FINAL REPORT

HERON'S HEAD PARK ANNUAL MONITORING
JANUARY 2003 - DECEMBER 2005

Prepared for
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This is the final monitoring report of the five-year monitoring program at Heron's Head Park in San Francisco. The report presents data from years four and five of the monitoring program, and summarizes the overall project conditions. Monitoring results show that most of the performance standards set for the project have been met. Small channels have continued to develop, vegetation cover on the marsh plain has increased, and there is a higher frequency of native plants.

Performance standards were established by the Port of San Francisco to evaluate the progress of the enhancement project (Port of San Francisco, 1998). The following is a summary of performance standards and a synopsis of progress toward meeting the standards:

- **Hydrology and Tidal Inundation**
  - Ponds should be completely inundated during high tides, and should remain ponded during low tides.

    Standard is being met.
  - At mean tide, the constructed tidal channel network should contain water up to 3rd order channels.

    Standard is not being met. At mean tide only the main tidal channels contain water.
  - At mean higher high water (MHHW), the marsh plain should be ponded.

    Standard is being met. Nearly the entire wetland area is ponded at high tide.
  - Development of 2nd and 3rd order channels from the created channel should occur over 5 years.

    Standard is near to being met. Channel network development is occurring.
  - Depth of the channel should be maintained.

    Standard is being met. See Section 3 for a complete discussion of site hydrology monitoring.
- **Erosion and Sedimentation**
  - Intertidal ponds should maintain an open (non-vegetated) water surface area.

    Standard is being met.
  - Intertidal ponds should maintain stable perimeters.

    Standard is being met.
  - The berm in Pond B should not erode.

    Standard is not being met. Erosion continues to occur on the berm in two locations. See Section 4 for a complete discussion of erosion and sedimentation.

- **Vegetation**
  - The marsh plain elevation should support salt marsh vegetation, predominantly pickleweed.

    Standard is being met. Vegetation colonization of the marsh plain continues to increase, with pickleweed being the dominant species.

  - Within the wetlands, there should be no large (>10 m^2) continuous patches dominated by exotic species or bare ground.

    Standard is being met, although there are some ponded areas with minimal pickleweed growth, and some small patches of non-native cordgrass.

  - The wetlands should be 80% covered by salt marsh plants within 5 years.

    Standard is near to being met. Marsh plain cover is presently 60% and has increased during each year of monitoring. See Section 5 for a complete discussion of vegetation monitoring.

- **Wetland Acreage**
  - A total of at least 8 acres of wetlands (5.05 restored and 2.95 enhanced) should be present at year 5.

    Standard is nearly met. A total of 7.50 acres of wetlands (4.06 restored and 3.44 enhanced) are present. The difference between the planned acreage and the current condition can be accounted for by two factors. First, the distinction between created and enhanced wetland was difficult to discern in the field.

    Secondly, there is a relatively large (0.71 acres) deposit of coarse material at the eastern end of the Park that was classified as "mud, rock, or sand" in the 2004/05 delineation. The rock and sand appeared to have been deposited during recent winter storm surge events, as concluded from observations of the pile's geomorphology and matted vegetation exending from under the edges of the pile.

    Heron's Head Park is a peninsula protruding into India Basin and as such is subject to the full force of Bay processes. These Bay initiated macro processes will continue to effect microtopographical changes on the site, such as the deposition of rock and sand near the eastern tip. The rock and sand area was not categorized as wetland because it is predominantly devoid of vegetation in 2004, but was considered wetland in the LFR design documents. Had this area been characterized as enhanced wetland the project would have exceeded the performance standard for wetland acreage.

    See Section 6 for a complete discussion of wetland acreage.

- **Avian Use**
  - Heron's Head Park will be used by birds for nesting, foraging, and roosting.

    Standard is being met. Habitat is primarily used for foraging and roosting. Nesting killdeer were observed during 2000 survey.

  - High species diversity will be present over the course of 1 year, greater than or equal to 78 species.

Standard is near to being met. Total species diversity continued to increase in years 4 and 5. A total of 70 species of birds have been observed over the 5 year monitoring period. See Section 7 for a complete discussion of avian activity.

Heron's Head Park is located on the San Francisco waterfront in the Hunter's Point Bayview District, between India Basin and Lash Liter Basin. Heron's Head Park, formerly called Pier 98, is a 25-acre peninsula artificially created in the mid-1970s by the Port of San Francisco (The Port). The Port obtained a permit (No. M7-70) from the San Francisco Bay Conservation and Development Commission (BCDC) to fill 45 acres at the site for use as a shipping terminal. Plans for this development were cancelled, and over time tidal wetlands began to form on the site. The BCDC required the Port to enhance the site's existing wetlands, and create additional wetlands on the peninsula because the Port had abandoned its plans to construct a shipping terminal. The BCDC permit number for the wetlands and park creation is M98-3. The U.S. Army Corps of Engineers Permit for this project is No. 22719S.

Prior to restoration, approximately 2.95 acres of jurisdictional wetlands existed on the southern shoreline of Pier 98, according to a wetland delineation conducted by Levine-Fricke-Recon (LFR) in late spring 1995. Also on the site were approximately 1.34 acres of unvegetated intermittently ponded hard panne and 1.1 acres of intertidal ponds (LFR 1997). Uplands dominated most of the remaining area on Pier 98. The restoration design prepared by LFR called for creation of 5.05 acres of wetlands, plus the enhancement of the existing 2.95 acres of wetlands (equals a total of 8 acres of wetlands) and 1.10 acres of existing intertidal ponds.

The Port of San Francisco completed the restoration of Heron's Head Park in mid-May 1999, using a design prepared by LFR. In March 2000, URS Corporation began a 5-year monitoring program at the site to evaluate the progress of the wetland restoration project.

This report covers monitoring activities that occurred from January 2003 through February 2005. URS biologists Francesca Demgen, Corinna Lu, and Kevin Fisher conducted the monitoring activities. As in 2000, 2001 and 2002, Heron's Head Park was monitored for tidal inundation, formation of tidal channels, sedimentation and erosion, vegetation cover and diversity, and bird abundance and diversity. A wetland delineation was also conducted in February 2005. The goals for each of these criteria are listed in the corresponding sections of this report. Table 2-1 summarizes the monitoring activities undertaken, and the corresponding months that these activities occurred.

Table 2-1
Schedule for Monitoring at Heron's Head Park
Monitoring Year 4- January to December 2003

Protocol	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hydrology												
Observe flooding extent in ponds & channel									•			
Measure water depth in ponds & channel hourly during 1 high tide cycle									•			
Record area of marsh plain inundation									•			
Formation of Tidal Channels												
IR aerial photo taken												
Sketch channel formation									•			
Measure channel width & depth									•			
Sedimentation/Erosion												
Read staff gages in ponds & channels									•			
Read staff gages in marsh plain									•			
Measure diameter of ponds									•			
Observe erosion at edge of ponds & channels									•			
Vegetation												
Survey vegetation along 8 transects									•			
Birds												
Survey birds; high & low tide	•	•	•	•				•	•	•	•	•

Table 2-2
Schedule for Monitoring at Heron's Head Park
Monitoring Year 5- January 2004 to February 2005

Protocol	Jan 04	Feb 04	Mar 04	Apr 04	May 04	Jun 04	Jul 04	Aug 04	Sep 04	Oct 04	Nov 04	Dec 04	Jan 05	Feb 05
Hydrology														
Observe flooding extent in ponds & channel				•					•					
Measure water depth in ponds & channel hourly during 1 high tide cycle				•					•					
Record area of marsh plain inundation				•					•					
Formation of Tidal Channels														
IR aerial photo taken												•		
Sketch channel formation				•					•					
Measure channel width & depth				•					•					
Sedimentation/Erosion														
Read staff gages in ponds & channels				•					•					
Read staff gages in marsh plain				•					•					
Measure diameter of ponds				•										•
Observe erosion at edge of ponds & channels				•					•					
Vegetation														
Survey vegetation along 8 transects									•					
Birds														
Survey birds; high & low tide	•	•	•	•						•	•	•		
Wetlands														
Wetland Delineation														•

3.1 HYDROLOGY (TIDAL INUNDATION)

3.1.1 Performance Standards

- **Hydrology and Tidal Inundation**
  - Ponds should be completely inundated during high tides, and should remain ponded during low tides.
  - At mean tide, the constructed tidal channel network should contain water up to 3rd order channels.
  - At mean higher high water (MHHW), the marsh plain should be ponded.
  - Development of 2nd and 3rd order channels from the created channel should occur over 5 years.
  - Depth of the channel should be maintained.

3.1.2 Methods

3.1.2.1 2003 and 2004 Monitoring

Hydrology monitoring took place on September 2, 2003, April 5 and September 28, 2004. The table below shows the tide statistics for these dates.

Table 3-1
Tides at Hunter's Point, CA during Hydrology Monitoring Events

	High Tide		Low Tide	
Date	**Time**	**Feet[1]**	**Time**	**Feet[1]**
09/02/03	1705	7.1	1039	2.3
04/05/04	1300	6.2	1842	0.9
09/28/04	1248	6.9	1848	0.8

1. Elevation in feet above MLLW (NOAA 2003).

Water depth was measured during the high tide cycle of a spring tide. Rebar that was installed in March, 2000, marked 11 hydrology monitoring stations (four stations on the marsh plain, four stations in the tidal channels, and one station in each of the three largest ponds). The locations of these monitoring stations are indicated in Figure 3-1.

Water depths were measured at the location of each rebar using a stadia rod graduated in feet, by tenths. Measurements are relative to themselves, not to a specific datum; in other words the rebar sampling locations and elevations were not surveyed. Water depth at each of the 11 stations was measured at approximately one-hour intervals through one flooding and ebbing tidal cycle.

During hydrology monitoring, the extent of flooding and water retention was recorded in the three largest ponds and in the marsh plain. The extent of flooding was recorded by sketching an outline of maximum horizontal extent of flooding on a site map.

Six photo points were identified to record inundation of the ponds, channel, and marsh plain during high tide. Their locations are indicated on Figure 3-1. The photos are provided in Appendix A.

3.1.3 Results

3.1.3.1 Extent of Ponding

The extent of ponding measured in 2003 and 2004 has not substantially different from that observed in 2002. During the September 2, 2003 and September 28, 2004 monitoring events, the extent of ponding was similar i.e, the marsh plain was fully inundated by the high tide. The extent of ponding is shown in Figure 3-1. At high tide, a continuous sheet of water extended from the eastern edge of Pond B to the western end of the marsh plain. Areas not inundated included the islands on the marsh plain, a shellspit area on the southern shore of the peninsula, areas adjacent to the mouth of the main tidal channel, and a portion of the shoreline west of the channel mouth. The ponding is this extensive on the spring tides (high tides of the month). At other tidal stages the main channel, the permanent ponds (A, B, and C), and some isolated pools on the marsh plain are inundated.

3.1.3.2 Tidal Inundation

Marsh Plain

Depth of inundation was measured at all hydrology monitoring stations on September 2, 2003, April 5 and September 28, 2004 (Tables 3-2 through 3-4). Figure 3-3 shows a plot of depth of inundation during the three monitoring events at hydrology monitoring station 4. The figure shows that the maximum depth of inundation at this station was 1.2 feet during the high tide of September 2, 2003. The figure also demonstrates that the high tide of 6.2 feet MLLW on April 5, 2004 did not flood the marsh plain at station 4. In fact, the April 5 tide event did not flood any of the marsh plain monitoring stations (Table 3-3). The table 3-5 shows tidal datum at Hunters Point station. These are the datum used as the basis for the LFR design.

Table 3-2
Tidal Inundation Data from September 2, 2003
(High Tide 7.1 Feet @ 17:05)

Station # 1	
Location:	Marsh plain
Time	Water Depth (feet)
14:19	0.26
15:20	0.28
16:20	0.90
17:18	1.10
18:16	0.70
19:15	0.40

Station # 2	
Location:	Marsh plain
Time	Water Depth (feet)
14:20	0.12
15:21	0.12
16:22	0.90
17:20	0.95
18:18	0.55
19:17	0.25

Station # 3	
Location:	Marsh plain
Time	Water Depth (feet)
14:21	0.04
15:22	0.04
16:24	0.95
17:21	1.00
18:19	0.50
19:18	0.15

Station # 4	
Location:	Marsh plain
Time	Water Depth (feet)
14:58	0.00
15:26	0.45
16:27	1.10
17:25	1.20
18:22	0.65
19:21	0.05

Station # 5	
Location:	Channel
Time	Water Depth (feet)
14:25	0.28
15:23	1.28
16:26	1.90
17:23	2.00
18:20	1.40
19:18	0.50

Station # 6	
Location:	Channel
Time	Water Depth (feet)
14:29	1.69
15:25	2.60
16:27	3.30
17:25	3.40
18:22	2.85
19:20	1.55

Station # 7	
Location:	Channel
Time	Water Depth (feet)
14:34	2.50
15:30	3.40
16:32	4.10
17:30	4.10
18:25	3.45
19:23	2.25

Station # 8	
Location:	Channel
Time	Water Depth (feet)
14:32	1.70
15:28	2.64
16:30	3.45
17:29	3.45
18:24	3.00
19:22	1.70

Station # 9	
Location:	Pond C
Time	Water Depth (feet)
14:50	1.00
15:38	2.15
16:39	2.75
17:37	2.75
18:32	2.15
19:28	1.25

Station # 10	
Location:	Pond B
Time	Water Depth (feet)
14:42	1.70
15:37	2.54
16:35	3.10
17:33	3.10
18:30	2.40
19:26	1.30

Station # 11	
Location:	Pond A
Time	Water Depth (feet)
14:54	0.56
15:21	1.46
16:32	2.20
17:30	2.15
18:26	1.60
19:25	0.90

Table 3-3
tidal Inundation Data from April 5, 2004
(High Tide 6.1 feet @ 13:00)

Station # 1	
Location:	Marsh plain
Time	Water Depth (feet)
11:20	0.25
12:20	0.30
13:20	0.30
14:24	0.30

Station # 2	
Location:	Marsh plain
Time	Water Depth (feet)
11:21	0.15
12:22	0.15
13:22	0.10
14:25	0.15

Station # 3	
Location:	Marsh plain
Time	Water Depth (feet)
11:22	0.05
12:24	0.10
13:22	0.10
14:26	0.10

Station # 4	
Location:	Marsh plain
Time	Water Depth (feet)
11:28	0.05
12:28	0.05
13:26	0.05
14:29	0.05

Station # 5	
Location:	Channel
Time	Water Depth (feet)
11:25	0.05
12:26	0.80
13:21	0.90
14:27	0.15

Station # 6	
Location:	Channel
Time	Water Depth (feet)
11:26	0.50
12:27	1.50
13:26	1.60
14:28	0.80

Station # 7	
Location:	Channel
Time	Water Depth (feet)
11:33	2.20
12:30	2.30
13:30	2.65
14:30	1.60

Station # 8	
Location:	Channel
Time	Water Depth (feet)
11:30	1.20
12:29	2.10
13:26	2.20
14:30	1.40

Station # 9	
Location:	Pond C
Time	Water Depth (feet)
11:35	0.80
12:37	1.50
13:33	1.50
14:40	1.10

Station # 10	
Location:	Pond B
Time	Water Depth (feet)
11:37	1.20
12:36	1.80
13:30	2.00
14:35	1.10

Station # 11	
Location:	Pond A
Time	Water Depth (feet)
11:34	0.40
12:30	0.55
13:28	0.95
14:31	0.75

Table 3-4
Tidal Inundation Data from September 28, 2004
(High Tide 6.9 feet @ 12:48)

Station # 1	
Location:	Marsh plain
Time	Water Depth (feet)
10:05	0.25
11:02	0.25
12:00	0.25
13:00	0.60
14:00	0.40
14:58	0.40

Station # 2	
Location:	Marsh plain
Time	Water Depth (feet)
10:06	0.15
11:04	0.15
12:01	0.15
13:02	0.50
14:01	0.30
14:59	0.20

Station # 3	
Location:	Marsh plain
Time	Water Depth (feet)
10:08	0.10
11:05	0.10
12:02	0.10
13:04	0.55
14:02	0.20
15:00	0.10

Station # 4	
Location:	Marsh plain
Time	Water Depth (feet)
10:09	0.10
11:08	0.10
12:06	0.50
13:07	0.70
14:06	0.15
15:03	0.10

Station # 5	
Location:	Channel
Time	Water Depth (feet)
10:09	0.10
11:06	0.55
12:04	1.30
13:05	1.55
14:03	0.90
15:01	0.15

Station # 6	
Location:	Channel
Time	Water Depth (feet)
10:10	0.40
11:07	1.30
12:05	2.10
13:06	2.35
14:05	1.60
15:02	0.65

Station # 7	
Location:	Channel
Time	Water Depth (feet)
10:13	1.65
11:10	2.60
12:08	3.20
13:13	3.45
14:08	2.90
15:06	1.90

Station # 8	
Location:	Channel
Time	Water Depth (feet)
10:12	0.90
11:11	1.80
12:07	2.55
13:10	2.85
14:06	2.20
15:05	1.15

Station # 9	
Location:	Pond C
Time	Water Depth (feet)
10:19	0.65
11:15	0.90
12:15	2.00
13:22	2.20
14:15	1.40
15:12	1.00

Table 3-4
Tidal Inundation Data from September 28, 2004
(High Tide 6.9 feet @ 12:48)

Station # 10	
Location:	**Pond B**
Time	**Water Depth (feet)**
10:17	0.90
11:12	1.80
12:12	2.55
13:17	2.85
14:12	2.20
15:09	1.15

Station # 11	
Location:	**Pond A**
Time	**Water Depth (feet)**
10:15	0.45
11:12	0.50
12:10	1.45
13:15	1.60
14:14	0.90
15:07	0.60

Table 3-5
Tidal Datum at Hunters Point, CA

Datum	Elevation Feet, MLLW
Mean Higher High Water (MHHW)	6.73
Mean High Water (MHW)	6.10
Mean Tide Level (MTL)	3.61
Mean Low Water (MLW)	1.12
Mean Lower Low Water (MLLW)	0.0

Given the Hunters Point station is in close proximity to Heron's Head park we can assume that tidal datum at the Park are similar. The high tide of 6.2 feet MLLW on April 5 did not flood the marsh plain. Thus, the marsh plain only floods during high tides greater than 6.2 feet MLLW or roughly MHW at Hunters Point station. The September 28, 2004 tide of 6.9 feet MLLW did result in complete inundation of the marsh plain (Tables 3-5). Inundation of the marsh plain occurred prior to the peak of the high tide. Therefore, we can conclude that the marsh plain is inundated during tides in the range between MHW and MHHW.

