Biological Study of Irondequoit Bay

Prepared for the

NY Department of State

Town of Irondequoit

Town of Penfield

Town of Webster

County of Monroe

This report was prepared for the New York Department of State with funds provided under Title 13 of the Environmental Protection Fund Act

by

James M. Haynes

Ronald C. Dilcher

Christopher J. Norment

James A. Zollweg

Nicholas F. Parnell

Environmental Science Program

SUNY College at Brockport

Brockport, NY 14420-2973

December 2002

I. Executive Summary

Irondequoit Bay is a major ecological resource in western New York, and much has been done for 30 years to improve its water quality and maintain its natural physical and ecological features. Although many studies have been done on selected groups of flora and fauna (particularly aquatic) in and near the Bay, this is the first comprehensive study of the biological resources of the Bay since the New York State Biological Surveys in the 1930s. This study provides scientific data to support recommendations for land and water use in the Irondequoit Bay Harbor Management Plan, and it provides a benchmark for future studies as development and natural resource management occur in the study area.

Aquatic Habitats

Extensive aquatic macrophyte beds seasonally cover 25-35 percent of the Bay, including 26-63 percent of the edges of the Bay outside of the shallow southern and northern ends that are completely covered with macrophytes from June through September. Few aquatic macrophytes grow deeper than 5 feet or shallower than 2 feet; therefore, the critical depths to protect for macrophyte survival and growth are between 2-5 feet. Based on historic mapping (1940-1982), it appears that submersed aquatic macrophytes have largely disappeared from the southeastern (Penfield) corner of the Bay, possibly due to boating and associated dredging activity. Sediments in Irondequoit Bay contain high amounts of silt and organic material; therefore, substantial chemical analyses, per NYSDEC regulations, are needed before any further dredging can be permitted.

No federal or state species of aquatic macrophytes, macroinvertebrates, fish, amphibians or wetland birds listed as endangered, threatened or of special concern were observed in this study. However, a young bald eagle (federally threatened) was seen and several listed species of wetland birds are known to live in habitats like those in the study area. One common amphibian previously unrecorded in the study area, the gray tree frog, also was observed.

Six aquatic habitats were sampled, and two were determined to be critical priorities for protection: Devil's/Helds Cove (high species diversity, important spawning and nursery habitat, the presence of walleye) and the southwestern corner of the Bay (high species diversity, warmwater fishes). Three aquatic habitats were determined to be a high priority for protection are Seabreeze (high aquatic macrophyte diversity, the presence of northern pike and longnose gar), Webster Sandbar/Stoney Point (high species diversity, extensive coverage by aquatic macrophyte, disturbance in boat traffic channels, the presence of walleye), and Irondequoit Bay Park West (high abundance and diversity of fish, especially in the spring spawning season). Because of very shallow water (less than one foot in many places in the fall) and the apparent limitation of aquatic macrophyte growth by the discharge of Irondequoit Creek into the Bay, much of the south central part of the Bay had few fish in the summer and fall.

Dredging

Historical sources of pollutants contaminated the sediments in Irondequoit Bay. The NYS DEC has a protocol for sediment chemical analysis required for dredging based on grain-size. Based on the proposed Harbor Management Plan, potential dredging areas were identified by the IBCC Technical Team. Four sediment samples were taken in these areas. These areas contain high amounts of silt and organic material; therefore, substantial chemical analyses are needed before dredging can be permitted.

Terrestrial Habitats

Twelve New York State-protected plants of special concern were found in the study, ranging from seven species in the southeastern corner of the study area (mostly Irondequoit Bay Park East) to none in the most developed areas (Rte. 104 bridge, Newport Landfill and Marina; Empire Blvd. commercial district). An “oak opening habitat,” listed as threatened by New York State was found in the Webster well field area. Small pockets of threatened “shrub swamp transitional habitat” may exist along the shore of the Bay, but they were not observed in this study.

High quality cherry, oak and maple hardwoods are in the upland of the Webster well field area, and aspen/poplar, beech, chestnut, maple and oak are in Irondequoit Bay Parks East and West and Devil’s/Helds Cove upland areas. Cottonwood grows along the shore and black locust grows in the upland regions of all areas examined.

Large contiguous upland forest tracts support a high diversity of birds and mammals, many of which were observed during plant surveys. One threatened bird, seven birds of special concern, and 13 mammals limited (required habitat) or influenced (used for food or temporary cover) by the availability of wetlands potentially occur in the study area, but none were observed. The study area is an important regional area of bat biodiversity, especially the area from Point Lookout to Rte. 590 where all five species found in the study were observed.

Erosion

The land contiguous to the Bay is highly susceptible to erosion. All-terrain vehicle activity is removing vegetation at many locations around the Bay, especially in Irondequoit Bay Parks East and West and the Webster well field, leaving soils highly vulnerable to erosion, landforms subject to destabilization, and protected plants in danger.

Environmental Impacts

The entire perimeter of the Bay is a Class I wetland that has the highest level of legal protection by New York State. The various submersed and emergent habitats that comprise the Irondequoit Bay wetlands perform valuable ecological functions as fish and wildlife habitat or food, and they should be preserved in their natural state to the maximum extent possible if the Bay is to maintain its currently healthy aquatic communities. There is already a suggestion of impairment of fish production in Devil’s/Helds Cove, possibly due to high levels of boating activity in the summer. More home development on the cliffs and associated docks in the cove will hurt wetland habitat, fish production and wildlife values. In addition, aquatic macrophytes are being cropped by boating activity in the Webster Sandbar and Stoney Point areas; further development here may impair a reasonably healthy fish community. Although over 20% of the shoreline of the Bay is privately owned and has slopes less than 7% (i.e., potentially developable), approximately two-thirds of this land is found in coves and stream deltas that should not receive further development.

The forests on the steep slopes surrounding the Bay also perform valuable ecological functions. In addition to providing habitats for a surprisingly diverse array of birds and mammals, presence of these natural vegetation communities is essential to stabilize the highly erodable upland soils and very steep cliffs that surround the Bay.

To the extent that the remaining natural aquatic and terrestrial habitats around the Bay are consumed for human activities, the diversity and abundance of plants, animals and ecological communities comprising the Bay ecosystem will decrease. Before development plans are approved, intensive on-site surveys need to establish which important plant and animal species communities and would be impacted. This information can then inform permit decisions and the scope and design of any approved development. In any event, fragmentation and elimination of plant communities will diminish the diversity of animals that can live around the Bay.

Study Limitations and Recommendations for Future Studies

Because coves and some aquatic and terrestrial areas that are or may be proposed for development were not specifically targeted for sampling, they should be intensively sampled before any development proceeds. By starting the project in late May instead of April, early development of aquatic macrophyte beds, fish spawning in the early spring, some likely calling amphibians, some likely breeding birds, and spring ground cover plants could not be observed and recorded. To complete the biological survey of the Bay study area requires sampling in April and May.

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II. Introduction

A. *Background*

This report provides biological data to accompany release by the Irondequoit Bay Coordinating Committee (IBCC) of a Preliminary Irondequoit Bay Harbor Management Plan (IBHMP, the Plan) that provides an overview of the Bay's resources in addition to recommendations and policies for regulatory agencies to use in reviewing development proposals for the Bay (IBHMP 2002). The Plan is designed to provide a comprehensive assessment of the current status of Irondequoit Bay and its surrounding terrestrial habitats (Map II.A.1). The need for such an assessment is based on the following factors:

1. Most of the remaining undeveloped areas surrounding the Bay have shallow shores or steep cliffs that are ecologically sensitive or hard to develop.
2. There is great pressure to develop the remaining few percent of shoreline with deep water or gentle slopes.
3. It is difficult to properly consider cumulative or long-term impacts when development applications are considered on a case-by-case basis.
4. There is conflict between private/public access to the waterfront and ecological concerns about the integrity of the remaining semi-natural habitats.

B. *Purposes and Objectives*

The purposes of this biological study are to provide:

1. Scientific data that will become the basis for the environmental review of the IBHMP, and that will be used to support the recommendations and policies contained in the Plan.
2. An assessment of the potential for dredging in areas that have been identified for additional deepwater access to Irondequoit Bay.

The objectives of the biological study are to:

1. Identify, map, and assess existing littoral (shallow water, near shore, sunlight reaches bottom) habitat, including field sampling of plants and animals living less than 16 feet (5 meters) deep (1 meter = 39.37 inches).
2. Identify, map, and assess existing upland habitat (including vegetative cover-type maps), ground-truth vegetation communities in sensitive areas, and characterize, mostly by literature review, vertebrate species likely to inhabit upland vegetation communities.
3. Identify key habitats and biological resources in the study area.
4. Determine compatibility of dredging with environmental conditions in areas specified in the preliminary IBHMP by doing sediment particle-size analysis.

C. Geological Setting and Environmental History of Irondequoit Bay

Located between $77^{o}30^{'}$W and $77^{o}32^{'}30^{''}$W and $43^{o}10^{'}$N and $43^{o}14^{'}$N (Bannister and Bubeck (1978), "Irondequoit Bay occupies the northern end of a broad valley eroded below sea level by an unknown number of glacial advances and filled with a complex series of glacial and postglacial sediments. The northern portion of the valley beneath the modern bay preserves a diverse sequence of fluvial [river] and lacustrine [lake] sediments" as a result of lake-level rises and falls and southwestward tilting of the Lake Ontario basin (Young 1988). The route of the Genesee River to Lake Ontario during immediate post-glacial times, the Bay now drains 153 mi^2 (395 km^2) of the Irondequoit Creek watershed. "Steep silt bluffs in excess of 50 m (164 ft) line the perimeter of the bay. These areas, bare of vegetation in places, are [highly] subject to erosion" (Bannister and Bubeck 1978).

According to Bannister and Bubeck (1978), the Bay itself can be divided roughly into quarters from north to south. The northern quarter is less than 10 feet deep (except where it has been dredged subsequent to the opening of the Bay in the early 1990s). Next is the deepest portion of the Bay (75 ft) followed by a moderately deep section (10-30 ft). The southernmost quarter is an extensive shallow area less than 10 ft deep (Map II.A.1). As natural sedimentation proceeded, extensive wetland areas with diverse biota developed along the edges of the Bay, especially at the shallow northern and southern ends. Depositional silts and sands rich in organic deposits lie under the Bay; however, land clearing in the watershed and filling and dumping in the Bay have covered the original sediments in many places. By 1970, about 10% of the water flowing into the Bay came from sewage treatment plants in the watershed (Bannister and Bubeck 1978).

Bannister and Bubeck (1978) described Irondquoit Bay's morphology (Table II.A.1), geological history, water input sources, chemistry and biology through 1971. Brown (2002) described changing physical-chemical conditions in the Bay from 1978 through 2001 after a series of management interventions to control hyper-eutrophication (great nutrient excesses, particularly phosphorus) of the Bay. Interventions began after 1970 and included diverting sewage flows into the southern Bay to the Van Lare Treatment plant (completed by 1987), placing alum on the bottom of the Bay to seal in excess phosphorus (done in 1986), and oxygen supplementation of the hypolimnion (bottom of the lake) that began in 1992 (Brown 2002). The end result of these management actions has been a steady improvement in the water quality of Irondequoit Bay (Brown 2002, Table II.A.1).

III. Study Approaches and Methodologies

A diverse set of sub-studies comprised the overall biological study of Irondequoit Bay.

A. *Particle-size Analysis of Sediments at Potential Dredging Sites*

This part of the study relied on the skills of two local geologists. Dr. William Chaisson (University of Rochester) collected sediment cores and interpreted particle-size data measured by Dr. Whitney Autin (SUNY Brockport). Sediments were collected using a gravity corer to a depth of approximately 12-15 inches (30-38 cm) at four sites (Sites C-1 to C-4) in extreme northern and southern Irondequoit Bay (Map III.A.1). The sediment was retained in plastic tubes inserted into a steel coring pipe driven into the sediment from a boat. Sediment grain size was measured at 12 -14 levels in each core with a laser diffractometer (Beckman Coulter LS 230 particle-size analyzer) that distinguished grain sizes from < 1 to 2000 micrometers (µm). Grain size proportions were calculated and compared to grain sizes found in previous studies.

B. *Aquatic Macrophyte Studies*

1. Mapping and Community Selection

Using a small boat and hand-held Geographic Positioning System (GPS) units with approximately 16-foot (5-meter) resolution, submersed macrophyte beds were mapped on June 27 ("spring"), July 26 ("summer") and September 24-28 ("fall") 2002. Six "distinct aquatic macrophyte community types" (Areas A-1 to A-6) were identified in June (Map III.A.1), and they were sampled in each season for submersed macrophytes, metaphyton (thick filamentous algae covering the water surface) cover, fish, and macroinvertebrates living in the vegetation. Geographic Information System (GIS) maps of aquatic macrophyte beds in Irondequoit Bay were prepared with ArcGIS version 8.1 and Spatial Analyst (ESRI) software.

2. Collection and Identification

From a boat, aquatic macrophyte specimens were collected by hand to a depth of about 39 inches (1 meter) at three locations along each of two transects perpendicular to shore at each of the six distinct macrophyte communities selected (Areas A-1 to A-6, Map III.A.1). Specimens were identified using Fassett (1980, as revised) and Gleason and Cronquist (1991) to the lowest practicable taxonomic level (usually to species). The value of aquatic macrophyte taxa as food and other resources for aquatic animals was determined by literature review (Fassett 1980, Borman et al. 1997).

3. Sediment and Metaphyton Evaluation

At the same sites along transects where aquatic macrophytes were collected, sediments were sampled and metaphyton cover was estimated (Sites A-1 to A-6, Map III.A.1). Sediments were collected with an Ekman grab (a box with spring-loaded jaws on a 5-foot [1.7-meter] pole) and characterized in the field (aerobic/anaerobic state by smell, approximate organic content by sight, dominant inorganic grain size by touch). Percent cover of metaphyton was estimated visually to provide an indication of its potential to foul or shade-out aquatic macrophytes that are important fish and invertebrate habitat.

C. *Sampling and Identifying Aquatic Animals*

1. Fish

Fish were collected by hoop nets (7 hoops, 4 ft opening, 2-25 ft wings, 1-50 ft lead, 1 inch bar mesh) and by electrofishing. One hoop net was set and two, 15-minute boat electrofishing runs (fish stunned by electricity come to the surface where they can be netted) were done in each season in each of the six aquatic macrophyte communities chosen in June (Areas A-1 to A-6, Map III.A.1). Fish were identified to species, counted, measured to the nearest 0.04 inch (1 millimeter) of total length, and released alive.

2. Amphibians

In late May 2002, the shoreline of Irondequoit Bay was searched for suitable patches of marsh habitat that might support breeding amphibians (primarily frogs and toads, Order Anura). Seven areas were selected for surveys: two areas at the south end of Irondequoit Bay (Sites AB-1 and AB-2), the cattail (*Typha* spp.) marshes in Irondequoit Bay State Marine Park (Site AB-3), Big Massaug Cove (Site AB-4), the marshes just north of

Snider Island (Site AB-5), the marshes just south of Point Lookout (Site AB-6), and the marshes in Devil's/Helds Cove (Site AB-7) (Map III.A.1).

Amphibian surveys used standardized methods developed by the Marsh Monitoring Program (MMP) at the Long Point Bird Observatory in Ontario, Canada to assess species richness and relative abundance in the Great Lakes Basin (Chabot and Helferty 1997). Using 180-degree, unlimited radius, fixed survey points established at each survey site, audio surveys were conducted for frogs and toads that call at night during breeding seasons. MMP counts were conducted for 3-minute listening periods, between one-half hour after sunset and midnight on nights when there was little or no wind, during which calling amphibian species were assigned to one of three calling code levels (Table III.C.1). The Marsh Monitoring Program protocol recommends that three surveys be conducted during the breeding season; at our latitude (43ºN), these surveys should occur between 15-30 April, 15-30 May, and 15-30 June (Chabot and Helferty 1997). Because the biological study for Irondequoit Bay was not finalized until mid-May of 2002, the first recommended sampling period was missed. Six of the sites (AB-1 through AB-6) were surveyed for amphibians on 31 May 2002, and again on 21 June 2002. Site AB-7 (Devil's/Helds Cove) was not sampled due to access problems that were not solved until the end of June.

3. Wetland Birds

Wetland birds were surveyed in the same areas as amphibians (Sites AB-1 to AB-7; Map III.A.1) using protocols similar to those developed by the Marsh Monitoring Program (Chabot and Helferty 1997). All marsh birds heard or seen within 180º, 100-meter radii of survey points were recorded during 10-minute counts. Because some marsh birds such as the Virginia Rail (*Rallus limicola*) and Least Bittern (*Ixobrychus exilis*) are secretive, a 5-minute tape of some common species in the Great Lakes Basin was broadcast at the conclusion of the timed counts to encourage birds to call back. Marsh bird surveys were conducted on 2 June 2002 and 23 June 2002 at Sites AB-1 to 2 and AB-4 to 6, and on 1 July 2002 at Sites AB-3 and AB-7 (Map III.A.1).

4. Macroinvertebrates

Six replicate samples of aquatic macroinvertebrates (e.g., insect larvae, snails, etc.) were collected in submerged vegetation at each of the six aquatic macrophyte communities (Areas A-1 to A-6, Map III.A.1). In the field, samples were relaxed in soda water, preserved in 4% formalin and placed on ice; upon returning to the laboratory later that day they were transferred to 70% ethanol with rose bengal dye. After a week, macrophytes in each sample were rinsed over a 600-micrometer (µm) sieve; dyed invertebrates were spread out on a white pan; and the first 100 organisms were picked out, identified and placed in a vial of 70% ethanol. Organisms were identified to the lowest practical taxonomic level using standard keys (Pennak 1989, Peckarsky et al. 1990, Merritt and Cummins 1996). Biotic indices of macroinvertebrate community health were computed using the methods of Bode et al. (1996).

D. *Surveying and Characterizing Terrestrial Plant Communities*

1. Creating Maps with Existing Data

The IBCC Technical Team, the Monroe County Environmental Management Council, and the NYSDEC Natural Heritage Program provided existing data on plant species, habitats and communities of importance or concern in the study area. In addition to information provided by these groups, we used digital orthophotos, an existing 1:250,000 scale Land Use-Land Cover database, and GPS-referenced field surveys to put land uses (e.g., roads, houses, businesses, parks) of the upland habitats of the study area into a GIS database. Digital orthophotos are aerial photographs that are geo-referenced and rectified. Geo-referencing means that the raster/image data has a geographic component that can be overlaid on any other geographic data. Rectification is adjustment of image data to account for topographic distortion and central perspective projection (i.e., the edges of an unadjusted photograph do not represent a straight down view). The digital orthophotos are available from the NY State GIS Clearinghouse (http://www.nysgis.state.ny.us/). The land use land cover data were obtained from the USEPA BASINS (Better Assessment Science Integrating Point and Non-point Sources) data set (http://www.epa.gov/OST/BASINS/). Information collected was put into an ArcGIS database.

2. Identifying Upland Plant Community Types and Species

The IBCC Technical Team identified nine critical terrestrial habitats (Areas T-1 to T-9, Map III.A.1) in which extensive walk-through surveys were conducted. Over 200 GPS-referenced photographs were taken; trees, shrubs and ground cover species associated with each photograph were identified; species were linked to an internet site that provides information about them; and a "virtual tour" through each community was created. Botanical nomenclature follows Gleason and Cronquist (1991). Taxa were identified with standard keys (Petrides 1958, Cobb 1963, Peterson and McKenny 1968, Hitchcock 1971, Newcomb 1977, Gleason and Cronquist 1991, Redington 1994).

E. *Assess Upland Habitat Suitability for Important Vertebrates*

Based on existing data and our terrestrial plant community surveys, the suitability of the nine upland habitats (Map III.A.1; Areas T-1 to T-9) for vertebrates was assessed. While information for most vertebrates was obtained from literature surveys of species expected to occur in habitats observed in the study area, some fieldwork was conducted on bats. The vertebrates we focused on by literature review only were 1) migrant and resident birds that use contiguous forest interiors, 2) riparian (water's edge) fauna, 3) terrestrial amphibians and reptiles, 4) terrestrial life stages of aquatic amphibians and reptiles, 5) vertebrates sensitive to human disturbance, and 6) endangered, threatened or special concern species. Functional analyses of habitat value included consideration of suitability for courtship, breeding and juvenile life stages of amphibians and reptiles; for nesting, brood rearing, resting and feeding of birds, bats and other mammals; and for migrating and over-wintering species.

1. Bats

Surveys of flying bats present special difficulties (Wilson et al. 1996). Thus, this part of the study relied on the skills of two local experts on bats, Martha L. Zettel, M.S., and Dr. William E. O'Neill (University of Rochester). They conducted bat surveys on the evenings of 16 July, 30 July, 1 August, and 10 August 2002. They searched for bats at four sites bordering Irondequoit Bay (Sites B-1 to B-4, (Map III.A.1); these areas were chosen to represent some of the best potential foraging habitat for bats in the study area.

a. B-1: *Irondequoit Bay Park East* included a dirt road through a heavily wooded area, a short trail section along the Bay, and numerous foot trails mostly through a heavily wooded and steep hillside. These trails were labeled as white, blue, and yellow. This area was surveyed on 16 July and 1 August.

b. B-2: *Irondequoit Bay Park West* included two short foot trails along old access roads plus numerous roadside stops along South Bay Front Road. These stops included spots north and south of the Sutter's Marine, as well as next to the Irondequoit Bay Fish and Game Club, and the foot trail leading to the Glen Haven fishing access spot, which included a cattail swamp and bayside waterfront. Ms. Zettel and Dr. O'Neill attempted to gain access to the Snider Island area but were not successful. This area was surveyed on 30 July and 1 August. Within Irondequoit Bay Park West, five sites were surveyed:

i. The trail along the access road off South Bay Front Road at the south end of the park close to the Orchard Park Blvd. entrance.

ii. A waterfront spot just north of Sutter's Marine. Recordings were done over the water as well as across South Bay Front Road along the woods containing dense growth of large trees.

iii. The parking area west of the Irondequoit Bay Fish and Game Club.

iv. The trail along the swamp that ends at numerous fishing-access points at Glen Haven, plus an old access road that ran southwest off South Bay Front Rd.

c. B-3: The *Town of Irondequoit Access Road* runs from Point Lookout southwest to near Rte. 590. This road passes through disturbed open fields, along a streambed, and then drops down into a heavily wooded area. This area was surveyed on 10 August.

d. B-4: The area surrounding *Big Massaug Cove* is heavily developed and access was very difficult. This area was surveyed on 10 August.

A variety of identification methods were employed to detect and identify bats. Primary identification was made using bat detectors of two types in order to collect more calls and compensate for the limitations of each type of detector. The first type was an Anabat® ultrasound bat detector connected to a Dell laptop computer through an Anabat ZCAIM interface. This detector records bat calls using the zero-crossing technique, which captures the predominant frequencies and temporal structure of the calls, but discards harmonic structure and amplitude information. Sounds detected with the Anabat were digitized and analyzed in the field in real time using Anabat 3.0 software. Sound files were further analyzed off-line using Analook© 4.2.

The second bat detector was a combination heterodyne and time expansion device (Pettersson D240X). The D240X is much more sensitive and has a better frequency response than the Anabat detector. In time-expansion mode, signal samples of 3.4-second duration were captured in the digital memory of the detector. The recorded signals were played back after 10x time expansion to make them audible in the field. The audible sounds were recorded on analog cassette tape with a Sony Pro Walkman WM-D3 tape recorder. Calls saved on tape were later transferred to a Dell laptop computer and analyzed with Batsound© 3.3 software (Pettersson Elektronik AB).

Diagnostic acoustic features of the recorded bat calls were extracted from both sets of records to identify bats using criteria such as call frequency range, pulse duration, pattern, and temporal shape. Calls were compared to previously recorded bats of positively identified species. In addition, visual identification of bats being recorded was attempted using spotlights. Information such as size, color, habitat, and flight speed and pattern also provided valuable information for identification. The latitude, longitude, and altitude of each site were taken with a Garmin 12 GPS receiver, although heavy tree coverage prevented readings in some instances. Temperature, humidity, wind and sky conditions were also recorded at the beginning of each survey night.

2. Distributional Surveys (Amphibians, Reptiles, Birds, Mammals)

For other terrestrial vertebrates, published and "on-line" sources of distributional data were used to determine whether or not they were likely to occur in the project area.

a. For amphibians and reptiles, we used general distributional and habitat data in *Amphibians and Reptiles of the Great Lakes Region* (Harding 1997). We also used information in the database assembled by the New York State Amphibian and Reptile Atlas project for the USGS Rochester East 7.5 topographic map survey block, which includes Irondequoit Bay (NYSDEC 2000).

b. For birds, we used data available from the two New York State Breeding Bird Atlas projects. The first was conducted between 1980-1984 (Andrle and Carroll 1988), while the second was begun in 2000 and is scheduled to continue until 2004 (NYSDEC 2002a). Data from the four, 3 mile by 3 mi (5 kilometer by 5 km) survey blocks that include portions of the Irondequoit Bay project area (2978A, 2978C, 2878B, 2878D) were used to develop a list of species potentially breeding within the study area. Species observed by us in possible nesting habitat during breeding season, but for which no other indication of breeding was noted, were included in the species list only if there was documented evidence of breeding from nearby areas (Beardslee and Mitchell 1965, Andrle and Carroll 1988, Levine 1998).

c. For mammals, we used general distributional and habitat data from *Mammals of the Great Lakes Region* (Kurta 1995), along with information on habitat selection from recent mammal biodiversity surveys conducted at Yanty Creek Marsh, Hamlin Beach State Park, Monroe County (Makarewicz *et al*. 2000), Bergen Swamp Preserve, Genesee County (Norment and Salter 2002), and other field surveys in Monroe County (C. Norment, SUNY Brockport, unpublished data).

We also requested that the New York Natural Heritage Program search their databases for rare or state-listed animals (NYS DEC, 2002b) documented as occurring within the Irondequoit Bay project area. Results of this search were linked to the lists assembled for each taxonomic group of terrestrial vertebrates.

3. Linkage of Vertebrate Distributions to Terrestrial Vegetation Habitats

Distributional data were then linked with habitat data, most of which were obtained by Dr. Ronald Dilcher during his surveys of terrestrial vegetation within the nine areas identified by the IBCC Technical Team as containing "potentially significant upland vegetative communities and/or wildlife habitat" (R. Bell, Monroe County Dept. of Planning and Development, personal communication). The nine areas (T1 to T9; Map III.A.1) contained a large number of overstory and understory woody species present in many assemblages that differed in taxonomic composition and structure. These assemblages have been created and maintained by the combined effects of land use history, the complex topography of the project area, and the ecological requirements of the various plant species (NYSDEC, no date). However, for purposes of this portion of the project, we assigned terrestrial vertebrates potentially occurring in the project area to one or more of seven habitat types:

a. *Oak/Hickory Woodland (**OW**)*: Generally occurring at higher elevations, along the top of the Irondequoit Bay escarpment, common overstory species include oaks (black, *Quercus velutina*; red, *Q. rubra*;, white, *Q. alba*; pin, *Q. palustris*), hickories (*Carya* spp.), walnut (*Juglans nigra*) and sassafras (*Sassafras albidum*). Conifer stands such as white pine (*Pinus strobus*) and red pine (*Pinus resinosa*) may also be present. This habitat type is roughly equivalent to the Central Hardwoods described in the "Irondequoit Bay Forestland Assessment" (NYSDEC, no date).

b. *Midslope Woodland (**MW**)*: Midslope woodlands contain a complex mixture of species, depending upon topography, exposure and land use history. Common overstory species included maples (red, *Acer rubrum*; silver, *A. saccharinum*; sugar, *A. saccharum*; Norway, *A. platanoides*), beech (*Fagus grandifolia*), basswood (*Tilia americana*), black locust (*Robinia pseudoacacia*), and white ash (*Fraxinus americana*). Some conifers, including white pine and eastern hemlock (*Tsuga canadensis*) were also present. This habitat type is roughly equivalent to the Allegheny Hardwoods described in the "Irondequoit Bay Forestland Assessment" (NYSDEC, no date).

c. *Riparian Woodland (**RW**)*: This habitat type occurs along the margins of Irondequoit Bay, and tributaries draining into the bay, including Densmore Creek and the stream that flows through Irondequoit Bay Park West and enters the bay just north of Snider Island. Common riparian woodland species included cottonwood (*Populus deltoides*), willow (*Salix* spp.), and box elder (*Acer negundo*). This habitat type does not have an equivalent in the "Irondequoit Bay Forestland Assessment" (NYSDEC, no date).

d. *Wetland (**M**)*: Wetland marshes were dominated by cattail (*Typha* spp.), and bordered by common reed (*Phragmites australis*), willow, cottonwood, and other moisture-tolerant species.

e. *Old field (**OF**)*: This uncommon habitat type included scattered old fields and early successional woodlands. Common shrub species included red-osier dogwood (*Cornus sericea*), brambles (*Rubus* spp.), and rose (*Rosa* sp.). Early successional tree species included sugar maple and white ash.

f. *Suburban (**H**)*: These were areas of human habitation, including suburban housing developments.

g. *Grassland (**G**)*: An uncommon habitat within the study area, this habitat was dominated by herbaceous species.

Terrestrial vertebrate species were also classified as *Widespread (**Wi**)* if they could be found in many of the seven habitats described above.

Results of the above processes were used to create species lists for amphibians and reptiles (Table IV.C.4), birds (Table IV.E.1), and bats and other mammals (Table IV.E.4). Each table contains information on species known or likely to occur within the

Irondequoit Bay project area, including preferred habitat, likelihood of occurrence in sensitive areas, and data source(s) used to make the determination. Occurrence was classified as:

a. *Known (**Y**)*: Used only for species identified by study team members during the project.

b. *Probable (**Pr**)*: Used for species very likely to occur within the study area, based on habitat preferences and distributional data.

c. *Possible (**Po**)*: Used for species that are generally uncommon in the region, but which may occur within the study area, based on habitat preferences and distributional data.

d. *Unlikely (**Un**)*: Used for species with range maps or Department of Environmental Conservation databases (NYSDEC 2000, 2002a) that suggest they may occur within the project area, but which are unlikely to be found due to their rarity or lack of appropriate habitat.

F. *Statistical Analyses*

One of the major objectives of this study was to determine if any of the aquatic communities (Areas A-1 to A-6) or terrestrial communities (Areas T-1 to T-9) are unique biologically and deserving of special protection (Map III.A.1). This issue was addressed using two statistical techniques: cluster analysis (CA) and principal components analysis (PCA) (PC-ORD 1999). Based on the types of organisms (taxa) found in each community, these statistical techniques calculate degrees of community similarity and allow visual interpretation of relationships. Three sets of analyses were done: aquatic communities (submersed/floating macrophytes, fish, macroinvertebrates combined; Areas A-1 to A-6; Figures IV.C.2 and 3), terrestrial plant communities (Areas T-1 to T-9; Figures IV.D.1 and 2), and transition zone (water to land) plant communities (Areas T-1 to T-9; Figures IV.D.3 and 4) (Map III.A.1).

