28-acre man-made pond surrounded by wooded wetlands and uplands with some abutting residences. Two major aquifers underlie the entire town center in a continuous layer of fresh water. The pond is part of the recharge area above one of those aquifers, which in turn supports five wells as part of the town water supply. The Bridgewater Water Department continues to work to provide excellent water quality which has been enhanced by the construction of the water treatment plant located at Carver's Pond. An example of this excellence is that in 2004 the Bridgewater Water Department was recognized by MADEP and USEPA as among the top 5% in the state for water quality.

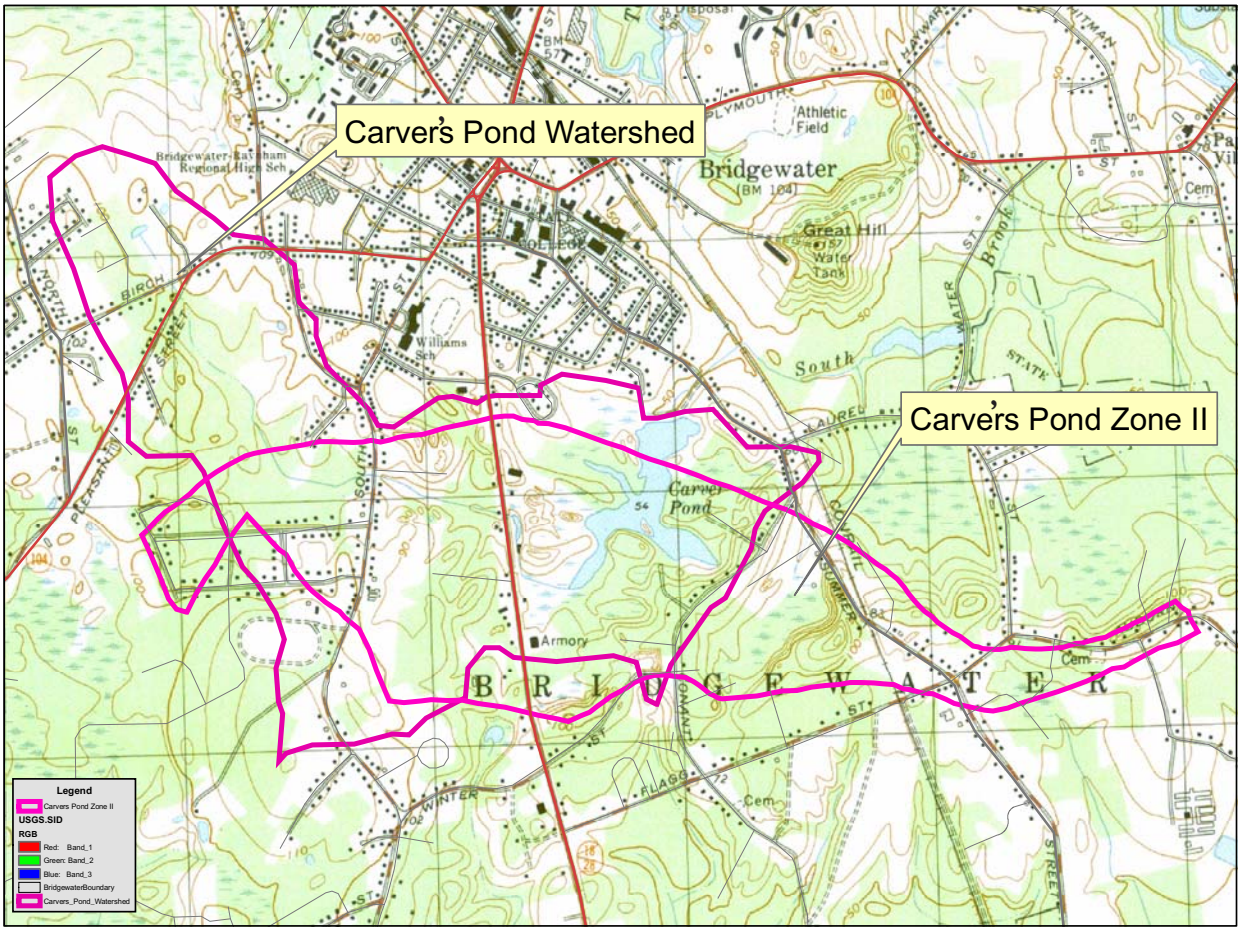
The pond has long been seen as an important resource. In the early 1700's, Carver's Pond was created to support local iron works. In the 19th century, before refrigeration was common, this pond was a valuable source for ice harvesting. Today its uses are primarily flood control and passive recreation with approximately 106 acres of publicly owned land around the pond. The site has two trails, one along the eastern edge of the pond and one along its western edge that crosses the spillway of the dam structure and the concrete foundations of the former icehouse. The pond is located between Summer Street and Bedford Street (Route 18 & 28), near Bridgewater center and the Bridgewater State College campus. Its main entrance is on Summer Street, where there is a small parking area. Outside of the restricted areas of the water treatment facilities, wellheads and private

residential development, recommended recreational uses of Carver's Pond include: picnicking, community events, hiking, cross country skiing, ice skating, nature study, walking dogs, fishing and canoeing.

This grant was intended to implement a public outreach and education program targeted to three diverse groups located within the study area: existing businesses, abutting residents and elementary school children housed in the George Mitchell Elementary School complex. In outreaching to these groups, the project promotes participation that will aid in the protection of Bridgewater's water supply through increased awareness of this resource area. Although the grant specifically targets those within the study area, the information developed through this grant work will be of value to all residents.

The Town of Bridgewater plays a key role in the South Shore area of eastern Massachusetts where the maintenance of high quality water supply is critical. In addition to supplying water to the over 25,000 residents, the Town of Bridgewater provides water to the nearly 10,000 Bridgewater State College students. In addition, Bridgewater would also be the host community to 20% of the population of Plymouth, Carver and Kingston in the event of a nuclear mishap. Components of this report have identified the various points of access and use around the pond, the area of the drinking water treatment plant and municipal wells. Additional history and recreational uses of Carver's Pond

Figure 1



have been further identified in a separate document prepared by NRTB as part of the Bridgewater Parklands.(Appendix A)

This grant work would not have been possible without the participation and hard work of many people. These acknowledgements are extended to Malcolm Harper, Edith Blackney and Kathleen Romero of the MADEP grant program staff; Joseph Silva, Lorraine Conti and Eileen Weinberg of the Bridgewater Water Department; JoAnn O'Donnell, Phyllis Tirrell and Laurie Guerrine of the Bridgewater Accounting Department; Vale Sime and Kristen Harris of the Bridgewater Board of Health; Ron Adams and Jolie Sprague-Martin of the Bridgewater Town Clerk's office; Anne Tavares of the Community Development Office; Lorraine Carrozza of the Senior Center; the many police officers who help out during the stormwater survey, including officers Mike Bothelo, Tom Lagrasta and Anne Schuster. Also, our appreciation is extended to employees of the school department, especially Paula Cantave, Dr. David Costa, Brian Lynch; the staff in the North, South and Central Houses; the 2nd through 4th grade teachers at the George Mitchell Elementary School and the janitorial staff at Bridgewater-Raynham Regional High School. The delineation of the vernal pools was supported by the use of the survey equipment provided by Nangle Consulting Associates, Inc. There were those who stepped in to provide technical and professional help: Elizabeth Hayes, Katherine Doherty, LaDonna Luckman, Anna Nalevanko and Dr. Patricia Hogan. Great volunteers included the story writers, Michelle Lyn Haskins and Rebecca Romasco, story illustrator Billie McGregor and story readers Melissa Sances and Jessica Rene Gifford. Lastly, a special thanks to the bakers who provided refreshments to the outreach program on April 23, Barbara Alden and Jean Tobey. These combined efforts made this truly a community product.

Section 2.0 Summary of tasks conducted

The tasks that were performed under this grant included the development of the following:

1. Delineation and development of mapping of aquifer and watershed boundaries around Carver's Pond and the municipal drinking water wells located at Carver's Pond
2. Evaluation of land use, access and potential adverse impacts to the Carver's Pond study area
3. Evaluation of private well, sewer utilities and septic use within the study area
4. Physical inventory and mapping of catch basins along roadway networks within the study area, showing flow direction and review of overall stormwater discharges
5. Certification of tentatively identified vernal pools
6. Description of status of Carver's Pond dam
7. A survey of those businesses located within the study area
8. Small business green initiatives
9. Residential informational program, targeted for those within the study area with the development of a community outreach program
10. Preparation of an informational handout for Bridgewater residents summarizing the scope of the grant
11. An education outreach program, including creation of a story book for elementary school students (2nd through 4th grade) about Carver's Pond
12. Completion of a final report

Following are detailed descriptions of the work performed during the course of this grant implementation. These sections relate to the educational and outreach tasks that have been performed. In addition to the development of the watershed and aquifer overlays, GIS mapping included the development of layers showing the sources that had been identified as potential concern, e.g. storm water runoff, overlay of septic systems, private wells and non-certified vernal pools. The development of maps provides easy to use and understandable information regarding the specific characteristics of the study region. The maps that were produced through this grant were made available to various town departments through the Community Development Office.

Concurrent with the Source Water Protection grant, the Natural Resources Trust of Bridgewater, a local non-profit organization, worked with the Massachusetts Audubon Society to prepare a Carver's Pond Management Plan. The Carver's Pond Management Plan was the last of six park management plans prepared by the NRTB. While the NRTB work was contracted separately from the work identified within the Source Water Protection Grant, it provided a complimentary and valuable scope of work.

The original work set forth in the Source Water Protection (SWP) grant included two tasks that were addressed in detail by NRTB: pond management and characterization. Therefore, the SWP grant work included a review of the NRTB Management Plan and has incorporated the comprehensive management and design plan for recreational use of the pond detailed within the NRTB Plan with a coordinated plan for protection of the town's drinking water supply wells. For the purposes of completeness, NRTB has permitted the inclusion of their management plan as an attachment to this report (Appendix A).

2.1 Delineation and development of mapping of aquifer and watershed boundaries

It is the goal of source water protection to identify potential adverse impact to a drinking water supply. In order to accomplish a plan for its protection, the first step is to identify the area of concern. For the purposes of this study, the area of consideration is defined by the pond, the limits of its local Zone II aquifer boundaries and the sub-basin delineation within the Taunton River watershed.

The water supply at Carver's Pond has been identified as a groundwater source. This source is identified by the limits of the Zone II. The Zone II limits of the underlying aquifer contributing to the wellfield and it is determined by hydrologic study. Typically, groundwater supplies are seen as less vulnerable than surface water supplies due to the lack of immediate access. However, groundwater supplies can be impacted by infiltration of contamination and depletion. Examples of contamination would be a leaking underground oil or hazardous materials storage tank; a similar release from an above ground storage tank without proper spill containment; excessive use of fertilizers, herbicides or pesticides, or; bacterial, viral or nutrient loading due to a failed septic system or release from a leaking sewer line. Depletion can result from prolonged drought or private well withdrawals.

Subwatersheds of the Taunton River Watershed within Bridgewater

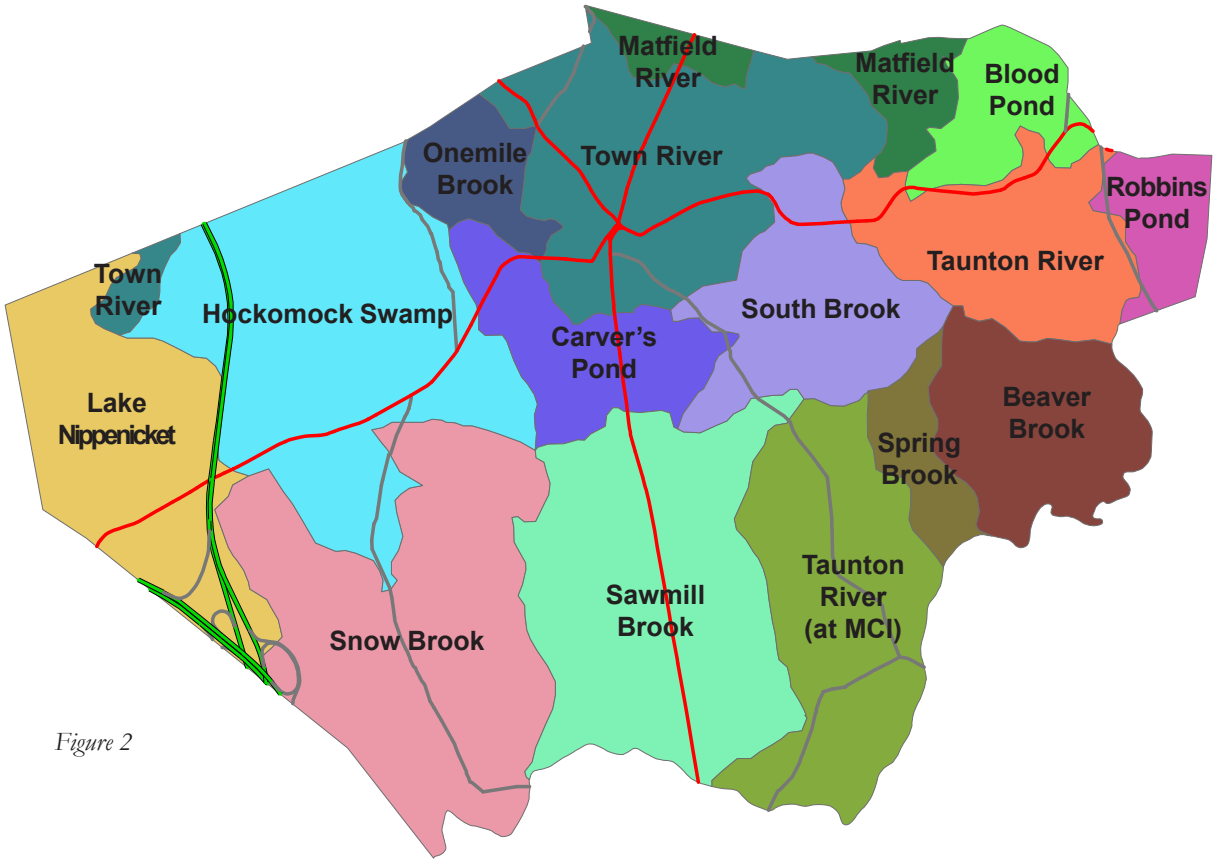


Figure 2

In addition, the long term impacts associated with stormwater loadings into Carver's Pond and the adjoining wetland may result in degradation of the underlying groundwater source. This includes that area described as the watershed. Carver's Pond is located in the Taunton River Watershed. However, it is more directly impacted by the sub-basin watershed which is influenced by local topography and hydraulically collects surface water flows which are directed toward the Carver's Pond impoundment, predominantly through the storm drain network. The local sub-basins within the Taunton River Watershed are shown on Figure 2. The Carver's Pond sub-basin is seen centrally located in the larger watershed. The overlapping lines delineate portions of the underlying Zone II aquifer.

Based upon the Zone II aquifer and watershed influences acting upon Carver's Pond, it was an important first step to translate their boundaries onto a common map. The visual aid prepared includes Carver's Pond (28 acres), Zone II aquifer (638 acres) and Carver's Pond sub-watershed (734 acres). The combined overlapping areas total 1,020 acres and were shown previously on Figure 1. The area also includes five of the town's nine drinking water wells and the water treatment plant.

Photo 1 — Scattered trash

Photo 2 — Damage

Photo 3 — Damage

2.2 Evaluation of land use, access and potential adverse impacts to the Carver's Pond study area

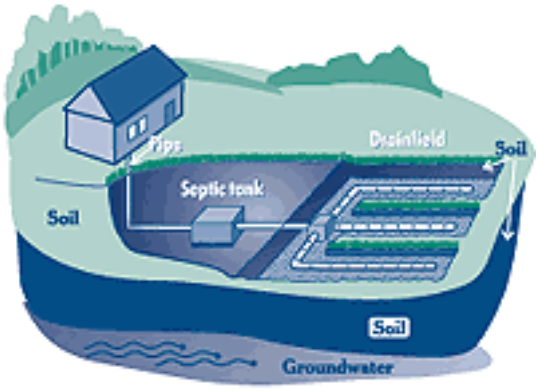
Using the information obtained from the mapping, a physical survey was performed of the study area, noting that Carver's Pond and the wellfields are located in the western portion of the 1,020 acres. In addition, a key to source water protection is providing education to those that live and work in the area of concern. As such, a review of the study area has shown that it is comprised of approximately 600 residential homes, 32 businesses along Bedford Street, a new police station and a large elementary school complex. At the time of this study, a new high school facility was being constructed at the uppermost end of the watershed. Wetlands and wooded uplands were also found.

The scope of the Source Water Protection grant work has included a preliminary identification of various potentials that may be present within the defined study area. As noted previously, potentially adverse impacts associated with this mixed land use typically may include excessive groundwater withdrawals and points of contaminant migration from improperly maintained private wells; nutrient loading from poorly maintained or failing septic systems; loss of groundwater recharge due to collection of sewage to the municipal sewer treatment plant; and herbicides and pesticides from landscaping and other non-point source stormwater discharges.

In addition, there is a concern for unauthorized uses, including off-road vehicles and all-terrain vehicles in restricted conservation/recreation areas. During the course of this grant work there was evidence of some damage to the conservation land adjacent to the Carver's Pond wellfield. Photos 1 through 3 illustrate some of the damage and scattered trash.

2.3 Evaluation of private well, sewer utilities and septic use

Potential adverse impacts to the source water may result from failed septic systems and depletion of groundwater supplies by private well use. Records for private wells and septic systems are available to property owners through the Bridgewater Board of Health. Homeowners or business owner who may have some concerns related to private well testing requirements and locating a licensed contractor to service their septic systems may contact the Board of Health.



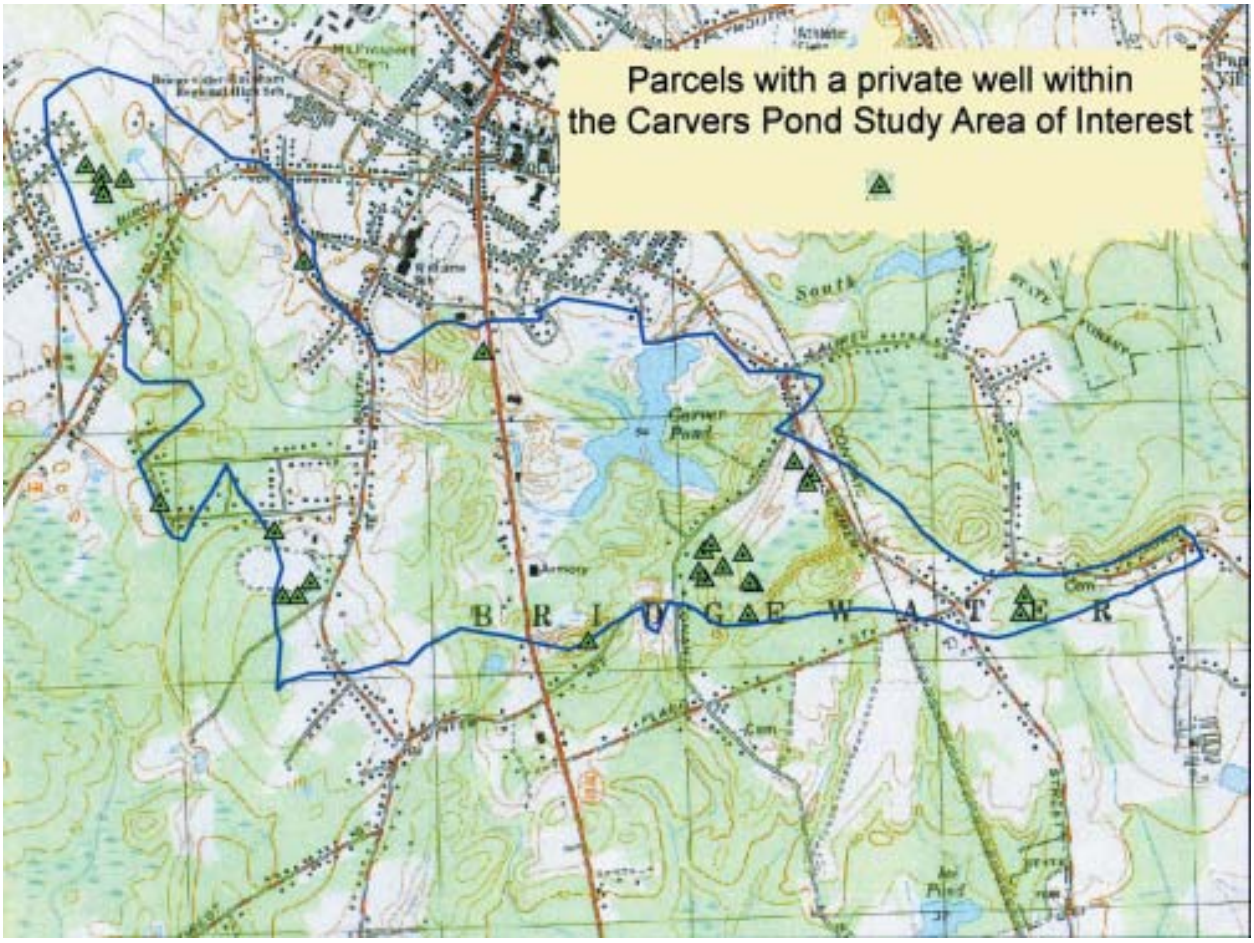


Figure 3

The most common use of private wells in Bridgewater is for non-potable irrigation. With conservation restrictions on use of lawn sprinklers in effect some homeowners have sought to provide water for that purpose using a private well. Typically, the use of these wells is seen during summer months when the municipal water system is experiencing high demand. A review of the data on private well installations indicated a significant increase in the number of wells in the past ten years within the study area from four to twenty-seven. The approximate locations of the private wells within the study area are shown on Figure 3. As noted, there are clusters of wells primarily in areas of more recent construction. These locations represent only those wells within the Carver's Pond study area. Similar trends of increasing numbers of private well installations are seen throughout Bridgewater. Presently, there are no regulations in place to restrict the use of these private wells.

Some private wells may be used for drinking water (potable) purposes. It is recommended that private well owners have their wells tested annually for bacteria as well as establish a testing schedule for other recommended parameters. A visual inspection should be made periodically to ensure that the well casing is in good condition. Precautions should be taken to prevent damage to the exposed portions of the well and keep the area free of accumulated waste material or other obstructions. The pump should be periodically checked to make sure that it is clean and working efficiently. Whether the homeowner uses their private well for irrigation or potable purpose, proper maintenance is a key to good health and long-term use.

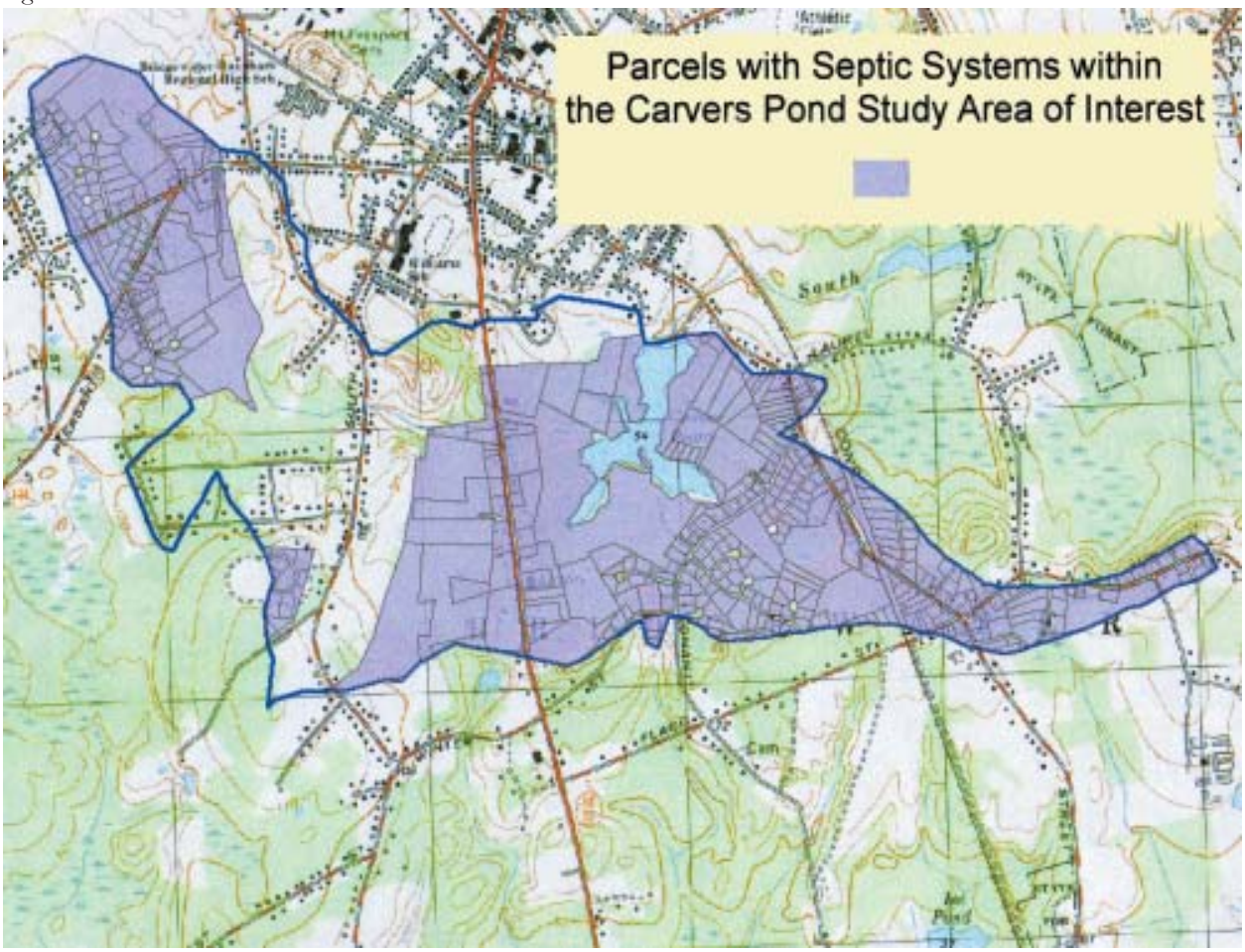
In addition to information available from the Board of Health, there are many on-line resources available that can provide information regarding the care and maintenance of a private well including:

http://www.epa.gov/region01/eco/drinkwater/private_well_owners.html

With regard to wastewater, significant portions of the Carver's Pond study area use on-site septic systems to handle wastewater discharges. As noted from Figure 4, large portions of the study area have on-site septic. Some areas to the east and west of Carver's Pond have access to municipal sewer connections. The Town of Bridgewater Sewer Department operates a wastewater treatment plant off Route 104 on Morris Avenue, northeast of the study area. Collected sewage is treated using a secondary treatment process including rotating biological contactors and discharged into the Town River which flows to the Matfield River, which flows into the Taunton River and then out to the Atlantic. There is a growing concern regarding the loss of the direct recharge benefit seen in this type of disposal system and a resulting diminishment in the aquifer.

In some cases, there is no alternative to a sewer connection. When possible, a well maintained septic system provides the convenience of an owner controlled system and has direct benefits to the environment associated with groundwater recharge. However, an improperly managed, overloaded, neglected system is not just a nuisance; it can represent a threat to surface and groundwater systems

Figure 4



as well. Simple rules apply to correct use of the well-designed septic system including routine pumping and inspection, avoiding discharge of oils, corrosive, caustic or volatile compounds into the system.

Once again, the Board of Health has information regarding licensed contractors that can inspect, pump and repair the septic systems. It is recommended that licensed contractors be used. In addition, there are many places where information is available regarding proper care for the septic system including on-line resources, such as this reference:

http://www.drinkingwaterwise.org/resources/septicsystem.html

Another area that the community can contribute to a healthier environment is by the use of "green" products. Green products are those that minimize impact by being less toxic; have a more neutral acidic nature; lower or no concentrations of volatile compounds; and are recyclable, reusable, and result in minimum waste. There is a growing awareness of the benefits gained from using green products and there are a number of resources available to the homeowner that provide examples of these products and consumer choices. A more in depth presentation has been made to the business community at large, however, there are many similar applications found in those resources that can be adopted by the homeowner. One example is a summary of environmentally friendly suggestions presented in the following web link, produced as part of the National Pollution Prevention Week 2000.

http://www.mass.gov/dep/bwp/dhm/tura/files/p2tips.pdf

2.4 Physical inventory and mapping of catch basins along roadway networks

Over a period of several days beginning in May 2005, a wet-weather inventory was conducted of the stormwater collection system that flows through the 1,020 acre Carver's Pond study area. There were a total of 117 catch basin structures and 47 outfalls along 23 streets inventoried. Approximately 100 photos were taken of the many and varied structures observed. The drainage sub-basin for Carver's Pond begins at the rear of Candy Lane in an area adjacent to the construction site for the new high school. There are two small ponds that flow in a southerly direction cross town through back lots, under roadways and across wetlands into Carver's Pond. Figure 5 shows the approximate locations of the drainage network and flow paths. An inventory of the system was tabulated and is included as Appendix B. Each of the catch basins was numbered and the outfalls were designated by letter series.

Key concerns noted during this survey were areas of dumping of grass clippings and brush that acts to obstruct the flow pathways (Photo 4), short-circuiting of drainage structures (Photo 5), submerged outfalls (Photo 6), oily sheens from roadway runoff (Photo 7), and a buried catch basin that resulted in a severe flooding condition (Photo 8).

