Section 7 BIG CANYON: SOIL ANALYSIS & RECOMMENDATIONS

1.0 INTRODUCTION

The investigation of the soil substrate can provide clues to previous historic conditions and to what drives the present plant communities in Big Canyon. Using soil profile descriptions and historic tidal maps dating from the 1800s, restoration actions for Big Canyon were formulated that tie into historic wetland conditions.

2.0 METHODS

Soil profile descriptions were examined in 6 keys areas throughout Big Canyon (see end of section for definitions). Soils were extracted using a 6-inch bucket auger and the profiles were placed in vertical position on the soil surface for examination. Soil color, texture, and horizon development were recorded, as well as other noted physical or chemical properties such as mottling or reducing conditions. Grab samples of the extracted soils were collected for laboratory analysis at one or two depths for each soil. Laboratory analysis included cation exchange capacity (CEC), base saturation, soil texture, soil organic matter analyzed by combustion, nitrate-nitrogen, total nitrogen, total carbon, carbon to nitrogen ratio, sodium adsorption ratio (SAR) and the standard agriculture suitability analysis which included pH, and an array of macro- and micronutrients.

3.0 RESULTS AND CONCLUSIONS

3.1 Tidal Area – Soil Samples # 1 and #2

3.1.1 Soil Sample Location

Soils were collected from west of Back Bay drive, adjacent to the Arizona crossing pond outfall from within the barren area where fill was once placed see Figure 7.1). Vegetation was sparse, dominated by ruderal vegetation. The soil profile was described to 5+ feet below the surface, and soil samples were collected at 18 inches and 5 feet below the surface for laboratory analysis.

3.1.2 Mapped Soil Description

The 1978 Natural Resources Conservation Service (NRCS) soil survey identifies this sampling area as "Beaches". This soil is not identified by a specific soil series, and therefore does not have a taxonomic classification. "Beaches" soil is described as "sandy, gravelly, or cobbly coastal shores that are washed and rewashed by tidal and wave action" (NRCS, 1978). This soil is a young, poorly developed soil, most likely falling in the Entisol soil order. Entisols are soils that "have little or no evidence of development of pedogentic horizons" (Soil Survey Staff 1975) and are typically simple soils with limited horizonation and are featureless in their soil profile development (Buol et al., 1989).

3.1.3 Results and Conclusions

The soil profile was examined to 5 feet in depth. The top 4 feet of the profile was a light colored gravelly sand. At 4 feet below the surface a 6-inch layer of pure gravel was encountered that was gleyed in color. The gley color, as described in the Munsell Soil Color Chart, indicates that the water table sits for a long duration at this elevation. The gravel layer as well as the gravelly sand surface is fill material. Below 4.5 feet, the soil texture changed to a sandy loam, and was also gleyed in color.

The laboratory analysis of the soil surface layer showed low nutrients levels, low salts, but a relatively high pH (8.82). The subsurface layer revealed a high salt content (Na^{+}, Ca^{2+}, Mg^{2+}) as well as an extremely high Sodium Adsorption Ration (SAR), which was recorded at 30.4. Salts in this layer were highest of all soil samples collected. Total carbon was comparable to other native soils. All other nutrient tests were within a similar range of the other soils collected within the project boundaries.

Several inferences and conclusions can be drawn from the profile description and the laboratory analysis. The change in soil color from a light brown to a gleyed color indicates that the water table is relatively stable at 4 feet below the surface of where the soil was described. The fill material had both physical and chemical characteristics, which differentiated it from the deeper layers. It can be inferred that the native soil lies at 4.5 feet.

The high salts, SAR, and relative organic matter content are indicative of salt or brackish water marsh soils. Some movement of sodium and other salts may have occurred down the profile, due to the sandy substrate of the fill material. The high SAR is probably a combination of salt within the water solution from Upper Newport Bay and translocation of salts down the profile. From the information collected, in addition to the "Beaches" mapped soil, it can be concluded with confidence that this area was once tidal.

3.1.4 Recommendations

The removal of the fill material would result in the exposure of the native soil. Due to the high salt levels represented by a SAR of greater than 30, plant establishment may be difficult due to both chemical and physical properties of the soil. Typically, plant growth becomes very limited above a SAR of 20. Excessive sodium levels can also lead to a "clogging" of soil pores resulting in physical changes to the soil, ultimately prohibiting water movement down the profile. When sodium dominates the soil profile, it is recommended that sodium levels be reduced and replaced by calcium or hydrogen ions. Most simply, calcium in the form of gypsum can be incorporated into the soil and the profile can be leached, effectively replacing the sodium with calcium ions.

3.2 Upland Fill Area – Samples #3 and #4

3.2.1 Soil Sample Location

Soils were collected from adjacent to the utility road, to the south of the pond in the area where fill had been placed some time in the past. Vegetation was sparse, occupied by both native and non-native forbs and grasses. The soil profile was described to 10.5+ feet below the surface, and soil samples were collected at 6 and 10.5 feet below the surface for laboratory analysis.

3.2.2 Mapped Soil Description

The 1978 NRCS soil survey identifies this sampling area as the Anaheim clay loam series. This series has been overlaid by fill material. The native Anaheim clay loam is in the Mollisol soil order. The taxonomic classification (Pachic Haploxerolls) describes the soil as moderately deep, extending 20 to 54 inches below the surface before reaching bedrock. Soils are well drained, weathered from soft sandstone or shale, have a dark surface horizon and typically contain sage scrub and oak vegetation, with an understory of annual grasses (NRCS, 1978).

3.2.3 Results and Conclusions

The soil profile was described to 10.5 feet below the surface. The top 5 feet of the surface is a pale brown sandy soil that contains limited yellowish red mottles. At approximately 5 feet, the soil color turns to very dark gray, indicating that the water table sits at this depth sufficient to form anaerobic or reducing conditions. Soil texture at this point also changes to a sandy clay loam. Yellowish red mottles are prevalent in the profile at this depth. Below 6 feet, the soil texture changes to clay, and the soil color is slightly yellowish gray. The native Anaheim soil has a dark surface horizon, and but fill was placed over the native soil some time in the past. The fill is believed to extend 6-8 feet below the surface. The native Anaheim soil is described as having a dark surface horizon. A darkening of the soil color is encountered at 5-6 feet in depth, however a change in soil texture from sandy clay loam to clay could indicate the native soil begins around 8 feet in depth. Soil color ranges from dark gray to black below 6 feet. At 8 feet a black clay lense is found. Soil is gley in color from 8 feet to below the maximum depth taken.

At 6 feet below the surface, where the first soil sample was collected, soils are high in salt, as reflected by the SAR of 12.9. Elemental P, K, and Fe were also high, but organic matter was on the low scale. The soil sample collected at 10.5 feet had a lower salt levels as well as a SAR of 8.8. The organic matter content of the soil was also higher at 3.3 %.

The salt content of the soil samples indicates that both the fill and the corresponding subsurface material were influenced by sodium, calcium, and magnesium prevalent in the soil and water solution. The fill material may have been dredge material taken from within the bay. The high SAR depicts that sodium has an overriding influence in the soil, and thus it can be inferred that this fill may have been material used to create the freshwater pond. The pond soil would have been influenced by tidal action (see sample #5 description below), thus

SOIL SAMPLING LOCATIONS

accounting for the high salt content. For restoration purposes, the soil at both 6 and 10.5 feet could support brackish marsh where the water table is sufficiently high, or saltbush scrub if uplands are restored. Nutrient content of the soil reflects the range of variability encountered throughout the site.

3.2.4 Recommendations

The removal of the fill material would result in the exposure of the native soil. As mentioned above, the high SAR ratio could be a limiting factor in plant establishment and soil structure. Further soil sampling for salinity should be conducted once the area has been restored.

3.3 Pond – Sample #5

3.3.1 Soil Sample Location

Soils were collected on the south side at the edge of the pond. Standing water was approximately 2-3 inches above the soil surface. Dominant vegetation was cattail (*Typha* sp.) and bulrush (*Scirpus* sp.). The soil profile was described to 12 inches below the surface. One soil sample was collected at 12 inches.

3.3.2 Mapped Soil Description

The 1978 NRCS soil survey identifies this sampling area as "Beaches". The soil survey was most likely mapped prior to the creation of the on-site pond. "Beaches" soil is described as "sandy, gravelly, or cobbly coastal shores that are washed and rewashed by tidal and wave action" (NRCS, 1978). See Soil Samples #1 and #2 for a further description of this soil type.

3.3.3 Results and Conclusions

Only the top 12 inches of the soil profile was described, due to the wetness of the soil and the difficulty of digging a deeper hole. The soil is dominated by sand particles, reflecting the soil description of "Beaches" listed in the soil survey. The top 1-2 inches of the soil profile had a fibrous organic matter mat, consisting of roots of the vegetation and decomposed vegetation. Below this "O" horizon the soil has layers of sandy to sandy clay loam, but little horizonation is found.

Salinity levels in the soil are high (SAR 9.5). The organic matter content was lower than anticipated (2.9%), given the duration of saturation within the soil profile. Sulfur odor was noted, indicating that the soils have been anaerobic for some time. These soil qualify as hydric, based upon the Field Indictor status developed by the US Department of Agriculture (USDA/NRCS 1996). All other nutrient levels and chemical parameters were comparable to other soils collected on the project area. The lack of soil profile, the sandy texture, coupled with the laboratory analysis results indicate that this area was tidally influenced, thus accurately representing the "Beaches" soil mapped for the area.

3.4 Peppertree Area – Samples #6, #6a, #6b

3.4.1 Soil Sample Location

Soils were collected in the riparian area dominated by Brazilian peppertree, upstream of the pond. Three soil cores were collected within this riparian area. Sample #6 was assessed to 12 inches below the surface and a sample was taken for laboratory analysis at 12 inches. Samples 6a and 6b were assessed to 60 inches each and a sample was collected from each location from between 40 and 60 inches in depth.

3.4.2 Mapped Soil Description

The 1978 NRCS soil survey identifies this sampling area as "Tidal flats". Tidal flats are described as "nearly level areas adjacent to bays and lagoons along the coast." These areas are periodically covered by tidal overflow, with the higher topographic positions being covered only during very high tides. These soils are stratified clayey to sandy deposits, which are poorly drained and high in salts (NRCS 1978). "Tidal flats" is not a soil series and has not been assigned a taxonomic classification. This soil is a young, poorly developed soil, most likely falling in the Entisol soil order.

3.4.3 Results and Conclusions

The three profiles examined in this area all exhibited hydric soil characteristics at or near the surface. Mottles, reduced soil matrix and/or gleyed soil color were observed in all three sampling locations. Consistent gleyed soil color was observed between 14 and 18 inches below the soil surface, indicating the level where water is consistently found. In July of 2003, when samples 6a and 6b were taken, the water table was between 21 and 24 inches below the surface. Soil texture varied throughout the profile from loam to sandy clay. The top 0-18 inches appeared to be alluvium carried in from upstream sources. The remaining profile appears to be formed in place.

The sample taken from the top 12 inches of the soil had high salt content, in addition to an extremely high sulfate level. The sulfate may be a result of fertilizer practices from upstream sources that settle out at this point. The phosphorus level was considered low, but other minor elements are well within the acceptable range for agronomic purposes. The SAR was 12.3, and could potentially pose a problem for plant establishment.

3.5 Upland Soils near Jamboree Road Samples #7 and #8

3.5.1 Soil Sample Location

Soils were described and collected at the upper end of the Big Canyon drainage area, at the foot of the slope by Jamboree Road. Samples were taken adjacent to a sewer line within an area occupied by ruderal vegetation. Sample #7 and #8 were taken from 2 feet and 4.5 feet below the surface, respectively.

3.5.2 Mapped Soil Description

The 1978 NRCS soil survey identifies this sampling area as Anaheim clay loam series. This soil series was also found buried at sample locations #3 and #4. See soil samples #3 and #4 for a further description of the Anaheim clay loam series.

3.5.3 Results and Conclusions

The soils within this area are sandy loams to sandy clay loams, and yellowish brown to gray in color. The profile reflects the upland nature of these soils.

Soil nutrient levels were consistent with other soils sampled from within Big Canyon. Calcium, magnesium, and sodium levels are moderate to high, but would not likely present a problem for plant establishment.

3.6 Willow Woodland in Northeastern section Sample #9

3.6.1 Soil Sample Location

The soil was described in the northeastern willow woodland of the study area. Soils were examined to 18 inches in depth and a soil sample was taken at 18 inches for laboratory analysis.

3.6.2 Mapped Soil Description

The 1978 NRCS soil survey identifies this sampling area as "Beaches". This soil type indicates that the area was once influenced by tidal action.

3.6.3 Results and Conclusions

A heavy root mass was encountered approximately 3 inches deep on the surface of the soil. This root mass was formed primarily by the shallow roots of the surrounding willow trees. The soil horizon directly below the root mass was gleyed with both brownish yellow and yellowish red mottles, indicating saturated and reducing soil conditions. This soil would be considered hydric based upon the Field Indicators developed by the USDA (USDA/NRCS 1996). Soils were examined to only 18 inches in depth. Silts dominated the soil texture, and are considered to be loam at the surface. The slightly higher loam content in the soil (45.9% loam versus 38.6% sand) may be the result of lighter soil particles being deposited from upstream sources, rather than a tie over of tidal influence. The dominant vegetation of this area is willow, which tolerate moderate amounts of salinity. The creek that runs through this area is fresh water, and thus sediments may be deposited in this area during flood events.

The pH of this soil was unusually high (8.83) in comparison with the other soils, which were in the 7 range (excepting sample #1). It is unknown what has caused this increase in pH, but it does not appear to be affecting plant health. Total carbon and total nitrogen were higher than other samples collected. This may be due to the shallowness of the soil sample collected. Although the sodium levels found within the soil were high, the SAR was low. This perhaps indicates the dominance of calcium and magnesium in the soil, which could also regulate pH. Overall, the nutrient levels were consistent with other samples taken from within the study area.

4.0 DEFINITIONS (from Brady & Weil, 1996)

1. Base saturation – the extent to which the adsorption complex of a soil is saturated

with exchangeable cations other than hydrogen or aluminum

2. Cation exchange capacity (CEC) – The sum total of exchangeable cations that soil can adsorb.
3. Entisol – soil that have no diagnostic pedogenic horizons
4. Gley soil – soil developed under conditions of poor drainage resulting in the reduction of iron and other elements and in gray colors and mottles
5. Horizon – a layer of soil differing in properties and characteristics from adjacent layers below or above it
6. Hydric soil – (as defined by the Federal Register, 1994) soils that are formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions
7. Mottling – spots or blotches of different color or shades of color interspersed with the dominant color
8. Ped – a unit of soil structure such as an aggregate, crumb, prison, block or granule, formed by natural processes.
9. Sodium Adsorption Ratio (SAR) – a ratio of sodium to calcium and magnesium in a soil that takes into consideration the adverse effect of sodium being moderated by the presence of calcium and magnesium ions
10. Soil – the collection of natural bodies occupying parts of the earth's surface that support plants and that have properties due to the integrated effect of climate and living matter acting upon parent material, as conditioned by relief, over periods of time
11. Soil organic matter – the organic fraction of the soil that includes plant and animal residues at various stages of decomposition, cells and tissues of soil organisms, and substances synthesized by the soil population
12. Soil texture – the relative proportions of various soil separates (sand, silt, clay) in a soil

5.0 LITERATURE CITED

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Section 8
BIG CANYON:
OPPORTUNITIES & CONSTRAINTS

Existing conditions were reviewed and documented by the consultant team, federal, regional, state and local agencies, and community representatives. Through this process, the site opportunities and constraints were defined.

Opportunities are existing elements that can be removed, exploited or modified through the design process to meet the specific goals of the project. Constraints are those elements that must be preserved or remain unaltered, or that limit restoration and modification.

OPPORTUNITIES ANALYSIS (see Figure 8.1)

The existing opportunities identified that shape the Big Canyon Creek Restoration Project include the following items:

- Historic tidal flow
- Potential habitat restoration areas
- Availability of year-round water for native plant restoration
- Constant water flow in creek
- Single point of water entry into canyon
- Continued degradation of existing pond
- Detrimental location of the parking lot within tidal wetlands
- Areas of dredge spoils and infertile soils
- Areas of non-native or invasive plants
- Presence of tidal-dependent benthic invertebrates at canyon mouth

Historic Tidal Wetlands

Reintroduction of tidal action into those areas that were once part of the historic tidal wetlands will quickly restore the original habitat. The daily influx of the tides will reestablish the drainage channels and redistribute seeds.

Constant Water Flow

Big Canyon Creek was historically an intermittent stream that dried up as the local rainfall disappeared through the summer months. Development throughout the two square mile watershed has changed the nature of the creek from intermittent to perennial. Year-round irrigation provides a constant base flow of 5 cubic feet per second (cfs) even through the dry summer months.

This flow supports the freshwater marsh and riparian habitats in the canyon today and provides a resource for the restoration of diverse native plant communities.

Benthic Invertebrates at Canyon Mouth

At the mouth of Big Canyon, below Back Bay Drive, the mudflats and shallow tidal channels support tidal-dependent estuarine invertebrates in numbers similar to other areas of Upper Newport Bay. This indicates that, if the area of tidal influence were increased, these invertebrates would naturally colonize the new mudflats and salt marsh that would result, creating healthy tidal wetland communities. This would provide additional food sources for shorebirds and bottom-foraging fish, increase the biological diversity, and enhance the use of Big Canyon by both fish and shorebirds due to the increased food supply and foraging habitat.

Treatment of Urban Runoff

All water and urban runoff generated in the Big Canyon Creek watershed flows through the project area. This flow carries heavy loads of contaminants, fertilizers, pesticides, heavy metals and other pollutants. This presents an opportunity to develop a system of non-structural, water quality improvement components and improved natural drainage to maximize the ability of the restored riparian and wetland habitats to filter toxins, nitrogen, phosphorus, heavy metals and fecal coliform bacteria before contaminated water reaches Upper Newport Bay.

Management of pollutants from the two square mile watershed will improve the water quality of Upper Newport Bay and coastal beaches. Because the Big Canyon Creek Restoration Plan provides an opportunity to address all storm water and urban runoff issues from an entire watershed in a discrete and publicly accessible area, the water quality improvements demonstrated in the Project will provide an important demonstration model for other small coastal watersheds.

Sedimentation of the Freshwater Pond
Originally constructed in the 1980s, the design of the freshwater pond did not provide maintenance access for removal of sediment. Continued sedimentation will eventually fill the entire pond. The pond is now only two feet deep and is severely degraded. The shallow water is too warm to support most native species. As the pond has become shallower and warmer, cattails have spread, displacing many species. The dense mat of cattails has blocked floodwaters in the canyon with disastrous effect to Back Bay Drive and to downstream boardwalks, trails and interpretive elements.

