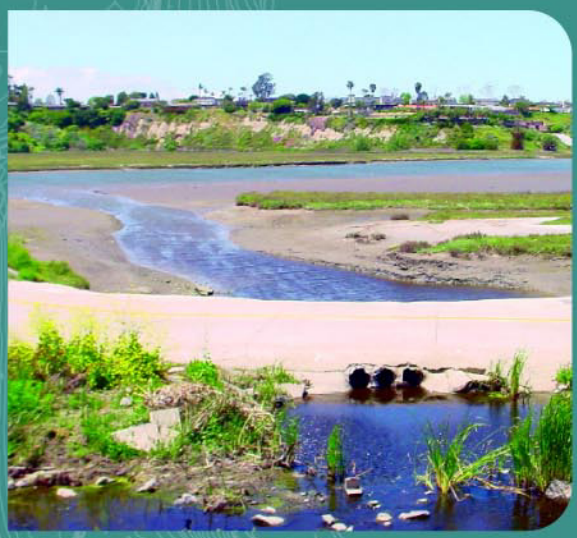
Prepared by Community Conservancy International

BIG CANYON CREEK

Historic Tidal Wetlands Conceptual Restoration Plan

Upper Newport Bay
Orange County, California
April 2004



Coastal Conservancy

Newport Bay Naturalists & Friends

City of Newport Beach California

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Funded by

California Coastal Conservancy,
Southern California Wetlands Recovery Project

City of Newport Beach

Community Conservancy International

Newport Bay Naturalists and Friends

PROJECT TEAM:

Project Direction and Development	Community Conservancy International
Aerial & Ground Survey	3Di West
Biological Assessment	Coastal Resources Management Keane Biological Consulting
Engineering, Hydrology, Soils	WRC Consulting Services Tetra Tech Coastal Frontiers Corporation
GIS Mapping	GreenInfo Network
Habitat Restoration	Earthworks Construction & Design Wetlands Research Associates
Landscape Architecture	Withers Sandgren Landscape Architecture Lynne Dwyer, Landscape Architect

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BIG CANYON CREEK RESTORATION PROJECT
PROJECT TEAM

Project Direction, Development & Planning	*Community Conservancy International*
Aerial & Ground Survey	*3Di West*
Biological Assessment	*Coastal Resources Management* *Keane Biological Consulting*
Wetlands Restoration	*Wetlands Research Associates*
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GIS Mapping	*GreenInfo Network*
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Landscape Architecture	*Withers Sandgren Landscape Architecture* *Lynne Dwyer*

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Upper Newport Bay

FIGURE 1.1

Big Canyon Creek Project Location

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FIGURE 1.2

BIG CANYON TOPOGRAPHY

Section 1
EXECUTIVE SUMMARY

INTRODUCTION

Community Conservancy International (CCI) is pleased to present this Historic Tidal Wetlands Conceptual Plan for Big Canyon Creek in Upper Newport Bay, Orange County, California. Funded by the City of Newport Beach and the California Coastal Conservancy Southern California Wetlands Recovery Project, with additional support from CCI and Newport Bay Naturalists and Friends, this conceptual plan is the result of more than a year of effort by CCI, many scientific and technical experts, federal, state, regional and local public agencies, conservation organizations and community members. CCI directed the planning effort, which included field research, site surveys, engineering and hydrological studies, historical research, GIS mapping, restoration analysis and design, public meetings and coordination with all involved public agencies.

Big Canyon Creek drains directly into Upper Newport Bay and runs through the 70-acre Big Canyon natural open space area in the City of Newport Beach; the lower half of Big Canyon is within the Upper Newport Bay State Ecological Reserve. With easy road access via Back Bay Drive, Big Canyon provides the key public access for the east side of Upper Newport Bay, attracting hundreds of thousands of visitors annually. Big Canyon is the only natural, undeveloped portion of the Big Canyon Creek Watershed, and the only significant remaining natural canyon on the east side of the Bay.

SPECIAL ECOLOGICAL SIGNIFICANCE OF UPPER NEWPORT BAY

The Big Canyon Creek Restoration Project is particularly significant both because of the ecological importance of Upper Newport Bay as an estuary and because of the severity of threats to its ecological integrity and health. Upper Newport Bay is especially important in Southern California because it has the largest number of wetland sub-habitats of all estuaries from Point Conception to the Mexican border, and is the only remaining Southern California wetlands system that still has all the habitat types of a coastal wetlands. Upper Newport Bay is even more important today because Southern California has already lost more than 80% of its coastal wetlands.

SERIOUS PROBLEMS IN BIG CANYON AND UPPER NEWPORT BAY

Natural tidal flow into Big Canyon was destroyed in the 1930s with the construction of Back Bay Drive, which effectively created a ten-foot high dam and destroyed more than five acres of tidal wetlands. There has been significant habitat degradation throughout the canyon due to decades of dumped dredge spoils and piecemeal projects, invasive non-native plants from surrounding developed areas, erosion, and lack of a comprehensive plan. Dumped dredge spoils in Big Canyon have resulted in large areas of saline and infertile soils, which cannot support native plant communities. The freshwater pond, constructed in the 1980s, is now a very shallow basin filled with sediment, with water temperatures too hot to support native populations.

Big Canyon Creek drains a two-square-mile urbanized watershed directly into Upper Newport Bay. The creek carries fertilizers, pesticides, heavy metals and other toxic pollutants. Contaminated water from unfiltered urban runoff carried by Big Canyon Creek is a serious problem, with direct impacts on Upper Newport Bay and the nearly 500 species of animals, fish and plants that depend on the Bay for survival. Big Canyon Creek carries unfiltered urban runoff from a two square mile urbanized watershed; this runoff contains fertilizers, pesticides, bacteria, metals and other pollutants directly into the Bay. The Bay is listed as an impaired water body under the federal Clean Water Act due to the high levels of pollutants flowing into the Bay.

Despite decades of human impacts, Big Canyon still supports a diversity of habitats and species, including 42 plant communities, 16 birds and plants that are endangered, threatened or of special concern, and well over 100 bird species. Big Canyon supports the largest population of the endangered Salt Marsh Bird's Beak in Southern California. Big Canyon includes a broad range of

habitats, ranging from open water channels, tidal wetlands, saltmarsh and mudflats, freshwater marshes, meadows, riparian woodlands, grasslands and coastal sage scrub. However, many are fragmented, discontinuous or threatened by invasive non-native species. Of Big Canyon's 202 plant species, 86 are native and 116 are non-native.

PROJECT PURPOSE

The Big Canyon Creek Restoration Project was developed to address serious water contamination, destruction of natural tidal flow, loss of tidal wetlands, dumped dredge spoils, erosion, flooding, habitat degradation and public access, trail and interpretive needs in Big Canyon.

The Big Canyon Creek Restoration Project focused on evaluating the potential for restoring tidal influence to Big Canyon Creek and re-establishing natural transitions between woodlands, freshwater marsh, salt marsh, mudflats and the Bay's open water channels. The project also includes providing improved, habitat-sensitive public trail access, scenic overlooks and interpretive opportunities throughout Big Canyon, improving drainage, removing dredge spoils and other infertile soils, repairing flood damage, addressing contaminated urban runoff into the creek, removing invasive non-natives, restoring native habitats and addressing the degraded freshwater pond constructed in the 1980s.

The Historic Tidal Wetlands Conceptual Plan for Big Canyon Creek addresses all of these issues as holistically as possible, while taking into consideration site constraints, maintenance needs and public safety issues. Long-term sustainability and feasibility of implementation were also key considerations in developing this conceptual plan.

SCIENTIFIC AND TECHNICAL STUDIES, RESEARCH AND RESTORATION PLANNING

CCI directed a talented team of biologists, engineers, scientists and restoration specialists to conduct the scientific and technical research and analysis of Big Canyon and its problems. Working together across many disciplines, and with input from all involved public agencies, community organizations and surrounding communities, we evaluated existing and historical site conditions, analyzed site needs and constraints and developed possible restoration alternatives.

PUBLIC AGENCY AND COMMUNITY INVOLVEMENT

The location of Big Canyon in a densely populated urban area meant that community input was very important to the planning process. CCI met with conservation organizations and held a public workshop to assess the needs and priorities of the project area, review the proposed restoration alternatives and develop the conceptual restoration plan. CCI worked closely with the City of Newport Beach and the Department of Fish and Game, who manage Big Canyon, as well as with the following agencies:

U.S. Fish and Wildlife Service
U.S. Army Corps of Engineers
National Marine Fisheries Service
State Coastal Conservancy
California Coastal Commission
Regional Water Quality Control Board
County of Orange Sanitation District
County of Orange

CCI worked closely with Newport Bay Naturalists and Friends, and met with a broad range of conservation organizations during the planning process. One public workshop was held to review and comment on needs in Big Canyon and the two restoration alternatives for addressing those needs. Information on the planning process and public workshops was distributed to a comprehensive mailing list consisting of homeowner, community, conservation and recreation organizations, user groups, local businesses, schools, public agencies and elected officials.

NEXT STEPS

This conceptual restoration plan completes the Phase I planning for the Big Canyon Creek Restoration Project. Additional planning, design refinement, technical and engineering studies, final design, legal review, public comment and permitting will be necessary to move the project to implementation. The State Water Resources Control Board has approved partial funding for Phase II planning, with an emphasis on

addressing water contamination issues through the design process. Additional funding to complete all planning and design, legal review and permitting is expected from the State Coastal Conservancy and the City of Newport Beach. All planning, design and permitting is expected to be completed 2005, with implementation anticipated in 2005 and 2006.

ABOUT CCI

CCI is a Los Angeles-based, non-profit organization dedicated to combining the protection and restoration of natural lands and waters with compatible community uses. With a focus on developing innovative solutions to challenging conservation problems, CCI is dedicated to working in areas with exceptional unmet needs: where natural habitats have been degraded; where communities have been neglected; and where recreation, economic, education and cultural opportunities are significantly lacking. CCI concentrates on the intersection between natural and human communities, and provides a broad range of expertise. CCI is committed to building strong partnerships by integrating local communities into all projects and by working closely with key stakeholders.

Section 2
PUBLIC AGENCY AND COMMUNITY INVOLVEMENT

CCI's planning process for Big Canyon emphasized the integration of input from public agencies, community members and leaders, and involved organizations. Community input was very important to the planning process. Over a two-year period, CCI met with public agencies, Newport Bay Naturalists and Friends and with other conservation organizations involved in Upper Newport Bay and Big Canyon. We held a well-publicized public workshop to assess the needs and priorities of the project area and to review and comment on the proposed restoration alternatives. This feedback was an important part of developing the Historic Tidal Wetlands Conceptual Restoration Plan for Big Canyon.

Big Canyon is heavily used by surrounding communities, schools from throughout Orange County, naturalists, researchers and the general public. Three quarters of a million people visit Upper Newport Bay annually, and Big Canyon provides one of the two major access points. CCI solicited public input on a number of issues pertaining to Big Canyon and Big Canyon Creek; the responses helped guide the development and refinement of the selected conceptual restoration plan (see Table 2.1). Project updates and public workshop information were mailed to 20 homeowners organizations and to local businesses, libraries, schools, elected officials, and civic, community, recreation and conservation organizations. Notices were placed in local newspapers and in the newsletters of local organizations.

The input of public agencies was also essential to the planning process. CCI met with a number of departments and staff at the City of Newport Beach, including the City Attorney, Department of Public Works, Utilities Department, Department of Engineering, Department of General Services, Park and Tree Superintendent and the Fire Warden. CCI also worked closely with the Department of Fish and Game, who manages the lower portion of Big Canyon.

Public agencies provided valuable guidance throughout the planning process. We held several planning meetings with the Project Team and with representatives from the following public agencies:

U.S. Fish and Wildlife Service
U.S. Army Corps of Engineers
National Marine Fisheries Service
State Coastal Conservancy
California Coastal Commission
Regional Water Quality Control Board
County of Orange Sanitation District
County of Orange

PROJECT GOALS

The following project goals were established as a result of input from public agencies, local organizations and the public.

- Re-establish a functioning complex of wetland and upland habitats:
  - restore tidal influence to Big Canyon Creek
  - allow natural transitions between open water, mudflats, salt marsh, freshwater marsh, riparian woodlands and upland habitats
- Address decades of degradation and effects of urbanization in Big Canyon
- Improve water quality in Upper Newport Bay by addressing contaminated urban runoff from Big Canyon Creek before it reaches the Bay
- Restore habitat and species diversity and expand endangered species' habitat
- Improve drainage patterns
- Repair flood damage and provide non-structural flood control
- Reduce erosion in Big Canyon and sedimentation into Upper Newport Bay
- Develop a system of habitat-sensitive public access and trails
- Develop scenic overlooks and expanded interpretive opportunities
- Remove non-native, invasive plants
- Remove dredge spoils and other infertile soils
- Able to be implemented and sustainable long-term

Table 2.1: Public Workshop Results, September 2003

Issues of Concern: Highest Priorities	% of Participants Who Ranked Issue a Concern
Contaminated water from urban runoff poisons critical food sources for shorebirds and fish (fertilizers & pesticides)	75.6%
Sustainability of restoration long-term/maintenance	61.0%
Damaged boardwalks & public trails	41.5%
Location of Back Bay Drive determines project design	34.1%
Loss of critical habitat for wetlands-dependent birds, fish & invertebrates	31.7%
Loss of natural tidal influence & tidal wetlands	26.8%
Impact on species currently using site during construction (road re-alignment on Bird'sBeak)	24.4%
Preservation & enhancement of freshwater pond (major experience for visitors)	19.5%
Public Access & Signage: Highest Priorities	
Damage done by dogs & horses	39.0%
Poor boardwalks (damaged, non-ideal locations, lack of coordinated system	36.6%
Effect of floods on improvements	34.1%
Boardwalks rather than trails in wetlands (less impact)	34.1%
Inappropriate use of step slopes	29.3%
Access & Safety during construction	26.8%
Restroom facilities (need vs. aesthetic)	26.8%
Rest Stops (benches along trails)	26.8%
OTHER ISSUES	
Roads too wide	
Car speed/conflicts with pedestrians	
Extensive public education needed/must build support	
Preservation of California Gnatcatcher habitat	
Should involve Native American communities	
Dog use & horses = problem	
Old & limited interpretive signage	
Group sites for interpretation	
People friendly signs/Dog on leash signs	
Do not encourage access from Jamboree	
Rest stops & signage should outline impacts on habitat & provide opportunity to learn & respect habitat	
No picnic tables	

FIGURE 3.1

BIG CANYON TODAY: ISSUES OF CONCERN

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1 *Open water pond is filling in with sediment*

2 *View of Newport Bay from Back Bay Drive*

3 *Non-native Brazilian Pepper trees crowd out native plants*

4 *Cattails dominate wetlands*

5 *Road blocks tidal flows and the view from boardwalk*

6 *Erosion on fragile bluffs increases sedimentation*

7 *Imported boulders limit quality of habitat*

8 *California gnatcatcher and other sensitive species are found in Big Canyon*

10 *Ornamental species from adjacent yards escape into native habitats*

9 *Non-native invasive species such as dill and mustard threaten native species*

Landforms & Elevations

- Raised road (Back Bay Drive) prevents tidal and creek flow
- Cement dams restrict water flow
- Raised terraces of infertile dredge material
- Ring of fragile bluffs
- Steep grades limit access

Habitats

- 42 plant communities
- Invasive non-native species throughout
- Cattails and algae choke pond
- 18 endangered/threatened wildlife species

Views and Aesthetics

- Views of Upper Newport Bay
- Views of Big Canyon
- 70 acres of open space in the urban environment

prepared by Withers & Sandgren Ltd. August 25, 2003

FIGURE 3.2

BIG CANYON TODAY: ISSUES OF CONCERN

Community Conservancy International

Roads, Trails and Boardwalks
- Back Bay Drive provides primary access
- Wide gravel and dirt sewer access roads
- Damaged bridges and boardwalks
- Limited official trails
- Unauthorized trails and access

Public Access and Interpretive Use
- Big Canyon is key public access to Upper Newport Bay
- One-way car access on Back Bay Drive
- Parking lot in sensitive wetlands area (35 cars, 2 buses)
- Limited bicycle access on Back Bay Drive
- No disabled access
- Deteriorating and isolated interpretive signage

Urban Infrastructure
- Constricted drainage at creek mouth
- Sewer lines and manholes
- Storm drains
- Cement "dams"
- Riprap edges (concrete stream banks)

10 *Manholes provide access to underground sewer line*

11 *Urban run-off from streets and landscaping drains into canyon*

14 *Unauthorized trails erode bluffs*

12 *Concrete debris used to stablize stream edges*

9 *Imported gravel used to construct maintenance roads*

8 *Poor quality, infertile soil from dumped dredge material*

13 *Culverts under Back Bay Drive constrict stream flow*

7 *Interpretive kiosk at edge of parking lot*

6 *Parking lot constructed in sensitive tidal wetlands*

1 *Creek enters the bay through three culverts under the Back Bay Drive*

3 *Damaged boardwalk*

4 *Damaged boardwalk eliminates disabled access*

5 *Back Bay Drive provides primary access to Big Canyon*

2 *Dam creates freshwater marsh*

prepared by Withers & Sandgren Ltd. August 25, 2003

Section 3
BIG CANYON TODAY: EXISTING SITE CONDITIONS

Big Canyon is a coastal canyon originally carved by an intermittent stream on the eastern shore of the Upper Newport Bay tidal estuary. Big Canyon drains a two square mile watershed that is now completely developed. Big Canyon is the only remaining natural and undeveloped area in the watershed.

The canyon slopes, the coastal plain and the tidal wetlands of Big Canyon are part of the Upper Newport Bay State Ecological Reserve managed by the California Department of Fish and Game. The Big Canyon Creek Restoration Project area is 70 acres and extends from Jamboree Road to the edge of the open water channel of Upper Newport Bay.

Residential development surrounds Big Canyon

Single-family homes and apartment buildings now surround the canyon. Year-round irrigation of the adjacent residential homes, other landscaped areas in the watershed and the Big Canyon Country Club golf course have created a perennial stream in the canyon that now feeds a constructed freshwater pond.

Untreated urban runoff from the two-square mile watershed drains directly into Upper Newport Bay through Big Canyon. Sediments, nitrogen, phosphorous, fecal coliform bacteria, pesticides, heavy metals and other contaminants are carried by Big Canyon Creek, threatening the health of native plants and wildlife in the canyon and in the Bay.

Figures 3.1 and 3.2 provide an overview of the issues of concern in Big Canyon today.

BIG CANYON: TIDAL WETLANDS

Currently the tidal inundation area of Big Canyon is limited to the bayside of Back Bay Drive. This scenic drive through the Upper Newport Bay Ecological Reserve follows the toe of the coastal bluffs on the east side of the estuary. Back Bay Drive was constructed across the mouth of Big Canyon through historic tidal wetlands, elevating the road ten feet above mean sea level, out of high tide range. Construction of Back Bay Drive cut off tidal flow destroying five acres of wetlands. A review of historic aerial photographs and maps of Big Canyon indicated that the historic range of the tidal wetlands once extended approximately 500 feet inland from Back Bay Drive and reached across the entire canyon mouth (see Figure 3.3). Big Canyon Creek currently drains through three 15-inch pipes under Back Bay Drive.

The isolated wetlands behind Back Bay Drive were then further degraded by the dumping of dredge spoils from the bay channel over many decades. Soil boring tests confirmed that the plateau on the south side of the freshwater pond is composed of approximately six feet of infertile and saline dredge spoils.

Construction of Back Bay Drive and deposition of the dredge spoils sufficiently modified the topographic features of Big Canyon to eliminate the natural transition between upland and freshwater habitats to brackish and tidal wetland habitats.

A freshwater pond was constructed in the lower portion of Big Canyon in the 1980s. To create the pond, a five-foot high, 500-foot long earth berm was constructed parallel to Back Bay Drive. There is now a twelve-foot drop in elevation from the water level in the pond to the mean sea level of the estuary. A concrete spillway directs overflow to culverts under Back Bay Drive.

Culverts under Back Bay Drive drain Big Canyon Creek into the Bay.

Sediment eroding from the bluffs and the un-compacted dredge spoils has accumulated in the pond, diminishing its capacity to hold storm water during high flows. The water depth is now two feet. Cattails now dominate the warm shallow water of the pond, creating a flood hazard and further reducing the diversity of the aquatic environment.

A secondary drainage channel follows the toe of the northern bluffs and exits under a bridged portion of Back Bay Drive. This channel is active primarily during winter storms and high flows. With the elimination of natural tidal influence, riparian woodland has become established in this area of Big Canyon.

Issues of Concern

- Loss of critical native habitat for endangered species
- Continuous flow of untreated contaminated water into Upper Newport Bay
- Loss of habitat diversity
- Degradation of freshwater pond
- Lack of flood management
- Infertile dredge materials
- Loss of natural transition from uplands to wetlands
- Destruction of historic tidal wetlands
- Poor drainage
- Infertile, saline and erosive soils due to dredge spoils

NATIVE HABITATS AND ENDANGERED SPECIES

There are 42 native plant communities identified in Big Canyon that attract an abundance of native birds, animals, reptiles and insects. Many of these communities are fragmented, discontinuous, and threatened by non-native plants. There are 86 native plant species, but 116 introduced non-native invasive species. Of the 86 native plant species occurring in Big Canyon, six have special status: Salt Marsh Bird's Beak; Southern Tar Plant; California Boxthorn; Southwestern Spiny Rush; Estuary Seablite; and Wooly Seablite. The Salt Marsh Bird's Beak an endangered species on both federal and state lists; with 30,000 plants counted in 2003, Big Canyon has the most significant population in Southern California of this wetlands-dependent plant.

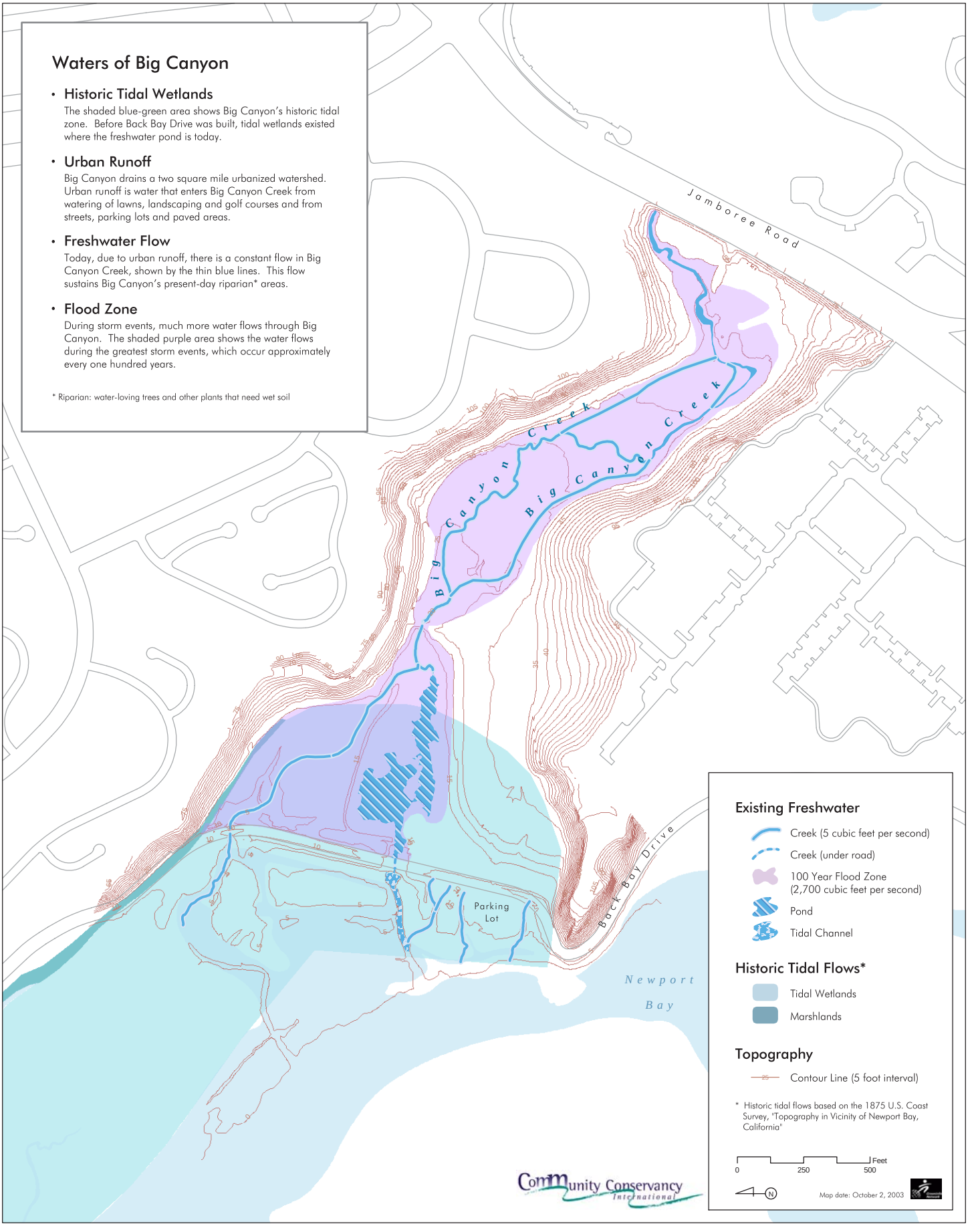
The native plant communities in the upper part of Big Canyon include arroyo willow scrub, alkali meadow, freshwater marsh, and sagebrush scrub. The lower portion (western) of the canyon is dominated by a large area of freshwater marsh, along with cottonwood-willow riparian forest, alkali meadow, brackish marsh, mulefat scrub, alkali grassland, chenopod scrub, coyote brush scrub, and sagebrush scrub. The canyon slopes contain areas of coastal bluff scrub and coyote brush scrub.

The tidal wetlands on the bayside of Back Bay Drive are dominated by saltmarsh, with smaller areas of alkali grassland, alkali meadow, alkali marsh, brackish marsh, mulefat scrub and sagebrush scrub along the edges of the roadway.

Salt marsh established on tidal mud flats

Ten bird species found in the project area are classified as endangered, threatened, or of special concern, including the Light-footed Clapper Rail, the California Gnatcatcher, California Brown Pelican, Belding's Savannah Sparrow, White-tailed

HISTORIC TIDAL WETLANDS & WATERS OF BIG CANYON



Kite, Vaux's Swift, Cooper's Hawk, Sharp-shinned Hawk, Peregrine Falcon, and Northern Harrier.

The mudflats and shallow tidal channels at the mouth of Big Canyon, near the culvert under Back Bay Drive, support a range of native benthic invertebrates that are a critical food source for shorebirds and bottom-foraging fishes. These tidal-dependent organisms are integral to a healthy tidal ecosystem, but are currently limited to the estuarine area, mudflats and salt marsh area below Back Bay Drive.

Issues of Concern

- Endangered and threatened species
- Continued loss and degradation of native habitat
- Loss of wildlife diversity
- Impacts of contaminated urban runoff

NON-NATIVE HABITATS

Invasive, non-native species found throughout the site have reduced the quality of the native habitats. A total of 116 plant species in Big Canyon have been identified as non-native and invasive.

Large areas of annual grassland found throughout the project area are dominated by non-native plants. Drought tolerant ornamental species used in residential landscaping have become established on the downhill slopes.

The cattails found in the pond are a native plant species that has become invasive due to the high levels of nitrogen in the water. Both the cattails and algae are choking the pond from the edges inward, and will continue to reduce the open water areas as they spread. Sediment from loosely aggregated dredge spoil areas is filling in the pond, and the increased shallows will encourage cattail encroachment.

Stands of Brazilian Pepper Tree associated with areas of infertile soils have choked out all native plants in those areas. The African Clawed Frog dominates the freshwater pond and devours native fish and amphibians.

Issues of Concern

- Degradation of native habitat due to non-native, invasive species
- Lack of eradication and management of highly invasive species
- Lack of fire management in restoration areas and on fragile bluffs
- Storm water run-off from surrounding streets and parking lots
- Fertilizer and pesticide contaminants from surrounding homes and golf course
- Sedimentation from bluffs and uncompacted dredge spoils

WATER QUALITY

Big Canyon Creek drains contaminated urban runoff and polluted storm water from the entire two square mile watershed directly into Upper Newport Bay. Water quality issues in Upper Newport Bay threaten the survival of hundreds of wetlands-dependent species and contribute to elevated bacterial counts at downstream beaches.

Portions of the Bay have been closed to water-contact recreation since 1974, and shellfish harvesting has been prohibited in the Ecological Reserve since 1978. Pesticides in the Upper Bay are now at levels toxic to aquatic life, and urban runoff continues to poison shellfish and invertebrates, the critical food source for shorebirds and fish.

Issues of Concern

- Impact of pesticides, fertilizers and other toxins on water quality of Upper Newport Bay
- Water quality contamination from urban runoff and storm water in the Big Canyon Creek watershed
- Flood management

ROADS, PARKING, TRAILS & BOARDWALKS

The primary access to Big Canyon is via Back Bay Drive, a one-way, single lane scenic drive with a class 2 bicycle lane and soft shoulders. Back Bay Drive cuts across the mouth of the canyon, through an area that was once tidal wetlands. An asphalt-paved parking lot is located on the western side of Back Bay Drive in the middle of existing tidal wetlands. Damage from recent storm surges is evident along the outer edges of the tarmac.

Damage to parking lot at wetlands' edge.

Maintenance roads traverse the site to access storm drains and sewer lines. Three controlled vehicle entrances are located on Back Bay Drive, Jamboree Road and Vista Bonita. The maintenance roads are surfaced in dirt, gravel and dredge material. Repairs to the roads in flood prone areas have been made by importing gravel and concrete construction debris to raise and armor the edges of the roadways. Over the years, resurfacing the roads has increased their width beyond the 11 feet necessary for maintenance vehicle access.

The maintenance road crosses the stream course in the middle of the canyon. Culverts under a concrete embankment constrict the winter flows, creating a riparian woodland and wet meadow upstream.

Concrete embankment and maintenance road crossing over creek

A small system of designated interpretive trails provides access to the downstream portion of the canyon. These trails follow the northern edge of the freshwater wetland to the middle of the canyon, cross over the stream and double back along the toe of the northern bluffs. The bridges and boardwalks adjacent to Back Bay Drive are deteriorated and flood-damaged and no longer provide the ADA-access to the area for which they were designed.

Unauthorized trails have been created on the fragile bluffs by local residents taking shortcuts into the canyon. These trails contribute to the erosion of the bluffs and intrude into sensitive habitat areas.

Issues of Concern

- Lack of coordinated public access and trails
- Location of parking lot in wetlands
- Constant maintenance and repair of parking lot and boardwalks close to water's edge
- Inappropriate use of gravel and asphalt as surfacing materials in wetland areas
- Size and proliferation of maintenance roads cutting through habitat areas
- Lack of ADA access
- Old and damaged boardwalks and public trails

PUBLIC ACCESS & INTERPRETIVE USE

More than 750,000 visitors visit Upper Newport Bay annually. Big Canyon is one of the primary access points to the Bay. This unique estuary is heavily used by the public for recreation, wildlife observation and wetland-based educational activities.

Newport Bay Naturalists and Friends currently sponsors a wide range of programs and activities oriented around the estuary for all ages and interests, in partnership with the Newport Unified School District, local Scout troops, the California Department of Fish and Game and the County of Orange. Big Canyon is the primary access point on the eastern side of the estuary.

Bicyclist crossing creek's northern drainage course

The shallow waters of Upper Newport Bay limit recreational boating to small craft such as kayaks. There is no official water access in the Big Canyon Creek project area, but the proximity of the parking lot to the water's edge encourages boaters to land and visitors to wade into the estuary.

Hikers, joggers and bicyclists tend to concentrate their activities along Back Bay Drive. Due to the lack of identifiable trailheads or passable trails, many visitors never explore the interior of the canyon.

The parking lot can accommodate 35 cars and two buses. Two unattractive port-a-potties are provided at the edge of the parking lot. There are no bicycle racks available in the parking lot to encourage visitors to arrive via bicycle instead of car. Bicycles are not permitted on the trails or maintenance roads in Big Canyon.

A wood timber kiosk is located a short walk from the parking lot. Sun-faded displays provide interpretive information on the ecology of the Bay and its relationship to the Pacific Coast Flyway. A brochure rack offers activity information from California State Parks and the City of Newport. The trails leading to the kiosk have been damaged by flooding and are not clearly marked.

Pedestrian access to Big Canyon from the parking lot area requires visitors to cross Back Bay Drive. The trail and interpretive facilities do not meet ADA requirements.

Old, damaged and deteriorating boardwalks, kiosks and interpretive signage have a negative impact on the visitor experience and add to a feeling of isolation and neglect.

Issues of Concern

- Lack of integrated public access and trail system
- Old and deteriorated kiosk and interpretive signs
- Poor quality of the interpretive experience
- Habitat damage due to public uses in sensitive areas
- Lack of scenic overlooks
- Lack of trail system in upper canyon

VIEWS & AESTHETICS

Whether by car, foot, bicycle, or by boat, visitors to Big Canyon come for the spectacular views of Upper Newport Bay and tidal flats, the freshwater marsh, and the coastal bluffs. Preservation of this unique setting is highly valued by communities.

Issues of Concern

- Protection of Bay and wetland views
- Raised terraces and dams block views into Big Canyon from Back Bay Drive
- Poor location and design of parking area
- Lack of scenic overlooks

URBAN INFRASTRUCTURE

Back Bay Drive is a levee roadbed with three 15" culverts underneath the road that drain fresh water from Big Canyon Creek into the estuary channel and into Upper Newport Bay. The constricted drainage at the creek mouth is a barrier to natural tidal flows, sediment movement, natural drainage patterns, and native plants and animals. Additionally, the constricted drainage has created serious flooding problems during winter storms, resulting in repeated and expensive damage to Back bay Drive.

Information obtained form the City of Newport Beach indicates that there are a number of existing storm drains that channel runoff from adjacent neighborhood streets into the canyon. Outfalls are typically located at the base of the bluffs to eliminate erosion on the bluffs.

A large culvert located beneath Jamboree Road drains the entire Big Canyon Creek watershed into Big Canyon Creek. Water quality is degraded due to fertilizers and pesticides from the golf course and other landscaped areas, oil, heavy metals and other contaminants draining into the creek from the watershed.

A county sewer line along the northern edge of the canyon joins a city-owned line that follows the southern edge. Maintenance of these lines is via manholes located throughout the project site.

No existing utilities are located within the Back Bay Drive right-of-way.

Issues of Concern

Roads, infrastructure, and the existing utilities within Big Canyon are constraints to restoration efforts currently under consideration. Major issues include:

- Restricted tidal flow
- Access for on-going removal of sediments from the constructed freshwater pond
- Unfiltered, contaminated urban run-off entering Big Canyon
- Flooding

Section 4
BIG CANYON: TERRESTRIAL BIOLOGICAL RESOURCES

1.0 ABSTRACT

This report summarizes the results of surveys of terrestrial (non-marine) biological resources conducted in Big Canyon during the spring and summer of 2003. Results are described in more detail in Appendix B (Terrestrial Biological Technical Appendix).