Tidal Channels and Ponds

Data from all three hydrologic monitoring events indicate that tidal channels and ponds were inundated to varying extents during the high tides (Figures 3-4 through 3-7). As expected, depth of inundation was a function of the magnitude of the high tide i.e., the higher the tide, the greater the measured water depth. The lowest inundation depths were recorded at monitoring station 5. The tidal channel at this station is a 2nd order channel. The channel was nearly completely drained at the start and end of the April 5 and September 28, 2004 surveys. The greatest inundation depths were recorded at monitoring station 7. The tidal channel at this station did not drain completely during any of the surveys.

Tidal pond's (A, B, C) bottom elevations are lower than the marsh plain. During the April 5 monitoring event when the marsh plain did not get inundated the tidal ponds showed

considerable amplitude in depth. Tidal inundation data at pond monitoring stations for the April 5, 2004 monitoring event are shown in Figure 3-7. This demonstrates the connection of the ponds to the Bay and/or the tidal channels. The ponds also remain inundated at low tides. This was determined by visual observation during multiple avian surveys conducted at low tides.

3.1.3.3 Salinity

On September 28, 2004, the incoming bay water had a salinity level of 33 parts per thousand (ppt) compared to 30 ppt in September, 2003, 34 ppt in September 2002, 33 ppt in October 2001, and 32 ppt in September 2000. The salinity of seawater is approximately 35 ppt.

On September 28, 2004 water salinities were also recorded at hydrology monitoring stations 1, 6, 9, 10, and 11. Salinities ranged from 42 ppt at hydrology station 1 to 25 ppt at station 6. Salinity is greatest at station 1 because there is standing water on the marsh plain that does not completely drain at low tide, and only mixes with Bay water at tides approximating MHHW. The standing water evaporates and salt concentration rises.

At station 6, a tidal channel, salinity was less than that recorded in the Bay (33 ppt). This is difficult to account for because there is little continuous freshwater input to the marsh. It is possible that water salinity in the tidal channel was diluted from groundwater discharge, or the salinity reading was not accurate. At stations 9, 10, and 11 (tidal ponds) salinity was 33 ppt. This salinity value suggests that the ponds have complete mixing with Bay water.

3.1.4 Discussion and Recommendations

The majority of hydrology and tidal inundation performance standards established for the project are being met. Specific standards are listed and discussed below.

Standard: *Ponds should be completely inundated during high tides, and should remain ponded during low tides.*

This standard is being met. As discussed in this section the all ponds are inundated at high tides and remain ponded during low tides.

Standard: *At mean tide, the constructed tidal channel network should contain water up to 3rd order channels.*

Although this standard was not formally evaluated, incidental observation during vegetation and avian monitoring activities suggest that the majority of the constructed tidal channel network remains inundated at mean tide. As noted in this section, monitoring station 5, at the distal end of the excavated 2nd order channel, was nearly completely drained at the start and end of the monitoring events. The channels that are beginning to form on the marsh plain are completely drained at mean tide.

Creation of 3rd order channels may have been an overly ambitious standard based on the drainage area of 4.06 acres. The construction project excavated a large channel into the marsh plain. This channel may evolve into a 3rd order channel over time as the marsh plain's channel network becomes more complex. The tidal prism is causing headcutting off the excavated channel. These small (1st order) channels are draining the marsh plain. The mouth of the excavated channel, although it is not a 3rd order channel, does remain inundated at mean tide.

Standard: *At mean higher high water (MHHW), the marsh plain should be ponded.*

This standard is being met. As discussed in this section, the marsh plain was ponded during the September 28, 2004 monitoring event (peak high tide of 6.9 feet MLLW). MHHW at the site is 6.7 feet MLLW. Given that inundation occurred prior to the peak of the tide, we can assume that the marsh plain was fully inundated at MHHW.

3.2 FORMATION OF TIDAL CHANNELS

3.2.1 Performance Standards

- Development of 2nd and 3rd order channels from the created channel should occur over 5 years.
- Depth of the main channel should be maintained.

3.2.2 Methods

Plan view sketches of channels was made on a field map while conducting the hydrology monitoring on September 2, 2003, April 5 and September 28, 2004. During the September 2, 2003 and April 5, 2004 hydrology survey, the maximum wetted channel width was measured at each of the 4 channel monitoring stations. Attempts were made to measure channel widths just prior to high tide, before water overtopped them.

3.2.3 Results

Channel Width

Table 3-6 provides data on maximum channel widths for the past eight survey dates. Generally, channel widths have remained stable since construction. No trends are evident that would indicate expansion or contraction of channels. The year-to-year variability is within the precision of this method of monitoring.

Table 3-6
Maximum Wetted Channel Width (feet), Past Six Survey Dates

Station #	9/28/00	3/9/01	10/18/01	3/28/02	9/9/02‡	9/2/03	4/5/04
5	7.75	9.5	52†	12	1	9.3	1.5‡
6	11.08	12.4	19.5†	12.2	9	13.6	12
7	26	28.5	28	26.9	24	27	26.9
8	11	11	32†	10.5	8.6	11.5	10.6

† Water overtopped bank at time of measurement

‡ Minimum width measured

Sketch of Channels

Small channels have continued to form on the northern side of the western channel reach. This is consistent with observations in the previous years, as of September 2, 2003 there were

approximately 14 small channels on the western arm of the channel. This number has likely remained stable, however, the initial stages of channels are difficult to map and define. One of these channels drains and fills a small marsh plain pond (Figure 3-1).

3.2.4 Discussion and Recommendations

During the hydrology monitoring of 2003 and 2004, we observed the continued development of small channels off the western channel reach. Performance standards are discussed below.

Standard: *Development of 2nd and 3rd order channels from the created channel should occur over 5 years.*

It may be more accurate to say that when the dendritic channel network develops on the marsh plain, the constructed channel may evolve into a 3rd order channel. This is because channel-order nomenclature begins with the smallest channels on the marsh plain that are denoted as 1st order channels. A 2nd order channel exists when two 1st order channels combine. A 3rd order channel is fed by two 2nd order channel drainages. Thus the deepest channel, created during project construction may evolve into a 3rd order channel as the drainage network gains complexity resulting from the establishment of vegetation and tidal pools, and microtopographical elevation changes.

First-order channels have begun to develop that are tributary to the created channel. This process has been relatively slow. Various factors can influence the rate at which a channel network develops. At the project site the principle factors controlling the rate of channel development are likely (1) tidal prism, and (2) the substrate of the wetland. The tidal prism is a function of the marsh area, elevation and hydrologic connectivity (i.e., channel geometry). The marsh area is relatively small and inundated only at tides greater than MHW. Therefore, the volume of water flowing into and out of the marsh in a tidal cycle (i.e., tidal prism) that is capable of forming a channel network is also relatively small. Hence, channels develop slowly. In addition, much of the material in the marsh is coarser than typical marsh sediments (bay mud). Erosion and sediment transport of this material may be slower than in native marsh substrate. It is anticipated that 1st order channels will continue to develop the marsh plain beyond the monitoring period.

Standard: *Depth of the channel should be maintained.*

Channel depth is being maintained. There is no visual evidence of sediment accumulation in the tidal channels. Depth of inundation at all tidal channel monitoring stations remained similar over the course of the monitoring program. The table below shows maximum depth of inundation at tidal channel monitoring stations for two tides of similar magnitude.

Table 3-7
Maximum Tidal Inundation at Channel Monitoring Stations

Station	March 28, 2002 (7.0 MLLW)	September 28, 2004 (6.9 MLLW)
	Depth of Inundation (feet)	
5	1.60	1.55
6	2.95	2.35
7	3.65	3.45
8	2.95	2.85

Data in Table 3-7 demonstrates that the channel depths are being maintained at all tidal channel monitoring stations. Depth of inundation measurements were slightly lower at all stations on September 28, 2004. These differences can be attributed to the March 28, 2002 tide being slightly higher, and the precision of the monitoring procedure.

4.1 PERFORMANCE STANDARDS

- Intertidal ponds should maintain an open (non-vegetated) water surface area.
- Intertidal ponds should maintain stable perimeters.
- The berm in Pond B should not erode (because if it does the tidal pond will become part of the open bay).

4.2 METHODS

Pond Widths

To measure pond width, two wooden stakes were placed opposite each other on the perimeter of each of the 3 largest ponds. These 2 stakes established a cross section for each pond. The width of the pond's open water was measured at the cross-section during the September monitoring event. Erosion occurring along pond perimeters and channel edges was also observed. Eroded areas more than 6 inches deep or wide were mapped.

Sedimentation Measure

Sediment accretion was monitored by measuring and recording the height of each of the rebar stakes placed at the 11 monitoring stations above the ground surface. This rebar was installed on September 28, 2000 after some of the gages placed in 2000 were lost. Baseline sediment measurements were made on this date, and subsequent measurements were made on March 9, and October 18, 2001, March 28, and September 9, 2002, September 2, 2003 and April 5 and September 28, 2004. Measurements are recorded in millimeters.

4.3 RESULTS

Pond Widths

The open water surfaces or pond widths have remained approximately the same from 2000 through 2004. This indicates stability in the pond shorelines. According to observations, the extent of vegetation bordering the ponds and the physical boundary of the ponds also did not change from one survey year to the next. Table 4-1 presents measurements of pond widths from 2000 through 2005.

Table 4-1
Pond Widths (feet)

Station #	Pond	3/16/00	9/28/00	3/9/01	10/18/01	3/28/02	9/9/02	9/2/03	2/2/05
11	A	52.5†	140.5‡	102.5	103	101.1	102.5	101.5	101
10	B	39.5	70‡	41	40	39	39.4	39	39.5
9	C	57	63‡	56.3	54.5	43.5	52.5	53	50.5

† Value not in agreement with overall trend and may reflect inconsistencies in monitoring station location

‡ Measurements taken of wetted width at high tide. Field notes indicate that vegetation perimeter had not changed since March 16, 2000 monitoring.

Sedimentation Measurements

Table 4-2 provides baseline sediment measurements along with measurements made in 2001, 2002, 2003 and 2004. These readings correspond with the length of the rebar above the ground surface. Measurement precision is diminished due to the unconsolidated nature of the substrate and water turbidity at pond and channel locations. To minimize this effect the measurements are taken at low tide.

Table 4-2
Baseline Sedimentation Measurements (mm)

Station #	Area	9/28/00	3/9/01	10/18/01	3/28/02	9/9/02	3/17/03	9/2/03	4/5/04	9/28/04	Change from 9/28/00 to 9/28/04
1	Marsh Plain	310	322	299	292	292	298	280	282	281	-29
2	Marsh Plain	302	307	295	281	289	282	281	288	285	-17
3	Marsh Plain	300	309	290	305	297	307	292	308	307	+8
4	Marsh Plain	303	275	286	285	289	296	302	294	290	-12
5	Channel	271	270	260	270	272	280	282	302	302	+31
6	Channel	476	lost	186 (new stake)	203	220	220	225	Missing	Missing	-
7	Channel	1092	1090	290 (new stake)	228	250	265	Missing	Missing	Missing	--
8	Channel	373	362	380	373	365	331	325	Missing	Missing	-48
9	Pond C	576	580[b]	570	480	435	482	518	529	505	-71
10	Pond B	749	712	700	432	413	428	400	398	398	-32 [c]
11	Pond A	610	610	615	600	612	632	631	635	627	+17

a) calculation based on stake installed 10/18/01.

b) sediment soft and visibility poor, so reading is estimate.

c) calculation based on stake installed 3/28/02.

The following variables affect sedimentation/erosion readings:

- Width of the post (i.e., variation in top elevation, post top is not flat),
- Localized scour or deposition at base of posts, and
- Turbidity affects visibility.

The sediment measurements show variability over time, but trends are indicated. The majority of the variability is likely the product of the precision of the methodology from year-to-year and the variables that affect the accuracy of the readings. There appears to be accretion occurring at Stations 1, 2, 4, 8, 9 and 10. The most significant deposition was 71 mm (2.8 inches) at channel

station 9. The data suggests that erosion is occurring at Stations 3, 5, 6, and 11. Channel scour of 31 mm (1.2 inches) measured at channel station 5.

The berm that separates Pond B from the Bay is eroding in two locations (Figure 3-1). It is difficult to predict erosion and accretion over the long-term because the rates measured are not likely to be linear over time. The design intent was for the bay to sheet flow into the pond on spring tides, which it does. However, the velocity of the ebbing tide could erode the berm and be detrimental to the integrity of the pond in the long term.

4.4 DISCUSSION AND RECOMMENDATIONS

Performance standards for erosion and sedimentation are discussed below.

Standard: *Intertidal ponds should maintain an open (non-vegetated) water surface area and should maintain stable perimeters.*

The standard is being met. The ponds have maintained an open water surface, and have maintained stable perimeters.

Standard: *The berm in Pond B should not erode (because if it does the tidal pond will become part of the open bay).*

Measures have been implemented to retard erosion of the berm separating Pond B from the Bay. The Port recognizes the importance of monitoring and maintaining the integrity of the berm and considers this to be an important consideration in the long-term management of the site.

5.1 PERFORMANCE STANDARDS

- Within the wetlands, there should be no large (>10 m^2) continuous patches dominated by exotic species or bare ground.
- The marsh plain should be 80% covered by salt marsh plants within 5 years. Excluded from this goal are areas below 1.0 foot mean sea level (MSL), areas with significant serpentine or hard panne soils, refugial islands, ponds, and channels.

5.2 METHODS

Vegetation was monitored on September 2 and 3, 2003 and September 28, 2004. Eight permanent transects established in 2000 at approximately 30 meter intervals in the restored and enhanced marsh were monitored. All of the transects began at the northern edge of the constructed marsh plain. Transects 1 and 2 extended across the newly constructed zone and transects 3-8 continued to the southern edge of the site. Inland endpoints of transects were marked with wooden stakes, and the compass direction of each transect was noted. Descriptions of stake locations and transect directions were recorded on field data sheets and referenced via permanent site and off site features. Transect locations are shown in Figure 5-1.

One-meter quadrats were placed at 10-meter intervals, on the east side of each transect. Within each quadrat, species were identified, and the cover class of each species was estimated. Coverage of algae, water, and dead vegetation were also recorded. Cover classes from 1 to 6 were used (Mueller-Domdois and Ellenberg 1974), and have been defined as follows:

Cover Class 1	=	0% - 5%
Cover Class 2	=	6% - 25%
Cover Class 3	=	26% - 50%
Cover Class 4	=	51% - 75%
Cover Class 5	=	76% - 95%
Cover Class 6	=	96% - 100%

Data on the vigor of each species was not collected in 2003. Data on the vigor was collected in 2004, but not analyzed. Maximum height of pickleweed (*Salicornia* spp.) was measured in each quadrat.

Relative frequency of each plant species' occurrence was calculated. Frequency is the total number of quadrats that contained a given species, and relative frequency is the frequency of one species compared with the frequency of all other species, expressed as a percent.

An overall ocular estimate of percent coverage of vegetation in the marsh plain was also made during the vegetation surveys. Photographs were taken at each end of each transect during the vegetation monitoring events to record the extent of vegetation growth. Photos are provided in Appendix B.

The monitoring protocols defined 2 habitat zones: the marsh plain and the transition zone and stated that the length of each zone be measured. In practicality, the transition zone was limited by site topography to a narrow strip, resulting from the grading that was done during construction. This zonal distinction was not made after the first year. The transition zone vegetative cover

data, which corresponded to a narrow band of approximately 1-5 feet wide, depending on the transect, was included with the marsh plain data.

5.3 RESULTS

Percent Cover

Ocular estimates of plant cover on the marsh plain were made in September 2003 and 2004. In 2003, the overall vegetation cover on the marsh plain was estimated to be 40 percent. By September 2004, vegetation cover had increased to approximately 60 percent. Vegetation cover and density is greatest on the microtopographically higher ground.

In 2004, percent cover in each of the vegetation transect quadrats was recorded. The average percent cover for all quadrats is 57 percent. This result confirms that the overall ocular estimate of 60 percent is an accurate assessment of marsh plain vegetation cover.

Pickleweed Height

Table 5-1 presents the pickleweed height averages and ranges in the five-year monitoring period. The average pickleweed height and the range of heights have remained relatively stable over the course of the monitoring period. Taller pickleweed plants grow on the undisturbed marsh plain that existed prior to the construction project. New pickleweed growth tends to be less vigorous in newly created marsh areas. These results are typical for marsh restoration projects.