Replacing or reconstructing the existing pond is essential for the preservation of the freshwater marsh and aquatic habitats in Big Canyon. Reconstruction will provide an opportunity to incorporate maintenance access, flood management features and interpretive elements.

Parking Lot Location
The existing asphalt parking lot is located in the sensitive tidal wetland zone. The wetlands were filled in along the bay side of Back Bay Drive to create the parking lot, and the edges were re-enforced with concrete construction debris. Winter storms scourge and erode the outer edge requiring repairs on a regular basis.

The inappropriate location of the parking lot is not suited to the preservation mission of the Upper Newport Bay Ecological Preserve. Additionally, the eroding asphalt surfacing, the lack of landscaping, and ad-hoc placement of the Port-o-potties in front of the interpretive kiosk create a visual sense of neglect in the canyon.

Relocation of the parking lot will provide an opportunity to restore the tidal wetlands and improve the image of the canyon.

Infertile Soils
Previous channel and Bay dredging operations deposited dredge spoils up to six feet deep on the south side of the canyon. Test borings of this area confirm this by the high degree of salinity in the upper layers of soil. These areas are quite barren, and existing plants consist primarily of non-native and invasive species.

These infertile, dredge spoil areas provide an opportunity to relocate infrastructure facilities such as the parking lot without destroying existing native plant communities and to restore degraded areas to native habitat that will support wildlife.

The soil in the area above the mid-canyon creek crossing, dominated by invasive non=native Brazilian pepper trees, has pockets with high sodium content. The soil profile is loam down to sandy clay. Due to the heavy growth of Brazilian pepper trees and the current soil conditions, this area is not able to support native habitat and is well suited for relocation of the freshwater pond by removing the invasive pepper trees.

Non-Native Plant Communities
Non-native plant communities are associated with the areas of dredge spoils and other infertile soils. To the north of the mid-canyon creek crossing a thicket of Brazilian Pepper trees has crowded out all other vegetation. Brazilian Peppers do not provide habitat for native birds and other wildlife species. Left unchecked, the trees pose a threat to Big Canyon. Removal of these highly invasive trees and the associated soils provides an opportunity to restore native plant communities and to provide needed interpretive facilities without destroying existing native habitats.

There are numerous other areas of invasive, non-native plants throughout Big Canyon that need to be addressed and which provide an opportunity for native habitat restoration (see Appendix A, Figure A3).

CONSTRAINTS TO RESTORATION (see Figure 8.2)
The constraints for the restoration project are limited to the following items:

- Sewer lines and manholes
- Existing established native habitat
- Back Bay Drive provides public access and is an established throughway

Sewer Infrastructure
The existing City- and County-owned sewer lines within the canyon, accessed by a series of manholes

and a connecting maintenance road, cannot be relocated. The maintenance road that links the manholes must be able to accommodate public works utility trucks. The Big Canyon Creek Restoration Plan proposes to work closely with the County and City to ensure that the road continues to serve this purpose while limiting the impacts to the restored plant communities.

Established Native Plant Communities

Established native plant communities, including the riparian and the wet meadow habitats on the canyon floor are valuable habitats and must be preserved.

The freshwater pond and associated freshwater marsh, while not naturally occurring in Big Canyon, are endangered habitats in Southern California. No net loss of this valuable habitat is a constraint to the project.

Past mitigation projects have restored coastal sage scrub. These areas are in need of invasive weed removal, but as established habitats should be preserved.

Back Bay Drive Access

Back Bay Drive is a vehicular throughway along the eastern side of the Upper Newport Bay Estuary and provides public access to Big Canyon Creek. The Big Canyon Creek Restoration Plan assumes this roadway is beneficial to the community and should be maintained as a thoroughfare.

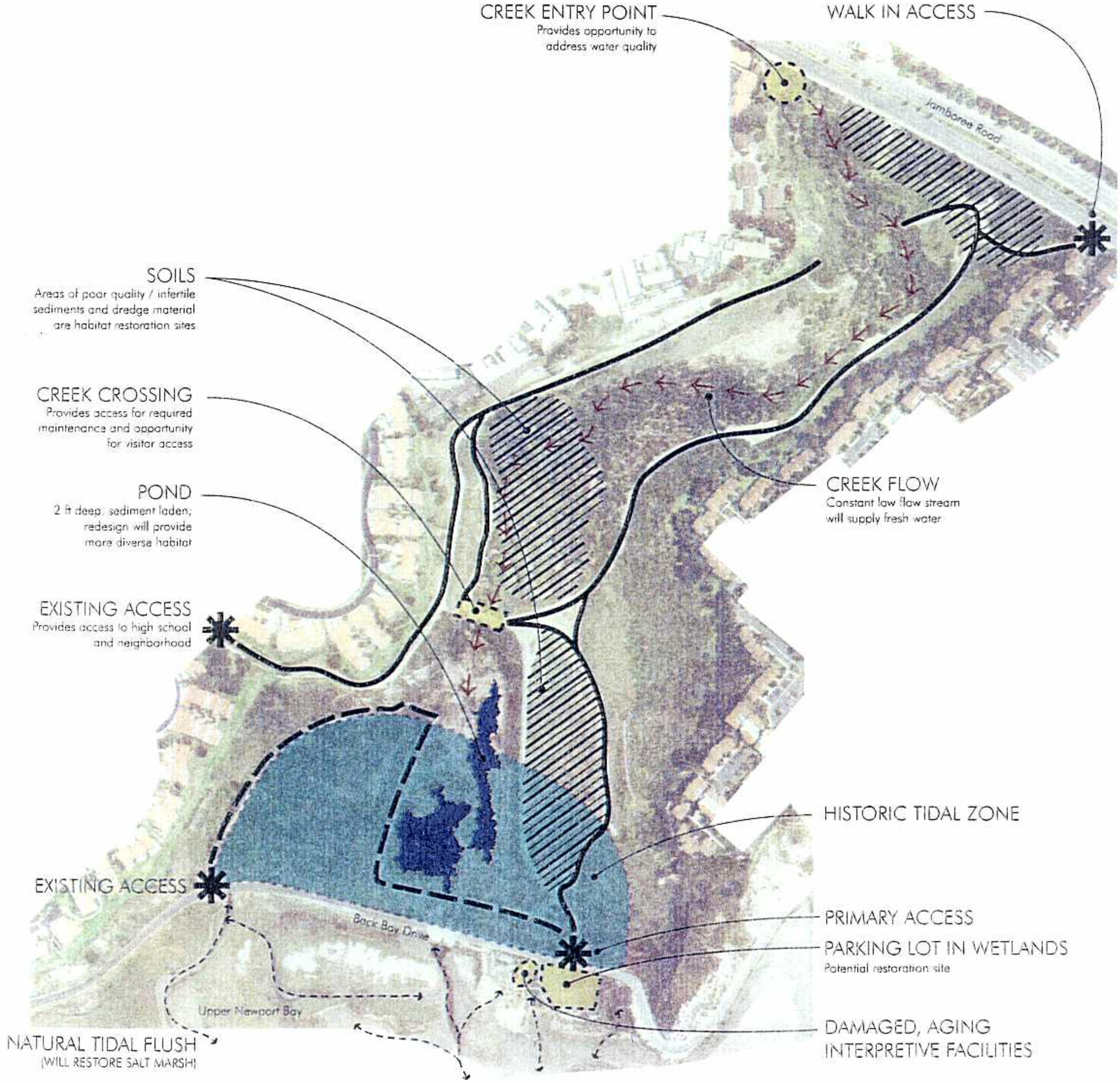
However, the roadway in its present configuration is subject to flooding and requires continued maintenance.

Big Canyon Creek Restoration Project

SITE OPPORTUNITIES

FIGURE 8.1

Community Conservancy International



prepared by Withers & Sandgren Ltd Aug 25 2003

Big Canyon Creek Restoration Project

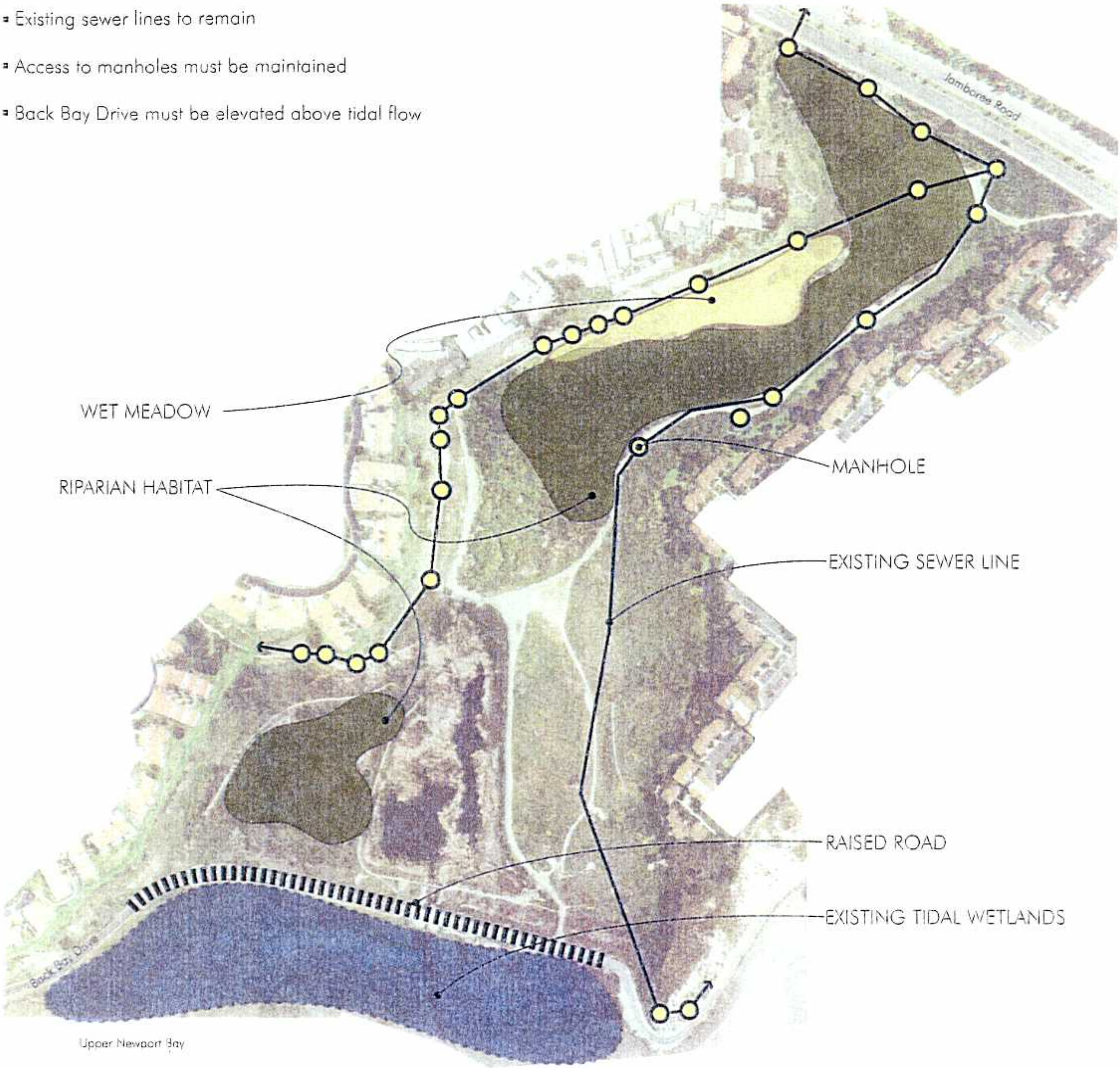
SITE CONSTRAINTS

FIGURE 8.2

Community Conservancy International

Summary:

- Established tidal and riparian habitats need to be preserved
- Existing sewer lines to remain
- Access to manholes must be maintained
- Back Bay Drive must be elevated above tidal flow



Section 9 BIG CANYON: CONCEPTUAL RESTORATION PLAN ALTERNATIVES

Two conceptual restoration plans that met the overall project goals were developed based on data gathered and analysis conducted by the project team. "No net loss" of valuable freshwater and riparian habitats while maximizing the number of restored acres of tidal wetlands guided the development of the two alternatives.

These alternatives were refined with consideration of specific habitat objectives and future water quality improvement needs. Proposed grading elevations for fresh water marsh and riparian zones referenced information from Earthworks Construction & Design (see Appendix D, Table D2). Wetlands Research Associates, Inc. was consulted for grading within the tidal marsh area (see Appendix D, Table D3). Major components relating to grading and drainage are included below.

After reviewing the two conceptual plans with federal, state, regional and local agencies, the alternatives were presented to the public for community input. Concept B, the Historic Tidal Wetlands Alternative, was selected as the preferred alternative. This alternative is discussed in detail in Section 10.

The two alternatives seem to be fairly compatible in the construction costs. The first alternative would, however, require significant maintenance of the constructed tidal marsh as well as the tidal opening.

The second alternative also has less erosion potential for Back Bay Drive from tidal wave action since part of the roadway is higher in elevation and is set back from direct tidal current in the Bay. In contrast to an engineered channel, Big Canyon will continue to experience natural flooding, erosion and sedimentation. The proposed plan intends to protect the investments in restoration and infrastructure with significantly reduced maintenance requirements and risks from frequent and minor storms as compared to the existing conditions.

Concept A:
Constructed Tidal Alternative
(Figure 9.1)

This alternative proposed to restore partial tidal influence and to re-create the freshwater pond immediately downstream of the mid-canyon creek crossing. The earthen dam would be reconstructed halfway between Back Bay Drive and the mid-canyon crossing. Access to the pond for maintenance would be provided adjacent to the mid-canyon crossing.

A portion of Back Bay Drive would be removed and a bridge constructed, allowing tidal flow to pass under the roadway. A tidal basin would be created inside of Back Bay Drive and the surrounding habitats would be impacted by the daily influx of salt water, creating tidal wetlands and related habitats.

Benefits of the Constructed Tidal Alternative
Tidal Wetlands

- New bridge creates 15-foot wide opening under Back Bay Drive to allow partial tidal flow to enter Big Canyon
- Portion of historic tidal wetlands restored on canyon side of Back Bay Drive
- Tidal wetlands restored in the existing parking lot area.

Freshwater Habitats

- Remove dredge spoils, move earthen dam to create new freshwater pond, marsh and meadows
- Long-term maintenance of pond made possible

Water Quality

- Improved water quality in creek through filtration system at Jamboree Road
- Improved sediment removal from freshwater pond

Public Access

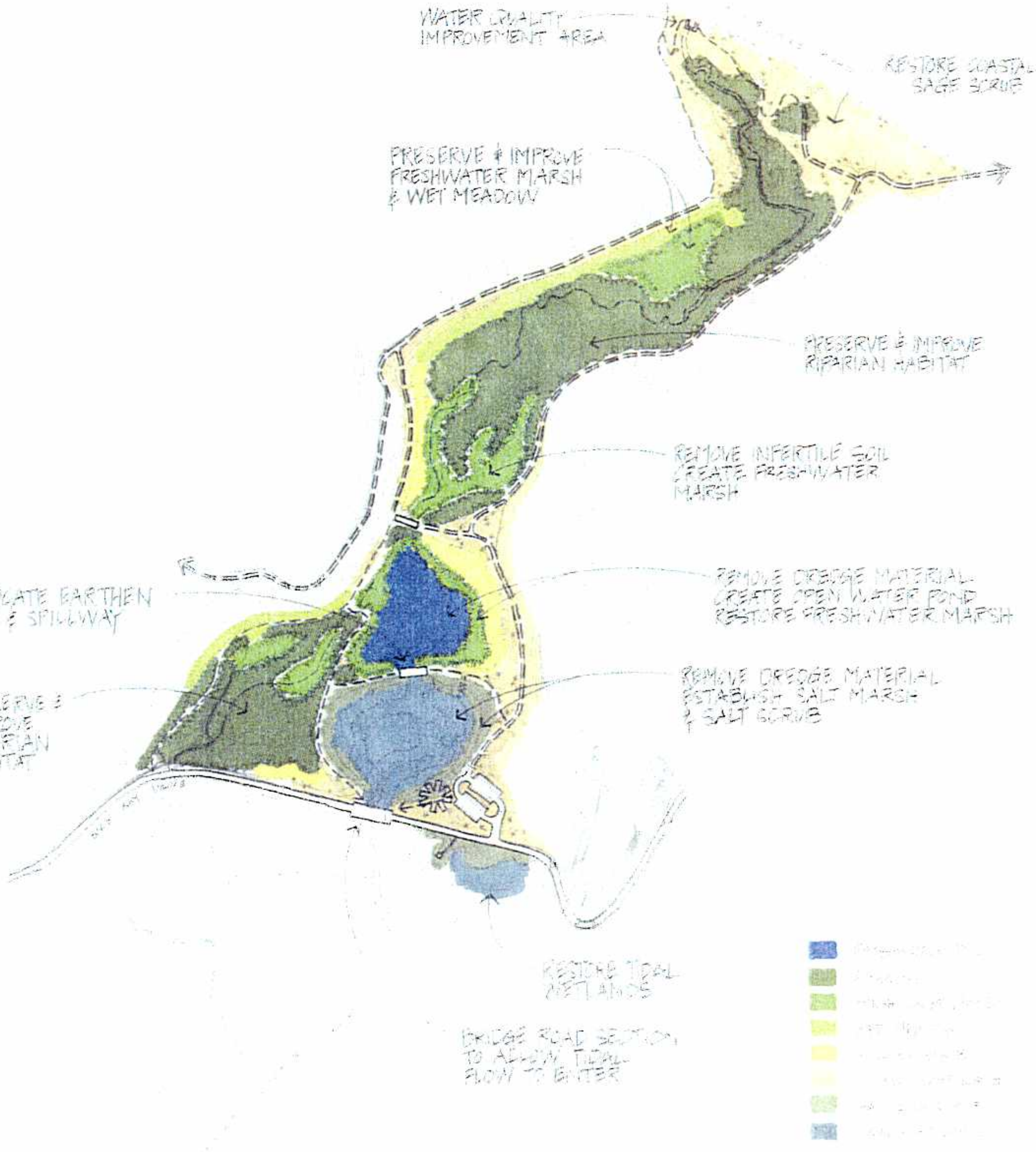
- Parking lot moved out of wetlands

- Scenic overlooks and interpretive areas provided to support educational programs and activities
- Complete system of hiking trails access entire project area

Grading and Drainage

- Excavate the existing freshwater pond above Back Bay Drive to a depth below mean sea level. Provide a bridge opening to connect the graded area to the existing tidal zone. This will allow for the creation of a tidal wetland upstream of the road.
- Excavate and expand the remaining portion of the existing pond to 10 feet deep in order to restore the freshwater marsh habitats.
- Remove the dredge spoils and modify the grading above the service road where non-native ornamental plants dominate.
- Provide other water quality treatment in the upstream sector.
- Excavate the existing parking lot and boardwalk area for tidal inundation.

