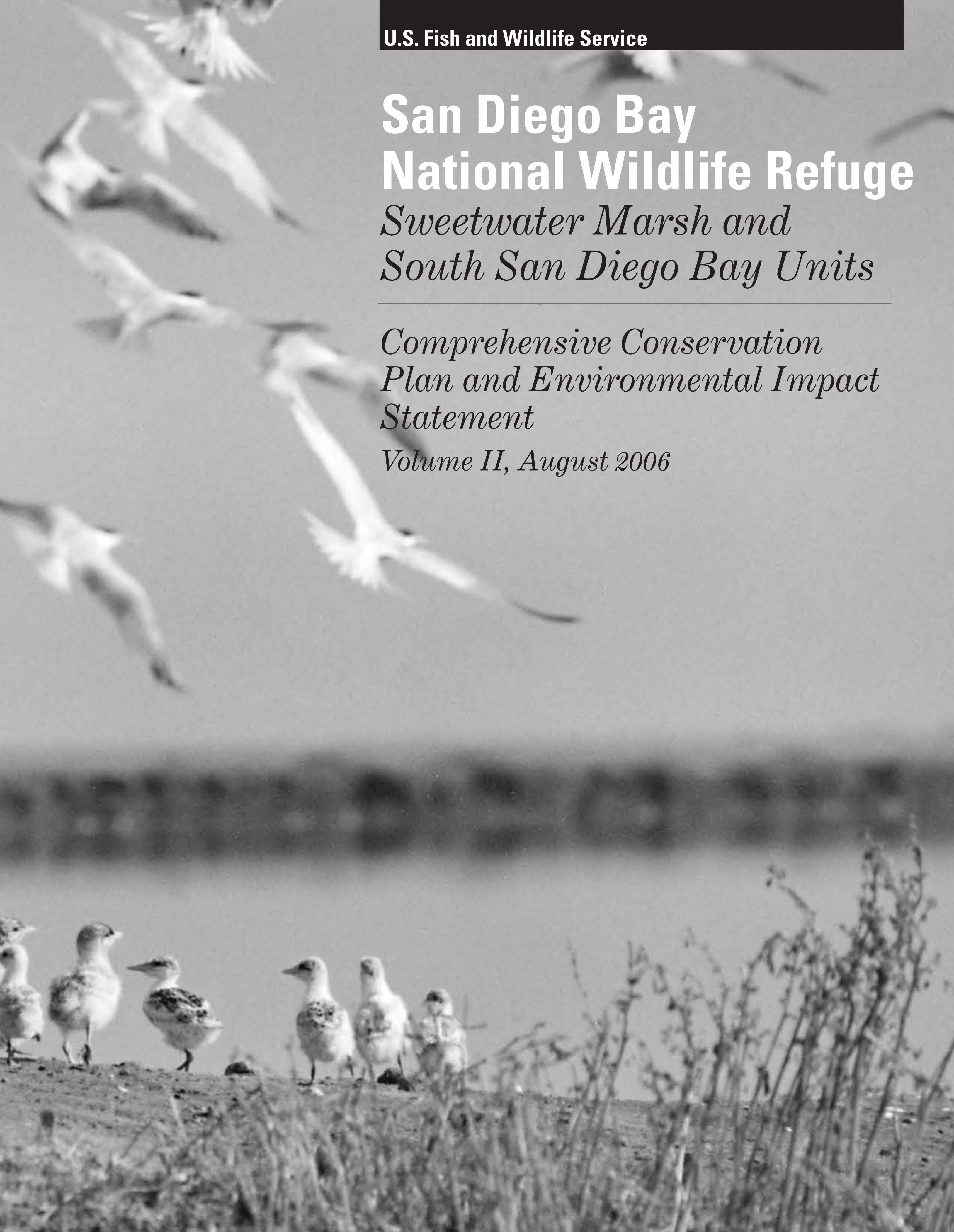
U.S. Fish and Wildlife Service

San Diego Bay National Wildlife Refuge

Sweetwater Marsh and South San Diego Bay Units

Comprehensive Conservation Plan and Environmental Impact Statement

Volume II, August 2006



Comprehensive Conservation Plans provide long-term guidance for management decisions and set forth goals, objectives, and strategies needed to accomplish refuge purposes and identify the Service's best estimate of future needs. These plans detail program planning levels that are sometimes substantially above current budget allocations and, as such, are primarily for Service strategic planning and program prioritization purposes. The plans do not constitute a commitment for staffing increases, operational and maintenance increases, or funding for future land acquisition.

U.S. Fish & Wildlife Service

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Final Comprehensive Conservation Plan and Environmental Impact Statement

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Vision Statement

The San Diego Bay National Wildlife Refuge protects a rich diversity of endangered, threatened, migratory, and native species and their habitats in the midst of a highly urbanized coastal environment. Nesting, foraging, and resting sites are managed for a diverse assembly of birds. Waterfowl and shorebirds over-winter or stop here to feed and rest as they migrate along the Pacific Flyway. Undisturbed expanses of cordgrass-dominated salt marsh support sustainable populations of light-footed clapper rail. Enhanced and restored wetlands provide new, high quality habitat for fish, birds, and coastal salt marsh plants, such as the endangered salt marsh bird's beak. Quiet nesting areas, buffered from adjacent urbanization, ensure the reproductive success of the threatened western snowy plover, endangered California least tern, and an array of ground nesting seabirds and shorebirds.

The San Diego Bay National Wildlife Refuge also provides the public with the opportunity to observe birds and wildlife in their native habitats and to enjoy and connect with the natural environment. Informative environmental education and interpretation programs expand the public's awareness of the richness of the wildlife resources of the Refuge. The Refuge serves as a haven for wildlife and the public to be treasured by this and future generations.

U. S. Fish and Wildlife Service
California/Nevada Refuge Planning Office
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August 2006

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Appendix A

Glossary of Terms

Appendix A: Glossary of Terms

1. Acronyms and Abbreviations

AAR	Acquisition Ascertainment Report
ACHP	Advisory Council on Historic Preservation
ACOE	United States Army Corps of Engineers
ADA	Americans with Disabilities Act
ADT	average daily traffic volumes
AHPA	Archaeological and Historic Preservation Act
Airport Authority	San Diego County Regional Airport Authority
APCD	San Diego Air Pollution Control District
APE	Area of Potential Effect
ARB	California Air Resources Board
ARPA	Archaeological Resources Protection Act
BCR	Bird Conservation Regions
BMPs	Best Management Practices
BOD	biological oxygen demand
Caltrans	California Department of Transportation
CAP	Contaminant Assessment Process
CAAQS	California Ambient Air Quality Standards
CCP	Comprehensive Conservation Plan
CDFG	California Department of Fish and Game
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
cm	centimeter
CNEL	Community Noise Equivalent Level
CO	Carbon monoxide
Code	California Fish and Game Code
combined federal project	Sweetwater River Flood Control Channel/State Highway Route 54/Interstate 5 Project
Commission	California State Historic Resources Commission
Complex	San Diego National Wildlife Refuge Complex
County	County of San Diego
CRMP	Cultural Resources Management Program
dB	decibel
dBA	A-weighted” noise scale
dB Leq	noise levels presented as average noise levels over a period of minutes or hours
DDT	Dichlorodiphenyltrichloroethane
DEA	Draft environmental sssessment
DEIS	Draft Environmental Impact Statement
DOI	Department of the Interior
DU	Ducks Unlimited

EA	environmental assessment
EBS	Environmental Business Solutions, Inc.
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ESA	Federal Endangered Species Act
FEMA	Federal Emergency Management Agency
FR	Federal Register
FTE	full-time equivalent
FY	Fiscal Year
gpm	gallons per minute
HMP	Habitat Management Plan
HRB	Historical Resources Board (City of San Diego)
HUD	U.S. Department of Housing and Urban Development
I-5	Interstate 5
Improvement Act	National Wildlife Refuge System Improvement Act of 1997
INRMP	San Diego Bay Integrated Natural Resources Management Plan
kV	kilovolt
LCP	Local Coastal Program
LEA	County of San Diego Department of Environmental Health, Solid Waste Local Enforcement Agency
Ldn	Day/Night Average Sound Level
LOS	Level of Service
LPP	Land Protection Plan
m^2	square meter
$\mu g/m^3$	micrograms per cubic meter
MBTA	Migratory Bird Treaty Act
MHHW	mean higher high water
MHPA	Multi-Habitat Planning Area, as defined in the City of San Diego's Multiple Species Conservation Program Subarea Plan
MHW	mean high water
MLLW	mean low low water
MOA	memorandum of agreement
MOU	Memorandum of Understanding
MPAs	Marine Protected Areas
mph	miles per hour
MSCP	Multiple Species Conservation Program
MSL	Mean Sea Level
MTDB	Metropolitan Transit Development Board
Municipal Permit	Municipal Storm Water NPDES Permit
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection and Repatriation Act
NASNI	Naval Air Station, North Island
NGOs	non-government organizations
NEPA	National Environmental Policy Act
NGDV	National Geodetic Vertical Datum
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NO_2	Nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NOLF	Navel Outlying Landing Field, Imperial Beach

NOx	Oxides of nitrogen
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
NRRF	Naval Radio Receiving Facility
NWI	National Wetlands Inventory
NWR	National Wildlife Refuge
NWRS	National Wildlife Refuge System
O_3	Ozone
OEHHA	Office of Environmental Health Hazard Assessment
OVRP	Otay Valley Regional Park
PAHs	polycyclic aromatic hydrocarbons
PCBs	polychlorinated biphenyls
PM_{10}	fugitive dust emissions or "inhalable particles" that are 10 microns (millionths of a meter) or less in diameter
$PM_{2..5}$	fine inhalable particles that are 2.5 microns and smaller
Port	Unified Port of San Diego (formerly San Diego Unified Port District, SDUPD)
ppm	parts per million
ppt	parts per thousand
PRISM	Program for Regional and International Shorebird Monitoring
PWC	personal watercraft
ROD	Record of Decision
RONS	Refuge Operating Needs System
RWQCB	Regional Water Quality Control Board
SANDAG	San Diego Association of Governments
SDUPD or Port	San Diego Unified Port District, now referred to as the Unified Port of San Diego
Service	U.S. Fish and Wildlife Service (also, USFWS)
SHPO	State Historic Preservation Office
SO_4	Sulfates
SOHO	Save Our Heritage Organization
SR 56	State Route 56
SSA	Special Study Area
State	California Department of Fish and Game
SUP	Special Use Permit
SWIA	Southwest Wetlands Interpretive Association
SWRCB	California State Water Resources Control Board
TACAN	instrument approach for NASNI
TBT	tributyltin
TEA-21	Transportation Enhancement Act for the 21st Century
THPO	Tribal Historic Preservation Officer
TOT	transit occupancy taxes
TRPH	total recoverable petroleum hydrocarbons
USC	United States Code
USDA	U.S. Department of Agriculture
USDA APHIS	U.S. Department of Agriculture, Animal Plant Health Inspection Service
USFWS	U.S. Department of the Interior, Fish and Wildlife Service (also, Service)
VFR	visual flight rules
VOC	volatile organic compounds

2. Glossary of Terms

Abiotic. The non-living parts of an ecosystem (e.g. light, temperature, water, oxygen, and other nutrients or gases).

Accessibility. The state or quality of being easily approached or entered, particularly as it relates to complying with the Americans With Disabilities Act.

Accumulation. The build-up of a chemical in an organism due to repeated exposure.

Adaptive Management. The rigorous application of management, research, and monitoring to gain information and experience necessary to assess and modify management activities. A process that uses feedback from refuge research and monitoring and evaluation of management actions to support or modify objectives and strategies at all planning levels. Analysis of results help managers determine whether current management should continue as is or whether it should be modified to achieve desired conditions.

Alluvial. Clay, silt, sand, gravel or other sedimentary matter transported and deposited in a delta or riverbed by flowing water.

Alternative. A reasonable way to fix an identified problem or satisfy a stated need, or a different set of objectives and strategies or means of achieving refuge purposes and goals, helping fulfill the refuge system mission, and resolving issues.

Approved Acquisition Boundary. A project boundary that the Director of the Service approves upon completion of the planning and environmental compliance process. An approved acquisition boundary only designates those lands which the Service has authority to acquire or manage through various agreements. The approval of an acquisition boundary does not grant the Service jurisdiction or control over lands within the boundary, and it does not make lands within the refuge boundary part of the National Wildlife Refuge System. Lands do not become part of the System until the Service buys them or they are placed under an agreement that provides for their management as part of the System.

Aquatic. Pertaining to water, in contrast to land.

Artifact. An object used or made by humans, usually in reference to projectile points, tools, utensils, art, food remains, and other products of human activity.

Benthic. Refers to organisms associated with the bottom of the ocean, bay, lake, or river.

Biodiversity (Biological Diversity). Refers to the full range of variability within and among biological communities, including genetic diversity, and the variety of living organisms, assemblages of living organisms, and biological processes. Diversity can be measured in terms of the number of different items (species, communities) and their relative abundance.

Biological Integrity. Biotic composition, structure, and functioning at the genetic, organism, and community levels consistent with natural conditions, including the natural biological processes that shape genomes, organisms, and communities.

Biota. The plant and animal life of a region.

Bivalve. Common term for pelecypods (members of Mollusca) in which the hard parts are composed of two sections fitting together to enclose a space that contains the soft part of the organism.

Categorical Exclusion. A category of actions that do not individually or cumulatively have a significant effect on the human environment and have been found to have no such effect in procedures adopted by a Federal agency pursuant to the National Environmental Policy Act.

Compatibility Determination. A written determination that a proposed or existing use of a National Wildlife Refuge is a compatible use or is not a compatible use.

Compatible Use. A proposed or existing wildlife-dependent recreational use or any other use of a National Wildlife Refuge that, based on sound professional judgment, will not materially interfere with or detract from the fulfillment of the National Wildlife Refuge System Mission or the purposes of the Refuge on which the use would occur.

Comprehensive Conservation Plan (CCP). A document that describes the desired future conditions of the refuge or planning unit and provides long-range guidance and management direction to achieve the purposes of the refuge, helps fulfill the mission of the Refuge System; maintains and, where appropriate, restores the ecological integrity of each refuge and the Refuge System; helps achieve the goals of the National Wilderness Preservation System; and meets other mandates.

C**oncern.** See issue.

Critical Habitat. According to U.S. Federal law, the ecosystems upon which endangered and threatened species depend.

Cultural Resource. The physical remains of human activity (artifacts, ruins, petroglyphs, etc.) and conceptual content or context of an area such as a traditional sacred site. It includes historically, archaeologically and architecturally significant resources.

Cultural Resource Inventory. A professionally conducted study designed to locate and evaluate evidence of cultural resources present within a defined geographic area. Inventories may involve various levels, including background literature search, comprehensive field examination to identify all exposed physical manifestations of cultural resources, or sample inventory to project site distribution and density over a larger area. Evaluation of identified cultural resources to determine eligibility for the National Register follows the criteria found in 36 CFR 60.4.

Cultural Resource Overview. A comprehensive document prepared for a field office that discusses, among other things, its prehistory and cultural history, the nature and extent of known cultural resources, previous research, management objectives, resource management conflicts or issues, and a general statement on how program objectives should be met and conflicts resolved.

Detritus. An accumulation of decomposing plant and animal remains.

Dioxin. A family of toxic chemicals, including polychlorinated biphenyls (PCBs), that all share a similar chemical structure and a common mechanism of toxic action. Dioxin levels in the environment have been declining; however, current exposures levels still remain a concern.

Disturbance. Significant alteration of habitat structure or composition. May be natural (e.g., fire) or human-caused events (e.g., aircraft overflight). Also see wildlife disturbance.

Easement. A privilege or right that is held by one person or other entity in land owned by another.

Ecological Integrity. The integration of biological integrity, natural biological diversity, and environmental health; the replication of natural conditions.

Ecoregion. A territory defined by a combination of biological, social, and geographic criteria, rather than geopolitical considerations; generally, a system of related, interconnected ecosystems.

Ecosystem. A dynamic and interrelating complex of plant and animal communities and their associated non-living environment.

Ecosystem Approach. Protecting or restoring the natural function (processes), structure (physical and biological patterns), and species composition of an ecosystem, recognizing that all components are interrelated.

Ecosystem Management. Management of natural resources using system-wide concepts to ensure that all plants and animals in ecosystems are maintained at viable levels in native habitats and basic ecosystem processes are perpetuated indefinitely.

Effect. A change in a resource, caused by a variety of events including project attributes acting on a resource attribute (direct), not directly acting on a resource attribute (indirect), another project attributes acting on a resource attribute (cumulative), and those caused by natural events (e.g., seasonal change).

Endangered Species (Federal). A plant or animal species listed under the Endangered Species Act that is in danger of extinction throughout all or a significant portion of its range.

Endangered Species (State). A plant or animal species in danger of becoming extinct or extirpated in California within the near future if factors contributing to its decline continue.

Environment. The sum total of all biological, chemical, and physical factors to which organisms are exposed; the surroundings of a plant or animal.

Environmental Assessment (EA). A concise public document, prepared in compliance with the National Environmental Policy Act, that briefly discusses the purpose and need for an action, alternatives to such action, and provides sufficient evidence and analysis of impacts to determine whether to prepare an Environmental Impact Statement or Finding of No Significant Impact.

Environmental Education. A process designed to develop a citizenry that has the awareness, concern, knowledge, attitudes, skills, motivation, and commitment to work toward solutions of current environmental problems and the prevention of new ones. Environmental education within the National Wildlife Refuge System incorporates materials, activities, programs, and products that address the citizen's course of study goals, the objectives of the refuge or unit, and the mission of the Refuge System.

Environmental Health. Abiotic composition, structure, and functioning of the environment consistent with natural conditions, including the natural abiotic processes that shape the environment.

Environmental Impact Statement (EIS). A detailed written statement required by Section 102(2)(C) of the National Environmental Policy Act, analyzing the environmental impacts of a proposed action, adverse effects of the project that cannot be avoided, alternative courses of action, short-term uses of the environment versus the maintenance and enhancement of long-term productivity, and any irreversible and irretrievable commitment of resources (40 CFR 1508.11).

Epibenthic. Pertaining to the environment and conditions of organisms living near the water bottom.

Estuarine. Deepwater tidal habitats and adjacent tidal wetlands that are usually partly enclosed by land but have some access to the open ocean and are diluted by freshwater.

Estuary. The wide lower course of a river into which the tides flow. The area where the tide meets a river current.

Euryhaline. Organisms that are tolerant of a wide range of salinity.

Exotic Species. Species that have been intentionally introduced to or have inadvertently infiltrated an area in which they are not natural found. Exotic species compete with native species for food or habitat.

Fallow. Allowing land that normally is used for crop production to lie idle.

Federal Trust Resources. A trust is something managed by one entity for another who holds the ownership. The Service holds in trust many natural resources for the people of the United States of America as a result of Federal acts and treaties. Examples are species listed under the Endangered Species Act, migratory birds protected by the Migratory Bird Treaty Act and other international treaties, and native plant or wildlife species found on the Refuge System.

Finding of No Significant Impact (FONSI). A document prepared in compliance with the National Environmental Policy Act, supported by an environmental assessment, that briefly presents why a Federal action will have no significant effect on the human environment and for which an environmental impact statement, therefore, will not be prepared (40 CFR 1508.13).

Floodplain. The relatively flat area along the sides of a river which is naturally subjected to flooding.

Fluvial. Pertaining to a river.

Flyway. A route taken by migratory birds between their breeding grounds and their wintering grounds. Four primary migration routes have been identified for birds breeding in North America: the Pacific, Central, Mississippi, and Atlantic Flyways.

Foraging. The act of feeding; another word for feeding.

Forb. A broad-leaved, herbaceous plant.

Fragmentation. The process of reducing the size and connectivity of habitat patches.

Gastropod. Any of a large class of mollusks, usually with a univalve shell or no shell and a distinct head bearing sensory organs, such as snails and slugs.

Goal. Descriptive, open-ended, and often broad statement of desired future conditions that conveys a purpose but does not define measurable units.

Habitat. Suite of existing environmental conditions required by an organism for survival and reproduction. The place where an organism typically lives.

Habitat Fragmentation. The breaking up of a specific habitat into smaller, unconnected areas.

Habitat Restoration. Management emphasis designed to move ecosystems to desired conditions and processes, and/or to healthy ecosystems.

Habitat Type. See Vegetation Type.

Hydrologic Regime. The local pattern and magnitude of water flow influenced by season.

Hydrology. The science dealing with the properties, distribution, and circulation of water on and below the earth's surface and in the atmosphere. The distribution and cycling of water in an area.

Impact. Refer to Effect.

Integrated Pest Management (IPM). Methods of managing undesirable species, such as weeds, including education; prevention, physical or mechanical methods or control; biological control; responsible chemical use; and cultural methods.

Interpretation. Interpretation can be an educational and recreational activity that is aimed at revealing relationships, examining systems, and exploring how the natural world and human activities are interconnected.

Intertidal Mudflat. Expanses of mud contiguous to a water body often covered and exposed by tides.

Invasive Species. Refer to Exotic Species.

Inversion. A state in which the temperature of the air increases with increasing altitude and keeps the surface air and pollutants down.

Invertebrate. Animals that do not have backbones. Included are insects, spiders, mollusks (clams, snails, etc.), and crustaceans (shrimp, crayfish, etc.).

Issue. Any unsettled matter that requires a management decision (e.g., a Service initiative, opportunity, resource management problem, a threat to the resources of the unit, conflict in uses, public concern, or the presence of an undesirable resource condition).

Landbird. A category of birds that obtains at least part of their food from the land and nest in mainland areas (though some can also be found on islands). Landbirds include raptors and songbirds among others.

Landform. The physical shape of the land reflecting geologic structure and processes of geomorphology that have sculpted the structure.

Landowner: A person or entity indicated as the owner of property on the various ownership maps maintained by the Office of the County Assessor.

Lease. A legal contract by which rights to use land or water are acquired for a specified period of time for a specified rent or compensation.

Levee. An embankment along the river or other body of water that retains water within the water body.

Macroinvertebrates. Invertebrates large enough to be seen with the naked eye (e.g., most aquatic insects, snails, and amphipods).

Management Alternative. A set of objectives and the strategies needed to accomplish each objective [FWS Manual 602 FW 1.4].

Management Concern. Refer to Issue.

Marsh. A periodically wet or continually flooded area where the water is shallow enough to allow the growth of emergent vegetation; a marsh can be influenced by freshwater, tides, or both.

Marsh Habitat. Habitat that is characterized by shallow water and emergent vegetation; unless otherwise specified, this term does not apply to similar habitat found in rivers, drains, or canals.

Migration. The seasonal movement from one area to another and back.

Migratory Bird. A bird that seasonally moves between geographic areas.

Mitigation. To avoid or minimize impacts of an action by limiting the degree or magnitude of the action; to rectify the impact by repairing, rehabilitating, or restoring the affected environment; to reduce or eliminate the impact by preservation and maintenance operations during the life of the action.

Model. A mathematical formula that expresses the actions and interactions of the elements of a system in such a manner that the system may be evaluated under any given set of conditions.

Monitoring. The process of collecting information to track changes of selected parameters over time. Monitoring is necessary to identify, track and analyze results of management actions at the Refuge so that future management actions may be adapted to obtain the best benefits to wildlife and habitat. See also Adaptive Management.

National Environmental Policy Act (NEPA). An act which encourages productive and enjoyable harmony between humans and their environment, to promote efforts that will prevent or eliminate damage to the environment and atmosphere, to stimulate the health and welfare of humans. The act also established the Council on Environmental Quality. The Act requires all agencies, including the Service, to examine the environmental impacts of their actions, incorporate environmental information, and use public participation in the planning and implementation of all actions. Federal agencies must integrate NEPA with other planning requirements, and prepare appropriate NEPA documents to facilitate better environmental decision making.

National Wildlife Refuge (Refuge or NWR). A designated area of land or water or an interest in land or water within the Refuge System, including National Wildlife Refuges, Wildlife Ranges, Wildlife Management Areas, Waterfowl Production Areas, and other areas (except Coordination Areas) under Service jurisdiction for the protection and conservation of fish and wildlife.

National Wildlife Refuge System. Various categories of areas administered by the Secretary of the Interior for the conservation of fish and wildlife, including species threatened with extinction; all lands, waters, and interests therein administered by the Secretary as wildlife refuges; areas for the protection and conservation of fish and wildlife that are threatened with extinction; wildlife ranges; games ranges; wildlife management areas; or waterfowl production areas.

National Wildlife Refuge System Improvement Act of 1997 (Public Law 105-57). Under the Refuge Improvement Act, the Service is required to develop 15-year Comprehensive Conservation Plans for all National Wildlife Refuges outside Alaska. The Act also describes the six public uses given priority status within the NWRS (i.e., hunting, fishing, wildlife observation, photography, environmental education, and interpretation).

National Wildlife Refuge System Mission. "The mission of the system 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."

Native Species. Species that normally live and thrive in a particular ecosystem.

Natural Recruitment. Plant establishment through natural processes.

Neotropical Migratory Birds. Migratory birds that breed in North American and winter in Central and South America.

No Action Alternative. An alternative under which existing management would be continued.

Notice of Intent (NOI). A notice that is published in the Federal Register announcing that an Environmental Impact Statement will be prepared and considered for a specific action.

Objective. An objective is a concise target statement of what will be achieved, how much will be achieved, when and where it will be achieved, and who is responsible for the work. Objectives are derived from goals and provide the basis for determining management strategies. Objectives should be attainable and time-specific and should be stated quantitatively to the extent possible. If objectives cannot be stated quantitatively, they may be stated qualitatively.

One-Hundred-Year Floodplain. The relatively flat portion of the river channel that has a one percent chance of being inundated by flood water in any given year.

Opportunities. Potential solutions to issues.

Ordinary High Water Mark. That line on the shore established by the fluctuations of water and indicated by physical characteristics such as clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas.

Outreach. Two-way communication between the Service and the public to establish mutual understanding, promote involvement, and influence attitudes and actions, with goal of improving joint stewardship of our natural resources.

Overbank Flooding. River flows that exceed the boundaries of the existing river channel and/or levees and flood adjacent areas.

Passerine Bird. A songbird or other perching bird that is in the order Passeriformes (blackbirds, crows, warblers, sparrows, and wrens for example).

Peak Flow. The maximum discharge of a stream or river during a specified period of time.

Perennial. In reference to a body of water, one that contains water year-to-year and that rarely goes dry.

Permeability. The property or capacity of porous rock, sediment, or soil to transmit water.

Personal Watercraft. Personal watercraft (PWC) are small vessels that use inboard motors to power water jet pumps. They are known by such trade names as Jet-ski, Waverunner, and Sea-Doo. Personal watercraft are high performance vessels, designed for speed.

Phenology. The life cycle of particular species.

Planning Area. The area upon which a planning effort is focused.

Planning Team. A team or group of persons working together to prepare a document. Planning teams are interdisciplinary in membership and function and generally consist of a planning team leader, refuge manager and staff biologists, a state natural resource agency representative, and other appropriate program specialists (e.g., social scientist, ecologist, recreation specialist).

Planning Unit or Unit. A single refuge, an ecologically or administratively related refuge complex, or distinct unit of a refuge. The planning unit also may include lands currently outside refuge boundaries.

Plant Association. A classification of plant communities based on the similarity in dominants of all layers of vascular species in a climax community.

Plant Community. An assemblage of plant species of a particular composition. The term can also be used in reference to a group of one or more populations of plants in a particular area at a particular point in time; the plant community of an area can change over time due to disturbance (e.g., fire) and succession.

Pollutant or Contaminant. Any introduced gas, liquid, or solid that makes a resource unfit for a specific purpose.

Polychaetes. Any of a class (Polychaeta) of chiefly marine annelid worms (such as clam worms), usually with paired segmental appendages, separate sexes, and a free-swimming trochophore larva.

Polychlorinated Biphenyls (PCBs). A mixture of individual chemicals which are no longer produced in the United States, but are still found in the environment.

Polycyclic Aromatic Hydrocarbons (PAHs). A group of over 100 different chemicals that are formed during the incomplete burning of coal, oil and gas, garbage, or other organic substances like tobacco or charbroiled meat. PAHs are usually found as a mixture containing two or more of these compounds, such as soot.

Population. All the members of a single species coexisting in one ecosystem at a given time.

Preferred Alternative. This is the alternative determined by the decision maker to best achieve the Refuge purpose, vision, and goals; contributes to the Refuge System mission, addresses the significant issues; and is consistent with principles of sound fish and wildlife management.

Prescribed Fire. The skillful application of fire to natural fuels under conditions of weather, fuel moisture, soil moisture, etc., that allows confinement of the fire to a predetermined area and produces the intensity of heat and rate of spread to accomplish planned benefits to one or more objectives of habitat management, wildlife management, or hazard reduction.

Prime Farmland. Farmland in an area or region that is considered to be the most ideal farmland based on several criteria; usually soil types and land productivity of the land are two of the most important criteria.

Priority Public Uses. Compatible wildlife-dependent recreation uses (hunting, fishing, wildlife observation and photography, and environmental education and interpretation).

Proposed Action. The Service's proposed action for Comprehensive conservation Plans.

Public. Individuals, organizations, and groups; officials of Federal, State, and local government agencies; Indian tribes; and foreign nations. It may include anyone outside the core planning team. It includes those who may or may not have indicated an interest in Service issues and those who do or do not realize that Service decisions may affect them.

Public Involvement. A process that offers impacted and interested individuals and organizations an opportunity to become informed about, and to express their opinions on Service actions and policies. In the process, these views are studied thoroughly and thoughtful consideration of public views is given in shaping decisions for refuge management.

Public Scoping: See Public Involvement.

Purpose(s) of the Refuge. The purpose of a refuge is specified in or derived from the law, proclamation, executive order, agreement, public land order, donation document, or administrative memorandum establishing, authorization, or expanding a refuge, refuge unit, or refuge subunit.

Raptor. A category of carnivorous birds, most of which have heavy, sharp beaks, strong talons, and take live prey (e.g., peregrine falcon, northern harrier). Also referred to as a bird of prey.

Record of Decision (ROD). A concise public record of decision prepared by the Federal agency, pursuant to NEPA, that contains a statement of the decision, identification of all alternatives considered, identification of the environmentally preferable alternative, a statement as to whether all practical means to avoid or minimize environmental harm from the alternative selected have been adopted (and if not, why they were not), and a summary of monitoring and enforcement where applicable for any mitigation.

Recruitment. The annual increase in a population as determined by the proportion of surviving offspring produced during a specific period (usually expressed per year).

Refuge Goal. Refer to Goal.

Refuge Operating Needs System (RONS). A national database that contains the unfunded operational needs of each refuge. The Service includes projects required to implement approved plans and meet goals, objectives, and legal mandates.

Refuge Purposes. Refer to Purposes of a Refuge.

Refuge Revenue Sharing Program. Provides payments to counties in lieu of taxes using revenues derived from the sale of products from refuges.

Refuge Use. Any activity on a refuge, except administrative or law enforcement activity carried out by or under the direction of an authorized service employee.

Refuge Vision. A succinct statement of the unit's purpose and reason for being.

Restoration. The return of an ecosystem to an approximation of its former unimpaired condition.

Revetment. A facing of stone, concrete, or other material placed on a riverbank to protect it from erosion.

Rhizomes. Rootlike stem growing horizontally below the surface. The rhizome is used for food storage and can produce roots and shoots.

Riparian. Refers to an area or habitat that is transitional from terrestrial to aquatic ecosystems; including streams, lakes wet areas, and adjacent plant communities and their associated soils which have free water at or near the surface; an area whose components are directly or indirectly attributed to the influence of water; of or relating to a river; specifically applied to ecology, “riparian” describes the land immediately adjoining and directly influenced by streams. For example, riparian vegetation includes any and all plant life growing on the land adjoining a stream and directly influenced by the stream.

Riparian Area. A transitional between terrestrial and aquatic ecosystems, distinguished by gradients in biophysical conditions, ecological processes, and biota; areas through which surface and subsurface hydrology connect waterbodies with their adjacent uplands.

Riparian Habitat. Gravel bars, sand dunes, non-vegetated riverbanks, herbaceous, scrub and forested vegetation, which provides habitat for plants, macro-invertebrates, fish and wildlife.

Riverine. Freshwater wetlands and deepwater habitats within a channel containing periodically or continuously moving water. It includes wetlands with primarily or mostly submerged vegetation but does not include those wetlands with mostly emergent vegetation or shrubs and trees. This habitat encompasses a river or stream, its channel, and the associated aquatic vegetation. Can also pertain to rivers and floodplains.

Seabird. A group of birds that obtain at least some food from the ocean by traveling some distance over its surface. They also typically breed on islands and along coastal areas. Seabirds include gulls, terns, pelicans, and cormorants, among others.

Sediment. Any material, carried in suspension by water, which ultimately settles to the bottom of water courses. Sediments may also settle on stream banks or flood plains during high water flow.

Shorebirds. Long-legged birds, also known as waders, belonging to the order Charadriiformes, which use shallow wetlands and mud flats for foraging and nesting.

Soil Erosion. The wearing away of the land's surface by water, wind, ice, or other physical process.

Songbirds. A category of birds that are medium to small, perching landbirds. Most are territorial singers and migratory. (Refer also to Passerines.)

Sound Professional Judgment. A finding, determination, or decision that is consistent with principles of sound fish and wildlife management and administration, available science and resources, and adherence to the requirements of the Refuge Administration Act of 1966 (16 U.S.C. 668dd-668ee), and other applicable laws. Included in the finding, determination, or decision is a refuge manager’s field experience and knowledge of the particular refuge’s resources.

Species. A distinctive kind of plant or animal having distinguishable characteristics, and that can interbreed and produce young. A category of biological classification.

Species Composition. A group of species that inhabit a specific habitat type in its healthy state.

Species Diversity. Usually synonymous with “species richness,” but may also include the proportional distribution of species.

Step-down Management Plan. A plan that provides specific guidance on management subjects (e.g., habitat, public use, fire, safety) or groups of related subjects. It describes strategies and implementation schedules for meeting CCP goals and objectives.

Strategy. A specific action, tool, or technique or combination of actions, tools, and techniques used to meet unit objectives.

Study Area. The area reviewed in detail for wildlife, habitat, and public use potential. For purposes of this CCP/EIS the study area includes the land and water within the approved Refuge boundary.

Sublittoral. Relating to or describing an organism living immediately below low-tide level.

Submergent Vegetation. Plants that grows completely submerged except when flowering.

Subsidence. Movement to a lower level or elevation.

Surface Water. A body of water that has its upper surface exposed to the atmosphere.

Terminus. In reference to a stream or river, its end point; where it flows into a lake or other basin.

Threatened Species (Federal). Species listed under the Endangered Species Act that are likely to become endangered within the foreseeable future throughout all or a significant portion of their range.

Tiering. The coverage of general matters in broader environmental impact statements with subsequent narrower statements of environmental analysis, incorporating by reference, the general discussions and concentrating on specific issues.

Trace Elements. Metallic elements generally occurring in trace amounts in water, including iron, manganese, copper, chromium, arsenic, mercury, and vanadium.

Turbidity. Cloudiness of a water body caused by suspended silt, mud, pollutants, or algae.

U.S. Fish and Wildlife Service Mission. "Working with others to conserve, protect, and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people.

Understory. Shrubs and herbaceous plants that typically grow beneath larger trees or shrubs.

Upland. An area where water normally does not collect and where water does not flow on an extended basis. Uplands are non-wetland areas.

Vegetation. The composition of plant species, their frequency of occurrence, density, and age classes at a specified scale.

Vegetation Community. Refer to Plant Community.

Vegetation Type or Habitat Type. A land classification system based upon the concept of distinct plant associations.

Waterfowl. A group of birds that include ducks, geese, and swans (belonging to the order Anseriformes).

Watershed. The entire land area that collects and drains water into a river or river system.

Wetland. Land that is transitional between upland (terrestrial) and aquatic systems (greater than about 6-feet deep) where the water table is usually at or near the surface or the land is covered by shallow water.

Wetland Habitat. Habitat provided by shallow or deep water (but less than 6-feet deep), with or without emergent and aquatic vegetation in wetlands. Wetland habitat only exists when and where a wetland or portion of a wetland is covered with water (visible surface water). Consequently, the size and shape of "wetland habitat" will fluctuate from season to season and year to ear while the size and shape of the "wetland" within which wetland habitat occurs will remain constant from season to season and from year to year.

Wildfire or Wildland Fire. A free-burning fire requiring a suppression response; all fire other than prescribed fire that occurs on wildlands.

Wildlife. All non-domesticated animal life; included are vertebrates and invertebrates.

Wildlife Corridor. A landscape feature that facilitates the biologically effective transport of animals between larger patches of habitat dedicated to conservation functions. Such corridors may facilitate several kinds of traffic, including frequent foraging movement, seasonal migration, or the once in a lifetime dispersal of juvenile animals. These are transition habitats and need not contain all the habitat elements required for long-term survival of reproduction of its migrants.

Wildlife-Dependent Recreational Use. "A use of a refuge involving hunting, fishing, wildlife observation and photography, or environmental education and interpretation." These are the six priority public uses of the Refuge System as established in the National Wildlife Refuge System Administration Act, as amended.

Appendix B

Distribution List

Appendix B: Distribution Lists

1. ***Distribution List for the Draft Comprehensive Conservation Plan/Environmental Impact Statement***

The following individuals, organizations, local businesses, Tribal governments, interested media, public agencies, and elected officials received notice of the availability of the San Diego Bay National Wildlife Refuge (Sweetwater Marsh and South San Diego Bay Units) Draft Comprehensive Conservation Plan/Environmental Impact Statement (CCP/EIS).

Individuals

Acheatel, David
Adams, Duane
Adams, Lissa
Adler, Gerrold
Aguila, Gabriela
Aguilar, Maricela
Aguirre, Barbara
Alfaro, Monica
Allds, Richard
Almanza, Lindsay
Amador, Luz
Anderson, Barbara
Anderson, John
Ansley, Wayne
Armour, Mike
Arzola, Raul
Ayala, Leticia
Backal, Jack
Baclagan, Cynthia
Baird, Terry
Ball, Alan
Ballis, Douglas
Barienbrock, Gordon
Barlow, Michelle
Barmann, Mark & Jan
Barnes, Bruce
Barnes, Lynnette
Barnum, PhD Douglas
Barrows, Karen
Barsz, Bill
Bartell, Richard
Batze, Bonnie
Baumgardner, John
Beam, Craig
Beck, Michael
Beckwith, Diane
Beh, Richard
Bernache, Brenda
Bertsch, Dr. Hans
Biddlecome, Kelly M.
Biggart, Neal
Bitterling, Andrea
Bittner, Dave
Boland, John
Bonamassa, Lois
Borrelli, Rosie
Borzik, Joette
Bourne, Helen
Bowlby, Eric
Bowling, Dennis
Boyer, David
Boze, Bob & Sheryl
Brady, Kristine
Bragg, Lorie
Bransford, Jack
Breslauer, Ann
Brienza, David
Brienza, Ralph
Bruce, Arlette
Buffett, Brad
Bulizak, Rose
Burkhart, Brad
Burleson, Charlene
Burns, Jim
Burrascano, Cindy
Butler, Liza
Butts, Nancy
Byington, Cindy
Cagle, Fred
Camozzi, Josie
Campbell, Leon
Canedo, Karina
Cantrell, Patricia
Capper, Carol Ann
Cardenas, Josefina
Carey, Debra
Carpenter, Raymond
Carson, Susan & Webb
Carvajal, Joseph
Casady, Derek & Nancy
Case, Ted J.
Cassedy, Marilyn & Tim
Cassidy, Nancy
Cavanaugh, Jim
Cave, Mrs. Judith
Celso, Juanito
Cerda, Irma
Chacez, Lisa
Charvet, Jan
Chase, C.D.
Cherney, Dan
Chesser, Tammy
Christian, Maria
Christianson, Jack
Christopherson, I. M.
Clark, Maxine
Cline, C.
Cline, Sandra
Clopp, David
Coatsworth, Jim
Collins, Asa
Collins, Dr. Charles
Collins, Dr. Tom
Conrad, Jim
Cook, Shirley

Cooke, Patti
Copelan, Jerome
Copper, Elizabeth
Correnti, Ruth
Cousino, Don
Cowling III, William
Cox Cheryl
Crabb David
Cramer, Cynthia
Crane, Jeane
Cronk, Jim
Crooks, Jeff
Crouch, Laura
Cruz, Arnie
Cuevas, Claudia
Curran, Gloria
Dale, Jenica
Dang, Emily
Daugherty, Jim & Linda
Davenport, Robert E.
Davis, Bill & Shannon
De Anda, Jr. Alfonso
Dederick, Art
Dedinsky, David
DeLaurier, A. Chris
Demarco, Darcy
Dennison, Melissa
Dibello-Hitta, Erica
Dickerhoff, Wendy
Dickey, Wayne
Dodero, Mark
Domingo, Maricar
Donnelley, John
Donovan, Christine
Dorr, Bill
Dougherty, Cher
Dowell, Jeff
Draper, Sandra
Driscoll III, J. Gerald
Driscoll, Joyce
Driscoll, Thomas
Dua, Arti
Dudley, Joan
Dudley, Marilyn
Dumka, Gabrielle & Will
Durazo, Laura
Eastman, Joel
Edwards, Claude
Edwards, Willard
Ehrlich, Shara
Eichenlaub Jr., Carl
Ekker, Tracey
Ellis, Joseph M.
Emerson, Lawrence
Engebretson, Pam
Esparza, Fred
Eva, Tania
Evans, Joyce
Evans, Michael U.
Fagan, Kathleen
Farrington, Kurt & Jacki
Fat, Thomas
Field, Marilyn
Fiore, David
Fisctton, Michael
Fisher, Dr. Robert
Fisher, Robert A.
Flom, Beryl
Flores II, Rodolfo D
Flores, Kevin
Ford, Richard
Fowler, Russell
Franks, Dr. Peter
Fraser, David
Freedman, Michael
Friedman, Jo
Fuller, Susan
Furnya, Lyn
Gabara, Stanley
Gaetzman, Anna
Gailband, Charles
Galang, Daphne
Gallegan, Andrea
Gallo, Paul
Galvaw, Natalie
Ganster, Dr. Paul
Gates, James
Gaylord, Tom
Ghio, Richard
Gilgun, Lynda
Gill, Betsy
Ginter, Kyle & Joann
Gledhill, Fred
Godshalk, Ted & Margaret
Goethe, Wayne
Goldman, Gayle
Gomez, David
Good, Deborah
Goodrich, Roberta
Gormican, Sue
Grace, Don
Griffith, Theodore
Guerry, Melyssa
Guilmette, Judy
Gutierrz, Allison
Haas, Jeremy
Hakes, William & Joanne
Hall, Frances
Hallman, Lynn
Hanna, Gail
Hanson, Bruce
Harmon, Wayne
Harshberger, Linda
Harvey, Kent
Hatfield, Al
Hemmingsen, Barbara
Henderson, Teresa
Herdt, Herman & Greida
Hernandez, Adam
Hernandez, Augustine
Hernandez, Cinthia
Hess, Carleen
Hewitt, Cliff
Hills, Richard
Hinton, Mel
Hirako, Sharon
Hirsch, Robert
Hoadley, Janna
Hodgson, Patricia
Hoffman, Connie
Holley, John
Hope, Charles
Horn, Ph.D. Michael H.
Huffman, Patricia
Hughes, Howard
Hugill, William
Ikegaya, Yaz
Inman, Sheila
Inzunza, Gilbert
Isaacs, Pamela
Jackson, Wanda
Jacoby, JoEllen
Javor, Barbara
Jenicks, Clinton
Jeter, Vicky
Jimenez, Lupita
Johnson, Deborah
Johnson, Elizabeth
Johnson, William
Johnston, Jan
Jones, Marilyn
Josephson, Gary
Jungman, Bob

Kaupp, Stephanie
Kay, Isabelle
Kellogg, Elizabeth
Kelly, James
Kelpin, Paul
Ketchum, R. Kevin
Kilpatrick, R.
Klein, Michael
Klovstad, Ann
Knight, Debarah
Knight, John
Koehler, Terry
Kraft, Mark & Vicki
Kravitz, Ed
Kriet, Paul & Shirley
Kuck, Beverly
Kuger, Christine
Lacy, Gordon & Ruth
Lalas, John
Lamb, David
Landess, Stan
Lara, Joe
Law, Mony
Ledinsky, David
Lehnert, Pat
Leising, Adam
Lelie, Herman & David
Lemmo, John
Leonardini, T. & K.
Leslie, Eric
Leslie, Gilda & James
Levin, Dr. Lisa
Lindquist, Mike
Lineham, Marsha & Bob
Lissner, Andrew
Littleton, Phyllis
Lockhart, Sharon
Loftin, Martin
Logsdon, William
Lorenzen, Fred
Loustalet, George
Lowery, Tony
Lubach, C.
Lynch, Reve
Lyons, Mik
Maas, Phyllis
Macias, Luis
Mack, Callie
Maffei, Wes
Malley, Tom
Mandel, Mark
Mangan, Michele
Mangum, Stephen
Marogy, Danny
Marquez, Viviane
Martel, Lynn
Martinez, Claudia
Martinez, Manuel
Martinez, Melanie
Matticola, Phil
Matto, Elizabeth
Maudsley, Clare H.
Mautino, John
Mazur, Zeke
Mazzola, Mary Ellen
Mazzoni, Joe
Mcafee, Allen
McClelland, David
McColl, Anne
McCoy, Mike
McDonald, Robert
McIntosh, Judy
McKirnan, Dan
McMaster, Tim
Meade, Jane & Pike
Mendez, Tanya
Merkel, Keith
Michitzie, Rita
Miller, Jr. James
Mock, Dr. Patrick
Moe, Dami
Moe, Frank & Rhonda
Molino, M & Elena
Molloy, Marie
Monroe, Dana
Monroe, Phil
Monsees, Edith Helen
Moon, Owen
Moore, Dorean & Donald
Morgan, Jack
Morris, Paul
Mosczwski, Steven
Mosher, Mary
Moss, Marsha & Bob L.
Movido, Jennifer
Moya, Maria
Mueller, Antoinette
Muir, Marquerite
Mulligan, Jill
Munguia, Leticia
Munoz, Olivia
Mutnick, Amanda Holley
Navarette, Henry
Neilsen, Tom
Nelson, Harry
Nelson, Larry & Gail
Nemo, William
Nerz, Mathew
Nicholas, Peter
Nichols, Jean
Nichols, Wallace
Nielsen, Thomas
Norberg, Robert
Nordby, Chris
North, Susan
Nunez, Antonio
Odermatt, Mary
Opdycke, Jeff
Opel, Don
O'Rourke, Ruth
Ortiz, Luzette
Osterberg, Brian
Owen, Wayne
Palencia, Raejean
Palomino, Luz
Panos, Harry
Pappas, Tammy
Paris, Heidi
Parker, Holly
Parr, Terry
Parystone, Stevan
Patel, Hemant
Patton, Robert
Pentis, Al & Mary Anne
Pepper, David
Perez, Rocio
Perez, Alberto
Peters, Clarke
Petitt, Terrance
Pettit, Josephine
Peugh, Allen
Peugh, Jim & Barbara
Phillips, Mike
Phipps, Louise
Piagentini, Dario
Picha, Lennis
Pickey, Wayne
Pierce, Nuri
Pierpoint, William
Plant, Edward
Player, Shannon
Potter, Cathy
Powers, Carolyn

Price, Megan
Pryde, Dr. Philip
Puentes, Cesar
Pulver, Sarita
Purnell, Lorraine
Quick, Terri
Radinovsky, Syd/Kathy
Ramirez, Elias
Ramshursa, Jimmy
Ratigan, Dr. Diane
Rees, Jim
Reynolds, Nick & Leslie
Rheaume, Christine
Richard, Lucille
Rippel, Tasi
Robby, Lister
Roberts, Bes
Roberts, Gail
Robertson, Keith
Robertson, Kenneth
Robey, Steve
Rocha, Rebecca
Rodriguez, Eliz./Rosa
Rodriguez, Sandra
Roe, Bill and Laura
Rogers, William
Rolfe, Allison
Romero, Connie
Roppe, Bea
Rosser, Anne
Roullard, Phil
Rowe, Reid
Ryan, Jon
Ryno, Marian
Sackett, Richard
Sanchez, Frank
Sandoval, Rafael Bahena
Sands, Jim
Sannicolas, Mecaila
Sansone, Larry
Santos, Ramon
Sarmiento, Mary & Steve
Sarvis, Laura
Sau, Luis
Scheid, Betty J
Scheidt, Vince
Schmersal, Walter
Schmidt, Brigitte
Schneider, Carrie
Schroeter, Steve
Schulenberg, Judy
Schulman, Melvyn
Scott, Doug
Scruggs, Jennifer
Seay, David"
Severns, Ken
Shaw, Marlene & Walter
Shenk, Art
Shepard, Joyce
Sherman, Craig
Sherman, Fred
Shirely, Ellen
Shively, Sandra
Sides, James
Sierra, Arsenio
Silliman, Ann
Simmons, Skeet
Simpson, Victoria
Slahuddin, A. & N.
Sloane, Florence
Smith, David
Smith, Gene
Smith, Rodney
Smith, Susan
Smith, Teri
Smothers, Ph.D. D'erdra
Solis, Rolando & Linda
Somers, Don
Somerville, Jan
Spencer, Ms. Glen
Sproul, Fred
Stand, Todd
Stanton, Linda
Stearns, Myra
Steinhoff, Gean
Stevens, Janet
Steward, Dan
Stewart, Gail
Stewart, Lorin
Stickel, Tracy
Stinson, Margie
Strickland, Carl
Swanson Jr., Robert
Sweeney, Marjorie
Swift, Mitzi
Sylvester-Gallo, Alice
Syrjala, Edward S.
Taliaferro, Frank
Tange, Lora
Tapia, Esther
Taubbitiz, Fredericka
Taylor, Donald
Taylor, Harriet
Terrazas, Octavio
Terrones, Victor
Thomas, Teresa
Thorbjarnarson, Kathryn
Tierney, Ryan
Tindall, Russell
Tirado, Victor
Torbett, Glenn
Torres, Roy
Treppa, Ray
Trusty, Wendy
Tunstall, Bill
Turner, Brian
Uybungco, Ginny
Van Inwegen, Earl
Vaught, Brent
Verbanal, Steve
Verdugo, Carmen
Victoria, Lorena
Vitalich, Nicholas
Vlassoff, Lt.
Vonnordheim, Randy
Wadham, Robert/Cecile
Wages, Kent
Wagner, Pat
Waldrop, Kathy
Wall, Ariadna
Walters, Courtney
Wasserman, Amalia
Watry, Peter
Watson, Becky
Webb, Keith
Weinberg, Jon
Welch, Shirley
West, Carl
Widmann, Sabina
Wilks Iii, John E.
Willet, John
Williams, Georgetta
Wilson, Deborah
Wilson, Lee
Winter, Mayda
Wolf, Joy
Wolf, Shaura
Wollitz, Bruce
Wu, Julian
Ymzon, Randy
Yoder, Inez
Young, Arnold
Young, Herb

Young, R. & G.
Youngberg, Martha
Zamisch, Art & Jan
Zanoni, Richard
Zeljecnjak, Marilyn
Zembal, Dick
Zetwo, Michelle
Ziegler, Dean
Zitlally, Reta
Zschiesche, Peter

Local Libraries

Chula Vista Public Libraries
- Civic Center Branch
- South Chula Vista Branch

Coronado Public Library
Imperial Beach Library
National City Library
City of San Diego Public Libraries
- Central Library, Gary Klockenga, Government Publications Librarian
- Logan Heights Branch Library
- Otay Mesa Branch Library
- Paradise Hills Branch Library

Organizations

American Tunaboat Association
Animal Protection Institute (C. Papouchis)
Aqua Adventures, Kayak Center
ATSF Railway
Buena Vista Audubon
Burlington Northern Santa Fe
Cabrillo Isle Marina LLC
California Native Plant Society
California Waterfowl Association
California Yacht Marina
Camp Surf
Center for Biological Diversity
Center for Conservation Strategies
Charles Company
Chula Vista Chamber of Commerce
Chula Vista Nature Center
Citizens Coordinate for Century 3
Congressional Sportsmen's Foundation
Conservation Biology Institute
Cooperative Alliance for Refuge Enhancement
Coronado Cays Home Owners Association
Coronado Chamber of Commerce
Crest/Dehesa/Harbison Canyon
Crossroads II
Defenders of Wildlife
Downtown San Diego Partnership
Ducks Unlimited Inc.
Duke Energy North America
Eagle Survey Project
Endangered Habitats League
Environmental Health Coalition
Environmental Advocates
Environmental Committee of Tijuana - S.D. Region
Environmental Warriors
Fiddler's Cove Marina
Friends of South Bay Wildlife
Glorietta Bay Marina
Habitat Mitigation Committee
Hornblower Dining Yachts
Horned Lizard Conservation Society
Imperial Beach Chamber of Commerce
Kelco Company
La Playa Yacht Club
League for Coastal Protection
Luce, Forward, Hamilton, & Scripps
Manchester Resorts LP
Mariner's Point
Maritime Museum Association of San Diego
Mission Bay Paddle Sports
National Audubon Society
National City Chamber of Commerce
National Fish and Wildlife Foundation
National Wildlife Federation, Western
Natural Resources Center
National Wildlife Refuge Association
Navy Sailing Center
Ocean Research International
Otay Mesa/Nestor Planning Group
Otay Valley Regional Park Committee
Outboard Boating Club of San Diego
Pacific Bell
Palomar Audubon

Point Reyes Bird Observatory
Port Coronado Association
Procopio, Cary, Hargreaves, & Savitch
San Diego Archaeological Society
San Diego Association of Realtors
San Diego Association of Yacht Clubs
San Diego Audubon Society
San Diego Bay Committee
San Diego Baykeeper
San Diego Chamber of Commerce
San Diego Council of Divers, Inc.
San Diego County Farm Bureau
San Diego County Fish and Game Association
San Diego County Fish and Wildlife Advisory Commission
San Diego Harbor Excursion
San Diego Herp Society
San Diego Jet Sports Club
San Diego League of Women Voters
San Diego Natural History Museum
San Diego Oceans Foundation
San Diego Personal Watercraft Association
San Diego Railway Partnership
San Diego River Park Foundation
San Diego Yacht Club
Save Our Bay Inc.
SDG&E, Public Affairs
Sheppard, Mullin, Richter, & Hampton LLP
Sierra Club, San Diego Chapter
South Bay Area Focus Team
South Bay Boat Yard
South Bay Salt Works
Southwestern Wetlands Interpretive Association
Southwestern College Sailing
Southwestern Yacht Club
Sportfishing Association of California
Surfrider Foundation, San Diego Chapter
Sweetwater Planning Group
The Nature Conservancy
The Wilderness Society
TRVEA
United Sportsfishers of San Diego
WHSRN Manomet Center for Conservation Sciences
Wild Coast
Wildlife Management Institute

Media

Eagle Newspapers
Imperial Beach Eagle & Times
San Diego Business Journal
San Diego Daily Transcript
San Diego Log
San Diego Union-Tribune
Star News

City Governments

City of Chula Vista, Mayor and City Council
City of Chula Vista, City Manager
City of Chula Vista, Director, Community Development
City of Chula Vista, Planning Director
City of Chula Vista, Police Department
City of Chula Vista, Redevelopment Projects Manager
City of Coronado, Mayor and City Council
City of Coronado, City Manager
City of Coronado, Director of Community Development
City of Imperial Beach, Mayor and City Council
City of Imperial Beach, City Manager
City of Imperial Beach, Community Development Director
City of Imperial Beach, Public Works Director
City of Imperial Beach, Planning Department
City of National City, Mayor and City Council
City of National City, City Manager
City of National City, Community Development
City of National City, Planning Director
City of San Diego, Mayor and City Council

City of San Diego, City Manager
City of San Diego, Community Planning
City of San Diego, Engineering and Capital Projects
City of San Diego, Environmental Services
City of San Diego, Metropolitan Wastewater
City of San Diego, Multiple Species Conservation Planning
City of San Diego, Park and Recreation Department
City of San Diego, Police Department
City of San Diego, Real Estate Assets Department

County Government
San Diego County Supervisor Greg Cox
San Diego County Supervisor Dianne Jacob
San Diego County Supervisor Ron Roberts
County of San Diego, Real Property Division
County of San Diego, Environmental Health Services
County of San Diego, Parks and Recreation Department
County of San Diego, Department of Planning and Land Use
County of San Diego, Department of Public Works

Other Local Agencies
California American Water Company
Center City Development Corporation - Public Works Department
Harbor Patrol, Dave Hall, Chief of Harbor Police
International Border Water Commission
Metropolitan Transit Development Board (MTDB)
Otay Water District
San Diego County Airport Authority
San Diego Association of Governments (SANDAG)
South Bay Irrigation District
Sweetwater Authority
Tijuana Valley Company Water District
Unified Port of San Diego

California State Agencies
Cal EPA
California Coastal Commission, Executive Director, Peter Douglas
California Coastal Commission, Federal Consistency, James Raives
California Coastal Commission, San Diego Coast District
California Coastal Conservancy
California Department of Forestry
California Fish and Game Commission
California State Parks, State Historic Preservation Officer
California State Parks, Superintendent, Ronilee Clark
Caltrans, District 11
Department of Boating and Waterways, Director, Raynor T. Tsuneyoshi
Department of Conservation
Department of Fish and Game, Director, Ryan Broddrick
Department of Fish and Game, Marilyn Fluharty
Department of Fish and Game, South Coast Regional Manager, Charles Raysbrook

Resources Agency, Secretary, Mike Chrisman
San Diego Regional Water Quality Control Board, Region 9, Executive Officer, John Robertus
San Diego Regional Water Quality Control Board, Region 9, Pete Michael
State Lands Commission, Executive Officer, Paul Thayer
State Water Resources Control Board, Arthur G. Baggett Jr., Chair
Wetlands Recovery Project
Wildlife Conservation Board

Tribal Governments
Barona Band of Mission Indians
Campo Band of Mission Indians
Cuyapaipe Community of Diegueno Mission Indians
Inaja Band of Mission Indians
Jamul Indian Village
La Jolla Band of Luiseno Indians
La Posta Band of Mission Indians
Los Coyotes Reservation
Manzanita Tribe of Kumeyaay Indians
Mesa Grande Band of Indians
Pala Band of Mission Indians
Pauma Band of Mission Indians
Rincon Indian Reservation
San Pasqual Band of Indians
Santa Ysabel Indian Reservation
Sycuan Band of Indians
Viejas Reservation
Carmen Lucas
Jim Velasques
Kumeyaay Cult. Repatriation Committee
Kumeyaay Cultural Heritage Preservation
Kumeyaay Cultural Historic Committee

Federal Agencies & Offices
EIS Filing Section US Environmental Protection Agency, Office of Federal Activities
FAA - ARPT DIV AWP-600
National Interagency Fire Center
NOAA Marine Fisheries, Bob Hoffman
U.S. Army, Corps of Engineers
U.S. Border Patrol, San Diego Sector
U.S. Coast Guard, Marine Safety Office
U.S. Coast Guard, Port Operations
U.S. Department of the Interior, Office of Environmental Policy and Compliance, Phyllis Davis
U.S. Department of Transportation, Federal Highway Administration
U.S. Environmental Protection Agency, Paul Michael
U.S. Environmental Protection Agency, Region 9
U.S. Geological Survey
U.S. Navy, Naval Facilities Engineering Command
U.S. Navy, Southwest Division, NAVFAC, Natural Resources Department, Mitch Perdue
U.S. Navy, Southwest Division, NAVFAC, Natural Resources Department, Tamara Conkle
USDA, APHIS, Wildlife Services, District Supervisor, John Turman
USDA, Natural Resource Conservation District of Greater San Diego County

USFWS

- Bellantoni, Liz, USFWS, Chief, Planning and Policy
- Bohan, Carolyn, USFWS, National Wildlife Refuge System
- Bortner, Brad, USFWS, Migratory Birds & Habitat Programs
- Concannon, Julie, USFWS, Region 1, NEPA Coordinator
- Drescher, Dave, USFWS, Region 1, Refuge Planning-Cartography/GIS
- Fuller, Nell, USFWS, Region 1, Refuge Support, Policy
- Hadley, Richard, USFWS, CNO, Assistant Refuge Supervisor
- Harrison, Ben, USFWS, Region 1, Land Protection Planning
- Harrison, Jean, USFWS, Region 1, Division of Visitor Services
- Houghten, Chuck, USFWS, Division of Refuge Planning
- Kier-Haggenjos, Kay, USFWS, Region 1, Division of Refuge Planning
- Kilbride, Kevin USFWS Refuge Biology
- Kolar, Marge, USFWS, Assistant Manager of Refuges
- Marxen, Mike, USFWS, Region 1, Division of Refuge Planning
- McAdams, Amanda, USFWS, Fire Planner
- Moore, Stephen USFWS, Region 1, Refuge Operations Support
- Paveglio, Fred USFWS, Refuge Biology
- Pavusko, Gary, USFWS, CNO, Fire Management Officer
- Pelz, Mark USFWS CA/NV Refuge Planning
- Rauch, Paul, USFWS, Engineering
- Raymond, Anan, USFWS, Region 1, Cultural Resources Team
- Saul, Susan, USFWS, External Affairs Office
- Shaffer, Robert, USFWS, Joint Venture Coordinator
- Sheppard, Cathy, USFWS, Region 1, Division of Realty
- Smiley, Tom, USFWS, Engineering
- Sobiech, Scott USFWS, Contaminants
- Speulda, Lou Ann, USFWS, Cultural Resources Branch
- Thompson, Steve, USFWS, Manager
- Walsworth, Dan, USFWS, Refuge Supervisor
- Zimmerman, Tara, USFWS, Migratory Birds & Habitat Programs

U.S. Congress

Honorable Barbara Boxer, U.S. Senate
Honorable Dianne Feinstein, U.S. Senate
Congresswoman Susan Davis, 53th District
Congressman Bob Filner, 51th District

California State Legislature

Governor Arnold Schwarzenegger
Lieutenant Governor Cruz Bustamante
State Senator Dede Alpert, 39th District
State Assemblyman Juan Vargas, 79th District
State Assemblywoman Christine Kehoe, 76th District
State Assemblywoman Shirley Horton, 78th District

2. *Distribution List for the Final Comprehensive Conservation Plan/Environmental Impact Statement*

The individuals, organizations, local businesses, Tribal governments, interested media, public agencies, and elected officials listed above as receiving notification of the draft CCP/EIS also received notice of the availability of the Final CCP/EIS unless they were subsequently removed from the distribution list at their request or because the Post Office was unable to deliver a notice to the address of record. The following additional individuals and other interested parties received notice of the availability of the Final CCP/EIS.

California State Legislature
State Senator Christine Kehoe, 39th District
State Assemblywoman Lori Saldana, 76th District

Organizations
Johnson & Hanson LLP

Individuals
Brian Foster
Kirsten Winter
Guy McCaskie
Therese Clawson
Kenneth Weaver
Susan Yamagata
Jack Daynes
Nils Warnock
Theresa Jancek
B. Sachau

The following libraries were provided with a complete set of the Final CCP/EIS:

Chula Vista Public Libraries
- Civic Center Branch
- South Chula Vista Branch

Coronado Public Library
Imperial Beach Library
National City Library
City of San Diego Public Libraries
- Central Library, Gary Klockenga, Government Publications Librarian
- Otay Mesa Branch Library

Appendix C

Bird Species Lists

Appendix C: Bird Species Lists

The following lists include bird species that have been observed at least once on the specified Refuge Unit. The birds' common and scientific names are provided in accordance with the 7th edition (1998) of the A. O. U. Checklist of North American Birds. (* Indicates bird species known to nest on the refuge.)

Sweetwater Marsh Unit

Common Name	Scientific Name
Red-throated Loon	*Gavia stellata*
Pacific Loon	*Gavia pacifica*
Common Loon	*Gavia immer*
Pied-billed Grebe	*Podilymbus podiceps*
Horned Grebe	*Podiceps auritus*
Eared Grebe	*Podiceps nigricollis*
Western Grebe	*Aechmophorus occidentalis*
Clark’s Grebe	*Aechmophorus clarkii*
American White Pelican	*Pelecanus erythrorhynchos*
Brown Pelican	*Pelecanus occidentalis*
Double-crested Cormorant	*Phalacrocorax auritus*
Pelagic Cormorant	*Phalacrocorax pelagicus*
Great Blue Heron	*Ardea herodias*
Great Egret	*Ardea alba*
Snowy Egret	*Egretta thula*
Little Blue Heron	*Egretta caerulea*
Tricolored Heron	*Egretta tricolor*
Reddish Egret	*Egretta rufescens*
Green Heron	*Butorides virescens*
Black-crowned Night Heron	*Nycticorax nycticorax*
White-faced Ibis	*Plegadis chihi*
Turkey Vulture	*Cathartes aura*
Snow Goose	*Chen caerulescens*
Ross's Goose	*Chen rossii*
Canada Goose	*Branta Canadensis*
Brant	*Branta bernicla*
Gadwall	*Anas strepera*
Eurasian Wigeon	*Anas penelope*
American Wigeon	*Anas americana*
Mallard	*Anas platyrhynchos*
Blue-winged Teal	*Anas discors*
Cinnamon Teal	*Anas cyanoptera*
Northern Shoveler	*Anas clypeata*
Northern Pintail	*Anas acute*
Green-winged Teal	*Anas crecca*
Canvasback	*Aythya valisineria*
Redhead	*Aythya americana*

Ring-necked Duck	*Aythya collaris*
Greater Scaup	*Aythya marila*
Lesser Scaup	*Aythya affinis*
Surf Scoter	*Melanitta perspicillata*
White-winged Scoter	*Melanitta fusca*
Black Scoter	*Melanitta nigra*
Long-tailed Duck	*Clangula hyemalis*
Bufflehead	*Bucephala albeola*
Common Goldeneye	*Bucephala clangula*
Hooded Merganser	*Lophodytes cucullatus*
Red-breasted Merganser	*Mergus serrator*
Ruddy Duck	*Oxyura jamaicensis*
Osprey	*Pandion haliaetus*
White-tailed Kite	*Elanus leucurus*
Bald Eagle	*Haliaeetus leucocephalus*
Northern Harrier	*Circus cyaneus*
Sharp-shinned Hawk	*Accipiter striatus*
Cooper's Hawk	*Accipiter cooperii*
Red-shouldered Hawk	*Buteo lineatus*
Swainson's Hawk	*Buteo swainsoni*
Red-tailed Hawk	*Buteo jamaicensis*
Ferruginous Hawk	*Buteo regalis*
Golden Eagle	*Aquila chrysaetos*
Crested Caracara	*Caracara cheriway*
American Kestrel*	*Falco sparverius*
Merlin	*Falco columbarius*
Peregrine Falcon	*Falco peregrinus*
Prairie Falcon	*Falco mexicanus*
California Quail	*Callipepla californica*
Light-footed Clapper Rail*	*Rallus longirostris levipes*
Virginia Rail	*Rallus limicola*
Sora	*Porzana Carolina*
Common Moorhen	*Gallinula chloropus*
American Coot	*Fulica americana*
Black-bellied Plover	*Pluvialis squatarola*
Pacific-golden Plover	*Pluvialis fulva*
Western Snowy Plover*	*Charadrius alexandrinus nivosus*
Semipalmated Plover	*Charadrius semipalmatus*
Killdeer*	*Charadrius vociferous*
Mountain Plover	*Charadrius montanus*
Black-necked Stilt	*Himantopus mexicanus*
American Avocet	*Recurvirostra americana*
Greater Yellowlegs	*Tringa melanoleuca*
Willet	*Tringa semipalmatus*
Lesser Yellowlegs	*Tringa flavipes*
Spotted Sandpiper	*Actitis macularia*
Whimbrel	*Numenius phaeopus*
Long-billed Curlew	*Numenius americanus*
Marbled Godwit	*Limosa fedoa*

Ruddy Turnstone	*Arenaria interpres*
Black Turnstone	*Arenaria melanocephala*
Surfbird	*Aphriza virgata*
Red Knot	Calidris canutus
Sanderling	*Calidris alba*
Semipalmated Sandpiper	*Calidris pusilla*
Western Sandpiper	*Calidris mauri*
Least Sandpiper	*Calidris minutilla*
Dunlin	*Calidris alpine*
Stilt Sandpiper	*Calidris himantopus*
Ruff	*Philomachus pugnax*
Short-billed Dowitcher	*Limnodromus griseus*
Long-billed Dowitcher	*Limnodromus scolopaceus*
Common Snipe	*Gallinago gallinago*
Wilson's Phalarope	*Phalaropus tricolor*
Red-necked Phalarope	*Phalaropus lobatus*
Parasitic Jaeger	*Stercorarius parasiticus*
Franklin's Gull	*Larus pipixcan*
Bonaparte's Gull	*Larus philadelphia*
Heermann's Gull	*Larus heermanni*
Mew Gull	*Larus canus*
Ring-billed Gull	*Larus delawarensis*
California Gull	*Larus californicus*
Herring Gull	*Larus argentatus*
Thayer's Gull	*Larus thayeri*
Western Gull	*Larus occidentalis*
Glaucous-winged Gull	*Larus glaucescens*
Black Skimmer	*Rynchops niger*
California Least Tern*	*Sternula antillarum*
Gull-billed Tern	*Gelochelidon nilotica*
Caspian Tern	*Hydroprogne caspia*
Forster's Tern*	*Sterna forsteri*
Royal Tern	*Thalasseus maximus*
Elegant Tern	*Thalasseus elegans*
Rock Dove	*Columba livia*
Mourning Dove*	*Zenaida macroura*
Greater Roadrunner	*Geococcyx californianus*
Barn Owl	*Tyto alba*
Great Horned Owl	*Bubo virginianus*
Burrowing Owl*	*Athene cunicularia*
Short-eared Owl	*Asio flammeus*
Lesser Nighthawk	*Chordeiles acutipennis*
Common Nighthawk	*Chordeiles minor*
Vaux's Swift	*Chaetura vauxi*
White-throated Swift	*Aeronautes saxatalis*
Black-chinned Hummingbird	*Archilochus alexandri*
Anna’s Hummingbird*	*Calypte anna*
Costa's Hummingbird*	*Calypte costae*
Rufous Hummingbird	*Selasphoras rufus*
Allen's Hummingbird	*Selasphorus sasin*
Belted Kingfisher	*Ceryle alcyon*

Northern Flicker	*Colaptes auratus*
Western Wood-Pewee	*Contopus sordidulus*
Willow Flycatcher	*Empidonax traillii*
Pacific-slope Flycatcher	*Empidonax difficilis*
Black Phoebe	*Sayornis nigricans*
Say's Phoebe	*Sayornis saya*
Ash-throated Flycatcher	*Myiarchus cinerascens*
Cassin's Kingbird	*Tyrannus vociferans*
Western Kingbird	*Tyrannus verticalis*
Loggerhead Shrike*	*Lanius ludovicianus*
Blue-headed Vireo	*Vireo solitarius*
Warbling Vireo	*Vireo gilvus*
Western Scrub Jay	Ap*helocoma californica*
American Crow	*Corvus brachyrhynchos*
Common Raven	*Corvus corax*
Magpie Jay	*Calocitta formosa*
Horned Lark*	*Eremophila alpestris*
Tree Swallow	*Tachycineta bicolor*
Violet-green Swallow	*Tachycineta thalassina*
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*
Cliff Swallow	*Petrochelidon pyrrhonota*
Barn Swallow	*Hirundo rustica*
Bushtit*	*Psaltriparus minimus*
Cactus Wren	*Campylorhynchus brunneicapillus*
Bewick's Wren*	*Thryomanes bewickii*
House Wren	*Troglodytes aedon*
Marsh Wren	*Cistothorus palustris*
Ruby-crowned Kinglet	*Regulus calendula*
Blue-gray Gnatcatcher	*Polioptila caerulea*
California Gnatcatcher	*Polioptila californica*
Mountain Bluebird	*Sialia currucoides*
Swainson's Thrush	*Catharus ustulatus*
Hermit Thrush	*Catharus guttatus*
American Robin	*Turdus migratorius*
Wrentit	*Chamaea fasciata*
Northern Mockingbird*	*Mimus polyglottos*
Sage Thrasher	*Oreoscoptes montanus*
California Thrasher	*Toxostoma redivivum*
European Starling*	*Sturnus vulgaris*
Red-throated Pipit	*Anthus cervinus*
American Pipit	*Anthus rubescens*
Cedar Waxwing	*Bombycilla cedrorum*
Phainopepla	*Phainopepla nitens*
Orange-crowned Warbler	*Vermivora celata*
Nashville Warbler	*Vermivora ruficapilla*
Yellow Warbler	*Dendroica petechia*
Magnolia Warbler	*Dendroica magnolia*
Yellow-rumped Warbler	*Dendroica coronata*
Black-throated Gray Warbler	*Dendroica nigrescens*
MacGillivray's Warbler	*Oporornis tolmiei*
Common Yellowthroat	*Geothlypis trichas*

Wilson's Warbler	*Wilsonia pusilla*
Western Tanager	*Piranga ludoviciana*
Green-tailed Towhee	*Pipilo chlorurus*
Spotted Towhee	*Pipilo maculatus*
California Towhee	*Pipilo crissalis*
Vesper Sparrow	*Pooecetes gramineus*
Lark Bunting	*Calamospiza melanocorys*
Savannah Sparrow	*Passerculus sandwichensis*
Belding’s Savannah Sparrow*	*Passerculus sandwichensis beldingi*
Large-billed Savannah Sparrow	*Passerculus sandwichensis rostratus*
Grasshopper Sparrow	*Ammodramus savannarum*
Nelson's Sharp-tailed Sparrow	*Ammodramus nelsoni*
Song Sparrow*	*Melospiza melodia*
Lincoln's Sparrow	*Melospiza lincolnii*
Swamp Sparrow	*Melospiza georgiana*
White-crowned Sparrow*	*Zonotrichia leucophrys*
Golden-crowned Sparrow	*Zonotrichia atricapilla*
Dark-eyed Junco	*Junco hyemalis*
Blue Grosbeak	*Guiraca caerulea*
Lazuli Bunting	*Passerina amoena*
Red-winged Blackbird	*Agelaius phoeniceus*
Tricolored Blackbird	*Agelaius tricolor*
Western Meadowlark*	*Sturnella neglecta*
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*
Brewer's Blackbird	*Euphagus cyanocephalus*
Great-tailed Grackle	*Quiscalus mexicanus*
Brown-headed Cowbird	*Molothrus ater*
Hooded Oriole	*Icterus cucullatus*
Bullock’s Oriole	*Icterus bullockii*
House Finch*	*Carpodacus mexicanus*
Lesser Goldfinch	*Carduelis psaltria*
Lawrence's Goldfinch	*Carduelis lawrencei*
American Goldfinch	*Carduelis tristis*
House Sparrow*	*Passerculus domesticus*

(*Source: Chula Vista Nature Center 1998 and* Merkel & Associates, Inc. 2000b)

South San Diego Bay Unit

Common Name	**Scientific Name**
Red-throated Loon	*Gavia stellata*
Common Loon	*Gavia immer*
Pied-billed Grebe	*Podilymbus podiceps*
Horned Grebe	*Podiceps auritus*
Eared Grebe	*Podiceps nigricollis*
Western Grebe	*Aechmophorus occidentalis*
Clark’s Grebe	*Aechmophorus clarkii*
American White Pelican	*Pelecanus erythrorhynchos*
Brown Pelican	*Pelecanus occidentalis*
Double-crested Cormorant*	*Phalacrocorax auritus*

Great Blue Heron	*Ardea herodias*
Great Egret	*Ardea alba*
Snowy Egret	*Egretta thula*
Little Blue Heron	*Egretta caerulea*
Tricolored Heron	*Egretta tricolor*
Reddish Egret	*Egretta rufescens*
Green Heron	*Butorides virescens*
Black-crowned Night Heron	*Nycticorax nycticorax*
White-faced Ibis	*Plegadis chihi*
Snow Goose	*Chen caerulescens*
Brant	*Branta bernicla*
Gadwall*	*Anas strepera*
American Wigeon	*Anas americana*
Mallard*	*Anas platyrhynchos*
Blue-winged Teal	*Anas discors*
Cinnamon Teal	*Anas cyanoptera*
Northern Shoveler	*Anas clypeata*
Northern Pintail	*Anas acute*
Green-winged Teal	*Anas crecca*
Redhead	*Aythya americana*
Ring-necked Duck	*Aythya collaris*
Greater Scaup	*Aythya marila*
Lesser Scaup	*Aythya affinis*
Surf Scoter	*Melanitta perspicillata*
Long-tailed Duck	*Clangula hyemalis*
Bufflehead	*Bucephala albeola*
Common Goldeneye	*Bucephala clangula*
Common Merganser	*Mergus merganser*
Red-breasted Merganser	*Mergus serrator*
Ruddy Duck	*Oxyura jamaicensis*
Osprey	*Pandion haliaetus*
White-tailed Kite	*Elanus leucurus*
Northern Harrier	*Circus cyaneus*
Sharp-shinned Hawk	*Accipiter striatus*
Cooper's Hawk	*Accipiter cooperii*
Red-tailed Hawk	*Buteo jamaicensis*
American Kestrel	*Falco sparverius*
Merlin	*Falco columbarius*
Peregrine Falcon	*Falco peregrinus*
Light-footed Clapper Rail*	*Rallus longirostris levipes*
American Coot	*Fulica americana*
Black-bellied Plover	*Pluvialis squatarola*
American Golden Plover	*Pluvialis dominica*
Western Snowy Plover*	*Charadrius alexandrinus nivosus*
Semipalmated Plover	*Charadrius semipalmatus*
Killdeer*	*Charadrius vociferus*
Black-necked Stilt*	*Himantopus mexicanus*
American Avocet*	*Recurvirostra americana*
Greater Yellowlegs	*Tringa melanoleuca*
Willet	*Tringa semipalmatus*

Lesser Yellowlegs	*Tringa flavipes*
Spotted Sandpiper	*Actitis macularia*
Whimbrel	*Numenius phaeopus*
Long-billed Curlew	*Numenius americanus*
Marbled Godwit	*Limosa fedoa*
Ruddy Turnstone	*Arenaria interpres*
Black Turnstone	*Arenaria melanocephala*
Surfbird	*Aphriza virgata*
Red Knot	Calidris canutus
Sanderling	*Calidris alba*
Western Sandpiper	*Calidris mauri*
Least Sandpiper	*Calidris minutilla*
Pectoral Sandpiper	*Calidris melanotos*
Dunlin	*Calidris alpina*
Short-billed Dowitcher	*Limnodromus griseus*
Long-billed Dowitcher	*Limnodromus scolopaceus*
Wilson's Phalarope	*Phalaropus tricolor*
Red-necked Phalarope	*Phalaropus lobatus*
Red Phalarope	*Phalaropus fulicaria*
Parasitic Jaeger	*Stercorarius parasiticus*
Franklin's Gull	*Larus pipixcan*
Bonaparte's Gull	*Larus philadelphia*
Heermann's Gull	*Larus heermanni*
Mew Gull	*Larus canus*
Ring-billed Gull	*Larus delawarensis*
California Gull	*Larus californicus*
Herring Gull	*Larus argentatus*
Western Gull*	*Larus occidentalis*
Glaucous-winged Gull	*Larus glaucescens*
Black Skimmer*	*Rynchops niger*
California Least Tern*	<u>*Sternula antillarum*</u>
Gull-billed Tern*	<u>*Gelochelidon nilotica*</u>
Caspian Tern*	<u>*Hydroprogne caspia*</u>
Black Tern	*Chlidonias niger*
Common Tern	*Sterna hirundo*
Forster's Tern*	*Sterna forsteri*
Royal Tern*	<u>*Thalasseus maximus*</u>
Elegant Tern*	<u>*Thalasseus elegans*</u>
Rock Dove	*Columba livia*
Mourning Dove	*Zenaida macroura*
Greater Roadrunner	*Geococcyx californianus*
Barn Owl	*Tyto alba*
Burrowing Owl	*Athene cunicularia*
Short-eared Owl	*Asio flammeus*
Anna’s Hummingbird	*Calypte anna*
Belted Kingfisher	*Ceryle alcyon*
Black Phoebe	*Sayornis nigricans*
Ash-throated Flycatcher	*Myiarchus cinerascens*
Western Kingbird	*Tyrannus verticalis*
Loggerhead Shrike	*Lanius ludovicianus*
American Crow	*Corvus brachyrhynchos*

Common Raven	*Corvus corax*
Horned Lark*	*Eremophila alpestris*
Tree Swallow	*Tachycineta bicolor*
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*
Cliff Swallow	*Petrochelidon pyrrhonota*
Barn Swallow	*Hirundo rustica*
Bushtit	*Psaltriparus minimus*
Marsh Wren	*Cistothorus palustris*
Northern Mockingbird	*Mimus polyglottos*
European Starling	*Sturnus vulgaris*
American Pipit	*Anthus rubescens*
Yellow-rumped Warbler	*Dendroica coronata*
Common Yellowthroat	*Geothlypis trichas*
Wilson's Warbler	*Wilsonia pusilla*
California Towhee	*Pipilo crissalis*
Belding's Savannah Sparrow*	*Passerculus sandwichensis beldingi*
Song Sparrow	*Zonotrichia leucophrys*
Blue Grosbeak	*Guiraca caerulea*
Red-winged Blackbird	*Agelaius phoeniceus*
Western Meadowlark	*Sturnella neglecta*
Brewer's Blackbird	*Euphagus cyanocephalus*
Hooded Oriole	*Icterus cucullatus*
House Finch	*Carpodacus mexicanus*
Lesser Goldfinch	*Carduelis psaltria*
House Sparrow	*Passer domesticus*

(*Source: City of San Diego 1987, USFWS 1994, US Navy 2000, Tierra Environmental Services 2001, and Tony Stands, pers. comm., April 2004*)

Appendix D

CCP Implementation

Appendix D: CCP Implementation

A. Introduction

The Final Comprehensive Conservation Plan (CCP) for the San Diego Bay National Wildlife Refuge will be prepared following approval of the Final EIS and issuance of the Record of Decision (ROD), which will identify the proposed action. This appendix combined with Chapters 1 and 3 and portions of Chapter 2 of the Final CCP/EIS will form the basis for the Final CCP. Implementation of the CCP can begin following the issuance of the ROD. Although it is our intent to implement the proposed strategies (projects) by the established deadlines, the timing of implementation may vary depending upon a variety of factors, including funding, staffing, compliance with Federal regulations, partnerships, and the results of monitoring and evaluation. Some strategies, such as those related to habitat restoration, will require the completion of step-down plans and appropriate environmental compliance documents before they can be implemented. This appendix will further define how implementation of the preferred alternatives for both the Sweetwater Marsh Unit and the South San Diego Bay Unit (described in Chapter 2) would proceed if they are identified as the proposed action in the ROD.

