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LIST OF ACRONYMS

ACOE. ..... U.S. Army Corps of Engineers
APDP ..... Action Plan Demonstration Project
BF..... The Bay Foundation of Morro Bay
BLM..... Bureau of Land Management
BMPs ..... Best Management Practices
BPA ..... Base Programs Analysis
CAC ..... Citizens Advisory Committee
CAL-EPA ..... California Environmental Protection Agency
Cal-Trans ..... California Department of Transportation
CCAMP ..... Central Coast Ambient Monitoring Program
CCC ..... California Coastal Commission
CCCorps..... California Conservation Corps
CCMP ..... Comprehensive Conservation and Management Plan
CCNHA..... Central Coast Natural History Association
CCRWQCB ..... Central Coast Regional Water Quality Control Board
CDA..... California Department of Agriculture
CDBW .....California Department of Boating and Waterways
CDC..... California Department of Corrections
CDF ..... California Department of Forestry & Fire Protection
CDFG..... .California Department of Fish and Game
CDOC ..... California Department of Conservation
CDPR ..... California Department of Parks and Recreation
CDHS ..... California Department of Health Services
CDIF.....Consent Decree Implementation Fund
CDTSC .....California Department of Toxic Substances Control
CDWR..... California Department of Water Resources
CEC ..... Santa Barbara Community Environmental Council
CEQA ..... California Environmental Quality Act
CFEP ..... Chorro Flats Enhancement Project
CFR ..... Code of Federal Regulations
cfs..... Cubic feet per second
CMB .....City of Morro BayCDFG
CMC ..... California Men's Colony

CNDD ..... California Natural Diversity Database
CNPS ..... California Native Plant Society
CRA.....California Resources Agency
CSD ..... Community Services District
CSLCNG..... Camp San Luis, California National Guard
CSLRCD..... Coastal San Luis Resource Conservation District
CWA ..... Clean Water Act
CZARA ..... Coastal Zone Act Reauthorization Amendments
CZLUO ..... Coastal Zone Land Use Ordinance
DEH .....San Luis Obispo County Department of Environmental Health
DO ..... Dissolved Oxygen
ECA..... Estero Conservation Alliance
EFDC ..... Environmental Fluids Dynamic Code
EMP..... Environmental Monitoring Plan
EQIP ..... Environmental Quality Incentives Program
ESA..... Endangered Species Act
ESH ..... Environmentally Sensitive Habitat
ESU ..... Evolutionary Significant Unit
FOE ..... Friends of the Estuary at Morro Bay
FSA ..... Farm Service Agency
GIS ..... Geographic Information System
HCP ..... Habitat Conservation Plan
HUA.....Hydrologic Unit Area
IPM ..... Integrated Pest Management
IWMA ..... Integrated Waste Management Authority
LOCSD ..... Los Osos Community Services District
LPC ..... Local Policy Committee
MBERF .....Morro Bay Estuary Restoration Fund
MBHD.....Morro Bay Harbor Department
MBNEP ..... Morro Bay National Estuary Program
MBNMP..... Morro Bay National Monitoring Plan
MBSEP..... Morro Bay State Estuary Program
MBTF..... Morro Bay Task Force
MBWEP ..... Morro Bay Watershed Enhancement Plan

MEGA ..... Morro Estuary Greenbelt Alliance
MOA ..... Memorandum of Agreement
MPN ..... Most Probable Number
MSD ..... Marine Sanitation Device
MURP ..... Model Urban Runoff Program
NEP ..... National Estuary Program
NEPA ..... National Environmental Policy Act
NGVD ..... National Geodetic Vertical Datum
NMP ..... National Monitoring Program
NOAA ..... National Oceanic and Atmospheric Administration
NPDES ..... National Pollutant Discharge Elimination System
NPSPC ..... Nonpoint Source Pollution Control
NRCS ..... Natural Resources Conservation Service
NSSP ..... National Shellfish Sanitation Program
OEHHA ..... Office of Environmental Health Hazard Assessment, CAL-EPA
OSPR..... Office of Oil Spillage Prevention & Response (DFG)
SBNEP ..... Sarasota Bay National Estuary Program
SCB ..... Southern California Bight
SCC ..... California State Coastal Conservancy
SCS ..... Soil Conservation Service
Sheriff Dive..... Sheriff's Dive Team
SIP ..... Stewardship Incentive Program
SLC ..... State Lands Commission
SLO..... San Luis Obispo
SLOCo..... San Luis Obispo County
SMW ..... State Mussel Watch
SRAs ..... Sensitive Resource Areas
SRF ..... State Revolving Fund
SSRCSCCC... Steelhead and Stream Recovery Coalition for the South Central Coast of California
SWAP ..... Small Wilderness Area Preservation
SWRCB ..... State Water Resources Control Board
TAC ..... Technical Advisory Committee
TDC ..... Transfer of Development Credits
TMDL ..... Total Maximum Daily Loads

UCCE. ..... University of California Cooperative Extension
USCG ..... United States Coast Guard
USDA ..... United States Department of Agriculture
USEPA ..... United States Environmental Protection Agency
USFS ..... United States Forest Service
USFWS ..... United States Fish and Wildlife Service
USGS ..... United States Geological Survey
USNMFS..... ...United States National Marine Fisheries Services
VMP ..... Volunteer Monitoring Program
WC..... Watershed Committee
WCB ..... Wildlife Conservation Board
WHIP ..... Wildlife Habitat Improvement Program
WRP ..... Wetland Reserve Program (federal)
WWTP ..... Wastewater Treatment Plant

GLOSSARY

Aggraded	Raising the grade or level of (a river valley, stream bed, etc.) by depositing detritus, sediment or the like.
Ambient	Refers to overall conditions surrounding a place or thing. For example, ambient monitoring refers to routine water quality monitoring which assess overall conditions for the particular site.
Anadromous	Describes fish that are born in fresh water, migrate to the sea, and return to fresh water to spawn (reproduce). Examples include salmon, sturgeon, shad, smelt, and steelhead.
Bathymetry	The physical shape of a basin which contains water, with special attention to the contours of depth; variations in mean depth in a body of water.
Benthic	Bottom-dwelling or substrate-oriented; at or in the bottom of a body of water.
Best Management Practices (BMPs)	Practice or combination of practices that are determined to be the most effective and practical means of controlling point and non-point source pollutants at levels compatible with environmental quality goals. The term originated from the rules and regulations developed pursuant to the federal Clean Water Act (40 CFR 130).
Brackish	Less salty than seawater, but more salty than fresh water. An intermediate saline habitat that falls between 4 and 18 ppm of salinity and usually found under low flushing conditions
Catch Basin	Box-like underground concrete receptacles with openings in curbs and gutters designed to collect water from streets and carry it into the storm drain system.
Depuration	To make or become free from impurities; purification.
Detention	The process of collecting and holding back stormwater for delayed release to receiving waters.
Dissolved Oxygen	Oxygen that is present (dissolved) in water and therefore available for fish and other aquatic animals to use. If the amount of dissolved oxygen in the water is too low, then aquatic animals may die. Wastewater and naturally occurring organic matter contain oxygen-demanding substances that consume dissolved oxygen.
Dredging	Any physical digging into the bottom sediment of a water body. Dredging can be done with mechanical or hydraulic machines, and it changes the shape and form of the bottom. Dredging is performed in order to maintain navigation channels that would otherwise fill with sediment and block ship passage.
Effluent	Wastewater discharged into a body of water from point sources. The material which flows out of a pipe or facility into a water body (or another larger pipe). For example the treated liquid discharged by a wastewater treatment plant is the plant's effluent.
Endemic	A native species defined in terms of a restricted geographical range.
Estuary	A semi-closed coastal water body which has free connection to the open sea and within which seawater is measurably diluted with freshwater. The degree of mixing and layering (freshwater tends to float on top of the sea water) depends on tidal conditions, river flow, and local currents. Estuaries typically support a biota which can tolerate varying salinities and therefore differ from marine and freshwater biotas.

Estuarine	Of or having to do with an estuary.
Fauna	The animals of a given region or period considered as a whole.
Fertilizers	Material added to the soil to supply chemical elements needed for plant nutrition.
Flora	The plants of a particular region or period, listed by species and considered as a whole.
Geographical Information Systems (GIS)	Computer mapping tool capable of overlaying data for manipulation and display.
Groundtruthed	Verification of aerial data by physically walking on the ground.
Heavy Metals	Metallic elements, such as lead, mercury, silver, cadmium, copper, chromium, and zinc, which have relatively high atomic weights and may be toxic at high concentrations. Such metals are toxic to life and continuously pose a threat because of resuspension.
Impaired Water	Pursuant to the Clean Water Act, Section 303(d), a water is listed as impaired if evidence exists that a violation, or potential future violation of a water quality standard has or may occur.
Inactive/Abandoned Mines	Inactive mines are subject to recovery costs by responsible parties, whereas abandoned mines are not.
Intertidal	That portion of the shore or structures in the ocean which is between high and low tide levels; the substrate and organisms in the intertidal are alternately covered by seawater and exposed to the air.
Mean	Mid-point between high and low.
National Estuary Program (NEP)	A federal program established in 1987 by amendments to the Clean Water Act and administered by the U.S. Environmental Protection Agency. The NEP's primary goal is to "protect estuaries of national significance that are threatened by degradation caused by human activity." The NEP employs community-based environmental planning, designating primary responsibility for program development and implementation to the local community.
Nitrate	A form of the nutrient nitrogen that is readily absorbed by plants.
Nonindigenous Species	Refers to non-native plants and animals that have been introduced (accidentally or intentionally) to a region. Some non-indigenous species establish and grow quickly, crowding out native species.
Non-point Source Pollution (NPS)	Pollution that enters water from dispersed and uncontrolled sources (such as surface runoff) rather than through pipes. Nonpoint sources (e.g., forest practices, agricultural practices, on-site sewage disposal, automobiles, and recreational boats) may contribute pathogens, suspended solids and toxicants. While individual sources may seem insignificant, the cumulative effects of nonpoint source pollution can be significant.

Nutrients	Any substance required by organisms for normal growth and maintenance. Mineral nutrients usually refer to inorganic substances derived from soil and water. Excessive amounts of nutrients, including nitrogen and phosphorus, may result in excessive growth of algae, leading to oxygen depletion and water quality degradation.
Pathogen	An agent, such as a virus, bacteria or fungus, that can cause disease in humans. Pathogens can be present in municipal, industrial and nonpoint source discharges.
Phytoplankton	Free-floating aquatic plants and plant-like organisms, usually algae; an important food source for many animals.
Point Source	A source of pollutants from a single point of conveyance, such as a pipe. For example, the discharge from a sewage treatment plant or a factory is a point source.
Priority Organics	A class of toxic pollutants found in wells near the Los Osos landfill. Specifically refers to tetrachorothylene volatile organics found in cleaning solvents.
Rare, Threatened or Endangered	Rare is a classification given only to a species when, although not presently threatened with extinction, it exists in such small numbers through its range that it may become endangered if its present environment worsens. A species is threatened when, although not presently at risk of extinction, it is likely to become an endangered species in the foreseeable future in the absence of special protection and management efforts. A species is considered endangered when it faces possible extinction throughout all, or a significant portion of, its range. The predominant cause is loss of habitat.
Riparian	Habitat occurring along the bank of a natural and freshwater waterway (e.g., river, stream or creek), which provides for a high density, diversity, and productivity of plant and animal species.
Sediment	Mud, sand, silt, clay, and other particles that settle on the bottoms of waterways.
Special Status Species	Federal and state classifications for plants and animals species that are either listed as threatened or endangered species, are formally recognized candidates for a listing, or are declining to a point where they may be listed.
Substrate	Material that forms a stream or lake bed (silt, sand, gravel, cobble, etc.)
Thalweg	(1) A line, as drawn on a map, connecting the lowest points of a valley; (2) the middle of the main navigable channel of a waterway that serves as a boundary line.
Total Maximum Daily Loads (TMDLs)	The maximum amount of pollution a body of water can receive in a 24-hour period without deterioration in water quality.
Turbidity	A measure of the amount of material suspended in the water. Increasing the turbidity of the water decreases the amount of light that penetrates the water column. High levels of turbidity are harmful to aquatic life.
Urban runoff	Water containing pollutants like oil and grease from leaking cars and trucks; heavy metals from vehicle exhaust; soaps and grease removers; pesticides from gardens; animal waste; and street debris, which washes into storm drains and gets carried out to the ocean.
Wastewater	Water contaminated with the byproducts of domestic, commercial, agricultural, or industrial uses.

Wastewater Treatment Processes that help remove solids, nutrients and other pollutants from water before it is discharged or reused.

Watershed The geographic region within which water drains into a particular river, stream, or body of water. A watershed includes hills, lowlands, and the body of water into which the land drains. Watershed boundaries are defined by the ridges of separating watersheds.

Wetlands Land where the water table is usually at or near the surface. Some wetlands contain water year-round; others may remain relatively dry for months, becoming moist only during periods of heavy rain. Wetlands are vital habitats for many species of plants and animals; they are protected by local, state and federal regulations.

Wildlife Undomesticated animals that live either live in a single geographic area or migrate from one area to another.

Sedimentation in the Delta Region of Morro Bay

Environmental Monitoring Plan
Morro Bay National Estuary Program

July 2000

1st Edition

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Chapter 1

INTRODUCTION

Why Morro Bay?

San Luis Obispo County is known for its rich biotic diversity. The uniqueness of the biotic resources and the scenic attraction of Morro Bay and its wetlands are enhanced by its relatively natural state and geographic location. As the "most significant wetland system in the central coast of California" (Arnold 1987), it is of vital importance to a great variety of migratory and resident species, including many rare and endangered species. The Morro Bay estuary is a 2,300 acre semi-enclosed body of water where freshwater flowing from the land mixes with the saltwater flowing in from the sea. This mixing supports a unique ecosystem containing numerous plants and animals that are not found in either totally freshwater systems or the ocean. The estuarine system includes coastal wetlands, such as salt and brackish tidal marshes, and intertidal flats, as well as deep water channels and parts of coastal streams. The estuarine system can be defined as consisting of deep water tidal habitats and adjacent tidal wetlands that are semi-enclosed by land but have access to the open ocean, and in which ocean water is diluted by freshwater runoff from the land. Some areas are continuously submerged and others are alternately exposed and flooded by tides.

The Morro Bay watershed covers approximately 48,000 acres or 75 square miles. Its highest elevation is 2,763 feet above sea level and its furthest point from the bay is approximately 10 miles. Morro Bay's watershed is comprised of two subwatersheds, Chorro and Los Osos. Chorro Creek drains the larger Chorro Creek subwatershed, which occupies approximately 60 percent of the watershed. Los Osos Creek drains the remaining 40 percent, and consists of combined flow of Los Osos and Warden Creeks. Chorro Creek terminates in a salt-marsh delta in the northeast portion of estuary, and Los Osos Creek terminates in tidelands in the southeast portion of the estuary. The semi-enclosed Morro Bay estuary in turn flows into the larger Estero Bay and the Pacific Ocean to the west. For more information on the physical characteristics on the Morro Bay estuary and watershed, please refer to the Volume II CCMP Characterization.

The National Estuary Program

The National Estuary Program (NEP), established in 1987 under Section 320 of the Clean Water Act, was created to address long term planning and management in nationally significant estuaries that are impacted by human activities. A Comprehensive Conservation and Management Plan (CCMP) is developed by each designated NEP, outlining strategy for action by the community. The Clean Water Act also requires the effectiveness of implemented actions to be tracked by programmatic and environmental monitoring.

Priorities of the Morro Bay National Estuary Program

The Morro Bay National Estuary Program has benefited from a grass-roots effort that originated more than 10 years ago and resulted in the designation of Morro Bay as California's first State Estuary in 1994. In 1995, Morro Bay was accepted into the National Estuary Program. The State and National efforts were combined and a Comprehensive Conservation Management Plan was drafted and approved through an army of dedicated volunteers, energetic committee representatives, talented staff, and alert citizens. Through this effort, seven priority problems were identified as major impacts to the estuary. These priority problems are:

1. Accelerated Sedimentation
2. Increased Bacteria Concentrations
3. Increased Nutrients Concentrations
4. Reduction of Freshwater Flow
5. Increased Heavy Metals and Toxics
6. Habitat Loss
7. Loss of Steelhead

Purpose of the Environmental Monitoring Plan (EMP)

The goals that are established by the USEPA (in National Estuary Program Guidance: Comprehensive Conservation and Management Plans: Content and Approval Requirements document) for the Monitoring Plan are:

- ✓ To measure the effectiveness of the management plan action and objectives
- ✓ To provide essential information that can be used to redirect and focus the CCP during implementation.

Monitoring Plan requirements that are detailed in this checklist include:

- ✓ To specify monitoring variables, including sampling locations, monitoring frequency, field and laboratory methods and QA/QC procedures,
- ✓ To specify data management system and statistical tests to analyze the monitoring data,
- ✓ To describe the expected performance of the initial sampling design, and
- ✓ To provide a timetable for analyzing data and assessing program performance.

The interagency Technical Advisory Committee convened five times to accomplish the required tasks, to develop a monitoring plan that builds upon previous recommendations. This Environmental Monitoring Plan was focused to provide reasoning for parameter and site selection, yet protocol specifics will be more fully detailed in the upcoming Morro Bay National Estuary Program's Quality Assurance Plan, due October 2000.

Monitoring Goals and Objectives

The MBNEP Environmental Monitoring Plan is based upon the following goal and eight objectives that are consistent with overall program goals. The objectives listed are in reference to evaluation and research needs of the CCMP. These public concerns, targets and method of measurement are described in **Project Management Chapters 5-13**. Further information on targets can be found in the CCRWQCB Basin Plan and in CCRWQCB's Technical TMDL's for Morro Bay watershed.

GOAL:	Track the implementation of CCMP actions and monitor the health of the Morro Bay ecosystem.

In addition to identifying priority problems, the Management Conference began formulating objectives for the program. The topics each objective was identified under, i.e. geomorphological, human use, etc., are used as the basis of organization for **Project Management** Chapters 5-13 of the Environmental Monitoring Plan. An additional topic was added in 1999, Data Tracking and Management, which is outlined in Chapter 13 of this document. The objectives are categorized as follows:

Geomorphological:

✓ **Slow sedimentation by implementing management measures that address erosion and sediment transport**

- Sustain no net loss of existing wetlands (baseline 2001 Wetland Delineation).

  Related CCMP Action Plan: All HAB, CC-1, All SED

- Reduction of average annual suspended loads sediment by 15% by 2010 in stream and estuary waters, as to comply with water quality standards (waters should not contain suspended material in concentrations that cause nuisance or adversely effect beneficial uses, as stated in the CCRWQCB Basin Plan) and will comply with Sediment TMDL's set forth by the CCRWQCB in 2001.

  Related CCMP Action Plan: CC-3, All SED

- Waters should not contain settable material in concentrations that result in deposition that causes nuisance or adversely affects beneficial uses, as depicted by bay bathymetry and wetland acreage assessments (as stated in the CCRWQCB Basin Plan) and will comply with Sediment TMDL's set forth by the CCRWQCB in 2001.

  Related CCMP Action Plan: CC-3, All SED

- One-hundred percent of publicly-owned creeks will be fenced (conducive to wildlife access) and revegetated by year 2010.

  Related CCMP Action Plan: CC-3,BACT-1, SED-4, 5, EDU-1

- No net increase in mudflat geographic acreage, relative to past 10 years baseline (as stated in the CCRWQCB Basin Plan) and will comply with Sediment TMDL's set forth by the CCRWQCB in 2001.

  Related CCMP Action Plan: CC-3, All SED

Human Use:

✓ **Ensure that bay water remains of sufficient quality to support a viable commercial shellfish industry, and safe recreational uses**

- Levels of bacteria will comply with Department of Health Services, CCRWQCB, and County Environmental Health standards for beneficial uses including shellfish harvesting and water contact recreation at all times. These measurable standards are listed in detail in the following Table 6-1.

  Related CCMP Action Plan: ALL BACT, CC-3

- For those waters with drinking water as a beneficial use, bacterial and other pollutant levels must comply with drinking water standards (as stated in the CCRWQCB Basin Plan).

  Related CCMP Action Plan: ALL BACT, CC-3

- Ensure that bay water remains of sufficient quality to support a viable commercial shellfish industry, and safe recreational uses

  Related CCMP Action Plan: ALL BACT, CC-3

- No closures of shellfish beds except for first flush rain event by year 2010.

  Related CCMP Action Plan: All BACT, CC-3

✓ **Protect social, economic, and environmental benefits provided by the bay and watershed through comprehensive resource management planning**

- Improve public access points to increase environmental and educational benefits.

  Related CCMP Action Plan: All EDU, HAB-1, 3

- Assess impacts and geographic area of environmentally sensitive habitats in the estuary that provide nursery rearing for commercial fish.

  Related CCMP Action Plan: CC-5, All FLOW, HAB-, EDU 3

- Freshwater flow sufficient at all times to maintain water quality by flushing and diluting pollutants.

  Related CCMP Action Plan: All FLOW

- For those waters with drinking water as a beneficial use, bacterial and other pollutant levels must comply with drinking water standards (as stated in the CCRWQCB Basin Plan).

  Related CCMP Action Plan: All BACT, CC-3

- Ensure that bay water remains of sufficient quality to support a viable commercial shellfish industry, and safe recreational uses

  Related CCMP Action Plan: All BACT, CC-3

- No closures of shellfish beds except for first flush rain event by year 2010.

  Related CCMP Action Plan: All BACT, CC-3

✓ **Promote public awareness and involvement in estuarine management issues through education outreach and use of volunteers**

- Promote public awareness and involvement in human health management issues through education outreach and use of volunteers

  Related CCMP Action Plan: CC-6, All EDU, All BACT

- Continue estuarine management education to K-12, general public and stakeholder groups.

  Related CCMP Action Plan: All EDU

- Maintain accurate data displays to public at local museums and events to promote involvement in estuarine management issues and recruit volunteers.

  Related CCMP Action Plan: All EDU

Water Quality

✓ **Ensure that bay water remains of sufficient quality to support a viable commercial shellfish industry, safe recreational uses, healthy eelgrass beds, habitats for listed species, cold water aquatic habitat, and thriving fish and shellfish populations**

- Sustain no net loss of existing wetlands (baseline 2001 Wetland Delineation).

  Related CCMP Action Plan: CC-1, All HAB, All SED

- Freshwater flow sufficient at all times for dilution of pollutants and flushing to maintain water quality.

  Related CCMP Action Plan: All FLOW

- Levels of bacteria will comply with Department of Health Services, CCRWQCB, and County Environmental Health standards for beneficial uses including shellfish harvesting and water contact recreation at all times. These measurable standards are listed in detail in the following Table 6.1.

  Related CCMP Action Plan: CC-3, All BACT

- For those waters with drinking water as a beneficial use, bacterial levels must comply with drinking water standards (as stated in the CCRWQCB Basin Plan).

  Related CCMP Action Plan: CC-3, All BACT

- Ensure that bay water remains of sufficient quality to support a viable commercial shellfish industry, and safe recreational uses

  Related CCMP Action Plan: CC-3, All BACT

- Decrease average annual nutrient inputs (loading) by 25% from urban and agricultural runoff by the year 2010. Levels of nutrients shall not cause nuisance aquatic growth or adversely affect beneficial uses (as listed in CCRWQCB Basin Plan Standards).

  Related CCMP Action Plan: All NUTR, CC-3

- Levels of nutrients shall not be present in creek and bay waters at levels which cause toxic effects to aquatic organisms and plants. These measurable standards are listed in detail in the following Table 10.1

  Related CCMP Action Plan: All NUTR, CC-3

- Water column dissolved oxygen concentrations shall remain above 5.0 mg/l at all times. Median values shall be maintained above 85 percent saturation. In cold freshwater habitats, dissolved oxygen concentrations shall not be reduced below 7.0 mg/l at any time (as listed in CCRWQCB Basin Plan Standards).

  Related CCMP Action Plan: CC-5,6

- Decrease levels of heavy metals (such as copper) and toxics (such as organophosphorous pesticides) to be in compliance with EPA Toxic rules in creeks and bay waters to natural background levels (which will be established by the year 2002), and shall not cause impacts to beneficial uses, such as cold water aquatic organisms, endangered species, drinking water or recreational use (as stated in CCRWQCB Basin Plan Standards)

  Related CCMP Action Plan: All HMT, CC-3

- Decrease metals and toxics in sediments to satisfy NOAA chronic/acute standards (i.e. the geometric mean copper levels in marine sediment shall not be over 25,000 ppb) for marine and freshwater sediment, and shall not cause impacts to beneficial uses, such as cold water aquatic organisms, endangered species, drinking water or recreational use (as stated in CCRWQCB Basin Plan Standards).

  Related CCMP Action Plan: All SED, All HMT

- To reduce urban NPS loads to comply with Storm Water Phase II rulings (see EPA Storm Water Phase II Final Rule document).

  Related CCMP Action Plan: CC-3,4

- To reduce agricultural NPS loads to satisfy applicable water quality standards within five years (see CCRWQCB Basin Plan).

  Related CCMP Action Plan: EDU-3,4, CC-3, SED-4-7, BACT-1, NUTR-3

- Reduce urban NPS loading by 20% from new and existing development by establishing residential load reduction programs within the next 10 years.

  Related CCMP Action Plan: All NPS actions

- Support regional efforts to improve advance land use and development planning measures consistent with CZARA and Storm Water II Final Ruling.

  Related CCMP Action Plan: CC-7

- Support regional actions to obtain compensation for environmental injuries are directed to the Morro Bay ecosystem.

  Related CCMP Action Plan: All Actions

- Eliminate the release of harmful materials (paints, solvents, etc.) from marinas and docksides within 10 years.

  Related CCMP Action Plan: CC-3, BACT-2,4,5, HMT 2-4, EDU-2

- Decrease illegal dumping and discharges (solid waste, toxics and hazardous waste) within 10 years.

  Related CCMP Action Plan: BACT-3

Living Resources:

✓ **Ensure integrity of the broad diversity of natural habitats and associated native wildlife species in the bay and watershed**

- Sustain no net loss of existing wetlands comparisons being results from 2001 Wetland Delineation..

  Related CCMP Action Plan: CC-1, All HAB, All SED

- Assess the status and trends of the quality and quantity of selected habitats (open channel, mudflat, salt marsh (low and high), freshwater marsh, riparian, coastal dune scrub, maritime chaparral, grassland, and oak woodland) to assist in evaluating the CCMP.

  Related CCMP Action Plan: All HAB

- Maintain freshwater flow during low flow seasons sufficient to support nursery habitat for steelhead trout

  Related CCMP Action Plan: CC-5, All STL, All FLOW, HAB-1

- Maintain freshwater flow during high flow seasons sufficient to support steelhead migration

  Related CCMP Action Plan: CC-5, All STL, All FLOW, HAB-1

- Increase and/or enhance habitats for species of special concern in the watershed and estuary by 15% of year 2001 acreages.

  Related CCMP Action Plan: All HAB, ALL STL

- Increase a minimum of 20% of eelgrass acreage from year 2000 levels to support of brant and other species.

  Related CCMP Action Plan: HAB-8

- Assess the intensity of selected human activities that impact the resources of Morro Bay and establish activity carrying capacity to advise habitat management decisions.

  Related CCMP Action Plan: CC-6, All HAB

- Increase populations of Federally/State listed and special concern species (such as eelgrass, redlegged frogs, steelhead trout, overall wintering bird migrants and Morro Manzanita) in the watershed and estuary from year 2000 inventory estimates.

  Related CCMP Action Plan: EDU-8, HAB-1,2,4,9

- Maintain benthic community indices at established baseline levels, based upon National Monitoring Program Final Report 2001 mean indices.

  Related CCMP Action Plan: All HAB, All STL

- Decreased coverage of prominent exotic species (veldt grass, hoary cress, Giant reed, Cape ivy) by 15% in sensitive areas (such as riparian corridor, coastal dune scrub, and Morro Estuary Natural Preserve) by year 2010.

  Related CCMP Action Plan: HAB-9

✓ **Reestablish healthy steelhead trout habitat in Chorro and Los Osos Creeks**

- Restore 50 % of stream geomorpholgical processes in Chorro and Los Osos Creeks to provide the minimum physical, chemical, and biological habitat requirements (for south-central coast ESU) steelhead as described by CDFG and NMFS (spawning, rearing and migration).

  Related CCMP Action Plan: CC-3,5, All STL

- Remove all fish barriers to stream habitat for spawning and rearing by 2010.

  Related CCMP Action Plan: STL-2, CC-5

- Increased population of steelhead fish in Los Osos and Chorro Creeks by the year 2010.

  Related CCMP Action Plan: All STL, CC-5

- Successful attainment of the goals of the Steelhead Recovery Plan (anticipated 2001) as listed by NMFS and CDFG in Morro Bay watershed.

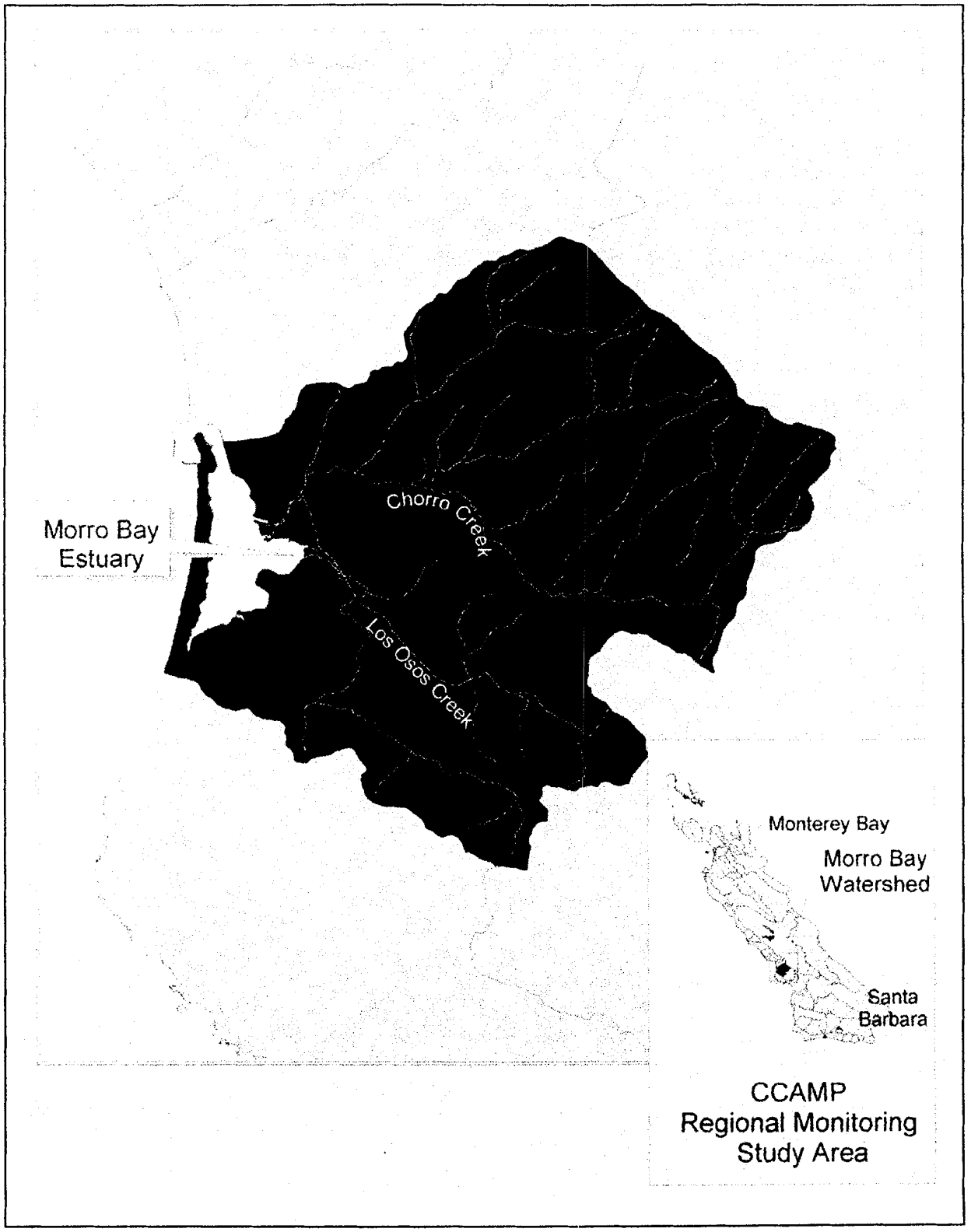
  Related CCMP Action Plan: All STL

A 10-year Integrated Regional Plan

The MBNEP CCMP calls for implementation of its Action Plans within five years. In order to evaluate actions based on a five-year time period, the Environmental Monitoring Plan (EMP) is envisioned as a ten-year effort at minimum. Where geographic information on priority problems is sparse, pre-implementation data will be continually gathered to establish baseline, (up to three years into the Implementation period, depending on sample size). Tracking will continue during the active implementation period (tentatively five years to assess apparent trends) and then continue for succeeding years to gather statistically significantly sample size and assess lasting effects of implemented CCMP actions. In order to reduce overlap and fill in monitoring gaps, the EMP will assist in coordinating various organizations and agencies to not only evaluate the Comprehensive Conservation Management Plan (CCMP) overall, but give a fuller ecological picture of the Morro Bay watershed and its estuary.

As the Morro Bay watershed is a part of the Central Coast Ambient Monitoring Program (CCAMP), it is the intention of the EMP to integrate data into a larger, regional monitoring framework. This region ranges from Santa Cruz south to Ventura (see Figure 1.1), and the Salinas basin to the east. With consistent protocols and parameters measured region wide, Morro Bay can contribute an intensive data source for other watersheds to draw upon as they build their comprehensive monitoring programs. Data comparisons available in a region-wide program are invaluable to assessing the overall health of the Morro Bay watershed in a biogeographical context.

Figure 1.1 Morro Bay Watershed in relation to the CCAMP Regional Monitoring Area



Document Organization

The EMP is organized into fifteen chapters, supplying historical and current framework (guidelines, objectives and existing monitoring and data) in the initial chapters. Chapter 4 is a brief summary of the scope of monitoring activities, broken up into three sections: 1) TREND (consistent) monitoring which is condensed primarily into two parameter variable tables and a time chart; 2) PROJECT-SPECIFIC monitoring for assess individual projects, and 3) RESEARCH NEEDS which outlines briefly information that needs to be gathered independently. Here, research needs are stated together from all relevant Project Management chapters topics and briefly expanded upon to give direction and rational to the MBNEP Technical Advisory Committee. Further details of monitoring activities are discussed in Project Management Chapters, 5-13, which outline all relative factors within each topic (i.e. geomorphology, public health issues). Data tracking, including public access and quality assurance are included in Chapter 14.

Introduction

Chapter 1: Introduction

Framework

Chapter 2: Developing the Environmental Monitoring Plan
Chapter 3: Current Monitoring in Morro Bay

Summary of EMP Monitoring Activities and Timeline

Chapter 4: Summary of TREND, PROJECT-SPECIFIC Environmental Monitoring, and RESEARCH NEEDS.

Geomorphological

Chapter 5: Tracking Changes in Sedimentation Rates*

Human Use

Chapter 6: Public Health Issues*
Chapter 7: Reduction of Freshwater Flow*

Living Resources

Chapter 11: Habitat Health*
Chapter 12: Tracking Species Biodiversity*

Water Quality

Chapter 10: Water and Sediment Quality*
Chapter 11: Non-Point Source Monitoring*
Chapter 12: Point Source Monitoring*
Chapter 13: Spills and Emergency Response*

Data Tracking and Management

Chapter 14: Information Tracking System

*The layout of each **Project Management** Chapter (5-13) includes the following discussion points:
Priority Problem, Management Objectives, Information Needs (monitoring questions), Parameter and Performance Critieria, Coordinating Agency, Supporting Agencies/Organizations, Watershed and Estuarine Monitoring Variables (parameter, implementers, frequency, location, related monitoring question and related priority problems). Research information needs, which are identified in each Project Management chapter, are detailed further in Chapter 15: Research Needs.

Chapter 2

Developing the Environmental Monitoring Plan

What is Monitoring?

According to the National Oceanic and Atmospheric Administration (1979), monitoring is defined as the:

"...continued systematic time-series observation of predetermined pollutants or pertinent components of the ecosystem over a period of time sufficient to determine 1) the existing levels, 2) trends, and 3) natural variations of measured components."

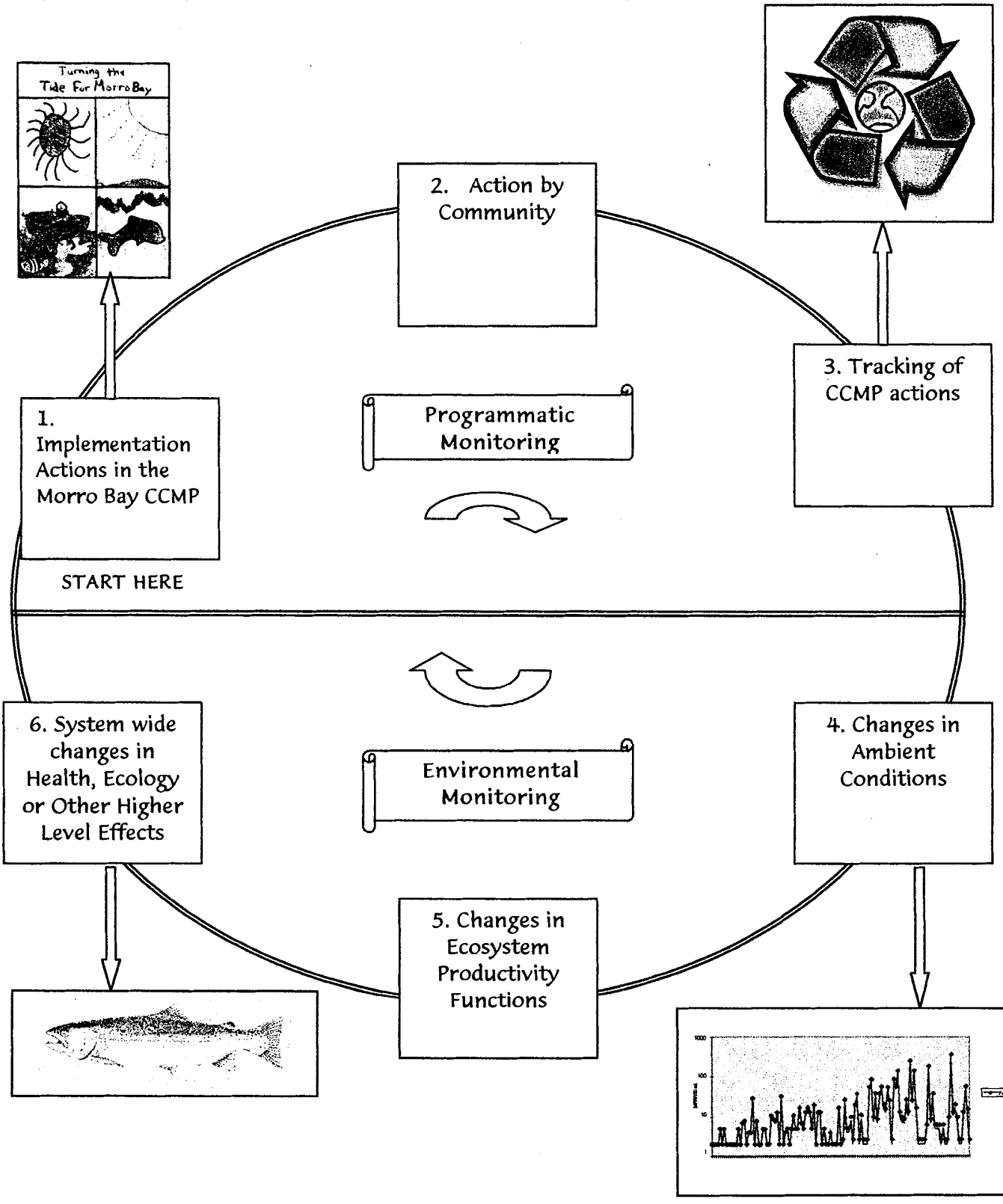
The MBNEP CCMP and companion documents address all three of the items stated in NOAA's monitoring definition above. Volume II of the CCMP includes the Characterization that summarizes existing levels and trends, whereas the EMP will describe measuring future trends and "natural variations of measured components."

Overview

Efforts to monitor the Morro Bay estuary and watershed are essential components to the success of the implementation strategy of the Morro Bay National Estuary Program (MBNEP) as well as tracking the health of the ecosystem. These two different aspects of monitoring used in the EMP are *programmatic and environmental monitoring.* Monitoring provides the community as well as resource and land managers a mechanism to assess the performance of actions taken and to reevaluate the effectiveness of existing strategies. Feedback of interpreted monitoring data creates more informed management decisions that may lead to revisions or new management strategies. Data collected to answer new management needs can then be reduced and analyzed, so that predictive models can be developed and management options are created and implemented.

To better understand how programmatic and environmental monitoring fit together while assessing the performance of the CCMP as well as the health of the ecosystem, please reference Figure 2.1 (which is modified from the Galveston Bay NEP). Programmatic monitoring is the initial driver, as the action plan, such as a urban stormwater runoff plan, must have targets and goals to recognize success. Once targets are established and the plan is implemented, then the community responds according, following critical measures to lessen pollutant loads in storm water runoff. From the community's action, changes are reported in pollutant discharge to the estuary. To understand the changes made by the stormwater runoff plan, assessments must be made by recording environmental change in the field. Long-term environmental monitors can then record not only changes in ambient conditions, such as water quality, but the effects of those conditions to the function of the entire ecosystem.

Figure 2.1 Programmatic and Environmental Monitoring in the EMP



Identified Guiding Principals

Primarily, the objective of the EMP is to assess implementation of the MBNEP CCMP. To achieve this goal, the EMP will provide strategy on how to provide critical long-term data to assess changing ambient trends in the estuary. The various principals which have guided the framework of this strategy are listed below.

1. ***Measure the status of actions***
   This principal is the basis for the EMP. An Implementation Tracking System (ITS), indicating *action summary, percentage complete, and identified roadblocks to implementation,* will be the consolidation of all action monitoring data, and will be available to the public through the MBNEP website, as well as at the central office location. Further information of the ITS system can be found in Chapter 14: Information Tracking System, of this document.

2. ***Characterize trends***
   All data resulting from programmatic tracking as well as direct environmental sampling efforts will be tested for meaningful correlations to better refine management strategy and decisions. Further information on past trends can be found in Volume II of the MBNEP CCMP: The Characterization.

3. ***Integrate ongoing efforts***
   To avoid duplication, reduce overlap and minimize costs, existing efforts are the basis of the EMP. Where essential monitoring gaps have been identified, efforts have been made to work with existing agencies and/or organizations to provide need information. Detailed information regarding ongoing monitoring efforts can be referenced in Chapter 3: Current Monitoring in Morro Bay, of this document.

4. ***Utilize bioindicators***
   Monitoring of all variables in an ecosystem to assess change and overall health is not feasible. Therefore it is valuable to utilize indicators to evaluate specific resource quality to reduce costs and assessment time. The EMP will make use of various bioindicators, depending on habitat, possible stressor, and timeframe in question. Further information on bioindicators that will be utilized can be found in Chapter 10: Habitat Health, of this document.

5. ***Utilize stakeholder-based Technical Advisory Committee (TAC)***
   Success of the EMP is based upon integrated efforts throughout the Morro Bay estuary and watershed. Without constant feedback of monitoring status, exchange of data, and refinements in the monitoring strategy, success will not be measure. To carry out these functions, it is necessary a stakeholder-based TAC be convened on a quarterly basis. For more information on roles and timelines of this TAC, please refer to page 13 of this chapter.

6. ***Utilize CCAMP data management strategy***
   Management of such a wealth of information requires a centralized data management strategy. Such a database exists, CCAMP (of the CCRWQCB), which will house data and metadata for all programs. This database and selected analytic tools will be available on the Internet as well as linked to the MBNEP website. Individual programs can input data directly into the CCAMP software to facilitate quarterly data reviews and annual reports. The analyses from this database will provide feedback to the MBNEP to evaluate action effectiveness and long-term trends. Further

information of CCAMP can be found in Chapter 14: Information Tracking System, of this document

Technical Advisory Committee

A Technical Advisory Committee, coordinated by MBNEP staff and made up of interagency and stakeholder technical experts, will convene at a minimum of four times a year to review current EMP progress, Quality Assurance standards, exchange pertinent technical knowledge and to prioritize and take action on needed research actions. In addition to these roles, the TAC will also be responsible for communicating outcomes to the Task Force at quarterly meetings as needed. Other possible agenda items may include:

- ✓ Setting topics for bienniel State of the Bay conference,
- ✓ Regional monitoring workshop agendas,
- ✓ Reviewing technical proposals to the MBNEP,
- ✓ Refining study design,
- ✓ Assisting in developing local bioindicators to track implemented actions, and overall health of the ecosystem.
- ✓ Assisting in extramural funding to support the EMP and prioritized research needs.