CONSTRUCTED TIDAL WETLANDS ALTERNATIVE



Concept B:
Historic Tidal Wetlands Alternative
(Figure 9.2)

This alternative proposed to restore historic tidal influence by building an earthen berm at the historic tidal limit and realigning Back Bay Drive on top of the berm. A series of re-enforced concrete culverts would allow freshwater to drain under Back Bay Drive but would also allow salt water to pass under the road during high tides. At least five acres of tidal wetlands would be restored.

A deeper and sustainable freshwater pond would be reconstructed upstream of the mid-canyon creek crossing by removing infertile soils and invasive non-native plants. Maintenance access would be located adjacent to the crossing. The existing pond would be allowed to continue to fill with sediment and evolve into freshwater marsh, meadow and riparian habitat.

Contaminated water flowing through Big Canyon Creek would be addressed through a series of natural infiltration areas in the upper portions of the canyon designed to filter out toxins and contaminants.

Benefits of the Historic Tidal Wetlands Alternative

Tidal Wetlands

- Maximum amount of historic tidal wetlands restored without damaging existing native habitats
- Tidal wetlands restored in existing parking lot
- Brackish transition habitat reestablished between saltwater and freshwater areas

Freshwater and Riparian Habitats

- Infertile soils and non-native plant communities removed to re-create freshwater pond above creek crossing
- New freshwater marsh re-created upstream of pond
- Existing pond converted to freshwater marsh, meadow and riparian habitat
- Preserve existing freshwater marsh, meadow and riparian habitats below creek crossing

Water Quality

- Comprehensive infiltration systems filter toxins, fertilizers and contaminants from urban runoff entering creek
- Maintenance of pond removes sediments and other nutrients from water before entering Upper Newport Bay
- Preservation of freshwater marsh and riparian habitats below pond further filter water before entering the Bay

Back Bay Drive

- Roadway protected from winter storm surges and future flooding
- Increased sustainability of long-term maintenance

Public Access

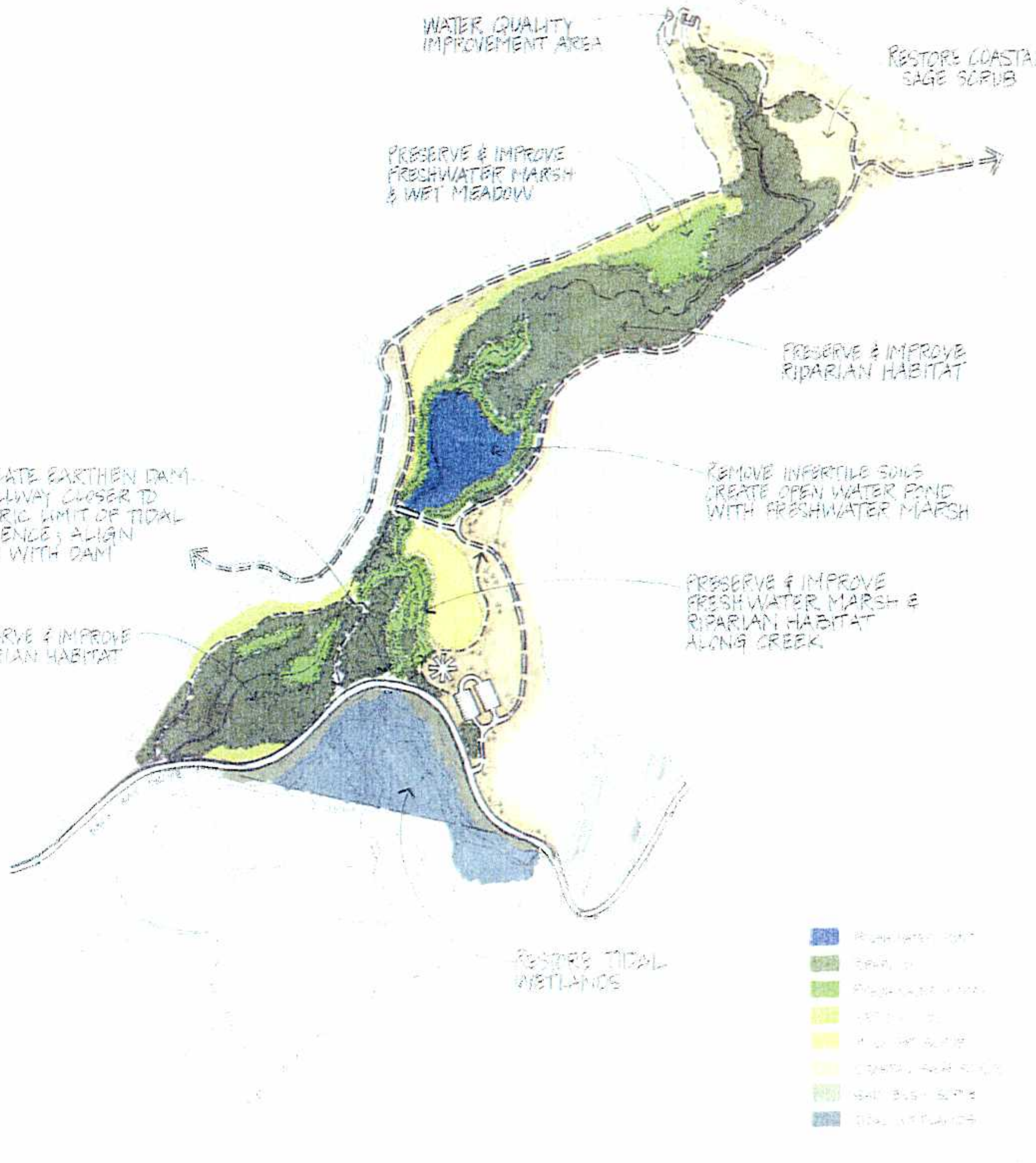
- Safer off-street parking provided with improved amenities
- Scenic overlooks provide views of Bay and key habitat zones
- Improved access and interpretive signs support educational programs and activities
- Complete network of hiking trails access entire project area

Grading and Drainage

- Realign Back Bay Drive to approximately the historical tidal limit and excavate the high ground on the south for tidal inundation.
- Grade, drain and remove the deposited sediments in the freshwater pond above the new roadway to provide a constructed wetland.
- Excavate the non-native plant area and provide drainage control to create open-water habitats and a freshwater marsh.
- Provide other water quality treatment in the upstream sector.
- Excavate the existing parking lot and boardwalk area for tidal inundation.

The Historic Tidal Wetlands Alternative was selected for its greater comprehensive environmental benefits, including restoration of historical tidal flows, number of acres of restored tidal wetlands, freshwater pond design, integrated public access, interpretive, overlooks and trail system and optimal potential to significantly improve water quality.

HISTORIC TIDAL WETLANDS ALTERNATIVE



Section 10
BIG CANYON CREEK: HISTORIC TIDAL WETLANDS CONCEPTUAL RESTORATION PLAN

The following elements comprise the proposed Historic Tidal Wetlands Concept Alternative for the Big Canyon Creek Restoration Plan (see Figures 10.1 and 10.2).

RESTORED TIDAL WETLANDS

Most of the historic tidal wetlands at the mouth of Big Canyon Creek will be restored by building a new earthen berm, realigning Back Bay Drive and relocating the existing parking lot out of the tidal area. More than five acres of increased tidal wetlands will result. The mixing of salt and freshwater at the canyon mouth will allow a natural, gradual transition between woodlands, freshwater marsh, brackish marsh, salt marsh, mudflats and the Bay's open water channels. This re-establishment of a complete spectrum of plant communities will provide additional habitat for endangered species, and will protect water quality in Upper Newport Bay by acting as a natural filter for the contaminated water entering Big Canyon Creek from surrounding urban areas.

Existing wetland communities will be protected by leaving the existing Back Bay Drive as a barrier during construction of the new berm and roadway. Grading will restore a gradual slope up to the new roadway. Once the new road is completed, the existing road will be removed, allowing the natural flush of the daily tide to re-carve natural drainage patterns and re-distribute tidal wetland species into the newly graded areas.

During the restoration of the tidal wetlands areas, tidal flow will be monitored to maximize tidal exchange and fluctuation in order to ensure successful establishment of tidal-dependent plant communities. Costs and effort of constructing and maintaining tidal fluctuation were considered during evaluation of the two alternatives.
Multiple culverts laid under the new roadway will provide for a regular flow of freshwater from Big Canyon Creek into the Bay, and will allow greater interchange of salt and freshwater under Back Bay Drive than can currently occur.

FRESHWATER POND AND WETLANDS

The Plan proposes to re-create the freshwater pond upstream of the mid-canyon creek crossing in an area of infertile soil completely dominated by a thicket of Brazilian Pepper trees (*Schinus terraebinethfolius*). This invasive non-native, which crowds out all other native plants, would be replaced with diverse aquatic habitats. These include a new freshwater pond up to ten feet deep with naturally sloping banks, and a transition from open water to freshwater marsh, meadows and riparian habitats.

The existing concrete dam and crossing structure will be reconstructed with a controlled out-flow to allow the pond to be drained for maintenance purposes and to control the flow of water into the lower canyon. The new structure will be designed as an aesthetic trail crossing and scenic overlook as part of the trail network. A maintenance road will be constructed to the south of the crossing providing truck access to the drained pond.

The dam will be designed so that floodwaters can spill over the top during major storm events without harming the new freshwater pond and marsh or destroying habitats downstream of the dam.

Portions of the existing pond and the split drainage pattern of the lower section of Big Canyon Creek will be preserved to protect existing riparian habitats. Some of the dredge spoils to the south of the existing pond will be excavated and re-graded to create a gentler and more natural slope. This will allow for the establishment of a greater diversity of native plants at differing elevations above the creek, creating a natural transition between freshwater meadows, marsh and riparian habitats.

Big Canyon Creek Restoration Project

BIG CANYON CREEK:
Historic Tidal Wetlands Conceptual Restoration Plan

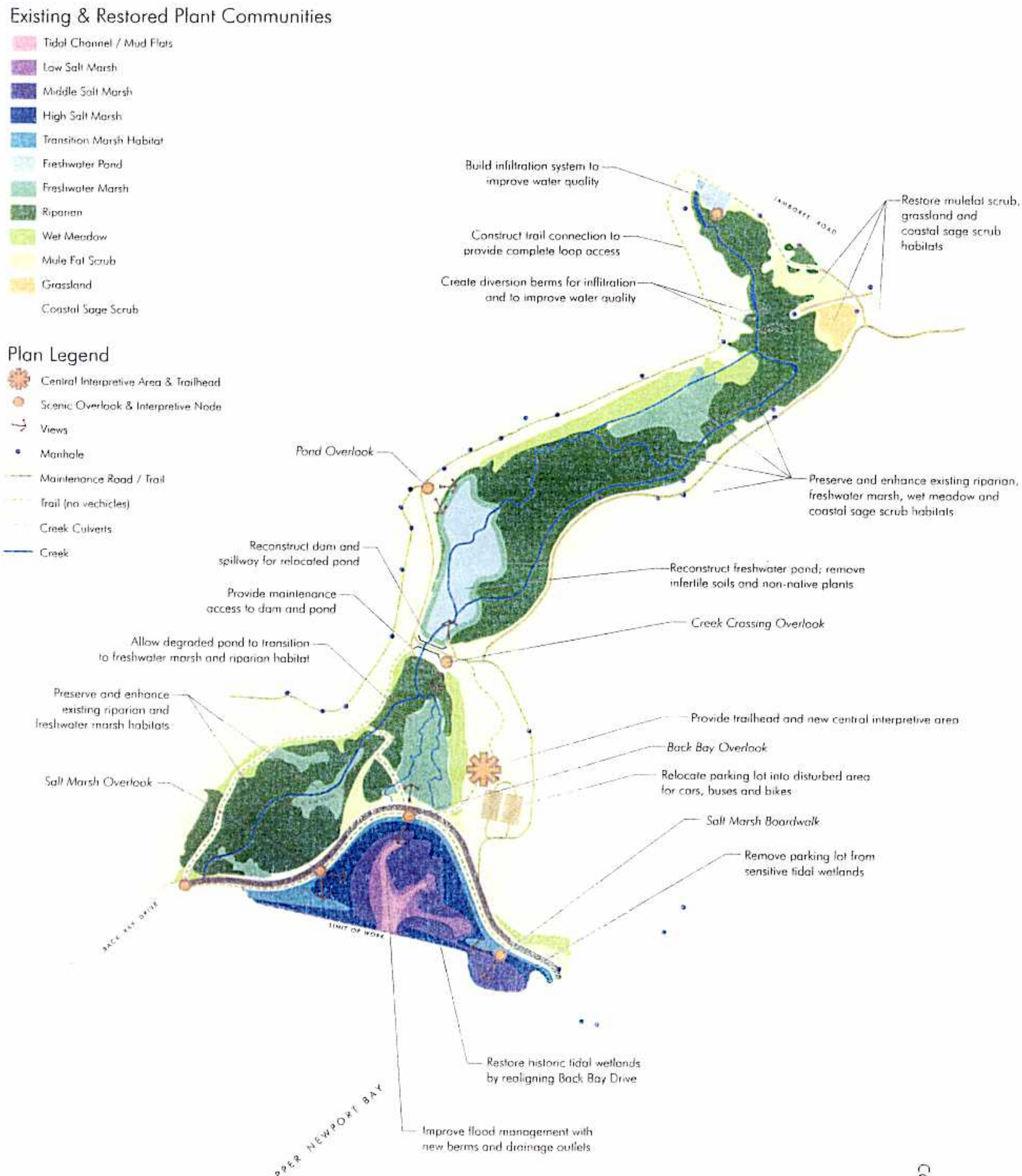


FIGURE 10.1
BIG CANYON CREEK
Historic Tidal Wetlands
Conceptual Restoration Plan

Withers & Sandgren Ltd.

WATER QUALITY IMPROVEMENTS

All runoff from the two square mile Big Canyon Creek watershed enters the canyon via a storm drain under Jamboree Road. This contaminated runoff, which contains fertilizers, pesticides, heavy metals and other toxins, will be filtered through a series of settling ponds at the upper end of the canyon. Suspended solids, trash and sediment will be allowed to drop out in the ponds before flowing downstream.

As the water flows through the canyon, the natural meandering stream flow and system of riparian habitat, meadows, ponds, freshwater marsh and wetlands will act as natural filters, trapping pollutants, sediments, metals, pesticides, bacteria and nutrients. The vegetation will help uptake these pollutants, removing them from Big Canyon Creek and preventing these contaminants from reaching Upper Newport Bay.

Higher flows and winter floodwaters will bypass this diversion structure and follow the existing drainage course. A series of small earthen berms will be constructed further downstream to slow the waters. This will further reduce the amount of suspended solids and assist with filtration and uptake of pesticides and fertilizers.

The relocated freshwater pond, new freshwater marsh and expanded tidal wetlands will also play a key role in filtering out and absorbing fertilizers, pesticides and any remaining pollutants, further protecting Upper Newport Bay.

NATIVE HABITAT RESTORATION

The freshwater marsh will be re-established on the fringes of the reconstructed pond. By grading the pond to depths of 8'-10', the cattails will be contained along the fringes of the pond, as they need shallow conditions to thrive. With the greater water depth, the pond will remain cooler and will be able to support a greater diversity of native aquatic life.

The slowed flow of water through the upper portion of the canyon will increase the amount of available ground water, as infiltration into the soil will be increased. This increased soil moisture will be crucial to the establishment of native plant communities adjacent to and above the riparian habitat in this area of the canyon, especially for wet meadow and riparian habitats.

VEHICULAR AND BICYCLE ACCESS AND PARKING

Vehicular access to Big Canyon will continue via Back Bay Drive. Back Bay Drive will continue to function as a throughway along this edge of the Upper Newport Bay Ecological Preserve, with one-way vehicular traffic and a dedicated bicycle lane on the bay side of the road. The scenic quality of the drive will be preserved and enhanced. The new location of the road above storm surges and flooding will reduce road closures and future maintenance costs.

The parking lot and restroom facilities will be moved out of the sensitive tidal wetlands area and relocated to the opposite side of the road in an infertile, barren area where dredge spoils were dumped and the salinity of the soil is very high.

This new location will prevent damage to the parking area from the tidal surges associated with winter storms, prevent costly maintenance, remove damaging and polluting uses from the Bay's edge and allow restoration of an acre of tidal wetlands.

The parking area will be constructed from compacted infertile soils recycled from other areas of the canyon. Buffer areas will be incorporated into the edges of the parking area to keep foot traffic and vehicles away from the adjacent restored plant communities. Native trees will be planted adjacent to the parking area to provide shade and screening. There will be space for 35 cars and two school buses, and bicycle racks will be provided.

Relocation of the parking lot will allow school groups to assemble safely away from traffic on Back Bay Drive. Restroom facilities, consisting of screened portable restrooms, will be provided adjacent to the parking area. A trailhead and central interpretive area will also be located adjacent to the parking area.

PUBLIC ACCESS AND TRAILS

The trail network in Big Canyon will be extended and improved to provide continuous trail access to the level areas of the canyon floor. Public access will follow both sides of the creek, with connections at the lower and upper ends of the canyon as well as the mid-canyon creek crossing adjacent to the new freshwater pond. Where appropriate, and without restricting access for maintenance, existing maintenance roads will be made more narrow and aesthetic. Native plants will be planted along roadways. New trail connections will allow a series of complete walking loops from the wetlands to the upper end of the canyon.

Un-authorized, erosive and hazardous trails on the canyon slopes will be blocked and posted, and an educational program undertaken to discourage people from using and further damaging the fragile slopes.

All trails downstream of the mid-canyon creek crossing will be completely ADA accessible. Recreation trails above the pond will be accessible with some physical exertion.

Overlooks, Boardwalks and Interpretive Facilities

A central interpretive area, with information on Big Canyon, its trails and habitats, will be located on the high ground adjacent to the parking lot and at the central trailhead. This facility will accommodate school and docent-lead groups. A trail map of the canyon will encourage visitors to venture beyond the parking lot and explore the upper reaches of the canyon. Seating will be provided that can serve as a small outdoor classroom.