Cluster analysis diagrams (Figures IV.C.2, IV.D.1 and IV.D.3) show how closely or distantly communities are related in terms of the kinds of organisms sampled in them, but they provide no indication of which organisms are responsible for the relationships. Principal components analysis is analogous to linear regression where a line of best fit (i.e., a least squares regression) is drawn through a series of data points, except that in PCA many regressions are done simultaneously to place taxa in relation to each other along two or more graphical axes. Taxa that are far out along an axis, either in a positive or negative direction, have a high correlation coefficient (r) with the axis and a high degree of association with each other; they can be said to be a distinct "community" (e.g., Tables IV.C.9, IV.D.3 and 4). Within the "taxa space" defined by the PCA axes, one can show the locations of communities sampled at different times or places; this is shown in Figures IV.C.3, IV.D.2 and IV.D.4. Again, the farther out along a PCA axis a community is, the higher its association with the taxa located in the same position along the axis. For the analyses that follow, a community (e.g., terrestrial T-4) was considered to be associated with an axis if it was located more than halfway along the axis from the origin. Taxa were considered to be associated with a community if they were in the top third of correlation coefficients of taxa associated with that axis. For example, in Figure IV.C.3.a aquatic areas A-3 and A-5 were associated with axis 1; areas A-1, A-4 and A-6 were associated with axis 2; and area A-2 was not associated with axis 1 or 2. However, because areas A-3 and A-5 were positively and negatively associated, respectively with axis 1 and areas A-1 and A-6 were negatively and positively associated, respectively, with axis 2, distinctive taxa were associated with each community (Table IV.C.9).

G. *Characterizing the Degree of Present and Future Environmental Impact on Ecological Resources in the Study Area*

Existing data, data gathered in this study, and maps from agencies represented on the IBCC Technical Team were used to construct GIS database layers and maps showing: 1) Existing development and disturbances in the study area, 2) Contiguity of undeveloped or minimally disturbed parcels with habitat locations thought to be important to vertebrates in the study area, and 3) Likely impacts of future development pressure. Using the maps created and spatial analysis techniques, after a few hours of training this GIS product will allow users to answer "what if" questions concerning future locations and patterns of development that might occur with and without the controls envisioned by the IBHMP.

IV. Results and Discussion

A. *Particle-size Analysis of Sediments at Potential Dredging Sites*

1. Description of Cores

a. Site *C-1* (Map III.A.1): Core C-1 was taken in the northwest corner of Irondequoit Bay (43.23140°N, 77.53671°W) at a water depth of approximately 6 feet. Fourteen inches of sediment was recovered, and a hydrogen sulfide (rotten egg) smell (anaerobic conditions, or no oxygen present) was present. From the surface sediment to the bottom of the core, the color of the core was dark greenish gray (0-5.2"), lighter greenish brown (5.2-6"), a layer of peat (6-7.5"), lighter greenish brown (7.5-12", same as above peat), layer of peat (12-13.5"), and darkest brown and least green (13.5-14"). Color changes were abrupt.

b. Site *C-2* (Map III.A.1): Core C-2 was taken in the northeast corner of Bay (43.23365°N, 77.52657°W) at a water depth of approximately 6 feet. A hydrogen sulfide (anaerobic conditions) smell was present in the 14.2 inches of sediment recovered. From the surface sediment to the bottom of the core, the color of the core changed from dark to light brown down to 11.5" where there was sharp transition to darker sediment. No gray layer was recovered at this site.

c. Site *C-3* (Map III.A.1): Core C-3 was taken in the southwest corner of Bay (43.18295°N, 77.52497°W) at a water depth of approximately 4 feet. Fourteen inches of sediment was recovered, and there was no hydrogen sulfide smell (aerobic conditions, or oxygen present in sediments). From the surface sediment to the bottom of the core, the color of the core varied from dark gray to black. (In cold storage the core changed to a uniform chocolate brown.)

d. Site *C-4* (Map III.A.1): Core C-4 was taken in the southeast corner of Bay (43.18241°N, 77.52169°W) at a water depth of approximately 4 feet. Twelve inches of sediment was recovered, and there was no hydrogen sulfide smell (aerobic conditions) present. From the surface sediment to the bottom of the core, the core was uniform, dark gray mud. (In cold storage the core changed to a uniform chocolate brown.)

2. Grain-size Analysis

The sediment at all four coring sites can be described as coarse silt (31.0 - 62.5 µm = micrometers, 5.0-4.0 ϕ (phi); Table IV.A.1). Phi units are a logarithmic (base 2) transformation of grain size expressed in millimeters. The mean (and median) grain size is coarser at the southern sites (C-3 and C-4) than at the northern sites (C-1 and C-2) (Table IV.A.2, Figure IV.A.1). This is perhaps because they are closer to the mouth of Irondequoit Creek that deposits sediments from the watershed into the southern portion of the Bay. They are also in more shallow water, and storm events may winnow fine sediments from the bottom more than at the northern end of the Bay. Finer sediments at the northern sites gave off an anaerobic hydrogen sulfide smell upon recovery. Sediments at the southern sites did not smell, despite being a darker color that suggested a higher organic content. In addition, numerous carbonate shell fragments were found at several levels in the northern cores, but not at the southern sites.

Cores at the northwest and southeast sites (Sites C-1 and C-4) had the greatest volume of relatively coarse sediment (a coarse silt); both of these sites have large peaks at ~42 µm grain size (Table IV.A.1, Figure IV.A.1). The primary mode (most common size) at C-3 (southwest) is a slightly finer coarse silt (~35 µm). The primary mode at C-2 (northeast) is a medium silt (~18 µm) (Table IV.A.1, Figure IV.A.1).

The distribution of grain size at all sites is left skewed toward finer grain sizes (Figure IV.A.1); there is a relatively long tapering tail toward the coarser grain sizes. The southern sites are better sorted (note that a small range of particle sizes comprise most of the sample) compared to a wider range of particle sizes at the northern sites. Particle-size results from core sampling are consistent with results from grab samples at Areas A-1 to A-5 in this study (Table IV.A.3) and with previous particle-size analysis for the dredging project that opened the Bay to Lake Ontario (Table IV.A.2).

3. Conclusions

Because there are fish consumption advisories for Irondequoit Bay, and far more than 10 percent of the particles sampled were much finer than sand and gravel (Table IV.A.2), NYSDEC (1994) guidelines will require contaminant analysis of sediments before any future dredging at the four sites we cored in Irondequoit Bay. The number of samples required depends on the area to be dredged and the degree of certainty about the presence of contamination. For Irondequoit Bay, 18 cores would need to be taken for each 100,000 cubic yards of material to be dredged (see criteria and formula in NYSDEC 1994). Previous dredging projects have required chemical analyses for 11 metals (with emphasis on chromium, mercury and cadmium), 19 pesticides (with emphasis on mirex), seven PCB Aroclors, and a number of other compounds (ammonia, phosphorus, chemical oxygen demand, total nitrogen, oil and grease, volatile solids, etc.) (Butkas 1984). Details for calculating sample numbers and for the types chemical analyses that might be required can be found in NYSDEC (1994) and through discussions with the regional DEC office.

For the Stony Point Development project (near northeastern site, C-2), cores were taken at eight locations and composite samples were analyzed (Larsen Engineers 1985). Chemical analyses for metals gave values below method detection limits (micrograms/ gram dry weight = parts per million, ppm) for all but chromium, copper, nickel, lead, zinc, iron, manganese and barium (Larsen Engineers 1985), but in many cases detection limits were higher than regulatory standards for unrestricted disposal of dredged sediments (NYSDEC 1994). Except for 4-4’ DDE (a DDT breakdown product), all pesticide and PCB concentrations were below detection limits in the Stony Point Development sediments (Larsen Engineers 1985), but again detection limits were far above regulatory standards for unrestricted disposal. Ammonia in the sediments exceeded regulatory standards for unrestricted disposal, and levels of total organic nitrogen (Kjeldahl method), total phosphorus, chemical oxygen demand, and oil and grease were quite high (Larsen Engineers 1985), although there were no standards to compare them with in NYSDEC (1994). Therefore, it is uncertain whether sediment contamination in northeastern Irondequoit Bay is a problem or not.

No comparative data was found for the other cores taken in the northwestern (Site C-1) and southern portions of the Bay (Sites C-3 and C-4). Given the high organic content of the sediments at sampling sites C-1 to C-4, the contaminants reported in Larsen Engineers (1985), and the lack of analytical sensitivity to detect many chemicals at levels of regulatory concern (Larsen Engineers 1985), it would appear that a full array of chemical analyses at appropriate minimum detection limits must be conducted before dredging at any of the sites (C-1 to C-4; Map III.A.1) proposed for Irondequoit Bay.

The U.S. Army Corps of Engineers also took sediment cores before opening the Bay to Lake Ontario in the early 1990s (USACE 1992). Their cores were in the current navigation channel at the northern end of the Bay; cores for the Stony Point Development were taken in a southeasterly direction from the federal navigation channel, but locations of the cores from both studies were not identified precisely enough to map them today.

B. *Submersed Aquatic Macrophyte Mapping and Communities*

1. Mapping

The entire perimeter of Irondequoit Bay is a Class I wetland (IBHMP 2002). In the discussion below, certain sections of the study area will also be referred to as “wetland,” but such usage does not imply separation from the whole wetland.

Both the north and south ends of the Bay were fully covered with submersed aquatic macrophytes when sampling began in June. Progressively greater coverage from June to September is the normal seasonal pattern for these plant communities, and submersed macrophyte beds comprised 25%, 29% and 35% of the surface area of Irondequoit Bay on June 18, July 22 and September 24, respectively (Map IV.B.1).

As the seasons progressed, the patchy submersed macrophyte beds along the eastern and western edges of the Bay mapped in June expanded and eventually formed a narrow, often contiguous band around the edges of the Bay (Map IV.B.1). The expansion of submersed macrophytes outside of the wide, shallow expanses on the northern and southern ends of the Bay was dramatic. Between imaginary lines connecting German Village and Stony Point in the north and Snider’s Island and Irondequoit Bay Park East in the south, the surface area of aquatic macrophytes expanded from 26% in June to 49% in July to 63% in September (Map IV.B.1).

2. Physical Descriptions of Aquatic Sampling Areas

Area A-1: At the southern end of the Bay, Area A-1 extends along the western shore from where the water depth becomes rapidly shallower to the channel markers for Irondequoit Creek (Map III.A.1). Depth ranges from 3-6 feet, and the substrate is deep, organic mud (Table IV.A.3). Winds out of the south and north create large swells and turbidity such that there is no visibility in the water. Aquatic macrophyte cover was limited to deeper areas, and was virtually absent in the fall. Visible shelter for fish was very limited; no physical structure, other than an occasional floating branch or log, was observed in Area A-1. Thus, it was not surprising that it was nearly devoid of fish, especially in the Fall when much of the substrate is exposed to air or covered by very shallow water.

Area A-2: This area at the far southern end of the Bay extends from the southern edge of Area A-1 (beginning with the Irondequoit Creek channel markers) to the south shore, but does not include the southwestern corner (see Area A-3) (Map III.A.1). Depth ranges from 0-2 feet, and is especially shallow in the fall. The substrate is deep, organic mud (Table IV.A.3). For these reasons, this region is known as the Empire Blvd. Mud Flats (Monroe County EMC 1996). Southerly and northerly winds create large swells and create turbidity such that there is no visibility. By mid-summer, shelter for fish was nearly non-existent due to the almost complete loss of plant cover due to very shallow water and lack of physical structure. Prolific metaphyton covered aquatic macrophytes and the bottom from mid-summer through early fall, and the area was nearly devoid of fish in early fall.

Area A-3: This area is at the southwestern corner of Bay shoreward of Area A-2 (Map III.A.1). Depth ranges from 3-8 feet, and lily pads and cattails are abundant in shallow reaches. The substrate is deep, organic mud (Table IV.A.3). Winds play a lesser role in this small, mostly sheltered area; however, a strong northerly wind will decrease visibility substantially. Shelter value for fish was high in all seasons, but lowest when water levels in the whole Bay were low in the fall. Submersed macrophytes were abundant, but not choking, and other physical structure observed included fallen trees and bushes near shore as well as lily pads and cattails. Area A-3 supported many carp, panfish and bowfin in the early seasons (they were probably spawning); however, it was nearly cut off from the Bay during the very low water experienced in the fall of 2002.

Area A-4: At the northwestern corner of Bay, Area A-4 extends from the cattail/common reed wetland along shore to the western edge of Area A-5 (Map III.A.1). Depth ranges from 0.5-6 feet. The substrate is partially organic mud mixed with granular shell fragments (Table IV.A.3). Southerly and easterly winds increased turbidity to a high degree. Shelter for fish is prevalent but only accessible when water levels are not too low. The good submersed macrophyte and other cover in June and July gave way to less desirable habitat during low water in the September. By September, submersed macrophytes had largely died out, and the cattails and a small cove with several overhanging trees, downed logs and other physical structures were inaccessible. Area A-4 was a high use area for longnose gar, as were a few other small coves on the western side of the Bay, especially in mid-summer.

Area A-5: The entire northern and northeastern end of Bay, from approximately the southern-most channel marker northward, comprises Area A-5 (Map III.A.1). Depth ranges from 3-10+ (dredged channel) feet, and substrate is a partially organic mud mixed with small sandy granules (Table IV.A.3). Aquatic macrophyte shelter is good in spring and summer, especially in western half; however, high boat traffic in the eastern half cuts off the top 2-3 feet of plants near the surface causing a loss of cover. Westerly winds can create waves and high turbidity in the eastern part of Area A-5, while the western part becomes very turbid with winds from the south. Large schools of yellow perch were encountered in this area, especially near the dredged channel (perch, walleye and other fishes often congregate near drop-offs). Also, several very large walleye were caught in Area A-5 during spring sampling, no doubt traveling between the Bay and the Lake during the night. Other than "cropped" submersed macrophytes, it was not possible to evaluate the effect of the heavy boat traffic on aquatic biota, especially in the spring and summer, because it was unsafe to set nets in the navigation channel or in the eastern half of Area A-5.

Area A-6: This is Devil's/Helds Cove, just south of the Rte. 104 bridge on the east side of the Bay (Map III.A.1). Depth ranges from 0.5-10+ feet, and the substrate is highly organic mud (Table IV.A.3). Wind from any direction has little effect on Area A-6 because it is sheltered by cliffs and islands. A large amount of submersed macrophyte cover is found in Area A-6, as well as complex structure made up of overhanging and downed trees, emergent vegetation, and diverse depths. Area A-6 is a very complex habitat that supports a diverse community of organisms. It is among the most important aquatic areas studied for this project, and may be the biggest fish nursery area in the Bay. Large schools of juvenile panfish, largemouth bass, yellow perch, and many gizzard shad were observed. Although Area A-6 did not yield the highest numbers of fish in our sampling, their small size meant that they were less susceptible to the trap netting and electrofishing methods used to collect fish, and that this is a fish nursery area.

3. <u>Submersed Aquatic Macrophyte Communities</u>

Based on the surveys of aquatic macrophyte distributions in June, six locations were identified for sampling of submersed and floating vegetation in potentially distinct communities (Map III.A.1, Appendices IV.B.1.a,b,c). Of the 20 taxa identified (Table IV.B.1) during the study, the greatest number was found in Area A-3 (n=9) at the southwest corner of the Bay and the fewest in Area A-4 (n=5) at the northwest corner (Map III.A.1, Table IV.B.1). Three taxa, hornwort (*Ceratophyllum demersum*), water milfoil (*Myriophyllum* sp., probably *M. spicatum*, the invasive Eurasian watermilfoil) and sago pondweed (*Potamogeton pectinatus*), were found in all areas, and two other taxa, lesser duckweed (*Lemna minor*) and water star grass (*Zosterella dubia*), were found in four and three areas, respectively (Table IV.B.1). Area A-3 was an isolated site with most of the submersed macrophytes seen elsewhere plus white water lily (*Nymphaea tuberosa*) and a diverse group of pondweeds (*Potamogeton* spp.). Waterweed (*Elodea* spp.) was found only at Sites A-2 and A-3 (both mostly shallow areas at the southern end of the Bay), and water starwort (*Callitriche* sp.) was found only at Sites A-4 and A-5 (both at the north end of the Bay) (Map III.A.1). Watershield (*Brasenia schreberi*) and smartweed (*Polygonum* sp.) were found only at Site A-6 (Devil's/Helds Cove; Map III.A.1). The submersed macrophytes found in 2002 were very similar to those found during 150 years of study of Irondeqoit Bay (Table IV.B.2; Forest 1986; 1987a,b).

At most of the undeveloped, low-lying (shallow slopes) sites along the shoreline, we observed bands of cattails (*Typha* spp.) and common reed (*Phragmites australis*) near the shoreline. Cattails emerged from shallow water adjacent to the submersed macrophyte beds we mapped, and common reed emerged inland from the cattails. At all terrestrial areas except Areas T-3, T-5 and T-9 (Map III.A.1), grasses, sedges and other land/water transition species were observed and identified (Table IV.B.3). Area T-3 had very steep, bare slopes; a steady rain of gritty particles along with high wave energy along this exposed section of shoreline is not conducive to emergent or submersed macrophyte growth. At Area T-5, the water off the solid wall of cattails appeared to be too deep to permit emergent macrophyte growth, while at Area T-9 the disturbed Empire Blvd. shoreline may not be suitable for emergent macrophytes. Emergent aquatic macrophytes were very similar to those found since 1939 at the margins of Irondequoit Bay (Table IV.B.2). Cattails provide nesting habitat for many marsh birds, spawning habitat for sunfishes, and food for some marsh animals, but common reed (an invasive species) has less food value and sometimes crowds out more valuable plants such as cattails (Borman et al. 1997). This occurs especially when cattail habitats are disturbed which gives invasive species like common reed and purple loosestrife (*Lythrum salicaria*) opportunities to gain footholds at edges such as might occur with dredging, dock construction and other development activities in and near cattail marshes.

4. <u>Sediment Composition</u>: Sediment compositions in the aquatic macrophyte beds (Areas A-1 to A-6, Map III.A.1) corresponded very well with the compositions at the potential dredging sites (Sites C-1 to C-4, Map III.A.1; see section III.A above). The southern end of the Bay (Areas A-1 to A-3) consisted primarily of aerobic silts with considerable organic material, while the northern end of the Bay was primarily anaerobic mud (Table IV.A.3). The finer particle size of mud vs. silt probably accounted for the lack of oxygen in the muddier northern Bay sediments. Water with fresh oxygen can enter pore spaces in coarser silts, but not finer silts and muds. Mollusk shell fragments were found at the northwest end of the Bay (Area A-4 and Site C-1). These similar results were obtained independently by different field teams collecting and analyzing samples with different methods from Sites C-1 to C-4 and Areas A-1 to A-6.

5. <u>Metaphyton (filamentous algae) Cover</u>: No metaphyton was observed in June, but highly variable cover was observed in July (0 – 60%) and September (0 – 30%) (Table IV.B.4). The average cover was 15% in July and 13% in September. There was also considerable variation in cover among areas. No metaphyton was observed at Area A-5 (NE), 10% or less cover was observed at Areas A-1 (SW) and A-4 (NW), about 22% cover was observed at Areas A-2 and A-3 (S), and about 33% cover was seen at Area A-6 (E) (Map III.A.1). Area A-5 was in a relatively deep area with heavy boat traffic and wave action that probably prevented establishment of metaphyton that requires calm water to remain floating on the water surface. Areas A-1 and A-4 were directly off cattail stands on the southwest and northwest sides of the Bay, respectively, but it is not clear why these conditions (cattails, west side) would inhibit metaphyton growth. Perhaps prevailing westerly winds push metaphyton out of these areas to sink in deeper waters of the Bay. Area A-2 is very shallow and Areas A-3 and Area A-6 (Devil's/Helds Cove) are physically protected from wind and wave action. These conditions provide plentiful attachment sites to submersed macrophytes (Area A-2) and protected areas (Areas A-3 and A-6) for metaphyton.

6. Conclusions

Submersed macrophytes are important shelter for fish and macroinvertebrates and have considerable value as food for waterfowl (see below). Few submersed macrophytes were found in water >5 feet or <2 feet deep (Map IV.B.1), suggesting that depths >5 feet do not have sufficient light for aquatic macrophyte seed germination and that depths <2 feet are too unstable for plant growth relative to wave action, sedimentation and seasonal water level fluctuations. Thus, the optimal depths for submersed macrophytes in Irondequoit Bay are between 2-5 feet deep. Development at lesser or greater depths is likely to have little impact on these plants (although development at lesser depths closer to shore will certainly adversely affect emergent aquatic macrophytes and transition-zone plants; see below). Such disturbance may provide a gateway for invasive species such as Eurasian watermilfoil and purple loosestrife, with less cover and food value than native plants, to gain footholds and out-compete natives in newly disturbed areas of the Bay.

The submersed macrophytes sampled have considerable value as habitat for invertebrates, fish, waterfowl and marsh birds, and mammals (Table IV.B.1). The three plants observed at all six sampling sites, hornwort, sago pondweed and water milfoil, all provide shelter for fish and the invertebrates that fish eat, and they provide food for waterfowl (Fassett 1980, Borman et al. 1997). However, compared to pondweeds and hornwort, water milfoil typically supports lower diversity (fewer species) and abundance of invertebrates (Borman et al. 1997). Hornwort is a very important substrate for invertebrates in the winter because it does not die back and remains floating in the water column (Borman et al. 1997). Found only at Sites A-4 and A-5, water celery (*Valisneria americana*) is considered to be a premiere waterfowl food, and clusters of water starwort stems provide good shelter for fish and habitat for invertebrates (Borman et al. 1997). Ecologically, the most important aquatic macrophyte communities in Irondequoit Bay appear to be A-6 (Devil’s/Helds Cove; high quality habitat with two unique species), those like A-4 and A-5 (water celery as waterfowl food), and Area A-3 (highest diversity). However, to the extent that further development of the littoral zone of Irondequoit Bay removes or disturbs aquatic macrophyte habitat, it can be expected that less protected and less productive habitat will be left for invertebrates, fish, waterfowl and marsh birds, and that animals generally will diminish in diversity and number.

Aquatic macrophytes were mapped in Irondequoit Bay in 1940, 1975 and 1982 (Map IV.B.2; Bannister and Bubeck, cited in Burton 1985). One major difference exists between current and past macrophyte distributions in the Bay. From 1940 to 1982 (Map IV.B.2), virtually the entire Bay south of the line from the Baywinde Senior Community to Snider Island was covered with macrophytes. In 2002, only isolated small patches of were mapped along the entire Penfield shore of the Bay (Map IV.B.1). While the lack of macrophyte bed development along shore in the summer and fall might be explained by low water levels in 2002, their absence in the deeper waters off the Penfield shore cannot be explained by low water, especially since macrophyte beds were intact on the Irondequoit side of the Bay. It appears that boat traffic or other factors unique to the southeastern end of the Bay have caused aquatic macrophytes to disappear from a large portion of the Bay.

High metaphyton cover can shade out rooted aquatic macrophytes, has little value as habitat for macroinvertebrates, and has little food value for fish and wildlife. High levels of metaphyton cover at Areas A-2, A-3 and A-6 in the summer and early fall have the potential to reduce invertebrate and fish production. As indicated below, invertebrate and fish abundance was relatively low at shallow Areas A-2 and A-3, but it was high at deeper Area A-6. Therefore, it is not possible from our data to separate the effects of metaphyton and shallow water on invertebrate and fish production. However, at the current levels of metaphyton cover, shallow depths, especially in the fall, appear to be a more important influence than metaphyton cover.

C. *Aquatic Animals*

1. Fish

The total number of fish captured by trap netting and electrofishing (spring, summer and fall combined; Appendices IV.C.1.a,b,c) varied from a low of 67 (Area A-4, NW corner of the Bay) to a high of 194 (Area A-1, SW side) (Map III.A.1, Table IV.C.1, Appendix IV.C.1.d). The southern end of the Bay generally had greater abundance and diversity of fish than the northern end. Areas A-1 to A-3 had 194, 115 and 154 fish caught, respectively, consisting of 15, 10 and 15 species, respectively, whereas Areas A-4 to A-6 had 67, 138 and 107 fish caught, respectively, consisting of 11, 9 and 14 species, respectively (Table IV.C.1, Map III.A.1). Species found at all sampling sites included bluegill (*Lepomis macrochirus*), pumpkinseed (*L. gibbosus*), brown bullhead (*Ameiurus nebulosus*) and yellow perch (*Perca flavescens*). In addition to the four species found at all sites, species found at two or more of Areas A-1 to A-3 (south end of the Bay) included alewife (*Alosa pseudoharengus*), black crappie (*Pomoxis nigromaculatus*), bowfin (*Amia calva*), common carp (*Cyprinus carpio*), channel catfish (*Ictalurus punctatus*), golden shiner (*Notemigonus crysoleucas*), goldfish (*Carassius auratus*), largemouth bass (*Micropterus salmoides*), white perch (*Morone americana*), and white sucker (*Catostomus commersoni*). Species found at two or more of Areas A-4 to A-6 (north end of the Bay) included alewife, freshwater drum (*Aplodinotus grunniens*), golden shiner, largemouth bass, northern pike (*Esox lucius*), walleye (*Stizostedion vitreum*), white perch and white sucker.

Length-frequency distributions of the five most abundant species sampled (bluegill, brown bullhead, pumpkinseed, white perch, yellow perch) are displayed in Figures IV.C.1.a-e. Most bluegill were 5-7 inches in total length in the spring and summer, but few were caught in the fall (Figure IV.C.1.a), suggesting they had moved to deeper water. Pumpkinseed averaged 5-7 inches in the spring, summer and fall (Figure IV.C.1.c), suggesting they are resident in shallow water year-round. Brown bullhead averaging 11-13 inches were quite abundant during the spring spawning season, but few were caught in the summer and fall (Figure IV.C.1.b), suggesting that they moved away from the shallow edges of the Bay, perhaps out into Lake Ontario. The data indicate that white perch are resident in shallow waters of the Bay; they averaged 6-8 inches in the spring, 6-9 inches in the summer and 8-11 inches in the fall (Figure IV.C.d). Yellow perch averaged 7-8 inches in the spring and fall (Figure IV.C.1.e), but few were caught in the summer, probably because warm water near shore caused them to move to deeper, cooler water in the Bay or into Lake Ontario.

Area A-1 at the southwestern edge of the Bay offshore of Irondequoit Bay Park West (Map III.A.1) had the highest diversity and abundance of fish, especially during the spring spawning period (Appendix IV.C.1.d). In contrast, except for migratory/ spawning white perch and yellow perch in the spring, shallow, macrophyte-rich Area A-2, comprising much of the southern portion of the Bay (Map III.A.1), had a smaller number and lower diversity of fish (Appendix IV.C.1.d). Diversity and abundance rose again in shallow Area A-3 (Appendix IV.C.1.d) in the southwestern corner of the Bay where submersed macrophyte abundance was high and depths increased. It appears that despite excellent aquatic macrophyte cover in Area A-2 throughout the summer and fall, shallow depths less than 1 foot reduce the desirability of this habitat for fish.

At the northern end of the Bay, Area A-5 had the greatest diversity and abundance of fish (including many walleye), but Area A-4 (and several other coves along the western shore) had the most unique fish (longnose gar). Because of deeper water, both Areas A-5 and A-6 maintained their fish populations through the fall of 2002, while Area A-4 became very shallow and fish abundance declined sharply (Appendix IV.C.1.d). Except for the dredged channel in Area A-5, both Areas A-5 and A-6 contained abundant fish and aquatic macrophytes (they were cropped down 2-3 ft by boat propellers in the boat traffic zones of Area A-5). Although numbers of fish caught were relatively low in Area A-6 (Devil's/Helds Cove), abundant small fish were observed during sampling, particularly largemouth bass and gizzard shad. Most of these fish were too small to be stunned effectively by electrofishing or to be caught in the mesh of nets. It is clear that Area A-6 is a protected, productive fish nursery full of submersed and emergent macrophytes; it should be a high priority for protection from further development.

Most members of the sunfish/black bass family (Centrarchidae) found in our sampling appear to be resident species in the Bay (Scott and Crossman 1973). Rock bass (*Ambloplites rupestris*) and smallmouth bass (*Micropterus dolomieu*) spawn on rocky substrates in tributaries to the embayments of Lake Ontario, but adults generally do not reside in the embayments year round (Gerber and Haynes 1989). Our earliest sampling (June 26 to July 1) was near the end of the spawning seasons in our region for rock bass and smallmouth bass (Scott and Crossman 1973). While these species were found in past studies (Table IV.C.2), late sampling in the spring is probably why these species were not found. In addition, we did not sample in the rocky habitats frequented by these species. There is no reason to believe that rock bass and smallmouth bass are not using Irondequoit Bay during other times of the year. Other Lake Ontario species sampled that use Irondequoit Bay primarily for breeding or nursery purposes (Scott and Crossman 1973) include alewife, common carp, channel catfish, freshwater drum, gizzard shad (*Dorosoma cepedianum*), northern pike, redhorses (*Moxostoma* spp.), walleye, white perch, white sucker and yellow perch, although some such as carp, northern pike and yellow perch also probably maintain resident populations.

Other species not sampled in this study, but collected in NYSDEC and other studies going back to 1969 (Table IV.C.2), include American eel (*Anguilla rostrata*), brown trout (*Salmo trutta*), rainbow trout (*Oncorhynchus mykiss*), quillback (*Carpiodes cyrinus*), emerald shiner (*Notropis atherinoides*), spottail shiner (*Notropis hudsonius*) and white bass (*Morone chrysops*). All of these species are primarily Lake Ontario residents that have relatively small populations (quillback, white bass), enter embayments infrequently (American eel, sea lamprey), enter only to reproduce (trout upstream, white bass), enter only during colder times of the year (salmon and trout) when we did not sample, or are mostly pelagic (open water) species (shiners) (Scott and Crossman 1973; Haynes, personal observations). In addition, most of them have been seen only infrequently in the past (Table IV.C.2).

Going farther back in history to the NYS Biological Surveys of the 1930s (relevant data summarized in Bannister and Bubeck 1978 and Haynes 1990), a number of other species were recorded in Irondequoit Bay (Table IV.C.2), primarily minnows and darters not usually associated with shallow, silty embayments but rather with gravelly streams (Scott and Crossman 1973). It seems likely that species living farther upstream in Irondequoit Creek were included in the data reported for Irondequoit Bay. Found in the 1970s, but not later, were sea lamprey (*Petromyzon marinus*) and burbot (*Lota lota*), both lake species not usually associated with embayments.

2. <u>Amphibians</u>

Calling Counts: Based on preliminary habitat surveys to determine where amphibians were likely to occur, sampling was conducted at six locations around the perimeter of Irondequoit Bay (Sites AB-1 to AB-6). Four species of calling amphibians were detected during the calling surveys: bullfrog (*Rana catesbiana*), green frog (*Rana clamitans*), gray tree frog (*Hyla versicolor*), and spring peeper (*Pseudacris crucifer*) (Table IV.C.3). The green frog was the most widely distributed species, as it was found at four of the six wetlands surveyed for amphibians, while the spring peeper was the only species that was detected at a calling code of 3 (too numerous to count). One species that we detected, the gray tree frog, was not recorded from the Amphibian and Reptile Atlas East Rochester survey block during the New York State Amphibian and Reptile Atlas Project (NYSDEC 2000). The Irondequoit Bay State Marine Park wetland (Site AB-3), just to the south of Lake Ontario (Map III.A.1), had the highest species richness (four species), while no species was recorded in the small area sampled in the southwestern corner of the Bay (Site AB-1). The absence of species of calling amphibians that are often found in wetlands along the south shore of Lake Ontario, such as the American toad (*Bufo americanus*), western chorus frog (*Pseudacris triseriata*), and northern leopard frog (*Rana pipiens*), is most likely attributable to the fact that counts were not begun until the end of May. Although these species were present at Yanty Creek Marsh, Hamlin Beach State Park, and at Braddock Bay, they were not detected after mid-May during surveys in 2000 (Makarewicz *et al.* 2000).

