Supplemental Draft
Environmental Impact Report/Statement

Monterey Peninsula Water Supply Project

APPENDICES

Monterey Peninsula Water Management District

U.S. Army Corps of Engineers
Permit Application #16516 S09

August, 1991

Statement A per Telecon
Roger Golden Army
Corps of Engineers
ATTN: CESPN-PE-R
San Francisco, CA 94105

NWW 9/6/91

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APPENDIX 1

TECHNICAL REFERENCE LISTS

June 1991

MONTEREY PENINSULA WATER MANAGEMENT DISTRICT
LIST OF ORIGINAL DOCUMENTS

DATE	AUTHOR	TITLE
1977	Hal Boudreau	Lessons Learned from Mandatory Water Rationing on the Monterey Peninsula 1977
Aug. 1978	Carlton J.	Review of Studies & Reports for Supplemental Clayton for Water Supply for Zone 11 (MCFC&WCD)
March 1979	Bruce Buel	Final - Report to the California Coastal Commission
April 1979	USGS	Los Padres Sedimentation Study
Nov. 1979	Clifford J. Cortright	Technical Feasibility Study (Carmel River Dam Sites)
Nov. 1979	Robert C. Lewis	Proposed Dams on the Carmel River in Monterey County (Steelhead Release Reconnaissance)
1980	***	Map - Possible Off-Stream Storage Sites
Jan. 1980	MPWMD Cal-Am	Draft - Position Paper Re Cal-Am Subcommittee Rate Application
Feb. 1980	John Logan	Reconnaissance Study of Off-Channel Reservoirs, Carmel River Basin
April 1980	John G. Williams	Stream Flow & Reservoir Yield at the San Clemente Site Carmel River
July 1980	Clifford J. Cortright	New San Clemente Dam & Reservoir Cost Estimates
July 1980	Harold C. Fritts Geoffrey A Gordon	Annual Precipitation for and California Since 1600 Reconstructed From Western North American Tree Rings

Aug. 1980	Clifford J. Cortright	Chupines Creek Dam & Reservoir Reconnaissance Level Cost Estimate
Oct. 1980	Robert Woodhouse	Physiological Ecology Reconnaissance Study
Oct. 1980	Recht, Hausrath & Associates	Economic & Demand Projections
Oct. 1980	Recnt, Hausrath & Associates	Financing Mechanisms & Revenue Sources
Oct. 1980	Kevin Walsh	Review of Seaside Ponding Project
Oct. 1980	Robert C. Lewis	Flow Requirements in the Carmel River With the Proposed New San Clemente Dam
Nov. 1980	U.C. Berkeley	Residential and Institutional Rainwater Collection Systems
Feb. 1981	USGS	Groundwater in the Seaside Area
Feb. 1981	SERL	Rainwater Collection System
May 1981	Bruce Buel	Standby Rationing Plan
May 1981	U.S. Army Corps of Engineers	Feasibility Report on Water Resources Development Carmel River (located on General Manager's bookshelf-very large document)
July 1981	Converse, Ward, Davis, and Dixon	Economic Feasibility Analysis & Comprehensive Water Supply Program
July 1981	John Logan	Reconnaissance of Alternatives for Recharging Seaside Aquifer
July 1981	Robert Curry and G. Mathias Kondolf	Carmel River Sediment Study
Aug. 1981	Kenneth D. Schmidt	Ryan Ranch Water Supply
Sept. 1981	D.W. Kelley & Associates	Reconnaissance of Water Development for the Carmel River
Oct. 1981	Joan Beattie and Patti Murphy, USC	Vegetation of the Carmel River Valley
Nov. 1981	Bruce Buel	Final - Investigation into Los Padres Reservoir Silt Release

Nov. 1981	Hydro Data, Inc.	Evaluation of Bank Erosion Near Manor Well
Nov. 1981	D.H. Dettman D.W. Kelley Associates	Reconnaissance Report: Streambed Sedimentation and Steelhead Habitat in the Carmel River Below Los Padres With Some Possible Solutions to the Problem
Nov. 1981	John Logan	Seaside Monitor Wells
Dec. 1981	Robert W. Curry	Sediment Transport Analysis Between Los Padres and San Clemente Reservoirs
Jan. 1982	WWD Corporation John Logan	Seaside Recharge Predesign Study Coastal Barrier Experiment
Feb. 1982	James Montgomerey, Consulting Engineer	Carmel Valley Wastewater Study
March 1982	John Logan	The Estimated "Excess" Capacity of Canada Pipeline
March 1982	Bruce Buel	Carmel River Management Program
March 1982	WWD Corporation John Logan	Seaside Recharge Predesign Study Injection Trials at Plumas 2
May 1982	D.W. Kelley & Associates	The Probable Effect of Carmel River Water Supply Alternatives on Steelhead Resources
May 1982	MPWMD	Model Ordinance
June 1982	John Logan	Hydrogeology of the Seaside Area
June 1982	John Logan	Recharge of the Carmel Valley Aquifer: A Preliminary Assessment
June 1982	MPWMD	MPWMD Water Supply Project - Initial Study and Scope of Work
June 1982	John Logan	Percolation at Ryan Ranch
July 1982	USGS	Letter Report on Old Carmel Rating Curve
July 1982	Frances Krebs	Krebs and McClain - Operations Model Documentation for On-Channel and Off-Channel Reservoirs

Aug. 1982	Recht, Hausrath & Associates	Draft Report - Economic & Demographic Forecasts
Aug. 1982	Converse Consultants	New San Clemente Project Preliminary Design & Feasibility Study
Sept. 1982	WWD Corporation	Pressurized Recharge at the Plumas Site, Seaside
Sept. 1982	USGS, Ken Muir	Groundwater in the Seaside Area
Oct. 1982	Converse Consultants	New San Clemente Project Conceptual Design & Cost Estimate of Fish Attraction Facilities
Nov. 1982	G. Mathias Kondolf and Robert Curry	Seepage Investigations, Carmel River, 1982 Water Year
Nov. 1982	Bruce Buel	Comparison of Water Supply Alternatives
Dec. 1982	Converse Consultants	New San Clemente Project Conceptual Design and Cost Allowance of Diversion Alternatives
Dec. 1982	Clifford J. Cortright	Arroyo Seco Dam Sites
Dec. 1982	Bruce Buel	Applications Relating to the MPWMD Water Supply and Management Project
Dec. 1982	Recht, Hausrath & Associates	Draft - Economic and Demographic Projections
Jan. 1983	G. Mathias Kondolf	Recent Channel Instability and Historic Channel Changes of the Carmel River
Jan. 1983	USGS, G.W. Kapple, M.J. Johnson, D.A. Van Schoten	Digital Flow Model of the Carmel Valley Alluvial Ground-Water Basin (draft)
Jan. 1983	Robert Woodhouse	Baseline Analysis of the Riparian Vegetation in the lower Carmel Valley

Jan. 1983	John Williams	Carmel River Watershed Management Plan Working Paper No. 1: Habitat Change in the Carmel River Basin
Jan. 1983	Recht & Hausrath	Economic & Demographic Projections
Feb. 1983	USGS	Sediment Data Collected in Carmel Valley
March 1983	Bruce Buel, MPWMD R. King, Anderson-Nichols	Engineer's Report, Carmel River Management Zone (MPWMD Zone #3)
March 1983	Federal Emergency Management Agency	Flood Insurance Study (preliminary)
Undated	San Diego Water Utilities Department	Municipal Sewage Treated to Potability Using Aquaculture Through Membranes
April 1983	John Williams	Carmel River Watershed Management Plan Working Paper No. 2: Water Supply Options for the Monterey Peninsula
April 1983	LAFCO	MPWMD Sphere of Influence
April 1983	John Logan	Final - The Carmel Valley Alluvial Aquifer: Bedrock Geometry, Hydraulic Parameters and Storage Capacity
May 1983	Recht, Hausrath & Associates	Draft Report - Economic & Demographic Forecasts
June 1983	D.W. Kelley & Associates	Draft - Assessment of Carmel Steelhead Resource: Its Relationship to Streamflow and to Water Supply Alternatives
June 1983	MPWMD	Revised Draft - Scope of Work - Water Supply Project Environmental Impact Report
June 1983	John Williams and G. Mathias Kondolf	Channel Stability & Fish Habitat Carmel River, CA - Symposium & Field Conference Guidebook
June 1983	Frances Krebs	Computation of Total Sediment Load of the Carmel River, CA

June 1983	William Snider Calif. Dept. of Fish and Game	Reconnaissance of the Steelhead Resource of the Carmel River Drainage
June 1983	Converse Consultants	Draft - New San Clemente Project Conceptual Design & Cost Estimate of a Rollcrete Dam Alternate
July 1983	John Logan	Storage Calculations, Carmel Valley Alluvial Aquifer
Aug. 1983	John Williams	Habitat Protection in the Carmel River Basin: Legal Issues CRWMP Working Paper No. 3
Aug. 1983	Molly Williams	Avifauna of the Carmel River Riparian Corridor - CRWMP - Working Paper No. 4
Aug. 1983	MPWMD	Carmel River Management Zone Assessment List
Sept. 1983	Bruce Buel	Letter to Riverfront Property Owners re Permit Process
Sept. 1983	John Williams	Legal Status of Carmel Valley Groundwater - CRWMP - Working Paper No. 6
Oct. 1983	Molly Williams	Riparian Mammals and Herptofauna of Carmel Valley - CRWMP - Working Paper No. 4 and 1/2
undated	Russ Mount	Pumping Tests of Four Wells in Lower Carmel Valley, CA for California-American Water Company (Draft)
Oct. 1983	Graham Matthews	Discharge & Sediment Load for Tributaries to the Carmel River - CRWMP - Working Paper No. 5
Oct. 1983	Graham Matthews	A Summary of the Report Entitled: Discharge & Sediment Load for Tributaries to the Carmel River - CRWMP - Working Paper No. 5
Various	Fred Adjarian	Misc. Documents Relating to EIR
Oct. 1983	Converse Consultants	New San Clemente Project Evaluation of Hydroelectric Power
Various	Fred Adjarian	EIR Segments

Oct. 1983	Charles H. Wagner	Study of Upstream and Downstream Migrant Steelhead Passage Facilities for the Los Padres Project and New San Clemente Project
Dec. 1983	R. Curry and G. Mathias Kondolf	Draft - Sediment Transport and Channel Stability, Carmel River, CA
Dec. 1983	Herman Kimmel & Associates	Traffic Engineering Analysis San Clemente Dam Project
Dec. 1983	Cal-Am Water Company	Carmel Valley Well Scheduling Program
Dec. 1983	WESTEC Services, Inc.	Cultural Resources Survey San Clemente Dam Enlargement Upper Carmel Valley
Dec. 1983	John Logan	A Review of 1982 Pumping Tests of the Pearce, Cypress, San Carlos and Rancho San Carlos Wells, Carmel Valley
Jan. 1984	WESTEC Services, Inc.	Noise Assessment San Clemente Dam Enlargement Upper Carmel Valley
Jan. 1984	Dick Heuer	Draft - Re-Examination of Supply and Demand in the Monterey Peninsula Water Management District
March 1984	John Williams	Draft - Carmel River Watershed Management Plan
March 1984	Robert Curry	Observations on Quaternary and Recent Fault Activity, Central Coastal California
April 1984	MPWMD - John Benoit	Final Draft - Water Conservation Plan for Monterey County
April 1984	MPWMD - Gary Page and Graham Matthews	Final - Carmel River Management Plan
April 1984	MPWMD	Water Conservation Plan - Executive Summary
April 1984	DMA Consulting Engineers	Phase I Report, Irrigation System Design Lower Carmel Valley Wells

April 1984	MPWMD	1984 Drought Report
May 1984	Converse Consultants	New San Clemente Project Fish Passage Facilities
May 1984	MPWMD - Gary L. Page	Engineer's Report - Boronda Erosion Control Project (MPWMD Zone No. 4)
May 1984	DMA Consulting Engineers	Preliminary Design & Cost Estimate Boronda Project - Irrigation System Carmel River Management Program
May 1984	Converse Consultants	New San Clemente Project Geotechnical Studies for the EIR
May 1984	Wulff, Hansen & Co.	Boronda Erosion Control Project Zone (Zone No. 4) - Underwriting
June 1984	Richard W. King	Assessing the Use of Direct Recycle of Wastewater for Potable Water Supply in the Monterey Peninsula
June 1984	Linda Maloney	Aquifer-Stream Interaction in the Lower Carmel Valley July 1983-January 1984
June 1984	Recht, Hausrath & Associates	Draft - Growth Impacts: Housing & Employment Forecasts With and Without the Proposed Project
June 1984	Recht, Hausrath & Associates	Socioeconomic Impacts of the Proposed San Clemente Dam Working Paper No. 1 Growth Impacts: Housing & Employment Forecasts With and Without the Proposed Project
June 1984	MPWMD	MPWMD Responsibilities and Expenditure History
June 1984	USGS	Analysis of the Carmel Valley Alluvial Ground-Water Basin
July 1984	Rauscher, Pierce Refnes, Inc.	Work Product No. 1 Pertaining to Financial Analysis of the San Clemente Dam Project

July 1984	Converse Consultants	New San Clemente Project Preappraisal Engineering Studies
July 1984	MPWMD	Contract Documents for the Drilling of Three Observation Wells and Fourteen Neutron Probe Access Tubes in Carmel Valley
July 1984	MPWMD - Gary L. Page	Analysis of Specific Works - Carmel Valley Trail & Saddle Club
July 1984	Prepared for the City of San Diego by the Health Advisory Committee	Proposed Workplan for the Evaluation of Potential Health Risk Associated with the San Diego Total Recovery Program
July 1984	John Logan	Draft - Increased Ground-Water Production in the Seaside Area
July 1984	Rogers E. Johnson Associates	New San Clemente Dam Geotechnical Investigation: Location of Faults Through or Near the Proposed Dam Site
August 1984	ESA	Carmel River Management Plan & Boronda Erosion Project EIR
August 1984	D.W. Kelley & Associates	Evaluation of Alternative Upstream Fish Passage Facilities Over San Clemente
August 1984	D.W. Kelley & Associates	Appendices to: Assessment of the Carmel River Steelhead Resource; Its Relationship to Streamflow; and to Water Supply Alternatives
August 1984	MPWMD Bruce Buel	Network Analysis San Clemente Dam
August 1984	Engineering Science	Draft EIR - Pebble Beach Community Services District Wastewater Treatment and Disposal Project
Sept. 1984	R.M. Woodhouse	Water Potential and Vegetation Survey of the Lower Carmel River
Oct. 1984	MPWMD	Willow Planting Guidelines

Oct. 1984	EIP Associates	Proposal to Prepare a Water Supply Project EIR and Presentation Report
Nov. 1984	MPWMD - Financial Advisory Committee	Final - Recommendation for the Financing of San Clemente
Nov. 1984	MPWMD - Graham Matthews	Draft - Carmel River Research Program - 1984
Dec. 1984	MPWMD - Henrietta Stern	Initial Study - Ord Village Reclamation Pilot Plant
Dec. 1984	MPWMD - John Byrnes	Field Report Discharges of the Carmel River and Carmel Valley Water Table Levels
Dec. 1984	Creegan & D'Angelo	Aquaculture Reclamation Program Ord Village Pilot Plant
Dec. 1984	Linda McGlochlin	Aquifer-Stream Interaction in the Lower Carmel Valley
Jan. 1985	MCFC&WCD	Flood Fighting and Erosion Control Manual
Jan. 1985	DMA Consulting Engineers	Phase 3 Report - Irrigation System Riparian Corridor Lower Carmel Valley
Jan. 1985	Converse Consultants	New San Clemente Project -- Joint Use Facilities Progress Report
Jan. 1985	Rogers E. Johnson	New San Clemente Dam Geotechnical Investigation of Faulting in the Knothole Area
Feb. 1985	Frances Krebs	An Analysis of the Sediment Discharged into the Carmel Bay from the Carmel River and the Carmel Sanitary District Outfall
March 1985	MPWMD Bruce Buel	Summary - San Clemente Dam Project
March 1985	MPWMD	Guidelines for Performance Appraisal

March 1985	Recht, Hausrath & Associates	Hotel Employee Projections as a Component of June 1984 Job Projections
April 1985	Michael Ricker	How are New Water Connection Fees Computed?
April 1985	Recht, Hausrath & Associates	Draft - Working Paper No. 3 - Socioeconomic Impacts of Proposed San Clemente Dam
April 1985	Recht, Hausrath	Hotel Employee Projection & AssociatesasComponent of June 1984 Job Projections Under All Three Scenarios
April 1985	Graham Matthews	Portable Irrigation System Testing Report
April 1985	Rogers E. Johnson & Associates	Investigation of Possible Fault Offsets in Stream Terraces along the Carmel River at Sleepy Hollow
April 1985	MPWMD - Graham Matthews	Summary of Boronda Erosion Control Project
May 1985	Geomatrix	Evaluation of Seismic Design Criteria New San Clemente Dam
May 1985	MPWMD- Bruce Buel	CA1-AM Allocation Summary
May 1985	MPWMD Bruce Buel	1985-86 Water Supply Strategy
May 1985	Henrietta Stern	Draft - EIR Ord Village Reclamation Plant
May 1985	Converse	Phase 1 Final Report - Ground-Consultants Water Evaluation of the Seaside Aquifer
May 1985	Converse Consultants	Addendum to Phase I Final Report Ground-Water Evaluation of Seaside Aquifer System
May 1985	Converse	New San Clemente Project - Consultants Joint Use Studies Draft Report

June 1985	MPWMD	Carmel River Management Program Newsletter - Summer, 1985
June 1985	Henrietta Stern	Project Summary - Ord Village Pilot Reclamation Plant
June 1985	Anderson-Nichols & Company, Inc.	Final - Hydrology Study for Point Lobos Ranch (with Addendum of June 1985)
June 1985	California Public Utilities Commission - Public Staff	General Report on the Results of Cal-Am Water Company for Test Years 1986 and 1987 in Connection With: (four Division application numbers)
June 1985	California Public Utilities Commission - Public Staff Division	Report on the Operations of Cal-Am Water Co. in the Monterey Peninsula District for Test Years 1986 and 1987
July 1985	Yoram Litwin and Davis	Review of the MPWMD Daily John Simulation Model
July 1985	MPWMD - Graham Matthews	MPWMD Irrigation Program: Review of Its Development
July 1985	David Laredo	Irrigation License and River Corridor Access Permission
July 1985	California Public Utilities Commission - Public Staff Division Rate of Return Section	Report on the Cost of Capital and Rate of Return for Cal-Am Water Co.
July 1985	Shirley J. Dreiss and Mark E. Reid, U.C. Santa Cruz	Data Analysis and Numerical Model Development for the Carmel Valley Aquifer
July 1985	Anderson-Nichols/ West	Monterra Ranch Water Supply Study
July 1985	DMA Consulting Engineers	Phase 3 Report Irrigation System Riparian Corridor Lower Carmel Valley
July 1985	Robert M. Woodhouse	Analysis of the Phase 3 Report on 1984 Lower Carmel Production Well Pumping Data

July 1985	Henrietta Stern	Working Draft - Final EIR Ord Village
July 1985	Recht, Hausrath & Associates - Richard Recht	The Effect of Revised Connection Fees & Water User Charges on Development
August 1985	Joseph Oliver	Independent Review of Pumping Test Documentation in DMA Phase 3 Report
August 1985	Joseph C. Clark and Mary A. McKittrick	Reconaissance Field Study ofthe Relationship Between Tularcitos & Navy Fault Zones
August 1985	R.M. Woodhouse	Analysis of the Phase 3 Report on 1984 Lower Carmel Production Well Pumping Data
August 1985	Converse Consultants	New San Clemente Project - Joint Use Studies Final Report
Sept. 1985	Creegan & D'Angelo	Feasability Analysis of Wastewater Reclamation for Groundwater Recharge
Sept. 1985	Anderson-Nichols	Water Supply Study for Laguna Seca Ranch
Sept. 1985	Henrietta Stern	Final EIR - Ord Village Pilot Reclamation Plant (plus David Shonman's Butterfly Report)
Oct. 1985	MPWMD	Draft - Water Conservation Plan for Monterey County
Oct. 1985	MPWMD	1985-86 District Goals & Objectives
Oct. 1985	Joseph Oliver	MPWMD Research Program for 1985-86
Oct. 1985	Yoram Litwin, Ph.D. and Darby Fuerst	Phase II Review of the MPWMD Daily Simulation Model of the Carmel River System
Nov. 1985	MPWMD	Summary of MPWMD Allocations, Adopted April, 1981
Nov. 1985	MPWMD	Fisheries Restoration Act of 1985 - Proposal Number One

Nov. 1985	Luhdorff & Scalmanini	Draft - Feasibility Study of Developing a Water Supply, Tularcitos Formation, Carmel Valley Ranch
Nov. 1985	Luhdorff & Scalmanini	Final - Feasibility Study of Developing a Water Supply, Tularcitos Formation, Carmel Valley Ranch
Dec. 1985	Aqua Terra	Proposal - Laguna Seca Ranch Water Supply
Dec. 1985	DMA	Drawdown Simulation Lower Carmel Valley
Jan. 1986	MPWMD - Michael Ricker	Final - Water Conservation Plan for Monterey County (see August 1987 for current revised version)
Jan. 1986	MPWMD	Carmel River Management Program Schulte Restoration Project
Jan. 1986	Rogers Johnson	Preliminary Report of Landsliding & Associates in the Vicinity of the Proposed New San Clemente Reservoir
Feb.1986	Frank Dryden	Draft - Evaluation of Alternative Water Reuse Projects for the Monterey Peninsula
Mar. 1986	Frank Dryden	Final - Evaluation of Alternative Water Reuse Projects for the Monterey Peninsula
Feb. 1986	U.S. Army Corps Engineers	Long-Range Water Supply Development of for Fort Ord, California
Feb. 1986	EIP Associates	Draft - New San Clemente Dam EIR
Feb. 1986	G. Matthews III & G. M. Kondolf	Transport of Tracer Gravels on a Coastal California River
April 1986	Charles McNiesh	Draft - Effects of Production Well Pumping on Plant Water Stress in Riparian Corridor of Lower Carmel Valley - Volumes 1, 2 and 3
April 1986	Joseph Oliver and Yoram Litwin Ph.D.	Draft - Technical Memorandum 86-02 - Procedure Outline for Estimating P-Ratio Functions for Carmel Valley Aquifers

April 1986	Joseph Oliver and Yoram Litwin Ph.D	Draft - Technical Memorandum 86-03 - Compilation of Ground-Water Data for Calibration of the Carmel Valley Simulation Model
April 1986	Joseph Oliver	Draft - Technical Memorandum 86-01 - Carmel Valley Ground-Water Storage Calculation
May 1986	MPWMD	Draft - MPWMD Projections
May 1986	Bruce Buel	1986-87 Water Supply Strategy
May 1986	Sutro & Co., Inc.	San Clemente Water Revenue Bonds Finance Report
June 1986	D.W. Kelley & Associates	Report on Field Reconnaissance and Review of Downstream Fish Passage Facilities at Reservoirs on the Santiam and North Fork Clackamas Rivers in Oregon
June 1986	Converse Consultants	Draft - New San Clemente Project Preliminary Design and Cost Estimate
June 1986	Henrietta Stern	Application for 404 Permit and Draft Notice of Intent
July 1986	D.W. Kelley & Associates	Relationships Between Steelhead Sport Catch Angling Success and Stream flow
Jan. 1987	Ken Greenwood	Appendicies to Draft CRWMP
Jan. 1987	Fort Ord	Department of the Army License for Fort Ord Monitor Wells
Jan. 1987	Staal, Gardner & Dunne, Inc.	Fort Ord Ground Water Monitoring Well Project
Jan. 1987	Chairman Dick Heuer	Statement to Mayors' Select Committee
Jan. 1987	Henrietta Stern	Final - Evaluation of Water Supply Alternatives for the Monterey Peninsula
Feb. 1987	(From David Laredo's Office)	MPWMD Law (West's Annotated California Codes--Water Code Appendix--1983 Supplement to Supersede 1982 Version)

April 1987	D.W. Kelley & Associates	Preservation of Carmel River Steelhead with Fish Passage Facilities Over San Clemente Dam or With a Hatchery Near Its Base
April 1987	Converse Consultants	Draft - New San Clemente Project Preliminary Design and Cost Estimate - Fish Conveyance Facilities
April 1987	Staál, Gardner & Dunne, Inc.	Hydrogeologic Assessment, Monterey Sand Company, Metz Road Well, Sand City, California
May 1987	Converse Consultants	Final - New San Clemente Project Preliminary Design and Cost Estimate - Fish Conveyance Facilities
May 1987	Converse Consultants	New San Clemente Project Engineering Summaries of Additional EIR Alternatives
May 1987	Converse Consultants	New San Clemente Project Dam Break Study Report
May 1987	Henrietta Stern	Supplementary - Evaluation of Water Supply Alternatives For the Monterey Peninsula
May 1987	Archaeological Consulting Incorporated (ACI)	Archaeological and Historical Investigations for the San Clemente Dam EIR/EIS, Carmel Valley, Monterey County, California
May 1987	Staal, Gardner & Dunne, Inc.	Hydrogeologic Investigation - Seaside Coastal Ground Water Basin, Monterey County, California
May 1987	Joseph Oliver	Technical Memorandum 87-09 - Summary of Seaside Coastal Ground-Water Basin Evaluation
June 1987	Henrietta Stern	Draft - Technical Memorandum 87-15 - Description of New San Clemente Project and "No Project" Conditions

June 1987	D.W. Kelley & Associates	Assessment of the Carmel River Steelhead Resource - Volume II - Evaluation of the Effects of Alternative Water Supply Projects on the Carmel River Steelhead Resource
June 1987	Joseph Oliver	Technical Memorandum 87-10 - Effects on the Upper Carmel Valley Aquifer from Additional Well Development
June 1987	Don and Robin Roberson	Carmel River Bird Survey
June 1987	Edward B. Thornton, Ph.D. and Saad Abdelrahman, Ph.D.	Draft - Impacts on Carmel River State Beach Due to the New Dam at San Clemente
June 1987	Graham Matthews	Draft - Technical Memorandum 87-13 Evaluation of the Effects of the Feasible New San Clemente Project Alternatives on the Channel Stability and Sediment Transport of the Carmel River
July 1987	EIP Associates	Administrative Draft EIR/EIS - New San Clemente Project
August 1987	MPWMD - Michael Ricker	Water Conservation Plan for Monterey County (Current in Effect)
August 1987	D.W. Kelley & Associates	Assessment of the Carmel River Steelhead Resource - Supplement to Volume II
July 1987	Bruce Buel	Development of Distribution Concept Allotments for Allocation System EIR
Sept. 1987	Henrietta Stern	New San Clemente Project Summary of Facts
Sept. 1987	Darby Fuerst and Yoram Litwin, PhD	Overview of Carmel Valley Simulation Model
Sept. 1987	EIP Associates	Draft EIR/EIS - New San Clemente Project
Sept. 1987	EIP Associates	Draft EIR/EIS - Appendices

Sept. 1987	EIP Associates	Summary - New San Clemente Project EIR/EIS
Sept. 1987	Henrietta Stern	New San Clemente Project - Summary of Facts
Sept. 1987	Darby W. Fuerst	Attachment A - Determination of Water Supply Categories for the Monterey Peninsula Water Resources System
Sept. 1987	Staal, Gardner & Dunne, Inc.	Draft - Hydrogeologic Investigation Phase II Point Lobos Ranch Water Supply Study
Oct. 1987	Planning Analysis Development	Administrative Draft - Water Allocation Program Environmental Impact Report
Oct. 1987	Staal, Gardner & Dunne, Inc.	Phase II Point Lobos Ranch Water Supply Study
Oct. 1987	D.W. Kelley and Associates	Final - Assessment of The Carmel River Steelhead Resource - Volume II - Evaluation of the Effects of Alternative Water Supply Projects on the Carmel River Steelhead Resource
Oct. 1987	Joseph Oliver	Draft - Technical Memorandum 87-17: Procedures Simulating Water Level Drawdowns in the Carmel Valley Aquifer Under Different Water Supply System

Production Conditions

Nov. 1987	Henrietta Stern	Written and Oral Comments on New San Clemente Project Draft EIR/EIS
Nov. 1987	CESAND	Permit System Users Manual
Nov. 1987	CESAND	Water Permit System Technical Documentation
Jan. 1988	CAL-AM Water	Report on the Results of Operations and Revenue Requirements
Feb. 1988	Henrietta Stern	Proposed Concept for Selection of Practicable Alternatives - The New San Clemente Project Supplementary Draft EIR/EIS

March 1988	PAD	Draft - Water Allocation Program EIR
March 1988	Henrietta Stern	Summary of Agency Comments on Alternatives Proposal and District Responses
March 1988	Bruce Buel	Proposed Process for Screening of Monterey Peninsula Water Supply Alternatives
March 1988	Prepared for Interagency Group	Draft MPWMD Staff Recommendations RE: Alternatives for Further Analysis in Screening Process
April 1988	EIP Associates	Estimates of Housing and Employment at Buildout within the Monterey Peninsula Water Management District
April 1988	Ken Greenwood	Conceptual Draft - Carmel River Watershed Management Plan
May 1988	Department of Water Resources	Report to the California Water Commission. Department of Water Resources Activities of April 1988
May 1988	J Laurence Mintier & Associates	Draft - Water Supply and Water Distribution Options. Draft Allocation Program EIR, Phase I
May 1988	MPWMD	Draft - Evaluation of Water Supply Alternatives for the New San Clemente Project Supplemental Draft Environmental Impact Report and Statement. Part I: Assessment of Practicability
June 1988	Bechtel Civil Inc.	New San Clemente Dam Project Evaluation of Slope Stability in the Reservoir Area
June 1988	Bechtel Civil Inc.	New San Clemente Dam Project Seismic Design Criteria Review of Previous Studies and Preliminary Recommendations
July 1988	EIP Associates	Final - Estimates of Housing and Employment at Buildout within the Monterey Peninsula Water Management District

August 1988	MPWMD	Draft 2 - Interim Relief Plan
August 1988	Charles McNiesh	Draft - A Methodology for Predicting Riparian Vegetation Impacts Due to Pumping the Carmel Valley Aquifer
Sept. 1988	MPWMD	Interim Relief Pl n
Sept. 1988	EIP Associates	Riparian Habitat Assessment. Alternatives of the New San Clemente Dam Project
Sept. 1988	MPWMD	Evaluation of Water Supply Alternatives for the New San Clemente Project Supplemental Draft Environmental Impact Report and Statement. Final - Part I: Assessment of Practicability
Sept. 1988	Archaeological Consulting	Preliminary Cultural Resources Reconnaissance of Erosion Control Projects, Carmel River, Monterey County, California
Sept. 1988	Staal, Gardner & Dunne, Inc.	Draft Phase II Hydrogeologic Investigation Laguna Seca Subarea, Monterey County, CA
Oct. 1988	J Laurence Mintier & Associates	Revised Draft - Water Supply and Water Distribution Options. Draft Allocation Program EIR Phase II
Oct. 1988	Charles M. McNeish	A Methodology for Predicting Riparian Vegetation Impacts Due to Pumping the Carmel Valley Aquifer
Oct. 1988	DMC Energy, Inc.	Monterey Peninsula Water Corps Preliminary Summary
Nov. 1988	MPWMD	Evaluation of Water Supply Alternatives for the New San Clemente Project Supplemental Draft Environmental Impact Report and Statement. Draft - Part II: Assessment of Performance
Nov. 1988	DMC Energy, Inc.	Final Report - Monterey Peninsula Retrofit Program

Nov. 1988	M. A. Matthews	Plant Survey, Carmel River, Mid Valley Area
Jan. 1989	Charles McNiesh	Final--An Inventory of the Riparian Vegetation Resource of the Carmel Valley
Feb. 1989	Staal, Gardner & Dunne, Inc.	Hydrogeologic Assessment--Ryan Ranch Mutual Water Company--Construction of Well Nos. 9 & 10 Monterey Research Park, Monterey County, California
Feb. 1989	Graham Matthews, MPWMD	Technical Memorandum 88-03--Evaluation of Reservoir Sedimentation Rates in the Upper Carmel River Watershed
March 1989	J Laurence Mintier & Assoc., Jones & Stokes Assoc., DW Kelley & Assoc., Water Resource Assoc.	Draft Environmental Impact Report--Water Allocation Program
March 1989	Joseph C. Clark	Geologic Analysis of the Cypress Point Fault in the Vicinity of the Lower Carmel River Valley
March 1989	Bechtel Civil Inc.	New San Clemente Dam Downstream Migrant Collection Facilities, Job No. 19523--Pine Creek Fish Screening Structure
March 1989	MPWMD, Lead Agency Carmel Sanitary Dist., Marina County Water Dist., Pebble Beach Community Services Dist., Monterey Regional Water Pollution Control Agency, Monterey Co. Flood Control & Water Conservation Dist.	Water Conservation Plan for Monterey County
March 1989	Denise Duffy & Associates	CSD/PBCSD Wastewater Reclamation Project Draft EIR

May 1989	Archaeological Consulting	Archaeological Literature Study and Mitigation Recommendations for the Can˜ada de la Segunda Reservoir, Carmel Valley, Monterey County, California
May 1989	Andrew Bell, MPWMD	Technical Memorandum 89-04--Analysis of New Los Padres Reservoir Rim Dam Concept
May 1989	Senator Henry Mello	Public Hearing on the MPWMD
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APPENDIX 2-A

WATER DEMAND ESTIMATES AT BUILDOUT

[illegible] covers a water allocation program, a mitigation program to protect natural resources such as vegetation, wildlife and fisheries. Alternatives for water resources are explored including acquisition of ground water, water import, ground water and storage reservoirs. A computerized simulation of Carmel Valley, California is discussed. Lists of riparian vegetation, animals, birds, trees [illegible] are included.

- This report discusses

TECHNICAL MEMORANDUM 89-06

DEVELOPMENT OF WATER DEMAND ESTIMATES AT BUILDOUT FOR THE MONTEREY PENINSULA WATER SUPPLY PROJECT EIR/EIS

Prepared by
Henrietta L. Stern

August 8, 1989

I. BACKGROUND

The Monterey Peninsula Water Management District (MPWMD) has proposed a new dam and reservoir on the Carmel River, and is evaluating several alternatives in its Water Supply Project EIR/EIS. One of the major project purposes is to provide water to meet the future needs of planned growth in the community. Estimated water use at "buildout" was determined to be the best indicator of future needs. Buildout is defined as the planned growth, both residential and commercial, that could legally exist within MPWMD boundaries under the General Plans, zoning and other applicable land use policies of the jurisdictions within the District as of January 1, 1988. The buildout estimate is not meant to be a projection of the most likely housing and employment values at a particular future year; instead, it is an estimate of maximum development potential under existing (January 1988) policies.

EIP Associates (July 1988) prepared a final report entitled "Estimates of Housing and Employment at Buildout within the Monterey Peninsula Water Management District." Each jurisdiction within the District (six cities and Monterey County) previously reviewed the draft report, suggested changes and formally approved the corrected final report. Based on the housing and employment estimates in the EIP report, as well as water use factors for residential and commercial sectors, conservation, remodels, intensification and a District reserve, an estimate of total water use in a normal year at buildout was developed.

This technical memorandum summarizes the methods and data used to develop the water demand estimates at buildout expected during normal water year conditions. It also explains how the drought year performance standard that is used to evaluate water supply alternatives in the EIR/EIS was determined.

II. ESTIMATED NORMAL YEAR WATER USE IN THE CAL-AM SYSTEM AT BUILDOUT

Tables 1 and 2 show the District-wide summary of housing and employment, respectively, developed by EIP (1988). Note that estimates for the California-American Water Company (Cal-Am) system, the largest water purveyor in the District, and the non Cal-Am system are identified separately. This section focuses only on water use within the Cal-Am system. Cal-Am provides about 82%

of water used within the District and serves the areas where most development is expected to occur under current plans.

Table 3 shows how the estimated normal year Cal-Am demand of 23,080 acre-feet (AF) was developed, and is explained in the following subsections. In summary, 8,411 AF of estimated new water use from new construction, remodels and intensification was added to a normalized 1988 base of 18,040 AF to yield 26,451 AF of "gross demand." A reduction of 15% due to conservation was applied to the gross demand to yield a conserved demand of 22,483 AF. A District reserve of 600 AF was added to the conserved demand to yield a normal year buildout estimate of 23,083 AF. A rounded value of 23,080 AF is used for all calculations and simulation regarding buildout demand.

Table 4 presents the calculations used to determine the normalized base, various components of new development, intensification and remodels. It should be noted that a 15% reduction in water use through conservation by the year 2020 is the stated goal of the District's Water Conservation Program (MPWMD, 1989).

A. Normalized Base of 18,040 AF

Because water use in one year may not accurately reflect demand, a normalized base was selected for use in water supply estimates. Thus the average water use per Cal-Am customer was calculated for the stable four-year period between fiscal years 1984-1987, where there was only a 3.3 percent difference between the lowest and highest value. This value of 0.530 AF per customer was multiplied by the number of Cal-Am customers on June 30, 1987. More recent data are not used because demand has been affected by voluntary and mandatory rationing imposed by the District due to drought.

B. New Development

The number of homes, apartment units, barracks, hotel rooms and jobs of different types were gleaned from EIP's 1988 report on buildout estimates. Water use factors derived from Cal-Am data and water use surveys conducted by the District were applied to each component of new growth. Water demand from new construction is estimated at 7,231 AF at buildout.

Examination of Cal-Am data shows that water use for single-family homes in cities is significantly lower than that in the unincorporated county areas. This is likely due to larger lots, more extensive landscaping and warmer weather in many county areas, especially Carmel Valley and the Highway 68 corridor. Water use at Monterey Research Park was calculated on the basis of square feet due to restrictions imposed on the type of businesses that could occur there. Water use for employees in other areas of the District was based on the average water use per non-hotel/non-golf course employee.

C. Intensification

Intensification refers to increased water use per water meter, especially within the residential sector, that is not associated with remodeling or new growth. Commercial intensification and remodels were accounted for in EIP's employment estimates. Examples of intensification include infrequently used vacation homes being rented or sold for full-time use, grown children returning to the parental home, and shared housing among unrelated adults due to high housing costs in the area. Inspection of 1980 Census and 1987 State Department of Finance data revealed that an 8% intensification factor applied to the residential sector was a reasonable estimate of additional water use generated by the aforementioned activities. This results in an additional 820 AF expected by buildout.

D. Remodels

Data collected by the District indicate that the cumulative effect of remodels may increase the residential portion of the normalized base by about 3.5%, or 360 AF by buildout.

E. Demand Reductions due to Water Conservation

The District has implemented a comprehensive water conservation program, including an ordinance that requires mandatory installation of low-flow devices. The program's goal is a 15% overall reduction in water demand by the year 2020 (MPWMD, 1989). This report assumes that the conservation program goal will be achieved in two ways: (1) per capita water consumption for existing residents and businesses will be reduced over time due to retrofits and behavioral changes, and (2) per capita water use for new construction in the future will be lower than that in 1987. Thus the estimated "gross buildout demand" of 26,451 AF is reduced by 15% (3,968 AF) to a "conserved buildout demand" value of 22,483 AF. The interplay of existing demand, new water demands from construction, intensification and remodels, and the counterbalancing effect of conservation is shown in the first equation in Table 3.

F. District Reserve

As shown in the second equation in Table 3, a District reserve of 600 AF is added to the conserved water demand value of 22,483 AF. The reserve allows for possible failure of small water systems and consequent incorporation into the Cal-Am system. Twenty-four smaller water systems currently extract ground water within the District, with production ranging from 2 AF to over 200 AF per year. Some of these systems have experienced water quality or water delivery problems in the past. Use of a District reserve in demand calculations may also serve as an "insurance policy" in case intensification/remodel effects are underestimated or the conservation program is not as successful as planned.

III. ESTIMATED NORMAL YEAR WATER USE IN THE NON CAL-AM SYSTEM AT BUILDOUT

Water demand estimates for areas of the District not served by Cal-Am were developed using a similar methodology as to that described above. Examples of non Cal-Am systems include some golf courses in Carmel Valley, small mutual water systems and private farms or homes. It should be noted that only those systems that would receive project benefits or are dependent on the Carmel Valley alluvial aquifer and Seaside Coastal ground water subbasin are considered. Thus water demand in areas such as Cachagua or Laguna Seca, for example, are not included in this analysis. Their supply is derived from ground water systems that are not considered to be part of those under study.

The 1988 base for the non Cal-Am area was derived from the District's annual water use surveys of registered water wells. As shown in Table 5, water use is tracked in four Carmel Valley aquifer subunits, as well as in the Seaside coastal subbasin. Additional water use from intensification and remodels was applied, based on U.S. Census and State Department of Finance data for the census tracts involved. Future water use from new construction was based on EIP's housing and employment for unincorporated areas of the County (Carmel Valley, Highway 68) and water use factors for these areas. A 15% reduction to conservation was also applied. The result is 2,959 AF of non Cal-Am demand expected at buildout. Combined with the 23,080 AF of Cal-Am demand, a normal year District water use of 26,039 AF is estimated at buildout.

IV. DROUGHT YEAR PERFORMANCE STANDARD TO ASSESS ALTERNATIVES

The preceeding discussion focuses on water demand that is expected in a normal year. For the purposes of this discussion, a "normal" year is when weather and rainfall patterns are not unusually hot or dry. More detailed statistical definitions are discussed in the New San Clemente Project Draft EIR/EIS (MPWMD, 1987), which summarizes the CVSIM computer model used to assess water supply performance and other parameters. Because a major purpose of the District's water supply project is drought protection, both now and in the future, performance (yield) in one or more critically dry years is a key factor in determining whether an alternative is feasible or not.

The purpose of this section is to explain how the minimum (drought year) yield standard was developed for the Part II evaluation of alternatives, conducted in November 1988. It is based on the normal year information presented above and District policy at the time on the level of performance that the community should expect from a multi-million dollar facility at buildout. Table 6 summarizes the calculations used to determine the minimum yield standard (firm yield) that must be supplied in a "worst case" situation. In the simulated 86-year period of record (water years 1902-1987) that was used to assess projects in the Part II Evaluation, the future "worst case" would be like water year 1977, the second year of the severe two-year drought of 1976-1977.

As shown in the first equation in Table 6, unconserved water demand (the sum of the normalized base, water use from new development, intensification, remodels and the District reserve) is increased by 5% to result in a gross dry year demand (GDD) of 28,404 AF. The 5% increase was based on Cal-Am metered sales for the period 1983 through April 1988, which showed that non- rationed water use increases in dry and critically dry years. The District reserve was included in this equation because in a future worst case scenario, small non-Cal-Am systems would have failed or 15% conservation would not have been achieved; thus the Cal-Am system would need to produce more water.

The second equation in Table 6 reflects the Board's policy decision that a project should provide at least 75% of unconserved dry year demand at buildout in a future severe drought (i.e., a 25% annual shortfall). Because the District's long-term conservation program is an integral part of any water supply project, it is assumed that the first 15% reduction would result from the conservation program. The subsequent 10% reduction would result from mandatory rationing or other means above and beyond the ongoing conservation program. Reductions beyond 25% were not considered reasonable due to (1) the community's expectation that a multi-million dollar facility should provide significant drought protection, and (2) the hardship imposed to conserve additional water when most accepted means (e.g., ultra-low flow toilets, shower heads, [illegible]ks, drip irrigation, etc.) would have already been implemented via the District's long-term conservation programs and ordinances.

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TABLE 1
DISTRICT-WIDE SUMMARY OF HOUSING

	Existing (Jan 1, 1988)[1]	Additional Potential	Buildout Total
Residential Units			
Single-Family Units			
Carmel-by-the-Sea	2,593	379	2,972
Del Rey Oaks	573	3	576
City of Monterey[2]	6,381	(313)	6,068
Pacific Grove	5,244	232	5,476
Sand City	74	0	74
Seaside (Cal-Am)[3]	4,901	295	5,196
Seaside (Non Cal-Am)[3]	620	0	620
County of Monterey (Cal-Am)	8,190	2,717	10,907
County of Monterey (Non Cal-Am)	868	887	1,755
Subtotal Single-Family	29,444	4,200	33,644
Multi-Family Units			
Carmel-by-the-Sea	619	506	1,125
Del Rey Oaks	9	151	160
City of Monterey[2]	6,721	5,089	11,810
Pacific Grove	2,769	2,661	5,430
Sand City	23	2,617	2,640
Seaside (Cal-Am)[3]	2,516	614	3,130
Seaside (Non Cal-Am)[3]	150	0	150
County of Monterey (Cal-Am)	1,955	279	2,234
County of Monterey (Non Cal-Am)	56	0	56
Subtotal Multi-Family	14,818	11,917	26,735
Total Dwelling Units	44,262	16,117	60,379
Population			
Carmel-by-the-Sea	4,978	1,589	6,567
Del Rey Oaks	1,520	402	1,923
City of Monterey[4]	31,397	10,922	42,319
Pacific Grove	16,367	5,909	22,276
Sand City	200	5,395	5,595
Seaside (Cal-Am)	21,808	2,673	24,481
Seaside (Non Cal-Am)[3]	2,264	0	2,264
County of Monterey (Cal-Am)	24,094	7,116	31,210
County of Monterey (Non Cal-Am)	2,195	2,107	4,301
Total Population at Buildout	104,823	36,112	140,937

[1] Population figures for January 1, 1988 differ slightly from those estimated by the California Department of Finance (DOF) because the dwelling unit counts used in this report differ slightly from those used by DOF.

[2] Excludes 2,520 existing and 396 future beds in military barracks.

[3] Excludes military housing at Fort Ord.

[4] Includes military population associated with 2,520 existing and 396 future beds in barracks.

SOURCE: EIP Associates, 1988

TABLE 2

DISTRICT-WIDE SUMMARY OF EMPLOYMENT

	Existing (Jan 1, 1988)	Additional Potential	Buildout Total
Carmel-by-the-Sea	3,555	1,409	4,964
Del Rey Oaks	498	266	764
City of Monterey (excluding Monterey Research Park)	27,175	12,173	39,348
Monterey Research Park	0	8,404	8,404
Pacific Grove	4,444	1,323	5,767
Sand City	1,550	4,390	5,940
Seaside (Cal-Am)	3,960	4,320	8,280
Seaside (Non Cal-Am)	170	30	200
County of Monterey (Cal-Am)	4,824	1,935	6,759
County of Monterey (Non Cal-Am)	101	471	572
Total Employment	46,277	34,721	80,998

SOURCE: EIP Associates, 1988

TABLE 3: CALCULATIONS FOR CAL-AM WATER DEMAND AT BUILDOUT UNDER NORMAL WATER YEAR CONDITIONS

The estimated (rounded value) normal year water demand for the Cal-Am system at buildout is 23,080 acre-feet. This value was derived using the following equation:

[NB + ND + I + R] x .85 = CD

CD + DR = BD

Where:

NB = Normalized base of 18,040 AF

ND = New Development using 7231 AF

I = Intensification of 820 AF

R = Remodels using 360 AF

CD = Demand with 15% conservation reduction applied

DR = District reserve of 600 AF

BD = Buildout demand of 23,083 AF

TABLE 4: CALCULATIONS FOR COMPONENTS OF BUILDOUT WATER DEMAND UNDER NORMAL WATER YEAR CONDITIONS

A. NORMALIZED BASE

.530 AF/customer x 34,040 customers	=	18,040 AF (rounded)

B. NEW DEVELOPMENT

New Single Family Homes

City: 596 units @ .251 AF each	=	150 AF
County: 2773 units @ .416 AF each	=	1,154 AF
SUBTOTAL	=	1,304 AF

New Multiple Family Dwelling Units (du)

11,917 units @ .169 AF each	=	2,014 AF

New Military Barracks

396 beds @ 100 gpd, including landscaping

396 beds x 100 gpd x 365 days / 325,851 gal/AF	=	44 AF

New Hotel Rooms

3,517 rooms @ .151 AF each	=	531 AF

New Employees (excluding Monterey Research Park)

23,098 non-hotel, non-golf @ .115 AF each	=	2,656 AF
45 golf course @ 2.82 AF each	=	127 AF
SUBTOTAL	=	2,783 AF

New Employees at Monterey Research Park (restrictions warrant use of square feet)

3,277,890 sq.ft. @ .0002 AF/sq.ft.	=	655.5 AF
subtract existing capacity limit of		-100.5 AF
Cal-Am Use	=	555.0 AF

NEW DEVELOPMENT TOTAL	**=**	**7,231 AF**

(continued)

Table 4, continued

C. INTENSIFICATION

Given: 57% of FY 1987 Cal-Am production is residential

Given: 1988 normalized base is 18,040 AF

Given: Residential intensification factor is 8%. This was determined from U.S. Census and State Dept. of Finance data on increasing numbers of persons per household.

Thus: (0.57 x 18,040) x .08 = 820 AF (rounded)

D. REMODELS

Given: 57% of FY 1987 Cal-Am production is residential

Given: 1988 normalized base is 18,040 AF

Given: Residential intensification factor is 3.5%, based on District water connection permit records

Thus: (0.57 x 18,040) x .035 = 360 AF (rounded)

TABLE 5: TOTAL DISTRICT WATER DEMAND AT BUILDOUT UNDER NORMAL YEAR CONDITIONS

(Excludes areas that will not receive project benefits or are not considered to be part of the Carmel Valley Alluvial Aquifer)

Cal-Am System:	23,080 AF
Non Cal-Am, Carmel Valley Aquifer Subunit 1:	89 AF
Non Cal-Am, Carmel Valley Aquifer Subunit 2:	363 AF
Non Cal-Am, Carmel Valley Aquifer Subunit 3:	785 AF
Non Cal-Am, Carmel Valley Aquifer Subunit 4:	949 AF
Non Cal-Am, Seaside Coastal Aquifer:	773 AF
SUBTOTAL:	2,959 AF
TOTAL DISTRICT DEMAND AT BUILDOUT:	26,039 AF

TABLE 6: CALCULATIONS FOR MINIMUM YIELD STANDARD FOR PART II ALTERNATIVES EVALUATION IN DROUGHT YEAR 1977, ASSUMING BUILDOUT DEMAND

The estimated (rounded value) drought year firm yield requirement for the Cal-Am system at buildout is 21,300 acre-feet. This value was derived using the following equations:

$$[\ NB + ND + I + R + DR\ ] \times 1.05 = GDD$$

$$GDD \times .75 = FYS$$

Where:

NB = Normalized base of 18,040 AF

ND = New Development using 7231 AF

I = Intensification of 820 AF

R = Remodels using 360 AF

DR = District reserve of 600 AF

GDD = Gross dry year demand of 28,404 AF, assuming a 5% increase in non-rationed demand in dry years

FYS = Firm yield standard of 21,300 AF (rounded), assuming that a project should produce at least 75% of gross dry year demand in a severe drought like years 1976-77.

APPENDIX 2-B

MPWMD WATER ALLOCATION PROGRAM EIR MITIGATION PLAN

MONTEREY PENINSULA
WATER MANAGEMENT DISTRICT
187 Eldorado • Suite E • P.O. Box 85 • Monterey, CA 93940 • (408) 649-4866

FINAL ENVIRONMENTAL IMPACT REPORT

WATER ALLOCATION PROGRAM

FIVE-YEAR MITIGATION PROGRAM FOR OPTION V -- 16,700 AF CAL-AM PRODUCTION

Adopted by the MPWMD Board

November 1990

Prepared by MPWMD Staff

FIVE-YEAR MITIGATION PLAN FOR OPTION V

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MONTEREY PENINSULA WATER MANAGEMENT DISTRICT

FINAL FIVE-YEAR MITIGATION PLAN FOR OPTION V -- 16,700 AF CAL-AM PRODUCTION

November 1990

INTRODUCTION -- CEQA PROCESS

In April 1990, the Water Allocation Program Final EIR was prepared for the Monterey Peninsula Water Management District (MPWMD) by Larry Mintier and Associates. On November 5, 1990, the MPWMD Board certified the Final EIR, adopted findings which included the mitigations contained in this plan, and passed a resolution that set Option V (16,700 AF Cal-Am production) as the new water allocation limit for the Cal-Am system. This document is the final mitigation plan that was adopted by the District Board. It serves as the blueprint for a comprehensive mitigation program that will be carried out over the next five years.

According to the California Environmental Quality Act (CEQA), the basic purpose of an EIR is to (1) inform governmental decision-makers and the public about potential, significant environmental effects of proposed activities, (2) identify ways the environmental damage can be avoided or significantly reduced, and (3) prevent significant, avoidable environmental damage by requiring changes in projects through the use of feasible alternatives or mitigation measures.

When an EIR shows that a project (or program) would cause substantial adverse changes to the environment, a governmental agency must respond by either changing the proposed project, imposing conditions on its approval, adopting plans or ordinances to avoid adverse changes, choosing an alternative way of meeting the same need, or disapproving the project. CEQA states that projects that entail significant environmental effects should not be approved if there are feasible alternatives or mitigation measures available that would substantially lessen these adverse effects.

The definition of "feasible" is important, because an agency can find that changing or altering a project is not feasible. In deciding what "feasible" means, an agency may consider economic, environmental, legal, social, and technological factors. An agency can also find that a project with significant environmental effects may be approved if (1) it publicly discloses that there is no feasible way to lessen or avoid the adverse effects, and (2) it specifically identifies how expected benefits from the project outweigh the general policy to avoid or reduce significant environmental impacts. This is done via a "Statement of Overriding Considerations," which becomes part of the project approval record.

CEQA states that agency decision-makers have an obligation to balance environmental objectives with economic and social factors, "in particular the goal of providing a decent home and satisfying living environment for every Californian." The MPWMD Board weighed the environmental impacts of the water supply options and water distribution alternatives analyzed in the Water Allocation Program Final EIR against the socio-economic impacts of each alternative. Part of their consideration included the feasibility and economic ramifications of this mitigation plan.

This final mitigation plan is judged to be technically feasible by District staff. Based on the cost estimates and other information provided by staff at two public workshops in August and September 1990, the Board has determined that this final plan is feasible in light of economic, social and legal factors.

SUMMARY OF FINAL FIVE-YEAR MITIGATION PLAN

The following sections outline the final mitigation plan for Water Supply Option V (16,700 AF Cal-Am production). Each mitigation measure recommended by the authors of the Water Allocation Program Final EIR was assessed by District staff for technical accuracy and feasibility. Staff then developed specific mitigation programs that would be necessary to implement the mitigations recommended in the EIR. The District Board then determined whether the specific mitigation should be implemented or amended, based on socio-economic factors and institutional feasibility.

The mitigations described herein will be funded and implemented by MPWMD over a five-year period. After five years, the allocation program as a whole, including the mitigation program, will be reassessed, based on results of the mitigation monitoring studies, development of new water supplies, and other factors. Necessary amendments to the program would be made at that time.

It should be noted that most of the mitigations described for the 16,700 AF option would be identical for other water supply options. The main difference would be the greater frequency that a mitigation would be needed with larger water supply options. This would be especially true for fishery mitigations. Capital costs would remain the same, but O&M costs could be significantly higher for supply options greater than 16,700 AF Cal-Am production. Mitigations are recommended whenever the EIR states that a water supply option would have "potentially significant" or "significant" impacts. It should be noted that the consultant often designated an impact as "potentially significant" when the degree of the impact was unknown or when the success of a mitigation measure couldn't be predicted.

Exhibit 1 summarizes the major Board-approved mitigations for each impact topic. Exhibit 2 provides a rough estimate of capital costs and O&M costs for each program as approved by the Board. The total program costs include annual costs of existing District environmental programs in addition to capital and annual costs of new Board-approved mitigations stemming from the Allocation Program EIR. Capital costs for the comprehensive District program would total about $442,700. Annual costs would total about $638,100 per year for most of five years. The Board-approved mitigation program would entail hiring four new permanent staffmembers (riparian program manager; three fishery technicians at 75% time) in addition to several seasonal river maintenance workers. Two additional fishery technicians would be needed during drought years.

REPORT STRUCTURE

The following pages outline the different impact topics and mitigations. For each topic, an introduction provides a brief summary of the consultant's conclusions about impacts in the Water Allocation Program Final EIR and his recommended mitigations. A brief description of existing District programs that address the issue is provided. Key assumptions that were included in the allocation EIR analyses are also noted, where applicable. Staff comments on the consultant's recommendations are provided, and the specific mitigation measures that were approved by the Board are enumerated.

To the extent possible, mitigations for each impact topic are discussed as follows: (1) description of existing District activities, (2) brief description and purpose of the mitigation, (3) implementation and facilities, (4) frequency of use, (5) monitoring and reporting program, (6) permits required, and (7) preliminary cost estimates.

Exhibit 1

SUMMARY OF MPWMD FINAL FIVE-YEAR MITIGATION PROGRAM
November 1990

FISHERIES

Continue existing programs
Capture and transport emigrating smolts in spring
Prevent stranding of fall/winter juvenile migrants
Rescue juveniles downstream of Robles del Rio in summer
Modify spillway and transport smolts around Los Padres Dam

RIPARIAN VEGETATION AND WILDLIFE

Continue existing programs
Conservation and water distribution management
Prepare and oversee Riparian Corridor Management Plan
Implement Riparian Corridor Management Program
Expand soil moisture and vegetative stress monitoring

LAGOON VEGETATION AND WILDLIFE

Continue existing programs
Assist with lagoon enhancement plan investigations
Expand long-term lagoon monitoring program
Identify feasible alternatives to maintain adequate lagoon volume

AESTHETICS

Restore riparian vegetation (see above)

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Exhibit 2

COST ESTIMATES FOR FINAL MITIGATION PROGRAM FOR OPTION V
November 1990

(Values shown are fully funded by MPWMD for five years.)