In addition to the central interpretive area, there are specific identified sites that will provide scenic overlooks to key natural features of the restored canyon, as well as excellent bird-watching locations. These sites are indicated on the illustrated conceptual restoration map (see Figure 10.1) and include:

- *Salt Marsh Overlook*
  At the north edge of the restored tidal wetlands, this overlook will allow visitors Bay-level scenic views of the wetlands, Upper Newport Bay, and the coastal bluffs

- *Salt Marsh Boardwalk*
  South of the restored tidal wetlands, this short, elevated boardwalk will provide visitors the experience of being in the salt marsh without damaging this fragile habitat, and bird-watching opportunities

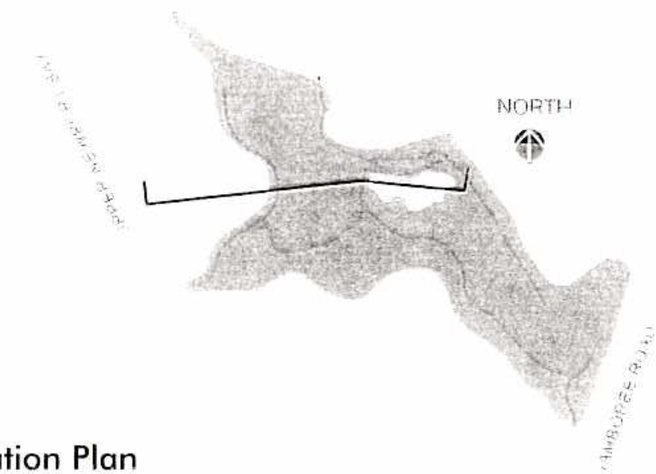
- *Back Bay Overlook*
  Located on the new earthen berm and elevated above the edge of the restored wetlands, this overlook will provide visitors with a panoramic view of the tidal wetlands, Upper Newport Bay and Big Canyon

- *Creek Crossing Overlook*
  Located at the southern end of the new freshwater pond, this overlook will provide views upstream of the new freshwater pond, and downstream of riparian areas and freshwater marsh

- *Pond Overlook*
  This overlook at the upper end of the freshwater pond will provide birdwatchers great opportunities to watch winged visitors to the pond

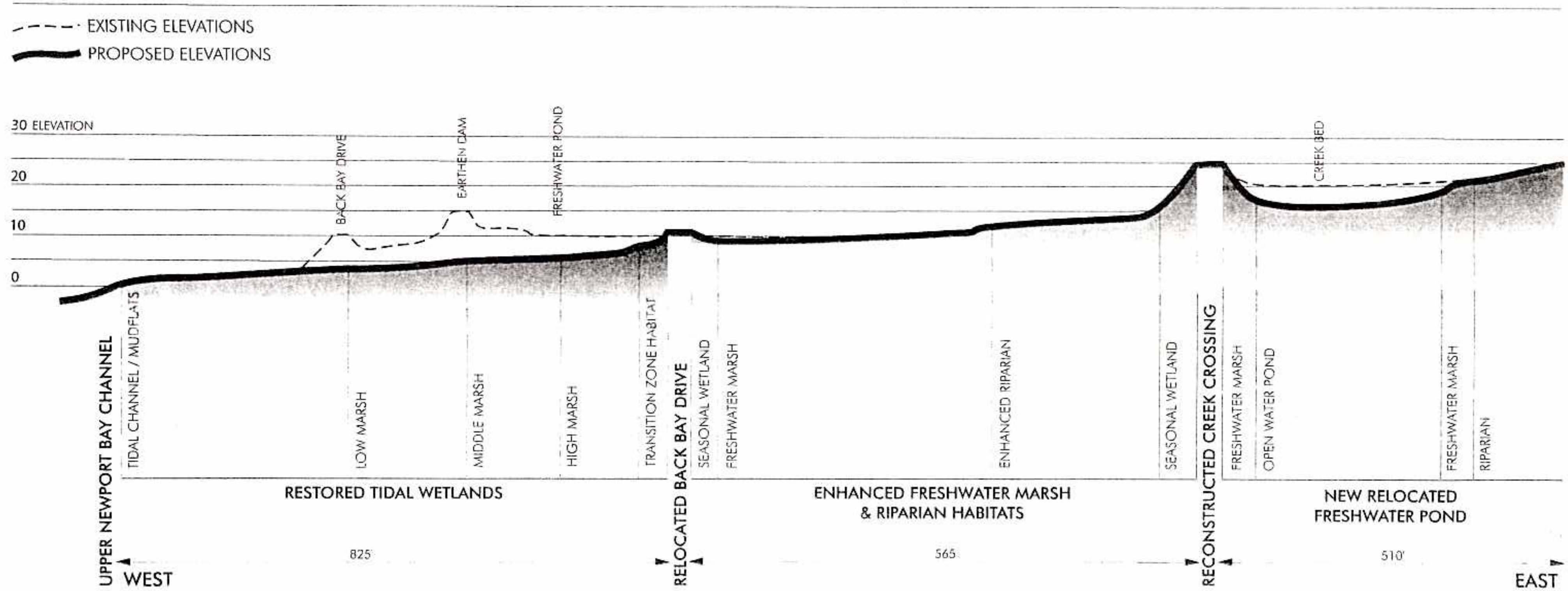
Other interpretive nodes throughout the canyon will be incorporated with the new trail system, and will present colorful and user-friendly information on the diverse habitats and native plants and wildlife of Big Canyon, restoration of tidal wetlands and other native habitats, water quality improvements in Big Canyon Creek, use of natural filtration systems to clean up contaminated urban runoff, removal of invasive non-native plants and other important information about Upper Newport Bay.

FIGURE 10.2



Big Canyon Creek Restoration Project

West-East Longitudinal Cross Section Through Historic Tidal Wetlands Conceptual Restoration Plan



APPENDIX

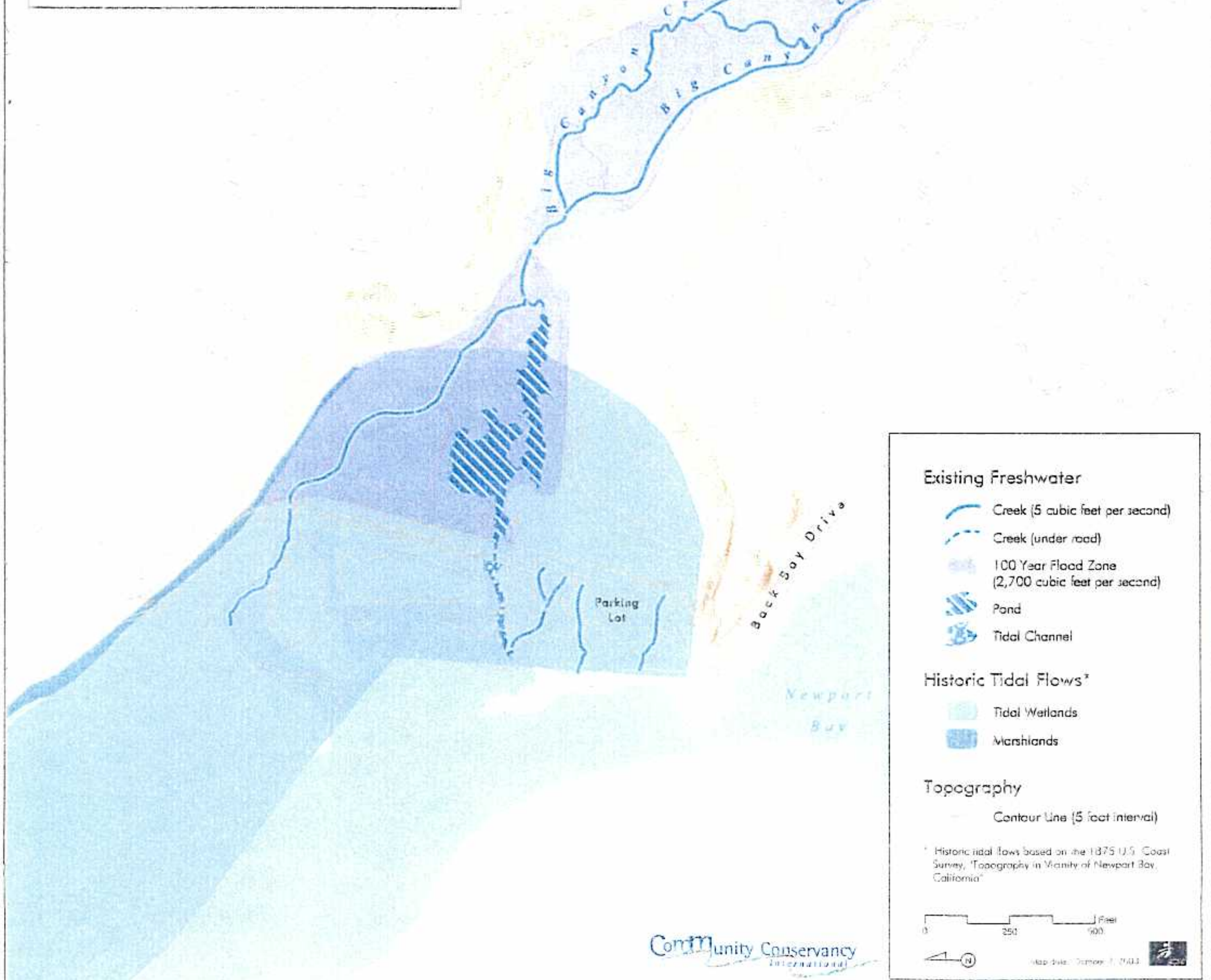
TECHNICAL APPENDIX TABLE OF CONTENTS

HISTORIC TIDAL WETLANDS & WATERS OF BIG CANYON

Waters of Big Canyon

- **Historic Tidal Wetlands**
  The shaded blue-green area shows Big Canyon's historic tidal zone. Before Back Bay Drive was built, tidal wetlands existed where the freshwater pond is today.
- **Urban Runoff**
  Big Canyon drains a two square mile urbanized watershed. Urban runoff is water that enters Big Canyon Creek from watering of lawns, landscaping and golf courses and from streets, parking lots and paved areas.
- **Freshwater Flow**
  Today, due to urban runoff, there is a constant flow in Big Canyon Creek, shown by the thin blue lines. This flow sustains Big Canyon's present-day riparian* areas.
- **Flood Zone**
  During storm events, much more water flows through Big Canyon. The shaded purple area shows the water flows during the greatest storm events, which occur approximately every one hundred years.

* Riparian: water loving trees and other plants that need wet soil



HABITATS AND SENSITIVE SPECIES OF BIG CANYON

Habitats of Big Canyon

A team of biologists conducted surveys in 2003 to record the many different plants and endangered and sensitive species living in Big Canyon. Big Canyon's 70 acres encompass the tidal area influenced by Big Canyon Creek and include mudflats, salt marsh and other wetlands habitats.

- **Diversity**

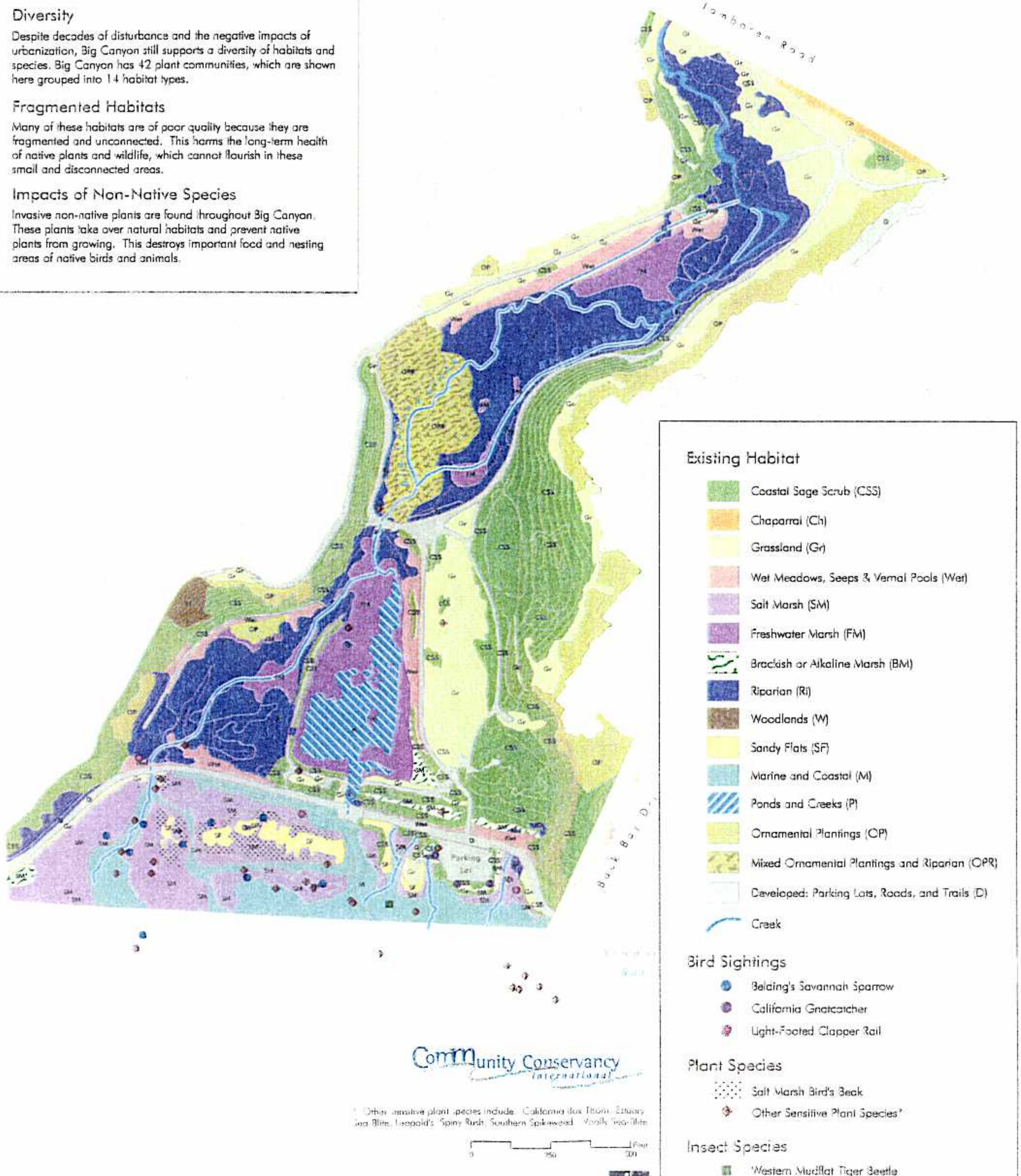
  Despite decades of disturbance and the negative impacts of urbanization, Big Canyon still supports a diversity of habitats and species. Big Canyon has 42 plant communities, which are shown here grouped into 14 habitat types.

- **Fragmented Habitats**

  Many of these habitats are of poor quality because they are fragmented and unconnected. This harms the long-term health of native plants and wildlife, which cannot flourish in these small and disconnected areas.

- **Impacts of Non-Native Species**

  Invasive non-native plants are found throughout Big Canyon. These plants take over natural habitats and prevent native plants from growing. This destroys important food and nesting areas of native birds and animals.



HABITAT RESTORATION NEEDS OF BIG CANYON

Restoration Needs of Big Canyon

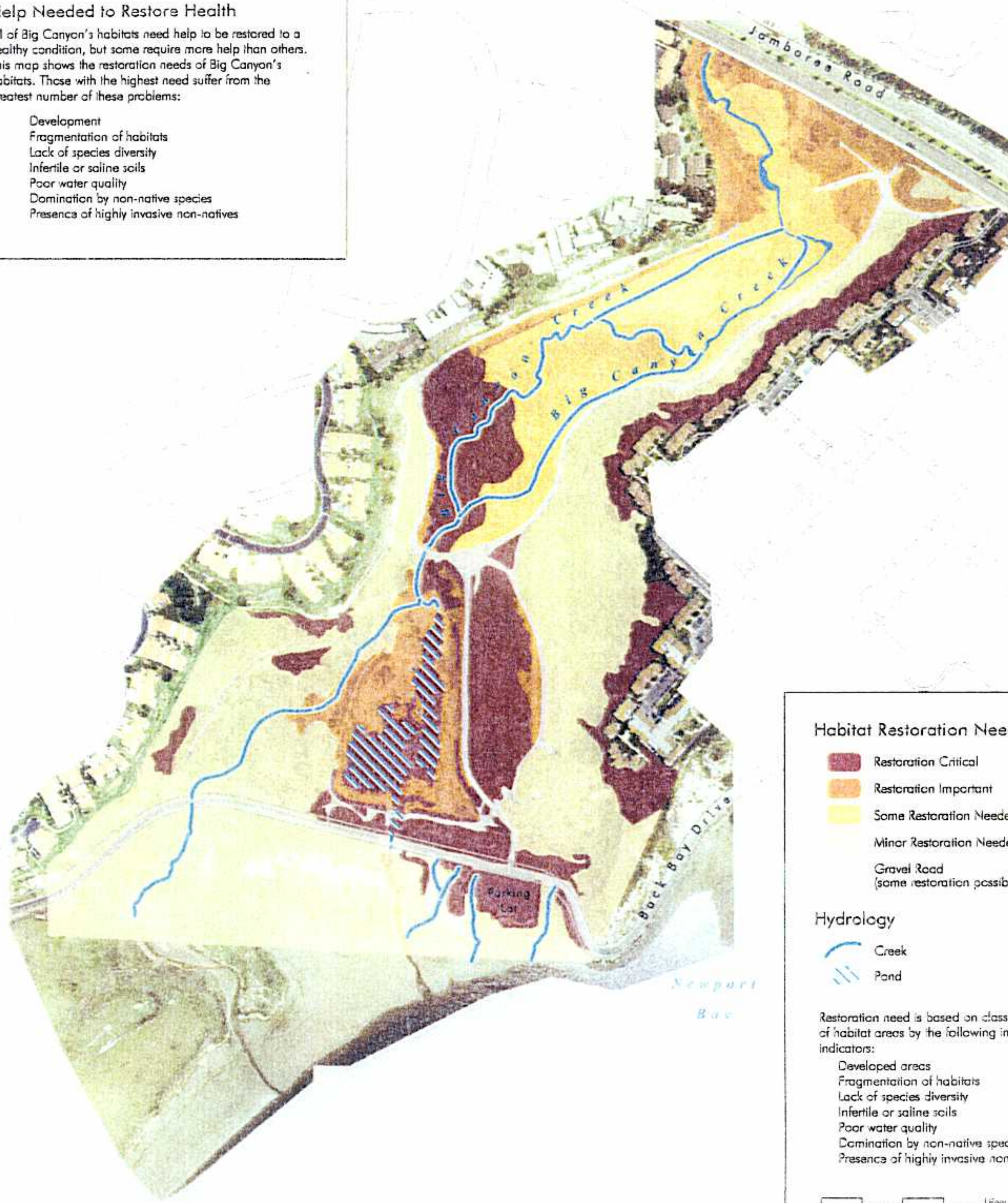
- **Big Canyon's Habitats Degraded**

  Big Canyon has been degraded by contaminated water from urban runoff, dumped dredge materials, road construction, urban development and invasive non-native plants and animals.