B. Implementation Overview

During the 15 years following CCP approval, the CCP will serve as the primary reference document for all Refuge planning, operations, and management. Presented in Tables D-1 and D-2 are the priorities for implementing the various wildlife and habitat management and visitor services (public use) strategies described in the preferred alternatives for the Sweetwater Marsh and South San Diego Bay Units. Completion of any of these actions would however be dependent upon the various factors discussed above and the order of implementation could change if funds for a specific project are identified earlier than anticipated. These strategies would be implemented with assistance from new and existing partners, including public agencies, non-governmental organizations, and the public. Consistent public outreach and continued coordination with Refuge constituents are essential components of this implementation process. Some of the partnership opportunities to be explored during the 15-year life of this CCP are described below, as are the projects, monitoring responsibilities, and staffing and funding requirements needed to successfully implement the CCP.

CCPs are intended to evolve with each Refuge, and the Improvement Act specifically requires that these plans be formally revised and updated at least every 15 years. The formal revision process will follow the same steps as those implemented for the initial CCP development process, with a major emphasis placed on public involvement. Until a formal revision is initiated, the Service will periodically review and update the CCP (at least as often as every five years) to address needs identified as a result of monitoring or in response to adaptive management procedures. This CCP will also be informally reviewed by Refuge staff while preparing annual work plans and updating the Refuge databases. It may also be reviewed during routine inspections or programmatic evaluations. Results of any or all of these reviews may indicate a need to modify the plan. The goals described in this CCP will not change until they are reevaluated as part of the formal CCP revision process. However, the objectives and strategies may be revised to better address changing circumstances or to take advantage of increased knowledge of Refuge resources. If revisions to the CCP are required prior to the initiation of formal revisions, the level of public involvement and associated NEPA documentation will be determined by the Refuge Manager.

Table D-1
San Diego Bay National Wildlife Refuge
Prioritized List of Wildlife and Habitat Management Projects*

Priority	Unit	Description
1	SSDB	Phase 1 - Salt Pond Restoration:
		a. Step-down planning and detailed engineering
		b. Restore tidal influence to Pond 11
		c. Restore tidal influence to Ponds 10 and 10A
2	SSDB	Phase 2 - Nesting Enhancements within the Salt Pond Complex:
		a. Step-down planning and detailed engineering
		b. Phased development of new nesting sites
		c. Enhance nesting substrate
		d. Reconfigure pond levees
3	SSDB	Otay River Floodplain Restoration:
		a. Step-down planning and detailed engineering
		b. Implement restoration plan
4	SSDB	Phase 2 Salt Pond Restoration:
		a. Step-down planning and detailed engineering
		b. Restore tidal influence to Ponds 12-15
		c. Restore tidal influence to Ponds 23-25 and 28-30
		d. Initiate the managed water system
		e. Prepare Pond 44 for seabird nesting habitat
5	SWM	Restore wetland habitat at the F&G Street Marsh:
		a. Step-down planning and detailed engineering
		b. Implement wetland habitat restoration
		c. Address contaminant issues at F&G Street Marsh
6	SWM	Improve tidal circulation within Paradise Marsh:
		a. Address contaminant issues in Paradise Marsh
		b. Step-down planning and detailed engineering to remove or lower existing weir
		c. Remove or lower the existing weir
7	SWM	Improve tidal circulation within Sweetwater Marsh:
		a. Step-down planning and detailed engineering to improve tidal circulation
		b. Add new culvert in the existing access road
		c. Remove old access road
		d. Address sediment accumulation in existing tidal channels
		e. Lower berm south of Gunpowder Point
8	SWM	Enhance D Street fill to improve nesting habitat quality and fledgling access:
		a. Step-down planning for substrate enhancement/improved fledgling access to foraging areas
		b. Implement nesting substrate enhancements
9	SWM	Improve access between nesting and foraging areas on the D Street Fill
10	SWM	Restore native upland and wetland habitat on Gunpowder Point:
		a. Step-down planning for habitat restoration
		b. Implement upland habitat restoration
		c. Implement wetland habitat restoration along the northern edge of Gunpowder Point
11	SSDB	Identify Long Term Funding for Predator Management in tern and plover nesting areas
12	SWM	Identify Long Term Funding for Predator Management in tern and plover nesting areas

* Restoration priorities may change or implementation may be accelerated if funding for a specific project is identified sooner than anticipated.

Table D-2
San Diego Bay National Wildlife Refuge
Prioritized List of Visitor Services Projects

Priority	Unit	Description
1	SSDB	Increase Opportunities for Wildlife Observation/Interpretation:
		a. Increase the number of guided tours within the salt pond complex
		b. Conduct step-down planning for pedestrian pathway and interpretation along south boundary
		c. Construct the pedestrian pathway from 7th to 10th Street
		d. Develop an interpretive overlook at the end of 10th Street
		e. Develop an observation deck at the end of 8th Street
		f. Construct the pedestrian pathway from Florida Street to 13th Street
		g. Construct an observation overlook in the vicinity of Florida Street
		h. Design and Construct an interpretive trail around Pond 28
		i. Design and implement an interpretive program about the history of hunting in San Diego Bay
2	SWM	Improve Opportunities for Wildlife Observation and Environmental Interpretation:
		a. Step-down planning for interpretive trail on Gunpowder Point
		b. Realign the existing trail
		c. Design and install new interpretive signs
		d. Work with National City and Chula Vista to provide environmental interpretation
3	SSDB	Expand the existing Habitat Heroes Environmental Education Program consistent with the CCP
4	SWM	Develop public outreach plan to reduce disturbance from adjacent areas
5	SWM	Develop public outreach plan to reduce wildlife disturbance in the open waters of the Refuge
6	SWM	Develop a Cultural Resource Management Plan for this Unit
7	SSDB	Develop a Cultural Resource Management Plan for this Unit

C. Wildlife and Habitat Management

The preferred alternatives for the Sweetwater Marsh and South San Diego Bay Units include a variety of wildlife and habitat management "strategies" or projects that when implemented will meet the goals and objectives outlined in the CCP. The timing for implementation of these projects is driven by the Service's trust responsibilities (i.e., endangered and threatened species, migratory birds), the mission of the Refuge system, Refuge purposes, and the availability of funding. The best science available will be used to measure the effectiveness of these projects in achieving the goals and objectives for the Refuge.

Past management on the Refuge has been focused on maintaining appropriate nesting habitat for seabirds, implementing predator control to protect listed species, and minimizing disturbance to resident and migratory bird populations. While these management practices would continue or be expanded (e.g., nesting substrate enhancement and nesting area expansion projects), additional management actions would be implemented as funding permits. Additional focus would be placed on the inventory and monitoring of the various species and habitats supported on the Refuge. As described below, considerable emphasis would be placed on habitat enhancement and restoration to benefit native wildlife and plant species.

Habitat Enhancement and Restoration

Various enhancement and restoration projects are described in the CCP that once implemented would expand and/or improve the overall habitat value of this Refuge for a variety of species. Full restoration of the structure and function of the coastal wetland habitats proposed within the CCP particularly for the South San Diego Bay Unit may not be achieved within the 15-year life of this plan, however, the direction provided in the CCP will ensure that significant strides towards the goal of providing fully functional, high value habitat for migratory birds and listed species such as the light-footed clapper rail, California least tern, and western snowy plover will be achieved.

Implementation of some of the projects would involve minimal effort such as removing or lowering the weir near Paradise Marsh, while restoration of the salt ponds in the South San Diego Bay Unit would require completion of additional studies, coordination with a variety of partners, preparation of final engineering and restoration plans, approval of various permits, and funding for both step-down planning and implementation.

Restoration of tidal influence within the majority of the salt ponds on the South San Diego Bay Unit could be implemented under several scenarios, as described in Chapter 2. One of the scenarios would involve a phased approach to restoration. The details of such a phased approach are presented below.

Salt Pond Restoration Phasing Plan

Phase 1 - Implement Restoration of the Western Ponds (Ponds 10, 10A, and 11) and Initiate Nesting Enhancement Projects throughout the Salt Works

Years 1, 2, and 3 – Studies, Final Restoration Planning, and Permitting

- Prepare a work plan outlining the various studies to be conducted prior to restoring tidal influence to the salt ponds. Studies would include, but are not limited to:
    - Characterization of the pond sediments (e.g., grain size, salinity levels, presence of any contaminants)
    - Collection of data regarding avifauna abundance, diversity, use, and distribution within the salt ponds and the adjacent mudflats
    - Identification of the invertebrates present within the various ponds
    - Analysis of material to be used for new nesting areas and/or for optimizing pond elevations to achieve desired habitat types

- Provide opportunities for public input during final restoration planning and host annual public workshops to provide for public input throughout the restoration process

- Explore and promote scientific research opportunities with various universities, USGS, and others that would begin in Year 1 and extend through the life of the project, as appropriate

- Design any water control structures, bridges, and levee protection measures that would be required following restoration of tidal influence into the ponds

- Prepare final engineering/restoration plans incorporating as appropriate the results of the tasks described above

- Design a monitoring plan for Pond 11

- Obtain all necessary permits and complete environmental compliance reviews

Year 4 – Prepare for and Restore Tidal Influence in Pond 11/Begin Nesting Enhancements

- Prepare Pond 11 for restoration:
  - Remove Pond 11 from the salt production system and make the necessary changes to the system to allow water to move from Pond 10 into Pond 12
  - Reconfigure the pond elevations per final engineering plans (this may involve moving material from Pond 10 to Pond 11, transporting material from the Otay River floodplain into Pond 11, or simply recontouring the pond to achieve the desired elevations)

- Restore tidal influence to Pond 11 in accordance with approved engineering/restoration plans

- Begin implementing nesting habitat enhancements including recontouring existing levees, widening some levees, and preparing new nesting areas within existing ponds

- Initiate monitoring of Pond 11 (e.g., monitor invertebrate, fish, and plant colonization, water quality, and possible presence of invasive species in restored Pond 11; also monitor avian response to pond restoration and enhanced nesting areas and any changes in wildlife community response within adjacent ponds and levees)

- Continue public involvement process

- *Phase 2 Work - Initiate studies in the eastern ponds in preparation for Phase 2 restoration planning that would begin in Year 6*

Years 5 and 6 – Monitoring/Adaptive Management/Lessons Learned

- Continue to implement nesting habitat enhancements within existing ponds

- Continue monitoring Pond 11 per the monitoring plan

- Provide an opportunity for public review of monitoring results through Planning Updates, public workshops, or other appropriate methods

- *Phase 2 Work - Continue studies related to restoration of the eastern ponds*

Year 7 – Prepare for and Restore Ponds 10 and 10A

- Reconfigure the bay water intake system for the salt operation to allow continued salt production on the east side of the Otay River channel

- Review monitoring results obtained for Pond 11 and based on an evaluation of these results determine if any changes in restoration management, implementation, or design are necessary or desirable to achieve habitat goals and objectives

- Prepare Ponds 10 and 10A for tidal restoration in accordance with final restoration plans (this may involve excavation or filling to achieve desired elevations and/or the construction of a low berm along the eastern edge of Pond 10A)

- Restore tidal influence to Ponds 10 and 10A

- Initiate monitoring in Ponds 10 and 10A per the monitoring plan

- Continue monitoring Pond 11 per the monitoring plan

- Continue public involvement process

- *Phase 2 Work - Continue studies associated with the restoration of the eastern ponds and begin detailed analysis of managed pond strategies and designs (including brine management ponds and associated discharge requirements)*

Years 8 and 9 – Monitoring/Adaptive Management/Lessons Learned

- Continue monitoring Pond 10, 10A, and 11 per the monitoring plan

- Provide an opportunity for public review of monitoring results through Planning Updates, public workshops, or other appropriate methods

- *Phase 2 Work – Complete studies associated with the restoration of the eastern ponds, prepare final engineering/restoration plans incorporating lessons learned from the restoration of the eastern ponds, complete environmental compliance documents, coordinate with appropriate agencies, and submit and obtain all required permit applications*

Phase 2 - Implement Restoration of the Ponds to the East of the Otay River and Continue to Implement Nesting Enhancement Projects throughout the Salt Works

Years 1, 2, and 3 – Studies, Final Restoration Planning, and Permitting for Phase 1

Year 4 – Initiate Studies for Restoration and Management of the Eastern Ponds

- Prepare a work plan outlining the various tasks (e.g., baseline studies, pre-restoration eelgrass surveys, numeric modeling, detailed analysis of the brine management component) needed to prepare detailed restoration plans for some ponds and water management plans for other ponds

- Initiate various studies and analyses per the work plan

- Explore and promote scientific research opportunities with various universities, USGS, and others for Phase 2 restoration activities

Years 5 and 6 – Continue Studies and Modeling of Pond Restoration and Management

- Continue implementation of the work plan, including analysis of how best to handle gypsum and crystallized salt deposits within some of the secondary and pickling ponds
- Conduct detailed analyses of managed pond strategies and designs (including brine management ponds and associated discharge requirements) and prepare a water management plan to establish the operating, maintenance, and monitoring activities and associated costs require maintain the propose managed water systems

Year 7 – Prepare Final Engineering/Restoration Plans

- Complete the tasks outlined in the work plan
- Prepare final engineering/restoration plans incorporating lessons learned from the restoration of Ponds 10, 10A, and 11
- Design a monitoring plan
- Continue public involvement process
- Complete environmental compliance documents, coordinate with appropriate agencies, and submit all required permit applications

Years 8 and 9 – Conduct Studies and Modeling for Restoration and Management of the Eastern Ponds

- Explore and promote scientific research opportunities with various universities, USGS, and others for Phase 2 restoration activities
- Obtain all permits required to restore tidal influence in some eastern ponds and manage water in other ponds
- In Year 9, prepare for removal of Ponds 12, 14, and 15 from the commercial salt production system
- By December 31, 2016, begin closure of the salt operation by closing the intake gate and continuing to move the remaining water through the system to produce the last harvest of salt

Year 10 – Implement Restoration of Remaining Primary Ponds

- Prepare Ponds 12, 13, 14, and 15 for tidal restoration in accordance with final engineering/restoration plans
- Restore tidal influence to Ponds 12, 13, 14, and 15
- Initiate monitoring, including ground nesting seabird response to pond restoration and post restoration monitoring of adjacent eelgrass beds

- <u>Continue to implement nesting habitat enhancements per the restoration plans</u>

<u>Years 11 and 12 – Monitoring/Adaptive Management/Lessons Learned</u>

- <u>Continue monitoring restored areas per the monitoring plan</u>
- <u>Provide an opportunity for public review of monitoring results through Planning Updates, public workshops, or other appropriate methods</u>

<u>Year 13 – Implement Restoration/Water Management Proposals for Remaining Salt Ponds</u>

- <u>South Bay Salt Works to implement the salt works closure provisions of the Special Use Permit</u>
- <u>Prepare specified ponds for tidal restoration in accordance with final engineering/restoration plans</u>
- <u>Prepare other ponds for long-term water management, including installing any new hydraulic structures needed to convey water into and/or out of the managed water ponds</u>
- <u>Restore tidal influence per the restoration plans</u>
- <u>Begin water management operations per the restoration plans</u>
- <u>Implement initial intensive water management monitoring per the water management plan</u>
- <u>Initiate monitoring of the restored ponds per the restoration monitoring plan</u>
- <u>Complete all proposed nesting habitat enhancements</u>

<u>Years 14 and 15 – Monitoring/Adaptive Management/Lessons Learned</u>

- <u>Continue monitoring restored and managed water areas per the appropriate monitoring plans</u>
- <u>Provide an opportunity for public review of monitoring results through Planning Updates, public workshops, or other appropriate methods</u>

Monitoring

Monitoring the effects of management actions on the Refuge's trust resources is an important component of the CCP, as is the documentation of the Refuge's baseline conditions. By completing baseline inventories and monitoring specific management actions, Refuge staff can better understand the species, habitats, and physical processes that occur on the Refuge and the ecological interactions that occur between species.

Monitoring is an ongoing management activity at both the Sweetwater Marsh and South San Diego Bay Units and will continue per available funding. Past monitoring efforts have focused primarily on California least tern and western snowy plover nesting, although monitoring of other colonial nesting birds, including the gull-billed tern, is also implemented at the South San Diego Bay Unit. <u>Current monitoring efforts</u> are adequate to identify trends in abundance, diversity, and nesting success of breeding seabirds and nesting attempts and success of snowy plovers. Monitoring programs, such as the current efforts, are focused on selected components that are representative of many other species or habitats due to funding limitations.

Monitoring is identified as a strategy in the CCP for managing the marsh complex on the Sweetwater Marsh Unit and as an integral component of salt pond restoration on the South San Diego Bay Unit. Monitoring will focus on measuring the success of CCP implementation, particularly the effectiveness of the various habitat enhancement and restoration strategies in achieving plan objectives. The objectives provided for each Refuge Unit are presented in Sections 2.2.5 and 2.3.5 of Chapter 2.

The monitoring activities associated with restoration of the Otay River floodplain and the salt ponds in the South San Diego Bay Unit are briefly described in Chapter 2. The potential salt pond restoration phasing plan, presented above, also demonstrates how monitoring could be incorporated into future detailed restoration plans. The specific details of such a plan would however be defined during step-down planning. Monitoring activities could include, examining the establishment of vegetation and invertebrates during the initial phases of tidal restoration within the ponds; monitoring seabird nesting activity on the salt pond levees following pond restoration, and initial monitoring of the managed pond areas to ensure appropriate salinity levels are maintained. The data obtained during such monitoring will provide information necessary to confirm that the objectives of the various management actions are being achieved or that changes through adaptive management are necessary to achieve desired habitat objectives.

Adaptive Management

Adaptive management involves sequential decision making, integrating project design, management, and monitoring to systematically test assumptions. Based on the data and lessons learned, subsequent phases of an ongoing restoration project or a new restoration project with similar objectives can be revised as necessary to maximize project objectives over time. Adequate baseline data, clearly defined and measurable project objectives, a monitoring plan focused on measurable results, and a process for refining and improving current and future management actions are all essential components of a successful adaptive management approach to restoration. Each of these components would be addressed during step down planning, and the details of the adaptive management approach would be integrated into final restoration plans. The step-down plans will also describe how coordination with other science-management teams involved in implementing and monitoring restoration of solar salt ponds, including those involved in salt pond restoration in San Francisco Bay, would be achieved.

D. Public Use

Various projects are included in the CCP that are intended to provide opportunities for increasing public awareness of the significance of the habitats and species protected within the Refuge, while also providing different ways for the public to experience these resources. The CCP emphasizes the importance of expanding opportunities for wildlife observation and environmental interpretation on both Refuge Units. In addition, the outstanding environmental education programs that are already being implemented on both Refuge Units would continue per available funding. Partners will be sought to expand the availability of these programs to more children throughout the region, while also expanding the depth of the programs to address the needs of older students. Other opportunities for public outreach would also be realized by continuing to permit fishing and boating within the South San Diego Bay Unit.

E. Step-Down Plans

Some projects such as public use programs and habitat restoration proposals require more in-depth planning than the CCP process is designed to provide. For these projects, the Service prepares step-down plans. Step-down plans provide additional planning and design details necessary to implement the strategies (projects or programs) identified in the CCP. Two step-down plans – the Fire Management Plan and Predator Management Plan – are included in this CCP as Appendices L and M, respectively. Several step-down plans are proposed for completion following the approval of the CCP including a Habitat Management Plan and an Interpretive Trail Plan for the Sweetwater Marsh Unit and detailed restoration planning for the South San Diego Bay Unit.

F. Compliance Requirements for Plan Implementation

All projects and step-down plans described in the CCP will be required to comply with NEPA and the Improvement Act, as well as a variety of other Federal regulations, executive orders, and legislative acts, which are described in greater detail in Chapter 5 of this document. The Final EIS is intended to address all proposed actions at the program level; however, some actions once defined in greater detail may require additional analysis and review under NEPA. In addition, all projects that involve disturbance of the land, changes to structures more than 50 years old, and/or changes to the use, design, and/or function of the salt works, which has been deemed eligible for inclusion on NRHP, would require coordination with the Regional Archaeologist. To initiate review by the Regional Archaeologist, a Request for Cultural Resource Compliance would be prepared early in the planning process for each proposed project.

G. Anticipated Costs of Fully Implementing the CCP

Funding for Projects

The estimated costs for the various projects described for the preferred alternatives, as well as the new staffing requirements for implementing these projects, are presented in Table D-3. The costs presented under the heading Recurring Base include the anticipated long-term annual costs of maintaining equipment, structures, facilities, signage, and/or restored or enhanced habitat areas, as well as the annual costs of maintaining programs such as existing and proposed environmental education, interpretation, and volunteer programs.

Current and Future Staffing

To implement all of the proposed actions and achieve the goals and objectives of the CCP for the two Refuge Units, additional funding and staff will be necessary. Tables D-4 and D-5 present the current and future (proposed) funding and staff needs for the combined management of the Sweetwater Marsh and South San Diego Bay Units. The base budget in FY2004 for the three San Diego Coastal Refuges: Sweetwater Marsh Unit, South San Diego Bay Unit, and Tijuana Slough NWR was $802,000.

Table D-5 presents the proposed future staffing requirements for the San Diego Coastal Refuges based on the types of projects that are proposed within the CCP.

Table D-3
ESTIMATED COSTS FOR IMPLEMENTING CCP PROJECTS
AND PROPOSED STAFFING INCREASES TO IMPLEMENT AND MAINTAIN THESE PROJECTS

Projects Proposed to Achieve Refuge Goals and Objectives	Operating Costs (in thousands)			
	FTEs	**One-Time**	**Recurring Base**	**Total 1st Year**
Habitat and Wildlife Management				
Increase habitat management activities within the Sweetwater Marsh Unit: Develop and implement a Habitat Management Plan that includes actions to improve and protect marsh quality including completion of an inventory of marsh species and mapping of special status species distribution/population size; improving conditions in upland transition areas to benefit salt marsh bird's beak propagation; increasing control of invasive plants; and performing annual monitoring and maintenance activities.	-	$25	$5	$25
Enhance and maintain tern and plover nesting habitat and improve nesting success: Enhance existing nesting areas at the D Street Fill and on the salt pond levees by adding a 6- to 8-inch layer of clean, light-color sand to areas with poor substrate quality, and by improving chick access to adjacent foraging areas. Follow up annually with 1) preseason tern and plover nest site preparation to control vegetation and maintain quality nesting substrate; 2) predator management to minimize losses of least tern and snowy plover eggs, chicks, and adults to avian and mammalian predators during the nesting season, and 3) monitoring site use by nesting least terns and snowy plovers and recording the reproductive success of each species within the two nesting areas.	-	$75	$2	$75
Improve nesting habitat for plovers within the salt pond complex: Seasonally manage the water level in Pond 20 or other appropriate pond to provide a minimum of 20 acres of dry salt flats in proximity to quality foraging areas to support western snowy plover nesting.	-	$5	$1	$5
General Refuge Management				
Reduce unauthorized access onto the Refuge: Develop and implement a public outreach program directed at reducing unauthorized access by people and their pets into sensitive Refuge habitats. The program, which should be design and implemented in partnership with other agencies and organizations, should incorporate the use of effective signage, brochures, and a speakers bureau (traveling public information program) to inform the public of the need to protect the sensitive resources on the Refuge; expand law enforcement and Refuge staff visibility on the Refuge, and encourage stewardship through hands-on volunteer opportunities.	-	$15	$1	$15

	FTEs	One-Time	Recurring Base	Total 1st Year
General Refuge Management (cont.)				
Reduce disturbance to wildlife in the open waters of the Refuge: Coordinate with the Coast Guard and Harbor Patrol to ensure enforcement of the designated 5 mph speed limit throughout the south bay and acquire a patrol boat to increase Refuge law enforcement presence within those portions of the Refuge located within San Diego Bay.	-	$50	$5	$50
Secure the eastern perimeter of the salt pond complex following closure of the salt operation: Install and maintain appropriate fencing and signage around the eastern perimeter of the salt ponds to minimize the incidence of unauthorized access into the area and to discourage entry into the area by stray dogs, cats, and other mammals that could pose a threat to nesting and feeding wildlife.	-	$45	$5	$45
Reduce the accumulation of fishing line within the Refuge: Develop and implement a Monofilament Recovery & Recycling Program to raise awareness about the dangers to wildlife of improperly discarding fishing line.	-	$15	$1	$15
Prepare a Cultural Resource Management Plan for the Refuge: Identify, record, and evaluate the cultural resources on the Refuge. With this information, develop and implement a cultural resource management plan, in consultation with all interested parties, that insures the long-term protection of the Refuge's sensitive cultural resources and encourages the interpretation of these resources as part of the overall interpretive program for the Refuge.	-	$25	$1	$25
Address contaminants issues affecting the Refuge: Develop and implement baseline sampling plans for potentially contaminated areas within the Refuge. Seek additional funding to develop and implement remediation plans for those areas that are determined to require remediation due to existing contaminant levels.	-	$100	-	$100
Improve volunteer services within the Refuge: Design a volunteer program for the San Diego Bay NWR that when implemented will improve and expand volunteer opportunities within the Refuge. Obtain basic supplies, equipment, and uniforms for the volunteers and design and implement a volunteer program that would support existing and expanded proposals for environmental education, interpretation and wildlife observation, assist Refuge staff in accomplishing projects related to habitat and wildlife management (e.g., wildlife and plant surveys, invasive species control, native plant propagation and planting, construction of nesting platforms), and facilitate other special events.	-	$25	$3	$25
Public Use				
Redesign the existing trail system and interpretive signage on Gunpowder Point: Design and implement an environmental interpretation plan for Gunpowder Point that includes a redesigned trail system and new interpretive signage to improve opportunities for wildlife observation, as well as to compliment and support the Refuge's existing environmental education programs.	-	$150	$2	$150

	FTEs	One-Time	Recurring Base	Total 1st Year
Public Use (cont.)				
Increase participation in existing environmental education programs: Continue to assist in the funding and implementation of the Refuge's environmental education program, particularly the Habitat Heroes and Sweetwater Safari Programs, with the goal of renewing existing partnerships and identifying new partners to assist in expanding current outreach programs to better serve underrepresented and underserved communities.	-	$15	$8	$15
Increase opportunities for guided tours of the salt ponds: Expand the number of guided tours provided at the salt works and acquire an electric multi-passenger vehicle to transport visitors along the levees.	-	$60	$5	$60
Develop a pedestrian pathway along the southern edge of the Refuge: Design and construct a pedestrian pathway from 7th to 10th Street, north of the Bayshore Bikeway, to provide opportunities for wildlife observation, environmental education, and interpretation.	-	$650	$2	$650
Develop an interpretive overlook at the end of 10th Street: Partner with the City of Imperial Beach to improve access to and develop an interpretive overlook on the coastal terrace just to the north of the Bayshore Bikeway and install interpretive panels and spotting scopes to provide opportunities to observe the birds that nest, forage, and rest within the restored salt ponds.	-	$50	$1	$50
Construct an observation area at the end of 8th Street: Design and construct an observation area to the north of the Bayshore Bikeway at the end of 8th Street in Imperial Beach to expand opportunities for wildlife observation and interpretation.	-	$25	$1	$25
Improve wildlife observation opportunities at the east end of the Refuge: Design and construct an observation area at the edge of Pond 29.	-	$20	$1	$20
Develop an Interpretive Nature Trail Around Pond 28: Design and construct an accessible, 1.5-mile interpretive nature trail around Pond 28 following the closure of the salt works.	-	$450	$2	$450
Design and implement an interpretive program about the history of hunting in San Diego Bay: Working with partners representing the hunting community, design and implement an interpretive program that would be conducted along the outer levee of the eastern salt ponds in late fall to interpret waterfowl hunting, historic hunting on the south bay, and hunting within the National Wildlife Refuge System.	-	$5	$0.5	$5
Habitat Restoration and Enhancement				
Enhance water circulation in Sweetwater Marsh/Paradise Marsh: Remove old fill areas, construct a new culvert, and remove/lower a weir to enhance tidal circulation over 130 acres of marsh habitat to benefit listed species and migratory birds.	-	$250	$0.5	$250

	FTEs	One-Time	Recurring Base	Total 1st Year
Habitat Restoration and Enhancement (cont.)				
Restore intertidal wetlands on the Sweetwater Marsh Unit: After 2010, when the existing mitigation leasehold overlays expire, restore up to 20 acres of intertidal wetlands, of which a minimum of ten acres would be restored to cordgrass-dominated salt marsh habitat. The actual areas available for restoration would be dependent upon how much restoration is implemented on the mitigation leasehold overlays prior to 2010. Potential restoration areas include approximately 13 acres at the eastern end of the D Street Fill, six acres at the F&G Street Marsh, and two acres along the northern edge of Gunpowder Point.	-	$2,000	$5	$2,000
Restore native upland and upland transition habitat on the Sweetwater Marsh Unit: After 2010, when the existing mitigation leasehold overlays expire, restore approximately 25 acres on Gunpowder Point to native upland vegetation and restore the native plant species historically found in the wetland-upland transition areas throughout the Refuge Unit. This project would involve the initial removal and long-term control of invasive, non-native species, planting and seeding of native vegetation, initial monitoring of restoration success, and long-term maintenance and monitoring of the restored habitat.	-	$300	$5	$300
Improve tidal circulation at the southern tip of Sweetwater Marsh: Conduct a hydrologic study to analyze the benefits of removing the berm located between the bay and the southern tip of Sweetwater Marsh, and if benefits to tidal circulation and habitat quality would be realized, prepare and implement engineering plans for removing or breaching the berm.	-	$750	$1	$750
Increase the total acreage of nesting habitat within the salt pond complex: Create a minimum of 33-acres of new nesting habitat within the salt pond complex by filling pond corners, creating "island" type fills within the ponds, widening some levees, recontouring some levee side slopes, and capping all nesting areas with appropriate depths of clean, light sand to benefit the California least tern, western snowy plover, and other ground nesting birds that nest on the levees.	-	$2,500	-	$2,500
Restore native wetland and upland habitat in the Otay River floodplain: Develop and implement step-down restoration plans to restore approximately 145 acres of disturbed habitat in the Otay River floodplain, creating freshwater wetland, coastal salt marsh, and native scrub habitats to benefit endangered species, migratory birds, and other Refuge resources.	-	$5,000	$5	$5,000
Restore the western salt ponds to tidal action: In accordance with final restoration plans and the associated phasing plan, prepare the western ponds for intertidal restoration and then breach the pond levees to restore 200 acres of intertidal habitat.	-	$2,000	$5	$2,000
Restore the eastern primary salt ponds to tidal action: In accordance with final restoration plans and the associated phasing plan, prepare the eastern ponds for tidal restoration, then breach the pond levees to restore 240 acres of salt ponds to tidal influence.	-	$1,500	$5	$1,500

	FTEs	One-Time	Recurring Base	Total 1st Year
Habitat Restoration and Enhancement (cont.)				
Convert the remaining salt ponds to tidal marsh and managed water areas: Restore an additional 200 acres of secondary salt ponds to tidal influence and implement measures to manage salinity, water levels, and water flow within the remaining 275 acres of salt ponds.	-	$1,500	$30	$1,500
Additional Staff/Contracting Needs to Achieve Refuge Goals and Objectives				
Implement a predator management program to protect listed species: Contract with APHIS-WS or other comparable contractor to conduct avian and mammalian predator control on the Refuge to protect listed species. Predator control would be implemented in accordance with the Refuge's approved Predator Management Plan.	1	-	$75	$75
Provide oversight of all Refuge operations and maintenance and management activities: Hire a Refuge Operations Specialist to work directly with the Refuge Manager to provide oversight of general Refuge operations and programs, including maintenance, visitor services and outreach, volunteer activities, and the Youth Conservation Corps.	1	$2	$60	$62
Maintain and manage the Refuge's natural and managed habitat areas and other facilities: Hire a Maintenance Worker/Heavy Engineering Equipment Operator to maintain the levees within the restored salt pond complex; install and maintain fencing and signage around the Refuge, where needed; annually conduct preseason nest site preparation on the D Street Fill and the salt pond levees; maintain and repair water structures, pumps, or other equipment needed to manage water in some of the salt ponds; and conduct other duties as necessary to maintain Refuge habitats and facilities.	1	$50	$55	$110
Implement the Refuge's various habitat management and monitoring plans: Hire a Biological Technician to assist the Wildlife Biologist in developing and implementing a Habitat Management Plan for the Sweetwater Marsh Unit and a future monitoring and maintenance plan for the restored salt ponds that include actions to improve and protect marsh quality (e.g., completion of an inventory of marsh species and mapping of special status species distribution/population size; improving conditions in upland transition areas on the Sweetwater Marsh Unit to benefit salt marsh bird's beak propagation; increasing control of invasive plants; performing annual monitoring).	1	$5	$40	$45
Improve volunteer services on the Refuge: Hire a volunteer coordinator to develop and implement a volunteer program that will support wildlife and habitat management (e.g., monitoring activity in least tern and snowy plover nesting colonies, assisting with revegetation programs) and visitor services (e.g., docent programs, nature guides).	.6	$5	$27	$32
Provide oversight of wildlife and habitat management programs: Hire a Supervising Wildlife Biologist to oversee all projects related to wildlife and habitat management, habitat restoration and enhancement, and listed species recovery on the Refuge.	.6	$5	$45	$50

Table D-4 Current Staffing Positions for the San Diego Coastal Refuges			
Staff Type	Employment Status	FTE	Salary Rating
Management			
Project Leader	PFT	0.6	GS 14
Deputy Project Leader	PFT	0.6	GS 13
Refuge Manager	PFT	1	GS 12
Refuge Operations Specialist	PFT	1	GS 11
Administrative			
Administrative Assistant	PFT	0.6	GS 7
Biology			
Wildlife Biologist	PFT	1	GS 11
Public Use			
Park Ranger	PFT	1	GS 5
Refuge Officer	PFT	1.5	GS 7/9
Information and Education Specialist	PFT	0.6	GS 11
Instructional Systems Specialist	PFT	0.6	GS 9
Refuge Planner	PFT	0.6	GS 12

Table D-5 Future (Proposed) Staffing for the San Diego Coastal Refuges			
Staff Type	Employment Status	FTE	Salary Rating
Management			
Project Leader	PFT	0.6	GS 14
Deputy Project Leader	PFT	0.6	GS 13
Refuge Manager	PFT	1	GS 12
Refuge Operations Specialist	PFT	2	GS 11
Administrative			
Administrative Assistant	PFT	0.6	GS 9
Receptionist/ Clerk/Typist	PFT	0.6	GS 6
Biology			
Supervising Wildlife Biologist	PFT	0.6	GS 12
Wildlife Biologist	PFT	1	GS 9
Biology Technician	PFT	1	GS 7

Table D-5 (continued)			
Public Use			
Park Ranger	PFT	1	GS 5
Volunteer Coordinator	PFT	0.6	GS 7
Information and Education Specialist	PFT	0.6	GS 11
Instructional Systems Specialist	PFT	0.6	GS 9
Refuge Planner	PFT	0.6	GS 12
Refuge Officer	PFT	1.5	GS 9
Maintenance			
Maintenance Worker/Heavy Engineering Equipment Operator	PFT	0.6	WG 8

Land Acquisition

The Service will continue to negotiate with the Port, City of Chula Vista, and State Lands Commission to secure management authority for all open water areas included within the approved acquisition boundary for the South San Diego Bay Unit.

H. Potential Funding Sources for Implementing CCP Projects

Several projects included in the CCP may be implemented in full or in part by sources other than the Refuge annual budget. These projects, which could include enhancement and restoration projects and public use-related projects, could be funded through partnerships with other local, state, or federal agencies, special legislative appropriations, or grants (i.e., Friends of the San Diego Refuges, National Fish and Wildlife Foundation, Ducks Unlimited, San Diego Audubon, Transportation Enhancement Funds). Other potential sources of funding for restoration projects include: the North American Wetlands Conservation Act Grants Program; the California Coastal Conservancy's Southern California Wetlands Recovery Project; the Service's National Coastal Wetlands Conservation Grant Program, if implemented in partnership with the State of California; the Cooperative Endangered Species Conservation Fund, also if implemented in partnership with the State of California; NOAA's Damage Assessment and Restoration Program for restoration projects applicable to specific oil spills or hazardous substance releases such as the American Trader Oilspill; restoration projects applicable to contaminants restoration programs (i.e., Montrose Settlements Restoration Program); and partnerships with the U.S. Army Corps of Engineers (Corps) under Sections 704, 906(b), and/or 1135 of the Water Resources Development Act of 1986. The Estuary Restoration Act of 2000 also authorizes a program under which the Corps can carry out restoration projects when the costs of the project are shared with non-Federal parties, however, funds to implement these types of programs have not yet been appropriated.

I. Partnership Opportunities

Long before the establishment of these Refuge Units, there was strong public interest in the protection, management, and stewardship of the habitats now preserved within the Refuge. This interest has continued, and several programs on the Refuge both existing and planned are made possible through a variety of public/private and interagency partnerships. Some of these partnerships focus on providing regionally significant environmental education programs (e.g., Sweetwater Safari and Habitat Heroes), while others focus on expanding opportunities for public

<u>use and improving habitat quality for fish and wildlife (e.g., clean ups sponsored by the Port, the Friends of the San Diego Refuges, and the Audubon Society, guided tours conducted by the Chula Vista Nature Center).</u> The proximity of the Refuge to urban development and the international border with Mexico, along with the designation of the Refuge as globally significant habitat, has and will continue to result in the development of unique and innovative partnerships with the local community and local, state, national, and international agencies and organizations.

Existing partnerships such as those between the Service and the Chula Vista Nature Center, San Diego Zoological Society, SeaWorld, SWIA, and many others will be strengthened and new partnerships will continue to be nurtured. New and existing partnerships will expand community support for the Refuge, increase stewardship of Refuge resources, and provide greater benefits to wildlife resources and the public than would be achievable within the Refuge's annual budgets.

Partnerships will be particularly important in obtaining funding to implement proposed habitat enhancement and restoration projects. More details regarding these types of partnerships are presented under the project funding and staffing discussion.

Appendix E

Summary of Public Scoping Comments

Appendix E: Summary of Public Scoping Comments

Introduction

The scoping process for the San Diego Bay NWR CCP is described in detail in Section 5.2 of the Final CCP/EIS. Comments related to the CCP were received via mail, email, and verbally at the initial scoping meetings. Additional comments were provided throughout the planning process, particularly during and immediately following the various public workshops held to address specific issues related to the CCP. A summary of the scoping comments is present below by topic.

Summary of Scoping Comments

ACQUISITION/BOUNDARY ISSUES

- Initiate the procedures necessary to take control (acquire/protect) of all lands and waters within the acquisitions boundaries for the South San Diego Bay Unit.
- Include all of the tidal mudflats in South San Diego Bay into the refuge boundaries, including the mudflats at Emory Cove, in the vicinity of the J Street Marina, and along Sweetwater Marsh.
- Extend the acquisition boundary for the South San Diego Bay Unit to the boundary for the Sweetwater Marsh Unit to create one continuous refuge.
- Incorporate into the Sweetwater Marsh Unit those portions of the D Street fill that are located to the north and west of the current refuge boundaries.
- Include all of Pond 20A within the South San Diego Bay Unit.

PUBLIC USE

General

- Emphasize the wildlife first perspective when considering the type and intensity of public uses to be permitted uses should not be permitted that would negatively impact endangered or other species.
- Limit public use because the refuge has been established for nesting birds.
- Link the public uses on the refuges to other public use areas, such as the Otay Valley River Park.
- Management goals should emphasize wildlife/habitat protection over public recreation uses.
- Promote ecotourism with minimal impacts to resources.
- Withhold final compatibility determination until population information is presented and analyzed.
- Include in the CCP, a thorough evaluation of all recreational activities presently allowed on the refuges and their impacts on native flora and fauna, especially threatened and endangered species.
- Maintain compatible wildlife-dependent recreational activities as a major component of the programs of the refuges.
- Strike a balance between wildlife and people, and manage the refuge as a place for people as well as wildlife, by accommodating passive, quiet human use.
- Manage public use to ensure that the refuge is maintained as a quiet place for waterfowl – the San Diego Bay is heavily used in almost all other areas, even kayaks in small numbers could have an impact on waterfowl.

- Don't restrict access to the refuges; rather take this as an opportunity to build support from future generations.

Hunting/Fishing
- Provide opportunities for dog trials and retrieval training.
- Prohibit dogs on the refuge.
- Provide opportunities for hunting.
- Prohibit consumptive use of wildlife on the refuge.
- Provide opportunities for fishing.
- There are enough fishing opportunities elsewhere in San Diego.
- Provide for youth-related hunting and fishing experiences.
- Prohibit hunting on the refuge.

Wildlife Observation
- Provide visual access to the bird colonies on the Salt Works through the use of video cameras.
- Provide access on the levees for viewing migratory birds within the Salt Works.
- Provide elevated bird blinds at the edges of the Salt Works to provide views of the migratory birds.
- Integrate bird viewing areas along the proposed Bayshore Bikeway.
- Consider the installation of elevated viewing platforms for wildlife viewing between 11th and 12th Streets next to the bike path and north of the Salt Works in the industrial area.
- Preserve the existing sound (ambient noise) characteristics of the salt ponds – avoid increasing human generated sounds in order to preserve evening silence, existing bird "chatter", and other nature sounds of this environment.

Wildlife Photography
- Provide bird blinds specifically for photographers.
- Provide for tourist photo opportunities.

Environmental Education
- Encourage more involvement with schools (K-6).
- Promote education by providing access for kids.
- Provide education/interpretive programs at the South Bay Unit and Paradise Marsh.
- Select places to education the public about these coastal resources that will not result in impacts in birds in the area.
- Educate the public about endangered species and how their survival is linked to human survival.
- Provide educational opportunities/birding brochures in Spanish.
- Working with partners, such as the City of National City and Paradise Creek Educational Park Inc., develop interpretive park elements in Paradise Marsh.
- Explain in the CCP how environmental education and interpretation will be provided and identify how these programs will relate to and support the purpose of the refuges.

Environmental Interpretation
- Provide duck feeding stations.
- Consider South Grand Caribe Island as a place for an interpretive stop on a kayak trail.
- Develop a comprehensive (e.g., biological resources, history, agriculture, culture, industry) and coordinated interpretive signage program around San Diego Bay.

- Create a multi-agency brochure that illustrates where all the interpretive signage around the bay are located.
- Establish a satellite interpretive facility near Bay View Elementary School.
- Provide interpretive areas/features through the refuge areas.

Boating

- Provide kayaking opportunities in the South Bay, including interpretive trails, resting areas and rentals.
- Provide a viewpoint for boaters, such as an island.
- Establish restrictions for boats and aircraft, including ultra-lights.

Trails

- Provide seasonal walking/jogging/birding trail around Ponds 10 and 11.
- Prohibit public access within the salt works.
- Limit public access to those areas in which such use would be compatible with wildlife resources, since inappropriate public access could result in impacts to threatened and endangered species, as well as all other nesting birds.
- Provide for a walking path adjacent to the Bayshore Bikeway.
- Allow bicycles to ride to Gunpowder Point on the Sweetwater Marsh Unit.
- Reduce motorized activity through Sweetwater Marsh.
- Consider the installation of boardwalks south of the J Street Marina over the existing mudflats and near the county park on the west side of the bay.
- Limit access to designated trails only and consider the use of physical barriers to ensure that trail users stay on the trail.
- Allow seasonal use of the dikes for walking.

Research

- Identify research opportunities that the refuge can support without adversely impacting biological resources or wildlife-dependent recreation.

WILDLIFE/HABITAT MANAGEMENT

General

- Develop management goals that are science-based and reflect the principles of conservation biology.
- Conduct a rigorous biological assessment and inventory of all flora and fauna inhabiting the refuge.
- Prior to planning, complete a thorough discussion and investigation of the biological integrity, diversity, and environmental health of the refuge areas.
- Follow the standardized sequence for refuge planning suggested in "Science-Based Stewardship: Recommendations for Implementing the National Wildlife Refuge System Improvement Act" (biological inventory ⇒ identification of plan goals ⇒ identification of threats ⇒ choice of focal species ⇒ CCP ⇒ monitoring and implementation ⇒ plan amendment [according to monitoring results]).
- Protect and, where appropriate, enhance wildlife habitat.
- Prepare monitoring and management procedures, define species habitat and monitoring protocols consistent with the MSCP protocols; conduct data management and reporting to allow integration with other MSCP preserve areas.
- Identify potential stressors of the lower Otay River and Sweetwater River systems.
- Ensure that conservation efforts/management do not degrade existing suitable habitat.
- Avoid developing a CCP that is a "mitigation dump."

- Reintroduce extirpated species.
- Incorporate adaptive management into the CCP through management goals, objectives, and strategies.
- Create corridors to connect different areas of the refuge.
- Avoid Habitat Evaluation Process (HEP) analysis.
- Preserve/enhance brackish marsh/freshwater habitat interface.
- Develop and maintain a database of pertinent scientific information regarding habitats and wildlife.
- Discuss in the CCP how anticipated trends in human population density and recreational use and other significant trends or anticipated problems will affect the distribution and abundance of native plants and animals on the refuges.

Predator Control
- Provide aggressive predator control for the protection of threatened and endangered species and other nesting species.
- Eliminate domestic and feral cats from the refuge year round.
- Make the dikes at the salt works predator proof.
- Use effective, long-term management strategies for protecting threatened and endangered species that are both humane and socially acceptable.
- Include a thorough discussion of predator control in the CCP.
- Incorporate into the predator control discussion, recent scientific research regarding non-lethal predator management methods for protection of threatened and endangered species, specifically with regard to predator exclusion techniques.

Consideration of Specific Organisms
- Consider the effects of restoration proposal on all species, not just endangered species (i.e. shorebirds versus least tern).
- Maintain/enhance existing habitat values for all currently occurring native species (shorebirds, nesting habitat for terns and shorebirds).
- Restore waterfowl habitat to original conditions, provide habitat for brants and widgeons.
- Create salt marsh that provides functional habitat for Belding's savannah sparrows, clapper rails, etc.
- Include specific management strategies for sea turtles.
- Consider insects, including wandering skipper, salt marsh skipper, globos dune beetle, tiger beetle, and lutica sand spiders, in protection, enhancement, and restoration planning.
- Study invertebrate populations in all habitats, terrestrial and aquatic.
- Restore the population of silvery legless lizards in the dunes.
- Pursue rare plant restoration and enhancement for species such as *Dudleya variegata* and *Lotus nuttlaliauus*.
- Establish as the primary management goal actions that benefit wintering and breeding birds.
- Optimize habitat conditions during the winter as well as during breeding season.
- Maximize nesting sites for terns, skimmers, and plovers.
- Manage the refuge primarily for the protection of migratory birds, breeding, and wintering birds.

Salt Ponds
- Consider the existing benefits of the salt works for shorebird use.
- Preserve brine shrimp, brine fly, hypersaline habitat to provide food source.
- Restore marsh habitat in the salt ponds without destroying the hypersaline habitat.

- Maintain the current salt works to preserve the current hypersaline environment.
- Restore the habitat in the salt ponds.
- Develop an understanding of the salt works ecosystem and its benefit before implementing changes.
- Explore if and how brine shrimp could be maintained in the salt ponds without making salt.
- Understand the different target areas of habitat enhancement/restoration will have different impacts on the integrity of salt production capacity (the more dilute the unit, the less effect on the system).
- Phase any changes in the salt operation to avoid impacts to existing habitat quality – don't disrupt the biogeochemistry of the system.
- Investigate various sizes of salt works operations that would be consistent with management objectives.
- Maintain the dikes within the salt ponds whether or not the salt making operation is continued.
- Breach the dikes within the salt ponds to create islands, if the salt making operations are discontinued.
- Consider creating nesting islands in the salt ponds.
- Consider Pond 10A as important biological habitat for herons and egrets.

Uplands

- Preserve upland transition areas and upland habitat around the Bay for sensitive and candidate species such as Loggerhead Shrike, Burrowing Owl, Northern Harrier, Horned Lark, and jack rabbit.

RESTORATION

Sweetwater Marsh Unit

- Restore Paradise Marsh, including reworking unsuccessful or incomplete restoration projects.
- Expand and reconnect the former 5.6 acres of marsh north of F Street to the F&G Street Marsh. Remove J Street in this area.
- Restore and improve tidal action in the F&G Street Marsh.

South San Diego Bay Unit

- Restore the degraded portions of the Otay River, while protecting existing important shorebird foraging areas.
- Integrate the restoration of Nestor Creek into the Otay River restoration proposals
- Restore coastal sage scrub on Egger-Ghio.
- Re-establish corridors between the Otay River Valley and the Bay for upland birds.
- Restore degraded salt ponds.
- Determine the most appropriate hydrologic restoration objectives for Egger-Ghio, and then develop a conceptual habitat restoration plan that is consistent with these objectives.
- Seek to correct problems at the Chula Vista Wildlife Reserve.
- Evaluate the extent of restoration, protection, and enhancement of habitats that is needed to sustain healthy populations of native plants and animals on the refuge.

MANAGEMENT OF INVASIVE SPECIES

- Eliminate/control non-native, invasive plants.
- Control/eradicate populations of Argentine ants on the refuge.
- Develop strategies for preventing new invasive species from becoming established on the refuges.

- Identify the current invasive species problems on the refuges and identify appropriate management responses.

HYDROLOGY/WATER QUALITY

- Identify methods for improving the quality of the runoff/storm water that flows from Nestor Creek and the Otay River, while also improving wetlands.
- Conduct a hydrologic study of Nestor Creek to determine if there is a connection between South Bay and the Tijuana floodplain.
- Evaluate the geomorphology of the lower Otay River, including its tributary canyons, to determine which wetland communities can be supported in the area.
- Address measures needed to maintain or restore water quality.

OPERATIONS

General Issues

- Develop a management overlay for the north end of the Otay River to give the Service some management authority.
- Monitor speeds in the bay and strictly enforce the 5 mph speed limit.
- Ensure adequate staff, training, and equipment for the refuge.
- Establish a long-term, extensive monitoring/research program to evaluate changes on the refuge.
- Monitor and record public access effects on wildlife.
- Secure the perimeter of the Sweetwater Marsh Unit to minimize unauthorized public access, particularly at the Sweetwater Channel and Paradise Creek intersection.

PROCDURAL ISSUES

- Conduct bilingual meetings and provide bilingual handouts/meeting notices.
- Work closely with the environmental community.
- Involve a group of stakeholders in the planning process.
- Allow Audubon to participate on the core team.
- Conduct single-issue public workshops.
- Make the vision statement and goals for the refuges available for public review and comment during the scoping and well before the preparation of the CCP and NEPA document.
- Take care to ensure that compliance with both NEPA and the Refuge Act are accomplished in the combined draft CCP/environmental document.
- Ensure that the California Department of Fish and Game is given the opportunity to participate in the process.
- Establish mechanisms to provide for thorough and responsive feedback to public comments made during the planning process.

PLANNING

- Allow for green space/park on the south end of Pond 20A and Egger-Ghio.
- Consider the inclusion of an oil spill mitigation plan in the CCP.
- Provide graphics in the CCP that demonstrate how the coastal areas are connected to the inland areas.
- Keep the planning process short and begin implementation immediately upon CCP approval.
- Consider the regional planning resource conservation and management objectives for the lower Otay River and Sweetwater River when developing the CCP.
- Address the relationship of the CCP to other existing landscape-level planning efforts.

- Establish and clearly state priorities for the activities proposed in the plan.

ADJACENT LAND USES
- Identify opportunities to connect commercial interests to the refuge.
- Work to achieve a good transition between Refuge property and any future commercial development that occurs on the south end of Pond 20A.
- Limit development between the two portions of Sweetwater Marsh and the adjacent bay front.
- Coordinate with Chula Vista planning regarding development adjacent to Sweetwater Marsh.

PARTNERSHIPS
- Identify specific partnership opportunities for funding projects or creating volunteer projects.

STEWARDSHIP PROJECT ISSUES
- Protect the snowy plover nesting areas on the site.
- Identify mitigation for the Navy on the Stewardship Project area – then the Stewardship Project could be replaced with a Refuge Overlay.
- Restore vernal pool habitat on the site.
- Remove *Carpobrotas edulis* at the site before it takes over everything on the dunes and other uplands.
- Survey for fairy shrimp in the existing vernal pools.

BAYSHORE BIKEWAY
- Provide screening along the bikeway in locations where shorebirds using the salt pond areas could be flushed.
- Select the least destructive route for the bikeway.
- Reroute the bike path from the tracks to the berm located on the south side of the tracks to allow more opportunities for river restoration.
- If Pond 20A is developed, aligned the bike path within the refuge/development interface.
- Upgrade the existing bike path.
- Complete the Bayshore Bikeway from E Street north to 24th Street.

MISCELLANEOUS QUESTIONS
- What is the timing for beginning work on the Stewardship Project?
- Why is Pond 20A excluded from the Refuge boundary, since it is an integral part of the system?
- Is the western refuge boundary provided on the maps correct? Why are the channels leading to the Coronado Cays not shown on the maps? What is their status with regards to the Refuge? Does the FWS have jurisdiction over them? Was this negotiated before the refuge was established?
- Who should someone call to report unauthorized activity on the refuge?
- Who has jurisdiction on the refuge (land/water)?
- If the South Bay Power Plant goes off line, what constraints would be placed on restoration due to the presence of sea turtles in the area?
- What is the biological status of pond 20A?
- Is the Comprehensive Conservation Plan a regulatory document for a local jurisdiction?
- What is the full range of alternatives that may be considered?

- The recognition of edge effects typically has what response from your agency, internal or external redress?
- Does a Comprehensive Conservation Plan include recommendations for land use changes or development standard modifications on properties adjacent, upstream, or near a refuge?
- Will hunting be considered as a possible public use on the refuge?
- Will there be any consideration of proposing additional boating restrictions on the Bay?

Appendix F

Description of the Salt Works Operation

Appendix F: Description of the Salt Works Operation

Brief History

The first formal reference to a commercial solar salt operation in south San Diego Bay is that of the La Punta Salt Works, which according to historic records began salt production in 1871 (*Gustafson and Gregory 2001*). Salt production in the south bay may however have begun prior to that time, based on one record from the San Diego Division of Natural Resources that cited 300 tons of salt production in San Diego Bay in 1870. The exact location of the La Punta Salt Works has not been verified, but is believed to have been located to the southwest of the current salt plant on Bay Boulevard. This facility appears to have been in operation until about 1901. In 1902, the Western Salt Company established a solar salt operation about a quarter of mile northeast of the La Punta Salt Works (*Gustafson and Gregory 2001*) within a portion of the present day salt works. By 1911, this operation had expanded into the south end of the bay. Additional changes to the configuration of the ponds have occurred since that time. The current operation encompasses approximately 1,035 acres and incorporates much of the southern end of San Diego Bay (Figure F-1). With the exception of brief closure in 1916 when flood waters severely damaged the salt plant and several ponds, salt has been produced continuously at this site since 1902.

Current Operation

South Bay Salt Works is the current operator of this facility, which produces salt through a process of solar evaporation. The salt works consists of a series of diked ponds (Figure F-2) that are designed to facilitate the concentration and ultimate precipitation of salts from bay water. Once seawater is taken from the bay, it is moved between the ponds through pumping and gravity flow. Approximately 60,000 to 80,000 tons of common salt (sodium chloride) are produced each year at this facility. This salt is sold commercially and used for water softeners, nitrate removal, ion exchange, pickling, deicing, as a dying additive, brine for petroleum products, and in the tuna industry as a means of controlling brine temperatures. Another salt produced as a byproduct of solar salt production is magnesium chloride, which is purchased by several industrial users in the area.

The evaporation ponds that form this solar salt operation can be divided into four categories based on specific gravity, which is defined as the ratio of the mass of a sample of seawater to the mass of an equal volume of pure water (*Stadtlander and Konecny 1994*). The four categories of ponds include the primary system, secondary system, crystallizer system, and the heavy brine or bittern ponds (refer to Figure F-2). Throughout the solar salt production industry, salinities in salt ponds are measured using a hydrometer scale, which describes salinity in degrees Baume (°Be) rather than specific gravity. A more common way of describing salinity would be in terms of total dissolved solids or parts per thousand (ppt). The conversion from °Be to total dissolved solids (TDS) or ppt is: TDS = (13 x °Be) – 21 (*Siegel and Bachand 2002*). In terms of TDS, the average salinity value for seawater is 35 ppt (*Siegel and Bachand 2002*). In San Diego Bay, salinity levels can be quite variable, particularly at the south end of the bay. Mean salinity within the south bay between July 1994 and April 1999 ranged from 31.6 ppt in April 1998 to 38.6 ppt in October 1996 (*Allen 1999*).

Figure F-1
Location of the Salt Works in San Diego Bay

Source: USFWS, Local Agency Partnership 2000 (2 ft imagery)

Carlsbad Field Office - 2003
/stem/stacey/ssdbay/fig_4-03/figures.apr

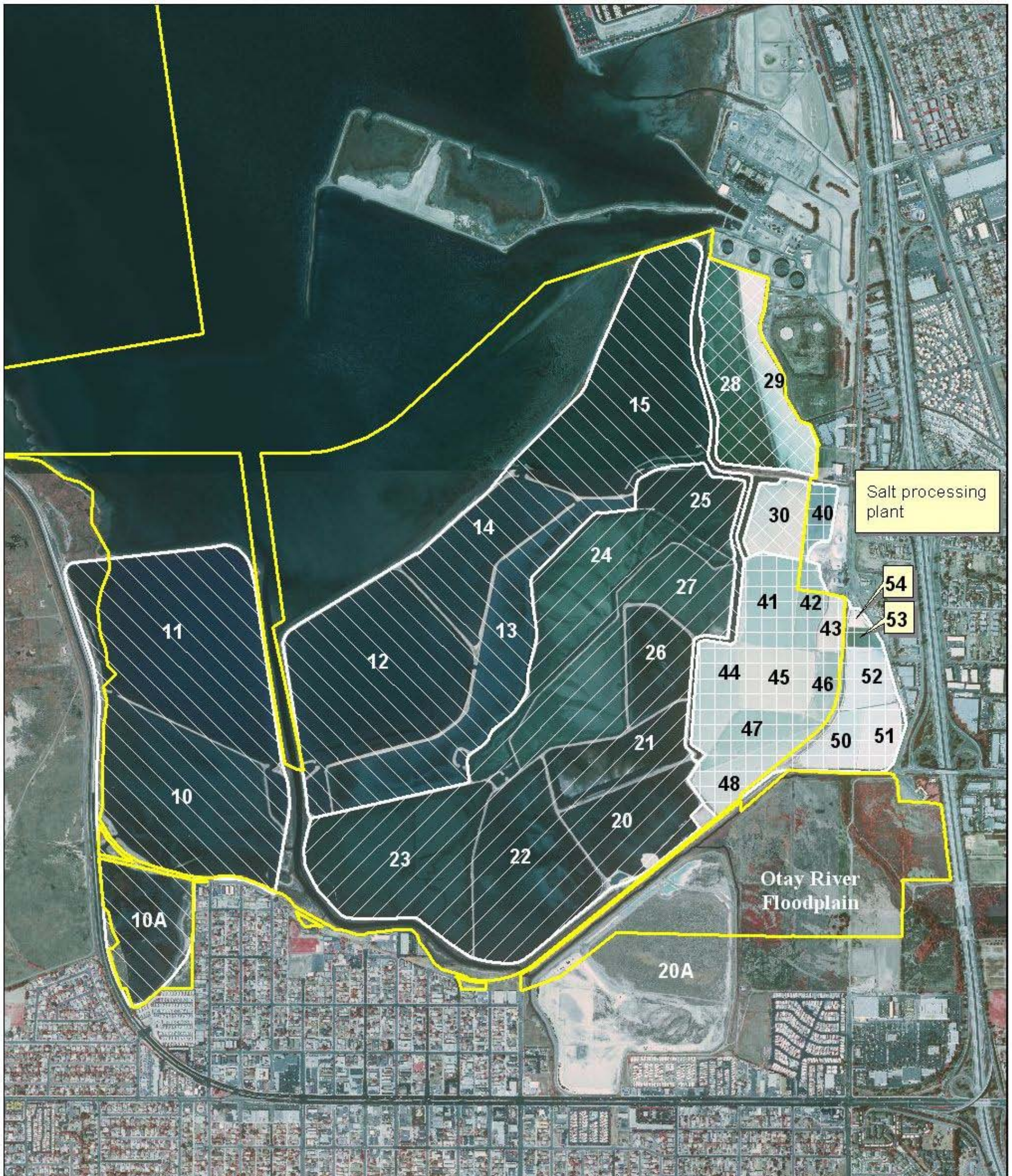

Figure F-2 South Bay Salt Works

Primary ponds | Pickling ponds | Refuge management boundary
Secondary ponds | Crystallizer ponds

N
500 0 500 1000 Feet

Source: USFWS, Local Agency Partnership 2000 (2 ft imagery)

Carlsbad Field Office - 2003
/stem/stacey/ssdbay/fig_4-03/figures.apr

To produce salt within the salt pond system, bay water is introduced into the primary pond system, which includes Ponds 10A and 10 through 15, through a tide gate located between the Otay River and Pond 10. This gate is pressure-regulated opening and allowing intake of water when the tidal level in the river is higher than the pond level. As the tidal level in the river lowers, the water pressure on the pond side closes the gate. As the water moves through this primary system, it is transported from Pond 11 to Pond 12 via a 30-inch siphon pipe that extends under the Otay River. The water is moved through the primary pond system via gravity flow as the appropriate salinity levels are reached in each pond. By the time the incoming seawater has reached the end of the primary system, the salinity has increased from 3.5 °Be to between 7 and 10 °Be or 70 to 109 ppt (*Western Salt Company 1997*). Once in the system, the water in the ponds is often referred to as brine. The depth of the primary ponds varies due to topographic variation within each pond, as well as due to seasonal variations in volume of water present in each pond. Although the average depth in these ponds is approximately three feet, the water level in Pond 10A can be significantly lower and during some parts of the year, the bottom of the pond may be exposed. During the intake of bay water into the system, a variety of fish and crustacean species enter the primary system, where they are able to tolerate the slightly increased salinities of bay water within the initial ponds of the primary system.

As needed, the brine is lifted by pump to the secondary system (Ponds 20 through 27), which consists of a series of smaller ponds. As the brine moves through the system, the salinities increase from 7 °Be to 19.5 °Be (70 to 232 ppt). Pond depths range from two to five feet at center. At about 12.9 °Be (147 ppt) gypsum, a crystal formed from the chemical precipitation of calcium and sulfate to form calcium sulfate, begins to precipitate from the water column forming a gypsum crust on the bottom of the ponds (*Siegel and Bachand 2002*). While attempting to survey the bottom elevations of these ponds, Ducks Unlimited engineers discovered that the gypsum crust in these ponds is highly irregular, with formations reminiscent of those gypsum formations found in Mono Lake.

At the end of the secondary system are the pickling ponds (Ponds 28, 29 and 30), which have salinities that range from between 15 °Be and 25.5 °Be (174 to 310 ppt). These ponds are used to distribute the concentrated brine into the crystallizer ponds. It is also in this part of the system that most of the remaining gypsum precipitation occurs. At about 25.5 °Be (310 ppt) the brine is saturated with sodium chloride and bittern salts (more soluble salts and ions consisting primarily of chloride, magnesium, sulfate, potassium, and bromide) and is ready to be introduced to the crystallizer system.

Precipitation of sodium chloride occurs within the crystallizer ponds (Ponds 40 through 48 and 50 through 52), which have salinities ranging from 25.5 to just under 29 °Be (310 to 356 ppt). (It should be noted that although Ponds 40 and 50 through 54 are not located within the refuge boundary, these areas are currently leased by the salt works operator for use in the existing solar salt operation.) Once the salt has precipitated out, the pond is drained and the salt is removed from the crystallizer ponds with heavy equipment such as front-end loaders.

Brine is eliminated from the crystallizer ponds before it reaches 29 °Be because brine of less than 29 °Be and brine of 29 °Be or greater do not mix. This situation can result in uneven crystal development. The brine discharged from the crystallizer ponds is referred to as heavy brine or bittern, which has a salinity of 29 to 30 °Be (356 to 369 ppt). Bittern is comprised of sodium chloride, magnesium sulfate and magnesium chloride. Sodium chloride and magnesium sulfate continue to be precipitated out in this part of the system, leaving magnesium chloride in a liquid state that is sold to local industry. The salts that precipitate out during this process are harvested and deposited into an unused production pond before being redistributed throughout the system (*Western Salt Company 1997*).

Once the salt is removed from the crystallizer ponds, it is transported to the washer complex where it is washed and rinsed. It is then moved to a stockpile for drying and then processed for sale in bags or shipped in bulk as needed to commercial and industrial users.

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Appendix G

Federal and State Ambient Air Quality Standards

Ambient Air Quality Standards

Pollutant	Averaging Time	California Standards [1]		Federal Standards [2]		
		Concentration [3]	Method [4]	Primary [3,5]	Secondary [3,6]	Method [7]
Ozone (O_3)	1 Hour	0.09 ppm (180 $\mu g/m^3$)	Ultraviolet Photometry	0.12 ppm (235 $\mu g/m^3$)[8]	Same as Primary Standard	Ultraviolet Photometry
	8 Hour	—		0.08 ppm (157 $\mu g/m^3$)[8]		
Respirable Particulate Matter (PM10)	24 Hour	50 $\mu g/m^3$	Gravimetric or Beta Attenuation	150 $\mu g/m^3$	Same as Primary Standard	Inertial Separation and Gravimetric Analysis
	Annual Arithmetic Mean	20 $\mu g/m^3$		50 $\mu g/m^3$		
Fine Particulate Matter (PM2.5)	24 Hour	No Separate State Standard		65 $\mu g/m^3$	Same as Primary Standard	Inertial Separation and Gravimetric Analysis
	Annual Arithmetic Mean	12 $\mu g/m^3$	Gravimetric or Beta Attenuation	15 $\mu g/m^3$		
Carbon Monoxide (CO)	8 Hour	9.0 ppm (10mg/m^3)	Non-Dispersive Infrared Photometry (NDIR)	9 ppm (10 mg/m^3)	None	Non-Dispersive Infrared Photometry (NDIR)
	1 Hour	20 ppm (23 mg/m^3)		35 ppm (40 mg/m^3)		
	8 Hour (Lake Tahoe)	6 ppm (7 mg/m^3)		—	—	—
Nitrogen Dioxide (NO_2)	Annual Arithmetic Mean	—	Gas Phase Chemiluminescence	0.053 ppm (100 $\mu g/m^3$)	Same as Primary Standard	Gas Phase Chemiluminescence
	1 Hour	0.25 ppm (470 $\mu g/m^3$)		—		
Sulfur Dioxide (SO_2)	Annual Arithmetic Mean	—	Ultraviolet Fluorescence	0.030 ppm (80 $\mu g/m^3$)	—	Spectrophotometry (Pararosaniline Method)
	24 Hour	0.04 ppm (105 $\mu g/m^3$)		0.14 ppm (365 $\mu g/m^3$)	—	
	3 Hour	—		—	0.5 ppm (1300 $\mu g/m^3$)	
	1 Hour	0.25 ppm (655 $\mu g/m^3$)		—	—	—
Lead[9]	30 Day Average	1.5 $\mu g/m^3$	Atomic Absorption	—	—	—
	Calendar Quarter	—		1.5 $\mu g/m^3$	Same as Primary Standard	High Volume Sampler and Atomic Absorption
Visibility Reducing Particles	8 Hour	Extinction coefficient of 0.23 per kilometer — visibility of ten miles or more (0.07 — 30 miles or more for Lake Tahoe) due to particles when relative humidity is less than 70 percent. Method: Beta Attenuation and Transmittance through Filter Tape.		No Federal Standards		
Sulfates	24 Hour	25 $\mu g/m^3$	Ion Chromatography			
Hydrogen Sulfide	1 Hour	0.03 ppm (42 $\mu g/m^3$)	Ultraviolet Fluorescence			
Vinyl Chloride [9]	24 Hour	0.01 ppm (26 $\mu g/m^3$)	Gas Chromatography			

See footnotes on next page …

1. California standards for ozone, carbon monoxide (except Lake Tahoe), sulfur dioxide (1 and 24 hour), nitrogen dioxide, suspended particulate matter—PM10, PM2.5, and visibility reducing particles, are values that are not to be exceeded. All others are not to be equaled or exceeded. California ambient air quality standards are listed in the Table of Standards in Section 70200 of Title 17 of the California Code of Regulations.

2. National standards (other than ozone, particulate matter, and those based on annual averages or annual arithmetic mean) are not to be exceeded more than once a year. The ozone standard is attained when the fourth highest eight hour concentration in a year, averaged over three years, is equal to or less than the standard. For PM10, the 24 hour standard is attained when the expected number of days per calender year with a 24-hour average concentration above 150 $\mu g/m^3$ is equal to or less than one. For PM2.5, the 24 hour standard is attained when 98 percent of the daily concentrations, averaged over three years, are equal to or less than the standard. Contact U.S. EPA for further clarification and current federal policies.

3. Concentration expressed first in units in which it was promulgated. Equivalent units given in parentheses are based upon a reference temperature of 25°C and a reference pressure of 760 torr. Most measurements of air quality are to be corrected to a reference temperature of 25°C and a reference pressure of 760 torr; ppm in this table refers to ppm by volume, or micromoles of pollutant per mole of gas.

4. Any equivalent procedure which can be shown to the satisfaction of the ARB to give equivalent results at or near the level of the air quality standard may be used.

5. National Primary Standards: The levels of air quality necessary, with an adequate margin of safety to protect the public health.

6. National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.

7. Reference method as described by the EPA. An “equivalent method” of measurement may be used but must have a “consistent relationship to the reference method” and must be approved by the EPA.

8. New federal 8-hour ozone and fine particulate matter standards were promulgated by U.S. EPA on July 18,1997. Contact U.S. EPA for further clarification and current federal policies.

9. The ARB has identified lead and vinyl chloride as 'toxic air contaminants' with no threshold level of exposure for adverse health effects determined. These actions allow for the implementation of control measures at levels below the ambient concentrations specified for these pollutants.

California Air Resources Board (7/9/03)

Appendix H

Air Quality Calculations

Jones & Stokes

September 30, 2004

Ms. Victoria Touchstone
U.S. Fish and Wildlife Refuge Complex
6010 Hidden Valley Road
Carlsbad, CA 92009

RE: Air Emission Estimates for the South Bay Salt Works (Requisition 1168040039)

Dear Ms. Touchstone:

As you requested, Jones & Stokes has generated emission estimates for two restoration alternatives (14 scenarios) described in the Sweetwater Marsh and South San Diego Bay Units of the San Diego Bay National Wildlife Refuge draft Comprehensive Conservation Plan and Environmental Impact Statement.

The emission estimates were generated to determine whether either of the project's alternatives would generate construction-related emissions that exceed the federal conformity thresholds for criteria pollutants, specifically reactive organic gases (ROG), carbon monoxide (CO), nitrogen oxides (NOx), or particulate matter less than 10 microns in diameter (PM10). At this time, a conformity analysis is not required for PM2.5.

The emission estimates were based on information provided for each restoration alternative, which included project schedule, soil import/export estimates (cubic yards of material), estimated truck trips needed to haul material, and estimates of the type and numbers of construction equipment that would be used for individual project phases. This information was to generate estimates of exhaust emissions and fugitive dust (PM10) generation. Exhaust emissions included on-road vehicles; such as trucks used to haul material on- and off-site, vendor trips, and worker commute trips. Exhaust emissions also included off-road construction equipment emissions.

The California Air Resources Board's (ARB) EMFAC2002 model was used to generate estimates of on-road vehicle emissions. Off-road emissions were based on ARB's off-road construction model. A modified version of the road construction emissions model was used to generate estimates of fugitive dust emissions and worker commute trips.

The emission estimates generated for each scenario are summarized in the following table. They show that each of the alternatives would generate emissions substantially below the federal

Jones & Stokes

conformity thresholds applicable within the San Diego Air Basin. Consequently, a conformity determination would not be required for this project.

	TONS PER YEAR			
Options	ROG	CO	NOx	PM10
Otay Option 1 only	1	9	11	4
Otay Option 1 and Salt Works Option 1	3	23	27	10
Otay Option 1 and Salt Works Option 2	3	25	28	8
Otay Option 2 only	2	16	16	4
Otay Option 2 and Salt Works Option 1	4	29	32	9
Otay Option 2 and Salt Works Option 2	4	30	32	9
Salt Works Option 1 only	2	14	15	5
Salt Works Option 2 only	2	15	16	6
Restored Salt Ponds	1	8	11	5
Restored Salt Ponds + Otay Restoration Option 1	3	18	22	10
Restored Salt Ponds + Otay Restoration Option 2	3	24	27	9
Restored Salt Ponds (Breach)	2	11	13	5
Restored Salt Ponds (Breach) + Otay Restoration Option 1	3	21	25	10
Restored Salt Ponds (Breach) + Otay Restoration Option 2	4	27	30	9
Conformity Threshold (tons/year)	100	100	100	100

Please let me know if you have any questions or concerns regarding these emission estimates.

Sincerely,

Tim Rimpo
Air Quality Project Director

Appendix I

Hydrodynamic Modeling Analysis

Lower Otay River Salt Marsh
and Wetland Restoration:
Hydrodynamic Modeling Analysis

Prepared for

The United States Fish and Wildlife Service

and

Ducks Unlimited, Inc.

Prepared by

Philip Williams & Associates, Ltd.

October 1, 2003

PWA Ref. 1594

Services provided pursuant to this Agreement are intended solely for the use and benefit of The United States Fish and Wildlife Service and Ducks Unlimited.

No other person or entity shall be entitled to rely on the services, opinions, recommendations, plans or specifications provided pursuant to this agreement without the express written consent of The United States Fish and Wildlife Service and Ducks Unlimited in coordination with Philip Williams & Associates, Ltd., 720 California Street, 6th Floor, San Francisco, CA 94108.

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1. INTRODUCTION

The U.S. Fish and Wildlife Service (FWS) and Ducks Unlimited (DU) contracted Philip Williams & Associates (PWA) to conduct a hydraulic analysis of the Lower Otay River, within Planning Unit A of the South San Diego Bay Unit of the San Diego National Wildlife Refuge. More specifically, PWA evaluated potential changes in flooding conditions associated with wetland restoration alternatives. FWS and DU staff had developed general alternative concepts for Planning Unit A to enhance and restore tidal and freshwater wetland habitats. PWA translated these general restoration concepts into representative surface and channel models of the site for use in the hydraulic analysis. PWA developed a one-dimensional hydrodynamic model to simulate surface water elevations for existing conditions and project alternatives.

Section 2 of this report describes the project site's physical setting and introduces restoration opportunities at regional and site-specific scales. Section 3 describes the hydraulic analysis including a discussion of the modeling approach, data sources, and modeling results for the existing baseline condition. In Section 4, restoration alternatives developed by the DU/FWS team are presented and compared to the baseline condition in terms of water surface elevations, changes in wetland area, excavation volume required, and potential scour conditions near the railroad bridge. In Section 5, this report concludes with a discussion of next steps to continue the restoration effort of the Lower Otay River site.

2. LOWER OTAY RIVER PROJECT SETTING

2.1 HYDROLOGIC AND GEOMORPHIC SETTING

The Otay River watershed is located in southwestern San Diego County encompassing approximately 143 square miles (Figure 2-1). From its mouth at the southern end of San Diego Bay, the elongated pear-shaped basin extends 25 miles east into the Cleveland National Forest. The maximum watershed elevation is 3,300 ft at White Mountain. The Otay basin is bordered by the Telegraph and Sweetwater basins to the north and the Tijuana watershed to the south. The Otay watershed includes two water supply reservoirs (Upper and Lower Otay Reservoirs), which influence downstream hydrologic conditions. The upper watershed (upstream of the reservoirs) is comprised of steep mountainous slopes with mostly igneous and metamorphic substrate. The steep tributary channels of the upper watershed have slopes averaging from 3 to 6%. Downstream of Savage Dam (Lower Otay Reservoir) tributary channels are generally less steep with average slopes between 2 to 3%. The western lower portion of the watershed is generally underlain by marine sediments that have been uplifted to create the characteristic mesa landscape. In the vicinity of the Highway 5 bridge crossing (towards the project site), the Otay River has a channel slope of less than 1% and is generally a sand and cobble bed stream. Towards the project site, bed materials tend towards finer sands, silts, and ultimately muds upon reaching the estuarine zone. The majority of the upper Otay watershed is unincorporated, but the lower watershed includes portions of the cities of Chula Vista, Imperial Beach, Coronado, National City, and San Diego.

The lower Otay River project site (between the Highway 5 crossing and San Diego Bay) represents a transitional hydrologic zone between a fluvial dominated riverine system upstream and a tidally dominated estuarine system downstream. As such, the project site involves a complex mixing of freshwater, brackish, and tidal flows and hosts a mosaic of habitat types. An early map of San Diego Bay from 1859 (Figure 2-2) provides an excellent reference to understand how the system functioned historically prior to subsequent impacts. As seen in the map of Figure 2-2, in 1859 the Otay river mouth was a deltaic feature that sloped northwesterly towards San Diego Bay. Three to four principal drainage channels crossed the deltaic plain, with the central bolder channel most likely being the direct conduit to the Otay River upstream. Depending upon the frequency and magnitude of episodic flood events, these principal channels would have shifted across the deltaic marsh plain. The hachuring, in Figure 2-2, between the principal channels indicates a tidal marsh environment that was regularly inundated. Towards the bay-ward fringe of the salt marsh, smaller tidal-slough type channels are seen that would have conveyed ebb and flood tides to and from the outer marsh plain.

Since the 1859 mapping, several significant impacts to the lower Otay River project area impaired its hydrologic, geomorphic, and ecologic functioning as a river-mouth/delta/marsh plain complex. The more significant of these impacts include: (1) constructing several dikes and levees to support salt ponds north of the project site; (2) relocating and reshaping of Otay and Nestor creeks through the project area; (3)

construction and operation of railroad dyke and bridges through the project area; (4) placing up to several feet of fill in a variety of places within the project site, to support agricultural practices; and (5) developing and operating a sanitation treatment plant in the 1950s and 1960s which was later reduced and transformed into a pumping station and pipeline.

2.2 PROJECT SITE CHARACTERISTICS

The Planning Unit A site is bordered by levees and ponds of The Western Salt Works Company to the west, northwest, and north; and Interstate-5 to the east. The southern project boundary bisects the Pond 20A site, Nestor Creek, and joins Interstate-5 near the southern most of the two Otay River bridge crossings (Figure 2-3). The Planning Unit A site is approximately 140 acres. The Pond 20A site is approximately 110 acres; 68 acres of which are administered under the authority of the Port of San Diego and 32 acres administered by the FWS. While Pond 20A is not formally a piece of the National Wildlife Refuge, for future planning and restoration purposes it is useful to consider Pond 20A in coordination with Planning Unit A. Topographically, the project site is generally flat, with a gradual slope from the southeast to the northwest (Figure 2-4). Ground elevations range from roughly 18 ft (NAVD88) near the Interstate-5 crossing and along the tops of the surrounding levees (Pond 20A and Western Salt Works levees) to approximately 6 ft (NAVD88) within Pond 20A. The channel profile of the Otay River ranges in elevation from about 8 ft (NAVD88) near Interstate 5 to –2 ft (NAVD88) at the San Diego Bay confluence.

The project site contains two river channels: Otay River and Nestor Creek. The Otay River enters the site from the east (beneath Interstate 5) then flows to the northwest for approximately 2500 feet before turning sharply to the west, and then southwest (south of the levee-salt ponds system to the north). From this point downstream to San Diego Bay, the river is bound by the salt pond levees, which constrain the river to the north (and to the east and west further downstream towards the Bay). Previous modeling analyses, observed flood levels, and published FEMA Flood Insurance Studies all indicate that during extreme flood events, excess flows from the Otay River will overtop this levee system at several locations and flood the neighboring salt works. FEMA Flood Insurance Rate Maps (FIRM) for the project area are shown in Figure 2-5.

