Comprehensive Management Plan for

Tijuana River National Estuarine Research Reserve

and

Tijuana Slough National Wildlife Refuge

Primary Agencies

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California Department of Parks and Recreation U.S. Fish and Wildlife Service National Oceanic and Atmospheric Administration

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COMPREHENSIVE MANAGEMENT PLAN FOR THE TIJUANA RIVER NATIONAL ESTUARINE RESEARCH RESERVE AND TIJUANA SLOUGH NATIONAL WILDLIFE REFUGE

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GLOSSARY OF ACRONYMS AND KEY TERMS USED

ADC	Animal Damage Control
APN	Assessor Parcel Number
BECC	Border Environment Cooperation Commission
CCC	California Coastal Commission
CDMO	Centralized Data Management Office
CDPR	California Department of Parks and Recreation
CESPT	Municipal Water Agency of Tijuana
CFR	Code of Federal Regulations
CEC	Commission on Environmental Cooperation
CMP	Comprehensive Management Plan
CNA	Federal Water Agency of Mexico
COLEF	Colegio de la Frontera Norte
CZMA	Coastal Zone Management Act
EBZ	Ecological Buffer Zone
EO	Executive Order
ERD	Estuarine Reserve Division
ESZ	Endangered Species Protection/Preservation Zone
EYS	Extended Year Curriculum
FWS	United States Fish and Wildlife Service
GIS	Geographic Information System
GPS	Global Positioning System

GRZ	General Recreation Zone
IBWC	International Boundary and Water Commission
IWTP	International Wastewater Treatment Plant
LCP	Local Coastal Plan
lps	liters per second
MAB	Man and the Biosphere
MARSH	Marsh Awareness with Resources for Slough Habitats
MAU	Mounted Assistance Unit
mgd	million gallons per day
MMS	Maintenance Management System
MOU	Memorandum of Understanding
MWWD	San Diego Metropolitan Waste Water District
NERR	National Estuarine Research Reserve
NERRS	NERR System
NOAA	National Oceanographic and Atmospheric Administration
NWR	National Wildlife Refuge
NWRS	National Wildlife Refuge System
OCRM	Office of Ocean and Coastal Resources Management
O&M	Operations and Maintenance
Operating Agencies	US Fish and Wildlife Service and California Department of Parks and Recreation Staff
PERL	Pacific Estuarine Research Laboratory

RONS	Refuge Operating Needs System
SBOO	South Bay Ocean Outfall
SBUSD	South Bay Unified School District
SDSU	San Diego State University
SCC	State Coastal Conservancy
SWIA	Southwest Wetlands Interpretative Association
TJVCWD	Tia Juana Valley County Water District
TRNERR	Tijuana River National Estuarine Research Reserve
USEPA	United States Environmental Protection Agency
USN	United States Navy
WCZ	Wetland/Wildlife Conservation Zone
WOZ	Wildlife Orientation/Interpretation Zone
YCC	Youth Conservation Corps

EXECUTIVE SUMMARY

This Management Plan has been prepared to guide Tijuana River National Estuarine Research Reserve (NERR) in fulfilling its mission of estuarine resource protection over the period 1998-2003. This plan also serves as the Comprehensive Management Plan for the Tijuana Slough National Wildlife Refuge, which comprises the northern portion of the Research Reserve.

The Tijuana River NERR encompasses approximately 2,531 acres of tidally flushed wetland, riparian, and upland habitats lying immediately north of the U.S. - Mexico border. These lands are owned and managed cooperatively by the California Department of Parks and Recreation (CDPR), U.S. Fish and Wildlife Service (FWS), the City of San Diego, the County of San Diego, and the U.S. Navy.

The Tijuana River NERR is linked to two federal land preservation networks: the National Estuarine Research Reserve System, administered by the National Oceanic and Atmospheric Administration (NOAA), and the National Wildlife Refuge System (NWRS), administered by the U.S. Fish and Wildlife Service. NERRs are estuarine areas protected and managed through a federal-state cooperative effort for long-term research, education, and interpretation. At Tijuana River NERR, CDPR is NOAA's partner in this state-federal cooperative effort. The Tijuana Slough National Wildlife Refuge, located within the Reserve, is one of over 512 units of the National Wildlife Refuge System (NWRS), the nation's largest system of public lands dedicated to the conservation of wildlife resources.

This plan has been prepared using a consensus-based planning process involving the Tijuana River NERR Management Authority, staff members of the operating agencies (CDPR and FWS), and community members. The group worked together using a "single negotiated text" to draft and edit proposed chapters of the plan. Each chapter evolved through several iterations, until facts, policies, and language presented in each was acceptable to all parties. This collaborative process marks an innovation in the preparation of NERR and NWR management plans and reflects the planning agencies' commitment to public and community involvement in decision-making.

FIVE-YEAR VISION STATEMENT FOR TRNERR

The 1998 Management Plan emphasizes the Reserve's international geographic significance as the southwestern-most corner of the United States. The Reserve is a largely undiscovered, biologically diverse open space on the Pacific Ocean, bordered in all terrestrial directions by dense urbanized communities in the U.S. and Mexico. Yet the southern end of the Reserve is unwelcoming to visitors. It has been degraded by sewage spills, soil erosion related to road construction, and sedimentation. Recent efforts by several agencies to counter these problems have inspired a shared vision of this area as a welcoming open space for visitors and researchers.

The Five-year Vision Statement for the Tijuana River NERR is:

To design and implement an improvement plan for the southern end of the Reserve, emphasizing the area of Goat Canyon, that integrates improvements in habitat restoration, resource management, public access, education, law enforcement, research, and monitoring.

These improvements to the southern end of the Reserve will reduce negative impacts currently affecting the Reserve's most sensitive core area, the Tijuana Slough NWR.

SEAMLESS RESERVE PRINCIPLE

An overarching principle of this Management Plan is to implement a “seamless reserve" while maintaining the integrity of each participating agency. This goal will be achieved by integrating and coordinating staffing, facilities, and programs. Programmatic coordination and integration are woven throughout the plan. All programs will address habitat restoration -- the primary emphasis of this next era of Reserve operations. The recreation, research, monitoring, and stewardship programs will also support the habitat restoration goals of the Reserve. The plan provides for the sharing of agency expertise with land stewards and citizens outside the Reserve, upstream in the Tijuana River Valley, and in Mexico to help preserve and improve the watershed.

ADMINISTRATIVE FRAMEWORK

Operational efficiency and financial management of both the FWS and CDPR are critical components of this plan. Staffing objectives of the Management Plan articulate and pursue a more efficient staff structure and improve interagency coordination. The structure of the Management Authority and its advisory committees has also been modified to respond to the agenda of the Management Plan.

RESOURCE PROTECTION, MANAGEMENT, AND RESTORATION PROGRAM

One important goal of this plan is to improve land stewardship. The plan presents a comprehensive proposal to improve land stewardship through law enforcement, large-scale habitat restoration, and monitoring human activities within and outside Reserve boundaries that may affect Reserve habitats. The plan recognizes that, since the mid-1980s, great progress has been made in the protection and management of NWR lands north of the Tijuana River. The plan guides the operating agencies as they extend increased stewardship and cooperative management to Reserve lands south of the River.

RESEARCH AND MONITORING PROGRAM

The Reserve presents an invaluable site for research and monitoring of natural resources. The plan will improve administration of research activities, broaden participation of research institutions in the Reserve research program, and integrate the monitoring program more fully with Reserve stewardship and educational programs. The plan recognizes that the addition of a

research institution to the Management Authority and designation of the Reserve as one of San Diego State University's Auxiliary Field Stations will improve the mutually beneficial relationship between the Reserve and research community. The plan also includes applied research within the watershed to address common binational problems.

EDUCATION AND INTERPRETATION PROGRAM

The plan marks a change in course for Tijuana River NERR's education program. This change incorporates and implements NERR system objectives. Basic education programs targeting K-12 throughout the watershed will continue. However, a new emphasis on reaching decision-makers will be developed to target public resource managers, land-use planners, and others on both sides of the border. In addition, the educational themes will relate to the broader Reserve goals of habitat restoration. All educational programs will be bilingual.

PUBLIC INVOLVEMENT, USE, AND ACCESS PROGRAM

The Reserve provides unique opportunities for the public to enjoy and appreciate estuarine resources such as tidal wetlands, riparian, and upland habitats. The plan is designed to increase visitor use and outreach at the Reserve, promote wildlife-dependent recreational activities, and encourage other compatible recreational uses. The plan also increases public involvement in Reserve management and promotes volunteerism at the Reserve.

FACILITIES DEVELOPMENT PROGRAM

The current facilities at the Reserve are inadequate to support the essential functions of the Reserve and the anticipated increases in staffing and public use. Increased public involvement in Reserve programs is a plan priority; therefore, increasing accessibility to the Reserve is an integral part of facility, trail design, and other improvements. These other improvements include the realignment of the road and corresponding sediment basins, and the improvement of recreational access. Additional facility needs include increasing office and storage space at the visitor center and expanding meeting space to accommodate large educational groups.

BINATIONAL WATERSHED COORDINATION PROGRAM

Watershed coordination is a new subject area for this plan update. Located at the terminus of the 1,700-square-mile binational watershed, the Tijuana River NERR is a natural center for many binational concerns relating to natural resources. The Reserve's role in supporting bilingual and cross-border environmental education is well-established and central to the Reserve's continuing mission. The Reserve embraces its international role and strives to improve U.S./Mexico collaborations. Watershed-level planning supports the FWS ecosystem management approach in management of Tijuana Slough NWR.

The plan specifies actions for the coordination of a binational watershed project with special emphasis on the Goat Canyon (also known as the Cañon de los Laureles) subwatershed. This project focuses on erosion and sediment control, and stormwater management. The project will use the Tijuana River Watershed GIS and build upon other important cross-border programs in

which the Reserve has participated. With this new initiative, the operating agencies hope to strengthen their understanding of how the Reserve is perceived by people living south of the border, to improve the design of future natural resource projects and environmental education initiatives, to explore other areas of importance to the watershed and the NERR program, and to increase applied research in the watershed.

INTRODUCTION

Tijuana River National Estuarine Research Reserve (NERR) is part of a nationwide network of National Estuarine Research Reserves known as the NERR system, which was established by Congress in 1972 as part of the Coastal Zone Management Act. The National Oceanic and Atmospheric Administration (NOAA) administers the NERR system to enhance scientific and public understanding of estuaries and thereby contribute to improved estuarine management.

NERRs are protected and managed through a federal-state cooperative effort for long-term research, education, and interpretation. The management practices and priorities of each reserve vary depending on each site's resources, level of use, ownership, and other factors. With its placement in a binational watershed, Tijuana River NERR faces a unique set of challenges that affect the resource protection, research, and education programs at the Reserve.

NOAA requires each NERR to prepare a written Management Plan, which identifies the Reserve's short- and long-term management issues and proposed actions. The plan must be approved by NOAA and periodically updated. Tijuana River NERR's initial management plan was prepared in 1986; this document is the first revision of that plan.

The Tijuana Slough National Wildlife Refuge, located inside the Reserve boundary, is a unit of the National Wildlife Refuge System (NWRS). Managed by the U.S. Fish and Wildlife Service (FWS), the 92-million-acre Refuge System is the nation's largest system of public lands dedicated to the conservation of wildlife resources.

The FWS requires that a Comprehensive Management Plan (CMP) be prepared for each unit of the NWRS. All refuges must develop their plans, in compliance with the National Environmental Policy Act, by the year 2005. Comprehensive Management Plans will be reviewed every 15 years, or as required. This is the first CMP for Tijuana Slough NWR.

THE CONTEXT OF THIS DOCUMENT AS A NATIONAL WILDLIFE REFUGE COMPREHENSIVE MANAGEMENT PLAN

Tijuana Slough National Wildlife Refuge (NWR) was established in 1980 under authority of the Endangered Species Act of 1973. The purposes of Tijuana Slough NWR are "...to conserve (A) fish or wildlife which are listed as endangered species or threatened species ... or (B) plants..." (16 USC 1534). Conservation of the endangered light-footed clapper rail was the primary impetus for this Refuge.

The NWRS is administered by the FWS under provisions of, among other legal guidance, the National Wildlife Refuge System Improvement Act of 1997 (16 USC 668dd et. seq.).

The mission of the FWS is to conserve, protect, and enhance fish and wildlife and their habitats for the continuing benefit of the American people (052 FW 1.3 A). The mission of the NWRS is "to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of fish, wildlife, and plant resources and their habitats within the

United States for the benefit of present and future generations of Americans."

The NWR System's four guiding principles for management and general public use of the NWRS address public use, habitat, partnering, and public involvement (E.O. 12996). These principles are:

- Identify six forms of wildlife-dependent recreational activities as priority public uses of the NWRS;
- Continue the NWR System's emphasis on conservation and enhancement of the quality and diversity of fish and wildlife habitat;
- Recognize that partnerships with other federal and state agencies, tribes, organizations, industry, and the public can make significant contributions to refuge management; and
- Require full and open opportunities for public involvement in decisions regarding acquisition and management of refuges.

The goals of the NWRS (602 FW 1.4 M) are:

- To preserve, restore, and enhance in their natural ecosystems (when practicable) all species of animals and plants that are endangered or threatened with becoming endangered;
- To perpetuate the migratory bird resource;
- To preserve a natural diversity and abundance of fauna and flora on Refuge lands;
- To provide an understanding and appreciation of fish and wildlife ecology and man's role in his environment, and to provide Refuge visitors with high-quality, safe, wholesome, and enjoyable recreational experiences oriented toward wildlife, to the extent these activities are compatible with the purposes for which the Refuge was established.

The goals and objectives for Tijuana Slough NWR, and the individual strategies and actions to achieve them, are found throughout this document.

The NWRS is a primary-use, federal land system. Each refuge has a purpose or set of purposes that are the highest priority use(s) of that refuge. All other uses (e.g., recreation, research, commercial, etc.) are secondary and may be permitted to occur only if they are compatible with the purpose(s) for which the refuge was established. Compatible uses are ones that may enhance, or will not materially interfere with or detract from, the NWRS mission or refuge purpose(s). A list of current compatibility determinations for approved secondary uses of Tijuana Slough NWR is located at Appendix 1.

The missions and goals of the Refuge System and Reserve System are generally complementary, but are not identical; some NERR top priorities are secondary uses on refuges. In any case of

conflict, FWS/NWRS missions and policy will supersede NOAA/NERR missions and policy on lands of Tijuana Slough NWR. However, a long history of cooperation between the NWR and NERR indicates that those conflicts will be rare.

FWS agreed to include NWR lands in the Tijuana River National Estuarine Research Reserve when the NERR was established as a National Estuarine Sanctuary in 1982. Subsequently FWS endorsed the 1986 Reserve Management Plan, agreed to implement that plan as part of FWS management activities, and provided an easement to the California Department of Parks and Recreation (CDPR) to build and operate the Tijuana River NERR Visitor Center on Refuge land. Since 1986, the Reserve Management Plan functioned as the only approved management plan for Tijuana Slough NWR. In 1996, FWS signed a Letter of Agreement with CDPR to cooperate in managing their lands as a seamless reserve (Appendix 6).

Soon after NOAA and CDPR initiated the planning process resulting in this document, FWS and other partners agreed to prepare a joint plan to serve both the Reserve and the Refuge. This joint planning effort supports the FWS “ecosystem approach" to management by emphasizing landscape-level planning and partnering.

The decision to prepare a joint document also requires some flexibility in agency planning policy and some additional explanations, including the following:

- To enhance the reading and understanding of this plan, the use of the terms "Tijuana River NERR" and "Reserve" throughout the document generally refer to all constituent land systems, including the NWR, Border Field State Park, and other lands of the Reserve. Where there are policy or other differences that apply to Tijuana Slough NWR, these differences are identified.

- A refuge CMP establishes goals, objectives, and strategies for that refuge. Approval of this CMP asserts FWS support of the goal statements in Chapters 4 - 10 as Reserve-wide goals, objectives and strategies. However, NWR goals are supported and funded through the Refuge Operating Needs System (RONS). Because of varied land ownerships, many Reserve-wide goals and projects are not appropriately funded through RONS. Approved NWR goals with a RONS nexus are indicated among Reserve-wide goals in bold type.

- A complete list of RONS projects for Tijuana Slough NWR, with cross- referencing to appropriate sections of the CMP, is found in Appendix 2.

- A list of required NWR Step-down Management Plans to be written is included in Appendix 3.

HISTORICAL PERSPECTIVE AND ACCOMPLISHMENTS AT TIJUANA RIVER NERR

When the local, state, and federal governments joined citizens in 1980 to propose the creation of the Tijuana River National Estuarine Research Sanctuary, the task was formidable and the resources were anything but pristine. Hard work by many agencies, organizations, and cities during the 1980s and 1990s resulted in the following achievements:

- Acquisition of approximately 2,500-acres of land within the Reserve boundary into public ownership;
- Establishment of Tijuana Slough NWR in 1980;
- Designation of the site as a sanctuary in 1981;
- Inclusion of U.S. Navy lands in the Refuge in 1984;
- Transfer of lands within Reserve boundaries to public ownership;
- Construction of a visitor center with interpretive exhibits;
- Development of educational programs and curricula targeting school districts, decision-makers, and recreationists in both the U.S. and Mexican portions of the watershed;
- Implementation of long-term monitoring, which included completion of the first site profile in the national system, and installation and maintenance of two data loggers to provide real-time monitoring of estuarine data;
- Implementation of a research program at the Tijuana Estuary that placed the Reserve in the international spotlight as a site for outstanding research on wetland ecology and restoration;
- Inclusion in a nation-wide permit from the U.S. Corps of Engineers to dredge the mouths of the Tijuana River and Oneonta Slough in the event of closure during a major storm, as well as acceptance of the Tijuana River Slough dredging by the Coastal Commission as appropriate to coastal management considerations;
- Development of a long-range strategy for habitat restoration, resulting in the completion of the tidal linkage channel in the northern end of the Reserve and a restoration plan for the 500-acre salt marsh in the Reserve's southern end; and,
- Development of Reserve-wide and watershed-wide Geographic Information System (GIS) to provide the first maps integrating natural resource and social data from both sides of the international border.

The managing agency vision of the Tijuana River NERR as a seamless reserve has become a reality. Each agency's agenda is met and promoted by an integrated program for resource protection, education and outreach, research and monitoring, and public use.

These integrated programs have been vital to the Reserve's long-term ecological restoration and conservation strategy. Many challenges, including the regulatory constraints and different policies of state, local, and federal agencies, arise when integrating the jurisdictional mandates of three managing agencies (FWS, NOAA, and CDPR), the restoration agenda of the State Coastal Conservancy, and the research interests of San Diego State University. Implementation of the program requires a tremendous amount of inter- and intra-agency flexibility and coordination. The Tijuana River NERR, while challenged by overlapping jurisdictions, is fortunate to have a mosaic of resource agencies that share many programmatic goals.

THE CONTEXT AND NEED FOR RESOURCE PROTECTION AT TIJUANA RIVER NERR

Management of the Reserve occurs against a backdrop of resource-degrading activities in the region. The Reserve has suffered from:

- Chronic pollution from domestic and industrial discharges, and continuous freshwater flows that have altered the natural hydrological regime and facilitated the invasion of exotic species;

- Accelerated sedimentation from erosion on both sides of the border, altering the topography and enabling invasion of exotic species;

- Travel by illegal immigrants from Mexico through reserve habitats, and the resulting trampling of sensitive habitats; and

- Chronic vandalism of signs, benches, research equipment, and facilities resulting from the Reserve's location in an urban environment.

REMAINING NEEDS AT TIJUANA RIVER NERR

Many Reserve needs must still be addressed. This Management Plan articulates those needs and responds with a series of objectives and tasks.

First, the agencies that have a stake in the management of the Reserve need to improve coordination. This requires improved efficiency of on-site inter- agency operations and the development of creative options for acquiring new full-time staff positions that are responsible in part for coordinating inter- agency activities. Program needs exceed the capacity of any one agency to implement the programs through staff and/or contracts. Expanded facilities are needed to accommodate the staff growth.

Second, through coordinated and concerted effort, the Reserve needs to address the long-standing and increasing resource degradation in the southern end of the Reserve. Historically this area has suffered more damage from natural events and human activity than the more accessible parts of the Reserve. Primary efforts will focus on erosion control and habitat restoration in Goat Canyon, a binational subwatershed within the Tijuana River Watershed. All programs will be

able to turn more of their efforts to this southern area, but the resource protection, management, and restoration programs will have the greatest bearing on this area during the life of this plan.

Third, the Reserve management needs to establish the Reserve's niche in the larger binational and watershed context in the areas of education, research and monitoring, stewardship, and management. The Reserve's management believes the effort is well-timed and the on-site programmatic foundation exists to tackle these very challenging issues in this next era of Reserve operations. The plan analyzes and provides a comprehensive approach for meeting the needs of the Reserve over the planning period.

Fourth, Reserve management needs to improve its relationship with the communities surrounding the Reserve and to provide recreational opportunities that are both consistent with environmental, conservation, and restoration goals and compatible with NWR purposes.

Fifth, integration of research and monitoring programs with operations, education, outreach, and stewardship must be enhanced. This requires a strategy to physically locate or access the Reserve databases on-site and to provide GIS expertise on site.

THE 1998 TIJUANA RIVER NERR MANAGEMENT PLANINWR CMP

This 1998-2003 Management Plan for the Tijuana River National Estuarine Research Reserve and Comprehensive Management Plan for Tijuana Slough NWR refines concepts presented in the original (1986) management plan and addresses many management issues that have developed since the early document was issued. This plan strengthens the Reserve's ability to provide stewardship, research, and education, and to meet the Refuge's wildlife purposes.

The plan reiterates the Reserve's commitment to estuarine stewardship, research, and education for local, governmental, scientific, and educational interests. It builds on programs successfully established under the 1986 plan and offers new means through which the Reserve can play a more active and public role. As a NWR CMP, this document is a 15-year plan that may be updated in conjunction with future NERR planning updates.

This plan was prepared in accordance with all relevant state, local, and federal regulations, and is consistent with the objectives of California Coastal Management Program and with state, local, and federal land-use plans, policies, and controls for the area under consideration.

This Management Plan is presented in 10 chapters. The early chapters of the plan describe the Tijuana River NERR physical environment and national framework (Chapter 1), core principles, goals, and objectives of the Reserve (Chapter 2), and the accomplishments at Tijuana River NERR since its creation (Chapter 3). The subsequent seven chapters -- Administrative Framework (Chapter 4), Resource Protection, Management, and Restoration (Chapter 5), Research and Monitoring (Chapter 6), Education and Interpretation (Chapter 7), Public Access, Involvement, and Use (Chapter 8), Facilities (Chapter 9) and Watershed Coordination (Chapter 10) -- use the following structures to frame issues and direct future management:

Mission: Describes the program's primary purpose.

Goals: Establishes several goals for the program that reflect the priorities of the Reserve and guide content, themes, and decisions within the program.

Policies: Describes relevant local, state, and federal policies that affect the program, and states any Reserve-specific policies established by the Management Authority or the operating agencies.

Existing Conditions and Perceived Needs: Sets the context for the program, outlines current operations, and defines areas where improvements should be made.

Plan of Action: Restates the goals of the program with objectives and specific tasks associated. Where relevant, scheduling or cost estimates are provided.

CHAPTER ONE: NATURAL, PHYSICAL, AND CULTURAL CONTEXT

INTRODUCTION

The Tijuana River National Estuarine Research Reserve (NERR) is unique in a local, regional, and national context. It offers one of the best and largest remaining examples of coastal wetlands that have been lost to urban development or seriously degraded elsewhere in southern California. This section includes a brief description of the importance of estuarine habitats and the natural resources protected within the Reserve.

I. THE NEED TO PROTECT ESTUARIES

A. DEFINITION

Estuaries are a hydrological and biological crossroads, defined as the portion of the earth's coastal zone where there is interaction of ocean water, freshwater, land, and atmosphere.

The specific plant and animal habitats that may be supported by an estuarine system are determined by conditions in the watershed and in the adjacent ocean. The rate at which fresh water enters the estuary, the amount and type of waterborne and bottom sediments, the degree of tidal flushing, and water depth (hence temperature and degree of sunlight), all combine to produce diverse biological communities in a dynamic and complex system. A significant physical change in any of those factors can trigger traumatic changes in the estuarine biologic community, greatly enlarging or reducing the size of various species' populations.

B. ESTUARINE PRODUCTIVITY

In a healthy estuarine system, the interaction of tides, unpolluted fresh water, and sediments concentrates nutrients more densely than in any other natural system on the planet. Sheltered shallow waters and soft mud or sand flats, regularly flooded by the tides, provide ideal conditions for abundant life.

Among the most important, but least understood, estuarine species are microscopic photosynthetic organisms: phytoplankton. Phytoplankton, like green plants, make the energy of sunlight available to animals as food. Phytoplankton are consumed by microscopic and minute animals called zooplankton. These tiny animals include the larvae of fish, crabs, clams, and other species, and are themselves part of the food supply for adults of their own or other species.

Marsh plants and eelgrass growing in shallow estuarine waters are critically important to estuarine animal life. Marsh vegetation not only provides cover for many animals, but also, as it dies back each season, creates detritus that feeds and houses the minute species on which larger species depend. The blades of eelgrass are homes for algae, snails, and other food for larger

animals. Juveniles of many commercially valuable species reach adulthood by hiding among estuarine vegetation.

In an undisturbed estuary, the wealth of food can support huge populations of immature and adult fish, crabs, shrimp, and other species. Those animals provide essential food for populations of birds and mammals, including people.

Some species spend their entire life cycles in estuaries. Other species rely on estuaries for intermittent but important life cycle stages.

C. MODIFICATION OF ESTUARIES

Estuaries--characteristically flat land that offers sheltered access to the sea, and a profusion of fish and other seafood--offer attractive conditions for human habitation, agricultural production, and transportation. Estuaries on the west coast of the U.S. supported native peoples for thousands of years and, more recently, settlers from other parts of the globe.

Prior to the 1970s, the value and finite nature of estuaries were not fully appreciated. It was not recognized that estuaries are integral to ecological and human well-being. Destruction of estuaries was disastrously affecting water quality, commercial and recreational fisheries, and overall ecosystem health. Estuary-dependent plants and animal populations began to dwindle with lost habitat, food sources, and reproductive sites. Affected species included not only salmon, crab, and clams, but also birds such as eagles and falcons, which feed on the tideflats. Increasing awareness of the value of estuaries triggered current efforts to preserve, conserve, and restore these fragile systems. Among the most significant of these efforts were passage of the Federal Coastal Zone Management Act in 1972 and the subsequent passage of the California Coastal Act in 1976.

II. THE TIJUANA RIVER NERR ENVIRONMENT

A. REGIONAL SETTING

1. Reserve Location and Boundaries

Tijuana River NERR is located at the southwest corner of the continental United States in southern San Diego County, California (Figure 1). The area within existing Reserve boundaries represents about 2,500 acres in downstream terminus of the Tijuana River watershed (Figure 2).

The western boundary of the Reserve follows the Pacific Ocean shoreline from the southern tip of Seacoast Drive to the U.S. - Mexico border. Along the northern part of the Reserve, the boundary extends along Seacoast Drive, Imperial Beach Boulevard, and connecting side streets, passing south of the Navy Outlying Landing Field. The eastern part of the Reserve falls within City of San Diego limits. Saturn Avenue marks the eastern extension of the Reserve into the agricultural lands of the Tijuana Valley. The southern boundary follows Monument Road and the U.S. - Mexico border, with the City of Tijuana extending immediately south of the border.

Like most remaining wetlands in southern California, the Tijuana Estuary is located close to a large urban population. It is the only coastal lagoon in southern California that is not bisected by roads and railroads. This points to the pressures that have been and will continue to be placed on Reserve resources, but also establishes the need for information, local involvement, and educational programs aimed at increasing public awareness and compatible visitor use.

2. Regional Access

Access to the Reserve is possible from several directions. The northern and western parts of the Reserve in the National Wildlife Refuge (NWR) are most accessible to visitors. The beach and Seacoast Drive provide pedestrian and vehicular access to the western edge of the Reserve and Refuge. Access to the south is via Monument Road-the entrance to Border Field State Park. Visitors can enter the northern part of the Reserve along Imperial Beach Boulevard, at 5th and Iris, and other local roads. Elsewhere, access is restricted by the Navy Outlying Landing Field and private agricultural properties. Off-road vehicles are prohibited except for use by enforcement and public safety officials. Hiking and equestrian use is accommodated by an extensive trail system. (See Chapter 8.)

3. Land Ownership

Reserve establishment brings a mosaic of federal, state, local, and privately owned lands under a single management framework. The major federal landowners are the U.S. Fish and Wildlife Service (FWS), the State of California, and the U.S. Navy (USN). FWS owns a 505-acre parcel and the USN controls an additional 551 acres, part of the Imperial Beach Navy Outlying Landing Field. Under a 1984 Memorandum of Understanding, FWS manages the 551 acres of Navy property for wildlife Refuge purposes. FWS fee lands, USN lands, and tidelands leased from the California State Lands Commission are all part of Tijuana Slough NWR that comprises the northern portion of the Reserve.

The State of California owns a 418-acre parcel -- Border Field State Park -- at the southern end of the Reserve. The park is operated by California Department of Parks and Recreation (CDPR). The location of Tijuana Slough National Wildlife Refuge and Border Field State Park within the Reserve is shown in Figure 3. Both the County and the City of San Diego also own significant public land within the Reserve. A transfer of City of San Diego lands to the State of California is currently underway in an effort to consolidate land management. All lands within the Reserve boundary are held in public ownership for resource conservation, with the exception of approximately 36 acres remaining in private ownership. The ownership of lands within Tijuana River NERR is shown in Figure 4.

B. RESERVE RESOURCES

The following synopsis draws from several resource overviews compiled in the past (Williams et al, 1996; RECON 1994; Zedler et al 1992; Entrix et al, 1991; Zedler, 1982d; U.S. Department of Commerce and California Coastal Commission, 1981; California Coastal Commission, 1978; McIlwee, 1970) and highlights the environmental conditions and resources contributing to the ecological significance of the site.

1. Environmental Conditions

a. Watershed Topography, Geology, and Soils

The Tijuana River is an ephemeral stream draining a 1,700-square-mile watershed, of which 73 percent lies in Mexico. The river originates at the confluence of Arroyo del Alamar and Rio de las Palmas in Mexico. The lower Tijuana valley is a relatively wide and flat area confined to the south by high mesas and to the north by steep-sloped terraces. Several narrow canyons also drain into the lower valley. The topography of the site is shown in Figure 5.

The principal geological formations prevailing in the Reserve are quaternary and recent alluvial and slopewash deposits reaching depths of 130 feet. Sandstones, shales, and limestones underlie the unconsolidated deposits. Recent beach sand deposits occur along the shoreward length of the estuary. The lower valley is bound to the north, east, and south by sandstone and conglomerates that account for the mesa topography (City of San Diego, 1979; U.S. Department of Commerce and California Coastal Commission, 1981).

Over the past few years, the low marsh areas have had consistent mean soil salinities that range from 40 to 44 ppt. High marsh areas appear to be more dependent on annual tide levels and weather patterns, causing the salinities to fluctuate from year to year (Williams et al, 1996). The mudflats at the mouth and lower parts of the estuary are occasionally covered by sands transported during storms from the beach. The saline Chino silt loams, considered highly erodable but suitable for agriculture, occur upstream from the flats. To the south, the fine sandy loams blanketing the mesas and terraces are also considered highly erodable and are probably contributing substantially to downstream sedimentation (City of San Diego, 1979).

b. Climate

Weather conditions are generally typical of a Mediterranean climate. Annual rainfall averages nine to ten inches. Recent studies have shown that the amounts and times of rainfall and stream flow in the entire watershed are
more important for estuarine dynamics than total precipitation (Zedler et al, 1992). In general, most rains fall from January to March. Average temperatures reach annual lows of 52'F (11'C) in winter and rise to 68'F (20'C) in July (California Department of Parks and Recreation, 1974). Prevailing winds come from the northwest in winter and from the southwest in summer.

c. Hydrology

As in many southern California rivers, annual streamflows of the Tijuana River can vary dramatically. Observations represent from 10 percent to 400 percent mean annual flow (Zedler and Koenigs, unpub.). Mean annual discharge for 44 years is based on upstream gauge readings of 29.1 cubic feet per second (cfs) (U.S. Department of Commerce and California Coastal Commission, 1981). The greatest peak flow on record was 75,000 cfs in 1916. In comparison, peak flows during the 1993 winter storms were 32,500 cfs. Based on records going back to 1973, the Tijuana River experiences low and high flows as frequently as intermediate class flows and

thus has a regime very distinct from rivers such as the San Diego River (Zedler, Koenigs, and Magdych, 1984). The hydrography and estimated floodplain of the Reserve are shown in Figures 6 and 7, respectively.

The Tijuana River is also distinct in that it experiences many months with no flow. It has highly variable year-to-year and month-to-month flow. As a result, the Tijuana Estuary is seasonally marine-dominated-though this state can last for several years-and occasionally fresh during flood events (Zedler et al, 1992). Any proposal that increases freshwater inflows could cause significant shifts in species composition (Zedler 1982). The flow of the Tijuana River is also regulated by three structures: the Morena Reservoir, the Barrett Reservoir, and the Rodriguez Darn on Rio de las Palmas.

Despite low flows that occur frequently during the summer, the Tijuana River mouth has generally remained open throughout the year (Zedler, Winfield, and Mauriello, 1978). This is considered a unique and important characteristic of the Reserve, since all other southern California estuaries are bisected by highways and railroads that have decreased tidal exchange and resulted in frequently or continuously blocked entrances (Zedler, 1983b). At the Tijuana site, the main river channel and the northern channel are normally flushed by mixed tides twice daily.

Heavy ocean storm surges have dramatically affected channel circulation and tidal exchange in the estuary. Waves washed beach sand into the tidal channels, closing off the southern channel during those winters, and reducing the opening of the northern channel. This has reduced tidal circulation within the northern channel, preventing the tides from flushing sediments out of the estuary, and apparently causing more frequent closures of the estuary's mouth including occurrences in the spring and summer of 1984. These closures present serious management problems for the estuary. However, since the dredging and opening of the mouth in December 1984, the estuary mouth has remained open.

Between 1852 and 1986, the estuary lost 80 percent of its diurnal tidal prisms (Williams and Swanson, 1987). Efforts to increase the tidal prism and help combat the sedimentation are described in Chapter 5.

d. Water Chemistry and Quality

Water chemistry in the open water channels of the Reserve is normally similar to the chemical composition of the ocean because of the small volumes of freshwater discharged from the Tijuana River during the spring, summer, and fall. During the winter, rains and releases from upstream storage and water treatment facilities can reduce the salinity in the estuary.

Deteriorated water quality represents a significant problem for the Tijuana Estuary, particularly in the river channel and along the ocean beach, and has necessitated short-term closure of parts of the Reserve for public health and safety. Effects of the sewage discharges on the estuary have not yet been fully investigated and have been difficult to evaluate due to two other environmental problems: heavy siltation and excessive amounts of fresh water.

Sewage from the Tijuana River basin is directed to a pump station in central Tijuana adjacent to

the international border. This station pumps wastewater along a canal to a treatment plant and then discharges it 5.6 miles south of the border. With only one sewage main and one canal, any maintenance shutdowns cause spillage into the river. Spillage also occurs due to frequent breakdowns of the force main. There are collector sites at both Goat Canyon and Smugglers Gulch (Matadero), and both have a history of main breakages and overflows that have led to significant wastewater flows into the Tijuana Estuary.

The International Wastewater Treatment Plant (IWTP) is being constructed in the United States directly north of Mexico's pump station. Primary treatment will average 25 million gallons per day (mgd) with peak flows up to 75 mgd. Mexico's pump station will collect wastewater from both eastern and central Tijuana and direct it to either the IWTP or the San Antonio de los Buenos plant in Mexico. If breakdowns occur at the pump station or Mexico's conveyance station, all flows will be directed to the IWTP for treatment.

Discharge of the advanced primary treated effluent will be through the already constructed South Bay Land Outfall and the South Bay Ocean Outfall (SBOO) under construction and scheduled for completion in 1998. The SBOO will run 200 feet below Border Field State Park in the southern end of the reserve and discharge 3.3 miles (5.7 km) offshore. This outfall -- to be used by the IWTP and the future City of San Diego Otay and South Bay treatment works -- will have a carrying capacity of 333 mgd. Though this project has gone through multiple environmental reviews, it is uncertain what the final impact on the estuary will be.

2. Living Resources

The tidal flushing of the Tijuana Estuary maintains a variety of habitats, which in turn support a broad range of organisms. A listing of plant and animal species with state or federal listing as threatened or endangered is provided in Appendix 4. The following provides an overview of habitats and describes the status of regionally significant resources.

a. Habitat Overview

- The Tijuana River National Estuarine Research Reserve includes the following coastal habitats (McIlwee, 1970):

- Sand dunes and beaches - Sand dunes and beaches represent about 80 acres of the total Reserve area. Sand deposits are continually shifted during floods and sea storms, thus creating relatively unstable habitat. In recent years, the dune system has become very unstable, allowing sand to be blown into the tidal channels.

- Open tidal channels and mudflats - The estuary includes 100-147 acres of open-water channels. Sand, silty clay, and mixed substrates create a variety of subtidal habitats and intertidal mudflats (Zedler, Winfield, and Mauriello, 1978).

- Salt marshes - Salt marshes amount to about 410 acres, of which 67 acres are classified as

"low marsh," 133 acres as "middle marsh," and 210 acres as "high marsh." These classes correspond to the shifts in species composition, community structure, soil salinity and texture, and tidal conditions that occur along the one-meter elevation gradient.

- Fresh-brackish marshes - Freshwater brackish marshes occur throughout the Reserve and are dominated by bulrushes and cattails.

- Riparian habitats - The riparian areas of the Reserve cover approximately 400 acres. These encompass the entire span of habitats upstream from mean high tide, including freshwater marshes and upland areas.

- Coastal sage scrub - The bluffs adjacent to the international border along the southern boundary of the Reserve are classified as coastal sage scrub. This community is considered sensitive habitat throughout San Diego County and Southern California.

- Vernal pools - A few small vernal pools can be found in the Reserve. These shallow pools, which hold a few inches of water during the wet months, host the San Diego fairy shrimp, a federally endangered species.

Vegetation communities are shown in Figure 8a. A key to vegetation communities is provided in Figure 8b.

The northwestern part of the Reserve is generally considered to be healthier than the southern or eastern regions. Tidal exchange in the north is generally better and sizable areas of mudflats are exposed at low tide at the northern end (U.S. Department of Commerce and California Coastal Commission, 1981). In contrast, channel banks are steep, tidal flushing is restricted, and low elevation communities are absent from the Reserve's southern end (Zedler, Winfield, and Mauriello, 1978).

b. Vegetation

The estuary's vegetation communities were important in the designation of the Reserve (U.S. Department of Commerce and California Coastal Commission, 1981). In addition to having regionally significant species, the Tijuana Estuary includes most of the plant communities found in other southern California wetlands (Zedler, 1982).

Distributions of species at Tijuana Estuary are similar to those found in large marshes in southern California, such as Sweetwater Marsh (Mudie, 1970), Mission Bay (Macdonald, 1967), Upper Newport Bay (Vogl, 1966; Massey and Zernbal, 1979), Anaheim Bay (Massey and Zembal, 1979), and Mugu Lagoon. The vegetation communities of the southern salt marshes are considered distinct from marshes north of Point Conception, including Elkhorn Slough, California's other National Estuarine Research Reserve, because of much more limited rainfall and hypersaline soils affecting plant growth rates and species composition (Zedler, 1983a).