Distributional Information: Data from Harding (1997) and the NYSDEC Amphibian and Reptile Atlas Project (NYSDEC 2000) produced a list of 35 species of amphibians and reptiles potentially occurring within the project area (Table IV.C.4). Of these, 14 species were reported from the Amphibian and Reptile Atlas Rochester East survey block (NYSDEC 2000). Four anuran (frog) species were observed within sensitive areas identified by the IBCC Technical Team (shorelines associated with Areas T-1 to T-9; Map III.A.1), while 20 species were judged as probable, one as possible, and 10 as unlikely (Table IV.C.4). Four potential species in the project area are listed as special concern species (NYSDEC 2002b). Salamanders in the Jefferson salamander complex (*Ambystoma laterale* X *jeffersonianum*) were found during the Amphibian and Reptile Atlas project (NYSDEC 2000) and are probably present within the sensitive areas. Spotted turtles (*Clemmys guttata*), wood turtles (*Clemmys insculpta*), and eastern spiny softshell turtles (*Apalone spinifera*) were judged as unlikely to occur within the sensitive areas due to insufficient habitat and their spotty distribution along the south shore of Lake Ontario (NYSDEC 2000).

3. Wetland Birds

Counts: Based on preliminary habitat surveys to determine where wetland birds were likely to occur, sampling was conducted at seven locations around the perimeter of Irondequoit Bay (Sites AB-1 to AB-7). Twelve species of birds were detected during timed counts in these seven sections of the Irondequoit Bay wetland (Table IV.C.5). The greatest species richness occurred at Sites AB-4 (Big Massaug Cove; eight species) and AB-1 (southwest corner of Irondequoit Bay; seven species) (Map III.A.1). The most widely distributed species in the Irondequoit Bay wetlands that we surveyed was the Red-winged Blackbird (*Agelaius phoenecius*), which was present at all seven sites; Yellow Warblers (*Dendroica petechia*) and Song Sparrows (*Melospiza melodia*) were each present at five sites (Table IV.C.5). Three of the twelve species observed in 2002 were not noted in the Breeding Bird Atlas blocks during the 1980-1984 surveys, but were present in 2000-2002 (NYSDEC 2002a): Mute Swan (*Cygnus olor*, an invasive species), Canada Goose (*Branta canadensis*, regional overwintering populations appear to be increasing, perhaps due to warmer winters), and American Coot (*Fulica americana*). Five of the species found in the Irondequoit Bay marshes are among the seven most common species recorded on Marsh Monitoring Program routes in the Lake Ontario Basin (Weeber and Vallinatos 2000): Tree Swallow (*Tachycineta bicolor*), Marsh Wren (*Cistothorus palustris*), Yellow Warbler, Song Sparrow, and Red-winged Blackbird. It is possible that counts made earlier during the breeding season would have detected other, less common wetland bird species, including the Swamp Sparrow (*Melospiza georgiana*) and Virginia Rail (*Rallus limicola*).

Distributional Information: Data from the New York State Breeding Bird Atlas for 1980-1984 and 2000-2002 (NYSDEC 2002a) produced a list of 28 species that frequently breed or forage in wetland habitats (included in Table IV.E.1). As mentioned above, 12 of these species were observed during the study (Table IV.E.1**)**. Three wetland species in Table IV.E.1 are New York State-listed as either threatened (Least Bittern; Sedge Wren, *Cistothorus platensis*) or special concern (American Bittern, *Botaurus lentiginosus*). Of these species, only the Sedge Wren has been documented as occurring in wetlands adjacent to Irondequoit Bay, but it was not seen in this study. The New York Natural Heritage Program lists a location for the species as “Irondequoit Bay and Creek, about 4.0 miles east of downtown Rochester” (NYSDEC 2000c). However, the wetlands adjacent to Irondequoit Bay do not offer ideal habitat for this species, which nests in sedges and grasses in wet meadows, hayfields, and the upland margins of marshes; Sedge Wrens abandon sites with standing water (Andrle and Carroll 1988, Schneider and Pence 1992). If this species exists locally, it is probably south of Empire Blvd. where sedge meadow habitat occurs (R. Dilcher, SUNY Brockport, personal observation).

4. Macroinvertebrates

Although quite variable across seasons (June, July, September) and locations (Areas A-1 to A-6), as is typical of patchily distributed macroinvertebrates in aquatic systems, aquatic earthworms (oligochaetes), snails (gastropods), scuds (*Gammarus fasciatus*), and midge flies (chironomids) dominated the samples collected (Table IV.C.6). The macroinvertebrates sampled in aquatic macrophyte beds at Areas A-1 to A-6 (Map

III.A.1) were similar to those found seasonally in Irondequoit Creek wetland vegetation south of Empire Blvd. (Haynes and McNamara 1998). Compared to Cook's (1998) study of chironomids throughout Irondequoit Creek and the wetland near its entry to the Bay, many more taxa were found in aquatic vegetation in this study (Note: George Cook also identified the invertebrates for this study, so inconsistent identifications are unlikely). It appears that the taxa richness of chironomids in the Bay is quite high. Raw data for macroinvertebrate samples can be found in Appendices IV.C.2.a-f. No protected macroinvertebrates were collected (NYSDEC 2002b).

Aquatic macroinvertebrates are commonly collected to assess water quality. Using the methods of Bode et al. (1996), the health of macroinvertebrate communities occupying aquatic macrophyte habitats in Irondequoit Bay was assessed (Table IV.C.7). While Bode et al.'s method does not specifically address aquatic macrophyte habitats, it does address soft sediments in slow moving water where macrophytes grow; this is the situation found in Irondequoit Bay. Bailey-Billhardt (2002) compared Bode et al.'s criteria for macroinvertebrate community health among aquatic macrophyte, gravel and mud habitats throughout the Irondequoit Creek watershed, including the wetland between Empire Blvd. and Browncroft Blvd. She found few differences in calculated values of community health between aquatic vegetation and soft sediments. Thus, we evaluated the health of the macroinvertebrate communities in submersed macrophytes at Areas A-1 to A-6 using Bode et al.'s criteria for soft sediments.

Bode et al. (1996) use five indicators (metrics) of macroinvertebrate health for soft sediment habitats: species richness (how many taxa are present in a sample), diversity (a measure of richness and evenness of the numbers in each taxon), Hilsenhoff Biotic Index (a weighted average based on pollution tolerance/sensitivity of the organisms sampled), dominance-3 (DOM-3—the combined percentage of the three most common taxa in a sample), and Percent Model Affinity (PMA—a measure of how well the sample matches an "ideal" community in soft sediments in New York). After calculating a raw value for each metric, that value is converted to a scaled value by a graphical interpolation. The scaled values are then averaged to produce a final score that is interpreted on a scale of no impact to slight, moderate or high impact (Bode et al. 1996).

Overall, the estimated level of impact on the six macroinvertebrate communities sampled in Irondequoit Bay (Areas A-1 to A-6; Map III.A.1) ranged from none at Area A-1 to moderate at Area A-2. Two metrics were not very useful for distinguishing communities. The Hilsenhoff Biotic Index rated every habitat a perfect "10", indicating very little pollution in the Bay (which is good), and the Shannon-Weaver diversity index gave each habitat the lowest quality rating. Thus, these consistently high and low values were excluded from calculations of average impact (Table IV.C.7). The "generosity"of the HBI was anticipated; Bailey-Billhardt (2002) also found that the HBI gave the "best" community ratings throughout the Irondequoit Creek watershed. The results of the Shannon-Weaver diversity index were consistent with the DOM-3 index; high values of the later indicate that only a few taxa comprise most of a sample, and lack of even numerical distribution of taxa results in a lower Shannon-Weaver diversity score.

5. <u>Aquatic Community Similarities and Differences</u>

Submersed macrophytes (Table IV.B.1), fish (Table IV.C.1) and macroinvertebrates (Table IV.C.6) found at Areas A-1 to A-6 were combined to assess the similarities of the six aquatic communities sampled. Using cluster analysis (PC-ORD 1999), Areas A-3 and A-6 were the most closely related, followed by Areas A-1 and A-2 and Areas A-4 and A-5 (Figure IV.C.2). These results make good sense. Areas A-3 and A-6 are protected, isolated areas generally high in diversity and abundance of submersed macrophytes, fish and macroinvertebrates. Areas A-1 and A-2 and Areas A-4 and A-5 are adjacent to each other at the southern and northern ends of the Bay, respectively (Map III.A.1).

In the principal components analysis, the three axes with the highest associations with the taxa found in the six communities explained 73.6% of the variation in the taxa observed (Table IV.C.8). Area A-1 had a significant association with seven invertebrate taxa (including five midge flies = chironomids), three fish taxa (channel catfish, golden shiner, white perch), and two submersed or floating macrophytes (lesser duckweed, water star grass) (Table IV.C.9). Area A-2 had a significant association with a similar, but smaller, group of taxa. Area A-3 had a significant association with eight invertebrate taxa (including three midge flies and four other insects), six fishes (including black crappie and largemouth bass), and four submersed macrophytes (Table IV.C.9). Area A-4 had a significant association with 11 invertebrates (including eight midge flies), five fishes (including longnose gar and northern pike), and two submersed macrophytes (including water celery, a very important food for waterfowl). Area A-5 had a significant association with eight invertebrates (including five midge flies), three fishes (freshwater drum, northern pike, walleye), and five submersed macrophytes (including water celery). Area A-6 had a significant association with five invertebrates, two fish (walleye, freshwater drum), and three submersed macrophytes (Table IV.C.9, Map III.A.1).

Note that principal components analysis cannot consider taxa that occur at all sampling sites; therefore, bluegill, pumpkinseed, bullhead, yellow perch, hornwort, sago pondweed, water milfoil and several invertebrate taxa were excluded from the PCA, but not from the cluster analysis. In other words, all sampled areas of the Bay support an array of submersed plants that provide shelter or food for invertebrates and fish.

6. Conclusions

a. *Aquatic Biota*: The Bay appears to maintain a healthy mix of expected resident and migratory fish (Table IV.C.1). No endangered, threatened or special concern fishes were found in our sampling, nor were any expected (NYSDEC 2002b). Only one currently endangered species (NYSDEC 2002b), the pugnose shiner *(Notropis anogenus*), last seen in the 1970s but common in 1939, has ever been reported from the Bay (Table IV.C.2). The Bay is classified by the NYS Natural Heritage Program as an unprotected (i.e., no legal protective status) warm water fish concentration area, a type of habitat that is apparently secure in New York (NYSDEC 2002c).

Overall, the health of aquatic macroinvertebrate communities appears to be good throughout the Bay. It is probably not a coincidence that Area A-1 had the highest macroinvertebrate community health index and the greatest diversity and abundance of fish, while Area A-2 had the lowest macroinvertebrate health index and the lowest diversity and abundance of fish. Both of these outcomes are most likely related to depth of water, not water quality. Area A-1 is deep enough to shelter a healthy fish community with sufficient submersed macrophytes to support an apparently non-impacted macroinvertebrate community capable of feeding the fish community. Despite a healthy submersed macrophyte community, the “Empire Blvd. mud flats” appear to be too shallow to support strong macroinvertebrate and fish communities, despite their importance as a feeding area for birds (see below).

Because of heavy boat traffic, we did not sample in the dredged channels of Area A-5 (Map III.A.1). Submersed macrophytes cropped down 2-3 feet below the surface (presumably by propellers) were observed in boat channels. Reduced submersed macrophyte abundance reduces habitat available for macroinvertebrates that, presumably, would support fewer fish. However, despite more disturbance, the greater depths in Area A-5 probably provide more shelter for fish than the undisturbed, more macrophyte rich but shallow Area A-2. If Area A-5 were as isolated and undisturbed as Area A-6 (Map III.A.1), because of similar depths it would probably have a similar set of macrophyte, invertebrate and fish communities.

Areas A-5 and A-6 both appear to be walleye feeding or spawning areas. Despite not catching as many species or fish in Area A-6 (Devil's/Helds Cove; Map III.A.1) as in some other Areas, it may be the most important spawning and nursery habitat in the Bay. Numerous small fish not vulnerable to our sampling methods and plentiful habitat (emergent and submersed macrophytes, logs, etc.) were observed. This area is important and requires a high degree of protection to maintain its productive potential for fish.

Area A-3, the isolated, macrophyte rich southwestern corner of the Bay was associated with largemouth bass and black crappie, and undoubtedly supports an important fishery consistent with the warmwater fishery designation of the Bay (NYSDEC 2002c). Areas A-4 and A-5, virtually the entire northern end of the Bay, have water celery that is perhaps the single-most import food for many migrating and resident waterfowl (Borman et al. 1997). All of these areas should be considered for a high level of protection

b. *Amphibians and Wetland Birds*: At the national level, about two-thirds of the birds and three-fourths of the amphibians federally listed as endangered or threatened are associated with wetlands (Mitsch and Gosselink 1993). The amphibian and bird species detected during counts in Irondequoit Bay wetlands were all relatively common species found in wetlands throughout much of the region (Herdendorf 1987, Andrle and Caroll 1988; NYSDEC 2000, 2002a). No New York State-listed amphibians or birds (endangered, threatened or special concern species, NYSDEC 2002b) or bird species of federal management concern (Schneider and Pence 1992) were identified during bird surveys in Irondequoit Bay wetlands, although several species could potentially live near the Bay (Table IV.C.4).

Although none of the emergent wetlands in Irondequoit Bay north of Empire Boulevard are large, they still represent important habitat that should be preserved, given the historical loss of wetlands along the southern Great Lakes shorelines (Herdendorf 1987, 1992). Several states in the Great Lakes Basin have lost over 50% of their wetlands since European settlement (Dahl 1990). Whillans et al. (1992) estimated that about 50% of the original wetlands have been lost in the Lake Ontario watershed, with loss rates as high as 80-100% along intensively urbanized sections of the coastline. Wetland loss may be contributing to the decline of amphibians such as the western chorus frog, which declined by 7.9%/year in the Great Lakes Basin during the first five years of the Marsh Monitoring Program (Weeber and Vallianatos 2000).

Among wetland birds, seven species in the Great Lakes Basin experienced declines during the first five years of the Marsh Monitoring Program, including three species noted during our counts: American Coot, Tree Swallow, and Red-winged Blackbird (Weeber and Vallianatos 2000). Within Region 5 of the United States Fish and Wildlife Service (the Northeast United States), Marsh Wrens and Red-winged Blackbirds were among the seven species experiencing significant declines during the period between 1966-2000 (Sauer et al. 2001). Among a selected set of 53 marsh birds detected on Marsh Monitoring Program routes, eight of the ten species with the highest conservation priority potentially occur within the Irondequoit Bay project area: Black-crowned Night Heron (*Nycticorax* nycticorax), Common Nighthawk (*Chordeiles minor*), Least Bittern, American Coot, American Bittern, Sora (*Porzana carolina*), Virginia Rail, and Common Snipe (*Gallinago gallinago*) (Weeber and Vallianatos 2000; Tables IV.C.5 and IV.E.1).

Numerous studies suggest that small wetlands may be important for the persistence of local populations of wetlands-associated animals (Gibbs 1993, Oertli et al. 2002) and for maintenance of regional biodiversity (Semlitsch 1998, 2000). If other habitat features are equal, there may be no minimum wetland size for breeding amphibians (Richter and Azous 1995). Metapopulations, which are collections of interacting local populations, of turtles, small birds, and small mammals may be particularly vulnerable to the loss of small wetlands (Gibbs 1993, Oertli et al. 2002). Although avian species richness generally increases with wetland size (Weller 1999), complexes of intermediate-sized wetlands may preserve wetland bird species diversity better than isolated, large wetlands (Brown and Dinsmore 1986). In New York State, small wetlands may be of particular value to waterfowl (Benson and Foley 1956).

In summary, the declines of many species of amphibians and wetland birds in the region, along with continued rates of habitat loss and the demonstrated importance of small wetlands to many species occurring in the project area, mandate that existing wetlands in the Irondequoit Bay should be completely protected from public and private development that will diminish their quantity (habitat area) and quality (ecological value).

D. *Upland Plant Communities and Species*

1. Soil Characteristics, Vegetation Supported and Development Constraints

The information below was compiled from the Monroe County Soil Survey (USDA 1973). It and Table IV.D.1 summarize soils found in Areas T-1 to T-9 and their development constraints. Map IV.D.1 shows soils, steep slopes and erosion potential.

Al: Alluvial Land. These lands flood frequently. Drainage is generally poor to very poor, making limitations for development severe.

AoB: Alton Gravelly Loam (3%-8% slopes). This soil is suited to fruit crops, pasture and woodland, providing erosion is controlled and irrigation is used. It has slight or moderate limitations (sloughing) for underground utilities, home sites, streets, hiking trails and picnic areas. However, because it is gravelly it has severe to moderate limitations for athletic fields, lawns and fairways. AoB is well suited for herbaceous plants and suited for hardwoods, conifers, open land and woodland wildlife, and grasses.

ArB: Arkport Very Fine Sandy Loam (0% to 6% slopes). These are deep, well-drained, medium textured soils. While these soils have slight limitations for home sites, street and parking, picnic areas, hiking trails, and lawns and fairways, they are subject to water erosion and soil blowing. They are suited to hardwoods, conifers and woodland wildlife, as well as to herbaceous plants, grasses and open land wildlife.

ArD: Arkport Very Fine Sandy Loam (12%-20% slopes). This very fine soil is subject to severe water erosion and blowing. ArD soils have moderate to severe limitations for underground utilities, home sites, streets and lawns because of sloughing and slopes. They are suited to herbaceous plants, hardwoods, conifers, and open land and woodland wildlife.

AtF3: Arkport, Dunkirk, and Colonie Soils (20% to 60% slopes, highly erodable). The limitations to all development are severe, including inability to sustain underground utilities; septic effluent; home sites; streets and parking lots; picnic, athletic and camping areas; hiking trails; and lawns and fairways. These soils should remain with natural vegetative cover. Any removed cover should be restored quickly because these soils are highly susceptible to continued erosion. AtF3 soils are suited to hardwood trees, conifers and general woodland wildlife. They are unsuited to wetland food and cover plants, impoundments and open land wildlife.

ClA: Colamer Silt Loam (0% to 2+% slopes). These soils are subject to erosion. They are moderately well drained, very fine sand and silt. The limitations for home site development are moderate because of seasonally high water tables 1.5-2 ft below the surface and slow septic permeability below 14 in. These soils have a low bearing capacity and so may compact, a limitation for roadways and foundations. Colamer silt loam soils are poorly suited for conifers and wetland food and cover plants, but are well suited to hardwoods and open land and woodland wildlife.

CoB: Colonie Loamy Fine Sand (0 – 6% slopes). These soils are deep, medium sand soils, well drained and easily wind-blown when exposed. They are severely limited for lawns and moderately limited for underground utilities and streets because of sloughing. Otherwise, they pose slight limitations for home sites. These soils are poorly suited for grasses, hardwoods, conifers, and open land and woodland wildlife in general.

CoD3: Colonie Loamy Fine Sand (12% to 20% slopes). This soil poses moderate limitations for underground utilities and severe limitations for home sites; streets and parking lots; lawns; and septic effluent because of slope and sloughing. It is poorly suited for herbaceous plants, hardwoods, conifers, impoundments, and upland and woodland wildlife.

FW: Freshwater Marsh. The water level over this organically rich, water-saturated soil fluctuates with bay/lake water levels. Cattails, rushes and other herbaceous vegetation are dominant.

GaB: Galen Very Fine Sandy Loam (0%-6% slopes). These are deep, moderately well drained soils. They are suited to vegetable and fruit crops, but are easily eroded. There are moderate limitations for underground utilities, septic systems, home sites, streets and athletic fields because of seasonally high water tables. They are well suited to wild herbs, hardwoods, conifers, and for open land and woodland wildlife.

HuB: Hudson Silt Loam (2% to 6% slopes). These soils are only moderately suited for underground utilities, home sites, and streets and parking because of seasonally high water tables, slopes, and a potentially unstable base of silt and clay. They have slight limitations for picnic areas, hiking trails, and lawns and fairways. Because they may be seasonally wet, they are severely limited for athletic fields and campsites. They are well suited for grasses, herbaceous plants, hardwoods, open land woodland wildlife. They are poorly suited for conifers and wetland wildlife.

Lb: Lake Beach. This mostly fine or coarse sandy material has been washed and rewashed by Lake Ontario waves. Very little vegetation exists except where flung cobble has established a barrier upon which scattered trees and other woody vegetation grow.

Lm: Lamson Very Fine Sandy Loam (0 – 2% slopes). This is a deep, poorly drained soil, with a seasonal high-water table. Lm soils are typically in long, narrow drainage ways. This soil has severe limitations for home sites, streets, lawns, hiking trails, and picnic/athletic fields. Lm soils are suited for hardwoods, conifers and woodland wildlife, but not for grasses, open land wildlife and herbaceous plants.

Pu: Pits and Quarries. These soils are exposed, often to great depths, at human-disturbed sites in the study area.

Wg: Wayland Silt Loam. These nearly level soils are adjacent to streams; they have prolonged high water tables and a tendency to flood. As such, they have severe limitations for home sites, septic systems, streets, lawns, trails, and other development. These soils are suited to hardwoods, conifers, wetland food and cover plants, and woodland wildlife. They are poorly suited to open land plants, grasses, wild herbaceous plants and impoundments.

2. Locations and Soils of the Nine Critical Terrestrial Areas

The boundaries of Areas T-1 to T-9 (Map III.A.1) were estimated on the 1998 "Irondequoit Bay Hiking Trail Plan" and approximated on soil maps (USDA 1973) of different scale than the trail map. Below we quote extensively from the Monroe County Environmental Management Council's (EMC) 1996 report, "Preservation of Environmentally Sensitive Areas in Monroe County," because our surveys of Areas T-1 to T-9 agree with their assessments.

Area T-1

Location: This area extends along the eastern Irondequoit Bay shoreline from Empire Boulevard north to Willow Point. It extends about 2000 ft along Empire Boulevard, then north to where it narrows at Irondequoit Bay Park East, widens at the YMCA properties, narrows at the Baywinde Senior Community area, then widens again to its northern border at McEwen Drive. Called the Southeast Slopes, this area has the EMC Preservation Committee's highest recommendation for preservation for several reasons, including extreme vulnerability to erosion and, therefore, protection of the Bay's water quality (Monroe County EMC 1996). The waters of the Bay constantly undercut the shoreline banks, and foot traffic near Irondequoit Bay Park East and the YMCA cause interior erosion. Also, two large surface-clearing development projects are underway in Area T-1, one at Willow Point and the other at 1440 Empire Blvd. at the southeastern corner of the Bay. Given their soils, these projects are subject to major erosion.

Soils: Most of Area T-1 is Arkport, Dunkirk and Colonie (AtF3) soils, highly erodable and unsuited for development of any kind, bordered by Hudson silt loam (HuB) soils along the eastern edge with small finger-like intrusions from the east of pit and quarry (Pu) and Collamer silt loam (ClA). Alluvial lands (Al) and Arkport very fine sandy loam (ArB) form small, localized deposits in Area T-1. Borrow and fill (Pu) occurred along old Route 104 (now Empire Blvd.) at the south end of Area 1.

Area T-2

Location: This area surrounds Devil's/Helds Cove, including Inspiration Point. It extends east to Bay Road and south to Sunset Trail, including Hillsboro Cove. Its dome extends north across Route 104 to Coronado Drive and Joran Drive. EMC's Preservation Committee cites the Devil's/Helds Cove area as highest priority for preservation (Monroe County EMC, 1996). The steep, wooded shoreline of Inspiration Point is bare and eroded in places. Other places have home sites at the shoreline.

Soils: The northern boundary of Area T-2 appears the follow the AtF3 contour from the Bay across Route 104. Most of Area T-2 is AtF3, with Alton gravelly loam (AoB) and Colonie loamy fine sand (CoB) soils on the eastern margin next to Bay Road. A small finger of Lamson sandy loam (Lm) extends along a drainage-way into the southern reaches of the CoB soil. The inland branches of Devil's/Helds Cove are or were freshwater wetlands with freshwater marsh (FW) soils. A small pit (Pu) area (from Route 104 construction?) extends into the area near Inspiration Point.

Area T-3

Location: Known as the "Webster Water Tower Woods," Area T-3 extends from DeWitt Road to the Bay and includes the Village of Webster water works and well field. Its southern edge borders a highly disturbed ATV "playground" and then the Route 104 rest area and NYSDOT facility. The narrow northerly projection west of Valley View Parkway extends along the Bay's shore to the southern edge of Stony Point. The EMC's Preservation Committee cites the area as highest priority for preservation (Monroe County EMC 1996.). DEC's Natural Heritage Program cites the area as home to rare insects and plants, and to a rare "oak opening" plant community characteristic of prairies (NYSDEC 2002c). The ATV playground feeds eroded trails throughout the woods.

Soils: All of the shoreline of Area 3 is Arkport, Dunkirk and Colonie (AtF3) "cliffs." A small portion of the northern border of Area 3 is Arkport very fine sandy loam (ArD). Most of the eastern and central parts of Area 3 are Colonie loamy fine sand (CoB). In Area 3 moderately steep, dune-like Colonie loamy fine sand (CoD3 has steeper slopes than CoB) lies narrowly between the shore-cliffs of AtF3 and the larger, easterly deposit of CoB. Erosion potential during and after development is very high in Area T-3.

Area T-4

Location: Area T-4 borders the shallow northeast cove of the Bay. From the Webster boat launch on Lake Road, this area curls inland around the easterly projection of Irondequoit Bay to the western end of Backus Road and Shorewood Drive, an area known as "The Bluffs". Its main body is west of the homes along Bay Road. The EMC's Preservation Committee gave the area highest priority for preservation, partly for its wildlife habitat and erosion protection values and partly to reinforce a protection covenant of 10.4 acres owned and controlled by The Bluffs Subdivision (Monroe County EMC 1996) which has built homes adjacent to the wooded area. The base of Area T-4's slope is high quality wetland. The status of the protected property should be checked.

Soils: Lake Beach (Lb) “soil” is found on the lake side of the Webster “Sandbar” where a road and railroad once “stabilized’ this highly disturbed areas. Most of the eastern Webster “boot” of the Bay in Area 4 is surrounded by “cliffs” of highly erodable Arkport, Dunkirk and Colonie (AtF3) soils. Fingers of Colonie loamy fine sand (CoB) and Galen very fine soil (GaB) intrude from eastern and southern margins of the area.

Area T-5

Location: This narrow area between Sea Breeze Expressway and the Bay extends from the outlet boat launch south to German village, including the Irondequoit Bay State Marine Park. Its bank is steep, held from erosion by mature trees. A narrow floodplain and a high quality wetland of cattails and common reed occupy portions of the shoreline, and a narrow footpath follows the shore. The cottages and homes at German Village are wedged on this narrow floodplain, with pilings to hold back the highly erodable bank.

Soils: Lake Beach (Lb) “soil” continues into Irondequoit from Webster across the Bay outlet. Very little vegetation grows here, and both sides of the beach are compromised by past (railroad) and current development. Most of Area T-5, especially the Bay’s shore, is Arkport, Dunkirk and Colonie (AtF3) soil. A large area of Colonie loamy fine sand (CoB) west of Route 590 and Culver Road extends eastward across Route 590 to the AtF3 soils along the Bay proper. That is, Route 590 in this area is built on CoB.

Area T-6

Location: Bisected by Route 104, Area T-6 includes the Newport Landfill on the south and the Big Massaug Cove area to the north. Roughly, its northern edge is Rudman Road/West Wood Drive and its westerly extension almost reaches Sunrise Acres. The Newport Landfill lies along the southern side of Route 104, and comprises most of the southern side of Area T-6.

Soils: Area T-6 is almost entirely Arkport, Dunkirk and Colonie (AtF3) soils completely unsuitable for development. The area is split by the raised fill (crossed by two drainage ways) for the Route 104 western approach to the Bay Bridge.

Area T-7

Location: Owned mostly the Town of Irondequoit, this area extends from Point Lookout west through the Rochester composting area adjacent to Route 590. Its southern limit is Granada Circle – Eagle Rock Drive. Its northern edge is San Rose Drive. Densmore Creek flows through the area to its outfall near Point Lookout. The City of Rochester owns a buffer area around Densmore Creek in Area T-7.

Soils: Area T-6 is a complex mixture of soils, most of which are highly (AtF3) to moderately (ClA) erodable, low lying and wet (Al, Wg), or with other development limitations such as high water tables (ClA, OnB). In Area T-7, the small parcel of OnB is surrounded by soils of greater limitations (ClA, AtF3). Wayland silt loam and alluvial land (Al) soils lie adjacent to streams and shoreline in Area T-7.

Area T-8

Location: The southwestern Bay shoreline from Glen Haven through Snider Island to the northwestern boundary of Area T-9 is included in Area T-8, with Orchard

Park Boulevard its southwest border. Irondequoit Bay Park West, the major middle portion, is rich in habitats and species diversity. The park's southern edge includes Foxhall Circle, Rich Edge Drive and Dean View Drive. The line of Glen Haven – Glen Ridge Lane – Shingle Mill Road is its approximate northern edge.

Soils: Area T-8 has a mix of soils with moderate to severe development limitations, including Arkport, Dunkirk and Colonie (AtF3, highly erodable), Colamer silt loam (ClA, seasonal high water table at 1.5-2 ft below the surface, slow septic permeability below 14 in, low bearing capacity). The area also has considerable alluvial (Al) land.

The most southerly portion of Area T-8, an area under strong development pressure, is mainly AtF3 soils that have severe limitations for underground utilities, streets, home sites and lawns. The adjacent shoreline to the north abuts the shallow bay area known as the Empire Boulevard Mud Flats cited by EMC's Preservation Committee as a highest priority, unique and essential habitat (Monroe County EMC 1996). Development in Area T-8 will create erosion and may alter the mud flats. The mudflats are essential for migrating shorebirds, waterfowl and other birds.

Area T-9

Location: This is the southern end of Irondequoit Bay proper, with Empire Blvd. the southern border of Area T-9. The eastern edge is the rest area east of LaSalle Park. North of the Area T-9 shoreline are the "Empire Boulevard Mud Flats," cited by the Monroe County EMC (1996) as having highest priority for preservation because they are a migratory route and habitat for many shorebirds and waterfowl and a unique habitat in Monroe County. Docks, dumping, old fill of unknown source and composition, and boat use in Area T-9 threaten the mud flat's existence.

Soils: Soils in Area T-9 are freshwater marsh soils and variable fill of unknown origins. Limitations to development are severe.

3. Upland Plant Communities Overview

Table IV.D.2 lists the terrestrial plant species observed during extensive walking surveys of Areas T-1 to T-9. Also included are results from previous plant surveys in the study area and ecological values of the plants found. Appendices IV.D.1.a-i list all of the overstory, understory and ground cover plants identified in Areas T-1 to T-9 along with GPS coordinates and photographic references to most sites where plants were identified. The GPS coordinates, photographs and species lists are linked together in a virtual tour (on CD) of Irondequoit Bay that can also be linked to the worldwide web to find out more about the plants found in the study area.

Area T-1: (Appendix IV.D.1.a) This extensive area (Map III.A.1), about a third of the bay's eastern shoreline, is being degraded by development at both ends. Seasonal activity between Irondequoit Bay Park East and the YMCA compromises its middle (Photos 20-VIII and 24-VIII). Generally, the area consists of mature Oak-Hickory (OW) Central Hardwood Forest (Photo 3-VIII) with Midslope Woodland (MW) (i.e., Alleghany Hardwood Forest), along its interspersed steep glens that open to the Bay. Where these glens are wet, cottonwoods and willows grow. Where they open to the Bay, conditions may permit cattails, wet-soil herbaceous plants and dogwood-alder shrubs to grow, bordered by willows and cottonwoods (Photos 10-IX, 11-IX and 12-IX). Otherwise, the shoreline is steep and wooded (Photo 11-VII); in places the willow-cottonwood cover is eroded away and the bay is undercutting the shoreline (PHOTO 13-VII). Near the south edge of Irondequoit Bay East Park is a shoreline trail made very dangerous by this erosion. Dense dogwood, honeysuckle, silver-berry and bramble grow in areas where, presumably, deforesting has occurred (Photo 16-VII). There are eroded ATV trails throughout Area T-1.