Nestor Creek, a comparatively small tributary to the Otay River, conveys local runoff from the community of Nestor, northward under Palm Avenue and flows east of Pond 20A until it joins the Otay River. FEMA (FIRM maps 060732C2153F, 060732C2154F) indicate that the urban community near Nestor Cr. north of Palm Avenue (in the vicinity of Boundary Ave., Canal St., and Thermal Ave.) is mapped as being inundated by the 100-yr flood event (Zone AE: base flood elevations determined. Within the project area, the 100-yr event causes overbank flooding out from Nestor Cr. towards the east and towards Pond 20A to the west (Figure 2-5).

Downstream of the Otay River/Nestor Creek confluence, the Otay River channel is confined between the Pond 20A levee to the south and the salt works levees to the north, resulting in a hydraulic constriction

(Figure 2-6). At 1000 ft downstream of the Nestor Creek confluence, the Otay channel splits into two parallel reaches, separated by the abandoned San Diego & Eastern Railway line. This side-by-side channel configuration (as seen in Figure 2-4) that is split by the railway line continues for roughly 1500 feet until the two parallel channels join and leave the Planning Unit A project site to the west. The railway line within this 1500 ft segment is supported by a dyke and two trestle bridges (Figures 2-7). The Otay River then continues to flow approximately one mile northwest and then north, discharging into South San Diego Bay.

Between Nestor Creek and the Otay River channel is a broad flat floodplain expanse (Figure 2-6). This floodplain, which historically formed a significant portion of the Otay River fresh and saltwater wetlands, was filled in the early 20th century to facilitate agricultural uses of the site. Today, this portion of the project site consists of very little vegetation, limited habitat and no fresh or saltwater wetlands.

Tidal flows influence the Planning Unit A site, enter from San Diego Bay and extend up the Otay River to approximately 1500 feet upstream beyond the Nestor Creek confluence. This inland tidal extent was field verified by the appearance of tidal mud flats, which typically indicate the presence of daily inundation. The wildlife refuge also experiences seasonal or intermittent flows from Otay River and Nestor Creek. These flows may come in the form of extreme flood events with discharges exceeding 25,000 cfs. Such stormflows have the potential to modify the site through channel scour, levee overtopping and/or breaching, and sediment deposition. Tidal and fluvial characteristics related to the modeling analysis are described in greater detail below in Section 3.

2.3 RESTORATION OBJECTIVES, SITE OPPORTUNITIES AND CONSTRAINTS

Developing an appropriate restoration concept for the lower Otay River project area requires an understanding of the complex hydrologic processes occurring at the site. Additionally, the restoration concept should incorporate an appreciation of how historic processes and features governed the site over the longer term and consider how recent impacts have altered the physical system, reduced habitat areas, and impaired ecologic functioning. The principal objectives for a restoration project at the lower Otay River site include:

- Restoration of functioning wetland habitat (tidal, freshwater, brackish) in areas that have become drier uplands
- Enhancement of existing wetland areas to increase circulation and improve habitat conditions
- Develop a sustainable, relatively self-maintaining wetland design
- Maintain or decrease current flood elevations to avoid exacerbating predicted flood conditions in the vicinity of the project
- Minimize environmental impacts and excavation and earth work costs associated with restoration
- Develop a restoration plan that is flexible enough to integrate other regional restoration efforts including the restoration of the south San Diego Bay salt ponds.

Current conditions at the lower Otay River (Planning Unit A) site provide both positive opportunities for restoration, as well as, limitations (or constraints) to reaching a successful restoration. Many of the site's primary physical, natural resource, and planning opportunities and constraints were described in the MKEG Wetland Enhancement Plan (Michael Brandman Associates, 1989). The key physical opportunities and constraints based upon Lower Otay River Wetland Enhancement Plan report include:

Opportunities

- Expanded tidal circulation is feasible
- Seasonal freshwater flows from Otay River and Nestor Creek can potentially support in-channel habitat
- Groundwater is available to support riparian vegetation
- Flood hazard reduction is also achievable through ecologic/habitat restoration
- Increased tidal prism on site will help reduce on-site sedimentation and channel in-filling
- Soils underlying fill historically supported salt marsh vegetation and could likely do so again successfully after restoration
- Site topography can be modified (with fill removed or relocated) to restore appropriate wetland elevations

Constraints

- Freshwater flows delivered by Otay River and Nestor Creek are episodic and infrequent
- Groundwater is slightly brackish potentially limiting vegetation to species with salt tolerance
- Extreme flood events may deliver large amounts of sediment to the project site (as observed in 1916)
- High groundwater levels might require special grading and excavating techniques
- Existing site elevations are high enough that a comprehensive wetland restoration effort would require extensive grading and earth moving
- Much of site is designated as a FEMA Floodway, potentially limiting the scope of work done on the site

3. HYDRODYNAMIC MODELING DEVELOPMENT

3.1 MODELING APPROACH

PWA used the hydrodynamic module of MIKE 11 to evaluate the hydraulic conditions of the Lower Otay River, Nestor Creek and South San Diego Bay. MIKE 11 is a one-dimensional hydrodynamic model, developed by the Danish Hydraulics Institute (DHI), which solves the vertically integrated conservation of mass and momentum equations (Saint-Venant equations). For the Otay setting, the model expands upon basic channel hydraulics by more realistically portraying interactions between river and creek channels, salt ponds, overbank floodplains, and the dynamic tidal and hydrologic boundary conditions. This added complexity allows the model to more accurately represent current site conditions and evaluate site conditions under different alternative configurations. However, it is important to remember that the hydraulic model developed for this study is at best an analytical tool used to simulate flow conditions and does not depict actual events.

3.2 DATA SOURCES

A number of existing information sources were collected and reviewed to provide input to the present hydrodynamic analysis. Project data were compiled into a spatial database (GIS) by thematic type (coverages) using ArcGIS software. This included site topography for existing and proposed alternative conditions and both tidal and surface runoff hydrology. The following sections describe these different input data sets.

3.2.1 Topography

The baseline topographic data used for this analysis was collected using differential GPS equipment and compiled into an AutoCAD contour map (1-foot resolution) by Ducks Unlimited Inc. This information was collected in 1999 and 2000 as part of a broader survey of the entire wildlife refuge area, salt works, and surrounding areas. Certain additional data were collected in June 2002 (as requested by PWA) including supplemental ground topography along the project boundary, additional channel cross-sections and invert measurements, and a more detailed survey of bridge crossings. All topographic data were collected in the State Plane (California Zone VI - feet) horizontal datum and North American Vertical Datum 1988 (NAVD88 - feet) vertical datum.

The GPS field survey data were integrated with the baseline contour maps to develop an ArcGIS Triangular Irregular Network (TIN). This TIN was used to generate a surface model which became the topographic foundation for the existing conditions model (Section 3.4). All MIKE 11 cross-sectional information for the existing conditions model was extracted from this surface model. For the alternatives analysis, the baseline surface model was modified according to the restoration concepts. Planform channel alignments and grading adjustments were made in accordance with the restoration concepts provided by FWS and DU (Appendix A). Similar to the digital terrain model developed for existing conditions topography, an ArcGIS TIN surface was developed for each alternative.

3.2.2 Hydrology

As a transitional estuary setting, the lower Otay River and wildlife refuge site are subject to tidal and river flows. These flows form the boundary conditions for the hydrodynamic model. These boundaries were limited to tides in San Diego Bay and river discharge from the Otay River and Nestor Creek. Other localized runoff sources were not considered significant relative to the volume and discharge of tides and river flows and were not included in the present analysis. The following sections present the tidal and surface runoff hydrology conditions adopted for the current modeling analysis and any limitations associated with their use.

3.2.2.1 Tidal Hydrology for Hydraulic Modeling

The tidal flows in San Diego Bay can be characterized by diurnal (daily) and spring-neap (monthly) variations, which inundate the bottom portion of the Otay River and Nestor Creek channels twice daily. Considered independently, these tidal flows do not increase water level on the project site enough to flood overbank areas that were historically salt marsh and fluvial wetlands.

Tidal hydrology reference levels refer to statistical stillwater tidal conditions in San Diego Bay and forms the downstream water level boundary condition for the hydrodynamic model. The National Oceanographic and Atmospheric Administration (NOAA) operates and maintains a long-term primary tide gage (9410170) located at Navy Pier near downtown San Diego. This gage, which has been in operation since 1900, is approximately 9 miles north of the project site. Tidal measurements collected over a previous tidal epoch (19-year period from 1960 – 1978) have been statistically reduced to obtain long-term average values of Mean Lower Low Water (MLLW), Mean Lower Water (MLW), Mean Tidal Level (MTL), Mean Higher Water (MHW), and Mean Higher High Water (MHHW). Table 3-1 presents the two published tidal datums for San Diego Bay.

Table 3-1. Published Tidal Datums for NOAA Tide Gage No. 9410170 in San Diego Bay

Mean Tidal Datum	Tidal Statistics for San Diego Bay (Feet)	
	Local MLLW Datum	NAVD88 Datum
MHHW	5.73	5.08
MHW	4.98	4.33
MTL	2.96	2.31
MLW	0.94	0.29
MLLW	0.00	-0.65

Tidal datums presented in Table 3-1 were converted into a representative tide cycle for San Diego Bay. This was accomplished by applying a cosine interpolation to each neighboring published tidal datum from Table 3-1 at a 5-min time interval. The result of this analysis is presented in Figure 3-1 which represents a typical diurnal tide cycle for San Diego Bay. A monthly tide cycle (Figure 3-2) exhibiting spring-neap variations was also developed using Tides & Currents Software (1993) and the published NOAA datum conversion from MLLW to NAVD88 or -0.65 feet.

According to the FEMA Flood Insurance Study (FIS) for San Diego County, California (Unincorporated Areas, January 2001), the 100-year water surface elevation for San Diego Bay at Chula Vista is 7.08 feet (NAVD88). Due to various coastal flooding mechanisms (e.g. river runoff, wind, storm surge), this published flood elevation is 2 feet higher than the representative MHHW datum used to form the tidal boundary condition for the present river flooding analysis. While acknowledging this difference, the MHHW datum was adopted as the high water tidal boundary condition to maintain consistency between the modeling analysis and upstream riverine flood insurance studies which use the 5.08 ft datum. For example, the current Otay River FEMA analysis uses the 5.08 ft MHHW datum as a downstream boundary condition. The current PWA analysis is consistent with Otay River FEMA study.

3.2.2.2 Surface Runoff Hydrology

In contrast to the tides which inundate the lower Otay River daily, watershed derived runoff to the Otay River and Nestor Creek is relatively sparse throughout the year. However, during extreme rainfall events, the runoff typically exceeds channel capacity and flooding occurs throughout the project site. Following a thorough review by PWA of available hydrologic data sources, it was determined that no compatible stream gage data was available within the Otay River watershed, nor had a comprehensive hydrologic analysis been previously completed. This was supported by a phone conversation with Joe Evelyn (Chief of Hydrology and Hydraulics Division, Army Corps of Engineers, Los Angeles District) who was reasonably certain that no such hydrologic analysis has ever been performed. Furthermore, several requests to FEMA to obtain the hydrology associated with the surrounding flood insurance studies provided no additional information as of the completion of this report.

In place of a comprehensive watershed derived hydrologic analysis or a complete statistical analysis of stream gage measurements, a simple equilateral triangular hydrograph (SCS method) was adopted. With the triangular hydrograph, storm duration was 24 hours, base flow was 10 cfs, and the peak discharge corresponded to the published FEMA 100-year stream flow. FEMA peak discharges were referenced from the most recent FEMA Flood Insurance Study[1] (FIS) for the reach of the lower Otay River through Planning Unit A (Table 3-2). A second triangular hydrograph was similarly developed for Nestor Creek. Nestor Creek and Otay River peak flows were modeled to occur simultaneously to simulate maximum flooding conditions on the site. The lower flow regime for the lower Otay River is significantly impacted by the upstream reservoir, which stores much of the low flows with no release. It does not impact the predicted major floods, as the available storage is small in comparison to the predicted flood volumes.

[1] FEMA Flood Insurance Study, January 19, 2001, San Diego County, Unincorporated Areas

Table 3-2. Summary of FEMA Published Peak Discharges for the Otay River

Return Period	Published FEMA Peak Discharge (cfs)	
	Otay River	Nestor Creek
10	1200	730
50	12000	990
100	22000	1135
500	50000	3630

3.3 USING DATA SOURCES TO DEVELOP INPUT MODEL PARAMETERS

Using the data sources described above, a model drainage network schematic was developed for the project site (Figure 3-3). The schematic included a delineation of the likely flow paths (channels, overbanks, ponds, levee overflows, etc.) and their flow relationship (inter-connection) to one another. In addition, the location of each cross-section was assigned to the network. This cross-sectional information was extracted and compiled into the MIKE-11 cross-section database, using the appropriate topographic surface as discussed in Section 3.2.1.

Following the development of a representative model schematic, channel roughness characteristics were assigned. Estimates of Manning's roughness coefficients (n) for the open channel portions were assigned based on field evaluations. Manning's *n* values for roughness varied according to in-channel or overbank positions and varied spatially across the project site according to existing or anticipated (for the alternatives) roughness conditions. Roughness designations for specific types of conditions (i.e. immediate overbank levee area, or channel bottom in mud) were held consistent for the alternatives. Roughness values for the mature marsh condition were used in modeling Alternatives C1 and C2. Manning's roughness values used in the numerical model are presented in Table 3-3. Modeled roughness values were consistent with the roughness coefficients applied in the FIS[1].

Table 3-3. Manning's Roughness Coefficients (*n*)

San Diego Bay	0.02
Otay Bridge	0.07
Otay Channel Bypass	0.06
Nestor Creek	0.06
Floodplain Areas	0.04

Boundary conditions were prescribed at three locations within the model drainage network representing tidal conditions in San Diego Bay (Section 3.2.2.1) and river discharges from Otay River and Nestor Creek (Section 3.2.2.2). As noted earlier, all other localized runoff was considered non-significant compared to the combined volume and discharge of water from the tides and river flows.

3.4 EXISTING CONDITIONS MODEL

An existing conditions model was developed for Planning Unit A of the lower Otay River project area between Palm Avenue to the south, Interstate 5 to the east, and the Western Salt Company salt pond levees and San Diego Bay to the north and west. The model includes 12 channels interconnected by 50 linking channels and 110 cross-sections. Figure 3-3 shows the location and extent of the channel network and cross-sections superimposed on a recent aerial photo. Two calculations were made using the existing conditions model: (1) an extreme flood event caused by 100-year river flows in Nestor Creek and the Otay River; and (2) a typical daily tidal cycle with no river discharge. The following two sections (3.4.1 and 3.4.2) describe the results of these analyses.

3.4.1 100-Year Flood Results

The extreme flood event simulation consists of 100-year flows occurring simultaneously for the Otay River and Nestor Creek with a typical daily tide cycle as a downstream boundary condition. The model was run for four days. Days 1 and 2 provided a spin-up time to achieve equilibrium tidal conditions throughout the model. The flood hydrographs were introduced on the third day, with the final day remaining to allow for complete draining of the system. Peak flows from Otay River and Nestor Creek were modeled to occur simultaneously with MHHW as shown in Figure 3-4.

Localized overbank flooding begins almost immediately with the onset of the flood event. As water levels continue to rise in the project site, flooding is further aggravated by the hydraulic constriction between the Pond 20A levee to the south and the salt works levees to the north. Relative to the hydraulic constriction caused by the Pond 20A levee (south) and the salt works levees (north), the railroad features (dyke and bridges) are not as significant as these other levees under the 100-yr flood condition for the existing topographic condition.

As shown in Figure 3-4, water levels continue to rise upstream of the constriction until overflow into the neighboring salt ponds begins. At flows of about 8000 CFS (approximately 25-year event) the salt works levees begin overtopping 4 to 5 hours after the initiation of the flood event (depending on the location and height of the levees). After about 10 hours into the flood event, the Pond 20A levees to the south are also overtopped. The maximum flood crest elevation (17.9 ft, NAVD88) at the confluence of Nestor Creek and the Otay River occurred roughly midway through the flood event at a time of 12 hours. From this point, water levels began to recede slowly draining the project site. Approximately 27 hours after the flooding began, and 3 hours after the river returned to baseflow conditions, the project site was completely drained and the diurnal tide cycle, which was the downstream boundary condition, predominated. Figure 3-4 provides a graphical representation of the flooding sequence. Modeling results indicate that Pond 20A is flooded mainly from Nestor Creek overflow. In Section 4 below, results for the alternatives are presented whereby Pond 20A is not flooded for alternatives C1, C2, Alt 3 and Alt 5. Potential flooding is also reduced along the Otay River (Figures 4-2 and 4-3).

Much of the 100-year flow volume for Otay River and Nestor Creek (combined) is not contained within the project site during a 100-year event. As flood levels overtop the neighboring salt works levees, over 60% of the event's flow volume is lost to the north. Table 3-4 and Figure 3-5 indicate volumetric losses and the locational sequence of overflowing based on the existing conditions model.

Table 3-4. Volumetric Overflow of Planning Unit A During 100-Year Flood Existing Conditions

Overflow Location	Volume (ac-ft)	Flooding Order
A	1321.0	1rst
B	0.0	no overtop
C	6188.3	4th
D	4563.9	2nd
E	302.3	5th
F	1504.9	3rd
Total Overflow	***13880***	
Total Model Inflow	***23413***	
% of Total Inflow Lost to Neighboring Salt Works	***59.3***	

PWA sought to verify existing conditions modeling results by comparing water surface elevations with published findings in the FEMA FIS. However, since the FEMA model was based upon a different modeling approach than the current PWA study (steady-state versus dynamic) and used different downstream boundary conditions, comparing results from the two studies is not considered meaningful. Section 4 below includes a discussion of potential scour conditions at the railroad bridge under existing and alternative conditions.

3.4.2 Typical Diurnal Tide Cycle Results

Results from the typical tidal analysis indicate that without modifications to the existing topography, the diurnal tide cycle will not exceed bankfull conditions. Furthermore, the maximum inland extent of the tides was predicted to be roughly 11,500 feet from the river mouth or approximately 1,500 feet upstream from the confluence of the Otay River and Nestor Creek. No direct verification was preformed for this calculation, although field observations and surveyed mud-line information (correlating to the MHW to MHHW range) supported modeling estimates. Figure 3-6 provides a graph of existing tidal water levels on the Otay River (just upstream of the railroad bridge) compared to downstream tides in San Diego Bay. This graph indicates some degree of tidal muting on the ebb tide. The role of tidal muting and its potential influence on the alternatives is discussed below in Section 4.7.

3.4.3 Consideration of Geomorphology & Habitat

It is useful to consider the existing conditions model in terms of geomorphology and habitat since this model provides the comparative basis for the alternatives analysis. Since both fluvial and tidal processes shape the existing Otay River channel, a long-term equilibrium channel geometry should exist whereby inputs/outputs of water and sediment are relatively balanced for fluvial and tidal sources. This geometry is best represented by historic conditions, when anthropogenic features did not strongly impact channel conditions. Such conditions, as illustrated in the 1859 map of Figure 2-1, indicate that a long-term geomorphically stable system would include a large deltaic marsh plain originating from the river source upstream. This marsh plain would include both freshwater and tidal wetlands, with the predominance of salt marsh increasing towards the Bay fringe.

Watershed alterations during the past century have significantly altered the hydrologic regime of the lower Otay River. The reservoir captures upstream sediment and reduces freshwater flows to the downstream channel reaches and the Bay. Concurrently, urbanization and other land use changes have affected the hydrology, sediment and water quality regime in the lower river. Urbanization around the project site perimeter is located in the floodplain, and is subject to damage during the design (100-year) storm.

The current lower Otay River configuration represents a significantly altered condition from the long-term geomorphic model. This is very evident in considering that areas inundated by tides under current conditions represent less than 1% of the historically inundated regions in the project area. Such reductions in tidal areas directly equate to reductions in habitat area and quality. Improving hydrologic and ecologic conditions at the existing Planning Unit A site is the goal of the subsequent alternatives analysis.

4. ALTERNATIVES ANALYSIS

4.1 DEVELOPING ALTERNATIVES

Four conceptual design alternatives for the lower Otay River project area were analyzed and compared to the baseline conditions model. The initial planning and development of the alternatives was conducted by FWS with review and suggestions provided by DU and PWA. FWS and DU provided PWA with general descriptions of the alternatives with conceptual site maps that included the principal restoration elements. These maps are shown in Appendix A. In general, the alternatives differ in: (1) the relative allocation of restored tidal or freshwater wetland habitats; (2) the alignment of channels; (3) the degree of earth moving and levee modification; and (4) project costs.

Based on the concepts shown in the alternative maps of Appendix A, PWA developed new surface topography (ArcGIS TIN) and representative channel cross sections to apply in the hydraulic modeling process. PWA also added a number of refinements in translating the alternative concepts shown in the Appendix A maps into more developed depictions of future site conditions. This process included refining channel geometry conditions and defining tidal slough channels and other wetland topographic elements. In refining these alternatives, PWA maintained consistency with the overall restoration goals of the project (Section 2.3). These are reiterated as follows:

- Restoration of functioning wetland habitat (tidal, freshwater, brackish) in areas that have become drier uplands
- Enhancement of existing wetland areas to increase circulation, improve habitat conditions
- Develop a sustainable, relatively self-maintaining wetland design
- Maintain or decrease current flood elevations to avoid exacerbating predicted flood conditions in the vicinity of the project
- Minimize environmental impacts and excavation and earth work costs associated with restoration
- Develop a restoration plan that is flexible enough to integrate other regional restoration efforts including the restoration of south San Diego Bay salt ponds.

The alternative concepts provided to PWA characterize the project site into three habitat regions: salt marsh, freshwater wetland, and restored uplands. These generic habitat types represent fundamentally different topographic, hydrologic, geomorphic, and ecologic conditions.

A restored salt marsh encompasses the full range of intertidal marsh habitats between mean lower low water (MLLW) and mean higher high water (MHHW). These include the low marsh region (dominated by intertidal mudflats (+3.5 ft MLLW and below) and cordgrass (Spartina foliosa) (generally +3.5 to +4.5 ft MLLW)); the middle and high marsh (dominated by perennial pickleweed (Salicornia virginica) above +4.5 ft MLLW); and a high marsh/fluvial transition zone including a diverse assemblage of other salt marsh plants. Most likely, channel geometry in this transitional zone is governed by tidal processes below MHHW and fluvial processes above (Mead et. al, 2000). In addition to the main Otay River and Nestor Creek channels, smaller tidal slough channels would be excavated throughout the proposed salt marsh plain area below the MLW level. The number and dimensions of these slough channels would be based on the sustainable area of tidal mud flats within the project site.

Freshwater wetland habitats also have a range of forms including: in-channel freshwater marshes; riparian woodland in the immediate channel bank and overbank floodplain zone; riparian scrub on the higher floodplain elevations; and a transitional zone to upland (non wetland) vegetation at higher elevations. Restored upland areas provide important buffering, foraging, and refuge functions to the neighboring wetland areas and also provide a useful depositional area for removed fill from potential site excavation.

Four alternatives are presented below. The first two involve different habitat configurations across the Planning Unit A site, while the third one focuses solely on channel improvements to the lower Otay River. The fourth presented alternative considers removal of a portion of the Pond 20A levee. The naming of these alternatives is adopted from FWS designations. Since there was originally a pool of several more alternatives, the alternatives that were selected for the modeling study have their original names below and do not follow an intuitive or sequential (A, B, C or 1, 2, 3) naming order.

4.2 ALTERNATIVE C (OPTION 1)

4.2.1 Configuration

Alternative C (Option 1) comprises widening the existing Otay River channel and significantly expanding both tidal and freshwater wetlands (Appendix A, Figure 4-1). To compensate for the excavation required to re-establish these wetlands, areas of restored upland are included to balance on-site cut and fill volumes. Thus, the design configuration of this alternative will minimize off-site earth disposal and its associated costs.

For Alternative C (Option 1), the basic alignment of the Otay River would remain unchanged, flowing generally northwestward to the edge of the existing salt works levee, then southwest, parallel to the levee, to the western edge of Pond 20A (Figure 4-1). The cross-sectional shape of the channel, however, would be significantly altered. The existing bankfull channel would be widened to approximately four times its current width. In the upper sections of the channel, fresh water wetlands would be re-established. A low-flow channel would be developed in this reach, with a meandering planform, that would slowly transition from fresh water wetland to salt water marsh and inter tidal mud flats. This re-established salt marsh area would be constructed with a similar widened channel configuration to the north along the salt works levee. The northern portion of the existing Pond 20A levee would also be removed and setback along the property line, thus creating additional tidal wetlands at the confluence of Nestor Creek. Soils excavated from the wetland areas of the site would be used to raise portions of the site previously identified as restored uplands. The volume of excavated soil in excess of that which can be accommodated on-site would be removed from the site, however for this alternative, off-site removal has been minimized.

4.2.2 Results

The total area of re-established tidal and freshwater wetlands associated with Alternative C (Option 1) is 78 acres, 61 of which would be salt marsh and 17 of which would be fresh water wetland. Under existing conditions, the only areas of sustained wetlands are within the channels themselves, amounting to less than 10 acres. Thus, Option 1 provides nearly a 1000% increase in wetland habitat area for Planning Unit A (Table 4-1).

Table 4-1. Changes in Wetland Area Associated with each Alternative

Wetland Habitat	Existing Conditions	Alternative C (Option 1)		Alternative C (Option 2)		Alternative 3		Alternative 5	
	Area (acres)	Area (acres)	% Increase	Area (acres)	% Increase	Area (acres)	% Increase	Area (acres)	% Increase
Fresh Water	5	17	340	17	340	5	0	N/A	N/A
Salt Marsh	3	61	2030	88	2930	3	0	N/A	N/A
Total	8	78	975	105	1310	8	0	N/A	N/A

Hydraulic results for Option 1 show that setting back the Pond 20A levee significantly increases conveyance capacity of the Otay River, reduces backwater effects extending upstream, and ultimately lowers the 100-year flood elevations by more than one foot. Figure 4-2 shows this reduction in upstream flood levels along the Otay River channel. Additionally, Figure 4-2 demonstrates the change in water surface slope, from relatively steep through the Pond 20A constriction under existing conditions, to generally flatter gradients when the Pond 20A levee is set back as part of the wetland restoration. Furthermore, because of this water level reduction, the upper portions of Pond 20A (south of the realigned levee) would not receive spill over from the Otay River under the modeled 100-year conditions. Significant overtopping of the salt works levees would still occur, however for a shorter period of time. Figure 4-3 shows water surface profiles for existing and alternative conditions along Nestor Creek, with lower water elevations under alternative scenarios. All of the alternatives show a reduced water level in Nestor Creek. The most significant decrease is shown with alternative C1 and results from removal of the levee along Pond 20. Water surface elevations for baseline and alternative conditions are compared for several locations below in Table 4-2. Comparison locations are referenced in Figure 4-4.

Table 4-2. Comparison of Peak Water Surface Elevations Under 100-Year Flow Conditions

	Location[1]	Existing Conditions	Alternative C (Option 1)	Alternative C (Option 2)	Alternative 3	Alternative 5
		Peak Water Surface Elevation (ft – NAVD88)				
Otay River	**A**. Approximately 1000 feet downstream from the I-5 Bridge	18.8	18.0	18.1	18.7	18.0
	B. Where the Otay River meets salt works levee system	18.2	16.8	16.7	18.1	16.6
	C. Confluence of Otay River and Nestor Creek	17.9	15.9	15.8	17.8	15.2
	D. Northwestern edge of Pond 20A	13.0	14.0	14.0	12.5	15.0
Nestor Creek	**E.** 2000 ft upstream of confluence with Otay River	18.2	16.9	17.8	18.1	17.5

1. See Figure 4-4 for comparison locations

Alternative C (Option 1) requires approximately 645,000 cu yd of soil materials to be excavated and disposed from the project site. All of the excavated soil can be accommodated on site into 60 acres of restored upland areas. Table 4-3 summarizes the excavation and disposal conditions for 3 of the 4 alternatives considered. Excavation volumes for Alternative 5 were not evaluated because a surface elevation model was unavailable (*personal communication with Steve Carroll at DU*).

Table 4-3. Excavation and Disposal Volumes Required for Wetland Restoration

Wetland Creation[1]	Alternative C (Option 1)	Alternative C (Option 2)	Alternative 3
	Volume (cu-yd)	Volume (cu-yd)	Volume (cu-yd)
Total Excavation	726,000	968,000	32,266
Total On-site Disposal[2]	726,000	322,666	0
Off-site Disposal	0	645,333	32,266

notes:

1. Excavation volumes calculated from GIS/CAD surface models discussed in Section 3.2.1.
2. On-site disposal will occur in areas designated as restored uplands.
3. Data for Alternative 5 are not available.

4.3 ALTERNATIVE C (OPTION 2)

4.3.1 Configuration

Alternative C (Option 2) is generally similar to Option 1 involving an expansion of tidal wetlands and setting back the Pond 20A levee (Appendix A, Figure 4-5). However, Option 2 does not include widening the upper portion of the Otay River channel. Instead, a freshwater wetland will be developed east of the northern extension of Saturn Drive (and pipeline easement). To the west of the Saturn Drive extension, complete re-establishment of tidal marsh is envisioned. This expanded tidal wetland zone replaces the restored uplands from Option 1. As a whole, the Option 2 design configuration restores more tidal salt marsh than Option 1, however costs would be significantly greater due to increased off-site soil disposal requirements.

4.3.2 Results

Restored tidal and freshwater wetland areas for Alternative C (Option 2) are presented above in Table 4-1. Option 2 (105 acres) provides 25% more restored habitat than Option 1 (78 acres). Whereas Option 1 provided a balance between required excavation and on-site disposal, the additional 27 acres of new marsh for Option 2 results in about 645,333 cu-yd of off-site disposal (Table 4-3). In terms of the hydraulic impacts, water level conditions for Option 2 are very similar to Option 1 (Table 4-2). Option 2's modified planform and expanded tidal wetland does not significantly alter estimated flood stages from Option 1 results because water levels upstream of Pond 20A are again governed by the backwater effects from the hydraulic constriction. For example, where the Otay River meets the salt works levee system, predicted water levels for Options 1 and 2 differ by less than two inches.

4.4 ALTERNATIVE 3 (HYDRAULIC IMPROVEMENTS TO EXISTING OTAY CHANNEL)

4.4.1 Configuration

Alternative 3 is qualitatively different from the previous two alternatives. Rather than focusing on habitat and wetlands restoration, this alternative reduces downstream channel constrictions along the Otay River by widening the channel at a location that is geomorphically suitable and where land is available for excavation. Thus, the focus of this alternative is solely flood reduction. Figure 4-6 illustrates the location where channel widening was simulated for the modeling analysis. PWA chose this location during a site visit due its channel/overbank form. A benched terrace exists along this reach, which could be modified to accommodate a wider channel. Because flood reduction was the sole focus of Alternative 3, many of the restoration goals outlined previously were not addressed. However this analysis does provide insight into the effect downstream channel capacity has on upstream flooding.

4.4.2 Results

The overall results for Alternative 3 indicate that channel improvements alone do not significantly reduce flood levels throughout the project site. Because the Pond 20A levees were not set back as in the previous alternatives, the hydraulic constriction remained and upstream flood levels were only somewhat reduced through widening the channel further downstream. More substantial improvements would be needed along the entire length of the Lower Otay River channel, especially adjacent to Pond 20A, to provide a more substantial reduction in upstream flooding. A study completed by Rick Engineering (1987) looked at substantially modifying and improving the flood capacity of the lower Otay River channel. The Rick Engineering report suggested lowering and hardening a large portion of the salt works levee system to allow controlled overflow into the salt ponds. Although Alternative 3 and the alternative developed by Rick Engineering address flood reduction, they do not provide the appreciable habitat benefits of the Alternative C options. Tables 4-1, 4-2, and 4-3 also include results for Alternative 3.

The hydraulic improvements of Alternative 3 were combined with the expanded wetland configurations of Alternative C (Options 1 and 2) to evaluate the combined effect of enlarging the downstream channel and expanding the upstream wetland configuration. Results from this analysis indicate that upstream flooding would not be significantly affected, however downstream of Pond 20A, peak flood levels would decrease by roughly 1-foot (Table 4-4, locations referenced in Figure 4-4).

Table 4-4. Alternative C: Comparison of Water Surface Elevations with/without Channel Improvements of Alternative 3

Location		Alternative C (Option 1)		Alternative C (Option 2)	
		w/out Alt 3	with Alt 3	w/out Alt 3	with Alt 3
		Peak Water Surface Elevation (ft – NAVD88)			
Otay River	**A**. Approximately 1000 feet downstream from the Interstate-5 Bridge	18.0	18.0	18.1	18.1
	B. Location where the Otay River meets the salt works levee system	16.8	16.7	16.7	16.7
	C. Confluence of Otay River and Nestor Creek	15.9	15.8	15.8	15.9
	D. Northwestern edge of Pond 20A	14.0	13.6	14.0	13.3
Nestor Creek	**E.** Approximately 2000 feet upstream from confluence with the Otay River	16.9	16.8	17.8	17.8

4.5 ALTERNATIVE 5 (POND 20A: LEVEE REMOVAL AND GRADING)

4.5.1 Configuration

The configuration of Alternative 5, shown in Figure 4-7, was developed by FWS/DU and described to PWA as follows. The portion of the Pond 20A levee that is located within the FWS Refuge Boundary is removed. The refuge land portion of Pond 20A is graded to achieve elevations that support intertidal habitat. Grading occurs to provide a marsh plain slope of approximately 10:1. The envisioned marsh plain consists of about 50% intertidal mud flat and 50% salt marsh habitat. Moving southward along the Pond 20A parcel, at the location/elevation that achieves MHHW, the slope gradient is changed to 2:1 towards the southern boundary of the Refuge parcel. Grading would daylight at the refuge boundary. Additionally, Alternative 5 includes a shallow pilot channel breach from Nestor Creek into Pond 20A. A surface model for this alternative was not available to PWA, all topographic changes and conditions associated with the alternative were modeled based upon received descriptions of the alternative. Representative cross sections, which portrayed the alternative concept, were developed and input to the model.

4.5.2 Results

Results for Alternative 5 indicate that levee removal and marsh plain grading in Pond 20A significantly increases flow capacity through Pond 20A and results in decreased upstream flooding. Maximum water levels decrease by: 0.8 ft near the I-5 Bridge; 2.7 ft at the Nestor Creek confluence; and 1.9 ft at the Otay River salt works levee. However, by removing the Pond 20A northern levee, the railroad bridge channel zone at the northwest corner of Pond 20A would now function as a natural constriction point for the 100-yr discharge. This process results in an estimated increase of surface water elevation by 2.2 ft near the railroad bridge. In this scenario, the bridge is exposed to higher discharge, pressure, and scour conditions. Under Alternative 5, additional bridge and channel modifications are recommended to increase flow capacity and channel/bridge structural integrity under the 100-yr event. It should be noted that the bikeway would be under water during the design (100-year) flood for both existing conditions and the alternatives discussed in this section.

4.6 SEDIMENT ENTRAIMENT AND POTENTIAL SCOUR EVALUATION

Hydraulic conditions and the potential for sediment entrainment and channel scour were evaluated at the railroad bridge location for existing and alternative scenarios. The following methods for computation of maximum potential local scour were used:

a) Laursen – (1960)
b) Laursen modified - (1960)
c) Liu - (1961)
d) Froehlich - (1987)

These equations are empirical and derived mostly with laboratory data. It is generally understood that scour estimates calculated using these equations tend to be greater than the scour observed in field conditions. The actual scour is affected by many variables including the degree of consolidation in channel bed sediments. Also, scour increases other channel hydraulic parameters such as cross sectional area, hydraulic radius, velocity and depth, creating a feedback which modifies flow parameters to reduce the scour potential.

Additionally, three structural factors were considered that could influence the local scour calculation at the railroad bridge.

1. The degree of channel contraction, measured by channel width and structural opening (width of the structure, abutments length or cross sectional area).
2. The degree of increase in flow resistance in the culvert/bridge crossing (obstructed area) relative the main channel. (Laursen 1960). In the case of higher resistance inside of the bridge, the potential scour can increase by 100% or more.
3. The ratio of obstructed flow area to adjacent channel area. (Froehlich). This method indicates the highest potential scour, given the significantly narrowed flow area at the railroad crossing.

The results from the scour analysis for the 100-yr flood event are summarized in Tables 4-5 and 4-6. Potential scour conditions for baseline and alternative conditions are compared for the 4 computational methods used in the analysis. These results should be considered as a basis for relative comparison rather than an assessment of absolute change, owing to the assumptions stated above. That being said, the percent changes for some alternatives exceed 20% increases from existing conditions and this is noteworthy. In the case of Alternative 5, increases in flow velocity, discharge and water level at the bridge crossing should be considered in any site restoration design or re-design of the existing trestle bridge.

Table 4-5. Comparison of Velocity Conditions at RR Bridge (100-yr flood conditions)

RR Bridge Velocity Evaluation (ft/s)	Existing	Alt C1	Alt C2	Alt 3	Alt 5
Velocity at RR Bridge	5.8	8.4	8.5	6.9	11.2
% change from existing conditions		+ 44.6%	+ 46.9%	+ 18.6%	+ 92.66%
Velocity upstream of RR Bridge	4.8	4.4	7.2	6.2	8.2
% change from existing conditions		-6.9%	+ 51.7%	+ 31.0%	+ 72.41%

Table 4-6. Comparison of Potential Scour at RR Bridge (100-yr flood conditions)

RR Bridge Scour Evaluation (ft)	Existing	Alt C1	Alt C2	Alt 3	Alt 5
Larsen 1960	5.1	7.3	5.2	4.9	5.1
Larsen 1960 (modified)	3.0	4.8	3.0	2.8	2.7
Liu 1961	10.0	11.9	11.6	10.7	12.8
Froehlich 1987	20.8	23.4	23.2	21.7	25.9
average	9.7	11.8	10.8	10.1	11.6
% change from existing conditions	-	+ 21.67%	+ 10.65%	+ 3.48%	+ 19.73%

4.7 TIDAL CONSIDERATIONS FOR ALTERNATIVES

The expected tidal functions of the four alternatives were compared to existing conditions in order to assess the feasibility of the proposed tidal restoration concepts. This initial assessment used the numerical model to simulate tidal hydrodynamics under restored conditions, as well as application of hydraulic geometry relations to predict the geomorphic response of lower Otay River.

4.7.1 Tidal Hydrodynamics Under Restored Conditions

Unlike the high-magnitude flood flows, the water level elevation of tidal inundation is not significantly affected by the hydraulic restrictions of the Otay River RR Bridge or its narrow channel between the salt works and Pond 20A levees. This is illustrated in Figure 4-8 which plots water surface elevations (just upstream of the RR bridge) under existing conditions and for each of the restoration alternatives. Figure 4-9 plots water surface elevations at the Nester Creek/Otay River confluence and shows a similar pattern for high water inundation reaching the project area.

These results show no significant muting for the flood tide water condition. However, low water drainage elevations are affected by the restoration alternatives during the ebb tide. This is presumably due to friction losses within the channels that are strongest during ebb flow when water depths decrease. Reduced low water drainage would not have a major effect on wetland establishment, and will improve as tidal scour deepens the main tidal channels (see discussion below). Alternatively, “starter channels” or other features could be included in the restoration design to accelerate development of an equilibrium main channel.

4.7.2 Geomorphic Adjustments to Lower Otay River

The morphology of the lower Otay River system will evolve after restoration due to an increase in tidal current velocities. Based on other restoration experience, we anticipate that increased tidal velocities will result in channel deepening (preferentially along the channel thalweg) until a new channel geometry occurs which is in equilibrium with the systems tidal prism. Numerical simulation of erosion and sediment transport is difficult due to the variability of soil properties and the complexity of the physical processes. Therefore, PWA applied hydraulic geometry relations to estimate an anticipated amount of channel down-cutting along the main channel following tidal restoration.

Empirical relationships between tidal prism and channel geometry have been developed for coastal salt marshes based on survey data collected in San Diego Bay and San Francisco Bay (PWA, 1995). Given the existing morphology of the lower Otay River, a modest amount of down-cutting is expected along the thalweg after tidal restoration. Based on hydraulic geometry relationships (see Figure 4-10), we estimate that the channel bed will eventually deepen about 3 ft after tidal restoration, depending on which restoration alternative is constructed (see Table 4-7). Estimates of the potential tidal prism were based on the footprint of the restored marsh area, and varied between 50 and 65 ac-ft for Alternatives C1 and C2 (see Figure 4-11).

Cross sectional area of Otay River downstream of the restored marsh area is expected to increase by a factor of 3 to 4. The channel will initially deepen in the short-term in response to the additional tidal prism, with channel widening continuing at a slower rate.

Table 4-7. Tidal Prism and Channel Depth Based on Hydraulic Geometry

Alternative	Tidal Prism (ac-ft)	Channel Depth (ft below MHHW)
Existing Conditions	6	5
Alternative C1	50*	7.5
Alternative C2	65*	8

* approximate potential tidal prism based on hydraulic geometry

5. SUMMARY AND RECOMENDATIONS

The primary objective of this hydraulic analysis was to evaluate how potential restoration concepts for the lower Otay River area (Planning Unit A) might impact flooding conditions on site and in surrounding areas to the project site. Results from the hydraulic modeling suggest that the considered restoration alternatives would not negatively impact flooding conditions, but would most likely reduce potential flooding hazards by reducing surface water elevations and durations (as indicated by the 100-yr design storm event). Modeling results indicated that increased channel capacity, either through levee setback or removal could provide moderate to significant additional benefits in flood reduction. As shown by alternatives C and 5, the set back or removal of the Pond 20A levee significantly reduced upstream flood levels. Analysis indicated that each of the alternatives increase flow velocities, water elevations, and scour potential at the railroad bridge crossing. Additional engineering studies and potential refinement of the railroad bridge channel/bridge crossing design is recommended as part of the on-going planning and restoration process. In addition to these primary conclusions, PWA refined project alternatives to maximize restored habitat areas while minimizing earth-moving costs.

While not modeled as part of this report, modifying or removing the Western Salt works levee system between the project site and the Bay is likely to significantly reduce the predicted flood levels at the project site and in upstream off-site areas. Additionally, eventually reconnecting the Planning Unit A and Western Salt Works areas would represent substantial progress towards restoring the historic geomorphic form and function of the lower Otay River floodplain and saltmarsh system, in which the channel mouth and adjacent wetlands function as a less constrained morphologic unit.

Building on the current study, PWA recommends moving into a more thorough restoration pre-design phase that will result in a well-defined project designed to preliminary standards that can be efficiently implemented. Although it is likely that additional environmental and technical aspects for a restoration program will need to be considered, in terms of hydrology/hydraulics, the following three issues are most compelling to support the restoration effort.

- Geomorphic analysis to develop a suitable channel size and network configuration. Channel density, depth, width, and sinuosity should be examined in terms of the expected long-term configuration. Additionally, this geomorphic analysis should be integrated into the design process in order to reduce the amount of earthwork required for restoration.
- Evaluation/refinement of bridge/channel crossing design based on hydraulic conditions of the alternatives.
- Integration of the current modeling analysis into the feasibility analysis of restoring the Salt Works areas north of Planning Unit A. Any hydrologic analysis of the potential salt pond restoration options should include the baseline modeling conditions developed for the current lower Otay River area.

6. LIST OF PREPARERS

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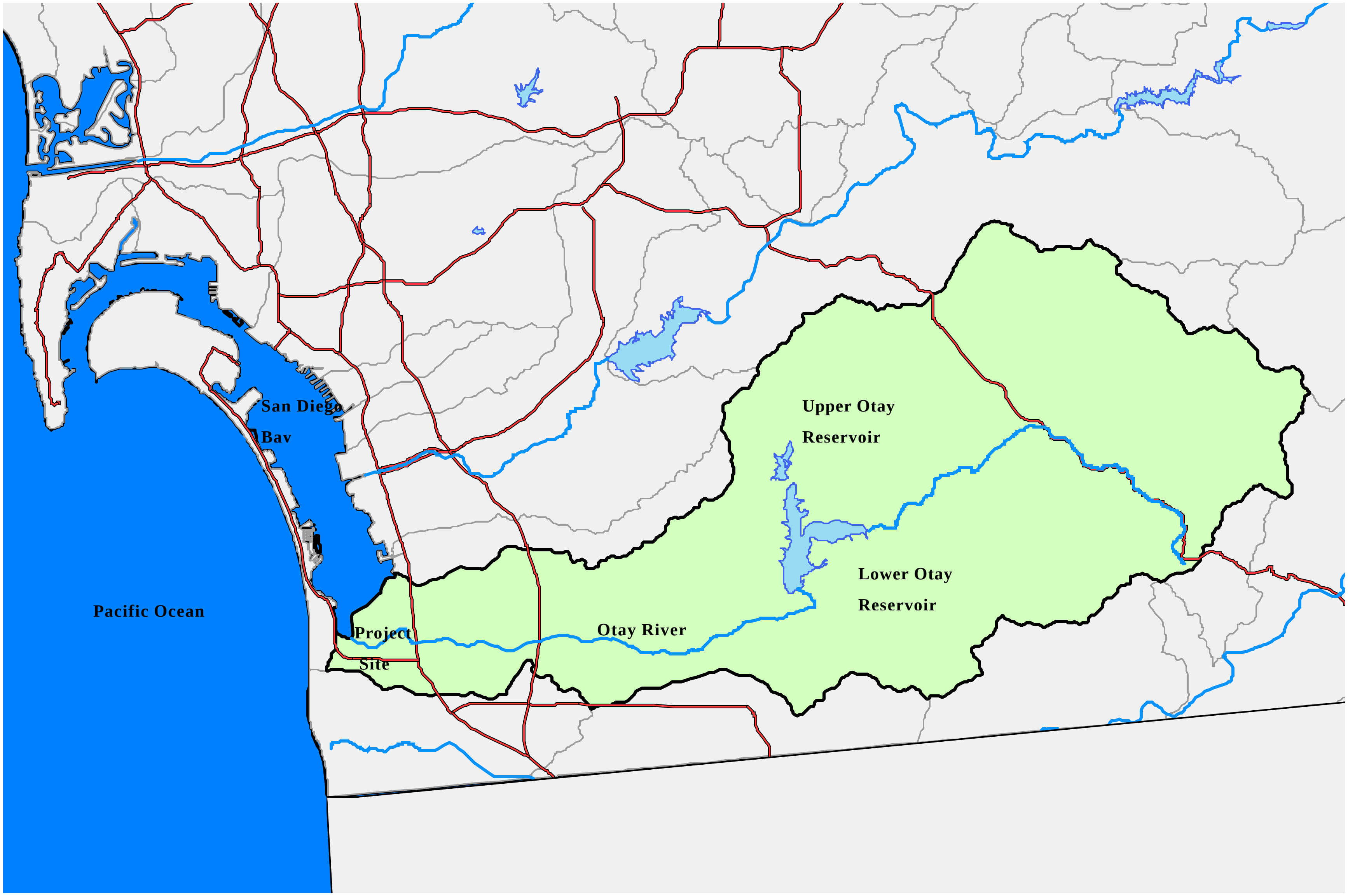
8. FIGURES

Appendix A

Planning Unit A:
Conceptual Restoration Alternatives (FWS)



f i g u r e 2-1

General Vicinity and Otay River Watershed Map

Lower Otay River Salt Marsh and Wetland Restoration

PWA

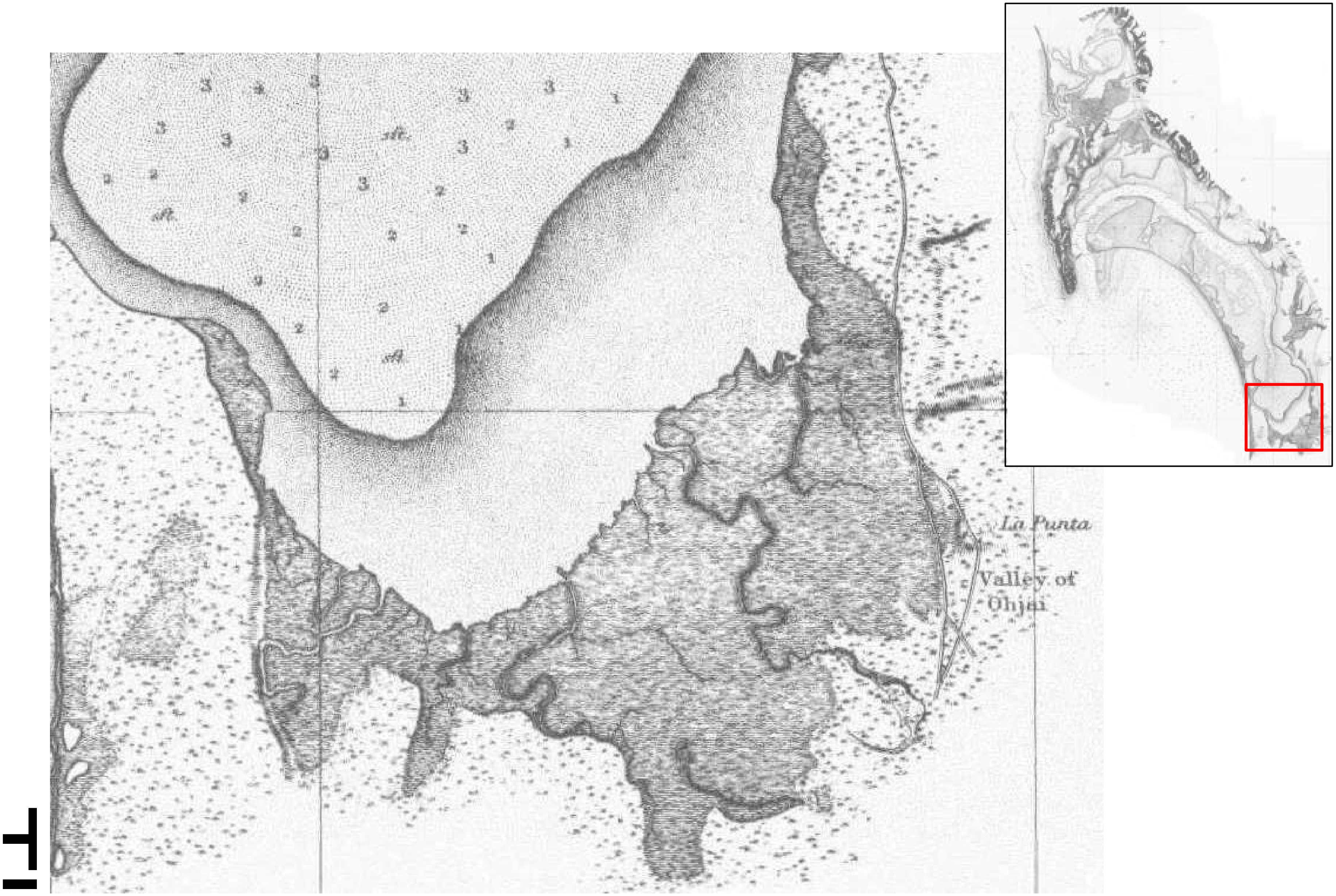


figure 2-2

Historic Site Conditions

Lower Otay River Salt Marsh and Wetland Restoration

Source: Survey of the Coast of the United States, Coastal Survey Office, 1859.

PWA

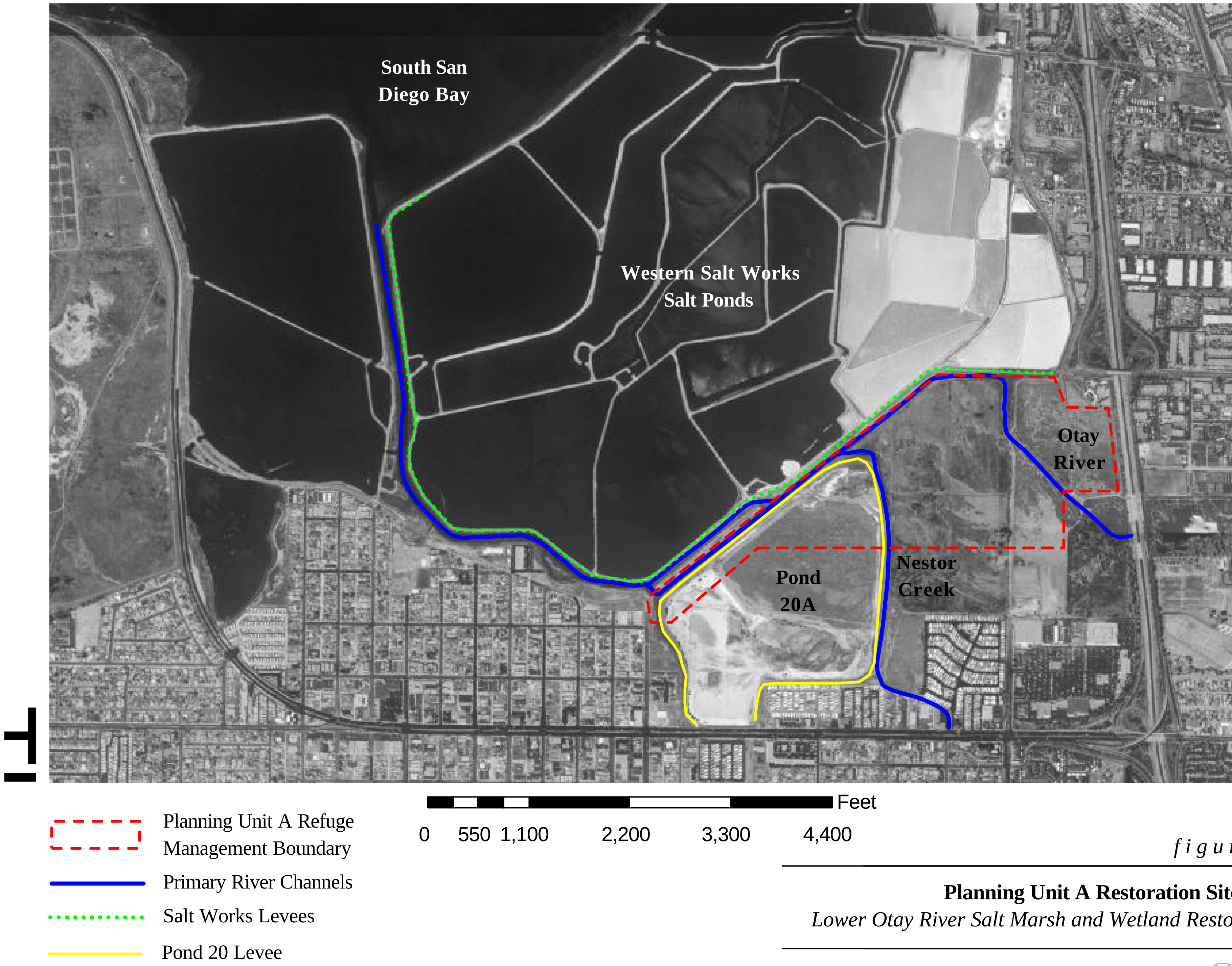


figure 2-3

Planning Unit A Restoration Site Map

Lower Otay River Salt Marsh and Wetland Restoration

PWA

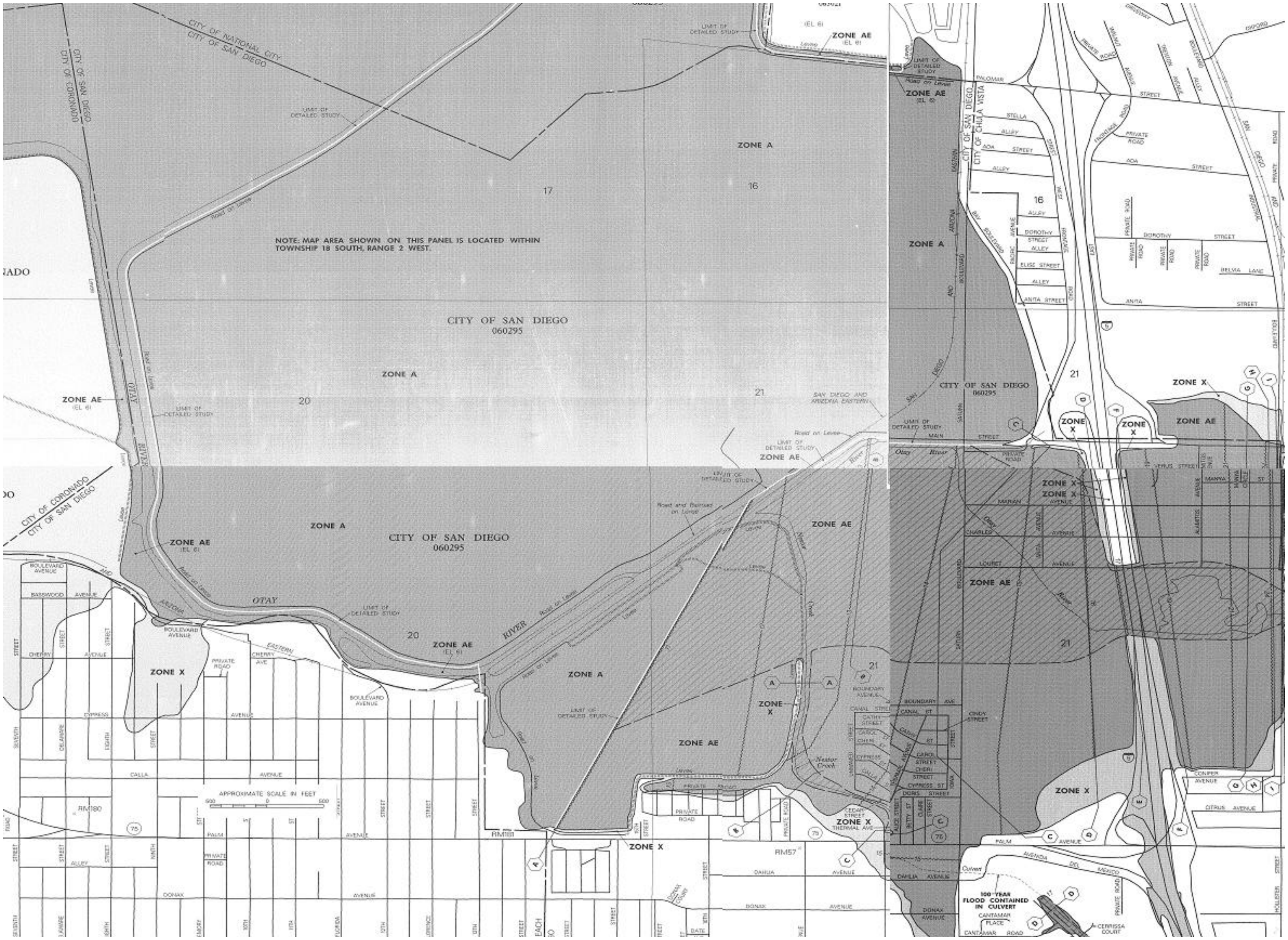


figure 2-5

FEMA FIS Flood Map

Lower Otay River Salt Marsh and Wetland Restoration

PWA

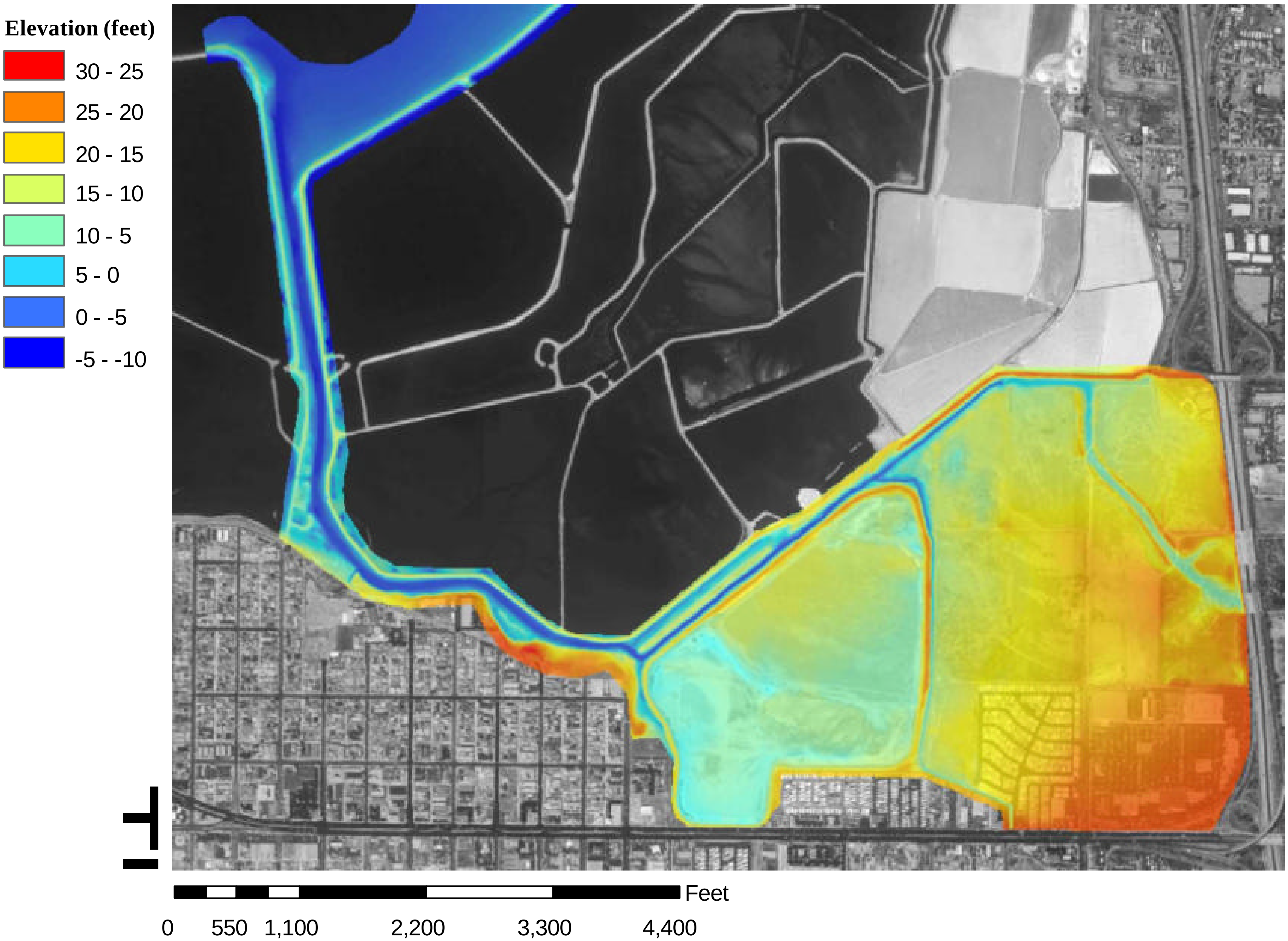


figure 2-4

Topographic Map of Project Site

Lower Otay River Salt Marsh and Wetland Restoration

Note: All Elevations are in the NAVD 88 (feet) Vertical Datum

PWA

Otay River – looking southwest between Pond 20 (near) and Salt Works Levee (far)

Otay River – looking southeast from Pond 20A (site of proposed marsh restoration)

figure 2-6

Planning Unit A Site Characteristics

Lower Otay River Salt Marsh and Wetland Restoration

PWA

Otay River RR Bridge downstream of Pond 20A

figure 2-7

Planning Unit A Site Characteristics – RR Bridge
Lower Otay River Salt Marsh and Wetland Restoration

PWA

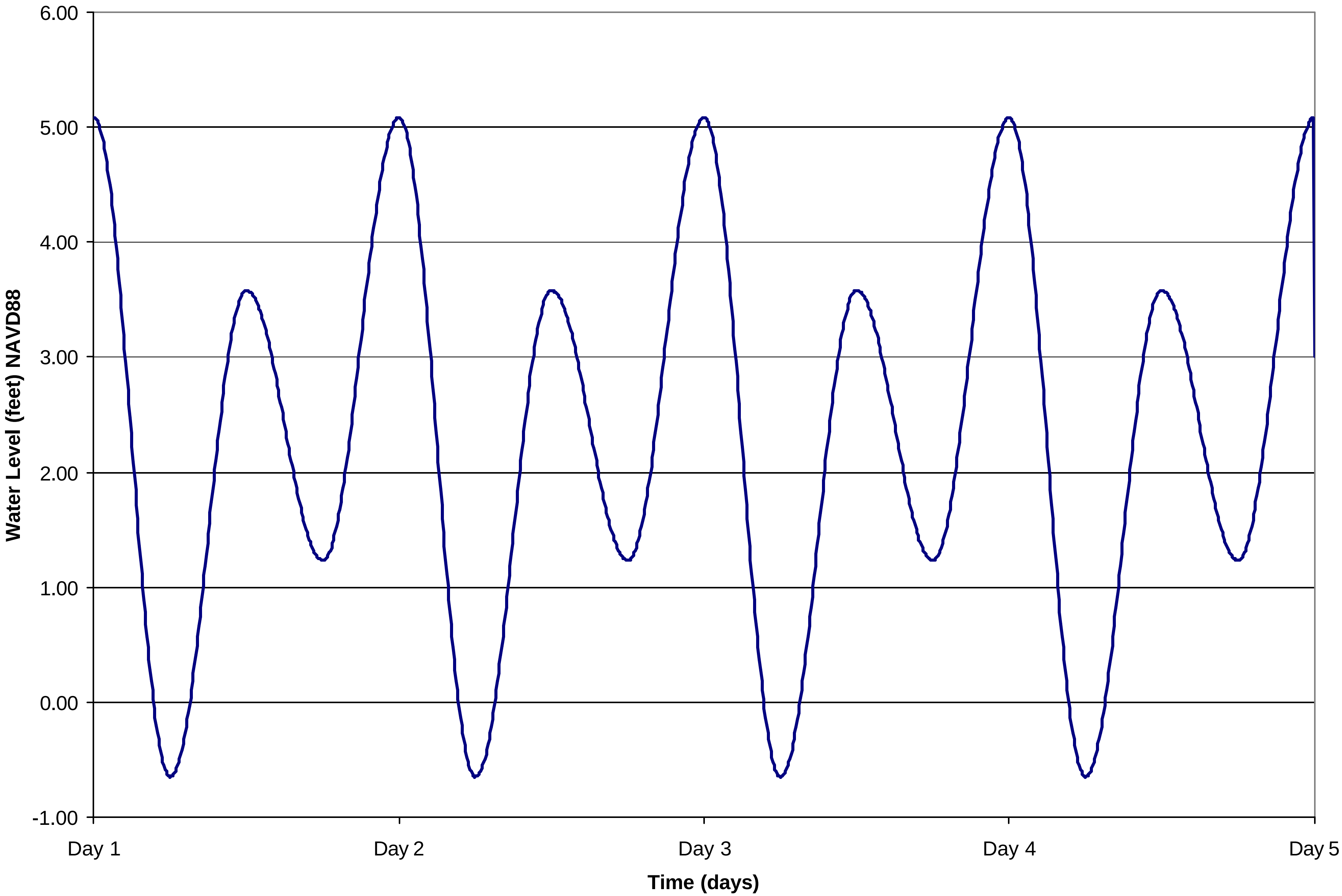
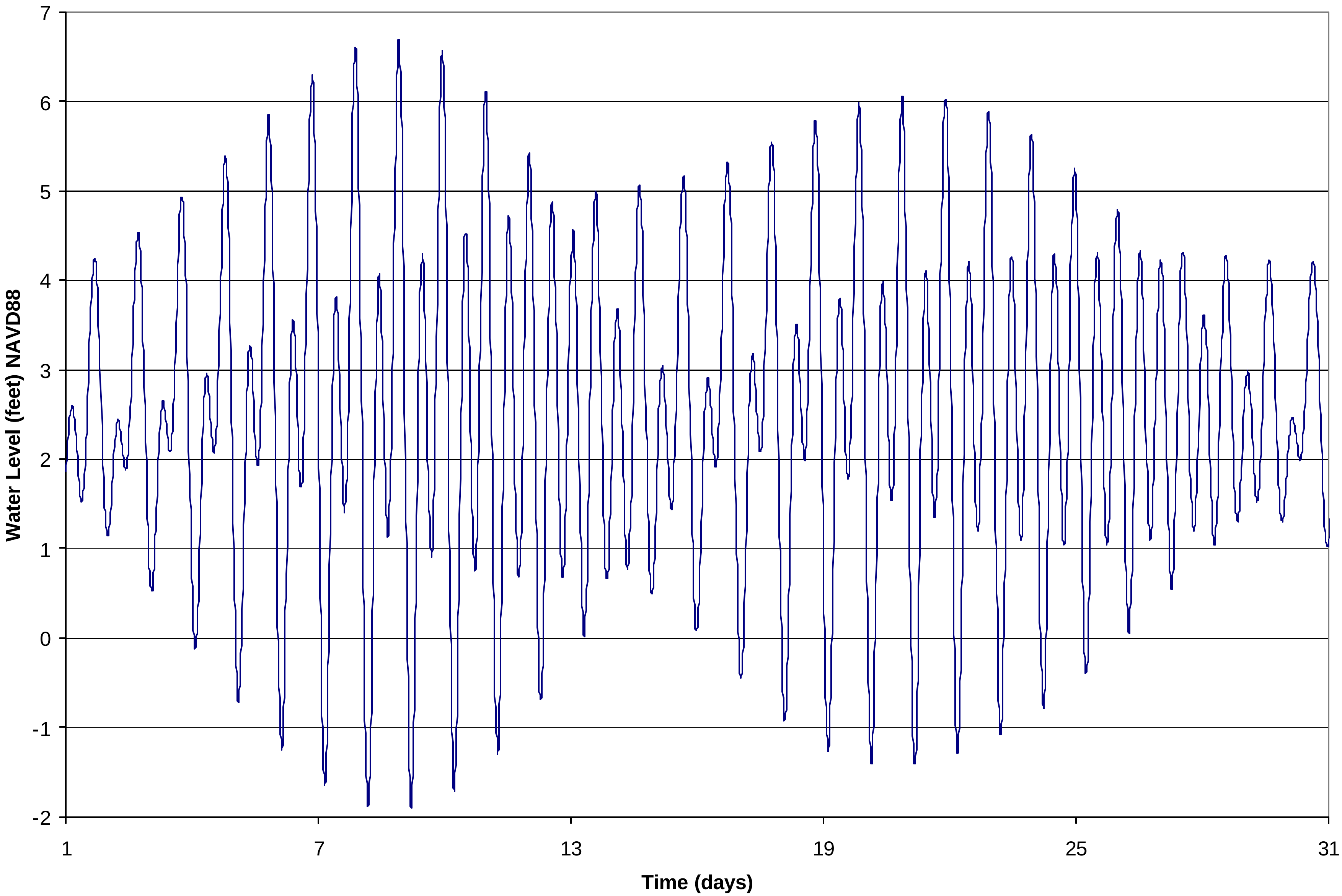


figure 3-1

Synthesized Diurnal Tide Cycle for San Diego Bay
Lower Otay River Salt Marsh and Wetland Restoration

PWA



f i g u r e 3-2

Representative Spring-Neap Tide Cycle for San Diego Bay
Lower Otay River Salt Marsh and Wetland Restoration

PWA

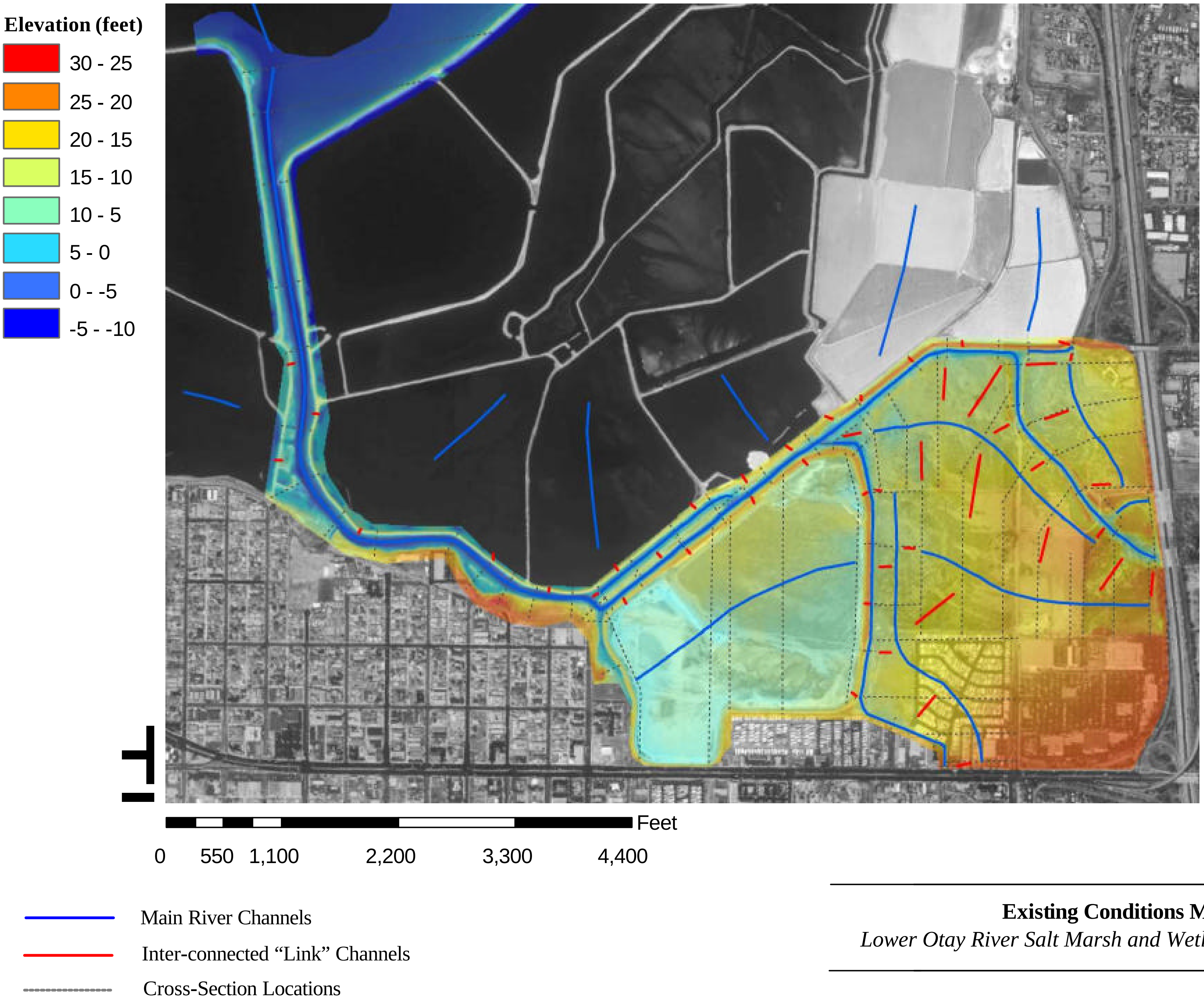


figure 3-3

Existing Conditions Model Schematic

Lower Otay River Salt Marsh and Wetland Restoration

PWA

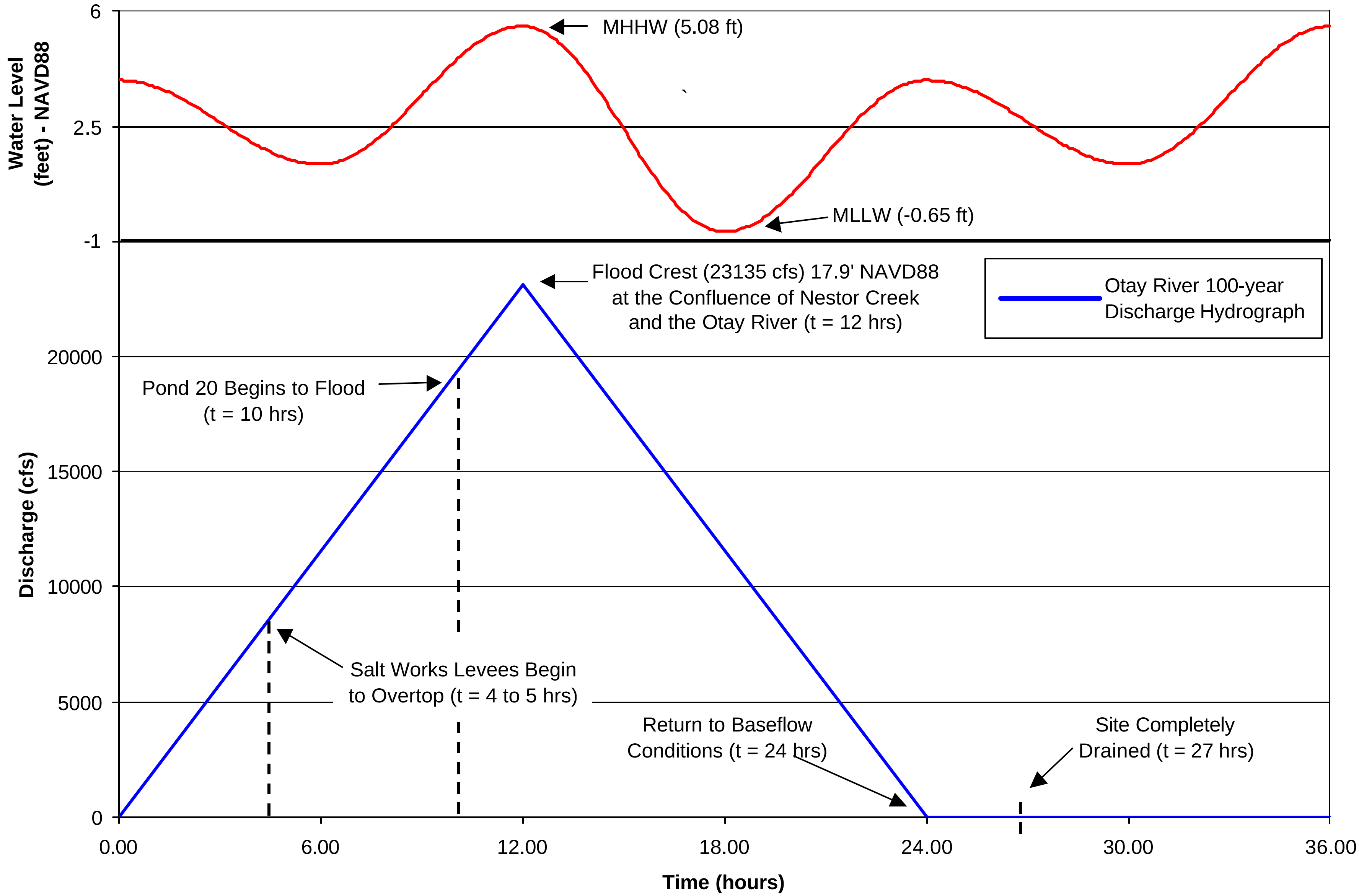


figure 3-4

Graphical Representation of the 100-Year Flooding Sequence on Planning Unit A

Lower Otay River Salt Marsh and Wetland Restoration

PWA

f i g u r e 3-5

Flooding Sequence for Table 3-4 (Existing Conditions)
Lower Otay River Salt Marsh and Wetland Restoration

PWA

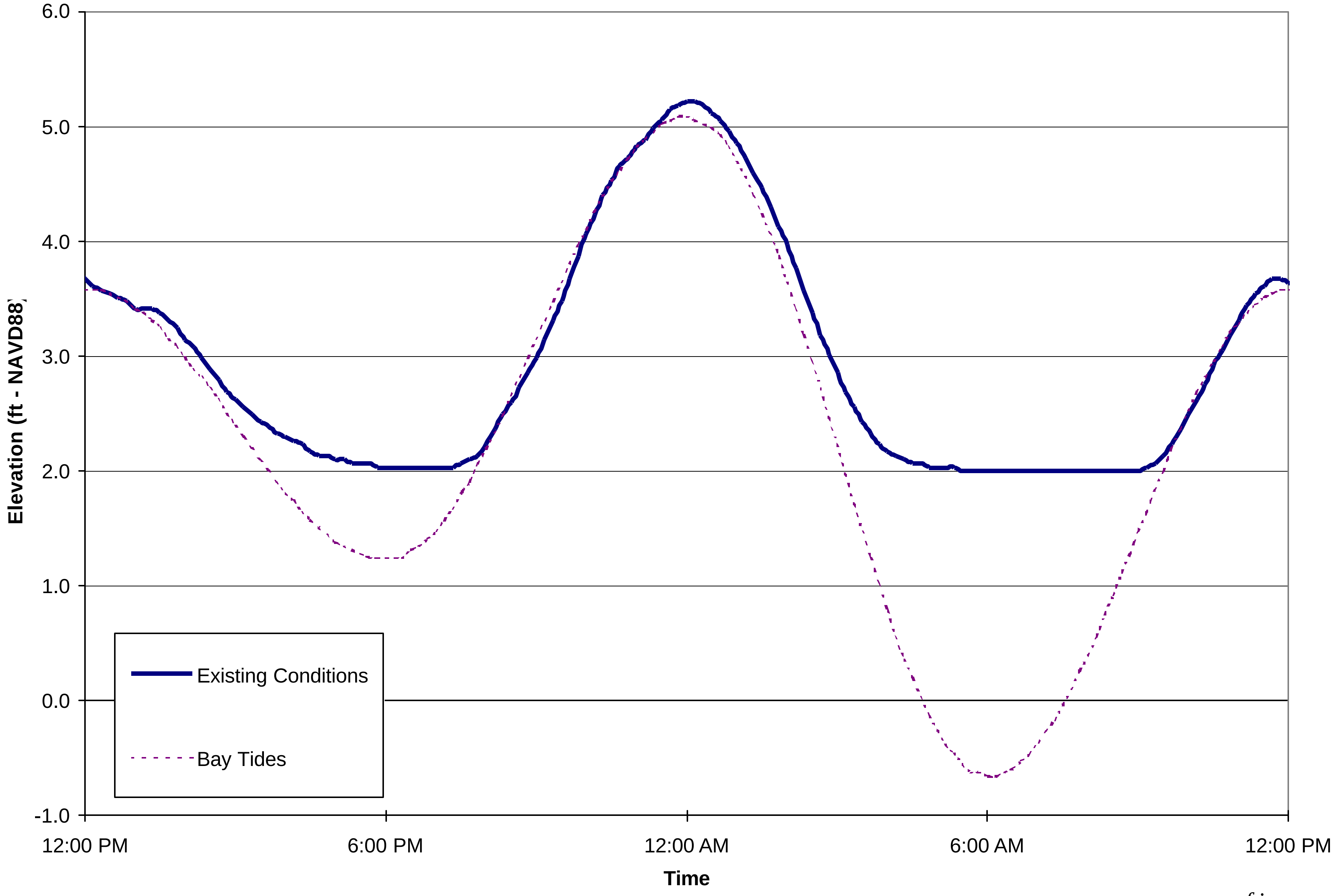


figure 3-6

Water Level Upstream of RR Bridge (Existing Conditions)