MITIGATION PROGRAM	CAPITAL COST			ANNUAL COST		
	Existing	New	Total	Existing	New	Total
Fisheries	$ 9,000	407,700	416,700	$ 12,800	200,100	(1) 212,900
Riparian Vegetation and Wildlife	$ 0	10,000	10,000	$295,000	121,000	416,000
Lagoon Vegetation and Wildlife	$ 26,000	25,000	51,000	$ 1,200	2,000	3,200
Aesthetics	$ 0	0	0	$ 6,000	0	6,000
GRAND TOTAL	$ 35,000	$442,700	$477,700	$315,000	$323,100	$638,100
ESTIMATED TOTAL COST OF BOARD APPROVED NEW PROGRAMS		$442,700				$323,100
ANNUAL FUNDS NEEDED TO CONTINUE EXISTING ENVIRONMENTAL PROGRAMS		N/A				$315,000
TOTAL MITIGATION PROGRAM COST		$442,700				$638,100

NOTE 1: Annual cost estimates for fishery resources are averages; the annual costs could be as high as $382,000 in individual critically dry years and as low as $78,700 in wet years.

u/henri/wp/alloeir.mitprog2

FINAL FIVE-YEAR MITIGATION PROGRAM FOR FISHERIES -- OPTION V

SUMMARY: The Water Allocation Program Final EIR found that all water supply options, including 16,700 AF Cal-Am production (Option V), would have significant adverse impacts to the fishery resource of the Carmel River without mitigations. Discussion of the mitigation program, which focuses on steelhead salmon, is found on page IV-91 of the document. The following mitigations were recommended by the consultant:

1. Juvenile rescue program downstream of Robles del Rio in summer and fall; includes holding facility near San Clemente Dam.

2. Partially reconstruct fish ladder and alter spillway gates at San Clemente Dam to facilitate adult and juvenile migrations.

3. Additional modifications to Los Padres Dam spillway to prevent fish injuries during emigration.

4. New wells in AQ4 to reduce pumping in AQ2, thereby preserving flow in this river reach.

5. Expand downstream smolt rescue and transport program in spring.

6. Capture and transport fall/winter migrants to prevent stranding in the lower river.

7. Attraction facility to capture and transport spawners to Narrows when there is insufficient flow at the river mouth, but adequate flow at the Narrows.

The consultant concluded that the impacts of Option V would be reduced to a less than significant level if these mitigations were implemented.

Existing District Programs: Ongoing District programs already address some of the environmental impacts of existing water supply practices on the steelhead resource of the Carmel River. The District engages in the following activities:

1. As part of the Interim Relief Program, employs half-time fisheries biologist to monitor steelhead status, conduct habitat assessments and coordinate rescue operations.

2. Rescues juvenile steelhead as waters recede, and transports them to safe habitat during critical flow periods.

3. As part of the Interim Relief Program, rescues smolts during critically dry years, transports them to

acclimation facilities, then releases them into the sea.

4. Designed and constructed emergency fish ladder in winter 1990 to attract spawning adults into the river for subsequent transport to safe habitat upstream.

5. Rehabilitates critical migration riffles.

6. As part of the Interim Relief Program, negotiates an agreement with Cal-Am and California Department of Fish and Game regarding diversion and releases from San Clemente Dam.

7. Submits annual report to State Water Resources Control Board on Interim Relief Program activities.

8. Works diligently towards a long-term water supply project that would result in improved streamflow conditions.

The existing fisheries program is modest in terms of cost, due partly to volunteer labor provided by the Carmel River Steelhead Association. About $45,200 was expended in FY 1989-90 for specific fisheries projects, including the experimental fish ladder described in District activity #4 above.

<u>Key Assumptions</u>: The fisheries analysis in the Allocation Program EIR was based on the following key assumptions:

1. A dredging program funded and implemented by Cal-Am would keep the Los Padres Reservoir at its existing usable storage of 1,968 AF.

2. Cal-Am's Carmel Valley filter plant could be operated at 1 to 3.5 cfs when inflow to San Clemente Dam is less than 8 cfs.

3. The existing practice of signing an annual agreement, with quarterly review and amendments, depending on the river inflow conditions, would be continued.

<u>Amendments to Consultant's Fisheries Mitigation Program:</u> Given that the text describing the fisheries mitigations in the Water Allocation Final EIR (page IV-91) was somewhat vague, District staff expanded on six of the seven mitigation measures recommended by the consultant. The facility design, cost estimates, and operations and maintenance are described in detail in the Draft Fisheries Mitigation Plan (Dettman, 1990).

Staff deleted the consultant's mitigation #4 (drilling new wells in aquifer subunit 4) because the results of CVSIM indicate the wells would have been needed only at the end of the 1976-77 drought. In addition, the new wells would exacerbate the environmental impacts identified for riparian vegetation in the lower Carmel Valley.

The District Board reviewed the staff interpretation of the consultant's mitigation program in terms of cost and institutional feasibility. It solicited comments on proposed mitigation facilities from regulatory agencies such as the California Department of Parks and Recreation (CDPR) and Fish and Game (CDFG), which would need to approve permits for these facilities. Based on their comments and other information, the Board deleted the consultant's mitigations #2 and #7, and modified mitigations #3 and #5.

The consultant's mitigation #2 (partially reconstruct the fish ladder and alter spillway gate operation at San Clemente Dam) was deleted by the District Board because it does not own and operate the dam. The District would consider contributing to a study of the effectiveness of passage at San Clemente Dam if such a study were deemed by CDFG as essential to maintaining the steelhead population. It should be noted that Cal-Am will be altering the spillway gates in the next few years to comply with the State Department of Water Resources -- Division of Safety of Dams requirements.

The consultant's mitigation #3 (additional modifications to the Los Padres Dam spillway) was amended by the Board to entail funding of a five-year study of the effectiveness of the spillway modifications made in 1986, based on a design by CDFG engineers. The District will request that CDFG help pay for the study as well. If the study indicates that additional modifications are necessary, the District assumes that construction will be funded by Cal-Am and CDFG.

The consultant's mitigation #5 (expand downstream smolt rescue and transport program) was altered slightly by the District Board. Instead of a formed, in-place (unmovable) concrete structure in the river, the smolt trap design was changed to consist of portable structures, which are less expensive. Also, the river channel itself has been known to move significantly after large storms; thus a portable unit would be more reliable. The effectiveness of the program would not be diminished by this change.

The consultant's mitigation #7 (attraction facility for spawning adults) was deleted by the Board due to questions about water availability, durability of the structure, institutional feasibility and cost. It is uncertain whether water could be appropriated to pump from an upstream location on the river to an attraction facility on the coast (especially in dry years); whether such diversions would be allowed if the State Water Resources Control Board (SWRCB) decides to adjudicate the basin in response to water rights complaints; and whether the diversion would impact aquatic habitat near the diversion site. The institutional feasibility appears unlikely, as CDPR (a key permitting agency) has indicated significant reservations about the concept. In a letter dated August 15, 1990, CDPR questioned whether "anyone wants to see an essentially wild run of fish becoming dependent upon the proper operation of a fish ladder at the mouth of the Carmel River." The cost of an attraction facility would be about $1.7 million, which is considered excessive, given questions about the durability of a fish ladder in the surf zone in winter.

<u>**Elements of District's Fisheries Mitigation Program**</u>: The above alterations and deletions to the consultant's fishery mitigation concepts by the District staff and Board result in the following specific fisheries mitigation measures that would be carried out by MPWMD. These mitigations would supercede most of the existing District programs:

1. Expansion of the existing program to capture emigrating smolts and transport them downstream during critical years; includes trapping and holding facilities.

2. A program to prevent stranding of early fall and winter migrants by capturing and transporting them to permanent habitat or a temporary holding facility, whenever a risk of stranding exists.

3. A permanent, fully funded program to rescue juveniles from the reach downstream of Robles del Rio to transplant them into permanent habitat or a holding facility below San Clemente Dam.

4. An experimental program to trap and transport steelhead smolts around Los Padres Reservoir to test the effectiveness of modifications to the spillway, and to measure mortality of fish that migrate through Los Padres Reservoir and over Los Padres Dam.

The following pages include a brief description of each mitigation measure and its purpose, implementation or facilities needed, the frequency of use with Option V, monitoring and reporting program, permits needed and preliminary cost estimates for the construction and operation of each measure. A more detailed description of the facility designs and operations is found in the Draft Fisheries Mitigation Plan (Dettman, 1990).

The total estimated capital cost of this Board-approved fisheries mitigation program would be $407,700 for the first five years. Average annual O&M costs for the first five years are estimated at $212,900 per year. Annual costs for individual critically dry years could be as high as $382,200, and as low as $78,700 in wet years. The fisheries mitigation program costs include funding for the existing fisheries biologist plus three permanent 75% time resource technician positions and two intermittent 100% time resource technicians during drought years. This cost information is summarized in <u>Exhibit 3</u>.

It should be noted that the fisheries mitigation program for the Allocation Program EIR would supercede and expand upon the existing

Interim Relief Program fisheries activities.

The MPWMD Board has adopted a Statement of Overriding Considerations in relation to the fisheries mitigations proposed by Larry Mintier and Associates as interpreted by the District fisheries biologist. With the four Board-approved measures, most impacts to the steelhead population would be reduced to a less than significant level. However, the overall impact of Water Supply Option V on the population will be significant because the impacts to the spawning adults will remain unmitigated (see discussion of consultant's mitigation #7 above). The run of returning adults would be denied access to the Carmel River in parts of January, February and March when flows upstream of the Narrows are suitable for adult migration, and when fish would have migrated in earlier decades with lower levels of municipal water demand and production. This scenario would occur in 21 out of 30 years (two-thirds of the time) for an average of 21 days per year, according to CVSIM output with 16,700 AF of Cal-Am production (Option V). The main effect would be compression of the run in time, which would lead to increased competition by adults and fry, lower survival rates, and a reduced steelhead population.

Exhibit 3

COST ESTIMATES FOR FINAL FISHERIES MITIGATION PROGRAM -- OPTION V
November 1990

(Values shown are fully funded by MPWMD for five years. These mitigations would encompass and supercede existing efforts for each measure.)

MITIGATION PROGRAM		CAPITAL COST			ANNUAL COSTS		
		Existing	New	Total	Existing	New	Total
1.	Expand program to capture emigrating smolts in spring	$ 9,000	110,200	119,200	$ 6,200	49,100	55,300
2.	Prevent stranding of early fall and winter migrants	$ 0	95,200	95,200	$ 3,600	75,300	78,900
3.	Rescue juveniles downstream of Robles del Rio in summer	$ 0	173,100	173,100	$ 3,000	54,600	57,600
4.	Experimental smolt transport at Los Padres Dam	$ 0	29,200	29,200	$ 0	21,100	21,100
	TOTAL COST	$ 9,000	407,700	416,700	$ 12,800	200,100	(1) 212,900

ESTIMATED TOTAL COST WITH BOARD-APPROVED PROGRAM	$407,700	$212,900

NOTE 1: Annual cost estimates are averages. Individual dry years may cost up to $382,200 per year, while wet year annual costs may be as low as $78,700 per year.

u/henri/wp/alloeir/mitprog3

FISHERIES MITIGATION #1: EXPAND PROGRAM TO CAPTURE EMIGRATING SMOLTS IN SPRING

Existing District Program

Under terms of the Interim Relief Program agreement, the District rescues and transports smolts during critically dry years. During the past two years, District staff, members of the Carmel River Steelhead Association (CRSA) and CDFG staff have rescued about 500 smolts from the lower Carmel River. The fish were transported to the ocean, to an acclimation facility at the Monterey Bay Aquarium or to a rearing facility at CDFG's Granite Canyon Marine Laboratory. District costs for this program totalled about $15,200 during FY 1989-90. Three District staffmembers were involved in this program for two months at one-quarter time.

Description and Purpose

The program to capture emigrating smolts and transport them to the ocean during critical years would be expanded to include all years when March, April and May flows are too low for successful smolt emigration. In addition to expanding the number of years when the program operates, the District would design, construct, and operate several facilities to improve the operation and overall success of the program. These include a seasonal trapping facility near Schulte Road or the Scarlett Narrows, and holding facilities near Schulte Road and at the Carmel River Lagoon. The purpose of the program is to increase the survival of steelhead smolts and the number of smolts which successfully emigrate to the ocean.

Implementation and Facilities

The District would improve the current program for transporting and holding smolts by designing and operating three facilities: (1) a smolt trap in the river near Schulte Road or the Scarlett Narrows, (2) holding facilities near Schulte Road and (3) holding facilties in the Carmel River Lagoon. Conceptual designs for these facilities are discussed in the Draft Fisheries Mitigation Plan (Dettman, 1990). As noted in the introduction of this section, the smolt traps have been changed to portable, rather than the in-place concrete structures described in the Draft Fisheries Mitigation Plan.

Frequency of Use

Studies have shown that the survival of emigrating of smolts is jeopardized as flows decline below 20 cfs. For this reason the District plans to trap and transport smolts during March, April, and May, when flows recede below 20 cfs at the USGS Near Carmel gage. Based on this plan and daily streamflows simulated by CVSIM, the District would operate the smolt emigration facility an average of 40 days per year. During extreme droughts, such as 1976-77, the facility would operate for a maximum of 92 days (March 1 - May 31).

Monitoring and Reporting

A marking program would test the effectiveness of rescuing and transporting juvenile steelhead downstream. As fish are captured at the facility near Schulte Road, District personnel will mark groups of juveniles with coded wire nose tags and release them at several locations and times to compare the survival of rescued, non-rescued, transported and non-transported fish. These comparisons will be made by sampling outmigrating juveniles at the mouth of the Carmel River as well as marked fish upon their return as adults. Annual monitoring reports will be provided to CDFG, SWRCB and the U.S. Fish and Wildlife Service (USFWS).

Permits Required

To construct and operate an expanded smolt trapping program, permits will be needed from Monterey County, CDFG, SWRCB, CDPR and the California State Coastal Commission (CSCC).

Preliminary Cost Estimates

The estimated costs for constructing a facility to trap, temporarily hold, and transport smolts to the ocean totals $110,200 (costs are shared with Mitigation #2). Operating costs would average about $55,300 per year and range from zero to $115,500 per year. These costs include the existing District activities, which would be superceded by this mitigation measure. On average, staff would be needed to run this program for 40 days per year, and up to 98 days (including clean-up) in dry years.

FISHERIES MITIGATION #2: PREVENT STRANDING OF EARLY FALL AND WINTER MIGRANTS

Existing District Program

There is no formal District program to prevent stranding of early fall and winter migrants. However, staff recognized this problem in the Carmel River, and as time allowed, staff conducted several rescues or coordinated CRSA rescues. District costs for this minimal program during FY 1989-90 were $3,600. Two staffpersons spent a total of 2-3 weeks on this program.

Description and Purpose

As in other Central California streams, juvenile steelhead in the Carmel River move downstream into lower reaches of the river well ahead of the peak emigration of smolts. There is a high risk that presmolts and other juvenile steelhead will be stranded following early fall and winter storms, which increase flows and stimulate the fish to move downstream into habitat that is subsequently dewatered after the storm peak passes. This risk could be reduced by a program to trap and capture downstream migrants during the high risk period of October through February.

Implementation and Facilities

A program to capture juvenile steelhead before they are stranded would rely on a combination of methods. During and following small fall and early winter storms, the trap and holding facilities for the smolt transport program would be used to intercept fish before they move into habitat that will dry up. Following larger storms that produce flows in excess of 40 cfs at the Schulte trapping facility, District staff will electrofish with backpack and streamside shockers to capture fish in the reach below the trap.

Frequency of Use

With Option V (16,700 AF production) the facility would operate an average of 57 days per year. The most frequent use would occur during and following dry periods. For example, during the simulated 1961-64 period the facility would have operated 94 days in 1961, 79 days in 1962, 126 days in in 1963, and 101 days in 1964.

Monitoring and Reports

Monitoring for this program would entail tabulating the annual number of fish rescued from drying reaches of the Carmel River downstream of the Narrows. The District would also initiate a marking program to test the effectiveness of rescuing and holding juvenile steelhead which migrate downstream into drying reaches. The protocol of this marking program would follow the monitoring design for smolts as described in Mitigation #1 above. As fish are rescued, District staff will mark groups of juveniles with coded wire nose tags and release them at several locations and times to compar the survival of rescued, non-rescued, held and non-held juveniles. Tallies of the number of marked fish which outmigrate at the mouth of the Carmel River will be the basis for comparing the survival of different groups. Annual monitoring reports will be provided to CDFG, SWRCB and USFWS.

Permits Required

To construct and operate a program to prevent stranding of early juvenile emigrants, permits will be needed from Monterey County, CDFG, and SWRCB.

Preliminary Cost Estimates

The estimated costs for constructing a facility to trap, temporarily hold, and transport juveniles totals about $95,200. Operating costs would average about $78,900 per year and range from zero to $188,000 per year. These costs include the existing program, which would be superceded by this mitigaiton measure. On average, staff would be needed to run this program for 57 days per year, and up to 151 days in dry years.

FISHERIES MITIGATION #3: RESCUE JUVENILES DOWNSTREAM OF ROBLES DEL RIO IN SUMMER

Existing District Program

There is no formal MPWMD program to rescue juvenile steelhead during summer months. CRSA has rescued several thousand juveniles during the past five years when water withdrawals isolated juvenile steelhead in pools throughout the lower river. In recognition of this problem, staff conducts rescues whenever conditions and time allow. During the summer of 1989, District staff, CDFG and CRSA rescued 130 juvenile steelhead and released them in safe habitat upstream of Robles del Rio. The District costs for these activities in FY 1989-90 totalled about $3,000. Two District staffmembers worked about two weeks on the rescues.

Description and Purpose

About 1.8 miles of juvenile rearing habitat between Boronda Road and Robles del Rio dry up nearly every summer. The District has proposed a program to rescue, transplant, and rear juvenile steelhead that are stranded during the dry season from June through December. The purposes of the program are to rescue juvenile steelhead from drying reaches, to transplant juveniles to permanent habitat below San Clemente Dam (if it is available), and to rear young-of-the-year steelhead in a facility below San Clemente Dam.

It should be noted that CVSIM results in the Allocation EIR determined that flows could be maintained at the Narrows in all years, except at the end of the most extreme droughts. However, this finding is based on two important assumptions: (1) Cal-Am would maintain the existing storage in both reservoirs via a dredging program, and (2) the Carmel Valley Filter Plant could be operated between 1.0 and 3.5 cfs.

Implementation and Facilities

Pending approval and agreement with Cal-Am, the District would construct a facility to hold and rear wild juvenile steelhead below San Clemente Dam, near the Sleepy Hollow Weir. The preliminary design consists of several holding pools and an artifical stream channel. The facility could hold and rear a maximum of 64,000 fish to a weight of about 13 grams, equivalent to the size of fish reared under natural conditions in the Carmel River. The fish would be allowed to naturally emigrate out of the holding facility, if habitat is available in the river.

Frequency of Use

The program to rescue and transplant juvenile steelhead will be used every year because a 1.8 mile reach between Boronda Road and Robles del Rio and the 9-mile reach between Highway 1 and the Narrows dry up about 97 percent of the time.

Monitoring and Reports

The program to rescue juveniles stranded in the Carmel River will be monitored by keeping accurate records of the number and size of fish rescued. Groups of juveniles will be marked, weighed and their survival to the smolt stage and returning adults will be compared to naturally reared smolts. Annual monitoring reports will be provided to CDFG, SWRCB and USFWS.

Permits Required

To construct and operate a program to rescue and rear stranded juvenile steelhead, permits will be needed from Monterey County, CDFG, SWRCB, and ACE. A focused EIR may be required.

Preliminary Cost Estimates

The District purchased most of the equipment for capturing and transporting juvenile steelhead as part of the Interim Relief Program, so no major capital expenditures are needed for fish capture equipment. Preliminary estimates of costs for construction of the holding and rearing facility total $173,100. Annual operating costs are expected to total about $57,600 per year. The O&M costs include the existing program, which would be superceded by this mitigation measure. This program would run from June through December each year, and staff would be needed for 214 days per year.

FISHERIES MITIGATION #4: EXPERIMENTAL SMOLT TRANSPORT PROGRAM AT LOS PADRES DAM

Existing District Program

No District program is presently in place to measure the survival of smolts past Los Padres Dam. The District fish biologist and other biologists and engineers have visited the dam, and have noted that conditions over the spillway may reduce survival of emigrating smolts.

Description and Purpose

No downstream fish passage facilities were built at Los Padres Dam when it was constructed in 1949. The situation is probably detrimental for emigrating smolts because the rough spillway abrades fish, and at low flows, fish fall onto the rocks below. In 1986 the spillway at Los Padres was modified to improve passage conditions. To date, no experimental releases of fish have been made to test whether these improvements reduce mortality. Recent photographs indicate that mortality still may occur at low flows.

The purpose of this program is to assess how well the previous spillway modifications are functioning. The mortality of fish emigrating over the spillway and through the reservoir versus the mortality of fish transported around the reservoir would be compared. Depending on the outcome of the experiments, a permanent program could be implemented to transport fish around the reservoir and past the dam.

Implementation and Facilities

The experiments to test mortality of emigrating smolts would be similar to a 1988 USFWS study of salmon smolts in the Sacramento - San Joaquin Delta. Groups of marked smolts are released at different locations and intensively sampled at a point downstream. The number of smolts from the upper release site divided by the number from the lower site is an index of survival. With the proposed experiments at Los Padres Dam, three groups of fish would be marked. Groups would be released at the head of the reservoir, at the top of the spillway and at the base of the spillway. The population of smolts would be intensively sampled at the Bedrock Chutes and at Syndicate Camp, located about 0.5 miles and 2.0 miles downstream of Los Padres Dam, respectively. A survival index would be developed based on the sampling data.

Frequency of Use

The experiments to determine mortality of emigrating smolts would extend over a period of 5 years. If a smolt transport program is needed, it would occur annually from late February through May.

Monitoring and Reporting

Monitoring will consist of annual reports to CDFG, USFWS, National Marine Fisheries Service and Cal-Am which describe the experimental results. After five years of study, a final report will identify whether additional modifications to the spillway are needed, and if so, the nature of the modifications. If modifications are made to the spillway, the monitoring should be extended to determine the success of the modifications. It should be noted that this information is also applicable to the long-term water supply project.

Permits Required

A permit from CDFG will be needed to trap and experimentally mark steelhead.

Preliminary Cost Estimates

Estimated capital costs for conducting mortality experiments would total $29,200 and annual O&M costs would total $21,100 for each of the five years. The smolt experiments would occur between late February and May each year. On average, staff would be needed to run this program for 30 days per year.

u/hs/wp/alloeir/fishmit.finl

FINAL FIVE-YEAR MITIGATION PROGRAM FOR RIPARIAN VEGETATION AND ASSOCIATED WILDLIFE -- OPTION V

SUMMARY: The Water Allocation Program Final EIR found that all water supply options, including 16,700 AF Cal-Am production (Option V), would have significant adverse impacts to the lower Carmel River (AQ3 and AQ4) riparian resource without mitigations. Option V would result in potentially significant effects in AQ2 in dry years, but adverse effects would be expected only near the Los Laureles wells. It should be noted that wildlife dependent on riparian vegetation would be similarly affected without mitigations. Discussion of the mitigation program is found on pages IV-52 through IV-54 of the Final EIR. The following mitigations were recommended by the consultant:

1. Implement a conservation program that retains water in the river and increases ground-water storage available to riparian vegetation. Entails inspection of yearly allocation amounts.

2. Identify existing riparian areas of greatest extent, and control drawdown to minimize the onset of water stress. Guarantee that no more than 10% would be lost due to drawdown. If plants die, replace with 300 trees/acre and ensure 70% survival. If 70% standard not met after 3 years, replant again. Identify and inspect sites at least two times per year.

3. Prioritize existing stands to be irrigated; continue and expand the present irrigation program. Guarantee no loss greater than 10%; replant if standard not met with standards in #2. Identify and preserve areas that may be destroyed or disturbed by urban or agricultural development.

4. Implement revegetation plan by creating new riparian habitat to replace lost habitat in lower terraces. Use 70% survivorship standard in 3 years; replant as necessary; monitor results as needed, and continue quarterly inspections after first three years; use qualified personnel for all these tasks.

5. As part of revegetation plan, purchase conservation easements on upper floodplain terraces for riparian revegetation of sycamores and valley oaks. Planting densities of 200 trees/acre with 70% survival. Inspections as noted above.

6. Identify sites where non-riparian/non-natives can be removed without threatening bank stability, and replant with riparian species as part of the above plans.

7. In droughts, increase irrigation to meet plant demands. Deep irrigation would be an objective. Where feasible, increase irrigated area in droughts. Replace vegetation that dies in a drought.

The EIR consultant stated that it was unknown whether these mitigations would reduce impacts to a less than signficant level. Based on this uncertainty, the consultant concluded that the mitigations would result in a potentially significant impact to riparian vegetation and dependent wildlife.

<u>Existing District Programs:</u> Ongoing District programs already address the environmental impacts of existing water supply practices on the riparian resource of the Carmel River. The District engages in the following activities:

1. Installs, operates and maintains drip irrigation systems to irrigate all major stands of riparian vegetation along nearly 6 miles of river between Via Mallorca Bridge and Cal-Am's Scarlett well. To date, about 450,000 lineal feet of drip irrigation line have been installed under the auspices of the Interim Relief Program and Irrigation Program, totalling about 75 acres of riparian land under irrigation.

2. Expands and renovates previously installed riparian irrigation systems.

3. Implements the Carmel River Management Program, which entails extensive vegetative plantings and irrigation of willows associated with erosion control projects.

4. Has retained a consulting agronomist to test the effectiveness of the District's irrigation system, assess application rates and refine irrigation schedules.

5. Installs permanent standpipes to monitor soil moisture profiles in several areas.

6. Has expanded the Emergency Irrigation Program to cover much of the 2-mile reach from near the Carmel River lagoon to Rancho Canada. Another 130,000 lineal feet of drip line are anticipated to irrigate vegetation in this reach. Four additional seasonal employees were hired in 1990 to implement the expansion.

7. Regularly monitors water levels, riparian plant stress, and soil moisture.

8. Implements comprehensive conservation program to reduce per capita use by 15% by the year 2020; develops annual MOA with Cal-Am and CDFG, and conducts the Water Supply Strategy and budget process to retain water in the river as much as possible.

9. Works diligently towards development of a long-term water supply project that would provide improved streamflow conditions.

As shown in Exhibit 4, the existing riparian programs are substantial in terms of cost. About $295,000 is expended annually by the District to fund the Carmel River Management Program, the Interim Relief Program (emergency irrigation), the annual MOA and Water Supply Strategy and Budget process, and irrigation around four Cal-Am wells in lower Carmel Valley. The latter program, which costs about $50,000 per year, is partially funded by Cal-Am (up to $7,000 annual contribution) as part of the permit conditions for the four wells. Four members of District staff are involved in existing programs, including the District Engineer, two river maintenance workers, and an Associate Hydrologist.

Amendments to Consultant's Riparian Mitigation Program: District staff assessed the recommended mitigations for technical accuracy and feasibility. Based on this work, the seven mitigations recommended by the consultant have been altered as follows:

The consultant's mitigation #1 is already in effect as part of the District's comprehensive water conservation program. The recommendation to carry out "inspections of yearly allocation amounts" was unclear. Staff interprets this to mean "monitor yearly production amounts," which is already done by the District.

The consultant's mitigation #2 entails control of drawdown near sensitive riparian areas. MPWMD cannot control drawdown from wells. It can, however, work with Cal-Am to develop pumping schedules that better regulate the rate of drawdown, which is the critical factor for riparian health. This is done through the Water Supply Budget and Strategy process, in addition to well rotation of the four lower Carmel Valley wells

The consultant's mitigation #3 includes a provision for MPWMD to identify and preserve riparian areas that may be destroyed or disturbed by urban development. Staff disagrees with the consultant for two reasons: (1) land preservation is an appropriate function for a park district, city or county -- not the MPWMD, and (2) given county zoning regulations and FEMA insurance constraints, it is very unlikely that future development would occur along the riparian corridor.

The consultant's mitigation #4 entails creation of new riparian habitat (by revegetation and irrigation) to replace vegetation losses in lower terraces along the Carmel River. The consultant does not identify a revegetation rate (acres per year) or total acreage that should be revegetated. Staff believes that creation of new riparian habitat is not as desirable as preservation of existing stands for two reasons. First, riparian habitat loss in Carmel Valley has occurred primarily due to farming and existing development, rather than withdrawal of ground water and diversion of surface flows. Second, survival of new riparian plantings in the lower terraces cannot be assured. Vegetation would be planted on the unconsolidated alluvium that makes up the lower terraces. This material is subject to erosion and removal during even moderate stormflows. Due to the high potential of loss in major storms, revegetation of denuded areas will not be an integral part of the riparian mitigation program approved by the District Board. The District efforts will focus on protection and enhancement of existing riparian habitat.

The consultant's mitigation #5, which entails purchase of conservation easements on upper floodplain terraces for riparian revegetation, is not warranted. The Water Allocation Program Final EIR does not identify damage to riparian vegetation on upper terraces due to any water supply option, nor any connection between vegetation on the upper terraces and lower terraces along the river.

The consultant's mitigation #6 entails removal of non-riparian and non-native species along the river unless bank stability would be threatened by the removal. Given that many private property owners have planted and maintain such species on their land, this mitigation should include replacement/removal of non-riparian and non-native species only if their presence threatens bank stability.

The consultant's mitigation #7 entails increased irrigation of riparian vegetation during droughts, which is already done by the District. Thus, this mitigation is not considered as a separate measure in the Board-approved final mitigation program.

Elements of the District's Riparian Mitigation Program: The above alterations and deletions to the consultant's riparian mitigation concepts by the District staff and Board result in the following specific measures that would be carried out along with existing District programs:

1. Conservation and water distribution management to retain w..ter in the river.

2. Prepare and oversee Riparian Corridor Management Plan; design projects; obtain access agreements.

3. Implement Riparian Corridor Management Programs; expand irrigation and planting programs; drill wells

4. Expand monitoring program for soil moisture and vegetative stress.

The following pages provide a brief description of each mitigation measure and its purpose, implementation and facilities needed, the frequency of use, monitoring and reporting program, permits needed, and preliminary cost estimates. New programs resulting from the Allocation EIR would total $10,000 in capital costs and $121,000 in annual costs. The total estimated capital cost of the Board-approved riparian mitigation program would be about $10,000. The total annual costs (including continuation of existing programs at a cost of $295,000 per year) would be about $416,000. Exhibit 4 summarizes the riparian mitigation cost data. The riparian mitigation program would entail hiring one additional full-time staffperson (program manager) and several additional seasonal river maintenance workers.

The four Board-approved mitigations, in addition to existing riparian programs, would reduce impacts of Supply Option V to riparian vegetation, but it is unknown whether impacts would be reduced to a less than significant level. Thus, the District program would result in potentially significant impacts to riparian vegetation and dependent wildlife.

Exhibit 4

COST ESTIMATES FOR FINAL RIPARIAN MITIGATION PROGRAM -- OPTION V
November 1990

(Values are fully funded by MPWMD for five years)

MITIGATION PROGRAM		CAPITAL COST			ANNUAL COSTS		
		Existing	New	Total	Existing	New	Total
1.	Conservation and water distribution management to retain water in river	$ 0	0	0	(1) $ 3,000	0	3,000
2.	Prepare and oversee Riparian Corridor Management Plan; design projects; obtain access agreements	$ 0	0	0	$ 0	60,000	60,000
3.	Implement Riparian Corridor Management Program; expand irrigation and planting programs; secure irrigation water	$ 0	0	0	(2) $287,000	(3) 60,000	347,000
4.	Expand monitoring program for soil moisture and vegetative stress	$ 0	10,000	10,000	$ 5,000	1,000	6,000
	TOTAL COST	$ 0	10,000	10,000	$295,000	121,000	416,000
ESTIMATED TOTAL COST WITH BOARD-APPROVED PROGRAM			$10,000				$416,000

NOTE 1: The District conservation program entails annual costs on the order of $300,000. Given that its purpose is broader than riparian vegetation mitigation, only activities associated with retaining water in the river are itemized here.

NOTE 2: Existing programs include the Carmel River Management Program, irrigation around four Cal-Am wells, and Interim Relief Program irrigation activities (emergency irrigation).

NOTE 3: Costs for implementation of the Riparian Corridor Management Program are anticipated to start in the second or third year, after the plan has been developed.

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RIPARIAN MITIGATION #1: CONSERVATION AND WATER DISTRIBUTION MANAGEMENT TO RETAIN WATER IN RIVER

Existing District Program

The District has carried out a comprehensive, long-term conservation program successfully for several years. The goal of this $300,000 per year program is 15% reduction in per capita water use by the year 2020. Long-term savings of about 9% have already been achieved. Aspects of the program include extensive public education, water saving kit distribution, drought tolerant landscape seminars and other activities. In order to retain water in the river, the District forges a Memorandum of Agreement (MOA) with Cal-Am and CDFG and develops a Water Supply Strategy and Budget for the Cal-Am system. In addition, Ordinances #19 and #41 limit diversions from San Clemente Dam to allow more water to flow downstream. The MOA and Budget processes cost about $3,000 per year in staff time and entail the work of several staffmembers for a few days each quarter in dry years (only once a year in normal years).

Description and Purpose

This mitigation would focus on aquifer subunit 2 (AQ2), where relatively small production from wells may have an impact on riparian vegetation during dry periods. The District would continue its conservation program, and its work with Cal-Am via the MOA and Water Supply Strategy and Budget processes to reduce production and/or the rate of drawdown in AQ2. This region would also be considered when developing a protocol for rationing in droughts. The purpose of this mitigation would be to maximize ground-water levels and river flows in the AQ2 region. CVSIM analysis has shown that conservation would not yield similar benefits in other aquifer subunits.

Implementation and Facilities

General conservation would be implemented via the Water Conservation Plan. Production reduction in AQ2 would be implemented as part of the annual MOA process with Cal-Am and CDFG. One component would be quarterly audits of Cal-Am operations, and management strategies that reduce pumping or the rate of drawdown in AQ2. The District would develop a specific rationing protocol that describes the mechanisms for when rationing would be initiated. An integral component or criterion would be the potential impact of water use on AQ2. Another would be a specific drought reserve that would be necessary to preclude rationing. The need for rationing would be assessed annually or quarterly in the District's Water Supply Strategy and Budget review, and monthly during droughts via a Water Supply Status Report.

Frequency of Use

General conservation and protection of the AQ2 area would be continual, with most attention during dry periods. Rationing would occur only during extended dry periods. Detailed statistics are not available.

Monitoring and Reporting

Monitoring would consist of annual reporting of water conservation activities and results, and monthly review of water production data from AQ2.

Permits Needed

No permits would be required to implement this program.

Preliminary Cost Estimate

This mitigation would not result in significant additional costs because elements are already part of ongoing programs. Thus, the total cost would remain at $3000 per year. Staff time would be necessary to develop the rationing criteria and mechanism.

RIPARIAN MITIGATION #2: PREPARE AND OVERSEE RIPARIAN CORRIDOR MANAGEMENT PLAN

Existing District Program

Several District programs that address the riparian corridor of the Carmel River are described in the following section (Riparian Mitigation #3). There is presently no Riparian Corridor Management Plan, although the Carmel River Management Plan (CRMP) addresses several riparian concerns.

Description and Purpose

Most of the mitigations proposed in the Allocation EIR (as described and amended above) would form the basis of a Riparian Corridor Management Plan along the Carmel River. The purpose of the plan would be to coordinate the many mitigation activities that are required so that they can be implemented in an orderly, cost-effective manner. An additional District staffperson with a background in botany/revegetation/irrigation would be hired to write and implement the plan.

Subcomponents of the Riparian Corridor Management Plan would include the existing erosion control program (CRMP), the new riparian mitigation projects described in the Water Allocation Program Final EIR (as amended herein) and continued irrigation around four Cal-Am wells and in other areas. Only the costs for the new mitigation activities are shown below.

Implementation and Facilities

The Riparian Corridor Management Plan would (1) identify and prioritize the existing vegetation that must be protected, (2) determine the location and design of irrigation systems, and (3) identify areas in which to selectively remove vegetation from the active channel bottom to reduce the risk of bank erosion, as well as water loss due to evapotranspiration. Agreements with property owners would be obtained to allow mitigation projects on their land. The District staff would be responsible for the completion of the plan and the necessary agreements to begin implementation.

Frequency of Use

Development of the plan is anticipated to require 1-2 years, depending on the level of cooperation by property owners and regulatory agencies.

Monitoring and Reporting

During development of the plan, progress would be reported annually. Once the plan is developed, monitoring would be carried out as described under Riparian Mitigation #3.

Permits Required

Permits would not be required for development of the plan. Permits from Monterey County, CDFG and/or the U.S. Army Corps of Engineers (USACE) may be required for specific activities recommended in the plan.

Preliminary Cost Estimates

No capital cost is listed for this mitigation. The annual cost is estimated to be $60,000 per year for an additional District staff person (program manager), including salary and benefits. The new program manager would work closely with existing District staff who are responsible for Carmel River management activities. Other costs for plan development would be included in ongoing District programs.

RIPARIAN MITIGATION #3: IMPLEMENT RIPARIAN CORRIDOR MANAGEMENT PROGRAM

Existing District Programs

As noted in the introduction of the riparian mitigation section, there are several ongoing District programs that address the environmental impacts of existing water supply practices on the riparian resource of the Carmel River. The District has installed and maintains drip irrigation systems for all major stands of riparian vegetation along nearly 6 miles of river between Via Mallorca Bridge and Cal-Am's Scarlett well. To date, about 450,000 lineal feet of drip irrigation line have been installed under the auspices of the Interim Relief Program and Irrigation Program, totalling about 75 acres of riparian land under irrigation. Previously installed riparian irrigation systems have also been expanded and renovated.

The Carmel River Management Program, which began in 1984, entails extensive vegetative plantings and irrigation of willows associated with erosion control projects in several areas along the river. These projects prevent loss of riparian habitat due to erosion.

Due to the severity of the current drought, the Emergency Irrigation Program was expanded to cover much of the 2-mile reach from near the Carmel River lagoon to Rancho Canada. Another 130,000 feet of drip line are anticipated to irrigate vegetation in this reach in 1990, and four additional seasonal employees were hired to implement the expansion. A consulting agronomist was also hired in 1990 to assess the effectiveness of the District's riparian vegetation programs to date, as well as refine irrigation rates and application schedules.

These existing programs total about $287,000 annually, and entail 6-8 staffmembers (4 full-time, and 2-4 parttime or on an intermittent basis).

Description and Purpose

Once a Riparian Corridor Management Plan (RCMP) is developed, the next step is implementation of the plan to carry out the recommended projects in order of priority. Note that existing programs will become subcomponents of the RCMP.

Implementation and Facilities

The Riparian Corridor Management Program will consolidate and expand upon existing MPWMD programs. The principal new activities being proposed initially are to increase the areas of riparian vegetation under irrigation, especially during droughts, and to maintain adequate channel capacity by selective removal of vegetation from the channel bottom. Given the extent of this program, combined with existing vegetation and irrigation programs, the District should consider drilling small irrigation wells in AQ3 and AQ4 instead of purchasing treated or untreated Cal-Am water. The water would be filtered to avoid clogged drip emitters. The District could secure an area along the river to establish a cottonwood and willow nursery for the projects. Alternatively, existing commercial nurseries could be contracted to provide a certain number of plants each year. Several seasonal river maintenance staff would be hired to assist the program manager. In areas where vegetation has encroached on the active channel bottom, vegetation would be selectively removed to reduce the risk of bank erosion, as well as water loss due to evapotranspiration.

Frequency of Use

This program would likely begin in the second or third year, after completion of the Riparian Corridor Management Plan. This program would be carried out annually until a new water supply project that provides improved streamflow conditions is developed.

Monitoring and Reporting

An annual report would be prepared on activities under the Riparian Corridor Management Plan, in accordance with the recommendations in the Allocation EIR. Parameters include number of plantings, nursery activities, survival rates, acreage irrigated, irrigation water applied, inspection results and vegetation removal data.

Permits Required

Permits from several agencies, including Monterey County, CDFG and/or USACE, may be required for some aspects of the program.

Preliminary Cost Estimates

No capital costs would be incurred for this mitigation. Annual O&M, including funds for seasonal river maintenance workers, overhead, vehicles, irrigation water and irrigation maintenance is estimated at $60,000 per year. These annual costs are anticipated to begin in the second or third year. This estimate includes $10,000 per year for irrigation water, an amount that could be reduced if wells are drilled. If it becomes necessary to acquire land or easements for the program, additional costs could be significant. The combined cost of existing and new programs would total $347,000 per year.

RIPARIAN MITIGATION #4: EXPAND MONITORING PROGRAMS FOR SOIL MOISTURE AND VEGETATIVE STRESS

Existing District Program

The District has installed permanent access tubes to monitor soil moisture profiles in selected areas in lower Carmel Valley. The District regularly monitors water levels, riparian plant stress and soil moisture. These activities cost about $5,000 per year and entail one staffmember working intermittently.

Description and Purpose

This mitigation entails an expanded monitoring program with additional locations for neutron probe access tubes, pressure bombing sites and canopy rating sites. This will allow the District to better assess the impact of prolonged depression or rapid drawdown of the water table. Conversely, the beneficial impacts of the mitigation programs described above could be documented.

Implementation and Facilities

The expanded monitoring program would entail analysis of data already collected and identification of new sites for continuous baseline data collection. In addition to measurements of soil moisture and vegetative moisture stress, the expanded program would include data analysis, weather monitoring and irrigation scheduling for drip lines already in place in the riparian corridor.

Frequency of Use

Once the new sites are located, monitoring and data analysis would be an onoing program. The frequency and location of monitoring would be determined in the Riparian Corridor Management Plan.

Monitoring and Reporting; Permits Required

An annual report on the results and findings of this monitoring program would be prepared and made available to interested agencies or members of the public. No permits would be required for this program.

Preliminary Cost Estimates

An estimated capital cost of $10,000 would be needed for new monitoring sites, equipment and calibration, and infrared photographs. Annual costs are expected to increase from $5,000 to $6,000 per year for the monitoring program. Additional personnel are not expected to be needed for this mitigation measure.

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FINAL FIVE-YEAR MITIGATION PROGRAM FOR LAGOON VEGETATION AND WILDLIFE -- OPTION V

SUMMARY: The Water Allocation Program Final EIR found that all water supply options would have potentially significant impacts on lagoon vegetation and dependent wildlife, even though a reduced impact is recognized for 16,700 AF production (Option V). Discussion of the mitigation program for lagoon vegetation is found on page IV-54 and IV-55 of the document. It should be noted that Option V would result in less than significant impacts to lagoon hydrology. The following mitigations for vegetation and wildlife were recommended by the consultant:

1. Reduce production from the MPWRS by providing additional supplies of water, thus allowing additional surface inflow into the lagoon. Pump water from the aquifers for release into the lagoon during the dry seasons. Additional volume into the lagoon should be recorded and should equal conservation savings.

2. An extensive monitoring program is described that entails vegetation mapping, ordinary high water mark, and soil salinity measurements. Monitoring would be performed every two years to compare status to the baseline. If more than 10% increases in vegetation type or coverage occurred, additional measures would occur (see #3-5). If these measures are not successful, implement a wetland restoration project with a goal of 110% of baseline acreage.

3. Increase reinvestment of conserved water to the lagoon.

4. Injection wells to recharge AQ4.

5. Grout curtain near lagoon to create a coastal barrier.

The consultant could not determine whether the above mitigations would lessen impacts to a less than significant level. The consultant concluded that the impacts would remain as potentially significant with mitigations.

__Existing District Programs:__ Ongoing District programs already address the environmental impacts of existing water supply practices on the Carmel River lagoon. MPWMD activities include:

1. Provides $25,000 to co-fund Carmel River Lagoon Enhancement Plan, which is in progress. The plan entails detailed mapping of vegetation, soils and survey data, lagoon history and compares alternative enhancement activities. Cosponsors include County Flood Control, State Parks, and California Coastal Conservancy.

2. Conducts regular monitoring of lagoon water quality parameters and other data.

3. Actively seeks major new wate. supply that would provide year-round river flow to the lagoon in most years.

4. Implements comprehensive long-term water conservation program, which would reduce overall demand on the water resource system.

As shown in Exhibit 5, the existing lagoon programs are modest in temrs of cost. About $1,200 is expended annually for lagoon monitoring, primarily by two District staff on a intermittent basis. In addition to the monitoring activities, the District has contributed $25,000 to the Carmel River Lagoon Enhancement Plan ($15,000 cash and $10,000 as in-kind services), and $1,000 towards monitoring. Thus, capital costs expended to date total $26,000.

Amendments to Consultant's Lagoon Mitigation Program: District staff evaluated the consultant's proposals for technical merit and feasibility. Staff concluded (and the Board agreed) that the recommended mitigations should be amended or deleted as follows:

The consultant's mitigation #1 entails pumping water from the lower Carmel Valley aquifers into the lagoon during dry seasons to maintain freshwater levels. District staff notes that this mitigation may exacerbate impacts to riparian vegetation and is not consistent with riparian mitigations. It also entails "reducing production in the MPWRS by providing additional supplies of water," which makes sense only if importation or desalination are water sources. The District has pursued importation and desalination as water supply alternatives, but they have not proven to be institutionally feasible to date. For these reasons, the District will not pursue this mitigation concept.

The consultant's mitigation #2 entails monitoring every two years. Due to the significant fluctuations in year-to-year weather patterns and streamflow, the baseline survey will be repeated during the next normal year and every five years thereafter.

The consultant's mitigation #3 entails increased reinvestment of conserved water to the lagoon if monitoring shows significant changes. This assumes that conservation savings would equal a specific volume of water to the lagoon, which would not be true. Instead, the District will determine the amount of water needed to maintain an adequate habitat for fish and wildlife, and explore alternative means to transport it to the lagoon. Preliminary studies indicate that the amount would be relatively small.

The consultant's mitigation #4 entails injection wells to recharge AQ4. A reliable source of injection water was not identified by the consultant. Unless a reliable source can be identified, the effectiveness of this mitigation is questionable. It should be noted that reclaimed wastewater could be an injection source if institutional constraints did not exist.

The consultant's mitigation #5 entails a grout curtain near the lagoon to create a coastal barrier. This would be a very expensive solution to the problem and has attendant technical concerns. A comprehensive engineering assessment would be needed prior to implementation of this measure. A more reasonable alternative would be to determine how to bring in the small amount of water that the lagoon needs to provide adequate habitat.

Elements of Lagoon Mitigation Program: The above alterations and deletions to the consultant's lagoon mitigation concepts by the District staff and Board result in the following specific measures that would be carried out in addition to existing District programs:

1. Assist with lagoon enhancement plan investigations.

2. Expand long-term monitoring program.

3. Identify feasible alternatives to maintain adequate lagoon volume.

The following pages include a brief description of the mitigation measure and its purpose, implementation and facilities needed, frequency of use with Option V, monitoring and reporting, permits required and a preliminary cost estimate. New programs resulting from the Allocation EIR would total $25,000 in capital costs and $2,000 in annual costs. The total estimated capital cost of the Board-approved program would be $25,000. Annual costs would be $3,200 per year. No additional staff would be needed to implement these mitigations. This information is summarized in Exhibit 5.

The three Board-approved mitigations, in addition to the existing lagoon programs, would reduce the impacts of Supply Option V, but it is unknown whether impacts would be reduced to a less than significant level. Thus, the District program would result in potentially significant impacts to lagoon vegetation and wildlife.

Exhibit 5

COST ESTIMATES FOR FINAL LAGOON MITIGATION PROGRAM -- OPTION V
November 1990

(Values are fully funded by MPWMD for five years)

MITIGATION PROGRAM		CAPITAL COST			ANNUAL COSTS		
		Existing	New	Total	Existing	New	Total
1.	Assist with Lagoon enhancement plan investigations	(1) $ 25,000	0	25,000	$ 0	0	0
2.	Expand long-term monitoring program	$ 1,000	20,000	21,000	$ 1,200	2,000	3,200
3.	Identify feasible alternatives to maintain lagoon volume	$ 0	5,000	5,000	$ 0	0	0
	TOTAL COST	$ 26,000	25,000	51,000	$ 1,200	2,000	3,200
ESTIMATED TOTAL COST WITH BOARD-APPROVED PROGRAM			$ 25,000				$ 3,200

NOTE 1: The District has contributed a one-time amount of $25 000 for the completion of the Lagoon Enhancement Plan.

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LAGOON MITIGATION #1: ASSIST WITH LAGOON ENHANCEMENT PLAN INVESTIGATIONS

Existing District Program

The District, County Flood Control, State Parks and the Coastal Conservancy presently co-fund the Carmel River Lagoon Enhancement Plan. The District will contribute $25,000 to this effort by the completion of the plan ($15,000 in cash and $10,000 as in-kind lagoon water quality monitoring services). The Plan, which is in preparation, is being written by Phillip Williams and Associates. District staff participate on a plan review committee, which meets on an as-needed basis.

Description and Purpose

A key aspect of the Lagoon Enhancement Plan is to identify alternative means to restore and enhance the lagoon environment. As part of the lagoon mitigation program, the District would continue to contribute staff expertise for enhancement plan investigations, and assistance in developing a final plan.

Implementation and Facilities

PWA is scheduled to complete a final Lagoon Enhancement Plan in 1991. The document would entail extensive review and input by District and other agency staff, as well as the public. Once a final plan of action is selected, the District could contribute staff expertise to implement the plan.

Frequency of Use

Completion of the Plan and implementation of projects would occur once, though other enhancement activities could be spread over a series of years.

Monitoring and Reporting; Permits Required

This mitigation would not entail monitoring. No permits would be required.

Preliminary Cost Estimates

No capital or annual costs are anticipated for this mitigation.

LAGOON MITIGATION #2: EXPAND LONG-TERM MONITORING PROGRAM

Existing District Program

The District has an existing program to monitor water quality, streamflow, sediment transport and changes in bedrock geometry in the lagoon on a monthly basis when the Carmel River flows into the lagoon. Water quality measurements (dissolved oxygen, carbon dioxide, specific conductance and temperature) are taken on a quarterly basis when there is no flow into the lagoon. This has been the case in the past three drought years. The annual cost in these years has been about $1,200 in staff time.

Description and Purpose

The lagoon habitat would be monitored as described in the Allocation EIR (mitigation #2) to quantify its existing status and the long-term response to ground water pumping. Major studies such as vegetative mapping and soil surveys would occur every five years. The purpose of the monitoring is to determine if specific changes in plant species distribution, diversity, acreage etc occur over time, and to implement additional mitigations if vegetative changes begin to occur.

Implementation and Facilities

Monitoring performed by District staff would be continued and expanded. Consultants would be retained to perform the detailed mapping and surveys similar to those being performed for the Lagoon Enhancement Plan.

Frequency of Use

Monitoring would be performed on a regular basis. Major mapping and survey studies would be performed every five years after an initial survey during the next normal water year.

Monitoring and Reporting; Permits Required

Annual reports with the findings of the monitoring program would be provided to interested agencies and members of the public.

Preliminary Cost Estimate

The cost for consultant mapping and surveys would be $20,000 every five years. Annual costs for monitoring by District staff would be increased by $2,000 per year from $1,200 to $3,200 annually.

LAGOON MITIGATION #3: IDENTIFY FEASIBLE ALTERNATIVES TO MAINTAIN ADEQUATE LAGOON VOLUME

Existing District Program

There is no existing program to calculate adequate lagoon volume.

Description and Purpose

In conjunction with mitigation #2 above, the volume required to keep the lagoon in a stable situation that can adequately support plants and wildlife would be identified. Alternative means to achieve and maintain the desired volume would be compared, and the most cost-effective means selected.

Implementation and Facilities

Identification of the needed volume would be done in conjunction with the monitoring studies noted above and the findings of the Lagoon Enhancement Plan. Development of alternative means to provide adequate volume would be coordinated with the implementation of the selected alternative in the final Lagoon Enhancement Plan. It should be noted that construction of a large surface reservoir would provide inflow to maintain adequate lagoon volume in most years. The District is pursuing construction of a dam as soon as possible.

Frequency of Use

This study would not begin until the end of 1992, or whenever a final lagoon enhancement program is determined.

Monitoring and Reporting; Permits Required

No monitoring or permits are associated with this mitigation.

Preliminary Cost Estimates

The one-time capital costs within the first five years to assess the volume of water needed to maintain adequate habitat in the lagoon would be $5,000. No annual costs are anticipated.

u/henri/wp/alloeir/lagoonmt.fin1

FINAL FIVE-YEAR MITIGATION PROGRAM FOR AESTHETICS -- OPTION V

SUMMARY: The Water Allocation Prorgam EIR found that all water supply options, including 16,700 AF Cal-Am production (Option V) would have significant impacts to aesthetics associated with riparian vegetation. According to the consultant, Option V would have potentially significant impacts due to the "brown lawn effect" if water supplies were limited. Discussion of this issue is found on page IV-107. The following mitigations were recommended:

1. For aesthetic impacts related to riparian vegetation, implement the riparian mitigations described previously.

2. For the brown lawn effect, plant drought-resistant landscaping and vegetation.

The consultant determined that, with these mitigations, there would still be potentially significant asthetic impacts associated with riparian vegetation. Aesthetics associated with the brown lawn effect would be reduced to a less than significant level.

__Existing District Programs:__ Ongoing District riparian programs are described in the riparian vegetation section. Programs relating to landscaping aesthetics include:

> As part of the District's comprehensive water conservation program, seminars, educational materials and resource lists are provided to the public about drought-tolerant plants and water conserving irrigation techniques (e.g., drip, cisterns). This program costs about $6,000 annually.

__Amendments to Consultant's Aesthetics Mitigation Program:__ District staff evaluated the consultant's recommendations for technical accuracy and feasibility, and found that mitigation #2 entails reasoning that is unclear. A reduction in the amount of water available for growth would result in __fewer__ instances of brown lawn in droughts because fewer people will be using the water supply. The brown lawn danger would occur only if all conservation savings went to new growth, thus increasing drought vulnerability. The EIR recommends that this not occur, and the District Board has adopted policies to preclude such action. Thus, this mitigation concept will not formally be part of the Board-approved mitigation program. It should be noted, however, that this mitigation is actually being performed as part of the District's ongoing conservation program.

__Elements of District's Aesthetics Mitigation Program:__ The following Board-approved mitigations will be carried out by the District to mitigate aesthetic impacts of Option V:

1. Implement riparian mitigation programs discussed above.

The costs for this program are described in the riparian mitigation section. They would reduce aesthetic impacts relating to riparian vegetation from significant to a potentially significant level.

u/henri/wp/alloeir/othermit.finl

APPENDIX 3: INITIAL EVALUATION OF ALTERNATIVES

3.1 INTRODUCTION

In compliance with federal and state law, the District investigated a broad spectrum of water supply alternatives to its originally proposed project, the 29,000 AF New San Clemente Dam. From 1988 and through mid-1990, alternatives were considered that might, at least conceptually, be able to meet two project purposes: (1) provide drought reserve for existing residents and supply for planned growth, and (2) provide year round Carmel River flow at the USGS "near Carmel" gage at least in normal and wetter years. On August 8, 1990, the Board amended the project purpose to include only one element: water supply to provide adequate drought reserve and meet the need of planned growth. This change did not affect the final results; it actually broadened the possibilities.

A multi-phase selection process that spanned several years was used to assess which alternatives should be analyzed in this Supplemental Draft EIR/EIS. The criteria, methodology and results of each phase are summarized in Chapter 3. This appendix describes the first phase, the Part I Evaluation of Alternatives, which was conducted in 1988.

A broad range of alternatives that could produce more water was explored, including (1) new dams on the Carmel River or its tributaries, (2) offstream storage reservoirs, (3) infiltration basins for recharge, (4) additional ground water development, (5) sediment removal from existing reservoirs, (6) importation of water and (7) desalination. In addition, the District considered alternatives that would more efficiently use existing resources, such as (7) wastewater reclamation and (8) additional components to the District's existing conservation program.

State and federal law require analysis of the No Project alternative, defined here as existing facilities and conservation efforts, with additional of new wells in the Seaside Coastal ground water subbasin. The No Project alternative is fully described in Chapter 4 of the Supplemental Draft EIR/EIS.

3.2 DESCRIPTION OF ALTERNATIVES CONSIDERED

The following sections briefly describe the numerous water supply alternatives that were examined by the District in the Part I Evaluation.