Surveys for terrestrial biological resources in Big Canyon in 2003 identified 42 plant communities and mapping units such as urban areas. The upper part of Big Canyon is primarily composed of arroyo willow scrub, annual grassland, alkali meadow, freshwater marsh, sagebrush scrub, and ornamental plant communities. In contrast, the lower portion (western) of the canyon is dominated by a large area of freshwater marsh, along with cottonwood-willow riparian forest, alkali meadow, brackish marsh, mulefat scrub, alkali grassland, annual grassland, chenopod scrub, coyote brush scrub, and sagebrush scrub. The slopes above the drainage contain areas of coastal bluff scrub, coyote brush scrub, and ornamental plant communities. The drainage also contains dense stands of Brazilian pepper (*Schinus terebenthifolius*)[1]. The area west of Back Bay Drive supports large areas of saltmarsh, with smaller areas of alkali grassland, alkali meadow, alkali marsh, brackish marsh, mulefat scrub and sagebrush scrub.

One special-status[2] insect species, the western mudflat tiger beetle (*Cicindela trifasciata sigmoidea*), was detected in Big Canyon during 2003 surveys. The wandering skipper butterfly (*Panoquina errans*) also likely occurs here; it was not detected because focused surveys for this species were not conducted. Six special-status plants were detected in Big Canyon including salt marsh bird's beak (*Cordylanthus maritimus* ssp. *maritumus*), southern tarplant (*Centromadia parryi* ssp. *australis*), California boxthorn (*Lycium californicum*), Southwestern spiny rush (*Juncus acutus ssp. leopoldii*), estuary seablite (*Suaeda esteroa*) and woolly seablite (*Suaeda taxifolia*). Diversity of amphibians and reptiles was low in Big Canyon during 2003 surveys, and no special-status amphibian or reptile species were detected during focused surveys; none are expected to occur in Big Canyon. Focused surveys for three special-status bird species, the least Bell's vireo (*Vireo belli pusillus*), California gnatcatcher (*Polioptila californica*) and Belding's savannah sparrow (*Passerculus sandwichensis beldingi*) were conducted during 2003. No least Bell's vireos were observed, and potential habitat in Big Canyon in its current condition is unlikely to support the species. One pair of California gnatcatchers and eight pairs of Belding's savannah sparrows were observed. No special-status mammals were observed during 2003 surveys and none are expected to occur in Big Canyon in its current condition.

Big Canyon supports a diversity of habitats, although many of these have been disturbed by human uses. Still, an abundance of plant and wildlife species occur in Big Canyon, although some are non-native or invasive and could benefit from restoration activities.

2.0 INTRODUCTION

2.1 Site Description

Big Canyon is located in the Newport Beach area of Orange County, California. Specifically, it is located in a relatively undisturbed strip of land between Jamboree Boulevard and Back Bay Drive approximately one mile north of Pacific Coast Highway (Highway 1) along the east shore of Upper Newport Bay. The 70-acre area consists of a nature park mostly east of Back Bay Drive that is situated between residential developments on bluffs overlooking the site to the north and south. Areas to the west of Back Bay Drive include a small parking lot, information kiosk, and Upper Newport Bay. The survey area is generally bounded as follows: on the west, approximately 200 feet west of Back Bay Drive, on the north by residential areas

[1] Scientific names are provided after the first mention of the common name in this report.

[2] The term "special-status" is similar to the formerly used term "sensitive" to describe plant and animal species whose populations are limited or declining and are thus designated endangered, threatened, rare, or species of concern by governmental resource agencies and/or conservation organizations. This concept, and special-status species known to occur or potentially occur in Big Canyon, is discussed in Section 6.

(Eastbluff Park and Santa Ana Heights), on the east by Jamboree Road; and on the south by residential and commercial developments. Thus, the survey area includes salt marsh and mud flat habitats on the west, and the north, south and east bluffs of the canyon. The survey area is situated within Section 23, Township 6S, Range 10W within the U.S.G.S. Newport Beach 7.5' series quadrangle map.

Land use varies within and adjacent to the survey area, and includes residential areas, golf courses, paved and unimproved roads, power lines, and commercial developments. Relatively undisturbed natural areas associated with the Upper Newport Bay Ecological Reserve (± 752 acres) are present within and at locations to the north, south, and west of Big Canyon. The Reserve was created in 1975 and is managed jointly by the California Department of Fish and Game and the County of Orange Department of Harbors, Beaches and Parks in cooperation with the City of Newport Beach and the U.S. Fish and Wildlife Service (USFWS).

Topographically, Big Canyon is characterized by steeply sloping bluffs and flat areas with a combined maximum vertical relief of roughly 75 feet between the highest and lowest elevation points on the property. Elevations range from approximately 0 to 75 feet above mean sea level. Surrounding topographic features in the project vicinity include gently to steeply sloping hills with canyons and ridgelines, and flat areas adjacent to Upper Newport Bay.

A perennial stream area is present within Big Canyon and supports willow, mulefat, sycamore, cottonwood, and associated riparian species as well as non-native species. Just east of Back Bay Drive is an artificial damn and freshwater pond, with a dense population of cattails. Several areas of Big Canyon support some form of human disturbance and associated ruderal and invasive vegetation. Coastal sage scrub is also present, particularly on the steep slopes along the north and south edges of Big Canyon.

2.2 Purpose of the Study

Baseline surveys of terrestrial biological resources were conducted in order to determine the existing biological conditions within Big Canyon and to assist in establishing opportunities and constraints for restoration. Surveys focused on documenting the locations of existing resources that have become degraded due to human activities, locations of non-native plant communities and invasive and other non-native species, and locations of special-status resources that warrant protection and/or that could benefit from creation or enhancement of additional habitat in Big Canyon. These surveys encompassed the entire 70-acre site from canyon edges on the north and south and from the coastal salt marsh on the west to Jamboree Road on the east. Surveys included:

- mapping of plant communities
- botanical assessment of the plant communities
- list of plant species including native, special-status and invasive species
- evaluation of dominant plant species within each plant community
- assessment of insect fauna
- assessment of herpetological (amphibian and reptile) fauna
- assessment of avian fauna
- assessment of mammalian fauna
- focused surveys for special-status species for which suitable habitat was located during the assessment surveys.

Methods used to conduct these surveys are discussed in Section 3.0.

3.0 METHODS

3.1 Methods for Plant Community and Botanical Surveys

Botanist Dave Bramlet conducted the plant community mapping, botanical surveys to develop an inventory of plant species in Big Canyon, conducted focused surveys for special-status plant species, and authored the botanical sections of this report. Surveys were conducted on several dates during May, June and July 2003. Survey methods are described in Section 1 of Appendix B.

3.2 Methods for Entomological (Insect) Surveys

Surveys for insect fauna in Big Canyon were conducted by entomologist Guy Bruyea on May 19, June 14, and July 10, 2003. The entomological surveys included a general daytime insect survey and an insect habitat survey, with special

consideration in locating potentially suitable habitat for rare, threatened, endangered, and other 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. Survey methods are described in the Section 2 of Appendix B.

3.3 Methods for Herpetological Surveys

Herpetological (amphibian and reptile) surveys in Big Canyon were conducted on numerous survey dates from May through July of 2003 by herpetologist Brian Leatherman, using various survey techniques further described in Section 3 of Appendix B.

3.4 Methods for Avian Surveys

3.4.1 General Bird Surveys

Surveys to document bird use of habitats within Big Canyon were conducted on March 14, April 20 and during focused surveys for special-status species. Surveys were conducted by ornithologists Kathy Keane, Spencer Langon, Nathan Mudry and Matthew Amalong. Survey methods are further described in Section 4 of Appendix B.

3.4.2 California Gnatcatcher Surveys

To determine the status of the California gnatcatcher (*Poliptila californica* spp. *californica*) in Big Canyon, focused presence/absence surveys were conducted on February 28, May 31, and July 10, 2003. Survey methodology followed the guidelines of Mock *et al*. (1990), the Southern California Coastal Sage Scrub Scientific Review Panel (Brussard *et al*. 1992) and the United States Fish and Wildlife Service (USFWS) monitoring protocol (USFWS 1997). Methods are further discussed in Section 4 of Appendix B.

3.4.3 Least Bell's Vireo Surveys

To determine the status of the least Bell's vireo (*Vireo belli pusillus*) at the proposed site, focused presence/absence surveys were conducted. All riparian habitat in Big Canyon potentially suitable for Least Bell's vireo was surveyed on April 10; May 31; June 10, 20, 30; and July 10, 20, 30, 2003. Survey methods followed the guidelines of the USFWS monitoring protocol (USFWS 2001), further discussed in Section 4 of Appendix B.

3.4.4 Belding's Savannah Sparrow Surveys

Saltmarsh habitat dominated by pickleweed (*Salicornia virginica*) noted to be suitable for Belding's savannah sparrow was identified west of Back Bay Drive and north of the kiosk and parking lot during an overview survey of the project area on April 16, 2003. Survey methods to census the approximate number of singing males were the same as those used during statewide censuses for this species and were conducted on April 23, April 27 and June 1. Methods are further discussed in Section 4 of Appendix B.

3.5 Methods for Mammalian Surveys

Mammalogist Shana Dodd conducted the mammal survey in Big Canyon using three techniques on June 9 and 10, 2003. Methods are further discussed in Section 5 of Appendix B.

4.0 HISTORICAL INFORMATION

4.1 Botanical History of Big Canyon

Existing literature specific to Big Canyon is limited; however, a review of existing literature on botanical resources occurring in Upper Newport Bay reveals that overall, the Bay supports an estuarine community, including open water, mudflats, and three associations of salt marsh vegetation. The creeks and channels associated with the Bay, including the Santa Ana Delhi Channel, San Diego Creek, and Big Canyon Creek support riparian herb, riparian scrub, and riparian forest, along with alkali, brackish, freshwater marshes. The upland areas consist of annual grassland, ruderal grassland, coastal sage scrub, chenopod scrub, coastal bluff scrub and toyon-sumac chaparral. In addition, the Bay supports large areas of ornamental vegetation, both as part of the adjacent residential and commercial developments, and large stands of "escaped" exotic (ornamental) plant species have established in a number of localities within the Bay. Some wetlands are also found in these localities, including alkaline meadows, and marshes.

Previous studies have noted the presence of 13 special-status plant species within or adjacent to Upper Newport Bay. One of these, the salt marsh bird's beak (*Cordylanthus maritimus ssp. maritimus*)

is currently listed as federally and state endangered. Further details on these species are provided in Section 6.2.

4.2 History of Wildlife Use in Big Canyon

Previous surveys of wildlife use of Upper Newport Bay have been conducted, but results of surveys focusing on Big Canyon are limited and some are unavailable. Several special-status species of birds have been observed in Big Canyon, including the threatened California gnatcatcher (*Poilioptila californica*) and endangered light-footed clapper rail (*Rallus longirostrus levipes*) and Belding's savannah sparrow (*Passerculus sandwichensis* ssp. *beldingi*). Statewide surveys that include Upper Newport Bay are conducted annually for light-footed clapper rail and approximately every three to five years for Belding's savannah sparrow; both species have been recorded at the mouth of Big Canyon over the approximately 20 years that surveys have been conducted. Kathy Keane conducted a color banding study of California gnatcatchers in Big Canyon in 1991; several pairs of gnatcatchers were present at that time. See Appendix B, section 6.5, for more detail.

5.0 ANALYSIS OF EXISTING BIOLOGICAL CONDITIONS

5.1 Plant Communities

The following section summarizes descriptions of the plant communities and other mapping units noted on the habitats and sensitive species map associated with this report (see Appendix A, Figure A2). Results of the rapid assessment percent cover technique for each plant community are listed in Appendix BB. More detailed discussions are included in Section 1 of Appendix B and a list of all observed plant species is provided in Appendix B.

5.1.1 Coastal Sage Scrub Habitats

Big Canyon supports several types of coastal sage scrub including southern coastal bluff scrub, southern coastal bluff scrub/chenopod scrub, sagebrush scrub, sagebrush scrub/chenopod scrub, coyote brush scrub, California bush sunflower scrub, California bush sunflower scrub/chenopod scrub, salt-bush or chenopod scrub, chenopod scrub/alkali meadow, sagebrush sage scrub/grassland ecotone, mixed sage scrub/grassland ecotone and mixed sage scrub/grassland ecotone/alkali meadow.

Each of these subtypes is described in detail in Appendix B. They are generally dominated by California bush sunflower (*Encelia californica*), California buckwheat (*Eriogonum fasciculatum*), coastal prickly pear (*Opuntia littoralis*), California sagebrush (*Artemisia californica*), bladderpod (*Isomeris arborea*), four-wing saltbush (*Atriplex canescens*), quail bush (*Atriplex lentiformis*), Mexican elderberry (*Sambucus mexicana*), and coyote brush (*Baccharis pilularis*), Emory's baccharis (*Baccharis emoryi*), coastal isocoma (*Isocoma menziesii*), and an unnamed, unidentified saltbush introduced into the canyon during a prior restoration project.

5.1.2 Chaparral Habitats

Two types of chaparral habitats were identified in Big Canyon: toyon-sumac chaparral and toyon-sumac chaparral with ornamental plantings. These plant communities include stands of lemonade berry (*Rhus integrifolia*), along with toyon (*Heteromeles arbutifolia*), Mexican elderberry, California sagebrush, coyote brush, Emory's baccharis, myoporum (*Myoporum laetum*), Brazilian pepper (*Schinus terebinthifolius*), and acacias (*Acacia* sp.). Another type of chaparral identified as is composed of a toyon-sumac chaparral with scattered acacia or oleander (*Nerium oleander*) and myoporum shrubs.

5.1.3 Grassland Habitats

Grassland habitats in Big Canyon include Annual grassland, annual grassland/Ornamental vegetation, ruderal grassland, alkali grassland and alkali grassland/ruderal. These areas are dominated by primarily non-native species including ripgut brome (*Bromus diandrus*), red brome (*Bromus madritensis* ssp. *rubens*), foxtail barley (*Hordeum murinum* ssp. *leporinum*), soft chess (*Bromus hordeaceus ssp. hordeaceus*), slender wild oat (*Avena barbata*), Italian ryegrass (*Lolium multiflorum*), foxtail fescue (*Vulpia myuros*), scattered acacia, myoporum, and/or Brazilian pepper trees (sometimes quite dense), small-flowered iceplant (*Mesembryanthemum nodiflorum*), five-hook bassia (*Bassia hyssopifolia*), bur clover (*Medicago polymorpha*), tocalote, Australian salt bush (*Atriplex semibaccata*), cheese weed (*Malva parviflora*), telegraph

weed (*Heterotheca grandiflora*), schismus (*Schismus barbatus*), Spanish sunflower (*Pulicaria paludosa*) statice (*Limonium sp.*), common horseweed (*Conyza canadensis*), and Bermuda grass (*Cynodon dactylon*), garland chrysanthemum (*Chrysanthemum coronarium*), alkali heliotrope (*Heliotropium currasivicum*), common sow thistle (*Sonchus oleraceus*), bristly ox tongue (*Picris echioides*), alkali heath (*Frankenia salina*), common woody pickleweed (*Salicornica virginica*), and salt grass (*Distichlis spicata*). Each of these areas is further described in Section 1 of Appendix B.

5.1.4 Saline Wet Meadows

A saline wet meadow dominated by native herbaceous species such as saltgrass (*Distichlis spicata)*, jaumea (*Jaumea carnosa*), and alkali heath. Other typical species include pickleweed, rabbit's foot grass (*Polypogon monspeliensis*) and other annual herbs. This community is restricted to areas with seasonal soil saturation and wetness with summer drying that brings salts to the soil surface. The greater abundance of native plants and the less disturbed soil profile distinguishes this area from alkali ruderal habitats.

5.1.5 Marsh Habitats

Several types of marsh are present in Big Canyon, including salt marsh (upper, middle and lower intertidal), freshwater marsh, coastal brackish marsh and cismontane alkaline marsh.

Salt marsh (upper, middle and lower intertidal salt marsh.) Characteristic species in these habitats 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*), and California cord grass (*Spartina foliosa*).

Freshwater marsh in big Canyon is present around a large pond that has formed above the outlet of Big Canyon Creek. This marsh is dominated by dense stands of broad-leaved cattail, with some occasional stands of California bulrush with margins supporting a variety of herbaceous plant species.

Coastal brackish marsh is influenced by brackish and freshwater and is often found in channels that may have some tidal influence. In some locations, these marshes may consist of dense stands of alkali bulrush (*Scirpus maritimus*). In other channels the marsh may be composed of broad-leaved cattail (*Typha latifolia*) and/or California bulrush (*Scirpus californicus*).

Cismontane alkaline marsh is found in moist or potentially inundated areas that lacked tidal fluctuations. These areas are dominated by open stands of broad-leaved or narrow-leaved cattails, along with stands of alkali bulrush.

5.1.6 Riparian Habitats

Several types of riparian habitats were identified at Big Canyon, including riparian herb, willow riparian scrub, mulefat scrub, black willow forest and willow riparian forest. Common species in these communities consist of rabbit's foot grass, yellow sweet clover, Spanish sunflower, bristly ox tongue, dwarf nettle (*Urtica urens*), common sow thistle, nettle-leaved goosefoot (*Chenopodium murale*), alkali heliotrope, mugwort (*Artemisia douglasiana*) water cress (*Rorippa nasturtium-aquaticum*), coarse goosefoot (*Chenopodium macrospermum*), lamb's quarters (*Chenopodium album*), black willow (*Salix gooddingii*), Fremont cottonwood (*Populus fremontii*), Brazilian pepper, and western sycamore (*Platanus racemosa*). Each of these communities if further described in Section 1 of the Appendix B.

5.1.7 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. These areas are further described in Appendix B.

5.1.8 Sandy Flats

Sandy flats are open sandy areas generally lacking vegetation that were found on the two islets on the western portion of the study site. 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.

5.1.9 Marine and Coastal Habitats

Tidal mudflats consist of tidal flats within the study area that are exposed by low tides. This mapping unit often has a large amount of green macro algae *(Ulva* and *Enteromorpha*) and diatoms growing on the muddy substrate.

5.1.10 Ponds and Creeks

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 duckweed (*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.

Creeks consist of the main and distributary channels of Big Canyon Creek. These channels are often vegetated as described above, but exhibit directional water flow. The main channel is well defined in the upper and lower portions of the canyon. In the middle, flatter portion of the Canyon, several distributary channels are found that discharge water primarily following storm events when the open water ponds are full.

5.1.11 Ornamental Plantings

Ornamental Plantings not associated with native plant communities were placed in this mapping unit. These areas support dense monotypic stands of ice plant and 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*). These species are further described in Appendix B.

5.1.12 Mixed Ornamental Plantings and Riparian

Other types of communities with ornamental plantings include Ornamental Plantings/Riparian and Ornamental Plantings/Willow riparian scrub and Ice plant plantings (15.5) consists of large areas of ice plant and included hottentot fig and at least two other iceplant species found within the canyon.

5.1.13 Developed

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. Back Bay 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.

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 Back Bay Drive was also placed in this mapping unit.

5.2 Entomological Survey Results

Five basic habitat types for insects were identified at the Big Canyon site. 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. A list of insects observed in Big Canyon during surveys is included in Appendix B, and results are further detailed in Section 2 of Appendix B.

A total of twenty-one relatively common butterfly species were observed during the survey in Big Canyon (see Section 8 of Appendix B). Butterflies can be a good indicator of habitat quality in a particular area.

Relatively few other insect species were observed during the survey. This may be due to several factors, including an atypically cool, wet and late spring in 2003, which may have delayed or disrupted insect emergence patterns.

Potential native and non-native nectar resources for insects were abundant on the site, and included Spanish sunflower, mulefat, alkali heliotrope, California buckwheat, tocalote, and other plants. However, the diversity of nectar-feeding insects such as bees and wasps was low. Sonoran

bumblebee (*Bombus sonorus*) and honeybee (*Apis mellifera*) were the most abundant bee species. Carpenter bees (*Xylocopa varipuncta*) and sand wasps (*Bembix comata*) were also observed.

Several species of dragonfly and damselflies were observed in association with the freshwater marsh pond at the mouth of Big Canyon. These and other insects observed during the surveys are further described and a list of observed insect species is provided in Appendix B.

5.3 Herpetological Survey Results

5.3.1 Herpetological Inventory

A total of seven species of amphibians and reptiles was observed at Big Canyon during the 2003 surveys (see Section 8 of Appendix B). Two of these, the Pacific tree frog (*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*).

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. Results are further detailed in Section 3 of Appendix B.

5.3.2 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 8 in Appendix B shows the number of observations of each species by habitat type and for the site 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).

The western fence lizard was the most abundant species at Big Canyon. 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. The southern alligator lizard was more abundant in the upland habitat. A list of amphibian and reptile species observed is provided in Section 8 of Appendix B.

5.4 Avian Survey Results

A total of 107 bird species was observed in Big Canyon during the three surveys, 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 avian surveys are further detailed in Section 4 of Appendix B, and a list of bird species observed at Big Canyon is provided in Section 8 of Appendix B. Results of surveys for special-status bird species (California gnatcatcher, least Bell's vireo, Belding's savannah sparrow) are discussed in Section 6.5 of this report.

5.5 Mammalian Survey Results

Mammal species that were recorded based on sign or visual detection 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*).

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. Other than

domestic dogs, no non-native mammals were detected on the site. 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 expected to occur in Big Canyon, as it is common throughout southern California, is the Virginia opossum (*Didelphis virginiana*). Results are further detailed in Section 5 of Appendix B, and a list of mammal species observed is provided in Section 8 of Appendix B.

6.0 ENDANGERED, THREATENED AND OTHER SPECIAL-STATUS SPECIES

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 (e.g., U.S. Fish and Wildlife Service [USFWS], California Department of Fish and Game [CDFG]) and/or resource conservation organizations (e.g., California Native Plant Society [CNPS] or the National Audubon Society [NAS]). Sources used to identify special-status species and sensitive plant communities potentially occurring in the project vicinity are listed in Appendix B and are available through http://www.dfg.ca.gov/whdab/html/lists.html.

This review and consultations with the biological experts conducting surveys for this study allowed us to determine which special-status species and sensitive plant communities may occur at Big Canyon. These are described in the following sections. See Appendix B for detail.

6.1 Plant Communities of Concern

The communities of special status are those declining communities of concern to the CDFG (CNDDB 2002b), or County of Orange (Gray and Bramlet 1994b). Special-status plant communities in Big Canyon include:

- coastal salt marsh
- freshwater marsh
- brackish marsh
- alkali marsh
- alkaline meadow
- riparian communities
- coastal sage scrub
- coastal bluff scrub
- alkali grassland
- estuarine/mudflats

6.2 Special-Status Plant Species

This section summarizes special-status plant species observed or expected to occur in Big Canyon. More detail on these species is provided in Table 10 of Appendix B. Special-status plant species observed in Big Canyon, listed by common name followed by scientific name in italics are:

- Salt marsh bird's beak, *Cordylanthus maritimus* ssp. *maritimus*
- Southern tarplant, *Centromadia (Hemizonia) parryi* ssp. *australis*
- Southwestern spiny rush, *Juncus acutus* ssp. *Leopoldii*
- California boxthorn, *Lycium californicum*
- Estuary seablite, *Suaeda esteroa*
- Wooly seablite, *Suaeda taxifolia*

Special-status plant species known to occur in Upper Newport Bay and therefore could potentially occur at Big Canyon, listed by common name followed by scientific name in italics are:

- Aphanisma, *Aphanisma blitoides*
- Coulter's saltbush, *Atriplex coulteri*
- South coast saltbush, *Atriplex pacifica*
- Many-stemmed dudleya, *Dudleya multicaulis*
- Upright burhead, *Echinodorus berteroi*
- Little spike-rush, *Eleocharis parvula*
- Beaked spike-rush, *Eleocharis rostellata*
- Vernal barley, *Hordeum intercedens*
- Coulter's goldfields, *Lasthenia glabrata* ssp. *Coulteri*
- *Microseris douglasii* var. *platycarpha*
- Coast woolly-heads, *Nemacaulis denudata* var. *denudata*
- Rayless ragwort, *Senecio aphanactis*

6.3 Special-status Insect Species

This section summarizes special-status insect species observed or expected to occur in Big Canyon. More detail on these species is provided in Table11 of Appendix B.

One special-status insect species, the western mudflat tiger beetle (*Cicindela trifasciata sigmoidea*), was observed in Big Canyon. Special-status insect species known to occur in Upper Newport Bay and therefore could potentially occur at Big Canyon, listed by common name followed by scientific name in italics are:

- Quino Checkerspot, *Euphydryas editha quino*
- El Segundo blue, *Euphilotes battoides allyni*
- Palos verdes blue, *Glaucopsyche iygdamus palosverdesensis*
- Wandering skipper, *Panoquina errans*
- Monarch Butterfly, *Danaus plexippus*
- Mormon metalmark butterfly, *Apodemia mormo* (El Segundo ecotype)
- Busck's gall moth, *Carolella busckana*
- Henne's eucosman moth, *Eucosma hennei*
- Ford's sand dune moth, *Psammobotys fordi*
- Globuse dune beetle, *Coelus globosus*
- Dorothy's dune weevil, *Trigonoscuta dorothea*
- Lange's el Segundo weevil, *Onychobaris langei*
- Sandy beach tiger beetle, *Cicindela hirticollis gravida*
- Sand due tiger beetle, *Cicindela latesignata*
- Gabb's tiger beetle, *Cicindela gabbii*
- Frost's tiger beetle, *Cicindela senilis frosti*
- El Segundo flower-loving fly, *Rhaphiomidas terminatus*
- Belkin's dune horsefly, *Brennania belkini*
- Jerusalem cricket, *Stenopelmatus* new species
- Sand roach, *Arenivaga* new species

6.4 Special-status Herpetological Species

No special-status herpetological species were located during the 2003 surveys. However, Big Canyon supports potential habitat, albeit marginal, for two special-status herpetological species, the Southwestern pond turtle *(Clemmys marmorata pallida)* and the San Diego horned lizard *(Phrynosoma coronatum blainvillei).* For more detail, see Section 6.4 of Appendix B.

6.5 Special-status Avian Species

Special-status avian species observed in Big Canyon, listed by common name followed by scientific name in italics are:

- California brown pelican, *Pelicanus occidentalis*
- Light-footed clapper rail, *Rallus, longirostris levipes*
- California least tern, *Sterna antilarum browni*
- Cooper's hawk, *Accipiter cooperii*
- Sharp-shinned hawk, *Accipiter striatus*
- White-tailed kite, *Elanus leucurus*
- Northern Harrier, *Circus cyaneus*
- Osprey, *Pandion haliaetus*
- Vaux's swift, *Chaetura vauxi*
- Coastal California gnatcatcher, *Polioptila californica*
- Belding's savannah sparrow, *Passerculus sandwichensis* ssp. *Beldingi*

Special status birds that may occur in Big Canyon or its vicinity include:

- Western snowy plover, *Charadrius alexandrinus nivosus* (may forage on mudflats)
- Merlin, *Falco columbarius*
- Peregrine falcon, *Falco peregrinus* (forage)
- Burrowing owl, *Speotyto cunicularia*
- Loggerhead shrike, *Lanius ludovicianus*
- California horned lark, *Eremophila alpestris actia* (during migration)
- Least Bell's vireo, *Vireo belli pusillus* (may occur as migrant)
- Coastal cactus wren, *Campylorynchus brunneicapillus couesi*
- California yellow warbler, *Dendroica petechia brewsteri* (may occur as migrant)
- Yellow-breasted chat, *Icteria virens* (may occur as migrant)

Further details are available in Table 12 of Appendix B.

6.6 Special-status Mammal Species

No potential habitat for special-status mammal species was located during the surveys. Thus, no mammal species are discussed in more detail in this section, no focused surveys were conducted for special-status mammals in Big Canyon, and none were located during general surveys. The Pallid Bat *(antrozous pallidus)* is likely to forage occasionally

over Big Canyon. More detail is available in Table 12 of Appendix B.

7.0 NON-NATIVE AND INVASIVE SPECIES OF CONCERN

7.1 Non-Native and Invasive Plant Species

The following section notes some of the more invasive, exotic plant species found in the Big Canyon study area. For further detail, see Section 7 of Appendix B.

Non-native and invasive plant species noted in the Big Canyon study area, listed by common name followed by scientific name in italics, are:

- Brazilian pepper, *Schinus terebinthifolius*
- Unknown Saltbush, *Atriplex sp.*
- Iceplants
- Spanish sunflower, *Pulicaria paludosa*
- Statice, *Limonium ramosissimum*
- Glaucous-leaved saltbush, *Atriplex glauca*
- Myoporum, *Myoporum laetum*
- Castor bean, *Ricinus communis*
- Pampas grass, *Cortaderia selloana*
- Evergreen (Shamel) ash, *Fraxinus uhdei*
- Italian thistle, *Carduus pycnocephalus*
- Tocalote, *Centaurea melitensis*
- Black mustard, *Brassica nigra*
- Garland chrysanthemum, *Chrysanthemum coronarium*
- Pride of Madera, *Echium candicans*
- Acacia, *Acacia longifolia*, *A. retinodes*, plus additional species
- Five-hook bassia, *Bassia hyssopifolia*
- Purple false brome, *Brachypodium distachyon*
- Tree tobacco, *Nicotiana glauca*
- Sweet fennel, *Foeniculum vulgare*
- Poison hemlock, *Conium maculatum*
- Bull thistle, *Cirsium vulgare*

7.2 Non-Native and Invasive Insect Species

Argentine ants *(Linepithema humile)* are small ants often present in great numbers. They are known to forage 24 hours a day. The Argentine ant is now permanently established in California and parts of the southern United States, including Georgia and Florida. These ants are most commonly encountered in urban areas and along the coast. Argentine ants are usually found on trees or shrubs, in flowerbeds, in and around mulch, and in trash heaps. Argentine ants are a serious threat to native ecosystems. They may eat nestling birds. They out-compete native ants and other native insects for food and habitat, thus reducing prey and displacing predators on native insects such as lizards, snakes, and spiders.

Other predators on native insects include non-native sow bugs (*Porcellio laevis*), expected to occur in Big Canyon, and earwigs (*Forficula auricularia*), observed in Big Canyon during surveys. Giant whitefly (*Aleurodicus dugesii*) may also be present on some of the ornamental trees and shrubs above Big Canyon, especially hibiscus. This insect has become a serious pest of plants in recent years from coastal San Diego to Los Angeles County.

7.3 Non-Native and Invasive Herpetological Species

African clawed frog and non-native crayfish are non-native species commonly found in freshwater marshes and streams in southern California, and both were observed in Big Canyon (see Section 3.2.1). These species are known to reduce the populations of native amphibians and fish species, sometimes to the point of extirpation, by consuming their eggs.

7.4 Non-Native and Invasive Avian Species

Several non-native bird species common to southern California are also found in Big Canyon, including the European starling (*Sturnus vulgaris*) and house sparrow (*Passer domesticus*). Both are species native to Britain that were introduced into the United States during the early- to mid-1900's. Both species take over nesting habitat of native species, thereby reducing the populations of native species, and both were observed in Big Canyon. Native species that are a problem for other native birds include the American crow (*Corvus brachyrhynchos*) and brown-headed cowbird (*Molothrus ater*). American crows are very well adapted for living in residential areas, and they prey heavily on native bird species. During surveys for Belding's savannah sparrow in Big Canyon, several crows were observed foraging within the pickleweed marsh, likely searching for garbage washed up during high tide as well as for eggs of native nesting birds of the coastal salt marsh. Brown-headed cowbirds are nest parasites that locate and remove eggs from nests of native birds,

replacing them with their own. The native birds typically do not recognize the foreign eggs and raise the young as if they were their own, thus producing no offspring of their own. No brown-headed cowbirds were observed in Big Canyon during 2003 surveys but they are known to occur in the area.

7.5 Non-Native and Invasive Mammal Species

Non-native and invasive mammal species in the vicinity of Big Canyon include feral cats, a widespread problem in many areas of southern California, as they consume native bird, reptile and mammal species. Another non-native species is the red fox (*Vulpes vulpes*). The red fox is very well adapted to human modified habitats and frequently resides in open space areas such as the borders of coastal salt marshes. Red foxes prey on native species, and substantial reductions in reproductive success as well as in populations of special-status bird species. No red foxes were observed at Big Canyon during the 2003 surveys, and it is likely that coyotes in the area, which prey on red foxes, keep the population in check.

8.0 SPECIES LISTS

Lists of plants, insects, reptiles and amphibians, birds, and mammals observed in Big Canyon during 2003 surveys are provided in Section 8 of Appendix B.

Section 5
BIG CANYON:
BENTHIC INVERTEBRATES & FISH

1.0 ABSTRACT

Coastal Resources Management (CRM) conducted a benthic invertebrate and fish survey in the vicinity of Big Canyon on the eastern side of Upper Newport Bay, Orange County, California in 2003. The purpose of the survey was to examine the community structure and distribution of marine invertebrates and shallow-occurring fishes between the channel of Upper Newport Bay to and including Big Canyon Pond. This study was conducted to assist in the development of design alternatives for the restoration of Big Canyon, including the potential to restore tidal action and to predict the types of benthic invertebrates and fish species that might colonize areas within Big Canyon that are reintroduced to tidal action. Channel, mudflat, and shallow freshwater pond benthic samples were collected. The survey yielded a total of 3,062 individuals of marine and freshwater invertebrates, encompassing 48 specific taxa. The distribution of the benthic invertebrates collected during the survey indicated that most species and abundances were associated with the shallow mudflat habitats between +1 to -0.3 ft Mean Lower Low Water (MLLW), and secondarily with deeper open water habitats in the main channel of Upper Newport Bay. Big Canyon Pond exhibited extremely low numbers and diversity of organisms; most were insects (midges).

A total of 1,334 individuals comprising six species of fish were collected at three stations in Upper Newport Bay between the main channel and the drainage culvert leading to Big Canyon Creek. The most abundant species was topsmelt (*Atherinops affinis*), which accounted for 96.4% of the total abundance. Other common species collected included yellowfin gobies (*Acanthogobius flavimanus*), killifish (*Fundulus parvipinnus*), and gobies (Gobiidae, unidentified). The size range of the individuals collected indicated that the area in the vicinity of Big Canyon within Upper Newport Bay supports a viable population of juvenile and subadult fish.

The results of this study suggest that extending tidal influence into Big Canyon will re-introduce a range of shallow water and mudflat-occurring estuarine benthic invertebrates and fishes and will result in higher population densities of benthic invertebrates compared to conditions that currently exist in the degraded Big Canyon Pond.