Lower Otay River Salt Marsh and Wetland Restoration

PWA

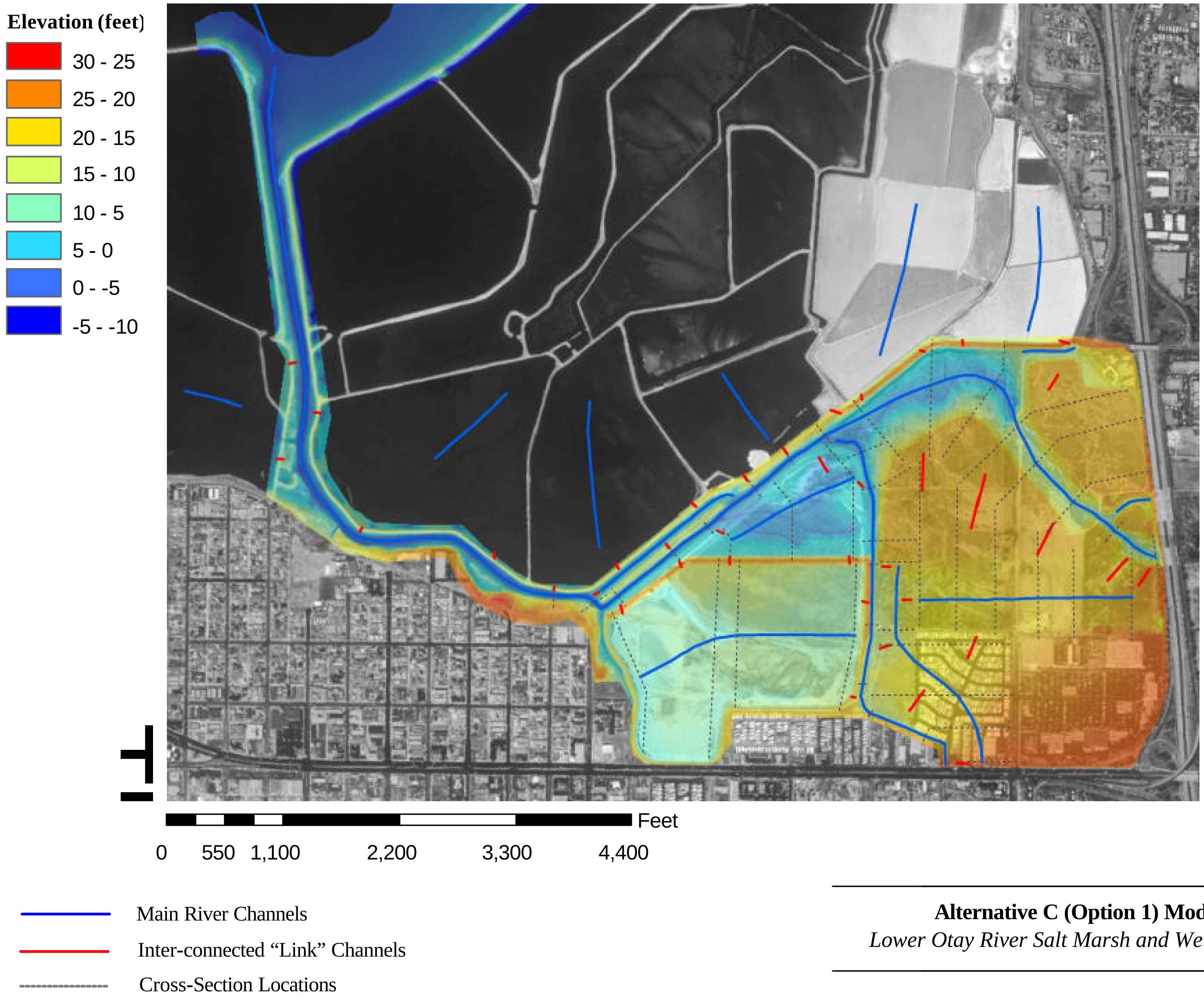


figure 4-1

Alternative C (Option 1) Model Configuration

Lower Otay River Salt Marsh and Wetland Restoration

PWA

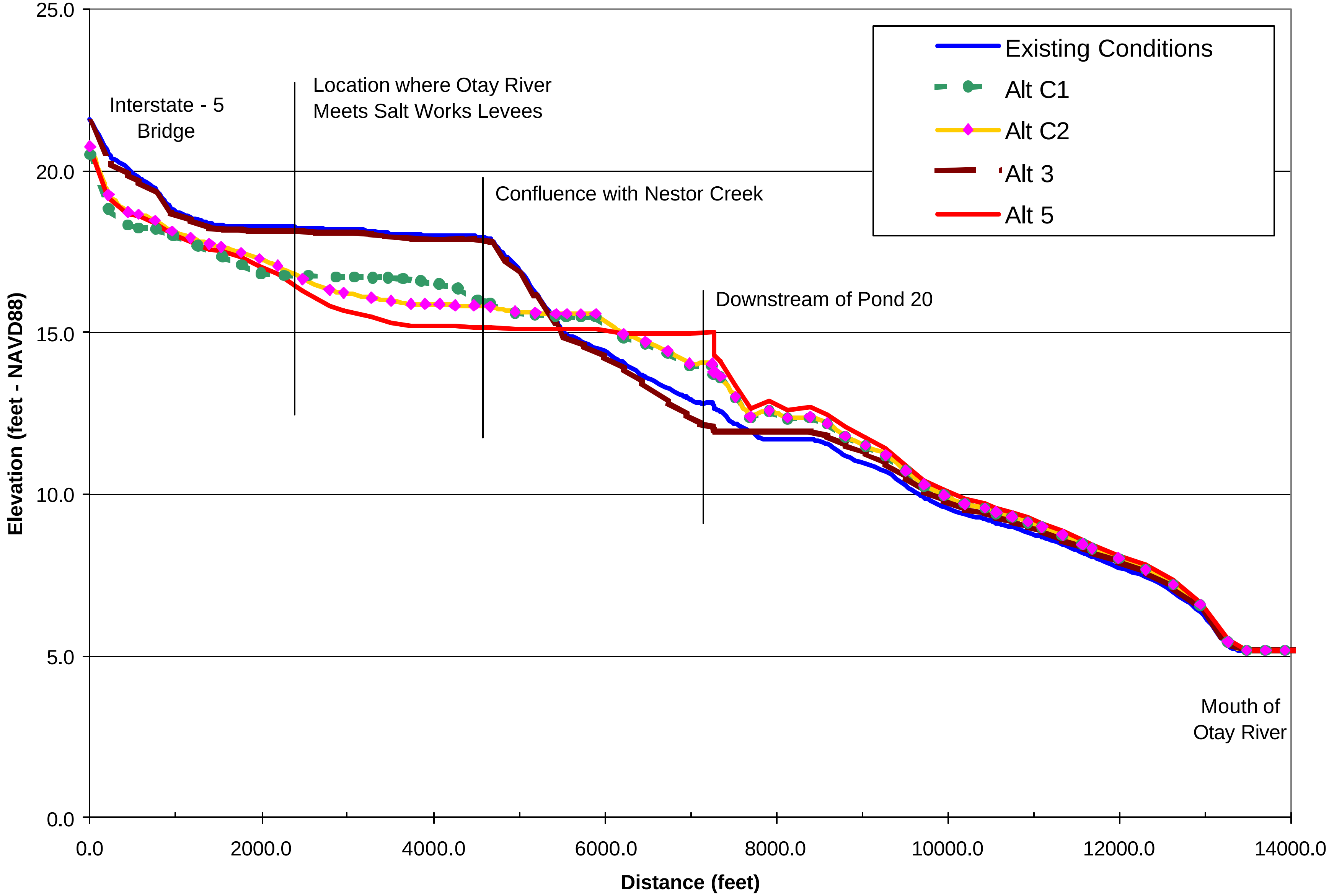


figure 4-2

Water Surface Profiles of Lower Otay River for Existing Conditions and Alternatives

Lower Otay River Salt Marsh and Wetland Restoration

PWA

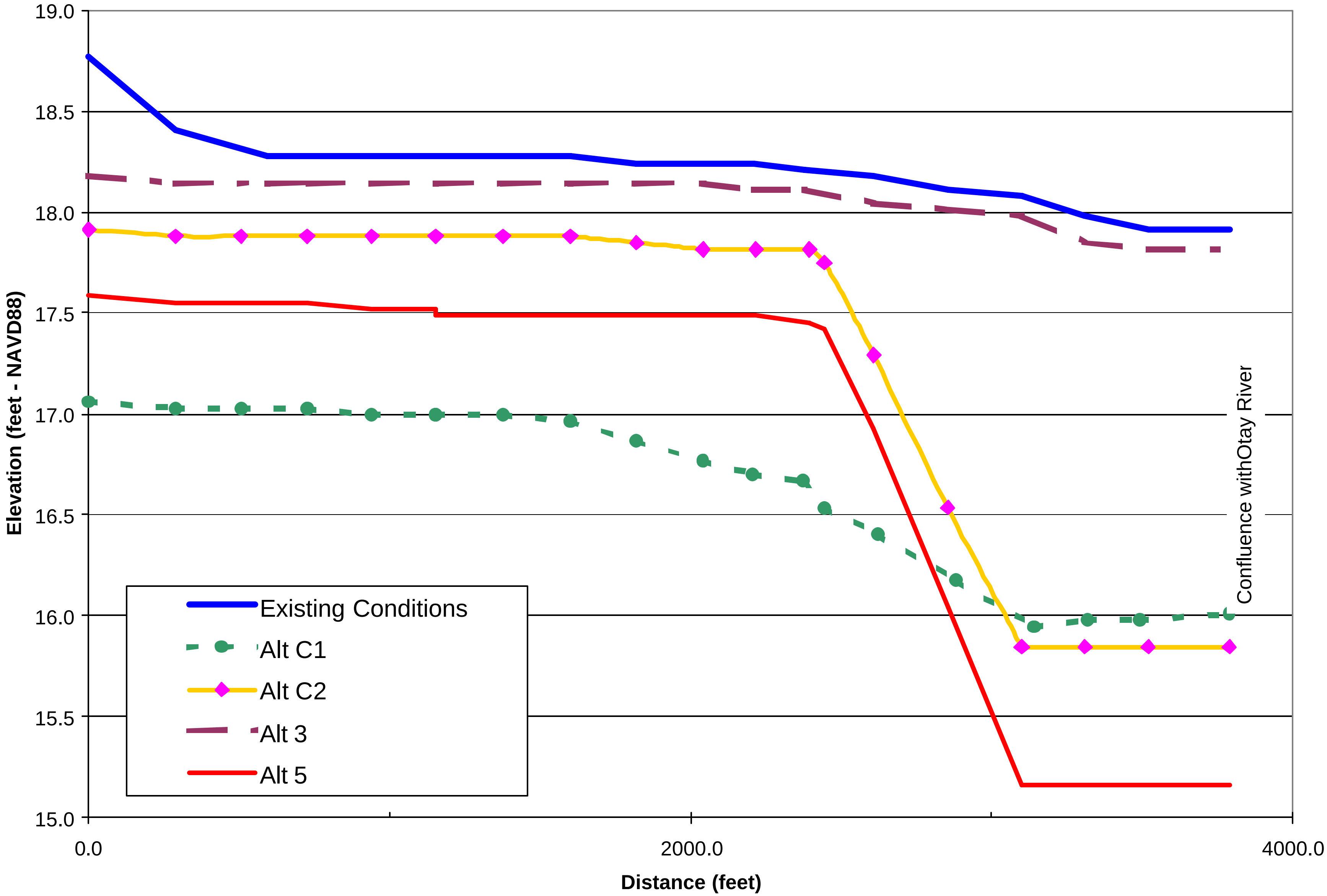


figure 4-3

Water Surface Profiles of Nestor Creek for Existing Conditions and Alternatives
Lower Otay River Salt Marsh and Wetland Restoration

PWA

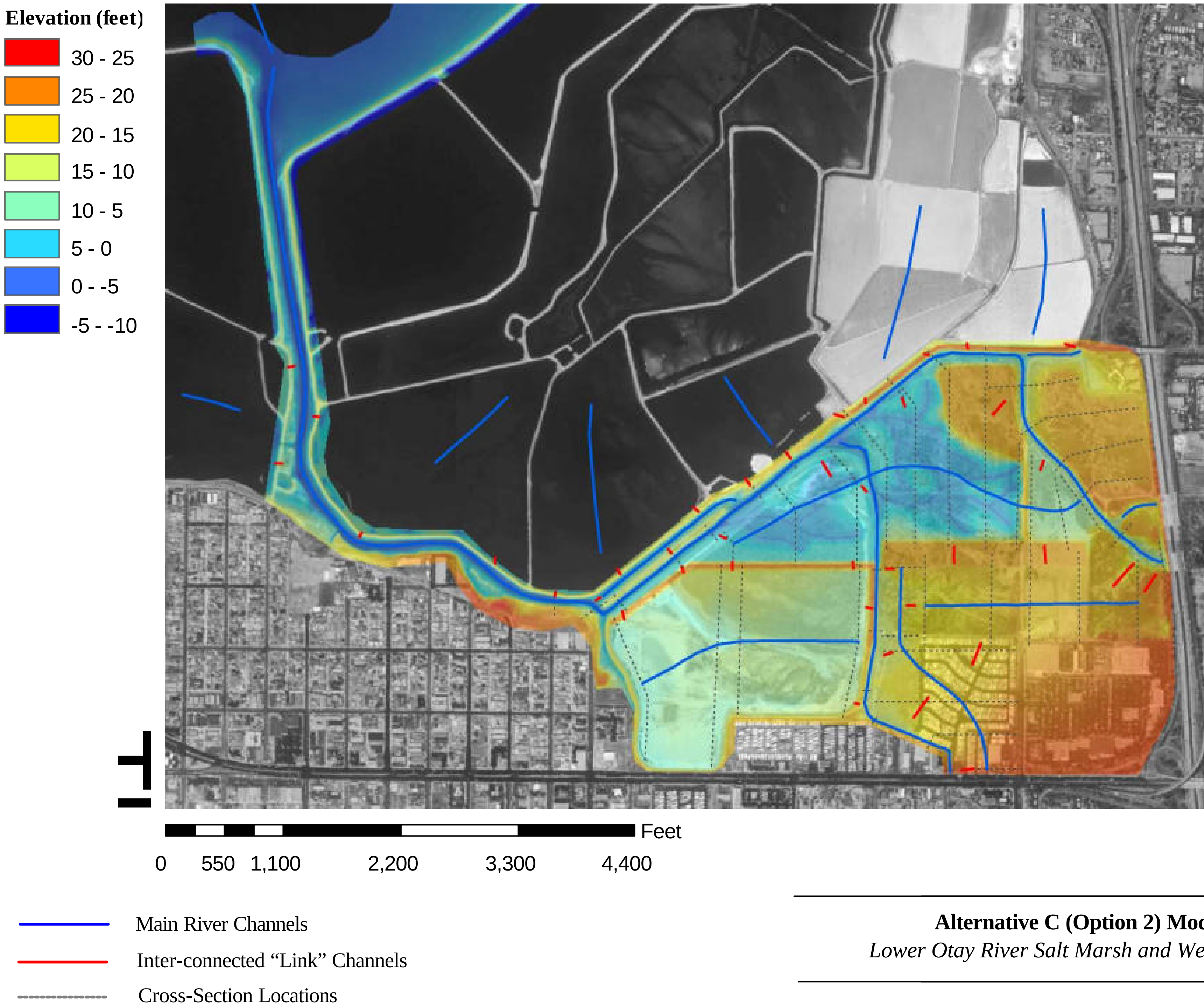


figure 4-5

Alternative C (Option 2) Model Configuration

Lower Otay River Salt Marsh and Wetland Restoration

PWA

figure 4-4

Reference Locations for Tables 4-2 and 4-4 Comparing 100-yr Water Surface Elevations

Lower Otay River Salt Marsh and Wetland Restoration

PWA

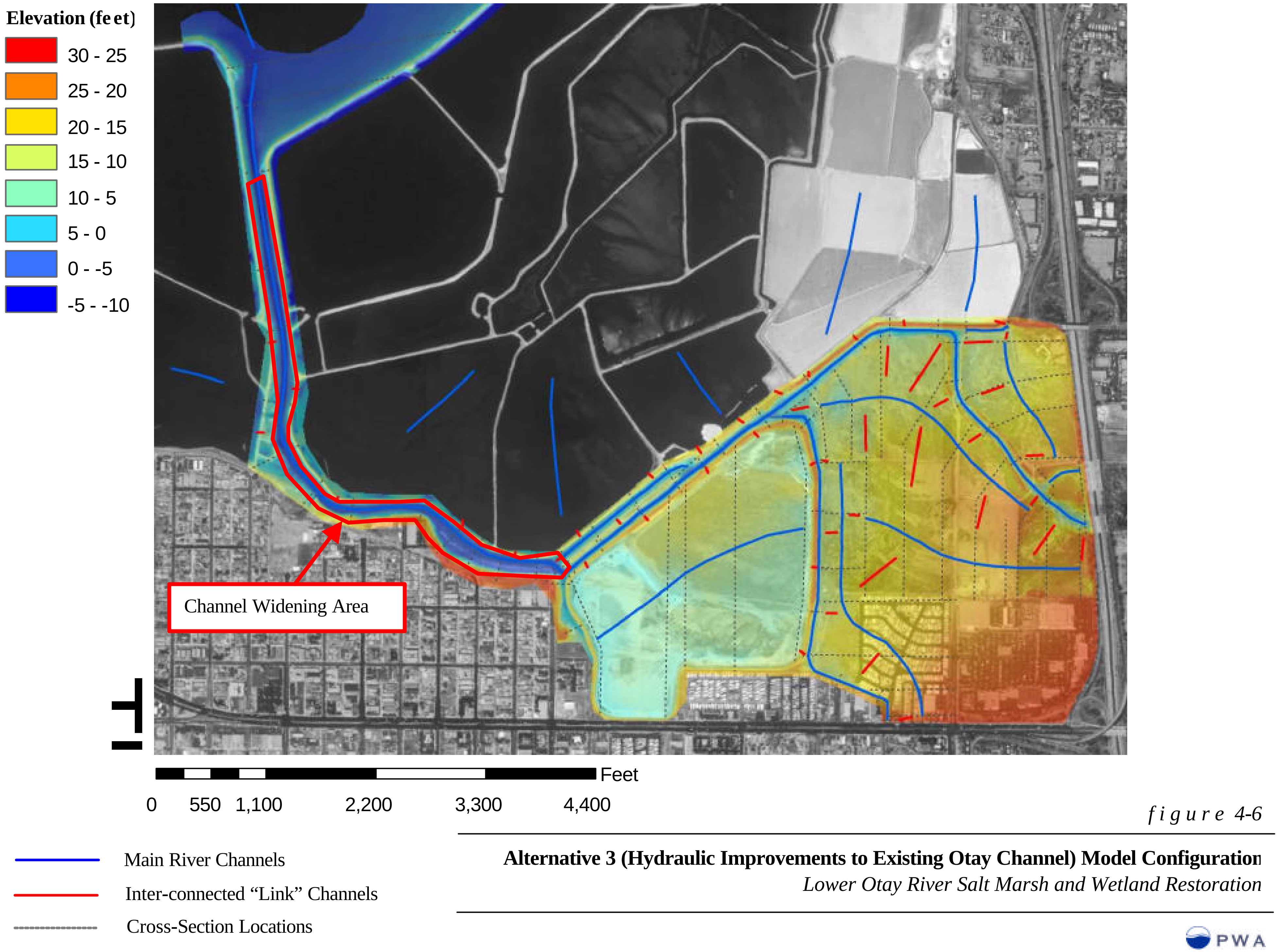
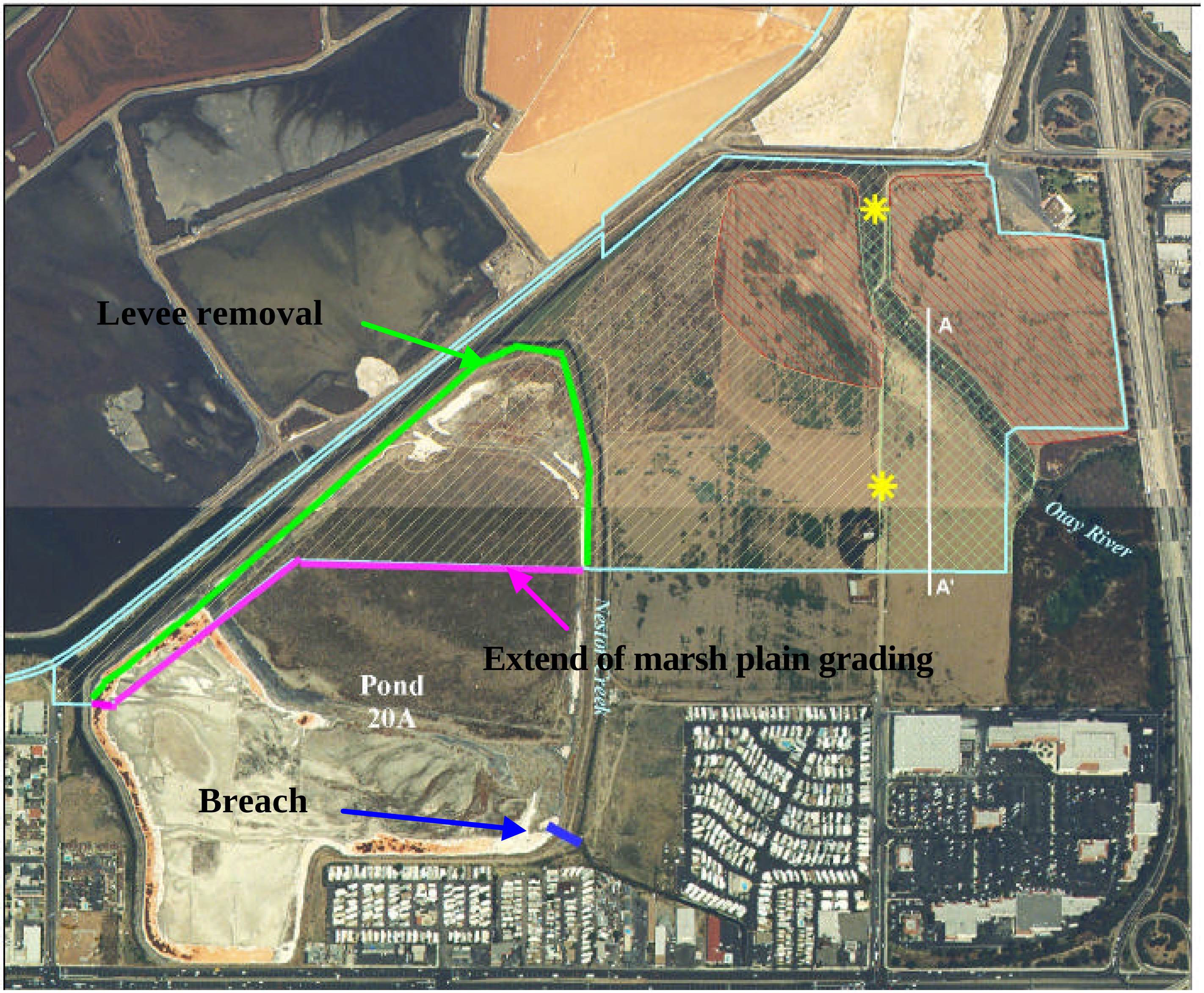


figure 4-6

Alternative 3 (Hydraulic Improvements to Existing Otay Channel) Model Configuration

Lower Otay River Salt Marsh and Wetland Restoration

PWA



Feet

0 550 1,100 2,200 3,300 4,400

Main River Channels

Inter-connected "Link" Channels

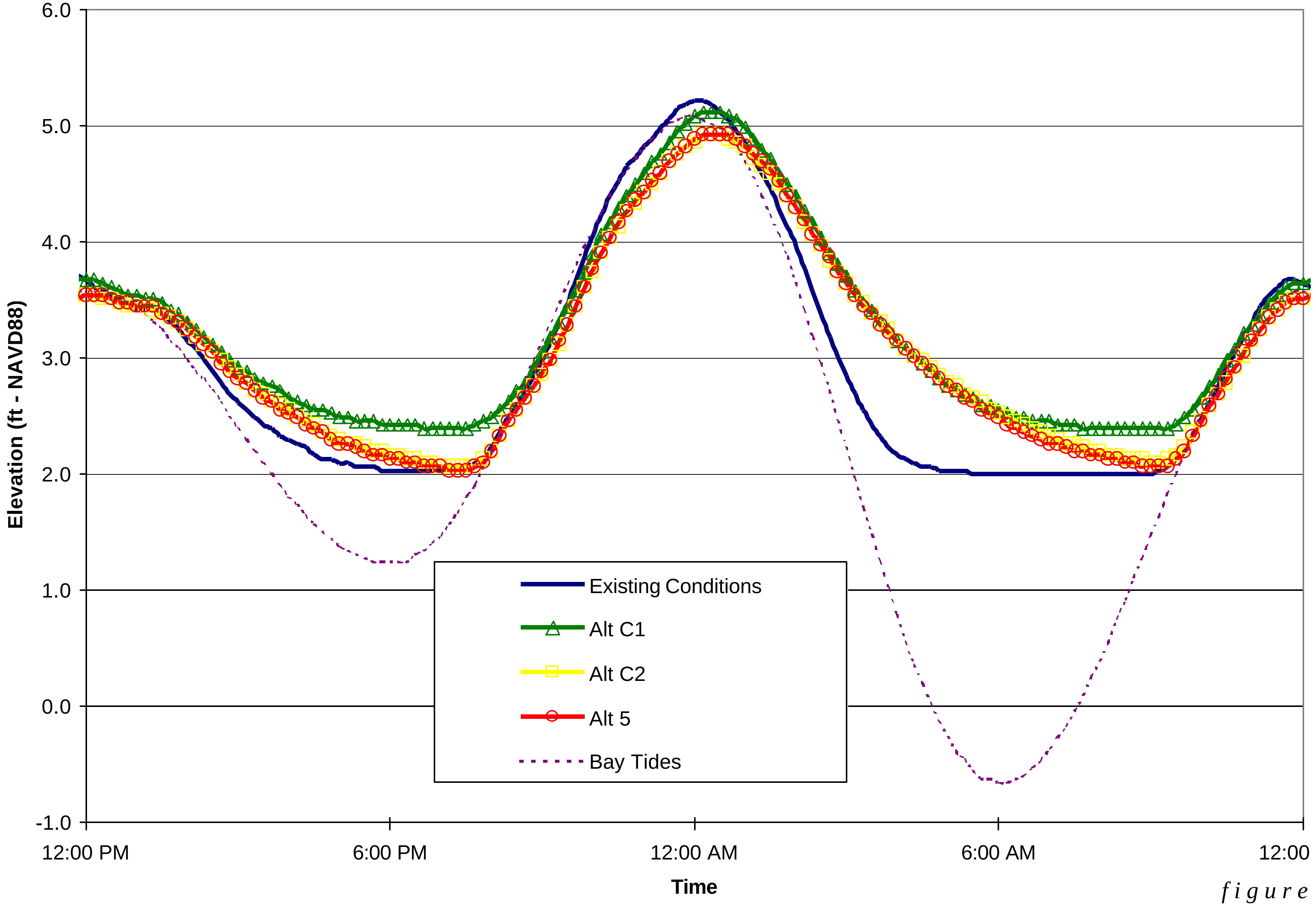
Cross-Section Locations

figure 4-7

Alternative 5 (Pond 20: Levee Removal and Grading)

Lower Otay River Salt Marsh and Wetland Restoration

PWA



f i g u r e 4-8

Simulated Water Levels Upstream of RR Bridge

Lower Otay River Salt Marsh and Wetland Restoration

PWA

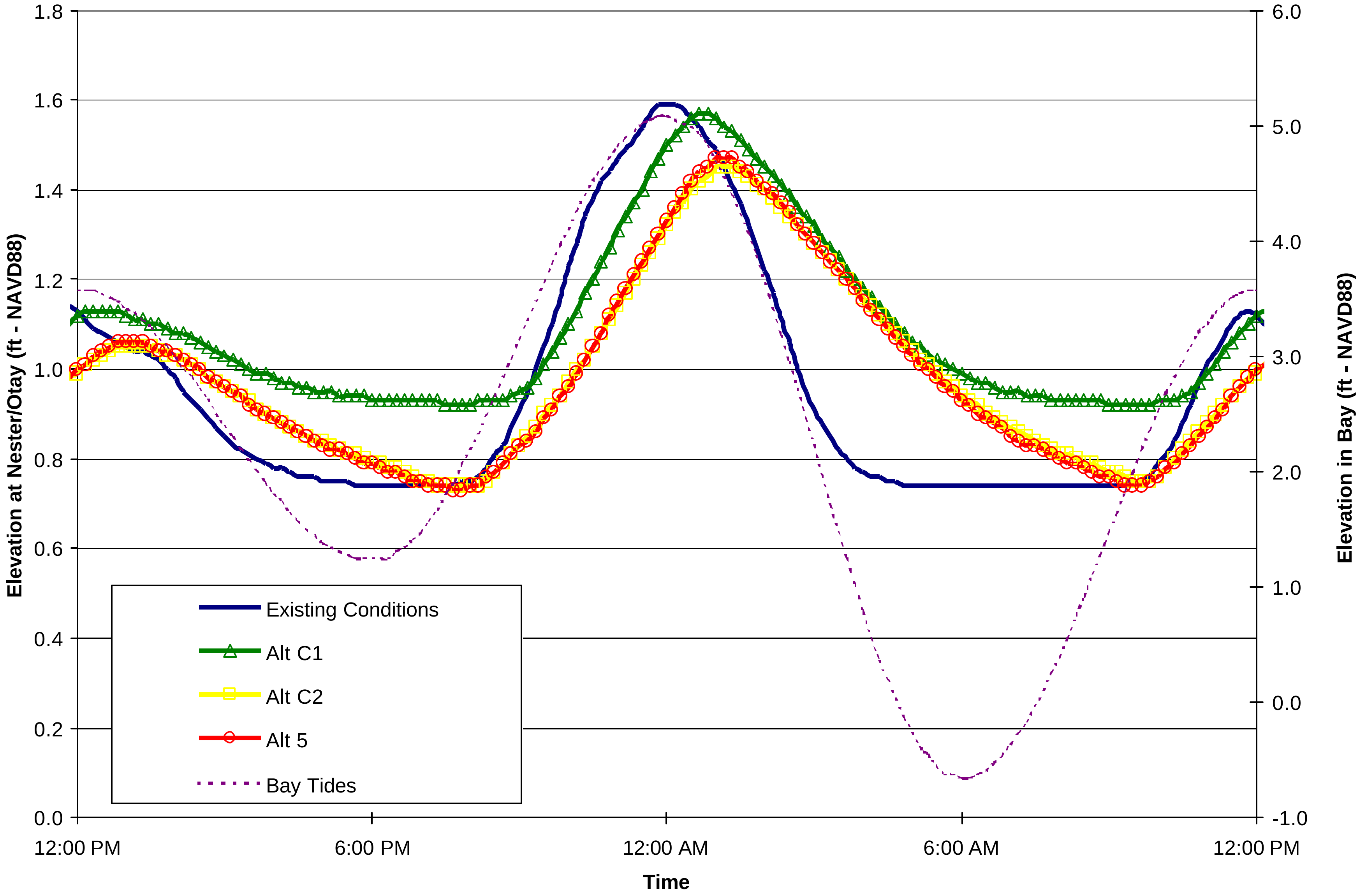


figure 4-9

Simulated Water Levels at Nester/Otay Confluence

Lower Otay River Salt Marsh and Wetland Restoration

Note that different scales are used to plot the tides in South San Diego Bay and at the confluence of Otay and Nester Creeks.

PWA

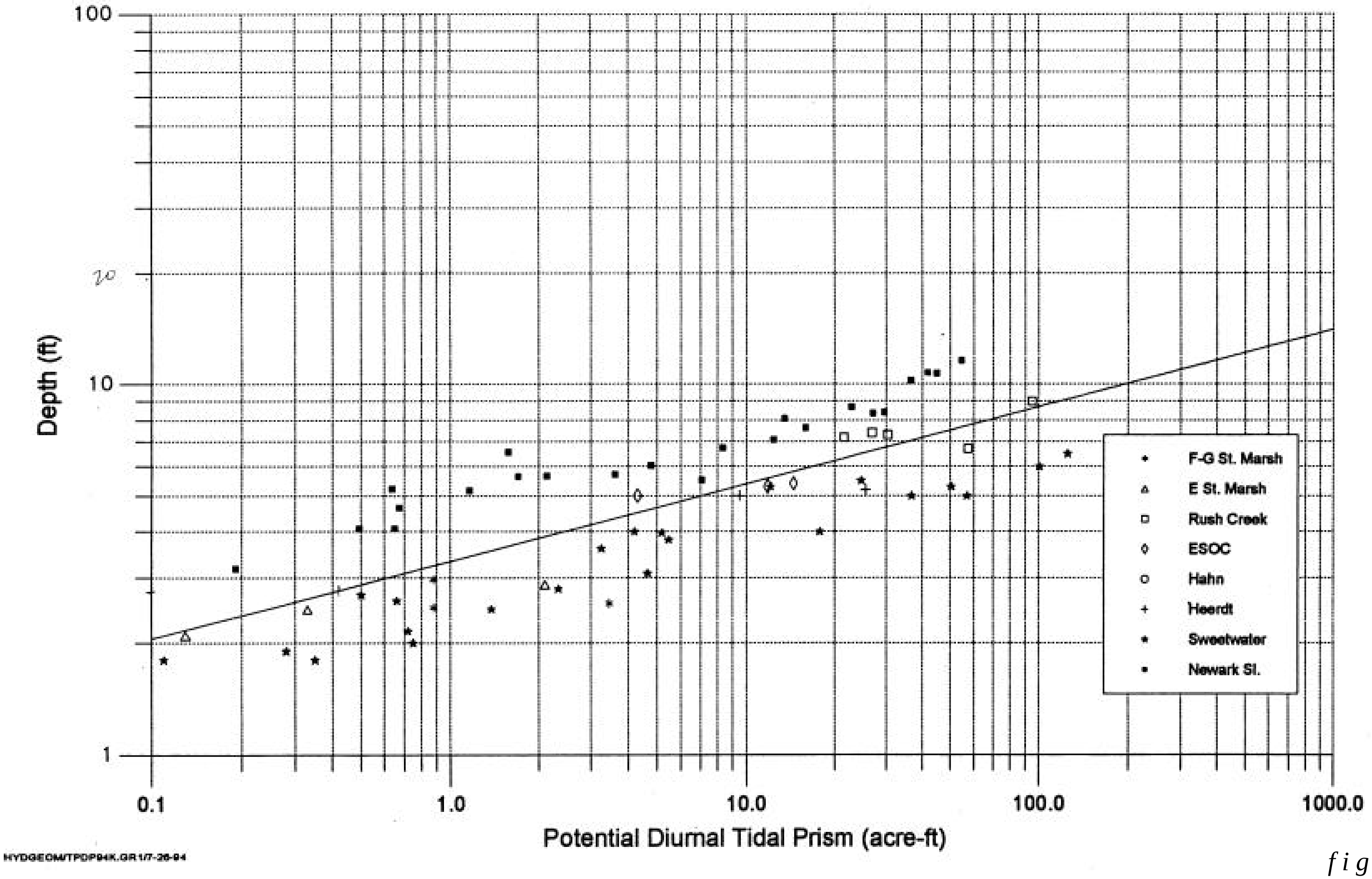


figure 4-10

Hydraulic Geometry for California Salt Marshes – Depth and Tidal Prism

Lower Otay River Salt Marsh and Wetland Restoration

Source: Philip Williams and Associates, Design Guidelines for Tidal Channels in Coastal Wetlands, Prepared for the U.S. Army Corps of Engineers, Waterways Experiment Station, January 1995.

PWA

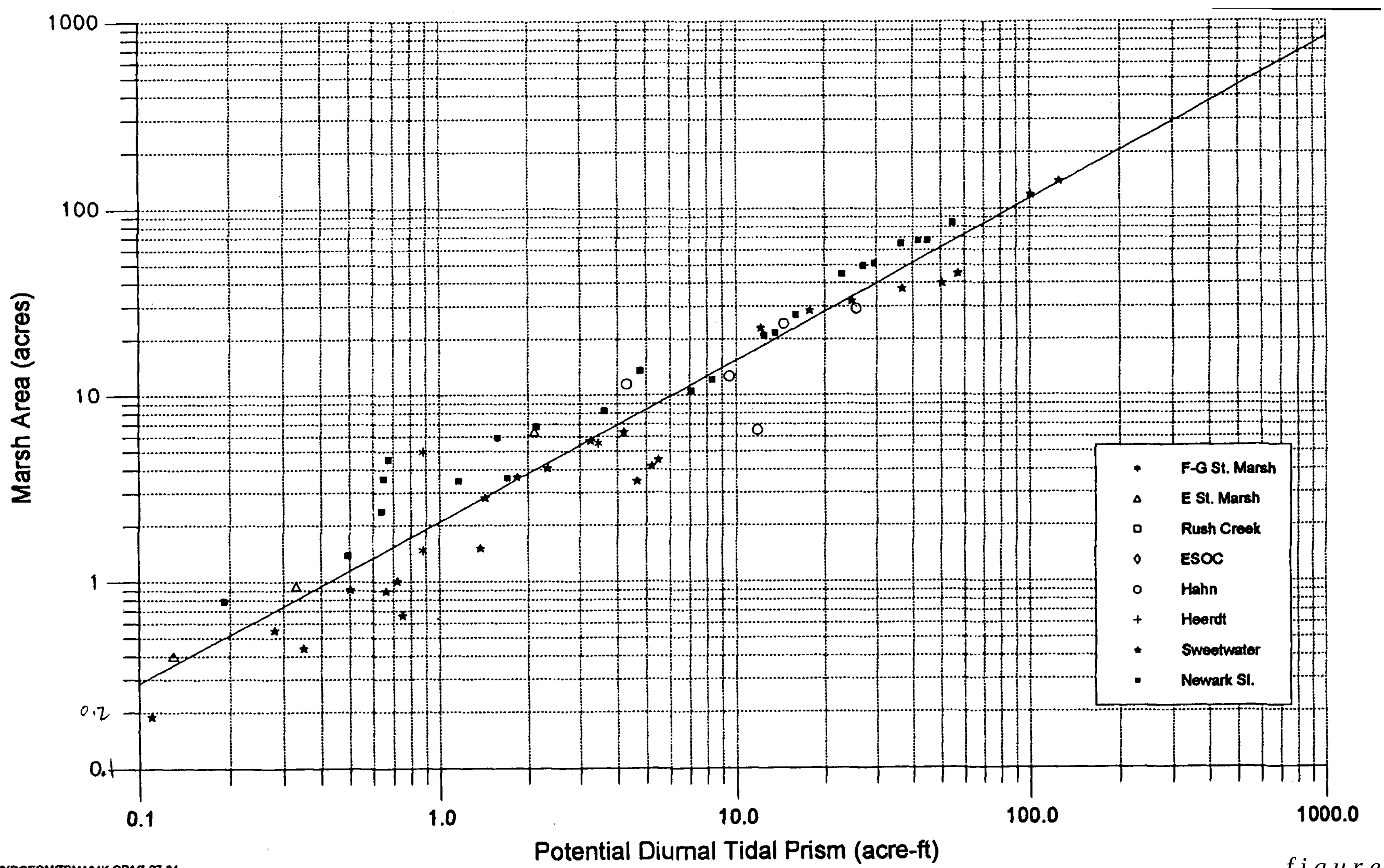


figure 4-11

Hydraulic Geometry for California Salt Marshes – Area and Tidal Prism

Lower Otay River Salt Marsh and Wetland Restoration

Source: Philip Williams and Associates, Design Guidelines for Tidal Channels in Coastal Wetlands, Prepared for the U.S. Army Corps of Engineers, Waterways Experiment Station, January 1995.

PWA

Appendix J

Desalinization and Brine Management Feasibility Assessment

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Preliminary Feasibility Assessment of Desalinization and Brine Management for the South San Diego Bay Salt Ponds Restoration

FINAL REPORT

Prepared for

Ducks Unlimited

Prepared by

Philip Williams & Associates, Ltd.

with

DHI Water & Environment

May 9, 2003

PWA REF. 1631

Services provided pursuant to this Agreement are intended solely for the use and benefit of the Ducks Unlimited and the US Fish & Wildlife Service.

No other person or entity shall be entitled to rely on the services, opinions, recommendations, plans or specifications provided pursuant to this agreement without the express written consent of Philip Williams & Associates, Ltd., 720 California Street, 6th Floor, San Francisco, CA 94108.

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1. INTRODUCTION

The U.S. Fish and Wildlife Service (USFWS) is currently developing a Comprehensive Conservation Plan (CCP) and Environmental Impact Statement (EIS) for the South San Diego Bay Unit of the San Diego National Wildlife Refuge. This plan includes alternatives to restore and enhance habitat for aquatic and avian wildlife species within the 1,050-acre salt pond complex along South San Diego Bay. Ducks Unlimited (DU) is assisting the USFWS in the planning effort and contracted Philip Williams & Associates, Ltd. (PWA) to carry out a preliminary assessment of salinity reduction and feasibility of a managed brine complex.

The restoration alternatives under development include various levels of tidal wetland restoration within the pond complex and reduction of acreages dedicated to commercial salt harvesting. USFWS and DU selected two specific alternatives for impact analysis that included restoration of many of the ponds fronting the bay to tidal inundation, and a reduced salt production operation (Alternative C Option 4, Figure 1) or complete elimination of salt production in favor of managed open-water and brine ponds (Alternative D, Figure 2). PWA conducted a preliminary technical assessment to answer the following key questions in support of the CCP and EIS process:

- What are the short-term effects on salinity in San Diego Bay that would result from breaching salt pond levees for desalination, and how quickly can these ponds be flushed to ambient salinity levels?

- Is the proposed brine operation feasible, given the flow rates required to maintain suitable habitat in the ponds and the necessary dilution of the hypersaline brine prior to discharge to the bay?

PWA conducted hydrodynamic and salinity transport modeling of two salinity reduction scenarios and applied a simple box model of the brine operations to address the questions above. DHI Water and Environment (DHI) was sub-contracted to develop and apply the numerical hydrodynamic and salinity transport model in support of this analysis.

2. KEY FINDINGS AND MANAGEMENT CONSIDERATIONS

2.1 KEY FINDINGS

PWA conducted hydrodynamic and salinity transport modeling to assess changes in pond and Bay salinities that would result from breaching salt pond levees for salinity reduction. We modeled a phased salinity reduction approach for Alternatives C4 and D. Phase 1 consists of salinity reduction in Ponds 10, 10A, and 11 (Figure 1). Phase 2 includes breaching of Ponds 12 – 15, assuming that the Phase 1 ponds are tidal and at ambient bay salinities (approximately 33 ppt). Alternative D (Figure 2) includes an additional third phase, in which Ponds 23-25 and 28-30 are breached once salinities in the Phase 2 ponds have reached ambient levels. Because of the limited number of model runs contracted for this study, we modeled salinity reduction for only Phases 2 and 3. Pond desalinization in Phase 1 is expected to occur more quickly and with fewer salinity effects to the Bay than in Phases 2 and 3 because of the smaller total mass of salt in the Phase 1 ponds. Key results from numerical modeling of the proposed salinity reduction alternatives include:

- Salinities in the Phase 2 ponds can be reduced to 38 ppt (+5 ppt above ambient levels) within approximately one month. The rate of salinity reduction is initially rapid, then slows over time as the ponds equilibrate to the salinity of the bay. Once salinities decrease to 38 ppt, further salinity reduction is very gradual. Salinity reduction is slowest in Pond 13, the only pond that is not directly adjacent to the Bay.

- The Phase 3 ponds drain almost completely on the first ebb tide and discharge into the Phase 2 Ponds. From there, flushing from the Phase 2 ponds into the bay is similar to the flushing that occurs in Phase 2. Because the bottom elevations of the Phase 3 ponds are above high tide levels, the ponds are not re-flooded in subsequent tide cycles. Isolated “puddles” of high salinity water remain due to the micro-topography of the ponds. Some ditching or grading may be required to drain these puddles for desalinization.

- Within San Diego Bay, salinity increases above 38 ppt (+5 ppt above ambient) are generally limited to areas south of the Chula Vista Nature Reserve and to the first week following breaching for both Phases 2 and 3. As expected, salinity effects are highest in the vicinity of the ponds and immediately after breaching. For Phase 2, salinities in the vicinity of the ponds peak at 50 ppt during the first ebb tide, then decrease to approximately 40 ppt one day after breaching. For Phase 3, salinities in the vicinity of the ponds peak at 120 ppt during the first ebb tide, then decrease to approximately 60 ppt one day after breaching. As expected, salinity in the immediate vicinity of the ponds varies greatly over the tide cycle, with maximum effects observed during low tide, as hypersaline pond water is discharged into the bay.

- Breach widths of approximately 5 meters appeared to provide a reasonable balance between rapidly reducing pond salinities and reducing initial salinity increases in the Bay. Mixing and salinity reduction in Pond 13 during Phase 2 could be enhanced by adding additional breaches to Pond 14 or 15. The breach sizes were selected for the purposes of salinity reduction. Final breach sizes will be selected based on habitat considerations and may be refined in size and location from those used here.

The preliminary feasibility assessment of the brine complex consisted of applying a box model to the proposed configuration of the brine ponds. The brine complex, located in the eastern part of the site, includes Ponds 42, 43, 45, 46, and 47 (Figure 2). We assumed that slightly hypersaline water (40 ppt) water from the managed ponds would serve as the source of inflow to the brine ponds and that the brine ponds would discharge to a mixing basin for dilution with Bay water to near ambient salinity levels (+ 5 ppt) prior to discharge to the Bay. From this preliminary assessment, we conclude the following:

- It appears feasible to manage the brine ponds to simultaneously meet the target salinities for habitat inside the ponds (80 – 120 ppt) and the target salinities for discharge to the Bay (discharge salinities below ambient + 5 ppt) using pumping. Required flow rates into the brine ponds and into the mixing basin for dilution are well within levels that can be accommodated by pumping.

- Flow rates into the brine ponds vary seasonally from about 60 to 170 gpm over the course of a typical year, with the highest rates in the summer due to rapid evaporation. The flows must be managed seasonally to maintain the ponds within the target salinity range. Allowing the pond salinities to vary within the target range allows peak summer flow rates to be reduced below those that would otherwise be required to meet a constant pond salinity target.

- Flow rates through the mixing basin (Pond 41) are much higher than those through the brine ponds, and vary between approximately 300 and 1300 gpm. These higher flow rates are needed to dilute the brine effluent to dischargeable levels and to offset the effects of evaporation in the mixing basin itself. Flushing times vary from 10 to 37 days. The peak flow rates could be reduced to about 830 gpm using flash mixing, in which brine outflow is rapidly diluted in a small basin or canal prior to discharge to the Bay. Flash mixing requires smaller flow rates since the effects of evaporation are negligible. However, dilution operations may need to be managed more closely in flash mixing since any variation in dilution rates would translate more quickly to salinity variations in waters released to the Bay. Despite the modest flow rates, operating costs may be large due to the continuous (or nearly continuous) pumping required.

2.2 MANAGEMENT CONSIDERATIONS

Application of the numerical model is useful for estimating pond desalinization times and characterizing the potential extent and magnitude of salinity effects in San Diego Bay. However, implementation of the salinity reduction program will also require adaptive management to respond to actual conditions during desalinization which may vary from predicted conditions for a variety of reasons. An adaptive management approach would include monitoring during desalinization and identification of adaptive actions, such as closing off the breaches, that could be applied if needed. It may also include staggering the levee breaches so that tidal action is restored to the ponds one at a time. Model limitations and additional management considerations are discussed in Section 4.4.

The brine management box model includes several simplifying assumptions for the purpose of preliminary feasibility assessment. If brine management is carried forward in project planning, these assumptions will need to be assessed in more detail later in the design process. Brine operations must be sufficiently flexible to prevent pond drying and levee overtopping for a range of climatological conditions, to maintain salinities within the target range for habitat, and to avoid hypersalinity and gypsum formation. Sufficient safeguards would be required to avoid high salinity discharges in the event of extreme wet and dry years, pump failure, or other atypical conditions. In addition, further analysis could be useful for identifying lower cost implementation approaches, particularly to reduce the cost of pumping. Model limitations and additional management considerations are discussed in Section 5.4. For the purposes of this study, we have assumed that inflow into the Brine complex is continuous. However, pumping rates that vary in a step-wise manner could be applied to the box model as well.

This study addresses the spatial and temporal extent of salinity changes associated with desalinization and ongoing brine management. This information can be used to assess ecological or other potential impacts associated with the salinity changes. We understand that these issues will be addressed in subsequent environmental review and planning. The salinity reduction and brine management operations may be refined as needed once project impacts have been more clearly defined.

3. MODEL DEVELOPMENT AND CALIBRATION OF EXISTING CONDITIONS

3.1 INTRODUCTION AND MODELING OBJECTIVES

We applied numerical modeling to simulate salinity reduction associated with restoration of the South Bay Salt Ponds. The model is a combined one-dimensional/two-dimensional hydrodynamic and salinity transport model. We used the model to assess the time scales needed to lower salinity in the ponds and the effects on San Diego Bay salinities following the hypersaline discharges.

We developed a Bay-wide numerical model that includes the entire San Diego Bay, the local offshore Pacific Ocean, the South Bay Salt Ponds and the tidal limits of the lower Otay River. The model is capable of predicting both the near-field (local) and far-field (regional) hydrodynamics and salinity impacts of high salinity discharges from breaching the salt ponds.

Application of a depth-averaged 2D model over San Diego Bay and the ponds was assumed appropriate since the shallow water depths in the South Bay will lead to a fairly well-mixed water column. The 1D model was added to simulate the lower Otay River and pond breaches.

3.2 OVERVIEW OF THE NUMERICAL MODELS

The Bay-Wide numerical model uses a combination of DHI's two-dimensional (MIKE 21) and one-dimensional (MIKE 11) modules in order to simulate flows in San Diego Bay, the salt ponds, and the lower Otay River. The MIKE 21 and MIKE 11 components are dynamically coupled at boundary link locations through the MIKE Flood interface. PWA and DHI have successfully applied the MIKE Flood model for desalinization and restoration design modeling of the Napa River Salt Ponds in San Francisco Bay. The Napa River salt ponds are similar in configuration to the San Diego ponds and the model was used to answer similar types of salinity reduction questions.

The numerical simulation of water levels and currents for the bay and ponds was carried out using MIKE 21 NHD (Nested Hydrodynamic) modeling system. Salinity modeling was carried out using the MIKE 21 NAD (Nested Advection-Dispersion) model. The NAD model runs dynamically coupled to the NHD model. The nested model includes the capability of allowing finer (smaller) local grids to be dynamically linked into coarser regional grids.

The MIKE 11 model is used to model the tidal reach of the lower Otay River, and incorporates a river model previously developed by PWA for DU. Breaches are effectively earth weirs and are modeled using control structure weir components of MIKE 11. This allowed breach widths smaller than the grid resolution of the two-dimensional model. The MIKE 21 model is used to simulate the ponds and San Diego Bay.

The MIKE 21 and MIKE 11 models have been dynamically coupled in the Bay-Wide model using the MIKE Flood interface. At each computational time step, momentum and mass are transferred across link points that couple the two modules. For the present applications, link points were specified at each breach location and the at lower reach of the Otay River.

3.3 DEVELOPMENT OF THE NUMERICAL BAY MODEL

The model covers the entire San Diego Bay (Figure 3), and extends offshore from west of Point Loma to upstream of the tidal limit of Otay River. The modeling program consisted of the following steps:

- model setup for existing conditions,
- validation, and
- scenario and production simulations.

The model setup phase involves translating the physics into the mathematical schematization, based on measurements, observations and engineering judgment. Typically, calibration is then conducted to adjust model parameters so that the model prediction compares well with measured data. For this study, since the timeline was short and the San Diego Bay has been extensively modeled in the past, we used published data from existing calibrated models in the initial model setup and proceeded directly to the validation phase. Validation involves using the calibrated model setup for a new period of time on an independent dataset and checking that model predictions compare well to measurements. Model setup is described in this section; model validation is described in Section 3.4.

We relied on calibration data available from Wang et al. (1998), who conducted an extensive hydrodynamic model calibration using measurements from NOAA from 1983. Other datasets were provided digitally from Dr. Ken Richter of Space and Naval Warfare Systems Command (SPAWAR), but time limitations on the project did not allow a treatment of these other sources. The current level of model calibration and validation is considered appropriate for this phase of project planning. See Section 4.4 for a discussion of model limitations.

3.3.1 Model Time Step, Extents and Grids

Model grids were developed from combined bathymetric and topographical databases available for the San Diego Bay area. Surveys by the US Navy on a 50-meter resolution were the main source of bathymetry data for the San Diego Bay. A more detailed description of the bathymetry and topography of the salt ponds complex was provided by DU in an AutoCAD DEM (Digital Elevation Model) (Figure 5).

In order to increase the efficiency of the MIKE 21 model, a 25-meter grid of the Salt Ponds and southern reach of the bay was nested into a 75-meter grid that covered the entire Bay and nearshore zone (Figure 3). Since lower Otay River and the pond breaches could not be resolved in the 25-meter grid, these elements were included in MIKE 11 and coupled to the larger MIKE 21 model using the MIKE Flood interface. Figure 4 shows the location of the MIKE 11 branch and link points as applied in the model.

The hydrodynamic model was setup to run with a time step of 5 seconds, a requirement for numerical stability in the AD (advection-dispersion) model. The exact dimensions and locations of the two-dimensional model are listed in Table 3-1.

Table 3-1. MIKE 21 Grid Specifications

Grid Spacing *(m)*	Dimension X *(# points)*	Dimension Y *(# points)*	Origin Longitude *(degree)*	Origin Latitude *(degree)*	Orientation *(degree)*
75	281	231	-117.30364	32.58160	-0.163595
25	181	193	-117.13425	32.58392	-0.073158

3.3.2 Hydrodynamics Model: Water Levels and Currents

The main input parameters in the hydrodynamic model are:

- Model geometry, bathymetry (discussed above)
- Bed resistance (Manning's number)
- Eddy viscosity
- Boundary conditions
- Source/Sink input (i.e. power plant intake and discharge)

3.3.2.1 Bed Resistance

A depth dependent Manning n map was developed based on roughness values proposed by Wang et al. (1998) for San Diego Bay. Table 3-2 gives the depth relationship for the Manning's number used in the model and taken from Wang 1998.

Table 3-2. Depth Dependent Manning Numbers

Water Depth (m, MSL)	Manning's n Values
0.6 > depth	0.024
2.0 > Depth > 0.6	0.022
6.5 > Depth > 2.0	0.020
12.5 > Depth > 6.5	0.018
Depth > 12.5	0.015

Source: Reprinted from Wang et al. 1998

3.3.2.2 Eddy Viscosity

Experience with similar coastal systems suggests that the eddy viscosity values can be reasonably predicted by $E \cong K\ \Delta x^2/\Delta t$, where E is eddy viscosity, K is an empirical constant that typically ranges between 0.01 and 0.06 (DHI, 2002), Δx is grid spacing, and Δt is the computational time setup. Although the model was not very sensitive to the eddy viscosity within these ranges of K, final calibrated values were selected to dampen unrealistic eddy patterns in the flow fields. The final values used a K of 0.02 and give:

$E = 22.5\ m^2/s$ (75 meter grid)
$E = 2.5\ m^2/s$ (25 meter grid)

3.3.2.3 Boundary Conditions

As shown in Figure 3, open boundaries exist at the offshore extents of the model domain and require the specification of boundary conditions that drive the tidal flows through the model area. For the present study, a time varying water level derived from astronomical tidal constituents for Scripps Pier was applied along the entire offshore model boundary with no phase or amplitude adjustment made.

3.3.2.4 Source/Sink

In order to account for flows in and out of the nearby power plant, a source-sink was included in the model. A constant recirculating flow was applied at intake and outfalls of the power plant equaling 17.5 m^3/s or approximately 400 million gallons per day (MGD). This value was selected as representative of typical power plant operating conditions at the time that desalinization would occur (winter season), based on data from Jenkins and Wasyl (1996). Historical flow rates vary between approximately 50 and 600 mgd, with most flow fluctuations occurring in the summer and early fall months. Any differences in flow rates from those used in this study may affect the local salinity distributions near the power plant intake and outfall. For example, if actual flow rates during desalinization are larger than those used here, higher salinity waters may extend closer to the intake and further from the outfall. Also, high velocities associated with large outfall flow rates will influence local mixing and stratification is likely to be short lived.

3.3.3 <u>Salinity Transport Modeling</u>

3.3.3.1 Overview and Discussion

The salinity transport modeling was performed using the MIKE 21 NAD (Nested Advection-Dispersion) model running together with the MIKE 21 NHD model, and coupled to the MIKE 11 model of Otay River. For reasons of time and budget constraints, a rigorous salinity calibration was not performed. Instead, DHI relied upon experience in similar environments to select model parameters (dispersion coefficients) related to salinity transport and mixing.

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3.3.3.2 Dispersion Coefficients

Dispersion coefficients are the main parameters specified in the salinity model. Selection of dispersion coefficients can be a difficult process, and requires detailed measurements. Instead of carrying out a comprehensive calibration procedure, the dispersion coefficients applied in the present study have been selected based on the assumption that the dispersion coefficients are dependent upon the grid spacing and time step of the model. The dispersion coefficients have been estimated through the relation:

$$D = K \bullet \Delta x^2 / \Delta t$$

where D is the dispersion coefficient, K is a proportionality constant, Δx is the grid spacing, and Δt is the computational time step. Based on our experience in similar systems, the constant K typically ranges from approximately 0.01 to 0.06. We selected a value of 0.02 for this study as the typical mid-range value from experiments, and has been found to provide reasonable mixing characteristics in similar model studies. From this relation above, the dispersion coefficients used in the modeling were:

D = 22.5 m^2/s (75 m grid)
D = 2.5 m^2/s (25 m grid)

3.4 MODEL VALIDATION

Results from the hydrodynamic model were compared to measured water levels and currents around the Bay. Measurements of water level and currents were available from various sources, and data collected by NOAA/USGS/US Navy from 1983 were used.

3.4.1 Water Level Validation

For the validation period, three tide level gauges were available for comparing against model predictions. Figure 6 shows the locations of these stations (SSD, SD, and BP). The time period used for the water level measurement validation was 9/6/83 to 10/6/83.[1] Table 3-3 compares the modeled versus measured tidal constituents for the main 4 constituents that represent the bulk of the tidal forcing due to the attraction of the moon and sun on surface waters of Earth. For mixed tides such as those in San Diego, the main semi-diurnal tidal constituents are M2 (principal lunar) and S2 (principal solar), and the main diurnal forcing from the K1 (luni-solar declination), 01 (principal lunar) constituents. The constituent harmonic analysis is based on a least squares method, using DHI's tidal analysis package (Foreman, 1977 and DHI, 2001). The results of the constituent analysis indicate that modeled water levels match well with measured water levels throughout San Diego Bay.

[1] The effects of sea level rise since 1983 are small and are expected to be within the range of error of the modeling.

3.4.2 Current Validation

For the validation period in 1983, eight mechanical current meters were identified as useable for comparing against model predicted currents. Figure 6 shows the locations of these current meter stations. The time period used for the water level measurement calibration was 9/6/83 to 10/6/83. Table 3-4 compares the modeled versus measured tidal current constituents for the main tidal constituent, M2. The constituent analysis is based on a least squares method as previously described in Section 3.4.1. Generally the comparison is quite good. Discrepancies are most likely attributable to the fact that there were reportedly some problems with the mechanical meters, and the fact that these point measurements may not be representative of depth-averaged conditions simulated by the model.

Table 3-3. Comparison of Modeled Versus Measured Water Levels Tidal Constituents

Results	M2		K1		O1		S2	
	Amp (cm)	Phase (deg)	Amp (cm)	Phase (deg)	Amp (cm)	Phase (deg)	Amp (cm)	Phase (deg)
Tides at Ballast Point (BP)								
Model	51.7	271.8	33.2	86.4	20.5	81.2	20.7	258.2
Field Data	51.6	270.1	33.6	87.3	21.9	81.2	20.4	256.2
Difference	0.1	1.7	-0.4	-0.81	-1.4	-0.0	-0.3	2.0
Tides Downtown (SD)								
Model	54.4	273.6	33.5	87.4	20.7	82.3	21.9	260.2
Field Data	54.0	271.7	33.7	87.8	21.4	80.8	22.4	260.5
Difference	0.4	1.8	-0.2	-0.4	-0.7	1.5	-0.4	-0.4
Tides at South San Diego Bay (SSD)								
Model	57.3	276.6	33.9	89.0	21.0	84.1	23.2	263.8
Field Data*	57.0	273.9	34.5	87.8	21.6	82.0	24.0	264.2
Difference	0.3	2.6	-0.6	1.2	-0.5	2.0	-0.8	-0.4

*Field data available only from 1993 and analysis performed on this data.

Field data constituents reprinted from Wang, et al. (1998)

Table 3-4. Comparison of Modeled Versus Measured Current Speed, for Tidal Constituent M2

Station	Model Results, 1983				From Measurements, 1983			
	Major (m/s)	Minor (m/s)	Inclination (deg)	Phase (deg)	Major (m/s)	Minor (m/s)	Inclination (deg)	Phase (deg)
Constituent M2								
N1	0.085	0.004	92.1	247.8	0.102	0.009	91.6	258.3
N2	0.063	-0.001	86.9	242.9	0.097	0.000	92.9	263.3
N4	0.121	0.002	86.1	242.1	0.106	-0.008	94.3	224.0
N5	0.171	0.0000	134.0	253.2	0.167	0.010	135.7	246.7
N8	0.387	-0.001	128.8	250.4	0.325	0.018	136.4	238.9
N10	0.233	0.001	26.1	67.4	0.265	0.005	27.1	59.0
N12	0.201	0.000	167.9	250.4	0.179	-0.015	163.0	244.0
N13	0.213	0.000	133.8	249.4	0.206	-0.005	139.3	246.0

Note: Inclination is the direction of the major axis of tidal current ellipse, in degrees and counterclockwise from x-axis (east-west axis). Major/minor is the speed of the dominant/weaker tidal current. Phase is a measure of the relative time reference

4. SALINITY REDUCTION MODELING

4.1 INTRODUCTION

The linked 1D-2D model described in Section 3 was applied to simulate tidal hydrodynamics and salinity transport within the Bay, ponds, and lower Otay River. In particular, the modeling effort assessed changes in pond and Bay salinities that would result from breaching salt pond levees for salinity reduction. This approach to salinity reductions relies on tidal mixing through the breaches to flush hypersaline water from the ponds. We modeled phased salinity reduction for Alternatives C4 and D, per discussions with DU and USFWS.

Results from the modeling effort are presented in two forms. Contour maps of salinity in the ponds and south San Diego Bay at various stages after breaching were generated in order to illustrate the magnitude and extents (spatial and temporal) of increases in Bay salinities. Since these contour plots show only "snapshots" at particular times, we also present continuous time series of salinities in the Bay and ponds for selected locations over the simulation periods.

Although no precise discharge criterion has been established for release of saline waters to the Bay, increases of 5 ppt above ambient conditions were selected as an initial target level. Prior to project implementation, acceptable discharge criteria will need to be selected in conjunction with regulatory agencies such as the Regional Water Quality Control Board and will need to consider impacts to species and existing ecology. Salinity levels in San Diego Bay can be quite variable. Surface salinities in San Diego Bay were monitored during a five-year fish study conducted between July 1994 and April 1999 (Allen 1999). Salinities in the bay were generally higher than in the ocean, with bay-wide average salinities ranging from 32 ppt to 39 ppt during the course of the study. Salinities were generally highest in October and in the south bay, where they reached highs of 40 ppt in October 1996.

4.2 ALTERNATIVES CONFIGURATION

The configurations of Alternative C Option 4 and Alternative D are shown in Figure 1 and Figure 2. We modeled phased salinity reduction for Alternatives C4 and D, per our discussion with DU and USFWS. For both alternatives, Phase 1 consists of desalinization of Ponds 10, 10A, and 11. Desalinization may occur through breaching or by routing the water from the Phase 1 ponds into other ponds. We assume that the Phase 1 ponds would be tidal and at ambient salinities (approximately 33 ppt) prior to initiating Phase 2. In Phase 2, Ponds 12-15 would be breached. Alternative D includes an additional third phase, in which Ponds 23-25 and 28-30 are breached once salinities in the Phase 2 ponds have reached ambient levels. In each phase, ponds breached and desalinated in previous phases were modeled as tidally active and at ambient salinity levels.

Because of the limited number of model runs contracted, we modeled only salinity reduction for Phases 2 and 3 in this study. Pond desalinization in Phase 1 is expected to occur more quickly and with fewer salinity effects to the Bay than in Phases 2 and 3 because of the lower salinities and total mass of salt in the Phase 1 ponds (see Table 4-1 for pond salinities).

We used the existing pond topographies from DU, modified to include the proposed supra-tidal nesting areas, as shown in Figures 1 and 2. Pond topographies were not modified to include final grading (cuts and fills) for cordgrass and tidal marsh creation, per instruction from DU (S. Carroll, pers. comm.). Therefore, we assume for this study that any grading would occur after desalinization. The exception is the inclusion of the nesting fills, which were incorporated into the model before the decision to maintain the existing pond grades had been made and these remained in the model. These fills do not significantly change the results or conclusions of this study.

We selected initial pond salinities and water levels representative of late September to mid-February conditions. Pond breaching would be conducted during this time of year to avoid impacts during the nesting season. Therefore, initial salinities were calculated by taking the average of measured salinities occurring between September and mid-February. The seasonally-averaged salinities are given in Table 4-1. Ambient salinity was assumed to be 33 ppt and was applied uniformly over the ocean, the bay and the Otay River for initial model startup. Water surface elevations were provided by DU and are shown in Table 4-1.

Salinity reduction was simulated over a two month period, using measured tide data from 9/4/1983 to 11/6/1983 to drive the model at the offshore boundaries. The hydrodynamic model was allowed to spin-up for two days prior to breaching the ponds, which occurred at slack high water during the peak of the spring tide cycle. Pond breaches were modeled as broad-crested weirs with crest elevations of time varying crest elevations which start at a high elevation (closed) and drop to the existing elevations of the pond bed at each location. The breaching process (lowering of the weir crest) was scaled over a 6-hour period. This scaling represents the time over which the breaches would be constructed and prevents model instabilities associated with sudden changes in system bathymetry.

For Phase 2, we used breach widths of 5 meters on all the ponds. A 5-meter width was found to provide a good balance between being large enough for rapid desalinization of the ponds, yet small enough to reduce the spike in bay salinities immediately after breaching. Breach widths of 10 meters, 15 meters, and 2.5 meters were also tested at a cursory level. Results from the 10- and 15-meter runs indicated a larger spike in the bay salinities immediately after breaching, but with no significant benefits in terms of more rapid desalinization times. Results from the 2.5-meter breach did not reduce these short-term impacts in the bay appreciably beyond those simulated by 5 meter breaches. A 5 meter breach width exhibits slight tidal damping compared to 10 meters width which was found to provide full tidal exchange with no damping. For Phase 3, we assume that 5-meter breaches connect the Phase 3 Ponds (Ponds 23, 24, 25, 28, 29 and 30) to Ponds 13 and 15. Breaches from the Phase 2 Ponds to San Diego Bay are assumed to have enlarged to widths of 10 meter in response to tidal action.

Breach sizes were selected for salinity reduction only. Breach locations were provided by USFWS and DU (Figures 1 and 2). Final breach sizing and locations will be based on habitat restoration objectives (e.g., full tidal exchange in the short and long-term, channel shape similar to natural channels), and will likely differ from those used here.

Table 4-1. Initial Conditions: Pond Water Surface Elevations and Salinities Prior to Breaching

POND NUMBER	Elevation (ft, NAVD)	Elevation (m,NAVD)	Elevation (m,msl)	Salinity (ppt)
Phase 1 Ponds				
10	5.8	1.77	1.06	33*
10A	5.8	1.77	1.06	33*
11	5.8	1.77	1.06	33*
Phase 2 Ponds				
12	5.5	1.68	0.97	61.0
13	5.2	1.58	0.88	76.7
14	5.2	1.58	0.88	90.7
15	5.0	1.52	0.82	92.6
Phase 3 Ponds				
20	11.4	3.47	2.77	111.5
21	11	3.35	2.65	114.7
22	8.5	2.59	1.89	142.8
23	8.4	2.56	1.86	214.3
24	8.3	2.53	1.83	262.4
25	8.2	2.50	1.80	268.0
28	7.0	2.13	1.43	281.0
29	9.3	2.83	2.13	290.4
L	7.0	2.13	1.43	NA
30	9.1	2.77	2.07	278.0

* Assume already breached in Phase 1 and restored to ambient salinities.

4.3 RESULTS

4.3.1 Phase 2

4.3.1.1 Salinity Reduction in the Ponds

Figure 7 shows a time series plot of the salinity variation inside the Phase 2 ponds. Note that the salinity values are averaged over the entire pond volume. Figure 8 through Figure 10 show the depth-averaged instantaneous salinity fields of the ponds at selected periods for 1 day, 7 days and 28 days after breaching, both at low and high tides.

Ponds 12, 14 and 15 reduce in salinity to nearly equal levels fairly rapidly, and after approximately 7 days have dropped below 38 ppt or 5 ppt above ambient levels. After 1 month they have reduced to about 35 ppt, or 2 ppt above ambient levels. Salinity reduction in Pond 13 is slightly slower due to the fact that it is not directly breached to the bay, and relies on tidal action in Pond 12 for flushing power during Phase 2. Also, the bed elevation of Pond 13 is higher in the tide frame and much of the pond is dry during low tide, which reduces the overall mixing capacity of the pond. Pond 13 is reduced to 38 ppt after 24 days.

4.3.1.2 Salinity Increases in San Diego Bay

Figure 8 through Figure 10 show the depth-averaged instantaneous salinity fields of the lower South Bay at selected periods for 1 day, 7 days and 28 days after breaching, both at low and high tides. Salinities at various locations in San Diego Bay (shown in Figure 11) are plotted as time series in Figure 12. The plots show that salinity impacts are most significant near the ponds, and are fairly well reduced by the time the plume reaches Location C. Salinities at all locations are significantly reduced and approach ambient conditions by 28 days.

4.3.2 Phase 3

4.3.2.1 Salinity Reduction in the Ponds

The existing elevations in the Phase 3 Ponds, as shown in Figure 5, are above mean tide level (MTL), with a majority above mean higher high water (MHHW). Due to the existing topography, these ponds are rarely tidal, except for ponds 25 and 28 which are partially tidal. Although these high-elevation ponds do not drain completely due to the micro topography of the bed surface, most of the water is discharged over just 6 hours, which corresponds to the duration of the first ebb tide. Therefore, salinity reduction in Phase 3 Ponds is very short, expect for localized areas where the hypersaline water is not able to completely drain.

4.3.2.2 Salinity Increases in San Diego Bay

Figure 13 through Figure 15 show near-field impacts to San Diego Bay 1, 7, and 28 days after breaching of the Phase 3 ponds at corresponding low and high tides. After 1 day, the greatest impacts to the bay salinity are mostly contained to the south of the power plant causeway, and are about 40 ppt above background levels. Note that salinities in the Phase 2 Ponds are even higher, and act to dampen the short-term impacts to the bay. After 7 days, the impacts north of the causeway are less than 5 ppt above background. Numerical results indicate that after 28 days, impacts to the bay are negligible.

Figure 16 plots time series of salinities at the points throughout the bay shown in Figure 11. Although these results are qualitatively similar to the far-field impacts for Phase 2, bay salinities following discharges from the Phase 3 Ponds are much higher. The results presented in Figure 16 show that salinity impacts are most significant near the ponds, and are fairly well reduced by the time the plume reaches Location C. Additionally, the impacts are only appreciable in the short-term, with bay salinities dropping to below the +5 ppt threshold shortly after 7 days.

4.4 MODEL LIMITATIONS AND MANAGEMENT CONSIDERATIONS

Application of the numerical model was useful in quickly developing estimates of flushing time in the ponds as well as increases in Bay salinities. However, the following items should be considering when interpreting the numerical results:

- The model provides estimates of the magnitudes and time scales of salinity impacts to the bay, and provides a basis for comparison between alternatives that is appropriate for preliminary feasibility assessment. It can be used to screen various salinity reduction alternatives. If the breaching salinity reduction alternative is carried forward in project planning, we recommend that the model be refined. This approach of using an initial screening level model and subsequent refinement was used in planning for the Napa Salt Marsh Restoration Project. Refinements would include additional calibration, validation, and sensitivity assessment, plus additional details of the restoration plan once these are developed. A more thorough calibration, validation, and sensitivity assessment would help to define and narrow the uncertainties in the modeled results.

- If more a refined analysis is required for alternative analysis during later stages of the planning effort, we recommend re-visiting the selection of the dispersion with a more complete dataset of measured salinity. This would reduce uncertainties associated with the incomplete calibration. Salinity measurements needed for a complete calibration of the advection-dispersion model were not available within the time frame dictated by the project schedule, and we relied on our experience with similar systems to construct the model. The choice of dispersion coefficient affects the size and magnitude of salinities in the bay. Large values of the dispersion coefficient will increase the spatial extent and lessen the magnitude of salinity increases (mass of salt is conserved). The converse is true for small values of the dispersion coefficient. The results of desalinating the ponds probably are not that sensitive to changes in dispersion coefficients, since the flushing of these ponds is driven by advection processes and due to the breach size and bed elevation of the ponds relative to the tide range.

- Breach sizes and locations are preliminary, and are expected to be refined based on habitat objectives later in project design (Section 4.2). Breach timing is also preliminary and may be refined based on detailed consideration of construction feasibility. Simultaneous breaching was assumed in the salinity reduction alternatives, resulting in hypersaline discharges from multiple ponds at the same time. Management of the actual salinity reduction program may include staggering the levee breaches so that tidal action is restored to the ponds one at a time. This would lessen the magnitude of salinity increases in the Bay, but extend salinity reduction of the complex. Adaptive management of the desalination program for the complex could be aided by monitoring salinity levels in South San Diego Bay to reduce the possibility of unanticipated adverse impacts to wildlife.

- The modeling assumes a certain set of initial pond salinity and water level conditions. The plan will need to include sufficient flexibility for actual conditions that vary annually.

- Application of the 2D MIKE model should be limited to systems without appreciable stratification. According to the literature (Wang et al 1998), San Diego Bay can be treated as well mixed, except during infrequent periods of freshwater inflow from the Sweetwater and Otay rivers. These rare stratifications could persist for a few days during low tide energy periods (neap tides). Stratification may also occur when warm water discharges from the South Bay power plant flow over more dense saline Bay water. The effect of this stratification on salinities would be strongest near the power plant discharge, although large velocities at the outfall wound tend to mix effluent throughout the water column. During desalination of the salt ponds, stratification may also develop if density differences between the effluent and receiving water outweigh the vertical mixing in the Bay. Therefore, the Estuarine Richardson Number (Fischer 1979) was computed using modeled results to asses the likelihood of stratification due to salinity reduction. This non-dimensional number is a measure of the stabilizing power of density differences to the mixing power in the Bay. The computed Richardson number is at the lower end of the range at which strongly stratified flow could be expected, suggesting that the depth-averaged model is appropriate for this level of analysis. Additionally, wind-waves were not included in the numerical model and would increase the vertical mixing in the shallow portions of South San Diego Bay.

- Dissolution of precipitated salts was not taken into account in the present modeling exercise, and may affect the time required to reduce pond salinities to ambient levels. However, we do not expect the dissolution process to significantly affect the short-term changes in Bay and pond salinities presented above. Uptake of precipitated salts and salinity in the underlying soils is likely a rate-limited process, with time scales longer than the flood-ebb tidal cycle.

5. BRINE FEASIBILITY

Alternative D contains a brine management component, shown in Figure 2. Brine ponds would be managed to create habitat for brine shrimp and brine flies, and foraging areas for waterfowl and shorebirds. PWA created a simple box model to assess the feasibility of maintaining the proposed brine operation in terms of the flow rates required to maintain suitable habitat in the ponds and to dilute the hypersaline brine prior to discharge to the Bay. This analysis was carried out at a conceptual level. No numerical modeling was performed in this initial assessment.

5.1 CONFIGURATION OF THE BRINE COMPLEX

As shown in Figure 2, the brine complex is located at the easternmost extents of the project area, and includes Ponds 42, 43, 45, 46, and 47. To ensure proper habitat for brine shrimp and brine flies, the target salinities in the brine ponds range between 80 and 120 ppt. Per our discussions with the planning team, we assume that new hydraulic structures would be installed to convey the required water and that pumps would be used as necessary to move water through the system. A preliminary criteria for release of water into San Diego Bay was +5 ppt. As per the salinity reduction discussion in Section 4, actual discharge criteria for the project will need to be agreed upon between the project sponsors and relevant agencies.

A number of management scenarios are possible for the brine complex. A source of inflow to the brine ponds is required to offset evaporation and maintain suitable conditions in the ponds. Due to the elevated salinity in the brine complex, discharges from these ponds must be diluted prior to release into San Diego Bay. The basic components of brine management are: a source of inflow to the brine ponds; a source of water, referred to as make-up water, to dilute the brine pond outflow; a mixing basin in which to combine the brine outflow and make-up water; and discharge to the Bay.

The assumed route for flows through the brine ponds is shown in Figure 17. We assumed that inflow to the brine ponds would be supplied from the managed ponds, since this water would already be at slightly elevated salinity levels and it makes more sense to route it to the brine ponds rather than discharging it to the Bay. Based on our experience with ponds managed for water fowl and shorebird habitat at the Napa River salt ponds in San Francisco Bay, we assumed that these managed ponds would have salinities of approximately 40 ppt. Several ponds would be suitable as mixing basins. We considered Ponds 41 and 48, since they are adjacent to the brine ponds. Pond 41 is shown as the mixing basin in Figure 17. Make-up water to the mixing basin is assumed to come from Bay water. This could be supplied from any of the tidal ponds, preferably as far from the eventual brine discharge point as possible. Salinities in the mixing basin would be maintained at ambient salinity +5 ppt. The diluted effluent could then be discharged into the canal west of Ponds 41 and 30. If pond 48 is used as the mixing basin, some grading and levee construction would be required to connect Pond 48 with the canal.

5.2 THE BOX MODEL

PWA developed an analytical mass-balance model to track salinity and water volumes in the brine complex and mixing basin. The brine ponds were considered one unit in order to simplify the analysis. Figure 18 shows a schematic of the box model structure. A mass balance of salt and water is applied to the brine complex, which receives inflow at 40 ppt from the managed ponds and discharges to the mixing basin. A second mass balance is applied to the mixing basin, which uses make-up water from the Bay to dilute the hypersaline (80 – 120 ppt) discharges from the brine ponds. Make-up water for the mixing basin is assumed to come from the Bay or tidal ponds at 34 ppt[2], and, as noted above, salinity in the mixing basin is limited to 39 ppt. Both the brine ponds and mixing basin are subject to freshwater losses and gains due to evaporation and precipitation.

Mean monthly rates of evaporation and precipitation were collected from readily available sources. Published mean monthly data collected by the National Weather Service (NWS 2002) at Chula Vista from 1960 – 1990 were used to establish typical rates of precipitation. Evaporation rates were determined based on data from the California Department of Water Resources (DWR). As shown in Figure 19, evaporation barely outpaces precipitation during the winter but is much more intense in the summer. Essentially, it is the net evaporation, along with the flow rates through the system, which determine the salinity and water volumes in the ponds.