Cordgrass *(Spartina foliosa)* forms robust stands along tidal channels in the northern reaches of

the Reserve. Large stands of this species are rare in the other more disturbed southern California wetlands. Because of the importance of cordgrass as habitat for the endangered light-footed clapper rail (Jorgensen, 1975), considerable attention has been given to the artificial germination of this species (Zedler, 1982d). Above the cordgrass-dominated community are found several succulents, including pickleweed *(Salicornia virginica)* and saitwort *(Batis maritima)* as dominants, and annual pickleweed *(Salicornia bigelovii)* and sea blite *(Suaeda esteroa).*

At higher elevations, these succulents grade into a dense matted cover of shoregrass *(Monanthochloe littoralis).* At the highest elevations, another species of pickleweed *(Salicornia subterminalis)* becomes co-dominant with shoregrass.

The low-growing, open canopies of vascular plants in southern California marshes allow light penetration to the soil surface and subsequent development of lush algal mats (Zedler, 1982d). Filamentous bluegreen and green algae and dozens of species of diatoms form mats up to one centimeter thick on moist soils. These occur at all intertidal elevations. The early studies on the composition of these marsh algal mats were performed at Tijuana River Estuary in the 1970s. These algal mats are about as productive as the overstory salt marsh plants (Zedler, 1980) and actually play a more important role as a food source in the estuarine food chain (Williams, 1981; Zedler, 1982c).

Reduced tidal circulation, natural flooding, prolonged excessive freshwater input, compaction by off-road vehicles, and the introduction of exotic species can cause changes in both salt marsh community structure and function (Zedler, 1982d). Salt marsh bird's beak *(Cordylanthus maritimus)* was once a common plant of the upper marsh but is now listed as endangered under the Federal Endangered Species Act. This plant likely owes its endangered status to the filling and destruction of upper marsh habitat in California. At the Tijuana River Estuary, salt marsh bird's beak occurs near areas with slightly disturbed soil surfaces, such as along the edges of paths and roads, sparsely vegetated openings, and depressions.

Another important source of disturbance to sensitive salt marsh vegetation is the large number of illegal or undocumented aliens from Mexico that enter the U.S. via the estuary. Until the mid-1990s, hundreds and occasionally thousands of individuals crossed the estuary every day, trampling the vegetation and creating numerous unnecessary trails. Although increased efforts by the U.S. Border Patrol have diminished the foot traffic through the Reserve, the patrols have created a number of new roads, particularly in the southern portion. Some of these roads pass through some of the most sensitive habitat areas. Areas disturbed by foot or vehicle traffic are slow to recover.

c. Invertebrates

Invertebrates, which include intertidal organisms such as aquatic insects, worms, clams, and crabs, and terrestrial insects and spiders, are likely major consumers in the salt marsh food chain and in turn are an important food source for the fishes and birds of the marsh (Zedler, 1982d).

Crabs are perhaps the most conspicuous invertebrates in southern California coastal salt marshes. This is also true of the Tijuana Estuary. Burrows of several species of crab occur throughout the

lower marsh. Another common and relatively conspicuous inhabitant of the estuary's tidal channels is the hornsnail. Many other invertebrate species are just as numerous but less obvious because of their size or location within the sediments. These include several species of clams and mud worms.

Recent studies have helped characterize the benthic community at the Tijuana Estuary, and a sampling project in the northern arm will help define the structure of the benthos. The northern arm of the estuary has a healthier benthic community than the southern arm (Entrix, 1991). This difference may be a result of the hydrology differences of the channels. The species composition and dominance change with the distance from the River's mouth. Captellid and Spinoid polycheates are found in both the estuary's northern and southern arms. *Protothaca staminea and Tagelus californianus* are the most common bivalves in the tidal channels (Williams et al 1996). California horn snail *(Cerithidea calfiorniensis)* is abundant especially in the winter.

Relatively little research has been done on the terrestrial invertebrates of the estuary and their ecological role. As in other salt marshes, some insects here probably feed on vascular plants, algae, and decaying plants, while others are carnivores. They serve as a food source for birds and other marsh vertebrates. Marsh insects are also important to the pollination of marsh flowering plants. The endangered salt marsh bird's beak, for example, is pollinated by bees (Zedler, 1982d).

Rove beetles *(Staphylinidae)* burrow in mud and salt flats. They are abundant in the estuary and appear to play a role in aerating soils and in reversing soil compaction resulting from off-road vehicles. Recent investigations suggest that the largest population of the wandering skipper *(Panoquina errans)* in the United States may be at the Tijuana Estuary (Zedler, 1982d). The estuary also supports a diverse and abundant population of coastal tiger beetles *(Cicindela sp.),* of which four species may be threatened (U.S. Fish and Wildlife Service, 1982). The Reserve is also a location for the globose dune beetle *(Coelus globosus),* a federal Category 2 species.

A distribution study (Williams et al, 1989) compared the arthropod community in different habitats within the Reserve. Wandering skippers were shown to be more abundant in the northern portion of Oneonta Slough, near the northern tidal pond, and in the southern arm of the estuary than in areas closer to the mouth. Globose dune beetles were only found south of the river mouth. However, considerable insect diversity was found throughout the estuary. The eradication of normative plant species is essential to the management of these rare insects (Williams, K. et al, 1989).

Eleven species of salt marsh mosquitoes breed in the saline and brackish pools of the estuary (U.S. Fish and Wildlife Service, California Department of Parks and Recreation, and Department of the Navy, 1983). Three species *(Aedes taeniorhynchus, Anopheles hermsi, and Culex tarsalis)* are of particular concern because of their potential as pests and possible disease vectors. Currently, chemical control methods are being used to combat larvae and adults in areas where there is a high concentration of these mosquitoes. These methods are further discussed in Chapter 5.

d. Fish

The small tidal creeks and channels of the estuary support a relatively diverse population of fish including 29 species representing 19 families (U.S. Department of Commerce and California Coastal Commission, 1981; US. Fish and Wildlife Service, 1982). For the past ten years, fish assemblages have been sampled in the estuary. In 1995, the catches were dominated by topsmelt *(Atherinops affinis),* longjaw mudsucker *(Gillichthys mirabilis),* arrow goby *(Clevelandia ios),* and California killifish *(Fundulus parvipinnis).* Adult striped mullet *(Mugil cepalus)* are also common. Abundance varies widely from year to year, but total density peaks in the summer and declines in the winter. The 1995 catch was the smallest to date, and populations of two of the most abundant species--arrow goby and topsmelt--were down. Declines in arrow goby may be attributed to more winter flooding, while increases in longjaw mudsuckers may be due to macroalgal blooms after the freshwater surge (Williams et al., 1996).

The tidal channels were shown to function as a nursery for important recreational fish, such as the diamond turbot and California halibut. Nordby (1982) found abundant eggs of the croaker family, topsmelt, and northern anchovy. Hence, the estuary appears to be providing nursery habitat for marine fishes; it may, therefore, be important for sport and commercial fisheries. Game fish such as kelp and sand bass, opaleye, and white croaker have also been found in the estuary (U.S. Department of Commerce and California Coastal Commission, 1981).

e. Reptiles and Amphibians

Relatively little is known about the use of the Reserve by reptiles and amphibians. Espinoza (1991) found 13 species of herptofauna in the estuary. Four species of frogs, six species of lizards, and three species of snakes were found, including the San Diego horned lizard *(Phrynosoma coronatum blainvillei),* and the Coronado skink *(Eumeces skiltonianus interparietalis).* Both are species of special concern.

California kingsnakes *(Lampropeltis getulus californiae)* and San Diego gopher snakes *(Pituophis melanoleucus annectens)* are common in transition habitats, but are also found in the drier areas of the salt marsh. Side blotched lizards (*Uta stansburiana)* are abundant on the dry ground of the reconstructed dunes and other sandy areas. Dunes are also home to the San Diego horned lizard and silvery legless lizard *(Annielia pulchra pulchra).*

Riparian area and freshwater ponds are home to the California toad *(Bufo boreas halophilus)* and the Pacific tree frog *(Hyla regilla).* Coastal sage scrub is habitat for the San Diego alligator lizard *(Gerrhonotus multicarinatus webbi)* and the Great Basin fence lizard *(Sceloporus occidentalis biseriatus).*

Management of reptiles and amphibians focuses on protecting the remaining open space in the Reserve and restricting horse, vehicle, and foot traffic to designated areas. The maintenance of the few freshwater ponds is important to the life cycles of the amphibians (Espinoza 1991). More information on populations and the presence of reptiles and amphibians is needed. Another survey of reptiles and amphibians is being planned.

f. Birds

Bird populations have been an important factor in the special protective status attributed to the Tijuana Estuary. A total of 370 bird species are reported for the area. Birds use the wide array of habitats present in the lower and upper estuary, including the ocean beach and dunes, mudflats, mudbanks, salt marshes, and riparian areas. A complete list of birds observed at the Reserve is provided in Appendix 5.

Seven federally listed threatened or endangered birds occur regularly in the Reserve: the light-footed clapper rail *(Rallus longirostris levipes), the* California least tern *(Sterna antillarum browni),* least Bell's vireo *(Vireo belli pusillus),* the California gnatcatcher, the western snowy plover *(Charadrius alexandrinus nivosus),* the California brown pelican *(Pelecanus occidentalis californicus),* and the peregrine falcon *(Falco peregrinus anatum).* Belding's savannah sparrow *(Passerculus sandwichensis beldingi)* is listed as endangered in the State of California. Other regionally or locally rare species include the elegant tern, black skimmer, and northern harrier. The light-footed clapper rail, California least tern, western snowy plover, least Bell's vireo, and Belding's savannah sparrow nest in the estuary. Their requirements and status are discussed further since these are the species most likely to be affected by management of the Reserve.

The decline of the light-footed clapper rail population in southern California is associated with the encroachment and destruction of coastal salt marshes. The use of the estuary by this species has been described by Jorgensen (1975, 1980) and summarized by the U.S. Fish and Wildlife Service (1982) and Zedler (1982d). Recent censuses indicate that the entire U.S. population of this subspecies may be as low as 325. In 1996, 77 pairs were recorded at Tijuana Estuary, making it the second largest population of this endangered species in the United States.

A total of 303 California least tern nests were reported in the Reserve for 1996. Fences and temporary enclosures have been built to protect the nesting areas. However, nests and fledglings are vulnerable to vehicle, horse, and foot traffic on the beach. Tern reproduction can be severely impacted by predation from an array of predator species.

A small number of western snowy plover also nest in the river mouth areas and dunes from mid-March to mid-September. Peak nesting occurs from April through June. A total of 15 nests were attempted in 1996, a slight increase from 11 nests in 1995. Nest success, formerly reduced by trampling by undocumented immigrant traffic, is now limited by avian predators.

Belding's Savannah sparrow uses the higher salt marsh habitats, particularly pickleweed communities, for nesting. Nesting occurs anywhere from March to August (Massey, 1979). With incomplete coverage in the survey in the southern portion of the Reserve, 250 pairs of sparrows were found in 1996. The long breeding season of this species, coupled with its sensitivity to disturbance, requires that human activities in the upper marsh be restricted for most of the year to avoid further declines in the population (Zedler, 1982b).

Least Bell's vireo nests in the riparian vegetation adjacent to intermittent streams and channels of the Tijuana River. Willow thickets are the main territorial sites both in the southern and eastern

portions of the Reserve. In 1995, there were approximately 54 least Bell's vireo territories in the estuary.

The Tijuana River Estuary is located along the Pacific flyway and is used for migration and wintering habitat for a variety of waterfowl and shorebirds. Wintering waterfowl include pintail, cinnamon teal, American widgeon, surf scoter, and ruddy duck. Reserve wetlands are important habitats for a large number of shorebirds (shorebirds account for the majority of the migratory bird population). While about 20 species occur regularly along the sandflats and mudflats of the estuary, four species -- willet, dowitcher, western sandpiper, and marbled godwit -- account for most of the shorebird population throughout the year (Boland, 1981). Abundance and species composition fluctuate seasonally. Intertidal sand and mudflats support the largest numbers of individuals and species.

g. Mammals

The estuary supports a mammal population typical of fields and lowland habitats. Rodents, including mice, the California ground squirrel, and rabbits, are most common, providing an important food source for the raptor population of the upper estuary. Coyotes, striped skunks, and the long-tailed weasel are also present in the Reserve (Taylor and Tiszler, 1989). The San Diego black-tailed jackrabbit, a California species of special concern, inhabits the southern portion of the Reserve.

3. Cultural Resources

A limited number of historical and archaeological sites exist in the lower Tijuana River Valley. Local records document about 16 archaeological sites in the nearby Border highlands area and along the coastal shore. An additional ten prehistoric sites have also been reported in a reconnaissance survey of Spooner's Mesa (City of San Diego, 1981). Excavations have uncovered three archaeological sites within the Reserve (California Department of Parks and Recreation 1974). Sites identified indicate past use by San Dieguito, La Jolla, and Yuman cultural groups.

Identified sites in Goat Canyon and Otay Mesa include a 4,000-year-old shell midden site in excellent condition, prehistoric quarries where stone was collected for the production of tools, and a habitation site. These sites show a range of human activities from thousands of years ago and are the best prehistoric lagoon occupations for this time period (Gallegos, 1992). The interpretive value of the midden site is very high as it can be used to discuss the range of biological life, prehistoric occupation at a coastal lagoon, and prehistoric occupation across Otay Mesa and southern California.

An early Spanish explorer observed a native village located in the valley in 1769, but the exact location of the village was not recorded. In addition, Smuggler's Gulch is believed to be the site of a camp made by Father Junipero Serra in the 1700s (City of San Diego, 1981).

The Reserve encompasses many recorded paleontological localities associated with two fossil-containing formations: the San Diego formation and unnamed Pleistocene terrace deposits

(Demere, 1984). The most significant aspect of these paleontological sites is the excellent preservation of the fossils. This is especially true for fossils from the San Diego Formation, which are preserved as original shell material. Some forms even retain color. Another significant aspect of these sites is that they are still available for field studies. This contrasts with other sites in the San Diego area, which have either been covered over or completely destroyed by urban development. The San Diego Formation (as studied in Chula Vista) also has a high potential for yielding important remains of fossil marine vertebrates, especially marine mammals. Marine mammal fossils are poorly known, and any sites containing such remains should be considered potentially significant and thus protected (Demere, 1984).

CHAPTER TWO: CORE PRINCIPLES

INTRODUCTION

This chapter articulates the core principles upon which the operation of the Tijuana River National Estuarine Research Reserve (NERR) is built. A summary of the statutory basis for the designation and the overarching mission of the site are provided first. Guiding principles for seamless operation and a five-year vision statement are discussed. The chapter also highlights a programmatic mission, and states the missions for seven substantive elements of the plan.

1. STATUTORY BASIS FOR THE TIJUANA RIVER NATIONAL ESTUARINE RESEARCH RESERVE AND THE TIJUANA SLOUGH NATIONAL WILDLIFE REFUGE SYSTEM

Tijuana Slough National Wildlife Refuge (NWR) was established in 1980 under provisions of the Endangered Species Act of 1973. The Reserve, which encompasses the Refuge, was established in 1982 under provisions of Section 315 of the federal U.S. Coastal Zone Management Act.

The Reserve operates as one of twenty-one units of the NERR System, and one of two on the California coast. This Reserve is also a unique composite of lands that comprise parts of other public lands systems operated by California State Parks, San Diego County Parks, City of San Diego, the Fish and Wildlife Service (FWS), and the Navy. Accordingly, the Reserve's core mission is derived from the NERR and NWR system mission and program goals, and from the goals, policies, missions, and statutory requirements of the landowning agencies.

A. THE NATIONAL ESTUARINE RESEARCH RESERVE SYSTEM PROGRAM GOALS

The National Oceanic and Atmospheric Administration (NOAA) regulations provide five specific goals for the NERR System:

1. Ensure a stable environment for research through long-term protection of National Estuarine Research Reserve resources;

2. Address coastal management issues identified as significant through coordinated estuarine research within the NERR System;

3. Enhance public awareness and understanding of estuarine areas and provide suitable opportunities for public education and interpretation;

4. Promote federal, state, public, and private use of one or more Reserves within the NERR System when such entities conduct estuarine research; and

5. Conduct and coordinate estuarine research within the NERR System, gathering and making available information necessary for improved understanding and management of estuarine areas.

B. NATIONAL WILDLIFE REFUGE SYSTEM GOALS

The goals of the FWS for the National Wildlife Refuge System are:

1. To preserve, restore, and enhance in their natural ecosystems (when practicable) all species of animals and plants that are endangered or threatened with becoming endangered;

2. To perpetuate the migratory bird resource;

3. To preserve a natural diversity and abundance of fauna and flora on Refuge lands;

4. To provide an understanding and appreciation of fish and wildlife ecology and man's role in his environment, and to provide Refuge visitors with high quality, safe, wholesome, and enjoyable recreational experiences oriented toward wildlife to the extent these activities are compatible with the purposes for which the Refuge was established.

II. TIJUANA RIVER NERR MISSION

Mission statements provide critical guidance to managers for the administration of public lands. All management plans and actions, and the obligation of resources, should support accomplishment of the mission.

Because Tijuana River NERR is a composite of lands and waters owned by a variety of local, state, and federal agencies, it is important to discuss and consider the missions of those agencies in the Management Plan/CMP. In the vast majority of cases, the mission statements of the constituent agencies/land systems are complementary and compatible with the NERR System Mission. In rare cases where missions may conflict, missions of the landowning agency have priority.

All constituent agencies have agreed to support the concept of a seamless reserve and the following mission statement for the Tijuana River National Estuarine Research Reserve:

"To preserve, protect, and manage the natural and cultural resources of the Research Reserve, enhance scientific understanding and education, ensuring compatible recreation and resource use for the benefit of present and future generations. This will be accomplished through partnerships with the community, educational institutions, and government entities working in the estuary, its binational watershed, and biogeographic region."

Management of the Reserve should also serve the missions of the NERR and NWR systems and landowning "operating" agencies CDPR and FWS (See Chapter 4). Those mission statements are

as follows:

NOAA, National Estuarine Research Reserve System:

"The National Estuarine Research Reserve System is a protected network of federal, state, and community partnerships that serve to promote informed management of the Nation's estuarine and coastal habitats through linked programs of stewardship, public education, and scientific understanding."

California Department of Parks and Recreation, California State Parks:

"The Mission of the California Department of Parks and Recreation is to provide for the health, inspiration, and education of the people of California by helping preserve the state's extraordinary biological diversity, protecting its most valued natural and cultural resources, and creating opportunities for high-quality outdoor recreation."

U. S. Fish and Wildlife Service, National Wildlife Refuge System:

The Mission of the National Wildlife Refuge System, as established by the National Wildlife Refuge System Improvement Act of 1997, is:

"To administer a national network of lands and waters for the conservation, management and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans."

III. THE TIJUANA RIVER NERR 5-YEAR VISION STATEMENT

The 1998 Management Plan articulates a new, bold vision for the Reserve that emphasizes its international geographic significance as the southwestern-most corner of the United States. The Reserve is a largely undiscovered, open space bordered on all sides by dense urbanized communities in the U.S. and Mexico. At present, the southern end of the Reserve is not visitor-friendly and contains degraded habitats. This area has been degraded by sewage spills, soil erosion, flooding, and sedimentation. Recent constructive efforts by several agencies to counter these problems have inspired a shared vision of this area as a welcoming open space for visitors and researchers.

The five-year vision statement for the Tijuana River NERR is as follows:

"To develop and implement an improvement plan for the southern end of the Reserve, emphasizing Goat Canyon, that integrates improvements in habitat restoration, stormwater management, resource management, law enforcement, public access, and education."

These improvements to the southern end of the Reserve will reduce negative impacts currently affecting the Reserve's most sensitive core area, the Tijuana Slough National Wildlife Refuge.

IV. PROGRAMMATIC MISSIONS

This Management Plan articulates a series of broad missions, goals, objectives, and tasks in the chapters that follow. Missions for each of the substantive management areas addressed in the plan are stated below.

A. ADMINISTRATIVE MISSION

- To provide administrative relationships and staff necessary to fulfill the Reserve's mission and goals as established in the administrative rules and interagency agreements.

B. RESOURCE PROTECTION, MANAGEMENT, AND RESTORATION MISSION

- To preserve the Reserve's ecosystems and maintain the integrity of those ecosystems through informed action.

C. RESEARCH AND MONITORING MISSION

- To contribute to an improved understanding of estuarine processes and dynamics that will benefit the management of the Tijuana River NERR and regional coastal ecosystems, and to improve the ability of resource managers to use monitoring to detect, quantify, and predict both short- and long-term changes in the health and viability of estuarine ecosystems.

D. EDUCATION AND INTERPRETATION MISSION

- To promote awareness of estuaries and improved stewardship through interactive, hands-on, thematic, bilingual environmental education to local and regional students, the community, and coastal decision-makers, working in partnership with local schools, community groups, and government agencies.

E. PUBLIC ACCESS, INVOLVEMENT, AND USE MISSION

- To provide diverse opportunities for public access and use of the Reserve, compatible with resource protection and Refuge purpose, and to create opportunities for the public to participate in Reserve operations.

F. FACILITIES MISSION

- To provide and maintain accessible facilities necessary to fulfill the Reserve's mission.

G. WATERSHED COORDINATION MISSION

- To advance the mission of the Reserve through the strategic development of working relationships with stakeholders and enhanced communication on scientific, cultural, political, and land-use issues in the Tijuana River watershed and the bioregion.

V. GUIDING PRINCIPLES FOR SEAMLESS OPERATION

A. COOPERATION AMONG AGENCIES

The cooperative relationship between the missions of the NERR System, NWR System, Tijuana River NERR, and the landowning and regulatory agencies is a core principle of the Reserve. All agencies agree that accomplishment of the Reserve's mission will further the accomplishment of their agency missions, and that their agency goals for their lands within the Reserve are, in fact, the goals of Tijuana River NERR. The Missions of the National Estuarine Research Reserve System, the National Wildlife Refuge System, and the California State Park System generally support each other. In rare instances of conflict, it is agreed that careful negotiation will be undertaken and that the fundamental policies of the underlying landowning agency takes precedence. (See Chapter 4, Administrative Framework).

B. MANAGEMENT AUTHORITY AS A CONSORTIUM THAT CREATES JOINT GAINS FOR TRNERR AND AGENCIES

The Tijuana River NERR Management Authority brings together the operating, landowning, resource, and law enforcement agencies, a research institution, and a public interest group in a structure that creates opportunities to advance the mission of the Reserve concurrent with the fulfillment of the missions of the respective agencies and organizations. While the Management Authority cannot set binding policies for the landowning and operating agencies, it provides guidance for the Reserve as a whole and facilitates coordination and cooperation between agencies. It is through this alliance that the complex network of interests at the Reserve can develop lasting, stable agreements on how to best protect the Reserve's resources.

C. RESERVE-WIDE PRIORITIES FOR RESOURCE PROTECTION AND RESTORATION

Protection and restoration of the estuarine environment and resources of the Reserve, consistent with the policies of landowning and land-use regulating agencies, are the highest priority goals of the Reserve. This priority underlies many of the programmatic goals, objectives, and tasks put forward in this Management Plan. The following approaches to implementing this priority are emphasized throughout the plan:

- Promote public awareness of and voluntary compliance with resource protection regulations.

- Coordinate resource protection activities among cooperating agencies.

- Implement the Tijuana Estuary Tidal Restoration Program and complementary projects to restore the tidal prism and representative populations of native fauna and flora to all degraded habitats, and to sustain high water quality in the Reserve.

- Avoid, minimize, and control on-site disturbances to estuarine resources and other

wetland and upland habitats.

- Identify, and where possible, minimize negative impacts to Reserve resources from off-site sources in the watershed.

D. PARTNERSHIPS

Forming partnerships is essential to the accomplishment of the mission and goals of Tijuana River NERR. The formation of partnerships is a core principle for successful communication and outreach, leveraging of resources, and solving internal and external problems related to successful management of any unit of public land. The Reserve exists, in its most basic form, as a partnership among member organizations and agencies of the Management Authority and NOAA. Without a positive spirit of cooperation among the members, the Reserve will fail to achieve its mission. Partnerships are a guiding principle of the National Wildlife Refuge System (E.O. 12996) and are part of the U.S. Fish and Wildlife Service's ecosystem approach to management.

This Management Plan recognizes the importance of partnerships in every facet of the Reserve's programs. Besides the internal partnership arrangement of the Management Authority, partnering is encouraged as an integral part of Resource Protection, Research, and Education and all Public Involvement, Access, and Use programs. The Management Authority and operating agencies will strive to partner with neighbors, community organizations, and the private business sector; with academia and the public sector research community; with other federal, state, and local law enforcement agencies; with non-governmental organizations; with agencies not represented formally on the Management Authority; with agencies and organizations in Mexico; and with other entities that can assist in accomplishing the Reserve's mission and goals.

CHAPTER THREE: ACCOMPLISHMENTS AT TIJUANA RIVER NATIONAL ESTUARINE RESEARCH RESERVE

INTRODUCTION

Since the establishment of the Tijuana River National Estuarine Research Reserve (NERR) in 1982, the list of accomplishments has grown significantly. Many of the actions first recommended in the 1986 Management Plan have been achieved. These accomplishments reflect the cooperative efforts of the agencies that have a stake in the protection and improvement of the Reserve. This chapter of the plan briefly summarizes accomplishments in the areas of facilities, resource protection, management and restoration, research and monitoring, education and interpretation, administration, and Reserve events. These accomplishments relied on innovative partnerships and creative funding initiatives. More detailed descriptions are provided in subsequent chapters.

1. FACILITIES ACCOMPLISHMENTS

A. VISITOR CENTER CONSTRUCTION AND DEVELOPMENT

The construction of the Tijuana River NERR visitor center building in 1991 was one of the most significant accomplishments at the Reserve. Funded by the National Oceanic and Atmospheric Administration (NOAA), the State Department of Parks and Recreation (CDPR), and the Coastal Conservancy in conjunction with Southwest Wetlands Interpretive Association (SWIA), the $1.5 million visitor center received several awards for design and gained acclaim both locally and nationally.

Shortly after the construction of the visitor center, the native plant garden and Phase I of the exhibits were completed. The exhibits were completed with funding and design input from NOAA, the U.S. Fish and Wildlife Service (FWS), CDPR, SWIA and other participants. Phase 11 of the exhibits is currently underway with funding from FWS and CDPR. The visitor center is operated jointly by FWS and CDPR and is open to the public five days a week.

B. TRAILS AND OUTLOOKS

Physical improvements to several key public access points at the Reserve have been made since 1986, including the following:

- Construction by FWS of a staircase from the city sidewalk to the trailhead for safer access at the end of the Refuge's Oneonta Trail (1997).

- Construction by FWS of a boardwalk on the east side of the Refuge, to provide safe access from the city street (1996).

- Construction by FWS of an interpretive overlook with several interpretive panels at the

end of Seacoast Drive. This outlook provides views of the marsh and dunes, and access to the beach (1995).

- Construction by FWS of an entry monument and interpretive deck at Imperial Beach Boulevard and Third Street. The outlook and monument provide a welcoming entry to the Reserve and, through placement of agency logos on the monument, indicate the cooperative arrangement between state and federal agencies (1994).

- Installation of bulletin boards at three key entrances to the Reserve: the trailhead of the 5th and Iris Trail, the southern end of Seacoast Drive, and the west end of Sunset Drive at the equestrian trail trailhead (1995-1997).

II. RESOURCE PROTECTION AND MANAGEMENT ACCOMPLISHMENTS

A. LAND ACQUISITION

From 1986 to 1998, 17 parcels comprising over 350 acres within the Reserve boundaries were transferred from private to public ownership, allowing for a more closely coordinated management effort. The following table summarizes acquisitions that have taken place since 1986.

TABLE 1: Summary of Land Acquisitions Since 1986

Parcel code*	**Acres**	**Year**	**Acquiring Entities**	**Method of Purchase**
QQ	25.0	1986	City of San Diego	Coastal Conservancy and NOAA funds
RR, TT, UU	72.96	1992	City of San Diego	Coastal Conservancy and NOAA funds
GG, HH, II	41.0	1997	County of San Diego	County Funds
OO	11.40	1996	City of San Diego	Donation
PP, WW, XX, YY, ZZ	52.88	1996	County of San Diego, State Parks, International Boundary and Water Commission	Multiple funding sources coordinated by Trust for Public Land
KK	79.39	1991	County of San Diego	County funds
R	26.30	1992	County of San Diego	County funds
JJ	39.83	1998	County of San Diego	County funds
Seacoast Dr. AP#632-040-16	1.25	1997	City of Imperial Beach	Multiple funding sources
TOTAL	**350.01**			

* Parcel codes keyed to 1986 Management Plan

B. ENDANGERED SPECIES PROTECTION

- Reserve employees have overseen the following activities to protect endangered species at the Reserve.

- The FWS initiated the "Tern Watcher" volunteer program in 1996 to improve signs and educate local citizens and beach users about how to enjoy the beaches without disturbing the California least terns and western snowy plovers.

- IBWC initiated cowbird trapping programs in the southern end of the Reserve in 1990 to remove nest parasites from critical habitat for the least Bell's vireo.

- In 1994, FWS listed riparian habitats in the Tijuana River Valley, including portions of the Reserve, as critical habitat for least Bell's vireo.

- FWS employees assigned to the Reserve assumed responsibility for on-site monitoring of California least tern/western snowy plover nesting areas in 1996.

- In the early 1990s, FWS initiated contracts with the Animal and Plant Health Inspection Service (APHIS) and qualified private contractors to provide dedicated predator management services to protect endangered species during the California least tern nesting season (April - September).

C. EXPANDED LAW ENFORCEMENT PROGRAM

The on-site presence of law enforcement officers at the Reserve has increased greatly since 1986. A full-time ranger from State Parks and FWS law enforcement officers patrol the Reserve, emphasizing coastal areas where the concentration of endangered species habitats is highest. There is increasing cooperation between the law enforcement divisions of the landowning agencies and the Volunteer Mounted Assistance Unit to provide more comprehensive public safety and law enforcement at the Reserve.

D. EXPANDED FIRE MANAGEMENT PROGRAM

FWS completed a fire dispatch plan for Tijuana Slough NWR in 1997. Additionally, starting in 1997, a seasonal FWS fire-fighting crew and engine were stationed at the Reserve.

E. DUNE STABILIZATION

FWS has conducted an annual program to stabilize and prevent erosion of dunes north of the River.

F. REOPENING OF RIVER CHANNEL AND CORPS OF ENGINEERS PERMIT

In 1989, following the repeated closures at the mouth of the estuary, FWS dredged the north channel of the estuary and reopened the estuary mouth to restore tidal flow. This project improved tidal circulation and promoted the flushing of sediments out of the estuary. Through a permit with the United States Army Corps of Engineers, in conjunction with other regulatory approval, re-dredging of the channels may be performed in response to flood or storm induced closures.

G. REMOVAL OF CONCRETE DEBRIS

To improve the visual esthetics and habitat values, 80 truckloads of broken concrete debris were removed from Navy lands operated by the FWS and from Refuge lands in 1995 and 1996. After the debris was removed from the four clean-up areas, the sites were revegetated with native plants and monitored for success in plant establishment.

H. REDUCTION IN CROSS-BORDER FOOT TRAFFIC

Through the early 1990s, Reserve habitats were degraded by foot traffic from undocumented immigrants from Mexico. A series of efforts by the Border Patrol and other state and federal agencies, including Operation Gatekeeper, resulted in increased enforcement at the U.S.-Mexico border by U.S. Border Patrol starting in 1994.

Ill. HABITAT RESTORATION

A. TIJUANA ESTUARY TIDAL RESTORATION PROGRAM

Hydrological and biological inventories and assessments were conducted and a Geographic Information System database was developed as a foundation for restoration planning. A long-range plan for restoring the estuary's tidal prism and intertidal wetlands was developed, and the plan was reviewed in a programmatic EIR/EIS approved and adopted by FWS and the Coastal Conservancy. The plan calls for approximately 500 acres of intertidal wetland restoration to be undertaken in increments using an adaptive management design process. The monitoring and evaluation of projects will influence design decisions for subsequent phases.

1. Construction of Oneonta Tidal Linkage

The first project of the program, a 1,200-foot channel connecting the northern end of Oneonta Slough and the tidal ponds southeast of the visitor center, was constructed in winter 1997. The channel is intended to improve the hydrology of Oneonta Slough, invigorating approximately 200 acres of prime saltmarsh. The Oneonta Tidal Linkage is a project coordinated by the California State Coastal Conservancy, and built by SWIA with funding from FWS and the Coastal Conservancy. An extensive research program is incorporated into the project and is being conducted by the Pacific Estuarine Research Laboratory.

2. Design for the Model Marsh

Final engineering plans for a 20-acre intertidal wetland restoration were prepared as a first module of the 500-acre south arm component of the Tijuana Estuary Tidal Restoration Program. The design emphasizes tidal creeks in the marsh plain. Excavated material is intended for use in a beach nourishment program. Implementation requires funding and additional regulatory approvals.

B. OTHER RESTORATION ACTIVITIES

1. Caspian and 3rd Street Riparian Area

In 1990, a stormwater channel was excavated to convey runoff from 3rd Street and Caspian Way to the marsh. The channel was planted with cottonwoods and willows to filter nutrients and contaminants, thereby protecting the Oneonta Slough habitats.

2. Native Plant Garden

A native plant garden was designed and planted shortly after the construction of the visitor center. The garden, which is approximately one acre in size, provides a welcoming entry to the visitor center and is part of the Reserve's interpretive program. The plants, which are all native to coastal southern California, are labeled and each species is described in a handout available at the Reserve.

IV. RESEARCH AND MONITORING

A. ACADEMIC RESEARCH

As one of the primary elements of the Reserve system, research has played an important role in the Tijuana River NERR. This is evidenced by the extensive research that has occurred during this time frame. A comprehensive list of the research is provided in Chapter Six of this plan.

Research accomplished by San Diego State University (SDSU) at Tijuana Estuary has guided the region's understanding of coastal wetland functioning. Several findings have led to general management recommendations at Tijuana Estuary and other coastal wetlands. Dozens of peer-reviewed publications, graduate theses, and technical reports have resulted from work at the Reserve.

Two types of outdoor experimental facilities were installed at the Reserve by SDSU's Pacific Estuarine Research Laboratory. One is a unique mesocosm facility that was used to test management techniques, such as salvage and propagation methods, controls on freshwater inflow, and modification of tidal flows. Results from experiments at the mesocosm facility were published in *Ecological Engineering* and *in Restoration Ecology*. The second major outdoor experiment relates to the Oneonta Tidal Linkage. Eighty-seven small plots were planted with 0, I-, 3-, and 6- species combinations and monitored to assess the differential nitrogen accumulation

capability, canopy complexity, and assemblage persistence. The four- year experiment is funded by the National Science Foundation, and results will help guide planting recommendation for the Reserve's restoration program.

B. DESIGNATION OF TRNERR AS AN AUXILIARY FIELD STATION

In July 1997, the Reserve was designated as one of San Diego State University's biological field stations. As an auxiliary field station, the Reserve strengthens its relationship between the Reserve and SDSU and the regional research community. The designation brings human resources to the Reserve and expands its opportunities for acquiring funding for research.

C. SITE PROFILE

A site profile of the Tijuana River NERR entitled The Ecology of Tijuana Estuary-.-- A National Research Reserve was completed in 1986 and revised in 1992 by Dr. Joy Zedler, Christopher Nordby, and Barbara Kus of Pacific Estuarine Research Laboratory, San Diego State University. Tijuana River NERR was the first NERR to publish a comprehensive description of its estuarine system. The description synthesizes and interprets the growing data base on the estuary's diverse biota.

D. ENDANGERED SPECIES MONITORING

Annual surveys for endangered species and their habitats have been performed by FWS since 1992 to assess changes in populations and range. Species surveyed include least Bell's vireo, light footed clapper rail, and least tern. The Tern Watcher program, which is largely staffed by volunteers, has been a highly successful integration of monitoring and public involvement.

V. EDUCATION AND INTERPRETATION

The construction of the visitor center and the permanent staffing of an education coordinator have enabled the education and interpretive programs to expand. The Reserve now sponsors interpretive tours, hosts school groups from the United States and Mexico (including an Extended-Year Program implemented in conjunction with the local school district), and offers teacher training workshops. All programs are offered in both English and Spanish. Teaching curricula have been developed that focus on the Tijuana River estuary and incorporate NERR system themes. A variety of printed materials and a website have been produced to assist in education and interpretation at the site.

Key achievements in educational programs, curriculum materials, and teacher workshops are:

- *Marsh Awareness with Resources for Slough Habitats:* Ecologically based curriculum about salt marshes written at the 4 to 6th grade level.

- *Making of a Naturalist:* Classroom and field activities that train students in the art of field observation.

- *Water Lines - Patterns in the Salt Marsh:* A curriculum for 10th grade that ties the watershed to the coastal wetland at the mouth of the drainage.

- *Rays-Recycle and You Save:* K-2 lesson plans for a recycling curriculum.

- ART-SCI: Workshops for teachers in how to use art to teach science.

- *'What's in Our Water" National Geographic Kid's Net:* Kid's Net kits distributed to schools, with additional materials tracing California's water distribution system and San Diego County watersheds.

- *Extended Year School - South Bay Union School District:* The education staff structured and scheduled classroom instruction and field work; provided teacher, teacher aide and volunteer training; developed and revised materials used at the estuary and in the classroom; and conducted field classes at the estuary, practicing field observation of birds and plants followed by activities in the garden.

- *Bilingual teacher training workshops.*

- *Weekly water-testing activities in the education laboratory.*

VI. ADMINISTRATION

A significant achievement at Tijuana River NERR was the recent signing of a Letter of Agreement between the CDPR and FWS that formalized the commitment of cooperation between agencies to manage a seamless reserve. CDPR and FWS now cooperatively handle operations throughout the Tijuana River NERR (in particular the visitor center). The two agencies authorized several specialist positions to carry out the goals of the Reserve program. The Reserve manager's supervisory status as an employee of CDPR enables this position to have full responsibility for the operations of CDPR programs and shared responsibility for cooperative programs. The FWS recently established a full-time position to serve as the on-site Interpretation/Education Coordinator. CDPR has authorized a full-time position to be in charge of the primary Education Program for the Reserve.

VII. VISITS, CONFERENCES, AND ACTIVITIES

The following is a partial list of site visits, conferences, and related activities hosted by the Reserve, or in which Reserve member agencies actively participated.

- United Nations Association Environmental Subcommittee - Held annually
- Imperial Beach Economic Development Committee - 1996
- Imperial Beach Tourism Task Force - 1995-1996
- Coastal Decision-makers Workshop - 1996

- Tijuana River Watershed GIS Project - 1996
- Site visit by Department of the Interior Binational Subcommittee
- Site visit by the Undersecretary of Commerce
- Ecoparque Opening in Tijuana
- International Art Exhibits
- Imperial Beach Bird Festival
- Eagle Scout Activities
- Creation of a Reserve website
- Natural History Lectures
- Reserve representation at International Sewage Treatment Hearings
- Reserve representation at Tijuana River Flood Task Force Meetings

CHAPTER FOUR: ADMINISTRATIVE FRAMEWORK

INTRODUCTION

Tijuana River National Estuarine Research Reserve (NERR) is a partnership between the United States and the State of California. Tijuana River NERR links together National Oceanic and Atmospheric Administration (NOAA), U.S. Fish and Wildlife Service (FWS), and California Department of Parks and Recreation (CDPR). In addition, several regional agencies and local municipalities share ownership and management responsibilities at the Reserve.

The Management Authority is the multi-agency body that coordinates policy and operations on a Reserve-wide basis. Through voluntary participation in the Management Authority, member agencies consent to establish Reserve-wide policies, jointly promote Reserve programs, and cooperate to provide funding and staff to accomplish the missions of the Reserve and the constituent land systems.

