# Aquatic Park
# Natural Resource Management Study
# (NRMS)

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# 1.0 INTRODUCTION

## 1.1 Purpose and Scope of Study

Aquatic Park is located on the western edge of the City of Berkeley and encompasses three separate lagoons stretching from north to south - the Main Lagoon, Model Yacht Basin (MYB), and Radio Tower Pond (RTP). These lagoons, artificially created in the 1930s, are separated from San Francisco Bay by Interstate 80 and receive tidal water through a series of culverts, or tide tubes. A variety of habitats border the lagoons along with roadways and parklands. Aquatic Park includes a number of active recreational areas including a Frisbee golf course, water-skiing and rowing areas, kids' playground, picnic areas and walking and bicycling trails. The Park totals 99 acres of water and upland areas.

In 2001, the City of Berkeley selected the team of Laurel Marcus and Associates, Hydroikos Associates, Hydrologic Systems, Inc. and Vallier Design Associates to prepare a Natural Resource Management Study (NRMS) for Aquatic Park.

The purpose of the Natural Resource Management Study (NRMS) is to evaluate the hydrological features, habitat extent and the recreational uses in Aquatic Park. The NRMS is primarily focused on improving water quality in the tidal lagoons of the Park and identifies a range of alternatives for water quality and habitat improvements, and management and maintenance needs. Each alternative provides the City of Berkeley with detailed information for use in the future management of Aquatic Park's natural and recreational resources. The NRMS uses an integrated approach to evaluate hydrologic improvements, potential habitat restoration concepts and existing recreational uses.

The NRMS includes a series of tasks:

**Task 1: Collect and Review Relevant Existing Data**
A broad effort was made to collect reports and studies on the natural resources of Aquatic Park as well as specific information relevant to the Study.

**Task 2: Collect Additional Data**
The primary focus of the NRMS is hydrological studies and monitoring, habitat analysis and evaluation of management and maintenance needs. A series of measurements were collected on the lagoons - bathymetry, or water depths; size and condition of all culverts, tide tubes and gates; tidal heights and duration, temperature and salinity of the Main Lagoon. Maps of the existing wildlife habitats and vegetation types around the lagoons, including locations of invasive non-native plants species and active recreational use areas of the Park were completed.

### Task 3: Prepare Description of Existing Environmental Conditions

An Existing Conditions Report was prepared and submitted for review by the City and Advisory Committee.

### Task 4: Identify Management Issues, Study Goals and Alternatives

Our team, in conjunction with City staff and the Advisory Committee, discussed a list of management issues and goals to be addressed in the development of alternatives for the NRMS. These goals address natural resources, water quality improvements, recreational uses and long-term management and maintenance.

### Task 5: Evaluate Study Alternatives

Our team, in conjunction with City staff and the Advisory Committee, discussed a set of alternatives to improve water quality and increase habitat areas.

### Task 6: Prepare Administrative Draft of Natural Resource Management Study

This Administrative Draft of the NRMS discusses existing conditions, the alternatives including hydrology improvements and habitat restoration areas. City staff and the Advisory Committee will review this Draft before it is finalized for public review.

### Task 7: Complete Natural Resource Management Study for Public Review

The Administrative Draft Study will be revised based on City staff and Advisory Committee comments and a Final Study will be presented to the Parks and Recreation and Waterfront Commissions in a public meeting.

## 1.2 Goals of the NRMS

The overall goals of the Aquatic Park Natural Resource Management Study were developed in conjunction with City staff and incorporate the Revised Proposed 2000 Draft Aquatic Park Master Plan Goals. At two meetings of the Advisory Committee, the following goals were reviewed and approved for the NRMS:

- Balance recreational uses with the enhancement and restoration of wetlands, other aquatic and terrestrial habitats, and improvements to lagoon water quality and circulation. Evaluate the southern portion of the Park as a focus of restoration of habitat for birds and other wildlife.
- Identify locations of invasive non-native plants and diseased and senescent plants and revegetate with native plant species in upland and shoreline areas.
- Design restoration of native habitats to avoid increases in management and unacceptable activities in the Park.
- Focus on low maintenance structures to reduce the need for long-term funding.
- Evaluate approaches to address water quality problems through mechanical harvesting, dredging, and increasing water circulation with improved flow structures.

## 1.3 Relationship to the 1990 Aquatic Park Master Plan

In 1990, the City of Berkeley prepared the Aquatic Park Master Plan. Revised Proposed 2000 Draft Aquatic Park Master Plan Goals include:

- Enhance natural resources and systems within the Park by restoring, expanding and maintaining the Park's wildlife habitat and improving water circulation and quality. As part of this approach, protect and enhance the south end of the Park as a bird sanctuary.
- Increase the number of users and types of uses within the Park. Balance increasing Park use with protecting and enhancing the Park's natural resources.
- Improve circulation and support facilities within the Park for pedestrians, bicyclists and wheelchair users. Limit auto access and circulation mainly to entrance areas within the Park, providing adequate auto parking in those areas for regular visitors and for special events.
- Develop and implement a realistic and effective Park maintenance program, which is periodically updated and actively encourages involvement of Park ten ants and users when feasible.
- Strategically pursue all viable and appropriate funding options to implement Park goals and strategies.

The following are examples of how the goals of the NRMS are consistent with the Master Plan goals:

- Focusing habitat restoration on the southern end of the Park;
- Enhancing the Park's physical appearance;
- Enhancing natural resources and improving water circulation and quality; and
- Developing a realistic and effective Park maintenance program.

# 2.0 EXISTING CONDITIONS

## 2.1 Existing Information Sources

Previous reports were reviewed including the Aquatic Park Water Quality Improvement Study by CH2M Hill (1994), a Hydrology and Water Quality Study by Philip Williams and Associates (PWA) (1990) and the Aquatic Park Master Plan by MPA Design (1990). In addition, assorted research papers written by University of California Berkeley students were reviewed. Topics included chemical and physical parameters affecting recreation and wildlife (C. Altamirano, 1983), biological parameters (I. Betts ,1983), aquatic vegetation (R.J. Jacobs 1989), and the history and development of Aquatic Park (C.L. Ferlin, 1983).

The following is a summary of previously completed hydrologic and bathymetric studies on Aquatic Park.

The CH2M Hill study evaluated the capacity of the Main Lagoon to receive and treat stormwater runoff from the Potter Street stormdrain and Strawberry Creek. The primary treatment objective of this study was the removal of suspended sediments and includes a qualitative description of nutrient removal capacity of aquatic plants.

The existing and historic (or non-functional) tide tubes are described in the reports by PWA, CH2M Hill, and the City of Berkeley. The Tidal Benchmark sheets for Berkeley were collected and the input files from the previous computer model of the lagoons were compiled from archived versions. Previous bathymetric measurements were also collected. AutoCAD maps of the Park and its topography and features were obtained from the City of Berkeley.

Only limited water quality data were available for the lagoons at Aquatic Park. The CH2M Hill study included sampling on 3 occasions during dry weather and one occasion in wet weather for bacteria, heavy metals, and chlorophyll-a, total suspended solids (TSS), temperature, salinity, dissolved oxygen and secchi depth (water clarity). Two sediment samples (from the Main Lagoon and the MYB) were analyzed for sediment grain size, heavy metals, and a few organic/toxic compounds.

Water quality studies of Aquatic Park done by UC Berkeley students in 1983 tested for temperature, dissolved oxygen, pH, conductivity, ammonia, organic nitrogen, turbidity, mercury, cadmium, lead, and bacteriological contamination (fecal coliform/fecal streptococci). Bacteriological tests were conducted periodically in all three lagoons by CH2M Hill from April of 1999 to October of 2001 and by the City of Berkeley in 2002.

## Wildlife

Information on fish and bird populations at Aquatic Park was researched. Joelle Buffa of the US Fish and Wildlife Service was contacted about the annual Christmas bird counts conducted by the Audubon Society, but the counts that include Aquatic Park encompass a much larger area, so the data is not useful for characterizing the Park. Steve Granholm of the Golden Gate Audubon Society was also contacted several times to obtain bird studies of Aquatic Park and no reply was received. Bird information from other representatives of the Golden Gate Audubon Society was requested, but no response was received. Christine Atkinson, the Fish and Game freshwater aquatic biologist for this region, did not have any fish population information for the Aquatic Park area. Becky Otta, the regional Fish and Game marine biologist was also contacted, but no reply was received. The only study found pertaining to bird populations was LSA's report on *Marsh Enhancement at Aquatic Park* that contained a reference to a *Marine Bird Census of Aquatic Park* done by C. Coates in 1989. No specific studies were found pertaining to fish populations at Aquatic Park.

## Recreational Use

Recreational user information was compiled as well as background on current maintenance practices and problems in the Park.

Stu Swanson, Landscape Gardner Supervisor for the City of Berkeley, was contacted to obtain information on current maintenance practices at Aquatic Park. Fred Conrad of the Berkeley Paddling and Rowing Club (BPRC) was contacted concerning boating and rowing activities at Aquatic Park. Daniel Stapelton and Dave Ritter were contacted about water-skiing activities at Aquatic Park. Brad Ricards of the City of Berkeley was contacted about the playground located on the central east side of the Main Lagoon at Aquatic Park. Neil Bondy was contacted for information on the disc golf course at Aquatic Park. Additional information from the NRMS oversight committee was included. City staff from various departments were consulted to make sure all the relevant information was collected for the NRMS.

## 2.2 Collection of Additional Data

Based on the review of the existing data, new additional data were collected on a variety of features of Aquatic Park to complete the analysis required for the NRMS.

**Tidal Conditions and Lagoon Bathymetry**

A number of measurements of the physical conditions of the lagoons were taken to allow for accurate calibration of the water circulation model to evaluate alternatives. These measurements include:

- Water depths or bathymetry to measure the volume of water in the tidal range and volume of water below the tidal range in each lagoon. Lagoon bathymetry also demonstrates the slope of the lagoon shorelines, an important consideration for habitat restoration.
- Tidal height measurements, both outside the lagoons in the Bay and inside the lagoons, to evaluate the amount of tidal exchange occurring in the lagoon and the size of the intertidal zone. These measurements were done twice - before and after a thorough cleanout of the lagoon culverts.
- Measurements of temperature and salinity in the water columns to determine the level of vertical mixing or lack thereof (stratification) in the lagoon. Stratification occurs in lagoons and lakes where layers of water separate due to differences in temperature (warm on top, cold on bottom) or salinity (fresh on top, saline on bottom) and can affect water quality.
- The condition, size and in some locations elevation of culverts, weirs and other water control structures.

In 2002, Sea Surveyor created a new bathymetric map of the Main Lagoon, the MYB, and the RTP (see Figure 2-1). The bathymetric map covers only the water areas of the lagoons and indicates depths in feet to 0.1 foot units. The condition of the culverts of the Main Lagoon, MYB and RTP were examined at Aquatic Park (see Figures 2-2, 2-3 and 2-4). The condition and invert elevations of the main culverts were determined. The location and elevations of the Strawberry Creek culvert and stormwater overflow weir were also determined.

Two recording tide gages were installed - one in the Bay, near the Main Lagoon inlet-outlet culverts and one in the Main Lagoon on the culvert headwall or terminus (see Figure 2-5). There were two different tidal monitoring periods - the first was May 29-July 1, 2002 and the second was April 5-16, 2003. The first set of readings were completed in 2002, prior to a clearing of the culverts by the City; the second set of readings were completed in 2003 to measure changes in tidal levels after cleaning the culverts. Each time, the tide gages were left in place for over two weeks and collected data at 15-minute intervals. During the first tidal

**Figure 2-1. Aquatic Park Bathymetry (ft. NGVD)**

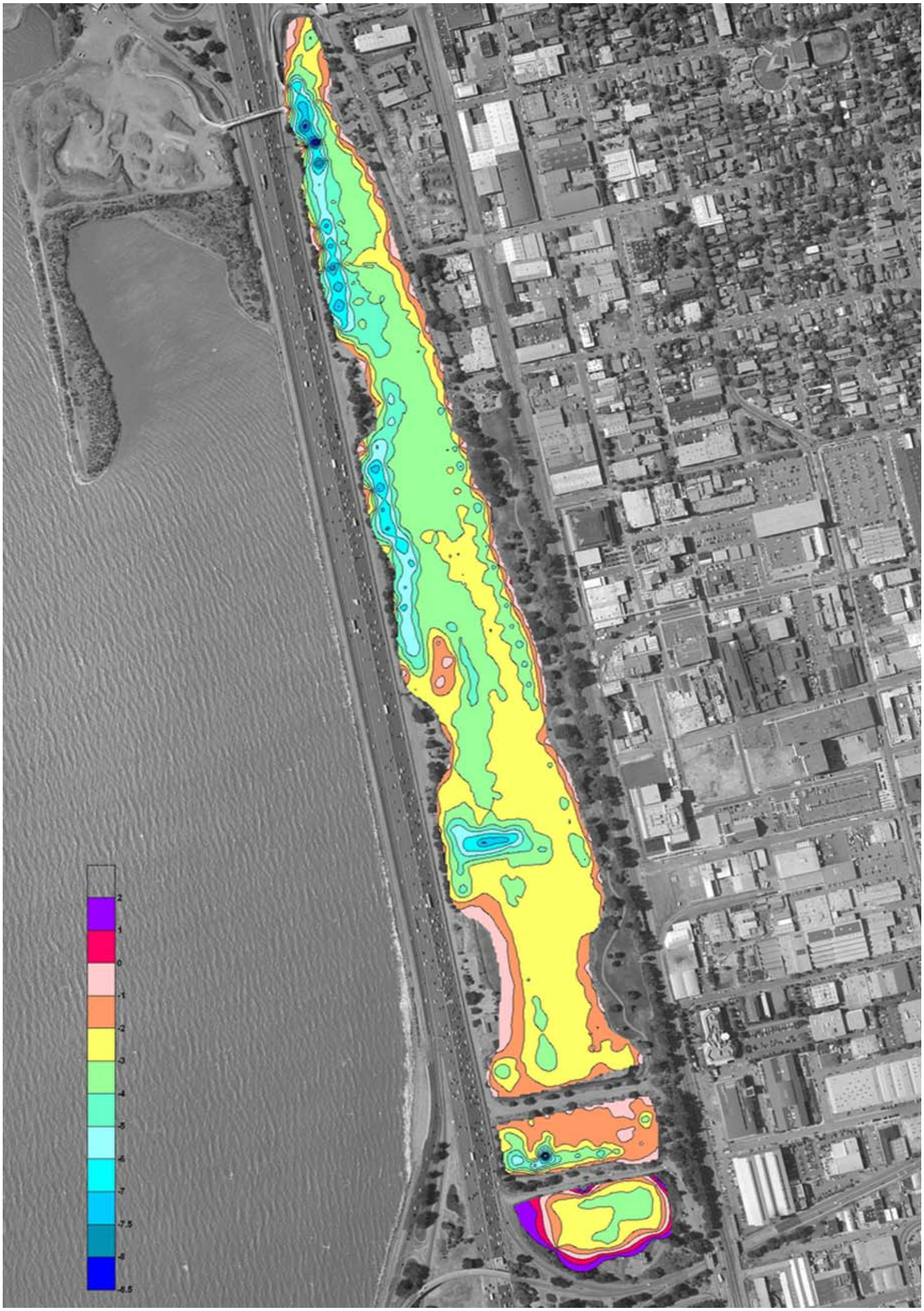


Figure 2-2. Aerial Photograph Showing Culvert Locations (Section 1)

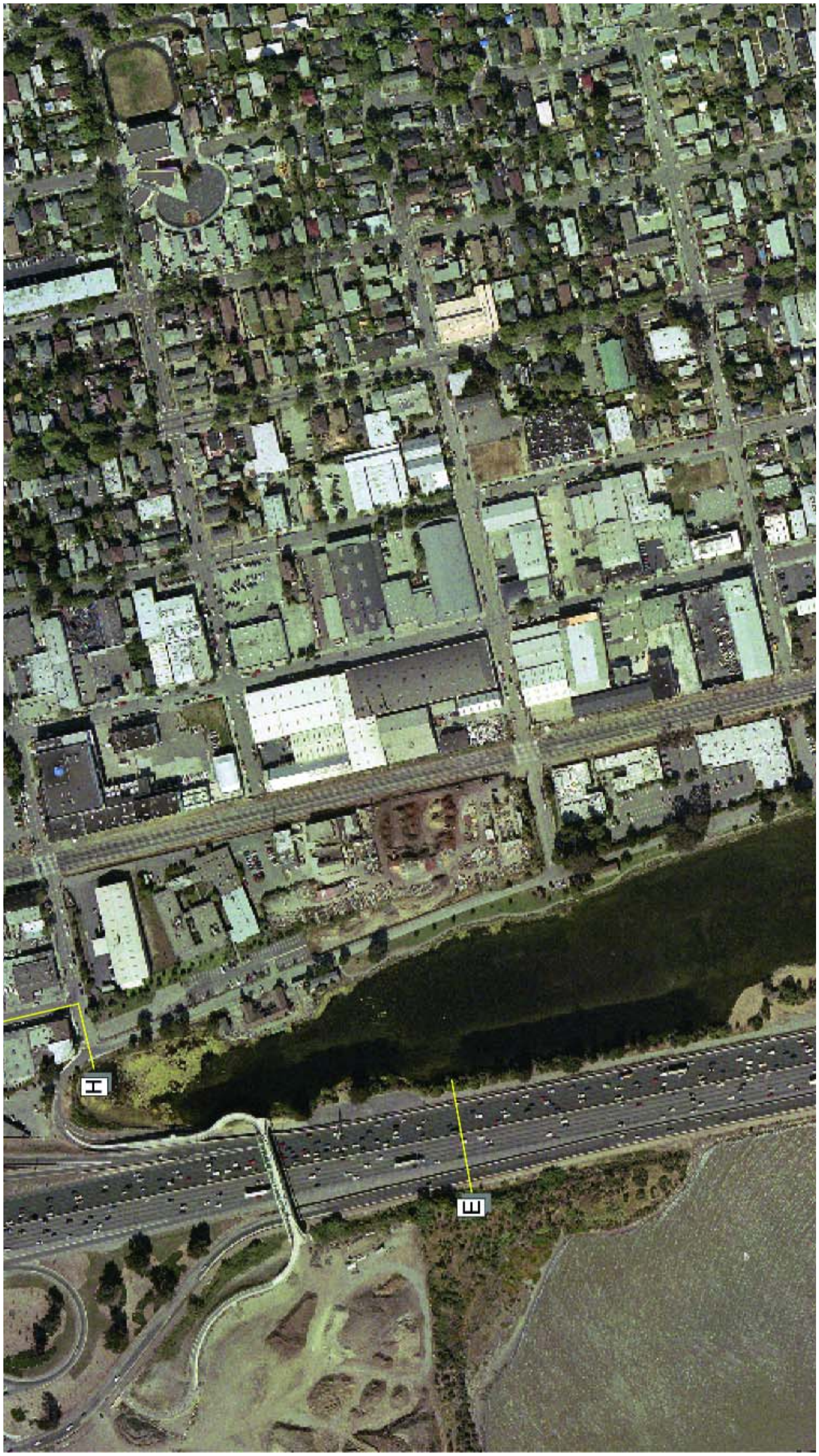
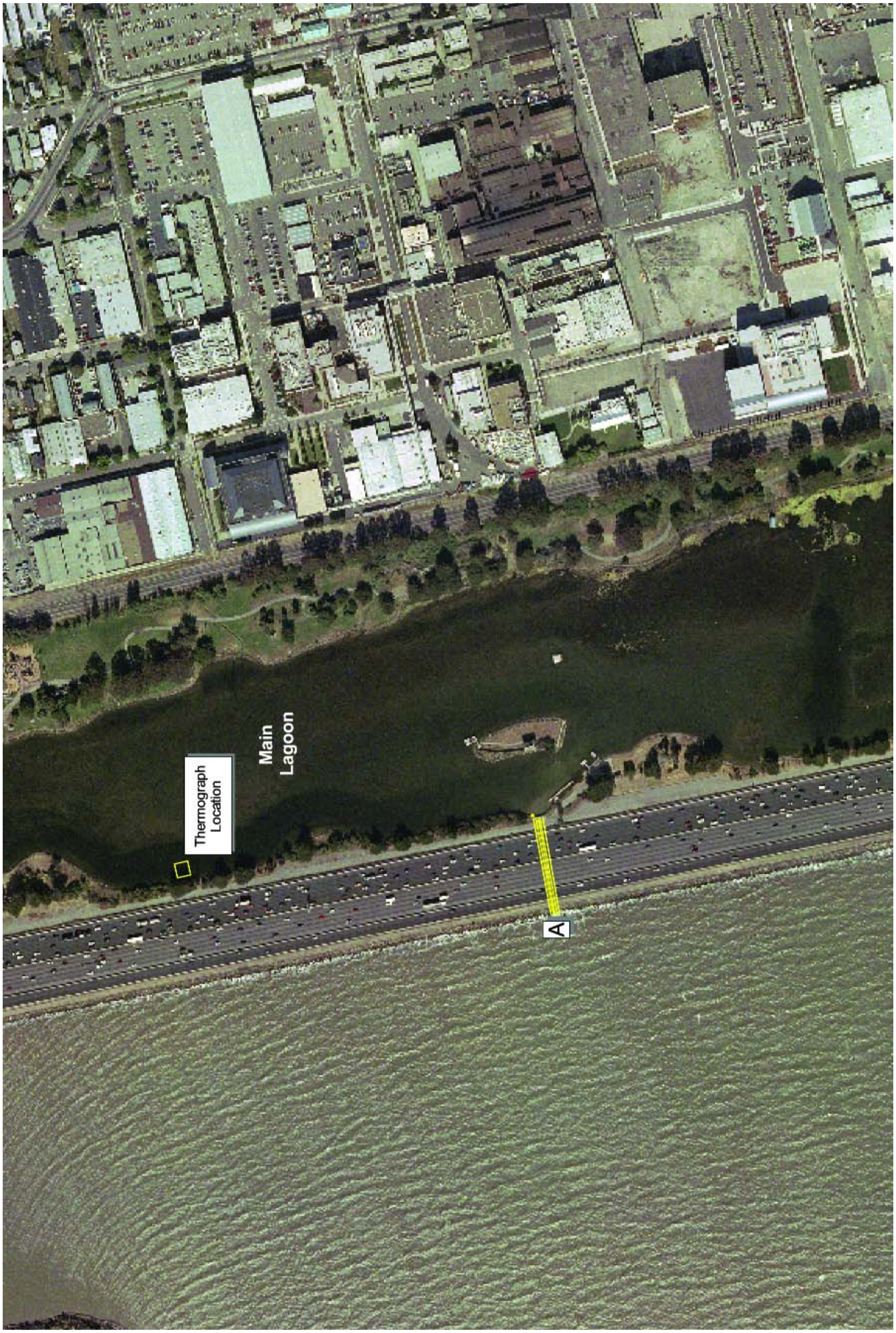


Figure 2-3.  Aerial Photograph Showing Culvert Locations (Section 2)



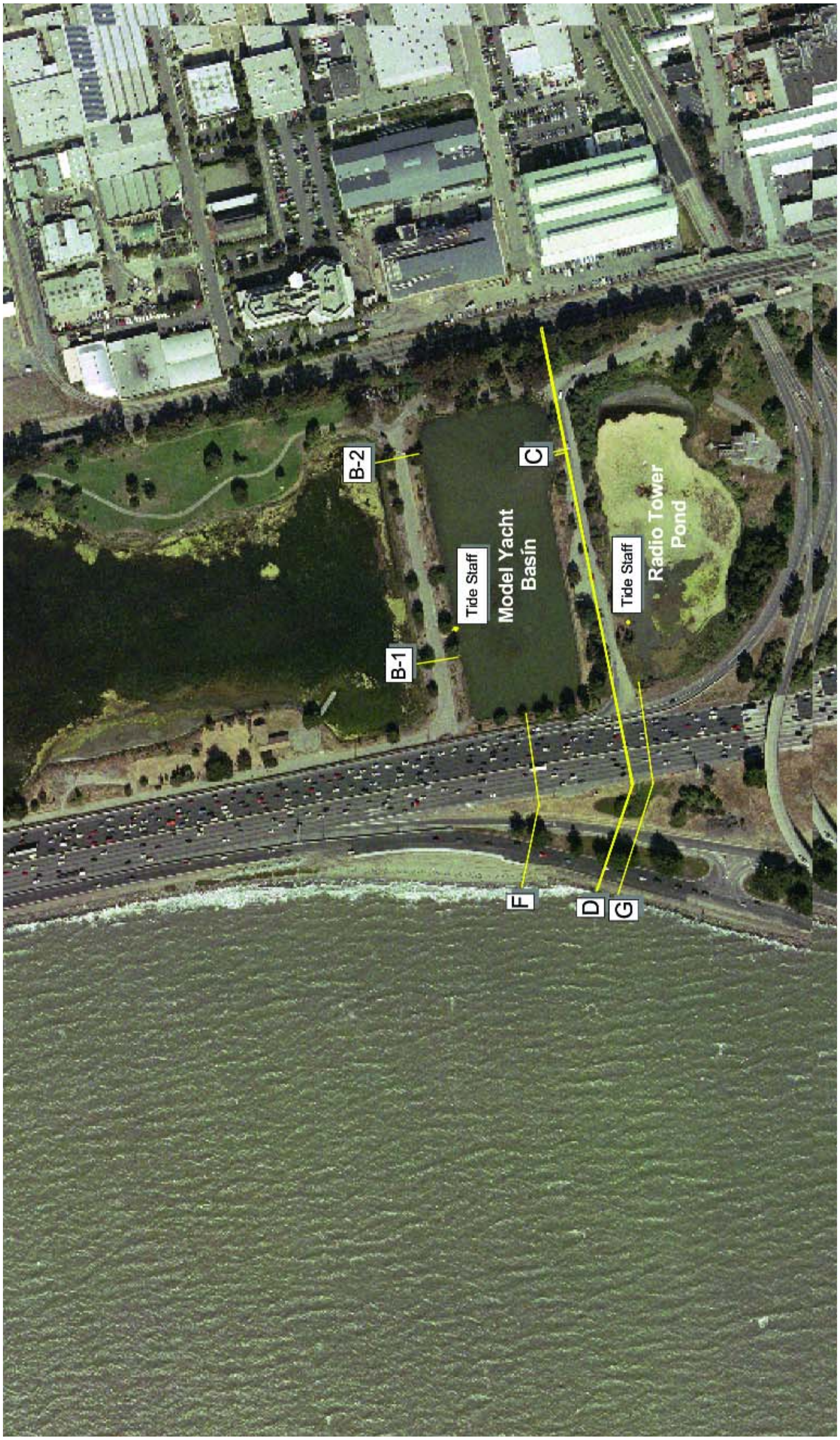



**Figure 2-4. Aerial Photograph Showing Culvert Locations (Section 3)**

**Figure 2-5. Recording Tide Gage Installed in Model Yacht Basin**

monitoring period, periodic staff readings were taken in the MYB and in the RTP. While during the second tidal monitoring period, a tide gage was placed in the MYB. This tide information was augmented with velocity data collected in the Main Lagoon at various locations during the second monitoring period.

In the first monitoring period, the degree of vertical stratification was determined in the Main Lagoon using recording thermographs, which were installed at one foot below the surface and at the bottom (eight feet below the surface). The data loggers were set to record at 15-minute intervals; the accuracy of the recorders used is 0.7°F (0.4°C). In addition, salinity was measured in surface and bottom samples at two locations in the northern half of the Main Lagoon.

### Wetlands, Invasive Non-native Plants and Land use

A new geo-referenced aerial photograph was produced by Pacific Aerial Survey in association with HJW GeoSpatial, Inc. for use in the NRMS. A detailed field survey of the Park was conducted to map the following:

- Location and extent of invasive non-native plants;
- Tidal/brackish wetland extent on shoreline of each lagoon;
- Senescent or diseased trees and shrubs;
- Extent and conditions of freshwater wetlands; and
- Location of recreational uses.

The entire perimeter of the Main Lagoon, the MYB and the RTP were inventoried, as were the surrounding uplands. Based on vegetation types and densities, size of habitat areas, degree of disturbance and proximity to heavily used recreational areas, each area of the Park was qualitatively evaluated for wildlife habitat values. These evaluations were used in formulating alternatives.

Photos were taken to document vegetation species, vegetation density, wetland areas, recreational usage, algal blooms, lagoon edge conditions, and other features of Aquatic Park. A GPS (Global Positioning System) unit was used to record locations of invasive plants and other points of interest. Field information was then converted into layers and placed on the geo-referenced aerial photograph of the Park using a GIS (Geographic Information System) (see Figures 2-48, 2-49, 2-50, 2-52, 2-53, 2-54, 3-10, 3-11 and 3-12).

## 2.3 Results of Additional Data Collection

### Culverts and Water Control Structures

The tidal circulation at Aquatic Park depends on the connection of the Main Lagoon and MYB with the Bay. The culverts or tide tubes under Interstate 80 were part of the original construction of the lagoons in the 1930s. The field inspection found some of the culverts are completely buried or collapsed; others are at times partly filled with sediment and aquatic organisms, and their capacity is reduced. Since the beginning of this study, the City had some of the culverts cleaned out, and they are now functioning better.

The Main Lagoon Inlet-Outlet Culverts
Five culverts with adjustable inside slide-flap gates connect the Main Lagoon directly with the Bay (see A on Figure 2-3). The outside end of one of the culverts is broken and collapsed. The City reportedly had the culverts cleaned of sediment and marine organisms in December 2002. At the headwall, or terminus, on the lagoon side, the culverts open into a box with an overflow weir positioned at an elevation to allow overflow of storm runoff from the Main Lagoon (see Figure 2-6). Weirs inside the box allow overflow from one culvert to spill into the adjacent culverts (see Figure 2-7). The City varies the number of closed and open gates from time to time, but the closed gates leak, allowing outflow as well as inflow.

The Main Lagoon-Model Yacht Basin Connection
Two culverts connect the Main Lagoon with the MYB (at B-1 and B-2 on Figure 2-4; see Figure 2-8). These culverts were formerly almost completely occluded by the calcareous tubes, or casings, of sabellid feather-duster worms, but since the City had them cleaned out they are now open.

The Potter Street Stormdrain
The MYB is connected to the Bay through the Potter Street stormdrain, which runs under Bolivar Drive, under Interstate-80 and the Ashby Avenue off-ramp, and empties into the Bay at a headwall (at D on Figure 2-4). At the outfall, the culvert is a concrete box that is connected inside to a concrete arch culvert that runs beneath Bolivar Drive.

Two culverts with weirs allow outflow from the MYB into the Potter Street culvert (at C on Figure 2-4; see Figure 2-9). Both of these culverts were formerly about 50 percent occluded by feather-duster worm casings, but are now open. Below the weirs, the outflow from the MYB enters the Potter Street stormdrain through two elliptical openings. On incoming tides, or during heavy storm runoff, the structure allows overflow into the MYB through steel grates above the weirs. Dead algae caught on the grate and scour of soil around the outlet attest to the volumes and velocities of water that flow up through the grate and into the MYB (see Figure 2-10).

**Figure 2-6.  Headwall of the Main Lagoon Inlet-Outlet Culverts**

**Figure 2-7.  Inside the Main Inlet-Outlet Box Culvert**

**Figure 2-8. Mouth of Culvert Showing Growth of Marine Worms that Limit Flow**

**Figure 2-9. Model Yacht Basin Connection to Main Lagoon**

**Figure 2-10. Grate Over Weir Box in the Connection Between the Model Yacht Basin and the Potter Street Stormdrain**

The Radio Tower Pond

The RTP has no present connection with the MYB or Potter Street stormdrain. A culvert connects the RTP directly with the Bay (at G on Figure 2-4). The opening of this culvert on the RTP side is crushed and partially blocked by sediment. The remaining section of the culvert connects into a vertical box structure. The vertical box structure connects to a culvert underneath Interstate 80 and to the Bay. The relatively constant low water level in the RTP suggests that there is a leaking tide gate in the culvert system, but none could be found and none is described in previous reports.

The Strawberry Creek Overflow

Strawberry Creek flows in a stormdrain under University Avenue. After crossing under Interstate 80, the culvert turns south and enters the Bay. During heavy runoff, the Strawberry Creek stormwater can overflow across a weir beneath Second Street and enter the north end of the Main Lagoon at the foot of Addison Street (at H on Figure 2-2). At the base of the weir is a flap gate that allows outflow from the Main Lagoon to Strawberry Creek. However, the pipe at the weir and tide gate structure is at an elevation that limits outflow from the Main Lagoon to Strawberry Creek.

Model Yacht Basin and Bay Connection

There is one culvert between the MYB and the Bay (at F on Figure 2-4). Until recently the outlet was buried in the sandy beach west of the Ashby off-ramp. With the recent cleaning, this culvert has begun to function again.

Minor Stormdrains

In addition to the Potter Street stormdrain, there are several small stormdrains that convey runoff under the railroad tracks and either directly into the Main Lagoon, or to one of the small wetlands, which then drain to the Main Lagoon. These minor stormdrains include the Parker Street, Carlton Street, Grayson Street and Heinz Avenue stormdrains, as well as the Allston Way, Bancroft Way, and Channing Way stormdrains.

Poorly Functioning Culverts

There is one culvert that is visible in the north section of the Main Lagoon, but whose outlet on the Bay side is buried and lost. The outlet is located in a ditch west of Interstate 80 and is buried. Due to the size and clogged condition of this ditch, there is little chance that this culvert could be made to function.

## Lagoon Bathymetry

Figure 2-1 shows the bathymetry of the Main Lagoon, the MYB, and the RTP as of December 2001. The acreage of the average water areas of each lagoon was measured using the GIS. The Main Lagoon is 56 acres; the MYB is 4.9 acres, and the RTP 3.9 acres. The bathymetric map was used to derive area-elevation and area-volume curves for the Main Lagoon and MYB. These curves are shown on Figures 2-11, 2-12, 2-13 and 2-14.