Given the importance of shallow water and mudflat benthic infaunal organisms in the detrital food web ecosystems of coastal wetlands, and the importance of benthic invertebrates in the diet of foraging shorebirds and marsh birds, the re-introduction of tidal flow, and the subsequent recolonization of Big Canyon wetlands by tidal invertebrates and fishes would result in an increase in coastal wetland habitat value.

2.0 INTRODUCTION

Benthic invertebrate and fish surveys were conducted by CRM in May and July 2003 to determine the community composition and abundance of invertebrates and fishes in the vicinity of the mouth of Big Canyon. This information is being collected to assist in the development of design alternatives for the restoration of Big Canyon, which include the reintroduction of tidal flow to areas within the Canyon that historically (pre-1875) were subjected to tidal influence (see Appendix A, Figure A1). The information collected provides a baseline that can be used to assist in predicting the types and abundances of estuarine and bay invertebrates and fishes that may potentially re-colonize Big Canyon tidal channels once tidal flow is re-introduced to the area.

3.0 METHODS

3.1 Benthic Invertebrates

CRM conducted the benthic invertebrate survey on 30 May 2003. The survey was conducted by Rick Ware, Steve Whitaker, and Jim Stickler, of Coastal Resources Management. A total of 14 stations were sampled in the vicinity of Big Canyon, located on the eastern side of Upper Newport Bay approximately 1.5 miles northeast of the Coast Highway Bridge (see Figure 5.1). The sampling sites are located within the Upper Newport Bay Ecological Reserve, and also within City of Newport

Beach Environmentally Sensitive Habitat Area (ESHA) #3 (Upper Newport Bay Ecological Reserve) and ESHA #7 (Mouth of Big Canyon). General vicinity photographs of station locations are shown in Photographs 1 through 7 in Appendix C. Photograph 8 in Appendix C illustrates the benthic sampler and the volume of sediments sampled in each benthic core.

Stations BC-1 through BC-6 were located in Upper Newport Bay at depths between -0.2 to -4 feet (ft) (MLLW). Stations BC-7 through B-12 were located in a tidal/drainage channel and mudflats surrounding the channel on the west side of Back Bay Drive. This channel connects the Big Canyon Pond with Upper Newport Bay via an outflow culvert that drains Big Canyon Pond and channels storm water runoff into the bay. The culvert primarily functions as a flood control device to channel heavy winter flows into Upper Newport Bay. Two stations (BC-13 and BC-14) were located within Big Canyon Pond. The characteristics of each station and geographic coordinates are listed in Appendix C, Table C1.

At each station, two 1-liter cylindrical core samples were collected by diver biologists using SCUBA apparatus or by biologists wading out on the mudflats. Biologists collected the samples by inserting the corer into the sediment to the top of the coring device, reaching below the corer and capping the sample, and putting the sample into a diver collection bag. Upon completing the collection of the two replicates, the divers returned the samples to the vessel and proceeded to the next station. Field information collected at the time of the survey included latitude/longitude positions (recorded with a Magellan 6000 hand-held Global Positioning System (GPS) unit equipped with a Differential GPS receiver), water depths (later standardized to MLLW), water temperature, and salinity. Water temperature was measured with a hand-held thermometer; salinity was measured with a refractometer.

The surface area of each sample was 0.0078 square meters (m^2). Samples were brought to shore, screened with seawater through a 1.0 mm Nitex screen, and the organisms retained on the screen were preserved in a 10% formalin solution. Photograph 8 illustrates the benthic coring device, the sieving screen, and a typical sediment core.
In the laboratory, samples were then rewashed and preserved in ethanol for taxonomic analysis. Samples were processed by Osprey Marine Services, Long Beach California. Invertebrates were sorted and identified to the lowest possible taxa by qualified invertebrate taxonomists and using procedures and taxonomic standards of the Southern California Association of Marine Invertebrate Taxonomists (SCAMIT).

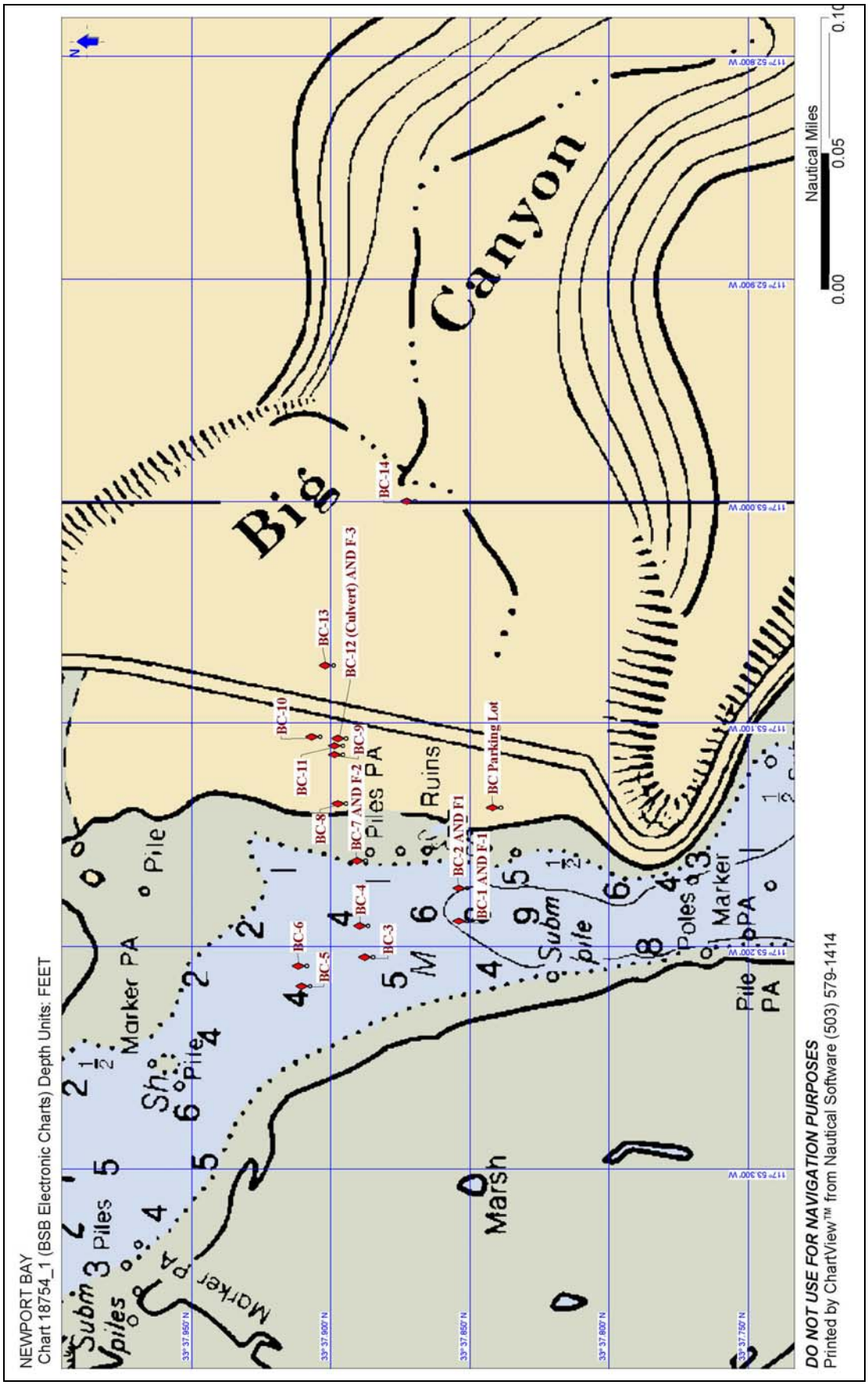
Completed lab data were entered into an Excel spreadsheet and the invertebrate data was compiled and sorted by replicate, station, and survey. A summary for each replicate and station was generated and included total number of individuals per sample, mean, % total, number of individuals per square meter, Shannon Weiner Species Diversity (H') and Species Eveness (J'). H' is a measure of the distribution of individuals among species within a particular sample. Higher numbers represent a higher species diversity of a sample. Species evenness measures the spread of individuals among each species.

3.2 Fish Surveys

Fish sampling was conducted on 15 July 2003. Mr. Rick Ware, Steve Whitaker, and Ray de Wit conducted the fish survey employing a 50-foot long, six-foot deep beach seine fish net. The sampling array focused on shallow water channel habitat and mudflats around the mouth of Big Canyon in Upper Newport Bay. Three stations were sampled (see Figure 5.1). Fish sampling station F-1 corresponds to BC-1 and BC-2; F-2 corresponds to BC-7; and F-3 corresponds to BC-12. The net was deployed with the aid of a 14-foot inflatable vessel and a crew who swung the net in an arc beginning at the shoreline. Upon completing the set, the crew then closed the net and pulled the cod end of the net onshore. The net fished approximately 218 cubic feet of water (182 cubic meters) during each set. All fish were identified and a sub-sample of each species was measured (standard length). The position of each station was recorded with a Differential Global Positioning System. All individuals were returned alive to Newport Bay.

FIGURE 5.1

BENTHIC STATION LOCATIONS



Water temperatures were also measured at each of the three stations. Completed data were entered into an Excel spreadsheet and compiled and sorted by replicate, station, and survey. A data summary for each station was presented based on two replicates per station and included total number of individuals, mean values per sample, percent total, and number of species per station.

4.0 HISTORICAL INFORMATION

Historically, much of Big Canyon was subject to tidal action and it supported salt marsh habitat (see Appendix A, Figure A1). The western one-third of Big Canyon received some form of tidal influence through approximately the early 1950s, when Upper Bay dredge material was placed across the mouth of Big Canyon. The tidal influence was significant enough to form coastal salt marsh within Big Canyon, along the periphery of Upper Newport Bay.

The 1875 United States Geographic Survey (USGS) topographic survey of Newport Bay shows marshes that extended to where the east end of Big Canyon Pond is currently located. A 1959 illustration (Stephenson and Emery) shows "reclaimed marshes" in existence at the mouth of Big Canyon in 1951. The 1950 National Oceanic & Atmospheric Administration (NOAA) chart (Figure 25, in Stephenson and Emery 1959) illustrates the mouth of Big Canyon with a dike across the front of Big Canyon. During the 1950s and 1960s, dredge material that originated from Upper Newport Bay dredging operations was placed in Big Canyon. Big Canyon Pond was created in the mid-1980s as mitigation for an Orange County Sanitation District trunk line sewer project. In essence, Big Canyon has not experienced tidal flows since about 1950.

Lower and Upper Newport Bay channel bottoms consist of sand, mud, or combinations of sand/shell hash sediments depending on current velocities, channel depths, the configuration of the bay, and proximity to sources of sediment inputs to the bay. These soft sediments support benthic invertebrates, some of which crawl over the surface of Newport Bay sediments, while others lead a sessile existence and protrude above the sediments from within a tube. While the majority of benthic invertebrates of bays and estuaries obtain their nutrition by consuming organic detritus, some graze on diatoms and algae or actively prey on other invertebrates. In turn, bottom feeding fishes and resident soft bottom-dwelling fishes (gobies, juvenile flatfish, and sand bass) and shorebirds rely upon these benthic organisms as food sources.

Over 300 species of benthic invertebrates have been identified from Newport Bay mudflats and subtidal channel sediments (Barnard and Reish 1959, Dawson 1963 Daugherty 1978, MBC and SCCWRP 1980, Seapy 1981, Ware 1985). At least 255 of these live in the sediments between the Pacific Coast Highway Bridge and San Diego Creek (California Department of Fish and Game 1989). The dominant types of benthic invertebrates are annelid worms (polychaetes and oligochaetes), arthropods (gammarid and caprellid amphipods, isopods, ostracods, and cumaceans), and mollusks (gastropods and pelecypods). Most forms are not endemic to the region, and do not necessarily reflect polluted bottom conditions. Rather, they are widely distributed and highly adaptable, and they survive well under stress conditions that occur naturally in many California coastal bays and estuaries.

The number of benthic infaunal species decreases between the harbor entrance and the regions where water circulation is restricted in Newport Harbor and Upper Newport Bay MBC and SCCWRP 1980, Daugherty 1978). These community changes occur because of increasing environmental stresses due to extremes in salinity, temperature, and dissolved oxygen, as well as decreasing grain sizes within the sediments they inhabit.

Common invertebrates that live in Upper Newport Bay sediments include:

- Polychaete Worms
  - *Capitella capitata*
  - *Pseudopolydora paucibranchiata*
  - *Streblospio benedicti*
  - *Haploscoloplos elongates*
  - *Tharyx* sp. *Neanthes arenaceodentata*
  - *Polydora socialis*
  - *P. ligni*
  - *P. nuchalis*
  - *Prionospio heterobranchia newportensis*
- Oligochaete Worms
- Amphipods

Grandidierella japonica
Monocorophium acherusicum
C. *insidiosum*
Ampithoe spp.

- Caprellid Amphipods
  Mayerella banksias
- Snails
  Cerithidea californica
  Assiminea californica
- Clams
  Theora lubrica
  Chione fructiflaga
  Macoma spp
  Tagelus subteres
  T. californianus

Newport Bay supports a substantial population of both ocean (pelagic) and bottom-oriented (demersal) fishes that occupy several different habitat types, including marsh channels, pools, mudflats, shallow subtidal channels and slopes deeper channels, and marinas (ACOE 2000; 1993). At least 78 species of fish have been identified from Newport Bay, although their distributions and abundance vary greatly by habitat type and time of the year.

The type of sampling gear used to conduct the fish surveys will also influence the types and abundances of species caught. Horn (1999) indicated that up to 40 fish species per year may utilize Newport Bay. However, only a few members of the fish community are numerically dominant. Over the years, these species include lower-trophic level feeders, such as deepbody anchovy, topsmelt, killifish, and mid-to-higher trophic level feeding gobies. There has also been a reduction in the number of freshwater species (mosquito fish, striped bass, bluegill, black bullhead, and threadfin shad occurring in the bay over the years (Allen 1988, ACOE 2000). This may be correlated to maintenance dredging activities allowing greater tidal flow into the upper regions of the Bay and perhaps a reduction in the release of some species (i.e., striped bass).

The bay supports a population of about 10 resident fish species, and is a nursery ground for juveniles of 33 species. Generally, highest abundances occur in spring and summer when transients move into the bay. Abundances are lowest when these species move out of the bay for more coastal and offshore locations during late fall and winter.

The bay's fish population is also an important food source for fish-eating birds such as brown pelicans, terns, herons, and osprey.

Very little fish sampling has occurred in Big Canyon Pond or immediately downstream of Big Canyon Pond. Camm Swift (Los Angeles County Museum of Natural History) and John Scholl (California Department of Fish and Game) collected fathead minnows (*Pimephales promales*) and largemouth bass (*Micropterus salmoides*) as well as African clawed frogs from the pond during a single sampling (Swift, pers. communication with R. Ware, 28 September 2003). Swift also noted the presence of rain water killifish (*Lucania parva*) downstream of the Big Canyon culvert entering Newport Bay (F-3, current study) after heavy El Nino storms. However, rainwater killifish are not usually present under typical climatological conditions.

5.0 ANALYSIS OF THE CURRENT PHYSICAL CONDITIONS AND BIOTA

5.1 SEDIMENT Types, Water Temperature and Salinity

Physical examination of the sediment types within the study area indicated that sediments ranged from fine muds to coarse gravel and rock (see Appendix C, Table C1). Channel and mudflat sediments fronting the main channel of Upper Newport Bay were generally soft muds, layers of sand over mud, or sand over clay (Stations BC-1 to BC-6). Within the narrower and constricted tidal channel leading to the Big Canyon culvert (BC-7 to BC-9 and BC-12), sediments were reflective of periodic, high flow rates with a lighter layer of silt covering a conglomerate of gravel, shell, cobble, and rock, some of which was placed in the area to protect the outflow culvert. The mudflats on both sides of the tidal channel (BC-10 and BC-11) leading to the culvert draining Big Canyon were covered with a green algal mat (*Enteromorpha* sp.). This algal mat covered sediments of soft muds and sands. In Big Canyon Pond, immediately east of the culvert, the sediments were also generally coarse and consisted of mixture of gravel, cobble, and mud. However, on the east side of Big Canyon Pond

(BC-14), the sediments were highly organic muds. Sediments at both BC-13 and BC-14 were mixed with decaying vegetation from the freshwater marsh.

Surface water temperatures ranged between 21 and 24.8 degrees Celsius (69.8 to 76.6 degrees Fahrenheit). Lowest surface water temperatures were in the main channel, whereas the highest temperatures were recorded at BC-6 over the mudflats north of the Big Canyon Drainage Channel, and at BC-14 within Big Canyon Pond.

Surface water salinity (one foot below the surface) declined along a gradient between the main channel of Upper Newport Bay to Big Canyon Pond (see Appendix C, Figure C2). Normal bay salinities of 31 and 32 parts per thousand (ppt) were recorded in the Upper Bay main channel and over the mudflats (Stations BC-1 to BC-6). Lower salinities were recorded in the drainage channel leading to the Big Canyon culvert (BC-7 to BC-12) and hyposaline, near freshwater conditions existed within Big Canyon Pond (4 ppt, BC-13 and BC-14).

5.2. Benthic Invertebrates

5.2.1. Station Results

A total of 3,062 benthic invertebrates and 48 species representing eight invertebrate phyla were collected in 28 benthic samples. Table C3 in Appendix C summarizes the mean data for each station and depth of sampling. Species richness (numbers of species) averaged between 3 and 16 species per station (BC-14 and BC-6, respectively). While there were only slight differences in the numbers of species occurring in Upper Newport Bay between BC-1 and BC-12 (depths varying between -4 ft and +3 ft MLLW), considerably fewer species were present in the Big Canyon Pond. Density by station varied from 1,346 to 45,449 individuals per square meter (BC-13 and BC-6, respectively). Invertebrate densities were lowest within Big Canyon Pond and highest at lower mudflat elevations and shallow channel depths (-1.0 and +0.3 ft MLLW, respectively). Highest densities were attributable to polychaete worms and microcrustaceans. Species diversity (H') values declined along a gradient between the deeper channel stations to Big Canyon Pond (see Appendix C, Table C3), with highest diversity (2.06) at BC-1, and lowest species diversity (0.79) at BC-14. Evenness (J') was lowest at shallow mudflat stations and indicative of conditions where a few species dominated the abundances. Highest J' values were within the Big Canyon Pond, where both abundances and numbers of species were low, and abundances were generally evenly distributed among the few species present.

5.2.2 Species Composition and Abundance

Table C4 in Appendix C summarizes the taxonomic composition of the benthic infaunal community sampled during the survey. Polychaete annelid worms contributed the most species – 17 or 34.5 % - while crustaceans and bivalves each contributed 7 species and 14.6% each of the total number of species. Each of the remaining major taxonomic groups contributed 4 or fewer species.

Polychaetes and crustaceans were also the most abundant invertebrate forms, accounting for 38.8% and 30.8% percent of the total abundance, respectively. Oligochaete worms were the third most abundant group of invertebrates, accounting for 16.8% of the total abundance. Organism density of each of the major taxonomic groups ranged between 4.6 individuals per square meter (cnidarians [anemones and hydroids]) to 5,444 per square meter (polychaete worms). Crustaceans (amphipods and isopods) also occurred in dense concentrations, averaging 4,317.8 individuals per square meter. Based upon the number of species and densities of individual species of crustaceans and polychaetes, crustaceans exhibited a greater mean density per species (617 individuals per square meter) than polychaete species (320 individuals per square meter).

5.2.3. Species Abundances

Table C5 in Appendix C lists the numerically dominant species occurring in the samples and their distributions among the 14 stations. Ten of the 48 species accounted for 93.4 % of the total abundances. These taxa included five annelid taxa:

Fabricinuda limnicola, Pseudopolydora pauci-branchiata, oligochaetes, *Capitella capitata*, and the spionid polychaete *Streblospio benedicti*), two amphipod crustaceans (*Grandidierella japonica* and

Mono-corophium acherusicum), two mollusks (the mussel *Musculista senhousei* and the California horn snail *Cerithidea californica*), and one phoronid worm (*Phoronis* spp.).

Of these ten species, three accounted for 55.6% of the abundance indicating a high numerical dominance of the benthic community by a relatively select few species. These species included the tube-building amphipod *Grandidierella japonica* (648 individuals, 21.2% of the total), the polychaete worm *Fabricinuda limnicola* (538 individuals, 17.6% of the total), and oligochaete annelid worms (515 individuals, 16.8% of the total).

Freshwater and brackish-water insects were present in some of the samples and included one order (Diptera) and three subfamilies of chironomids (midges). Nineteen of 22 individuals were in the subfamily Chironomini and all of these were present in the Big Canyon samples. Two other midge subfamilies (Orthocladiinae and Tanypodinae) were represented each by a single individual. These were located at BC-11 and BC-13, respectively.

Taxa with primary affinities to the Upper Newport Bay channel habitats and lower elevational mudflats included anemones and hydroids, the majority of gastropods and pelecypods, the polychaetes *Exogone cf verguera*, *Euchone limnicola*, *Pseudopolydora paucibranchiata*, *Scoletoma* sp. C, *Scoloplos acmeceps*, *Fabricinuda limnicola*, *Marphysa* spp NBB1 (a new species), and the phoronid *Phoronis* spp.

Taxa that exhibited wide distributions in both the Upper Newport Bay channel, low elevational mudflats, and the Big Canyon drainage channel leading back to the Big Canyon culvert included the polychaetes *Streblospio benedicti* and *Polydora cornuta*, oligochaetes, and amphipods (*Grandidierella japonica* and *Monocorophium acherusicum*). Oligochaetes and *G. japonica* were also found in the hyposaline areas within Big Canyon samples.

Taxa with a generally restricted distribution in the drainage channel, Big Canyon, or a combination of both areas included the California horn snail (*Cerithidea californica* (found in algal samples in the drainage channel), the polychaetes *Capitella capitata* and *Polydora nuchalis*, and the three subfamilies of insects referenced above. Despite its restricted occurrences in the samples from the drainage channel, the horn snail is one of the most abundant epifaunal species of invertebrates occurring on the mudflats of Upper Newport Bay (R. Ware, personal observation). Estimates of horn snail density on the mudflats along the periphery of Lower Shellmaker in April 2003 ranged from 256 to 586 individuals per square meter (Coastal Resources Management 2003).

Comparatively, 59 species of mudflat and shallow subtidal invertebrates and 2,889 individuals were collected in 18 one-liter box core samples (0.01 square meter surface area) on the De Anza/Bayside marsh peninsula near the Coast Highway Bridge in July 1984 (Ware 1985). Density varied between 6,233 and 42,796 per square meter. Annelids accounted for 86% of the abundances and 41% of the species and crustaceans (primarily amphipods) accounted for 17 species (28.9%) and 247 individuals (8.5%). Many of the dominant species on the De Anza Peninsula were the same as those present near Big Canyon in 2003. The dominants included the polychaetes *Fabricia limnicola, Polydora socialis, Pseudopolydora paucibranchiata, Capitella capitata, and Scoloplos acmeceps, and the amphipods Corophium uenoi, Grandidierella japonica, and Monocorophium acherusicum.*

5.3 FISHES

Data, by station, replicate, and species is provided in Appendix C, Table C6.

5.3.1 Water Temperature

During the survey in July, water temperature was substantially higher than during the May 30th 2003 benthic infaunal survey. Temperatures varied between 76 degrees F (24.4 degrees C) and 81 degrees F (27.2 degrees C) at F-1 and F-3, respectively.

5.3.2 Species Composition and Abundance

A total of six 50 foot long by 6 feet deep beach seine sets were made at three stations in the vicinity of the mouth of Big Canyon. The survey yielded a total of six species of fish and 1,334

individuals. By station, the number of species collected per replicate (minus invertebrates) varied between 0 (F-3) to 5 (F-2). The total number of species per station varied between 3 (F-3) to 5 (F-2).

The species captured, in rank order of abundances from highest to lowest, included topsmelt (*Atherinops affinis*), yellowfin goby (*Acanthogobius flavimanus*), killifish (*Fundulus parvipinnus*), deep body anchovy (*Anchoa compressa*), juvenile gobies (unidentified), and a juvenile croaker (Scienidae, unidentified). In addition, yellow shore crabs and sponges were also incidentally taken in the beach seine nets, along with significant amounts of *Enteromorpha* (green algae) particularly at Stations F-2 and F-3.

The catch was dominated by topsmelt, which accounted for 96.3 % of the catch and an average of 214 individuals per set. It occurred in all six beach seine sets, although 91% of the fish were found in Upper Newport Bay over channel depths and mudflats at F-1. The size range of individuals collected ranged from 16 to 66 mm, young of the year and juvenile age classes.

The second most abundant species (yellowfin goby, 27 individuals and 2% of the catch) was taken from the Big Canyon drainage channel (F-2 and F-3). It was abundant in samples at F-2, where large amounts of green algae (*Enteromorpha* sp.) were collected in the net. Twenty-six of 27 individuals were collected at this station, with an overall mean catch of nine individuals/set. The sizes of individuals caught ranged between 36 to 86 mm, representing juvenile and adult individuals.

California killifish accounted for 0.5% of the catch (7 individuals). Six of the seven individuals were collected at F-1. The size range of individuals caught at F-1 and F-2 ranged between 34 and 81 mm.

Deepbody anchovy accounted for 0.4% of the total abundance, and was collected at F-1 and F-2, in the channel and over the mudflats. The size range of deepbody anchovies varied between 58 to 119 mm; this represents juvenile and adult size classes.

Comparisons of the catch data with a previous beach seine study conducted as part of a larger Army Corps of Engineers study (MEC, Inc. 1997) in the same general vicinity as the CRM July 2003 study indicate that all of the dominant fish species observed during the 1997 surveys were also recorded during the Big Canyon survey in 2003. The CRM survey collected six of the nine species recorded by MEC near Big Canyon, and the mean abundance (446 individuals per station) was substantially greater than recorded during the September 1997 MEC survey (mean of 32 individuals), due to higher numbers of topsmelt collected by CRM in summer 2003. The CRM survey also documented the presence and relatively high dominance of the non-native yellowfin goby in the study area. This species has increased in abundance over time (MEC 1997), and become one of the most abundant gobies in Upper Newport Bay. Other species that are known to occur in the shallow water and channel habitat in the vicinity of Big Canyon, but not sampled by beach seine methods in this study include California halibut, diamond turbot, and pipefish.

6.0 ENDANGERED, THREATENED, OR SENSITIVE SPECIES

6.1 Benthic Invertebrates

No State or Federal listed species of invertebrates occur in Upper Newport Bay. However, one Federal Species of Concern (FSC) is present in Upper Newport Bay-the California brackish water snail (*Tryonia imitator*). This snail inhabits permanently submerged areas within coastal lagoons, estuaries, and salt marshes. Its known range is from Sonoma County to San Diego County. In Upper Newport Bay, its primary habitat is coarse sediments in low salinity (brackish) areas at the mouth of the Santa Ana-Delhi channel and San Diego Creek. It is also recorded from the main channel near Shellmaker Island, but in significantly lower densities and mostly during winter and spring when storm water run-off reduces the salinity in the main channel (US. Army Corps of Engineers, 2000; MBC and SCCWRP 1980). No *Tryonia*, either live specimens, or shells of dead *Tryonia* were found in the focused sampling around the mouth of Big Canyon, a low-salinity and coarse sediment habitat during the summer 2003 CRM investigation.

6.2 Fishes

No State or Federal listed species of fish are found in Upper Newport Bay. However, the California halibut (*Paralichthys californicus*), a species of local and regional sports fish of commercial importance, regularly uses the Upper Bay as a nursery area (Allen 1988, Horn and Allen 1981, USACOE 2000). California halibut spawn at sea and the larval stages are planktonic. After several months, the larval fish settle to the bottom, and migrate into shallow coastal waters, including Newport Bay. Halibut are distributed throughout the waters of Lower and Upper Newport Bay, primarily as juveniles, although larger individuals are caught near the ocean entrance and offshore. Young-Of-The-Year (YOTY) prefer shallow waters between about
–0.45 meters (1.5 ft) and –1.0 meter (3.5 ft) MLLW, whereas juveniles prefer deeper channel bottoms to a maximum depth of approximately 4.5 meters (15 ft) MLLW. After spending nearly nine months in Newport Bay, juveniles will move out into the open coastal environment. This species is known from the main channel of Upper Newport Bay, in waters near the Big Canyon area.

7.0 RESTORATION RECOMMENDATIONS

The results of the benthic survey indicate that the mudflats and shallow tidal channels near Big Canyon support an estuarine invertebrate fauna not unlike those occurring throughout the rest of Upper Newport Bay (MBC and SCCWRP 1981; Daugherty 1978; Seapy 1981). These organisms exist in a seasonally euryhaline and eurythermal environment nearby the culvert leading to Big Canyon. Big Canyon Pond, however, is species poor and dominated by relatively low numbers of freshwater insects. However, all of these organisms are integral in the local food web by consuming detritus and releasing nutrients back into the ecosystem. In turn, the benthic invertebrate population is a critical food source for shorebirds and bottom-foraging fishes.

Several species of bottom-dwelling and water column fishes are present near the mouth of Big Canyon and all are known from other regions of Upper Newport Bay, the most abundant being topsmelt and yellowfin gobies. No rare or sensitive species of fish were collected near the mouth of Big Canyon.

Restoration of the historic tidal wetlands in Big Canyon (or a portion of it), and restoration of tidal influence to Big Canyon would increase the biological diversity of the western one-third of Big Canyon by re-introducing tidal-dependent species and communities to an area that has been degraded by fill, invasive plant species, and poor water quality.

Creating a tidal channel, mudflats, and additional salt marsh within Big Canyon would widen the distribution of the Upper Bay estuarine invertebrate community. Species most likely to colonize new tidal habitat in Big Canyon are the polychaetes *Polydora nuchalis*, *Streblospio benedicti* and *Polydora cornuta*, oligochaetes, and amphipods *(Grandidierella japonica* and *Monocorophium acherusicum*). Larger marsh invertebrates, such as California horn snails, yellow shore crabs, and fiddler crabs would also be potential recolonizers. The potential increase in benthic secondary productivity as a consequence of increasing the tidal prism in Big Canyon would also enhance the use of Big Canyon by both fishes and shorebirds because of the increased food supply and foraging habitat for these resource groups.

The following recommendations are made in respect to restoring tidal habitats in Big Canyon.

- Determine restoration priorities and focused objectives for tidal restoration in association with other planned restoration activities in Big Canyon;
- Identify potential channel connection points and tidal volumes required for restoration tidal-influenced areas;
- Maximize tidal flat and tidal channel restoration and provide for gentle sloped salt marsh elevations along the periphery of the tidally influenced areas. This is in keeping with the Department of Fish and Game's Upper Newport Bay Management Plan (1988) to maximize restoration of tidal influence to Upper Newport Bay and;
- Conduct post-construction tidal invertebrate and fish surveys at intervals of 0 months, 3 months, 1 year, 2 years, and 3 years following restoration to document tidal habitat restoration success, recolonization by

invertebrates and fishes, and shorebird use. Prepare monitoring survey reports and determine if additional site remediation is necessary to maintain tidal habitat quality and insure use of the habitats by invertebrates, fishes, and shore birds.

8.0 ACKNOWLEDGEMENTS

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Section 6
BIG CANYON: HYDROLOGY, WATER RESOURCES & ENGINEERING

This section provides a summary of the technical review conducted and evaluation of the water supply, floodplain, soils and infrastructure issues related to the development of the restoration projects within Big Canyon.

The two square-mile upper watershed of Big Canyon Creek contributes significant water flow to the Big Canyon Creek Restoration Project Area. There is now a constant flow of 5 cubic feet per second (cfs). Under major flood conditions, such as a 100-year flood, the entire canyon floor will be inundated, with the exception of the raised terrace of dredge spoils south of the freshwater pond. Since the canyon slopes are relatively steep, erosion and sedimentation will occur during these events.

Big Canyon Creek is in a natural, un-channelized condition. The natural function of Big Canyon includes accommodating storm events and flooding; during large floods, the entire canyon floor is expected to be inundated. This natural flooding process provides the necessary soil moisture for plant growth. However, the inundation depth and frequency must be managed in order to establish and protect restored habitats, protect existing habitats and protect existing and proposed infrastructure in of he Big Canyon Creek Restoration Project Area.

SOILS & GEOTECHNICAL FEATURES

Boring tests of the Big Canyon Creek Restoration Project Area consistently revealed that key areas of the project site were covered by dredge spoils, some with very distinct chemical properties such as high salt and sulfide contents. According to the soil texture analysis, the fill materials are typically silty sand while the native site material contains sandy clay.

Approximately five boring logs were explored to identify surface and subsurface soils properties as described in the soils report (see Appendix D, Table D1). These boring tests were performed to obtain slope stability recommendations and planting suitability analyses (see Appendix D, Tables D2 and D3). The boring depth was limited to 10 feet and two samples were excavated to only 2 feet due to high soil moisture. Soil test results confirm the historic tidal maps. Additionally, the soil tests show where dredge spoils have been placed over native soils.

The deposition of dredge materials in Big Canyon combined with the construction of Back Bay Drive have apparently modified the topographic features of the canyon and influenced the establishment of both native and non-native plant communities. The specific soil chemistry and soil characteristics of the dredge spoil locations have created large infertile areas and areas dominated by exotic species (see Appendix A, Figure A2 and Section 7).

Special attention in these areas will be required for grading, drainage, roadway and foundation preparation for structural components. Compaction and over-excavation will be required for any new infrastructure construction.

HYDROLOGY & FLOODPLAIN

Big Canyon Creek's watershed of approximately 1,300 acres (two square miles) is highly urbanized and completely developed. Big Canyon Creek drains this entire watershed directly into Upper Newport Bay (see Figure 6.1). The headwaters are located near the San Joaquin Reservoir east of MacArthur Blvd. Although Big Canyon Creek is a sizable tributary to the Bay, no complete hydrology study has ever been undertaken.

Based on information provided by the City of Newport Beach Master Plan of Drainage (1999) and the 2002 study entitled "Erosion and Water Quality Issues in Big Canyon in the City of Newport Beach" produced by California Department of Fish and Game, the 100-year-flood discharges for Big Canyon Creek are estimated to be 2,910 cfs at Jamboree Road and 3,660 cfs at the outlets at Back Bay Drive. Calculation of these discharges did not consider the proper lag time from the storm drain outlet to the downstream concentration points; therefore, they are considered overly conservative for purposes of this report.

Using the Orange County Hydrograph method, and based on land use, topographic features and soils, the discharges were re-calculated for a 100-year flood. They are estimated to be 2,510 cfs at Jamboree Road and 2,770 cfs at Back Bay Drive (see Table 6.4 below).

Table 6.4: Flood Peak Discharge

WRC Consulting, October-03

Concentration Point	Drainage Area (acres)	Peak Discharge (cfs)		
		10-yr. Flood	100-yr. Flood	2-yr Flood
Jamboree Rd.	1,100	1680	2510	1260
Back Bay Dr.	1,350	1860	2770	1390

The 100-year floodplain boundaries were identified as shown in Appendix A, Figure A1, based on an approximate hydraulic analysis. However, the scope of this project did not allow for a detailed, two-dimensional modeling of freshwater flow distribution between the different channels of Big Canyon Creek. The HEC-RAS Model, developed by the U.S. Army Corps of Engineers, was applied to obtain the tidal backwater profile using eight cross-sections.