Photo 4 — Obstructed flow pathway

Photo 6 — Submurged outfalls

Photo 5 – Short-circuiting of drainage structure

Photo 7 — Oily sheens from roadway runoff

Photo 8 — Buried catch basin resulting in severe flooding

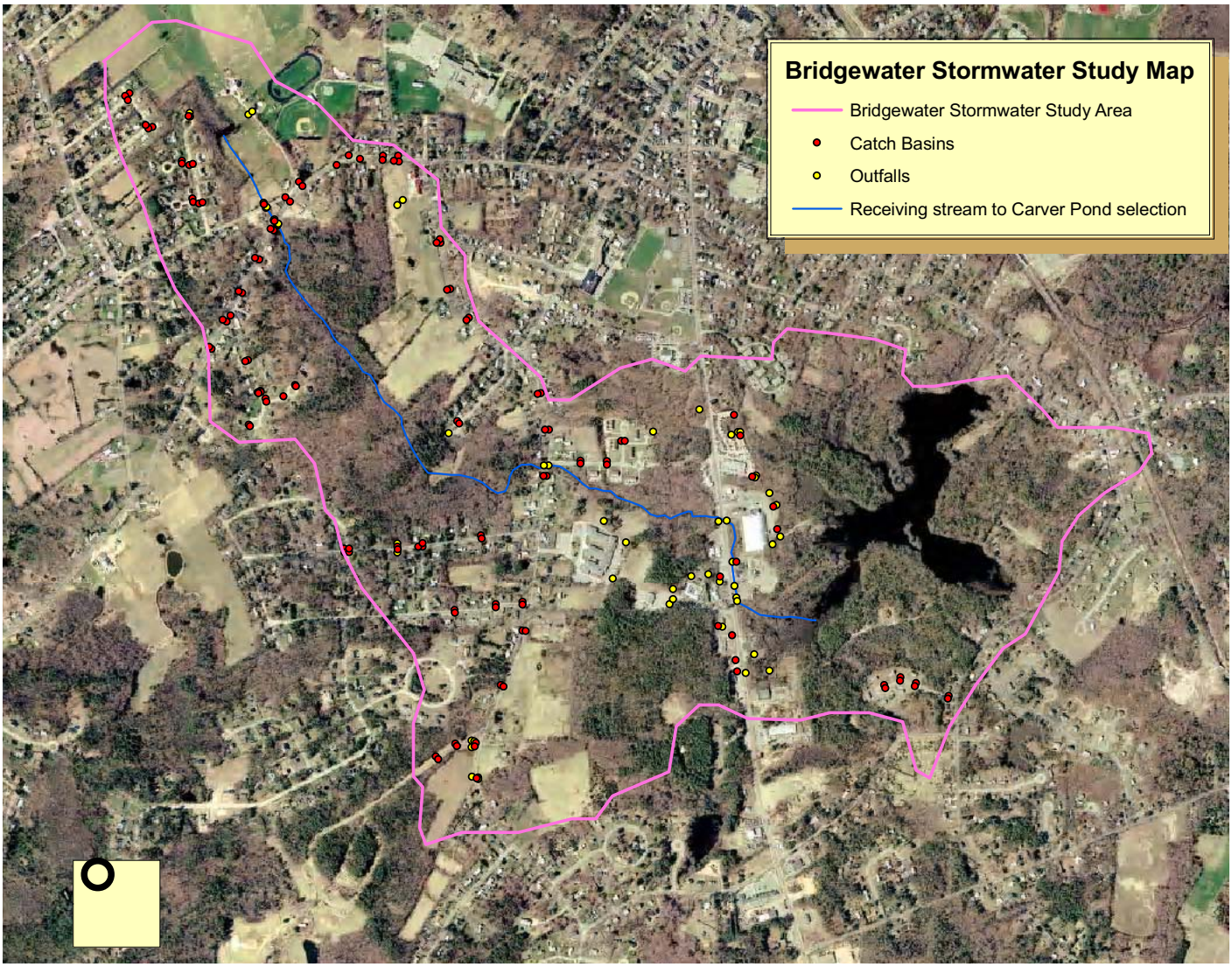


Figure 5

2.5 Certification of tentatively identified vernal pools

In fulfillment of the Obligate Species Method for pond certification, photographic evidence of egg masses of two amphibious species, along with the confined basin characteristics, was presented in defense of two possible vernal pools located adjacent to Carver's Pond. Photos 9-12 are representative of those submitted in the defense of the certification of these pools. Other documentation requirements included a USGS topographic map with the location of the vernal pool clearly marked, an aerial photo of Carver's Pond with location of pools and a large-scale topographic map with directions and distances to each pool. As a part of this study, a survey of the pools was performed courtesy of NCA, Inc., and a map has been prepared showing the elevations and boundaries of each pool. The final component of the certification packet is the Field Observation Form. A copy of the report prepared by LaDonna Luckman is included as Appendix C for reference. Mrs. Luckman had completed this work as part of her studies at Bridgewater State College.

Photo 9 — Spotted salamander eggs

Photo 10 — Vernal pool

Photo 11 — Vernal pool

Photo 12 — Wood frog egg masses

2.6 Status of Carver's Pond dam

The earliest reference to Carver's Pond is the 1737 historical reference to Edson's Furnace which would indicate that the dam was constructed prior to that time. It was inspected in 1999 by PARE consulting firm and based upon a review of records with the Massachusetts Office of Dam Safety, it is presently ranked as a significant hazard with an uncontrolled free-overall spillway nine feet wide. It is a reinforced earthen dam with a crest length of 700 feet. Photo 13 was taken of the spillway and Photo 14 shows the density of vegetation over the dam during the course of the SWP Grant work. The spillway can be seen along the walking path accessed from Summer Street, referenced previously, as adjacent to the remnants of the former ice house. The dam is privately owned and currently used for recreation and flood control purposes. The Massachusetts Office of Dam Safety plans on conducting an inspection of this dam and may provide some recommendations to the owner for future action.

Photo 13 — Spillway

Photo 14 — Density of vegetation

2.7 Business Survey

As part of the project's public outreach and education, information was sought from businesses located in the Carver Pond Aquifer Protection District that includes the Zone II and sub-watershed. This outreach also provided an opportunity to discuss grant goals and the importance of protection of the town's water supply.

This summarizes the outreach approach and data collection from businesses in the protected district, identified to be those businesses and public agencies falling in the address range of 295 to 725 Bedford Street (Route 18) covering a geographic area of approximately two-thirds of a mile. The total number of viable businesses within this range is 32 (refer to Table 1).

The total of property owners is 20. This is a lower figure than total businesses since some properties are a business complex owned by one individual (e.g., six businesses in the 481 Bedford Street complex are under the ownership of one individual). Of the 32, four are public or non-profit The agencies (refer to Table 2). Note that the Conant Health Center is counted as one business though they lease space to five health centered organizations and there are a couple of small businesses that lease space in the Bridgewater Sports Complex building.

Outreach efforts were initiated through a letter from the project lead, Fawn Sances. This letter (Appendix D), delivered to organizations in the Spring 2005, served to inform businesses of this study and to request their participation in a survey.

The purpose of the survey was to gather data on individual business water and sewer related infrastructure, handling of hazardous waste, problem areas, and anticipated water and sewer related needs. The survey instrument was reviewed by the project team and grant contract manager and finalized (Appendix D).

A next step was to deliver the two-page survey to businesses and conduct in-person interviews. Due to the nature of many of the businesses (i.e., limited staff, busy season, etc.), the interviewer needed to make more than one visit to many sites to accommodate the work schedules of owners/managers. Since the identified businesses are located within a close geographic area, making return visits was not a significant effort. Some managers completed the written survey instead of being involved an in-person interview. Tow other problems presented in this outreach effort were that some businesses had limited hours and were difficult to reach and some business owners that leased their property from an off-site owner were not able to answer all survey questions.

Interviews were arranged and fully completed with 18 of the 32 businesses (56%). Some respondents that were business managers, not business owners or property owners, could not answer all survey questions since they were not fully familiar with all aspects of the property. One other survey was initiated but not completed since the owner was not able to make time in his schedule to complete this. Of the 20 property owners/managers, 12 were reached and interviewed.

Generally, the businesses along this segment of Route 18 are small, one- to three-person businesses. For example, four out of the six automotive related businesses interviewed employ one to three full time staff.

The two largest businesses (a restaurant and health club) employ the largest staffs (combined total of 6 full-time, 66 part-time). Another larger operation is the Conant Health Center. They house five

Table 1: Businesses in Identified Route 18 Business District

Business Name	Business Type	Address
HarborOne	Financial Institution	295 Bedford Street
LaBelle Chevrolet	Automotive-Sales & Repair	300 Bedford Street
Dom's Auto Body	Automotive-Body Shop	320 Bedford Street
Bridgewater Auto Body	Automotive-Body Shop	333 Bedford Street
McGlone Family Motors	Automotive-Sales	333 Bedford Street
Bridgewater Sports Complex	Recreation	350 Bedford Street
Castaways	Restaurant	425 Bedford Street
Russo's Wine & Spirits	Retail	455 Bedford Street
Cycle Pros/Auto Pros	Automotive-Sales & Repair	456 Bedford Street
New England Auto Electric	Automotive	470 Bedford Street
Bedford Street Medical	Health/Human Services	481 Bedford Street
Endodonic Health	Health/Human Services	481 Bedford Street
Bridgewater Veterinary Clinic	Petcare	481 Bedford Street
Secret Garden	Petcare	481 Bedford Street
Eagle Photography	Professional Services	481 Bedford Street
E.T. Engineering Enterprise	Professional Services	481 Bedford Street
Primary Health Care Affiliates	Health/Human Services	545 Bedford Street
Biker Boutique & Café	Restaurant	552 Bedford Street
Murphy Auto Sales	Automotive-Sales	560 Bedford Street
MA Army National Guard/Army Reserve	Military	576 Bedford Street
Knights of Columbus	Recreation	Rear 576 Bedford Street
NovaCare	Health/Human Services	620 Bedford Street
Polished Image	Professional Services	620 Bedford Street
Bridgewater Fitness Center	Recreation & Health	620 Bedford Street
M&P Corporation	Landscaping Services	620 R Bedford Street
Fullman Family Chiropractic	Health/Human Services	683 Bedford Street
Dixon Auto	Automotive-Repair	707 Bedford Street
707 Auto City	Automotive-Sales	707 Bedford Street
HomeCore	Building Construction/Sales	707 Bedford Street
Macon Landscaping Services	Landscaping Services	722 Bedford Street
Bridgewater Senior Center	Health/Human Services	Wally Krueger Way
Conant Community Health Center	Health/Human Services	5 Wally Krueger Way

Table 2: Breakdown by Business Type

Business Category	# in Category
Auto Industry	9
Health/Human Service	7
Professional Services	3
Recreational	3
Landscaping	2
Pet Care	2
Restaurants	2
Building Construction/Sales	1
Financial Institutions	1
Military Recruitment	1
Retail	1
Total	**32**

Table 3:Breakdown by Business Type

Business Name	Business Type	# Employees
HarborOne	Financial Institution	6 FT, 7 PT
LaBelle Chevrolet	Automotive-Sales & Repair	Unknown
Dom's Auto Body	Automotive-Body Shop	2 FT, 1 PT
McGlone Family Motors	Automotive-Sales	1 FT
Bridgewater Sports Complex	Recreation	Unknown
Castaways	Restaurant	4 FT, 36 PT
Russo's Wine & Spirits	Retail	2 FT
Cycle Pros/Auto Pros	Automotive-Sales & Repair	4 FT, 1 PT
Bedford Street Medical	Health/Human Services	1 FT, 4 PT
Bridgewater Veterinary Clinic	Petcare	4 FT, 5 PT
Eagle Photography	Professional Services	1 FT
E.T. Engineering Enterprise	Professional Services	6 FT, 3 PT
Primary Health Care Affiliates	Health/Human Services	10 FT
Biker Boutique & Café	Restaurant	1 FT, 2 PT
Murphy Auto Sales	Automotive-Sales	1 FT
Bridgewater Fitness Center	Recreation & Health	2 FT, 30 PT
707 Auto City	Automotive-Sales	3 FT
Bridgewater Senior Center	Health/Human Services	3 FT, 4 PT
Conant Community Health Center	Health/Human Services	1 FT, 70 FT& PT *

** There are five lessees in the Conant Health Center, which total to be about 40 staff (many are out of the office most of the day such as one lessee, Visiting Nurses Association) and 30 children (day care, special needs program).*

lessees, with a total staff of about 40 FT/ PT (as reported by the building manager), with about 30 children attend a special needs program daily (refer to Table 3 for number of employees).

All of the businesses interviewed are tied into town water. Four businesses have septic systems and the remaining 15 are connected to town sewage All of the businesses interviewed are tied into town water. Four businesses have septic systems and the remaining 15 are connected to town sewage lines. Two property owners (representing three businesses) chose not to connect to sewer lines even though there is access (reason given that operations were small and therefore capacity of septic was adequate). One business, the Bridgewater Fitness Center, expressed a desire to transition from septic to the town sewer system for potential business expansion but sewer tie-in is not available to them. The owner expressed some confusion about the capacity of the existing sewer line that extends to the Winter Place plaza and ability to tie into this and/or planned expansion of service.

Though questions were asked relating to storm water discharge as a part of this business outreach, the respondents were not clear on describing the storm water structures in place. With stricter

federal and state guidelines, requirements have been more stringent the last few years (according to Bridgewater's Town Engineer) and therefore businesses built within the past five years have the most effective systems. Requirements for upgrades were not imposed on existing buildings nor are stricter requirements imposed on new owners when an older facility becomes under new management (i.e., Castaways).

Table 4: Busionesses Surveyed

Water, Sewer, Stormwater, Hazardous Materials Handling*

Business Name	Business Type	Water (town or well)	Sewer (septic or town)	Stormwater Drainage Structures (Y, N, Minimal, Inadequate)	Hazardous/Regulated Materials (Y with description, N)
HarborOne	Financial Institution	T	T	Y	N
LaBelle Chevrolet	Automotive-Sales & Repair	T	T	I (currently before Conservation Commission)	Y (oil, other auto fluids)
Dom's Auto Body	Automotive-Body Shop	T	S	N	Y (paint, solvents)
McGlone Family Motors	Automotive-Sales	T	S	Uncertain	N
Bridgewater Sports Complex	Recreation	T	T	Y	N
Castaways	Restaurant	T	T	N	Y (grease from fryolator)
Russo's Wine & Spirits	Retail	T	T	Y	N
Cycle Pros/Auto Pros	Automotive-Sales & Repair	T	T	M (drains)	Y (oil, other auto fluids)
Bedford Street Medical	Health/Human Services	T	T	Y	Y (medical sharps)
Bridgewater Veterinary Clinic	Petcare	T	T	Y	Y (medical sharps)
Eagle Photography	Professional Services	T	T	Y	N
E.T. Engineering Enterprise	Professional Services	T	T	Y	N
Primary Health Care Affiliates	Health/Human Services	T	T	M (drains)	Y (medical sharps)
Biker Boutique & Café	Restaurant	T	T	N	N
Murphy Auto Sales	Automotive-Sales	T	T	Y	N
Bridgewater Fitness Center	Recreation & Health	T	S	I (disturbed this spring)	N
707 Auto City	Automotive-Sales	T	S	N	N
Bridgewater Senior Center	Health/Human Services	T	T	Y	N
Conant Community Health Center	Health/Human Services	T	T	Y	N

** Note: this is the information as reported or learned about in the process of conducting this study.*

The data shows that the newer buildings (constructed within past five years) have the catch basin and oil/water separator structures while the older properties have no structures or very limited structures (i.e., one drain in pavement) to handle run-off. Refer to Table 4 for an overview of responses to infrastructure and hazardous materials questions.

Six of the businesses reported handling hazardous/regulated waste and properly disposing of this through on-site above ground storage containers and collection by a regulated hauler. A seventh would also have some regulations imposed since they do auto repair work but this information was not provided directly by the respondent (LaBelle). Waste materials identified were: paint/paint solvents, medical sharps, automotive fluids (i.e., oil, antifreeze), and food oil used for frying.

Two of the sites reported having had contamination problems on property in the past. The Biker Café's location at 552 Bedford Street is a listed site with MADEP and the groundwater is routinely tested following removal actions performed in 1999-2000. It had been contaminated by a previous furniture refinishing business. One of the automotive body shops reported that his floor drain was sealed about ten years ago after a mandate following a state inspection.

Some other findings include:

- √ Businesses with paved areas, the east side of the street that is closest to Carver's Pond, have storm water retention structures.
- √ Only three businesses identified drains in parking areas.
- √ Only one business identified use of environmentally friendly cleaning products. Some are not aware of what is being used by their contracted cleaner but were encouraged to discuss use of environmental friendly products with these companies.
- √ All expressed awareness of problems associated with pouring chemicals into drains (some did not consider household cleaners not used extensively to be a problem).
- √ Hazardous materials (to include oil, other automotive fluids, and paint) are handled in auto repair and body shops and stored in above ground tanks or barrels and are properly marked and disposed of (most have bi-monthly or monthly pick-up by a licensed collection company).
- √ Most were not aware of how the use of cleaning fluids can impact the water supply.

2.8 Small Business Green Initiatives

Based upon a review of the types of businesses located in the Carver's Pond study area it was seen that there was a large number of businesses involved in providing automotive services. As a follow up to the survey conducted, Dr. Hogan, Director of Suffolk University's Environmental Engineering program, was contracted to provide some limited consulting services and review of business operations. Based upon her review some recommendations were made regarding the possible use of green initiatives. These Best Management Practices (BMPs) are defined as a practice or combination of practices that minimizes harm to the environment and are effective and practicable. Some applicable BMPs for businesses are the use of less toxic cleaning products, using energy efficient equipment and office appliances, purchasing and using recycled products, using integrated pest management techniques, and selecting paints with low levels of volatile organic compounds (VOCs). For businesses with septic systems, proper septic system maintenance (care in what is put down the drain and regular pump outs) is an effective means of protecting the environment and avoiding expensive replacement costs.

Concern for the environment is rapidly becoming a focused initiative for big business because of a number of market factors: increased number of regulatory compliance issues and the costs associated with environmental compliance; increased understanding of consumers' desire to work with environmentally friendly companies; costs of using, recycling, and disposing of hazardous materials; awareness of costs of litigation for industrial and consumer exposures and accidents with hazardous materials; and increased need to be competitive in the global marketplace where energy efficiency and material conservation will be the determinants of business viability. Also, some larger companies are embracing the concept of environmental stewardship as part of their business philosophy. Most recently, General Electric has committed to a $1.5 billion effort ("Ecomagination") in the development of energy efficient technologies and resource conserving systems (http://ge.ecomagination.com/). Much of the emphasis of these environmental initiatives is on "greening" of organizations (opting for the use of less hazardous, recoverable or recyclable materials), energy conservation, and water conservation.

One of the goals of this outreach to the small businesses operating in the Carver's Pond study area was to make them aware that they can also embrace the ideas of environmental stewardship and help their customers understand the importance of environmental issues. To help them achieve this, several references were provided including a significant site set up by the United States Environmental Protection Agency (USEPA) for small businesses: the Small Business Ombudsman at http://www.epa.gov/sbo/. USEPA has made a commitment to unifying its activities related to small businesses and incorporating their voice into the development of regulatory initiatives (EPA Small Business Strategy Implementation Plan - Final, October 2004 [PDF file, 174KB] at http://www.epa.gov/sbo/).

USEPA has produced a number of assistance documents and other resources to help small businesses comply with their regulatory requirements and to be proactive about selecting more environmentally friendly methods and products, such as 100 EPA Small Business Initiatives [PDF file, 232KB]), resource guides for environmental assistance services and environmental assistance providers (Environmental Assistance Services For Small Businesses: A Resource Guide [PDF file, 210KB]; A Resource Directory of Small Business Environmental Assistance Providers EPA 233-B-02-001, March 2002 [PDF file, 970KB]), and recommendations for handling hazardous wastes (Little Known But Allowable Ways to Deal with Hazardous Waste [PDF file, 599KB]). All these files are available at www.epa.gov/sbo/.

Since Bridgewater is located in EPA Region 1, the appropriate link is www.epa.gov/region01/assistance/smallbusiness/index.html. Links on this page include Pollution Prevention (P2) practices to minimize waste and reduce the costs associated with their generation, treatment, and disposal (http://www.epa.gov/p2/), a downloadable P2 Small Business Guide for the prevention of waste generation located at (http://www.epa.gov/p2/assist/sbg.htm), and a National Pollution Prevention Resource Guide (http://www.epa.gov/p2/pubs/resource.pdf). The National Pollution Prevention Resource Guide provides information on agencies, organizations, and businesses committed to sound environmental practices, like the Green Business Network (www.Green.Biz.com) and WaterWiser (www.waterwiser.org), an Internet clearinghouse for water-efficiency and conservation.

There is also guidance available on conducting environmental audits, which allows small businesses to evaluate their performance regarding compliance with existing regulatory requirements, effective-

ness of management policies, and the status of greening efforts. A good resource is the Small Business Sourcebook on Environmental Auditing (EPA 233-B-00-003, May 2000) at http://www.epa.gov/sbo/auditbook_500.pdf. Even if a business has conducted an audit in the past, it is good practice to revisit environmental compliance issues on a regular basis to ensure continued compliance and to learn about alternatives — for example, greener cleaning products.

In addition to more general information for small businesses, guidance documents for specific classes of businesses are also available. For example, a number of the businesses in the area of interest for this grant are automotive repair facilities. USEPA has published a Consolidated Screening Checklist for Automotive Repair Facilities Guidebook (October 2003). The guide, an update to the 1997 version, was developed as a public service to auto service and repair industry. Owners can assess their compliance with federal requirements and determine if a more comprehensive self-audit is necessary. The guide is available online at www.ccargreenlink.org/vshops/FinalAutoGuide_092503.pdf. More regulatory assistance is available through the CCAR-Greenlink® Compliance Assistance Center at www.ccar-greenlink.org . Some of this material was used in the outreach to the Carver's Pond study area.

As well as UESPA resources and links, there are initiatives put forth by the Commonwealth of Massachusetts that will help small businesses think about their role in stewardship of the environment. Small businesses can learn about the reduction of the use of toxic materials at www.mass.gov/dep/bwp/dhm/tura/turhome.htm and find a number of useful links at www.mass.gov/dep/bwp/dhm/tura/other.htm, including the Northeast Business Environmental Network (www.nben.org/) and the Environmental League of Massachusetts (www.environmentalleague.org/).

To aid businesses see how using green products can help their bottom line, a USEPA document entitled "Greening Your Products: Good for the environment, good for you bottom line." (February 2002) may be helpful. This document is available at http://www.epa.gov/opptintr/epp/pubs/jwod_product.pdf

As noted there is an abundance of material available to businesses with information on ways to incorporate more environmentally friendly products and practices into their business that will result in cost savings. One of the most obvious obstacles is that abundance. Too often businesses neither have the resources or the time to review and/or implement changes in the way that they do business.

For example, in limited post-survey follow-up visits to four businesses in the Carver Pond area, the following information was evident:

- Businesses seemed aware of the sensitive nature of the Carver Pond area.
- In order to consider the use of environmentally friendly products or services, a quantifiable positive economic benefit to the small business must be demonstrable.
- Variability exists on where small businesses get their environmental regulatory and preferred practice information. Information sources cited were chemical suppliers, hazardous waste haulers, professional societies, Internet resources, insurers, and government websites.
- Some industry targeted documents (for example, the Consolidated Screening Checklist for Automotive Repair Facilities Guidebook) were not known to exist.

- Variability exists in how environmental issues are routinely addressed. In most cases, environmental issues were managed on an "as needed" basis, usually by the owner.

Based on these limited observations, some recommendations are as follows:

- Continue the conversation with small businesses in the Carver Pond area by providing targeted information to the specific businesses in the protection area. One possible venue would be business organizations in the Bridgewater area.
- Encourage owners and operators to view environmental issues on a less sporadic basis by making suggestions on incorporating brief environmental checks that can be incorporated into monthly routines.

2.9 Residential informational program and community outreach

Photo 15

On Saturday April 23, 2005, a public forum was presented to residents and interested parties, shown in Photo 15. The presentation was targeted as part of Earth Day activities. It was held at the Bridgewater Senior Center, 10 Wally Krueger Way, from 10:00 to 11:30 am. A 400 piece mailing was sent out to residents identified within the study area that were on town septic and have private wells. In addition, a widespread emailing effort was made and posters were distributed to the library, grocery store, Senior Center, and churches.

Dr. Hogan of Suffolk University's Environmental Engineering program, Katherine Doherty of Natural Resources Trust of Bridgewater, and Anna Nalevanko grant business outreach coordinator each presented information relative to the Carver's Pond study area. Copies of the mailing, information that was distributed, the sign up sheet and meeting minutes are included in Appendix E.

In addition, informational tables were set up at the May and June Town Meetings where several hundred handouts were distributed. The handouts included a summary of the grant work, a map of the study area, information on the recreational use of Carver's Pond and a trail map. Included was information regarding the vernal pools, with general information on the certification process.

There were also photos taken from a recent incident of vandalism near the wellfields. There was evidence of extensive use of ATVs, rutting and ramps along with significant amounts of trash left in the area. The area that this incident was reported to have occurred in is an area that is designated restricted use. No area of the Carver's Pond conservation land is designated for motor vehicle use, aside from Water Department service trucks.

In explaining this destruction, one young resident expressed concern for the lack of areas set aside for ATV use and did not understand how riding in a conservation area could harm the environment. It was explained that the destruction of the vegetation, the rutting and ramping and trash changes

the nature of that environment and leaves it vulnerable to the introduction of contamination carried in by the vehicles. Unfortunately, he appeared unconvinced.

On May 2, 2005, grant coordinators met with local area volunteer, Maura Chappelle, to discuss ways to provide interested residents opportunities to present results of the grant work. Although there were several attempts to coordinate this effort, including several phone calls to local residents, the grant coordinator was unable to schedule a separate local meeting during the course of this grant work. The grant coordinator has expressed willingness to participate in future meetings of the Carver's Pond neighborhood group.

2.10 Preparation of an informational handout for Bridgewater residents

Following the completion of the work performed and concurrent with the preparation of the final report, an informational brochure was prepared that included a summary of the primary components of the grant. Eighty-five hundred copies of the brochure were produced and distributed, using the same mailing list that the Water Department uses for the Consumer Confidence Report. This provided consistency and assurance that all water users in Bridgewater would be informed regarding the grant work. This was a labor intensive project that required considerable volunteer hours in addition to the preparation of a concise and attractive piece. A copy of the brochure is included as Appendix F.

2.11 Education outreach program - 2nd through 4th grades George Mitchell Elementary School

Meetings were conducted with Dr. David Costa, Mr. Brian Lynch and several teachers beginning in January 2004 to involve the elementary school administration and faculty in the development of suitable material for the targeted second through fourth grade classes.

Ultimately, a group of Suffolk University students volunteered to develop a story about Carver's Pond and beyond. This story was the second in a series of stories by this talented group of students. It provides an entertaining and educational tool to assist young people in their understanding of the workings of the environment at and around Carver's Pond. A sample of the story is included in Appendix B of this report. It was printed with recycled paper in black and white, so that the students could use it as a coloring book. Twelve hundred copies of the story were published and distributed in the elementary school.

This outreach was coordinated with Dr. Costa, the administrative staff at the three houses and all 2nd, 3rd and 4th grade teachers. It was conducted on June 6 and 8, 2005, according to a prepared schedule, using two teams consisting of two educators and two college student volunteers who provided a 20-25 minute presentation to the 28 classrooms. There were a total of 770 students, with an average class size of 28 students.

The two-day outreach effort that involved the 28 classes was launched by Fawn Sances and her colleagues. Dr. Patricia Hogan of Suffolk University and Melissa K. Sances visited 14 classes. During

each visit, Dr. Hogan explained what the grant was and reviewed terms like watershed, aquifer, water cycle and groundwater. She asked the class if they had been to Carver's Pond, and most students had. Ms. Sances then read the class the story that Dr. Hogan's students had written about Carver's Pond, and following the story Dr. Hogan fielded questions. (Photo 16)

The second team consisted of Fawn Sances and Anna Nalevanko on Monday and Fawn Sances with Jessica Rene Gifford on Wednesday. These groups covered the other 14 classes. Mrs. Sances began by asking the students if they brushed their teeth in the past day or so. To this all the hands went up. Then, she asked if they had flushed a toilet in the past day? Some seemed a little unsure of this question. But, they all knew that both these actions required water. The classes talked about where we get water and where does it go once we've used it. As with Dr. Hogan's team, most of the students had visited Carver's Pond, many with their second grade teacher, Mrs. Cantave.

Photo 16 — Students listening to the Pollution Prevention story

All classes were attentive, though some were fairly subdued. Students were generally very enthusiastic about sharing their relationship with Carver's Pond. Many shared anecdotes about trips they took to the pond, or described where they lived in relation to the pond.

Most students recognized terms related to the water cycle but could not define them without prompting. However, they were able to describe the water cycle in detail, though many thought that evaporation always followed precipitation. Dr. Hogan explained the concept of runoff to several classes, and prompted the classes to think about how wells functioned and how water got into and back out of the ground. When doing so, she described the watershed as "a huge Earth bowl," in which all the water settled at the bottom, as it would if water were poured into a traditional bowl. Students seemed to enjoy this analogy and have a basic understanding of the term.

Most students retained key information in the story and were excited about taking it home. Questions about the story included, but were not limited to: What kind of species was Alexandria? Is eutrophication in the glossary? Did they really clean the pond in real life? How old are the ducks? Where does the water go when the pond turns into land? (This question was asked in regards to the process of eutrophication.) Do you guys live at Carver's Pond?

Students seemed to enjoy being involved in the presentation. They responded well to questions and even if they did not fully understand a concept, they responded enthusiastically when prompted. Many classes applauded at the end of the story; they seemed to like being read to, and seemed to retain information better if they were asked questions periodically throughout the story.

The format of the presentation seemed to work well; students were sometimes asked to sit in a circle around the presenters. The students were given the books after the presentation so that they were not distracted. The story seemed to work well as it was interactive; the animal characters also made the story fun and the concepts easier to understand. The story did seem a little long and dense at times; in the future it might be better to focus on a few key issues using a shorter book.

2.12 Completion of a final report

At the completion of this grant work this final report has been prepared. It includes detailed information relating to the various components of study, including photographs, data tables, maps, and other reference material. Copies of this report have been submitted to the Massachusetts Department of Environmental Protection, Bridgewater Water Department, Board of Health, Conservation Commission, Planning Board, Board of Selectmen, Community Development Office, Fire and Police Department. In addition, copies of the report were provided to the Bridgewater Public Library, George Mitchell Elementary School, and Bridgewater State College. It is the intention of the program coordinators that a copy of this report be made available in an electronic format compatible with that used by the Town of Bridgewater for posting on the webpage through the Office of Community Development (OCD).

3.0 Successes and/or effectiveness of the project

The application of this grant provided necessary support to meet the desired education of the three targeted groups. There were two significant successes. The first was the creation of the story book by the Suffolk University students. This was a delightful story that has provided some enthusiastic discussion at the dinner tables around town, according to some recent feedback.

The second was the business outreach. The effectiveness of direct contact provides an invaluable link between the businesses and the town government. There was a direct benefit noted by the degree of involvement on the part of many of the businesses. This demonstrates the importance of "face to face" contact.