The stage volume curve demonstrates the volume of water (horizontal axis) for each particular elevation (vertical axis). The stage area curve depicts the acre-feet of water (horizontal axis) at various elevations (vertical axis). These figures show how shallow the lagoons are. The termed NGVD used in these figures and in the report is the standard datum. NGVD stands for National Geodetic Vertical Datum and is an average of the tidal levels for a tidal epoch. 0.0 ft. NGVD is roughly equivalent to mean sea level.

**Tidal Range, Tidal Circulation and Vertical Mixing**

Figure 2-15 shows the results of the first tidal monitoring for the period May 29 - July 1, 2002. Figure 2-16 shows the detail for the period June 24 - 27, 2002. The chart shows that the tidal range in all three basins is severely restricted. Note that measurements of tide height in the MYB were always higher than in the Main Lagoon, which in turn was always higher than the water level in the RTP.

Figure 2-17 shows the results of the second tidal monitoring for the period April 5-16, 2003. The chart shows that the tidal range in the Main Lagoon is smaller than in the MYB. The upward jump in tide height on April 16th is due to a storm, with both runoff and possibly a storm surge in the Bay contributing to increased tide height in the lagoons. The tidal monitoring was carried out over a longer time period in the Main Lagoon than in the MYB for the second monitoring period.

Figure 2-15 compared to Figure 2-17 shows the increase in tidal heights in the MYB and Main Lagoon as a result of the culvert cleaning. The lagoons have a very limited intertidal area. San Francisco Bay has an average tidal range of six feet between the levels of mean higher high water and mean lower low water. Since the culverts were cleaned, the Main Lagoon has a tidal range of +0.6 ft. to +2.2 ft. NGVD and the MYB has a tidal range of +1.1 ft. to +1.75 ft. NGVD. Prior to the culvert cleaning, the tidal range in the Main Lagoon was measured as +1.1 ft. to +1.6 ft. NGVD and the MYB +1.5 ft. to +1.7 ft. NGVD.

An important feature of the tidal regime in systems with restricted tidal flow is the phenomenon of "tidal pumping". In a natural tidal system, the elevation of the high and low tides varies over a monthly period. There are the very highest of the high tides termed spring tides and the very lowest of the low tides termed neap tides. Although the lagoons have a very limited tidal range, tidal heights do show an increase and decrease over the month in the Main Lagoon and MYB associated with neap and spring tides. The result is a zone around the edge of the lagoons that is inundated continuously for 4-5 days every month, and then exposed and dry for 4-5 days every month.

**Figure 2-11. Main Lagoon Stage-Area Curve**

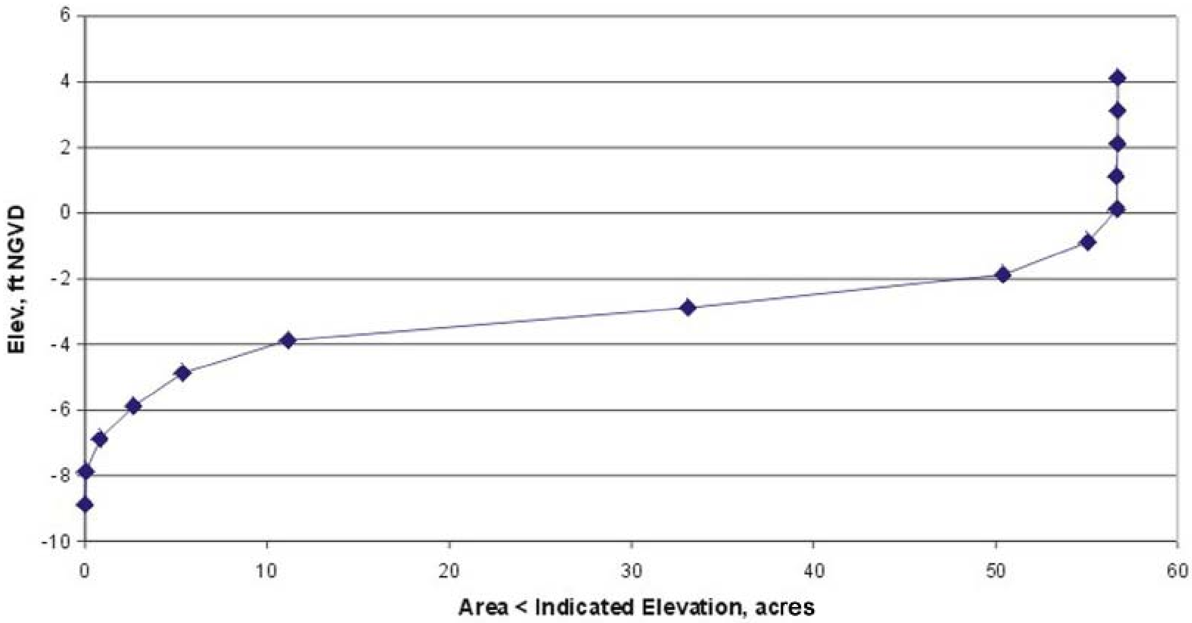



**Figure 2-12. Model Yacht Basin Stage-Area Curve**

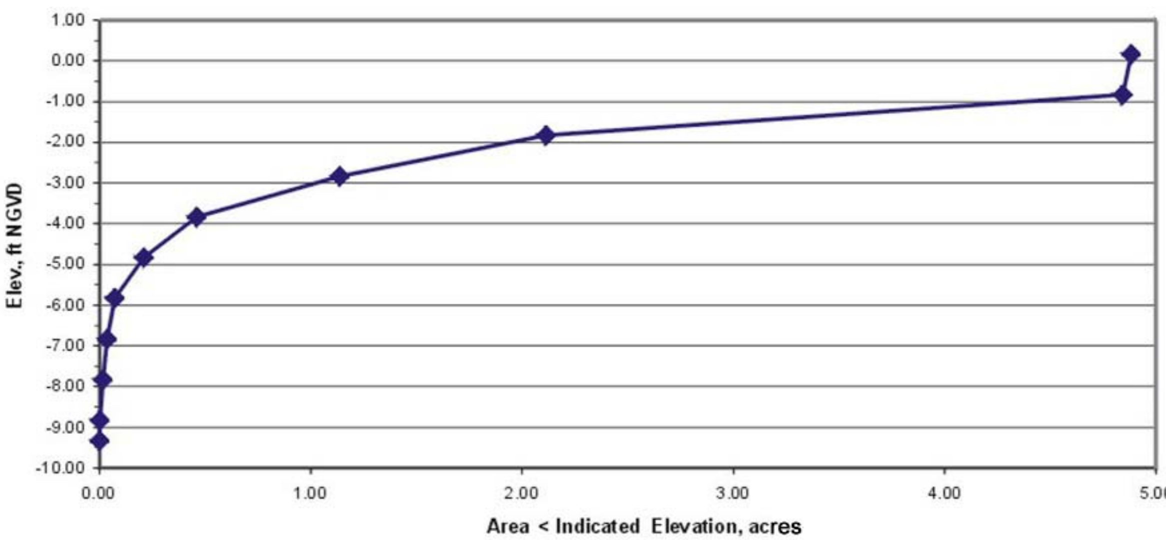


**Figure 2-13. Main Lagoon Stage-Volume Curve**

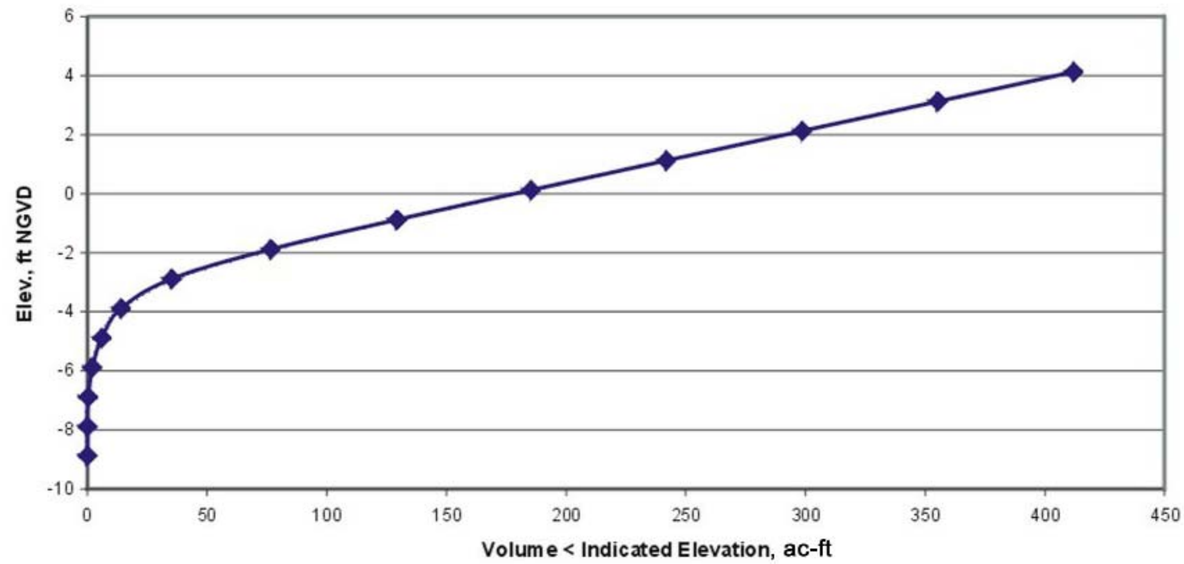



**Figure 2-14. Model Yacht Basin Stage-Volume Curve**

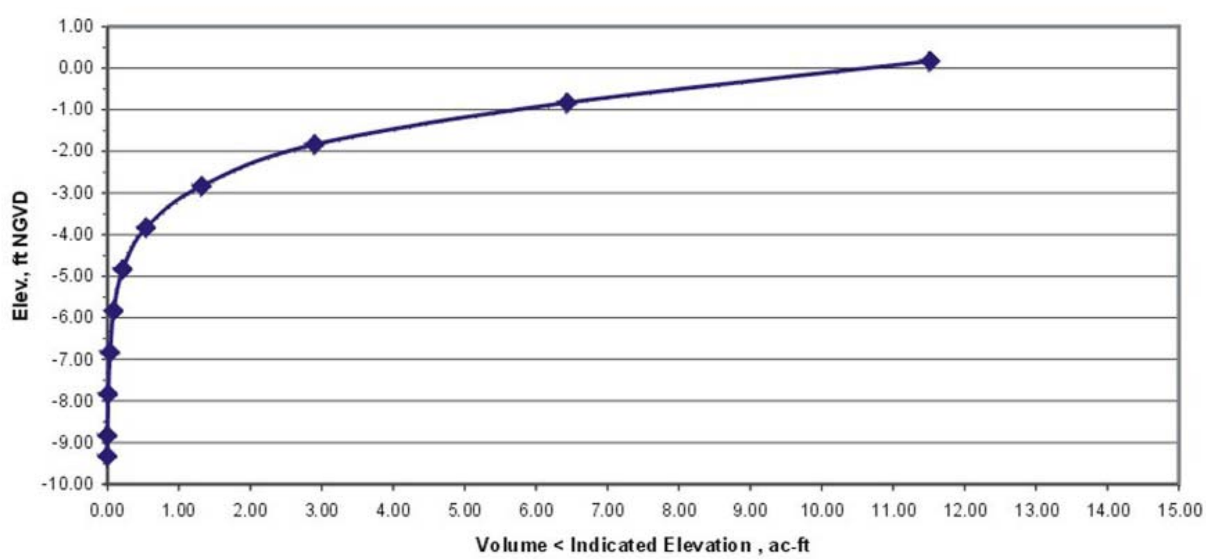


**Figure 2-15. Tide Heights at Aquatic Park During First Tidal Monitoring Period, May 29 - July 1, 2002 -Before Culverts Were Cleaned by City**

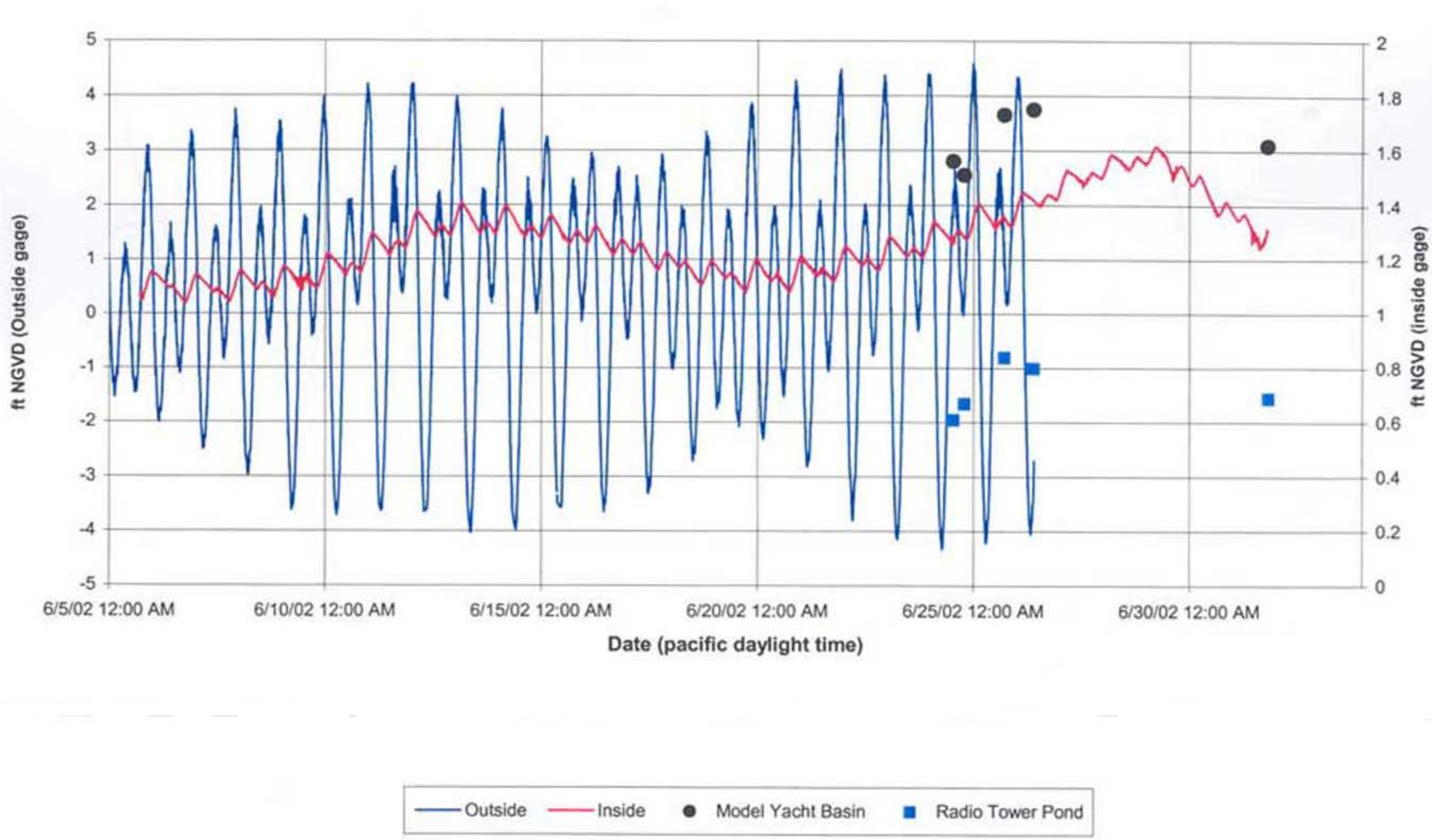


**Figure 2-16. Tide Heights at Aquatic Park, During First Tidal Monitoring Period, June 24 - 27,2002 -Before Culverts Were Cleaned by City**

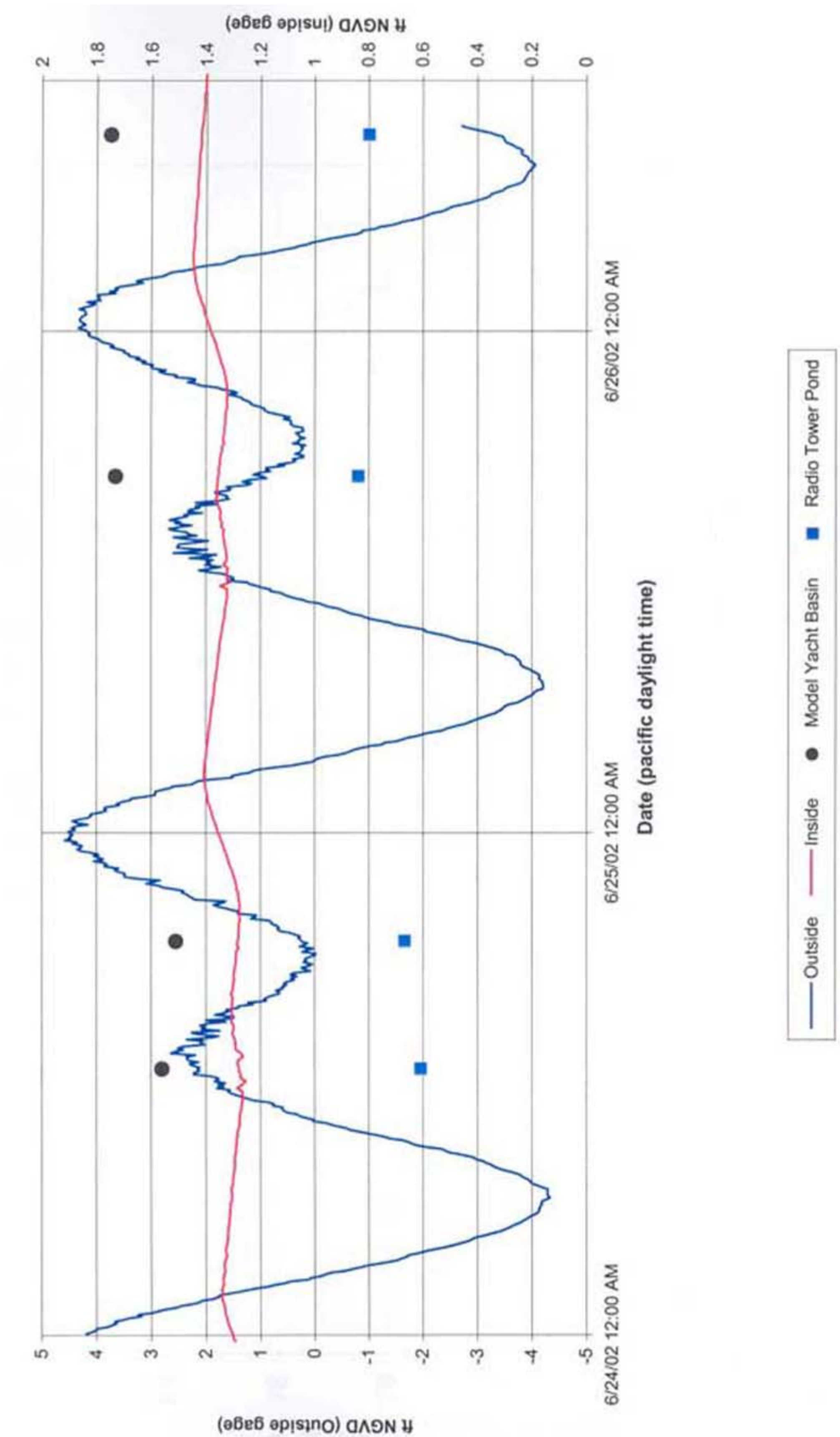
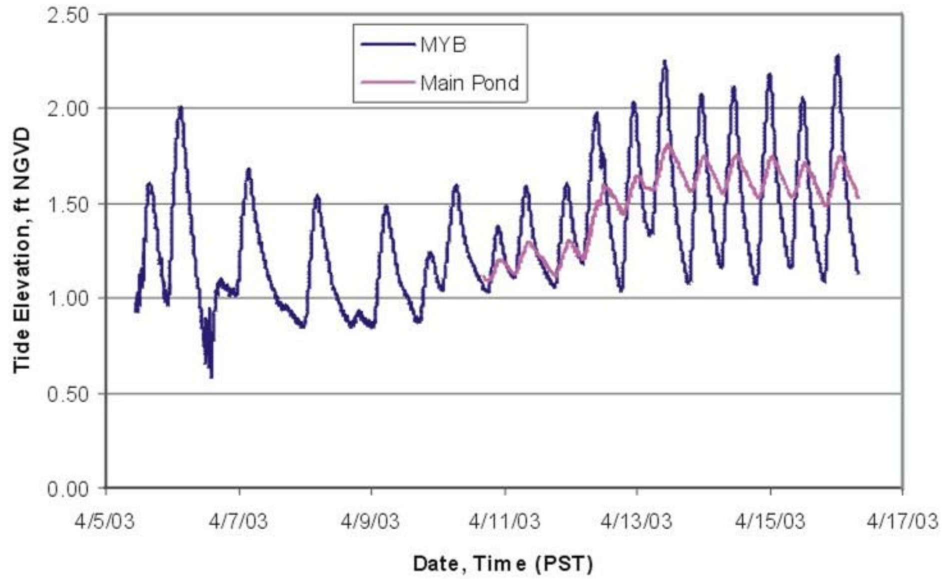


**Figure 2-17. Tide Heights at Aquatic Park, During Second Tidal Monitoring Period, April 2003 - After Culverts Were Cleaned by City**



Stratification is a process that occurs naturally in lakes and some lagoons. A lake is considered "stratified" if a surface layer is less dense than the underlying water. This can occur as a result of heating at the surface during the summer, or as a result of the inflow of less dense freshwater over salt water. The vertical density difference may become a barrier to mixing within the water column and can adversely affect water quality. If the Main Lagoon became stratified and remained so for a period of time, the dissolved oxygen (DO) in the deeper water could drop below levels that can sustain most fish and invertebrates. The thermographs used in this Study to measure stratification were installed at the end of a period of unusually hot weather, when the Main Lagoon would be expected to reach its maximum thermal stratification.

Figure 2-18 shows the surface and bottom water temperatures in the Main Lagoon over a 2-day period (August 10-12, 2002) and Figure 2-19 shows temperatures over a 7-day period (August 11-17). Figure 2-20 shows the difference between the surface and bottom water temperatures over a 7-day period. The measurements show the Main Lagoon becomes thermally stratified every day, reaching its maximum stratification around 5:00 p.m. But during the period measured, the surface waters cooled during the evening, and the Main Lagoon water vertically mixed by 10:00 p.m. to 12:00 a.m.

Salinity measurements were completed at two locations in the Main Lagoon in surface and bottom samples and stratification was not found.

Based on the temperature and salinity measurements of the lagoons, it seems unlikely that stratification occurs regularly creating severe and persistent anoxic conditions to develop in the water column. The sediment in the Main Lagoon, however, is clearly anaerobic (non-oxidized), even in shallow water. It was noted that following the die-off of the early summer algae bloom in 2002, the sediment became black, and gave off a strong odor of hydrogen sulfide. As a result, areas with poor circulation, especially at the north and south ends of the Main Lagoon, sometimes produce foul odors in late summer.

## Vegetation Types

### <u>Tidal Wetlands</u>

As shown in Figures 2-56 through 2-61, salt marsh in the lagoons occurs as a thin strip or as scattered plants along the shoreline, interrupted with sections of riprap (see Figures 2-21 and 2-22). Salt marsh vegetation, such as bulrush (*Scirpus robustus*) (see Figure 2-23), pickleweed (*Salicornia virginica*), (see Figure 2-37) and marsh gumplant (*Grindelia stricta*) (see Figure 2-24) were found along the shoreline of the lagoons along with invasive non-native and ornamental plants.

**Figure 2-18. Surface and Bottom Water Temperatures in the Main Lagoon over a 2-day Period in August 2002**

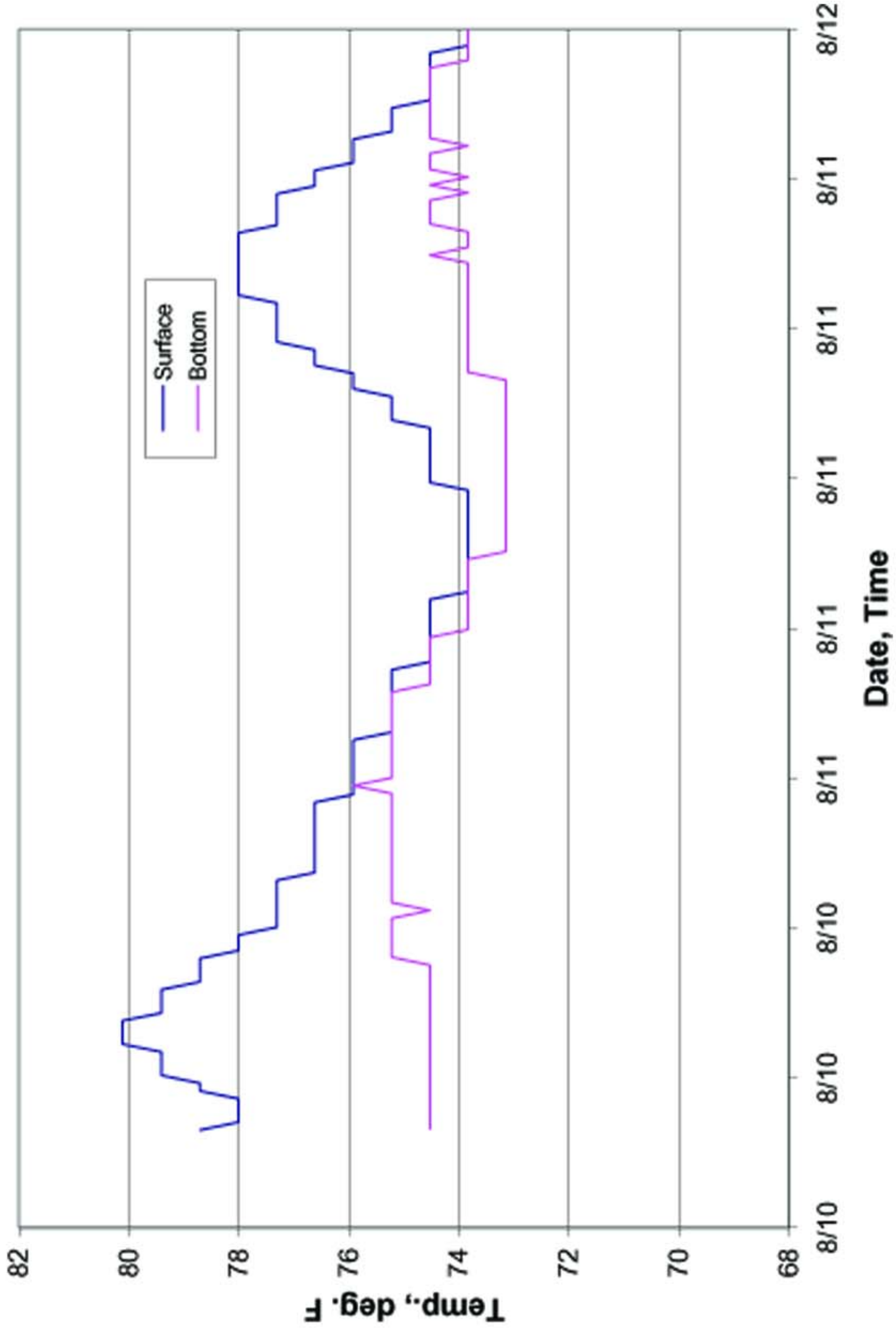


**Figure 2-19. Surface and Bottom Water Temperatures in the Main Lagoon over a 7-day Period in August 2002**

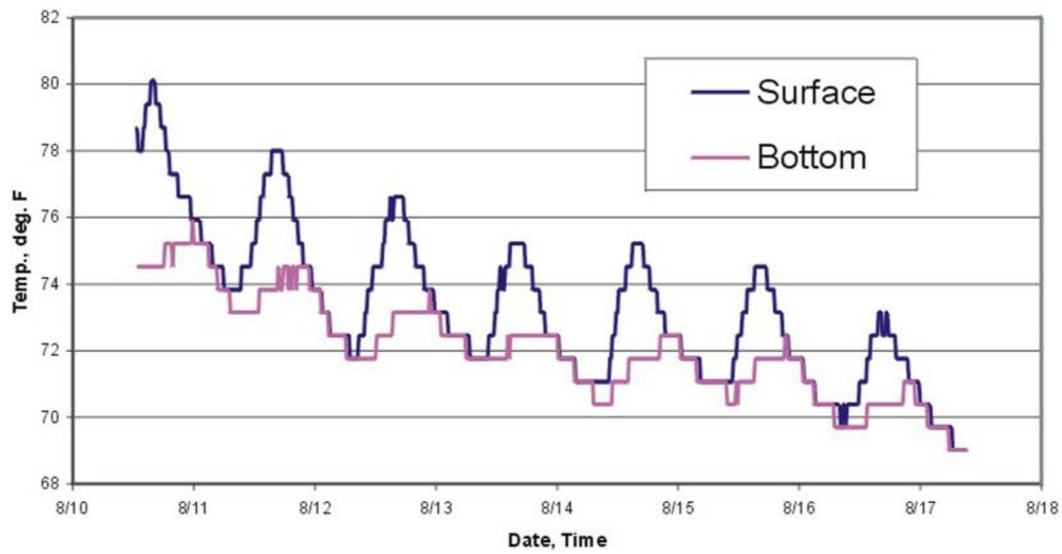



**Figure 2-20. Difference Between Surface and Bottom Water Temperatures in the Main Lagoon over a 7-day Period in August 2002**

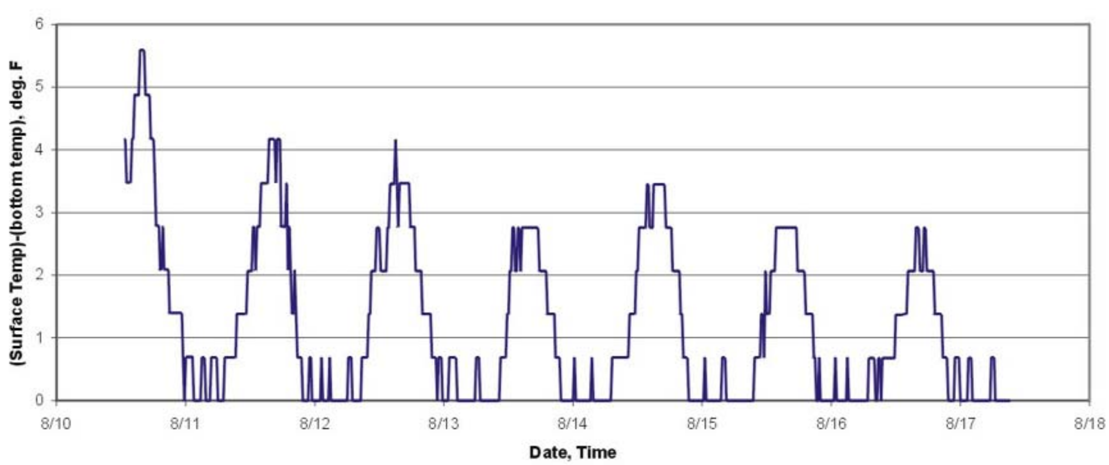


**Figure 2-21. Thin Strip of Wetland Vegetation on the Northeastern Shoreline of Main Lagoon**

**Figure 2-22. Thin Strip of Wetland Vegetation on the Northeastern Shoreline of Main Lagoon**

**Figure 2-23. Alkali Bulrush (*Scirpus robustus*) on the Eastern Shoreline of the Main Lagoon**

**Figure 2-24. Marsh Gumplant (*Grindelia stricta* var. *angustifolia*) along the Eastern Shoreline of the Main Lagoon**

**Figure 2-37. Pickleweed (*Salicornia virginica*)**

There are also many areas along the Main Lagoon that have little to no vegetation (see Figures 2-25 and 2-26). Much of the shoreline of the lagoons is at a steeper slope (greater than 1%) (see Figures 2-27, 2-28, 2-29, 2-30, 2-31 and 2-32) than marsh vegetation is able to colonize. Wind driven waves create a high-energy environment that limits the ability of the plants to grow. At numerous locations along the lagoon shoreline, erosion is evident and riprap has been undercut. The combination of wave action and the steep shorelines limits the area where tidal marsh can grow. The total acreage of salt marsh at Aquatic Park, measured using the GIS, is 0.78 acres.

Tidal mudflats are areas in the lagoons that are exposed at low tide and have little to no vegetation (see Figure 2-33 and 2-34). The 4-5 days of continuous exposure and submergence each month of the intertidal zone, creates difficult and unnatural conditions for the invertebrates that typically inhabit these areas.