- **Help Needed to Restore Health**

  All of Big Canyon's habitats need help to be restored to a healthy condition, but some require more help than others. This map shows the restoration needs of Big Canyon's habitats. Those with the highest need suffer from the greatest number of these problems:

  Development
  Fragmentation of habitats
  Lack of species diversity
  Infertile or saline soils
  Poor water quality
  Domination by non-native species
  Presence of highly invasive non-natives



Habitat Restoration Needs

- Restoration Critical
- Restoration Important
- Some Restoration Needed
- Minor Restoration Needed
- Gravel Road (some restoration possible)

Hydrology

- Creek
- Pond

Restoration need is based on classification of habitat areas by the following impact indicators:

Developed areas
Fragmentation of habitats
Lack of species diversity
Infertile or saline soils
Poor water quality
Domination by non-native species
Presence of highly invasive non-natives

0 250 500 Feet

Community Conservancy International

TERRESTRIAL BIOLOGICAL TECHNICAL APPENDIX

By Kathy Keane, Spencer Langdon, Nathan Mudry, Guy Bruyea,
Brian Leatherman, Shana Dodd and Dave Bramlet
Keane Biological Consulting

1.0 PLANT COMMUNITIES AND BOTANICAL RESOURCES

1.1 Methods for Plant Community Mapping and Botanical Surveys

Dave Bramlet, botanist with over twenty years of experience conducting general and focused botanical investigations including development of the Orange County plant community classification system, conducted the plant community mapping and botanical surveys for this project. Mr. Bramlet also authored the botanical sections of this report. He began with a general review of the existing literature before the initiation of the field surveys. Reviewed literature consisted of reports describing the botanical resources in Upper Newport Back Bay, including reports by Marsh (1990), PSBS 1991a, and the U.S. Army Corps of Engineers (2000). However, no reports were located that documented the environmental studies or restoration efforts in Big Canyon. Other aspects of the literature review are described in the Section 4.

Field surveys were then conducted in Big Canyon to determine the plant communities present at this locality. The initial surveys were conducted on May 2, 7, 14 and 19, 2003. These field examinations consisted of walking along the existing service roads, and noting the dominant species in each community. The aerial photograph was too cumbersome to take into the field; therefore, plant community mapping was conducted in the office based on the observations in the field. Field checking of the vegetation, using copies of the draft map, was conducted on June 24, 2003.

The field examinations also noted the presence of plant species of special-status. Before the surveys were conducted, known localities of the salt marsh bird's beak and coastal woolly heads *(Nemacaulis denudata var. denudata)* were examined to determine the phenology of these species at the time of the field survey. The presence of the salt marsh bird's beak and other plant species of special status were noted during the surveys. At each locality the UTM coordinate was noted, plus the plant community, and associated species where the species was located. In addition the total number of plants at each locality was counted or estimated.

Surveys were then conducted in June to complete the surveys for special-status plant species. Surveys were conducted on June 10 and 11, 2003 to complete the surveys for the salt marsh bird's beak, especially on the small islets near the mouth of Big Canyon. Work was also initiated on collecting qualitative data on the plant communities. This procedure used a modified "rapid assessment" method of California Native Plant Society (CNPS) (2002), and noted the percent cover of the plant species that comprised the most common plant communities in the Big Canyon study area. The sampling was completed during surveys conducted on July 20, 24 and 26, 2003.

The locality of the plant species of concern, and other features was noted using a Garmin 12XL GPS receiver. The data was initially collected using a NAD 27 datum in Universal Transverse Mercator (UTM) coordinates, since the locational data was initially transferred to CD topographic maps. The data was later translated to Latitude and Longitude (decimal degrees) using a NAD 1983 datum. The Topo! CD map program was used to covert the coordinates on the localities of these species in Big Canyon.

Plant species were identified in the field or collected for later identification. Plants were identified using taxonomic keys in Hickman (1993), Munz (1974), and Mason (1957). Nomenclature for plants generally follows Hickman (1993), for scientific names and Roberts (1998) for common names with some modifications from the recent taxonomic literature (Baldwin 2000). Scientific and common names for the plant special-status species follow the CNPS Inventory of Rare and Endangered Plants in California (CNPS

2001). Plant community classification generally follows Gray and Bramlet (1992) and Jones and Stokes (1993).

1.2 Plant Communities

The following section presents the descriptions of the plant communities and other mapping units, such as urban areas and streets, noted on the vegetation map developed for Big Canyon. The communities are presented in the numerical order of the Orange County Classification system (Gray and Bramlet 1992), rather than the total area covered by these communities within the canyon and adjacent slopes. Locations of these plant communities are depicted in the Habitats and Sensitive Species of Big Canyon Map (Figure A2). A list of all plant species observed in Big Canyon is provided in Section 9, and results of an analysis of percent cover for each of the plant communities is provided in Section 10.

1.2.1 Coastal Sage Scrub Habitats

Several types of coastal sage scrub were identified in Big Canyon, as discussed in this section. **Southern coastal bluff scrub** is found on the cliffs and slopes on the north and south sides of Big Canyon. This community consists of California bush sunflower (*Encelia californica*), California buckwheat (*Eriogonum fasciculatum*), coastal prickly pear (*Opuntia littoralis*), California sagebrush (*Artemisia californica*), bladderpod (*Isomeris arborea*), and coastal prickly pear (*Opuntia littoralis*). Less common shrubs include California box thorn (*Lycium californicum*), coastal cholla (*Opuntia prolifera*), and woolly sea blite (*Suaeda taxifolia*). Myoporum (*Myoporum laetum*), tree tobacco (*Nicotiana glauca*), and castor bean (*Ricinus communis*) were some of the weedy shrubs found on these slopes. Perennial herbs in the southern coastal bluff scrub habitat include Parish's pickleweed (*Arthrocnemum subterrminale*), alkali heath (*Frankenia salina*), lance-leaved live forever (*Dudleya lanceolata*), crystal ice plant (*Mesembryanthemum crystallinum*), and hottentot fig (*Carpobrotus edulis*). The annual cover consists of black mustard (*Brassica nigra*), red brome (*Bromus madritensis* ssp. *rubens*), alkali weed (*Cressa truxillensis*), Nuttall's snapdragon (*Antirrhinum nuttallianum*), summer mustard (*Hirschfeldia incana*), Russian thistle (*Salsola tragus*), nasturtium (*Tropaeolum majus*), and alkali heliotrope (*Heliotropum curassavicum*).

The **southern coastal bluff scrub/chenopod scrub** community consists of a coastal bluff scrub with large stands of four-wing saltbush (*Atriplex canescens*), and/or quail bush (*Atriplex lentiformis*). Other species found in this community include California bush sunflower, California buckwheat, coyote brush (*Baccharis pilularis*), California sagebrush, and coastal isocoma (*Isocoma menziesii*). Typical understory species include black mustard, red brome, and yellow sweet clover (*Melilotus indica*).

Sagebrush scrub was dominated by stands of California sagebrush. Other shrubs include California bush sunflower, Emory's baccharis (*Baccharis emoryi*), California buckwheat, Mexican elderberry (*Sambucus mexicana*), and coyote brush. Uncommon species are quail bush, myoporum, and an unidentified saltbush (*Atriplex sp.*) likely planted during a previous restoration project in the area. The understory consists of ripgut brome (*Bromus diandrus*), red brome, red-stemmed filaree (*Erodium cicutarium*), black mustard, yellow sweet clover, summer mustard, foxtail fescue (*Vulpia myuros*), foothill needle grass (*Nassella lepida*), alkali heath, tocalote (*Centaurea melitensis*), and soft chess (*Bromus hordeaceus*).

Sagebrush scrub/Chenopod scrub is composed of open to dense stands of an unknown saltbush in stands of sagebrush scrub. **Coyote brush scrub** is characterized by dense stands of coyote brush, which is associated with some California sagebrush, saltbush, California buckwheat, California bush sunflower, giant wild rye (*Leymus condensatus*), and coastal isocoma. Both lemonade berry (*Rhus integrifolia*) and Mexican elderberry are shrubs uncommonly found in this scrub. The understory is composed of soft chess, ripgut brome, yellow sweet clover, black mustard, red brome, Italian thistle (*Carduus pycnocephalus*), summer mustard, alkali heath, western verbena (*Verbena lasiostachys*), curly dock (*Rumex crispus*), and white sweet clover (*Melilotus alba*).

California bush sunflower scrub is characterized by dense stands of California bush sunflower. Other shrubs are uncommon but included California buckwheat, four-wing salt bush, coastal prickly pear, California sagebrush, coastal cholla, tree tobacco, and coyote brush. The understory consists of red brome, black mustard, crystal ice plant, summer mustard, salt grass (*Distichlis spicata*), and alkali heath. California bush sunflower scrub/Chenopod scrub consists of large patches of four-wing saltbush and/or quail bush, intermixed with a California bush sunflower scrub.

Salt-bush or Chenopod scrub is dominated by various species of shrubby or subshrub saltbush species. In some areas this consisted of dense stands of four-wing saltbush or quail bush. Other localities were totally dominated by an unknown saltbush that does not appear in other localities in Upper Newport Bay. Associated shrubs in these habitats include California bush sunflower, California sagebrush, coyote brush, and coastal isocoma. The understory is comprised of red brome, black mustard, yellow sweet clover, glaucous-leaved saltbush (*Atriplex glauca*), tocalote, alkali heath, five-hook bassia (*Bassia hyssopifolia*), alkali heliotrope, soft chess, salt grass, common woody pickleweed (*Salicornia virginica*), and fascicled tarplant (*Deinandra fasciculata*).

Chenopod scrub/alkali meadow consists of very open stands of quail bush or an unknown saltbush in an alkali meadow community. Sagebrush sage scrub/grassland ecotone community consists of very open stands of California sagebrush within an annual grassland community. Other shrubs found in this ecotonal community include coyote brush, California bush sunflower, and coastal isocoma. The grassland is primarily composed of black mustard, summer mustard, ripgut brome, red brome, horehound (*Marrubium vulgare*), Italian thistle, alkali heath, five-hook bassia, hottentot fig, and tocalote.

Mixed sage scrub/grassland ecotone consists of open stands of coastal isocoma, coyote brush California sagebrush, saltbush, and California bush sunflower in an annual grassland community. The grassland includes black mustard, yellow sweet clover, red brome, tocalote, yellow sweet clover, foxtail barley, ripgut brome, tocalote, soft chess, summer mustard, alkali heath, five-hook bassia, and fascicled tarplant.

Mixed sage scrub/grassland ecotone/Alkali meadow consist of an open shrub cover of coyote brush, Emory's baccharis, coastal isocoma, and California sagebrush in a alkali meadow community that is poorly developed (limited in species diversity). Openings in the shrub cover are dominated by summer mustard, horehound, foxtail barley (*Hordeum murinum* ssp. *leporinum*), slender wild oat (*Avena barbata*), five-hook bassia, white sweet clover, and crystal ice plant. These habitats also contain fairly dense patches of alkali heath, salt grass, western ragweed (*Ambrosia psilostachya*), and rabbit's foot grass (*Polypogon monspeliensis*).

1.2.2 Chaparral Habitats

Toyon-Sumac chaparral is poorly developed within the canyon, and consists some apparently planted material along the margin of the upper canyon and Jamboree road and a locality in the northwest edge of the canyon. The community consists of stands of lemonade berry, along with toyon (*Heteromeles arbutifolia*) in some localities. Other species include Mexican elderberry, California sagebrush, and coyote brush. This habitat was considered a toyon-sumac chaparral with ornamental plantings, due to the presence of acacia (*Acacia spp.*) and other ornamental plantings. This type of chaparral is composed of a toyon-sumac chaparral with scattered acacia or oleander (*Nerium oleander*) and myoporum shrubs. The second location for this community was not separately mapped, since it was found adjacent to arroyo willows on the north side of the existing interpretative trail. This locality was composed of lemonade berry, Emory's baccharis, toyon, myoporum, coyote brush, Brazilian pepper (*Schinus terebinthifolius*), and acacias. It was found adjacent to areas of arroyo willow riparian scrub.

1.2.3 *Grassland Habitats*

Annual grassland is dominated by naturalized annual grasses and forbs. Characteristic grass species in this community include ripgut brome, red brome, foxtail barley, soft chess, slender wild oat, Italian ryegrass (*Lolium multiflorum*), foxtail fescue (*Vulpia myuros*), and occasionally purple false brome (*Brachypodium distachyon*). Common forbs include black mustard, wild radish (*Raphanus sativa*), fascicled tarplant , yellow sweet clover, tocalote, red-stemmed filaree, summer mustard, scarlet pimpernel (*Anagallis arvensis*), common sow thistle (*Sonchus oleraceus*), horehound (*Marrubium vulgare*), pygmy sand weed (*Crassula connata*), coyote melon (*Cucurbita foetidissima*), Italian thistle (*Carduus pycnocephalus*), western verbena, and sweet fennel (*Foeniculum vulgare*).

In some areas, the grassland consists of dense stands of sweet fennel, interspersed with summer mustard, and black mustard, while other areas were dominated by red brome, ripgut brome, tocalote, curly dock, slender wild oat, scarlet pimpernel, Italian thistle, wild radish, and poison hemlock (*Conium maculatum*). Other grasslands are characterized by dense stands of ripgut brome, interspersed with patches of alkali heath. Other typical species in these localities consist of red brome, black mustard, Italian thistle, curly dock, and alkali heliotrope.

Annual grassland/Ornamental vegetation consists of scattered acacia, myoporum, and/or Brazilian pepper trees, which are sometimes quite dense, within an annual grassland matrix. **Ruderal grassland** is composed of species typically found in disturbed areas. Characteristic species included foxtail barley, ripgut brome, small-flowered iceplant (*Mesembryanthemum nodiflorum*), five-hook bassia, garland chrysanthemum, crystal ice plant, bur clover (*Medicago polymorpha*), tocalote, Australian salt bush (*Atriplex semibaccata*), summer mustard, cheese weed (*Malva parviflora*), glaucous-leaved saltbush, telegraph weed (*Heterotheca grandiflora*), schismus (*Schismus barbatus*), yellow sweet clover, sweet alyssum (*Lobularia maritima*), Spanish sunflower (*Pulicaria paludosa*) statice (*Limonium sp.*), and lesser wort cress (*Coronopus didymus*). Other areas of ruderal grassland in Big Canyon support open stands of crystal ice plant, statice, tocalote, glaucous-leaved saltbush, and summer mustard. Along some of the existing maintenance roads, disturbed sites often contained dense stands of five-hook bassia, hottentot fig, common horseweed (*Conyza canadensis*), Australian saltbush, and foxtail barley.

Alkali grassland in Big Canyon is poorly developed in comparison with some other localities in Upper Newport Bay. In Big Canyon, this community consists of a combination of annual grassland, and alkali meadow plant species. Common species included foxtail barley, ripgut brome, yellow sweet clover, sickle grass (*Parapholis incurva*), soft chess, black mustard, five-hook bassia, tocalote, small-flowered ice plant , sweet fennel, Bermuda grass (*Cynodon dactylon*), Australian saltbush, Italian ryegrass, garland chrysanthemum (*Chrysanthemum coronarium*), alkali heliotrope, glaucous-leaved saltbush, summer mustard, common sow thistle (*Sonchus oleraceus*), and bristly ox tongue (*Picris echioides*). Typical alkali elements found in this grassland include alkali weed, salt grass, alkali heath, and occasionally woody pickleweed.

Alkali grassland/ruderal is found in the old dredged material disposal area and consists of a disturbed annual grassland vegetation with elements of the alkali grassland. Common species are five-hook bassia, foxtail barley, tocalote, white sweet clover, red brome, London rocket (*Sisymbrium irio*), crystal ice plant, glaucous-leaved saltbush, alkali heliotrope, foxtail barley, Australian saltbush, hottentot fig, garland chrysanthemum, Australian saltbush, ripgut brome and Russian thistle (*Salsola tragus*). Scattered within the grassland are dense patches of alkali heath, common woody pickleweed, salt grass, and alkali weed.

1.2.4 Wet Meadows, Seeps & Vernal Pools

Alkali meadow is characterized by a dominance of perennial grasses and herbs and emergent species, such as cat-tails are uncommon in this meadow habitat. Meadows found in Big Canyon are dominated by dense stands of saltgrass, jaumea (*Jaumea carnosa*), or alkali heath. Other typical species include woody pickleweed, common celery (*Apium graveolens*), rabbit's foot grass (*Polypogon monspeliensis*), yellow sweet clover, ripgut brome, Spanish sunflower, soft chess, alkali heliotrope, five-hook bassia, halberd-leaved saltbush (*Atriplex patula*), bristly ox tongue, prickly sow thistle (*Sonchus asper*), African brass buttons (*Cotula coronopifolia*), white sweet clover, and western rag weed (*Ambrosia psilostachya*). Uncommon species in these meadows include narrow-leaved cat-tail (*Typha domingensis*), alkali bulrush (*Scirpus maritimus*), southwestern spiny rush (*Juncus acutus* ssp. *leopoldii*), and southern tarplant (*Centromadia parryi* ssp. *australis*).

1.2.5 Marsh Habitats

Salt Marsh habitats in Big Canyon include upper, middle and lower intertidal salt marsh.
Upper intertidal salt marsh is found within the boundaries of the high tide fluctuations and has the highest plant species diversity of the saltmarsh communities. Charachteristic species within this salt marsh region include jaumea, salt grass, shore grass (*Monanthochloe littoralis*), alkali heath, California marsh rosemary (*Limonium californicum*), common woody pickleweed, estuary sea blite (*Suaeda esteroa*), American saltwort (*Batis maritima*), and in some areas the salt marsh bird's beak (*Cordylanthus maritimus*). Other less common species consist of alkali weed, salty dodder (*Cuscuta salina*), round-leaved arrow grass (*Triglochin concinna*), and Parish's pickleweed. The upper margin of this marsh contains southwestern spiny rush and rabbit's foot grass, woolly sea blite, five-hook bassia, and alkali heliotrope.