The roles and responsibilities for the Management Authority, the operating agencies, and affiliate organizations are defined in this chapter. This chapter also provides an action plan through which the Reserve can improve its administrative framework to better serve the public.

I. MISSION

The mission of the administrative framework plan at the Reserve is to:

Provide administrative relationships and staff necessary to fulfill the Reserve's mission and goals as established in the administrative rules and interagency agreements.

II. GOALS

Goal 1.
Maintain an administrative framework that maximizes interagency cooperation and allows the Reserve to take full advantage of funding opportunities.

Goal 2.
Establish and maintain an effective administrative structure that provides clear policy direction and guidance in the management of the Reserve.

Goal 3:
Coordinate and cooperate with federal, state, and local partners to manage a seamless reserve that addresses watershed and ecosystem-level concerns while meeting the established purpose of the National Wildlife Refuge (NWR) (Refuge Goal).

III. POLICIES

A. RELATIONSHIP TO FEDERAL AND STATE GOVERNMENT

1. The National Estuarine Research Reserve System Administration

Each National Estuarine Research Reserve (NERR) is jointly operated by a state and the federal government. The federal interest is represented by NOAA's Estuarine Reserve Division (ERD). NOAA's mission includes management of the nation's coastal resources and promotion of global stewardship of the world's oceans and atmosphere through science and service. ERD coordinates the NERR System nationally and administers NOAA grant funds to state partners at individual Reserves.

The NERR System is intended to operate as a federal/state partnership. Although the management of a reserve, including development of site-specific policies, is a state's responsibility, NOAA provides overall system policies and guidelines, funding, and program assistance. In addition, NOAA evaluates the reserves every three years. The purpose of the NOAA review is to ensure that a state is complying with NOAA/NERR goals, approved work plans, and reserve management plans.

Pursuant to Coastal Zone Management ACT (CZMA) enabling legislation (Sections 312 and 315), NOAA must conduct performance evaluations of the operation and management of each reserve while NOAA's federal financial assistance continues. If deficiencies in the operation or types of research conducted at a reserve are found, NOAA may withdraw financial assistance to the reserve until remedies are in place. National Estuarine Research Reserve designation can be withdrawn by NOAA when a reserve is found to be deficient and fails to correct deficiencies within a reasonable time.

The state interest is usually represented through one or more state agencies or universities. Typically these are agencies charged with environmental, wildlife or coastal management responsibilities. States usually administer reserve personnel and day-to-day reserve management.

2. The National Wildlife Refuge System Administration

The Tijuana River NERR is an atypical NERR because FWS is an additional federal partner. NOAA provides no funding for or oversight over NWR management. On the NWR portion of the Reserve, FWS, not the state, has primary authority. At the Reserve, FWS and CDPR have agreed to cooperate in joint day-to-day Reserve management.

Tijuana Slough National Wildlife Refuge (NWR) is a unit of the National Wildlife Refuge System (NWRS), administered by U.S. Fish and Wildlife Service (FWS). The Refuge System includes habitats in all 50 states, Puerto Rico, the Virgin Islands, and Guam. Since establishment of the first NWR in 1903, the NWRS has grown to include over 512 units, totaling over 92 million acres. The Refuge System is the only federal lands system dedicated to wildlife conservation and is the most diverse and complete collection of habitats managed by any resource agency in the world.

Tijuana Slough NWR is administered by FWS Region 1, headquartered in Portland, Oregon. Tijuana Slough NWR is one of four NWRs of the San Diego NWR Complex, headquartered in Carlsbad, CA. The project leader for the San Diego Complex administers all NWRS units in the county and represents FWS on the Management Authority. Budget and personnel ceilings for the Tijuana Slough are included in Complex allocations. The on-site manager oversees day-to-day operations at Tijuana Slough, including coordinating the Operating Agency partnership with CDPR, directing and supervising assigned staff, and planning and executing all Refuge programs at the Reserve.

3. California Department of Parks and Recreation Administration

CDPR is the federally designated administrative lead agency at Tijuana River NERR. As the designated state agency in the NERR partnership, the state matches NOAA's financial contribution, primarily by providing staffing for the Reserve. As one of the major landowners within the Reserve, CDPR also manages Border Field State Park as part of the overall state parks system.

IV. EXISTING CONDITIONS AND PERCEIVED NEEDS

A. OVERVIEW OF EXISTING ADMINISTRATIVE FRAMEWORK

The Reserve is unique among the 21 units of the NERR System in its composition and management. Unlike most NERRS, which are managed by a single state agency with state and NOAA funding, the Reserve is an aggregation of local, state, and federal lands subject to "hands-on" management by each landowning agency.

CDPR is the NERR-designated state agency that, with NOAA support, contributes significantly to the Reserve. The Fish and Wildlife Service contributes additional significant federal resources. Additional state resources are provided by the California Coastal Conservancy and the California Coastal Commission. Local governments, including the County of San Diego, the City of San Diego, and the City of Imperial Beach, each contribute to the Reserve program and coordinate policy with Reserve staff.

Like most NERRS, the Reserve's activities are reviewed by a Management Authority comprised of representatives of the cooperating agencies and organizations, landowners, and non-owners. The Management Authority coordinates and unifies Reserve programs.

Within the Reserve, CDPR owns and administers 418-acre Border Field State Park. The Superintendent of Border Field State Park also serves as Reserve manager and is responsible for administering NOAA funding and programs at the Reserve.

The Fish and Wildlife Service administers Tijuana Slough National Wildlife Refuge, including fee lands of the FWS and U.S. Navy, and adjacent state tidelands under a lease from the California State Lands Commission.

The City of San Diego and County of San Diego also own and administer land within the Reserve. County lands are part of the San Diego County Parks System. City lands are currently operated and maintained by the County Park System under a City/County Memorandum of Understanding.

The management structure of the Reserve is shown in Figure 9.

B. OVERVIEW OF ROLES AND RESPONSIBILITIES BY AGENCY CATEGORY

1. Roles and Responsibilities of the Management Authority

The Management Authority member agencies have joined together to coordinate policy, enhance communication, leverage resources, and achieve mutual Reserve- wide missions and goals. The responsibilities of the Reserve's Management Authority are:

- to coordinate activities of the various constituent agencies;
- to provide Reserve-wide policy guidance;
- to oversee progress toward achieving NERR System requirements and Reserve goals; and
- to provide a forum for discussing complex issues and addressing conflict.

The Management Authority meets quarterly, or as needed, to conduct Reserve business and obtain public input. In the rare situation where an agreement cannot be reached through the Management Authority voting process, each agency retains the responsibility and authority to carry out its primary objectives on the property it owns or manages. Any activities carried out in the Reserve must, however, be consistent with this plan.

a. Composition of the Management Authority

The Management Authority consists of nine permanent members and two term members, as described below. Once appointed, permanent and term members have equal status. Additional seats, whether permanent or term, may be created by the Management Authority.

(Updated table of TRNERR Administrative Structure (FIGURE 9) to be created here)

i. Permanent Members

Permanent members of the Management Authority are appointed representatives of the major public landowning agencies, the cities and the county where the Reserve is located, and state agencies with primary missions to protect coastal resources.

The nine permanent positions on the Management Authority are held by representatives from each of the following agencies:

California Coastal Commission

California Department of Parks and Recreation
U.S. Fish and Wildlife Service
State Coastal Conservancy
U.S. Navy
City of Imperial Beach
City of San Diego
County of San Diego
U.S. Border Patrol

In addition, NOAA holds a permanent, nonvoting seat on the Management Authority.

ii. Term Appointments

There term positions are held by organizations that promote the mission of the Reserve. One position is held by a representative of a local university or research facility. A second position is held by a representative of a non-governmental organization with 501(c)(3) status and a stated mission that supports the Reserve. Terms last two years; there is no limit to the number of terms for each organization. The nine permanent members of the Management Authority are responsible for appointing the two term positions. The Management Authority may offer term membership to universities or non-profit organizations based on the following criteria:

- an expressed interest in participating in the Management Authority,
- a demonstrated commitment to the long term mission of the Reserve, and
- an assessment that the organization would provide a partnership that is beneficial to multiple Reserve programs.

Upon ratification of the updated Management Plan, two-year term memberships will be offered to San Diego State University (SDSU, a research institution) and Southwest Wetland Interpretive Association (SWIA, a non-governmental organization).

2. Roles and Responsibilities of Management Authority Committees

Five standing committees advise the Management Authority in the conduct of its business:

- Resource Protection, Management, and Restoration Committee: responsible for Reserve-wide biological and cultural resource management programs, law enforcement, habitat management, restoration, and enhancement.

- Research and Monitoring Committee: responsible for coordinating research and scientific monitoring at the Reserve.

- Education and Interpretation Committee: responsible for environmental education and outreach activities of the Reserve.

- Public Access, Use, and Involvement Committee: responsible for recreation programs, law enforcement, signage and publications, and public affairs.

- Watershed Coordination Committee: responsible for cross-border programs with partners in Mexico, and all binational issues affecting the Reserve, its resources, and its programs.

These committees assist the Management Authority in accomplishing the goals of this plan. Committees consist of the Reserve staff and interested community members. Each committee must include at least one member of the Management Authority, who is designated as the committee chair. Committees are charged with considering issues referred by the Management Authority, developing options, proposing strategies, and making recommendations to the Management Authority. An important function of the committees is to involve the public directly in the decision-making process at the Reserve. Committee chairs accept assignments from the Management Authority and hold regular committee meetings. The committees may provide reports and recommended actions to the Management Authority for their approval. Reports and recommended actions are to be provided to the Management Authority in writing prior to the Management Authority meeting.

Ad hoc committees are formed to address specific issues outside the existing committee format. Ad hoc committees have been formed on the issues of trails, law enforcement, and visitor center exhibits.

3. Roles and Responsibilities of the Operating Agencies

Day-to-day management of Reserve programs, including resource protection, land management, and all public-use programs, is a joint responsibility of the operating agencies (CDPR and FWS). The operating agencies have agreed, through a "Letter of Agreement" (Appendix 6), to operate a seamless reserve and to conduct their operations in a coordinated manner. Both operating agencies are equally committed and responsible for all Reserve programs. This is a major change from the 1986 Management Plan framework, in which FWS was the lead agency for wildlife resource/biological programs, and CDPR was lead agency for all other programs.

The one exception to shared responsibilities for Reserve management is the relationship with NOAA, including administration of NOAA resources supporting the Reserve. By law, the Reserve manager is a state employee. At the Reserve, the state park superintendent serves as Reserve manager. The Reserve manager is the public voice for NERR System programs and is responsible for meeting NOAA reporting requirements, administering NOAA grants, and reporting on NOAA funding and reviews to the Management Authority.

The Reserve manager and on-site Refuge manager constitute the Reserve management team. They are charged by their respective agencies and the Management Authority with closely coordinating all Reserve programs, and ensuring that the operating agencies' efforts and leveraged resources are cooperative and directed at achieving the Reserve mission. While each agency administers its lands in accordance with agency policy, decisions on day-to-day program operations are reached jointly by the on-site managers of the operating agencies to the maximum extent possible.

Development, operations, and maintenance of Reserve facilities are the responsibility of the operating agencies. The operating agencies recommend Reserve-wide proposals to the Management Authority. The Management Authority will provide advice and act to advance the Reserve mission.

4. Roles and Responsibilities of the Cooperating Agencies

Cooperating Agencies serve on the Management Authority but are not involved in the daily operation of the Reserve. They are as follows:

a. Office of Ocean and Coastal Resource Management (OCRM)

OCRM is the NOAA division responsible for implementing the NERR System in partnership with state and local governments, federal agencies, non-governmental organizations, and universities.

The NERR System is administered by the Estuarine Reserve Division (ERD) of OCRM within NOAA. This division is authorized under the Coastal Zone Management Act to make matching grants to states for acquisition, development, and operation of NERRs (not NWRS). As part of this authority, the ERD is responsible for ensuring that each reserve is managed according to the NERR Regulations (15 CFR 921) and individual grant awards.

b. State Coastal Conservancy

The State Coastal Conservancy is responsible for coordinating reserve land acquisition and resource restoration programs outlined in the Management Plan. The Conservancy carries out its work in close coordination with each landowning agency and the Management Authority. The Conservancy's emphasis is to facilitate planning across jurisdictional boundaries, both within the Reserve and adjacent areas of the watershed. Work includes the analysis and planning necessary to support restoration and acquisition activities, and identifying and securing funds needed for implementation and management of projects.

c. California Coastal Commission (CCC)

The CCC is responsible for reviewing coastal development permits in areas of the coastal zone not covered by a local government's Local Coastal Program (LCP); monitoring the implementation of local government LCPS; enforcing violations of the California Coastal Act; and reviewing certain federal activities and federally funded or permitted projects for consistency with the State's approved coastal management program. The CCC also maintains a land-use planning role and works with local jurisdictions in development and amendments to their LCPS.

d. City of San Diego

As the majority of the Reserve and U.S. portions of the Tijuana River Valley are located within the San Diego corporate limits, the City has land use and regulatory responsibilities. The City

also has responsibilities for providing local services (police, fire, etc.); the permitting or construction and maintenance of new and existing infrastructure improvements (flood control); and ensuring compliance with federal floodway regulations. In addition, the City is a landowner, and held approximately 285 acres of land within the Reserve boundary at the time this document was drafted. An agreement established in July of 1997 transfers ownership of lands south of the Tijuana River to Border Field State Park. Remaining City-owned parcels near the eastern boundary of the Reserve are managed by the County of San Diego under a 1996 agreement. The City is also involved in the construction of portions of the International Wastewater Treatment Plant, the South Bay Ocean Outfall, the water reclamation plant, the replacement of bridges at Dairy Mart Road and Hollister Street, and mitigation associated with all projects currently under design or construction.

e. County of San Diego

The County of San Diego is responsible for land acquisition, restoration, resource protection, management, and environmental education on County Parks lands within the estuary and the Tijuana River Valley. The County provides matching funds and in-kind services, when available, and coordinates with other agencies. County of San Diego representatives also provide consultation and services related to ocean water quality testing, integrated pest management, hazardous materials management, mosquito control, and disease prevention.

f. City of Imperial Beach

The City of Imperial Beach owns no land within the Reserve, but has land-use responsibility over portions of the Reserve within its corporate limits. The City is responsible for any general plan amendments and modification to zoning plan ordinances. The City is planning to appoint a representative to identify and explore opportunities within the City of Imperial Beach to promote eco-tourism and use in the Reserve.

g. U.S. Border Patrol

The United States Border Patrol prevents illegal immigration into the U.S. and is the most visible agency in the southern end of the Reserve. As a member of the Management Authority, the Border Patrol is able to coordinate its patrol efforts with the Reserve's resource management program and advise and contribute to resource protection efforts.

h. San Diego State University

The Reserve is an auxiliary field station for San Diego State University. The majority of the research conducted at the Reserve since its designation has been conducted by the university's Pacific Estuarine Research Laboratory. SDSU is nationally recognized for its work in coastal wetland restoration and advises on the Reserve's restoration activities.

i. Southwest Wetland Interpretive Association

Southwest Wetland Interpretive Association (SWIA) is a non-profit organization with 501(c)(3)

status dedicated to preservation, restoration, and education in the Tijuana River Valley and its wetlands. It is member supported and works with federal and state resource agencies dedicated to the protection and enhancement and interpretation of wetlands. SWIA's primary objectives are protection of the Reserve, fundraising, and administration of grants for restoration of damaged wetlands, education and revegetation, and the preservation of threatened resources through land trust acquisitions.

C. ROLES AND RESPONSIBILITIES FOR RESOURCE PROTECTION MANAGEMENT, AND RESTORATION

1. TRNERR Management Authority

Consistent with the 1995 NERR System Strategic Plan and the Management Plan, the Management Authority reviews and approves annual and long-term priorities for resource protection and restoration work within the Reserve as well as involvement of the Reserve in the Tijuana River watershed. The Management Authority also develops new programs and funding sources to address new resource protection and restoration issues as they arise, and provides input to regulatory agencies that review off-Reserve projects within the watershed.

Within the Management Authority, the Resource Protection, Management and Restoration Committee has the primary role of evaluating resource protection proposals and projects and makes recommendations on them to the full Authority.

2. The Operating Agencies - CDPR and FWS

The operating agencies are each responsible for all resource protection and restoration activities that occur within the boundaries of their land units (State Park and National Wildlife Refuge shown in Figure 3). The operating agencies also develop plans for restoration projects and assist in preparation of environmental compliance documents for restoration work.

When possible, the operating agencies provide funding, technical assistance, and personnel to assist in planning, supervision, construction, monitoring, and maintenance of restoration and resource protection projects. The operating agencies also coordinate with the Management Authority on all controversial or sensitive resource protection and restoration activities.

The operating agencies are the primary law enforcement agencies in the Reserve. CDPR and FWS are both responsible for protection of resources in their jurisdictions, and for coordinating and cooperating with each other and with other law enforcement, including San Diego Police, San Diego County Sheriff, California Department of Fish and Game, and the U.S. Border Patrol. A Law Enforcement Memorandum of Agreement is currently being negotiated and will detail the Reserve Enforcement Program.

3. The Cooperating Agencies

<u>a. The State Coastal Conservancy</u>

The State Coastal Conservancy is the primary agency responsible for planning and coordinating execution of Reserve-wide habitat restoration. The Conservancy provides funds and staffing, as available, to plan habitat protection and restoration projects. The Coastal Conservancy also seeks outside sources of funding for Reserve programs. The Coastal Conservancy serves as a liaison for agencies that regulate Reserve activities.

b. The California Coastal Commission

The California Coastal Commission is responsible for regulating coastal zone development in areas not covered by the certified Local Coastal Program (LCP), and as such must review Reserve projects and provide permits for restoration projects. The Coastal Commission also monitors implementation of local government's LCPs and enforces violations of the Coastal Act.

c. The County of San Diego

The County is responsible for managing County and City of San Diego-owned lands of the Reserve consistent with county policy and this plan, and coordinates land use and resource protection activities that overlap the Reserve and Tijuana River Valley Regional Park.

D. ROLES AND RESPONSIBILITIES FOR EDUCATION AND INTERPRETATION

1. TRNERR Management Authority

The Management Authority reviews annual priorities for interpretation and education to ensure consistency with NERR Strategic Plan and Three-Year Action Plan goals. The Management Authority also evaluates progress toward achieving NERR and Reserve goals in these program areas and adjusts long-term priorities. The Management Authority's Research and Monitoring, Education, and Interpretation and Public Access, Use, and Involvement committees each have responsibilities to study, review, and recommend changes and improvements to the education and interpretation programs.

2. Operating Agencies

CDPR and FWS are jointly responsible for operational planning and execution of Reserve education and interpretation programs. The Reserve manager/park superintendent and the on-site Refuge manager agree to tailor their staff assignments to best meet program needs with minimal duplication of effort and maximum economy. Specific responsibilities will vary, depending on staffing levels and skills and abilities of staff.

As viewed by the Management Authority and the operating agencies, the Interpretation and Education program includes formal environmental education to primary and secondary school students, educational efforts directed at coastal zone regulators and managers, staff-presented and self-guided interpretive programs, outreach and media relations, and teacher and docent training.

With NOAA funding, CDPR will generally provide the Reserve environmental education

coordinator. FWS provides a public use specialist.

3. Cooperating Agencies

a. Southwest Wetlands Interpretive Association (SWIA)

SWIA provides non-governmental support to the interpretation and environmental education programs of the Reserve. SWIA raises funds through operation of the Cooperating Association Sales Outlet (bookstore) in the Reserve Visitor Center and a variety of other means. Part of those funds are used to enhance interpretation and environmental education programs. Requests for SWIA funding are submitted by the Reserve manager for review and approval by the SWIA Board of Directors. Many SWIA members also volunteer at the Reserve, serving as docents and educators.

b. Other Cooperating Agencies

The California Coastal Conservancy, California Coastal Commission, County of San Diego, and City of San Diego may all provide technical assistance and funding (as available) to assist the operating agencies in implementing the public use, interpretation, and education programs of the Reserve.

E. ROLES AND RESPONSIBILITIES FOR RESEARCH AND MONITORING

1. TRNERR Management Authority

The research responsibilities of the Management Authority include reviewing Reserve Research plans to ensure they complement NOAA Strategic and Three- Year Action Plan research goals, and evaluating the overall progress toward achieving NERR System and Reserve priorities.

Most of the research responsibilities of the Management Authority are executed by the Research and Monitoring Committee (See Chapter 6). The Research and Monitoring Committee meets with the operating agencies to review applications to conduct research at the Reserve. Applications are accepted twice a year and are reviewed by a committee representing the Management Authority, operating agencies, and members of the scientific community. (See Chapter 6 for details of Reserve Research Protocol.) Research on Tijuana Slough NWR must be compatible with the Refuge purpose.

The Research and Monitoring Committee also assists and advises the operating agencies in execution of NERR System-wide monitoring efforts at the Reserve.

2. Operating Agencies

CDPR and FWS are responsible for approval of research that occurs on State Park and National Wildlife Refuge (including Navy lands), respectively. All research on the Reserve must be approved and authorized under a special-use permit signed by the Reserve manager or Refuge manager. CDPR and FWS will institute a joint permitting system to be used whenever practical.

The operating agencies will coordinate closely with the Research and Education Committee of the Management Authority to ensure that research conducted on the Reserve is compatible with resource protection; scientifically sound; compatible with existing public uses including interpretation, education, and existing research efforts; and whenever possible, contributory to NERR System goals. The review of research applications will be a joint exercise of the operating agencies and the Research and Education Committee. Research on Tijuana Slough NWR must be compatible with the Refuge purpose.

The operating agencies are responsible for implementing the Reserve Monitoring Program funded by NOAA. This may be accomplished by CDPR or FWS personnel under direction of the Reserve manager and on-site Refuge manager, or by a Reserve-administered contract with universities or other entities.

3. Cooperating Agencies

a. Landowning Agencies

Landowning agencies are ultimately responsible and have final approval over research proposed to be conducted on their lands.

b. San Diego State University

Historically, SDSU has funded and its scientists have conducted the vast majority of research at the Reserve, and plays an active role on the Research and Monitoring Committee. SDSU serves as a liaison with the academic community and advises the Reserve staff on resource protection and restoration. A wide range of research and monitoring, including the NERR System monitoring activities, are performed by SDSU.

4. Affiliated Organizations

a. Researchers

Research personnel from all sources, including universities, government agencies, nongovernmental organizations, and private citizens are all welcome to apply to conduct scientific studies at the Reserve. Researchers are responsible for following the protocol established in Chapter 6 of this Management Plan, including meeting all deadlines for applications and meeting all permitting requirements. Failure to follow procedures or meet deadlines may result in rejection of applications.

F. ROLES AND RESPONSIBILITIES FOR PUBLIC ACCESS, INVOLVEMENT, AND USE

1. TRNERR Management Authority

The Management Authority coordinates Reserve-wide policies for public involvement, use, and access. The meetings of the Management Authority provide a forum where the public can

present comments and suggestions on Reserve operations. The committees of the Management Authority are a vital link to the public; members of the public are recruited to lend their expertise to committees.

2. Operating Agencies

The operating agencies designate and maintain safe access to and through the Reserve. They encourage visitor use and involvement to the extent compatible with resource protection (and, where applicable, with Refuge purposes). They also staff the volunteer program and a public relations program and coordinate with independent volunteer groups.

3. Cooperating Agencies

Individual agencies and organizations provide recommendations and funding for improved public access. In some cases, cooperating agencies own land adjacent to the Reserve boundary and can collaborate on trail linkages and regional recreational planning.

G. ROLES AND RESPONSIBILITIES FOR FINANCIAL MANAGEMENT AND ACQUISITION OF FUNDING

1. TRNERR Management Authority

The Management Authority may make recommendations to the operating agencies on the financial needs and priorities for spending at the Reserve, but has no specific financial reporting responsibilities.

2. Operating Agencies

The responsibility for accurate financial tracking and reporting lies primarily with the operating agencies.

a. CDPR

The Reserve manager is responsible for accurately budgeting operation needs and sending financial statements and performance reports to State Parks headquarters and NOAA.

Many Reserve projects are supported through grants or funding from Cooperating Agencies such as NOAA, SWIA, and the State Coastal Conservancy. Grant categories have included operation and management, development, planning and construction, acquisition, education, and research and monitoring. In order to receive each financial assistance award, quarterly or semi-annual performance and financial reports are required.

In addition to submitting financial reports, the Reserve must "draw down" on federal funds available. This requires coordination between CDPR's field office in San Diego and CDPR's headquarters in Sacramento.

In past years, financial management of NOAA funds at the Reserve has needed improvement. During a NOAA 312 review, completion of an updated Management Plan and implementation of a financial and program reporting system were required of the Reserve staff. The actions regarding reporting were completed by February 1997 and are now part of standard practices at the Reserve.

b. FWS

FWS funds operations and maintenance of Tijuana Slough NWR and, within the overall Reserve, is a major federal contributor of funds and staff resources. FWS receives no funding from NOAA and has no financial management responsibilities to NOAA. Funding of the Reserve is a responsibility of the NOAA/CDPR relationship. Refuge and Reserve budgets and financial management are separate and are tied only through voluntary cooperation of FWS and CDPR.

Refuge management is funded through annual congressional NWR Operations and Maintenance (O&M) appropriations. Refuge O&M funds are targeted and managed at the San Diego NWR Complex headquarters. Besides the O&M account, special funds for programs such as Fire Management or the Partners for Fish and Wildlife Program may also be available to the Refuge on an annual basis. All funds are Complex funds and are not specifically targeted to Tijuana Slough NWR.

The Refuge Complex Manager annually provides funds to the Refuge manager, Tijuana Slough NWR, for staff salaries, supplies, equipment, programs, and contracts. FWS contracting officer support and timekeeping/payroll support are provided by the Complex headquarters in Carlsbad, CA, and the regional office in Portland, OR. The on-site manager is an authorized government Visa cardholder and is authorized to make most routine purchases required for day-to-day operation of the Refuge.

FWS is authorized by various legislation to make grants to, and enter cooperative agreements with, state and local government agencies and certain educational and non-profit private organizations. These authorities provide excellent mechanisms to leverage resources within the Reserve partnership. FWS is authorized to accept contributed funds. FWS can also receive and provide funds to other federal agencies through a variety of mechanisms.

Refuge funding needs are identified, and appropriations justified, through the NWRS Maintenance Management System (MMS) and Refuge Operating Needs System (RONS) databases. MMS projects identify funding needs to replace, rehabilitate, or repair existing real and capitalized property. RONS projects identify additional funding and staffing requirements needed to operate the NWR at the level necessary to accomplish the goals of this Comprehensive Management Plan. A list of RONS projects is located at Appendix 2.

Tijuana Slough NWR may also receive FWS fiscal resources through other appropriations. These may include funds from fire management and private lands sub-activities, and contributed funds. Again, these resources are fund targeted to the Refuge Complex and managed similar to Refuge O&M funds.

3. Cooperating Agencies

When possible, Cooperating Agencies seek funding from within their agencies to fund Reserve projects. Cooperating agencies may also seek grants from outside sources to fund projects at the Reserve.

H. TRNERR STAFFING

An overview of current staffing is provided below.

TABLE 2: Current Staffing at Tijuana River NERR'

(table to be created for new plan)

TABLE 3: Proposed Additions and Modifications to Staffing at TRNERR

(table to be created for new plan)

1. Description of Additional Staff Positions Needed

Office Assistant

Administrative support is needed for both the Refuge and Reserve manager. The Reserve is currently without administrative support and the addition of this position would improve the Reserve performance in responding to grant proposals, permit proposals, and financial reporting. Proposed duties include clerical support and record-keeping. Either CDPR or FWS could contribute funding for this position.

Research Coordinator

Current needs for the position are identified in the Research and Monitoring section of this plan (see Chapter 6). Proposed duties would include maintaining and improving the Reserve GIS system, reviewing research applications, acting as a liaison with research institutions to promote management-oriented research, improving record-keeping and documentation of historic and current research at the Reserve, and implementing the NERR System research and monitoring guidelines. Research coordination currently falls to the Reserve and Refuge managers. Potential funding sources for this position are NOAA, CDPR, FWS, and SDSU.

Law Enforcement Officer

Law enforcement needs are identified in the Resource Protection, Management, and Restoration section of this plan (see Chapter 5). The FWS law enforcement officer would patrol Tijuana Slough NWR and other refuges in the San Diego NWR Complex, direct crime prevention at the Refuge, act as a liaison for coordination with other agencies on law enforcement matters, plan public use and law enforcement programs, assist with the interpretive program, and serve as the

complex safety officer.

Watershed Coordinator

The watershed coordinator would implement the watershed plan identified in chapter 10. Currently, watershed coordination functions are performed in a limited capacity through the Education and Interpretation program. The watershed coordinator is likely to be a State Parks employee. Potential funding sources are CDPR, NOAA, cooperating agencies, and grants from state and federal sources.

Volunteers

In addition to regular staff, community members support the Tijuana River NERR in diverse capacities. Recruitment, orientation, and work schedules are currently coordinated by the Interpretive and Education Specialist and by staff members.

V. ADMINISTRATIVE PLAN OF ACTION

Goal 1. Maintain an administrative framework that maximizes interagency cooperation and allows the Reserve to take full advantage of funding opportunities.

Objective 1a: Maintain and foster a mutually supportive administrative relationship between the operating agencies.

Task:

- Maintain cooperative management structure of the Reserve by the Refuge and Reserve managers and their staffs as detailed in the Letter of Agreement.

Objective 1b: Ensure adequate staffing, to accomplish the mission, goals and objectives of the Reserve.

Tasks:

- Acquire funding for additional staff positions through funding agencies or grants.
- Improve staffing by expanding the volunteer program.

Objective 1c: Maintain and foster a positive, mutually rewarding relationship with NOAA's NERR System.

Objective 1d: Fulfill the mission and goals of the National Wildlife Refuge System and the San Diego National Wildlife Refuge Complex.

Goal 2. Establish and maintain an effective administrative structure that provides clear policy direction and guidance in the management of the Reserve.

Objective 2a: Maintain the role of the Management Authority as an advisory and policy-

coordinating body that promotes cooperation between the 12-member representatives.

Objective 2b: Increase the level of decision-making done at the committee level, where opportunity for public involvement is greater.

Objective 2c: The Management Authority should annually establish Reserve priorities to ensure successful implementation of the Management Plan.

Goal 3. Coordinate and cooperate with federal, state, and local partners to manage a seamless reserve that addresses watershed and ecosystem-level concerns while meeting the established purpose of the NWR. (Refuge Goal)

CHAPTER FIVE: RESOURCE PROTECTION, MANAGEMENT, AND RESTORATION

INTRODUCTION

The Tijuana River National Estuarine Research Reserve (NERR) resource protection, management and restoration programs provide coordinated, proactive responses to the unique opportunities and challenges to habitat protection the Reserve faces. The three sections of the plan -- protection, management, and restoration -- work in concert to meet a shared set of goals. The Resource Protection section first addresses state and federal laws directing the protection and preservation of the estuary and describes how those laws are implemented. In the Resource Management section, the current Reserve-specific management actions and needed improvements are described. The Restoration section describes the opportunity and need for habitat restoration, the accomplishments to date, and the priorities for future restoration activities. The Plan of Action, which concludes the chapter, sets a course for enhanced protection and management of the Reserve's natural resources.

In keeping with the vision statement for this Management Plan, many of the protection, management, and restoration tasks emphasize improvements in the southern end of the Reserve. The proposed protection, management, and restoration actions will substantially improve the quality of the resources and the experience of Reserve visitors.

The Tijuana River NERR Resource Protection, Management, and Restoration program will be periodically reviewed and revised in response to changing watershed conditions and as new habitat management opportunities emerge. All actions will be based on the best technical information available.

I. MISSION

The mission of the Resource Protection, Management, and Restoration Plan is:

To preserve the Reserve's ecosystems and maintain the integrity of those ecosystems through informed action.

II. GOALS

The Tijuana River Resource Protection, Management, and Restoration Plan addresses past, present, and future conditions that have affected or can affect the integrity of the estuarine ecosystem. The Resource Protection, Management and Restoration plan has four goals:

Goal 1: Preserve, restore, enhance and protect habitats to maintain biodiversity, maintain important migratory bird resources, and aid in the recovery of threatened and endangered species (Refuge goal).

Goal 2: Respond to identified problems, particularly those in the southern end of the Reserve, by establishing cooperative and integrated programs and approaches.

Goal 3: Monitor and assess land use activities within the watershed, particularly the neighboring Tijuana River Valley, and attempt to influence practices to promote the health of the Reserve.

Goal 4: Complete acquisition of all parcels within the adopted Reserve boundary.

III. POLICIES

A. GENERAL SUPPORT AND POLICY GUIDANCE

Because each of the agencies involved in the management of the Reserve must abide by its own laws and policies, the Management Authority cannot prescribe resource protection policy to the operating agencies. However, the Management Authority does provide an essential forum for liaison and coordination. The role of the Management Authority and its Resource Protection, Management and Restoration Committee is to assist all the participating agencies to implement their policies in a coordinated fashion to achieve the goal of a seamless reserve.

Through Management Authority action in preparation of this Management Plan, all participants agree that the public lands of the Tijuana River Estuary are set aside for long-term protection of significant estuarine and other natural and cultural resources. Low-intensity recreational, educational, and research uses of the area are permitted to the extent they are compatible with resource protection and Refuge purposes. The following tools will be employed to enhance the protection, management, and restoration of Reserve resources:

- The Conceptual Zoning Scheme established for the Reserve at its creation and reaffirmed as part of this plan will guide land-use decisions.

- An active and integrated law enforcement program will be employed. This includes actions ranging from preventative measures such as high visibility patrols to aggressive action to investigate and convict violators.

- A coordinated public education program implemented through informal personal contacts, formal classes, signing, brochures, news releases and other outreach will inform the public about Reserve resources and requirements for their protection.

- Barriers including fences, posts, and cables will be employed as necessary, in addition to signing, to passively channelize public use and keep unauthorized people from entering environmentally sensitive areas.

- The efforts of U.S. Border Patrol are necessary to control undocumented immigration across the international border. These efforts should be employed in a manner that does not damage resources.

- Adaptive management principles (described in the Resources Management section of this chapter) will be applied to managing the resources of the Reserve.

- Management Authority members will actively seek funding to complete habitat restoration of all Reserve habitats to ensure that the entire land base serves as viable habitat for native flora and fauna. This will include provisions for use of the Reserve as a site to mitigate off-site resource damage. Habitat restoration that mitigates for damage to other habitats may be conducted at the Reserve only as directed by the policy provided in this chapter.

- Control of feral dogs and cats and exotic and alien species that prey on endangered wildlife will be controlled. Active management of native predator populations may also be required to protect endangered species. Invasive exotic plants degrade habitats and likewise require aggressive control efforts.

- All management activities, including siting of new buildings and other facilities are subject to environmental compliance review to ensure they do not unduly harm resources.

- Reserve management will cooperate with adjacent municipalities to resolve boundary-related issues in a manner that considers needs of infrastructure maintenance, neighbors' safety, and resource protection.

- Management of healthy, native habitats (located primarily on Refuge lands) will be accomplished primarily through preservation, with little active manipulation of vegetation or hydrology. Active habitat management techniques generally will be applied only to restore degraded ecological functions, protect endangered species, or control exotic species of plants and animals.

- Vector control is necessary to prevent mosquito-borne human disease. The Reserve places primary reliance on biological agents and seeks to minimize the use of chemical treatments.

- Land acquisition will be pursued to eliminate inholdings in public lands, acquire necessary buffers to rare habitats, and meet the restoration program needs.

B. CONCEPTUAL ZONING SCHEME AND OVERALL LAND MANAGEMENT POLICIES

The conceptual zoning scheme has been prepared for the Reserve based on the sensitivity of natural resources. The zoning is periodically reviewed as new information is developed about the dynamic conditions within the Reserve. The Reserve Geographic Information System will be maintained and updated to store all information required to substantiate sensitivity classifications. The Reserve manager, the Refuge manager, and both Restoration and Research committees of the Management Authority all share responsibility for identifying necessary changes in the conceptual use zones. The public will be provided opportunities to comment on any proposed changes in access and public use.

Proposed changes in the zoning scheme are brought before the Management Authority for review and action as needed. Proposals for changing land uses within the Reserve will be reviewed by the Management Authority to ensure that they are consistent with the mission and goals of the Reserve and landowning agencies. Program regulations acknowledge the value of secondary uses as long as the purposes for which the Research Reserve and Refuge were established are maintained. Changes in land uses are expected for the development of facilities that are integral to the Reserve's mission.

The zoning scheme within the Reserve includes five resource use zones:

Endangered Species Protection/Preservation Zone (ESZ)
Wetland/Wildlife Conservation Zone (WCZ)
Wildlife Orientation/Interpretation Zone (WOZ)
General Recreation Zone (GRZ)
Ecological Buffer Zone (EBZ)

The zoning scheme assumes that management and restriction of uses will be aimed at protecting areas that contain sensitive, natural estuarine habitat and endangered or threatened species. Varying degrees of use and management will be allowed in other zones depending on the presence of disturbed habitat and existing uses. Zoning assignment for Reserve lands are shown in Figure 10. Provided below is a summary of the zoning scheme.

TABLE 4: Tijuana River NERR Resource Use Zones

RESOURCE ZONE	DESCRIPTION
Endangered Species Protection/Preservation Zone (ESZ)	Encompasses most of the lower estuary and includes the tidal channels, natural salt marsh habitat, and the back dunes. The main management objective of this zone is to maintain a natural and healthy estuarine ecosystem that can support the endangered species dependent on this habitat (the clapper rail, least tern, and salt marsh bird's beak are all inhabitants of this zone). Uses, future development, and management actions are limited to activities directly contributing to resource protection and restoration.
Wetland/Wildlife Conservation Zone (WCZ)	Encompasses disturbed marsh and upland habitats that are immediately adjacent to the Endangered Species Protection/Preservation Zone. The main management objective in this zone is to maintain relatively natural conditions that can provide complementary habitat to endangered species and other wildlife, and to minimize any direct impacts on the Endangered Species Protection/ Preservation Zone. Since this zone includes several areas of disturbed estuarine and riverine habitat, more intensive management and wetland/upland enhancement and restoration is

	needed. Some public use is also allowed in this zone, mainly along pedestrian and equestrian trails.
Wildlife Orientation/Interpretation Zone (WOZ)	Encompasses a northern section of the Reserve that has been identified as particularly appropriate for estuarine education and interpretation because of its location, history of disturbance, and access. The main purpose of this zone is to offer visitors an opportunity to see the estuary and learn about its resources while minimizing visitor-related impact.
General Recreation Zone (GRZ)	Encompasses parts of the Reserve that have been traditionally used for compatible coastal-related recreation and are set aside for such use in the future. This zone includes parts of the Border Field State Park and the intertidal beach immediately fronting the ocean (and not including the back dunes). Compatible recreational activities include horseback riding, hiking, picnicking, and a variety of beach uses. Temporary access restrictions may be employed if endangered species nest seaward of the dunes.
Ecological Buffer Zone (EBZ)	Encompasses both vacant and agricultural parcels under production in the eastern part of the Reserve and adjacent to the river corridor. The main objective of this zone is to provide a land-use buffer between the sensitive estuarine habitats and incompatible land uses.

The zoning scheme adopted in the 1986 Reserve Management Plan was reevaluated in 1997, and is retained in the current plan. A review of appropriate changes to the zoning scheme will be performed as part of the Goat Canyon Management Plan in the south end of the Reserve. Many facilities, including trails, have been developed according to this scheme, and the public is well-informed and comfortable with the current zoning. It is important to recognize that the scheme was adopted when the primary endangered species of management concern were the light-footed clapper rail and California least tern. Hence ESZ was restricted to salt marsh and dune habitats of those species. In the interim, least Bell's vireo and its Critical Habitat were listed in the Reserve. That habitat occurs in the WCZ and EBZ. Because existing public uses have proven compatible with the vireo, no extension of ESZ is planned.