The ground at the Willow Point project is completely bare at present (Photos 17-VII through 22-VII). At the edge of construction oaks, cherry, ash and maple form the overstory. Ash and maple saplings, staghorn sumac, honeysuckle and dogwoods are the understory. Grape, a ubiquitous problem around the bay, sassafras and various herbaceous plants are ground cover.

Toward the Bay from the Willow Point project is a wet glen with mature willow and cottonwood (Photoss 5-VIII and 6-VIII) and an understory of alder, honeysuckle, willow, witch-hazel and others. Farther west is a ridge with a trail leading to a small cleared area of unknown purpose (Photos 7-VIII and 9-VIII). Nearby is a trash area.

The southern end of Area T-1 at 1440 Empire Blvd. is also a bare construction area (Photos 24-VII and 25- VII). Here oak and tulip tree form the overstory at the project's west (Bay) side. Maple, oak and tulip tree along with a few hemlocks form an understory. Emergent wetland vegetation occupies a small inlet adjacent to Bounty Harbor Marina.

NYS-protected species found in Area T-1 (Table V.A.1) are American bittersweet (*Celastrus scandens*), butternut (*Juglans cinerea*), Christmas fern (*Polystichum acrostichoides*), flowerng dogwood (*Cornus florida*), great lobelia (*Lobelia siphilitica*), maidenhair fern (*Adiantum pedantum*) and white baneberry (*Actaea alba*).

In giving this area its highest recommendation for preservation, EMC's Preservation of Sensitive Areas Committee says the following: "The southeastern section of Irondequoit Bay consists of a hardwood forest growing in the steep glens that run down to meet the bay shoreline. These ravines consist of mostly sand and are extremely erodable. The hardwoods and herbaceous under story, which include bittersweet and sassafras, are critical in holding this loose sandy soil in place. The bank is being undercut continuously by the bay waters. Light foot traffic in the area contributes to the erosion problem. This 272-acre site, which is largely undisturbed, provides a diverse wildlife habitat, as well as a scenic view of and access to the bay. At the southern end of the site there is a small freshwater marsh. The wetlands along the bay's shoreline are NYSDEC Class I and support many birds and mammals, as well as contribute to the beauty of the site. These wetlands and wooded ravines protect the water quality of the bay and, in turn, must be protected because of their extreme vulnerability." (Monroe County EMC 1996, p. 10)

Area T-2: (Appendix IV.D.1.b) This area (Map III.A.1) surrounds Devil's/Helds Cove and includes Inspiration Point (Photos 20-III and 24-III). It extends from the Bay to Bay Road (Photos 8-III and 9-III). To the south are the Damascus Temple property and Hillsboro Cove (Photos 15-III to 19-III). To the north, across Route 104 (Photo 12-III), is Colorado Drive.

Area T-2 features erosive ridges cut by steep-sided ravines (Photo 11-III) that open to the bay as coves (Photo 19-III). Oak, black walnut and sugar maple form the overstory on the ridges (Photo 24-III). The understory includes chestnut, honeysuckle, birch, flowering dogwood and other dogwoods, witch-hazel, azalea, buckthorn, ferns, and leaf litter in places. The inner forked tail of Devil's/Helds Cove (Photos 7-X to 11-X) extends upland to include cattails, skunk cabbage, lizard's tail and various wet-soil shrubs and trees (Photo 10-III).

The Inspiration Point highland has a canopy of walnut and oak that extends down slope where a fringe of willow and cottonwood grow. However, bayside development and bare-soil erosion also occur in this region (Photos 20-III and 24-III).

South of Devil's/Helds Cove lies the Damascus Temple property where the Bay-side slope has been logged recently. Roadways and paths extend from Bay Road to the shoreline (Photos 15-III to 19-III). Moisture-tolerant shrubs and trees form thickets in lower, wetter areas, but the whole area is sandy and easily eroded. Development here will affect the habitat quality of Devil's/Helds Cove. American bittersweet, a NYS protected species, grows here.

Along Sunset Drive (Photo 23-III) there is a typical gradation of trees and shrubs for this area. From uphill to down, the overstory is oak, maple, willow and cottonwood. The understory is ash, oak, cherry, viburnum, silver maple and sumac. Grape, poison ivy and sensitive fern are ground cover.

EMC's Preservation Committee recommends the Devil's Cove area be given highest priority for preservation: "Devil's Cove is an inlet of Irondequoit Bay and is one of the many environmentally sensitive sites on the bay. The location of Devil's Cove protects it from bay currents. This may cause it to be prone to degradation because of the accumulation of pollution and sediment deposits caused by erosion. The steep, unstable sandy slopes of the cove are held in place by American chestnut, black walnut, red oak, white oak, sugar maple, and witch-hazel trees. Flowering dogwood, buckthorn, bidens, Solomon's seal and various ferns make up the understory. From the top of the slopes there is an excellent view of the bay. The shoreline of the cove is a NYSDEC Class I wetland. Any development on this site would be environmentally unsound due to the highly erodible slopes and the potential harmful effects on the water quality of the cove." (Monroe County EMC 1996, p.10).

NYS-protected species (NYSDEC 2002d) found in Area T-2 (Table V.A.1) include American bittersweet, azalea (*Rhododendron* sp.), Christmas fern, flowering dogwood and squaw-root (*Conopholis americana*).

Area T-3: (Appendix IV.D.1.c**)** Mostly the Webster Water Tower Woods, this area (Map III.A.1) lies north of the Route 104 rest area and DOT facility at the bridge. Its slim northern finger curls along the bay shoreline to the edge of Stony Point. Its fat portion, the Webster water works and well field, extends from Dewitt Road to the Bay. The southern edge is a dirt field used as an ATV playground; highly erosive and eroded ATV trails radiate from here throughout the woods (Photos 3-III, 2-X, 3-X). There are waterworks roads as well. The northern finger is mostly fenced in by homeowners.

The soils are sandy and the shoreline is erosively steep, wooded in places and bare in others (Photos 15-I and 16-I). The floodplain is very narrow, but wetland vegetation lies along the shore. The ridges and sandy ravines are heavily wooded with oak, maple, cottonwood, sassafras, tulip tree, hickory and an occasional mulberry from the area's former silk industry (Photo 19-I). A few conifers, including a small, planted stand, exist there as well. In places large grape vines grow in the trees (Photo 3-III), stifling and breaking them, a long-term problem elsewhere around the bay as well (NYSDEC undated). A fuel tank for a shoreline cottage lies atop a shoreline ridge (Photo 13-I, left foreground).

The DEC's Natural Heritage Report on Rare Species and Ecological Communities (2002c) and EMC's Preservation Committee (1996) recognize an unprotected oak opening community in this area as containing rare insects and NYS-protected plants and deserving highest priority protection (Photos 5-X and 6-X). Over 60 specimens of the protected butterfly-weed (*Asclepias tuberosa*) (NYSDEC 2002d) were observed in Area T-3 (Table V.A.1), and some plants are threatened by ATV activity (Photos 4-III, 5-III, 2-X). A NYS-protected flat sedge also grows in Area T-3.

The EMC's Protection Committee states: "Webster well field (*sic*) is also located adjacent to Irondequoit Bay. A NYSDEC Class I wetland is located on this site along the bay's shoreline. The soils are primarily sandy and extremely steep slopes leading to the bay are heavily wooded. The woodland consists of dense stands of black oaks, some over 100 years old. In addition to the black oaks there are maple, cottonwood, shagbark hickory, sassafras, wild grapes, and pitch pine. There is an oak opening within the site, which is a rare plant community that is characteristic of the prairies that covered this region following the last glacial period. The site provides habitat for birds and many mammals, especially deer, fox, and turkey. The site also possesses the ancient Lake Iroquois shoreline. Its bluff provides a viewing distance of greater than five miles to the west. There is an extensive network of trails throughout the site that show damage caused by motorized vehicles. Currently, the village of Webster pumps water from the well fields for drinking water. It is unclear what would be done with the site if the village were to stop using the area as a drinking water source." (Monroe County EMC 1996, p. 9)

Area T-4: (Appendix IV.D.1.d) This is the eastern toe of the upside-down Irondequoit Bay boot (Map III.A.1), a shallow area with a strong odor of decomposition (probably decaying macrophytes washed up along the shore). The Bluffs subdivision is Area T-4's southern edge (Photo 21-II).

Three sandy ravines with their ridges (Photos 7-I and 19-II) approach the narrow floodplain adjacent to Lake Road where wet-adapted cottonwood and willow form the shoreline canopy. Higher and dryer, oak, maple, birch, beech, cherry and an occasional white pine make up the canopy (Photos 8-I and 9-I). Fungal disease and carpenter ants infest some of the mature oaks (Photo 22-II), a food source for some of the Pileated Woodpeckers found throughout the Bay area. There are black locusts at roadside (Photo 4-I). The understory includes black locust, ubiquitous grape (some large), honeysuckle, viburnum, box elder (some large), silver maple, elm, dogwood, silver-berry and serviceberry. The ground cover includes ferns, barberry, grasses and sarsaparilla, plus leaf litter on slopes and higher places (Photos 5-I and 6-I).

Foot trails follow the dry places and children have excavated a fort near The Bluffs housing development (Photo 10-I). The housing along Bay Road comes near the most easterly ravine (Photo 20-II). Fishermen use the narrow floodplain; although the bank at the bluffs is steep, there is a docking area there. Farther west, Lake Road is very near the water; a non-permitted boat launch exists here along with roadside parking used by fishermen (Photo 3-I).

American bittersweet, Christmas fern and flowering dogwood, all NYS-protected plants (NYSDEC 2002d), were observed in Area T-4. There was also a tentative identification of a protected orchid (*Hellaborine* sp.) (Table V.A.1).

EMC's Preservation Committee gives Area T-4 highest priority for preservation: "The northeastern shoreline of Irondequoit Bay contains steep slopes which meet the shoreline. These sandy ravines are held in place by a canopy of maple, oak, pine, birch, beech, cottonwood, poplar, cherry and sassafras trees. Some of these trees are at least one hundred years old. The understory consists of barberries, raspberries, honeysuckles, may apples, ferns, buttercups and pokeweeds. These plants also helps (sic) to limit erosion. The tops of the ravines provide a suitable habitat for many mammals and songbirds, as well as an outstanding view of the bay and Lake Ontario. The NYSDEC Class I wetland at the base of the slopes is an ideal feeding and nesting ground for waterfowl. The Town of Webster has approved a residential development of approximately 50 acres in this northeast section of the bay. The Bluffs Subdivision is currently being constructed and will include 10.4 acres that will be left untouched protecting the steep slopes, ravines, and wetlands. This protected area will be owned and controlled by the subdivision homeowner's association" (Monroe County EMC 1996, p. 9). We did not determine if this area remains untouched.

Area T-5: (Appendix IV.D.1.e) This narrow area extends from the Bay outlet bridge south to German Village (Photo 2-II), including the Irondequoit Bay State Marine Park (Photos 3-II and 6-II). It is bounded by the Sea Breeze Expressway and the Bay, but excludes developed property (Map III.A.1).

The Bayside slope of the park is very steep (approximately 60%), sandy, and in some places covered only with leaf litter (Photos 4-II, 9-II, 10-II, top to bottom). In other places the slope is thick with tree of heaven, box elder, willow, cleavers and tangled grape (Photo 14-II), with an overstory of cottonwood, black locust, willow and Norway maple (Photo 13-II). A narrow, wooded ridge with Norway maple, red maple and oak lies atop the slope at the park's south end (Photo 5-II). At the base of the slope is a cattail/common reed marsh bordered by willow and scouring rush (Photo 11-II).

At German Village, cottages and homes perch on a narrow, built-up flood plain hard against a steep, eroded sandy slope held back by pilings. The steep, wooded slope grows oak, cottonwood, black locust and Norway maple (Photo 16-II) as overstory with an understory of tree of heaven, box elder, sassafras, cherry, viburnum and dogwood where conditions permit (Photo 17-II).

This area is very erodable, stabilized only by the mature tree cover that must be maintained if those living downslope are to be protected. One protected plant, an orchid (*Habenaria* sp.) was observed in Area T-5 (Table V.A.1).

Area T-6: (Appendix IV.D.1.f) This area in the Town of Irondequoit is split by Route 104, with the habitat around and west of Big Massaug Cove to the north and the Newport Landfill to the south (Map III.A.1). The west approach to the Bay Bridge is grass, with a fringe of cattail and a clump of oak and willow at the cove's entrance (Photo 1-IV). The narrow cove shore is developed but otherwise wooded to property lines (Photo 2-IV). Easily erodable wooded slopes, covered by oak, red maple, black locust, ash and cherry, approach the streets in the area (Photos 3-IV and 4-IV). The understory is sparse with tall saplings of locust, ash, Norway and red maple, and viburnum shrubs. The ground is bare or covered with leaf litter.

Oak, cherry, and red maple grow atop the ridges, with viburnum, silver-berry and an occasional chestnut as understory. The groundcover is mostly leaf and branch litter. Photos 5-IV, 6-IV and 7-IV are views in three directions from the same location atop a ridge. Pileated Woodpeckers, a forest interior-dependent species, live here.

The drainage gully into the "southern tail" of Big Massaug Cove lies along the DOT access road at the Bay Bridge's northwest exit. This thick tangle has an overstory of cottonwood, oak, black locust and ash. Tree of heaven, silver-berry, honeysuckle, staghorn sumac, willow and ubiquitous grape form an understory thicket (Photos 2-V, 3-V and 4-V). Rudman Road, the north border, is similar (Photos 1-V and 25-IV).

Newport Marina occupies the south side of the west bridge approach. A clump of oak, willow and cottonwood grows where leachate coming out of the Newport Landfill (Photo 10-IV) drains from a plastic pipe to the north (Photo 23-IV) into wetlands along Route 104 (Photos 24-IV, 7-V and 8-V)) that drain into the Bay at Newport Marina. The leachate has a mild septic odor that also was observed near the south side of the landfill. The wetland of cattail, cottonwood, oak and willow is critical to the health of Irondequoit Bay for it acts as a filter for the landfill leachate. The landfill itself, once considered for a potential "Newport Canal Park," and now for sale by the Town of Irondequoit, is covered with grasses and weeds (goldenrod, mugwort, thistle, ragweed) (Photos 17-IV, 18-IV, 19-IV, 20-IV and 21-IV). Deer and turkeys were seen here.

The southwest tip of Area T-6 has a small cattail/common reed marsh bordered by maple, cherry, oak, willow and tree of heaven (Photo 20-IV). Its southwestern edge, in places eroded (Photos 21-IV and 22-IV), adjoins houses; black locust, oak, Norway and red maple form a canopy over honeysuckle, spicebush, witch-hazel and ubiquitous grape. Across the Bay lies Inspiration Point, Devil's/Helds Cove and the eroded shoreline of AREA T-2 (Photos 13-IV, 14-IV, 15-IV and 16-IV).

No protected plant was observed in Area T-6.

Area T-7: (Appendix IV.D.1.g) Area T-7 area extends from Point Lookout west to Route 590. Its southern extents are Granada Circle, Venice Circle and Eagle Rock Drive. Densmore Creek and its associated tributaries and wetlands fill the middle. A Rochester composting facility makes up the western portion (Map III.A.1).

Denmore Creek joins the Bay through a marsh of cattails immediately south of Point Lookout, with poplar, willow, ash and box elder as the border (Photo 5-V). Access to this area was refused. Upstream to the west, across Bay Shore Boulevard, is a swampy marsh of willow, box elder, silver maple and sedge/cut grass (Photo 6-V). On the north side is a roadway and open area of grasses, ragweed and mugwort bordered by black locust, cottonwood and Norway maple (Photo 9-V).

Farther west is an overgrown roadway (trail now) shaded by plane tree, oak and ash. American bittersweet, a protected species (NYSDEC 2002d), grows among the nettles, mugwort, ragweed, goldenrod and vetch. The trail through second growth vegetation (Photos 11-V and 12-V) eventually opens onto the Rochester composting area (Photos 13-V and 14-V), an open area with scattered weeds. The area is bordered north and south by branches of Densmore Creek that flows through treed gullies (Photos 14-V, 15-V and

16-V). The overstory there is cottonwood, willow, oak and black locust with an understory of tree of heaven, willow, silver-berry and box elder. The ground cover is old field weeds (sweet clover, grasses, Queen Anne's lace, mugwort, goldenrod, vetch, ragweed, daisy, etc.).

The trail in the forest along the south edge of Area T-7, eastward from Bay Shore Boulevard, goes from a small clearing of brush and weeds (Photo 17-V) to a maturing forest of hemlock, sugar maple, black cherry, oak, black and yellow birch, and ash (Photos 18-V, 19-V, 20-V, 21-V and 22-V). The steep slope down to the wetter of two gullies is mainly erosion-prone bare soil and leaf litter. It is a pleasant, restful area with plentiful deer, fox and other wildlife.

American bittersweet and Christmas fern, both NYS-protected species (NYSDEC 2002d) were observed in Area T-7 (Table V.A.1). In addition, a number of emergent wetland plants (sedges, scouring rush, bur-reed) were observed along the shoreline.

Area T-8: (Appendix IV.D.1.h) Area T-8 extends along the southwest side of Irondequoit Bay from Glen Haven to Empire Blvd. Its middle section is the richly diverse Irondequoit Bay Park West (Map III.A.1). Offshore in the southern part are the fragile Empire Boulevard Mud Flats, an area highly recommended for preservation (Monroe County EMC 1996).

Off South Glen Road, near the Bayview Apartments, is a popular shoreline fishing area (Photo 7-VI) adjacent to a common reed (*Phragmites*) marsh. Willow and cottonwood line the shore; dogwood, silver-berry, staghorn sumac, honeysuckle, goldenrod, grasses, and ubiquitous grape line the path (Photo 8-VI). Farther south along the shoreline, past more cattail and common reed marsh (Photo 11-VI) lies Snider Island (Photos 9-VI, 12-VI and 13-VI) with its cover of oak, white pine, cottonwood, honeysuckle, staghorn sumac, ash, maple, sassafras and willow. Between it and the adjacent Irondequoit Bay Fish and Game Club is shallow water, dry at times, where cattails and water lilies grow. Across the bay, prominent eroded cliffs show on Inspiration Point (Photo 10-VI).

North from the fishing access area toward the Bay View Apartments and Glen Haven, the easily erodable land is crossed with steep ravines and ridges. Maple, ash, tree of heaven and cottonwood predominate in the gullies and sides of slopes (Photos 21-VI and 22-VI); a complex of oak and hickory predominate on ridges where old logging trails run (Photo 23-VI, 24-VI and 25-VI). A "sunken roadway" with 70-degree, sloping sides runs from the apartments to South Glen Road (Photo 20-VI). Photos 1-VII and 2-VII show the oaks and hickories atop ridges and the maples, ash, cherry and sassafras on the slope near homes near Glen Haven.

Irondequoit Bay Park West itself follows a small stream into which drainage from the adjacent gullies flows. This arrangement of ridges and gullies, some north-south, some east-west, some wet, some dry, produces a richness of habitat that supports a rich flora and fauna. The Park's forested habitat is extensive enough to support interior species and erosively fragile enough to warrant protection in its entirety. Extensive trails run throughout the Park, including potentially erosive ATV trails.

The entrance gully off South Glen Road has a sugar maple, cottonwood and willow canopy over ash, red maple, tree of heaven and witch hazel (Photo 15-VI). The floodplain of the small, sorted-gravel brook at this location (Photo 6-VI) is thick with goldenrod, mustard, ragweed, mugwort, eupatorium and various grasses. Scattered willow, maple, tree of heaven, cattail, ash and spicebush grow there as well (Photos 5-VI and 3-VII). The north side of the floodplain is steep, terraced and very erosive (Photos 5-VII, 6-VII and 7-VII). Here oak, sugar maple, black birch and cottonwood form a canopy over ash, oak, beech, cherry, sassafras and an occasional pine. The ground cover is mostly leaf- and branch litter.

On the south side of the park, off Orchard Park Boulevard, ridges and drier gullies predominate (Photos 25-V, 2-VI, 3-VI and 4-VI). Oak and maple predominate on the ridges while cherry, sassafras, tulip tree, beech, ash and even witch-hazel and spicebush are characteristic of the slopes and valleys. The ground is often bare or litter-covered, although ferns, including the NYS-protected Christmas fern, mustard and Virginia-creeper grow as well. On the west end of the park, at the end of Homewood Lane (next to Route 590), a housing project is underway (Photo 10-VII).

The south end of Area 8 ends near Empire Blvd. (Photos 18-IX and 19-IX). The woods here include oak, walnut and cottonwood as canopy over willow, tree of heaven, black locust, elm, sassafras, cherry, box elder and various shrubs such as honeysuckle, dogwood and silver-berry (Photos 20-IX and 21-IX). The ground cover of leaf litter and discarded brush is broken by beds of lily-of-the-valley (planted?), mustard, dogbane, beggar-ticks, Virginia stickseed and ubiquitous grape (Photos 20-IX and 21-IX). In logged areas these plants are quite dense.

One small, logged swath cut the second growth from one Orchard Park Boulevard home to water's edge (Photo 22-IX). The problem with such seemingly innocuous activity is that neighbors follow suit, erosive channels open and the protection of these highly erodable slopes is lost. One large white oak nearby appears to be the sole anchor for the end of an entire ridge. Protection of the highly erosive soils, then, depends upon maintaining maturing forest. Slope erosion endangers the unique, offshore Empire Boulevard mud flats that are highly recommended for preservation because of their importance for migrating birds (Monroe County EMC 1996.). A study of the Yanty Creek marsh at Hamlin Beach State Park suggested that fall migrating, small birds arrive from Canada over Lake Ontario depleted of stored energy resources that they replenish by heavy feeding in the cattail marsh (Makarewicz, et. al. 2000). It is quite likely that migrating songbirds, as well as shorebirds and waterfowl, use the mud flats area extensively for feeding.

The immediate wooded shoreline along the southern end of Area T-8 has been cleared for a utility line (Photos 23-IX and 24-IX). The zonation inland from the waterline is: cattail, common reed, willow and scouring rush. Oak, silver-berry, sassafras, dogbane and goldenrod appear in the upslope woods.

NYS-protected Christmas fern was observed at Area T-8 (Table V.A.1).

Area T-9: (Appendix IV.D.1.i) This is the Irondequoit and Penfield Empire Blvd. shoreline of Irondequoit Bay as far east as the rest area (Map III.A.1).

The rest area, with its LaSalle's Landing historical marker, is bordered by plane tree, willow and pine. Tree of heaven and honeysuckle form the understory. Cattail, goldenrod, purple loosestrife, ragweed, mugwort and smartweed form the ground cover

(Photo 13-X). To the west, the cattail marsh area is bordered by tree of heaven, plane tree and goldenrod (Photo 14-X).

The area between 1250-1300 Empire Blvd. is composed of unknown, old fill bordered by cottonwood and black locust. The understory is black locust, dogwood and box elder. Most of the ground cover is mugwort (Photo 15-X). Since the origin and composition of the fill is unknown, its impact on the wetlands of Area T-9 and the Bay is unknown.

A vacant lot lies immediately west of Lombardi Auto Sales (Photo 16-X). For sale, this ecological Old Field grows mugwort, grasses, beds of vetch, Queen Anne's lace, touch-me-not and the ubiquitous grape. The shoreline is dense with common reed and beds of vetch (Photo 19-X). Its adjacent drainage way is choked with cattail; its shore is edged with goldenrod, common reed, cottonwood, tree of heaven, beds of vetch and more ubiquitous grape (Photo 17-X).

Looking west behind Marine Sales one sees the Irondequoit T-8 shoreline (see Photo 18-IX for close-up) over a cattail marsh (Photo 18-X). A little farther west is the Town of Penfield's portion of the LaSalle's Landing Development District (Photos 20-X, 21-X, 22-X, 23-X and 24-X). Irondquoit Creek lies along its west edge (Photo 22-X). Beyond is a marine sales business with a parking lot that extends west along Empire Boulevard to a clump of willow and cottonwood that extend onto the mud flats (Photo 2-I). This portion of Area T-9 is the Town of Irondequoit's portion of the LaSalle's Landing Development District along Empire Blvd.

This Empire Blvd. end of the Bay, Area T-9, is quite developed (Photo 25-IX) and aesthetically challenged. Although the terrestrial area is ecologically damaged (as evidenced by the relatively few taxa observed), the "mud flats" off shore are important feeding areas for resident and migratory birds (Monroe County EMC 1996). The LaSalle's Park Development District is a very important attempt to improve the aesthetic and ecological quality of Area T-9.

No protected plant was observed in highly disturbed Area T-9.

4. <u>Terrestrial and Transition Zone Plant Community Similarities</u>

a. *Terrestrial Plants*: Using cluster analysis (PC-ORD 1999), Areas T-1 and T-8 were most closely related, followed by Areas A-2 and A-6 (Figure IV.D.1). Interestingly, these areas are directly across the Bay from each other and include Irondequoit Bay Parks East and West, respectively (Map III.A.1). Area T-3, the Webster water tower woods, is also closely related to Areas T-1 and T-8. Areas T-5 and T-7 are closely related followed by Area T-4 and distantly related Area T-9. The distance of Area T-9 from the other taxa is not surprising; because of development and disturbance in the area only 40 taxa were observed compared to 58-101 taxa in other areas (Table IV.D.2). Based on the cluster analysis, three pairs of communities are very similar: Areas T-1 and T-8 and Areas T-2 and T-6 are very closely related and Areas T-5 and T-7 are somewhat less closely related. Areas T-3, T-4 and T-9 are less related to the pairs of areas mentioned above.

In the principal components analysis (Figure IV.D.2.a,b,c), the three axes with the highest associations with plant taxa explained 53.6% of the variance in the nine terrestrial communities sampled (Table IV.C.8). Given the large number of taxa (150) and the eight PCA axes needed to explain 100% the variance in the data, these results are remarkably good. Areas T-1, T-2 and T-8 had a significant association with overstory species including aspen, beech, black birch, chestnut, maple, pin oak, poplar, sugar maple and white oak plus associated understory and ground cover species (Table IV.D.3). Area T-3 had a rich overstory of hardwoods including black cherry, black oak, Norway maple and red maple plus associated understory and ground cover species mostly different from those observed in Areas T-1, T-2 and T-8 (Table IV.D.3, Map III.A.1). Overstory species common to all terrestrial sampling sites, and thus not analyzed by PCA, included black locust and cottonwood. Several overstory species were found at all terrestrial areas except Area T-9: black cherry, black oak, cherry, Norway maple, red maple and silver maple (Table IV.D.2).

Few to no associations were found between Areas T-4, T-5, T-6 and T-7 and specific plant taxa, a result that suggests these areas were similar in community composition as sampling proceeded from the shoreline up often steep slopes to the higher ground surrounding the Bay (Table 111.D.3). These areas also have a fair amount of existing development that may have blurred distinctions among their plant communities. This interpretation is supported by the similar species richness of these four areas that ranged from 58 to 73 taxa (Table IV.D.2). Area T-9 also had few significant associations with plant taxa (Table 111.D.3), likely a result of the low diversity of taxa (40) and the disturbed nature of the area. In summary, Area T-3 is a unique hardwood forest in the study area that should have a high priority for conservation. Areas T-1, T-2 and T-8 also are high quality communities with a composition different from Area T-3 that also should be preserved as habitat for animals requiring the conditions in those plant communities. Finally, Areas T-4, T-5, T-6 and T-7 have similar plant communities that likely harbor a different set of animals (Figure IV.D.2.a,b,c).

b. *Transition Zone Plants*: Based on visual observations during both terrestrial plant and submersed macrophyte surveys, aquatic to terrestrial transition plants along the shore of the Bay were identified (Table IV.B.3). Using cluster analysis (PC-ORD 1999), Areas T-6, T-8 and T-1 were most closely related, followed by Areas T-2 and T-4 and Areas T-5 and T-7 (Figure IV.D.3). Areas T-9 and T-3 are more distantly related to the other communities, probably because of disturbance along the shoreline along Empire Blvd. (Area T-9) and the steep slopes off the Webster well field area that minimize transition zone community development (Map III.A.1). These community relationships are surprisingly close to the pattern of terrestrial plant community relationships (Figures IV.D.1 and 3), and the similarities suggest associations, probably based on physical habitat similarities, between terrestrial and their associated transition zone plant communities.

In the principal components analysis (Figure IV.D.4.a,b,c), the three axes with the highest associations with plant taxa explained 61.6% of the variance in the nine transition zone communities sampled (Table IV.C.8). Area T-1 was associated with eupatorium, alder, lizard’s tail and purple loosestrife (an invasive species that displaces native species); Area T-3 was associated with buttercup and northern swamp-dogwood; Area T-5 was associated with cattail, common reed (also an invasive species), mallow and water flag; and Areas T-7 and T-8 were associated with sedge (*Carex* spp.), cut-grass and scouring rush (Table IV.D.4). These communities appear to be somewhat distinct, probably support different animals, and should be protected to maintain the diversity of transition zone communities at the edges of the Bay.

5. Conclusions

Our results and other surveys (Monroe County EMC 1996) agree that many soils and terrestrial habitats around Irondequoit Bay are highly sensitive to environmental disturbance and in need of protection. The combination of steep slopes and highly erodable soils (Map IV.D.1) strongly suggest that any future housing developments must be keep well inland, on the plateau away from the Bay, especially in Areas T-1 to T-3 and T-7 and T-8. In order maintain slope stability, keep soils from sloughing into the Bay, and preserve existing forest and other vegetative habitats, ideally no further development will take place in wooded areas with steep slopes.

Two important upland forest types were identified by principal components analysis (Table IV.D.3, Map IV.D.2). Area T-3 (Webster well field) has high quality hardwoods: cherry, hickory, maple and oak. Areas T-1 (Irondequoit Bay Park East), T-2 (Devil's/ Helds Cove) and T-8 (Irondequoit Bay Park West) have a more diverse forest in diverse elevations and slopes: aspen/poplar, beech, birch, chestnut, maple and oak.

Wherever slopes are not steep along the Bay-shore and development of boat docks, etc. has not occurred, emergent aquatic macrophytes and riparian (shoreline species in wet soils) vegetation are often found. It is critical to protect these plant communities so that the animals associated with them will survive.

Finally, a number of NYS-protected plants were found during terrestrial plant surveys (Tables IV.D.2, V.A.1). Great lobelia (*Lobelia syphilitica*), maidenhair fern (*Adiantum pedatum*) and butternut (*Juglans cinera*) were found in Area T-1. American bittersweet was found in Areas T-1, T-2, T-4 and T-7. Flowering dogwood was found in Areas T-1 and T-7 to T-9. Orchids were found in Areas T-4 and T- 5. Christmas fern (*Polystichum acrostichoides*) was found in Areas T-1, T-2, T-4, T-8 and T-9, and abundant butterfly-weed (*Asclepias tuberosa*) was found in Area T- 3. These species are categorized in the lowest level of special concern (NYSDEC 2002d), not as endangered or threatened. Nonetheless, great care must be taken before allowing further human activity in areas where these plants are located. Already, ATV trails are near protected plants, especially in Area T-3, and the trails are rapidly eroding soils in the study area.