The computer generated GIS mapping has also provided the Town of Bridgewater with useful tools regarding the delineation of the sub-basins within the Taunton River Watershed, the stormwater mapping, the location of two vernal pools, the series overlay of private wells and the shaded mapping of non-sewered areas. The maps are an effective way to show the widespread responsibilities of the various town departments and the breadth of their protective efforts. These layers will add to GIS work completed by the OCD and under the Wellhead Protection Grant.

Lastly, the creation of this report document can be of great value by the nature of its completeness. It incorporates in detail significant characteristics of the various components that make up the Carver's Pond study area and provides a guide to others who may want to undertake similar study.

4.0 Difficulties and how they were addressed

The outreach work was performed by contract personnel, in the absence of town employees. Additional printing costs were reallocated from the existing salaries budget to facilitate greater educational outreach. The changes in personnel from the original grant were necessitated due to the absence of a Community Development Coordinator. This position was vacated shortly after the grant was received. Due to budget constraints the Town of Bridgewater has not filled the position and remaining staff hours have been severely limited. One of the original team members, Fawn Sances, former Water and Sewer Commissioner, has been authorized by the Water Department to

act of their behalf as the Project Manager to facilitate the completion of the Source Water Protection Grant. To assist in the preparation of the GIS components, LaDonna Luckman, a student at Bridgewater State College was recommended by Katherine Doherty to work on that scope of work. Working together, the outstanding tasks were completed.

The loss of several key staff persons during the course of the grant presented difficulty in maintaining consistency with reporting requirements. Future grant work will include a plan to address the reporting in the event that key personnel are absent and an alternative person will be selected.

During the course of the work completed under this grant several areas were identified that have been recommended for upgrade and improvement, specifically, the information relative to stormwater and drainage issues. Several areas of concern were identified during the course of the survey including areas of dumping of grass clippings and brush that acts to obstruct the flow pathways, short circuiting of drainage structures, submerged outfalls, oily sheens from roadway runoff, and a buried catch basin that resulted in a severe flooding condition. This information will be provided to the Bridgewater Highway Department for their review and action.

5.0 Recommendations for future Source Water Protection projects

There was a strong desire to incorporate a modeling component in the evaluation of the surface water. Carver's Pond has been the subject of much study by the Bridgewater State College Watershed Laboratories, headed by Dr. Kevin Curry. It was initially hoped that more work could have been conducted jointly, however, schedules did not allow the additional time necessary. This would have entailed accumulating the data that has been collected and putting it into a usable format for incorporation into one of the water models (i.e. Lake 2k, P8 or BASINS).

Along similar lines, it might have been recommended to include some water quality testing, particularly, some of the parameters used in stormwater evaluations. And possible some other forms of modeling to demonstrate the potential impact associated with private well withdrawals.

The development of a physical model was also considered, that would provide a way to demonstrate the interaction of municipal wells, private wells, septic systems, sewerage systems and the hydrologic cycle.

Appendix A

NRTB Carver's Pond Management Plan

Carver's Pond Management Plan And Handbook

Prepared for the
Natural Resources Trust of Bridgewater

By

Mass Audubon
Protecting the Nature of Massachusetts
Ecological Extension Service

November 2004

The preparation of this report was made possible with grant funding from The Boston Foundation and other private donations.

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Cover Photo - Aerial view looking over Water Treatment facility toward Town Center with college on right. Photo by Jack Manchester.

How This Management Plan Was Prepared

The Natural Resources Trust of Bridgewater, working with the Massachusetts Audubon Society Ecological Extension Service, prepared the Carver's Pond Management Plan and Handbook. Kitty Doherty managed the project for the NRTB and Bill Giezentanner served as the park management consultant from Mass Audubon. Ecological Extension Service is a program through which Mass Audubon shares its expertise in land management with conservation partners such as land trusts, towns, and agencies.

Funding for this project was provided in part through a grant from The Boston Foundation's Fund for the Environment and through private donations.

This plan is the result of an open process that involved citizens of Bridgewater and representatives of the town's government. There were a variety of publicly advertised opportunities to have input into the management plan. On June 17, 2003 and on November 22, 2003 there were publicly advertised site walks at the pond where neighbors, potential stewards, and interested residents reviewed a variety of aspects about the site's history and future management. Goals and objectives for the future management of the pond were discussed. In the summer of 2004, the draft plan was available on the NRTB website and at the Public Library, and dozens of individuals offered edits and comments to the plan. NRTB is grateful to all who participated in the development of this guidance document, assuring thoughtful and appropriate management of Carver's Pond in the future.

"Nicky" looking over Pond. Photo by Carrie Silva.

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The Natural Resources Trust of Bridgewater and the Mass Audubon Ecological Extension Service would like to acknowledge the timely and thoughtful assistance provided by the following persons and agencies:

Name	Representing
Leslie Goldberg	Friends of Carver's Pond
Mark Goldberg	Friends of Carver's Pond
Ursula Garfield	Friends of Carver's Pond
Larry Spector	Friends of Carver's Pond
Bob Giamperoli	Friends of Carver's Pond

Name	Representing
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Steve Wilson	Friends of Carver's Pond
Gay Wilson	Friends of Carver's Pond
Jack Hart	Friends of Carver's Pond
Pat Hart	Friends of Carver's Pond
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Peter Fletcher	Friends of Carver's Pond, abutting neighbor
Don Wood	Abutting neighbor
Chet Wood	Abutting neighbor
Skip Copeland	Abutting neighbor, NRTB
Kitty Doherty	NRTB
Bob Frederick	NRTB
James Hayes-Bohanan	NRTB
Eileen Hiney	NRTB
Hank Estabrook	NRTB
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Kevin Curry	Professor of Biology, BSC
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Maura Chappelle	Lead Steward at Carver's Pond
Andy Bagas	Superintendent, Highway & Forestry Departments
Fawn Saunces	Municipal Planning Board, Master Plan Implementation Committee
Cindy Allen	Master Plan Implementation Committee
David Matton	Master Plan Implementation Committee
Herb Lemon	Board of Selectmen
Rick Krane	Conservation Commission
Laurie Keane	Conservation Commission
David Moore	Town Historian
Paula Cantave	Elementary Teacher—Outdoor classroom
Carole Smudin	Community resident
Hal Estabrook	Community resident
Madeline Moore	Community resident
Nancy Rowbottom	Community resident
Theresa King	Community resident
Vaughn Easton	Community resident
Jason Veaudry	Community resident
Erika Shaw	Community resident
Jack Manchester`	Photography
Carrie Silvia	Photography

Carver's Pond Management Plan

Introduction

The Natural Resources Trust of Bridgewater, working with the Massachusetts Audubon Society's Ecological Extension Service, has prepared this Management Plan for Carver's Pond. In accordance with the approved Community Master Plan, Bridgewater has been working to enhance an already rich constellation of open spaces. This management plan is one effort of many to understand and improve their management. Design plans and management plans are being contemplated or prepared for other town open spaces, with each site presenting unique challenges and opportunities. In 1999 students at the Conway School of Landscape Design, at the request of the Natural Resources Trust of Bridgewater, prepared a preliminary design plan for Carver's Pond. This management plan builds on that effort and provides a basis for ongoing development of trails and other facilities. It includes design recommendations and details that will allow the town and volunteers to help realize the potential offered by this important site.

Size, Location, Access, and Surroundings

The Town of Bridgewater owns 107-acres around Carvers Pond, with the 20-acre pond serving as an important part of its municipal water supply and also as an open space for passive recreation. The Pond is located between Bedford Street and Summer

Street—two very busy roads. Its main access is located south of Bridgewater State College on Summer Street, only a short walk from the center of Bridgewater.

The neighborhood has a very pleasant, historic feeling with older homes as well as some newly developed residences. Currently there is a small parking area (6 to 8 cars) where Summer Street crosses South Brook. There is an attractive orientation kiosk and map at the entrance, created by the Friends of Carver's Pond Stewardship Group.

J. W. Lynch

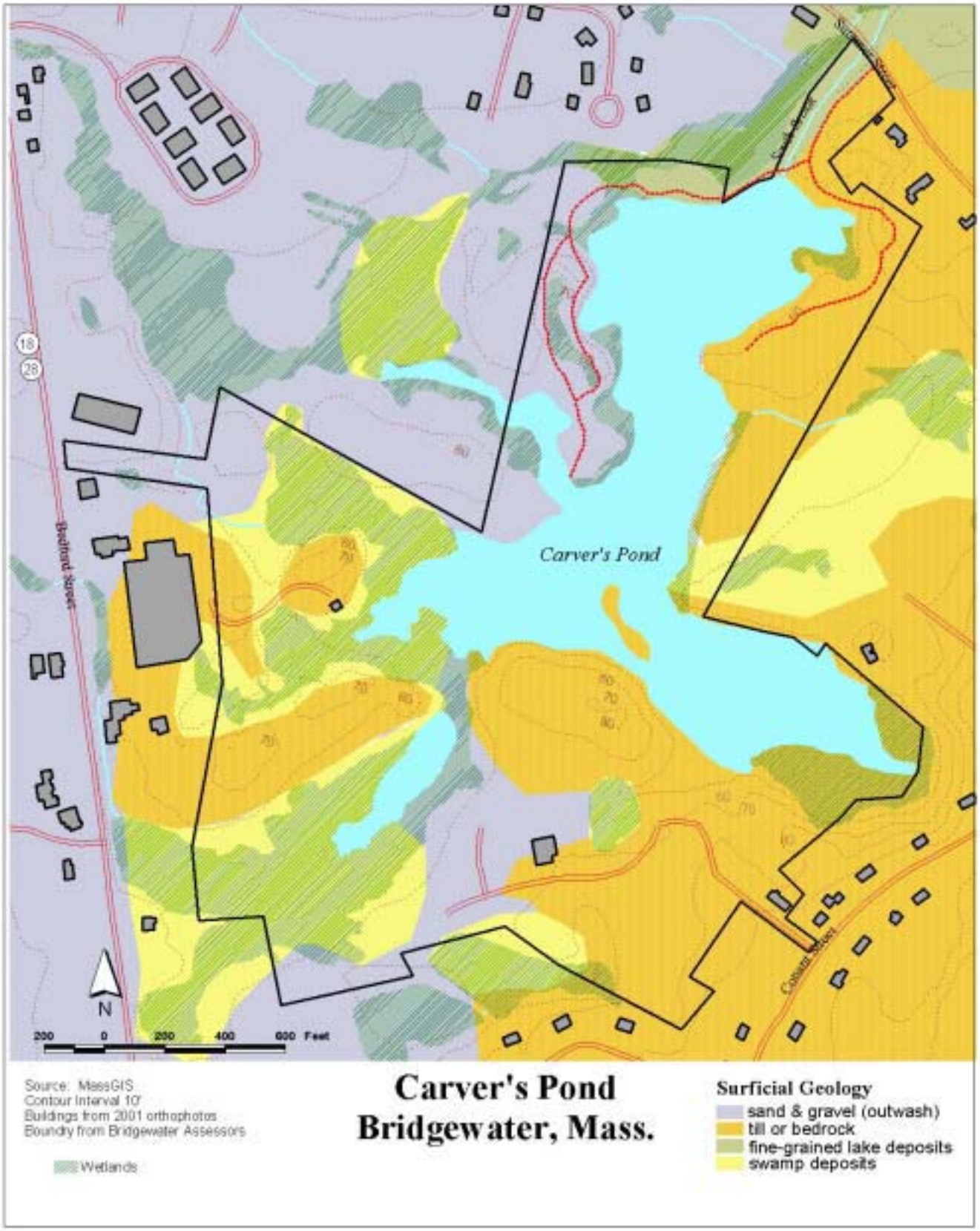
The pond itself has 9,300 feet of shoreline, a maximum depth of 7.9 feet, and a mean depth of 3.4 feet.

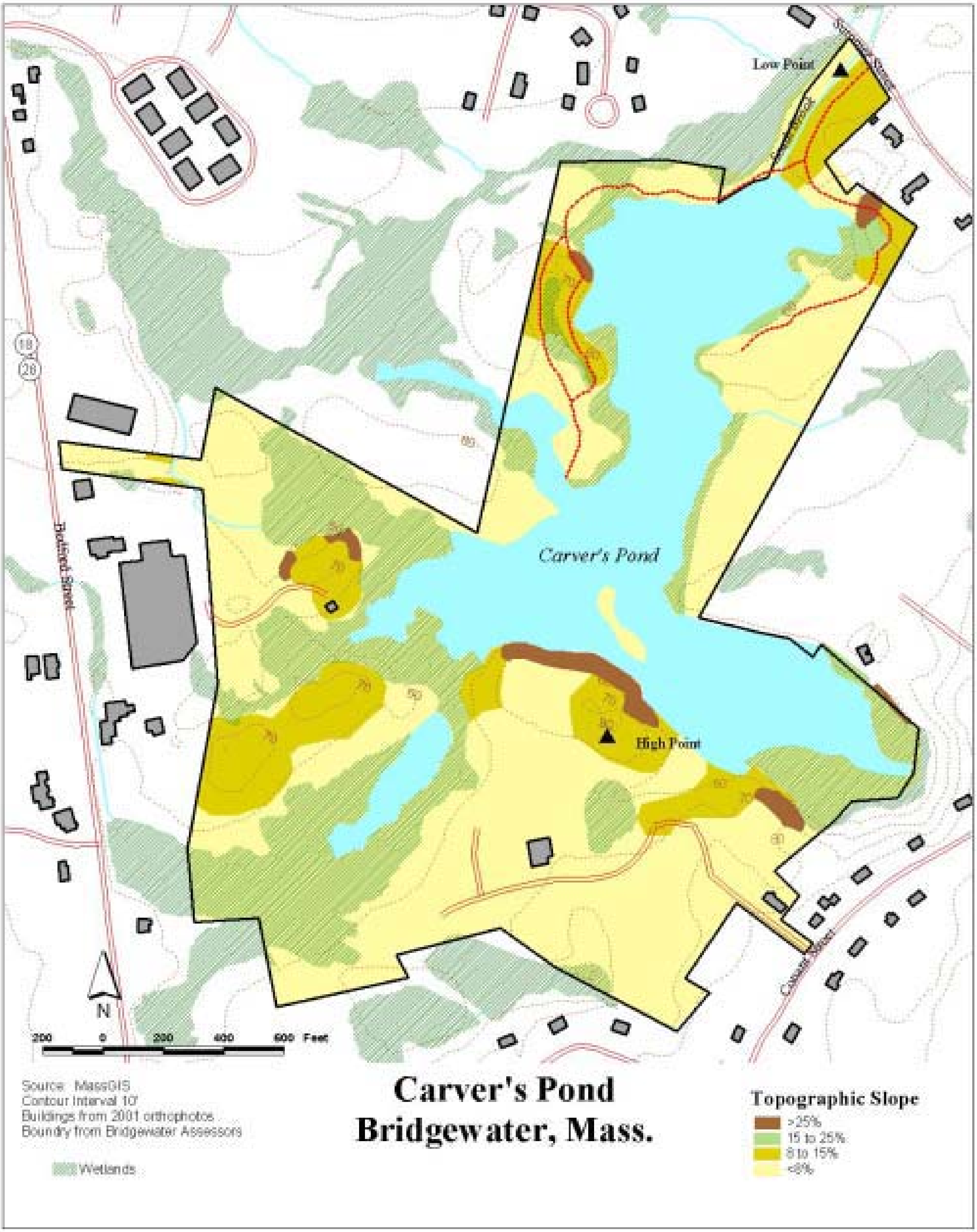
The southern end of the town-owned land is the site of five of the town's water supply wells (wells #1, 2, 4, 5, and 7 – which ironically is inactive because it has insufficient useable water!). These wells are rated to supply 1.5 million gallons per day, even in the summer. Other town wells are located on the southerly bank of the Matfield River at High Street. The Water Department maintains four pump houses and the Municipal Water Treatment plant at Carver's Pond.

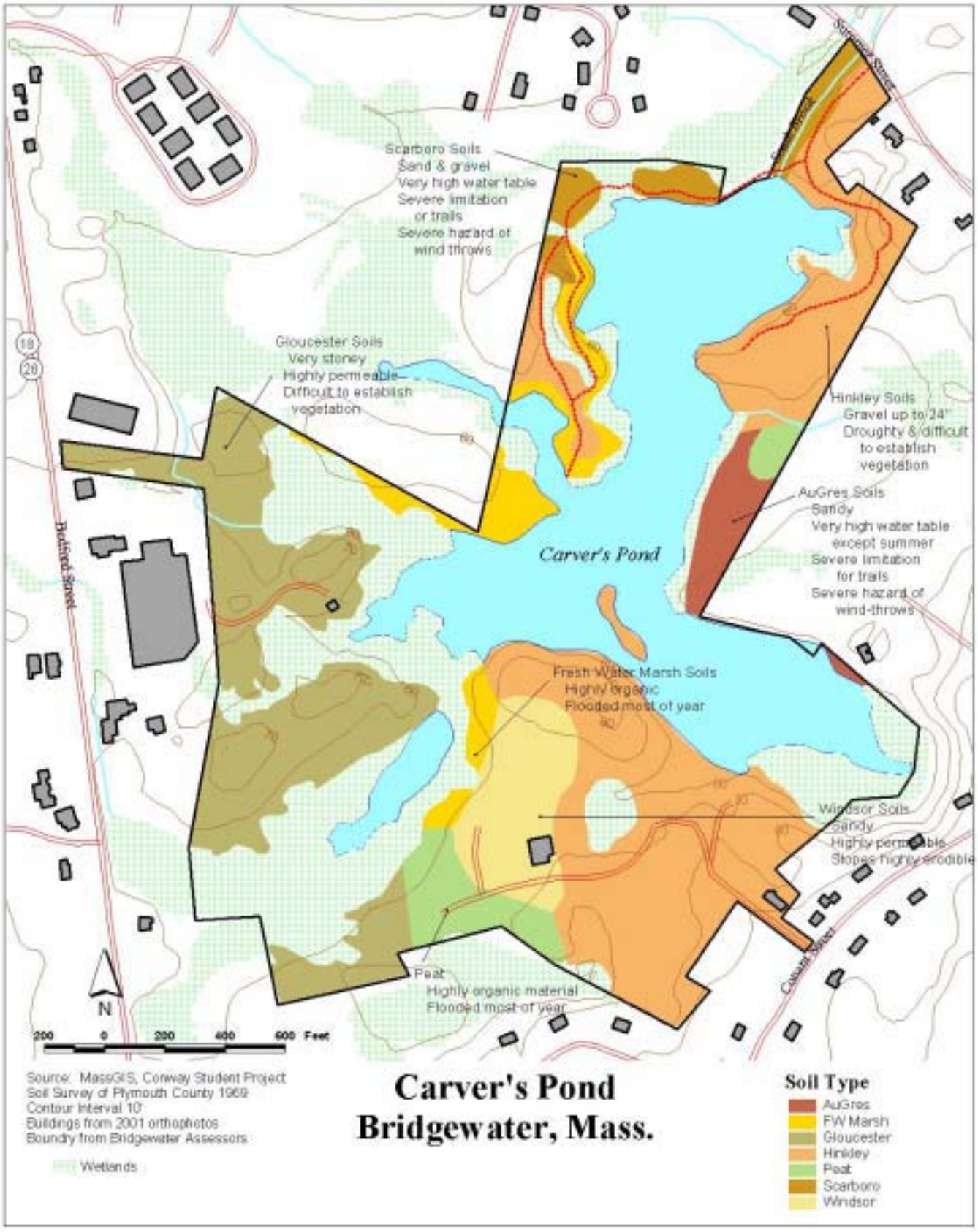
Geology, Topography, Slope, and Soils

Surficial geology is the underlying basis for both natural systems and human use and provides important information about an area's environmental potentials and vulnerabilities. The glaciers that covered New England more than 20,000 years ago left their mark on Bridgewater and the Carver's Pond site. As the two-mile thick layer of ice moved south it scraped the solid rock beneath it and carried along rocks and soil. A mix of material ranging from clay to boulders (glacial till) was deposited at the base of the glacier as it passed over the area. About 19,000 years ago, the temperature began to rise and the ice slowly retreated. As the ice melted, the melting water deposited sand and gravel, referred to as outwash. South and east of Carver's Pond was a large glacial lake (Glacial Lake Taunton) that existed at the end of the glacial era but has since drained, leaving extensive areas of lakebed silts and clays. Carver's Pond lies within an area of outwash deposits of sand and gravel. The low-lying areas on the western side of Carver's Pond were originally shallow water bodies that have filled in over time with organic debris (soft muck). Fine-grained alluvial deposits are left behind by slow moving water and are located along South Brook as it flows through Skeeter Mill Pond toward the Town River.

The water level in the pond is 54 feet above sea level while the site's highest point is about 80 feet on the top of a hill at the southern end of the pond; the lowest point is about 50 feet, below a small dam where South Brook crosses under Summer Street.


Carver's Pond
Bedford Street
18
28
N
200 0 200 400 600 Feet
Source: MassGIS
Contour Interval 10'
Buildings from 2001 orthophotos
Boundry from Bridgewater Assessors
Wetlands
Carver's Pond
Bridgewater, Mass.
Surficial Geology
sand & gravel (outwash)
till or bedrock
fine-grained lake deposits
swamp deposits


Low Point
High Point
Carver's Pond
Bedford Street
N
200 0 200 400 600 Feet
Source: MassGIS
Contour Interval 10'
Buildings from 2001 orthophotos
Boundry from Bridgewater Assessors
Wetlands
Carver's Pond
Bridgewater, Mass.
Topographic Slope
>25%
15 to 25%
8 to 15%
<8%


Scarboro Soils
Sand & gravel
Very high water table
Severe limitation
or trails
Severe hazard of
wind throws
Gloucester Soils
Very stoney
Highly permeable
Difficult to establish
vegetation
Hinkley Soils
Gravel up to 24"
Droughty & difficult
to establish
vegetation
AuGres Soils
Sandy
Very high water table
except summer
Severe limitation
for trails
Severe hazard of
wind-throws
Carver's Pond
Fresh Water Marsh Soils
Highly organic
Flooded most of year
Windsor Soils
Sandy
Highly permeable
Slopes highly erodible
Peat
Highly organic material
Flooded most of year
Bedford Street
Cobbett Street
Summer Street
18
28
N
200 0 200 400 600 Feet
Source: MassGIS, Conway Student Project
Soil Survey of Plymouth County 1969
Contour Interval 10'
Buildings from 2001 orthophotos
Boundry from Bridgewater Assessors
Wetlands
Carver's Pond
Bridgewater, Mass.
Soil Type
AuGres
FW Marsh
Gloucester
Hinkley
Peat
Scarboro
Windsor

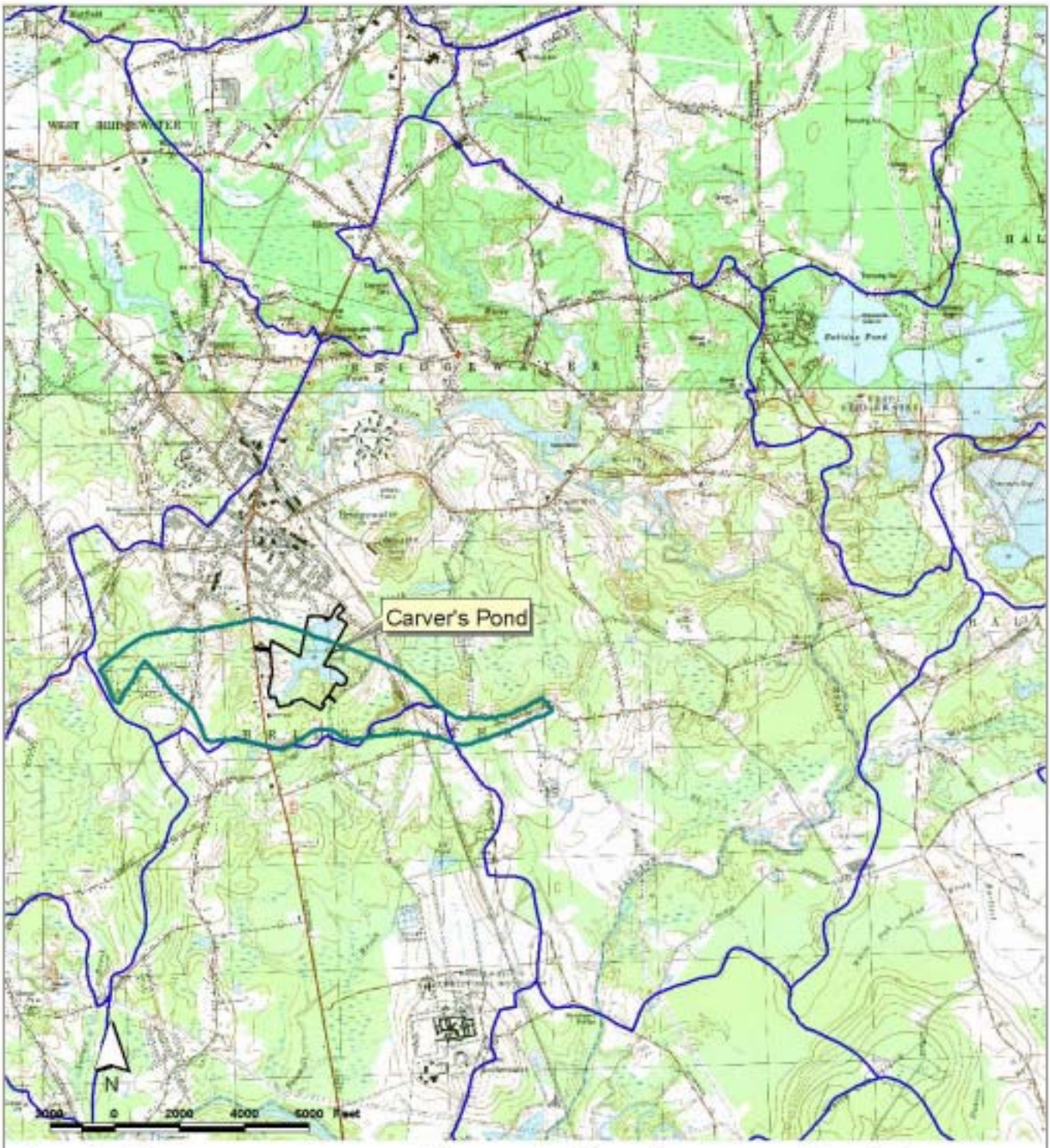
The great majority of the site is gently sloping to rolling. Steep slopes, some more than 25%, occur along portions of the banks of the pond and along the edges of a few hills. A small esker-like ridge lies along the western edge of the pond.

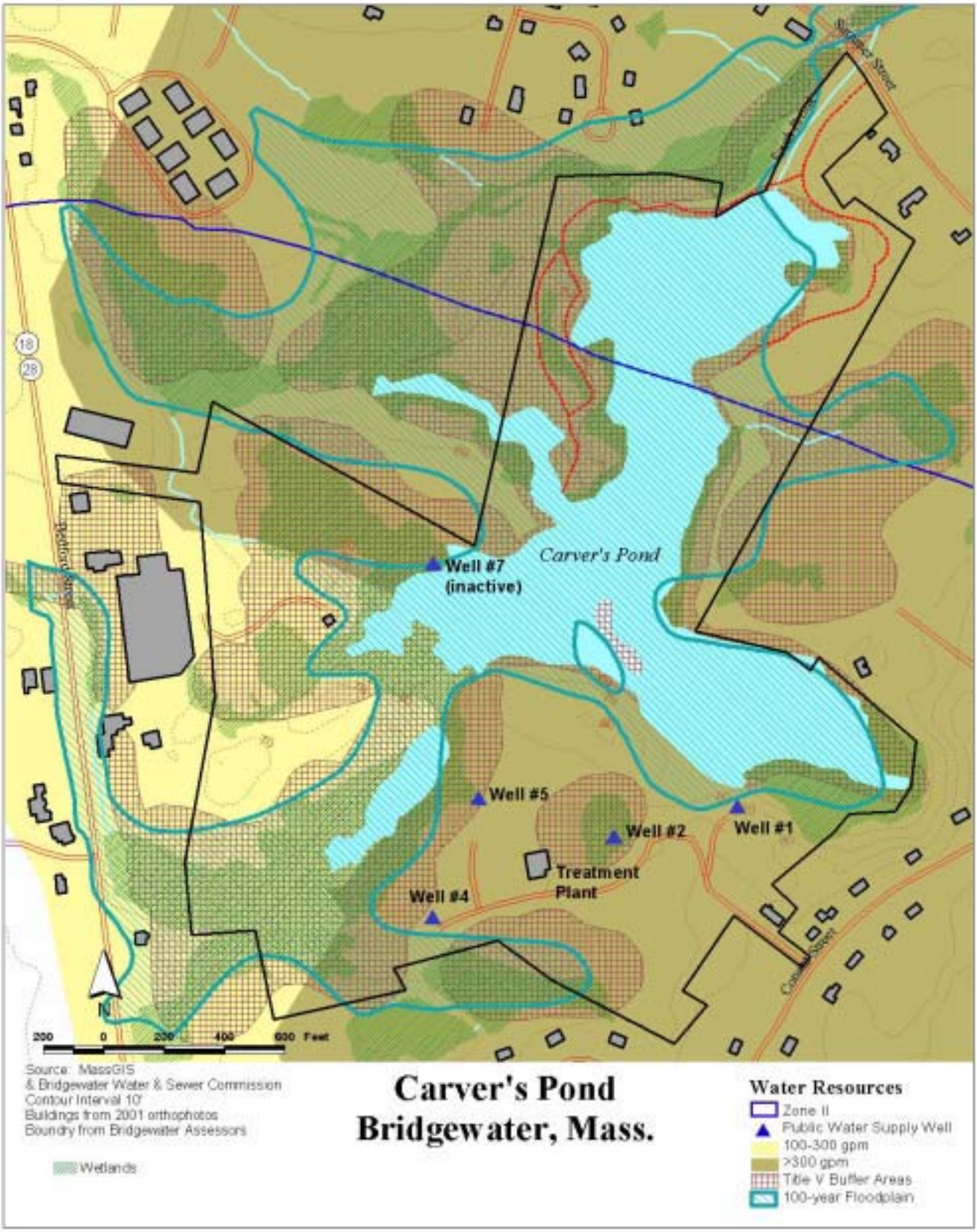
The site includes seven soil types—AuGres, Fresh Water Marsh, Peat, Scarboro, Hinkley, Gloucester, and Windsor. The AuGres soil type is located on the eastern edge of the pond. It is a very sandy wetland soil that has a seasonal high water table at or near the surface during the wet season of the year. Because of wetness it is generally poorly suited for trails. Fresh Water Marsh soils fringe much of the pond and cover much of the western side of the pond. Gloucester soils are located on the upland areas of the western side of the pond. This soild type is generally excessively drained and very stoney. Peat is located on the eastern edge of the site and along part of the southern boundary. These marshy soils are flooded much of the year and have a high content of organic material. The Scarboro soils are located along South Brook and the northwestern edge of the pond. They are wetland soils with a very high water table and because of wetness are generally poorly suited for trails; trees are not deeply rooted and can be easily blown over. The Windsor soil type covers an area on the southern side of the pond. It consists of deep sands and is highly permeable. Windsor and Hinkley soils are generally suitable for trails and other recreational uses so long as steep slopes are avoided. Areas of Windsor, Gloucester, and Hinkley soils have very rapid permeability and are often groundwater recharge areas.