Table 5-1
Pickleweed Height (cm)

Year	Average Height	Range (Min/Max)
2004	22.4	9 / 43
2003	24.1	5 / 47
2002	23.2	2 / 50
2001	19.6	4 / 38
2000	22.1	5 / 47

Species Richness

In September 2003, 22 plant species were recorded. Twenty-one plants were identified to species and there was 1 unidentified plant. Eleven species were native and ten species were non-native. Species richness has remained constant compared to 2002 (22 taxa versus 21 in 2002), but it has decreased compared to 2001 and 2000 (22 taxa versus 33 in 2001 and 31 in 2000). The number of non-native species is substantially smaller than in the previous three years (10 non-native species compared to 23 species in 2002, 18 species in 2001 and 19 species in 2000). The number of native species has remained approximately the same as in 2002 (11 species in 2003 versus 10 species in 2002). Three non-native species were found at the site in 2003: acacia, bur-clover, and narrow-leaf plantain. Table 5-2 presents those results.

In September 2004, 22 plant species were recorded. Seventeen plants were identified to species, 4 were identified to genus, and there was 1 unidentified plant. Eleven species were native and ten species were non-native. Species richness has remained constant compared to 2003.

Table 5-2
Results of Vegetation Surveys in 2003 and 2004

Species (Scientific Name)	Species (Common Name)	Native/Non-Native	Avg. Cover Class Sept 2003	Relative Frequency Sept 2003	Avg. Cover Class Sept 2004	Relative Frequency Sept 2004
Acacia sp.	Acacia	Non-native	2	0.6	--	--
Algae (likely Fucus sp.)	N/A	N/A	--	--	--	--
Atriplex semibaccata	Australian saltbush	Non-native	--	--	--	--
Atriplex triangularis	Fat hen	Native	1	0.6	--	--
Avena barbata	Wild oat	Non-native	3	1.0	1	0.3
Brassica sp.	Mustard	Non-native	--	--	--	--
Bromus diandrus	Ripgut brome	Non-native	1	0.3	--	--
Cakile edentula	American searocket	Non-native	--	--	--	--
Centaurea solstitialis	Yellow star thistle	Non-native	--	--	--	--
Cuscuta salina	Dodder	Native	1	1.3	1	1.3
Cotula coronopifolia	Brass buttons	Non-native	--	--	--	--
Distichlis spicata	Salt grass	Native	2	17.1	3	15.8
Foeniculum vulgare	Sweet fennel	Non-native	--	--	1	0.3
Frankenia salina	Frankenia	Native	2	2.6	3	3.2
Grindelia stricta	Gum plant	Native	2	4.8	2	6.1
Heteromeles arbutifolia	Toyon	Native	1	0.3	--	--
Jaumea carnosa	Jaumea	Native	2	12.9	1	11.6
Lactuca seriola	Prickly lettuce	Non-native	--	--	2	1.3
Limonium californicum	Sea lavender	Native	1	6.5	2	8.7
Lolium perenne	Perennial ryegrass	Non-native	--	--	2	1.6
Lotus corniculatus	Bird's foot trefoil	Non-native	1	1.3	--	--
Malva sp.	Mallow	Non-native	--	--	--	--
Medicago polymorpha	Bur-clover	Non-native	1	0.3	1	0.3
Melilotus alba	White sweet clover	Non-native	2	0.6	--	--
Melilotus officinalis	Yellow sweet clover	Non-native	--	--	--	--
Parapholis incurva	Sickle grass	Non-native	2	3.5	2	3.5
Picris echioides	Bristly ox-tongue	Non-native	--	--	--	--
Plantago species	plantain	Non-native	1	3.5	2	4.8
Plantago lanceolata	Narrow-leaf plantain	Non-native	1	0.3	--	--
Plantago maritima	Alkali plantain	Native	2	0.6	--	--
Polypogon monspeliensis	Rabbit's foot grass	Non-native	--	--	--	--
Raphanus sativa	Wild radish	Non-nativ5-2	--	--	--	--
Rumex pulcher	Fiddle dock	Non-native	--	--	--	--
Salicornia virginica	Pickleweed	Native	2	39.0	3	40.5

Table 5-2
Results of Vegetation Surveys in 2003 and 2004

Species (Scientific Name)	Species (Common Name)	Native/Non-Native	Avg. Cover Class Sept 2003	Relative Frequency Sept 2003	Avg. Cover Class Sept 2004	Relative Frequency Sept 2004
Salsola soda	Russian thistle	Non-native	1	0.6	2	0.6
Sonchus asper	Prickly sow thistle	Non-native	--	--	--	--
Stellaria calycantha	Chickweed	Native	1	1.6	--	--
Vulpia myuros	Foxtail Fescue	Non-native	--	--	--	--
Unknown 1	--	--	1	0.3	--	--

* Species observed in 2003 and not in 2002.

Note: This table is a continuation from the previous page.

Cover Class Ratings

Class 1 = 0-5% Class 4 = 51-75%
Class 2 = 6-25% Class 5 = 76-95%
Class 3 = 26-50% Class 6 = 96-100%

Table 5-3 summarizes the relative frequency of the top five species on each survey date from 2000 to 2004. Since October 2001, the four of the most frequently observed plants have been the same species, and all four are native. Pickleweed remains the most frequent plant and its relative frequency continues to increase over the years. The relative frequency for pickleweed has increased from 23.7% in 2000 to 40.5% in 2004.

The number of non-native species at Heron's Head Park has decreased substantially throughout the monitoring period. Their relative frequency, a measure of dominance, appears is decreasing as well. Of note is the decrease in the frequency of four non-native species: bird's foot trefoil (*Lotus corniculatus*), white sweet clover (*Melilotus alba*), sickle grass (*Parapholis incurva*), and Russian thistle (*Salsola soda)*. This is due in part to the vegetation maintenance performed by City staff and the programs administered by Literacy for Environmental Justice.

Table 5-3
Most Frequent Plants (Comparison from 2000 to 2004)

Species	Native/ Non-Native	Relative frequency						
		Sept 2004	Sept 2003	Sept 2002	Oct 2001	May 2001	Sept 2000	May 2000
Pickleweed	Native	40.5%	39.0%	35.5%	26.4%	22.4%	23.7%	22.2%
Salt grass	Native	15.8%	17.1%	14.5%	11.5%	9.8%	7.9%	No data
Jaumea	Native	11.6%	12.9%	10.5%	10.3%	9.2%	No data	No data
California Sea lavender	Native	8.7%	6.5%	9.3%	11.5%	11.5%	9.4%	No data
Gum plant	Native	6.1%	4.8%	8.0%	6.9%	8.7%	No data	No data

Table 5-3
Most Frequent Plants (Comparison from 2000 to 2004)

Species	Native/ Non-Native	Relative frequency						
		Sept 2004	Sept 2003	Sept 2002	Oct 2001	May 2001	Sept 2000	May 2000
Sand-spurrey	Non-native	0.0%	0.0%	0.0%	0.0%	0.0%	9.4%	8.1%
Russian thistle	Non-native	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	10.3%
Sicklegrass	Non-native	3.5%	3.5%	8.0%	6.3%	7.7%	9.4%	8.1%
Plantain species	Non-native	4.8%	4.4%	2.5%	7.5%	6.6%	No data	6.5%

Species were also classified by the community in which they were found (Table 5-4). Most of these plants were found in the high marsh zone. Plants sometimes become established in unusual zones during the "start-up" phase of a project while the physical conditions are coming to equilibrium.

Table 5-4
Plant Species by Community

Species (Scientific Name)	Species (Common Name)	Community
Fucus sp.	Sea lettuce	Aquatic
Atriplex semibaccata	Australian saltbush	Transition zone
Atriplex triangularis	Fat hen	Transition zone
Avena barbata	Wild oat	Upland
Brassica sp.	Mustard	Upland
Bromus diandrus	Ripgut brome	Transition zone /Upland
Cakile edentula	American sea rocket	High marsh/ Transition
Centaurea solstitialis	Yellow star thistle	Upland
Cuscuta salina	Dodder	High marsh
Distichlis spicata	Salt grass	High marsh
Foeniculum vulgare	Sweet fennel	Upland
Frankenia salina	Alkali heath	High marsh
Grindelia stricta	Gum plant	High marsh
Jaumea carnosa	Jaumea	Marsh plain
Lactuca serriola	Prickly lettuce	Upland
Limonium californicum	Sea lavender	High marsh
Lolium perenne	Perennial ryegrass	Upland
Lotus corniculatus	Bird's foot trefoil	High marsh
Malva sp.	Mallow	Upland
Melilotus alba	White sweet clover	High marsh/ Upland
Melilotus officinalis	Yellow sweet clover	High marsh/ Upland
Parapholis incurva	Sickle grass	Marsh plain
Picris echioides	Bristly ox-tongue	Upland

Table 5-4
Plant Species by Community

Species (Scientific Name)	Species (Common Name)	Community
Plantago coronopus	Rat-tail plantain	High marsh
Plantago maritima	Alkali plantain	High marsh
Polypogon monspeliensis	Rabbit's foot grass	High marsh
Raphanus sativus	Wild radish	Upland
Rumex pulcher	Fiddle dock	Upland
Salicornia virginica	Pickleweed	Marsh plain
Salsola soda	Russian thistle	Marsh plain
Sonchus asper	Prickly sow thistle	Transition zone
Stellaria calycantha	Chickweed	Transition zone
Vulpia myuros	Foxtail fescue	Upland

5.4 SUMMARY AND RECOMMENDATIONS

The newly created marsh area of Heron's Head park was designed to promote the establishment of high marsh vegetation such as pickleweed. The marsh plain has been colonized by pickleweed and other salt marsh plant. Specific performance standards for the project are discussed below.

Standard: *The marsh plain should be 80% covered by salt marsh plants within 5 years. Excluded from this goal are areas below 1.0 foot mean sea level (MSL), areas with significant serpentine or hard panne soils, refugial islands, ponds, and channels.*

Standard is nearly met. Percent cover of vegetation in the marsh plain is approximately 60 percent after five years of monitoring. The wetland is progressing steadily toward the goal of 80% vegetation coverage.

Standard: *Within the wetlands, there should be no large (>10 m^2) continuous patches dominated by exotic species or bare ground.*

Standard is being met. No large (>10 m^2) patches are dominated by exotic species. There are some small patches (<5m^2) of cordgrass (Spartina spp.) in the marsh that are likely a non-native species or a hybrid. The Port has made efforts to control the establishment and spread of non-native cordgrass in the marsh. These efforts will continue as part of the long-term management of the site.

There are some areas of open water within the marsh. These areas are slight topographic depressions that do not drain completely at low tide. These pools are important habitat features for wildlife and add diversity to the marsh plain. Many wading birds such as avocet, egrets, yellowlegs and killdeer are often observed foraging in these ponds.

Standard: *The marsh plain elevation should support salt marsh vegetation, predominantly pickleweed.*

This standard was evaluated using the vegetation monitoring protocols. The relationship between marsh plain elevation and pickleweed coverage is based on tidal inundation. Pickleweed generally grows in a band between mean high water and mean higher high water. Prior to restoration work, the existing vegetated salt marsh elevation on the Pier 98 site was between 5.0

and 7.0 feet MLLW (approximately 1 foot below MHW to just above MHHW). The densest pickleweed areas at the site were located just above MHW and below MHHW (6.0 to 6.5 feet MLLW). The tidal marsh plain, designed to support pickleweed and associated halophytic plant species, was constructed at about 6.5 feet MLLW. Typically, constructed Bay Area tidal marsh design elevations are set at approximately 6 inches below MHHW in areas of positive sedimentation. This design elevation has been set about 3 inches higher, assuming that the site is still subsiding (LFR 1997).

Marsh plain cover was 60% during the September 2004 monitoring event, with pickleweed being the dominant plant species. Cover has been continuously increasing. This indicates progress towards the goal of creating a marsh plain with salt marsh vegetation, predominantly pickleweed.

Marsh plain development west of the main tidal channel includes formation of small tidal ponds, similar to the tidal ponds located east of the main tidal channel. These ponds are used by shorebirds as refugia and for foraging. The tidal pond area decrease the area available for vegetation cover, however this trade-off adds to the habitat complexity of the site.

6.1 PERFORMANCE STANDARDS

A total of at least 8 acres of wetlands (5.05 restored and 2.95 enhanced) should be present at year 5.

6.2 METHODS

To assess created and enhanced wetland acreage in Heron's Head Park a color infrared (IR) aerial photo of the project site was taken on December 21, 2004. The photo was geo-referenced to a USGS quadrangle using ArcGIS 9.3 geographical information systems (GIS) software. Original permitting and construction documents prepared by LFR were digitized and overlayed on the aerial image to establish existing conditions prior to implementation of the project. Figure 6-1 (Design view) shows the aerial image with the proposed project design overlay.

The aerial image was interpreted to estimate various habitat types in the project site. Polygons were created to delineate areas of created and enhanced wetlands, tidal channels and ponds, and ecotone. The interpretation of the aerial image was ground-truthed in the field on February 2, 2005. Boundaries of the various habitat types were verified and adjusted as necessary. The aerial image with the final ground-truthed habitat classification overlay is also shown in Figure 6-1 (Current view).

A wetland delineation was conducted using the Army Corps of Engineers 1987 manual procedures (USACE 1987) to verify the regulatory status of the habitat types in the project area. Two wetland delineation points were established: one point in the ecotone (#1) and another in the tidal marsh (#2). The location of these data points are shown on Figure 6-1. Wetland delineation data sheets are provided in Appendix B.

6.3 RESULTS

Figure 6-1 summarizes the acreage amounts of the various habitat types in the project area. The project planned to create 5.05 acres of wetland. The current estimate for created wetlands is 4.06 acres (3.91 tidal wetland, and 0.15 tidal channels). The difference between the design and created wetland areas occurs predominately on the margins of the site. The exact transition between upland and wetland is often indistinct, as are the boundaries between created and enhanced wetland. Overall, the footprint of the design and current created condition are similar. There are some obvious differences in the design versus current condition in the northwest portion of the site (Figure 6-1). The wetland border in this area was constructed in a different manner than that shown in the LFR (1997) planning documents that were used to create the design overlay.

The project planned to enhance 2.95 acres of wetland. The current estimate for enhanced wetlands is 3.44 acres (2.23 tidal wetland, and 1.21 tidal ponds). There is currently more enhanced area than in the original design because of the field interpretation of created versus enhanced areas.

The wetland delineation points were taken to confirm jurisdictional status of the wetlands. At Point #1, located in the ecotone area, vegetation is dominated by wetland indicator species such as buckhorn plantain [*Plantago coronopus,* facultative (FAC) species] and gumplant [*Grindelia stricta,* facultative wetland species (FACW), but plant cover is low (approximately 40%). The

point has primary wetland hydrology indicators (i.e., drift lines are present), but lacked soil saturation. The site also lacked hydric soils indicators. This may be due to the fact that the wetland is constructed of fill material. The point was determined not to be a wetland because it lacked hydric soils, the site is not regularly saturated during the growing season and wetland vegeatation cover is low (i.e., less than 40%). The project planning documents also considered this area not to be a wetland (Figure 6-1).

At Point #2, located in the marsh area, vegetation is dominated by obligate wetland species such as pickleweed and jaumea, and plant cover is 100%. The point has many primary wetland hydrology indicators such as saturated soils, sediment deposits, and a drainage pattern. The site lacks hydric soil indicators. This may be due to the fact that the peninsula was built with sandy fill and construction debris material that will not develop indicators rapidly. The point was determined to be a wetland because it has dense hydrophytic vegetation, saturated soils and numerous hydrology indicators.

6.4 SUMMARY AND RECOMMENDATIONS

Performance standard for wetland acreage is discussed below.

Standard: *A total of at least 8 acres of wetlands (5.05 restored (created) and 2.95 enhanced) should be present at year 5.*

The Heron's Head Park has created a total of 7.50 acres of wetlands (4.06 restored and 3.44 enhanced). The difference between the acreage projected for creation by the LFR design report and the current condition can be accounted for by two factors. First, the distinction between created and enhanced wetland was difficult to discern in the field.

Secondly, there is a relatively large (0.71 acres) deposit of coarse material at the eastern end of the Park that was classified as "mud, rock, or sand" in the 2004/05 delineation. The rock and sand appeared to have been deposited during recent winter storm surge events, as concluded from observations of the pile's geomorphology and matted vegetation extending from under the edges of the pile.

Heron's Head Park is a peninsula protruding into India Basin and as such is subject to the full force of Bay processes. These Bay initiated macro processes will continue to effect microtopographical changes on the site, such as the deposition of rock and sand near the eastern tip. The rock and sand area was not categorized as wetland because it is predominantly devoid of vegetation in 2004, but was considered wetland in the LFR design documents. Had this area been characterized as enhanced wetland the project would have exceeded the performance standard for wetland acreage.

7.1 PERFORMANCE STANDARDS

- Heron's Head Park will be used by both waterbirds and passerines for nesting, foraging, and roosting;
- High species diversity will be present over the course of 1 year. Prior to project construction 78 bird species were identified at the site during 30 monitoring events conducted between February and December 1999 (Rush 1999). Using this as a baseline, achievement of the high species diversity goal will be determined by the presence of at least 78 species of birds.