The simplicity of the box model allowed PWA to quickly screen various configurations and management scenarios at a cursory level. Table 5-1 summarizes the model set up for each of the five screening runs analyzed by PWA. Based on the results of the screening runs (Table 3-1), we selected Run 4 for further consideration. Run 4 consisted of prescribing an intake flow rate from the managed ponds into the brine complex (Q_{IN}), and using the box model to estimate the resulting salinity. Management of the brine complex was then optimized by minimizing the peak summer pumping rate (Q_{IN}) while keeping the brine ponds in their target salinity range (80 – 120 ppt). The box model was then applied to calculate the make-up flow rate (Q_{MUP}) required to maintain the mixing basin at a constant 39 ppt. The intake and make-up flows were seasonally-varied in order to stay within the range of target brine salinities and were optimized within the constraints of the configuration to reduce the peak summer pumping rates.

5.3 RESULTS

Results for Run 4 are discussed below.

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[2] Ambient salinity levels for the brine analysis were assumed to be 34 ppt since make-up water will be drawn from the southernmost reach of the Bay. Measurements from the Port of San Diego show seasonally-averaged salinities in this area to be slightly higher than the central and northern sections of the Bay.
(Data source: http://www.portofsandiego.org/sandiego_environment/bay_water_sampling.asp)

5.3.1 Brine Ponds

Results from the brine complex are shown in Figure 20, which plots the flow rates and salinity through these ponds. The results show that, under typical metrological conditions, the brine ponds delineated in Alternative D can be maintained between 80 – 120 ppt with modest pumping rates. Pumping into the brine ponds varies from approximately 60 gpm in the winter to 170 gpm during the summer months. Peak salinity levels in the ponds lag the peak pumping by about three months, with the highest salinities (approximately 120 ppt) occurring in late autumn. During the late winter and early spring months, salinity in the brine ponds drops to 80 ppt. Peak salinities lag peak pumping rates by three months because of evaporation and the pumping strategy employed in the model. The pumping strategy shown in Figure 20 was to "prime" the brine ponds by reducing their salinity early in the summer, when it was relatively easy to outpace evaporation. Then during the summer, the brine ponds are not near the upper-limit of acceptable salinity and can accommodate increases in salinity. If salinities were not "primed" (i.e., lowered) at the beginning of the summer, it would be more difficult to outpace intense summer evaporation, there would be less management flexibility, and peak pumping rates would probably be higher.

Water levels in the brine ponds varies seasonally and, for the configuration modeled, levee improvements may be required to prevent overtopping in Pond 42. A uniform water surface elevation was assumed across the brine ponds and average bed elevations were used to convert the water volume computed by the box model to the depths plotted in Figure 21. Water levels in the brine ponds are inversely related to salinity, with a maximum depth in mid-March and minimum in late autumn. It may be possible to avoid levee improvements, using different brine pond management strategies. For example, it may be possible to limit water levels in Pond 42, but allow higher water levels elsewhere in the brine complex.

5.3.2 Mixing Basin

As described above, the box model was applied to Pond 41 to estimate how much make-up water is required to maintain the mixing basin (Pond 41) at 5 ppt above ambient levels for the brine discharges plotted in Figure 20. As shown in Figure 22, the flow rate of make-up water into the mixing basin peaks at about 1330 gpm. Approximately 900 gpm (68 % of the total) is needed to dilute the brine effluent to discharge levels, and the remaining 420 gpm (32 % of the total) is required to offset the effects of evaporation within the mixing basin. These results suggest that the required pumping rates are feasible, assuming continuous pumping. Discharges to the Bay range between 330 and 1330 gpm (Figure 22).

The pumping rates could be reduced by diluting the brine discharges with flash mixing, in which brine outflow is rapidly diluted in a small basin or canal prior to discharge to the Bay. Flash mixing requires smaller flow rates since the effects of evaporation on a small pond surface area are negligible. Flash mixing reduces peak flows to approximately 800 gpm (from 1330 gpm). Make-up flows with flash mixing are shown as the green line in Figure 22. The canal west of Ponds 30 and 41 provides a possible location for flash mixing. An alternative solution may include a passively-managed, gravity-driven system that relies on tidal flushing. Such a system, however, would require grading (excavation) of Pond 41 since its bed elevation is currently above high water levels (see Figure 5).

The resulting flushing time[3] varies from approximately 10 days when the make-up flow rate is maximum, to about 37 days during periods of low flow (Figure 23). Flushing times greater than a month may lead to deteriorated water quality, and the low pumping rates during these periods could be increased to alleviate these concerns.

5.4 MODEL LIMITATIONS AND MANAGEMENT CONSIDERATIONS

The box model suggests that management for brine habitat is feasible from a physical processes perspective. The box model includes several simplifying assumptions for the purpose of preliminary feasibility assessment. If the brine management component is carried forward in project planning, these assumptions will need to be assessed in more detail later in the planning and design process. In addition, further analysis could be useful for identifying lower cost implementation approaches, particularly to reduce the cost of pumping.

Brine operations should include flexibility in management of flows. Management considerations include: pond drying or levee overtopping, climatic variations (discussed further below), maintaining brine salinities within the target range for habitat, potential for gypsum formation if salinities exceed approximately 150 ppt, water quality in the ponds, and potential for temporary pump failure.

The box model considers the brine ponds as one large, well-mixed pond with uniform water levels. In reality, salinities and water levels will vary between the ponds, with the extent of variation dependent on the exact pond configuration.

The model assumes average monthly rainfall and evaporation conditions. Daily and annual (wet and dry year) variations will affect the amount of pumping required for brine management and dilution. These variations could also affect brine salinities and the potential for pond drying and levee overtopping. Brine management scenarios for wet and dry years should be considered during future planning stages prior.

The modeled brine configuration assumes a seasonal-varying supply of 40 ppt water from the managed ponds. Managed pond operations have not been modeled and we did not evaluate the feasibility of meeting the assumed inflows to the brine ponds. However, given the high evaporation rates in South San Diego Bay, it is likely that a significant amount of flow through the managed ponds will be required to maintain suitable salinities in those ponds. Additionally, it would be possible to meet the brine pond target salinities even if Bay water (at approximately 34 ppt) were needed to augment the inflow from the managed ponds. This would affect flow rates in the brine pond and mixing basin flow, as well as residence times. Operations for the brine complex will need to be coordinated with those for the managed ponds in later project planning.

Intake and make-up flows were fit to the shape of a sine wave for ease in modeling seasonal variations.

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[3] Flushing Time = Pond 41 Volume / Make-up Flow Rate = V / Q_{MUP}

In reality, brine operations are likely to use stepped or discontinuous flow/pumping rates. Therefore, actual operations may require higher pumping rates than those modeled here. For stepped pumping, differences from the peak modeled flows are expected to be minor. For discontinuous pumping, peak flow rates will be several times the modeled rates, but still within the range of typical pumping operations (e.g., pumping one day out of seven yields increases peak flow rates from 2.9 to 20 cfs). More detailed brine runs could be conducted to optimize the pumping rates. Additional cost reduction may be possible by modifying the management configuration to use gravity-driven flows for brine inflow and/or dilution.

Table 5-1. Run Catalog for Box Model

	Brine Complex			Mixing Basin				Comments
	Volume	Salinity	Intake Flow	Pond	Volume	Salinity	Make-up Flow	
Run 1. Constant brine salinity	Prescribe as constant	Constant (100 ppt)	Calculated	48	Constant	Constant (39 ppt)	Calculated	Flow into the brine complex and mixing basing peak at 209 gpm and 1200 gpm, respectively.
Run 2. Constant brine intake flow	Calculated	Calculated	Prescribe as constant	48	Constant	Constant (39 ppt)	Calculated	Constant flow into brine ponds of 110 gpm cannot maintain salinity within the target range of 80 – 120 ppt.
Run 3. Varying brine salinity and intake flow	Calculated	Calculated	Prescribe as time-varying	48	Constant	Constant (39 ppt)	Calculated	Flow into the brine complex and mixing basin peak at 170 gpm and 1036 gpm, respectively. Brine salinity in 80 – 120 ppt range.
Run 4. Same as Run 3, but with Pond 41 as mixing basin	Calculated	Calculated	Prescribe as time-varying	41	Constant	Constant (39 ppt)	Calculated	Make-up flow into mixing basin increases to 1326 gpm due to greater surface area of Pond 41.
Run 5. Same as Run 4, but allowing mixing basin salinity and volume to vary	Calculated	Calculated	Prescribe as time-varying	41	Calculated	Calculated	Prescribe as time-varying	Make-up flows similar to Run 4.

Note: “Calculated” means that this parameter was determined from the box model.

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FIGURES

Source: USFWS

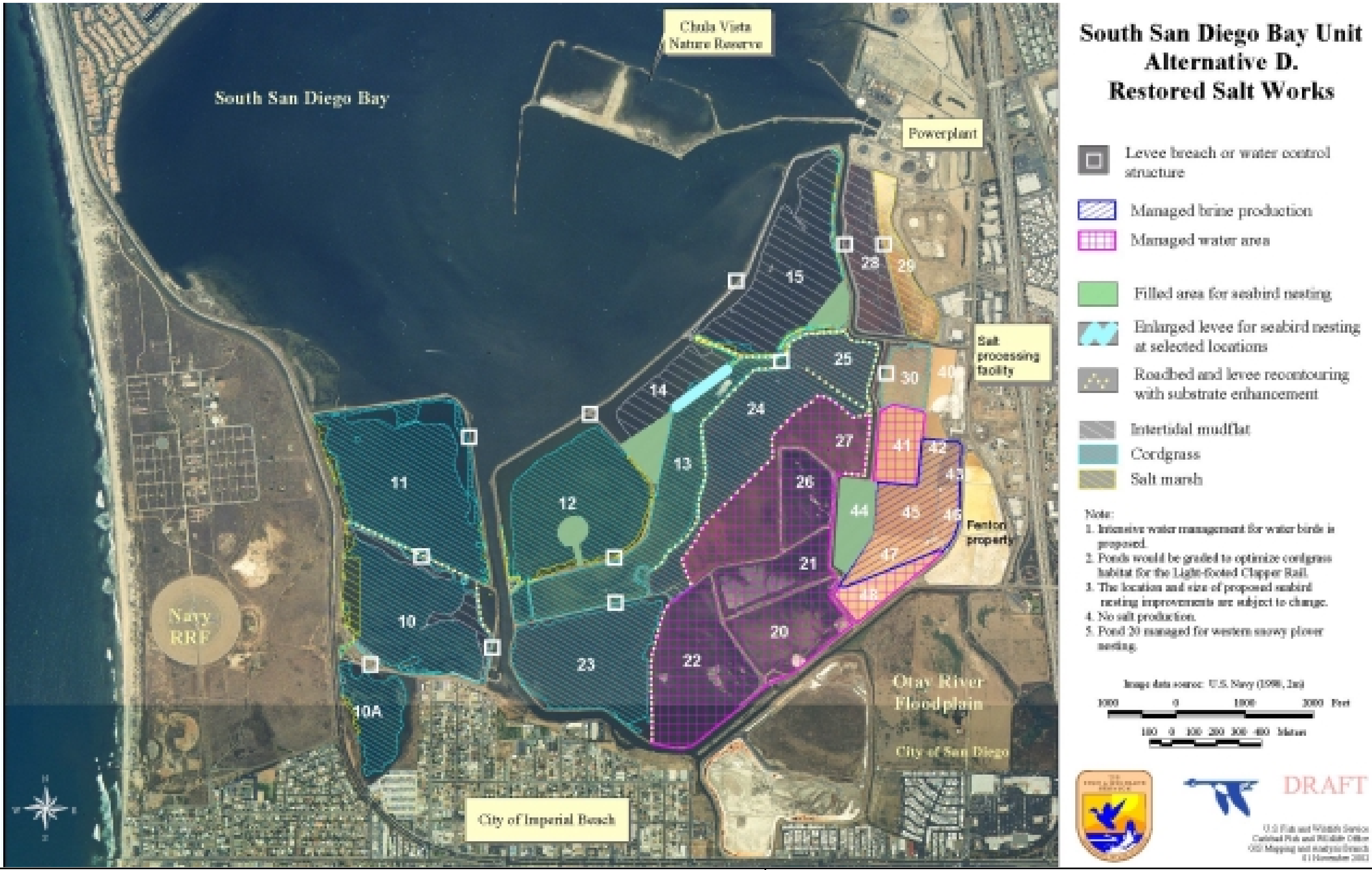
f igure 1

South San Diego Bay Salt Ponds

Configuration of Restoration Alternative C Option 4

PWA Ref 1631

PWA



Source: USFWS

figure 2

South San Diego Bay Salt Ponds

Configuration of Restoration Alternative D

PWA Ref 1631

PWA

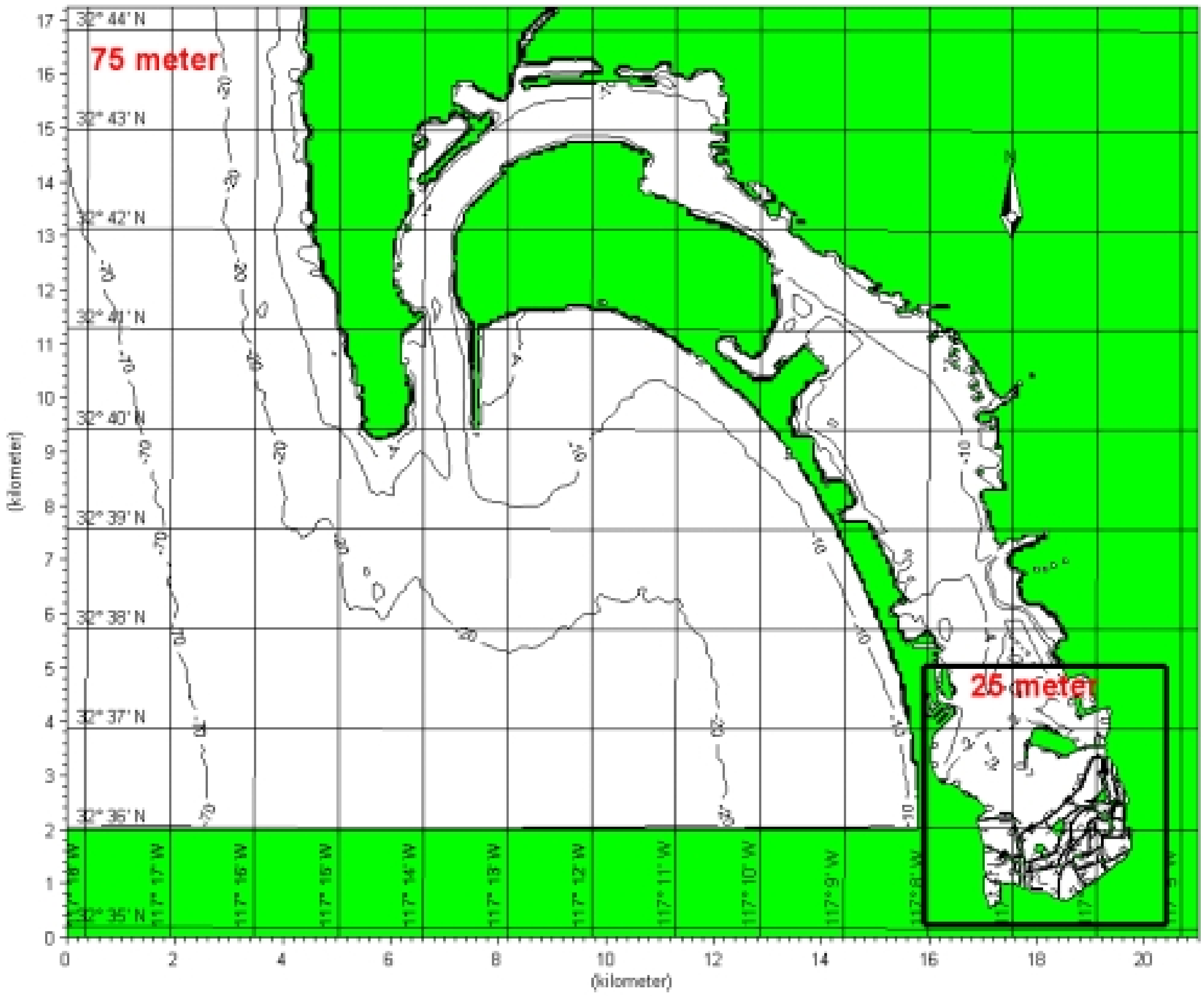


figure 3

South San Diego Bay Salt Ponds

Extent of MIKE 21 Nested Model Grids

PWA Ref 1631

PWA

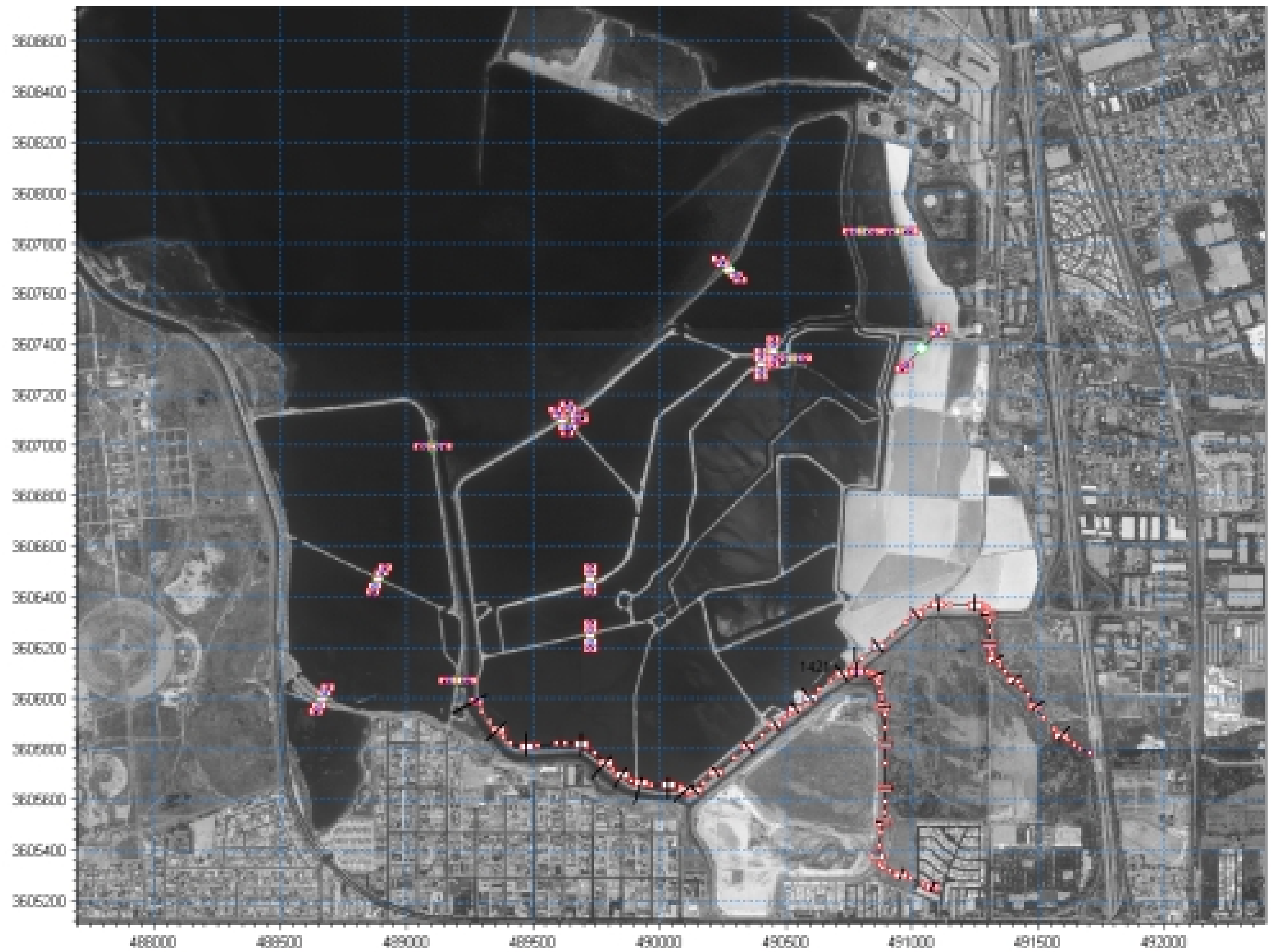


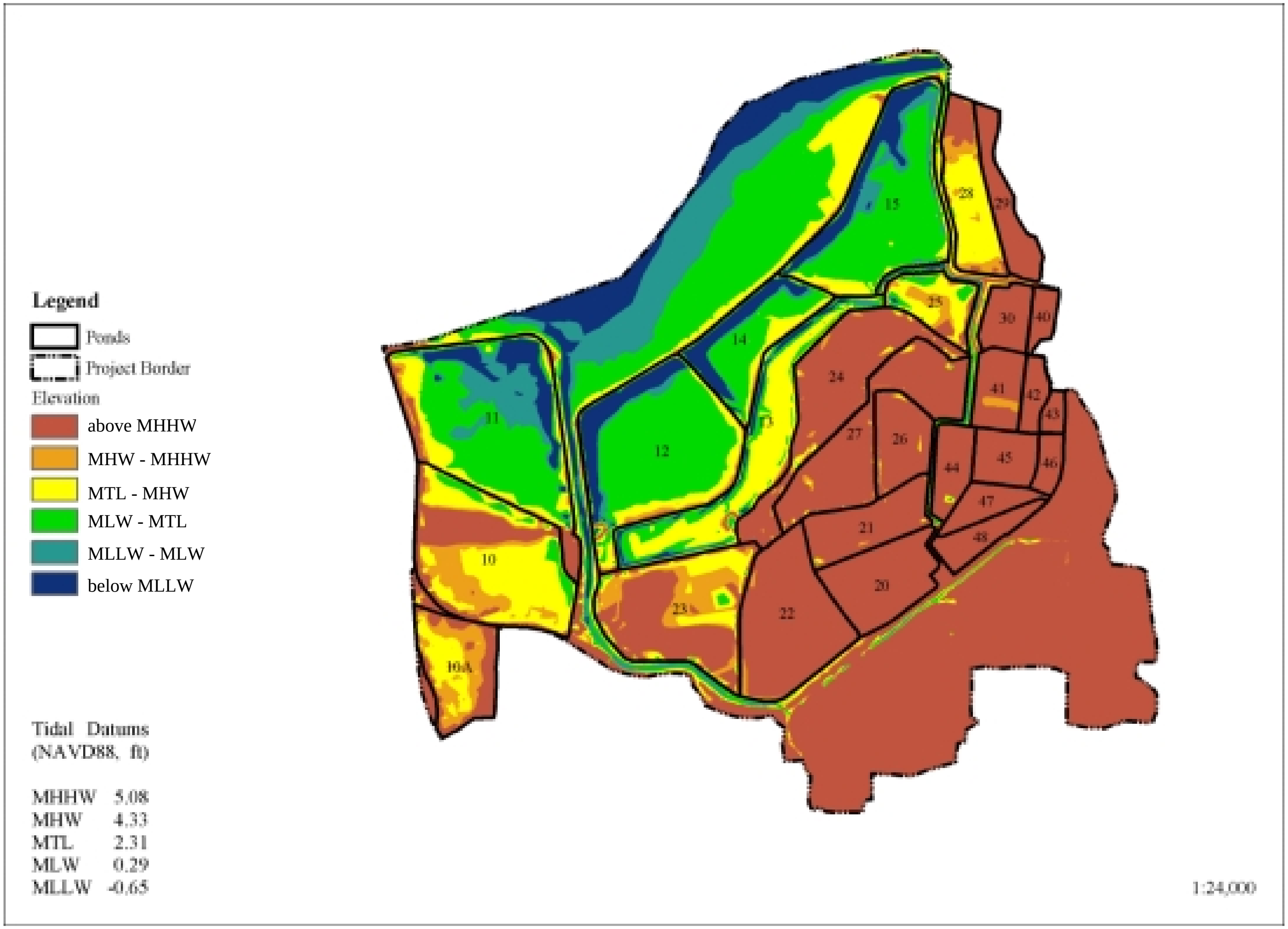
figure 4

South San Diego Bay Salt Ponds

Location of MIKE 11 Otay River and Breaches

PWA Ref 1631

PWA



Source: DTM from DU

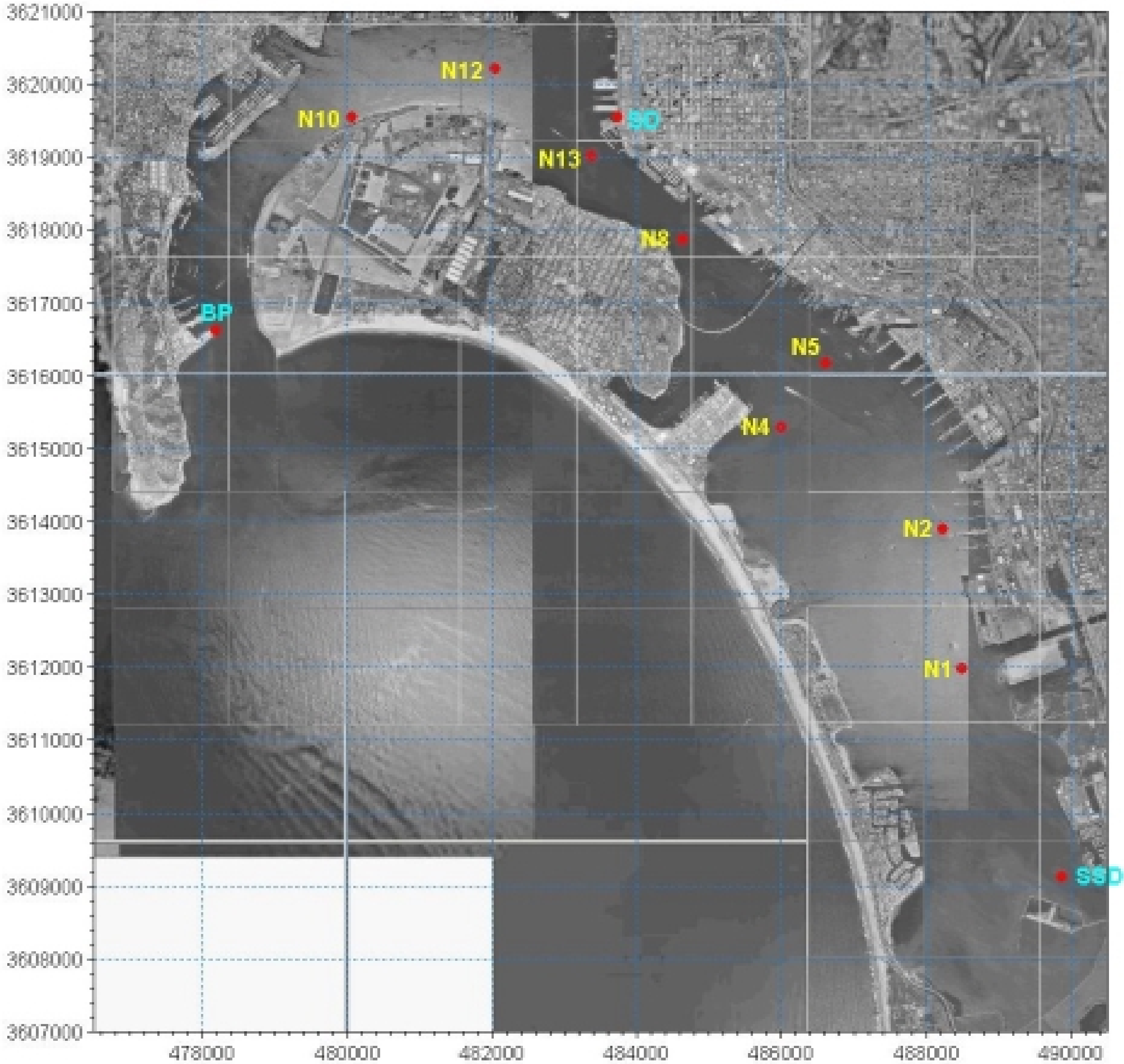
figure 5

South San Diego Bay Salt Ponds

Bed Elevations for Salt Ponds

PWA Ref 1631

PWA



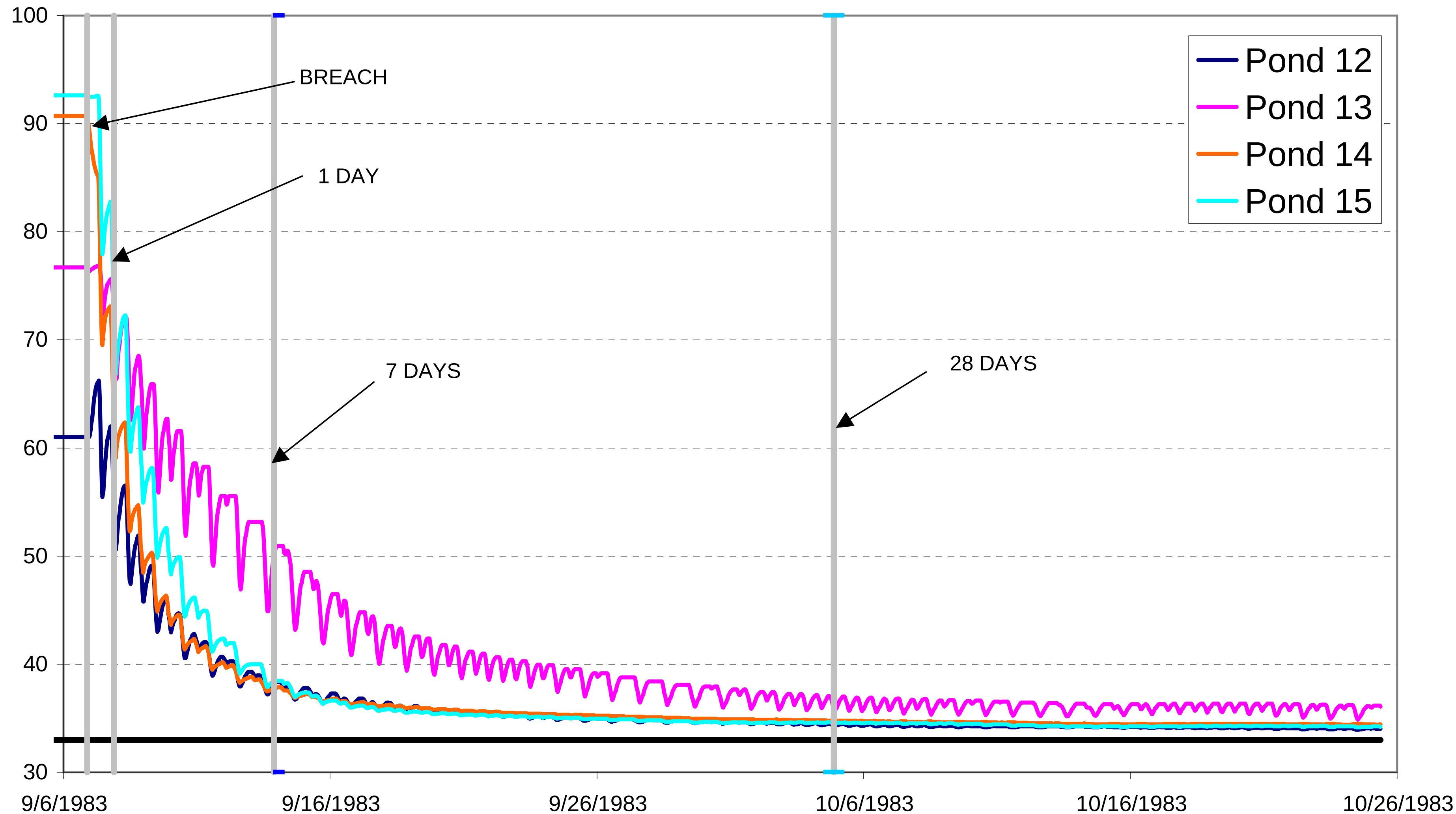
Source: NOAA Measurements from 1983

figure 6

South San Diego Bay Salt Ponds

Locations of NOAA Current Measurements during the 1983 Measurement Period

PWA Ref 1631



Notes:
Salinities in Ponds are weighted average concentrations over the entire pond.

Black bar represents ambient salinity (33 ppt).

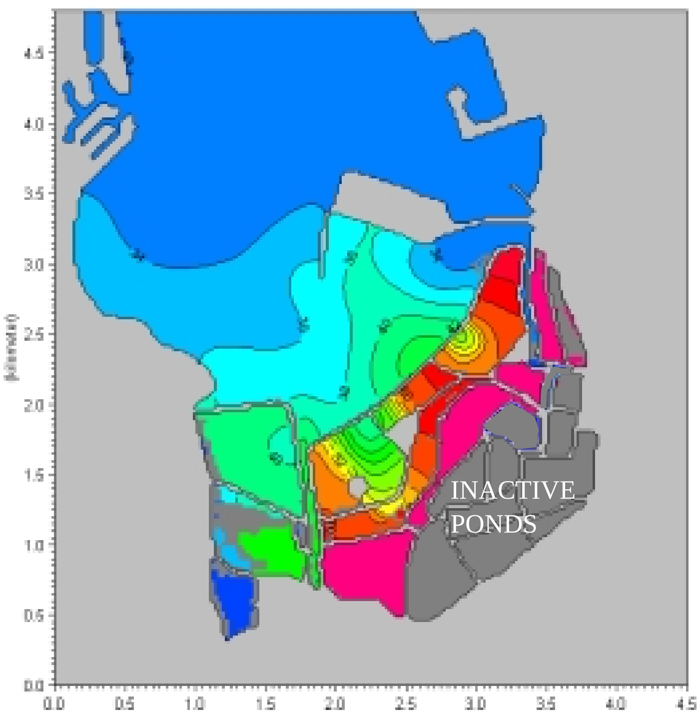
figure 7

South San Diego Bay Salt Ponds

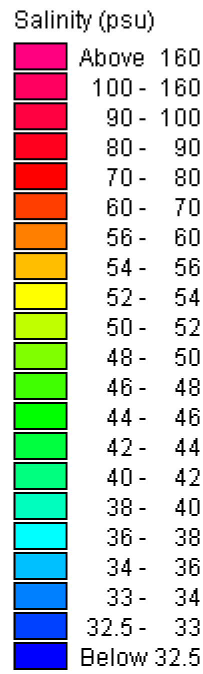
Pond Salinity Time Series, Phase 2

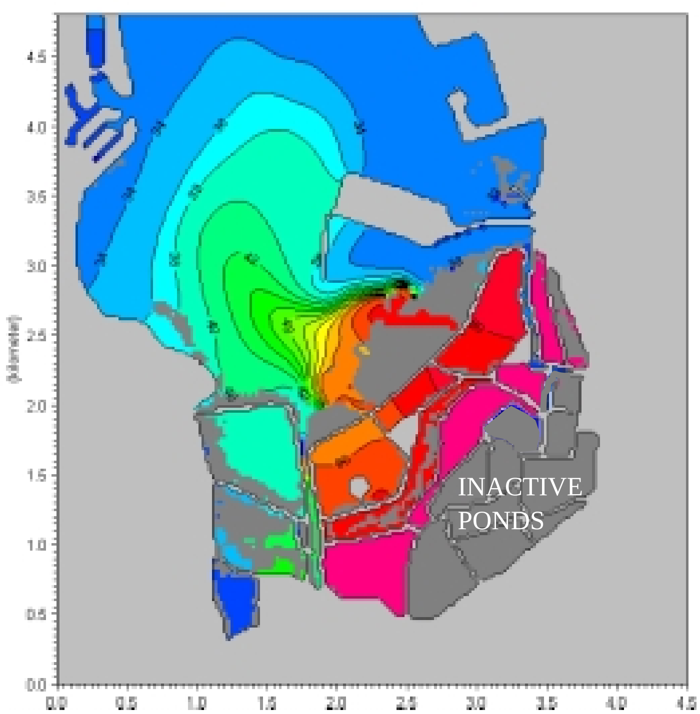
PWA Ref 1631

PWA



Salinity
Distribution in
South San Diego
Bay at *high tide*
1 day after breach.





Salinity
Distribution in
South San Diego
Bay at *low tide*
1 day after breach.

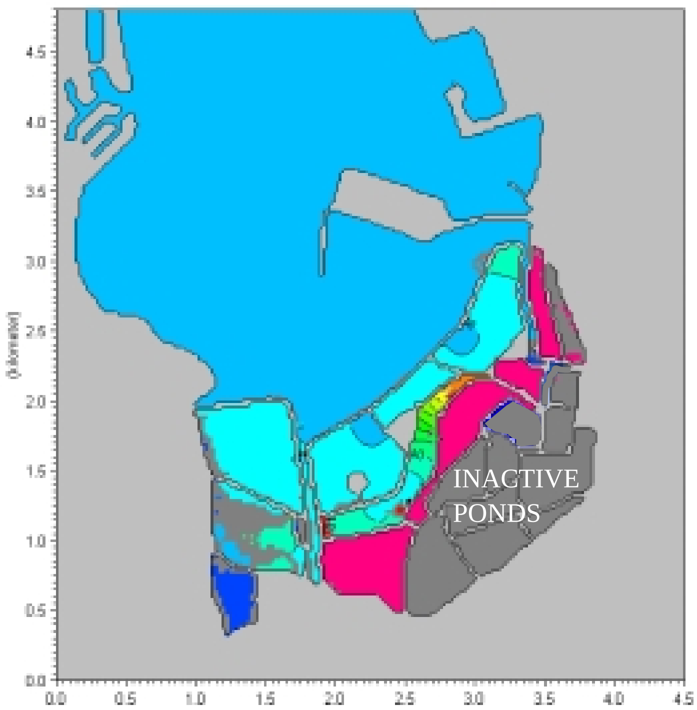
Notes: Simulated salinities at low and high tides, 1 day after breach of Alternative C Option 4.

figure 8

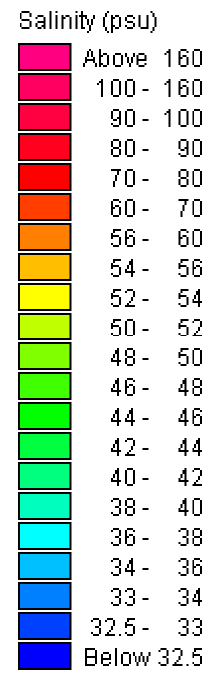
South San Diego Bay Salt Ponds
Salinity Distribution in the South Bay & Ponds,
Phase 2 , 1 Day After Breach

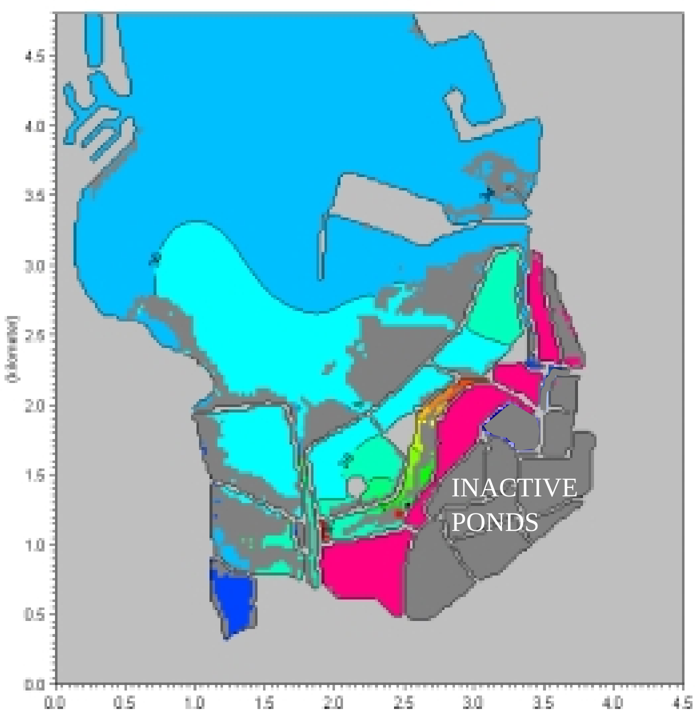
PWA Ref 1631

PWA



Salinity Distribution
in South San Diego
Bay at *high tide*
7 days after breach.





Salinity Distribution
in South San Diego
Bay at *low tide*
7 days after breach.

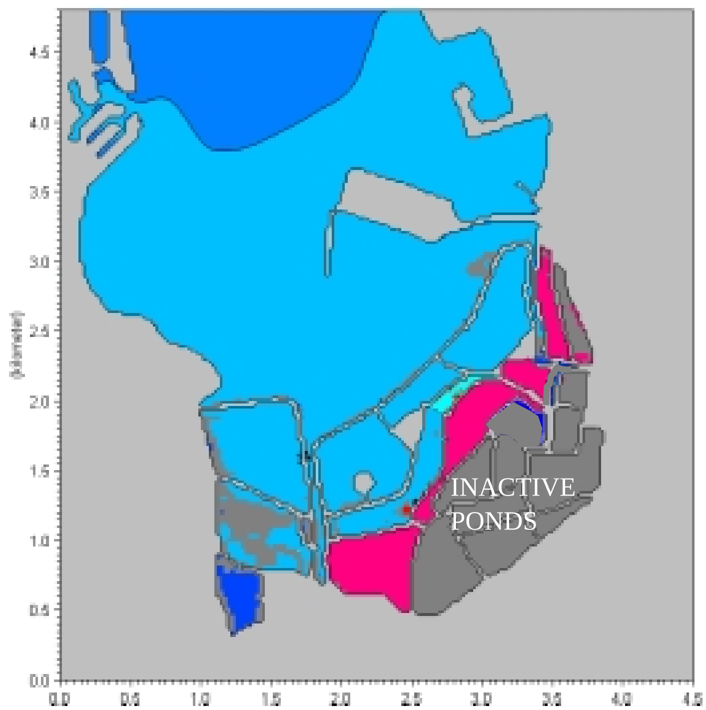
Notes: Simulated salinities at low and high tides, 7 days after breach of Alternative C Option 4.

figure 9

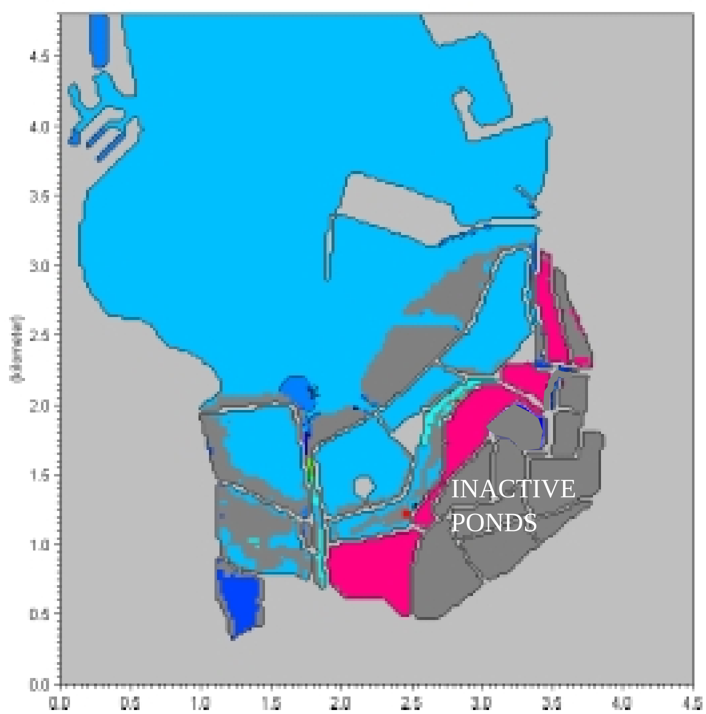
South San Diego Bay Salt Ponds
Salinity Distribution in the South Bay & Ponds
Phase 2 , 7 Days After Breach

PWA Ref 1631

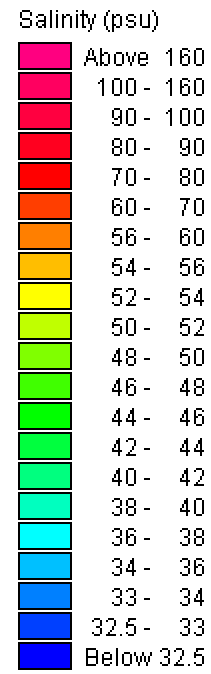
PWA



Salinity Distribution in South San Diego Bay at *high tide* 28 days after breach.



Salinity Distribution in South San Diego Bay at *low tide* 28 days after breach.



Notes: Simulated salinities at low and high tides, 28 days after breach of Alternative C Option 4.

figure 10

South San Diego Bay Salt Ponds

Salinity Distribution in the South Bay & Ponds, Phase 2 , 28 Days After Breach

PWA Ref 1631

PWA

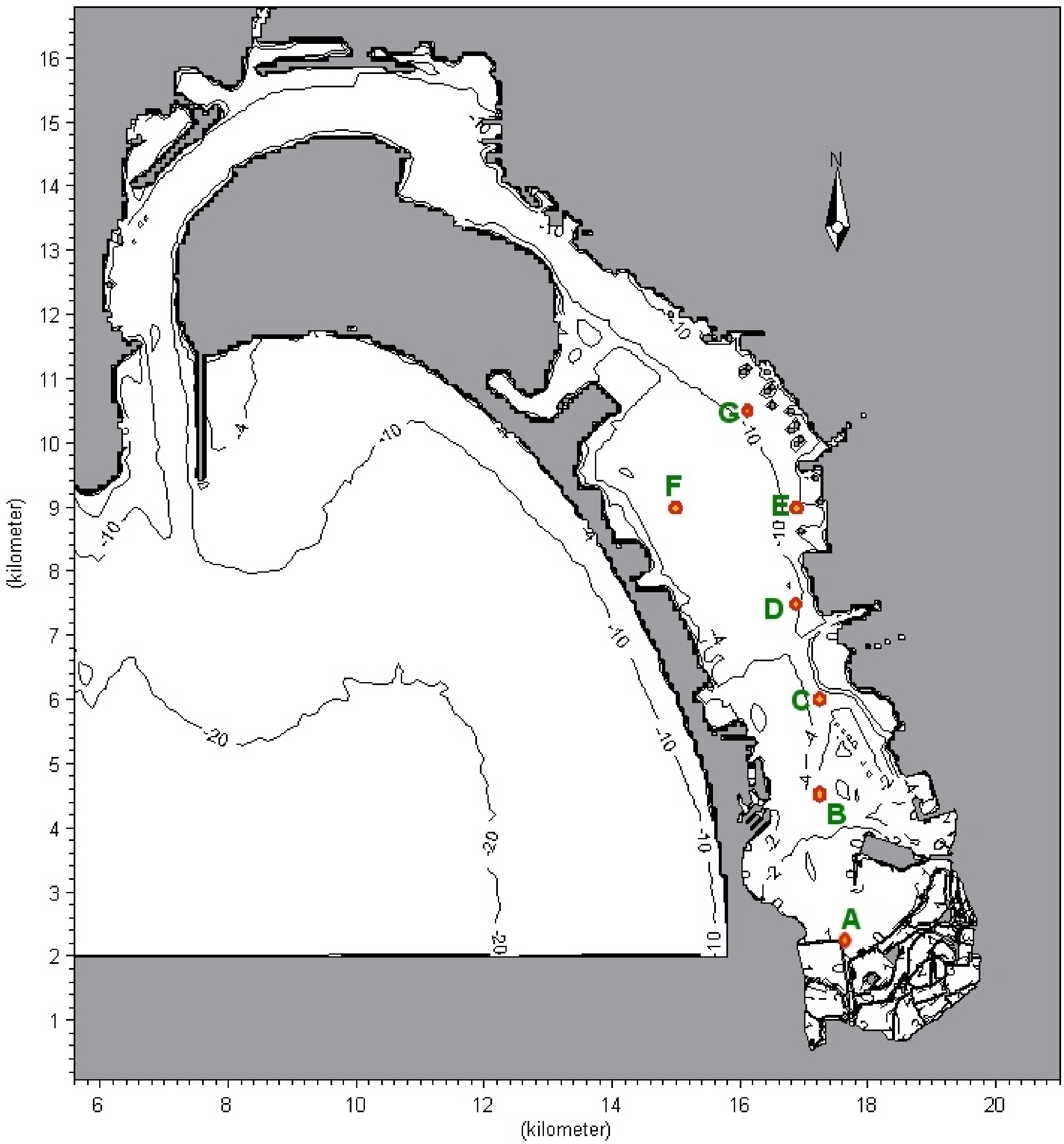
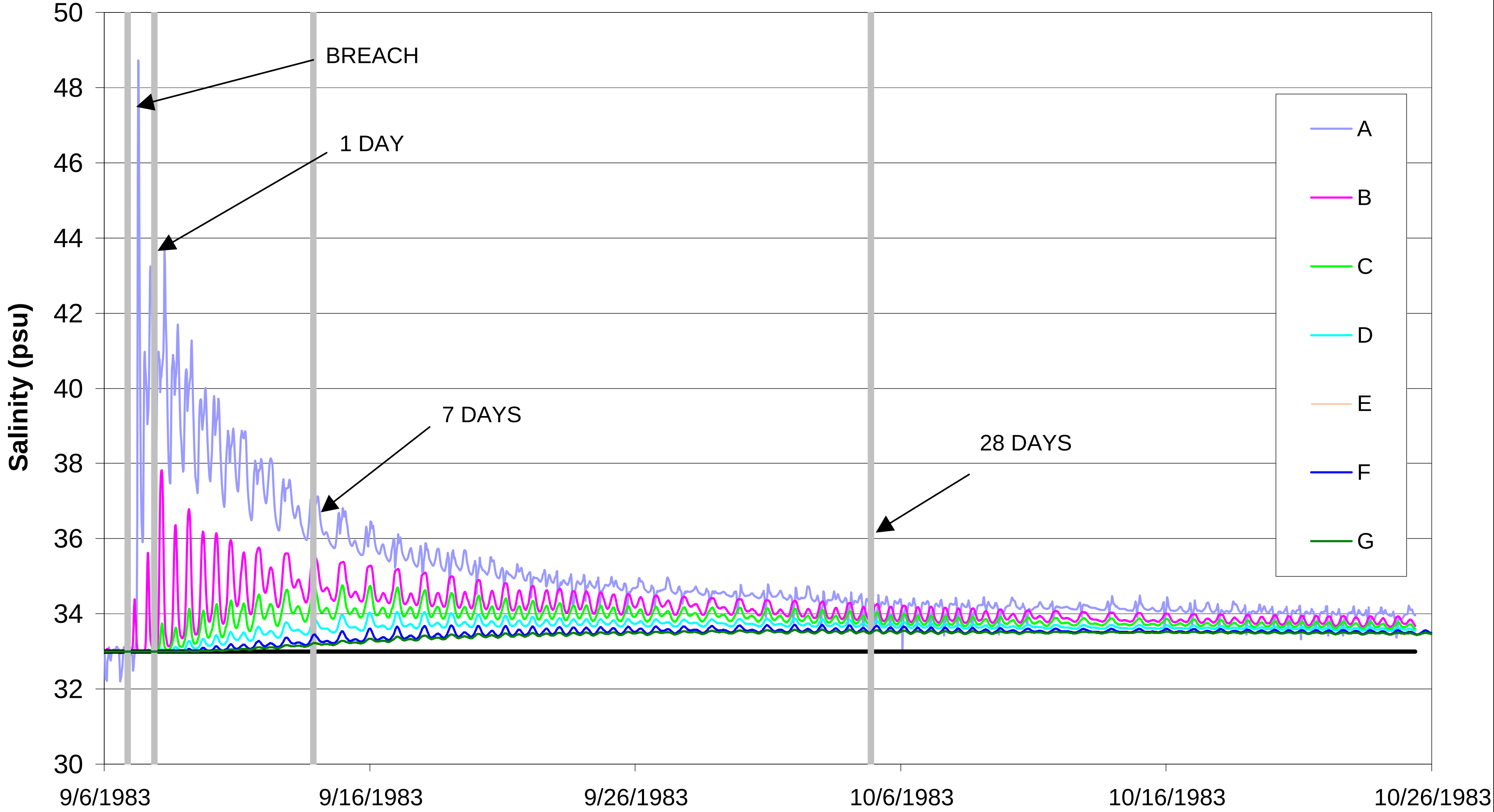


figure 11

South San Diego Bay Salt Ponds

San Diego Bay Salinity Point Locations - Alternative C Option 4

PWA Ref 1631



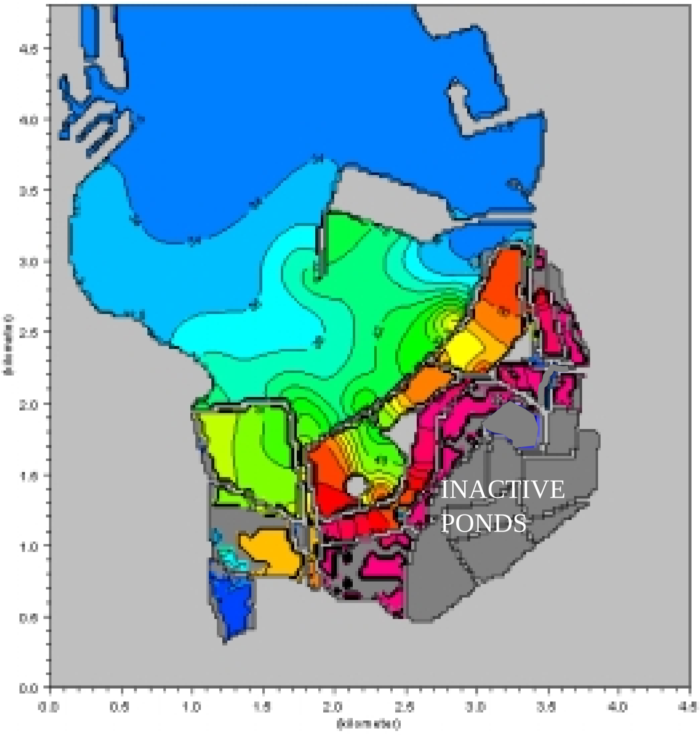
Notes: See Figure 4.6 for location points A through G

figure 12

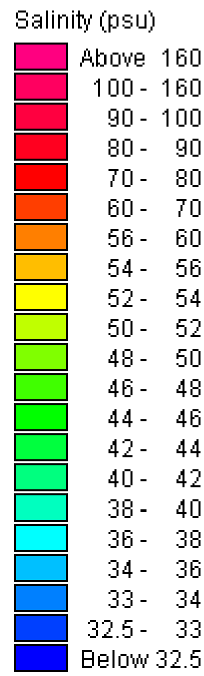
South San Diego Bay Salt Ponds

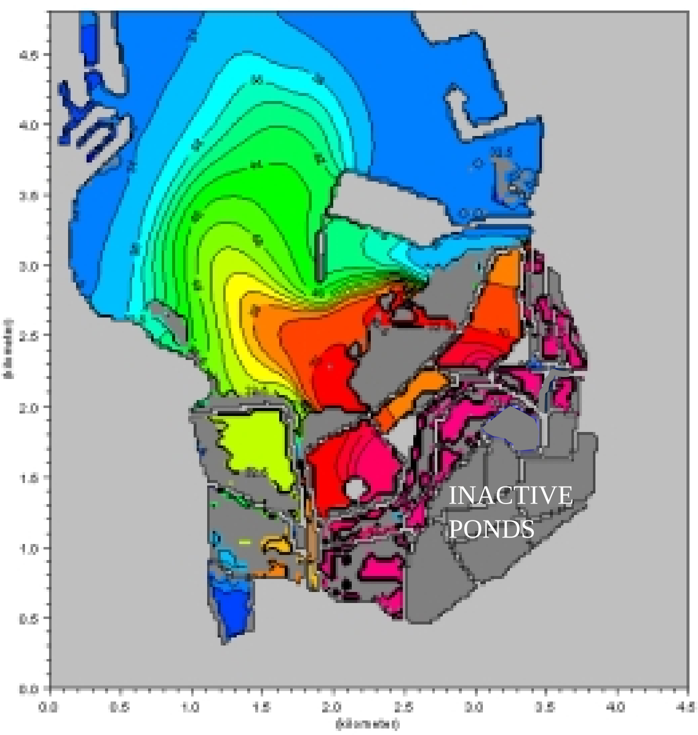
San Diego Bay Salinity Time Series , Phase 2

PWA Ref 1631



Salinity Distribution in South San Diego Bay at *high tide* 1 day after breach.





Salinity Distribution in South San Diego Bay at *low tide* 1 day after breach.

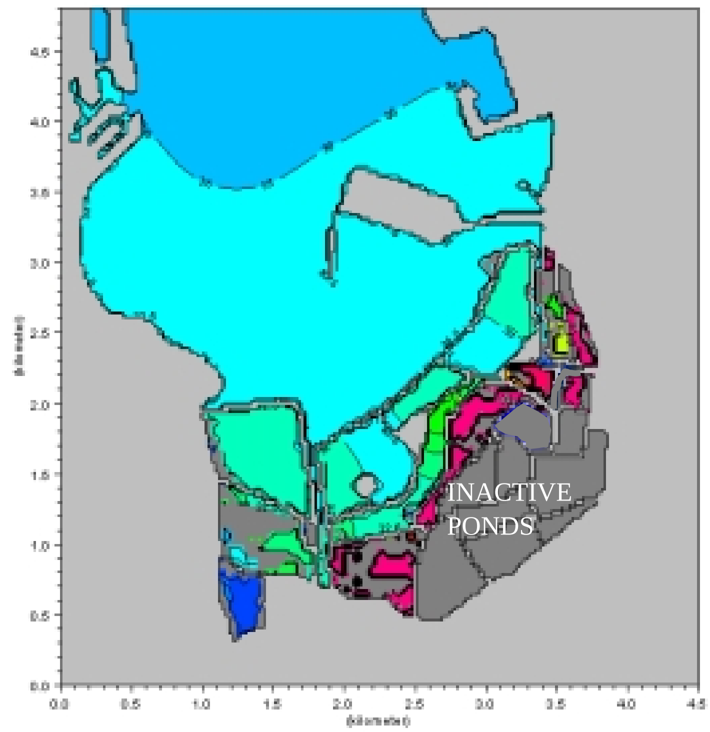
Notes: Simulated salinities at low and high tides, 1 day after breach of Alternative D.

figure 13

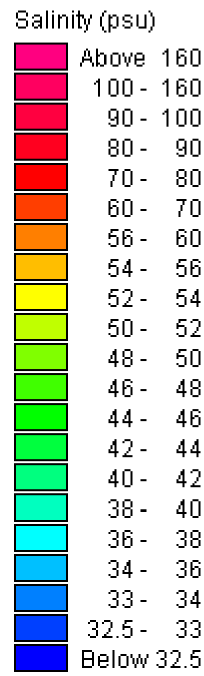
South San Diego Bay Salt Ponds
Salinity Distribution in the South Bay & Ponds, Phase 3, 1 Day After Breach

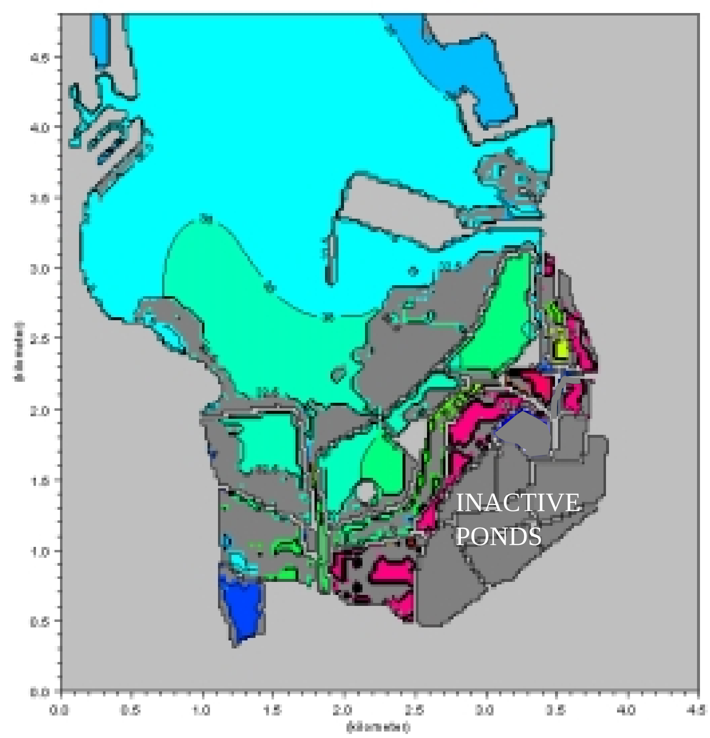
PWA Ref 1631

PWA



Salinity Distribution in South San Diego Bay at *high tide* 7 days after breach.





Salinity Distribution in South San Diego Bay at *low tide* 7 days after breach.

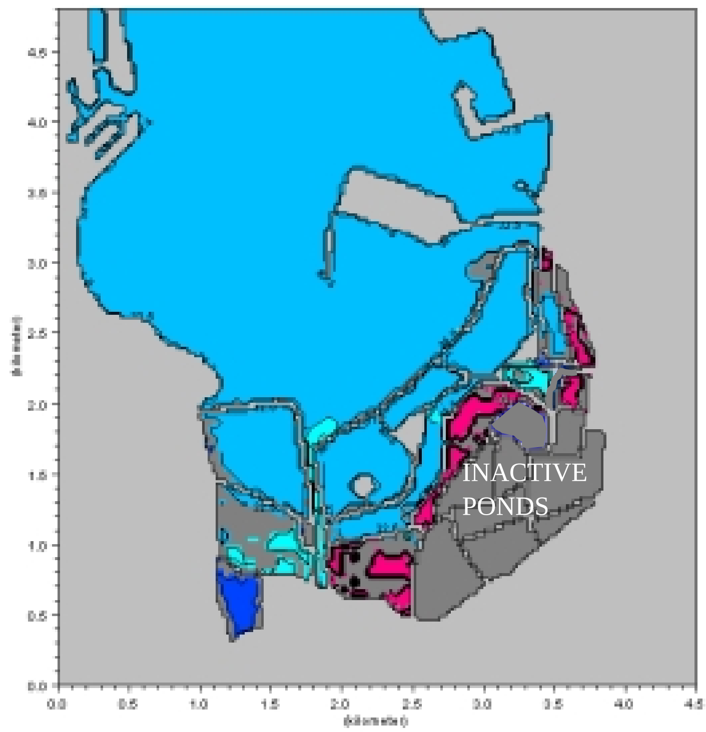
Notes: Simulated salinities at low and high tides, 7 days after breach of Alternative D.

figure 14

South San Diego Bay Salt Ponds
Salinity Distribution in the South Bay & Ponds, Phase 3, 7 Days After Breach

PWA Ref 1631

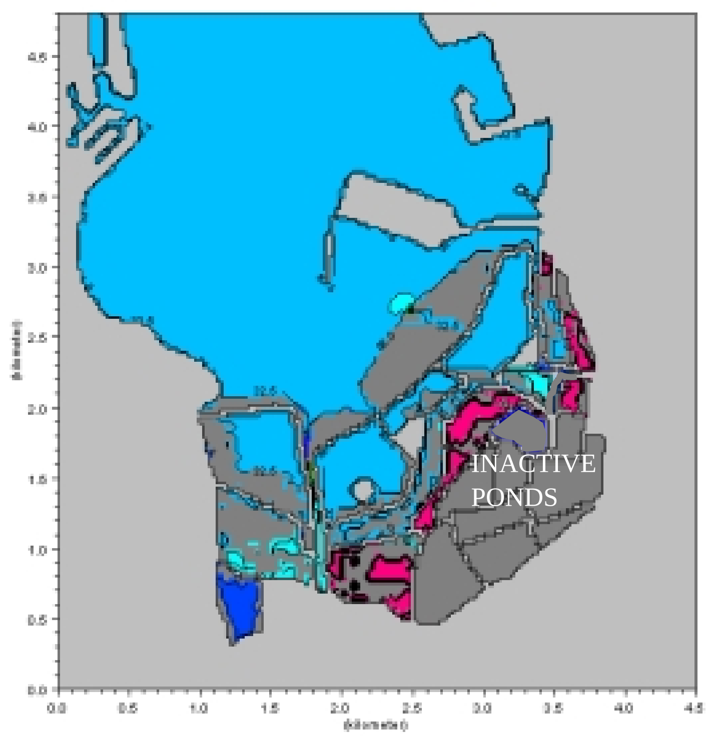
PWA



Salinity Distribution in South San Diego Bay at *high tide* 28 days after breach.

Salinity (psu)

- Above 160
- 100 - 160
- 90 - 100
- 80 - 90
- 70 - 80
- 60 - 70
- 56 - 60
- 54 - 56
- 52 - 54
- 50 - 52
- 48 - 50
- 46 - 48
- 44 - 46
- 42 - 44
- 40 - 42
- 38 - 40
- 36 - 38
- 34 - 36
- 33 - 34
- 32.5 - 33
- Below 32.5



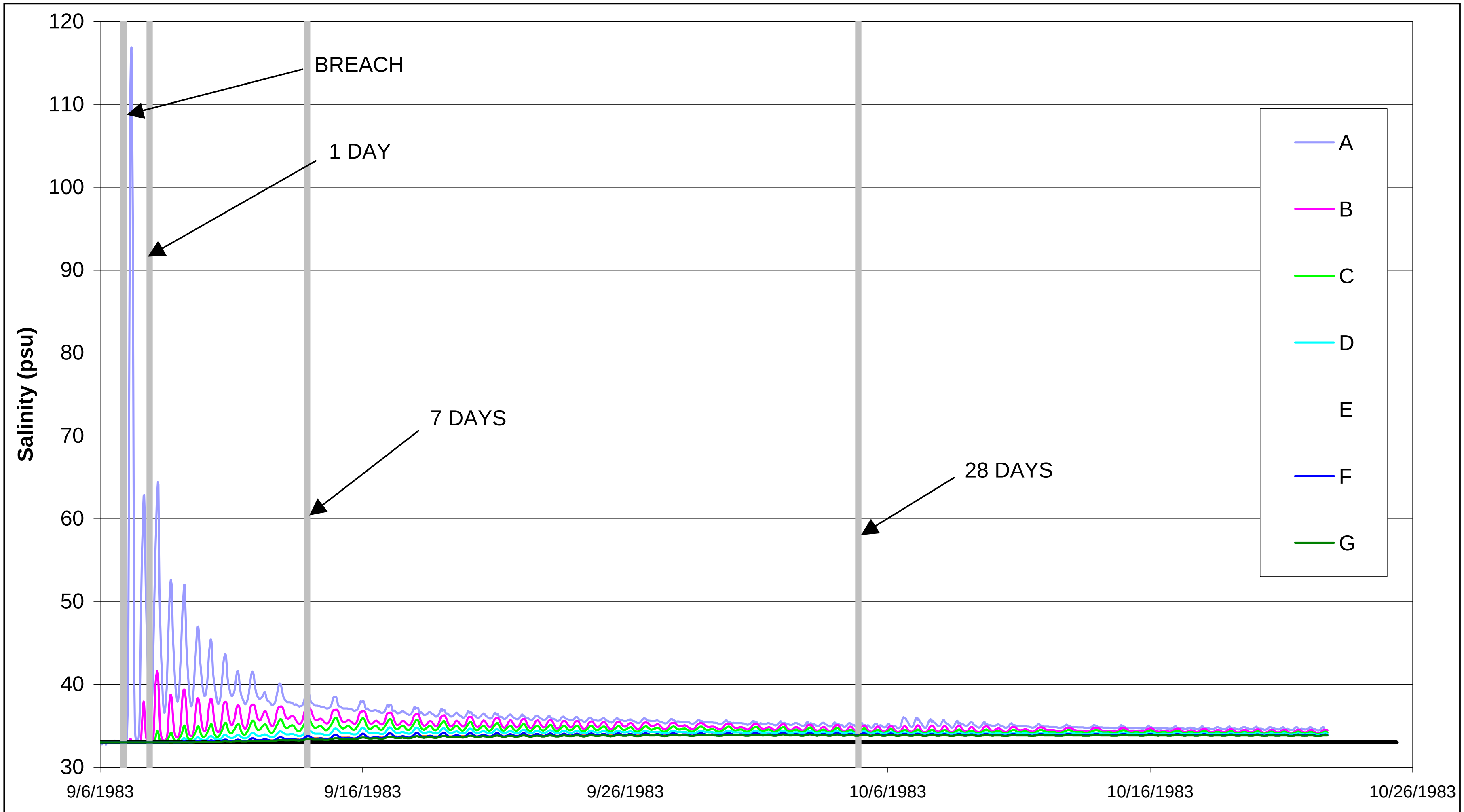
Salinity Distribution in South San Diego Bay at *low tide* 28 days after breach.

Notes: Simulated salinities at low and high tides, 28 days after breach of Alternative D.

f igure 15

South San Diego Bay Salt Ponds
Salinity Distribution in the South Bay & Ponds, Phase 3, 28 Days After Breach

PWA Ref 1631



Notes: See Figure 4.6 for location points A through G.

figure 16

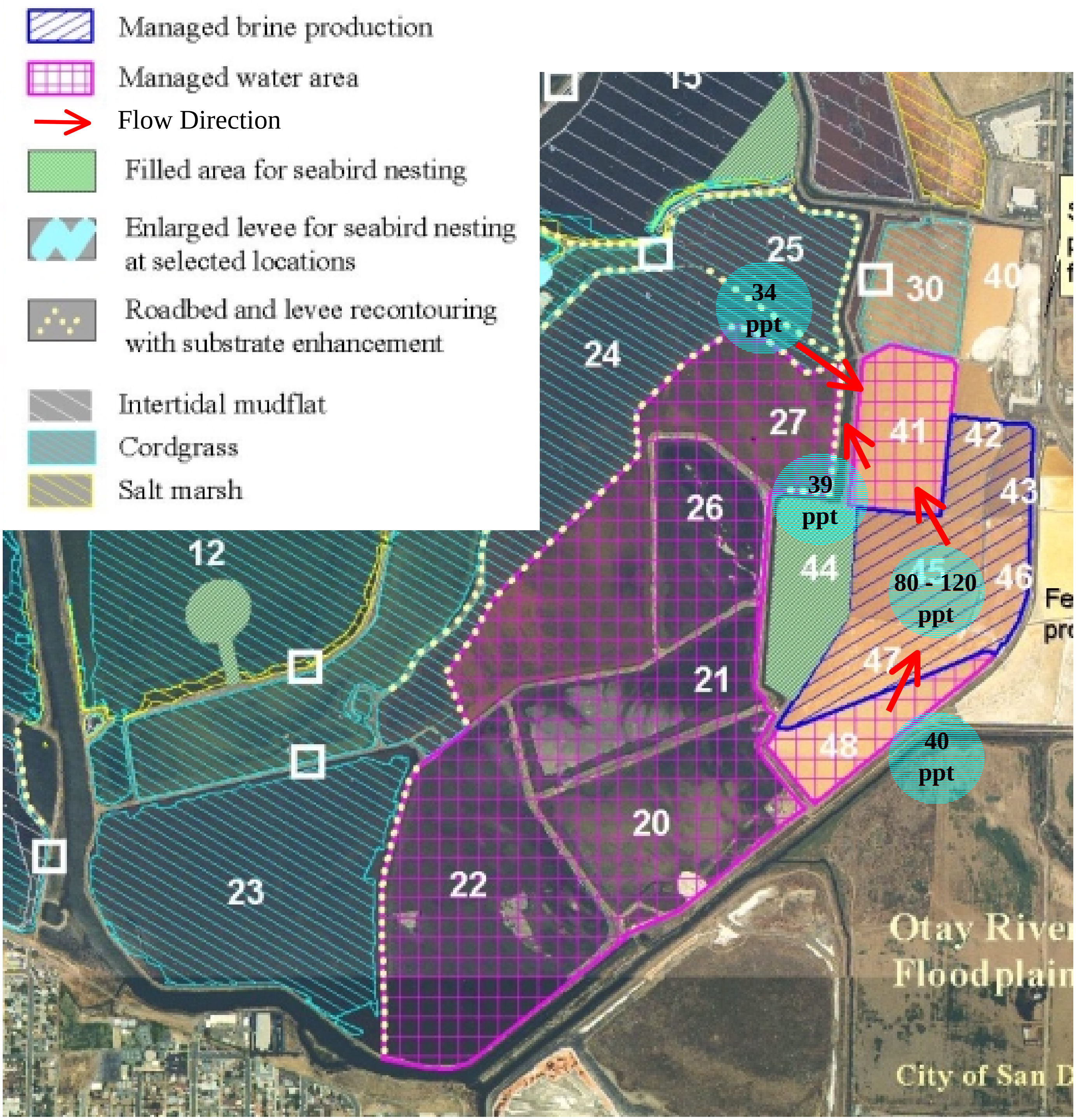
South San Diego Bay Salt Ponds

San Diego Bay Salinity Time Series , Phase 3

PWA Ref 1631

PWA

Projects\1631-00_San_Diego_Salt_Ponds\Task6-Reporting\figures\ Chapter4_ALTD-rev.xls \ fig16



Source: Background image from USFWS (01 November 2002)

f igure 17

South San Diego Bay Salt Ponds

Configuration of Brine Complex

PWA Ref 1631

PWA

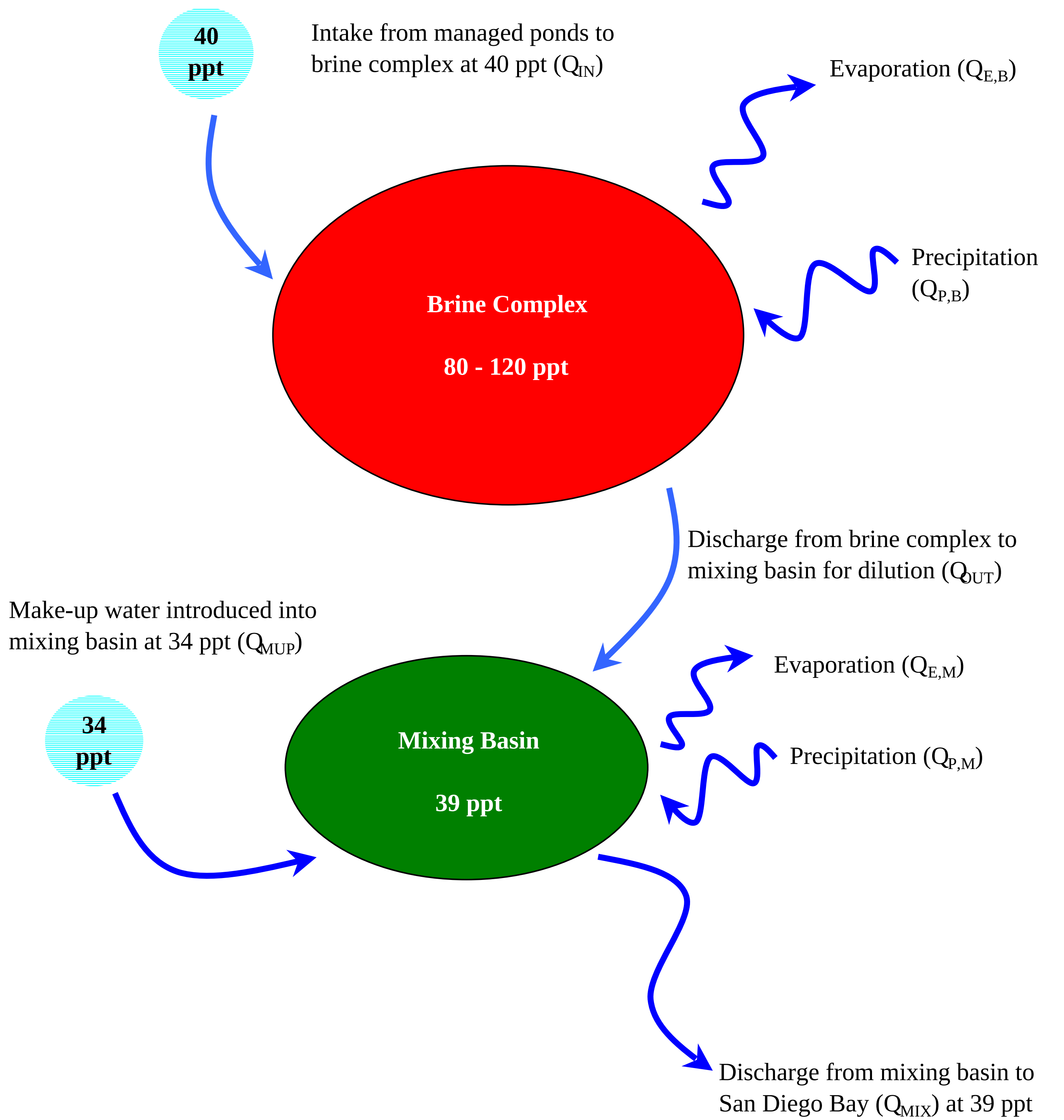


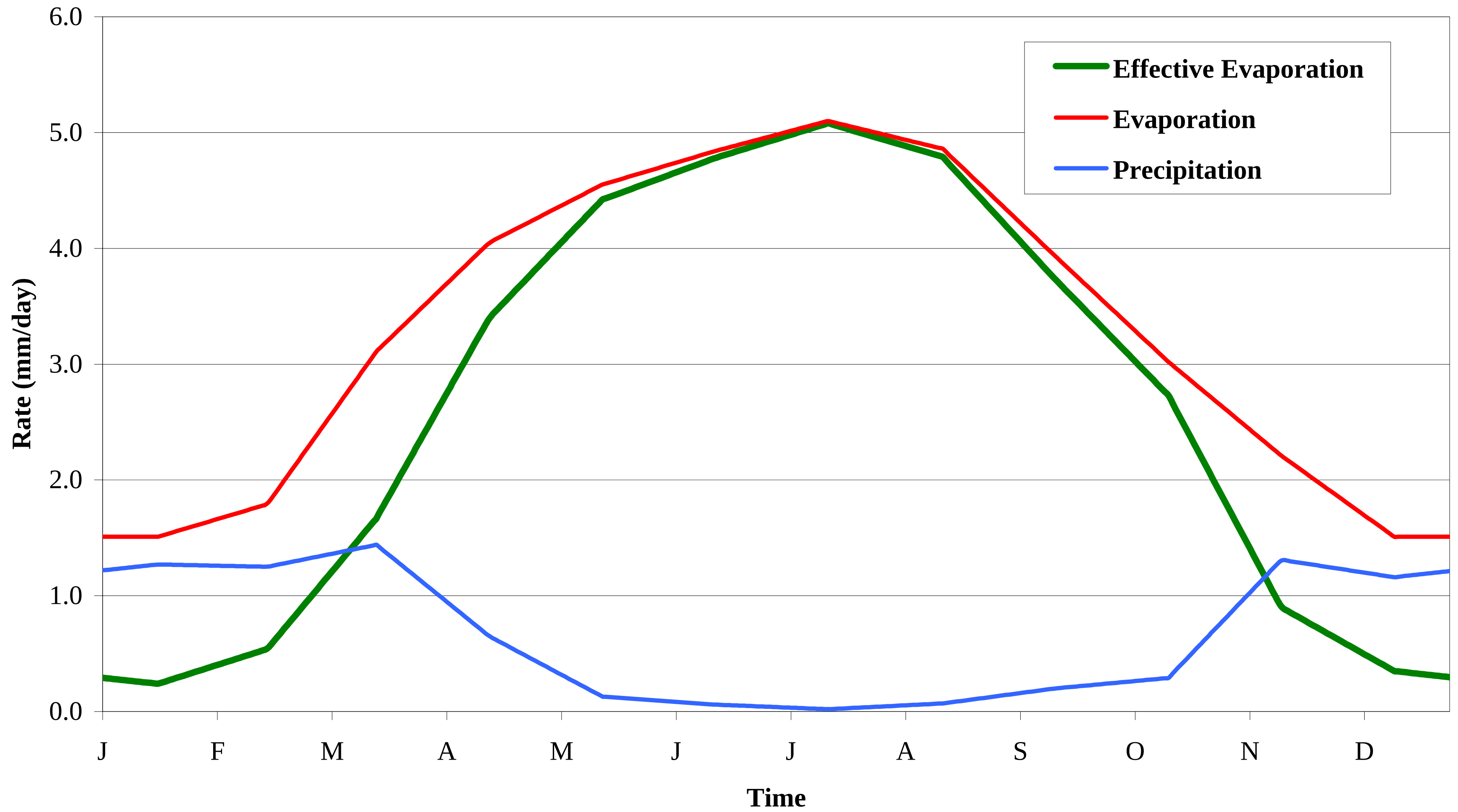
figure 18

South San Diego Bay Salt Ponds

Conceptual Layout of Box Model

PWA Ref 1631

PWA



Notes: Precipitation from 1961 to 1990; Freshwater evaporation from 1918 to 1979 (values independently adjusted with Fullerton Class A pan coefficient)

Source: National Weather Service (NWS)Cooperative Network - Chula Vista.