3.2.1 CARMEL RIVER MAINSTEM DAMS

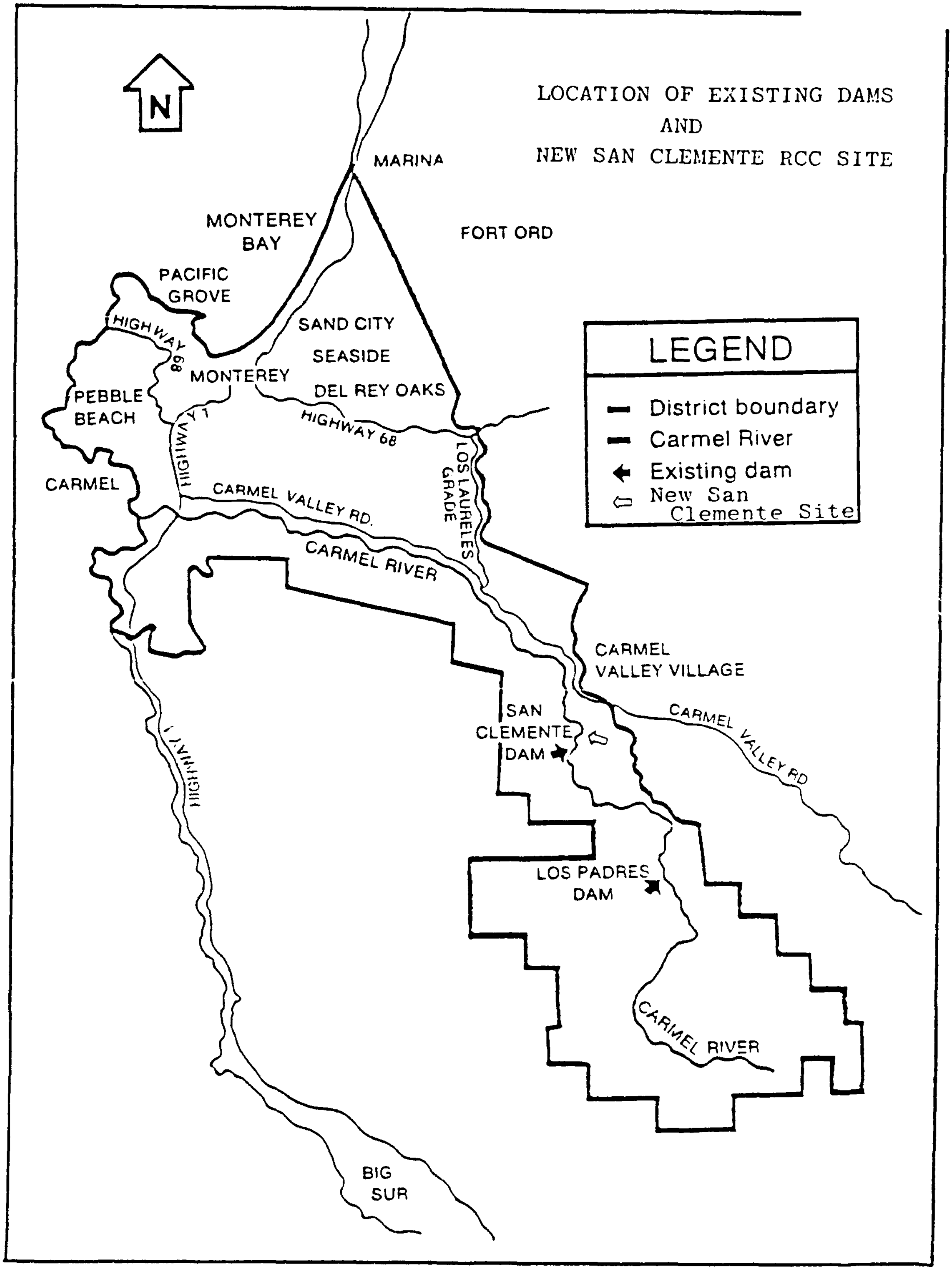
MPWMD New San Clemente Project – RCC Dam

The MPWMD New San Clemente alternative originally entailed a roller compacted concrete (RCC) dam sized to create a storage reservoir of up to 29,000 acre-feet (AF). The MPWMD issued a Notice of Preparation for a 29,000 AF project in June 1982 and a Notice of Intent for the same sized project in August 1986. Project sizes of 16,000 AF, 20,000 AF and 29,000 AF were described in the 1987 Draft EIR/EIS.[1]

The New San Clemente Dam would be located on the Carmel River 18 miles upstream from the river's mouth and about 3.5 miles south of Carmel Valley Village (Figure 3-1). The new dam would be about 3,600 feet downstream of the existing San Clemente Dam and would inundate the existing dam and reservoir. The maximum sized dam would be 300 feet high with a crest length of 900 feet. The 29,000 AF reservoir would inundate about 345 acres.

Other facilities include a spillway and stilling basin at the downstream toe of the dam to prevent erosion. Trap and truck facilities would be built to pass steelhead spawners migrating upstream; downstream facilities would most likely consist of a set of screens to trap fish before they enter the reservoir for transport to a release site below the dam. Dam features would include a multiple level intake structure and two regulating valves at the outlet works for low flow and normal releases. A permanent access road would be constructed for the project that would be linked to Carmel Valley Road via San Clemente Drive.

FIGURE 3-1


LOCATION OF EXISTING DAMS
AND
NEW SAN CLEMENTE RCC SITE
N
MARINA
FORT ORD
MONTEREY
BAY
PACIFIC
GROVE
HIGHWAY 68
SAND CITY
SEASIDE
MONTEREY
DEL REY OAKS
PEBBLE
BEACH
HIGHWAY 1
HIGHWAY 68
CARMEL
CARMEL VALLEY RD.
LOS LAURELES
GRADE
CARMEL RIVER
LEGEND
District boundary
Carmel River
Existing dam
New San
Clemente Site
CARMEL
VALLEY VILLAGE
SAN
CLEMENTE
DAM
CARMEL VALLEY RD
HIGHWAY 1
LOS PADRES
DAM
CARMEL RIVER
BIG
SUR

Management of the proposed reservoir would be coordinated with the Carmel Valley and Seaside ground-water basins on a conjunctive use basis to maximize municipal and in-stream benefits. The basic operations goal is to keep the Carmel Valley aquifer as full as possible and maintain the maximum amount of water in the Carmel River for fish and vegetation. Operations also entail a schedule of minimum release targets for steelhead, varying with the type of water year.

A 29,000 AF project was evaluated assuming a January 1988 construction capital cost estimate of $44.9 million with O&M costs of $533,000 per year. Total annual costs to finance and operate a 29,000 AF project were estimated at $6.5 million per year.

In March 1989, the MPWMD Board chose to no longer designate the 29,000 AF New San Clemente Project as the proposed project, based on state and federal agency concerns. Its size was also reduced to 23,000 AF. Chapter 4 of the EIR/EIS provides more detailed, recent cost estimates for a 23,000 AF New San Clemente project, which will be analyzed in this EIR/EIS.

MPWMD New San Clemente Dam-- Rockfill Type

The New San Clemente rockfill alternative would be a 29,000 AF concrete faced rockfill dam located 1,200 feet downstream of the existing dam (Figure 3-1). This dam was considered as a "fall-back" alternative if geotechnical studies showed that a roller- compacted concrete dam is not appropriate. It would be 300 feet high at crest elevation 726 with a crest length of 1,200 feet.[2] About 340 acres would be inundated. Associated facilities would similar to those described for the RCC dam.

This project was evaluated assuming a January 1988 construction capital cost of $50.8 to $61.9 million with O&M costs of $454,000 to $495,000 per year. Total annual costs would be $8.6 to $10.3 million per year.

MPWMD New San Clemente Dam – Joint Use with Fort Ord and Marina

This concept consists of a jointly funded 45,000 AF New San Clemente Reservoir (Figure 3-1) covering 460 acres that would provide water to residents within MPWMD, Fort Ord and Marina. Facilities would include a 320-foot high RCC dam with a crest length of 1,200 feet and a diversion weir and pumping station near the Scarlett Road Narrows. A 135,000 foot (25.6 mile) pipeline would convey untreated water to Fort Ord; a treatment plant would be built at Fort Ord near Marina. Connections would be made to the Fort Ord pumping station and the Marina Well No. 10. Treated water would be distributed to the existing systems of Marina and Fort Ord via these two points.[3]

This project was evaluated assuming a January 1988 construction cost of $56.5 million for the dam and $62.1 million for the pipeline and water treatment. O&M costs for the dam and transmission facilities would be $645,000 and $905,000 per year, respectively. Depending on the cost sharing plan selected, the low and high end of the cost allocation would be:

MPWMD	–	$17 to $36.4 million capital cost; $2.0 to $4.0 million O&M
Fort Ord	–	$48 to $59.3 million capital cost; $5.3 to $6.5 million O&M
Marina	–	$34.3 to $42.3 million capital cost; $4.0 to $4.8 million O&M

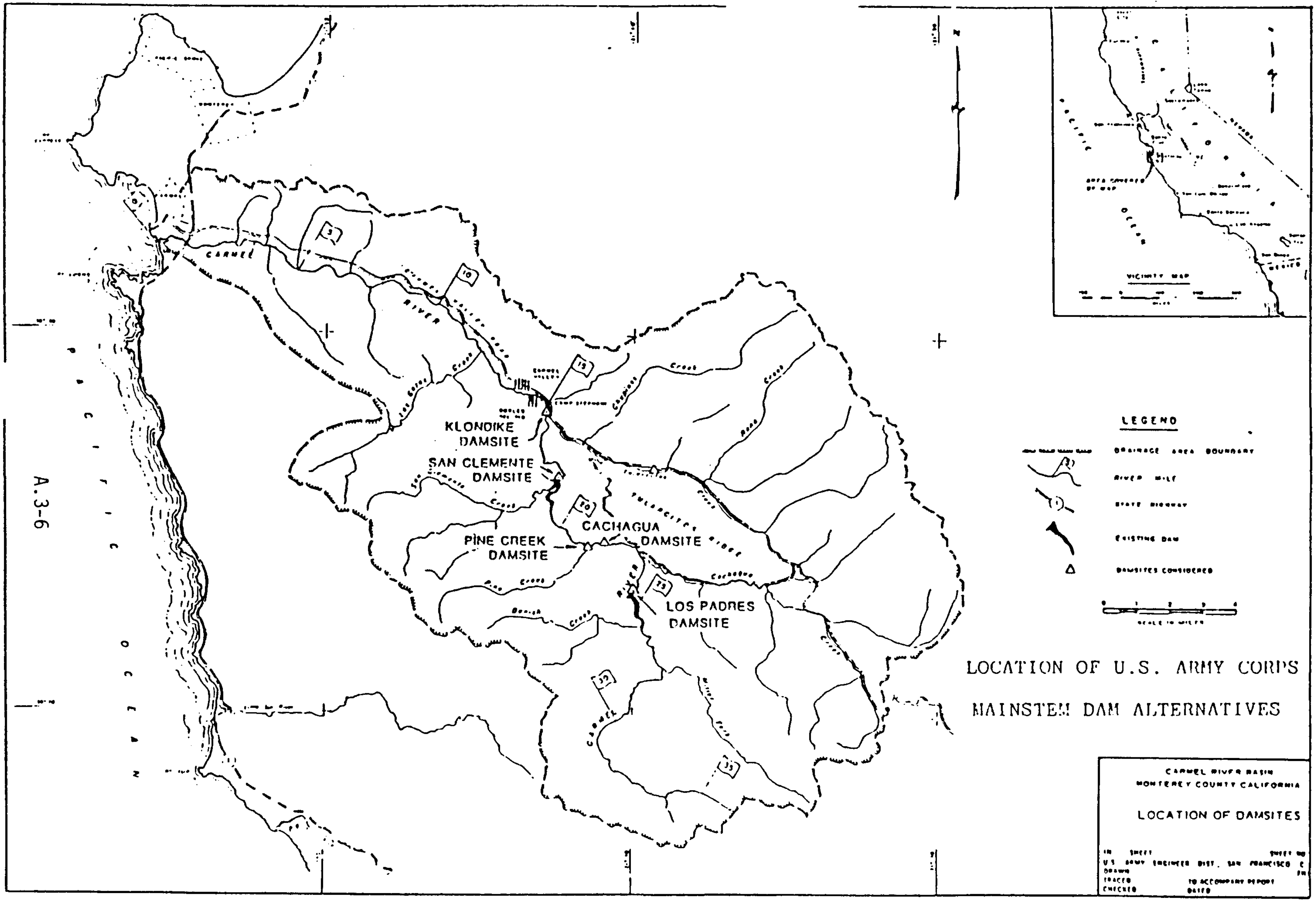
U.S. Army Corps of Engineers Proposals

In 1971, the U.S. Army Corps of Engineers (Corps) began evaluating means to solve flood problems in Carmel Valley and municipal water supply needs for the Monterey Peninsula, Fort Ord and Marina. A variety of solutions, including five mainstem dams shown in Figure 3-2, were considered. The Corps sites included New San Clemente, Cachagua (Upper Syndicate), Pine Creek (Lower Syndicate), Klondike and Los Padres.[4]

The Corps evaluated each site as a single-purpose flood control project, a single-purpose water supply project and a multiple purpose project. The Corps believed that the Wilderness Act of 1964 would preclude construction of any reservoir that inundated any portion of the Ventana Wilderness. Thus project sizes were limited to the point at which inundation encroached upon Wilderness lands.

The basic concept for all mainstem dams was to store excess runoff in reservoirs along the river. The Corps assumed that the most economical construction would be a rockfill embankment, an open cut abutment spillway in undisturbed earth, and a tunnel outlet works to release stored water. The dams would be sized and operated to maintain a storage reserve to carry over from year to

FIGURE 3-2



LOCATION OF U.S. ARMY CORPS MAINSTEM DAM ALTERNATIVES

Source: Corps of Engineers, May 1981

year to meet demands during extended dry periods. Fish passage facilities were not envisioned; instead, hatcheries would be built to offset fishery resource losses.

In the Corps' 1981 Main Report and Environmental Impact Statement, the 154,000 AF San Clemente Dam and Reservoir was determined as the best means of developing additional water supplies and providing flood protection. This proposal was later abandoned by the Corps due to lack of community support, which was necessary to fund the dam. The local community would be responsible for 84% of the cost.

The District reviewed the Corps Draft EIS and reevaluated the sites with the MPWMD project purposes in mind. Its findings are summarized in Section 3.3.

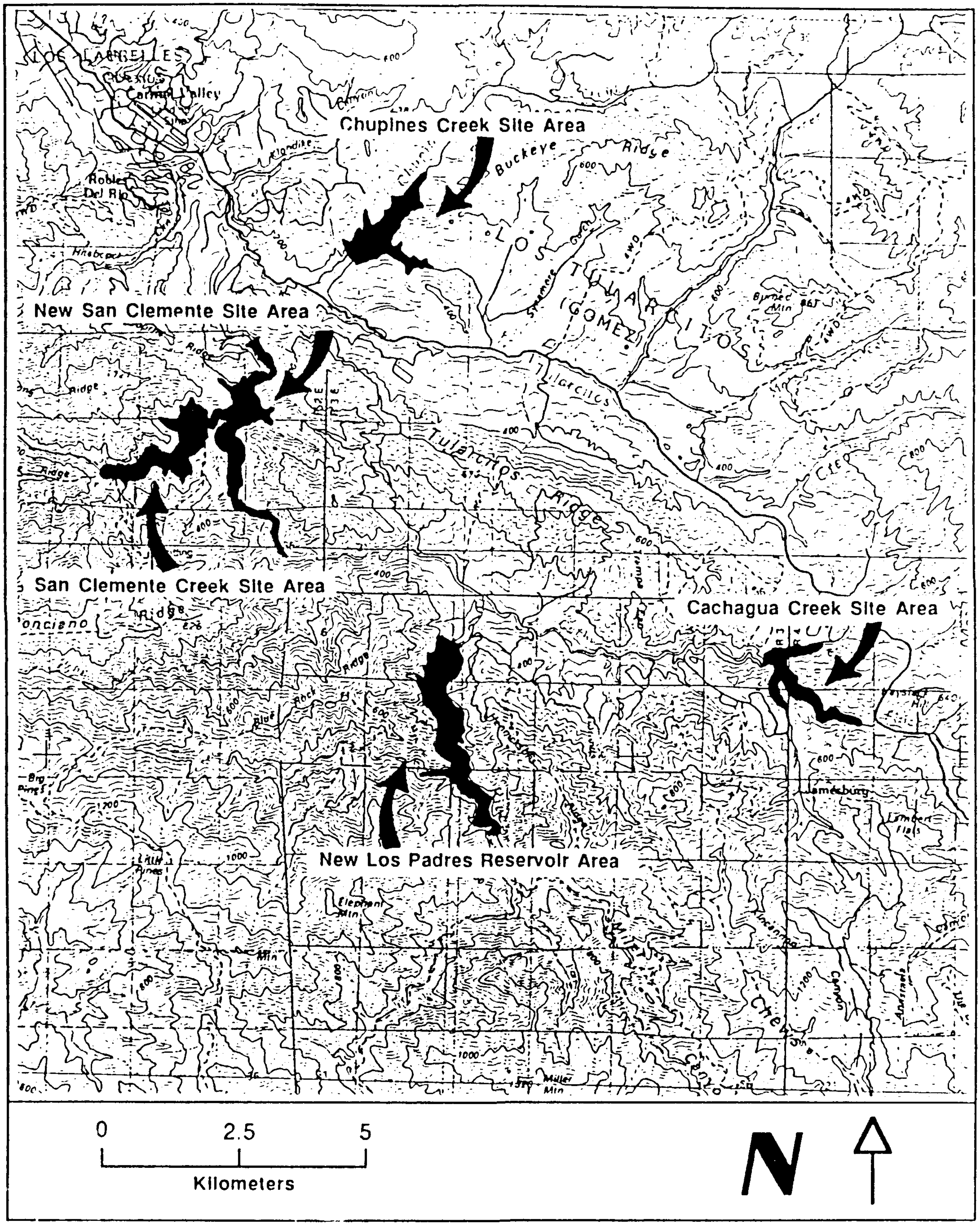
MPWMD New Los Padres Reservoir

The original MPWMD concept was to enlarge the existing Los Padres Dam (or build a new dam downstream) to create a reservoir of up to about 19,000 AF. This concept was evaluated in the Part I and Part II evaluations of alternatives. The 19,000 AF project was later amended to the 24,000 AF New Los Padres Dam and Reservoir, which was selected as the District's proposed project for the Section 404 Permit in March 1989.

The New Los Padres project would be an RCC dam located near river mile 24, about 3,400 feet downstream of the existing dam (Figure 3-3). A 24,000 AF reservoir would require a 261-foot high dam with a crest elevation of 1,120 feet,[5] and would inundate the existing Los Padres Dam. The 24,000 AF reservoir would inundate about 273 acres, including four acres of the existing Ventana Wilderness near the confluence of Danish Creek and the Carmel River. In November 1990, Public Law 101-539 was signed, which would amend the wilderness boundary if this alternative receives a 404 permit. District considered the concept of constructing a dike on Danish Creek to prevent the new reservoir from encroaching onto the Ventana Wilderness, but found it to be infeasible.

Facilities also include a spillway and stilling basin at the toe of the dam to prevent erosion. Trap and truck facilities would be built to pass steelhead spawners migrating upstream; downstream facilities would consist of either a fish attraction device and trapping facility near the face of the

FIGURE 3-3



SOURCE: ACI

dam or a set of screens to trap fish before they enter the reservoir for transport to a release site below the dam. A multiple level intake structure would be built near the upstream face of the dam. Regulating valves would be installed at the outlet works for low flow and normal releases. Access roads to the dam already exist, but additional roads may need to be built for fish screens.

Management of the proposed reservoir would be coordinated with the existing San Clemente Reservoir and the Carmel Valley and Seaside ground-water basins on a conjunctive use basis to maximize municipal and instream benefits. The basic operations goal is to keep the Carmel Valley aquifer as full as possible and maintain the maximum amount of water in the Carmel River for fish and vegetation. A schedule of minimum release targets for steelhead, varying with the type of water year, was developed in conjunction with resource agencies.

Project cost estimates for a 24,000 AF project (in 1989 dollars) are a construction capital cost of $61.2 million with total annual costs of $8.7 million per year. The revised cost estimates and project design are described in Chapter 4 of the EIR/EIS.

3.2.2 CARMEL RIVER TRIBUTARY DAMS

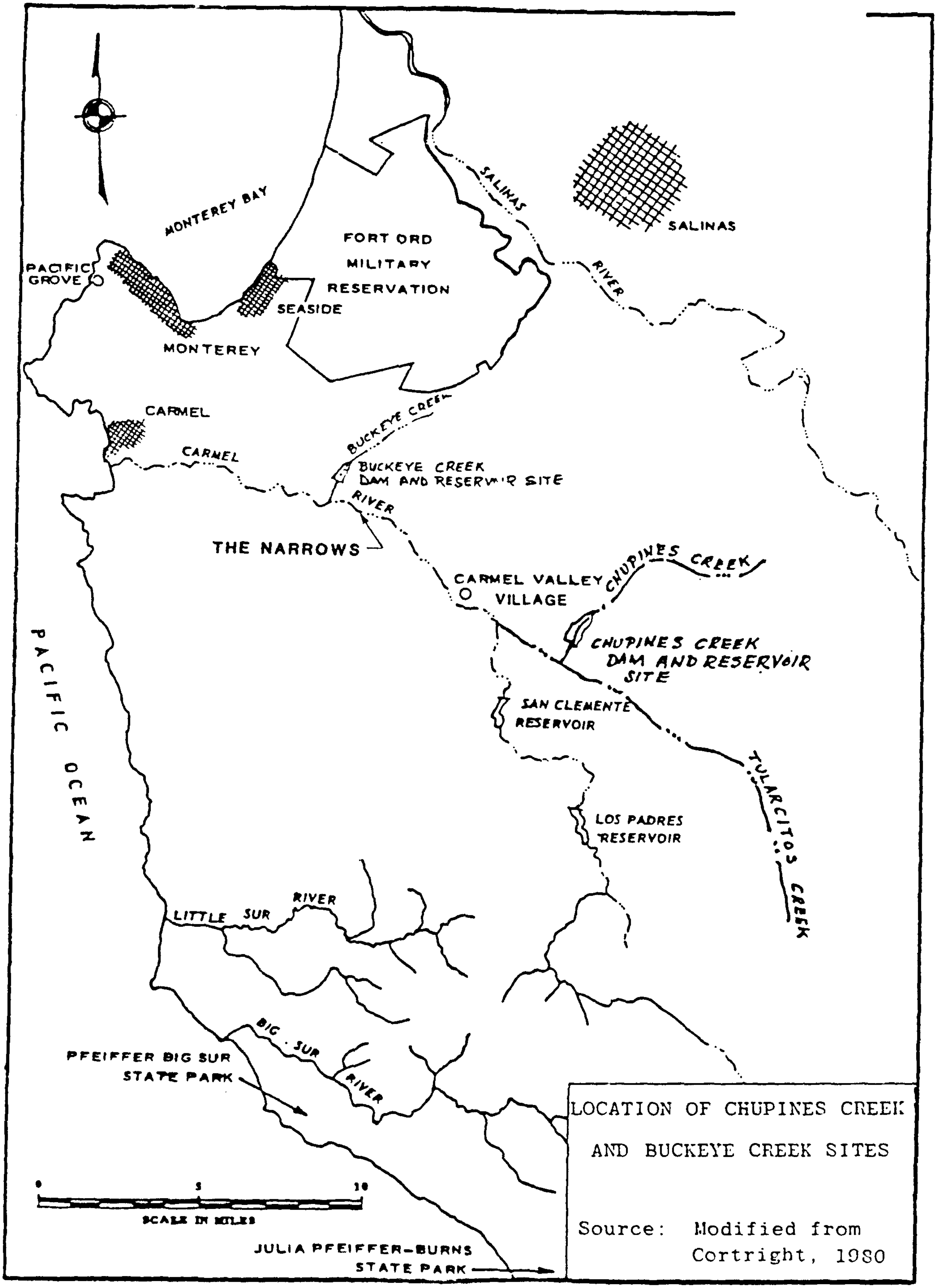
Buckeye Creek Dam

This alternative includes a dam and 2,000 AF reservoir on Buckeye Creek, which joins the Carmel River northwest of Carmel Valley Village about one mile downstream of the Narrows (Figure 3-4). A 2,000 AF Buckeye Creek reservoir would inundate 50 acres of land.[6]

There are two basic concepts for this alternative, both of which use Buckeye Creek Reservoir as a pumped storage impoundment. In one variation, water would be diverted from the existing San Clemente Reservoir utilizing excess capacity of the Cal-Am filter plant. This excess production would be transmitted through Cal- Am's existing Carmel Valley main as far as Buckeye Canyon. A new pipeline and pumping plant would boost water from this point to Buckeye Creek Reservoir, approximately 1.1 miles north of Carmel Valley Road.

In the second variation, water would be either diverted from surface flows at the Narrows or pumped from new wells in the Carmel Valley alluvial aquifer, then boosted to Buckeye Creek

FIGURE 3-4



LOCATION OF CHUPINES CREEK AND BUCKEYE CREEK SITES

Source: Modified from Cortright, 1980

Reservoir. With both variations, water from Buckeye Creek Reservoir would be treated and introduced into Cal-Am's main Carmel Valley pipeline when needed to meet municipal demands. A cost estimate has been made only for the San Clemente Reservoir diversion variation of the Buckeye Creek alternative. This project was evaluated using a January 1988 capital construction cost estimate of $10 million with O&M costs of $410,000 per year. Costs to finance this project would total $1.8 million per year. More detailed information is provided in Appendix C1.

Cachagua Creek Dam

This alternative consists of a dam and reservoir on Cachagua Creek, located approximately ten miles southeast of Carmel Valley Village, between the existing Los Padres and San Clemente Dams (Figure 3-3). A dam in the 5,000 - 7,000 AF range was envisioned to be operated in conjunction with the existing Los Padres and San Clemente Reservoirs. A 1982 design included the dam, spillway, outlet works, intake structure, and road relocations.[2] No provision was made for fish passage facilities. A 7,000 AF Cachagua Creek reservoir would inundate 116 acres of land, including approximately 2.8 miles of stream channel.

A reservoir in Cachagua Creek would be operated in conjunction with the existing Los Padres and San Clemente reservoirs and the Carmel Valley and Seaside groundwater basins. The operation would be similar to that of a new mainstem reservoir, with the exception that an offstream reservoir would have a much smaller storage capacity, and inflow to the reservoir would be much less. Excess winter and spring flows would be stored for later release for instream and municipal uses.

An earthfill embankment dam with a reservoir storage capacity of 7,000 AF was evaluated assuming a January 1988 capital construction cost of $33 million with O&M costs of $530,000 per year. Total annual costs for the project would be $5.0 million per year. A 6,000 AF Cachagua Creek reservoir combined with a 3 MGD desalination plant was selected for analysis in this EIR/EIS. Additional information about this project, including revised cost estimates, are provided in Chapter 4 of the EIR/EIS.

Chupines Creek Dam

This alternative consists of a dam and reservoir on Chupines Creek, a tributary of Tularcitos Creek, which in turn joins with the Carmel River about 1.5 miles southeast of Carmel Valley Village

(Figure 3-3). A reservoir in the 10,000 - 15,000 AF size range was envisioned, as well as a spillway, intake and outlet works, pumping station, surge tank, a pipeline between the existing San Clemente Reservoir and a reservoir on Chupines Creek, and a pipeline connecting this latter pipeline to Cal-Am's existing Carmel Valley filter plant.[7] Fish passage facilities would not be included. A 10,000 AF Chupines Creek reservoir would inundate 174 acres of land, including approximately 2.6 miles of stream channel.

The Chupines Creek Dam would be operated as a pumped storage project in conjunction with the existing San Clemente Reservoir. Excess winter and spring flows of the Carmel River would be diverted at the existing San Clemente Dam and pumped to Chupines Creek Reservoir. Water stored in Chupines Creek Reservoir would be routed via a pipeline to the Carmel Valley filter plant for municipal uses. Flows of Chupines Creek would not be regulated and would be released downstream as outflow from the Chupines Creek Reservoir.

A 10,000 AF earthfill embankment was evaluated assuming a January 1988 capital construction cost of $53 million with O&M costs of $930,000 per year. Costs to finance the project would total $8.1 million per year. A 10,500 AF reservoir was selected for analysis in this EIR/EIS, as described in Chapter 4, along with revised cost estimates.

San Clemente Creek Dam

This alternative consists of a dam and reservoir on San Clemente Creek, a tributary to the Carmel River, that enters the existing San Clemente Reservoir (Figure 3-3). An upper and lower site were evaluated as follows: (1) a dam at the upstream site without pumped storage; (2) a dam at the downstream site without pumped storage; and (3) a dam at the downstream site with pumped storage. Size variations considered at both sites included reservoir storage capacities up to 11,700 AF. For this reservoir capacity, the downstream site would require a dam approximately 300 feet high, with a reservoir surface area of about 115 acres. At the upstream site, an 11,700 AF reservoir would require a dam approximately 275 feet high and would have a 135-acre surface area.

Spillway, outlet works, access roads, and other major features would vary depending on the site and size variation. A pumped storage project would require a large diameter pipeline approximately 3,000 feet long, pumping facilities, a surge tank, and valves and other controls.[2]

A reservoir on San Clemente Creek would be operated in conjunction with the existing Los Padres and San Clemente Reservoirs. The basic operation would be similar to that of a new mainstem reservoir, with the exception that no increase in steelhead attraction flows in January through March would be provided from storage. Releases to maintain a flow of 20 cfs at the Carmel River lagoon would be made in April and May. In the pumped storage variations, excess Carmel River flows would be pumped from the existing San Clemente Reservoir and stored in the new reservoir for later release.

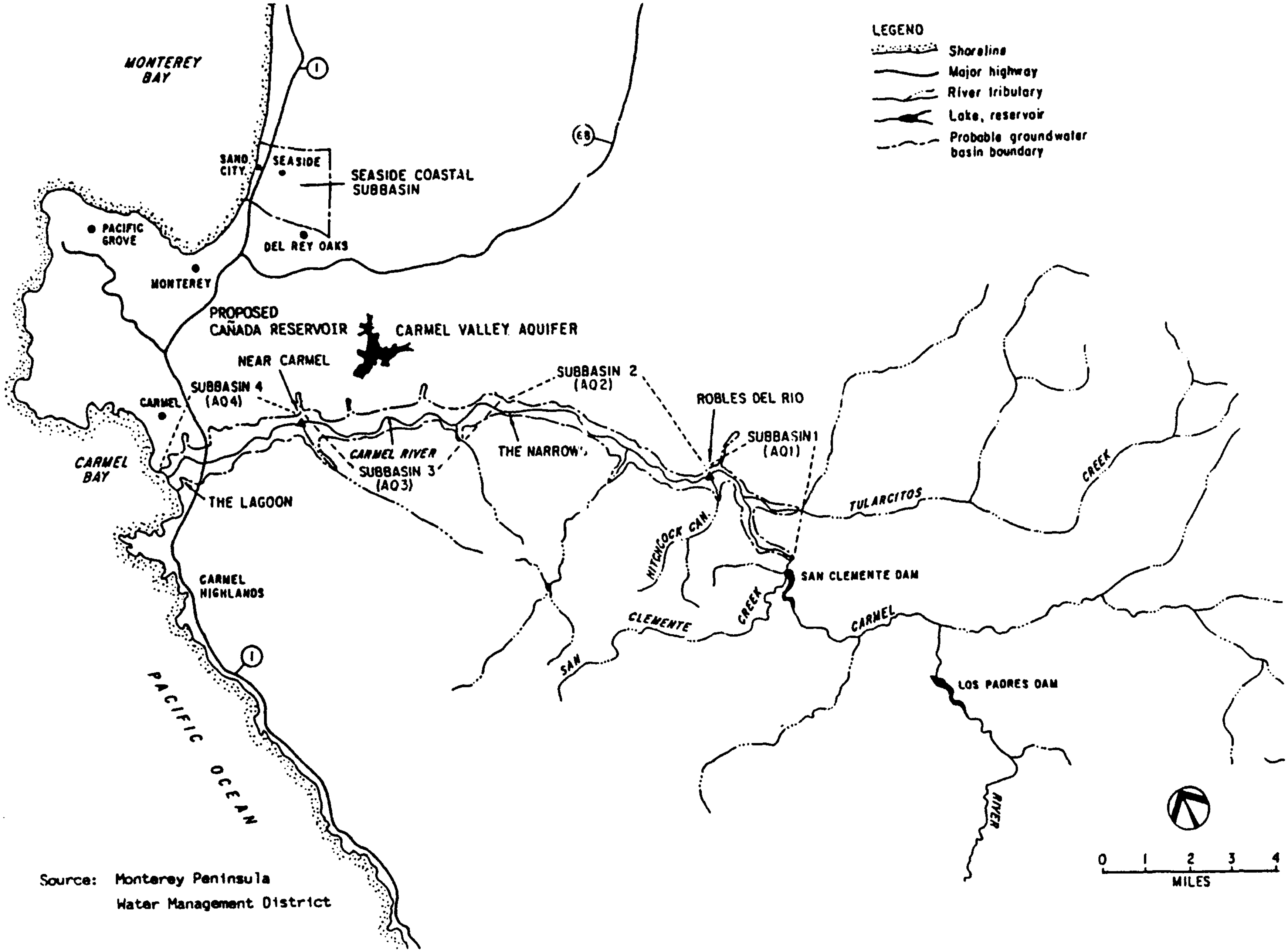
Reservoirs ranging in size from roughly 8,000 - 12,000 AF were evaluated assuming a January 1988 capital construction cost of $40 million to $72 million for a pumped storage project. The O&M costs would range from $530,000 to $930,000 per year. Thus total annual costs would range from $5.9 - $7.8 million per year. An 11,000 AF reservoir at the lower site with pumped storage was selected for analysis in this EIR/EIS. Additional information, including revised cost estimates are provided in Chapter 4 of the EIR/EIS.

Cañada Reservoir

On February 13, 1989 a consortium of private landowners and the California-American Water Company (Cal-Am) made a presentation to the District Board on their intention to separately pursue construction of Cañada Reservoir. This project entails diversion of water from the Carmel River, preferably via an infiltration gallery, during high flow periods and pumping to an offstream reservoir of about 25,000 AF in size. The reservoir would be built in Cañada del la Segunda, a canyon on the north side of the Carmel River, about 5 miles upriver from Carmel Bay (Figure 3-5). The reservoir would be used primarily for base demand, and ground water in lower Carmel Valley would be used as drought reserve. Preliminary cost estimates performed in 1989 indicate that the capital cost of the reservoir, infiltration gallery/pumping facilities and Cañada filter plant would range from $73 - $113 million.[8] Annual O&M costs would be about $1.5 million per year.

The Cañada site was not evaluated by the District in its Part I and Part II alternatives evaluations because an early investigation of potential reservoir sites performed by Logan 1980 dismissed a dam in Cañada de la Segunda.[6] Logan's assessment was based primarily on the poor ratio of dam height to storage volume ratio, assuming a reservoir size range of 3,000 to 5,000 AF. Other

FIGURE 3-5



Carmel River Watershed

technical concerns related to the presence of the Navy earthquake fault and the suitability of native fractured shale with which to build an embankment dam.

A 1989 assessment performed by Grice Engineering[9] shows that the height-to-volume ratio is much better than Logan's earlier assessment when the currently proposed reservoir sizes of 20,000 to 28,000 AF are considered. Preliminary engineering and geologic data provided by Grice Engineering[10] indicate that construction of a dam from native materials appears to be questionable.[11] Thus, additional studies were performed by Brown and Caldwell in late 1989 and early 1990 to confirm the site feasibility, assess potential seepage rates, address identified geotechnical and hydrologic concerns, and develop more accurate cost estimates.[12,13]

The MPWMD assisted Cal-Am to develop a more definitive project description and operations scenario by January 1991, based on simulations from the District's CVSIM computer model. In addition, Cal-Am requested that the District be the lead agency for the EIR/EIS on the Cañada project in 1990. The Cañada Project is analyzed in this EIR/EIS; additional information on the project description and revised cost estimates are provided in Chapter 4 of the EIR/EIS.

3.2.3 SEDIMENT REMOVAL FROM EXISTING RESERVOIRS

This alternative consists of dredging or excavating accumulated sediment in the existing Los Padres and/or San Clemente Reservoirs (Figure 3-5). Based on analyses performed in 1988, storage capacity in Los Padres Reservoir has been reduced from 3,032 AF to 2,179 AF; capacity in San Clemente Reservoir has been reduced from 2,136 AF to 796 AF. Assuming both reservoirs could be returned to full capacity, there would be a 2,193 AF increase in reservoir storage, bringing the total to 5,168 AF.

Dredging or excavation equipment would be required to remove sediment. Depending on the disposal method, facilities to dewater the sediment would be necessary prior to transport and placement. The reservoir would need to be lowered or drained with the excavation method, and resident fish relocated and the river diverted to the dam outlet works. Disposal of the spoils would entail about 270,000 truck trips to a landfill or transport to a nearby canyon, perhaps via conveyor belt. Work could occur only in the summer and early fall to avoid storm flows and water quality impacts.

This project was evaluated assuming a January 1988 construction capital cost of $14 million for Los Padres Reservoir and $15 million for San Clemente Reservoir. O&M costs would be $50,000 and $75,000 for each reservoir, respectively. Total annual costs to finance the project would be $1.9 million per year for Los Padres Reservoir and $2.0 million for San Clemente Reservoir. A long-term maintenance dredging program to keep the reservoirs free of sediment would add approximately $100,000 per year to the total annual cost.

3.2.4 STORAGE AND INFILTRATION BASINS/RECHARGE

Fort Ord Depressions/Reservoir Sites

Several natural depressions and valleys exist in and adjacent to the U.S. Army's Fort Ord Military Reservation (Figure 3-4). The concept is to fill them with water imported via pipeline from Carmel Valley, when available. The proposed facilities consist of either lined depressions with possible small saddle dams (if used as storage basins) or unlined depressions (if used as infiltration basins). In addition, water treatment facilities, monitoring facilities, and a transmission system would be required for lined depressions; and additional recovery wells may be required for use with unlined depressions.

Two operational schemes have been identified: (1) water could be stored in lined depressions for later release to meet demands, or (2) water could infiltrate into unlined depressions for eventual recovery from new or existing wells located downgradient from the depressions.

Cost estimates have been developed only for the scheme that would use unlined depressions as infiltration basins with recovery by existing wells in the Seaside Coastal ground-water subbasin. Based on 1981 a report,[14] the construction capital cost was $1.6 million, with total annual cost of $838,000. Impermeable liners for the depressions would raise these costs by an undetermined but considerable amount.

Seaside Groundwater Recharge - Coastal Barrier

This alternative entails trenches, small diameter wells or large diameter wells that would be installed near the coast. Reclaimed water from a sewage treatment facility or fresh water from the Cal-Am system could be injected to create an artificial barrier to sea-water intrusion. This barrier would allow for additional production from wells in the Seaside Coastal groundwater subbasin (Figure 3-6) while protecting against seawater intrusion. The barrier also could be operated in combination with an inland recharge system with wells to further increase the amount of water available. Water could be allowed to infiltrate into the coastal dunes through open, unlined trenches, or could be injected via small diameter wells or larger diameter wells. Several possible recharge barrier schemes have been studied, and are summarized in Appendix C1.

Based on a 1981 report,[14] capital costs for various barrier recharge schemes ranged from $210,000 for Cal-Am water to $1.7 million for treated wastewater. Annual costs ranged from $134,000 to $332,000 per year.

Seaside Coastal Groundwater Subbasin – Recharge with Wells

This alternative scheme considers recharge and recovery of water through existing and new wells in the Seaside Coastal Groundwater Subbasin (Figure 3-6). When available, water would be diverted from Carmel Valley via the Cañada de la Segunda pipeline to serve as a local source for recharge. Cal-Am and Seaside Municipal wells could conceivably be used for injection and later recovery of water imported into the coastal subbasin. Also, an additional well or wells could be installed to more effectively recover the injected water. This recharge and recovery system could be combined with a coastal recharge barrier facility to further increase the yield available from the coastal subbasin.

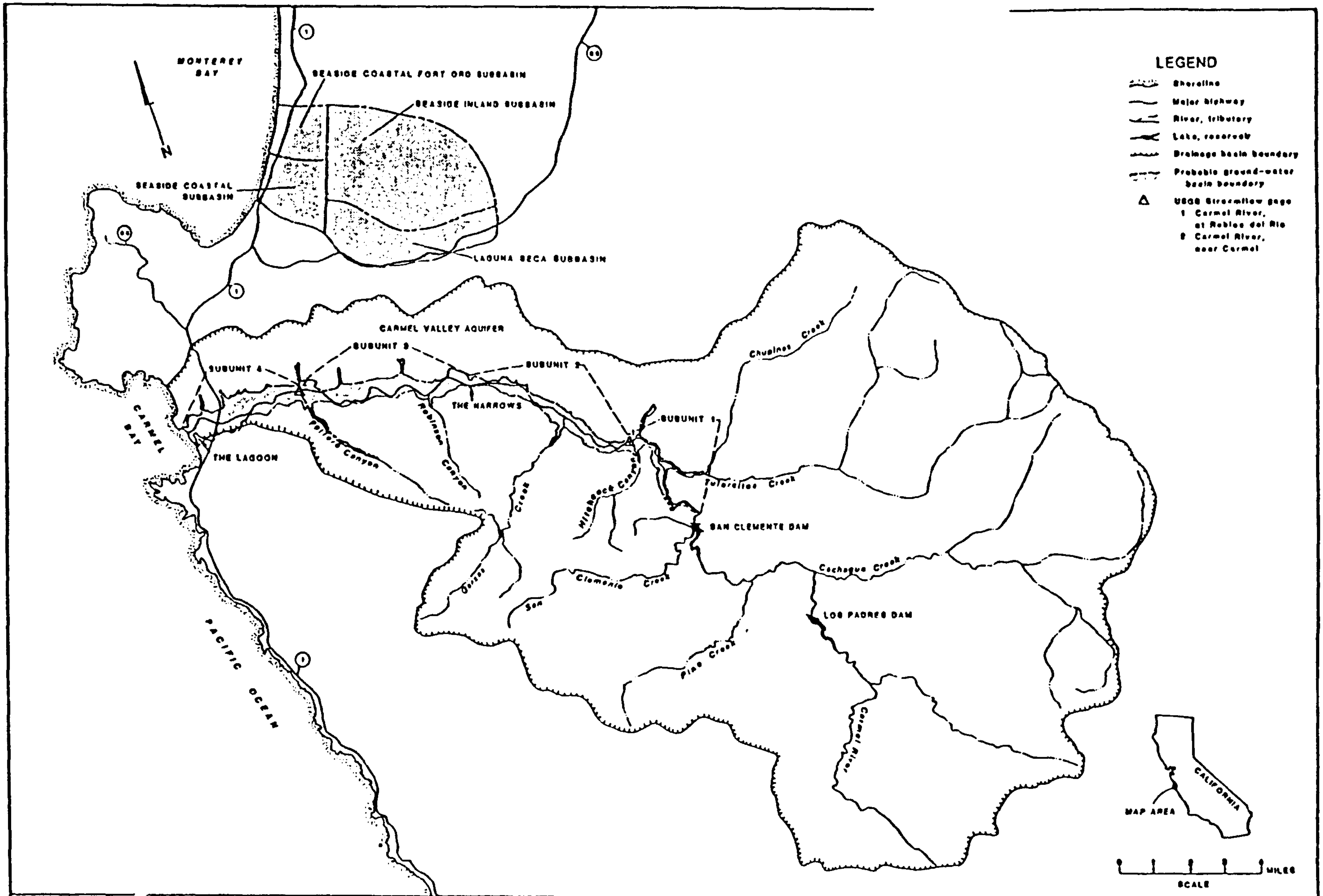
Based on a 1981 report,[14] the capital construction cost estimate in 1988 dollars is $458,000 with annual operations and maintenance costs of $703,000.

3.2.5 GROUND WATER DEVELOPMENT

Seaside Coastal Groundwater Subbasin Well Development

This alternative entails increased municipal well production capacity in the Seaside Coastal ground-water subbasin (Figure 3-6). Cal-Am's existing well network has an estimated operational capacity of about 3,780 gallons per minute (16.7 AF/day). A net 600 gpm increase in production capacity is planned by Cal-Am through replacement of existing wells and installation of an additional well or wells. Assuming an operational efficiency loss of 13 percent, the adjusted

FIGURE 3-6



Water Resources System for the Monterey Peninsula Area

MONTEREY PENINSULA WATER MANAGEMENT DISTRICT

Drafted from: USGS 1:100,000 scale topographic map

Drafted by: AHP 8/87

increase in capacity would be 522 gallons per minute. Production from new and existing wells in coastal Seaside would be managed to offset short-term increased Cal-Am system demands during dry periods while maintaining the long-term yield of the coastal subbasins. The short-term annual production maximum would be less than 5,000 AF/year.

This project was evaluated using a January 1988 capital construction cost of $240,000 (two new wells at $120,000 each) with annual O&M costs of $40,000 ($20,000 per well). Costs to finance this alternative would total $72,000 per year. It should be noted that the District and Cal-Am have been cooperatively developing new wells in the Seaside Coastal area in 1990; a new well that could provide an additional 1000 AF/year is scheduled to be on-line in mid-1991.

Seaside Inland Groundwater Subbasin Well Development

This alternative entails groundwater development from the Seaside Inland subbasin for use within the District (Figure 3-6). Depending on the quantity that is available from this largely unexplored area, the additional production could be used to meet annual and/or drought reserve needs of the District. Because much of the inland subbasin is utilized by the U.S. Army as light artillery firing ranges, the area has limited access for the purpose of water supply exploration and development.

The quantity and type of facilities necessary for this alternative have not been determined. However, a ground-water supply system in the inland subbasin would likely entail a well field, transmission and treatment facilities, as the water locally contains excess total dissolved solids, iron and/or manganese.

This project was evaluated in January 1988 based on cost projections made for a 1985 proposal.[15] These cost estimates include exploration, testing, well construction, water transmission, treatment and other appurtenant facilities. The construction capital cost would be $5.7 million with annual O&M costs of $614,000. Costs to finance the project would total $1.4 million per year.

Upper Carmel Valley Well Development

This alternative involves the construction of new Cal-Am water supply wells in the upper Carmel Valley aquifer, which extends from below the existing San Clemente Dam downstream to the Scarlett Road Narrows (Figure 3-5). One or two new wells with a total anticipated production capacity of 1,200 gpm have been proposed by Cal-Am for the Boronda area. The new wells would increase production capabilities in an area where wells do not exist and would increase the efficiency of service to users in this area of the Carmel Valley. These wells would be operated similar to other Cal-Am wells in upper Carmel Valley in that they would only be pumped during winter months when significant flow exists in the river or during dry periods when system demands cannot be met by other sources.

This project was evaluated in January 1988 assuming a capital construction cost of $240,000 (construction of one well, materials, land acquisition, transmission system) with annual operation and maintenance cost of $10,000. Costs to finance the project would total $42,000 per year.

Lower Carmel Valley Well Development

This alternative involves ground-water development in the lower Carmel Valley aquifer, that area of the aquifer from the Narrows to Carmel Bay (Figure 3-5). New wells could be installed in areas where Cal-Am wells currently do not exist, or existing wells could be relocated to more optimal locations, thereby increasing the overall production capacity of the Cal-Am water supply system. Water in lower Carmel Valley must be treated at the Begonia Treatment Plant to remove excess iron and manganese.

Additional groundwater development in lower Carmel Valley has been discussed but not formally proposed. The most likely area would be in Aquifer Subunit 4 downstream of the Cal-Am Rancho Cañada well, where an additional well or wells could be drilled. Additional or expanded treatment facilities may be required. No new wells are proposed for Aquifer Subunit 3.

Assuming for discussion purposes only an additional well capacity of 2,400 gallons per minute (two wells at 1,200 gallons per minute each), continuous production over a six month period would translate to approximately 2,000 acre feet. Operating conditions for any new wells in Aquifer Subunit 4 have not been determined.

Costs for new wells in lower Carmel Valley are assumed to be similar to those in upper Carmel Valley, except that costs would be somewhat higher due to water quality monitoring and to the additional treatment requirements. A January 1988 evaluation assumed a construction capital cost of $480,000 with an annual O&M of $20,000. Costs to finance the project would total $84,000 per year.

3.2.6 IMPORTATION OF WATER

Importation from Arroyo Seco River

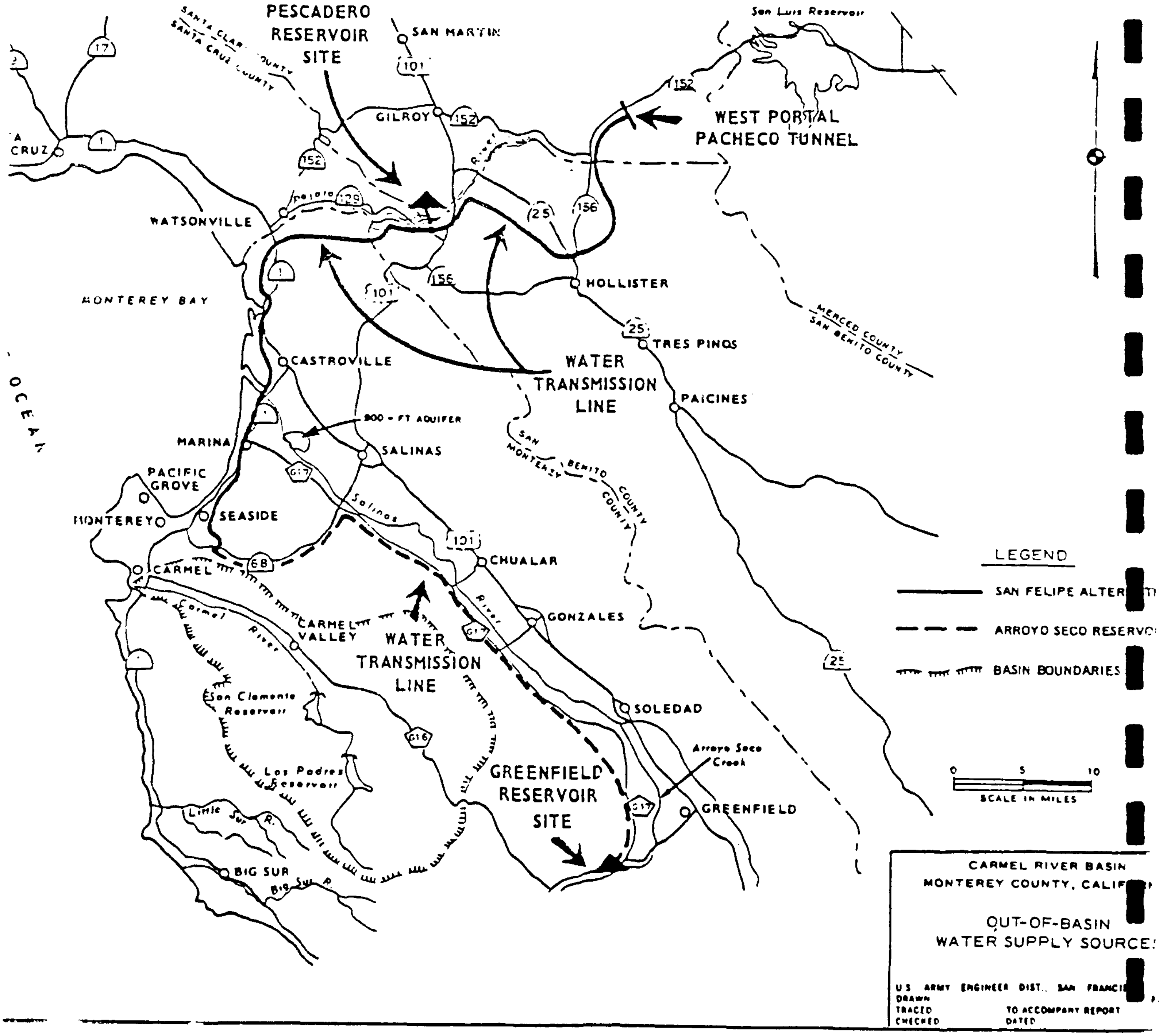
In 1981 and 1982, Monterey County Flood Control and Water Conservation District studied a multiple-use dam and 100,000 AF reservoir for water supply, flood control, hydroelectric power and recreation at one of two sites on the Arroyo Seco River, a tributary to the Salinas River, in southern Monterey County.[16] The two sites included the Pools site, located in the Los Padres National Forest, and the Greenfield site, located at the mouth of the canyon just above the Greenfield bridge (Figure 3-7). The primary beneficiaries would have been farmers in the Salinas Valley, but a 56-mile lined canal was envisioned to provide water for Fort Ord, Marina, parts of North County, Toro and the Seaside areas.

Project costs for the Pools site dam and conveyance facilities to Salinas would be $66.1 million (January 1988 dollars). An additional $13.4 million would be required for water delivery in the Fort Ord-Monterey Peninsula area. County consultants estimated that annual costs for the Fort Ord-Monterey Peninsula area would be about $2.8 million per year. In 1983, the Monterey County Board of Supervisors voted not to proceed with the project. This concept was included in a County-wide capital facilities feasibility study,[17] but was not selected as a likely option.

Importation from Lower Salinas Basin

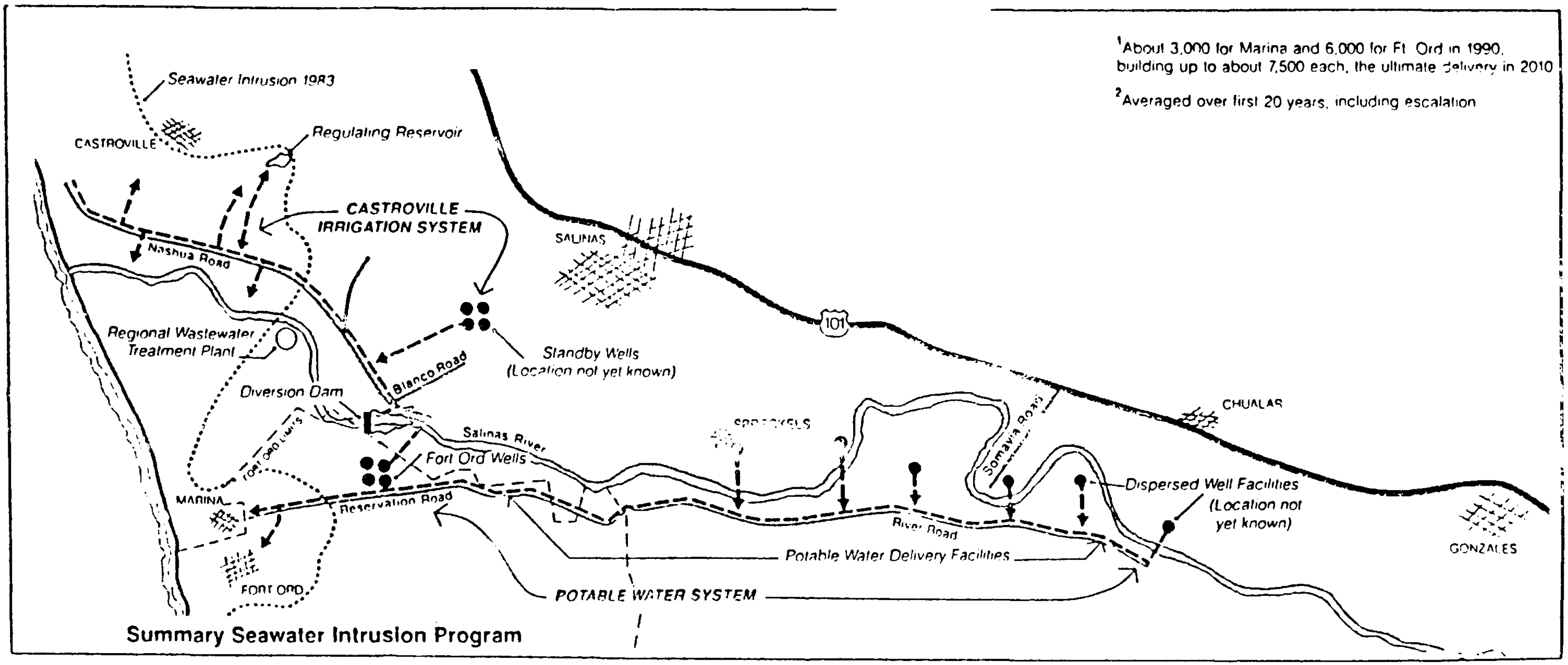
Monterey County developed this proposal as an alternative to the Arroyo Seco project. Water for agricultural use would be released from the existing San Antonio and Nacimiento reservoirs down the Salinas River to a diversion dam near Salinas. The dam would create a small pool of water of sufficient depth to allow operation of pumps to lift water for transmission to one or more small regulating reservoirs. The reservoirs would store water for peak, short-term irrigation needs of about 10,000 acres of land. In addition, a series of dispersed wells would be drilled near Salinas and water would be conveyed to Fort Ord and Marina via pipeline for municipal supply (Figure 3-8).[18]

FIGURE 3-7



Source: Corps of Engineers, May 1981

FIGURE 3-8



SCHEMATIC OF

SALINAS SEAWATER INTRUSION PROGRAM FACILITIES

Source: Seawater Intrusion Committee, January 1987, The Salinas Valley Seawater Intrusion Program

The Lower Salinas project was not designed to yield water to the Monterey Peninsula. Eligibility for water is contingent on having riparian rights along the Salinas River and on being located within the zone that funded Nacimiento and San Antonio dams. Neither of these criteria are met by MPWMD. The County is presently preparing an EIR/EIS in cooperation with the Bureau of Reclamation for this project as a solution to salt water intrusion problems experienced by Fort Ord, Marina and North County agriculture.