7.2 METHODS

Four bird observation points were designated on March 30, 2000, the first bird survey date. The location of the bird observation points are identified in Figure 3-1. These points were selected to view each of the habitats present in the park. In 2004, surveys took place on January 10, February 5, March 4, April 21, October 12, November 8 and December 16. Observations were recorded at each point using binoculars and a spotting scope. Birds were counted in the survey if they met one of the following criteria: located on Heron's Head Park, flying over if they had previously alighted within the park, in Lash Lighter Basin, or in a band approximately 32 feet (10 meters) wide from the park's south shore in India Basin. In the instances when a bird could not be identified to species, the taxon was recorded, such as gull species or sandpiper species. Greater and lesser scaup were not differentiated and were recorded as scaup species.

Field data sheets were used to record the number of birds of each species, their behavior (feeding, roosting and flying over) and habitat. The habitats are defined below and depicted in Figure 6-1:

- The marsh plain is the intertidal area constructed in 1999.
- Tidal ponds or channels are the tidally influenced aquatic areas within Heron's Head Park that are permanently inundated. They consist of Ponds A, B, and C as well as the channels in the Park.
- The transitional/upland areas are the areas that are either grasses, forbs or shrubs, areas along the trail, or the sloping area between the marsh plain and the grassy upland.
- Rocky intertidal or rip-rap areas border the perimeter of Heron's Head Park and consist either of rip rap, large rocks or rocky beaches.
- Mudflats are exposed at low tide in areas outboard of the rocky intertidal zone.
- Open water comprised any water within 50 feet (15 meters) surrounding Heron's Head Park and included the water within the PG&E intake basin.

Surveys included observations of passerines in uplands as well as shorebirds and waterfowl. The number of people using the park, their location, and activity were also recorded during the bird surveys. Monitoring human activity began in response to concerns raised that the increased presence of people and dogs at Heron's Head Park has reduced the number of birds that use the site.

7.3 RESULTS AND DISCUSSION

During the surveys conducted in 2004, a total of 55 bird species were identified. A cumulative total of 70 species of birds have been observed during five years of monitoring. The 2004 surveys included 2 species not seen in previous years: marbled godwit and black-necked stilt. Species observed in 2003 but not 2004 include western sandpiper, mallard, American coot, common loon, horned grebe, Anna's hummingbird and loggerhead shrike.

During five years of monitoring, the following species were only seen once: marbled godwit, black-necked stilt, canvasback, green heron, black crowned night heron, northern flicker, American robin, and peregrine falcon. Table 7-1 lists the bird species observed between 2000-2004. Two special status species have been observed at the site since 2000: the California brown pelican (state and federally listed as endangered) and the peregrine falcon (state listed as endangered and federally de-listed). The California brown pelican was observed from 2000-2002 and again in 2004, and the American peregrine falcon was seen only in 2000. No special status species were observed in 2003.

Table 7-1
Bird Species Observed at Heron's Head Park Between 2000-2004

Common Name	Scientific Name	2000	2001	2002	2003	2004
Shorebirds						
spotted sandpiper	*Actitis macularia*	●	●	●	●	●
great blue heron	*Ardea herodias*	●	●	●	●	●
dunlin	*Calidris alpina*	●	●	●	●	●
western sandpiper	*Calidris mauri*	●	●	●	●	
least sandpiper	*Calidris minutilla*	●	●	●	●	●
great egret	*Casmerodius albus*	●	●	●	●	●
willit	*Catoptrophorus semipalmatus*	●	●	●	●	●
semi-palmated plover	*Charadrius semipalmatus*	●	●	●	●	●
killdeer	*Charadrius vociferus*	●	●	●	●	●
snowy egret	*Egretta thula*	●		●	●	●
black oyster-catcher	*Haematopus palliatus*		●	●	●	●
black-necked stilt*	*Himantopus mexicanus*					●
marbled godwit*	*Limosa fedoa*					●
dowitcher sp.	*Limnodromus scolopaceus* and *L. griseus*	●	●	●	●	●
long-billed curlew	*Numenius americanus*		●	●	●	●
whimbrel	*Numenius phaeopus*	●	●	●	●	●
black-bellied plover	*Pluvialis squatarola*	●	●	●	●	●
American avocet	*Recurvirostra americana*	●	●	●	●	●
greater yellowlegs	*Tringa melanoleuca*	●	●	●	●	●

Table 7-1
Bird Species Observed at Heron's Head Park Between 2000-2004

Common Name	Scientific Name	2000	2001	2002	2003	2004
Non-shorebird waterbirds						
Clark's grebe	*Aechmophorus clarkii*	●	●	●	●	●
western grebe	*Aechmophorus occidentalis*	●	●	●	●	●
American wigeon	*Anas americana*	●	●	●	●	●
Eurasian wigeon	*Anas penelope*			●		●
mallard	*Anas platyrhynchos*		●	●	●	
canvasback	*Aytha valisineria*		●			
scaup sp.	*Aythya marila* and *A. affinis*	●	●	●	●	●
Canada goose	*Branta canadensis*	●	●		●	●
bufflehead	*Bucephala albeola*	●	●	●	●	●
common goldeneye	*Bucephala clangula*	●		●	●	●
green heron	*Butorides virescens*	●				
American coot	*Fulica americana*	●	●	●	●	
Common loon	*Gavia immer*				●	
surf scoter	*Melanitta perspicillata*		●	●	●	●
black crowned night heron	*Nycticorax nycticorax*	●				
ruddy duck	*Oxyura jamaicensis*	●	●	●	●	●
American white pelican	*Pelecanus occidentalis*		●	●	●	●
California brown pelican	*Pelecanus occidentalis californicus*	●	●	●		●
double-crested cormorant	*Phalacrocorax auritus*	●	●	●	●	●
horned grebe	*Podiceps auritus*		●	●	●	
eared grebe	*Podiceps nigricollis*	●	●	●	●	●
pied-billed grebe	*Podilymbus podiceps*	●	●	●	●	●
Upland and Passerine Birds						
red-winged blackbird	*Agelaius phoeniceus*	●	●	●		●
Anna's hummingbird	*Calypte anna*			●	●	
house finch	*Carpodacus mexicanus*			●	●	●
belted kingfisher	*Ceryle alcyon*	●	●	●	●	●
northern flicker	*Colaptes auratus*			●		
rock dove	*Columba livia*	●		●	●	●
American crow	*Corvus brachyrhynchos*	●	●	●	●	●
yellow-rumped warbler	*Dendroica coronata*	●	●	●		
Brewer's blackbird	*Euphagus cyanocephalus*	●	●	●	●	●
barn swallow	*Hirundo rustica*				●	
loggerhead shrike	Lanius ludovicianus			●		●
savannah sparrow	*Passerculus sandwichensis*	●	●	●	●	●
black phoebe	*Sayornis nigricans*		●	●	●	●

Table 7-1
Bird Species Observed at Heron's Head Park Between 2000-2004

Common Name	Scientific Name	2000	2001	2002	2003	2004
Say's phoebe	*Sayornis saya*		●			
western meadowlark	*Sturnella neglecta*	●	●	●	●	●
European starling	*Sturnus vulgaris*	●	●	●	●	●
American robin	*Turdus migratorius*			●		
mourning dove	*Zenaida macroura*	●		●		●
golden-crowned sparrow	*Zonotrichia atricapilla*		●			
white-crowned sparrow	*Zonotrichia leucophrys*	●	●	●	●	●
hummingbird sp.			●			
Raptors						
American peregrine falcon	*Falco peregrinus*		●			
American kestrel	*Falco sparverius*				●	●
Gulls and Terns						
California gull	*Larus californicus*	●	●	●	●	●
mew gull	*Larus canus*	●	●	●	●	●
ring-billed gull	*Larus delawarensis*	●	●	●		
western gull	*Larus occidentalis*	●	●	●	●	●
Bonaparte's gull	Larus philadelphia	●		●		
Caspian tern	*Sterna caspia*	●	●	●	●	●
Forster's tern	*Sterna forsteri*	●	●	●	●	●

* species observed for the first time during the 2004 surveys

Species abundance is shown in tables 7-2 through 7-4. Table 7-2 shows the cumulative total of the most abundant species observed at high and low tides at Heron's Head Park for all surveys in 2004. Table 7-3 lists the most abundant species observed during each survey event for high and low tides for 2004. Table 7-4 shows the numbers of species present by habitat for high and low tide for 2004. The most abundant species observed at high and low tides and the most abundant species observed during each survey event for high and low tides from 2000-2003 are shown in Appendix C.

European starling and mew gull were the most abundant species during the 2004 surveys for low and high tide, respectively. Mew gull and least sandpiper were the second and third most abundant species during low tide. European starling and scaup were the second and third most abundant species during high tide. European starling, mew gull, scaup and least sandpipers have been the most abundant species in the past from 2000-2003 (Appendix C).

As in previous years, most birds were found to be roosting or resting, while some foraging also took place, mostly in the marsh plain and open water, although sometimes in the ponds. More birds used the rocky intertidal habitat than any other habitat in 2004, with an average of 336 birds in this habitat per survey. This high number is likely attributed to one large flock of European starlings and one large flock of mew gulls that were observed in the rocky intertidal during low tide. In the last five years, the most utilized habitat in terms of bird numbers has been

predominantly rocky intertidal, although in 2003, the marsh plain adjacent to the rocky intertidal areas was more utilized. Birds that tend to flock in large groups, such as mew gulls and European starlings roost in both of these habitats regularly, and survey dates and timing most likely plays a large role in which habitat is determined to be most utilized during any given year. The least utilized habitats in the park in 2000, 2001 and 2004 were the ponds. In 2002 and 2003, tidal flats were less utilized than the ponds.

Table 7-2
Cumulative Total of Individuals from the Ten Most Abundant Species in 2004

Species	Low Tide Numbers	Species	High Tide Numbers
European starling *Sturnus vulgaris*	1724	mew gull *Larus canus*	926
mew gull *Larus canus*	669	European starling *Sturnus vulgaris*	227
least sandpiper *Calidris minutilla*	162	scaup *Aythya* sp.	119
scaup *Aythya* sp.	92	dunlin *Calidris alpina*	97
western gull *Larus occidentalis*	78	western gull *Larus occidentalis*	83
American avocet *Recurvirostra americana*	50	American avocet *Recurvirostra americana*	83
western meadowlark *Sturnella neglecta*	37	least sandpiper *Calidris minutilla*	73
black-bellied plover *Pluvialis squatarola*	34	western meadowlark *Sturnella neglecta*	60
Bufflehead *Bucephala albeola*	31	ruddy duck *Oxyura jamaicensis*	44
double-crested cormorant *Phalacrocorax auritus*	24	bufflehead *Bucephala albeola*	37

Table 7-3
Ten Most Abundant Species by Survey in 2004

Date	Species	Low Tide Numbers	Date	Species	High Tide Numbers
10/12/04	European starling *Sturnus vulgaris*	900	3/4/04	mew gull *Larus canus*	771
11/8/04	European starling *Sturnus vulgaris*	600	12/16/04	European starling Sturnus vulgaris	180
3/4/04	mew gull *Larus canus*	520	4/16/04	Dunlin *Calidris alpina*	83
3/4/04	European starling *Sturnus vulgaris*	220	1/10/04	mew gull *Larus canus*	71

Table 7-3
Ten Most Abundant Species by Survey in 2004

Date	Species	Low Tide Numbers	Date	Species	High Tide Numbers
3/4/04	least sandpiper *Calidris minutilla*	131	1/10/04 12/16/04	scaup *Aythya* sp.; mew gull *Larus canus*	65 65
2/5/04	mew gull *Larus canus*	85	2/5/04 11/8/04	mew gull *Larus canus*	60 60
2/5/04	western gull *Larus occidentalis*	66	1/10/04	western meadowlark *Sturnella neglecta*	50
1/10/04	mew gull *Larus canus*	50	1/10/04 2/5/04	American avocet *Recurvirostra Americana;* European starling *Sturnus vulgaris*	30 30
2/5/04	scaup *Aythya* sp.	*38*	2/5/04 3/4/04	scaup *Aythya* sp.	27 27
1/10/04	*Scaup* Aythya *sp*.	*31*	1/10/04 3/4/04	American avocet *Recurvirostra Americana;* bufflehead *Bucephala albeola*	20 20

Table 7-4
Total Number of Species, by Habitat, for Low and High Tides

	Number of Species									
Year	High Tide					Low Tide				
Habitat	2004	2003	2002	2001	2000	2004	2003	2002	2001	2000
Marsh plain	21	27	22	20	14	18	15	6	13	8
Open water	23	28	16	19	17	18	21	10	21	11
Overhead	15	18	16	12	3	6	15	5	11	20
Pond	3	8	19	11	9	10	11	15	8	7
Rocky	22	25	21	13	21	19	23	5	12	26
Tidal flat	0	1	10	5	19	2	11	13	7	5
Upland	6	7	26	15	1	5	7	11	13	2

Bird species diversity by habitat varied each year, but was predominantly greatest in the marsh plain and open water. In 2002, species diversity was greatest in the uplands. The greatest number of species per habitat during the 5-year monitoring period ranged from 37 species in the upland in 2002 to 25 species in the open water in 2000. The most species present at one survey was 40, during low tide in February 2002. Table 7-4 presents the total number of species by habitat for high tide and low tide for 2000-2004. Figure 7-2 illustrates the total number of species by habitat for both high and low tides combined for 2000-2004.

In past years, the greatest number of species present in the park has been at low tide. This is most likely due to the availability of rocky intertidal and marsh plain habitats at low tide. This type of

habitat is not abundant in the immediate vicinity of Heron's Head Park and most likely provides additional foraging and roosting habitat for waterbirds in the vicinity.

Human Activity: Heron's Head Park continues to be used for recreational activities and environmental education. Public use of the park including number and location of people (on or off trail) as well as activity was recorded during the bird surveys to track human use and domestic pet activity. An average of 2 people were recorded using the park during each survey date in 2004. Human activity has ranged from approximately 2 people per survey (2002-2004) to 6 people per survey (2001). Throughout the survey period, most people were observed on the main path, but some were observed walking and fishing on the shoreline. Portions of the shoreline are clearly marked to deter such use. Other activities observed included using the park for bike riding, clam digging, and dog walking.

The majority of dogs in 2004 were observed off-leash. A total of 12 dogs were observed off-leash and 1 was observed on-leash. Observations for past years have also recorded a majority of dogs off-leash. In 2004, all of the dogs were observed close to the main path and were not actively disturbing wildlife. This has not always been the case during the monitoring period, where there were isolated incidents of dogs actively flushing birds from the marsh plain. Due to the potential of disturbance to birds, off-leash dogs pose one of the greatest threats to wildlife. Although monitoring of human-related activity is recorded during bird surveys, the protocol is not designed to critically evaluate human related impacts on bird use, thus no firm conclusions (e.g. cause-effect relationships) can be drawn from the survey data.

7.4 SUMMARY

- The total number of birds continues to increase and the total number of species observed throughout all of the survey years continues to increase.
- Seventy species of birds have been observed during the five years of monitoring. Although the total number of birds did not reach the target number, the difference in monitoring frequency per year between the Rush study and the current monitoring may be a mitigating factor. Rush conducted 30 bird surveys over an 11-month period in 1999, whereas the current monitoring occurs once per month for 7 or 8 months in the year.
- Brewer's blackbirds, sandpiper species, mew gulls, European starlings and scaup species were the most abundant species during the 5-year monitoring period for high and low tides. The most abundant species observed during low tide was observed in October 2004, when a large flock (900) of European starlings were present. Mew gulls were the most abundant species observed at one time during high tides, with 711 birds observed during high tide of the March 2004 survey.
- Bird species diversity numbers varied by habitat throughout the monitoring period. Overall, the marsh plain, open water and upland habitats had the most diverse avian use in the park.
- Total bird species diversity has increased each year of the survey season. The monitoring suvey with the greatest number of bird species was February 2002, with 40 bird species.
- More birds were present during the October 12, 2004 high-tide survey than on any other survey. There were 968 birds present.

Standard: *Heron's Head Park will be used by both waterbirds and passerines for nesting, foraging, and roosting;*

The abundance of birds at Heron's Head Park over the 5-year monitoring period has increased. The highest number of birds observed during one survey was observed in October 2004 during low tide, when 968 birds were observed. This was primarily due to a large flock (900) of European starlings were present. Mew gulls were the most abundant species observed at one time during high tides for the 5-year monitoring period, with 711 birds observed during high tide of the March 2004 survey. Bird abundance by tide varied throughout the monitoring period (Figures 7-5 and 7-6). Abundance was higher in some years during high tide and higher in some years during low. This shift could be due to the stochastic, or random, presence of large flocks of passerines roosting during high tide or large flocks of waterbirds such as mew gulls roosting during low tide during a survey period.

Standard: *High species diversity will be present over the course of 1 year. Prior to project construction 78 bird species were identified at the site during 30 monitoring events conducted between February and December 1999 (Rush 1999). Using this as a baseline, achievement of the high species diversity goal will be determined by the presence of at least 78 species of birds.*

While the yearly bird species diversity increased from 2000-2002 (48 species, 52 species and 58 species, respectively), it remained stable in 2003 and 2004 at 52 and 51 species. The total number of species observed in all years is 70. This reduction in species diversity can be contributed in part to the infrequency of occurrences and numbers of some of the species observed, such as red flicker, loggerhead shrike, American robin, Bonaparte's gull and Eurasian wigeon (all observed in 2002) and not due to a decline in habitat quality or use of the park. Overall, it appears that the yearly species diversity is remaining constant.