Middle intertidal salt marsh is dominated by stands of common woody pickleweed. Other species found in this portion of the tidal prism include American saltwort, jaumea, round-leaved arrow grass, alkali heath, and uncommonly California cord grass (*Spartina foliosa*). Scattered stands of the annual Bigelow's pickleweed (*Salicornia bigelovii*) become apparent in the summer months. This species is very typically uncommon in developed stands of the common woody pickleweed. However, fairly dense stands of this species appear to develop in the open mudflats, at a slightly lower elevation in the tidal prism and/or in poorly developed stands of the common woody pickleweed.

Lower intertidal salt marsh is dominated by dense stands of Pacific cord grass. Other species found in this portion of the marsh include common woody pickleweed, American saltwort, and jaumea. In some of the tidal channels lower salt marsh vegetation is mixed with elements of the brackish marsh community, especially coastal bulrush (*Scirpus robustus*), and alkali bulrush (*Scirpus maritimus*).

Coastal brackish marsh is influenced by brackish and freshwater and is often found in channels that may have some tidal influence. In some localities these marshes may consist of dense stands of coastal or alkali bulrush. In other channels the marsh may be composed of broad-leaved cat-tail (*Typha latifolia*), narrow-leaved cat-tail, and/or California bulrush (*Scirpus californicus*), with stands of alkali bulrush. Other species in this marsh consist of common woody pickleweed, hoary nettle (*Urtica dioica*), jaumea, salt grass, alkali heath, yellow sweet clover. At some of the localities of this marsh type, Emory's baccharis and mulefat (*Baccharis salicifolia*) is scattered along the upper margins of the marsh.

Cismontane alkaline marsh is found in moist or potentially inundated areas that lacked tidal fluctuations. These areas support open stands of broad-leaved or narrow-leaved cat-tails, along with stands of alkali bulrush. Other taller herbaceous species included marsh fleabane (*Pluchea odorata*), Spanish sunflower, yellow sweet clover, common woody pickleweed, bristly ox tongue (*Picris echioides*), rabbit's foot grass, poison hemlock, western ragweed (*Ambrosia psilostachya*), common celery, jaumea, and alkali heath. There was often some shrubby species on the margin of this marsh including Emory's baccharis, mulefat, and coyote brush

Freshwater marsh in big Canyon is present around a large pond that has formed above the outlet of Big Canyon Creek. This marsh consists of dense stands of broad-leaved cat-tail, with some occasional stands of California bulrush with margins supporting a variety of herbaceous plant species including western ragweed, hoary nettle, rabbit's foot grass, yellow sweet clover, salt grass, common woody pickleweed, and alkali heath.

1.2.6 Riparian Habitats

The riparian herb community is found along the margins of the riparian scrub or riparian forest (described below) and in some of the openings within these communities. This habitat is distinguished from the marsh and meadow habitats in lacking a dense cover of perennial grasses and/or emergent cat-tails or rushes. Common species in this herb community consist of rabbit's foot grass, yellow sweet clover, Spanish sunflower, bristly ox tongue, hoary nettle, western rag weed, prickly sow thistle, poison hemlock, dwarf nettle (*Urtica urens*), common sow thistle, nettle-leaved goosefoot (*Chenopodium murale*), white sweet clover, common celery, curly dock, western verbena, alkali heliotrope, western ragweed, and mugwort (*Artemisia douglasiana*). In some areas there are also occasional patches of alkali heath, and woody pickle weed. Broad-leaved cat-tail, Olney's bulrush, and alkali bulrush were also uncommon found scattered along the stream margins. Several localities along Biog Canyon Creek also support dense mats of water cress (*Rorippa nasturtium-aquaticum*), along with white sweet clover, halberd-leaved saltbush, cocklebur (*Xanthium strumarium*), common celery, rabbit's foot grass, coast goosefoot (*Chenopodium macrospermum*), lamb's quarters (*Chenopodium album*), curly dock, and pale spike rush (*Eleocharis palustris*).

The willow riparian scrub community is the most common riparian community found along Big Canyon Creek. This riparian scrub was dominated by a shrub cover of arroyo willow (*Salix lasiolepis*), along with mulefat, Brazilian pepper, and occasionally Mexican elderberry, evergreen ash (*Fraxinus uhdei*), and black willow (*Salix gooddingii*). Typical understory species consisted of soft chess, white sweet clover, hoary nettle, bristly ox tongue, common celery, black mustard, Spanish sunflower, beardless wild rye, mugwort, Mexican tea, alkali heath, scarlet pimpernel, white nightshade (*Solanum americanum*), ripgut brome, sweet fennel, and western verbena. Pockets of marsh species also occur in willow riparian scrub, characterized by areas of broad-leaved cat-tail, alkali bulrush, and/or Olney's bulrush. These often occur with hoary nettle, alkali heath, poison hemlock, salt grass, marsh fleabane, Spanish sunflower, western ragweed, and mugwort. Invasive weeds noted in willow riparian scrub included Brazilian pepper, evergreen ash, pampas grass, castor bean, Pride of Madeira (*Echium candicans*), poison hemlock, sweet fennel, bull thistle, and blue periwinkle (*Vinca major*).

Mulefat scrub is often found on the outer margins of the willow scrub, along the existing maintenance roads, and/or in isolated stands within Big Canyon Creek. It is also found in moist areas adjacent to Backbay Drive, where it was associated with meadow or marsh communities. This community is characterized by stands of mulefat, along with Emory's baccharis, coyote brush, arroyo willow, and uncommonly Mexican elderberry. The understory of this shrub community consisted of yellow sweet clover, alkali heath, narrow-leaved cat-tail, summer mustard, white sweet clover, common sow thistle, bristly ox tongue, and beardless wild rye.

Small patches of a black willow forest occur in the southeastern portion of the creek. This community consists of sapling black willow trees along with arroyo willow, Brazilian pepper, and mulefat. The understory consisted of broad-leaved cat-tail, hoary nettle, and mugwort.

The northwestern portion of Big Canyon supports a willow riparian forest characterized by an mixed upper canopy of Fremont cottonwood (*Populus fremontii*), black willow, Brazilian pepper, and western sycamore (*Platanus racemosa*). The shrub layer includes arroyo willow, Emory's baccharis, Mexican elderberry, poison oak (*Toxicodendron diversilobum*), California wild rose (*Rosa californica*), myoporum, and coyote brush. The understory is composed of common celery, hoary nettle, white sweet clover, rabbit's foot grass, Spanish sunflower, black mustard, soft chess, alkali heath, broad-leaved cat-tail, water cress, sweet fennel, ripgut brome, weedy cudweed (*Gnaphalium luteo-album*), common horse weed, western golden rod (*Euthamia occidentalis*), mugwort, western ragweed, and curly dock. Some of the marsh outer margins support areas of salt grass, common woody pickleweed, jaumea, alkali bulrush, and alkali heliotrope, southwestern spiny rush, and yerba mansa (*Anemopsis californica*).

1.2.7 Woodlands

The Mexican elderberry woodland/Ornamental woodland community consists of a dense stand of Mexican elderberry, associated with a large area of castor bean. Other species in this habitat included California sagebrush, coastal goldenbush, California bush sunflower, bladderpod, horehound, and Russian thistle.

1.2.8 Marine and Coastal Habitats

Sandy flats are open sandy areas generally lacking vegetation that were found on the two islets on the western portion of Big Canyon. These open sandy areas were subject to occasional tidal inundation, but were not considered disturbed sites. There was often some scattered cover of batis, shore grass, salt grass, jaumea, and/or alkali heath within or on the margin, but overall these flats were unvegetated. Tidal mud flats consist of tidal flats within Big Canyon that are exposed by low tides. This mapping unit often has a large amount of algal species and diatoms within the muddy substrate.

1.2.9 Lakes and Basins

Open Water consists of the large freshwater pond found at the western end of the creek. The only plant species noted in this habitat were some Pacific mosquito fern (*Azolla filiculoides*), and lesser duck weed (*Lemna minor*) floating on the surface of the pond. Other smaller ponds along the creek were not mapped, since they were obscured on the aerial by the overstory of willows and mulefat shrubs.

1.2.10 Developed Areas

Urban & Commercial (including paved streets) includes existing residences and associated streets found the north and south sides of the canyon. It also includes portions of Jamboree road and the adjacent sidewalk. Backbay Drive was also mapped in this unit. Non urban/commercial structures (includes boardwalks, kiosks, etc.) include the existing kiosk and portions of the boardwalks found within Big Canyon. Ornamental Plantings (15.5) not associated with native plant communities were placed in this mapping unit. This generally excluded the dense monotypic stands of ice plant found on some portions of the slopes above the canyon. In general these plantings consisted of dense stands of several species of acacia, eucalyptus (*Eucalyptus spp.*), myoporum, pines (*Pinus spp.*), Mexican fan palm (*Washingtonia robusta*), Pride of Madera, lantana (*Lantana camara*), cape honeysuckle (*Tecomaria capensis*) and silk oak (*Grevillea robusta*). Other species typically planted on these slopes consisted of English ivy (*Hedera helix*), oleander, bougainvillea (*Bougainvillea glabra*), Japanese honeysuckle (*Lonicera japonica*), pampas grass, Mediterranean fan palm (*Chamaerops humilis*), and trailing African daisy (*Osteospermum ecklonis*).

Ornamental Plantings/Riparian could also be considered a Brazilian pepper riparian forest and is found near the center of Big Canyon, along Big Canyon Creek. This community consists of dense stands of Brazilian pepper. There are occasionally some evergreen ash trees but these species are very uncommon in this riparian forest. There is little shrub layer in this riparian community; however, in some of the openings of the canopy a few or arroyo willows or mulefat shrubs, along with poison, are found. The understory is composed of common celery, Spanish sunflower, mugwort (*Artemisia douglasiana*), nasturtium, yellow sweet clover, bristly ox tongue, and rabbit's foot grass.

Ornamental Plantings/Willow riparian scrub consists of scattered Brazilian pepper within a willow riparian scrub. This was most noticeable in the riparian habitat adjacent to the Brazilian pepper riparian forest, but occurred in other localities along the creek. **Ice plant plantings** consists of large areas of ice plant and included hottentot fig and at least two other iceplant species found within the canyon.

The **graded** mapping was used to map the existing dirt roads, and some open disturbed areas that had previously been graded or disturbed by maintenance activities. The parking lot off of Backbay Drive was also placed in this mapping unit.

2.0 ENTOMOLOGICAL RESOURCES

2.1 Methods for Entomological Surveys

Big Canyon was surveyed by Guy P. Bruyea, entomologist with 20 years of experience conducting insect surveys in southern California, on May 19, June 14, and July 10, 2003. Survey times and other information are presented in Table 1. Mr. Bruyea also authored the entomological sections of this report.

Table B1. Timing and Weather Data for Big Canyon Insect Surveys
May-July 2003

Date	Time	Weather
May 19	1100-1500	Sunny, 71-75 °F
June 14	1000-1500	Sunny, 69-75°F
July 14	1000-1715	Sunny, 69-80°F

The entomological surveys included a: 1) general daytime insect survey; and 2) insect habitat survey. Special consideration was given in locating potentially suitable habitat for rare, threatened, endangered, and special-status insects, including the wandering skipper butterfly (*Panoquina errans*) and several species of tiger beetles (*Cicindella* sp.) (see Section 6). Focused surveys for the presence or absence of these or other special status species were not conducted during this assessment.

The entire area of Big Canyon was surveyed and was covered on foot by conducting a series of transects across the subject property where possible, stopping periodically for observations and notations. This field survey was conducted during daylight hours from 1000 to 1715 Pacific Daylight (Savings) Time (PDT). Temperatures recorded during the survey ranged from 69 to 80°F (degrees Fahrenheit) and conditions were generally sunny (a marine layer was present during parts of the survey) with little or light winds (at or less than 1 Beaufort scale). Digital photographs were taken to record the condition of Big Canyon during the survey and are available on CD-ROM on request. Plant and insect species were identified in the field or later identified using various texts. All observed plant and animal species and any additional biological information relevant to this study were recorded on a general site assessment form. Diurnal surveys were conducted throughout Big Canyon, surveying at least a portion of each of the habitat types during each visit. During these field surveys, insects observed and recorded included those found flying, on various substrates such as on plants, on the ground, in leaf litter, or in aquatic situations. Additional small insects were sampled from plants with the aid of sweep nets and beating sheets. Some species, such as ants and termites, were best observed with the use of an aspirator.

Species that were not readily identified in the field were collected. Voucher specimens collected during the survey period were classified to whatever taxonomic level possible and are currently being prepared and labeled. Most adult insect specimens will be mounted on insect pins, labeled, and stored in Cal Academy drawers at the University of California-Riverside (UCR) Entomological Research Museum. Soft-bodied insects are stored in glass vials containing 70% ethanol, also at the UCR Museum. A complete taxonomic listing of insects found during the survey is provided in Section 9 of this report.

Limitations of the insect survey exist as the surveys were only conducted in May, June and July 2003. Due to seasonal restrictions and the atypically cool conditions present in May and June 2003, not all insects that may have been present at Big Canyon were necessarily observable (or identified) during this survey. For an exhaustive insect assessment, surveys are best performed throughout the year to achieve thorough insect inventories. The insect survey was performed during daylight hours only, so nocturnal insect species with a probability of occurrence were not directly observed. In addition, this survey did not involve various passive trapping methods (such as malaise or pitfall traps). Mr. Bruyea's general knowledge of insect resources for this area was utilized in an effort to determine the probability of occurrence for some special-status insect species, discussed in Section 6.

For special-status insect species, a reconnaissance survey to the Imperial Beach and Tijuana Estuary areas in southern San Diego County was performed by Mr. Bruyea on July 13, 2003. David Hawks, a University of California, Riverside (UCR) entomologist and research associate, accompanied Mr. Bruyea on that survey. The purpose of the survey was to assess the 2003 flight period status of several rare tiger beetle species that are known to occur within this general region of San Diego County. On that date at the Imperial Beach location, all species known to occur at that location were active, including *C. hirticollis gravida*, *C. latesignata*, *C. trifasciata sigmoidea*, *C. gabbii*, and *C. haemorrhagica*. Based on the results of that survey, Mr. Bruyea's final visit to Big Canyon was performed immediately thereafter in an effort to assess the *Cicindela* inhabitants of the area.

2.2 Entomological Survey Results

Five basic habitat types for insects were identified at Big Canyon. These are: 1) tidal salt marsh, 2) freshwater marsh, 3) riparian, 4) coastal sage scrub, and 5) disturbed and/or ruderal. Virtually all habitat types at Big Canyon are insect habitats. However, most are inhabited by insect species that are still considered to be fairly widespread. Some habitats probably support insect species that should be considered of special status, but because of a lack of knowledge about the taxonomy and distribution of many of these insects, most cannot be regarded as special-status insect species at this time.

Except in the cases of relatively few predators, omnivorous herbivores, or highly vagile species (such as dragonflies and some butterflies), insect species are closely linked to a particular host plant or habitat type. Several insect species described in this report exemplify some of the many strategies and niche partitioning characteristics of insects in coastal southern California.

Many butterflies are becoming increasingly scarce in southern California, especially in coastal and valley areas were natural habitats have been converted for human uses or have been adversely impacted by various anthropogenic disturbances. Additionally, in the relatively less disturbed foothill and mountain areas the spread of invasive non-native weedy vegetation, grazing, fire suppression, and off-road vehicle activity is threatening many native plants, including butterfly larval host plants.

Butterflies are among the more familiar and easily identified insects to the amateur entomologist or nature enthusiast, and can be a good indicator of habitat quality in a particular area. Many butterfly species are easily monitored and respond quickly to changes in habitat, and their absence (in places where they were formerly present) can be an important indicator of habitat degradation. Thus, butterfly occupants of Big Canyon are discussed in detail below.

There are approximately 96 recorded butterfly species from Orange County, of which approximately 75 are considered resident (Orsak, 1978). Some species have adapted well to ornamental landscapes, but many formerly common species have now become increasingly rare over the past few decades due to urban expansion and other factors. Orsak (1978) reports that Upper Newport Bay has at least 33 resident species, which represents the second most diverse site in Orange County (second only to Silverado Canyon in the Santa Ana Mountains with 39 species recorded).

A total of twenty-one relatively common butterfly species were observed during the survey (see Table 2 and Section 9).

Table B2.
Big Canyon Lepidoptera Observations
May–July 2003

Common Name / Scientific Name	Survey Dates		
	May 19	June14	July14
Western Tiger Swallowtail (*Papilio rutulus*)	x	x	
Anise Swallowtail (*Papilio zelicaon*)		x	x
Checkered White (*Pontia protodice*)	x	x	x
Cabbage White (*Pieris rapae*)	x	x	x
Sara Orange-tip (*Anthocharis sara*)	x		
Alfalfa Sulfur (*Colias eurytheme*)		x	
Painted Lady (*Vanessa cardui*)		x	
Red Admiral (*Vanessa atalanta*)	x[1]		x
West Coast Lady (*Vanessa annabella*)		x	x
Virginia Lady (*Vanessa virginiensis*)	x[2]		x
Buckeye Butterfly (*Junonia coenia*)		x	
Mourning Cloak (*Nymphalis antiopa*)	x	x	x
Gulf Fritillary (*Agraulis vanillae incarnata*)		x	
Fiery Skipper (*Hylephila phyleus*)	x		x
W. Checkered Skipper (*Pyrgus communis albescens*)			x
Eufala Skipper (*Lerodea eufala*)	x		
Funereal Duskywing (*Erynnis funeralis*)	x		
Acmon Blue (*Icaricia acmon*)		x	x
Pygmy Blue (*Brephidium exilis*)		x	x
Marine Blue (*Leptotes marina*)			x
Common Hairstreak (*Strymon melinus*)	x		
21 Species Total			

[1] Larva observed on host plant, stinging nettle (*Urtica dioica*).
[2] Larvae observed on host plant, everlasting cudweed (*Gnaphalium luteo-album*)

The absence of higher butterfly diversity at Big Canyon is probably due primarily to habitat fragmentation and other human related disturbances in the immediate vicinity. In addition, atypically cool conditions before the start of the survey, and/or the limits of the present study, undoubtedly limited what butterfly species were observed.

Relatively few other insect species were observed during the present study. This may be due to several factors, including an atypically cool late spring in 2003, which may have delayed or disrupted insect emergence patterns. In other parts of southern California, lack of sufficient rainfall from 2000 to 2002 had an adverse effect on some insect species, and it may take several years for some species to recover to pre-drought population densities. Disturbances to native vegetation in adjacent areas by residential and/or commercial developments have likely affected insect diversity and abundance in the Upper Newport Bay area.

Potential native and non-native nectar resources were abundant and included Spanish sunflower, mulefat, wild heliotrope, flat top buckwheat, tocalote, thistle, and other plants. Many insects observed during the survey were found in association with these and other blooming plants.