Importation from San Felipe Project

The San Felipe Project refers to a joint venture of the U.S. Bureau of Reclamation and the State of California. Sacramento-San Joaquin Valley water that is pumped from the Delta to San Luis Reservoir in Merced County during high flow periods is then conveyed to Santa Clara and San Benito Counties via the Pacheco tunnel and other facilities. The project service area also includes the Pajaro River Valley, which straddles the boundary between Monterey and Santa Cruz Counties (Figure 3-7). The San Felipe Division, a tunnel through the Diablo Range, has a design capacity of 216,000 AF per year. Santa Clara and San Benito Counties have contracted for 152,500 AF/year and 43,800 AF/year, respectively. The remaining 19,700 AF/year was allocated to the Pajaro Valley area, which is now served by the Pajaro Valley Water Management Agency. Monterey and Santa Cruz Counties previously shared the responsibility for the Pajaro Valley area.[19]

The MPWMD explored the possibility of purchasing and importing water from the Pajaro Valley area, if water were available. A 30-40 mile pipeline would be built from Watsonville to the Monterey Peninsula at an estimated cost of $64 million. A reservoir to store off-peak supply would also need to be built as no yield would be available during peak demand periods. A 5,000 to 10,000 AF reservoir would cost an additional $30 million. Total annual costs, including the cost of purchasing water, would easily exceed $10 million per year. As described in Section 3.3, the feasibility of this project is unlikely due to the lack of available water and excessive cost.

Importation from Big or Little Sur Rivers

The Big and Little Sur Rivers are coastal streams with drainage areas of 47 and 38 square miles, respectively, which are located south of, and adjacent to,the Carmel River Basin (Figure 3-7). No detailed studies have been made for these two watersheds as possible sources for water importation to the Carmel River basin and its water service area. Although no designs or cost estimates were prepared, it is believed that obtaining water from either of these two basins would be very expensive in comparison with other importation solutions. Because of the high mountain ridge over, or through, which water from the Big or Little Sur rivers would need to be transmitted into the water service area, the cost of conveyance facilities can be expected to be high. Both rivers have been designated under the California Protected Waterways Program and are considered for protection under the Wild and Scenic Rivers Act. It is unlikely that permission would be granted to import water from either of these streams.[20]

3.2.7 DESALINATION

Desalination is the separation of water from dissolved impurities whereby nearly pure water is recovered from influent such as wastewater, brackish water or seawater. Large desalination plants occur mainly in water starved areas such as the Middle East, and smaller systems are used in areas in the U.S. where local needs exceed economically available fresh water supplies. Desalination is presently being investigated by the Metropolitan Water District of Southern California, Marin County, the City of Santa Barbara and other communities to augment existing supplies.

The District concept will likely entail reverse osmosis (RO) to force pure water molecules through a semi-permeable membrane under high pressure. Most of the dissolved impurities remain behind and are discharged as brine. No specific desalination project proposal was assessed in the alternatives evaluation process. It was assumed that a 3-7 MGD desalination plant could be constructed at an abandoned Monterey wastewater treatment plant with beach wells. Hydrogeological studies performed in 1990 indicated that this site was poor for beach wells.[21] In 1991, the District, PG&E and the Marine County Water District conducted a feasibility study of seven desalination sites. Two sites -- one at the PG&E Moss Landing Power Station, and one at the MRWPCA Regional Wastewater Treatment Plant -- were selected for further analysis in a separate EIR.

Capital costs for a 3 MGD plant are in the $34-41 million range.[22] Costs for desalination are highly sensitive to energy costs and project operations. The maximum annual O&M cost could exceed $2.5 million, resulting in a total annual cost of over $7.1 million for a seawater desalting plant operated continuously. The total cost per acre-foot would be in the $2,400-3,300/AF range for the facility. A 7 MGD desalination plant was selected for analysis in this EIR/EIS. In addition, a 3 MGD plant is combined with three reservoir alternatives. More information, including detailed cost estimates, may be found in Chapter 4 of the EIR/EIS.

3.2.8 RECLAMATION

Reclamation for Ground-water Recharge

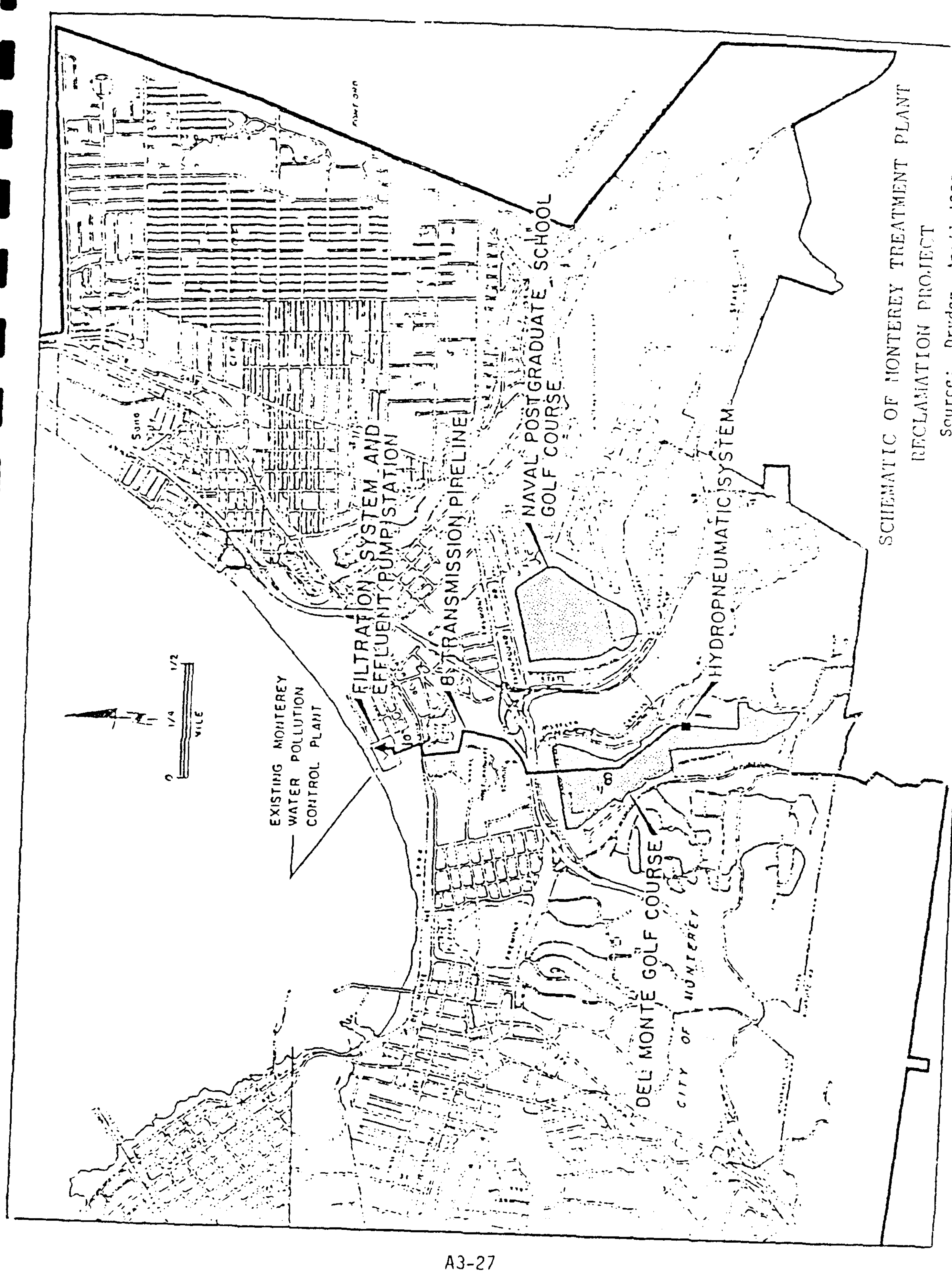
This concept entails reclamation for injection into the Seaside Coastal ground-water subbasin to form a barrier to seawater intrusion or to recharge the aquifer (Figure 3-6). Potential facilities include the existing Monterey and Fort Ord treatment plants, which are scheduled for demolition when a new regional system is completed. The project concepts are modeled after the Orange County Water District's Water Factory 21 Advanced Water Treatment Plant and San Diego's use of aquaculture for wastewater reclamation. A reclamation volume of 3 MGD was assumed.

The MPWMD conducted several studies to determine the feasibility and cost effectiveness of both conventional advanced treatment and use of aquaculture.[23] The studies indicated that reclamation could be technically feasible, although the cost of the water produced would be relatively high when compared to other sources. As noted in Section 3.2.4.1 (Seaside Ground-water Recharge -- Coastal Barrier), the technical feasibility of ground-water injection is questionable.

Use of Monterey Treatment Facility

The Monterey Regional Water Pollution Control Agency plans to abandon the existing 6 MGD Monterey wastewater treatment plant (Figure 3-9) when its new regional plant becomes operational. The project concept is to convert the Monterey plant into a 1 mgd reclamation facility to produce 415 AF in a dry year. The water would be used to irrigate the Del Monte Golf Course (170 AF/yr) and the Naval Post Graduate School grounds and golf course (245 AF/yr). Force mains would be constructed to Del Monte Lake and would continue to the Del Monte Golf Course. The Navy would use its existing pumping and distribution system located at Del Monte Lake to deliver water into its irrigation system. A 10,000 gallon hydropneumatic tank will be required at the golf course to handle surges in flow.[24] Participation by the Navy, which is critical to the project's success, is not confirmed. In addition, the treatment plant site is presently the proposed site for a desalination project.

FIGURE 3-9



SCHEMATIC OF MONTEREY TREATMENT PLANT
RECLAMATION PROJECT
Source: Dryden, April 1988

This alternative was evaluated assuming an April 1988 capital cost totaling $1.9 million with annual O&M costs of $325,000. Total annual costs to finance the project would be $579,300.

Irrigation of Turf in Del Monte Forest

Since 1985, MPWMD has coordinated a joint public agency and private sector reclamation project to irrigate nine golf courses in the Del Monte Forest and other turf areas. The basic features of the proposed project include 1.3 MGD tertiary treatment facilities at the Carmel Sanitary District plant, a 22,000-foot force main through the City of Carmel to the Poppy Hills Golf Course, a small regulating reservoir, a distribution system to the nine golf courses, and revising the existing golf course irrigation systems to provide a dual system as per public health requirements (Figure 3-10).[25] A market of about 800 AF per year requirements for golf course irrigation exists; this amount of potable water would be "freed up" due to the reclamation project.

A preliminary cost estimate for the 1.3 mgd facility totaled $11.3 million (1984 dollars) for capital costs and $185,000 for O&M. Total annual costs (1988 dollars) would be $1.8 million. An unusual feature of this project is that a private sponsor is willing to fund the project. Formal agreements were signed in Fall 1989 and the project should be completed by late 1992. The MPWMD has included this alternative in the "No Project" description for this EIR/EIS, as part of ongoing conservation efforts.

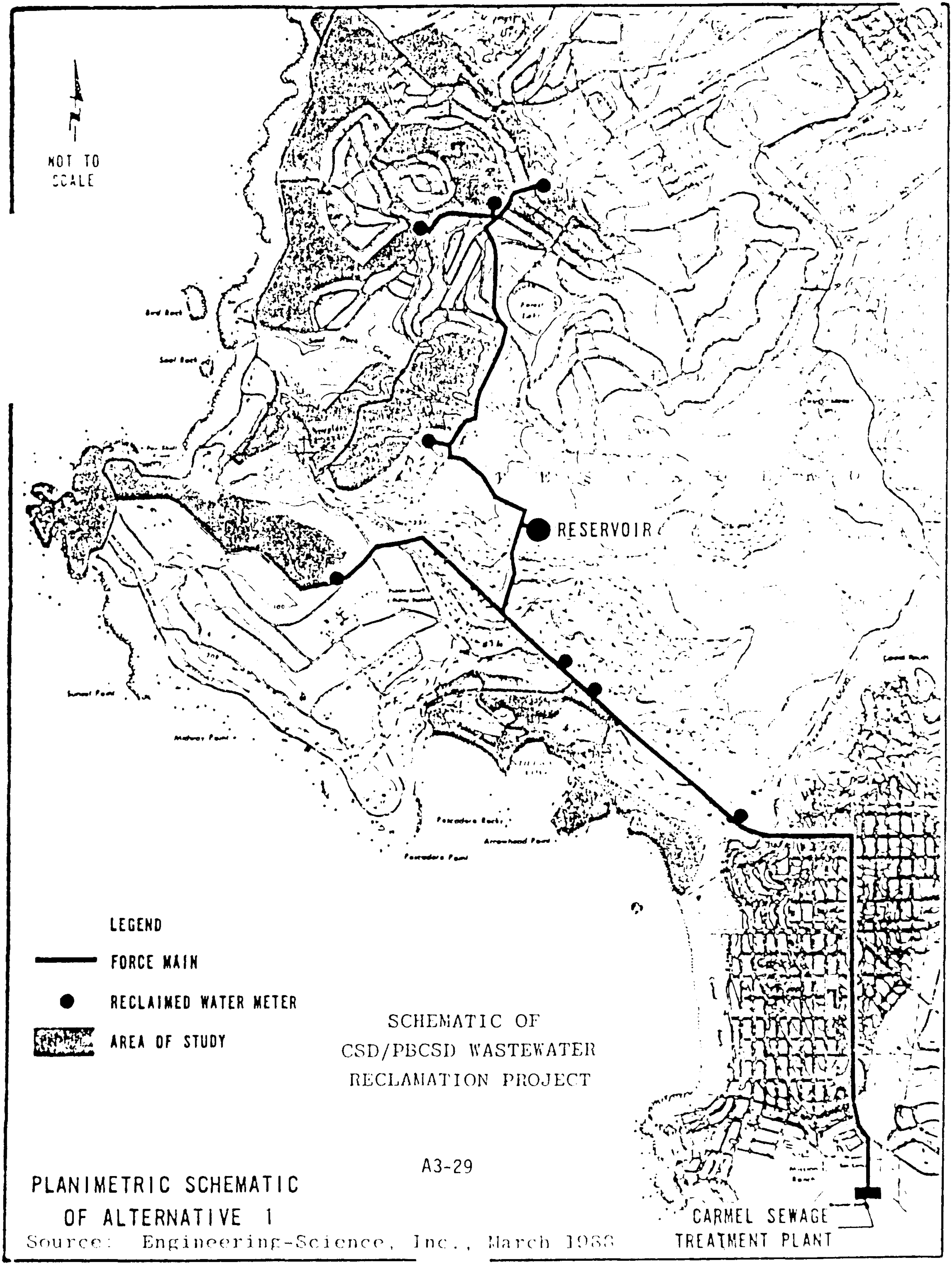
3.2.9 CONSERVATION

Residential and Institutional Cisterns

Cisterns entail collection of rainwater from roofs, then transmission via gutters to various sized tanks. The stored water is then used for garden, turf or landscape irrigation. The feasibility and cost effectiveness of residential and institutional cisterns on the Monterey Peninsula was studied, using homes and a middle school in Pacific Grove as models.[26] The performance and cost per gallon of numerous combinations of roof size, tank volume and garden area was modeled based on historic rainfall near Pacific Grove.

The construction cost of a residential tank was estimated at $.50 per gallon; a typical residential gutter system was estimated to cost $500. The cost of water for the median combination of roof

FIGURE 3-10



SCHEMATIC OF
CSD/PBCSD WASTEWATER
RECLAMATION PROJECT

PLANIMETRIC SCHEMATIC
OF ALTERNATIVE 1

Source: Engineering-Science, Inc., March 1988 size and tank size was $66/1,000 gallons, or $22,000/AF. For the institutional cisterns, the most efficient use of a 50,000 gallon tank cost $32 per 1,000 gallons, or $10,000/AF. For the 300,000 gallon tank, the most efficient use cost $51 per 1,000 gallons, or $17,000/AF.

Comprehensive Conservation Program with Mandatory Retrofit Ordinance

The MPWMD has adopted a water conservation goal of a 9% reduction in projected use by the year 1990 and a 15% reduction in projected use by the year 2020. A comprehensive water conservation plan has been adopted and a rigorous ordinance was enacted in August 1987. The requirements of the ordinance include installation of ultra-low flow toilets and water saving showerheads and faucet aerators in all new construction, mandatory replacement of toilets with ultra-low flow models at the time of sale of any home or business, and installation of water saving kits for all commercial establishments. In addition, the District distributed free toilet dams, low-flow showerheads and faucet aerators to every residence within the MPWMD boundaries. Other elements of the conservation plan include a turf management program and seminars, seminars on leak detection for water purveyors and numerous public awareness and educational programs. This alternative is included in the "No Project" description in this EIR/EIS.

According to the 1987 AMBAG Systems Capacity Analysis[27] a water conservation program meeting the 9% goal by 1990 would save about 1,700 AF per year at a total cost of $513,000 to the District. Ongoing administrative costs are about $25,000 annually. The free kit program should reduce yearly consumption by about 1,000 AF at an annual cost of about $100/AF. The water conservation ordinance should reduce consumption by about 725 AF per year at an annual cost of about $33/AF. Costs do not include consumer costs for new fixtures or energy and water cost savings.

3.3 PART I EVALUATION OF ALTERNATIVES

3.3.1 PURPOSE

Section 404 of the federal Clean Water Act requires that all practicable alternatives that could achieve the project purposes be investigated. "Practicable" is defined as "available and capable of being done after taking into consideration cost, existing technology and logistics in light of overall project purposes."[28] The federal intent is for the project proponent to "consider those alternatives that are reasonable in terms of the overall scope/cost of the proposed project"[29] California state law also requires that potential environmental effects be assessed for reasonable alternatives to the proposed project, even if, to some degree, they do not achieve the project goals or may be more costly than desired.[30]

The Part I evaluation was conducted in 1988 and completed in September of that year. Subsequent research in 1989 clarified the status of questionable alternatives. The Part I evaluation considered all of the water supply alternatives described in Section 3.2 and summarized in Table 3-1. The purpose of the Part I analysis was to determine feasible alternatives on a primarily qualitative basis, based on preliminary information, and identify those with serious cost, technological, logistical, availability or environmental constraints.

Five criteria were used to assess alternatives in the Part I evaluation:

- Total annual cost limit of $8.64 million (includes capital cost, interest and other bond charges, and annual O&M). This limit reflected the Board's desire to impose no more than a 30 percent increase to the average Cal-Am residential water bill in 1988.
- Reliable technology
- Logistical constraints
- Availability
- Environmental effects

3.3.2 ALTERNATIVES THAT SATISFIED PART I CRITERIA

Fourteen alternatives were identified as satisfying or conditionally satisfying the Part I criteria. They include two mainstem dams, three tributary dams, dredging existing reservoirs, ground water development in Carmel Valley and Seaside, desalination, mandatory conservation and reclamation. The 28,000 AF Cañada Reservoir was not proposed until after the Part I evaluation had been completed, and thus was not analyzed.

3.3.3 ALTERNATIVES THAT DID NOT SATISFY PART I CRITERIA

The following alternatives did not satisfy the Part I evaluation criteria and are not considered as feasible alternatives. These alternatives will not be addressed in subsequent chapters of this EIR/EIS. The reasons for this determination are briefly summarized for each alternative below.

TABLE 3-1

RATINGS FOR ALTERNATIVES CONSIDERED IN PART I SCREENING

Alternative	Pass	Cond. Pass [1]	Fail
I. Carmel River Mainstem Dams			
A. New San Clemente – RCC	X		
B. New San Clemente – Rockfill			X
C. New San Clemente – Joint Use			X
D. U.S. Army Corps of Engineers Proposals			
1. San Clemente Site			X
2. Cachagua Site			X
3. Pine Creek Site			X
4. Klondike Site			X
5. Los Padres			X
E. Enlarged Los Padres	X		
II. Carmel River Tributary Dams			
A. San Clemente Creek Variations	X		
B. Cachagua Creek Variations		X	
C. Chupines Creek Variations		X	
D. Buckeye Creek Variations			X
III. Sediment Removal			
A. Los Padres Reservoir	X		
B. San Clemente Reservoir	X		
IV. Storage and Infiltration Basins/Recharge			
A. Fort Ord Depressions			X
B. Seaside Groundwater Recharge – Coastal Barrier			X
C. Seaside Coastal Groundwater Subbasin – Recharge with Wells			X
V. Groundwater Development			
A. Seaside Coastal Groundwater Subbasin Well Development	X		
B. Seaside Inland Groundwater Subbasin Well Development			X
C. Upper Carmel Valley Well Development	X		
D. Lower Carmel Valley Well Development	X		
VI. Importation of Water from Distant Sources			
A. Arroyo Seco River			X
B. Lower Salinas Basin			X
C. San Felipe Project			X
D. Big and Little Sur Rivers			X
VII. Desalination		X	

Alternative	Pass	Cond. Pass [1]	Fail
VIII. Reclamation			
A. Used for Groundwater Recharge			X
B. Use of Monterey Treatment Facility		X	
C. Irrigation of Del Monte Forest Golf Courses	X		
IX. Conservation			
A. Residential and Institutional Cisterns			X
b. Comprehensive Program including Mandatory Retrofit	X		

[1] Conditionally Passes — Additional information may result in subsequent determination that this alternative fails to satisfy Part I screening criteria.

New San Clemente Dam (Rockfill): This dam was considered as a "fall-back" alternative if geotechnical studies performed by Bechtel in 1989 showed that an RCC dam would not be appropriate at the District's New San Clemente site. The rockfill option will not be pursued because the Bechtel studies were positive for the RCC dam. In addition, the rockfill method would be more costly and time-consuming than the RCC method, with no additional water supply or environmental benefits.

New San Clemente Dam – Joint Use (45,000 AF): This concept was rejected by the City of Marina and Fort Ord due to expensive pipeline and transmission costs. Those two agencies are independently pursuing water supply sources in the Lower Salinas Basin. Without joint funding, this alternative is not feasible.

Army Corps Dam at San Clemente Site (154,000 AF): The Corps concluded that this alternative was the best means to solve flood control and water supply problems for the area. This multiple-purpose project was abandoned by the Corps due to lack of community support, which was necessary to fund 84% of the cost. The District concluded that this project was not feasible for several reasons: (1) it is highly unlikely that the community would fund a $238 million (1979 dollars) project, (2) the significant environmental effects of inundating 1,160 acres, including 100 acres of riparian vegetation, could not be mitigated, and (3) a dam this size is not needed because flood control is not a District project purpose.

Army Corps Dam at Cachagua (Upper Syndicate) Site: In 1981, the Corps concluded that this alternative did not warrant a more detailed evaluation and it was rejected in favor of the New San Clemente site. On August 10, 1988 federal and state resource agency biologists and District consultants performed a Habitat Assessment of the riparian corridor within the inundation area. Due to the extremely high quality of the riparian habitat and the abundance of prime fish spawning and nursery habitat, the District and agency staff agreed that the District should not pursue the Upper Syndicate alternative. It also should be noted that topographic and physical features of the site are also less favorable for construction than other mainstem sites. For the above reasons, the Upper Syndicate alternative will not be considered further.

Army Corps Dam at Pine Creek (Lower Syndicate) Site: In 1981, this alternative was rejected by the Corps in favor of the New San Clemente site due to inundation of homes and roads in the

Cachagua area, and substantially higher costs per acre-foot than for a project at the New San Clemente site. On August 10, 1988 federal and state resource agency biologists and District consultants performed a Habitat Assessment of the riparian corridor within the inundation area. Due to the extremely high quality of the riparian habitat and the abundance of prime fish spawning and nursery habitat, the District and agency staff agreed that the District should not pursue the Lower Syndicate alternative. Thus the Lower Syndicate alternative will not be considered further.

Army Corps Dam at Klondike Site: This site was initially considered one of the more favorable sites until two active geologic faults were discovered traversing the valley at this location. Dam height would be limited and designs necessary to construct and maintain a safe structure would result in high costs. In 1981, the Corps concluded that this alternative did not warrant a more detailed evaluation and it was rejected in favor of the New San Clemente site. The District agrees with the Corps conclusion for reasons noted above. In addition, inundation and the need to relocate about one mile of Carmel Valley Road, Tularcitos Guard Station, facilities at the Carmel Valley filter plant, and the Sleepy Hollow subdivision would be prohibitively expensive. Erosion concerns due to the blockage of Tularcitos Creek as well as more pronounced construction impacts to Carmel Valley Village are other reasons not to pursue a dam at this site.

Army Corps Dam at Los Padres Site: In order to avoid inundating any lands in the Ventana Wilderness, the Corps concluded that storage at Los Padres Reservoir could be increased by only 4,000 AF and was not reasonable to pursue. The District agrees with the Corp's conclusion because a 4,000 AF increase in storage is not sufficient to meet the future water supply needs of the Monterey Peninsula. It should be noted that the District's concept for a 24,000 AF New Los Padres Dam is considered as a feasible alternative, even though four acres of the Ventana Wilderness would be inundated.

Buckeye Creek Dam: This alternative was eliminated from consideration due to serious technical problems. The Berwick Canyon fault crosses Buckeye Creek near the toe of the Buckeye dam site. Field investigation indicates that the left abutment is formed entirely of landslide material, forming a lobe-shaped ridge about 80 to 120 feet in thickness. Geologic conditions of unsuitable foundation material and seismic hazard preclude construction of a dam at the Buckeye Creek site. There are water quality concerns as well due to high values of total dissolved solids, cadmium and other metals in the Monterey Shale.[31]

Fort Ord Depressions and Associated Reservoir Sites: This alternative was not considered feasible due to availability, water quality and quantity, and cost considerations. Use of the depressions would require the cooperation of Fort Ord for access easements and water rights agreements. This is unlikely because much of the potential basin storage areas are within firing range impact areas, and use of the depressions as water supply facilities could severely disrupt present military operations. Also, there is uncertainty regarding water quality impacts from spent ammunition that exists throughout the firing range impact areas.

The technical complications and cost would be considerable to line all the depressions with impermeable material; the total area to be lined would approach one square mile. The probability of recovering infiltrated water from unlined depressions with wells in the Seaside Coastal area is uncertain given that the directions of leakage have not been determined. The installation of new wells closer to the depressions would be limited by their locations with respect to the Fort Ord firing range impact areas.

Seaside Groundwater Recharge – Coastal Barrier: This alternative is not considered feasible due to several technical reasons. Recharge trials conducted for the District in late 1981 indicated that a barrier recharge scheme would not be successful in the coastal dunes of the Seaside area due to the high transmissivity of the local materials.[32] Even if the recharge trials had shown that a barrier could be maintained here, it remains uncertain whether such a near-surface coastal barrier would successfully protect the aquifer against sea-water intrusion due to the variability of local hydrogeologic conditions.

The necessary recharge water from Carmel Valley may not be available during times when it is needed most (dry periods) or may not be suitable to transmit through the existing Cañada de la Segunda pipeline during wet periods due to excessive turbidity. Regulatory constraints would preclude the possibility of using treated wastewater for recharge. Responsible agencies have not been willing to allow the injection of treated wastewater into a subsurface fresh water source in the Monterey Peninsula area.

Seaside Coastal Groundwater Subbasin – Well Recharge: Technical constraints preclude this alternative from being considered further. The technical feasibility of recharging the coastal subbasin was tested in 1982 at Cal-Am's Plumas well facility in Seaside.[33] The first set of trials concluded that gravity injection was not capable of achieving the required injection rates. The second set of trials utilized a specially constructed pressurized recharge well. These tests also failed to achieve the recharge rates desired for a successful operational recharge scheme.[34] The availability of water from Carmel Valley for recharging the coastal subbasins would be limited by the capacity of the existing Cañada de la Segunda pipeline (unless an additional pipeline was constructed), the turbidity of the water, and any environmental restrictions placed on the export of this water.

Seaside Inland Groundwater Subbasin – Well Development: The District determined that additional wells in the Seaside Inland Subbasin should not be retained for additional analysis due to questionable supply, lack of available well fields due to firing ranges and preemptive Federal water rights. An exploratory drilling and monitor well installation program at three sites in 1986 concluded that ground-water production potential is considered poor.[35] This finding raises questions regarding the ability of other areas within the inland subbasin to meet water supply needs on the Monterey Peninsula.

Light artillery firing ranges exist over much of the inland subbasin, thereby restricting locations for ground-water supply exploration and development. Several Fort Ord wells have been taken out of production due to salt water intrusion and the Army is actively pursuing new sources of supply. Two 1986 reports commissioned by the Army recommended that additional well development in the Seaside ground-water basin be retained for further consideration.[36,37]

Even if ground-water development looked more promising in the subbasin, the District would not be able to preempt the federal reserve water rights of the U.S. Army. If a substantial water supply was found in the inland subbasin, it would be in the interest of Fort Ord to develop this supply for its own use rather than to allow the MPWMD to withdraw it. The U.S. Army would always hold the superior right to extract this water and could force outside entities to stop pumping completely or to curtail their pumping if the Fort Ord reservation operations were threatened.[38]

Lower Carmel Valley Well Development: The District's Water Allocation Program Final EIR[39] determined that the density and capacity of existing wells in aquifer subunit 3 has significant environmental effects. Thus development of additional production capacity from this area should not be considered further.

Few wells occur in aquifer subunit 4. Thus the concept of new wells in aquifer subunit 4 conditionally passed the Part I alternatives evaluation, pending additional study. Further research assessed the capability of increasing the production capacity without inducing sea water intrusion, impacting the riparian corridor or degrading the Carmel River lagoon.[40] The study results indicated that limited pumping could occur without inducing seawater intrusion, but there was a high likelihood of degrading the lagoon and riparian corridor. Based on this information, the Board voted in 1989 not to pursue new wells in lower Carmel Valley. More information is provided in Appendix C3.

A series of injection wells using reclaimed water from a nearby treatment plant has been suggested as a means of precluding sea water intrusion while allowing for additional ground-water development. However, the use of reclaimed wastewater for injection does not appear likely to be permitted by the responsible health authorities at this time.

Importation From Distant Sources: The State of California Statutes of 1977 that created the MPWMD include restrictions on development of water resources outside the District. The Statutes mandate, "To the extent feasible, the District policy shall require development of water resources within the district boundaries before utilizing water originating outside its boundaries."[41] The MPWMD Board would have to make findings and determine that all other alternatives within the District are infeasible before pursing options outside the District. As described in other sections of this document, feasible options within the District do exist. Additional jurisdictional, logistical or cost constraints preclude the following importation alternatives from being considered as feasible.

Arroyo Seco River: In 1983, the Monterey County Board of Supervisors voted not to proceed with the Arroyo Seco project. Though it may have been economically feasible for the MPWMD to participate in this jointly funded project in the past, this option is not feasible as a sole venture due to project costs and inter-basin transfer concerns. In addition, 8-10 miles of fish habitat would be inundated and up to 23 miles of steelhead spawning and rearing habitat would be blocked.

Lower Salinas Basin: The Lower Salinas project was not designed to yield water to the Monterey Peninsula. Eligibility for water is contingent on having riparian rights along the Salinas River and on being located within the zone that funded Nacimiento and San Antonio Dams. Neither of these criteria are met by the MPWMD. Monterey County is considering this project as a solution to salt water intrusion problems experienced by Fort Ord, Marina and North County agriculture.[18]

San Felipe Project: The Corps considered this alternative in 1977 and 1981 and concluded that supply of water from the San Felipe project is uncertain, and that "importation cannot be considered as a practical, or viable, solution."[4] The District agrees with the Corps conclusion for the following reasons:

(1) The Pajaro Valley Water Management Agency has contractual rights to the remaining 19,700 AF of San Felipe Project water and has submitted a resolution of intent to the Bureau of Reclamation to contract for its AF share. San Benito County and Santa Clara Valley water agencies have indicated that they would exercise their first rights to any remaining entitlement.[42,43]

(2) The Bureau of Reclamation confirmed that no yield would be available during peak periods; MPWMD could build a reservoir to store off-peak supply with the construction of a 30- to 40-mile pipeline.[44]

(3) The annual costs associated with the $64 million pipeline alone exceed the $8.64 million maximum set as a screening criterion. This limit would be greatly exceeded when the costs of purchasing water, construction and O&M of a reservoir were added.

The lack of available water due to other agencies' prior water rights, excessive costs associated with a 30-mile pipeline and the need to build a storage reservoir indicate that the San Felipe alternative is not a feasible alternative.

Big And Little Sur Rivers: Both rivers have been designated under the California Protected Waterways Program and the Big Sur River is being considered for protection under the Wild and Scenic Rivers Act. There are no extenuating circumstances or reasons in evidence at this time which would justify seeking exception to the prohibition of constructing a dam on either of these streams. This fact, together with the adverse environmental impacts, the likely high cost of construction and transmission due to extremely rugged terrain, make a plan for importing water from the Big Sur or Little Sur rivers highly impractical.

Reclamation Used For Groundwater Recharge: Though several wastewater recharge projects exist in California, health concerns, jurisdictional and permit constraints are major barriers to implementing new projects. Health issues include the potential acute or chronic effects of trace metals, minerals, pathogens and a variety of organic compounds. The State Department of Health Services typically opposes projects that introduce wastewater, however well treated, into drinking water sources because the long-term effects of chemicals found in wastewater are unknown.[45] Locally, the Monterey County Environmental Health officer has not allowed turf irrigation with reclaimed water where reclaimed water percolates more than 4" into a potable water aquifer. This policy precludes any recharge into coastal aquifers.

In 1987, the State Scientific Advisory Panel on Ground Water Recharge with Reclaimed Wastewater concluded that, "Other factors notwithstanding, wastewater should not be used as a source unless it can be demonstrated that natural and engineered treatment can be expected to produce consistently a better quality of drinking water than other alternatives. Accordingly, before recharge projects are undertaken, other alternatives . . . should be thoroughly evaluated."[46] Based on this information, the MPWMD determined that wastewater reclamation for recharge is not practicable on the Monterey Peninsula. This finding does not preclude reclamation for turf irrigation in areas that do not impact potable water aquifers.

Reclamation Using the Old Monterey Treatment Site: This alternative is not considered practicable due to the tenuous nature of the site and facilities, and questionable cost effectiveness. The site is leased to the regional sewer agency (MRWPCA) by the U.S. Navy. MRWPCA is presently taking bids for demolition of the facility unless another entity will assume responsibility and liability for the site. The liability issue is problematic due to a suit brought against MRWPCA by a nearby homeowners group regarding recurrent odor problems. An agreement recorded with the court stated that MRWPCA would not operate the Monterey plant as a wastewater treatment facility once the regional plant became operational; in return, the neighbors would drop their suit. It is unknown whether the homeowners association would sue the new operator of a reclamation facility.

Dryden[24] concluded that the project would be worthwhile to pursue based on an annual production of 415 AF. However, if the Navy chooses not to participate, it is very questionable whether the project would be warranted due to the high costs of converting the Monterey plant to reclaim only

170 AF/yr. At a public workshop in October 1989, the Navy indicated it had drilled several subpotable wells with which to irrigate its golf course, lessening the need for reclaimed water.

The above concerns may be moot as there is serious interest by MPWMD to use the Old Monterey site for a small desalination facility rather than for reclamation. The District has initiated discussions with the Navy regarding a desalination facility at the site.

Residential and Institutional Cisterns: This alternative is not considered practicable as a District-wide water supply project due to the combination of high cost per acre-foot and marginal benefits. In 1981, researchers concluded that "the rational user will generally not install collection systems if an adequately reliable supply of public water is available."[26] Use of cisterns as an "insurance policy by those who wish to protect valuable garden areas" was suggested. It should be noted that State Health laws preclude using untreated rainwater or grey water for many domestic uses.

If every home in the District installed cisterns, a 3% to 11% reduction in water use would occur; the more likely scenario of 25% installation would result in a 1% to 2% overall reduction. Benefits from cisterns are limited because most rainfall occurs in winter on the Monterey Peninsula. Thus the effective supply for the remainder of the year is the volume of the storage tank.

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OVERVIEW OF THE CARMEL VALLEY SIMULATION MODEL

PREFACE

This overview of the Carmel Valley Simulation Model (CVSIM) is presented in two parts. The first part is the original overview of the CVSIM model which appeared as Appendix A in the September 1987 Draft EIR/EIS for the New San Clemente Project.

The second part is an addendum to the CVSIM overview prepared in August 1991 for the Supplemental Draft EIR/EIS on the Monterey Peninsula Water Supply Project. It discusses the major changes made in CVSIM between 1987 and 1990, and describes specific revisions to the data, assumptions and procedures used in CVSIM.

Both the original overview and the addendum were written by Mr. Darby Fuerst, who is the Water Resources Manager for the Monterey Peninsula Water Management District. Dr. Yoram Litwin of RAMLIT Associates, a consultant to the District, contributed to the model development, calibration and technical review.

OVERVIEW OF CARMEL VALLEY SIMULATION MODEL

INTRODUCTION

This appendix presents an overview of the Carmel Valley Simulation Model (CVSIM) and the data, assumptions, and procedures that were used in its development. The descriptions in this appendix are purposely brief. A more detailed description and discussion of CVSIM will be given in District Technical Memorandum 87-01 (in preparation).

The overview of CVSIM is presented in four parts:

I. A general definition of CVSIM, including its purpose, operation, structure, and development.

II. Description of the water resources system of the Monterey Peninsula area, including physical and production aspects.

III. Representation of the system in CVSIM, focusing on the hydrologic inputs and processes.

IV. Description of the water management algorithm, with emphasis on the daily operation of the system.

The overview concludes with a discussion of the accuracy of the model.

The purpse of the overview is to provide sufficient information so that readers can properly evaluate the model-related results presented in the New San Clemente Project Environmental Impact Report/Environmental Impact Statement (EIR/EIS).

I. CVSIM DEFINITION

Simulation refers to the mathematical formulation of a physical system and is used to preview the response of the system to specific plans or actions. The Carmel Valley Simulation Model (CVSIM) is a computer-based simulation model of the water resources system for the Monterey Peninsula area.

Purpose

The model was developed as a planning tool to evaluate various water supply alternatives for the New San Clemente Project EIR/EIS. The model was designed to simulate the performance of the water resources system under varying physical, structural and management conditions. Specifically, CVSIM was tailored to simulate daily processes in the Carmel River basin and provide information relating to streamflow, municipal yield, reservoir operations, and fishery impacts.

In addition, the process of developing CVSIM served to focus the District's research and improve its understanding of the water resources system.

Operation

CVSIM operates on a daily time-step and incorporates both surface and ground-water responses and interactions. CVSIM is a dynamic, accounting model based on *the continuity* equation. This equation simply means that inflow minus outflow equals the change in storage. Mathematically,

$$I - O = \Delta S$$

Where I = inflow during a given period to a specific area,

O = outflow during a given period from a specific area, and

ΔS = change in volumetric storage during a given period for a specific area

In its current version, CVSIM accounts for inflow, outflow, and storage effects in five aquifer subunits and two to three surface reservoirs, depending on the water supply alternative under investigation.

In addition to simulating the basic hydrologic system, CVSIM also includes options for different structural and operational plans. Sample options include various reservoir sites and sizes, municipal demands, instream flow releases, and rationing parameters. The current and proposed water management algorithms in CVSIM were developed by the District based on extensive computer analyses. The District relied on information provided by the California-American Water Company (Cal-Am), the major water purveyor in the district. The management algorithms were designed to be compatible with Cal-Am's present and projected production and treatment capacities.

Structure

CVSIM was structured based on a modular concept with the MAIN program the central element. The modular concept was used to facilitate refinements to individual components of CVSIM. In addition to basic input and output specifications, the MAIN program contains the water management algorithm that determines the daily production sequence and calls the various subroutines. These subroutines and brief descriptions of their functions are listed in Table A-1.

The MAIN program consists of four, nested loops. The three outer loops--annual, monthly, and daily--are controlled by specific time-steps. The innermost loop is based on satisfying daily municipal demands and instream flow requirements and allows up to six iterations each day.

Development

CVSIM was developed by District staff with assistance by RAMLIT Associates in 1985-1987. Two daily versions--CVSIM1 and CVSIM2--were developed and installed on the IBM 3033 computer system at the U.S. Naval Postgraduate School in Monterey, California. CVSIM1 was designed to represent New San Clemente Project alternatives and CVSIM2 was developed to simulate existing, No-Project and non San Clemente Project alternatives. Both CVSIM programs were based on earlier monthly (CV3) and daily (SAVEDAY) models developed by the District. The District's original computer model was developed in 1980.

TABLE A-1

CARMEL VALLEY SIMULATION MODEL SUBROUTINE DESCRIPTION

NAME	FUNCTION
READ	Reads daily, reconstructed Carmel River mainstem and tributary inflows; option to create synthetic sequence of inflow.
RESRVR	Reads area-capacity-elevation values for specified reservoirs, 2) adjusts reservoir capacities for sedimentation and dredging, and 3) computes reservoir elevation and area from capacity
DAM	Operates mainstem dams and calculates resulting releases, diversions, and storage.
TRBDAM	Operates tributary dams and calculates resulting releases, diversions, and storage; option for pumped storage.
EVAPO	Calculates net reservoir evaporation.
FLASH	Operates flashboards at existing San Clemente Dam.
FISHRL	Determines fishery flows required for the Carmel River at the Narrows and the Lagoon.
AQUIFR	Operates Carmel Valley aquifer subunits and calculates riparian evapotranspiration, pumpage, recharge, storage, and outflow.
SEASID	Operates Seaside coastal ground-water basin and calculates pumpage, recharge and outflow.
RATION	Determines reductions in demand required to maintain specified levels of drought reserve.
FREQ	Calculates monthly and annual exceedance frequency values: 10, 20, 40, 50, 60, 80, and 90 percentiles.
STAT	Calculates daily, monthly, and annual statistics; minimum, maximum, mean and sum.
OUTPUT	Prints daily, monthly, and annual values in tabular form.

II. SYSTEM DESCRIPTION

The water resources system for the Monterey Peninsula area is shown in Figure 1 and consists of the Carmel River drainage basin, Carmel Valley alluvial aquifer, and Seaside aquifer system. The Carmel River basin drains 255 square miles and includes nine major tributaries. Streamflow on the Carmel River is measured by the U.S. Geological Survey at two locations--at Robles del Rio and near Carmel. Records have been maintained at these sites since 1957 and 1962, respectively. Monthly, unimpaired flows at San Clemente Dam were reconstructed by the U.S. Corps of Engineers for the period 1902-1978. This record has been extended through 1985 by the District and is shown in Figure 2.

The long-term, reconstructed record shows significant annual and seasonal variation. Annual flows at San Clemente ranged from 2,600 to 229,000 acre-feet, with an average flow of 67,660 acre-feet. On a seasonal basis, runoff occurs in almost direct response to rainfall, with nearly 90% of the average annual flow occurring between December and April. The highest flow months are January, February, and March, with this period accounting for two-thirds of the annual flow.

Streamflow in the basin is regulated by two dams--Los Padres and San Clemente. A New San Clemente Dam has been proposed and would be located 0.7 miles below the existing San Clemente Dam.

The Carmel Valley alluvial aquifer extends 16 miles with a maximum thickness of about 190 feet near the Highway 1 bridge. The aquifer is composed of unconsolidated gravel, sand, silt, and clay. It is unconfined and has a surface area of six square miles. For purposes of analysis, the aquifer was divided into four subunits. Specific yield values range from 0.25 in the upper subunit to about 0.20 in the lower subunits.

The Seaside aquifer system is located north of the Carmel River basin and encompasses 24 square miles. The Seaside system consists of four vertical water-bearing units. In addition, the system has been divided into four areal sub-basins.

Each of the reservoir and aquifer units used in CVSIM are listed in Table A-2 and described by location.

Cal-Am is the major producer of water in the Monterey Peninsula area and supplies over 80% of the water used in the district. The remaining users obtain their water from small water systems and private wells. The Cal-Am system includes Los Padres and San Clemente Dams, 18 wells in Carmel Valley, 11 wells in the Seaside coastal area, and two water treatment plants. Cal-Am's operations are regulated by a number of agencies including the District, the California Department of Fish and Game, the California Department of Safety of Dams, and the California Public Utilities Commission.

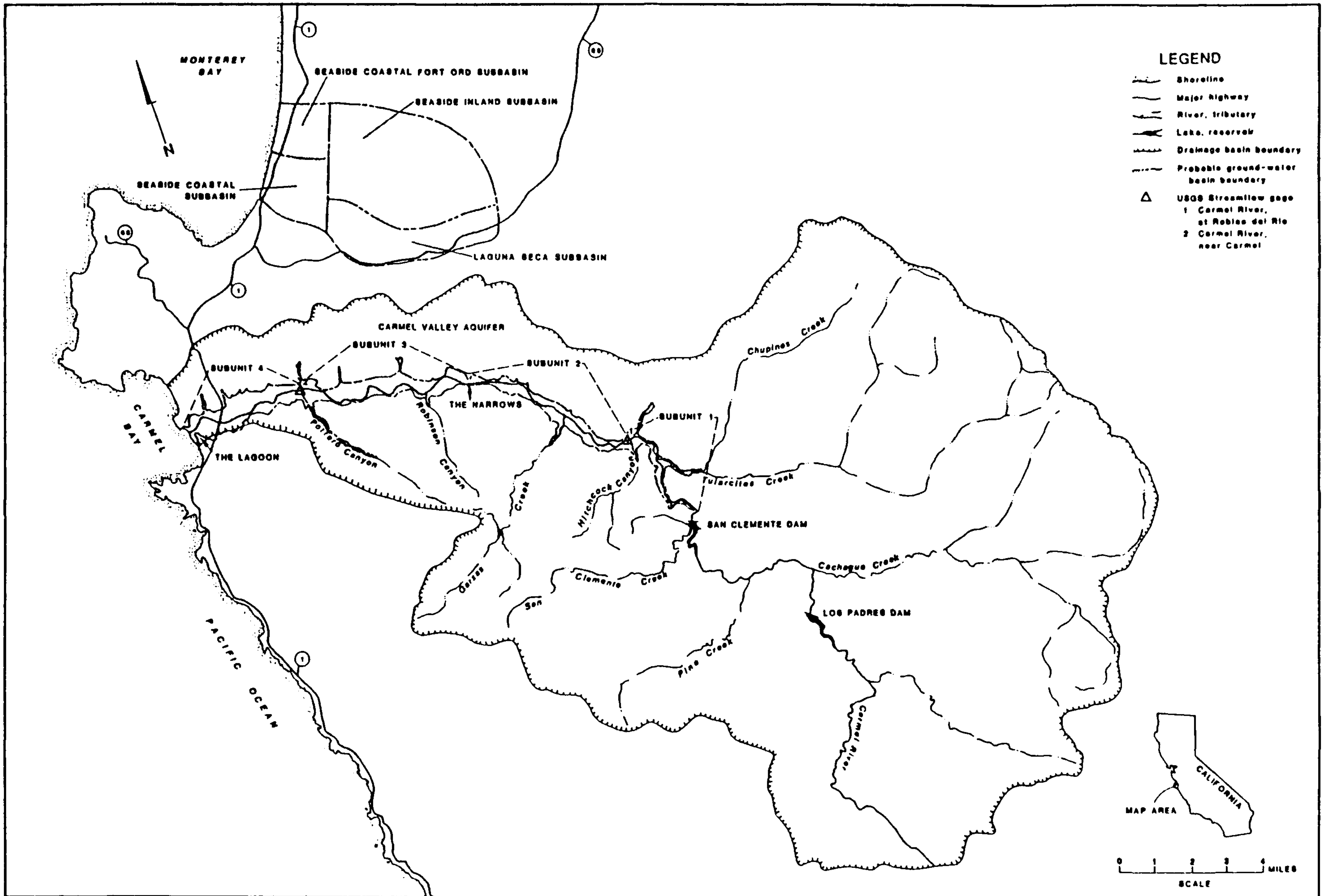


Figure 1. Water Resources System for the Monterey Peninsula Area

MONTEREY PENINSULA WATER MANAGEMENT DISTRICT

Drafted from USGS 1:100,000 scale topographic map

Drafted by AHF 6/87

Figure 2

CARMEL RIVER AT SAN CLEMENTE DAM

Reconstructed Annual Flows: 1902 – 1985

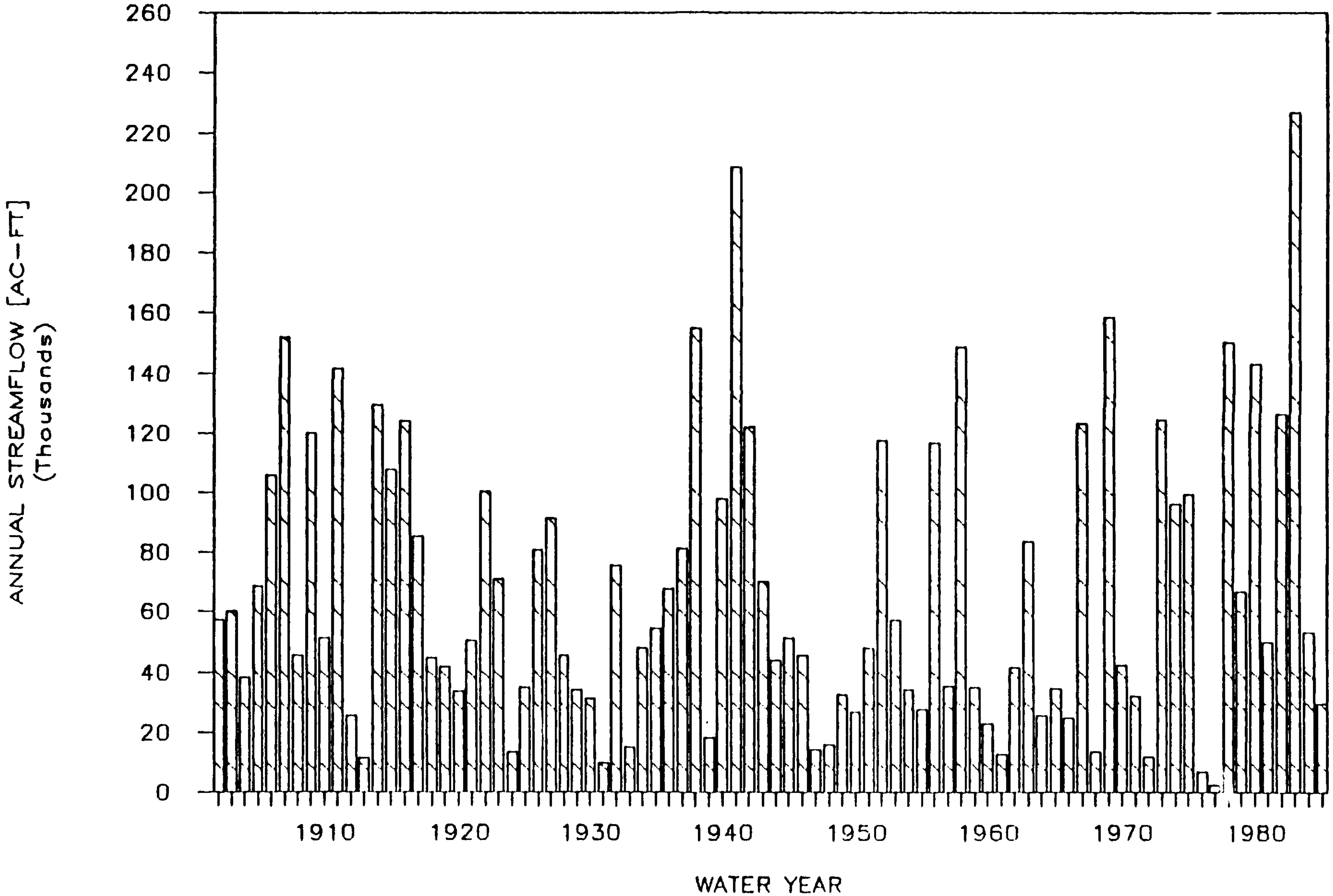


TABLE A-2

CARMEL VALLEY SIMULATION MODEL

RESERVOIR AND AQUIFER UNITS

UNIT	LOCATION	RIVER MILE
CARMEL RIVER RESERVOIRS		
Los Padres	- - - - - - - -	24.8
San Clemente	- - - - - - - -	18.5
New San Clemente	- - - - - - - -	17.8
CARMEL VALLEY AQUIFER		
Subunit 1	San Clemente Dam to the Robles del Rio gage	18.5 14.8
Subunit 2	Robles del Rio gage to the Narrows	14.8 9.7
Subunit 3	The Narrows to the near Carmel gage	9.7 3.6
Subunit 4	Near Carmel gage to the Lagoon	3.6 0.0
SEASIDE AQUIFER		
Coastal Subunit	Seaside	

Note: River miles are referenced from mouth.

III. SYSTEM REPRESENTATION

The water resources system for the Monterey Peninsula area is a complex system involving both hydrologic and operational constraints. In order to simulate this system, some simplification was necessary. Figure 3 shows a schematic of the simplified water resources system that was used in CVSIM. The schematic shows the general configuration of the flow system and the relative storage volumes for each reservoir and aquifer subunit. The volumes shown represent usable storage and do not include dead storage or water reserved for minimum pool requirements or as a safeguard against sea-water intrusion. The schematic also shows the location of the major tributaries in the system.

In CVSIM, the Carmel River drainage and Carmel Valley aquifer subunits were represented by a series of six, interconnected reservoirs. Flow and storage values were determined in a downstream order beginning at Los Padres Reservoir and ending at the Carmel River Lagoon. All values were expressed in acre-feet. For each reservoir or aquifer subunit, a water-balance calculation was made. Outflows calculated from upstream units were used as inflows to downstream units. Components for the reservoir and aquifer water balances are illustrated in Figure 4.

In the upper watershed (i.e., above San Clemente Dam), streamflow was simulated at four sites:

1) Inflow to Los Padres Reservoir;

2) Outflow from Los Padres Reservoir;

3) Inflow to San Clemente Reservoir; and

4) Outflow from San Clemente Reservoir.

These flows were based on reconstructed mainstem and tributary inflows, reservoir effects, and diversions. Reservoir effects included controlled releases to the river, spills, evaporation, and leakage. Ground-water flow in the upper watershed is considered negligible and was not included in CVSIM.

In the lower watershed, streamflow was simulated at four additional mainstem sites:

1) Robles del Rio,

2) Scarlett Narrows,

3) Near Carmel, and

4) Carmel River Lagoon.