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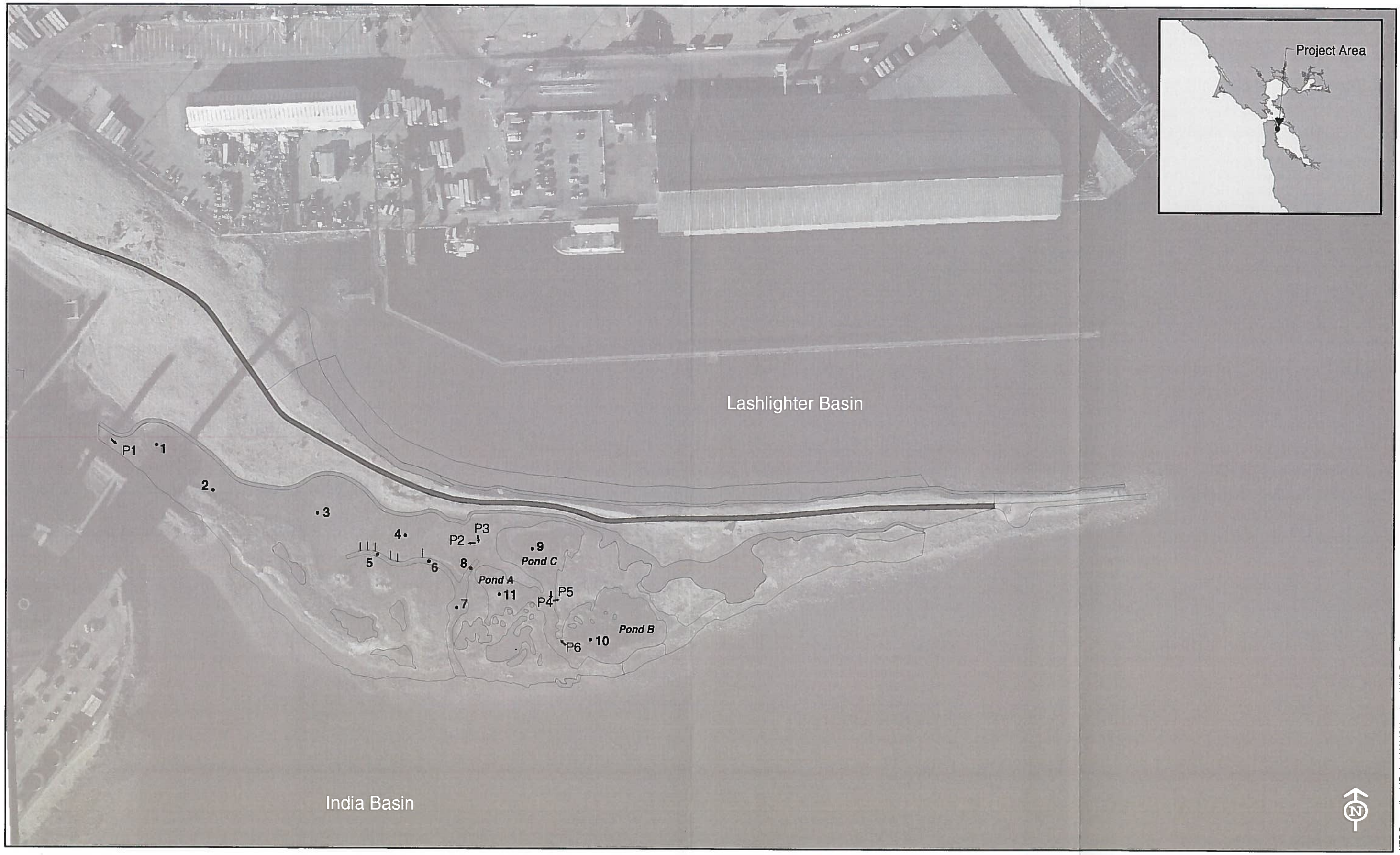
Figures



- Gage Station
- Tidal Channel Formation
- Photo Point

California State Plane Zone III Feet
Lambert Conformal Conic
NAD83
Imagery acquired December 20, 2004

URS

Heron's Head Park
San Francisco, CA

Project # 28065429

Site Locator Map

Figure 3-1

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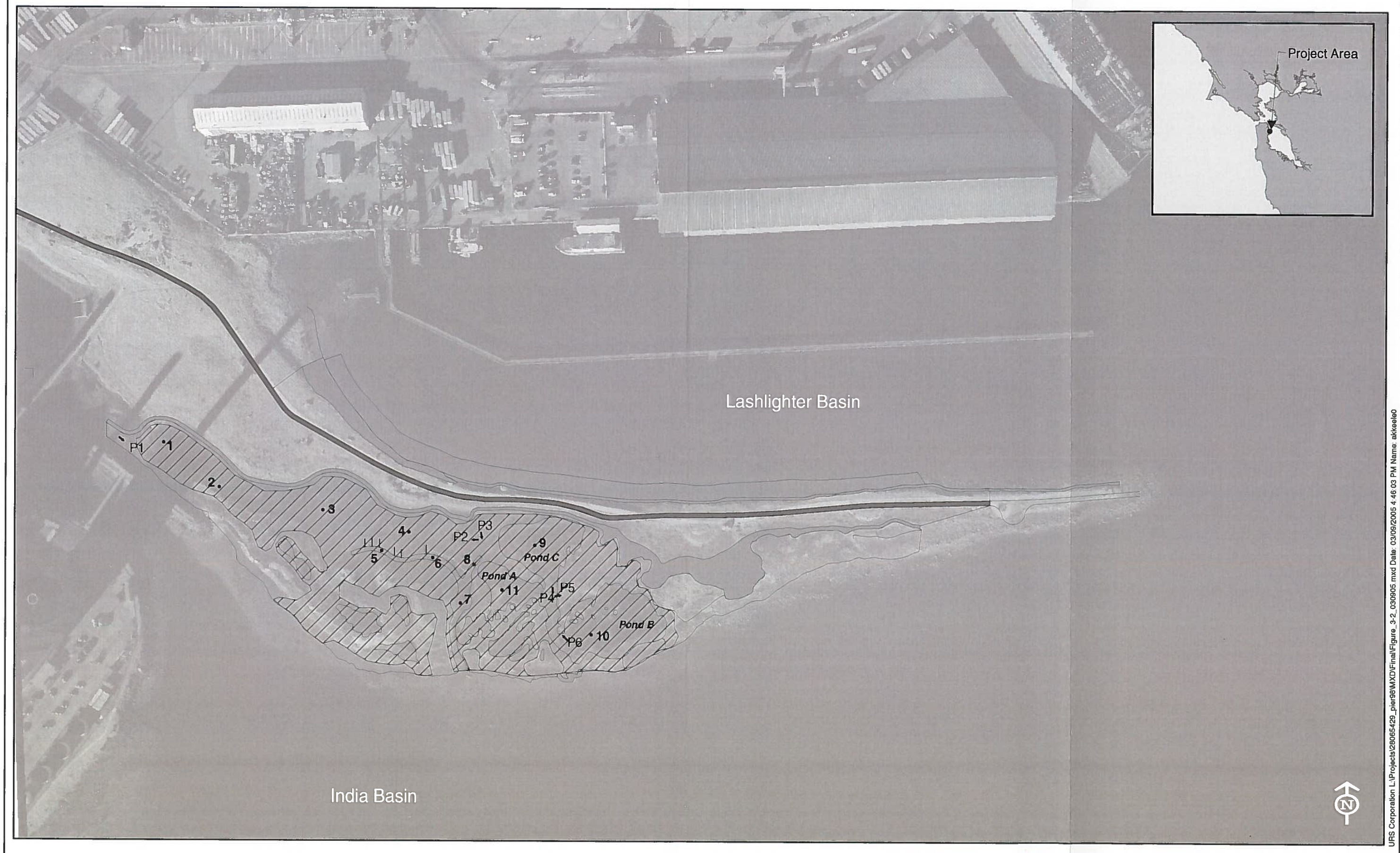

Extent of Ponding
Gage Station
Tidal Channel Formation
Photo Point

California State Plane Zone III Feet
Lambert Conformal Conic
NAD83
Imagery acquired December 20, 2004

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Heron's Head Park
San Francisco, CA

Project # 28065429

Extent of Ponding

Figure 3-2

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Figure 3-3. Tidal Inundation at Montioring Station 4 (Marsh Plain)

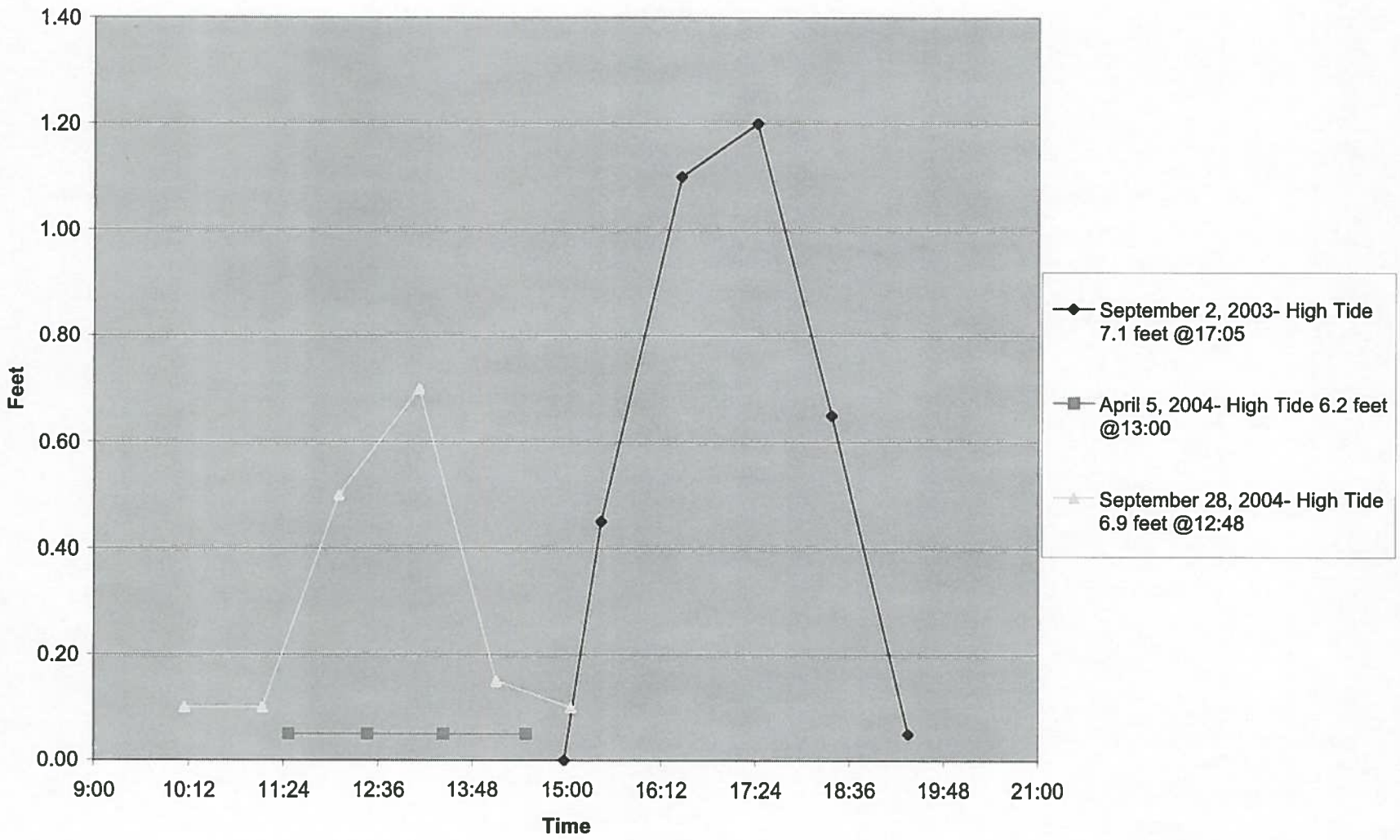


Figure 3-4. Tidal Inundation at Montioring Station 5 (Channel)

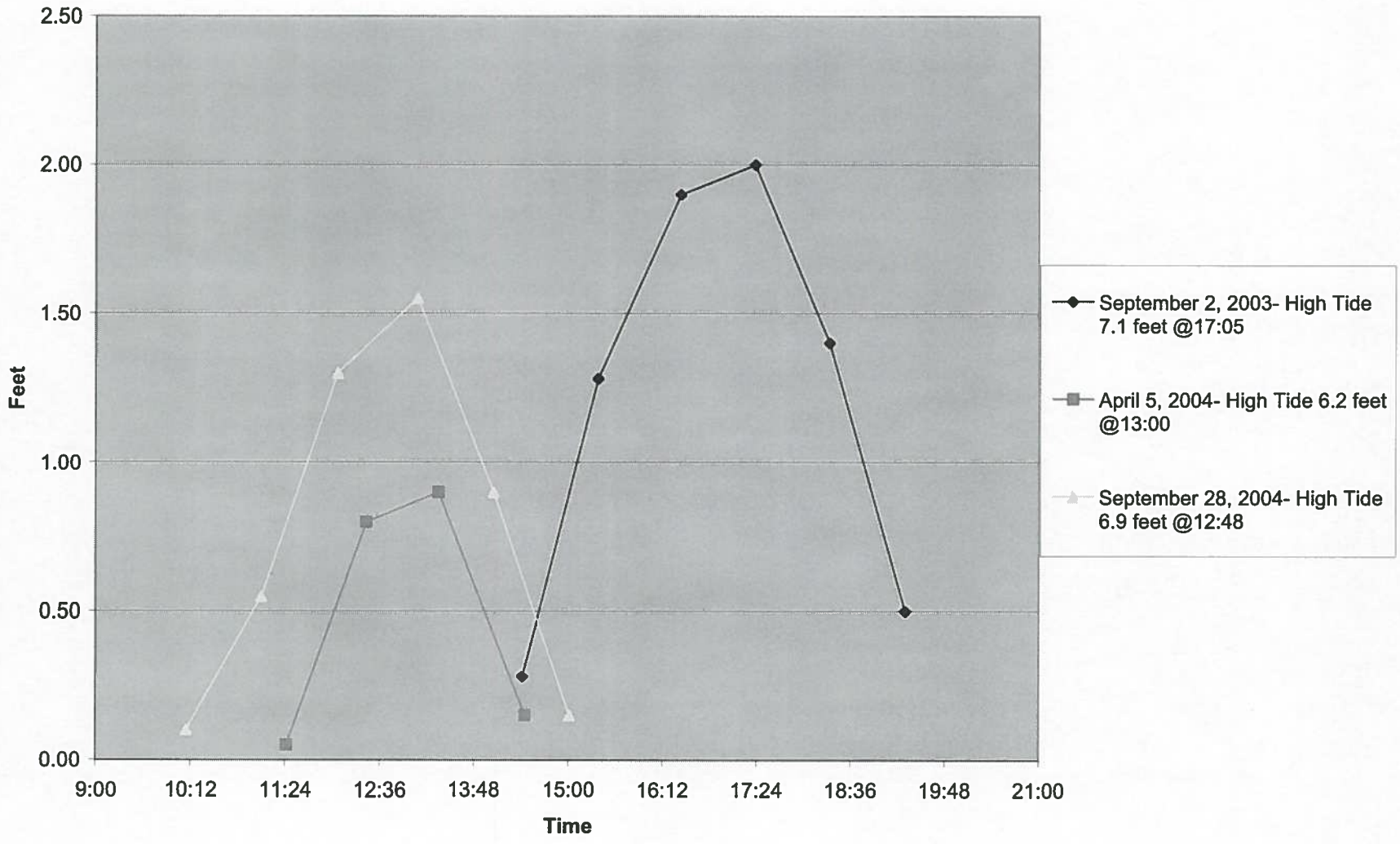


Figure 3-5. Tidal Inundation at Montioring Station 6 (Channel)

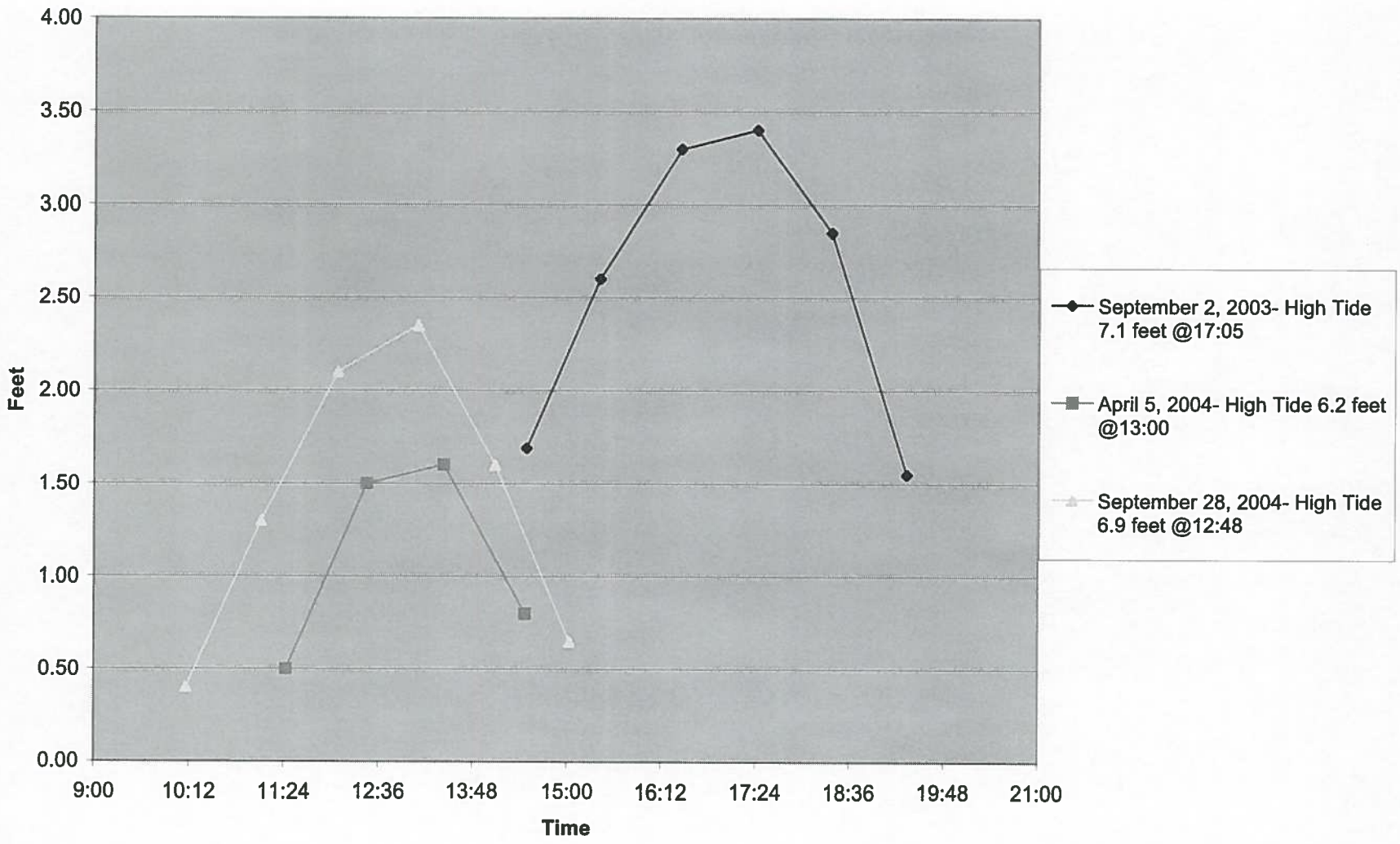


Figure 3-6. Tidal Inundation at Montioring Station 9 (Pond)