Given San Diego County's biodiversity and continuing urbanization, it is likely that additional species will be listed in the future. It is possible that habitats of those species will include areas of the Reserve. That event will not automatically require revision of the conceptual zoning scheme. However, the Management Authority and operating agencies are aware that existing and proposed secondary uses may need to be reevaluated as habitat areas of endangered species change.

C. POLICIES REGARDING THE USE OF TRNERR AS A MITIGATION SITE

Requests for mitigation activity within the Reserve will be considered by the Management Authority on a case-by-case basis. Projects will generally be evaluated for their compatibility with the Tijuana Estuary Tidal Restoration Program and ancillary support programs developed by the restoration committee of the Management Authority. Each proposal will be judged on whether it is appropriate in terms of existing Reserve policies, conceptual use zones, current conditions, and long-range restoration, research, public access and facilities development plans.

Priority is given to proposed restoration and/or mitigation projects as follows:

Priority 1: Habitat restoration with no connection to off-site activities.

Priority 2: Habitat restoration to satisfy damage assessment or penalty

Priority 3: Compensatory mitigation.

An assessment of the environmental impact from which the mitigation arises will also be part of the Management Authority deliberation.

Land owning agencies maintain authority for decisions to accept mitigation funds for activities on their lands. Actions by the Management Authority will be considered advisory and will be factored into the ultimate decision-making process by the landowning agency along with pertinent agency policies and covenants. Actions involving lands that are deed-restricted due to public trustee requirements related to initial acquisition will be considered in accordance with the provisions established in the underlying deed.

IV. EXISTING CONDITIONS AND PERCEIVED NEEDS

A. RESOURCE PROTECTION

1. Land Acquisition Status

a. Context for Land Acquisition

The goal of the land acquisition program is to secure under public ownership all areas within the designated Reserve boundary, as shown in Figure 2. Land acquisition is coordinated by the State Coastal Conservancy and, in most cases, is carried out by the Coastal Conservancy in consultation with the Reserve Management Authority and NOAA. Funding has generally been provided in equal amounts by the Coastal Conservancy and NOAA. In periods of limited funding, important innovations have been and will continue to be undertaken to acquire properties. These purchases involve complex agreements between collaborating organizations in the public and nonprofit sectors and depend on multiple funding sources and creative acquisition approaches.

A land acquisition program was initiated with the designation of the Reserve in 1981 and outlined in the final environmental impact statement (FEIS) prepared at that time. The specific properties to be acquired and program priorities are periodically reconfirmed by the Management Authority. Since initiation of the program, 582 acres have been acquired, largely in a cooperative program carried out by the Coastal Conservancy and the City of San Diego. Approximately 36 acres remain in private ownership, and are detailed in Table 5. Acquisition has been undertaken exclusively on a "willing seller" basis. Landowners are periodically contacted by member agencies of the Management Authority to determine their interest in selling.

As of July 1998, there was not a precise authoritative summary of land area within the Reserve. Review of the land acquisition program shows that land ownership within the Reserve boundary has experienced states of flux. Land management agencies agree that the total acreage within the Reserve boundary is approximately 2500 acres, and are working to produce a detailed breakdown specifying the acreage managed by each agency. A preliminary land status map was presented to the Management Authority at their July 2, 1998 meeting (Appendix 13).

None of the lands remaining in private ownership are within an approved NWR acquisition boundary. Additional planning documents would be required before FWS could pursue additional NWR acquisition.

b. Assessment of Boundaries

Reserve boundaries were initially delineated in the FEIS based on the following principles (Department of Commerce and California Coastal Commission, 1981):

- Encompass the critical habitats and resource features of Tijuana River Estuary; provide an "umbrella" for existing public ownership;

- Delineate Reserve boundaries in an area large enough to preclude direct threats of encroachment into critical habitat areas;

- Include enough of the watershed area for reasonable and consistent management of the immediate floodplain possible; and

- Facilitate reasonable public access and use of the site for research, education, and other compatible activities.

As new data has been acquired and the Reserve has developed experience with land management, a better understanding has been gained of the role and characteristics of buffer areas and the relationship between sensitive estuarine resources and upstream habitats and land uses. New information may indicate a need to change the existing Reserve boundaries, either to include new land areas or remove areas currently within the boundaries. The National Estuarine Research Reserve Program Regulations (15 CFR Part 921) acknowledge that boundary changes may be required. Opportunities for public comment will be provided if changes proposed by the Reserve Management Authority are judged necessary by NOAA.

Criteria for including new land parcels not currently within Reserve boundaries include:

- Parcels include land classified as "Endangered Species Protection/Preservation Zone" or lie immediately adjacent to lands classified as such;

- Parcels are judged essential for implementing key aspects of the management plan (i.e., estuarine restoration, education, and research);

- Parcels are evaluated as having wildlife conservation value and are donated for National Estuarine Research Reserve purposes.

c. Priority Parcels

Land parcels not in public ownership are assessed and assigned one of three priority levels as part of the land acquisition program. The designations are as follows:

Priority 1: Parcels that include core wetland areas (i.e., lower, middle, and upper marsh communities, and tidal channels). These correspond roughly to parcels including areas classified as "Endangered Species Protection/Preservation Zone" and "Wetland/Wildlife Conservation Zone" in the conceptual land use zoning scheme.

Priority 2: Parcels that may include riparian habitat, salt pannes, brackish ponds, and upland coastal scrub, and therefore, have some wildlife value, or parcels that are of strategic importance for management because they provide critical access for restoration, interpretation and enforcement activities. These parcels may be classified as "Wildlife Orientation/Interpretation zone," "General Recreation zone," and "Ecological Buffer Zone" in the conceptual land use zoning scheme.

Priority 3: Parcels where there is a need to maintain current land uses that are compatible with Reserve objectives. These parcels are all classified as "Ecological Buffer Zone" in the conceptual land use zoning scheme.

The following parcels are privately owned properties within the Reserve that were previously identified for acquisition and remained in private ownership as of June of 1998. Privately owned parcels are described in the following table.

TABLE 5: Lands Proposed for Acquisition by TRNERR

Property	**Description**	**Land Use Zone**	**Priority**	**Acreage**
CC (APN #662-020-09)	Riparian Scrub, vacant land	WCZ	1	20..34

Seacoast Dr. parcel-- (APN #632-030-14)	Oneonta Slough wetlands	ESZ	1	.13
Seacoast Dr. parcel --(APN #632-040-15)	Oneonta Slough wetlands	ESZ	1	.13
SS (APN #663-02-002)	Vacant land on U.S./Mexico border—includes several brackish ponds	EBZ	2	14.30
J (APN #636-010-10)	Small parcel on Sunset	WCZ	2	.79
TOTAL				**35.69**

The location of parcels proposed for purchase within the Reserve is shown in Figure 11.

d. Consolidation of Land Ownership to Streamline Reserve Management

In 1996-1997 the Management Authority recognized the need to reduce the administrative complexity of planning for projects in the southern end of the Reserve. Projects are urgently needed to address progressive damage to natural resources, stormwater and sediment management, and public access problems in the vicinity of Goat Canyon.

In 1997, the Coastal Conservancy proposed a transfer of approximately 400 acres of highly degraded land owned by the City of San Diego to the California Department of Parks and Recreation (CDPR), Border Field State Park. Public agency staff and community interests tentatively reached agreement in spring of 1997 to transfer land. This transfer was formally approved in the summer of 1997 and the transaction was initiated. The land was originally purchased by the City with state and federal funds in a cooperative program as part of the creation of the Tijuana River NERR. The transfer of ownership occurred with no cost to either party.

2. Law Enforcement and Surveillance Activities

a. Existing Conditions

i. General

Law enforcement is necessary at Tijuana River NERR to protect natural resources, ensure public safety, and protect private and public property from criminal activity. Enforcement is a critical part of Reserve and Refuge management. A unique enforcement issue at Tijuana River NERR is control of the international border and illegal entry into the United States.

Law enforcement at the Reserve is a joint responsibility of the landowning agencies and the political jurisdictions in which the Reserve is located. Hence, a number of agencies have varying

jurisdictions, authorities, and responsibilities related to law enforcement within the Reserve. This arrangement is positive in that many agencies are present and interested in protecting Reserve resources, visitors, and property. The arrangement can be difficult at times due to different jurisdictions, incompatible communication systems, and non-standard agency policies and procedures.

ii. Responsible Agencies

Following is a list of various law enforcement agencies within the Reserve and their general responsibilities.

TABLE 6: Matrix of Law Enforcement Responsibilities at the Reserve

LAW ENFORCEMENT AGENCY	RESPONSIBILITIES
California - Department of Parks and Recreation (CDPR)	CDPR Rangers are responsible for patrol activities at Border Field State Park, and for enforcement of State Park Regulations codified in Title 14, State of California Code. State Park Rangers and Superintendents with law enforcement authority are Peace Officers of the State of California and, as such, have full police powers throughout the state, including all federal, city, and county lands in the Reserve.
U. S. Fish and Wildlife Service (FWS)	Some FWS employees assigned to Tijuana Slough NWR are law enforcement officers of the National Wildlife Refuge System. Refuge officers may be full-time law enforcement officers or dual-role employees with both enforcement and other duties. Both full-time and dual-capacity refuge officers have identical authority and jurisdiction. Refuge Officers enforce Refuge regulations of Subchapter C, Title 50, Code of Federal Regulations, which apply only to Refuge lands. They are also able to enforce the Endangered Species Act, Migratory Bird Treaty Act, and other federal wildlife laws throughout the jurisdiction of the United States. However, at this time, Refuge officers of the Reserve have no state authority and cannot enforce state laws off-Refuge. Occasionally, special agents of the FWS Division of Law Enforcement may be detailed to work on special cases at the Reserve. Their legal authority is the same as Refuge officers.
California Department of Fish and Game	State game wardens enforce wildlife regulations throughout the state. As California Peace Officers, they have full police power. However, no CDF&G officers are assigned full time to the Tijuana Valley, and their work there is generally on an on-call basis.
San Diego County Sheriff, and San Diego City Police	The sheriff has the broadest authority of any enforcement officer, and sheriff's deputies have jurisdiction over all lands and all laws and regulations at the Reserve. The Sheriff's Department also provides police services for the City of Imperial Beach.

	The San Diego City Police are responsible for general law enforcement within the City of San Diego, including City owned areas of the Reserve. Although the City Police and Sheriff's Department have full jurisdiction, they usually restrict active enforcement to general criminal activity and traffic, as opposed to natural resource offenses. Sheriff's deputies regularly investigate general criminal activities such as larcenies and burglaries that occur in the Reserve headquarters area in Imperial Beach.
U. S. Border Patrol	The Border Patrol of the U. S. Immigration and Naturalization Service is charged with controlling the borders of the United States, including apprehension of persons entering the country without proper authorization. Historically, the Reserve area has been a major avenue of illegal entry into the United States, and immigrant traffic has produced devastating impacts to the Reserve. The Border Patrol has a large presence in the Tijuana Valley. The success of Operation Gatekeeper in reducing foot traffic has been a recent major success for habitat preservation at the Reserve. Besides apprehending undocumented immigrants, the Border Patrol also deals with drug smugglers and other criminals entering the United States. The 24-hour-a-day presence of many Border Patrol agents, and their substantial transportation and communications capabilities, make them an integral part of the Reserve law enforcement community. In the Reserve, the Border Patrol uses a network of roads constructed to assist in surveillance.
San Diego County, Department of Parks and Recreation	San Diego County Park Rangers patrol County Parks, including Dept. of Parks and county lands in the Reserve, to enforce park regulations. County Park Rangers cannot make arrests or issue citations.

iii. Memorandum of Understanding:

In August 1996, a Memorandum of Understanding for Interagency Joint Response Law Enforcement was drafted by a Law Enforcement Committee of the Management Authority. The draft was prepared for participation by: Border Patrol, FWS, CDPR, San Diego City Police Department, San Diego County Sheriff, and San Diego County Department of Parks and Recreation. The agreement has not been finalized or signed.

b. Perceived Needs in Law Enforcement

The following activities have been identified as necessary to implement a successful, sustainable law enforcement program at Tijuana River NERR:

- The MOU for Interagency Law Enforcement support needs to be completed and signed by participating agencies.

- FWS needs to hire a full-time enforcement officer to work at Tijuana River NERR.

- FWS needs to acquire state authority for Refuge officers. This could come from CDPR, California Department of Fish and Game, or from the Sheriff. Without state authority, Refuge officers have inadequate jurisdiction to fully participate in resource protection throughout the Reserve.

- The Law Enforcement subcommittee of the Management Authority needs to resume its work in this area until the following tasks are accomplished:

    The MOU is signed;

    All participants have the necessary authority to function in a seamless reserve;

    Standard procedures for interagency communications are developed and adopted by all cooperating agencies.

- Once FWS has a full-time officer, the operating agencies' patrol and surveillance program should be better coordinated by the Reserve manager and Refuge manager.

- The operating agencies (FWS and CDPR) need to coordinate more closely with other agencies, especially the Sheriff's Department and Border Patrol.

- A Reserve-wide system for reporting violations and apprehensions needs to be developed for statistical and management action purposes, with annual reports generated to inform the Management Authority of enforcement issues, problems, and accomplishments. Each agency currently maintains separate records systems. Those will remain intact, but a joint reporting system is also needed.

3. Construction of Fences and Barriers

Physical barriers are used or needed in various locations in the Reserve to direct, control, or prevent human use that might damage natural resources. Barriers include wire fences, timber and rock barriers, and planted vegetation. Efforts are made to harmonize fence and barrier design with the natural environment and associated structures.

Temporary barriers are periodically needed at construction sites and in areas where access must be restricted to establish vegetation or protect sensitive species. Efforts will be made in the design and use of materials to harmonize with the natural environment. An exception is made where public safety or resource protection calls for use of bright colors or particular materials. All temporary barriers will be removed at the earliest possible time to prevent unnecessary visual impact.

Currently, no fencing protects the California least tern nesting colony site at Tijuana River NERR/NWR. Terns nest in different areas from year to year, and the dynamic nature of the dunes and estuary make fencing difficult. However, fencing has been effective at many tern colony sites to protect nesting endangered species from mammalian predators and human disturbance. If terns could be attracted to a fenced nesting site, the need for predator management through trapping could be reduced. FWS will investigate the feasibility of providing a fenced colony site, with input from the Management Authority, the local community, and user groups.

A fence has been constructed by the United States government at the international border in an effort to control cross-border travel. Proposals have been made to change the design of the fence to improve effectiveness. Landowning agencies within the Reserve should receive notice of proposals for any changes at the international border. Any proposed change and associated mitigation efforts should be considered by the Management Authority for review in relation to Reserve policies.

4. Cross-Border Resource Damage and Immigration Enforcement

Illegal cross-border foot traffic has resulted in erosion of upland soils; trampling of sensitive upland, dune, and wetland vegetation; and direct loss of listed threatened and endangered species. Control of foot traffic from Mexico, in addition to control of foot traffic and equestrian use by legal visitors to the Reserve, is essential to the Reserve's resource protection effort.

Border policing efforts in the mid-1990's resulted in a major increase of 4-wheel- drive vehicle use in the Reserve for border surveillance and migrant apprehension. Secondary roads and informal trails within the Reserve have been improved to facilitate policing. The U.S. Border Patrol has proposed additional roads to accommodate patrol vehicles both in the immediate area of the border and in riparian and wetland areas to the north.

The operating agencies are working with Border Patrol to assure that agents minimize off-road travel. Road construction and off-road vehicle use is a major source of soil loss through erosion. This cycle of erosion and sedimentation is largely responsible for the extensive loss of wetlands in the southern portion of the Reserve. A review of additional access required for border policing is needed as part of a comprehensive public access and facilities assessment for the south end of the Reserve. This assessment must necessarily be integrated with plans for sediment and erosion control and habitat restoration for degraded parcels in the same area.

5. Illegal Dumping

Chronic illegal dumping occurs along the edges of the estuary, particularly where boundaries between private and public property are not clearly established. Large amounts of debris are accumulating in the southern reaches of the Reserve. This degrades marsh and riparian habitat in several areas, impairs water quality, and imposes a threat for flooding.

Proposed activities needed to protect habitats from dumping include:

- Improve Reserve surveillance and reporting of illegal dumping and encourage coordination among agencies.
- Educate public about Reserve regulations using printed materials. Encourage enforcement actions by local authorities.
- Organize regular clean-up events in areas prone to dumping.

All of these activities require an active presence of Reserve staff in the southern portion of the Reserve. Current limited staffing does not allow for routine visits.

6. Water-borne Debris

Water-borne litter and trash accumulate in and degrade the habitat value of the Reserve's tidal wetlands. In the NWR's Oneonta Slough, where tidal action is best, huge amounts of plastic and other garbage collect in the marsh. While often hidden by marsh vegetation, or very high tides, the prime clapper rail habitat is covered with an almost solid mat of floating garbage.

The trash enters the estuary from the ocean and from the watershed during flood and run-off events. Once in the tidal creeks, garbage gets trapped in vegetation and accumulates. The garbage greatly detracts from aesthetic qualities of the marsh and poses an unquantified threat to wildlife from entanglements and ingestions. The volume of trash is likely great enough to impact vegetation germination, growth, and density.

FWS will investigate methods to remove the trash, in partnership with volunteers and local jurisdictions. Manual removal of the litter is not feasible; the amount of foot traffic that would be required, even if labor was available, would destroy the habitat values of the marsh. Some type of boat/rake device, operated at high tides during the non-breeding season, might be effective to gather large volumes to adjacent shorelines for removal by heavy equipment. A "trash boom" across the mouth of Oneonta Slough would also be required to reduce the re-accumulation of water-borne trash.

7. Resource Protection through Public Education and Information

Prevention is the most effective measure of law enforcement. It is essential that recreational visitors and users of the Reserve be provided with complete and easily understood information about regulations, the reasons for them, the shared government responsibility for their enforcement, and penalties for breaking the rules. Communication through brochures, signs, and other devices will be directed primarily at major access points (See Chapter 8 - Public Access, Involvement, and Use). A synopsis of relevant regulations is provided in the general Reserve brochure. The same synopsis will appear on the signs at the interpretive overlooks planned for the Research Reserve. In addition, regulatory symbol signs for "No Motorized Vehicles" and "Dogs on Leash" will be posted in locations where problems have occurred in the past.

The enforcement staff, including the equestrian volunteers, will play an important role in developing this positive and preventative approach to resource protection. The emphasis during certain critical periods (e.g., the least tern nesting season) will be on personal contact and

information exchange.

B. RESOURCE MANAGEMENT

1. Management of Habitats

a. Introduction to Habitat Management at TRNERR

The Tijuana River and its estuary are a dynamic system. In changing, it is like all wetlands and coastal ecosystems. Even before the arrival of Native Americans, the forces of flood, erosion, sedimentation, storm, and fire constantly changed the face of the river and the estuary and their habitats, flora, and fauna. The Tijuana River Estuary of today is unlike the one that existed at the time of European settlement, and the system that existed in 1850 was different than it was 100 or 1,000 years before that.

However, the changes produced by human activity since the mid-19th century are unprecedented in both their scope and impact on native communities. Decades of disturbance to the watershed have significantly altered the environmental factors that control habitats. The physiographic and hydrologic conditions that produced the pre-1900 ecological communities of the Tijuana Valley have been irreversibly changed.

Since 1900 some communities, such as the dune shrub community, have been completely lost. Increased sedimentation, altered stream flows, and intentional wetland filling have all changed the face of the estuary. In more recent decades, sewage flows increased nutrients, lowered salinities, and threatened human health; increased foot traffic and vehicle use trampled vegetation and crushed nests of endangered birds. As a result, the system is highly degraded and badly needs management and restoration.

The current habitat array of the Tijuana River and Estuary is unnatural. It is different than it would have been without the human impacts incurred in the last 150 years. However, while impaired, the river and estuary ecosystem still functions, provides huge resource benefits and supports many natural communities and hundreds if not thousands of native species.

The overall habitat management goal of the Reserve is to maintain and restore an array of naturally occurring habitats that will support the behavioral and physiologic needs of representative populations of all native plants and animals. The operating agencies recognize that the river and estuary retain dynamics that will cause change, regardless of management action. Between the flood potential of the watershed and the power of the Pacific Ocean, events will occur to alter, sometimes dramatically, the face of the Reserve. That given, the following tenets will guide habitat management efforts in support of the overall goal.

b. Guiding Principles for Habitat Management at Tijuana River NERR

Following are guidelines shared by all agencies involved in management of Tijuana River NERR:

- Management must be based on the best science available and must adapt to new conditions and new knowledge. Land management is also an art; research will never provide easy answers to every question.

- Storms and floods that close the mouth of the river to the Pacific Ocean will occur. Such closures will be addressed aggressively with immediate action to re- open the estuary to the tides. Pre-planning with regulatory agencies is ongoing to ensure quick response to a closure of the river mouth.

- Management should not and will not be able to control the actions of the Tijuana River and the ocean. Changes will occur, regardless of restoration/management. Management will try to work with nature and recognizes that no habitat array is permanent.

- It is not necessary to recreate the same proportions of different habitat types that occurred in 1850 or 1900. Management must only ensure that no communities vanish through the action of humans, and that viable representative samples of each habitat type persist.

- A holistic, ecosystem approach to management will be used. "Single-species" management will be avoided. However, the presence of numerous federal- and state-listed endangered species requires that no action jeopardizes survival of those species; by law, they do have a priority. (Although the riparian woodland along the Tijuana River does not emulate pre-1900 conditions, it is Critical Habitat for least Bell's vireo and therefore cannot be restored to a more open habitat).

- Restoration ecology is an imperfect art and science. No planned action will produce guaranteed results. Ecological conditions necessary to produce certain plant and animal responses may occur infrequently; patience is required.

- Management of human activity is essential. Continued control of undocumented immigrant foot traffic from Mexico is critical to habitat protection. Vehicle trespass, the activity of authorized recreational users, and the illegal actions of private landowners must be regulated through education, signing, and enforcement.

- Feral and free-roaming dogs and cats are a significant threat to native wildlife. Efforts to control and remove feral dogs and cats are essential. Successful recovery of endangered species, especially vulnerable colonial nesting birds, requires active monitoring management of exotic, alien, and native predators.

c. Management for Habitats

Following is a qualitative description of the various habitat types of the Reserve and their recognized resource values and problems, based on recommendations in The Ecology of the Tijuana Estuary, California -- A National Estuarine Research Reserve (Zedler, et.al.). Several of these habitats are represented in Figures 8A and 8B.

i. Transition from Upland Habitat to Wetland

This is a diminishing habitat in southern California; it is valued for its rarity, its function as a buffer between wetland and urbanized areas, and its role as a foraging ground for bird species. Habitats that are transitional between wetland and upland will be the wetlands of the future, as sea level continues to rise. Hence, a broad transition zone is needed to ensure persistence of this fringe community and the high marsh below it. Species of concern include sensitive birds (i.e., short-eared owls, black shouldered kites) and the horned lizard. *Frankenia Palmeri* is a potential member of this habitat, but it has not been recorded at Tijuana Estuary.

The generic problem facing the transition habitat is urban encroachment, which occurs as fill, trash disposal, trampling, and invasion by dogs and cats. Associated impacts are invasion by exotic weeds and altered densities of native animals. In this habitat type, there is a need to remove fill, control visitor access, revegetate unofficial trails, control dumping of trash, control feral and domestic animals, control exotic plants, and plant native perennials that are likely to have occurred here in the past.

ii. Salt Marsh

The most widely valued attribute of the salt marsh is the habitat it provides for rare and endangered species. The cordgrass-dominated marsh is nesting and foraging habitat for the light-footed clapper rails; the pickleweed-dominated areas are important to Belding's savannah sparrows; and the upper marsh is the sole habitat for salt-marsh bird's beak. In addition, the marsh is essential habitat for a variety of other organisms, including many insects, migratory birds, and other invertebrates. Salt marsh vascular plants and algal mats contribute substantially to the primary productivity base that supports estuarine food chains.

Non-tidal conditions can reduce the natural diversity of plant communities, and some species do not recover from such disturbance (e.g., annual pickleweed). There is a need to excavate and expand the salt marsh habitats. New techniques need to be explored for creating fully functional salt-marsh habitats.

iii. Salt Pannes

The natural values of salt pannes are not often recognized, and proposals are often made to convert them to other uses. During both the wet and dry phases, salt pannes are important areas for insects, including rove beetles, and mudflat tiger beetles. When inundated, the areas serve as feeding grounds for migrant and resident birds. Species associated with the intertidal salt marsh and the transition to upland also use these areas.

Lack of qualitative information about the habitat value of salt pannes limits our ability to manage and restore them. Another continuing problem in salt pannes is the compaction of soils caused by vehicles and foot traffic.

iv. Brackish Marsh

Areas that have reduced salinities through most of the year are currently maintained by rainfall and urban runoff. Although artificial in this sense, they do support a community of native species. Elsewhere in the region, brackish marshes are valued for their augmentation of habitat and populations of clapper rails, black- necked stilts, snowy egrets, and other birds. They also increase habitat diversity at the estuary and attract species that would not otherwise occur there (e.g., red-winged blackbirds.)

The management problem associated with brackish marsh is its potential expansion at the expense of saline wetlands. Freshwater runoff leaches soils of salts, and the brackish marsh species expand and displace those of the salt marsh. When exotic weeds (such as brass buttons) and horticultural escapes establish, the expansion of brackish conditions detracts from the goal of maintaining natural habitats.

Curtailing the daily flows of sewage into the Tijuana River Estuary was a major improvement in brackish marsh control. There is a need to improve the circulation of salt water and further reduce chances for brackish marsh expansion. Brackish and freshwater marsh habitats should be expanded upstream of the estuary tidal prism. Suitable sites exist along the Tijuana River and in abandoned agricultural lands. The use of treated wastewater is encouraged for creation and maintenance of artificial marshes.

v. Tidal Channels and Creeks

The channel habitats at Tijuana River Estuary are important to nearly all estuarine animals. All of the endangered birds use tidal channels and creek areas for feeding. In previous years, there have been recreational shell fisheries and commercial bait fisheries. At present, both shellfish gathering and fishing are prohibited at the estuary.

The problems that affect the channels and creeks ultimately have an impact on the entire estuary, because the estuarine waters move throughout the system. Tidal closure, sedimentation, disturbance from dredging, and reduced water quality (waste water input, nuisance algal blooms, and reduced salinity) all require active management. Increased sedimentation rates have an impact on benthic organisms, and the associated turbidity affects water-column species. Dredging to remove accumulated sediments and restore tidal flushing in turn creates turbidity and alters the substrate.

The tidal restoration plan should make existing channels more suitable for fish and invertebrate use. Excavation of the intertidal marsh and channels should have beneficial effects downstream as increased flows erode the fine materials that have accumulated in the channel network. New channels that will be constructed throughout the new tidal marshes should expand this habitat type substantially.

vi. Sand Flats and Mudflats

The intertidal flats are closely associated with tidal channels and creeks, and the impact of disturbances and consideration for management are similar. The primary values attributed to these sites are their habitat for shorebird resting and foraging and feeding areas for the light-

footed clapper rail and Belding's savannah sparrow.

vii. Beaches and Dunes

The esthetic quality of beaches makes them the habitat most highly valued by the recreational public. Consequently, human use is extensive throughout the year. Ecologically, the habitats are valued for their support of native animals, including the globose dune beetle, sandy beach tiger beetle, sand dune tiger beetle, wandering skipper, and two nesting birds: the California least tern and snowy plover. Other species, such as Belding's savannah sparrow, feed on dune and beach insects. The native plants are especially important to the ecosystem because they stabilize dunes, which in turn protect the estuary from sea storms.

Coastal erosion is the major problem facing the beach and dunes. Substantial losses of sand occur each winter, but not all is replenished each summer; a continual net loss is obvious from aerial photos from 1928 through 1985. The height and location of dunes has changed with recent storm overwashes, and stabilization is needed. In addition, exotics have invaded.

Fencing has helped to protect the dunes from trampling, but not all areas are protected by well maintained fences. It is widely agreed that additional dune stabilization is needed. Attempt to rebuild the dunes with dredge spoils began north of the mouth in 1985. Although the reconstructed dunes helped protect estuarine channels from overwash during the 1986 storms, there was substantial erosion on the seaward side and dune crest, and most of the transplanted dune species died. Dune reconstruction south of the mouth was attempted but storms and drought ravaged the site before vegetation could stabilize the sand.

The activities underway include fencing to reduce trampling and stabilize the sand, thereby facilitating revegetation efforts. Dunes from the river mouth to Seacoast Drive have been rebuilt each fall to prevent overwash into Oneonta Slough. There is a need to continue these actions.

viii. River Channels

A riparian woodland developed after the 1980 flood, and dense vegetation is now found within the Reserve. Currently, much of this habitat is federally listed critical habitat for the endangered least Bell's vireo (50 CFR 17.95). Many future changes at Tijuana River Estuary may have their greatest impact on this habitat type. As sewage spills come under control, streamflows will decline. Determining the best management practices for this international river remains a major challenge. The cumulative impacts of denudations, sedimentation, mouth closure, drought, hypersalinity, and sewage spills have significantly altered the estuary.

2. Water Treatment and Groundwater Management in the Tijuana River Valley

a. Water Treatment Facilities

Sewage contamination problems in the Tijuana River have been chronic since the 1930s. The contamination has been the result of Tijuana's rapid and constant population growth coupled with a lack of corresponding sewerage infrastructure.

Due to the physiogeographic setting and relationship of the City of Tijuana to the United States, sewage that is not captured and treated in Tijuana flows into the United States in the Tijuana River or through north-draining canyons and gullies. This raw waste stream contaminates surface waters and nearshore ocean waters and degrades the Tijuana River Estuary. The contamination adversely impacts the agricultural production, coastal recreational opportunities, sensitive wildlife in the Reserve, and quality of life for residents of the river valley. A principle concern during the extended period of sewage contamination has been the reduction in salinity in the estuary and intertidal wetlands because of the wet season flows of contaminated fresh water and the extended season of freshwater flow. The extensive damage to the estuary from these flows has been documented by PERL (Estuary Profile, 1982).

Detailed agreements reached between the U.S. and Mexican governments over the past decade have enabled the construction of an International Treatment Plant, Ocean Outfall, and improvements and expansion to the existing Mexican infrastructure. Several of the facilities will be located in the Goat Canyon area, including the underground outfall pipe which will pass under Goat Canyon and areas to the west.

i. International Treatment Facility and Water Reclamation Plant

The International Boundary and Water Commission (IBWC) has constructed the International Treatment Plant to treat sewage overflows from Tijuana, Mexico. The City of San Diego Metropolitan Waste Water District (MWWD) is currently proposing the construction of a water reclamation plant near the intersection of Monument and Dairy Mart Road, just north of the international border and adjacent to an International Wastewater Treatment Plant. This project may make freshwater available for purposes beneficial to the Reserve.

MWWD is also proposing the construction of a new bridge and road improvements to replace the existing Dairy Mart Road and Bridge. During peak storm events the existing road and bridge is often flooded or washed out. This project will provide an all-weather access to the South Bay Water Reclamation Plant, the International Treatment Plant, and the southern Tijuana River Valley.

ii. South Bay Ocean Outfall

MWWD is currently constructing the South Bay Ocean Outfall, which passes underground through the Reserve boundaries. The outfall will convey treated effluent from the international treatment facility and future City of San Diego plants to the ocean for disposal. The ocean outfall is a joint project between the City and the federal government. Construction impacts to Reserve resources will be fully mitigated once construction is completed. Mitigation plans will be reviewed and approved by the Management Authority.

iii. Sewage Collection Systems

Sewage flows that drain into the U.S. through Canyon del Sol, Silva Drain, Stewarts Drain, Goat Canyon, and Smuggler Gulch from unsewered areas of Tijuana will be collected and conveyed to

the International Wastewater Treatment Plant by MWWD using interceptor-canyon collection systems in each drainage area. At Goat Canyon, a new interceptor system, gravity main, and pump station will be constructed to collect and convey flows. Construction of the Goat Canyon Collector began in September 1996 and will be completed in February 1998.

b. Groundwater

Excessive extraction of groundwater has contributed to the depletion of groundwater supplies and to saltwater intrusion in the Tijuana River Valley. The Tia Juana Valley County Water District (TJVCWD) oversees and monitors the area's groundwater basins and intends to implement programs to actively recharge them. The TJVCWD is studying the feasibility of recharging these basins with excess stored water from surface water reservoirs and/or with reclaimed wastewater from the proposed South Bay Water Reclamation Plant. MWWD is assessing several possible markets for reclaimed water and distribution.

There is a need to explore the potential affects of the ground water recharge on Reserve habitats.

3. Flood Control Practices

Damage from floodwaters is a significant concern throughout the Tijuana River Valley, and the effects of the 1993 floods are still felt in the Tijuana River NERR. The most extensive flood damage to the Reserve, however, was from localized flooding and sedimentation from Goat Canyon Creek. Riparian and wetland habitats in the southern area of the Reserve were degraded by flooding and sedimentation. The principle public access to the Reserve, Monument Road, was severely damaged during 1993 and 1995 storms. A comprehensive plan for stormwater and sediment management and construction of a new all-weather road is underway (see Chapter 9 - Facilities Plan).

Additionally, a plan for the Tijuana River Valley has been developed by the City of San Diego. These projects are outside the Reserve boundaries but are likely to have a bearing on Reserve lands. The plan uses existing flow paths and includes the removal of berms and fill that have been placed in the valley. The City also proposes an armored berm along the northern subdivision to provide for additional freeboard above anticipated 100-year flooding and to provide for increased protection while other measures are being implemented.

4. Sediment and Erosion Control: Goat Canyon Creek Watershed Project

Land-use activities throughout the watershed have accelerated sedimentation and resulted in the obstruction of tidal channels and the loss of wetlands. The reduced tidal exchange has triggered changes in vegetation communities and the habitat of several significant estuarine populations. A long-term program at the watershed scale is required to affect the erosion/sedimentation cycle.

Because of significant Mexican influences on the downstream Reserve, a binational erosion control plan has been identified by the Management Authority as a priority for the Reserve. The U.S. Environmental Protection Agency has committed to participate in the program and share in its funding. The IBWC has expressed strong interest in the program. Mexican partners, including

the City of Tijuana Planning Department, have expressed interest in the initiative.

The southern end of the Reserve, particularly the Goat Canyon area, is extremely vulnerable to erosion, sedimentation, and resulting flood damage. A comprehensive erosion control and restoration program is being developed for this watershed. Figure 12 shows the location of the Goat Canyon Watershed.

Start-up funding has been provided to the Coastal Conservancy by the U.S. EPA to develop strategies to reduce sediment flows to the estuary from the Goat Canyon Creek watershed. The State Coastal Conservancy and Southwest Wetlands Interpretive Association (SWIA) are jointly developing a needs assessment for 1998. Technical analyses and program elements will encompass the 4.6-square-mile watershed and include extensive U.S./Mexican collaboration. The proposal includes developing site-specific plans and specifications for identified problem areas and for more generalized treatments.

The combined erosion control and restoration program is needed to protect the south arm wetland restoration site from continuing sedimentation. Plans will be based on a careful assessment of stormwater and are expected to include structural and nonstructural erosion control methods, additional sediment management techniques, biotechnical slope and streambed stabilization measures, and associated habitat development techniques. The program will produce a unified binational plan that identifies low-cost implementation strategies. A particular emphasis will be placed on the highly degraded, lower 1-mile reach of the creek and its critical connection to the south arm wetlands. Detailed restoration recommendations will be developed.

The Goat Canyon Creek project is closely interlinked with an initiative for improved public access to the south end of the Reserve. Funding requests have emphasized the need for a comprehensive project for the Goat Canyon area that results in plans for stormwater and sediment management, all-weather public access, and habitat restoration. It's expected that planning for improved interpretive features and visitor-serving facilities will soon follow.

Work in Mexico will be coordinated with the Municipio de Tijuana Planning Department and will focus on stormwater management and slope instability problems. Reserve representatives and City officials have acknowledged the interrelationship of interests and seek to engage in a planning process that identifies strategies and specific projects to control erosion and enhance public safety.

5. Exotic/Invasive Species Control

a. Invasive Plant Control

The control of exotic species is critically important to maintaining and enhancing resource values throughout the Reserve. Several severe invasions by exotic plant species threaten the viability of native habitats' ability to support species of special status at the Reserve. These include:

- Invasion of the coastal back dunes and upper marsh areas, especially at Border Field State Park,. by the exotic succulent sea fig *(Carpobrotus edulis);*

- Invasion of the riparian corridor in the Tijuana River Valley by several species of tamarisk *(Tamarix* sp.), and giant cane *(Arundo donax);* and

- Invasion of the disturbed upland areas by a host of normative grasses and annuals.

Past management activities have approached these problems in a sporadic and ineffective manner. Volunteer groups occasionally pull and remove some of the more common exotics. Effective control of these exotics will require an organized effort by the managing agencies.

The following species control measures are priorities:

- Control of *Carpobrotus* infestations in the back dunes by localized spraying of Glyphosate herbicide by licensed pesticide applicators.

- Control of Tamarisk and *Arundo* in the river valley by the "cut and paint" method. Plants are cut to the ground and the stems are immediately "painted" with a systemic herbicide. This project is a very large one and must be approached on at least a local watershed basis.

- Salt addition, as guided by recent research, to control exotic species invasion at street drains and sewage spills.

- Hand removal of plant species.

Any control efforts will be coordinated by the operating agencies to protect existing habitats, particularly nesting habitats.

Research into control techniques that favor native grasses or perennials over exotic invasive annuals is needed. Areas of research needed could include bio-control, control by prescribed burning, or pesticide applications.

A second important facet of species control is preventing colonization by new invasive species from outside the Reserve. Efforts are being taken by Reserve staff and restoration project managers to ensure plant propogules are collected on-site to avoid the transfer of aquatic invertebrates from other wetlands.

b. Predator Management

Southern California is a "biological diversity hotspot," one of a handful of places in the world where limited unique climate and soils have resulted in the evolution of myriad endemic species. That same climate has attracted millions of people to live and work here. Urban development, land use, and general human activities have destroyed or degraded the limited native habitats to a point where many species are now threatened with extinction.

The Reserve is home to numerous federally listed threatened and endangered species (see

Appendix 4.) Conservation and recovery of those species is the highest priority of the Reserve. Unfortunately, the same land-use forces that resulted in species endangerment have also fragmented the ecosystem to a point where active management intervention is required to ensure survival and aid recovery of the light-footed clapper rail, California least tern, western snowy plover, and least Bell's vireo.

Maintenance, enhancement, and restoration of habitats is essential for the survival of these species. Once habitat concerns are adequately addressed, research and monitoring data indicate, predation is the greatest threat to the survival and recovery of these endangered birds. Management of predator populations is essential. On-going management of predators in the Refuge is performed by FWS. FWS contracts annually with licensed and permitted government agencies or private organizations to provide predator management services during the nesting season for California least terns and light-footed clapper rails (March - September). Stray and feral dogs and cats are reported to local municipal animal control agencies, and some stray dogs and cats are occasionally captured by FWS personnel and turned over to an approved animal shelter.

These past and current efforts have helped protect endangered species, but more needs to be done. Feral and stray cats--major bird predators known to kill light-footed clapper rails--remain common in the northern portion of the Reserve.

Free-running dogs are a threat to all native wildlife, to reserve visitors, and horses. Native avian predators have also caused severe losses of California least terns in recent years.

FWS will prepare a detailed step-down management plan on predator management following approval of this Refuge Comprehensive Management Plan. The following principles and policy guidance will be followed in that plan and are intended to inform the public of what steps need to be taken -- and will be taken -- to protect endangered species within the Reserve.

i. Predators of Concern

The following species are known predators of endangered birds and/or their eggs at the Reserve.