Freshwater Wetlands

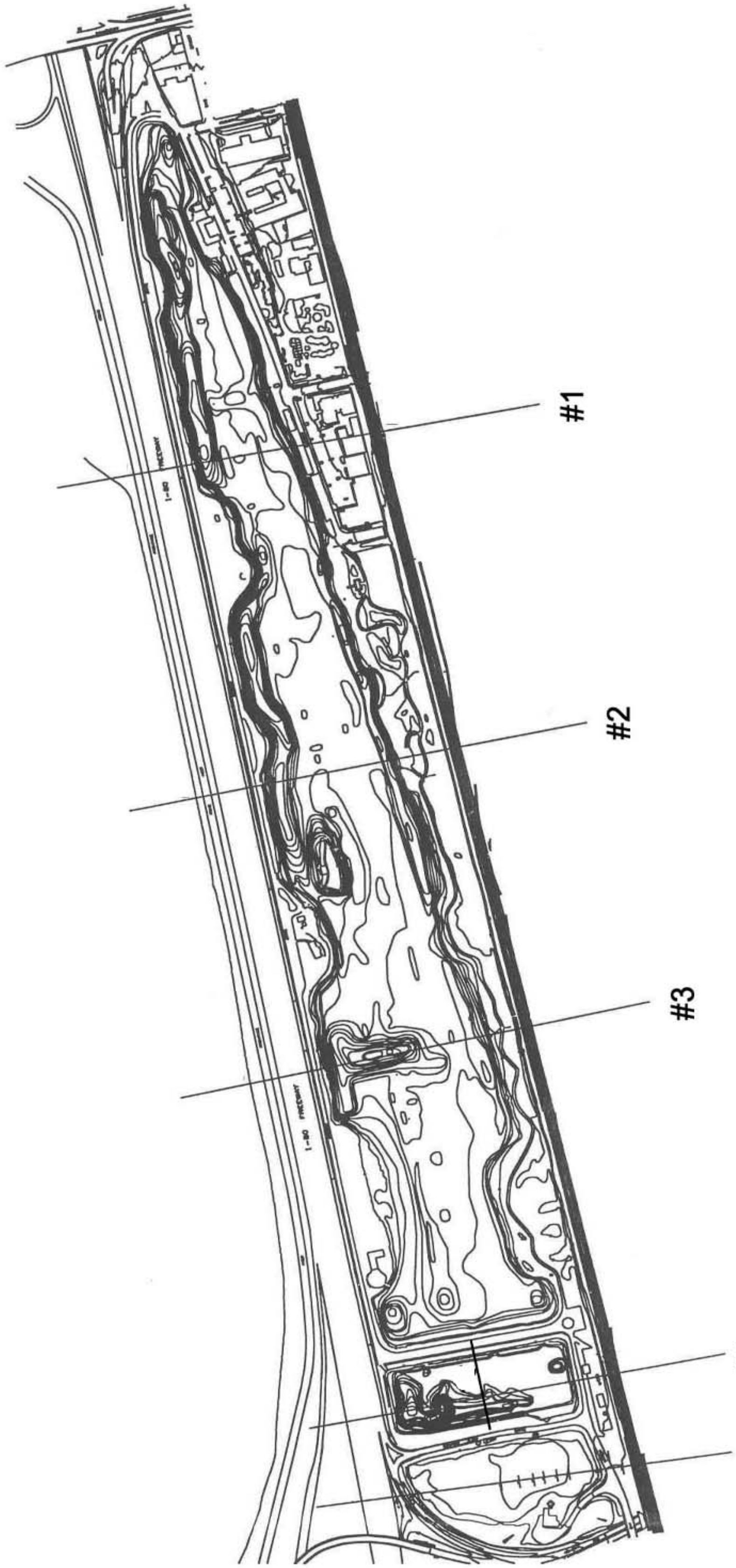
Freshwater wetlands are located along the eastern side of Aquatic Park (see Figures 2-35 and 2-56 through 2-61). Freshwater wetlands are similar to salt marshes, due to the predominance of waterlogged soils and growth of specialized plants. These wetlands occur from the ponding of stormwater and groundwater in low-lying areas along the Railroad Berm. Mounds west of the freshwater wetlands were constructed when the Park was created and serve to reduce drainage and cause the wetlands to pond water (see Figure 2-36). The soil remains waterlogged, or moist, for much of the year. Small creeklets move water from the wetlands to the lagoons though the grass covered shoreline. The total acreage of freshwater wetland at Aquatic Park, measured using the GIS, is 1.37 acres. Each freshwater wetland was given a number and its condition evaluated in detail in Table 2-1.

The freshwater wetlands have a mixture of native plants, such as willows (*Salix* sp.), cattails (*Typha latifolia*) and bulrush (*Scirpus acutus*) as well as non-native invasive plants and are adjacent to the recreational areas of the Park. Homeless encampments, frequent forays by Park users to retrieve Frisbees and balls, and other heavy recreational uses of the Park result in pathways of trampled vegetation through the freshwater wetlands. The proximity of heavily used recreational areas and other activities create a high and constant level of disturbance to the small freshwater wetlands.

**Figure 2-25. Area of Sparse to No Vegetation along the Western Shoreline of the Main Lagoon**

**Figure 2-26. Area of Sparse to No Vegetation along the Western Shoreline of the Main Lagoon**

Figure 2-27. Key to Aquatic Park Cross Sections



## Figure 2-28. Cross Section 1 - Main Lagoon

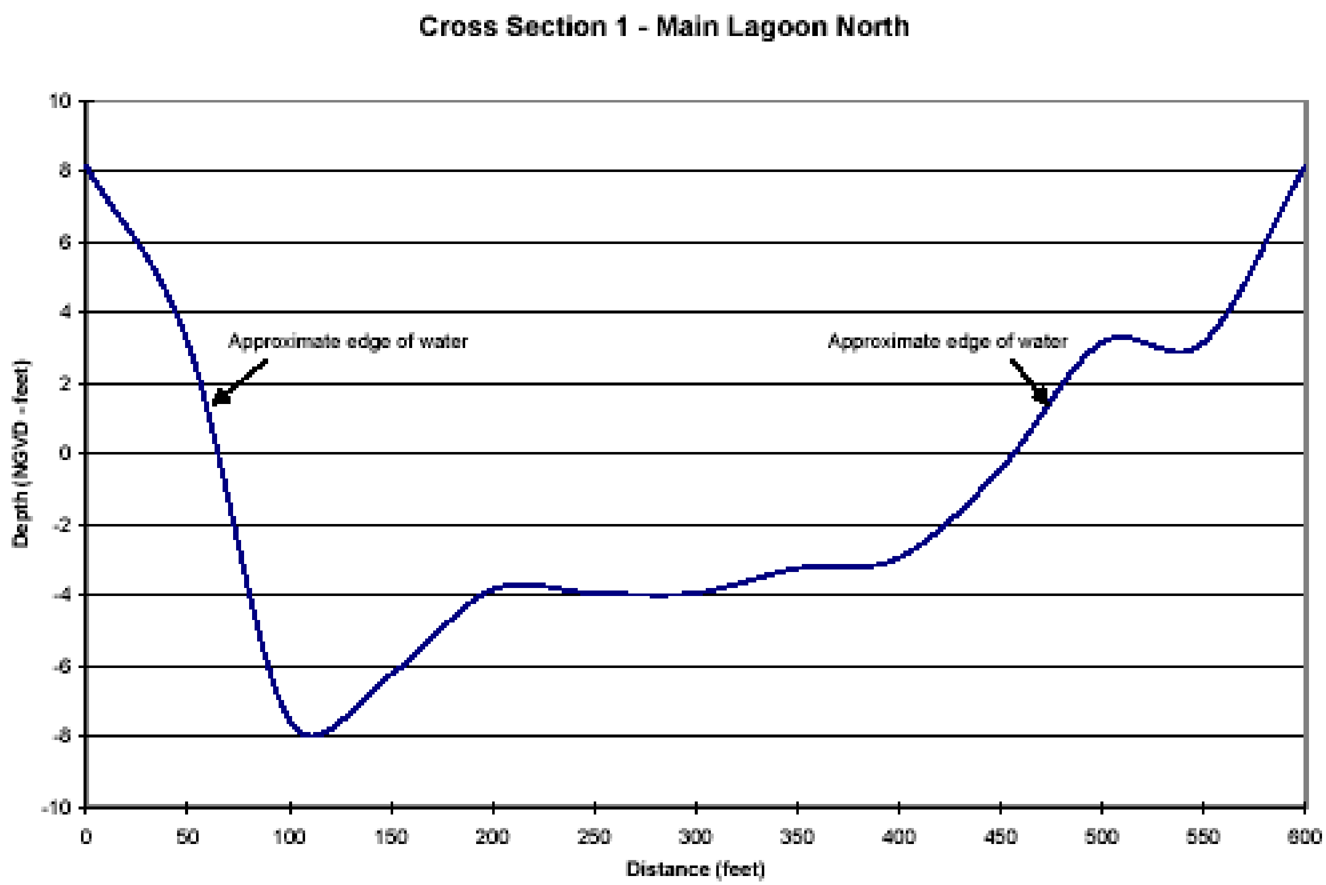


**Figure 2-29. Cross Section 2 - Main Lagoon**

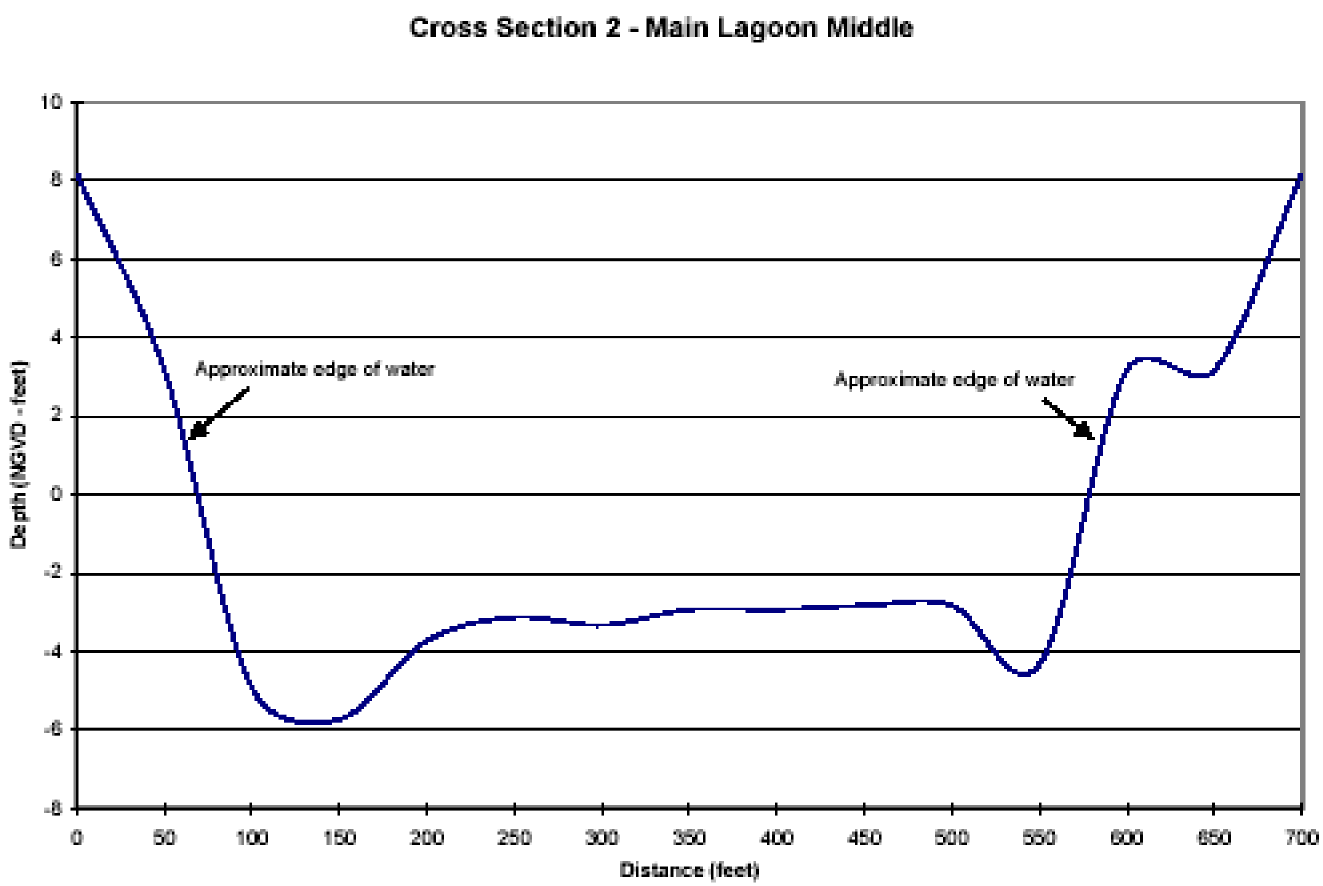


**Figure 2-30. Cross Section 3 - Main Lagoon**

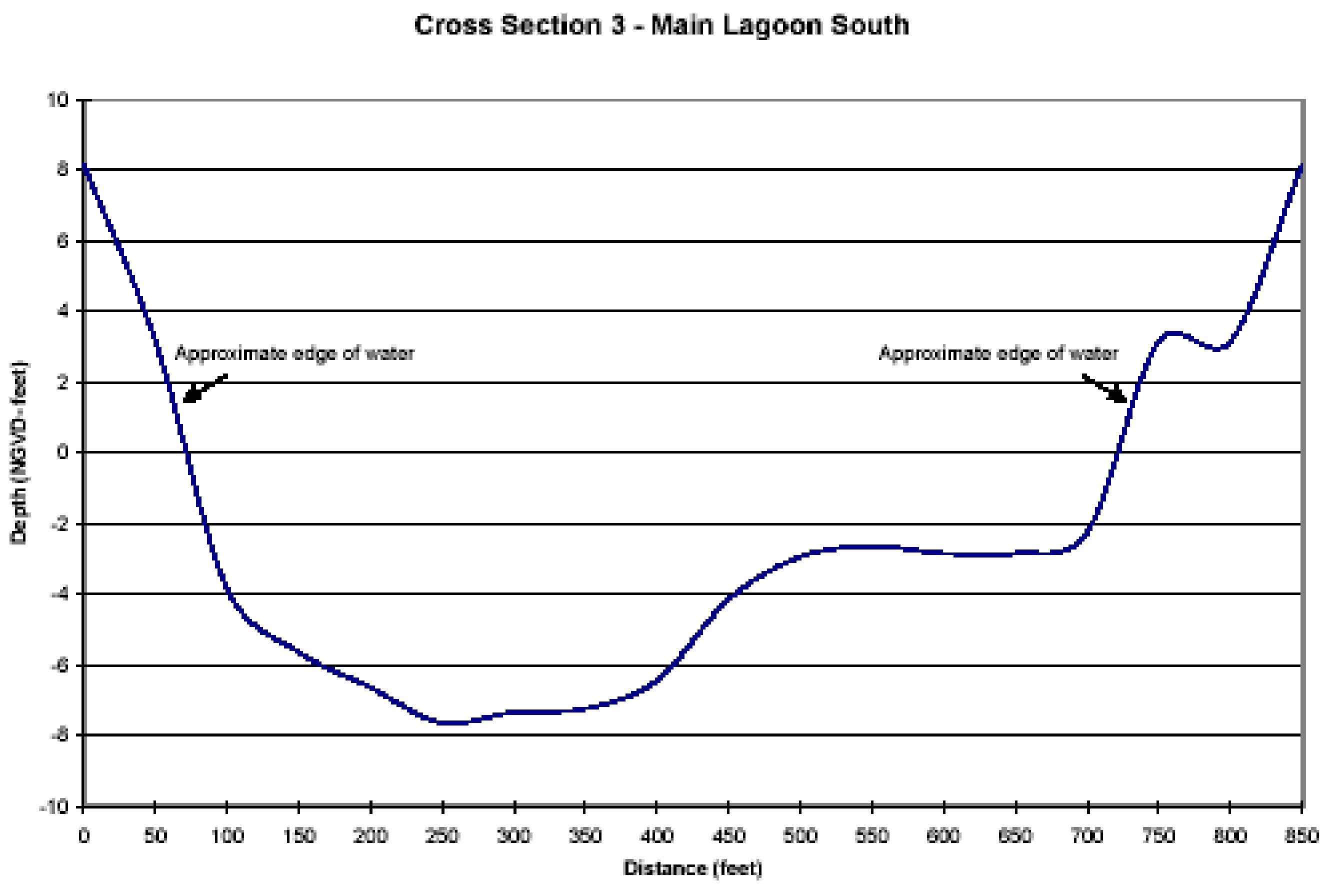


**Figure 2-31. Cross Section 4 - Model Yacht Basin**

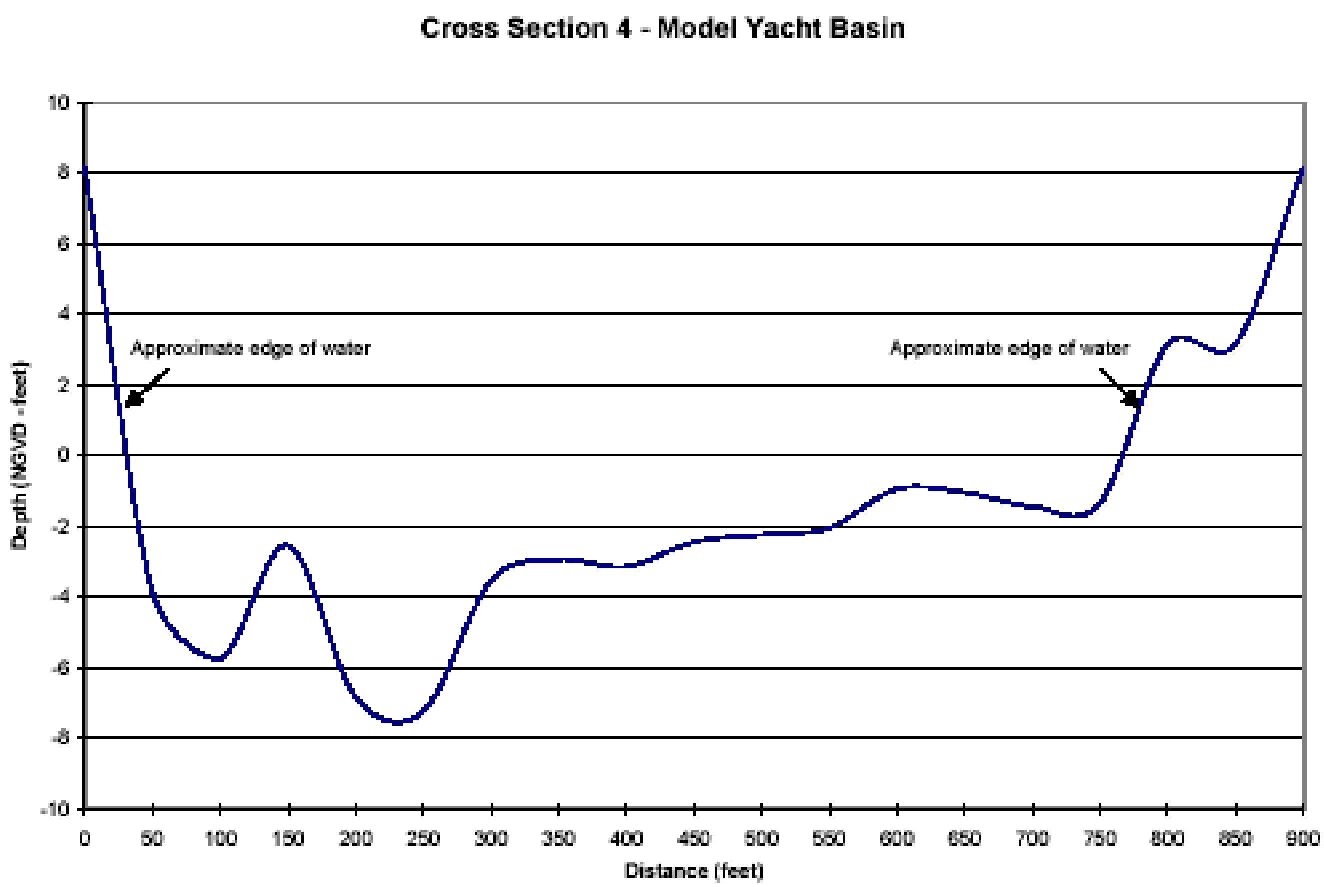


**Figure 2-32. Cross Section 5 - Radio Tower Pond**

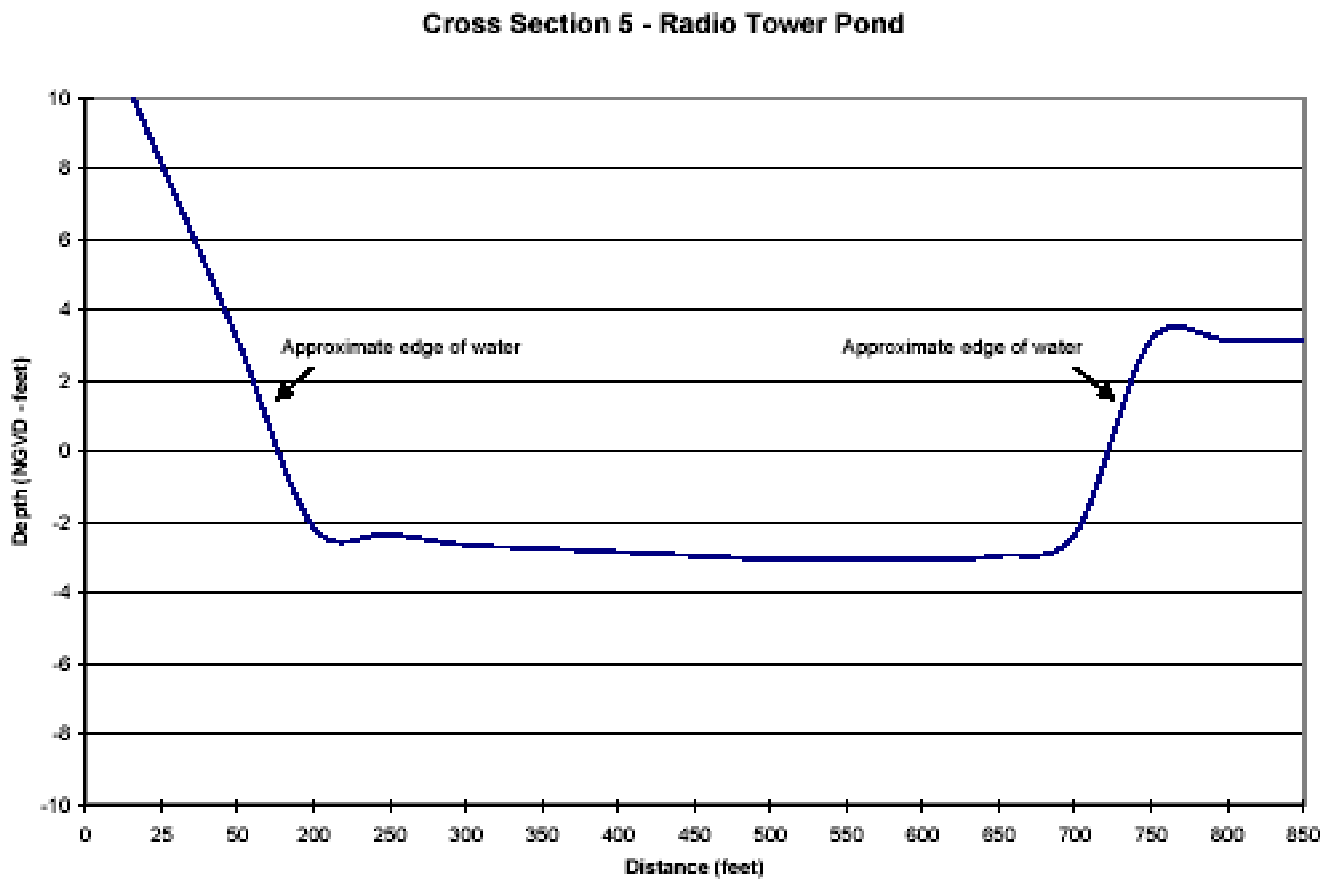


**Figure 2-33. Tidal Mudflat with Vegetation Border along the Southwestern Shoreline of the Main Lagoon**

**Figure 2-34. Tidal Mudflat with Vegetation Border along the Western Shoreline of the Main Lagoon**

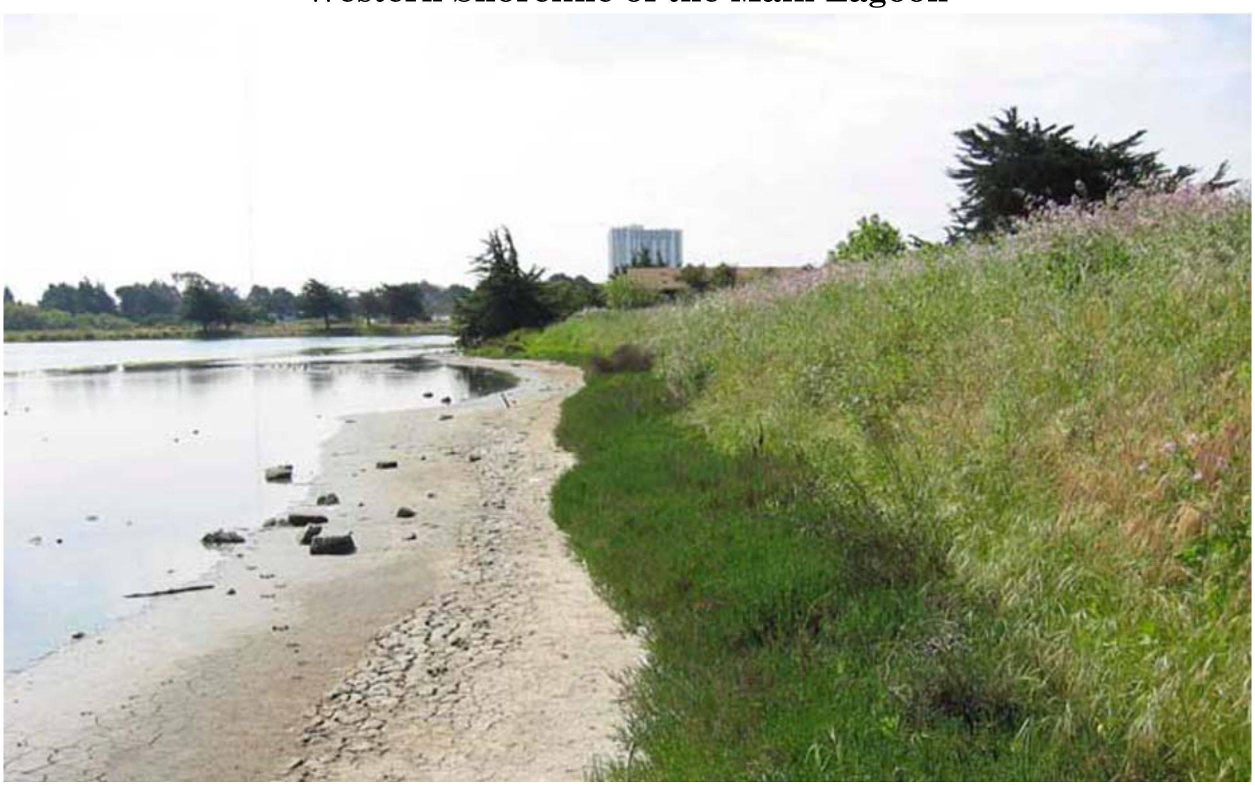


**Figure 2-35. Freshwater Wetlands on the Eastern Side of Aquatic Park**

**Figure 2-36. Grassy Berm or Mound Between the Main Lagoon and the Freshwater Wetlands**

**Table 2-1. Freshwater Wetlands at Aquatic Park**

| Wetland Number | Wetland Description |
|---|---|
| Wetland #1 (W1) | Freshwater wetland at edge of the RTP with invasive non-native plants - English ivy. |
| Wetland #2 (W2) | Emergent wetlands along the base of the Railroad Berm with non-native invasive plants - giant reed and broom along the edge. |
| Wetland #3 (W3) | Narrow drainage ditch from base of Railroad Berm to east side of Main Lagoon with kikuyu grass along the ditch and acacia trees along the top of bank. See Figure 2-38. |
| Wetland #4 (W4) | Wetland along base of Railroad Berm with narrow drainage ditch into east side of Main Lagoon with cattails and bulrush and invasive non-native plants - English ivy, kikuyu grass, and pampas grass. See Figures 2-39 and 2-40. |
| Wetland #5 (W5) | Large ponded area with cattails, bulrush and willows along the base of the Railroad Berm; narrow drainage ditch occurs between the emergent marsh and the east side of the Main Lagoon. This is a highly disturbed area overgrown with English ivy and with a large homeless encampment. See Figures 2-41 and 2-42. |
| Wetland #6 (W6) | Narrow drainage ditch from wetland to the east side of the Main Lagoon with non-native invasive plants - cotoneaster. |
| Wetland #7 (W7) | Northern extension of large emergent wetland along the base of the Railroad Berm with cattails and bulrush and non-native invasive - English ivy. See Figures 2-43 and 2-44. |
| Wetland #8 (W8) | Small ponded area with narrow drainage toward the east side of the Main Lagoon; this drainage appears to join the drainage from Wetland # 9 and not flow directly into the Main Lagoon. This site is dominated by non-native invasive - English ivy. See Figures 2-45 and 2-46. |
| Wetland #9 (W9) | Emergent marsh with narrow drainage channel that outlets along the east bank of the Main Lagoon with cattails and non-native plant species - English ivy. See Figure 2-47. |

**Figure 2-38. Freshwater Wetland #3 - Narrow Drainage from Railroad Berm to Main Lagoon**

**Figure 2-39. Freshwater Wetland #4 along Base of the Railroad Berm**

**Figure 2-40. Freshwater Wetland #4 - Narrow Drainage to Main Lagoon**

**Figure 2-41. Pathway across Freshwater Wetland #5. Note English ivy in Trees**

**Figure 2-42. Marshy area of Freshwater Wetland #5**

**Figure 2-43. Freshwater Wetland #7 along Base of Railroad Berm. Note English Ivy in Trees**

**Figure 2-44. Freshwater Wetland #7 along Base of Railroad Berm**

**Figure 2-45. Freshwater Wetland #8 -
Narrow Drainage flowing toward Wetland #9**

**Figure 2-46. English Ivy in Trees along Railroad Berm in Freshwater Wetland #8**

**Figure 2-47. Freshwater Wetland #9 - Narrow Drainage to Main Lagoon**

Uplands

Upland areas surround the lagoons and are not regularly inundated. The upland areas of Aquatic Park consist of the Railroad Berm, and the eastern and western shoreline areas. They encompass ornamental plantings along the western shoreline, a berm of eucalyptus and other plants along the railroad, and lawns and plantings of acacia and a few native species along the eastern shoreline. The lagoons are also bordered by extensive paved roadways and parking areas.

The Railroad Berm along the eastern border of Aquatic Park is primarily covered in invasive non-native plants such as eucalyptus, acacia, Himalayan blackberry, broom, pampas grass, giant reed, and English ivy. In some locations, ornamental non-native, but non-invasive species such as Monterey cypress and Lombardy poplars also occur. Native willow, oaks, and some other plants also grow on the Berm. There are a number of areas with no vegetation.

## Vegetation

Non-native Invasive Plant Species

Many species of invasive non-native vegetation were observed along the perimeter of the lagoons at Aquatic Park (see Figures 2-48, 2-49 and 2-50). Invasive non-native plants area a major problem for wildlife habitats. These species are typically rapid colonizers that spread into native habitats and out-compete native vegetation. The feeding, roosting and nesting values provided by the native vegetation are not provided by the invasive plants and wildlife values are lost. Aquatic Park has a large number of invasive non-native plants.

**Iceplant** (*Carpobrotus edulis*) was found in thick strips in several locations along the shoreline of the lagoons (see Figure 3-14).

**Tamarisk** (*Tamarix* sp.) or saltcedar (see Figure 3-15) was observed at various points around the Main Lagoon, mostly on the western shore.

A linear planting of non-native blue **gum trees** (*Eucalyptus globulus*) occurs along the Railroad Berm on the east shore of the Main Lagoon (see Figure 3-40).

**Giant reed** (*Arundo donax*) was observed in isolated stands among the freshwater wetlands near the Railroad Berm on the east shore of the Main Lagoon (see Figure 3-16).

**Pampas grass** (*Cortaderia sellonana*) was observed in isolated stands among the freshwater wetlands near the Railroad Berm on the east shore of the Main Lagoon (see Figure 3-18).

**Figure 2-48. Aerial Photograph Showing Invasive Plants and Dead Trees (Section 1)**

**Figure 2-49. Aerial Photograph Showing Invasive Plants and Dead Trees (Section 2)**

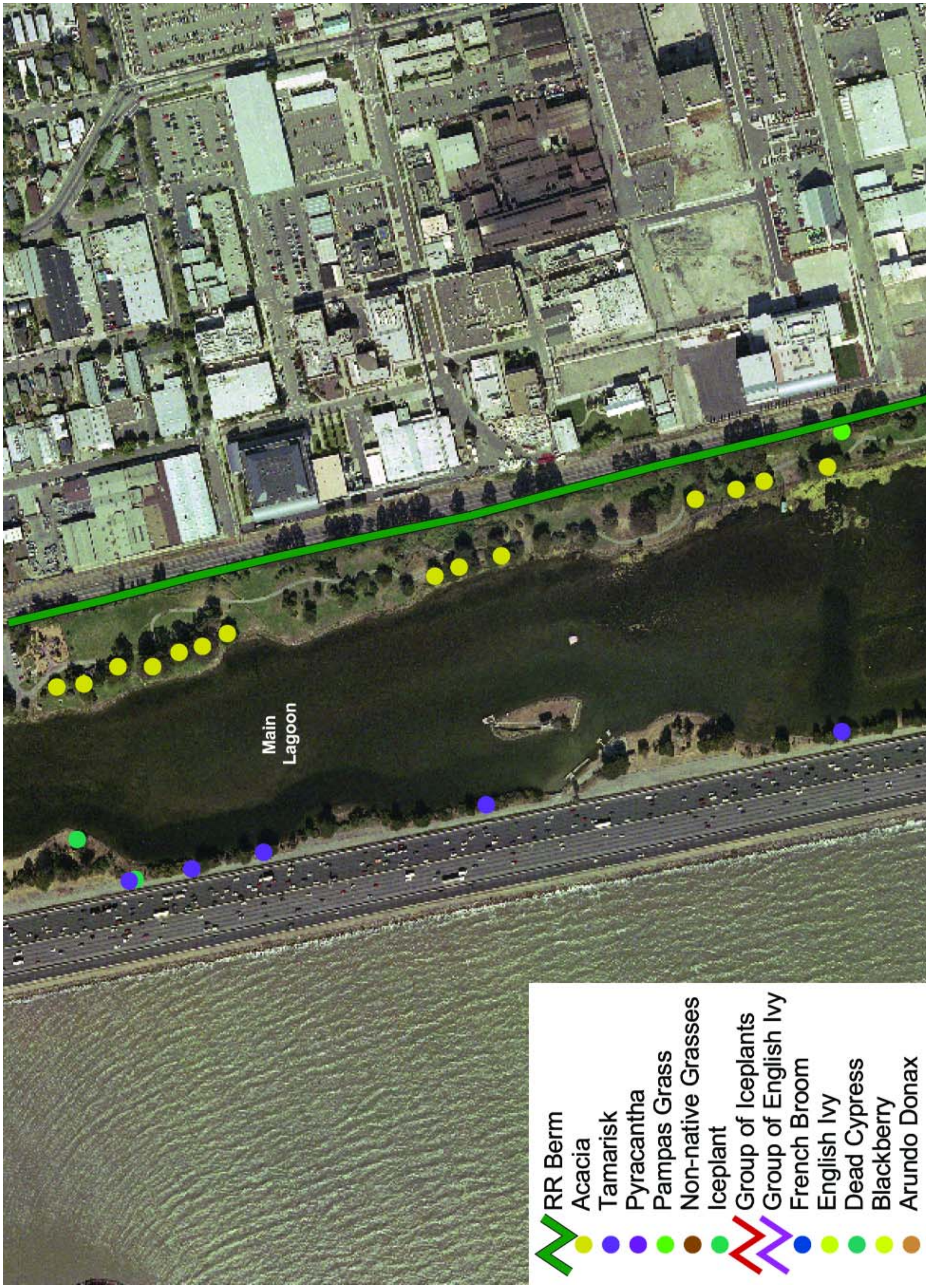


**Figure 2-50. Aerial Photograph Showing Invasive Plants and Dead Trees (Section 3)**

**Acacias** (*Acacia* sp.) were planted as ornamentals on the eastern and western shore of the Park (see Figure 3-39). They provide little habitat and obstruct views from the pedestrian path to the Main Lagoon.