E. *Terrestrial Vertebrates Associated with Upland Plant Communities*

1. Birds

Distributional Information: Data from the New York State Breeding Bird Atlas for 1980-1984 (Anderle and Carroll 1988) and 2000-2002 (NYSDEC 2002a) produced a list of 117 breeding species that potentially occur within the project area (Table IV.E.1). Fifty-nine species were observed within the nine sensitive areas identified by the IBCC Technical Team (Map III.A.1), while 19 species were judged as probable, 19 as possible, and 20 as unlikely (Table IV.E.1) in the study area.

Eight species in Table IV.E.1 are New York State-listed (NYSDEC 2002b) as either threatened (Henslow's Sparrow, *Ammodramus henslowii*) or special concern (Sharp-shinned Hawk, *Accipiter striatus*; Common Nighthawk, *Chordeiles mnior*; Red-headed Woodpecker, *Melanerpes erythrocephalus*; Horned Lark, *Eremophila alpestris*; Golden-winged Warbler, *Vermivora chrysoptera*; Cerulean Warbler, *Dendroica cerula*; and Grasshopper Sparrow, *Ammodramus savannarum*). None of these species has been documented as definitely occurring within the sensitive areas identified by the IBCC Technical Team, although data from the New York Breeding Bird Atlas project (NYSDEC 2002a) indicate that several species may occur in the project area. Habitat preferences of the Common Nighthawk, Red-headed Woodpecker and Cerulean Warbler suggest that these species possibly breed in the project area. In New York State, the Common Nighthawk most often nests on rooftops. The center of distribution for the Red-headed Woodpecker is the Great Lakes Plain, while the Cerulean Warbler is most common in wooded swamps and along streams and lakeshores with tall deciduous trees (Andrle and Carroll 1988).

Three listed species are primarily grassland species and probably do not occur in the project area due to insufficient habitat: Horned Lark, Henslow's Sparrow and Savannah Sparrow. The lack of large tracts of wetland habitat make it unlikely that either the Least Bittern or American Bittern occur in the project area. The Sharp-shinned Hawk usually nests in areas of extensive forest, and it requires coniferous trees for nesting (Andrle and Carroll 1988). Finally, rarity of the Golden-winged Warbler in New York State and its requirement for old-field habitat makes it unlikely that the species occurs within the project area.

Because a large amount of forested habitat is present within the project area, and the IBCC Technical Team expressed interest in knowing which woodland-dependent species were potentially present, we identified bird species that generally require large tracts of forest habitat for breeding. Among the 117 breeding species that potentially occur within the project area, 30 were identified as generally requiring relatively large of contiguous forest habitat for breeding; these species are indicated in boldface in Table IV.E.1.

In addition to the birds discussed above, 11 other species of migratory or vagrant birds were observed from May to October, primarily waterfowl and gulls (Table IV.E.2). However, a juvenile Bald Eagle (*Haliaeetus leucocephalus*), federally listed as threatened, also was seen.

2. <u>Bats</u>

Surveys: Five species of bats were detected in the Irondequoit Bay project area: little brown bat (*Myotis lucifugus*), red bat (*Lasiurus borealis*), hoary bat (*Lasiurus cinereus*), silver-haired bat (*Lasionycteris noctivagans*), and big brown bat (*Eptesicus fuscus*) (Table IV.E.3). The big brown bat was the most widely distributed species, and was also the most abundant species found during the bat surveys. Results of the bat surveys are given below.

1) *Irondequoit Bay Park East*: Irondequoit Bay Park East was surveyed on two nights. On 16 July 2002, bat activity was very low. A little brown bat made one pass at the dock area along the waterfront and never returned. Two big brown bats were observed in the parking area at the top of the hill. No other bats were found despite extensive searching. On 1 August 2002, searches were conducted along the dirt road to the waterfront, along the bay and up the white-blazed trail. Searches also were made along the yellow-blazed and blue-blazed trails up and down the hillside in thick woods. Few bats were detected, despite searches covering an extensive area. Two big brown bats were sighted along the road near the parking area. In addition, one little brown bat was detected near the woods' edge and one silver-haired bat was found hunting deep in the woods over a dry streambed on the white-blazed trail.

2) *Irondequoit Bay Park West*: Five different sites were surveyed within Irondequoit Bay Park West on two nights. On 30 July 2002, they surveyed the following sites:

Site 1: Trail along access road off South Bay Front Road at the south end of park close to the Orchard Park Blvd entrance. Big brown bats were detected along this corridor.

Site 2: Waterfront spot just north of Sutter's Marine. Recordings were done over the water as well as across South Bay Front Road along the woods containing dense growth of large trees. Numerous big brown bats were detected flying along the tree line, and a hoary bat was observed flying over the bay.

Site 3: The parking area west of the Irondequoit Bay Fish and Game Club. The wooded area across the road from the parking lot was an extremely productive area. There were many bats flying above and through the wooded area, but given the density of the woods and lack of access, bats were only recorded along the woods' edge. Bats detected were the hoary bat and the red bat. In addition, numerous big brown bats were recorded along South Bay Front Road.

Site 4: The trail along the swamp that ends at numerous fishing access points at Glen Haven. Surprisingly, there were no bats detected anywhere along the swamp or at the fishing access area.

Site 5: On 1 August, this site was surveyed via the old access road running southwest off South Bay Front Road, and numerous big brown bats were found.

3) *Town of Irondequoit Access Road* running from Point Lookout southwest to near Rte. 590: As much of the road as possible was searched, through open areas, fields, and woods. On 10 August 2002, this access road provided more species diversity than any other site surveyed. Five species were detected, all hunting along and above the wooded sections running along the access road: big brown bats, little brown bats, hoary bats, red bats, and silver-haired bats.

4) *Big Massaug Cove* area from the Newport Yacht Club as well as from along Shore Drive: On 10 August, no bats were detected around this highly developed bay area. Access to the cove was difficult, so it is probable that any bats hunting over the cove were missed.

Distributional Information: Although range maps for the five species of bats recorded during the surveys include the study area (Kurta 1995), the diversity of bats found is relatively high for surveys of this type conducted in the region (M. Zettel, personal communication). For example, bat surveys conducted at Yanty Creek Marsh at Hamlin Beach State Park in late June and July 2000 located only little brown bats and big brown bats (Makarewicz *et al*. 2000). Bat surveys conducted in the Bergen Swamp Preserve, Genesee County, in August 2000 found four species: little brown bat, northern myotis (*Myotis septentrionalis*), silver-haired bat, and big brown bat (Norment and Salter 2002). Three species with ranges that include the study area (Kurta 1995) were not found during the 2002 surveys: small-footed myotis (*Myotis leibii*), northern bat, and eastern pipistrelle (*Pipistrellus subflavus*). Of these species, only the northern myotis, which is most common in deciduous forest habitat (Kurta 1995), might be expected to occur in the study area; small-footed myotis and eastern pipistrelles are uncommon in our area (Kurta 1995), and probably occur most often during migration (M. Zettel personal communication). One surprising result of the bat survey is that the most numerous species was the big brown bat; in contrast, the little brown bat is usually more abundant at waterside study sites such as the Yanty Creek Marsh at Hamlin Beach State Park (Makarewicz et al. 2000). In summary, the Irondequoit Bay study area provides very good habitat for bats relative to western New York as a whole.

3. Other Mammals

Distributional Information: Maps of distributions in Kurta (1995) suggest that 47 species of mammals potentially occur in the Irondequoit Bay study area (Table IV.E.4). Of these, 18 were observed in the nine sensitive areas (Areas T-1 to T-9) identified by the IBCC Technical Team, while 21 were judged as probable, two as possible, and six as unlikely (Table IV.E.4). Only one of the unlikely species, the small-footed myotis, is currently listed by the State of New York as a special concern species (NYSDEC 2002b). Therefore, while the terrestrial areas studied harbor a wide diversity of mammals, none appear to be threatened locally or regionally.

Among the mammals potentially occurring in the project area (Table IV.E.4), Fritzell (1988) has listed seven species as “limited” and six species as “influenced” by the amount of wetland habitat. "Limited" species are those for which wetlands are an essential habitat, while "influenced" species are those for which wetlands provide important sources of food or cover (Fritzell 1988). Wetland-limited species potentially occuring in the project area include the star-nosed mole (*Condylura cristata*), smoky shrew (*Sorex fumeus*), water shrew (*Sorex palustris*), pygmy shrew (*Sorex hoyi*), muskrat (*Ondatra zibethicus*), beaver (*Castor canadensis*), and mink (*Mustela vison*). Wetland-influenced species include the masked shrew (*Sorex cinereus*), short-tailed shrew (*Blarina brevicauda*), meadow vole (*Microtus pennsylvanicus*), southern bog lemming (*Synaptomys cooperi*), meadow jumping mouse (*Zapus hudsonius*), and short-tailed weasel (*Mustela erminea*). Fritzell’s list does not include bats, many of which forage over wetlands and riparian areas more frequently than they do over terrestrial habitats (Knutson and Naef 1997).

4. Conclusions

a. *Birds*: The extensive deciduous forest tracts in the Irondequoit Bay study area, which are present in most of the sensitive areas identified by the IBCC Technical Team, are particularly important for woodland-dependent birds. Woodland-dependent breeding birds in the Northeast currently are doing relatively well as a group (60% of species with positive trends; Breeding Bird Survey data, Sauer et al. 2001). Some of the concern expressed in the 1970s and 1980s about declining trends for forest-interior species (e.g., Whitcomb 1977, Robbins 1979, Askins and Philbrick 1987) has moderated. However, Breeding Bird Survey data indicate that a number of species which undoubtedly occur within the project area have declined in Region 5 of the United States Fish and Wildlife Service between 1966-2000. These species include the Eastern Screech-Owl (*Otus asio*), Eastern Wood-Pewee (*Contopus virens*), Wood Thrush (*Hylocichla mustelina*), Veery (*Catharus fuscescens*), Downy Woodpecker (*Picoides pubescens*), and Scarlet Tanager *(Piranga olivacea*) (Sauer et al. 2001). Given the importance of large, relatively undisturbed tracts of forest for many woodland birds and the increases in brood parasitism and nest predation that often occur in fragmented landscapes (Faaborg et al. 1995, Robinson et al. 1995), planning for future development in the Irondequoit Bay area should minimize the fragmentation of remaining tracts of woodland in the project area.

b. *Bats and other Mammals*: Because of the quite high diversity of bats found at relatively few sites (although they were picked for the likelihood of having bats) on only a few nights, it appears that the Irondequoit Bay study area has very favorable habitats for bats that should be protected. Bat species richness is probably relatively high in the area due to the proximity of favorable roost sites (deciduous forest habitat, buildings) and foraging areas, which include fields, emergent wetlands, such as sites AB1-AB7 (Map III.A.1), and open water over Irondequoit Bay.

As with birds, loss of woodland habitat in the Irondequoit Bay project area could lead to declines in species richness or population size of resident mammals. Small deciduous forest woodlots in the Midwest contain fewer species and lower densities of forest-dependent small mammals than do larger tracts of habitat (Gottfried 1979, Yahner 1983). Although recent experimental studies have shown that habitat fragmentation has distinct effects on different small mammal species (Diffendorfer et al. 1995), fragmentation could decrease species richness or population size of resident mammals in forest patches - especially if corridors of suitable habitat are not maintained. Studies in eastern Canada have shown that corridors enhance metapopulation connectivity for mammals (Merriam and Villard 1991), and are used by eastern chipmunks (*Tamias striatus*) and white-footed mice (*Permoyscus leucopus*) to recolonize vacant habitat patches (Wegner and Meriam 1979, Henderson et al. 1985).

V. Environmental Impact Analyses

A. *Existing Development and Disturbance in the Study Area*

1. Aquatic

a. *Irondequoit Marine Park and Boat Launch* (Area A-4 in this study; Map III.A.1): This facility is very active from April (beginning of the spring salmon and trout fishery) through September (end of the fall salmon and trout fishery). In between, anglers fish extensively for warmwater (bass, panfish, etc.) and coolwater (pike, perch, etc.) fishes in the Bay, and many recreational boaters launch from this facility, especially on weekends. Currently, there is no evidence of disturbance at aquatic sampling Area A-4 by these activities, but that would change if the proposed Sea Breeze Revitalization Plan extended into Area A-4, one of the most significant aquatic habitats found in our study. Area A-4 had a significant association with 11 invertebrates, five fishes (including longnose gar and northern pike), and two submersed macrophytes (including water celery, a very important food for waterfowl) (Table IV.C.9).

b. *Webster Sandbar* (Area A-5 in this study; Map III.A.1): Currently extensive boat docks and boating activity in this area extend from the outlet to Lake Ontario through the docks of the Stony Point Landing development. Boating activity was so intense during June and July that our sampling was forced out of its intended area in the middle of Area T-5 to the edges. Wherever navigation channels exist, submersed macrophytes are cropped 2-3 feet below the water surface. In our study, Area A-5 had a significant association with eight invertebrates, three fishes (freshwater drum, northern pike, walleye), and five submersed macrophytes (including water celery) (Table IV.C.9). Noise, waves and motor fuel undoubtedly disturb aquatic biota, but the degree of disturbance is uncertain, as is the ability of the currently healthy aquatic community to tolerate further disturbance.

c. *Devil's/Helds Cove* (Area A-6 in this study; Map III.A.1): Currently there are a few cottages and homes around the cove and on its islands along with small docks. During the summer, many boats anchor in the cove for a variety of recreational activities. Although many small fish, strongly suggesting an important nursery habitat, were observed during our sampling, fewer fish and fewer species were caught in the Cove than was expected given the visibly high quality of the physical habitat. It may be that the intense human use of the Cove has already impacted its fish production capacity. However, in our study, Area A-6 had a significant association with five invertebrates, two fish (including walleye), and three submersed macrophytes (Table IV.C.9).

d. *Dredging*: has occurred at several locations in the Bay since 1985 when the channel to Lake Ontario was opened. Keeping the channel and access to the Irondequoit Marine Park launching ramps open has required dredging 4,000 to 12,500 yd^3 in each of the years 1985-1986, 1988, 1993 and 2000. Sediments dredged in the Bay were low to moderately polluted sand/silt/clay (IBHMP 2002). Additional dredging of "unpolluted" sediments was done 1992 to provide access to the Bay from the docks of residents of the Stony Point development (12,500 cubic yards, northeast end of the Bay, Map II.A.1), and for boats at the Bounty Harbor Marina (7,000 cubic yards) at the southeast corner of the Bay (IBHMP 2002). Current dredging plans include maintenance dredging to keep the channel between the lake and Bay open and access to the Irondequoit Marine Park. Dredging temporarily removes submersed macrophytes and macroinvertebrates from the target area and displaces fish. Restoration of original plant and animal communities may or may not occur depending on whether substrate composition and depth (re: light penetration) are changed significantly (Taylor and Salomon 1968, cited in Sherk 1971)

2. Terrestrial

The primary land use in the study area is single-family residential, much of which occurs in areas of combined conservation-residential zoning (IBHMP 2002). Only a small amount of privately owned, undeveloped land is left in the study area, primarily the Damascus Temple property in the Town of Webster (a large parcel south of the Village of Webster well field) (Area T-3, Map V.A.1; IBHMP 20002, Exhibit 8). Most of the remaining land has major environmental constraints (e.g., steep wooded slopes, wetlands) that preclude development (Area T-3, Map IV.D.1; IBHMP 2002, Exhibit 12). The only currently active project is Willow Point in the Town of Webster just south of Glen Edith and north of the Penfield Town line (Area T-1, Map IV.D.1; IBHMP 20002, Exhibit 8). Permits for more single family homes and new docking facilities at Willow Point are pending with the NYSDEC (IBHMP 2002). Recent land clearing was observed at 1440 Empire Blvd. at the in the southeastern corner of the Bay (far south end of Area T-1).

Commercial waterfront usage occurs mostly in three areas: Sea Breeze/Culver Road in the Town of Irondequoit (Area T-5), "Sandbar"/Lake Road in the Town of Webster (Area T-4), and Empire Blvd. (Area T-9) (Map IV.D.1) in the Towns of Irondequoit and Penfield (IBHMP 2002, Exhibits 5,6,7). To better control development in the Town of Webster, the Harbor Management Plan proposes to change zoning of the "Sandbar" and Glen Edith areas from "waterfront development" to "restricted waterfront development

(IBHMP 2002). In our analyses, no distinctive terrestrial plant communities were associated with Areas T-4 and T-5, probably because of the considerable development that has already taken place in those areas. However, a distinct group of native transition zone plants, cattail, mallow and water flag, was associated with Area T-5. An orchid of special concern was tentatively identified in each area, *Hellaborine* sp. in Area T-4 and *Habenaria* sp. in Area T-5; in addition, American bittersweet, flowering dogwood and Christmas fern were found in Area T-4. No distinct transition zone or NYS-protected plants were associated with Area T-9 (Table IV.D.4). Terrestrial plants associated with Area T-9 included basswood, flea bane, ginkgo, plane tree, primrose, red-osier dogwood, sweet clover, teasel, thistle and tree of heaven (Table IV.D.3); overall, Area T-9 was a community with many weeds and a few quality trees probably left over from pre-development times.

3. <u>Conclusions</u>

Existing development and disturbance in and around the Bay arise from two major sources: 1) Dock construction and boating activity in shallow, near shore waters in the Class I wetland surrounding the Bay, and 2) Clearing of land and subsequent construction on highly erodable soils in often steep-sloped, upland areas. Clearly, the Bay ecosystem can withstand only a limited amount of these anthropogenic stresses before it begins to change ecologically. Areas currently being developed or that may be proposed for development in the future contain distinct plant communities (particularly the hardwoods in Area T-3, Map IV.D.2) or many species of special concern (particularly in Area T-1). Before further development proceeds, intensive surveys need to establish that important plant communities and species are not being removed by land clearing or dock building, and that plant communities are not being fragmented or eliminated which will diminish the diversity of animals that can live around the Bay.

B. *Undeveloped, Minimally Disturbed and Important Habitats*

1. <u>Important Aquatic Habitats and Communities</u>

According to the IBHMP (2002), Irondequoit Bay is the “prototype” for a Great Lakes aquatic bed community, defined by the NYS Natural Heritage Program as shoals or quiet bays protected from wave action. Floating and submersed aquatic macrophytes are part of this habitat. Overall, 52% of the Bay is less than 6 feet deep, and the critical sheltering, feeding, spawning and nursery habitats provided for fish and macroinvertebrates by floating and submersed macrophytes comprised 45%, 52% and 63% of this shallow littoral portion of the Bay in June, July and September, respectively. The current and previous fishery surveys confirm the ecological importance of this habitat for fish (Cooper 1984, Lane 1986, 1988; NYSDOS 1986, USFWS/DEC 1985); however, the IBHMP (2002) does not indicate the rarity, globally or locally, of this community. Although it is a common habitat along the southern shore of Lake Ontario (Haynes, personal observation), less of it as a result of more docks and boat traffic will mean less potential for warmwater fish production and coolwater fish spawning in the Bay.

The IBHMP (2002, II.36-39) reviews important aquatic habitats and interactions with important organisms at Irondequoit Bay. The Monroe County Environmental Management Council (EMC), NYS Natural Heritage Program, and the NYS Department of State consider the entire Irondequoit Bay Ecosystem to be environmentally sensitive and an important fish and wildlife habitat. Particular areas named include the entire shoreline, the Webster well field area, Devil's/Helds Cove, the southeast slopes of Penfield, the Empire Blvd. mud flats, and the southwest slopes of Irondequoit.

Because of our study design, we did not target coves for sampling; however, the importance of coves to fish production in the Bay cannot be overstated. Coves are particularly important fish and wildlife habitat, especially Little Massaug, Big Massaug, Newport (already changed by road construction and development), Densmore Creek (moderately developed, some natural shoreline lost to bulkheads), and the Glen Haven/Snider Island complex on the west side of the Bay (IBHMP 2002). Among the six coves on the east side of the Bay, Willow Point and Devil's/Helds remain mostly undeveloped and retain considerable ecological value for birds and as fish spawning habitat (IBHMP 2002). Other significant habitats include the mud flats north of Empire Blvd. (for birds), areas of gravel/rubble bottom around Stony Point (for fish spawning), and the "Sandbar" area in Webster (protective feature, habitat for shorebirds and waterfowl) (IBHMP 2002).

In our studies, only Area A-2 seems to be of lesser importance ecologically for aquatic communities in the Bay. Areas A1, A-3, and A-4 have relatively little disturbance and support distinctive aquatic communities. Area A-5 is huge with considerable disturbance, but it still supports a quality aquatic community. Area A-6 appears to be a critical nursery area for fish and must be protected, especially since it already shows signs of disturbance (i.e., relative low fish diversity and abundance vs. its high quality physical habitat).

2. Important Transition Zone Habitats and Communities

Of the transitional habitat in the study area, 20% is equally divided (IBHMP 2002) between wetlands and shore area (< 7% slope), but relatively little of this habitats should be considered for further development. Of the 91,312 feet (27,839 meters) of Irondequoit Bay shoreline, 23.5% is "undeveloped" private land. Developed areas are those significantly impacted by human activities; the dominant aspects of land use are structures, parking, lawns and boat facilities. Areas dominated by trees, shrubs and other "natural" vegetation are considered undeveloped, even if there is an occasional cottage tucked in the woods, because these minimally impacted areas are much closer to a natural state than to intensely developed conditions. Of the total 9,076 feet (2,767 meters) of "undeveloped," privately-owned shoreline with slopes less than 7% (i.e., potentially developable), 4,943 feet (1,507 meters, 54.5%) are located in Devil's/Helds Cove (57.4%), other eastside deltas and coves (34.0%), and Big and Little Massaug Coves (16.6%). These locations are predominately places where small streams enter the Bay and create wetland deltas. From the results of this and previous studies (Cooper 1984, Lane 1986, 1988; NYSDOS 1986, USFWS/DEC 1985), it is obvious that these areas should not receive more development.

The already disturbed LaSalle's Landing Development district at the southern end of the Bay comprises 31.3%, and scattered patches of other privately owned land comprise 14.3%, of the undeveloped land with less than 7% slope around the Bay. Of this 14%, only a tiny fraction is not in coves or areas already under development (Table IV.D.1). The calculations above were made with GIS by quantifying potentially developable, 164 ft x 164 ft (50 m x 50 m) parcels of land along the shoreline with less than 7% slope, and assignments were “generous” (i.e., if a parcel was dominated by, but not completely with slopes less than 7%, it was included as potentially developable).

The IBHMP (2002, II.31-33) reviews the characteristics, ecological importance, and rarity of the major aquatic plant communities along the shore in Irondequoit Bay. Inshore from the “aquatic bed” habitat with submersed macrophytes are shallow emergent marshes less than 3 ft deep consisting of cattails, common reed, rushes and sedges (IBHMP 2002). This habitat is common along the edges of the Bay. The IBHMP (2002) describes the importance of this habitat for filtering sediments and pollutants and for stabilizing water-level fluctuations. This habitat is easily impaired by excessive wave action, dredging and vegetation removal; common reed and purple loosestrife often replace native species after such disturbance (IBHMP 2002). Emergent marshes are rated secure globally and locally by the NYS Natural Heritage Program (IBHMP 2002).

Shrub swamp habitat is a narrow transition zone, subject to periodic flooding, between emergent marshes and terrestrial habitat (IBHMP 2002). Fish and amphibians may spawn in this habitat during spring flooding, and the dense vegetation protects fry from predators (IBHMP 2002). Occurring primarily at the base of coves and in stream valleys, this habitat also stabilizes soils at the toes of steep slopes (IBHMP 2002). Devil’s/Helds Cove, the cove at Willow Point, and high areas behind the emergent marsh at the southern end of the Bay (Map II.A.1) are the best remaining examples of shrub swamp in the Bay (IBHMP 2002). Shrub swamps are rated secure globally and locally by the NYS Natural Heritage Program (IBHMP 2002).

Sedge meadow habitat, consisting of sedges and herbaceous wetland species, has been reported in the Bay, but does not appear on existing maps (IBHMP 2002). Susceptible to development due to its location in shallow-sloped stream deltas and flood plains, several species of rare or unusual songbirds use this habitat exclusively for nesting and feeding (IBHMP 2002). This habitat considered globally and apparently locally secure (but rare in parts of its range such as Irondequoit Bay) by the NYS Natural Heritage Program (IBHMP 2002). We observed sedge meadow habitat at AreasT-3 (Photos 5-X and 6-X; also mentioned in the NYS DEC Natural Heritage Report 2002), T-7 and T-8 (Table IV.D.4). A small sedge/rush area also exists near the Area T-5 marsh (Photo 11-II], and possibly along the south fork of Big Massaug Cove. Otherwise, we suspect the area south of Empire Blvd is where most of the remaining sedge marsh habitat of the Bay is located, and with it the threatened Sedge Wren mentioned in Natural Heritage Program information (NYS DEC 2002c). These areas should be protected.

Our transition zone observations combined the habitats mentioned above. Key communities identified included sedge, cut-grass and rush at the Bay margins of Areas T-7 and T-8; eupatorium, alder, lizard’s tail and purple loosestrife at Area T-1; cattail, common reed, mallow and water flag at Area T-5; and buttercup and northern swamp-dogwood at Area T-3 (Table IV.D.4).

The IBHMP (2002, II.36-39) reviews interactions with important organisms in the Irondequoit Bay study area. Edge transition zones support fish spawning and nursery life stages and birds, and this habitat is lost when shoreline development occurs. The Bay serves as a feeding and resting site for raptors, such as hawks, harriers, ospreys and eagles, that move along the Lake Ontario flyway, mostly in April and May. Positive aspects of Bay ecology for raptors include fish availability as food, lack of water obstructions, water clarity and availability of perches. Boat activity disturbs feeding, so raptors tend to concentrate in the less developed southeastern Bay (IBHMP 2002).

3. Important Terrestrial Habitats and Communities

About 40% of the land in the study area is a flat plateau (<7% slope) that is mostly developed. Another 40% of the land consists of steep slopes (15% to 60%) that are mostly undeveloped (IBHMP 2002) and should not be developed if soil is to be kept in place and sedimentation of the Bay is to be avoided.

The IBHMP (2002, II.33-35) reviews the characteristics, ecological importance, and rarity of the major terrestrial plant communities surrounding Irondequoit Bay. Because of the Bay's location adjacent to Lake Ontario that moderates local climate, both northern and southern hardwoods (oaks, beech, cherry, birch, hickory) in various successional (post-logging) stages are present, especially on steep slopes where they are critical for stabilizing soils. Successional hardwood communities are rated secure globally and locally by the NYS Natural Heritage Program. We found the most valuable hardwood community in Area T-3, but distinctive communities also exist in Areas T-1, T-2 and T-8.

Rich mesophytic forest (oaks, birch, cherry, white pine) occurs in stream valleys and in more mature woodlands along the edge of the Bay (IBHMP 2002). Considered secure globally, the rich mesophytic forest ecotype is vulnerable in New York and rare locally (IBHMP 2002); therefore it should be preserved in the Irondequoit Bay study area. We observed this community in ravines opening into the Bay.

Oak openings are a rare ecological community globally and locally (IBHMP 2002). One was found in the Webster well field area; this area will remain only through deliberate protection and preservation. Successional old field (post-agricultural) plant communities are common globally and locally (IBHMP 2002); if allowed to develop naturally in the study area they will become one of the forest communities described above.

In our study, Area T-1 (location of the proposed Willow Point development and current land clearing at 1440 Empire Blvd.) had a significant association with overstory species including aspen/poplar, beech, black birch, chestnut, maple, pin oak, sugar maple and white oak plus associated understory and ground cover species (Table IV.D.3). Also, the greatest number of NYS-protected plants (seven) was observed in Area T-1. Area T-3 (location of the Damascus Temple property) had a rich and unique (for the Bay study area) overstory of hardwoods including black cherry, black oak, Norway maple and red maple plus associated understory and ground cover species mostly different from those observed in other areas (Table IV.D.3). Terrestrial species of special concern that we found included many specimens of butterfly-weed (*Asclepias tuberosa*) in Area T-3 and butternut (*Juglans cinera*), great lobelia (*Lobelia syphilitica*), American bittersweet (*Celastrus scandens*), flowering dogwood (*Cornus florida*), white baneberry (*Actaea alba*), maidenhair fern (*Adiantum pedantum*) and Christmas fern (*Polystichum acrostichoides*) in Area T-1.

Areas T-4 to T-7 showed no distinctive plant communities; these areas also were in more developed regions of the study area. Area T-9 had the most development and the most disturbed vegetation community in the study area; only 40 species were observed.

Although we were not charged with conducting intensive ground surveys for any group of terrestrial vertebrates, the list of species potentially occurring within the Irondequoit

Bay project area includes 20 amphibians, 17 reptiles, 117 breeding birds, and 47 mammals (Tables IV.C.3 and 4, IV.E.1 and 4). Thus, the Irondequoit Bay project area may support upwards of 200 species of terrestrial vertebrates, and represents an important local and regional resource from a biodiversity standpoint. In terms of terrestrial vertebrate biodiversity, the two most important habitats in the nine sensitive areas identified by the IBCC Technical Team probably are emergent wetlands and the extensive tracts of deciduous forest occurring on the slopes and plateaus surrounding the Bay. Emergent wetland and the submersed macrophyte beds offshore are critical habitat for fish, macroinverebrates, amphibians and reptiles, and wetland birds and mammals. A mix of mature and successional forest communities offer a diversity of habitats for upland birds and mammals, especially in the Webster water tower and well field areas.

Bat surveys detected a surprisingly rich fauna, with five species present during July and August sampling dates. The red bat, hoary bat, and silver-haired bat are encountered infrequently in the local area (M, Zettel, personal communication), so the Irondequoit Bay study area appears to be a regional center of bat biodiversity.

4. Conclusions

Formally threatened or endangered habitats in the study area include the oak opening terrestrial habitat and the shrub swamp transitional habitat (NYSDEC 2002b). However, the entire perimeter of the Bay is a Class I wetland that has the highest level of legal protection by New York State. The various submersed and emergent habitats that comprise the Irondequoit Bay wetlands perform valuable ecological functions as fish and wildlife habitat, and they should be preserved in their natural state. The forests on the steep slopes surrounding the Bay also perform valuable ecological functions. In addition to providing diverse habitats for a surprisingly robust array of birds and mammals, presence of these natural vegetation communities is essential to stabilize highly erodable soils on the very steep cliffs that surround the Bay.

No endangered, threatened or special concern species of aquatic macrophytes, macroinvertebrates, fish, amphibians, reptiles, birds or mammals were collected or observed during our study, although the habitats of the study area are suitable for some of these species (Tables IV.C.1-5 and IV.E.1-4). However, many species of NYS-protected terrestrial plants were found (Table V.A.1), including American bittersweet, butterfly-weed, squaw-root, white baneberry, azalea, butternut and one, possibly two, orchids (*Hellaborine/Habenaria* sp.), as well as flowering dogwood, great lobelia, and Christmas and maidenhair ferns.

C. *Likely Impacts of Future Development Pressure*

Public lands comprise a substantial portion of the study area (IBHMP 2002, Exhibits 8,9). Monroe County administers the East and West Irondequoit Bay Parks and recently purchased 10 acres of land for a park near Devil’s/Helds Cove. The Town of Penfield owns land at LaSalle’s landing at the southeast end of the Bay (IBHMP 2002). Non-park public land includes the abandoned Irondequoit Town landfill and wastewater treatment plant (on Newport Road and Bayshore Blvd., respectively), the Village of Webster’s well field along Dewitt Road, and the former Hojak rail line in Webster now owned by New York State (IBHMP 2002, Exhibit 9). Much of the public land surrounding the Bay is not developed for recreational use, but provides limited access to the Bay and preserves sensitive areas and critical habitats, particularly steep wooded slopes and wetlands (IBHMP 2002). However, the IBHMP proposes a number of public recreational development projects. As part of a proposed hiking trail around the Bay, a Sea Breeze boardwalk and public dock west of the current boat launch in Irondequoit and a LaSalle's Landing boardwalk in Penfield are proposed. In Webster, a public waterfront park is proposed for the "Sandbar" area by the Town's Comprehensive Plan (IBHMP 2002). Alternatively, there may be private proposals for hotel, restaurant and dock development along the "Sandbar." In addition, the Town anticipates purchasing two privately owned parcels on either side of Lake Road that are the last 6 acres of undeveloped land at shore level in Webster (IBHMP 2002).