Water Resources

Wm Giezentanner

As the location of several town wells, this site is almost all about water resources. Carver's Pond itself is the site's major surface water feature. It is located near the eastern edge of the


Carver's Pond
N
0
2000
4000
6000 Feet
Source: MassGIS
Contour Interval 10'
Carver's Pond
Bridgewater, Mass.
Watershed
Watershed Boundary
Watershed Protection Area
(Zone II)


Carver's Pond
Well #7
(inactive)
Well #5
Well #2
Well #1
Treatment
Plant
Well #4
18
28
N
200 0 200 400 600 Feet
Source: MassGIS
& Bridgewater Water & Sewer Commission
Contour Interval 10'
Buildings from 2001 orthophotos
Boundry from Bridgewater Assessors
Wetlands
Carver's Pond
Bridgewater, Mass.
Water Resources
Zone II
Public Water Supply Well
100-300 gpm
>300 gpm
Title V Buffer Areas
100-year Floodplain

South Brook Watershed, a sub-watershed of the Town River. South Brook flows into the pond from the westerly side of Bedford Street and flows out on the east, under Summer Street, then northeast under the railroad tracks, through Skeeter Mill Pond, and along Water and Wood Streets, under Plymouth Street to join the Town River upstream from the Hayward Street Bridge. Here the Town River meanders before joining the Matfield River to become the major Taunton River at Plymouth Street (Route 104). These rivers are important canoe and kayak routes that can be used to visit a chain of Bridgewater open spaces including Iron Works Park, Stiles & Hart Conservation Area across the stream from the Town River Landing, Tuckerwood Conservation Area, Wyman Meadow Conservation Area, several protected farms, state land, and the Titicut Conservation Area. About 12 river-miles long, the Town River begins at the northeast corner of Lake Nippenicket on the west side of Bridgewater and passes through the Hockomock Swamp into West Bridgewater. After it meanders for miles and joins the Matfield River to form the Taunton River it flows 44 miles to the ocean at Mount Hope Bay. These rivers are important habitat for seasonal migration of herring, and popular for recreational fishing as well, offering the sportsman good fishing for bass, trout, pickerel, yellow perch, crappie, and other fish.


Water Treatment Plant

As mentioned earlier, Carver's Pond is the source for 60%-70% of the Town's water supply. Most of the pond and a more extensive upland area to the south are designated as a Zone II Watershed Protection Area. The Town of Bridgewater also designates this area as an Aquifer Protection District. Special state and local laws apply to this area in order to protect the town's drinking water supply. For example, gas stations are not permitted in the Zone II area (the Getty Station at Winter and Bedford Streets is grand-fathered). The underlying aquifer is a geologic formation of rock, sand and gravel that contains significant amounts of water. The Water Resources map shows the aquifer in two tones indicating the amount of water provided in gallons per minute.

Another water related feature of the site is the floodplain around the pond and its wetlands. The 100-year floodplain shows that a portion of the site is subject to periodic flooding.

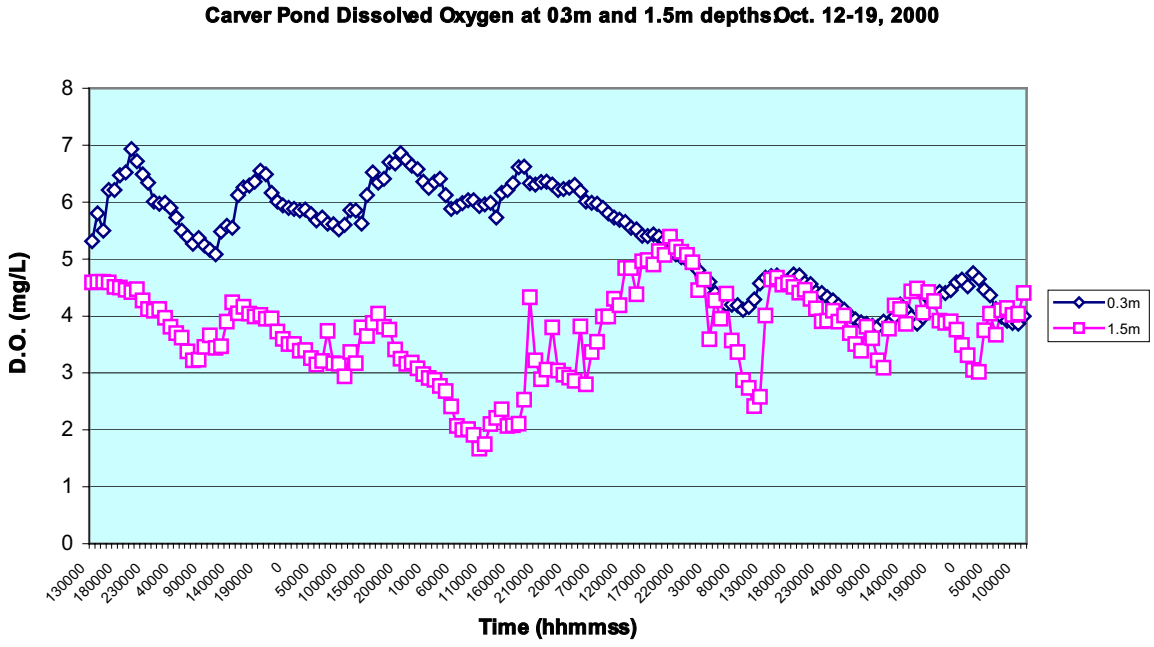
There are also Title V Buffer Areas around the pond and the surrounding wetlands. These areas have health code limitations restricting the installation of septic systems in order to prevent water pollution.

Eutrophication

One of the main questions about the future of Carver's Pond revolves around eutrophication. This is a natural process that results in the slow filling in of a pond. It normally occurs over a period of thousands of years. But the rate of filling can be increased by nutrients added from human activities. Agricultural runoff, urban runoff, lawn fertilizers, leaking septic systems, sewage discharges, eroded stream-banks, and similar causes can increase the flow of nutrients and organic substances into an aquatic system. These substances (especially phosphorous and nitrogen) can over-stimulate the growth of algae, creating conditions that interfere with the water body's appearance, its recreational uses, and the health and diversity of indigenous fish, plant, and animal populations.

Algal blooms hurt the system in two ways. First, they cloud the water and block sunlight, causing underwater grasses to die. Because these grasses provide food and shelter for aquatic creatures, spawning and nursery habitat is destroyed and waterfowl have less to eat as grasses die off. Second, when the algae die and decompose, oxygen is used up. Dissolved oxygen in the water is essential to most organisms living in the water, such as fish. Much of Carver's Pond is shallow and some observers have noted algal blooms. The Massachusetts Office of Water Resources Lakes and Ponds Program funded a public education effort in 2000 to work with an outdoor classroom for school-aged children and develop an informational brochure, signage and a video to increase public awareness on the ecosystem of the pond.

Adequate dissolved oxygen (D0) is necessary for good water quality. Oxygen is a necessary element to all forms of life. Most DO in ponds is produced during photosynthesis by aquatic plants and algae. For this reason DO increases during daylight hours, declines during the night, and is lowest just before daybreak. As dissolved oxygen levels in water drop below 5.0 mg/l, aquatic life is put under stress—the lower the concentration, the greater the stress. Dissolved oxygen concentrations below 5 mg/L may be harmful to fish and "piping" (gulping air at the surface) may be observed when DO falls below 2 mg/L. Oxygen levels that remain below 1-2 mg/l for a few hours can result in large fish kills. Dr. Kevin Curry and his Bridgewater State College classes have collected information on dissolved oxygen over the last several years. The following chart shows DO levels for one week in October 2000 at two different depths near the Piney Point area of the pond. It shows that the DO levels were well below 5.0 mg/l for a significant part of the observation period.



Another of his studies showed that the littoral areas near the shores start out in May with dissolved oxygen values in the low to mid 5.0-range. By the end of the summer, the higher temperature, lower water levels and extensive organic decomposition has pulled down dissolved oxygen levels below 1.0 mg/L. These samples show that Carver's Pond is

suffering some of the symptoms of low oxygen levels that are often associated with eutrophication.

What can be done about eutrophication? Prevention is much less expensive than pond restoration, which may involve dredging. There are many ways to curb the flow of nutrients into a pond but they take a concerted educational effort and may involve passing new regulations. See the Management section for recommendations on eutrophication.

Some observers have noted a decrease in the quantity and size of bass and pickerel in the Pond and wonder if this is a consequence of water pollution or eutrophication. The State Division of Fish and Game should be asked to do an assessment of the Pond and its fishery.

History

Much of the following material was adapted from a short history prepared by David R. Moore titled "Carver's Pond History and Other Stories."

For nearly 12,000 years the rivers in Bridgewater and the surrounding region provided a favorable ecological setting for local hunters and gathers. The rivers provided access to estuarine resources, smaller streams, and lakes and ponds, like Carver's Pond, that teemed with fish and other aquatic species. Various anadromous fish were particularly important subsistence resources since, on their spring spawning runs, a surplus of food could be harvested with little effort. The region's wetlands and forested uplands provided adequate food and cover for a wide range of resident and transient wildlife throughout the year. Sometime between 3,000 and 1,700 year ago, during what is called the Early Woodland Period, rich alluvial soils along the rivers were found to be suitable for raising newly domesticated maize, beans and squash (sometimes referred to as "the Three Sisters"). This led to more permanent settlements and a growth in population spurred by a more reliable food supply.

The hundreds of prehistoric sites within the Taunton River Drainage attest to the region's ecological viability throughout prehistory. Clearly the indigenous inhabitants recognized the region's potential and took advantage of the opportunities it offered. The existing archaeological record documents the resilience of the local peoples; it is a nearly 12,000-year old record of changing climates and ecological settings to which they responded by adjusting and adapting their cultural systems. In so doing they were enormously successful colonists and settlers. After the arrival of the first European ships to the Bay Colony, it took only a few short years for those 12,000 years of cultural adaptation to come to an end. The local Native American populations were ravaged by a series of devastating plagues (1616-1617, 1633-1634) and further cultural disruption was caused by conflicts with the European settlers, and finally internecine warfare, which, combined left much of southeastern Massachusetts depopulated of its indigenous people by the end of the 17th century. It is likely that Native Americans used the shores of Carver's Pond before it was dammed for hunting and fishing.

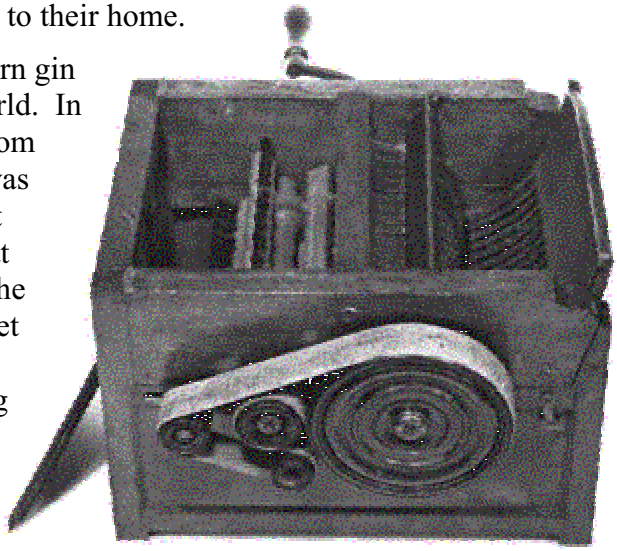
Carver's Pond was named for Eleazer Carver who owned a farm the area in the 1820s and '30s. Enoch Leonard had built a sawmill on South Brook more than one hundred years earlier. Early maps show Leonard's mill on a smaller pond at the west side of what is now

Carver's Pond[1]. In 1727 John Washburn bought shares in the sawmill owned by Enoch and Ephraim Leonard. In 1735 he also purchased the rights to an adjacent iron furnace from Nathaniel Ames. In 1737 he leased the land and mills to a group of men interested in the manufacture of iron. Among these were Capt. Jeremiah (Josiah) Edson, who was operating the iron foundry when it was closed by British troops in 1750—to assure the colonists' dependence on England. The Edson dam, powering the foundry, created Carver's Pond as we know it now. Edson's furnace may have been located at the northeast corner of the pond next to the old access road. Robert Washburn bought all of the property in 1746. In 1759 he leased the property to Timothy Perkins and Joseph Washburn. The mill would continue operation until the early 1800s under the operation of the Washburn family and was sometimes referred to as the Magnolia Mill.[2]

Eleazer Carver was born in 1785, at 45 Main St., just north of the center of town. As a young man he trained as a millwright at the Lazell Perkins Company iron works on High Street. He also apprenticed under Jacob Perkins and assisted him in opening a foundry in Franconia, New Hampshire. In the fall of 1806, he left Bridgewater to seek his fortune with little more than his box of tools. He traveled west to the Ohio River and then traveled south to Mississippi on a handmade raft. While living in Natchez he encountered several of Eli Whitney's cotton gins—a recent invention that saved many hours of hand labor and made cotton growing much more profitable. A plantation owner, Major Minor, near Natchez, hired Eleazer Carver to construct a gin for use on his cotton plantation. Although the first attempt was quite crude, it worked better than any other machine in production at the time. Encouraged by his success and financially backed by Major Minor, he continued to refine and produce his version of the cotton gin for the next few years.

In 1816 Carver returned to Bridgewater and founded The Bridgewater Cotton Gin Company, also known as the Carver Washburn and Company[3]. Abraham Washburn had been active in the iron business at Titicut and at Carver's Pond. Eleazer Carver eventually married Bethsheba Washburn in 1819 and built a magnificent home on Summer Street just north of the brook, where he resided until his death in 1866. To many, this was known as the "Four Legged Tree Farm" because of four elm trees that Mr. Carver had chained together and grew to form an arch over the front walk and entrance to their home.

Production rapidly grew and the Carver Washburn gin became a fixture in the south and around the world. In 1853 Carver was presented with a gold medal from India for his development of the cotton gin. It was said that Eli Whitney invented the cotton gin but Eleazer Carver made it work. Work continued at Carver's Pond until 1822 when Eleazer moved the operation to the "Great Mills" on Plymouth Street on the west bank of the Town River in Bridgewater. Later the cotton gin manufacturing plant was moved to East Bridgewater on the Sautucket River. Bridgewater in the 1800's,



An early cotton gin.

[1] Bridgewater Map 1741, Bridgewater Public Library
[2] Bridgewater Independent, July 18, 1906
[3] History of Plymouth County, D.H. Hurd, pg. 791

earned a reputation around the world as a center for early cotton gin production. Many of the machines produced here can be found in textile museums around the world. A fine example is in the Textile Museum in Lowell, Massachusetts.

The Carver Washburn Company continues to produce machinery for processing a variety of agricultural and industrial products. It is now located in Georgia and is called Carter, Inc.

Following the demise of cotton gin manufacturing at Carver's Pond, the waterpower continued to be used to run a sawmill until around 1900. Robert McNeeland, founder of Bridgewater Ice and Coal, used the pond for many years for his ice business, beginning as early as 1860 and probably up until the 1920's, when mechanical refrigeration became more economical. Icehouses were built with double walls, with the cavity between filled with sawdust for insulation. They would easily keep ice cut from the pond in the winter through the year until the next ice season. An icehouse was built on the north side of the pond. Its foundation is still visible.

The pond was also used for recreation as a place for boating, swimming, fishing, and just general relaxing and dreaming. There are a number of accounts in the newspapers after 1900 when homesick immigrants from Eastern Europe who worked in the shoe factories in town found peace on the shores of Carver's Pond.

There were 4 small, 2-3 room cottages built during the 1920s along the pond. These structures were not used after 1950 and had been destroyed by vandals by 1970. The remaining large concrete foundations and blocks of concrete are all part of the McNeeland Ice House. In the early 50's McNeeland donated their old office and moved it to the southeast corner of the icehouse foundation for use by the Boy Scouts. By 1965 this building also had fallen to lack of attention and vandals.

The town acquired the area in the late 1970s.

Natural Communities

Carver's Pond has natural interest and considerable diversity. Mixed Forest with a combination of deciduous and coniferous trees dominates the site. Areas of Deciduous Forest occur on the northern edge of the pond and to the west. There are also several small areas of white pines, pond, and pond-shore habitats, and a small area of cultural grassland or mowed lawn. Wetland habitats include Bog, Deep Marsh, Shrub Swamp, and both Deciduous and Mixed Wooded Swamps. We have used the standard descriptions found in the Draft *Classification of the Natural Communities of Massachusetts* by Patricia C. Swain and Jennifer B. Kearsley (July, 2000) to describe the habitats on this site. The appendix includes a preliminary list of the species of plants found at Carver's Pond. While the NRTB has sponsored several species inventories taken in connection with Massachusetts Biodiversity Days, only a cursory botanical inventory has been completed as part of this project. A more intensive biological inventory should be done to confirm this preliminary list and have a more complete catalogue of the site's natural resources.

Mixed Forest

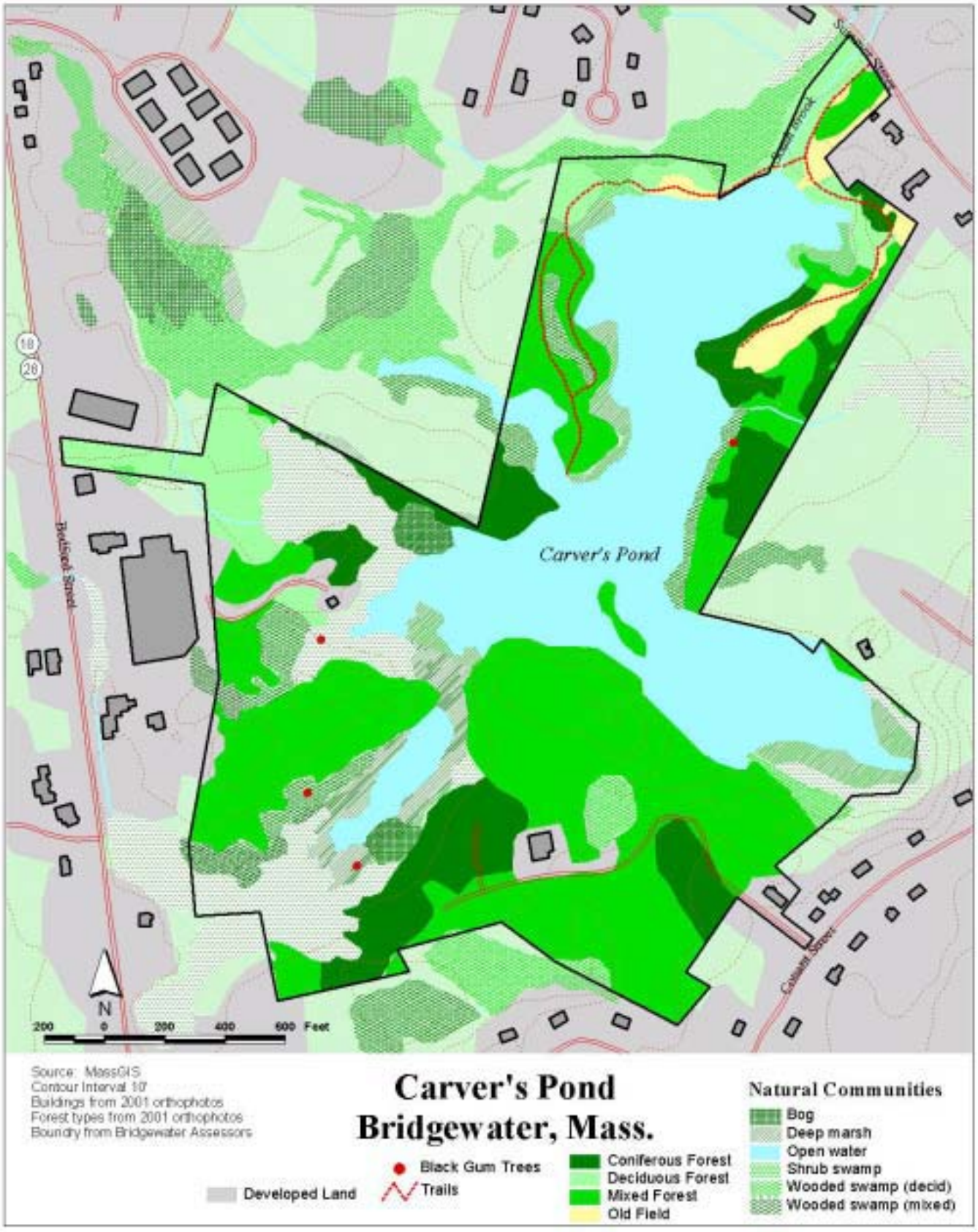
The majority of the forested area at Carver's Pond is a Mixed Forest including a combination of northern hardwoods, hemlocks, and white pines. Red oaks, red maple, and gray birch are mixed with white pine and a few hemlocks. The mostly open shrub layer includes small trees of the species mentioned. The herbaceous layer is also sparse but can be fairly diverse.

This natural community is used by a variety of birds and animals. Owls sometimes nest in larger white pines and woodpeckers are expected. A variety of neo-tropical migrant birds, including warblers, use the area in the spring and fall. Other birds seen at the pond include yellow warbler, Baltimore orioles, grackles, eastern kingbirds, Canada geese, and mute swan, to name a few. Mammals include white-tailed deer, woodchuck, red fox, coyote, gray squirrel, red squirrel, chipmunks, voles, shrews, and white-footed mice. Amphibians may include wood frogs and salamanders, and expected reptiles include garter snakes.

Deciduous Forest

Before the area was farmed and the dam developed, much of this site may have been subject to annual flooding and probably would have had an "alluvial red maple swamp" with a canopy dominated by silver maple and green ash trees or red maples. Oaks would also be common in these forest types. White pine and black cherry would have occurred in elevated areas. The shrub layer would have included silky dogwood, arrow-wood, and perhaps buttonbush in wetter areas. The herbaceous layer may have included sensitive fern and false nettle mixed with other ferns and sedges. Today the Deciduous Forest areas of the site include many of these species but also include some areas with rampant growth of Asiatic bittersweet, multiflora rose, and honeysuckle, invasive exotic species that warrant some control efforts.

More upland Deciduous Forest is located off of Bedford Street. This area has more red and white oaks and fewer red maples and can be classified as a Mixed Oak Forest. Shrubs include sheep-laurel and a scattered herbaceous layer includes sedges and grasses.


Carver's Pond
18
28
N
200 0 200 400 600 Feet
Source: MassGIS
Contour Interval 10'
Buildings from 2001 orthophotos
Forest types from 2001 orthophotos
Boundry from Bridgewater Assessors
Carver's Pond
Bridgewater, Mass.
Black Gum Trees
Trails
Developed Land
Coniferous Forest
Deciduous Forest
Mixed Forest
Old Field
Natural Communities
Bog
Deep marsh
Open water
Shrub swamp
Wooded swamp (decid)
Wooded swamp (mixed)

These deciduous communities are often preferred habitat for a wide diversity of wildlife including gray catbirds, least flycatchers, yellow warblers, chestnut-sided warblers, rose-breasted grosbeaks, red-eyed vireos, swamp sparrows, song sparrows, red-winged blackbirds, common grackles, white-tailed deer, star-nosed moles, water shrews, cottontails, meadow voles, and minks. Acorns are an important food source. Cavities in dead trees or dead limbs are especially valuable for wildlife.

There are two species of trees that warrant additional discussion—white ash and black gum or tupelo. White ash (*Fraxinus americana*) trees are subject to a disease, ash yellows, that is causing a gradual its decline. The disease is caused by a microbe that is thought to be spread by leafhoppers and related insects. White ash sustains permanent and often rapid decline in growth. Slow twig growth and short internodes can cause foliage to appear tufted at tips of twigs and the crown to appear more transparent than normal. Subnormal leaf size and light green leaf color, upturned leaf margins, and premature fall coloration are common. Eventually a progressive dieback of branches begins and witches'-brooms may develop at the trunk base. Witches'-brooms are clusters of upright spindly shoots. Vertical cracks and cankers are common on the trunk near the ground. There is no known way to prevent or cure ash yellows. White ashes that become infected when young do not grow to full size. Larger diseased ash trees can live for at least 5-10 years. Dying limbs of diseased trees that overhang trails could become a hazard and should be removed. The dead trunks become habitat for woodpeckers. There are several infected ash trees along the entrance pathway.

The locations of clumps of black gum or tupelo (*Nyssa sylvatica*) trees are indicated on the Natural Communities map. Tupelo, the more common New England name, is said to come from the Creek language, *eto* meaning "tree", and *opelwv* "swamp." *Nyssa* is the name of a water nymph in classical mythology while *sylvatica*, of course, means that it is of the forest. This water nymph of the forest grows in swampy woods or along the shores of streams and ponds from Maine to Florida and west to the south shore of Lake Michigan. In summer it has glossy, leathery leaves that turn a gorgeous burgundy red in the fall. Frequently one half of the leave retains its lustrous summer green, adding to its colorfulness. After the leaves have fallen, the handsome blue drupes are a favored food for birds in the late fall and early winter. The tupelo can grow to about 60 feet but frequently never attains more than 30 feet. The wood cannot be split so lumbermen usually ignored it. Because it could not be split it was sometimes used for the handles of mauls.

Coniferous Forest

Also known as "successional white pine forest," this community is scattered around the pond on the more permeable (drier) soils. It is a community that usually grows up after agricultural land is abandoned, especially pastures. The forest floor in this community is typically carpeted with needles, often with only a sparse layer of herbaceous plants. White pine dominates the canopy but usually there are also scattered white oak, red oak, and red maple. The shrub layer can vary in density from sparse to thick. It usually includes elderberry, black cherry, maple leaved viburnum, and often non-native species such as

Carver's Pond—showing pond shore, shrub swamp on far shore, open water, deciduous and coniferous forest and two swans. Photo by Cindy Allen.

buckthorn, honeysuckle, and/or multiflora rose. A variety of blackberry vines (often forming thickets), and poison ivy often covers the ground near openings or in formerly open disturbed areas. The herbaceous layer is usually sparse and variable.

This community type, if large enough, is often a preferred habitat for ovenbirds, yellow warblers, Cooper's hawks, and northern goshawks. More generalist species such as black-capped chickadees and red-breasted nuthatches are also likely to occur here along with a large variety of other birds and mammals that will occasionally pass through this habitat.

Open Water

Carver's Pond is the site's major open water resource. The presence of this area greatly increases the attractiveness of the site for wildlife. Great blue heron have been observed, and mink, otter, and raccoons are attracted to open water habitats and a variety of fish are dependent upon this water resource (see Water Resources section). Turtles and frogs are also found in the pond and along its edges.

Cultural Grassland (Old Field)

There are cleared grassy areas at the pond's edge near the entrance, along the northern edge of the pond, and along the eastern edge of the pond. These open areas provide an opportunity to have views and are inviting features of the site. They also provide areas for group gatherings and out-door classrooms. The total area is too small to be significant to many species of animals that specialize in grasslands, although the many dragonflies that feed in the area on the eastern side of the pond should not be disturbed. Some owls may hunt the fields at night. Meadow voles, meadow jumping mice, and northern short-tailed shrews may also frequent this open area and they would be hunted by garter snakes and long-tailed weasels. It is an attractive area for visitors to the pond.

Pond-shore

The pond-shore areas may generally be divided into the following transitional zones:

1. Upland forest
2. Shrub border dominated by sweet pepperbush, silky dogwood, greenbrier, speckled alter, and other shrubs.
3. Emergent exposed pond shore dominated by rushes and sedges.
4. Semi-permanently flooded zone also characterized by deeper water rushes and sedges.
5. Hydromorphic rooted vegetation in deeper water that may include yellow water lily, white water lily and cattails.

These pond-shore areas are important habitats for dragonflies and damselflies. Dr Kevin D. Curry of Bridgewater State College has begun an inventory of the dragonflies and damselflies at Carver's Pond as part of a broader study of the Taunton River. His list of species found at Carver's Pond in the 2003 season is included in the Appendix. Frogs and reptiles and other amphibians also frequent these pond-shore areas.

Green Darner
Anax junius male

Bog

The wetlands include two small bogs located on the south and western edges of the pond. A mixture of shrubs that are predominately members of the heath family characterizes this community type. They include sheep laurel and rhodora. Labrador tea, cranberry, and leatherleaf may also be present. Sphagnum moss makes up much of the surface and there are often sundews and other specialized bog plants.

The high acidity and low oxygen content of the water in bogs make them inhospitable to most reptiles, fish, and amphibians. However, several state-listed rare animals can be found in bogs.

Deep Marsh

Deep marshes border much of the open water areas of the pond, especially along the shore of the peninsula on the western edge of the pond and along the southern shores of the pond. Water depth averages between 6 inches and 3 feet. Broad-leaved cattail and phragmites or

common reeds form extensive stands. Other characteristic plants include common arrowhead and several grasses, sedges, and rushes.

Deep marshes are excellent waterfowl habitat and also provide important habitat for frogs and newts, especially leopard, pickerel, green and bull frogs.

Shrub Swamp

Shrub swamps are often found in the transition zone between marsh and wooded swamps. At Carver Pond they are found along some of the pond edges and in extensive areas to the west of the pond. Shrub swamps have a mixture of speckled alder, silky dogwood, northern arrow-wood, smooth alder, buttonbush, highbush blueberry, winterberry, and scattered red maples. There may also be sedges, rushes, grasses, ferns, sphagnum moss, and skunk cabbage.

These shrub swamp areas may serve as breeding habitat for a variety of salamanders and other amphibians if fish are not present.

Deciduous Wooded Swamp

Deciduous wooded swamps are so dominated by red maples that they are often called red maple swamps. Red maples often provide 90% of the canopy cover. Other trees can include yellow birch, black gum, white ash, white pine, hemlock, and swamp white oak. Sweet pepperbush and swamp azalea are dominant shrubs. Highbush blueberry, common winterberry, spicebush, speckled alder, and poison sumac may also occur. Ferns are usually abundant in the herbaceous layer along with skunk cabbage, false hellebore, and spotted touch-me-not.