WATER SUPPLY

The Big Canyon Creek watershed contains golf courses, parks, and large landscaped residential yards. Irrigation runoff from these landscaped areas make up the base flow in Big Canyon Creek and, given the consistent volume of irrigation water, this runoff can be expected to be a reliable and constant source of water. This is confirmed by water consumption data from the City of Newport Beach. The City's sprinkler reports from sprinkler meters in the Big Canyon watershed and seasonal water consumption records (see Appendix D, Figure D4) show that far more water is being applied via sprinklers than is being taken up by vegetation; the difference results in irrigation runoff. Since the Big Canyon watershed has been completely developed for more than ten years, including the landscaped areas, it is anticipated that the resulting irrigation runoff will continue and be available as dry season water supply for restored habitat.

In addition, dry season measurements from the United States Geological survey measurement station for San Diego Creek at Campus Drive show that average summer daily flows in San Diego Creek range from 1 to 3 cfs. Big Canyon Creek does not have a gauging station to record daily flow measurements, but as a sub-watershed of San Diego Creek, can be expected to show similar flow rates. Additionally, the Big Canyon Creek watershed, although smaller, is far more urbanized than the San Diego Creek watershed. As a result, a dry season base flow in Big Canyon Creek due to urban runoff from extensive landscaping and irrigation in the watershed can be expected. This has been confirmed through on-site observation. This dry season flow appears to be sufficient to maintain soil moisture in Big Canyon and to provide adequate water to sustain proposed habitat restoration areas.

TIDAL FLOW

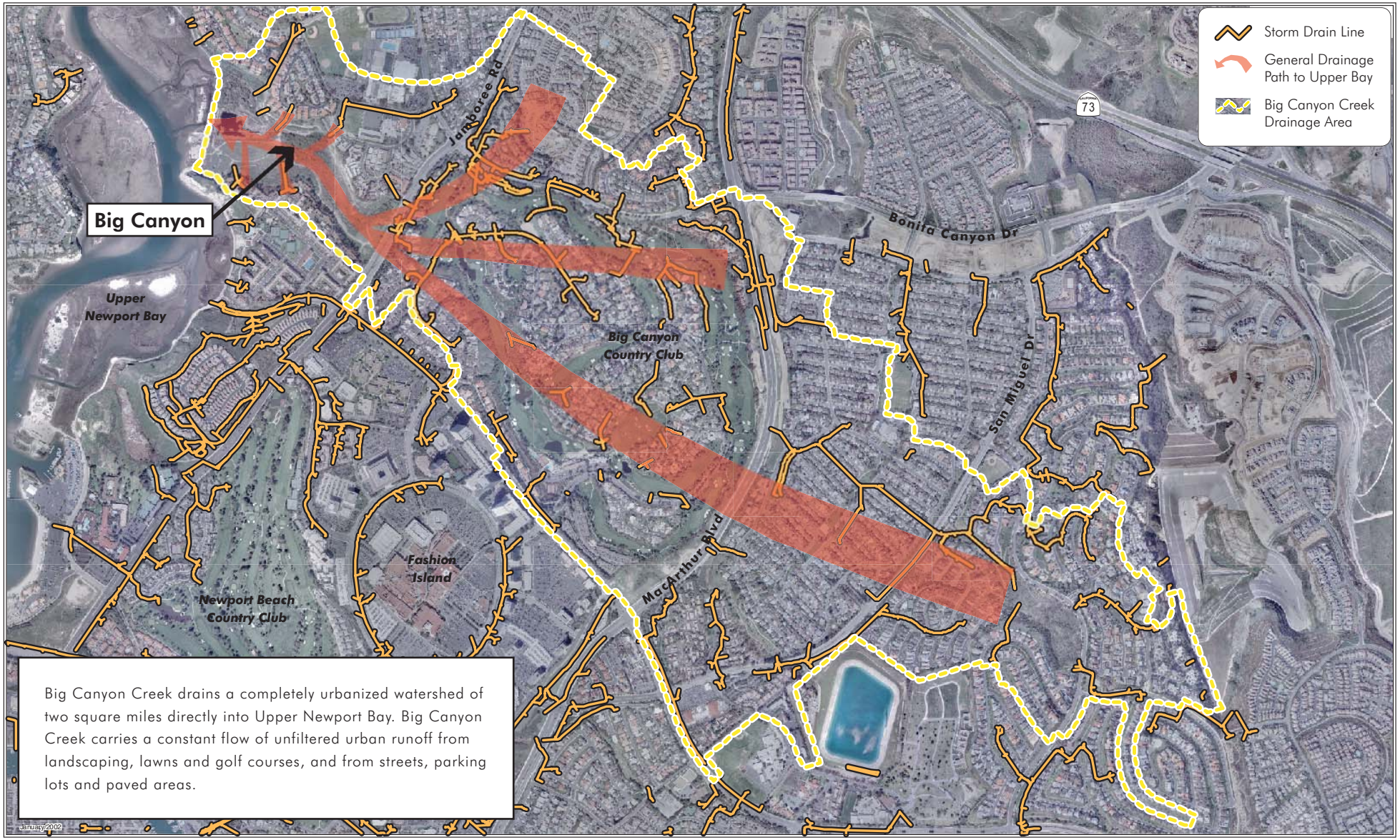
Tidal inundation and fluctuation of tidal range are critical to the restoration of salt marsh. Currently, the tidal inundation area is limited to the bayside of Back Bay Drive. The roadway was constructed at an elevation of ten feet above mean sea level, out of the high tide range, although it may be subject to wave action during storms. The roadway embankment has been damaged by storms in the past, requiring costly repairs and maintenance by the City of Newport Beach.

The tidal inundation area and the topographic features at the outlet of Big Canyon Creek are not typical of the morphological pattern of a small coastal stream. Research of historic aerial photographs and maps revealed that, historically, the full range of the tidal zone extended as far as 500 feet north of Back Bay Drive, as shown in Appendix A, Figure A1. Since then, Big Canyon's tidal flow was blocked with construction of the roadway embankment for Back Bay Drive, and additional fill was added on the canyon side of the road. The result is an abrupt change in elevation from the Bay to the roadway, completely blocking tidal flow. The potential of restoring the historic tidal area was considered and evaluated in the formulation of alternatives during concept plan development.

Upper Newport Bay, Orange County

Community Conservancy International

BIG CANYON CREEK WATERSHED & URBAN RUNOFF FLOWS INTO BIG CANYON CREEK



Big Canyon Creek drains a completely urbanized watershed of two square miles directly into Upper Newport Bay. Big Canyon Creek carries a constant flow of unfiltered urban runoff from landscaping, lawns and golf courses, and from streets, parking lots and paved areas.

Base map provided by the City of Newport Beach GIS Division. Map edited by GreenInfo Network. www.greeninfo.org

0 550 1100 FEET

FIGURE 6.1

Tidal fluctuation and elevation ranges are also critical to tidal habitat restoration. A study by the U.S. Army Corps of Engineers and Coastal Frontiers, Inc., in 1992 was reviewed pertaining to the project site. Figure D5 in Appendix D shows the tidal curve at the Newport Bay entrance and Figure D6 in Appendix D shows its comparison to Upper Newport Bay for a selected period. This study shows that there is negligible change in tidal attenuation between the harbor mouth and Upper Newport Bay. Based on this study, there is sufficient tidal inundation and fluctuation in Upper Newport Bay to permit restoration of the historic tidal flow and re-establishment of tidal wetland habitats in Big Canyon, if existing barriers to tidal flow in Big Canyon are removed and current sedimentation control efforts in the Bay continue.

EROSION & SEDIMENTATION

Erosion in Big Canyon has been a problem associated with past storms. The erosion sources have been identified as follows: loose fill from uncompacted dredge spoils; uncompacted gravel access roads; cliffs; and tidal wave action during storm events. The erosion pattern is considered localized and without the risk of gross instability.

The Big Canyon Creek flow regime is sub-critical and the average flow velocities are relatively slow and range from 4 to 8 feet per second (fps) for a 100-year flood. While the general scour may not be significant with this velocity range, local scouring can and has caused roadway and structural failure and substantial damage to sensitive habitat areas. Additionally, local erosion from uncompacted maintenance roads and dredge spoils and from the canyon cliffs damage native plant habitats.

Because Big Canyon Creek is a natural channel, some erosion and sedimentation is expected. While it is healthy for the Big Canyon ecosystem to experience nominal erosion and sedimentation, proper management of the creek drainage is important in order to minimize erosion and sedimentation problems during storm events and to address the erosion impacts of the decades of human manipulation of Big Canyon.

Eroded sediments have accumulated in the freshwater pond, further contributing to the scour in the downstream portion of Big Canyon Creek. The current channel at the outlet of the pond has been armored with concrete to prevent head-cutting. Back Bay Drive is currently serving as the overtopping weir for flood flows and is subject to major erosion potential both from canyon flows and from tidal surges during storm events.

Because Big Canyon Creek is a natural channel, Big Canyon still functions essentially in a natural manner. The canyon is subject to a certain amount of natural erosion and sedimentation, and accommodates the natural fluctuations of Big Canyon Creek during storm and flood events. The proposed restoration plan needs to consider these natural functions of Big Canyon and Big Canyon Creek, and must address debris management, sediment control and flood protection of infrastructure in order to protect restored habitats and new infrastructure.

WATER QUALITY

Although Big Canyon Creek has little historical water quality measurements, sufficient data exists to conclude that the creek has the same water contamination problems as other coastal streams located within heavily urbanized drainage basins, including sedimentation, eutrophication, bacterial and toxic contamination, pesticides and heavy metals. The Santa Ana Regional Water Quality Control Board Region (8) Watershed Management Initiative Chapter for the Newport Bay Watershed Area highlights all of these water quality problems.

The water in Big Canyon Creek is unfiltered urban runoff draining a two-square mile developed and completely urbanized watershed; the creek carries fertilizers and pesticides from lawns, landscaping and golf courses and pollutants from cars, streets and paved areas. During storms, water sampling has shown very high levels of fecal bacteria at the Big Canyon Creek outlet in Upper Newport Bay.

Upper Newport Bay is listed as an impaired water body under section 303 (d) of the federal Clean Water Act. According to this classification, the following contaminants occur in both Upper and Lower Newport Bay: pesticides and metals; nutrients; pathogens; and sedimentation/siltation. Total Minimum Daily Loads (TMDLs) for Newport

Bay have been established for sediments, nutrients and fecal coliform. A more detailed description of the water quality issues for Upper Newport Bay can be found in "Erosion and Water Quality Issues in Big Canyon in the City of Newport Beach" (2002).

The Big Canyon Creek Restoration Project intends to help meet these TMDLs by addressing the polluted runoff in Big Canyon Creek before contaminated water can reach Upper Newport Bay. Properly designed wetlands systems in other areas have been found to provide the most efficient measures for stream-flow pollution control. The proposed concept plan includes an integrated system of water quality improvement components, erosion and sedimentation control and use of natural habitats.

Water quality testing and analysis will need to be carried out to establish baseline information, prioritize pollutant treatment efforts, and confirm post restoration results.

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

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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.

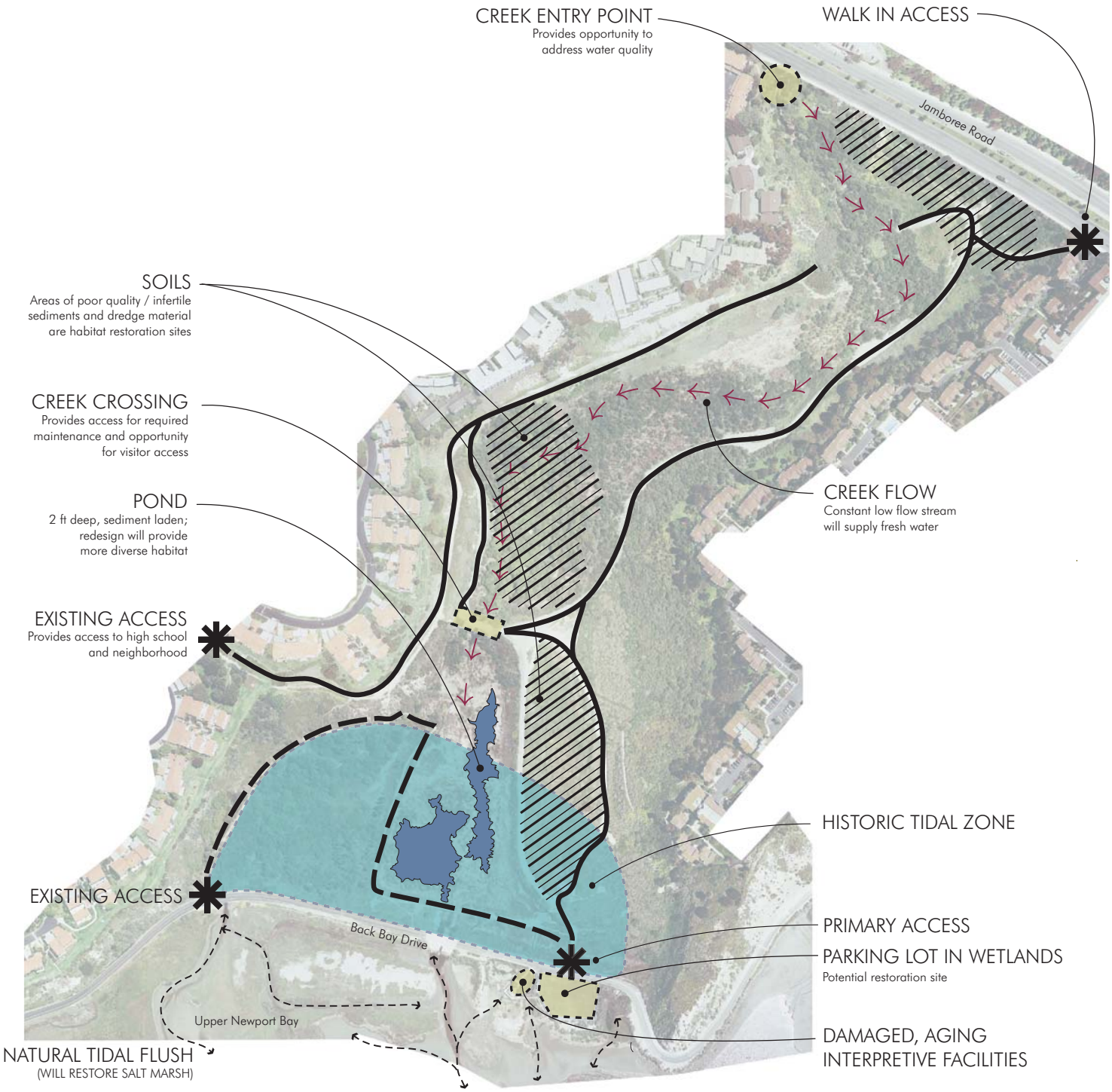
However, the roadway in its present configuration is subject to flooding and requires continued maintenance.

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

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

prepared by Withers & Sandgren Ltd. Aug 25, 2003

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

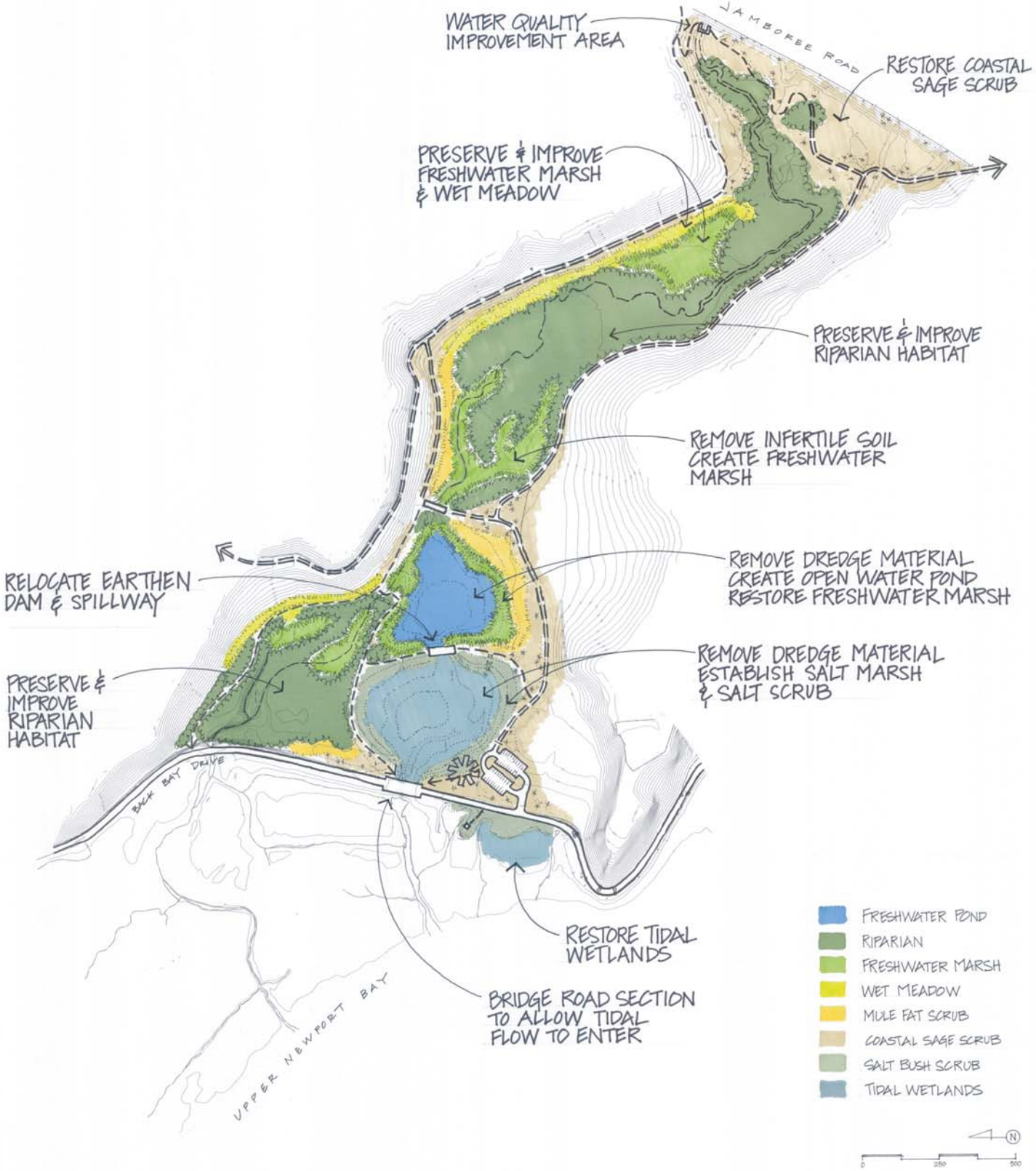
Grading and Drainage

- 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.

FIGURE 9.1

CONSTRUCTED TIDAL WETLANDS ALTERNATIVE

Community Conservancy International



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

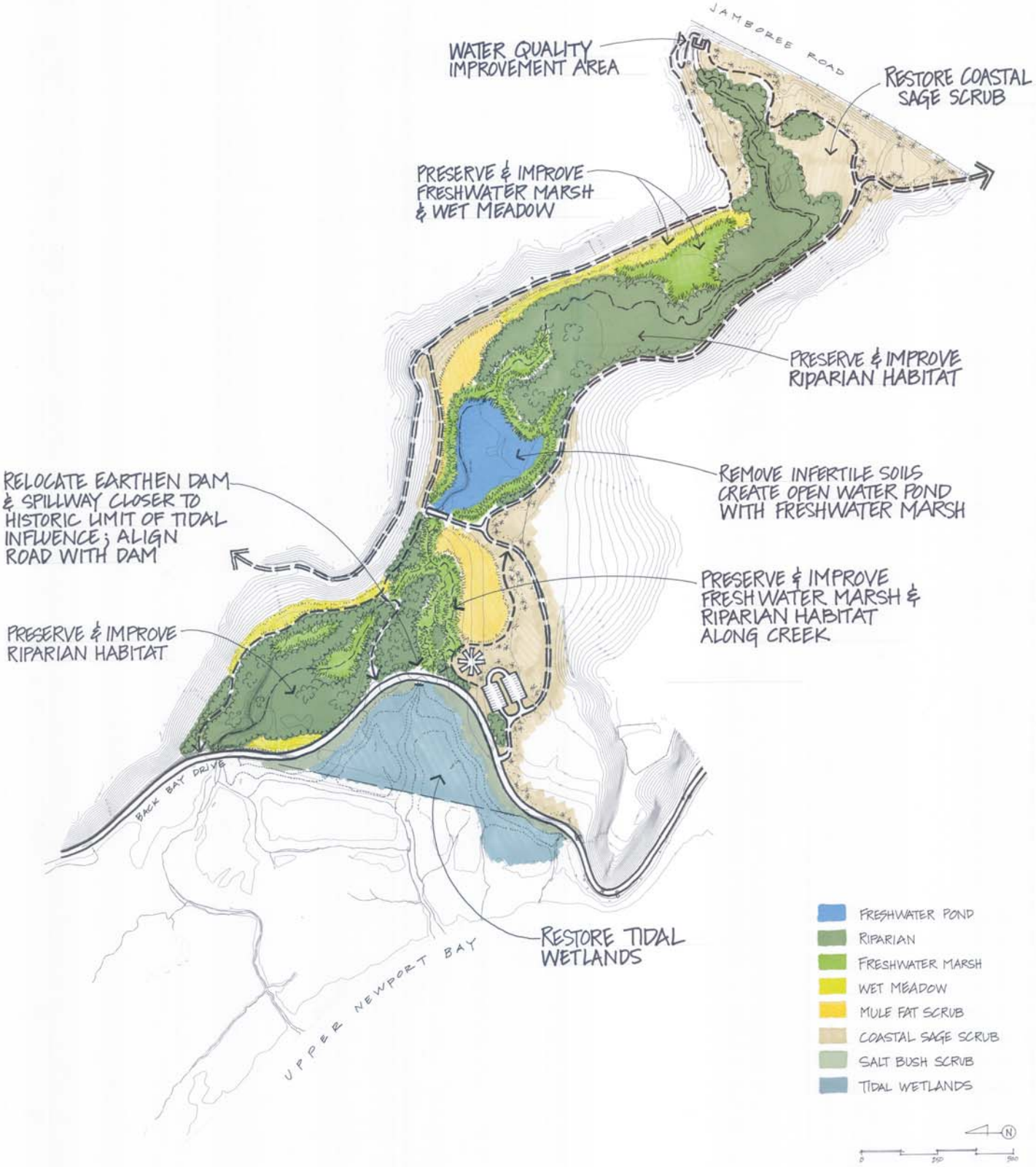
- Realign Back Bay Drive to approximately the historical tidal limit and excavate the high ground on the south for tidal inundation.
- Grade, drain and remove the deposited sediments in the freshwater pond above the new roadway to provide a constructed wetland.
- Excavate the non-native plant area and 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.

FIGURE 9.2

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

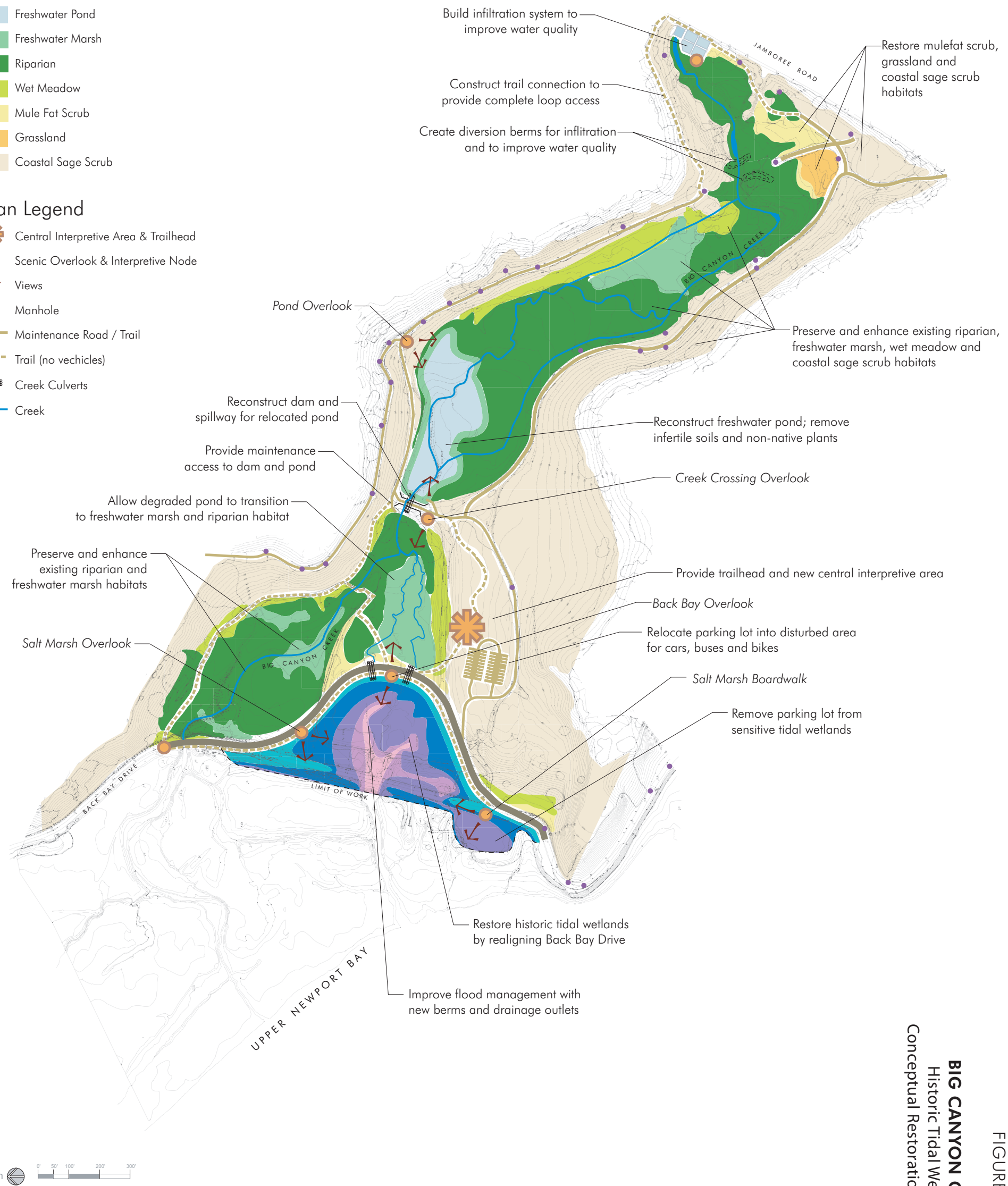
Community Conservancy International

Existing & Restored Plant Communities

- Tidal Channel / Mud Flats
- Low Salt Marsh
- Middle Salt Marsh
- High Salt Marsh
- Transition Marsh Habitat
- Freshwater Pond
- Freshwater Marsh
- Riparian
- Wet Meadow
- Mule Fat Scrub
- Grassland
- Coastal Sage Scrub

Plan Legend

- Central Interpretive Area & Trailhead
- Scenic Overlook & Interpretive Node
- Views
- Manhole
- Maintenance Road / Trail
- Trail (no vechicles)
- Creek Culverts
- Creek



prepared by Withers & Sandgren Ltd. April 2004

FIGURE 10.1

BIG CANYON CREEK
Historic Tidal Wetlands
Conceptual Restoration Plan

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 by-pass 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

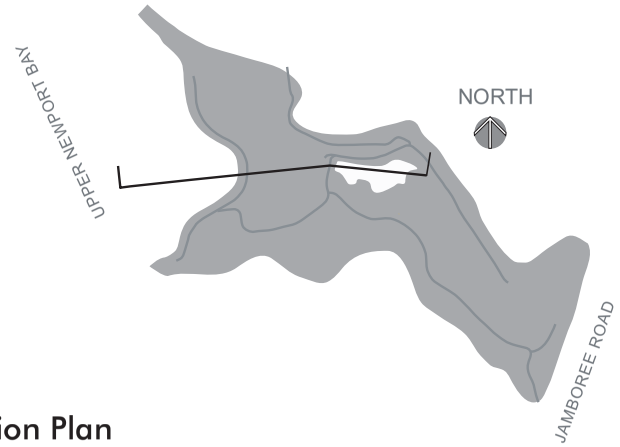
- *Back Bay Overlook*
  Located on the new earthen berm and elevated above the edge of the restored wetlands, this overlook will provide visitors with a panoramic view of the tidal wetlands, Upper Newport Bay and Big Canyon

- *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

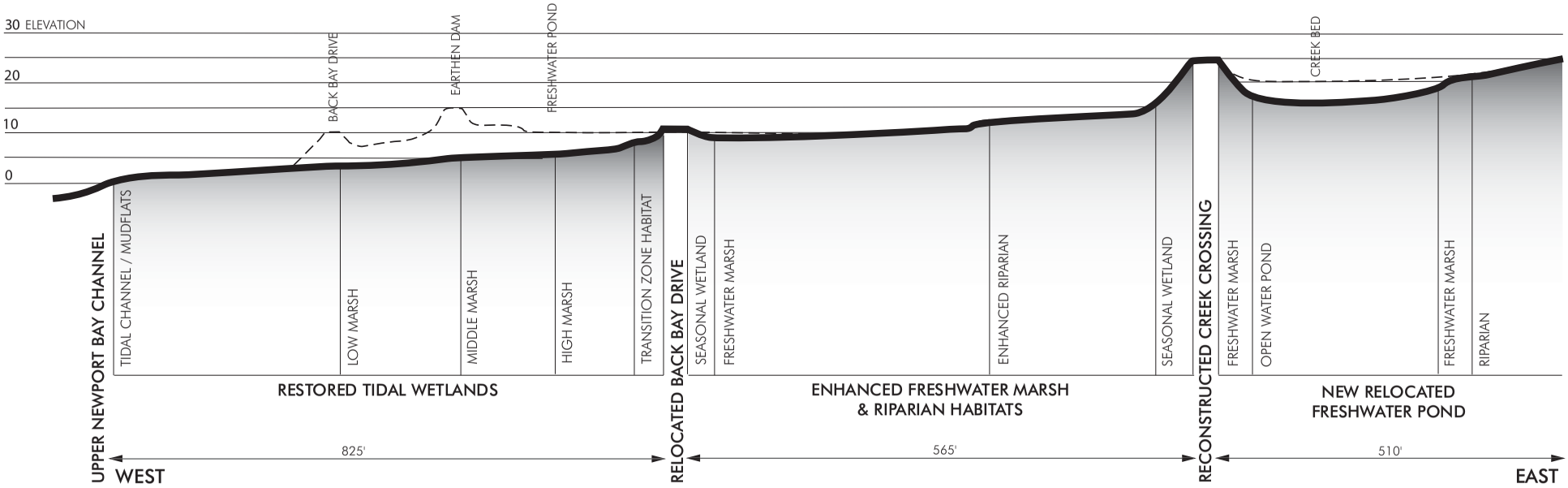
Other interpretive nodes throughout the canyon will be incorporated with the new trail system, and will present colorful and user-friendly information on the diverse habitats and native plants and wildlife of Big Canyon, restoration of tidal wetlands and other native habitats, water quality improvements 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



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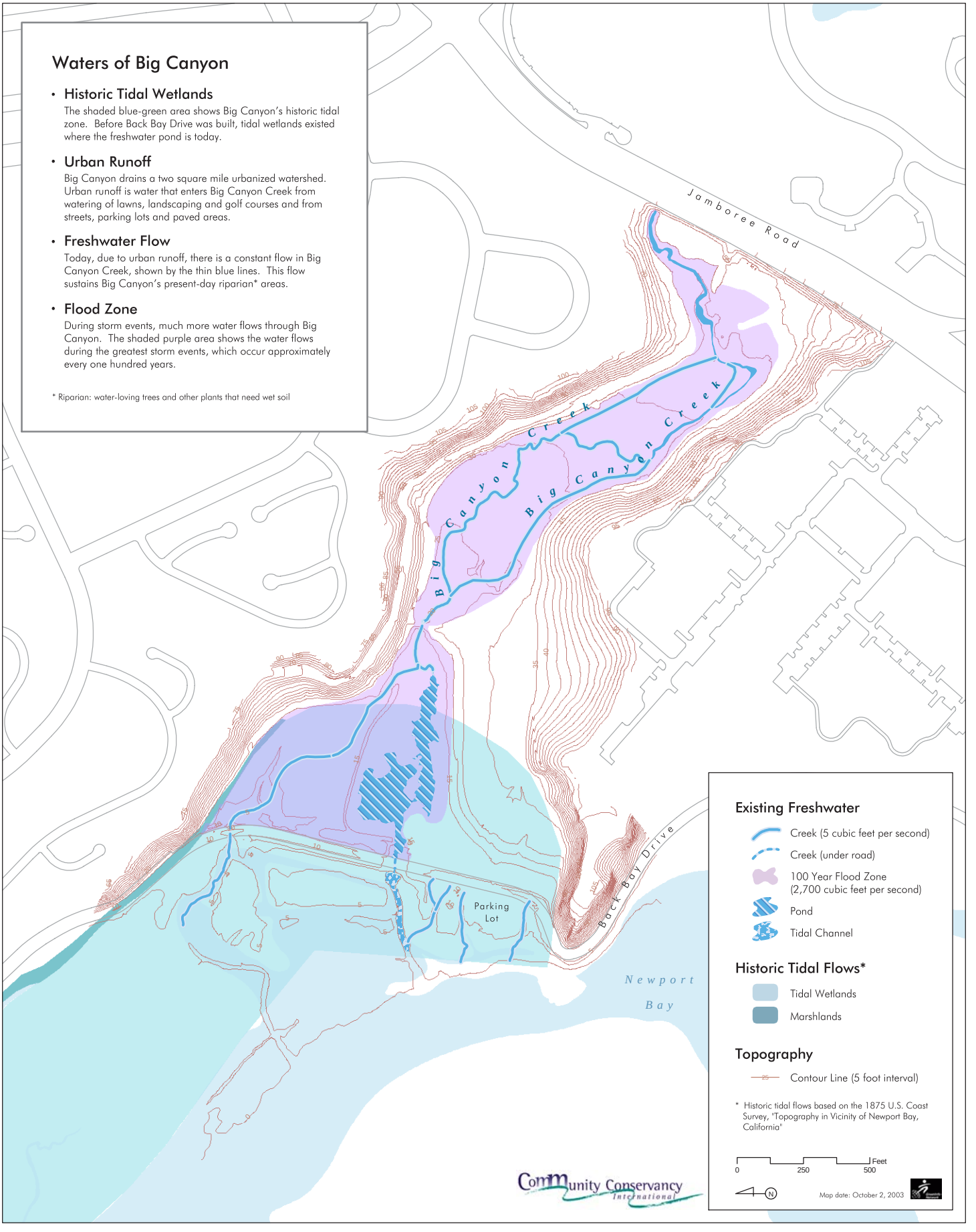
HISTORIC TIDAL WETLANDS & WATERS OF BIG CANYON