1. domestic cat*
2. domestic dog*
3. coyote
4. grey fox
6. red fox*
5. striped skunk
6. raccoon*
7. opossum*
8. California ground squirrel
9. long-tailed weasel
10. Norway rat*
11. barn owl
12. burrowing owl
13. northern harrier
14. loggerhead shrike
15. red-tailed hawk
16. peregrine falcon
17. gulls (several species)
18. raven
19. common crow
20. gull-billed tern
21. kestrel

*indicates non-native (exotic, introduced, or naturalized) species.

This list is not exhaustive, and other species including small rodents, snakes, and predatory birds may also prey on endangered birds and their eggs. Brown-headed cowbirds are not a predator, but they paracitize the nests of least Bell's vireo and other songbirds and are subject to control efforts in the Tijuana Valley, outside the Reserve.

ii. Program Responsibility

Predator management activities will be conducted and supervised by uniformed employees of government agencies, primarily USDA Animal and Plant Health Investigative Service - Animal Damage Control and FWS. Local government animal control agencies may also be used to control domestic dogs and cats.

iii. Responsibilities and Authorities

50 CFR 25.11 states that National Wildlife Refuges are established "…for the protection and preservation of endangered or threatened species and their habitat." 50 CFR 30.11 authorizes control of feral animals, including dogs and cats, on National Wildlife Refuges. 50 CFR 31.14 authorizes taking of animal species detrimental to the management program of a wildlife refuge. 50 CFR 28.43 authorizes the disposal of dogs and cats running at large on a national wildlife refuge and harming humans or wildlife. Approved Endangered Species Recovery Plans for California least tern and light-footed clapper rail call for predator management programs as essential to the recovery of those species.

iv. Control Methods

Non-lethal control methods are preferred. Live-trapping of known predators will be vigorously attempted before any lethal methods are employed. The most humane methods available will be used.

- Exclosures and predator fences are not a viable management option at the Reserve because of the dispersed nature of endangered species nesting sites and the fact that nesting birds use different portions of the Reserve in different years.

- Live trapping may include box style live mammal traps, decoy funnel traps for cowbirds, and Bal-chatri traps for raptors.

- Hazing or scare tactics may be used to deter predators from disrupting and hunting in least tern colonies. This may include the use of pyrotechnics, firearms, or other audio or visual stimuli to scare predators. Special authorization from the Regional Office, FWS, must be obtained to haze predators that are themselves endangered (e.g., peregrine falcon).

- Some predators, particularly canids, are not vulnerable to box-trapping methods. Padded jaw steel traps may be used to humanely capture mammalian predators if other live-trapping methods prove ineffective. Pole traps may be used to capture avian predators if less severe methods (hazing, Bal-chatri traps) prove ineffective.

- As a last resort, lethal methods, including shooting or body-grip traps, may be used to take predators that are identified as known and immediate threats to endangered species within the Reserve.

v. Disposition of Captured Predators

- All domestic dogs and cats captured will be taken to an approved shelter facility operated by a cooperating local unit of government, or a Humane Society, or a veterinary care facility.

- All live-captured raptors and other avian predators will be removed from the Reserve and held in a licensed rehabilitation center or permitted holding center until they can be released back into the wild. Captured birds will be released at a suitable distant location; if a suitable location is not available, the predatory birds will be released at the Reserve after the endangered species nesting season.

- Non-target wildlife such as rabbits and hares that are captured unharmed will be released immediately at the location of capture.

- Nonnative wild mammalian predators will be euthanized using approved humane methods.

- Native mammalian predators such as coyotes or weasels that are known to take endangered species in an opportunistic/non-methodical fashion will be released back into suitable habitat, away from endangered species nesting areas, as soon as possible. If a native mammalian predators those which has been identified as problem individual

- Target and non-target predators that are injured may be euthanized, or taken to an approved rehabilitation center/veterinary care facility, depending on species status and extent of injuries, at the discretion of the Refuge manager.

vi. Operations

- Live-trapping of feral and free-roaming cats will be conducted year-round, by Refuge personnel. Initiation of this program will be preceded by a public awareness/education program to inform and educate Refuge neighbors of the threat that cats pose to wildlife, and the need to control cats on the Reserve.

- General predator management activities are tied temporally and spatially to California least tern nesting. Control efforts will be initiated annually by April 1, and will continue through the end of least tern nesting attempts. Efforts will include monitoring predator activities within and around nesting areas, and preemptive and post-incident control activities involving both avian and mammalian predators.

- Several species are known threats to least terns, and by their biology, are assumed to be hunting endangered species when they are in the area. These include red fox, kestrel, and loggerhead shrike. Red fox are normative and will be removed whenever they occur on the Reserve. Kestrels and loggerhead shrikes are valuable and common components of Reserve avifauna. But the propensity of those birds to prey on least terns makes their presence incompatible with endangered species conservation. Kestrels and loggerhead shrikes will be removed whenever they appear at least tern colonies.

- Several potential serious avian predators of least terns are themselves “sensitive" species. Those include gull-billed terns, burrowing owls, northern harriers, and other native raptors. Control action against these species will be taken after predation is documented. Once documented, control actions must be aggressive to prevent devastation of endangered species.

- Traps of any type will not be set unless they can be tended regularly by authorized personnel. Traps set for mammalian predators will be checked daily within two hours of sunrise. Traps set for avian predators will be checked frequently, at least every four hours. Checks may be made by remote sensing.

vii. Coordination

Local law enforcement and the Border Patrol will be informed of any planned carrying or use of firearms by predator management personnel within the Reserve. Coordination and approval of the landowning agency must be obtained prior to initiating predator control activities off National Wildlife Refuge land within the Reserve.

6. Fire Suppression

Wildfires are of great concern at the Tijuana River NERR. Although large wildfires (40 acres and larger) have not been documented in this area, fire occurrence is related to the amount of human use and activity that are occurring in the estuary. Small fires (under 40 acres) have been a part of the history of the area, with nearly all fires documented as human-caused. Many of the wildfires have been caused by escaped illegal campfires created for cooking and warmth by illegal immigrants or transients occupying the area. Routine fire patrols in high-activity areas during the summer months when fire danger is highest can minimize the number of these nuisance fires.

Fire suppression for the Reserve is conducted by agency resources and personnel as well as through assistance from local, state, and federal fire departments as needed. The FWS maintains administrative roads and trails that could serve as firebreaks during wildfire suppression. Defensible space is maintained around all Refuge facilities, and water sources are available for fire suppression needs.

The Refuge currently has a fire dispatch plan that addresses initial response to wildfires, as well as the procedure for requesting additional fire-fighting resources. In addition, a detailed Fire

Management Plan is being prepared for the Refuge.

The FWS may use prescribed burning as a tool to restore wildlife habitats, reduce fuel loads, and minimize wildfire hazards on Refuge property. The role and implementation of prescribed burning in resource management and fuel reduction projects would be addressed specifically in prescribed burn plans written for each project to be conducted on Refuge property.

7. Mosquito Control

To protect public health and safety, mosquito abatement efforts are performed by the Vector Surveillance and Control Division of the San Diego County Department of Environment Health, in coordination with the operating agencies. The operating agencies encourage the minimum use of chemical treatments.

A mosquito management plan was prepared in 1984 to provide short-term relief and long-range control of mosquito populations while minimizing problems normally associated with the use of conventional pesticides by FWS, CDPR, and Department of the Navy. The operating agencies and the Research committee of the Management Authority need to revisit this plan and identify opportunities to reduce the use of or need for chemical applications without compromising public health. Issues to consider include:

- Endangered species;
- Chemicals used;
- Frequency of use;
- Use of ditching; and
- Emerging issue of monitoring effects of chemicals, particularly on invertebrates

C. RESTORATION

1. Introduction to Restoration at Tijuana River NERR

In the 1980s, hydrological and biological studies were undertaken to begin developing an understanding of the estuary's natural resources and conditions. These studies were undertaken by a number of organizations, principal among them the Pacific Estuarine Research Laboratory (PERL) at San Diego State University (SDSU), FWS, and various private consultants under contract with Management Authority agencies. The studies documented extensive wetlands loss in the estuary during the past 50-100 years and extremely variable habitat quality in the existing wetland and riparian areas. Most significantly, studies indicated that the tidal flushing in the estuary, as indicated by the diurnal tidal prism, had been reduced by approximately 80 percent since 1852, primarily a result of human-induced sedimentation. Since 1981, a principal goal of the Reserve has been to protect, enhance, and restore the delicately balanced wetland ecosystem.

2. 1998 Habitat Enhancement Objectives

Upon presentation of the Tijuana Estuary Hydrologic Analysis (Philip Williams Associates, February 1987), the Management Authority declared the following restoration objectives for the lands within the Research Reserve. The objectives have been reviewed and modified to represent the current restoration priorities.

a. Objectives for Restoring the Estuary

1. Restore the tidal prism to approximately the size that existed in the 19th century to encourage removal of the sediment by the tides and to minimize the potential for channel closure.

2. Allow for continued functioning of a tidal hydrodynamic system with future anticipated geomorphic changes, including sea level rise, migration of the barrier beach, and changing river channel locations. Successful restoration of the tidal prism is predicated on reducing sedimentation rates and reducing the potential for dune overwash.

3. Minimize future loss of restored and existing wetland area due to inland migration of the barrier beach by dune restoration.

4. Minimize future loss of restored and existing wetland area by Tijuana River sedimentation.

5. Minimize future loss of wetland area by sedimentation from Goat Canyon.

6. Restore areas of former salt marsh affected by sedimentation to the maximum extent feasible.

7. Restore former mudflat affected by sedimentation to the maximum extent feasible.

8. Minimize the disturbance of marsh plain areas in the north arm of the estuary.

9. Minimize the potential year-round reduction in salinity in the marsh plain and intertidal areas due to possible future wastewater flows, while preserving the ability for flood flows to lower salinity for short periods in winter.

10. Restore the barrier beach dune and vegetation by restricting public access and coordinating appropriate plant community restoration projects.

11. Provide same acreage of high marsh. High marsh acreage may be decreased in some locales as a result of increases in tidal circulation. Increase quality and extent of transition zone habitats.

12. Identify existing resources so that a salvage operation can be planned and carried out as an integral part of implementing the enhancement plan.

13. Integrate research findings in the restoration effort.

14. Incorporate a phasing program in the enhancement plan by implementing the project in stages. This approach provides a method to manage the complexity of planning, financing and managing the complete project.

15. Minimize impact on privately owned parcels.

16. Protect and enhance endangered species habitat.

b. Objectives for Restoring the River Corridor

1. Control exotic plant species invasions in the riparian corridor.

2. Provide for the restoration of a continuous native riparian woodland corridor.

3. Ensure that flood hazards are not increased.

4. Manage gravel extraction activities to the benefit of sediment management and future creation of plant and wildlife habitats.

5. Consider future groundwater management for beneficial development of the riparian corridor.

6. Enhance riparian endangered species habitat by controlling exotic species and monitoring endangered species populations.

3. Adaptive Management Design Approach

With leadership from PERL, restoration planning at Tijuana Estuary has been conceived as an adaptive management design approach. This approach to restoration design and implementation acknowledges the numerous uncertainties in the restoration field and incorporates careful review of actions taken in a phased approach. Alternatives are often tested on a small scale before full-scale implementation. Elements of the design which are less certain become the experimental treatments of a pilot program. Results are then evaluated in selecting the approach for later project components. Inherent in adaptive management is the need for long-term, ecosystem level monitoring. In adopting this approach, the Management Authority acknowledges the thorough integration of research and restoration as a basic tenet of the Reserve program.

4. Post-Construction Monitoring

An appropriate monitoring program is expected for any restoration activity within the Reserve. Intertidal wetland restoration, in particular, is expected to entail extensive monitoring to better determine design and construction techniques through the adaptive management design process

described above. The integration of the restoration planning and construction with post-project implementation programs is also envisioned. However, if adaptive management is successful, research and monitoring requirements will decline as restoration proceeds. For example, the extensive and costly research component of the Oneonta Tidal Linkage project need not be repeated as basic experimental designs are implemented.

The Management Authority has recognized the need for personnel to coordinate the linkages between the programs. A commitment has been made by the Management Authority to hire a Research Coordinator who could meet this need (see Chapter 4 - Administrative Framework, and Chapter 6 - Research and Monitoring). These responsibilities are now distributed between Restoration and Research committees and the overextended staff of the state and federal lead agencies.

5. Tijuana Estuary Tidal Restoration Program

A conceptual plan for wetland and estuarine restoration, the Tijuana Estuary Tidal Restoration Program, was selected by the Management Authority in 1988 to achieve many of the restoration objectives. A more detailed level of planning and design, environmental impact statement and regulatory review was undertaken. With funding and coordination from the Coastal Conservancy and FWS, a programmatic EIR/EIS was prepared and certified in October 1992.

The Tijuana Estuary Tidal Restoration Program area includes approximately 520 acres of intertidal wetland and estuarine channel restoration in the north and south arms of the Tijuana River Estuary. The first phase of the program consisted of two areas of excavation: the Oneonta Tidal Linkage in the north arm of the estuary and the Model Marsh in the south arm. A third area initially identified for excavation, known as the Oneonta Slough Excavation, was eliminated due to its environmental impact and the development of alternative remedies for maintaining a functional channel.

The primary goal of the Restoration Program is to restore natural habitat values of the Reserve that have been degraded. Over the past 50 to 100 years, the Tijuana Estuary has experienced large scale sedimentation events, incipient sedimentation, dune overwash and channel constriction, localized diking and filling, and extended periods of sewage contamination. The Tijuana Estuary Tidal Restoration Program is designed to increase salt marsh habitat and restore tidal flushing to areas that have silted in over the past few decades. Intertidal mudflats are also a priority for habitat restoration.

a. Oneonta Tidal Linkage

The first component of the multi-phased project, the Oneonta Tidal Linkage, was constructed in the north arm of the estuary in winter 1997 (shown in Figure 13, along with other completed restoration projects).

The Oneonta Tidal Linkage provides a tidal connection between the northern part of Oneonta Slough and tidal lagoons located southeast of the Estuary Visitor's Center (see Figure 13). The channel is expected to enhance circulation in some 200 acres of intertidal saltmarsh stabilizing

the channel system in the north arm and reducing sedimentation in the tidal channels. The project includes a timber footbridge to maintain visitor access. The channel and bridge concentrate public use on the upland ridge immediately south of the Visitor Center, offering increased protection to the Oneonta Slough saltmarsh, which supports San Diego County's largest population of endangered light-footed clapper rail. The project will result in an increase of approximately 1.8 acres of salt marsh habitat immediately adjacent to the Visitor Center, thereby providing an excellent interpretive opportunity. An extensive research program to be conducted by PERL is integrated into the Oneonta Tidal Linkage design.

b. Model Marsh

A 20-acre intertidal wetland with tidal channels will be constructed on a degraded marsh plain in the southern arm of the estuary (shown in Figure 14). The original site selected for the Model Marsh was adjacent to the existing Old River Slough channel just north of the visitor's kiosk in Border Field State Park. However, because of extensive sedimentation of Old River Slough by Goat Canyon Creek, project planners have proposed its relocation to an adjacent site on the South Arm Slough, while the Goat Canyon Creek sediment control measures are undertaken. This new site is under study.

The Model Marsh is the first component of approximately 500 acres of intertidal wetland restoration planned for the southern arm of the estuary. Information gained from the Oneonta Tidal Linkage construction will be incorporated into the 20-acre marsh design. New basic research relating to variable site characteristics -- elevations, proximity to water, soils, and planting protocols -- will be incorporated into the project. Research and monitoring data from the Oneonta Tidal Linkage and the Model Marsh will be used to determine design details for the subsequent components in the southern restoration area.

Soils analysis must be conducted for the selected site prior to completing project engineering and design. Soil classifications and grain size in the area are varied. It is expected that construction will require separating soil by grain size, with part of the material used for beach replenishment and the remainder marketed for construction products. Construction funding for the 20-acre marsh and subsequent components has not been identified.

c. Subsequent Intertidal Restoration Components

Approximately 500 acres of restoration modules contiguous to the Model Marsh site were identified in the Tijuana Estuary Tidal Restoration Program EIR/EIS. Engineering design and supplemental environmental review is required to facilitate additional development. Preliminary field investigation reveals a high sand content, indicating likelihood that the project can be engineered as a wetland excavation/beach replenishment project. The project buildout is estimated at 20 years because of the combined effects of regulatory review for each project component, adherence to the adaptive management design approach, and the considerable per-acre cost of implementation.

d. Oneonta Slough Channel Migration

An excavation of Oneonta Slough was originally included as part of the Tijuana Estuary Tidal Restoration Program. The Oneonta Slough project consists of excavation of a hardpan area on the east bank of the slough near its junction with the river. The removal of the hardpan was recommended to offset the eastward migration of the barrier beach. It was believed that the channel migration would be impeded by the hardpan and constriction would occur, resulting in deteriorated water quality to the north with detrimental results for saltmarsh species.

Upon consultation with hydrologist Phil Williams, the Restoration Committee concluded that while incremental loss of channel capacity at the site may occur due to barrier beach migration, the incremental action is likely to be accommodated by channel development to the east. It was concluded that the main hazard to Oneonta Slough habitats resulting from the hardpan would arise from a catastrophic event such as occurred in 1983, when an unusual ocean storm resulted in waves overtopping the dunes and the sudden filling of the Oneonta Slough channel with beach sand. Following the 1983 disaster, the FWS was unable to secure a permit from the Army Corps of Engineers to dredge the channel for six to seven months. A hypersaline drought ensued, resulting in a precipitous loss of life in Oneonta Slough.

Based on discussions with engineers and Phil Williams, the Restoration Committee recommended putting on hold plans for hardpan excavation and instead, is seeking a standing permit with the Corps to reopen the channel should it be closed by a sudden storm. FWS is in the process of obtaining such a permit.

6. Other Restoration Programs

a. Dune Re-establishment and Stabilization

Prior to storms in recent decades, the barrier beach along Tijuana estuary consisted of sand dunes. Historical air photos of the area show that these dunes were originally stabilized by vegetation. Photos from the 1960s show extensive vehicle damage to the dunes.. Together with foot traffic, these disturbances set the stage for massive erosion. During the winters of 1982-83 and 1988-89, storm waves washed over the beach and pushed enormous quantities of dune sand into the estuarine channels. The result has been a further reduction of the tidal prism and an ongoing threat of the closing of the ocean entrance.

Future maintenance of the estuarine channels requires the re-establishment of the coastal dunes and their stabilization with native dune vegetation. Unless the dunes are stabilized, they will continue to be washed into the channels during storms, greatly reducing the effectiveness of the dredging program. Native coastal dune vegetation has probably suffered a greater percentage of destruction than any other habitat in San Diego County. It is therefore recommended that the removal of exotic plants be undertaken concurrent with a revegetation program.

The following dune stabilization needs exist:

- Replacement of dune sand from estuarine channels back to the beach;
- Planting of native dune species over the dunes and removal of exotics;

- Irrigation of transplants to ensure establishment; and
- Monitoring of dune vegetation and slope profiles to assess success.

b. Caspian and Third Street Riparian Area

In 1990, a stormwater channel was excavated to convey runoff from 3rd Street and Caspian Way to the marsh. The channel was planted with cottonwoods and willows to filter nutrients and contaminants, thereby protecting the Oneonta Slough habitats.

7. Relationship of Restoration Plan to Other Program Areas

Because of the large scale of intertidal wetland and estuarine channel restoration proposed for Tijuana Estuary, and a recognition of the present rudimentary knowledge of the art and science of restoration, the restoration program is designed in increments with careful monitoring and review of initial phases informing the design of subsequent phases. The design process can be enhanced further by coordinating applied research with project monitoring, thereby providing more information to the process and enhancing the likelihood of success. This approach, referred to as an adaptive management program, is described in detail in Chapters I and 2 of the Tidal Restoration Program EIR/EIS.

Through the Tijuana Estuary Tidal Restoration Program, the Management Authority and the state and federal lead agencies (Coastal Conservancy and FWS) have acknowledged and endorsed the integration of research and restoration. The Management Authority through its committees will work to ensure that this coordinated effort succeeds and that both restoration and research proceed without undue cost or delay resulting from the coordinated adaptive management approach.

8. Restoration Needs

The large scale restoration proposed for the Reserve will require a considerable investment of funds. Clearly, such a large program far exceeds the restoration budgets of the Reserve operating agencies and its member organizations. Implementation of the multi-million dollar program requires an innovative fundraising approach that targets a variety of funding sources, both public and private.

In recent years, the primary source of funding for large-scale natural resource restoration projects in the region has been from mitigation funds arising from damages attributed to large private developments and public infrastructure projects. The needs of possible funding organizations have not influenced restoration design. The Reserve mitigation policies are described in the policies section of this chapter. The current program balances resource management and protection with human activities, and incorporates an adaptive management process that includes research and monitoring.

With the construction of the Oneonta Tidal Linkage in 1997 and completion of Model Marsh plans and permits scheduled for 1998, the Reserve is prepared to compete in earnest for

restoration funding. Planning and implementation for additional phases of the Tijuana Estuary Tidal Restoration Program and numerous other supporting natural resource projects remain unfunded.

The Coastal Conservancy, working closely with the Reserve manager, will continue to coordinate fundraising for Reserve restoration programs. State wildlife bond funds, other appropriate state and federal funding sources, including competitive environmental awards, and private sources, both within the nonprofit and corporate sectors, will be considered.

V. RESOURCE PROTECTION, MANAGEMENT, AND RESTORATION PLAN OF ACTION

Goal 1. Preserve, restore, enhance and protect habitats to maintain biodiversity, maintain important migratory bird resources, and aid in the recovery of threatened and endangered species.

Objective la: Maintain effective law enforcement and fire suppression programs that cover the entire Reserve and are well-coordinated between agencies.

Tasks:

- Increase preventative law enforcement measures including high visibility patrols and increased communication with stable owners to ensure compliance of the renters with regulations.

- Where appropriate, cross-deputize law enforcement officials from FWS, CDPR, and County of San Diego.

- Formalize the relationship with County of San Diego for emergency response to ensure the entire Reserve area receives emergency services.

- Maintain funding for the fire-suppression crew.

- Develop a program to reduce illegal dumping at the southern end of the Reserve (coordinated with law enforcement program) that assigns responsibilities for removal of debris among landowning agencies and establishes a Reserve-wide policy for illegal dumping.

- Obtain funding for an additional full-time law enforcement officer.

- Establish communication system (e.g., radio frequencies) between operating agencies.

- Develop methods to execute clean-up of water-borne trash in Oneonta Slough and install a boom across the Slough mouth to reduce deposition of water-borne trash in the marsh.

Objective 1b: Manage habitats, predators and people to maximize recruitment of endangered species.

Tasks:

- Develop and implement a comprehensive predator management program, including year-round control of feral dogs and cats and seasonal monitoring and management of native predators.

- Investigate potential to enhance saltmarsh habitats for light-footed clapper rail through creation of small tidal creeks in cordgrass stands.

- Maintain annual, recurring monitoring efforts to document populations and production of endangered species (clapper rail spring call counts and winter high-tide counts; California least tern and western snowy plover nest monitoring; least Bell's vireo breeding survey; annual surveys on distribution and abundance of salt marsh bird's beak).

- Increase active enforcement of areas closed to protect endangered species.

- Complement "Tern-Watch" and other wildlife educational efforts with signs announcing apprehension and prosecution of violators.

- Evaluate Reserve vernal pool habitats and develop plan for restoration and introduction/re-introduction of listed vernal pool species as appropriate.

- Evaluate upland sites for potential creation of new vernal pool habitats

- Develop a cooperative agreement between operating agencies and U.S. Border Patrol to enhance apprehension efforts near the border and reduce operation of enforcement vehicles in wetland habitat areas.

Objective 1c: Management of habitats within the Reserve based on the habitat management guidelines put forward in the Resource Protection, Management and Restoration section.

Tasks:

- Develop and fund a plan to control invasion by exotic plants.

- Review existing mosquito/vector control program with San Diego County Health Department and NOAA to identify ways in which to minimize use of chemical pesticides.

- Operating agencies will continue ongoing habitat management practices, such as dune re-establishment, until habitats are stabilized.

- Establish protocols by which impacts from events such as storms and floods are assessed and repaired.

Goal 2. Respond to identified resource management problems, particularly those in the southern end of the Reserve, by establishing cooperative and integrated programs and approaches.

Objective 2a: Develop a comprehensive erosion control program that anticipates border-area land management.

Tasks:

- Develop and initiate implementation of an erosion control program for the Goat Canyon sub-watershed.

  Subtasks:

  1) Target priority problems
  2) Identify and involve all stakeholders
  3) Apply integrated solutions that make use of the expertise and authority of multiple agencies
  4) Measure success through strategic monitoring

- Work with landowning agencies and the U.S. Border Patrol to ensure that management activities and road building and road maintenance activities have minimal impacts on downstream habitats and complement the goals of the erosion control plan.

Objective 2b: Restore degraded habitats based on the guidelines put forward in the Resource Protection, Management and Restoration chapter.

Tasks:

- The Restoration committee of the Management Authority will maintain an updated and prioritized list of projects needed to restore degraded habitats.

- Acquire funding to implement priority projects, including components of the Tidal Restoration Program, in a sequence determined by the design team and reviewed by the Restoration Committee.

- Acquire funding to plan and implement restoration programs specific to the Goat Canyon sub-watershed.

- The Management Authority will use criteria and priorities established in this plan to guide selection, approval and monitoring of restoration projects funded and/or performed by entities not affiliated with the Reserve

Goal 3. Monitor and assess land use activities within the watershed, particularly the

neighboring Tijuana River Valley, and attempt to influence practices to promote the health of the Reserve.

Objective 3a: Establish relationships with land managers, municipalities and others to promote land management practices that improve the health of the Reserve.

Tasks:

- Identify the land uses that have particular impact on downstream resources and are amenable to conservation practices.

- Identify key partnerships through which agreements can lead to improved resource values at the Reserve.

- Coordinate with neighboring municipal governments to identify and generate strategies to avoid impacts of public works projects on downstream Reserve resources.

- Establish program outline, goals and objectives, and task forces for initiating proactive resource protection work outside the Reserve.

Objective 3b: Initiate programs that build upon existing water quality monitoring and treatment programs in the watershed to bear direct benefits to the Reserve resources.

Goal 4. Complete acquisition of all parcels within the adopted Reserve boundary.

Tasks:

- Maintain a list of status of each parcel, willingness of owner to sell, and special circumstances or conditions that may affect transaction.

- Update appraisals as opportunities arise for negotiation and/or purchase.

- Identify funding sources or public agencies willing to purchase properties

- Enlist assistance of private or quasi-public agencies to assist with funding for acquisition or to facilitate property ownership transaction.

CHAPTER SIX: RESEARCH AND MONITORING PROGRAM

INTRODUCTION

The international scope of the Tijuana River watershed, the diversity of habitats, and the range of human and physical problems facing the Reserve make it an area rich for study in both the life and social sciences. Tijuana River National Estuarine Research Reserve (NERR) is situated near several biological research institutions. Most significant among them is the Pacific Estuarine Research Laboratory (PERL) at San Diego State University (SDSU). The long-standing, mutually beneficial relationship between PERL and the Tijuana River NERR has contributed greatly to the scientific understanding of the region's estuarine ecosystems and to the science of wetland restoration. To further this relationship, two noteworthy changes reflected in this plan are the inclusion of SDSU on the Management Authority and the identified need for the addition of a research coordinator to improve the research and monitoring program.

The Reserve's research and monitoring programs are guided by national plans that identify goals, priorities, and implementation strategies for these programs, as well as research needs specific to the Tijuana River NERR. This approach, when used in combination with the education and outreach programs, helps ensure the availability of scientific information that has long-term, system-wide consistency and utility for managers and members of the public to use in protecting or improving natural processes in their estuaries. This chapter describes the mission and goals of the research and monitoring programs of, the Tijuana River NERR and concludes with a plan of action to promote and encourage research to the extent possible without compromising resource protection.

I. MISSION

The research and monitoring mission at Tijuana River NERR is to:

Contribute to an improved understanding of estuarine processes and dynamics that will benefit the management of the Reserve, Tijuana Slough National Wildlife Refuge (NWR) and regional coastal ecosystems and (through monitoring) to improve the ability of resource managers to detect, quantify, and predict both short and long- term changes in the health and viability of estuarine ecosystems through monitoring.

II. GOALS

Goal 1: Foster understanding of impacts from activities occurring within and outside the Reserve's boundaries and study options to mitigate damages from those activities, with a particular emphasis on the restoration of ecological habitats.

Goal 2: Provide opportunities for compatible research that improves the available scientific information for use in the protection of coastal ecosystem integrity, biodiversity, and endangered

species habitat.

Goal 3: Improve the availability of research information as a basis for more informed coastal ecosystem management decisions.

Goal 4: Fund and staff a research program at the Reserve that encourages broad-view (watershed and regional scope) and interdisciplinary research of estuarine ecosystems.

Goal 5: Enhance involvement with research institutions in the region to promote research with the Reserve and its watershed and to further coordinate their research agendas

Goal 6: Using the Reserve's GIS system, characterize and monitor the environment of estuarine habitats under the management of the Reserve.

Goal 7: Expand the existing monitoring plan such that it records physical and biological parameters relevant on national, regional, and local scales and can influence decision-making relating to estuarine resources.

Goal 8: Involve the public in monitoring as a means to augment the amount of data collected and promote citizen involvement in stewardship.

III. POLICIES

A. INTEGRATING NERR SYSTEM GOALS AND REFUGE SYSTEM GOALS INTO TIJUANA RIVER NERR'S RESEARCH PROGRAM

The NERR System research and monitoring programs are designed to facilitate and coordinate scientific understanding of estuarine systems, and to establish and regularly monitor the baseline conditions of estuaries in the System. In creating the NERR System, Congress required that research priorities, objectives, and methodologies should be coordinated nationally for the broadest application of research results and maximum use of the System.

The research program at Tijuana River NERR is designed to fulfill the NERR System goals as defined in the Code of Federal Regulations. As described in "Conservation of the Nation's Coasts and Estuaries: A Strategic Plan for the National Estuarine Research Reserve System," the NERR System goals are to:

- Address coastal management issues identified as significant through coordinated estuarine research within the NERR System;

- Promote federal, state, public, and private use of one or more reserves within the NERR System when such entities conduct estuary research; and

- Conduct and coordinate estuarine research within the NERR System, gathering and

making available information necessary for improved understanding and management of estuarine areas.

It also recognizes the NERR System strategic plan developed to address both research and monitoring activities on a national scale. The NERR System research and monitoring programs include the Graduate Research Fellowship program and a three-phased monitoring program that itself includes:

- Phase I - environmental characterization, including the studies necessary for inventory and comprehensive site description.

- Phase 11 - site profile development, including a synthesis of data and information; and

- Phase III - monitoring, including implementation of a systematic long- term monitoring program focusing on selected parameters.

The NERR System-funded research and monitoring programs are intended to generate and supply information to state and local governments, such as to fish and wildlife management and land use management/permitting agencies, as well as to various stakeholders and users of coastal resources. Coastal governments, policy-makers and the public should be able to use research results to make informed land use and management decisions, to gauge the effect of activities, and to restore estuarine habitat. Researchers should have access to a database that describes estuarine conditions on a variety of geographic and temporal scales.

The research program at Tijuana River NERR also incorporates Fish and Wildlife's (FWS) research mission: to understand endangered species and their habitats, without harm to the species or their habitats. Research results are the foundation upon which habitat or species recovery plans are developed.

B. SETTING PRIORITIES FOR RESEARCH AT TRNERR

Research by independent or Reserve staff scientists may be conducted in the Reserve on any topic consistent with the NERR goals and NWR, and may be funded from any source. In practice, the topics investigated at the Reserve typically have been prioritized and funded by NOAA or FWS, or selected for study by PERL.

NOAA is a significant source of research funding for both independent and NERR staff researchers. NOAA encourages coordinated research among reserves and other scientists by preferentially funding research proposals on specific estuarine topics that it has identified as national priorities. This unified approach promotes the exchange of research findings among reserves, state and federal agencies, and members of the academic research community.

1. NERR System Research Priorities

The NERR System funds a total of 42 research fellowships focused on improving coastal zone

management while providing students with hands-on training in ecological monitoring. Areas of scientific study supported by these fellowships are:

- non-point source pollution
- biodiversity and effects of invasive species
- estuarine ecosystem restoration
- sustaining estuarine ecosystems

2. NWR System Research Priorities

FWS funding for research at the Tijuana River NERR is limited. Small investigations can be funded by Refuge at the discretion of the Refuge manager. Highest priority is given to projects that:

- Have direct implications for management of Refuge resources;

- Have management implications for federal trust resources (migratory birds, endangered species, marine mammals, and inter-jurisdictional fisheries, and wetlands); and

- Are part of long-term programs that have high probability of significantly increasing the body of scientific knowledge and understanding of relationships with regional management implications.

C. CRITERIA FOR EVALUATING RESEARCH PROPOSALS

Should funding be made available to the Reserve for research, the most important criterion for evaluating research proposals will be confirmation that the research topic addresses one or several stated research goals of the Reserve as identified in this Management Plan.

D. ACCESS AND RESPONSIBILITIES FOR RESEARCHERS

Qualified scientists, students, non-profit research organizations, and local, state, or federal agencies have conducted research at Tijuana River NERR. Any researcher with adequate scientific qualifications and financial support may request permission to conduct research within Tijuana River NERR, and such requests are typically granted if they meet the compatibility.

Projects that involve manipulation of habitat require advance approval by the research committee of the Management Authority. By federal regulation, projects known to be destructive to habitat or otherwise counter to Tijuana River NERR goals are not permitted. Projects that have been approved must be discontinued if they are determined by the research committee to be destructive.

All visiting researchers are asked to complete a form briefly summarizing their work and research site(s) within the Reserve to avoid duplicative projects, or incompatible projects at the same site. To ensure access, researchers are requested to contact the appropriate operating

agency when they intend to visit the Reserve.

All researchers are responsible for complying with the terms of their special use permits to use Reserve study areas, including removal of all sampling devices and property from the Reserve upon the completion of their study. Researchers must submit an annual progress report to the Reserve manager by January 15 of each year covering activities of the preceding calendar year. A final report must also be submitted.

All publications that result from work conducted at Tijuana River NERR must acknowledge the assistance of the Reserve, the landowning agency, and any funding provided by the Reserve or its member agencies. For graduate programs in which the Reserve is a primary study area, candidates will provide one copy of the thesis/dissertation to the Reserve library. Five reprints of the each journal article resulting from work at the Reserve will be provided to the Reserve manager.

IV. EXISTING CONDITIONS AND PERCEIVED NEEDS

A. RESEARCH PROGRAM

1. Introduction

To improve the planning for restoration projects, research efforts at Tijuana River NERR have addressed critical management issues such as the impacts of sewage on fish and plant communities, effects of sedimentation on habitats, and wetlands dynamics. Research is conducted by non-staff investigators and is coordinated by the Reserve and Refuge managers. Tijuana River NERR provides administrative, physical, and informational support for estuarine research by scientists and students from universities, research institutions, and other organizations. The Reserve also offers access to long term estuarine monitoring results from Tijuana River NERR and other estuaries in the NERR System.

The following table summarizes research and monitoring activities conducted at the Tijuana River NERR since 1986:

Table 7: Research Projects Conducted at the TRNERR

YEAR	SUBJECT	INSTITUTION	RESEARCHER
1986	The ecology of Tijuana Estuary: an estuarine profile	SDSU	Zedler, Nordby
1986	Monitoring and Manipulation of Phytoplankton dynamics	SDSU	Fong
1987	Tijuana Estuary enhancement hydrologic analysis	Coastal Conservancy	Williams, Swanson
1987	Soil morphology of the Tijuana River NERR	SDSU	Mayer, Greenwood
1987	Artificial Coastal Wetlands: Can They Duplicate Natural Ecosystem Functions?	SDSU*	
1988	The Integration of Simulation and Salt Marsh Monitoring for Improved Management at Tijuana Estuary	SDSU	
1989	Border Field State Park Coastal Dune Ecosystem	SDSU	Fink, Zedler

	Assessment and Research		
1989	Wastewater Wetlands: Pulsed Discharges to Protect Coastal Water Bodies	SDSU*, California Sea Grant	
1989	Linkages: Among Estuarine Habitats and with the Watershed	SDSU*	Zedler, et al
1989	Effects of dune over-wash during the January 18, 1988 storm at the Tijuana Estuary	SDSU	Fink
1989	Ecology and conservation of the endangered least Bell's vireo	FWS	Franzreb
1989	Marsh Restoration Plan	SDSU*	PERL
1990	Assessing the Sources and Loading of Pollutants Affecting Tijuana Estuary	SDSU*	Zedler
1990	Using Wastewater Wetlands to Protect Tijuana Estuary from Sewage Pollution	SDSU*	Zedler
1990	Status of the Belding's Savannah sparrow at theTijuana Estuary	Army Corps of Engineers	Kus
1990	Status of the least Bell's vireo at the Tijuana River	Army Corps of Engineers	Kus
1990	Light-footed clapper rail census and study, 1990	SDSU	Zembal
1990	Wetland Boundary Determination for the Naval Outlying Landing Field, Imperial Beach	SDSU	Winfield
1990	Accelerating the Development of Restored and Natural Wetlands	SDSU*	Zedler
1990	Long-term dynamics of salt marsh vegetation at Tijuana Estuary	SDSU	Griswold, Zedler
1991	Accelerating the Development of Ecosystem Functions in Restored and Natural Wetlands	SDSU*	Zedler
1991	Ecosystem Responses to Changes in Tidal and Sewage Inflows to Tijuana Estuary	SDSU*	Zedler
1991	Methods to Improve Restoration of Pacific Estuarine Ecosystems	SDSU*	Zedler
1991	Habitat use and breeding status of the least Bell's vireo at the Tijuana River	IBWC	Kus
1991	Comparisons of constructed and natural salt marshes of San Diego Bay	SDSU	Zedler, Langis
1991	Assessing the effects of sewage inflows on Tijuana Estuary	SDSU	Zedler, Langis, Nyden, Busnardo
1992	Improved Restoration of Southern California Coastal Wetland Habitats	SDSU	
1992	Ecosystem Response to Changes in Tidal and Sewage Flows to Tijuana Estuary	SDSU*	
1992	Restoring Tijuana Estuary: Salt Marsh Mesocosms with Tidal Flow and Freshwater Treatments	SDSU*	PERL
1992	Methods to Improve Restoration of Pacific Estuarine Ecosystems	SDSU*	
1993	Tidal Restoration Research	SDSU	
1993	Restoring Tijuana Estuary: Salt Marsh Mesocosms with Tidal Flow and Freshwater Treatments	SDSU*	
1993	Improved Restoration of Southern California coastal Wetland Habitats	SDSU	Zedler, Williams
1993	Effect of Sea Level Rise on Southern California Wetlands and Wetland-Dependent Species	National Biological Survey	Powell, Zedler
1994	Impact of Non-Point Source Pollution on the Salt Marsh at Tijuana Estuary	SDSU	

* Funding Received From NOAA

A summary of publications relating to research conducted at TRNERR is provided in Appendix 10. A listing of theses completed in the biology department at San Diego State University is provided as Appendix 11.

2. Administration of the Research Program

The Research and Monitoring Committee of the Tijuana River NERR Management Authority prepares an annual research plan. This annual research plan ensures that research conducted on the Reserve is compatible with resource protection, is scientifically sound, is compatible with the education and interpretation programs, and whenever possible, is contributory to NERR's and FWS's goals. The Research and Monitoring Committee also makes recommendations for research to be funded by NOAA or the operating agencies. The Committee chair acts as a liaison with the director of PERL and other researchers to identify and encourage research areas wherein additional research would benefit the management of the Reserve.

