2.0 USERS AND ACTIVITIES ON THE WATER SHEET OF THE CHARLES RIVER BASIN

This section contains the results of an inventory, interviews and on-site visits of a diverse amount of water sheet users in the Charles River Basin. It also contains assessments of the distribution, density of the users, their various use schedules and conflicts.

2.1 INVENTORY OF USERS AND ACTIVITIES ON THE WATER SHEET

The inventory was conducted during the summer of 1997 by first mailing a survey form to each of the user groups followed by formal or informal on-site visits in many instances. Copies of the completed surveys are contained in Appendix A and the results are summarized in Table 2-I. A summary of community involvement programs is contained in Appendix B.

As indicated in Table 2-II, which is a synthesis of Table 2-I, the majority of water sheet users are institutional organizations (schools and universities). Rowing is the most popular form of recreational activity on the Charles River. Although private organizations show the majority of memberships, this is due in large part to the high membership at Community Boating with 5,000 members.

Sculls and sailboats are most numerous and account for more than 1,076 and 259 craft respectively. There are an additional 134 canoes and kayaks. However, these are predominantly located in the more riverine section being put in after renting from Charles River Canoe and Kayak at Herter Park.

Approximately 390 motorized craft are berthed on the Charles River each summer, excluding launches for rowing and sailing interests. Four yacht clubs are based on the Charles River; the Charles Gate Yacht Club and Charles River Yacht Clubs being located along Memorial Drive in Cambridge and close to the Science Museum dam, and the Newton Yacht Club and Watertown Yacht Club being located at the upstream end of the project area in Newton and Watertown, respectively.

In addition to these motorized craft, two commercial tourist operations also use the River daily during the summer. They are the Charles Riverboat Company and Boston Duck Tours. The Charles Riverboat Company has three vessels and offers excursions along the river and into Boston Harbor. It moors its vessels off the Science Museum. Boston Duck Tours operates sightseeing tours with amphibious military type "ducks", entering and leaving the river from a ramp at North Point. The Duck Tours operate up to approximately the Harvard Bridge. Sometimes two or three "ducks" may be operating in the river at the same time.

2.2 DATA ASSESSMENT AND CARRYING CAPACITY

An assessment of the users and activities taking place on the Charles River water sheet included an analysis of the distribution, density, temporal use patterns and circulation of water traffic as described below.

2.2.1 Distribution of Water Sheet Users and Activities

Between the Science Museum dam and the Watertown dam there are approximately 666 acres of water sheet. On a physiographic basis, the Charles River study area can be divided into two segments: The lower wide "basin section", and the narrow and curving "riverine section". The basin section extends from the Science Museum Dam upstream to about the Boston University Bridge with approximately 440 acres of water sheet. The

narrow and more riverine section is located above the Boston University Bridge and has an area of 226 acres. As shown on Figure 2-1 and summarized in Table 2-III, the survey data indicate there are 23 facilities such as boat houses and club houses in the study area. These are about evenly distributed in number between the "basin section" and the "riverine section".

In addition, the MDC has a public launch ramp off Nonantum Road near the Daly Rink in Newton. While estimates on the level of use of the ramp are not available, the ramp is the closest point of entry from the western suburbs to Boston Harbor via the Col. Richard Gridley locks in the new dam. The parking area has marked spaces for 109 cars and four car/boat trailer units. Alternatively, the parking lot could be used for more than 50 car/boat trailer combinations. The level of use for launching motorized boats is reported to be high and was estimated at 50 power boat launchings per weekend day.

MDC records for boat movements through the Gridley Locks were reviewed for information on the net flow of boat traffic into and out of the River. A summary of the 1996 records are given in Table 2-IV. As was expected, the July 4th holiday results in the highest number of boat movements through the locks. Unfortunately, the records are not accurate enough to determine any net flow as they indicate that over 15,100 vessels move into the Charles River and only 6,700 vessels depart on an annual basis. This is not a realistic balance.

2.2.2 Density of Water Craft

While the above data give some estimate of the distribution of water craft which could be on the Charles River at any one time, it is also important to consider the density and recreational schedules.