The initial TAC meetings for transition into implementation are scheduled for late September and March. Committee chair, and workgroup chairs must be selected by the January 2001 Task Force meeting to proceed with normal agenda items.

Expected Performance of EMP

Site placement for the Morro Bay watershed monitoring program was based upon historical sites from the NMP. As illustrated by Figure 2.1, seventeen sites have been monitored bimonthly since 1993 for conventional water quality parameters. Of these, ten sites at major confluences with Chorro Creek or Los Osos Creek will be sampled past the NMP ending year of 2001. Phasing down of sample frequency and number of sites will coincide with the FOE's VMP taking over the NMP sites. Additional sites were added on both major drainages to add power of spatial change detection to the data set, as Table 2.1 details below.

Quantitative changes in the watershed that occurs during implementation will be easily detected due to the statistically powerful large data set (n=approximately 272 for any given parameter at a site) from the Morro Bay National Monitoring Program (MBNMP). The large watershed data set also adds to the strength of detecting various changes in the watershed as it has spanned various weather and fire events.

Little consistent sampling efforts have been focused on the Morro Bay estuary. Many limited-term studies have been executed from the Morro Bay Volunteer Monitoring Program (MBVMP), CCRWQCB and County Department of Health. The only long term monitoring has come from regulated economic bases such as NPDES dischargers and shellfish harvesters, with focused data collection not expanded to the entire estuary. The aim of the EMP is to take monthly water quality samples throughout the estuary, and perform annual ecological data collection to evaluate freshwater, saltwater, urban and background wildlife pollutant input.

Site selection for estuarine sites was based upon habitat type (mudflat, fresh/marine inflow channels, salinity gradients), tidal circulation (mid-incoming tide and mid-outgoing tide) and input (urban areas, wildlife, outer bay, watershed). As little data exists in the bay, change detection in the Morro Bay estuary will be reliant upon frequent data collections to increase sample size and pre-implementation trends.

Table 2.1 Expected Detection At Watershed Grab Sampling Sites

SITE TAG	SITE NAME	Expected change detection	Part Existing NMP data set?*
UCC	Upper Chorro Creek	• Upstream site for Dairy Creek nutrient inputs • Catchall for upper Chorro Creek	No
DAM	Dairy Creek	• Decrease in turbidity, pollutant loads. On public land with active BMPs. • Rising nutrient input	Yes
PEN	Pennington Creek	• Used as a reference for Dairy Creek pairing, low nutrients, turbidity	Yes
CAN	Canet Road, (Chorro Creek Middle)	• 30 years of continuous County flow gauge data • Downstream site for CMC wastewater input, Chumash and Walters Creeks • High fecal Coliform levels	Yes
SLU	San Luisito Creek	• 24 years of continuous County flow gauge data • Healthy riparian corridor • Large drainage of steep uplands • High turbidity (75,000 ntu 1995 Highway 41 fire)	Yes
SBE	San Bernardo Creek	• High nutrient input, Adjacent row crop and ranch land • High fecal Coliform levels	Yes
TWB	Twin Bridges	• Estuarine input, low saltwater mixing potential • Sediment deposition zone • Downstream of all major Chorro basin tributaries	Yes
SYB	Santa Ysabel	• Estuarine input, low saltwater mixing potential • High nutrients, turbidity • Downstream of all major Los Osos basin tributaries	Yes
WAR	Warden	• Estuarine input, low saltwater mixing potential • High nutrients, low DO • Marsh, downstream of Warden Lake	Yes
ETO	Eto Creek	• High nutrient input, legume row crop adjacent	No
LVR	Los Osos Valley Road	• High suspended sediment, turbidity, phosphates • Clark Valley Canyon arm of Los Osos • Downstream of high erosional potential areas	Yes
CLK	Clark Valley	• Upstream of high erosional potential areas • Reference creek for macroinvertebrate indices in Los Osos basin • High habitat scores; steelhead trout present	No
TUR	Turri Road	• High nutrient input, super-saturated dissolved oxygen values • Adjacent to row crops • Middle downstream site of intensive agriculture basin drainage	Yes
UWC	Upper Warden Creek	• Upper agricultural basin, BMP detector • High nutrient values • Low habitat values	Yes

*NMP data set has over 272 samples for nearly every conventional water quality parameter, and is ongoing until year 2001. Sites not included in this data set have minimum historical data.

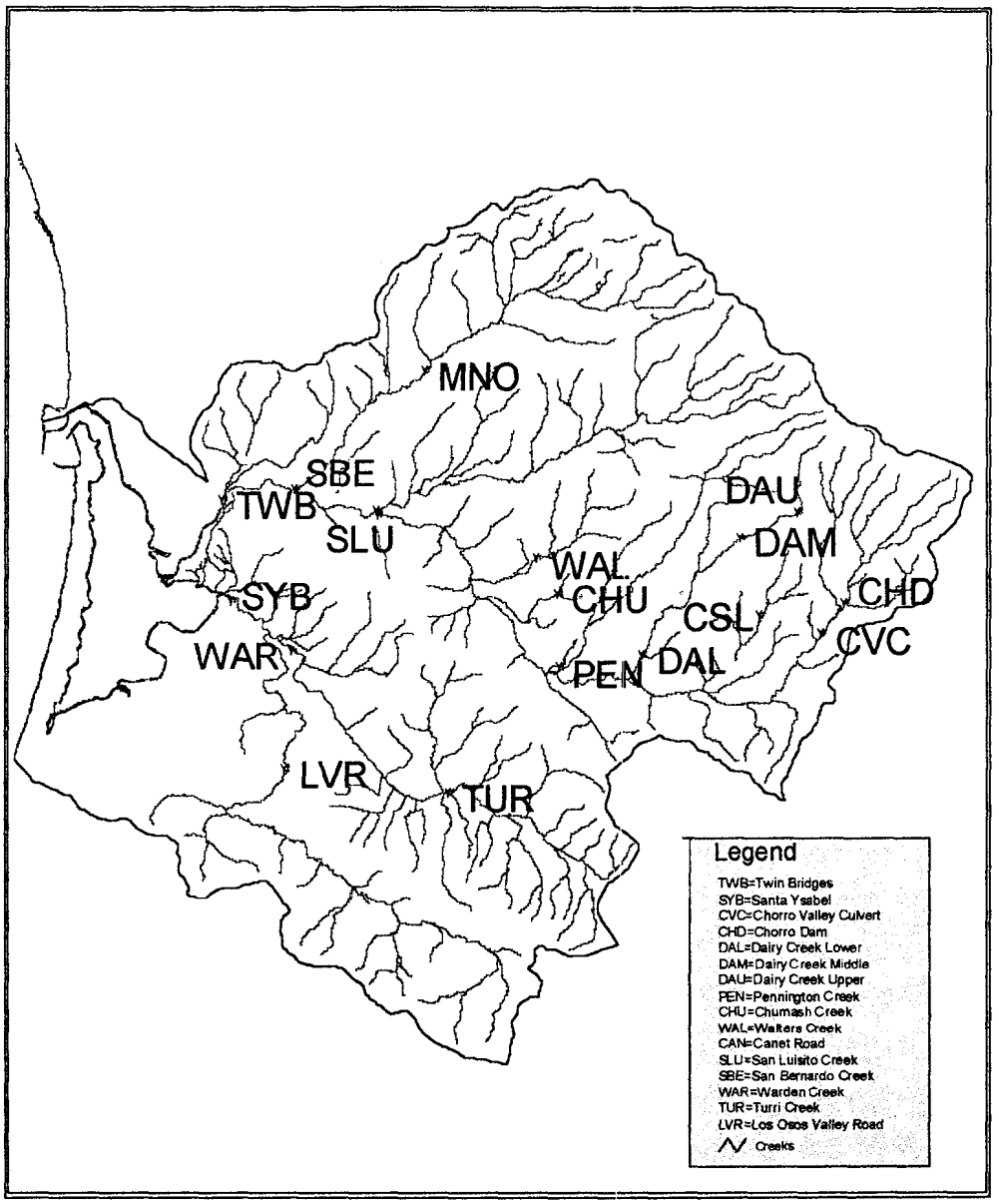
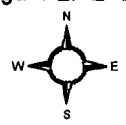


Figure 2. 2 Locations of Morro Bay Watershed National Monitoring Program sampling stations



MBNEP Characterization 1999

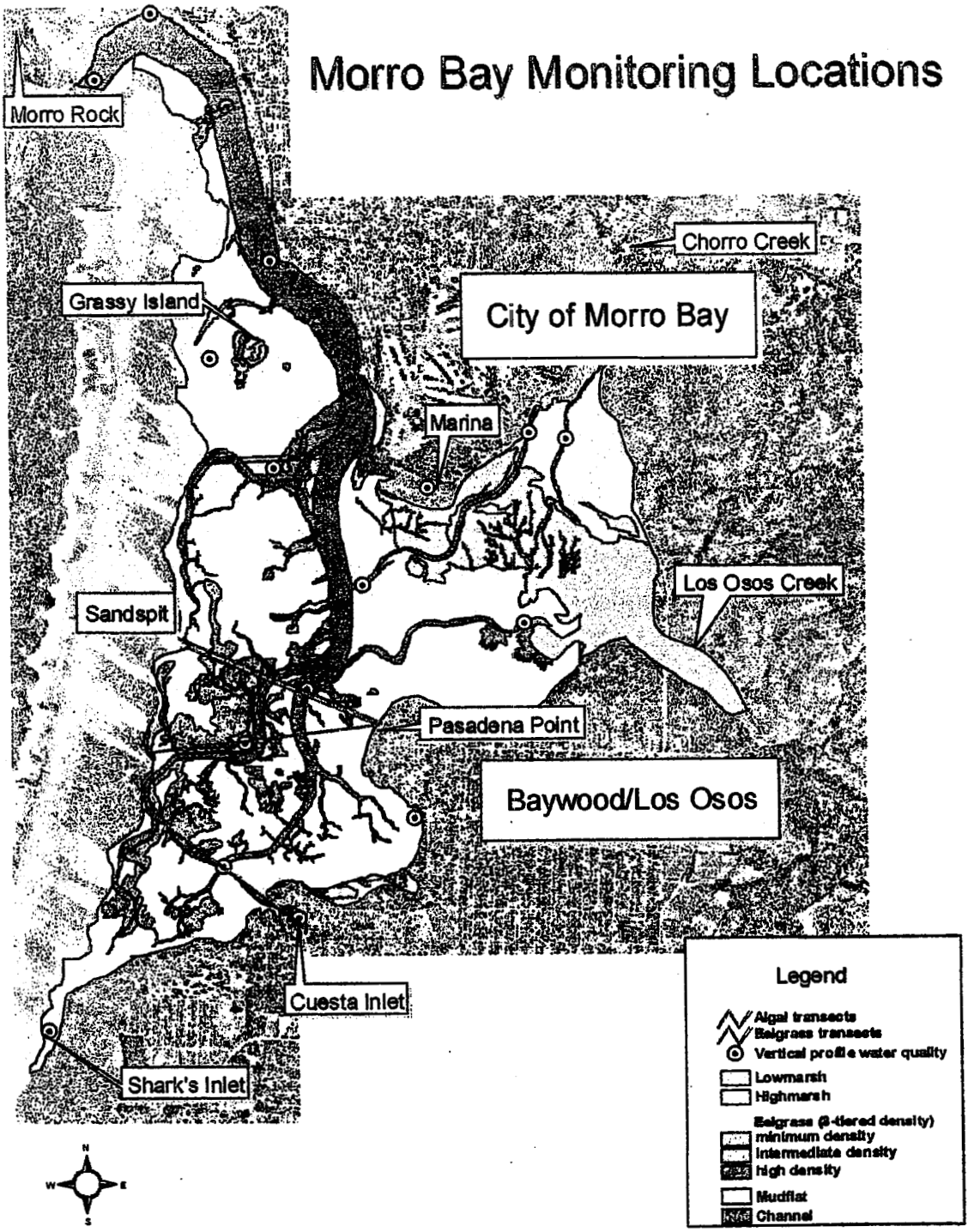


Figure 2.3 Locations of Morro Bay estuary sampling sites.
Source: Morro Bay Volunteer Monitoring Program, 1999

These sites will be sampled as part of the MBNEP EMP to evaluate success of the CCMP, and track overall ecosystem health.

Chapter 3

Current Monitoring in Morro Bay

Existing monitoring efforts in the Morro Bay estuary and watershed are the foundation of the MBNEP Environmental Monitoring Plan (EMP). The wide array of natural communities interacting with a relatively small amount of anthropomorphic impacts, creates a noiseless framework to test hypothesis and detect change from the Comprehensive Conservation Management Plan. Coordinating with the many stakeholders monitoring in the study area, a comprehensive long-term monitoring plan can be established.

Stakeholder Monitoring Base

Stakeholders involved in the EMP include many local organizations and agencies. In many cases, the stakeholders will work closely together, sharing program resources and collaborating to develop strategies to ensure the most appropriate approach to use to collect data. For example, CCAMP will be sampling the confluences of Chorro and Los Osos Creek and the estuary as part of their program. In addition, Friends of the Estuary will be monitoring those locations monthly as well, collaborating on labor, lab timing and coordination for mutual benefit. Stakeholder involvement is outlined in Table 3.1, listing primary and secondary implementers crucial to the evaluation of the CCMP. Asterisks indicate parameters that will not initially be measured, yet will be phased in when funding becomes available.

The MBNEP staff, to insure consistency in evaluating monitoring questions will track the data collected by these groups. The data will be tracked via Intemet through CCAMP and SLO Logic data streams for the entire county. The MBNEP will electronically house all MBNEP/Friends of the Estuary (FOE) information gathered to evaluate specific actions as well trend data. The data collected will be utilized to develop quarterly monitoring summaries and annual reports to assist in biennial review. Below is a highlighted list of major existing monitoring agencies and organizations active in the Morro Bay estuary and watershed.

Federal Agencies

Army Corp. of Engineers (ACOE)

The ACOE has been dredging the Morro Bay harbor mouth since 1948. In the protocol listed for the dredging of waterways, the ACOE monitors sediment cores before dredging activities initiate, and analyzes dredge spoils before they are permitted to deposit the load outside the harbor entrance. This sediment data is crucial for understanding the rate at which the channels are filling in, as well as sources of erosion.

State Agencies

Central Coast Regional Water Quality Control Board (CCRWQCB)

Central Coast Ambient Monitoring Program:
The Regional Water Quality Control Board's CCAMP intensively focuses on one watershed at a rotation (one year), while monitoring coastal river mouths through the Coastal Confluences Program. In 1999, CCAMP began monitoring Chorro (TWB) and Los Osos (SYB) Creek mouths as part of the monthly ambient task. The program plans on continuing documenting conventional water quality parameters, as well as sediment chemistry, and benthic invertebrates at the existing sites. Near shore sites, in Estero Bay may also be picked up through this program in the near future.

Morro Bay National Monitoring Program:
The Morro Bay National Monitoring Program began a 10-year funded study of BMP effectiveness in the Morro Bay Watershed in 1993, which has detected change at various locations in the watershed. Within three years, significant reductions of fecal Coliform have been documented at Dairy Creek Cattle Exclusion and Chum ash/Walters Rotational Grazing Management Project within three years after implementation. Significant reductions in turbidity have been documented four years after cattle grazing practices were modified. Also, row-crop land use has been found to be the largest contributor of nutrients in the watershed relative to livestock practices or point sources. The year 2002 marks the end of this focused study, however many of the same sites will be continued by the FOE Volunteer Monitoring Program to make use of the statistically powerful data set.

TMDL Monitoring:
Since 1984, the CCRWQCB has been involved in assessing the nutrient pollutant loads in the area. The CCRWQCB will monitor nitrate as nitrate and orthophosphate as per their Nutrient TMDL Monitoring Plan for Chorro Creek. The CCRWQCB has also been assessing the sediment and metals pollutant loads in the area. They will also monitor turbidity and acreage of wetland habitats as per their Sediment TMDL Monitoring Plan for Chorro Creek and the Morro Bay Estuary. Monitoring for metals for the Chorro Creek and Morro Bay Estuary TMDL will be outlined in the Metals TMDL Monitoring Plan. They will also monitor turbidity and acreage of wetland habitats as per their Sediment TMDL Monitoring Plan for Chorro Creek and the Morro Bay Estuary.

Department of Health Services

Shellfish Monitoring Program:
The California State Department of Health Services has been in charge of monitoring the shellfish leases since 1974 Williams Shellfish Farms measures their leases for bacterial contamination on a monthly basis as part of a self-monitoring program (see Appendix I). DHS is also participating in the DNA Fingerprinting Study with the CCRWQCB and Cal Poly University to help identify allocations of high fecal coliform loads in the estuary.

Citizen Monitoring Programs

Friends of the Estuary (FOE)/MBNEP

Watershed Monitoring:
The Morro Bay Volunteer Monitoring Program (MBVMP), established by the FOE in 1993, has been assisting the National Monitoring Program (see under CCRWQCB, State Agencies) and the National Estuary Program in monitoring the Morro Bay watershed since 1997. Flow monitoring has been conducted at NMP sites along with even-interval data gathering. In the fall months, cross-sectional stream profiles have been surveyed at over 20 sites throughout the watershed to document erosion/depositional changes in streambank habitats. In the spring, the Volunteer Monitoring Program will complete its fourth year of sampling macroinvertebrates documenting fires and El Nino events in the analyzed data set. As of Spring 2000, the Friends of the Estuary are currently under going contract management for a three year 319 (h) grant (2000-2003) to assist in environmental evaluation of the implemented CCMP. Their teams will continue monitoring the ongoing protocols, while adding more intensive monitoring, such as diurnal dissolved oxygen creek monitoring to their scope of work.

Estuarine Monitoring:
The MBVMP has been monitoring estuarine water quality since 1997. The "Dawn Patrol" has documented seasonal fluxes in the Back Bay, and has recently begun noting vertical profiles of salinity, dissolved oxygen, temperature and depth at diurnal cycles throughout the bay.

Beginning in Fall 2000, the MBVMP will implement the Bay Monitoring Program. It will focus on 16 sites in the marine/estuarine environment on an even-interval basis to provide additional data that will help to detect change during the implementation phase. In addition, the MBVMP will continue monitoring sites for nutrients in back bay freshwater seeps and creeks. High values of nitrates from the freshwater seeps have been documented, and it is planned to continue monitoring the seeps to continue assessing implemented actions and change in groundwater nutrient levels when the local area becomes sewered.

Audubon

Audubon coordinates the nation wide Christmas bird count where Morro Bay estuary has often listed in the top five bird counts in the nation. They also participate in coordinating Snowy Plover surveys, in cooperation with CDPR on the Morro Strand Natural Preserve. Audubon has also been supportive of volunteer brant surveys noting age structure and migrating/resident annual density for the last seven years. Currently these monitoring activities are planned on continuing for the next five years at a minimum.

Point Reyes Observatory

Avian community structure has been long monitored in the Morro Bay estuary as it is a crucial stop over on the Pacific Flyway for migrating waterfowl. Focused studies include: the Point Reyes Observatory Shorebird Surveys that have documented shorebird species diversity and density in Morro Bay for the last decade.

NPDES Dischargers

Morro Bay Power Plant

A NPDES permit, through the Regional Water Quality Control Board currently regulates the operation of the Duke Energy Morro Bay Power Plant. The permit requires Duke to monitor and report on a wide variety of constituents. These constituents include flow, temperature, chlorine, pH, dissolved oxygen, suspended solids, oil and grease, and a wide variety of metals and other priority pollutants. Additional requirements include: bottom sediment monitoring in the ocean for metals, sulfides, and PCB's; velocity and sediment deposition measurements at the intake structure; and a bioassay test using abalone to detect chronic toxicity to metals. Appendix I includes copies of NPDES permits that include details on parameters measured, frequency and location.

California Men's Colony

The California Men's Colony wastewater treatment plant is also regulated through the NPDES process, through the Regional Water Quality Control Board. The CMC is mandated to monitor flow, settleable solids, chlorine (residual and used), sulfur dioxide, and pH daily. Additional parameters that are measured monthly include temperature, total coliform, dissolved oxygen and biochemical oxygen demand.

Current Information Gaps

Tables 3-1 and 3-2 illustrates that a more intensive focus has existed primarily on conventional water quality and various physical and chemical monitoring of Morro Bay and it's watershed, versus biological and ecological parameters. Table 3-3 below summarizes the weaknesses existing in physical and chemical information on Morro Bay. The greatest weaknesses are as follows:

- Long-term and geographical organic pollutant monitoring
- Temporal variability within setteable and suspended metals
- Wide-spread benthic organism monitoring information
- Bioaccumulation of metals and other toxics on a geographic and temporal scale
- Toxicity and chemical effects on biological organisms
- Overall lack of temporal monitoring among ongoing efforts

Table 3-4 below summarizes the weaknesses existing in biological and ecological information on Morro Bay. The greatest weaknesses are as follows:

- Little overall information on toxicity/chemical effects and bioaccumulation and its effect on a wide range of indicators.
- General wildlife information is sparse, especially concerning long-term trends, quality assurance and level of detail.
- Ecological data on benthos and plankton is primarily short duration studies, with little temporal and companion data to create hypothesis.
- Little high quality geographic coverage and temporal variability of wetlands.
- No consistent format of any geographic coverage assessments.

Table 3-1 Summary of existing physical/chemical monitoring Morro Bay.

	Hydrology /Freshwater Inflow	Circulation	Pollutant Sources	Conventional Water Quality	Pollutant: Metals	Pollutants: Organics	Sediment Quality	Sediment Transport	Dredged Material	Land Use
MBVMP	◘		◘	■	□		⊡			
RWQCB	◘		⊡							
NMP	◘		◘	■	◘					
CCAMP			⊡	■	■					
Cal Poly							⊡	⊡		⊡
UCCE				□			⊡			⊡
NRCS	⊡	□					◘	◘		⊡
RCD	⊡						◘	◘		⊡
CDPR										
CDHS										
CDFG										
CMC				□						
NMFS		□								
Sea Grant										
Cty Eng.	□								□	
Cty Ag										◘
Cty Hlth			□							
CSLO					⊡					⊡
Morro Bay										⊡
ACOE							◘		■	
USFWS	□									□
Duke	⊡	□		□			□	□		
Audubon										
Tenera				⊡	⊡					
Morro Group	◘	□	□				□	⊡		⊡
Jones Stokes										
Cleath & Assoc.	⊡									

■ **Extensive Data** ◘ **Substantial Data** ⊡ **Moderate Data** □ **Minor Data**

Table 3-2 Summary of existing biological/ecological monitoring Morro Bay.

	Wetlands	Plankton	Benthos	Oyster	Fish (other)	Herps	Birds	Mammals	Bioaccumulation	Toxicity/ Chemical Effects
MBVMP	☐	☐	⊡				☐			
RWQCB	☐			⊡					☐	☐
NMP			⊡				☐			
CCAMP									☐	
Cal Poly		⊡			☐	☐		☐		
UCCE										
NRCS	☐									
RCD	☐									
CDPR	☐					☐	☐			
CDHS		■		■					☐	☐
CDFG	⊡	⊡		☐	■	☐	■	⊡		
CMC										
NMFS					⊡			⊡		
Sea Grant								⊡	☐	
Cty Eng.										
Cty Ag										
Cty Hlth		☐								
CSLO										
Morro Bay										
ACOE										
USFWS	☐					☐	☐	☐		
Duke										
Audubon						☐	⊡			
Tenera						☐				
Morro Group	☐					☐				
Jones Stokes	⊡									
Cleath & Assoc.										

■ **Extensive Data** ■ **Substantial Data** ⊡ **Moderate Data** ☐ **Minor Data**

Table 3-3 Summary of physical and chemical information on Morro Bay.

■ Extensive Data ◘ Substantial Data ⊡ Moderate Data ☐ Minor Data	Geographic Coverage	Temporal Variability	Duration	Level of Detail	Quality Assurance
Hydrology/Freshwater Inflow	◘	☐	◘	☐	☐
Circulation	◘	⊡	⊡	⊡	☐
Pollutant Sources	◘	⊡	☐	⊡	◘
Conventional Water Quality	■	■	⊡	■	■
Pollutant: Metals	⊡	☐	☐	☐	⊡
Pollutants: Organics	☐	☐	☐	☐	☐
Sediment Quality	◘	⊡	◘	◘	◘
Sediment Transport	⊡	☐	◘	◘	◘
Dredged Material	■	☐	■	■	■
Land Use	■	☐		⊡	■

Table 3-4 Summary of biological and ecological information on Morro Bay.

■ Extensive Data ◘ Substantial Data ⊡ Moderate Data ☐ Minor Data	Geographic Coverage	Temporal Variability	Duration	Level of Detail	Quality Assurance
Wetlands	◘	☐	☐	☐	⊡
Plankton	⊡	⊡	☐	☐	☐
Benthos	☐	☐	☐	☐	☐
Oyster	■	■	■	■	■
Recreational Fish	■	⊡	☐	☐	☐
Fish (Other)	⊡	☐	☐	☐	☐
Herps	⊡	☐	☐	☐	☐
Birds	■	◘	⊡	⊡	⊡
Mammals	⊡	☐	☐	☐	☐
Bioaccumulation	☐	☐	☐	☐	☐
Toxicity/Chemical Effects	☐	☐	☐	☐	☐

Chapter 4

Summary of Environmental Monitoring

(TREND, PROJECT-SPECIFIC, and RESEARCH NEEDS)

Currently, ongoing monitoring in the watershed and bay provides the starting point for developing a comprehensive environmental protection program. To achieve its goals the EMP must coordinate a large range of variables including diverse stakeholders, numerous parameters and multiple objectives incorporated into the CCMP. Where essential monitoring gaps have been identified, efforts have been made to work with existing agencies and/or organizations to provide need information. This chapter summarizes how the monitoring effort will be coordinated according to specificity of trend characterization, project-specific success and research needs. Therefore, the three coordinating components are as follows:

1) TREND Monitoring
2) PROJECT-SPECIFIC Monitoring
3) RESEARCH Monitoring

These three components discussed in this chapter, constitute the strategy that the MBNEP will use to help determine whether the stated CCMP actions and their objectives are being met. Further details of monitoring activities are discussed in **Project Management** Chapters 5-13.

TREND monitoring are those activities that will assess trends and track overall watershed and estuarine health and include all environmental monitoring efforts occurring in the watershed and bay. *RESEARCH* include activities developed to provide additional information needed to guide long-term planning, implementation, and monitoring. *PROJECT-SPECIFIC monitoring* are those activities required to determine whether individual action plans are successful at reaching the goals of the MBNEP. Specific monitoring activities may overlap more than one category and answer more than one question.

Trend Monitoring Workplan

The following discussion summarizes TREND monitoring to list measurable parameters, frequency of sampling and location of sites.

The TREND Monitoring workplan is summarized in two parts, the watershed and the estuarine sampling schemes. The analytes and parameters listed below in Tables 4.1a (watershed components) and Table 4.1b (estuarine components) comprise the basis for the Morro Bay Environmental Monitoring Plan. These parameters will be consistently monitored through the duration of the CCMP's implementation period, and until their respective monitoring questions have been answered.

Table 4.1a Morro Bay Watershed Monitoring Parameters/Variables

Watershed Component	Parameter/ Variables	Implementer *Primary/ Secondary	Frequency	Location	Data Info Need	Related Action Plan
Conventional Water Quality	Nutrient Series, Chloride, Total Suspended Sediment, Coliform Series, Turbidity, Dissolved Oxygen, pH, Salinity, Conductivity, Temperature, Chlorophyll a	*CCAMP Funding/ FOE collection	Monthly	2 sites: SYB/TWB	SR-5 PH-2-5 HH-6 WSQ-2,4,5,7 NPS-3-5	CC-3 CC-4 CC-5 All SED All BACT All NUTR FLOW-1,4 All HMT
Volunteer Water Quality	Nutrient Series, Total Suspended Sediment, Coliform Series, Turbidity, Dissolved Oxygen, pH, Salinity, Conductivity, Temperature, Chlorophyll a, Flow	*FOE	Monthly	15 sites: Tributary/ Confluence per VMP Flow sites, Per VMP	SR-5 PH-2-5 RF-2-5 HH-6,8,13 SD-4,8 WSQ-2,4-7	CC-2,3,4,6 All SED All BACT All NUTR All FLOW All HMT
Sediment Chemistry	Title 22 Hazardous waste metals, Organochlorine Pesticides and PCBs, Organophosphorous Pesticides, Carbamate and Urea Pesticides (HPLC), Particle size, Polynuclear Aromatic Hydrocarbons	*CCAMP	Annually	2 sites: SYB/TWB	WSQ-8,9 NPS-3,4	CC-3 CC-5 CC-6 All HMT EDU-4
Bioaccumulation (bivalves)	Trace Organics full scan +PAH Full Scan Metals	*CCAMP	Annually	2 sites: SYB/TWB	WSQ-8,9	CC-3 CC-6 All HMT
Bioaccumulation (fish)	Trace Organics full scan +PAH Full Scan Metals	*CCAMP	TBD by TAC	TBD by TAC	SD 7,8 WSQ-8,9	CC-3 CC-6 All HMT All STL
Freshwater Bioassessment	Benthic Macroinvertebrates, Harpactacoids, Plankton	*FOE, *CCAMP	Annually	10 sites Figure 9.2	SR-7 RF-6 HH-7,11 SD6 WSQ 2,6,9	CC-6
Fish Surveys	Community Diversity/Density	*FOE/NEP	TBD by TAC	4 sites as coordinate d by CDFG	HH-8,9 SD-7.8	CC-5 CC-6 All HAB All STL
Bird Surveys	Community Diversity/Density	*FOE	Quarterly	10 sites per VMP	HH8,9 SD-3	CC-6 All HAB SED-6
Geomorphological Suite	Stream Cross-Sectional and Longitudinal Profiles, Habitat Typing, Photodocumentation	*FOE/RCD	Annually	21 sites on Chorro and Los Osos tributaries	SR-3,4-6 HH-3,5,8,9,12-14 SD-6,8 WSQ-6	CC-5 CC-6 All HAB
Habitat Delineation	Acreage of habitats (listed in Chapter 8/9) Satellite imagery Groundtruthing	NEP/FOE	Every five years beginning in 2001.	All major habitat types	RF-6	CC-1 All HAB

Table 4.1b Morro Bay Estuarine Monitoring Parameters/Variables

Estuarine/ Near Shore Component	Parameter/ Variables	Implementer Primary/ Secondary	Frequency	Location	Data Info Need	Related Action Plan
Volunteer Water Quality	Nutrient Series, Coliform Series, Turbidity, Dissolved Oxygen, pH, Salinity, Conductivity, Temperature, Chloropyll a	FOE	Monthly	16 sites: per VMP	PH 2-5 HH-6 SD-4,8 WSQ-2,5-7 PS-5,7	CC-3,4,6 All SED All BAC All NUT All FLW
Pathogen Indicators	Total Coliform, Fecal Coliform, Enterococcus, *E. coli*	FOE/DHS, Local Government	Monthly	10 sites: per VMP	PH 2-5 NPS-3-5 WSQ-7 PS-5,7	CC-3,6 All BAC
Sediment Chemistry	Title 22 Hazardous waste metals, Organochlorine Pesticides and PCBs, Organophosphorous Pesticides, (HPLC), Particle size, Polynuclear Aromatic Hydrocarbons	CCAMP	TBD by TAC	At all water quality sites. 16 sites: per VMP	WSQ-9 NPS-3,4	CC-3,6 All HMT EDU-4
Bioaccumulation (bivalves)	Trace Organics full scan +PAH Full Scan Metals	RWQCB – TMDL/FOE	Initial Screening only	5 sites: 2 Delta, 1 Bay mouth, 2 Mudflat	WSQ-8,9	CC-3,6 All HMT
Bioaccumulation (fish)	Trace Organics full scan +PAH Full Scan Metals	*CCAMP	TBD by TAC	5 sites: 2 Delta, 1 Bay mouth, 2 Mudflat	WSQ-8,9 SD-7,8	CC-3,6 All HMT All STL
Nutrient Biological Impact	Nutrient Series, Eelgrass Productivity, Eelgrass Ephiphytic Index, Turbidity, Eelgrass density transects	NEP/Cal Poly	Three Year Monitoring Project	5 Transects based on J. Chestnut/Tetra Tech transects	HH-6 WSQ-4	CC-3 CC-6 All NUT HAB-8
Benthic Infauna (Partial RBP)	Eelgrass Community Diversity Benthic Macroinvertebrates, Plankton	NEP/Cal Poly	Three Year Monitoring Project	5 Transects based on J. Chestnut/Tetra Tech transects	SR-7 RF-6 HH-3,4,6,7 WSQ-9	HAB-8 CC-6
Brant Surveys	Brant Migration / Resident Timeline, Brant Density, Brant Age Composition, Brant Habitat delineation	J. Roser, Audobon/ NEP	Daily October-May	6 Observation points on bay perimeter. 2 Front bay, 1 delta, 2 back bay	SD-3	CC-6 All HAB
Fish Trawls	Community Density/ Diversity	CDFG	Annually	4 sites as coordinated by CDFG	SD-7,8	CC-6 All STL All HAB

Shore Bird Survey	Community Density/ Diversity	Pt. Reyes Observatory/ Audobon	Annually	6 Observation points on bay perimeter. 2 Front bay, 1 delta, 2 back bay	SD-3	CC-6 SED-6 All HAB
Eelgrass Survey	Community Density/ Distribution	NEP/ J. Chestnut & Cal Poly	Annually	5 Transects based on J. Chestnut/Tetra Tech transects	RF-6 HH-12 SD-6	CC-6 HAB 8
Plankton Survey	Community Density/ Diversity Turbidity, Temperature	UCCE, DHS/ Coast Guard, FOE	Monthly	4 sites: Estero Bay, Harbor Mouth, N. T-Pier, Back Bay Channel	HH-8,9 SD-5 PS-5	CC-6
Algal Cover Transects	Percent Cover	FOE	Four times a year, during algal growth season. One time in dormant season.	4 Transect Sites: Chorro Delta, Shark Inlet, Pasadena Point, and Grassy Isl.	HH-6,8,9,12 SD-4,6	CC-6
Estuarine Bioassessment	Plankton, Macroinvertebrates/ Harpactacoids	FOE/NEP	Annually for five years	5 sites: 2 Delta, 1 Bay mouth, 2 Mudflat	RF-6 HH-5,8 SD-5	CC-6
Near Shore Metals/ Pathogen Indicators	Title 22 Hazardous waste metals, Coliform series	CCAMP	Annually	3 sites in Estero Bay	WSQ-8,9 PS-5	CC-3 CC-6 All BACT All HMT
Geomorphological Suite	Stream Cross-Sectional and Longitudinal Profiles, Habitat Typing, Photodocumentation, Bay Bathymetry, Artifical Depo Markers	*FOE/RCD	Annually	21 sites on Chorro and Los Osos tributaries	SR-3,5,6 HH-5,12 SD-6,8	CC-6 All HAB
Habitat Delineation	Acreage of habitats (listed in Chapter 8/9) Satellite imagery Groundtruthing	NEP/FOE	Every five years beginning in 2001.	All major habitat types	RF-2,5,6 HH-3,4,6,10,12 SD-3,4,6,8 WSQ-6	All HAB

The TREND Monitoring Workplan will be coordinated primarily by the Friends of the Estuary's (FOE) Volunteer Monitoring Program (MBVMP) with assistance by the Morro Bay National Estuary Program (MBNEP) and the Central Coast Regional Water Quality Control Board (CCRWQCB). Funding for the program coordination will come from Friends of the Estuary's State Water Resource Control Board 319(h) grant through June 2003. Research to identify extramural funding to support the TREND Monitoring workplan will begin in July 2001.

Time Frame

Time frames for implementing specific monitoring elements are presented in the Table 4.2 below. The parameters indicated are those that will be initiated, or funded through MBNEP CCMP Environmental Monitoring Plan. Initial monitoring activities will be focused upon gathering pre-implementation data to support evaluation following action plan implementation. Watershed data will be based upon the ten-year study of MBNMP (Figure 4.1), and will transition from bimonthly sampling to monthly sampling due to the accrued large data set. Number of sites will be decreased to better focus on evaluating BMPs on a tributary basis instead of individual BMPs that have already been proven effective.

Table 4.2 MBNEP Monitoring TREND Timetable

		MBNEP Monitoring TREND Timetable 2000-2001											
Related CCMP Action	**Monitoring Component (See Tables 4.1a/b)**	**Jul-00**	**Aug-00**	**Sep-00**	**Oct-00**	**Nov-00**	**Dec-00**	**Jan-01**	**Feb-01**	**Mar-01**	**Apr-01**	**May-01**	**Jun-01**
All Priority Actions	Conv./Volunteer Water Quality												
SED –2,4.5	Sediment Chemistry												
CC-4 BACT-1,3,4	Bioaccumulation (bivalves)												
CC-6 HAB-1,9	Freshwater Bioassessment												
CC-6, HAB 1,9 STL – 2,3	Fish Surveys												
CC-6 HAB – 1,9	Bird Diversity			9/15 – 9/30			10/15 – 10/30			3/15-3/30			7/15
SED –5 STL – 3	Geomorphological Suite		Creek sites									Aerial	
CC –4,6 BACT –1,3,4	Pathogen Indicators												
NUTR – 1,2	Nutrient Biological Impact												
HAB – 1 STL - 3	Benthic Infauna												
CC-6 HAB – 1,9	Brant Surveys												
CC-6, HAB 1,9 STL – 2,3	Fish Trawls/Counts												
CC-6 HAB – 1,9	Shorebird Surveys												
CC -6 HAB -8	Eelgrass Surveys												
CC – 6 HAB –1	Plankton Surveys												
CC –6 HAB –1	Algae Cover Transects												
CC –6 HAB -1	Estuarine Bioassessment												

Table 4.3 Primary and Secondary EMP Implementers

(*Asterisks indicate parameters that will not initially be measured, yet will be phased in when funding becomes available.)

EMP Monitoring Tasks	Primary	Secondary
Watershed Sampling		
Conventional Water Quality	CCAMP	FOE
Volunteer Water Quality (fresh)	FOE	
Sediment Chemistry (full)	CCAMP	
Sediment Chemistry (Metals Only)	RWQCB-TMDL	NEP
Water Toxicity Sites (w chemistry)*	CCAMP*	
Water Chemistry*	CCAMP*	
Bioaccumulation (bivalves)	CCAMP	
Bioaccumulation (fish) *	CCAMP*	
Freshwater Bioassessment	FOE	CCAMP
Fish Surveys	NEP	FOE
Bird Surveys	FOE	
Geomorphology Suite	FOE	
Estuary Sampling		
Volunteer Water Quality (Marine)	FOE	
Pathogen Indicators	FOE	Local Government
Sediment Chemistry	NEP	FOE
Bioaccumulation(bivalves metals only)	RWQCB-TMDL	
Bioaccumulation(fish) TSM*	CCAMP*	
Nutrient Biological Impact	NEP	Cal Poly
Benthic Infauna (Partial RBP)	NEP	Cal Poly
Brant Surveys	J. Roser	NEP
Fish Trawls	CDFG	
Shore Bird Survey	Pt. Reyes	Audubon
Eelgrass Surveys	NEP/FOE	J. Chestnut/Cal Poly
Plankton Surveys	UCCE/DHS	FOE/Coast Guard
Algal Cover Transects	FOE	
Estuarine Bioassessment	FOE	NEP
Near Shore Sampling		
Metals, Synthetic Organics, and Toxicity	NPDES	
Pathogen Indicators	NPDES	
General Program Expense		
Volunteer/NEP Monitoring Coordinator	FOE/NEP	
VMP Coordinator	FOE	
VMP Bookkeeper	FOE	
Misc. VMP Program Expenses	FOE	
Equipment Replacement	FOE/NEP	

PROJECT-SPECIFIC MONITORING WORKPLAN

The data for the PROJECT-SPECIFIC monitoring workplan will be collected by the project proponents and coordinated by the MBNEP. An environmental monitoring plan will accompany each action plan proposal when it is submitted to the MBNEP for funding and approval, and will be based upon either a pre/post or a upstream/downstream study design (see Appendix C). The MBNEP staff will be responsible for prescribing monitoring details that will coincide with the consistent TREND monitoring workplan, if applicable. The monitoring results will then be used to determine action effectiveness and to provide a "feed back loop" to each implementer to help them effectively manage and maintain their actions.

Each monitoring plan will contain the following:

1. Define the action plan objectives and performance criteria.

2. List the questions that the monitoring plan will answer and how the evaluation techniques will be used to answer the questions.

3. Identify the qualitative methods (i.e., photo points, video taping, or recording visual observations during storm events) or quantitative methods (i.e. water quality sampling, or cross sections) to be used to determine project performance.

4. Identify sampling locations, frequency of sampling, and sampling procedures.

5. Provide a schedule for submitting data to the MBNEP in a data format suitable for incorporation into the CCAMP master database.

6. Identify how the project is consistent California Nonpoint Source Pollution Control Program. (Please refer to Volume I: CCMP, Appendix E.)

Site-Specific Monitoring Checklist

1. List the action plan(s) that the proposal meets?

2. Using the Action Plan Evaluation Tables (at the end of each Project Management Chapter) of the Environmental Monitoring Plan (EMP), list what performance criteria is applicable for the proposal.

3. List the questions that the monitoring plan (in Section III of the EMP) will answer, or prepare new questions that will be answered.

4. What evaluation techniques will be used to answer the above monitoring questions?

5. Identify the qualitative methods (i.e. photo points, video taping, or recording visual observations during storm events) or quantitative methods (i.e. water quality sampling, or cross sections) to be used to determine project performance.

6. Check box to affirm items below are attached to proposal:
- ✓ Sampling locations (description and map)
- ✓ Frequency of sampling
- ✓ Sampling procedures
- ✓ Schedule for submitting monitoring reports and raw data to the MBNEP.

7. Identify how the project is consistent California Nonpoint Source Pollution Control Program. (Please refer to Volume I: CCMP, Appendix E.)

Research Priorities For Morro Bay

"Research," as reported by the National Research Council, is "referred to [as] measurement and experimental programs undertaken to answer more open-ended questions." Research needs are important to understanding fully the background processes that occur in the Morro Bay estuary and watershed. Fulfilling these needs can also aid in development of techniques that may help answer monitoring and management questions.

Research needs will be prioritized upon action implementation timelines and funding availability. The MBNEP Technical Advisory Committee (TAC) will determine whether these studies will be done by contractor or by the MBNEP when funding becomes available. Some studies will be funded and coordinated through other avenues than the MBNEP, however data from these studies will be an integral part of evaluating success of MBNEP goals.

The technical community developed the identified Research Needs for the MBNEP study areas listed below over the last nine years. In 1991, the Bay Foundation of Morro Bay prepared a list of research needs. The list included specific research needs for the estuary and watershed including, but not limited to, a tidal and bathymetric survey of the estuary, water quality assessments, and habitat inventories. In 1995, a research needs workshop was held to build on the existing list and to identify questions still remaining to effectively manage the watershed and to prioritize actions. Workshop participants identified five primary areas in which research is needed: sedimentation, fresh water inflow, biological resources, toxins, and land use. In the Volume II: The Characterization, the data gaps below are also referenced in the end of each relevant chapter, detailing additional background information.

In 1997, the MBNEP initiated a bathymetric survey and the development of a tidal circulation model, a streamflow and sediment loading study, a nutrient loading study, a bacteria loading study, and a bay habitat characterization. Further Research Needs include, but are not limited to:

Sediment Reduction

SR-8 What are the sediment plume effects on Morro Bay and Estero Bay?

- Sediment deposition is filling in the Bay, impacting a wide variety of habitats, and affects virtually all other aquatic biological species.

SR-9 What is the effective minimum width for fenced riparian buffer to improve water quality improvement?

- Buffer strips are a proven effective BMP at reducing sediment, bacteria, and nutrient levels in surface waters. Buffer width effectiveness is dependent on various factors such as slope length, slope angle, soil type, vegetation types, volume of runoff, and adjacent land uses.

SR-10 Is there a positive correlation between salt and freshwater flow mixing zone and spatial particle size deposition?

- Sediment deposition in the estuary is influenced by differences between fresh and salt-water density.

SR-11 Is the lack of water clarity positively correlated with decreasing eelgrass productivity?

- Eelgrass production appears to be dependent upon low turbidity conditions. A decrease in the area of eelgrass has been observed after high runoff seasons with large sediment loads.