**Broom** (French - *Genista monspessulana;* or Scotch - *Cytisus scoparius*) occurs in scattered areas along the eastern shoreline (see Figure 3-17).

**English ivy** (*Hedera helix*) is widespread along the Railroad Berm and in many areas of the freshwater wetlands (see Figure 3-19).

**Kikuyu Grass** (*Pennisetum clandestinum*) occurs along the eastern areas of the Park including the freshwater wetland areas.

Dead trees were also surveyed and only one was observed (see Figures 2-48, 2-49 and 2-50).

## Habitats

Aquatic Park has a combination of lagoon and wetland habitats and recreational areas. While proximity to San Francisco Bay attracts wildlife to the lagoons other features of the Park discourage wildlife use. For example, the three lagoons total 65 acres of open water habitat. Salt marsh wetlands and mudflats along the edges of these lagoons encompass less than one acre. The steep side slopes of the lagoons, limited tidal range, as well as wave and shoreline erosion, limit the extent of wetland areas. These features create habitat for certain fish and bird species in the open water areas, but limit feeding and roosting areas for shorebirds and other species needing mudflats and wetlands.

Habitat size, habitat structure, and habitat diversity are important elements to wildlife. Larger patches of habitat are more valuable than smaller patches. Strips of salt marsh barely wider than one or two feet are unusable by any salt marsh species. The value of a small pond with no shoreline cover or a patch of cattails no bigger than 100 square ft. is nearly nonexistent for marsh-loving birds. A narrow upland berm along the edge of a railroad track with little vegetative cover would not be expected to support many animals. Nor would any of these areas support adequate prey for predatory birds.

Habitat structure, or the mix of vegetative layers in the Park is low at present. Habitat diversity in the Park is slightly higher, with the presence of ponds, turf, small wetlands, San Francisco Bay, and a variety of trees. But it is of low to moderate value as a whole because each habitat element is limited in structure, patch size, or both. The proximity of walking paths to the shoreline produces a high disturbance factor. Trails are 20-60 ft. from the shoreline and there are no barriers to stop humans and unleashed dogs from disturbing wildlife near shore.

These features essentially limit wildlife uses to the open water or trees for roosting and thus limits the species that will use the Park.

The small size and very high level of active recreation and human use adjacent to the freshwater wetlands reduce their value as wildlife habitat. The upland areas are also frequented by Park users and disturbance to wildlife uses is high. Additionally, homeless encampments and other human activities in these wetland areas are commonplace, creating continual disturbance to wildlife use.

The following discussion summarizes the limited studies of the wildlife in Aquatic Park and the likely species of fish and birds to be found at the Park.

Marine Invertebrates

As described previously, the intertidal areas around the lagoons have extended periods of inundation or exposure (4-5 days). This feature creates a harsh environment for the marine invertebrates that live in natural intertidal areas and are adapted to only 6-10 hours of continuous exposure or inundation.

No inventories or studies of marine invertebrates in the lagoons were located, but given the physical conditions it is likely the fauna is less diverse and abundant than San Francisco Bay and may provide limited feeding habitat for birds.

Fish

No extensive long-term studies of fish populations at Aquatic Park were found. It can be assumed that fish species in the lagoons at Aquatic Park are similar to those in other muted-tidal urban water bodies in the local area. Lake Merritt is a body of water in Oakland located a few miles from Aquatic Park. Fish surveys of Lake Merritt found seasonal populations of topsmelt (*Atherinops affinis*), yellowfin goby (Acanthogobius flavimanus), staghorn sculpin (*Leptocottus armatus*), northern anchovy (*Engraulis mordax*), threespine stickleback (*Gasterosteus aculeatus*), and brown smoothhound shark (*Mustelus henlei*). Striped bass (*Morone saxatilis*) were observed during a fish kill from red tide in the lagoons at Aquatic Park (C. Marchetti, personal communication 2002). The fish species found in Aquatic Park must be hardy in order to tolerate the high temperatures, algal blooms, and urban runoff.

Fish occurring in the lagoons of Aquatic Park provide food to birds including several species of grebes, double-crested cormorants, California brown pelicans, Forster's terns and Caspian terns. The birds appear to forage most actively during incoming tides. Egrets and herons forage along the shoreline and feed on the juvenile and other small fish.

Birds

Aquatic Park is used by waterfowl and other birds due to its proximity to San Francisco Bay (Aquatic Park Master Plan 1990). San Francisco Bay lies along the Pacific Flyway, which is one of the four flyways used by migratory birds in North America. During the late summer through winter, waterfowl, shorebirds, gulls and other birds move through the Bay regions in their annual migration from their northern breeding grounds to milder southern climates. Many birds pass through enroute to wintering grounds in Central and South America, but a large number of migratory birds will winter in the Bay region. In addition, the Bay supports resident populations of water-associated birds, including species of geese, waterfowl, wading birds, shorebirds and gulls.

Birds that were observed at Aquatic Park during our field studies include waterfowl such as mallards, Canada geese and American coots; shorebirds such as willets, black-necked stilts, as well as brown pelicans and several species of gulls and terns, double-crested cormorants, snowy egrets, great egrets, black-crowned night herons, great blue herons, northern harriers and belted kingfishers. Coates (1989) counted 32 species of marine birds using the Park during her surveys from November 1988 through mid-February 1989.

The lagoons and surrounding areas at Aquatic Park provide different habitat functions for birds. Birds such as pelicans, gulls, terns, ducks, geese and cormorants use the open-water areas of the lagoons for feeding. Herons and egrets feed along the water's edge. Some of the trees around the lagoons provide roosting areas for birds such as the great egret, snowy egret and black-crowned night heron.

Shorebirds such as willets and black-necked stilts forage on the one somewhat isolated mudflat along the western shore of the Main Lagoon and the Radio Tower Pond at low tide (see Figure 2-51). These remote areas with lower levels of Park activity attract shorebirds.

The freshwater wetlands and upland areas may attract some songbirds. Many of these wetlands and creeklets are already too small to support wildlife such as ducks, but with the added limitation of heavy recreational use, small songbirds, wading birds, and small mammals are unlikely to inhabit these areas. Additionally, many of the larger shrubs and trees are invasive non-native species such as acacia, which offer few food resources to songbirds.

Overall the open water areas of Aquatic Park provide the most valuable habitat for birds to feed or roost. With the lack of isolated areas, birds are unable to adequately undergo successful breeding, nesting and fledging of offspring, therefore nesting activity is likely very low.

**Figure 2-51. Shorebirds in the Mudflat Area along the Western Shore of the Main Lagoon**

**Land Uses**

There are a variety of recreational uses at Aquatic Park (see Figures 2-52, 2-53 and 2-54).

The Berkeley Paddling and Rowing Club use the Boathouse area at the southwest end of the Main Lagoon. The user log reported that the usage in 2001 averaged 321 individuals per month. The rowers and kayakers generally use the center of the Main Lagoon, staying away from the island and other shores. The primary types of boats used are rowing shells and flat water kayaks.

The Berkeley Water Ski Club (BWSC), a social and tournament club, was once the largest and most active competition water ski club in the United States. The center portion of the west side of the Main Lagoon has a Ski Club building and the boats enter the water via the boat ramp near the only island in the Main Lagoon. The City of Berkeley owns the island just offshore of the boat ramp. The boats use about 35% of the water through the middle of the Main Lagoon. The slalom course goes from the flagpole at the north end to the buoy on the south end. The boats primarily used are inboard competition ski boats. Water-skiing season starts May 1st and runs through the end of September (open for 5 months).

The playground located on the central east side of the Main Lagoon was a community-built playground, designed by Leathers Associates, and funded in partnership with Berkeley Partners for Parks and the City of Berkeley. Completed on July 5, 1999, it is intended for all ages of children, tots to school-age (ages 2-15). The City of Berkeley Parks Maintenance Division provides periodic maintenance of the playground. Volunteer workdays are organized by the Berkeley Partners for Parks throughout the year.

The Frisbee golf course is located along the east shore of Aquatic Park from the playground to the end of the Main Lagoon. The course is 18 holes and consists of cement starting blocks and 18 metal disc golf baskets for the holes. The course gets moderate usage during the week and heavy usage on the weekends, with greater number in the summer. There are several disc golf tournaments at Aquatic Park throughout the year in addition to regular use. Frisbees regularly land in the Main Lagoon and freshwater wetlands.

There are a wide variety of other recreational uses at Aquatic Park. There are sunbathers, bird-watchers, dog-walkers, bikers, joggers, walkers and rollerbladers. There are many traditional team sports such as soccer, football, baseball and ultimate Frisbee on the playing field adjacent to the playground. A few people use the Park as a driving range for golf, while others bring their motorized model boats or cars. Kite flying has become quite popular since the playground was put in. The world championships of footbag golf was held in the Park in 2001. The Park is also used for large picnics and barbeques.

**Figure 2-52. Aerial Photograph Showing Recreational Land Use (Section 1)**

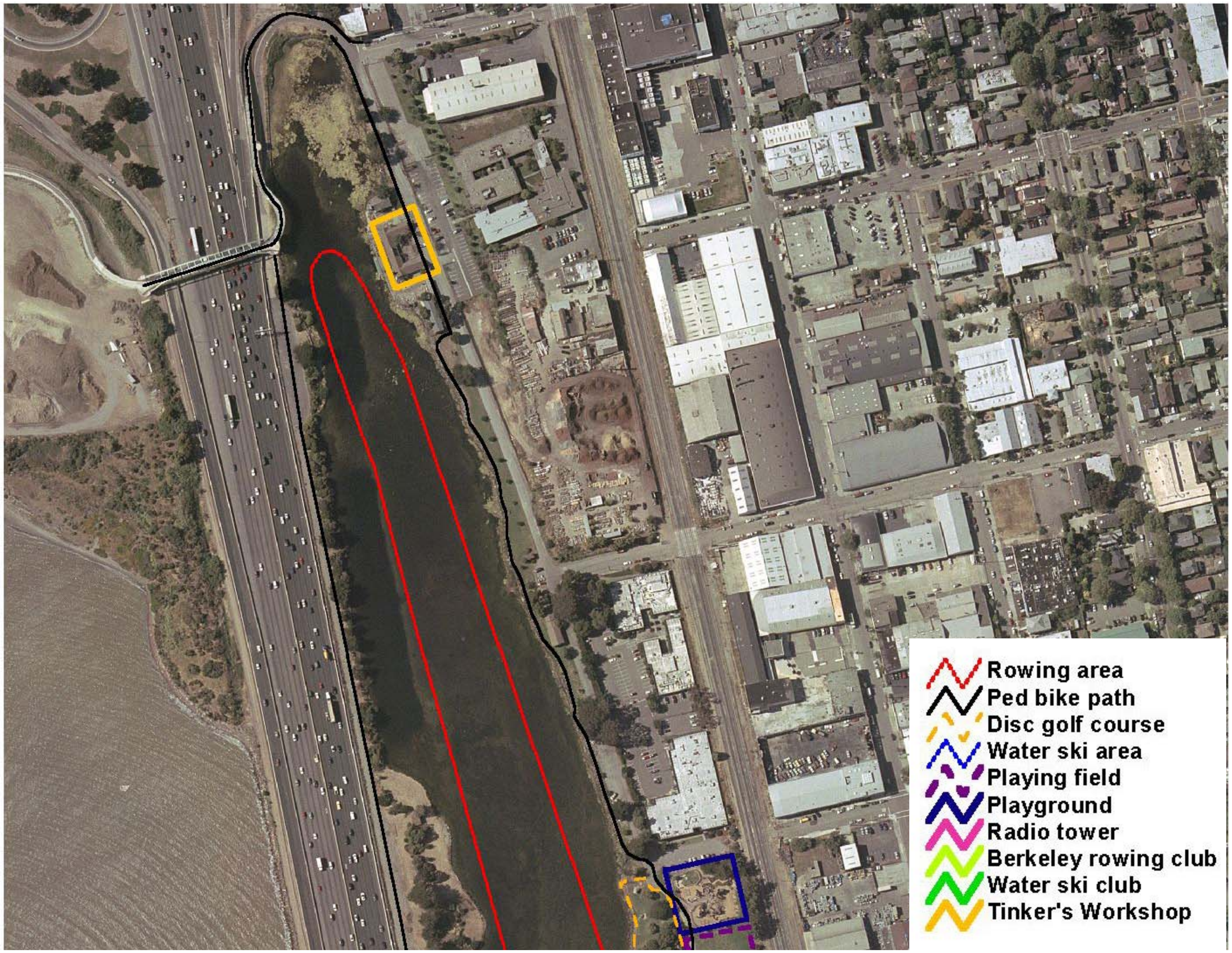


Figure 2-53. Aerial Photograph Showing Recreational Land Use (Section 2)

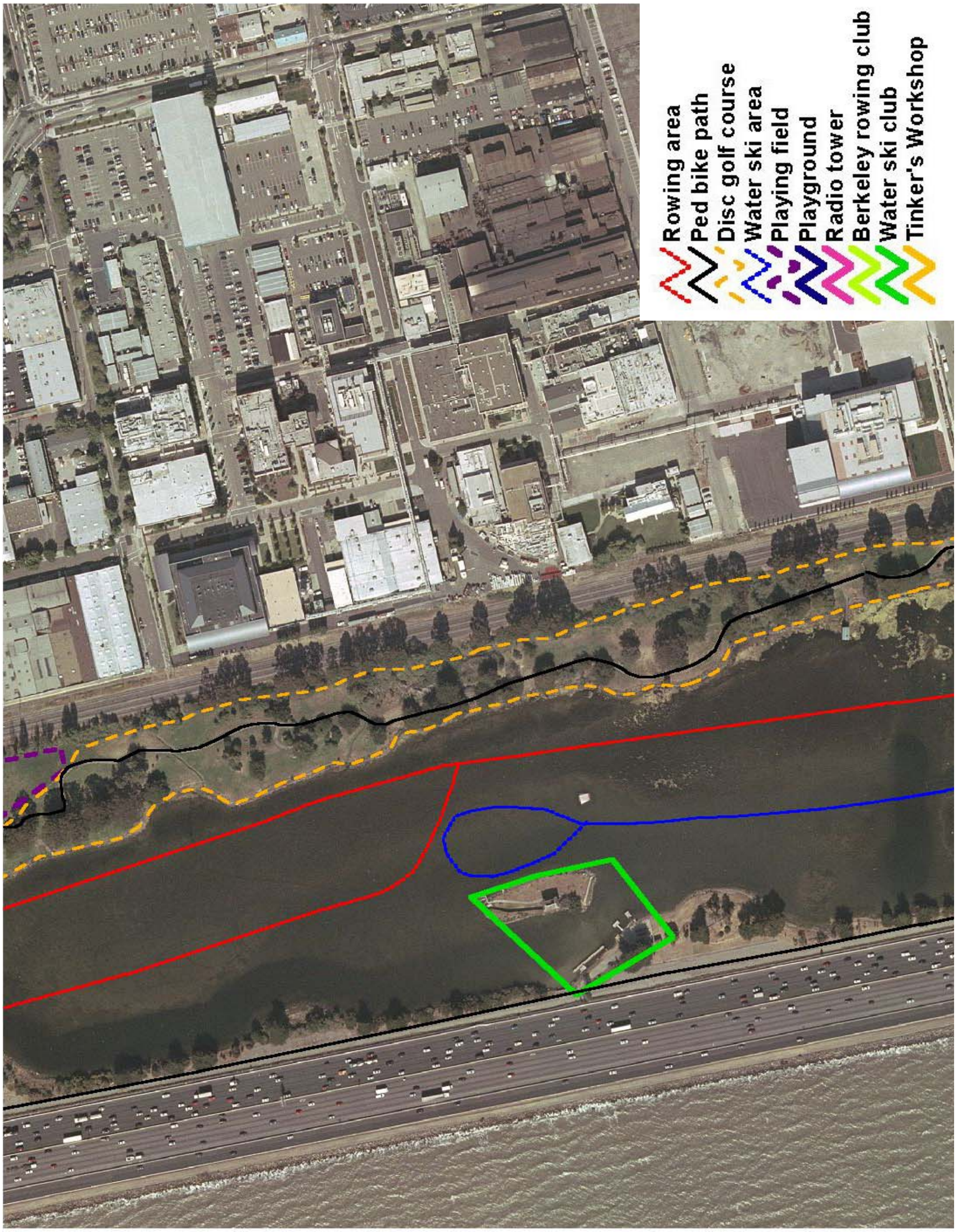


Figure 2-54. Aerial Photograph Showing Recreational Land Use (Section 3)

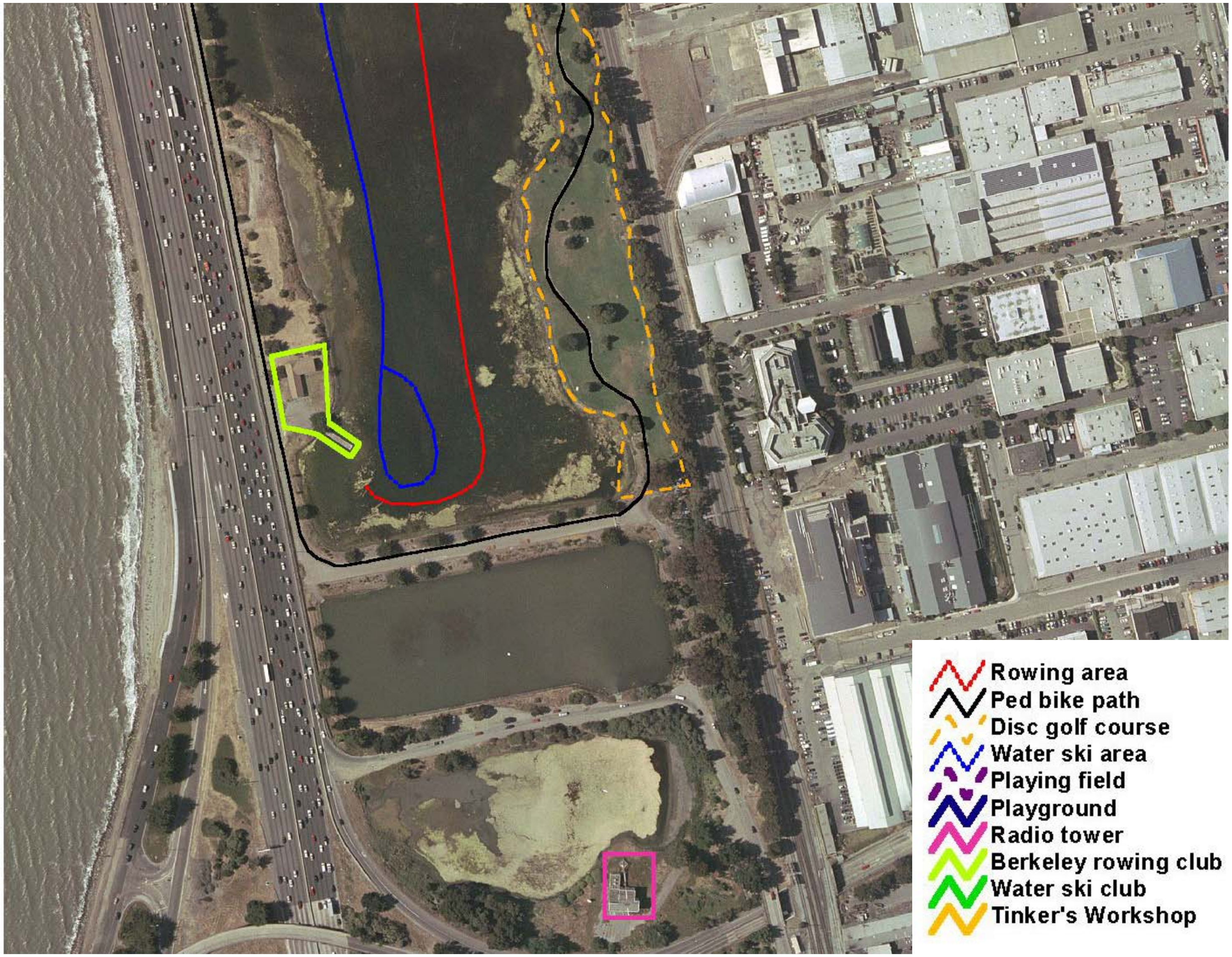


**Figure 2-55 Key to Sections of Aerial Photograph Showing Wetlands Features**

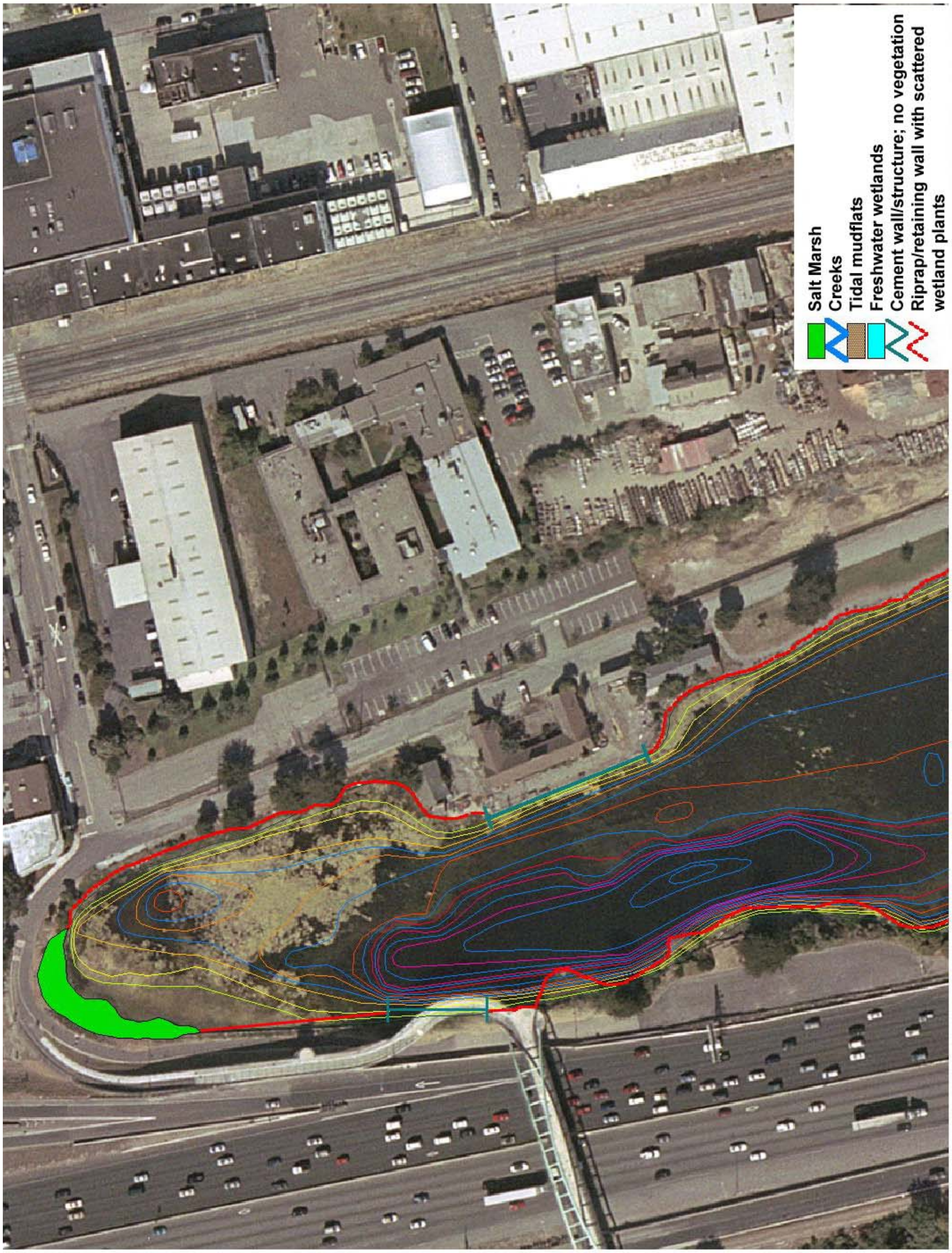



**Figure 2-56. Aerial Photograph Showing Wetland Features (Section 1)**

Figure 2-57. Aerial Photograph Showing Wetland Features (Section 2)

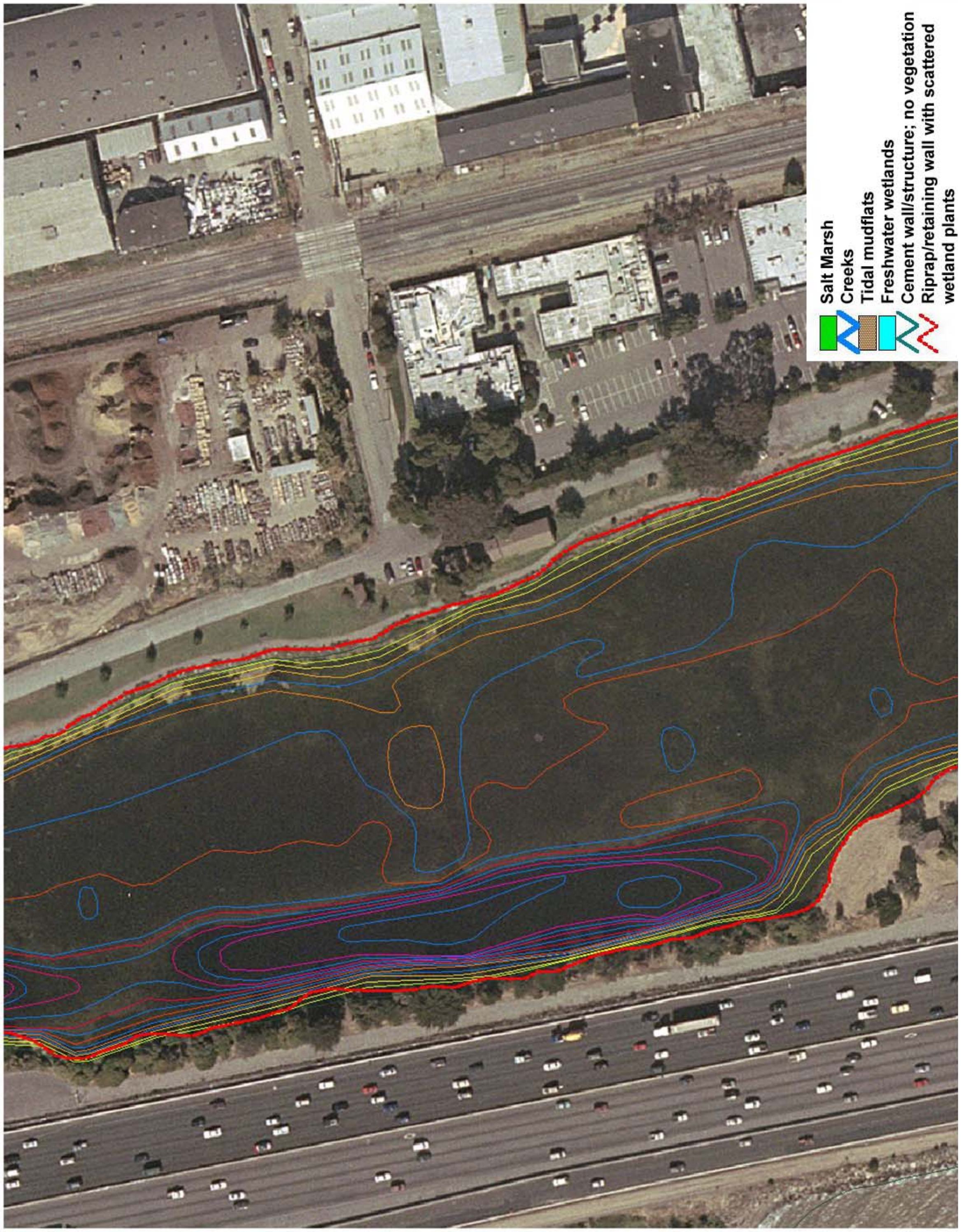
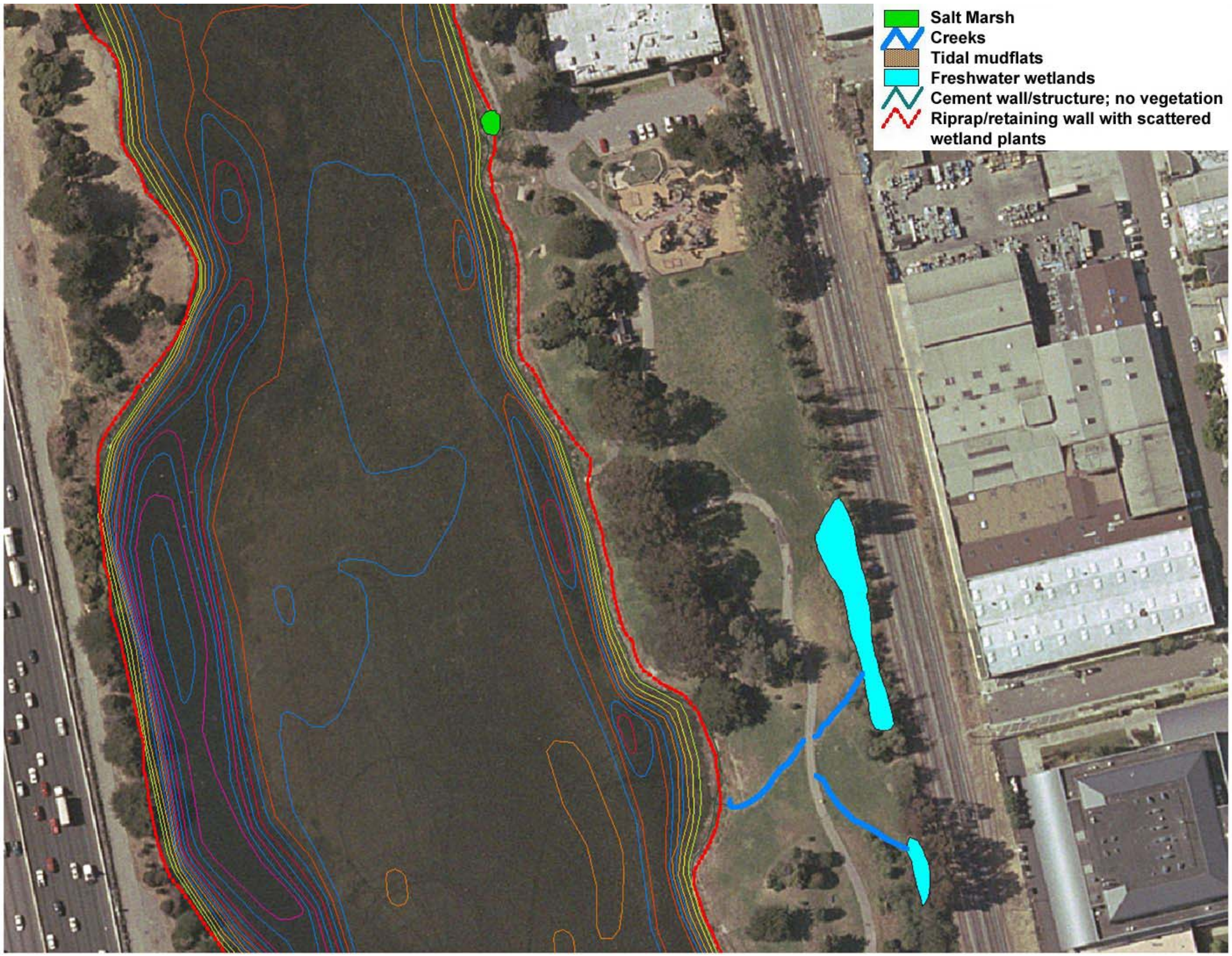