The survey data indicate that more than 1,980 water craft of various types are berthed/housed on and along the Charles River during the summer. These consist of 633± water craft on the "basin section" and a possible inventory of 1,347± water craft in the "riverine section". This creates a theoretical water craft to water sheet area density of approximately one water craft per acre, and six water craft were acre in each of the sections, respectively.

From outward appearances, these ratios may appear high especially in the riverine section. However, not all water craft are in use at the same time and use patterns become a more important factor than density.

2.2.3 Daily Water Sheet Use Schedules

Using the survey data, the daily patterns of use by each water group or type of users (i.e., rowing, sailing, motor boating) were examined and the results are shown in Figures 2-2 through 2-4. During each season, the number of rowers is highest in the early morning and later afternoon while the inverse is found for sail boaters. This is due to the rower's preference for calmer water during these periods. In the spring, the number of motor boaters does not enter into the use patterns. In the summer and fall, motor boaters peak in the later afternoon. Although the pattern is not plotted, canoeists also use the river in a pattern similar to that of the motor boaters.

Therefore, due to the opposite peaking factors between the rowers and other users, a typical "traffic jam" type situation does not take place. This is not to say, however, that conflicts or near saturation conditions do not arise. The Newton and Watertown yacht clubs have 215 motorized vessels which may travel the length of the river to Boston Harbor on a weekend. When up to approximately 50 additional motor boats are added from the Nonantum Road public ramp, congestion does occur between these vessels and rowers and canoeists, especially in the narrow "riverine section" of the river.

2.2.4 Watercraft Travel Patterns

The patterns that various types of water craft travel along the Charles River were assessed. In the basin section, the traffic patterns have been worked out between the users where sailboats use the majority of the water sheet and smaller motorized craft from the yacht clubs on the river generally travel along the periphery, although in sufficiently deep water. The larger yachts, tour vessels and others navigate through the sailboats. Some individual rowers and canoeists use the periphery of the basin section. Racing sculls generally make straight runs through the basin, however, during periods when sailboat and other traffic is minimal.

In the riverine section, traffic movement is linear, with motorized vessels using the center of the river and canoeists and rowers general along the sides. In view of these boating patterns, however, there are no established and/or published traffic patterns for the Charles River.

2.2.5 Carrying Capacity

In the context of use of the water sheet, the concept of carrying capacity is defined by the National Water Safety Congress as:

> "The capability of a waterway to provide an opportunity for certain types of satisfactory and safe experiences over time without significant degradation of the resource."

Based on the information in the proceeding sections, it may be observed that due to the differences in temporal use patterns, problems with carrying capacity do not exist. However, when one considers the question of how many additional vessels can be safely placed on the Charles River, the answer is more elusive and requires intensive monitoring of vessel density and flow patterns to adequately answer. Nonetheless, an estimate of the relative degree of density and distribution of watercraft was derived from the surveys and interviews.

2.3 CONFLICTS IN USE OF THE CHARLES RIVER WATER SHEET

The survey and interviews also elicited responses from user groups and individuals on conflicts that are experienced on the Charles River, either between users or River conditions. The types of conflicts that were raised by each organization are contained in Table 2-I. They are:

- Speeding by transient users either entering from Boston Harbor or at the MDC's Nonantum Road boat ramp.
- Excessive wakes.
- Lack of understanding the rules of the road and good etiquette.
- Rowers conflicting with sailing interests.
- Fishing under the bridge spans causes passage problems.
- Races are not adequately scheduled nor advertised.
- Shallow water is severely limiting navigation upstream of the Arsenal Street bridge.
- Dense vegetation causes fouling of propellers, oars and obstructs passage for many boats especially rowers and canoes.

Conflicts caused by some transient motor boaters who originate either from Boston Harbor or the Nonantum Road boat ramp were mentioned as the single largest cause of conflict. This includes speeding, excessive wakes and a general lack of good boating etiquette. It must be stressed, however, that this type of behavior is not the norm of the motor boating community but the acts of a low number. In addition, conflicts also result from the actual number of motor boats that are launched from the Nonantum Road ramp. The addition of 50± motor boats at this location has caused general conflicts over rights-of-way and the general density of motor boaters versus the other person powered craft.