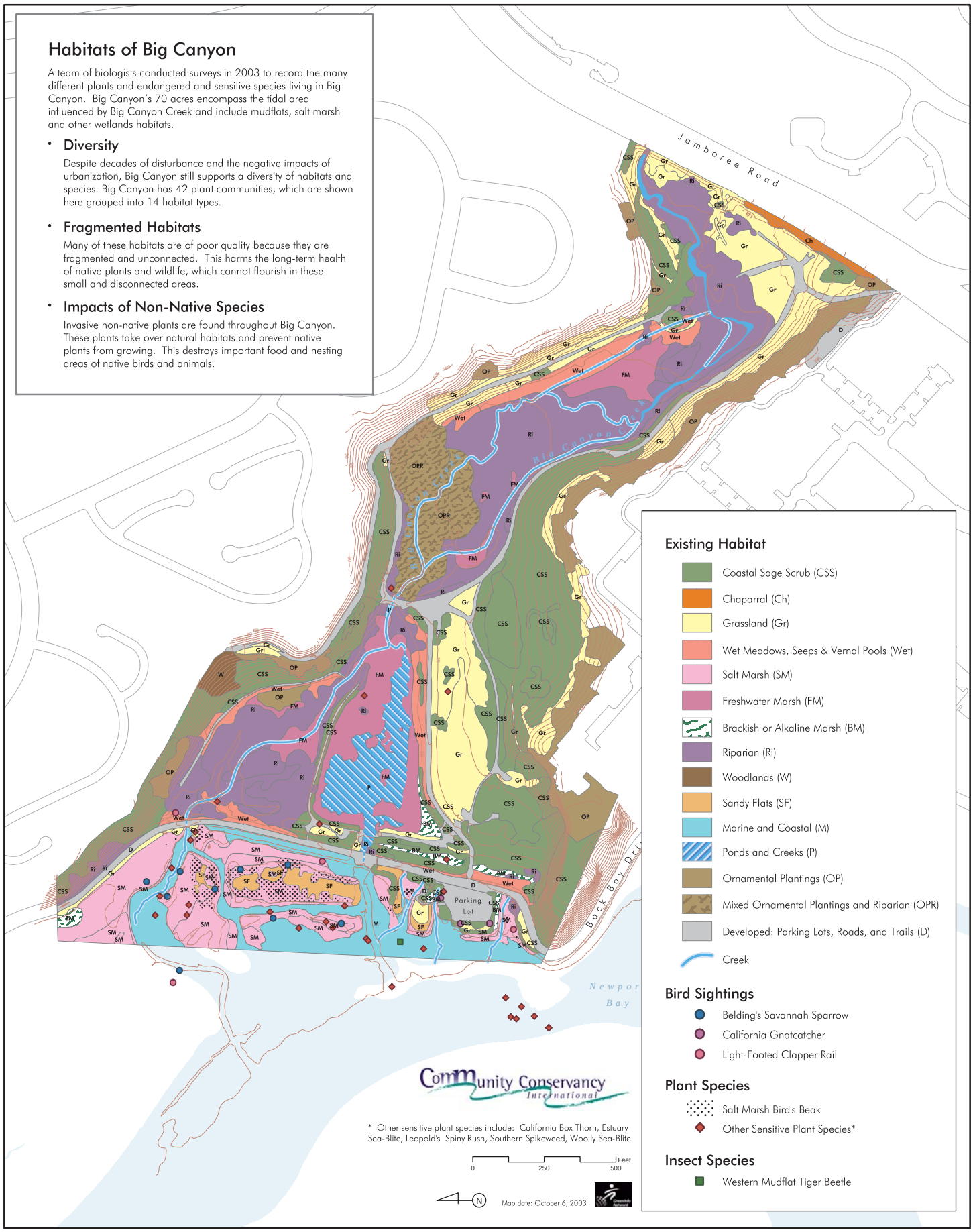


HABITATS AND SENSITIVE SPECIES OF BIG CANYON

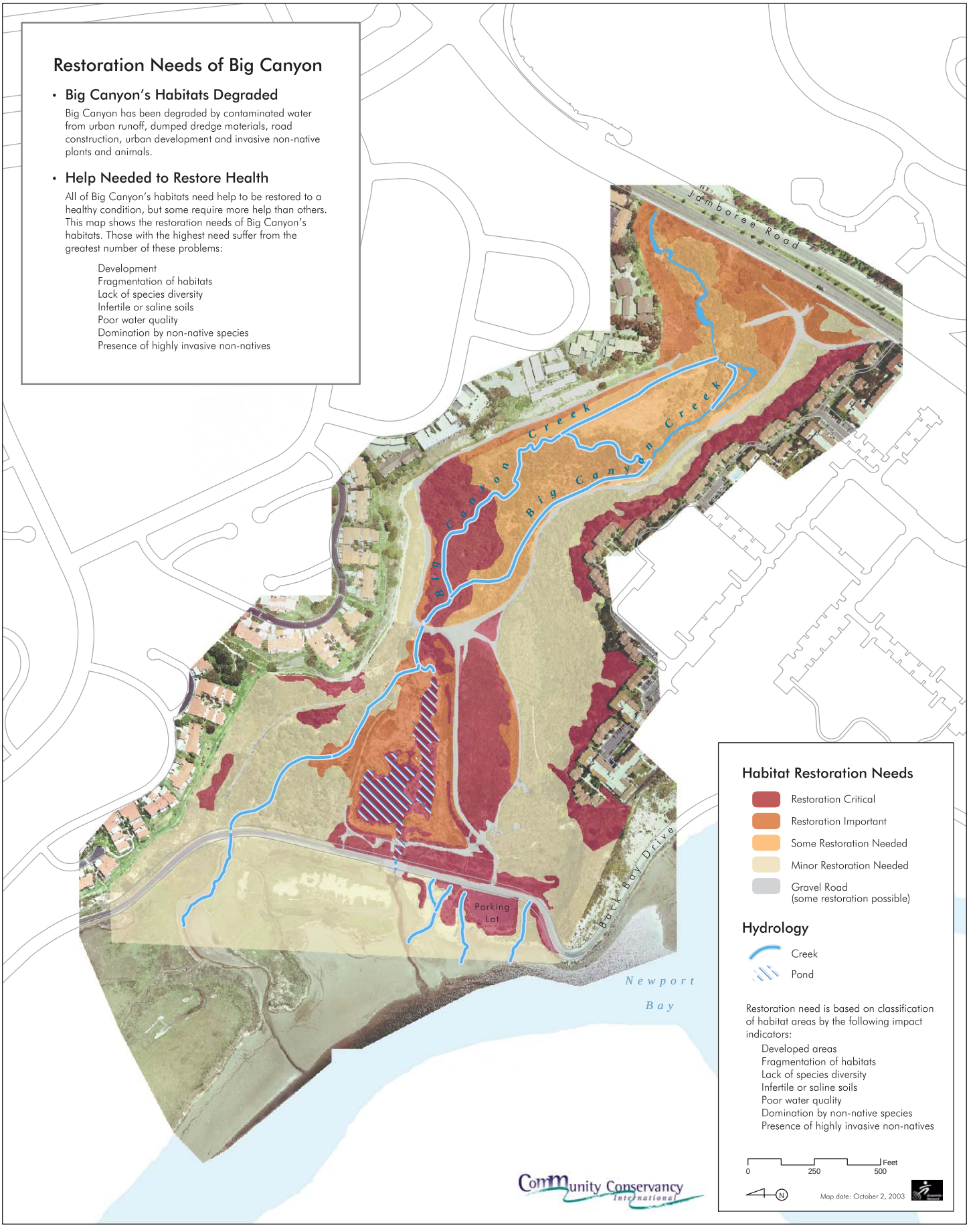
Habitats of Big Canyon

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



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

Joaquin Hills, and Upper Newport Bay. During 2003 surveys, California boxthorn was found in coastal bluff scrub and California bush sunflower scrub on the slopes above Big Canyon. A total of seven localities, and 40 shrubs were observed in Big Canyon. It is assumed that additional shrubs occur within Big Canyon, but were overlooked in the observations of these steep slopes.

6.2.13 Coast woolly heads (Nemacaulis denudata var. denudata)

This spreading, prostrate annual is found in sandy, back dune habitats in localities extending from Los Angeles to San Diego Counties, and into Baja California. There are approximately 16 known localities in San Diego, and a few have a large number of plants. The two localities in Los Angeles County, Long Beach and San Pedro, are historical, but there still is some potential habitat in these areas. In Orange County this species is recorded from several localities in Upper Newport Bay, and from Bolsa Chica. A historical site has also been recorded from the Anaheim Bay region. Although, the coast woolly heads currently occur at several localities within the Bay (Shellmaker Island), this species has not been previously recorded from or observed within the Big Canyon study area, nor was it observed during 2003 surveys here.

6.2.14 Estuary seablite (Suaeda esteroa)

This species is restricted to upper salt marsh habitats in the estuaries from Santa Barbara to San Diego Counties and into northern and southern Baja California. It is reported from roughly 12 estuaries in southern California, where it is never very common due to the restricted preferred habitat of this species. Although currently distributed in estuaries along most of the Baja California coast, recent taxonomic revisions may greatly reduce the range of this species.

In Orange County the estuary seablite has been recorded in Upper Newport Bay, Bolsa Chica and Anaheim Bay. The estuary seablite is restricted to the upper intertidal salt marsh, and is an uncommon species within this community. A total of 12 localities were observed during the field surveys and 249 plants were observed in Big Canyon.

6.2.15 Woolly seablite (Suaeda taxifolia)

The woolly seablite is found in coastal salt marshes and coastal bluff habitats along the coast of Central and lower (northern Baja) California. This species is found from San Luis Obispo County to Baja California, including the Channel Islands, but is never very common, since it is restricted to the salt marsh or bluff areas. Therefore, it has been placed on the CNPS watch list, since the habitats in which this species occurs are continuing to decline. In Orange County this species is known to occur at Upper Newport Bay, Bolsa Chica, Huntington Beach, Laguna Beach, Dana Point, and other coastal localities within the County. The woolly seablite was found in coastal bluff scrub, alkali grassland, and alkali meadow communities. A total of four localities and 39 plants were observed in Big Canyon. Table 10, below, details special-status plant species in the vicinity of Big Canyon. The species shown in bold were observed in Big Canyon during 2003 surveys. The following categories are used to define status:

Federal Status:
FE - Listed as federally endangered.
SOC - Species of Concern, former Federal Candidate 2 Species
State Status:
SE - endangered by the state of California
ST - threatened by the state of California
California Native Plant Society (CNPS):
List 1A- Plants presumed extinct in California
List 1B - Plants considered rare, threatened or endangered in California and elsewhere
List 2 - Plants rare, threatened or endangered in California but more common elsewhere
List 3 - Plants about which we need more information - A review list
List 4 - Plants of limited distribution - A watch list
Other:
Locally rare - Rare in Orange County (Gray and Bramlet 1994a).

Table B10. Special-Status Plant Species in the Vicinity of Big Canyon

Species	Status:				Habitat	Known Localities and Occurrence in Big Canyon
	Federal	State	CNPS	Other		
Aphanisma blitoides Aphanisma			List 1B		Coastal bluffs	Historically occurred in coastal bluff scrub on the West Bay.
Atriplex coulteri Coulter's saltbush			List 1B	Locally rare	Grassland, Sage Scrub, Alkali meadow?	Newport Beach (north of exisiting library), San Joaquin Hills.
Atriplex pacifica South coast saltbush	SOC		List 1B	Locally rare	Grassland, Sage scrub, Alkali meadow?	Historically known from coastal Orange County, currently known only from the San Clemente area
Cordylanthus maritimus* ssp. *maritimus **Salt marsh bird's beak**	**FE**	**SE**	**List 1B**		**Salt marsh**	**Upper Newport Bay & Anaheim Bay; 15 locations & ~30,000 individuals found in Big Canyon salt marsh habitat during 2003 surveys**
Dudleya multicaulis Many-stemmed dudleya			List 1B		Coastal sage scrub	UCI Ecological Reserve San Joaquin Hills
Echinodorus berteroi Upright burhead				Locally rare	Fresh Water marsh	Delhi Channel-Upper Newport Bay, Wintersburg Channel at Bolsa Chica
Eleocharis parvula Little spike-rush				List 4	Coastal salt marsh	Upper Newport Bay
Eleocharis rostellata Beaked spike-rush				Locally rare	Coastal salt marsh Fresh water marsh	Santa Ana River
Centromadia* (*Hemizonia*) *parryi* ssp. *australis **Southern tarplant**	**SOC**		**List 1B**		**Alkali meadows, grasslands**	**Upper Newport Bay west and east mesas, San Joaquin Marsh, UC Irvine, Mason Park, Fairview Park, Mile Square Park, Peters Canyon Channel. Found in 12 locations, over 2,000 inviduals found during 2003 surveys**
Hordeum intercedens Vernal barley			List 3		Moist grasslands and alkali meadows	Newport Beach (north of exisiting library), Fairview Park, UCI Ecological Reserve
Juncus acutus* ssp. *leopoldii **Southwestern spiny rush**			**List 4**		**Salt marsh, brackish marsh**	**Upper Newport Bay Anaheim Bay Bolsa Chica; 5 locations and 77 individuals found in Big Canyon during 2003 surveys**
Lasthenia glabrata ssp. *coulteri* Coulter's goldfields	SOC		List 1B		Alkali meadows	Los Alamitos, Hellman Ranch Garden Grove Crystal Cove (Historic)

Species	Status:				Habitat	Known Localities and Occurrence in Big Canyon
	Federal	State	CNPS	Other		
Lycium californicum **California boxthorn**			**List 4**		**Coastal sage scrub**	**Upper Newport Bay Crystal Cove; 7 locations and 40 individuals found during 2003 surveys**
Microseris douglasii var. *platycarpha*			List 4		Clay grasslands	N. Newport Beach Library UCI Ecological Reserve
Nemacaulis denudata var. *denudata* Coast woolly-heads			List 2		Coastal dunes, margins of salt marshes	Upper Newport Bay (Shellmaker Island), Bolsa Chica
Senecio aphanactis Rayless ragwort			List 2		Coastal sage scrub	UCI Ecological Reserve
Suaeda esteroa **Estuary seablite**			**List 1B**		**Salt marsh**	**Upper Newport Bay, Bolsa Chica; 12 locations and 249 individuals found in Big Canyon during 2003 surveys**
Suaeda taxifolia **Woolly seablite**			**List 4**		**Salt marsh, coastal bluff**	**Upper Newport Bay, Newport-Laguna Coast, Bolsa Chica; 4 locations and 39 individuals found in Big Canyon during 2003 surveys**

6.3 Special-Status Insect Species

This section discusses special-status insect species with a potential to occur, or that were observed, in Big Canyon. Table 11 at the end of this section summarizes special-interest insect species recorded in the vicinity of Big Canyon; those observed in Big Canyon are shown in bold in the Table 11.

6.3.1 Wandering skipper butterfly (Panoquina errans)

The wandering skipper is a small (about one-inch wingspread) butterfly is considered a California species of concern. This species occurs in localized colonies along the coast of southern California from the Santa Barbara area southward along both coasts of Baja California, Mexico. It is associated only with its larval host plant, saltgrass, which grows primarily in sandy habitats along beaches, bluffs and estuaries including lower Big Canyon. In southern California, this species is active as an adult during several generations from March to November. Focused surveys for the wandering skipper were not conducted at Big Canyon. However, based on the presence of saltgrass, the results of the present study, and observations reported by Orsak (1978), the wandering skipper butterly likely still occurs in lower Big Canyon and surrounding areas of Upper Newport Bay. Orsak (1978) additionally reported that Upper Newport Bay might very well support the largest extant colony of this butterfly in Orange County.

6.3.2 Tiger beetles (Cicindela sp.)

Approximately 100 species (with many named subspecies) of tiger beetles occur in the United States. About three-fourths of these are in the genus *Cicindela*. Many tiger beetles are brilliantly colored, and others are well camouflaged to blend in with their surroundings. Most tiger beetles are less than 0.5 inch in length, and are predominately found in open sandy habitats, mud flats, beaches, along streams, and near other wetland areas. Tiger beetle presence or absence can be an important indicator of wetland habitat quality.

Larval and adult tiger beetles are voracious predators. The larvae live in burrows in hard-packed or damp sand from which they capture with their large mandibles other small insects that pass by. Adults actively search for prey by rapidly running and flying over their beach or dune habitats. These agile beetles are quick

to take flight, and observers rarely have the opportunity to get very close to them making field identification difficult or not possible without actively collecting them with the aid of nets. Tiger beetles can be found year round, but most species are primarily active on warm sunny days in the late spring and early summer months.

Several special-status tiger beetles are known from southern California, including Western Mudflat Tiger Beetle (*Cicindela trifasciata sigmoidea*), Sandy Beach Tiger Beetle (*Cicindela hirticollis gravida*), Frost's Tiger Beetle (*Cicindela senilis frosti*), Sand Dune Tiger Beetle (*Cicindela latesignata*), and Gabb's Tiger Beetle (*Cicindela gabbii*). Special-status tiger beetle species potentially occurring at or near Big Canyon are inhabitants of sandy beaches (*C. hirticollis gravida* and *C. latesignata*) or dark-colored mud and salt flats in estuaries and salt marshes (*C. senilis frosti, C. gabbii,* and *C. trifasciata sigmoidea*) along the coast of southern California. These species (especially the first four) have been extirpated from many historical southern California localities due to development, habitat fragmentation, and other anthropogenic disturbances.

Two other tiger beetles that may occur on or near Big Canyon, *C. haemorrhagica* and *C. oregona*, are widespread and highly vagile and are not considered to be special-status by agencies or entomologists. *C. trifasciata sigmoidea* is also fairly widespread and extremely vagile (LaRue, 1990), but is much less common than *C. haemorrhagica* and *C. oregona*. Due to the lack of sandy beaches on the subject property, no suitable habitat exists for *C. hirticollis* gravida and *C. latesignata*. It is possible that *C. senilis frosti* exists or formerly occurred on the mud and salt flats west of Backbay Drive. However, GPB's survey period did not include this species' spring and fall activity periods, and none were observed during the present study. Additional focused surveys for *C. senilis frosti* should be conducted on sunny, warm days during the spring (March-April) or fall (September-October) months to determine whether this rare tiger beetle is present at Big Canyon.

C. trifasciata sigmoidea was observed commonly during the survey on the mud flats just west of the kiosk and Backbay Drive. On the July 14 survey, hundreds of individuals were observed, especially later in the afternoon as the low tide exposed more mud flats and suitable tiger beetle habitat increased. No *C. gabbii* were encountered during the present study, but this uncommon species has been documented from areas with similar habitat in the vicinity of Seal Beach, approximately twelve to fifteen miles north of Big Canyon (Nagano, 1980). *C. gabbii* was observed on mud flats north of Imperial Beach in San Diego County on July 13, 2003, but they were uncommon and may only be in the early stages of their annual flight period as of that date (personal observation, Guy Bruyea). In addition, *C. gabbii* is very agile and wary of human approach and is therefore not as easily identified or collected as other tiger beetle species.

The more widespread *C. haemorrhagica* and *C. oregona* may also be present at the mud flats west of Backbay Drive, but none were observed during the present study. *C. haemorrhagica* was observed in the Seal Beach area in mid-July 2003 (personal observation, Guy Bruyea), and is known from several other locations along coastal southern California. *C. oregona* is active during the spring and fall only. Additional surveys in October may detect this species.

6.3.3 Other Special-Status Insect Species

Species presently considered rare and/or declining in coastal southern California in the vicinity of Big Canyon are summarized in Table 11. Only one of these was found at Big Canyon, although, as mentioned above, other tiger beetles may also occur here. Species shown in bold were observed in Big Canyon during 2003 surveys. "Range" indicates whether or not Big Canyon is within known historical range and has sufficient natural resources (habitat, host plants, etc.) of idicated taxon. "Status" denotes species that are federally endangered (FE), a species of concern (C), or have a highly restricted and/or declining range (R).

Though the monarch butterfly is probably not at risk currently, its overwintering, or nesting, sites should be protected. Also note that the El Segundo flower-loving fly is known historically from El Segundo dune complex and was presumed extinct since 1957. In 2001, a small colony was rediscovered near Palos Verdes Peninsula. The related Delhi sands flower-loving fly (ssp. *abdominalis)* is federally endangered.

Table B11. Special-Status Insects in the Vicinity of Big Canyon

Common Name	Scientific Name	Status	Range*
Quino Checkerspot	***Euphydryas editha quino***	**FE**	**No**
El Segundo Blue	***Euphilotes battoides allyni***	**FE**	No
Palos Verdes Blue	***Glaucopsyche lygdamus palosverdesensis***	**FE**	No
Wandering Skipper	***Panoquina errans***	**C**	**Yes**
Monarch Butterfly	***Danaus plexippus***	[1]	**Yes**
Mormon Metalmark Butterfly	***Apodemia mormo* (El Segundo ecotype)**	**R**	No
Busck's Gall Moth	***Carolella busckana***	**C**	No
Henne's Eucosman Moth	***Eucosma hennei***	**R**	No
Ford's Sand Dune Moth	***Psammobotys fordi***	**R**	No
Globuse Dune Beetle	***Coelus globosus***	**C**	No
Dorothy's Dune Weevil	***Trigonoscuta dorothea***	**C**	No
Lange's El Segundo Weevil	***Onychobaris langei***	**R**	No
Sandy Beach Tiger Beetle	***Cicindela hirticollis gravida***	**C**	No
Western Mudflat Tiger Beetle	*Cicindela trifasciata sigmoidea*	R	Yes
Sand Dune Tiger Beetle	***Cicindela latesignata***	**R**	**No**
Gabb's Tiger Beetle	***Cicindela gabbii***	**R**	**Yes**
Frost's Tiger Beetle	***Cicindela senilis frosti***	**R**	**Yes**
El Segundo Flower-loving Fly	***Rhaphiomidas terminatus terminatus***	[2]	No
Belkin's Dune Horsefly	***Brennania belkini***	**R**	No
Jerusalem Cricket	***Stenopelmatus* new species**	**R**	No
Sand Roach	***Arenivaga* new species**	**R**	No

Legend for Table 11:
*Indicates whether Big Canyon is within known historical range and has sufficient natural resources (habitat, host plants, etc.) of indicated taxon. (bold=observed during study)
FE=Federally endangered, C=Species of Concern, R=Highly restricted range and/or declining (No status)
[1] Overwintering (or nesting) sites should be protected, butterfly probably not at risk currently
[2] Known historically from El Segundo dune complex and presumed extinct since 1957; a small colony was rediscovered in 2001 near Palos Verdes Peninsula. The related Delhi sands flower-loving fly (ssp. *abdominalis*) is federally endangered.

6.4 Special-Status Herpetological Species

No special-status herpetological species were located during the 2003 surveys. However, Big Canyon supports potential habitat, albeit marginal, for two special-status species, further described below. Several additional special-status species are known from the project vicinity; these are included in Table 12 at the end of Section 6.6.

6.4.1 Southwestern pond turtle (Clemmys marmorata pallida)

The southwestern pond turtle is a California reptile Species of Special Concern with a relatively continuous distribution in most pacific coast drainages from the Columbia River to northern Baja California, although few viable populations occur in Southern California. The pond turtle is normally found in and along riparian areas, although gravid females have been reported up to a mile away from water in search of appropriate nest sites. The preferred habitat for these turtles includes ponds or slow-moving water with numerous basking sites (logs, rocks, etc.), food sources (plants, aquatic invertebrates, and carrion), and few predators (raccoons, introduced fishes, and bullfrogs). The pond at Big Canyon offers some habitat for this species, but no southwestern pond turtles were trapped during the two-night trapping period. Water temperatures were too warm for this species, and potential predators including 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. Therefore, no southwestern pond turtles are expected to occur in Big Canyon in its current condition, though there is potential to restore this species to the canyon.

6.4.2 San Diego horned lizard (Phrynosoma coronatum blainvilli)

The horned lizard is a California reptile species of Special Concern. It occurs along the southern California coast from Santa Barbara south to northern Baja, Mexico. It is found in a wide variety of habitats including coastal sage scrub, chaparral and riparian woodland, in loose fine soils with high sand content. Potential habitat for this species is limited in Big Canyon, and collecting, human disturbance and potential predators likely limit the potential for its occurrence.

6.5 Special-status Avian Species

Three species listed as endangered or threatened (light-footed clapper rail, California gnatcatcher and Belding's savannah sparrow) and several other special-status bird species were observed during 2003 surveys in Big Canyon. These are discussed below. Table 12, at the end of Section 6.6, summarizes information for these and other special-status bird species that may occur in Big Canyon.

6.5.1 California brown pelican (Pelicanus occidentalis californicus)

The California brown pelican is federally and state-listed as an endangered species. It is observed primarily in the open ocean and beaches but is also common in estuaries, tidal rivers, rocky coasts, breakwaters, and islands. Breeding locations along the west coast of California are limited to the Channel Islands. During the late 1960's and early 1970's, the brown pelican population suffered a widespread and dramatic decline linked to egg shell thinning due to DDT, first noted in 1962. The population is now recovering well. Brown pelicans do not breed on the mainland but are frequent inhabitants of Upper Newport Bay and other southern California estuaries and harbors. No pelicans were observed during surveys in Big Canyon but they are known to forage in the open water west of Big Canyon.

6.5.2 Light-footed clapper rail (*Rallus longirostris levipes*)

The light-footed clapper rail is federally and state-listed as endangered. It is one of three subspecies of clapper rails that occur as residents in coastal salt marshes from Bahia de San Quintin, Baja California north to Carpinteria Marsh, Santa Barbara County (Zembal and Massey 1981, Zembal 1991). Light-footed clapper rails occupy tidal habitats dominated by cordgrass and pickleweed. Nests are typically built of cordgrass and attached to living cordgrass stems so that they float with the rise and ebb of the tide. Radio-telemetry

studies at Upper Newport Bay indicate that rail pairs maintain territories averaging two acres in size (Zembal 1991). Although the majority of the light-footed clapper rail population at Upper Newport Bay occurs on the west side of the bay, light-footed clapper rails were observed during 2003 surveys at Big Canyon and likely breed as well in cordgrass habitat west of Big Canyon. Annual surveys for this species in Upper Newport Bay and other areas are conducted by Dick Zembal with the Orange County Water District. In 2003, twelve pairs were present on Middle Island just west of Big Canyon in 2003 (Zembal, pers. comm.), and one male was observed just north of the bend in Back Back Drive on the south side of Big Canyon, just south of the parking lot. On the north side of Big Canyon, near the bridge, another pair occurs in freshwater marsh habitat, and there is occasionally a pair north of the pond overflow area. Finally, two pairs occur on Upper Island in the northern portion of Big Canyon near the creek outflow west of Back Bay Drive (Zembal, pers. comm.).

6.5.3 California least tern (Sterna antillarum browni)

California least tern is federally- and state-listed as endangered. A migratory species, it nests from April through August along the coast of California from San Francisco south to Baja California. It presumably winters in Central America or northern South America, although the specific location of its wintering range is unknown. California least tern population is now estimated at over 4,000 pairs, up from approximately 600 when it was listed in the early 1970's. Least terns breed on sparsely vegetated sandy beaches, salt flats, and dredge spoil in colonies of up to several hundred nesting pairs. Many nesting sites are located adjacent to estuaries, which are used for foraging (feeding) for small fish. California least terns are known to nest at 35 to 38 sites in California, including the northern portion of Upper Newport Bay. No potential nesting habitat is present at Big Canyon, although least terns were observed foraging in open water channels of the salt marsh at Big Canyon during surveys.

6.5.4 White-tailed kite (Elanus leucurus)

The White-tailed Kite is a year-round resident and a California Special Animal, a designation pertaining to species that are of concern. Populations have fluctuated widely in the past; however, Southern California birds appear to be in a long-term decline at this time. White-tailed kites nest in well-developed woodlands and forage primarily in grasslands. This species was observed foraging in Big Canyon during 2003 surveys but likely does not breed here due to human disturbance.

6.5.5 Cooper's hawk (Accipiter cooperii)

The Cooper's hawk is a medium-sized hawk and a California Species of Special Concern. It is an uncommon but perhaps increasing breeder in Southern California, where it is found mainly in well-developed oak and willow woodlands. Cooper's hawks were observed in Big Canyon during 2003 surveys and may nest in the riparian woodland of Big Canyon; they are becoming more common in residential areas.

6.5.6 Sharp-shinned hawk (Accipiter striatus)

The sharp-shinned hawk is smaller than Cooper's hawk but otherwise looks very similar and has similar foraging habits. It is also a California Species of Special Concern. It was observed during 2003 surveys and likely forages occasionally to frequently in Big Canyon during the winter months. However, it would not nest in Big Canyon as does not breed in coastal southern California.

6.5.7 Peregrine Falcon (Falco peregrinus)

Like the brown pelican, the peregrine falcon suffered a population decline in the 1960's and 1970's because of DDT-induced eggshell thinning, and the species was listed as endangered by the state of California and the federal government in the early 1970's but was delisted by the federal government in June 1999; it is still state-listed as endangered. It was once a fairly common permanent resident along the coast of California, taking various species of birds as prey. Coastal wetlands offer important foraging habitat for

peregrine falcons because of large congregations of shorebirds and waterfowl that are favored prey. In more recent years, the California population has recovered to nearly its former numbers, and pairs are known to nest in urban environments as well as more natural habitats. For example, one pair occupies the Long Beach City Hall and forages on the rock doves (commonly called pigeons) that frequent city streets. One peregrine falcon was observed flying over Big Canyon during surveys; the species likely forages occasionally in Big Canyon, particularly in the salt marsh habitat, but no suitable breeding habitat is present in Big Canyon for peregrine falcon.

6.5.8 Merlin (Falco columbarius)

Although not known to breed in California, sightings of the merlin, a California Species of Special Concern and formerly a fairly common winter visitor and migrant, have declined drastically, along with populations throughout the United States and Canada. Because population reductions are believed to be related to DDE contamination and falconry rather than to a loss of breeding habitat, the merlin was designated a California Species of Special Concern. No observations of merlin occurred during 2003 surveys in Big Canyon, but it likely occurs here occasionally during migration

6.5.9 Coastal California gnatcatcher (Polioptila californica)

The California gnatcatcher, federally listed as threatened, is a small, insectivorous bird endemic to southern California and Baja California, Mexico. It occurs in a variety of sage scrub habitats and uses adjacent chaparral, grassland and riparian habitats. Its habitat has become highly fragmented as the result of development of the valleys and foothills of southern California. Focused surveys for California gnatcatcher were conducted in Big Canyon in 2003, as described in Section 3.4.2. One pair of California gnatcatchers was found during surveys, primarily using the saltbush scrub adjacent to Back Bay Drive. Potential for restoration exists in Big Canyon for this species, as it was formerly more numerous in this area.

6.5.10 Least Bell's vireo (Vireo belli pusillus)

The Least Bell's vireo, federally and state-listed as endangered, is a small, migratory songbird listed as endangered by both federal and state resource agencies. The Least Bell's Vireo once nested commonly throughout much of lowland California, but during the mid-1900's its breeding range became reduced to a relatively small number of major riparian systems in Southern California. The decline was attributed to widespread loss and degradation of riparian habitat, combined with brood parasitism by the Brown-headed cowbird (*Molothrus ater*). Aggressive recovery efforts, including cowbird trapping and restoration of high-quality riparian habitat areas across coastal Southern California, brought encouraging results during the 1990's, with the species recolonizing several riparian systems in Orange County. Riparian woodlands at Big Canyon are marginally suitable for nesting Least Bell's vireos; however, no birds were detected during the focused surveys.

6.5.11 California horned lark (Eremophila alpestris actia)

The California horned lark is a California Species of Special Concern that occupies grasslands and crop lands from Humboldt County south to northwestern Baja California. Populations are declining across much of this range, particularly in coastal California, due to conversion of grasslands and agricultural fields to housing and other uses. The species is considered uncommon and very localized in Orange County. It was not observed during 2003 surveys and may occur as a migrant, but the open habitats at Big Canyon are likely too disturbed and overrun with potential predators for this species to successfully breed at Big Canyon.

6.5.12 Loggerhead shrike (Lanius ludovicianus)

The Loggerhead shrike is a California Species of Special Concern that is an uncommon but widespread resident of Southern California. This species typically occupies open habitats with scattered trees. As with the horned lark, because such habitats are becoming more scarce in Southern California, loggerhead shrike is a

California Species of Special Concern (CDFG 1992). No loggerhead shrikes were observed during surveys; however, the species may use Big Canyon on a seasonal basis.

6.5.13 California yellow warbler (Dendroica petechia morcomi)

The California yellow warbler is a California Species of Special Concern. This colorful songbird breeds in a variety of woodland habitats and is fairly common and widespread during migration. In Southern California, the breeding population has declined due to habitat loss, habitat degradation and parasitism by Brown-headed cowbirds. In Orange County, yellow warblers now nest primarily in well-developed riparian woodlands of the higher mountains, though a few possible breeders are also found each year in expansive riparian woodlands of the foothills and lowlands. The riparian habitat of Big Canyon is likely not well-developed enough to support breeding yellow warblers, although the species may occur occasionally during migration.

6.5.14 Yellow-breasted chat (Icteria virens)

The yellow-breasted chat is a large warbler designated a California Species of Special Concern. It nests in well-developed riparian woodlands, often adjacent to upland scrub habitats. California breeding populations, particularly those in the southern half of the state have declined significantly, probably resulting from a combination of habitat loss, habitat degradation and brood parasitism by the brown-headed cowbird. The yellow-breasted chat is a rare to uncommon nesting species in the lowlands and foothills of Orange County. The riparian habitat of Big Canyon is likely not well-developed enough to support breeding yellow-breasted chats, although the species may occur occasionally during migration.

6.5.15 Belding's savannah sparrow (Passerculus sandwichensis beldingi)

The Belding's savannah sparrow is listed as threatened by the state of California. It occurs from Morro Bay south to El Rosario, Baja California in coastal salt marshes and coastal estuaries where pickleweed, sea-blite, salt bush, and salt grass are dominant plant species. Diet includes a variety of crustaceans as well as seeds of pickleweed and they have been observed foraging in habitats adjacent to coastal salt marsh and are capable of drinking salt water. Nests are built low in pickleweed in middle to upper portions of salt marshes, or in non-tidal seepage areas dominated by pickleweed Predators include red fox (*Vulpes vulpes*), striped skunk (*Mephites mephites*), raccoon (*Procyon lotor*), and domestic cat. The population of Belding's savannah sparrow population has declined over the past century due to destruction of suitable salt marsh habitat by filling for housing, industrial use and marina development. Potential habitat for Belding's savannah sparrow occurs in Big Canyon, and focused surveys in 2003, as discussed in Section 3.4.4, revealed an estimated eight territories (pairs) of Belding's savannah sparrows.