Carvers Pond—showing areas of deep marsh and open water with areas of coniferous and deciduous forest in background. Photo by Wm Giezentanner.

Like shrub swamp, these areas may serve as breeding habitat for a variety of salamanders and other amphibians if fish are not present.

Mixed Wooded Swamp

The mixed wooded swamp areas are scattered around the pond. They are generally on more poorly drained soils. Red maples, hemlocks, and white pines are the dominant trees. Yellow birch can also occur. Typical shrubs include alders, highbush blueberry, and winterberry. The ground layer often includes various mosses, and ferns.

Also like shrub swamp and deciduous wooded swamp, these areas may serve as breeding habitat for a variety of salamanders and other amphibians if fish are not present.

Uncertified Vernal Pools

There are two or three areas located along the trail on the western side of the pond that are vernal pools—species that are characteristic of these special habitats have been found. These low areas fill with water in the spring and provide important breeding habitat for salamanders and wood frogs as well as a suite of other species that are dependent upon this unique habitat type. Forms provided by the state should be completed so that they become certified vernal pools.

Current Uses, Administration, and Management Issues

Dr. Kevin Curry with class at Pona

Since the Town of Bridgewater acquired the property around the Pond, the Water & Sewer Commission and the Conservation Commission have administered it. The southern portion of the site has five of the town's water supply wells and two associated buildings. Four wells are accessed from Conant Street, and #7 (now inactive) is accessed from Bedford Street. A small parking area on Summer Street provides access for passive uses. Here there is a trailhead with information kiosk. One 400-foot long trail divides at the pond with one fork running 1,125 feet along the east side of the pond and the other 1,760 feet along the west side. Both dead-end and do not make a circuit, as private property borders part of the shoreline. No other public facilities have been developed on the site.

In the summer of 2000, the NRTB arranged to have the AmeriCorps Student Conservation Service remove much of the brush along the trail near where it forks and this area has been maintained as field. The SCS also improved the existing trails.

Current Uses

The Natural Resources Trust of Bridgewater has sponsored a number of volunteer days to help clean up the site and hosted activities such as Massachusetts Biodiversity Days events, bird walks, aquatic identification programs, and recreational ice-skating in the winter. The site is regularly used as an outdoor classroom by the college as well as by public school classes. Trash and litter occasionally attest to some unofficial access and abuse of the site, and there are annual incidents of brush and grassland fires. Overnight tenting at Carver's Pond is no longer encouraged, especially near the water treatment plant. Hunters use the bog lands and abutting undeveloped private property, in accordance with Massachusetts Fish & Game Regulations. Fishermen visit Carver's Pond year round and local neighbors explore the site and/or walk their dogs. Informal picnicking also is a regular activity.

Carver's Pond being used as an "Outdoor Classroom"

Administration and Legal Restrictions

The Water & Sewer Commission administers the southern end of the pond while the Conservation Commission administers the northern portion as an integral part of the developing town open space system. The Conservation Commission and the Board of Selectmen have recently formed the Parkland Stewardship Council (PSC) to develop, with volunteers, an administrative framework for managing the town's growing number of parcels of land that have been set aside for conservation purposes. The PSC is the link between Volunteer Stewards and the Conservation Commission.

The Conservation Commission has established a set of "General Guidelines for Public Use on Town-Owned Conservation Areas" (see Appendix).

The Conservation Commission has also developed the following specific rules and regulations for Carver's Pond and initiated a permit system for its use. It also suggests the following uses; community events, hiking, picnicking, cross-country skiing, ice-skating, nature study, walking dogs, fishing, and canoeing.

EXISTING CARVER'S POND RULES AND REGULATIONS – 1/9/2003

- The area is to be used for non-intrusive recreation only: hiking, canoeing, fishing, tenting, bird watching, photography, etc.


Parking Area
& Trailhead
Site of Ice House
Foundation
Open Field
Eroded
Pond Bank
Sites of Suspected
Vernal Pools
North Shore
Open Field
Piney Point East
Carver's Pond
Woodchuck
Island
Bedford Street
Water Department
Facilities
Water Department
Facilities
Carver's Pond
Bridgewater, Mass.
200
0
200
400
600 Feet

- No dirt bikes or all-terrain vehicles permitted on Conservation land. No automobiles are permitted off designated roads.
- Only hand-carried tents and watercraft are permitted: No boat trailers or camping trailers allowed.
- Area is to be left undisturbed in its natural state.
- No person shall remove vegetation, soil or stones from the area or dig or disturb any artifacts or archaeological remains. There shall be no unauthorized use of chain saws.
- All fires must be in designated areas only and be completely extinguished before you leave the site. All trash must be removed by the user at the time of departure.
- No discharge of firearms, drunkenness, or chemical abuse is permitted on Conservation Land.
- Use of premises is free of charge; the user however, is liable for any damage to Town property

In 1956 the Bridgewater Ice & Coal Company transferred a deed for several acres of land around the old icehouse at Carver's Pond to a charitable corporation know as the Algonquin Sportsmen's Club. This property was obtained for the benefit of Troop 72, Boy Scouts of America, to be used as a camping site. A cabin was donated and moved to a corner of the former icehouse foundation. On June 23, 1981 the town meeting voted to accept a gift of the 5 acres owned by the Algonquin Sportsmen's Club with the provision that the scouts could continue to camp at the pond. No deed was recorded at the time and one is now being prepared to formalize the town's ownership.

In consideration of the town's population growth and the vulnerability of its public water supply, it is no longer appropriate to sanction overnight camping at Carver's Pond. However, there are several other sites within the Municipal Parkland System that do encourage this passive activity.

Management Issues

The overriding management issue is deciding the future of this important site and working together to achieve the resources to implement that future. Considerations include the vulnerability of the pond itself, the vulnerability of the public water supply, and the vulnerability of the natural world at the pond as we encourage public activity. As documented above, the site has a rich natural history that is key to its future use.
The general guidelines and specific rules and regulations listed above cover most management situations that will arise due to public use. Most of the site's users will follow these common sense guidelines. Many people will be frequent visitors to Carver's Pond and care for it as an island of nature and beauty in their lives. Still, several management issues can be expected as a result of experience with uses at this site in the past and with other similar sites. The following is a short list and description of the issues that can be expected, and will need mitigation.

Potential Issues Associated with Existing Prohibited Uses

- After hours use. Most parks, especially ones as accessible to a college community and a neighborhood as Carver's Pond, experience occasional illicit use between dusk and dawn.
- Dog control and removal of dog wastes. Many parks also experience problems with uncontrolled dogs and owners who do not remove dog wastes.
- Problems with ATVs and other motorized recreational vehicles.
- Collection of vegetation and other natural items is not permitted yet college classes and outdoor classroom users may need to take specimens. There is a need to resolve the inconsistency between students' need for specimens—plant collections, aquatic inventories, etc. and the rule to not remove any plants, rocks, or natural items.
- Discharge of firearms is generally not permitted on Town Conservation Land yet hunting on the southwest bog land and adjacent private land occurs in accordance with state hunting regulations.

Potential Issues Associated with Presently Permitted Uses

- Canoe access might need to be addressed in the final design. There is no designated area to launch a canoe and increased activity could cause erosion of the banks around the pond.
- Likewise, fishing access could damage the pond-shore habitat. Anglers need to properly dispose of discarded fishing line and hooks, and not leave them to potentially injure children or wildlife. Vegetation also becomes trampled down.
- Safety will also be a concern. Water is attractive but may be a hazard for children. Water depths along the shore at Carver's Pond are generally shallow. Some areas may warrant "living fences," plantings of native shrubs along the shore to help 'manage' human activity.
- Trash removal and litter are frequent problems associated with public use. If picnicking is allowed there will be an inclination to leave trash and if trash barrels are placed in the parking lot, they will invite the discarding of household rubbish.
- Camping is permitted in the general guidelines for the whole municipal Parkland System. Since this area is the town's potable water supply, and the surrounding upland area is relatively small and lacks sanitary facilities, it does not seem reasonable that camping be permitted.

Watershed Management

Watershed Management is another important issue for Carver's Pond. The town's water supply is a critical concern for the health of its present residents and for the future growth of the community.

These issues will be addressed in the Management Plan Section.

A Vision for Carver's Pond

What will Carver's Pond be like in the future? It has a rich natural history and offers the town's residents a unique opportunity to explore its natural resources and beauty. It has valuable natural attributes, especially the pond and its potential as a site for fishing and nature study so close to schools and the town center. It may also have the potential to serve more general recreation and open space functions. Residents seek places for such activities as picnicking, games, and just quiet contemplation. But no site this small can be everything for everyone. The following is a listing of the results of several efforts to explore a vision for Carver's Pond at public meetings and walks to discuss its present use and future. Some ideas, such as formal areas for games and paved paths, were discussed but thought to be "too managed" for this site.

- An attractive, user friendly, and well-managed place to enjoy the unique and beautiful natural features.
- A place with a mix of some small area of managed and mostly "natural" landscapes.
- Rustic trails and benches that provide access through the site and to a variety of areas to view the pond and/or some of its natural features, including a handicapped accessible trail and fishing area.
- A small gathering place for neighborhood and other town residents within a natural setting.
- A place for personal outdoor activities in every season, such as walks, guided natural history walks, fishing, bird watching, picnicking, and community events. Winter activities such as a bonfire or ice-skating on the pond are popular.
- A welcoming entrance with a kiosk listing upcoming events and activities.
- A place for families, college and school students, and individuals to enjoy and learn about the pond and the site's wildlife.
- One of a well-managed system of parks and conservation areas in Bridgewater that is loved and cared for by its residents and an active cadre of volunteers.

Goals and Objectives

The Carver's Pond Management Plan is based on the following general goals and specific objectives. It is the nature of a management plan to need periodic revision. One major goal is that this plan be reviewed and revised at a minimum of every five years, as part of the Municipal Open Space & Recreation Plan and the Community Master Plan documents.

Protect the Area's Natural and Cultural Resources

- Protect the water resource—both its quantity and its quality.
- Protect and encourage the natural areas on this site by defining and/or improving pathways, picnic areas, areas for nature interpretation, and other areas for public use.
- Protect fragile vegetation areas.
- Periodically control invasive exotic vegetation.
- Define canoe landing and fishing areas to help prevent erosion of the banks and facilitate these methods of enjoying the site.
- Protect steep slopes from erosion.

- Consider the potential for expanding the site as other bordering properties become available, and linking it to other nearby conservation sites, perhaps by a marked walking trail connecting the pond through Bridgewater State College Campus to the Town River Landing off Spring Street, over a pedestrian bridge to the Stiles & Hart Conservation Area.

Insure the Quality of Experience for Visitors

- Interpret the site's history as a source of ice and its present importance as one of the town's most important sources of drinking water. Provide appropriate interpretive materials (signs, brochures, etc.) to allow visitors to learn about the cultural and natural history of the site and its approved uses.
- Encourage use of the site by children and students so that they can learn about the area's cultural and natural history. Develop curriculum materials to facilitate this type of use.
- Provide attractive facilities (paths, picnic areas, interpretive facilities, fishing area, etc.) for visitor uses.
- Develop a set of site-specific use regulations to assure safety and compatibility of uses. Periodically review and revise these regulations as necessary.
- Periodically provide on-site stewards to help interpret the site's natural history and its use regulations.

Insure Relative Ease of Implementation and Maintenance

- In conjunction with the Conservation Commission and Parkland Stewardship Council, develop a landscape design plan that is within the capabilities of volunteer labor and the Town Highway Department to implement.
- Provide a detailed, season-by-season maintenance schedule with specific tasks for volunteer labor and town departments.

Management Plan

The preceding section on Management Issues identified several concerns that need to be addressed in order to meet the goals and objectives for Carver's Pond. Many of these issues revolve around existing and anticipated future uses and several recommendations have design and construction implications that will be addressed in more detail in the design plan for the park. Many of these recommendations will also require funds and other resources before they can be achieved.

Opportunities for Creating Connections

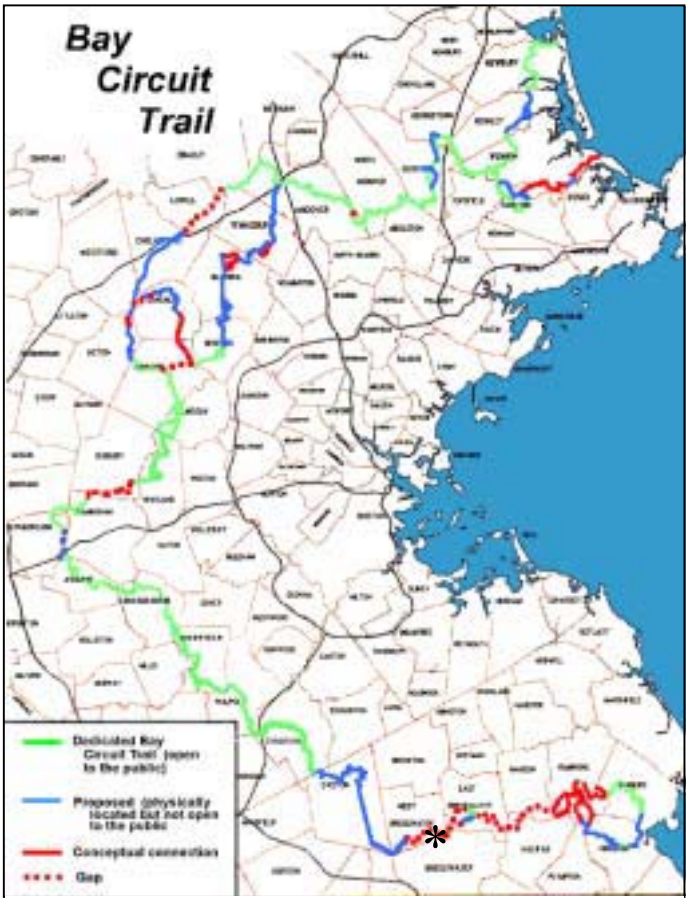
Public parkland at Carver's Pond presents some exciting opportunities for making connections with its neighborhood and the community at large. The pond is already a place where people make connections with each other. Families have picnics, neighbors meet each other, and residents visit the site to make connections with nature. Elementary school


Potential
River Trail
Stiles & Hart
Conservation Area
Town River
Gaspps Plaza
Town River
Landing
Plymouth Street
Bridgewater
State College
Town
Center
Commuter Rail
Station
Summer Street
Bedford Street
Carver's Pond
Carver's Pond
Bridgewater, Mass.

groups study about natural history, our public water supply, and the importance of ice before there were electric refrigerators. College classes come to study botany and aquatic insects and to learn how to canoe and kayak. Canoeists put in at the North Shore of the pond and explore or fish. Sidewalks and trails also provide opportunities for walkers to make connections with the neighborhood's historic charm.

Example of Pedestrian Bridge

An extended trail system—a Greenway Connection from Carver's Pond—could be developed that would follow along Summer Street to the town center or through the beautifully landscaped Bridgewater State College to connect with the Stiles & Hart Conservation Area by way of a pedestrian bridge at the Town River Landing off Spring Street. It could join another possible River Trail to the Iron Works Park at High Street. Such a system of trails and sidewalks could be the basis of a self-guided walking tour of this central area of Bridgewater making connections downtown and to a network of trails that join this neighborhood to other communities.



An extension trough West Bridgewater and East Bridgewater would also connect to the Bay Circuit Trail, a 200-mile long regional hiking trail that runs from Newburyport on the North Shore to Kingston Bay on the South Shore. Parts of this regional trail system are undefined while other parts are developed and open to the public. Upstream, the canoeable Town River also connects to the West Bridgewater War Memorial Park, and downstream to the confluence with the Matfield River, a part of the Wampanoag Commemorative Canoe Trail that extends from Mount Hope Bay to Massachusetts Bay.

Star at Iron Works Park

Carver's Pond has great potential as an Outdoor Classroom and as a key component in a linked parkland system.

Land Additions

Much of the land around Carver's Pond is wetland and floodplain that cannot be developed and could be added to the parkland and help control activity near the town's water supply while also expanding the site's recreation and natural history values. Some of the nearby uplands will be proposed for development at some time in the future. The town administration should insist on maximum protection for the water supply, floodplain, and wetland recharge areas as development proposals are made.

It also appears from studying maps and conducting field studies that part of the trail on the west side of the pond crosses over private land. This area should be professionally surveyed and if the property line is found to be correct, perhaps this strip of land could be added to the town's ownership. The privately owned dam and a strip of land to the west of South Brook should also be added to Carver's Pond parkland to protect the impoundment and assure access. The maintenance of the dam is critical to the future of the pond.

Control of Access

As with all parks, there needs to be good control of the access to the site. Common methods for gaining control of access to the site include the following:

- Gated entrances
- Boulders, heavy timber fences, or earth mounds placed to prevent unauthorized vehicle access
- Signs posting the rules and regulations and the hours that the site is open
- Strict enforcement of trespass violations

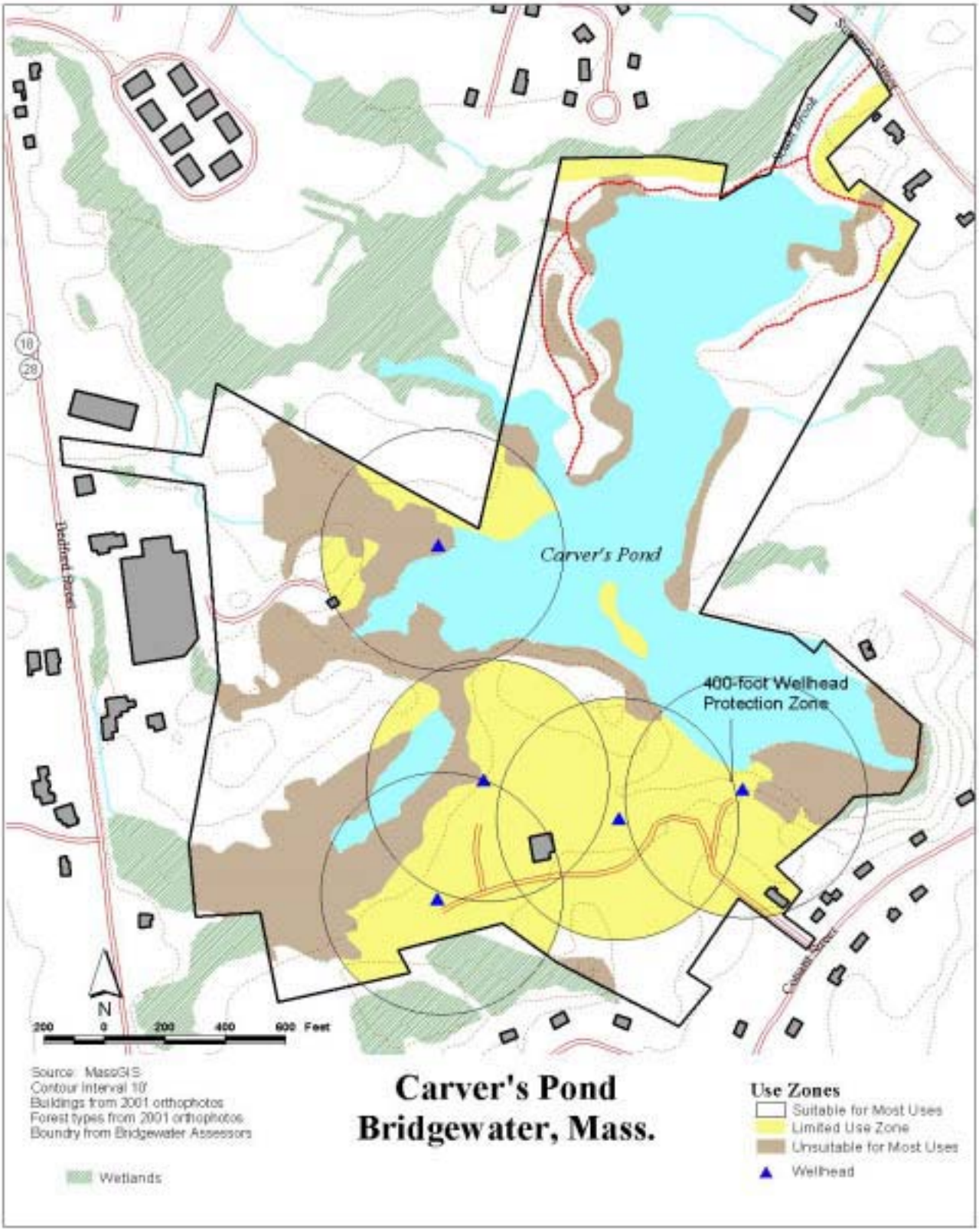
A combination of all of these methods is recommended for Carver's Pond. Having a gated parking area is one method of limiting unwanted use. In some cases it may be advisable to post signs reminding park users to respect the privacy of neighbors. Police vigilance, especially on spring, summer, and fall weekends, will also be effective. Volunteer stewards and neighbors should also be part of the deterrence for unwanted uses. The covered information board also helps orient visitors and provides information about the site and its uses.

Control of Use

As in the past, there are bound to be some management issues that will come to light as a result of increased use of the parkland. For this reason it is advisable to review this management plan as needed to make adjustments based on this experience. It is recommended that this Carver's Pond Management Plan become part of the town's official Open Space & Recreation Plan, and thus be updated at least every five years as part of that planning document review.

Use Zones

Some of the site is well suited to public uses while other parts are not. The following map zones the site into three levels of use. The white area is suitable for the uses that will be encouraged on the site. The yellow area is also suitable for most encouraged uses, serving as a buffer to the neighborhood and protecting fragile resources. It includes areas within 400-feet of any of the town's wellheads, an area that is generally restricted to little or no use to


Carver's Pond
400-foot Wellhead
Protection Zone
Bedford Street
Crescent Street
N
200 0 200 400 600 Feet
Source: MassGIS
Contour interval 10'
Buildings from 2001 orthophotos
Forest types from 2001 orthophotos
Boundry from Bridgewater Assessors
Wetlands
Carver's Pond
Bridgewater, Mass.
Use Zones
Suitable for Most Uses
Limited Use Zone
Unsuitable for Most Uses
Wellhead

protect the water supply. The brown area is unsuitable for most uses because of steep slopes, wetlands, flooding, and types of soils. These management zones are based on the information about the site that has been presented in the preceding sections and on ideas presented in the design plan.

Use of Southern Portion of Carver's Pond

Some people have asked about increasing public access to the southern portion of Carver's Pond, the area with the water supply wells and new water treatment facilities. They have suggested a trail/boardwalk connection that would make it possible to walk all the way around the pond. A right-of-way for such a trail/boardwalk system would be difficult because of current private ownership along parts of the shore, and it would be initially expensive to build. It would also require on-going maintenance. In addition, increased access to this portion of the site would raise concerns about security for the Water & Sewer Commission facilities and the town's water supply. The Water & Sewer Commissioners have established policy that entrance to this area for any reason is only by permission of the Water Superintendent. This section of Carver's Pond does have rich natural areas that will continue to protect biodiversity, serving as habitat for wildlife.

Watershed Management

The management of the watershed is an important issue for protecting the quality of the town's water supply and is also likely to affect the recreational qualities of Carver's Pond. Regulations to protect the Zone II Watershed Protection Area have been included in the town's Aquifer Protection District. Town zoning prohibits the following uses and requires a special permit for expanding or altering already existing uses:

- Land fills or open dumps
- Storage of liquid petroleum products except normal household use and statue required waste oil retention facilities
- Gasoline service station
- Land filling of sludge or septage
- Storage of sludge or septage unless such storage is in compliance with state regulations
- Storage of deicing chemicals unless such storage is within a structure design to prevent the escape of contaminated runoff
- Storage of animal manure in quantities greater than one cubic yard unless covered or contained in accordance with specification of the US Soil Conservation Service
- Facilities that generate, treat, store, or dispose of state regulated hazardous wastes with certain exceptions
- Automobile graveyard or junkyards and repair shops except shops that are deemed to be very small generators of wastes
- Treatment of disposal works for state-regulated non-sanitary wastes except replacement or repair of existing system(s) that will not result in increased capacity and state approved systems for the treatment of contaminated water
- Stockpiling or disposal of snow or ice containing deicing chemicals brought for outside of the district
- Use of septic system cleaners that contain toxic or hazardous chemicals
- Application of fertilizers and pesticides unless in accordance with State and Federal standards

- Earth removal to within six feet of maximum high ground water with certain exceptions
- Non-residential storm water drainage systems unless designed to recharge groundwater without degrading it

The following uses or activities are permitted but require a special permit:

- Construction of dams or other water control devices, ponds, pools, or other changes in water bodies or water courses, created for swimming, fishing, or other recreational purposes or drainage improvements
- Construction of dams or other water control devices, ponds, pools, or other changes in water bodies or water courses, created for agricultural uses that do not constitute normal maintenance or emergency practices
- Any use that will render impervious certain amounts of lots must be provided with a stormwater drainage system that meets specific design requirements

All of these activities and uses are prohibited or require special permits and design attention because they have the potential to endanger the town's water supply.

Class inside Water Treatment Plant.

The fact that recreation and water supply protection both occur at Carver's Pond means that education is a critical component of watershed management and should be targeted to recreational users, businesses and residents in the Aquifer Protection District, town officials, schools, and citizens in general area. The Department of Environmental Protection has funded the Water & Sewer Commission to conduct an education program for the Carver's Pond watershed. It will produce education materials and develop classes and workshops for schools, businesses, and residents in the Aquifer Protection District. Interactive community programs, including: storm drain stenciling, "rain gardens," hazardous waste recycling days, responsible pet clean-up, water conservation education, holding lake friendly home design workshops and promoting the use of phosphorus-free fertilizer help encourage citizen involvement and convey the message about the value of these important water resources.

Outdoor Classroom/Educational Use

As mentioned in the section on Management Issues there is an inconsistency between the use of Carver's Pond as an Outdoor Classroom and the collection of plant and animal specimens for study and identification and the existing rule to not remove any plants, rocks, or natural items. Carver's Pond has proven to be a valuable teaching resource for both the college and for local primary and secondary schools. This use should continue and be encouraged.

However, indiscriminate collection of living material and other natural and cultural items should be discouraged, as should collection for commercial purposes. Massachusetts requires permits for the scientific collection of mammals, reptiles, amphibians, fish, and birds for research or educational purposes, but no permit is required for collecting plants, minerals, or insects. A federal permit is also required for the collection of migratory, threatened and/or endangered species. There should be a simple permit system for teachers wanting to use the pond for educational purposes and take specimens. The permit should be issued to the individual teacher who will be responsible for the collection activities and encourage the teacher to share information about the species collected with the Conservation Commission.

Fishing

Fishing is a favorite recreational activity at Carver's Pond. It is a link between present day enjoyment of the pond and its pre-colonial use by Native Americans. It was noted in the section on eutrophication (page 11) that some observers had noted a decrease in the quantity and size of bass and pickerel and an assessment of the pond's fishery by the State Division of Fish and Game was recommended.

Some have also inquired about the potential of restoring a herring run up South Brook and into Carver's Pond. The Department of Marine Fishery noted that getting herring to Carver's Pond would involve the construction of fish ladders at the Carver's Pond dam and under Water Street at Skeeter Mill Pond at great expense, and there is no assurance that the ecologically challenged area—South Brook and Carver's Pond are no longer pristine—could support a population of herring. The capacity of the habitat in the South Brook watershed would need to be considered along with the competition in the food chain that herring would add and their impact on other species. Limited funds for restoration might be more effectively spent elsewhere.

Eutrophication

As mentioned in the Water Resources section, eutrophication, or the slow filling in of the pond is an important question about the future recreational uses of Carver's Pond. The largest cause of the increase in the rate of eutrophication is increased sources of nutrients, especially phosphorous and nitrogen. These nutrients come from urban runoff that may include animal wastes, lawn fertilizers, and leaking septic systems. Pet-owners and homeowners are key players in stemming the flow of these nutrients into Carver's Pond. Maintaining septic systems, reducing or curtailing the use of phosphorous containing fertilizers, and responsible pet ownership will help slow eutrophication. Education and regulations on homeowners may be the only strategy to slow this process short of the more drastic steps outlined below.

If algal blooms and fish die-offs become more common, more drastic and much more expensive steps may be considered. The fist step would be a comprehensive study of the pond to determine where nutrients are coming from and how they may be slowed or stopped. A second step to consider might be some form of pond restoration. This step would need considerable study to understand the consequences of the available options. Those options include the following:

In Pond Restoration Techniques

Method	Advantages	Disadvantages
Dredging	Deepens the pond by removing the accumulated sediments and increasing the water volume. Improves clarity. Removes aquatic plant matter.	Temporarily disturbs the habitat and increases turbidity. May release toxins from sediment if they are present.
Aeration	Adds oxygen to deeper waters. Limits the release of phosphorus from sediments.	May cause destratification. Will not control macrophytes. May cause algal blooms.
Water Drawdown	A control technique for macrophytes.	Negative impact on fish and other organisms. May have negative impact on out flowing streams due to reduced water flow.
Aluminate Sulfate Treatment	Lowers phosphorus levels. Blocks the release of phosphorus from sediments. Increases water clarity.	May be toxic during application. May cause an increase in plant growth due to improved water clarity.
Artificial Circulation	May prevent/disrupt stratification. Increases the levels of oxygen in the water and extends aerobic zone.	May increase turbidity. Will not affect plant/algae growth.
Bio-manipulation (altering the fish community)	Usually increases the number of zooplankton that eats algae.	Still in experimental stages. Will not reduce blue-green algae.
Dilution (flushes the pond)	Removes algae on the surface. Lowers the levels of nutrients.	Requires a large amount of water. Will not effect the inputs phosphorus to the water body may have downstream impacts.

Most of these methods require permits and need to be implemented by a professional. Due to the importance of the watershed as a primary source of drinking water, any restoration technique would require careful review by the Water & Sewer Commission.

If a comprehensive study determines that only plant removal is required there are another set of alternatives to consider, these include the following:

Plant Removal Techniques

Method	Advantages	Disadvantages
Manual Methods (hand pulling, cutting)	Inexpensive and non-toxic. Affects only the target plant species. Does not harm beneficial plants.	Not practical for very large areas. Labor intensive. Stirs up sediment.