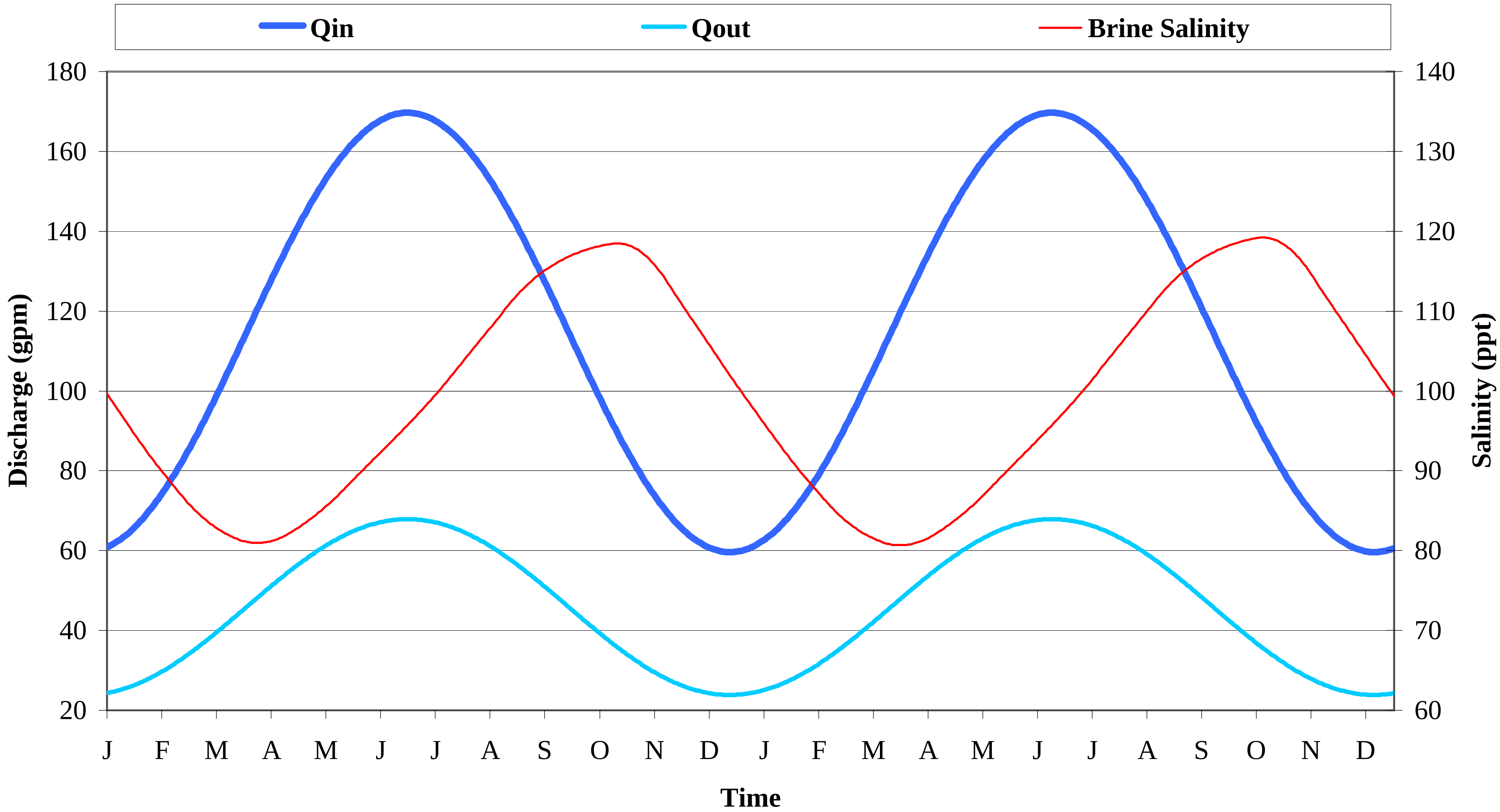
figure 19

South San Diego Bay Salt Ponds

Monthly Mean Evaporation and Precipitation Rates for Chula

PWA Ref #1631

PWA



Notes: Fit flows to a sine-wave and solve for time-varying volume and salinity of brine complex; set volume and salinity of mixing basin as constants and solve for time-varying flow (Run 4).

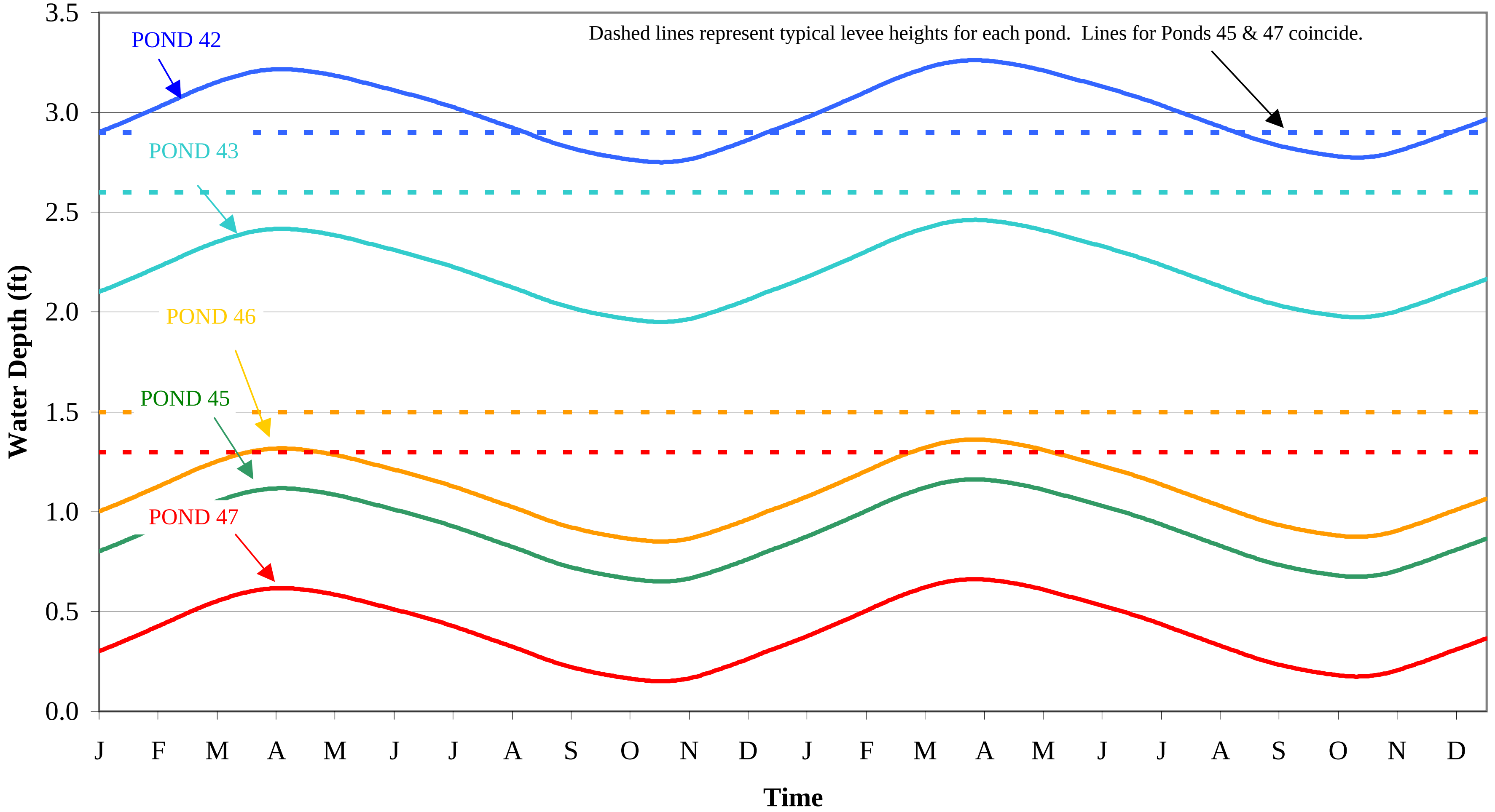
f igure 20

South San Diego Bay Salt Ponds

Time Series of Discharges and Salinity in Brine Ponds

PWA Ref #1631

PWA



Notes: Fit flows to a sine-wave and solve for time-varying volume and salinity of brine complex; set volume and salinity of mixing basin as constants and solve for time-varying flow (Run 4)

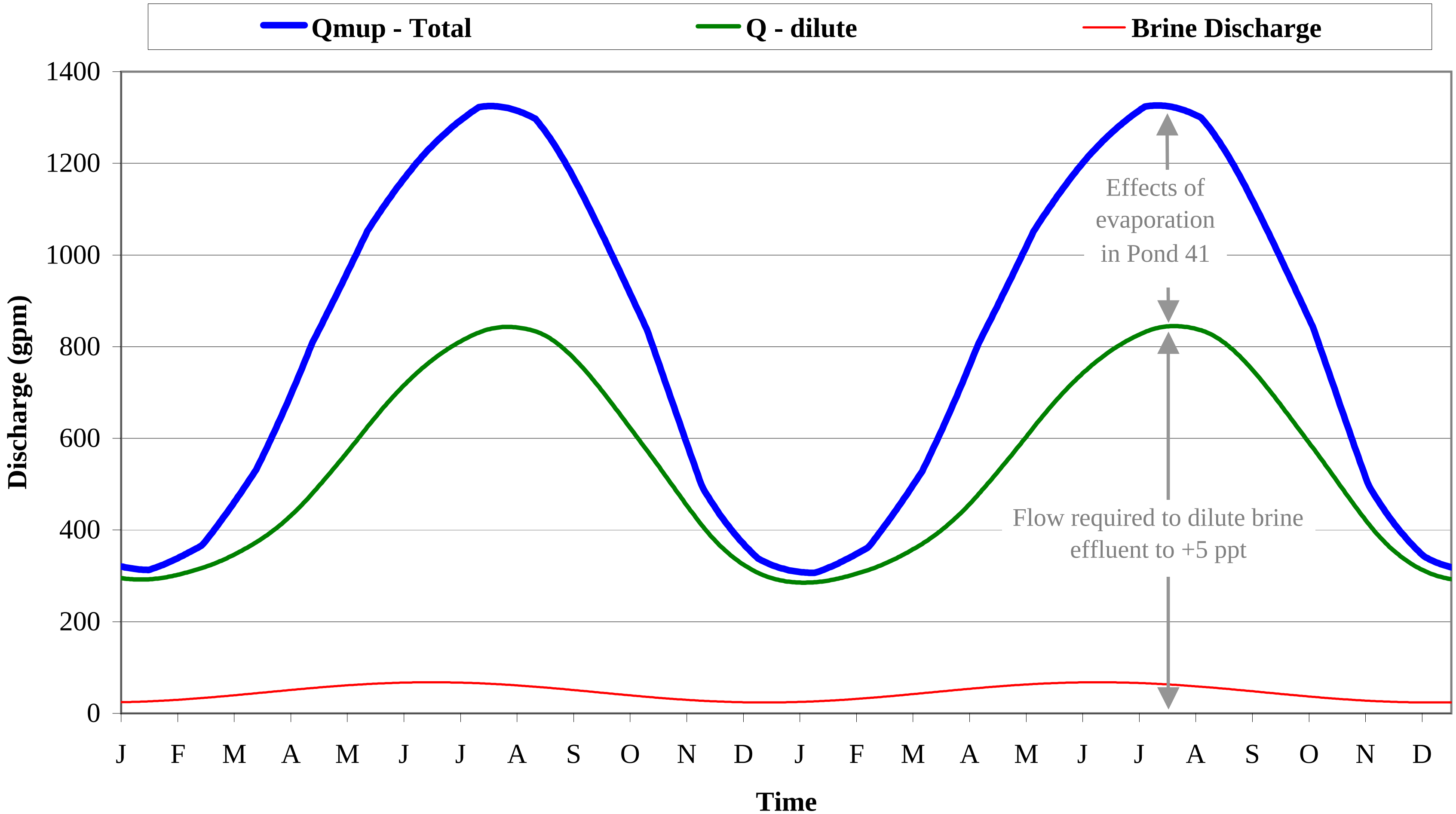
figure 21

South San Diego Bay Salt Ponds

Time Series of Brine Pond Water Depths

PWA Ref #1631

PWA



Notes: Fit flows to a sine-wave and solve for time-varying volume and salinity of brine complex; set volume and salinity of mixing basin as constants and solve for time-varying flow (Run 4). Discharge into the bay is = Qmup-total (blue line) + Qout (red line) - Pond 41 Evap.

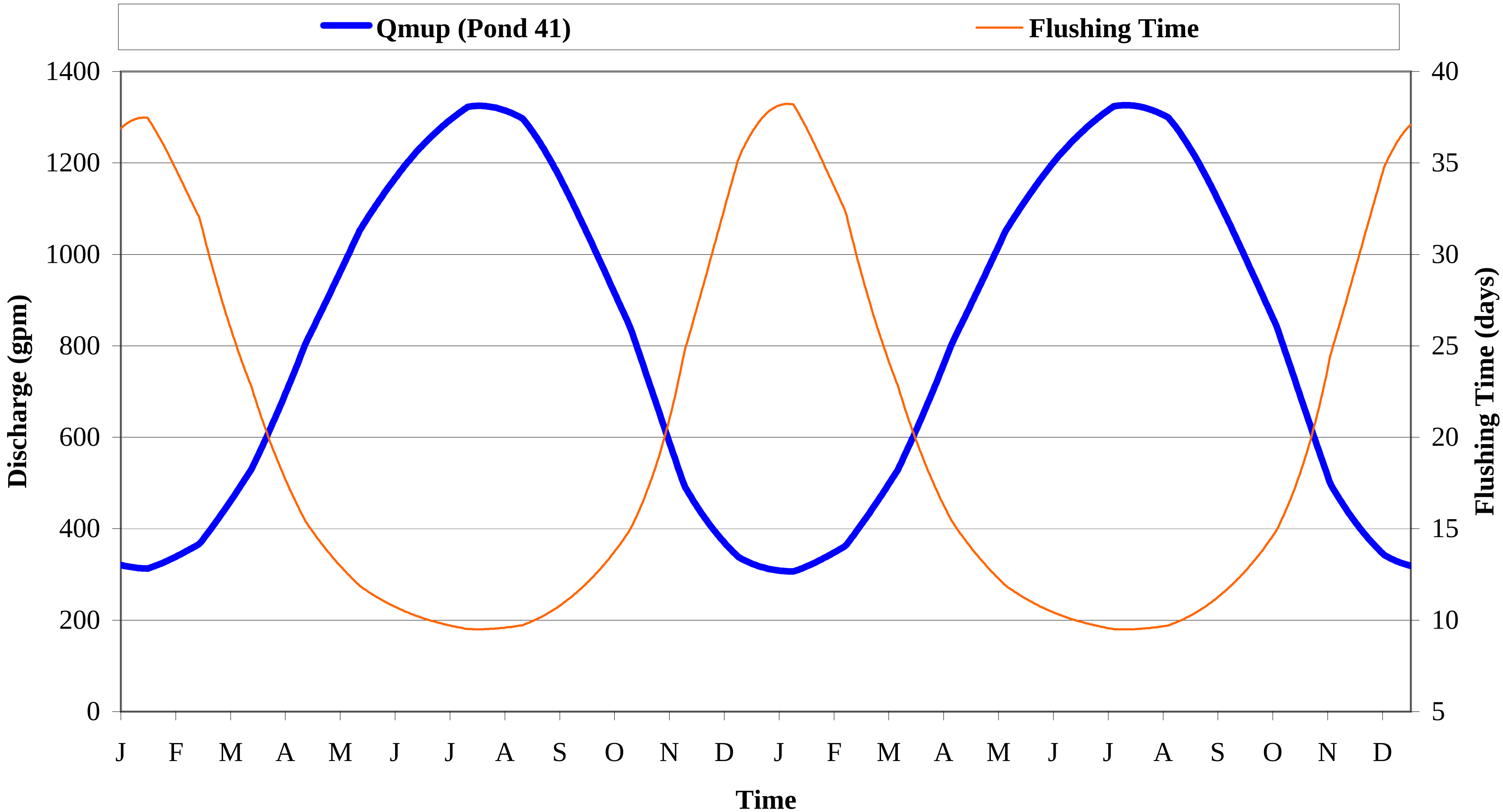
figure 22

South San Diego Bay Salt Ponds

Time Series of Mixing Basin Discharges

PWA Ref #1631

PWA



Notes: Fit flows to a sine-wave and solve for time-varying volume and salinity of brine complex; set volume and salinity of mixing basin as constants and solve for time-varying flow (Run 4)

figure 23

South San Diego Bay Salt Ponds

Flushing Time in Mixing Basin

PWA Ref #1631

PWA

Appendix K

Compatibility Determinations

Compatibility Determinations

Appendix K includes the following draft compatibility determinations:

<u>Sweetwater Marsh Unit</u>
Wildlife Observation and Photography
Environmental Education and Interpretation
Mosquito Management
Fishing
Water Trail

<u>South San Diego Bay Unit</u>
Wildlife Observation and Photography
Environmental Education and Interpretation
Mosquito Management
Regional Trail

Compatibility Determination
-FINAL-

Use: Wildlife Observation and Photography

Refuge Name: Sweetwater Marsh Unit of the San Diego Bay National Wildlife Refuge (San Diego County, Cities of Chula Vista and National City, California)

Establishing and Acquisition Authorities:
The authorities for the establishment of the Sweetwater Marsh Unit are the Endangered Species Act of 1973, as amended (16 U.S.C. §§1531-1543); Fish and Wildlife Act of 1956, as amended (16 U.S.C. §§742a-742j, not including 742d-742l); and the Fish and Wildlife Coordination Act of 1934, as amended (16 U.S.C. §§661-667e).

Refuge Purposes:
The San Diego Bay National Wildlife Refuge (NWR) was established:

> "to protect, manage, and restore habitats for federally listed endangered and threatened species and migratory birds, and to maintain and enhance the biological diversity of native plants and animals" 16 U.S.C. § 1531-1543 (Endangered Species Act of 1973, as amended) and 70 Stat. 1119 (Fish and Wildlife Act of 1956, as amended);
>
> "…for the development, advancement, management, conservation, and protection of fish and wildlife resources...for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude..." (Fish and Wildlife Act of 1956).
>
> [This refuge] "shall be administered by him [Secretary of the Interior] directly or in accordance with cooperative agreements...and in accordance with such rules and regulations for the conservation, maintenance, and management of wildlife, resources thereof, and its habitat thereon..." (Fish and Wildlife Coordination Act of 1934).

National Wildlife Refuge System Mission:
The mission of the National Wildlife Refuge System 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" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd-668ee]).

<u>Description of Use</u>:
At the scoping meetings for the Sweetwater Marsh and South San Diego Bay Units of the San Diego Bay NWR Comprehensive Conservation Plan (CCP), the public expressed a desire to see the existing opportunities for wildlife observation and photography on Gunpowder Point continued. There was also an interest in developing additional wildlife observation opportunities in the vicinity of Paradise Marsh. Wildlife observation and photography represent two of the six priority public uses of the National Wildlife Refuge System that if determined to be compatible uses should be facilitated on National Wildlife Refuges.

As described in the Public Use Program discussion in Section 2.2.2.1 of the Final CCP/ Environmental Impact Statement (EIS) (USFWS 2006), existing opportunities for wildlife observation and photography on the Sweetwater Marsh Unit are currently provided on Gunpowder Point. From the Chula Vista Nature Center, an observation pavilion located near the edge of the bay, and portions of the existing interpretive trail system (refer to Figure 2-1 of the Final CCP/EIS), Refuge visitors can observe migratory birds foraging within the salt marshes and tidal mudflats located adjacent to Gunpowder Point. Also available from the observation pavilion and portions of the trail system, are the sights and sounds of birds, such as black brant (*Branta bernicla nigricans*) and elegant tern (*<u>Thalasseus</u> elegans*), foraging and loafing in the bay. Although no new opportunities for wildlife observation and photography are proposed on Gunpowder Point, the CCP does include a proposal to redesign the existing interpretive trail system (refer to the Compatibility Determination prepared for environmental education and interpretation on the Sweetwater Marsh Unit, as well as Section 2.2.2.3 of the Final CCP/EIS). It is anticipated that this redesign would improve opportunities for wildlife observation.

Public access onto Gunpowder Point is only available via a bus that transports visitors from a satellite parking area (located to the east of the Refuge) to the Chula Vista Nature Center. The City of Chula Vista, which operates this shuttle bus, does not collect a fee to use the bus; however, an admission fee is collected to enter the facilities operated by the Chula Vista Nature Center. No fee is collected from visitors interested only in observing wildlife from the existing trail system and observation pavilion on Gunpowder Point. Public access onto the Refuge is permitted during those hours in which the Chula Vista Nature Center is open (Tuesday through Sunday, 10:00 AM - 5:00 PM, except major holidays). Approximately 35,000 people visited the Nature Center during 2003 and many of these visitors spend time on the interpretive trails located on the Refuge.

Appropriate upland sites are not available on Refuge property in the vicinity of Paradise Marsh or F&G Street Marsh to accommodate new opportunities for wildlife observation. Therefore, to address the public's request for wildlife observation sites in these areas, the CCP recommends that the Refuge Manager coordinate with adjacent local agencies (National City and Chula Vista) to develop wildlife observation sites within the public rights-of-way that abut Paradise Marsh and the F&G Street Marsh (see Figure 1-3 of the Final CCP/EIS).

Availability of Resources:
Direct costs to administer opportunities for wildlife observation and photography, including monitoring of trail user activities, are primarily in the form of staff time. Adequate staff positions and financial resources are currently available and committed to manage the continuation of existing opportunities for wildlife observation and interpretation on Gunpowder Point. To adhere to the stipulation regarding additional regulatory signage on the Refuge, approximately $5,000 would be required to fabricate and install up to five signs on the Refuge. There is adequate funding in the current budget to cover this expense. The development of observation areas in the vicinity of Paradise Marsh and F&G Street Marsh would require participation by the adjoining property owners, which in this case are the Cities of National City and Chula Vista, respectively. Funding is not currently available in the Refuge budget to assist in the construction of observation areas in these locations, however, potential future funding sources could include Federal cost share grants, other state or local grants, private donations, and/or contributions from the Refuge's Friends Group.

Anticipated Impacts of the Use:
Activities related to wildlife observation and photography can result in negative impacts to wildlife by altering wildlife behavior, reproduction, distribution, and habitat (DeLong and Schmidt 2000). In addition, birds frequently approached by humans engaged in these activities may reduce foraging times in the affected area or avoid the area entirely (Huffman 1999). During studies conducted in south San Diego Bay, Huffman observed that human activity along the shoreline and in the mudflats would flush all birds within a 50 to 100 meter radius. To minimize these types of impacts within the Sweetwater Marsh Unit, various measures have been implemented in an attempt to keep individuals within designated observation areas and out of sensitive habitats. These measures include post and cable fencing, regulatory signage, and periodic monitoring of trail user activities.

Endangered and Threatened Species: Human activity can have adverse impacts to listed species, particularly when avian nesting or foraging activities are disrupted. Of particular concern are potential disturbances to the endangered light-footed clapper rail (*Rallus longirostris levipes*), which is supported by the salt marsh habitat that occurs on the Refuge. Maintaining designated trails to accommodate wildlife observation and photography, as well as regulatory and interpretive signage to keep authorized users out of sensitive areas, has minimized disturbance to this species. Another Federally-listed endangered species that is susceptible to harm as a result of off-trail activity is the salt marsh bird's beak (*Cordylanthus maritimus maritimus*), an annual plant found in the high marsh. The measures described above also minimize the potential for impacts to this species as a result of authorized wildlife observation and photography activities on the Refuge. However, to further minimize the potential for disturbance to these species, as well as to reduce the amount of unauthorized access onto the Refuge from adjoining parcels, additional signage would be installed to keep the public out of sensitive habitat areas.

Public uses such as wildlife observation and photography are only permitted on Gunpowder Point, the remainder of the Refuge is closed to public access in an effort protect sensitive habitat and the endangered and threatened species and migratory birds supported by that habitat. As a result, no impacts to the endangered California least tern (*Sternula antillarum*) or threatened western snowy plover (*Charadrius alexandrinus nivosus*) are anticipated.

Sensitive Habitats: Opportunities for wildlife observation and photography are generally limited to the area in and around the Chula Vista Nature Center and on the existing trail system, therefore, impacts to sensitive habitats as a result of these uses would be minimal (refer to the discussion provided under Endangered and Threatened Species).

Migratory Birds: The existing trail system provides access to the edge of the Refuge where expansive mudflats provide foraging habitat during low tides. To minimize off-trail activity in this area, post and cable fencing has been installed along the trails. Additional signage is recommended in areas where these trails abut sensitive habitat to further potential impacts.

Public Review and Comment:

Wildlife observation and photography have been discussed a several occasions at public workshops held in conjunction with the Comprehensive Conservation Plan (CCP) process. To initiate the CCP process, a Notice of Intent was published in the Federal Register on June 23, 2000 (65 FR 39172). At that time, written comments were solicited. In July 2000, two initial scoping meetings were held, one in Imperial Beach and one in Chula Vista, to receive input from the public on issues related to the South San Diego Bay and Sweetwater Marsh Units. Due to the public's level of interest in these refuges, focused public workshops were held in September 2000 and June 2001 to specifically address the issue of public use. Three additional workshops were held between November 2000 and May 2001 to receive input from the public on wildlife management and restoration proposals for these refuges. All of the public meetings were well attended with at least 40 people present at each meeting. Approximately 50 to 60 people attended those meetings related to public use.

At each workshop, the public was encouraged to provide verbal comments or to send us written comments following the workshop. A CCP web page (www.sandiegorefuges.fws.gov) was established to provide the public with specific information regarding the topics addressed at the various workshops and to present information regarding when and where to provide comments. A number of Planning Updates have also been prepared to summarize the progress of the CCP and to discuss specific issues related to the planning process. One of these updates was devoted entirely to the topic of public use. These Planning Updates have been distributed to more than 1,000 individuals and organizations representing interested members of the public, conservation organizations, hunting, fishing and boating organizations, public agencies, municipalities, special districts, Tribes, and adjoining property owners. We received more than 50 letters, emails, and phone calls related to public use between June and November 2001 and numerous other communications relevant to public uses on the Refuge were received in 2002 and 2003.

During the scoping meetings and public use workshops for the CCP, a number of individuals expressed a general desire to see additional opportunities for wildlife observation and photography within the south bay, however, most of the site specific suggestions related to the South San Diego Bay Unit. The one recommendation that related to the Sweetwater Marsh Unit involved a request to see opportunities for wildlife observation and interpretation in the vicinity of Paradise Marsh in the northern end of the Refuge.

The draft Compatibility Determination for wildlife observation and photography on the Sweetwater Marsh Unit was circulated for public review and comment as part of the San Diego Bay National Wildlife Refuge Draft Comprehensive Conservation Plan/Environmental Impact Statement (CCP/EIS). Specifically, it was included in Appendix K of the draft CCP/EIS. The Notice of Availability for the draft CCP/EIS was published in the Federal Register on July 22, 2005 and a Planning Update announcing the availability of the draft was sent to over 1,000 individuals, agencies, non-governmental organizations, and other stakeholders. In addition, the draft CCP/EIS was provided to over 275 interested parties and made available for review on the Refuge's CCP website. Public comments were accepted through September 19, 2005. No comments related to this Compatibility Determination were received during the public comment period.

Determination:

__ Use is Not Compatible

X Use is Compatible with the Following Stipulations

Stipulations Necessary to Ensure Compatibility:

The following measures will be taken to minimize impacts to wildlife:

1. To discourage off-trail activity "Closed Area" or "Sensitive Habitat" signs will be installed in areas where trails or observation areas abut sensitive habitat.

2. Periodic monitoring of trail user activities will continue to determine if unauthorized off-trail activity is occurring in or around sensitive areas of the Refuge. If during monitoring it is determined that off-trail activity could result in impacts to Refuge resources, the Refuge Manager shall implement measures, such as additional signage, fencing, and/or barrier plantings, to further discourage this activity.

Justification:

The continuation of wildlife observation and photography on Gunpowder Point and the possible expansion of wildlife observation opportunities in the vicinity of Paradise Marsh and F&G Street Marsh would not adversely affect the Refuge's wildlife or its habitat. In addition, as the public engages in these types of activities on the Refuge, many will go away with a greater understanding of the importance of protecting native habitats and their associated wildlife species. The overall benefits of facilitating these uses would support the purposes of the Refuge by improving opportunities for managing, conserving, and protecting fish and wildlife resources. In the same manner, allowing the public to observe the wildlife that is being protected within the Refuge without materially interfering with their daily activities supports the fulfillment the National Wildlife Refuge System (System) mission's of wildlife first. The National Wildlife Refuge System Improvement Act (the Act) states that "compatible wildlife-dependent recreation is a legitimate and appropriate general public use of the System, directly related to the mission of the System...and through which the American public can develop an appreciation for fish and wildlife..." Wildlife observation and photography are two of the six priority public uses of the System, as defined by the Act, that when found to be compatible, should be facilitated. The continuation of these programs would implement the Refuge goal of fostering a broader understanding of the value of, and need for, wildlife conservation.

Mandatory Re-Evaluation Date:

X Mandatory 15-year Re-Evaluation Date (for priority public uses)

__ Mandatory 10-year Re-Evaluation Date (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision:

__ Categorical Exclusion without Environmental Action Statement

__ Categorical Exclusion and Environmental Action Statement

__ Environmental Assessment and Finding of No Significant Impact

X Environmental Impact Statement and Record of Decision

References Cited:

DeLong, Anita and Janet Schmidt. 2000. Literature Review: Effects of Human Disturbance on Wildlife with Emphasis on Wildlife-Dependent Recreation Relevant to Stillwater National Wildlife Refuge (Draft).

Huffman, Kathy. 1999. San Diego South Bay Survey Report – Effects of Human Activity and Water Craft on Wintering Birds in the South San Diego Bay.

U.S. Fish and Wildlife Service. 2006. San Diego Bay National Wildlife Refuge (Sweetwater Marsh and South San Diego Bay Units) Final Comprehensive Conservation Plan/Environmental Impact Statement.

Refuge Determination:

Prepared by: ______________________________Date: _________

Refuge Manager/
Project Leader
Approval: ______________________________Date: _________

Concurrence:

Refuge Supervisor: ______________________________Date: _________

Assistant Manager, Refuges
California/Nevada
Operations Office: ______________________________Date: _________

Manager, California/Nevada
Operations Office: ______________________________Date:_________

Compatibility Determination
- FINAL -

Use: Environmental Education and Interpretation

Refuge Name: Sweetwater Marsh Unit of the San Diego Bay National Wildlife Refuge (San Diego County, Cities of Chula Vista and National City, California)

Establishing and Acquisition Authorities:
The authorities for the establishment of the Sweetwater Marsh Unit are the Endangered Species Act of 1973, as amended (16 U.S.C. §§1531-1543); Fish and Wildlife Act of 1956, as amended (16 U.S.C. §§742a-742j, not including 742d-742l); and the Fish and Wildlife Coordination Act of 1934, as amended (16 U.S.C. §§661-667e).

Refuge Purposes:
The San Diego Bay National Wildlife Refuge (NWR) was established:

> "to protect, manage, and restore habitats for federally listed endangered and threatened species and migratory birds, and to maintain and enhance the biological diversity of native plants and animals" 16 U.S.C. § 1531-1543 (Endangered Species Act of 1973, as amended) and 70 Stat. 1119 (Fish and Wildlife Act of 1956, as amended);
>
> "…for the development, advancement, management, conservation, and protection of fish and wildlife resources...for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude..." (Fish and Wildlife Act of 1956).
>
> [This refuge] "shall be administered by him [Secretary of the Interior] directly or in accordance with cooperative agreements...and in accordance with such rules and regulations for the conservation, maintenance, and management of wildlife, resources thereof, and its habitat thereon..." (Fish and Wildlife Coordination Act of 1934).

National Wildlife Refuge System Mission:
The mission of the National Wildlife Refuge System 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" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd-668ee]).

<u>Description of Use</u>:
<u>Environmental Education</u>: As described in the Public Use Program discussion in Section 2.2.2.1 of the Final San Diego Bay NWR Comprehensive Conservation Plan (CCP)/Environmental Impact Statement (EIS) (USFWS 2006), the Sweetwater Marsh Unit is currently the setting for several environmental education programs involving students from Chula Vista and National City, as well as from the greater San Diego region. These programs represent a collaborative effort between the Service, the Chula Vista Nature Center, National City, several school districts, and nonprofit organizations. One program, implemented by the Chula Vista Elementary School District, focuses on a science and social studies curriculum. The program serves some 12,000 kindergarten through 12th grade students annually. The Refuge, specifically Gunpowder Point (refer to Figure 2-1 of the Final CCP/EIS), provides the outdoor classroom for this program where students study topics such as the tides, water quality, native vegetation, and birds.

Another program, created by the San Diego Zoological Society, Chula Vista Nature Center, and the San Diego NWR Complex through a grant to the Zoo's Habitat Conservation Education Department, is Sweetwater Safari. This program, which meets the State of California's science standards for fourth grade, was created for students to learn about science and the local environment through a hands-on experience. The program includes on-site curriculum that is conducted on the refuge and a post-visit curriculum that is conducted in the classroom. The on-site curriculum is taught by the teachers. To lead the self-guided on-site program, which takes place on Gunpowder Point, the teacher must first participate in a training session conducted by Refuge staff, Chula Vista Nature Center staff, and other volunteer teachers. These training sessions, which are provided free of charge, are conducted quarterly at the Chula Vista Nature Center. Once a teacher has completed this training, he or she can arrange a time with the Nature Center to guide his/her class through the program. Equipped with backpacks containing relevant educational materials, the class travels along the 0.5 mile trail system on Gunpowder Point gathering information regarding the many resources supported by the Refuge. The Refuge trails are flat, wide and wheelchair accessible. Transportation grants to bring student onto the refuge are available for this program.

Another program supported by the Refuge is conducted by Kimball Elementary School in National City. This program, which generally occurs just upstream of the Refuge, presents a science and mathematics-based curriculum focused on the protection of watersheds, the function of wetland systems, and water quality testing.

The Refuge also partners with the Chula Vista Nature Center, San Diego Zoo, Kimball Elementary, Paradise Creek Educational Park, Aquatic Adventures, and others to facilitate occasional field trips to the Refuge to support the organizations' desire to introduce students to the biological and cultural resources of the region, including those resources supported on the refuge. The majority of these programs incorporate language arts, math, and social sciences into their curriculum in accordance with California State Education Standards. Several of these programs have been developed to reach the underserved youth of the region whose opportunities to experience the natural environmental first hand may be limited.

Environmental education programs are conducted on the Refuge once or twice a week throughout the year, with field trip opportunities open to only one classroom of approximately 32 students per day. Participants are generally transported to the site by bus or van. In some cases, the students use the existing shuttle bus that provides access to the Refuge from a satellite parking facility located off Refuge property.

The environmental education community has also expressed a desire to have the various environmental programs available within the south bay coordinated by a single point of contact, a South Bay environmental education facilitator. The Refuge Complex proposes to partner with other agencies and institutions in the region to support the creation of and identify funding for such a position. This environmental education facilitator would be responsible for contacting school districts about the many field experience curricula available in the South Bay, including those on the Sweetwater Marsh Unit, developing a region-wide strategy for filling teacher workshops, soliciting transportation grants to be used by each program, and developing teacher in-service agreements with local school districts to more efficiently reach the greatest number of educators.

<u>Environmental Interpretation</u>: Interpretation of the many resources found on the Sweetwater Marsh Unit is currently provided through a series of interpretive panels installed along an existing half-mile trail system located on Gunpowder Point (refer to Figure 2-4 of the Final CCP/EIS). These panels provide general information about the coastal resources protected within the Refuge. Additional interpretation of the historic resources on Gunpowder Point is also provided along the trail system. Several of the existing interpretive elements along these trails are in need of refurbishment and/or replacement.

Public access onto the Refuge is only available via a bus that transports visitors from a satellite parking area (located east of the Refuge) to the Chula Vista Nature Center. The City of Chula Vista, which operates this shuttle bus, does not collect a fee to use the bus; however, an admission fee is collected at the Nature Center, should visitors wish to enter the facilities operated by the Chula Vista Nature Center. No fee is collected from visitors interested only in walking along the existing trail system. Public access onto the Refuge is permitted during those hours in which the Chula Vista Nature Center is open (Tuesday through Sunday, 10:00 AM - 5:00 PM, except major holidays). Approximately 35,000 people visited the Nature Center during 2003 and many of these visitors spend time on the interpretive trails located on the Refuge.

The Chula Vista Nature Center, which is located on Refuge lands that are leased to the City of Chula Vista, includes exhibits and signs that interpret Refuge resources, as well as the many biological resources of San Diego Bay. Included within the Nature Center are several live animal exhibits, including an aviary that includes various shorebirds commonly found in the area and a breeding pair of light-footed clapper rails. Several times a week, Nature Center docents lead small groups of people on interpretive walks along the Refuge's trail system.

The public has expressed a desire to not only see uses related to environmental interpretation continued on the Refuge, but also to see the existing opportunities expanded to reach a larger segment of the surrounding community. To improve opportunities for environmental interpretation, a step-down interpretive trail plan is proposed for Gunpowder Point. This plan would address the need to replace outdated interpretive panels and would include designs for new interpretive elements. The plan would also include an evaluation of the existing trail system on Gunpowder Point and where necessary propose a realignment of current trails to provide better coordination with the educational and interpretive programs occurring on the Refuge. This trail system, to be referred to as The Discovery Trail, would be provided primarily for the purpose of facilitating the Refuge's environmental education and interpretation programs. The redesigned trail system would also improve opportunities for wildlife observation and photography.

To address the public's desire to expand opportunities for environmental interpretation in other portions of the Refuge, the Refuge Manager would coordinate with adjacent local agencies (National City and Chula Vista) to develop interpretive elements within the public rights-of-way that abut Paradise Marsh and the F&G Street Marsh (refer to Figure 2-4 of the Final CCP/EIS).

Availability of Resources:

Direct costs to administer the current environmental education and interpretation programs are in the form of staff time. One environmental education program that includes all fourth grade students in the City of Chula Vista is administered and funded by the City of Chula Vista. The development and implementation of another program, Sweetwater Safari, was initially funded by a grant, while the responsibility for training is shared by Refuge staff and the Nature Center.

Additional funding would be required to prepare and implement a step-down interpretive trail plan for Gunpowder Point to expand and improve interpretive opportunities on the Refuge. Major construction expenses would involve replacing existing interpretative signage and creating new trail segments, while also closing and restoring other segments. The estimated cost to the Complex for current refuge education programs is under $500 per year. This includes material costs and some staff time for occasional oversight of the programs, periodic updates to the current curriculum, and participation in teacher training sessions.

To implement and administer the proposed environmental education and interpretive programs described, the following staffing and materials/facilities would be required:

Staffing			
Position	**Involvement**	**FTE**	**Cost**
Project Leader/Deputy Project Leader	General oversight of programs	0.2/0.2	$25,700/$22,000
Refuge Manager	Periodic on-site oversight	0.4	$36,400
Refuge Operations Specialist	Periodic on-site oversight, occasional monitoring of program activities	0.3	$26,000
Wildlife Biologist	Monitoring, reporting, assistance in program development, oversight of biological technician	0.3	$26,000
Information and Education Specialist	Coordinate and provide oversight of environmental education programs and assist in interpretive plan design	0.3	$23,400
Outdoor Recreation Planner	Evaluate and redesign as required the existing interpretive trail system, assist in the design and siting of new interpretive signage, supervise trail construction	0.5	$22,750
Law Enforcement Officer	Law enforcement	0.3	$20,800
Park Ranger	Assist in trail realignment and installation of interpretive signage, facilities maintenance	0.3	$13,000
Biological Technician	Field data collection, assistance with monitoring, analysis, and report writing	0.3	$15,170
TOTAL FTES AND COSTS FOR STAFFING		3.1	$231,220

Facilities		
Material/Facility Required	**Explanation of Need**	**Cost**
Education materials and supplies	Various materials are required annually to implement existing environmental education programs	$500
Prepare a step-down interpretive trail plan for Gunpowder Point	Design new interpretive signs and redesign the existing trail system to better facilitate the Refuge's environmental education and interpretation programs	$35,000
Refurbished and/or new interpretive elements	Updated existing interpretative signs to better facilitate education and interpretation programs.	$50,000
Realign/refurbish existing trail system	New trail construction would be required to implement the step-down interpretative trail plan	$25,000
Interpretive elements to be installed along public right-of-ways	Contribute funds to assist in the installation of interpretive elements along designated public rights-of-way near Paradise Marsh and F&G Street Marsh.	$10,000
TOTAL COST FOR FACILITIES		$120,200

Adequate staff positions and financial resources are currently available and committed to manage the continuation of existing opportunities for environmental education and interpretation. However, the current Refuge budget is not adequate to fund the development and implementation of a step-down interpretive trail plan. The plan itself would be developed to address the current status of the existing trail system and the identification of appropriate realignments of some trails and the closure and revegetation of others. Also included in the plan would be designs for updated interpretive elements that would better coordinate with the environmental education programs conducted on the Refuge. In light of budget shortfall, project could be broken into phases funding sources are identified. Potential sources for additional funding include Federal cost share grants, state grants that focus on environmental education, private funding sources, and contribution from the Refuge's Friends group.

Anticipated Impacts of the Use:
Potential impacts associated with the continued and expanded implementation of environmental education and interpretation programs would be similar to those described in the Compatibility Determination prepared for wildlife observation and interpretation on the Sweetwater Marsh Unit. Such impacts can include disturbance to wildlife and trampling or damage to native habitats and sensitive plant species. These types of impacts would be minimized through appropriate program design, adequate Refuge oversight and supervision of educational activities, and ongoing coordination among partners.

Endangered and Threatened Species: Human activity can have adverse impacts to endangered and threatened species, particularly when avian nesting or foraging activities are disrupted. Of particular concern are potential disturbances to the Federally-listed endangered light-footed clapper rail (*Rallus longirostris levipes*), which is supported by the salt marsh habitat that occurs on the Refuge. Maintaining designated trails to accommodate environmental education and interpretation activities has minimized disturbance to this species. Another Federally-listed endangered species that is susceptible to harm as a result of off-trail activity is the salt marsh bird's beak (*Cordylanthus maritimus maritimus*), an annual plant found in the high marsh. Through appropriate supervision of students and the use of post and cable fencing along the trail, the potential for impacts has been minimized.

Activities related to environmental education and interpretation occur almost exclusively on Gunpowder Point, as a result, no adverse impacts to the endangered California least tern (*Sternula antillarum*) or threatened western snowy plover (*Charadrius alexandrinus nivosus*) are anticipated due to the continuation of these uses on the Refuge.

Interpretive elements proposed adjacent to Paradise Creek and F&G Street Marsh would occur within existing public access rights-of-way outside the boundaries of the marsh, therefore, the potential for impacts to the light-footed clapper rail and salt marsh bird's beak would be minimal.

Sensitive Habitats: The environmental education programs conducted on the Refuge utilize an existing trail system on Gunpowder Point to explore the resources present on the Refuge This trail system is clearly delineated with post and cable fencing and students are supervised at all times. As a result, the potential for intentional and unintentional intrusion into sensitive habitat from this use is minimal.

Interpretive programs conducted on Gunpowder Point could be self-guided or lead by Chula Vista Nature Center docents. These activities would be confined to a designated system of trails on Gunpowder Point, therefore, the potential for off trail activity is low. Despite these measures, there would still be the potential for self-guided visitors to leave the trail and enter sensitive areas. The highest potential for such activities is at the end points of the existing trail system, where the trail brings users to the edge of sensitive habitat and then stops. In these areas, users may be temped to travel beyond the existing post and cable fencing to gain better views of the adjacent mudflats or salt marsh habitats. As described in the Compatibility Determination for wildlife observation and photography for the Sweetwater Marsh Unit, realigning the trail to provide a loop system, thereby avoiding dead-end trails, would minimize the potential for such off-trail activity.

New interpretive elements proposed adjacent to Paradise Marsh and F&G Street Marsh would be placed within existing public access rights-of-way where no impacts to sensitive resources are anticipated.

Migratory Birds: The existing trail system provides access to the edge of the Refuge where expansive mudflats provide foraging habitat during low tides. Off-trail human activity in this area could result in disturbances to foraging migratory birds. Various studies have shown that frequent human disturbance can negatively impact wildlife by altering wildlife behavior, reproduction, distribution, and habitat (DeLong and Schmidt 2000). In addition, birds frequently approached by humans engaged in these activities may reduce foraging times in the affected area or avoid the area entirely (Huffman 1999). During studies conducted in south San Diego Bay, Huffman observed that human activity along the shoreline and in the mudflats would flush all birds within a 50 to 100 meter radius. To minimize these types of impacts within the Sweetwater Marsh Unit, various measures have been implemented in an attempt to keep individuals on the designated trail and out of sensitive habitats. These measures include post and cable fencing along the trail, regulatory signage at trail ends, and periodic monitoring of trail user activities.

Public Review and Comment:

Environmental education and interpretation have been discussed on several occasions at public workshops held in conjunction with the Comprehensive Conservation Plan (CCP) process. To initiate the CCP process, a Notice of Intent was published in the Federal

Register on June 23, 2000 (65 FR 39172). At that time, written comments were solicited. In July 2000, two initial scoping meetings were held, one in Imperial Beach and one in Chula Vista, to receive input from the public on issues related to the South San Diego Bay and Sweetwater Marsh Units. Due to the public's level of interest in these refuges, focused public workshops were held in September 2000 and June 2001 to specifically address the issue of public use. Three additional workshops were held between November 2000 and May 2001 to receive input from the public on wildlife management and restoration proposals for these refuges. All of the public meetings were well attended with at least 40 people present at each meeting. Approximately 50 to 60 people attended those meetings related to public use.

At each workshop, the public was encouraged to provide verbal comments or to send us written comments following the workshop. A CCP web page (www.sandiegorefuges.fws.gov) was established to provide the public with specific information regarding the topics addressed at the various workshops and to present information regarding when and where to provide comments. A number of Planning Updates have also been prepared to summarize the progress of the CCP and to discuss specific issues related to the planning process. One of these updates was devoted entirely to the topic of public use. These Planning Updates have been distributed to more than 1,000 individuals and organizations representing interested members of the public, conservation organizations, hunting, fishing and boating organizations, public agencies, municipalities, special districts, Tribes, and adjoining property owners. We received more than 50 letters, emails, and phone calls related to public use between June and November 2001 and numerous other communications relevant to public uses on the Refuge were received in 2002 and 2003.

At the scoping meetings and public workshops for the CCP, the public expressed a desire to see the existing opportunities for environmental education and interpretation on the Sweetwater Marsh Unit continued. There were several recommendations to expand the current educational program. One individual suggested that opportunities for high school students be expanded. Another person recommended that additional interpretive opportunities be provided in the vicinity of Paradise Marsh and the F&G Street Marsh. Several community members commented that the Refuge's education and interpretive programs could reach a broader audience if the programs included multi-lingual outreach materials.

The draft Compatibility Determination for environmental education and interpretation on the Sweetwater Marsh Unit was circulated for public review and comment as part of the San Diego Bay National Wildlife Refuge Draft Comprehensive Conservation Plan/Environmental Impact Statement (CCP/EIS). Specifically, it was included in Appendix K of the draft CCP/EIS. The Notice of Availability for the draft CCP/EIS was published in the Federal Register on July 22, 2005 and a Planning Update announcing the availability of the draft was sent to over 1,000 individuals, agencies, non-governmental organizations, and other stakeholders. In addition, the draft CCP/EIS was provided to over 275 interested parties and made available for review on the Refuge's CCP website. Public comments were accepted through September 19, 2005. No comments related to this Compatibility Determination were received during the public comment period.

Determination:
__Use is Not Compatible

_X_ Use is Compatible with the Following Stipulations

Stipulations Necessary to Ensure Compatibility:
The following measures will be taken to ensure compatibility for environmental education and interpretation:

Prior to implementing a new environmental education program within this Refuge Unit, the various parties developing the program shall coordinate with the Refuge Manager to agree upon appropriate times of the year to conduct the program, access routes, maximum number of participants per visit, and appropriate activities to be conducted. All individuals who will be conducting these programs shall be made aware of these conditions.

The Refuge's Information and Education Specialist will review all materials and programs to ensure consistency with Refuge goals and the mission of the National Wildlife Refuge System.

"Closed Area" signs will be installed at the end of all trails leading to the edge of the bay.

Prior to installing any new interpretive elements at Paradise Marsh and F&G Street Marsh, the Refuge Manager shall review the sites to verify that no impacts to Refuge resources would occur as a result of anticipated human activity around the interpretive elements.

Justification:
The continuation and expansion of environmental education and interpretation uses on the Sweetwater Marsh Unit would not adversely affect the Refuge's wildlife or its habitat. In addition, as the public engages in these types of activities on the Refuge, many will go away with a greater understanding of the importance of protecting native habitats and their associated wildlife species. The overall benefits of facilitating these uses would support the purposes of the Refuge by improving opportunities for managing, conserving, and protecting fish and wildlife resources. In the same manner, presenting the public with information about the importance of the resources supported on the Refuge without materially interfering with their daily activities supports the fulfillment the National Wildlife Refuge System

(System) mission's conservation mission. The National Wildlife Refuge System Improvement Act (the Act) states that "compatible wildlife-dependent recreation is a legitimate and appropriate general public use of the System, directly related to the mission of the System...and through which the American public can develop an appreciation for fish and wildlife..." Environmental education and interpretation are two of the six priority public uses of the System, as defined by the Act, that when found to be compatible, should be facilitated. The continuation of these programs would implement the Refuge goal of fostering a broader understanding of the value of, and need for, wildlife conservation.

Mandatory Re-Evaluation Date:
X Mandatory 15-year Re-Evaluation Date (for priority public uses)

__Mandatory 10-year Re-Evaluation Date (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision:
__Categorical Exclusion without Environmental Action Statement

__Categorical Exclusion and Environmental Action Statement

__Environmental Assessment and Finding of No Significant Impact

X Environmental Impact Statement and Record of Decision

References Cited:
DeLong, Anita and Janet Schmidt. 2000. Literature Review: Effects of Human Disturbance on Wildlife with Emphasis on Wildlife-Dependent Recreation Relevant to Stillwater National Wildlife Refuge (Draft).

Huffman, Kathy. 1999. San Diego South Bay Survey Report – Effects of Human Activity and Water Craft on Wintering Birds in the South San Diego Bay.

U.S. Fish and Wildlife Service. 1985. Salt Marsh Bird's Beak (*Cordylanthus maritimus* subsp. *maritimus*) Recovery Plan.

U.S. Fish and Wildlife Service. 2006. San Diego Bay National Wildlife Refuge (Sweetwater Marsh and South San Diego Bay Units) Final Comprehensive Conservation Plan/Environmental Impact Statement.

Refuge Determination:

Prepared by: ________________________________Date: __________

Refuge Manager/
Project Leader
Approval: ________________________________Date: __________

Concurrence:

Refuge Supervisor: ________________________________Date: __________

Assistant Manager, Refuges
California/Nevada
Operations Office: ________________________________Date: __________

Manager, California/Nevada
Operations Office: ________________________________Date:__________

Compatibility Determination
-FINAL-

Use: Mosquito Management

Refuge Name: Sweetwater Marsh Unit of the San Diego Bay National Wildlife Refuge (San Diego County, Cities of Chula Vista and National City, California)

Establishing and Acquisition Authorities:
The authorities for the establishment of the Sweetwater Marsh Unit are the Endangered Species Act of 1973, as amended (16 U.S.C. §§1531-1543); Fish and Wildlife Act of 1956, as amended (16 U.S.C. §§742a-742j, not including 742d-742l); and the Fish and Wildlife Coordination Act of 1934, as amended (16 U.S.C. §§661-667e).

Refuge Purposes:
The San Diego Bay National Wildlife Refuge (NWR) was established:

> "to protect, manage, and restore habitats for federally listed endangered and threatened species and migratory birds, and to maintain and enhance the biological diversity of native plants and animals" 16 U.S.C. § 1531-1543 (Endangered Species Act of 1973, as amended) and 70 Stat. 1119 (Fish and Wildlife Act of 1956, as amended);
>
> "…for the development, advancement, management, conservation, and protection of fish and wildlife resources...for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude..." (Fish and Wildlife Act of 1956).
>
> [This refuge] "shall be administered by him [Secretary of the Interior] directly or in accordance with cooperative agreements...and in accordance with such rules and regulations for the conservation, maintenance, and management of wildlife, resources thereof, and its habitat thereon..." (Fish and Wildlife Coordination Act of 1934).

National Wildlife Refuge System Mission:
The mission of the National Wildlife Refuge System 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" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd-668ee]).

<u>Description of Use</u>:
Mosquito management throughout the coastal refuges of San Diego County is conducted under the auspices of a Refuge Special Use Permit (SUP) in coordination with the San Diego County Department of Environmental Health, Vector Control Division. The SUP is issued annually. The primary purpose for implementing mosquito management on this Refuge is to avoid threats to public or wildlife health from specific mosquito-borne disease. Mosquito management is implemented on the Sweetwater Marsh Unit through a phased approach that emphasizes early detection and treatment, if warranted, with larvicides. The use of adulticides is to be reserved for addressing human health emergencies.

Several mosquito species are expected to occur in the vicinity of the Refuge that are capable of transmitting microbial organisms that cause human diseases such as malaria and encephalitis. The mosquitoes of major concern in California belong to the genera *Culex*, *Ochlerotatus,* and *Anopheles*. The species of greatest public health concern include *Culex tarsalis, Culex pipiens, Culex quinquefasciatus* and *Anopheles hermsi*. Of lesser importance are the salt marsh mosquitoes: *Ochlerotatus squamiger* and *Ochlerotatus taeniorhynchus*.

The closest mosquito traps to the Sweetwater Marsh Unit are located at the Otay River and Hollister Street. These traps are monitored by the County of San Diego, Department of Environmental Health, Vector Control Division. The data collected from these traps in 2003 indicates that eight species of mosquito are commonly found in the general area, however, to date, the degree to which each of these species occurs within the Sweetwater Marsh Unit has not determined. The most common species found in the Otay traps include:

Anopheles hermsi – This species, which is very commonly found in the Otay traps, is a highly competent vector of malaria, although this disease is not prevalent in this region.

Culex erythrothorax – This species, which is the most common mosquito in San Diego, is typically considered a nuisance. It is commonly found in the Otay traps and occurs in densely vegetated freshwater marshes and heavily vegetated backwater zones. It is not considered to be a major disease carrier, although its ability to potentially harbor West Nile Virus (WNV) is currently unknown.

Culex tarsalis – A highly competent vector mosquito, this species is quite common in the Otay traps. Viewed generally as a nuisance mosquito, this species can also be an effective carrier of disease.

Culiseta incidens and *Culiseta particeps* – These two species are regularly captured in the Otay traps in small to moderate numbers. Neither species is considered to be a disease vector, but can be a biting nuisance. Their ability to harbor WNV is unknown.

Ochlerotatus increpitus – Primarily a nuisance mosquito, this species, which bites during the day, is common in the Otay traps. Its ability to vector WNV is unknown.

Ochlerotatus taeniorhynchus and *Ochlerotatus squamiger* – These mosquito species are prevalent in salt marsh habitat. *Ochlerotatus taeniorhynchus* is primarily a day-biting nuisance, and neither species is currently considered to be a disease carrier; however their ability to transmit WNV is unknown.

Mosquito management on the Sweetwater Marsh Unit is addressed through an integrated pest management approach in which Refuge and County vector control officials coordinate efforts to manage the overall environmental health of adjacent communities while minimizing impacts to Refuge trust resources. County and Refuge staff work together to agree upon issues related to access, methods of operation, and timing of access, as well as to exchange information related to listed species occurrences, permitting, and relevant agency policy.

The current procedures for implementing mosquito management on this Refuge involve an annual meeting between County and Refuge staff to coordinate all necessary permitting and implementation planning required to conduct mosquito monitoring and control on the Refuge for the upcoming year. Issues such as access points and pathways to be used by County personnel, appropriate hours of operation, and requirements for field coordination are discussed, agreed upon, and incorporated into the SUP. As part of this coordination process, County vector control personnel are provided with data generated by the Refuge biologist on listed species and other trust resources. County personnel share relevant data related to mosquito and disease monitoring in the vicinity of the Refuge. In addition, periodic meetings are conducted in the field with County field staff and the Refuge biologist to further coordinate activities. These meetings are scheduled throughout the season when warranted to ensure protection of endangered and threatened migratory birds and to avoid disturbance to nesting birds.

Following the conditions included in the SUP, County vector control personnel conduct periodic mosquito larvae surveys in many discrete areas throughout the Refuge. Because the primary means of mosquito management is the use of larvicides, it is essential that larvae be observed prior to pupation so that they may be treated appropriately by the least environmentally damaging means. As a result, the frequency of larvae surveys increases throughout the mosquito breeding season. Currently, treatment areas are determined based on the season, the species and density of the mosquitoes detected, the proximity of the vectors to surrounding urban areas, and the life stage the mosquitoes are found in. Control of adult or pupal mosquitoes is not currently conducted on the Refuge.

Public concern over human health issues related to mosquito-borne disease has intensified on the west coast with the advance of WNV across the United States. To address mosquito management, a phased response strategy has been developed for implementation on refuges in the Pacific Region. This strategy encourages an integrated pest management approach that incorporates habitat and best management practices to reduce the need for and use of insecticides on refuges, while also ensuring that legitimate human, fish, and wildlife health concerns are addressed. To implement this phased response strategy, the current procedures for managing mosquitoes on this Refuge will be augmented to better identify thresholds for mosquito treatment and presents specific responses to various conditions encountered in the field. Under this new program, if mosquito population monitoring and disease surveillance (implemented by County vector control personnel) indicate that human health thresholds are exceeded, the use of larvicides, pupicides, and/or adulticides may become necessary. In some cases, emergency actions may be required that are not addressed by this Compatibility Determination.

Two larvicide compounds that could be used to manage mosquitoes on the Refuge include: Bti (*Bacillus thuringienensis israelensis*) and Altosid (methoprene). Both are larvicides intended to control mosquitoes in wetlands prior to their emergence as adults. Bti is used primarily to control early stage larvae and is available in liquid and granular formulations. Altosid is used on later stage mosquito larvae and is available in liquid, briquet and pellet formulations. Both compounds are highly specific to mosquito larvae. The use of Golden Bear 1111, which is effective at preventing adult mosquito emergence from wetlands but toxic to fish and other aquatic organisms, is not permitted within the Sweetwater Marsh Unit.

Availability of Resources:
To implement and administer mosquito management on the Sweetwater Marsh Unit, the following staffing and facilities are required:

Staffing			
Position	**Involvement**	**FTE**	**Cost**
Project Leader/Deputy Project Leader	General oversight	0.2/0.2	$25,700/$22,000
Refuge Manager	Periodic on-site oversight	0.3	$30,300
Refuge Operations Specialist	On-site oversight when necessary	0.3	$26,000
Wildlife Biologist	Monitoring, reporting, plan development, and oversight of vector control activities	0.3	$26,000
TOTAL FTES AND COSTS FOR STAFFING		1.3	$130,000

TOTAL COST FOR FACILITIES	none	$0

Adequate staff positions and financial resources are currently available and committed to implement mosquito management on the Sweetwater Marsh Unit.

Anticipated Impacts of the Use:
The purpose of this section is to critically and objectively evaluate the potential direct, indirect and cumulative effects mosquito management could have on the Refuge's endangered and threatened species and other fish and wildlife resources.

Habitat and Wildlife Disturbance: Vegetation trampling resulting from mosquito monitoring and mosquito control, as well as the possible creation of channels to drain stagnant water areas, could adversely impact native vegetation and wildlife habitat. In addition, these activities could result in disturbances to the existing wildlife that utilizes this area. At present, the marsh complex within the Refuge supports a variety of coastal wetland habitats including subtidal, intertidal mudflat, and salt marsh habitats. These wetland areas provide foraging, resting, and nesting habitat for a variety of birds, including migratory shorebirds, waterfowl, and songbirds. To minimize impacts related to disturbance, the Refuge biologist would coordinate with County vector control personnel at least annually to review appropriate conduct within these sensitive habitat areas. Specific field implementation protocols for working in sensitive habitat areas would be included in the Refuge SUP. No impacts to upland habitat are anticipated as a result of mosquito management activities.

Endangered and Threatened Species: One of the purposes for the establishment of the Sweetwater Marsh NWR is to protect Federally- listed endangered or threatened species. Human activity can have adverse impacts on endangered and threatened species, particularly when this activity disrupts bird nesting or foraging. The California least tern (*Sternula antillarum*) and California brown pelican (*Pelecanus occidentalis californicus*), both Federally-listed endangered species, forage within the main tidal channel within the Sweetwater Marsh, while the threatened western snowy plover (*Charadrius alexandrinus nivosis*) forages year round along the channel banks. The D Street Fill portion of the Refuge also supports least tern and western snowy plover nesting. Human activity within the Refuge's main marsh complex could disrupt the foraging activity of all of these species.

The Federal endangered light-footed clapper rail also occurs within Sweetwater Marsh Unit in the Refuge's salt marsh and brackish marsh habitats. Threats to the light-footed clapper rail consist primarily of direct habitat or nest losses through trampling of cordgrass or pickleweed. The State endangered Belding's savannah sparrow (*Passerculus sandwichensis beldingi*) occupies the high salt marsh vegetation throughout Sweetwater Marsh. Human intrusion into these areas could disrupt foraging activities, as well as result in direct habitat or nest losses through trampling of pickleweed. Impacts to these salt marsh species would be minimized through adherence to the field implementation protocols established for mosquito management in the Refuge SUP.

In addition to endangered and threatened bird species, the Sweetwater Marsh Unit also supports the Federally-listed endangered annual plant species, salt marsh bird's beak (*Cordylanthus maritimus maritimus*). Salt marsh bird's beak is distributed in various locations throughout the marsh, primarily in upper marsh elevations that are inundated by tides on a regular basis, but above areas that receive daily salt water flooding. Such areas are more likely to be impacted by human activity in the marsh, because they are drier than other portions of the marsh. Yearly population numbers depend directly on seed dispersal and successful plant establishment. Field observations indicate that even a moderate amount of foot traffic can damage the fragile seedlings (USFWS 1985), resulting in decreased population numbers. To reduce the potential for impacts to this species, periodic meetings would be conducted in the field with County field staff and the Refuge biologist to identify sensitive areas that should be avoided during monitoring and control activities and designate other areas that can be accessed without concern for habitat damage.

<u>Nesting Season Disturbance</u>: The nesting season varies with species but can generally be described as occurring between mid-February and mid-September. Disturbance to nesting bird species may occur if vector control personnel are present in the vicinity of avian nesting colonies or individual nests.

Several species, four of which are state and/or Federally-listed as endangered or threatened, nest within the Sweetwater Marsh Unit. As described above, the habitats present within the marsh complex support light-footed clapper rail and Belding's savannah sparrow nesting. Cordgrass stands within the marsh support clapper rail nesting, while high salt marsh vegetation supports savannah sparrow nesting. In addition, the California least tern and western snowy plover nest on the D Street Fill portion of the Refuge. To avoid impacts to nesting species, periodic meetings would be conducted in the field with County field staff and the Refuge biologist to coordinate activities and delineate sensitive nesting areas that should be avoided.

<u>Public Review and Comment</u>:

Two public scoping meetings and a series of public workshops to discuss habitat management, restoration, and public use were held in conjunction with the CCP process. To initiate the CCP process, a Notice of Intent was published in the Federal Register on June 23, 2000 (65 FR 39172). At that time, written comments were solicited. In July 2000, two initial scoping meetings were held, one in Imperial Beach and one in Chula Vista, to receive input from the public on issues related to the Sweetwater Marsh and South San Diego Bay Units. Due to the public's level of interest in these refuges, focused public workshops were held in September 2000 and June 2001 to specifically address the issue of public use. Three additional workshops were held between November 2000 and May 2001 to receive input from the public on wildlife management and restoration proposals for these refuges. All of the public meetings were well attended with at least 40 people present at each meeting.

At each workshop, the public was encouraged to provide verbal comments or to send us written comments following the workshop. A CCP web page (www.sandiegorefuges.fws.gov) was established to provide the public with specific information regarding the topics addressed at the various workshops and to present information regarding when and where to provide comments. A number of Planning Updates have also been prepared to summarize the progress of the CCP and to discuss specific issues related to the planning process. These Planning Updates have been distributed to more than 1,000 individuals and organizations representing interested members of the public, conservation organizations, hunting, fishing and boating organizations, public agencies, municipalities, special districts, Tribes, and adjoining property owners. We received more than 50 letters, emails, and phone calls related to the CCP between June and November 2001 and numerous other communications relevant to public uses on the Refuge were received in 2002 and 2003. No public comments related to mosquito management have been received to date.

The draft Compatibility Determination for mosquito management on the Sweetwater Marsh Unit was circulated for public review and comment as part of the San Diego Bay National Wildlife Refuge Draft Comprehensive Conservation Plan/Environmental Impact Statement (CCP/EIS). Specifically, it was included in Appendix K of the draft CCP/EIS. The Notice of Availability for the draft CCP/EIS was published in the Federal Register on July 22, 2005 and a Planning Update announcing the availability of the draft was sent to over 1,000 individuals, agencies, non-governmental organizations, and other stakeholders. In addition, the draft CCP/EIS was provided to over 275 interested parties and made available for review on the Refuge's CCP website. Public comments were accepted through September 19, 2005. No comments related to this Compatibility Determination were received during the public comment period.

Determination:
_Use is Not Compatible

__X__ Use is Compatible with the Following Stipulations

Stipulations:

1. The County of San Diego, Department of Environmental Health, Vector Control Division shall operate on Refuge lands under the terms and conditions outlined in a USFWS Refuge Special Use Permit, which shall be reviewed annually.

2. Special Use Permit conditions will stipulate that all control work will be carried out in conformance with pre-approved USFWS Pesticide Use Proposals, Section 7 Endangered Species Act consultations, and existing and future USFWS policies on mosquito management.

<u>Justification</u>:
Mosquito management would be implemented on this Refuge in accordance with the guidance provided for the Pacific Region by the Regional Office in March 2003. This guidance for mosquito management incorporates a phased-response strategy developed to manage mosquitoes in a manner that is compatible with refuge purposes and uses the best available science while minimizing impacts to fish and wildlife, which is consistent with the mission of the National Wildlife Refuge System. Mosquito management proposed for this Refuge would also address legitimate human, fish, and wildlife health concerns. Implementing mosquito control in accordance with the stipulations presented above would therefore not materially interfere with the ability to achieve the wildlife management goals established for this Refuge.

<u>NEPA Compliance for Refuge Use Decision</u>:
__Categorical Exclusion without Environmental Action Statement

__Categorical Exclusion and Environmental Action Statement

__Environmental Assessment and Finding of No Significant Impact

_X_ Environmental Impact Statement and Record of Decision

References Cited:
U.S. Fish and Wildlife Service. 1985. Light-footed Clapper Rail Recovery Plan.

U.S. Fish and Wildlife Service. 2006. San Diego Bay National Wildlife Refuge (Sweetwater Marsh and South San Diego Bay Units) Final Comprehensive Conservation Plan/Environmental Impact Statement.

<u>Refuge Determination</u>:

Prepared by: ________________________________Date: __________

Refuge Manager/
Project Leader
Approval: ________________________________Date: __________

<u>Concurrence</u>:

Refuge Supervisor: ______________________________Date: _________

Assistant Manager, Refuges
California/Nevada
Operations Office: ______________________________Date: _________

Manager, California/Nevada
Operations Office: ______________________________Date:_________

Compatibility Determination
-FINAL-

Use: Recreational Fishing

Refuge Name: Sweetwater Marsh Unit of the San Diego Bay National Wildlife Refuge (San Diego County, Cities of Chula Vista and National City, California)

Establishing and Acquisition Authorities:
The authorities for the establishment of the Sweetwater Marsh Unit of the San Diego Bay National Wildlife Refuge (NWR) are the Endangered Species Act of 1973, as amended (16 U.S.C. §§1531-1543); Fish and Wildlife Act of 1956, as amended (16 U.S.C. §§742a-742j, not including 742d-742l); and the Fish and Wildlife Coordination Act of 1934, as amended (16 U.S.C. §§661-667e).

Refuge Purposes:
The San Diego Bay National Wildlife Refuge was established:

> "to protect, manage, and restore habitats for federally listed endangered and threatened species and migratory birds, and to maintain and enhance the biological diversity of native plants and animals" 16 U.S.C. § 1531-1543 (Endangered Species Act of 1973, as amended) and 70 Stat. 1119 (Fish and Wildlife Act of 1956, as amended);
>
> "…for the development, advancement, management, conservation, and protection of fish and wildlife resources...for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude..." (Fish and Wildlife Act of 1956).
>
> [This refuge] "shall be administered by him [Secretary of the Interior] directly or in accordance with cooperative agreements...and in accordance with such rules and regulations for the conservation, maintenance, and management of wildlife, resources thereof, and its habitat thereon..." (Fish and Wildlife Coordination Act of 1934).

National Wildlife Refuge System Mission:
The mission of the National Wildlife Refuge System 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" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd-668ee]).

Description of Use:

Recreational fishing is one of the six wildlife dependent recreational uses that should be facilitated on a Refuge when determined to be compatible with the Refuge purposes and the mission of the National Wildlife Refuge System (System). The public has expressed an interest in seeing fishing continue within the south bay, therefore, the potential for establishing a fishing program within the Sweetwater Marsh Unit was considered. As illustrated in Figure 1-3 of the Final San Diego Bay NWR Comprehensive Conservation Plan (CCP)/Environmental Impact Statement (EIS) (USFWS 2006), the areas available for fishing within the Sweetwater Marsh Unit are limited to the tidal channels that meander through the Refuge's coastal salt marsh habitat. Currently, these waters are closed to public access, including access related to fishing and boating. To facilitate shoreline fishing within the Refuge, it would be necessary to permit pedestrian access through coastal salt marsh or along the edge of the D Street Fill, as these are the primary areas of the Refuge that abut open water. Because of the sensitivity of the marsh habitat and presence of two Federally-listed endangered species within the marsh, opening the Refuge to shoreline fishing was not evaluated.

Consideration was given to permitting fishing from non-motorized boats and float tubes within the main tidal channel that extends along the south end of the D Street Fill (refer to Figure 1-3 of the Final CCP/EIS). The use of motorized vessels was not considered due to the shallow depths generally present in the tidal channel. If fishing in this area were to be implemented, it would be permitted only during daylight hours and only between mid-September and the end of January to avoid the nesting season. This proposal assumes no launching or landing of boats or float tubes within the Refuge. Existing boat ramps in National City and Chula Vista would be available to accommodate visitors.

Prior to opening the Refuge to this use, regulatory signage would have to be installed at the main tidal channel entrances to the Refuge, an information brochure describing fishing regulations and sensitive Refuge resources would have be to prepared, and a monitoring and periodic fishing line clean-up program would have to be in place. The effects of this activity on shorebird foraging and loafing would be monitored twice a month for a period of three years. If shorebird activity on the tidal mudflats that border the main tidal channels decreases as a result of the introduction of human activity in this area, measures to reduce disturbance would have to be implemented.

Availability of Resources:

To regulate fishing activities on the Sweetwater Marsh Unit, the following staffing and equipment would be required:

Staffing			
Position	**Involvement**	**FTE**	**Cost**
Project Leader/Deputy Project Leader	General oversight	0.2/0.2	$25,700/$22,000
Refuge Manager	Periodic on-site oversight	0.4	$36,400
Refuge Operations Specialist	Periodic on-site oversight, monitoring of fishing and law enforcement activities	0.5	$39,000
Wildlife Biologist	Monitoring, reporting, oversight of technician	0.5	$39,000
Biological Technician	Field data collection, assistance with monitoring, analysis, and report writing	0.5	$22,750
Outdoor Recreation Planner	Coordinate the development of a brochure describing the fishing opportunities and regulations within Sweetwater Marsh	0.4	$18,200
Information and Education Specialist	Assist in design of the brochure and the development and implementation of the fishing line clean-up program	0.2	$15,600
Law Enforcement Officer	Law enforcement	0.5	$31,200
Park Ranger	Assist in Refuge patrol, maintenance, and fishing line clean-up program	0.3	$13,000
Maintenance Worker	Install and maintain signs and buoys	0.3	$12,870
TOTAL FTES AND COSTS FOR STAFFING		4.0	$275,720

Equipment		
Type of Equipment	**Explanation of Need**	**Cost**
Patrol boat/trailer	Needed to patrol refuge waters to ensure adherence to Refuge regulations, and to monitoring fishing activity	$50,000
Signs/Boundary Buoys	Needed to delineate the Refuge boundary, post regulations, and establish closed areas	$10,000
Create and Print an Informational Brochure	Needed to provide additional information about fishing opportunities, rules and regulations, wildlife friendly conduct, etc.	$5,000
TOTAL COST FOR EQUIPMENT		$65,000

Based on the Refuge's current staffing level, adequate staff to patrol and monitor fishing activity on the Refuge is not available to support the proposed use. The coastal refuges including Sweetwater Marsh and South San Diego Bay Units and the Tijuana Slough NWR currently share one Park Ranger, a Wildlife Biologist, and a Law Enforcement Officer. Additional staff time and personnel (including a biological technician, maintenance worker, and outdoor recreation planner) would be needed to implement and monitor a fishing program on the Refuge. In addition, access to potential fishing areas for monitoring and law enforcement patrol would be difficult and time consuming. To provide adequate staff to support this use based on the current Refuge budget, the priorities within the current work program would have to be reevaluated or staffing levels and the Refuge budget would have to be increased.

Implementation of this use would also require approximately $65,000 to purchase a patrol boat and trailer, design and print an informational brochure, and produce and install signs and buoys in the area proposed for fishing. Adequate funding is available to implement periodic clean ups of the area to control trash and discarded fishing line accumulation.

Anticipated Impacts of the Use:

DeLong and Schmidt (2000) in their literature review of the effects of human disturbance on wildlife summarized the results of a number of studies related to fishing. The majority of these studies concluded that fishing activities could influence the composition, distribution, abundance, and productivity of waterbirds. Such effects include bird fatalities resulting from entanglement with fishing line, trampling of vegetation, degraded habitat due to litter accumulation, and reduced water quality due to the deposition of sewage and other chemicals. The anticipated impacts of developing a recreational fishing program for this Refuge are presented below.

Endangered and Threatened Species: Human activity associated with fishing and boating can have adverse impacts to endangered and threatened species, particularly when this activity disrupts nesting or foraging activities. The California least tern (*Sternula antillarum*) and California brown pelican (*Pelecanus occidentalis californicus*), both Federally-listed endangered species, forage within the Refuge's main tidal channel. In addition, the threatened western snowy plover (*Charadrius alexandrinus nivosis*) forages along the channel banks. Potential threats to these species from fishing include disturbance during foraging, displacement from preferred feeding areas for prolonged periods, and death from entanglement in discarded fishing line. Observations of up to several dead or dying terns entangled in one length of fishing line are not unusual within the more dense nesting colonies at the South Bay Salt Works. Similar incidents could occur here. The potential for birds to become entangled in discarded fishing line could be reduced through public outreach to discourage improper disposal of fishing line and periodic cleanup in and along the banks of the channel.

The D Street Fill also supports least tern and western snowy plover nesting. Disturbance impacts would be reduced by closing the Refuge to fishing during the nesting season, although it is likely that some unauthorized fishing activity may continue to occur during the nesting season, potentially resulting in direct impacts to nesting least terns and western snowy plovers.

The endangered light-footed clapper rail (*Rallus longirostris levipes*) occurs year-round in salt marsh and brackish marsh habitats within the Refuge. Threats to this species consist primarily of direct habitat or nest losses through trampling of cordgrass or pickleweed that could occur if fishing boats are landed along the shoreline or during clean up of trash and discarded fishing line. Although clapper rails are not as prone to reacting to the presence of humans in the vicinity of their habitat as are other species, fishing boats that remain in one area for too long could disrupt clapper rail foraging activities. Of equal concern to the health and safety of the Refuge's clapper rail population is the accumulation of discarded fishing line along the marsh's narrow channels. Rails could become entangled in the line and die. Trash accumulation resulting from fishing activity in the area could pose a similar threat in that predators such as coyotes could be attracted into clapper rail habitat.

The State endangered Belding's savannah sparrow (*Passerculus sandwichensis beldingi*) occupies the salt marsh associated vegetation throughout Sweetwater Marsh. Human disturbance in these areas could disrupt foraging activities, as well as result in direct habitat or nest losses through trampling of pickleweed. This species would also be most directly impacted by unauthorized shoreline fishing or landing of fishing boats, permitting access into the marsh. Such activity would likely result in vegetation trampling and habitat degradation.

In addition to endangered and threatened bird species, the Sweetwater Marsh Unit also supports the Federally-listed endangered annual plant species, salt marsh bird's beak (*Cordylanthus maritimus maritimus*). The salt marsh bird's beak is distributed in various locations throughout the marsh, primarily in upper marsh elevations that are inundated by tides on a regular basis, but above areas that receive daily salt water flooding. Such areas are more likely to be impacted by unauthorized pedestrian access, because they are drier than other portions of the marsh. Yearly population numbers depend directly on seed dispersal and successful plant establishment. Field observations indicate that even a moderate amount of foot traffic can damage the fragile seedlings (USFWS 1985), resulting in decreased population numbers. Therefore, unauthorized shoreline fishing or landing of fishing boats along the shoreline could result in direct impacts to this species. Fishing line cleanups could also result in impacts to this species.

<u>Sensitive Habitats</u>: Recreational fishing within the Sweetwater Marsh Unit would introduce human activity into the center of the Refuge and permit boating activity in proximity to sensitive wetland habitat, creating the potential for direct and indirect impacts to sensitive habitat. These impacts could involve trampling of vegetation, disturbance to tidal mudflats, possible damage to cordgrass habitat, and increased erosion along the shore.

<u>Migratory Birds</u>: The Sweetwater Marsh Unit provides essential habitat for avian species migrating along the Pacific Flyway. The coastal salt marsh within the Refuge, with its many interconnecting channels, provides important resting and feeding areas for many migratory birds. Common wintering and migrating birds include long-billed curlew (*Numenius americanus*), whimbrel (*Numenius phaeopus*) and willet (*Catoptrophorus semipalmatus*). The extensive mudflats that occur immediately to the west of the D Street Fill, outside the Refuge boundary, also provide important habitat for these and other migratory birds.

A study of the effects of watercraft on foraging and resting birds in San Diego Bay reported that all watercraft, including motorized boats and non-motorized boats, result in some level of disturbance to waterbirds (Huffman 1999). Observations made during the study indicate that when a boat approaches the shoreline, waterfowl located between the boat and shore and any shorebirds along the shoreline are flushed regardless of the speed of the watercraft. Huffman noted that when non-motorized vessels, including rowboats, kayaks, canoes, and longboats, came within 30 meters of the shoreline all waterfowl between the craft and the shore would flush. At the widest point, the channels within the Sweetwater Marsh are approximately 20 meters in width. Therefore, as a fishing boat moves through the channel, any birds foraging or resting on the tidal mudflats adjacent to the channel would be flushed. These birds would then be forced to move to another location in the general vicinity. Frequent disturbance to foraging and loafing shorebirds could occur depending upon the number of boats using the channel on a given day. Such disturbance would reduce an individual bird's ability to meet its energy requirements, while also causing the bird to expend energy in the process of flying away from the disturbance. If disturbance becomes to frequent, those birds that do not habituate could permanently leave the area (West et al. 2002). Increasing the intensity of boating activity in the vicinity of the mudflats immediately to the west of Gunpowder Point could also result in cumulative impacts to the migratory shorebirds that forage in proximity to the Refuge.

Huffman also documented disturbance to migratory birds as a result of pedestrian activity along the shoreline. This disturbance was greatest during low tides when pedestrians left designated accessways to explore the mudflats. This activity affected both shorebirds and waterfowl. Huffman observed that human activity along the shoreline and in the mudflats would flush all birds within a 50 to 100 meter radius. Based on these observations, it is assumed that if fishing were to be permitted along the shoreline on Refuge lands, the availability of habitat for migratory birds could be reduced. This is because the presence of anglers along the shoreline would cause most birds to avoid those habitats located as much as 100 meters away from the fishermen.

Migratory birds could also experience injury or death as a result of discarded fishing line. Once a bird becomes entangled in fishing line, it generally dies. Many bird deaths have been attributed to fishing line entanglement within the south bay.

<u>Nesting Season Disturbance</u>: The nesting season varies with individual species, but can generally be described as occurring between mid-February and mid-September. Nesting occurs within the Refuge's salt marsh habitat, as well as on D Street Fill. Several ground nesting avian species utilize the bare areas of the D Street Fill including the endangered California least tern and the threatened western snowy plover. Forster's terns (*Sterna forsteri*) also periodically nest in this area. Nesting activity on D Street Fill generally occurs from mid-April through mid-September.

Disturbance to nesting bird species may occur if persons are present in the vicinity of avian nesting colonies or individual nests. Biologists performing nesting surveys on the South San Diego Bay Unit report that nesting seabirds responded to human activity occurring at some distance from the colony. Similar disturbance patterns would be expected at D Street Fill. In general, avian responses to disturbance can include flocking, alarm calling, nest abandonment, colony abandonment, and inter-colony antagonistic behaviors leading to crushed eggs and killed chicks. Predatory species, particularly avian species such as northern harrier, ravens, and crow, may also use disturbance episodes to depredate eggs and chicks while the adults are flocking or otherwise distracted. Disturbance to nesting birds from activities associated with fishing and boating can occur in several ways: disturbance from vessels located too close to the shoreline and disturbance from human encroachment into nesting areas when watercraft are landed along the shore. Human disturbance near nesting grounds has been identified as a primary limiting factor for seabird reproductive productivity in nesting areas with urban interfaces. By closing the Refuge to fishing during the nesting season, such impacts could be reduced. However, occasional monitoring and enforcement actions would likely be required during the closure, which could result in disturbance to nesting birds.