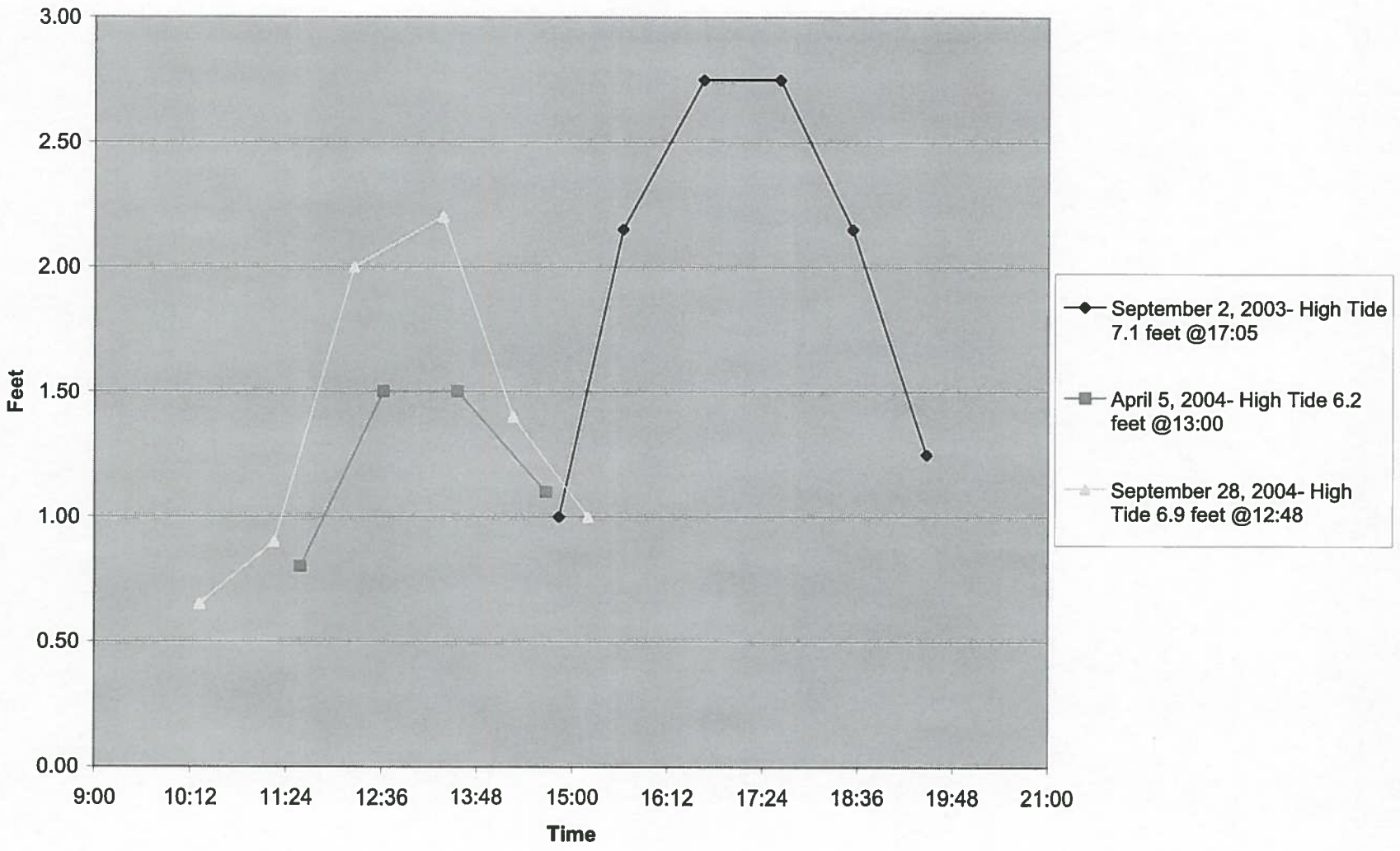
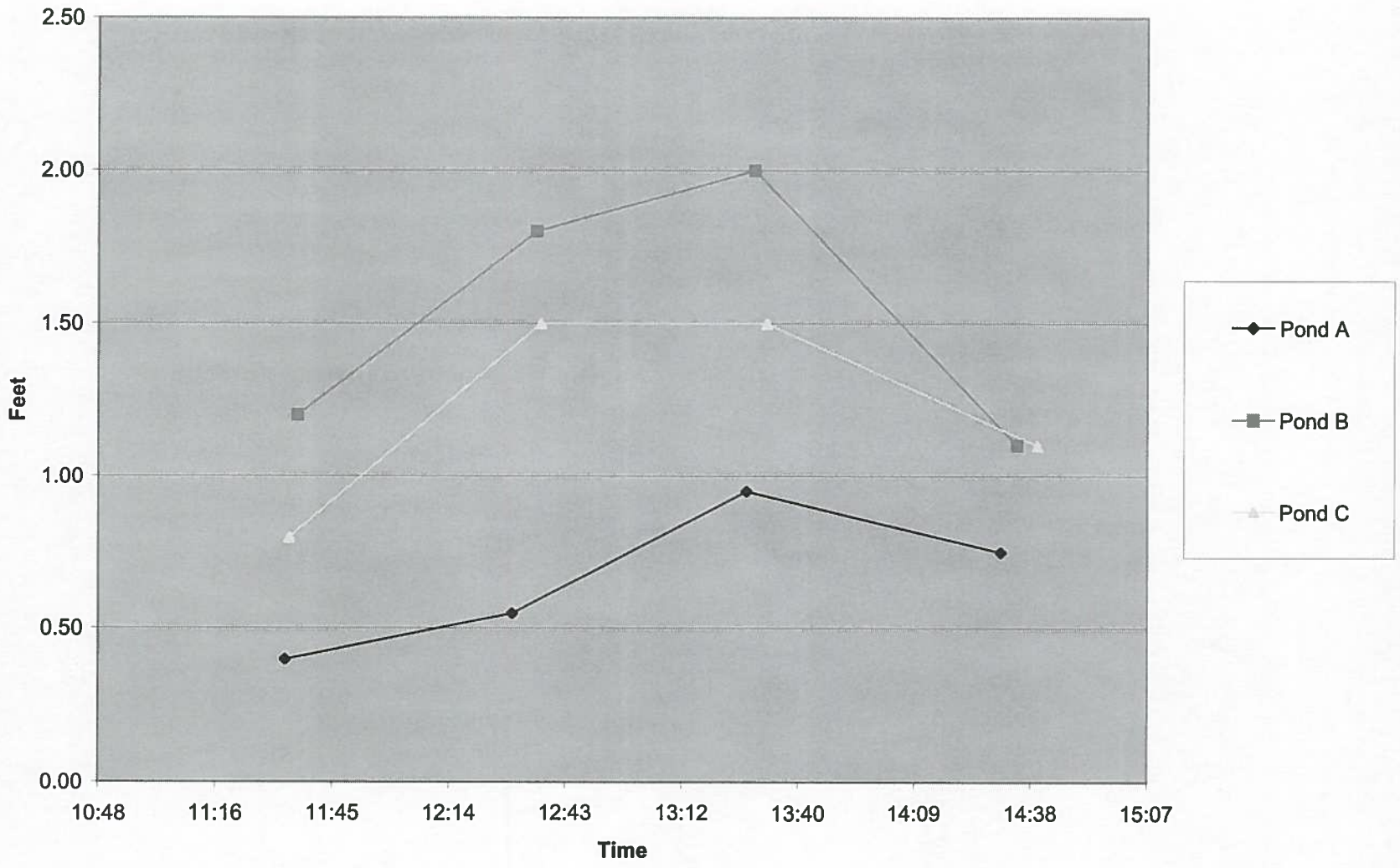
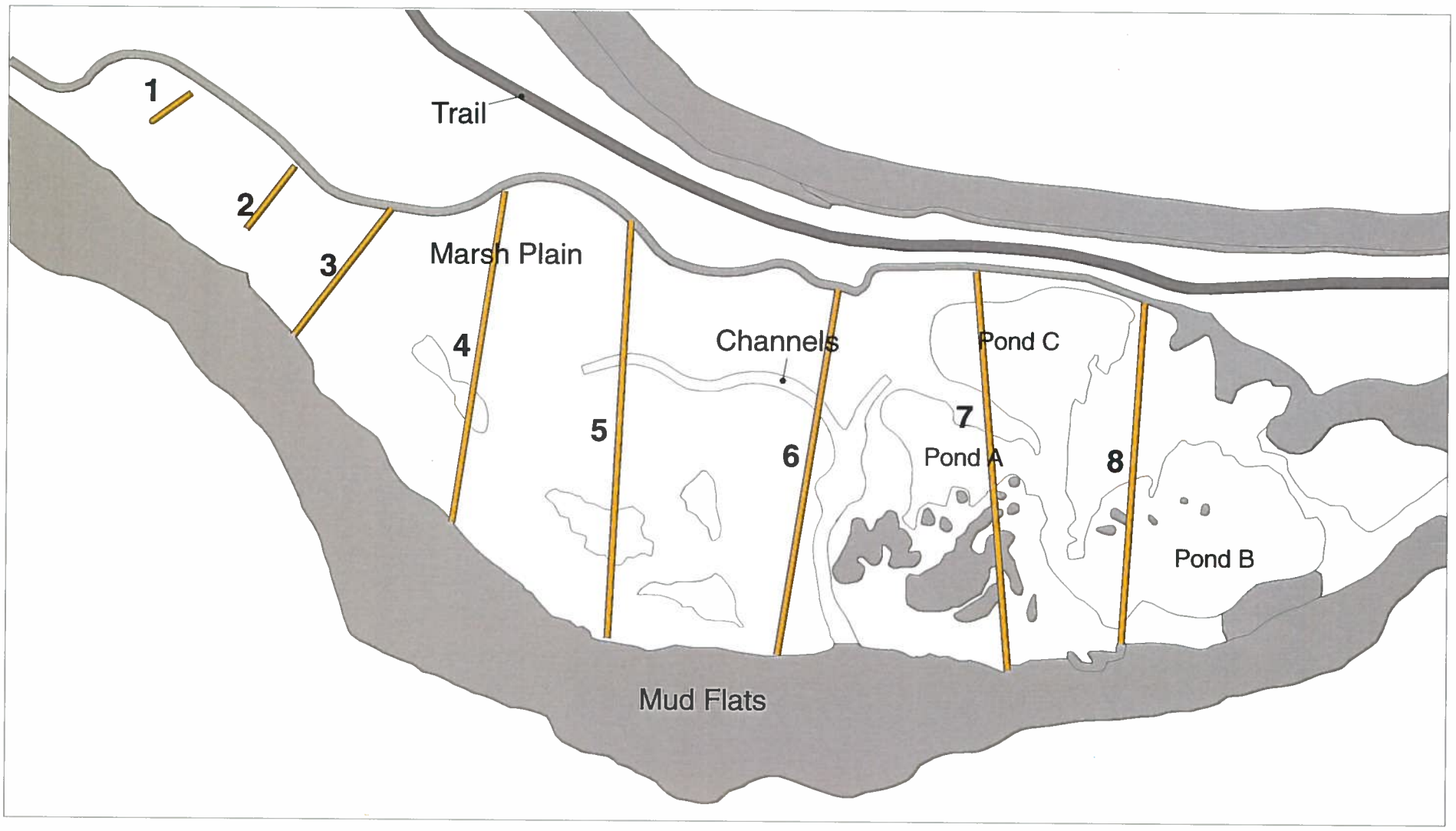


Figure 3-7. Tidal Inundation of Ponds during April 5, 2004 Monitoring





Vegetation Transects

100 50 0 100 Feet

N

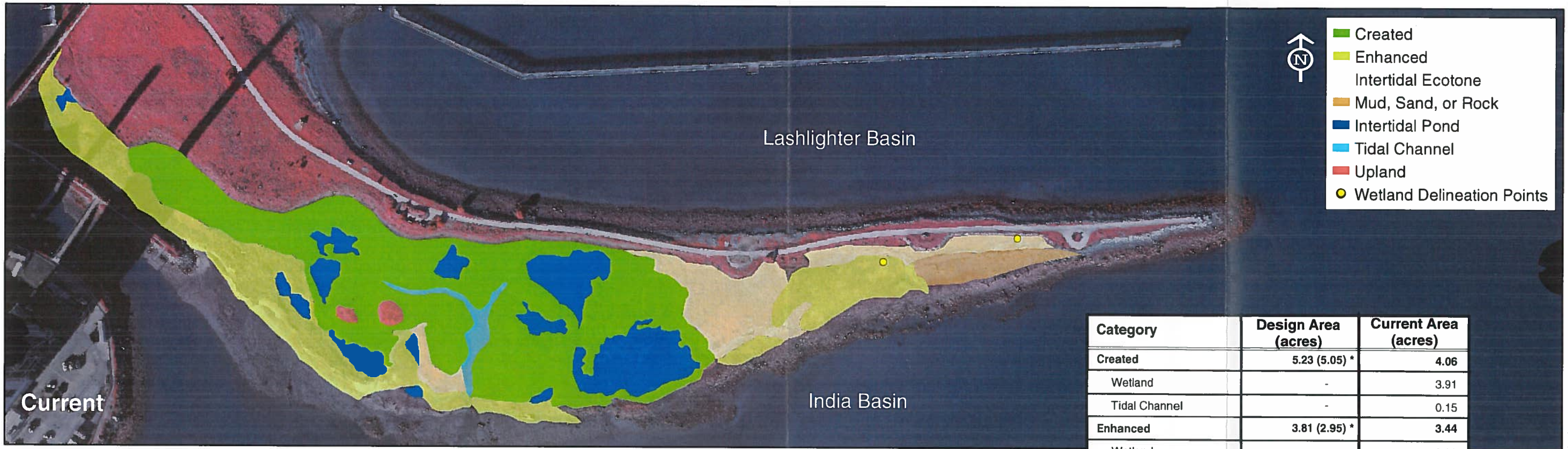
URS

Heron's Head Park
Annual Monitoring

Project No. 28065429

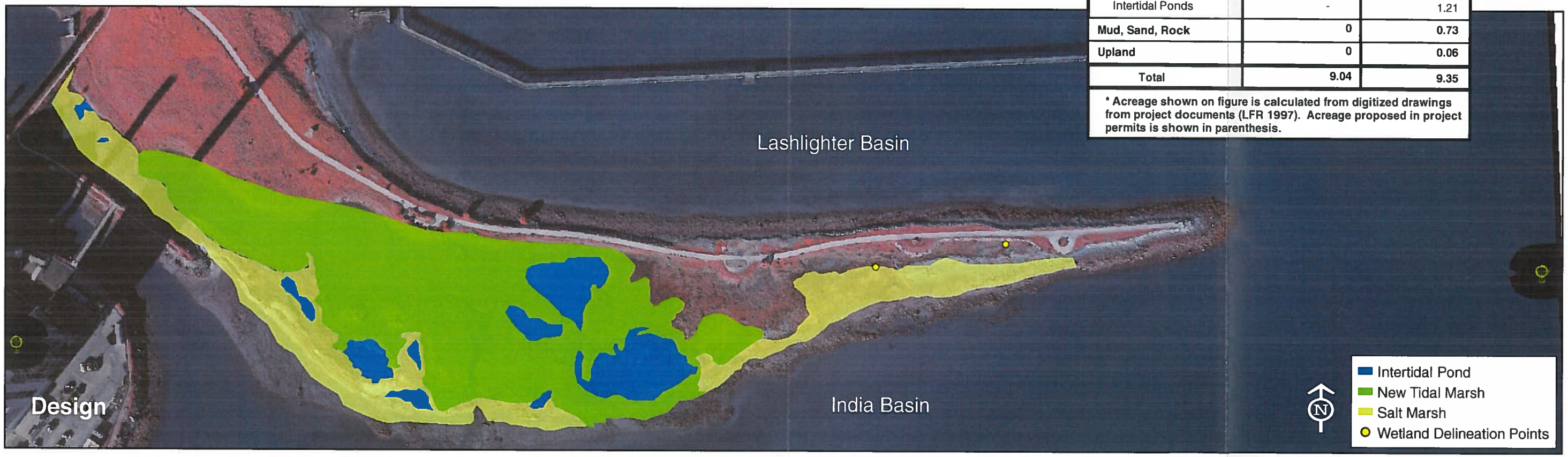
Vegetation Transect Locations

Figure
5-1



Category	Design Area (acres)	Current Area (acres)
Created	**5.23 (5.05) ***	**4.06**
Wetland	-	3.91
Tidal Channel	-	0.15
Enhanced	**3.81 (2.95) ***	**3.44**
Wetland	-	2.23
Intertidal Ponds	-	1.21
Mud, Sand, Rock	**0**	**0.73**
Upland	**0**	**0.06**
Total	**9.04**	**9.35**