**Figure 2-58. Aerial Photograph Showing Wetland Features (Section 3)**



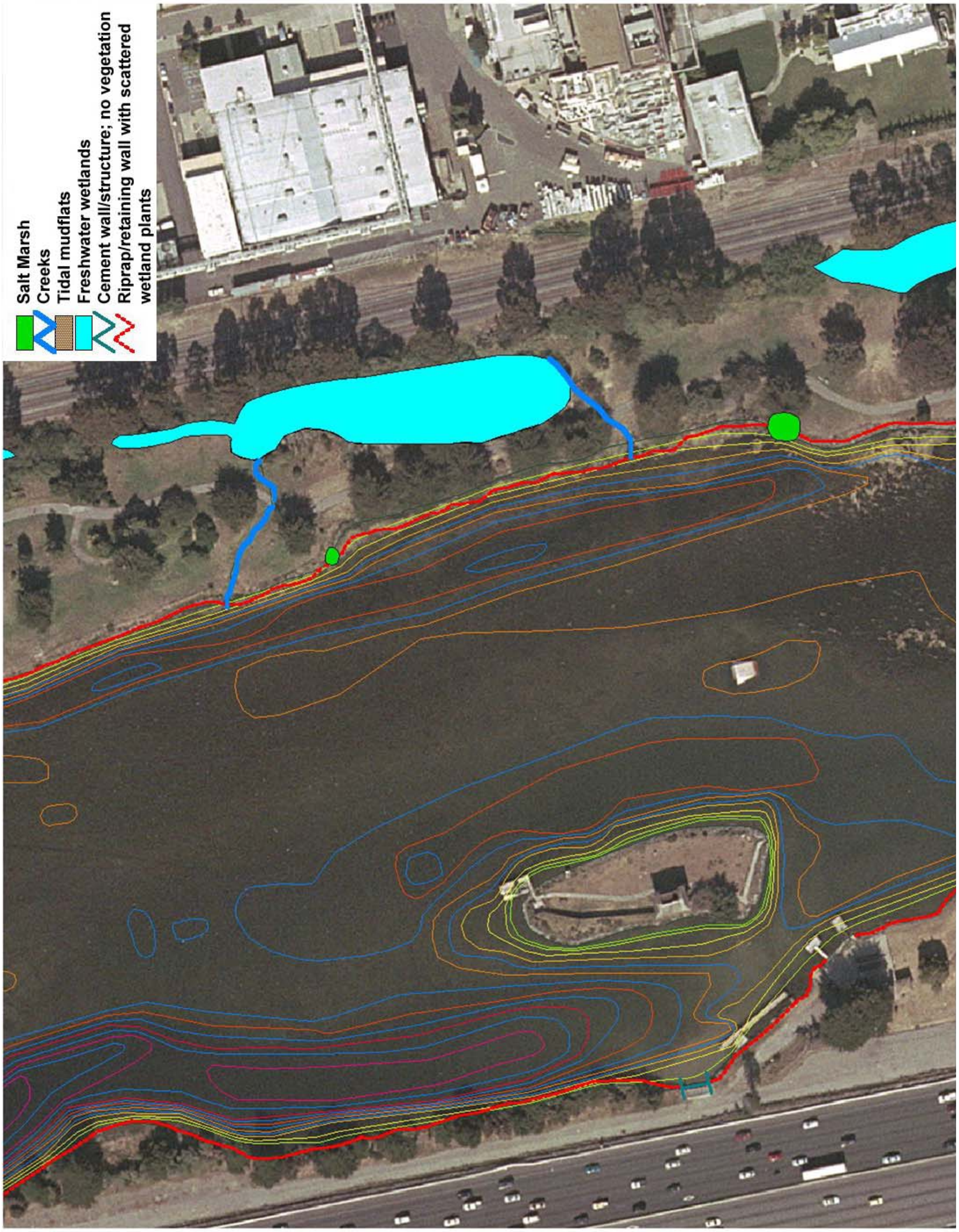



**Figure 2-59. Aerial Photograph Showing Wetland Features (Section 4)**

**Figure 2-60. Aerial Photograph Showing Wetland Features (Section 5)**

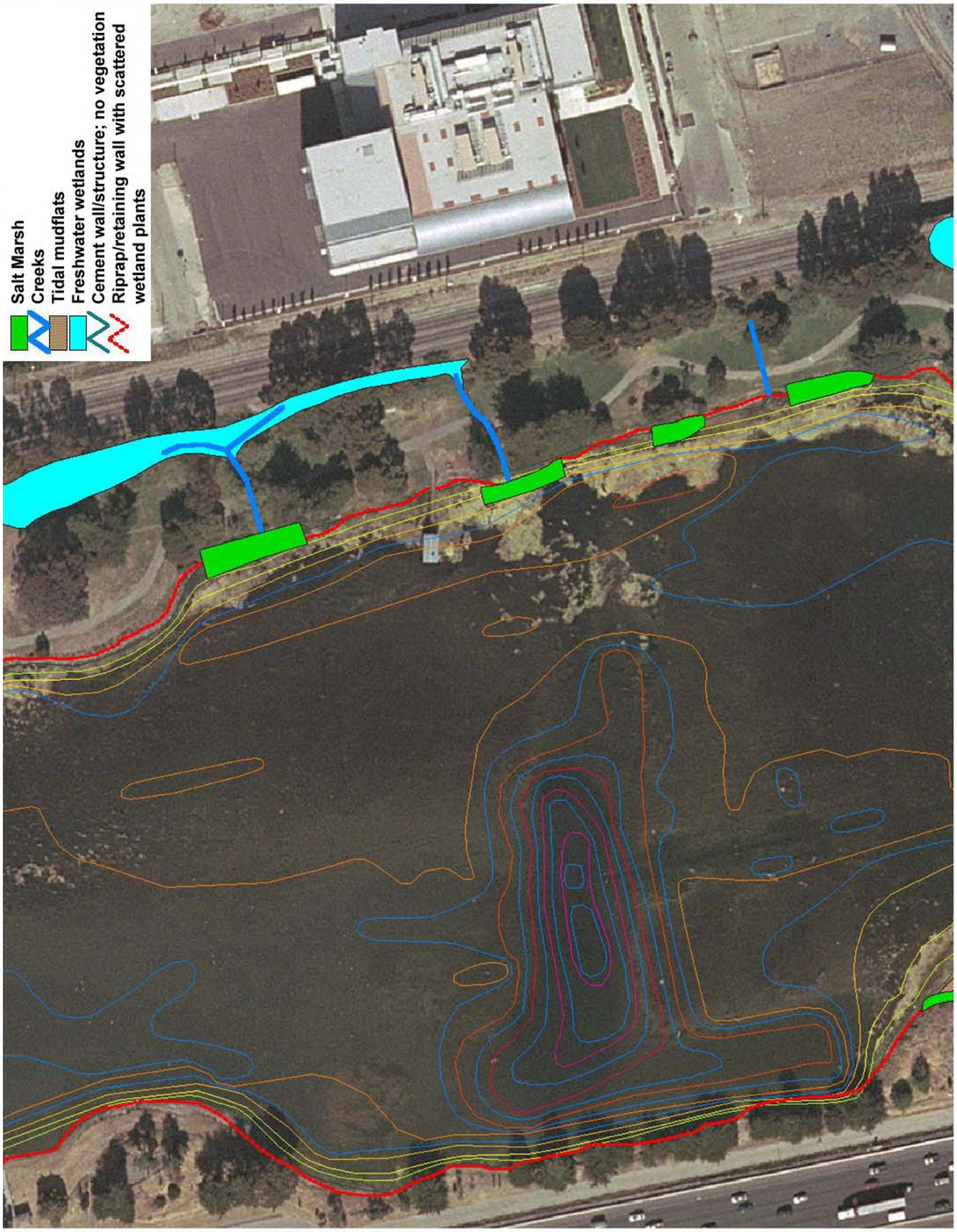


Figure 2-61. Aerial Photograph Showing Wetland Features (Section 6)

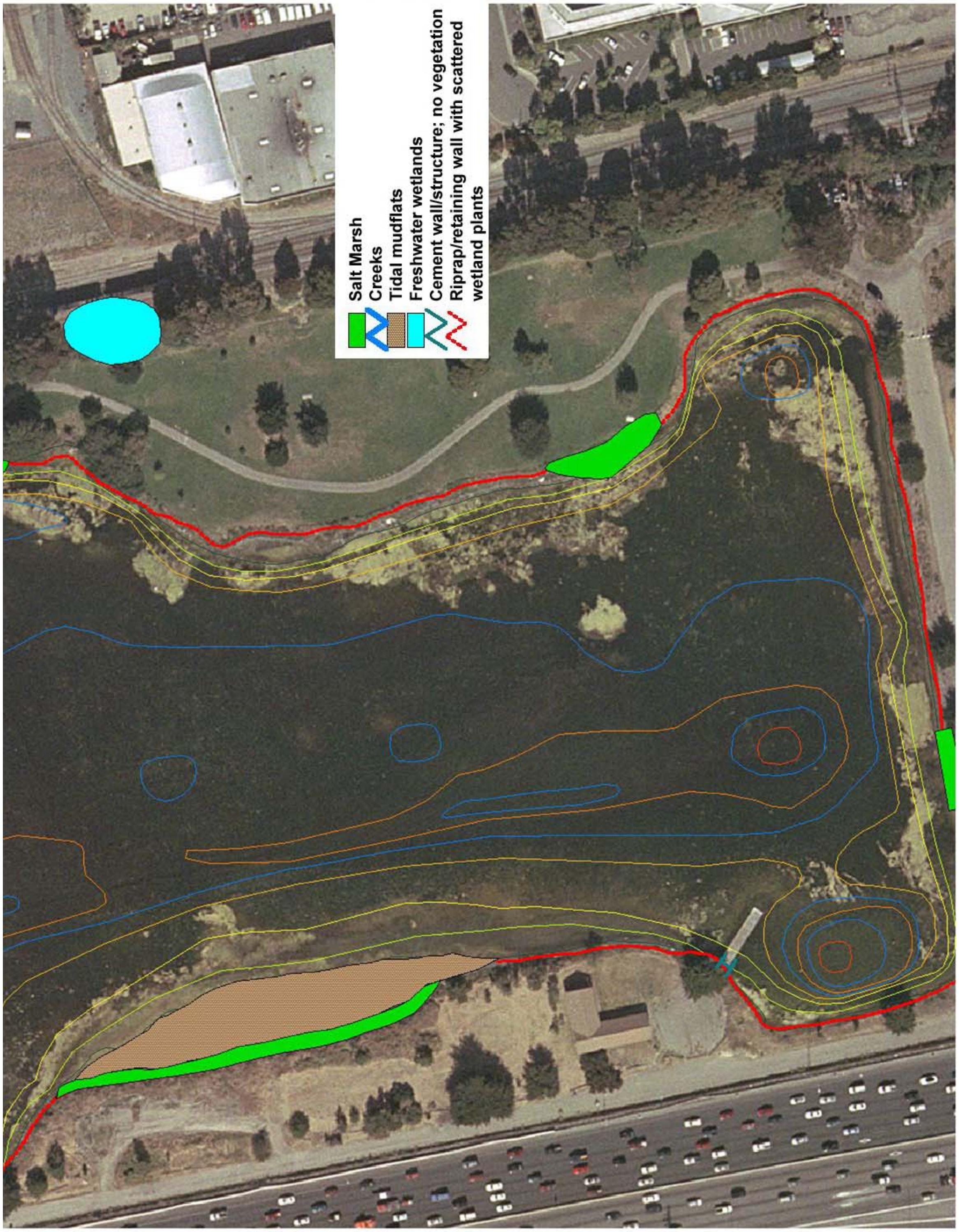
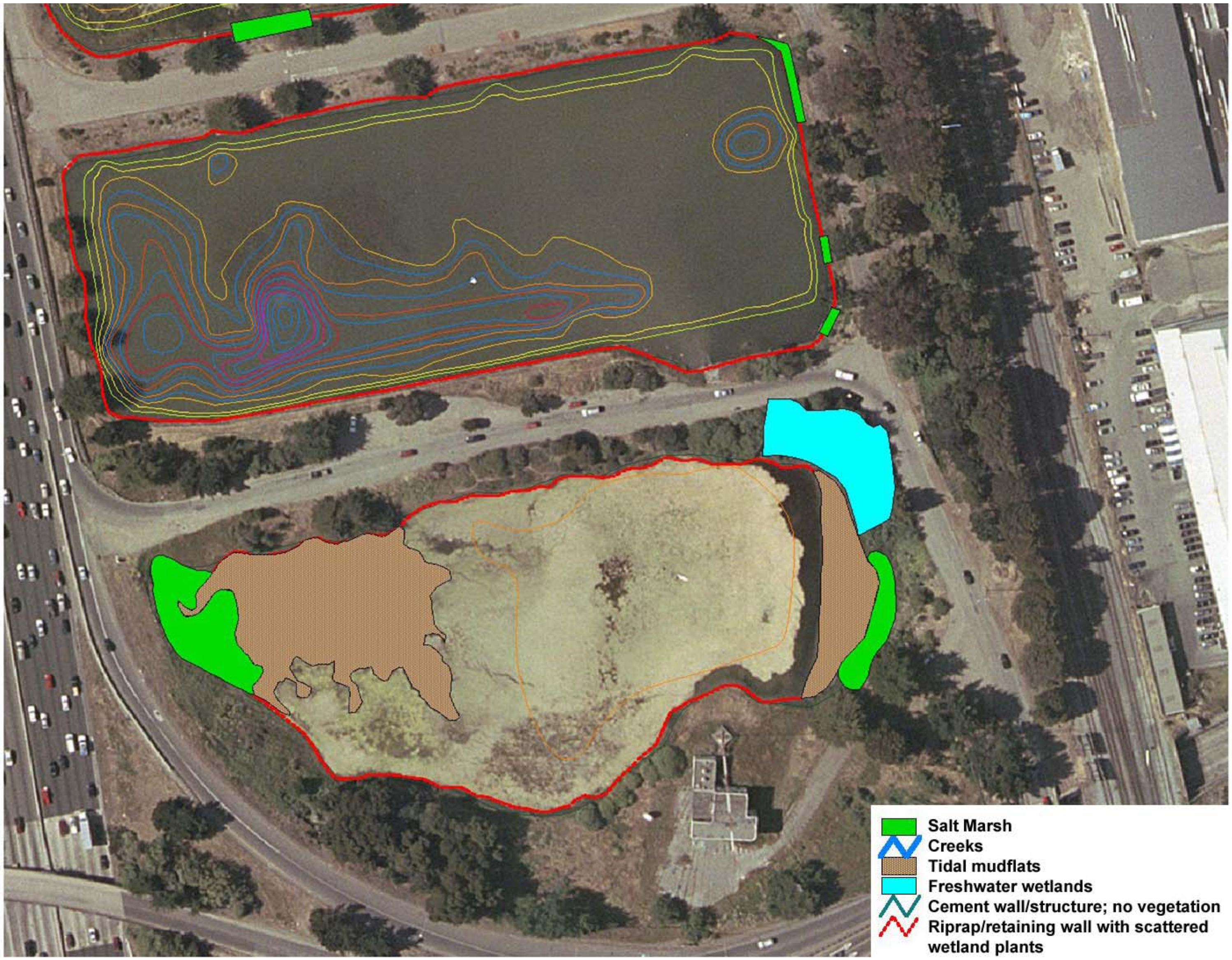


**Figure 2.62 Aerial photograph showing wetland features (Section 7)**



Homeless encampments and use of the dense vegetation for illicit activities have been frequent problems at the Park.

### Planned Developments

<u>Sound Wall</u>
A sound wall bordering Interstate 80 and the west shore of the Main Lagoon is on the CalTrans list of projects, but no action has taken place in the recent past and no date is set for construction (L. Caronna, personal communication 2002).

Mitigation measures in the EIR for Interstate 80 call for 3,100 linear feet of sound wall along Aquatic Park. A community process led to the request for 5,600 linear feet (the entire length of the Park). There are plans for a peripheral bike loop around the Main Lagoon using the existing roadway and walking paths.

### Evaluation of Regulations

Aquatic Park is a wetland area on the shoreline of San Francisco Bay and as such is subject to a variety of regulations. A review of the major laws and regulations, which would affect any projects or improvements proposed as part of this plan, is included as Appendix A.

## 2.4 Summary of Existing Conditions

Aquatic Park is a man-made set of three lagoons connected to San Francisco Bay by a set of culverts. Measurement of water depths, tidal cycles, temperatures and salinity found:

- The lagoons are relatively shallow with steep slopes along the shoreline.
- A number of culverts, many dating from the construction of the lagoon in the 1930s, provide tidal flow to the lagoons and between lagoons. Some of these culverts are no longer functional and many are subject to sediment accumulation and blockage from marine organisms attached to the inside of the culvert.
- Due to the constricted tidal flow created by the culverts even when the culverts were cleaned, the lagoons have a small tidal range of 1.4 ft. for the Main Lagoon and 0.6 ft. for the MYB compared to the average tidal range in San Francisco Bay of six feet. Another aspect of the tidal system in the lagoons is an extended period of inundation and exposure of 4-5 days due to monthly spring and neap tides.

- Stratification does not appear to occur in the lagoons. Stratification involves the formation of a layer of water of higher temperature or lower salinity on top of deeper layers of lower temperatures or higher salinity. Stratification reduces circulation in the water column and can create low dissolved oxygen levels for fish.
- The lagoons exhibit seasonal algal blooms and stagnant water conditions, primarily due to limited tidal circulation and shallow depths.

Evaluation of vegetation types and habitats around the lagoon shorelines and throughout the Park found:

- Tidal marsh is very limited around the lagoons due to the steep slopes of the shoreline and prevalence of riprap to stabilize the shoreline. There is less than one acre of salt marsh in the Park.
- A series of nine freshwater wetlands occur along the Railroad Berm drained to the lagoons by several creeklets. Mounds placed when the Park was created, reduce drainage and impound stormwater. There are 1.37 acres of freshwater wetlands.
- Upland areas in the Park encompass the lawn areas, Railroad Berm, ornamental plantings, roads and pathways around the Main Lagoon.
- Invasive non-native plants are abundant and have colonized the freshwater wetlands, as well as the salt marsh and upland areas. Invasive plants are a major problem for native habitats and are often able to out-compete native plant species and dominate areas where they are not removed.
- There are a number of different habitat types in the Park - open water of the lagoons, lagoon shoreline, freshwater marshes, and uplands.
- The uplands, freshwater marshes and lagoon shoreline have limited ability to support wildlife. The Park is primarily an urban park with high levels of recreational uses. As such, wildlife areas are small in size and adjacent to areas of high recreational activity. Unleashed dogs and homeless encampments give them low habitat value. Additionally, many areas dominated by invasive non-native plant species, which provide minimal habitat values. However, wildlife may roost or occasionally feed in these areas.
- The open water habitat of the lagoons total 65 acres and support a number of waterfowl and other migratory birds. Terns, gulls, a variety of egrets and herons, cormorants and pelicans also use the lagoons. Most of these species are fish eaters. Overall bird use is mostly feeding and roosting in the open water areas.

Evaluation of recreational and land uses in the Park found:

- Aquatic Park is a heavily used urban park and one of the few areas along the Bay where water recreation occurs.
- Water recreation is seasonal and includes water-skiing, rowing and kayaking.
- The upland and shoreline areas host a wide variety of activities, including Frisbee golf, bicycling, walking, children's playground, dog walking, team sports, kite flying, and picnicking.
- Significant changes in the tidal range of the Main Lagoon would impact recreational uses of the Lagoon and the shoreline by putting them under water on a regular basis.
- There are also a number of problematic uses of the Park including homeless encampments and illicit activity in the dense vegetation.

# 3.0 ALTERNATIVES

Alternatives were developed to match water quality and habitat maintenance and management practices with the proposed uses of the draft Aquatic Park Master Plan. These alternatives fall into three major categories: improvements to water quality through changes in water circulation; improvements to wildlife habitats; and improvements to Park aesthetics and habitat through removal of invasive non-native plants and changes in Park landscaping.

The alternatives are not necessarily dependent upon one another unless noted. The alternatives represent a set of short- and long-term actions for the City and community to implement to improve the function and overall condition of Aquatic Park.

In the process of formulating alternatives, those ideas that were not feasible were removed, such as installing new, larger tidal culverts by excavating through Interstate 80. This concept might provide for improvements to the lagoons, but is likely to face vast opposition due to the heavy traffic on this highway and the need to interrupt and redirect traffic to implement the culvert replacement.

Similarly, the NRMS does not evaluate alternatives that would remove or severely alter recreational uses from current heavily used areas. Due to the noted effect of recreational activities in reducing the value of wildlife habitats, the alternatives focus on segregating the Park areas and concentrating wildlife improvements in the southern area of the Park, while retaining on-going uses in other areas. This concept is consistent with the Aquatic Park Master Plan (see Section 1.3).

## 3.1 Alternatives for Enhancing Water Circulation

The Natural Resource Management Study goals include:

- Balance recreational uses with the enhancement and restoration of wetlands, other aquatic and terrestrial habitats, and improvements to lagoon water quality and circulation. Evaluate the southern portion of the Park as a focus of restoration of habitat for birds and other wildlife.
- Focus on low maintenance structures to reduce the need for long-term funding.
- Evaluate approaches to address water quality problems through mechanical harvesting, dredging, and increasing water circulation with improved flow structures.

**The key to enhancing water quality in Aquatic Park is enhancing tidal exchange with the Bay and improving flow between the lagoons.** There are several constraints in formulating alternatives to enhancing water circulation:

- Existing tide tubes, stormdrains and culverts under Interstate 80 will be used.
- The current tidal range of the Main Lagoon cannot be significantly increased without affecting shoreline buildings, recreational areas and uses.
- The existing configuration of the shoreline can only be slightly modified to increase the water area of the lagoons through removal of portions of roads and some uplands on the shoreline so the overall area of the lagoons cannot change without significantly affecting existing recreational uses.
- Significant deepening of the lagoons through dredging is a costly short-term action that will result in sand/mud from the Bay re-filling the dredge area. Therefore, deepening the lagoons to any significant degree is not feasible.

In order to evaluate alternatives for improving tidal exchange, two different models were used. The data collected on culvert size and function, and tidal heights and cycles for the lagoons and the Bay were used to calibrate the models. Calibration is an important step in assuring the model reflects real world conditions at the lagoons and produces the most accurate results for a series of alternatives involving changes in those conditions. The first model used (PondRout) was a one-dimensional pond routing model that calculates the water elevations for different alternatives. The second model used (FESWMS) was a two-dimensional finite element model that calculates internal circulation. The model results are expressed as height-duration curves. These curves show the percent of the time that a given water elevation is equaled or exceeded and thus demonstrate tidal heights and circulation over time.

Tidal height changes under each alternative are summarized in Table 3-1. To demonstrate the level of water quality improvement produced by each alternative, the lagoons were broken into zones (see Figure 3-1). The percent improvement of water volume exchange or circulation for each zone is then reported in Table 3-2 for each alternative.

Improvements to water quality within the lagoons are highly dependent on the ability to exchange lagoon water with water from San Francisco Bay. With each tidal cycle, a portion of the lagoon water is discharged to the Bay, and in turn, Bay water flows into the lagoons. This exchange is beneficial, because the volume of lagoon water that is discharged to the Bay carries with it, the warm nutrient rich water that is the engine for algal growth in the lagoons. The Bay water that enters the lagoons is cooler, and contains greatly reduced nutrient levels. The more water that is discharged to the Bay, the more nutrients and pollutants that are removed from the lagoons. To be most effective, this exchange of water must occur throughout all sections of the lagoon system. Repeatedly exchanging the water that is only within the vicinity of the culverts would not appreciably change the water quality throughout the remainder of the lagoon system. To evaluate how effective each alternative was throughout the lagoon system, the lagoon system was divided into 10 zones, as was shown in Figure 3-1.

The hydrodynamic model was run for the existing condition and each of the 7 alternatives. The model was run for a 60-hour period, during which, we had measured water levels in the lagoons and the Bay. Figure 3-2 is a tabulation of the high and low lagoon levels that were computed for each alternative.

The percentage of water in each zone that was exchanged with Bay water was computed within the hydrodynamic model. The percentage was computed as the volume exchanged with the Bay divided by the dead storage in each zone. The dead storage in each zone is the volume of water below the lowest water level in the lagoon. The effectiveness of each alternative was determined by comparing the percent of the volume that was exchanged with Bay water to the percent of volume that was exchanged under the existing condition. This comparison was done for each of the 10 zones under each of the 7 alternatives. The average percent improvement for each alternative was computed by averaging the percent improvement for each of the 10 zones. These averages are listed in Table 3-2 and shown graphically in Figure 3-3.

Many of the alternatives are combined to attain the greatest improvements. For example, Alternative 3 increases tidal flow from the Potter Street stormdrain into the MYB, but unless this improvement is combined with Alternative 2, which installs new large culverts between the MYB and the Main Lagoon, the greatest circulation improvements are not gained. So while each specific change is described as a separate alternative, it is clearly noted which alternatives are implemented together and which do not.

A number of concepts for alternatives to change tidal circulation were discussed with City staff and the Advisory Committee. A total of six alternatives were evaluated and are represented graphically in Figures 3-4, 3-5 and 3-6.

### Alternative 1: Opening the slide-flap gates between the Main Lagoon and San Francisco Bay

The slide-flap gates on the inside of the main inlet-outlet culverts between the Main Lagoon and the Bay are designed to maintain a high water level during low and neap tide periods. In a closed position they allow tidal inflows, but reduce the outflow. It appears they leak and allow some outflow even when closed. Figure 3-7 shows the height-duration curves that result from opening all of the gates. The net effect of keeping the gates open is to reduce the water elevation in the Main Lagoon by about 0.3 ft. during low and neap tides; high tide levels are not much affected. A greater duration of low water could decrease the suitability of the Main Lagoon for water skiing and rowing and create longer exposure times for shoreline areas. The effect of this alternative on the water quality within each circulation zone is described in Table 3-1. In general, this alternative would increase water circulation in the Main Lagoon except in its very southern area, but create little to no improvement in the MYB and RTP. This alternative is not dependent on the implementation of any other alternative.

**Alternative 2: Improving the exchange of water between the Main Lagoon and Model Yacht Basin**

In this alternative, two new six-foot wide box culverts would be installed between the Main Lagoon and MYB. They would be open at the top, but covered with steel grates to provide easy access for cleaning. If they are installed near the locations of the existing culverts (or even closer to the east and west edges of the Main Lagoon), they should improve circulation in the Main Lagoon. This might be especially beneficial at the southeast corner, were anaerobic decomposition is causing foul odors. This alternative is not dependent on the implementation of any other alternative.

Figure 3-8 shows the effect of this alternative on the height-duration curves in the Main Lagoon and MYB. The tidal range in the Main Lagoon would be increased by about 0.2 ft. but the tidal range in the MYB would be decreased by about the same amount. There would be some improvement to water quality in the Main Lagoon, but some detrimental effect on water quality in the MYB due to this increase in tidal range. The improvement in the exchange in water within each of the circulation zones is described in Table 3-2.

**Alternatives 3a and 3b: Improve the exchange of water between the Model Yacht Basin, and enlarge the connection between the Model Yacht Basin and the Potter Street stormdrain.**

In this alternative four larger culverts would replace the two existing culverts between the MYB and Potter Street stormdrain. A weir box would be placed between each culvert and the stormdrain at the same elevation as the existing weirs. The culverts would be equipped with gates in order to allow for closure during floods or a water quality emergency. The culverts would also be fitted with racks to catch trash and debris that would otherwise enter the MYB from the Potter Street stormdrain. This alternative assumes that Alternative 2 is implemented.

Figure 3-9 shows the height-duration relationships for this alternative. The tidal range in the Main Lagoon and in the MYB would both be about the same as the MYB is at present.

Two variations of Alternative 3 were evaluated for improving the flow into the MYB. These two variations, Alternatives 3a and 3b, were evaluated as options for reducing the cost of Alternative 3. Alternative 3a would just remove the culverts between the two existing weir structures and the MYB, without altering the weir boxes or the connection to the Potter Street stormdrain. Alternative 3b would remove the two culverts that connect the weir boxes with the MYB and double the size of the weirs.

The effect on water quality for Alternatives 3a and 3b are described in Table 3-2. This alternative is only effective if combined with Alternative 2, which replaces the culverts between the Main Lagoon and MYB. Then the increased tidal flow from the Potter Street stormdrain gained from Alternative 3 can efficiently flow into and out of the Main Lagoon. Alternative 3a, in conjunction with Alternative 2, shows significant improvement in both the Main Lagoon and MYB. Alternative 3b, in conjunction with Alternative 2, shows even greater improvement in the MYB and Main Lagoon.

**Alternatives 4 and 5: Modify Bathymetry at North End of Main Lagoon**

The northern end of the Main Lagoon has been experiencing water quality problems that are typically worse than in the southern and central portions of the Main Lagoon. There is little that can be done in this area for increasing direct circulation. The drain to Strawberry Creek at the northern end of the Main Lagoon is undersized and due to its elevation, will carry very little flow from the Main Lagoon. Increasing the maximum and minimum water levels (increasing the tidal prism) through manipulation of the five main culverts and the weirs in the MYB as described in the previous sections will help, but they will not promote direct water flow through this area.

For Alternative 4 the northern end of the Main Lagoon would be dredged to -3.0 NGVD to increase the volume below the tidal prism. This will lower the percent of the total volume that is exchanged with each tidal cycle, but it will increase the volume and depth of water, which can also have some benefit to water quality. Deeper water allows for wind to provide greater water circulation and increase water quality. This will also allow for continued recreation within this zone, and deeper water will allow the Park operators to access the zone to collect windblown debris and algae mats that may accumulate. The effect of this alternative on water quality is described in Table 3-2.

Dredging the northern area of the Main Lagoon under Alternative 4 would not improve water circulation as much as Alternative 5. Alternative 4 would be implemented with Alternatives 2 and 3a and increase water quality significantly in the other areas of the Main Lagoon and the MYB. This alternative would slightly increase high tide elevations, but not affect low tides.

Alternative 5 would involve filling a portion of the northern end of the Main Lagoon to low tide elevation (+0.0 NGVD) with clean sand in order to increase the percent of the total volume that is exchanged with each tidal cycle. This alternative would be implemented in conjunction with Alternatives 2 and 3a. The effectiveness of exchanging water through a change in the tidal prism is dependent on the existing volume within each zone that is not within the tidal prism. If there is no water below the tidal prism, (i.e. the lagoon bottom is exposed at low tide), then with each tidal cycle, there is a 100% exchange of water. This can be effective for removing poor water quality from the Main Lagoon. The volume of water that is below the tidal prism is called the dead storage. If there is a large amount of water below the tidal prism, then the percent of water that is exchanged in each tidal cycle is small, and some poor quality water will remain within the zone for each cycle.

Filling the northern portion of the Main Lagoon to +1.0 ft. NGVD under Alternative 5 would improve conditions in this northern area significantly. Since Alternative 5 would also require implementation of Alternatives 2 and 3a the improvements to the other areas of the Main Lagoon and MYB would be significant (see Table 3-2). The filled area would become a tidal mudflat. This alternative would slightly increase high tide elevations, but not affect low tides.

**Alternative 6: Single Direction Flow**

Throughout the tidal cycle, water is moving into and out of the lagoons through the different culverts and weirs in the lagoon system. Some of the water brought into a lagoon may not flow back out of the lagoon before the next tidal cycle. Therefore, what appears to be water exchange may actually be movement of the same water back and forth.

By imposing a single direction on water circulation within the lagoon, a better and more positive exchange of water with the Bay can be achieved. For this alternative, two eight-foot wide weirs would be installed in the MYB connection to the Potter Street stormdrain. Water would be allowed only to enter the MYB through the weirs and flap gates would restrict water flow out of the MYB. The MYB would be open to the Main Lagoon, as described in Alternative 2, and the five main culverts in the Main Lagoon would only allow water to flow out to the Bay, and not back into the Main Lagoon. This configuration would impose a clockwise circulation of water through the lagoon system. This alternative could be designed using gates or weirs on the culverts to reduce the inflow of urban stormwater into the MYB in winter floods and to maximize the inflow of tidal water during the remainder of the year.

Alternative 6 would create a substantial increase in water quality in the Main Lagoon and MYB (see Table 3-2). It would require implementation of Alternative 2 (new culverts between the Main Lagoon and MYB), revisions to the inlet-outlet culverts in the Main Lagoon (described in Alternative 1) and some revisions to the new connections between the Potter Street stormdrain and MYB (Alternative 3).

Alternative 6 would slightly increase high tide levels, but not change low tide elevations.

**Summary: Water Circulation Alternatives**

Improvements to water quality within the lagoons are highly dependent on the ability to exchange lagoon water with water from San Francisco Bay. Each alternative was evaluated by computing the amount of water that is exchanged within each of the 10 zones delineated in Figure 3-1. The volume of water exchanged in each alternative was compared with the volume of water that is being exchanged under the existing condition.

Table 3-1 is a tabulation of the high and low lagoon water levels that were computed for the existing condition and each alternative. Table 3-2 is a summary of the percent of the dead storage within each zone that was exchanged with water from the Bay. Along with the percent volume is the percent increase in the amount of exchanged water compared to the existing condition. Except for Alternative 1, each alternative shown in the table includes implementation of the other listed alternatives. The average percent improvement is shown graphically in Figure 3-3.

Based on the mean percent improvement, Alternative No. 6 is the preferred alternative for improving water quality in the Main Lagoon.

This is primarily due to the imposition of the one-way circulation in the lagoon. This forced circulation pattern insures a more positive flushing action through the lagoons system.