The Towns of Irondequoit, Penfield and Webster all have comprehensive land use plans that include interrelated Waterfront Development Districts (WDD), Environmental Protection Overlay Districts (EPOD), and Local Waterfront Revitalization Plans (LWRP). These plans prescribe land uses for many areas in the Irondequoit Bay study area. WDDs in the Town of Webster are the "Sandbar" area separating northeastern Irondequoit Bay from Lake Ontario and the Stoney Point Landing development (IBHMP 2002, Exhibit 7). In the Town of Irondequoit, WDDs include the area around the Newport House restaurant and marina complex and the LaSalle's Landing Development District (LLDD) along Empire Blvd. that is shared with the Town of Penfield (IBHMP 2002, Exhibits 5,6). The LLDD permits a variety of water enhanced or dependent uses, but does not permit dredging or significant water depths (designed to protect warmwater fishery habitat and populations in that area) (IBHMP 2002). The 1996 revision of the Town of Penfield's LWRP prohibits new marina development in the southern part of the Bay (IBHMP 2002), so only maintenance dredging for existing marinas is anticipated for the future. Interestingly, this study suggests that much of the southern end of the Bay is too shallow to support a vibrant fish community; however, the shallow, weedy mudflat habitat provides important food resources for waterfowl and other migrating birds. Also, this study provides evidence that a considerable area of aquatic macrophytes has disappeared in the southeastern portion of the Bay (Maps IV.B.1 and 2), a likely result of dredging or boating activity.

EPODs are designed to protect environmentally sensitive areas. At the state level, the entire perimeter of the Bay is a Class I freshwater wetland (the highest classification, Freshwater Wetland Act, Article 24, Environmental Conservation Law) (IBHMP 2002, Exhibit 13). The bluffs at many places around the Bay are coastal erosion hazard areas (protected under the "natural protective features" provision of the Coastal Erosion Hazard Management Act, Article 34, ECL) (Map IV.D.1; IBHMP 2002, Exhibit 14). The NYS Department of State classifies the Bay and associated habitats as a Significant Fish and Wildlife Habitat, particularly for warmwater fisheries. In addition, the Town of Irondequoit has EPODs for steep slopes, wood lots, wetlands/flood plains, and water-courses (Irondequoit LWRP 1988), and the Town of Penfield has EPODs for wood lots, steep slopes, proposed land uses, and waste disposal areas (Penfield LWRP 1991). If these plans are updated based on the information provided in this report, it should be possible to protect the aquatic and terrestrial resources of the Bay for future generations.

1. <u>Future Aquatic Development</u>

a. *Irondequoit Marine Park and Boat Launch*: Docking space appears to be limited at the northern end of Irondequoit Bay. In its Sea Breeze Revitalization Plan, the Town of Irondequoit proposes to add a facility west of the Marine Park at the northwest corner of the Bay owned by the NYS Office of Parks, Recreation and Historic Development and operated by the Monroe County Parks Department. Suggested facilities in an expanded marina might include transient docking, a small marina for hand-powered watercraft or a public dock for a regional ferry, excursion boats, etc. (IBHMP 2002). Placing these facilities in this area will damage an important aquatic community in the Bay (e.g., northern pike, longnose gar, water celery).

b. *Webster Sandbar*: The Town of Webster is considering proposals for a public boat launch or private boat launch/marina at the "Sandbar" area of northeastern Irondequoit Bay (IBHMP 2002). This action will aggravate the already intense usage of the northeastern arm of the Bay by boats and create further disturbance of a habitat that still supports a reasonably healthy aquatic community, including walleye

c. *Devils/Helds Cove*: As new homes are built on the plateau above Devil's Cove, owners' request docking space in the cove. As one of the most sensitive aquatic habitats in the Bay in terms of fish spawning and nursery potential (including walleye), more dock development will increase disturbance in the Cove and is not recommended.

d. *Willow Point Development*: It is proposed to build boat docks and other aquatic recreation facilities in the cove for homeowners on the plateau. Although not sampled directly is this study (the macrophyte community in June was not distinctive), extensive aquatic macrophyte beds did develop later in the summer (Map IV.B.1). Protected cove areas generally are productive fish nurseries and should be conserved and protected around the Bay.

2. <u>Future Terrestrial Development</u>

a. *1440 Empire Blvd. Property* (east of Bounty Harbor Marina): Land clearing has occurred recently at this location at the far southeastern portion of Area T-1 (Photo 24-VII, Appendix IV.D.1.a). Important plants in the surrounding areas include ash, black oak, white oak, cherry, cottonwood, eastern hemlock, Norway maple, red maple and tulip tree (Photos 23-VII and 25-VII, Appendix IV.D.1.a). No additional activity should occur on this property until a complete inventory of impacted communities and species can be made.

b. *Newport Cove Apartments/Condominiums*: No distinctive terrestrial or aquatic transition zone plant communities were found in Area T-6 that encompasses this area proposed for development, and only one special concern plant (Christmas fern) was found. However, leachate from the Newport Landfill is already entering the cattail marsh surrounding Newport Cove. Although we did not sample Newport Cove (again, the aquatic macrophyte community in June was not distinctive), runoff from large parking lots associated with multifamily housing developments must be prevented from entering the Cove in order to protect its potential as a fish production and nursery area.

c. *LaSalle's Waterfront Development District* (Empire Blvd): There is little environmental concern about further development on land at Area T-9 that is already highly disturbed by commercial and roadway development. What is important is to not let development in Area T-9 or associated aquatic recreation development in Area A-2 affect the rich warmwater aquatic community in Area A-3 or the mud flats important for birds in Area A-2 (Map III.A.1). Based on our findings, it would appear that narrowly limited dredging and low speed boating activity confined to dredged channels in the southern portion of the Bay will not further adversely affect the most impoverished aquatic community in the Bay (due to naturally shallow water).

3. Conclusions

Aquatic: Whatever development is permitted in Areas A-4 and A-5 (Sea Breeze boardwalk/public dock and "Sandbar" waterfront park) and, especially, Areas A-1 and A-3 (LaSalle's Landing boardwalk), must carefully consider that dredging or other removal/disturbance of aquatic macrophytes will diminish fish abundance and, perhaps, diversity. Area A-4 is the only area where longnose gar were found in the Bay (although they were observed in westside coves that were not sampled), and several walleye were caught in Areas A-5 and A-6 (Table IV.C.1, Appendix IV.C.1.d), probably attempting to spawn. Area A-3 west of the LaSalle's Landing Development District is a prime habitat for warmwater fishes such as largemouth bass, and should not be disturbed. Despite some evidence of impairment (lower fish abundance and diversity than expected based on the appearance of the physical habitat), further development should not be permitted in Devil's/Helds cove, which is one of the most important fish nursery areas in the Bay.

Terrestrial: The land clearing at 1440 Empire Blvd. at the southern end of Area T-1 should be brought under regulatory control immediately so that detailed site surveys to identify important habitats and species of special concern can be conducted. Any further development at Newport Cove must provide for storm water controls so that runoff does not enter cove that is already receiving leachate from the Newport Landfill. The composition of the leachate should be examined to determine its toxicity and potential to harm biota in the Cove and Bay. Finally, proposed terrestrial development in the LaSalle's Landing Development District will improve the aesthetic appearance of the area and, if done properly, should not adversely impact critical aquatic habitat and communities in Area A-3 or somewhat less important habitat and communities in Area A-2. Overall, land development in terrestrial portions of the Irondequoit Bay study is severely constrained steep slopes (Map IV.D.1), plants of special concern, distinctive forest communities, and existing private and public uses of land. Before further development proceeds, intensive surveys are needed to establish that important plant communities and species are not being removed by land clearing or dock building, and that plant communities are not being fragmented or eliminated which will diminish the diversity of animals that can live around the Bay.

D. *Recommended Future Studies*

1. Aquatic

Conduct three-season sampling for submersed and emergent macrophytes, fish, fish reproduction and juvenile fish production at proposed aquatic development sites and in all coves.

Search for rare fen habitats associated with aquatic-terrestrial plant transition zones. One fen habitat may possibly be located near the Webster-Penfield Town Line at 80, 86, 90 and 100 Avalon Trail (R. Shearer, NYSDEC, Avon, NY, pers. comm.).

Survey amphibians in April to complete the standard Marsh Monitoring Protocol.

Determine the source and nature of the leachate entering the Newport Cove marsh.

2. Terrestrial

Survey plant communities in the spring to catalog ground cover plants.

Identify sedges and other genera with many species, some of which are endangered, threatened or of special concern, to better determine the presence of listed species predicted for study area.

Conduct intensive three-season searches in and around areas of current and proposed development sites for NYS-listed plants and animals.

Do detailed GPS/GIS mapping of important forest and other plant communities.

Conduct field sampling for upland animals, especially forest interior-dependent birds, mammals, amphibians and reptiles.

VI. General Conclusions

This report summarizes the first comprehensive study of the biological resources of Irondequoit Bay since the New York State Biological Surveys in the 1930s. The scientific data reported here supports land and water use recommendations in the Irondequoit Bay Harbor Management Plan, which is scheduled for adoption by the Towns surrounding the Bay in 2003. It also provides a benchmark for future biological studies as development and natural resource management proceed in the study area.

Aquatic Habitats

Six aquatic habitats were identified for sampling by the researchers, based on aquatic macrophyte beds observed in June 2002.

Aquatic Macrophyte Bed Distributions

Extensive aquatic macrophyte beds cover 25-35 percent of the entire Bay, and 26-63 percent of the edges of the Bay beyond the completely covered shallow southern and northern ends, from June through September. The macrophyte beds harbor diverse and abundant macroinvertebrate and fish communities.

Few aquatic macrophytes grow deeper than 5 feet, probably due to lack of sunlight, and few are found shallower than 2 feet, probably the result of wave action. Therefore, the critical depths to avoid disturbing in order to protect aquatic macrophyte survival and growth are between 2-5 feet.

A comparison of historical submersed aquatic macrophyte beds (1940-1982) and beds mapped in 2002 appear to indicate that they have largely disappeared from the southeast (Penfield) corner of the Bay, possibly due to boating activity and associated dredging.

Protected or Special Concern Species

No federal or state species of aquatic macrophytes, macroinvertebrates, fish, amphibians or wetland birds listed as endangered, threatened or of special concern were sampled in this study. However, a young bald eagle (federally threatened) was seen and several listed species of birds are able to live in the study area

One amphibian previously unrecorded in the study area, the gray tree frog, was observed.

<u>Dredging</u>

Historical sources of pollutants contaminated the sediments in Irondequoit Bay. The NYS DEC has a protocol for sediment chemical analysis required for dredging based on grain size. Based on the proposed Harbor Management Plan, potential dredging areas were identified by the IBCC Technical Team. Four sediment samples were taken in these areas. These areas contain high amounts of silt and organic material; therefore, substantial chemical analyses are needed before dredging can be permitted.

<u>Policy Recommendations</u>

Aquatic habitats sampled with critical priority for protection are Devil's/Helds Cove (Area A-6: high species diversity, important spawning and nursery habitat, walleye present) and the southwestern corner of the Bay (Area A-3: high diversity, warmwater fishes). These areas and similar ones, such as undeveloped coves, should receive the highest protection available.

Aquatic habitats sampled with high priority for protection are Seabreeze (Area A-4: high aquatic macrophyte diversity, longnose gar present), Webster Sandbar/Stoney Point (Area A-5: high diversity, extensive area, macrophytes disturbed in boat traffic channels, walleye present), and Irondequoit Bay Park West (Area A-1: high abundance and diversity of fish, especially in the late spring spawning season). At most, only small portions of these areas should be considered for possible development, and any development should minimize impacts on the shore.

Because of very shallow water (less than one foot in many places) and the apparent limitation of aquatic macrophyte growth by the discharge of Irondequoit Creek into the Bay, much of the south central part of the Bay had few fish in the summer and fall, but it is valuable migratory bird habitat.

Terrestrial Habitats

Nine terrestrial areas around the Bay were identified for study by the IBCC Technical Team.

<u>Protected and Special Concern Species and Communities</u>

Twelve NYS-protected plants of special concern were found, ranging from seven species in the southeastern corner of the study area (Area T-1: mostly Irondequoit Bay Park East) to none in the most developed areas (Area T-6: Rte. 104 bridge, Newport Landfill and Marina; Area T-9: Empire Blvd. commercial district)

An "oak opening" habitat, formally listed as threatened by NYS, was found in Area T-3. Threatened "shrub swamp transitional habitat" reportedly exists along the shore of the Bay, but it was not observed in this study.

High quality cherry, oak and maple hardwood forest was found in the upland of Area T-3, and stands of aspen/poplar, beech, chestnut, maple and oak were found in Areas T-1, T-2 and T-8. Cottonwood grows along the shore and black locust grows in the upland regions of all areas examined.

Animals Associated with Terrestrial Plant Communities

Large contiguous upland forest tracts support a high diversity of birds and mammals, many of which were observed during plant surveys. One threatened bird, seven birds of special concern and 13 mammals limited (required habitat) or influenced (used for food or temporary cover) by the availability of wetlands potentially occur in the study area, but none were observed. The study area is an important regional center of bat biodiversity, especially the area from Point Lookout to Rte. 590 where all five species observed in the study were found.

Erosion

The land contiguous to the Bay is highly susceptible to erosion. All-terrain vehicle activity is removing vegetation at many locations around the Bay, especially areas T-1, T-3 and T-8, leaving soils highly vulnerable to erosion, landforms subject to destabilization, and protected plants in danger.

Environmental Impacts

The entire perimeter of the Bay is a Class I wetland that has the highest level of legal protection by New York State. The various submersed and emergent plant communities that comprise the Irondequoit Bay wetland perform valuable ecological functions as fish and wildlife habitat, and they should be preserved in their natural state. There is already a suggestion of impairment of fish production in Devil's/Helds Cove, possibly due to high levels of boating activity in the summer. More home development on the cliffs and associated docks in the cove will hurt wetland habitat, fish production and wildlife values. In addition, aquatic macrophytes are being cropped by boating activity in the Webster Sandbar and Stoney Point areas; further development here may impair a reasonably healthy fish community.

The forests on the steep slopes surrounding the Bay also perform valuable ecological functions. In addition to providing diverse habitats for a surprisingly diverse array of birds and mammals, presence of these natural vegetation communities is essential to stabilize highly erodable soils on the very steep cliffs that surround the Bay.

Although over 20% of the shoreline of the Bay is privately owned and has slopes less than 7% (i.e., potentially developable), approximately two-thirds of this land is found in coves and stream deltas that should not receive further development. To the extent that the remaining natural aquatic and terrestrial habitats around the Bay are consumed for human activities, the diversity and abundance of plants, animals and ecological communities comprising the Bay ecosystem will decrease.

Study Limitations and Recommendations for Future Studies

Because coves and some aquatic and terrestrial areas that may be proposed for development were not specifically targeted for sampling, they should be intensively sampled before any further development proceeds.

By starting the project in May instead of April, early development of aquatic macrophyte beds, fish spawning in the early spring, some likely calling amphibians, some likely breeding birds, and spring ground cover plants could not be observed and recorded. To complete the biological survey of the Bay study area requires sampling in April and May.

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V.A.1. NYS Special Concern Plant Species Found in the Irondequoit Bay Study Area

Table V.A.1. NYS special concern plant species found in the Irondequoit Bay study area (NYSDEC 2002d).

Common Name	Scientific Name	Area T-1	Area T-2	Area T-3	Area T-4	Area T-5	Area T-6	Area T-7	Area T-8	Area T-9
Bellflower Family	Campanulaceae									
Great Lobelia	*Lobelia siphilitica*	Y								
Bittersweet Family	Celustraceae									
American Bittersweet	*Celastrus scandens*	Y	Y		Y			Y		
Broomrape Family	Orobanchaceae									
Squaw-root	*Onopholis americana*		Y				Y			
Buttercup Family	Ranunculaceae									
Baneberry, White	*Actaea alba*	Y								
Dogwood Family	Cornaceae									
Dogwood, Flowering	*Cornus florida*	Y	Y		Y					
Fern; Maidenhair Family	Adiantaceae									
Maidenhair Fern	*Adiantum pedantum*	Y								
Fern; Spleenwort Family	Aspleniaceae									
Christmas Fern	*Polystichum acrostichoides*	Y	Y		Y		Y	Y	Y	
Heath Family	Ericaceae									
Azalea	*Rhododendron* sp.		Y							
Milkweed Family	Asclepiadaceae									
Butterfly-weed	*Asclepias tuberosa*			Y						
Orchid Family	Orchidaceae									
Habenaria	*Habenaria* sp.					Y				
Hellaborine	*Epipactis hellaborine*				Y					
Walnut Family	Juglandaceae									
Butternut	*Juglans cinerea*	Y								

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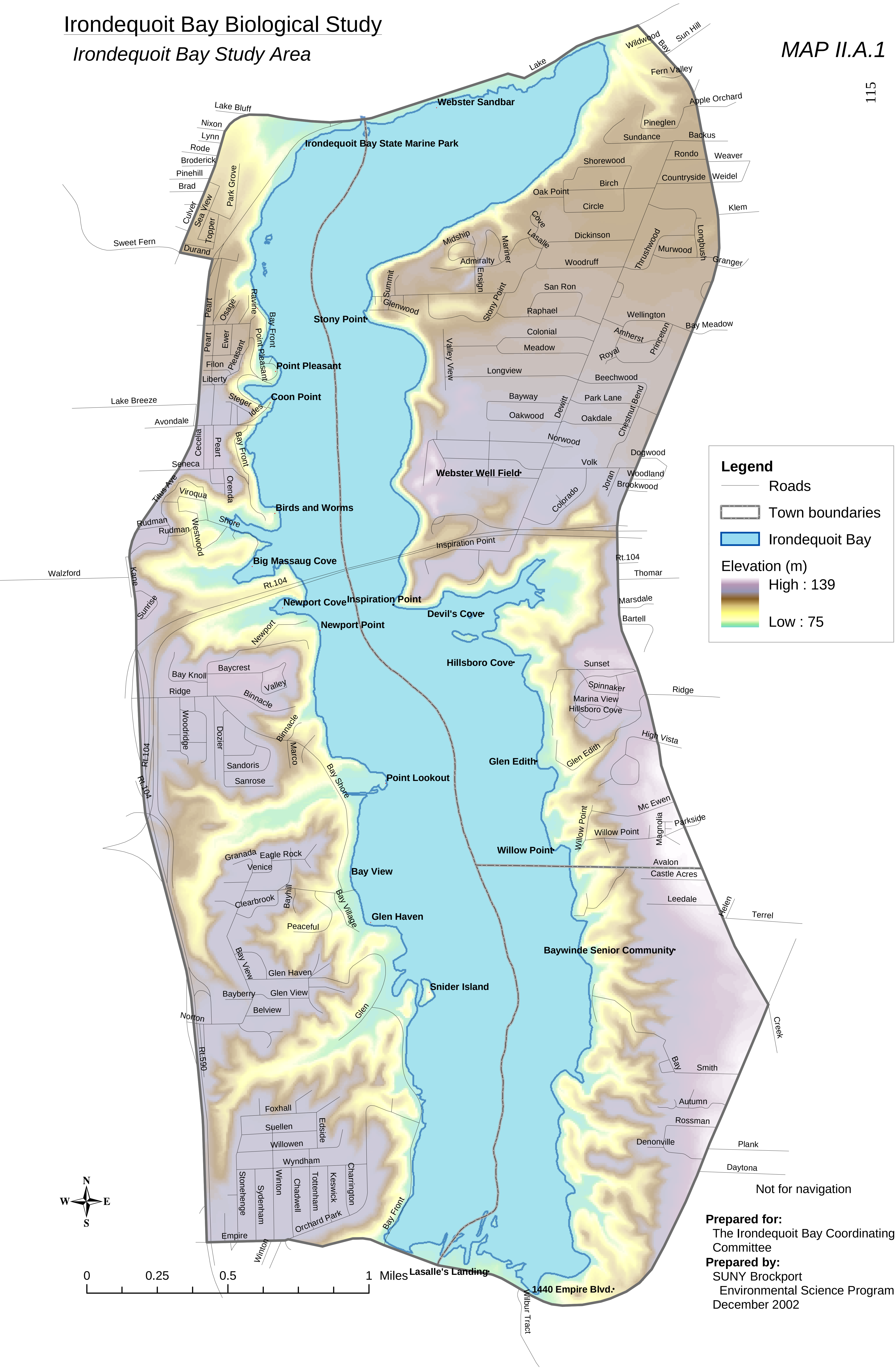
Irondequoit Bay Biological Study

Irondequoit Bay Study Area

MAP II.A.1



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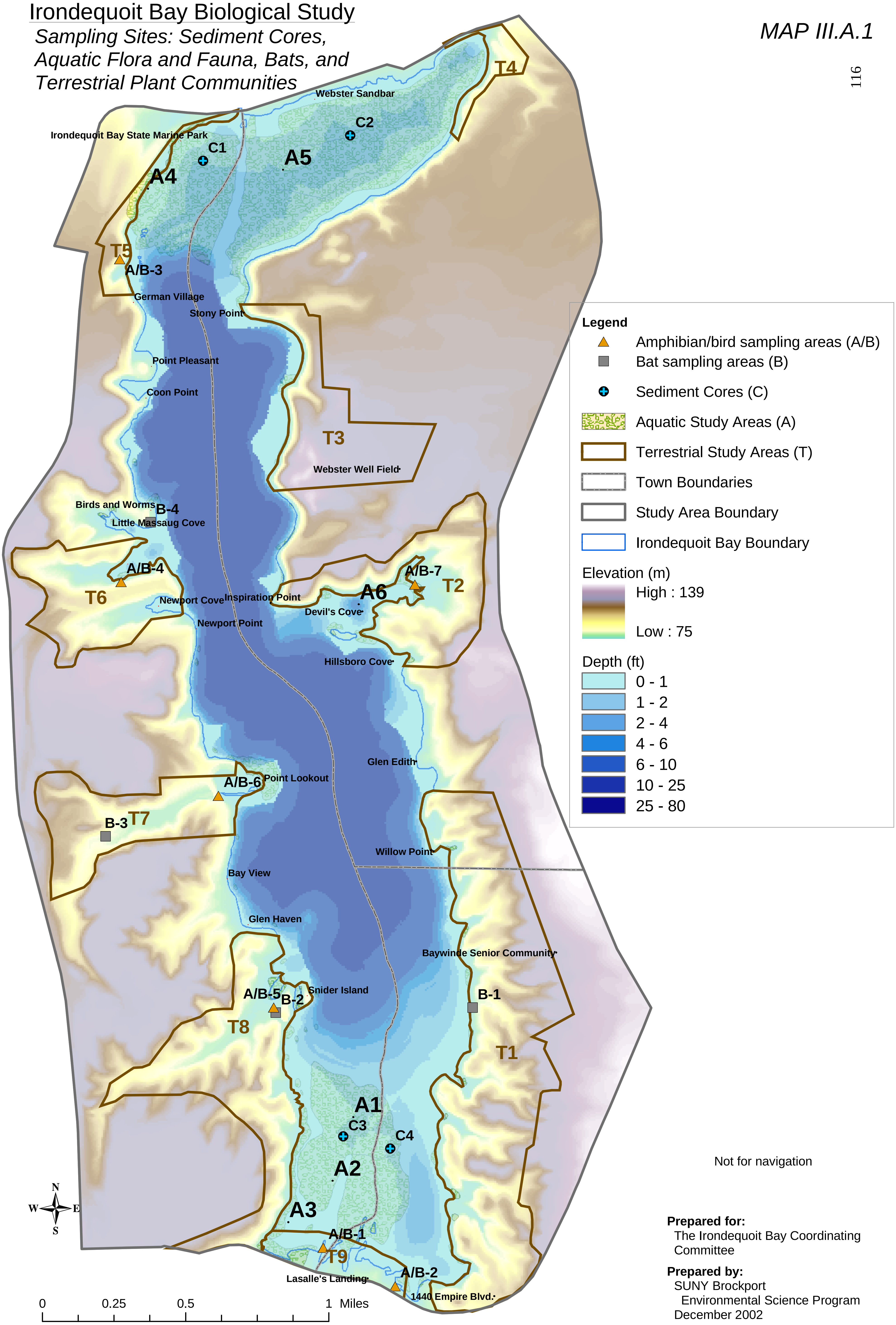
The Irondequoit Bay Coordinating Committee

Prepared by:
SUNY Brockport
Environmental Science Program
December 2002

Irondequoit Bay Biological Study

Sampling Sites: Sediment Cores, Aquatic Flora and Fauna, Bats, and Terrestrial Plant Communities

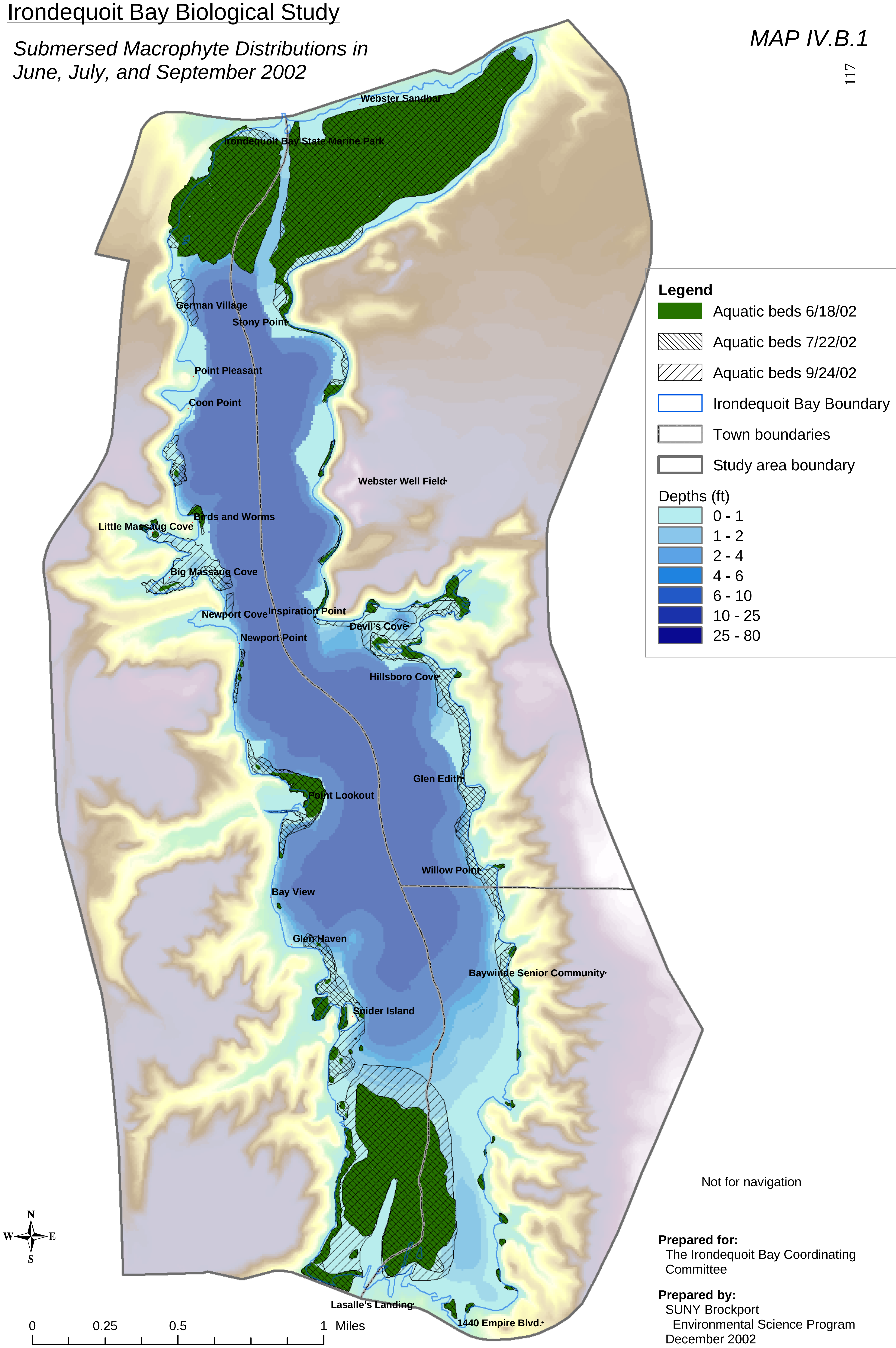
MAP III.A.1



Irondequoit Bay Biological Study

Submersed Macrophyte Distributions in June, July, and September 2002

MAP IV.B.1



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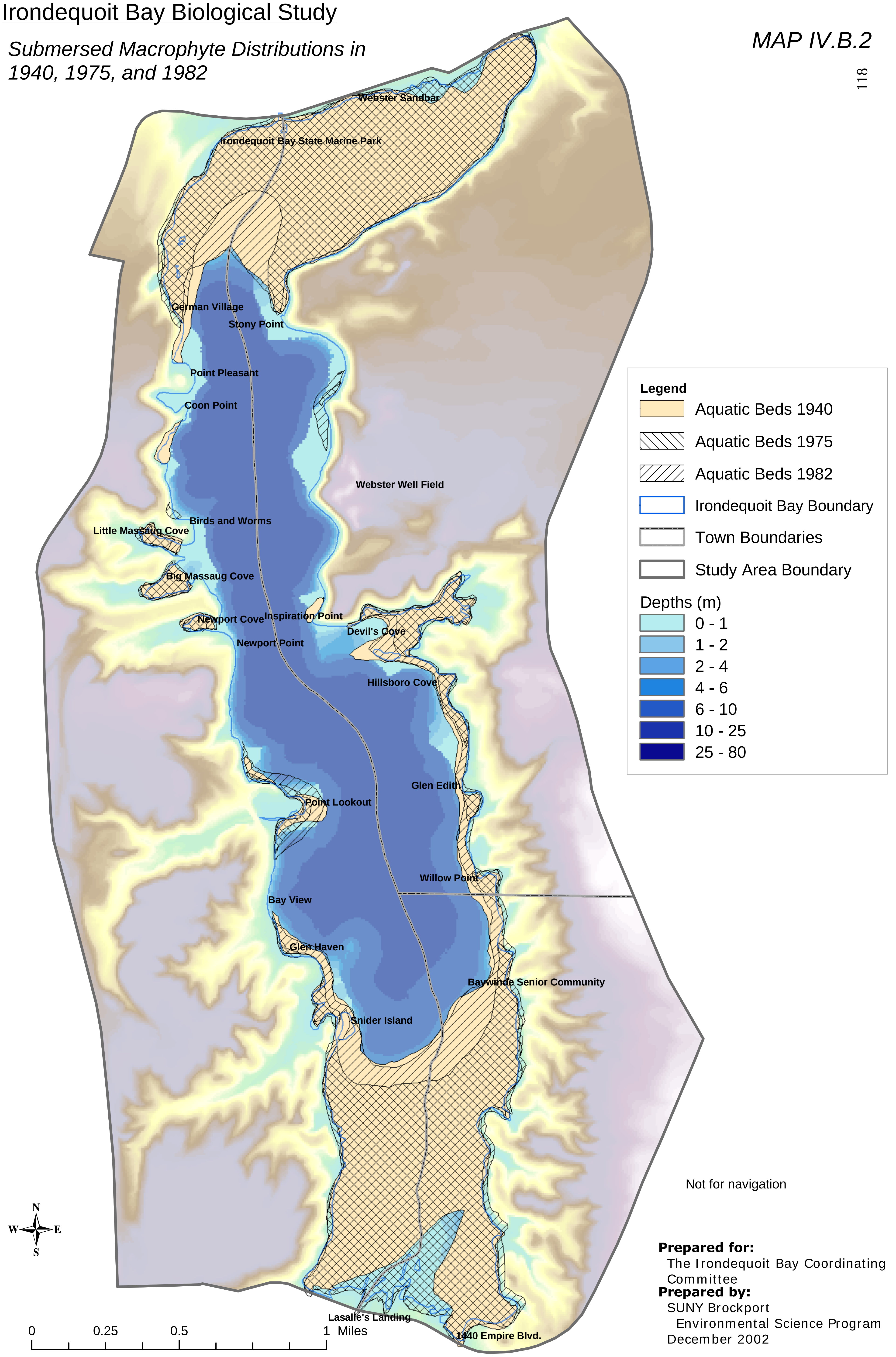
Submersed Macrophyte Distributions in 1940, 1975, and 1982