The Federal endangered light-footed clapper rail and State endangered Belding's savannah sparrow nest in Refuge's salt marsh vegetation, which abuts the main tidal channel. Nesting generally occurs from mid-February to mid-September. The primary threats to nesting these species from recreational fishing would occur if unauthorized fishing occurs from the shoreline or fishing boats are landed and fishermen enter sensitive nesting habitat along the edges of the marsh. As described above, such impacts could be minimized, although probably not avoided, by closing the Refuge to fishing during the nesting season. Clapper rail chicks could also be directly or indirectly impacted by the accumulation of trash and discarded fishing line in the marsh.

<u>Public Review and Comment</u>:
Recreational fishing has been discussed on several occasions at public workshops held in conjunction with the CCP process. To initiate this process, a Notice of Intent was published in the Federal Register on June 23, 2000 (65 FR 39172). At that time, written comments were solicited. In July 2000, two initial scoping meetings were held, one in Imperial Beach and one in Chula Vista, to receive input from the public on issues related to the San Diego Bay NWR. Due to the public's level of interest in these refuges, focused public workshops were held in September 2000 and June 2001 to specifically address the issue of public use. Three additional workshops were held between November 2000 and May 2001 to receive input from the public on wildlife management and restoration proposals for these refuges. All of the public meetings were well attended with at least 40 people present at each meeting. Approximately 50 to 60 people attended those meetings related to public use.

At each workshop, the public was encouraged to provide verbal comments or to send us written comments following the workshop. A CCP web page (www.sandiegorefuges.fws.gov) was established to provide the public with specific information regarding the topics addressed at the various workshops and to present information regarding when and where to provide comments. A number of Planning Updates have also been prepared to summarize the progress of the CCP and to discuss specific issues related to the planning process. One of these updates was devoted entirely to the topic of public use. These Planning Updates have been distributed to more than 1,000 individuals and organizations representing interested members of the public, conservation organizations, hunting, fishing and boating organizations, public agencies, municipalities, special districts, Tribes, and adjoining property owners. We received more than 50 letters, emails, and phone calls related to public use between June and November 2001 and numerous other communications relevant to public uses on the Refuge were received in 2002 and 2003.

The public provided a range of written and verbal comments related to fishing. These comments included requests to permit fishing within the Sweetwater Marsh and South San Diego Bay Units and to manage the refuge ecosystems for fish, prohibit fishing within both refuges, permit the use of low power motorized boats to accommodate fishing, and clearly define fishing and non-fishing areas if fishing is permitted on each refuge. Although most comments related to fishing from boats, there was a request to provide access along the shoreline to accommodate fishing for non-boat owners. Several individuals also expressed concerns regarding the adverse affects that discarded fishing line can have on seabirds.

The draft Compatibility Determination for recreational fishing on the Sweetwater Marsh Unit was circulated for public review and comment as part of the San Diego Bay National Wildlife Refuge draft CCP/EIS. Specifically, it was included in Appendix K of the draft CCP/EIS. The Notice of Availability for the draft CCP/EIS was published in the Federal Register on July 22, 2005 and a Planning Update announcing the availability of the draft was sent to over 1,000 individuals, agencies, non-governmental organizations, and other stakeholders. In addition, the draft CCP/EIS was provided to over 275 interested parties and made available for review on the Refuge's CCP website. Public comments were accepted through September 19, 2005. No comments related to this Compatibility Determination were received during the public comment period.

Determination:
X Use is Not Compatible

__ Use is Compatible with the Following Stipulations

Justification:
The salt marsh complex within the Sweetwater Marsh Unit is the largest remaining coastal salt marsh within San Diego Bay, and as such it provides regionally significant habitat for

numerous migratory shorebirds. Further, this is one of only a few places in San Diego County that provides suitable habitat for the Federally-listed endangered light-footed clapper rail. It is for these reasons that the Sweetwater Marsh Unit was established. The Refuge purposes include conserving fish and wildlife which are Federally-listed as endangered or threatened species and managing, conserving, and protecting fish and wildlife resources.

After evaluating the anticipated impacts of implementing a recreational fishing program on the Sweetwater Marsh Unit, the Refuge Manager has determined that opening a portion of the Refuge to recreational fishing would materially interfere with one of the primary Refuge purposes, “to conserve endangered and threatened species.” The only areas available within the Refuge for fishing are the relatively narrow channels that flow through the existing coastal marsh habitat. The edges of these marsh channels provide important foraging and resting habitat for migratory birds and several listed species, including the light-footed clapper rail, one of the rarest avian species in California, and the western snowy plover. If fishing were permitted in these channels, direct and indirect impacts to clapper rails and their habitat could occur, which would be in direct conflict with Refuge’s current endangered species management efforts. In addition to potential impacts to listed species, introducing this use into the center of the Refuge would result in disturbance impacts to migratory birds potentially displacing those shorebirds and seabirds that forage along the main tidal channel within the marsh. These effects would materially interfere with the mission of the National Wildlife Refuge System.

Due to the sensitivity of the area available to accommodate the recreational fishing on this Refuge, it is not possible to facilitate a recreational fishing program and still achieve the Refuge’s endangered species and coastal wetland protection goals. In addition, to implement this proposal would require the identification of additional funds to cover the cost of materials and staff to monitor this activity. The reallocation of staffing priorities to implement this use would necessarily interfere with the Refuge’s ability to implement wildlife dependent recreational uses such as environmental education and interpretation that are currently occurring on the Refuge. The affects of implementing this proposal would therefore be contrary to the Refuge goal of providing opportunities for wildlife-dependent recreational uses that are compatible with refuge purposes and foster a broader understanding the value of, and need for, wildlife conservation.

NEPA Compliance for Refuge Use Decision:

__ Categorical Exclusion without Environmental Action Statement

__ Categorical Exclusion and Environmental Action Statement

__ Environmental Assessment and Finding of No Significant Impact

X Environmental Impact Statement and Record of Decision

References Cited:

DeLong, Anita and Janet Schmidt. 2000. Literature Review: Effects of Human Disturbance on Wildlife with Emphasis on Wildlife-Dependent Recreation Relevant to Stillwater National Wildlife Refuge (Draft).

Huffman, Kathy. 1999. San Diego South Bay Survey Report – Effects of Human Activity and Water Craft on Wintering Birds in the South San Diego Bay.

U.S. Fish and Wildlife Service. 1985. Salt Marsh Bird's Beak (*Cordylanthus maritimus maritimus*) Recovery Plan.

U.S. Fish and Wildlife Service. 2006. San Diego Bay National Wildlife Refuge (Sweetwater Marsh and South San Diego Bay Units) Final Comprehensive Conservation Plan/Environmental Impact Statement.

West, A. D., J. D. Goss-Custard, R. A. Stillman, R. W. G. Caldow, S. E. A. le V. dit Durell and S. McGrorty. 2002. Predicting the impacts of disturbance on shorebird mortality using a behaviour-based model. Biological Conservation 106:319-328.

Refuge Determination:

Prepared by: ______________________________ Date: _________

Refuge Manager/
Project Leader
Approval: ______________________________ Date: _________

Concurrence:

Refuge Supervisor: ______________________________ Date: _________

Assistant Manager, Refuges
California/Nevada
Operations Office: ______________________________ Date: _________

Manager, California/Nevada
Operations Office: ______________________________ Date:_________

Compatibility Determination
-FINAL-

Use: Interpretive Water Trail (Recreational Boating)

Refuge Name: Sweetwater Marsh Unit of the San Diego Bay National Wildlife Refuge (San Diego County, Cities of Chula Vista and National City, California)

Establishing and Acquisition Authorities:
The authorities for the establishment of the Sweetwater Marsh Unit are the Endangered Species Act of 1973, as amended (16 U.S.C. §§1531-1543); Fish and Wildlife Act of 1956, as amended (16 U.S.C. §§742a-742j, not including 742d-742l); and the Fish and Wildlife Coordination Act of 1934, as amended (16 U.S.C. §§661-667e).

Refuge Purposes:
The San Diego Bay National Wildlife Refuge (NWR) was established:

> "to protect, manage, and restore habitats for federally listed endangered and threatened species and migratory birds, and to maintain and enhance the biological diversity of native plants and animals" 16 U.S.C. § 1531-1543 (Endangered Species Act of 1973, as amended) and 70 Stat. 1119 (Fish and Wildlife Act of 1956, as amended);
>
> "…for the development, advancement, management, conservation, and protection of fish and wildlife resources...for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude..." (Fish and Wildlife Act of 1956).
>
> [This refuge] "shall be administered by him [Secretary of the Interior] directly or in accordance with cooperative agreements...and in accordance with such rules and regulations for the conservation, maintenance, and management of wildlife, resources thereof, and its habitat thereon..." (Fish and Wildlife Coordination Act of 1934).

National Wildlife Refuge System Mission:
The mission of the National Wildlife Refuge System 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" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd-668ee]).

Description of Use:
Currently the waters of the Sweetwater Marsh Unit are closed to public access including any form of boating. During the September 2000 public workshop for the Sweetwater Marsh and South San Diego Bay Units of the San Diego Bay NWR Comprehensive Conservation Plan (CCP), the public expressed a desire to see an interpretive water trail developed through the Sweetwater Marsh for kayaks and canoes. As a result, such a proposal was considered during the development of alternatives for the CCP. Water trails and boating are not identified as wildlife dependent recreational uses, however, these uses would facilitate wildlife observation and photography and environmental interpretation, three of the six priority public uses that should be facilitated on a Refuge when determined to be compatible with the purpose of the Refuge and the mission of the System.

The development of an interpretive water trail on this Refuge would require that a portion of tidal channels within the Refuge be opened to boating. Due to the limited width and depth of the water channels within Sweetwater Marsh, only non-motorized, paddle-type vessels, such as kayaks and canoes, would be permitted to use the water trail. All other types of boats would be prohibited. This analysis assumes that non-motorized vessels would only be permitted to travel along a specific designated trail route; all other water areas of the Refuge would continue to be closed to public access. The trail route, which would be illustrated on signs placed at the two water entrances to the Refuge and delineated through small buoys, water markers, and/or signs, would begin in the Sweetwater flood control channel to the south of the point where the Paradise Marsh tidal channel enters the flood control channel (refer to Figure 2-1 in the Final CCP/EIS). From here, the trail would travel south through the connector marsh to its convergence with the historic Sweetwater River channel, then the trail would turn to the west. The trail would then continue west along the old river channel to the point where the channel reenters the Bay.

It is assumed that use of the interpretive water trail would be permitted daily from sunrise to sunset, although users would be encouraged to avoid periods of low tide when the water levels would be too shallow to permit easy navigation through the tidal channel. The trail would be closed during the nesting season (between mid-February through mid-September) to minimize disturbance to birds nesting on the D Street Fill. Prior to opening the Refuge to this use, regulatory signage would have to be installed at the water entrances to the Refuge and a monitoring program would have to be in place. Periodic monitoring of the effects of human activity on shorebird foraging and loafing would be necessary to ensure that no adverse effects to migratory birds were occurring.

Even if non-motorized boat use were to be permitted in the Refuge, the launching and landing of watercraft within the Refuge would be prohibited at all times. Watercraft would have to be launched from one of the existing boat launches to the north or south of the Refuge. Because this trail would travel through sensitive habitat that supports the Federal endangered light-footed clapper rail (*Rallus longirostris levipes*), as well as numerous species of shorebirds, it would likely be necessary to implement a reservation system to limit the number of boats or groups of boats traveling through the area per week. The number of disturbances that could occur within this area without adversely affecting the rails and other birds supported by the surrounding tidal mudflats and salt marsh habitat would have be determined through a monitoring program.

To implement this use, the general route of the trail would have to be delineated with buoys and/or water markers and the tidal channels branching off from the main channel would have to be marked as closed. In addition, an interpretive pamphlet or brochure would be developed that would include a map of the trail route, rules and regulations to be followed while using the trail, and a description of the reservation system and how to reserve a time to use the trail. This information would be made available at the Chula Vista Nature Center, Refuge offices within the San Diego NWR Complex, and other appropriate locations. The information would also be provided on the Complex's website.

Availability of Resources:
To implement an interpretive water trail and regulate and monitor the activities associated with the use of the trail, the following staffing and equipment would be required:

Staffing			
Position	**Involvement**	**FTE**	**Cost**
Project Leader/Deputy Project Leader	General oversight	0.2/0.2	$25,700/$22,000
Refuge Manager	Periodic on-site oversight	0.4	$36,400
Refuge Operations Specialist	Periodic on-site oversight, assist in the development of a reservation system, monitor law enforcement activities	0.5	$39,000
Wildlife Biologist	Assist in design of the trail, prepare and implement a monitoring plan to evaluate disturbance impacts, supervise bio tech	0.5	$39,000
Biological Technician	Field data collection, assistance with monitoring, analysis, and report writing	0.5	$22,750
Information and Education Specialist	Coordinate design of informational pamphlet and update website, assist in the development of a reservation system	0.3	$23,400
Outdoor Recreation Planner	Design the water trail and assist in siting of buoys and regulatory signs	0.5	$22,750
Park Ranger	Implement the reservation system, install and maintain buoys, water markers, and signs along the trail, monitor trail use	0.3	$13,000
Law Enforcement Officer	Law enforcement	0.5	$31,200
TOTAL FTES AND COSTS FOR STAFFING		3.9	$275,200

Equipment		
Type of Equipment	**Explanation of Need**	**Cost**
Buoys, water trail markers, and signs	Buoys or water trail markers are needed to mark the alignment of the water trail; signs would illustrate the trail route, inform uses of closed areas, and provide general information about rules and regulations	$20,000
Patrol Boat/Trailer	Needed to patrol refuge waters for enforcement of Refuge regulations, monitoring, and safety related issues	$50,000
Information Pamphlet	Design, layout, and printing of an information pamphlet or brochure to illustrate the trail route, present rules and regulations, and provide interpretive information about the resources along the trail	$5,000
TOTAL COST FOR EQUIPMENT		$75,000

Refuge staff availability is critical to the implementation and administration of a seasonal interpretive water trail within the Sweetwater Marsh Unit due to the biological significance of the area in which the use is proposed. Based on the Refuge's current staffing level, adequate staff is not available to support the proposed use. The coastal refuges including Sweetwater Marsh and South San Diego Bay Units and the Tijuana Slough NWR currently share one Park Ranger, a Wildlife Biologist, and a Law Enforcement Officer. Additional staff time would be needed to monitor and patrol the proposed interpretive trail, requiring either a reassessment of the current work program to change priorities or an increase in current staffing levels to support the use. Implementation of this use would also require approximately $20,000 to purchase buoys, water markers, and signs needed to delineate the water trail and post closed areas and to design and print an informational pamphlet for the trail. An additional $50,000 would be required to purchase a patrol boat and trailer to facilitate patrol and monitoring of boating activity within the Refuge.

Although funding may be identified through Federal cost share grants, local or state grants, or contributions to the Refuge's Friends Group to purchase required materials, the lack of adequate staffing to implement the program could only be resolved through an increase in the current Refuge budget.

The proposal to open a portion of the Refuge waters to accommodate an interpretive water trail would not require any funds to develop boat ramps or other boating-related facilities as they would not be constructed within the Refuge. Adequate accommodations for such facilities are provided just outside the Refuge boundary in Chula Vista and Coronado.

Anticipated Impacts of the Use:
The effects of human disturbance on waterfowl and wintering birds have been the subject of numerous studies (DeLong and Schmidt 2000). These studies indicate that the degree of disturbance varies depending upon the use (Korschgen and Dahlgren 1992) and that boating activity can cause foraging and loafing shorebirds to flush if the activity occurs too close to the shoreline (Huffman 1999). The potential affects of introducing human activity into the marsh to accommodate an interpretive water trail are summarized below.

<u>Migratory Birds</u>: The Sweetwater Marsh Unit provides important habitat for avian species migrating along the Pacific Flyway. The Refuge's coastal salt marsh, with its many interconnecting channels and adjacent tidal mudflats, provide important foraging and resting areas for many wintering and migrating shorebirds and waterfowl. Some of the most common of these species include the long-billed curlew (*Numenius americanus*), whimbrel (*Numenius phaeopus*) and willet (*Catoptrophorus semipalmatus*).

In an effort to characterize species richness, relative abundance, and spatial distribution of the waterbird community in central and south San Diego Bay, waterbird surveys were conducted in South San Diego Bay between April 15, 1993 and April 14, 1994 (USFWS 1995). According to the report, "a mean of 6,981 birds were observed each visit during peak winter months (November through February)." In describing the locations of waterbird occurrences throughout central and south San Diego Bay, the report states that, "areas with relatively low water recreational intensity supported a greater abundance of waterbirds."

Between January and March 1998, a study was conducted to observe the effects of watercraft on wintering birds in the southern end of San Diego Bay (Huffman 1999). The study, which was prepared for the Fish and Wildlife Service, was designed to observe and record the effects of human disturbance, particularly disturbances related to watercraft, on wintering birds in the bay. During the study, Huffman observed that operating any watercraft, including motorized boats, non-motorized boats, jet skis, wind surfers, and parasails, within the Bay resulted in some level of disturbance to waterbirds. The degree of disturbance depended upon the vessel's speed, proximity to rafting birds, proximity to the shoreline, and amount of noise produced during operation. Of all the types of watercraft used in the bay, Huffman observed that powerboats resulted in the greatest disturbances to the avian community. Huffman also noted that disturbance to birds was greatly reduced when boats traveled at the posted "No Wake" speed (5 mph).

Other observations made by Huffman included the effect that watercraft had on shorebirds foraging along the edge of the bay. Huffman reports that in cases in which motorized watercraft were within 100 meters off the shore, all waterfowl between the boat and shore and any shorebirds along the shoreline would flush regardless of the speed of the watercraft. Similarly, when non-motorized vessels, including kayaks, canoes, and longboats, came within 30 meters of the shoreline all waterfowl between the craft and the shore would flush to another portion of the bay. The approximate width of the tidal channels that would be included within the water trail route is 20 meters, therefore, based on the results of Huffman's observations; frequent disturbance to foraging and loafing shorebirds would be expected as a result of the proposed boating. Such disturbance can reduce an individual bird's ability to meet its energy requirements by causing the bird to expend energy in the process of flying away from the disturbance. If disturbance becomes to frequent, those birds that do not habituate could permanently leave the area (West et al. 2002). Increasing the intensity of boating activity in the vicinity of the mudflats immediately to the west of Gunpowder Point could also result in cumulative impacts to the migratory shorebirds that forage in proximity to the Refuge.

<u>Endangered and Threatened Species</u>: One of the purposes for the establishment of the Sweetwater Marsh Unit is to protect Federally-listed endangered or threatened species. Human activity can have adverse impacts on endangered and threatened species, particularly when this activity disrupts bird nesting or foraging. The California least tern (*<u>Sternula</u> antillarum*) and California brown pelican (*Pelecanus occidentalis californicus*), both Federally-listed endangered species, forage within the main tidal channel within the Sweetwater Marsh, while the threatened western snowy plover (*Charadrius alexandrinus nivosis*) forages year round along the channel banks. The D Street Fill portion of the Refuge also supports least tern and western snowy plover nesting. Increasing human activity within the Refuge's main tidal channel could disrupt current foraging patterns for these species, and possibly displace these species to other less productive portions of the Refuge.

The Federal endangered light-footed clapper rail also occurs within Sweetwater Marsh Unit in the Refuge's salt marsh and brackish marsh habitats. Threats to the light-footed clapper rail consist primarily of direct habitat or nest losses through trampling of cordgrass or pickleweed. Such impacts would occur if boats were landed along the channel banks and unauthorized intrusion into the marsh was to occur. Clapper rails are also at risk because they are slower to react to the presence of humans in the vicinity of their habitat as are other bird species; therefore, they are more vulnerable to injury and death from human intrusion. The introduction of human activity along the Refuge's primary tidal channel could indirectly impact the Refuge's rail population by forcing the birds to relocate away from the main areas of disturbance. Because the main tidal channel is located near the center of the Refuge, the rails would actually be relocating closer to the edges of the Refuge where the chances for predation would be greater. The potential affects to clapper rails of introducing human activity into the marsh would be contrary to the objectives of the Light-footed Clapper Rail Recovery Plan (USFWS 1985a). Specifically, the Plan's primary objective is to increase the rail breeding population by providing adequately protected, suitably managed, secure wetland habitat. Some of the recommendations included in the Recovery Plan include protecting existing habitat, controlling human disturbance in clapper rail areas, and increasing the carrying capacity and stability of existing habitat.

The State endangered Belding's savannah sparrow (*Passerculus sandwichensis beldingi*) occupies the high salt marsh vegetation throughout Sweetwater Marsh. Human intrusion into these areas could disrupt foraging activities, as well as result in direct habitat or nest losses through trampling of pickleweed. This species would also be most directly impacted by unauthorized access into the marsh from boats that have landed on the shoreline. Such activity would likely result in vegetation trampling and habitat degradation.

In addition to endangered and threatened bird species, the Sweetwater Marsh Unit also supports the Federally-listed endangered annual plant species, salt marsh bird's beak (*Cordylanthus maritimus maritimus*). Salt marsh bird's beak is distributed in various locations throughout the marsh, primarily in upper marsh elevations that are inundated by tides on a regular basis, but above areas that receive daily salt water flooding. Such areas are more likely to be impacted by unauthorized pedestrian access, because they are drier than other portions of the marsh. Yearly population numbers depend directly on seed dispersal and successful plant establishment. Field observations indicate that even a moderate amount of foot traffic can damage the fragile seedlings (USFWS 1985b), resulting in decreased population numbers. Therefore, the unauthorized landing of boats along the edges of the marsh's main channel could result in direct impacts to this species.

<u>Nesting Season Disturbance</u>: Human disturbance to nesting birds from activities associated with watercraft can occur in several ways: disturbance from the vessel itself due to encroachment on the shoreline and disturbance from human encroachment into nesting areas when watercraft are landed along the shore. Huffman (1999) observed bird flushing when motorized watercraft came within 100 meters of the shoreline and non-motorized vessels came within 30 meters of the shoreline. Similar effects to nesting seabirds would be expected. When a kayaker landed along the shore of the Chula Vista Wildlife Reserve, a habitat mitigation area created by the Unified Port of San Diego that is located just to the north of the salt works in the southern end of San Diego Bay, Huffman noted that the remaining shorebirds and other upland birds in the area flushed. Such human disturbance on the nesting grounds has been identified as a primary limiting factor for seabird reproductive productivity in nesting areas with urban interfaces.

Disturbance to nesting migratory bird species may occur if a watercraft is present in the vicinity of a nesting colony or individual nests. Several species, many of which are rare, sensitive or state and/or Federally-listed, nest on the relatively bare ground at D Street Fill, as well as in vegetated habitats within Sweetwater Marsh. The Belding's savannah sparrow nests in salt marsh associated vegetation throughout Sweetwater Marsh, while the endangered California least tern and threatened western snowy plover nest at D Street Fill. Biologists performing nesting surveys at the salt works on the South San Diego Bay Unit report that seabird colonies will respond to pedestrian traffic. These responses vary with date, nature of disturbance and other unknown factors. Avian responses to disturbance can include flocking, alarm calling, nest abandonment, colony abandonment and inter-colony antagonistic behaviors leading to crushed eggs and killed chicks. Predatory species, particularly avian predators such as northern harrier, common raven, American crow, and some gull species, may also use disturbance episodes to depredate eggs and chicks while the adults are flocking or otherwise distracted. Closing the water trail during the nesting season would reduce these types of disturbance impacts, however, enforcement of the nesting season closure could be difficult once the public becomes accustom to the trail being open during much of the year. Opening the water trail only to those with a reservation could help in the process of informing the public about when and how the proposed trail can be used.

Public Review and Comment:
The development of water trails to facilitate wildlife dependent recreational uses was discussed on several occasions at public workshops held in conjunction with the Comprehensive Conservation Plan (CCP) process. To initiate the CCP process, a Notice of Intent was published in the Federal Register on June 23, 2000 (65 FR 39172). At that time, written comments were solicited. In July 2000, two initial scoping meetings were held, one in Imperial Beach and one in Chula Vista, to receive input from the public on issues related to the Sweetwater Marsh and South San Diego Bay Units. Due to the public's level of interest in these refuges, focused public workshops were held in September 2000 and June 2001 to specifically address the issue of public use. Three additional workshops were held between November 2000 and May 2001 to receive input from the public on wildlife management and restoration proposals for these refuges. All of the public meetings were well attended with at least 40 people present at each meeting. Approximately 50 to 60 people attended those meetings related to public use.

At each workshop, the public was encouraged to provide verbal comments or to send us written comments following the workshop. A CCP web page (www.sandiegorefuges.fws.gov) was established to provide the public with specific information regarding the topics addressed at the various workshops and to present information regarding when and where to provide comments. A number of Planning Updates have also been prepared to summarize the progress of the CCP and to discuss specific issues related to the planning process. One of these updates was devoted entirely to the topic of public use. These Planning Updates have been distributed to more than 1,000 individuals and organizations representing interested members of the public, conservation organizations, hunting, fishing and boating organizations, public agencies, municipalities, special districts, Tribes, and adjoining property owners. We received more than 50 letters, emails, and phone calls related to public use between June and November 2001 and numerous other communications relevant to public uses on the Refuge were received in 2002 and 2003.
The draft Compatibility Determination for a water trail through the Sweetwater Marsh Unit was circulated for public review and comment as part of the San Diego Bay National

Wildlife Refuge Draft Comprehensive Conservation Plan/Environmental Impact Statement (CCP/EIS). Specifically, it was included in Appendix K of the draft CCP/EIS. The Notice of Availability for the draft CCP/EIS was published in the Federal Register on July 22, 2005 and a Planning Update announcing the availability of the draft was sent to over 1,000 individuals, agencies, non-governmental organizations, and other stakeholders. In addition, the draft CCP/EIS was provided to over 275 interested parties and made available for review on the Refuge's CCP website. Public comments were accepted through September 19, 2005. No comments related to this Compatibility Determination were received during the public comment period.

Determination:
X Use is Not Compatible

__ Use is Compatible with the Following Stipulations

Justification:
After evaluating the anticipated impacts of implementing an interpretive water trail on the Sweetwater Marsh Unit, the Refuge Manager has determined that allowing this use would materially interfere with one of the primary purposes of this Refuge, which is "to conserve endangered and threatened species." The introduction of human activity within the main portion of the marsh would impede the foraging and nesting activities of the light-footed clapper rail and could potentially disrupt foraging activity of the western snowy plover. The proposed activity would also result in frequent disturbance to shorebirds that forage and rest on the tidal mudflats along the main tidal channel in the marsh. These impacts would be contrary to the wildlife conservation mission of the National Wildlife Refuge System. The affects of implementing this proposal would therefore be contrary to the Refuge goal of providing opportunities for wildlife-dependent recreational uses that are compatible with refuge purposes and foster a broader understanding the value of, and need for, wildlife conservation.

NEPA Compliance for Refuge Use Decision:
__ Categorical Exclusion without Environmental Action Statement

__ Categorical Exclusion and Environmental Action Statement

__ Environmental Assessment and Finding of No Significant Impact

X Environmental Impact Statement and Record of Decision

References Cited:

DeLong, Anita and Janet Schmidt. 2000. Literature Review: Effects of Human Disturbance on Wildlife with Emphasis on Wildlife-Dependent Recreation Relevant to Stillwater National Wildlife Refuge (Draft).

Huffman, Kathy. 1999. San Diego South Bay Survey Report – Effects of Human Activity and Water Craft on Wintering Birds in the South San Diego Bay.

Korschgen, Carl and Robert Dahlgren. 1992. Human Disturbances of Waterfowl: Causes, Effects, and Management.

U.S. Fish and Wildlife Service. 1985a. Light-footed Clapper Rail Recovery Plan.

U.S. Fish and Wildlife Service. 1985b. Salt Marsh Bird's Beak (*Cordylanthus maritimus* subsp. *maritimus*) Recovery Plan.

U. S. Fish and Wildlife Service. 1995. Waterbirds of Central and South San Diego Bay 1993-1994.

U.S. Fish and Wildlife Service. 2006. San Diego Bay National Wildlife Refuge (Sweetwater Marsh and South San Diego Bay Units) Final Comprehensive Conservation Plan/Environmental Impact Statement.

West, A. D., J. D. Goss-Custard, R. A. Stillman, R. W. G. Caldow, S. E. A. le V. dit Durell and S. McGrorty. 2002. Predicting the impacts of disturbance on shorebird mortality using a behaviour-based model. Biological Conservation 106:319-328.

Refuge Determination:

Prepared by: ______________________________Date: _________

Refuge Manager/
Project Leader
Approval: ______________________________Date: _________

Concurrence:

Refuge Supervisor: ______________________________Date: _________

Assistant Manager, Refuges
California/Nevada
Operations Office: ______________________________Date: _________

Manager, California/Nevada
Operations Office: ______________________________Date:_________

Compatibility Determination
-FINAL-

Use: Wildlife Observation and Photography

Refuge Name: South San Diego Bay Unit of the San Diego Bay National Wildlife Refuge (San Diego County, Cities of Coronado, Chula Vista, Imperial Beach, National City, and San Diego, California)

Establishing and Acquisition Authorities:
The authorities for the establishment of the San Diego National Wildlife Refuge are the Fish and Wildlife Act of 1956, as amended (16 U.S.C. 742a-742j, not including 742d-742l), and the Endangered Species Act of 1973, as amended (16 U.S.C. 1531-1543).

Refuge Purposes:
The San Diego Bay National Wildlife Refuge was established:

> "to protect, manage, and restore habitats for federally listed endangered and threatened species and migratory birds, and to maintain and enhance the biological diversity of native plants and animals" 16 U.S.C. § 1531-1543 (Endangered Species Act of 1973, as amended) and 70 Stat. 1119 (Fish and Wildlife Act of 1956, as amended);

> "…for the development, advancement, management, conservation, and protection of fish and wildlife resources...for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude..." (Fish and Wildlife Act of 1956).

> [This refuge] "shall be administered by him [Secretary of the Interior] directly or in accordance with cooperative agreements...and in accordance with such rules and regulations for the conservation, maintenance, and management of wildlife, resources thereof, and its habitat thereon..." (Fish and Wildlife Coordination Act of 1934).

National Wildlife Refuge System Mission:
The mission of the National Wildlife Refuge System 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" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd-668ee]).

Descriptions of Use:
At present, the primary opportunities for wildlife observation and photography from within the Refuge boundary are available via watercraft in the open waters of the Refuge or immediately adjacent to the Refuge along the Bayshore Bikeway. Opportunities for the public to observe wildlife from within the salt works are also available via guided tours.

At the scoping meetings for the Comprehensive Conservation Plan (CCP), as well as at subsequent public use workshops held in September 2000 and June 2001, the public expressed an interest in expanding opportunities for wildlife observation and photography within the South San Diego Bay Unit. As described in the Public Use Program discussion in Section 2.3.2.4 of the Final CCP/Environmental Impact Statement (EIS) for the South San Diego Bay Unit (USFWS 2006), the CCP includes several proposals for expanding opportunities for these uses including:

1. Increasing the number of guided tours provided of the salt works between mid-September and early February of each year to about two per month;

2. Establishing observation points on the north side of the Bayshore Bikeway: at the northern terminus of 10th Street, at the northern terminus of 8th Street, and in the vicinity of Florida Street in Imperial Beach. From these areas, the wildlife activities occurring in the river channel and Ponds 22, 23, and 10 can be observed (refer to Figure 2-14 of the Final CCP/EIS);and

3. Establishing an observation area along the eastern edge of Pond 29 in the City of Chula Vista, where views of the northeastern pond system could be provided (refer to Figure 2-14 of the Final CCP/EIS).

An elevated platform was also proposed near 13th Street in the draft CD, however, upon further analysis, it was determined that this structure was not needed to achieve the goals for wildlife observation and photography. The existing elevations to the north of the bikeway in the vicinity of Florida Street are high enough to allow for observations of avian activities within the salt ponds without the need for an elevated platform. As a result, the elevated platform has been replaced with a proposal to construct an overlook area on a knoll to the north of the Bayshore Bikeway and the northeast of the terminus of Florida Street.

The observation areas proposed around the perimeter of the Refuge would be accessible from the Bayshore Bikeway and several public streets in northern Imperial Beach. A parking area that serves users of the Bayshore Bikeway is available at the northern terminus of 13th Street and on-street parking is available along Florence Street, 8th Street, and Boulevard Avenue. The City of Imperial Beach also proposes to construct a new parking area at the terminus of 10th Street. Based on preliminary concepts for the observation areas, the design would be relatively informal, consisting of a leveled area with a hardened surface of stabilized soil or decomposed granite. A post and cable fence or other appropriate barrier would be provided at the northern edge of the observation areas to minimize disturbance to adjacent vegetation. These observation areas would also include interpretive elements as described in the Compatibility Determination for environmental education and interpretation for this Unit.

A reservation system would be established in association with the expansion of the salt works guided tour program, as these tours would be limited to approximately 15 people per tour. About two tours per month would be conducted between mid-September and mid-February. No tours would be provided during the breeding season to avoid disturbance to nesting birds.

Availability of Resources:
To implement and administer opportunities for wildlife observation and photography, the following staffing and materials/facilities would be required:

Staffing			
Position	**Involvement**	**FTE**	**Cost**
Project Leader/Deputy Project Leader	General oversight	0.2/0.2	$25,700/$22,000
Refuge Manager	Periodic on-site oversight	0.3	$27,300
Refuge Operations Specialist	Periodic on-site oversight, monitoring of law enforcement activities	0.4	$31,200
Wildlife Biologist	Monitoring, reporting, assistance in the design and siting of overlook areas and oversight in their implementation, oversight of bio tech; assist in conducting tours	0.5	$39,000
Biological Technician	Field data collection, assistance with analysis and report writing	0.3	$22,750
Information and Education Specialist	Assist in the development, design, and coordination of the step-down wildlife observation plan and develop and assist with the guided tour program	0.3	$23,400
Law Enforcement Officer	Law enforcement	0.3	$20,800
Park Ranger	Facilities maintenance; take reservations for and assist in conducting guided tours	0.4	$15,600
TOTAL FTES AND COSTS FOR STAFFING		2.9	$227,750

Facilities		
Material/Facility Required	**Explanation of Need**	**Cost**
Step-down Plan	Needed to develop construction plans and specifications for observation areas and to describe and provide cost estimates for necessary amenities (i.e. benches, signage, fencing, viewing scopes, etc.)	$35,000
Observation Areas (with benches/fencing, scopes)	Level sites with surfaces prepared to meet accessibility standards; amenities to aid in observing wildlife	$70,000
Regulatory signage and fencing	Signs and appropriate fencing are required to delineate areas open to public access and those that are closed	$30,000
8 – 10 passenger van	An accessible van with good visibility needed to accommodate seasonal guide tours	$45,000
TOTAL COST FOR FACILITIES		$180,000

The current Refuge budget is not adequate to fund all of the wildlife observation proposals included in the CCP, therefore, additional funding must be identified before these proposals can be implemented. It is possible to implement these proposals in phases as funding sources are identified. Potential sources for funding include Federal cost share grants, interagency partnerships, state and private grants, and contributions from Friends groups.

Increasing the number of guided tours conducted on the salt works could be facilitated through the Refuge's current partnership with the City of Chula Vista's Nature Center. Additional funding, estimated at approximately $45,000, would be needed to acquire an additional van for the Refuge Complex and another $35,000 would be required to prepare the step-down wildlife observation plan and specific construction plans. The actual cost of developing the observation areas cannot be determined until more specific plans are development.

Anticipated Impacts of the Use:
A number of studies have been conducted to evaluate the effects of wildlife observation and photography on wildlife. The studies are summarized in a literature review prepared for the Stillwater National Wildlife Refuge (DeLong and Schmidt 2000). In summarizing the findings of these studies, DeLong and Schmidt state that wildlife observation and photography can "negatively impact wildlife by altering wildlife behavior, reproduction, distribution, and habitat." In addition, these studies show that birds frequently approached by humans may reduce foraging times in the area or avoid the area entirely. Huffman (1999) in observing waterbird disturbance in South San Diego Bay documented disturbance to migratory birds as a result of pedestrian activity along the shoreline. This disturbance was greatest during low tides when pedestrians left designated accessways to explore the mudflats. This activity affected both shorebirds and waterfowl. Huffman observed that

human activity along the shoreline and in the mudflats would flush all birds within a 50 to 100 meter radius.

To reduce the potential for disturbance to wildlife, the majority of the new opportunities for wildlife observation and wildlife photography on the South San Diego Bay Unit would be provided along the perimeter of the Refuge rather than dispersed throughout the Refuge. For a discussion of the potential impacts to Refuge resources associated with wildlife observation and photography uses conducted in bay from water vessels, refer to the Compatibility Determination for recreational boating on the South San Diego Bay Unit.

<u>Endangered and Threatened Species</u>: Human activity can have adverse impacts on endangered and threatened species, particularly when it disrupts bird nesting or foraging activities. Requests from the public to consider opening the levees around Ponds 10 and 11(refer to Figure 2-6 of the Final CCP/EIS) to public access were evaluated in the CCP/EIS, where it was determined that such access could result in disturbances to nesting tern colonies located across the river channel (refer to the discussion of Nesting Season Disturbance below), as well as disturbances to an established California brown pelican (*Pelecanus occidentalis californicus*) roosting area located on the levee separating Ponds 10 and 11. Opening these levees to public access could also adversely affect the Federally-listed endangered light-footed clapper rail (*Rallus longirostris levipes*), which has been observed within the South Bay Biological Study Area, located immediately to the north of Pond 11. Potential threats to clapper rails from human activity on these levees consist primarily of direct habitat or nest losses resulting from human intrusion in the adjacent salt marsh areas. The effects of such disturbance would become even more significant following the restoration of Ponds 10 and 11, which are proposed for restoration to support the clapper rail. Repeated intrusion into clapper rail occupied salt marsh habitat could disrupt foraging and intrusion into restored habitat could discourage the use of restored areas by this species.

No adverse effects to listed species are anticipated from the current proposals to provide wildlife observation points around the perimeter of the Refuge. In addition, closing the salt works to guided tours during the nesting season would avoid any potential impacts to the Federally-listed endangered California least tern (<u>*Sternula antillarum*</u>) or threatened western snowy plover (*Charadrius alexandrinus nivosus*).

<u>Nesting Season Disturbance</u>: The nesting season varies for each species, but can generally be described as occurring between mid-February and mid-September of a given year. Disturbance to nesting bird species may occur if persons are present in the vicinity of avian nesting colonies or individual nests. A variety of ground nesting avian species utilize the levees around the salt ponds for nesting, including colonies of Caspian terns (*Sterna caspia*), elegant terns (<u>*Thalasseus*</u> *elegans*), royal terns (*Thalasseus maximus*), gull-billed terns (<u>*Gelochelidon*</u> *nilotica vanrossemi*), Forster's terns (*Sterna forsteri*), endangered California least terns and black skimmers (*Rynchops niger*). Loud noises from activities on adjacent

areas could result in disturbances to those nesting colonies located closest to activity areas. Avian responses to disturbance can include flocking, alarm calling, nest abandonment, colony abandonment, and inter-colony antagonistic behaviors leading to crushed eggs and killed chicks. Predatory species, particularly avian predators such as northern harriers, ravens, crows, and other gulls, may also use disturbance episodes to depredate eggs and chicks while the adults are flocking or otherwise distracted by the initial source of the disturbance.

The observation areas to be located along the southern edge of the Refuge would be situated approximately 150 meters or more from known nesting sites and physically separated from these sensitive areas by the Otay River channel. As a result, activities occurring at the observation areas would not be expected to result in disturbance to nesting seabirds.

No guided tours of the salt works would be conducted during the nesting season; therefore, no nesting season disturbance from this use would occur.

<u>Sensitive Habitats</u>: Although the proposed wildlife observation sites would be located around the perimeter of the Refuge, they would still occur in proximity to sensitive wetland habitat. Therefore, to avoid disturbance related impacts to sensitive habitat, such as trampling of vegetation, observation areas would be located along existing public trails and/or in areas where topographic relief or existing or future fencing would make it difficult for the public to gain access to sensitive areas.

The potential for impacts to sensitive habitats as a result of guided tours would be negligible due to the level of supervision that would occur during such tours.

<u>Migratory Birds</u>: Proposed observation areas have been sited away from locations that support an abundance of migratory bird foraging and loafing, therefore, disturbance from human activity in the vicinity of these areas is expected to be minimal.

Disturbance and possible displacement of migratory shorebirds could occur around the salt works if guided tours result in excessive out-of-vehicle activity. According to DeLong and Schmidt (2000), Klein (1993) tested the behavioral response of waterbirds to human disturbance, including vehicular travel at Ding Darling NWR and found that as the intensity of disturbance increased, avoidance response by waterbirds tended to increase. Out-of-vehicle activity was also observed to be more disruptive than vehicular movement through the area. Although the degree of disturbance may vary for the species and local populations of waterbirds occurring within the South San Diego Bay Unit, similar differences between out-of-vehicle activity and vehicle travel related to guide tours through the salt works would be expected.

Public Review and Comment:
Wildlife observation and photography have been discussed a several occasions at public workshops held in conjunction with the Comprehensive Conservation Plan (CCP) process. To initiate the CCP process, a Notice of Intent was published in the Federal Register on June 23, 2000 (65 FR 39172). At that time, written comments were solicited. In July 2000, two initial scoping meetings were held, one in Imperial Beach and one in Chula Vista, to receive input from the public on issues related to the South San Diego Bay and Sweetwater Marsh Units. Due to the public's level of interest in these refuges, focused public workshops were held in September 2000 and June 2001 to specifically address the issue of public use. Three additional workshops were held between November 2000 and May 2001 to receive input from the public on wildlife management and restoration proposals for these refuges. All of the public meetings were well attended with at least 40 people present at each meeting. Approximately 50 to 60 people attended those meetings related to public use.

At each workshop, the public was encouraged to provide verbal comments or to send us written comments following the workshop. A CCP web page (www.sandiegorefuges.fws.gov) was established to provide the public with specific information regarding the topics addressed at the various workshops and to present information regarding when and where to provide comments. A number of Planning Updates have also been prepared to summarize the progress of the CCP and to discuss specific issues related to the planning process. One of these updates was devoted entirely to the topic of public use. These Planning Updates have been distributed to more than 1,000 individuals and organizations representing interested members of the public, conservation organizations, hunting, fishing and boating organizations, public agencies, municipalities, special districts, Tribes, and adjoining property owners. We received more than 50 letters, emails, and phone calls related to public use between June and November 2001 and numerous other communications relevant to public uses on the Refuge were received in 2002 and 2003.

During the CCP scoping meetings and public use workshops, a number of individuals expressed their desire to see the needs of the Refuge's wildlife met before any consideration is given to the provision of public uses on the Refuge. Others stated that the Refuge should be managed as a place for people as well as wildlife. With respect to wildlife observation, one individual requested that the ability to observe the sounds of wildlife on the Refuge, particularly during seabird nesting season, be preserved. The San Diego Audubon Society expressed an interest in having one or more viewing platforms provided near the salt works to permit viewing into the salt works. A number of potential observation areas were suggested, including those described above.

The draft Compatibility Determination for wildlife observation and photography on the South San Diego Bay Unit was circulated for public review and comment as part of the San Diego Bay National Wildlife Refuge Draft Comprehensive Conservation Plan/Environmental Impact Statement (CCP/EIS). Specifically, it was included in Appendix K of the draft

CCP/EIS. The Notice of Availability for the draft CCP/EIS was published in the Federal Register on July 22, 2005 and a Planning Update announcing the availability of the Draft was sent to over 1,000 individuals, agencies, non-governmental organizations, and other stakeholders. In addition, the draft CCP/EIS was provided to over 275 interested parties and made available for review on the Refuge's CCP website. Public comments were accepted through September 19, 2005. No comments related to this Compatibility Determination were received during the public comment period.

Determination:

__Use is Not Compatible

_X_ Use is Compatible with the Following Stipulations

Stipulations Necessary to Ensure Compatibility:

1. Prior to constructing any observation areas within the Refuge, a step-down wildlife observation plan that includes specific designs for the various observation areas will be developed and approved by the Refuge Manager. During the development of this plan, concepts will be reviewed with the adjacent community to receive comments and recommendations regarding its design.

2. To reduce the potential for off-trail activity on Refuge lands and waters, regulatory signage and fencing or other appropriate barriers will be installed prior to opening an observation area.

3. For three years following the completion of an observation area, monitoring shall be conducted during the nesting season to determine the effects, if any, of increased human activity at the site on nearby nesting seabirds. Additionally, weekly monitoring during peak migration periods shall also be conducted to observe any effects to bird foraging and resting behavior as a result of increases in activity at the observation site. If adverse effects are observed, additional measures shall be implemented to reduce disturbance.

4. Guided tours of the salt works shall not be conducted during the nesting season (February 15 through September 15). From February 1 to February 14 and September 16 to September 30 of each season, the Refuge Biologist shall confirm one day prior to a scheduled tour that no nesting or fledgling activity is occurring on or within 150 meters of the tour route.

5. To avoid excess disturbance during migration, the Refuge Manager shall establish guidelines for when and how often visitors on a guided tour are permitted to exit the vehicle for observation purposes.

Justification:
Expanding the opportunities for wildlife observation and photography on the South San Diego Bay Unit will enhance the public's appreciation of the wildlife resources supported within this Refuge. Although adequate funding is not currently available to implement all of the proposals, implementation can be phased over several years. As new opportunities are provided, the public's appreciation for the species and habitats found within the Refuge will increase, and in turn conditions will improve for ensuring the protection and management of the Refuge's listed species and other wildlife. This outcome is consistent with the Refuge purposes of protecting, managing, and restoring habitats for Federally-listed endangered and threatened species and migratory birds and maintaining and enhancing the biological diversity of native plants and animals. A review of the environmental consequences of implementing these uses, as provided in the Final CCP/EIS (USFWS 2006), demonstrates that these uses would not materially interfere with or detract from the fulfillment of the National Wildlife Refuge System mission, provided the stipulations to ensure compatibility are followed. Further, wildlife observation and photography are two of the six priority public uses of the System, as defined by the Act. Therefore, implementation of these programs would contribute to the fulfillment of the Refuge System mission, and the achievement of the goals established for the Refuge, particularly the goal to provide opportunities for compatible wildlife-dependent recreational uses that foster public appreciation of the unique natural and cultural heritage of South San Diego Bay.

Mandatory Re-Evaluation Date:
_X_ Mandatory 15-year Re-Evaluation Date (for priority public uses)

__ Mandatory 10-year Re-Evaluation Date (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision:
__ Categorical Exclusion without Environmental Action Statement

__ Categorical Exclusion and Environmental Action Statement

__ Environmental Assessment and Finding of No Significant Impact

_X_ Environmental Impact Statement and Record of Decision

References Cited:
DeLong, Anita and Janet Schmidt. 2000. Literature Review: Effects of Human Disturbance on Wildlife with Emphasis on Wildlife-Dependent Recreation Relevant to Stillwater National Wildlife Refuge (Draft).

Huffman, Kathy. 1999. San Diego South Bay Survey Report – Effects of Human Activity and Water Craft on Wintering Birds in the South San Diego Bay.

Klein, M. L. 1993. Waterbird Behavioral Responses to Human Disturbances. Wildlife Society Bulletin 21:31-39.

U.S. Fish and Wildlife Service. 2006. San Diego Bay National Wildlife Refuge (Sweetwater Marsh and South San Diego Bay Units) Final Comprehensive Conservation Plan/Environmental Impact Statement.

Refuge Determination:

Prepared by: ________________________________ Date: __________

Refuge Manager/ Project Leader
Approval: ________________________________ Date: __________

Concurrence:

Refuge Supervisor: ________________________________ Date: __________

Assistant Manager, Refuges
California/Nevada
Operations Office: ________________________________ Date: __________

Manager, California/Nevada
Operations Office: ________________________________ Date: __________

Compatibility Determination
-FINAL-

Use: Environmental Education and Interpretation

Refuge Name: South San Diego Bay Unit of the San Diego Bay National Wildlife Refuge

(San Diego County, Cities of Coronado, Chula Vista, Imperial Beach, National City, and San Diego, California)

Establishing and Acquisition Authorities:
The authorities for the establishment of the San Diego National Wildlife Refuge are the Fish and Wildlife Act of 1956, as amended (16 U.S.C. 742a-742j, not including 742d-742l), and the Endangered Species Act of 1973, as amended (16 U.S.C. 1531-1543).

Refuge Purposes:
The San Diego Bay National Wildlife Refuge was established:

> "to protect, manage, and restore habitats for federally listed endangered and threatened species and migratory birds, and to maintain and enhance the biological diversity of native plants and animals" 16 U.S.C. § 1531-1543 (Endangered Species Act of 1973, as amended) and 70 Stat. 1119 (Fish and Wildlife Act of 1956, as amended);
>
> "…for the development, advancement, management, conservation, and protection of fish and wildlife resources...for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude..." (Fish and Wildlife Act of 1956).
>
> [This refuge] "shall be administered by him [Secretary of the Interior] directly or in accordance with cooperative agreements...and in accordance with such rules and regulations for the conservation, maintenance, and management of wildlife, resources thereof, and its habitat thereon..." (Fish and Wildlife Coordination Act of 1934).

National Wildlife Refuge System Mission:
The mission of the National Wildlife Refuge System 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" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd-668ee]).

Descriptions of Use:
Various community members identified the development of environmental education and interpretation programs for the South San Diego Bay Unit as a key element of the Comprehensive Conservation Plan (CCP) for this Refuge. As a result, existing environmental education and interpretation programs are proposed for expansion. Environmental education, particularly the Habitat Heroes program, would be expanded to focus on new partnerships with area elementary, middle school, high school, and community college districts. In addition, a variety of interpretive concepts are proposed in response to comments received during the public workshop process. Many of these concepts would be implemented in conjunction with expanded opportunities for wildlife observation. New and expanded environmental education and interpretation programs are intended to provide the community and visitors to the region with an opportunity to better understand the wildlife and habitats found within the Refuge, increase public awareness for the need to protect these resources, and experience through interpretation the traditional wildlife-dependent recreational uses of the National Wildlife Refuge System.

Environmental Education: As described in the Public Use Program discussion in Section 2.3.2.3 of the Final CCP/Environmental Impact Statement (EIS) for the South San Diego Bay Unit (USFWS 2006), continuation of the Refuge's Habitat Heroes program would provide elementary through community college students with the opportunity to participate in an innovative program that incorporates the use of GIS technology, traditional and internet-based instruction, cross-age student mentoring, and habitat-based investigations for the purpose of developing an appreciation for the importance of the coastal wetlands protected within the Refuge. This program would continue to focus on two significant threats to the habitat quality of these coastal wetlands: invasive plant species and stormwater pollution. Working on an upland area along the southern perimeter of the Refuge in Imperial Beach, students will have the opportunity to map native and nonnative plants, remove invasive plant species, and cultivate and plant native plants. The continued implementation of the program, which involves partnering with elementary, secondary, and post secondary students and teachers, volunteer groups, trained environmental educators, the City of Imperial Beach, and interested individuals from the surrounding community, will require the identification of additional funding sources.

A significant activity of "Habitat Heroes" will be the inclusion of students' work on a national web site with links to other such education programs in which the Complex participates called, "Hands on the Land." Hands on the Land is sponsored by numerous federal agencies including the U.S. Fish and Wildlife Service and is funded by Congress through the National Environmental Education and Training Foundation.

Environmental Interpretation: The interpretive program proposed for the South San Diego Bay Unit, as described in the Public Use Program discussion in Section 2.3.2.4 of the Final CCP/EIS (USFWS 2006), would include several components. The first is a proposal to design a variety of interpretive elements that would provide the public with an overview of the many resources present on the Refuge, including coastal wetland and upland habitats, migratory birds, colonial nesting seabirds, and endangered and threatened species. These interpretive elements would be installed around the southern perimeter of the bay, where visual and other sensory access into the Refuge is readily available. The second component involves a proposal to interpret one of the traditional wildlife-dependent recreational uses of the National Wildlife Refuge System, hunting.

Opportunities for interpreting the resources protected within the Refuge would be provided along the strip of upland terrace that defines the Refuge's southern boundary, generally the area immediately to the north of the Bayshore Bikeway (refer to Figure 2-14 in the Final CCP/EIS). Interpretive sites are proposed to generally correspond to the proposed wildlife observation areas, described in the Compatibility Determination prepared for wildlife observation and photography. These interpretive sites would be developed at the following locations: 1) between the northern terminus of 13th Street and the northern terminus of Florida Street; 2) at the northern terminus of 10th Street, near the City of Imperial Beach's Public Works facility; and 3) at the northern terminus of 8th Street. All of these locations are located within the City of Imperial Beach. An observation area would be collocated at the interpretive site proposed for the end 10th Street. The City of Imperial Beach proposes to construct a bike path connection from the adjacent community onto the Bayshore Bikeway at this location, to develop a parking lot just to the south of the Refuge boundary, and to assist in the development of the proposed observation and interpretive site. The specific design for the proposed interpretive sites would be developed as part of a step-down interpretive plan.

All of the proposed sites would be accessible from the Bayshore Bikeway and several public streets in northern Imperial Beach. A parking area that serves users of the Bayshore Bikeway is available at the northern terminus of 13th Street and on-street parking is available along Florence Street, 8th Street, and Boulevard Avenue. The interpretative areas would be accessible during daylight hours. The interpretive theme for each of these sites, the types of interpretive elements to be installed, and the detailed cost estimates for each interpretive site would be developed as part of the step-down plan. Opportunities for additional interpretation at existing public use locations where interpretive elements such as kiosks, signs, remote video cameras and other cutting edge approaches to public interpretation could be provided would also be examined in this step-down plan.

Several members of the public expressed a desire to see hunting recognized on this Refuge as one of the traditional wildlife-dependent recreational uses of the National Wildlife Refuge System. To address this suggestion, the interpretive program for the Refuge would include the seasonal interpretation of a waterfowl hunting program along the northern levee of the salt ponds. This interpretive program, which would be conducted approximately four times a year between November and January, would involve up to 12 participants per session and each session would take place during the hours of sunrise to 9:00 a.m. One or two temporary hunting blind would be installed along the northern levee and as part of the interpretive program waterfowl historically harvested in the south bay would be called in to simulate the traditional hunting method. A docent would be present to describe historic hunting activities within the south bay, answer questions about waterfowl hunting programs in general, and discuss various hunting opportunities throughout the National Wildlife Refuge System. Participants would be transported from an off refuge location in vans and reservations would be needed to participate. No fee would be required to participate in this program.

The CCP also recommends the development of a coordinated interpretive program for San Diego Bay that would involve collaboration among all of the agencies surrounding the Bay including the Cities of Coronado, Imperial Beach, National City, Chula Vista, and San Diego, County of San Diego, U.S. Navy, and Port of San Diego. The Refuge is interested in working with these agencies to interpret bay habitats and refuge resources in a coordinated style so that a member of the public traveling along the Bayshore Bikeway will be able to experience different yet harmonious interpretive elements that serve to enhance an understanding of the bay ecosystem as a whole, while allowing for individual interpretation of various discrete characteristics of bay habitats, endangered species, watershed issues, and cultural and historic values.

Availability of Resources:

To implement and administer the environmental education and interpretation programs described, the following staffing and materials/facilities would be required:

Staffing			
Position	**Involvement**	**FTE**	**Cost**
Project Leader//Deputy Project Leader	General oversight	0.2/0.2	$25,700/$22,000
Refuge Manager	Periodic on-site oversight	0.3	$27,300
Refuge Operations Specialist	Periodic on-site oversight, monitoring of law enforcement activities	0.3	$26,000
Wildlife Biologist	Monitoring, reporting, review interpretive plan, and provide oversight of bio tech	0.3	$26,000
Information and Education (I&E) Specialist	Coordinate the development of curriculum for the environmental education program and assist in the design of the interpretive plan, build partnerships with other agencies and organizations, and outreach to schools	0.3	$23,400
Law Enforcement Officer	Law enforcement	0.3	$20,800
Park Ranger	Facilities maintenance, participate in the educational and interpretation programs, and assist with interpretive programs	0.3	$15,000
Maintenance Worker	Maintain interpretive areas and amenities	0.3	$12,870
Biological Technician	Field data collection, assistance with analysis and report writing	0.3	$15,170
TOTAL FTES AND COSTS FOR STAFFING		2.8	$214,240

Facilities		
Material/Facility Required	**Explanation of Need**	**Cost**
Step-down Plan	Needed to design and prepare specifications for the interpretive sites proposed at the northern terminus of 8th, 10th, and 13th Streets and to identify the interpretive theme for each area, the types of interpretive elements to be provided, and fabrication and installation specifications for the interpretive elements.	$45,000
Construct an Interpretive Trail w/ associated upland restoration on Refuge land near the northern terminus of 10th Street	To interpret the importance of coastal uplands to the function and value of coastal wetlands on an upland area; would involve the removal of nonnative vegetation and the installation of native plants and the construction of an a pathway through the restored area with access from the Bayshore Bikeway	$35,000
Interpretive elements for the interpretive trail	Fabricate and install 20 small interpretive plant signs and three larger interpretive panels	$15,000
Temporary hunting blind	To accommodate the interpretation of hunting in the South Bay and throughout the NWRS	$500
Development of educational curriculum for a middle school program	Curriculum for the elementary school program has been developed, but a middle school curriculum for the Habitat Heroes program is still needed.	$5,000
Materials/Instructors to Implement the Habitat Heroes Program	Annual costs associated with implementing the program including instructors, miscellaneous materials, and native plants	$25,000
TOTAL COST FOR FACILITIES		$125,500

The current Refuge budget is not adequate to fund all of the environmental and interpretive programs proposed, therefore, additional funding must be identified before these proposals can be fully implemented. The first year of the Habitat Heroes program was funded through a challenge cost share grant. To fully implement this program, which would involve expanding the program to reach elementary, middle, and high school students would require funding of approximately $25,000 annually. Funding could come from a combination of sources including the Refuge operating budget, funds from individual schools involved in the program and one-time or on-going public and private grant funds awarded to the Refuge's Friends Group. Additional assistance would be provided by volunteers and participating teachers and student mentors.

Implementation of the interpretation proposals could be phased to coincide with the identification of appropriate funding sources. Potential sources for interpretive funding include Federal cost share grants, state grants that focus on education and/or the environment, local partnerships, private funding sources, and contributions from the Refuge's Friends group. Funding for the hunting interpretive program could be provided by local hunting groups and/or state and national organizations interested in traditional hunting activities.

Anticipated Impacts of the Use:
As described in Section 4.2.2.3 of the Final CCP/EIS (USFWS 2006), potential impacts associated with the implementation of the proposed environmental education and interpretation programs could include disturbance to wildlife, destruction of native habitats, and intrusion onto sensitive refuge lands by members of the public. Such impacts would be minimized through appropriate program design, adequate Refuge oversight and supervision of educational activities, and ongoing coordination among partners.

Endangered and Threatened Species: Human activity can have adverse impacts to endangered and threatened species, particularly when this activity disrupts nesting or foraging activities. Through adherence to the stipulations outlined below, the potential for adverse impacts to the endangered light-footed clapper rail (*Rallus longirostris levipes*) that could occur as a result of increased human activity in the vicinity of the northern terminus of 8th Street and between Ponds 10 and 10A would be minimized. As part of the design of future interpretive areas, issues such as location, size, orientation, construction timing and access, as well as specific activities to be permitted and physical improvements to be completed, would be reviewed by the Refuge Biologist to ensure that there would be no direct, indirect, or cumulative impacts to clapper rails or their habitat. It may be necessary to construct physical barriers such as post and cable fencing between the interpretive element and the wetlands to reduce the potential for habitat damage. These types of measures would be incorporated into the design of the interpretive areas as part of the future step-down interpretive plan.

The interpretive elements proposed along the Bayshore Bikeway would be topographically separated from the more sensitive habitat areas within the Refuge making access into these areas difficult. The combination of natural barriers and the installation of additional post and cable fencing and signage would minimize the potential for impacts to clapper rails and other sensitive coastal wetland species. No adverse effects to the Federally-listed endangered California least tern (*Sternula antillarum*), the endangered California brown pelican (*Pelecanus occidentalis californicus*), or the threatened western snowy plover (*Charadrius alexandrinus nivosus*) are anticipated as a result of the current environmental education and interpretation proposals.

The hunting interpretive program would be confined to the salt works and would occur during the non-breeding season; therefore, no adverse effects to endangered or threatened species are anticipated.

Sensitive Habitats: The Habitat Heroes program would utilize an isolated, degraded upland area located on Refuge land. This upland, which is separated from nearby wetlands to the north by the Bayshore Bikeway, is located adjacent to a remnant of a much larger historic marsh area that was filled many decades ago to accommodate urban development. The playground of the Bayside Elementary School abuts the marsh to the south. Although the marsh supports several native coastal salt marsh plant species, it also includes various exotic, invasive plants and currently provides little benefit to native wildlife. The educational use of the adjacent upland could result in some trampling of native marsh vegetation; however, such impacts would be minimized through adequate teacher participation and monitoring of student activity. The proximity of this degrade marsh land provides opportunities to increase the students' understanding of the importance of protecting wetland and native upland areas and adjacent watersheds. These benefits would outweigh the limited impacts to wetland plants from occasionally trampling.

Locating interpretive areas around the perimeter of the Refuge, taking advantage of topographic barriers to separate public uses from sensitive resources, and installing appropriate signage and fencing where required would minimize the potential for impacts to sensitive habitats as a result of increased human activity. Public access onto the salt works during the nesting season is not proposed, therefore, no impacts to sensitive tern nesting habitat are anticipated.

Migratory Birds: The salt ponds and mudflats along the edges of the Otay River support a diverse array of migratory birds including shorebirds, ducks, and seabirds. Various studies have shown that frequent human disturbance can negatively impact wildlife by altering wildlife behavior, reproduction, distribution, and habitat. Such disturbances may also cause birds to reduce their foraging times in these areas or avoid the areas entirely (DeLong and Schmidt 2000). Human activity in the vicinity of the proposed interpretive areas, particularly the areas to be located at the end of 10th Street and 8th Street, could result in some disturbance to resting and foraging migratory birds. These areas are already impacted to some degree by existing activities occurring along the Bayshore Bikeway. The addition of interpretive areas along the bikeway would likely increase the intensity of use resulting in an increase in the frequency of disturbance. Because the proposed interpretive elements and the environmental education program site are located along the perimeter of the Refuge, the birds that are flushed would likely move further into the Refuge and resume foraging or resting. Therefore, the effects of these uses on migratory birds are expected to be minimal.

Disturbance and possible displacement of migratory shorebirds could occur around the salt works if guided tours result in excessive out-of-vehicle activity. According to DeLong and Schmidt (2000), Klein (1993) tested the behavioral response of waterbirds to human disturbance, including vehicular travel at Ding Darling NWR and found that as the intensity of disturbance increased, avoidance response by waterbirds tended to increase. Out-of-vehicle activity was also observed to be more disruptive than vehicular movement through the area. Although the degree of disturbance may vary for the species and local populations of waterbirds occurring within the South San Diego Bay Unit, similar differences between out-of-vehicle activity and vehicle travel could occur at the salt works. To avoid excessive disturbance, guides would reduce the number of stops in areas where high concentrations of foraging birds are located in proximity to the access road.

Because the activity associated with the hunting interpretive program would be confined to one or two areas along the northern levees of Ponds 12, 14, and 15, disturbance along the mudflats would also be limited. In addition, this activity would be scheduled to occur during period of high tide when shorebirds are less likely to be present in large numbers. Based on the timing of the activity, which would coincide with the high tide, the small size of the groups, and the limited number of times that participants in this activity would be present along the levee during the year, disturbance impacts as a result of this activity would be minimal.

Public Review and Comment:

Environmental education and interpretation have been discussed on several occasions at public workshops held in conjunction with the Comprehensive Conservation Plan (CCP) process. To initiate the CCP process, a Notice of Intent was published in the Federal Register on June 23, 2000 (65 FR 39172). At that time, written comments were solicited. In July 2000, two initial scoping meetings were held, one in Imperial Beach and one in Chula Vista, to receive input from the public on issues related to the Sweetwater Marsh and South San Diego Bay Units. Due to the public's level of interest in these refuges, focused public workshops were held in September 2000 and June 2001 to specifically address the issue of public use. Three additional workshops were held between November 2000 and May 2001 to receive input from the public on wildlife management and restoration proposals for these refuges. All of the public meetings were well attended with at least 40 people present at each meeting. Approximately 50 to 60 people attended those meetings related to public use.

At each workshop, the public was encouraged to provide verbal comments or to send us written comments following the workshop. A CCP web page (www.sandiegorefuges.fws.gov) was established to provide the public with specific information regarding the topics addressed at the various workshops and to present information regarding when and where to provide comments. A number of Planning Updates have also been prepared to summarize the progress of the CCP and to discuss specific issues related to the planning process. One of these updates was devoted entirely to the topic of public use. These Planning Updates have been distributed to more than 1,000 individuals and organizations representing interested members of the public, conservation organizations, hunting, fishing and boating organizations, public agencies, municipalities, special districts, Tribes, and adjoining property owners. We received more than 50 letters, emails, and phone calls related to public use between June and November 2001 and numerous other communications relevant to public uses on the Refuge were received in 2002 and 2003.

Opportunities for environmental education and interpretation were addressed at the initial scoping meetings for the CCP, as well as at the June 21, 2001 Public Use Workshop. Several members of the public expressed the desire to see the Refuge used as a setting for environmental education and others suggested the development of an interpretive area in proximity to the Bayside Elementary School. Creating partnerships with other agencies, school districts, and the adjacent community to implement educational programs was also emphasized.

The draft Compatibility Determination for environmental education and interpretation on the South San Diego Bay Unit was circulated for public review and comment as part of the San Diego Bay National Wildlife Refuge Draft Comprehensive Conservation Plan/Environmental Impact Statement (CCP/EIS). Specifically, it was included in Appendix K of the Draft CCP/EIS. The Notice of Availability for the Draft CCP/EIS was published in the Federal Register on July 22, 2005 and a Planning Update announcing the availability of the Draft was sent to over 1,000 individuals, agencies, non-governmental organizations, and other stakeholders. In addition, the Draft CCP/EIS was provided to over 275 interested parties and made available for review on the Refuge's CCP website. Public comments were accepted through September 19, 2005. No comments related to this Compatibility Determination were received during the public comment period.

Determination:
__Use is Not Compatible

X Use is Compatible with the Following Stipulations

Stipulations Necessary to Ensure Compatibility:

1. Each year, prior to initiating the Habitat Heroes program, all participating teachers, outside instructors, and other facilitators shall coordinate with the Refuge Manager to review the area-specific guidelines for implementing the program in a manner that will minimize impacts to wildlife and its habitat. These guidelines will specify the maximum number of participants per visit to the site, appropriate access routes into and through the site, the activities that can be conducted, and any times during the year when activities should be suspended or minimized.

2. The Refuge's Information and Education Specialist shall review all materials and programs to ensure consistency with Refuge goals and the mission of the National Wildlife Refuge System.

3. All required regulatory signage and fencing or other appropriate barriers shall be installed prior to the opening of interpretive sites at the northern terminus of 10th Street and 8th Street to reduce the potential for off-trail activity on Refuge lands and waters.

4. Hunting interpretation programs will be scheduled to coincide with the high tide to reduce disturbance to migratory birds.

5. Monitoring of the effects of increased human activity on migratory birds and nesting seabirds shall be implemented weekly during the first three years of the

environmental education program and the first three years following the completion of an interpretive area. This monitoring should be conducted during peak migration periods, as well as during the nesting season, to determine what, if any, effect increases in activity as a result of these programs are having on bird foraging, resting, and/or nesting behavior. If excessive disturbance is observed, additional measures should be implemented to reduce these effects.

Justification:
The development of environmental education and interpretation programs for the South San Diego Bay Unit would provide various opportunities to inform community members and visitors to the region of the importance of the resources protected within the Refuge. In addition, the Habitat Heroes program is designed to encourage stewardship of the many resources protected in the Refuge. Although adequate funding is not currently available to implement all of the elements proposed within these programs, the phasing of program implementation over several years would have no adverse effects. Rather, the benefits of these programs would simply take longer to be realized.

An informed and involved public, cultivated as a result of these programs, will benefit the wildlife and habitats protected and managed within the Refuge consistent with the Refuge purposes of protecting, managing, and restoring habitats for federally-listed endangered and threatened species and migratory birds and maintaining and enhancing the biological diversity of native plants and animals. A review of the environmental consequences of implementing these uses, as provided in the Final CCP/EIS (USFWS 2006), demonstrates that these uses would not materially interfere with or detract from the fulfillment of the National Wildlife Refuge System mission, provided the stipulations to ensure compatibility are followed. Further, environmental education and interpretation are two of the six priority public uses of the System, as defined by the National Wildlife Refuge System Improvement Act of 1997. Therefore, implementation of these programs would contribute to the fulfillment of the Refuge System mission, as well as the achievement of the goals established for the South San Diego Bay Unit, particularly the goal to provide opportunities for compatible wildlife-dependent recreational uses that foster public appreciation of the unique natural heritage of South San Diego Bay.

Mandatory Re-Evaluation Date:
_X_ Mandatory 15-year Re-Evaluation Date (for priority public uses)

__Mandatory 10-year Re-Evaluation Date (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision:
__Categorical Exclusion without Environmental Action Statement

__Categorical Exclusion and Environmental Action Statement

__Environmental Assessment and Finding of No Significant Impact

_X_ Environmental Impact Statement and Record of Decision

References Cited:

DeLong, Anita and Janet Schmidt. 2000. Literature Review: Effects of Human Disturbance on Wildlife with Emphasis on Wildlife-Dependent Recreation Relevant to Stillwater National Wildlife Refuge (Draft).

U.S. Fish and Wildlife Service. 2006. Final San Diego Bay National Wildlife Refuge Comprehensive Conservation Plan/Environmental Impact Statement.

Refuge Determination:

Prepared by: ______________________________Date: _________

Refuge Manager/
Project Leader
Approval: ______________________________Date: _________

Concurrence:

Refuge Supervisor: ______________________________Date: _________

Assistant Manager, Refuges
California/Nevada
Operations Office: ______________________________Date: _________

Manager, California/Nevada
Operations Office: ______________________________Date:_________

Compatibility Determination
-FINAL-

Use: Mosquito Management

Refuge Name: South San Diego Bay Unit of the San Diego Bay National Wildlife Refuge (San Diego County, Cities of Coronado, Chula Vista, Imperial Beach, National City, and San Diego, California)

Establishing and Acquisition Authorities:
The authorities for the establishment of the San Diego National Wildlife Refuge are the Fish and Wildlife Act of 1956, as amended (16 U.S.C. 742a-742j, not including 742d-742l) and the Endangered Species Act of 1973, as amended (16 U.S.C. 1531-1543).

Refuge Purposes:
The San Diego Bay National Wildlife Refuge was established:

> "to protect, manage, and restore habitats for federally listed endangered and threatened species and migratory birds, and to maintain and enhance the biological diversity of native plants and animals" 16 U.S.C. § 1531-1543 (Endangered Species Act of 1973, as amended) and 70 Stat. 1119 (Fish and Wildlife Act of 1956, as amended);
>
> "…for the development, advancement, management, conservation, and protection of fish and wildlife resources...for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude..." (Fish and Wildlife Act of 1956).
>
> [This refuge] "shall be administered by him [Secretary of the Interior] directly or in accordance with cooperative agreements...and in accordance with such rules and regulations for the conservation, maintenance, and management of wildlife, resources thereof, and its habitat thereon..." (Fish and Wildlife Coordination Act of 1934).

National Wildlife Refuge System Mission:
The mission of the National Wildlife Refuge System 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" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd-668ee]).

<u>Description of Use</u>:
Mosquito management throughout the coastal refuges of San Diego County is conducted under the auspices of a Refuge Special Use Permit (SUP) in coordination with the San Diego County Department of Environmental Health, Vector Control Division. The SUP is issued annually. The primary purpose for implementing mosquito management on this Refuge is to avoid threats to public or wildlife health from specific mosquito-borne diseases. Mosquito management is implemented on the South San Diego Bay Unit through a phased approach that emphasizes early detection and treatment, if warranted, with larvicides. The use of adulticides is to be reserved for addressing human health emergencies.

Several mosquito species occur in and around the South San Diego Bay Unit that are capable of transmitting microbial organisms that cause human diseases such as malaria and encephalitis. The mosquitoes of major concern in California belong to the genera *Culex*, *Ochlerotatus,* and *Anopheles*. The species of greatest public health concern include *Culex tarsalis, Culex pipiens, Culex quinquefasciatus* and *Anopheles hermsi*. Of lesser importance are the salt marsh mosquitoes: *Ochlerotatus squamiger* and *Ochlerotatus taeniorhynchus*.

Specific data regarding the species presence in the vicinity of the Refuge was collected in 2003 at the Otay River and Hollister Street mosquito trap array by the County of San Diego, Department of Environmental Health, Vector Control Division. This data indicates that eight species of mosquito are commonly found in this area. These species include:

Anopheles hermsi – This species, which is very commonly found in the Otay traps, is a highly competent vector of malaria, although this disease is not prevalent in this region.

Culex erythrothorax – This species, which is the most common mosquito in San Diego, is typically considered a nuisance. It is commonly found in the Otay traps and occurs in densely vegetated freshwater marshes and heavily vegetated backwater zones. It is not considered to be a major disease carrier, although its ability to potentially harbor West Nile Virus (WNV) is currently unknown.

Culex tarsalis – A highly competent vector mosquito, this species is quite common in the Otay traps. Viewed generally as a nuisance mosquito, this species can also be an effective carrier of disease.

Culiseta incidens and *Culiseta particeps* – These two species are regularly captured in the Otay traps in small to moderate numbers. Neither species is considered to be a disease vector, but can be a biting nuisance. Their ability to harbor WNV is unknown.

Ochlerotatus increpitus – Primarily a nuisance mosquito, this species, which bites during the day, is common in the Otay traps. Its ability to vector WNV is unknown.

Ochlerotatus taeniorhynchus and *Ochlerotatus squamiger* – These mosquito species are prevalent in salt marsh habitat. *Ochlerotatus taeniorhynchus* is primarily a day-biting nuisance, and neither species is currently considered to be a disease carrier; however their ability to transmit WNV is unknown.

Mosquito management on this Unit is addressed through an integrated pest management approach in which Refuge staff and County vector control officials coordinate efforts to manage the overall environmental health of adjacent communities while minimizing impacts to Refuge trust resources. Working together, the two agencies agree upon issues related to access, methods of operation, and timing of access, as well as to exchange information related to listed species occurrences, permitting, and relevant agency policy.

The current procedures for implementing mosquito management on this Refuge involve an annual meeting between County and Refuge staff to coordinate necessary permitting and implementation planning required to conduct mosquito monitoring and control on the Refuge for the upcoming year. Issues such as access points and pathways to be used by County personnel, appropriate hours of operation, and requirements for field coordination are discussed, agreed upon, and incorporated into the SUP. As part of this coordination process, County vector control personnel are provided with data generated by the Refuge biologist on listed species and other trust resources. County personnel share relevant data related to mosquito and disease monitoring in the vicinity of the Refuge. In addition, periodic meetings are conducted in the field with County field staff and the Refuge biologist to further coordinate activities. These meetings are scheduled throughout the season when warranted to ensure protection of listed species and to avoid disturbance to nesting birds.

Following the conditions included in the SUP, County vector control personnel conduct periodic mosquito larvae surveys in many discrete areas throughout the Refuge. Because the primary means of mosquito management is the use of larvicides, it is essential that larvae be observed prior to pupation so that they may be treated appropriately by the least environmentally damaging means. As a result, the frequency of larvae surveys increases throughout the mosquito breeding season. Currently, treatment areas are determined based on the season, the species and density of the mosquitoes detected, the proximity of the vectors to surrounding urban areas, and the life stage the mosquitoes are found in. Control of adult or pupal mosquitoes is not currently conducted on the Refuge.

Public concern over human health issues related to mosquito-borne disease has intensified on the west coast with the advance of WNV across the United States. To better address mosquito management, a phased response strategy has been developed for implementation on refuges in the Pacific Region. This strategy encourages an integrated pest management approach that incorporates habitat and best management practices to reduce the need for and use of insecticides on refuges, while also ensuring that legitimate human, fish, and wildlife health concerns are addressed. To implement this phased response strategy, current procedures for managing mosquitoes on this Refuge will be augmented to better identify thresholds for mosquito treatment and present specific responses to various conditions encountered in the field. Under this new program, if mosquito population monitoring and disease surveillance (implemented by County vector control personnel) indicate that human health thresholds are exceeded, the use of larvicides, pupicides, and/or adulticides may become necessary. In some cases, emergency actions may be required that are not addressed by this Compatibility Determination.

Two larvicide compounds that could be used to manage mosquitoes on the Refuge include Bti (*Bacillus thuringienensis israelensis*) and Altosid (methoprene). These larvicides are intended to control mosquitoes in wetlands prior to their emergence as adults. Bti is used primarily to control early stage larvae and is available in liquid and granular formulations. Altosid is used on later stage mosquito larvae and is available in liquid, briquet and pellet formulations. Both compounds are highly specific to mosquito larvae. The use of Golden Bear 1111, which is effective at preventing adult mosquito emergence from wetlands but toxic to fish and other aquatic organisms, is not currently permitted for use on the Refuge.

The potential for mosquito production during and following brackish and freshwater wetland restoration on the Refuge would be reduced by appropriate restoration design, as described in Section 2.3.2.3 of the Final San Diego Bay NWR Comprehensive Conservation Plan (CCP)/Environmental Impact Statement (EIS) (USFWS 2006). Specifically, deeper water channels (greater than 4 feet) would be included in the design to break up areas of dense emergent vegetation and provide access for aquatic predators that feed on mosquito larvae. These restored wetlands would also include appropriate surveillance access points to aid County vector control personnel in monitoring wetlands for potential mosquito production.

Availability of Resources:
To implement and administer mosquito management on the South San Diego Bay Unit, the following staffing and facilities are required:

Staffing			
Position	**Involvement**	**FTE**	**Cost**
Project Leader/Deputy Project Leader	General oversight	0.2/0.2	$25,700/$22,000
Refuge Manager	Periodic on-site oversight	0.3	$30,300
Refuge Operations Specialist	On-site oversight	0.3	$26,000
Wildlife Biologist	Monitoring, mosquito management plan prep., coordination/oversight of vector control activities, annual prep. of SUP	0.3	$26,000
TOTAL FTES AND COSTS FOR STAFFING		1.3	$130,000
TOTAL COST FOR FACILITIES	none		$0

Adequate staff positions and financial resources are currently available and committed to implement mosquito management on the South San Diego Bay Unit.

Anticipated Impacts of the Use:

The purpose of this section is to critically and objectively evaluate the potential direct, indirect and cumulative effects mosquito management could have on the Refuge's endangered and threatened species and other fish and wildlife resources. The evaluation of direct impacts focuses primarily on existing and future freshwater wetlands and coastal salt marsh areas of the South San Diego Bay Unit, as these portions of the Refuge are or will be most prone to mosquito production. The potential for indirect impacts to the remainder of the Refuge, which consists of the open bay, salt pond levees, mudflats, and upland habitat, is also evaluated.

Habitat and Wildlife Disturbance: Vegetation trampling resulting from mosquito monitoring and mosquito control, as well as the possible creation of channels to drain stagnant water areas, could adversely impact native vegetation and wildlife habitat. In addition, these activities could result in disturbances to the existing wildlife that utilizes this area. At present, the Otay River floodplain and the existing salt ponds on the Refuge support both native and non-native vegetation and wetland habitats of varying types. The most significant habitats supported within the Otay River floodplain include freshwater marsh and willow scrub habitat, which occurs along the eastern portions of the Otay River channel and the salt marsh areas located along the western end of the river channel. These wetland areas provide foraging, resting, and nesting habitat for a variety of birds, including migratory shorebirds, waterfowl, and songbirds, as well as various native mammals, reptiles, and amphibians. To minimize impacts related to disturbance, the Refuge biologist would coordinate with County vector control personnel at least annually to review appropriate conduct within sensitive habitat areas. Specific field implementation protocols for working in sensitive habitat areas would be included in the Refuge SUP.

Although the upland portion of the Otay River floodplain currently supports non-native vegetation, this area does provide foraging habitat for a variety of raptor species including northern harriers (*Circus cyaneus*), white-tailed kites (*Elanus leucurus*), American kestrels (*Falco sparverius*) and red-tailed hawks (*Buteo jamaicensis*). Foraging and nesting opportunities for raptors should not be reduced by mosquito control activities.