Figure 3. Schematic of the Water Resources System for the Monterey Peninsula Area

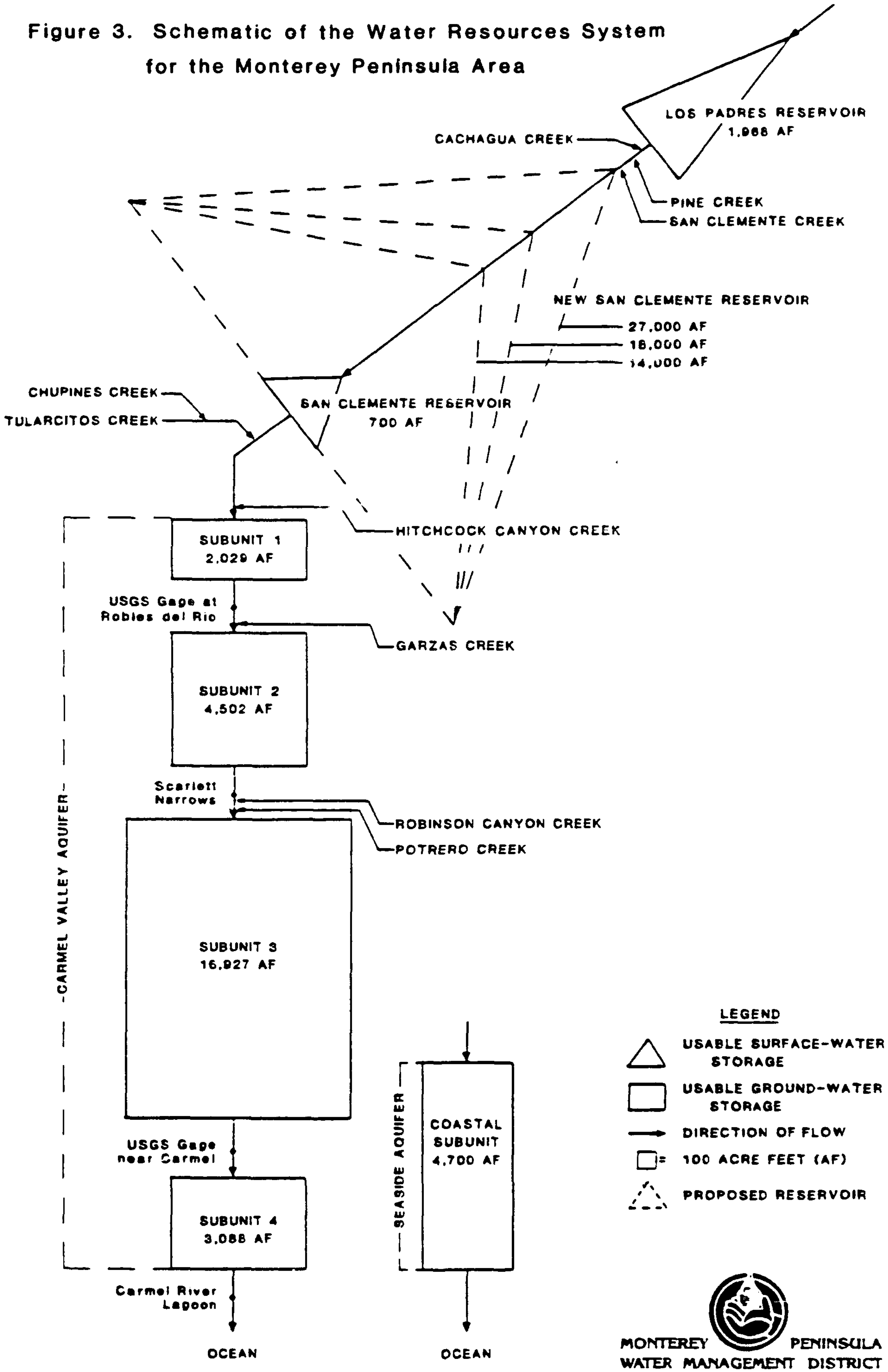
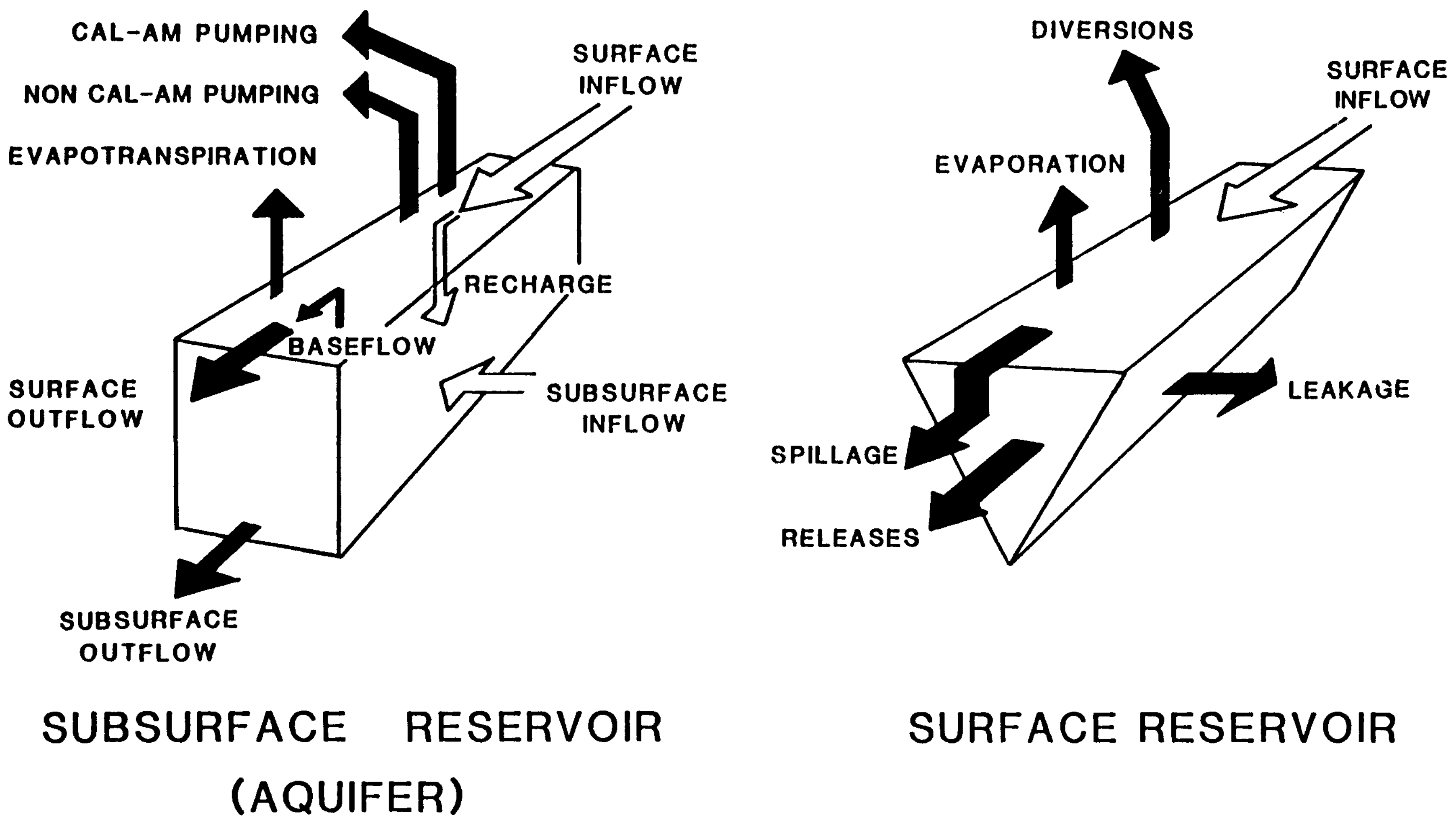


Figure 4. Carmel Valley Simulation Model Accounting Units



These flows were based on upstream mainstem inflow, reconstructed tributary inflows, aquifer effects, and pumpage. Aquifer effects included recharge, subsurface flow, evapotranspiration, and baseflow. Ground-water flow in the lower watershed was estimated from each subunit based on hydraulic conductivity, gradient, and cross-sectional area.

Storage volumes for the reservoir and aquifer units in the Carmel River watershed were calculated based on current storage and simulated inflows and outflows.

Storage and flow values for the Seaside coastal subunit were estimated in a similar, but simplified manner. For this unit, a single value was used to represent net inflow. This value was based primarily on subsurface inflow from the inland subbasins but also included adjustments for recharge from surface sources and losses due to evapotranspiration. No hydrologic connection exists or was assumed between the Seaside subbasin and Carmel River watershed. The units are connected only through the Cal-Am distribution system.

System Parameters

Various parameters were specified in simulating the water resources system for the Monterey Peninsula area. These parameters include estimates of storage, inflows, demand, operational capacities, and hydrologic processes. These parameters, as well as associated distributions, are presented below.

Storage

Refined storage estimates, particularly for the aquifer subunits, were critical in the development and calibration of CVSIM. Earlier estimates of aquifer storage were revised to correspond with specific subunit areas and to reflect operational and water quality constraints. Reservoir storage estimates were updated to reflect recent sedimentation. Table A-3 shows the total, usable, and initial storage values specified in CVSIM. The initial storage estimates were based on mean end-of-year storage values from preliminary simulation runs.

The large difference between total and usable storage in Carmel Valley Subunit 4 and the Seaside Coastal Subbasin is due to concerns regarding sea water intrusion. In the Seaside subbasin, the unusable storage (64,100 acre-feet) is below sea level. In Carmel Valley Subunit 4, 10,763 acre-feet are defined as unusable. Maintenance of this storage provides a positive fresh-water gradient to the ocean and minimizes the potential for sea water intrusion. In addition, most of this storage is not available to the existing Cal-Am production wells.

TABLE A-3

CARMEL VALLEY SIMULATION MODEL

RESERVOIR AND AQUIFER STORAGE ESTIMATES

STORAGE UNIT	TOTAL STORAGE (Acre-Feet)	USABLE STORAGE (Acre-Feet)	INITIAL STORAGE (1)	
			PROJECT (%)	NO PROJECT (%)
Carmel River Reservoirs				
Los Padres	2,180	1,968	50	80
San Clemente	316-796 (2)	220-700 (2)	—	80
New San Clemente	16,000-29,000 (3)	14,000-27,000 (3)	65	—
Carmel Valley Aquifer				
Subunit 1	2,029	2,029	100	100
Subunit 2	6,099	4,502	100	95
Subunit 3	19,615	16,927	90	80
Subunit 4	13,851	3,088	95	95
Seaside Aquifer				
Coastal Subbasin	68,800	4,700	98	98

(1) Percentage of total storage; based on simulated mean end-of-year values.

(2) With flashboards lowered and raised.

(3) Range of feasible reservoir sizes.

Inflows

Daily flows for the Carmel River at Los Padres Reservoir and nine, selected tributaries were estimated for use as inputs to CVSIM. The estimates were based on the daily flows recorded by the U.S. Geological Survey on the Carmel River at Robles del Rio.

The entire flow record through water year 1985 -- October 1, 1957 to September 30, 1985 -- was used in the estimation procedure. The procedure was developed to estimate daily inflow for the SAVEDAY model. The procedure and associated data were updated and extended for use in CVSIM.

The estimates of daily flow for each tributary were made by correlation with the flow at Robles del Rio. Regression equations for each tributary were developed based on periodic tributary flow measurements made by the District in 1981-1986 and corresponding flows recorded at Robles del Rio. Table A-4 shows the nine tributaries that were selected and includes associated drainage areas and mean annual flows. These tributaries were selected based on their flow and sediment contributions.

The daily flow on the Carmel River at Los Padres Reservoir was estimated by routing the flow at Robles del Rio back through the system. In this routing, the flow at Robles del Rio was reduced to offset tributary inflow, increased to account for diversions at San Clemente Dam, and adjusted for changes in storage (plus or minus) at San Clemente and Los Padres Reservoirs. The final result represents natural, unregulated flow at Los Padres Reservoir and averaged 54,977 acre-feet annually.

Demand

In CVSIM, water demand consisted of municipal supply and instream flow requirements. Municipal use included Cal-Am demand and non Cal-Am demand and was estimated for "Project" and "No-Project" conditions through the year 2020. Non Cal-Am demand included pumpage by small distribution systems and private pumpers and was aggregated by aquifer subunit. Table A-5 shows a breakdown of the demands used in CVSIM for existing "Project" and "No-Project" conditions. The No-Project demand is based on the existing, maximum allocation adopted by the District. The Project demands are based on development planned through the year 2020.

In the simulation, it was assumed that 33% of the non Cal-Am pumpage in Carmel Valley would percolate into the aquifer as return flow. No return flow was assumed for 1) Cal-Am pumpage in Carmel Valley, and 2) All pumpage in Seaside.

The demands shown in Table A-5 represented normal-year use and were increased for dry conditions. The increases in demand were made each month based on river flow conditions with a 7.5% annual maximum. Table A-6 shows the monthly distribution used to increase municipal demand and also lists the percentages used to distribute the annual Cal-Am and non Cal-Am demands. Mean daily

TABLE A-4

CARMEL VALLEY SIMULATION MODEL

SELECTED CARMEL RIVER TRIBUTARIES

TRIBUTARY	DRAINAGE AREA (Square Miles)	SIMULATED MEAN ANNUAL FLOW (1) (Acre-Feet)
Cachagua Creek	46.3	4,338
Pine Creek	7.8	4,039 (2)
San Clemente Creek	15.6	8,078
Tularcitos Creek	40.5	3,721 (3)
Chupines Creek	15.8	1,463 (4)
Hitchcock Canyon Creek	4.6	1,043
Garzas Creek	13.2	6,301
Robinson Canyon Creek	5.4	1,552
Potrero Creek	5.2	903

(1) Based on 1958-1985 period.

(2) Estimate based on area-yield relationship with San Clemente Creek.

(3) Adjusted for flow from Chupines Creek.

(4) Estimate based on area-yield relationship with Tularcitos Creek.

TABLE A-5

CARMEL VALLEY SIMULATION MODEL

ESTIMATED MUNICIPAL WATER DEMAND

USER/SOURCE	NORMAL-YEAR DEMAND: ACRE-FEET		
	EXISTING CONDITIONS (1987)	NO-PROJECT CONDITIONS (2020)	PROJECT CONDITIONS (2020)
CAL-AM			
System-wide	18,000	20,000	22,895
NON CAL-AM			
Carmel Valley Aquifer Subunit 1	130	139	139
Carmel Valley Aquifer Subunit 2	331	340	340
Carmel Valley Aquifer Subunit 3	676	697	697
Carmel Valley Aquifer Subunit 4	793	796	796
Seaside Coastal Aquifer Subbasin	825	850	850
TOTAL	20,755	22,822	25,717

TABLE A-6

CARMEL VALLEY SIMULATION MODEL

DEMAND-RELATED MONTHLY DISTRIBUTIONS

MONTH	PERCENTAGE OF ANNUAL CAL-AM DEMAND (1) (%)	PERCENTAGE OF ANNUAL NON CAL-AM (2) DEMAND (%)	PERCENTAGE INCREASE OF NORMAL-YEAR (3) DEMAND (%)
OCTOBER	8	7	6
NOVEMBER	6	2	7
DECEMBER	6	2	7
JANUARY	7	2	7
FEBRUARY	6	2	8
MARCH	7	4	15
APRIL	7	9	20
MAY	10	13	8
JUNE	11	16	7
JULY	11	15	7
AUGUST	11	15	2
SEPTEMBER	10	13	2

(1) Based on median monthly values for 1967-1983.

(2) Based on District well reporting program data for 1984-1985.

(3) Applied during dry and critically dry months, i.e., lower quartile flow at San Clemente Dam.

demands were estimated by dividing the monthly demands by the number of days in each respective month.

Instream flow releases for the steelhead fishery on the Carmel River were included in both "Project" and "No-Project" simulations. For No-Project conditions, the fishery flow releases were based on procedures specified in a Memorandum of Understanding between Cal-Am, the California Department of Fish and Game, and the District. In CVSIM2, a minimum, year-round release of three cubic feet per second (cfs) was specified at San Clemente Dam. This release was equivalent to an annual requirement of 2,171 acre-feet.

For New San Clemente Project conditions, the fishery flow releases were based on a flow schedule recommended by D.W. Kelley and Associates (DWK). The schedule was developed to satisfy the needs of the steelhead during each phase of their life cycle and varied according to water supply conditions. Requirements were specified at two sites below the dam: the Narrows and the Carmel River Lagoon. A constant flow of 20 cfs was specified at the Narrows and was equivalent to an annual requirement of 14,476 acre-feet. This water was available for recharge to the lower subunits in the Carmel Valley aquifer.

The flows that were specified at the Lagoon varied daily depending on runoff and storage conditions. Table A-7 shows the proposed flow schedule and includes a breakdown by water year type, month, and purpose. The annual requirement at the Lagoon can range from 3,014 acre-feet, under critically-dry conditions, to 24,308 acre-feet under normal or wet conditions. This water would not be available for recharge.

To simulate the proposed fishery flow releases, operating rules were developed jointly by the District and DWK. These rules are complicated and involve a number of factors including:

1) Water year classification,

2) New San Clemente Reservoir storage,

3) Daily inflows at Los Padres Reservoir, and

4) Daily flow at the Lagoon

Water Year Classification. In the process of developing the proposed flow schedule, DWK defined four water year types based on selected, non-exceedance flow frequencies. Table A-8 shows each type and selected non-exceedance frequency and value for the reconstructed annual flows at San Clemente.

In order to classify inflow conditions during the water year, the selected frequencies values were determined for the cumulative monthly flows. These cumulative values are shown in Table A-9

TABLE A-7

PROPOSED STEELHEAD FISHERY FLOW SCHEDULE
FOR NEW SAN CLEMENTE PROJECT

JAN	FEB	MAR	APR	MAY	JUN - DEC
NORMAL OR BETTER WATER YEARS					
Adult migration and spawning:			Smolt emigration:		Juvenile rearing:
A. Maintain 5 cfs to Lagoon until attraction event (storm)			40 cfs to Lagoon for	40 cfs to Lagoon for	20 cfs to Narrows for
B. Attraction event triggers release of 200 cfs to Lagoon for			30 days	31 days	214 days
					and
2 days	4-7 days	4-7 days			5 cfs to Lagoon for
C. After attraction release, maintain 75 cfs to Lagoon until next attraction event or through March 31, if no more attraction events occur					214 days
BELOW NORMAL YEARS (1)					
Adult migration and spawning:			Smolt emigration:		Juvenile rearing:
A. Maintain 5 cfs to Lagoon until attraction event; if no attraction event by March 1, release 40 cfs to Lagoon all days in March			40 cfs to Lagoon for	30 cfs to Lagoon for	20 cfs to Narrows for
			30 days	31 days	214 days,
B. Attraction event triggers release of 200 cfs to Lagoon for					and
					5 cfs to Lagoon for
0 days	5 days	5 days			214 days
C. After attraction release, maintain 75 cfs to Lagoon until next attraction event or through March 31, if no more attraction events occur					

TABLE A-7 (CONT.)

PROPOSED STEELHEAD FISHERY FLOW SCHEDULE
FOR NEW SAN CLEMENTE PROJECT

JAN	FEB	MAR	APR	MAY	JUN - DEC
DRY YEARS (1)					
Adult migration and spawning:			Smolt emigration:		Juvenile rearing:
A. Maintain 5 cfs to Lagoon until attraction event; if no attraction event by March 1, release 40 cfs to Lagoon all days in March			40 cfs to Lagoon for 30 days	30 cfs to Lagoon for 31 days	20 cfs to Narrows for 214 days, *and* 0 cfs to Lagoon
B. Attraction event triggers release of 200 cfs to Lagoon for					
0 days	0 days	5 days			
C. After attraction release, maintain 75 cfs to Lagoon until next attraction event or through March 31, if no more attraction events occur					
CRITICAL YEARS (1)					
Adult migration and spawning:			Smolt emigration:		Juvenile rearing:
A. No attraction requirement			30 cfs to Lagoon for 30 days	20 cfs to Lagoon for 31 days	20 cfs to Narrows for 214 days, and 0 cfs to Lagoon

(1) If total reservoir storage exceeds 15,000 acre-feet, the "normal or better year" release schedule is in effect regardless of the actual water year type.

and were used to indicate natural inflow conditions **to date.** The cumulative values were, in turn, used as the basis for estimating the inflow expected through the remainder of the water year. Given the cumulative flow to date, estimates of the minimum flow expected for the remainder of the water year were made for each water year type. The estimates of expected inflow were specified at the 25% risk level. The expected inflows are shown in Table A-10 and were used in conjunction with the cumulative inflows to predict water year type for the entire year. The various levels of fishery flow releases were made based on this prediction of water year type. In the simulations, this prediction was updated at the beginning of each month.

Daily Inflows at Los Padres Reservoir. The timing of steelhead attraction releases during the January - March season was based on daily flow increases at Los Padres Reservoir. Specific sequences of 4-day and 3-day flow events were used to determine the appropriate release. The sequences were developed by DWK based on observed fishery response and were designed to mimic natural attraction events as closely as possible. In the simulations, the sequences were characterized by specific levels of increasing flow for each attraction month and were assessed daily. The duration of the releases depended on when the releases occurred within each month.

New San Clemente Reservoir Storage. The operating rules were designed to utilize storage in New San Clemente Reservoir for two purposes. The first purpose was to regulate flow so that the releases proposed for various water year types were maintained. The second purpose was to augment flow so that proposed releases could be increased whenever sufficient storage was available at New San Clemente Reservoir. Specifically, whenever total reservoir storage exceeded 15,000 acre-feet, "normal or better" year releases were made regardless of actual water year classification.

Daily Flow at the Lagoon. The operating rules also accounted for inadvertent attraction flows at the Lagoon. If attraction releases occurred at the Lagoon due to reservoir spill or downstream tributary inflows, releases were continued to maintain the attraction and migration event. In CVSIM1, if the flow at the Lagoon on the previous day exceeded 190 cfs, releases were made to maintain the attraction and migration requirements.

Operational Capacities

Operational capacities for the Cal-Am system and non Cal-Am users were specified in CVSIM. For the Cal-Am system, the capacities included surface-water diversion, ground-water pumpage, and water treatment facilities. Maximum, daily pumping capacities for Cal-Am wells were aggregated by aquifer subunit and decreased by 13% for system-wide depreciation.

TABLE A-8

CARMEL VALLEY SIMULATION MODEL

WATER YEAR CLASSIFICATION

WATER YEAR TYPE	CARMEL RIVER AT SAN CLEMENTE DAM (1)	
	NON-EXCEEDANCE FLOW FREQUENCY (2) (%)	NON-EXCEEDANCE FLOW VALUE (Acre Feet)
NORMAL OR BETTER	> 50	> 48,100
BELOW NORMAL	50 - 25	48,100 - 31,750
DRY	25 - 12.5	31,750 - 14,925
CRITICALLY DRY	< 12.5	< 14,925

(1) Based on reconstructed, unimpaired flow at San Clemente Dam: 1902-1978.

(2) Frequencies derived by D.W. Kelley and Associates. Originally applied to Carmel River flow at Robles del Rio (D.H. Dettman, personal communication).

TABLE A-9

CARMEL VALLEY SIMULATION MODEL

CUMULATIVE INFLOWS AT NEW SAN CLEMENTE SITE (ACRE-FEET)

	WATER SUPPLY CLASS			
Period	"Normal or Better" (1)	"Below Normal" (2)	"Dry" (3)	"Critically Dry" (4)
End of October	> 200	200 - 100	100 - 1	0
Oct - November	> 1,000	1,000 - 500	500 - 200	< 200
Oct - December	> 4,100	4,100 - 1,700	1,700 - 1,175	< 1,175
Oct - January	> 11,800	11,800 - 5,450	5,450 - 4,100	< 4,100
Oct - February	> 26,300	26,300 - 14,400	14,400 - 7,550	< 7,550
Oct - March	> 39,100	39,100 - 21,950	21,950 - 10,925	< 10,925
Oct - April	> 46,400	46,400 - 28,300	28,300 - 12,975	< 12,975
Oct - May	> 47,400	47,400 - 30,650	30,650 - 14,425	< 14,425
Oct - June	> 48,000	48,000 - 31,550	31,550 - 14,900	< 14,900
Oct - July	> 48,100	48,100 - 31,700	31,700 - 14,925	< 14,925
Oct - August	> 48,100	48,100 - 31,750	31,750 - 14,925	< 14,925

NOTE: Classes derived from monthly unimpaired flows to San Clemente Dam for the period 1902-1978. The unimpaired flows were estimated by the U.S. Army Corps of Engineers (1981).

TABLE A-10

CARMEL VALLEY SIMULATION MODEL

EXPECTED INFLOWS AT NEW SAN CLEMENTE SITE WITH 25% RISK (ACRE-FEET)

Period	WATER SUPPLY CLASS			
	"Normal or Better" (1)	"Below Normal" (2)	"Dry" (3)	"Critically Dry" (4)
November - September	48,100 1)	45,975	30,450	23,200
December - September	32,700	30,400	26,400	14,250
January - September	27,400	20,975	15,600	9,700
February - September	25,000	17,300	9,100	7,225
March - September	22,850	10,500	5,300	3,050
April - September	12,700	5,700	3,050	1,350
May - September	5,200	2,525	1,600	500
June - September	2,000	825	750	100
July - September	675	150	75	0
August - September	200	0	0	0
September	0	0	0	0

1) Annual median value.

For non Cal-Am users, the operational capacities were limited to ground-water production. Maximum daily pumping capacity for each aquifer subunit was estimated based on reported peak monthly pumpage.

Table A-11 shows the existing operational capacities for the Cal-Am system and non Cal-Am users. For New San Clemente Project conditions, the treatment capacity at the Begonia Iron Removal Plant was increased to 54.0 acre-feet/day and pumping capacities in Carmel Valley aquifer subunit 2 and Seaside coastal aquifer were increased to 14.76 and 19.01 acre-feet/day, respectively. Similar increases were assumed for the No-Project conditions, with the exception of the 5.38 acre-feet/day increase in Carmel Valley aquifer Subunit 2.

Reduced Pumping Capacity. In CVSIM, it was also assumed that ground-water pumping capacity would decrease as ground-water levels declined. Specific functions relating pumping capacity to ground-water storage in each aquifer subunit were developed. The functions were used to determine the percentage of maximum pumping capacity for the Cal-Am wells that would be available at various storage levels. Table A-12 shows the equations developed for each aquifer subunit. Pumping capacity goes to zero when water levels drop below the perforations of the Cal-Am wells.

Hydrologic Processes

In developing the water balance equations for the surface and subsurface reservoirs in CVSIM, a number of hydrologic processes were specified. These processes included:

1) Aquifer recharge,

2) Baseflow,

3) Subsurface flow,

4) Riparian evapotranspiration, and

5) Reservoir evaporation and leakage.

Each of these processes is described below.

Aquifer recharge. In CVSIM, it was assumed that all aquifer recharge in the Carmel Valley occurred via infiltration through the bed of the Carmel River. Tributary flows were added to the mainstem flow before estimating recharge. The recharge functions used in CVSIM were based on a set of monthly percolation-runoff-drawdown curves developed by the U.S. Corps of Engineers for the Carmel River. These curves were modified to provide daily recharge estimates in CVSIM. Based on three drawdown ranges--0-1,000, 1,000-3,000, and greater than 3,000 acre-feet--different equations were used to estimate the percentage of specified

TABLE A-11

CARMEL VALLEY SIMULATION MODEL

EXISTING OPERATIONAL CONSTRAINTS

FACILITY	OPERATIONAL CAPACITY: ACRE-FEET/DAY	
	CAL-AM SYSTEM	NON CAL-AM USERS
Carmel Valley Filter Plant (1)	32.00	----
Begonia Iron Removal Plant (2)	48.00	----
Carmel Valley Aquifer		
Subunit 1 Wells	2.61	0.80
Subunit 2 Wells	9.38	2.03
Subunit 3 Wells	57.20	4.14
Subunit 4 Wells	7.69	4.86
Seaside Aquifer		
Coastal Wells	16.70	2.63

(1) Also represents surface-water diversion capacity from San Clemente Dam.

(2) Treatment is required for all production wells in Carmel Valley aquifer subunits 3 and 4 except for Scarlett Wells #4 and #7 (7.61 acre-feet/day).

TABLE A-12

CARMEL VALLEY SIMULATION MODEL

REDUCED GROUND-WATER PUMPING CAPACITIES

AQUIFER SUBUNIT	EQUATION RELATING CAL-AM PUMPING CAPACITY TO GROUND-WATER STORAGE (1)
Carmel Valley Aquifer	
Subunit 1	$y = 0.97\ (x)^{0.34}$
Subunit 2	$y = 1.03\ (x)^{0.32}$; if $x > 0.46$
	$y = 2.68\ (x) - 0.58$; if $x < 0.46$
	$y = 0$; if $x < 0.26$
Subunit 3	$y = 1.02 + 0.45\ (x)$
	$y = 0$; if $x < 0.14$
Subunit 4	$y = 1.01 + 0.44\ (\ln x)$
	$y = 0$; if $x < 0.78$
Seaside Aquifer	
Coastal Subbasin	$y = 0.80 + 0.20\ (x)$

(1) Where:

x = percentage of total ground-water storage available.
y = percentage of Cal-Am pumping capacity available.

streamflow that would percolate into the aquifer. Recharge increased with increased streamflow and decreased with increased water levels. The recharge functions were applied to each aquifer subunit and uniform drawdown within each subunit was assumed.

Recharge from surface sources in the Seaside coastal subbasin is minor and was included in the estimate for net subsurface inflow.

Baseflow. In the simulation, baseflow occurred whenever aquifer subunit storage capacity was exceeded. At these times, the excess water was added to the surface outflow. Baseflow was not calculated for the Seaside coastal subbasin.

Subsurface flow. Estimates of the subsurface flow rates between the Carmel Valley aquifer subunits were initially developed as equations based on Darcy's law. During calibration of CVSIM, these rates were adjusted and expressed as constants. A flow rate of 7.62 acre-feet/day was specified into and out of Subunits 1 and 2. In the lower valley, 7.62 acre-feet/day were specified as inflow to Subunit 3 and 2.43 acre-feet/day as outflow. In Subunit 4, 2.43 acre-feet/day was specified as inflow and 0.95 acre-feet/day as outflow to the ocean.

Subsurface inflow to the Seaside coastal subbasin was specified as 3,950 acre-feet annually. This inflow was distributed uniformly during the year. The estimate was based on a comparison of basin water level response to varying ground-water extraction and recharge conditions. Subsurface outflow was specified as 500 acre-feet/year.

Riparian evapotranspiration. Evapotranspiration losses for the riparian vegetation along the Carmel River were specified as 600 acre-feet/year. This estimate was based on a riparian area of 160 acres extending 18.5 miles from San Clemente Dam to the Carmel River Lagoon. Evapotranspiration losses were calculated for each aquifer subunit and were not adjusted for dry conditions. Table A-13 shows the monthly distribution that was specified for riparian evapotranspiration in CVSIM.

Reservoir evaporation and leakage. Reservoir evaporation was calculated as the product of reservoir surface area and monthly net evaporation rate. The monthly net evaporation rates are shown in Table A-13 and were derived by the U.S. Army Corps of Engineers for Los Padres Reservoir. Negative, net evaporation occurs when precipitation exceeds evaporation. In CVSIM, gross evaporation rates were used during dry and critically dry periods. Annual net evaporation was 2.56 feet/acre for Los Padres and San Clemente Reservoirs.

Reservoir leakage for the existing and proposed San Clemente Dams was estimated as 2.0 acre-feet/day. No leakage was estimated for Los Padres Reservoir.

TABLE A-13

CARMEL VALLEY SIMULATION MODEL

MONTHLY EVAPORATION RATES

MONTH	NET RESERVOIR EVAPORATION RATE (Feet/Acre)	RIPARIAN VEGETATION EVAPOTRANSPIRATION (Acre-Feet)
October	0.247	42
November	-0.001	24
December	-0.230	18
January	-0.286	24
February	-0.185	30
March	0.030	42
April	0.238	60
May	0.612	84
June	0.612	72
July	0.645	78
August	0.563	66
September	0.419	60
Total	2.560	600

IV. CVSIM MANAGEMENT AND OPERATIONS

Water management algorithms were developed for the Project and No-Project conditions. The algorithms focused on operation of the Cal-Am system and were designed to meet the water supply goals of the District. The Project and No-Project algorithms were similar but differed mainly in the volume of municipal water and fishery flow requirements that were supplied. Each algorithm utilized conjunctive-use management to maximize the benefits from the surface and ground-water resources.

The algorithms were designed to reflect District policy and to be consistent with present and projected Cal-Am production facilities. All water management decisions were structured in a real-time context and were based on a comparison between system supply and demand. Both short-term (daily) and long-term (seasonal and annual) comparisons were considered in the water management algorithms.

In general, water management decisions were made within the water year--October through September--at the beginning of each month. Specific water production sequences and fishery flow releases were determined daily.

The decisions were made in a downstream, sequential order. The management sequence began with the Seaside coastal subbasin and then moved through the Carmel River system (Figure 3). The decision process was complicated by two factors: 1) the extreme seasonal and annual flow variability, and 2) the dynamic nature of the system. The uncertainty regarding future inflow made it difficult to reliably plan reservoir releases. The complex stream-aquifer-pumping interaction in the Carmel Valley also made it difficult to maintain flow requirements and meet municipal demands. These difficulties were overcome by including a recursive routine in the daily operations and running numerous trial simulations.

The water management algorithms can be divided into two elements:

1) Monthly management decisions, and

2) Daily operations.

Each of these elements are described below, with special emphasis on the daily operations.

Monthly Water Management

Current and expected water supply conditions were assessed monthly in CVSIM. Current conditions were represented by:

1) All usable surface and subsurface reservoir storage, and

2) All unimpaired inflow to San Clemente Dam to date.

The cumulative inflow at San Clemente was compared with selected non-exceedance flow values (Table A-9) to classify flow conditions. This index was termed CUMFLO and consisted of four classes, with "1" representing "normal or better".

CUMFLO was used to determine:

1) the dry-year adjustment to municipal demand,

2) the diversion to the filter plant under Project conditions,

3) the effective reservoir evaporation rate, and

4) the expected inflow for the remainder of the water year.

Expected water supply conditions were represented by:

1) the inflow expected at San Clemente for the remainder of the water year, and

2) the sum of the inflow to date (CUMFLO) and the expected inflow for the remainder of the water year.

The estimates for expected inflow were based on the flow to date and were provided at the 25% risk level (Table A-10). This means that, given the current inflow, the expected inflow will equal or exceed the indicated value three out of four times. The expected inflow was termed EXPINF.

CUMFLO and EXPINF were summed and compared to the selected, annual frequency values to predict the eventual water year class. This predicted water year type was termed STATUS and was used to determine fishery flow releases. STATUS was ordered like CUMFLO, with "1" equivalent to "normal or better".

Filter Plant Diversions

Diversions to the Carmel Valley filter plant from the New San Clemente Project were determined monthly based on reservoir storage and cumulative inflow conditions. Storage, in excess of fishery flow requirement for the current and following month, was calculated and allocated for diversion. The maximum diversion (32 acre-feet/day) was reduced by 65% in below normal years and set at the minimum (6 acre-feet/day) under dry and critically dry conditions. For existing and No-Project conditions, annual diversion to the filter plant was specified as 35% of Cal-Am annual demand and was distributed monthly based on a schedule developed by Cal-Am.

Rationing

Rationing requirements were determined monthly based on a comparison of expected system demand and supply. If needed, reductions in demand were specified to forestall and lessen the impacts from severe or sustained drought. The reductions used in CVSIM are shown in Table A-14 and were applied to Cal-Am and non Cal-Am users.

The rationing procedure was designed to maintain selected levels of drought reserve. If the expected system supply fell below the expected demand, rationing was initiated. Three levels of drought reserve were specified and included in the expected system demand. The reserves were expressed as percentages--90%, 40%, 0%--of Cal-Am dry-year demand.

Daily Operations

The daily operations plan was developed principally for the Cal-Am system and consisted of a series of decisions related to the timing and magnitude of reservoir releases and diversions and ground-water pumpage. The plan was designed to:

1) Satisfy and, when possible, augment the proposed steelhead flow requirements, and

2) Satisfy Cal-Am and non Cal-Am demands as frequently as possible, and

3) Maintain system equipment and efficiency.

The daily operations involved an 11-step procedure. The last step in the process was a test to see if the municipal supply and fishery flow requirements had been met. If not satisfied, the procedure was repeated up to six times to correct for the shortages. Each of the steps in the operations procedure for the New San Clemente Project is described below.

1. Pump Seaside coastal subbasin. Cal-Am's initial pumpage is based on an annual production target of 2,500 acre-feet. This value is divided among the months using Cal-Am demand distribution (Table A-6). If a shortage occurs in the Cal-Am system, Seaside production is increased to offset or reduce the deficit.

2. Determine the fishery flow releases at the Narrows and Lagoon.

TABLE A-14

CARMEL VALLEY SIMULATION MODEL

MUNICIPAL DEMAND REDUCTION DUE TO RATIONING

POLICY	DEMAND REDUCTION (%)
No Rationing	0
Voluntary Rationing	10
Mandatory Outdoor Restrictions	25
Mandatory Outdoor and Indoor Restrictions	40

3. Select the controlling fishery flow release. The controlling release is the greater of the two requirements and includes associated conveyance losses. For example, a 5 cfs requirement at the Lagoon that requires a 40 cfs release at the dam is greater than a 20 cfs requirement at the Narrows that requires a 25 cfs release at the dam. Therefore, the 5 cfs requirement is the control and a release of 40 cfs is specified at the dam. The conveyance loss is treated as a fishery flow shortage and is determined by trial and error through the iterations.

4. Increase filter plant diversion to maximum capacity if New San Clemente Reservoir storage exceeds 15,000 acre-feet. This increase overrides the monthly determination and is included to account for large stormflows within a month.

5. Operate Los Padres Reservoir. No diversions are made at Los Padres Reservoir and a constant 5 cfs instream flow release is initially specified. If shortages occur, releases are increased to offset diversions from New San Clemente Reservoir.

6. Operate New San Clemente Reservoir. Make filter plant diversions and river releases based on earlier determinations.

7. Pump Carmel Valley Aquifer Subunit 1. If total storage in Subunit 2 is less than 4,380 acre-feet (approximately 15 feet drawdown), maximize pumping. If storage is greater, limit pumping to maintenance level. The maintenance level was defined as pumping at half capacity for one day each week.

8. Pump Carmel Valley Aquifer Subunit 2. If total storage in Subunit 3 is less than 10,730 acre-feet (approximately 40 feet drawdown) or total storage in New San Clemente Reservoir is less than 10,000 acre-feet, maximize pumping. If both storages are greater, limit pumping to maintenance level.

9. Pump Carmel Valley Aquifer Subunit 3. Calculate remaining Cal-Am demand and distribute demand between Subunits 3 and 4. Subunit 3 is assigned 85% of the remaining demand based on relative pumping capacities. Total pumping from Subunit 3 and 4 is compared with the maximum capacity at the Begonia treatment plant and reduced, if necessary.

10. Pump Carmel Valley Aquifer Subunit 4. Pump specified demand.

11. Determine shortages for Cal-Am system or fishery flow requirements. If shortages occur, add shortage increment to respective requirement and repeat procedure. Maximum number of iterations is currently six.

It should be noted that after each production source was operated, the remaining Cal-Am demand was calculated and a test for over-production was made. If yield exceeded demand, then the last source was reduced accordingly and production from the remaining sources was bypassed.

V. CVSIM ACCURACY

CVSIM was calibrated using two flow periods: 1976-1978 and 1984-1985. The 1976-1978 period was chosen because it represents the critical dry period and includes an above-normal year. The 1984-1985 period was used because it represents a below-normal period and includes pumpage from Cal-Am's four new wells in the lower Carmel Valley subunits. In the calibration, emphasis was placed on the 1976-1978 period. This is the Project design period and, from a water management perspective, accuracy during this period was considered foremost. Observed data were available at two mainstem flow sites--Robles del Rio and near Carmel--and four reservoirs--Los Padres, San Clemente, Carmel Valley Subunit 3, and Carmel Valley Subunit 4. Graphs comparing the observed and simulated values for streamflow near Carmel and storage in Carmel Valley Aquifer Subunit 3 are presented in Figure 5 and 6, respectively.

In general, the results indicated good agreement between the recorded and simulated values, especially for ground-water storage.

Other checks on model accuracy included:

1) Detailed review of the computer codes by District staff and RAMLIT Associates,

2) Automatic daily water balance calculations for each reservoir and aquifer unit, and

3) Optional monthly and annual water balance calculations for the total system.

Figure 5

CARMEL RIVER NEAR CARMEL

Water Years 1976 – 1978

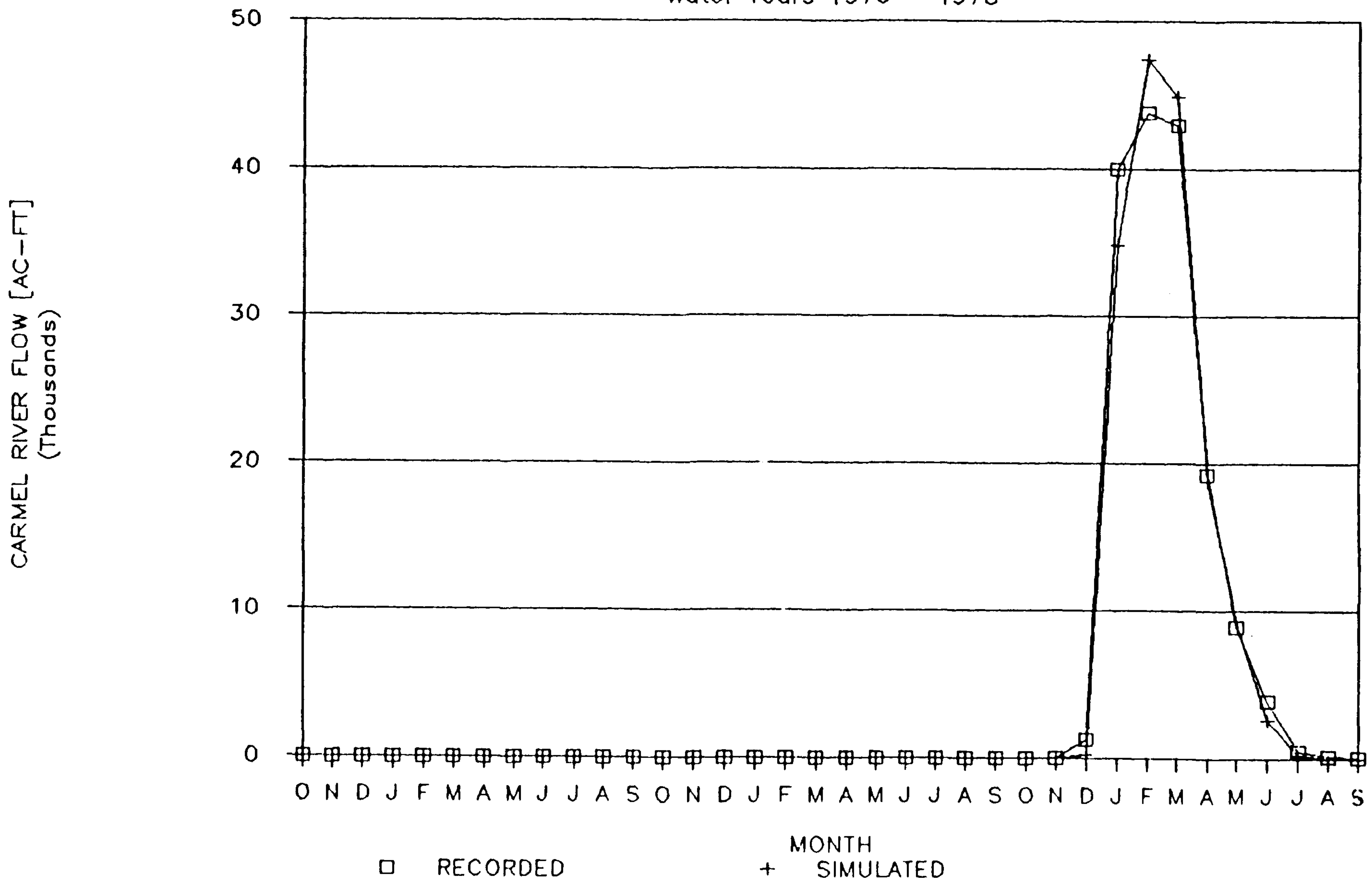
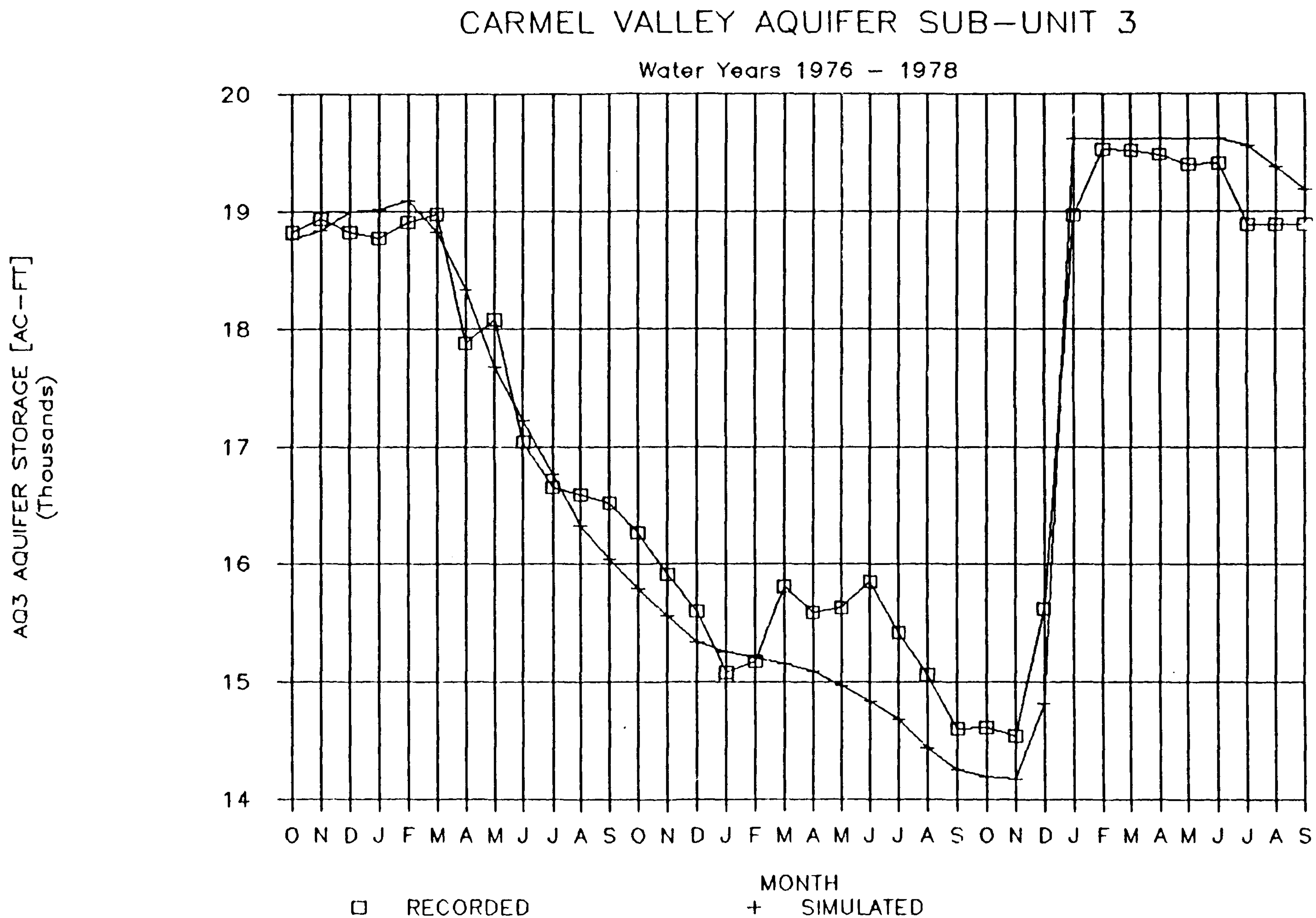


Figure 6



CARMEL VALLEY AQUIFER SUB-UNIT 3
Water Years 1976 - 1978
AQ3 AQUIFER STORAGE [AC-FT]
(Thousands)
20
19
18
17
16
15
14
O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S
MONTH
RECORDED
+ SIMULATED

OVERVIEW OF THE CARMEL VALLEY SIMULATION MODEL

ADDENDUM

This addendum updates the information regarding the Carmel Valley Simulation Model (CVSIM) that was presented in Appendix A of the New San Clemente Project Draft Environmental Impact Statement/Environmental Impact Report (EIS/EIR) that was published in September 1987. The addendum is divided into two sections. In Section I, the major changes made to CVSIM between 1987 and 1990 are discussed. In Section II, specific revisions to the data, assumptions, and procedures used in CVSIM are described.

I. MAJOR CHANGES

Two major changes were made to CVSIM for the Supplemental Draft Environmental Impact Report/Environmental Impact Statement (SDEIR/EIS) for the Monterey Peninsula Water Supply Project. The first change reflected the decision by the District to analyze the performance and impacts of a wider range of water supply alternatives, and involved the development of several new options and alternatives in CVSIM. Several of these alternatives (e.g. San Clemente Creek, Cachagua Creek and Chupines Creek Reservoirs; Carmel Valley and Seaside ground water development; and reservoir dredging) were simulated with CVSIM for the original EIR/EIS analyses. Other alternatives such as New Los Padres Reservoir, Cañada Reservoir, desalination, or new combinations of facilities were developed specifically for the SDEIR/EIS analyses. Each of the water supply alternatives that was simulated by CVSIM for the SDEIR/EIS is listed in Table 1.

The second change centered on the decision by the District to operate all of the water supply alternatives that would either impound or pump excess flow from the Carmel River mainstem according to the bypass logic proposed by the California Department of Fish and Game (CDFG) for evaluating the Cañada Reservoir Project in 1989. CDFG proposed the bypass logic in an effort to minimize active reservoir management and dependence upon humans for upstream and downstream migration flows. Conceptually, the bypass logic is designed to reflect and mimic natural flow conditions to the greatest degree possible. The District incorporated the bypass logic in its project operation to comply with CDFG recommendations and to provide a common basis for comparing project performance and environmental impacts.

Table 1

MONTEREY PENINSULA WATER SUPPLY PROJECT
WATER SUPPLY ALTERNATIVES SIMULATED WITH CVSIM

ALTERNATIVE	REFERENCE
24,000 AF New Los Padres Reservoir	24 NLP
16,000 AF New Los Padres Reservoir with 3 MGD desalination plant	16 NLP/D
9,000 AF New Los Padres Reservoir with 3 MGD desalination plant	9 NLP/D
23,000 AF New San Clemente Reservoir	23 NLP
11,000 AF San Clemente Creek Reservoir with pumped storage	11 SCC
10,500 AF Chupines Creek Reservoir with pumped storage	10 CHU
6,000 AF Cachagua Creek Reservoir with 3 MGD desalination plant	6 CAC/D
25,000 AF Cañada Reservoir	25 CAN
7 MGD desalination plant	7 DSL
No Project	NO PRJ

Note: CVSIM refers to Carmel Valley Simulation Model

II. SPECIFIC REVISIONS

1. <u>CVSIM4 Development</u> -- A separate program code, CVSIM4, was developed to simulate the performance of the Cañada Reservoir Project. CVSIM4 was created to test CDFG's bypass logic at the Cañada diversion site and provide a means to respond to several special modeling requests made by the Cañada Reservoir Project proponent, California-American Water Company (Cal-Am) and its consultants.

2. <u>Ground Water Storage Estimates</u> -- The volume of total and usable ground water storage in the subunit 4 of the Carmel Valley Aquifer and the Seaside Coastal Subbasin were revised based on additional hydrogeologic investigations. Specifically, the usable storage in Carmel Valley Aquifer subunit 4 was increased from 3,088 to 5,000 acre-feet and the usable storage in the Seaside Coastal Subbasin was increased from 4,700 to 7,500 acre-feet.

3. <u>Inflow Record Extension</u> -- The daily streamflow records used as inputs to CVSIM were extended to include Water Years 1988, 1989, and 1990. These records included flows for the Carmel River at Los Padres Reservoir and nine, selected tributaries. The records were extended to include all available data, especially information from the current drought event (i.e. 1987 - 1990).

4. <u>Cal-Am Demand</u> -- "Project" demand for the Cal-Am system was estimated for buildout conditions. Buildout refers to the growth that could legally occur within the District under the General Plans, zoning, and other applicable land use policies of the jurisdictions within the District as of January 1988. Project demand for the Cal-Am system in normal years was estimated to be 23,080 acre-feet of production.

   "No Project" demand for the Cal-Am system in normal years was estimated to be 20,000 acre-feet of production. The No Project demand was based on the District's current allocation for the Cal-Am system (16,744 acre-feet) plus an increase in demand for intensification.

5. <u>Non Cal-Am Demands</u> -- The non Cal-Am demands were revised to take into account recent changes in water well ownership and use and expected conservation savings. Specifically, demand in Carmel Valley Aquifer subunits 1 through 4 in normal years was specified as 89.1, 363.0, 784.7, 948.8 acre-feet, respectively. Non Cal-Am demand in the Seaside Coastal Subbasin in normal years was specified as 1,110 acre-feet and included production from the Fort Ord Coastal Subbasin. The non Cal-Am demands were assumed to be the same under both Project and No Project conditions.

Variable rates of return flow for non Cal-Am pumping in Carmel Valley were assumed, depending on the type of land use in place.

6. Demand Adjustments -- Normal year water use was adjusted for wet, dry, and critically-dry weather conditions based on streamflow conditions. The adjustments were made monthly and in wet years resulted in an eight percent decrease in annual demand, assuming all months were wet during the year. Similarly, a two and one-half percent increase in annual demand was applied for 12 months of dry conditions and a five percent increase was applied for 12 months of critically-dry conditions.

7. Instream Flow Releases -- For the mainstem storage alternatives, releases for instream flows were based on the flow schedule recommended by CDFG for fishery flows near the Highway 1 Bridge over the Carmel River. These flows are shown in Table 2 and include a flow duration, rate, and volume for each portion of the steelhead lifecyle.

   For the tributary storage alternatives, releases for instream flows were based on a flow schedule developed specifically for smaller, off-channel projects. These flows are shown in Table 3 and have similar purposes as those shown for the same periods in Table 2. The flow schedule for the tributary storage projects reflect two key features of these projects. That is, these projects (1) would have relatively limited storage capacity and (2) would not substantially affect high-flow events in the Carmel River mainstem. Accordingly, storage from these projects would be conserved during the high-flow period (January-March) and would be released during the low-flow period (April-December) to satisfy downstream fishery flow requirements.

   For all of the upstream storage projects, except the 9,000 AF New Los Padres/Desalination alternative, releases for instream flows would be augmented with stored water, whenever available. These additional releases would be made to balance surface and ground water storage and to minimize the conveyance losses associated with the bypass flows.

TABLE 2

MINIMUM FISHERY FLOW REQUIREMENTS AT THE HIGHWAY 1 BRIDGE FOR UPPER CARMEL RIVER BASIN MAINSTEM STORAGE PROJECTS

Period	Purpose	Flow		
		Duration (Days)	Rate (Cfs)	Volume (AF)
January-March	Attraction	18	200	7,200
	Spawning, incubation, and migration	72	75	5,800
April-May	Incubation, migration, and rearing	61	20	2,240
June-December	Rearing	214	5	2,200
Total		365		17,440

Source: California Department of Fish and Game, 1986.

Note: These requirements also apply to the 25,000 AF Cañada Reservoir Project

TABLE 3

MINIMUM FISHERY FLOW REQUIREMENTS AT NARROWS AND LAGOON FOR UPPER CARMEL RIVER BASIN TRIBUTARY STORAGE PROJECTS

Period	Flow at Narrows			Flow at Lagoon		
	Duration (Days)	Rate (Cfs)	Volume (Af)	Duration (Days)	Rate (Cfs)	Volume (Af)
January-March	0	0	0	90	5	890
April[1]	0	0	0	30	5	300
				30	**20**	**1,190**
May[1]	0	0	0	31	0	0
				31	**20**	**1,230**
June-December[2]	214	5	2,120	0	0	0
	214	**20**	**8,490**			

Dry-Year Total: 3,310 acre-feet
Wet-Year Total: **11,800** acre-feet

Source: Krebs, 1982

Notes:

1. If usable reservoir storage is greater than 7,000 acre-feet, the fishery flow requirements at the Lagoon are increased as shown in bold type. In CVSIM, the increases are made daily based on current reservoir storage. The volumes shown in bold were calculated assuming that the storage exceeds 7,000 acre-feet every day of the year.

2. If inflow conditions for the water year are projected to be normal or better, the flow requirements at the Narrows are increased as shown in bold type. In CVSIM, inflow conditions are assessed monthly. The volume shown in bold was calculated assuming that inflow conditions were expected to be normal or better every month of the year.

8. Pumping Capacities -- The pumping capacities for Cal-Am's production wells in each aquifer subunit and subbasin were revised to reflect updated conditions and information. Specifically, the 13 percent depreciation factor previously used for the entire Cal-Am system was eliminated and replaced with updated capacity values for each well in the Cal-Am system. These values included an implicit inefficiency value. The revised capacities for Carmel Valley Aquifer subunits 1 through 4 were 2.61, 12.30, 57.53, and 8.84 acre-feet per day, respectively. The revised pumping capacity for Cal-Am's existing production wells in the Seaside Coastal Subbasin was 13.26 acre-feet per day. An additional 13.26 acre-feet per day of capacity was included to represent capacity that will be added to the Cal-Am system in Seaside as new wells are developed (e.g. Paralta). Total pumping capacity for the Cal-Am system from the Seaside Coastal Subbasin is projected to be 26.52 acre-feet per day.

9. Water Treatment Capacity -- The treatment capacity at the Begonia Iron Removal and Water Treatment Plant was revised to 54.0 acre-feet per day. This increase reflects the addition of a new filter at the plant. It should be noted that Cal-Am has corrected its initial estimate of maximum capacity at the Begonia Plant from 54.0 to 55.3 acre-feet per day. This correction was not included in the simulations for the SDEIR/EIS, but has been incorporated into CVSIM for future simulations.

10. Riparian Evapotranspiration -- Evapotranspiration losses due to riparian vegetation along the Carmel River were increased from 600 to 1,310 acre-feet per year based on updated mapping studies.

11. Water Rationing -- This option was not used in the simulations for the SDEIR/EIS.

12. Project Operations -- The revised project operations, based on CDFG's bypass proposal, and No Project operations are described in Chapter 4, Description of Projects Analyzed in the EIR/EIS, of the main text.

13. CVSIM Accuracy -- No additional calibration or verification of CVSIM has been made. A rigorous verification and sensitivity study is planned for 1992, based on information gathered during the current drought period (1987 - 1991).

    It should be noted that CVSIM has been used for several studies -- MPWMD's Water Allocation Program EIR, Monterey County's Capital Facilities Study, and Cal-Am's Cañada Reservoir Study. In the course of these studies, CVSIM and its results have been thoroughly reviewed by a number of independent consultants. Several minor revisions and improvements have been suggested and have been or will be incorporated into CVSIM.

APPENDIX 5B: WATER SUPPLY PERFORMANCE OF ALTERNATIVES

This appendix provides more detail on the water supply performance of each of the ten alternatives summarized in Chapter 5 of the EIR/EIS.