Method	Advantages	Disadvantages
Benthic Barriers (bottom covers)	Restricts upward plant growth. Limits light to lake bottom. Good for small areas without affecting the rest of the water body. Non-toxic.	Harmful to benthic community. Accumulated sediments must be removed. Need to inspect often. May be damaged. Must anchor securely as gases may cause the barrier to float up.
Mechanical Cutting (clipping plants below the water surface)	Inexpensive. Immediate results. Targets one area of the water body. Fairly species specific. Non-toxic.	May cause plant fragments that can re-grow. Roots may re-grow. Must do several cuts each season. Not species specific.
Mechanical Harvesting	Removes all plants from the area.	Labor intensive and expensive. Does not target specific plants. Plant fragments may re-grow. Can only cut up to 5' below surface.
Hydro-raking	Removes plant roots. Removes all plants from the area.	Disturbs sediments that negatively impacts bottom dwellers, increases turbidity, and may release nutrients and toxins from sediments. Causes fragments that may re-grow.
Biocontrols (weevils)	Species specific and non-toxic. Potential for long-term control.	Will not remove all the plants. Expensive. Slow response.
Herbicides	Very effective and ideal for large areas. May be used to spot treat specific plants.	May harm beneficial plants. Decomposing plant matter may release nutrients and decrease oxygen levels in the water. Recreational activities may be temporarily restricted. Potential impacts on ground water need to be considered especially in a Watershed Protection Area.
Drawdowns	Non-toxic and works on most plants.	Not species specific and may affect other organisms. Weather conditions may alter effectiveness/ feasibility. May affect out-flowing streams and wells.

Control of Non-native Invasive Plants

Control of non-native invasive species is another management issue affecting all managers of natural areas. Fortunately, only five invasive non-native plant species were noted at Carver's Pond during the preparation of the preliminary list of plant species: Norway maple was found along the main trail near the entrance. Multiflora rose, honeysuckle, Asiatic bittersweet, and winged euonymus were also present but not in large numbers. These aggressive non-native plants often out-compete native species because the predators and diseases that control their spread in their native setting are absent in Massachusetts, and they

are free to spread without these natural limitations. Left unchecked they could spread and threaten the site's biological diversity.

The appendix includes a list of other non-native invasive plants to be on the lookout for at Carver's Pond and other natural areas in Bridgewater. Information on how to identify and find out about control methods for the five species currently occurring at Carver's Pond is included in the appendix. It is recommended that a program to control these species be included as part of the annual maintenance of this site.

Addressing Other Management Issues

As population increases and more land is developed, there is a growing need to recognize the values and potential conflicts that can arise on public lands like Carver's Pond. Bridgewater is experiencing changes associated with its growth. Litter, animal wastes, hunting, fishing, and many other uses have consequences that were negligible when there were fewer people using these natural areas.

In general it is good to encourage "carry in – carry out" practices in public parkland, but at Carver's Pond, the Highway Department or volunteer stewards have been tending a trash barrel and it may help prevent littering along the trails. However, this trash receptacle should be moved into the parkland away from the parking lot, as people driving by have been dropping off household rubbish instead of taking it to the transfer station.
Litter associated with fishing can be unsightly and, especially monofilament line and hooks, hazardous to wildlife. A special notice to fishermen may be needed during the fishing season to help them understand the potential consequences of their carelessness.

A plastic bag dispenser and dog-waste disposal bin should also be installed at the park entrance to remind visitors of their responsibility for their pets. Attractively designed dispenser/receptacles are becoming common in many parks as the public becomes more aware of this source of water pollution and annoyance for other park visitors. An example is included in the appendix.

Hunting may be a concern especially as population and outdoor classroom use of the site increases. Discharge of a firearm is prohibited on most Town conservation land and at Carver's Pond. Discharge of a firearm or hunting on the land of another within 500 feet of any dwelling or building in use, except as authorized by the owner or occupant thereof, is prohibited by state hunting regulations. Hunting is also sometimes a useful management tool for controlling nuisance species. For example, geese have been implicated as a source of water contamination in some reservoirs (note: Carver's Pond is not a reservoir, the water supply is in the underground aquifer) and hunting has been encouraged as a means of reducing their numbers. Most hunters are responsible and very knowledgeable about wildlife and the role of public land in assuring future populations of the animals they like to hunt.

Many admire geese and swans, but they can become a management problem. Droppings can be a nuisance and even a source of water pollution as noted above. Swans can be very aggressive and have been known to injure children. Feeding or otherwise encouraging these species should not be allowed.

Roles of Volunteer Stewards

Bridgewater is fortunate to have dozens of residents who care about their open land. The Natural Resources Trust of Bridgewater is now sponsoring a program to train volunteers as

Parkland Stewards. Volunteer Stewards can provide valuable services that help safeguard and interpret the natural and cultural resources of the site and the safety of visitors. Neighbors, abutters, and friends of conservation land are logical "eyes and ears" who can help interpret the values of the site, report problems, lock gates, monitor public use, mow fields or other grass areas, record presence of wildlife, and call the police or Conservation Commission and Parkland Stewardship Council (PSC) to discuss local issues. Many of these stewardship roles will also help assure the quality of the visitor experience.

Organization, education and training are key to an effective volunteer stewardship program. There is no municipal funding available for the care and upkeep of this local parkland system, so Bridgewater depends on the generosity of these trained volunteers to manage the town-owned parklands.

Unreliable or untrained volunteers can be a drain on an organization and can produce more damage than benefit. Such training and organization takes time but is essential for a successful program. Recognition is also important for rewarding good volunteers. The Carver's Pond Stewardship group, formerly known as the "Friends of Carver's Pond," has chosen a lead steward to represent this parkland on the PSC and to serve as the primary liaison to assure communication between the public, the volunteers, the PSC, police, other town services, as well as the other stewards.
As the stewardship group develops, it will need to establish a schedule of who does what and when, and there also needs to be a level of training provided for each volunteer. The following is a list and short description of possible roles.

- Each volunteer needs to be familiar with the site's boundaries, natural and cultural history, surrounding uses, and the regulations governing its use. They should also be aware of the basic contacts for reporting problems.
- Site Monitors—as mentioned above this site will require an on-going effort to manage use once it is more developed and open to the public. Site monitors would be designated representatives of the Parkland Stewardship Council and carry identification. They would pass through the park on peak use days. They would provide information about the history of the site and its use regulations.
- Natural/Cultural History Walk Leaders—Carver's Pond offers many opportunities for interpretation. It has an interesting history that can stimulate curiosity in both young and old. It is also an excellent site for guided natural history walks. Scheduling and advertising a series of community walks throughout the year could be a popular activity for both individuals and families with children. Such walks could also be

Educational Use of Carver's Pond—Outdoor Classroom

offered to local school classes in conjunction with learning about local natural history.

- Maintenance Workers—a group spring-cleaning day could be an event that attracts a group of stewards and other volunteers. In addition to picking up litter and sprucing up the other facilities to be developed in the park, these days could also be used to work on controlling non-native invasive species.

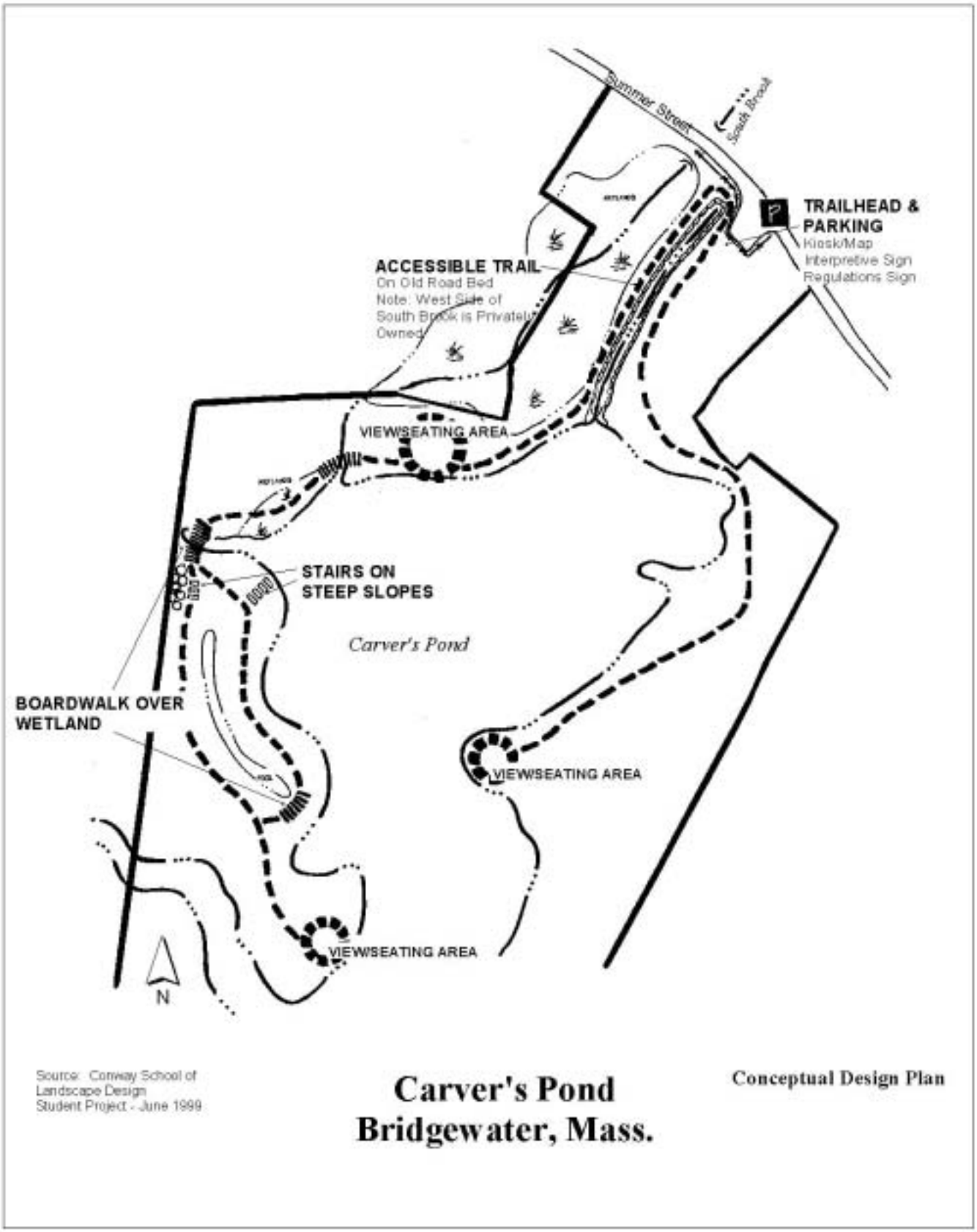
Conceptual Design

In 1999, the Natural Resources Trust of Bridgewater received a grant from the Boston Foundation to contract with students at the Conway School of Landscape Design to prepare a Conceptual Design plan for Carver's Pond. It was based on an analysis of the site and discussions with the NRTB. It proposed that appropriate uses included walking, nature observation, picnicking, canoe put-in/takeout, mountain biking, and fishing. It proposed maintaining the existing pedestrian entrance on Summer Street with an interpretive kiosk and trailhead. It also suggested three viewing areas with seating to help give the trail system a sense of arrival at a destination instead of disappointment at finding a dead-end. One view/seating area was proposed at Piney Point East, one near the foundation of the former icehouse, and one at the end of the trail on the west side of the pond. The small parking area on Summer Street would remain, but an accessible trail leading to the viewing area at the foundation of the icehouse would be developed. The student plan did not recommend making a trail link to the southern part of the site. Their plan recommended boardwalks over wetland areas currently crossed by the existing trail on the west side of the pond. They also recommended building stairs on steep slopes on this existing trail and on a slope that is sometimes used as a canoe landing and fishermen's access to the pond shore. It should also be noted that the student plan shows a private parcel (to the west of South Brook) as part of the existing public ownership. While the bank of the brook and the wetlands would be desirable additions this area is currently privately owned.

In 2000 the NRTB, in accordance with the Conway Design Plan and with approvals of the Conservation Commission and the Water & Sewer Commission, applied for and received assistance from the AmeriCorps Student Conservation Corps. Six young folks from all over the United States spent a rainy week developing the suggested trail system around the pond, making great headway in creating pleasant trails at this site.

Design Plan

The student plan is basically sound. It recognizes certain problems with the current use of trails like wetland crossings, potential erosion on steep slopes, and a lack of "destinations" for the trail system. It addresses these problems with boardwalks, stairs, and view/seating areas. It also proposes a universally accessible trail to accommodate handicapped residents. It doesn't make any specific design provision for fishermen or canoeists.


Summer Street
South Brook
TRAILHEAD &
PARKING
Kiosk/Map
Interpretive Sign
Regulations Sign
ACCESSIBLE TRAIL
On Old Road Bed
Note: West Side of
South Brook is Privately
Owned
VIEW/SEATING AREA
STAIRS ON
STEEP SLOPES
Carver's Pond
BOARDWALK OVER
WETLAND
VIEW/SEATING AREA
VIEW/SEATING AREA
N
Source: Conway School of
Landscape Design
Student Project - June 1999
Carver's Pond
Bridgewater, Mass.
Conceptual Design Plan

The Design Plan presented here modifies the Conway Student Plan and hopefully makes it a bit easier to implement. It utilizes the existing parking area and trailhead. The existing trailhead has a handsome kiosk with a relief map of the pond (created by the Friends of Carver's Pond with funding from an earlier DEM Lakes & Pond Grant) and a second information board with a display of student observations about the pond and its wildlife. This exhibit is a 2001 project created by the 4th grade class at the Burnell School. Integrating these two elements into one kiosk that would also have a posting of the Carver's Pond regulations would reduce clutter at the entrance. Consolidating the several pond signs at the parking lot into one simplified announcement, and camouflaging the trash barrels behind a screen fence or moving them into the interior of the parkland would also improve the approach to the pond.

The main trail should be universally accessible. It could arrive at an accessible Fishing Dock/Canoe Launch that would also have Seating. The dock would be built on helical supports that would minimize damage to the pond shore. See the appendix for design details.

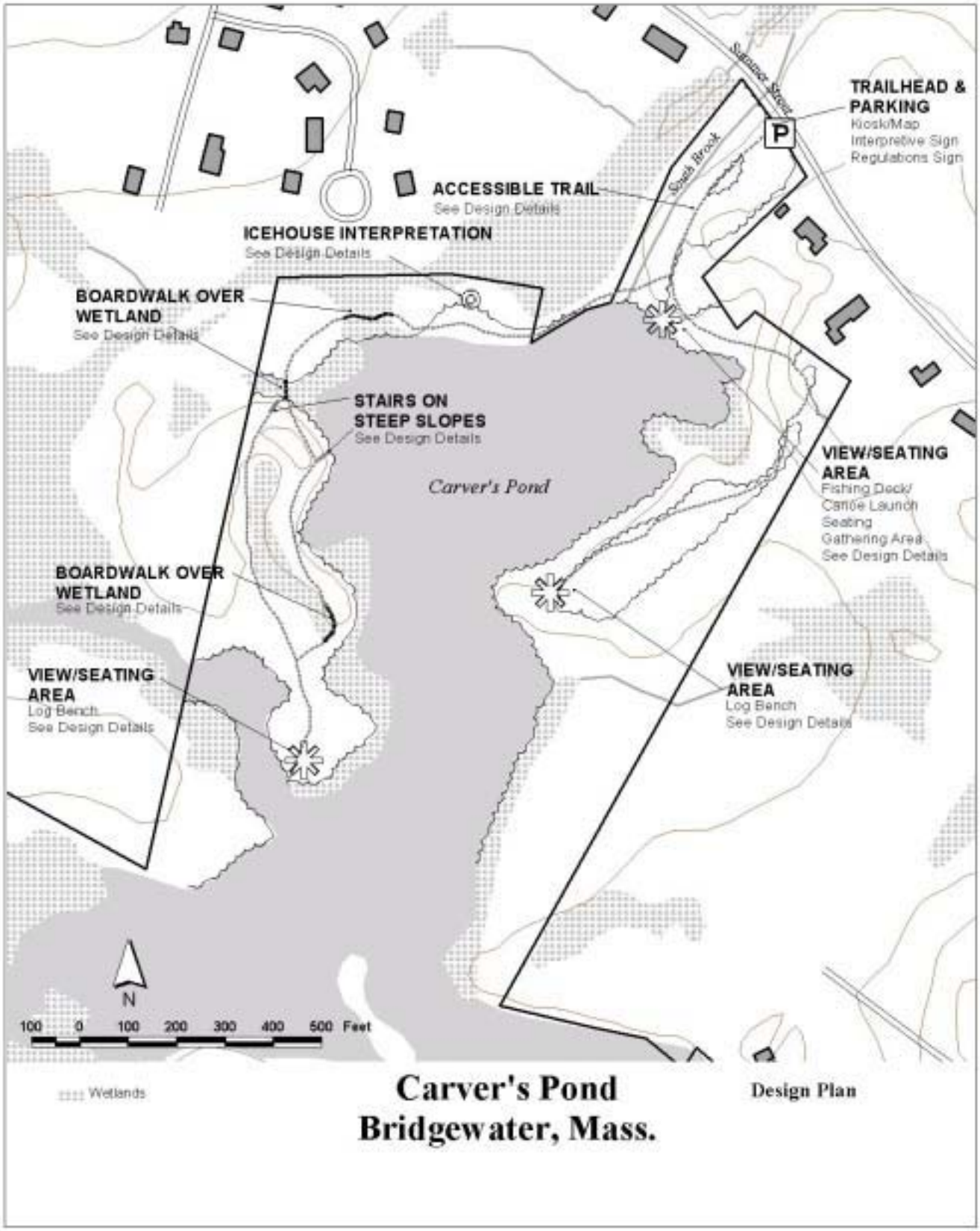
An Interpretive Sign with information about the Icehouse and perhaps an historic photo, if one can be found, would help describe the history of the pond and the importance of ice when homes did not have electricity. It would also be interesting to tie this ice industry to local shipbuilding, (see the Titicut Stewardship Management Plan 2002) and to international commerce in the Caribbean in the 1700s and 1800s where ice, shoes, and other local products were traded for rum and molasses.

Wetland Boardwalks are proposed for three locations along the trail on the west side of the pond and Stairs are proposed on steep slopes.

Two other View/Seating Areas are proposed—one at Piney Point East, and one at the terminus of the trail on the west side of the pond. These areas would consist of a small clearing and a log bench or two where a visitor could pause and enjoy the view and perhaps eat a bag lunch before turning back to the entrance.

Implementation Actions (Next Steps)

The Parkland Stewardship Council (PSC) was established in 2003 through the Bridgewater Selectmen's Office as the administrative link between the dozens of grassroots volunteer stewards and the municipal Conservation Commission, that branch of town government accountable for the preservation of town-owned conservation land, several parcels of which were purchased with state Self-help Grants. While the various stewardship groups remain somewhat informal in structure, each group chooses a Lead Steward to represent their parkland on this council. The Lead Stewards are then appointed to the PSC by the Selectmen for a term of one year, and currently hold quarterly meetings in accordance with Open Meeting Law. The PSC is a sub-committee of the Conservation Commission, and may be reached by contacting the commission secretary. The volunteer (grassroots) Stewards discuss the parkland issues, and the concerns taken to the PSC (town) by the Lead Steward for resolution, sometimes within the PSC, sometimes with action by the Conservation Commission.


Summer Street
TRAILHEAD & PARKING
Kiosk/Map
Interpretive Sign
Regulations Sign
P
Stush Brook
ACCESSIBLE TRAIL
See Design Details
ICEHOUSE INTERPRETATION
See Design Details
BOARDWALK OVER WETLAND
See Design Details
STAIRS ON STEEP SLOPES
See Design Details
Carver's Pond
VIEW/SEATING AREA
Fishing Deck/
Canoe Launch
Seating
Gathering Area
See Design Details
BOARDWALK OVER WETLAND
See Design Details
VIEW/SEATING AREA
Log Bench
See Design Details
VIEW/SEATING AREA
Log Bench
See Design Details
N
100 0 100 200 300 400 500 Feet
Wetlands
Carver's Pond
Bridgewater, Mass.
Design Plan

The Conservation Commission establishes general policies and regulations, and adopts a development plan for each site that is then implemented by the PSC via the Stewards and other volunteers. Funding comes from partnering grants and donations. The 2004 challenge facing Bridgewater is that the town is currently ineligible for many state and private grants as their Open Space & Recreation Planning document is outdated and has lost accreditation. Revising this vital planning document should be a priority.

Carver's Pond is a valuable location for residents to explore nature and enjoy the beauty of this hidden treasure. To achieve the Design Plan and assure good management of the pond will take a coordinated and sustained effort. Well meaning yet uncoordinated efforts can dilute the impact of hard work and waste resources. The following is a listing of tasks or steps that will be required to fulfill the vision outlined for Carver's Pond. Several of these steps can be taken almost immediately and simultaneously; others will require more time and resources. It is suggested that the Parkland Stewardship Council take the lead to get action started, in a coordinated fashion.

- Develop a cadre of volunteer stewards to work with the Parkland Stewardship Council and the Conservation Commission. This step has begun.
- Explore in more detail the land additions and potential connections listed above.
- Increase efforts to raise public awareness of the park and Bridgewater's system of parklands and conservation areas. Some ideas include activities at the parks, like seasonal community picnics and/or interpretive walks. Other ideas include sending flyers home with school students, having a table at a local supermarket with information about the conservation parklands, cable television programs, etc.
- Use these public awareness steps to increase efforts to raise funds and develop other resources for improving the parklands.
- Request an assessment of the fishery in Carver's Pond by the Division of Fish and Game.
- Develop final design and engineering drawings for Fishing Dock/Canoe Launch.
- Prepare applications for grants of funds from government agencies and private foundations.
- Develop a list of early action steps. Items that show that progress is being made and that can be implemented with little expenditure.
- Solicit contributions of labor and materials from local suppliers, contractors, and garden clubs based on the designs proposed in the Design Plan and detailed in the appendix.
- Involve volunteers, other town departments, and service organizations, including scouting groups and garden club, in implementing the plans.
- Involve contractors for those tasks that are beyond the capabilities of town or volunteer labor.
- Maintain an active Biodiversity Inventory.
- Develop partnerships for the Outdoor Classroom Concept

Appendix I – Preliminary Plant List

The following is a preliminary list of plants found at Carver's Pond. Inventory was done in February and many species, especially wildflowers and other herbs would be better represented in a follow-up inventory in the spring and summer. Potentially invasive non-native species are indicated in **bold type** Abundance is indicated in five categories with five as abundant. Wildlife value is an indication of the number of animal species that utilize the plant for food or shelter if the information is known.

Common Name	Scientific Name	Abundance	Wildlife Value
Trees			
white pine	*Pinus strobus*	2	47
white oak	*Quercus alba*	3	75
white ash	*Fraxinus americana*	3	11
red spruce	*Picea rubus*		
red oak	*Quercus rubra*		75
red maple	*Acer rubrum*		
black gum	*Nyssa sylvatica*		
black willow	*Salix nigra*		
American beech	*Fagus grandifolia*		
gray birch	*Betula populifolia*		
hemlock	*Tsuga canadensis*		
Norway maple	*Acer platanoides*		
Shrubs			
common green briar	*Smilax rotundifolia*		?
red maple	*Acer rubram*		?
honeysuckle	*Lonicera spp.*		18
Asiatic bittersweet	*Celastrus orbiculatus*		15
blackberries	*Rubus allegheniensis*		49
swamp dew-berry	*Rhubus hispidus.*		49
multiflora rose	*Rosa multiflora*		
rose species	*Rosa spp.*		
sheep-laurel	*Kalmia latifolia*		
northern red cedar	*Thuja occidentalis*		
witch-hazel	*Hammamelis virginiana*		
sweet pepperbush	*Clethra alnifolia*		
speckled alder	*Alnus rugosa*		
silky dogwood	*Cornus amomum*		
swamp-fetterbush	*Leucothoe racemosa*		
rhodora	*Rhododendron canadense*		
grape sp.	*Vitae sp.*		
winged euonymus	*Euyonmous alatus*		
winterberry	*Ilex verticillata*		

Common Name	Scientific Name	Abundance	Wildlife Value
Herbs			
common dandelion	*Taraxacum officinale*	2	?
plantain	*Plantago spp.*	2	?
cinquefoil	*Potentilla spp.*	3	9
wintergreen	*Gaultheria procumbens*		
spotted wintergreen	*Chimaphila maculata*		
skunk-cabbage	*Symplocarpus foetidus*		
sphagnum moss	*Sphagnum sp.*		
princess pine	*Lycopodium sp*		
cattail	*Typha sp.*		
pink lady's slipper	*Cypripedlum acaule*		
grasses		4	?
sedges	*Carex spp.*	1	?

Appendix II – Dragonfly and damselfly adults collected and identified during Phase I of the Taunton River Dragonfly and Damselfly Database development: Summer 2003. Dr. Kevin D. Curry, Bridgewater State College.

Carver Pond Species:
Anisoptera (Dragonfly):
- Aeshnidae: Darners
  - *Aeshna verticalis*
  - *Anax junius*
- Cordulliidae: Emeralds
  - *Epitheca cynosura*
- Libellulidae: Skimmers
  - *Celithemis eponina*
  - *Leucorrhinia intacta*
  - *Pachydiplax longipennis*
  - *Erythemis simplicicollis*
  - *Libellula pulchella*
  - *Libellula cyanea*
  - *Libellula luctuosa*
  - *Libellula incesta*
  - *Libellula lydia*
  - *Perithemis tenera*

Zygoptera (Damselfly) Species:
- Lestidae: Spreadwings
  - *Lestes inequalis*
  - *Lestes vigilax*
- Calopterydidae: Broad-winged Damsels
  - *Calopteryx maculate*
- Coenagrionidae: Pond Damsels
  - *Enallagma exsulans*
  - *Enallagma signatum*
  - *Ischnura kellicotti*

Dragonflies and damselflies are insects in the taxonomic order Odonata, so named for their formidable biting mouthparts (*odon* meaning tooth in Greek) and predatory nature. Two suborders occur in North America, Anisoptera (dragonflies) and Zygoptera (damselflies). Though "dragonfly" refers to the Anisoptera, the name is often used to refer to the entire order.

Also known as Mosquito Hawks or Devil's Darning Needles, there are more than 400 species in North American and about 166 species occur in Massachusetts. Dragonflies hold their wings in a horizontal position when at rest; the smaller, rather delicate damselflies hold their wings upward and toward the back. The aquatic larvae of both are dull-colored, awkward-looking creatures with large chewing mouthparts. The larvae feed on other larvae, worms, small crustaceans, or even small fishes. In turn, they are an important food of many larger

fish. Adults mate in flight. Females deposit their eggs in the water, in floating plant masses, in sand, or in holes cut by the females in plant stems—the place and method of laying eggs varies with the species. Some species complete their life cycle from egg to adult in three months; others may take up to five years and pass through many states before becoming adults. Transformation from nymph to adult takes place on a piling, on a plant stem sticking out from the water, or on some similar object. The nymph's outer skin splits lengthwise on the upper surface and the adult emerges. It must wait for its wings to dry before it can fly.

Odonates spend the majority of their lives as larvae and are integral components of aquatic ecosystems. Threats to larvae and their habitats are the most serious due to the sensitivity of the larval state. Threats include:

Alteration of larval aquatic habitat

- Direct loss of habitat by construction, in-filling, removal of substrate, trampling, and ORV use
- Increase in sediment load by destruction of vegetation cover in catchment area and subsequent erosion
- Destruction of wetland margins and rate of flow alteration by channelization
- Intermittent exposure of shoreline by dam release, draining, draw-down from wells, or water diversion
- Eutrophication and subsequent changes in dissolved oxygen concentration
- Direct and indirect effects of insecticides (*e.g.*, mosquito control, agricultural runoff)
- Chemical or thermal contamination by runoff or discharge of agricultural, industrial, or urban effluent
- Major pollution event
- Acidification of lakes by airborne industrial emissions
- Degradation by invasive non-native plants and animals

Predation

- Increased predation of larvae due to stocking of fish, or by introduction of waterfowl

Appendix III – General Guidelines for Public Use on Town-Owned Conservation Areas

- Bridgewater Conservation Parkland is open to the public from dawn to dusk except by Special Permit obtained from the Commission.
- The areas are to be used for NON-INTRUSIVE, passive recreation only including but not limited to: hiking, fishing, canoeing, bird watching, photography, picnicking, etc., and where site approved, tenting, horseback riding and hunting.
- Areas are to be left undisturbed in their natural state. Practice *Leave No Trace* principles. See Appendix V for a fuller explanation of *Leave No Trace*.
- There are no public toilets available.
- No dirt bikes, all-terrain vehicles, or snowmobiles are permitted on conservation parkland. No automobiles are permitted off designated roads or parking areas.
- All dogs must be leashed in accordance with the local Canine Control Law. Owners are to promptly and properly remove dog wastes.
- Only hand-carried tents and watercraft are permitted: No boat trailers or camping trailers allowed.
- No person shall remove vegetation, soil or stones from the area or dig or disturb any artifacts or archaeological remains.
- There shall be no unauthorized use of chain saws.
- The Bridgewater Fire Department must permit campfires and cook fires (508 697-0900). Fires must be kept in designated areas only, and be completely extinguished before user leaves the site. The user must remove all trash at the time of departure.
- No alcohol or illegal substances are permitted on conservation parkland.
- Visitors should check the rules for individual parks regarding site-specific management and user-policy.
- Use of Bridgewater Conservation Parkland is free of charge; the user however, is liable for any damage to town property.

Appendix IV – Annual Maintenance/Monitoring Schedule

Task/Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Spring Cleanup				X								
Invasive Plant Control				X					X			
Trailside Mowing*					X	X	X	X	X			
Field Mowing										X		
Periodic Clean Up*					X	X	X	X	X	X		

* or as needed.

Spring Cleanup would include general litter removal; trail maintenance and trimming of overhanging vegetation; and raking. It could also include control of non-native invasive plant species. The paths and field are currently mowed a couple of times each growing season. It is generally adequate to do field mowing every other year after most of the woody growth has been reduced. Some assistance from the Highway Department would aid in this task.