6.6 Special-Status Mammal Species

No potential habitat for special-status mammal species was located during the surveys. Thus, no mammal species are discussed in more detail in this section, no focused surveys were conducted for special-status mammals in Big Canyon, and none were located during general surveys. Special-status mammals that may occur in the project vicinity, and the reasons they are not expected to occur in Big Canyon, are summarized in Table 12. Table 12 details all special status wildlife species observed or potentially present in Big Canyon. Species shown in bold were observed in Big Canyon during 2003 surveys. The following categories from the Department of Fish and Game at (http://www.dfg.ca.gov/whdab/html/lists.html) were used to indicate status:

FE - Federally listed Endangered
FT - Federally listed Threatened
SE - State listed Endangered
ST - State listed Threatened
FP - State Fully Protected
FC - Federal Candidate. Sufficient biological information to support a proposal to list the species as Endangered or Threatened
FSC – Federal Species of Concern
CSC - California Species of Special Concern

Table B12. Special-Status Wildlife Species Observed or Potentially Present in Big Canyon

Species	Federal Status	State Status	Preferred Habitat	Potential for Occurrence
Arroyo toad *Bufo microscaphus californicus*	FE	CSC	Oak woodland, riparian habitats	None; habitat in Big Canyon too disturbed with non-native predators.
Southwestern pond turtle *Clemmys marmorata pallida*	FSC	CSC	Reservoirs; deep pools in riparian habitats; adjacent upland habitats for breeding	Very low; pond too shallow and warm; potential predators including African clawed frog.
San Diego horned lizard *Phrynosoma coronatum blainvillei*	FSC	CSC	Sandy openings in coastal sage scrub and chaparral	Low; degraded and disturbed habitat, presence of feral cat and other predators.
California brown pelican *Pelicanus occidentalis*	**FE**	**SE**	**Nearshore ocean, estuaries, bays**	**Observed foraging in channels west of salt marsh at Big Canyon**
Light-footed clapper rail *Rallus longirostris levipes*	**FE**	**SE**	**Coastal salt marsh dominated by cordgrass**	**Upper Newport Bay supports the largest population of this species; several pairs occur in salt marsh of Big Canyon**
Least Bittern (*Ixobrychus exilis*)			Freshwater marsh with cattails	Known to nest in Harbor Lake and El Dorado Park; no current breeding records in Orange County. Potential habitat exists in Big Canyon but not expected due to human disturbance.
Western Snowy Plover *Charadrius alexandrinus nivosus*	FT	CSC	Breeds on sandy beaches and salt flats	Known to nest at Bolsa Chica but suitable nesting habitat is lacking at Big Canyon and the rest of Upper Newport Bay; may forage occasionally on mudflats
California least tern (*Sterna antilarum browni*)	**FE**	**SE**	**Nests on sandy beaches and salt flats; forages in ocean, estuaries, freshwater**	**Known to nest at north end of Upper Newport Bay; no potential nesting habitat at Big Canyon but forages in salt marsh channels and possibly in freshwater marsh**
Cooper's hawk *Accipiter cooperii*		**CSC**	**Nests in woodlands, forages in many habitats in winter and migration.**	**Observed foraging during 2003 surveys; may nest in Big Canyon.**
Sharp-shinned hawk *Accipiter striatus*		**CSC**	**Forages in many habitats, in winter and migration**	**Observed foraging during 2003 surveys; does not nest in coastal So. Calif.**
White-tailed kite *Elanus leucurus*	**FSC**	**CSC FP**	**Nests in woodlands and ruderal habitats, forages in many habitats**	**Observed foraging during 2003 surveys; not expected to nest in Big Canyon.**
Northern Harrier *Circus cyaneus*		**CSC**	**Open fields, coastal salt marshes**	**Observed foraging over the salt marsh during 2003 surveys; not expected to nest in Big Canyon.**
Osprey *Pandion haliaetus*		**CSC**	**Nests in tall trees or cliffs on freshwater lakes and rivers and along seacoast; feeds on fish.**	**Observed during 2003 surveys; not expected to breed in Big Canyon; occasional forager at Upper Newport Bay.**

Species	Federal Status	State Status	Preferred Habitat	Potential for Occurrence
Merlin *Falco columbarius*		CSC	Uses many habitats in winter and migration including woodlands and open habitats	Moderate; occurs in local area in low numbers during migration and winter. Does not nest in California.
Peregrine falcon *Falco peregrinus*	Delisted[3] FSC, FS	CE	Known to forage in canyons and foothills.	Observed during 2003 surveys flying high over Big Canyon; not expected to breed but will forage, esp. for shorebirds in salt marsh.
Long-eared owl *Asio otus*		CSC	Roosts and nests in oak and willow riparian woodland.	Not expected to occur; very rare now in coastal So. Cal. And very sensitive to human disturbance.
Burrowing owl *Speotyto cunicularia*	FSC	CSC	Grasslands & ruderal habitats with friable soils or and existing squirrel burrows	Some potential habitat but human disturbance limits its occurrence; nearly extirpated from Orange County.
Vaux's Swift *Chaetura vauxi*	**FSC**	**CSC**	**Mature old growth forests; riparian woodlands**	**Moderate; observed during survey; migrant foraging above Big Canyon salt marsh; not likely to nest**
Southwestern willow flycatcher *Empidonax traillii extimus*	FE	SE[4]	Breeds in riparian woodlands, particularly those dominated by willows and cottonwoods.	Not expected to occur; riparian habitat in Big Canyon not suitable for breeding; may occur occasionally as a migrant.
Loggerhead shrike *Lanius ludovicianus*	FSC, MNBMC	CSC	Nests in tall shrubs & dense trees, forages in grasslands, and ruderal habitats.	Moderate; appropriate habitat present in Big Canyon, may nest trees and shrubs in Big Canyon.
California horned lark *Eremophila alpestris actia*		CSC	Open habitats, ruderal areas agricultural areas	May occur during migration but habitat at Big Canyon likely too disturbed to support nesting.
Least Bell's vireo *Vireo belli pusillus*	FE	SE	Breeds in riparian woodlands, particularly those dominated by willows	Not observed during 2003 surveys; habitat has limited potential due to disturbance; may occur as a migrant.
Coastal cactus wren *Campylorynchus brunneicapillus couesi*		CSC	Nests and forages in large cactus patches within coastal sage scrub and chaparral	Low, some cactus in Big Canyon but not in patches it typically prefers; may occasionally forage in Big Canyon. Known from other areas of Newport Bay.
Coastal California gnatcatcher *Polioptila californica californica*	**FT**	**CSC**	**Forages and nests in coastal sage scrub**	**One pair observed during 2003 surveys in saltbush scrub. Big Canyon previously supported a higher population.**
California yellow warbler *Dendroica petechia brewsteri*		CSC	Breeds in riparian woodlands dominated by willows and cottonwoods.	Habitat not suitable; not expected to breed in Big Canyon; may occur a migrant.
Yellow-breasted chat *Icteria virens*		CSC	Breeds in riparian woodlands, particularly those dominated by willows and cottonwoods.	Low; not expected to breed in riparian habitat of Big Canyon but may occur as a migrant.
Southern California rufous-crowned sparrow		CSC	Breeds & forages in coastal sage scrub and chaparral	Very low; potential habitat in Big Canyon too sparse and isolated from other potential habitat.

[3] Delisted as endangered or threatened by the USFWS on August 25, 1999
[4] The entire species, not just the subspecies, is listed by the State of California

Species	Federal Status	State Status	Preferred Habitat	Potential for Occurrence
Aimophila ruficeps canescens				
Belding's savannah sparrow *Passerculus sandwichensis*		**ST**	**Coastal salt marsh dominated by pickleweed**	**Occurs throughout Upper Newport Bay; 8 territories observed in the salt marsh of Big Canyon during 2003 surveys**
San Diego black-tailed jackrabbit *Lepus californicus benettii*		CSC	open chaparral, coastal sage scrub	Low; degraded and disturbed habitat, presence of feral cat and other predators
Pacific pocket mouse *Perognathus longimembris pacificus*	FE		loose, sandy soils in relatively open scrub habitats.	Not expected to occur in Big Canyon; previously documented in San Joaquin Hills, Spyglass Hill, but thought to be extinct from this locale since the 1970's due to development. The nearest known extant population occurs on the Dana Point Headlands.
Los Angeles pocket mouse *Perognathus longimembris brevinasus*		CSC	ruderal habitat (with fine sands)	None; habitat (fine sands) not present
Dulzura pocket mouse *Chaetodipus californicus femoralis*		CSC	chaparral, coastal sage scrub (sandy soils)	Low; degraded and disturbed habitat, presence of feral cat and other predators.
Southern grasshopper mouse *Onychomus torridus Ramona*		CSC	chaparral, oak woodland, coastal sage scrub	Low; degraded and disturbed habitat, presence of cats and other predators limits its occurrence in Big Canyon.
San Diego desert woodrat *Neotoma lepida intermedia*		CSC	coastal sage scrub	Low; degraded and disturbed habitat, presence of cat and other predators limits its occurrence in Big Canyon.
Pallid bat (*Antrozous pallidus*)		CSC	Forages over many habitats; roosts in buildings, rocky outcrops & crevices in mines &	Moderate; likely to forage occasionally over Big Canyon.
Spotted bat *Euderma maculatum*	FSC	CSC	all native habitats	Low; possible occasional forager over the riparian areas of Big Canyon.

7.0 NON-NATIVE AND INVASIVE SPECIES OF CONCERN

7.1 Non-Native and Invasive Plant Species

The exotic, invasive plant species known to occur in California have been noted by the California Exotic Plant Pest Council (CEPPC 1999), and by Bossard et al. (2000). Invasive plant species generally known to occur in Upper Newport Back Bay were addressed in the biological resource documentation for the Upper Newport Bay Regional Park (Marsh 1990, EDAW 1991). The following section will note some of the most invasive, exotic plant species noted in the Big Canyon study area.

7.1.1 Brazilian pepper (Schinus terebinthifolius)

This invasive tree species has developed into a monotypic riparian forest within the middle section of Big Canyon creek, and scattered trees and found throughout the riparian habitat within the creek.

7.1.2 Unknown Saltbush (Atriplex sp.)

This unknown, introduced saltbush shrub (subshrub), has developed into a separate community in the southwestern section of Big Canyon. There is a high potential for this species to continue to spread into the coastal sage and annual grassland communities within Big Canyon.

7.1.3 Iceplants

Iceplants (including the species *Carpobrotus edulis, Mesembryanthemum crystallinum, M. nodiflorum* and *Malephora? crocea* and additional species) now cover large areas of the slopes of the canyon and in disturbed, open areas on the canyon floor. The species within large infested sites need to be identified, and the procedures for removing the larger infestations should be developed.

7.1.4 Spanish sunflower (Pulicaria paludosa)

This species is found scattered within most of the riparian herb, and margins of the riparian scrub community found in Big Canyon. It is also occurs on the margins of some of the alkali meadows found within Big Canyon.

7.1.5 Statice (Limonium ramosissimum?)

This naturalized statice still needs to be identified. However, the mats formed by this perennial herb are found in alkali meadows, alkali grassland, and ruderal habitats. It appears to be rapidly spreading into wetland habitats within the canyon.

7.1.6 Glaucous-leaved saltbush (Atriplex glauca)

This species is found spreading throughout the annual grassland found in the southwest corner of Big Canyon, and other localities within the canyon.

7.1.7 Myoporum (Myoporum laetum)

Scattered myoporum shrubs were found scattered in the riparian habitat and on the slopes within Big Canyon.

7.1.8 Castor bean (Ricinus communis)

At least one fairly large stand of this invasive weedy species, was noted in Mexican elderberry woodland, and sage scrub habitats in the northwest portion of the canyon.

7.1.9 Pampas grass (Cortaderia selloana)

A few individuals of this highly invasive grass species were noted adjacent to riparian habitats in the upper Big Canyon creek drainage and scattered in several other localities within the drainage.

7.1.10 Evergreen (Shamel) ash (Fraxinus uhdei)

Several stands of the evergreen ash (identification needs to be verified) were noted in the willow riparian scrub in the northeast portion of Big Canyon.

7.1.11 Italian thistle (Carduus pycnocephalus)

Stands of Italian thistle were noted in grasslands within the northeast section of Big Canyon.

7.1.12 Tocalote (Centaurea melitensis)

Tocalote is found in all of the annual grasslands of Big Canyon, and in some localities forms relatively dense stands.

7.1.13 Black mustard (Brassica nigra)

Dense stands of black mustard were noted on the slopes of the bluffs of the southwestern portion of Big Canyon, and in other annual grasslands found within the canyon.

7.1.14 Garland chrysanthemum (Chrysanthemum coronarium)

To date this species is limited to alkali grasslands found along Backbay Drive.

7.1.15 Pride of Madera (Echium candicans)
Pride of Madera was noted in at least one stand on the slopes of the canyon. It was not determined if these were planted or adventive, however, there is the potential of this species spreading into areas of the canyon.

7.1.16 Acacia (Acacia longifolia, A. retinodes, plus additional species)
Acacias have been used for landscaping along the margins of the canyon, and these species have the potential to escape into natural habitats. At least one golden wattle shrub was noted in the riparian habitats of Big Canyon Creek.

7.1.17 Five-hook bassia (Bassia hyssopifolia)
The five hook bassia is relatively common in disturbed alkali habitats.

7.1.18 Purple false brome (Brachypodium distachyon)
Patches of this species were noted in annual grasslands in the southeast portion of Big Canyon.

7.1.19 Tree tobacco (Nicotiana glauca)
This weedy shrub was uncommonly noted in some of the disturbed habitats in Big Canyon.

7.1.20 Sweet fennel (Foeniculum vulgare)
Sweet fennel is found occasionally in annual grassland, coastal sage scrub, and the margins of riparian scrub habitats.

7.1.21 Poison hemlock (Conium maculatum)
Poison hemlock was uncommonly noted in riparian herb and riparian scrub communities in the northeastern section of Big Canyon.

7.1.22 Bull thistle (Cirsium vulgare)
This species was uncommonly found in some of the riparian herb, and alkali meadow communities within Big Canyon.

7.2 Non-Native and Invasive Insect Species
Argentine ants *(Linepithema humile)* are small ants often present in great numbers. They are known to forage 24 hours a day. The Argentine ant is now permanently established in California and parts of the southern United States, including Georgia and Florida. These ants are most commonly encountered in urban areas and along the coast. Argentine ants are usually found on trees or shrubs, in flowerbeds, in and around mulch, and in trash heaps. Argentine ants are a serious threat to the ecosystem. They may eat nestling birds. They out-compete native ants and other native insects for food and habitat, thus reducing prey and displacing predators on native insects such as lizards, snakes, and spiders.

Other predators on native insects include non-native sow bugs (*Porcellio laevis*), expected to occur in Big Canyon, and earwigs (*Forficula auricularia*), observed in Big Canyon during surveys. Giant whitefly (*Aleurodicus dugesii*) may also be present on some of the ornamental trees and shrubs above Big Canyon, especially hibiscus. This insect has become a serious pest of plants in recent years from coastal San Diego to Los Angeles County.

7.3 Non-Native and Invasive Herpetological Species
African clawed frog and non-native crayfish are non-native species commonly found in freshwater marshes and streams in southern California, and both were observed in Big Canyon (see Section 3.2.1). These species are known to reduce the populations of native amphibians and fish species, sometimes to the point of extirpation, by consuming their eggs.

7.4 Non-Native and Invasive Avian Species

Several non-native bird species commong to southern California are also found in Big Canyon, including the European starling (*Sturnus vulgaris*) and house sparrow (*Passer domesticus*). Both are species native to Britain that were introduced into the United States during the early- to mid-1900's. Both species take over nesting habitat of native species, thereby reducing the populations of native species, and both were observed in Big Canyon. Native species that are a problem for other native birds include the American crow (*Corvus brachyrhynchos*) and brown-headed cowbird (*Molothrus ater*). American crows are very well adapted for living in residential areas, and they prey heavily on native bird species. During surveys for Belding's savannah sparrow in Big Canyon, several crows were observed foraging within the pickleweed marsh, likely searching for garbage washed up during high tide as well as for eggs of native nesting birds of the coastal salt marsh. Brown-headed cowbirds are nest parasites that locate and remove eggs from nests of native birds, replacing them with their own. The native birds typically do not recognize the foreign eggs and raise the young as if they were their own, thus producing no offspring of their own. No brown-headed cowbirds were observed in Big Canyon during 2003 surveys but they are known to occur in the area.

7.5 Non-Native and Invasive Mammal Species

Non-native and invasive mammal species in the vicinity of Big Canyon include feral cats, a widespread problem in many areas of southern California, as they consume native bird, reptile and mammal species. Another non-native species is the red fox (*Vulpes vulpes*), which is very well adapted to human modified habitats and frequently resides in open space areas such as the borders of coastal salt marshes. Red foxes prey on native species, and substantial reductions in reproductive success as well as in populations of special-status bird species. For example, prior to an intensive trapping program during the late 1980's that removed red foxes from the Anaheim Bay marsh at the Seal Beach Naval Weapons Station, red foxes had succeeded in extirpating light-footed clapper rails from the area. The clapper rail population there has since recovered and is doing well. No red foxes were observed at Big Canyon during the 2003 surveys, and it is likely that coyotes in the area, which prey on red foxes, keep the population in check.

8.0 SPECIES LISTS

Table B13. Plant Species Observed in Big Canyon, 2003 Surveys

FAMILY Common Name	*Scientific Name*	Native (N)/ Introduced (I)
AXOLLACEAE mosquito fern		
Pacific mosquito fern	*Azolla filiculoides*	N
GYMNOSPERMS		
Pines	*Pinus spp.*	I
DICOTS DICOTYLEDONES		
AMARANTHACEAE amaranth		
Tumbling pigweed	*Amaranthus albus*	I
AIZOACEAE carpet weed		
Hottentot fig	*Carpobrotus edulis*	I
Crystal ice plant	*Mesembryanthemum crystallinum*	I
Small-flowered ice plant	*Mesembryanthemum nodiflorum*	I
Iceplant	*Mesembryanthemum spp.*	I
ANACARDIACEAE sumac		
Lemonade berry	*Rhus integrifolia*	N
Brazilian pepper	*Schinus terebinthifolius*	I
Poison oak	*Toxicodendron diversilobum*	N

FAMILY Common Name	*Scientific Name*	Native (N)/ Introduced (I)
APIACEAE carrot		
Common celery	*Apium graveolens*	I
Poison hemlock	*Conium maculatum*	I
Sweet fennel	*Foeniculum vulgare*	I
APOCYNACEAE dogbane		
Oleander	*Nerium oleander*	I
Blue periwinkle	*Vinca major*	I
ARALIACEAE ginseng		
English ivy	*Hedra helix*	I
Algerian ivy	*Hedra canariensis*	I
ASTERACEAE sunflower		
Western ragweed	*Ambrosia psilostachya*	N
California sagebrush	*Artemisia californica*	I
Mugwort	*Artemisia douglasiana*	N
Emory's baccharis	*Baccharis emoryi*	N
Coyote brush	*Baccharis pilularis*	N
Mulefat	*Baccharis salicifolia*	N
Italian thistle	*Carduus pycnocephalus*	I
Tocalote	*Centaurea melitensis*	I
Common pineapple weed	*Chamomillia suaveolens*	I
Garland chrysanthemum	*Chrysanthemum coronarium*	I
Bull thistle	*Cirsium vulgare*	I
Flax-leaved horseweed	*Conyza bonariensis*	I
Common horseweed	*Conyza canadensis*	N
Common sand aster	*Lessingia filaginifolia*	N
Australian brass buttons	*Cotula australis*	I
African brass buttons	*Cotula coronopifolia*	I
California bush sunflower	*Encelia californica*	N
Western goldenrod	*Euthamia occidentalis*	N
Narrow-leaved filago	*Filago gallica*	I
Gazania	*Gazania linearis*	I
Bi-colored cudweed	*Gnaphalium bicolor*	N
Weedy cudweed	*Gnaphalium leteo-album*	I
Southern tarplant	*Centromadia parryi ssp. australis*	N
Fascicled tarweed	*Deinandra fasciculata*	N
Telegraph weed	*Heterotheca grandiflora*	N
Smooth cat's ear	*Hypochaeris glabra*	I
Coastal goldenbush	*Isocoma menziesii*	N
Jaumea	*Jaumea carnosa*	N
Cliff malacothrix	*Malacothrix saxatilis*	N
African daisy	*Osteospermum fruticosum*	I
Bristly ox tongue	*Picris echioides*	I
Marsh fleabane	*Pluchea odorata*	N
Pulicaria paludosa	*Spanish sunflower*	I
Common Groundsel	*Senecio vulgaris*	I
Milk thistle	*Silybum marianum*	I

FAMILY Common Name	*Scientific Name*	Native (N)/ Introduced (I)
Prickly sow thistle	*Sonchus asper*	I
Common sow thistle	*Sonchus oleraceus*	I
Tall wreath plant	*Stephanomeria virgata*	N
Cocklebur	*Xanthium strumarium*	N
BATACEAE saltwort		
American saltwort	*Batis maritima*	N
BIGNONIACEAE – Cape honeysuckle	*Tecomaria capensis*	I
BORAGE –	*BORAGINACEAE*	
Common fiddleneck	*Amsinckia menziesii*	N
Common cryptantha	*Cryptantha intermedia*	N
Pride of Madera	*Echium candicans*	I
Alkali heliotrope	*Heliotropium curassavicum*	N
BRASSICACEAE mustard		
Black mustard	*Brassica nigra*	I
Field mustard	*Brassica rapa ssp. sylvestris*	I
Shepherd's purse	*Capsella bursa-pastoris*	I
Lesser wart cress	*Coronopus didymus*	I
Western tansy mustard	*Descurania pinnata*	N
Summer mustard	*Hirshfeldia incana*	I
Sand peppergrass	*Lepidium lasiocarpum*	N
Shining peppergrass	*Lepdium nitidum var. nitidum*	N
Sweet alyssum	*Lobularia maritima*	I
Wild radish	*Raphanus sativa*	I
Water cress	*Rorippa nasturtium-aquaticum*	I
London rocket	*Sisymbrium irio*	I
Hare's ear cabbage	*Sisyimbrium orientale*	I
CACTACEAE cactus		
Coastal prickly pear	*Opuntia littoralis*	N
Coastal cholla	*Opuntia prolifera*	N
CAPPARACEAE caper		
Bladderpod	*Isomeris arborea*	N
CAPRIFOLIACEAE HONEYSUCKLE		
Japanese honeysuckle	*Lonicera japonica*	I
Mexican elderberry	*Sambucus mexicana*	N
CARYOPHYLLACEAE pink		
Four-leaved polycarp	*Polycarpon tetraphyllum*	I
Windmill pink	*Silene gallica*	I
Salt marsh sand spurry	*Spergularia marina*	N
CHENOPODIACEAE goosefoot		
Parish's pickleweed	*Arthrocnemum subterminale*	N
Saltbush	*Atriplex sp.*	I
Fourwing saltbush	*Atriplex canescens*	N
Glaucous-leaved saltbush	*Atriplex glauca*	I
Quail bush	*Atriplex lentiformis*	N
Halberd-leaved saltbush	*Atriplex patula var. patula*	N

FAMILY Common Name	*Scientific Name*	Native (N)/ Introduced (I)
Australian saltbush	*Atriplex semibaccata*	I
Five-hook bassia	*Bassia hyssopifolia*	I
Garden beet	*Beta vulgaris*	I
Lamb's quarters	*Chenopodium album*	I
Mexican tea	*Chenopodium ambrosioides*	I
Coast goosefoot	*Chenopodium macrospermum*	N
Nettle-leaved goosefoot	*Chenopodium murale*	I
Common woody pickleweed	*Salicornia virginica*	N
Russian thistle	*Salsola tragus*	I
Estuary sea blite	*Suaeda esteroa*	N
Woolly sea blite	*Suaeda taxifolia*	N
CONVOLVULACEAE morning glory		
Bindweed	*Convovulus arvensis*	I
Alkali weed	*Cressa truxillensis*	N
Salty dodder	*Cuscuta salina*	N
CRASSULACEAE stonecrop		
Pygmy stone crop	*Crassula connata*	N
Lance-leaved live-forever	*Dudleya lanceolata*	N
CUCURBITACEAE gourd		
Coyote melon	*Cucurbita foetidissima*	N
Manroot	*Marah macrocarpa*	N
EUPHORBIACEAE spurge		
Spotted spurge	*Chamaesyce maculata*	I
Golondrinia	*Chamaesyce polycarpa*	N
Dove weed	*Eremocarpus setigerus*	N
Petty spurge	*Euphorbia peplus*	I
Castor bean	*Ricinus communis*	I
FABACEAE pea		
Blue-leaved wattle	*Acacia cyanophylla*	I
Golden wattle	*Acacia longifolia*	I
Blackwood acacia	*Acacia melanoxylon*	I
Wirilda	*Acacia retinoides*	I
Arroyo lupine	*Lupinus succulentus*	N
Bur clover	*Medicago polymorpha*	I
White sweet clover	*Meliotus alba*	I
Yellow sweet clover	*Melilotus indica*	I
FRANKENIACEAE alklai heath		
Alkali heath	*Frankenia salina*	N
GERANIACEAE geranium		
Red-stemmed filaree	*Erodium cicutarim*	I
White-stemmed filaree	*Erodium moschatum*	I
Carolina geranium	*Geranium caolinianum*	N
HYDROPHYLLACEAE waterleaf		
Common eucrypta	*Eucrypta chrysanthemifolia*	N

FAMILY Common Name	*Scientific Name*	Native (N)/ Introduced (I)
LAMIACEAE mint		
Horehound	*Marrubium vulgare*	I
MALVACEAE mallow		
Cheeseweed	*Malva parviflora*	I
MYOPORACEAE myoporum		
Myoporum	*Myoporum laetum*	I
MYRTACEAE myrtle		
Eucalyptus	*Eucalyptus spp.*	I
NYCTAGINACEAE four-o'clock		
Bouganvillea	*Bouganvillea glabra*	I
California wishbone bush	*Mirabilis californica*	N
OLEACEAE olive		
Evergreen ash	*Fraxinus udehi*	I
ONAGRACEAE eveningprimrose		
Beach evening primrose	*Camissonia cheiranthifolia*	N
PLATANACEAE sycamore		
Western sycamore	*Platanus racemosa*	N
PLUMAGINACEAE leadwort		
California marsh rosemary	*Limomium californicum*	N
Statice	*Limomum sp.*	I
Perez's sea lavender	*Limomium sinuatum*	I
POLYGONACEAE buckwheat		
California buckwheat	*Eriogonum fasciculatum ssp. fasciculatum*	N
Common knotweed	*Polygonum arenastrum*	I
Willow smartweed	*Polygonum lapathifolium*	N
Curly dock	*Rumex crispus*	I
PORTULACACEAE purslane		
Common purslane	*Portulaca oleracea*	I
PRIMULACEAE primrose		
Scarlet pimpernel	*Anagallis arvensis*	I
PROTEACEAE protea		
Silk oak	*Grevillea robusta*	I
ROSACEAE rose		
Toyon	*Heteromeles arbutifolia*	N
California blackberry	*Rubus ursinus?*	N?
California wild rose	*Rosa californica*	
RUBIACEAE madder		
Common bedstraw	*Galium aparine*	I

FAMILY Common Name	*Scientific Name*	Native (N)/ Introduced (I)
SALICACEAE willow		
Fremont cottonwood	*Populus fremontii*	N
Black willow	*Salix gooddingii*	N
Arroyo willow	*Salix lasiiolepis*	N
SAURURACEAE lizard-tail		
Yerba mansa	*Anemopsis californica*	N
SCROPULARIACEAE figwort		
Nuttall's snapdragon	*Antirrhinum nuttallianum*	N
Salt marsh bird's beak	*Cordylanthus maritimimus ssp. maritimus*	N
SOLANACEAE nightshade		
Jimson weed	*Datura meteloides*	N
California box thorn	*Lycium californicum*	N
Tree tobacco	*Nicotiana glauca*	I
White nightshade	*Solanum americanum*	I
TAMARICACEAE tamarisk		
Mediterranean tamarisk	*Tamarix ramosissima*	I
TROPAELOLACEAE tropaeolum		
Nasturium	*Tropaeloum majus*	I
URTICACEAE nettle		
Western nettle	*Hesperocnide tenella*	N
Hoary nettle	*Urtica dioca ssp. holosericea*	N
Dwarf nettle	*Uritica urens*	I
VERBENACEAE vervain		
Lantana	*Lantana camara*	I
Western verbena	*Verbena lasiostachys*	N
MONOCOTYLEDONES monocots		
AGAVACEAE agave		
Century plant	*Agave americana*	I
ARECACEAE palm		
Mediterranean fan palm	*Chamaerops humilis*	I
Mexican fan palm	*Washingtonia robusta*	I
CYPERACEAE sedge		
Tall umbrella sedge	*Cyperus eragrosits*	N
Pale spike rush	*Eleocharis palustris*	N
Olney's bulrush	*Scirpus americanus*	N
California bulrush	*Scirpus californicus*	N
Alkali bulrush	*Scripus robustus*	N
Coastal bulrush	*Scripus maritimus*	N
JUNCACEAE rush		
Southwestern spiny rush	*Juncus acutus ssp. leopoldii*	N

FAMILY Common Name	*Scientific Name*	Native (N)/ Introduced (I)
Toad rush	*Juncus bufonius*	I
JUNCAGINACEAE ARROW GRASS		
Arrow grass	*Triglochin concinna*	I
LEMNACEAE duck weed		
Lesser duckweed	*Lemna minor*	N
POACEAE grass		
Water bent	*Agrostis semiverticillata*	I
Slender wild oat	*Avena barbata*	I
Wild oat	*Avena fatua*	I
Purple false brome	*Brachypodium distachyon*	I
Rescue grass	*Bromus catharticus*	I
Ripgut brome	*Bromus diandrus*	I
Soft chess	*Bromus hordeaceus ssp. hordeaceus*	I
Red brome	*Bromus madritensis ssp. rubens*	I
Pampas grass	*Cortaderia sellonana*	I
Bermuda grass	*Cynodon dactylon*	I
Salt grass	*Distichlis spicata*	N
Barnyard grass	*Echinochloa crus-galli*	I
Foxtail barley	*Hordeum murinum ssp. leporinum*	I
Goldentop	*Lamarkia aurea*	I
Giant wild rye	*Leymus condensatus*	N
Beardless wild rye	*Leymus triticoides*	N
Italian ryegrass	*Lolium multiflorum*	I
English ryegrass	*Lolium perenne*	I
Small-flowered melic	*Melica imperfecta*	N
Shore grass	*Monanthochloe littoralis*	N
Foothill needlegrass	*Nassella lepida*	N
Sickle grass	*Parapholis incurve*	I
African fountain grass	*Pennisetum villosum*	I
Smilo grass	*Piptatherum miliaceum*	I
Annual blue grass	*Poa annua*	I
Rabbit's foot grass	*Polypogon monspeliensis*	I
St. Augustine grass	*Stenotaphrum secundatum*	I
Foxtail fescue	*Vulpia myuros*	I
TYPHACEAE cat-tail		
Narrow-leaved cat-tail	*Typha domingensis*	N
Broad-leaved cat-tail	*Typha latifolia*	N

Table B14. Insect Species Observed in Big Canyon, 2003 Surveys

FAMILY Common Name	Scientific Name	Host plant
Butterflies and Moths: Order Lepidoptera		
SWALLOWTAILS – *Papilionidae*		
Pale Swallowtail	*Papilio eurymedon*	*Ceanothus spp.*
Western Tiger Swallowtail	*Papilio rutulus*	*Salix, Populus, Platanus*
Anise Swallowtail	*Papilio zelicaon*	*Foeniculum vulgare, Carrot,, Apiacae*
BRUSH-FOOTED BUTTERFLIES – *Nymphalidae*		
Gulf Fritillary	*Agraulis vanillae incarnata*	*As above*
Lorquin's Admiral	*Basilarchia lorquini*	*Salix, Populus*
California Ringlet	*Ceonympha tullia californica*	*Various grasses*
Gabb's Checkerspot	*Charidryas gabbii*	*Lessingia filaginifolia, H. grandiflora*
Monarch	*Danaus plexippus*	*Asclepias spp.*
Buckeye	*Junonia coenia*	*As above*
Mourning Cloak	*Nymphalis antiopa*	*As above*
West Coast Lady	*Vanessa annabella*	*As above*
Red Admiral	*Vanessa atalanta*	*As above*
Painted Lady	*Vanessa cardui*	*As above*
Virginia Lady	*Vanessa virginiensis*	*As above*
WHITES AND SULFURS – *Pieridae*		
Sara Orange-tip	*Anthocharis sara sara*	*As above*
California Dogface	*Colias eurydice*	*Amorpha californica*
Alfalfa Sulfur	*Colias eurytheme*	*As above*
Nicippe Yellow	*Eurema nicippe*	*Cassia spp.*
Cabbage White	*Pieris rapae*	*As above*
Checkered White	*Pontia protodice*	*As above*
BLUE, HAIRSTREAKS, COPPERS – *Lycaenidae*		
Pygmy Blue	*Brephidium exilis*	*As above*
Bramble Hairstreak	*Callophrys perplexa*	*Lotus scoparius, Eriogonum fasc.*
Bernardino Blue	*Euphilotes Bernardino*	*Eriogonum fasciculatum*
Southern Blue	*Glaucopsyche lygdamus australis*	*Lotus scoparius*
Edward's Blue	*Hemiargus ceraunus gyas*	*Prosopis, Medicago*
Acmon Blue	*Icaricia acmon*	*As above*
Western Elfin	*Incisalia augustinus iroides*	
Marine Blue	*Leptotes marina*	*As above*
Common Hairstreak	*Strymon melinus*	*As above*
METALMARKS – *Riodinidae*		
Behr's Metalmark	*Apodemia mormo virgulti*	*Eriogonum fasciculatum*
SKIPPERS – *Hesperiidae*		
Field Skipper	*Atalopedes campestris*	*Various grasses, incl. Cynodon*
Funereal Duskywing	*Erynnis funeralis*	*As above*
Mournful Duskywing	*Erynnis tristes*	*Quercus spp. (lobata, agrifolia)*
Fiery Skipper	*Hylephila phyleus*	*As above*
Eufala Skipper	*Lerodea eufala*	*As above*
Woodland Skipper	*Ochlodes slyvanoides sylvanoides*	*Various grasses*
Wandering Skipper	*Panoquina errans*	*Distichlis spicata*