5B.1 24,000 AF NEW LOS PADRES RESERVOIR (24 NLP)

Performance at Buildout

Project Benefits and Drought Reserve. At a buildout demand of 23,080 AF Cal-Am production and no rationing, the 24,000 AF New Los Padres project would provide water supply benefits when compared to the Future Reference Baseline (FRB). The 24 NLP alternative would result in 27 percent more yield than the FRB in the 1976-78 period and 11 percent more in the 1988-90 event.

As shown in Table 5B-1, the drought reserve at the end of the simulated 1976-77 event would be nearly 12,100 AF, or 52 percent of a normal year's water use at buildout. A reserve of about 5,900 AF, or about 25 percent of buildout demand, would remain if the simulated 1988-90 drought ended in September 1990.

Supply in Droughts. As shown in Table 5B-1, the average yield from the 24 NLP project would provide 100 percent of average demand in the 1976-78 period and 92 percent of average demand in the 1988-90 period. Only one annual shortfall greater than 1,000 AF would occur in the simulated 89 years of record. With no voluntary or mandatory demand reductions, it would total about 5,000 AF in simulated water year 1990, which corresponds to a 21 percent annual deficit. Viewed monthly, the 24 NLP project would provide adequate supply throughout the 89 years of record, except for five months with shortages greater than 10 percent in simulated water year 1990 (Figure 5B-1).

TABLE 5B-1

WATER SUPPLY PERFORMANCE AT BUILDOUT[1] (23,080 AF CAL-AM PRODUCTION)

Alternative	System Reserves At End of Droughts (% Normal Demand)		Meeting Demand In Droughts (% Average Demand Met)		Significant Annual Shortfalls[2] (Worst Shortage)	
	Dec '77	Sept '90	1976-78	1988-90	No. Years	% Shortfall
24 NLP	52	25	100	92	1	21
16 NLP/D	53	32	100	98	1	7
9 NLP/D	44	36	99	98	1	5
23 NSC	53	33	100	94	1	15
6 CAC/D	38	32	93	96	2	12
11 SCC	38	27	92	89	3	26
10 CHU	36	23	93	87	3	30
25 CAN	63	29	98	94	1	17
7 DSL	54	73	100	100	0	0
FRB	29	23	79	83	6	35
CAL-AM DEMAND AT 20,000 AF PRODUCTION						
NO PRJ	42	36	94	97	2	9
11 SCC	–	–	100	100	1	5
10 CHU	–	–	100	98	1	7
ALL OTHERS	–	–	100	100	0	0

[1] All values are rounded.
[2] A significant shortfall is greater than 1,000 AF.

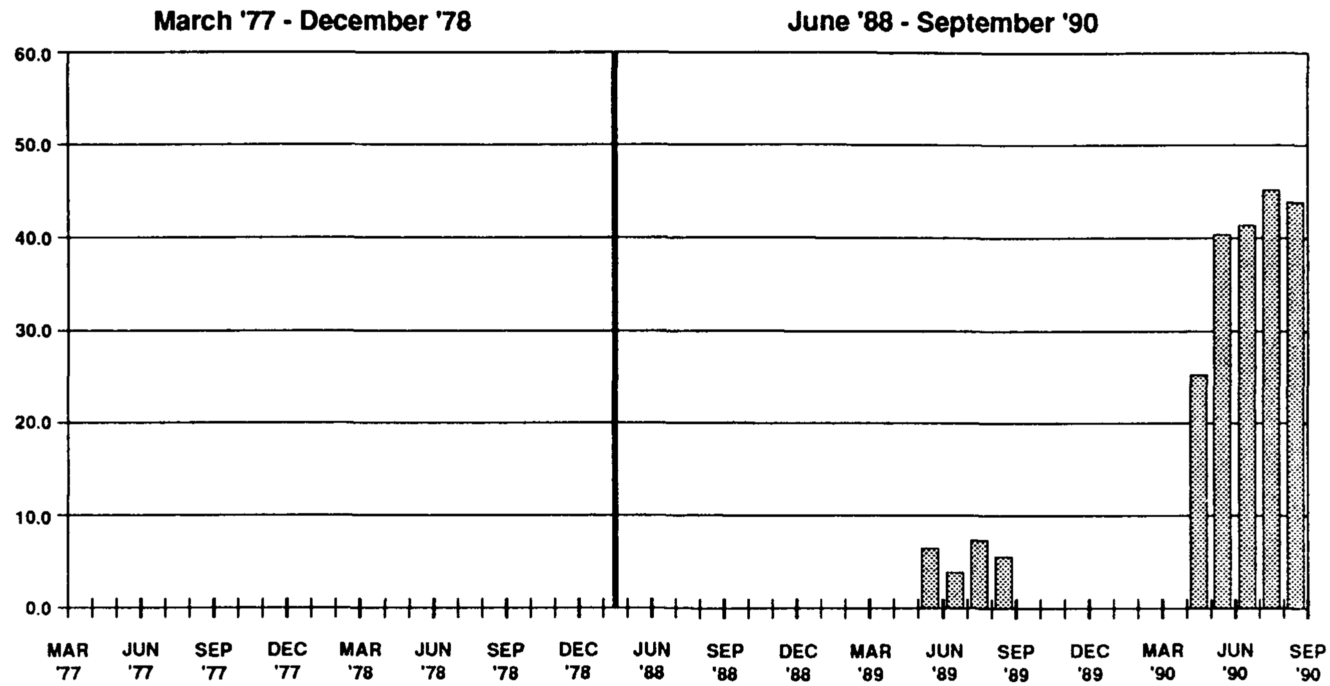
Source: MPWMD.

MONTHS OF SHORTAGES & PERCENT SHORTFALL IN TWO DROUGHTS
AT BUILDOUT -- 23,000 AF CAL-AM PRODUCTION

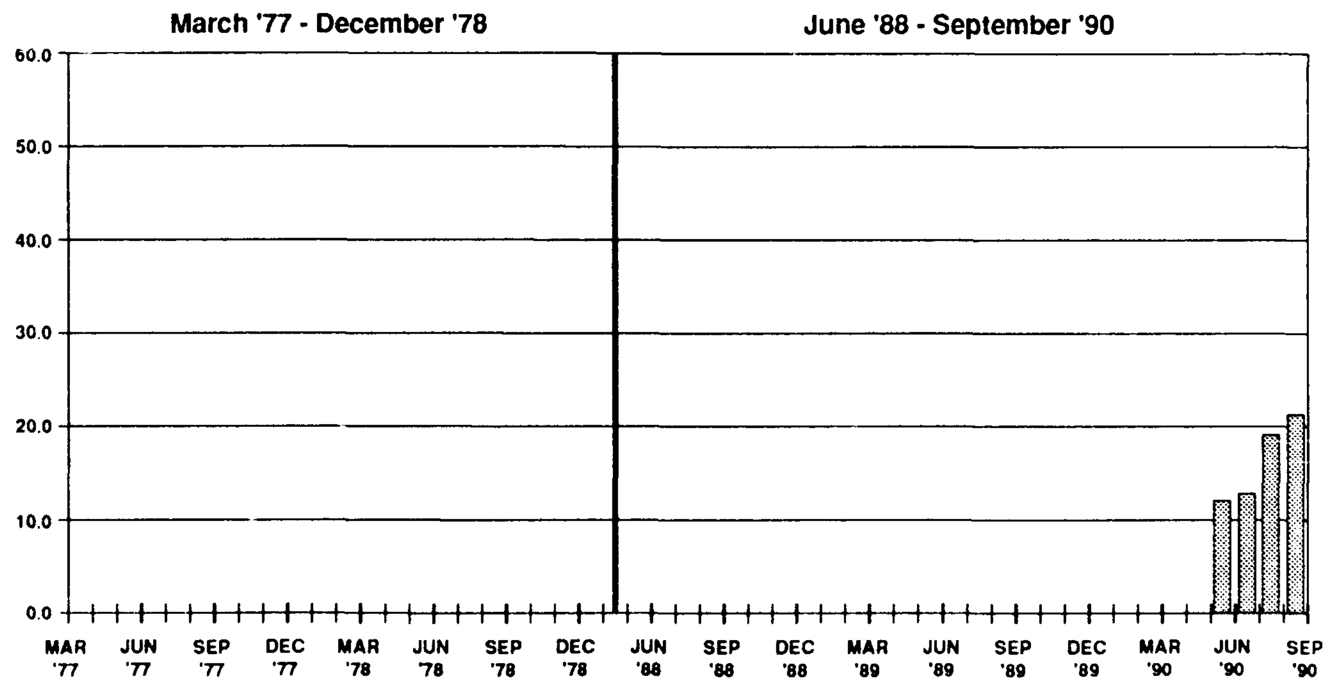
FIGURE 5B-1

Analysis assumes NO rationing or demand management.

24 NLP Alternative



16 NLP/D Alternative



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Performance at Other Demand Levels

With a demand of 20,000 AF Cal-Am production, the 24 NLP project would result in adequate supply at all times. It would provide substantial benefits compared to the No Project alternative, which would entail 9 percent shortfalls in simulated years 1990 and 1977. If buildout demand increased to 24,670 AF Cal-Am annual production, the 24 NLP would still result in adequate supply in all simulated water years except for 1989 and 1990. However, performance would deteriorate at this high demand. There would be 15 months of substantial shortfalls in simulated 1989-90, and the annual yield would fall short of demand by 32 percent in simulated water year 1990.

Assessment

Construction of the 24 NLP alternative would result in water supply benefits compared to the existing situation, the No Project and the FRB. Even at buildout (demand equals 23,080 Cal-Am production), there would be no need for rationing in an event like the 1976-77 drought. There would also be significantly less rationing in a drought like the 1988-90 event. Drought reserves in most years would be substantially higher due to the addition of the 24,000 AF reservoir to the resource system.

At a buildout demand of 23,080 AF Cal-Am normal year production, the 24 NLP would result in a 21 percent annual shortfall in simulated water year 1990. A generally recognized (but not formalized) goal is that facilities should produce enough water in a sustained drought to result in no more than a 10 percent annual shortage. Because no rationing or demand management is coded in the CVSIM model, simulated shortfalls in spring/summer 1990 result in a 21 percent annual deficit for the 24 NLP project. Water year 1990 is the only year in 89 simulated years that would result in a shortfall greater than 10 percent. This annual shortfall would be reduced to the 10 percent level in all water years by instituting one or a combination of the following measures (applicable to all alternatives):

- o demand management;
- o additional facilities;
- o alteration of project operations;
- o increase in reservoir size; and
- o limit normal-year system demand (allocation).

Because a significant shortfall would occur only once in 89 years at buildout, Measure A (demand management) may be the most appropriate (and least costly) mitigation measure. The simulated 20 percent annual shortfall in 1990 resulted from unchecked demand until spring/summer 1990, the fourth consecutive drought year. If 10 percent voluntary conservation is enacted as a matter of policy in the third drought year (e.g., water year 1989), shortfalls in 1990 would not exceed 10 percent.

Additional facilities (Measure B) would be required to reduce the 1990 shortfall if demand management is not desired, or if more severe droughts occur in the future. A 3 MGD desalination plant combined with the 24,000 AF reservoir could reduce shortfalls to manageable levels at all times. Operation at maximum capacity only during droughts would lower annual costs of this relatively expensive technology. Additional facilities could enable reductions in reservoir size, as demonstrated by the performance of the 16 NLP/D alternative.

Another option is to include additional pumping capacity in aquifer subunits, although this measure could have significant impacts on the river habitat. Usable aquifer storage in Subunits 3 and 4 would be diminished in a year like 1990 at buildout, so additional pumping capacity would not substantially improve performance. However, tapping the nearly 6,500 AF of usable storage remaining in Aquifer Subunit 2 by drilling new wells or increasing the pumping capacity of existing wells could improve performance. Recall that the 24 NLP and all alternatives assume significant increases to the pumping capacity and usable storage in the Seaside Coastal Subbasin.

The 24 NLP alternative is operated to maximize recharge of the aquifers in lower Carmel Valley, a practice that results in environmental benefits. Alternative reservoir operations (Measure C) that result in more stored water for drought reserve may improve water supply performance (example: less water released from the reservoir for downstream recharge in dry years).

An increase in reservoir size (Measure D) would improve performance in a sustained drought, but the effectiveness of this measure is reduced as the length of drought continues. For example, MPWMD staff found that a reservoir size increase of 6,000 AF for the 23 NSC alternative improved performance by only 1,300 AF, a ratio of 4.6:1. Environmental effects of inundation would also be greater with increased reservoir size. For the 24 NLP, an increased reservoir size would mean additional wilderness inundation at the upstream end of the reservoir.

Placing a limit on community demand (Measure E), even in normal years, would also result in improved performance in a sustained drought such as 1988-90. For example, a plot of acre-feet shortfall for the 24 NLP versus normal year demand at three levels (20,000 AF, 23,080 AF and 24,670 AF) shows that a demand of about 21,500-22,000 AF would result in no more than a 10 percent shortage in simulated water year 1990. This result is based on the operations for the 24 NLP presently coded in the CVSIM model, with no rationing or demand management. Results would differ significantly if demand management was included.

5B.2 16,000 AF NEW LOS PADRES RESERVOIR / DESALINATION (16 NLP/D)

Performance at Buildout

Project Benefits and Drought Reserve. At a buildout demand of 23,080 AF Cal-Am production and no rationing, the 16,000 AF New Los Padres Project combined with a 3 MGD desalination plant (16 NLP/D) would provide water supply benefits when compared to the Future Reference Baseline (FRB). The 16 NLP/D alternative would result in 27 percent more yield than the FRB in the 1976-78 period, and 18 percent more in the 1988-90 event.

As shown in Table 5B-1, the drought reserve at the end of the simulated 1976-77 event would be 12,300 AF, or about 53 percent of a normal year's water use at buildout. A reserve of about 7,320 AF, or about 32 percent of buildout demand, would remain if the simulated 1988-90 drought ended in September 1990.

Supply in Droughts. As shown in Table 5B-1, the average yield from the 16 NLP/D alternative would provide 100 percent of average demand in the 1976-78 period and 98 percent of average demand in the 1988-90 period. Only one annual shortfall greater than 1,000 AF would occur in the simulated 89 years of record. With no voluntary or mandatory demand reductions, it would total about 1,630 AF in simulated water year 1990, which corresponds to a 7 percent annual deficit. Viewed monthly, the 16 NLP/D would provide adequate supply throughout the 89 years of record, except for four months in simulated water year 1990 (Figure 5B-1).

Performance at Other Demand Levels

With a demand of 20,000 AF Cal-Am production, the 16 NLP/D would result in adequate supply at all times. It would provide substantial benefits compared to the No Project, which would entail 9 percent shortfalls in simulated years 1990 and 1977.

If buildout demand increased to 24,670 AF Cal-Am annual production, the 16 NLP/D would still result in adequate supply in all simulated water years except for 1990. Performance would begin to deteriorate at this high demand; there would be seven months of substantial shortfalls in simulated 1989-90, and the annual yield would fall short of demand by 19 percent in simulated water year 1990.

Assessment

Construction of the 16 NLP/D alternative would result in water supply benefits compared to the existing situation, the No Project and the FRB. Even at buildout (demand equals 23,080 Cal-Am production), there would be no need for rationing in an event like the 1976-77 drought. There would also be only a modest 7 percent shortage a drought like the 1988-90 event. Drought reserves in most years would be substantially higher due to the addition of the 16,000 AF reservoir to the resource system.

5B.3 9,000 AF NEW LOS PADRES RESERVOIR / DESALINATION (9 NLP/D)

Performance at Buildout

Project Benefits and Drought Reserve. At a buildout demand of 23,080 AF Cal-Am production and no rationing, the 9,000 AF New Los Padres Project with 3 MGD desalination would provide water supply benefits when compared to the Future Reference Baseline. The 9 NLP/D alternative would result in 26 percent more yield than the FRB in the 1976-78 period and 18 percent more in the 1988-90 event.

As shown in Table 5B-1, the drought reserve at the end of the simulated 1976-77 event would be over 10,100 AF, or about 44 percent of a normal year's water use at buildout. A reserve of about 8,400 AF, or about 36 percent of buildout demand, would remain if the simulated 1988-90 drought ended in September 1990.

Supply in Droughts. As shown in Table 5B-1, the average yield from the 9 NLP/D alternative would provide 99 percent of average demand in the 1976-78 period and 98 percent of average demand in the 1988-90 period. Only one annual shortfall greater than 1,000 AF would occur in the simulated 89 years of record. With no voluntary or mandatory demand reductions, it would total about 1,250 AF in simulated water year 1990, which corresponds to a 5 percent annual deficit. Viewed monthly, the 9 NLP/D would provide adequate supply throughout the 89 years of record, except for three months with shortages greater than 10 percent in simulated water year 1990 (Figure 5B-2).

Performance at Other Demand Levels

With a demand of 20,000 AF Cal-Am production, the 9 NLP/D alternative would result in adequate supply at all times, and would provide substantial benefits in droughts compared to the No Project alternative. If buildout demand increased to 24,670 AF Cal-Am normal year annual production, the 9 NLP/D project would still result in adequate supply in all simulated water years except 1977 and 1990. Performance would somewhat worsen at this higher demand. There would be nine months of significant shortfalls in simulated 1977 and 1989-90; the annual yield would fall short of demand by 17 percent in water year 1990.

Assessment

Construction of the 9 NLP/D alternative would result in water supply benefits compared to the existing situation, the No Project and the FRB. Even at buildout (demand equals 23,080 Cal-Am production), there would be no need for rationing in an event like the 1976-77 drought. There would also be only a modest 5 percent shortfall in a drought like the 1988-90 event. Drought reserves in most years would be significantly higher due to the addition of the 9,000 AF reservoir and the desalination plant to the resource system.

5B.4 23,000 AF NEW SAN CLEMENTE RESERVOIR (23 NSC)

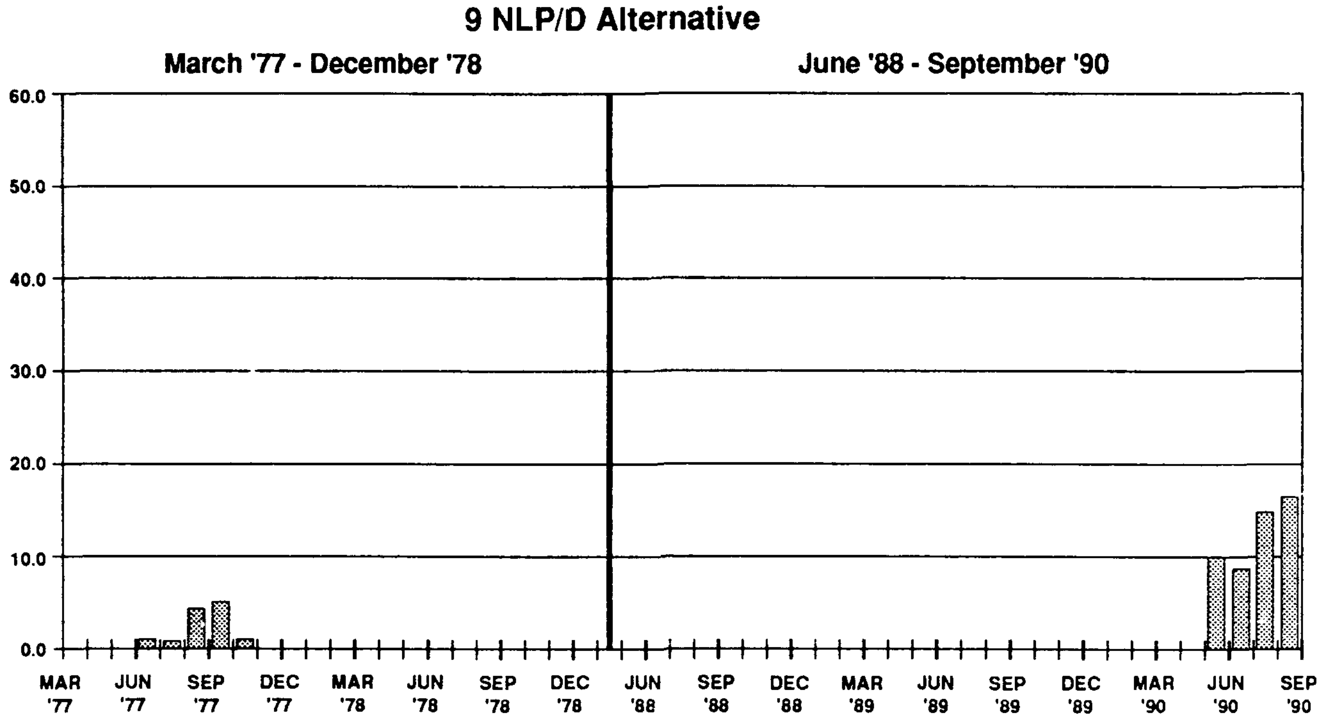
Performance at Buildout

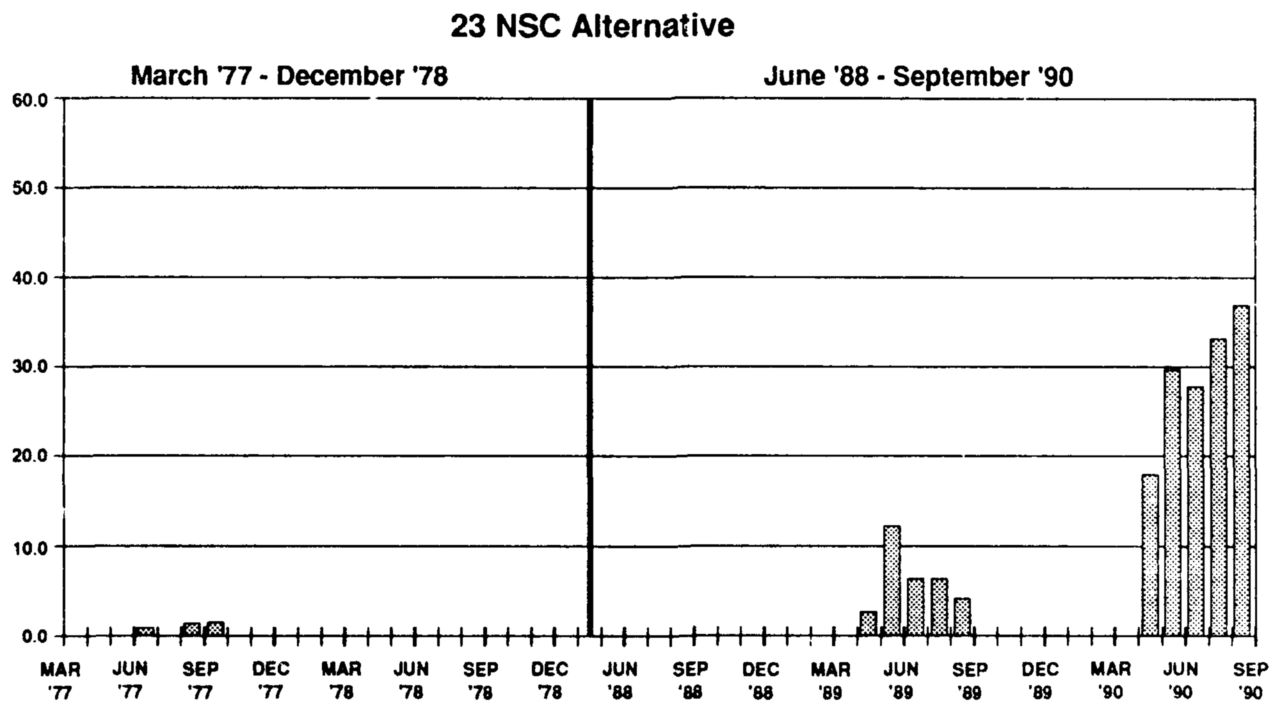
Project Benefits and Drought Reserve. At a buildout demand of 23,080 AF Cal-Am production and no rationing, the 23,000 AF New San Clemente Reservoir (23 NSC) would provide water

MONTHS OF SHORTAGES & PERCENT SHORTFALL IN TWO DROUGHTS
AT BUILDOUT -- 23,000 AF CAL-AM PRODUCTION

FIGURE 5B-2

Analysis assumes NO rationing or demand management.





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supply benefits when compared to the Future Reference Baseline. The 23 NSC alternative would result in 27 percent more yield than the FRB in the 1976-78 period and 13 percent more in the 1988-90 event.

As shown in Table 5B-1, the drought reserve at the end of the simulated 1976-77 event would be over 12,100 AF, or almost 53 percent of a normal year's water use at buildout. A reserve of about 7,600 AF, or about 33 percent of buildout demand, would remain if the simulated 1988-90 drought ended in September 1990.

Supply in Droughts. As shown in Table 5B-1, the average yield from the 23 NSC alternative would provide 100 percent of average demand in the 1976-78 period and 94 percent of average demand in the 1988-90 period. Only one annual shortfall greater than 1,000 AF would occur in the simulated 89 years of record. With no voluntary or mandatory demand reductions, it would total about 3,650 AF in simulated water year 1990, which corresponds to a 15 percent annual deficit. Viewed monthly, the 23 NSC would provide adequate supply in the two most recent droughts, except for six months with shortages greater than 10 percent in simulated water years 1989 and 1990 (Figure 5B-2).

Performance at Other Demand Levels

With a demand of 20,000 AF Cal-Am production, the 23 NSC alternative would result in adequate supply at all times, and would provide benefits in droughts compared to the No Project alternative. If buildout demand increased to 24,670 AF Cal-Am normal year annual production, the 23 NSC alternative would result in adequate supply in all simulated water years except for four: 1961, 1977, 1989 and 1990. Performance would deteriorate at this higher demand. There would be 25 months of shortfalls in these four years, and the annual yield would fall short of supply by 25 percent in simulated water year 1990.

Assessment

Construction of the 23 NSC alternative would result in water supply benefits compared to the existing situation, the No Project and the FRB. Even at buildout, there would be no need for rationing in an event like the 1976-77 drought. There would also be substantially less rationing in a drought like the 1988-90 event. Drought reserves in most years would be substantially higher due to the addition of the 23,000 AF reservoir to the resource system.

At a buildout demand of 23,080 AF Cal-Am normal year production, the 23 NSC would result in a 15 percent annual shortfall in simulated water year 1990. Water year 1990 would be the only year in 89 years that would result in a simulated shortfall greater than 10 percent. The measures described in Section 5B.1 to reduce annual shortages would apply to the 23 NSC alternative, although the specific numerical values would differ.

5B.5 6,000 AF CACHAGUA CREEK RESERVOIR/DESALINATION (6 CAC/D)

Performance at Buildout

Project Benefits and Drought Reserve. At a buildout demand of 23,080 AF Cal-Am production and no rationing, the 6,000 AF Cachagua Creek Reservoir with 3 MGD desalination would provide water supply benefits when compared to the Future Reference Baseline. The 6 CAC/D alternative would result in 18 percent more yield than the FRB in the 1976-78 period, and 16 percent more in the 1988-90 event.

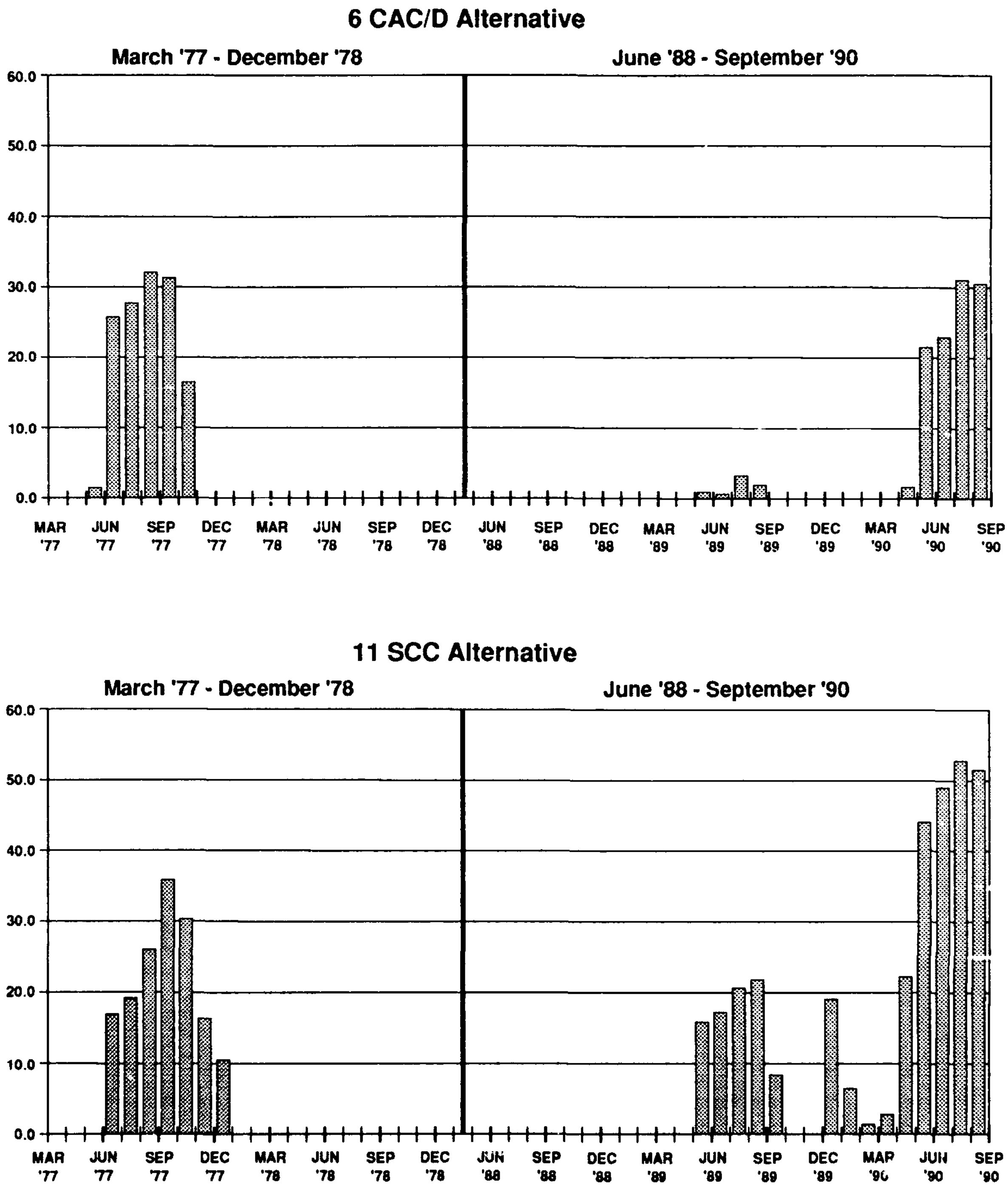
As shown in Table 5B-1, the drought reserve at the end of the simulated 1976-77 event would be about 8,700 AF, or almost 38 percent of a normal year's water use at buildout. A reserve of about 7,400 AF, or about 32 percent of buildout demand, would remain if the simulated 1988-90 drought ended in September 1990.

Supply in Droughts. As shown in Table 5B-1, the average yield from the 6 CAC/D alternative would provide 93 percent of average demand in the 1976-78 period and 96 percent of average demand in the 1988-90 period. Two annual shortfalls greater than 1,000 AF would occur in the simulated 89 years of record. With no voluntary or mandatory demand reductions, shortfalls would total about 3,000 AF and 2,800 AF in simulated water years 1977 and 1990, respectively. This corresponds to a 12 percent annual deficit in both cases. Viewed monthly, the 6 CAC/D would result in nine months with shortages greater than 10 percent in the two most recent droughts (Figure 5B-3).

MONTHS OF SHORTAGES & PERCENT SHORTFALL IN TWO DROUGHTS
AT BUILDOUT -- 23,000 AF CAL-AM PRODUCTION

FIGURE 5B-3

Analysis assumes NO rationing or demand management.



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Performance at Other Demand Levels

With a demand of 20,000 AF Cal-Am production, the 6 CAC/D alternative would result in adequate supply at all times, and would provide benefits in droughts compared to the No Project alternative. If buildout demand increased to 24,670 AF Cal-Am normal year annual production, the 6 CAC/D alternative would result in adequate supply in all simulated water years except for three: 1977, 1989 and 1990. There would be 16 months of shortfalls in these three years, and the annual yield would fall short of supply by 21 percent in both simulated water years 1989 and 1990.

Assessment

Construction of the 6 CAC/D alternative would result in moderate water supply benefits compared to the existing situation, the No Project and the FRB. At buildout, there would be shortfalls in droughts like the 1976-77 and 1988-90 events, but they would be about half of what presently exists. Drought reserves would be similar to the No Project alternative and slightly greater than the FRB.

At a buildout demand of 23,080 AF Cal-Am normal year production, the 6 CAC/D would result in a 12 percent annual shortfall in simulated water years 1977 and 1990. Only two out of 89 simulated years would result in a significant shortfall slightly greater than 10 percent. These data indicate that this alternative provides moderate protection.

The measures described in Section 5B.1 to reduce annual shortages would apply to the 6 CAC/D alternative, though the specific numerical values would differ. An additional variation on measures B and D (add facilities and increase reservoir size) could be to add pump-storage to a larger Cachagua Creek Reservoir. This would improve performance, but may be prohibitively expensive, given the already high annual costs associated with desalination.

5B.6 11,000 AF SAN CLEMENTE CREEK RESERVOIR (11 SCC)

Performance at Buildout

Project Benefits and Drought Reserve. At a buildout demand of 23,080 AF Cal-Am production and no rationing, the 11,000 AF San Clemente Creek Reservoir would provide water supply benefits when compared to the Future Reference Baseline. The 11 SCC alternative would result in 18 percent more yield than the FRB in the 1976-78 period, but only 7 percent more in the 1988-90 event.

As shown in Table 5B-1, the drought reserve at the end of the simulated 1976-77 event would be about 8,700 AF, or almost 38 percent of a normal year's water use at buildout. A reserve of about 6,300 AF, or about 27 percent of buildout demand, would remain if the simulated 1988-90 drought ended in September 1990.

Supply in Droughts. As shown in Table 5B-1, the average yield from the 11 SCC alternative would provide 92 percent of average demand in the 1976-78 period and 89 percent of average demand in the 1988-90 period. Three annual shortfalls greater than 1,000 AF would occur in the simulated 89 years of record. With no voluntary or mandatory demand reductions, shortfalls would total about 6,250 AF and 2,500 AF in simulated water years 1990 and 1977, respectively. In addition, a 1,900 AF shortfall would occur in simulated water year 1989. These correspond to a 26 percent annual deficit in simulated year 1990, and 8 percent and 10 percent annual deficits in simulated years 1989 and 1977, respectively. Viewed monthly, the 11 SCC alternative would result in 17 months of shortfalls greater than 10 percent in the two most recent droughts (Figure 5B-3).

Performance at Other Demand Levels

With a demand of 20,000 AF Cal-Am production, the 11 SCC alternative would result in adequate supply at all times, except for a 5 percent annual shortfall in simulated year 1990. This is similar to the 9 percent annual deficit that would occur in 1990 with the No Project alternative. If buildout demand increased to 24,670 AF Cal-Am normal year annual production, the 11 SCC alternative would result in adequate supply in all simulated water years except for five: 1961, 1977, 1978, 1989 and 1990. This indicates that performance would be poor in any significant drought at this demand level. There would be 28 months of shortfalls during these five years, and supply would fall short of demand by 35 percent in simulated water year 1990.

Assessment

Construction of the 11 SCC alternative would result in some water supply benefits compared to the existing situation, the No Project and the FRB. At buildout, there would be shortfalls in droughts like the 1976-77 and 1988-90 events, but they would be about half of what has been historically required. Even at lower levels of demand (20,000 AF), shortfalls similar to the No Project would occur in a drought like 1988-90, but the 11 SCC would provide protection in a shorter drought such as the 1976-77 event.

At a buildout demand of 23,080 AF Cal-Am normal year production, the 11 SCC alternative would result in a 26 percent annual shortfall in simulated water year 1990, as well as 10 percent and 8 percent shortfalls in 1977 and 1989, respectively. During the Part II alternatives evaluation process (see Chapter 3), the District Board approved a standard that no project should result in more than a 25 percent annual shortage. Because the 11 SCC results in a 26 percent shortage in water year 1990, this is considered inadequate performance. The above data indicate that this alternative offers modest drought protection – shortfalls would be reduced from current levels, but they would not be eliminated.

If the measures described in Section 5B.1 to reduce shortages were applied to the 11 SCC alternative, the shortfall could be reduced to an acceptable level. However, the cost of a larger-sized dam or a desalination component would be prohibitive.

5B.7 10,500 AF CHUPINES CREEK RESERVOIR (10 CHU)

Performance at Buildout

Project Benefits and Drought Reserve. At a buildout demand of 23,080 AF Cal-Am production and no rationing, the 10,500 AF Chupines Creek Reservoir would provide water supply benefits when compared to the Future Reference Baseline. The 10 CHU alternative would result in 18 percent more yield than the FRB in the 1976-78 period, but only 5 percent more in the 1988-90 event.

As shown in Table 5B-1, the drought reserve at the end of the simulated 1976-77 event would be about 8,300 AF, or about 36 percent of a normal year's water use at buildout. A reserve of about 5,400 AF, or about 23 percent of buildout demand, would remain if the simulated 1988-90 drought ended in September 1990. It should be noted that nearly all of this reserve would be in upper Carmel Valley, where facilities are presently inadequate to extract it rapidly for use in a drought.

Supply in Droughts. As shown in Table 5B-1, the average yield from the 10 CHU alternative would provide 93 percent of average demand in the 1976-78 period and 87 percent of average demand in the 1988-90 period. Three annual shortfalls greater than 1,000 AF would occur in the simulated 89 years of record. With no voluntary or mandatory demand reductions, shortfalls would total about 7,250 AF and 2,450 AF in simulated water years 1990 and 1977, respectively. In addition, a 2,300 AF shortfall would occur in simulated water year 1989. These correspond to a 30 percent annual deficit in simulated year 1990, and 10 percent annual deficits in both simulated years 1989 and 1977. Viewed monthly, the 10 CHU project would result in 18 months with shortages greater than 10 percent in the two most recent droughts (Figure 5B-4).

Performance at Other Demand Levels

With a demand of 20,000 AF Cal-Am production, the 10 CHU would result in adequate supply at all times, except for a 7 percent annual shortfall in simulated year 1990. This is similar to the 9 percent annual deficit that would occur in 1990 with the No Project. If buildout demand increased to 24,670 AF Cal-Am normal year annual production, the 10 CHU would result in adequate supply in all simulated water years except for five: 1961, 1977, 1978, 1989 and 1990. This indicates that performance would be poor in any substantial drought at this demand level. There would be 31 months of significant shortfalls in these five years, and the annual yield would fall short of supply by 39 percent in simulated water year 1990.

Assessment

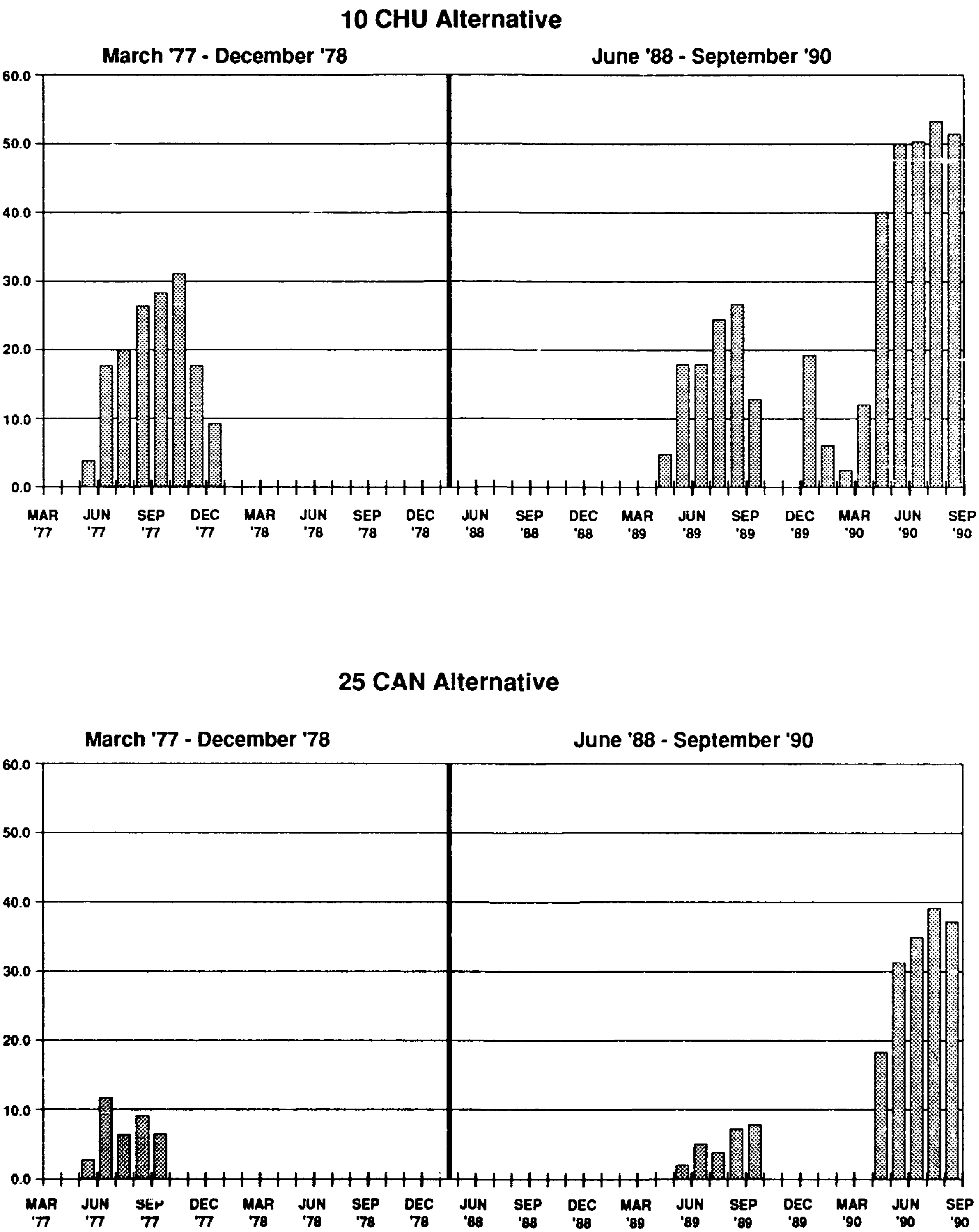
Construction of the 10 CHU alternative would result in some water supply benefits compared to the existing situation, the No Project alternative, and the FRB. At buildout, there would be shortfalls in droughts like the 1976-77 and 1988-90 events, but they would be about half of what has been historically required. Even at lower levels of demand (20,000 AF), shortfalls similar to the No Project alternative would occur in a drought like 1988-90, but the 10 CHU alternative would provide protection in a shorter drought such as the 1976-77 event.

At a buildout demand of 23,080 AF Cal-Am normal year production, the 10 CHU would result in a 30 percent annual shortfall in simulated water year 1990, as well as 10 percent shortfalls in 1977 and 1989. During the Part II alternatives evaluation process (see Chapter 3), the District Board approved a standard that no project should result in more than a 25 percent annual shortage.

MONTHS OF SHORTAGES & PERCENT SHORTFALL IN TWO DROUGHTS
AT BUILDOUT -- 23,000 AF CAL-AM PRODUCTION

FIGURE 5B-4

Analysis assumes NO rationing or demand management.



Because the 10 CHU results in a 30 percent shortage in water year 1990, this is considered inadequate performance. The above data indicate that this alternative offers modest drought protection – shortfalls would be reduced from current levels, but they would not be eliminated. If the measures described in Section 5B.1 to reduce shortages were applied to the 10 CHU alternative, the shortfall could be reduced to an acceptable level. However, the cost of a larger-sized dam or a desalination component would be prohibitive.

5B.8 25,000 AF CAÑADA RESERVOIR (25 CAN)

Performance at Buildout

Project Benefits and Drought Reserve. At a buildout demand of 23,080 AF Cal-Am production and no rationing, the 25,000 AF Cañada Reservoir would provide water supply benefits when compared to the Future Reference Baseline. The 25 CAN would result in 25 percent more yield than the FRB in the 1976-78 period, and 13 percent more in the 1988-90 event.

As shown in Table 5B-1, the drought reserve at the end of the simulated 1976-77 event would be about 14,470 AF, or about 63 percent of a normal year's water use at buildout. A reserve of 6,745 AF, or about 29 percent of buildout demand, would remain if the simulated 1988-90 drought ended in September 1990.

Supply in Droughts. As shown in Table 5B-1, the average yield from the 25 CAN alternative would provide 98 percent of average demand in the 1976-78 period and 94 percent of average demand in the 1988-90 period. Only one annual shortfall greater than 1,000 AF would occur in the simulated 89 years of record. With no voluntary or mandatory demand reductions, it would total about 4,000 AF in simulated water year 1990, which corresponds to a 17 percent annual deficit. Viewed monthly, the 25 CAN would result in six months of significant shortfalls (greater than 10 percent) in the two most recent droughts (Figure 5B-4).

Performance at Other Demand Levels

With a demand of 20,000 AF Cal-Am production, the 25 CAN would result in adequate supply at all times. It would provide benefits compared to the No Project, which would entail 9 percent shortfall in simulated years 1990 and 1977. If buildout demand increased to 24,670 AF Cal-Am normal year annual production, the 25 CAN would result in adequate supply in all simulated water years except for five: 1961, 1977, 1989 and 1990. This indicates that performance would be poor in any significant drought at this demand level. There would be 17 months of significant shortfalls during these five years, and supply would fall short of demand by 25 percent in simulated water year 1990.

Assessment

Construction of the 25 CAN alternative would result in water supply benefits compared to the existing situation, the No Project, and the FRB. At buildout, there would be minor shortfalls in droughts like the one in 1976-77, significantly less rationing in a drought like the one in 1976-77, and significantly less rationing in a drought like the 1988-90 event. Drought reserves in most years would be significantly higher due to the addition of the 25,000 AF reservoir to the resource system.

At a buildout demand of 23,000 AF Cal-Am normal year production, the 25 CAN would result in a 17 percent annual shortfall in simulated water year 1990. Water year 1990 would be the only year in 89 years that would result in a simulated shortfall greater than 10 percent. The measures described in Section 5B.1 to reduce annual shortages would apply to the 25 CAN alternative, although specific numerical values would differ.

5B.9 7 MGD DESALINATION FACILITY (7 DSL)

Performance at Buildout

Project Benefits and Drought Reserve. At a buildout demand of 23,080 AF Cal-Am production and no rationing, the 7 MGD desalination Plant would provide water supply benefits when compared to the future reference baseline, more than any other alternative. The 7 DSL alternative would result in 27 percent more yield than the FRB in the 1976-78 period and 21 percent more in the 1988-90 event. Performance would be similar to the large mainstem dams for the simulated 1976-77 drought, but significantly better in the 1988-90 event.

As shown in Table 5B-1, the drought reserve at the end of the simulated 1976-77 event would be about 12,400 AF, or about 54 percent of a normal year's water use at buildout. A reserve of about 17,000 AF, or about 73 percent of buildout demand, would remain if the simulated 1988-90 drought ended in September 1990. This amount would be more than any other alternative.

Supply in Droughts. As shown in Table 5B-1, the average yield from the 7 DSL alternative would provide 100 percent of average demand in the 1976-78 period and 100 percent of average demand in the 1988-90 period. There would be no annual or monthly shortfalls in the simulated 89 years of record (Figure 5B-5).

Performance at Other Demand Levels

With a demand of 20,000 AF Cal-Am production, the 7 DSL would result in adequate supply at all times, and would provide benefits in droughts. If buildout demand increased to 24,670 AF Cal-Am normal year annual production, the 7 DSL would continue to provide adequate supply with no annual shortfalls greater than 1,000 AF in any year. Only four months of shortfall averaging a 6 percent deficit would occur in simulated year 1977.

Assessment

Construction of the 7 DSL alternative would result in water supply benefits compared to the existing situation, the No Project alternative, and the FRB. At buildout, there would be no significant shortfalls in any drought. The ability of the 7 DSL alternative to provide water independent of rainfall is the key to its superior performance in sustained droughts.

5B.10 NO PROJECT (NO PRJ) (Demand Limited to 20,000 AF)

Performance at 20,000 AF

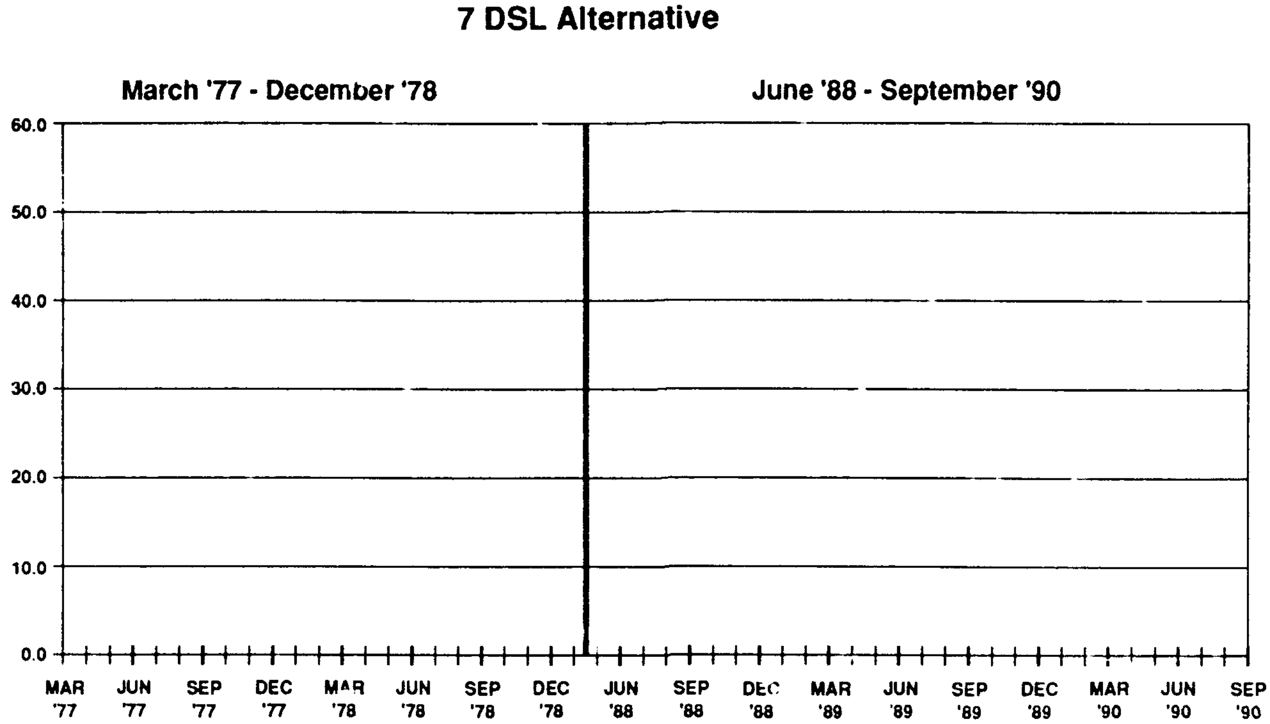
Project Benefits and Drought Reserve. This alternative differs from those discussed above because demand is limited to 20,000 AF Cal-Am production rather than the buildout demand of 23,080 AF. Recall that the No Project alternative entails increased pumping capacity via new wells in Seaside. With limited demand and no rationing, the No Project alternative would provide some water supply benefits when compared to the Future Reference Baseline. Its benefits would be (at most) about one-third that of a large mainstem dam or desalination plant. Even with its reduced demand, the No Project alternative results in 4 percent more yield than the FRB in the 1976-78 period, and only 1 percent more in the 1988-90 event.

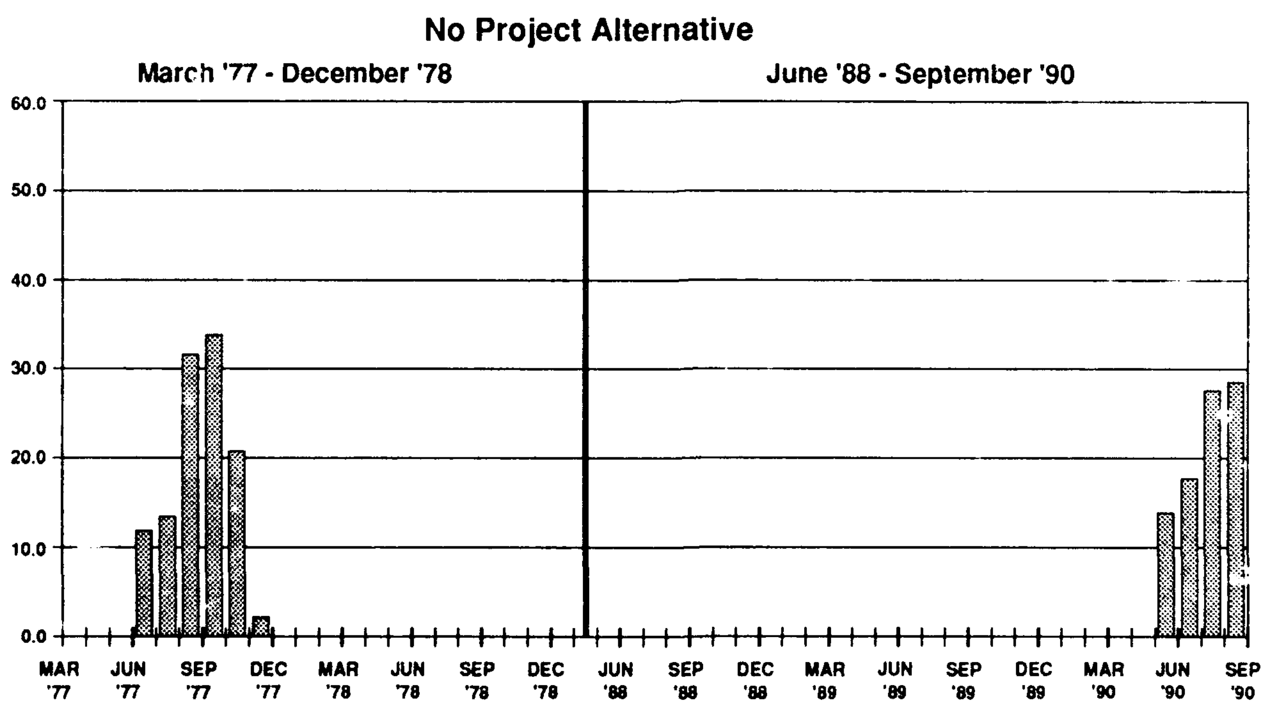
Data on the No Project performance is summarized in Table 5B-1. It should be noted, however, that it is not directly comparable to the other alternatives because its demand is 3,000 AF less than

MONTHS OF SHORTAGES & PERCENT SHORTFALL IN TWO DROUGHTS
AT BUILDOUT -- 23,000 AF CAL-AM PRODUCTION

FIGURE 5B-5

Analysis assumes NO rationing or demand management.





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buildout demand of 23,080 AF. The drought reserve at the end of the simulated 1976-77 event would be about 8,400 AF, which is about 42 percent of the 20,000 AF of demand for the No Project alternative. A reserve of over 7,100 AF, or about 36 percent of the 20,000 AF No Project demand, would remain if the simulated 1988-90 drought ended in September 1990.

Supply in Droughts. Using a normal year demand of 20,000 AF as a base, the average yield from the No Project alternative would provide 94 percent of average demand in the 1976-78 period and 97 percent of average demand in the 1988-90 period (Table 5B-1). Two annual shortfalls greater than 1,000 AF would occur in the simulated 89 years of record. With no voluntary or mandatory demand reductions and a normal year demand of 20,000 AF, shortfalls would total about 1,900 AF and 1,850 AF in simulated water years 1977 and 1990, respectively. These correspond to 9 percent annual deficits in both years. Viewed monthly, the No Project alternative would result in nine months of shortfalls greater than 10 percent in the two most recent droughts (Figure 5B-5).