Appendix V – Invasive Non-native Plants

Invasive Non-Indigenous Plants in Massachusetts

Scientific Name	Common Name	Potentially Invasive	Widespread	Invasive
Acer ginnala	Amur maple			X
Acer platanoides	Norway maple		X	X
Acer pseudoplatanus	Sycamore maple		X	X
Actinidia arguta	Kiwi vine	X		
Aegopodium podagraria	Goutweed			X
Alliaria petiolata (officinalis)	**Garlic mustard**			**X**
Ampelopsis brevipedunculata	Porcelain berry		X	X
Anthriscus sylvestris	Chervil	X		X
Berberis thunbergii	Japanese barberry			X
Berberis vulgaris	Common barberry			X
Cabomba caroliniana	**Fanwort**			**X**
Celastrus orbiculatus	**Oriental bittersweet**			**X**
Centaurea maculosa	**Spotted knapweed**			**X**
Echinochloa crusgalli	Barnyard grass		X	X
Egeria densa	**Giant Waterweed**	**X**		**X**
Eleagnus angustifolia	Russian olive		X	X
Eleagnus umbellata	**Autumn olive**			**X**
Epilobium hirsutum	Hairy willow-herb			X
Euonymus alatus	Winged euonymus		X	X
Euphorbia cyparissias	Cypress spurge		X	X
Glaucium flavum	Sea poppy			X
Glyceria maxima	English water grass			X
Hesperis matronalis	Dame's rocket		X	X
Humulus japonicus	Japanese hops			X
Iris pseudacorus	Yellow iris			X
Ligustrum obtusifolium	Blunt-leaved privet		X	X
Ligustrum vulgare	Privet		X	X
Lonicera japonica	**Japanese honeysuckle**		**X**	**X**
Lonicera maackii	Amur honeysuckle	X		X
Lonicera morrowii	**Morrow honeysuckle**			**X**
Lonicera tatarica	Tartarian honeysuckle	X		X
Lysimachia nummularia	Moneywort, Creeping Jenny			X
Lythrum salicaria	**Purple loosestrife**			**X**
Morus alba	White mulberry		X	X
Myosotis scorpioides	True forget-me-not			X
Myriophyllum heterophyllum	**Variable water-milfoil**		**X**	
Myriophyllum spicatum	**Spiked water-milfoil**			**X**
Najas minor	**Lesser naiad**			**X**

Invasive Non-Indigenous Plants in Massachusetts (continued)

Scientific Name	Common Name	Potentially Invasive	Widespread	Invasive
Nasturtium officinale	Watercress			X
Nymphoides peltata	**Yellow floating heart**			**X**
Paulownia tomentosa	Princess tree, empress tree			X
Phalaris arundinacea	Reed canary grass		X	X
Phragmites australis	**Phragmites, common reed**			**X**
Polygonum aubertii	Silver fleece vine			X
Polygonum cuspidatum	**Japanese knotweed**		**X**	**X**
Populus alba	White cottonwood		X	X
Potamogeton crispus	**Curly or crisped pondweed**			**X**
Pueraria lobata	Kudzu			X
Ranunculus repens	Creeping buttercup			X
Rhamnus cathartica	**Common buckthorn**			**X**
Rhamnus frangula	**Glossy or smooth buckthorn**			**X**
Robinia pseudoacacia	Black locust			X
Rosa multiflora	**Multiflora rose**			**X**
Thymus pulegioides	Wild thyme		X	X
Trapa natans	**Water chestnut**			**X**
Tussilago farfara	Coltsfoot			X
Wisteria floribunda	Japanese wisteria		X	X

Bold = "most invasive" in either Hellquist, C. B. 1994 or Weatherbee, P. B. 1994. Mass. Wildlife 54 (2).

Sources: Hellquist, C. B. & P. B. Weatherbee. 1992. Non-native Invasive Plant Species in Massachusetts. Unpublished list.

Sorrie, B. A. & C. B. Hellquist. 1990. Invasive Alien Plants in Massachusetts, Widespread or Locally Abundant Alien Species in Massachusetts, & Potential Invasive Alien Plants in Massachusetts. Unpublished list.

Walker, D. 1992. Partial List of Exotic Invasive Plant Species. Unpublished list.

This table is a compilation of lists from several of the state's most knowledgeable field botanists. It reflects their views on degree of "invasiveness" in Massachusetts. It was prepared as a working document for the *ad hoc* "Native Plant Advisory Committee" which meets periodically at Natural Resources Conservation Service offices in Amherst. It is not a regulatory list nor does it represent any official policy position by any of the agencies or organizations participating on the Committee. Further documentation of the "invasiveness" of most of these taxa is desired.

Paul Somers, Ph.D., State Botanist 6 March 1996
Mass. Natural Heritage & Endangered Species Program
Division of Fisheries & Wildlife, Westboro, MA 01581

An update of this page is available on-line at:
http://cufp.clemson.edu/scnativeplants/eastern_region_invasive_plants.htm
Also see: http://invasives.eeb.uconn.edu/ipane/

Information on the control of invasive non-native species is available on-line at:
The Nature Conservancy's Wildland Invasive Species Team page.url:
http://tncweeds.ucdavis.edu/

Appendix VI - Principles of Leave No Trace

See http://www.lnt.org/ .

The Leave No Trace Principles of outdoor ethics form the framework of Leave No Trace's message:

1. ***Plan Ahead and Prepare***
2. ***Travel and Camp on Durable Surfaces***
3. ***Dispose of Waste Properly***
4. ***Leave What You Find***
5. ***Minimize Campfire Impacts***
6. ***Respect Wildlife***
7. ***Be Considerate of Other Visitors***

- ***Plan Ahead and Prepare***
  - ***Know the regulations and special concerns for the area you'll visit.***
  - ***Prepare for extreme weather, hazards, and emergencies.***
  - ***Schedule your trip to avoid times of high use.***
  - ***Visit in small groups. Split larger parties into groups of 4-6.***
  - ***Repackage food to minimize waste.***
  - ***Use a map and compass to eliminate the use of marking paint, rock cairns or flagging.***
- ***Travel and Camp on Durable Surfaces***
  - ***Durable surfaces include established trails and campsites, rock, gravel, dry grasses or snow.***
  - ***Protect riparian areas by camping at least 200 feet from lakes and streams.***
  - ***Good campsites are found, not made. Altering a site is not necessary.***
    In popular areas:
    - ***Concentrate use on existing trails and campsites.***
    - ***Walk single file in the middle of the trail, even when wet or muddy.***
    - ***Keep campsites small. Focus activity in areas where vegetation is absent.***

    In pristine areas
    - ***Disperse use to prevent the creation of campsites and trails.***
    - ***Avoid places where impacts are just beginning.***

- ***Dispose of Waste Properly***
  - ***Pack it in, pack it out. Inspect your campsite and rest areas for trash or spilled foods. Pack out all trash, leftover food, and litter.***
  - ***Deposit solid human waste in catholes dug 6 to 8 inches deep at least 200 feet from water, camp, and trails. Cover and disguise the cathole when finished.***
  - ***Pack out toilet paper and hygiene products.***
  - ***To wash yourself or your dishes, carry water 200 feet away from streams or lakes and use small amounts of biodegradable soap. Scatter strained dishwater.***

- ***Leave What You Find***
  - ***Preserve the past: examine, but do not touch, cultural or historic structures and artifacts.***
  - ***Leave rocks, plants and other natural objects as you find them.***
  - ***Avoid introducing or transporting non-native species.***
  - ***Do not build structures, furniture, or dig trenches.***

- ***Minimize Campfire Impacts***
  - ***Campfires can cause lasting impacts to the backcountry. Use a lightweight stove for cooking and enjoy a candle lantern for light.***
  - ***Where fires are permitted, use established fire rings, fire pans, or mound fires.***
  - ***Keep fires small. Only use sticks from the ground that can be broken by hand.***
  - ***Burn all wood and coals to ash, put out campfires completely, then scatter cool ashes.***

- ***Respect Wildlife***
  - ***Observe wildlife from a distance. Do not follow or approach them.***
  - ***Never feed animals. Feeding wildlife damages their health, alters natural behaviors, and exposes them to predators and other dangers.***
  - ***Protect wildlife and your food by storing rations and trash securely.***
  - ***Control pets at all times, or leave them at home.***
  - ***Avoid wildlife during sensitive times: mating, nesting, raising young, or winter.***

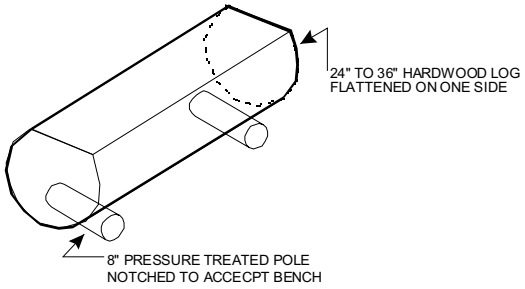
- ***Be Considerate of Other Visitors***
  - ***Respect other visitors and protect the quality of their experience.***
  - ***Be courteous. Yield to other users on the trail.***
  - ***Step to the downhill side of the trail when encountering pack stock.***
  - ***Take breaks and camp away from trails and other visitors.***
  - ***Let nature's sounds prevail. Avoid loud voices and noises.***

Appendix VII – Design Details

View/Seating Areas

The two proposed areas would include a small clearing and one or two of the log benches illustrated below.

Log Benches



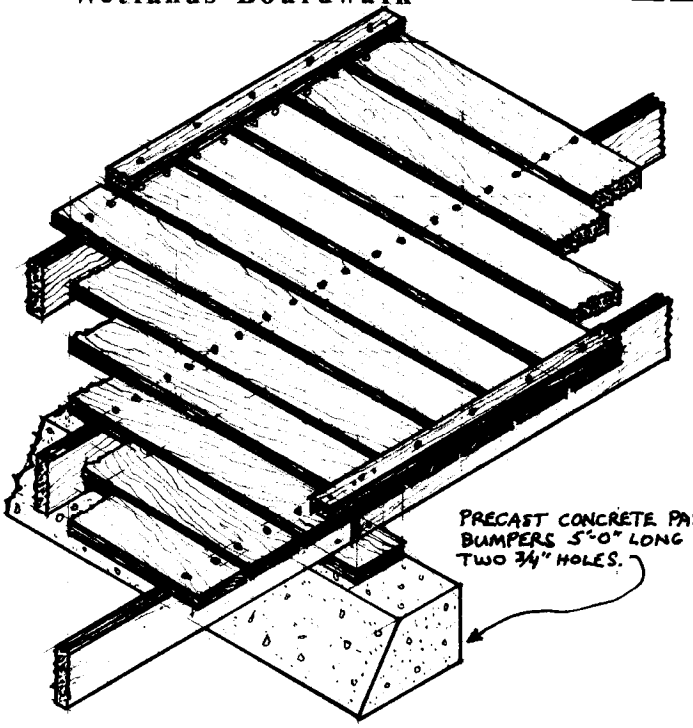
Example of Log Bench

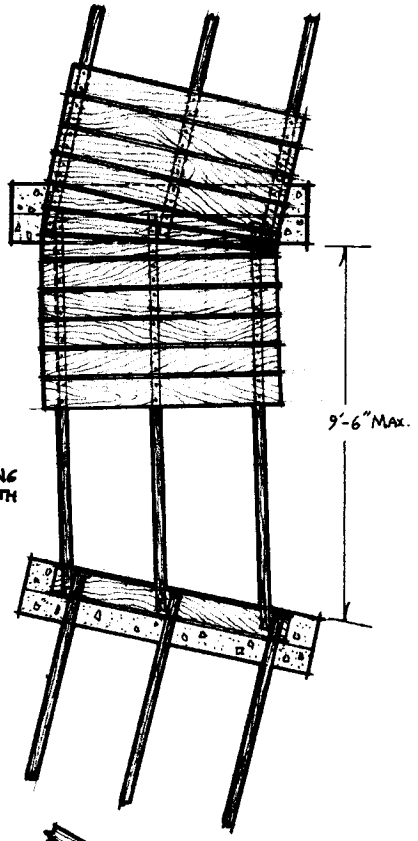
Pet Waste Station

Examples of a Dog Waste notice and plastic bag dispensers.

Wetlands Boardwalk

Massachusetts Audubon Society

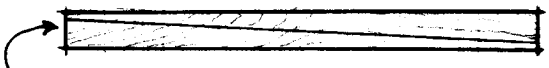


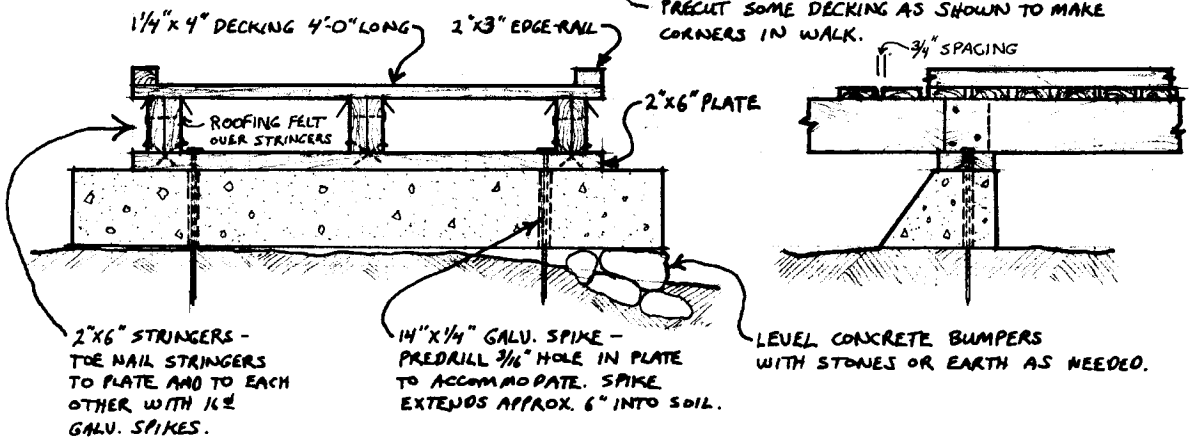


PLACE CONCRETE BUMPERS TO SUIT TERRAIN BUT NOT MORE THAN 9'-6" APART. ATTACH PLATE WITH 14" SPIKES THROUGH 3/16" PRE-DRILLED HOLES. IF WATER LEVEL RISES WALKWAY WILL RIDE UP ON THE 14" SPIKES (UP TO 12" ABOVE NORMAL) AND THEN RETURN TO ITS ORIGINAL POSITION AS WATER LEVEL DROPS.

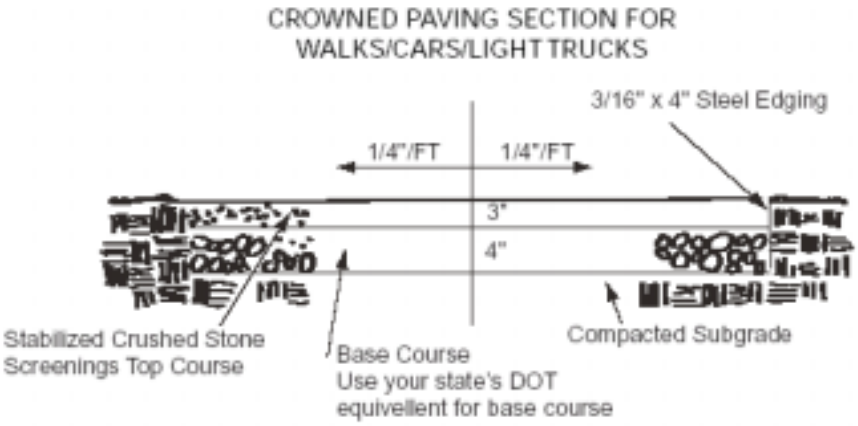
USE ALL PRESSURE TREATED LUMBER AND GALVANIZED NAILS.

NAIL DECKING TO STRINGERS WITH 8¢ GALV. COMMON NAILS.



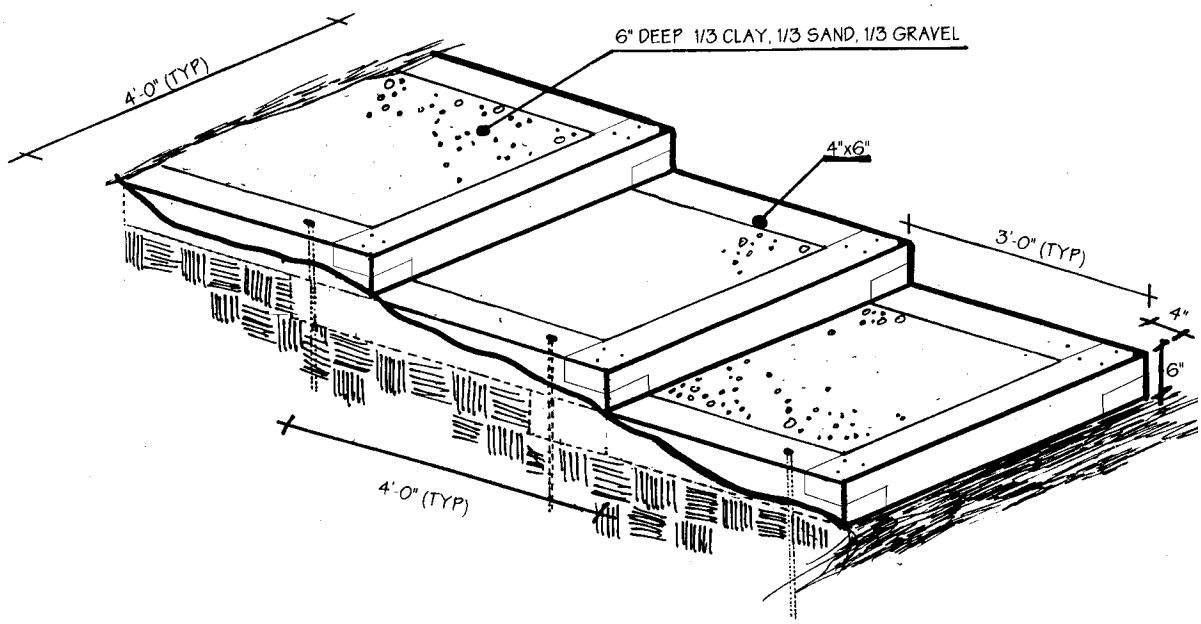


Handicapped Trail



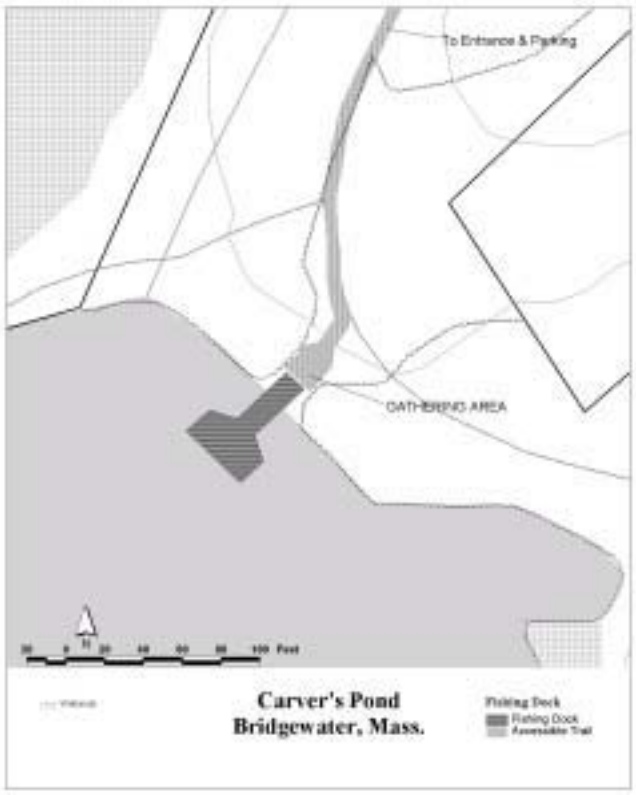
Note: Soil stabilizer is an additive made from psyllium husk powder.

Stairway Down Steep Portion of West Trail and down to Pond Shore
Design model also available in the Stiles & Hart parkland, installed by the AmeriCorp Student Conservation Service in 2003.



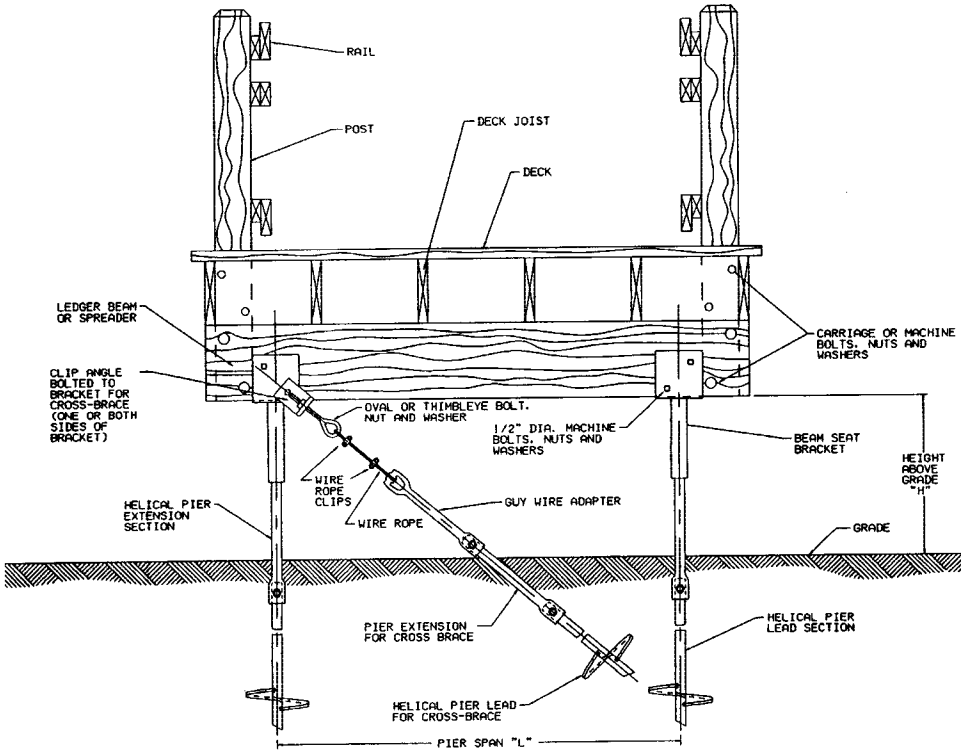
- May be built of approved pressure treated timbers or fashioned from logs.
- Use 30" reinforcement rods driven through drill holes in overlapping timbers to provide structural stability.
- Mix sand, clay and gravel before filling cribwork.

Fishing Dock/Canoe Launch

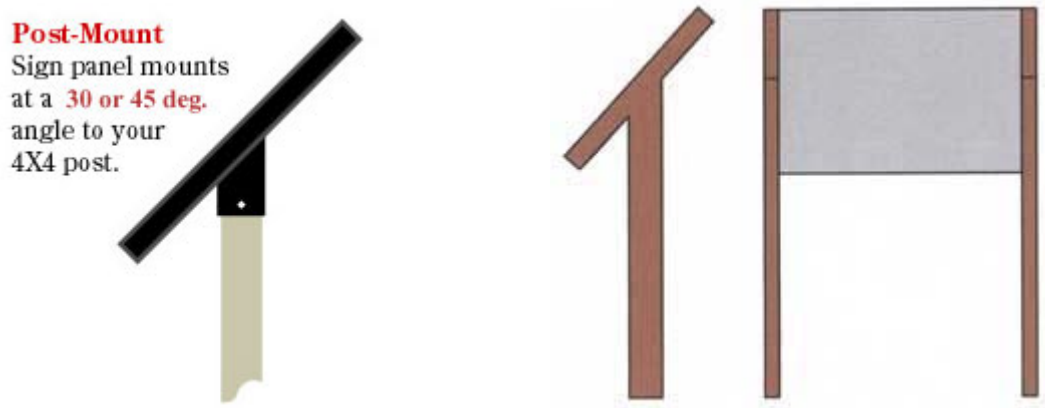


Helical Pier Support System

- Minimal disturbance—supports "screw" into substrate
- Transfers loads to bearing capable strata
- Isolates structure from seasonal surface changes
- Modular helical foundation and extension sections,
- Portable hand-held installing equipment.



Interpretive Signs



May be mounted on one post or two depending on size.

Design models may also be found in the Titicut Conservation Parkland and at the Iron Works Park.

Appendix VIII – Cost Estimates

Item	Source	Units	Cost
Fishing Dock/Canoe Launch	Local Contractor	1,200 sf	$15,000
Log Bench	Local Contractor Or Highway Department	each	$1,200.00 installed
Accessible Trail	Local Contractor Or Highway Department	460 feet 3,500 sf	$6,000
Stairs	Volunteers	each	$500 for Materials
Dog Waste Disposal System	Several Manufactures	each	$300
Wetlands Boardwalk	Volunteers	240 feet	$2,100

Appendix IX – Recommended Native Wildflowers, Shrubs, and Vines

Listed by Wildlife Value

Species	Latin Name	Soil	Pond Shore	Meadow	Forest	Wildlife Value
Shrubs and Vines						
Allegheny Blackberry	*Rubus allegheniensis*	dry, acid	x	x		97
Wild Raspberry	*Rubus idaeus v strigosus*	dry, acid	x	x		97
Black Raspberry	*Rubus occidentalis*	dry, acid	x			97
Running Raspberry	*Rubus pubescens*	wet, acid/alk.			x	97
Dewberry	*Rubus hispidus*	wet,acid	x	x		97
Scrub Oak	*Quercus ilicifolia*	dry, acid	x			96
Dwarf Chinkapin Oak	*Quercus prinoides*	dry, acid	x			96
Fire or Pin Cherry	*Prunus pensylvanica*	dry, acid	x			81
Choke Cherry	*Prunus virginiana*	dry, acid/alka.	x		x	81
Common Elderberry	*Sambucus canadensis*	wet, acid	x			79
Summer Grape	*Vitis aestivalis*	dry/wet, acid	x		x	75
Riverbank Grape	*Vitis riparia*	wet, acid/alk.	x			75
Fox Grape	*Vitis labrusca*	dry, acid	x			75
Red Osier Dogwood	*Cornus stolonifera*	wet, alkaline	x			64
Flowering Dogwood	*Cornus florida*	dry, acid	x		x	64
White Dogwood	*Cornus racemosa/foemina*	dry, acid/alka.	x			64
Silky Dogwood	*Cornus amomum*	wet, acid/alk.	x			64
Pagoda Dogwood	*Cornus alternifolia*	dry, alkaline	x		x	64
Roundleaf Dogwood	*Cornus rugosa*	dry, alkaline	x			64
Tall Shadbush	*Amelanchier arborea*	dry, acid/alka.	x		x	58
Smooth Shadbush	*Amelanchier laevis*	dry, acid			x	58
Running Shadbush	*Amelanchier stolonifera*	dry, acid	x			58
Thicket Shadbush	*Amelanchier canadensis*	wet, acid	x		x	58
Highbush Blueberry	*Vaccinium atroccum/corymbosum*	wet, acid/alk.	x	x	x	58
Low Sweet Blueberry	*Vaccinium angustifolium*	dry, acid	x	x		53
Velvetleaf Blueberry	*Vaccinium myrtilloides*	dry/wet, acid	x		x	53
Deerberry	*Vaccinium stamineum*	dry, acid	x			53
Woodland Blueberry	*Vaccinium vacillans*	dry, acid	x		x	53
Cranberry	*Vaccinium macrocarpon*	wet, acid	x	x		53
Winged Sumac	*Rhus copallinum*	dry, acid	x			50
Smooth Sumac	*Rhus glabra*	dry, acid	x			50
Staghorn Sumac	*Rhus typhina*	dry, acid	x			50
Virginia Creeper	*Parthenocissus vitacea/inserta*	dry, alkaline	x	x	x	37
Inkberry	*Ilex glabra*	dry, acid	x		x	36
American Holly	*Ilex opaca*	dry, acid			x	36
Smooth Winterberry	*Ilex laevigata*	wet, acid			I	36
Common Winterberry	*Ilex verticillata*	wet, acid/alk.	x		x	36

Species	Latin Name	Soil	Pond Shore	Meadow	Forest	Wildlife Value
Bayberry	*Myrica pensylvanica*	dry, acid	x			36
Sweet Gale	*Myrica gale*	wet, acid	x	x		36
Sawbrier	*Smilax glauca v leurophylla*	dry/wet, acid	x		x	33
Catbrier	*Smilax rotundifolia*	dry/wet, acid	x		x	33
Prickly Gooseberry	*Ribes cynosbati*	dry, acid			I	32
Common Gooseberry	*Ribes hirtellum*	dry/wet, acid	x			
American Black Currant	*Ribes americanum*	wet, acid/alk.	x		x	32
Hawthorns	*Crataegus spp.*	dry, acid/alka.	x		x	29
Hobblebush	*Viburnum alnifolium*	wet, acid			x	25
Sweet Viburnum	*Viburnum lentago*	wet, acid/alk.	x		x	25
Wild Raisin	*Viburnum cassinoides*	dry, acid	x		x	25
Smooth Arrowwood	*Viburnum recognitum*	wet, acid/alk.	x		x	25
Southern Arrowwood	*Viburnum dentatum*	dry, acid	x		x	25
Pasture Rose	*Rosa carolina*	dry, acid	x	x		24
Virginia Rose	*Rosa virginiana*	dry/wet, acid	x	x		24
Swamp Rose	*Rosa palustris*	wet, acid/alk.	x			24
American Hazelnut	*Corylus americana*	dry, acid	x		x	23
Beaked Hazelnut	*Corylus cornuta*	dry, acid/alka.	x		x	23
Eastern Yew	*Taxus canadensis*	dry/wet, acid			I	17
Speckled Alder	*Alnus rugosa*	wet, acid	x			16
Common Alder	*Alnus serrulata*	wet, acid	x			16
Black Huckleberry	*Gaylussacia baccata*	dry, acid	x		x	14
Dangleberry	*Gaylussacia frondosa*	dry/wet, acid	x		x	14
Fly-honeysuckle	*Lonicera canadensis*	dry, acid/alka.	x		I	14
Mt. Fly-honeysucle	*Lonicera villosa*	wet, acid/alk.	x			14
Limber Honeysuckle	*Lonicera dioica*	dry, acid/alka.			x	14
American Mountain-ash	*Sorbus americana*	dry, acid	x		x	14
Spicebush	*Lindera benzoin*	wet, acid/alk.	x		I	12
Black Chokeberry	*Aronia melanocarpa*	dry/wet, acid	x		x	11
Red Chokeberry	*Aronia arbutifolia*	dry/wet, acid			x	11
Shrubby Cinquefoil	*Potentilla fruticosa*	dry, alkaline		x		10
Bearberry	*Arctostaphylos uva-ursi*	dry, acid	x	x		8
Wildflowers and Grasses						
Common Smartweed	*Polygonum hydropiper*	wet, acid	x	x		66
Swamp Sunflower	*Helianthus angustifolius*	wet, acid	x	x		60
Sunflower	*Helianthus annuus*	dry, acid	x	x		60
Intermediate Dogbane	*Apocynum medium*	dry/wet, acid	x	x	x	43
Common Milkweed	*Asclepias syrica*	dry, acid	x	x		42
Northern Bayberry	*Myrica pensylvanica*	dry/wet, acid	x	x		22
Sweet Goldenrod	*Solidago odora*	dry, acid	x	x	x	20
Gray Goldenrod	*Solidago nemoralis*	dry, acid	x	x	x	20
Swamp Milkweed	*Asclepias incarnata*	wet, acid	x	x		20
Butterfly Weed	*Asclepias tuberosa*	dry, acid	x	x		20
Heart-leaved Aster	*Aster cordifolius*	dry, acid	x	x	x	19
New England Aster	*Aster novae-angliae*	dry/wet, acid	x	x	x	19
American Vetch	*Vicia americana*	dry/wet, acid	x	x		14
Wild Lupine	*Lupinus perennis*	dry, acid	x	x	x	13
Tickseed Sunflower	*Bidens coronata*	wet, acid	x	x		10

Species	Latin Name	Soil	Pond Shore	Meadow	Forest	Wildlife Value
Common Cinquefoil	*Potentilla simplex*	dry, acid	x	x		10
Wild Geranium	*Geranium maculatum*	dry/wet, acid	x	x	x	9
Joe-pye Weed	*Eupatorium maculatum*	wet, acid	x	x		9
Sedges	*Carex spp.*	wet, acid	x	x	x	8
Canada Violet	*Viola canadensis*	dry/wet, acid	x	x	x	7
Sweet Violet	*Viola ororata*	dry/wet, acid	x	x		7
Spotted Touch-me-not	*Impatiens capensis*	wet, acid	x	x		7
Pale Touch-me-not	*Impatiens pallida*	wet, acid	x	x		7
Purple Coneflower	*Echinacea purpurea*	dry, acid	x	x		7
Fireweed	*Epilobium angustifolium*	dry, acid	x	x		5
Evening Primrose	*Oenothera biennis*	dry, acid	x	x		5
Blue-eyed Grass	*Sisyrinchium angustifolium*	dry, acid	x	x	x	5
Bee Balm	*Monarda didyma*	dry/wet, acid	x	x		2
Wild Bergamot	*Monarda fistulosa*	dry, acid	x	x		2
Bluebell	*Campanula rotundifolia*	wet, acid	x	x		
Indian Paintbrush	*Castilleja coccinea*	wet, acid	x	x		
Lance-leaved Coreopsis	*Coreopis lanceolata*	dry, acid	x	x		
Shooting Star	*Dodecatheon meadia*	dry/wet, acid	x	x		
Sneezeweed	*Helenium autumnale*	wet, acid	x	x		
Northern Blazing Star	*Liatris borealis*	dry, acid	x	x	x	
Turk's Cap Lily	*Lilium superbum*	wet, acid	x	x		
Black-eyed Susan	*Rudbeckia seroyina*	dry/wet, acid	x	x		
Spiderwort	*Tradescantia virginiana*	dry, acid	x	x	x	
New York Ironweed	*Vernonia noveboracensis*	wet, acid	x	x		
Columbine	*Aquilegia canadensis*	dry, acid	x	x	x	
Spring Beauty	*Claytonia virginica*	wet, acid	x	x	x	
Trout Lily	*Erythronium americanum*	wet, acid	x	x	x	
Crested Iris	*Iris cristata*	dry/wet, acid	x	x	x	
Foxglove Beardtongue	*Penstemon digitalis*	dry, acid	x	x	x	
False Indigo	*Baptisia australis*	dry/wet, acid	x	x	x	
Wild Indigo	*Baptisia tinctoria*	dry, acid	x	x		

Wildlife value is based on the number of animal species that are known to use the plant.