In certain instances, boat fishermen fishing around bridge piers has caused problems with the ability of rowers to pass, especially under the bridges with only two or three spans.

Problems caused by shallow water and dense vegetation growth are discussed individually in Sections 3.0 and 4.0, respectively.

2.4 RECOMMENDATIONS

While conducting interviews and public meetings, a number of suggestions were made which could result in improved safety and quality of the recreational experience on the Charles River. These are summarized below.

2.4.1 Posting of Speed and Wake Limits, Rules of The Road and Travel Patterns

The problems and conflicts caused by the presence of a low number of troublesome motor boaters resulted in many comments and requests from the public for better signage about the speed limits and rules of the road. Some signs are present on the new locks and at several other locations. However, in some instances the signs are faded and in general difficult to read. The signs declaring the speed limit (10 mph) and no wake rule (no wake within 50 yards of canoes, shells, rowboats or sailboats) (350 CMR 12.00) are not easily observed. Therefore, simpler and more easily read signage is necessary. One suggestion was made for kiosks with spoken messages about etiquette and rules of the road to be located at the major public input points such as the Nonantum Road ramp, Herter Park and as boats are lifted through the Gridley Locks.

In addition, the lack of a uniform set of travel patterns, lanes or areas, also adds to weekend confusion. This could be partially mitigated by the incorporation of specific travel patterns, lanes and areas for various types of watercraft in the riverine and basin sections of the Charles River.

2.4.2 Police Patrolling

Requests have also been made for increased police patrolling of the river. Several years past, there were several weekends where intensive patrolling took place. The response was unanimous that the conflicts caused by speed and wakes were dramatically reduced. This level of patrolling should be repeated.

2.4.3 Boat Launching Facilities

Although the daily recreational schedules reported in Section 2.2.3 appear to result in a set of mutually compatible use frequencies which work to mitigate any density problems, the presence of additional motorized boats from the Nonantum Road ramp does create conflict, congestion and confusion particularly with canoeists and rowers. This is due to the presence of "transient" boaters on the river who lack a familiarity with the use patterns, rules of the road and are anxious to get to Boston Harbor. At the speed limit or under the no wake rule, the trip from Nonantum Road to the Gridley locks takes approximately one hour which invites speeding.

Therefore, an additional recommendation is for the MDC to consider a restriction at the Nonantum Road Boat ramp to non-motorized vessels. It is also recommended that an additional boat ramp closer to the Harbor be constructed.

In this same context, adverse comments were also received about the difficulty in using the public ramp at the Schrafft Center on the tidal portion of the Mystic River in Boston. In partial resolution of the access problem, the DEP was advised of the complaints and has discussed the compliance with the conditions of its Chapter 91 License with the Flatley Company.

2.4.4 Increased Coordination Between Users

A suggestion was made for the re-establishment of a Charles River Users Conference. Such a group had met periodically in the past and was composed of representatives of each of the use groups. Such a proactive group would include all user groups along the Charles River Basin and its activities would include scheduling of events on the water sheet, resolution of conflicts and problems and to be an advocacy group to assist in the management of the Charles River's resources.

2.4.5 Additional Monitoring of Water Sheet Use and Watercraft Density

The lack of adequate spatial and contemporaneous data on water craft movements makes the resolution of carrying capacity unresolved. Therefore, it is recommended that "traffic counts" be conducted on two representative weekends and one peak weekend except July 4th. This could be conducted by cameras mounted at various parts of the two river sections. The information would add to a better understanding of how much additional boat traffic can be accommodated on the river.

2.4.6 Navigation Aids and Impediments to Navigation

Some boaters commented that the navigation lights on many of the bridges are inoperative. The marking lights need to be replaced or repaired on many bridges. The lights on the North Beacon Street Bridges, for example, are hanging in the water.

Impediments to navigation along the Charles River were investigated and recommendations are reported in Section 3.0.

3.0 BATHYMETRY OF THE CHARLES RIVER BASIN

Cortell conducted soundings of the Charles River to determine water depths in the lower basin as well as to determine if there are any impediments to navigation along the River. The soundings were conducted on July 31 and October 9, 1997 utilizing a Si-Tex recording fathometer. The accuracy was checked by making manual depth measurements from a stationary position and comparing them with the fathometer recording. Adjustments were not needed. The depth of the transducer below the water surface was measured and the final indication on the recording has been adjusted accordingly. Finally, the water elevation of the basin itself was determined by making readings of the staff gages on the upstream end of the locks before and after the soundings. The relation of the water elevation at the time of the soundings is related to the managed basin elevation on the profiles.