Public Health Issues

PH-7 What other processes are effective at filtering bacteria from surface water? Wetlands? Floodplains, etc?

- Constructed wetlands have demonstrated high removal rates for bacteria. Providing streams access to their floodplains would reduce bacteria and other pollutant loads from reaching the Bay.

PH-8 What is the effective minimum width for fenced riparian buffer to improve water quality improvement?

- Buffer strips are a proven effective BMP at reducing sediment, bacteria, and nutrient levels in surface waters. Buffer width effectiveness is dependent on various factors such as slope length, slope angle, soil type, vegetation types, volume of runoff, and adjacent land uses.

PH-9 What is the best pathogen indicator for stormwater runoff?

- Technical studies have demonstrated high bacteria levels in stormwater runoff from urban and suburban areas.

Reduction of Freshwater Flow

RF-7 How do changes in wastewater management affect distribution of freshwater wetland habitats?

RF-8 What is the effective minimum width for fenced riparian buffer to improve water quality improvement?

- Buffer strips are a proven effective BMP at reducing sediment, bacteria, and nutrient levels in surface waters. Buffer width effectiveness is dependent on various factors such as slope length, slope angle, soil type, vegetation types, volume of runoff, and adjacent land uses.

RF-9 Is there a positive correlation between salt and freshwater flow mixing zone and spatial particle size deposition?

- Sediment deposition in the estuary is influenced by differences between fresh and saltwater density.

RF-10 What are the optimum instream flow allotments for the Chorro Valley Users Group?

- Water diversions and withdrawals directly affect freshwater flow available for aquatic habitat and threatened and endangered species.

RF-11 What are the effects of Morro Bay Power Plant on bay circulation patterns?

- The power plant's cooling water intake structure is located near the mouth of the bay. The power plant is currently permitted to intake up to 725 million gallons a day.

RF-12 What are the impacts of changes in freshwater inflow on oligohaline habitats?

- The freshwater/saltwater interface is a critical ecotone where changes in biota could be an indicator for evaluating progress on the priority problems.

Water and Sediment Quality

WSQ-10 Are nutrients adversely affecting aquatic communities? Eelgrass?

- High nutrient loads increase algal blooms, which reduce dissolved oxygen levels and impacts aquatic biota.

WSQ-11 What is the effective minimum width for fenced riparian buffer to improve water quality improvement?

- Buffer strips are a proven effective BMP at reducing sediment, bacteria, and nutrient levels in surface waters. Buffer width effectiveness is dependent on various factors such as slope length, slope angle, soil type, vegetation types, volume of runoff, and adjacent land uses.

WSQ-12 What is the optimum amount of nutrients needed for row croppers of the Los Osos and Chorro Valleys?

- Excess nutrient applications can drain into surface or ground water causing algae blooms, which reduces dissolved oxygen levels and impacts aquatic biota.

WSQ-13 What function does nutrient variances have on Eelgrass productivity in Morro Bay? (Comparison of Instantaneous And Comprehensive Methodologies)

- Eelgrass habitat has been highly variable over time and provides the primary food source for the over-wintering brant geese population.

WSQ-14 What are the ecological effects of algal blooms (Freshwater And Estuarine)

- Algal blooms decrease dissolved oxygen levels, which can impact other aquatic biota.

WSQ-15 What are the extent of natural and anthropogenic sources of hypoxia?

- High nutrient loads increase algal blooms, which reduce dissolved oxygen levels and impacts aquatic biota.

WSQ-16 What are the limiting nutrients in both freshwater and estuarine environments?

- Available nutrient sources are limiting to population size and community diversity.

WSQ-17 Are marine and freshwater organisms in Chorro and Los Osos Creeks and in the Morro Bay estuary impacted by concentrations of metals or toxic chemicals?

- These substances can enter the streams and estuary from many sources including abandoned mines, roads, industrial areas, urban areas, and agricultural practices.

WSQ-18 Does dredging cause toxic substances to be re-suspended?

- Toxic substances may be buried in the bottom sediments and not impacting the biota since they are unavailable.

WSQ-19 Do metals degrade any surface water beneficial uses?

- Metals typically accumulate in the food chain and become toxic to the higher trophic levels. These substances can enter the streams and estuary from many sources including abandoned mines, roads, industrial areas, urban areas, and agricultural practices.

Habitat Health

HH-8 What are the sediment plume effects on Morro Bay and Estero Bay?

- Sediment deposition is filling in the Bay, impacting a wide variety of habitats, and affects virtually all other aquatic biological species.

HH-9 What is the effective minimum width for fenced riparian buffer to improve water quality improvement?

- Buffer strips are a proven effective BMP at reducing sediment, bacteria, and nutrient levels in surface waters. Buffer width effectiveness is dependent on various factors such as slope length, slope angle, soil type, vegetation types, volume of runoff, and adjacent land uses.

HH-10 Is there a positive correlation between salt and freshwater flow mixing zone and spatial particle size deposition?

- Sediment deposition in the estuary is influenced by differences between fresh and saltwater density.

HH-11 Is the lack of water clarity positively correlated with decreasing eelgrass productivity?

- Eelgrass production appears to be dependent upon low turbidity conditions. A decrease in the area of eelgrass has been observed after high runoff seasons with large sediment loads.

HH-12 Perform Wetland Delineation using Satellite Imagery Analysis and groundtruthing

- Location and extent of wetlands will be valuable during the implementation and acquisition components of the CCMP.

HH-13 What are the most critical habitats impacted by recreation and economic uses?

- Identifying and avoiding future land use conflicts will help protect the most critical habitats

HH-14 What is the temporal species richness and relative abundance of benthic invertebrates in Morro Bay?

- Benthic invertebrates provide a valuable indicator for evaluating progress on the priority problems.

HH-15 What is the extent of acreage of the most invasive exotic species? What are the trends over time?

- Exotic species can easily out-compete native species and cause habitat conversion and loss.

HH-16 What function does nutrient and turbidity variances have on Eelgrass productivity in Morro Bay? (Comparison of Instantaneous And Comprehensive Methodologies)

- Eelgrass habitat has been highly variable over time and provides the primary food source for the over-wintering brant geese population.

HH-17 What are the ecological effects of algal blooms (Freshwater And Estuarine)?

- Algal blooms decrease dissolved oxygen levels, which can impact other aquatic biota.

HH-18 What is the extent of natural and anthropogenic sources of hypoxia?

- High nutrient loads increase algal blooms, which reduce dissolved oxygen levels and impacts aquatic biota.

HH-19 What are the ecological impacts of Morro Bay Power Plant?

Air Deposition, Entrainment, Circulation (Data Stream Tracking)

- The power plant's cooling water intake structure is located near the mouth of the bay. The power plant is currently permitted to intake up to 725 million gallons a day.
- Fish and invertebrate larvae are drawn in with the cooling water and killed.
- Impacts from air deposition are not currently suspected, but lack of data causes this issue to be unknown at this time.

HH-20 What are the impacts of changes in freshwater inflow on oligohaline habitats?

- The freshwater/saltwater interface is a critical ecotone where changes in biota could be an indicator for evaluating progress on the priority problems.

Species Diversity

SD-9 What habitats are crucial to special species? Are there recreational activities that interfere with their critical habitat needs?

- Identifying and avoiding future land use conflicts will help protect the most critical habitats

SD-10 What exotic species are in the estuary and watershed? Are they increasing or decreasing? what impacts do exotic species have on native species?

- Exotic species can easily out-compete native species and cause habitat conversion and loss.

Point Source

PS-8 How do changes in wastewater management affect distribution of freshwater instream and terrestrial wetland habitats?

- Freshwater flow volume is essential to aquatic habitat needs and the survival of threatened and endangered species.

PS-9 What are the effects of Morro Bay Power Plant on bay circulation patterns?

- The power plant's cooling water intake structure is located near the mouth of the bay. The power plant is currently permitted to intake up to 725 million gallons a day.

PS-10 What are the effects of Morro Bay Power Plant on bay entrainment of larvae?

- Fish and invertebrate larvae are drawn in with the cooling water and killed, but lack of data prohibits any conclusions on impacts.

PS-11 What are the effects of Morro Bay Power Plant on bay air deposition?

- Impacts from air deposition are not currently suspected, but lack of data prohibits any conclusions on impacts.

PS-12 What are the impacts of changes in freshwater inflow on oligohaline habitats?

- The freshwater/saltwater interface is a critical ecotone where changes in biota could be an indicator for evaluating progress on the priority problems.

Chapter 5

Tracking Changes in Sedimentation Rate

Priority Problem: Accelerated Sedimentation Rate

Background

Excessive sediment loading into the bay is of primary concern to the long-term health of Morro Bay. Sedimentation is resulting in losses of mudflat and open water habitat and other resources dependent upon specific water depths and salinity concentrations. Elevated turbidity and suspended solids result in decreased light penetration through the water column, impacting aquatic plants and the organisms dependent on them. Aquatic vegetation, fish, and bottom-dwelling organisms can be smothered by excessive sedimentation, both in the estuary and in adjacent tributaries.

In Morro Bay it has been observed that the salt marsh area is increasing in size, the riparian area at the mouth of Chorro Creek is increasing, and the deeper water areas, those that support eelgrass, are decreasing due to buildup of sediment. The degree of physical change caused by sedimentation has typically been estimated through comparisons of historic photographs and bathymetric surveys, as Figure 5.1 illustrates the decrease in the mean tidal prism since 1884 (Tetra Tech 1998). Additionally, Figure 5.2 is an example of a winter day snapshot of sediment thickness distribution throughout the bay, with the darker the color, the thicker the sediment. This graphic was produced by modeling one-day bed sediment thickness after 160-day simulation from a sediment loading model produced by Tetra Tech (1998).

The degree of ecological change caused by sedimentation is less definitively described in the literature. Seasonal runoff from the watershed produces measurable turbidity in mid-estuary zones (Phillips 1984). Increased turbidity can lead to decreased eelgrass growth, and can reduce the depth range at which it will occur. Desiccation through sediment accumulation is a major factor that can limit the upper intertidal distribution of eelgrass. There appears to be no species succession in the eelgrass stage of the ecosystem. Eelgrass is the initial Colonizer as well as the climax stage of development (Phillips 1984). Impacts to eelgrass habitat are discussed further in Section 3, Habitat Loss of the MBNEP Characterization Document.

Management Objectives:

- ✓ Sustain no net loss of existing wetlands (baseline 2001 Wetland Delineation).

  Related CCMP Action Plan: All HAB, CC-1, All SED

- ✓ Reduction of average annual suspended loads sediment by 15% by 2010 in stream and estuary waters, as to comply with water quality standards (waters should not contain suspended material in concentrations that cause nuisance or adversely effect beneficial uses, as stated in the CCRWQCB Basin Plan) and will comply with Sediment TMDL's set forth by the CCRWQCB in 2001.

  Related CCMP Action Plan: CC-3, All SED

- ✓ Waters should not contain settable material in concentrations that result in deposition that causes nuisance or adversely affects beneficial uses, as depicted by bay bathymetry and wetland acreage assessments (as stated in the CCRWQCB Basin Plan) and will comply with Sediment TMDL's set forth by the CCRWQCB in 2001.

  Related CCMP Action Plan: CC-3, All SED

- ✓ One-hundred percent of publicly-owned creeks will be fenced (conducive to wildlife access) and revegetated by year 2010.

  Related CCMP Action Plan: CC-3, BACT-1, SED-4, 5, EDU-1

- ✓ No net increase in mudflat geographic acreage, relative to past 10 years baseline (as stated in the CCRWQCB Basin Plan) and will comply with Sediment TMDL's set forth by the CCRWQCB in 2001.

  Related CCMP Action Plan: CC-3, All SED

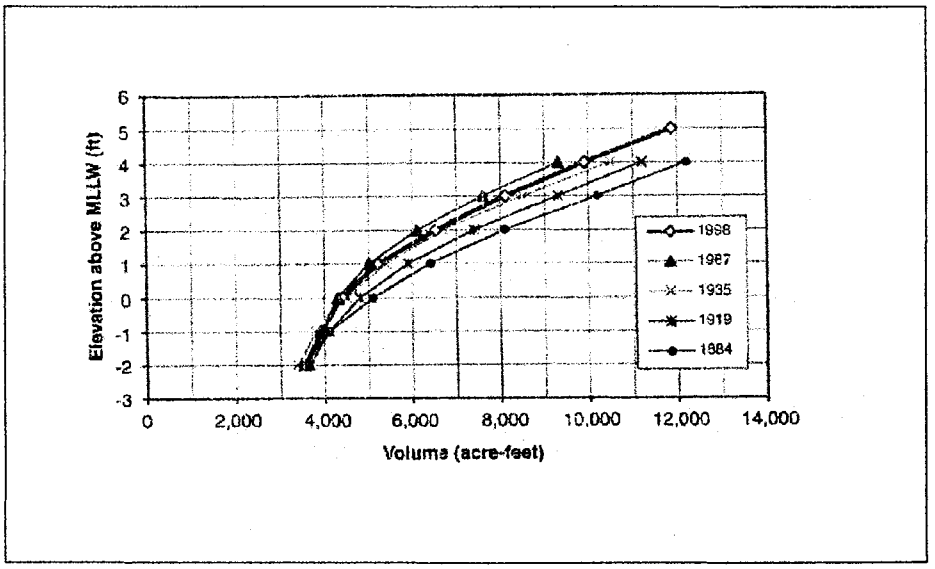


Figure 5.1 Historical Volume Versus Depth For Morro Bay (illustrating a decrease in mean tidal prism between 20 and 30 percent), 1884-1998. *Source: Tetra Tech 1998*

Data Information Needs

The primary objective of the Environmental Monitoring Program is tracking and assessing effectiveness of implemented CCMP actions. The MBNEP Technical Advisory Committee has reviewed the following monitoring questions, and set forth a list of parameters (Table 5-1) by which to gather environmental data. Questions to help drive monitoring of these Sedimention Rate actions (SR-1 through SR-10) are split into Programmatic (P), Environmental (E) and Research (R) categories, as illustrated below.

Programmatic

SR-1 Are sediment quality objectives and targets (see anticipated Sediment TMDL CCRWQCB, 2001) sufficient to maintain a healthy ecosystem?

SR-2 What are the sources and allocations of sediment contamination?

Environmental

SR-3 Are sedimentation rates decreasing in the bay-delta region since the installation of BMPs?

SR-4 Is stream bank erosion decreasing over time?

SR-5 Is siltation of instream gravels and steelhead spawning habitat decreasing over time?

SR-6 Is the lack of water clarity positively correlated with decreasing eelgrass distribution?

SR-7 Is sedimentation rates correlated with Morro Bay benthic community indices?

Research

SR-8 What are the sediment plume effects on Morro Bay and Estero Bay?

SR-9 What is the effective minimum width for fenced riparian buffer to improve water quality improvement?

SR-10 Is there a positive correlation between salt and freshwater flow mixing zone and spatial particle size deposition?

SR-11 Is the lack of water clarity positively correlated with decreasing eelgrass productivity?

Table 5-1 Parameter and Performance Criteria for Sediment Assessments

Environmental Monitoring Parameter	Data Quality Objective	Related Monitoring Question
Bay bathymetry	+/- 0.25 ft	SR-3
Artificial deposition markers	+/- 0.13 inch	SR-3
Turbidity	+/- 1.00 NTU	SR-6
Total suspended sediment	+/- 1.00 mg/l	SR-5
Acreage of wetland habitats		SR-3
Stream Cross-sectional Profiles	+/- 0.05 ft	SR-4
Habitat Typing: Bank stability, Vstar, Percent vegetation cover, Pool/riffle ratios, Embededness of instream gravels, Substrate particle size	 +/- 0.10 m +/- 0.50 % +/- 0.10 mm +/- 0.10 mm	SR-5
Benthic community assessments	Community index	SR-7
Photodocumentation		SR-3,4,6

Coordinating Agency: Morro Bay National Estuary Program

Supporting Agency: Central Coast Regional Water Quality Control Board
Central Coast Ambient Monitoring Program (CCRWQCB)
National Resource Conservation Service
Resource Conservation District
California Conservation Corps

Supporting Organization: Morro Bay Volunteer Monitoring Program

Table 5-2 Watershed Sediment Monitoring Variables

Watershed Component	Parameter/ Variables	Implementer *Primary/ Secondary	Frequency	Location	Related Monitoring Question #	Related Priority Problem
Conventional Water Quality	Nutrient Series, Chloride, **Suspended Solids,** Coliform Series, **Turbidity**, Dissolved Oxygen, pH, Salinity, Conductivity, Temperature, Chlorophyll a	*CCAMP Funding/ FOE collection	Monthly	2 sites: SYB/TWB	SR-5	CC-3 CC-4 All SED All BACT All NUTR FLOW-1,4 All HMT
Volunteer Water Quality	Nutrient Series, **Suspended Solids**, Coliform Series, **Turbidity,** Dissolved Oxygen, pH, Salinity, Conductivity, Temperature, Chlorophyll a, Flow	*FOE	Monthly	15 sites: Tributary/ Confluence Flow sites, Per VMP	SR-5	CC-3 CC-4 CC-6 All SED All BACT All NUTR All FLOW All HMT
Freshwater Bioassessment	**Benthic Macroinvertebrates,** Harpactacoids, Plankton	*FOE, *CCAMP	Annually	10 sites Figure 9.1	SR-7	CC-6
Geomorphological Suite	**Stream Cross-Sectional and Longitudinal Profiles, Habitat Typing, Photodocumentation**	*FOE/ RCD	Annually	21 sites on Chorro and Los Osos tributaries	SR-3,4, 6	CC-6 All HAB

Table 5-3 Estuarine Sediment Monitoring Variables

Estuarine/ Near Shore Component	Parameter/ Variables	Implementer Primary/ Secondary	Frequency	Location	Related Monitoring Question #	Related Action Plan
Volunteer Water Quality	Nutrient Series, Coliform Series, **Turbidity,** Dissolved Oxygen, pH, Salinity, Conductivity, Temperature, Chloropyll a	FOE	Monthly	16 sites: per VMP	SR-3	CC-3,4,6 All SED All BAC All NUT All FLW
Nutrient Biological Impact	Nutrient Series, Eelgrass Productivity, Eelgrass Ephiphytic Index, **Turbidity,** Eelgrass density transects	NEP/Cal Poly	Three Year Monitoring Project	5 Transects based on J. Chestnut/Tetra Tech transects	SR-6	CC-3 CC-6 All NUT HAB-8
Benthic Infauna (Partial RBP)	**Eelgrass Community Diversity Benthic Macroinvertebrates,** Plankton	NEP/Cal Poly	Three Year Monitoring Project	5 Transects based on J. Chestnut/Tetra Tech transects	SR-7	HAB-8 CC-6
Eelgrass Survey	**Community Density/ Diversity**	NEP/ J. Chestnut & Cal Poly	Annually	5 Transects based on J. Chestnut/Tetra Tech transects	SR-6	CC-6 HAB-8
Estuarine Bioassessment	Plankton, **Macroinvertebrates/ Harpactacoids**	FOE/NEP	Annually for five years	5 sites: 2 Delta, 1 Bay mouth, 2 Mudflat	SR-7	CC-6
Habitat Delineation	Acreage of habitats (listed in Chapter 8/9) Satellite imagery Groundtruthing	NEP/FOE	Every five years beginning in 2001.	All major habitat types	SR-5	All HAB

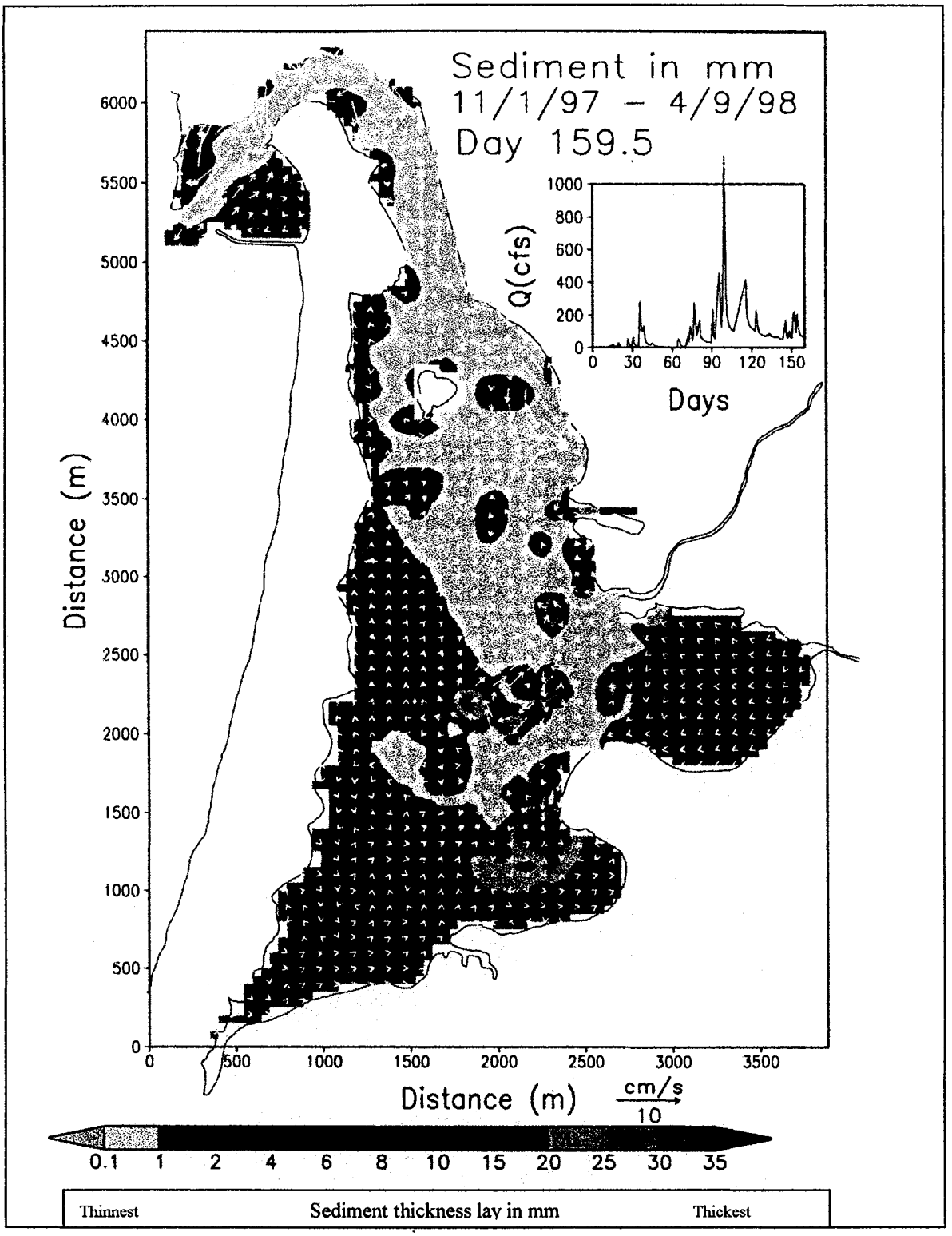


Figure 5.2 One day sediment bed thickness in Morro Bay modeled after a 160 day simulation period.
Source: Sediment Loading Study, Tetra Tech 1998.

Chapter 6

Public Health Issues

Priority Problem: Increased Bacteria Concentrations

Background

Twenty-five of the 28 National Estuary Programs, from every region of the United States, have identified pathogens such as bacteria as a water quality management issue. In Morro Bay, elevated levels of bacteria present a potential health threat to those who utilize the bay for recreational purposes and economic threats to those who depend upon the resources of the bay for their livelihood. Concentrations of fecal coliform bacteria in Morro Bay have often exceeded, and continue to exceed, CCRWQCB standards for water recreation. Viral or protozoan pathogens may also be present in elevated levels of bacteria.

Human illness can result from eating seafood that has been contaminated by bacteria. Total and fecal coliform inputs into the Bay above State standards have forced periodic closure of commercial oyster harvesting. To prevent illness, the California Department of Health Services (DHS) requires the Morro Bay oyster grower to shut down for many days after significant rainfall and not harvest on portions of his lease area. Elevated levels of fecal coliforms are an indication that the bay may be unsafe for seafood consumption as well as swimming and other forms of water contact activities.

Preliminary National Monitoring Program (NMP) data collected since 1993 suggests that best management practices such as managed grazing systems and cattle exclusions are effective in reducing fecal coliform concentrations. Implementation of these types of BMPs throughout the watershed could reduce the bacteria loading in Chorro Creek, and thus reduce the potential for contamination of oyster growing areas. Additional details can be found in the National Monitoring Program's 1998 annual report (RWQCB, 1998.)

Further information on potential pathogen transports, such as from Chorro Creek and Los Osos Creek, urban runoff from the cities of Morro Bay and Los Osos, and groundwater inputs (see Figure 6.1) can be found in Chapter 6 of Volume II: The Characterization

The DHS and CCRWQCB have monitored coliform bacteria at shellfish leases in Morro Bay estuary illustrated in Figure 6.2 since 1974, and the National Monitoring Program (NMP) has monitored coliform bacteria in the creeks since 1993. The MBNEP, Morro Bay Volunteer Monitoring Program (MBVMP) have monitored coliform bacteria in the bay and watershed since 1996.

Due to the aggregated nature of bacteria, regulatory standards for monitoring coliforms are usually based on a statistical number derived from multiple sampling events. The standards and respective regulatory agency are listed in detail in Table 6-1. More information on this data and its trends can be found in the Volume II of the CCMP, MBNEP Characterization Document.

Management Objectives:

- ✓ Levels of bacteria will comply with Department of Health Services, CCRWQCB, and County Environmental Health standards for beneficial uses including shellfish harvesting and water contact recreation at all times. These measurable standards are listed in detail in the following Table 6-1.

  Related CCMP Action Plan: ALL BACT, CC-3

- ✓ For those waters with drinking water as a beneficial use, bacterial levels must comply with drinking water standards (as stated in the CCRWQCB Basin Plan).

  Related CCMP Action Plan: ALL BACT, CC-3

- ✓ Ensure that bay water remains of sufficient quality (see Table 6-1) to meet state standards for commercial shellfish industry, and safe recreational uses by year 2010.

  Related CCMP Action Plan: ALL BACT, CC-3

- ✓ Promote public awareness and involvement in human health issues management issues through education outreach and use of volunteers

  Related CCMP Action Plan: CC-6, All EDU, All BACT

- ✓ No closures of shellfish beds except for first flush rain event by year 2010.

  Related CCMP Action Plan: All BACT, CC-3

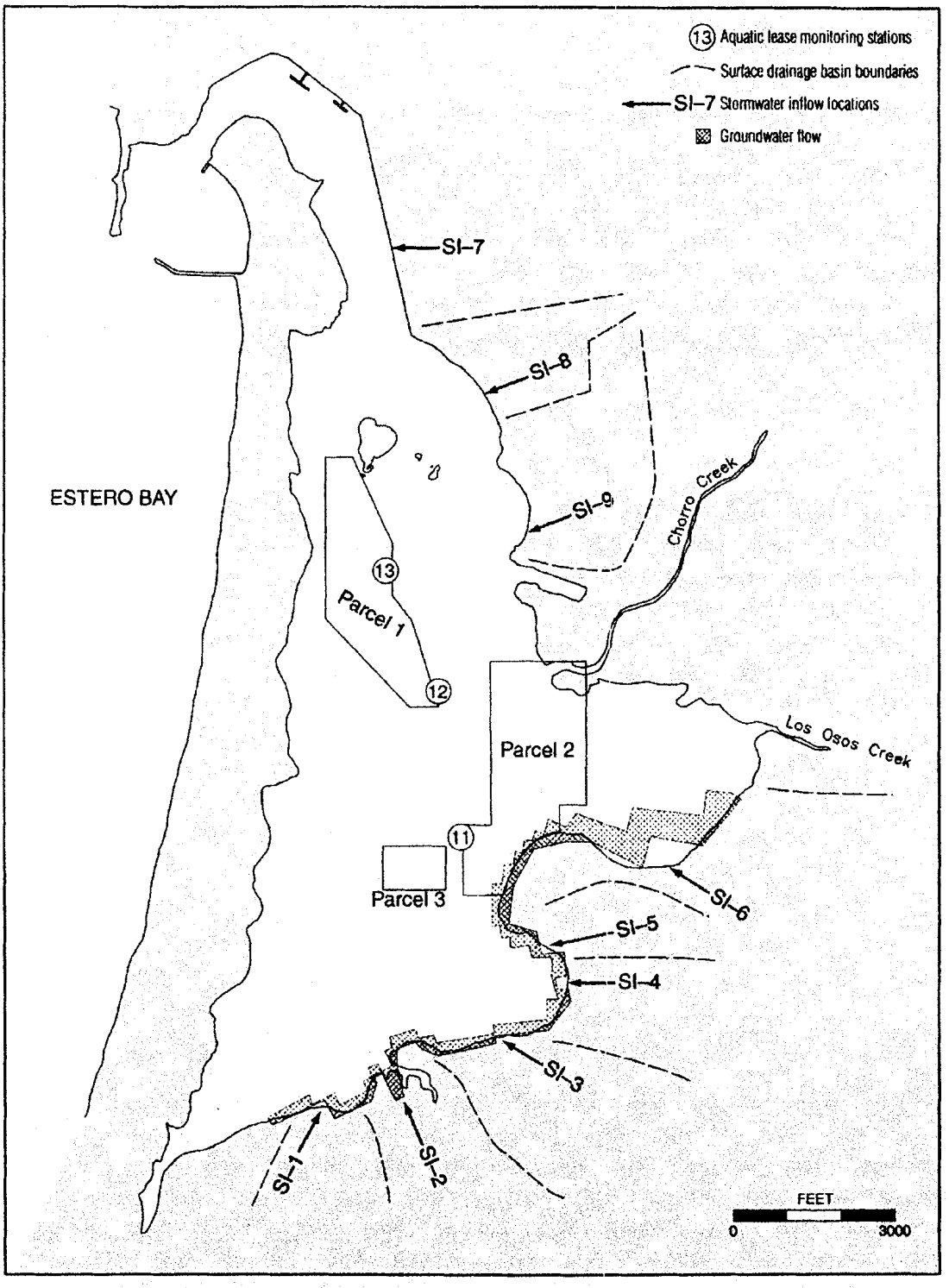


Figure 6.1 Stormwater, surface and ground water inflow basins to the estuary and proximity to shellfish leases. Groundwater seeps are also noted in shaded region.
Source: Bacteria Loading Study, Tetra Tech, 1999.

Data Information Needs

The primary objective of the Environmental Monitoring Program is tracking and assessing effectiveness of implemented CCMP actions. The MBNEP Technical Advisory Committee has reviewed the following monitoring questions, and set forth a list of parameters (Table 6-1) by which to gather environmental data. Questions to help drive monitoring of these Public Health actions (PH-1 through PH-9) are split into Programmatic (P), Environmental (E) and Research (R) categories, as illustrated below.

Programmatic

PH-1 Are bacteria objectives and targets (see anticipated Bacteria TMDL CCRWQCB, 2001, DHS, SLO County of Environmental Health) sufficient to maintain a safe recreating environment and a healthy ecosystem?

Environmental

PH-2 Are local shellfish safe to eat year-round?

PH-3 Is the Morro Bay estuary safe for water contact recreation?

PH-4 What are the coliform trends in surface water?

PH-5 What are the trends of live-aboard discharges?

PH-6 How effective are the BMPs in reducing bacteria loading? What is the time lag between different BMP installations and reduced loading?

Research

PH-7 What other processes are effective at filtering bacteria from surface water? Wetlands? Floodplains, etc?

PH-8 What is the effective minimum width for fenced riparian buffer to improve water quality improvement?

PH-9 What is the best pathogen indicator for stormwater runoff?

Table 6-1 Parameter and Performance Criteria for Public Health Issues

Environmental Monitoring Parameter	Data Quality Objective	Related Monitoring Question
Total Coliform-shellfish	CCRWQCB: Median total coliform concentrations shall not exceed 70/100 ml for any 30 day period.	PH-2
Total Coliform-recreational water contact	DES: No more than 20 percent of the samples in any 30-day period shall exceed 1,000 MPN/100ml, and no single verified or duplicated sample shall exceed 10,000 MPN/100ml within a 48-hr period.***	PH-3,4,5
Fecal Coliform-shellfish	DHS: For water quality samples taken on a monthly basis during a three-year period, no more than 10% of the samples shall exceed 43 MPN 100 ml for fecal coliform; or, 2) the geomean of the samples shall not exceed 14 MPN/100 ml.	PH-2
Fecal Coliform- recreational water contact	CCRWQCB: The geometric mean of five samples within a 30-day period must not exceed 200MPN/100ml; or ten percent of all samples taken during any 30-day period must not exceed 400MPN/100ml.***	PH-3,4,5,6
E. coli	***	PH-3,5
Enterococcus	***	PH-3,4,5,6

***New standards for *enterococcus* and *fecal* coliform are presently being proposed through AB411 (Draft Standards, February, 1 1999). The new minimum protective bacteriological standards for waters adjacent to public beaches and public water-contact sports areas are proposed to be:

1) Based on a single sample, the density of bacteria in water from each sampling station as a public beach or public water contact sports shall not exceed:
   a) 1,000 total coliform bacteria per 100 milliliters, if the ratio of fecal/total coliform bacteria exceeds 0.1; or
   b) 10,000 total coliform bacteria per 100 milliliters; or
   c) 400 fecal coliform bacteria per 100 milliliters; or
   d) 104 enterococcus bacteria per 100 milliliters.

2) Based on a the mean of the logarithms of the results of at least 5 weekly samples during any 30-day sampling period, the density of bacteria in water from any sampling station as a public beach or public water contact sports shall not exceed:
   a) 1,000 total coliform bacteria per 100 milliliters; or
   b) 200 fecal coliform bacteria per 100 milliliters; or
   c) 35 enterococcus bacteria per 100 milliliters.

Coordinating Agency: California Department of Health Services

Supporting Agencies: Central Coast Regional Water Quality Control Board
National Monitoring Program (CCRWQCB)
Central Coast Ambient Monitoring Program (CCRWQCB)
San Luis Obispo County of Environmental Health

Supporting Organization: Morro Bay National Estuary Program
Morro Bay Volunteer Monitoring Program

Table 6-2 Watershed Public Health Monitoring Variables

Watershed Component	Parameter/ Variables	Implementer *Primary/ Secondary	Frequency	Location	Related Monitoring Info Need	Related CCMP Action
Conventional Water Quality	Nutrient Series, Chloride, Suspended Solids, **Coliform Series,** Turbidity, Dissolved Oxygen, pH, Salinity, Conductivity, Temperature, Chlorophyll a	*CCAMP Funding/ FOE collection	Monthly	2 sites: SYB/TWB	PH-2-5	CC-3 CC-4 All SED All BACT All NUTR FLOW-1,4 All HMT
Volunteer Water Quality	Nutrient Series, Suspended Solids, **Coliform Series,** Turbidity, Dissolved Oxygen, pH, Salinity, Conductivity, Temperature, Chlorophyll a, Flow	*FOE	Monthly	15 sites: Tributary/ Confluence	PH-2-6	CC-3 CC-4 CC-6 All SED All BACT All NUTR All FLOW All HMT

Table 6-3 Estuarine Monitoring Public Health Parameters/Variables

Estuarine/ Near Shore Component	Parameter/ Variables	Implementer Primary/ Secondary	Frequency	Location	Related Monitoring Info Need	Related CCMP Action
Volunteer Water Quality	Nutrient Series, **Coliform Series,** Turbidity, Dissolved Oxygen, pH, Salinity, Conductivity, Temperature, Chloropyll a	FOE	Monthly	16 sites: per VMP	PH-2-6	CC-3,4,6 All SED All BAC All NUT All FLW
Pathogen Indicators	**Total Coliform, Fecal Coliform, Enterococcus, *E. coli***	FOE/DHS, Local Government	Monthly	10 sites: Figure 6.2	PH-2-6	CC-3,6 All BAC
Plankton Survey	**Community Density/ Diversity** Turbidity, Temperature	UCCE, DHS/ Coast Guard, FOE	Monthly	4 sites: Estero Bay, Harbor Mouth, N. T- Pier, Back Bay Channel	PH-2	CC-6

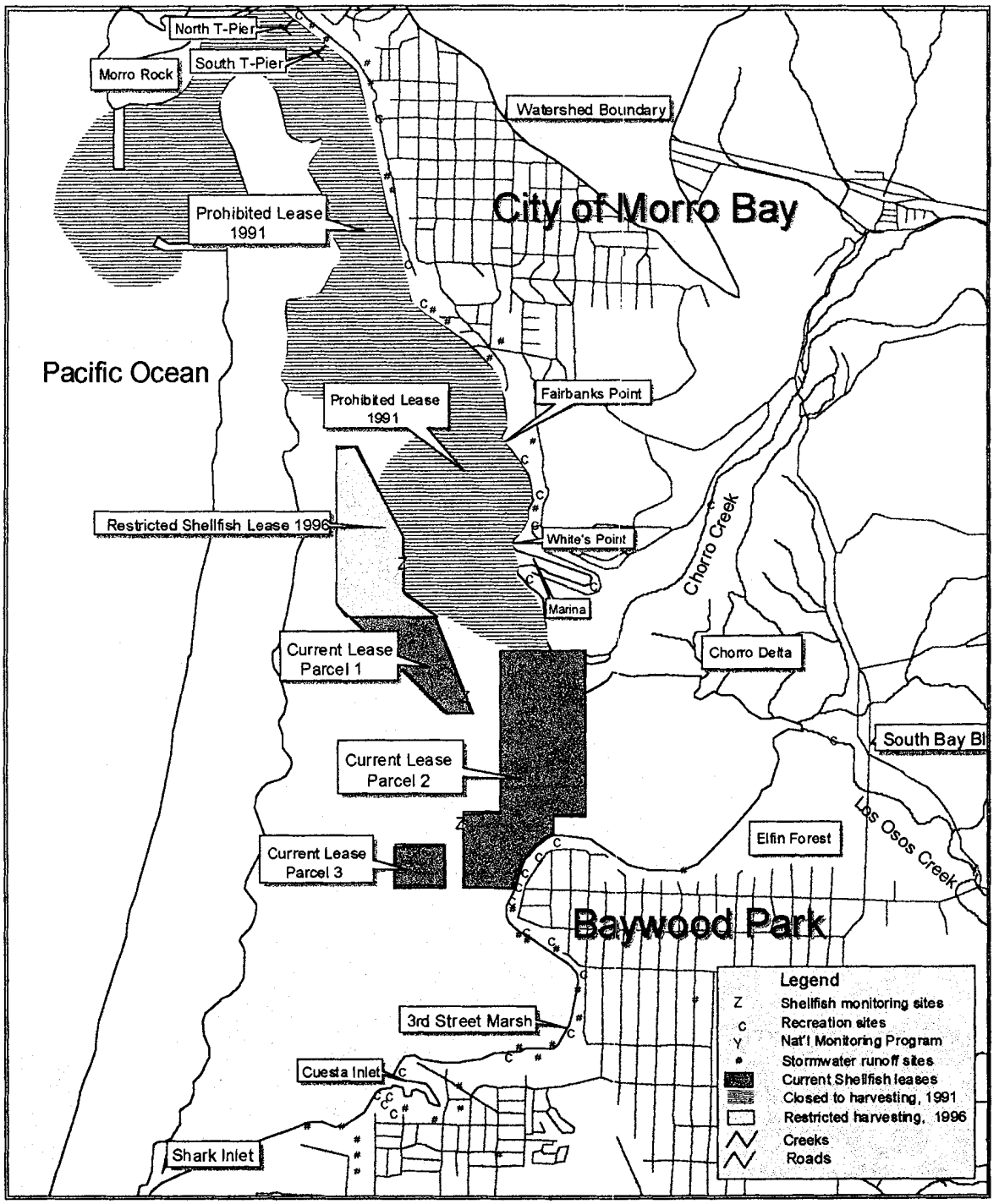


Figure 6.2 Shellfish Leases and Bacteria Sampling Sites in Morro Bay National Estuary
Source: DHS, CCRWQCB, and MBVMP
MBNEP Characterization 1999

Chapter 7

Reduction of Freshwater Flow

Priority Problem: Reduction of Freshwater Flow

Background

Reductions to freshwater flows in the watershed and to the bay have a direct impact on a wide variety of designated beneficial uses of water and on social and economic conditions in the region. The major creeks within the Morro Bay watershed are shown in Figure 7.1. The watershed is divided into two primary systems, the Chorro Creek watershed and the Los Osos Creek watershed.

Since the 1970's significant flooding has and continues to occur in the community of Los Osos/Bay wood Park, in part due to residential development and the corresponding increase in impermeable surfaces. Development has resulted in increased impervious surfaces, disruption of natural drainage routes without provisions for surface drainage, and inadequate containment of onsite drainage. Rising groundwater is also likely a factor.

The State Water Resources Control Board (SWRCB) has listed the Los Osos drainage as "fully appropriated", meaning all water available outside ecosystem function is already allotted, and believes the drainage cannot support further appropriative extractions from the area (Worcester 1991). All of Los Osos Creek, including all of its tributaries, are listed as fully appropriated from May 15 through October 31. Chorro Creek and all of its tributaries downstream of the California Men's Colony (CMC) Waste Water Treatment Plant (WWTP) outfall are listed for the period between July 15 and November 30.

Another problem resulting from loss of flow volume is reduction of flushing of pollutants in the low circulation areas of the bay. As flow volume drops, resident times for pollutants rise, promoting bacterial, plankton and algal growth which adds to supersaturated eutrophicated conditions. This relationship is illustrated by Morro Bay EFDC model flushing analysis under high and low flow conditions (see Figure 7.2 and 7.3). More information on this data and its trends can be found in Chapter 8 of the MBNEP Characterization Document.

Management Objectives:

- ✓ Sustain no net loss of existing wetlands (baseline year 2001 Wetland Delineation).

  Related CCMP Action Plan: All HAB, CC-1, All SED, All FLOW

- ✓ Maintain watershed functional integrity through appropriate riparian corridor management, and impervious surface management, measured through riparian and storm runoff volumes.

  Related CCMP Action Plan: All SED, All FLOW

- ✓ Freshwater flow during low flow seasons sufficient to support nursery habitat for steelhead trout

  Related CCMP Action Plan: CC-5, All STL, All FLOW, HAB-1

- ✓ Freshwater flow during high flow seasons sufficient to support steelhead migration

  Related CCMP Action Plan: CC-5, All STL, All FLOW, HAB-1

- ✓ Freshwater flow sufficient at all times to maintain water quality by flushing and diluting pollutants.

  Related CCMP Action Plan: All FLOW

Data Information Needs

The primary objective of the Environmental Monitoring Program is tracking and assessing effectiveness of implemented CCMP actions. The MBNEP Technical Advisory Committee has reviewed the following monitoring questions, and set forth a list of parameters (Table 7-1) by which to gather environmental data. Questions to help drive monitoring of these Reduction of Flow actions (RF-1 through RF-12) are split into Programmatic (P), Environmental (E) and Research (R) categories, as illustrated below.

Programmatic

RF-1 What flow is needed to restore critical steelhead habitat or life stages to preserve sustainable populations?

Environmental

RF-2 What are the status and trends of flow on all major tributaries?

RF-3 Are freshwater surface flows sufficient to recharge groundwater?

RF-4 Are freshwater flows adequate to restore steelhead in Chorro and Los Osos Creeks?

RF-5 What is the rate of flow for major freshwater springs to Morro Bay estuary? What are the trends?

RF-6 Are freshwater habitats being decreased in correlation with reduction in freshwater flow rates?

Research

RF-7 How do changes in wastewater management affect distribution of freshwater wetland habitats?

RF-8 What is the effective minimum width for fenced riparian buffer to improve water quality improvement?

RF-9 Is there a positive correlation between salt and freshwater flow mixing zone and

spatial particle size deposition?

RF-10 What are the optimum instream flow allotments for the Chorro Valley Users Group?

RF-11 What are the effects of Morro Bay Power Plant on bay circulation patterns?

RF-12 What are the impacts of changes in freshwater inflow on oligohaline habitats?