Although potential nectar resources were abundant at Big Canyon, hymenoptera diversity was conspicuously poor during the present study. Sonoran bumblebee (*Bombus sonorus*) and honeybee (*Apis mellifera*) were the most abundant bee species. Carpenter bees (*Xylocopa varipuncta*) were also observed. Sand wasps (*Bembix comata*) were observed commonly along some of the roads and trails throughout Big Canyon where sandy patches are present. Less conspicuous smaller bees and wasps were rare during the present study.

Dragonflies were observed in association with the pond located at the mouth of Big Canyon just east of Backbay Drive. Species observed include common green darner (*Anax junius*), blue-eyed darner (*Aeshna multicolor*), variegated meadowhawk (*Sympetrum corruptum*), flame skimmer (*Libellula saturata*), and black saddlebags (*Tramea lacerta*). Damselflies were also observed in these habitats, and included dancers (*Argia* sp.) and bluets (*Enellagma* sp.). A list of insects observed and identified in Big Canyon in 2003 is included in Section 9.

3.0 HERPETOLOGICAL RESOURCES

3.1 Methods for Herpetological Surveys

Herpetological (amphibian and reptile) surveys were conducted by Brian Leatherman, who possesses over 12 years of experience conducting general and focused surveys for amphibians and reptiles including endangered and other special-status species, conducted the herpetological surveys in Big Canyon and authored herpetological sections of this report. The purpose of the herpetological surveys was twofold. The first was the development of an inventory of the amphibians and reptiles in the Big Canyon Creek Restoration Project area. The second was to sample the amphibians and reptiles in a manner that is easy to implement, repeatable, and standardized so that if surveys are conducted after the completion of the restoration project, the results could be compared with those reported here.

A variety of factors influence effectiveness of different survey techniques, but in general, reptiles and amphibians are difficult to census. The success of different techniques varies with survey season, survey duration, recent weather, time of day, observer bias and skill, types of habitats sampled, and differences in activity patterns among species (Vogt and Hine 1982). Therefore, use of a combination of sampling techniques over an extended period of time is desirable for an inventory that is as complete as possible (Campbell and Christman 1982). Several techniques and incidental sightings were used to develop the inventory. Herpetological cover boards (cover boards) were the primary method of determining the relative abundance within Big Canyon.

3.1.1 Methods for Herpetological Inventory

Every amphibian and reptile species incidentally observed while in the Big Canyon area was noted for inclusion in the inventory. Techniques to develop the inventory included the used of cover boards, transect surveys between boards, turtle traps to sample for the presence of southwestern pond turtle (*Clemmys marmorata pallida*), a night-time survey to sample for the presence of calling amphibians (on 16 July 2003), and intensive ground searches that included lifting and replacing debris, rocks, boards and any other objects that might have harbored amphibians and reptiles.

Trapping for southwestern pond was conducted on the nights of July 16 and 17, 2003. Trapping involved the use of six traps constructed of 0.5 inch hardware cloth, measuring 24 inches long, 24 inches wide, and 9.5 inches tall. There is a funnel-shaped opening at one end that is 24 inches wide with a 1.5 inch gap. Each trap was baited with half a mackerel and placed along the edge of the pond at an angle to provide an air pocket, with the majority of the trap underwater.

3.1.2 Methods for Herpetological Relative Abundance

Relative abundance of amphibians and reptiles was determined using cover boards and walking transects for surface-active animals between the cover board locations. The use of cover boards allows the target species to be sampled passively (i.e. without capture). Therefore, the cover boards can be checked on a weekly basis, spreading the sampling period over a larger time frame and minimizing the effects of differences in activity patterns among the target species over the course of a season. A total of 56 cover boards, all measuring 2 X 2 feet square, were placed throughout the Big Canyon area. Half of the cover boards (28) were placed in riparian habitat, and half were placed in upland habitats. Therefore, relative abundance for amphibians and reptiles can be measured for each of these habitat types and for Big Canyon as a whole.

Cover boards were placed in the riparian and upland habitats on May 9, 2003 and were checked once per week over the course of 9-week sampling period for a total of 504 cover board sampling days. An equal number of cover board sampling days (252) were completed in riparian and upland habitats. Dates, times and weather conditions for each of the survey days are included in Table 3.

Table B3. Timing and Weather Data for
Big Canyon Herpetological Surveys, 2003

Date	Time	Temp (F)	Wind (mph)	Cloud Cover
May 16	1315	75	5	0%
May 23	815	59	5	100%
May 30	845	66	0	100%
June 4	845	62	0	100%
June 13	730	64	0	100%
June 20	700	66	0	100%
June 27	830	68	5	50%
July 7	800	74	5	100%
July 16	900	77	5	0%

3.2 Herpetological Survey Results

3.2.1 Herpetological Inventory

A total of seven species of amphibians and reptiles was inventoried at the Big Canyon Creek Restoration Project area during the 2003 surveys (Table 4). Six species were detected in riparian habitats, and four species were detected in upland habitats. Three species were detected in the riparian habitat but not the upland habitat. Two of these, the Pacific treefrog (*Hyla regilla*) and African clawed frog (*Xenopus laevis*), are stream breeding amphibians. The third species, the common kingsnake (*Lampropeltis getula*), would likely be detected in the upland area in a more extensive survey effort. One species was observed in upland habitat but not in riparian habitat. This species was the southern alligator lizard (*Elgaria multicarinata*). This species likely occurs in the riparian habitats, and would likely be found there in a more extensive effort.

Table B4. Results of Big Canyon Herpetological Inventory, 2003			
Common Name	Scientific name	Riparian	Upland
Pacific Treefrog	*Hyla regilla*	x	
African Clawed Frog	*Xenopus laevis*	x	
Southern Alligator Lizard	*Elgaria multicarinata*		x
Western Fence Lizard	*Sceloporus occidentalis*	x	x
Side-blotched Lizard	*Uta stansburiana*	x	x
Common Kingsnake	*Lampropeltis getula*	x	
Gopher Snake	*Pituophis catenifer*	x	x
Total		6	4

No southwestern pond turtles were trapped during the two-night trapping period. Twenty-five crayfish (*Procambarus clarkii*) and sixteen African clawed frogs were trapped, and a large numbers of these species were observed in the system during the nocturnal survey.

3.2.2 Relative Herpetological Abundance

A total of five different species representing 98 observations was made during the transect and cover board surveys. When expressed as a rate of detection, cover board success averaged 0.19 specimens per cover board per day (observations were made at an average of one out of every five boards per day).

Table 5 shows the number of observations of each species by habitat type and for Big Canyon as a whole. The raw numbers shown in the table are equivalent to the relative abundance because standardized methods were used to collect the data in each habitat type (i.e., the same transects were walked, the same number of cover boards were used, and the same amount of time was taken to complete the sampling each week).

Table B5. Relative Abundance of Herpetofauna Based on Transects and Cover Boards				
Common Name	Scientific Name	Riparian	Upland	Total
Southern Alligator Lizard	*Elgaria multicarinata*	0	5	5
Western Fence Lizard	*Sceloporus occidentalis*	39	23	62
Side-blotched Lizard	*Uta stansburiana*	5	23	28
Common Kingsnake	*Lampropeltis getula*	0	1	1
Gopher Snake	*Pituophis catenifer*	1	1	2
Total (Species)		3	5	5
Total (Relative Abundance)		45	53	98

The western fence lizard was the most abundant species in Big Canyon. It was significantly more abundant in the riparian habitat than in the upland habitat ($x^2 = 0.042$). The second most abundant species was the side-blotched lizard, which, unlike the western fence lizard, was significantly more abundant in the upland habitat than in the riparian habitat ($x^2 = 0.0007$). This is expected because downed logs and trees in the riparian habitat represent good habitat for the western fence lizard, whereas the open scrub and disturbed upland areas with rock and sand substrates represent good habitat for the side-blotched lizard.

The western fence lizard and side-blotched lizard were equally abundant in the upland area, but the western fence lizard was significantly more abundant than the side-blotched lizard in the riparian habitat (x^2 = 3E -

07). The southern alligator lizard was more abundant in the upland habitat based on the samples reported here, but more extensive sampling would likely result in observations in the riparian habitat as well. The small sample size of the snakes makes comparisons impossible.

3.2.3 Discussion of Herpetological Survey Results

The seven species recorded in the Big Canyon area likely under-represents the complete herpetofaunal diversity in Big Canyon. Several other species that may occur include the Pacific slender salamander (*Batrachoceps pacificus*), western toad (*Bufo boreas*), western skink (*Eumeces skiltonianus*), ring-neck snake (*Diadophis punctatus*), and western rattlesnake (*Crotalus viridis*). The survey period was not likely inclusive of the activity period for the Pacific slender salamander, and additional surveys during winter and spring rain events would likely result in detection of this species. We expected to find the western toad; however, because this seems to have been a very good recruitment year for the western toad throughout Orange County (pers. obs.), the lack of observations suggests it does not currently occur. The lack of sightings of the western skink is unusual given its relative abundance on the coastal plain of Orange County. The ring-neck snake is a secretive fossorial species that can be difficult to detect even in areas where it is common. Our inability to detect the western rattlesnake in the Big Canyon area may be due to the propensity of nearby residents to kill these venomous reptiles and resulting low population levels. All of these species are relatively common in the region and may be found in the greater Newport Back Bay area.

The number of species detected in the Big Canyon area is low compared to other coastal sites in Orange County. For comparison, Fisher (2000) documented nine species on the University of California-Irvine (UCI) campus preserve and 19 species in Crystal Cove State Park (Table 6). Both of those areas are larger and support more extensive and diverse habitats. In addition, the Big Canyon area is surrounded by development on three sides and has been subjected to substantial recreational use for decades. Nonetheless, a herpetological survey of the greater Newport Back Bay area, of which Big Canyon is only a small part, would likely result in the detection of additional species, and a higher diversity than reported here for the Big Canyon area alone.

Table B6. Comparison of Reptile and Amphibian Species Detected in Big Canyon, UCI and Crystal Cove				
Common Name	Scientific name	Big Canyon	UCI	Crystal Cove
	Amphibians			
Black-bellied slender salamander	*Batrachoceps nigriventris*			x
Pacific slender salamander	*Batrachoceps pacificus*		X	x
Arboreal Salamander	*Aneides lugubris*			x
Western Toad	*Bufo boreas*			x
Pacific Treefrog	*Hyla regilla*	X		x
African Clawed Frog	*Xenopus laevis*	X		
Western Spadefoot	*Spea hammondii*			X
	Reptiles–lizards			
Southern Alligator Lizard	*Elgaria multicarinata*	X	x	X
Western Skink	*Eumeces skiltonianus*		x	X
Western Whiptail	*Cnemidophorus tigris*			X
Western Fence Lizard	*Sceloporus occidentalis*	X	x	X
Side-blotched Lizard	*Uta stansburiana*	X	x	
Coast Horned Lizard	*Phrynosoma coronatum*			X
	Reptiles–snakes			
Western Blind Snake	*Leptotyphlops humulis*			x
Racer	*Coluber constrictor*			x
Ring-necked Snake	*Diadophis punctatus*		x	
Common Kingsnake	*Lampropeltis getula*	X	x	x
California Whipsnake	*Masticophus lateralis*			x
Coachwhip	*Masticophis flagellum*		x	
Gopher Snake	*Pituophis catenifer*	X	x	x
California Black-headed Snake	*Tantilla planiceps*			x
Red Diamond Rattlesnake	*Crotalus rubber*			x
Western Rattlesnake	*Crotalus viridis*			x
Total Species		7	9	19

4.0 AVIAN RESOURCES

4.1 Methods for Avian Surveys

4.1.1 General Bird Surveys

Surveys to document bird use of habitats within Big Canyon were conducted on March 14, April 20 and during all surveys for California gnatcatcher and least Bell's vireo (described in 3.4.2, 3.4.3 and 3.4.4). Surveys were conducted by Kathy Keane, Spencer Langon, Nathan Mudry and Matthew Amalong, all ornithologists each with a minimum of 10 years experience identifying bird species in southern California and elsewhere. Kathy Keane authored sections of this report discussing avian resources. All birds observed by sight and/or sound during the surveys were recorded on prepared data sheets, along with information on the type of habitat in which the observation occurred so that bird use by habitat type in Big Canyon could be assessed. Breeding behavior (carrying nesting material or food for young) also was recorded.

4.1.2 California Gnatcatcher Surveys

To determine the status of the California gnatcatcher in Big Canyon, focused presence/absence surveys were conducted. All potentially suitable gnatcatcher habitat in Big Canyon, including coastal sage scrub and saltbush scrub, was surveyed three times. Surveys were conducted on: February 28, May 31, and July 10, 2003; survey times and conditions are provided in Table 7. The methodology used for California gnatcatcher surveys followed the guidelines of Mock *et al.* (1990), the Southern California Coastal Sage Scrub Scientific Review Panel (Brussard *et al.* 1992) and the USFWS monitoring protocol (USFWS 1997), as follows:

- Surveys were conducted during the morning hours and when the temperature exceeded 55°F.
- No more than 100 acres were surveyed by each biologist per day, and no surveys were conducted during windy (>15 miles per hour), rainy, or extremely hot (>95°F) conditions.
- Taped vocalizations of gnatcatchers were used to elicit a response from resident birds, if they were present.
- All located birds were observed long enough to determine their breeding status (whether paired or unpaired).
- Located birds were observed long enough to determine if they were banded.
- All data were recorded on standardized data sheets and male/pair locations were plotted on 200-scale topographic maps of Big Canyon.

Table B7. Timing and Weather Data for Big Canyon California Gnatcatcher Surveys, 2003

Date	Time	Temp (F)	Wind (mph)	Cloud Cover
February 28	6-930	63	S at 5mph	100
May 31	9-12	66	S at 5mph	100
July 10	930-1130	78	S at 5mph	50

4.1.3 *Least Bell's Vireo Surveys*

To determine the status of the least Bell's vireo at Big Canyon, focused presence/absence surveys were conducted. All potentially suitable least Bell's vireo habitat in the project vicinity was surveyed on eight dates. The methodology used in the surveys followed the survey guidelines of the USFWS monitoring protocol (USFWS 2001), as follows:

- All riparian areas and any other potential vireo habitats were surveyed at least eight (8) times during the period from April 10 to July 31; survey dates and weather conditions are presented in Table 8.
- Surveys were conducted in favorable weather between dawn and 11:00 a.m.
- No more than 50 acres were surveyed by each biologist per day
- Taped vocalizations of least Bell's vireo were NOT used.
- All located birds were to be observed long enough to determine their breeding status (whether paired or unpaired).
- Located birds were to be observed long enough to determine if they were banded.
- The numbers and locations of all brown-headed cowbirds (*Molothrus ater*) were to be recorded and reported.
- All data were recorded on standardized data sheets and male/pair locations were to be plotted on 200-scale topographic maps of the Big Canyon.

Table B8. Timing and Weather Data for
Big Canyon Least Bell's Vireo Surveys, 2003

Date	Time	Survey conditions
April 10	6-930	cloudy, 66 degrees, south wind to 5 mph
May 31	530-9	cloudy, 66 degrees, south wind to 5 mph.
June 10	530-9	cloudy, 68 degrees, southwest winds to 5 mph.
June 20	6-11	drizzle/fog, 66 degrees, west wind to 3 mph.
June 30	530-930	mostly cloudy, 72 degrees, south gusts to 9 mph.
July 10	530-930	partly cloudy, 78 degrees, south wind to 5 mph.
July 20	6-10	mostly sunny, 74 degrees, south wind to 3 mph.
July 30	530-930	drizzle/clouds, 66 degrees, south wind to 3 mph.

4.1.4 Belding's Savannah Sparrow Surveys

Saltmarsh habitat dominated by pickleweed (*Salicornia virginica*) noted to be suitable for Belding's savannah sparrow was identified during an overview survey of the project area on April 16, 2003. Suitable Belding's savannah sparrow habitat is located west of Back Bay Drive and north of the kiosk and parking lot; areas south and immediately west of the parking lot do not support suitable habitat. Survey methods used during statewide censuses for this species were used on April 23, April 27 and June 1. The June 1 survey was conducted so that additional territories established later in the breeding season, possibly after breeding failure at another location, could be detected. Survey conditions are presented in Table 9 below.

Table B9. Timing and Weather Data for
Big Canyon Belding's Savannah Sparrow Surveys, 2003

Date	Time	Temp (F)	Wind (mph)	Cloud Cover
April 23	0702-0855	55	0	20%
April 27	0722-0905	58	0-2	100%
June 1	0803-0913	65	0-2	100%

No standard protocol exist for Belding's savannah sparrow surveys; however, Dick Zembal, an expert on this subspecies, recommends that surveys be conducted during early morning hours of the breeding season and that surveys not be conducted during inclement weather. In addition, personal observations indicate that detection of Belding's savannah sparrows is often higher during sunny rather than overcast weather. Thus, during overcast conditions (April 27 and June 1), another area of Upper Newport Bay known to harbor Belding's savannah sparrows (south or west of the Big Canyon survey area) was visited to determine whether sparrows were singing, and the above surveys were not begun until singing was detected in other areas.

Surveys detected and recorded the location and number of birds and behaviors such as vocalizations (call notes and songs), courting and nesting activities, perching, chasing, and fleeing. The presence of potential predators was also noted. From these breeding and territorial behaviors, the number and approximate locations of individuals, paired birds, and territories were estimated. Individuals were determined to be a member of a pair based on behavior (if they were observed in close proximity or were otherwise interacting as a pair, not demonstrating territorial defensive behavior to one another). Each pair as well as individual birds displaying territorial behavior (chasing other individuals, perched vocalizing and warning [full song and/or warning "chip" notes], or carrying food or nesting material, or present with fledglings) were considered to be an active territory.

Data recorded on survey maps included location and number of birds and behaviors such as vocalizations (call notes and songs), courting and nesting activities, perching, chasing, and fleeing. The presence of potential predators was also noted.

From breeding and territorial behaviors recorded, the number and approximate locations of individuals, paired birds, and territories were estimated. Each pair as well as individual birds displaying territorial behavior (chasing other individuals, perched vocalizing and warning [full song and/or warning "chip" notes], or carrying food or nesting material, or present with fledglings) were considered represent an active territory. This method has been used by the U.S. Fish and Wildlife Service and California Department of Fish and Game consistently when the scope of the surveys does not include precise determination of the number of territories present (Dick Zembal, pers. comm.)

4.2 Avian Survey Results

A total of 107 bird species was observed in Big Canyon during the three surveys (Section 9), suggesting that Big Canyon supports a diversity of bird species. Surveys conducted during the fall and winter would likely yield additional migrating and wintering species. Observations by major habitat type revealed that eight species were observed in aerial habitat, eight in alkaline meadow, 11 in coastal sage scrub, nine in freshwater marsh, 36 in coastal salt marsh, 16 in willow riparian and three in ruderal/ornamental habitat.