Endangered and Threatened Species: One of the purposes of the South San Diego Bay Unit is to conserve fish and wildlife that are listed as endangered or threatened. A number of listed species occur within the boundaries of this Refuge, including several that utilize the wetland areas within the Otay River floodplain. The Federal endangered California least tern (*Sterna antillarum browni*) forages within the Otay River channel during the spring and summer, while the Federal endangered light-footed clapper rail (*Rallus longirostris levipes*) and State endangered Belding's savannah sparrow (*Passerculus sandwichensis beldingi*) utilize the wetland habitats along the river channel year round. The cordgrass stands and brackish marsh habitat growing along the river channel provide foraging, resting, and/or breeding habitat for both species.

Potential impacts to the light-footed clapper rail and Belding's savannah sparrow would consist primarily of direct habitat or nest losses through trampling of cordgrass or pickleweed where nests could occur, but would also include indirect adverse affects related to the disruption of foraging opportunities in both clapper rail and Belding's savannah sparrow territories. The relatively limited time that vector control personnel would be present in these habitat areas, as well as the use of those controlled access points and pathways agreed upon between the County and Refuge personnel and described in the Refuge SUP would minimize the potential for adverse affects to these species as a result of mosquito management.

Mosquito control in this area does require some access to sensitive wetland areas; however no mowing or ditching of wetland areas is authorized. The level of allowed activity, combined with its controlled management by Refuge biological staff would not likely result in direct, indirect, and cumulative impacts to the light-footed clapper rail.

Nesting Season Disturbance: The nesting season varies with species but can generally be described as occurring between mid-February and mid-September. Disturbance to nesting bird species may occur if vector control personnel are present in the vicinity of avian nesting colonies or individual nests.

Several species, many of which are rare, sensitive or state and/or Federally-listed occur within the South San Diego Bay Unit. As described above, the habitats present within the Otay River channel support light-footed clapper rail and Belding's savannah sparrow nesting. Cordgrass stands along the Otay River channel and the brackish marsh within the channel support clapper rail nesting, while high salt marsh vegetation, such as the pickleweed stands that occur in the intertidal habitats within the river channel, are known to support savannah sparrow nesting. No nesting survey monitoring reports for the savannah sparrow are available for this location, but it is probable that nesting attempts by the species do occur within the area being evaluated. To avoid impacts to nesting species within the lower portions of the Otay River channel, periodic meetings would be conducted in the field with County field staff and the Refuge biologist to coordinate activities and delineate sensitive nesting areas that should be avoided or entered within extreme caution.

There is also a potential for direct and indirect impacts to breeding waterfowl such as gadwall (*Anas strepera*) and mallard (*Anas platyrynchos*), which have also been observed nesting in the Otay River channel, however these impacts are not likely to be significant due to the controlled and limited nature of the access into habitat areas by authorized personnel.

A variety of ground nesting avian species utilize the levees around the salt ponds for nesting, including colonies of Caspian terns (*Sterna caspia*), elegant terns *(Sterna elegans*), royal terns (*Sterna maxima*), gull-billed terns (*Sterna nilotica vanrossemi*), Forster's terns (*Sterna forsteri*), endangered California least terns, and black skimmers (*Rynchops niger*). Avian responses to disturbance can include flocking, alarm calling, nest abandonment, colony abandonment, and inter-colony antagonistic behaviors leading to crushed eggs and killed chicks. Predatory species, such as ravens, crows, certain gulls, and harriers, may also use disturbance episodes to depredate eggs and chicks while the adults are flocking or otherwise distracted by the initial source of the disturbance. However, it is not anticipated that there will be a need in the immediate future for access by vector control personnel to the salt pond nesting areas. Implementation of restoration plans for the salt works (refer to Section 2.3.2.4 of the Final CCP/EIS) would however restore wetland habitats in these areas that would require monitoring. Therefore, additional procedures for monitoring would be incorporated into the Refuge SUP following restoration to ensure protection of nesting seabirds, eggs, and fledglings.

<u>Future Impacts</u>: As described above, the Final CCP/EIS (USFWS 2006) includes a proposal to restore portions of the South San Diego Bay Unit to native vegetation. The intent of this restoration is to restore habitat for the variety of sensitive and endangered species that currently and historically occurred in this area. Following restoration, the field implementation protocols for mosquito management that are included in the Refuge SUP shall be adjusted annually to incorporate new landscape conditions as they develop.

To minimize the potential for successful mosquito breeding in restored wetlands, primarily brackish to freshwater areas, conditions that favor the development of thick stands of aquatic freshwater wetland vegetation would be avoided. Designs for all future restored wetland areas would take into account vector control related issues as well as habitat development. For instance, deep water areas (greater than 4 feet in depth) such as channels through the marsh would be constructed and maintained to provide open areas between stands of vegetation. This would provide access for mosquito predators such as fish and aquatic insects. Open areas of water would also make it difficult for female mosquitoes to lay eggs and mosquito larvae to find cover from predation.

<u>Public Review and Comment</u>:

Two public scoping meetings and a series of public workshops to discuss habitat management, restoration, and public use were held in conjunction with the CCP process. To initiate the CCP process, a Notice of Intent was published in the Federal Register on June 23, 2000 (65 FR 39172). At that time, written comments were solicited. In July 2000, two initial scoping meetings were held, one in Imperial Beach and one in Chula Vista, to receive input from the public on issues related to the South San Diego Bay and Sweetwater Marsh Units. Due to the public's level of interest in these Refuges, focused public workshops were held in September 2000 and June 2001 to specifically address the issue of public use. Three additional workshops were held between November 2000 and May 2001 to receive input from the public on wildlife management and restoration proposals for these refuges. All of the public meetings were well attended with at least 40 people present at each meeting.

At each workshop, the public was encouraged to provide verbal comments or to send us written comments following the workshop. A CCP web page (www.sandiegorefuges.fws.gov) was established to provide the public with specific information regarding the topics addressed at the various workshops and to present information regarding when and where to provide comments. A number of Planning Updates have also been prepared to summarize the progress of the CCP and to discuss specific issues related to the planning process. These Planning Updates have been distributed to more than 1,000 individuals and organizations representing interested members of the public, conservation organizations, hunting, fishing and boating organizations, public agencies, municipalities, special districts, Tribes, and adjoining property owners. We received more than 50 letters, emails, and phone calls related to the CCP between June and November 2001 and numerous other communications relevant to public uses on the Refuge were received in 2002 and 2003. No public comments related to mosquito management have been received to date.

The draft Compatibility Determination for wildlife observation and photography on the South San Diego Bay Unit was circulated for public review and comment as part of the San Diego Bay National Wildlife Refuge Draft Comprehensive Conservation Plan/Environmental Impact Statement (CCP/EIS). Specifically, it was included in Appendix K of the Draft CCP/EIS. The Notice of Availability for the draft CCP/EIS was published in the Federal Register on July 22, 2005 and a Planning Update announcing the availability of the draft was sent to over 1,000 individuals, agencies, non-governmental organizations, and other stakeholders. In addition, the draft CCP/EIS was provided to over 275 interested parties and made available for review on the Refuge's CCP website. Public comments were accepted through September 19, 2005. No comments related to this Compatibility Determination were received during the public comment period.

Determination:

___ Use is Not Compatible

_X_ Use is Compatible with the Following Stipulations

Stipulations:

1. The County of San Diego, Department of Environmental Health, Vector Control Division shall operate on Refuge lands under the terms and conditions outlined in a USFWS Refuge Special Use Permit, which shall be reviewed annually.

2. Special Use Permit conditions shall stipulate that all control work will be carried out in conformance with pre-approved USFWS Pesticide Use Proposals, Section 7 Endangered Species Act consultations, and existing and future USFWS policies on mosquito management.

Justification:
Mosquito management would be implemented on this Refuge in accordance with the guidance provided for the Pacific Region by the Regional Office in March 2003. This guidance for mosquito management incorporates a phased-response strategy developed to manage mosquitoes in a manner that is compatible with refuge purposes and uses the best available science while minimizing impacts to fish and wildlife, which is consistent with the mission of the National Wildlife Refuge System. Mosquito management proposed for this Refuge would also address legitimate human, fish, and wildlife health concerns. Implementing mosquito control in accordance with the stipulations presented above would therefore not materially interfere with the ability to achieve the wildlife management goals established for this Refuge.

NEPA Compliance for Refuge Use Decision:
__Categorical Exclusion without Environmental Action Statement

__Categorical Exclusion and Environmental Action Statement

__Environmental Assessment and Finding of No Significant Impact

_X_ Environmental Impact Statement and Record of Decision

References Cited:
U.S. Fish and Wildlife Service. 1985. Light-footed Clapper Rail Recovery Plan.

U.S. Fish and Wildlife Service. 2006. San Diego Bay National Wildlife Refuge (Sweetwater Marsh and South San Diego Bay Units) Final Comprehensive Conservation Plan/Environmental Impact Statement.

Refuge Determination:

Prepared by: ______________________________Date: _________

Refuge Manager/
Project Leader
Approval: ______________________________Date: _________

Concurrence:

Refuge Supervisor: ________________________________Date: __________

Assistant Manager, Refuges
California/Nevada
Operations Office: ________________________________Date: __________

Manager, California/Nevada
Operations Office: ________________________________Date:__________

Compatibility Determination
-FINAL-

Use: Regional Trail

Refuge Name: South San Diego Bay Unit of the San Diego Bay National Wildlife Refuge (San Diego County, Cities of Coronado, Chula Vista, Imperial Beach, National City, and San Diego, California)

Establishing and Acquisition Authorities:
The authorities for the establishment of the San Diego National Wildlife Refuge are the Fish and Wildlife Act of 1956, as amended (16 U.S.C. 742a-742j, not including 742d-742l) and the Endangered Species Act of 1973, as amended (16 U.S.C. 1531-1543).

Refuge Purposes:
The San Diego Bay National Wildlife Refuge was established:

> "to protect, manage, and restore habitats for federally listed endangered and threatened species and migratory birds, and to maintain and enhance the biological diversity of native plants and animals" 16 U.S.C. § 1531-1543 (Endangered Species Act of 1973, as amended) and 70 Stat. 1119 (Fish and Wildlife Act of 1956, as amended);
>
> "…for the development, advancement, management, conservation, and protection of fish and wildlife resources...for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude..." (Fish and Wildlife Act of 1956).
>
> [This refuge] "shall be administered by him [Secretary of the Interior] directly or in accordance with cooperative agreements...and in accordance with such rules and regulations for the conservation, maintenance, and management of wildlife, resources thereof, and its habitat thereon..." (Fish and Wildlife Coordination Act of 1934).

National Wildlife Refuge System Mission:
The mission of the National Wildlife Refuge System 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" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd-668ee]).

Description of Use:
At the eastern end of the South San Diego Bay Unit is the Otay River floodplain. This area is included within the approved planning boundary of the Otay Valley Regional Park (OVRP), a multi-jurisdictional planning effort by the County of San Diego and the cities of San Diego and Chula Vista. The planning boundary for the OVRP, which was approved prior to the establishment of the South San Diego Bay Unit, encompasses more than 8,000 acres, and extends about 13 miles inland from the southeastern edge of the salt ponds at the mouth of the Otay River, through the Otay River Valley, to the land surrounding both Lower and Upper Otay Lakes. A Concept Plan for the OVRP was approved by the participating agencies in May 2001 (County of San Diego 2001). One of the components of the OVRP, as described in the Concept Plan, is a proposal to create a regional trail through the Otay River Valley. The trail would extend east/west through the river valley, from the eastern planning boundary to the Bayshore Bikeway located to the west of Interstate 5 (I-5). To implement this proposal, the County of San Diego and supporters of the OVRP have requested that the Refuge allow the western end of the trail to extend through the Refuge where it would then connect with the Bayshore Bikeway.

This Compatibility Determination addresses the proposal to designate an alignment through the Refuge for the future construction of a portion of this regional trail. Although the exact alignment of the trail will be worked out with the various agencies involved in implementing the OVRP, the alignment presented in the Comprehensive Conservation Plan (CCP) extends west from the I-5 undercrossing, north of the river channel, then travel northwest along the eastern border of the South San Diego Bay Unit for approximately 2,000 feet. When constructed, the trail would connect to the proposed Bayshore Bikeway near the northeastern corner of the Refuge. The Concept Plan does not include any specifics regarding the recommended width, proposed surfacing materials, or permitted uses for the trail, as these specifications would be worked out during step-down planning. The local agencies participating in the development of the OVRP would be responsible for obtaining approval from the Refuge Manager prior to constructing the trail, funding and installing the trail in accordance with the requirements placed on the project by the Refuge, maintaining the trail and associated amenities such as fencing and signage, monitoring trail use, and patrolling the trail to ensure compliance with established trail regulations.

Once constructed, the trail would support two wildlife dependent recreational uses: wildlife observation and environmental interpretation.

Availability of Resources:
Designation of an alignment for the Otay Valley Regional Trail would not result in the expenditure of any additional Refuge funds and trail construction and maintenance, as well as required fencing and regulatory signage, would be the responsibility of the local agencies participating in the OVRP. However, refuge resources would still be required to assist the local agencies in developing a trail design that meets the approval of the Refuge Manager, as well as

to monitor the potential effects of trail use on Refuge wildlife and native habitat. Periodic patrol by Refuge law enforcement would also be required; however, enforcement is already required in this area due to its proximity to urban uses. The following staffing would be required:

Staffing			
Position	**Involvement**	**FTE**	**Cost**
Project Leader/ Deputy Project Leader	General oversight	0.2/0.2	$25,700/$22,000
Refuge Manager	Periodic on-site oversight	0.3	$27,300
Refuge Operations Specialist	On-site oversight	0.3	$26,000
Wildlife Biologist	Monitoring, reporting, assist in the design and siting of the trail, provide some oversight of trail construction and long-term monitoring of refuge resources surrounding the trail, oversight of biological technicians	0.3	$26,000
Refuge Planner	Assist in the design and siting of the trail, provide some oversight of trail construction	0.2	$16,510
Park Ranger	Assist in trail monitoring, facilities maintenance	0.3	$13,000
Law Enforcement Officer	Law enforcement	0.3	$20,800
TOTAL FTES AND COSTS FOR STAFFING		2.1	$177,310

Refuge staffing is adequate to accommodate law enforcement, wildlife monitoring, and planning related to trail design and layout. No Refuge funds would be needed for trail construction or long-term trail maintenance. Adequate resources are available to allow for this use.

Anticipated Impacts of the Use:

The proposed alignment for the future regional trail, which would extend along the Refuge's eastern border, has been designed to avoid fragmentation of habitat and minimize impacts to wildlife. However, the construction and use of the proposed trail does have the potential to adversely affect the diversity and abundance of wildlife and the quality of its habitat. These impacts may include: direct loss of native vegetation; displacement of native vegetation due to the introduction of invasive species, including noxious weeds; and disturbance and displacement of wildlife. In addition, trail construction and trail use can disturb and compact soils, causing changes in infiltration and runoff that can lead to increased erosion and siltation in adjacent waterways (DeLong and Schmidt 2000). Unauthorized off trail activities can also occur resulting in additional disturbance and compaction of soil, vegetation trampling, and wildlife disturbance.

In reviewing studies related to the influence of recreational trails on bird communities, Delong and Schmidt (2000) report that several of these studies suggest that both the physical presence of a trail and human disturbance associated with the trail can affect bird abundance, species composition, and nest predation in the immediate vicinity of a trail. Many of these impacts can be minimized through proper trail planning that limits fragmentation of habitat, avoids sensitive habitat areas, and establishes clearly defined paths to reduce off trail activities. The anticipated impacts of accommodating the proposed OVRP Trail are presented in detail in Chapter 4 of the Final CCP/EIS (USFWS 2006) and summarized below.

Endangered and Threatened Species: One of the purposes for the establishment of the South San Diego Bay Unit is to protect Federally-listed endangered or threatened species. With the exception of the Federal endangered light-footed clapper rail, the habitats that support the Refuge's listed species do not occur in proximity to the proposed regional trail alignment. If however off trail activities increase following the construction of the trail, disturbance to other listed species such as the Federal endangered California least tern (*Sternula antillarum*) and State endangered Belding's savannah sparrow (*Passerculus sandwichensis beldingi*) could occur.

Human activity can have adverse impacts on endangered and threatened species, particularly when their nesting or foraging activities are disrupted. Human activity within the Otay River floodplain could increase as a result of the construction of the proposed regional trail potentially impacting several sensitive species, including the clapper rail, which has been observed in the habitats that extend along the Otay River channel within the Refuge boundary. Threats to light-footed clapper rail from humans consist primarily of direct habitat or nest losses due to trampling of vegetation where nests occur. Belding's savannah sparrow utilize the higher salt marsh habitat that occurs near the western end of the river channel, as well as along the edges of the river channel further upstream. Human disturbance in these areas as a result of off trail activity could disrupt foraging activities, as well as result in direct habitat or nest losses through trampling of pickleweed. These species are also vulnerable to injury or death if dogs are not confined to the designed trail. The potential for off trail activity can be reduced through appropriate fencing and signage along the trail and patrol of the trail to regulate the activities of trail users.

Nesting Season Disturbance: The nesting season varies for each species, but can generally be described as occurring between mid-February and mid-September. Disturbance to nesting bird species may occur if persons or dogs are present in the vicinity of avian nesting colonies or individual nests.

Several species, many of which are rare, sensitive or Federally and/or State listed, nest within the South San Diego Bay Unit. As described above, the habitats present within the Otay River channel support light-footed clapper rail and Belding's savannah sparrow nesting. Cordgrass stands along the Otay River channel and the brackish marsh within the channel provide nesting habitat for clapper rails, while high salt marsh vegetation such as the pickleweed stands that occur in the intertidal habitats within the river channel are known to support savannah sparrow nesting. Off trail activities by humans and dogs would most likely result in direct adverse impacts to both of these species. Similar impacts to breeding waterfowl, such as gadwall (*Anas strepera*) and mallard (*Anas platyrynchos*), which have been observed nesting in the Otay River channel, could occur.

Sensitive Habitats: With the exception of the native vegetation occurring within the river channel, the general area proposed for the future construction of the regional trail is highly disturbed and dominated by non-native, weedy vegetation. Under these conditions, the impacts of trail construction and trail use on sensitive habitats would be minimal, although unauthorized off trail activity could result in impacts to native wetland vegetation. The CCP proposes to restore the upland portions of the Otay River floodplain to native upland habitat necessitating coordination between restoration planning and trail design to avoid future impacts to restored upland areas. The proposed trail alignment is located along the perimeter of the Refuge to minimize the effects of habitat fragmentation. Once native upland vegetation is restored, impacts to this sensitive habitat could occur as a result of unauthorized off trail activities. These impacts could be avoided through the implementation of appropriate measures such as fencing and signage to discourage off trail activities by humans and dogs. Migratory Birds: The alignment proposed for the regional trail is located in an area that does not currently support migratory bird foraging and loafing, therefore activities on the trail would not be expected to impact these resources. However, if off trail activities were to occur, disturbance to migratory birds could result. The use of appropriate fencing and signage along the trail is expected to reduce the potential for off trail activities. In addition, by providing a well-designed trail within this area to accommodate recreational users, some of the existing unauthorized access on the Refuge could be reduced, resulting in minor benefits to Refuge resources.

Public Review and Comment:

The OVRP Trail has been discussed on several occasions at public workshops held in conjunction with the CCP process. To initiate the CCP process, a Notice of Intent was published in the Federal Register on June 23, 2000 (65 FR 39172). At that time, written comments were solicited. In July 2000, two initial scoping meetings were held, one in Imperial Beach and one in Chula Vista, to receive input from the public on issues related to the South San Diego Bay and Sweetwater Marsh Units. Due to the public's level of interest in these refuges, focused public workshops were held in September 2000 and June 2001 to specifically address the issue of public use. Three additional workshops were held between November 2000 and May 2001 to receive input from the public on wildlife management and restoration proposals for these refuges. All of the public meetings were well attended with at least 40 people present at each meeting. Approximately 50 to 60 people attended those meetings related to public use.

At each workshop, the public was encouraged to provide verbal comments or to send us written comments following the workshop. A CCP web page (www.sandiegorefuges.fws.gov) was established to provide the public with specific information regarding the topics addressed at the various workshops and to present information regarding when and where to provide comments. A number of Planning Updates have also been prepared to summarize the progress of the CCP and to discuss specific issues related to the planning process. One of these updates was devoted entirely to the topic of public use. These Planning Updates have been distributed to more than 1,000 individuals and organizations representing interested members of the public, conservation organizations, hunting, fishing and boating organizations, public agencies, municipalities, special districts, Tribes, and adjoining property owners. We received more than 50 letters, emails, and phone calls related to public use between June and November 2001and numerous other communications relevant to public uses on the Refuge were received in 2002 and 2003.

The provision of trails on the Refuge generated relatively few comments during the public scoping process and at the Public Use Workshop held on June 21, 2001. Comments that were provided included a desire to see limited access provided to those areas of the Refuge in which such use would be compatible with and not result in impacts to the Refuge's sensitive wildlife resources. There was also a suggestion that a seasonal walking trail be provided around Ponds 10 and 11, while others requested that all public access be prohibited with the salt works.

The draft Compatibility Determination for wildlife observation and photography on the South San Diego Bay Unit was circulated for public review and comment as part of the San Diego Bay National Wildlife Refuge Draft Comprehensive Conservation Plan/Environmental Impact Statement (CCP/EIS). Specifically, it was included in Appendix K of the draft CCP/EIS. The Notice of Availability for the draft CCP/EIS was published in the Federal Register on July 22, 2005 and a Planning Update announcing the availability of the draft was sent to over 1,000 individuals, agencies, non-governmental organizations, and other stakeholders. In addition, the draft CCP/EIS was provided to over 275 interested parties and made available for review on the Refuge's CCP website. Public comments were accepted through September 19, 2005. No comments related to this Compatibility Determination were received during the public comment period.

Determination:

__ Use is Not Compatible

X Use is Compatible with the Following Stipulations

Stipulations Necessary to Ensure Compatibility:

1. Prior to the design and construction of the trail, the entity responsible for implementing the OVRP Concept Plan or one of Park's member agencies shall enter into an agreement and/or obtain a Special Use Permit from the Fish and Wildlife Service. This agreement or permit to allow the installation and use of the proposed trail must outline the responsibilities of each agency. This agreement/permit should specify that the entity responsible for the OVRP will: 1) work cooperatively with the Refuge Manager in the

design and proposed alignment of the trail; 2) receive written approval for the final trail design from the Refuge Manager; 3) be responsible for complying with all CEQA/NEPA requirements, as well as obtaining all required local, state, and federal permits for the trail; 4) finance and implement all aspects of trail construction including any required environmental mitigation and monitoring requirements, fencing, signage, and revegetation; 5) maintain the trail in perpetuity; and 6) establish and maintain a volunteer trail patrol to assist the agencies in monitoring trail conditions, the activities of trail users, and wildlife responses to trail use by the public. If an adequate number of volunteers (as determined by the Refuge Manager) cannot be found, a paid patrol officer should be provided in perpetuity, or until the OVRP volunteer program is activated.

2. The specific route for the trail and any materials developed to publicize the trail shall be coordinated with and receive written approval from the Refuge Manager.

3. The OVRP is responsible for the development and installation of special signage at both points along the trail where the trail enters Refuge property. This signage, which is to be in place before the trail is opened to public access, must explain that the trail is entering a National Wildlife Refuge and describe the importance of staying on the trail.

4. Appropriate fencing and regulatory signage, which must be paid for and installed by the OVRP before the trail opens, is to be provided along the trail as it passes through the Refuge.

5. The trail surface must be approved by the Refuge Manager and should consist of native soil, decomposed granite, or a hardened surface.

6. Equestrian uses will not be permitted on the portion of the trail that crosses the Refuge lands.

7. Use of the trail between dusk and dawn will be prohibited and this regulation should be included on all appropriate trail signage.

8. All stipulations must be in place prior to opening the trail for public use.

Justification:
The extension of the proposed Otay Valley Regional Trail onto refuge lands, if permitted in accordance with the stipulations listed above, would not materially interfere with or detract from the purposes for which the South San Diego Bay Unit was established or the fulfillment of the National Wildlife Refuge System mission. This trail, although not regarded as a priority public use, would provide the public with additional opportunities to observe wildlife on Refuge lands, therefore contributing to the goal of providing safe wildlife dependent recreational activities on

the Refuge.

Mandatory Re-Evaluation Date:

__Mandatory 15-year Re-Evaluation Date (for priority public uses)

X Mandatory 10-year Re-Evaluation Date (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision:

__Categorical Exclusion without Environmental Action Statement

__Categorical Exclusion and Environmental Action Statement

__Environmental Assessment and Finding of No Significant Impact

X Environmental Impact Statement and Record of Decision

References Cited:

DeLong, Anita and Janet Schmidt. 2000. Literature Review: Effects of Human Disturbance on Wildlife with Emphasis on Wildlife-Dependent Recreation Relevant to Stillwater National Wildlife Refuge (Draft).

County of San Diego. 2001. Otay Valley Regional Park Concept Plan. Adopted by the County of San Diego Board of Supervisors, the Chula Vista City Council, and the San Diego City Council.

U.S. Fish and Wildlife Service. 2006. San Diego Bay National Wildlife Refuge (Sweetwater Marsh and South San Diego Bay Units) Final Comprehensive Conservation Plan/Environmental Impact Statement.

Refuge Determination:

Prepared by: ________________________________Date: __________

Refuge Manager/
Project Leader
Approval: ________________________________Date: __________

<u>Concurrence</u>:

Refuge Supervisor: ________________________________Date: __________

Assistant Manager, Refuges
California/Nevada
Operations Office: ________________________________Date: __________

Manager, California/Nevada
Operations Office: ________________________________Date:__________

Appendix L

Fire Management Plan for the San Diego NWR Complex

Appendix L: Fire Management Plan Summary

The Department of the Interior (DOI) fire management policy requires that all refuges with vegetation that can sustain fire must have a Fire Management Plan that details fire management guidelines for operational procedures and values to be protected and/or enhanced. The San Diego National Wildlife Refuge Complex has year-round fire-funded personnel that are stationed at the San Diego NWR.

The Fire Management Plan (FMP) for the San Diego National Wildlife Refuge Complex provide guidelines for appropriate suppression and/or prescribed fire programs at the San Diego Bay, San Diego, Seal Beach, and Tijuana Slough National Wildlife Refuges. With respect to San Diego Bay NWR, the plan focuses on preparedness, wildland fire operations, prevention, and detection. Prescribed and wildlife fire use are not proposed as a strategy for achieving land management objectives on this Refuge.

The Plan outlines the fire management objectives for the Complex, describes the Complex's wildland fire management situation, and presents the Complex's fire management strategies. Values considered in the Fire Management Plan include protection of Refuge resources and neighboring private properties, effects of burning on refuge habitats/biota, and firefighter safety. Refuge resources include properties, structures, cultural resources, trust species including endangered, threatened, and species of special concern, and their associated habitats. The Fire Management Plan will be reviewed periodically to ensure that the fire program is conducted in accordance and evolves with the U.S. Fish and Wildlife Service (USFWS) mission and the San Diego National Wildlife Refuge Complex goals and objectives.

Copies of the Fire Management Plan are available for review at the San Diego National Wildlife Refuge Complex, 6010 Hidden Valley Road, Carlsbad, CA 92011 or by contacting Victoria Touchstone, Refuge Planner, at (760) 431-9440 extension 349.

Appendix M

Final Predator Management Plan

Final
PREDATOR MANAGEMENT PLAN
San Diego Bay National Wildlife Refuge
(Sweetwater Marsh and South San Diego Bay Units)

I. Overview

Pursuant to its endangered species management responsibilities and in conjunction with other wildlife and habitat management activities, the U.S. Fish and Wildlife Service (Service) will implement, per available funding, predator management on the San Diego Bay National Wildlife Refuge (Refuge). Species to benefit from this action include the Federal endangered California least tern (*Sternula antillarum*) and light-footed clapper rail (*Rallus longirostris levipes*) and the threatened western snowy plover (*Charadrius alexandrinus nivosis*). Predator management is identified in the draft San Diego Bay National Wildlife Refuge (NWR) Comprehensive Conservation Plan (CCP)/Environmental Impact Statement (EIS) (*USFWS 2005*) as one of several actions to be implemented in support of the Refuge's listed species.

This predator management plan has been developed as a comprehensive wildlife damage control program that addresses a range of management actions from vegetation control and nesting habitat enhancement to non-lethal and lethal control. The most effective, selective, and humane techniques available to deter or remove individual predators or species that threaten nesting, breeding, or foraging least terns, snowy plovers, or clapper rails will be implemented.

II. Purpose

The San Diego Bay NWR was established to conserve Federal endangered and threatened species. The two Refuge Units share the common goal of "*supporting the recovery and protection efforts for Federal endangered and threatened species, other species of concern, and their habitats.*" The objectives of this predator management plan are intended to assist the Service in achieving this goal and meeting the purpose for which the Refuge was established.

The implementation of this predator management plan is intended to increase the productivity of the Refuge's federally-listed endangered and threatened seabird and shorebird species. Numerous incidents of predation on listed species by a variety of native and nonnative mammalian and avian predators are documented annually within the Refuge. The Refuge, along with most other habitat available to California least terns, western snowy plovers and light-footed clapper rails, represent some of the best remaining examples of coastal wetland habitats in southern California. As such, these remaining habitats act as magnets for the community of migratory and endemic wildlife that survive in the current landscape. Urbanization has led to increased numbers of many species of generalist, common predators. The potential impact of increased native and non-native predator densities on endangered species populations is a significant impediment to their recovery.

Reducing the number of California least tern, light-footed clapper rail, and western snowy plover adults, chicks, and eggs lost to predation is an important strategy in achieving the management objective of recovering and maintaining stable populations of these listed species on the Refuge. Other species that could indirectly benefit from predator management include the Federal endangered California brown pelican (*Pelecanus occidentalis californicus*), which roost along the salt pond levees of the South San Diego Bay Unit, and the State listed endangered Belding's savannah sparrow, which nests in the pickleweed-dominated salt marsh habitat of both the Sweetwater Marsh and South San Diego Bay Units. Several species identified by the Service as Birds of Conservation Concern (*USFWS 2002*), including the black skimmer (*Rynchops niger*), elegant tern (*Sterna elegans*), and western gull-billed tern (*Sterna nilotica vanrossemi*), will also derive some benefits from the implementation of this plan.

The western gull-billed tern, however, is a special case in the context of this plan. Since the South San Diego Bay Unit was established in 1999, the gull-billed tern has benefited from various Refuge management activities including predator management and nest site enhancement. Due in part to these Refuge management actions, the breeding population of this species at the salt works has increased from an estimated 11 to 20 breeding pairs in 1999 (*Patton 2001*) to approximately 40 pairs in 2004 (*Patton pers. comm.*). During this same period, the number of least tern and snowy plover chicks lost to gull-billed tern predation has also increased (*Patton 2004*). This interaction between the gull-billed tern and the listed species that nest at the salt works cannot easily be addressed because of the extremely small population size of the western gull-billed tern. Various programs within the Service, including the Division of Migratory Bird Management, Ecological Services, and the National Wildlife Refuge System, are currently working together to identify appropriate actions that when implemented will ensure the recovery and conservation of all three of these trust species (least terns, snowy plovers, and gull-billed terns) throughout their range.

Predator Management Plan Objectives:

- Increase the productivity of California least tern and western snowy plover by reducing the loss of eggs and chicks to predation and reducing the number of adult birds of these species that are lost or driven away by predators;

- Reduce the loss of adult and juvenile light-footed clapper rails and eggs due to predation;

- Reduce the number of individual problem predators in localized areas within the Refuge (*Problem predators* are defined as individual predators that are exhibiting hunting behavior in listed species nesting areas or essential habitat areas or that have been identified as actually preying on a listed species.);

- Eliminate disturbance to roosting California brown pelicans by non-native mammalian predators; and

- Reduce disturbance and predation by mammalian predators within seabird nesting colonies on the South San Diego Bay Unit.

III. Background and Description of Problem

California's coastal wetlands provide essential habitat for a variety of avian species, including the Federal endangered and threatened species and other species of concern supported on the Refuge. The decline in the population of many of these species has been attributed to habitat loss, the introduction of exotic species populations, water and air pollution, habitat degradation, and human disturbance. The California Coastal Commission (*1987*) estimates that as much as 90 percent of California's original coastal wetlands have been lost to development. Additionally, the majority of California's sandy beaches that historically provided expansive habitat areas for seabirds, such as the California least tern, and shorebirds, like the western snowy plover, are now extensively utilized for human recreation and/or have been modified to support beachfront housing and other coastal development.

Today, coastal migratory birds are faced with two converging problems that seriously reduce reproductive success: limited viable nesting habitat and the concentration of native and non-native predators in proximity to nesting areas. The direct conversion of habitat to urban development and indirect losses of habitat resulting from increased human activity have greatly reduced the availability of suitable nesting areas. With fewer viable sites available, nesting seabirds and shorebirds are concentrated on fewer and more geographically limited nesting areas than previously occurred under more natural landscape conditions. Predation potential under current conditions has increased as predator foraging activities have become more intensely focused on the same remnant areas of coastal habitat that have been set aside for the protection of nesting migratory birds. Additionally, urban development has created conditions that are advantageous to many native, generalist predators resulting in larger populations of some predator species than were present historically. An abundance of non-native predators, such as feral dogs and cats and Virginia opossums, are able to enter the Refuge from adjacent urban areas. Their presence negatively impacts the viability of remaining coastal habitats for supporting endangered species.

Many populations of southern California coastal nesting bird species are declining and others are endangered or threatened with extinction. Without human intervention, it is likely that several of these species will not survive. Reproductive success is strongly influenced by food availability, quality of breeding habitat, and predation pressure. Controlling the numbers of predators in endangered and threatened species habitats is the main variable that humans can directly control in a localized context. Providing additional breeding areas (protected nesting sites) to give the protected species greater opportunity to successfully breed continues to be pursued by land management agencies, however, there are very limited opportunities for such efforts in Southern California's dense urbanizing environment. Therefore, management to reduce the potential for significant losses of threatened and endangered species due to predation on nesting grounds or other crucial habitat areas is an essential wildlife conservation goal.

Various conservation plans have been or are being developed that outline conservation priorities for specific assemblages, guilds, and communities of birds. Among the population conservation issues for waterbirds, as addressed in the North American Waterbird Conservation Plan (*Kushlan et al. 2002*), and the priority conservation actions for shorebirds, as outlined in the Southern Pacific Shorebird Conservation Plan (*Hickey et al. 2003*), is the need for appropriate predator management in waterbird and shorebird nesting areas.

The following are brief summaries of relevant information relating to species populations targeted for protection under this predator management plan.

California Least Tern

The California least tern is a loosely colonial, ground nesting, migratory seabird that returns from tropical latitudes to breed in southern California. Least tern nest sites are largely unvegetated, flat, open areas consisting of light colored, sandy surfaces near water bodies supporting abundant small fish. This tern once nested on beaches throughout southern California, south through Baja California, Mexico, and north to the San Francisco Bay area, however, increasing urbanization and habitat loss has led to the decline of its population with the majority of the remaining nesting colonies confined to San Diego and Orange Counties. With the loss of traditional beach nesting sites, this species has been forced to find alternative, less traditional nesting colony sites including landfills and airports (*Patton 2002*).

The Service published a rule, effective June 2, 1970, listing the California least tern as endangered under the Endangered Species Act of 1973, as amended (ESA). The California least tern is endangered throughout its range as a result of the loss and degradation of nesting and foraging habitat and disturbance of nesting birds. Recovery actions described in the California Least Tern Recovery Plan (*USFWS 1985a*) include preserving and managing existing nesting colonies and providing new nesting sites in protected areas, maintaining adequate foraging habitat for nesting colonies, and minimizing disturbance and mortality by preventing human disturbance and minimizing predation.

Today, nest sites are largely fixed in their location and size, with two of seven San Diego Bay sites falling within Refuge management responsibility. Historically, least tern nesting success at the salt works within the South San Diego Bay Unit has been poor although little active predator management occurred on the property until the Refuge Unit was established in 1999. On the Sweetwater Marsh Unit, the nesting success on the D Street Fill nesting area has been seasonally variable, with site disturbance and predation being the primary factors in least tern breeding failure.

The least tern is vulnerable to a long list of predators, some of which are very abundant in urban environments, such as feral or domestic cats and dogs, American crows (*Corvus brachyrhychos*), and American kestrels (*Falco sparverius*). In the 2000 nesting season, 20 species were observed preying on or taking a least tern egg, chick, fledgling, or adult in California. Twelve of these species are considered possible predators on the Refuge (*Patton 2002*); including feral dog, coyote (*Canis latrans*), gray fox (*Urocyon cinereoargenteus*), opossum (*Didelphis virginiana*), peregrine falcon (*Falco peregrinus*), American kestrel, gull-billed tern, and various gull species. Between 1999 and 2002, there were numerous documented losses of California least tern chicks due to predation.

Under this plan, the nest site management actions presented below will be implemented to improve least tern reproductive success.

- Vegetation management to control weeds, avoid excessive plant growth, and maintain barren, sandy areas occurs annually at the D Street Fill in partnership with the Unified Port of San Diego (Port);

- Nesting substrate is periodically enhanced by adding clean, light sand to various salt pond levees;

- Signs and fencing are maintained in various areas to reduce human and mammalian disturbance in seabird nesting areas;

- Endangered species monitoring has been conducted annually in the nesting colonies to record reproductive success and document factors affecting success including disturbance and predation (monitoring will continue in accordance with available funding);

- Predator monitoring is conducted annually during the nesting season to provide current data regarding the presence of predators within the vicinity of the nesting colony and to document and address incidents of predation within the colony;

- Active nest sites are often protected using tiles, exclosures, and other physical devices to reduce accessibility of eggs and chicks to predators; and

- All mammalian predators observed in nesting areas are removed and individual problem avian predators may be controlled as appropriate to reduce loss of least tern eggs, chicks, and adults.

Western Snowy Plover

On March 5, 1993, the Pacific coast population of the western snowy plover was listed as threatened under the provisions of the ESA. The western snowy plover is threatened throughout its range as a result of the loss and disturbance of habitat and nesting sites. There are only a handful of snowy plover breeding locations currently used in southern California. Regularly used locations include Bolsa Chica (Orange County), Camp Pendleton, Batiquitos Lagoon, Naval Amphibious Base-Coronado, Silver Strand State Beach, and Tijuana Estuary in San Diego County. Within the South San Diego Bay Unit, snowy plover nesting occurs regularly at the salt works (six of the last nine years) with one to four nest attempts each year. Unfortunately, reproductive success has been poor. No nest attempts were observed at the salt works in 2003. Between two and ten snowy plover nesting attempts with poor reproductive success have historically occurred at the D Street Fill on the Sweetwater Marsh Unit, however, since 2000, there have been no known nesting attempts by snowy plovers in this area. Disturbance and predation are the most likely reasons for this poor history of reproductive success.

The list of potential predators of snowy plover eggs and chicks is long. During extensive surveys of breeding and wintering snowy plovers conducted in San Diego County between 1994 and the winter of 1999, it was determined that most nest failures in 1994, 1996 and 1997 were the result of predation (*Powell et al. 2002*). Documented egg predators included corvids (ravens and crows), coyotes, Argentine ants and gulls. Although the causes of chick mortality are more difficult to determine, several species were determined to be likely causes of mortality during these surveys including great horned owl (*Bubo virginianus*), burrowing owl (*Athene cunicularia*), gull-billed tern, and American kestrel. Due to high densities in surrounding urban areas, corvids, kestrels, and feral dogs and cats represent significant threats to the snowy plover population on this Refuge.

The Western Snowy Plover Pacific Coast Population draft Recovery Plan (*USFWS 2001*) includes the prevention of excessive predation of snowy plover as one of the recovery tasks requiring implementation to maximize the survival and productivity of this species. The draft plan encourages the employment of an integrated approach to predator management that considers a full range of management techniques and recommends seeking assistance from U.S. Department of Agriculture (Wildlife Services Branch) biologists, State wildlife agency biologists, and others. Specific management techniques addressed by the plan include manual removal of litter and garbage from nesting areas, removal of predator perches and unnatural habitats, use of predator exclosures where appropriate, removal of predators where warranted, and removal of bird and mammal carcasses in nesting areas. These actions, as well as those described for the California least tern, will be implemented on the Refuge under this plan.

Light-footed Clapper Rail

Light-footed clapper rails are year-round residents of coastal salt marshes and lagoons, although they may also occasionally be found upstream in freshwater marsh habitat. Generally, they nest in the lower littoral zone of a salt marsh where dense stands of cordgrass (*Spartina foliosa*) are present (*USFWS 1985b*). As a result of the destruction of coastal wetlands throughout southern California, the total population of light-footed clapper rails became so seriously low that on October 13, 1970, this species was added to the Federal list of endangered species and was designated as endangered within the United States.

The leading threats to clapper rails are salt marsh habitat loss, degradation, and fragmentation. These rails are also threatened by disturbance, diseases, contaminants, and predation. Potential predators of clapper rail eggs, nestlings, and adults include California ground squirrel (*Spermophilus beecheyi*), rats (*Rattus* spp.), long-tailed weasels (*Mustela frenata*), garter snakes (*Thamnophis* sp.), striped skunk (*Mephitis mephitis*), feral dogs and cats, opossum, and a variety of hawks and owls (*USFWS 1985b*). The Recovery Plan for the Light-Footed Clapper Rail (*USFWS 1985b*) includes as a recovery action the need to identify and control predators within marshes where predation is believed to be a significant problem.

Clapper rails within the Refuge suffer from a lack of adequate high-tide refugia which limits the rails' ability to hide when forced out of the salt marsh during high tide events. It is a goal the Refuge to restore and manage a fully functional coastal salt marsh/coastal sage scrub transitional habitat for the protection of the rail during its entire life cycle. However, this is a long-term commitment and will take many years to achieve. The rail will need additional management measures intended to protect and restore its populations including predator management. The FWS is currently working with several partner agencies to develop a captive breeding protocol development program for the light-footed clapper rail. This program seeks to bolster the genetic and demographic diversity of the species within isolated wetlands in the United States. As salt marshes are restored, it is hoped that various management actions taken now, will give the species the best possible chance to remain viable within coastal salt marshes in southern California well into the future.

The following actions will be implemented to protect the Refuge's clapper rail population:

- Regulatory signage and periodic patrol by the Refuge law enforcement office is provided to minimize human disturbance in clapper rail habitat;

- Nesting platforms are maintained in the marsh to provide chicks and eggs with enhanced protection from avian predators; and

- Year-round predator monitoring is conducted to identify and control native and non-native mammalian predators that pose a threat to the rails.

California Brown Pelican

The California brown pelican was listed as endangered on June 02, 1970 because of widespread pollutant-related reproductive failures. This bird is extremely sensitive to bioaccumulation of the pesticide DDT (and other organochlorine pesticides), which causes reproductive failure by altering calcium metabolism and thinning eggshells (*USFWS 1983*). Although California breeding populations have rebounded since the elimination of DDT use, the continued presence of DDT and its byproducts in the ecosystem, as well as other factors, still threaten this species. Delisted in1985 in the areas of the U.S. Atlantic coast, Florida, and Alabama, this species is still considered endangered within California, Louisiana, Mississippi, Oregon, Puerto Rico, Texas, Virgin Islands, Washington and Central and South America.

Today, the availability of adequate food supplies is a major concern for the long-term recovery of this species. Commercial over-harvesting of Pacific mackerel, Pacific sardine, and the northern anchovy has resulted in less food availability for these birds, particularly during the breeding season. Pelicans are also threatened by human development along the coast, which increases disturbance to these birds in their breeding and resting habitats. The availability and quality of roosting and loafing areas influence the energy budgets and reproductive potential of these birds (*Jaques and Anderson 1987*). Management of these essential habitats to minimize disturbance is therefore important for both breeding and non-breeding birds. The South San Diego Bay Unit, particularly the levee between Pond 10 and 11 within the salt works, is an important roosting area for brown pelicans during the non-breeding season. Feral and domestic dogs, coyotes and human disturbance represent the largest threats to these roosting pelicans. Roosting opportunities within the South San Diego Bay Unit were recently expanded to include a floating platform within the salt works. The use of this platform will be monitored and if adequate numbers of pelicans are using the platform for night roosting, additional platforms may be installed.

Birds of Conservation Concern

The 1988 amendment to the Fish and Wildlife Conservation Act mandates the Service to "identify species, subspecies, and populations of all migratory non-game birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act of 1973." To meet this mandate, the Service has prepared Birds of Conservation Concern 2002 (*USFWS 2002*), which is intended to accurately identify the migratory and non-migratory bird species (beyond those already federally designated as threatened or endangered) that represent our highest conservation priorities and draw attention to species in need of conservation action. The goal of the Service is to preclude the need for additional bird listings under the Endangered Species Act by implementing proactive management and conservation actions. Within the Sweetwater Marsh Unit, four of the shorebirds that frequent the marsh have been identified as Birds of Conservation Concern; these include the whimbrel, long-billed curlew, marbled godwit, and short-billed dowitcher. Six shorebirds and three colonial nesting seabirds included on the list of Birds of Conservation Concern 2002 are supported by the habitats within the South San Diego Bay Unit. These species include the whimbrel, long-billed curlew, marbled godwit, black turnstone, red knot, short-billed dowitcher, gull-billed tern, elegant tern, and black skimmer. The elegant tern and black skimmer could indirectly benefit from the implementation of this predator management plan.

Gull-Billed Tern (*Gelochelidon nilotica vanrossemi*)

Management for the suite of avian species that utilize the Refuge is complex and difficult. The species conflicts inherent in managing the changing community of organisms utilizing coastal wetlands in southern California today present challenges that traditional wildlife managers may never have encountered historically. A case in point is the western gull-billed tern in San Diego Bay.

The gull-billed tern is designated as a Bird of Conservation Concern (BCC) at the national, regional (USFWS Pacific Region), and local scale (Southern Coastal California Bird Conservation Region). The Fish and Wildlife Conservation Act (1988 Amendment) requires that the Service "*identify species, subspecies, and populations of all migratory non-game birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act of 1973*". BCC 2002 is the 3rd edition of this congressionally-mandated list and represents the most comprehensive effort thus far to identify species in need of active conservation measures. The gull-billed tern was included in the list because of its declining population trends and threats to breeding birds. At the subspecies level, the western gull-billed tern is of increased concern due to its extremely small population size (<600 known nesting pairs range-wide), limited distribution (ten sites range-wide), suspected population declines, and threats during the breeding season. The BCC designation does not impose regulatory conditions; however, birds included on the BCC 2002 list are deemed priorities for conservation actions. In addition, under Executive Order 13186, "Responsibilities of Federal Agencies to Protect Migratory Birds," Federal agencies are to avoid and/or minimize adverse impacts on birds, and BCC species in particular, while conducting agency actions and are encouraged to restore and enhance habitat for migratory birds. Additionally, one of the Service's primary goals is to conserve avian diversity in North America. Conserving ecosystem diversity is one of the goals of the National Wildlife Refuge System.

The western gull-billed terns that nest at the salt works benefit from a number of recovery actions implemented to conserve the California least tern and western snowy plover. These recovery actions include habitat protection, habitat enhancement, reduced human disturbance, and predator management. In addition to the benefits of refuge management and management for endangered species recovery, the Service has also been monitoring the gull-billed terns at the salt works and throughout its range to better understand the population size, nesting ecology, and conservation needs of this species. In 2003, the Service joined with biologists in Mexico to conduct comprehensive surveys of gull-billed terns in western Mexico. The results of these surveys were reported in Palacios and Mellink (*2003*).

Based on the information available to date, the estimated population of this subspecies in western Mexico is 376 breeding pairs, with 80 percent of the population occurring within two relatively large colonies (Cerro Prieto, Baja California and Laguna de Pericos, Nayarit) (*Palacios and Mellink 2003*). Within the United States, this subspecies only nests in two locations: the Salton Sea and the salt works within the South San Diego Bay Unit. The combined population of these two colonies in 2003 is estimated at about 190 breeding pairs (*Seto pers. comm.*). Ongoing monitoring of gull-billed tern colonies by the Service and others will improve our understanding of the breeding biology and distribution of the gull-billed tern range-wide. Information provided by these studies will also assist in developing management actions to conserve this species. Further, we will be able to better assess how conservation of the gull-billed tern can be coordinated with ongoing endangered species recovery actions in Southern California.

Gull-billed tern nesting on the South San Diego Bay Unit was first documented in 1987 (*Terp and Pavelka 1999*). Between 1999 and 2004, the number of breeding pairs at the salt works has slowly increased from between 11 and 20 in 1999 (*Patton 2001*) to approximately 40 in 2004 (*Patton pers. comm.*). Unlike the other colonial nesting seabirds at the salt works, the gull-billed tern is an opportunistic feeder, foraging on a variety of terrestrial and aquatic animals. A recent study conducted in San Diego Bay by Molina and Marschalek (*2003*) found small invertebrates (primarily mole crabs, *Emerita analoga*) and small fish to be the primary prey items delivered by adults to chicks. Lizards (*Uta stansburiana* and *Sceloporus occidentalis*), insects, and small black-necked stilt (*Himantopus mexicanus*), killdeer (*Charadius vociferus*), western snowy plover and California least tern chicks were also part of the gull-billed tern's diet. The first report of gull-billed tern predation on a least tern chick occurred in 1988 in Mississippi (*Densmore 1990*). Predation of least tern and western snowy plover chicks by gull-billed terns has been documented at the San Diego Bay NWR since 1999 (*Patton pers. comm.*).

Over the past few nesting seasons, gull-billed terns nesting at the salt works have become effective predators of young least tern and western snowy plover chicks. The largest losses occurred in 2003, when 54 chicks were known to be lost to gull-billed tern predation. During the 2004 nesting season, 43 chicks were lost to gull-billed terns. It should be noted that these are minimum numerical estimates of listed species chick losses due to the fact that observers are only present at certain times. Biologists monitoring these nesting populations infer that depredation by gull-billed terns on snowy plover and least tern chicks is ongoing when observers are not present, therefore, the impacts that gull-billed terns have had on the productivity of nesting sites throughout San Diego Bay and the Tijuana Estuary are not insignificant (*Brian Collins pers. comm.*).

Since 2001, the Service has met with private biologists, land managers, and Service staff prior to each nesting season to discuss strategies for addressing gull-billed tern predation. Based on input from these meetings, the Service has chosen to refrain from conducting predator control actions on the gull-billed tern. The question of whether or not the Refuge should manage the size of the gull-billed tern colony at the salt works in an effort to reduce the loss of least tern and snowy plover chicks to gull-billed tern predation was raised again during the preparation of this predator management plan. Based on the desire to maintain/enhance the numbers of breeding gull-billed terns in Southern California, it was determined that no lethal control of this species will be considered at this time. Instead, over the next few years, the Service will implement several actions to address gull-billed tern predation of least terns and snowy plover chicks including the initiation of a pilot project to experiment with different types of chick shelters for California least terns and developing an experimental design to better document avian predation on both least terns and snowy plovers. In addition, during the 2005 breeding season a limited monitoring program of the gull-billed tern colony at the salt works will be implemented to evaluate nesting activity, reproductive success, and predation activities. The Service's Migratory Birds Program will also continue to work with partners in Mexico to complete year two of a range-wide survey for gull-billed terns.

IV. Existing Predator Management Efforts in the San Diego Bay Region

San Diego National Wildlife Refuge Complex. The San Diego National Wildlife Refuge Complex (Complex) currently conducts a variety of management activities on the Tijuana Slough NWR, Sweetwater Marsh Unit, and South San Diego Bay Unit for the purpose of protecting colonies and/or pairs of California least tern, western snowy plover, light-footed clapper rail, and other Federal trust species of migratory birds. Management activities currently conducted to minimize attractants to predatory populations include: trash management, installation and maintenance of perimeter fencing in some locations, removal or trimming of large shrubs and trees in proximity to nesting areas to reduce the availability of resting and perching areas, and the use of various forms of exclosures over the nests of some species such as the western snowy plover. Another activity, public education and outreach, is an important component of the predator management program conducted at the Tijuana Slough NWR. This involves ongoing education programs relating to endangered species, the annual distribution of educational materials to the local community just prior to the nesting season. These materials address the problems associated with intended or unintended feeding of feral populations of domestic animals, clearly identify wildlife protected areas, and explain the importance of responsible control of household pets to the Refuge's wildlife species. Special emphasis, usually in the form of door-to-door distribution of materials, is placed on getting these materials to those residents who live immediately adjacent to the Refuge.

Predator management activities are closely coordinated with regular biological monitoring of nesting colonies in part to provide evidence of the identity of problem predators and the magnitude of the predation impacts to listed species populations. When indirect means do not provide adequate protection based upon data gathered through biological monitoring, direct predator management actions, including non-lethal and if necessary lethal control, are implemented.

Unified Port of San Diego. The Unified Port of San Diego (Port) manages two sites surrounding the Bay, including tern nesting areas within Lindbergh Field (San Diego International Airport) and the Chula Vista Wildlife Reserve. The D Street Fill portion of the Sweetwater Marsh Unit is co-managed by the Port and the Service, which each owns a portion of this fill area. Management is similar to that conducted on the San Diego Bay NWR and includes site preparation, annual monitoring, and predator control. USDA APHIS-WS currently conducts active predator management on these areas under contract with the Port.

United States Navy. The United States Navy manages three of the six current least tern and snowy plover nesting areas surrounding San Diego Bay. These three locations are located within the Naval Air Station North Island and Naval Amphibious Base Coronado. Management is similar to that conducted on the San Diego Bay NWR and includes site preparation, annual monitoring, and predator control. However, some nesting areas occur within heavily used training areas and the Navy's training needs may influence the timeliness of these programs. The Navy has historically contracted with USDA APHIS-WS for predator management implementation at these sites.

Interagency Coordination. Coordination among agencies is ongoing and statewide pre and post-breeding season least tern and western snowy plover meetings are held annually to discuss plans and results of the various management programs for that season. These meetings provide the opportunity to discuss what actions are most effective in achieving the recovery goals for the various endangered and threatened species covered by these programs. Additionally, interagency meetings are periodically scheduled to address species-specific issues related to predation and recovery. Interagency meetings to address issues related to gull-billed terns have been conducted since 2001. These meetings have led to support for continuing population assessments for the species, as well as support by some for the candidacy as threatened or endangered for the western North American population of the gull-billed tern.

V. Management Plan

The predator management plan for the San Diego Bay NWR will be implemented to reduce damage by predators to Federal threatened or endangered species populations. The threat may be to adults, chicks, or eggs. A range of management actions, including non-lethal and lethal control, will be implemented. As such, the plan represents a comprehensive wildlife damage control program that will integrate and apply practical methods of prevention and control to reduce damage by wildlife while minimizing the harmful effects of the control measures on humans, other species, and the environment. The activities conducted on the Refuge will vary depending upon the specific wildlife damage problem that is occurring. A particular predator problem may be addressed through the implementation of activities related to resource management, physical exclusion, wildlife management, or any combination of these.

For most predatory species, removal will be accomplished primarily by hazing or live trapping and secondarily by lethal control. In all cases, the most humane methods available will be used. Efforts will be made to avoid and minimize losses of non-target native wildlife and all uninjured non-target species inadvertently captured will be immediately released near the site of capture or at a suitable location at the discretion of the Refuge Manager.

Direct control methods will include live-capture and translocation of individual predators; the intentional hazing (scaring off) of predatory species from nesting areas; and in some cases the lethal removal of problem predators. Lethal removal, which may involve shooting or the use of body grips or gas cartridges, may be used to remove predators that are identified as known and immediate threats to endangered or threatened species within the Refuge. Only licensed and authorized agencies or individuals will implement predator management actions.

Without continued management of mammalian and avian predators, the Refuge's population of light-footed clapper rails could be eliminated and the population size and nesting success of snowy plovers and least terns could decline dramatically. As a result, the Service believes that the following approach to predator management within the various areas of the Refuge will achieve the goals, objectives, and legal mandates of the Service on the San Diego Bay NWR.

D Street Fill

This 40-acre area on the Sweetwater Marsh Unit will continue to be jointly managed by the Service and the Port. Management will include the removal of weedy vegetation and control of shrubs and other potential perching or hiding areas for avian and mammalian predators. To reduce accessibility to the site by large mammals, the Service will continue to maintain the fence and gate at the eastern edge of the property. Roof tiles, exclosures, and other nest shelters will also be used when deemed appropriate to minimize take of eggs and chicks by avian predators. Under this plan, predator monitoring on the D Street Fill will be conducted during the nesting season. Endangered species monitoring within the nesting colony will also be conducted provided that adequate funding is available. Throughout the nesting season (March through September), the colony will be monitored for signs of specific predators, tracks, or other indicators of the presence of mammalian predators in the vicinity of nesting areas. The area will also be monitored for evidence of losses due to avian predators. Endangered species monitoring of nesting colonies will provide hatch and fledge rates, as well as adult survivorship and population size.

The predators that will be most commonly targeted for control include feral cats and dogs, California ground squirrels, Virginia opossums, Norway and black rats, striped skunks, common raven, American crow, and western gull. Prior to each nesting season ground squirrels will be lethally removed from the site to reduce the loss of tern and plover eggs. Coyotes, foxes, and other native mammalian predators will be trapped or shot when found within the nesting colony.

Non-lethal methods will be emphasized as the preferred tool for controlling avian predators. During the nesting season only, individual problem avian predators may be live-captured and later released in a suitable location. In cases where trapping is unsuccessful and an individual predator has learned to depredate tern or plover eggs and chicks, the predator may be lethally removed upon approval of the Refuge Manager.

Salt Pond Levees

Management actions to protect nesting least terns and western snowy plovers on the salt pond levees of the South San Diego Bay Unit will be similar to those described for the D Street Fill. Levee tops and other nesting areas will be maintained annually as needed. Fencing will be installed as needed to reduce access into the area by mammals, and predator monitoring will occur during the nesting season. During monitoring, dead animals that might attract predators to the area will be removed from the site.

Paradise Marsh/Sweetwater Marsh/Otay River Floodplain

Predator management will also be implemented within those areas of the Refuge that support the endangered light-footed clapper rail. The clapper rail is a year-round resident of the Refuge; therefore, predator management will also be conducted year-round. Various actions will be taken to reduce clapper rail predation. A public outreach program will be conducted annually to inform nearby residents of the adverse effects that cats and dogs can have on the species. Unauthorized access by the public into sensitive marsh areas will be controlled through signs, fencing, and patrol by law enforcement personnel. Nesting platforms will be installed and maintained where appropriate to protect eggs and young clapper rail chicks. Mammalian predators are the primary predators of concern for this species. These include domestic and feral cats, raccoons, and the non-native red fox, among others. Predator monitoring will be implemented throughout the year to look for signs of specific predators, tracks, or other indicators of the presence of mammalian predators in the marsh that could pose a threat to the rails. Avian predators are documented to take light-footed clapper rails. Avian predators will be treated on a case-by-case basis. Non-lethal methods will be tried first before implementing lethal removal.

VI. Direct Control of Predators - Species Specific Protocols

The direct control of predators on the Refuge has historically been implemented by U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service, Wildlife Services (APHIS – WS) through an interagency agreement with the Service. It is likely that this arrangement will continue in the future, provided funds are available. Contracts will be issued annually and will include detailed descriptions of approved control methods, disposition procedures for captured predators, and species-specific protocols. Predator management will be implemented year-round, although the majority of the contracted activities will occur during the breeding season. During the non-breeding season for endangered species, APHIS – WS will concentrate on the control of feral dogs and cats and mammalian predators such as skunks and opossums, which pose a threat to the light-footed clapper rail.

Various types of equipment and techniques will be used to implement predator management on the Refuge and all such implementation will occur in accordance with federal and state regulations. The preferred control methods include live trapping and hazing. Knowledge of the particular predator's habits, particularly the habits of avian predators, will determine which trapping technique is employed.

Live trapping may include the use of box type mammal traps, Bal-chatri traps [a type of baited monofilament line leg-hold/cage trap], scent baited padded leg-hold traps and perch pole traps. Manual capture methods may also be employed using hand held capture poles or other manual techniques. Traps are inspected in accordance with State Fish and Game Code and Service policy. Specifically, traps set out overnight for mammalian predators are checked within two hours of sunrise and traps left out during daylight hours are monitored regularly and checked a minimum of four times per day. Traps set for avian predators may be left out overnight if nocturnal predation is considered a threat to protected species. The use and monitoring of pole traps will be conducted in accordance with Service policy.

Hazing may be used to deter particular predators at the discretion of the Refuge Manager, and can include the use of firearms, pyrotechnics, and/or audio or visual stimuli.

When deemed necessary, lethal removal by shooting, body grip traps, and gas cartridges may be used to take predators that are identified as known and immediate threats to endangered or threatened species. Lethal removal of avian predators is most often employed when an individual problem predator has focused its foraging activities on the nesting colony. In this case, an entire colony's productivity or even survival can be jeopardized in a short time frame. One such example occurred in 1997. A pair of burrowing owls was observed preying on adult and chick California least terns at the Tijuana Estuary. Refuge staff determined that live trapping was the preferred method of control because of a concern for the sensitivity of the local burrowing owl population. Over about a 12-day period (the time it took to locate and live-capture the owls), this pair of owls had taken between 70 and 80 breeding adult least terns and an unknown number of chicks. This one event resulted in the lost of approximately 18% of all breeding individuals in the colony during that nesting season (*Patton 1998*). Under this plan, selective removal of individual problem predators will be permitted for all avian predators with the exception of gull-billed terns.

Routine predator monitoring will be conducted in the nesting colonies. Problem predators may be identified through direct observation of predators in the act of hunting or preying on listed species. The presence of predators in the colony can also be established through the identification of tracks of birds, reptiles, or mammals in the nesting colony, dissection of raptor pellets (disgorged undigested material from previous meals), observations of preyed-upon individuals, eggs, or other material. In many cases these observations can be used to identify, at least to species, the predator impacting the site.

Some problem predators will defeat all attempts at hazing or live trapping and will be removed by lethal methods. Prior approval from the Refuge Manager is required for all actions involving the lethal removal of <u>a</u> predator. <u>This approval for</u> lethal removal may be in the form of blanket discretionary removal of certain species found within the confines of the breeding colony site (such as for corvids, feral dogs, or feral cats where live trapping has been ineffective and nesting has begun) or on a case-by-case basis (such as for identified individual raptors).

Although not approved for use on these Refuges at this time, the avicide DRC 1339, a pesticide used to control corvid populations, may be approved for use in the future if deemed necessary, to control corvids. DRC 1339 is injected into chicken eggs, which are then secured onto strategically placed elevated bait stations in the vicinity of endangered species nesting areas. Ingestion of the pesticide is lethal to the crow or raven. Specific baiting and pre-baiting activities are conducted to eliminate the possibility of attracting non-target species.

<u>**Species Specific Protocols**</u>

Procedures for intervention with predators will be dependent upon several factors, including, but not limited to: 1) the degree of threat the individual predator poses to protected populations; 2) the native or non-native status of the predator; 3) the conservation status of specific predator species populations; and 4) the general condition of a particular protected species nesting colony including; species, nest colony phenology, relative disturbance levels from other sources, numbers of vulnerable individuals on site, and other factors.

The following species may be trapped or otherwise removed if observations, tracks, or other indicators of the presence of the species are found within the vicinity of protected species' nesting areas during the nesting season, or if it is determined that the species poses a threat to light-footed clapper rails or roosting California brown pelicans: domestic and feral dogs and cats, coyote, red fox, gray fox, California ground squirrel, Virginia opossum, striped skunk, raccoon, Norway rat, black rat, common crow, common raven, or injured gulls.

The following native avian species will be live trapped from the immediate vicinity of nesting terns and plovers, when they are determined to pose a threat to these species by USDA

APHIS-WS in consultation with the Refuge Manager: American kestrel, loggerhead shrike, barn owl, great horned owl, burrowing owl, red-tailed hawk, sharp-shinned hawk, Cooper's hawk, and various gull species.

The following species require prior consultation with the Refuge Manager before lethal or non-lethal control actions can be taken: peregrine falcon, northern harrier, and short-eared owl.

Disposition of Captured Animals
All raptors and other avian predators that are live captured will be removed and held in a licensed/permitted rehabilitation/holding center until they can be released back into the wild. Release will be at a suitable location after the endangered species nesting season is completed. Holding facilities and the location of all release sites must be approved by the Refuge Manager.

All non-native mammalian predators, other than dogs and cats, will be euthanized using approved humane methods. Target and non-target predators that are injured during trapping will be treated on a case-by-case basis. These animals may be euthanized or taken to an approved rehabilitation/veterinary care facility depending on species and extent of injuries.

All non-target wildlife (animals determined not to be a threat to protected species) that is captured unharmed will be immediately released near the capture site or at another suitable location. All domestic or feral dogs and cats, when feasible, will be taken to an approved shelter facility operated by a cooperating local unit of government, humane society or a veterinary care facility.

VI. Monitoring and Reporting

Implementation of this predator management plan will be monitored and a report will be issued annually describing the actions taken to control predation and the numbers and types of predators controlled. In addition, the report will include documented incidents of predation on listed species, recommendations on how predation might be further reduced, and an evaluation of how the current year's predator management actions relate to the objectives established for this plan.

VII. Cooperators

This plan will be implemented in cooperation with the following agencies and organizations, as appropriate:

- Fish and Wildlife Service, Carlsbad Ecological Services Field Office
- Fish and Wildlife Service, Division of Migratory Birds and Habitat Programs, Region 1
- California Department of Fish and Game
- U.S. Department of Agriculture, Animal Plant Health Inspection Service -Wildlife Services
- Unified Port of San Diego
- San Diego County Department of Animal Control
- Project Wildlife

VIII. Other Recovery Actions to be Implemented on the Refuge

Predator management is just one of several strategies that will be implemented to achieve the management goal of recovering and maintaining stable populations of the Federal threatened and endangered species and species of concern that occur within the Refuge. Other strategies described in detail in the San Diego Bay NWR Comprehensive Conservation Plan (CCP) include expanded habitat and wildlife management activities, habitat enhancement, and habitat restoration strategies are described below.

Various management strategies are proposed in the CCP to minimize human disturbance of sensitive habitat areas, including fencing, signage, and public education and outreach. Habitat enhancement is proposed to improve tidal circulation within existing marsh habitat, improve the quality of the nesting substrate for ground nesting birds, and expand the availability of cordgrass-dominated salt marsh habitat to support the clapper rail.

The CCP also includes a variety of habitat restoration proposals that would provide additional nesting, foraging, and resting habitat for endangered and threatened species and other species of conservation concern. Within the Sweetwater Marsh Unit, coastal salt marsh restoration is proposed that would provide additional nesting and foraging habitat for the light-footed clapper rail and additional habitat for foraging least terns and a variety of migratory shorebirds. Large areas of coastal salt marsh restoration are proposed within the South San Diego Bay Unit that would benefit the clapper rail, least tern, and various Birds of Conservation Concern. Also proposed is the creation of additional nesting areas that could benefit the least tern and snowy plover, as well as several colonial nesting seabirds. Water management proposals within the salt ponds could also provide additional nesting and foraging habitat for the western snowy plover.

IX. Alternatives Considered

In addition to the predator management plan presented above, various alternative methods for addressing predation of listed species on the Refuge were considered. These included:

- Non-lethal Control Only
- Indirect Control Only (implement management activities that reduce predation without non-lethal or lethal removal of predators)
- No Predator Management

Proposed Plan

The proposed predator management plan combines direct actions to control predation along with indirect actions related to reduced disturbance and improved habitat quality. The Service believes this proposal represents the most effective and most humane alternative.

Non-lethal Control Only

A predator plan that relies on the control of all predators using only non-lethal methods could have devastating effects on the Refuge's least tern and snowy plover populations. This is particularly true if an avian predator learns to prey on the eggs or young of a listed species. In some cases, considerable time can pass before a problem predator is trapped; as was the case in 1997 involving a pair of burrowing owls at the Tijuana Slough NWR (refer to Section IV.). Because lethal removal was not implemented in this case, the offending burrowing owls took a large number of chicks and more importantly, breeding adults. These events had a lasting effect on productivity at the site since losses of breeding adults can have population effects for many seasons. Least terns can be quite long-lived birds and may make many nesting attempts in their lives.

Indirect Control Only

Indirect control of predation would involve implementing management activities that reduce predation without lethal or non-lethal removal of predators. Instead, measures such as the use of visual and auditory repellents and physical barriers would be employed. Visual and auditory repellants are limited by several factors, including: 1) unintentional hazing of protected species while attempting to haze predatory species; 2) reduced effectiveness over time as some predatory species become accustomed to particular stimuli and begin to ignore them; 3) difficulties in effectively deploying such repellents in the field; and 4) limited effectiveness of repellents on particular species. Physical barriers are a part of an integrated predator management program and will be used for some purposes such as keeping most off-leash dogs out of the nesting colonies. However, physical barriers in the absence of the ability to remove a predator are ineffective in controlling avian predation, as well as some forms of mammalian predation. The use of exclosures over nesting plovers has been effective in protecting eggs, but once the chicks leave the exclosure, they are once again vulnerable to predation. Although predation reduced to some extent through indirect control, this reduction in loss is not considered adequate to achieve the goals and objectives of the Refuge for listed species.

No Predator Management
Under this alternative, no actions would be taken on the Refuge for the specific purpose of controlling predators. Mammalian and avian predators would not be harassed or specifically deterred from traveling or flying through the Refuge or entering the nesting colonies. Based on previously documented losses of listed species to predation, it is likely that the Refuge's population of least terns, snowy plovers, and light-footed clapper rails would no longer be able to achieve sustainability goals for fledging success. In addition, a dramatic reduction in nest productivity could cause least terns and snowy plovers to abandon the existing nesting areas on the Refuge. A management strategy that excludes any form of predator management would place the viability of the Refuge's listed species at risk and would be inconsistent with the purposes for which this Refuge was established.

X. Justification

The implementation of this predator management plan will result in temporary localized reductions in populations of some mammalian and native avian predators around the Refuge. In recent years, the California ground squirrel, Norway rat, and black rat were the mammalian species most affected by predator management, while ravens and western gulls were the avian species most often removed from nesting areas. The lethal removal of some raptors and large native mammalian predators will occur annually on the Refuge, however the numbers of individuals lost will be low (one to three annually). Lethal removal will generally only be implemented after other non-lethal methods for removal and relocation have proved to be unsuccessful. For the most part, avian predators, with the exception of corvids and some gulls, will be trapped and released into suitable habitat elsewhere, and only those avian predators that are foraging within nesting areas will be removed.

The Federal endangered and threatened avian species supported by these Refuges were once more widely distributed throughout southern California and the sizes of the various populations throughout the region were much larger. The loss of coastal habitat, displacement of nesting areas due to increasing human use of beaches and surrounding wetlands, increases in non-native predators in proximity to natural areas, and the concentration of native predators into smaller, more isolated natural areas have all contributed to significant declines in the populations of California least tern, western snowy plover, and light-footed clapper rail. The recovery plans prepared for the Refuge's Federal endangered and threatened species (*USFWS 1985a, 1985b, 1998, 2001, 2002*), as well as the conservation plans prepared to address declines in the populations of shorebirds and waterbirds (*Page et al. 2003 and Kushlan et al. 2002*), all include predator control in the list of recovery and conservation actions that must be considered if reversal of these population declines is to be achieved. However, predator control alone cannot achieve the recovery goals established for these species, which is why this predator management plan is just one component of a larger overall management plan for the Refuge. The CCP for this Refuge includes habitat enhancement and restoration proposals, as well as additional actions directed at reducing disturbance to sensitive species. Through this combination of efforts, the Refuge's populations of endangered and threatened species are expected, at a minimum to sustain their current sizes, and ideally to increase as these various actions are implemented.

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Appendix N

Wilderness Inventory

Appendix N: Wilderness Inventory

Introduction

The purpose of a wilderness review is to identify and recommend for Congressional designation National Wildlife Refuge System (System) lands and waters that merit inclusion in the National Wilderness Preservation System (NWPS). Wilderness reviews are a required element of comprehensive conservation plans (CCPs) and conducted in accordance with the refuge planning process outlined in 602 FW 1 and 3, including public involvement and the National Environmental Policy Act (NEPA) compliance.

There are three phases to the wilderness review: 1) inventory, 2) study; and 3) recommendation. Lands and waters that meet the minimum criteria for wilderness are identified in the inventory phase. These areas are called wilderness study areas (WSAs). WSAs are evaluated through the CCP process to determine their suitability for wilderness designation. In the study phase, a range of management alternatives are evaluated to determine if a WSA is suitable for wilderness designation or management under an alternate set of goals and objectives that do not involve wilderness designation. The recommendation phase consists of forwarding or reporting recommendations for wilderness designation from the Director through the Secretary and the President to Congress in a wilderness study report.

If the inventory does not identify any areas that meet the WSA criteria, we document our findings in the administrative record for the CCP, fulfilling the planning requirement for a wilderness review. We inventoried Service lands and waters within the Sweetwater Marsh and South San Diego Bay Units of the San Diego Bay NWR and found no areas that meet the eligibility criteria for a WSA as defined by the Wilderness Act. This appendix summarizes the wilderness inventory for the Sweetwater Marsh and South San Diego Bay Units of the San Diego Bay NWR.

Inventory Criteria

The wilderness inventory is a broad look at the planning area to identify WSAs. These are roadless areas that meet the minimum criteria for wilderness identified in Section 2(c) of the Wilderness Act.

> "*A wilderness, in contrast with those areas where man and his works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. An area of wilderness is further defined to mean in this Act an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions, and which: (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and (4) may also contain ecological, geological or other features of scientific, educational, scenic, or historical value.*"

A WSA must be a roadless area or island, meet the size criteria, appear natural, and provide outstanding opportunities for solitude or primitive recreation. The process for identification of roadless areas and islands in the Sweetwater Marsh and San Diego Bay Units and application of the wilderness criteria are described in the following sections.

Identification of Roadless Areas and Roadless Islands

Identification of roadless areas and roadless islands required gathering and evaluating land status maps, land use and road inventory data, and aerial photographs for the Sweetwater Marsh and South San Diego Bay Units. "Roadless" refers to the absence of improved roads suitable and maintained for public travel by means of motorized vehicles primarily intended for highway use. Only lands currently owned by the Service in fee title were evaluated.

Evaluation of the Size Criteria

Roadless areas or roadless islands meet the size criteria if any one of the following standards apply:

- An area with over 5,000 contiguous acres. State and private lands are not included in making this acreage determination.
- A roadless island of any size. A roadless island is defined as an area surrounded by permanent waters or that is markedly distinguished from the surrounding lands by topographical or ecological features.
- An area of less than 5,000 contiguous Federal acres that is of sufficient size as to make practicable its preservation and use in an unimpaired condition, and of a size suitable for wilderness management.
- An area of less than 5,000 contiguous Federal acres that is contiguous with a designated wilderness, recommended wilderness, or area under wilderness review by another Federal wilderness managing agency such as the Forest Service, National Park Service, or Bureau of Land Management.

Evaluation of the Naturalness Criteria

In addition to being roadless, a WSA must meet the naturalness criteria. Section 2(c) defines wilderness as an area that "... generally appears to have been affected primarily by the forces of nature with the imprint of man's work substantially unnoticeable." The area must appear natural to the average visitor rather than "pristine." The presence of historic landscape conditions is not required. An area may include some human impacts provided they are substantially unnoticeable in the unit as a whole. Significant human-caused hazards, such as the presence of unexploded ordnance from military activity, and the physical impacts of refuge management facilities and activities are also considered in evaluation of the naturalness criteria. An area may not be considered unnatural in appearance solely on the basis of the "sights and sounds" of human impacts and activities outside the boundary of the unit.

Evaluation of Outstanding Opportunities for Solitude or Primitive and Unconfined Recreation

In addition to meeting the size and naturalness criteria, a WSA must provide outstanding opportunities for solitude or primitive recreation. The area does not have to possess outstanding opportunities for both solitude and primitive and unconfined recreation, and does not need to have outstanding opportunities on every acre. Further, an area does not have to be open to public use and access to qualify under this criteria; Congress has designated a number of wilderness areas in the Refuge System that are closed to public access to protect resource values.

Opportunities for solitude refer to the ability of a visitor to be alone and secluded from other visitors in the area. Primitive and unconfined recreation means non-motorized, dispersed outdoor recreation activities that are compatible and do not require developed facilities or mechanical transport. These primitive recreation activities may provide opportunities to experience challenge and risk; self reliance; and adventure.

These two "opportunity elements" are not well defined by the Wilderness Act but, in most cases, can be expected to occur together. However, an outstanding opportunity for solitude may be present in an area offering only limited primitive recreation potential. Conversely, an area may be so attractive for recreation use that experiencing solitude is not an option.

Evaluation of Supplemental Values
Supplemental values are defined by the Wilderness Act as "...ecological, geological, or other features of scientific, educational, scenic, or historic value." These values are not required for wilderness but their presence should be documented.

Inventory Findings

As documented below, none of the parcels in the Sweetwater Marsh or South San Diego Bay Units of the San Diego Bay NWR meet the criteria for a WSA.

Roadless Areas and Roadless Islands
The Sweetwater Marsh Unit includes an access road that accommodates motorized access to both the Chula Vista Nature Center and the Refuge office. This road, although gated and not available for travel by the general public, is used to transport the public to and from the Nature Center and Refuge via a bus. No public roads are located within the portion of the South San Diego Bay Unit that is owned by the Service in fee title.

Size Criteria
A total of 316 acres of Service owned-land are included within the Sweetwater Marsh Unit. The majority of the 2,324 acres of land included within the current boundary of the South San Diego Bay Unit is leased to the Service from the State of California for management as a National Wildlife Refuge. Approximately 90 acres of the Refuge are owned by the Service in fee title. No islands are included within the San Diego Bay NWR.

Naturalness Criteria
The marsh habitat within the Sweetwater Marsh Unit appears natural to the refuge visitor. However, the upland area on Gunpowder Point, which was the site of industrial and agricultural activity for many decades prior to the establishment of the Refuge, continues to include evidence of these past activities and supports a mix of exotic plants, weedy invasive plants, and some native shrubs. The Otay River floodplain portion of the South San Diego Bay Unit was also farmed for several decades and currently supports weedy vegetation that would not appear natural to the refuge visitor. Also included within this Unit is an active commercial solar salt operation.

Outstanding Opportunities for Solitude or Primitive and Unconfined Recreation
The San Diego Bay NWR is located immediately adjacent to the urbanized communities of National City, Chula Vista, San Diego, Coronado, and Imperial Beach. Although the Refuge does provide opportunities for escape from the urban environment, the sites and sounds of urbanization are always present just beyond the Refuge boundary.

Supplemental Values
The San Diego Bay NWR includes portions of San Diego Bay, which provides significant scenic value to visitors of the Refuge and the surrounding communities. The undisturbed salt marsh habitat on the Sweetwater Marsh Unit also provides scenic and regionally significant ecological value.

Appendix O

Letter from the California Department of Fish and Game

Appendix O: Letter from the California Department of Fish and Game

P. 02

State of California - The Resources Agency
DEPARTMENT OF FISH AND GAME
http://www.dfg.ca.gov
1416 Ninth Street
Sacramento, CA 95814
(916) 653-7667

GRAY DAVIS, Governor

November 3, 2003

Steve Thompson, Director
United States Fish and Wildlife
California/Nevada Operations
2800 Cottage Way, Room W 2605
Sacramento, California 95825

Re: Management Plan for the South San Diego Bay Wildlife Refuge

Dear Mr. ~~Thompson~~: Steve

I write concerning the management plan now under development for the South San Diego Bay Wildlife Refuge. The Department strongly supports your efforts to develop a comprehensive management plan, including provisions for public access, for the refuge. We have, however, received numerous expressions of concern and outright opposition to the proposal to allow hunting in the refuge. Many if not all of the contacts I've received indicate opposition to hunting at this refuge from a broad spectrum of the public. This opposition includes much of the elected leadership in San Diego and the South Bay, law enforcement authorities and the United States Navy, all of whom believe that the proposal to allow hunting in the refuge is inconsistent with public health, safety and security.

The Department of Fish and Game administers California's recreational hunting and fishing programs and we believe strongly that access to hunting and fishing opportunities should be protected and, where possible, expanded. I recognize, however, that not every refuge is situated in a setting where hunting is appropriate and feasible. The nearby urban environment including private homes and schools as well as the proximity of operations areas for the Navy places the South Bay Refuge into a unique category in which normally permissible activities, like hunting, may not be advisable.

Conserving California's Wildlife Since 1870

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Steve Thompson
November 3, 2003
Page 2

The lease pursuant to which the United States has management authority over State owned lands within the boundary of the refuge allows waterfowl hunting if a "joint determination" is made by the Fish and Wildlife Service and the Department of Fish and Game that such hunting is "consistent with public safety considerations..." Pursuant to section 2, paragraph 4 of Lease PRC 8075.9 the Department of Fish and Game has concluded that the proposed hunting of waterfowl at the South San Diego Bay Refuge is not consistent with public health and safety. We have therefore determined that waterfowl hunting on the lands subject to the lease is not appropriate.

Thank you for your consideration of my concerns. Inquiries concerning this matter may be addressed by contacting Deputy Director Sonke Mastrup at (916) 653-4207.

Sincerely,

Robert C. Hight

ROBERT C. HIGHT
Director

cc: Sen. Denise Moreno Ducheny

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San Diego Bay National Wildlife Refuge Complex
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U.S. Fish & Wildlife Service
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For Refuge information
1 800/344 WILD

August 2006
Photo: USFWS/J. Konecny