3.1 FINDINGS

As shown on the river bottom profiles (Figures 3-1 through 3-13), the findings indicate sufficient depth of water for recreational needs in the mid-river reaches upstream through the Arsenal Street bridge. Between the Arsenal Street bridge and the North Beacon Street bridge there is a large sand bar in front of BWSC Outfall No. 032. The sediment is clean medium to fine grain sand which rises to within inches of the water surface. The sand bar precludes approximately one third of the river for navigation at this location.

In the area of the MDC's Nonantum Road public boat launching ramp and upstream past the Newton Yacht Club and Watertown Yacht Club, the water becomes very shallow. The bottom is visible at many locations, with some mid-river locations having a water depth of less than one foot. In front of the Newton Yacht Club, a dark medium to coarse sand is present with organic materials from vegetation. More organic materials are present closer to the Watertown Yacht Club. Further upstream in the narrowest river sections, a gravel bottom can be observed. Upstream of the Hyde Brook outfall in Newton, the river deepens slightly to approximately four feet in mid-river (see Figure 3-13).

3.2 HISTORICAL PERSPECTIVE AND TRENDS

A bottom profile of the lower basin between the new Charles River dam and the Watertown dam is shown in Figure 3-14. The profile was prepared by Camp Dresser & McKee as part of its work on the destratification project in the basin (Camp Dresser & McKee Inc. An Evaluation of The Removal of Salt Water From The Charles River Basin, August 1976). Although the profile is undated in the Camp Dresser & McKee report, Jonathan French (CDM's Project Manager) reported that the soundings were apparently made sometime between 1967 and 1976. In the river reaches upstream of the MDC Nonantum Road public boat ramp, water depths of eight feet or more were reported in the profile. In addition, the profile do not show any suggestion of the presence of the sand bar at BWSC Outfall 032.

While conducting this Master plan, interviews and site visits were held with the Newton Yacht Club and Watertown Yacht Club. Both clubs reported that the shallow water depths and extremely dense aquatic vegetation have become so limiting that the ability for the yacht clubs to utilize their facilities is severely threatened. The shallow water situation is particularly severe at the Newton Yacht Club where it was reported that between 1985 and the present, approximately three feet of water depth has been lost. Even at a normal river stage of 108 ft, the water is barely deep enough to avoid propellers churning the bottom. Boats at the Newton Yacht Club often hit bottom in their berths. Water depths at the Watertown Yacht Club are slightly deeper, yet also threatening its operations.

By comparing the profile data and the present soundings, it was found that an extremely high rate of sedimentation has resulted in the filling of approximately five or more feet of water over the past 20–30 years. The source(s) of the sedimentation is not known.

In terms of the impacts to future navigation, sedimentation in the upper reaches of the basin has already reached the point of being a detriment to navigation by power boats. Such conditions are found at BWSC Outfall 032 and in upstream areas leading to the Newton and Watertown yacht clubs. The shallow water depths which in mid-river have been found to be approximately one foot, do not at present represent an impediment to rowers and canoeists. Dense vegetation growth, however, has an adverse effect on all users of the water sheet.

While water depths have changed dramatically, they may be in, or approaching, a steady state condition. This is due to the effect of decreasing water depth combined with recurring flow volume results in increased water flow velocity. As water over a given cross section becomes shallower, water flow velocity must increase thereby increasing the erosive velocity on sediments. In the future, suspended solids contributed to the river will merely accumulate over a larger area and extend further downstream. Historic USGS flow data for the Moody Street gage in Waltham indicate an average annual flow rate of 305 cubic feet per second (cfs), a highest daily mean of 2,940 cfs and an instantaneous peak flow of 4,150 cfs. At the Newton Yacht Club, these flow volumes convert to approximate flow velocities of 0.7 feet per second (fps), 7 fps and 10 fps, respectively. For perspective, the erosive velocities for fine sand and gravel range from approximately 0.6 fps to 6 fps.