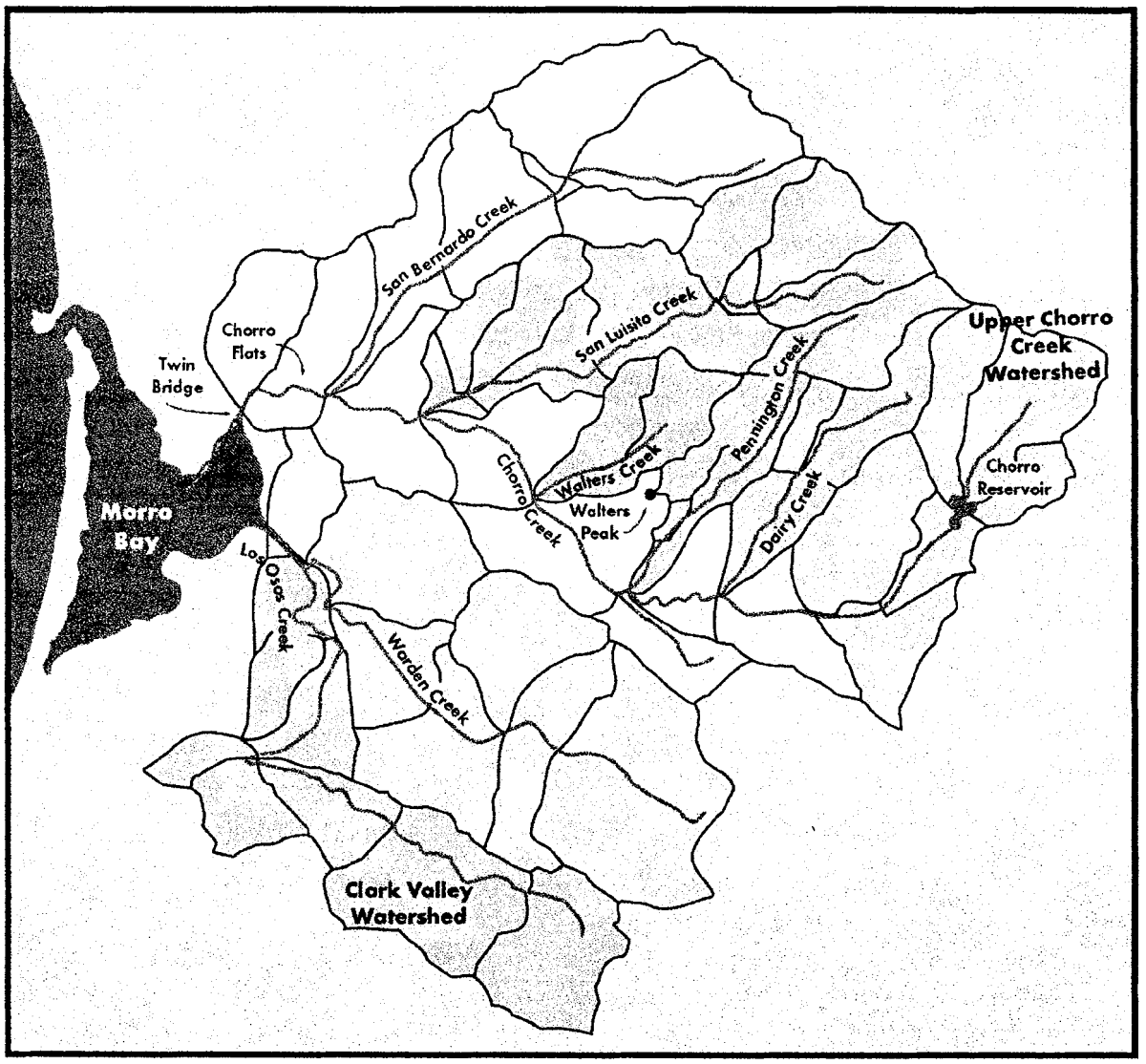


Figure 7.1 Major Drainage Basins Of The Morro Bay Watershed
Source: Tetra Tech Streamflow Model 1998

Table 7-1 Parameter and Performance Criteria for Sediment Assessments

Environmental Monitoring Parameter	Data Quality Objective	Related Monitoring Question
Freshwater flow (pygmy gurley meter, weirs, gauge stations)	+/- 0.25 cu^3/ft	RF-2,3,4,5
Depth of water in groundwater wells	+/- 0.10 inch	RF-3
Freshwater wetland distribution	+/- 1 meter	RF-2,6
Tidal flow (w/gages)	Volume, timing	RF-6
Precipitation, runoff coefficients		RF-2-6

Coordinating Agency: Morro Bay National Estuary Program

Supporting Agency: Central Coast Regional Water Quality Control Board
National Monitoring Program (CCRWQCB)
Central Coast Ambient Monitoring Program (CCRWQCB)
National Resource Conservation Service
Resource Conservation District

Supporting Organization: Morro Bay Volunteer Monitoring Program

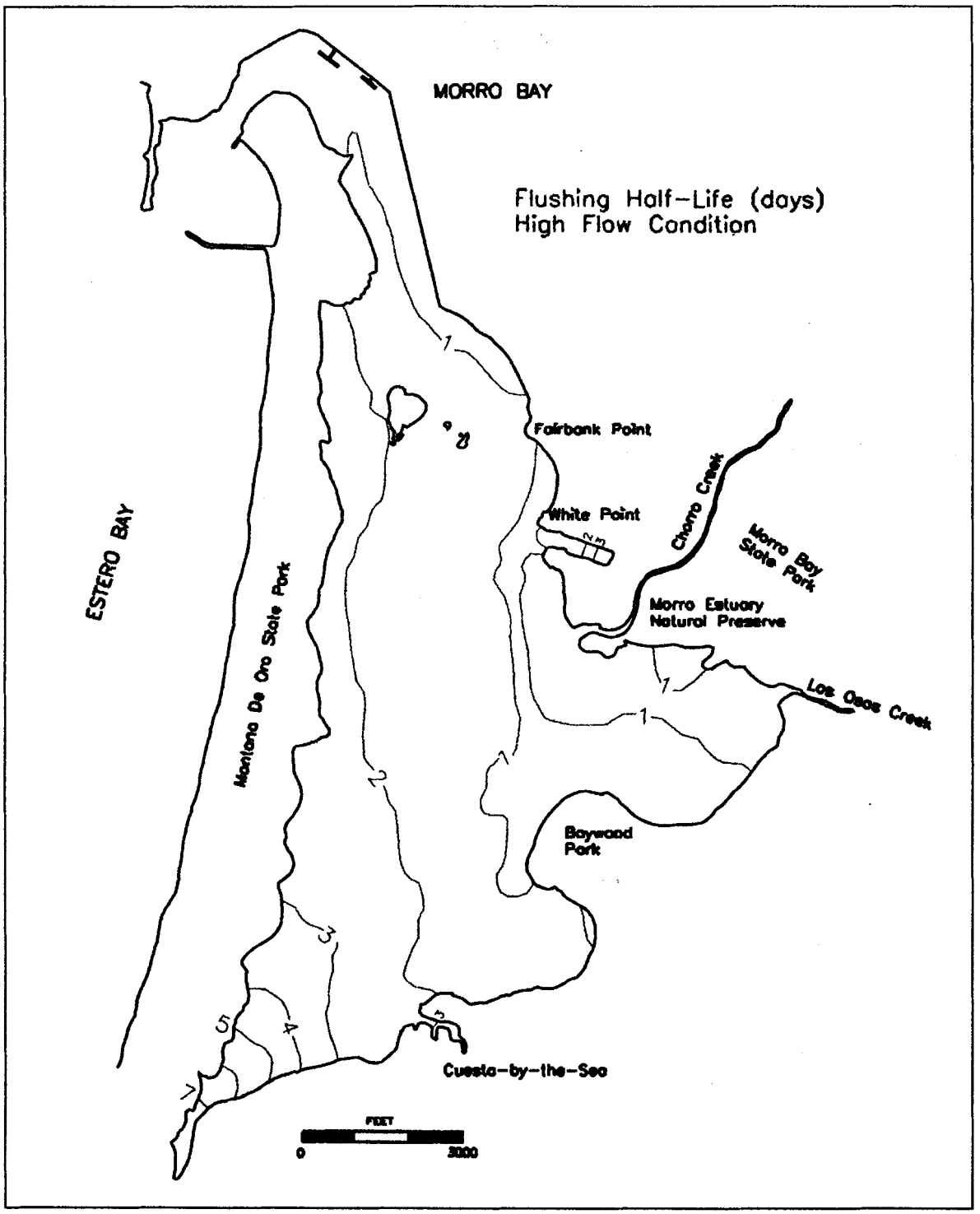


Figure 7.2 Resident time (days) for pollutants under high flow conditions in Morro Bay.
Source: Bay Circulation Model, Tetra Tech, 1999.

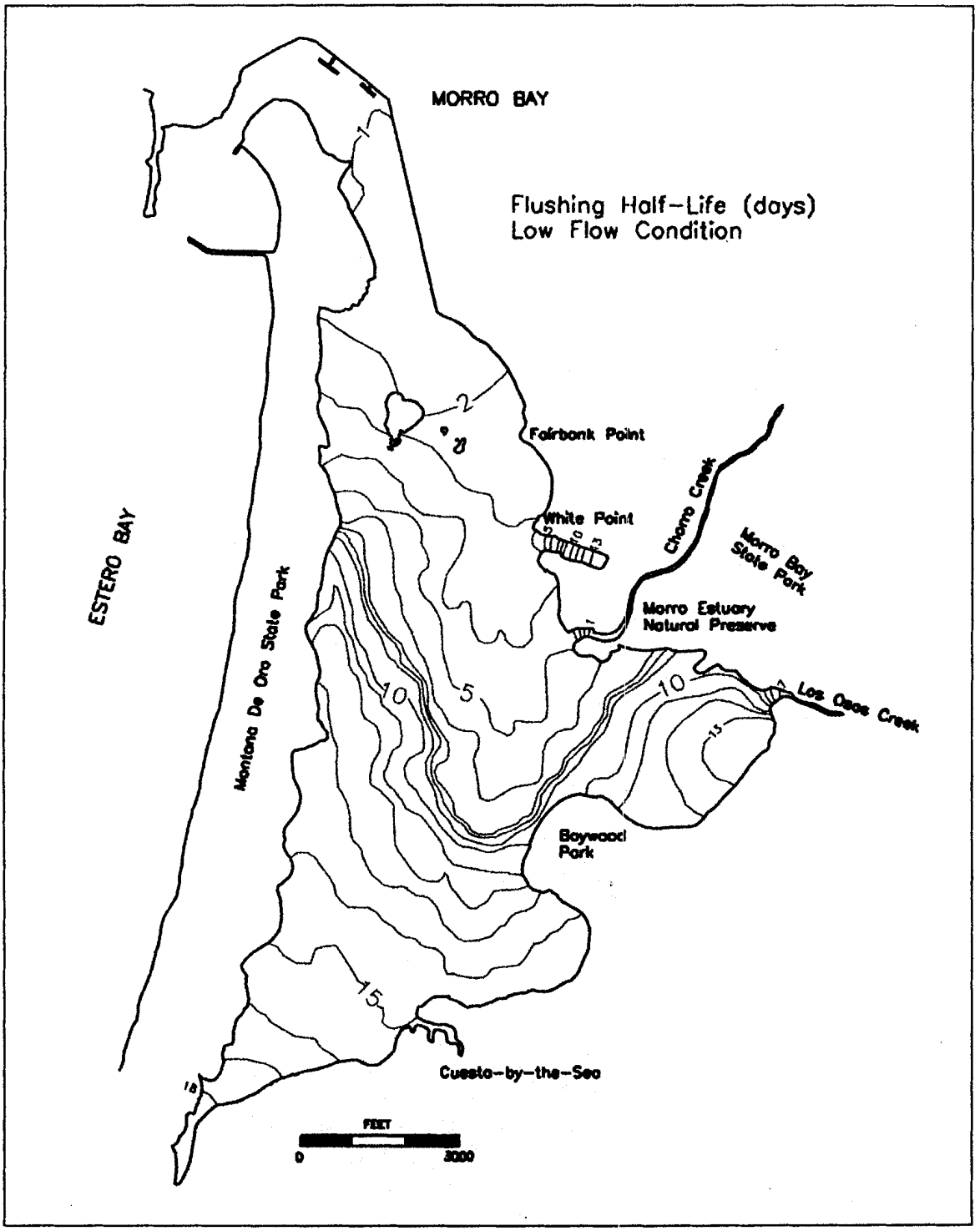


Figure 7.3 Resident time (days) for pollutants under low flow conditions in Morro Bay.
Source: Bay Circulation Model, Tetra Tech, 1999.

Table 7-2 Watershed Freshwater Flow Monitoring Variables

Watershed Component	Parameter/ Variables	Implementer *Primary/ Secondary	Frequency	Location	Related Monitoring Info Need	Related CCMP Action
Volunteer Water Quality	Nutrient Series, Suspended Solids, Coliform Series, Turbidity, Dissolved Oxygen, pH, Salinity, Conductivity, Temperature, Chlorophyll a, **Flow**	*FOE	Monthly	15 sites: Tributary/ Confluence per VMP	RF-2-5	CC-3 CC-4 CC-6 All SED All BACT All NUTR All FLOW All HMT
Freshwater Bioassessment	**Benthic Macroinvertebrates, Harpactacoids, Plankton**	*FOE, *CCAMP	Annually	10 sites Figure 11.1	RF-6	CC-6

Table 7-3 Estuarine Monitoring Freshwater Flow Parameters/Variables

Estuarine/ Near Shore Component	Parameter/ Variables	Implementer Primary/ Secondary	Frequency	Location	Related Monitoring Info Need	Related CCMP Action
Plankton Survey	**Community Density/ Diversity** Turbidity, Temperature	UCCE, DHS/ Coast Guard, FOE	Monthly	4 sites: Estero Bay, Harbor Mouth, N. T- Pier, Back Bay Channel	RF-6	CC-6
Estuarine Bioassessment	**Plankton, Macroinvertebrates/ Harpactacoids**	FOE/NEP	Annually for five years	10 sites: TBD	RF-6	CC-6

Chapter 8

Habitat Health

Priority Problem: Habitat Loss

Background:

San Luis Obispo County is known for its rich biotic diversity. The uniqueness of the biotic resources and the scenic attraction of Morro Bay and its wetlands are enhanced by its relatively natural state and geographic location. As the "most significant wetland system in the central coast of California" (Arnold 1987), it is of vital importance to a great variety of migratory and resident species, including many rare and endangered species.

The complex interaction of marine, estuarine and upland plant communities are presented in Figure 8.1. Wetland habitat in Morro Bay estuary provides feeding, resting and nursery areas for thousands of migratory birds as well as fish and marine mammals. The high percentage of publicly owned lands in and adjacent to the bay helps to maintain the integrity of many environmentally sensitive areas, including habitats of rare species.

Unique, fragile or rare community types are represented in public areas such as the Morro Bay sandspit, Los Osos Oaks State Preserve, and the Elfin Forest. Rare and endangered species are protected at Morro Rock, Morro Dunes, Sweet Springs Preserve, and Morro Bay State Park. Coastal dune scrub, one of the world's most endangered habitats, occurs in private land in Los Osos, providing valuable habitat for many special status species. A number of Monarch Butterfly roosts are present that are not protected (Nagano and Lane, 1985). Outstanding representatives of natural communities are included within Morro Bay State Park, on Black Hill, and on the sandspit. Particular areas of educational value include the heron rookery at Morro Bay State Park, the Chorro delta, and Los Osos Oaks State Reserve. All these areas are visited regularly by school groups and the public.

Habitat loss occurs as a result of many of the priority problems (sediment, bacteria, nutrients, reduction in flow, heavy metals and toxics) discussed in previous sections of this document, and of the Characterization companion document. Downward trends being observed have little quantitative data to support them, and therefore it is a focus of the EMP to document these trends.

Wetland habitats being threatened include eelgrass beds, coastal salt, brackish, and freshwater marsh, and riparian vegetation. Eelgrass beds were seriously affected by the sedimentation caused by the highway 41 fire and the storms that resulted afterward. These eelgrass beds are critically important as a food resource for brant geese. Portions of coastal salt marsh, brackish marsh and freshwater marsh habitats have been greatly affected by sedimentation and aggressive takeover by invasive exotic species. As developable lots in Los Osos decrease, more pressure is put on wetland habitats that occur at the edge of the bay. Some are protected by virtue of their present land ownership status.

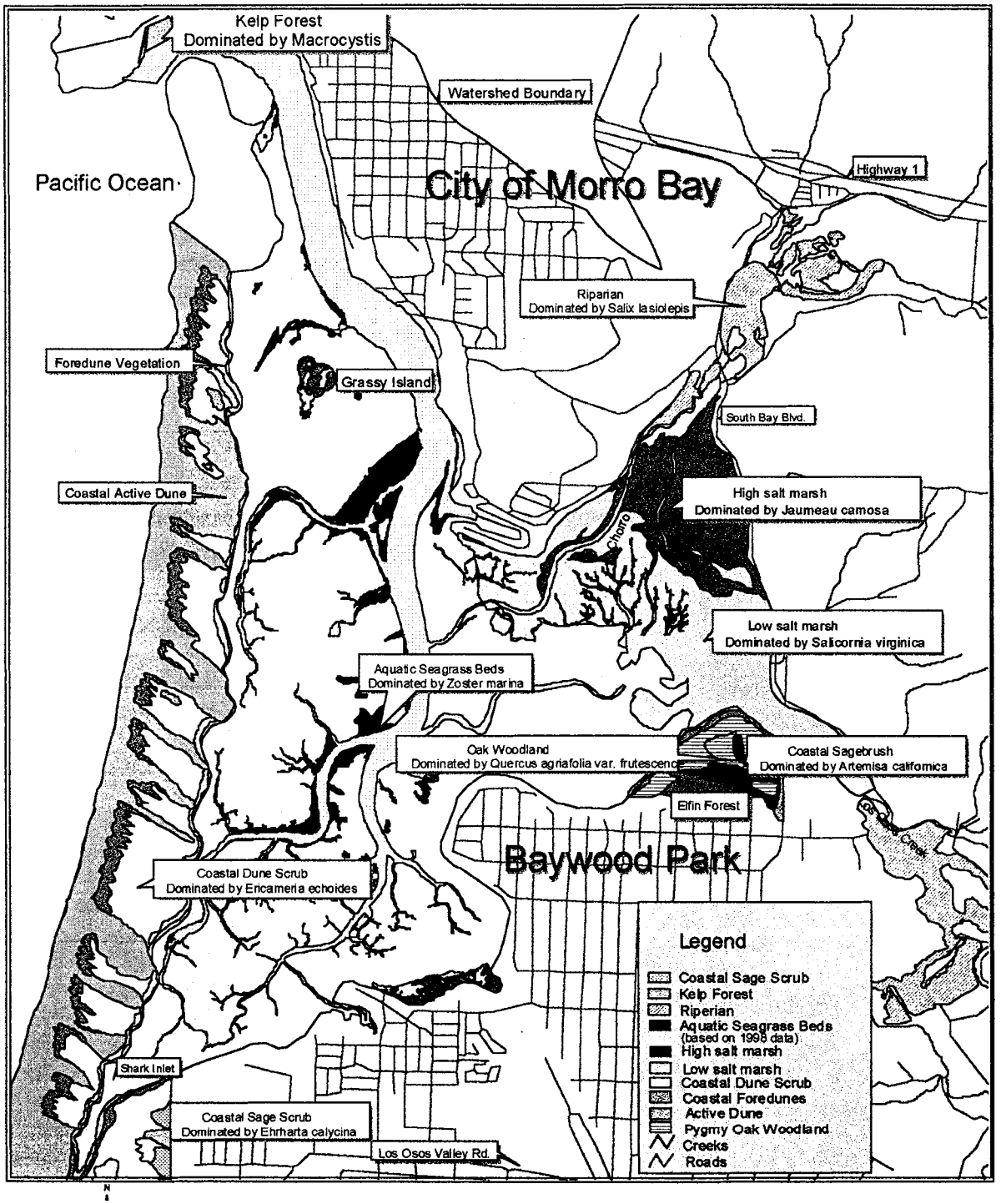


Figure 8.1 Distribution of Wetland Habitats in Morro Bay
Source: Tetra Tech Habitat Survey 1999, and CDPR 1999
MBNEP Characterization 1999

Threatened upland types include coastal dune scrub and maritime chaparral. Coastal dune scrub is considered one of the most imperiled habitat types in California. It is inherently rare, occurring only in a few areas along the California coast, and locally has been seriously affected by the spread of invasive exotic species (e.g., veldt grass) and the pressures of residential development.

Urban development results in the direct loss of habitat. According to San Luis Obispo County (1999), 85 percent of the Los Osos area coastal dune scrub community has been converted to suburban or urban development. Residential development in the Los Osos area has increased drastically since about 1969, rising to 6,597 units in 1999. The year 2015 buildout goal is 11,179 units, a large increase from current numbers. This housing trend is also reflected in the decrease in acreage of habitat for endemic species such as the Morro Bay Kangaroo Rat (see Figure 8-2), Morro manzanita and the Morro shoulderband snail. All these species occur in areas of Baywood fine sands, where development also occurs. Their numbers continue to decline because of urban development. The 353 acres of Morro manzanita habitat remaining is a small range for any species, especially considering that approximately 76 percent of this is private, fragmented holdings (Tyler and Odion 1996).

As discussed in Sections 5, 7 and 8 of Volume II: The Characterization document, many of the priority problems (sediment, nutrients and lack of freshwater flow) in the estuary have caused loss of habitat for aquatic organisms. Decreased stream flow caused by municipal and agricultural well pumping and water diversions has fragmented habitat for steelhead trout. Increases in fine sediment deposition can create unsuitable conditions for migrating, spawning or developing aquatic organisms.

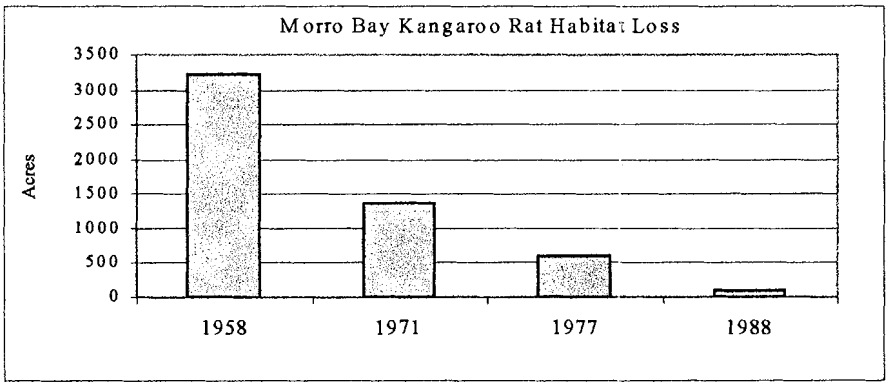


Figure 8-2. Acres of Habitat, Morro Bay Kangaroo Rat (*Dipodomys heermanni morroensis*), 1958-1988. *Sources: Gambs and Holland 1988; Stewart and Roest 1960; Roest 1977; Congdon and Roest 1975; Congdon 1971; Stewart and Roest 1960.*

Another crucial habitat in the Morro Bay ecosystem are eelgrass beds. The eelgrass beds in Morro Bay are known as the largest and least impacted of any in Central or Southern California (Hoffman in lit.). The estimated extent of eelgrass found in Morro Bay, however, has fluctuated widely. Published estimates have ranged between 335 and 732 acres of habitat. Recently, eelgrass in Morro Bay has undergone catastrophic contraction first observed in the 1994-95 winter season. This well documented decline coincides with the winter following the destructive Highway 41 fire in 1994, and the concurrent end of the 1990's drought cycle. Eelgrass distribution continued to decline for subsequent years, and reached an historic low of less than 50 total acres, in the Spring of 1997 (Chesnut 1999). Tetra Tech (1998) identified 82 acres of eelgrass in Morro Bay, but some "sparse" beds as defined by other researchers were not included in that analysis. In addition, the timing of the surveys (spring) was

not optimal for the eelgrass resource. Chesnut mapped about 120 acres in September of 1998 (Chesnut 1999). The Morro Bay National Estuary Program (MBNEP) conducted a Habitat Characterization and Assessment Study to provide data to support the preparation of this document (Tetra Tech 1999). An initial step was to compile and review existing information. Field studies were also conducted, and the results are presented in Chapter 10 of the MBNEP Characterization Document.

Management Objectives:

- ✓ Sustain no net loss of existing wetlands (baseline year 2001 Wetland Delineation).

  Related CCMP Action Plan: CC-1, All HAB, All SED

- ✓ Assess the status and trends of the quality and quantity of selected habitats (open channel, mudflat, salt marsh (low and high), freshwater marsh, riparian, coastal dune scrub, maritime chaparral, grassland, and oak woodland) to assist in evaluating the CCMP.

  Related CCMP Action Plan: All HAB

- ✓ Increase and/or enhance habitats for species of special concern in the watershed and estuary by 15% of year 2001 acreages.

  Related CCMP Action Plan: All HAB, ALL STL

- ✓ Increase a minimum of 20% of eelgrass acreage from year 2000 levels to support of brant and other species.

  Related CCMP Action Plan: HAB-8

- ✓ Assess the intensity of selected human activities that impact the resources of Morro Bay and establish activity carrying capacity to improve habitat management decisions.

  Related CCMP Action Plan: CC-6, All HAB

- ✓ Restore 50 % of stream geomorpholgical processes in Chorro and Los Osos Creeks to provide the minimum physical, chemical, and biological habitat requirements (for south-central coast ESU) steelhead as described by CDFG and NMFS (spawning, rearing and migration).

  Related CCMP Action Plan: CC-3,5, All STL

- ✓ Remove all fish barriers to stream habitat for spawning and rearing by 2010.

  Related CCMP Action Plan: All STL, CC-5

Data Information Needs

The primary objective of the Environmental Monitoring Program is tracking and assessing effectiveness of implemented CCMP actions. The MBNEP Technical Advisory Committee has reviewed the following monitoring questions, and set forth a list of parameters (Table 8-1) by which to gather environmental data. Questions to help drive monitoring of these Habitat Health actions (HH-1 through HH-29) are split into Programmatic (P), Environmental (E) and Research (R) categories, as illustrated below.

Programmatic

HH-1 Are sediment quality objectives and targets (see anticipated Sediment TMDL CCRWQCB, 2001) sufficient to maintain a healthy ecosystem?

HH-2 What are the sources and allocations of sediment contamination?

Environmental

HH-3	What are the annual fluctuations in eelgrass habitat acreage?
HH-4	What affect does fluctuating eelgrass habitat have on brant populations?
HH-5	Is siltation of benthic fauna habitat decreasing over time?
HH-6	Is the lack of water clarity positively correlated with decreasing eelgrass distribution?
HH-7	Is sedimentation rates correlated with Morro Bay benthic community indices?
HH-8	What habitats are crucial to special species? Are there recreational activities that interfere with their critical habitat needs?
HH-9	What exotic species are in the estuary and watershed? Are they increasing or decreasing? What impacts do exotic species have on native species?
HH-10	What are the trends in acreage and density of Morro Bay and Estero Bay kelp beds?
HH-11	What are the status and trends of benthic invertebrate assemblages in streams and the bay?
HH-12	What is the extent of key habitats (open channel, salt marsh (high/low), mudflats, algal flats, freshwater marsh, riparian, coastal dune scrub, maritime chaparral, grasslands, oak woodlands, etc.)? Are they decreasing or increasing?
HH-13	Is the rate of siltation of instream pools decreasing since the implementation of Steelhead action plans? Is overall mileage of steelhead habitat increasing?
HH-14	Is in-stream cover increasing at sites adjacent to implemented BMPs?

Research

HH-15	What are the sediment plume effects on Morro Bay and Estero Bay?
HH-16	What is the effective minimum width for fenced riparian buffer to improve water quality improvement?
HH-17	Is there a positive correlation between salt and freshwater flow mixing zone and spatial particle size deposition?
HH-18	Is the lack of water clarity positively correlated with decreasing eelgrass productivity?
HH-19	Perform wetland delineation using satellite imagery analysis and groundtruthing.
HH-21	What are the most critical habitats impacted by recreation and economic uses?
HH-22	What is the temporal species richness and relative abundance of benthic invertebrates in Morro Bay?
HH-23	What is the extent of acreage of the most invasive exotic species? What are the trends over time?
HH-24	What function does nutrient and turbidity variances have on Eelgrass productivity in Morro Bay? (Comparison of Instantaneous And Comprehensive Methodologies)
HH-25	What are the ecological effects of algal blooms (Freshwater And Estuarine)?
HH-26	What is the extent of natural and anthropogenic sources of hypoxia?
HH-27	What is the effective fenced riparian buffer width to improve water quality?
HH-28	What are the ecological impacts of Morro Bay Power Plant? Air Deposition, Entrainment, Circulation (Data Stream Tracking)
HH-29	What are the impacts of changes in freshwater inflow on oligohaline habitats?

Table 8-1 Parameter and Performance Criteria for Habitat Health Assessments

Environmental Monitoring Parameter	Data Quality Objective	Related Monitoring Question
Bay bathymetry	+/- 0.25 ft	HH-12
Freshwater flow (pygmy gurley meter, weirs, gauge stations)	+/- 0.25 cu^3/ft	HH-13
Artificial deposition markers	+/- 0.13 inch	HH-12
Turbidity (vertical profile)	+/- 1.00 NTU	HH-6
Total suspended sediment	+/- 1.00 mg/l	HH-6
Water temperature (vertical profile)	+/- 0.50 C	HH-6,8
Sample depth	+/- 0.10 meter	HH-6
Dissolved oxygen (vertical profile)	+/- 1.0 mg/l	HH-5,8
Acreage of wetland habitats: open channel, mudflat, low saltmarsh, high saltmarsh, eelgrass beds (3-tiered densities), algal flats, kelp beds, coastal dune scrub, freshwater marsh, riparian, grasslands, coastal sage scrub, maritime chaparral and oak woodland.		HH-3,4,6,8,9,10,12
Habitat Typing: Bank stability, Vstar, Percent vegetation cover, Pool/riffle ratios, Embededness of instream gravels, Substrate particle size	 +/- 0.10 m +/- 0.05% +/- 0.10 mm +/- 0.10 mm	HH-5,8,12-14
Benthic community assessments	Community index	HH-7,11
Photodocumentation (landmark, satellite)		HH-3,8,9
Eelgrass surveys (Productivity, epiphytes, density, habitat extent)		HH-3,4,6
Vegetation transects in all identified wetland habitats (community diversity)	Community index	HH-9

Coordinating Agency: Morro Bay National Estuary Program

Supporting Agency: Central Coast Regional Water Quality Control Board
Central Coast Ambient Monitoring Program (CCRWQCB)
National Resource Conservation Service
Resource Conservation District
California Conservation Corps

Supporting Organization: Morro Bay Volunteer Monitoring Program

Table 8-2 Watershed Monitoring Variables

Watershed Component	Parameter/ Variables	Implementer *Primary/ Secondary	Frequency	Location	Related Monitoring Info Need	Related CCMP Action
Conventional Water Quality	Nutrient Series, Chloride, **Suspended Solids,** Coliform Series, **Turbidity**, Dissolved Oxygen, pH, Salinity, Conductivity, Temperature, Chlorophyll a	*CCAMP Funding/ FOE collection	Monthly	2 sites: SYB/TWB	HH6	CC-3 CC-4 All SED All BACT All NUTR FLOW-1,4 All HMT
Volunteer Water Quality	Nutrient Series, **Suspended Solids**, Coliform Series, **Turbidity,** Dissolved Oxygen, pH, Salinity, Conductivity, Temperature, Chlorophyll a, Flow	*FOE	Monthly	15 sites: Tributary/ Confluence per VMP	HH6,8,13	CC-3 CC-4 CC-6 All SED All BACT All NUTR All FLOW All HMT
Freshwater Bioassessment	**Benthic Macroinvertebrates,** Harpactacoids, Plankton	*FOE, *CCAMP	Annually	10 sites Figure 9.1	HH7,11	CC-6
Geomorphological Suite	**Stream Cross-Sectional and Longitudinal Profiles, Habitat Typing, Photodocumentation**	*FOE/ RCD	Annually	21 sites on Chorro and Los Osos tributaries	HH3,5,8,9, 12-14	CC-6 All HAB
Habitat Delineation	Acreage of habitats (listed in Chapter 8/9) Satellite imagery Groundtruthing	NEP/FOE	Every five years beginning in 2001.	All major habitat types	HH3,4,6, 10,12	All HAB
Bird Surveys	Community Diversity/Density	*FOE	Quarterly	10 sites per VMP	HH8,9	CC-6 All HAB SED-6

Table 8-3 Estuarine Monitoring Variables

Estuarine/ Near Shore Component	Parameter/ Variables	Implementer Primary/ Secondary	Frequency	Location	Related Monitoring Info Need	Related CCMP Action
Volunteer Water Quality	Nutrient Series, Coliform Series, **Turbidity,** Dissolved Oxygen, pH, Salinity, Conductivity, Temperature, Chloropyll a	FOE	Monthly	16 sites per VMP	HH6	CC-3,4,6 All SED All BAC All NUT All FLW
Nutrient Biological Impact	Nutrient Series, Eelgrass Productivity, Eelgrass Ephiphytic Index, **Turbidity,** Eelgrass density transects	NEP/Cal Poly	Three Year Monitoring Project	5 Transects based on J. Chestnut/Tetra Tech transects	HH6	CC-3 CC-6 All NUT HAB-8
Benthic Infauna (Partial RBP)	**Eelgrass Community Diversity Benthic Macroinvertebrates,** Plankton	NEP/Cal Poly	Three Year Monitoring Project	5 Transects based on J. Chestnut/Tetra Tech transects	HH3,4,6,7	HAB-8 CC-6
Eelgrass Survey	**Community Density/ Distribution**	NEP/ J. Chestnut & Cal Poly	Annually	5 Transects based on J. Chestnut/Tetra Tech transects	HH12	CC-6 HAB-8
Estuarine Bioassessment	Plankton, **Macroinvertebrates/ Harpactacoids**	FOE/NEP	Annually for five years	5 sites: 2 Delta, 1 Bay mouth, 2 Mudflat	HH8	CC-6
Geomorphological	Bay Bathymetery Artificial deposition markers	NEP/FOE	Annually for five years	Based off Tetra Tech Circulation Study 1999	HH12	All HAB

Chapter 9

Tracking Species Biodiversity

Priority Problem: Species biodiversity is a cross-cutting issue is related to all priority problems identified: Sedimentation, Increased Bacterial Concentrations, Increased Nutrients, Freshwater Flow, Heavy Metals and Toxics, Habitat Loss, and Loss of Steelhead

Background:

Species biodiversity is one indicator of maintaining a healthy ecosystem. Diversity can indicate a variety of available niches, a large range healthy habitat options. Tracking biodiversity gives resource managers two perspectives on ecosystem health: 1) allows for targeting ecosystem productivity; and 2) with a large sample size, allows for trend building and change detection of large catastrophic events, i.e. fire, drought. Morro Bay supports a large number of State/Federally listed and special concern species, as presented in Table 9.1. All actions of the CCMP will be consistent with recovery plans these and other sensitive wildlife.

Following is a summary of three indicator species, Steelhead trout, Brant geese, and Red-legged frog, which are all particularly sensitive to change. For more information on this complex topic, please refer to Chapters 3, 10 in companion document, Volume II: The Characterization.

Steelhead

A totem species in the Morro Bay watershed, Southern steelhead populations have been listed as federally endangered by the National Marine Fisheries Service because of declining habitat quality throughout the species range. Water diversion projects, migration barriers, drought and siltation upstream have greatly reduced the viability of local steelhead populations in these two streams. Steelhead trout are generally spring spawners, but will often move up major coastal rivers in the fall and wait until spring to spawn (McGinnis 1984).

Steelhead populations in the Morro Bay watershed fall into the South-Central Evolutionary Significant Unit (ESU) (see Figure 9.1) as defined by the National Marine Fisheries Service. Main characteristics of this ESU habitat include flash floods and high erosion rates that are thought to be stressful to steelhead. Historically, the southern steelhead trout populations once numbered in the ten thousands. Presently, the population has declined to less than "one percent of their 1850 abundance" (Edmondson 1999).

Steelhead trout are a cold water fish species. Temperatures over 65°F can become lethal for these fish, particularly over prolonged periods. When water flow is abundant and shaded by adjacent vegetation, temperatures remain cool. Steelhead also require fairly high dissolved oxygen levels in the water. Cooler water holds more oxygen. Well-shaded corridors are an important way to maintain appropriate water quality temperatures for these fish.

Table 9-1. Special Status Species Known to Occur Within the Study Area.

Species	State Status	Federal Status	Recovery Plan Status
American peregrine falcon	Endangered	Delisted FE 1999	Final 1983, Delisted 1999
Brown pelican	Endangered	Endangered	Final 1983
California Black Rail	Threatened		
California Clapper Rail	Endangered	Threatened	
California red-legged frog		Threatened	Public draft under development
California sea-blite		Endangered*	Public draft under development
Chorro Creek bog thistle	Endangered*	Endangered*	Public draft 1997; final in progress
Cuesta Grade checkerbloom	Rare		
Indian Knob mountainbalm	Endangered*	Endangered*	Public draft 1997; final in progress
Least Bell's vireo	Endangered	Endangered	Public draft 1988; final in progress
Morro Bay kangaroo rat	Endangered*	Endangered*	Final 1982; under revision
Morro manzanita		Threatened*	Public draft 1997; final in progress
Morro shoulderband snail		Endangered*	Public draft 1997; final in progress
Salt marsh bird's-beak	Endangered*	Endangered	Final 1982
Southern sea otter		Threatened	Final 1982; revised public draft, 1996
Southern steelhead trout		Threatened	Contact NMFS
So.western Willow Flycatcher		Endangered	
Swainson's Hawk	Threatened		
Tidewater goby		Endangered	
Western snowy plover		Threatened	Public draft under development

*endemic to the vicinity of the Morro Bay Watershed

Source: U.S. Fish and Wildlife Service, 1999. California Department of Fish and Game 1999.

Sedimentation of instream habitat is another serious problem. Steelhead are anadromous, which means that they spend most of their adult life in the ocean, returning eventually to their home streams to spawn. Spawning success can be greatly affected by the amount of sediment present in the spawning gravel. Sediment fills in the spaces between the gravel, actually smothering eggs and larvae, reducing the insect food sources attached to the gravel, or "cementing" the gravel, making it too compacted for use as spawning habitat. Creek gravels that are clean enough to support steelhead spawning and reproduction probably also indicate a system that isn't overloaded by sediment. Details regarding threats to steelhead habitat and trends is in the resource presented in Section 8 of the MBNEP Characterization, "Freshwater Flows," and Section 10, "Habitat Loss."

Brant

Morro Bay supports large numbers of Black brant from November through April. Black brant breed at coastal arctic nesting sites in eastern Russia, western and northern Alaska and northwestern Canada. Brant winter in lagoons and estuaries from the Pacific coastal states to the Baja peninsula and mainland Mexico. Outside of the breeding season brant are closely associated with their primary food source, eelgrass (*Zostera marina*). It has been estimated that as many as 25,000 brant may stop and utilize Morro Bay as a feeding and resting site during migration to and from Mexico, with the majority of brant stopping on their way north from mid-January through early May (D. Ward pers. comm.).

During their southward migration many brant fly nonstop from their primary fall staging area on the Alaska Peninsula to Mexico, however, the northward migration is very different. Brant leapfrog up the coast stopping at regular feeding sites. This allows them to maintain higher body mass during migration, which ultimately leads to larger clutch sizes and increased reproductive fitness. Since many important brant wintering areas in southern California have been lost to habitat alteration, Morro Bay has become the last significant brant wintering area and migration stop between San Quintin Bay in Baja and northern California.

Morro Bay will probably continue to support large numbers of brant in the future if two main conservation issues are monitored and addressed as necessary. These issues are: 1) important eelgrass foraging areas need to be conserved; and 2) human disturbance needs to be monitored to assure that it remains within tolerable levels for brant to maintain normal behaviors (appropriate foraging and resting time) to assure a healthy energy budget. Currently brant experience a significant amount of disturbance from recreational users (kayaks, canoes, sailboards, etc.) on some weekend days, but on most days there is relatively little disturbance. However, a steadily increasing regional and bayside population coupled with an increasing proportion of recreational users of the bay within this population could lead to unacceptable levels of human activity for wintering and migrant brant.

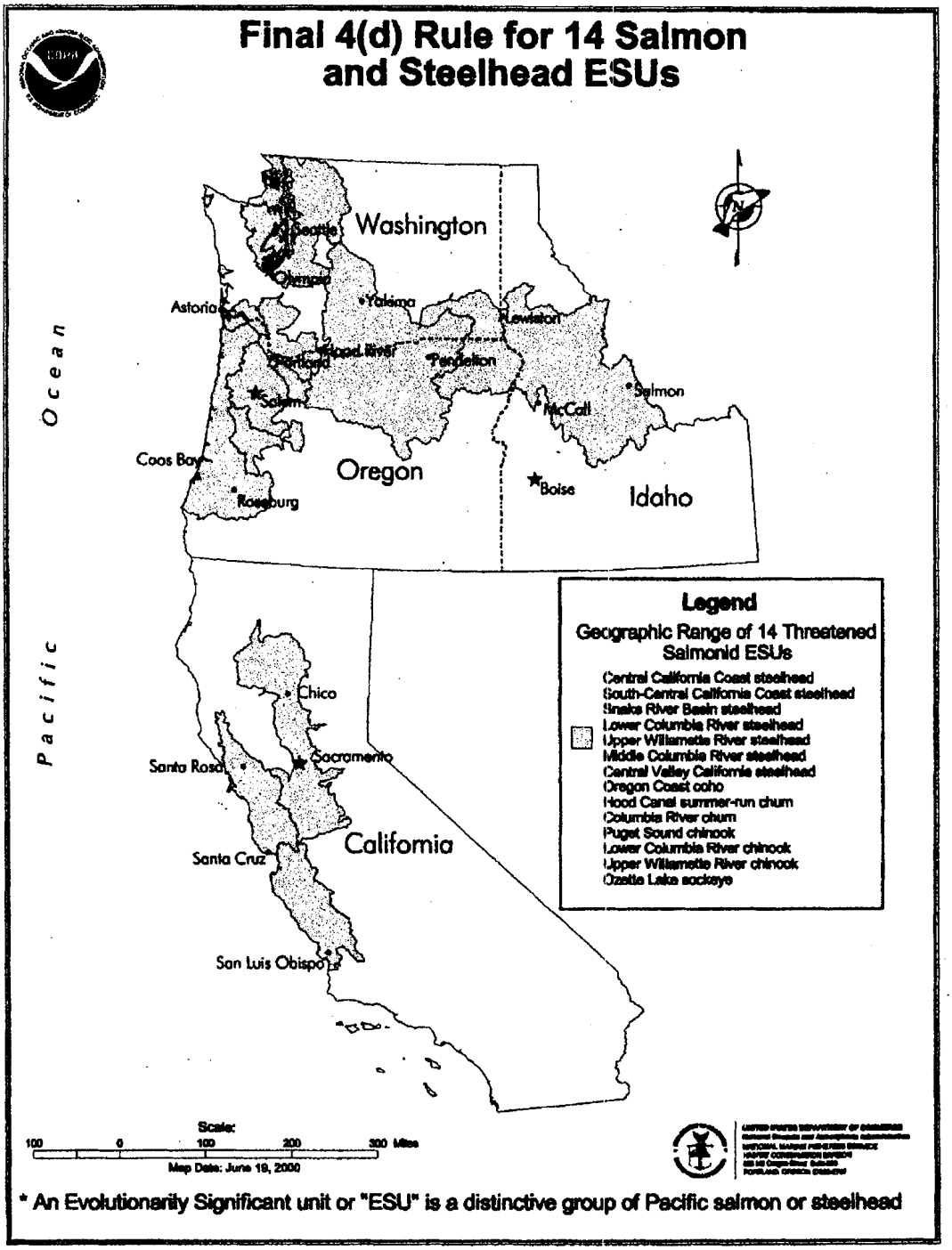
California Red-legged Frog

The California red-legged frog is protected by the CDFG as a species of special concern (1982) and is federally listed as threatened under the U. S. Endangered Species Act (United State Fish and Wildlife Service (USFWS) 1996). This species frequents marshes, slow parts of streams, lakes, reservoirs, ponds, and other usually permanent water sources. It occurs primarily in wooded areas in lowlands and foothills, although it can also be found in grassland. It is considered a pond frog (Stebbins 1966) and is typically associated with deep-water pools (at least 1.6 feet in depth) that are fringed by thick vegetation, particularly arroyo willow or cattails (*Typha* sp). During the breeding season, the males call from the water. The adults are strictly nocturnal and extremely wary; any attempt to census this species must be conducted at night (ERCE 1993).

The red-legged frog generally occurs where freshwater is present. Recent documented locations within the estuary include the mouth of Chorro Creek at the northern edge of the Chorro delta (Worcester 1991). Within the Morro Bay watershed, the red-legged frog is known to occur at locations along lower and upper Chorro, Dairy, Pennington, and Gilardi creeks, as well as some ponds on Camp San Luis Obispo (Duke, B., pers. comm, Froland, J., pers. comm. 1999). Potential habitat also exists at Walters, San Luisito, and San Bernardo creeks (San Luis Obispo County 1997 - Chorro Valley Pipeline environmental monitoring records).