FAMILY Common Name	Scientific Name	Host plant
Umber Skipper	*Paratrytone melane*	*Various grasses, incl. Cynodon*
Sandhill Skipper	*Polites sabuleti*	*Distichlis spicata*
Western Checkered Skipper	*Pyrgus communis albescens*	*As above*
Other Insect Orders		
SILVERFISH – *Lepismatidae*		
Silverfish	*Lepisma saccharina*	*Host plants are unknown or n/a for this species*
BRISTLETAILS – *Machilidae* *Host plants are unknown or n/a for this species*		
Bristletail	*Machilinus* sp.	*Host plants are unknown or n/a for this species*
DRAGONFLIES – *Aeshnidae*		
Dragonfly	*Anax junius*	*Host plants are unknown or n/a for this species*
Dragonfly	*Aeshna multicolor*	*Host plants are unknown or n/a for this species*
DRAGONFLIES – *Libellulidae*		
Dragonfly	*Libellula saturate*	*Host plants are unknown or n/a for this species*
Dragonfly	*Sympetrum corruptum*	*Host plants are unknown or n/a for this species*
Dragonfly	*Tramea lacerate*	*Host plants are unknown or n/a for this species*
DAMSELFLIES – *Coenagrionidae*		
Damselfly	*Enallagma* sp.	*Host plants are unknown or n/a for this species*
Damselfly	*Argia* sp.	*Host plants are unknown or n/a for this species*
GRASSHOPPERS – *Acrididae*		
Grasshopper	*Melanoplus* sp.	*Host plants are unknown or n/a for this species*
Grasshopper	*Trimarotropis* sp.	*Host plants are unknown or n/a for this species*
Grasshopper	*Schistocerca nitens*	*Host plants are unknown or n/a for this species*
GRASSHOPPERS – *Gryllidae*		
Grasshopper	*Acheta assimilis*	*Host plants are unknown or n/a for this species*
EARWIGS – *Forficulidae*		
Earwig	*Forficula auricularia*	*Host plants are unknown or n/a for this species*
PSOCIDS AND LICE – *Liposcelididae*	Not identified to species	*Host plants are unknown or n/a for this species*
THRIPS – *Thripidae*	Not identified to species	*Host plants are unknown or n/a for this species*
TRUE BUGS – *Pentatomidae*		
No common name	*Murgantia histrionica*	*Host plants are unknown or n/a for this species*
TRUE BUGS – *Cydnidae*		
No common name	*Pangaeus* sp.	*Host plants are unknown or n/a for this species*
TRUE BUGS – *Lygaeidae*		
No common name	*Geochoris* sp.	*Host plants are unknown or n/a for this species*
TRUE BUGS – *Reduviidae*		
No common name	*Zelus* sp.	*Host plants are unknown or n/a for this species*

FAMILY Common Name	Scientific Name	Host plant
TRUE BUGS – *Miridae*	Not identified to species	*Host plants are unknown or n/a for this species*
TRUE BUGS – *Anthocoridae*	Not identified to species	*Host plants are unknown or n/a for this species*
CICADAS, HOPPERS, AND APHIDS – *Cercopidae*	Not identified to species	*Host plants are unknown or n/a for this species*
CICADAS, HOPPERS, AND APHIDS – *Cicadellidae*	Not identified to species	*Host plants are unknown or n/a for this species*
CICADAS, HOPPERS, AND APHIDS – *Aphididae*	Not identified to species	*Host plants are unknown or n/a for this species*
CICADAS, HOPPERS, AND APHIDS – *Margarodidae*	Not identified to species	*Host plants are unknown or n/a for this species*
CICADAS, HOPPERS, AND APHIDS – *Aleyrodidae*	Not identified to species	*Host plants are unknown or n/a for this species*
CICADAS, HOPPERS, AND APHIDS – *Psyllidae*	Not identified to species	*Host plants are unknown or n/a for this species*
LACEWINGS – *Chrysopidae*		
Lacewing	*Chrysoperla* sp.	*Host plants are unknown or n/a for this species*
BEETLES – *Carabidae*		
unidentified species		*Host plants are unknown or n/a for this species*
BEETLES – *Cicindelidae*		
Western mudflat tiger beetle	*Cicindela trifasciata sigmoidea*	*Host plants are unknown or n/a for this species*
BEETLES – *Scarabaeidae*		
No common name	*Serica* sp.	*Host plants are unknown or n/a for this species*
No common name	*Diplotaxis* sp.	*Host plants are unknown or n/a for this species*
BEETLES – *Coccinellidae*		
No common name	*Hippodamia convergens*	*Host plants are unknown or n/a for this species*
No common name	*Coccinella californica*	*Host plants are unknown or n/a for this species*
BEETLES – *Tenebrionidae*		
Several species, "stink beetles"	*Eleodes* sp.	*Host plants are unknown or n/a for this species*
BEETLES – *Oedemeridae*	Not identified to species	*Host plants are unknown or n/a for this species*
BEETLES – *Elateridae*	Not identified to species	*Host plants are unknown or n/a for this species*
BEETLES – *Cantharidae*	Not identified to species	*Host plants are unknown or n/a for this species*
BEETLES – *Curculionidae*	Not identified to species	*Host plants are unknown or n/a for this species*
BEETLES – Chrysomelidae		
No common name	*Diabrotica undecimpunctata*	*Host plants are unknown or n/a for this species*
BEETLES—Staphylinidae	Not identified to species	*Host plants are unknown or n/a for this species*
BEETLES – *Melyridae*		
No common name	*Collops* sp.	*Host plants are unknown or n/a for this species*
MOTHS - *Gelechiidae*	Not identified to species	*Host plants are unknown or n/a for this species*
MOTHS - *Pyralidae*	Not identified to species	*Host plants are unknown or n/a for this species*

FAMILY Common Name	Scientific Name	Host plant
MOTHS - *Tortricidae*	Not identified to species	*Host plants are unknown or n/a for this species*
MOTHS - *Scythridae*	Not identified to species	*Host plants are unknown or n/a for this species*
MOTHS - *Arctiidae*		
No common name	*Estigmene acrea*	*Host plants are unknown or n/a for this species*
MOTHS – *Noctuidae*		
No common name	*Autographa californica*	*Host plants are unknown or n/a for this species*
No common name	*Trichoplusia ni*	*Host plants are unknown or n/a for this species*
MOTHS – *Sphingidae*		
No common name	*Hyles lineata*	*Host plants are unknown or n/a for this species*
		Host plants are unknown or n/a for this species
FLIES – *Tipulidae*	Not identified to species	*Host plants are unknown or n/a for this species*
FLIES – *Culicidae*	Not identified to species	*Host plants are unknown or n/a for this species*
FLIES – *Chironomidae*	Not identified to species	*Host plants are unknown or n/a for this species*
FLIES – *Bibionidae*	Not identified to species	*Host plants are unknown or n/a for this species*
FLIES – *Ephydridae*	Not identified to species	*Host plants are unknown or n/a for this species*
FLIES – *Drosophilidae*	Not identified to species	*Host plants are unknown or n/a for this species*
FLIES – *Asilidae*		
No common name	*Stichopogon coquillettii*	*Host plants are unknown or n/a for this species*
FLIES – *Bombyliidae.*		*Host plants are unknown or n/a for this species*
No common name	*Exoprosopa eremita*	*Host plants are unknown or n/a for this species*
No common name	*Villa* sp.	*Host plants are unknown or n/a for this species*
FLIES – *Syrphidae*		*Host plants are unknown or n/a for this species*
No common name	*Eristalis tenax*	*Host plants are unknown or n/a for this species*
No common name	*Copistylum mexicana*	*Host plants are unknown or n/a for this species*
FLIES – *Coelopidae*	Not identified to species	*Host plants are unknown or n/a for this species*
FLIES – *Tephritidae*	Not identified to species	*Host plants are unknown or n/a for this species*
FLIES – *Dolichopodidae*	Not identified to species	*Host plants are unknown or n/a for this species*
FLIES – *Chloropidae*	Not identified to species	*Host plants are unknown or n/a for this species*
FLIES – *Anthomyiidae*	Not identified to species	*Host plants are unknown or n/a for this species*
FLIES – *Muscidae*		
No common name	*Musca domestica*	*Host plants are unknown or n/a for this species*

FAMILY Common Name	Scientific Name	Host plant
No common name	*Stomoxys calcitrans*	*Host plants are unknown or n/a for this species*
FLIES – *Calliphoridae*		
No common name	*Phaenicia* sp.	*Host plants are unknown or n/a for this species*
No common name	*Calliphora* sp.	*Host plants are unknown or n/a for this species*
FLIES – *Sarcophagidae*	Not identified to species	*Host plants are unknown or n/a for this species*
FLIES – *Tachinidae*	Not identified to species	*Host plants are unknown or n/a for this species*
WASPS – *Braconidae*	Not identified to species	*Host plants are unknown or n/a for this species*
WASPS – *Ichneumonidae*	Not identified to species	*Host plants are unknown or n/a for this species*
ANTS – *Formicidae*		
ant	*Iridomyrmex humilis*	*Host plants are unknown or n/a for this species*
ant	*Solenopsis* sp.	*Host plants are unknown or n/a for this species*
WASPS – *Pompilidae*		
wasp	unidentified species	*Host plants are unknown or n/a for this species*
WASPS – *Vespidae*		
Yellow-jacket wasp	*Vespula pensylvanica*	*Host plants are unknown or n/a for this species*
wasp	*Polistes fuscatus*	*Host plants are unknown or n/a for this species*
WASPS – *Sphecidae*		
No common name	*Bembex comata*	*Host plants are unknown or n/a for this species*
No common name	*Ammophila* sp.	*Host plants are unknown or n/a for this species*
No common name	*Chalybion californicum*	*Host plants are unknown or n/a for this species*
No common name	*Sceliphron caementarium*	*Host plants are unknown or n/a for this species*
No common name	*Podalonia* sp.	*Host plants are unknown or n/a for this species*
BEES – *Halictidae*		
No common name	*Agapostemon texana*	*Host plants are unknown or n/a for this species*
BEES – *Anthophoridae*		
No common name	*Anthophora* sp.	*Host plants are unknown or n/a for this species*
No common name	*Xylocopa varipuncta*	*Host plants are unknown or n/a for this species*
BEES – *Apidae*		
European honey bee	*Apis melifera*	*Host plants are unknown or n/a for this species*
Sonora bumblebee	*Bombus sonorus*	*Host plants are unknown or n/a for this species*

Table B15. Amphibian and Reptile Species Observed in Big Canyon, 2003 Surveys

Common Name	Scientific name	Native (N) / Introduced (I)
Pacific Treefrog	*Hyla regilla*	N
African Clawed Frog	*Xenopus laevis*	I
Southern Alligator Lizard	*Elgaria multicarinata*	N
Western Fence Lizard	*Sceloporus occidentalis*	N
Side-blotched Lizard	*Uta stansburiana*	N
Common Kingsnake	*Lampropeltis getula*	N
Gopher Snake	*Pituophis catenifer*	N

Table B 16. Bird Species Observed in Big Canyon, 2003 Suveys

FAMILY and Common name	*Scientific Name*
PODICIPEDIDAE	
Pied-billed Grebe	*Podilymbus podiceps*
Eared grebe	*Podiceps nigricollis*
Western grebe	*Aechmophorus occidentalis*
PHALACROCORACIDAE	
Double-crested Cormorant	*Phalacrocorax auritus*
ARDEIDAE	
Great blue heron	*Ardea herodias*
Great egret	*Ardea alba*
Snowy egret	*Egretta thula*
Black-crowned Night-Heron	*Nycticorax nycticorax*
CATHARTIDAE	
Turkey vulture	*Cathartes aura*
ANATIDAE	
American wigeon	*Anas americana*
Mallard	*Anas platyrhynchos*
Blue-winged Teal	*Anas discors*
Cinnamon teal	*Anas cyanoptera*
Northern shoveler	*Anas clypeata*
Northern pintail	*Anas acuta*
Green-winged Teal	*Anas crecca*
Lesser scaup	*Aythya affinis*
Surf scoter	*Melanitta perspicillata*
Bufflehead	*Bucephala albeola*
ACCIPITRIDAE	
Osprey	*Pandion haliaetus*
White-tailed Kite	*Elanus leucurus*
Northern harrier	*Circus cyaneus*
Sharp-shinned Hawk	*Accipiter striatus*
Cooper's hawk	*Accipiter cooperii*
Red-shouldered Hawk	*Buteo lineatus*
Red-tailed Hawk	*Buteo jamaicensis*
FALCONIDAE	
American kestrel	*Falco sparverius*
Peregrine falcon	*Falco peregrinus*

FAMILY and Common name	*Scientific Name*
ODONTOPHORIDAE	
California quail	*Callipepla californica*
RALLIDAE	
Clapper rail	*Rallus longirostris*
Common moorhen	*Gallinula chloropus*
American coot	*Fulica americana*
CHARADRIIDAE	
Killdeer	*Charadrius vociferus*
RECURVIROSTRIDAE	
American avocet	*Recurvirostra americana*
SCOLOPACIDAE	
Greater yellowlegs	*Tringa melanoleuca*
Willet	*Catoptrophorus semipalmatus*
Spotted sandpiper	*Actitis macularia*
Long-billed Curlew	*Numenius americanus*
Marbled godwit	*Limosa fedoa*
Western sandpiper	*Calidris mauri*
Least sandpiper	*Calidris minutilla*
Long-billed Dowitcher	*Limnodromus scolopaceus*
LARIDAE	
Ring-billed Gull	*Larus delawarensis*
California gull	*Larus californicus*
Western gull	*Larus occidentalis*
Caspian tern	*Sterna caspia*
Forster's tern	*Sterna forsteri*
COLUMBIDAE	
Rock dove	*Columba livia*
Mourning dove	*Zenaida macroura*
TYTONIDAE	
Barn owl	*Tyto alba*
APODIDAE	
Vaux's swift	*Chaetura vauxi*
White-throated Swift	*Aeronautes saxatalis*
TROCHILIDAE	
Anna's hummingbird	*Calypte anna*
Rufous hummingbird	*Selasphorus rufus*
Allen's hummingbird	*Selasphorus sasin*
ALCEDINIDAE	
Belted kingfisher	*Ceryle alcyon*
PICIDAE	
Downy woodpecker	*Picoides pubescens*
Northern flicker	*Colaptes auratus*
TYRANNIDAE	
Pacific-slope Flycatcher	*Empidonax difficilis*
Black phoebe	*Sayornis nigricans*
Say's phoebe	*Sayornis saya*
Ash-throated Flycatcher	*Myiarchus cinerascens*
Western kingbird	*Tyrannus verticalis*

FAMILY and Common name	*Scientific Name*
CORVIDAE	
Western scrub-jay	*Aphelocoma californica*
American crow	*Corvus brachyrhynchos*
Common raven	*Corvus corax*
HIRUNDINIDAE	
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*
Cliff swallow	*Petrochelidon pyrrhonota*
Barn swallow	*Hirundo rustica*
AEGITHALIDAE	Bushtits
Bushtit	*Psaltriparus minimus*
TROGLODYTIDAE	
Bewick's wren	*Thryomanes bewickii*
House wren	*Troglodytes aedon*
Marsh wren	*Cistothorus palustris*
SYLVIIDAE	
California gnatcatcher	*Polioptila californica*
TURDIDAE	
Western bluebird	*Sialia mexicana*
American robin	*Turdus migratorius*
TIMALIIDAE	
Wrentit	*Chamaea fasciata*
MIMIDAE	
Northern mockingbird	*Mimus polyglottos*
California thrasher	*Toxostoma redivivum*
STURNIDAE	
European starling	*Sturnus vulgaris*
PARULIDAE	
Yellow-rumped Warbler	*Dendroica coronata*
Black-throated Gray Warbler	*Dendroica nigrescens*
Common yellowthroat	*Geothlypis trichas*
Wilson's warbler	*Wilsonia pusilla*
Yellow-breasted Chat	*Icteria virens*
EMBERIZIDAE	
Spotted towhee	*Pipilo maculatus*
California towhee	*Pipilo crissalis*
Rufous-crowned Sparrow	*Aimophila ruficeps*
Chipping sparrow	*Spizella passerina*
Belding's savannah sparrow	*Passerculus sandwichensis beldingi*
Grasshopper sparrow	*Ammodramus savannarum*
Fox sparrow	*Passerella iliaca*
Song sparrow	*Melospiza melodia*
White-crowned Sparrow	*Zonotrichia leucophrys*
Golden-crowned Sparrow	*Zonotrichia atricapilla*
CARDINALIDAE	
Black-headed Grosbeak	*Pheucticus melanocephalus*
ICTERIDAE	
Red-winged Blackbird	*Agelaius phoeniceus*
Brewer's blackbird	*Euphagus cyanocephalus*

FAMILY and Common name	*Scientific Name*
Common grackle	*Quiscalus quiscula*
Great-tailed Grackle	*Quiscalus mexicanus*
FRINGILLIDAE	
House finch	*Carpodacus mexicanus*
Lesser goldfinch	*Carduelis psaltria*
American goldfinch	*Carduelis tristis*
PASSERIDAE	
House sparrow	*Passer domesticus*

Table B17. Mammal Species Observed in Big Canyon, 2003 Surveys

Common Name	*Species Name*	Native (N) / Introduced (I)
DIDELPHIDAE		
Virginia Opossum	*Didelphis virginiana*	I
SORICIDAE		
Shrew	*Sorex sp.*	I
LEPORIDAE Audubon's Cottontail	Sylvilagus audubonii	N
SCIURIDAE		
California Ground Squirrel	Spermophilus beecheyi	N
GEOMYIDAE		
Botta's Pocket Gopher	Thomomys bottae	N
CRICETIDAE		
Western Harvest Mouse	Reithrodontomys megalotis	N
Woodrat	*Neotoma sp.*	N
CANIDAE		
Coyote	Canis latrans	N
Domestic Dog	*Canis familiaris*	I
PROCYONIDAE		
Raccoon	Procyon lotor	N
MUSTELIDAE		
Long-tailed Weasel	Mustela frenata	I
FELIDAE		
Domestic Cat	Felis silvestris	I

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APPENDIX BB

Data Collected by Dave Bramlet
June-July 2003

Coastal Bluff Scrub

CBS-1

Shrub Cover %	22.0%
Herbaceous Cover %	42.0%
Total Vegetative Cover	54.0%
Litter Cover	
Dead Wood	
Bare Ground	46.0%
Total Non Vegetative Cover	

Species

Shrubs

Artemisia californica	15.0%
Encelia californica	1.0%
Eriogonum fasciculatum	2.0%
Lycium californicum	0.1%
Opuntia littoralis	0.0%
Opuntia prolifera	0.0%
Suadea taxifolia	0.1%
Arthrocnemum suberminale	3.0%

Grasses & Forbs

Brassica nigra	35.0%
Mesebryanthemum crystallinum	0.1%
Frankenia salina	5.0%
Bromus madritensis	0.1%
Lichens	1.0%

CBS-2

Shrub Cover %	35.0%
Herbaceous Cover %	26.0%
Total Vegetative Cover	45.0%
Litter Cover	
Dead Wood	
Bare Ground	55.0%
Total Non Vegetative Cover	55.0%

Species

Shrubs

Encelia california	26.0%
Opuntia littoralis	5.0%
Eriogonum fasciculatum	5.0%
Opuntia prolifera	2.0%
Lycium californicum	2.0%

Grasses & Forbs

Mesebryanthemum crystallinum	25.0%
Salsola tragus	1.0%

Coastal Sage Scrub
California sagebrush sage scrub
CSS-1

Shrub Cover %	65.0%
Herbaceous Cover %	55.0%
Total Vegetative Cover	75.0%
Litter Cover	5.0%
Dead Wood	
Bare Ground	20.0%
Total Non Vegetative Cover	25.0%

Species
Shrubs

Artemisia californica	55.0%
Encelia californica	2.0%
Atriplex lentiformis	1.0%
Baccharis pilularis	1.0%
Baccharis emoryi	1.0%

Grasses & Forbs

Brassica nigra	30.0%
Centaurea melitensis	10.0%
Hirschfeldia incana	5.0%
Erodium cicutarium	5.0%
Marrubium vulgare	2.0%
Conyza canadensis	1.0%
Camissonia sp.	1.0%
Heterotheca grandiflora	0.01

Coastal Sage Scrub
Coyote bush sage scrub
CBSS-1

Shrub Cover %	53.0%
Herbaceous Cover %	60.0%
Total Vegetative Cover	70.0%
Litter Cover	25.0%
Dead Wood	
Bare Ground	5.0%
Total Non Vegetative Cover	30.0%

Grasses & Forbs
Mesebryanthemum sp.
Distichlis spicata
Frankenia salina
Bromus rubens
Brassica nigra
Lactuca serriola
Cortaderia sellonana

Species
Shrubs
Baccharis pilularis
Artemisia californica
Atriplex lentiformis
Isocoma menziesii
Isomeris arborea
Sambucus mexicana
Rhus integrifolia
Baccharis salicifolia

Grasses & Forbs
Brassica nigra
Melilotus indica
Carduus pycnocepalus
Hirschfeldia incana
Frankenia salina
Bromus hordeacues
Picris echioides
Marrubium vulgare
Verbena lasiostachya

Encelia sage Scrub

Coyote bush sage scrub

ESS-1

Shrub Cover %	84.0%
Herbaceous Cover %	16.0%
Total Vegetative Cover	90.0%
Litter Cover	
Dead Wood	
Bare Ground	10.0%
Total Non Vegetative Cover	10.0%

Species

Shrubs

Encelia californica	65.0%
Atriplex canescens	12.0%
Eriogonum fasciculatum	5.0%
Atremisia californica	3.0%
Opuntia littoralis	2.0%
Opuntia prolifera	1.0%
Lycium californicum	1.0%

Toyon-Sumac Chaparral

TSC-1

Shrub Cover %	90.0%
Herbaceous Cover %	6.0%
Total Vegetative Cover	96.0%
Litter Cover	4.0%
Dead Wood	
Bare Ground	
Total Non Vegetative Cover	4.0%

Species

Shrubs

Rhus integrifolia	80.0%
Heteromeles arbutifolia	1.0%
Baccharis emoryi	1.0%
Schinus terebinthifolius	4.0%
Myoporum laetum	4.0%

Grasses & Forbs

Pilucaria paludosa	4.0%
Typha domingenesis	1.0%
Ambrosia psilostachya	1.0%

Annual grassland

Ag-1

Shrub Cover %	3.0%
Herbaceous Cover %	62.0%
Total Vegetative Cover	
Litter Cover	
Dead Wood	
Bare Ground	35.0%
Total Non Vegetative Cover	

Species

Shrubs

Isocoma menziesii	3.0%

Grasses & Forbs

Deiandra fasciculata	45.0%
Bromus madritensis	5.0%
Centaurea melitensis	5.0%
Bromus hordeaceus	1.0%
Melilotus indica	1.0%
Atriplex glauca	1.0%
Centromadia parryi ssp. *australis*	1.0%
Limonium sp.	0.1%

Ag-2

Shrub Cover %	0.0%
Herbaceous Cover %	95.0%
Total Vegetative Cover	
Litter Cover	2.0%
Dead Wood	
Bare Ground	3.0%
Total Non Vegetative Cover	

Ag-3

Shrub Cover %	0.0%
Herbaceous Cover %	95.0%
Total Vegetative Cover	
Litter Cover	2.0%
Dead Wood	
Bare Ground	3.0%
Total Non Vegetative Cover	

Species

Grasses & Forbs

Brassica nigra	60.0%
Bromus diandrus	15.0%
Carduus pycnocephalus	10.0%
Raphanus sativa	5.0%
Hirschfeldia incana	2.0%
Foeniculum vulgae	2.0%
Marrubium vulgare	1.0%
Amaranthus albus	0.1%
Rumex crispus	0.1%
Solanum americanum	0.1%
Cirsium vulgare	0.1%

Species

Grasses & Forbs

Raphanus sativa	65.0%
Brassica nigra	20.0%
Hirschfeldia incana	5.0%
Conzya canadensis	2.0%
Rumex crispus	1.0%
Tropaeolum majus	1.0%
Urtica dioica	1.0%
Frankenia salina	1.0%
Marrubium vulgare	0.1%

Alklali grassland

Shrub Cover %	0.0%
Herbaceous Cover %	90.0%
Total Vegetative Cover	
Litter Cover	
Dead Wood	
Bare Ground	10.0%
Total Non Vegetative Cover	

Species	
Grasses & Forbs	
Melilotus indica	40.0%
Centaurea melitensis	40.0%
Brassica nigra	10.0%
Salicornia virginica	5.0%
Bromus madritensis	5.0%
Atriplex glauca	3.0%
Bromus hordeaceus	2.0%
Mesembryanthemum crystallinum	2.0%
Heliotropium curassavicum	1.0%
Frankenia salina	1.0%
Bassia hyssopifolia	1.0%
Centromadia parryi ssp. *australis*	0.1%
Avena barbata	0.1%
Schismus barbatus	0.1%
Erodium cicutarium	0.1%
Polypogon monspeliensis	0.1%

Alkali meadow 1

Shrub Cover %	0.1%
Herbaceous Cover %	97.0%
Total Vegetative Cover	
Litter Cover	
Dead Wood	
Bare Ground	3.0%
Total Non Vegetative Cover	

Species	
Shrubs	
Baccharis emoryi	0.1%
Grasses & Forbs	
Distichilis spicata	70.0%
Jaumea carnosa	15.0%
Salicornia virginica	5.0%
Apium graveloens	5.0%
Pulicaria paludosa	2.0%
Polypogon monspeliensis	1.0%
Typha domingensis	0.1%
Triglochin concinna	0.1%
Scirpus robustus	0.1%
Pluchea odorata	0.1%

Alkali meadow 2

Shrub Cover %	0.0%
Herbaceous Cover %	95.0%
Total Vegetative Cover	
Litter Cover	
Dead Wood	
Bare Ground	5.0%
Total Non Vegetative Cover	

Species	
Grasses & Forbs	
Salicornia virginica	90.0%
Heliotropium curassavicum	3.0%
Polypogon monspeliensis	1.0%
Limonium sp.	1.0%
Atriplex glauca	0.1%

Alkali meadow 3

Shrub Cover %	0.0%
Herbaceous Cover %	85.0%
Total Vegetative Cover	
Litter Cover	
Dead Wood	
Bare Ground	15.0%
Total Non Vegetative Cover	

Species	
Grasses & Forbs	
Frankenia salina	70.0%
Bassia hyssopifolia	5.0%
Ambrosia psilostachya	5.0%
Melilotus indica	2.0%
Atriplex patula	1.0%
Polypogon monspeliensis	1.0%
Urtica dioica	1.0%
Pulicaria paludosa	0.1%

Alkali meadow 4

Shrub Cover %	0.1%
Herbaceous Cover %	100.0%
Total Vegetative Cover	
Litter Cover	
Dead Wood	
Bare Ground	0.0%
Total Non Vegetative Cover	

Species	
Shrubs	
Myoporum laetum	0.1%
Grasses & Forbs	
Salicornia virginica	35.0%
Frankenia salina	30.0%
Disticlis spicata	30.0%
Ambrosia psilostachya	3.0%
Urtica dioica	1.0%
Picris echioides	1.0%
Rumex crispus	0.1%
Polypogon monspeliensis	0.1%
Foeniculum vulgare	0.1%
Pulicaria paludosa	0.1%

Upper Salt Marsh 1

Shrub Cover %	
Herbaceous Cover %	100.0%
Total Vegetative Cover	
Litter Cover	
Dead Wood	
Bare Ground	
Total Non Vegetative Cover	

Species	
Grasses & Forbs	
Jaumea carnosa	70.0%
Distichlis spicata	12.0%
Salicornia virginica	5.0%
Frankenia salina	5.0%
Moanthochloe littoralis	5.0%
Cressa truxillensis	3.0%

Upper Salt Marsh 2

Shrub Cover %	
Herbaceous Cover %	100.0%
Total Vegetative Cover	
Litter Cover	
Dead Wood	
Bare Ground	
Total Non Vegetative Cover	

Species	
Grasses & Forbs	
Monanthochloe littoralis	80.0%
Jaumea carnosa	5.0%
Distichlis spicata	5.0%
Frankenia salina	5.0%
Salicornia virginica	3.0%
Limonium californicum	2.0%
Suaeda esteroa	0.1%

Upper Salt Marsh 3

Shrub Cover %	
Herbaceous Cover %	100.0%
Total Vegetative Cover	
Litter Cover	
Dead Wood	
Bare Ground	
Total Non Vegetative Cover	

Species	
Grasses & Forbs	
Frankenia salina	60.0%
Salicornia virginica	20.0%
Distichlis spicata	14.0%
Monanthochloe littoralis	5.0%
Batis maritima	1.0%
Limonium californicum	0.1%
Suaeda esteroa	0.1%

Upper Salt Marsh 4

Shrub Cover %	
Herbaceous Cover %	100.0%
Total Vegetative Cover	
Litter Cover	
Dead Wood	
Bare Ground	
Total Non Vegetative Cover	

Species	
Grasses & Forbs	
Batis maritima	75.0%
Salicornia virginica	15.0%
Monanthochloe littoralis	5.0%
Suaeda esteroa	3.0%
Limonium californicum	2.0%

Middle Salt Marsh 1

Shrub Cover %	
Herbaceous Cover %	95.0%
Total Vegetative Cover	
Litter Cover (Algal)	
Dead Wood	
Bare Ground	5.0%
Total Non Vegetative Cover	

Species

Grasses & Forbs

Salicornia virginica	85.0%
Batis maritima	5.0%
Frankenia salina	5.0%
Cuscuta salina	0.1%

Middle Salt Marsh 2

Found on open mud flats, that appear have only a minor vegetative cover, except for the summer months

Shrub Cover %	
Herbaceous Cover %	48.0%
Total Vegetative Cover	
Litter Cover (Algal)	5.0%
Dead Wood	
Bare Ground	47.0%
Total Non Vegetative Cover	

Species

Grasses & Forbs

Salicornia bigelovii	45.0%
Salicoria virginica	3.0%

Lower Salt Marsh 1

Shrub Cover %	
Herbaceous Cover %	95.0%
Total Vegetative Cover	
Litter Cover	
Dead Wood	
Bare Ground	5.0%
Total Non Vegetative Cover	

Species

Grasses & Forbs

Spartina foliosa	85.0%
Salicornia bigelovii	5.0%
Salicornia virginica	3.0%
Batis maritima	2.0%

Brackish Marsh 1

Shrub Cover %	2.0%
Herbaceous Cover %	98.0%
Total Vegetative Cover	100.0%
Litter Cover	
Dead Wood	
Bare Ground	
Total Non Vegetative Cover	

Species

Shrubs

Baccharis emoryi	2.0%

Grasses & Forbs

Emergent Layer

Typha domingensis	85.0%

Herb Layer

Frankenia salina	60.0%
Salicornia virginica	10.0%
Pulicaria paludosa	5.0%
Heliotropium curassavicum	5.0%
Pulchea odorata	2.0%
Apium graveloens	2.0%
Polypogon monspeliensis	1.0%

Brackish Marsh 1

Shrub Cover %	2.0%
Herbaceous Cover %	93.0%
Total Vegetative Cover	95.0%
Litter Cover	5.0%
Dead Wood	
Bare Ground	
Total Non Vegetative Cover	

Species

Shrubs

Baccharis emoryi	1.0%
Atriplex lentiformis	1.0%

Grasses & Forbs

Emergent Layer

Scirpus californicus	60.0%
Typha latifolia	5.0%

Herb Layer

Frankenia salina	20.0%
Salicornia virginica	15.0%
Heliotropium curassavicum	5.0%
Pluchea odorata	1.0%

Alkali Marsh 1

Shrub Cover %	
Herbaceous Cover %	90.0%
Total Vegetative Cover	
Litter Cover	5.0%
Dead Wood	
Bare Ground	5.0%
Total Non Vegetative Cover	10.0%

Species

Shrubs

Baccharis emoryi

Grasses & Forbs

Emergent Layer

Scirpus cf robustus 45.0%

Herb Layer

Jaumea carnosa 80.0%

Salicornia virginica 3.0%

Frankenia salina 2.0%

Cuscuta salina 0.1%

Freshwater Marsh 1

Shrub Cover %	
Herbaceous Cover %	100.0%
Total Vegetative Cover	
Litter Cover	
Dead Wood	
Bare Ground	
Total Non Vegetative Cover	

Species

Emergent Layer

Typha latifolia 99.0%

Urtica dioica 1.0%

Herb Layer

Chenopodium murale 0.1%

Solanum americanum 1.0%

Riparian Herb 1

Shrub Cover %	
Herbaceous Cover %	
Total Vegetative Cover	
Litter Cover	
Dead Wood	
Bare Ground (Mud)	5.0%
Open Water	10.0%
Total Non Vegetative Cover	

Species

Emergent Layer

Typha domingensis	2.0%
Scirpus americanus	0.1%

Herb Layer

Rorippa nasturium-aquaticum	75.0%
Melilotus albus	5.0%
Pulicaria paludosa	2.0%
Atriplex patula	1.0%
Xanthium strumarium	0.1%

Mulefat Scrub

MS-1

Shrub Cover %	65.0%
Herbaceous Cover %	80.0%
Total Vegetative Cover	80.0%
Litter Cover	20.0%
Dead Wood	
Bare Ground	
Total Non Vegetative Cover	

Species

Shrubs

Baccharis salicifolia	63.0%
Salix lasiolepis	1.0%
Encelia californica	1.0%
Isocoma menziesii	0.1%

Grasses & Forbs

Hirschfeldia incana	50.0%
Foeniculum vulgare	10.0%
Apium graveolens	5.0%
Frankenia salina	5.0%
Melilotus alba	5.0%
Typha domingensis	1.0%
Heterotheca grandiflora	1.0%
Sonchus oleraceus	1.0%

Willow Scrub

WS-1

Shrub Cover %	85.0%
Herbaceous Cover %	80.0%
Total Vegetative Cover	85.0%
Litter Cover	15.0%
Dead Wood	
Bare Ground	
Total Non Vegetative Cover	

Species

Shrubs

Salix lasiolepis	80.0%
Schinus terebinthifolius	5.0%

Grasses & Forbs

Pulicaria paludosa	60.0%
Rorippa nasturium-aquaticum	10.0%
Apium graveolens	5.0%
Urtica dioica	2.0%
Typha latifolia	2.0%
Pulchea odorata	1.0%

Schinus Forest

SH-1

Overstory Tree Cover	85.0%
Shrub Cover %	5.0%
Herbaceous Cover %	5.0%
Total Vegetative Cover	95.0%
Litter Cover	
Dead Wood	
Bare Ground	5.0%
Total Non Vegetative Cover	5.0%

Species	
Trees	
Schinus terebinthifolius	84.0%
Myoporum laetum	1.0%
Washingtonia robusta	0.1%
Shrubs	
Toxicodendron diversilobum	5.0%
Grasses & Forbs	
Apium graveloens	5.0%
Cortaderia sellonana	0.1%
Pulicaria paludosa	0.1%
Artemisia douglasiana	0.1%
Ambrosia psilostachya	0.1%

Willow Forest

SH-1

Overstory Tree Cover	75.0%
Shrub Cover %	5.0%
Herbaceous Cover %	83.0%
Total Vegetative Cover	90.0%
Litter Cover	10.0%
Dead Wood	
Bare Ground	
Total Non Vegetative Cover	10.0%

Species	
Trees	
Salix gooddingii	20.0%
Salix lasiolepis	50.0%
Populus fremontii	5.0%
Schinus terebinthifolius	0.1%
Shrubs	
Baccharis emoryi	4.0%
Artemisia californica	1.0%
Grasses & Forbs	
Salicornia virginica	75.0%
Ambrosia psilostachya	5.0%
Apium graveloens	1.0%
Picricis echioides	1.0%
Distichlis spicata	1.0%

Mexican elderberry woodland

MEW-1

Shrub Cover %	100.0%
Herbaceous Cover %	
Total Vegetative Cover	
Litter Cover	
Dead Wood	
Bare Ground	
Total Non Vegetative Cover	

Species	
Shrubs	
Sambucus mexicana	40.0%
Ricinus communis	55.0%
Encelia californica	3.0%
Artemisia californica	2.0%
Nicotiana glauca	0.1%

All tables, figures and photos in Appendix C were produced by Coastal Resources Management, unless otherwise noted.