Appendix B

Inventory of catchbasins and outfalls

Stormwater Study Field Notes

Outfalls/catchbasins				
Desig.	***type***	***dia. (I.d.)***	***location***	***notes***
A			#85 Crescent Dr. culdesac	paved swale into wetland
B		16.0"	at s.d. #7-Foxhill Dr.	
C		24.0"	at s.d. #8-Foxhill Dr.	
D	Circ. Grate		#54 South St. in side yard	part of drainage outfall through s.d. #'s 12 & 13
E	concrete	15.0"	end of Aspen culdesac	set into concrete headwall - drain in wetland - no flow
F	concrete	31.0"	#254 Birch St. at s.d. #34	rec. stream under Birch flow toward Pleasant St.
G1	concrete	29.0"	Birch St.	receiving stream under street toward Pleasant St.
G2	PVC	8.0"	Birch St.	22.0" above streambed
H1	concrete	12.0"	Swift Rd.	pipe half-submerged - 2" sediment build up
H2	concrete	12.0"	Swift Rd.	connect from outfall I - into small pond
I1	concrete	39" x 30"	Pleasant St.	sq. culvert rec.stream - Pleasant St. near s.d. #64
I2	galv.cor.steel	12.0"	Pleasant St.	steel drain pipe - direct connect to s.d. #64
J1	concrete	18.0"	Pleasant St.	set into concrete headwall - rec. stream - steady flow
J2	concrete	33" x 27"	Pleasant St.	sq. culvert rec.stream - Pleasant St. near s.d. #64
J3	concrete	14.0"	Pleasant St.	set into concrete headwall - rec. stream - slow flow
K1	concrete	12.0"	Private Dr.	runoff from Faith Chapel parking lot - under drive into wetland/receiving stream
K2	concrete	12.0"	Private Dr.	runoff from Faith Chapel parking lot - under drive into wetland/receiving stream
L1	concrete	16.0"	South St. - south side	conical concrete flange drain - 1/2 full - standing water
L2	concrete	12.0"	South St. - south side	concrete round 1/2 full - flowing east across 10" headwall

Stormwater Study Field Notes

M	concrete	15.0"	South St. - north side	conical flange into large riprap and grass retention basin - overflow to L1
N	concrete	10.0"	Harvest Ln.	con.flange outflow - no water flowing
O	concrete	13.0"	Harvest Ln.	twin 13.0" con.flanges - east pipe appears to backflow? West pipe flows out.
P	concrete		near #526 South St.	concrete block drain w/stone-lined ret/det area - connect to s.d. #79 / #80
Q	concrete	36.0"	Mitchell Elementary School	all stormdrains/roofdrains flowing to low point of lot - into basin enclosed by fencing
R	concrete	48.0"	Mitchell Elementary School	a network of lines feed in from parking/roadway - concrete flanges into stone basin -
				overflow into DMH in roadway.
S	stone/concrete	6' X 4'	Under South St.	carrying stream to Carver Pond - drain DMH to metal pipe T
T	steel, corregated	18.0"	South St.	metal pipe from s.d. drains- flowing water
U	concrete/steel	12.0"	behind Willowridge	metal pipe set in concrete block - pipe deformed - flow into wetland
V	concrete	42.0"	behind Police Station	Two "V" notch weir outlets from detention basin w/ parking lot outfalls - flowing
**	Foxrun Apts. Bedford St. Sheetflow with no obvious swales - stormwater flows downslope into BVW - well maintained lawn areas.			
W	concrete/steel		Harbor One Bank, Bedford St.	roofdrains - onsite well. (4) catchbasins in pkg. Lot connect to onsite CB w/ "v" notch weir
X	ponded CB		W. Earl Chevrolet, Bedford St.	connection to s.d. #100 (42" oil/water sep) some flow is short-circuited - berm not well buffered.
				rapid flow through 14" concrete flange out into catchbasin - 8" blue PVC above water level.
Y	ponded CB		W. Earl Chevrolet, Bedford St.	connection to s.d.#101 flow to 16" concrete flange, 1/3 underwater, 12" PVC pipe and 8"
				PVC out with rapid flow, 1/2 underwater - parking lot is newly paved w/ stone buffer.
**	Dom's Autobody, Bedford St. No drainage - cars parked on upaved surfaces.			
**	McGlone Motors, Bedford St. No drainage - many cars parked on unpaved surfaces.			

Stormwater Study Field Notes

Z	PVC	12.0"	behind Dome	piped outfall flowing into wetland - connect from s.d. #103
AA	PVC	14.0"	behind Dome	corregated black PVC pipe - connect from s.d. #104
BB	concrete	15.0"	behind Dome parking lot	concrete flange - flowing - need more riprap
CC	vegetated CB		between Bedford St. & Dome	retention basin w/ "V"-notch weir connection to 8 to 10 roof leaders runoff
DD	concrete	8.0"	behind Dome	concrete flange - filled with silt and rocks
EE1	concrete headwall		Bedford St. at entrance Dome	no drain or pipe visible - completely submerged -
EE2	concrete headwall		Bedford St. other side of EE	no drain or pipe visible - completely submerged - swale from street runoff
FF	Ponded CB		Castaway's, Bedford St.	direct runoff from parking at Castaways - haybales around back of property
GG	vegetated CB		Russo's Liquors, Bedford St.	sm. Veg retention basin w/2 "v" notch weirs - not functioning properly - heavy water flow and
				retention behind basin and silt fencing.
HH	PVC pipes	6.0" ea	Russo's Liquors, Bedford St.	between Russo's and M.D office lot - (3) pvc pipes poorly functioning - water flowing around
II	vegetated CB		Comm. Health Ctr. Bedford St.	small retention pond w/bridge - (2) outlets from roof drains
JJ	stone/concrete		B'water Senior Ctr. Bedford St.	stone/concrete swale into retention pond at front - receiving s.d. from parking lots
KK1	cement	14.0"	B'water Senior Ctr. Bedford St.	cement flange flowing in to pond - outflow through 12" concrete pipe
KK2	cement	12.0"	B'water Senior Ctr. Bedford St.	concrete outflow pipe from retention pond.
LL	cement	14.0"	B'water Senior Ctr. Bedford St.	cement flange receive water from retention pond - outflow into BVW
			** 3 sets of s.d. catchments feed waters down to Rt. 18/Bedford St.	
MM	cement	14.0" (3)	Women's Health Ctr. Bedford St.	Back lot retention basin - (3) 14" flanges feed in lg. Outflow tank w/"v"notch weirs to s.d.'s
				on Wally Krueger Way - flowing to Rt. 18/Bedford St.
NN	cement	4' or 6'	Cycle Pro, Bedford St.	Stream and outflow - runoff has oily sheen - headwall covered with vegetation
OO	cement	4' or 6'	Cycle Pro, Bedford St.	other end of open swale - heavy veg'd - large stonework noted - new construction
PP	cement	18'	Cycle Pro (side lot), Bedford St.	arched drive - new construction - 8ft stream flow into wetland - flowing SE toward pond.

Stormwater Study Field Notes

QQ	stone/asphalt		Bedford St. (just past Cycle Pro)	large rip/rap swale receiving waters from Rt. 18/Bedford St. - directly across from WHC
**	Biker Boutique, Bedford St.		No drainage - sheetflow off rear embankment into BVW	
			Out of memory space on camera - no photos after this point	
RR	PVC	12.0"	Murphy's, 560 Bedford St.	corregated PVC with rip/rap swale into retention basin - concrete 'v' notch weir into BVW
				Some erosion/siltation into drainage basin - several autos parked in non-striped areas
SS	concrete	12' x 4.5'	Bedford St. (across fm Anthony's)	concrete block structure approx. 2ft below surface of Rt. 18 - outlet completely submerged
TT	stone/asphalt		Bedford St.(just before Armory)	rip/rap swale receiving waters from Rt. 18 - flowing into BVW.
				sheetflow erosion at corner of Armory off road.
UU	Ponded CB		Knights of Columbus, Bedford St.	retention basins with flow channels receiving at stormwater from property - "v" notch weirs
				control flow into wetland - no visible flow, water is ponded - functioning properly?
**	Bridgewater Fitness Center, Bedford St. **back lot near Jungle Gym - flooded - runoff from Rt.18/Bedford St. and front lots - stormwater retained on site?			

Appendix C

Vernal pools certification report

Vernal Pools Certification at Carver Pond
Bridgewater, MA

Submitted by LaDonna Luckman

July 2, 2005

With the assistance of Maura Chappelle, the Carver Pond volunteer steward, and Dr. John Jahoda, Professor of Biology at Bridgewater State, I successfully located the two potential vernal pools on the northwest side of Carver Pond. To certify a vernal pool through the Massachusetts Natural Heritage and Endangered Species Program, specific guidelines must be followed. I obtained those guidelines through the NHESP website, along with the certification forms that are to be submitted along with outlined evidence and mapping of the potential pools. For evidence of vernal pool habitat, I intended to use the Obligate Species Method. This method states that you must supply "evidence of a confined basin depression with no permanently flowing outlet" (NHESP DFW, 2000) and either evidence of breeding obligate amphibians or adult obligate invertebrates (Fairy shrimp). Acceptable breeding evidence can be photos of any one of the following:

1. Breeding frog/toads or salamanders
2. Egg masses (two or more required)
3. Larvae (tadpole or salamander)
4. Transforming juveniles (tadpoles with tail remnant evident; salamander with gill remnants evident).

I began my forays to the vernal pools in late March after much of the winter snow had begun to melt. In early April, I began to hear some chorusing frogs, but did not locate any mating adults. On April 11, I was very excited to find dozens of egg masses in the smaller vernal pool (#1). I counted upward of 60 egg masses, and estimate there were probably over 100 in this area alone – an area approximately four feet in diameter. These egg masses are of the Wood frog (*Rana sylvatica*) species, and the number evident is more than enough for certification. I took many digital photos of these egg masses, and later on in the month I was able to photograph the hatching tadpoles (Appendix IV). On April 13, I located two egg masses at the back end of the larger vernal pool (#2). These eggs were decidedly different from the masses found at the other pool (Appendix V). Using the information I had gathered online regarding vernal pools habitat, I made the tentative identification of these egg masses as Spotted Salamander (*Ambystoma maculatum*). I took digital photos of these,

and with the photos of the Wood frog eggs, I emailed them to Dr. Jahoda for confirmation. He replied that my identifications were correct, I had photos of Wood frog and Yellow Spotted Salamander and he encouraged me to continue to investigate the larger pond for additional egg masses.

I borrowed a set of waders from the biology dept., and made another couple of trips out to the vernal pools. On April 26, I located seven additional salamander egg masses at the larger pool. I took several photos for evidence (Appendix V). The photographic evidence of egg masses of these two amphibious species, along with the confined basin characteristics of both pools, fulfills the Obligate Species Method of certification. Other documentation requirements that I will be submitting are a USGS topographic map with the location of the vernal pool clearly marked, an aerial photo of Carver Pond with location of pools, and a large-scale topographic map with directions and distances to each pool. I also plan to submit the survey data showing the elevations and boundaries of each pool. The final component of the certification packet is the Field Observation Form. A separate form must be submitted for each pool - and so there will actually be two separate certification packets complete with separate topographic maps and photos. I estimate having gathered all the above information I will be able to submit the completed certification applications by the end of May 2005.

Web Resources:

- Massachusetts Geographic Information System – MassGIS – various online maps, raster files and data layers – site last accessed on May 10, 2005 at http://www.mass.gov/mgis/
- Massachusetts Natural Heritage and Endangered Species Program website last accessed on May 10, 2005 at http://www.mass.gov/dfwele/dfw/nhesp/nhesp.htm
- National Wetlands Inventory homepage – U.S. Fish and Wildlife last accessed on May 10, 2005 at http://www.nwi.fws.gov/
- New England Herpetological Society – identification of amphibian species – site last accessed on May 10, 2005 at http://www.neherp.com/index.html
- The Natural Resources Trust of Bridgewater (NRTB) – Parklands and Open Space Management Plans – site last accessed on May 10, 2005 at http://www.nrtb.org/pdfs/CarversPndMP.pdf

Appendix D

Business outreach documents

TOWN OF BRIDGEWATER

WATER DEPARTMENT

SEWER DEPARTMENT

TELEPHONE: (508) 697-0910
FAX: (508) 279-1307
E-Mail: water@bridgewaterma.org

ACADEMY BUILDING
66 CENTRAL SQUARE
BRIDGEWATER, MA 02324-2595

TELEPHONE: (508) 697-0937
FAX: (508) 697-0938
E-Mail: sewer@bridgewaterma.org

March/April 2005

Dear Bridgewater Business Owner/Property Owner:

This letter is intended to serve as an introduction to a study that the Town of Bridgewater is currently conducting: Bridgewater Wellhead Protection Grant.

The project focus is the Carver Pond Aquifer Protection District. The main project goal is to provide a basis for implementing a program for future management of the surface and ground water resources in this area. We seek to integrate the Town's Source Water Protection Plan with the recently completed Carver Pond Management Plan incorporating the comprehensive management and design plan for recreational use of the pond with a coordinated plan for protection of four of the town's drinking water supply wells.

One activity of this grant is the implementation of a public outreach and education program targeted at three diverse groups: existing businesses, abutting residents, and elementary school children housed in the school complex located within the Carver Pond Aquifer Protection District that includes the Zone II and sub-watershed. In outreaching to these groups the project will be promoting participation to aid in the protection of the Town's water supply. As a result of this study, individual businesses will be provided with on-site assessments of existing and possible future threats to water quality.

As a business owner in this defined area, your involvement is critical to our project. As part of our data gathering, we are requesting that you complete a brief survey. You will be contacted by one of our team members, Anna Nalevanko. She will set a time to meet with you for about 20 minutes at your place of business to review/complete the survey.

Once the data is compiled from these surveys and from other project information gathering, we plan to share these results at a public hearing that will be scheduled for this spring.

Your support is greatly appreciated!

Sincerely,

Fawn L. Sances
Project Manager

Town of Bridgewater - Survey of Bedford Street Businesses March/April 2005
Source Water Protection Technical Assistance Grant

This project has been financed partially with Federal Funds from the Environmental Protection Agency (EPA) to the Massachusetts Department of Environmental Protection (DEP) under a Source Water Protection Technical Assistance/Land Management Grant Competitive grant. The contents do not necessarily reflect the views and policies of EPA or of DEP, nor does the mention of trade names or commercial products constitute endorsement or recommendation for use.

Thank you for completing this survey!

I. Contact Information

Business Name: _____

Contact: _____ **Address:** _____

Telephone #: _____ **Email:** _____ **Website:** _____

Facility Owner Name : _____
(if different from business)

Telephone #: _____ **Email:** _____

II. General Background

1. Describe the primary purpose of your business/organization.

_____

_____

2. Years at current location: _____

3. Business SIC code (if known): _____

4. Number of persons employed:
Full time _____ Part-time _____ Other _____

5. Days/hours of operation:

	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	Sun.
Hours of Operation							

6. Business location (check one):
Stand alone building _____ Multiple buildings _____ Business complex _____

III. Infrastructure: Water, Sewage, Waste, Hazmat, & Heating Systems

1. Water source (check one):
Private well _____ Connection to Town water _____

If private, would you prefer connection to Town water line? *Yes* _____ *No* _____

If connection to Town, what is your estimated monthly use? _____
If connection to Town, is service adequate? *Yes* _____ *No* _____

If no, please describe:

_____

_____

2. Describe how you manage stormwater discharge.

_____

_____

What is the total pavement areas around building? _____

Do you have any mitigation run off from the lot? (if applicable): _____

3. Sewage disposal system (check one):
Septic _____ Tie-in to Town sewer lines _____

Do you experience problems with your current sewage disposal system? *Yes* _____ *No* _____
If yes, please describe:

_____

_____

If septic, please respond to these questions:
What is frequency of pumping out septic tank? _____
Are you aware of which chemicals cans cause problem if disposed down the drain?
Yes _____ *No* _____ *Unsure* _____
Would you prefer a tie-in to Town sewer? *Yes* _____ *No* _____ *Unsure* _____

4. Solid waste (non-hazardous) disposal method (check one):
Private hauler: _____ Private hauler (shared): _____ Other: _____
(individual)
What is collection frequency? _____

5. Do you currently handle hazardous/regulated materials? *Yes* _____ *No* _____
If yes, please list materials handled, how contained, and disposal method in the table:

Material	Containment/Leak Detection System	Disposal Method

6. Do you purchase green/environmentally preferable chemicals/products?
Yes _____ *No* _____

7. Above ground and underground tanks:
# of tanks currently in use:
above ground _____ *describe* _____
underground _____ *describe* _____

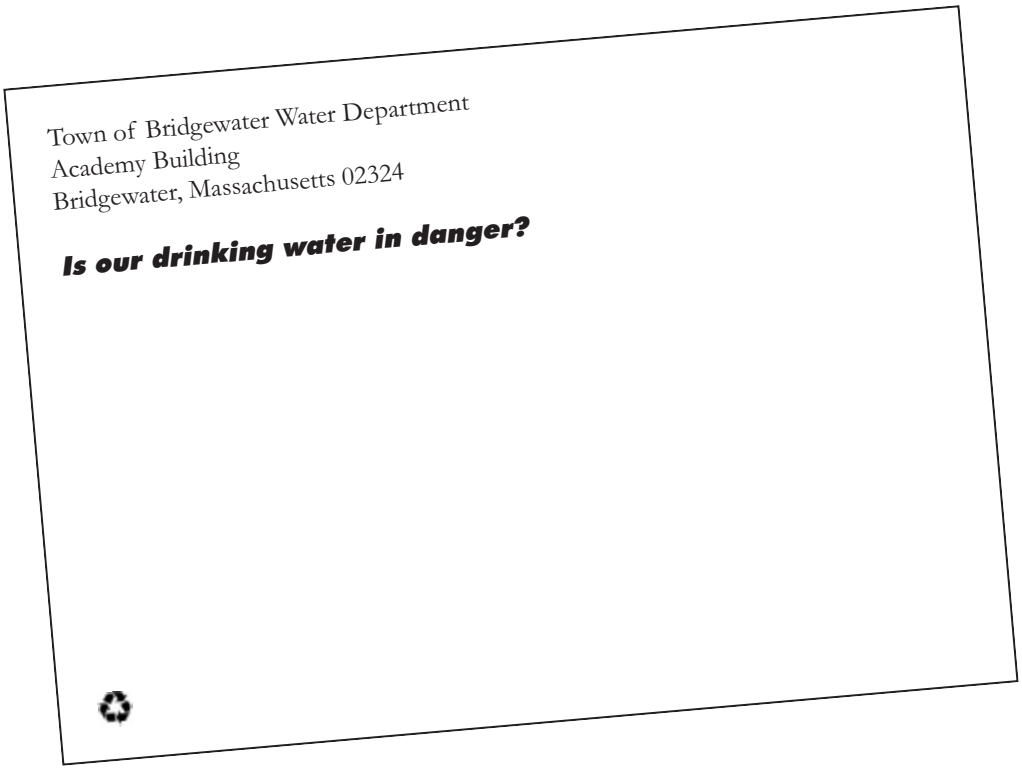
Are these regulated under state/federal programs? *Yes* _____ *No* _____
Do you have inactive tanks? *Yes* _____ *No* _____

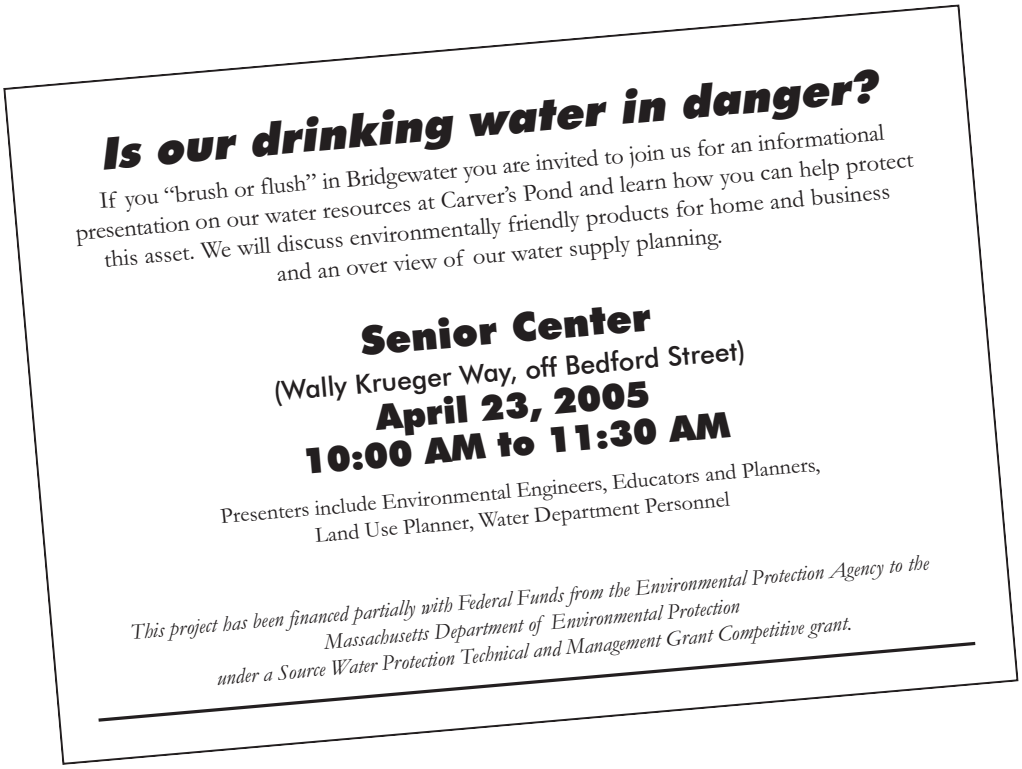
8. Do you have floor drains connected or not connected to oil/water separator?
Yes _____ *No* _____
Describe: _____

9. Heating system:
Oil: _____ Natural gas: _____ Other (describe): _____

Appendix E

Residential outreach documents





Postcard mailed to residents in the study area having town septic and private wells

On behalf of the town of Bridgewater Water Department, the 2002 Source Water Protection Grant Program application for the Bridgewater Source Water Protection was submitted to the Massachusetts Department of Environmental Protection (MDEP). Based upon review of the application by MDEP and the US Environmental Protection Agency, the grant was awarded to Bridgewater in June 2002. The development of the material for this grant is consistent with the 2002 Bridgewater Master Plan and is coordinated with the recently completed NRTB Carver's Pond Management Plan.

The Source Water Protection Grant was designed to develop and distribute educational material that could be used by the three groups that make up the unique character of the Carver's Pond Watershed. The Carver's Pond study area includes residents, businesses and a large elementary school complex and serves as a resource to the community in many ways including passive recreation, drinking water supply, watershed, and aquifer. It also provides a setting for several vernal pools. Some areas of its vulnerability include storm water, nearby private wells and septic systems. The comprehensive outreach and educational efforts identified in the SWP Grant will improve the understanding of the pond's ecological resources and the importance to view the integration of these various and complex components. Through this grant, a beginning point is created from which to see the way that they interact.

By way of introduction, the study area for this grant includes Carver's Pond, the aquifer protection district and sub-watershed region of the Taunton River, as shown on Figure 1. Together, these two areas represent the defined area of study which expands well beyond the boundaries of the pond, into the surrounding business and residential areas.

Carvers Pond is a more than 28-acre pond surrounded by wetlands and upland. The publicly owned area totals just over 106 acres. It is near Bridgewater State College and is a popular site for nature study and short walks. The site has two trails, one along the western edge of the pond and one along its eastern edge. It also has the concrete foundations of an old icehouse.

The pond is located between Summer Street and Bedford Street (Route 18 & 28) about 3,600 feet from the center of Bridgewater. Its main entrance is on Summer Street, where there is a small parking area (for about 8 cars), an entrance kiosk with a map of the area, and an interpretive display board. The pond is about 500 feet from this entrance.

As noted, this grant was intended to implement a public outreach and education program targeted to three diverse groups located within the study area: existing businesses, abutting residents, and elementary school children housed in the George Mitchell Elementary School complex. In outreaching to these groups, the project promotes participation that will aid in the protection of the Bridgewater's water supply through increased awareness of this critical resource area. Although the grant specifically targets those within the study area, the information developed through this grant work will be of value to all residents.

If you have any questions, please feel free to contact either the local grant coordinator, Fawn Sances 508-279-0182 or the MDEP SWP Grant Program, Kathy Romero 617-292-5727.

Town meeting handout

Appendix F

Brochure

Massachusetts
Department of Environmental Protection

Source Water Protection Grant Program

Carver's Pond Outreach
Submitted by Bridgewater Water Department
2005

For further information regarding this grant:
http://www.mass.gov/dep/brp/dws/dwspubs.htm

Appendix G

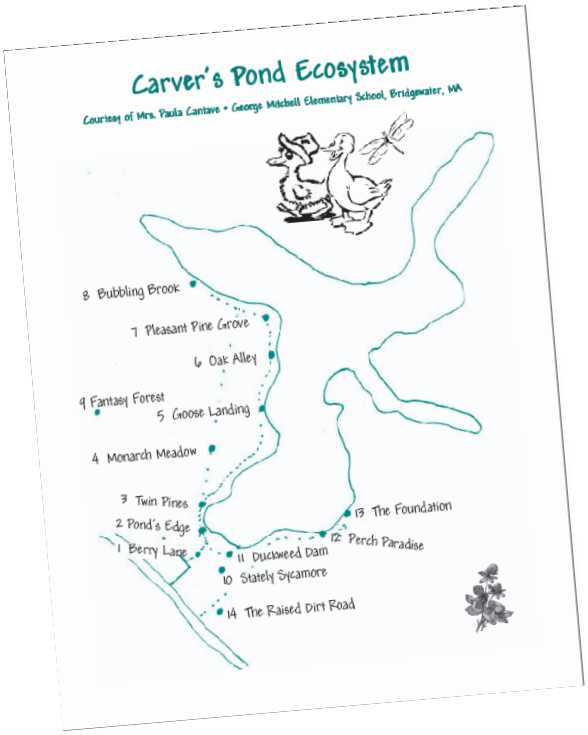
Selected pages from
Pollution Prevention:
A Story about Carver's Pond Cleanup

Pollution Prevention

A Story of Carver's Pond Cleanup

By Michelle Lyn Haskins & Rebecca L. Romasco

Illustrated by Billie McGregor



Introduction

Characters

Noah, the male scientist duck

Mandy, the female scientist duck

Alexandria, the female damselfly

Time: The future, 2050

Place: ***Carver's Pond***, Bridgewater, MA

"Actually, Alexandria and I explored ***Carver's Pond*** and beyond. The Carver's Pond Watershed is part of the larger **Taunton River Watershed.** This adventure took us to 43 different towns around ***Carver's Pond***.

We went to Brockton, Taunton, Fall River, Attleboro and New Bedford.

I tested the water and soil for pollution, while **Alexandria** pushed for better protection laws."