Results of surveys for special-status bird species (California gnatcatcher, least Bell's vireo, Belding's savannah sparrow) are discussed in Section 6.5

5.0 MAMMALOGICAL RESOURSES

5.1 Methods for Mammalian Surveys

Shana Dodd, mammalogist with over ten years experience conducting both general and focused surveys for mammals (including endangered species) conducted the mammal survey in Big Canyon. Ms. Dodd also authored the mammal sections of this report. The mammal survey consisted of using three approaches during the two-day survey period, 9-10 June 2003. Big Canyon was thoroughly ground-surveyed to detect the presence of mammals based on tracks, scat, and burrows. For the most part, these surveys followed trails, and areas of thick scrub were not surveyed, except for forays into the riparian forest wherever possible. Two flour track stations also were set at dusk and checked for tracks the following morning. These stations consisted of a 1-meter circle of flour baited with cat food. Additionally, 70 live traps were monitored for one night. The traps were set at dusk, baited with mixed birdseed, and checked in the morning. All small mammals captured were identified to the species level and recorded. All captured animals were released unharmed at there point of capture. Weather conditions during the survey consisted of temperatures between 60-65°F, 100% marine layer, and light to moderate breezes.

5.2 Mammalian Survey Results

Soils throughout much of Big Canyon were gravelly or hardened and did not provide a good tracking medium. Species that were recorded based on sign or visual detection during the ground surveys and flour track stations included California ground squirrel (*Spermophilus beecheyi*), Audubon's cottontail (*Sylvilagus* audubonii), wood rat (*Neotoma* sp.), Botta's pocket gopher (*Thomomys bottae*), coyote (*Canis latrans*), raccoon (*Procyon lotor*), and domestic dog (Canis *familiaris*). Only one species was captured in the live traps, which was the western harvest mouse (*Reithrodontomys megalotis*). Heavy human and dog foot-traffic was observed throughout the trail system on both survey days.

The results of this survey suggest that Big Canyon, although disturbed by trails, non-native vegetation, and human encroachment, is still used by an assortment of native mammals. However, the diversity and abundance of native mammals in Big Canyon is undoubtedly negatively affected by these fairly heavy disturbances. Previous and historic surveys of the canyon should be reviewed for a more complete list of mammals that historically and may still use the area.

Very little could be assessed on relative abundance of mammals, as well as the total variety of species that may actually be present. For instance, no assessment could be made on more secretive and hard to detect species (e.g., long-tailed weasels [*Mustela frenata*] or shrews [*Sorex sp.*]). The small mammal community also appears to be disturbed, although the limited number of trap-nights conducted should be considered. However, only harvest mice were captured when usually at least several species would be expected.

Other than domestic dogs, no non-native mammals were detected at Big Canyon. However, domestic or free-roaming cats are likely due to the close proximity of residential areas on either side of the canyon. Cats are an important consideration because they are a significant cause of mortality for native wildlife. Another introduced species that poses some concern to native species is the Virginia opossum (*Didelphis virginiana*). The opossum was not detected but because it is very common throughout southern California, it is expected in the canyon.

In summary, even though Big Canyon is quite disturbed, an assortment of native mammals still appears to occur at Big Canyon. However, the human disturbances in the canyon and surrounding area have likely altered the natural mammal community.

6.0 ENDANGERED SPECIES, THREATENED SPECIES OR SPECIES OF CONCERN

Prior to conducting surveys, Keane Biological Consulting (KBC) reviewed the project maps and existing literature on the biological resources of Big Canyon to ascertain habitat suitability and use of Big Canyon by special-status species and other native wildlife species. KBC also reviewed documents pertaining to special-status species that may be present in the project vicinity. A plant or wildlife species is defined as special-status when it has been afforded special recognition by federal, state, or local resources conservation agencies and/or resource conservation organizations. Sources used to identify special-status species and sensitive plant communities potentially occurring in the project vicinity are available through http://www.dfg.ca.gov/whdab/html/lists.html and include the following,:

- State and Federally Listed Endangered, Threatened and Rare Plants of California, CDFG, Natural Heritage Division, January 2003 (CDFG 2003a)
- Special Plants List, CDFG, Natural Heritage Division, January 2003 (CDFG 2003b)
- State and Federally Listed Endangered and Threatened Animals of California, CDFG, Natural Heritage Division, January 2003 (CDFG 2003b)
- Special Animals (including California Species of Special Concern), CDFG, Natural Heritage Division, January 2003 (CDFG 2003d)
- California Natural Diversity Data Base, Newport Beach quadrangle (CNDDB 2003)

This review, and consultations with he biological experts conducting surveys for this study, allowed us to determine which special-status species and sensitive plant communities that may occur at Big Canyon. These are described in the following sections and summarized in tables within the sections.

6.1 Plant Communities of Concern and Environmentally Sensitive Habitat Areas (ESH)

The communities of special status are those of concern to the CDFG (CNDDB 2002b), or County of Orange (Gray and Bramlet 1994b).

6.1.1 Coastal salt marsh

The coastal salt marsh is considered one of the most sensitive plant communities within Orange County, due to the limited area of these marshes found within the County. It is estimated that from 75-90% of salt marsh habitat in southern California has been destroyed, and much of the remaining habitat had been highly degraded (Ferren 1989). In addition, the salt marsh found in the Big Canyon Creek area are found within the boundaries of the Upper Newport Bay Ecological Reserve, and the CDFG is currently managing the reserve to maintain the diversity and habitat value of its biological resources. The County of Orange considers salt marshes to be communities of "extreme" concern (Gray and Bramlet 1994b). The CNDDB lists all of the plant associations (alliances) that comprise the salt marsh, including the cordgrass grassland, and south coast pickleweed marsh as sensitive plant communities.

6.1.2 *Freshwater marsh, Brackish marsh, and alkali marsh*

The marshes found in Big Canyon would all be considered sensitive habitats, due to the small remaining acreage of marshes within southern California. The USFWS considers the alkali marsh to be a sensitive habitat, especially the more interior marshes, due to the small number of this type of marsh community within southern California. Freshwater marshes and brackish marshes are considered of "high" concern, while the alkali marshes are considered of "highest" concern by the County of Orange (Gray and Bramlet 1994b). Although the CNDDB does not consider the freshwater *Typha* (freshwater marsh) to be a sensitive community, it does consider brackish phases of *Typha* stands, and *Scirpus maritimus, S. robustus* associations to be sensitive communities, and this would include the brackish and alkali marshes.

6.1.3 *Alkaline meadow*

The alkaline meadow is considered a sensitive community, since it is a wetland habitat with limited distribution. The County of Orange lists this community as a habitat of "high" concern. The CNDDB does not list the alkali meadow as sensitive.

6.1.4 *Riparian forest, scrub, and herb communities*

Riparian communities are considered sensitive communities by the CDFG. The riparian herb community is generally not considered highly sensitive, e.g on the "watch" list of sensitive Orange County communities. However, the riparian scrub is considered a sensitive community by the County of Orange (High concern), and by the CNDDB, for the arroyo willow riparian scrub. The riparian forest has higher habitat values, due to the additional canopy layers, and is considered to be the most sensitive riparian habitat in Big Canyon. This community is considered to be of the "highest" concern by Orange County, and is considered a sensitive plant community by the CNDDB. Of course, the value of this habitat may be greatly reduced by invasive plant species, many of which have colonized the Big Canyon riparian areas.

6.1.5 *Coastal sage scrub, Coastal bluff scrub*

All of the sage scrub communities, including all of the associations or "subassociations" of the Venturan-Diegan sage scrub are considered communities of concern. The Natural Communities Conservation Planning Act was established in the state to allow for multi-species conservation planning, and goals to conserve coastal sage scrub were developed as a means to protect habitat for the coastal California gnatcatcher. The project area is within the boundaries of the central coastal reserve (USFWS and County of Orange 1996). The coastal buff scrub is considered a unique sage scrub community, that is more highly restricted than other sage scrub communities within the county. Coastal bluff scrub is considered a community of concern by the CDFG (2002b), and is ranked as a community of "extreme" concern by the County of Orange (Gray and Bramlet 1994b).

6.1.6 *Alkali grassland*

The alkali grassland is not a community recognized in the Orange County classification system (Gray and Bramlet 1992), and it has not been noted by the CNDDB (2002b). However, similar habitats have been noted as alkali vernal plains by Ferren (1993) for localities in Riverside County. This community is considered sensitive since it may be considered a wetland, and the dominance of native species within the grasslands. However, the alkali grasslands found in Big Canyon are highly disturbed and the grasslands within Big Canyon would not be considered a sensitive resource.

6.1.7 *Estuarine, Mudflats*

Although not plant communities, estuarine habitats are considered of "extreme" concern, due to the importance of these habitats to a number of endangered animal and plant species. The mudflats within the estuaries are also considered highly sensitive areas, and classified as habitats of "highest" concern by the County of Orange.

6.2 Special-Status Plant Species

This section discusses special-status plant species known to occur in Upper Newport Bay and potentially expected in Big Canyon, as summarized in Table 10 at the end of this section 6.2; plant species actually observed in Big Canyon are shown in bold in Table 10. The discussion below and Table 10 includes both plant species listed as endangered or threatened and species of concern per the California Native Plant Society (CNPS 2001) or County of Orange (1994a) and recorded from the general vicinity of Upper Newport Bay. Only six of these were located during surveys at Big Canyon.

6.2.1 *Aphanisma (Aphanisma blitoides)*

Aphanisma is a species associated with coastal bluffs and is known to occur from Los Angeles County to Baja California. In Orange County this species has been recorded in Costa Mesa, Upper Newport Bay, Arch Beach and South Laguna (Roberts 1990). A recent locality occurred in Upper Newport on the west side but was lost due to land slippage in the 1990's. This species was not located during 2003 focused botanical surveys in Big Canyon.

6.2.2 *Coulter's saltbush (Atriplex coulteri)*

Coulter's saltbush is a low, spreading perennial saltbush species known to occur in coastal bluff and grassland habitats with some alkalinity. The red stems distinguish it from the more common, introduced Australian saltbush. This species is distributed from Los Angeles County east to San Bernardino County and south to Baja California. It is most commonly found on the Channel Islands. In Orange County this species has been recorded in Laguna Beach, Pelican Hill, North of the Newport Beach library, Cristianitos Canyon, Whispering Hills, and Trabuco Canyon. This species was not located during 2003 focused botanical surveys in Big Canyon.

6.2.3 *South coast saltbush (Atriplex pacifica)*

The south coast saltbush is a prostrate annual found on coastal bluffs, often in eroded sites with little vegetation. This species is easily confused with the native Coulter's saltbush, since it also has red stems and may occur in the same habitats as this species. The south coast saltbush is generally restricted to the coastal areas of southern California, extending from Los Angeles County to Baja California and extending onto the Channel Islands. This species has historically been recorded in Upper Newport Beach, and Laguna Beach in Orange County. However, these sites are apparently extirpated and the only known localities in the County are from Crystal Cove State Park, and San Clemente State Beach. This species was not located during 2003 focused botanical surveys in Big Canyon.

6.2.4 *Southern tarplant (Centromadia parryi ssp. australis)*

The southern tarplant is an annual, spiny tarplant with yellow flowers which blooms in the late spring into the summer. Previously described in the genus *Hemizonia*, recent systematic modification within the tarweeds, has placed this taxon within the genus *Centromadia* (Baldwin 2000). This species occurs in a number of highly fragmented populations from Santa Barbara County to northern Baja California. The southern tarplant is found in annual grasslands, around the margins of vernal pools, alkaline meadows, brackish marshes and estuaries. In Orange County it is known from a number of scattered populations occurring at: Upper Newport Bay, Newport Beach oilfields, Bolsa Chica area, Seal Beach (Hellman Ranch site), Fairview park, San Joaquin Marsh, UCI campus, Peters Canyon channel, Sand Canyon, Bonita Creek, Laguna Canyon, Canada Gobenadora, and in Canada Chiquita. Historic localities in the County included

Cypress, Westminister, Garden Grove, Santa Ana and Rossmor, however, all of these areas are heavily urbanized and these localities may be extirpated. In Upper Newport Bay the southern tarplant is known from Big Canyon, and other scattered localities along BackBay Drive. It is also known from at least six localities on the West Bay parcel, and probably occurs at other locations within the Upper Newport Bay region.

Focused surveys in 2003 at Big Canyon for southern tarplant located a total of 12 localities for the southern tarplant, consisting of a total of approximately 2,169 plants in early May and June. These plants were found alongside roads or trails and/or in other disturbed, open soil areas found within Big Canyon Creek. However, the surveys were conducted too early to detect all of the localities in Big Canyon. Surveys in late summer to early fall are likely to find additional localities and higher number of plants within Big Canyon.

6.2.5 *Salt marsh bird's beak (Cordylanthus maritimus ssp. maritimus)*

The salt marsh bird's beak is a federally and state listed as endangered. It is restricted to the upper salt marsh community, and ranges from San Luis Obispo to San Diego Counties, and into Baja California. It is only known from approximately 16 localities in southern California, and 3 localities in Baja California. Roughly six of the known sites in southern California are assumed to be extirpated and several of the other localities contain only small numbers of this bird's beak.

In Orange County this species has been recorded from Bolsa Chica, Upper Anaheim Bay, and Upper Newport Bay. It is assumed to be extirpated from Bolsa Chica, and the Anaheim Bay site contains only a small number of plants. The bird's beak localities in Upper Newport Bay are restricted to the east side of the bay. Records from the 1980's note the presence of over 10,000 plants in localities adjacent to Backbay Drive, principally from Shellmaker Island, north of the intersection of San Joaquin road and Backbay Drive, and around the mouth of Big Canyon. Recent observations have noted that the distribution generally is similar to the 1980's observations, although there appear to be more locations around the mouth of Big Canyon.

A total of fifteen general localities were noted for the federally endangered salt marsh bird's beak. Through direct counts and estimates, it was determined that roughly 30,000 individuals of salt marsh bird's beak occur at Big Canyon.

6.2.6 *Many-stemmed dudleya (Dudleya multicaulis)*

This small, vernal live-forever is found on rocky outcrops or in clay soils. It is often found in openings of coastal sage scrub or on the margins of grasslands. This species is found in Los Angeles, San Bernardino, Riverside, Orange and Los Angeles Counties. The populations of this small dudleya are often small and scattered. The principal area of its distribution appears to be in the northeast corner of Orange County in Fremont and Weir Canyons.

In Orange County this species is found throughout the foothill areas, extending from Gypsum Canyon in the north of the County to Cristianitos Canyon in south Orange County. This species is also been recorded from many localities in the San Joaquin Hills, Laguna Beach, and the UCI Ecological Reserve (Roberts 1990). There has been speculation of historic localities of this species in Upper Newport Bay; however, there has been no documentation of the presence of this species historic or recent within Big Canyon, and this species was not located during 2003 focused botanical surveys in Big Canyon.

6.2.7 *Upright burhead (Echinodorus berteroi)*

This is a wetland species found on moist shorelines, ephemeral pools, roadside ditches or riparian habitats. The upright burhead has a wide ranging distribution, being found throughout the inland valleys of California and extending into the central United States and into South America. However, this species is not usually common in any part of its distributional range, since it is limited to wetland habitats. In southern California it is uncommon, although it extends throughout the basin. In Orange County it has been found in channels draining into the Newport Back Bay and other scattered localities. This species was not located during 2003 focused botanical surveys in Big Canyon.

6.2.8 Little spike-rush (Eleocharis parvula)

This small, perennial spike-rush occurs in coastal salt marshes from Humboldt County to Orange County and is found distributed throughout North America. Although the published literature (Mason 1959) notes this as a species restricted to salt marshes, recent compilations (CalFlora 2003) also include records from freshwater marshes far from the coast. This spike-rush is also noted as occurring in the San Gabriel, and San Bernardino Mountains. It also has been noted from a single locality in Orange County, presumably Upper Newport Bay. However, there have been no recent observations of this species in the area, and the species was not located during 2003 focused botanical surveys in Big Canyon.

6.2.9 Beaked spike-rush (Eleocharis rostellata)

This small, perennial spike-rush occurs in springs, channel bottoms or alkaline marshes in the cismontane and desert areas of southern California, and is distributed throughout North America. In the cismontane areas of southern California it has been found from Ventura County to Orange County and is found only at scattered salt or alkaline marsh localities. In Orange County this species has been recorded for the Santa Ana River and other marshy sites along the coast. This species was not located during 2003 focused botanical surveys in Big Canyon.

6.2.10 Vernal barley (Hordeum intercedens)

The vernal barley is generally a cismontane species found from San Francisco, and a few areas of Kern County, extending south into Baja California and onto the Channel Islands. This species is difficult to identify and its distribution on the mainland has been known from scattered (often misidentified) collections throughout the range of this species. This species was recently added to the CNPS 3 list due to the continued declines in preferred habitat, the limited collections, and general lack of knowledge of this species. In Orange County, this species is found both in wetland and clay soil habitats. It has been found in the foothill region from just north of Irvine Park, to areas in Cristianitos Canyon on open clay soils. Along the coast the species has been noted north of the Newport Beach library and at Fairview Park, French Hill, UCI Ecological Reserve, the San Joaquin Hills, Laguna Canyon, and the Dana Point Headlands. Although the related low barley (*Hordeum depressum*) has been observed at Upper Newport Bay, vernal barley has not been observed or collected here, and it species was not located during 2003 focused botanical surveys in Big Canyon.

6.2.11 Southwestern spiny rush (Juncus acutus ssp. leopoldii)

This large, spiny rush is found in salt, brackish and riparian marshes and alkaline meadows along the coast. This species is known to occur from San Luis Obispo County to Baja California, along the coast and is also found at desert oases in San Diego County. Due to its affinity with declining wetland habitats and its scattered distribution this species has been placed on the CNPS watch list (List 4). In Orange County this species is known from Upper Newport Bay, Bolsa Chica, and Monarch Beach. Focused surveys for southwestern spiny rush during 2003 located this species on the upper margin of the salt marsh community, in alkali meadows, and in willow riparian scrub. A total of five localities and 77 plants were observed in Big Canyon.

6.2.12 California boxthorn (Lycium californicum)

The California boxthorn is found along coastal bluff scrub habitats from San Diego County into Orange County and very uncommonly found on bluff habitats in Los Angeles County. It is also found on the Channel Islands, and into Baja California. In Orange County this species is found along coastal bluffs, and sage scrub habitats along the immediate coast including areas along San Clemente, Dana Point, the San