The decline of the California red-legged frog, as well as other western ranids (frogs), is believed to be the result of numerous confounding facts. These include competition and predation from introduced species (bullfrogs and squawfish), acid rain, pathogens and parasites, catastrophic events (severe drought and scouring floods), and habitat alteration (Hayes and Jennings 1988). These frogs often exist in small populations (Storm 1960) and as such are sensitive and subject to local extinctions. Red-legged frogs are not drought tolerant and are incapable of surviving without water for greater than six weeks. Dispersal in this species is apparently restricted to juveniles (females <80mm, males <65 mm) and, for the most part, occurs only within drainages rather than between drainages. The tadpoles of this frog require cool water; therefore, habitat alterations that increase water temperature, such as removal of riparian vegetation or reduction in stream flow, could lead to local extinctions. At this time, the California red-legged frog appears to be almost extinct south of Ventura County and is declining elsewhere in its range.

Figure 9.1 Relative Geographic Distriubiton of South-Central Coast Steelhead.
Source: NMFS, 2000



Management Objectives:

- ✓ Remove all fish barriers to stream habitat for spawning and rearing by 2010.

  Related CCMP Action Plan: STL-2, CC-5

- ✓ Increased population of steelhead fish in Los Osos and Chorro Creeks by the year 2010.

  Related CCMP Action Plan: All STL, CC-5

- ✓ Increase populations of Federally/State listed and special concern species (such as eelgrass, redlegged frogs, steelhead trout, overall wintering bird migrants and Morro Manzanita) in the watershed and estuary from year 2000 inventory estimates.

  Related CCMP Action Plan: EDU-8, HAB-1,2,4,9

- ✓ Maintain benthic community indices at established baseline levels, based upon National Monitoring Program Final Report 2001 mean indices.

  Related CCMP Action Plan: All HAB, All STL

- ✓ Decreased coverage of prominent exotic species (veldt grass, hoary cress, Giant reed, Cape ivy) by 15% by year 2010.

  Related CCMP Action Plan: HAB-9

- ✓ Successful attainment of the goals of the Steelhead Recovery Plan (anticipated 2001) as listed by NMFS and CDFG in Morro Bay watershed.

  Related CCMP Action Plan: All STL

Data Information Needs

The primary objective of the Environmental Monitoring Program is tracking and assessing effectiveness of implemented CCMP actions. The MBNEP Technical Advisory Committee has reviewed the following monitoring questions, and set forth a list of parameters (Table 9-2) by which to gather environmental data. Questions to help drive monitoring of these Species Diversity actions (SD-1 through SD-10) are split into Programmatic (P), Environmental (E) and Research (R) categories, as illustrated below.

Programmatic:

SD-1 Are any freshwater, marine, or terrestrial species being reduced or eliminated by human activities?

SD-2 What is the status of listed species recovery plans for Morro Bay study area? Are they improving species survival rates?

Environmental:

SD-3 What are the annual resident/migrating brant populations? What is the community age structure? What are the trends over time?

SD-4 What are the trends in acreage and density of Morro Bay and Estero Bay kelp beds? How are they correlated with diversity/density of community species?

SD-5 Are toxic plankton blooms increasing or decreasing over time?

SD-6 What are the status and trends (density, diversity, distribution) of benthic invertebrate assemblages in streams and the bay? Is there a positive correlation with eelgrass, algal flat, and riparian cover?

SD-7 Are steelhead population levels increasing Chorro and Los Osos Creeks?

SD-8 Is mileage of accessible stream habitat increasing since the implementation of Steelhead action plans?

Research:

SD-9 What habitats are crucial to special species? Are there recreational activities that interfere with their critical habitat needs?

SD-10 What additional exotic species have potential to arrive in the estuary and watershed? Are they increasing or decreasing? What impacts do exotic species have on native species?

Table 9-2 Parameter and Performance Criteria for Species Diversity Assessments

Environmental Monitoring Parameter	Data Quality Objective	Related Monitoring Question
Bay bathymetry	+/- 0.25 ft	SD-6
Artificial deposition markers	+/- 0.13 inch	SD-4
Turbidity (vertical profile)	+/- 1.00 NTU	SD-4,8
Total suspended sediment	+/- 1.00 mg/l	SD-4,8
Water temperature (vertical profile)	+/- 0.50 C	SD-4
Sample depth	+/- 0.10 meter	SD-4
Dissolved oxygen (vertical profile)	+/- 1.0 mg/l	SD-4,8
Trace Organics full scan +PAH Full Scan Metals	ug/l	Research baseline
Acreage of wetland habitats: open channel, mudflat, low saltmarsh, high saltmarsh, eelgrass beds (3-tiered densities), kelp beds, coastal dune scrub, freshwater marsh, riparian, grasslands, coastal sage scrub, maritime chaparral and oak woodland.		SD-3,4,6,8
Habitat Typing: Bank stability, Vstar, Percent vegetation cover, Pool/riffle ratios, Embededness of instream gravels, Substrate particle size	 +/- 0.10 m +/- 0.05% +/- 0.10 mm +/- 0.10 mm	SD-6,8
Benthic community assessments	Community index	SD-6
Photodocumentation		SD-3,4,6-8
Algal surveys		SD-5,6
Eelgrass surveys (Productivity, epiphytes, density, habitat extent)		SD-6
Vegetation transects in all identified wetland habitats (community diversity)	Community index	SD-4,6
Brant surveys (population, age class, geographic distribution)		SD-3
Plankton surveys		SD-4,5
Fish surveys		SD-7,8
Bird surveys (terrestrial/shorebird)		SD-3
Nutrient series (see WSQ Objectives)		SD-5

Table 9.3 Morro Bay Watershed Monitoring Parameters/Variables

Watershed Component	Parameter/ Variables	Implementer *Primary/ Secondary	Frequency	Location	Data Info Need	Related CCMP Action
Conventional Water Quality	Nutrient Series, Chloride, Suspended Solids, Coliform Series, **Turbidity, Dissolved Oxygen, pH, Salinity, Conductivity, Temperature, Chlorophyll a**	*CCAMP Funding/ FOE collection	Monthly	2 sites: SYB/TWB	SD-4,8	CC-3 CC-4 All SED All BACT All NUTR FLOW-1,4 All HMT
Volunteer Water Quality	Nutrient Series, Suspended Solids, Coliform Series, **Turbidity, Dissolved Oxygen, pH, Salinity, Conductivity, Temperature, Chlorophyll a, Flow**	*FOE	Monthly	15 sites: Tributary/ Confluence per VMP	SD-4,8	CC-3 CC-4 CC-6 All SED All BACT All NUTR All FLOW All HMT
Freshwater Bioassessment	**Benthic Macroinvertebrates, Harpactacoids, Plankton**	*FOE, *CCAMP	Annually	10 sites Figure 9.2	SD-6	CC-6
Fish Surveys	**Community Diversity/Density**	*FOE/NEP	TBD by TAC	4 sites as coordinated by CDFG	SD-7,8	CC-5 CC-6 All HAB All STL
Bird Surveys	**Community Diversity/Density**	*FOE	Quarterly	10 sites per VMP	SD-3	CC-6 All HAB SED-6
Geomorphological Suite	**Stream Cross-Sectional and Longitudinal Profiles, Habitat Typing, Photodocumentation,**	*FOE/RCD	Annually	21 sites on Chorro and Los Osos tributaries	SD-6,8	All HAB All SED

Table 9.4 Morro Bay Estuarine Monitoring Parameters/Variables

Estuarine/ Near Shore Component	Parameter/ Variables	Implementer Primary/ Secondary	Frequency	Location	Related Monitoring Info Need	Related CCMP Action
Volunteer Water Quality	Nutrient Series, Coliform Series, **Turbidity, Dissolved Oxygen, pH, Salinity, Conductivity, Temperature, Chloropyll a**	FOE	Monthly	16 sites: Figure 4.2	SD-4,8	CC-3,4,6 All SED All BAC All NUT All FLW
Bioaccumulation (fish)	**Trace Organics full scan +PAH Full Scan Metals**	*CCAMP	TBD	5 sites: 2 Delta, 1 Bay mouth, 2 Mudflat	SD-7,8	CC-3,6 All HMT All STL
Nutrient Biological Impact	**Nutrient Series, Eelgrass Productivity, Eelgrass Ephiphytic Index, Turbidity, Eelgrass density transects**	NEP/Cal Poly	Three Year Monitoring Project	5 Transects based on J. Chestnut/Tetra Tech transects	SD-5,6	CC-3 CC-6 All NUT HAB-8
Benthic Infauna (Partial RBP)	**Eelgrass Community Diversity Benthic Macroinvertebrates, Plankton**	NEP/Cal Poly	Three Year Monitoring Project	5 Transects based on J. Chestnut/Tetra Tech transects	SD-6	HAB-8 CC-6
Brant Surveys	**Brant Migration / Resident Timeline, Brant Density, Brant Age Composition, Brant Habitat delineation**	J. Roser, Audobon/ NEP	TBD	6 Observation points on bay perimeter. 2 Front bay, 1 delta, 2 back bay	SD-3	CC-6 All HAB
Fish Trawls	**Community Density/ Diversity**	CDFG	Annually	4 sites as coordinated by CDFG	SD-7,8	CC-6 All STL All HAB
Shore Bird Survey	**Community Density/ Diversity**	Pt. Reyes Observatory/ Audobon	Annually	6 Observation points on bay perimeter. 2 Front bay, 1 delta, 2 back bay	SD-3	CC-6 SED-6 All HAB
Eelgrass Survey	**Community Density/ Diversity**	NEP/ J. Chestnut & Cal Poly	Annually	5 Transects based on J. Chestnut/Tetra Tech transects	SD-6	CC-6 HAB 8
Plankton Survey	**Community Density/ Diversity Turbidity, Temperature**	UCCE, DHS/ Coast Guard, FOE	Monthly	4 sites: Estero Bay, Harbor Mouth, N. T- Pier, Back Bay Channel	SD-6	CC-6
Algal Cover Transects	**Percent Cover**	FOE	Four times a year, during algal growth season. One time in dormant season.	4 Transect Sites: Chorro Delta, Shark Inlet, Pasadena Point, and Grassy Isl.	SD-4,6	CC-6

Estuarine Bioassessment	**Plankton, Macroinvertebrates/ Harpactacoids**	FOE/NEP	Annually for five years	5 sites: 2 Delta, 1 Bay mouth, 2 Mudflat	SD-5	CC-6
Geomorphological Suite	**Stream Cross-Sectional and Longitudinal Profiles, Habitat Typing, Photodocumentation, Bay Bathymetry, Artifical Depo Markers**	*FOE/RCD	Annually	21 sites on Chorro and Los Osos tributaries	SD-6,8	CC-6 All HAB
Habitat Delineation	Acreage of habitats (listed in Chapter 8/9) Satellite imagery Groundtruthing	NEP/FOE	Every five years beginning	All major habitat types	SD-3,4,6,8	All HAB

Chapter 10

Water and Sediment Quality

Priority Problem: Quality of water and sediment is a cross-cutting issue that can effect all priority problems identified: Sedimentation, Increased Bacterial Concentrations, Increased Nutrients, Freshwater Flow, Heavy Metals and Toxics, Habitat Loss, and Loss of Steelhead

Background

This background section outlines contributing factors, such as nutrients and heavy metals and toxics, which can impact water and sediment quality. Factors that have already been detailed in earlier sections are not included here. Additional background on geomorphological monitoring is detailed in Chapter 5: Tracking Changes in Sedimentation Rates. For background on increased coliform in the watershed and to the bay, please reference Chapter 6: Public Health Issues. For background on flow, please see Chapter 7: Reductions to freshwater flows. Further information on habitat health and monitoring species diversity can be found in Chapters 8 and 9 respectively.

Nutrient Background

Nutrients are of concern both in the estuary and the watershed. Data from the National Monitoring Program has identified row crop areas as high contributors of nutrient loads to the estuary. Figure 10.1 depicts a relative comparison of nitrate loads on a tributary basis. Bay researchers have identified algae blooms as a problem in the back bay, particularly those involving *Ulva and Enteromorpha,* which are both opportunistic algal species which thrive in nutrient-rich environments (Josselyn 1989). Blooms are often the result of excessive nutrients reaching the water body.

Much of the bay flushes completely during tidal changes and the overall impacts of nutrients on the health of the system are currently unclear. There is a need for a more detailed examination of the current impacts of nutrients on the estuary, and an assessment of probable future impacts linked to predicted changes in nutrient loading. Additional problems arise when nutrients promote algal blooms, which in turn deplete dissolved oxygen in shallow lagoons such as the Morro Bay estuary. The supply of dissolved oxygen is crucial for freshwater and marine organisms to respire.

A nutrient sampling effort that was conducted quarterly by the MBNEP and Friends of the Estuary Volunteer Monitoring Program during 1996 (see Figure 10.2) revealed elevated nitrates in bay water in localized areas, but in many samples nitrate was not detected. Results from Tetra Tech's Nutrient Loading Study (1999) indicate that groundwater sources of nitrogen are elevated at south shore stations, where future monitoring will be focused. More information on this data and its trends can be found in Chapter 7 of the MBNEP Characterization Document.

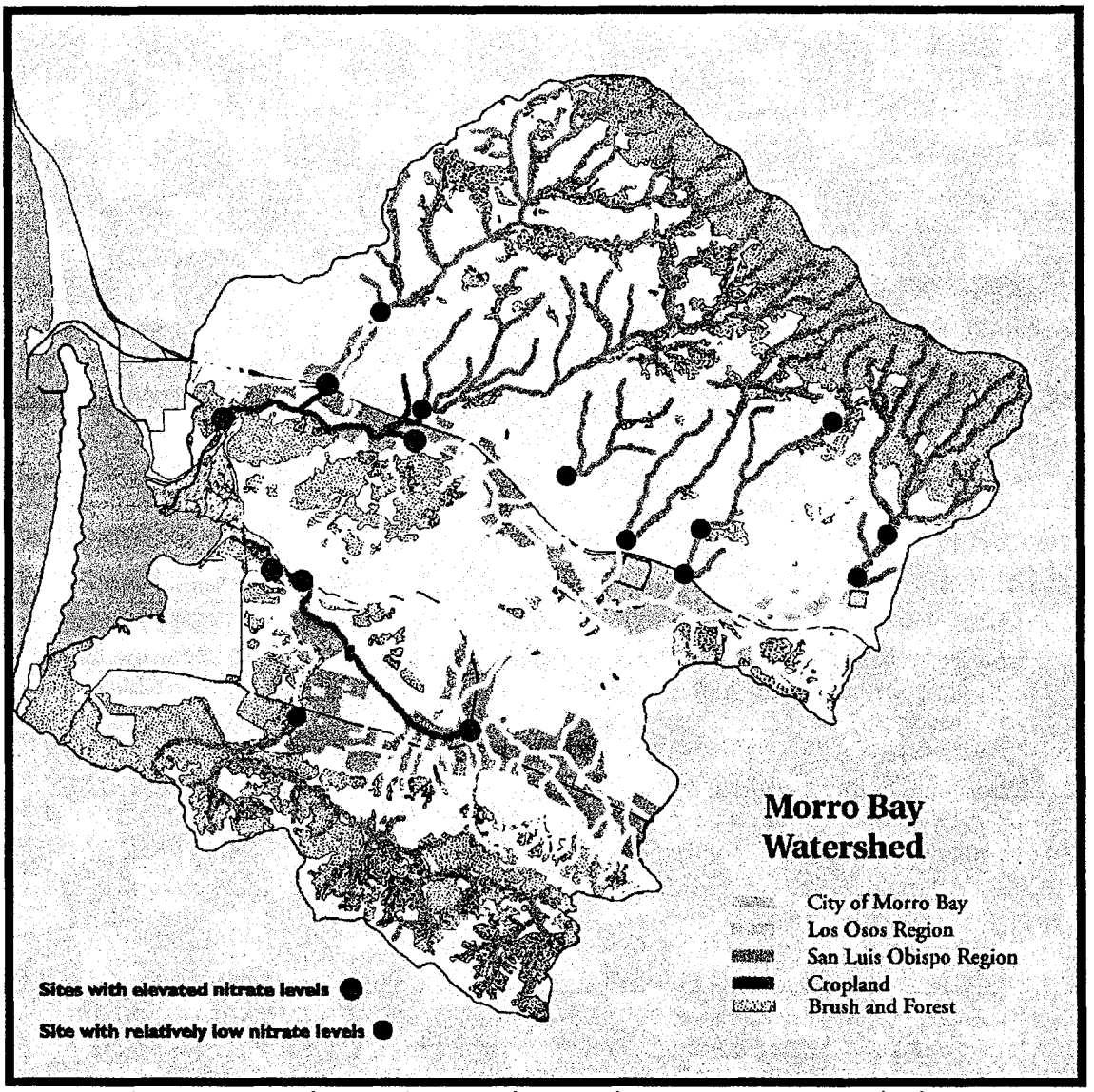


Figure 10.1 Relative nitrate values in the Morro Bay watershed.
Source: National Monitoring Program data, 1993-1998.

Heavy Metals and Toxics Background

Toxic pollutants include pesticide residuals, organic compounds, and heavy metals. Heavy metals such as nickel, cadmium, chromium, and arsenic are a serious water quality concern because of their toxicity and persistence.. Marine wildlife, shellfish harvesting fish migration, spawning habitat, and rare, threatened, and endangered species habitat are beneficial uses that could potentially be affected by heavy metals and other toxic pollutants. Such metals can accumulate in sediments and in fish and shellfish tissue. Aquatic organisms can be acutely affected even by very low concentrations of toxic pollutants.

Sources of metals and toxic pollutants vary, but they are often found in storm water runoff. Typical

Sources of metals and toxic pollutants vary, but they are often found in storm water runoff. Typical sources are vehicle brake pad dust, runoff from inactive mine tailings, solid waste disposal areas, and household and industrial sources. Copper and tributyltin were once used in "antifouling" paints used on boats. These materials were added to paints to prevent marine invertebrates from fouling the bottoms of boats. Toxic pollutants can be discharged to surface waters during wet weather storms or they can arise from other incidents such as oil spills or illegal discharges. Both toxic constituents and metals can sometimes be found in wastewater discharge.

Dredging of sediments that contain metals or toxic pollutants in concentrations that are determined to be unsuitable for unconfined aquatic disposal can result in additional costs for material handling, treatment, and disposal. This special handling of unsuitable material significantly increases the cost of dredging. Data collected from the State Mussel Watch and the Toxic Substance Monitoring programs suggest that metal concentrations and other toxic pollutants (e.g., synthetic organics) are not present in estuary waters in concentrations dangerous to fish or mussels (SWRCB, Bulletin 96-2WQ, 1996). However, as mentioned above, sampling within the upper watershed suggests a persistent problem with chromium and nickel that are believed to be eroding from inactive/abandoned mines. Effective Best Management Practices and monitoring at regular intervals can ensure that beneficial uses are protected.

The Morro Bay estuary and Chorro Creek are listed on the Central Coast Regional Water Quality Control Board (CCRWQCB) 303(d) list as "impaired water bodies" for metals. Sampling has shown that the concentrations of chromium and nickel in Chorro Creek sediments exceed numerous sediment quality standards. However, not enough data exists to assess background levels for Chorro Creek, Los Osos Creek, or the estuary. Further sampling efforts will be coordinated with the CCRWQCB to fill these data gaps. Los Osos Creek is listed on the 303(d) list for priority organics primarily because of historical data regarding pollutants from the Los Osos landfill. More recent data show that this problem has been corrected (San Luis Obispo County Engineering Department, 1998). For further information, please refer to Volume II: The Characterization.

Management Objectives:

(See relevant chapters 5 through 9 for additional management objectives)

- ✓ Decrease annual nutrient inputs (loading) by 25% from urban and agricultural runoff by the year 2010. Levels of nutrients shall not cause nuisance aquatic growth or adversely affect beneficial uses (as listed in CCRWQCB Basin Plan Standards).

  Related CCMP Action Plan: All NUTR, CC-3

- ✓ Levels of nutrients shall not be present in creek and bay waters at levels which cause toxic effects to aquatic organisms and plants. These measurable standards are listed in detail in the following Table 10-1.

  Related CCMP Action Plan: All NUTR, CC-3

- ✓ Dissolved oxygen concentrations shall remain above 5.0 mg/1 at all times. Median values shall be maintained above 85 percent saturation. In cold freshwater habitats, dissolved oxygen concentrations shall not be reduced below 7.0 mg/1 at any time (as listed in CCRWQCB Basin Plan Standards).

  Related CCMP Action Plan: CC-5,6

- ✓ Decrease levels of heavy metals (such as copper) and toxics (such as organophosphorous pesticides) to be in compliance with EPA Toxic rules in creeks and bay waters to natural background levels (which will be established by the year 2002), and shall not cause impacts to beneficial uses, such as cold water aquatic organisms, endangered species, drinking water or recreational use (as stated in CCRWQCB Basin Plan Standards).

  Related CCMP Action Plan: All HMT, CC-3

- ✓ Decrease metals and toxics in sediments to satisfy NOAA chronic/acute standards (i.e. the geometric mean copper levels in marine sediment shall not be over 25,000 ppb) for marine and freshwater sediment, and shall not cause impacts to beneficial uses, such as cold water aquatic organisms, endangered species, drinking water or recreational use (as stated in CCRWQCB Basin Plan Standards).

  Related CCMP Action Plan: All SED, All HMT

Data Information Needs

The primary objective of the Environmental Monitoring Program is tracking and assessing effectiveness of implemented CCMP actions. The MBNEP Technical Advisory Committee has reviewed the following monitoring questions, and set forth a list of parameters (Table 10-1) by which to gather environmental data. Questions to help drive monitoring of these Water and Sediment Quality actions (WSQ-1 through WSQ-19) are split into Programmatic (P), Environmental (E) and Research (R) categories, as illustrated below.

Programmatic

WSQ-1 Are water and sediment quality standards (as identified in the CCRWQCB Basin plan and anticipated 2001 Nutrient, Bacteria and Sediment TMDL for Chorro Creek and Morro Bay Estuary) being upheld?

Environmental

WSQ-2 Is nutrient input positively correlated with increased toxic phytoplankton blooms in the estuary (red tide, etc.)?

WSQ-3 What are the natural background nitrate and phosphate levels in the estuary?

WSQ-4 Are the seasonal and/or spatial trends in nutrient inputs decreasing?

WSQ-5 Are nutrient levels in groundwater changing with modified management practices?

WSQ-6 Are freshwater habitats being decreased in correlation with reduction in freshwater flow rates?

WSQ-7 What are the status and trends of conventional water quality on all major tributaries?

WSQ-8 What levels of nickel and chromium are typical in background sediments in the Chorro watershed?

WSQ-9 What types of toxic chemicals exist in bay sediments? Where are they located?

Research

WSQ-10 Are nutrients adversely affecting aquatic communities? Eelgrass?

WSQ-11 What is the effective minimum width for fenced riparian buffer to improve water quality improvement?

WSQ-12 What is the optimum amount of nutrients needed for row croppers of the Los Osos and Chorro Valleys?

WSQ-13	What function does nutrient variances have on Eelgrass productivity in Morro Bay? (Comparison of Instantaneous And Comprehensive Methodologies)
WSQ-14	What are the ecological effects of algal blooms (Freshwater And Estuarine)
WSQ-15	What are the extent of natural and anthropogenic sources of hypoxia?
WSQ-16	What are the limiting nutrients in both freshwater and estuarine environments?
WSQ-17	Are marine and freshwater organisms, (such as red-legged frogs, steelhead, or the tidewater goby) in Chorro and Los Osos Creeks and in the Morro Bay estuary impacted by concentrations of metals or toxic chemicals?
WSQ-18	Does dredging cause toxic substances to be re-suspended?
WSQ-19	Do metals degrade any surface water beneficial uses?

Coordinating Agency:	Morro Bay National Estuary Program
Supporting Agency:	Central Coast Regional Water Quality Control Board National Monitoring Program (CCRWQCB) Central Coast Ambient Monitoring Program (CCRWQCB) National Resource Conservation Service Resource Conservation District
Supporting Organization:	Morro Bay Volunteer Monitoring Program

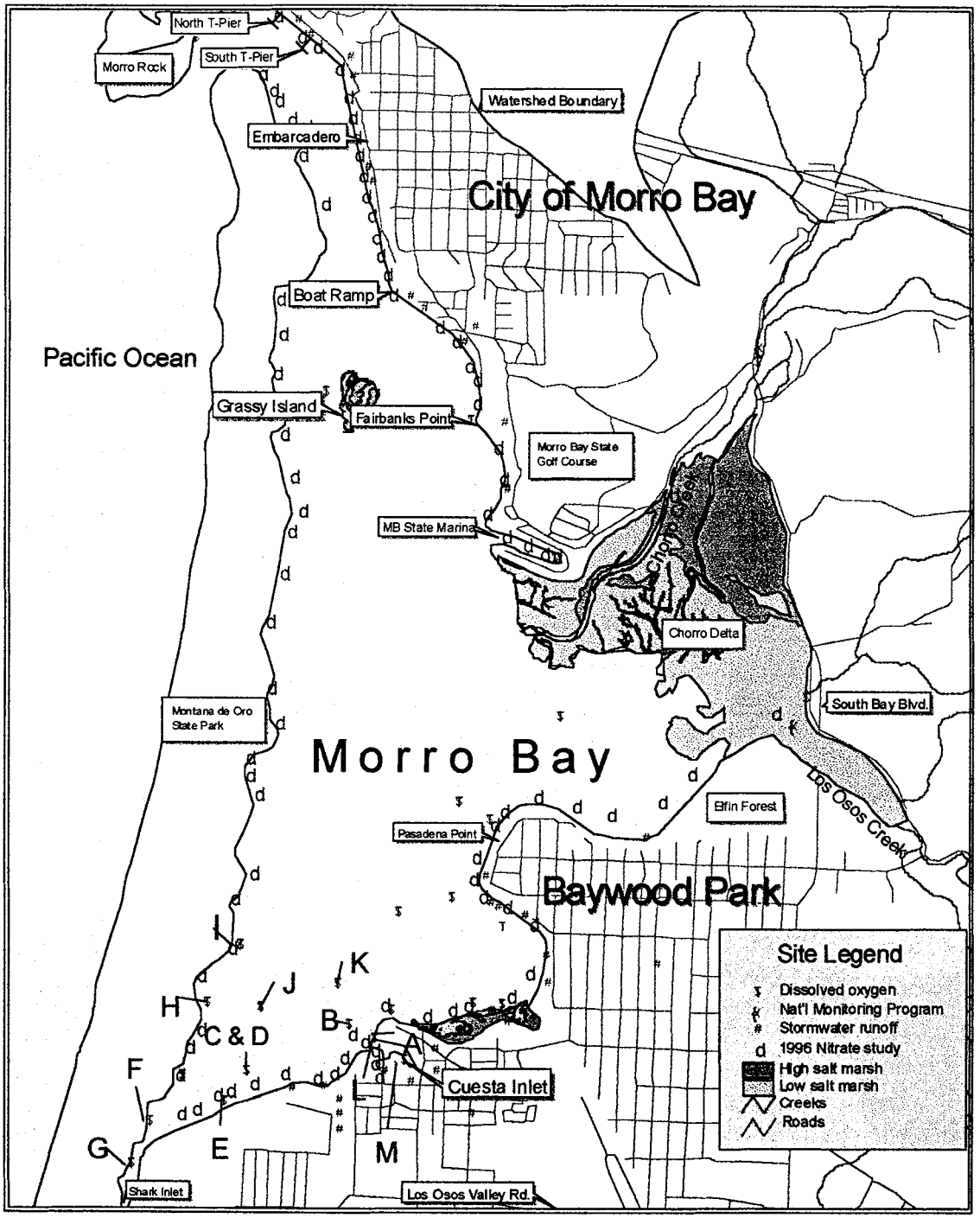


Figure 10.2 Location of Nutrient Sampling Sites in Morro Bay
Source: MBVMP, MBNEP and CCRWQCB
MBNEP Characterization 1999

Table 10-1
Parameter and Performance Criteria for Water and Sediment Quality Assessments

Environmental Monitoring Parameter	Data Quality Objective	Related Monitoring Question
Benthic community assessments	Community index	WSQ-9
Chlorophyll-a		WSQ-7
Conductivity	+/- 0.10 SU	WSQ-7
Depth of water in groundwater wells	+/- 0.10 inch	RF-3, PS-5
Dissolved metals	ug/l**	WSQ-9
Dissolved oxygen	+/- 1.0 mg/l	WSQ-7
E. coli	***	PH-3,5 PS-7 WSQ-7
Eelgrass surveys (Productivity, epiphytes, density, habitat extent)		WSQ-7
Enterococcus	***	PH-3-6, PS-7 WSQ-7
Fecal Coliform- recreational water contact	CCRWQCB: The geometric mean of five samples within a 30-day period must not exceed 200MPN/100ml; or ten percent of all samples taken during any 30-day period must not exceed 400MPN/100ml.***	WSQ-7
Freshwater flow (pygmy gurley meter, weirs, gauge stations)	+/- 0.25 cu^3/ft	WSQ-5-7 PS4,6 RF-2-5
Freshwater wetland distribution	+/- 1 meter	RF-2,6
Nutrient series: Nitrite, Nitrate, Total-Kjeldahl Nitrogen,	+/- 1.0 mg/l	WSQ-2-4,7
Ortho-Phosphate	+/- .01 mg/l	WSQ-3,7
Particle size	ug/l**	
Percent Algal cover	+/- 1.00 percent	WSQ-7
pH	+/-umhos/com, 3 sig figs	WSQ-7
Plankton		WSQ-2
Precipitation, runoff coefficients		WSQ-7
Salinity	+/- 0.10 ppt	WSQ-7
Sample Depth	+/- 0.10 meters	WSQ-7
Sediment bound metals	ug/l**	WSQ-8
Sediment bound organics	ug/l**	WSQ-9
Sediment toxicity tests	% survival	WSQ-9
Temperature	+/- 0.50 C	WSQ-7,9
Tidal flow (w/gages)	Volume, timing	
Total Coliform-recreational water contact	DES: No more than 20 percent of the samples in any 30-day period shall exceed 1,000 MPN/100ml, and no single verified or duplicated sample shall exceed 10,000 MPN/100ml within a 48-hr period.***	PH-3-5 PS-7
Total suspended sediment	+/- 1.00 mg/l	SR-5
Turbidity	+/- 1.00 NTU	SR-6

**Objective will be based on the State defined minimum analytical levels
*** See Chapter 6: Public Health issues for newly established criteria

Table 10.2a Morro Bay Watershed Monitoring Parameters/Variables

Watershed Component	Parameter/ Variables	Implementer *Primary/ Secondary	Frequency	Location	Data Info Need	Related Action Plan
Conventional Water Quality	Nutrient Series, Chloride, Total Suspended Sediment, Coliform Series, Turbidity, Dissolved Oxygen, pH, Salinity, Conductivity, Temperature, Chlorophyll a	*CCAMP Funding/ FOE collection	Monthly	2 sites: SYB/TWB	SR-5 PH-2-5 HH-6 WSQ-2,4,5,7 NPS-3-5	CC-3 CC-4 All SED All BACT All NUTR FLOW-1,4 All HMT
Volunteer Water Quality	Nutrient Series, Total Suspended Sediment, Coliform Series, Turbidity, Dissolved Oxygen, pH, Salinity, Conductivity, Temperature, Chlorophyll a, Flow	*FOE	Monthly	15 sites: Tributary/ Confluence per VMP Flow sites, Per VMP	SR-5 PH-2-5 RF-2-5 HH-6,8,13 SD-4,8 WSQ-2,4-7	CC-3 CC-4 CC-6 All SED All BACT All NUTR All FLOW All HMT
Sediment Chemistry	Title 22 Hazardous waste metals, Organochlorine Pesticides and PCBs, Organophosphorous Pesticides, Carbamate and Urea Pesticides (HPLC), Particle size, Polynuclear Aromatic Hydrocarbons	*CCAMP	Annually	2 sites: SYB/TWB	WSQ-8,9 NPS-3,4	CC-3 CC-6 All HMT EDU-4
Bioaccumulation (bivalves)	Trace Organics full scan +PAH Full Scan Metals	*CCAMP	Annually	2 sites: SYB/TWB	WSQ-8,9	CC-3 CC-6 All HMT
Bioaccumulation (fish)	Trace Organics full scan +PAH Full Scan Metals	*CCAMP	TBD by TAC	TBD by TAC	SD 7,8 WSQ-8,9	CC-3 CC-6 All HMT All STL
Freshwater Bioassessment	Benthic Macroinvertebrates, Harpactacoids, Plankton	*FOE, *CCAMP	Annually	10 sites Figure 9.2	SR-7 RF-6 HH-7,11 SD6 WSQ 2,6,9	CC-6
Fish Surveys	Community Diversity/Density	*FOE/NEP	TBD by TAC	4 sites as coordinate d by CDFG	HH-8,9 SD-7.8	CC-5 CC-6 All HAB All STL
Bird Surveys	Community Diversity/Density	*FOE	Quarterly	10 sites per VMP	HH8,9 SD-3	CC-6 All HAB SED-6
Geomorphological Suite	Stream Cross-Sectional and Longitudinal Profiles, Habitat Typing, Photodocumentation	*FOE/RCD	Annually	21 sites on Chorro and Los Osos tributaries	SR-3,4-6 HH-3,5,8,9,12-14 SD-6,8 WSQ-6	CC-6 All HAB
Habitat Delineation	Acreage of habitats (listed in Chapter 8/9) Satellite imagery Groundtruthing	NEP/FOE	Every five years beginning in 2001.	All major habitat types	RF-6	All HAB

Table 10.2b Morro Bay Estuarine Monitoring Parameters/Variables

Estuarine/ Near Shore Component	Parameter/ Variables	Implementer Primary/ Secondary	Frequency	Location	Data Info Need	Related Action Plan
Volunteer Water Quality	Nutrient Series, Coliform Series, Turbidity, Dissolved Oxygen, pH, Salinity, Conductivity, Temperature, Chloropyll a	FOE	Monthly	16 sites: per VMP	PH 2-5 HH-6 SD-4,8 WSQ-2,5-7 PS-5,7	CC-3,4,6 All SED All BAC All NUT All FLW
Pathogen Indicators	Total Coliform, Fecal Coliform, Enterococcus, *E. coli*	FOE/DHS, Local Government	Monthly	10 sites: per VMP	PH 2-5 NPS-3-5 WSQ-7 PS-5,7	CC-3,6 All BAC
Sediment Chemistry	Title 22 Hazardous waste metals, Organochlorine Pesticides and PCBs, Organophosphorous Pesticides, (HPLC), Particle size, Polynuclear Aromatic Hydrocarbons	CCAMP	TBD by TAC	At all water quality sites. 16 sites: per VMP	WSQ-9 NPS-3,4	CC-3,6 All HMT EDU-4
Bioaccumulation (bivalves)	Trace Organics full scan +PAH Full Scan Metals	RWQCB – TMDL/FOE	Initial Screening only	5 sites: 2 Delta, 1 Bay mouth, 2 Mudflat	WSQ-8,9	CC-3,6 All HMT
Bioaccumulation (fish)	Trace Organics full scan +PAH Full Scan Metals	*CCAMP	TBD by TAC	5 sites: 2 Delta, 1 Bay mouth, 2 Mudflat	WSQ-8,9 SD-7,8	CC-3,6 All HMT All STL
Nutrient Biological Impact	Nutrient Series, Eelgrass Productivity, Eelgrass Ephiphytic Index, Turbidity, Eelgrass density transects	NEP/Cal Poly	Three Year Monitoring Project	5 Transects based on J. Chestnut/Tetra Tech transects	HH-6 WSQ-4	CC-3 CC-6 All NUT HAB-8
Benthic Infauna (Partial RBP)	Eelgrass Community Diversity Benthic Macroinvertebrates, Plankton	NEP/Cal Poly	Three Year Monitoring Project	5 Transects based on J. Chestnut/Tetra Tech transects	SR-7 RF-6 HH-3,4,6,7 WSQ-9	HAB-8 CC-6
Brant Surveys	Brant Migration / Resident Timeline, Brant Density, Brant Age Composition, Brant Habitat delineation	J. Roser, Audobon/ NEP	Daily October-May	6 Observation points on bay perimeter. 2 Front bay, 1 delta, 2 back bay	SD-3	CC-6 All HAB

Fish Trawls	Community Density/ Diversity	CDFG	Annually	4 sites as coordinated by CDFG	SD-7,8	CC-6 All STL All HAB
Shore Bird Survey	Community Density/ Diversity	Pt. Reyes Observatory/ Audobon	Annually	6 Observation points on bay perimeter. 2 Front bay, 1 delta, 2 back bay	SD-3	CC-6 SED-6 All HAB
Eelgrass Survey	Community Density/ Distribution	NEP/ J. Chestnut & Cal Poly	Annually	5 Transects based on J. Chestnut/Tetra Tech transects	RF-6 HH-12 SD-6	CC-6 HAB 8
Plankton Survey	Community Density/ Diversity Turbidity, Temperature	UCCE, DHS/ Coast Guard, FOE	Monthly	4 sites: Estero Bay, Harbor Mouth, N. T-Pier, Back Bay Channel	HH-8,9 SD-5 PS-5	CC-6
Algal Cover Transects	Percent Cover	FOE	Four times a year, during algal growth season. One time in dormant season.	4 Transect Sites: Chorro Delta, Shark Inlet, Pasadena Point, and Grassy Isl.	HH-6,8,9,12 SD-4,6	CC-6
Estuarine Bioassessment	Plankton, Macroinvertebrates/ Harpactacoids	FOE/NEP	Annually for five years	5 sites: 2 Delta, 1 Bay mouth, 2 Mudflat	RF-6 HH-5,8 SD-5	CC-6
Near Shore Metals/ Pathogen Indicators	Title 22 Hazardous waste metals, Coliform series	CCAMP	Annually	3 sites in Estero Bay	WSQ-8,9 PS-5	CC-3 CC-6 All BACT All HMT
Geomorphological Suite	Stream Cross-Sectional and Longitudinal Profiles, Habitat Typing, Photodocumentation, Bay Bathymetry, Artifical Depo Markers	*FOE/RCD	Annually	21 sites on Chorro and Los Osos tributaries	SR-3,5,6 HH-5,12 SD-6,8	CC-6 All HAB
Habitat Delineation	Acreage of habitats (listed in Chapter 8/9) Satellite imagery Groundtruthing	NEP/FOE	Every five years beginning in 2001.	All major habitat types	RF-2,5,6 HH-3,4,6,10,12 SD-3,4,6,8 WSQ-6	All HAB

Chapter 11

Non-Point Source Monitoring

Priority Problem: Non-Point Source pollution is a Cross-cutting issue that can effect all priority problems identified: Sedimentation, Increased Bacterial Concentrations, Increased Nutrients, Freshwater Flow, Heavy Metals and Toxics, Habitat Loss, and Loss of Steelhead

Non-Point Source background:

Non-Point Source pollutants are those pollutants that enter water from dispersed and uncontrolled sources, such as storm water runoff, rather than from direct discharges, such as a culvert. Non-point sources (e.g., forest practices, agricultural practices, on-site sewage disposal, automobiles and recreational boats) may contribute pathogens, suspended solids and toxicants. While individual sources may seem insignificant, the cumulative effects of non-point source pollution are the leading factor in the seven priority problems listed for Morro Bay.

Technical studies (1998-1999) from TetraTech Inc., estimate that over 76 % of pollutant loads are from non-point sources. The same documents also indicate over 60% of bacteria loads are from non-point sources coming from Chorro Creek. All actions implemented and monitored will be consistent with goals listed in California's Non-point Source Pollution Control Program (see Appendix F, Volume I of the CCMP) and the Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters (g-Guidance (USEPA [1993]) which responds to the Coastal Zone Act Reauthorization Amendments of 1990 (CZARA).

Management Objectives:

- ✓ To reduce urban NPS loads to comply with Storm Water Phase II rulings (see EPA Storm Water Phase II Final Rule document).

  Related CCMP Action Plan: CC-3,4

- ✓ To reduce agricultural NPS loads to satisfy applicable water quality standards within five years (see CCRWQCB Basin Plan).

  Related CCMP Action Plan: EDU-3,4, CC-3, SED-4-7, BACT-1, NUTR-3

- ✓ Eliminate the release of harmful materials (paints, solvents, etc.) from marinas and docksides within 10 years.

  Related CCMP Action Plan: CC-3, BACT-2,4,5, HMT 2-4, EDU-2

- ✓ Reduce urban NPS loading by 20% from new and existing development by establishing residential load reduction programs within the next 10 years.

  Related CCMP Action Plan: CC-7, SED-1

- ✓ Support regional efforts to improve advance land use and development planning measures consistent with CZARA and Storm Water II Final Ruling.

  Related CCMP Action Plan: CC-7

Data Information Needs

The primary objective of the Environmental Monitoring Program is tracking and assessing effectiveness of implemented CCMP actions. The MBNEP Technical Advisory Committee has reviewed the following monitoring questions, and set forth a list of parameters (Table 11-1) by which to gather environmental data. Questions to help drive monitoring of these Non-Point Source actions (NPS-1 through NPS-5) are split into Programmatic (P), Environmental (E) and Research (R) categories, as illustrated below.

Programmatic

NPS-1 Are local stormwater management plans effective?

NPS-2 Are local agencies management goals consistent with CZARA?

Environmental

NPS-3 Is urban stormwater runoff decreasing in pollutant loadings?

NPS-4 Are marina BMPs decreasing toxic substance loadings to Morro Bay?

NPS-5 Are marina management practices decreasing the pathogen concentrations in low flushing areas of Morro Bay?

Table 11-1 Parameter and Performance Criteria Non- Point Source Assessments

Environmental Monitoring Parameter	Data Quality Objective	Related Monitoring Question
Total Coliform-recreational water contact	DES: No more than 20 percent of the samples in any 30-day period shall exceed 1,000 MPN/100ml, and no single verified or duplicated sample shall exceed 10,000 MPN/100ml within a 48-hr period.***	NPS-5
Fecal Coliform- recreational water contact	CCRWQCB: The geometric mean of five samples within a 30-day period must not exceed 200MPN/100ml; or ten percent of all samples taken during any 30-day period must not exceed 400MPN/100ml.***	NPS-3-5
E. coli	***	NPS-5
Enterococcus	***	NPS-3,4,5
Nutrient series: Nitrite, Nitrate, Total-Kjeldahl Nitrogen,	+/- 1.0 mg/l	NPS-3,4
Ortho-Phosphate	+/- .01 mg/l	NPS-3,4
Particle size	ug/l**	NPS-3,4
Precipitation, runoff coefficients		NPS-3,4
Sediment bound metals	ug/l**	NPS-3,4
Sediment bound organics	ug/l**	NPS-3,4
Sediment toxicity tests	% survival	NPS-3,4
Dissolved metals	ug/l**	NPS-3,4

**Objective will be based on the State defined minimum analytical levels

*** See Chapter 6: Public Health issues for newly established criteria

Coordinating Agency:	Morro Bay National Estuary Program
Supporting Agency:	US Environmental Protection Agency Central Coast Regional Water Quality Control Board City of Morro Bay, Harbor Patrol US Coast Guard, Morro Bay
Supporting Organization:	Morro Bay Volunteer Monitoring Program

Chapter 12

Point Source Monitoring

Priority Problem: Reduction of Freshwater Flow, Increased Nutrients, Increased Bacterial Concentrations, Habitat Loss

Background

Point source pollutants are those that are discharged from a single point of conveyance, such as a culvert. For example, the discharge from a sewage treatment plant or a factory is a point source. The discharge from these point sources are permitted under National Pollution Discharge Elimination System (NPDES) permits by the Regional Water Quality Control Boards. Currently, Morro Bay watershed has only two permitted point sources are active, the Morro Bay Power Plant and the California Men's Colony wastewater treatment plant, which are detailed out below. Other permitted dischargers in the study area include (see Figure 12.1): Abalone Farms, Inc. and the Morro Bay-Cayucos wastewater treatment plant. Just south of the study area lay PG&E Nuclear Power Plant, which is mapped only for reference.

A NPDES permit, through the Regional Water Quality Control Board currently regulates the operation of the Duke Energy Morro Bay Power Plant. The permit requires Duke to monitor and report on a wide variety of constituents. These constituents include flow, temperature, chlorine, pH, dissolved oxygen, suspended solids, oil and grease, and a wide variety of metals and other priority pollutants. Additional requirements include: bottom sediment monitoring in the ocean for metals, sulfides, and PCB's; velocity and sediment deposition measurements at the intake structure; and a bioassay test using abalone to detect chronic toxicity to metals. Appendix I includes copies of NPDES permits that include details on parameters measured, frequency and location.