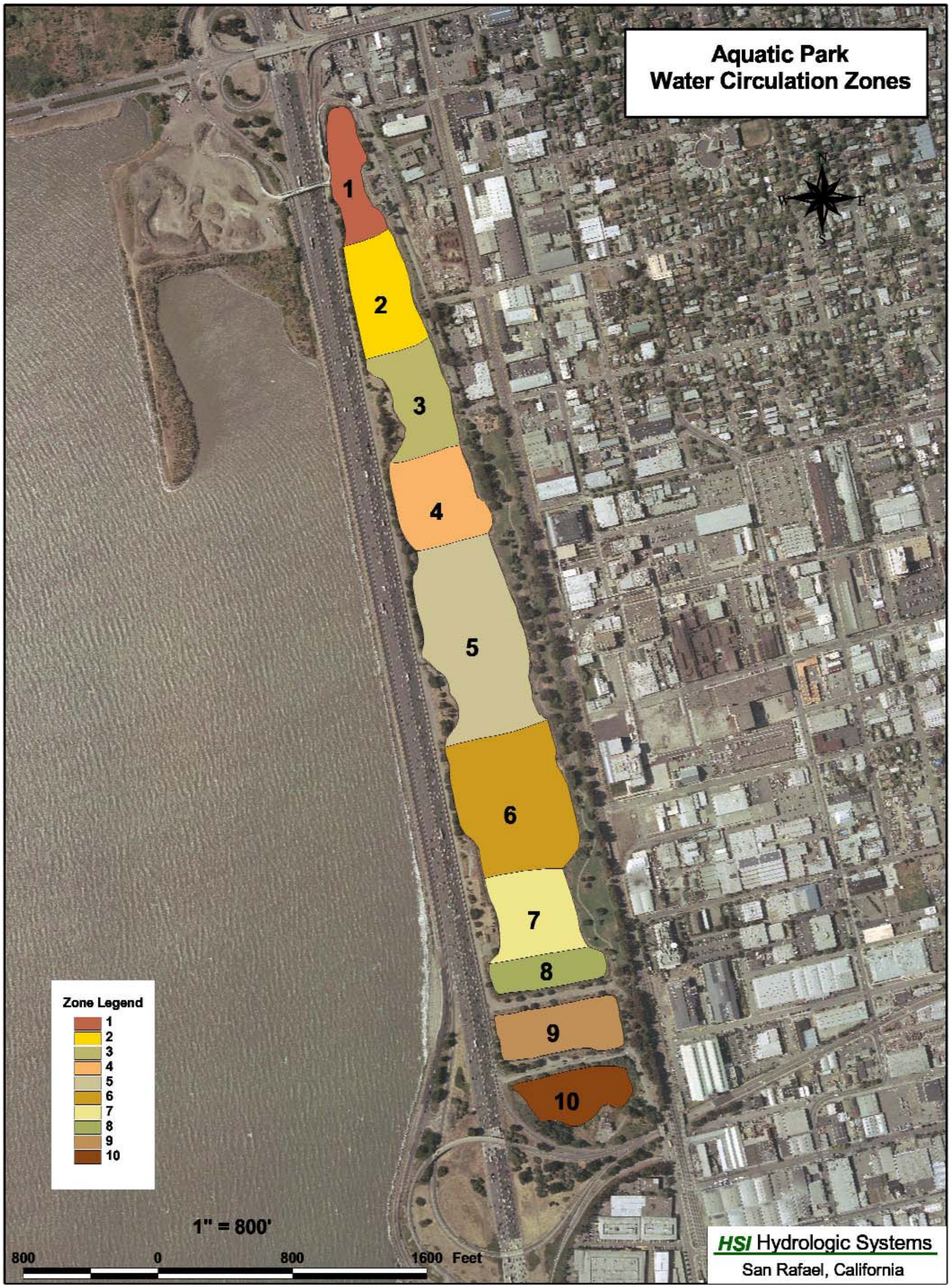
**Implications for Flooding**

During periods of high runoff, the Potter Street stormdrain overflows into the MYB. With an improved connection between the MYB and Main Lagoon, the water elevation in the latter would be somewhat higher than with the present configuration, but lower in the MYB than at present. At least one of the buildings near the Main Lagoon-the Tinkers' Workshop (#80 East Bolivar Drive) near the north end-could be subject to flooding during periods of combined high tide and heavy storm runoff. An evaluation of the effects of the alternatives on flood elevations is beyond the scope of this study. The City's five-foot contour interval AutoCAD map of the Park is not detailed or accurate enough to provide a useful tool for this analysis. As part of the engineering for project design surveying of shoreline areas and development of a set of runoff hydrographs for the Potter Street stormdrain would be necessary to determine the need for flood protection structures.

**Table 3-1. Lagoon Elevation Range For Different Alternatives (ft. NGVD)**

| Alternative | | Model Yacht Basin | | Inside Main Lagoon | | Outside Main Lagoon | | Radio Tower Pond | |
|---|---|---|---|---|---|---|---|---|---|
| | | Min | Max | Min | Max | Min | Max | Min | Max |
| | Existing Condition | 1.10 | 2.04 | 1.10 | 1.43 | -3.00 | 3.00 | 0.69 | 1.23 |
| 1 | Open Up All Flap Gates | 1.10 | 2.04 | 0.87 | 1.24 | -3.00 | 3.00 | 0.69 | 1.23 |
| 2 | Connect MYB to Main Lagoon | 1.09 | 1.53 | 1.09 | 1.53 | -3.00 | 3.00 | 0.69 | 1.23 |
| 3a | Improve MYB Connection to Potter Street Stormdrain (2-3 ft. weirs | 1.09 | 1.79 | 1.09 | 1.79 | -3.00 | 3.00 | 0.69 | 1.23 |
| 3b | Improve MYB Connection to Potter Street Stormdrain (2-6 ft. weirs | 1.09 | 2.01 | 1.09 | 1.99 | -3.00 | 3.00 | 0.69 | 1.23 |
| 4 | Dredge Northern End of Main Lagoon | 1.05 | 2.04 | 1.10 | 1.43 | -3.00 | 3.00 | 0.69 | 1.23 |
| 5 | Fill Northern End of Main Lagoon | 1.09 | 1.79 | 1.09 | 1.79 | -3.00 | 3.00 | 0.69 | 1.23 |
| 6 | Single Direction Flow | 1.06 | 1.98 | 1.06 | 1.94 | -3.00 | 3.00 | 0.69 | 1.23 |

**Figure 3-1. Aquatic Park Water Circulation Zones**



## Table 3-2. Aquatic Park Water Quality Model - Percent Volume Exchange Within Each Circulation Zone

| Description of Alternative | Zone* Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| **Existing Condition** | 7% | 12% | 12% | 16% | 29% | 15% | 19% | 8% | 60% | 12% |
| **1: Open Up All Flap Gates** | | | | | | | | | | |
| % Volume Exchange | 14% | 26% | 40% | 49% | 52% | 32% | 40% | 9% | 60% | 12% |
| % Improvement** | 110% | 111% | 230% | 203% | 77% | 112% | 112% | 8% | 0% | 0% |
| **2: Connect Model Yacht Basin With Main Lagoon** | | | | | | | | | | |
| % Volume Exchange | 12% | 21% | 32% | 41% | 33% | 14% | 43% | 57% | 61% | 12% |
| % Improvement** | 70% | 71% | 166% | 150% | 11% | -8% | 126% | 618% | 2% | 0% |
| **3: Improve MYB Connection to Potter Street Stormdrain (2-3 ft. weirs)** | | | | | | | | | | |
| % Volume Exchange | 17% | 31% | 47% | 58% | 39% | 30% | 123% | 206% | 188% | 12% |
| % Improvement** in Conjunction with Alternative 2 | 149% | 150% | 290% | 259% | 33% | 104% | 552% | 2481% | 214% | 0% |
| **3b: Improve MYB Connection to Potter Street Stormdrain (2 - 6 ft. weirs)** | | | | | | | | | | |
| % Volume Exchange | 24% | 44% | 67% | 84% | 73% | 35% | 210% | 411% | 362% | 12% |
| % Improvement** in Conjunction with Alternative 2 | 258% | 261% | 462% | 417% | 150% | 138% | 1,008% | 5,048% | 504% | 0% |
| **4: Dredge the Northern Zone 1 of the Main Lagoon to Elevation -3.0 NGVD** | | | | | | | | | | |
| % Volume Exchange | 11% | 31% | 47% | 58% | 39% | 30% | 123% | 206% | 188% | 12% |
| % Improvement** in Conjunction with Alternatives 2 and 3a | 66% | 150% | 290% | 259% | 33% | 104% | 552% | 2,481% | 214% | 0% |
| **5: Fill In the Northern Zone 1 of the Main Lagoon to Elevation +1.0 NGVD** | | | | | | | | | | |
| % Volume Exchange | 199% | 31% | 47% | 58% | 39% | 30% | 123% | 206% | 188% | 12% |
| % Improvement** in Conjunction with Alternatives 2 and 3a | 2,828% | 150% | 290% | 259% | 33% | 104% | 552% | 2,481% | 214% | 0% |
| **6: Single Direction Flow** | | | | | | | | | | |
| % Volume Exchange | 24% | 43% | 65% | 82% | 207% | 146% | 496% | 766% | 670% | 12% |
| % Improvement** in Conjunction with Alternatives 1, 2, and 3a | 249% | 251% | 447% | 403% | 605% | 321% | 581% | 9,504% | 1,018% | 0% |

* For zones see Figure 3-2
** Percent Improvement is with respect to the Existing Condition

**Figure 3-2. Aquatic Park Water Quality Model - Predicted vs Measured Water Surface Elevation**

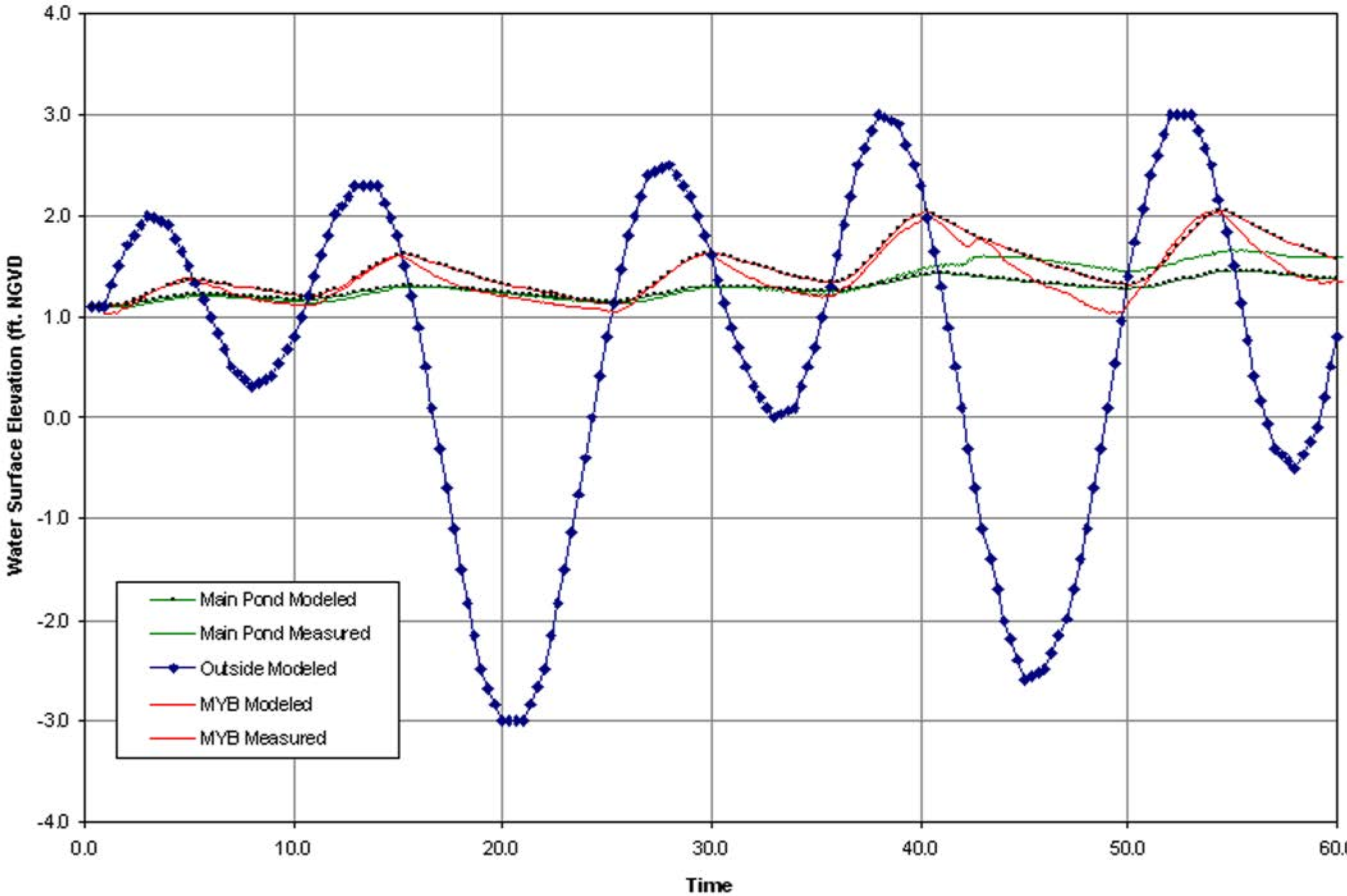
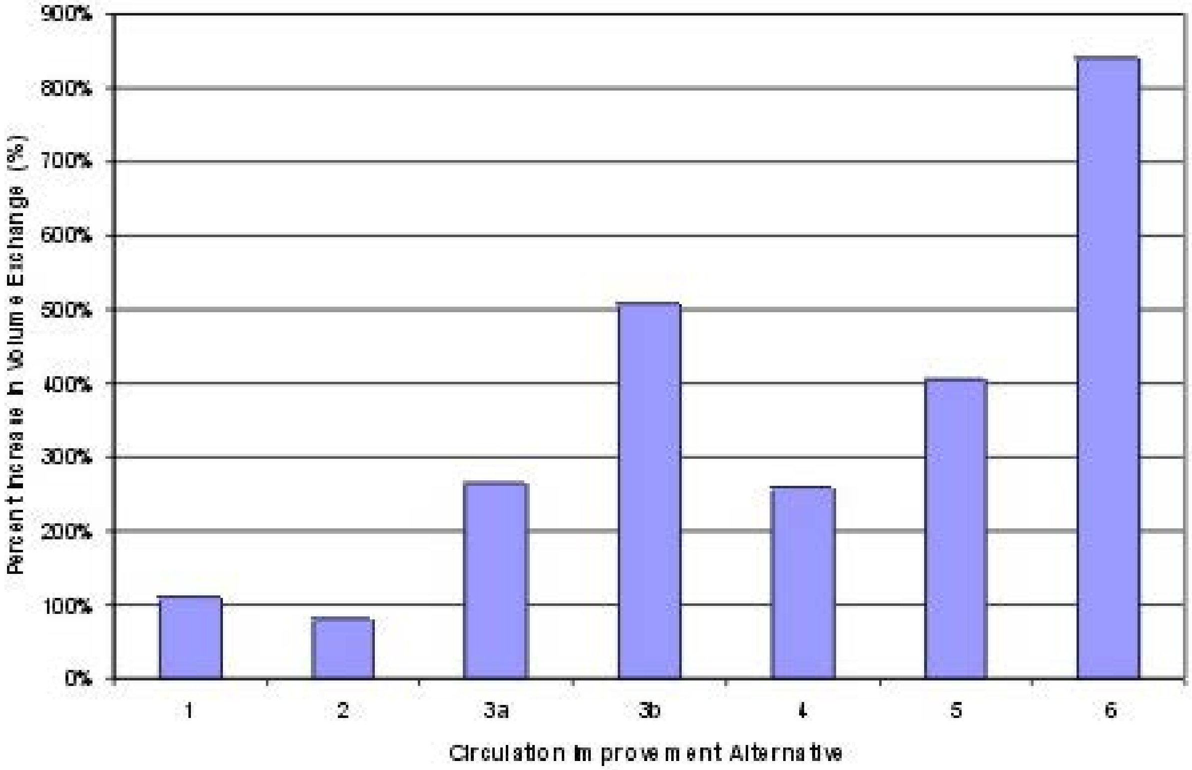


**Figure 3-3. Mean Increase in the Volume of Water Exchanged with the Bay Compared to the Existing Condition***




* See Table 3-2 for description of alternatives

**Figure 3-4 Aerial Photograph Showing Water Quality Alternatives (Section 1)**

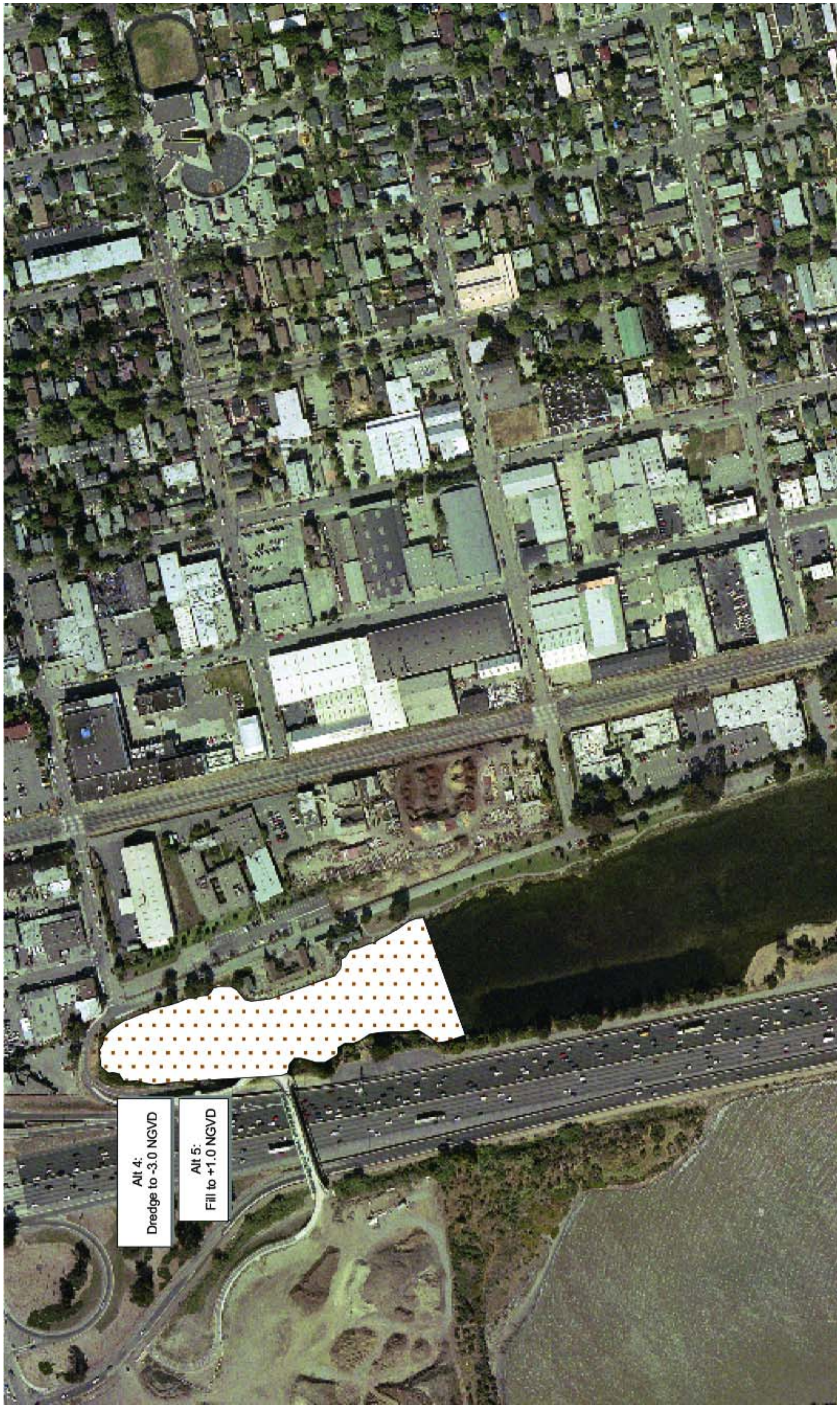


Figure 3-5  Aerial Photograph Showing Water Quality Alternatives (Section 2)

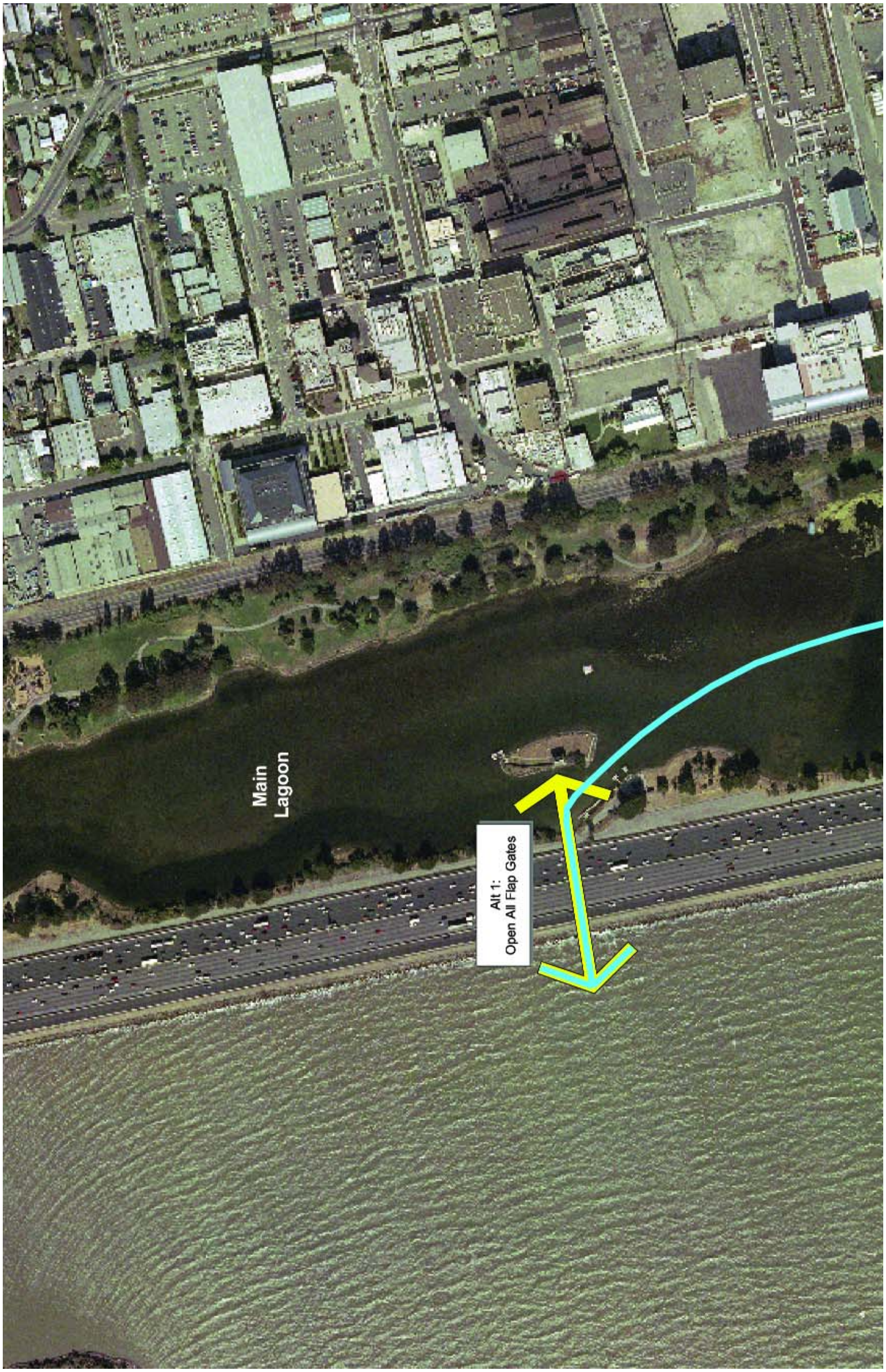


**Figure 3-6 Aerial Photograph Showing Water Quality Alternatives (Section 3)**

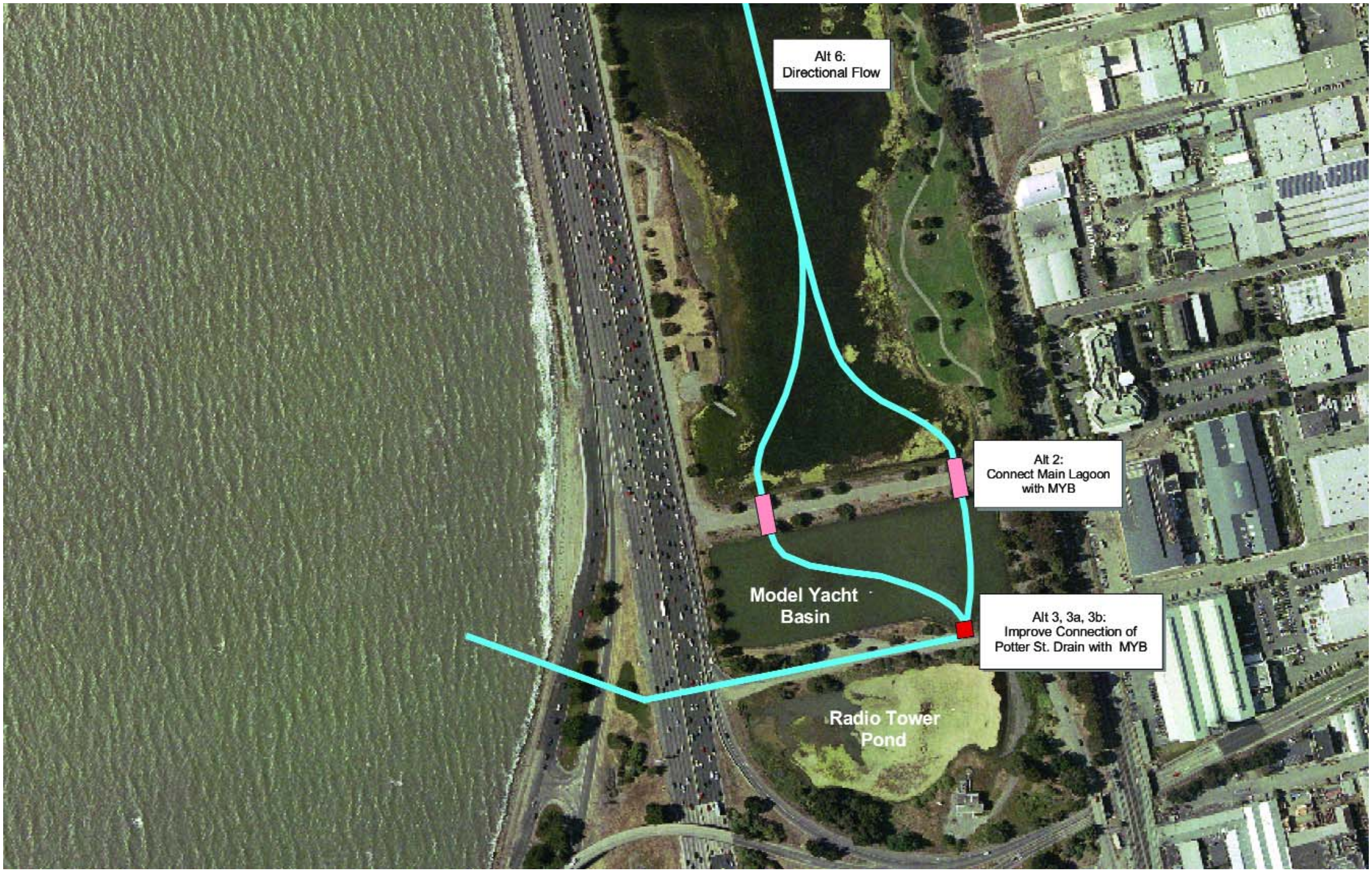


**Figure 3-7. Tide Height-Duration at Aquatic Park under Alternative 1**

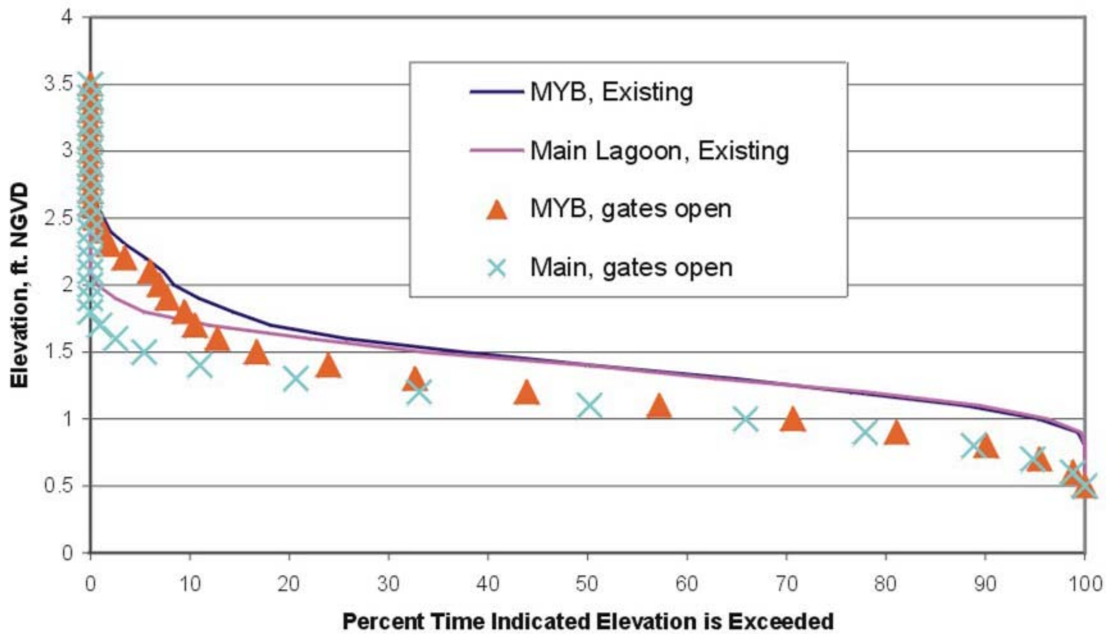



**Figure 3-8. Tide Height-Duration at Aquatic Park under Alternative 2**

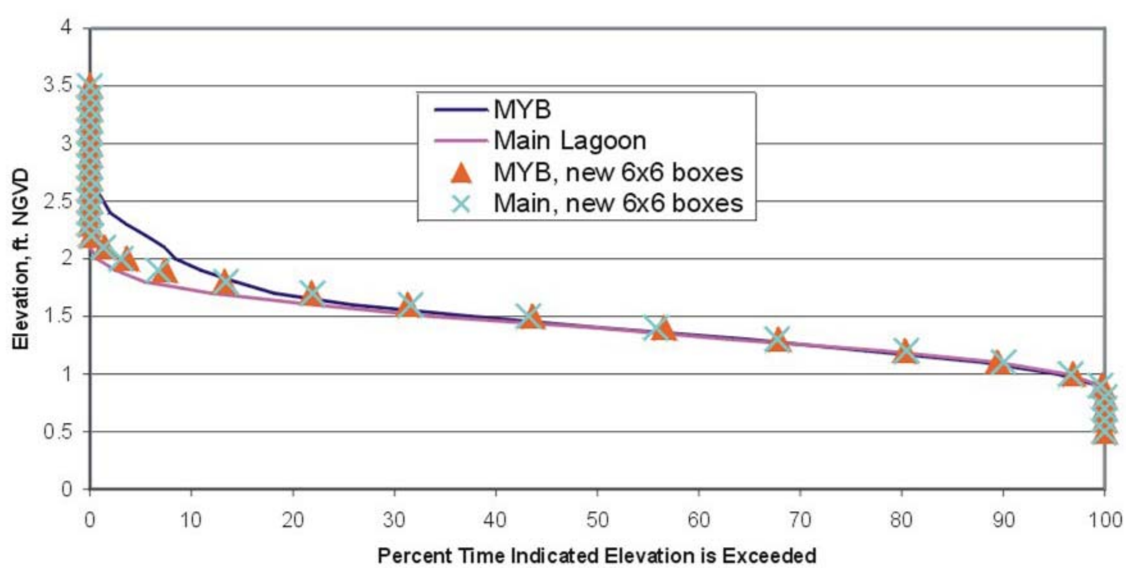
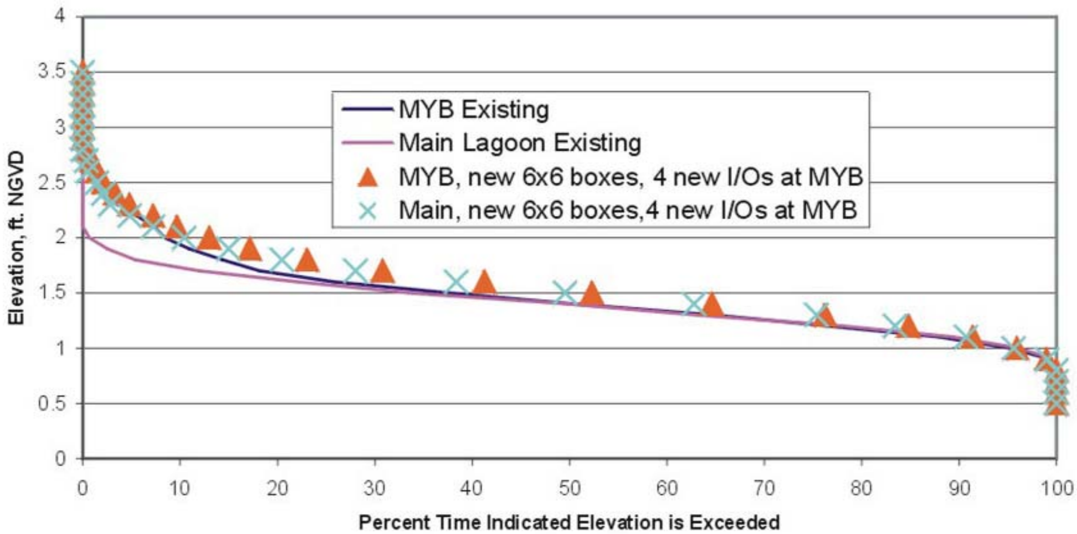


**Figure 3-9. Tide Height-Duration at Aquatic Park under Alternative 3**



## 3.2 Alternatives for Enhancing Habitats

The Natural Resource Management Study goals include:

- Balance recreational uses with the enhancement and restoration of wetlands, other aquatic and terrestrial habitats, and improvements to lagoon water quality and circulation. Evaluate the southern portion of the Park as a focus of restoration of habitat for birds and other wildlife.
- Identify locations of invasive non-native plants and diseased and senescent plants and revegetate with native plant species in upland and shoreline areas.
- Design restoration of native habitats to avoid increases in management and unacceptable activities in the Park.

Alternatives for habitat enhancement at Aquatic Park consist of several types:

- Creation of additional tidal habitats
- Enhancement and protective management of tidal habitats
- Removal of invasive non-native plants
- Revegetation with native plant species

There are a number of factors to consider regarding enhancing habitat at Aquatic Park:

There is a high level of active recreational use adjacent to the lagoons. Several studies in the Bay Area found that wetlands with a high degree of human use nearby have the least amount of bird use (Josselyn 1989). This has proven true for public access areas near wildlife habitat. Many bird species abandon nests and demonstrate decreased reproductive success when disturbance levels are high (BCDC 2001). This is not the case with all bird species. Some, such as gulls, Canada geese, coots and mallards may acclimate to human presence, to a degree.