Performance at Other Demand Levels

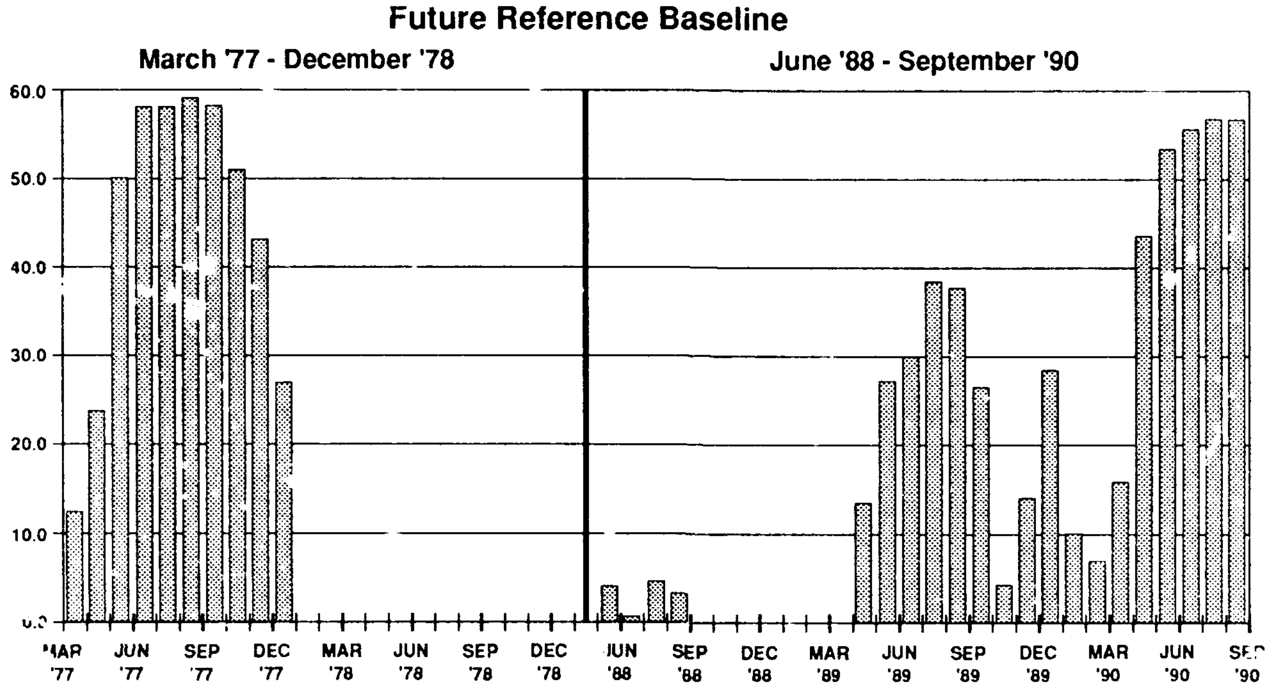
In essence, the No Project alternative becomes the Future Reference Baseline (FRB) when its facilities are analyzed at buildout demand levels (see Table 5B-1). At a demand of 23,080 AF Cal-Am production and no rationing, six years with significant annual shortfalls would occur in the simulated 89-year period. The 35 percent and 32 percent annual deficits in simulated 1990 and 1977, respectively, would be onerous. The annual deficits for the other four water years would range from 7 percent to 15 percent. Nearly one-half of the 25 months with shortages greater than 10 percent would have deficits over 40 percent in the previous two droughts (Figure 5B-6).

As shown in Table 5B-1, the drought reserve for the FRB at the end of the simulated 1976-77 event would be about 29 percent of a normal year's water use at buildout. A reserve of about 23 percent would remain if the simulated 1988-90 drought ended in September 1990. It should be noted that the Seaside Coastal basin as well as Carmel Valley Aquifer Subunits 3 and 4, where most production wells occur, would be drained in this scenario. The FRB reserve is found only in Aquifer Subunits 1 and 2, where current pumping capacity is inadequate to meet daily or monthly demand in a drought. New wells would need to be drilled to extract sufficient quantities of water to meet daily demand.

MONTHS OF SHORTAGES & PERCENT SHORTFALL IN TWO DROUGHTS
AT BUILDOUT -- 23,000 AF CAL-AM PRODUCTION

FIGURE 5B-6

Analysis assumes NO rationing or demand management.



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If demand increased to 24,670 AF Cal-Am production, significant (and sometimes severe) shortfalls would occur during every drought event. Twelve out of 89 simulated years (about one in seven) would have annual deficits averaging 15 percent. The simulated annual shortfalls in 1990 and 1977 would be 41 percent and 40 percent, respectively, including 17 months with deficits in the 40 to 70 percent range.

Assessment

Construction of the No Project facilities (increased pumping capacity in Seaside) and limiting demand to 20,000 AF normal year Cal-Am production would result in some water supply benefits compared to the existing situation. There would be annual shortfalls in droughts like the 1976-77 and 1988-90 events, but they would not exceed 10 percent.

At a buildout demand of 23,080 AF Cal-Am normal year production, the No Project facilities would result in onerous annual shortfalls in all droughts that entail two or more sequential critically dry years. This would be considered unacceptable performance in terms of water supply.

The No Project and FRB data provided above reflect the existing understanding of the local water resource system – in most years, more than adequate rainfall and runoff meet community water demand. However, in a series of two or more critically dry years, shortages rapidly develop due to inadequate water storage and production facilities. Monthly and annual shortages would reach unacceptable levels that would be difficult, if not impossible, to reduce with demand management.

Many of the measures described in Section 5.B.1 to reduce shortages would not apply to the No Project alternative, as it is defined with specific demand limits and facilities (any additional facilities would constitute a "project"). Even the addition of new wells in upper Carmel Valley would not provide enough supply to reduce the shortfall to less than significant levels. It also should be noted that limiting demand contradicts the basic project purpose of providing adequate water supply for planned growth.

SUMMARY

The water supply analysis indicates that the alternatives mainly provide drought protection. In normal and wet years, more than adequate supply is available from the resource system to meet community needs, even at buildout demand levels. However, in two or more sequential drought years, shortages currently develop rapidly due to lack of adequate storage or production facilities. The record in the past 100 years shows numerous instances of multi-year droughts, some lasting five or more years.

If normal year Cal-Am demand increased from the present level of about 17,000 AF production to 20,000 AF, all alternatives except for Chupines Creek Reservoir, San Clemente Creek Reservoir and the No Project would provide adequate supply at all times.

If normal year demand reached buildout levels, estimated at 23,080 AF, various alternatives would provide modest to substantial benefits when compared to the existing situation. The District computer simulations, which result from the specific size and operations coded for each alternative, indicate that the best performer in terms of water supply alone is the 7 MGD desalination plant. There would be no annual shortages greater than 1,000 AF under any condition or demand level with this alternative due to its independence of rainfall. The feasibility of desalination in the greater Monterey Peninsula is presently being confirmed by the District.

The 16 NLP/D and 9 NLP/D alternatives, along with the three largest dams (24 NLP, 23 NSC and 25 CAN), provide water supply benefits, but not to the same degree as the 7 MGD desalination facility.

Performance of the 6,000 AF Cachagua Creek Reservoir, even though it is combined with a 3 MGD desalination plant, would provide moderate supply benefits at buildout. Its size is limited by lack of natural inflow. An increased reservoir size and pumped storage from Los Padres Dam would improve performance, but the economic feasibility of these measures is questionable.

Chupines and San Clemente Creek Reservoirs, which already entail pumped storage, provide modest benefits over the existing situation. Performance is less than satisfactory as these reservoirs perform similarly to the No Project at 20,000 AF of demand, and result in annual shortages greater than 25 percent at buildout demand levels. Performance could be improved if these reservoirs were combined with a desalination plant, but the economic feasibility of this measure is questionable.

The No Project, which entails additional pumping capacity in the Seaside Coastal area in addition to a Cal-Am production limit of 20,000 AF/year, provides acceptable performance at the 20,000 AF level. It should be noted that the No Project does not meet the basic project purpose of drought protection and water supply for planned growth. If demand increased toward buildout levels with the No Project facilities, significant shortfalls would occur during every multi-year dry period.

MONTEREY PENINSULA WATER MANAGEMENT DISTRICT

TECHNICAL MEMORANDUM 90-01

SPAWNING HABITAT MITIGATION PLANS FOR

ALTERNATIVE WATER SUPPLY PROJECTS IN THE CARMEL RIVER BASIN

Prepared By
David H. Dettman
AUGUST 1990

INTRODUCTION

The Monterey Peninsula Water Management District is analyzing the impact of several alternative water supply projects on the steelhead resource in the Carmel River Basin, and preparing preliminary mitigation plans for each alternative. Several alternative projects will inundate or block steelhead spawning habitat. The amount of spawning habitat impacted by construction of projects ranges from zero with Canada Reservoir to about 14,800 square feet with San Clemente Creek Reservoir.

OBJECTIVE

The objectives of this memorandum are: (1) to describe the quantity, quality and location of existing and potential spawning habitat in the Carmel River between the confluence with Tularcitos Creek at rivermile 15.9 (RM 15.9) and Los Padres Dam (RM 23.5); (2) to describe the effects of each water supply alternative on spawning habitat, and (3) to develop mitigation measures for alternatives that inundate or block spawning habitat. The mitigation measures include: an initial placement of spawning sized gravel at specific locations; subsequent injection of gravel at several locations during storm flows; and periodic monitoring of spawning habitat to insure enough is maintained to compensate for losses.

BACKGROUND

The California Department of Fish and Game (CDF&G), the National Marine Fisheries Service (NMFS) and the United States Fish and Wildlife Service (USFWS) will require at least full mitigation for any steelhead spawning habitat inundated or blocked by a water supply project.

In the Carmel River Basin three practicable approaches exist for mitigating the loss of steelhead spawning habitat. First,spawning habitat can be increased by adding gravel to spawning glides where the habitat is limited by insufficient amounts of appropriately sized gravel. Second, in some years, projects with storage above spawning habitat can provide optimum flows which produce the maximum amount of spawning. Third, natural or manmade barriers, which block adults from reaching potential spawning habitat, can be modified to open additional areas for spawning and rearing steelhead.

HYDRAULIC AND SUBSTRATE CONDITIONS INFLUENCING SPAWNING HABITAT

In central coastal California streams adult steelhead usually spawn in "glide habitat", which is the transition between pools and riffles. This portion of the stream is relatively stable during the winter because fine sediment tends to be scoured away and suitable gravel tends to be deposited on ascending and descending flows. Water depth is sufficient to provide space for spawning adults and highly oxygenated water exists for incubating eggs. Yet, velocities are not so high as to sweep adults and eggs downstream. In small tributaries of the Carmel Basin and within some riffles in the mainstem Carmel River, steelhead probably spawn in small pockets of gravel, particularly where large boulders create local conditions that match hydraulic conditions at the transition of pools and riffles.

DISTRIBUTION AND EXTENT OF SPAWNING GLIDES

Kelley and Dettman (1982) mapped the distribution of spawning glides in the mainstem of the Carmel River, downstream of San Clemente Dam, upstream of Los Padres Dam and in portions of Cachagua and Danish Creeks. During spring 1989 the location of spawning glides in the mainstem between San Clemente and Los Padres Dams and several other tributaries were mapped to assess the impacts of the proposed New Los Padres and San Clemente Creek Dams.

Table 1 lists spawning habitat area in the mainstem and in smaller tributaries affected by alternative water supply projects. Figures 1, 2 and 3 illustrate the existing distribution of the principal spawning glides in the mainstem between Los Padres Dam and San Clemente Reservoir and immediately below San Clemente Dam.

LIMITS TO SPAWNING HABITAT

Although adult steelhead can potentially use all glides, the actual spawning habitat is often limited by hydraulic factors (water depth and velocity) and by the extent and size distribution of gravel.

The Relationship Between Spawning Habitat and Streamflow

The streamflow over potential spawning glides influences the quality and quantity of spawning habitat by creating a mosaic of

Table 1 Summary of steelhead spawning habitat measured in 26 reaches of the Carmel River Basin upstream of Tularcitos Creek and estimates of spawning habitat in the Carmel River and selected tributaries upstream of Tularcitos Creek.

STREAM	REACH		Length of Reach (ft) [1]	Portion of Reach Surveyed (ft)	Spawning Habitat Measured in Portion of Stream Surveyed (sqft)	Estimate of Total Spawning Habitat in Reach (sqft)	Potential Number of Steelhead Nests (nos.)	Spawner Index (nos./mi)
Carmel River	The Narrows to Sleepy Hollow		57,750	57,750	45,445	45,445	909	166
	Sleepy Hollow to San Clemente Dam		7,000	5,350	1,864	2,439	49	74
		subtotal	64,750			47,884	958	156
	San Clemente Res. to Pine Creek		10,600	8,122	3,369	4,397	88	88
	Pine Creek to Syndicate Camp		5,350	5,478	2,482	2,482	50	98
	Syndicate Camp to Cachagua Creek		6,300	3,594	1,797	3,150	63	106
	Cachagua Creek to Los Padres Dam		6,300	6,503	722	722	14	24
		subtotal	28,550			10,751	215	80
	Danish Creek to Bluff Camp		7,200	5,171	7,480	10,415	208	306
	Bluff Camp to Bruce Fork		5,900	1,785	1,573	5,199	104	186
	Bruce Fk to trib. above Sulphur Sprgs.		3,850	1,828	2,987	6,291	126	345
	Trib. above Sulphur Spr to trib below Buckskin Camp		5,650	2,733	2,254	4,660	93	174
	Trib. below Buckskin Camp to rightbank trib. above Buckskin		4,350	1,811	6,826	16,396	328	796
	Rightbank trib above Buckskin Camp to trib below Benchmark 1743		4,750	3,234	10,557	15,506	310	689
	Tributary below Benchmark 1743 to Barrier above Ventana Mesa Creek		4,200	489	119	1,022	20	51
		subtotal	35,900			59,489	1,190	350
	Total Mainstem Carmel River		129,200	103,848	87,475	118,124	2,362	193
		(miles)	24.47	19.67				

1 From Dettman and Kelley (1986)

(Table 1. continued)

MILLER FORK	Confluence with Carmel River to meadow ~ 1 mile upstream	5,150	1,117	137	632	13	26
	Meadow to Clover Basin Camp	5,750	1,908	1,659	5,000	100	184
	Clover Basin Camp to Miller Canyon	2,850	1,503	698	1,324	26	98
	Miller Canyon Camp to probable migration barrier	17,300	1,201	50	720	14	9
	Subtotals Miller Fork Basin	31,050	5,729	2,544	7,675	154	52
	(miles)	5.88	1.09				
DANISH CREEK	Confluence with Carmel River to migration barrier	9,000	2,442	1,386	5,108	102	120
	(miles)	1.70	0.46				
CACHAGUA CREEK	From Carmel River to Conejo Creek	24,500	14,011	841	1,471	29	13
	Conejo Creek to Finch Creek	750	680	56	62	1	17
-Finch Creek	From James Creek to Big Creek	10,900	2,405	543	2,461	49	48
-James Creek	From Finch Creek to Lambert Ranch	5,600	451	34	422	8	16
	Subtotals Cachagua Creek Basin	41,750	17,547	1,474	4,416	88	22
	(miles)	7.91	3.32				
SAN CLEMENTE CREEK	San Clemente Reservoir to Trout Pond Dam	9,000	?	?	3,906	78	92
	Trout Pond Reservoir to Black Rock Creek	3,450	2,315	1,005	1,498	30	92
	Confluence with Blk Rk Crk to end of permanent flow	9,750	669	161	2,346	47	51
-Black Rock Creek	Confluence with San Clemente Creek to confluence of North and South Forks	3,450	1,460	410	969	19	59
--No.Fork Black Rock Cr	Confluence with South Fork to permanent barrier at White Rock Dam	12,350	1,494	184	1,522	30	26
	Subtotals San Clemente Creek Basin	38,000			10,241	205	57
	(miles)	7.20					

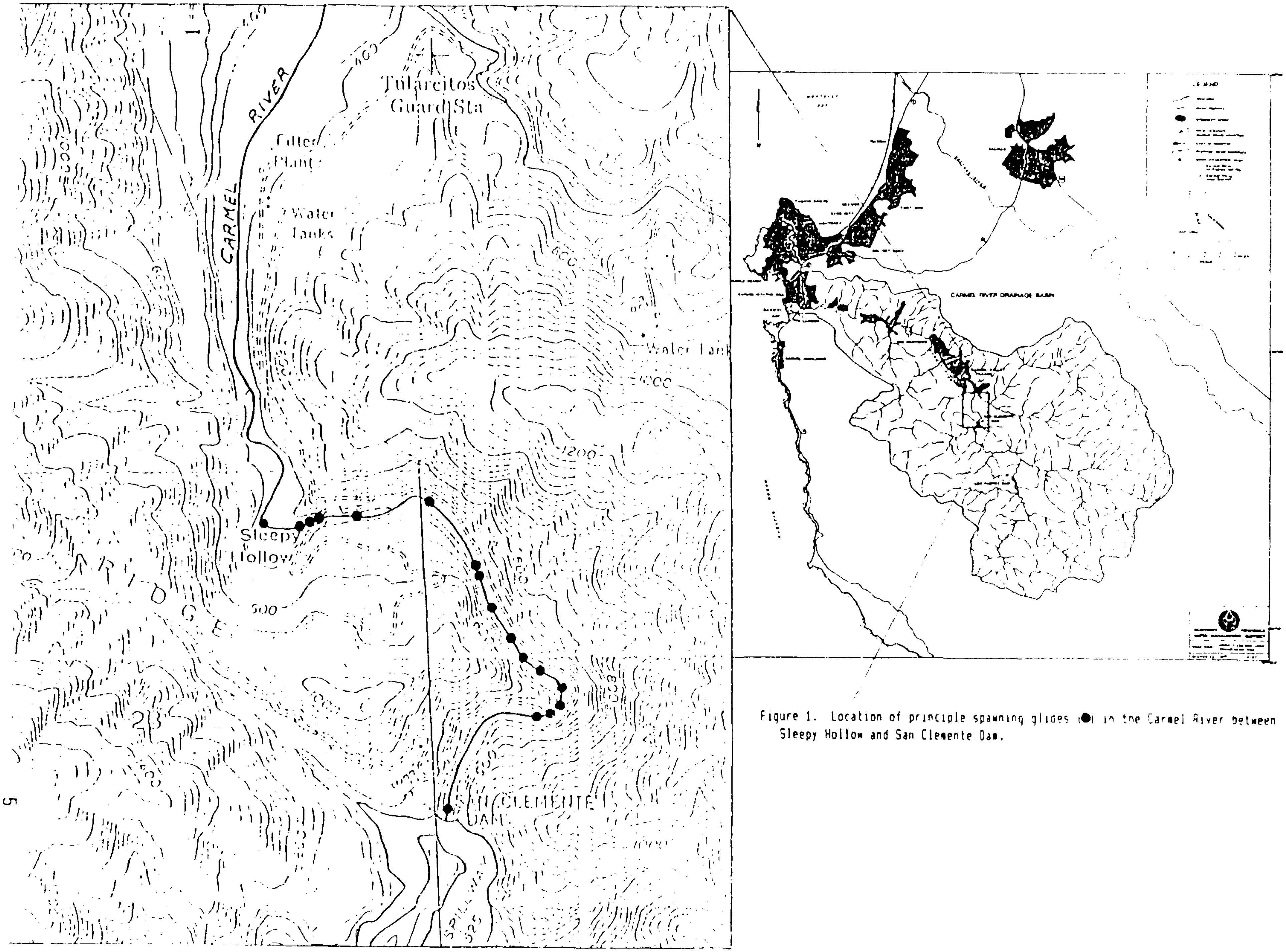


Figure 1. Location of principle spawning glides (●) in the Carmel River between Sleepy Hollow and San Clemente Dam.

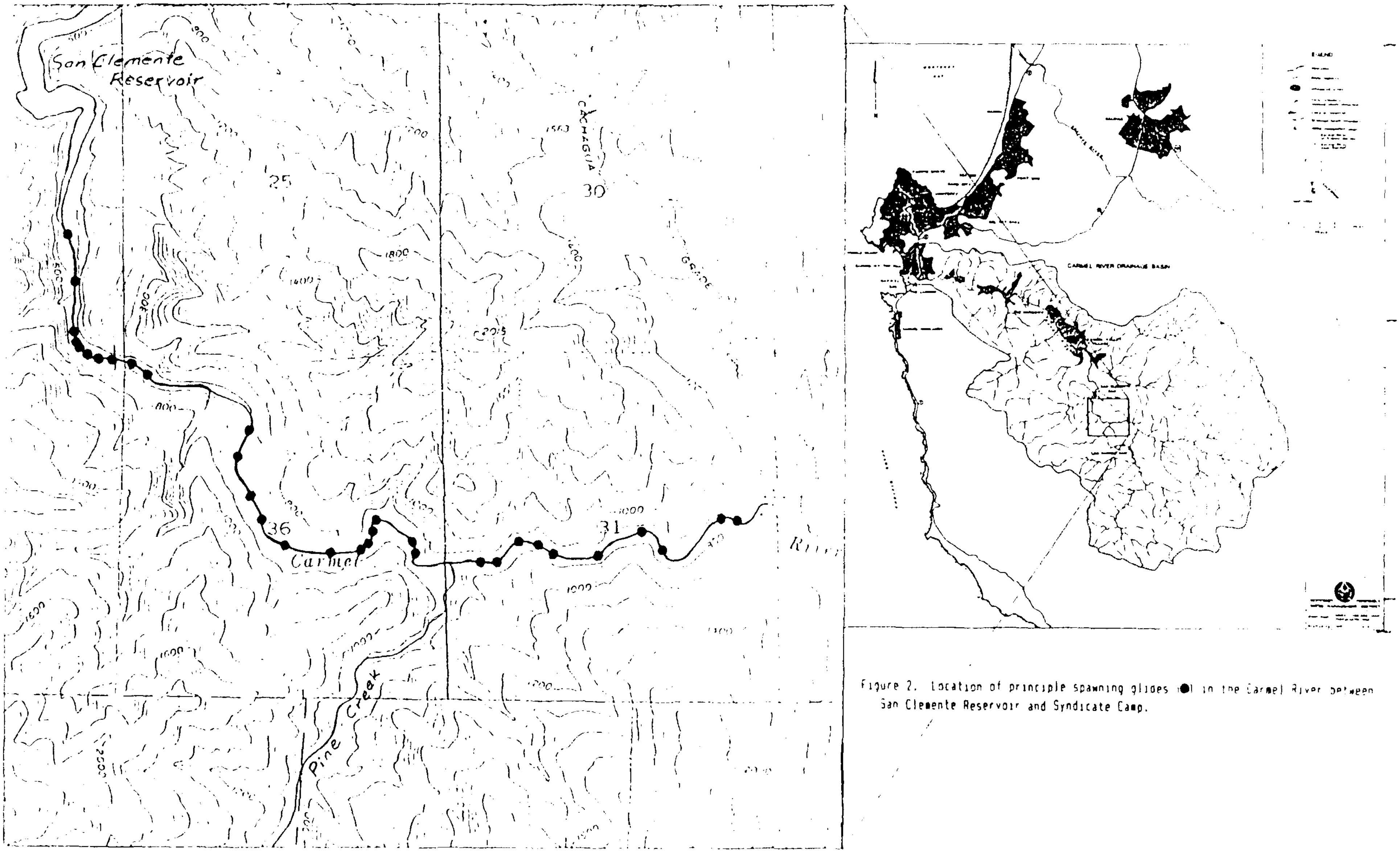


Figure 2. Location of principle spawning glides (●) in the Carmel River between San Clemente Reservoir and Syndicate Camp.

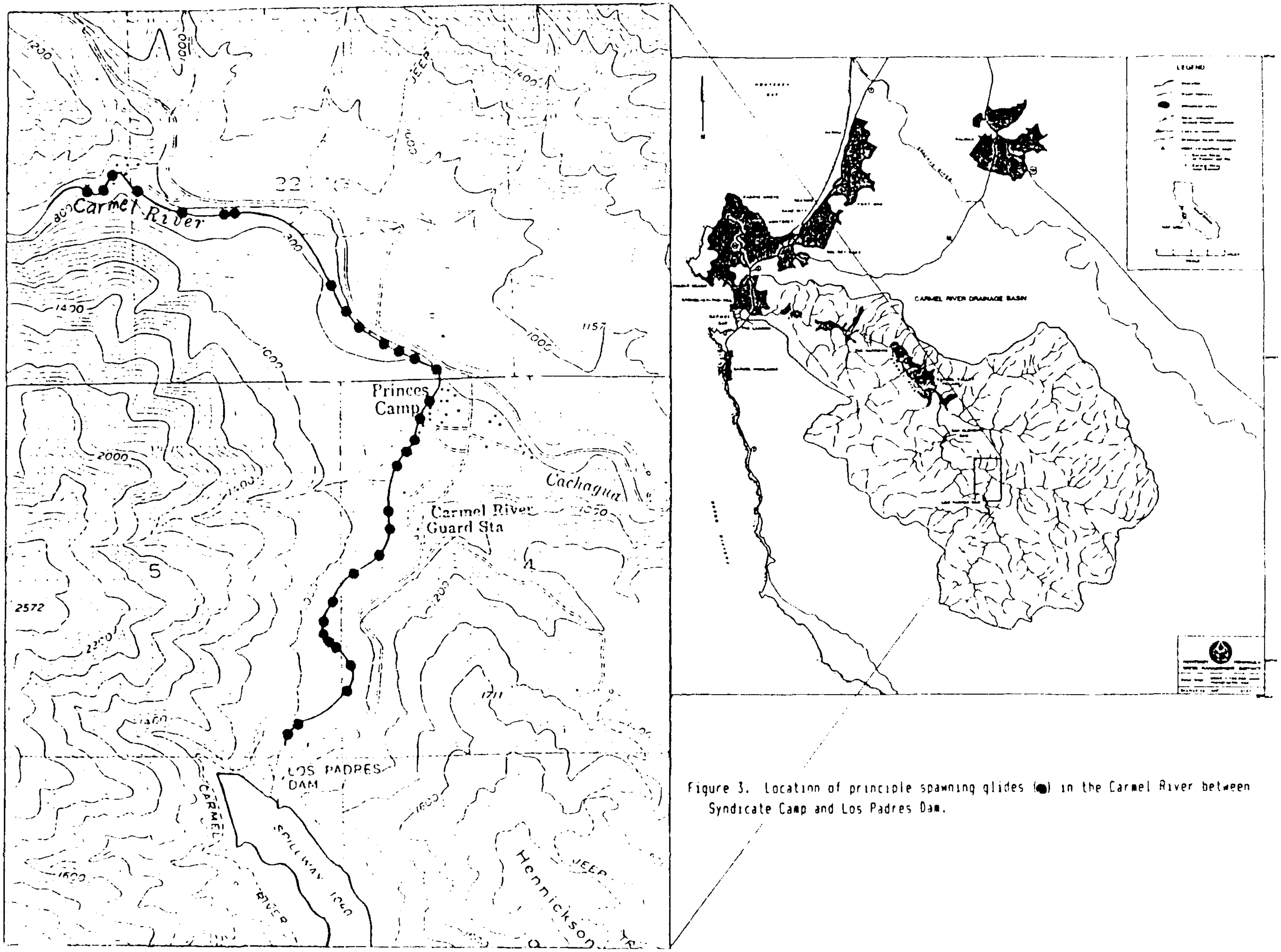


Figure 3. Location of principle spawning glides (●) in the Carmel River between Syndicate Camp and Los Padres Dam.

depths and velocities across the stream channel. Spawning females select an appropriate combination of depth, velocity, and substrate conditions which allow them to construct and nest. As flows change, a greater or less portion of the channel i covered with the appropriate combination of depth, velocity, and suitably sized gravel.

The influence of streamflow on spawning habitat in the Carmel River was studied by Nakaji (1980), Kelley and Dettman (1986), and Alley, Hoefler and Mori (1990). Nakaji (1980) applied the USFWS Instream Flow Incremental Method (IFIM) in two reaches of the river below San Clemente Dam and estimated Weighted Usable Spawning Area (WUA) at flows ranging from 30 to 400 (Figure 4). Based on this study the USFWS recommended a flow of 200 cfs during the January through March period to provide near maximum spawning habitat.

Dettman and Kelley (1986) developed criteria for evaluating spawning habitat, based on observations of spawning steelhead, and applied an alternative method for evaluating the influence of streamflow. They estimated the square footage of spawning habitat in the mainstem between the Narrows and San Clemente Dam at flows ranging from 40 to 150 cfs (Figure 5). Based on this study Dettman and Kelley concluded that a flow of 75 cfs during the January through March period would provide spawning habitat for 200 female steelhead, habitat for incubating eggs, and enough swim-up fry to fully seed the river below San Clemente Dam with young-of-the-year.

Alley, Hoefler, and Mori (1990) applied the USFWS IFIM to the Carmel River between San Clemente and Los Padres Reservoirs and estimated WUA in three reaches at flows ranging from 5 to 200 cfs (Figure 6). This study indicates at least 90 percent of maximum amount of spawning habitat in the Carmel River between the dams is produced at flows ranging from 90 to 135 cfs. The results indicate the optimum spawning flow is about 120 cfs, but that only one-third of the potential spawning habitat is produced at the optimum flow because the streambed is too coarse.

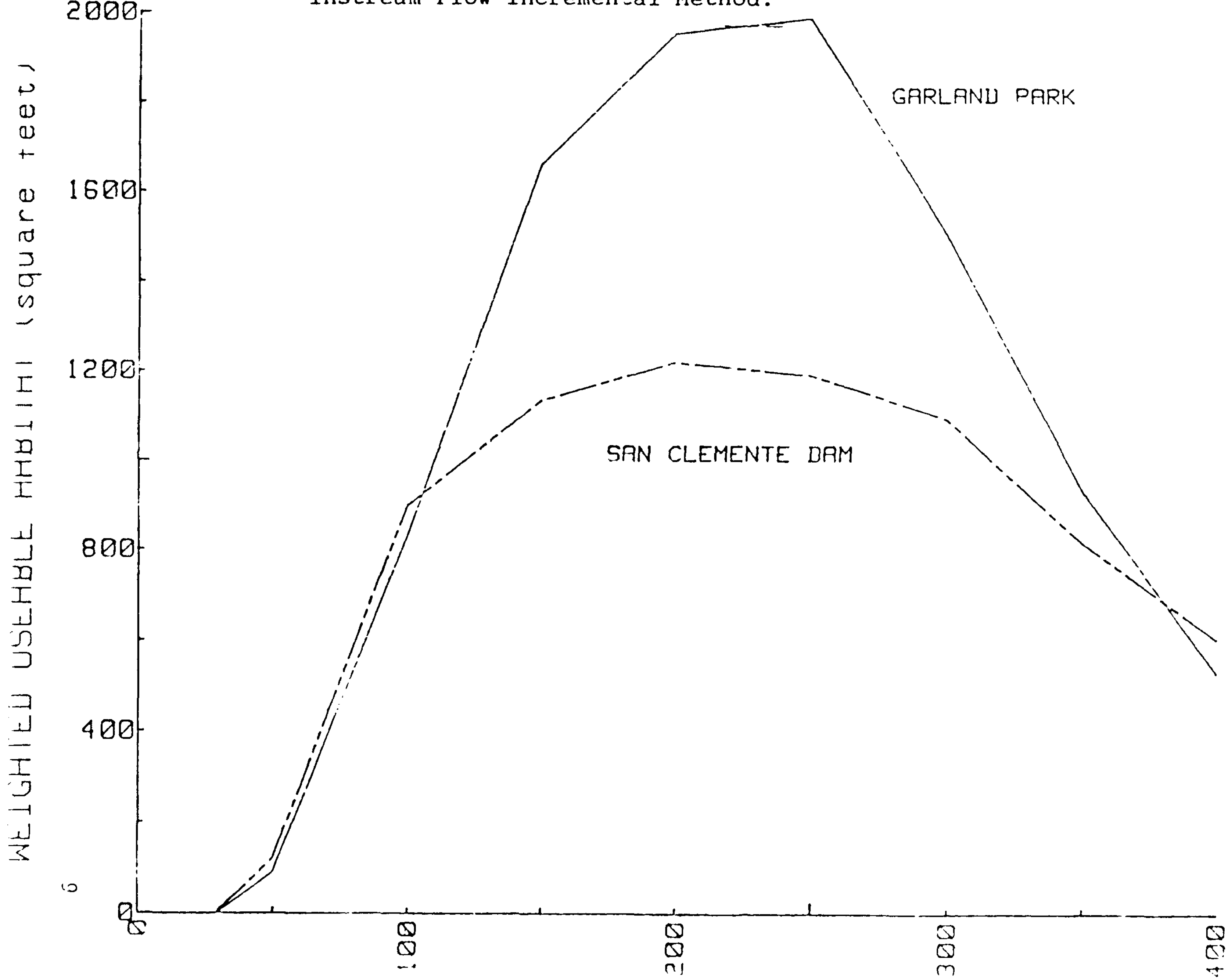
The Influence of Substrate Conditions On Spawning Habitat

The depth and velocity of water over glides can be within suitable ranges, yet steelhead do not use the glide for spawning, or only use a portion of the glide. Common reasons for this are that the size of gravel is outside suitable limits and that insufficient gravel is available to fully cover the bottom of the stream. Both of these problems occur in the Carmel River, particularly below Los Padres and San Clemente Dams where the recruitment of spawning gravel has been blocked by the existing dams.

Size of Suitable Gravel

Dettman and Kelley (1986) investigated the size of gravel utilized by steelhead by sampling undisturbed gravel immediately

Figure 4. Relationship between Weighted Useable Spawning Habitat Area and streamflow in the Carmel River at Garland Park and below San Clemente Dam. From Nakaji (1982) and based on application of the United States Fish and Wildlife Service Instream Flow Incremental Method.



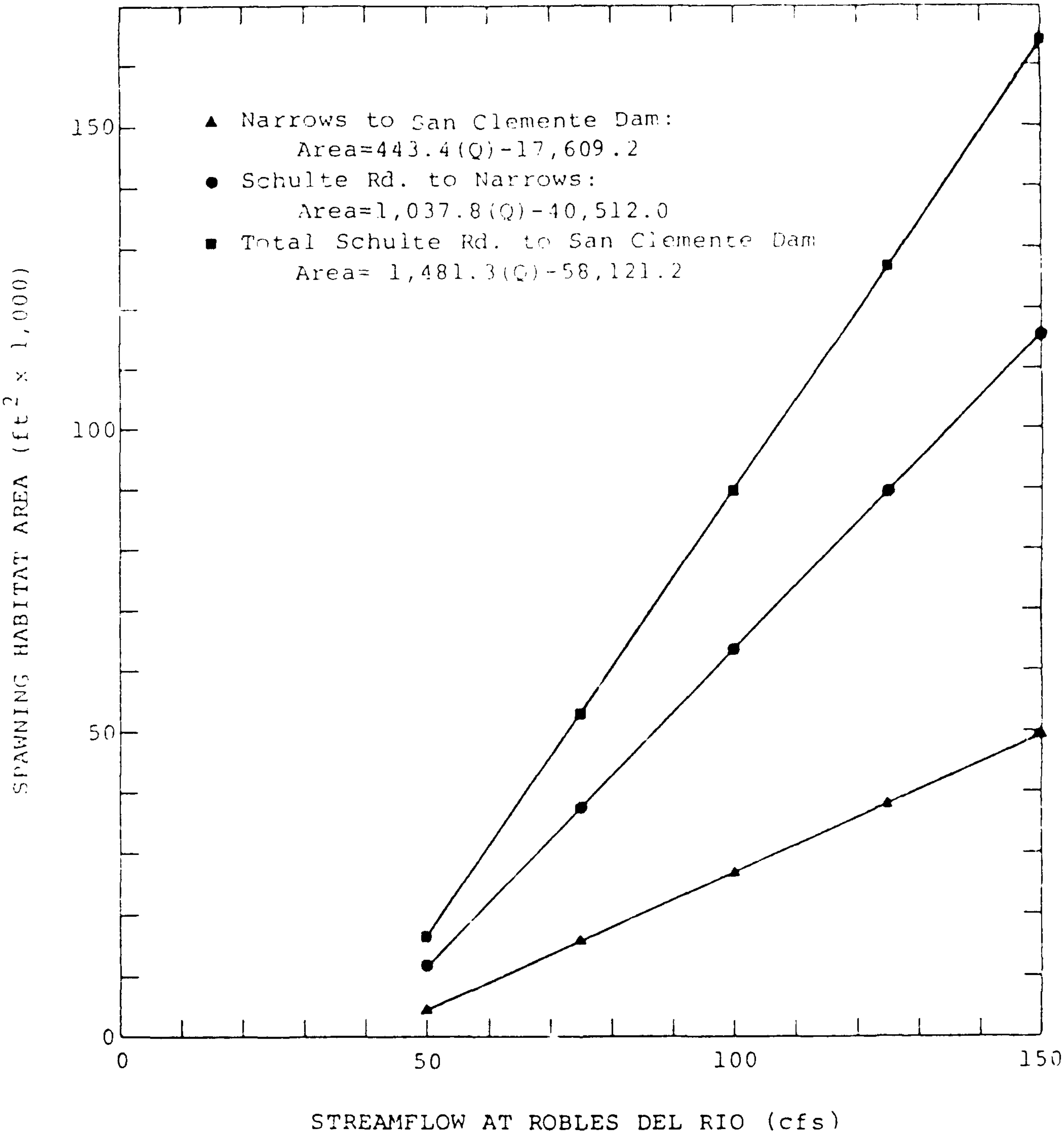


Figure 5. Relationship between steelhead spawning habitat area and streamflow in the Carmel River during 1982. Streamflow measured at Robles del Rio USGS gaging station. From Dettman and Kelley (1986).

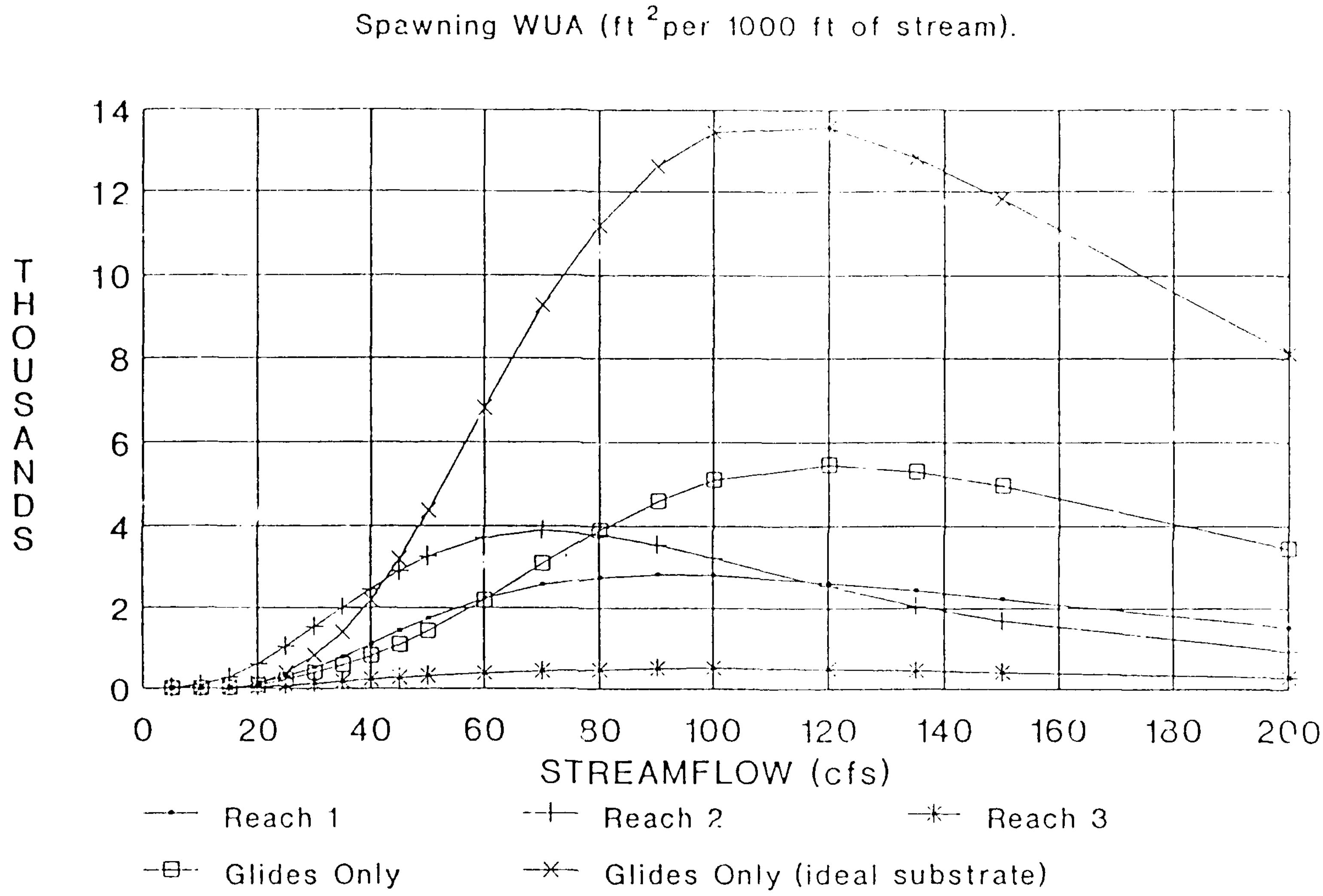


Figure 6. Steelhead Habitat, Carmel River, Composite Weighted Useable Area (WUA) from hydraulic simulations with appropriate weighting factors. From Alley, Hoefler, and Mori (1990).

adjacent to freshly built nests in the Carmel River between Robinson Canyon and San Clemente Dam. Figure 7 illustrates the size range of gravel utilized by steelhead in the Carmel River. This size range is similar to ranges found in other steelhead streams throughout California and the Pacific Northwest.

Size of Substrate Material in Spawning Glides Below Los Padres and San Clemente Dams

During spring 1989 D. W. Kelley and Associates sampled gravel in the Carmel River between San Clemente and Los Padres Dams and between Tularcitos Creek and San Clemente Dam to assess whether spawning habitat is limited by the size of gravel. After mapping the location of spawning glides, seven were selected in the reach between the dams, including glides used to develop estimates of WUA with the IFIM applied by Alley, Hoefler, and Mori (1990). Between Sleepy Hollow and San Clemente Dam five glides were randomly selected to represent conditions between Tularcitos Creek and San Clemente Dam. At each glide four transects were placed across the stream in a X-shaped pattern. To approximate the location where adult steelhead spawn, transects were placed within 25 feet of the hydraulic break between the glide and riffle. This guideline was developed by biologist Paul Bratovich, who found that 90 percent of the steelhead and salmon in Lagunitas Creek (Marin County) spawned just upstream of the glide-riffle break (Bratovich and Kelley, 1988). To characterize the size of substrate in potential spawning glides, the median diameter of substrate particles was measured and classified into following metric size classes:

2-4 mm
4-5.6 mm
5.6-8 mm
8-11 mm
11-16 mm
16-22 mm
22-32 mm
32-45 mm
45-64 mm
64-90 mm
90-128 mm
128-180 mm
180-256 mm
256-360 mm
360-512 mm
512-720 mm
> 720 mm

Figures 8 and 9 illustrate and Tables 2 - 5 list the size distribution of gravel in potential spawning glides between the dams and immediately below San Clemente Dam. Most of the substrate in spawning glides is comprised of cobble and larger sized material. A comparison of these distributions with the distribution of gravel used by steelhead (Figure 7) indicates

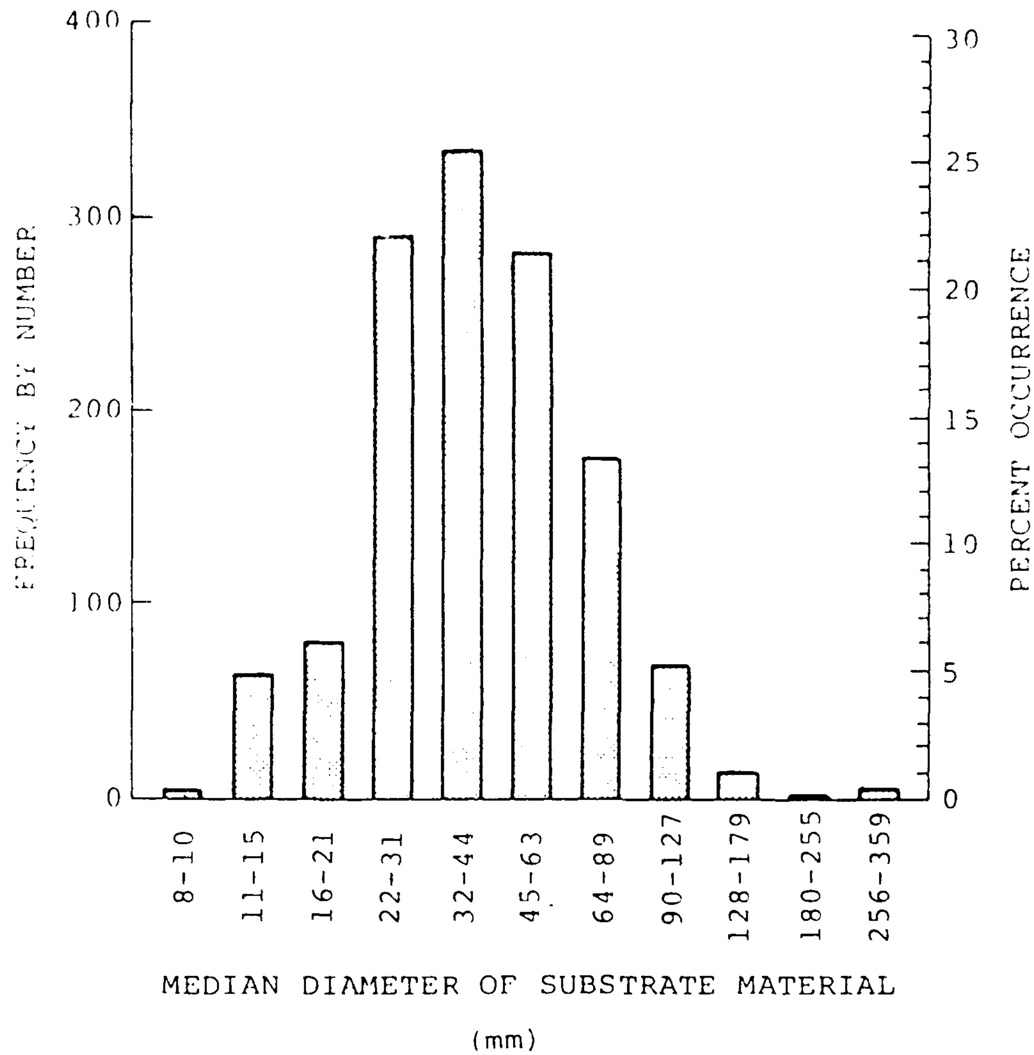
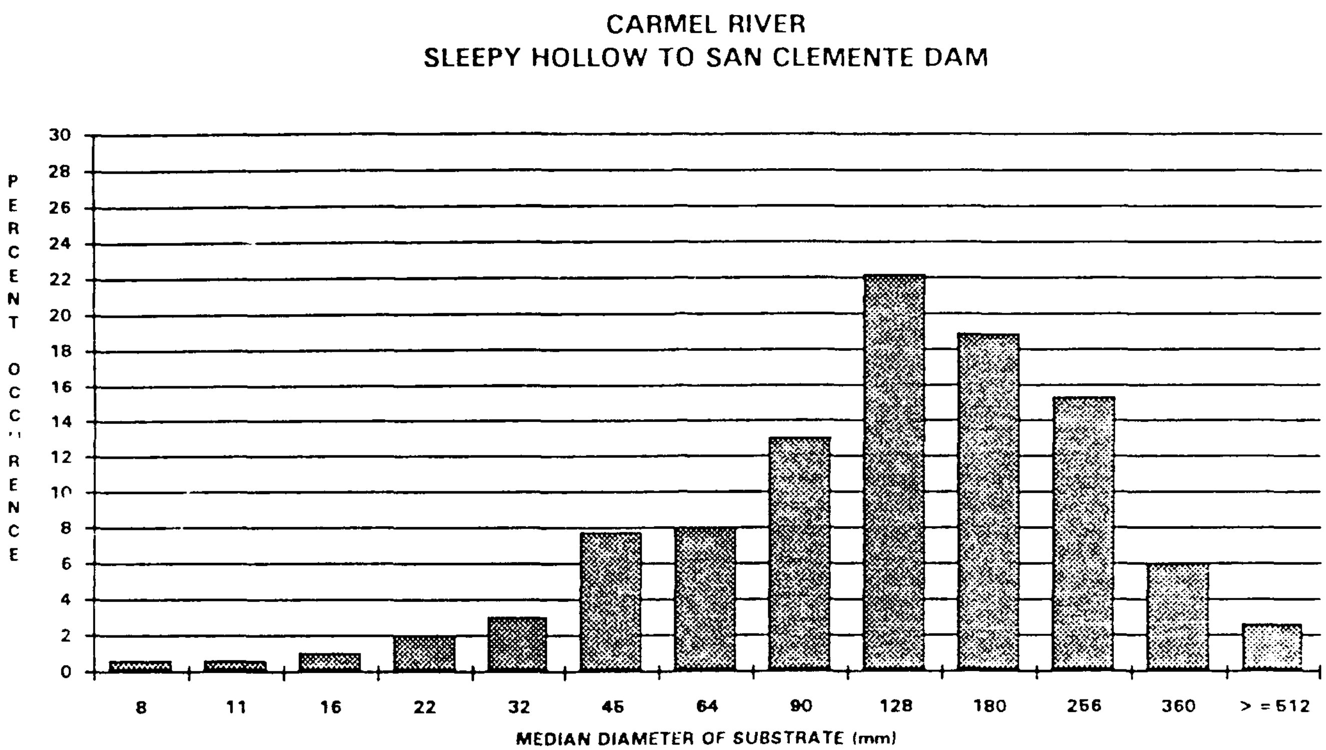


Figure 7. Size class composition of substrate mixture directly adjacent to 15 steelhead nests in the Carmel River between Robinson Canyon and San Clemente Dam. Based on median diameter measurements in a 3 square foot sample of surface gravel and cobble with diameters greater than 8 mm.



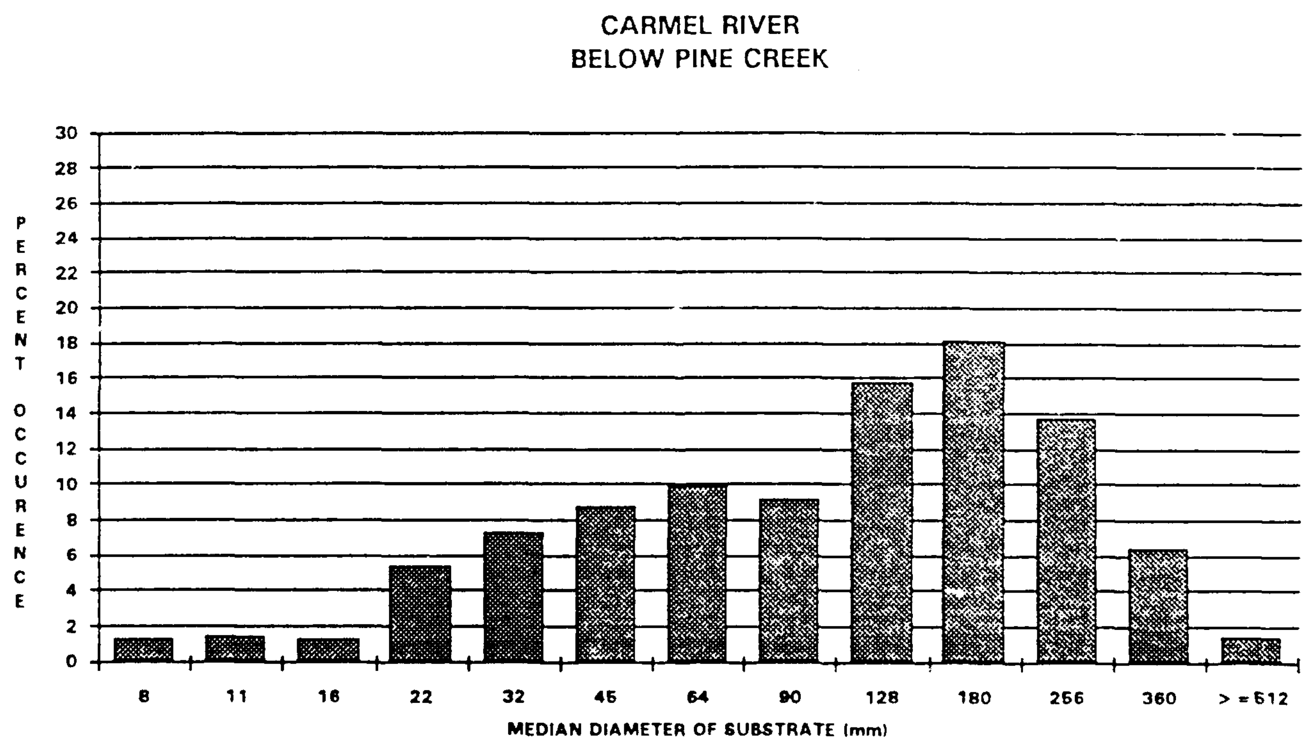
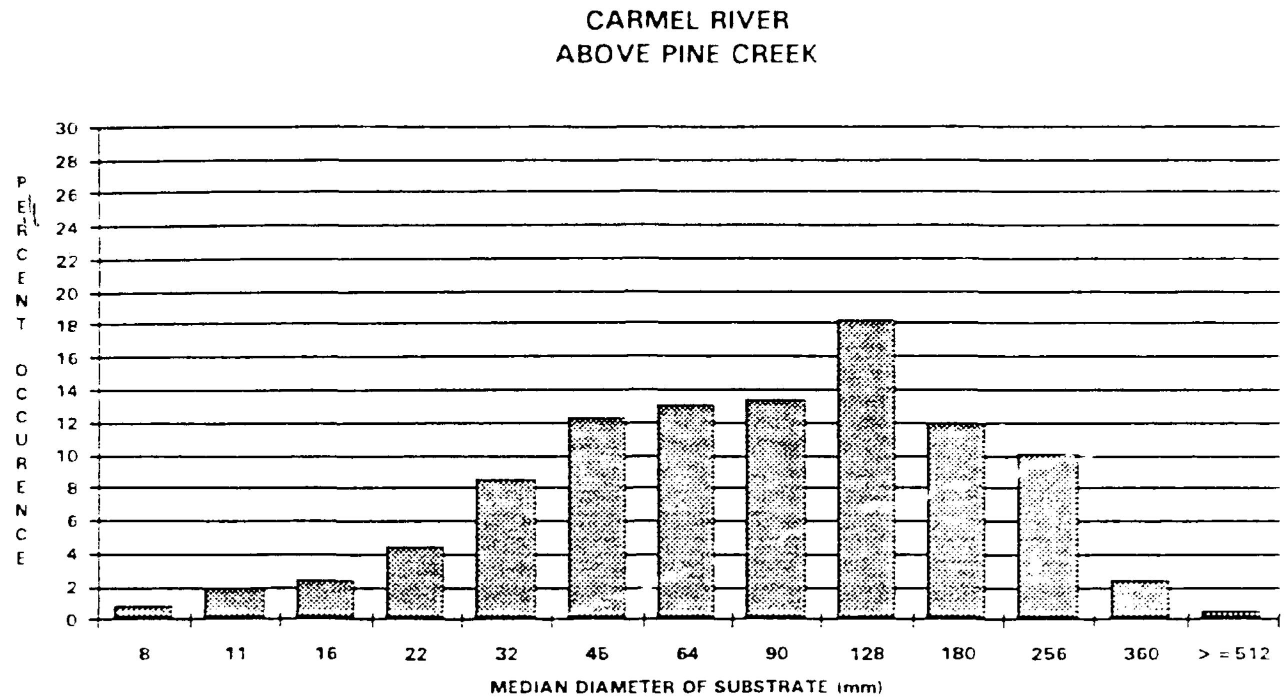


Figure 8. Size class composition of substrate mixture in spawning glides in the Carmel River between Sleepy Hollow and San Clemente Dam (top graph) and between San Clemente Reservoir and Pine Creek (bottom graph). Sleepy Hollow distribution based on measurements of median diameter of 658 rocks in five spawning glides. San Clemente to Pine Creek distribution based on measurements of 543 rocks in three spawning glides used for IFIM Study (TBP 1B,



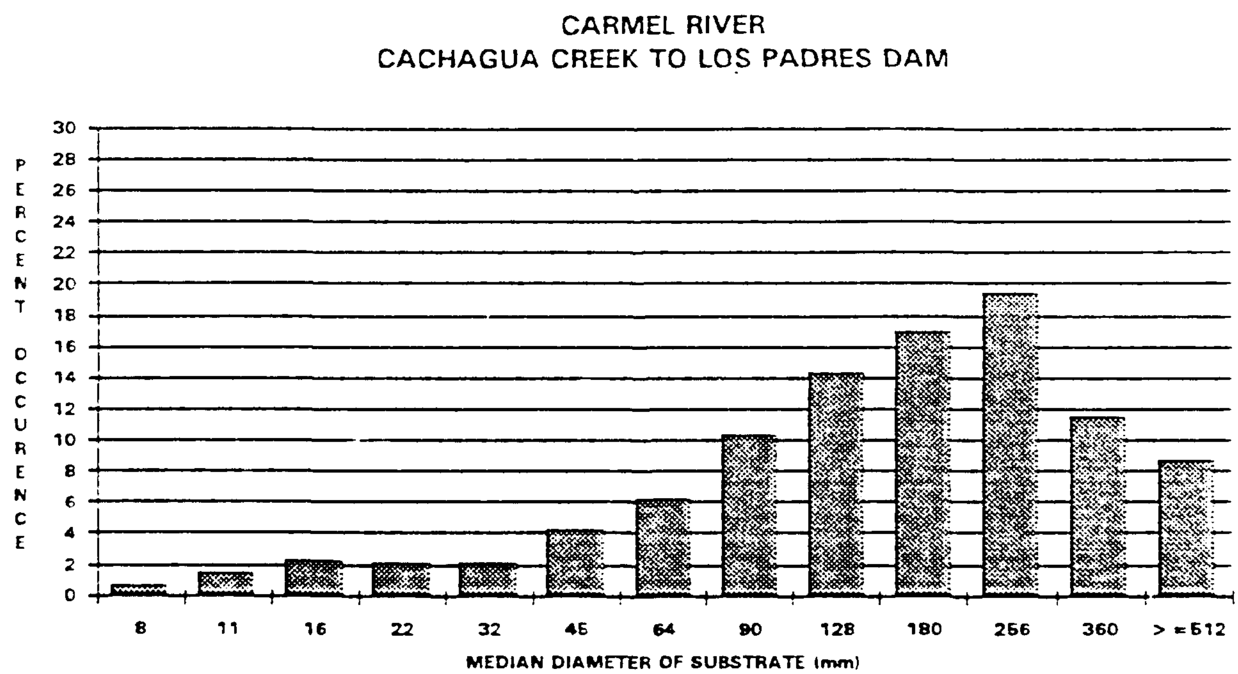


Figure 9. Size class composition of substrate mixture in spawning glides in the Carmel River between Pine Creek and Syndicate Camp (top graph) and between Cachagua Creek and Los Padres Dam (bottom graph). Pine Creek to Syndicate Camp distribution based on measurements of median diamteter of 417 rocks in two spawning glides used for IFIM Study (TAP 4 and TAP 14) and glide downstream of critical riffle (TAP CR1). Cachagua Creek to Los Padres distribution based on measurements of 639 rocks in five spawning glides (TAC 6, below TAC 1, below TAC 2, TAC 0, and below TAC 9).