The Research and Monitoring Committee of the Tijuana River NERR Management Authority periodically convenes special advisory groups of regional and national scientists on an ad hoc basis. These groups provide expert assistance in planning and implementation of Reserve projects. The Research and Monitoring Committee reviews applications from researchers to use Reserve facilities and to assess the functioning and staffing needs of the research and monitoring programs.

At each meeting of the Management Authority, time is allocated for a presentation on the status and results of Tijuana Estuary research and monitoring. This enables the operating agencies to adjust their management practices based on relevant and current research.

Monitoring of wildlife within the Refuge and Reserve is performed by FWS staff who divide their time between several refuges in the San Diego NWR Complex. There is currently no staff position at the Reserve that specifically attends to the coordination and implementation of the research and monitoring program; the need for a research coordinator has been identified.

3. Review and Approval of Projects and Research Permits

Research proposals that involve on-site activities at the Tijuana River NERR are sent to the Reserve manager, who currently is responsible for coordinating the Research Committee review. This review of permit applications on a case-by-case basis has become overly burdensome for both the Reserve and Refuge managers. A modified application process, with two month-long application periods per year, is under development.

4. Information, Facilities, and Equipment Support for All Researchers

Dissemination of information about ongoing and completed research is one the most important functions of any NERR. Tijuana River NERR actively shares technical information with specialized audiences through several means. The Reserve anticipates that this important function will be improved with the addition of the Research Coordinator.

Tijuana River NERR facilitates research by making information available about historic conditions in the ecosystem, and by maintaining visual and quantified records of selected aspects of the Reserve's natural system. Reserve background information includes aerial photographs, Geographic Information System (GIS) maps, publications, and reprints. Data collected from on-site research, and parallel data from other reserves, are available to visiting researchers.

5. Relationship with the Research Community

Tijuana River NERR is fortunate to be located near several universities and research institutions that conduct extensive research in fields relating to estuarine resources. Since the designation of Tijuana Estuary as a NERR, most research activities have been conducted and/or coordinated by PERL or other departments at SDSU. This relationship between the Reserve and SDSU has been mutually beneficial. Both parties agree that a research coordinator is needed to properly implement Reserve research and monitoring programs.

With the ratification of this plan, a two-year term seat will be added to the Management Authority for a research institution. SDSU will be the first institution to fill this seat.

6. Role of Pacific Estuarine Research Laboratory (PERL) and San Diego State University (SDSU)

The NERR has a long standing relationship with PERL, which was formed in 1984 when PERL began research projects along Monument Road. It has since become an internationally recognized research program. In 1997 SDSU designated the Tijuana River NERR as an auxiliary field station (see Chapter 3 - Accomplishments). PERL has also gained recognition for translating research information to aid decision-makers. The Environmental Protection Agency (EPA) and Environmental Law Institute recognized that role with a National Wetland Award for use of scientific knowledge in wetland conservation. PERL's former director, Dr. Joy Zedler, was instrumental in the original designation of Tijuana Estuary for protection and has maintained a strong program researching the estuarine ecosystem. PERL has also had a long-term role in the monitoring of the estuary, through the NOAA-funded monitoring programs, and unfunded work with water quality data loggers.

PERL has a staff of 14 researchers, 11 of whom conduct 50 percent or more of their research at Tijuana River NERR. PERL has collaborated with Tijuana River NERR on a number of important management decisions, including co- authoring the EIR/EIS for the Tidal Restoration Plan, which is a significant, long term management tool used by the Management Authority and the operating agencies.

PERL has received two large awards to conduct restoration research at the Tijuana Estuary. Various aspects of the research are underway, and a portion of the award could best be spent at a large (20+ acre) excavated restoration site as called for in the Tijuana Estuary Tidal Restoration Plan.

7. The Tijuana River Watershed Management Project

The Tijuana River Watershed Management Project is a cooperative effort between SDSU and Colegio de la Frontera Norte (COLEF) that supports the development of a comprehensive GIS for the Tijuana River Watershed. Startup funding for the project was supplied by NOAA with assistance from other project partners.

The Watershed Management project consists of five components: GIS Database Development, Community Outreach, Education, Scientific Research, and Watershed Management. The GIS will be used to study a wide range of subjects such as environmental impacts of land use activities. Numerous research initiatives have been identified by SDSU and its partners to be coordinated with the Watershed Management Project. These include: environmental and toxics risk assessment, water and air pollution analysis, multiple species habitat modeling, evaluation of services and infrastructure needs, and land use analysis.

This project provides opportunities for the Tijuana River NERR to integrate its programs with others in the watershed. In supporting this project, the funding partners are promoting proactive protection of the Tijuana River NERR.

8. Application of Research Results for Resource Protection

Research results need to be applied to Reserve operations through review of environmental impact reports, attendance at hearings and council meetings, and writing of letters to inform decision-makers of relevant information. This type of information transmission is currently done based on research results from the Reserve, but it is unorganized, and the NERR is not always credited with this activity. The translation of scientific findings into specific applications for management or public policy making is typically not required of researchers. It constitutes extra activity that may or may not carry some kind of recognition or compensation.

Thus, an important objective for the NERR is to facilitate development of an endowment that could fund some translation of research results. Findings of pure and applied research should be further extended to the policy-making arena. Position papers should be developed and distributed among local researchers at Tijuana River NERR and other NERRS.

9. Research Program Needs

The Research Committee has identified that a research coordinator is essential for developing and implementing a research and monitoring program. The primary function of this position will be providing support for estuarine research by scientists and students from universities, research institutions, and other agencies. Visibility of the Reserve and credibility of the research program

will be improved by the efforts of a research coordinator networking with other scientists studying in the region and the state.

The research coordinator will:

- strengthen the relationship with SDSU and other institutions;
- serve as a point of contact for researchers using the Reserve;
- assist researchers in the development of research projects;
- maintain a Reserve research data base;
- aid in disseminating research results;
- identify funding opportunities for research at the Reserve;
- maintain GIS program of the Reserve for managers and researchers.

B. MONITORING PROGRAM

1. NERR Monitoring

The monitoring strategy at Tijuana River NERR is based on the understanding that physical, chemical, and biological aspects of habitats and communities of organisms are excellent indicators of a vast array of ecological factors. Chronic disturbance, predation, and competition are expressed through change in habitat quality, species composition, population abundance and distribution. Accordingly, Tijuana River NERR monitors critical habitat parameters and the dynamics of selected communities to gain insights into ecosystem health. Benefits of monitoring include:

- early warning of potential problems in the estuary (e.g. exotic plants and animals)
- baseline information to detect long-term changes, including direct anthropogenic impacts (e.g., changes in sewage inputs, stormwater runoff, fresh water inputs) and more gradual changes (e.g., El Nino, habitat shifts, sea-level rise); and
- documentation of rare and unusual species.

By providing documentation of changes in the estuary, the data from the monitoring program can provide the basis for generating hypotheses for future ecological research and for developing management strategies to address these changes.

The following table summarizes monitoring activities at the Reserve:

TABLE 8: Ecological Monitoring Conducted at TRNERR

Time Period	Population	Sponsor	Researcher
Annually	California Least Tern Breeding Colony	FWS	
Annually	Light Footed Clapper Rails	FWS (Carlsbad)	Zembal
Annually	Belding's Savanna Sparrow Populations	FWS	
Annually	Herpetofaunal Survey	FWS	UCSD Personnel

Periodically	Small mammal trapping survey	FWS	Pavelka, Mitchell
Quarterly	Benthic Invertebrates	FWS	PERL/SDSU*
Annually	Vegetation	FWS	PERL/SDSU*
Quarterly	Fish Community	FWS	PERL/SDSU*
Continuous	Hydrological monitoring/Nutrients/etc	FWS	PERL/SDSU*

* Funding Received from NOAA

The Reserve is also participating in the NERR national monitoring program by developing an inventory and continuing record of Reserve biotic and abiotic conditions, which can be used by researchers and by coastal ecosystem managers to track long-term trends. One function of the Tijuana River NERR monitoring program is to provide benchmark information to researchers, coastal communities, and ecosystem managers. Degrees of change in regional estuarine ecosystems can be measured by comparison to known, regularly monitored conditions in the Reserve. The Inventory and Monitoring Plan for Tijuana River NERR is modeled on the strategic plan developed for the NERR System.

The NERR System has recently developed a system-wide monitoring program that would simultaneously provide critically needed, standardized information on national estuarine environmental trends while allowing the flexibility to assess coastal management issues of regional or local concern. This program is designed to enhance the value and vision of the NERR System as a network of national reference sites. The program's three components will be implemented in phases, depending on funding:

- Abiotic Parameters: Each Reserve will monitor a uniform suite of physical and chemical processes that either impact or reflect the health of estuarine ecosystems. These will include basic water quality indicators, atmospheric conditions, and specific processes such as tidal and groundwater flow and contaminants. Where possible, existing data collected by other agencies will be incorporated.

- Biodiversity: Across the NERR System, each site will monitor two fundamental features of its estuarine ecosystem: (i) basic community structure in major estuarine habitat types (e.g., uplands, emergent wetlands, benthos, etc.); and (ii) population trends of important "target species" including those of commercial, recreational, or conservation significance (e.g., submerged aquatic vegetation, marsh plants, wading birds, endangered species, etc.).

- Land Use Patterns: In recognition of the profound influence of land and water use on estuarine resources, the NERR System monitoring program will compile existing and new data on major patterns of habitat classification and use within NERR System watersheds. Data gathered from a variety of state and federal sources will be updated periodically and used to monitor significant changes in watershed uses and impacts on Reserve resources.

Information generated by the NERR System monitoring program will be compiled electronically at a central data management "hub," and will be disseminated to all Reserves, CZM programs,

the Office of Ocean and Coastal Resource Management (OCRM) and other users. Each Reserve will have constant electronic access to all system-wide data and summary statistics on environmental trends at the national, regional, or site-specific levels.

The NERR System monitoring program is scheduled for implementation in three phases: 1) water quality and weather, 2) biological population and communities, and 3) coastal watershed land-use patterns. Presently water quality is being monitored in the 21 sites of the NERR System and a Centralized Data Management Office (CDMO) is being established at the North Inlet-Winyah Bay NERR. The CDMO will facilitate information exchange among reserves in the NERR System, state coastal zone management programs and OCRM. At this time, PERL maintains and monitors the water quality dataloggers at the Reserve, and conducts biological monitoring of plants, invertebrates, and fish.

2. Past Monitoring

Monitoring efforts completed at the Reserve include:

- Extensive sampling of surface and bottom water salinity. This included 12 stations throughout the estuary. Work ended when PERL's funding from the National Biological Service (now Biological Resources Division of USGS) terminated.
- Intermittent sampling of fecal and total coliforms terminated at the same time as the above sampling and for the same reason.
- Extensive sampling of salt marsh plant species took place from 1979 through 1988. The monitoring program then shifted to a more intensive sampling of selected low, mid and high marsh sites.
- During the biological surveys that were conducted for the EIR/EIS for the Tidal Restoration of Tijuana Estuary (ENTRIX, 1991), there were widespread sampling efforts for plants, insects, herpetofauana, mammals, and birds. These efforts ended when funding terminated.
- From time to time, graduate students have conducted systematic sampling of invertebrates, fish larvae, birds, and other organisms during their thesis research. Of necessity, such efforts end when the thesis is complete.

3. Available Inventory Information

A comprehensive inventory of physical and biotic resources was completed in 1992 by Joy B. Zedler, Christopher S. Nordby, and Barbara E. Kus entitled The Ecology of Tijuana Estuary - A National Estuarine Research Reserve. This work synthesizes and interprets the growing data base of the estuary's diverse biota. Research at Tijuana River NERR is described extensively in Tidal Wetland Restoration: A Scientific Perspective and Southern California Focus, by Dr. Joy Zedler.

There is also a substantial body of work produced by scientists working individually over the years on a wide range of topics. Results from these research activities are maintained in the Reserve library.

4. Current Monitoring Activities

The systematic long-term monitoring at Tijuana River NERR currently consists of the following surveys:

- water quality
- salt marsh vegetation
- salt marsh soil salinity
- fish
- invertebrates
- birds

The surveys are performed by PERL researchers with substantial funding from NOAA. Annual reports of these monitoring activities are completed by PERL and provided to the Reserve.

5. Monitoring Program Needs

The following needs have been identified for the monitoring program at Tijuana River NERR:

- Update data dictionary for Reserve GIS
- Modify GIS program to improve its utility to Reserve and Refuge managers
- Centralize and organize monitoring results

V. RESEARCH AND MONITORING PLAN OF ACTION

Goal 1. Foster understanding of impacts from activities occurring within and outside the Reserve's boundaries and study options to mitigate damages from those activities, with a particular emphasis on the restoration of ecological habitats.

Objective 1a: Perform timely assessment of changes created by significant unforeseen natural events or human activity. Create a mechanism for responding to these changes.

Objective 1b: Encourage study of the effects of recreation on habitats.

Task:

- Perform an assessment of user motivation for activities that cause damage to habitats.

Objective 1c: Use and improve upon existing Geographic Information System (GIS) in the Tijuana River watershed to develop a more advanced research and monitoring program.

Task:

- Monitor habitat changes within the Reserve in order to plan for restoration of up to 500

acres of transitional and upland habitat.

Goal 2. Provide opportunities for compatible research that improves the available scientific information for use in the protection of coastal ecosystem integrity, biodiversity, and endangered species habitat.

Objective 2a: Encourage and facilitate projects that focus on identified sets of national and site-specific priorities.

Tasks:

- Prepare and distribute an annual description of NOAA and FWS- sponsored research within the Reserve.

- Maintain and distribute a list of state contributions available as matching funds for research opportunities.

- The NERR Management Authority shall institute a mechanism to write letters of support for projects that will facilitate research at the NERR.

- Implement protocols to establish the following: a) a policy for the management of research activities within the Reserve, including the Tijuana Slough Wildlife Refuge, b) guidance for researchers seeking to use the Reserve for their studies, and c) insurance that Reserve resources are not adversely impacted by research activities. (See attached Protocols)

Objective 2b: Make necessary innovations to encourage scientists to carry out management-oriented research at the Reserve, including developing long term relationships with research institutions.

Tasks:

- Coordinate and streamline procedures for the review and approval of research proposals and permits.

- Seek funding at the national level for research and monitoring proposals of national significance.

- Provide access to a national estuarine information exchange program.

- Encourage joint U.S.-Mexico estuarine research projects.

- Identify sources of funding for research at the Reserve.

Goal 3. Improve the availability of research information as a basis for more informed coastal ecosystem management decisions.

Objective 3a: Provide resource managers and coastal ecosystem decision-makers with access to Tijuana River NERR research and baseline information, including computerized and GIS data.

Tasks:

- Develop methods for standardizing data collection at the Reserve.
- Conduct polls of researchers to indicate how their work may be translated into improved management of resources.
- Create an electronic database of the Reserve library to facilitate searches by researchers, managers, and the general public.
- Add a list of TRNERR research titles and abstracts to the Reserve homepage.

Objective 3b: Fund a series of research reports that provide results of research that bear on management issues. The papers will address all three major goals of the NERR System: to improve restoration, rehabilitation, protection and preservation of the coastal bio-region.

Goal 4. Fund and staff a research program at the Reserve that encourages broad-view (watershed and regional scope) and interdisciplinary research of estuarine ecosystems.

Objective 4a: Develop a job description and obtain funding for a full-time Research Coordinator at the Reserve. The primary function of this position will be to facilitate graduate level research and proposals, assist and track technical aspects of research, and improve communication within the NERR System and with external partners so as to optimize NERRs efforts.

Objective 4b: Integrate interdisciplinary research, scientific information, education, and compatible uses, so that the NERR will have appropriate guidance for long-term operations and daily management.

Goal 5. Enhance involvement with research institutions in the region to promote research with the Reserve and its watershed and to further coordinate their research agendas.

Goal 6. Using the Reserve's GIS system, characterize and monitor the environment of estuarine habitats under the management of the Reserve.

Objective 6a: Complete data collection, field inventory, and habitat assessment necessary to update the data dictionary for the GIS system.

Tasks:

- Seek funding for the following surveys and research:

    1. Bird usage -- Annual survey focusing on trends

2. Aerial imagery of habitat types
3. Water quality -- Sampling and sustained monitoring of salinity, pathogens, contaminants, or nutrients.
4. Groundwater and surface water hydrology
5. Monitoring erosion (e.g. beach erosion) and sedimentation in the Reserve.

Goal 7. Expand the existing monitoring plan such that it records physical and biological parameters relevant on national, regional, and local scales and can influence decision-making relating to estuarine resources.

Tasks:

- Map exotic species and delineate their boundaries.
- Implement contaminant monitoring with particular emphasis on heavy metals and organics.
- Evaluate contaminants in primary prey species of clapper rails and least terns.
- Monitor extent of user activity and its impact on Reserve resources.
- Install vehicle counting devices.

Goal 8. Involve the public in monitoring as a means to augment the amount of data collected and promote citizen involvement in stewardship.

CHAPTER SEVEN: EDUCATION AND INTERPRETATION PROGRAM

INTRODUCTION

Education is an integral component of resource protection and ecosystem management at Tijuana River National Estuarine Research Reserve (NERR). In order to develop lasting solutions to problems ranging from habitat destruction by visitors to upstream water pollution, education on the value of estuarine and wildlife resources is required. At the Reserve, education and outreach are viewed as powerful tools the operating agencies [California Department of Parks and Recreation (CDPR) and U.S. Fish and Wildlife Service (FWS)] can use in overseeing the human aspect of resource management.

The education and outreach programs at Tijuana River NERR strive to go beyond providing information to resource users, as information alone does not protect the resources. To have a lasting effect on user behavior, education programs must instill knowledge and cultivate a sense of responsibility in target audiences. Research helps resource managers identify which groups are contributing to resource degradation and understand how and why. Once these questions are answered, education efforts can be developed to address specific target audiences regarding resource management issues.

Because long-term protection of the Reserve requires wise planning throughout the watershed, the Reserve's education program reaches out to audiences on both sides of the international border.

During the period covered by this planning document, the educational and interpretation programs will seek to expand high school science programs that connect the Reserve's education and research programs, to develop programs for middle school students, to plan and implement a long-term education program for coastal decision-makers, and to integrate existing educational programs with watershed coordination.

I. MISSION

The mission of the Education and Interpretation Program at Tijuana River NERR is to:

Provide interactive, hands-on, thematic, bilingual environmental education to local and regional students, the community, and coastal decision-makers through partnerships with local schools, community groups, and government agencies to promote and support estuarine stewardship by an informed and active citizenry.

II. GOALS

Goal 1: Maintain and strengthen high-quality, interpretive and school- based environmental education programs offered through the visitor center and outdoor

classroom sites (Refuge goal).

Goal 2: Refine existing and develop new interpretive and educational programs at Tijuana River NERR to support restoration efforts in the southern portion of the Reserve.

Goal 3: Develop and implement a coastal decision-maker training program.

Goal 4: Develop water quality monitoring as a cornerstone theme throughout the education program.

Goal 5: Ensure that a complete and well-trained staff is in place to implement the educational and interpretive programs.

Goal 6: Integrate educational and interpretive programs with other Reserve programs, particularly the research program.

III. POLICIES

A. NERR SYSTEM EDUCATION AND INTERPRETATION POLICIES

The National Estuarine Research Reserve System was created in 1972, as part of the Coastal Zone Management Act (CZMA), to increase the ability to responsibly manage estuarine ecosystems. A critical aspect of this mandate for the NERR System is the education, interpretation, and outreach component. In part, a reserve must "...serve to enhance public awareness and understanding of estuarine areas and provide suitable opportunities for public education and interpretation" as described in CZMA § 315(b)(2)(C). Each NERR develops and implements a program that links education to scientific research and stewardship. Each Reserve's education program functions independently, but all have commonalities with other NERR education programs.

One goal of the NERR System's education program is to provide a crucial linkage between research and coastal management. This requires translating the monitoring and ongoing research at the sites to appropriate audiences in a method that can be understood and applied by decision-makers, students, and members of the public. The link between research and management also requires the development of education programs that address resource management goals and objectives.

The NERR System and State Coastal Zone Management Programs share the common goal: "To enhance informed decision-making on coastal issues by facilitating the exchange of technical information (basic and applied sciences) to audiences that have the resources and ability to influence the management of coastal resources," (Coastal Decision-makers Training summary document, Ginger Hinchcliff, Rookery Bay NERR, p. 1).

Education policy at the Reserve is designed to fulfill the guiding principles for designing and implementing an education program as defined in the NERR System strategic plan. These

principles are to:

- Develop education programs that further the goals of the NERR System and the National Wildlife Refuge (NWR) System;
- Target a culturally diverse audience of educators and students, environmental professionals, coastal resource decision-makers, and resource users;
- Function as a "system of sites" to nationally coordinate estuarine education efforts;
- Develop the NERR System as resource centers specializing in estuarine and watershed education, taking into account the diversity of differences of each reserve site;
- Capitalize on the NERR System's ability to directly link education, research, stewardship, resource management, and restoration;
- Ensure that education priorities are based on program evaluation results by continually assessing education programs and implementing changes as necessary; and
- Encourage NERR education coordinators to be active participants in the education community.

In addition to these guiding principles, "NERR Education: A Field Perspective" lists the following series of more specific educational objectives for reserves:

- Develop programs that encourage citizen stewardship of estuaries;
- Develop reserves as resource centers that address coastal issues of global, national, regional, state, and local significance;
- Maintain a cadre of professional environmental educators in the NERR System; and
- Evaluate program quality and program cost effectiveness. (Program effectiveness is measured as it relates to educational objectives and resource management goals.)

B. CALIFORNIA DEPARTMENT OF PARKS AND RECREATION EDUCATIONAL POLICIES

The primary interpretive policy of the CDPR is to heighten and increase public understanding, appreciation, and enjoyment of the natural, cultural, and recreational values of California as represented in the state park system; and to increase public understanding and concern for people's place in their environment and thereby awaken an increased desire to protect and enjoy the natural and cultural heritage of this state (Department Operations Manual, 1300.2, April 1986).

C. EDUCATION AND INTERPRETATION IN THE NATIONAL WILDLIFE REFUGE SYSTEM

At Tijuana Slough NWR, an urban refuge, the U.S. Fish and Wildlife Service provides visitors an opportunity to understand and appreciate fish and wildlife resources. Through environmental education and interpretation -- priority uses of the NWR System (16 USC 668 dd et.seq) -- and recreation, FWS offers activities compatible with Refuge purposes. FWS continues to seek public input on ways to enhance those compatible uses.

IV. EXISTING CONDITIONS AND PERCEIVED NEEDS

A. INTERPRETIVE AND EDUCATIONAL THEMES FOR ALL PROGRAMS

In 1995, the Reserve developed a number of interpretive themes for its educational and interpretive programs. The themes are divided into three main groups: 1) Wetlands and Water; 2) Ecosystem Relationships; and 3) Human Interaction. A list of all subthemes is provided as Appendix 7. Some programs focus on a specific subtheme; other programs present several themes to emphasize the relationships between different aspects of the ecosystem.

B. GEOGRAPHIC SCOPE FOR EDUCATIONAL AND INTERPRETIVE PROGRAMS

The Reserve's interpretive and educational programs are targeted towards the local community, the watershed, and the San Diego region.

1. Local Community

The visitor center is located in the South Bay Union School District (SBUSD) in the City of Imperial Beach. Approximately two-thirds of the families in the district live on incomes below the poverty line. About 60 percent of the elementary school students in the district are Latino. The Reserve works closely with SBUSD and middle and high schools from Sweetwater Union School District.

2. Tijuana River Watershed and San Diego Region

Because pollution and ecosystems stretch beyond political boundaries, the Reserve's education programs target school systems and communities on both sides of the border. The Reserve also serves schools outside the watershed in San Diego County.

C. EDUCATIONAL PROGRAMS

The Reserve offers a wide range of interpretive and educational programs attended by students, decision-makers, and the general public.

TABLE 9: Education and Interpretation Visitation at TRNERR

Program Category	**Visitors**		
	1995	**1996**	**1997**
Visitor Center Visitation	16,250	16,200	16,200
School Group	2,965	2,810	3,740
Junior Rangers After-School Program	550	800	940
Special Events	925	940	1,250
Guided Walks for	1,500	2,880	1,240

Families			
University Groups	250	350	320
Miscellaneous Groups	270	270	350

1. Coastal Decision-makers

As authorized under the Coastal Zone Management Act, the NERR System provides decision-makers with information and insight into effective protection and management options for estuarine resources.

In 1996, as part of this NERR program, the Reserve held a day-long workshop for coastal decision-makers. The workshop, financed by a the National Oceanic and Atmospheric Administration (NOAA) grant and organized by the California Coastal Commission, covered a wide-range of resource management challenges in the Tijuana River watershed and provided an overview on activities, facilities, and services at the Reserve. The program consisted of technical presentations, discussions, and field visits. The event was attended by about two dozen decision-makers, professors, architects, geographers, planners, environmental specialists, project analysts, and ecologists. Attendees represented numerous local and state agencies (from the U.S. and Mexico), political constituencies, and universities.

Based on the success of the workshop, the Reserve education program intends to develop and implement a long-term coastal decision-makers' program that reaches out to current, near-future, and future decision-makers in the watershed. This program will be designed to complement other Reserve programs and to support the overall restoration and management goals of the Reserve.

2. School-Based programs

The Reserve has placed significant effort and emphasis on its educational and interpretive school programs. Participants in these programs make up the largest group of visitors to the Reserve.

a. Field Trips and Teacher Workshops

Approximately 125 school classes visit the Reserve each year. Most visiting classes are from elementary schools. Before bringing their students to the Reserve, teachers are required to attend a two-hour workshop presented by Reserve staff (see Appendix 8). The training orients the teachers to the Reserve, presents information on the history and mission of Reserve, and provides pre- and post-visit curricula and activities for the teachers to use in their classrooms.

Bilingual programs are available, as well as those accommodating special education classes and students with physical disabilities.

b. Collaboration with Local Schools

The education program at the Reserve has a successful history of collaboration with elementary schools. The program is currently developing a partnership with Southwest High School, part of

the Sweetwater Union School District. Students in the program will undertake individual and group research and monitoring projects at the Reserve. High school students will be matched with undergraduate interns from area colleges and universities, who will then guide the research projects and mentor the younger students. Projects will be designed to match the research and monitoring needs of the Reserve to the highest degree possible.

c. Materials Used for School-Based Educational Programs

Several sets of curricula and a wide range of activities are used in the educational program. While the materials are well received and have been recognized for their innovation in teaching, the curriculum offered by the Reserve does not always correspond with content, skill level, and themes being taught in schools. Reserve staff have identified the need to better coordinate the content of Reserve materials with the school group's own classroom curriculum and with the State Science Framework, School Curriculum Articulation (under development by the South Bay Union School District), Benchmarks for Science Literacy (see Appendix 9). The Reserve has written or assembled the following materials for school-based educational programs:

- **Extended-Year School curriculum (EYS).** The EYS curriculum was originally written by the Reserve and SBUSD teachers. The curriculum was revised and correlated to the California State Science Framework and Benchmarks for Science Literacy in 1995-96. It contains nine days of classroom lessons and six days of field-based lessons. It is targeted for fifth grade, but has been also successfully used for fourth/fifth grade special education classes. Some of the lessons are drawn from the Marsh Awareness with Resources for Slough Habitats (MARSH) curriculum. The EYS curriculum is not available in Spanish.

- **Preschool/kindergarten (non-reader) curriculum and activities.** A packet of classroom activities and lessons for non-readers was developed for use in the South Bay Headstart program. South Bay Headstart trains all of its teachers to bring students to the Reserve.

- **Elementary curriculum and activities.** The Reserve has developed two elementary school programs that provide teachers with activities for students and information on wetland ecology. "MARSH" and "Making of a Naturalist," both developed by the Reserve with NOAA funding, are available in English and Spanish. A packet of pre- and post-field trip lessons and activities assembled from MARSH, EYS, and other sources is also available. Teachers are trained on the use of this curriculum before bringing their classes to the Reserve.

- **Posters.** The following posters are available free to teachers: *Tijuana Estuary Visitor Center Exhibit Opening* [provided by Southwest Wetlands Interpretive Association (SWIA)], *Estuaries, Where Rivers Meet the Sea* (provided by NOAA), *Salt Marsh Food* Chain-English, and *Salt Marsh Food Chain-Spanish.*

- **Videos.** The following videos are available for loan to teachers: MARSH and Waterlines (English and Spanish versions), Timeless River (English and Spanish versions), Hidden Treasures, Fabulous Wetlands, Tide of the Heron, just a Drop in the Ocean, Time and

Tide, Outta Sight, Outta Mind, Garbageman, Surfer, and videos by other NERRs (South Slough, Apalachicola, North Carolina).

- **Activities.** The following games and activities are available for loan to teachers: Watershed Model, Competitive Feeding Game, Wetland Metaphors, Water Quality Monitoring Kits-2 (teachers must complete training before use), and Salt Marsh Plants.

d. Water Quality Monitoring Education Program

The Reserve's water quality monitoring education program is a watershed- wide project that provides water quality education and experiments for students and teachers on both sides of the border. The project provides hands-on training for teachers and students and offers a classroom curriculum. The Reserve is also developing broader water quality education programs that make use of a new on-site coliform monitoring and educational lab, funded by NOAA, the San Diego County Water Authority, and the California Department of Education. Local and regional high school students will be able to use the lab to process water samples and for other projects. Using data they collect, students will conduct outreach projects to the community.

In addition, the monitoring project will allow students to link their research to Geographical Information System (GIS) mapping processes and to existing water quality monitoring carried out by San Diego State University's Pacific Estuarine Research Laboratory as part of NOAA's System-Wide Monitoring Program (SWMP 1).

See also Chapter 10 for a discussion of how the water quality monitoring program relates to the Reserve's watershed coordination plan.

e. Needs for School-Based Programs

The following needs have been identified for the school-based programs:

- Recruit and organize a core group of 8-10 trained education volunteers to work with school groups.
- Make EYS curriculum available for use by elementary teachers.
- Make all program materials available in English and Spanish.
- Develop activities and curriculum for middle school students.
- Periodically update or revise current evaluation surveys for teacher workshops and school field trips.

The following needs have been identified specifically for the water quality monitoring program:

- Expansion of testing parameters to include metals and other substances, as well as soil testing.
- Funding for outreach portion of program and training videos.
- Coordination of data with other water quality monitoring data.

- Creation and maintenance of a locally based database.
- Acquisition of ongoing funding for watershed coordinator salary, materials, training, and interns.

3. Non-School-Based Programs

The non-school-based programs are designed to target a diverse audience. These programs play a vital role in obtaining public support and assistance in the protection and preservation of the Reserve.

a. Interpretive Walks and Special Events

The Reserve currently offers six scheduled interpretive walks per month, and more frequently on a seasonal basis, based on availability of staff and volunteers. About half a dozen people attend each walk.

A variety of special events are offered throughout the year, including full- and new-moon walks, grunion runs, international migratory bird day, beach clean-ups, bat mania, Halloween trick or treating, hummingbird, and raptor presentations. Annual events include National Wildlife Refuge Week events and the Imperial Beach Bird Festival.

Outreach for these events is conducted through fliers and press releases to more than two dozen local media outlets (newspapers, magazines, newsletters, television, and the internet).

b. Interpretive Signs on Trails

Interpretive trail signs exist at the Oneonta Slough overlook, the south Seacoast Drive overlook, and at the Border Field State Park overlook. Additionally, there are identification plaques for plants in the visitor center's native plant garden.

c. Junior Rangers After-School Program

The Reserve conducts weekly Junior Ranger programs for elementary-aged children. These highly successful programs serve mainly local children, averaging twenty per week. Most children attend every week. Constraints on the program have been a lack of sufficient classroom space and the difficulty of working with a group of children of mixed ages (age 4 to 13). Evaluation of the program thus far has been quantitative (e.g., numbers of children attending) and based on informal feedback, rather than formal and qualitative.

d. Artist-in-Residence

Cosponsored by the California Arts Council, the Reserve hosts an artist-in- residence, who offers workshops at the Reserve and in local schools, focusing on wetland art.

e. Needs for Non-School-Based Programs

- Additional interpretive signage on the trails is needed. In the short- to medium-term, this need could be met with printed interpretive handouts, with information on the handouts coordinated with a series of numbered signs installed on the trails. Not only is this much less expensive than installing interpretive panels, but it allows for timely and seasonal interpretation, as well as inexpensive translation into Spanish.

- The Reserve's website needs to be updated on a regular basis.

- Additional classroom space is needed for Junior Ranger, Artist-in- Residence, and other programs. Additionally, the existing classroom is unusable during certain times of the year because it becomes too hot.

- A group of reliable, trained volunteers is needed to split the Junior Rangers into two age-based groups.

- An evaluation tool for the quality of Junior Ranger programs needs to be developed and implemented.

4. Visitor Center Services and Exhibits

The visitor center provides an array of educational and interpretive exhibits and services that are jointly funded by NOAA, CDPR, and FWS.

a. Exhibits

Phase I of the visitor center exhibits were completed in June 1994. A second phase was completed in 1997. Many exhibits are designed for hands-on use. They address the following themes:

Tides
Migration
Food Chains
Clapper Rails
Bird Beak Adaptations Geology
Habitats
Wetlands
Land-Use Management
Plant Adaptations to Salt
Tijuana River Watershed
Seasonal Changes at the Estuary

Additionally, a three-dimensional diorama of a salt marsh scene is on exhibit at the visitor center.

A CD-ROM terminal will be made available in the visitor center in 1998. It will feature: *A Tour*

of the Reserves, which has images and information on all National Estuarine Research Reserves; *Turning the Tide,* an interactive CD-ROM for marine protection; *Life in the Salt Marsh,* an interactive guide to the salt marsh; and *Otter Point,* a GIS demonstration game.

b. Printed and Visual Interpretive Materials

The following materials are available to Reserve visitors:

- Reserve brochure -- a general brochure on the Reserve is being developed.
- Your Native Plant Garden -- a description of the visitor center native plant garden
- Bird checklist
- Education programs -- a one-page document that describes the educational programs at the Reserve. This will be redesigned to fit as an insert into the Reserve brochure.
- Typical Field Trips -- Information for Teachers
- Newsletter -- a quarterly newsletter for volunteers

The Reserve offers several video, laser disc, and slide programs. The Reserve also maintains a resource library of approximately 500 titles available to the public if requested. There is no catalog or database of library materials.

c. Needs for Visitor Center Exhibits and Services

The following needs have been identified for visitor center services and exhibits:

- A newsletter needs to be made available for the public. It should contain summaries of recently completed research at the Reserve and a description of education and interpretation programs and upcoming activities.

- The library needs to be catalogued and an electronic check-out system needs to be established.

- The text of the visitor center's exhibits need to be translated into Spanish and made available to the public, possibly through handouts.

- Permanent or semi-permanent exhibits on the cultural history of the Reserve and the region need to be funded, developed, and installed.

- Permanent or semi-permanent exhibits on the different land management systems operating at the Reserve (including NWRS and California State Park System) need to be funded, developed, and installed.

- Funding needs to be identified to develop and install outdoor exhibits that will line the pathway to the visitor center.

- Adequate staffing and volunteer levels need to be established to have the visitor center open seven days per week.

D. INTEGRATION OF EDUCATION WITH OTHER PROGRAMS

The Reserve education program integrates research, education, interpretation, and stewardship into programs that meet site and national estuarine management goals. To meet the particular needs of improving water quality, increasing biodiversity, and restoring habitat, the Reserve aims to engage various audiences with effective programs that incorporate information developed by educators and researchers through estuarine monitoring. Key steps to this integration of programs include forming staff teams to develop specific programs that integrate education, interpretation, monitoring, and research to address problem issues.

E. STAFFING AND ADMINISTRATION

1. Current Educational and Interpretive Staff

The current staffing of the Education and Interpretation Program is as follows:

- Education Coordinator -- Permanent, full time
- Education Specialist --Permanent, 3/4 time
- Watershed Coordinator -- Temporary, 3/4 time

2. Education Committee of the Management Authority

The Education Committee of the Management Authority meets once each year to provide advice and ideas to the education department, and to report to Management Authority on activities of the education program. Quarterly reports on the education program will be provided to the Management Authority via the Reserve manager. The Education Committee will also serve to promote integration with other program areas, such as research, resource management, and watershed management.

3. Volunteers and Internships

Volunteers are used in the educational and interpretive programs to assist with visitor center services, office work, native plant garden, educational programs, and mounted patrol. Training for these volunteers includes a visitor center orientation, a nature walk, a bird walk, and supplemental training through Chula Vista Nature Center. Specialized training for field trips is provided through job shadowing and teacher training workshops. Monthly training on various topics is provided for volunteers and staff.

Two unpaid education interns work with the Reserve's education department. Several unpaid interns will be assisting with the water quality monitoring education project. No funding is currently available for paid internships.

4. Needs for Staffing and Administration of Educational and Interpretive Programs

The following needs exist within the staffing of the Reserve's education and interpretation program:

- Permanently fund the watershed coordinator position.
- Recruit and train volunteers for educational field trips, Junior Rangers, and special events.
- Recruit and train education interns for water quality monitoring and other programs.

F. PARTNERSHIPS IN EDUCATION

Successful educational and interpretive programs coordinate with other organizations to share ideas and resources and to avoid duplication of efforts. The Reserve has worked with the following organizations and groups:

- **Commission on Environmental Cooperation (CEC) project: San Diego Natural History Museum, PROBEA, San Diego County Water Authority.** This project trains teachers throughout the watershed (U.S. and Mexico) on water quality monitoring, provides teachers with monitoring kits, supports teachers in monitoring and reporting, and will create a database of monitoring results. It is funded by the North American Environmental Cooperation. (See also above, Water Quality Monitoring Program.)

- **Southwest Wetlands Interpretive Association (SWIA).** The Reserve staff works with SWIA to reach the local community and obtain funding for interpretive and education programs.

- **South Bay Union School District (SBUSD).** The Reserve established this partnership through the Extended-Year School program and will continue this partnership through other options with SBUSD.

- **Southwest High.** This partnership is newly established and will involve students in ecological research and monitoring projects, including performing services such as GPS mapping of trails and use of the GIS database to observe Reserve conditions.

- **Oneonta School and California Applied Science Implementation (CAPSI) project.** The Reserve, Oneonta School, and CAPSI partner to implement hands-on, inquiry-based science education in a four-year project that will begin at Oneonta Elementary School and ultimately go district-wide.

- **City of Imperial Beach Public Works Department.** This partnership centers around water quality monitoring training and annual pollution prevention activities.

- **Chula Vista Nature Center.** The Chula Vista Nature Center provides training for Reserve volunteers.

V. EDUCATION AND INTERPRETATION PLAN OF ACTION

Goal 1. Maintain and strengthen high-quality, interpretive and school-based environmental education programs offered through the visitor center and outdoor classroom sites.

Objective 1a: Maintain and expand high-quality educational programs developed for each grade level.

Tasks:

- Assemble curricula and develop an educational program for middle school students.
- Improve structure for receiving feedback and assessment of programs from teachers and develop qualitative methods for program evaluation.
- Increase the number of components of the educational program available in Spanish, translating curriculum and exhibit text into Spanish and training more bilingual volunteers.
- Revise educational programs to better coordinate programs with California State Science Framework, School Curriculum Articulation, and Benchmarks for Science Literacy.
- Assess the feasibility of bringing more schools from Mexico to visit the Reserve. Explore in particular, the opportunities to pair Mexican school children with U.S. school children during visits.

Objective 1b: Maximize beneficial partnerships within the education and environmental community.

Tasks:

- Increase teacher services, e.g., establish curriculum library for teachers.
- Maintain partnerships with South Bay Union School District and Sweetwater Union School District.
- Partner with the Municipality of Tijuana, teacher groups such as Probea, and Mexican schools to host Mexican school groups and to extend the influence of educational programs.