MAP IV.B.2



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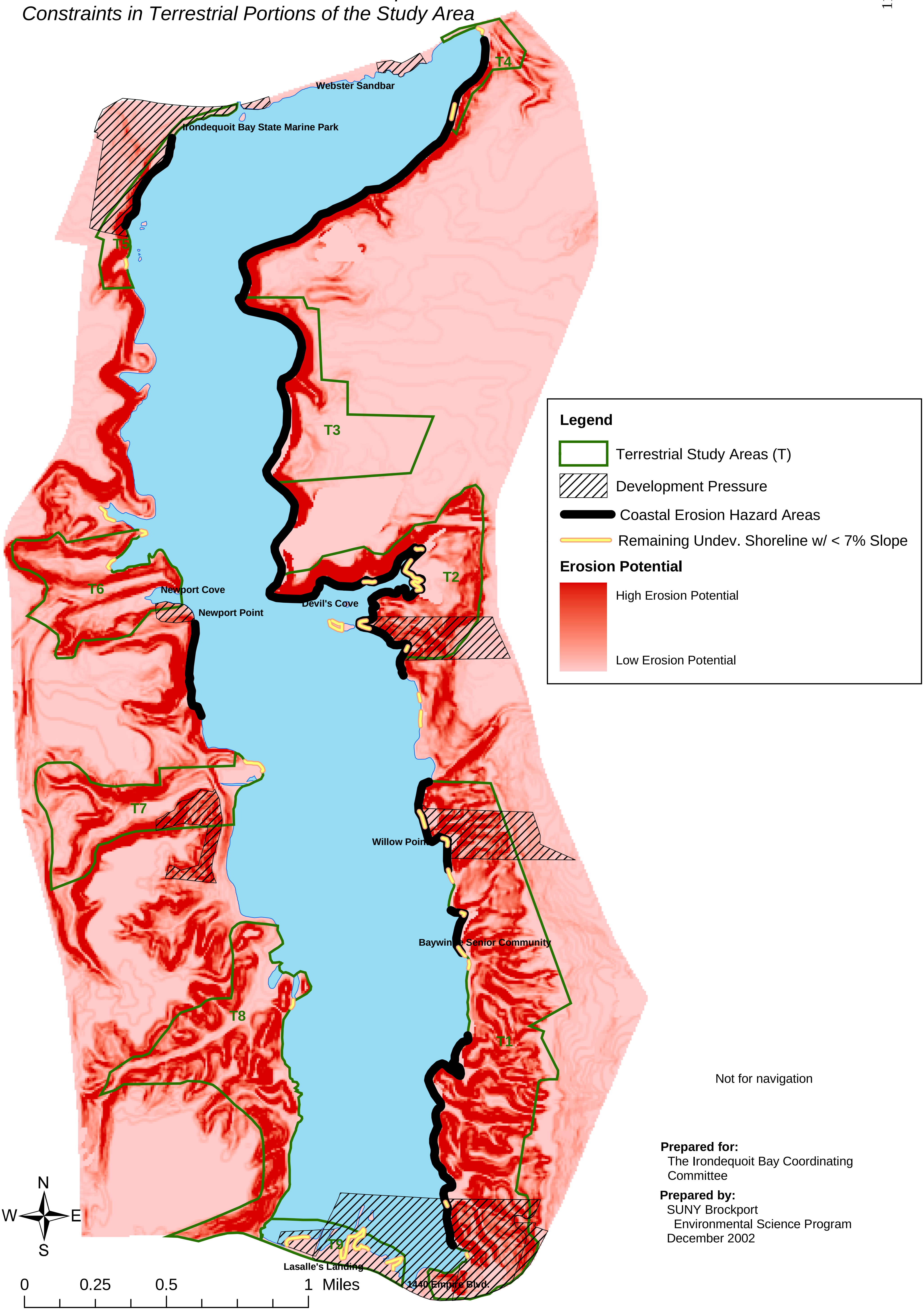
MAP IV.D.1

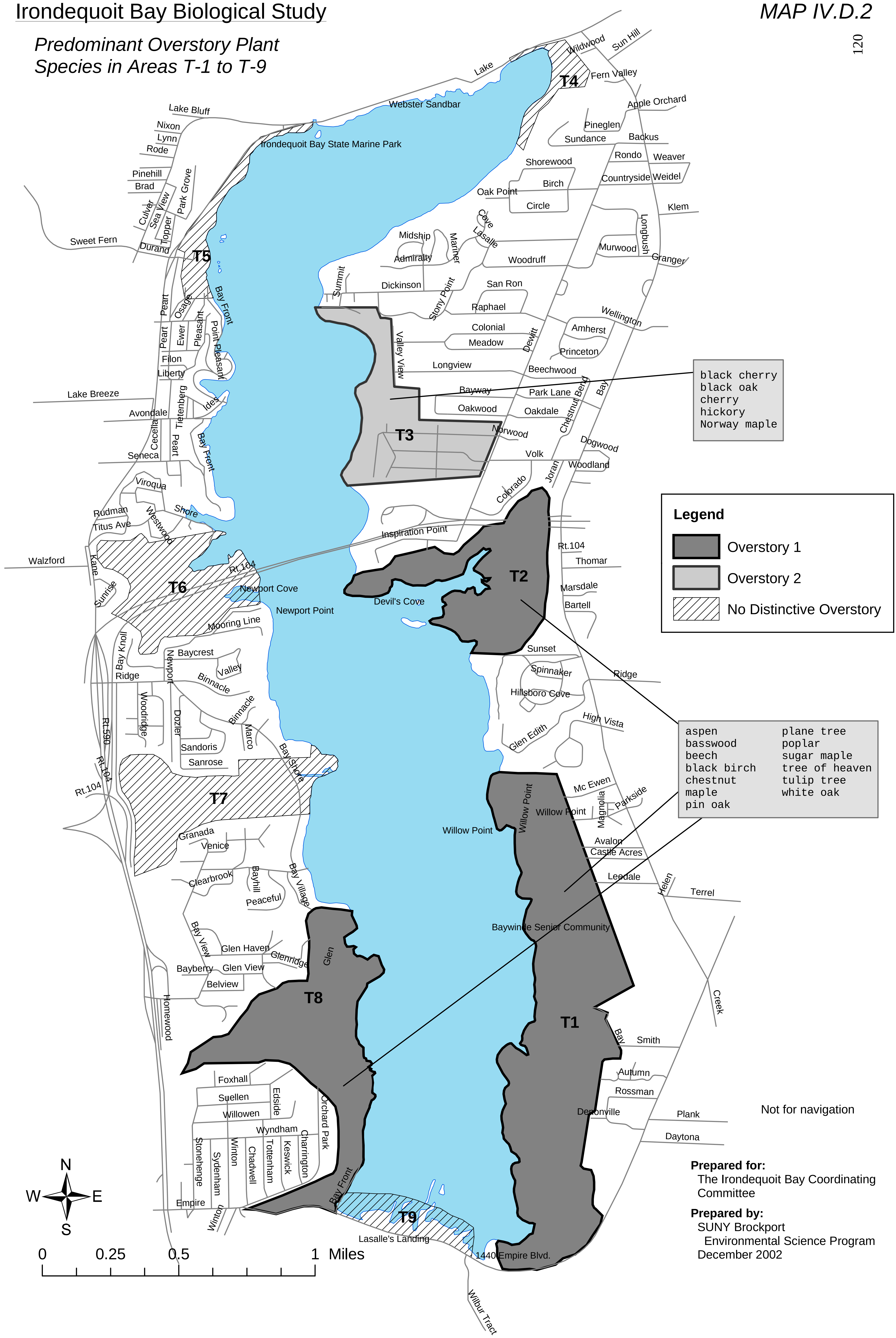
Erosion Potential and Hazards and Development Constraints in Terrestrial Portions of the Study Area



Irondequoit Bay Biological Study

MAP IV.D.2

Predominant Overstory Plant Species in Areas T-1 to T-9



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December 2002

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IV.A.1. Sediment Grain-size Distributions

IV.C.1. Size Distributions of Abundant, Important Fishes

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- b. Bullhead
- c. Pumpkinseed
- d. White Perch
- e. Yellow Perch

IV.C.2. Cluster Dendrogram for Aquatic Biota

IV.C.3. Aquatic Biota Community Relationships to PCA Axes

- a. Axes 1 and 2
- b. Axes 1 and 3
- c. Axes 2 and 3

IV.D.1. Cluster Dendrogram for Terrestrial Plants

IV.D.2. Terrestrial Plant Community Relationships to PCA Axes

- a. Axes 1 and 2
- b. Axes 1 and 3
- c. Axes 2 and 3

IV.D.3. Cluster Dendrogram for Transition Zone Plants

IV.D.4. Transition Zone Plant Community Relationships to PCA Axes

- a. Axes 1 and 2
- b. Axes 1 and 3
- c. Axes 2 and 3

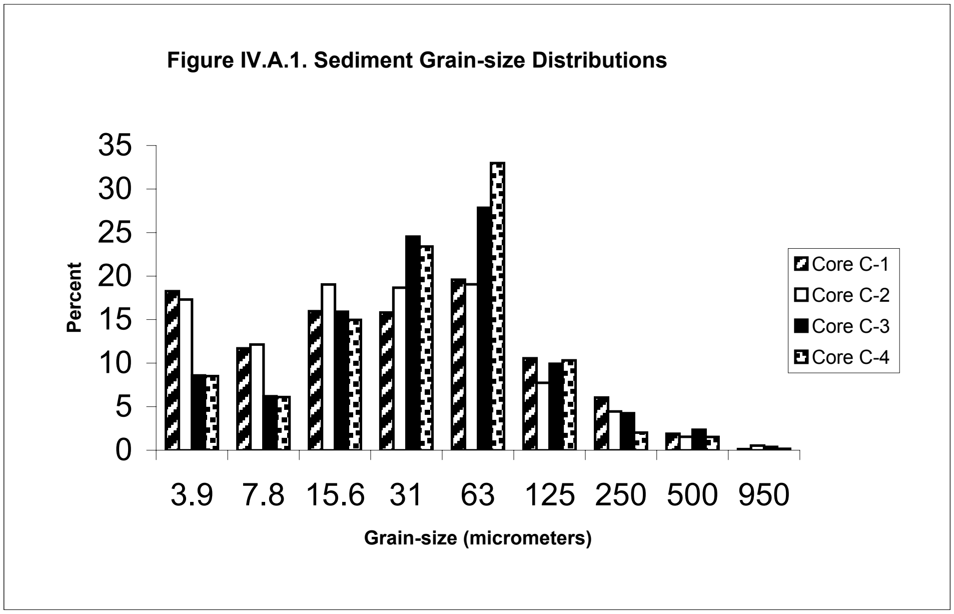


Figure IV.A.1. Sediment Grain-size Distributions
35
30
25
20
15
10
5
0
Percent
3.9
7.8
15.6
31
63
125
250
500
950
Grain-size (micrometers)
Core C-1
Core C-2
Core C-3
Core C-4