3.3 RECOMMENDATIONS

These findings of such large-scale sedimentation, prompt the recommendation for the following actions to be taken in the area upstream of the MDC's Nonantum Road public boat ramp and in the area of the Newton and Watertown yacht clubs, and the sand bar at BWSC Outfall 032. The chemical data that are contained in the draft U.S. Army Materials Technology Laboratory Supplemental Phase 2 Remedial Investigation of the Charles River were reviewed and the maximum concentration of surface and deeper sediment (<6 inches) are summarized in Table 3-I. However, these data are specifically located adjacent to the Watertown Arsenal superfund site and around the Watertown Yacht Club. Subsequent investigations will have to be expanded in order to adequately characterize the nature of the sedimentation.

The recommendations are:

- That water quality investigations be instituted to determine the sources and rates of sediment input to the Charles River basin.

- That the horizontal and vertical extent of sediments and their chemical composition be investigated through more intensive bathymetric mapping between the Watertown Dam and the North Beacon Street bridge, as well as at BWSC Outfall 032.

  That stratified core sampling be conducted to a minimum depth of ten feet below the present sediment surface. Core logs must be prepared and physical and chemical analyses must be conducted. The investigations and analytical testing must satisfy the minimal requirements of DEP Policy No. COMM-94-007 (Interim Policy for Sampling, Analysis, Handling and Tracking Requirements for Dredged Sediment Reused or Disposed at Massachusetts Permitted Landfills, February 15, 1995) as well as the requirements in DEP Policy No. COMM-97-001 (Reuse and Disposal of Contaminated Soil At Massachusetts Landfills, 15 August, 1997).

- That engineering design studies be instituted to reduce the input of solids to the river, including structural and non-structural alternatives, Best Management Practices, and other procedures that are consistent with the Massachusetts Stormwater Management Policy.

- That engineering design studies be conducted to determine the amount of dredging that is necessary to provide improved berthing and navigation at the Newton Yacht Club and Watertown Yacht Club. These studies should also determine the dredging method(s) as well as locations for handling the dredged materials (stilling basins as in the case of hydraulic dredging), disposal locations and costs.

- In order for the water sheet users upstream of the North Beacon street bridge to continue their uses of the Charles River, dredging must be conducted as soon as possible. Therefore, it is also recommended that the implementation of the above design studies be conducted as soon as possible.

TABLE 3–I

MAXIMUM SURFACE/DEEP CHEMICAL CONCENTRATIONS IN CHARLES RIVER SEDIMENT

Constituent	DEP Lined Landfill Reuse Criteria	DEP Unlined Landfill Reuse Criteria	Upstream Of Watertown Yacht Club Transects 2–3	Watertown Yacht Club Basin Transects 4–5	Channel Behind Island and Down River Transects 6–12	Downstream of N. Beacon Street Bridge Transects 13–15
Total Arsenic	40	40	14.2e/28.4e	2.7e/NA	**53.2**/24.9e	10.6e/**42.2e**
Total Cadmium	80	30	10.4/**39.5**	**39.5**/NA	23.5/20.6	9.95/**68.3**
Total Chromium	1,000	1,000	123e/250e	191e/NA	278/173	90.7e/335e
Total Copper	nc	nc	223e/355e	349e/NA	552/299	177/546e
Total Lead	2,000	1,000	639e/**1,060e**	**1,110e**/NA	800e/696	574e/**1,200e**
Total Mercury	10	10	0.59e/1.1e	0.98e/NA	1.71e/0.99e	1.0e/1.4e
Total Nickel	nc	nc	34.4/44.5	38.2/NA	51.6/49.2	33.1/64.4
Total Zinc	nc	nc	784/920	757/NA	757e/649e	653e/892
Total Petroleum Hydrocarbons	5,000	2,500	2,450e/**6,170e**	**6,690e**/NA	**4,920e/7,100e**	**2,920e/6,360e**
Total PCBs	<2	<2	0.96/1.4e	1.00/NA	**4.10**/1.70e	0.48/**2.5e**
Total SVOCs	100	100	**207e/221e**	**120e**/NA	**231e/144e**	92e/**158e**
Total VOCs	10	4	NA/0.42e	NA/NA	0.55e/0.016e	0.12/0.59e
Grain Size	nc	nc	sandy silt	silty sand	silty sand	silty sand
Conductivity (umhos/cm)	8,000	4,000	NA/NA	NA/NA	NA/NA	NA/NA
Listed or Characteristic Hazardous Waste	None	None	NA/NA	NA/NA	NA/NA	NA/NA