Objective 1c: Increase signage and written trail interpretation throughout the Reserve.

Tasks:

- Create a Reserve-wide interpretive sign plan as a joint effort of the managing agencies.

- Obtain funding to implement an interpretive sign plan.

Objective 1d: Expand and diversify interpretative programs

Tasks:

- Design and implement kayak or canoe interpretive program, in conjunction with an outdoor outfitter.

- Design and implement horseback interpretive programs, in conjunction with Tijuana River Valley Equestrian Association and Mounted Assistance Unit.

Goal 2. Refine existing and develop new interpretive and educational programs at Tijuana River NERR to support restoration efforts in the southern portion of the Reserve.

Tasks:

- Develop strategies to integrate Goat Canyon restoration initiatives into educational programs.

- Develop new interpretive programs on the cultural history of the Tijuana Estuary area.

Goal 3. Develop and implement a coastal decision-maker training program.

Tasks:

- Identify goals and audiences for a coastal decision-maker training program.

- Work with resource managers to determine key themes to be conveyed to decision-makers.

- Work with partners to encourage revision in statewide education to include watershed themes.

- Communicate with decision-makers to identify: 1) which coastal resource issues are most pressing to their agencies or constituencies, and 2) issues on which they wish to be better informed.

- Secure funding to implement the coastal decision-maker training program.

Goal 4. Develop water quality monitoring as a cornerstone theme throughout the education program.

Objective 4a: Use water quality monitoring to unite the community, schools, and agencies throughout the watershed.

Objective 4b: Integrate multiple education themes and service-learning projects into the water quality monitoring education program.

Task:

- Work with teachers to develop water quality projects at the Reserve for students.

Objective 4c: Expand the water quality monitoring education program to increase the utility of information of data recorded.

Tasks:

- Develop standard monitoring protocols with guidance from the research community.
- Develop a database of water quality results and make database available to the public.

Objective 4d: Relate water quality monitoring to programs in the watershed, the bioregion, and beyond.

Tasks:

- Integrate Reserve efforts with the United Nations Environmental Program to determine land-based sources of marine pollution.
- Integrate NERR system-wide information via Estuary-Net on-line database.

Goal 5. Ensure that a complete and well-trained staff is in place to implement the educational and interpretive programs.

Tasks:

- Secure long-term sources of funding for staffing.
- Hire permanent staff person to assist education program manager.
- Recruit and train a dependable corps of education volunteers.

Goal 6. Integrate educational and interpretive programs with other Reserve programs, particularly the research program.

Objective 6: Integrate research results in the school-based and non-school-based programs.

Tasks:

- Centralize research information, in conjunction with the Reserve research coordinator.
- Provide current research information to staff and volunteers in the educational and interpretive programs.
- Integrate research results into public newsletters and visitor center exhibits.

CHAPTER EIGHT: PUBLIC ACCESS, INVOLVEMENT, AND USE PLAN

INTRODUCTION

Fostering an appreciation of the Reserve is dependent upon on providing opportunities for the public to experience the site. While the primary uses of the Refuge and Reserve are for wildlife habitat and research, Tijuana River National Estuarine Research Reserve (NERR) provides exceptional opportunities for the public to access and use the site for recreational purposes. In keeping with the five-year vision for the development of the Reserve, the Public Access, Involvement, and Use Plan emphasizes the need for improvements in the southern end of the site. This chapter puts forward a plan to allow for maximum public enjoyment and usage of the site compatible with its protection.

I. MISSION

The Public Access, Involvement, and Use Plan mission of Tijuana River NERR is to provide diverse opportunities for public access and use of the Reserve, compatible with resource protection, and to create opportunities for the public to participate in Reserve operations.

II. GOALS

Goal 1: Encourage public involvement in Reserve governance and management.

Goal 2: Provide opportunities for volunteer- activities in educational, research assistance, recreational, and cultural programs at the Reserve.

Goal 3: Encourage and improve public access and use opportunities of the Reserve to the extent compatible with resource protection, with emphasis in the southern areas.

Goal 4: Emphasize and expand priority, wildlife-dependent recreational activities with wildlife observation and photography (Refuge goal).

III. POLICIES

A. RESERVE-WIDE POLICIES FOR PUBLIC ACCESS, INVOLVEMENT, AND USE

It is the policy of the Reserve and the constituent landowning agencies to encourage wildlife-oriented recreation. Activities compatible with recreation include wildlife observation, photography, interpretation, and education. Some forms of non-wildlife-oriented recreation such as hiking, horseback riding, and beach use are also encouraged wherever they are compatible.

Fishing is permitted from the intertidal beach, in accordance with state regulations, except in areas seasonally posted as closed to protect endangered species. Hunting, shooting, off-road vehicle operation, or overnight camping are not authorized. Dogs, where permitted, must be kept on leashes at all times.

Conceptual land-use zoning (see Chapter 5 - Conceptual Zoning Scheme) provides general guidance for public access. Some areas of the Reserve contain more sensitive resources than others; spatial zoning provides for resource protection while ensuring appropriate access and recreational opportunities. The general policy for public access in various zones is as follows:

ESZ - Endangered Species Protection Zone (most sensitive): Public access generally prohibited except by Special Use Permit.

WCZ - Wetland /Wildlife Conservation Zone: Access generally limited to Special Use Permits, organized environmental education, and guided interpretive tours.

WOZ - Wildlife Orientation/Interpretive Zone: Access/use as listed above, plus general foot access for wildlife observation and photography.

GRZ - General Recreation Zone: All above uses plus equestrian use on trails, general hiking, and beach use.

EBZ - Ecological Buffer Zone: All above uses, with equestrian and bicycle use located on outer edge of buffer.

Approved trails for hiking and horseback riding are found in Figures 6 and 15. While generally located in the Wildlife Orientation/Interpretive and General Recreation zones, designated trails may provide on-trail access to other areas. Trails are posted to designate authorized modes of use (equestrian, foot, and/or bicycle).

The Reserve is open to the public from 30 minutes before sunrise to 30 minutes after sundown, except by special authorization from the landowning agency.

B. NATIONAL WILDLIFE REFUGE SYSTEM PUBLIC USE POLICY

1. General

Public involvement is a guiding principle of National Wildlife Refuge (NWR) System management. This includes providing regular opportunities for the public to comment on refuge management plans and operations.

All secondary uses of an NWR, including public access and recreation, must be compatible with the purposes for which the refuge is established (see Appendix 1).

Partnering and volunteer programs are very important to many aspects of NWR management and have full support of the U.S. Fish and Wildlife Service (FWS).

2. Wildlife-Dependent Recreation

Executive Order 12996 and The National Wildlife Refuge System Improvement Act of 1997 designate the following six forms of wildlife-dependent recreational activities as priority public uses of the NWRS:

- Hunting
- Fishing
- Wildlife Observation
- Wildlife Photography
- Environmental Education
- Interpretation

The Secretary of Interior has directed FWS to provide expanded opportunities for these priority uses of refuges when they are compatible and consistent with sound principles of fish and wildlife management and are otherwise in the public interest.

At Tijuana Slough NWR, wildlife observation and photography, environmental education, and interpretation have been determined to be compatible uses of the Refuge and are actively promoted by facilities, programs, and this plan.

There have been no known requests or proposals for a Refuge hunting program at Tijuana Slough NWR. There are no big game species in the Refuge; small game and waterfowl are present. However, the entire Refuge is located within the corporate limits of San Diego and Imperial Beach, both of which prohibit the discharge of firearms. Due to safety issues, the fragility of the habitat and concerns about endangered species, hunting has been determined to be an incompatible use of Tijuana Slough NWR.

Fishing is authorized in the Pacific Ocean from the intertidal beach areas of Tijuana Slough NWR. All fisheries located in the Refuge are located in state tidelands that are operated as part of the NWR under provisions of California State Land Commission Lease No. PRC 5938.9. The lease specifies that public access and use of the beaches and strand between the ocean and estuary will not be unreasonably restricted. Hence, FWS lacks jurisdiction for determining whether fishing is a compatible use.

At Tijuana Slough NWR, emphasis is placed on enhancing and expanding compatible opportunities for wildlife observation and photography, and environmental education and interpretation. Public input is encouraged, and the Reserve enters into partnerships with other federal, state, and local agencies and private entities.

IV. EXISTING CONDITIONS AND PERCEIVED NEEDS

A. PUBLIC INVOLVEMENT

1. Visitor Center

In 1991, the Tijuana River achieved one of the major goals established in the 1986 Management Plan: constructing a visitor center in the northern section of the Reserve on a FWS easement provided to the California Department of Parks and Recreation (CDPR). The visitor center has contributed greatly to the public's awareness of the Reserve by providing a centralized location where the public can turn for information, education, interpretation, and general involvement with the Reserve.

2. Public Involvement with Management and Decision-Making

Current opportunities for public involvement in management and decision- making at the Reserve include involvement at the committee level of the Management Authority, public comment during Management Authority meetings and the recently added suggestion box at the Visitor's Center. There is a need to improve understanding in the local community about the Reserve and its goals. Responses to this need are listed in the plan of action at the end of this chapter.

3. Volunteer Program

Volunteers at the Reserve serve as community ambassadors. They share their enthusiasm for and knowledge of the Reserve area with visitors from within and outside the region. As a result, they become an invaluable asset to the Reserve. This important link with the community enhances public awareness and interest, ultimately serving to secure the future of the Reserve. Reserve staff seek to give volunteers a rich and rewarding experience in order to encourage community members to contribute their time and talent to the achievement of Reserve goals.

The Tijuana River NERR volunteer program is co-managed by the operating agencies. It draws upon the system-wide volunteer programs of CDPR and the NWRS. Volunteer activities are coordinated by Refuge staff with guidance from Reserve and Refuge managers. Reserve staff maintain a “contact list” of individuals, groups, and schools that provide services to the Reserve. Approximately 250 hours a month are donated by these individuals and groups to a variety of Reserve projects. Volunteers work with staff members on particular projects such as education or watershed monitoring (see Chapter Seven). In 1996, a Volunteer Stewards Program Handbook was completed to ensure standardized training for all volunteers.

Under present staff levels, the following volunteer opportunities are available at the Reserve:

TABLE 10: Volunteer Opportunities at Tijuana River NERR

Administration	Visitor center docents provide support to visitor center staff and assist in the visitor center's general operations.

Research and Monitoring	Biology volunteers assist biologists in a variety of field and office work related to wildlife management in the San Diego Refuge Complex. Several wildlife populations are monitored with assistance from volunteers, including the California least tern and snowy plover nesting sites.
Education and Interpretation	Environmental education docents assist the program through a wide variety of tasks, including helping with educator-led school field trips, designing and preparing educational displays, developing and presenting slide programs at schools about the Reserve, assisting with workshops for teachers and other educators, and helping with public relations.
Public Involvement, Access, and Use	The Mounted Assistance Unit (MAU) offers opportunities for experienced horseback riders to patrol equestrian trails and educate other riders about protocols and habitat protection. The MAU is not part of the Reserve-sponsored volunteer program, but provides important information on the use and conditions of equestrian trails. This information is communicated directly to the Reserve manager.
Facilities	Stewards monitor the condition of the native plant garden and, in consultation with a staff person or trained volunteer, care for the garden.
Resource Protection, Management, and Restoration	Habitat restoration and steward volunteers monitor conditions in the Reserve or adopt a project or section, and -- in consultation with a staff person or trained volunteer -- take steps to care for and enhance the Reserve. Typical duties include removing normative plant species, planting and seeding appropriate native plant species, and undertaking dune restoration. Biology volunteers (as described above) also contribute to resource management.

4. Perceived Needs in Public Involvement

There is a perceived need to more fully develop the volunteer program to provide greater recognition and support to volunteers. Currently, the volunteer program is hindered by the lack of a full-time volunteer coordinator. Ideally, the program will establish a corps of trained volunteers who can keep the visitor center open seven days a week. Office of Coastal Resource Management (OCRM) has recommended adding a volunteer coordinator position.

- Expansion of the volunteer program in the following areas would improve Reserve operations:

- Docents could be trained to supervise volunteers who work with members of the public.

- A comprehensive volunteer clean-up program could be developed for beaches, trails, flood debris removal, and other needed projects, with particular emphasis on the southern areas of the Reserve.

- Relationships could be improved among the volunteer Mounted Assistance Patrols, equestrians, and bicyclists.

- A pool of public speakers could be developed and trained to make presentations on the Reserve to organizations, schools, and other venues.

B. PUBLIC ACCESS

1. Recreational Visitors

Visitors to the Reserve are also important and valued components of the NERR/NWR. The Reserve recognizes the need to address the compatibility of public uses to serve the broad range of interests of those visiting the Reserve.

With the construction of the visitor center, the Reserve has made great strides towards its established goal of creating a northern public entrance that is welcoming and inviting. Despite this accomplishment, there is a need to strengthen the Reserve's identity for visitors and the general public both locally and regionally. Many of the improvements identified in this Management Plan are intended to promote and increase recreational uses in the lesser-used southern end of the site.

On occasion, Border Field State Park is closed due to sewage spills or other public health and safety concerns. It is the aspiration of the Reserve to keep the park open year-round; the improvements to treatment facilities in Tijuana River will contribute toward this goal.

2. Perceived Needs for Public Access

- Perceived needs for Public Access at Tijuana River NERR are as follows:

- Improve Monument Road access through expanded entrance hours, enhanced roadway conditions, and additional roadside facilities.

- Improve signage on Monument Road to better direct visitors to Border Field State Park.

- Improve signage on Route 75 and Interstate 5 to better direct the public to the Reserve's visitor center.

- Provide interpretive signs, trail signs, and directions to parking.

- Increase the visibility of operating agencies in the southern end of the Reserve.

- Better explain Reserve management to the public, emphasizing information on who to contact about access, regulations, and hours of operation at the Reserve.

- Improve the appearance along the southern perimeter of the Reserve to make it easier for visitors to appreciate the national significance of the site.

- Develop a large-scale effort to plan and improve accessibility to the southern end of the Reserve.

C. PUBLIC USE

1. Types of Public Use

The majority of public use at Tijuana River NERR takes place on Refuge lands and the beaches of Border Field State Park. Visitation and use of the site has increased steadily since the construction of the visitor center and the expansion of Reserve programs. Estimated public use of the Reserve between 1995 and 1997 is provided below.

TABLE 11: Visitor Use of TRNERR 1995-1997

	1995	**1996**	**1997**
Activity	**Number of Users**	**Number of Users**	**Number of Users**
Environmental Education	3,000	3,500	4,500
Interpretive Programs	1,650	2,880	3,500
Special Events	925	940	940
Recreation			
Wildlife Observation	5,000	8,000	9,500
Foot Trails	18,000	18,900	21,000
Equestrian Trails	12,000	13,000	13,000
Beach Use	28,000	29,000	30,500
Surfing	800	800	800
Photography	200	250	300
Research	500	800	850
TOTAL	70,075	78,075	84,890

Source: Station summaries prepared and submitted by FWS and approximations from education coordinator and Refuge manager.

2. Barriers to Public Use

Prior to 1994 and the implementation of Operation Gatekeeper by the U.S. Border Patrol, foot traffic by undocumented immigrants from Mexico was rampant throughout the Reserve and Tijuana River Valley. Unauthorized access by immigrants far exceeded the legitimate public uses encouraged by the Reserve. Reserve staff confirm that this trespassing by immigrants

caused concerns among the public and undermined the development and maintenance of public-use facilities throughout the Reserve.

3. Use of Foot Trails System

Authorized foot trails are depicted in Figure 6. Foot trails on Tijuana Slough NWR north of the Tijuana River, are generally well marked, well maintained, and frequently used by the public for wildlife observation and general walking. These trails included the McCoy Trail, the 5th and Iris Trail, and the Oneonta PERL Trail from Seacoast Drive past the visitor center to Grove Street. The 5th and Iris trail is also posted for equestrian and bicycle use.

While these trails are generally well maintained and marked, some sign maintenance and replacement is needed. There are additional opportunities for interpretive signing and trail improvements.

Dogs are permitted in only three areas of the Reserve and must remain under control on a leash at all times. Dogs are permitted (1) along the beach north of the Tijuana River mouth on the west side of the dunes, (2) on the marked Fifth and Iris trail in the Refuge, and (3) in the parking/picnic area on the mesa within Border Field State Park.

Foot trails south of the Tijuana River are less well-maintained and have suffered from trespassing. These southern trails are also less heavily used due to poor access to trailheads south of the river. Access to trails may be closed, by posting, as needed to protect endangered species or when required to ensure public health and safety.

4. Use of Equestrian Trails System

Horseback riding has a long, positive history in the Tijuana Valley. The equestrian community has been a staunch defender of the ecological health of the Valley and has demonstrated its commitment to the Reserve through active participation in many volunteer and community-action programs. The operating agencies view horseback riding as an integral and permanent part of the Reserve's public-use program.

Authorized equestrian trails are depicted in Figure 15. Horseback riding in the Reserve is restricted to designated trails. Dogs are not allowed on equestrian trails. In many cases, trails are maintained by organized and individual users. Many trails are deliberately kept narrow and primitive, both to satisfy users' preferences and to minimize habitat disturbance.

Because many equestrian trails are located in the floodplain of a braided river, trails are subject to flooding and subsequent damage by siltation and erosion. Following floods, Reserve staff consult with user groups to determine if former trails should be rehabilitated or relocated. Major trail rehabilitation or relocation requires consultation with the FWS Division of Ecological Services to ensure compliance with the Endangered Species Act. Some trails wind through designated critical habitat for least Bell's vireo, a federally listed species. Vireo populations have been increasing despite the presence of equestrian use, and solutions to trail rerouting are generally available.

Beaches from south of the Tijuana River's mouth to the Mexican border are some of the few places in southern California where the public can ride next to the Pacific Ocean. It is important to maintain this cultural and recreational experience. Equestrian users recognize that these beaches also provide significant breeding habitat for the endangered California least tern and threatened western snowy plover. During the tern and plover breeding season, horses must travel below the mean high tide line, close to the edge of the surf. Depending on annual distribution of tern nests, temporary closure of some trails may be necessary in order to avoid "take" of endangered species. The Operating Agencies are required by law to protect endangered species. However, every effort will be made to provide alternative public trails accessing the beach for hikers and equestrians.

This balancing of endangered species protection with public access needs is a critical function of Reserve management. If endangered species distribution requires closures of public access trails, such as the trail extending west off Monument Road, signs directing equestrians to trails further south will be posted at the same time trail closure signs are posted. The Operating Agencies will call regular meetings of the Round Table Trails Committee beginning in March and lasting through September of each year to keep the trail-using public informed of the progress of the tern nesting season. In the event that endangered species distribution requires temporary closure of a trail, the Reserve of Refuge manager will immediately notify the public via signs and press releases. Commercial stable operators will be notified via telephone, and the Operating Agencies will call an immediate meeting of the Round Table Trails Committee to discuss the closure. Currently there are multiple approved trails for equestrian beach access.

The Volunteer Mounted Assistance Unit (MAU) is a group of approximately 35 active members that assists with trail maintenance; provides first responder assistance in emergencies, including first aid; maintains radio communication capabilities; and reports violations and incidents to law enforcement personnel, including the Border Patrol. The MAU also provides a valuable public information and education service by informing visitors of Reserve regulations. Encouraging proper trail etiquette to ensure a safe and enjoyable riding experience is an important MAU function. MAU members coordinate regularly with law enforcement rangers of the CDPR and FWS to inform the operating agencies of trail conditions, violations, and maintenance needs.

Equestrian trails are used by both private citizens and customers of commercial stables in the Tijuana Valley. Both groups have equal access to the Reserve's trails. However, commercial operations have a special responsibility to inform customers of Reserve policies and regulations and to ensure compliance.

In 1991, the Round Table Trails Committee was formed by the operating agencies, representatives of landowning groups, and the equestrian community. The Management Authority directs trails issues to the committee and looks to it for recommendations on re-routing, maintenance, new trails, and trail use.

5. Use of Bicycles at TRNERR

All roads in Border Field State Park accessible to motorized vehicles are also open to bicycle

traffic, unless otherwise marked. In Tijuana Slough NWR, bicycles are allowed on the Fifth and Iris multi-use trail that provides access to the estuary and a viewpoint of the river mouth, dunes, and excellent bird- watching locations.

Bicycle use is being considered on other trails in the Refuge to connect city streets in the vicinity of the visitor center to the Fifth and Iris Trail. Bicycle use will not be considered for existing foot/equestrian trails in the riparian habitat areas of the NWR. Efforts are currently underway to plan trail systems for the Tijuana River Valley Regional Park, immediately upstream of the Reserve. The Management Authority and Operating Agencies will work with Regional Park authorities to provide connectivity of trail systems, and access to the coast, in the State Park portion of the Reserve.

Bicycle use within the Reserve is oriented to "family-style" recreation and pollution-free transportation for visitors. "Off-road"-style mountain biking may damage sensitive wetland and upland habitats and will not be promoted in the riparian zone, nor in the Border Mesa areas, except on roads open to motor vehicles.

6. Perceived Needs in Public Use

a. Foot Trails Use Needs

In the northern end of the Reserve, an improved, accessible trail is needed along the eastern boundary between Grove Street and the 5th & Iris kiosk. The interpretive signs program needs to be developed and implemented.

In the southern end of the Reserve, many improvements are needed. These needs include an improved access road to Border Field State Park, well- marked trailheads, parking areas, and improved signage. The viability of pedestrian trails in the southern end of the Reserve should be investigated.

The Round Table Trails Committee should determine possible improvements to the pedestrian trails when considering improvement to the equestrian trails system.

b. Equestrian Trail Use Needs

To continue adequate access, enhance enjoyment of equestrian use in the Reserve, and meet resources protection goals, the following actions regarding equestrian trails are needed:

1. The operating agencies, landowning agencies, the Tijuana River Valley Equestrian Association, and the Mounted Assistance Unit need to develop and implement a memorandum of understanding (MOU) relating to trail routing, maintenance, and use (see Appendix 12).

2. An improved trail linkage from the area of Border Patrol headquarters to the west end of Sunset Avenue is needed and should be designated, with consideration for endangered species.

3. New river crossings are needed to provide safe access to the south side of the Reserve. Particular emphasis is needed to address the "old 19th Street" crossing.

4. Equestrian use and safety must be addressed in plans to rehabilitate and/or relocate Monument Road.

5. Wetland restoration projects in the southern end of the Reserve should integrate trail and access needs, and trails should be included in the engineering designs for marsh restoration projects.

6. Corral and latrine facilities in Border Field State Park need to be upgraded and kept open during park hours.

7. Any new trails should be designed to serve multiple needs to reduce the area disturbed by trail construction.

8. Proposals for any new recreation uses of the Reserve (e.g., mountain biking) must be carefully analyzed to ensure they are compatible not only with resource protection, but also with existing authorized uses such as horseback riding.

9. Additional education and enforcement efforts are needed to ensure equestrian compliance with leash laws and area closures for endangered species nesting.

10. The operating agencies and county parks need to negotiate a Special Use Permit system for all commercial operators to ensure that businesses profiting from public lands are held accountable for the actions of their customers.

11. The operating agencies should organize a training program for business owners and their guides to orient them to the purpose, rules, and regulations of the Reserve.

12. Consistent signage needs to be established to improve public awareness of the Reserve's identity and its boundaries.

13. Signage and public awareness about the importance of keeping dogs leashed needs to be improved.

c. Other Recreational Improvements

1. Investigate the potential for diversifying recreational opportunities, including guided canoe and kayak tours.

V. PUBLIC ACCESS, INVOLVEMENT, AND USE PLAN OF ACTION

Goal 1. Encourage public involvement in Reserve governance and management.

Tasks:

- Continue to encourage public participation in Management Authority monthly meetings and committees.

- Increase outreach to Mexican officials, organizations, and individuals regarding TRNERR events and programs.

- Increase notice and posting of Management Authority meetings. Ensure that meeting notices and minutes are circulated to the appointing bodies of the Management Authority members and staff of all elected officials representing portions of the Research Reserve.

- Produce and distribute a periodic Reserve newsletter (see also Chapter 7 - Education and Interpretation Plan of Action).

- Schedule regular open houses at the Reserve where questions and concerns from the community can be discussed with Management Authority members and Reserve staff.

- Biannually convene evening meetings (one in the spring, and one in the fall) of the Management Authority where at least one full hour is allocated for public comment.

- Continue the Round Table Trails Committee and extend membership to boarding and rental stable owners. This Committee should meet at least quarterly to encourage the participation of local business owners with equestrian interests.

Goal 2: Provide opportunities for volunteer activities in educational, research assistance, recreational, and cultural programs at the Reserve.

Tasks:

- Seek funding for a full-time, volunteer coordinator position to administer an effective volunteer program.

- Create work teams among volunteer and agency staff to enable volunteers to participate in day-to-day operations of the Reserve.

- Expand opportunities for volunteers to conduct activities for the public (e.g., school group nature walks).

Goal 3. Encourage and improve public access and use opportunities to the Reserve to the extent compatible with resource protection, with emphasis in the southern areas.

Objective 3a: Restore public access at Monument Road.

Tasks:

- Repair Monument Road and improve the entrance.
- Incorporate equestrian uses and safety concerns in the new design of Monument Road.
- Install adequate and interpretive signage.

Objective 3b: Maintain and improve signage to clarify Reserve boundaries and access points.

Tasks:

- Maintain printed materials that explain the Reserve, its purpose, and its boundaries.
- Implement national graphic and industrial standards for signage and interpretive facilities.
- Improve signage to Reserve on Route 3 and 75.

Objective 3c: Maintain all existing facilities and improve facilities in the southern areas of the Reserve.

Tasks:

- Develop and facilitate a regularly scheduled maintenance plan for the Reserve.
- Design and install interpretive signs to explain habitat and recreational opportunities.
- Develop a day-use, equestrian campground at the old parking lot below the border mesa.
- Restore the day-use area and equestrian staging site at the lower parking lot in southern Border Field State Park. Horse pens, picnic tables, barbecues, tie racks, bicycle racks, and a portable rest room are needed.

Objective 3d: Establish recreational guidelines for low-impact use of the Reserve.

Tasks:

- Review potential impacts of proposed new trail uses (such as mountain biking on state lands) to ensure they are compatible not only with resource protection, but also with existing authorized uses.
- Upgrade upper Border Field State Park. Actions include undertaking erosion control measures and providing signage, viewing facilities, and recreational facilities (i.e.,

telescopes, bicycle racks, and barbecues).

- Maintain pedestrian and equestrian trails that provide quality interpretive experiences. Construct additional trails where needed.

- Encourage the development of adequate and appropriate parking areas with trailheads and interpretive signage, especially in the southern end of the Reserve.

- Continue to develop community outreach programs such as guided walks, films, talks, and equestrian activities.

- Promote continued Reserve-sponsored, equestrian activities such as trail maintenance projects/potlucks and Adopt-a-Trail Programs within the river valley, and guided (birding) rides.

Objective 3e: Maintain and improve recreational opportunities on equestrian trails.

Tasks:

- Work with Border Patrol to minimize impacts to the equestrian trail system.

- Schedule a series of equestrian trail workshops to consider existing trails, new trails, and proposed linkages. These workshops will assess potential realignments due to natural changes, mitigation activities, and Border Patrol access issues.

- Work with commercial stable operators through the Special Use Permit system to ensure customers are fully informed of Reserve regulations. Operating agencies will set a use fee for commercial operators, but will also accept "in-kind" payment. Proposed "in-kind" methods of payment are trail maintenance, cowbird trapping, and assistance with posting and monitoring of tern colonies.

- Prepare an educational flyer summarizing relevant Reserve regulations (e.g., leash laws, avoiding sensitive habitats) for distribution to visitors renting horses from stables.

Goal 4. Emphasize and expand priority, wildlife-dependent recreation activities with wildlife observation and photography.

Objective 4a: Maintain and improve recreational opportunities for wildlife observation and photography on designated trails.

Tasks:

- Improve signage on foot trails, particularly in the southern end of the Reserve.

- Improve trails and trailhead markings throughout the Reserve, with particular emphasis in

the southern end.

- Post interpretive signs for new restoration projects and research projects.

- Seek support to build an approved trail along the eastern boundary of the Reserve between Grove Street and the 5th & Iris kiosk.

- Incorporate opportunities for recreational activities into improvement plans for the southern end of the Reserve.

Objective 4b: Increase and diversify wildlife-dependent recreational opportunities compatible with resource protection.

Tasks:

- Investigate carefully managed, seasonal water-related recreational opportunities, such as wildlife observation from canoes and kayaks.

- Explore linkages to existing trails systems, including the Otay Valley Regional Parks Trails System.

- Promote programs such as ecotourism visits by intercession/school groups and the Imperial Beach Bird Fest.

- Develop at least one accessible wildlife observation/photography blind in NWR.

CHAPTER NINE: FACILITIES PLAN— BUILDINGS, TRAILS, AND ROADS

INTRODUCTION

The 1986 Management Plan for Tijuana River National Estuarine Research Reserve (NERR, then an Estuarine Sanctuary) called for five major physical improvements at the Reserve. These improvements included construction of 1) a wetland restoration and enhancement facility, 2) a regional estuarine research facility, 3) a visitor center, 4) trails, and 5) signage. All of these projects were completed by 1993, although the Research facility (located south of the Tijuana River) was abandoned due to problems with vandalism.

The earlier sections of this document have introduced the Reserve-wide programs. These programs are designed to protect and manage the Tijuana River NERR resources, to enhance research and monitoring of the resources, to educate the public on resource values, and to share the resource with the public. This chapter identifies the physical structures needed to advance the goals of those programs.

Consistent with the five-year vision statement established in the Executive Summary, this Facilities Plan emphasizes improvements to the southern end of the Reserve in order to make it more accessible to the public. The Goat Canyon Creek Watershed project is expected to result in plans for stormwater and sediment management, all weather public access, and habitat restoration (See Chapter 5 - Restoration Section). Planning for improved interpretive features and visitor-service facilities will follow.

I. MISSION

The facilities mission of Tijuana River NERR is to provide and maintain accessible facilities necessary to fulfill the Reserve's mission.

II. GOALS

Goal 1: Provide accessible buildings that support and facilitate the Reserve's mission.

Goal 2: Provide and maintain accessible foot, bicycle, and equestrian trails.

Goal 3: On existing roads, maintain appropriate vehicular access with minimum ecological impact.

Goal 4: Explore linkages with the Tijuana River Valley Regional Park trails system

III. POLICIES

A. GENERAL POLICIES FOR FACILITY DESIGN AND CONSTRUCTION

Facilities are constructed and operated to support the Tijuana River NERR programs and achieve the Reserve's goals. Accordingly, Tijuana River NERR will be guided by the following principles in facility development.

Policies applicable to all Tijuana River NERR construction:

- All facilities, at a minimum, will comply with the Americans with Disabilities Act (ADA).
- Facilities and access routes will minimize visual impact or view obstruction both within and beyond the Reserve's administrative boundaries.
- Facilities will be designed and located to support multiple Reserve goals.
- Facility siting will consider impacts from increased site use, including transportation, parking, storm water, wastewater and sewage disposal.
- Construction techniques shall be adapted for minimal environmental impact.
- To the greatest possible extent, construction will minimize soil erosion and compaction.

Policies for on-site building construction:

- Siting of all buildings, vehicular access, and pedestrian access routes will be consistent with Tijuana River NERR stewardship and land-use planning.
- Only native plant species will be used in new plantings.
- Buildings will be designed in an environmentally sensitive manner, and esthetics will be considered in construction.
- Site facilities will encourage pedestrian access.
- Neighbors and interested groups will be encouraged to participate in the planning of new facilities.

Policies for Reserve trails:

- Interpretive trails will be designed to accommodate both educational groups and individual visitors.

- Trail construction and maintenance will make use of the best available technical information and adopt techniques for minimal environmental impact.

- Trail construction crews will receive instruction in ecologically appropriate trail construction techniques.

- Trail design will anticipate and discourage "short cuts" or other off-trail excursions.

- In developing new trails, decisions regarding location will take into consideration the valley-wide, grid-mapping system now being developed by the County of San Diego.

Policies for Reserve roads:

The Reserve's continuing policy is to construct and maintain roads and trails only to the extent necessary to meet Reserve goals. Paved and unpaved roads and parking areas compact soils, accelerate runoff rates, exacerbate erosion, disrupt habitat, and impact visitors' trail experiences. Gravel placed on wetland soils for roads and parking alters percolation and vegetation patterns. Moreover, heavy metals and oil deposited on roads by motor vehicles are ultimately flushed into the ecosystem.

All jurisdictions at the Reserve maintain strict limitations on areas for motorized vehicle use in the Reserve. Roads are necessary in some areas of the Reserve to provide trail access for employees and visiting researchers, as well as for transporting large equipment used by researchers, law enforcement, vector control, and maintenance or construction crews.

IV. EXISTING CONDITIONS AND PERCEIVED NEEDS

A. BUILDINGS

1. Tijuana River NERR Visitor Center

The visitor center, located along the northern border of the Reserve, is strongly associated with the Reserve's public identity and is frequently used by school groups. The visitor center is used by both of the operating agencies.

The visitor center houses a large public area for interpretive exhibits, a reception desk with a small bookstore, an audio-visual room, a classroom, a small library, public restrooms, and staff office space. The audio-visual room is designed for formal presentations and is also frequently used as a community meeting room. The large classroom is used for education programs, the artist-in-residence program, the water quality monitoring programs, and the coliform lab. The entire public area is fully accessible.

Staff work in two areas: a shared common area within the main visitor center building, and a stand-alone building known as the "block house." The staff area in the main visitor center consists of two offices and a staff common area. The majority of the staff common area is currently occupied by a photocopy machine, fax machine, closet for office supplies, and small

kitchen area. The block house has office space for three staff members.

2. Storage Facilities

A garage for storage of vehicles and landscaping equipment is located across the parking lot from the visitor center. In the original design, part of this building was designated for use as a small research laboratory. However, due to the need for storage space, there is no longer space for a laboratory.

3. Other Buildings

Two other buildings exist on the site:

- a kiosk at Border Field State Park, (currently not in use, due primarily to safety concerns), and

- a restroom and storage structure for maintenance equipment at the Border Field State Park Mesa.

4. Perceived Needs for Buildings

The Tijuana River NERR programs have outgrown their existing structures. Due to the shortage of space, staff must exert extra efforts in order to carry out scientific research, education programs, and administrative functions. Staffing is expected to expand over the next two years to include seven California Department of Parks and Recreation (CDPR) employees, six U.S. Fish and Wildlife Service employees, and several more volunteers (see Chapter 4 - Administrative Framework).

As part of the effort to make the southern end of the Reserve more welcoming, a CDPR presence is needed. A kiosk located in Border Field State Park is not in use due to concerns for the safety of lone employees assigned to staff the building. With the realignment of Monument Road, a safer and more suitable location for a kiosk may be identified. The existing kiosk could be relocated or a new one could be built.

Additional storage area is needed for equipment and vehicles. Space for a variety of community and public meetings would promote and support community relationships.

5. Proposed Improvements for Buildings

During the 1998-2003 planning period, the most significant building construction or acquisition needed is for additional office space and, if funds become available, a classroom/community room. The operating agencies plan to create office space in the south end of the existing garage building. This will provide up to five workstations. The remainder of existing National Oceanic and Atmospheric Administration (NOAA)/CDPR construction funds will be used to design a community space for the visitor center.

The following is a proposed facilities improvement plan with costs and proposed scheduling:

TABLE 12: Short-Term Building Improvements at Tijuana River NERR

Description	Installation Date	Estimated Cost	Funding Source
Create space for large bookstore in visitor center	1998	$1,000	CDPR/NOAA
Office space for increased staffing	1998	$20,000	CDPR/NOAA
Community Room design	1998	$75,000	CDPR/NOAA
Renovation and reopening of Border Field State Park	1999	$20,000 to $50,000	CDPR
Small research lab	2002	$20,000	CDPR

6. Long-Term Facilities Improvements

Beyond the near-term improvements described above, there is also a need to promote greater contact with the local community and establish the visitor center as an inviting, accessible public facility. Several modifications to the current facilities could accomplish this.

Should additional funding become available, the following improvements to the visitor center will be considered to create a larger space for gathering or hosting events or ceremonies:

- Expansion of the public meeting area behind the interpretive area, either by extending the existing concrete patio or constructing an amphitheater in the rear, southwest area of the visitor center.
- Creation of an observation deck on the roof of the visitor center.
- Construction of a visitor contact center in Border Field State Park.
- Creation of temporary housing for interns and volunteers.

B. TRAIL MAINTENANCE AND CONSTRUCTION

1. Existing Trails

The trail systems at Tijuana River NERR provide the following functions:

- act as a medium for research, recreation, and educational activities;
- provide an integral part of the Public Access and Use Programs; and
- support the Resource Protection Program by controlling pedestrian and equestrian access

within the Reserve to minimize visitor impacts on sensitive resources.

Since 1983, volunteer labor from California Conservation Corps, Youth Conservation Corps, scouting groups, Southwest Wetlands Interpretive Association (SWIA), and others have built about four miles of trail. Tijuana River Valley Equestrian Association has contributed to the maintenance. The Tijuana River trail surfaces are predominantly earthen. The locations of all Reserve trails are shown in Figures 6 and 15.

Trails within the boundaries of the Tijuana Slough NWR are designated for pedestrian use and are maintained cooperatively by both operating agencies. All other trails within the Reserve are designated for mixed use.

Both pedestrian and mixed-use trails are closed during times important to the protection of endangered species and their habitats. These closures are coordinated and enforced by the operating agencies. For more description on the public use of the trails, please refer to Chapter 8: Public Access, Involvement, and Use Plan of Action.

2. Perceived Trail Needs

The equestrian community has recommended several improvements regarding access and signage. There is a need for the operating agencies and equestrian community to meet and assess potential realignment of equestrian trails (see also Chapter 8).

C. ROADS AND PARKING

1. Existing Roads and Parking

Two main roads provide access to the Reserve -- Caspian Way, which leads to the Visitor Center, and Monument Road, which offers access to Border Field State Park. Emergency vehicles also use the 5th & Iris trails and several other trails in the southern end of the Reserve.

In 1992, Monument Road was severely damaged by flooding. Funding from NOAA for reconstruction of the road was approved in 1997, and design and construction will begin in 1998. Pending Management Authority approval, State Parks plans to realign Monument Road to the south of the existing road at an elevation that should provide for year-round access.

In the areas of the Reserve near the U.S.-Mexico border, U.S. Border Patrol has engaged in road-building independent of the operating agencies. These roads have been linked to problems with erosion and deterioration of habitat. The Management Authority and the operating agencies have agreed to review current and past road-building activities with the goal of reducing these impacts.

2. Perceived Needs for Roads and Parking

The major road improvement proposed for the Reserve is the reconstruction of Monument Road. The final conceptual design for the realignment is expected to be ready for review by the

Management Authority in January 1998. Once underway, construction is expected to last 12-18 months. The overall cost is estimated at between $250,000 and $300,000.

There is a need to reduce soil erosion tied to road-building activities in the southern end of the Reserve. Operating agencies are now working with U.S. Border Patrol to ensure that road-building techniques minimize potential impacts to habitat. Road placement, the use of erosion control measures, and seasonal factors all help limit the damage caused by building roads.

V. FACILITIES PLAN OF ACTION

Goal 1. Provide accessible buildings that support and facilitate the Reserve's mission.

Objective 1: Construct new facilities to improve the Reserve's effectiveness and staff efficiency.

Tasks:

- Create office space for the increased staffing called for by both operating agencies.
- Create space for use as a community room.
- Construct or gain access to a small research laboratory.
- Construct or gain access to additional equipment and vehicle storage.
- Expand the fire cache area.
- Evaluate the value of constructing temporary housing for seasonal and/or short-term staff positions.
- Collaborate with adjacent landowners on facilities development.
- Design and implement a Border Field kiosk relocation/construction plan following the reconstruction of Monument Road.
- Review the feasibility of establishing a visitor contact center at Border Field State Park.