*** Acreage shown on figure is calculated from digitized drawings from project documents (LFR 1997). Acreage proposed in project permits is shown in parenthesis.**



California State Plane Zone III Feet
Lambert Conformal Conic
NAD83
Imagery acquired December 20, 2004

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Heron's Head Park
San Francisco, CA

Project # 28065429

Wetland_Acreages

Figure 6-1

Figure 7-1 Average Number of Birds per Survey by Habitat

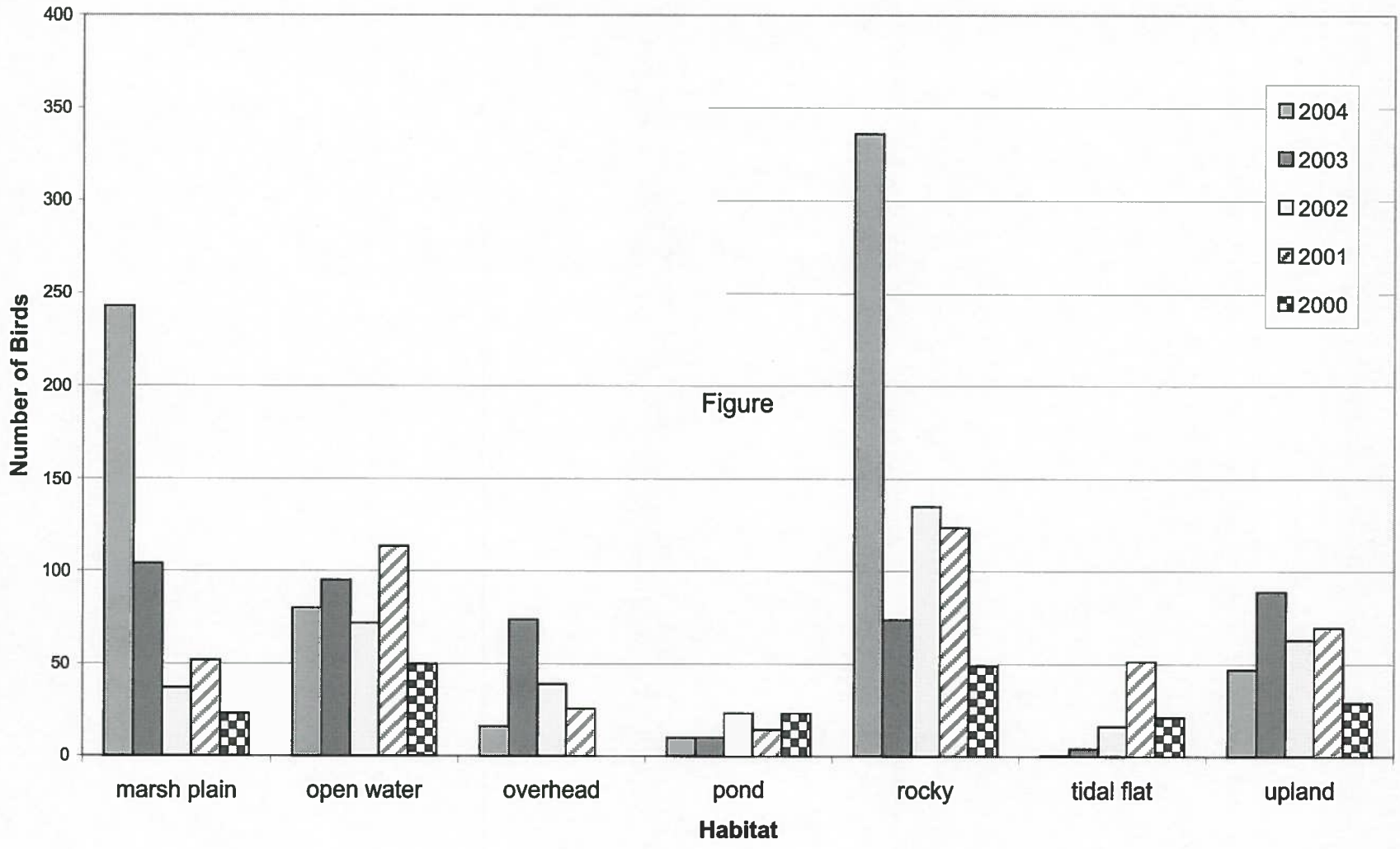

Figure 7-2. Number of Species per Habitat

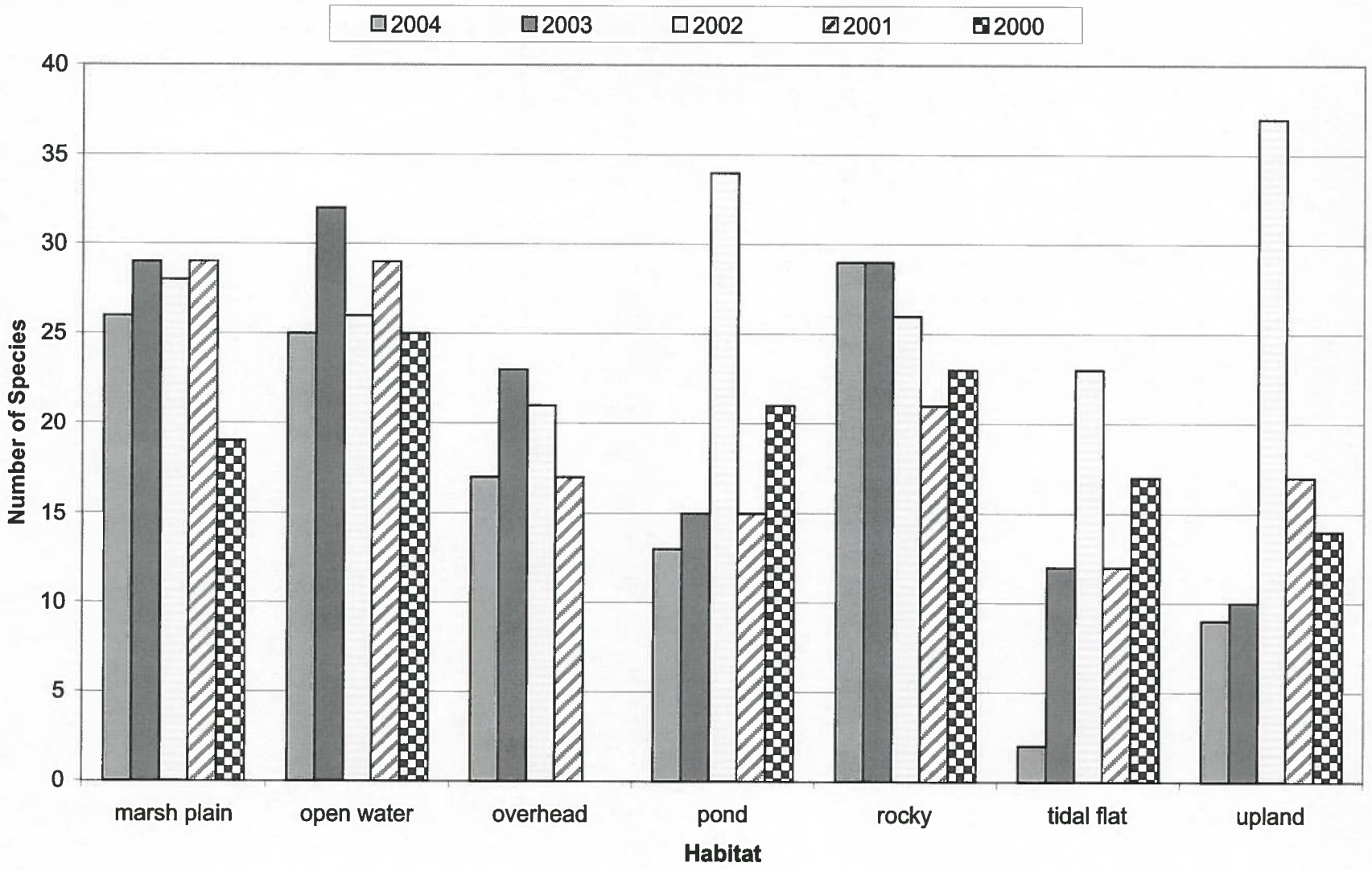

Figure 7-3. Number of Species per Month at High Tide

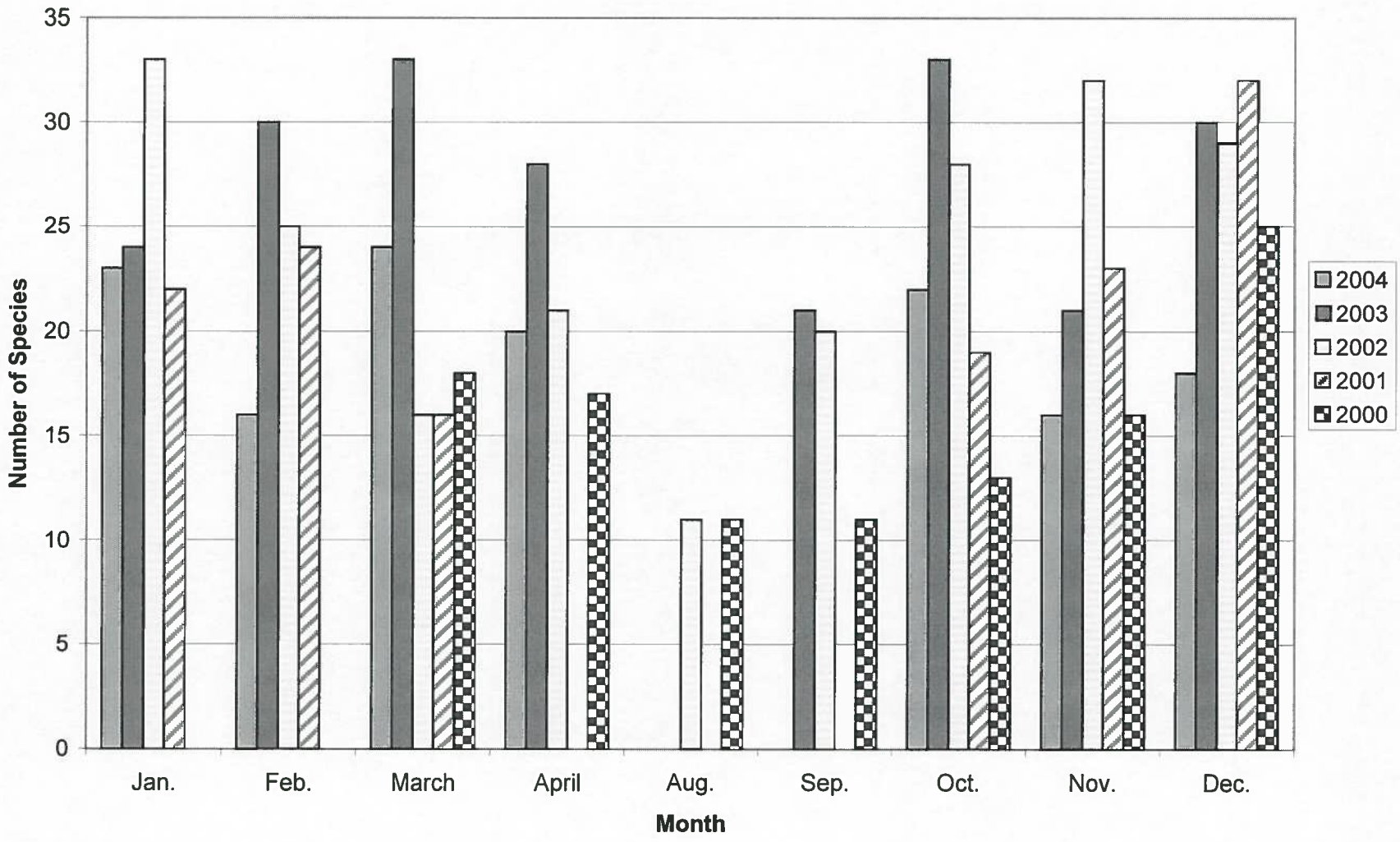

Figure 7-4. Number of Species per Month at Low Tide

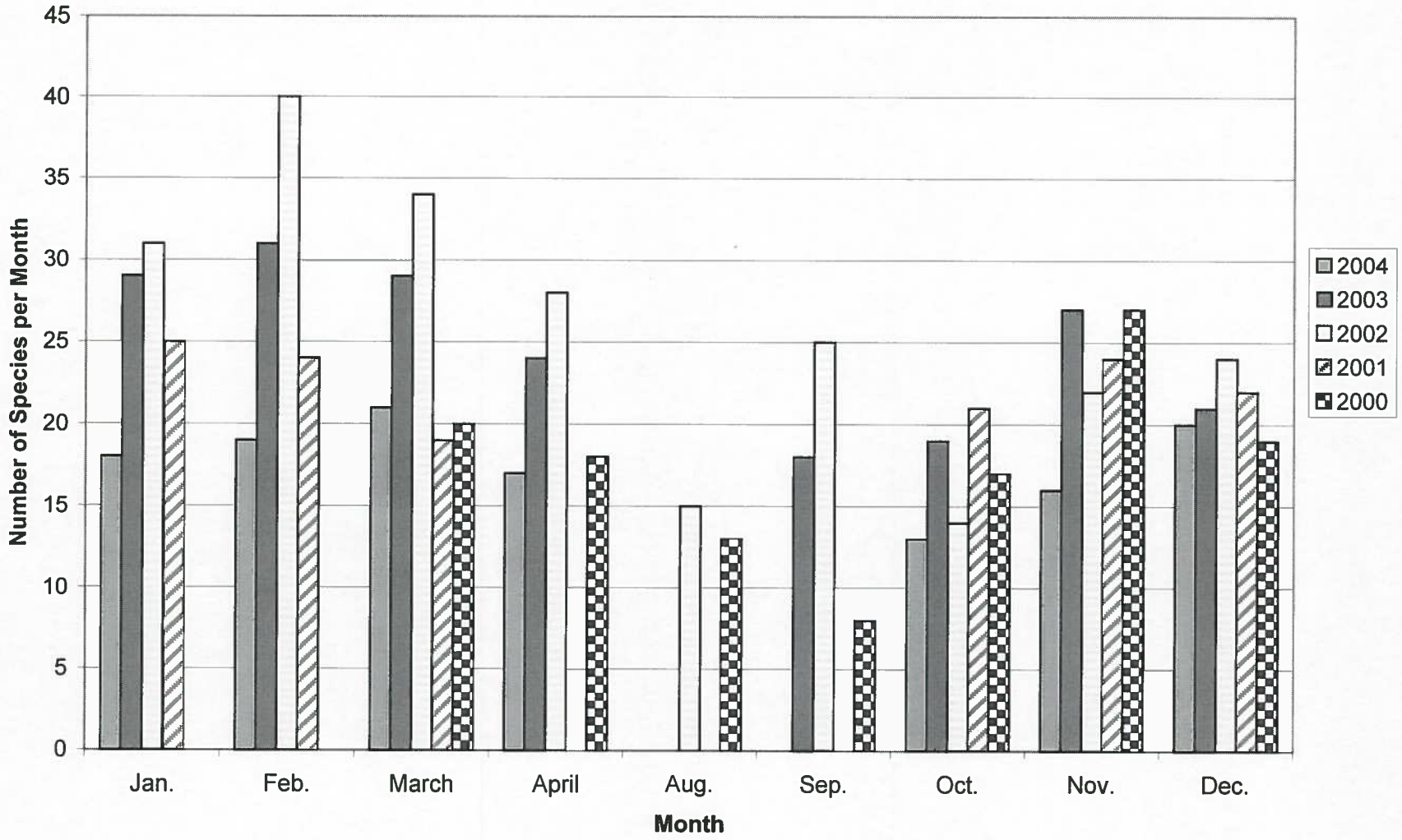

Figure 7-5. Abundance of Birds per Month at High Tide

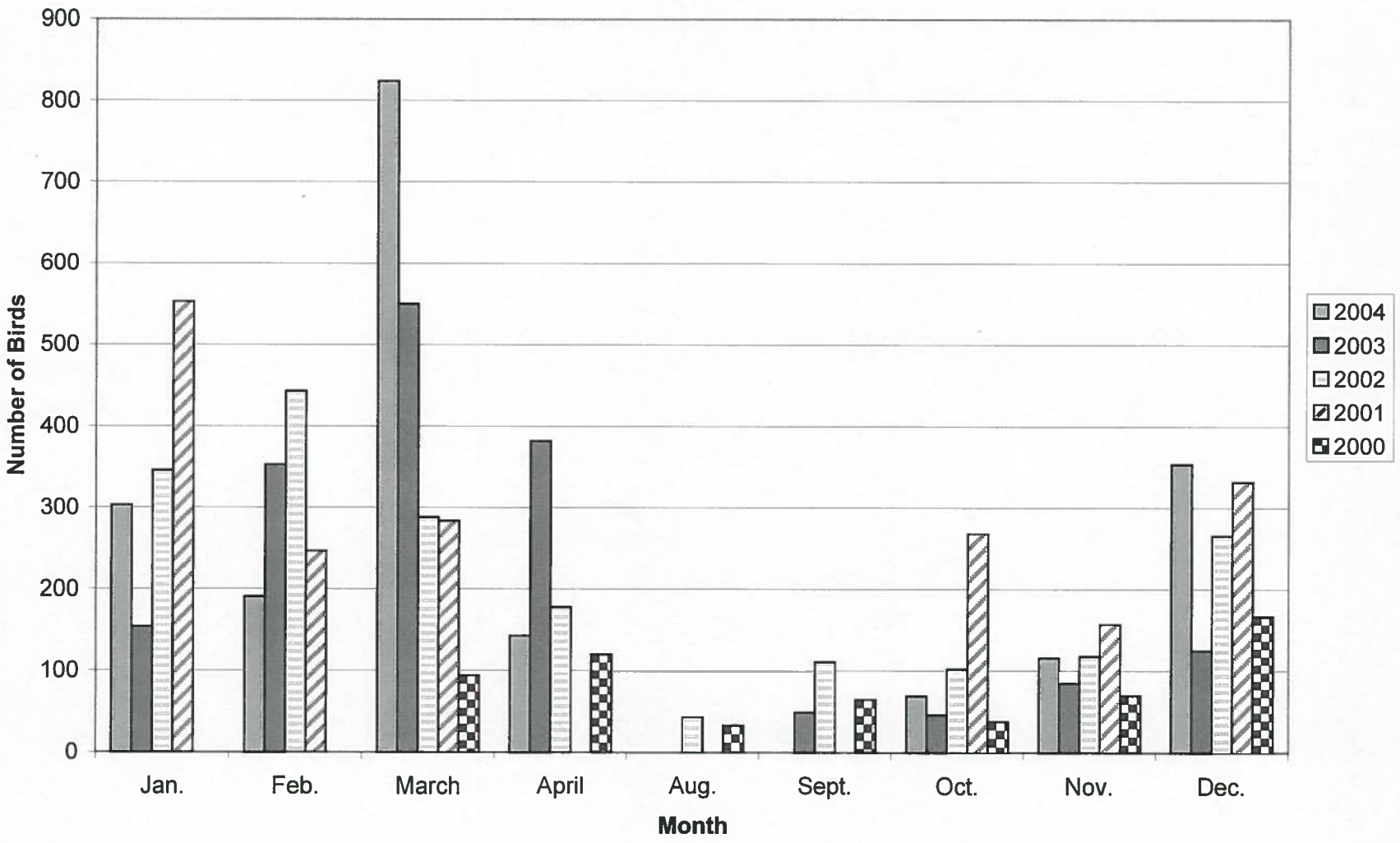

Figure 7-6. Abundance of Birds per Month at Low Tide

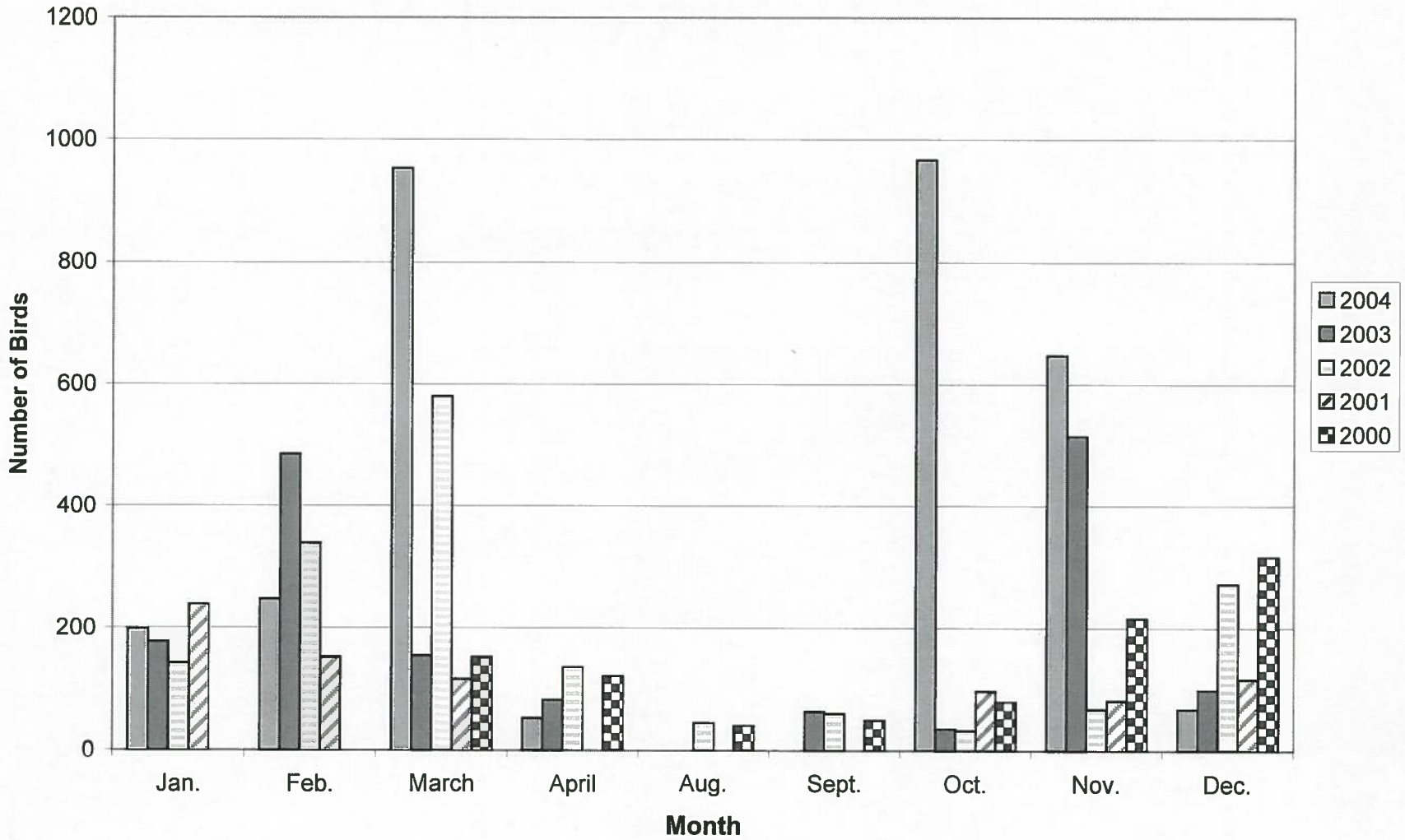

Photo 1. Marsh plain at low tide from photo point 2, September 9, 2002.

Photo 2. Marsh plain at low tide from photo point 2, September 28, 2004.

Photo 3. Tidal channel at low tide from photo point 3, September 9, 2002.

Photo 4. Tidal channel at low tide from photo point 3, September 28, 2004.

Photo 5. Marsh plain at low tide from photo point 1, April 5, 2004.

Photo 6. Intertidal pond and marsh plain at low tide from photo point 4, April 5, 2004.

Appendix B
Wetland Delineation Forms

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Herons Head Park
Applicant/Owner: Port of San Francisco
Investigator: F. Demgen, K. Fisher

Date: 2/2/5
County: San Francisco
State: CA

Do Normal Circumstances exist on the site? (Yes) No
Is the site significantly disturbed (Atypical Situation)? (Yes) No
Is the area a potential Problem Area? Yes (No)
(If needed, explain on reverse.)

Community ID: _____
Transect ID: _____
Plot ID: #1

VEGETATION

Dominant Plant Species	Stratum	Indicator
1. Plantago ~10	Herbaceous	FAC
2. Grindelia		FACW
3. Medicago ~2%		FAC
4. Lolium		FAC*
5.		
6.		
7.		
8.		

Dominant Plant Species	Stratum	Indicator
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). _____

Remarks: ~40% plant cover

HYDROLOGY

___ Recorded Data (Describe in Remarks):
___ Stream, Lake, or Tide Gauge
___ Aerial Photographs
___ Other
___ No Recorded Data Available

Field Observations:

Depth of Surface Water: _____(in.)

Depth to Free Water in Pit: _____(in.)

Depth to Saturated Soil: _____(in.)

Wetland Hydrology Indicators:
Primary Indicators:
___ Inundated
___ Saturated in Upper 12 Inches
___ Water Marks
X Drift Lines — Site is below EHW but above OHW
___ Sediment Deposits
___ Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
___ Oxidized Root Channels in Upper 12 Inches
___ Water-Stained Leaves
___ Local Soil Survey Data
___ FAC-Neutral Test
___ Other (Explain in Remarks)

Remarks:

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Herons Head Park
Applicant/Owner: Port of San Francisco
Investigator: F. Dengler, K. Fraser

Date: 2/2/05
County: SF
State: CA

Do Normal Circumstances exist on the site? (Yes) No
Is the site significantly disturbed (Atypical Situation)? (Yes) No
Is the area a potential Problem Area? Yes (No)
(If needed, explain on reverse.)

Community ID:
Transect ID:
Plot ID: ~~1~~ 2

VEGETATION

Dominant Plant Species	Stratum	Indicator
1. Salicornia virginica		OBL
2. Jaumea carnosa		OBL
3.		
4.		
5.		
6.		
7.		
8.		

Dominant Plant Species	Stratum	Indicator
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-). 100 %

Remarks:

HYDROLOGY

✓ Recorded Data (Describe in Remarks):
- ___ Stream, Lake, or Tide Gauge
- ___ Aerial Photographs
- ___ Other

___ No Recorded Data Available

Field Observations:

Depth of Surface Water: ND (in.)

Depth to Free Water in Pit: ND (in.)

Depth to Saturated Soil: 0" (in.)

Wetland Hydrology Indicators:
Primary Indicators:
- ✓ Inundated
- ✓ Saturated in Upper 12 Inches
- ___ Water Marks
- ___ Drift Lines
- ✓ Sediment Deposits
- ___ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- ___ Oxidized Root Channels in Upper 12 Inches
- ___ Water-Stained Leaves
- ___ Local Soil Survey Data
- ___ FAC-Neutral Test
- ___ Other (Explain in Remarks)

Remarks:

Appendix C

Bird Species Abundance 2000-2003

Most Abundant Species in 2000

Species	Low Tide Numbers	Species	High Tide Numbers
gull sp. *Larus* sp.	102	least sandpiper *Calidris minutilla*	108
mew gull *Larus canus*	83	scaup sp. *Aythya* sp.	53
sandpiper sp. *Calidris* sp.	66	Brewer's blackbird *Euphagus cyanocephalus*	50
scaup sp. *Aythya* sp.	61	double-crested cormorant *Phalacrocorax auritus*	48
American wigeon *Anas americana*	45	American wigeon *Anas americana*	44
California gull *Larus californicus*	42	Forster's tern *Sterna forsteri*	34
dowitcher sp. *Limnodromus sp.*	37	dunlin *Calidris alpina*	32