Habitat restoration in urban areas is challenging because of the constraints resulting from human use and recreational activity. Because urbanization results in considerable changes in the physical system, the kinds of habitats that can be restored are limited. For example, as pointed out by Ehrenfeld (2000) constraints on defining and evaluating the success of restored wetland systems in urban areas include the fact that human uses may be more valued and may eclipse the extent of achievable restoration actions. As is the case at Aquatic Park, habitat patches are isolated and small in size, and hydrology has been greatly altered and no longer able to support historical habitats. In addition, Aquatic Park has few buffer areas between potential shoreline restoration areas and walking and recreational trails. Creating wetland habitat immediately adjacent to high use areas is unlikely to provide much value to wildlife currently using the Park.

Homeless encampments, unleashed dogs and recreational activities, affect the level at which birds and wildlife use the Park. To successfully create habitat and encourage biodiversity, wildlife habitats need to be relatively undisturbed. For example, trampling from human pedestrian traffic across the restoration site will need to be controlled or the wetland plants will be unable to establish successfully.

Relative to wildlife and habitats, the NRMS focuses more on overall habitat enhancement areas than on specific trees, dead branches, or brush piles. From a wildlife perspective, the removal of this or that dead branch is less important than a general policy of removing them only if they create a safety hazard, interfere with human activities, or are unsightly. A dead branch hanging over turf is not important for wildlife. A dead tree in the middle of the Park, while good for few birds, may be unsightly and ultimately unsafe. Dead branches or dead trees within a habitat system, however, create structure, support insects and cavity-nesting birds, fall to the ground and create cover for mammals, and decay to create mulch an enrich the soil.

A habitat system provides for numerous requirements of wildlife such as feeding, nesting and roosting through a diversity of vegetation types - wetlands, lagoons and uplands in an area of adequate size to support wildlife in moderate numbers. Small areas with little plant and habitat diversity and high levels of recreational activity have minor value for most wildlife. The south end of the Park could be enhanced for wildlife in a way that not only increased habitat value, but also minimized disturbance by recreational uses. The value of all elements of the habitat - dead and live trees, brush, wetlands, and water could then be realized.

<u>Invasive non-native plants</u> are a major problem in the Park. Any habitat enhancement project must address these plants both initially and over the long-term if native habitat is to establish and provide value to wildlife.

The <u>open water areas of the lagoons</u> currently provide habitat for many birds and fish. Implementation of Alternative 6 would provide the best improvement for water circulation and quality, which will enhance these aquatic habitats.

The lagoons were constructed to have <u>steep slopes</u> along their shorelines and are lined with rock. Wetland plants require very flat intertidal surfaces to grow. Some revisions to the shoreline of the lagoons will be needed to expand tidal wetland areas.

The <u>intertidal range</u> is very narrow and provides for a limited extent of salt marsh and mudflat habitats.

The freshwater wetlands are highly compromised areas dominated by high levels of recreational use and containing significant infestations of invasive non-native plants. Enhancement actions without removing adjacent recreational uses are not likely to produce viable wildlife habitat; therefore, alternatives addressing these areas focus on management to eradicate invasive non-native plants, increase native plantings, increase aesthetics and openness, and provide interpretive and educational values for the public. The following alternatives are graphically depicted in Figures 3-10, 3-11 and 3-12.

**Alternative 7: Wetland Restoration North of the Berkeley Rowing Club**

The Rowing Club Wetland would provide additional area on the western shoreline for shorebirds, wading birds and waterfowl to feed and roost (see Figure 3-11). The implementation of the water quality alternatives would benefit this alternative, but not be required as the alternatives only slightly alter tidal elevations over existing conditions.

Restoration of a tidal wetland at the Rowing Club site includes the removal of 300,000-420,000 cubic yards of material, regrading and revegetation with tidal wetland plant species (see Figure 3-13). This site would be excavated to the same elevation as the existing mudflat and salt marsh at this site. The graded area would be no greater than 1% slope and the western edge of the excavation may require riprap to stabilize the slope. The site would be excavated from the upper edge of the tidal marsh to the edge of the road. The existing ornamental vegetation and any invasive non-native plants in the area would be removed (Alternative 10). Salt marsh plants such as gumplant (*Grindelia stricta*) (see Figure 2-24), pickleweed (*Salicornia virginica*) (see Figure 2-37), jaumea (*Jaumea carnosa*), salt marsh heather (*Frankenia grandifolia*), and others would be planted. A transitional zone between the road and the Rowing Club Wetland would be planted with coyote brush, native grasses and other species and would provide a buffer.

The proposed wetland restoration should be separated from the area needed by the rowing club by a minimum of 50 ft. The recreational users of the rowing club should be involved in project design and understand that their activities should be maintained within a designated area and not extend to the wetland and its buffer. Loud noises, light from nighttime uses and unleashed dogs should not be allowed near the wetland and its buffer. A fence would enclose the site to restrict trampling as a result of recreational uses and unleashed dogs.

Depending on the quality of the material to be excavated, it could be used as land-scaping material in other areas of the Park such as in parking lot areas #1-3 (Alternative 13).

**Figure 3-10. Aerial Photograph Showing Habitat Enhancement Alternatives (Section 1)**

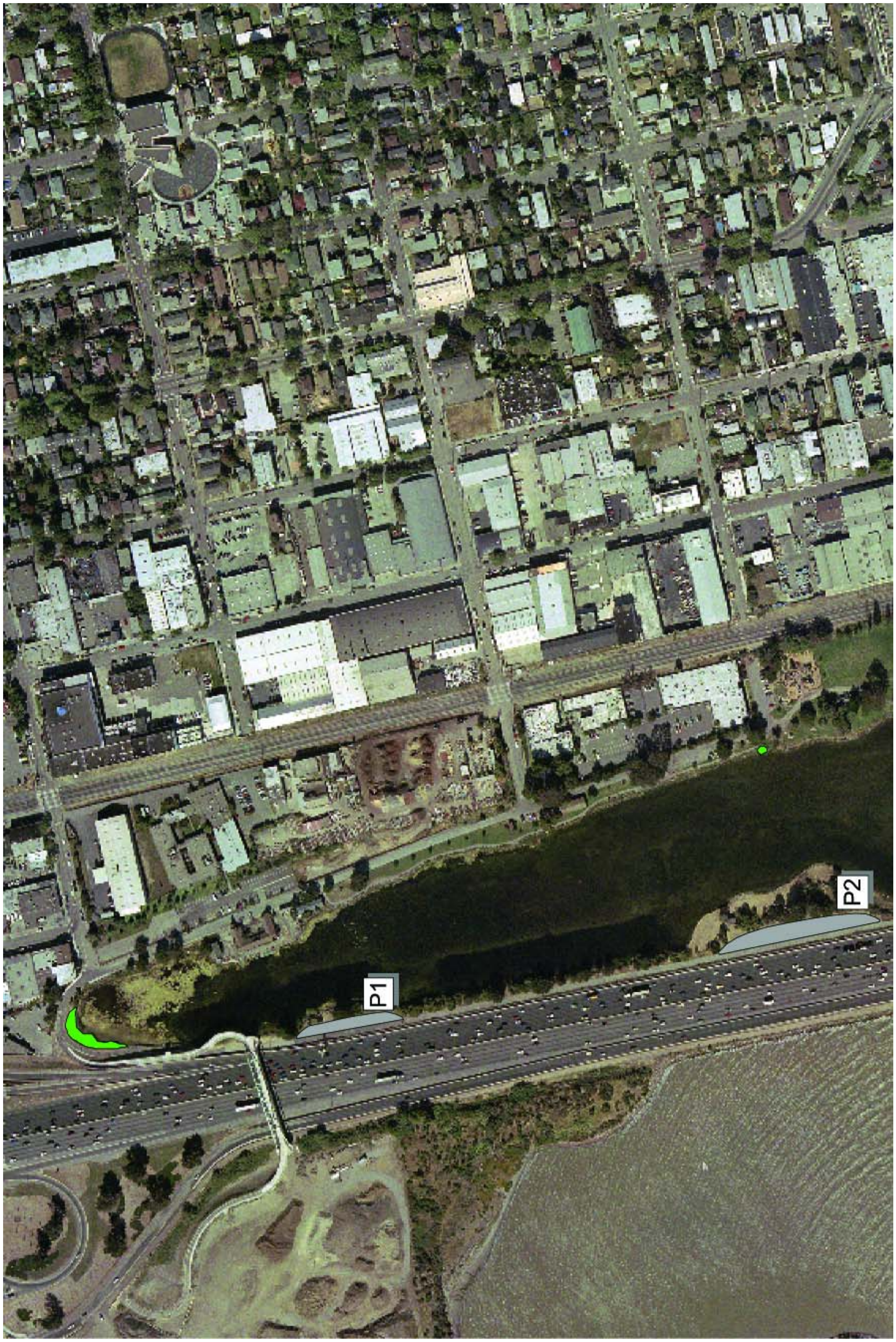


**Figure 3-11. Aerial Photograph Showing Habitat Enhancement Alternatives (Section 2)**

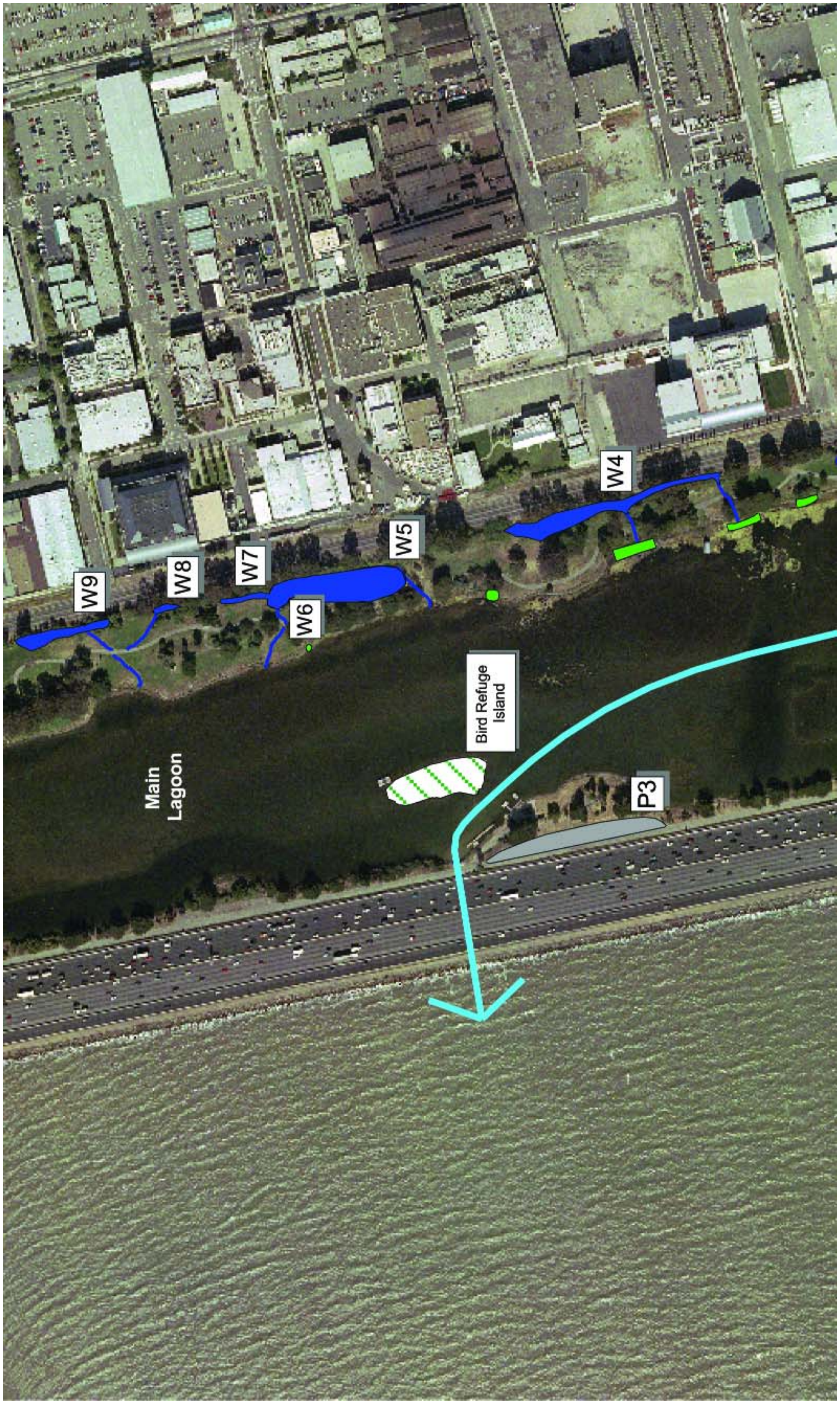


**Figure 3-12. Aerial Photograph Showing Habitat Enhancement Alternatives (Section 3)**

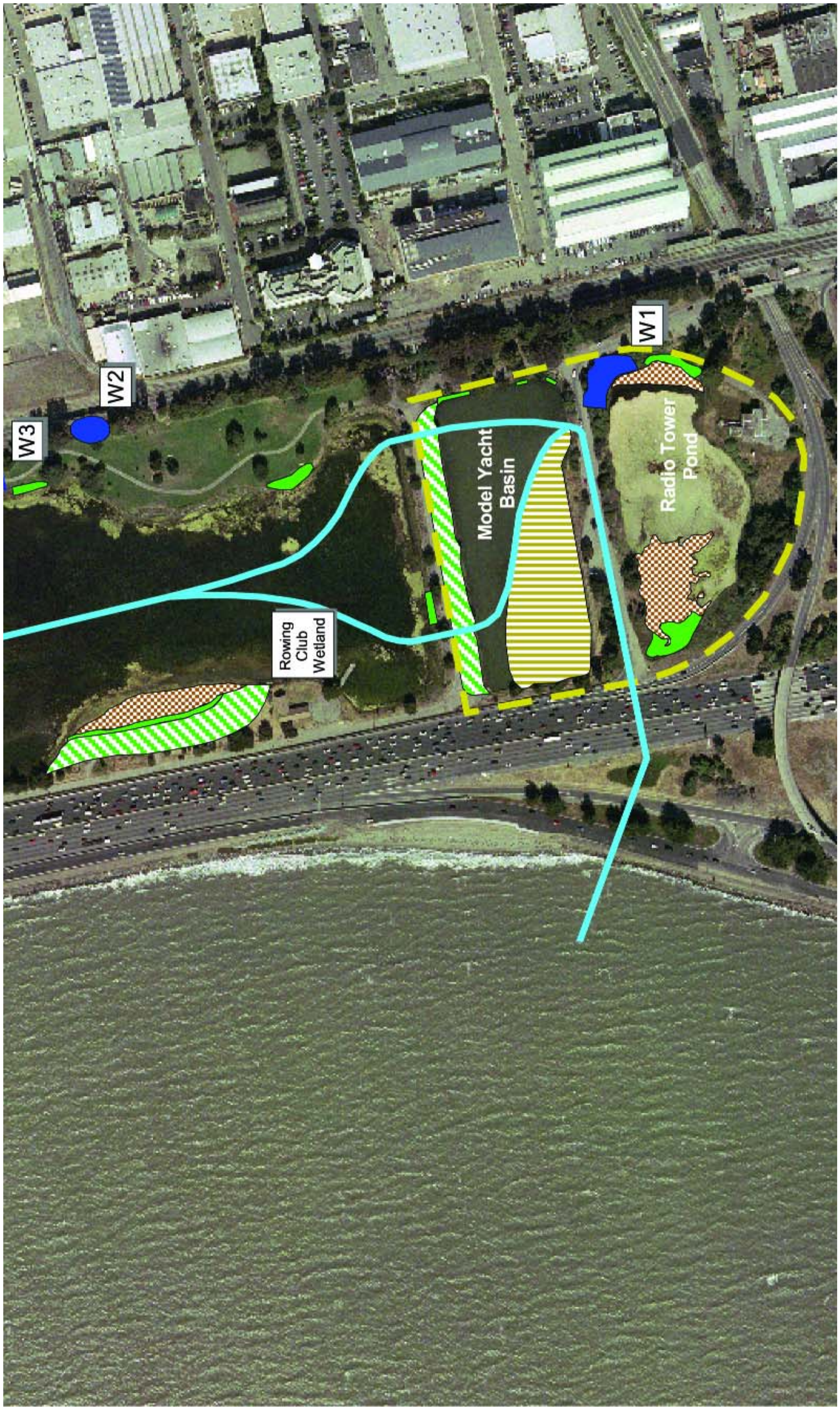


**Figure 3-13. Potential Rowing Club Wetland Area**

## Alternative 8: Allow the Model Yacht Basin to Develop into a Wetland and Manage the Model Yacht Basin as a Wildlife Area

As part of implementing changes to the lagoons water circulation (Alternatives 2, 3 or 6), the MYB would be connected to the Potter Street stormdrain. As tidal water flows into the MYB, it will carry sediment as is typical of Bay water. The tidal flow will then enter the Main Lagoon through two new sets of culverts. As this process occurs, the MYB is expected to slowly fill in with sediment in areas without flow-through currents (see Figure 3-12).

The roadway between the MYB and the Main Lagoon and pavement along the eastern and western edges of the MYB could be partially removed to create more area for wetland. The original shoreline of the MYB was constructed as a seating area and these rocks could be removed and the side slopes graded to a flatter slope by removing portions of the MYB/Main Lagoon divider road. The road will need to allow vehicle access to the boat ramp, which still leaves ten feet or so to be removed.

When the Ashby Avenue interchange is improved and Bolivar Drive, which separates the MYB and RTP is closed, some of the pavement may be removed for habitat expansion. The Potter Street stormdrain is located in this road so it cannot be completely removed.

As part of focusing habitat enhancement in the southern area of the Park, the MYB and RTP would be fenced off from public access to reduce disturbancea as a result of recreational activities. Fencing will need to physically restrict access to the area by people and dogs to be effective. There are various designs to achieve this. A good example can be found at a recent wetland restoration project at Martin Luther King Jr. Regional Shoreline Park in Oakland. To accommodate public interest in the enhancement project, an interpretive/ observation station providing a duck blind style observation site could be included in the fencing plan.

As part of the revisions to the MYB shoreline, invasive non-native plants should be removed (Alternative 10) and continued to be removed as a maintenance activity. Revegetation with native plant species would be planned once all of the water circulation changes are made, pavement removal completed and fence plan finalized. Selection of native plant species should reflect elevations in relationship to tidal water and emphasize a wetland shoreline with gumplant (*Grindelia stricta*) (see Figure 2-24), pickleweed (*Salicornia virginica*) (see Figure 2-37) and alkali bulrush (*Scirpus robustus*) (see Figure 2-23) and other species with a transitional buffer area of coyote brush and native grasses. Native upland species such as monkeybush, native blackberry, coast live oak (see Figure 3-51), native currant, toyon (see Figure 3-37) and other food plants for birds.

This alternative provides for enhancement of wetland habitats and upland areas to support a variety of birds including waterfowl, wading birds, shorebirds and song-birds, as well as small mammals and birds of prey. Restricting public use to a look, not disturb, area reduces conflicts between humans and wildlife and should provide for a higher quality habitat than currently exists.

### Alternative 9: Bird Island as a Bird Roosting Habitat and Refuge Area

The island in the Main Lagoon has been used for water recreation (see Figure 3-11). There is a building, some vegetation and other items on the Island and it is occasionally used. In the future, when recreational uses are not in need of the Island, it could be enhanced as a roosting island for birds in the Park. Wading birds, such as egrets and herons currently have no isolated safe area to roost. They use cypresses along the western shoreline, but this area is subject to high disturbance factors from Park users and dogs. The Bird Island could provide an isolated safe roosting area both for wading birds and waterfowl.

Enhancement of Bird Island would require removal of the structures and any invasive non-native plants, and an analysis of the island's stability. It may be necessary to enclose the island with rock or some type of crib wall and build up the elevation to reduce the effects of subsidence. A variety of native tree, shrub and herbaceous vegetation could provide a dense protective habitat (see Figures 3-20 through 3-38 and 3-44 through 3-51). There may also be freshwater piped to Bird Island which, if the system is in good condition, could provide a water source and further support water birds. Alternatively, the island could be improved for shore-bird roosting using a covering of crushed shell and sand with no vegetation.

### Alternative 10: Eradication of Invasive Non-native Plant Species - Phase 1

Alternative 10 should be implemented either prior to or at the same time as any habitat enhancement alternative. Even if none of the habitat enhancement alternatives are implemented, Alternative 10 should be implemented to reduce the spread of invasive non-native plants to areas outside the Park and to protect the current habitats in the Park from being overcome by invasive non-native plants.

Removal of invasive non-native plants is an important step in a natural resource enhancement program. Once begun, it can require up to 10 years of mechanical removal to achieve eradication of invasive non-native plant species. Follow up monitoring of re-sprouts is required regardless of which removal method is used.

Two phases of invasive non-native plant removal are described as Alternatives 10 and 11. The first phase addresses a large number of invasive non-native plant species that are currently growing throughout the Park, particularly in wetland and shoreline areas. These species will impair any habitat enhancement efforts and reduce the value of existing habitats over time. The second phase addresses a longer-term removal of ornamental invasive non-native plant species. Revegetation concepts for areas where invasive non-native plants are removed will vary with location and are described in Alternatives 12-14.

When contemplating the removal of invasive non-native plants, the way the plant spreads, by seed or vegetatively, should be considered. Control efforts should also include an evaluation of the extent of the invasion and the formulation of a strategy for eradication. Control measures should always start at the furthest upland area, working down to avoid re-infestation. The strategy for controlling many species involves removal of single individual plants and small patches first and then the removal of large patches. Disposal of removed plants or seeds should to be done so that another area is not infested. Removal of invasive non-native plants should incorporate erosion control measures and revegetation with native species endemic to the area and planted in locations the species would naturally grow.

The City of Berkeley has an ordinance prohibiting the use of herbicides in City parks, however, in almost all trials and studies of invasive non-native plant removal, herbicide has proven more effective than mechanical removal methods. However, mechanical removal performed several times a year consistently for a decade or more can completely eradicate invasive non-native plants if re-infestations are not allowed to occur. There are several aquatic formulations of herbicides approved for use in eradication of invasive non-native plants.

Removal and control of invasive non-native plants has been carried out and investigated by many researchers and land managers. This information is included for many species in a new book, *Invasive Plants of California's Wildlands* (Brossard, et. al. Eds. 2000). Recommended removal methods are described below for the primary invasive non-native species observed in Aquatic Park. Figures 2-48, 2-49, and 2-50 identify the locations of these species.

The following lists some of the invasive non-native species found in Aquatic Park and the recommended methods for eradication. Any use of herbicides should be done in full accordance with label directions and restrictions. It is recommended that the "cut and paint" method be used to reduce the possibility of drift that spray methods involve. The stem or trunk is cut and a paintbrush is used to apply the herbicide. When invasive non-native plants are removed, all plant parts - leaves, stems and roots need to be completely collected and disposed of in a landfill. This is very important, as most of the species will re-sprout from small plant parts and an eradication project can spread the plant if done incorrectly. Garbage receptacles should be on-site when removal is done and all participants should understand removal practices. For all invasive non-native plant species, eradication follow-up should occur at least once a year at the appropriate time to avoid and continue seed production.

It is also important to note that if a large area of invasive non-native plants is removed, the area should be revegetated with natives soon after the eradication to avoid reinvasion or erosion. Native plant sprigs or container stock should be on order when the eradication is done, as these species are not readily available from nurseries.

The selection of native species to be planted is made based on the location in the Park. Alternative 11 describes revegetation measures for the freshwater marshes; Alternative 12 and 13 describe revegetation measures for upland areas. Alternatives 7 and 8 describe revegetation measures for tidal shoreline areas. Figures show some of these plant species listed.

Iceplant (*Carpobrotus edulis*)

Iceplant is a ground-hugging succulent perennial whose roots and nodes have a creeping habit and often forms deep mats covering large areas (see Figure 3-14). It has been widely planted for soil stabilization and landscaping. Native to coastal areas in South Africa, it was brought to California in the early 1900s for stabilizing soil along railroad tracks. It spreads both vegetatively and by seed. It can reproduce roots and shoots at every node and any shoot segment can become a propagule, making it important to remove all material from the site when attempting eradication. It can establish and grow in the presence of competitors and herbivores and can form impenetrable mats that dominate resources, including space. It can suppress the growth of native seedlings and mature shrubs.

*Recommended Removal Method: Physical Control - Manual/ Mechanical Removal*

Iceplant is easily removed by hand pulling. As mentioned above, because the plants can grow roots and shoots at every node, all live shoot segments must be removed from contact with the soil to prevent re-sprouting.

*Alternate Removal Method: Chemical Control*

The herbicide glyphosate, in concentrations of 2 percent or higher, has been effectively used to kill Iceplant clones. It takes several weeks for the clones to die off, and re-sprouting can occur for several months. Subsequent growth from seedlings needs to be controlled.

**Figure 3-14. Iceplant (*Carpobrotus edulis*)**

**Figure 3-15. Tamarisk (*Tamarix* sp.)**

Tamarisk (*Tamarix* sp.)

Tamarisk is a many-branched shrub or tree less than 26 ft. tall that can generate up to 100 seeds per inch, or 500,000 tiny seeds per year (see Figure 3-15). It spreads by seeds and vegetative growth, is very aggressive and once established, is difficult to eliminate. It uses far more water than native plants and is abundant where surface or subsurface water is available for most of the year, thriving in saline soils and disturbed sites. It can withstand salinities up to 36 ppt (seawater). Native to central Asia, it was planted for erosion control, as a wind-break, for shade, and as an ornamental.

*Recommended Removal Method: Chemical Control*

Several proven methods exist for removing tamarisk. The most frequently used method in California, Arizona and Utah is to cut the shrub near to the ground before it has had a chance to flower, and apply triclopyr with a paintbrush. Remove duff with seeds to the greatest extent possible. Pull out all seedlings and retreat any re-sprouting stumps with foliar application of an herbicide, such as glyphosate in late spring or early fall.

*Alternate Removal Method: Physical Control - Manual/Mechanical Removal:*

Saltcedar is difficult to kill with mechanical methods, as it is able to re-sprout vigorously. Root plowing and cutting are effective initially, but are successful only when combined with follow-up treatment with herbicide. Mechanical control has proven unsuccessful in the Colorado River system.

Giant reed (*Arundo donax*)

Giant reed is a robust perennial grass growing up to 30 ft. tall, growing in many-stemmed clumps, spreading from horizontal rootstocks below the soil, and often forming large, dense colonies (see Figure 3-16). It spreads vegetatively by rhizomes or fragments. Giant reed displaces native plants and associated wildlife species because of the massive stands it forms. It monopolizes soil moisture and shades out competing native species. As it replaces native vegetation, it reduces habitat and food supply, particularly insect populations.

*Recommended Removal Method: Chemical Control*

In many, if not all, situations it may be necessary to use chemical methods to achieve eradication of Arundo, especially in combination with mechanical removal. In late August to early November, cut stalks within 2 to 4 inches of the substrate. Immediately apply concentrated glyphosate with a paintbrush directly to cut stems. Solution must be applied within 30 seconds from cutting because translocation ceases within minutes of cutting. It may be helpful to add a dye or food coloring to the solution to identify treated material. Follow-up assessment and treatment should be conducted.

*Alternate Removal Method: Physical Control - Manual Removal*

Hand pulling is effective with new plants under six feet tall. This method works best in loose soils after rain has made substrate workable. Plants can be dug up using hand tools (pick-ax, mattock, and shovel), in combination with cutting stems near the base with pruning shears, machete, or chainsaw. All stems and roots have to be removed from the site to avoid re-sprouting. Follow-up assessment and treatment should be conducted. Arundo can also be cut to ground level and covered with thick black tarps for 12 months.

Broom - Scotch (*Cytisus scoparius*) or French (*Genista monspessulana*)

Broom is a perennial shrub up to ten feet tall that produces abundant seed and spreads rapidly (see Figure 3-17). One medium-sized shrub can produce over 12,000 seeds a year. It is a strong competitor and can dominate a plant community, forming a dense monoculture; it is also very fire prone. Native to Europe and North Africa, it was first introduced to California in the 1850's as an ornamental in the Sierra Nevada foothills; it was later used to prevent erosion and stabilize dunes.

*Recommended Removal Method: Physical Control - Manual/ Mechanical Removal*

Pulling with weed wrenches in late spring, after seed germination period, is recommended because it removes the entire mature shrub, eliminating re-sprouting. Remove as much of the seed duff layer as possible. However, the resultant soil disturbance tends to increase depth of seedbank (Bossard 1991, Usery and Krannitz 1998). This method is labor-intensive, but can be used in most kinds of terrain and allows targeting of broom plants with low impact on desirable species in the area. Broom seedlings must be monitored and removed for ten years.

*Alternative Removal Method: Chemical Control*

For larger shrubs, cut stalks within 2 to 4 inches of the substrate. Apply concentrated glyphosate with a paintbrush directly to cut stems within 30 seconds. Solution must be applied immediately following cutting because translocation ceases within minutes of cutting. Follow-up assessment and treatment should be conducted with hand removal of seedlings.

**Figure 3-16. Giant reed (*Arundo donax*)**

**Figure 3-17. Broom - Scotch (*Cytisus scoparius*) or French (*Genista monspessulana*)**

Pampas grass (*Cortaderia sellonana)*

Pampas grass is a perennial grass up to 15 ft. tall with long leaves arising from a tufted base or tussock (see Figure 3-18). It reproduces vegetatively and from seed. It creates a fire hazard and can slow the establishment and growth of natives. Common as an ornamental in California, it has escaped cultivation and spread throughout coastal regions. It is native to Argentina, Brazil, and Uruguay and was first introduced to California in 1848.

*Recommended Removal Method: Physical Control - Manual Removal*

Pulling or hand grubbing seedlings is highly effective. For removing established clumps, a Pulaski, mattock, or shovel are the safest and most effective. It should always have its flowering stalks removed prior to seeding and it is important to remove the entire crown and top section of roots to prevent re-sprouting. Remove all material from site to avoid re-sprouting. A large chainsaw or weed eater can expose the base of the plant, allowing better access for removal of the crown and making disposal of the detached plant more manageable. The clump and rootball can be mechanically removed.

*Alternate Removal Method: Chemical Control*

Control of pampas grass can be achieved by spot treatment of glyphosate at about 2 percent solution. Fall applications result in better control compared to summer applications.

English ivy (*Hedera helix*)

English ivy is a perennial, evergreen woody vine with deep green, glossy leaves (see Figure 3-19). It is especially common in forests and wet areas near urban areas. It spreads vegetatively, by runners, as well as by seed. English ivy creates a dense ground cover suppressing all other plants and climbs up trees, often debilitating or killing them. It also kills trees in the understory and overstory by shading them out. Removal of ivy should be a very high priority.

*Recommended Removal Method: Physical Control - Manual/ Mechanical Removal*

The best method for controlling English ivy is hand removal of vines using pruners to cut the vines and then pulling the plants up from the ground and down from the trees. Removing and killing vines that spread up into trees is especially important because the fertile branches grow primarily on upright portions of the vine. If vines are cut at the base of the tree, the upper portions will die quickly, but may persist on the tree for some time; vines on the ground around the tree should also be removed to prevent re-growth up the tree.

**Figure 3-18. Pampas grass (*Cortaderia sellonana)***

**Figure 3-19. English ivy (*Hedera helix*)**

*Alternate Removal Method: Chemical Control*

Spray with glyphosate and remove and re-spray all survivors until it is gone.

<u>Kikuyu Grass (*Pennisetum clandestinum*)</u>

Kikuyu grass is a low-growing, deep-rooted aggressive perennial that forms a dense turf. It prefers sandy soils and is not drought tolerant. It spreads by seed and by producing a network of stems that form the thick mat that crowds out native species. It invades ground covers and low-growing shrubs, blocking out light and reducing vigor. Native to Africa, it was originally imported to California around 1918.

*Recommended Removal Method: Physical Control - Manual/ Mechanical Removal*

Hand removal with a hand trowel is effective for small infestations or if it is interspersed with native species.

*Alternate Removal Method: Chemical Control*

Large infestations can be effectively eradicated with a spot treatment of triclopyr or a sponge application of glyphosate in summer or fall.

<u>Himalayan blackberry (*Rubus discolor*)</u>

Himalayan blackberry grows as a dense thicket of long, bending branches, appearing as tall 10-foot mounds. It is an invasive plant that will take over native areas. Asexual reproduction contributes to its aggressive spreading capabilities, as well as large production of berries.

*Recommended Removal Method: Physical Control - Manual/ Mechanical Removal*

Cutting with hand-pruners or using a weed wrench can effectively remove canes, but crowns will re-sprout more aggressively than before. If infestation is small, removing rootstocks by hand digging is a slow, but effective way of removal. Each piece of root that breaks off and remains in the soil may produce a new plant. Cutting should occur when plant begins to flower. Very thick gloves should be used and yearly maintenance is needed.

*Alternative Removal Method: Chemical Control*

Spray with glyphosate in areas where other native plants will not be affected. Cutting and painting stems with glyphosate is also effective.

## Alternative 11: Revegetation and Management of the Freshwater Wetlands

The freshwater wetlands could be enhanced and integrated into the Park and its ongoing activities. The first step in the enhancement of the freshwater wetlands is to remove invasive non-native plants (see Alternative 10). Dense cattail growth would be removed and the wetlands and creeklets replanted with native species. These native species are low growing and require little maintenance once established.

Revegetation recommendations for the freshwater wetlands vary for the zone adjacent to standing water, further away and along the creeklets.

Appropriate plant species for the lower part of the creeklet bank include spiny buttercup (*Ranunculus muricatus*) (see Figure 3-20) and rushes (*Juncus patens, J. phaeocephalus, J. xiphioides*) (see Figures 3-21, 3-22, 3-23, 3-24, and 3-25).

Plants for the top of bank include native grasses such as little quaking grass (*Bryza minor*) (see Figure 3-26), meadow barley (*Hordeum branchyantherum*) (see Figure 3-27), California semaphore grass (*Pleuropogon californicus*) (see Figure 3-28) and herbaceous plants, such as mint (*Mentha arvensis*) (see Figure 3-29) and monkey flower (*Mimulus guttatus*) (see Figure 3-30).