Table C1. Benthic Sampling Station Locations

Date	Time	Station	Latitude	Longitude	Station Description	Depth (ft) MLLW
Benthic Invertebrates						
May 30 2003	1025	BC-1	33 37.853	117 53.189	UNB Channel (south end of Big Canyon (BC), sand over mud	-4.7
May 30 2003	1034	BC-2	33 37.853	117 53.174	UNB Mudflat (south end of BC) sand over mud	-0.8
May 30 2003	1047	BC-3	33 37.887	117 53.205	UNB Channel (centered, on culvert) mud	-4.2
May 30 2003	1056	BC-4	33 37.889	117 53.191	UNB Mudflat (centered on culvert) mud over packed clay	0.3
May 30 2003	1200	BC-5	33 37.910	117 53.218	UNB Channel (north end of BC) sand over clay	-3.8
May 30 2003	1226	BC-6	33 37.911	117 53.209	UNB Mudflat (north end of BC) sand over mud	0.2
May 30 2003	1239	BC-7	33 37.890	117 53.162	BC Channel Entrance gravel/shell/cobble/silt	0.2
May 30 2003	1243	BC-8	33 37.897	117 53.136	Center of BC Channel, mid way to culvert gravel/shell/rock/silt	0.1
May 30 2003	1254	BC-9	33 37.898	117 53.114	Center of BC Channel, 2/3 way to culvert	1.0
May 30 2003	1258	BC-10	33 37.906	117 53.106	BC Mudflat, Mid mudflat on north side of channel, mud	3.0
May 30 2003	1310	BC-11	33 37.898	117 53.110	BC Mudflat, Mid mudflat on south side of channel, algae, sand, mud	2.9
May 30 2003	1319	BC-12	33 37.897	117 53.107	BC Culvert, 10 meters from outlet, soft mud	-4.2
May 30 2003	1416	BC-13	33 37.901	117 53.074	BC Pond before outlet to Bay cobble se	13 MSL
May 30 2003	1510	BC-14	33 37.871	117 53.000	BC Pond, eastern end in BC. mud and algae	15 MSL
Fishes						
July 15 2003	1000	F-1	33 37.853	117 53.189	Beach seine location, deep edge of set, same as BC-1	0.3 to -4.7
July 15 2003	1230	F-2	33 37.890	117 53.162	Beach seine location, BC channel, same as BC-7	0.2 to +2.0
July 15 2003	1400	F-3	33 37.897	117 53.107	Beach seine location, same as BC-12	+2.0 to -4.2

Figure C2. Water Column Salinity

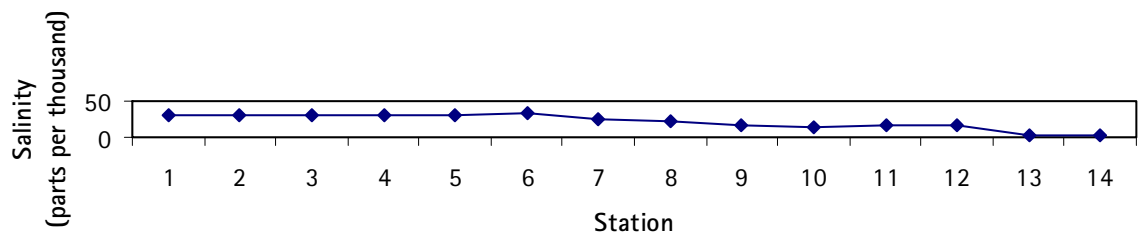

Table C3. Benthic Sampling Station Summary

DATE	STATION	TYPE	Depth (MLLW)	Mean* Number of Species	Mean* Abundance Per Sample	Mean* Density (sq m)	Shannon Wiener Diversity (H')*	Eveness (J')*
5/30/2003	BC-1	Channel	-4.7	11.5	44	5,641	2.06	0.85
5/30/2003	BC-2	Mudflat	-0.8	12	174	22,244	1.67	0.67
5/30/2003	BC-3	Channel	-4.2	13.5	85	10,897	1.94	0.75
5/30/2003	BC-4	Mudflat	0.3	9	67	8,526	1.61	0.73
5/30/2003	BC-5	Channel	-3.8	14	166	21,218	1.90	0.72
5/30/2003	BC-6	Mudflat	0.2	16	355	45,449	1.88	0.68
5/30/2003	BC-7	Channel	0.2	6	91	11,603	0.81	0.48
5/30/2003	BC-8	Channel	0.1	9	155	19,872	1.69	0.77
5/30/2003	BC-9	Channel	1	10.5	92	11,731	1.71	0.73
5/30/2003	BC-10	Mudflat	3	7.5	19	2,436	1.81	0.90
5/30/2003	BC-11	Mudflat	2.9	9	236	30,192	0.95	0.43
5/30/2003	BC-12	Channel	-4.2	6	25	3,205	1.48	0.83
5/30/2003	BC-14	Pond	15	3	15	1,923	0.79	0.81
5/30/2003	BC-13	Pond	13	4	11	1,346	1.02	0.78

* Mean of two replicates per station

Table C4. Benthic Invertebrate Survey Summary

Taxa	Species	% of Total	NIND	% of Total	Density/Sq M
Cnidaria	3	6.3	3	0.1	13.7
Platyhelminthes	1	2.1	10	0.3	45.8
Nemertea	3	6.3	8	0.3	36.6
Nematoda	1	2.1	1	0.0	4.6
Mollusca-Gastropoda	4	8.3	68	2.2	311.4
Mollusca-Bivalva	7	14.6	53	1.7	242.7
Annelida-Polychaeta	17	35.4	1,189	38.8	5,444.1
Annelida-Oligochaeta	1	2.1	515	16.8	2,358.1
Arthropoda-Crustacea	7	14.6	943	30.8	4,317.8
Arthropoda-Insecta	3	6.3	21	0.7	96.2
Phoronda	1	2.1	251	8.2	1,149.3
Total	**48**	**100.0**	**3,062**	**100.0**	**14,020.1**

Table C5. Numerically Dominant Infaunal Species

SPECIES	COMMON NAME	TOTAL	% TOTAL	MEAN ABUNDANCE PER SAMPLE	NUMBER OF OCCURRENCES	MEAN DENSITY PER /SQ M
Grandidierella japonica	amphipod	648	21.2	23.1	26.0	2,967.0
Fabricinuda limnicola	polychaete worm	538	17.6	19.2	15.0	2,463.4
Oligochaete	oligochaete worm	515	16.8	18.4	25.0	2,358.1
Monocorophium acherusicum	amphipod	288	9.4	10.3	22.0	1,318.7
Pseudopolydora paucibranchiata	polychaete worm	284	9.3	10.1	17.0	1,300.4
Phoronis spp.	phoronid worm	251	8.2	9.0	12.0	1,149.3
Capitella capitata	polychaete worm	151	4.9	5.4	15.0	691.4
Streblospio benedicti	polychaete worm	110	3.6	3.9	19.0	503.7
Musculista senhousei	mussel (invasive)	41	1.3	1.5	10.0	187.7
Cerithidea californica	horn snail	37	1.2	1.3	5.0	169.4

Table C6. Beach Seine Fish Survey-Data Summary

Common Name	Scientific Name	Station F-1 (n=2)	Station F-2 (n=2)	Station F-3 (n=2)	Area Total (n=6)	% Total (fish and inverts)
Fish						
Deepbody Anchovy	*Anchoa compressa*	1/0.5*	5/2.5	0	6/1	0.4
California killifish	*Fundulus parvipinnus*	6/3	1/.5	0	7/1.2	0.5
Topsmelt	*Atherinops affinis*	1,159/579.5	12/6	118/59	1,289/214	96.3
Yellowfin Goby	*Acanthogobius flavimanus*	0	26/13	1/0.5	27/4.5	2.0
Juvenile goby, unid	Gobiidae, unid (juvenile)	0	4/2	0	4/0.67	0.3
Juvenile croaker, unid.	Scienidae, unid. (juvenile)	0	0	1/0.5	1.16	0.1
Incidental Invertebrates						
Yellow shore crab	*Hemigrapsus oregonensis*	3/1.5	0	0	3/0.5	0.2
Unid. yellow sponge	Porifera, Unid.	1/0.5	0	0	1/.16	0.1
Fish Abundance		1,166/583	48/24	120/60	1,334/222	
Total Abundance		1,170/585			1,338/223	100.0
Number of Fish Species		3	5	3	6	75.0
Total Number of Species		5	5	3	8	100.0

Photograph 1. Big Canyon area and tidal channel leading to Big Canyon, facing east

Photograph 2. Tidal channel leading to Big Canyon, facing west

Photograph 3. Stations BC-1 and BC-2, and F-1 and F-2, Upper Newport Bay

Photograph 4. Sampling areas BC-3 through BC-7, Upper Newport Bay (North of Big Canyon Channel)

Photograph 5. Stations BC-7 through BC-12, Upper Newport Bay in the tidal channel leading to Big Canyon

Photograph 6. Sampling Location BC-13, Big Canyon Pond immediately east of culvert and Back Bay Drive

Photograph 7. Sampling Location BC-14, east side of Big Canyon Pond

Photograph 8. Representative benthic core sample prior to sieving

All tables and figures in Appendix D were produced by WRC Consulting, unless otherwise noted.

Table D1: Soils Report

WALLACE LABS	SOILS REPORT		June 2, 2003
365 Coral Circle	Location	Big Canyon Park Soil Sample Analysis	
El Segundo, CA 90245	Requester	Margot Griswold, Earthworks & WRC Consulting Services, Dr. Lan Weber	
(310) 615-0116	graphic interpretation: * very low, ** low, *** moderate		

ammonium bicarbonate/DTPA — **** high, ***** very high

extractable - mg/kg soil	Sample ID Number	3-150-01		3-150-02		3-150-03		3-150-04		3-150-05	
Interpretation of data		Sample #1 Tidal Flats Surface		Sample #2 Tidal Flats Sub Surface		Sample #3 Upper Fill 6" Surface		Sample #4 Upland Fill Subsurface depth 10.5'		Sample #5 Pond Soil Surface	
low medium high	elements		graphic		graphic		graphic		graphic		graphic
0 - 7 8-15 over 15	phosphorus	4.91	**	9.51	***	17.28	*****	7.25	**	20.72	*****
0-60 60 -120 121-180	potassium	28.49	*	547.75	*****	332.45	*****	572.74	*****	435.93	*****
0 - 3 3 - 5 over 5	iron	2.65	**	72.66	*****	177.69	*****	192.70	*****	324.80	*****
0- 0.5 0.6- 1 over 1	manganese	0.33	**	1.83	****	5.91	****	11.06	*****	22.35	*****
0 - 1 1 - 1.5 over 1.5	zinc	0.85	**	0.60	**	0.82	**	1.42	***	0.70	**
0- 0.2 0.3- 0.5 over 0.5	copper	0.39	***	0.66	****	3.51	*****	3.03	*****	1.09	****
0- 0.2 0.2- 0.5 over 1	boron	0.13	**	2.16	*****	1.29	*****	1.17	*****	2.02	*****
ratio of calcium to magnesium	calcium	445.29	****	356.55	***	254.33	***	272.58	***	332.74	***
needs to be more than 2 or 3	magnesium	27.10	**	477.34	*****	394.93	*****	564.45	*****	681.68	*****
should be less than potassium	sodium	44.36	*	1,342.96	*****	880.15	*****	819.57	*****	946.23	*****
	sulfur	6.99	*	170.96	***	1,726.44	*****	221.95	***	359.92	***
	molybdenum	n d	*	0.20	****	0.41	****	0.52	****	0.71	****
The following trace	aluminum	n d	*	n d	*	2.21	***	0.07	*	3.56	****
elements may be toxic	arsenic	0.10	*	0.13	*	0.66	**	0.20	*	0.18	*
The degree of toxicity	barium	0.22	*	1.04	*	0.42	*	0.82	*	1.13	*
depends upon the pH of	cadmium	0.02	*	0.05	*	0.05	*	0.07	*	0.14	*
the soil, soil texture,	chromium	n d	*	n d	*	0.01	*	n d	*	0.04	*
organic matter, and the	cobalt	n d	*	0.12	*	0.12	*	0.16	*	0.24	*
concentrations of the	lead	0.73	*	2.50	**	3.99	**	2.16	**	1.86	**
individual elements as	lithium	0.27	*	0.34	*	0.20	*	0.38	*	0.23	*
well as to their	mercury	n d	*	0.03	*	n d	*	n d	*	n d	*
interactions.	nickel	n d	*	0.62	*	0.53	*	0.59	*	2.34	**
	selenium	n d	*	0.08	*	n d	*	n d	*	0.05	*
The pH optimum depends	silver	n d	*	n d	*	n d	*	n d	*	n d	*
upon soil organic	strontium	1.69	*	3.14	*	0.97	*	1.93	*	1.70	*
matter and clay content-	tin	0.02	*	0.09	*	n d	*	0.03	*	0.14	*
for clay and loam soils:	vanadium	0.17	*	2.09	***	1.81	**	3.15	****	3.26	****
under 5.2 is too acidic											
6.5 to 7 is ideal	Saturation Extract										
over 9 is too alkaline	pH value	8.82	*****	7.44	***	7.63	****	7.82	****	7.05	***
The ECe is a measure of	ECe (milli-	0.25	*	15.05	*****	9.36	*****	2.33	****	6.47	*****
the soil salinity:	mho/cm)		millieq/l		millieq/l		millieq/l		millieq/l		millieq/l
1-2 affects a few plants	calcium	14.7	0.7	129.2	6.5	405.6	20.3	79.3	4.0	267.7	13.4
2-4 affects some plants,	magnesium	3.0	0.3	217.6	18.0	216.8	17.9	30.3	2.5	203.0	16.8
> 4 affects many plants.	sodium	43.6	1.9	2,438.2	106.0	1,290.4	56.1	364.1	15.8	848.7	36.9
	potassium	6.7	0.2	133.2	3.4	83.5	2.1	31.2	0.8	59.3	1.5
	cation sum		3.1		133.9		96.4		23.1		68.6
problems over 150 ppm	chloride	43	1.2	3,976	112.0	1,524	42.9	307	8.7	1,249	35.2
	nitrate as N	1	0.1	24	1.7	5	0.4	4	0.3	7	0.5
	phosphorus as P	0.6	0.0	5.6	0.2	0.9	0.0	0.8	0.0	0.2	0.0
toxic over 800	sulfate as S	8.0	0.5	202.6	12.7	776.9	48.6	209.3	13.1	412.3	25.8
	anion sum		1.8		126.6		91.9		22.0		61.5
toxic over 1 for many plants	boron as B	0.11	*	1.54	*****	1.29	*****	0.47	***	1.32	*****
increasing problems start at 6	SAR	2.7	**	30.4	*****	12.9	*****	8.8	****	9.5	*****
est. gypsum requirement-lbs./acre		306		12,303		8,009		9,860		12,302	
	infiltration rate inches/hour	fair/good		slow		fair		fair		fair/slow	
	soil texture	sand		sandy loam		sandy loam		silty clay		sandy clay loam	
	sand	93.8%		65.4%		69.7%		9.3%		59.5%	
	silt	4.1%		18.3%		15.5%		40.8%		17.2%	
	clay	2.1%		16.3%		14.8%		50.0%		23.3%	
	lime (calcium carbonate)	yes		no		yes		yes		no	
	Total nitrogen	0.017%		0.067%		0.035%		0.064%		0.060%	
	Total carbon	0.194%		0.980%		0.338%		0.876%		0.742%	
	carbon:nitrogen ratio	11.4		14.6		9.7		13.7		12.3	
	organic matter based on carbon	0.39%		1.96%		0.68%		1.75%		1.48%	
	organic matter (LOI)	0.41%		2.23%		1.57%		3.31%		2.91%	
	moisture content of soil	3.1%		25.8%		12.2%		44.7%		41.5%	
	half saturation percentage	14.9%		19.4%		18.7%		46.6%		26.5%	

ideal percentages of cations				% saturation		% saturation		% saturation		% saturation		% saturation
abt 5 %	potassium	millieq K	0.07	1%	1.82	12%	0.73	4%	1.30	6%	0.98	5%
< 3%	sodium	millieq Na	0.19	3%	4.67	32%	2.01	11%	2.15	9%	2.51	12%
abt 70%	calcium	millieq Ca	6.33	93%	3.69	25%	13.10	69%	14.63	64%	11.97	57%
15 - 20%	magnesium	millieq Mg	0.25	4%	4.49	31%	3.07	16%	4.90	21%	5.68	27%
	total millieq/100 grams		6.84		14.67		18.91		22.99		21.14	

Elements are expressed as mg/kg dry soil or mg/l for saturation extract.

pH and ECe are measured in a saturation paste/extract. nd means not detected.

Source: Earthworks Construction & Design

WALLACE LABS	SOILS REPORT		June 2, 2003
365 Coral Circle	Location	Big Canyon Park Soil Sample Analysis	
El Segundo, CA 90245	Requester	Margot Griswold, Earthworks & WRC Consulting Services, Dr. Lan Weber	
(310) 615-0116	graphic interpretation: * very low, ** low, *** moderate		
ammonium bicarbonate/DTPA	**** high, ***** very high		

extractable - mg/kg soil	Sample ID Number	3-150-06		3-150-07		3-150-08		3-150-09	
Interpretation of data		Sample #6 Exotic Remua Area Su		Sample #7 Water Quality Basin Surf		Sample #8 Water Quality Basin Su		Sample #9 Willow Woodland 1'	
low medium high	elements		graphic		graphic		graphic		graphic
0 - 7 8-15 over 15	phosphorus	7.15	**	11.70	***	3.34	**	5.88	**
0-60 60 -120 121-180	potassium	525.50	*****	1,107.85	*****	829.01	*****	237.43	*****
0 - 3 3 - 5 over 5	iron	93.41	*****	4.91	***	0.80	*	196.83	*****
0- 0.5 0.6- 1 over 1	manganese	57.67	*****	0.36	**	0.38	**	5.56	****
0 - 1 1 - 1.5 over 1.5	zinc	4.28	****	0.96	**	0.75	**	1.75	****
0- 0.2 0.3- 0.5 over 0.5	copper	11.33	*****	1.53	****	3.78	*****	4.21	*****
0- 0.2 0.2- 0.5 over 1	boron	3.56	*****	0.23	***	0.77	****	1.35	*****
ratio of calcium to magnesium	calcium	318.13	***	375.03	***	448.98	****	427.94	****
needs to be more than 2 or 3	magnesium	689.20	*****	326.48	*****	733.24	*****	440.88	*****
should be less than potassium	sodium	1,445.22	*****	80.39	**	601.18	*****	468.88	*****
	sulfur	6,890.84	*****	33.73	**	520.31	****	254.41	***
	molybdenum	0.69	****	0.06	***	0.14	****	1.02	*****
The following trace	aluminum	n d	*	n d	*	n d	*	10.28	****
elements may be toxic	arsenic	0.25	*	0.05	*	0.05	*	0.41	*
The degree of toxicity	barium	0.36	*	2.47	*	0.69	*	0.45	*
depends upon the pH of	cadmium	0.49	*	1.11	**	2.26	**	0.19	*
the soil, soil texture,	chromium	0.13	*	n d	*	n d	*	0.02	*
organic matter, and the	cobalt	0.74	**	n d	*	0.02	*	0.61	**
concentrations of the	lead	4.67	**	0.22	*	0.39	*	11.58	***
individual elements as	lithium	0.49	*	0.24	*	0.30	*	0.51	*
well as to their	mercury	n d	*	n d	*	n d	*	n d	*
interactions.	nickel	3.58	**	0.57	*	1.41	**	1.84	**
	selenium	n d	*	n d	*	0.06	*	n d	*
The pH optimum depends	silver	n d	*	n d	*	n d	*	n d	*
upon soil organic	strontium	0.76	*	1.60	*	1.50	*	1.00	*
matter and clay content-	tin	0.03	*	0.02	*	0.06	*	0.04	*
for clay and loam soils:	vanadium	1.25	**	0.62	*	0.92	*	2.31	***
under 5.2 is too acidic									
6.5 to 7 is ideal	Saturation Extract								
over 9 is too alkaline	pH value	7.23	***	7.84	****	7.52	****	8.33	*****
The ECe is a measure of	ECe (milli-	11.56	*****	1.25	***	4.81	*****	3.09	****
the soil salinity:	mho/cm)		millieq/l		millieq/l		millieq/l		millieq/l
1-2 affects a few plants	calcium	544.3	27.2	45.9	2.3	423.7	21.2	208.8	10.4
2-4 affects some plants,	magnesium	440.4	36.4	20.8	1.7	183.6	15.2	89.3	7.4
> 4 affects many plants.	sodium	1,596.8	69.4	68.4	3.0	467.8	20.3	386.0	16.8
	potassium	83.4	2.1	170.2	4.4	121.5	3.1	24.9	0.6
	cation sum		135.2		11.3		59.8		35.2
problems over 150 ppm	chloride	1,709	48.1	150	4.2	770	21.7	327	9.2
	nitrate as N	12	0.8	1	0.0	3	0.2	1	0.1
	phosphorus as P	9.2	0.3	1.6	0.1	1.3	0.0	0.0	0.0
toxic over 800	sulfate as S	1,134.5	70.9	84.0	5.2	542.3	33.9	371.5	23.2
	anion sum		120.2		9.6		55.8		32.5
toxic over 1 for many plants	boron as B	2.32	*****	0.31	**	0.67	***	1.55	*****
increasing problems start at 6	SAR	12.3	*****	2.1	**	4.8	***	5.6	***
est. gypsum requirement-lbs./acre		15,844		1,578		10,613		5,788	
	infiltration rate inches/hour	slow		slow		slow		fair	
	soil texture	loam		sandy loam		sandy clay loam		loam	
	sand	40.7%		71.9%		51.9%		38.6%	
	silt	45.6%		10.3%		19.7%		45.9%	
	clay	13.6%		17.8%		28.3%		15.6%	
	lime (calcium carbonate)	yes		no		no		no	
	Total nitrogen	0.074%		0.046%		0.080%		0.091%	
	Total carbon	1.061%		0.933%		0.841%		1.355%	
	carbon:nitrogen ratio	14.3		20.3		10.5		14.9	
	organic matter based on carbon	2.12%		1.87%		1.68%		2.71%	
	organic matter (LOI)	4.37%		1.90%		3.95%		3.57%	
	moisture content of soil	42.0%		7.4%		30.4%		39.8%	
	half saturation percentage	36.4%		17.1%		30.3%		40.7%	

ideal percentages of cations				% saturation		% saturation		% saturation		% saturation
abt 5 %	potassium	millieq K	1.20	3%	3.05	20%	2.20	10%	0.49	3%
< 3%	sodium	millieq Na	1.65	4%	0.28	2%	1.37	6%	0.64	4%
abt 70%	calcium	millieq Ca	36.19	80%	8.72	58%	12.32	56%	10.00	69%
15 - 20%	magnesium	millieq Mg	6.00	13%	2.98	20%	5.99	27%	3.43	24%
		total millieq/100 grams	45.04		15.03		21.88		14.56	

Elements are expressed as mg/kg dry soil or mg/l for saturation extract.

pH and ECe are measured in a saturation paste/extract. nd means not detected.

Table D2: Water Use & Inundation Guidelines for Habitats of Big Canyon

Habitat Zones	Estimated ETc[1] (total for year)	Inundation	Comments
Open Water			
Freshwater Marsh (FWM) (cattails, bullrushes, rushes)	5.40 ft/year	0.5' -2' continual	FWM grow in areas on the fringe of pond where standing water from 0.5' - to 2'. After 2' depth generally these plants will not grow
Wet Meado (WM) (saltgrass, meadow barley, ragweed)	3.59 ft/yr	seasonal	WM will grow in areas with somewhat saline soils in areas not continually inundated and not deeply shaded. This habitat zone will need saturated soils throughout the winter and spring season with limited standing water.
Willow Riparian (WR) (willow trees, mulefat, mugwort)	4.30 ft/yr	seasonal	WR will grow in areas adjacent to creeks with suffcient seasonal inundation and dry season water flows to support the water needs of the habitat. WR will root to maximum of 16' for groundwater. Particular species of willows require wetter conditions such as black willow, while the arroyo willow grows better with only seasonal inundation.
Mulefat Scrub (MFS) (mulefat, ragweed, saltgrass)	2.87 ft/yr	seasonal	MFS will grow on higher elevation areas between upland habitat areas and wetter zones such as WR or WM Habitat Zones
Saltbush Scrub and Coastal Sage		none	Upland habitat for areas outside of normal seasonal inundation zone. Saltbush scrub will tolerate saline soil conditions

[1] Evapotranspiration (Etc) based on ETo maps of the project area and estimated crop factor.

Source: Earthworks Construction & Design, October 2003

Table D3: Grading & Inundation Guidelines for Salt Marsh Habitat

Habitat Type	approximate % of total	Elevation midpoint	Elevation Range				
mudflat	10	+0.75 ft	0 - +01.5				
low marsh	15	+2.0	+1.5 - +2.5				
mid marsh	35	+3.25	+2.5 - +4.0				
high marsh	25	+4.25	+4.0 - +4.5	overgrade by 6 inches for topsoil application			
marsh transition	10	+5.5	+4.5 - +6.5	overgrade by 6 inches for topsoil application			
upland buffer	5	>	> +6.5	overgrade by 6 inches for topsoil application			
slope from road:	2: 1 Max 7:1 prefered						

Source: Earthworks Construction & Design, October 2003

Figure D4: City of Newport Beach Sprinkler Consumption

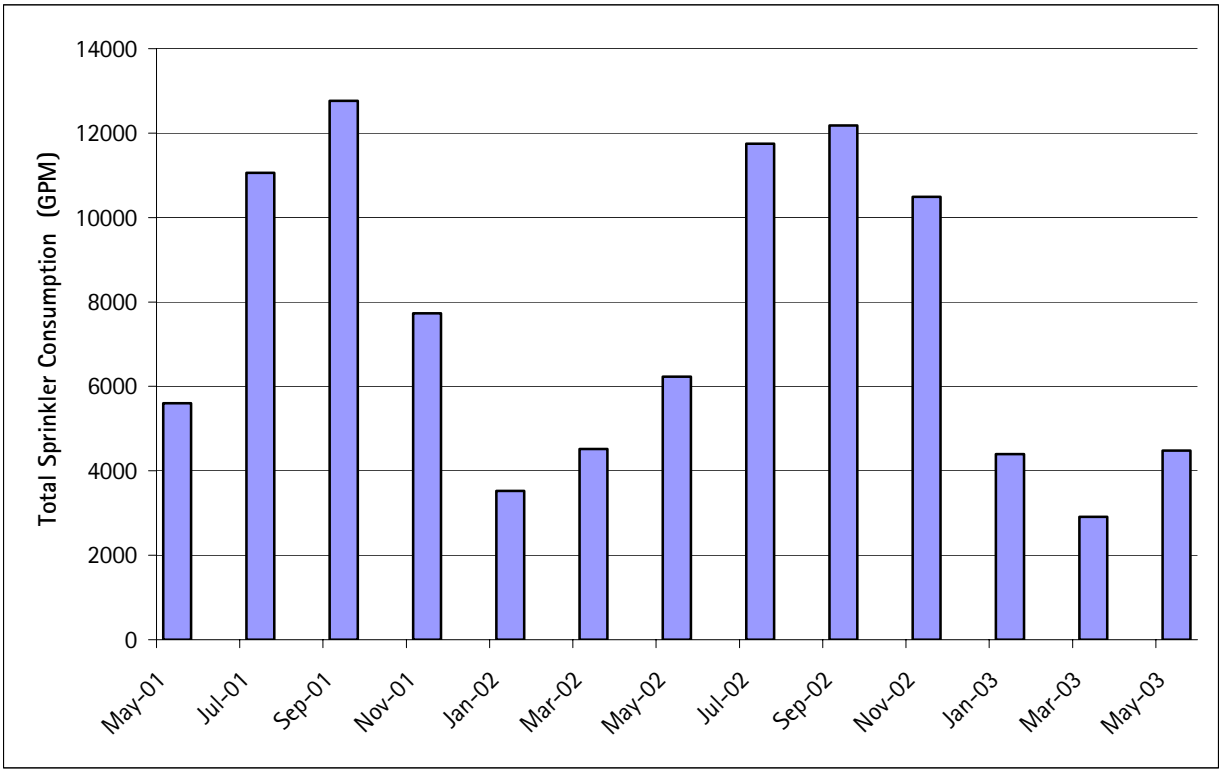

Figure D5: Tidal Curves at Newport Bay (Harbor) Entrance

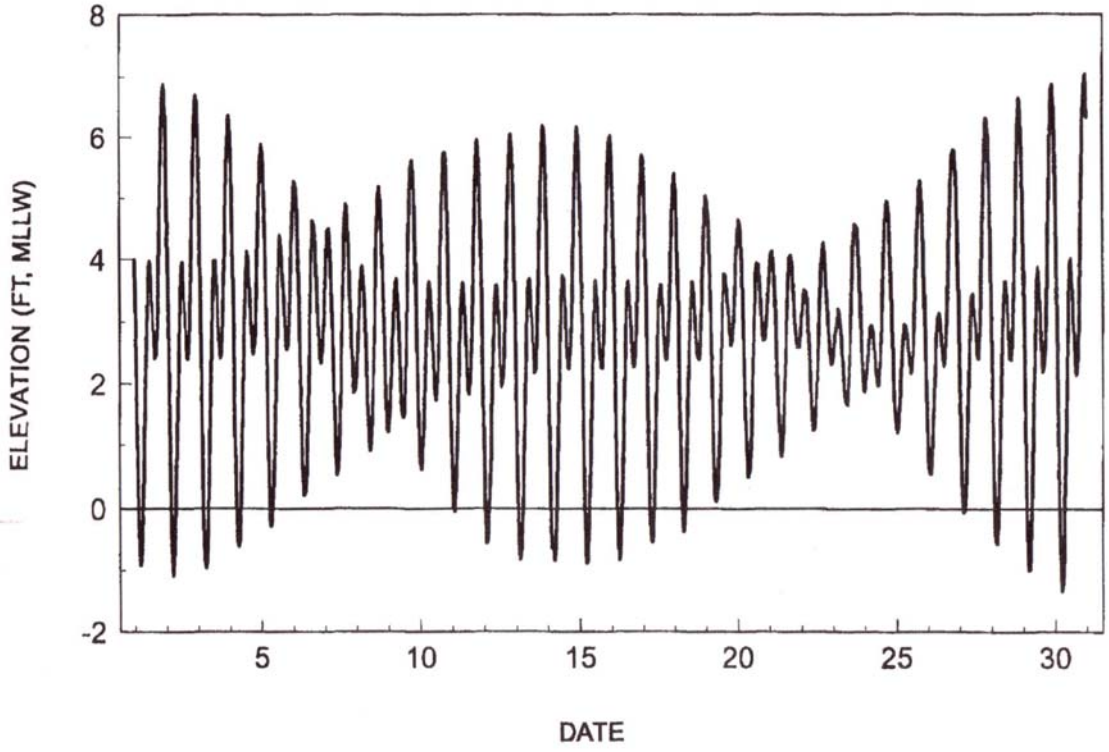
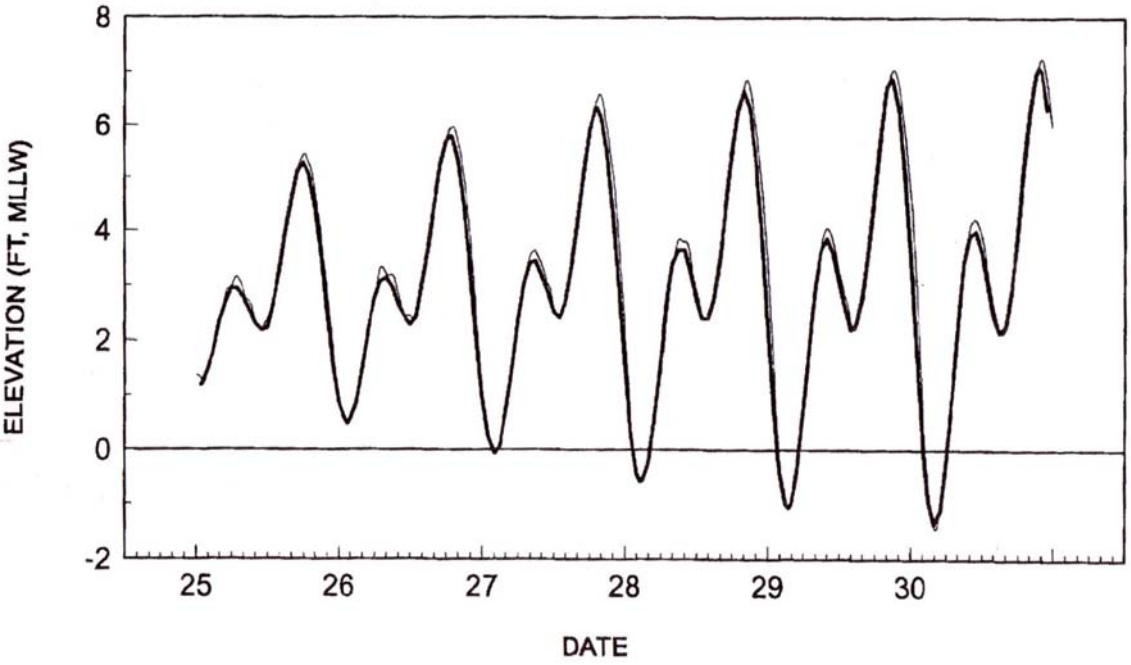
Figure D6: Tidal Curves at Upper Newport Bay Dike