Figure IV.C.1.a. Bluegill Length-Frequency Data by Season

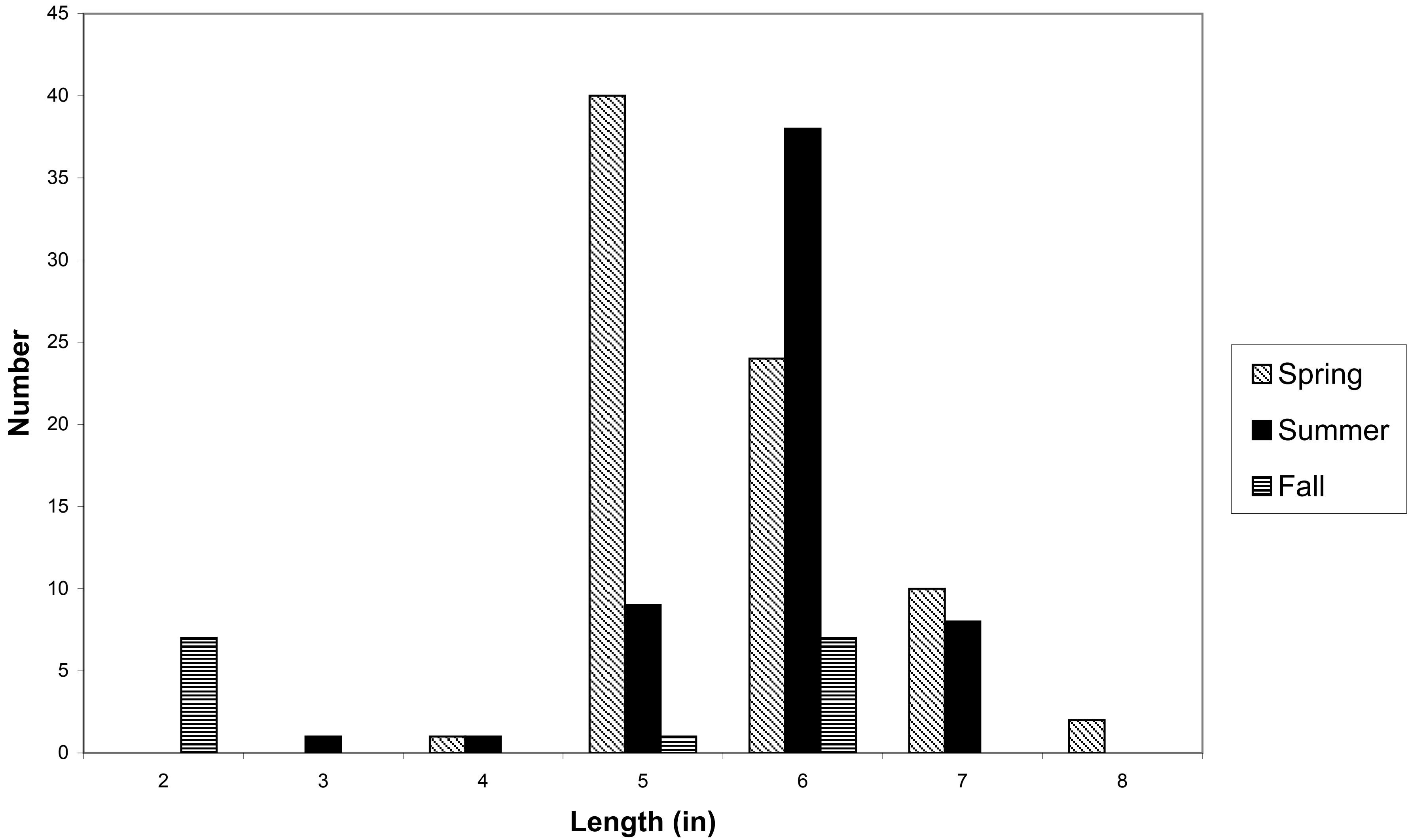


Figure IV.C.1.b. Bullhead Length-Frequency Data by Season

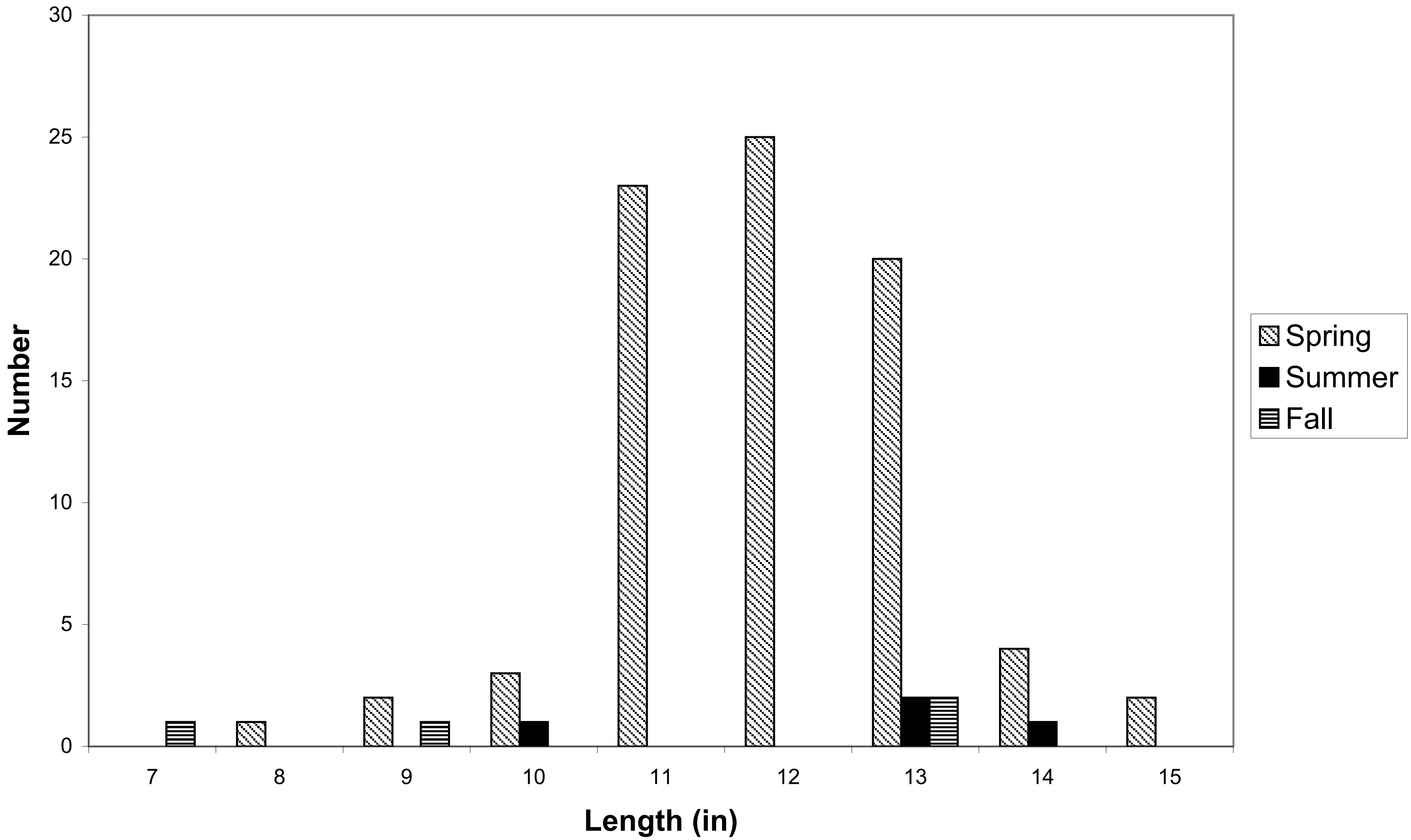


Figure IV.C.1.c. Pumpkinseed Length-Frequency Data by Season

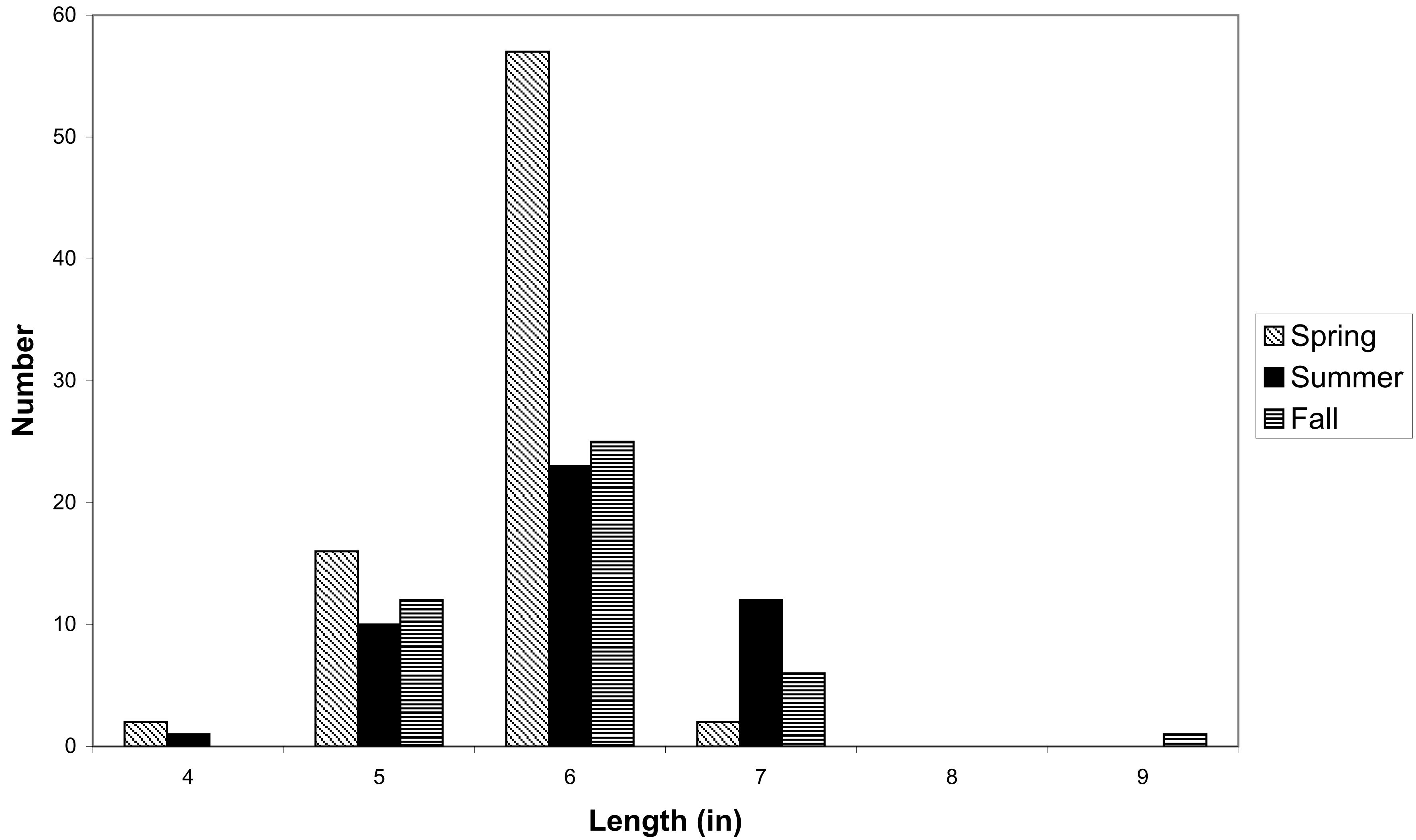


Figure IV.C.1.d. White Perch Length-Frequency Data by Season

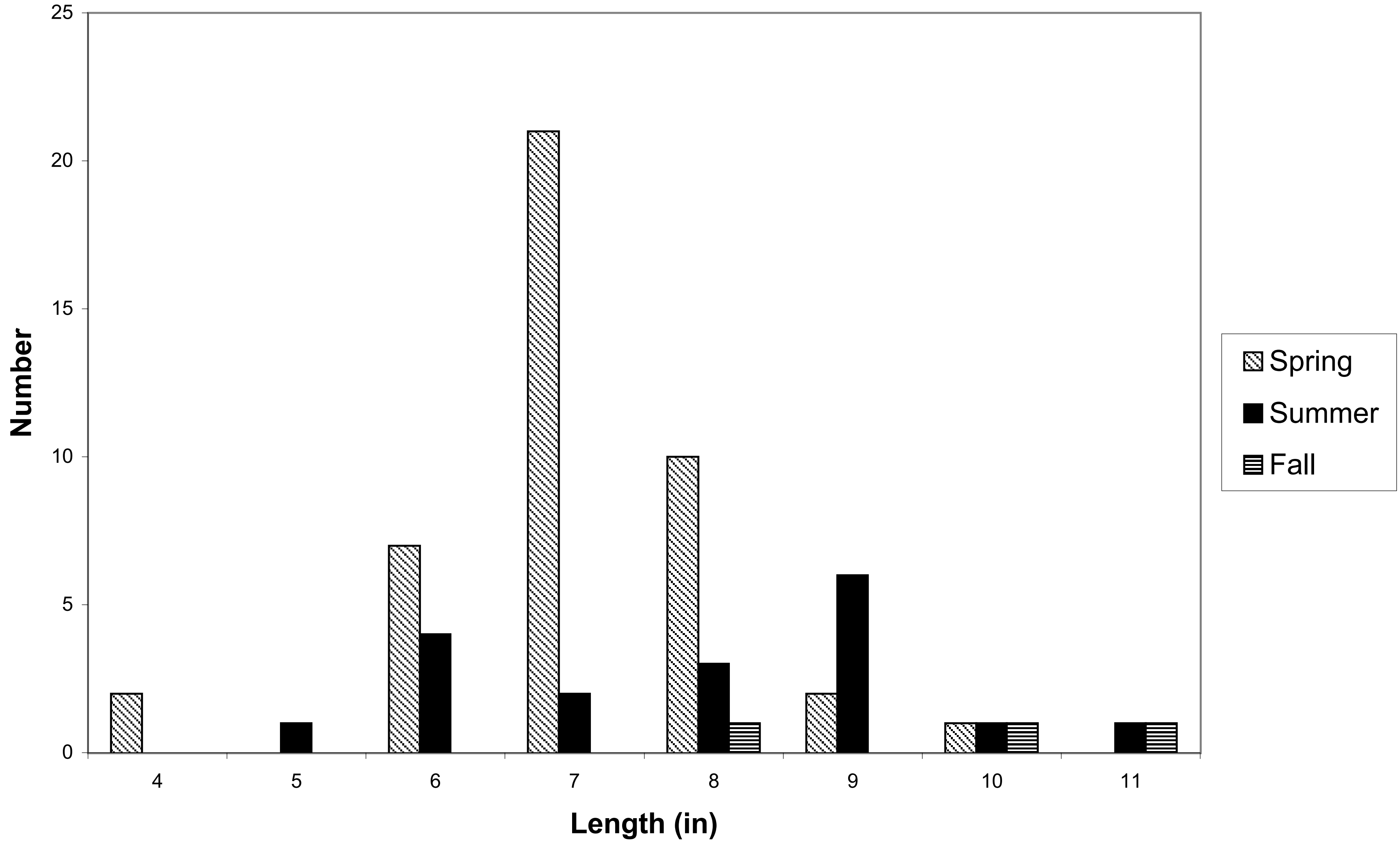


Figure IV.C.1.e. Yellow Perch Length-Frequency Data by Season

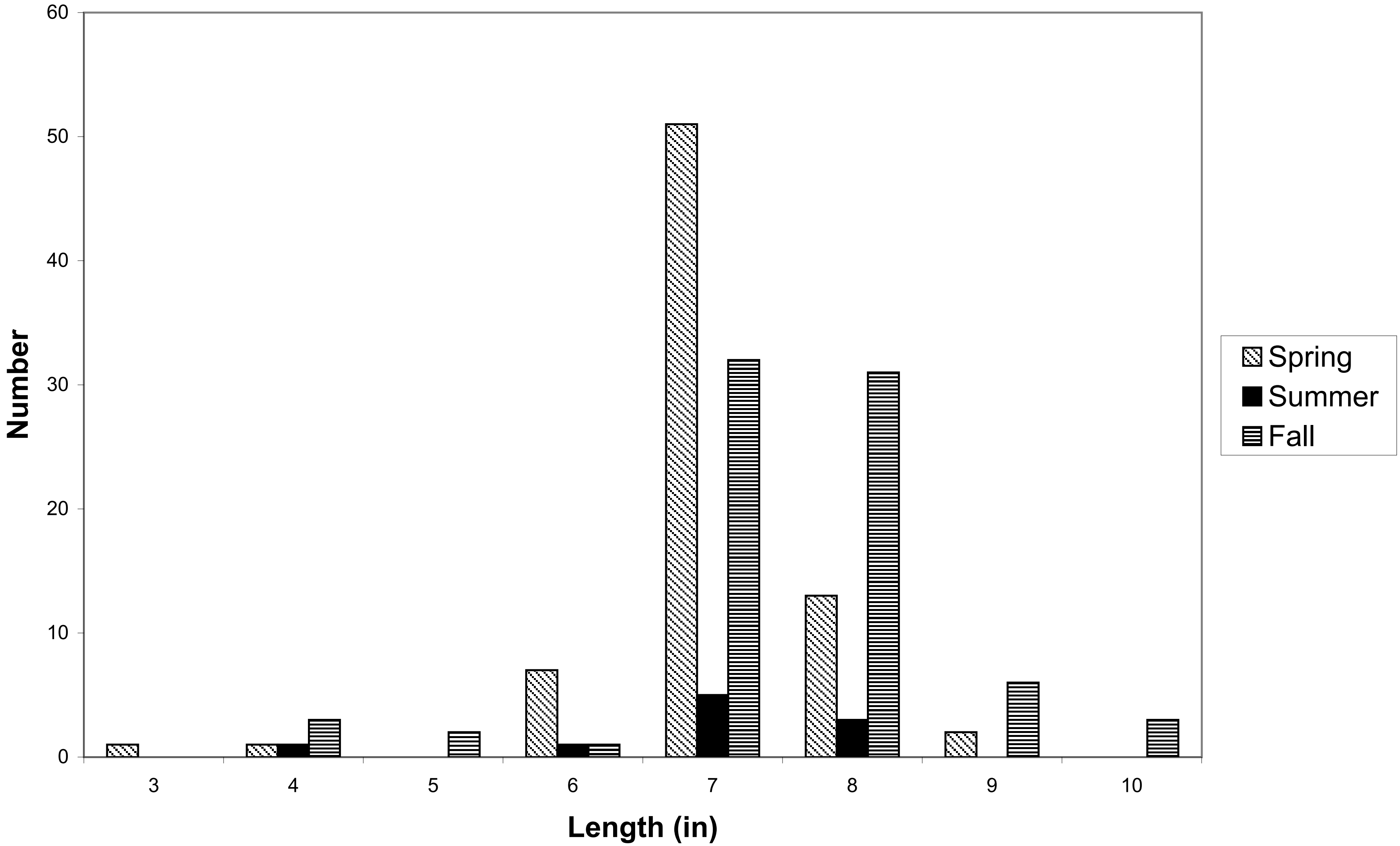


Fig. IV.C.2. Cluster Dendrogram for Aquatic Biota

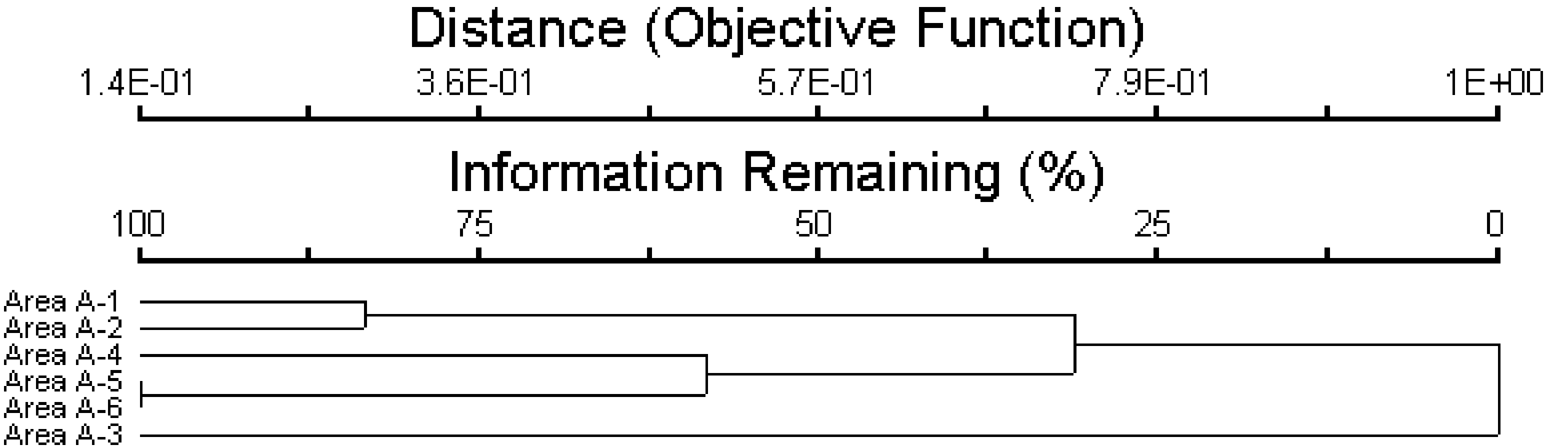


Fig. IV.C.3.a. Aquatic Community PCA Axes 1,2

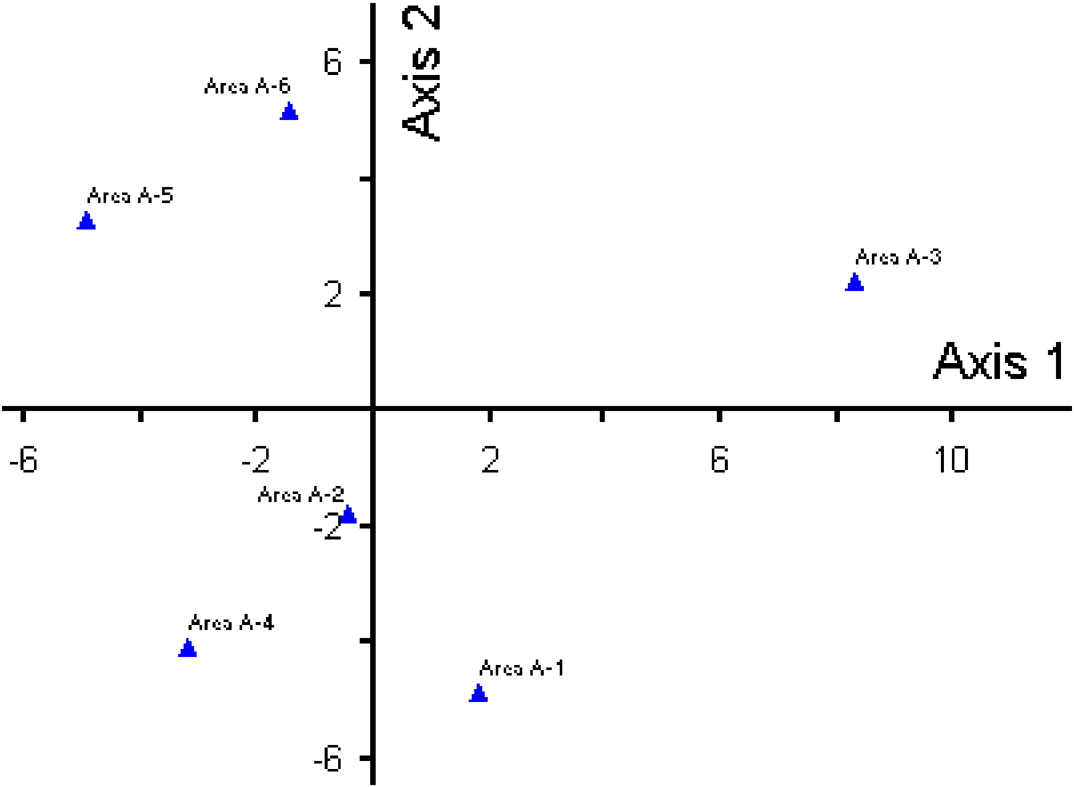


Fig. IV.C.3.b. Aquatic Community PCA Axes

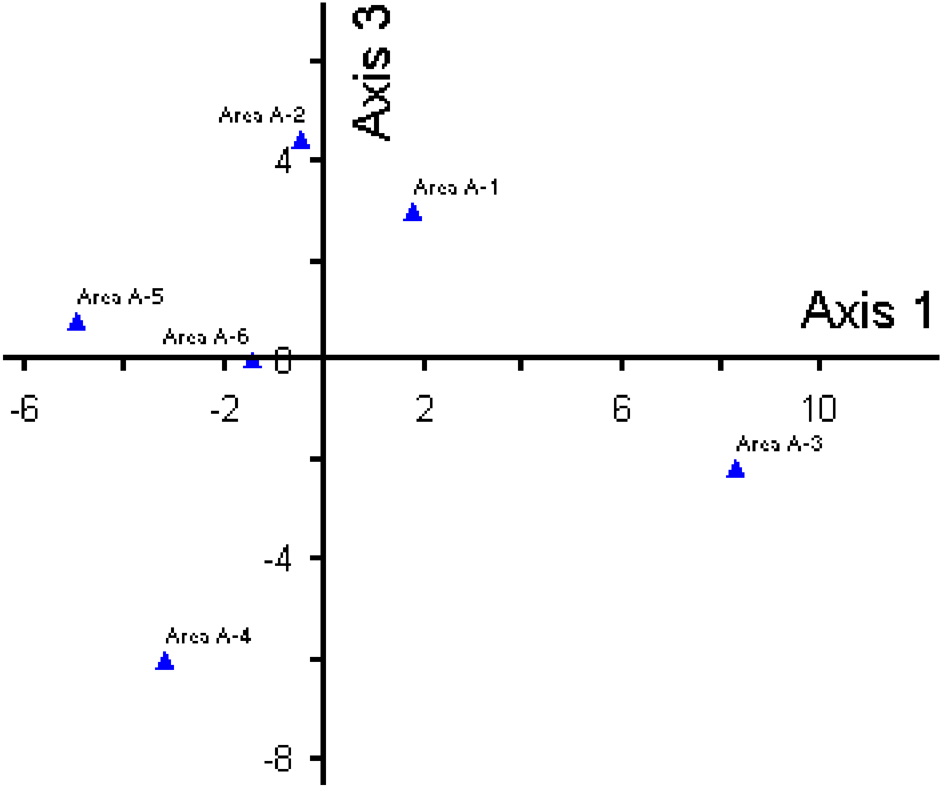


Fig. IV.C.3.c. Aquatic Biota PCA 2,

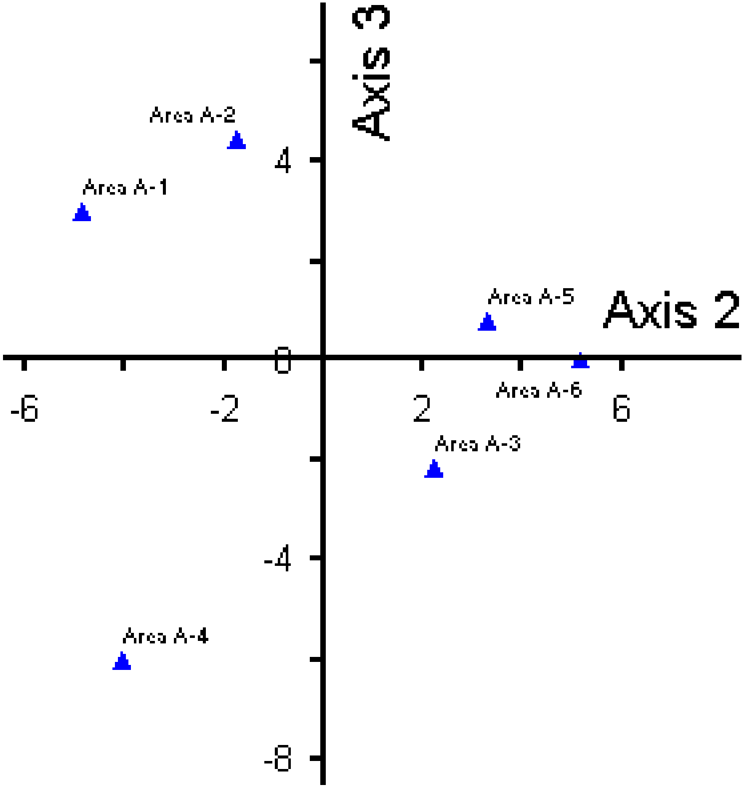


Fig. IV.D.1. Cluster Dendrogram for Terrestrial Plants

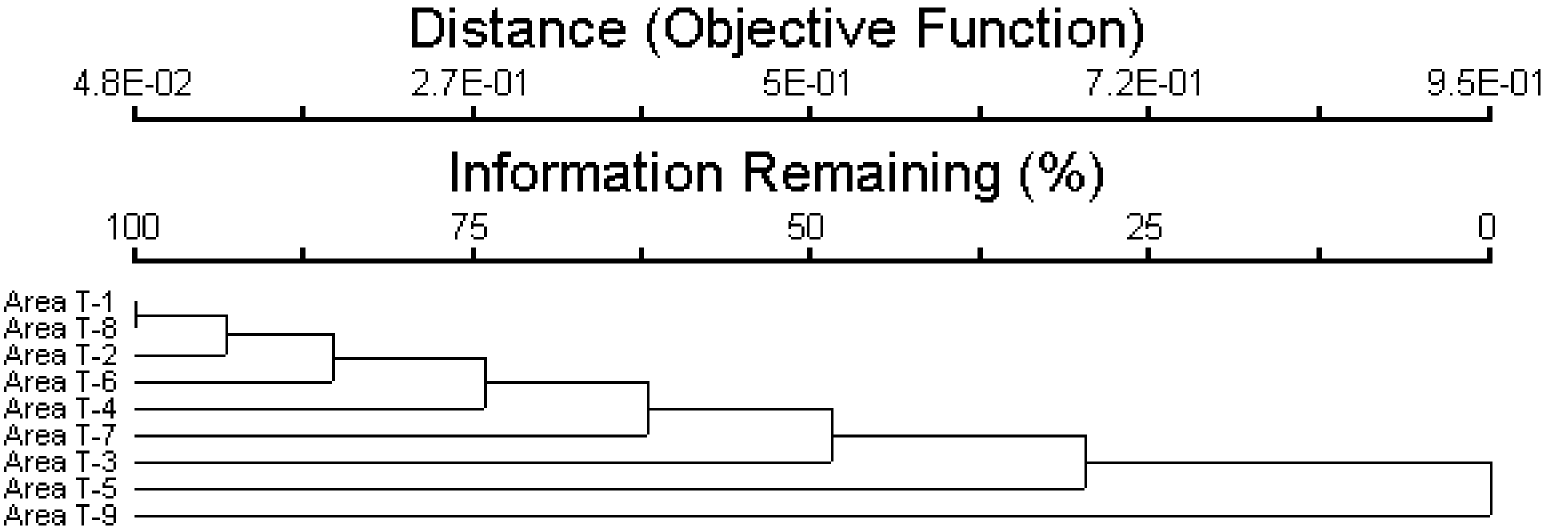


Fig. IV.D.2.a. Land Plant PCA 1,2

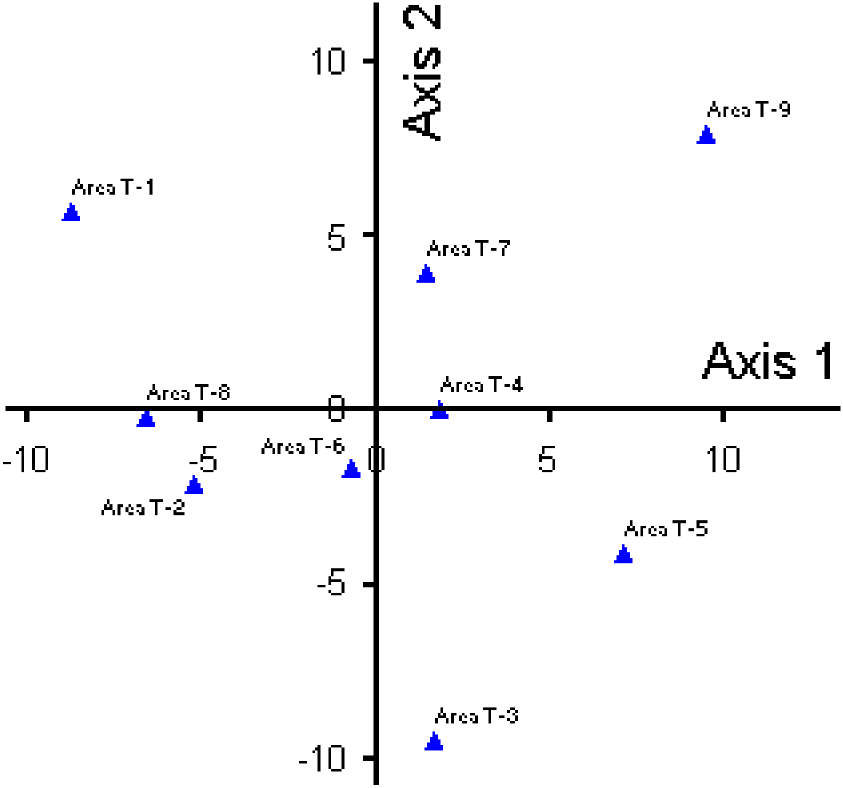


Fig. IV.D.2.b. Land Plant PCA 1,3

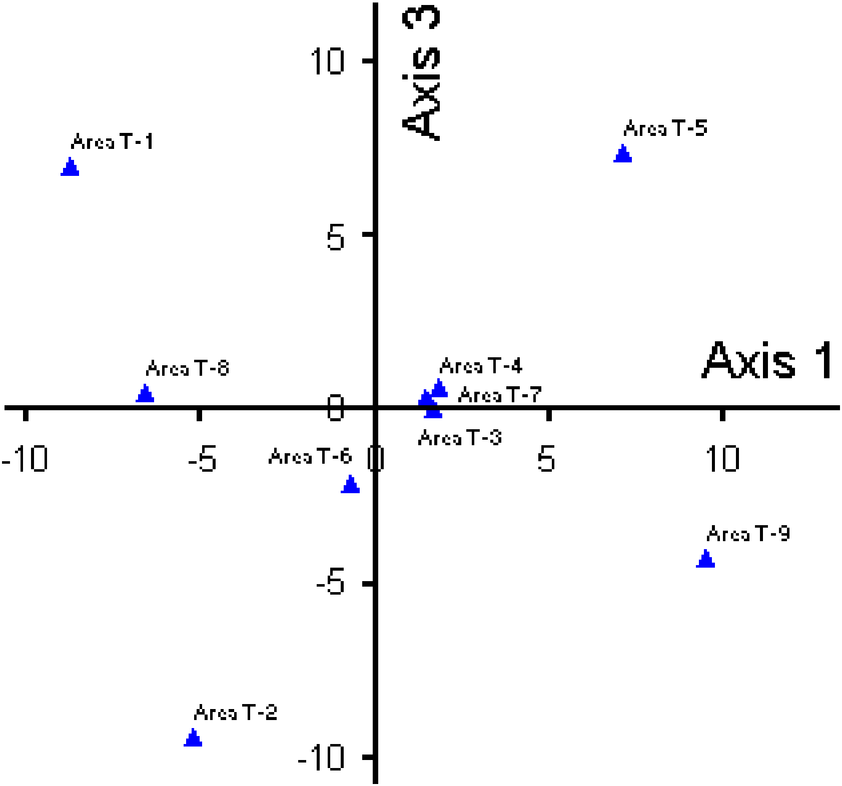


Fig. IV.D.2.c. Land Plant PCA 2,3

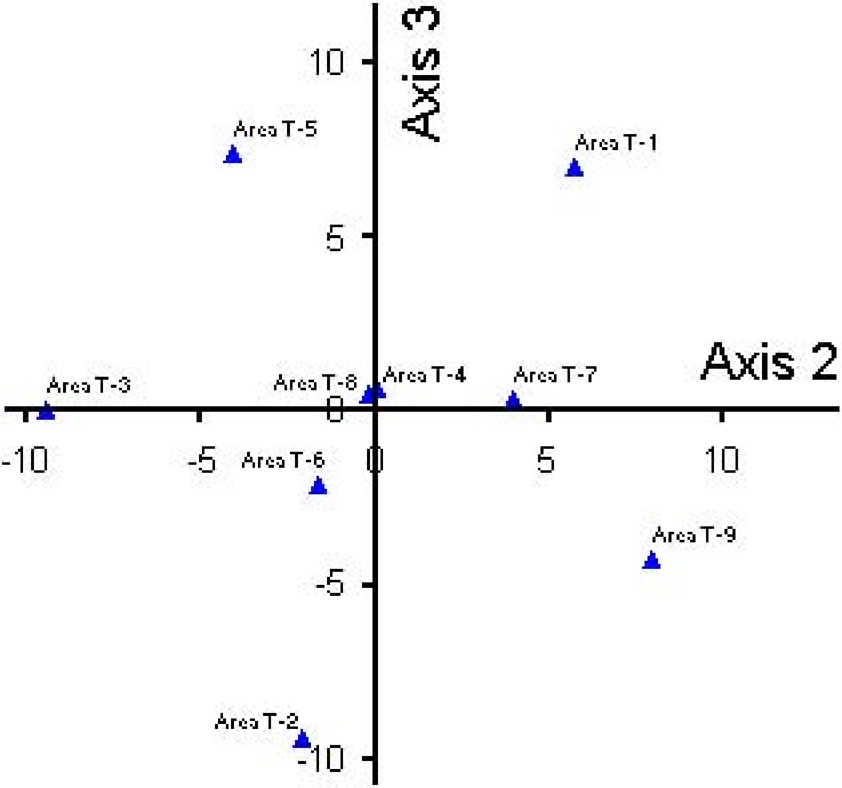


Fig. IV.D.3. Cluster Dendrogram for Transition Zone Plants

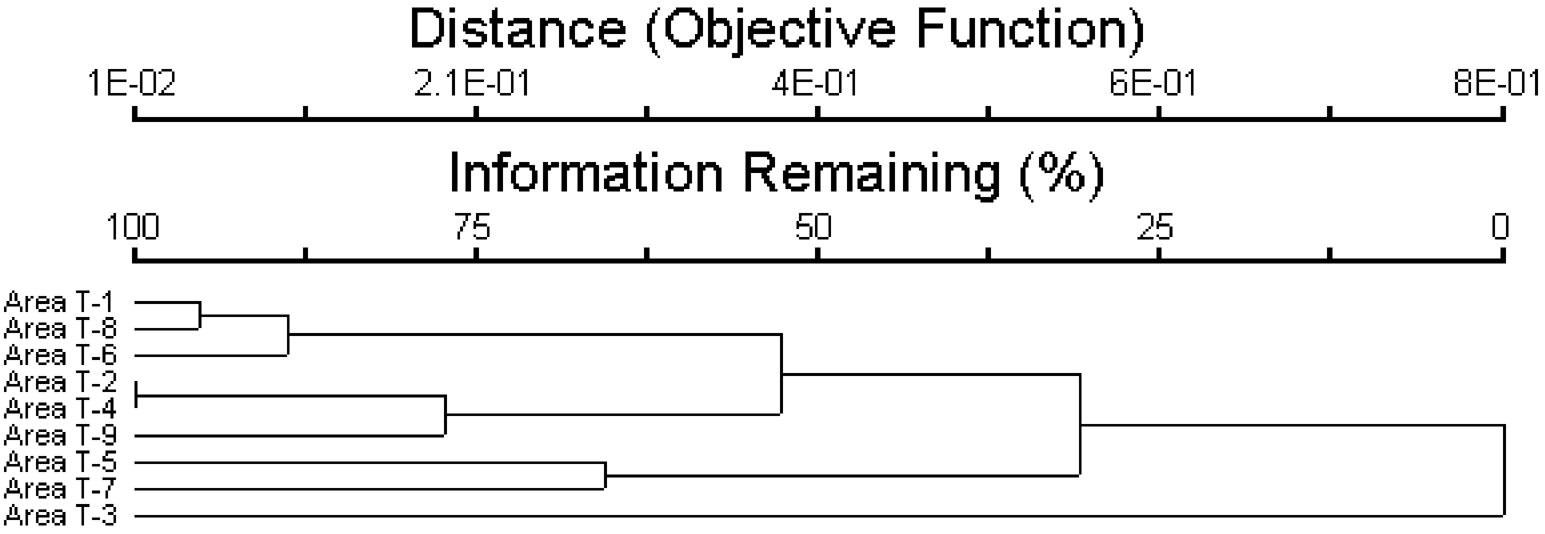


Fig. IV.D.4.a. Transition Plant PCA 1,2

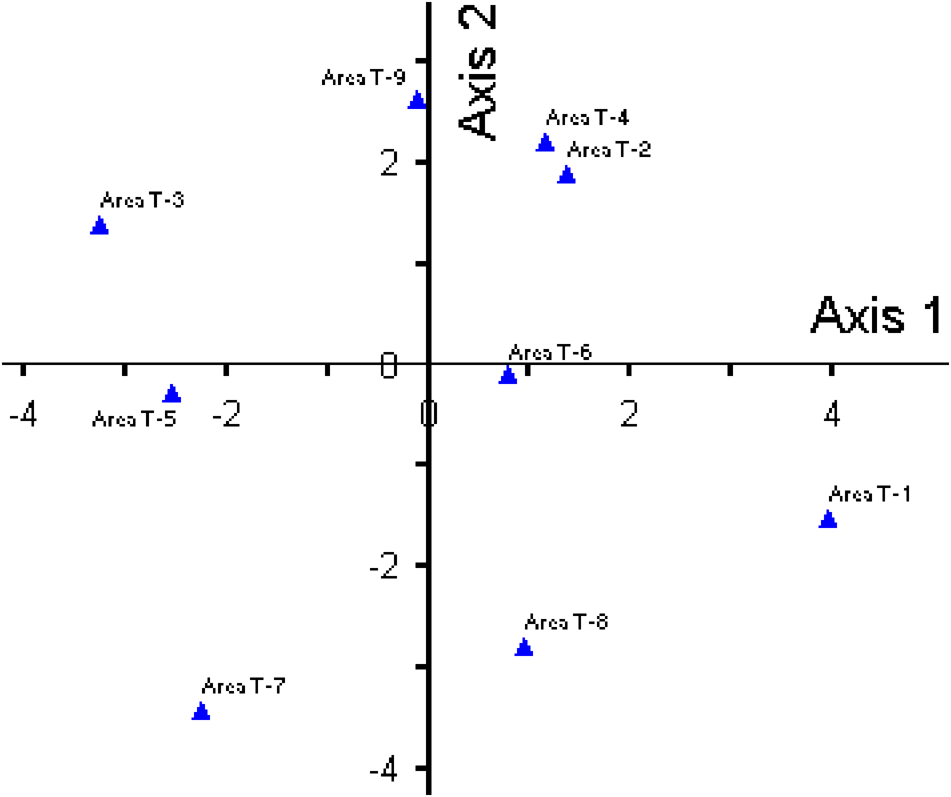


Fig. IV.D.4.b. Transition Plant PCA 1,3

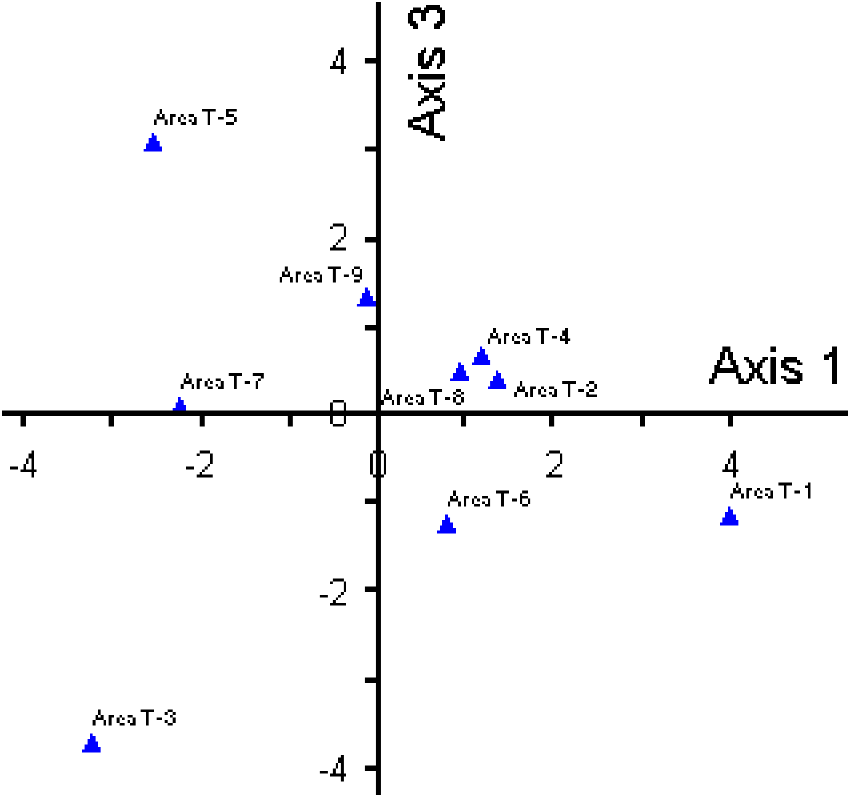
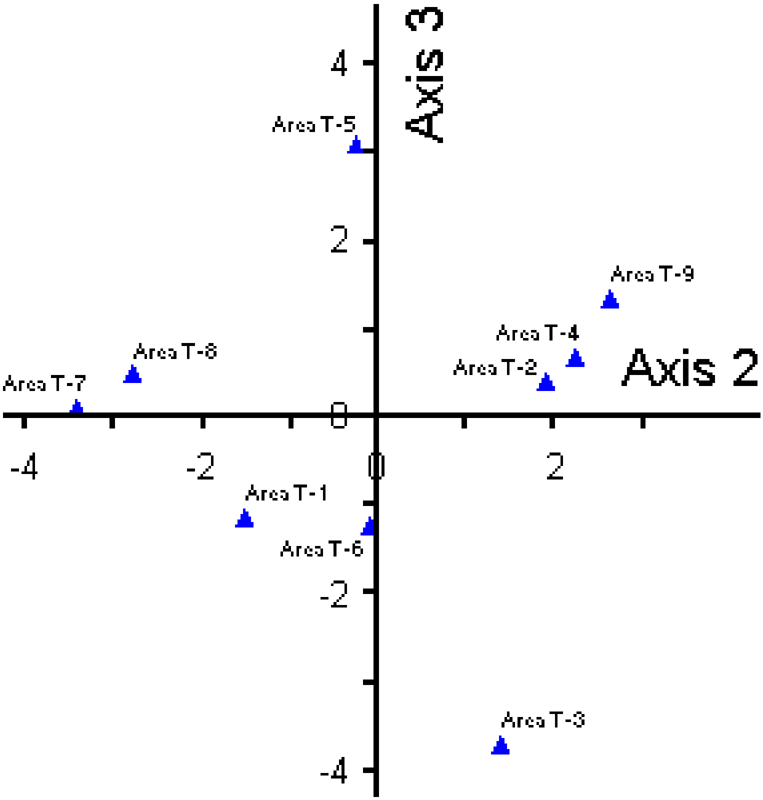


Fig. IV.D.4.c. Transition Plant PCA 2,3



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IV.B.1. Raw Sampling Data for Aquatic Macrophytes in 2002

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b. Summer
c. Fall

IV.C.1. Raw and Summarized Sampling Data for Fish in 2002

a. Spring
b. Summer
c. Fall
d. Summarized

IV.C.2. Raw Sampling Data for Macroinvertebrates in 2002

a. Area A-1
b. Area A-2
c. Area A-3
d. Area A-4
e. Area A-5
f. Area A-6

IV.D.1. Plants Identified and Communities Photographed in the Nine Terrestrial Areas of Concern Surrounding Irondequoit Bay in 2002

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b. Area T-2
c. Area T-3
d. Area T-4
e. Area T-5
f. Area T-6
g. Area T-7
h. Area T-8
i. Area T-9

Appendix IV.D.1.c. Terrestrial plant communities at Area T-3 (continued).				
Photograph (Bearing)	GPS Coordinates	Overstory Plants	Understory Plants	Groundcover Plants
				Butterfly-weed*
				(*Asclepias tuberosa*)
				Virginia Stickseed
				(*Hackelia virginiana*)
				Verbena
				(*Verbena* sp.)
2-III (198)	43 12971 - 77 31445	Black/Pin Oak	Honeysuckle	Grape
		(*Quercus* spp.)	(*Lonicera* sp.)	(*Vitis* sp.)
		Black Locust	Black Walnut	Poison Ivy
		(*Robinia pseudoacacia*)	(*Juglans nigra*)	(*Toxicodendron radicans*)
		Common Cottonwood	Silver-berry	Mustard
		(*Populus deltoides*)	(*Elaeagnus* sp.)	(*Brassica* sp.)
			Tree of Heaven	Grasses
			(*Ailanthus altissima*)	(Poaceae family)
			Black Locust	Raspberry
			(*Robinia pseudoacacia*)	(*Rubus* sp.)
				Stinging-nettle
				(*Urtica dioica*)
				Milkweed
				(*Asclepias* sp.)
				Queen Anne's Lace
				(*Daucus carota*)
				Goldenrod
				(*Solidago* sp.)
				Ragweed
				(*Ambrosia* sp.)
				Butterfly-weed*
				(*Asclepias tuberosa*)
3-III (150)	43 12972 - 77 31490	Black Oak	Black Oak	Poison Ivy
		(*Quercus velutina*)	(*Quercus velutina*)	(*Toxicodendron radicans*)
			Sassafras	Goldenrod
			(*Sassafras albidum*)	(*Solidago* sp.)
			Honeysuckle	Milkweed
			(*Lonicera* sp.)	(*Asclepias* sp.)
			Downy Juneberry	Queen Anne's Lace
			(*Amelanchier arborea*)	(*Daucus carota*)
			Norway Maple	Ragweed
			(*Acer platanoides*)	(*Ambrosia* sp.)
			Cherry	Raspberry
			(*Prunus* sp.)	(*Rubus* sp.)
			Hickory	Mustard
			(*Carya* sp.)	(*Brassica* sp.)
			Silver-berry	Grape
			(*Elaeagnus commutata*)	(*Vitis* sp.)
			Dead Oak saplings	
4-III (55)	43 12940 - 77 31474		Silver-berry	Butterfly-weed*
			(*Elaeagnus commutata*)	(*Asclepias tuberosa*)
				Common St. John's-wort
				(*Hypericum perforatum*)
				Bouncing Bet
				(*Saponaria officinalis*)
				Grasses
				(Poaceae family)
				Soil highly disturbed (trails)