least sandpiper *Calidris minutilla*	36	savannah sparrow *Passerculus sandwichensis*	27
western gull *Larus occidentalis*	27	American avocet *Recurvirostra americana*	24
double-crested cormorant *Phalacrocorax auritus*	25	white crowned sparrow *Zonotrichia leucophrys*	24

Most Abundant Species per Survey in 2000

Date	Species	Low Tide Numbers	Date	Species	High Tide Numbers
3/30	American widgeon *Anas americana*	31	3/30	scaup *Aythya* sp.	15
4/21	dowitcher sp. *Limnodromus* sp.	37	4/21	scaup *Aythya* sp.	38
8/15	double-crested cormorant *Phalacrocorax auritus*	10	8/15	least sandpiper *Calidris minutilla*	10
9/21	least sandpiper *Calidris minutilla*	14	9/21	least sandpiper *Calidris minutilla*	36
11/01	least sandpiper *Calidris minutilla*	8	11/01	least sandpiper *Calidris minutilla*	21
11/30	mew gull *Larus canus*	33	11/30	double-crested cormorant *Phalacrocorax auritus*	41
12/20	gull sp. *Larus* sp.	100	12/20	Brewer's blackbird *Euphagus cyanocephalus*	23

Most Abundant Species in 2001

Species	Low Tide Numbers	Species	High Tide Numbers
Scaup *Aythya* sp.	125	Mew gull *Larus canus*	449
Least sandpiper *Calidris minutilla*	103	Least sandpiper *Calidris minutilla*	409
Mew gull *Larus canus*	71	Scaup *Aythya* sp.	183
Western meadowlark *Sturnella neglecta*	65	European starling *Sturnus vulgaris*	162
Western gull *Larus occidentalis*	54	Dunlin *Calidris alpina*	86
Brewer's blackbird *Euphagus cyanocephalus*	48	Brewer's blackbird *Euphagus cyanocephalus*	64
Double-crested cormorant *Phalacrocorax auritus*	42	Western meadowlark *Sturnella neglecta*	53
American wigeon *Anas americana*	35	American wigeon *Anas americana*	50
Snowy egret *Egretta thula*	31	Sandpiper sp. *Calidris* sp.	44
Bufflehead *Bucephala clangula*	29	Bufflehead *Bucephala clangula*	33

Most Abundant Species per Survey in 2001

Date	Species	Low Tide Numbers	Date	Species	High Tide Numbers
1/29	mew gull *Larus canus*	58	1/29	mew gull *Larus canus*	334
2/26	scaup *Aythya* sp.	43	2/26	mew gull *Larus canus*	57
3/29	scaup *Aythya* sp.	44	3/29	European starling *Sturnus vulgaris*	80
10/22	Sandpiper sp. *Calidris* sp.	14	10/22	least sandpiper *Calidris minutilla*	205
11/20	savannah sparrow *Passerculus sandwichensis*	15	11/20	least sandpiper *Calidris minutilla*	72
12/12	least sandpiper *Calidris minutilla*	40	12/12	least sandpiper *Calidris minutilla*	80

Most Abundant Species in 2002

Species	Low Tide Numbers	Species	High Tide Numbers
mew gull *Larus canus*	311	mew gull *Larus canus*	296
scaup *Aythya* sp.	157	scaup *Aythya* sp.	231
sandpiper sp. *Calidris* sp.	141	sandpiper sp. *Calidris* sp.	181
American wigeon *Anas americana*	103	Brewer's blackbird *Euphagus cyanocephalus*	159
Bonaparte's gull *Larus philadelphia*	82	European starling *Sturnus vulgaris*	144
California gull *Larus californicus*	82	dunlin *Calidris alpina*	109
European starling *Sturnus vulgaris*	63	least sandpiper *Calidris minutilla*	88
least sandpiper *Calidris minutilla*	61	American wigeon *Anas americana*	60
western meadowlark *Sturnella neglecta*	61	American avocet *Recurvirostra americana*	45
American avocet *Recurvirostra americana*	41	ruddy duck *Oxyura jamaicensis*	44

Most Abundant Species per Survey in 2002

Date	Species	Low Tide Numbers	Date	Species	High Tide Numbers
1/16	American wigeon *Anas americana*	22	1/16	mew gull	130
2/14	mew gull *Larus canus*	57	2/14	sandpiper sp. *Calidris* sp.	150
3/18	mew gull *Larus canus*	254	3/18	European starling *Sturnus vulgaris*	82
4/15	European starling *Sturnus vulgaris*	40	4/15	European starling *Sturnus vulgaris*	58
8/22	western gull *Larus occidentalis*	12	8/22	least sandpiper *Calidris minutilla*	10
9/24	black-bellied plover *Pluvialis squatarola*	7	9/24	Brewer's blackbird *Euphagus cyanocephalus*	50
10/22	western meadowlark *Sturnella neglecta*	6	10/22	sandpiper sp. *Calidris* sp.	26
11/15	scaup *Aythya* sp.	15	11/15	Brewer's blackbird *Euphagus cyanocephalus*	18
12/12	Bonaparte's gull *Larus philadelphia*	82	12/12	Bonaparte's gull *Larus philadelphia*	74

Most Abundant Species in 2003

Species	Low Tide Numbers	Species	High Tide Numbers
Brewer's blackbird *Euphagus cyanocephalus*	400	sandpiper sp. *Calidris* sp.	306
European starling *Sturnus vulgaris*	293	mew gull *Larus canus*	230
mew gull *Larus canus*	120	scaup *Aythya* sp.	189
American avocet (*Recurvirostra americana)*, scaup (*Aythya* sp.), western meadowlark (*Sturnella neglecta)*	72	American wigeon *Anas americana*	89
American wigeon *Anas americana*	67	least sandpiper *Calidris minutilla*	78
ruddy duck *Oxyura jamaicensis*	57	Bonaparte's gull *Larus philadelphia*	57
western gull *Larus occidentalis*	52	American avocet *Recurvirostra americana*	49
bufflehead *Bucephala albeola*	28	ruddy duck *Oxyura jamaicensis*	43
Bonaparte's gull *Larus philadelphia*	27	dunlin *Calidris alpina*	37
least sandpiper *Calidris minutilla.*	26	bufflehead *Bucephala albeola*	31