Next to the ponded wetlands, plant red willows (*Salix laevigata*) (see Figure 3-31) relatively close to the edge of the water and prune to encourage growth as taller trees and not shrubs. Alder (*Alnus rhombifolia*) (see Figure 3-32) or cottonwood (*Populus fremontii*) can also be planted next to the ponded area. Plant species such as California rose (*Rosa californica*) (see Figure 3-33) and button bush (*Cephalanthus occidentalis*) (see Figure 3-34) can be planted as understory shrubs with the willows or other riparian species.

California buckeye (*Aesculus californica*) (See Figure 3-35) and California bay laurel can be planted farther up the berm or in areas away from the wetland edge. Monterey cypress (*Cupressus macrocarpa*) (see Figure 3-36), toyon (*Heteromeles arbutifolia*) (see Figure 3-37), or redbud (*Cercis occidentalis*) (see Figure 3-38) are low growing shrubs that can be planted on the upper berm next to the wetlands. Rocks should be placed along the edges of the larger wetlands to indicate a "no mowing zone".

As part of the revegetation and enhancement of the freshwater wetlands, an interpretive path and signs could be developed. The path would connect the wetlands with other areas of the Park and include signs describing the native plants, stormwater sources, and how residents can improve water quality, invasive non-native plants and the problems they cause and other subjects. The interpretive path could begin at the native garden next to the children' s play area

**Figure 3-20. Spiny Buttercup (*Ranunculus muricatus*)**

**Figure 3-21. Rushes (*Juncus patens)***

**Figure 3-22. Rushes (*Juncus phaeocephalus*)**

**Figure 3-23. Rushes (*Juncus xiphioides*)**

**Figure 3-24. Rushes**

**Figure 3-25. Rushes and Other Native Plant Species**

**Figure 3-26. Little Quaking Grass (*Bryza minor*)**

**Figure 3-27. Meadow Barley (*Hordeum branchyantherum*)**

**Figure 3-28. California Semaphore Grass (*Pleuropogon californicus*)**

**Figure 3-29. Mint (*Mentha arvensis*)**

**Figure 3-30. Monkey Flower (*Mimulus guttatus*)**

**Figure 3-31. Red Willows (*Salix laevigata*)**

**Figure 3-32. White Alder (*Alnus rhombifolia*)**

**Figure 3-33. California Rose (*Rosa californica*)**

**Figure 3-34. Button Bush (*Cephalanthus occidentalis*)**

**Figure 3-35. California Buckeye (*Aesculus californica*)**

**Figure 3-36. Monterey Cypress (*Cupressus macrocarpa*)**

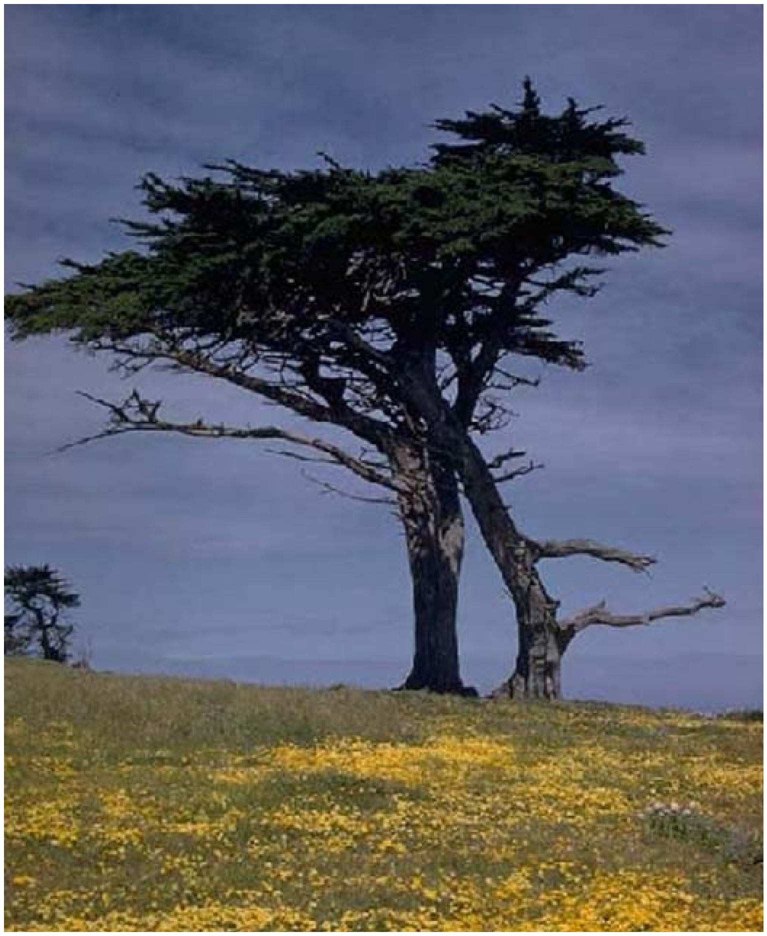


**Figure 3-37. Toyon (*Heteromeles arbutifolia*)**

**Figure 3-38. Redbud (*Cercis occidentalis*)**

and extend along the wetlands, taking into account the Frisbee golf course, to reduce conflicts. By creating a specific access trail and revegetating and enhancing the wetlands, they will appeal to more Park visitors and provide an additional amenity in the Park.

**Alternative 12: Eradication of Invasive Non-native Plant Species - Phase 2**

Alternative 12 addresses the removal of two invasive non-native plant species in the Park - acacia (see Figure 3-39) and eucalyptus (see Figure 3-40).

The Railroad Berm along the eastern border of Aquatic Park is primarily covered in invasive eucalyptus and acacia. In some locations, ornamental, but non-native species also occur such as Monterey cypress and Lombardy poplars, as well as native willow, oaks, and some other plants also grow on the Berm. There are a number of areas with no vegetation.

The eucalyptus on the Railroad Berm should be removed in phases. Removal of all of the non-native trees along the Railroad Berm at one time is not recommended. Instead, the areas should be broken into sections of 50-100 ft. and removal of non-native plants would be done along with revegetation of natives. Signs regarding the project should be placed throughout the Park. Native plant species that should be planted on the Berm are: willows, white alder, California buckeye, and California bay laurel in areas adjacent to freshwater wetlands or where these plants already occur. Ceanothus, toyon, redbud, and silk tassel are relatively low growing shrubs that could be planted on the upper area of the Berm. The native planting could also incorporate tree species such as coast live oak or Monterey cypress. However, the planting plans should take into account the need for pruning and removal of limbs along the rail line. All the existing, healthy native and ornamental non-invasive species on the Railroad Berm should be retained. Removal in phases would reduce effects in roosting wildlife by allowing birds to move to other trees in the Park while eradication and revegetation is ongoing.

For the most part, eucalyptus and acacia provide limited wildlife habitat, but will support roosting by some birds such as egrets and herons. However, these birds also use Monterey cypress in the Park for roosting.

Acacias were planted as ornamental plants along the eastern shoreline of the Main Lagoon. The acacias in most locations block the view and provide limited habitat value.

These two species are numerous in the eastern area of the Park and City staff and the community should evaluate their removal. The removal would improve views and Park aesthetics and allow for a transition to native plants. The City and

**Figure 3-39. Acacia (*Acacia melanoxylon*)**

**Figure 3-40. Blue gum (*Eucalyptus globulus*)**

community may wish to only remove portions of the eucalyptus and acacias or remove these trees in phases. Since implementation of Alternative 12 is likely to have the greatest effect on the physical appearance of the Park, this alternative will likely require the most discussion and consideration. The following information is provided to assist the City and community in considering this alternative.

Acacia (*Acacia melanoxylon*)

Acacias are woody ornamentals that grow up to 50 ft. tall. The trees reproduce by seed and thrive in disturbed areas.

*Recommended removal method: Physical control - Manual/ Mechanical*

The method for removal of acacia is cutting of the mature tree and cutting of all seedlings and removal as firewood and green waste. Stumps can re-sprout and require up to ten years of mechanical removal to achieve eradication. Once cut, the stumps should be ground and removed along with the seeds and duff, if the removal will not destabilize the site. Hand-pull seedlings before roots are well established.

*Alternate Removal Method: Chemical control*

The method for removal of acacia should include cutting of the mature tree and cutting of all seedlings and removal as firewood and green waste. Immediately after cutting, apply glyphosate or triclopyr to cut trunk.

Along the eastern shoreline, the acacias could be removed in phases. Signs regarding the removal should be placed in the Park. The primary purpose for removing the acacias would be to create more grassy area and improve shoreline use and views. A native plant demonstration garden could also be created in one of the existing acacia areas.

Blue gum (*Eucalyptus globulus*)

Blue Gum, or eucalyptus is a tall (150-180 ft.), aromatic, straight-growing tree with bark that sheds in long strips, leaving contrasting smooth surface areas. It reproduces by seeds and re-sprouts readily from the main trunk. It aggressively invades neighboring plant communities if adequate moisture is available; it is most invasive on sites subject to summer fog drip. Biological diversity within eucalyptus groves is lost due to displacement of native plant communities. Understory establishment is inhibited by the production of allelopathic chemicals in the tree litter. Native to Australia, eucalyptus has been planted extensively worldwide because of its rapid growth and adaptability to a wide variety of site conditions. It was first cultivated in California in 1853 as an ornamental. Eucalyptus is extremely flammable and provides very limited habitat value except for bird roosting.

*Recommended Removal Method: Physical Control - Mechanical/ Manual Removal and Chemical Control*

The method for removal of eucalyptus should include chain sawing of the mature tree in the fall, and cutting of all seedlings and removal as firewood and green waste. As the trees are felled, glyphosate or triclopyr should be painted with a paintbrush directly on the cut stumps to control re-sprouting. Stumps should be cut as low to the ground as practical and brushed clean of sawdust to maximize absorption of the herbicide. For mechanical control, stumps can also be ground and completely removed if the removal will not destabilize the site. Seedlings should be pulled and duff removed.

**Alternative 13: Western Shoreline Enhancement**

There are a number of parking lots (P1, P2, and P3 on Figure 3-10 and 3-11 and Figures 341, 3-42 and 3-43) located along the western shoreline of the Main Lagoon that are no longer accessible to cars. Adjacent to the parking lots are areas of various ornamental plants such as Tea Tree, as well as invasive non-native plants such as tamarisk, ice plant, English ivy, and kikuyu grass. There are also several old structures that appear to need rebuilding or removal. These areas could be enhanced through the removal of the asphalt parking lots, dead or diseased trees and shrubs, and non-native vegetation (see Alternative 10). If Alternative 7 is implemented, the clean soil from the excavated area would be placed on the parking lot areas. The healthy ornamental species in these areas could be pruned to increase health and aesthetics of the plants.

Revegetation actions include revegetation with native plant species such as meadow barley (*Hordeum brachyantherum*) (see Figure 3-27) beach aster (*Erigeron glaucus*) (see Figure 3-44), sand strawberry (*Fragaria chiloensis*) (see Figure 3-45), Douglas iris (*Iris douglasiana*) (see Figure 3-46), monkey flower (*Mimulus guttatus*) (see Figure 3-30), coffeeberry (*Rhamnus californica*) (see Figure 3-47), oceanspray (*Holodiscus discolor*), wild lilac (*Ceanothus griseus var. horizontalis*) (see Figure 3-48), Monterey cypress (*Cupressus macrocarpa*) (see Figure 3-36), flannel bush (*Fremontodendron californicum*) (see Figure 3-49), silk tassel (*Garrya "James Roof"*) (see Figure 3-50), coast live oak (*Quercus agrifolia*) (see Figure 3-51), and toyon (*Heteromeles arbutifolia*) (see Figure 3-37). A native plant demonstration garden could also be installed in one of these areas.

**Figure 3-41. Western Shoreline Abandoned Parking Lot #1**

**Figure 3-42. Western Shoreline Abandoned Parking Lot #2**

**Figure 3-43. Western Shoreline Abandoned Parking Lot #3**

**Figure 3-44. Beach Aster (*Erigeron glaucus*)**

**Figure 3-45. Sand Strawberry (*Fragaria chiloensis*)**

**Figure 3-46. Douglas Iris (*Iris douglasiana*)**

**Figure 3-47. Coffeeberry (*Rhamnus californica*)**

**Figure 3-48. Wild Lilac (*Ceanothus griseus var. horizontalis*)**

**Figure 3-49. Flannel Bush (*Fremontodendron californicum*)**

**Figure 3-50. Silk Tassel (*Garrya "James Roof"*)**

**Figure 3-51. Coast Live Oak (Quercus agrifolia)**

# 4.0 SUMMARY OF RECOMMENDATIONS

The Aquatic Park Natural Resource Management Study compiled information and studies of the Park and collected additional information on tidal circulation and heights, culvert conditions and functions, lagoon stratification from temperature or salinity variations and lagoon bathymetry. The extent of tidal and freshwater wetlands were mapped as were the locations of invasive non-native plant species. The locations and types of recreational uses were documented and the effects of human recreational uses of the Park on wildlife habitats were discussed. These analyses concluded:

- Aquatic Park is an urban park with heavy recreational use.

- Tidal flow reaches the lagoons through culverts underneath Interstate 80. Tidal range is very small in the lagoons and circulation is currently low creating water quality problems.

- The lagoons were constructed with steep side slopes and much of the shoreline is lined with riprap. These shoreline conditions, combined with the very small tidal range, greatly limit the extent of tidal wetlands.

- The open water areas of the lagoons provide habitat for birds and fish and the majority of the bird species observed in the Park use open water habitats.

- A series of freshwater wetlands along the eastern border of the Park are over grown with invasive non-native plants and are limited in value to wildlife by adjacent use.

- Invasive non-native plants occur throughout the Park and reduce the area for native species and in some areas reduce habitat values.

- Upland areas around the lagoons include areas that are not regularly inundated such as the lawn areas and ornamental plantings. These areas offer opportunities to enhance native plantings and potential aesthetic improvements incorporated with existing recreational uses.

A series of six alternatives to improve water circulation and water quality were formulated and evaluated using a two-dimensional computer model calibrated with the tidal data collected for the NRMS. The model determined the percentage improvement in water circulation for various areas of the lagoons.

A series of seven alternatives to enhance wetland and upland habitats were formulated. Some of these alternatives require implementation of the water circulation improvements, but most do not. Table 4-1 summarizes the alternatives and their features.

## Recommendations

In order to fulfill the goals of the NRMS, the first priority for implementing alternatives should be:

- Alternative 6 - Single Direction Flow would produce the greatest improvements to water circulation and water quality in the overall lagoon systems and is superior to Alternatives 1-5.

- If Alternative 6 is implemented, then Alternative 8 - Wetland Enhancement of MYB and Management of MYB and RTP as a Wildlife Area should be implemented.

- Alternative 10 - Eradication of Invasive Non-Native Plant Species - Phase 1 would involve removal of invasive species from the Park, with the exception of acacia and eucalyptus, to avoid the spread of these noxious plants outside of the Park and to allow for enhancement of native habitats. Acacias and eucalyptus species could be removed in later phases of invasive plant eradication (Alternative 12).

A number of other alternatives - 7, 9, 11, 12 and 13 would provide additional improvements to the Park, but should be considered as lower priority, longer-term projects.

## Table 4-1. Summary of Alternatives

| Alt. # | Description | Level of Improvement | Proposed Priority | Cost |
|---|---|---|---|---|
| 1 | Open up all flap gates on inlet-outlet culverts in Main Lagoon | Moderate improvement in Main Lagoon; no improvement in MYB | Low | Low |
| 2 | Install new, larger culverts between Main Lagoon and MYB | High improvement in MYB; low improvement in Main Lagoon | High - part of recommended Alternative 6 | Moderate |
| 3 | Enlarge and improve connection between MYB and Potter Street stormdrain | High improvement in MYB; high to moderate improvement in Main Lagoon | High - part of recommended Alternative 6 | Moderate |
| 4 | Dredge northern portion of Main Lagoon to -3.0 ft. NGVD | Low improvement to Main Lagoon | Low | If mud has contaminants, cost for disposal could be very high; if not, costs would be moderate |
| 5 | Fill northern portion of Main Lagoon to +1.0 ft. NGVD | Moderate improvement to Main Lagoon | Low | Depending on source of fill material, costs could be high to moderate. |
| 6 | Create one direction of flow - install larger connection from MYB to Potter Street stormdrain with inflow only; install new culverts between MYB and Main Lagoon and manage main inlet-outlet culverts for outflow only. | High improvement to MYB and Main Lagoon | High | Moderate to high |

(*continued on next page*)

## Table 4-1. Summary of Alternatives (cont.)

| Alt. # | Description | Level of Improvement | Proposed Priority | Cost |
|---|---|---|---|---|
| 7 | Excavate shoreline north of rowing club to create tidal mudflat/wetland - Rowing Club Wetland | Increase in tidal habitat in Main Lagoon | Low | Depending on method of disposal of excavated material cost could be moderate to high |
| 8 | This alternative requires Alternative 6 to be implemented and could allow MYB to develop wetland and management of MYB and RTP wildlife area with restricted public access. | Increase in wetland habitat for MYB and protection of habitats from recreational activities | High if Alternative 6 implemented | Low |
| 9 | Change of Bird Island to bird roosting and refuge area | Creation of refuge and roosting habitat in Main Lagoon | Moderate | Moderate |
| 10 | Eradication of invasive non-native plant species - Phase 1 to reduce spread of invasive species off-site and revegetation and enhancement of native habitats | Enhancement of all habitats in Park and reduction in spread of invasive species into other areas | High | Moderate, but requires 10 year follow up |
| 11 | Revegetation and improved management of freshwater wetlands | Enhancement of freshwater wetlands on eastside of Park | Moderate | Low |
| 12 | Eradication of invasive non-native plant species - Phase 2 - acacia and eucalyptus on eastern area of Park and revegetation with natives | Railroad Berm, eastern shoreline | Moderate | Moderate to high - requires 10 year follow up |
| 13 | Removal of asphalt in abandoned parking lots, improvement to ornamental plants and revegetation with native plants | Western uplands | Low | Low to moderate, depending on removal and disposal of asphalt |

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**Personal Communication**

BCDC was contacted about jurisdiction, September 2002.

Becky Otta - regional Fish and Game marine biologist, contacted September 2002.

Brad Ricards of the City of Berkeley was contacted about the playground located on the central east side of the Main Lagoon at Aquatic Park, April 2002.

Christine Atkinson - Fish and Game freshwater aquatic biologist, contacted April 2002.

City of Berkeley staff from various departments were consulted to make sure all the relevant information was collected for the NRMS.

Daniel Stapelton and Dave Ritter were contacted about water-skiing activities at Aquatic Park.

Fred Conrad of the Berkeley Paddling and Rowing Club (BPRC), contacted April 2002.

Joelle Buffa - US Fish and Wildlife Service, contacted April 2002.

L. Caronna - CalTrans, contacted April 2002.

Neil Bondy was contacted for information on the disc golf course at Aquatic Park, April 2002.

Steve Granholm - contacted to obtain bird studies of Aquatic Park, April, May and September 2002.

Stu Swanson, Landscape Gardner Supervisor for the City of Berkeley, contacted April 2002.

Tinker's Workshop employee, contacted September 2002.

# APPENDIX A

# REGULATIONS

# EVALUATION OF REGULATIONS

Aquatic Park is a wetland area on the shoreline of San Francisco Bay and as such is subject to a variety of regulations. The following description reviews the major laws and regulations, which would affect any projects or improvements proposed as part of this plan.

## Federal Laws and Regulations

### Clean Water Act

Section 404 of the Clean Water Act (CWA) regulates the placement of dredged or fill material into waters of the United States and establishes the U.S. Army Corps of Engineers (Corps) as the federal agency responsible for issuing permits pursuant to Section 404 of the Clean Water Act. The Environmental Protection Agency (EPA) can veto the Corps issuance of a permit to allow filling of jurisdictional waters of the United States.

"Waters of the United States" includes all waters that are used, or could be used, for interstate commerce, including all waters subject to the ebb and flow of the tide, all interstate waters, tributaries of waters of the United States, other waters such as intrastate lakes, rivers streams, mudflats, sandflats, etc. and wetlands.

"Wetlands" are defined as "…areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." The landward extent of the Corps' jurisdiction in tidal waters extends to the high tide line or to the upland boundary of wetlands that are adjacent to tidal waters.

The Corps issues individual and nationwide permits. Nationwide permits are a type of general permit that are designed for expedited permitting as long as the proposed activity complies with the general and specific conditions of the nationwide permits and the resulting impacts to waters of the United States are minimal. If the Corps determines that the impacts are more than minimal or the project does not comply with the nationwide permit conditions, an individual permit is required. Before the Corps can issue an individual permit pursuant to Section 404 of the Clean Water Act, an applicant must demonstrate that the proposed activity will comply with the substantive requirements of the Section 404 (b)(1) guidelines. The EPA in consultation with the Corps developed the 404 (b)(1) guidelines and a project must comply with the guidelines before the Corps can issue a 404 permit.

The 404(b)(1) guidelines establish a presumption that there are practicable upland alternatives to filling wetlands or other special aquatic sites. Where a project proposes to discharge fill into wetlands, all practicable alternatives that do not involve a discharge into wetlands are presumed to have less adverse impacts on the aquatic system, unless it can be clearly demonstrated otherwise. The applicant has the burden to demonstrate that there are no practicable alternatives that would not involve the filling of wetlands. The Corps requires mitigation for impacts to waters of the United States. In addition, the Corps must evaluate the proposed project to determine if authorizing the project would serve the public interest (public interest review).

A 401 Water Quality Certification or a wavier from the Regional Water Quality Control Board (RWQCB), San Francisco Bay Region, is required before the Corps can issue a Section 404 permit to authorize the placement of dredged or fill material in waters of the United States. The 401 Water Quality Certification requirement applies to both nationwide permits and individual permits issued by the Corps in California. Although a specific alternatives analysis is not required by the Corps for a nationwide permit, the Regional Water Quality Control Board, San Francisco Bay Region, has incorporated the 404 (b)(1) guidelines into its Basin Plan and requires that an applicant for a Clean Water Act Section 401 Certification demonstrate compliance with the substantive requirements of the 404(b)(1) guidelines.

Under Section 401 the RWQCB may waive its certification authority, certify that the discharge will comply with all pertinent water quality standards, or deny certification. The RWQCB may specify conditions needed to remove or mitigate potential impacts to water quality standards. These conditions must be included in the Corps Section 404 permit.

The discharge of effluent from dredged material disposal along the shoreline would be considered a point source discharge under Section 402 of the CWA. This section requires that the discharger obtain a National Pollutant Discharge Elimination System (NPDES) permit. The RWQCB has NPDES permit authority in the State of California; therefore the RWQCB-San Francisco Bay Region would also be responsible for issuance of any NPDES permits for the effluent discharge. NPDES permits are valid for five years and include effluent limitations and a self-monitoring plan.

Dredging and disposal of dredge material at a site in San Francisco Bay or the ocean is regulated under the CWA and a number of other laws. A combined state and federal permitting process is overseen by the Corps through the Dredged Material Management Office (DMMO). The DMMO is a joint program of the San Francisco Bay Conservation and Development Commission (BCDC), San Francisco Bay Regional Water Quality Control Board (RWQCB), State Lands Commission (SLC), the San Francisco District U.S. Army Corps of Engineers (COE), and the U.S. Environmental Protection Agency (EPA). Also participating are the California Department of Fish and Game, the National Marine Fisheries Service, and the Fish and Wildlife Service who provide advice and expertise to the process. The purpose of the DMMO is to cooperatively review sediment quality sampling plans, analyze the results of sediment quality sampling and make suitability determinations for material proposed for disposal in San Francisco Bay. The goal of this interagency group is to increase efficiency and coordination between the member agencies and to foster a comprehensive and consolidated approach to handling dredged material management issues. Applicants using the DMMO fill out one application form, which the agencies then jointly review at bi-weekly meetings before issuing their respective authorizations.

**Rivers and Harbors Appropriation Act of 1899**

Section 10 of the Rivers and Harbors Appropriation Act of 1899 gives the Corps authority to regulate activities in traditionally navigable waters of the United States. Traditionally navigable waters of the United States are defined as those waters subject to the ebb and flow of the tide and/or waters that are, or have been used, to transport interstate or foreign commerce. The landward extent of the Corps' jurisdiction under the Rivers and Harbors Appropriation Act of 1899 is the mean high tide line. Activities subject to the Corps' jurisdiction under this act include dredging, disposal of dredged or fill material, construction of bridges over navigable waters, placement of buoys, etc. or any other activity that could affect the extent of reach of traditionally navigable waters.

**National Environmental Policy Act**

The National Environmental Policy Act (NEPA) of 1969 and its supporting legislation and implementing regulations require that all federal agencies consider the effects of a proposed project and its alternatives on all components of the environment prior to initiating a federal action, such as issuing a permit. If, for example, the Corps determines that a proposed activity could be authorized by a nationwide permit, further NEPA compliance would not be necessary since nationwide permits are subject to NEPA analysis and compliance before the Corps issues them. If the Corps determines that an individual 404 permit is required, then NEPA is triggered. If the project triggers NEPA, the preparation of an Environmental Impact Statement (EIS), or an Environmental Assessment (EA), under the direction of a federal lead agency for NEPA compliance is required.

**Endangered Species Act**

The Endangered Species Act (ESA) was passed for the purpose of conserving threatened and endangered plant and animal species. Section 7 of the ESA outlines procedures that must be undertaken by all federal agencies to ensure that any agency action (issuance of a 404 permit) does not jeopardize the continued existence of any listed, or proposed threatened, or endangered species, or its designated Critical Habitat. Federal agencies are required to consult with the U.S.

Fish and Wildlife Service (Service) if a project may affect most species listed as threatened or endangered under the federal Endangered Species Act. The National Marine Fisheries Service (NMFS) oversees consultations involving listed marine mammals and anadromous and marine fish species.

Other federal agencies normally do not issue their permits or approvals until the Service, or NMFS, has rendered its Biological Opinion (BO) concerning potential effects of project implementation on listed, proposed, and candidate species. The Biological Opinion is incorporated into the permit conditions as decided by the lead agency. If the Service, or NMFS, determines that the project could affect a threatened or endangered species then mitigation measures are likely to be required.

**Migratory Bird Conservation Act/ Migratory Bird Treaty Act**

The Migratory Bird Conservation Act of February 18, 1929 established a Migratory Bird Conservation Commission to approve areas recommended by the Secretary of the Interior for acquisition with Migratory Bird Conservation Funds. The Commission, through its chairman, is directed to report to Congress on its activities during the preceding fiscal year. The Secretary of the Interior is authorized to cooperate with local authorities in wildlife conservation and to conduct investigations, to publish documents related to North American birds, and to maintain and develop refuges. The Act provides for cooperation with States in enforcement. It established procedures for acquisition by purchase, rental or gift of areas approved by the Commission for migratory birds. Subsequent amendments included authority to purchase or rental of a partial interest in land or waters.

The Migratory Bird Treaty Act is the domestic law that affirms, or implements, the United States' commitment to four international conventions (with Canada, Japan, Mexico, and Russia) for the protection of a shared migratory bird resource. Each of the conventions protects selected species of birds that are common to both countries (i.e., they occur in both countries at some point during their annual life cycle).

The North American Waterfowl Management Plan (NAWMP) is an international agreement between the U.S., Canada, and Mexico to address waterfowl populations. The NAWMP is a federal, state, and private cooperative initiative designed to protect wetland habitat and increase wetland wildlife populations while improving water quality, reducing soil loss and addressing many other wetland ecosystem issues. Implementation of the NAWMP occurs through the formation of multilevel partnerships (known as joint ventures) between diverse public and private organizations who share common interest in the conservation, maintenance, and management of key wetland ecosystems. The NAWMP identifies 34 "waterfowl habitat areas of major concern" and targets these areas for the establishment of joint ventures. The San Francisco Bay region is recognized as one of these areas of major concern. The San Francisco Bay Joint Venture was established in 1996 and implements the NAWMP for the Bay region.

**Fish and Wildlife Coordination Act**

The Fish and Wildlife Coordination Act (FWCA) requires all federal agencies to consult with state and federal wildlife management agencies prior to approving any federal action (issuance of a 404 permit) that may affect any stream or other body of water. The purpose of this act is to ensure that wildlife resources are given equal consideration with other resources in agency planning and decision-making processes. The requirements of this act are normally satisfied during the NEPA or CEQA compliance process, specifically during agency review of the EIS or Environmental Impact Report (EIR).

## State Laws and Regulations

**California Environmental Quality Act**

A public agency must comply with the California Environmental Quality Act (CEQA) prior to reaching a decision on a project that may have an effect on the environment. CEQA requires agencies to consider, among other things, the possible environmental effects of the proposed project, alternatives to the proposal, and measures to mitigate the projects significant adverse effects.

- Once a project description is completed, the lead agency (most likely the City of Berkeley) must determine whether the proposed project is subject to CEQA or covered by a statutory or categorical exemption
- If subject to CEQA, the lead agency prepares an "initial study" outlining the potential environmental effects of the project
- If the initial study indicates there will be no significant effects, the lead agency prepares and circulates a negative declaration to document this finding
- If the initial study indicates that project development may result in one or more potentially significant effects, the lead agency prepares an EIR
- If the lead agency decides to prepare an EIR, all other responsible agencies must be notified
- Each responsible agency must respond to the notification of intent to prepare an EIR by sending their comments and concerns regarding the scope and content of the EIR
- The lead agency prepares a draft EIR (DEIR), circulates it for review, responds to comments received, and prepares a final EIR (FEIR)
- The lead agency approves or disapproves the project after adoption of the FEIR, or a Negative Declaration
- Each responsible agency must consider the lead agency's environmental document and make a decision on approval of the application

Permit evaluation and environmental review usually occur simultaneously. The maximum time required to obtain all approvals, if an EIR is required, is normally 18 months.

**Porter-Cologne Water Quality Control Act**

The Porter-Cologne Water Quality Control Act grants authority to the Regional Water Quality Control Boards (RWQCB) to issue Waste Discharge Requirements (WDRs) to regulate discharges of waste to land or water. Chapter 15, Title 23, CCR, specifies the requirements for discharges to surface impoundments including the requirement to prepare a Report of Waste Discharge and obtain WDRs. Seismic, geo-technical, and groundwater studies may also need to be conducted before a Report of Waste Discharge is prepared.

The Regional Board has prepared and updates a Water Quality Control Plan (Basin Plan) for the San Francisco Bay and its tributaries under its state and federal mandates to protect the beneficial uses of the by and its tributaries. The Basin Plan defines the beneficial uses, sets water quality objectives to protect these uses, and defines strategies and schedules for achieving water quality objectives. The Basin Plan identifies Aquatic Park as a significant surface water. Several of the beneficial uses defined in the Basin Plan are identified for Aquatic Park including migrating fish habitat, water contact recreation, non-contact water recreation, and potentially fish spawning habitat. Water quality objectives for these beneficial uses are listed in the Basin Plan.

**California Endangered Species Act**

The California Department of Fish and Game (CDFG) completes endangered species consultation, similar to a Section 7 of the (federal) Endangered Species Act. The California Endangered Species Act (CESA) includes provisions intended to improve the protection afforded endangered and threatened species affected by development projects subject to the California Environmental Quality Act. CESA states that it is the policy of the state that state agencies should not approve projects as proposed which would jeopardize the continued existence of any state-listed endangered or threatened species, or result in the destruction or adverse modification of habitat essential to the continued existence of those species, if there are reasonable and prudent alternatives available consistent with conserving the species or its habitat which would prevent jeopardy. To accomplish this goal, CESA provides that each lead agency shall consult with the CDFG, in accordance with guidelines, to ensure that any action authorized, funded, or carried out by the state lead agency is not likely to jeopardize the continued existence of any state-listed endangered or threatened species.

For projects in which there are federally listed species, and which include an action authorized, funded, or carried out by a federal agency, that agency must consult with the USFWS and obtain their Biological Opinion. For species that are both state and federally listed species, CESA directs that, whenever possible, the CDFG adopt the Federal Biological Opinion. If a project affects both a state and federally listed species and a state (only) listed species and the CDFG concurs with the Federal Biological Opinion, the DFG must still prepare a separate Biological Opinion for the state-listed species.

**California State Fish and Game Code**

Sections 1600-1603 of the Fish and Game Code requires that for projects that will substantially divert or obstruct the natural flow or substantially change the bed, channel, or bank of any river, stream, or lake or use materials from a streambed the applicant notify the Department before beginning the project. Similarly, under section 1601 of the Fish and Game Code, before any state or local governmental agency or public utility begins a construction project that will: 1) divert, obstruct, or change the natural flow or the bed, channel, or bank of any river, stream, or lake; 2) use materials from a streambed; or 3) result in the disposal or deposition of debris, waste, or other material containing crumbled, flaked, or ground pavement where it can pass into any river, stream, or lake, it must first notify the Department of the proposed project. In order to notify the Department of a project described above, the person, governmental agency, or public utility (applicant) needs to complete a Notification of Lake or Streambed Alteration form and Project Questionnaire form and submit these forms, along with any other required documents and applicable fees to the Department of Fish and Game.

Notification is generally required for any project that will take place in or in the vicinity of a river, stream, lake, or their tributaries. Based on the notification materials submitted to the Department and, if necessary, an investigation of the project site by the Department, the Department will determine if the proposed project may impact fish or wildlife resources. If the Department determines that the proposed project may substantially adversely affect existing fish or wildlife resources, a Lake or Streambed Alteration Agreement from the Department will be needed and the proposed project will have to be reviewed in accordance with CEQA.

**McAteer-Petris Act (State)/Coastal Zone Management Act (Federal)**

The San Francisco Bay Conservation and Development Commission (BCDC) has jurisdiction over all tidal areas of San Francisco Bay, including projects within 100 ft. of the shoreline. The BCDC is authorized to control filling and dredging in the Bay and Bay-related shoreline development.

Because tidal flows into Aquatic Park are partially controlled by tidal gates, BCDC staff determined that their jurisdiction does not apply to Aquatic Park (personal communication, BCDC 2002).