The California Men's Colony wastewater treatment plant is also regulated through the NPDES process, through the Regional Water Quality Control Board. The CMC is mandated to monitor flow, settleable solids, chlorine (residual and used), sulfur dioxide, and pH daily. Additional parameters that are measured monthly include temperature, total coliform, dissolved oxygen and biochemical oxygen demand.

Management Objectives:

- ✓ Sustain no net loss of existing wetlands (baseline 2001 Wetland Delineation).

  Related CCMP Action Plan: CC-1, All HAB, All SED

- ✓ Freshwater flow during low flow seasons sufficient to support nursery habitat for steelhead trout

  Related CCMP Action Plan: CC-5, All STL, All FLOW, HAB-1

- ✓ Freshwater flow during high flow seasons sufficient to support steelhead migration

  Related CCMP Action Plan: CC-5, All STL, All FLOW, HAB-1

- ✓ Freshwater flow sufficient at all times for dilution of pollutants and flushing to maintain water quality.

  Related CCMP Action Plan: All FLOW

- ✓ Levels of bacteria will comply with Department of Health Services, CCRWQCB, and County Environmental Health standards for beneficial uses including shellfish harvesting and water contact recreation at all times. These measurable standards are listed in detail in the following Table 12-1.

  Related CCMP Action Plan: CC-3, All BACT

- ✓ For those waters with drinking water as a beneficial use, bacterial levels must comply with drinking water standards (as stated in the CCRWQCB Basin Plan).

  Related CCMP Action Plan: CC-3, All BACT

- ✓ Ensure that bay water remains of sufficient quality to support a viable commercial shellfish industry, and safe recreational uses

  Related CCMP Action Plan: CC-3, All BACT

Data Information Needs

The primary objective of the Environmental Monitoring Program is tracking and assessing effectiveness of implemented CCMP actions. The MBNEP Technical Advisory Committee has reviewed the following monitoring questions, and set forth a list of parameters (Table 12-1) by which to gather environmental data. Questions to help drive monitoring of these Point Source actions (PS-1 through PS-13) are split into Programmatic (P), Environmental (E) and Research (R) categories, as illustrated below.

Programmatic

PS-1	Are agreements being upheld from all regulated dischargers?
PS-2	What are the trends of intake flow and larvae from the Morro Bay Power Plant?
PS-3	What are the trends of water quality and quantity from the California Men's Colony?

Environmental

PS-4	What are the status and trends of flow on all major tributaries?
PS-5	What are the trends of metals and pathogens in Estero Bay?
PS-6	Are discharged freshwater flows adequate to restore steelhead in Chorro and Los Osos Creeks and to recharge groundwater?
PS-7	Are nutrient and coliform hits higher below Chorro Creek dischargers than above?

Research

PS-8	How do changes in wastewater management affect distribution of freshwater instream and terrestrial wetland habitats?
PS-9	What are the effects of Morro Bay Power Plant on bay circulation patterns?
PS-10	What are the effects of Morro Bay Power Plant on bay entrainment of larvae?
PS-11	What are the effects of Morro Bay Power Plant on bay air deposition?
PS-12	What are the effects of Morro Bay Power Plant on bay circulation patterns?
PS-13	What are the impacts of changes in freshwater inflow on oligohaline habitats?

Table 12-1 Parameter and Performance Criteria Point Source Assessments

Environmental Monitoring Parameter	Data Quality Objective	Related Monitoring Question
Freshwater flow (pygmy gurley meter, weirs, gauge stations)	+/- 0.25 cu^3/ft	PS-4,6
Depth of water in groundwater wells	+/- 0.10 inch	PS-5
Freshwater wetland distribution	+/- 1 meter	Research baseline
Total Coliform-shellfish	CCRWQCB: Median total coliform concentrations shall not exceed 70/100 ml for any 30 day period.	Research baseline
Total Coliform-recreational water contact	DES: No more than 20 percent of the samples in any 30-day period shall exceed 1,000 MPN/100ml, and no single verified or duplicated sample shall exceed 10,000 MPN/100ml within a 48-hr period.***	PS-7
Fecal Coliform-shellfish	DHS: For water quality samples taken on a monthly basis during a three-year period, no more than 10% of the samples shall exceed 43 MPN 100 ml for fecal coliform; or, 2) the geomean of the samples shall not exceed 14 MPN/100 ml.	Research baseline
Fecal Coliform- recreational water contact	CCRWQCB: The geometric mean of five samples within a 30-day period must not exceed 200MPN/100ml; or ten percent of all samples taken during any 30-day period must not exceed 400MPN/100ml.***	PS-7
E. coli	***	PS-7
Enterococcus	***	PS-7
Plankton diversity/density		Research baseline
Benthic infauna		Research baseline

**Objective will be based on the State defined minimum analytical levels

*** See Chapter 6: Public Health issues for newly established criteria

Coordinating Agency: Morro Bay National Estuary Program

Supporting Agency: Central Coast Regional Water Quality Control Board
Central Coast Ambient Monitoring Program (CCRWQCB)

Supporting Organization: Morro Bay Volunteer Monitoring Program

Table 12.1a Morro Bay Watershed Monitoring Parameters/Variables

Watershed Component	Parameter/ Variables	Implementer *Primary/ Secondary	Frequency	Location	Related Monitoring Info Need	Related CCMP Action
Conventional Water Quality	Nutrient Series, Chloride, Suspended Solids, **Coliform Series,** Turbidity, Dissolved Oxygen, pH, Salinity, Conductivity, Temperature, Chlorophyll a	*CCAMP Funding/ FOE collection	Monthly	2 sites: SYB/TW B	PS-5,7	CC-3 CC-4 All SED All BACT All NUTR FLOW-1,4 All HMT
Volunteer Water Quality	Nutrient Series, Suspended Solids, **Coliform Series,** Turbidity, Dissolved Oxygen, pH, Salinity, Conductivity, Temp. Chlorophyll a, **Flow**	*FOE	Monthly	15 sites: Tributary/ Confluenc e per VMP	PS-4,6,7	CC-3, 4,6 All SED All BACT All NUTR All FLOW All HMT

Table 12.1b Morro Bay Estuarine Monitoring Parameters/Variables

Estuarine/ Near Shore Component	Parameter/ Variables	Implementer Primary/ Secondary	Frequency	Location	Related Monitoring Info Need	Related CCMP Action
Volunteer Water Quality	Nutrient Series, **Coliform Series,** Turbidity, Dissolved Oxygen, pH, Salinity, Conductivity, Temperature, Chloropyll a	FOE	Monthly	16 sites: per VMP	PS-5,7	CC-3,4,6 All SED All BAC All NUT All FLW
Pathogen Indicators	**Total Coliform, Fecal Coliform, Enterococcus, *E. coli***	FOE/DHS, Local Government	Monthly	10 sites: per VMP	PS-7	CC-3,6 All BAC
Benthic Infauna (Partial RBP)	**Eelgrass Community Diversity Benthic Macroinvertebrates, Plankton**	NEP/Cal Poly	Three Year Monitoring Project	5 Transects based on J. Chestnut/Tetra Tech transects	Research baseline	HAB-8 CC-6
Plankton Survey	**Community Density/ Diversity** Turbidity, Temperature	UCCE, DHS/ Coast Guard, FOE	Monthly	4 sites: Estero Bay, Harbor Mouth, N. T-Pier, Back Bay Channel	PS-5	CC-6
Estuarine Bioassessment	**Plankton, Macroinvertebrates/ Harpactacoids**	FOE/NEP	Annually for five years	5 sites: 2 Delta, 1 Bay mouth, 2 Mudflat	PS-5	CC-6
Geomorphological Suite	Stream Cross-Sectional and Longitudinal Profiles, Habitat Typing, Photodocumentation, **Bay Bathymetry,** Artifical Depo Markers	*FOE/RCD	Annually	21 sites on Chorro and Los Osos tributaries	PS-5	CC-6 All HAB

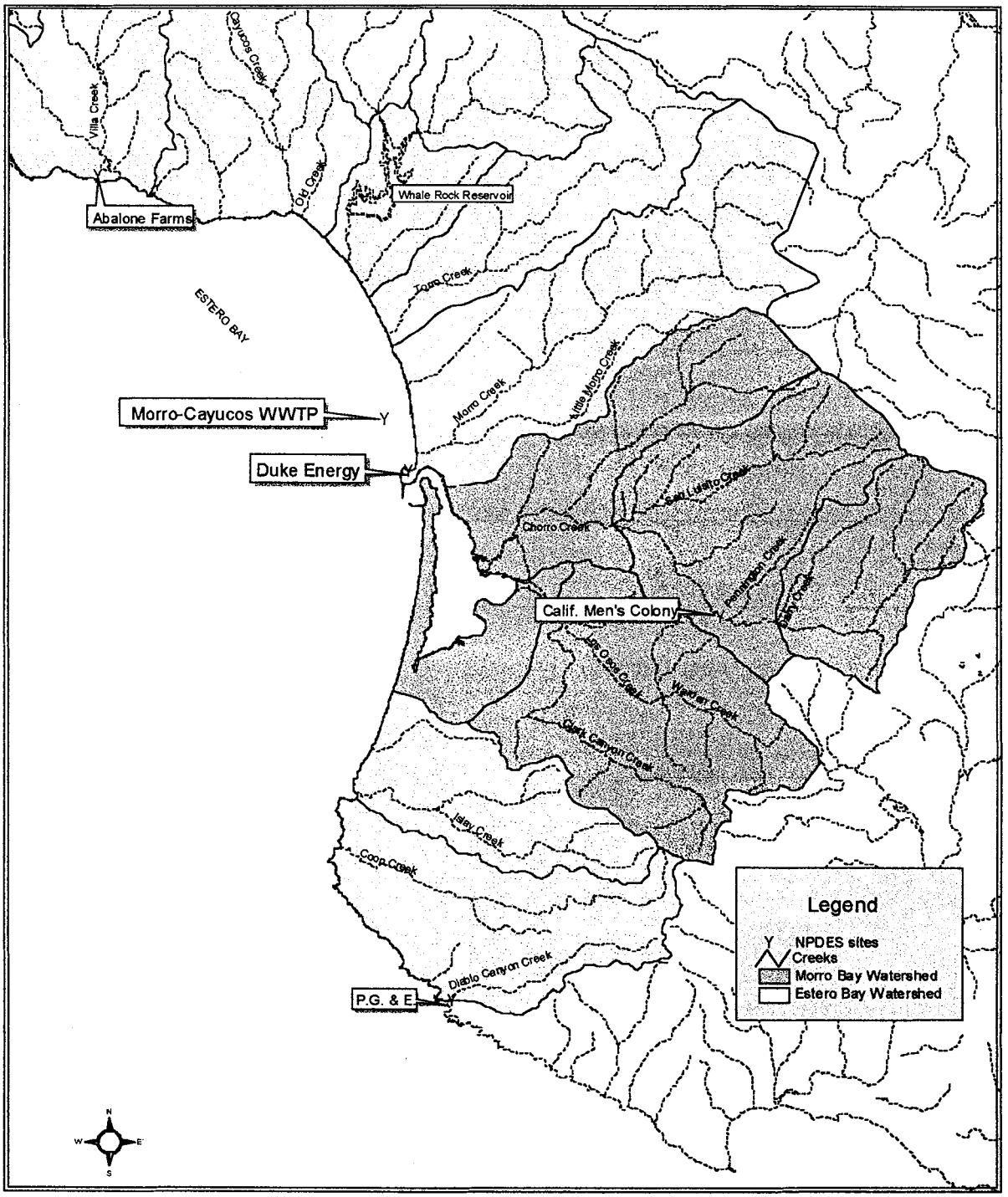


Figure 12.1 Locations of Permitted Industrial Point Sources in the MBNEP Study area and vicinity. MBNEP Characterization 1999

Chapter 13

Spills and Emergency Response

Sudden spills of toxic and hazardous materials are another critical impact to the overall health of the ecosystem that is difficult to pinpoint unless preparations are made to monitor. Spills can be caused by a variety of bay uses including: storage, human error during transfer operations, boat collisions, groundings, and natural catastrophic events. Past spills have been addressed in cooperation with the Emergency Response Unit of the California Department of Fish and Game (CDFG), located in Morro Bay. In order to provide adequate monitoring of such incidents, coordination between agencies and organizations must be addressed. Currently, the CDFG is revamping their interagency coordination of an Emergency Response team according to the California State Contingency Response Plan. This team will assess weaknesses in the current structure and make improvements accordingly. According to CDFG, some of the top weaknesses to be addressed include:

- Lack of communication between agencies
- Lack of a "job description" for specific spills

Spills of toxic and hazardous materials are primarily monitored through programmatic efforts. Assisting CDFG in coordinating consistent readiness trainings, educating targeted users and supplying support for acquiring restorative compensation is the bulk of the tracking for this action. Environmental monitoring will be utilized only when taking samples at the onset of a spill and any needed tracking of ambient conditions preceding an event.

Management Objectives:

- ✓ Support regional efforts to improve advance planning measures.

  Related CCMP Action Plan: CC-7

- ✓ Support regional actions to obtain compensation for environmental injuries to ensure covered funds are used to mitigate for the Morro Bay ecosystem.

  Related CCMP Action Plan:

- ✓ Decrease illegal dumping by 50 percent within 10 years.

  Related CCMP Action Plan: BACT-3

Coordinating Agency:	California Department of Fish and Game
Supporting Agencies:	United States Coast Guard, Morro Bay City of Morro Bay, Harbor Department California Fire Department California Department of Parks and Recreation Central Coast Regional Water Quality Control Board
Supporting Organizations:	Morro Bay National Estuary Program The Baywood Navy Morro Bay Volunteer Monitoring Program (Friends of the Estuary)

Chapter 14

Information Tracking System

Participants in the MBNEP recognize that the value of monitoring lies in the ability to communicate meaningful results to appropriate managers and the public. The MBNEP will regularly assess progress towards completing the action plans contained in the CCMP.

Reporting to the Public

The goal of the MBNEP EMP is to collect data to make informed management decisions and to evaluate implemented actions, and to inform the community. The data tracked by MBNEP staff will be available to the community in various formats to insure accessibility to information as well as further understanding of the current status of the Morro Bay estuary and watershed. Table 14.1 presents a summary overview of the ways that monitoring data can be used to inform and educate the public.

Table 14.1 Summary of Public Reporting Venues for EMP

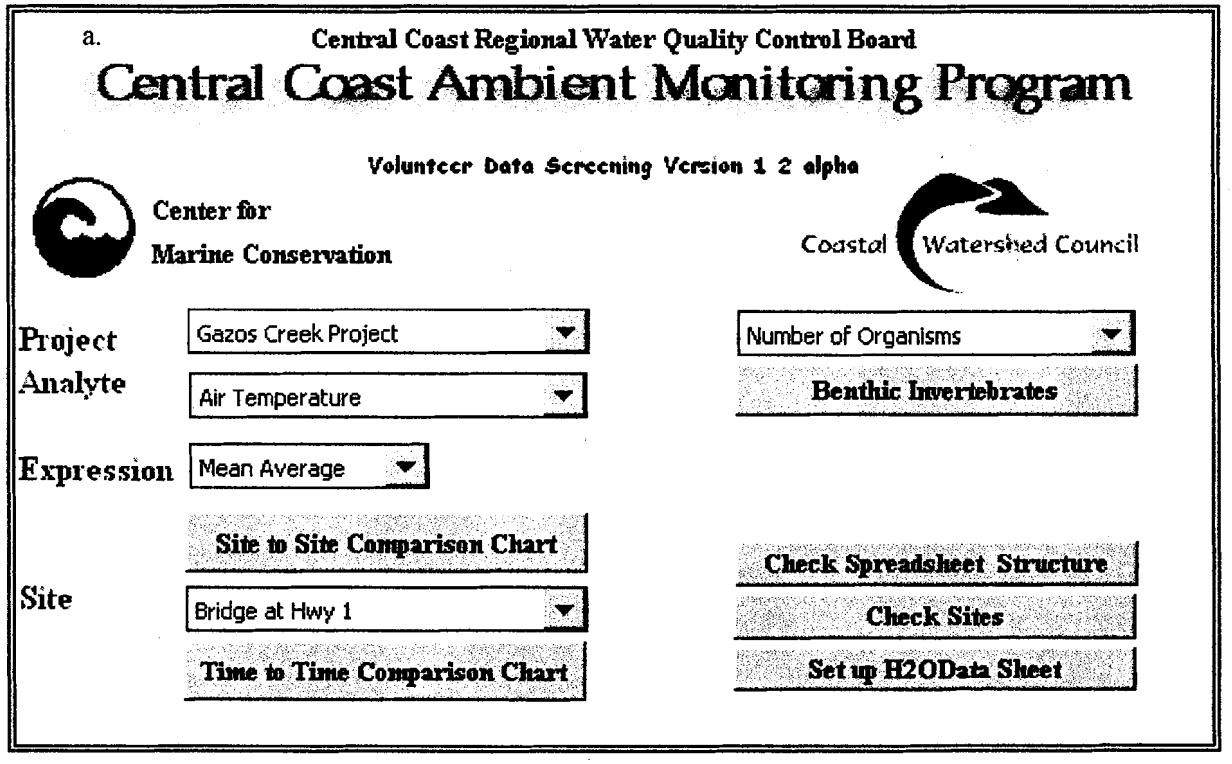
Public Reporting Venues	
Media	Quarterly "Turning the Tide" newsletter, articles in local newspapers (EDU-7)
Internet	Monthly MBNEP webpage update (www.mbnep.org) (EDU-7)
	Central Coast Ambient Monitoring Program (CCAMP) data management storehouse (CC-6)
	CCMP Implementation Tracking System (ITS)
Speakers Bureau	Public Outreach Group (POW) task (EDU-1)
Display	Natural history Museum interactive estuarine monitoring exhibit (EDU-6)
	Creek Day, Baywood Oktoberfest, Harbor Festival, Earth Day, Environmental Education Faire, Estuary Day
Conferences	State of the Bay 2002 (EDU-5)
Technical Reporting	Annual EMP status reports and Biennial Reviews

Data Management

The CCAMP (of the CCRWQCB) database will house data and metadata for all programs. This database and selected analytic tools will be available on the Internet as well as linked to the MBNEP website (see Figure 14.1a). Individual programs can input data directly into the CCAMP software to facilitate quarterly data reviews and annual reports (see Figure 14.1b). The analyses from this database will provide feedback to the MBNEP to evaluate action effectiveness and long-term trends. CCAMP also provides basic statistical tools, such as t-tests and Analysis of Variance, which will be available to the MBNEP to detect significant changes in data sets.

CCAMP includes data from projects within the CCRWQCB's jurisdiction (northern Ventura to southern San Mateo counties). The availability of this data provides opportunities for valuable data comparisons between the Morro Bay watershed and other similar areas. The database can also be used to track non-CCMP projects within the Morro Bay watershed and their potential impact on CCMP project evaluation. The data will also be available on the MBNEP website (www. MBNEP.org) for individual implementers and the Morro Bay National Estuary Program to track progress. These tools should prove to be very useful for MBNEP analysis and decision-making, as well as for providing information to the public. Further information can be found in this document, Chapter 13: Implementation Tracking System.

Figure 14.1 a) CCAMP Web site options menu



Quality Assurance For Sampling And Laboratory Anaylsis

Quality Assurance (QA)/Quality Control (QC) for the EMP will be based off the existing MBNEP QA/QC which will be amended to the EMP no later than October 10, 2000. All field data will be collected under the MBNEP QA, and all TREND and PROJECT-SPECIFIC monitors will be tested by standards listed. Laboratory data will strictly adhere to the Quality Control procedures detailed in the QA/QC submitted. Data entry will be checked by the protocols listed in the CCMP Data Management Strategy. Metadata will be stored for all data through CCAMP, and can be accessed as read only through the Internet. Passwords will be given to those trained to check or add data to the database.

Figure 14.1b. Data entry fields for CCAMP data management system.

ProjId	SiteTag	DateTime	pH	Cond_uS	Cond_ppt	Turb_N	DO_ppm	DO_SAT	H2O Temp
Demo1	NTR	12/19/97 15:20	7.0	342.000		5.000	7.600		9.000
Demo1	EST	4/3/98 14:30	6.5	200.000		410.000	10.600		10.000
Demo1	BRI	4/3/98 14:45	6.5	210.000		25.000	10.200		10.000
Demo2	SOQ	6/7/01 10:30	8.1	808.600	0.316	28.000	6.700	68.000	16.600
Demo2	APT	6/7/02 10:00	7.4	900.000	0.350	130.000	9.800	93.000	16.100
Demo2	SAN	6/7/02 10:45	7.7	921.000	1.520	168.000	8.500	87.000	16.700
Demo2	SOQ	7/5/02 9:45	8.2	731.000	0.277	16.600	5.900	59.000	16.200

Timetable for Analyzing Data & Assessing Program Performance

Within staff resources, data entry for any data collected will be inputted electronically within 30 days of sample date. This time frame is to prevent disorganization as well as to allow the database to be always available to query or test.

The MBNEP staff will be responsible for the monitoring tasks displayed Table 14.2 below. This table lists deliverable tasks that are identified in the **Project Management** Chapters 5-13, and their relative timeframe. Data reports from monitoring organizations will be summarized quarterly and presented at the quarterly Task Force meetings. Applicable data will then be incorporated into the Morro Bay National Estuary Program Implementation Tracking System, and the quarterly newsletters to be available to the public.

Monitoring adjustments made at the Technical Advisory Committee (TAC) will be incorporated within thirty days, and reported quarterly as well in the Annual Monitoring Reports. Overview reports, such as the Annual Monitoring Reports will serve as the basis for State of the Bay 2002, as well as the biennial review process.

Table 14.2 Timeline for Deliverable Monitoring Tasks and Evaluation

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
TAC Meetings			■						■			
Task Force / Quarterly Summaries	■			■			■			■		
Quarterly Newsletter			■			■			■			■
Annual Data displays Estuary Day									■			
Website Tracking Update (ITS)						■						
Annual Monitoring Reports						■	■					

The MBNEP will use an approach similar to the San Francisco Bay Estuary Project to document progress towards implementing the CCMP and report results in a consistent manner. Table 14.3 provides an up-to-date progress report on implementing CCMP actions.

Table 14.3 Implementation Tracking System Information Needs

CCMP ACTION	Government & Private Initiatives (Public, private and cooperative programs and good intentions)	On-the-Ground Implementation (Examples of specific local completed or in progress projects)	Current Gaps & Roadblocks	Ideas and Opportunities for Further Progress	Total % Complete of the Action (Estimate)
CC-1 Land Acquisition (Related HAB – 1.3.5; STL – 2,4)	Trust for Public Lands, MEGA, and MBNEP partnership	• Acquistion of 15 acre coastal dune scrub parcel (in progress)	Public access issues need to be considered in agreement		%100
CC-6 Volunteer Monitoring Program	Multi-agency participation, Friends of the Estuary grant proposal submitted	• Volunteer Monitoring Program (APDP in progress since 1995)	Limited resources		%100
SED – 7 BMP Incentives (Related: EDU – 3)	Cooperation of permitting agencies, participation of landowners in short courses.	• Sustainable Conservation Permit streamlining project (APDP in progress)	Permitting delays & costs; loss of productive ag land		%75
BACT –1 Grazing Management	Multi-agency and landowner coordination, National Monitoring Program (RWQCB)	• Riparian fencing projects (APDP in progress)	Prioritization of problem areas needed, Willing landowner involvement needed		%70
BACT – 3 Illegal Moorings	Agreement with oyster grower to monitor boats and mooring	• Harbor debris removal (APDP in progress)	Agency coordination needed		%60
NUTR – 4 Residential BMPs (Related: EDU –1)	35% of urban residents already have bay-friendly gardens	• Development of *Yards and Neighbors Brochure* project (APDP)			%60
HMT – 2 Marina BMPs (Related: EDU – 2)	Coordination with bay front businesses, CEC assessment	• Boatyard BMPs • Boat rinse station project			%50
HAB –10 Nonindigenous Species	Coordination with public landowners and permitting agencies	• Restoring Los Osos (veldt grass removal project)(APDP) • *A. donax* eradication project (APDP)			%70

Performance Criteria

Monitoring the performance of the action plans in achieving the MBNEP goals is essential to the long-term success of the program. This section describes how the MBNEP will measure the effectiveness and monitor the status of actions implemented under the CCMP. The information in this section is an expansion of the evaluation information provided for each action in Chapter 4 of the CCMP.

In order to assess the success of various actions, evaluation methods have been established. In addition, the MBNEP will monitor actions against priority problems to measure success at meeting the program goals (e.g., reduced sediment loading), The Environmental Monitoring Plan identifies measures for determining whether water and habitat quality objectives and MBNEP goals are being met. Tables 14.4 through 14.11 summarize how actions will be evaluated. These Tables refer to programmatic criteria as well as environmental criteria the MBNEP will use to evaluate the success of the CCMP.

Table 14.4 Cross Cutting Action Plan Objectives and Evaluation Methods*

Action Plan	Programmatic Objectives	Environmental Objectives	Related Monitoring Questions
CC-1 Habitat Acquisition	▪ Establishment of a habitat acquisition committee ▪ Habitat selection & recommendations identified ▪ Acres of land purchased & put into easement ▪ Prioritized list of habitat acquisition opportunities	▪ Improved and/or maintained high habitat and water quality (suspended sediment, bed load; turbidity; stream profiles and vegetation cover) ▪ Buffered non-point source runoff	▪ SR -3 ▪ HH -12 ▪ SD -8 ▪ HH -17
CC-2 Drainage	▪ Number of projects implemented ▪ Acreage of wetland habitat created ▪ Community wide drainage plan ▪ Reduced frequency of structure and road flooding in Los Osos ▪ Increased volume of stormwater detention/retention	▪ Pre & Post project monitoring using automatic samplers to determine pollutant load reduction ▪ Pre & Post Photo or video documentation, especially during storm events	▪ PH -4 ▪ WSQ -5 ▪ RF –3,4
CC-3 TMDLs	▪ Develop technical components of TMDL (water quality attainment strategy) ▪ Complete TMDL Implementation and Monitoring Plan ▪ Implement Plans ▪ Acreage of marine to terrestrial habitat alteration	▪ Will be based upon CCRWQCB's TMDL monitoring plan and Numerical Targets ▪ Removal of water bodies from the 303(d) listing or documented improvements to water quality	▪ SR 3-6 ▪ PH –2,3,4 ▪ WSQ -4 ▪ WQS – 8,17,19
CC-4 Urban Runoff	▪ Number of BMP's installed and maintained ▪ Annual reports for permit compliance	▪ Trends in water quality above and below storm drain filters ▪ Pre & Post project monitoring using automatic samplers to determine pollutant load reduction	▪ WSQ -2,4 ▪ PH –9,18
CC-5 Stream geomorphology and water quality for steelhead	▪ Number of projects implemented ▪ Periodic channel typing evaluations ▪ Periodic Riparian corridor mapping and GIS update ▪ ID maintenance and restoration efforts at areas of critical habitat and stability	▪ Measurable improvements in water quality and habitat over time (VMP) ▪ Use Rapid bio-assessment protocols to measure improvements to species diversity and stream ecology ▪ % Are increase in critical habitat types ▪ Stream cross sections and profiles ▪ Changes in stream classifications to more stable types	▪ SR 5,6 ▪ RF -4 ▪ WQS -17 ▪ HH -8.11 ▪ SD –7,8, ▪ HH – 17,18
CC-6 Volunteer Monitoring Program	▪ Participation in the VMP ▪ Annual VMP status reports ▪ Public survey polls showing changes in knowledge of local issues ▪ Collection of additional data to fill in data gaps	▪ Environmental Monitoring is not applicable for this action	N/A
CC-7 Watershed Crew	▪ Feedback from project sponsors on the Quality and Quantity of work products completed ▪ Number of projects completed	▪ Environmental Monitoring is not applicable for this action	N/A

***Overall objective is to meet state water quality standards for sediment, bacteria, nutrients, heavy metals and other toxic substances**

Table 14.5 Sediment Action Plan Objectives and Evaluation Methods

Action Plan	Programmatic Objectives	Environmental Objectives	Data Need
SED-1 Road Management	▪ Inventory of roads and identification of problem areas ▪ Numbers of maintenance and construction measures implemented ▪ Training for maintenance crews and landowners ▪ Incorporate management measures into city, county, and state practices	▪ Measured reduction in sediment (suspended sediment, turbidity) from roadways and in drainage areas to waterbodies	SR –1,3
SED-2 Sediment Traps	▪ Numbers of sediment traps (i.e. flood plain restoration projects, sediment ponds, filter strips) installed ▪ Number of projects completed ▪ Number of sediment traps used in road networks ▪ Feasibility study of Warden Lake ▪ Increase in land owners using sediment traps on their property	▪ Measured habitat improvements ▪ Measured reduction in sediment (suspended sediment, bed load; turbidity) at upstream and downstream sites following implementation ▪ NMP and VMP water quality data as a pre-post project comparison ▪ Measurements of sediment trapped in specific structures	SR –1, 3, 8, 9
SED-3 Fire Management	▪ Watershed Fire Management Plan completed ▪ Annual Report documenting projects completed ▪ Evaluation of the effects to sensitive species, habitats, air quality, and impacts of an escaped fire conducted ▪ Action Plan Implementation	▪ Vegetation analysis of age class conducted using transect data, mapping, and GIS overlays ▪ Estimated reduction in sediment loading to the bay during peak flows	
SED-4 Landowner BMPs	▪ Numbers and acres of BMPs installed ▪ Number of landowners provided with opportunities for technical assistance and funding	▪ NMP data on project effectiveness ▪ Estimates of sediment captured ▪ Measured reduction in suspended sediment and turbidity at downstream sites following implementation ▪ Estimates of erosion prevented (RUSLE or WEPP)	SR -3
SED-5 Creek Restoration Projects	▪ Numbers and acres of BMPs installed ▪ Technical assistance and funding provided to landowners ▪ Miles of stream restored	▪ Entire system evaluated for upstream effects ▪ NMP data on project effectiveness ▪ Estimates of erosion prevented and/or sediment captured ▪ Measured reduction in suspended sediment and turbidity at downstream sites following implementation ▪ Improved and/or maintained habitat at BMP sites ▪ Specific Monitoring Plans will be developed with each project to determine environmental effectiveness such as: ▪ Pre & post photo or video documentation ▪ Changes in stream classification to more stable types ▪ Improvements to riparian habitat quantity & diversity	SD –8 SR –9 PH –8

		▪ Vegetation transects to document revegetation efforts ▪ Cross sections and long profiles to document streambed and stream bank adjustments	
SED-6 Sandspit Revegetation	▪ ESH designation ▪ Number of revegetation projects implemented ▪ Number of acres of land revegetated ▪ State acquisition of privately owned sandspit areas	▪ Improved and/or maintained high quality habitat through transects and GIS/aerial overlays ▪ Measured reduction in sand delivered to Morro Bay estuary from sandspit using air photo documentation	
SED-7 BMP Incentives for Landowners	▪ Development of incentives ▪ Number of incentive programs and users ▪ Provide WQ monitoring kits and training to landowners for self monitoring evaluations ▪ Implementation/adoption of streamlined permit	▪ Reduced sediment loading to receiving waters ▪ Photo or video documentation of BMP effectiveness during storm events	WQS –1 SR –8
SED-8 Estuary Restoration Project	▪ Local sponsors and contracting entities are selected for the ACOE feasibility study ▪ Implementation of projects ▪ Reduced harbor maintenance for navigation	▪ Environmental monitoring will be developed as part of the project planning and implementation phases ▪ Measurable improvements to the hydrodynamics and tidal prism of the bay	

Table 14.6 Bacteria Action Plan Objectives and Evaluation Methods

Action Plan	Programmatic Evaluation	Environmental Objectives	Related Monitoring Actions
BACT-1 Grazing Management	▪ Number of ranches implementing mgt. Measures	▪ Reduction in fecal coliform % levels using a pre/post or an upstream/downstream study design, targets based off proven Morro Bay Watershed BMP's ▪ Vegetation transects demonstrating riparian vegetation improvements ▪ Use air/satellite photos to document increases in numbers of acres of riparian habitat	▪ SR 3-6 ▪ PH 2,3,4,6,7 ▪ RF -8
BACT-2 Pump-outs	▪ Number of Boater's Guides distributed ▪ Survey Boaters to determine usage of pump-out facilities and how to improve them ▪ Use meters to measure number of gallons of sewage pumped-out	▪ Decrease in fecal coliform at high use areas using pre/post-monitoring design to meet state water quality standards.	▪ PH - 2,3,4,5,6
BACT-3 Illegal Moorings	▪ Number of illegal moorings removed ▪ Inventory and map locations of existing buoys, and track changes over time ▪ Create temporary mooring facility at CDPR Marina	▪ Environmental Monitoring is not applicable for this action	N/A
BACT-4 Abandoned Boats	▪ Number of boats removed ▪ Inventory and map locations of existing boats, and track changes over time	▪ Environmental Monitoring is not applicable for this action	N/A
BACT-5 Liveaboard Boats	▪ Survey boaters to determine \usage of pump-out facilities ▪ Use meters to measure number of gallons of sewage pumped-out at pump-out facilities	▪ Decrease in fecal coliform at high use areas using pre/post monitoring design to meet state water quality standards	▪ PH -3,4,5
BACT-6 Biofiltration	▪ Final Project Report	▪ Statistical analysis of bacterial and chlorophyll data from the oyster tank and the control tank	▪ PH - 2,3,6,7
BACT-7 Bird Deterrents	▪ Evaluate pre & post avian activity	▪ DNA study results ▪ Document bird use pre & post project	▪ PH 2,3,6
BACT-8 Pet Waste	▪ Establishment of an off-leash dog park ▪ Number of people using the pet waste system ▪ Number of dispensers installed and maintained ▪ Public acceptance poll	▪ DNA study results ▪ Overall reduction in fecal coliform loads in storm water to meet state water quality standards (based on TMDL)	▪ PH - 2,3,4,6
BACT-9 Water Quality Standards	▪ Document resources saved by sharing data, and revising monitoring guidelines and requirements	▪ Environmental monitoring is not applicable for this action	N/A

Table 14.7 Nutrient Action Plan Objectives and Evaluation Methods

Action Plan	Programmatic Objectives	Environmental Objectives	Related Monitoring Actions
NUTR-1 Los Osos Wastewater	▪ Document progress on wastewater treatment facility planning and implementation	▪ Improved quality of groundwater and freshwater seeps ▪ Reduction in nutrient loads from freshwater seeps using pre/post flow weighted sampling, based on percentage	▪ WQS – 2,3,4,5,10 ▪ PH 2,3,4,7
NUTR-2 CMC Wastewater	▪ Compliance with monitoring requirements ▪ Revise treatment level and methods	▪ Collection and analysis of effluent samples, receiving surface waters, and groundwater	▪ WQS – 2,3,4,10
NUTR-3 Agricultural BMPs	▪ Number of farms implementing mgt. Practices ▪ Provide WQ monitoring kits and training to landowners for self monitoring evaluations	▪ Reduction in nutrient levels using a pre/post or upstream/downstream study design, targets are based upon proven Morro Bay Watershed BMP's, as measured in percentage	▪ WQS – 2,3,4,5,10 ▪ HH – 17,18 ▪ RF -8
NUTR-4 Residential BMPs	▪ Number of BMP's installed and maintained	▪ Improvement in stormwater runoff quality at sites where BMP's have been installed, based on percentage ▪ Pre & Post project monitoring using automatic samplers to determine pollutant load reduction	▪ WQS – 2,3,4,5,10 ▪ HH – 17,18.

Table 14.8 Freshwater Flow Action Plan Objectives and Evaluation Methods

Action Plan	Programmatic Objectives	Environmental Objectives Evaluation	Related Monitoring Actions
FLOW-1 CMB Wastewater Treatment Plant	▪ Construction of new treatment plant ▪ Reporting of discharge flows into Chorro Creek	▪ Quantify upstream and downstream flows and effluent at discharge site to determine changes	▪ RF -2
FLOW-2 Chorro Valley Water Users Workgroup	▪ Convene Workgroup ▪ New agreements to maintain minimum flows of 1.5 cubic feet/second	▪ Monitor upstream and downstream flow from the site	▪ RF –2,3,4
FLOW-3 Water Conservation	▪ Development of a water conservation program in conjunction with all water users and purveyors ▪ Reduced water demand	▪ Measurable increases in streamflow or groundwater elevations near water supply wells, as measured in cf and depth of water in wells	▪ RF –2,3,4
FLOW-4 Wastewater Treatment Plant Releases	▪ MBNEP will evaluate the flow monitoring requirements contained in the agreements for adherence to minimum flow requirements ▪ CCRWQCB will evaluate compliance with NPDES permit	▪ Monitor upstream and downstream flow from the site ▪ City of Morro Bay well level and stream flow monitoring will be assessed for maintenance of groundwater levels and instream flow levels	▪ RF –2,3

Table 14.9 Heavy Metals & Toxics Action Plan Objectives and Evaluation Methods

Action Plan	Programmatic Objectives	Environmental Objectives	Related Monitoring Actions
HMT-1 Mine Remediation	▪ Restoration of natural habitat along the creek ▪ Number of reclaimed mines	▪ Reduction of heavy metal loadings from Chorro Creek watershed, will be based upon CCRWQB's TMDL target, as measured in percentage	▪ HM – 9,17,19
HMT-2 Marina BMPs	▪ Number of demonstration projects ▪ Number of educational materials distributed ▪ Wash-water filtration system usage	▪ Improvement in stormwater runoff quality, as measured in percentage ▪ Pre & post Bay water and/or sediment quality samples	▪ HM – 9,17,18
HMT-3 Boat Haul Out	▪ Number of local boats using haul-out facilities ▪ Quantity of pollutants diverted to hazardous waste facilities	▪ Decrease of boat yard related pollutants in high use areas using pre/post monitoring, as measured in percentage	▪ HM – 9,17,19
HMT-4 Hazardous Waste Network	▪ Tons of haz. waste delivered to the facilities ▪ Number of boats serviced and gallons of bilge water processed ▪ Number of facilities established	▪ Pre & post Bay water and/or sediment quality samples	▪ HM – 9,17,19

Table 14.10 Habitat Action Plan Objectives and Evaluation Methods

Action Plan	Programmatic Objectives	Environmental Objectives	Data Need
HAB-1 Overlay Maps	▪ Identify acres of critical habitat ▪ Develop overlays ▪ Annual change (in acres) by habitat		HH –13, 21 SD –9 PS –8, 13
HAB-2 Upland Habitats	▪ Committee establishment ▪ ID and report upland habitats to the community ▪ Develop management measures for the protection of habitat ▪ Establishment of protection measures for upland habitat	▪ Increase or stabilization of trends quantified by community diversity transects at given upland habitats	
HAB-3 Mapping	▪ Completed maps of pre-1850 conditions ▪ Completed maps of current habitats ▪ Quantified % change of wetland and riparian habitats	▪ Environmental monitoring is not applicable for this action	N/A
HAB-4 Species Recovery Plans	▪ Implementation of actions in recovery plans ▪ Criteria for evaluating the successful implementation of the objectives should be established by the working group	▪ Increase or stabilization of endangered species in vegetation or animal surveys	
HAB-5 Beneficial Dredging	▪ Number of acres of habitat protected and restored	▪ Increase in eelgrass density using transects number of eelgrass plants per square meter ▪ Decrease in turbidity levels in eelgrass habitat using sechi disk or other measuring techniques. ▪ Increase in eelgrass productivity after dredging events	SR 6,11 HH –3, 4, 6, 18, 24 WSQ – 10, 13
HAB-6 Riparian Vegetation	▪ Annual reports from implementing agencies and projects ▪ Workshops ▪ Ongoing wildlife/water quality monitoring on a portion of a treated stream ▪ Improved health /abundance of wetlands	▪ Air/satellite photos quantifying increases in wetland and riparian habitat ▪ Vegetation transects quantifying expansion of wetland and riparian habitat	RF –7 HH –12, 19
HAB-7 Riparian and Wetland Policies	▪ ID areas subject to new policies ▪ Increased protection of coastal streams, wetlands, and sensitive habitats due to new policies ▪ # of new protection programs and policies	▪ Air/satellite photos quantifying increases in wetland and riparian habitat ▪ Vegetation transects quantifying expansion of wetland and riparian habitat	RF –7 HH –12, 19

HAB-8 Eelgrass		▪ % Change in acreage of eelgrass habitat, as a measure in percentage increase or decrease. ▪ Monitor eelgrass for bed width, shoot density, and turbidity	SR 6,11 HH –3, 4, 6, 18, 24 WSQ – 10, 13
HAB-9 Exotic Species	▪ Establishment of a Weed Mgt. Committee ▪ No new introductions of exotic species	▪ Reduced acreage of existing exotic species	HH –15, 23 SD -10
Hab-10 *A. donax* Removal	▪ Number and location of stands of *A. donax* before and after control treatment ▪ 3rd year comparisons of data depicting occurrence of individual stands of *A. donax* within the Chorro Creek watershed before and after control treatment	▪ Vegetation surveys in riparian communities	

Table 14.11 Steelhead Action Plan Objectives and Evaluation Methods

Action Plan	Programmatic Objectives	Environmental Objectives	Related Monitoring Actions
STL-1 Recovery Plan	▪ Successful attainment of the USNMFS Recovery Plan (% increase in population, % increase in habitat?)	▪ Environmental monitoring is not applicable for this action	N/A
STL-2 Habitat Access	▪ Miles of stream accessible to steelhead ▪ Number of barriers removed	▪ Photo or video documentation ▪ Habitat typing evaluations ▪ Depth of water at critical riffle areas ▪ Surface area and depth of critical rearing and smolting habitat	SR –5 RF –1,4 HH – 5,13 SD –7, 8 WQS –17 PS -6
STL-3 Pool/Riffle Structure	▪ Mileage of stream habitat evaluated ▪ Habitat scoring over time ▪ Number of individuals trained in appropriate instream habitat maintenance	▪ Habitat typing evaluations	SR –5 RF –1,4 HH – 5,13 SD –7, 8 WQS –17 PS -6
STL-4 Riparian Corridors	▪ Miles of riparian corridor fenced ▪ Miles of levee removed ▪ Stream channel profile measurements ▪ Riparian shading measurements	▪ Changes to benthic invertebrate composition ▪ % Increase in riparian vegetation acreage, as measured in percent quantity.	SR –5 RF –1,4 HH – 5,13 SD –7, 8 WQS –17 PS -6

Table 14.12 Education Action Plan Objectives and Evaluation Methods

Action Plan	Programmatic Objectives	Environmental Objectives	Related Monitoring Actions
EDU-1 General Public Education & Outreach	▪ Significant changes in the publics understanding of local issues ▪ Attendance at forums and public displays ▪ Screened nonpoint source runoff from urban areas ▪ Number of public forums held and attendance rates ▪ Number of educational displays exhibited in the community ▪ Number of storm drains stenciled in urban areas	▪ Environmental monitoring is not applicable for this action	N/A
EDU-2 Boater Outreach	▪ Number of boater's Guides distributed ▪ Increased use of pump-out facilities ▪ Results of surveys ▪ Feedback through periodic roundtable forums	▪ Environmental monitoring is not applicable for this action	N/A
EDU-3 Agricultural Outreach	▪ Attendance at workshops and feedback via written comments	▪ Reduction in bacteria and nutrient loads in the creeks (VMP), as measured by percentage	▪ SR -3 ▪ PH -6 ▪ RF -8
EDU-4 Pesticide Workshops		▪ Environmental monitoring is not applicable for this action	N/A
EDU-5 Estuary Conference	▪ Conference attendance	▪ Environmental monitoring is not applicable for this action	N/A
EDU-6 CCNHA Exhibit	▪ Number of system "sign-ons" per year	▪ Environmental monitoring is not applicable for this action	N/A
EDU-7 Media	▪ Number of press releases, articles, sound bites, newsletters published, lectures given, etc.	▪ Environmental monitoring is not applicable for this action	N/A
EDU-8 Public Access	▪ Number of trash cans installed ▪ Improved small craft launch ramp	▪ Environmental monitoring is not applicable for this action	N/A
EDU-9 K-12	▪ Attendance at special workshops ▪ Attendance at after school projects ▪ Number of educational guides used within five years of distribution ▪ ID educational goals	▪ Environmental monitoring is not applicable for this action	N/A
EDU-10 Mini-Grants	▪ Number of grants disbursed	▪ Environmental monitoring is not applicable for this action	N/A
EDU-11 CEQA Checklist	▪ Timely adoption of new CEQA checklist by City and County	▪ Environmental monitoring is not applicable for this action	N/A

Appendices

A. Capital Equipment Needed
B. Summary Annual Budget
C. Summary IO-year Budget
D. List of Acronyms
E. Glossary
F. Bibliography