Note: All concentrations are in mg/kg unless noted.
e Estimated concentration, usually below the detection limit.
nc No Criteria
NA Not Analyzed
Bold indicates that a DEP landfill criterion is exceeded.

Source: Draft U.S. Army Materials Technology Laboratory Supplemental Phase 2 Remedial Investigation of the Charles River (U.S. Army Environmental Center Contract No. DAAM01–94–D–0020 Task Order 005. May 1997)

AQUATIC VEGETATION IN THE CHARLES RIVER BASIN

Aquatic vegetation has grown profusely in the Charles River and has been the subject of studies for its control as well as recent harvesting in the "lakes region" above the Moody Street Dam in Waltham. During the Master Plan, the extent of aquatic vegetation in the Charles River basin was determined in order to assess its nuisance level, potential future problems, and potential controls.

FINDINGS

The extent of the aquatic vegetation in the Charles River basin was assessed while conducting the bottom soundings on July 31, 1997 and during subsequent visits. The commonly found aquatic plant species included:

Duckweed	Lemna sp.
Fanwort	Cambomba caroliniana
Water Chestnut	Trapa natans
Watermeal	Wolffia sp.
White Water Lily	Nymphaea odorata

Aquatic vegetation was not found to be growing between the Science Museum and the River Street bridge. This is due to the presence of bulkheads and the limited extent of littoral zone as well as the presence of a rocky and gravel substrate where bulkheads are not present. Upstream of the River Street bridge, water chestnut appears first as scattered patches and further upstream of the North Beacon Street bridge as a very dense infestation.

The distribution and general density of aquatic vegetation is shown on Figures 4-1 and 4-2.

HISTORICAL PERSPECTIVE AND TRENDS

Nuisance levels of aquatic vegetation in the Charles River have been present for decades and included the presence of large quantities of white water lily, spatterdock, (yellow water lily) and fanwort. More recently, the water chestnut has made a rapid invasion of the Charles River. In 1997, the growth of water chestnut was extensive along the shoreline and into the river except for the deeper sections.

During 1995, 1996 and 1997, the MDC funded $250,000 for harvesting programs in areas above the Moody Street Dam.

The growth of fanwort at the Newton Yacht Club and the Watertown Yacht Club has been a problem for many years. However, in recent years the growth of fanwort (a submerged species) has declined due to shading and out-competing by the dense infestation of water chestnut. The invasion of the water chestnut exacerbated problems at the marinas and so compounded navigation and travel that control of water chestnut has been conducted by both yacht clubs. The vegetation problems are particularly severe at the Watertown Yacht Club where, without harvesting, the entire Yacht Club basin would be occluded with very dense growths. The Watertown Yacht Club has spent over $31,000 in harvesting some acres in recent years. The Newton Yacht Club has harvested approximately four acres at a cost of $10,000.

4.3 RECOMMENDATIONS

The water chestnut will expand downstream as the seeds germinate and successfully grow in fine sediment deposits that are most likely interspersed within the coarser sediments along the river banks. Once established, the plant stems then reduce the velocity of water and promote the further deposition of fine sediments and organics which in turn enhance expanded plant growth. Success has been found in reducing the extent of water chestnut infestations in certain areas of Lake Champlain which have been targeted for harvesting for five or more years. Based on the experiences from the Lake Champlain work, it is prudent to take aggressive management actions against the spread of the water chestnut now, while its extent is confined to smaller areas.

In order to limit the expansion of the water chestnut, a harvesting program is recommended. At a minimum, the harvesting should target all locations where the plant is found upstream of the River street bridge. The River Street bridge was the downstream most location where the growth of any aquatic plant was found. The harvesting should be conducted soon enough in the growing season to remove plants with seeds but before the seeds drop for the summer.