Goal 2. Provide and maintain accessible foot, bicycle, and equestrian trails.

Tasks:

- Operating agencies will coordinate trail closures for protection of special-status species or their habitat.
- Operating agencies will publicize trail closures and share enforcement responsibilities.

- Operating agencies and Management Authority will review public proposals for new trails and meet with the equestrian community to assess the potential realignment of equestrian trails.

Goal 3. On existing roads, maintain appropriate vehicular access with minimum ecological impact.

Tasks:

- Design and reconstruct Monument Road in new location.

- Work with U.S. Border Patrol to minimize road-building impacts. Convene a panel to review the network of roads within the Reserve boundaries.

- Assess all vehicular roads in the Reserve and designate roads to be maintained, improved, or retired.

Goal 4. Explore linkages with the Tijuana River Valley Regional Park trails system.

CHAPTER TEN: WATERSHED COORDINATION PROGRAM

INTRODUCTION

Many of the ecological problems faced by the Tijuana River National Estuarine Research Reserve (NERR) originate in the 1,700-square-mile, binational, Tijuana River watershed -- an area that stretches well beyond the Reserve's borders. While the connections between upstream activities and their effects on Reserve lands can be observed in many locations, the Reserve has no formal authority to influence land use beyond its boundaries.

The Watershed Coordination Program seeks to establish communication and cooperation between the Reserve and other programs, agencies, and governments whose actions influence the long-term health of the Reserve. The Watershed Coordination Plan describes the Reserve's efforts to influence and respond to activities in the watershed and to build partnerships that promote the sustained health of the watershed and the Reserve.

For the 1998-2003 planning period, the Watershed Coordination Program focuses on the sub-watershed known as Goat Canyon (or Cañon de los Laureles). Goat Canyon spans the U.S.-Mexico border in the highly disturbed southern end of the Reserve. It presents a clear example of how upstream factors -- unplanned urbanization, erosion, pollution, and other factors -- have directly generated negative effects on downstream Reserve resources. This plan addresses the most pressing issues at Goat Canyon: slope instability, erosion, sediment control, and storm water management. The Goat Canyon Management Plan and accompanying projects in this sub-watershed will bring the Reserve an important step closer to addressing broader and more complex watershed and bioregional issues in the future.

The location of the Tijuana River watershed is shown in Figure 1. The location of Goat Canyon sub-watershed is shown in Figure 12.

I. MISSION

The mission for the Watershed Coordination Program is:

To advance the mission of the Reserve through the strategic development of working relationships with stakeholders and enhanced communication on scientific, cultural, political, and land-use issues in the Tijuana River watershed and the Point Conception to San Quintin bioregion.

II. GOALS

Goal 1: Coordinate with watershed stakeholders, agencies, institutions, and representatives to facilitate the Goat Canyon Management Plan and future watershed projects.

Goal 2: Co-develop and support programs and projects that promote understanding the upstream and downstream interactions.

Goal 3: Measure the success of projects and intervention through strategic cooperative monitoring and assessment.

Goal 4: Use and expand the education program developed at the Reserve to educate the general public and decision-makers on the U.S. and Mexican sides in an effort to gain support for future restoration efforts in Goat Canyon and other areas of the Reserve.

Goal 5: Establish closer linkages with other National Estuarine Research Reserves, National Wildlife Refuges, and other ecological reserves, particularly within our bioregion (Point Conception to San Quintin).

Goal 6: Maximize protection offered to the Reserve through national and international ecological and coastal special-area designation programs.

Goal 7: Adequately fund and staff the watershed/binational coordination program.

III. POLICIES

Because watershed-wide planning is a new concept, most agencies have not developed specific policies to address it. This is particularly true for watersheds crossing international boundaries. By nature, a watershed covers many jurisdictions and for this reason, watershed coordination requires compliance with the policies of many managing agencies and other stakeholders scattered throughout the watershed. To effectively work together on watershed initiatives, Reserve managers must initiate communication with these jurisdictions and stakeholders. There are currently no policies at the Tijuana River NERR directing binational watershed management.

IV. EXISTING CONDITIONS AND PERCEIVED NEEDS

A. PROGRAM OVERVIEW

Currently, the Tijuana River NERR is managed essentially as an isolated system with few formal connections to the surrounding watershed and bioregion. There are limited resources available to analyze these interactions and forge the necessary links that will address, correct, and prevent watershed-derived degradation of the Reserve. While its influences on the Reserve are vitally important, the greater Tijuana River watershed has not been adequately studied due to its sheer size, political complexities, and language and cultural barriers.

Despite these limitations, the Reserve has been successful in building working relationships and collaborations within the watershed, particularly on educational projects. It has also played a role in other institutions' efforts to coordinate diverse partners and needs within the watershed. As these cooperative relationships are formalized, broadened, and better integrated into a Watershed Management Plan, Reserve managers will be better equipped to fulfill their mission of resource

protection.

The Tijuana River Watershed Geographical Informational System project, described on page 180, opened the door for greater involvement of and cooperation with Mexican officials (in this case, the Municipality of Tijuana) in watershed planning efforts. To date, the Reserve has sought to expand on those foundation relationships and has worked with Mexican local and federal water agencies on volunteer water quality monitoring. Through the Goat Canyon Management Plan's (see page 182) first binational workshop on sediment control and revegetation, the Reserve has made many more contacts with various agencies (Public Works, Ecology, Education and Social Services) of the Municipalities of both Tijuana and Tecate. Through a second binational workshop and additional future projects, the Reserve will continue to promote Best Management Practices in the region while seeking out opportunities for education and cooperative enhancement, planning and management.

B. CURRENT WATERSHED COORDINATION PROJECTS

1. The Binational Water Quality Monitoring Program

The binational water quality monitoring program is a watershed-wide project that provides water quality education and awareness for students and teachers on both sides of the border through a hands-on, water quality testing program. By providing an organizing site at the Reserve, the program has sparked numerous projects. The program encouraged local high schools to base science fair projects on the Tijuana River Estuary and its water, brought water data together with GIS mapping, and created binational exchange days based on shared training in water quality. A new coliform monitoring and educational lab, funded by the San Diego County Water Authority, the National Oceanic and Atmospheric Administration's (NOAA) Estuary-Net, and the California Department of Education, will be part of the broader water quality program.

The binational water quality monitoring program has created closer links between the Reserve and local and state water agencies in San Diego, the San Diego Natural History Museum, and other NERRs involved in similar efforts. The Program has also been successful in building cross-border linkages with the following groups: Proyecto Fronterizo de Educación Ambiental (Border Environmental Education Project), Universidad Autónoma de Baja California (Autonomous University of B.C.), the Commission for Environmental Cooperation, CESPT (municipal water agency of Tijuana), CNA (federal water agency of Mexico), Pro-Esteros, Dirección General de Ecología de B.C. (state agency), secondary schools in Tijuana, teachers, students, and community leaders. These established and growing relationships will prove an invaluable resource for upcoming Goat Canyon watershed planning and restoration efforts.

There is interest on both the U.S. and Mexican side to expand the existing program, including broader monitoring coverage, data and student exchange, and enhanced public education efforts throughout the watershed by way of media events, traveling exhibits, speakers, and other outreach. To move the project forward, an agency or organization in Tijuana must be willing to carry out the Mexican portion of the water quality monitoring program. Such involvement by a Mexican regional agency would increase the program's longevity and effectiveness and enhance the program's practical application. The Reserve currently funds a seasonal position of a

watershed coordinator whose primary responsibility is the implementation of this project on both sides of the border.

2. GIS System and Watershed Planning

The Tijuana River Watershed Geographical Informational System (GIS) provides tools for the management of geographical data and sets the stage for cooperative projects in resource management, planning, restoration, and education. The GIS has also established close working relationships with Colegio de la Frontera Norte and the Planning Department of the City of Tijuana. These relationships offer an opportunity for sharing analysis, resources, and relevant sub-watershed information. Sample maps produced by Tijuana River Watershed Project, Watershed Land Use (Figure 16), Tijuana River Watershed Vegetation Classes (Figure 17), and Watershed Major Sub-basins and Streams (Figure 18) are provided.

The GIS database is a powerful planning tool, but it must be put to use in order to achieve its potential. Researchers at SDSU have used the GIS Tijuana River Watershed database to delineate sub-watersheds and characterize associated land use in these drainage basins. They have connected this data with water quality field sampling to highlight causal relationships and predictor variables for water quality. This land use/water quality model will be a useful tool in Goat Canyon planning efforts, particularly on the Mexican side, where land use has the greatest impact.

3. Goat Canyon Management Plan

The Goat Canyon Watershed Management Plan is in its early stages of development. The efforts are being spearheaded by the State Coastal Conservancy and the Southwest Wetlands Interpretive Association (SWIA), with support and input from Reserve staff. The process for development and implementation of the Goat Canyon Management Plan follows.

TABLE 13: Development and Implementation of the Goat Canyon Management Plan

Component	Task	Work Product
PHASE 1: Framing problems in the Goat Canyon Watershed and selecting a solution	Conduct background research	Short memorandum addressing historic involvement of agencies and organizations in Goat Canyon
	Inventory resource	Written assessment of existing conditions, opportunities, and constraints
	Identify stakeholders	List of stakeholders in U.S. and Mexico with interest and influence in Goat Canyon
	Assess needs and priority improvements needed	Comprehensive list of areas in need of improvement, including but not limited to erosion and sediment control, flood and waste-water

		control, and habitat restoration
	Identify range of potential solutions	List of potential solutions to needs identified in the assessment
	Evaluate solutions and opportunities for stakeholders to contribute in-kind services	Summary of solutions and opportunities for implementation from both the U.S. and Mexican sides
	Select solutions	List of priority activities
PHASE II: Implementing solutions, monitoring, and evaluation	Design and permit selected solutions	Implementation plans for each solution
	Begin implementation	
	Complete implementation program	
	Monitor results	Annual monitoring reports
	Modify solutions as needed	Annual adaptive management summary

4. Perceived Needs in Watershed Coordination

The Reserve does not currently take full advantage of its strategic location on the border, in the center of its bioregion, and at the terminus of a binational watershed. The Reserve would benefit from being better informed about and taking a greater role in related activities currently undertaken and funded by other groups. This might include educational efforts funded by Pro-Esteros (a binational environmental organization) or the San Diego Natural History Museum, watershed research initiatives funded by the U.S. Environmental Protection Agency (EPA), the Regional Water Quality Control Board, San Diego State University, monitoring efforts undertaken by the IBWC, or planning efforts by Tijuana River Valley planning committees.

By keeping in closer contact with other NERRS, NWRS, and organizations of the greater bioregion, the Reserve will benefit in terms of publicity, funding opportunities, shared resources and ideas, and in the exchange of lessons learned here and elsewhere. Indeed, better connections with other organizations and groups in the region would more closely mirror the shared natural links common to migratory animals, pollution flows, urbanization, ocean currents, and broad environmental shifts.

To overcome past deficiencies, address current needs, and take full advantage of existing opportunities, it is critical for the Watershed Coordination Program to expand in the following areas:

1. Monitoring watershed-related projects and planning issues. This includes identifying which groups or agencies are responsible for different developments and changes in land use, assessing positive and negative effects of different projects on the Reserve, and determining how Reserve staff and volunteers might take a role and have a voice in key projects and research. This also includes coordinating with public and private landowners

in the Tijuana River Valley in order to enhance project effectiveness and foster cooperative efforts in the south end of the Reserve.

2. Compiling and updating relevant research data that connects Reserve health to the watershed and then making this data accessible to staff, researchers, and project leaders. This would include updating the 1986 GIS database of the Reserve, collecting relevant watershed data from Mexican agencies, compiling water quality data from various sources, and utilizing NOAA-funded researchers to address information gaps.

3. Sharing information on erosion/sediment issues. This includes collecting information on the erosion/sediment process, forming connections with potential partners in Mexico and in the Border Patrol, and formulating an action plan, project proposals, and funding options for restoration work and sediment prevention.

4. Tackling pollution issues. The program could establish and publicize the negative effects on the Tijuana River Estuary of sewage, industrial waste, street runoff and trash. It also could investigate where effort, education, public information meetings, and future funding might be most effectively applied, and then formulate project proposals and funding options for research, clean-up, restoration, and prevention.

5. Assessing immigration issues. Continue to work with Border Patrol and other interests north and south of the border on how best to avoid negative effects on natural resources associated with undocumented immigrants and Border Patrol activities. The nature and location of impacts from immigration in the Tijuana River Valley have changed in recent years. As a result, the impacts caused by immigrants crossing through and damaging critical wetland habitat have diminished. However, immigration *to Tijuana* from other parts of Mexico, or from other countries, is still a problem for the Reserve. Squatters' villages, all lacking sewage service, continue to expand on the eroding hillsides of Tijuana Watershed canyons. They present a challenge for the Reserve in terms of erosion/sedimentation, water quality concerns, and trash washed down with rain runoff. Better coordination with Mexican agencies on Goat Canyon and future projects will enable the Reserve to take positive steps toward confronting this situation.

6. Focusing on the bioregion. Expand research and form connections with others involved in natural resource management, other ecological reserves, and regional preservation agreements.

To expand this program, additional funding is needed. It also requires better coordination, awareness, and efficient use of resources. Beyond available funding from the operating agencies and from NOAA, possible funding sources to carry out elements of the Watershed Coordination Plan are the EPA, Border 21, Commission on Environmental Cooperation (CEC), Border Environment Cooperation Commission (BECC), Border Patrol, the Port District, California Department of Education, Cal Trans, State Parks Foundation, State Coastal Conservancy, and private foundations.

V. PLAN OF ACTION

Goal 1. Coordinate with watershed stakeholders, agencies, institutions, and representatives to facilitate the Goat Canyon Management Plan and future watershed projects.

Objective 1a: Target priority problems within Goat Canyon and the Reserve affected by activities in the watershed.

Tasks:

- Using existing data sources, prepare maps of baseline geomorphic, hydrologic, biologic, and land-use data. Prepare additional graphic materials to assist in illustrating watershed conditions, problem areas, and alternative treatment approaches.

- Assemble a list of problematic issues -- including erosion/sediment, pollution, and trash -- and their respective potential watershed-based causes, including both physical and social parameters. Identify existing sources for this information (GIS, SDSU and PERL data, Coastal Conservancy, consultant reports, etc.).

Objective 1b: Identify the potential sources of Goat Canyon and Reserve impacts and begin working with U.S. and Mexican watershed stakeholders, agencies, and institutions positioned to help create solutions.

Tasks:

- Conduct meetings with stakeholders to develop agreements on project parameters, goals and objectives, and specific project recommendations. Identified stakeholders include U.S. and Mexican local and binational government officials, environmental and education organizations, and Tijuana Valley recreational advocates. A minimum of two meetings will be binational with English/Spanish translation.

- Review existing technical data, analyze discrete problems, and make recommendations for alternative project components and conceptual construction designs.

- Encourage estuary visits and meetings with stakeholders and key watershed players to begin discussing relevant issues. Encourage new (binational) research on these issues.

Objective 1c: Formally establish connections with relevant stakeholders, agencies, and institutions and allow for their representation and collaboration in Goat Canyon and other Reserve projects. Encourage their interest in the shared watershed and in the Reserve as a resource to all.

Tasks:

- Convene a joint planning meeting with the U.S. EPA Border Environmental Program and the San Diego Regional Water Quality Control Board to take stock of current initiatives

and opportunities for collaboration.

- Assemble a roster of stakeholders concerned with binational aspects of the watershed.

- Offer the Reserve as a research and public education resource to watershed-wide user groups.

- Establish regular communication, via newsletter, e-mail, or other means, with watershed stakeholders, institutions, and agencies. Keep these contacts informed of activities and request their input and cooperation.

Objective 1d: Issue a report addressing Goat Canyon problems identified by stakeholders.

Task:

- Prepare a final report with recommended solutions and designs to counter problems stakeholders identified at Goat Canyon. Include unit cost estimates for constructed works in the Report. Preparation will include coordinated review and consultation among stakeholders.

Goal 2. Co-develop and support programs dedicated to understanding the upstream and downstream interactions.

Objective 2a: Work cooperatively to eliminate or ameliorate the detrimental effects of those interactions on the Goat Canyon sub-watershed, the Tijuana River Watershed, and the estuary.

Tasks:

- Identify research projects underway; communicate with project leaders; offer support and collaboration; express the needs of the Tijuana River Estuary as it relates to the project; create a database of projects and make the data readily available.

- Pursue and implement cooperative projects with watershed stakeholders/residents to address the most pressing issues, among them sediment loads in Goat Canyon.

- Support companion projects in Mexico which might improve the Canyon de los Laureles environment.

Objective 2b: Apply integrated solutions that make use of the expertise and authority of multiple agencies and organizations.

Task:

- Actively seek out project partners and funding options; take advantage of stakeholder expertise and authority.

Goal 3. Measure the success of projects and intervention through strategic cooperative monitoring and assessment.

Tasks:

- Characterize existing monitoring carried out by U.S. EPA, San Diego Regional Water Quality Control Board, and other agencies.

- Develop monitoring methodology/plans.

- Collaborate with monitoring/research organizations to carry out plans and assess intervention effectiveness.

- Make use of the expertise and authority of agencies and organizations to accomplish this goal.

Goal 4. Use and expand the education program developed at the Reserve to educate the general public and decision-makers on the U.S. and Mexican sides in an effort to gain support for future restoration efforts in Goat Canyon and other areas of the Reserve.

Objective 4a: Encourage binational support among decision-makers for sustaining healthy coastal resources.

Tasks:

- Use the unique natural setting of the Tijuana River Estuary as a focal point for public education days (Watershed Day, etc.), school science projects, research exchange programs, public meetings, and events that involve the local community. Use the education program as a building block for these events.

- Encourage watershed stakeholders, U.S. and Mexican agency representatives, and decision-makers to visit and use the Reserve.

- Seek out opportunities to demonstrate the value and uniqueness of this local resource through public presentations, traveling exhibits, and other offerings.

Goal 5. Establish closer linkages with sister National Estuarine Research Reserves, National Wildlife Refuges and other ecological reserves, particularly within our bioregion (Point Conception to San Quintin).

Objective 5a: Establish greater exchange of information and methodology between Tijuana River NERR and counterpart agencies.

Tasks:

- Establish and improve personal contacts and regular communication with other Refuges

and Reserves, placing particular emphasis on the Elkhorn Slough NERR and the Channel Islands Marine Sanctuary.

- Develop mechanisms to share ideas and information (on-line, newsletters, monthly conference calls, annual visits, etc.).

Objective 5b: Implement projects designed and developed by Tijuana River NERR and counterpart agencies

Tasks:

- Work jointly on projects that enhance communication and interaction.

- Investigate and cooperate on bioregional projects as needs dictate (bird monitoring, water quality, etc.).

Goal 6. Maximize protection offered to the Reserve through national and international ecological and coastal special-area designation programs.

Tasks:

- Use the watershed coordinator to explore the costs and benefits of these options, such as "RAMSAR" and "Man and the Biosphere."

- Procure other staff time or volunteer time to explore these options.

- Move forward on the certification process, if advisable.

Goal 7. Adequately fund and staff the watershed/binational coordination program.

Tasks:

- Investigate sources of funding and secure funds.

- Investigate and propose funding levels needed for staff to carry out these tasks on a full-time basis.

- Investigate use of NGO staff or volunteers to help achieve the goals outlined in this chapter.

LISTING OF APPENDICES

APPENDIX 1

Compatibility Determinations - Tijuana Slough NWR

The National Wildlife Refuge (NWR) System is a primary-use federal land system. No secondary uses of a Refuge may be allowed unless they are determined to be compatible with the primary wildlife conservation purpose for which the refuge was established. Secondary uses may include recreation, commercial activities, rights-of-way, and research. These types of uses are all discretionary. Before they are authorized, they must be found compatible. For recreational uses, the Refuge Manager must also determine that sufficient funds and staff resources are available to implement programs. Public safety and interference with other authorized uses are reasons that some uses compatible with refuge purposes may not be authorized on an NWR.

Compatible secondary uses of refuge are uses that either promote and enhance, or at least do not materially interfere with the purpose(s) for which the refuge was established. The U.S. Fish and Wildlife Service (FWS) must also have sufficient jurisdiction over NWR lands to exercise the compatibility rule.

Tijuana Slough NWR was established in 1980 under authority of the Endangered Species Act of 1973. The refuge was established specifically to protect habitat for and enhance recovery of the endangered light-footed clapper rail. The official purpose of the refuge is "... to conserve (A) fish or wildlife which are listed as endangered species or threatened species ... or (B) plants..." That is the purpose against which proposed secondary uses are tested during a compatibility determination.

On FWS fee-title land of Tijuana Slough NWR, FWS has full jurisdiction. On NWR lands operated under the 1984 Memorandum of Understanding (MOU) with the U.S. Navy and on state tidelands operated as part of the NWR under the 1980 Lease No. PRC 5938.9 of the California State Lands Commission, FWS exercises jurisdiction only as specified in the MOU and Lease, and does not have complete jurisdiction over all secondary uses.

The following secondary uses of Tijuana Slough NWR have been determined to be compatible with the purpose(s) of the refuge, as qualified in the individual compatibility determinations.

- Environmental Education: found compatible in Compatibility Determination and Environmental Action Memorandum of September 1, 1994.

- Pest Management (including removal of exotic vegetation and mosquito control): found compatible in Compatibility Determination and Environmental Action Memorandum of September 21, 1994.

- Research (including population monitoring and surveys): found compatible in Compatibility Determination and Environmental Action Memorandum of September 1,

1994. (Note: Individual research proposals may be subject to additional compatibility determination.)

- Boating (non-motorized): found compatible in Compatibility Determination and Environmental Action Memorandum of September 1, 1994.

- Wildlife Observation and Photography: Compatibility Determination in preparation.

- Wildlife Interpretation: Compatibility Determination in preparation.

- Foot, bicycle and equestrian trails: Compatibility Determination in preparation.

APPENDIX 2

List of Refuge Operating Needs System (RONS) Projects for Tijuana Slough NWR

RONS Proj. No.	Project Description	CMP Location
11681-97001	Visitor Services: "Trekking the Refuge" Environmental Education Program (1.0 FTE).	Chapter 7, Table 4.2
11681-97002	Visitor Services: Construct Visitor Center additions (1.0 FTE).	Chapters 7,9 Table 4.2
11681-97005	Visitor Services: Construct amphitheater/observation deck (no new staff requirements).	Chapter 9
11681-97006	Visitor Services: Publish walker's guide and bird list; provide "Songbird Blues" Env. Educ. text for children (no new staff requirements).	Chapter 7
11681-97008	Visitor Services: acquire, post new (bilingual) interpretive and regulatory signs (no new staff requirements).	Chapters 5,7,9
11681-98001	Law Enforcement: protect rare species/habitats (0.5 FTE).	Chapter 5, Table 4.2
11681-98002	Wetland Restoration: inventory, enhance and restore vernal pools on refuge (no new staff requirements).	Chapter 5
11681-98003	Predator & Exotic Control: control feral cats, remove invasive exotic vegetation, predator management (0.5 FTE).	Chapter 5 Table 4.2
11681-98005	Contaminant Investigation and clean-up. Characterize and clean up old landfills on refuge (no new staff requirements).	Chapter 5
11681-98XXX	Resource Protection: Clean up trash and install protective boom on Oneonta Slough to reduce water- borne trash (0.5 FTE).	Chapter 5, Table 4.2
11681-98XXX	Visitor Services: Create NWRS	Chapter 7

	interpretive displays for TRNERR Visitor Center (no new staff).	
11681-98XXX	Visitor Services: Build an accessible wildlife observation and photography blind on Tijuana Slough NWR.	Chapter 8

APPENDIX 3

Tijuana River NERR/Tijuana Slough NWR Comprehensive Management Plan Step-down Management Plans - Tijuana Slough NWR

The following Step-down Management Plans are needed and will be prepared to support this Comprehensive Management Plan in accordance with FWS Policy (602 FW 3.1).

Step-down Management Plan Title	Completion Date
Occupational Safety and Health*	6/30/99
Safety Program	
Hazard Communications Program	
Occupational Health	
Public Use**	9/30/99
Sign Program	
Volunteer Program	
Interpretation Program	
Law Enforcement Program*	6/30/99
Fire Management Program*	3/31/99
Populations Management**	9/30/99
Wildlife Inventory Program	
Predator Management	
Disease Prevention and Control	

* Indicates Plan that will be prepared as a Complex-wide plan for San Diego NWR Complex
** Indicates a plan that will be prepared specifically for Tijuana Slough NWR

APPENDIX 4

Species Listed as Endangered or Threatened For Tijuana Slough NWR

As of November 1997

Common Name	Scientific Name	Status
BIRDS		
American Peregrine falcon	*Falco peregrinus anatum*	E
Brown pelican	*Pelecanus occidentalis*	E
California least tern	*Sterna antillarum* (=albifrons) *browni*	E
Least Bell's vireo	*Vireo bellii pusillus*	E
Light-footed clapper rail	*Rallus longirostris levipes*	E
Western snowy plover (coastal population)	*Charadrius alexandrinus nivosus*	T
Southwestern willow flycatcher	*Empidonax traillii extimus*	E
Belding's savannah sparrow	*Passerculus sandwichensis beldingi*	T*
PLANTS		
Salt marsh bird's-beak	*Cordylanthus maritimus ssp. maritimus*	E

* Indicates California state listing. All others are federal designations.

APPENDIX 5

Bird List for the Tijuana River NERR

For nearly 40 years, the Tijuana River estuary and valley have been a magnet for birds and birders. This list intends to cover these areas, as well as the adjacent communities of Imperial Beach and Nestor to the north, Spooner Mesa to the south, and the ocean visible from shore to the west. This list does not include any part of San Diego Bay, or the salt works at its southern end.

The Tijuana River valley has experienced enormous changes in its habitats over the decades. Many species of birds have appeared and disappeared with these changes. Much of the data on birds in the Tijuana River reflects past conditions -- more extensive agriculture, different crops, fewer trees, and flooded swamps. Current conditions (1997) are so new that the status of many species under them is unclear. Some species that once occurred frequently are now rare or absent. With the drying of the ponds along Dairy Mart Road, many water birds that nested for a few years can do so no longer. Therefore, the status by season on this list is, for many species, an estimate based on their response to current conditions, even though it encompasses all species ever recorded there.

KEY:

C: Common. Species seen on nearly every visit at the proper season, usually in good numbers (>10 per day).

U: Uncommon. Species seen on most visits at the proper season, usually in small numbers (<10 per day).

O: Occassional. Species not seen on most visits, even at the proper season, but small numbers can be expected nearly every year with repeated searching.

R: Rare. Species seen only sporadically, not annually; as few as on record.

*: Species breeds or probably breeds regularly.

(*): Species breeds sporadically or bred formerly. The current breeding status of many species is uncertain, requiring ongoing surveys.

Note: The bird list is currently not available in the electronic version of the 2000 Comprehensive Management Plan.

APPENDIX 6

Letter of Agreement

United States Fish and Wildlife Service
And California State Parks
Regading the management of the
Tijuana River National Estuarine Research Reserve

Note: this letter is currently not available on the electronic version of the 2000 Comprehensive Management Plan.

APPENDIX 7

Listing of Educational Program Themes

1. Wetlands and Water

The Reserve seeks to provide visitors with an understanding of the role wetlands and water play in an estuary. This theme includes the following concepts and principles:

- An estuary is where a river meets the sea and is a highly productive habitat. Estuaries are affected in multiple ways by the ocean tides and tidal flushing.

- Estuarine wetlands function to filter out toxics from the water, provide flood control and water storage, and are a nursery, feeding area, and breeding area, for many bird and fish species.

- The type and quality of water defines the habitats that exist in a wetland. Types of water include salty, brackish, or fresh.

- The wetland's water quality is a result of the interrelationship of water quality parameters and their effects on the ecosystem. These parameters include human and natural impacts on water quality.

- California has lost 91% of its wetlands.

- Watersheds or drainage basins are important because they supply a wetland with its water. One fourth of the Reserve's watershed is in the United States and three fourths of the watershed is in Mexico.

2. Habitat and Wildlife

The Reserve programs seek to make visitors aware of the interrelationship among Reserve biological communities. This theme includes the following concepts and principles:

- The Reserve encompasses a number of different habitats including salt marsh, mudflats, uplands, riparian, dunes, salt panne, and coastal sage scrub.

- Animals and plants have developed interesting and unusual physical and behavioral adaptations to these habitats which include but are not limited to salt excretion or storage, types of camouflage, types of food consumed, and various protections against specific predators.

- Most of the plants and animals in these habitats are part of food webs where all producers, consumers, and decomposers are interdependent.

- The Reserve located on the Pacific Flyway serves as an important habitat for approximately 320 migratory bird species. The Reserve serves as a stopover spot for some migratory birds and a wintering spot for others.

- The Reserve is also home to many endangered and threatened species, including the light-footed clapper rail, California least tern, Western snowy plover, California brown pelican, least Bell's vireo, Belding's savannah sparrow, and Salt marsh bird's beak. Human activities can cause habitat loss and pollution which threaten these species.

3. Human Environment Interaction

The Reserve seeks to make visitors aware of the Reserve's cultural history and the impact of human activity on the native habitats. This theme includes the following concepts and principles:

- The Reserve has a history of use by the Kumeyaay, ranchos, and the military.

- A number of the plants from the Reserve have traditional uses.

- Many of the plants and animals now found at the Reserve are non-native. The invasion of these plants and animals has disrupted native ecosystems.

- The Reserve's watershed spans the US/Mexico border and pollution entering the watershed does not respect political boundaries.

- The protection and maintenance of the Reserve and its programs occurs through the joint efforts of a number of federal, state, and local agencies.

- The Reserve serves as an important "human refuge" providing open space for the enjoyment of nature through compatible recreational activities.

APPENDIX 8

Description of Typical School Field Trips to the Estuary

Visits can last between 1 1/2 hours and 3 hours, depending on time available.

Divide children into three groups. Review field manners. Each group then rotates through three activities, such as:

I. Plant Observation

Materials:
Plant observation sheets
Plant cards
Hand lenses (optional)
Pencils and clipboards

Activitv: Choose a habitat, such as uplands (native plant garden), salt marsh, or riparian.

Talk about the differences among habitats (how plants are different in each area and how they've adapted to dry conditions, salty soil, etc.).

Have students work in pairs. Each group chooses a plant and fills out the worksheets using observations from the plant.

Suggestions for Multiple Visits:
Choose another habitat in which to observe plants.

II. Bird Observation

Materials:
Bird observation sheets and/or bird checklist
Birds at the estuary
Bird cards (optional)
Binoculars (available at the visitor center)
Pencils and clipboards

Activitv: Take group to the tidal ponds, located on the McCoy Trail.

Observe the tide and other conditions. Talk about how this affects the species of birds observed (mud feeders such as sandpipers, willets, dowitchers, long-billed curlews, etc. are more evident at low tide; fishers and swimmers such as ducks, egrets, herons, kingfishers, ospreys, etc. are more evident at high tide).

Have students observe the birds and their behavior, recording answers on the worksheets.

Suggestions for Multiple Visits:
Use different worksheets, e.g. feeding styles, bird behavior, bird checklist.

III. Visitor Center Activities

Materials: None

Activities:
View *Timeless River* video (20 min.)

Visit exhibits

Watershed Game (if time):

- Explain the significance of the watershed map and watersheds (see materials packet for teacher background).
- Place students at various points on the map (mountains, cities, reservoirs, etc.).
- Tell students they are drops of rainwater and ask them to trace their paths to the Estuary, noticing where they pass through (dams, crossing the border, etc.).
- Ask students where they passed. Discuss what it would mean if they were drops of pollution (oil, chemicals, etc.) instead of water.

Suggestions for Multiple Visits:

Natural Scavenger Hunt (included in Field Trip Materials)

IV. Walk to the River Mouth

On subsequent visits to the Estuary, an observational walk to the mouth of the Tijuana River is suggested. The group can either walk from the south end of Seacoast Drive along the beach to the river, or may take the trail from 5th and Iris Streets. The distance is about the same; the walk can last from 1-3 hours.

APPENDIX 9

Educational Curriculum Guidelines

Science curriculum materials used by teachers in California classrooms and supplementary field activities are expected to align with the Science Framework for Public School Kindergarten Through Grade Twelve adopted by the California State Board of Education in 1990. The framework addresses the nature of science and the need for science educators to model the attributes of scientific investigation, including objectivity, testability and consistency. The framework also calls for the thematic presentation of science concepts so that students appreciate the connections across science disciplines and learn how science relates to other subjects. In addition, the state couples the enjoyment of learning science with an interest in responsibility for protecting the environment.

The adoption and implementation of the Science Framework has prompted the development of standards-based systems throughout the state, which are aligned with national standards, to clarify expected student outcomes. The Tijuana River NERR education program also takes the following guides into consideration when planning school programs.

California Guide to Environmental Literacy which applies ecological principles with a broad systems perspective to the framework. Drafts were circulated in 1996 and 1997.

Science Standards from the California Department of Education address content and performance.

Performance Standards from San Diego City Schools, for literacy, mathematics, science, history-social science, and applied learning.

Benchmarks for Science Literacy, American Association for the Advancement of Science. New York: Oxford University Press, Inc., 1993.

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APPENDIX 10

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APPENDIX 11

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APPENDIX 12

MOU FOR INTER-AGENCY TRAIL COORDINATION

MEMORANDUM OF UNDERSTANDING BETWEEN: UNITED STATES BORDER PATROL, THE UNITED STATES FISH AND WILDLIFE SERVICE, CALIFORNIA STATE DEPARTMENT OF PARKS AND RECREATION, SAN DIEGO COUNTY PARKS AND RECREATION DEPARTMENT, CITY OF SAN DIEGO, STATE PARK MOUNTED ASSISTANCE UNIT (MAU), THE TIJUANA RIVER VALLEY EQUESTRIAN ASSOCIATION (TRVEA) AND CITIZENS AGAINST RECREATIONAL EVICTION (CARE), UNITED STATES NAVY

RECITALS

A. The signatory public agencies and citizen organizations to this memorandum of understanding desire to establish a framework for the coordinated planning, alignment, design and development of trails within the Tijuana River Valley

B. The signatory public agencies and citizen organizations to this memorandum of understanding have found that the development of regional and local trails helps to achieve a higher quality of life for the residents of San Diego County by providing recreational opportunities, promoting alternative non-motorized transportation corridors, preserving and providing open space areas, creating links between parks and other recreational areas, and providing other benefits

C. The signatory public agencies and citizen organizations desire to establish a committee to be known as the Tijuana River National Estuarine Research Reserve Management Authority (also known as TRNERRMA) Trails Subcommittee (hereafter the "Committee") to provide a clearinghouse for information relating to trails and for coordination of trail planning, design and development by the various signatory public agencies. This memorandum of understanding establishes a framework for the creation and responsibilities of the Committee

D. This memorandum of understanding does not establish a contract between any of the signatory public agencies or citizen organizations nor shall this memorandum be construed to be an agreement for the joint exercise of powers or creating a joint powers agency under the provisions of Government Code Section 6500 et seq. Each signatory public agency shall retain full regulatory authority with respect to the subject matter of this memorandum of understanding and full discretionary authority with respect to the provision of trails within their respective jurisdictions

Therefore, in furtherance Recitals the signatory public understanding as follows:

THE COMMITTEE

1. The chief administrative officer (e.g. City Manager, Chief Executive officer, Executive Director, etc.) of each signatory public agency or citizen group will appoint a member (and an alternate) of the agency staff to serve as a member of the Committee. The Committee shall be established as soon as three members are appointed.

2. The purpose of the Committee will be to do all of the following:

a. Coordinate recreational trail links and associated facilities between and within the Tijuana River Valley. Develop recommendations for trail features (i.e. bicycling, hiking, equestrian uses, staging areas, paving, fencing, furniture, landscaping, signage, interpretive centers, handicap accessibility and other features). Develop plans for regional trail routes which connect regional recreational areas, open space areas, historic areas, educational institutions, culturally significant areas and transportation staging areas and other significant areas in the Tijuana River Valley.

b. Research and pursue various mechanisms to plan, acquire, develop, patrol and maintain trails associated open space corridors.

c. Pursue financial and other support from the public agencies (including agencies of the state and federal government), community service groups, educational institutions, businesses and individuals to supplement funding by the respective signatory public agencies.

d. Generate volunteer support.

e. Encourage and assist in the development of integrated processing procedures for the preservation of open space corridors and trails through the planning processes of each of the signatory public agencies.

f. Draft proposed ordinances, plans and other implementation documents for consideration by the signatory public agencies. Attached herein and labeled "Appendix A" is a Trail Use Policy. This Policy represents the consensus of the Committee at the time of MOU signing and will serve as the foundation document for future trail management decisions.

g. Pursue applications for grant funding to support construction, operation, and maintenance (including cowbird trapping) of regional trails.

h. Pursue the formation of a formal joint powers authority or joint exercise of powers agreement and make a recommendation to the signatory public agencies regarding the desirability of such an authority agreement.

The Committee has no legislative or administrative authority and shall act solely in an advisory capacity to the chief administrative officer of each signatory public agency or to the appropriate planning, parks and recreation or other similar department of each signatory public agency as

may be determined appropriate by each agency.

3. The Committee shall commence meeting as soon as three members have been appointed. The Committee shall conduct meetings not less frequently than once every three months at such times and places as the committee may designate. The Committee may establish by-laws which are not inconsistent with this memorandum of understanding. Meetings of the committee shall be open to the public in accordance with all applicable State and local laws. A simple majority of the members shall constitute a quorum for the transaction of any business of the Committee. Formal actions of the Committee shall require an affirmative vote by a majority of the quorum.

PLANNING ACTIVITIES

4. Trail planning activities by the various signatory public agencies should be coordinated with the goal of establishing a regional public trail network within the Tijuana River Valley. Particular emphasis should be placed on establishing connections between trail systems within the boundaries of the various signatory agencies and on avoiding conflicts in trail types, uses and designs where such conflict would inconvenience or endanger the public. Trail use and the creation of any new or alternative trail routes shall avoid impacts to designated critical habitat for the least Bell's Vireo, proposed critical habitat for the Southwestern willow fly catcher and habitats utilized by the California least tern, Western snowy plover and any other listed species to the greatest extent practicable. Where feasible and consistent with public safety, easements for major utility and transportation facilities (other than streets) should be made available for joint use as trails. Each signatory agency should consider the trail planning activities of the other signatory agencies in developing trail routes within their respective jurisdictions.

5. Each signatory public agency agrees to refer applicable proposals for major land developments to the Committee for comment regarding trail program implementation as a part of the development review process.

6. The signatory public agencies agree to coordinate regional trails planning with land use regulations while maintaining local land use control.

7. The signatory public agencies will each bear their own costs of implementing this memorandum of understanding. Expenses of copying, document preparation, mailing or other similar common costs should be shared equally among the signatory agencies, or rotated between the agencies on a regular basis.

8. The Committees should pursue grant or other funding to support its activities.

MISCELLANEOUS

9. This memorandum shall become effective upon the execution by any three of the public agencies which are listed in the title hereof. Any public agency listed in the title hereof may become a signatory public agency at any time or may withdraw as a signatory public agency at any time.

10. Each signatory agency shall be solely responsible for its own acts or omissions taken with respect to activities within its jurisdiction with respect to the subject matter of this memorandum. No signatory agency shall be liable with respect to any comments or requests whether implemented or not, pertaining to trail activities of any other public agency. Where trail of one public agency adjoin or abut the trails or property of another public agency, liability to the third persons with respect to personal injury or property damage shall be determined according to ordinary principles of law without regard to this memorandum.

(Signatures)

APPENDIX 13

LAND STATUS MAP (TO BE UPDATED)

APPENDIX 14

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