Capital Equipment Needed

	#	Price	Cost	Useful Life (years)	Annual cost (dollars)	Annual Maintenance/ Calibration
Recording fathometer	1	1,200	1,200	5	240	50
Differential GPS	1	1,000	0	3	333	100
Digital camera (EPSON 2020)	1	700	700	3	233	25
Hydrolab w/ chlor a probe	1	14,000	14,000	7	2,000	1,000
Spectophotometer	1	10,000	10,000	10	1,000	50
Recording tide gauges	3	200	600	7	86	10
Pygmy gurley meters	2	600	0	3	400	50
Stadia rods	2	80	0	5	32	0
Survey scopes	2	650	0	5	260	0
Survey tripods	2	350	0	5	140	0
RBA Net	1	330	0	5	66	0
RBA Sifting Pans	2	40	0	7	11	0
Petri Headlamps	2	45	0	5	18	20
Graduated Cylinders	2	60	0	7	17	0
Macropipetter 1-10ml	1	210	0	10	21	180
Test tube racks	3	64	0	10	6	0
500 ml Beakers	2	50	0	7	14	0
Field Thermometer	2	25	0	1	50	0
Autoclave Thermometer	1	45	0	1	45	0
Autoclave	1	1,200	0	10	120	20
Incubator	1	1,300	0	10	130	20
Bacteriological Sample Jars	12	6	0	5	15	0
Bacteriological Dilution Bottles	12	6	0	5	15	0
UV Light	1	250	0	10	25	15
Mud Flat Shoes	1	100	0	5	20	0
Battery Recharger	1	80	0	2	40	0
Hach Nitrate Colorimeter	1	399	0	10	40	100
YSI 90 Gold DO Meter	1	1,200	0	5	240	40
YSI 85 Silver DO Meter	1	900	0	5	180	40
Hach Turbidity Meter	1	1,000	0	10	100	240
Hydrolab Multiparameter	1	7,500	0	7	1,071	400
Hydrolab CHLOR a probe	1	5,000	5,000	7	714	600
Boston Whaler	1	0	0	10	0	1,550
Nanson Bottle	1	500	0	10	50	0
100 Meter Tapes	3	45	135	4	34	0
Total		**$ 48,862**	**$ 31,635**		**$ 7,842**	**$ 4,510**

Monitoring Budget	Sites	$/Sample	Samples/yr	Sample #	Total$	$/Site	Hrs/	Primary	Secondary
Watershed Sampling									
Conventional Water Quality	2	103	12	24	2,472	1236		**CCAMP**	
Volunteer Water Quality (fresh)	15	16	12	180	2,790	186		**FOE**	
Sediment Chemistry(full)	2	526	1	2	1,052	526		**CCAMP**	
Sediment Chemistry(Metals Only)	0	286	1	0	0	0		**TMDL**	
Water Toxicity Sites (w chemistry)*	0	0	0	0	0	0		**CCAMP***	
Water Chemistry*	0	0	0	0	0	0		**CCAMP***	
Bioaccumulation(bivalves)	2	3,312	1	2	6,624	3312		**CCAMP**	
Bioaccumulation(fish)*	0	4,248	1	0	0	0		**CCAMP***	
Freshwater Bioassessment	10	525	1	10	5,250	525		**FOE**	CCAMP
Fish Surveys	10		2	20	0	0		**NEP**	FOE
Bird Surveys	10		4	40	0	0		**FOE**	
Watershed Sampling Subtotal					$18,188				
Estuary Sampling									
Volunteer Water Quality (Marine)	16	16	12	192	3,072	192		**FOE**	
Pathogen Indicators	10	65	12	120	7,800	780		**FOE**	Local Gov't*
Sediment Chemistry	0	526	1	0	0	0		**NEP**	FOE
Bioaccumulation(bivalves metals only)	5	1,421	1	5	7,105	1421		**TMDL**	
Bioaccumulation(fish) TSM*	0	3,312	1	0	0	0		**CCAMP***	
Nutrient Biological Impact	0	90	12	0	0	0		**NEP**	Cal Poly
Benthic Infauna (Partial RBP)	0	525	1	0	0	0		**NEP**	Cal Poly
Brant Surveys	10	0	25	250	0	0		**J. Roser**	
Fish Trawls	3	0	1	3	0	0		**CDFG**	
Shore Bird Survey	0	0	1	0	0	0		**Pt. Reyes**	Audubon
Eelgrass Surveys	0	0	1	0	0	0		**NEP/FOE**	Chestnut/C. Poly
Plankton Surveys	4	0	12	48	0	0		**UCCE/DHS**	FOE/C. Guard
Algal Cover Transects	4	0	5	20	0	0		**FOE**	
Estuarine Bioassessment	10	525	1	10	5,250	525		**FOE**	NEP
Estuary Sampling Subtotal					$23,227				
Near Shore Sampling									
Metals*	0	286	0	0	0	0		**CCAMP***	
Pathogen Indicators*	0	65	0	0	0	0		**CCAMP***	
Near Shore Sampling Subtotal					0				
General Program Expense									
VMP/NEP Monitoring Coordinator					38,500		2160	**FOE/NEP**	
Volunteer Program Coordinator					27,250		1557	**FOE**	
Misc Vol Progam Expenses					2,200			**FOE**	
Equipment Replacement					7,741			**FOE/NEP**	
General Program Expense Subtotal					$75,691				
Total Expenditures					**$117,106**				

10-year Plan	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Watershed Sampling										
Conventional Water Quality	2,472	2,472	2,472	2,472	2,472	2,472	2,472	2,472	2,472	2,472
Volunteer Water Quality (fresh)	2,790	2,790	2,790	2,790	2,790	2,790	2,790	2,790	2,790	2,790
Sediment Chemistry(full)	1,052	1,052	1,052	1,052	1,052	1,052	1,052	1,052	1,052	1,052
Sediment Chemistry(Metals Only)	0	0	0	0	0	0	0	0	0	0
Water Toxicity Sites (w chemistry)*	0	0	0	0	0	0	0	0	0	0
Water Chemistry*	0	0	0	0	0	0	0	0	0	0
Bioaccumulation(bivalves)	6,624	6,624	6,624	6,624	6,624	6,624	6,624	6,624	6,624	6,624
Bioaccumulation(fish)*	0	0	0	0	0	0	0	0	0	0
Freshwater Bioassessment	5,250	5,250	5,250	5,250	5,250	5,250	5,250	5,250	5,250	5,250
Fish Surveys	0	0	0	0	0	0	0	0	0	0
Bird Surveys	0	0	0	0	0	0	0	0	0	0
Watershed Sampling Subtotal	**18,188**	**18,188**	**18,188**	**18,188**	**18,188**	**18,188**	**18,188**	**18,188**	**18,188**	**18,188**
Estuary Sampling										
Volunteer Water Quality (Marine)	3,072	3,072	3,072	3,072	3,072	3,072	3,072	3,072	3,072	3,072
Pathogen Indicators	7,800	7,800	7,800	7,800	7,800	7,800	7,800	7,800	7,800	7,800
Sediment Chemistry	0	0	0	0	0	0	0	0	0	0
Bioaccumulation(bivalves metals only)	7,105	0	0	0	0	0	0	0	0	0
Bioaccumulation(fish) TSM*	0	0	0	0	0	0	0	0	0	0
Nutrient Biological Impact	0	0	0	0	0	0	0	0	0	0
Benthic Infauna (Partial RBP)	0	0	0	0	0	0	0	0	0	0
Brant Surveys	0	0	0	0	0	0	0	0	0	0
Fish Trawls	0	0	0	0	0	0	0	0	0	0
Shore Bird Survey	0	0	0	0	0	0	0	0	0	0
Eelgrass Surveys	0	0	0	0	0	0	0	0	0	0
Plankton Surveys	0	0	0	0	0	0	0	0	0	0
Algal Cover Transects	0	0	0	0	0	0	0	0	0	0
Estuarine Bioassessment	5,250	5,250	5,250	5,250	5,250	5,250	5,250	5,250	5,250	5,250
Estuary Sampling Subtotal	**23,227**	**16,122**	**16,122**	**16,122**	**16,122**	**16,122**	**16,122**	**16,122**	**16,122**	**16,122**
Near Shore Sampling										
Metals*	0	0	0	0	0	0	0	0	0	0
Pathogen Indicators*	0	0	0	0	0	0	0	0	0	0
Near Shore Sampling Subtotal	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

General Program Expense										
VMP/NEP Monitoring Coordinator	38,500	38,500	38,500	12,000	12,000	12,000	12,000	12,000	12,000	12,000
Volunteer Program Coordinator	27,250	27,250	27,250							
VMP Bookkeeper	1,200	1,200	1,200							
Misc Vol Progam Expenses	1,000	1,000	1,000							
Equipment Maintenance and Supplies	4,330	4,330	4,330	4,330	4,330	4,330	4,330	4,330	4,330	4,330
Equipment Purchase	31,635									
Equipment Replacement		7,741	7,741	7,741	7,741	7,741	7,741	7,741	7,741	7,741
General Program Expense Subtotal	**103,915**	**80,021**	**80,021**	**24,071**	**24,071**	**24,071**	**24,071**	**24,071**	**24,071**	**24,071**
Total Expenditures	**145,330**	**114,331**	**114,331**	**58,381**	**58,381**	**58,381**	**58,381**	**58,381**	**58,381**	**58,381**
Resources										
MBNEP(FY 2000 earmarked)(CWA320)	28,000	0	0	0	0	0	0	0	0	0
MBVOL(CWA319)	80,000	80,000	80,000	0	0	0	0	0	0	0
MBNMP(CWA319)	15,000	15,000								
CCRWQCB (TMDL)	7,105									
CCAMP(SWRCB)	11,198	11,198	11,198	11,198	11,198	11,198	11,198	11,198	11,198	11,198
Cal Poly(Soil Science Dept)	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200
Post BMP project performance				0	0	0	0	0	0	0
California Men's Colony-NPDES										
City of Morro Bay-NPDES	780	780	780	780	780	780	780	780	780	780
Duke Energy-NPDES		0	0	0	0	0	0	0	0	0
Los Osos CSD-NPDES	780	780	780	780	780	780	780	780	780	780
Oyster Leasee-DHS	3,120	3,120	3,120	3,120	3,120	3,120	3,120	3,120	3,120	3,120
City/County/CSD		0	0	0	0	0	0	0	0	0
Friends of the Estuary	0	0	0	0	0	0	0	0	0	0
Resources Total	**137,183**	**130,078**	**125,078**	**17,078**	**17,078**	**17,078**	**17,078**	**17,078**	**17,078**	**17,078**
Total Expenditures	**145,330**	**114,331**	**114,331**	**58,381**	**58,381**	**58,381**	**58,381**	**58,381**	**58,381**	**58,381**
Net Profit(-loss)	1,843	26,253	11,253	-41,303	-41,303	-41,303	-41,303	-41,303	-41,303	-41,303

Appendix D - List of Acronyms

ACOE ..... U.S. Army Corps of Engineers
APDP ..... Action Plan Demonstration Project
BF ..... The Bay Foundation of Morro Bay
BLM ..... Bureau of Land Management
BMPs ..... Best Management Practices
BPA ..... Base Programs Analysis
CAC ..... Citizens Advisory Committee
CAL-EPA ..... California Environmental Protection Agency
Cal-Trans ..... California Department of Transportation
CCAMP ..... Central Coast Ambient Monitoring Program
CCC ..... California Coastal Commission
CCCorps ..... California Conservation Corps
CCMP ..... Comprehensive Conservation and Management Plan
CCNHA ..... Central Coast Natural History Association
CCRWQCB ..... Central Coast Regional Water Quality Control Board
CDA ..... California Department of Agriculture
CDBW ..... California Department of Boating and Waterways
CDC ..... California Department of Corrections
CDF ..... California Department of Forestry & Fire Protection
CDFG ..... California Department of Fish and Game
CDOC ..... California Department of Conservation
CDPR ..... California Department of Parks and Recreation
CDHS ..... California Department of Health Services
CDIF ..... Consent Decree Implementation Fund
CDTSC ..... California Department of Toxic Substances Control
CDWR ..... California Department of Water Resources
CEC ..... Santa Barbara Community Environmental Council
CEQA ..... California Environmental Quality Act
CFEP ..... Chorro Flats Enhancement Project
CFR ..... Code of Federal Regulations
Cfs ..... Cubic feet per second
CMB ..... City of Morro Bay

CMC ..... California Men's Colony
CNDD ..... California Natural Diversity Database
CNPS ..... California Native Plant Society
CRA ..... California Resources Agency
CSD ..... Community Services District
CSLCNG ..... Camp San Luis, California National Guard
CSLRCD ..... Coastal San Luis Resource Conservation District
CWA ..... Clean Water Act
CZARA ..... Coastal Zone Act Reauthorization Amendments
CZLUO ..... Coastal Zone Land Use Ordinance
DEH ..... San Luis Obispo County Department of Environmental Health
DO ..... Dissolved Oxygen
ECA ..... Estero Conservation Alliance
EFDC ..... Environmental Fluids Dynamic Code
EMP ..... Environmental Monitoring Plan
EQIP ..... Environmental Quality Incentives Program
ESA ..... Endangered Species Act
ESH ..... Environmentally Sensitive Habitat
ESU ..... Evolutionary Significant Unit
FOE ..... Friends of the Estuary at Morro Bay
FSA ..... Farm Service Agency
GIS ..... Geographic Information System
HCP ..... Habitat Conservation Plan
HUA ..... Hydrologic Unit Area
IPM ..... Integrated Pest Management
IWMA ..... Integrated Waste Management Authority
LOCSD ..... Los Osos Community Services District
LPC ..... Local Policy Committee
MBERF ..... Morro Bay Estuary Restoration Fund
MBHD ..... Morro Bay Harbor Department
MBNEP ..... Morro Bay National Estuary Program
MBNMP ..... Morro Bay National Monitoring Plan
MBSEP ..... Morro Bay State Estuary Program
MBTF ..... Morro Bay Task Force
MBWEP ..... Morro Bay Watershed Enhancement Plan

MEGA ..... Morro Estuary Greenbelt Alliance
MOA ..... Memorandum of Agreement
MPN ..... Most Probable Number
MSD ..... Marine Sanitation Device
MURP ..... Model Urban Runoff Program
NEP ..... National Estuary Program
NEPA ..... National Environmental Policy Act
NGVD ..... National Geodetic Vertical Datum
NMP ..... National Monitoring Program
NOAA ..... National Oceanic and Atmospheric Administration
NPDES ..... National Pollutant Discharge Elimination System
NPSPC ..... Nonpoint Source Pollution Control
NRCS ..... Natural Resources Conservation Service
NSSP ..... National Shellfish Sanitation Program
OEHHA ..... Office of Environmental Health Hazard Assessment, CAL-EPA
OSPR ..... Office of Oil Spillage Prevention & Response (DFG)
SBNEP ..... Sarasota Bay National Estuary Program
SCB ..... Southern California Bight
SCC ..... California State Coastal Conservancy
SCS ..... Soil Conservation Service
Sheriff Dive ..... Sheriff's Dive Team
SIP ..... Stewardship Incentive Program
SLC ..... State Lands Commission
SLO ..... San Luis Obispo
SLOCo ..... San Luis Obispo County
SMW ..... State Mussel Watch
SRAs ..... Sensitive Resource Areas
SRF ..... State Revolving Fund
SSRCSCCC... Steelhead and Stream Recovery Coalition for the South Central Coast of California
SWAP ..... Small Wilderness Area Preservation
SWRCB ..... State Water Resources Control Board
TAC ..... Technical Advisory Committee
TDC ..... Transfer of Development Credits
TMDL ..... Total Maximum Daily Loads
UCCE ..... University of California Cooperative Extension

USCG ..... United States Coast Guard
USDA ..... United States Department of Agriculture
USEPA..... United States Environmental Protection Agency
USFS..... United States Forest Service
USFWS ..... United States Fish and Wildlife Service
USGS..... United States Geological Survey
USNMFS ..... United States National Marine Fisheries Services
VMP ..... Volunteer Monitoring Program
WC..... Watershed Committee
WCB ..... Wildlife Conservation Board
WHIP ..... Wildlife Habitat Improvement Program
WRP ..... Wetland Reserve Program (federal)
WWTP ..... Wastewater Treatment Plant

Appendix E - GLOSSARY

Aggraded	Raising the grade or level of (a river valley, stream bed, etc.) by depositing detritus, sediment or the like.
Ambient	Refers to overall conditions surrounding a place or thing. For example, ambient monitoring refers to routine water quality monitoring which assess overall conditions for the particular site.
Anadromous	Describes fish that are born in fresh water, migrate to the sea, and return to fresh water to spawn (reproduce). Examples include salmon, sturgeon, shad, smelt, and steelhead.
Bathymetry	The physical shape of a basin which contains water, with special attention to the contours of depth; variations in mean depth in a body of water.
Benthic	Bottom-dwelling or substrate-oriented; at or in the bottom of a body of water.
Best Management Practices (BMPs)	Practice or combination of practices that are determined to be the most effective and practical means of controlling point and non-point source pollutants at levels compatible with environmental quality goals. The term originated from the rules and regulations developed pursuant to the federal Clean Water Act (40 CFR 130).
Brackish	Less salty than seawater, but more salty than fresh water. An intermediate saline habitat that falls between 4 and 18 ppm of salinity and usually found under low flushing conditions
Catch Basin	Box-like underground concrete receptacles with openings in curbs and gutters designed to collect water from streets and carry it into the storm drain system.
Depuration	To make or become free from impurities; purification.
Detention	The process of collecting and holding back stormwater for delayed release to receiving waters.
Dissolved Oxygen	Oxygen that is present (dissolved) in water and therefore available for fish and other aquatic animals to use. If the amount of dissolved oxygen in the water is too low, then aquatic animals may die. Wastewater and naturally occurring organic matter contain oxygen-demanding substances that consume dissolved oxygen.
Dredging	Any physical digging into the bottom sediment of a water body. Dredging can be done with mechanical or hydraulic machines, and it changes the shape and form of the bottom. Dredging is performed in order to maintain navigation channels that would otherwise fill with sediment and block ship passage.
Effluent	Wastewater discharged into a body of water from point sources. The material which flows out of a pipe or facility into a water body (or another larger pipe). For example the treated liquid discharged by a wastewater treatment plant is the plant's effluent.
Endemic	A native species defined in terms of a restricted geographical range.

Estuary	A semi-closed coastal water body which has free connection to the open sea and within which seawater is measurably diluted with freshwater. The degree of mixing and layering (freshwater tends to float on top of the sea water) depends on tidal conditions, river flow, and local currents. Estuaries typically support a biota which can tolerate varying salinities and therefore differ from marine and freshwater biotas.
Estuarine	Of or having to do with an estuary.
Fauna	The animals of a given region or period considered as a whole.
Fertilizers	Material added to the soil to supply chemical elements needed for plant nutrition.
Flora	The plants of a particular region or period, listed by species and considered as a whole.
Geographical Information Systems (GIS)	Computer mapping tool capable of overlaying data for manipulation and display.
Groundtruthed	Verification of aerial data by physically walking on the ground.
Heavy Metals	Metallic elements, such as lead, mercury, silver, cadmium, copper, chromium, and zinc, which have relatively high atomic weights and may be toxic at high concentrations. Such metals are toxic to life and continuously pose a threat because of resuspension.
Impaired Water	Pursuant to the Clean Water Act, Section 303(d), a water is listed as impaired if evidence exists that a violation, or potential future violation of a water quality standard has or may occur.
Inactive/Abandoned Mines	Inactive mines are subject to recovery costs by responsible parties, whereas abandoned mines are not.
Intertidal	That portion of the shore or structures in the ocean which is between high and low tide levels; the substrate and organisms in the intertidal are alternately covered by seawater and exposed to the air.
Mean	Mid-point between high and low.
National Estuary Program (NEP)	A federal program established in 1987 by amendments to the Clean Water Act and administered by the U.S. Environmental Protection Agency. The NEP's primary goal is to "protect estuaries of national significance that are threatened by degradation caused by human activity." The NEP employs community-based environmental planning, designating primary responsibility for program development and implementation to the local community.
Nitrate	A form of the nutrient nitrogen that is readily absorbed by plants.
Nonindigenous Species	Refers to non-native plants and animals that have been introduced (accidentally or intentionally) to a region. Some non-indigenous species establish and grow quickly, crowding out native species.

Non-point Source Pollution (NPS)	Pollution that enters water from dispersed and uncontrolled sources (such as surface runoff) rather than through pipes. Nonpoint sources (e.g., forest practices, agricultural practices, on-site sewage disposal, automobiles, and recreational boats) may contribute pathogens, suspended solids and toxicants. While individual sources may seem insignificant, the cumulative effects of nonpoint source pollution can be significant.
Nutrients	Any substance required by organisms for normal growth and maintenance. Mineral nutrients usually refer to inorganic substances derived from soil and water. Excessive amounts of nutrients, including nitrogen and phosphorus, may result in excessive growth of algae, leading to oxygen depletion and water quality degradation.
Pathogen	An agent, such as a virus, bacteria or fungus, that can cause disease in humans. Pathogens can be present in municipal, industrial and nonpoint source discharges.
Phytoplankton	Free-floating aquatic plants and plant-like organisms, usually algae; an important food source for many animals.
Point Source	A source of pollutants from a single point of conveyance, such as a pipe. For example, the discharge from a sewage treatment plant or a factory is a point source.
Priority Organics	A class of toxic pollutants found in wells near the Los Osos landfill. Specifically refers to tetrachorothylene volatile organics found in cleaning solvents.
Rare, Threatened threatened **or Endangered**	Rare is a classification given only to a species when, although not presently with extinction, it exists in such small numbers through its range that it may become endangered if its present environment worsens. A species is threatened when, although not presently at risk of extinction, it is likely to become an endangered species in the foreseeable future in the absence of special protection and management efforts. A species is considered endangered when it faces possible extinction throughout all, or a significant portion of, its range. The predominant cause is loss of habitat.
Riparian	Habitat occurring along the bank of a natural and freshwater waterway (e.g., river, stream or creek), which provides for a high density, diversity, and productivity of plant and animal species.
Sediment	Mud, sand, silt, clay, and other particles that settle on the bottoms of waterways.
Special Status Species	Federal and state classifications for plants and animals species that are either listed as threatened or endangered species, are formally recognized candidates for a listing, or are declining to a point where they may be listed.
Substrate	Material that forms a stream or lake bed (silt, sand, gravel, cobble, etc.)
Thalweg	(1) A line, as drawn on a map, connecting the lowest points of a valley; (2) the middle of the main navigable channel of a waterway that serves as a boundary line.
Total Maximum Daily Loads (TMDLs)	The maximum amount of pollution a body of water can receive in a 24-hour period without deterioration in water quality.
Turbidity	A measure of the amount of material suspended in the water. Increasing the turbidity of the water decreases the amount of light that penetrates the water column. High levels of turbidity are harmful to aquatic life.

Urban runoff	Water containing pollutants like oil and grease from leaking cars and trucks; heavy metals from vehicle exhaust; soaps and grease removers; pesticides from gardens; animal waste; and street debris, which washes into storm drains and gets carried out to the ocean.
Wastewater	Water contaminated with the byproducts of domestic, commercial, agricultural, or industrial uses.
Wastewater Treatment	Processes that help remove solids, nutrients and other pollutants from water before it is discharged or reused.
Watershed	The geographic region within which water drains into a particular river, stream, or body of water. A watershed includes hills, lowlands, and the body of water into which the land drains. Watershed boundaries are defined by the ridges of separating watersheds.
Wetlands	Land where the water table is usually at or near the surface. Some wetlands contain water year-round; others may remain relatively dry for months, becoming moist only during periods of heavy rain. Wetlands are vital habitats for many species of plants and animals; they are protected by local, state and federal regulations.
Wildlife	Undomesticated animals that live either live in a single geographic area or migrate from one area to another.

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Morro Bay National Estuary Program
Data Management Strategy

Morro Bay National Estuary Program
Data Management Strategy

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INTRODUCTION

In order to effectively assess the impacts of human activities on the Morro Bay estuary, watershed, and nearshore regions, it is necessary to develop and implement a strategy for collecting, compiling, analyzing and disseminating data.

Data management efforts in the watershed lack uniform standards for data description, collection, quality assurance, storage, and distribution. The lack of common access to baseline data required in decision making processes increases costs. The costs come in the form of economic, environmental, social, and cultural damage to the resources of the estuary and the activities which depend on these resources.

Data collection and management efforts by federal, state, county, city, and private sector interests are currently largely designed to serve project specific goals and do not provide an effective common ground for multi-jurisdictional decision making. Improved coordination and integration of watershed-wide monitoring and data management programs is necessary.

A comprehensive monitoring and data management program will be used to measure the effectiveness of planning, regulatory, engineering, and management efforts, evaluate long-term trends in environmental quality, improve decision making, and help prevent overlaps and duplications in data collection and application.

The foundation for the data management and quality assurance strategy for the program will be a centralized database maintained by the program. This structure is possible because of the relatively simple jurisdictional structure within the watershed. The database will consist of information collected by the program and by other agencies and organizations. Individual agencies will retain control of data for which they are currently responsible. The program will collect these individual data sets and be responsible for reformatting the data for compatibility with the centralized database. The program will work with the individual agencies to establish uniform methods for data exchange and formatting.

The Morro Bay monitoring and data management program will be designed to:

(1) assess the health of the estuary and its resources

(2) identify environmental problems

(3) provide data and other information to measure the success of programs

(4) document ecological changes over time in the estuary and its watershed

(5) support research activities by making scientifically valid data accessible

DATA SOURCES

Morro Bay National Estuary Program

The Morro Bay National Estuary Program (MBNEP) will provide management, technical and administrative support for the data management program. The MBNEP will facilitate cooperation among the agencies involved in the program, provide data management staff, provide central data management, and provide access to data and interpretive reports.

Information collected by the program will include a diverse variety of characterizations, including water quality, habitat, ecological, climatological and hydrological data. This information will be stored in GIS database form or as tabular data files suitable for statistical and other analysis.

Morro Bay National Monitoring Program

The MBNEP will implement its data collection and management strategies in the watershed through cooperation with and expansion of the Morro Bay National Monitoring Program. Location, timing and frequency of sampling for water quality in the watershed will follow the approach outlined in the annual work plan for the National Monitoring Program and will be coordinated with the existing sampling effort. The National Monitoring Program collects water and habitat data using protocols, quality assurance checks, data storage and reporting procedures detailed in its Quality Assurance Project Plan (QAPP).

The National Monitoring Program has focused it effort on analysis of the effectiveness of Best Management Practices being implemented in the watershed. This information will be useful in developing cost/benefit analyses and for targeting the location and types of BMPs to be implemented.

Implementation of the Morro Bay National Monitoring Program is ongoing and expected to continue for the next six years. Amendments to the existing QAPP are underway and are scheduled for completion in the first eighteen months of the MBNEP.

The MBNEP will coordinate its efforts with the Monitoring Technical Advisory Committee (TAC) convened by the National Monitoring Program. This committee is composed of representatives from federal, state, and local agencies, industry, the scientific community, and the public. The Monitoring TAC is charged with reviewing and commenting on aspects of data management including:

(1) goals and objectives for a watershed-wide monitoring program,
(2) a technical design for monitoring,
(3) a data management system to handle monitoring data,
(4) cost estimates and identification of funding sources,
(5) the role of citizen monitoring, and
(6) a strategy for updating and integrating the data with decision making processes.

Figure 1. Initial Monitoring TAC Membership

Morro Bay National Estuary Program

Central Coast Regional Water Quality Control Board

County of San Luis Obispo

City of Morro Bay

California Department of Fish and Game

California Department of Health Services

Friends of the Estuary at Morro Bay

US Fish and Wildlife Service

US Army Corps of Engineers

Natural Resources Conservation Service

Pacific Gas and Electric Co.

Cal Poly State University

Cuesta College

San Luis Obispo County Morro's Advisory Committee

Tenera Inc.

Cleath and Assoc.

Ecoanalysis, Inc.

Interested Citizens

Friends of the Estuary Volunteer Monitoring Program

The MBNEP will assist the Friends of the Estuary at Morro Bay in the development of a citizens' monitoring program to collect data which will supplement the National Monitoring program and act as an educational and public involvement tool.

Citizen monitors will carry out portions of program tasks deemed appropriate by staff. Staff from cooperating agencies and the Monitoring TAC will provide technical support and oversight for citizens' monitoring projects. MBNEP staff will provide volunteer-management support for citizens' monitoring projects.

Data collected under citizens' monitoring programs will be subject to quality assurance checks appropriate for the intended application. Quality assurance plans for volunteer programs will be incorporated into the NEP Quality Assurance document. Training will be provided for volunteers by NEP staff and cooperating agencies using protocols outlined in the NEP Quality assurance plan. Citizens' monitoring projects associated with the program are currently being initiated and will be carried out on a continuing basis.

Agency Data Sources

City of Morro Bay - The City maintains records of well levels and well production on Chorro Creek, and tracks the water quality of each. The City also will be tracking surface flow in Chorro Creek as a result of a recent water rights decision. Various studies on environmental quality within the bay have been conducted for the City as part of various environmental assessments. Information on storm water drainage facilities and wastewater treatment plant operations is also available.

County of San Luis Obispo - The County maintains several flow gauges on Chorro and Los Osos creeks. The County also maintains meteorological stations at several locations in the watershed. This data will be of critical importance to a number of NEP technical activities. Groundwater data is also available from several county studies conducted in association with the Los Osos sewer project, as well as from the County Environmental Health department. This department also collects information on surface water quality.

The County Department of Agriculture collects permitting information on pesticide and land use in the Morro Bay watershed. County engineering studies for specific projects, such as the Los Osos drainage plan, the Los Osos sewer plan, and the Dairy Creek golf course, will provide information which can be utilized by the program.

The County is updating the area general plan, which includes demographics, land use and zoning information, an economic analysis, an environmental constraints analysis and GIS support database.

The implementation of the MBNEP GIS will be coordinated with the data management activities of the county wide GIS Consortium. This group is establishing a coordinated

approach to county-wide use of GIS technology and data. Data generated by the Morro Bay program will be made available at no or low cost to all users. Data from other sources will be distributed in accordance with County GIN Consortium guidelines.

State of California - Data is available from a wide variety of state agencies. The California Department of Fish and Game maintains databases on sensitive species and habitats, and has historical information including stream surveys, fish population analyses, and marine mammal and fisheries data. Fish and Game also has conducted the State Mussel Watch Program and the Toxic Substances Monitoring Program in the bay and watershed. The Department of Parks and Recreation maintains habitat information regarding the land it manages around and within the bay

The State Water Resources Control Board has extensive information on water rights activities in the watershed. The Regional Water Quality Control Board maintains information on quality of effluent discharges, surface water and groundwater. It has collected data on bay substrate quality through the Bay Protection and Toxic Cleanup Program. Department of Health Services has been collecting data on bacterial levels in the bay for a number of years. Department of Water Resources has maps of agricultural land use and other information.

Teale Data Center maintains GIS data for the State of California. CERES is a Resource Agency database with a variety of applications and information. Data from both of these sources is being acquired on a continuing basis.

The California National Guard monitors the condition of its land as part of a state-wide monitoring program, which includes a GIS component. Monitoring wells have been installed adjacent to several abandoned landfills on the property, which provide water quality data. The California Men's Colony maintains water quality data on wastewater discharged to Chorro Creek from their treatment plant.

U.S. Government - The National Marine Fisheries Service maintains a long-term database on harbor seal populations in Morro Bay and along the central Coast. The U.S. Fish and Wildlife Service maintains a National Wetlands Inventory and other data collected specifically on Morro Bay.

The U.S. Army Corps of Engineers has been dredging the Morro Bay harbor for a number of years and has extensive bathymetric information available on the northern portion of the bay. The COE has also conducted environmental and economic analyses associated with the dredging projects, and has developed a scale model of the bay entrance to design and test proposed dredging projects.

Other sources include Census Bureau data, USGS groundwater and seismic studies, NOAA oceanographic information, USDA (soil surveys, etc.), Coast Guard oil spill response data, National Weather Service meteorological and climatological data, and U.S. EPA water quality data (STORET, ODES, etc.).

Other Data Sources

Cal Poly State University - Cal Poly University maintains a Morro Bay GIS system which contains data being collected for numerous projects within the watershed. This system will be used as the repository for the program's GIS data. The Cal Poly GIS lab is an ongoing operation which has provided services to a variety of agencies and organizations in the watershed. The Morro Bay GIS will include information on Morro Bay resources and environmental conditions at a scale appropriate for regional planning and analysis. The Morro Bay GIS will be used to prepare program reports and analyses, as appropriate.

Cal Poly has conducted a variety of research studies on the bay. These have included senior projects, master's theses, and faculty research. Most of these documents have been identified in the Morro Bay Bibliography, and will be used by the program as appropriate.

Environmental Impact Reports and Statements
Data collected for inclusion in environmental impact reports for a variety of projects in the region will be incorporated into the MBNEP database. The MBNEP will contact original data providers to obtain original, unmanipulated data.

Private consulting firms
The MBNEP has established data sharing relationships with a number of private consultants working on projects in the watershed. As the program grows, the MBNEP expects to expand the number of firms that are cooperating with the program in these sharing relationships.

DATA MANAGEMENT TACTICS

The Morro Bay National Estuary Program will utilize a centrally coordinated data management system. Program staff will develop and maintain a central database, a bibliographic reference database, and a computerized data inventory. Data generated under the program will meet the quality assurance requirements specified in the program quality assurance document. Quality assurance standards used for data generated outside of the program, as well as meta-data descriptions, will be documented and made available through the same means of dissemination as the data itself.

Program staff will collect data from cooperating agencies and transfer data to the central database following quality assurance checks. Standardized computer codes and formats specified by the program staff will be used uniformly for all data transfers between and among cooperating agencies and the program.

GIS data layers intended for use by the program will be screened for overall quality by MBNEP staff and by user groups identified by staff. Ground truthing will be undertaken on selected data layers to the extent permitted by funding constraints. Meta-data descriptions will include descriptions of resolution, accuracy, and precision of each data layer, as well as explanations of the original intended use and other information dictated by the nature of the data.

The program will compile information collected in conjunction with other technical studies and activities. These may include receiving water monitoring data collected by dischargers, information compiled as part of environmental review processes, and other environmental data that are compatible with the data collected under the program.

Because of the variety of data sources and diversity of data types being collected and compiled for the program, several methods of ensuring data integrity will be required. In general, the program will employ the following procedures with regard to data preparation, tracking, entry, quality assurance, storage, analysis, dissemination, and security.

Preparation

Field data collection method descriptions and field data forms - Field data forms will be designed in a way that is easy to use, provides a complete data record for the intended end use, supports chain of custody tracking, and minimizes calculations in the field. Field data forms will be archived by the program and referenced by name and page number in the meta-data description. Each meta-data description will contain an explanation of how the data was collected and the limitations of the data collection method.

Tracking

Data chain of custody logs - Records will be kept of who collected the data, who entered the data, who processed the data, and who analyzed the data. If the data was not collected by the program, the record will also contain the location of the raw data and the name of who to contact to acquire the data in its most unprocessed form.

Data chain of process logs - The meta-data description will contain a description of how the raw data was processed. This record will contain a log of data validation and screening procedures, including identification of records rejected due to quality assurance considerations.

Data Entry

Data entry procedures and validation - User data entry software will contain traditional key entry data validation mechanisms, such as field typing, character set screening, range checking, menu-driven field value selection, and other similar methods. When the MBNEP is provided with data in machine readable form from external sources, the data will be screened for overall quality using procedures described in this document.

Software - In order to support long-term data collection needs, the program will develop data entry software which ensures consistency and ease of use. Data entry software created by the program will be made available for use by cooperating agencies and volunteer programs. This software will include documentation of appropriate raw data screening procedures to be applied after the data entry process is complete.

Data quality assurance

Raw data screening procedures - Standardization of nomenclature, range checking, graphic visualization, exploratory data analysis, and other methods will be employed to ensure the validity, integrity, and usability of data. With small data sets these procedures can include sorting the dataset on each field in the data record to examine adjacent records in the resulting data lists. With large datasets, other exploratory data analysis techniques will be employed. Repeated values, excessive zero data values, missing data, improper characters, overrange values, and several other dataset defects become apparent using these procedures. Summary statistical analysis of datasets can also be employed as a screening method.

Data storage

Data storage protocols, file formats, and cataloging - Initially, data will be structured in a way that provides adequate cross referencing for transfer to a relational database. Individual data files will be structured to minimize redundant and overlapping entries. Data will be stored in file formats which facilitate migration paths between various data handling and analysis software. File format conversion software will be created by program staff as required to enable data transfers between dissimilar systems. A catalog of data files with meta-data descriptions will be maintained. A catalog of inhouse file format conversion software and format migration pathways based on available commercial software will be also maintained.

Data developed as part of the MBNEP and National Monitoring Program will be submitted for entry into STORET or ODES, as appropriate. National Monitoring Program data is also stored and processed using the Nonpoint Source Management System (NPSMS) provided by the U.S. EPA.

Data analysis

Analytic software - Various commercial software products will be employed during data analysis. Software will be selected based on the end use requirements. The stringency requirements for algorithm validation will depend upon intended data uses, which may range from pollutant screening to litigation. Program staff will maintain inhouse software capabilities, as well as access to other hardware and software sources which support the overall objectives of the program.

Data dissemination

Online and CD-ROM data distribution - The program staff will prepare a *Morro Bay Data Directory*, as a supplement to the existing *Morro Bay Bibliography*, which will be written for a non-technical audience. The *Morro Bay Data Directory* will include information developed by the MBNEP and cooperating agencies, as well as other entities. It is a bibliographic reference to available data and will include version control information as available for data provided.

The program will make data available on the Internet via the program's World Wide Web home page. The home page will contain a copy of the Morro Bay Data Directory

for reference. Data will be made available periodically in CD-ROM format. Data from the National Monitoring Program is already available in this format.

Presentation software and file format conversions
The program will from time to time release reports and data which require specialized software for cross platform viewing in various computer hardware environments. The program will supply such third party or inhouse software as required to fulfill these needs.

Report formatting and data presentation standards
The program will establish standards and design guidelines for report generation and multimedia data presentations based on anticipated target audiences. These guidelines will be made available to contributing authors and editors as well as to cooperating agencies.

Security

Data integrity - Public access data uploads will be examined, screened, and validated by program staff prior to being included in program distribution channels. Version control will be administered through the *Morro Bay Data Directory.*

Data storage redundancy - The program will maintain CD-ROM backup copies of key documents and data sets at the NEP headquarters office in Los Osos, CA and the Central Coast Regional Water Quality Board office in San Luis Obispo, CA.

Data Management Program Evaluation

In order to ensure that the data management program remains useful and cost-effective, and generates data useful to scientists, water quality managers, and other decision makers, periodic evaluations of the program will be conducted. Because the Morro Bay State Estuary Program requires a plan update every two years, a performance evaluation of data management will be included in that report. These evaluations will take into consideration the following:

(1) the effectiveness of program sampling, analyses and data management in meeting program goals;
(2) the degree to which quality-assurance requirements are met and are effective in generating high-quality data;
(3) the degree to which program reports are effective and appropriate in meeting the program goals;
(4) the degree to which program is being implemented according to the overall design strategy; and
(5) the degree to which program results are used in making decisions about water quality management.

Turning the Tide

Executive Summary

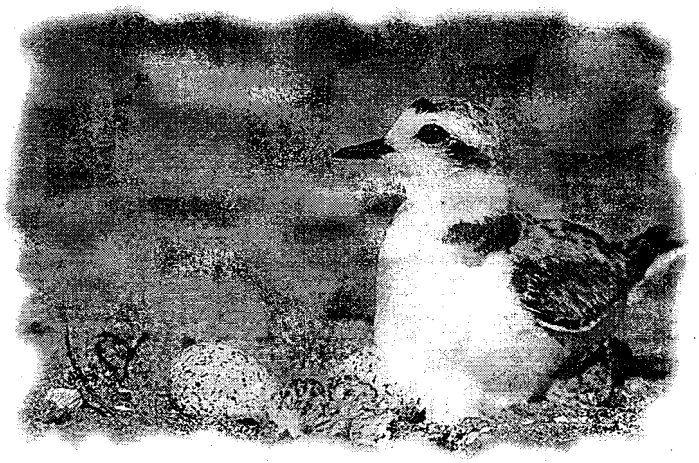
of the
Morro Bay
National
Estuary
Program's

Comprehensive
Conservation &
Management Plan

Published July 2000
Morro Bay, California

companion documents:
Comprehensive Conservation & Management Plan (CCMP), Characterization, Base Programs Analysis, Monitoring Plan

Contents



A Western snowy plover on its nest in the dunes of the Morro Bay Estuary.

To meet the challenge of managing the Morro Bay Estuary and its extremely complex resources, the watershed communities of Morro Bay, Los Osos, Baywood, Cuesta-by-the-Sea and Chorro Valley have worked together for the last four years to develop the Morro Bay Comprehensive Conservation Management Plan (CCMP).

These communities have been confronting environmental problems such as:

- accelerated sediment loads in the estuary,
- bacterial contaminations of shellfish areas,
- runoff causing algal blooms,
- traces of heavy metals in creeks,
- reductions in functional habitat, and
- declining fish stocks such as steelhead trout and other native species.

These problems are causing social, economic and recreational impacts in the area. The CCMP is designed to address these environmental problems through the implementation of 61 recommended action items. Implementation of these actions is just the beginning of the ardent journey to a fully functioning, healthy estuary and watershed.

We take this opportunity to recognize the hundreds of citizens, organizations, agencies and businesses which assisted in developing the CCMP. In particular, we acknowledge the Bay Foundation of Morro Bay and the California Central Coast Regional Water Quality Board for serving as the financial administrators of the MBNEP. In addition, we acknowledge the Friends of the Estuary for coordinating the Volunteer Monitoring Program and the countless individuals who devote their time and energy to protecting the estuary and its watershed.

Why is Morro Bay Special?

The Morro Bay Estuary supports one of the most important wetland systems on California's coast. Rich in natural diversity, Morro Bay sustains a wide variety of habitats as well as numerous sensitive and endangered species of plants and animals. Its rich resources support one of the state's largest waterfowl habitats. Morro Bay's role as a crucial stop on the Pacific Flyway attracts vast numbers of migrating birds to the area, as evidenced by the fact that Morro Bay repeatedly ranks in the top ten of the Audubon Christmas bird counts. The estuary and its watershed also offer many beneficial human uses, such as agriculture, commercial and recreational fishing, recreational boating, oyster farming, tourist attractions which support many community businesses, diverse water oriented recreational opportunities, and electric utility power generation. A healthy bay and watershed are vital to all these natural functions and human activities.

There is no doubt that Morro Bay contains a variety of important natural resources. But one of the greatest resources may well be the community of people who have created a legacy of caring for Morro Bay, its watershed, and its resources. There are dozens of local organizations who have charged themselves with preserving what Morro Bay has to offer, be it clean water, open space, thriving fisheries, or native habitat. Without the desire and dedication of local people, agencies, and government – as expressed through countless hours of work – there would be no Morro Bay as we now know it. However, there remains much work to do as the community moves forward to protect these resources.

The goals of the Morro Bay National Estuary Program were developed over a decade by members of the local community, and as a result reflect the diverse – but not mutually exclusive – interests of the community. The central coast thrives on its tourism and prides itself on having a fine quality of life. Hence, environmental and commercial interests are both of concern as the stakeholders of Morro Bay work together to preserve and enhance what they have identified as important. This program exists because of and for the people of this community.

An estuary is a partially closed body of water formed where freshwater from rivers and streams flows into the ocean, mixing with salty sea water. The productivity and variety of estuarine habitats foster a wonderful abundance and diversity of wildlife including: shore birds, fish, shellfish and marine mammals.

Watersheds are nature's boundaries. They are geographic regions within which water drains into a particular waterbody, such as a river, stream, lake, or bay.

American peregrine falcon
Brown pelican
California black rail
California clapper rail
California red-legged frog
California sea-blite
Chorro Creek bob thistle
Cuesta Grade checkerbloom
Indian Knob mountainbalm
Least bell's vireo
Morro Bay kangaroo rat
Morro manzanita
Morro Bay shoulderband snail
Salt marsh bird's beak
Southern sea otter
Southern steelhead trout
Southwestern willow flycatcher
Swainson's hawk
Tidewater goby
Western snowy plover

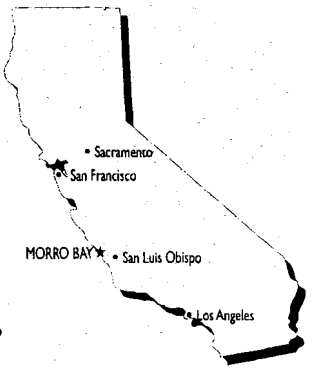
California black rail

Eelgrass beds serve as spawning and nursery grounds for many species of fish, including halibut and English sole.

The Morro Bay Estuary is the only significant eelgrass habitat available to the black brant in central or southern California. Because eelgrass comprises more than 75% of the brant's food intake, the future health of the Pacific Flyway brant population is dependent on the continued preservation of this resource.

Eelgrass improves the water clarity and quality of the bay because the dense foliage of the beds function as a trickling filter and a moderator of current and wave action.

The Place



Morro Bay ...

- is located on California's central coast in San Luis Obispo County, about halfway between San Francisco and Los Angeles.

The Morro Bay Estuary ...

- encompasses about 2,300 acres of mudflats, tidal wetlands, and open water habitat.
- supports a rich eelgrass resource, whose apparent decline may be an indication of compromises to the entire Morro Bay watershed system.

The Morro Bay Watershed ...

- contains about 48,000-acres, including the estuary.
- provides habitat for a number of endangered and/or threatened species, including but not limited to: steelhead trout, California red-legged frog, tidewater goby, Morro Bay kangaroo rat, southern sea otter, and western snowy plover.

The Past

The rolling breakers of the outer bay, the sandspit, and quiet inner bay are guarded by the ancient Morro Rock, towering 576 feet above the entrance to Morro Bay. One of a chain of peaks stretching inland from the sea, Morro Rock was a landfall for Spanish galleons sailing the coast of California. The town of Morro Bay was founded in 1870 by Franklin Riley, who built an embarcadero where wagons could reach the deep water near the shore. This wharf soon became a center of thriving commerce, despite the treacherous harbor entrances. These early changes started a progression of growth that continues to this day.

Over the years, to improve the safety of the harbor and protect seafaring commerce, Morro Rock was quarried to provide materials for breakwaters and a jetty, which closed the north entrance to the harbor. The south channel was dredged and later the economy of Morro Bay boomed as commercial fisherman began bringing in huge catches of albacore, salmon, and cod.

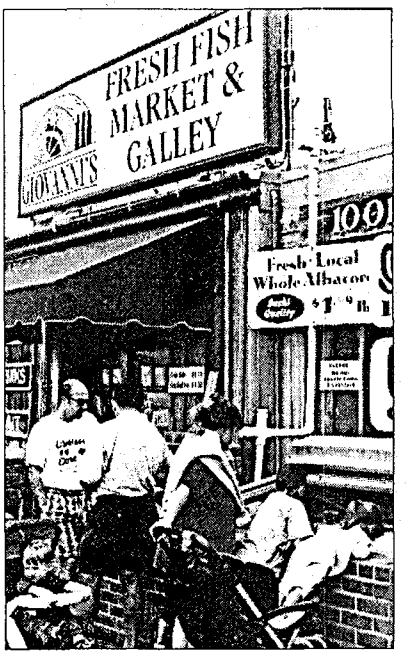
In 1968, Morro Rock was designated as a State Historical Landmark. While the years of quarrying had forever changed this natural monolith, it still covers 50 acres at its base. Now protected, this "Gibraltar of the Pacific" can only be altered by nature.

While Morro Rock is protected from further harm, the Morro Bay Estuary is still vulnerable to environmental degradation. Although the Morro Bay Estuary still remains relatively unspoiled, it is under pressure from tremendous demands and stresses. The known and potential threats to Morro Bay include accelerated sedimentation, water quality concerns, alterations in freshwater flows, and loss of critical habitat. The lack of estuarine data for the central coast of California severely limits our ability to assess potential effects of human activities. To that end, the Morro Bay National Estuary Program commissioned four studies to help provide data for developing the CCMP: Stream Flow and Sediment, Habitat Characterization, Bay Bathymetry and Tidal Circulation, and Bay Nutrients.

The Present

The City of Morro Bay has come a long way since the 1870 census, when the Moro Township was described as having 21 dwellings and 118 inhabitants. Since then, links to outlying communities have continued to expand and influence the area. Now, there are two primary coastal communities within the Morro Bay watershed. The City of Morro Bay has a population of 10,000 and the unincorporated communities of Los Osos and Baywood Park have a combined population of 15,800.

Commercial fishing is one of the area's chief economic activities. Commercial landings in the area had an ex-vessel value of $ 6.9 million in 1993. Other valuable commercial endeavors within the watershed include farming, ranching, and tourism. Morro Bay attracts an estimated average of 4,000 tourists daily, or 1.5 million people annually to its environs. A primary attraction for this high level of tourism is the estuary and the scenic waterfront and surrounding watershed. Morro Bay's economy is dominated by tourism and visitor-serving businesses: they generate an estimated 37 percent of all jobs in the city and one-third of the city's general fund revenues.



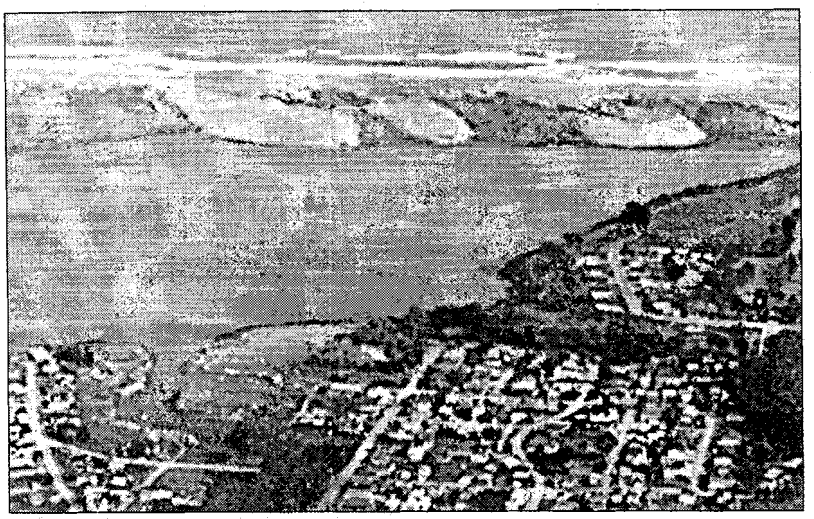
The Morro Bay Estuary system supports a variety of uses, including tourism and commercial fishing.

"...to the south an estuary of immense size enters this valley, so large that it looked like a harbor to us; its mouth opens to the southwest and we noticed that it is covered with reefs which cause a furious surf. At a short distance from it, we saw a great rock in the form of a morro, which at high tide is isolated and separated from the coast by little less than a gunshot."
— *Father Crespi, Portola Expedition, 1769*

Morro Rock is a nationally known historic peregrine falcon nest site that continues to support the breeding attempts of resident pairs of falcons. After intensive nest management from 1977 through 1992, a Morro Rock pair of peregrines produced young without assistance from 1993 through 1997. Though following years brought breeding failures and the deaths of those two adults, early reports in the spring of 2000 indicated that a new pair of peregrines would probably be successful in their breeding efforts.

Actions being taken to help achieve future nesting success include reducing human disturbance by keeping climbers off the rock, eliminating feral cats from the area, and maintaining the necessary habitat within and around the estuary which will continue to attract adequate numbers of the peregrines' avifauna food supply.

The Morro Bay NEP



An aerial view of the Morro Bay Estuary

How did Morro Bay become a National Estuary Program?

In 1987, Congress established the National Estuary Program (NEP) as part of the Clean Water Act. The purpose of the NEP is to identify, restore and protect estuaries along the coasts of the United States. The goal of the Program is to involve local communities and encourage them to take responsibility for managing their estuaries.

In April 1994, through the efforts of the Friends of the Estuary (FOE), the Governor established Morro Bay as California's first State Estuary. This designation formally recognized the importance of "preserving and enhancing Morro Bay and its watershed as one of the state's rare natural treasures" and further required a multi-jurisdictional planning effort. With the designation of Morro Bay as a State Estuary and the continuous dedication of local grass roots efforts, Morro Bay was accepted into the National Estuary Program (NEP) in October 1995. Subsequently, the MBNEP was charged with finding ways to achieve the goals of the program, which were identified during the previous decade by the Morro Bay Task Force and through subsequent MBNEP activities.

Morro Bay is one of 28 NEP Programs

Currently, there are 28 NEPs around the country, and all are at least partially funded by the U.S. Environmental Protection Agency (EPA).

Other NEPs include:

- San Francisco Estuary, California
- Santa Monica Bay, California
- Puget Sound, Washington
- Lower Columbia River Estuary, Oregon and Washington
- Tillamook Bay, Oregon
- Long Island Sound, Connecticut and New York
- Barataria-Terrebonne Estuarine Complex, Louisiana
- Tampa Bay, Florida

Like Morro Bay, virtually all of these estuaries are facing similar problems, such as sedimentation, habitat loss, degradation to water quality, and threats to economic activities dependent on the

What is the CCMP?

The Comprehensive Conservation and Management Plan (CCMP), is a plan to address seven priority problems causing harmful impacts to the Morro Bay National Estuary. From the many cross cutting actions such as Urban Runoff, Stream Geomorphology, and Total Maximum Daily Load Allocations, to specific actions under each priority problem, the CCMP strives to sustain existing wildlife resources and environmental quality, taking into account and addressing pollution from a variety of sources.

What is the Management Conference?

The MBNEP Management Conference (MC) refers to the collection of stakeholders, organizations, agencies, and individuals that have been involved in developing the CCMP. The MC includes a Local Policy Committee (LPC), a Watershed Committee (WC), and a Technical Advisory Committee (TAC).

Local involvement in the MC has been critical in integrating all aspects of the planning process, as well as resolving conflicts over management goals among stakeholders who live and work in the watershed. In total, over 75 agencies, organizations, and businesses will participate in the implementation of the CCMP.

The Goals of the Morro Bay National Estuary Program

- Slow the process of bay sedimentation through implementation of management measures which address erosion and sediment transport.
- Reestablish healthy steelhead trout habitat in Chorro and Los Osos Creeks through measures including reduction of sediment loading in gravels, stabilization of riparian corridors, removal or mitigation of migration barriers, improvement of water quality, and restoration and maintenance of adequate freshwater flow.
- Ensure that bay water remains of sufficient quality to support a viable commercial shellfish and mariculture industry, safe recreational uses, healthy eelgrass beds, and thriving fish and shellfish populations.
- Ensure the integrity of the broad diversity of natural habitats and associated native wildlife species in the bay and watershed.
- Maintain watershed functional integrity through appropriate management of fires, grazing, riparian corridors and impervious surfaces.
- Protect social, economic, and environmental benefits provided by the bay and watershed, including agriculture and fisheries, through comprehensive resource management planning.
- Promote public awareness and involvement in estuarine management issues through outreach, educational programs, and the use of volunteers in ongoing bay monitoring and other programs.

Management Conference

The MBNEP Management Conference (MC) refers to the collection of stakeholders, organizations, agencies, and individuals that have been involved in developing the CCMP. The MC structure and responsibilities were defined by the following groups throughout the CCMP development process.

Local Policy Committee (LPC) had the primary authority for the Morro Bay National Estuary Program (MBNEP). It was the executive decision making body and had the leadership role in selecting and guiding the program director, revising the Management Conference Agreement as needed, and approving annual work plans and budgets.

Watershed Committee (WC) advised the LPC and ensured adequate representation of the agencies, organizations, and local interests in the development of the CCMP. Individuals of the WC served as delegates for the particular group or agency that they represent and kept their constituents informed of the progress, actions and decisions of the WC. The group also served as the Citizens Advisory Committee.

Technical Advisory Committee (TAC) provided the WC with an appropriate scientific and technical basis for decision making. It also reviewed and offered input on technical studies, action plans and other CCMP documents.

Fight Against Internal Sedimentation Already Underway

To date, the Morro Bay Watershed Enhancement Plan (MBWEP) — developed by the Coastal San Luis Resources Conservation District (CSLRCD) — has provided the technical and financial assistance necessary to install over 245 conservation practices in the watershed.

These projects have kept over 172,000 tons of soil erosion from entering Morro Bay, and caught an estimated 300,000 cubic yards of sediment.

The most significant single action included in the MBWEP is the Chorro Flats Enhancement Project (CFEP), which essentially reconnected Chorro Creek with its historical floodplain, allowing sediment to be deposited there instead of in Morro Bay.

Anticipating the erosion potential following the 1994 Highway 41 fire, a 500-foot section of the levee confining Chorro Creek was removed. After the 1995 floods at Chorro Flats, three to four feet of sediment was deposited in some areas, an estimated 140,000 cubic yards of soil that would have ended up in Morro Bay.

Identifying the Problems

Since 1995, a broad group of citizens, scientists and government specialists has been studying the Morro Bay Estuary and watershed, examining its health, identifying its high-priority problems, and devising plans of action. The goal has been to create a balance of interests in the watershed by including advisors and advocates from all the groups who had a stake in the process, including agriculturalists, environmentalists, landowners, tourism-based business owners, commercial fishers, and recreational boaters. Seven important areas of concern were identified by this broad coalition, and focused studies were then undertaken to gather more information. This new information, coupled with past studies dating back as far as the 1960s, has provided important information about trends.

The Priority Problems

Rapid sedimentation –
The size of Morro Bay is decreasing at an alarming rate. Erosion in the watershed and sedimentation in the estuary are believed to be the greatest threats. The rate of sediment delivery has increased rapidly due to changes in land use, alteration of natural sediment deposition areas, and wildfires.

Increased bacterial concentrations –
Bacterial contamination is threatening shellfish operations within the bay to the extent that harvesting is always restricted in about one quarter of the lease area, and other areas are closed to harvesting during storm events. High coliform counts have been found in both summer and winter near shoreline locations discharging contaminated water into the bay.

Increased nutrient concentrations –
Runoff from agricultural areas, grazing pastures, roadsides and lawns is increasing nutrient concentrations in the bay, resulting in increased algal growth and reduced levels of dissolved oxygen, which can affect aquatic organisms. Poorly functioning septic systems, fertilizers, and animal waste are believed to be contributing to this problem.

Above: The 7th Annual National Non-Point Source Monitoring Conference was held in Morro Bay in 1998.
Below: Volunteer monitor Al Pardo measures a stream channel in one of the creeks within the Morro Bay watershed.
Volunteer monitoring has been and will continue to be a crucial vehicle for obtaining data about the Morro Bay Estuary and its watershed.

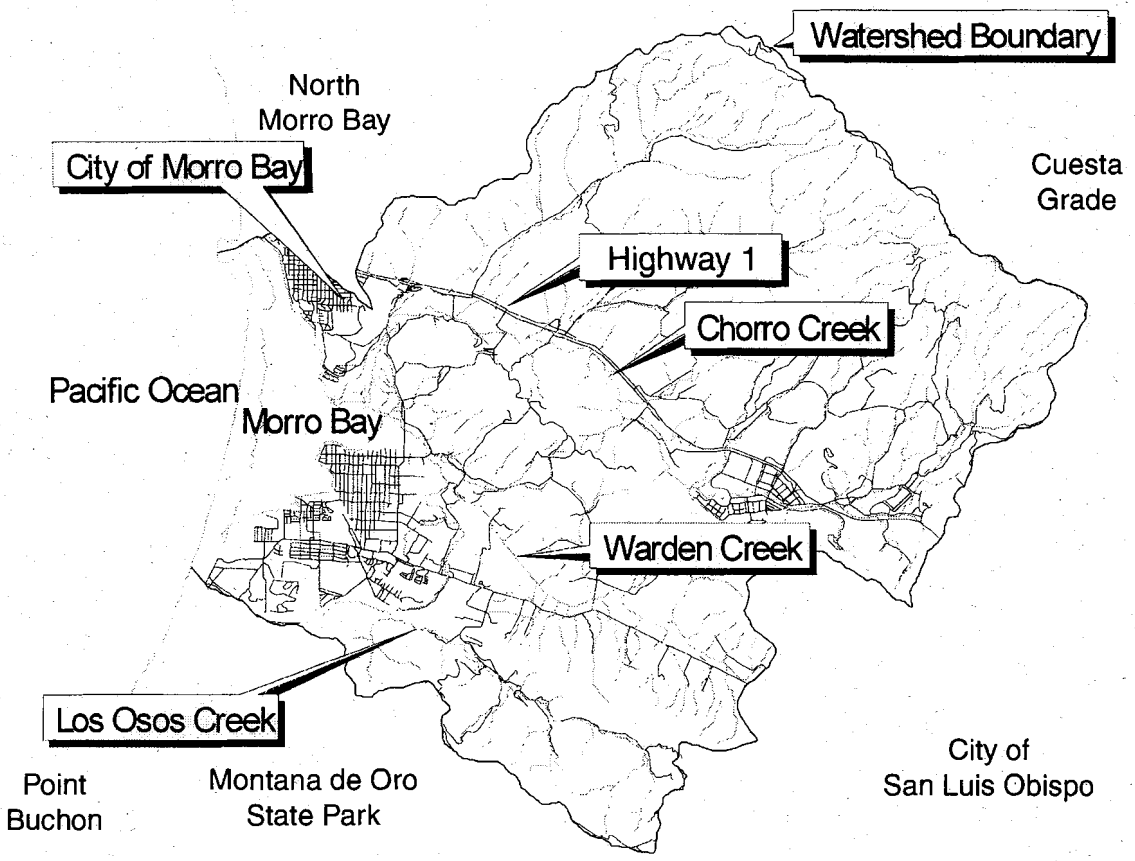
Freshwater flow reductions –
Groundwater aquifers are recharged from the same sources that provide freshwater to the estuary. Increases in surface and groundwater diversions directly affect the quality, and timing of creek flow into the bay, as well as the wildlife and botanic values associated with the supply of freshwater.

Increased heavy metal and toxic pollutant concentrations –
Inactive mines in the upper watershed are believed to be the source of eroding sediment containing high levels of heavy metals into Chorro Creek. Runoff from urban stormwater and bayside marina activity also introduces heavy metals and and other toxic pollutants into the bay.

Habitat loss –
Development pressures in this region of the central coast are rapidly increasing. Greater population density and altered land use threaten water quality and wildlife habitat. Changes in drainage patterns, erosion, and invasive species are contributing to this problem.

Steelhead loss –
Water diversion projects, migration barriers, drought and siltation upstream have greatly reduced the viability of steelhead in Chorro and Los Osos Creeks.

The Morro Bay Watershed



This GIS-generated map shows the streams and waterways of the Morro Bay Estuary and its watershed system.
The major creeks – Chorro, Los Osos, and Warden – are marked, as are several relevant landmarks.

The Morro Bay watershed encompasses an area of approximately 48,000 acres, or 75 square miles.
Its highest elevation is 2,763 feet above sea level and its furthest point from Morro Bay is about 10 miles.

The Action Plans

At the heart of the CCMP are the 61 "Action Plans." These actions have been developed based on information from scientific studies, the goals and objectives of the NEP, the priority issues, and significant stakeholder input. The MC ranked the top 31 high priority actions, as noted below by this symbol: ★. Like other aspects of the NEP, this priority ranking is subject to change as various opportunities and needs arise.

Cross-Cutting Actions

Most of the action plans are organized by the priority issue they most directly address. However, due to the complexity of the watershed environment and the interrelationships of problems, the cross-cutting objectives and actions broadly cover a number of the priority issues.

★	CC-1	Acquire and protect lands with ecologically valuable habitat and/or beneficial functions
★	CC-2	Reduce drainage problems by acquiring detention and retention areas
	CC-3	Develop and implement Total Maximum Daily Loads (TMDLs)
★	CC-4	Implement urban storm water Best Management Practices (BMPs)
	CC-5	Maintain, restore, and enhance stream geomorphology and water quality for steelhead
★	CC-6	Expand and maintain the existing Volunteer Monitoring Program (VMP)
	CC-7	Establish a Watershed Crew to provide planning, labor, outreach and mapping services

Sedimentation

It is a natural process for estuaries to eventually fill due to sedimentation. However, Morro Bay has been experiencing abnormally accelerated rates of sedimentation due to watershed disturbances. The contributing factors may include upland and streambank erosion, as well as land disturbances such as roads, construction, agricultural and mining activities, and sediment transportation by ocean currents.

Objectives

- Reduce sedimentation into the estuary and increase clarity of estuary waters
- Decrease erosion from upland areas
- Minimize agricultural soil loss, increase stakeholder involvement; implement Best Management Practices (BMPs)
- Reduce bedload (in-stream) and stream bank soil erosion
- Decrease the rate of shoreline erosion and dune migration

Save Bay Tips

Keep your septic systems functioning at optimum levels, and use boat pumpout facilities.

Landscape your yard using plants that have low requirements for water, fertilizers, and pesticides.

Apply lawn and garden chemicals sparingly and according to directions.

Keep litter, pet waste, leaves, and debris out of street gutters and storm drains — these outlets drain directly to the bay and its watershed.

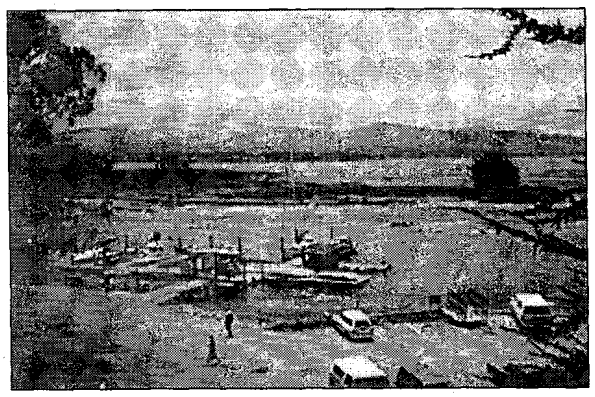
Drive less — Automobiles emit tremendous amounts of airborne pollutants, which increase acid rain; they also deposit toxic metals and petroleum byproducts into the environment.

Regular tuneups and inspections can help keep automotive waste and byproducts from contaminating runoff.

Use water-based products whenever possible

Dispose of used oil, antifreeze, paints, and other household chemicals properly, not in storm sewers or drains.

One quart of oil can contaminate up to two million gallons of drinking water!



Actions

- SED-1 Increase use of management measures for road maintenance and construction activities
- ★ SED-2 Install new and maintain existing sediment traps
- ★ SED-3 Develop and implement a watershed fire management plan
- ★ SED-4 Assist landowners to implement Best Management Practices (BMPs)
- ★ SED-5 Assist landowners to implement creek restoration projects
- SED-6 Revegetate north sandspit areas
- SED-7 Encourage landowners to control erosion and retain sediment
- SED-8 Improve degraded estuary navigation channels and habitat, and increase circulation

Bacteria

Morro Bay has experienced elevated levels of bacteria, which present a potential health threat to those who utilize the bay for recreational purposes and economic threats to those who depend upon the resources of the bay for their livelihood. Sources of high bacteria include discharged effluent, failing septic systems, wildlife and domestic animal waste, boats with inadequate waste disposal capabilities, and urban and agricultural runoff.

Objectives

- Reduce the length of closures for restricted shellfish lease areas and meet standards for water contact recreation
- Decrease levels of bacteria originating from live-aboard boats
- Minimize bacterial pollution from wildlife, domestic pets and horses
- Promote consistent and comprehensive water quality standards and monitoring efforts

Actions

- ★ BACT-1 Implement grazing management measures
- BACT-2 Provide new and upgrade existing pump-out facilities
- ★ BACT-3 Remove illegal moorings in the backbay
- ★ BACT-4 Remove abandoned, derelict boats and vessels in the backbay
- BACT-5 Decrease levels of bacteria from live-aboard boats
- BACT-6 Explore the bio-filtration potential of the Pacific oyster *(Crassostrea gigas)*
- BACT-7 Install and maintain bird-deterrent floats in shellfish growing areas
- BACT-8 Promote an off-leash dog park and horse trails away from creekbeds and other estuarine areas
- BACT-9 Coordinate state and local bacteriological water quality standards and monitoring efforts

Preserve existing trees, and plant three levels of vegetative cover (trees, shrubs, and ground cover) to help prevent erosion and promote infiltration of water into the soil.

Use drip irrigation, and/or keep a careful watch on watering. If water is running off the yard area, it's not getting to your plants, and maybe carrying away valuable topsoil.

Water in the evening or early morning, not during the heat of the day.

Over-watering may also increase leaching of fertilizers to ground water.

Take short showers instead of baths and avoid letting faucets run unnecessarily.

Repair leaking faucets, toilets, and pumps. The drips add up!

Nutrients

Nutrient enrichment impacts the beneficial uses of drinking water, commercial and sport fishing, shellfish harvesting and wildlife habitat. The potential sources of these excess nutrients include urban runoff, leaking or failing septic systems, animal waste, wastewater discharges, fertilizer application and other natural processes.

Objectives

- Reduce the concentrations of nitrates in watershed creeks, streams and groundwater
- Decrease fertilizer runoff from residential and golf course areas
- Protect social, economic, and environmental benefits provided by the bay and watershed
- Promote public awareness and involvement in estuarine management issues

Actions

★ NUTR-1 Support efforts to increase and improve the level of wastewater treatment in Los Osos

★ NUTR-2 Develop nitrogen-control measures for wastewater effluent

NUTR-3 Implement agricultural management practices which reduce nitrate levels

NUTR-4 Implement Best Management Practices (BMPs) to decrease fertilizer runoff

Freshwater Flow

The Morro Bay Estuary ecosystem is dependent on the delicate balance of salt water and freshwater. Significant reductions in freshwater flow to the watershed and bay have a direct impact on a wide variety of social and economic conditions in the region, including water supply, flooding, habitat, recreation, and fishing. Potential causes of these reductions in freshwater flow include water usage and poor water management.

Objectives

- Increase and maintain freshwater flow in the Chorro and Los Osos basins

Actions

FLOW-1 Support City of Morro Bay efforts to reclaim water

FLOW-2 Maintain minimum stream flows in Chorro Creek

★ FLOW-3 Promote ground water conservation and reuse

FLOW-4 Maintain and dedicate wastewater treatment plant releases to prevent streamflow reduction and enhance fishery and wildlife uses of Chorro Creek

Heavy Metals and Toxics

A variety of toxic substances and heavy metals are reaching Morro Bay in small amounts. Heavy metals can be a serious water quality concern because of their toxicity, persistence and potency. Sources of heavy metals and toxic substances include stormwater runoff, vehicle brake pad dust and other discharges, mine runoff, solid waste disposal areas, household and industrial uses, agriculture and wastewater discharges.

Participate in the Volunteer Monitoring Program

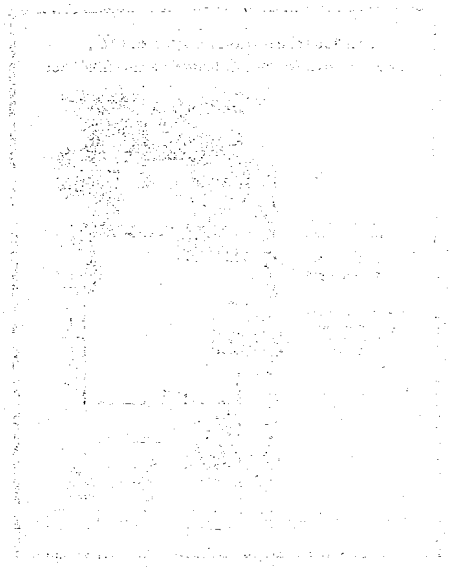
Show the "Change on the Range" video to your class or group

Attend MBNEP Public Meetings

Volunteer for groups, such as SWAP or MEGA.

Enjoy a walk or field trip that gets you, your family, and friends out on the estuary or in the watershed

Realize that YOUR actions ultimately affect the health of the Morro Bay Estuary and watershed



Landscape using native plants, or at least using non-invasive plants that will not threaten the native vegetation. For more information about this type of landscaping, refer to the "Yards and Neighbors Brochure" developed by Friends of the Estuary and available at the MBNEP.

Wash your car only when necessary; use a bucket to save water. Alternatively, go to a commercial carwash that uses water efficiently and disposes of runoff properly.

Use low-flow faucets, shower heads, reduced-flow toilet flushing equipment, and energy and water efficient appliances.

Use dishwashers and clothes washers only when fully loaded, and use low-phosphate or phosphate-free detergents.

Participate in local clean-up activities.

Objectives

- Reduce the introduction of heavy metals and other toxic pollutants to watershed streams, estuary waters and sediments

Actions

★	HMT-1	Remediate inactive/abandoned mines and reduce heavy metals and sediment loadings
	HMT-2	Implement marina Best Management Practices (BMPs)
	HMT-3	Support development and design for environmentally friendly boat haulouts and maintenance facilities for large vessels
	HMT-4	Establish a network of easily accessible hazardous waste facilities, including bayside locations

Loss of Habitat

Due to the interdependency of ecosystem components, habitat loss has become a significant priority problem in Morro Bay and its watershed. Habitat loss and degradation occur as a result of other priority problems–sedimentation, nutrients, bacteria, heavy metals and toxics and freshwater flows. Habitat impacts from these problems include decreased waterfowl populations, reduced recreational and commercial value, fewer pollutant buffers, and less biodiversity.

Objectives

- Support and strengthen actions by public agencies and private parties to protect habitat and function
- Increase the quality and quantity of riparian corridors and estuarine wetland habitats
- Reduce habitat loss to invasive species

Actions

★	HAB-1	Develop planning overlay maps for sensitive habitat and listed species
	HAB-2	Inventory and protect ecologically significant upland habitat
	HAB-3	Map shoreline, near shoreline wetlands, upland vernal pools and riparian vegetation along all creeks and their tributaries
	HAB-4	Implement appropriate actions in existing and future species recovery plans
	HAB-5	Implement policies and projects to protect, restore and create habitats, including wetlands, in connection with dredging projects
	HAB-6	Maintain and promote wetland resources and riparian vegetation through proven management techniques
	HAB-7	Develop methods, including voluntary and incentive programs to protect riparian and wetland resources
★	HAB-8	Implement restoration activities to improve the quantity and quality of eelgrass habitat
★	HAB-9	Implement management measures to control the impacts of nonindigenous species
	HAB-10	Implement pilot project to remove A. *donax* from riparian vegetation corridors

Loss of Steelhead

In the Morro Bay watershed, both Chorro and Los Osos Creeks support southern steelhead populations. However, declining habitat, water diversion projects, migration barriers, drought and siltation have greatly reduced the viability of local steelhead population. In August 1997, southern steelhead was listed as federally threatened by the National Marine Fisheries Service.

Objectives

- Protect and enhance steelhead populations and habitat

Actions

	STL-1	Implement steelhead trout recovery goals
★	STL-2	Restore and increase access to critical habitat
★	STL-3	Maintain and enhance pool/riffle structure
	STL-4	Maintain and enhance riparian corridors

Public Outreach

The ultimate goal of the MBNEP is the protection and restoration of the unique natural resources of Morro Bay. Through the cooperative efforts of federal, state and local interests, the program is focused on promoting environmentally sound management of the estuary. Broad-based public involvement and support are required to accomplish this goal.

Objectives

- Increase public awareness of resources, processes and priority problems
- Increase children's awareness of resources, processes and priority problems
- Improve cooperative efforts and understanding of issues for partnering agencies, organizations and stakeholders

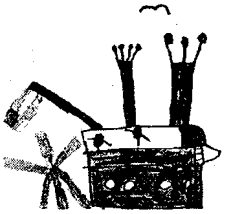
Actions

★	EDU-1	Conduct general outreach and education focused on a healthy environment
★	EDU-2	Develop educational materials regarding marine pollution and habitat issues
★	EDU-3	Develop educational materials regarding erosion, sedimentation, sensitive resources and fertilizers
★	EDU-4	Organize workshops on the positive and negative uses of pesticides
★	EDU-5	Coordinate "State of the Estuary" conference to encourage community involvement
★	EDU-6	Create an interactive monitoring display for the Morro Bay Natural History Museum
★	EDU-7	Increase public knowledge of MBNEP and projects through the media
★	EDU-8	Provide at least two public access locations to the estuary in Los Osos
★	EDU-9	Prepare an education plan focusing on natural resources and watershed enhancement for k-12 schools
★	EDU-10	Develop a mini-grants program for community organizations to assist in the implementation of the CCMP
★	EDU-11	Review and refine the CEQA/NEPA initial study environmental checklist

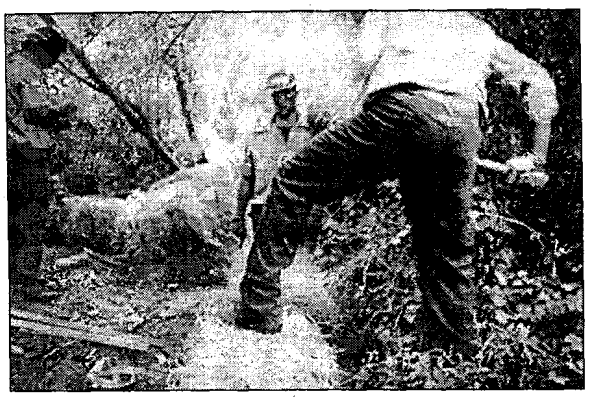
Since 1995, the MBNEP has been holding a poster contest involving SLO County students of all ages to help educate students, parents and the community about the challenges facing the Morro Bay Estuary and watershed.

Last year, some 130 children turned in poster entries.* Artwork from entries has been used in MBNEP documents, a calendar, notepads, and magnets.

In 2000, the MBNEP also co-sponsored a poetry contest in conjunction with the Morro Bay Winter Bird Festival and Friends of the Estuary.



** At left is artwork from last year's Grand prize winner Bethany Anderson*



We celebrate the dedication and determination of the numerous citizens, organizations, agencies and businesses which are committed to the protection and restoration of Morro Bay and its watershed. The difficult phase of developing the CCMP has been completed. The next step is to move into the implementation process. The Management Conference signed the final draft CCMP on May 4, 2000 and sent it forward to California Governor Gray Davis and EPA Administrator Carol Browner for final approval.

Watershed Committees

Upon receipt of the final approval, the Management Conference will turn over implementation responsibilities to a new MBNEP organizational structure. This structure will be composed of an Executive Committee, Implementing Committee, Task Force and MBNEP Staff. Although each of these organizational groups will have unique responsibilities in the implementation process, the larger objective is to function as an united body to effectively and efficiently facilitate and administer important supporting projects carried out by community stakeholders, organizations, agencies and individuals.

"The Morro Bay watershed communities have been the cornerstone of the CCMP..."

"In total, over 75 agencies, organizations, and businesses will participate in the implementation of the CCMP."

"Thanks to community involvement and the considerable investment of time, energy and vision of each stakeholder, the CCMP accurately reflects the priority problems of the Morro Bay National Estuary, as well as makes recommendations that community members can individually or jointly help to implement."

Public Participation

Thanks to community involvement and the considerable investment of time, energy and vision of each stakeholder, the CCMP accurately reflects the priority problems of the Morro Bay National Estuary, as well as makes recommendations that community members can individually or jointly help to implement. To streamline projects and ensure steady progress, the MBNEP office will be the primary coordinator of implementation activities. In addition to these duties, the office will continue to promote general community awareness of the MBNEP, encourage formal and informal educational opportunities related to the estuary and its watershed, and remain committed to engaging further public participation in future MBNEP planning processes.

There are many more ways to participate, contact the MBNEP at 1400 3rd Street, Los Osos, CA 93402, (805) 528-8126, Fax: (805) 528-3420, Email: mbnep@mbnep.org for more information.

Volunteer Monitoring

The Volunteer Monitoring Program has developed into a partnership between many agencies, organizations and citizens. The Bay Foundation and the Central Coast Regional Water Quality Board (through the MBNEP) provide support for volunteer coordination, program management, and laboratory funds for monitoring activities. The Friends of the Estuary provides funds for water quality equipment and volunteer recognition. Partnerships are continually forming to expand the watershed wide Volunteer Monitoring Program. Hundreds of volunteers have gotten their feet wet in the creeks and bays. To find out how you can get involved, contact the MBNEP staff at (805) 528-8126.

Current Opportunities:

Benthic Invaders

Each spring, citizen monitors venture into the creeks using kicknets to gather benthic macroinvertebrates from the stream bottom gravels. These bottom-dwelling aquatic insects are surveyed as indicators of water and habitat quality as part of a sampling method called Rapid Bioassessment.

Bac Attackers

Routine sampling for *E.coli*, total coliform, and nitrates has also been occurring bi-weekly on the fringes of the bay at freshwater seeps. The Bac Attackers collect and analyze bacteria levels in conjunction with the Surfrider Foundation's Blue Water Task Force.

Stream Profilers

Habitat assessments and stream channel profiles are conducted once a year, during the summer, when flows in the creeks are low. These assessments are conducted to evaluate characteristics such as riparian corridor health, creek channel shading, stream bank stability, fish habitat quality, and siltation of stream bottoms.

SLO Floaters

Every other week, rain or shine, volunteers measure creek flows in the tributaries that flow into Morro Bay. Volunteers also help collect water quality samples at these locations as part of a ten-year EPA funded cooperative program between Cal Poly State University and the CCRWQCB - The National Monitoring Program.

Dawn Patrol

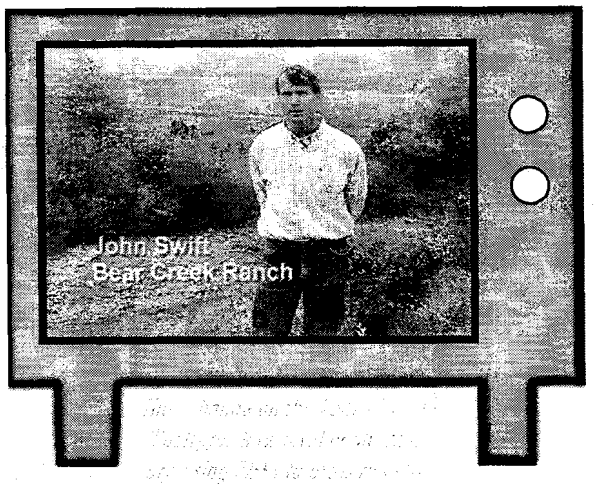
Every month, the Dawn Patrol takes to the water in kayaks to measure dissolved oxygen. The team gathers their data before sunrise to document oxygen levels that may be stressful for fish and other marine organisms.

Bay Nitrate Monitoring

Volunteers venture into the bay by boat, canoe, and kayak to collect nitrate and salinity samples as part of a Cal Poly senior project coordinated study. The data collected is being used to evaluate quarterly nutrient levels in the estuary.

Drain Rangers

The Drain Rangers are "on call" to collect storm water runoff samples from culverts and storm drains during the winter season. Volunteers collect samples during the "first flush," when the first large storm of the rainy season flushes accumulated pollutants from roads and other surfaces.



Funding

The MBNEP receives funding from the U.S. EPA, but a large portion of implementation funding is expected to come from Consent Decree funds (awarded to the MBNEP via a legal settlement in 1997) .The Bay Foundation (a local non-profit organization) acts as bursar for all NEP funds; however, decisions regarding Consent Decree funding are made jointly by the Bay Foundation, the California Regional Water Quality Board (a State agency), and the Local Policy Committee. This partnership is unusual for an NEP, as most NEPs are administered solely by state or local government entities.

On July 2, 1998, the Watershed Committee (WC) approved funding for several Action Plan Demonstration Projects (APDPs). The primary goals of these projects were to improve the water and habitat quality of the Morro Bay Estuary, and demonstrate the effectiveness of action plans being considered for the CCMP.

- Morro Bay Watershed Run-Off Model
- Introduced Marine Species Management
- "Yards and Neighbors" Brochure
- Permit Streamlining
- Environmental Photojournalism
- Veldt Grass Suppression
- Bayfront Boatyards/Marinas BMPs
- Giant Reed (*Arundo donax)* Eradication
- Poster Contest and MBNEP Calendar
- Harbor Debris Removal
- Riparian Fencing Project
- Boat Rinse Station Project
- Volunteer Monitoring Program
- "Change on the Range" Video

(More information about these projects is available in Appendix C of the CCMP.)

Measuring Progress

The MBNEP anticipates that the CCMP Action Plan will take 5 years to implement. The Action Plan has been divided into 7 sections corresponding to each of the priority problems. Each priority problem contains specific actions for implementation, providing a total of 61 recommendations for action. From the total, 31 actions have been determined to have precedence for implementation and have been given priority implementation deadlines.

To measure progress, the MBNEP will track the implementation of these actions and provide formal updates to the U.S. Congress, MBNEP Committees and to the Morro Bay community. The MBNEP Office will use a variety of reporting techniques including: quarterly newsletters, annual reports, online status updates available through the MBNEP website and community presentations. For more information about the CCMP implementation strategy or progress, please refer to the MBNEP Office at (805) 528-7746 or online at www.mbnep.org.

The CCMP was carefully drafted using the best information available. However, circumstances may arise which require necessary adjustments to the Plan. The MBNEP Committees have made organizational preparations and designed the CCMP to be flexible to allow for adaptations to be made if necessary. Nevertheless, MBNEP is confident that implementation will occur without delay. In fact, many of the action items have already begun to be implemented!

The Morro Bay Estuary and its watershed are important and extremely complex resources, and managing them is a significant challenge. The Morro Bay Estuary is still vulnerable to environmental degradation, and environmental protection must be integrated with the uses of the land, water, and other natural resources. The Comprehensive Conservation and Management Plan (CCMP) offers an array of actions to protect and restore the health of the Estuary and watershed.

The most valuable tools and resources for the work ahead exist in the community committed to carrying out the Action Plans. This community has demonstrated that with increased awareness and interest, people become more involved in protection, restoration, and management of the Morro Bay Estuary and watershed. With their involvement, watershed management can strengthen a sense of community, help reduce conflicts, increase commitment to the actions necessary to meet environmental goals, and ultimately, improve the likelihood of success.

The active involvement of the local community is the essential key to making the CCMP a true living document that grows and improves with lessons learned and successes gained, rather than just a plan that remains on a shelf. The commitment of the Morro Bay community certainly offers a future bright with promise for the Estuary and all of its inhabitants.

Mara Waddell, William Chesnut, Casey Unger, and Shane Wilwane celebrate the completion of their Morro Bay Watershed Run-Off Model APDP.

Morro Bay National Estuary Program

The MBNEP maintains an office within the Morro Bay watershed under the auspices of the Bay Foundation of Morro Bay and the state's Central Coast Regional Water Quality Control Board (CCRWQCB).

The office is located at: 1400 Third Street, Los Osos, CA 93402
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Morro Bay NEP Website — http://www.mbnep.org

EPA National Estuary Program Website — http://www.epa.gov/owow/estuaries/nep.htm

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page 17: Bethany Anderson – Grade 3, Monarch Grove Elementary (*1999 Grand Prize Winner of the MBNEP Poster Contest)*

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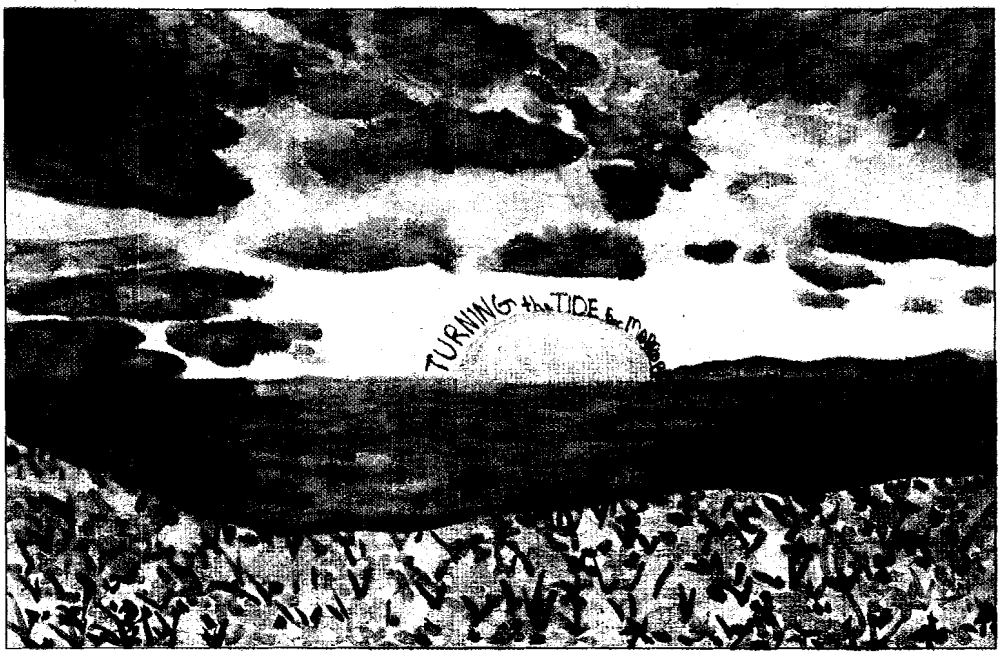

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