Table 2. Size class distribution of substrate material in spawning glides in the Carmel River between Sleepy Hollow and San Clemente Dam, spring 1989.

SIZE CLASS	Sleepy Hollow Number 1			Sleepy Hollow Number 2			Sleepy Hollow Number 3			Sleepy Hollow Number 4			Sleepy Hollow Number 5			Overall		
	num	cnum	c %	num	cnum	c %	num	cnum	c %	num	cnum	c %	num	cnum	c %	num	cnum	c %
<4	4	4	2.1	0	0	0.0	14	14	10.9	0	0	0.0	0	0	0.0	18	18	2.7
4	0	4	2.1	5	5	4.9	12	26	20.3	2	2	2.1	3	3	2.2	22	40	6.1
5.6	0	4	2.1	0	5	4.9	0	26	20.3	0	2	2.1	1	4	2.9	1	41	6.2
8	0	4	2.1	1	6	5.9	2	28	21.9	0	2	2.1	0	4	2.9	3	44	6.7
11	1	5	2.6	0	6	5.9	0	28	21.9	0	2	2.1	2	6	4.3	3	47	7.1
16	0	5	2.6	2	8	7.8	2	30	23.4	1	3	3.2	1	7	5.1	6	53	8.1
22	1	6	3.1	2	10	9.8	3	33	25.8	5	8	8.4	1	8	5.8	12	65	9.9
32	2	8	4.1	5	15	14.7	4	37	28.9	3	11	11.6	4	12	8.7	18	83	12.6
45	14	22	11.3	9	24	23.5	8	45	35.2	7	18	18.9	9	21	15.2	47	130	19.8
64	17	39	20.0	2	26	25.5	15	60	46.9	3	21	22.1	12	33	23.9	49	179	27.2
90	37	76	39.0	5	31	30.4	13	73	57.0	8	29	30.5	17	50	36.2	80	259	39.4
128	48	124	63.6	14	45	44.1	22	95	74.2	15	44	46.3	37	87	63.0	136	395	60.0
180	41	165	84.6	18	63	61.8	12	107	83.6	13	57	60.0	32	119	86.2	116	511	77.7
256	24	189	96.9	22	85	83.3	14	121	94.5	20	77	81.1	14	133	96.4	94	605	91.9
360	6	195	100.0	15	100	98.0	2	123	96.1	11	88	92.6	3	136	98.6	37	642	97.6
>=512	0	195	100.0	2	102	100.0	5	128	100.0	7	95	100.0	2	138	100.0	16	658	100.0

SIZE CLASSES > 8 mm

SIZE CLASS	num	cnum	c %	num	cnum	c %	num	cnum	c %	num	cnum	c %	num	cnum	c %	num	cnum	c %
8	0	0	0.0	1	1	1.0	2	2	2.0	0	0	0.0	0	0	0.0	3	3	0.5
11	1	1	0.5	0	1	1.0	0	2	2.0	0	0	0.0	2	2	1.5	3	6	1.0
16	0	1	0.5	2	3	3.1	2	4	3.9	1	1	1.1	1	3	2.2	6	12	1.9
22	1	2	1.0	2	5	5.2	3	7	6.9	5	6	6.5	1	4	3.0	12	24	3.9
32	2	4	2.1	5	10	10.3	4	11	10.8	3	9	9.7	4	8	6.0	18	42	6.8
45	14	18	9.4	9	19	19.6	8	19	18.6	7	16	17.2	9	17	12.7	47	89	14.4
64	17	35	18.3	2	21	21.6	15	34	33.3	3	19	20.4	12	29	21.6	49	138	22.4
90	37	72	37.7	5	26	26.8	13	47	46.1	8	27	29.0	17	46	34.3	80	218	35.3
128	48	120	62.8	14	40	41.2	22	69	67.6	15	42	45.2	37	83	61.9	136	354	57.4
180	41	161	84.3	18	58	59.8	12	81	79.4	13	55	59.1	32	115	85.8	116	470	76.2
256	24	185	96.9	22	80	82.5	14	95	93.1	20	75	80.6	14	129	96.3	94	564	91.4
360	6	191	100.0	15	95	97.9	2	97	95.1	11	86	92.5	3	132	98.5	37	601	97.4
>=512	0	191	100.0	2	97	100.0	5	102	100.0	7	93	100.0	2	134	100.0	16	617	100.0

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Table 3. Size class distribution of substrate material in spawning glides in the Carmel River between San Clemente Reservoir and Pine Creek, spring 1989.

SIZE CLASS	IFIM Transect # TBP 1B			Upstream IFIM Transect # TBP 2			IFIM Transect # TBP 10			OVERALL			
	num	cnum	c %	num	cnum	c %	num	cnum	c %	num	%	cnum	c %
<4	30	30	14.0	21	21	10.7	7	7	5.3	58	11	58	11
4	2	32	15.0	2	23	11.7	2	9	6.8	6	1	64	12
5.6	0	32	15.0	0	23	11.7	0	9	6.8	0	0	64	12
8	2	34	15.9	2	25	12.8	0	9	6.8	4	1	68	13
11	6	40	18.7	1	26	13.3	0	9	6.8	7	1	75	14
16	6	46	21.5	0	26	13.3	0	9	6.8	6	1	81	15
22	12	58	27.1	8	34	17.3	6	15	11.3	26	5	107	20
32	21	79	36.9	7	41	20.9	7	22	16.5	35	6	142	26
45	19	98	45.8	7	48	24.5	16	38	28.6	42	8	184	34
64	19	117	54.7	15	63	32.1	14	52	39.1	48	9	232	43
90	15	132	61.7	17	80	40.8	12	64	48.1	44	8	276	51
128	18	150	70.1	38	118	60.2	20	84	63.2	76	14	352	65
180	28	178	83.2	39	157	80.1	20	104	78.2	87	16	439	81
256	19	197	92.1	34	191	97.4	13	117	88.0	66	12	505	93
360	15	212	99.1	5	196	100.0	11	128	96.2	31	6	536	99
>=512	2	214	100.0	0	196	100.0	5	133	100.0	7	1	543	100
SIZE CLASSES > 8 mm													
8	2	2	1.1	4	4	2.3	0	0	0.0	6	1	6	1
11	6	8	4.4	1	5	2.9	0	0	0.0	7	1	13	3
16	6	14	7.7	0	5	2.9	0	0	0.0	6	1	19	4
22	12	26	14.3	8	13	7.4	6	6	4.8	26	5	45	9
32	21	47	25.8	7	20	11.4	7	13	10.5	35	7	80	17
45	19	66	36.3	7	27	15.4	16	29	23.4	42	9	122	25
64	19	85	46.7	15	42	24.0	14	43	34.7	48	10	170	35
90	15	100	54.9	17	59	33.7	12	55	44.4	44	9	214	44
128	18	118	64.8	38	97	55.4	20	75	60.5	76	16	290	60
180	28	146	80.2	39	136	77.7	20	95	76.6	87	18	377	78
256	19	165	90.7	34	170	97.1	13	108	87.1	66	14	443	92
360	15	180	98.9	5	175	100.0	11	119	96.0	31	6	474	99
>=512	2	182	100.0	0	175	100.0	5	124	100.0	7	1	481	100

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Table 4 . Size class distribution of substrate material in spawning glides in the Carmel River between Pine Creek and Cachagua Creek, spring 1989.

SIZE CLASS	2 nd Glide d.s. IFIM # TAPCR 1 num	cnum	c %	IFIM Transect # TAP 14 num	cnum	c %	IFIM Transect # TAP 4 num	cnum	c %	OVERALL num	%	cnum	c %
<4	26	26	26.0	9	9	5.7	15	15	9.4	50	12	50	12
4	0	26	26.0	0	9	5.7	0	15	9.4	0	0	50	12
5.6	0	26	26.0	0	9	5.7	0	15	9.4	0	0	50	12
8	1	27	27.0	0	9	5.7	2	17	10.7	3	1	53	13
11	1	28	28.0	4	13	8.2	2	19	11.9	7	2	60	14
16	4	32	32.0	3	16	10.1	2	21	13.2	9	2	69	17
22	6	38	38.0	6	22	13.9	4	25	15.7	16	4	85	20
32	7	45	45.0	11	33	20.9	13	38	23.9	31	7	116	28
45	6	51	51.0	17	50	31.6	22	60	37.7	45	11	161	39
64	5	56	56.0	20	70	44.3	23	83	52.2	48	12	209	50
90	8	64	64.0	22	92	58.2	19	102	64.2	49	12	258	62
128	14	78	78.0	27	119	75.3	26	128	80.5	67	16	325	78
180	9	87	87.0	18	137	86.7	17	145	91.2	44	11	369	88
256	10	97	97.0	15	152	96.2	12	157	98.7	37	9	406	97
360	3	100	100.0	4	156	98.7	2	159	100.0	9	2	415	100
>=512	0	100	100.0	2	158	100.0	0	159	100.0	2	0	417	100

SIZE CLASSES > 8 mm

SIZE CLASS	num	cnum	c %	num	cnum	c %	num	cnum	c %	num	%	cnum	c %
8	1	1	1.4	0	0	0.0	2	2	1.4	3	1	3	1
11	1	2	2.7	4	4	2.7	2	4	2.8	7	2	10	3
16	4	6	8.1	3	7	4.7	2	6	4.2	9	2	19	5
22	6	12	16.2	6	13	8.7	4	10	6.9	16	4	35	10
32	7	19	25.7	11	24	16.1	13	23	16.0	31	8	66	18
45	6	25	33.8	17	41	27.5	22	45	31.3	45	12	111	30
64	5	30	40.5	20	61	40.9	23	68	47.2	48	13	159	43
90	8	38	51.4	22	83	55.7	19	87	60.4	49	13	208	57
128	14	52	70.3	27	110	73.8	26	113	78.5	67	18	275	75
180	9	61	82.4	18	128	85.9	17	130	90.3	44	12	319	87
256	10	71	95.9	15	143	96.0	12	142	98.6	37	10	356	97
360	3	74	100.0	4	147	98.7	2	144	100.0	9	2	365	99
>=512	0	74	100.0	2	149	100.0	0	144	100.0	2	1	367	100

Table 5. Size class distribution of substrate material in spawning glides in the Carmel River between Cachagua Creek and Los Padres Dam, spring 1989.

SIZE	IFIM Transect # TAC 6			IFIM Transect BTAC#1			IFIM Transect BTAC#2			IFIM Transect ATAC#0			IFIM Transect BTAC#9			OVERALL			
CLASS	num	cnum	c %	num	cnum	c %	num	cnum	c %	num	cnum	c %	num	cnum	c %	num	%	cnum	c %
<4	0	0	0.0	2	2	1.4	0	0	0.0	3	3	1.8	0	0	0.0	5	1	5	1
4	2	2	1.9	0	2	1.4	1	1	1.1	1	4	2.5	0	0	0.0	4	1	9	1
5.6	0	2	1.9	0	2	1.4	0	1	1.1	0	4	2.5	0	0	0.0	0	0	9	1
8	1	3	2.8	0	2	1.4	1	2	2.1	2	6	3.7	0	0	0.0	4	1	13	2
11	3	6	5.6	2	4	2.9	4	6	6.3	0	6	3.7	0	0	0.0	9	1	22	3
16	7	13	12.0	0	4	2.9	5	11	11.6	2	8	4.9	0	0	0.0	14	2	36	6
22	0	13	12.0	2	6	4.3	3	14	14.7	5	13	8.0	3	3	2.2	13	2	49	8
32	4	17	15.7	5	11	7.9	2	16	16.8	2	15	9.2	0	3	2.2	13	2	62	10
45	3	20	18.5	6	17	12.2	4	20	21.1	12	27	16.6	2	5	3.7	27	4	89	14
64	11	31	28.7	10	27	19.4	5	25	26.3	8	35	21.5	5	10	7.5	39	6	128	20
90	14	45	41.7	22	49	35.3	7	32	33.7	9	44	27.0	13	23	17.2	65	10	193	30
128	24	69	63.9	24	73	52.5	15	47	49.5	14	58	35.6	13	36	26.9	90	14	283	44
180	19	88	81.5	25	98	70.5	16	63	66.3	22	80	49.1	25	61	45.5	107	17	390	61
256	17	105	97.2	21	119	85.6	17	80	84.2	37	117	71.8	30	91	67.9	122	19	512	80
360	3	108	100.0	13	132	95.0	11	91	95.8	30	147	90.2	15	106	79.1	72	11	584	91
>=512	0	108	100.0	7	139	100.0	4	95	100.0	16	163	100.0	28	134	100.0	55	9	639	100

SIZE CLASSES > 8 mm

SIZE CLASS	num	cnum	c %	num	cnum	c %	num	cnum	c %	num	cnum	c %	num	cnum	c %	num	%	cnum	c %
8	1	1	0.9	0	0	0.0	1	1	1.1	2	2	1.3	0	0	0.0	4	1	4	1
11	3	4	3.8	2	2	1.5	4	5	5.3	0	2	1.3	0	0	0.0	9	1	13	2
16	7	11	10.4	0	2	1.5	5	10	10.6	2	4	2.5	0	0	0.0	14	2	27	4
22	0	11	10.4	2	4	2.9	3	13	13.8	5	9	5.7	3	3	2.2	13	2	40	6
32	4	15	14.2	5	9	6.6	2	15	16.0	2	11	6.9	0	3	2.2	13	2	53	8
45	3	18	17.0	6	15	10.9	4	19	20.2	12	23	14.5	2	5	3.7	27	4	80	13
64	11	29	27.4	10	25	18.2	5	24	25.5	8	31	19.5	5	10	7.5	39	6	119	19
90	14	43	40.6	22	47	34.3	7	31	33.0	9	40	25.2	13	23	17.2	65	10	184	29
128	24	67	63.2	24	71	51.8	15	46	48.9	14	54	34.0	13	36	26.9	90	14	274	43
180	19	86	81.1	25	96	70.1	16	62	66.0	22	76	47.8	25	61	45.5	107	17	381	60
256	17	103	97.2	21	117	85.4	17	79	84.0	37	113	71.1	30	91	67.9	122	19	503	80
360	3	106	100.0	13	130	94.9	11	90	95.7	30	143	89.9	15	106	79.1	72	11	575	91
>=512	0	106	100.0	7	137	100.0	4	94	100.0	16	159	100.0	28	134	100.0	55	9	630	100

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spawning habitat in the reaches between the dams and below San Clemente Dam is limited by gravel size. The differences are most noticeable immediately downstream of Los Padres and San Clemente Dams where the supply of gravel has been cut off since construction of the dams. For example, while steelhead selected a mixture composed of 80 percent of material within the range of 22 to 90 mm, only 25 percent of the substrate material in glides below Los Padres Dam fell into this size range. The majority of the substrate was larger than 128 mm. Based on these comparisons, it appears there are ample opportunities for improving the quality of spawning gravel between the dams and below San Clemente Dam.

Extent of Suitable Gravel in Potential Spawning Glides

While the measurements of gravel size in spawning glides provides data to determine whether the quality of gravel limits spawning habitat, it does not provide enough information to assess how much additional habitat could be created by adding gravel to the river. To assess this, a survey was conducted to map the distribution of suitable substrate within potential spawning glides.

In selected potential glides between San Clemente and Los Padres dams, a series of steel pins were driven into the stream bottom around patches where substrate conditions were judged to be suitable for spawning (Plate 1). The following criteria were applied in the field to judge whether substrate was suitable:

1) 75 percent of material larger than 8 mm, and

2) at least 50 percent of substrate in medium gravel to small cobble size range (22 - 64 mm), and

3) at least 75 percent of substrate in medium gravel to medium cobble size range (22 - 90 mm)

These criteria are based on the size class distribution of gravel used by spawning steelhead (Figure 7). Following the placement of pins, the distance between pins was measured to the nearest 0.1 foot. After measuring the distances between pins, the total potential spawning area was mapped by measuring distances between pins set along the base of each bank at approximately 5-foot intervals starting at the glide/riffle break. Later, the location of all pins was mapped at a scale of 1" = 5 feet and the potential and actual spawning habitat areas were measured with a planimeter. Figure 10 is a sample of the maps used for this procedure.

Table 6 lists estimates of actual and potential spawning habitat area based on the procedure outlined in the previous paragraph and estimates in other spawning glides based on field measurements of actual and potential area. Potential area was

Plate 1. Photo illustrating the placement of pins outlining area with suitable spawning gravel within a glide. Area outlined in overlay corresponds to suitable habitat area in Figure 10.

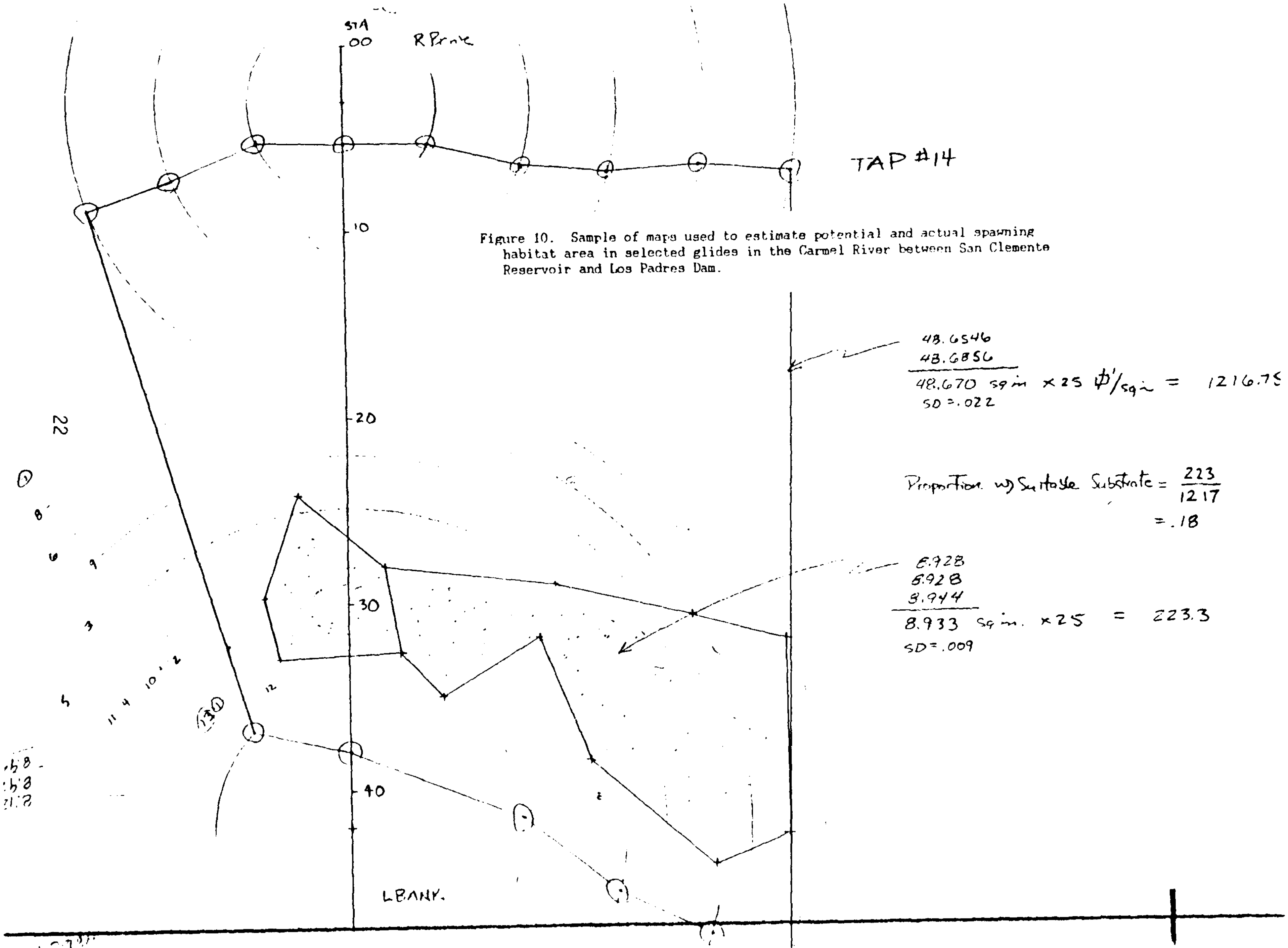

Figure 10. Sample of maps used to estimate potential and actual spawning habitat area in selected glides in the Carmel River between San Clemente Reservoir and Los Padres Dam.

Table 6. Estimated suitable and potential spawning habitat area in glides in the Carmel River between Sleepy Hollow and Los Pa Dam. Measurements of suitable habitat include areas where depth, velocity and substrate conditions are within range used spawning steelhead. Measurements of potential habitat include areas where depth and velocity are within range, but where s mixture is too coarse for construction of steelhead nests.

REACH	LENGTH (ft)	LENGTH SURVEYED (ft)	EXISTING HABITAT Measured (sqft)	EXISTING HABITAT Estimated (sqft)	POTENTIAL HABITAT Measured (sqft)	POTENTIAL HABITAT Estimated (sqft)	PERCENT OF POTENTIAL HABITAT WITH SUITABLE GRAVEL (%)
SLEEPY HOLLOW TO SAN CLEMENTE DAM							
--Above Damsite[1]	3,953	1,397	351	926	3,247	6,007	
--Below Damsite	3,047	3,047	1,513	1,513	5,830	5,830	26
Total	7,000	5,350	1,864	2,439	9,047	11,837	21
SAN CLEMENTE RES. TO PINE CREEK	10,600	8,122	3,369	4,397	12,579	16,417	27
PINE CREEK TO SYNDICATE CAMP	5,350	5,478	2,092	2,092	7,237	7,237	29
SYNDICATE CAMP TO CACHAGUA CREEK	6,300	3,594	1,797	3,150	7,699	13,496	23
CACHAGUA CREEK TO LOS PADRES DAM							
--Above Damsite[1]	2,725	2,725	132	132	6,648	6,648	2
--Below Damsite	3,575	3,575	590	590	6,363	6,363	9
Total	6,300	6,300	722	722	13,011	13,011	6
SLEEPY HOLLOW TO LOS PADRES DAM	35,550	28,844	9,844	12,800	49,573	61,998	21

estimated in the field by multiplying the gross width of the glide times 25 feet upstream from the glide/riffle break. Actual spawning areas were estimated by multiplying the length times the width of patches with suitable substrate conditions.

Overall, only 21 percent of the potential habitat area in glides is covered with appropriately-sized gravel (Table 6). Based on these estimates and a comparison of potential habitat to actual habitat, it is reasonable to conclude spawning habitat between the dams and below San Clemente Dam is limited by the lack of appropriately sized gravel. Application of these estimates to other portions of the river indicates the 5.4 mile-long reach from San Clemente Reservoir to Los Padres Dam and the 1.3 mile-long reach from Sleepy Hollow to San Clemente Dam can support a total of 264 nests, or about 80 spawners per mile of river (Table 1). This habitat represents one-third as much spawning habitat per unit of stream, as compared to the remainder of the mainstem, where the river accommodates a total 2,100 nests, or about 240 spawners per mile (Table 1). The lack of spawning gravel probably limits the population of spawning adults that can be accommodated without interference and overlap between nests. Ultimately, the lack of suitable gravel will reduce the population of returning adults in the reach between the dams and below San Clemente Dam.

Based on comparisons of gravel size and on estimates of potential and actual spawning habitat area, it appears the losses of spawning habitat with alternative water supplies could be mitigated by adding appropriately sized gravel to the reach between the dams and below San Clemente Dam.

LOSS OF SPAWNING HABITAT WITH WATER SUPPLY ALTERNATIVES

Table 7 from Dettman (1989) lists the amount of spawning habitat inundated or blocked by water supply alternatives. The losses range from zero with the no project and Canada Reservoir to about 14,800 square feet with New Los Padres Reservoir.

MITIGATION PLAN

The District's plan for mitigating losses of spawning habitat includes a program to increase and maintain spawning habitat by placing gravel in key spawning glides where existing spawning habitat is limited by the size and quantity of gravel. The goal of the program would be to permanently offset losses which occur due to inundation and blockage of spawning habitat.

Key features of the program are collection of spawning gravel, initial placement of gravel in potential glides, long-term, periodic monitoring of key spawning glides, and injection of appropriately sized gravel during periods of high flow to maintain spawning habitat.

Table 7. Estimates of steelhead spawning habitat inundated or blocked by alternative water supply projects. Based on measurements of spawning habitat in the Carmel River and selected tributaries during 1982 and 1989.

			Length of Stream					Amount of Spawning Habitat			Potential Loss of Steelhead	
			Inundated		Blocked		Total	Inundated	Blocked	Total	Nests	Spawners
ALTERNATIVE	STREAM	REACH	(ft)	(mi)	(ft)	(mi)	(mi)	(sqft)	(sqft)	(sqft)	(nos)	(nos.)
New Los Padres Dam 24,000 acft	Carmel River	below LPD	2,726	0.62	0	0.00	0.62	302	0	302	6	12
		above LPD	6,124	1.16	0	0.00	1.16	8,868	0	8,868	177	364
	Danish Creek		2,386	0.46	6,612	1.26	1.70	1,366	3,753	5,108	102	204
New Los Padres Dam 16,000 acft	Carmel River	below LPD	2,726	0.62	0	0.00	0.62	302	0	302	6	12
		above LPD	[illegible]	0.71	0	0.00	0.71	5,406	0	5,406	108	216
	Danish Creek		1,494	0.28	7,506	1.42	1.70	848	4,260	5,108	102	204
New Los Padres Dam 9,000 acft	Carmel River	below LPD	2,726	0.62	0	0.00	0.62	302	0	302	6	12
		above LPD	1,360	0.26	0	0.00	0.26	1,953	0	1,953	39	78
	Danish Creek		600	0.11	8,400	1.59	1.70	341	4,768	,106	102	[illegible]
Cachagua Creek Dam 6,000 acft	Cachagua Cr.		2,831	0.54	0	0.00	0.54	[illegible]	0	187	4	7
	James Creek		2,672	0.51	2,812	0.55	1.06	201	220	421	8	17
	Finch Creek		6,621	1.25	4,283	0.81	[illegible]	1,495	969	2,464	49	99
San Clemente Creek Dam 11,000 acft	San Clemente Creek		9,785	1.86	10,569	2.00	3.86	4,252	4,588	8,840	177	354
	Black Rock Creek		0	0.00	15,817	3.00	3.00	0	2,481	2,481	50	100
New San Clemente Dam 23,000 acft	Carmel River	below SCD	3,953	0.75	0	0.00	0.75	1,377	0	1,377	28	55
		above SCD	[illegible]	1.44	0	0.00	1.44	3,148	0	3,148	63	126
	San Clemente Creek Basin		3,216	0.61	34,784	6.59	7.20	1,396	8,847	10,243	205	410
Chupines Creek Dam 10,600 acft	Chupines Creek		4,890	0.93	18,314	3.47	4.39	411	1,538	1,949	39	78
Canada Dam	seasonal arroyo		0	0.00	0	0.00	0.00	0	0	0	0	0

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(Table 7 con't

			Length of Stream					Amount of Spawning Habitat			Loss of Steelhead	
			Inundated		Blocked		Total	Inundated	Blocked	Total	Nests	Spawners
ALTERNATIVE	STREAM	REACH	(ft)	(miles)	(ft)	(miles)	(mi)	(sqft)	(sqft)	(sqft)	(nos)	(nos)
Summary Totals For Each Alternative												
NEW LOS PADRES DAM (24,000 acft)			11,237	2.13	6,612	1.25	3.38	10,516	3,753	14,269	285	571
NEW LOS PADRES DAM (16,000 acft)			7,866	1.51	7,506	1.42	2.93	6,566	4,260	10,816	216	433
NEW LOS PADRES DAM (9,000 acft)			4,676	0.89	8400	1.59	2.48	2,596	4,768	7,364	147	295
CACHAGUA CREEK DAM (6,000 acft)			12,124	2.30	7,206	1.36	3.66	1,883	1,189	3,072	61	123
SAN CLEMENTE CREEK DAM (11,000 acft)			9,796	1.86	26,386	5.00	6.86	4,252	7,078	11,331	227	453
NEW SAN CLEMENTE DAM (23,000 acft)			14,769	2.80	34,784	6.59	9.38	5,922	8,847	14,769	295	591
CHUPINES CREEK DAM (10,600 acft)			4,390	0.83	18,314	3.47	4.39	411	1,538	1,949	39	78
CANADA DAM (any size)			0	0.00	0	0.00	0.00	0	0	0	0	0
NON-DAM ALTERNATIVE			0	0.00	0	0.00	0.00	0	0	0	0	0
NO PROJECT ALTERNATIVE			0	0.00	0	0.00	0.00	0	0	0	0	0
EXISTING CONDITION			0	0.00	75,800	14.36	14.36	0	72,300	72,300	1,446	2,892

Collection of Spawning Gravel

Initial Collection--The existing San Clemente and Los Padres Reservoirs have extensive deltas of gravel deposited at the upstream end of the inundation zones. The District proposes to extract and stockpile 360 to 2,700 cubic yds of appropriately sized gravel from the inundation zones of the existing reservoirs (Table 8). This is equivalent to about five times the amount of gravel needed to fully mitigate losses. The stockpiles would be used to replenish gravel after a new reservoir is constructed.

Maintenance--The stockpile of gravel from the initial collection will last for an unknown period, after construction of the new reservoir. Before it is exhausted, the District will institute a program to maintain the supply of gravel for injecting at appropriate locations.

Initial Placement of Spawning Gravel

The District has received a grant from CDF&G to restore spawning habitat between the dams. Following the outline of methods in the grant, the District will place gravel in spawning glides by using a sluiceway in locations that are accessible to truck and tractor, and a helicopter in locations that are inaccessible with trucks.

Periodic Monitoring of Key Spawning Glides

The goal of the spawning mitigation program would be to perpetually maintain enough spawning habitat to mitigate for the losses caused by construction and operation of a new reservoir. This requires monitoring to measure the amount of spawning habitat over time. The District proposes to fund and conduct a monitoring program to measure spawning habitat in several "key" glides. At a minimum, spawning habitat will be measured annually. However, during most wet years, it will be necessary to measure habitat several times during the winter to insure that enough gravel is added during storm events.

Injection of Appropriately Sized Gravel

The District will hire a consulting hydrogeologist to develop a program for injecting gravel into the river. Initially, the river is expected to rapidly scour and move the gravel added to the river. During the first few years of operation the movement of gravel bedload will be measured to develop a bedload transport curve at locations near spawning glides. This curve will be used a guideline to recommend the amount of gravel that must be added to maintain spawning habitat.

Gravel from the stockpile will be added at several locations including, below existing Los Padres Dam (RM 23.5) or New Los Padres Dam (RM 23.0), Flavin's Crossing (RM 22.0), Syndicate Camp (RM 21.5), below San Clemente Dam (RM 18.1), and San Clemente Ford

Table 8. Estimated volume of gravel added to four reaches in the Carmel River for mitigating the spawning habitat inundated or blocked by water supply alternatives.

ALTERNATIVE	REACH	# GLIDES	SPAWNING HABITAT AREA (sqft) UNIMPROVED POST PROJECT	TOTAL POTENTIAL	MITIGATED POST PROJECT	INCREASE (sqft)	INCREASE (%)	Volume of Gravel added (cubic yds)
New Los Padres (24,000 acft)	Sleepy Hollow to San Clemente Dam	16	2,439	11,837	6,150	3,711	152	137
	San Clemente Res. to Syndicate Camp	30	6,489	23,654	7,987	1,498	23	55
	Syndicate Camp to Cachagua Creek	12	3,150	13,496	6,500	3,350	106	124
	Cachagua Creek to Los Padres Dam	8	590	6,363	6,300	5,710	968	211
	Total	66	12,668	55,350	26,937	14,269	113	528
New Los Padres (16,000 acft)	Sleepy Hollow to San Clemente Dam	16	2,439	11,837	5,000	2,561	105	95
	San Clemente Res. to Syndicate Camp	30	6,489	23,654	6,489	0	0	0
	Syndicate Camp to Cachagua Creek	12	3,150	13,496	5,779	2,629	83	97
	Cachagua Creek to Los Padres Dam	8	590	6,363	6,300	5,710	968	211
	Total	66	12,668	55,350	23,568	10,900	86	404
New Los Padres (9,000 acft)	Sleepy Hollow to San Clemente Dam	16	2,439	11,837	4,500	2,061	85	76
	San Clemente Res to Syndicate Camp	30	6,489	23,654	6,489	0	0	0
	Syndicate Camp to Cachagua Creek	12	3,150	13,496	5,043	1,893	60	70
	Cachagua Creek to Los Padres Dam	8	590	6,363	4,000	3,410	578	126
	Total	66	12,668	55,350	20,032	7,364	58	273

(Table 8 continued)

ALTERNATIVE	REACH	# GLIDES	SPAWNING HABITAT AREA (sqft) UNIMPROVED POST PROJECT	TOTAL POTENTIAL	MITIGATED POST PROJECT	INCREASE (sqft)	INCREASE (%)	Volume of Gravel added (cubic yds)
Cachagua Creek (6,000 acft)	Sleepy Hollow to San Clemente Dam	16	2,439	11,837	3,733	1,294	53	48
	San Clemente Res. to Syndicate Camp	30	6,489	23,654	6,489	0	0	0
	Syndicate Camp to Cachagua Creek	12	3,150	13,496	3,150	0	0	0
	Cachagua Creek to Los Padres Dam	18	722	13,011	2,500	1,778	246	66
	Total	76	12,800	61,998	15,872	3,072	24	114
San Clemente Creek (11,500 acft)	Sleepy Hollow to San Clemente Dam	16	2,439	11,837	5,000	2,561	105	95
	San Clemente Res. to Syndicate Camp	30	6,489	23,654	6,489	0	0	0
	Syndicate Camp to Cachagua Creek	12	3,150	13,496	5,000	1,850	59	69
	Cachagua Creek to Los Padres Dam	18	722	13,011	7,642	6,920	958	250
	Total	76	12,800	61,998	24,131	11,331	89	420
New San Clemente (23,000 acft)	Sleepy Hollow to San Clemente Dam	10	1,513	5,830	5,000	3,487	230	129
	San Clemente Res. to Syndicate Camp	10	2,092	7,237	4,246	2,154	103	80
	Syndicate Camp to Cachagua Creek	12	3,150	13,496	5,000	1,850	59	69
	Cachagua Creek to Los Padres Dam	18	722	13,011	8,000	7,278	1008	270

	Total	50	7,477	39,574	22,246	14,769	198	547

(Table 8 continued)

ALTERNATIVE	REACH	# GLIDES	SPAWNING HABITAT AREA (sqft) UNIMPROVED POST PROJECT	TOTAL POTENTIAL	MITIGATED POST PROJECT	INCREASE (sqft)	(%)	Volume of Gravel added (cubic yds)
Chupines Creek (10,000 acft)	Sleepy Hollow to San Clemente Dam	16	2,439	11,837	3,610	1,171	48	43
	San Clemente Res. to Syndicate Camp	30	6,489	23,654	6,489	0	0	0
	Syndicate Camp to Cachagua Creek	12	3,150	13,496	3,150	0	0	0
	Cachagua Creek to Los Padres Dam	18	722	13,011	1,500	778	108	29
	Total	76	12,800	61,998	14,749	1,949	15	72

(RM 17.3).

CONCEPTUAL COSTS FOR SPAWNING HABITAT MITIGATION PROGRAM

Table 9 summarizes a comparison of capital and O&M costs for the alternatives. With projects that require mitigation, the estimated capital cost for mitigating losses of spawning habitat ranges from $26,000 to $122,200 and estimated O&M costs range from $10,800 to $24,900, depending on which alternative is constructed. Three alternatives, Canada, Desalination and the No Project do not inundate or block any spawning habitat, so no mitigation is required.

Tables 10 - 16 outline tasks and list conceptual cost estimates for constructing and operating the spawning habitat mitigation program with each alternative.

Table 9. Summary of preliminary conceptual costs for mitigating the loss of spawning habitat inundated or blocked in the Carmel River Basin with alternative water supply projects.

ALTERNATIVE	INITIAL COST	ANNUAL OPERATION COST
New Los Padres Reservoir (24,000 acre-feet)	$176,000	$22,300
New Los Padres Reservoir (16,000 acre-feet)	$122,800	$18,000
New Los Padres Reservoir (9,000 acre-feet)	$104,800	$15,100
Cachagua Creek Reservoir (6,000 acre-feet)	$86,600	$10,500
San Clemente Creek Reservoir (11,000 acre-feet)	$144,100	$19,900
New San Clemente Reservoir (23,000 acre-feet)	$176,100	$24,200
Chupines Creek Reservoir (10,000 acre-feet)	$83,100	$10,200
Canada Reservoir (any size)	$0	$0
Desalination	$0	$0
No Project	$0	$0

Table 10. Preliminary conceptual cost estimate for program to mitigate the the loss of spawning habitat inundated or blocked with the 24,000 acre-foot New Los Padres Reservoir.

INITIAL COSTS

--LABOR	Number of Days	Hours	Hourly Rate	Total
Biologist	11	88	$20.19	$1,777
Hydrologist	19	152	$19.23	$2,923
Field Tech	37	296	$12.40	$3,670
Equipment Operator	57	456	$35.00	$15,960
Laborer	57	456	$9.00	$4,104
			Subtotal:	$28,434
Staff Benefits at 40%				$11,374
			Total Labor Costs:	$39,808

--MATERIALS AND SUPPLIES	
Read Screenall Mod RD25B	$48,100
500 feet 10" PVC @ $7.00/ft	$3,500
500 feet 12" ABS Flex Pipe @ $5.00/ft	$2,500
500 feet 3" PVC @ $.87/ft	$435
250 gal/min pump, 3 inch discharge	$850
3-inch suction hose	$300
Misc Valves	$250
Misc PVC and ABS connectors	$1,000
Safety Items	$250
Hoppers for gravel (3 @ $500)	$1,500
Misc tools and supplies	$500
Total Materials and Supplies:	$59,185

--OPERATING EXPENSES	
4-wheel drive tractor with backhoe and load bucket (60 days @ $100.00 per day)	$6,000
5-yd dump truck (60 days at $160.00 per day)	$9,600
Subcontractor, Heliocopter (56 hours @ $500.00/hr)	$28,000
Diesel Fuel (600 gal at $1.50/gal)	$900
Gasoline (600 gal at $1.50/gal)	$900
Maintenance supplies, oil, grease, etc.	$200
Mobilization/Demobilization (10% operating costs)	$4,560
Total Operating Expenses:	$50,160

--CONTINGENCY AND OVERHEAD	
Administrative overhead at 5 % (labor + operation)	$4,498
Contingency (15 % of personnel, material and operating costs)	$22,373
TOTAL INITIAL COST	$176,024

ANNUAL OPERATING COSTS

--LABOR	Number of Days	Hours	Hourly Rate	Total
Biologist	7	56	$20.19	$1,131
Hydrologist	7	56	$19.23	$1,077
Field Tech	10	80	$12.40	$992
Equipment Operator	14	112	$35.00	$3,920
Laborer	14	112	$9.00	$1,008
			Subtotal:	$8,128
Staff Benefits at 40%				$3,251
			Total Labor Costs:	$11,379

--MATERIALS AND SUPPLIES	
Materials on hand, but assume 25% replacement of expendable material cost per year	$2,771
Total Materials and Supplies:	$2,771

--OPERATING EXPENSES	
4-wheel drive tractor with backhoe and load bucket (14 days @ $100.00 per da)	$1,400
5-yd dump truck (14 days at $160.00 per da)	$2,240
Diesel Fuel (100 gal at $1.50/gal)	$150
Gasoline (100 gal at $1.50/gal)	$150
Maintenance supplies, oil, grease, etc.	$200
Mobilization/Demobilization (10% operating costs)	$414
Total Operating Expenses:	$4,554

--CONTINGENCY AND OVERHEAD	
Administrative overhead at 5 % (labor + operation)	$797
Contingency (15 % of personnel, material and operating costs)	$2,806
TOTAL ANNUAL OPERATING COST	$22,306

Table 11. Preliminary conceptual cost estimate for program to mitigate the the loss of spawning habitat inundated or blocked with the 16,000 acre-foot New Los Padres Reservoir.

INITIAL COSTS

--LABOR	Number of Days	Hours	Hourly Rate	Total
Biologist	10	80	$20.19	$1,615
Hydrologist	18	144	$19.23	$2,769
Field Tech	30	240	$12.40	$2,976
Equipment Operator	45	360	$35.00	$12,600
Laborer	45	360	$9.00	$3,240
			Subtotal:	$23,200
Staff Benefits at 40%				$9,280
			Total Labor Costs:	$32,480

--MATERIALS AND SUPPLIES	
Read Screenall Mod RD25B	$48,100
500 feet 10" PVC @ $7.00/ft	$3,500
500 feet 12" ABS Flex Pipe @ $5.00/ft	$2,500
500 feet 3" PVC @ $.87/ft	$435
250 gal/min pump, 3 inch discharge	$850
3-inch suction hose	$300
Misc Valves	$250
Misc PVC and ABS connectors	$1,000
Safety Items	$250
Misc tools and supplies	$500
Total Materials and Supplies:	$57,685

--OPERATING EXPENSES	
4-wheel drive tractor with backhoe and load bucket (45 days @ $100.00 per day)	$4,500
5-yd dump truck (45 days at $160.00 per day)	$7,200
Diesel Fuel (450 gal at $1.50/gal)	$675
Gasoline (450 gal at $1.50/gal)	$675
Maintenance supplies, oil, grease, etc.	$200
Mobilization/Demobilization (10% operating costs)	$1,325
Total Operating Expenses:	$14,575

--CONTINGENCY AND OVERHEAD	
Administrative overhead at 5 % (labor + operation)	$2,353
Contingency (15 % of personnel, material and operating costs)	$15,711
TOTAL INITIAL COST	$122,804

ANNUAL OPERATING COSTS

--LABOR	Number of Days	Hours	Hourly Rate	Total
Biologist	7	56	$20.19	$1,131
Hydrologist	7	56	$19.23	$1,077
Field Tech	9	72	$12.40	$893
Equipment Operator	10	80	$35.00	$2,800
Laborer	10	80	$9.00	$720
			Subtotal:	$6,620
Staff Benefits at 40%				$2,648
			Total Labor Costs:	$9,268

--MATERIALS AND SUPPLIES	
Materials on hand, but assume 25% replacement of expendable material cost per year	$2,396
Total Materials and Supplies:	$2,396

--OPERATING EXPENSES	
4-wheel drive tractor with backhoe and load bucket (10days @ $100.00 per da)	$1,000
5-yd dump truck (10 days at $160.00 per da)	$1,600
Diesel Fuel (100 gal at $1.50/gal)	$150
Gasoline (100 gal at $1.50/gal)	$150
Maintenance supplies, oil, grease, etc.	$200
Mobilization/Demobilization (10% operating costs)	$310
Total Operating Expenses:	$3,410

--CONTINGENCY AND OVERHEAD	
Administrative overhead at 5 % (labor + operation)	$634
Contingency (15 % of personnel, material and operating costs)	$2,261
TOTAL ANNUAL OPERATING COST	$17,970

/N/EXCEL/OTHER/DD/TECHMEMO/COS16NLP.XLS

MONTEREY PENINSULA WATER MANAGEMENT DISTRICT

Table 12. Preliminary conceptual cost estimate for program to mitigate the loss of spawning habitat inundated or blocked with the 9,000 acre-foot New Los Padres Reservoir.

INITIAL COSTS

--LABOR	Number of Days	Number of Hours	Hourly Rate	Total
Biologist	5	40	$20.19	$808
Hydrologist	14	112	$19.23	$2,154
Field Tech	18	144	$12.40	$1,786
Equipment Operator	31	248	$35.00	$8,680
Laborer	31	248	$9.00	$2,232
			Subtotal:	$15,659
Staff Benefits at 40%				$6,264
			Total Labor Costs:	$21,923
--MATERIALS AND SUPPLIES				
Read Screenall Mod RD25B				$48,100
500 feet 10" PVC @ $7.00/ft				$3,500
500 feet 12" ABS Flex Pipe @ $5.00/ft				$2,500
500 feet 3" PVC @ $.87/ft				$435
250 gal/min pump, 3 inch discharge				$850
3-inch suction hose				$300
Misc Valves				$250
Misc PVC and ABS connectors				$1,000
Safety Items				$250
Misc tools and supplies				$500
			Total Materials and Supplies:	$57,685
--OPERATING EXPENSES				
4-wheel drive tractor with backhoe and load bucket (31 days @ $100.00 per day)				$3,100
5-yd dump truck (31 days at $160.00 per day)				$4,960
Diesel Fuel (310 gal at $1.50/gal)				$465
Gasoline (310 gal at $1.50/gal)				$465
Maintenance supplies, oil, grease, etc.				$200
Mobilization/Demobilization (10% operating costs)				$919
			Total Operating Expenses:	$10,109
--CONTINGENCY AND OVERHEAD				
Administrative overhead at 5 % (labor + operation)				$1,602
Contingency (15 % of personnel, material and (operating costs)				$13,457
TOTAL INITIAL COST				$104,776

ANNUAL OPERATING COSTS

--LABOR	Number of Days	Number of Hours	Hourly Rate	Total
Biologist	7	56	$20.19	$1,131
Hydrologist	6	48	$19.23	$923
Field Tech	10	80	$12.40	$992
Equipment Operator	7	56	$35.00	$1,960
Laborer	7	56	$9.00	$504
			Subtotal:	$5,510
Staff Benefits at 40%				$2,204
			Total Labor Costs:	$7,714
--MATERIALS AND SUPPLIES				
Materials on hand, but assume 25% replacement of expendable material cost per year				$2,396
			Total Materials and Supplies:	$2,396
--OPERATING EXPENSES				
4-wheel drive tractor with backhoe and load bucket (7 days @ $100.00 per da)				$700
5-yd dump truck (7 days at $160.00 per da)				$1,120
Diesel Fuel (100 gal at $1.50/gal)				$150
Gasoline (100 gal at $1.50/gal)				$150
Maintenance supplies, oil, grease, etc.				$200
Mobilization/Demobilization (10% operating costs)				$232
			Total Operating Expenses:	$2,552
--CONTINGENCY AND OVERHEAD				
Administrative overhead at 5 % (labor + operation)				$513
Contingency (15 % of personnel, material and (operating costs)				$1,899
TOTAL ANNUAL OPERATING COST				$15,074

Table 13. Preliminary conceptual cost estimate for program to mitigate the loss of spawning habitat inundated or blocked with the 6,000 acre-foot Cachagua Creek Reservoir.

INITIAL COSTS

--LABOR	Number of Days	Number of Hours	Hourly Rate	Total
Biologist	3	24	$20.19	$485
Hydrologist	13	100	$19.23	$1,923
Field Tech	14	112	$12.40	$1,389
Equipment Operator	14	112	$35.00	$3,920
Laborer	14	112	$9.00	$1,008
			Subtotal:	$8,724
Staff Benefits at 40%				$3,490
			Total Labor Costs:	$12,214

--MATERIALS AND SUPPLIES	
Read Screenall Mod RD25B	$48,100
500 feet 10" PVC @ $7.00/ft	$3,500
500 feet 12" ABS Flex Pipe @ $5.00/ft	$2,500
500 feet 3" PVC @ $.87/ft	$435
250 gal/min pump, 3 inch discharge	$850
3-inch suction hose	$300
Misc Valves	$250
Misc PVC and ABS connectors	$1,000
Hoppers for gravel (0 @ $500 each)	$0
Safety Items	$250
Misc tools and supplies	$500
Total Materials and Supplies:	$57,685

--OPERATING EXPENSES	
4-wheel drive tractor with backhoe and load bucket (14 days @ $100.00 per day)	$1,400
5-yd dump truck (14 days at $160.00 per day)	$2,240
Subcontractor, Heliocopter (0 hours @ $500.00/hr.)	$0
Diesel Fuel (140 gal at $1.50/gal)	$210
Gasoline (140 gal at $1.50/gal)	$210
Maintenance supplies, oil, grease, etc.	$200
Mobilization/Demobilization (10% operating costs)	$426
Total Operating Expenses:	$4,686

--CONTINGENCY AND OVERHEAD	
Administrative overhead at 5 % (labor + operation)	$845
Contingency (15 % of personnel, material and operating costs)	$11,188
TOTAL INITIAL COST	$86,618

ANNUAL OPERATING COSTS

--LABOR	Number of Days	Number of Hours	Hourly Rate	Total
Biologist	5.5	44	$20.19	$888
Hydrologist	5.5	44	$19.23	$846
Field Tech	7	56	$12.40	$694
Equipment Operator	3.5	28	$35.00	$980
Laborer	3.5	28	$9.00	$252
			Subtotal:	$3,661
Staff Benefits at 40%				$1,464
			Total Labor Costs:	$5,125

--MATERIALS AND SUPPLIES	
Materials on hand, but assume 25% replacement of expendable material cost per year	$2,396
Total Materials and Supplies:	$2,396

--OPERATING EXPENSES	
4-wheel drive tractor with backhoe and load bucket (3.5 days @ $100.00 per da)	$350
5-yd dump truck (3.5 days at $160.00 per da)	$560
Diesel Fuel (35 gal at $1.50/gal)	$53
Gasoline (35 gal at $1.50/gal)	$53
Maintenance supplies, oil, grease, etc.	$200
Mobilization/Demobilization (10% operating costs)	$122
Total Operating Expenses:	$1,337

--CONTINGENCY AND OVERHEAD	
Administrative overhead at 5 % (labor + operation)	$323
Contingency (15 % of personnel, material and operating costs)	$1,329
TOTAL ANNUAL OPERATING COST	$10,510

Table 14. Preliminary conceptual cost estimate for program to mitigate the loss of spawning habitat inundated or blocked with the 11,000 acre-foot San Clemente Creek Reservoir.

INITIAL COSTS

--LABOR	Number of Days	Number of Hours	Hourly Rate	Total
Biologist	9	72	$20.19	$1,454
Hydrologist	15	120	$19.23	$2,308
Field Tech	47	376	$12.40	$4,662
Equipment Operator	47	376	$35.00	$13,160
Laborer	47	376	$9.00	$3,384
			Subtotal:	$24,968
Staff Benefits at 40%				$9,987
			Total Labor Costs:	$34,955

--MATERIALS AND SUPPLIES	
Read Screenall Mod RD25B	$48,100
500 feet 10" PVC @ $7.00/ft	$3,500
500 feet 12" ABS Flex Pipe @ $5.00/ft	$2,500
500 feet 3" PVC @ $.87/ft	$435
250 gal/min pump, 3 inch discharge	$850
3-inch suction hose	$300
Misc Valves	$250
Misc PVC and ABS connectors	$1,000
Safety Items	$250
Hoppers for gravel (3 @ $500 each)	$1,500
Misc tools and supplies	$500
Total Materials and Supplies:	$59,185

--OPERATING EXPENSES	
4-wheel drive tractor with backhoe and load bucket (47 days @ $100.00 per day)	$4,700
5-yd dump truck (47 days at $160.00 per day)	$7,520
Subcontractor, Heliocopter (24 hours @ $500.00/hr.)	$12,000
Diesel Fuel (470 gal at $1.50/gal)	$705
Gasoline (470 gal at $1.50/gal)	$705
Maintenance supplies, oil, grease, etc.	$200
Mobilization/Demobilization (10% operating costs)	$2,583
Total Operating Expenses:	$28,413

--CONTINGENCY AND OVERHEAD	
Administrative overhead at 5 % (labor + operation)	$3,168
Contingency (15 % of personnel, material and (operating costs)	$18,383
TOTAL INITIAL COST	$144,104

ANNUAL OPERATING COSTS

--LABOR	Number of Days	Number of Hours	Hourly Rate	Total
Biologist	8	64	$20.19	$1,292
Hydrologist	8	64	$19.23	$1,231
Field Tech	15	120	$12.40	$1,488
Equipment Operator	10	80	$35.00	$2,800
Laborer	10	80	$9.00	$720
			Subtotal:	$7,531
Staff Benefits at 40%				$3,012
			Total Labor Costs:	$10,543

--MATERIALS AND SUPPLIES	
Materials on hand, but assume 25% replacement of expendable material cost per year	$2,771
Total Materials and Supplies:	$2,771

--OPERATING EXPENSES	
4-wheel drive tractor with backhoe and load bucket (10 days @ $100.00 per da)	$1,000
5-yd dump truck (10 days at $160.00 per da)	$1,600
Diesel Fuel (100 gal at $1.50/gal)	$150
Gasoline (100 gal at $1.50/gal)	$150
Maintenance supplies, oil, grease, etc.	$200
Mobilization/Demobilization (10% operating costs)	$310
Total Operating Expenses:	$3,410

--CONTINGENCY AND OVERHEAD	
Administrative overhead at 5 % (labor + operation)	$698
Contingency (15 % of personnel, material and (operating costs)	$2,509
TOTAL ANNUAL OPERATING COST	$19,931

Table 15. Preliminary conceptual cost estimate for program to mitigate the loss of spawning habitat inundated or blocked with the 23,000 acre-foot New San Clemente Reservoir.

INITIAL COSTS

--LABOR	Number of Days	Number of Hours	Hourly Rate	Total
Biologist	12	96	$20.19	$1,938
Hydrologist	17	136	$19.23	$2,615
Field Tech	60	480	$12.40	$5,952
Equipment Operator	60	480	$35.00	$16,800
Laborer	60	480	$9.00	$4,320
			Subtotal:	$31,626
Staff Benefits at 40%				$12,650
			Total Labor Costs:	$44,276
--MATERIALS AND SUPPLIES				
Read Screenall Mod RD25B				$48,100
500 feet 10" PVC @ $7.00/ft				$[illegible],500
500 feet 12" ABS Flex Pipe @ $5.00/ft				$2,500
500 feet 3" PVC @ $.87/ft				$435
250 gal/min pump, 3 inch discharge				$850
3-inch suction hose				$300
Misc Valves				$250
Misc PVC and ABS connectors				$1,000
Safety Items				$250
Hoppers for gravel (3 @ $500 each)				$1,500
Misc tools and supplies				$500
			Total Materials and Supplies:	$59,185
--OPERATING EXPENSES				
4-wheel drive tractor with backhoe and load bucket (60 days @ $100.00 per day)				$6,000
5-yd dump truck (60 days at $160.00 per day)				$9,600
Subcontractor, Heliocopter (48 hours @ $500.00/hr.)				$24,000
Diesel Fuel (600 gal at $1.50/gal)				$900
Gasoline (600 gal at $1.50/gal)				$900
Maintenance supplies, oil, grease, etc.				$200
Mobilization/Demobilization (10% operating costs)				$4,160
			Total Operating Expenses:	$45,760
--CONTINGENCY AND OVERHEAD				
Administrative overhead at 5 % (labor + operation)				$4,502
Contingency (15 % of personnel, material and operating costs)				$22,383
TOTAL INITIAL COST				$176,106

ANNUAL OPERATING COSTS

--LABOR	Number of Days	Number of Hours	Hourly Rate	Total
Biologist	8	64	$20.19	$1,292
Hydrologist	7	56	$19.23	$1,077
Field Tech	19	152	$12.40	$1,885
Equipment Operator	14	112	$35.00	$3,920
Laborer	14	112	$9.00	$1,008
			Subtotal:	$9,182
Staff Benefits at 40%				$3,673
			Total Labor Costs:	$12,855
--MATERIALS AND SUPPLIES				
Materials on hand, but assume 25% replacement of expendable material cost per year				$2,771
			Total Materials and Supplies:	$2,771
--OPERATING EXPENSES				
4-wheel drive tractor with backhoe and load bucket (14 days @ $100.00 per da)				$1,[illegible]00
5-yd dump truck (14 days at $160.00 per da)				$2,240
Diesel Fuel (140 gal at $1.50/gal)				$210
Gasoline (140 gal at $1.50/gal)				$210
Maintenance supplies, oil, grease, etc.				$200
Mobilization/Demobilization (10% operating costs)				$426
			Total Operating Expenses:	$4,6[illegible]5
--CONTINGENCY AND OVERHEAD				
Administrative overhead at 5 % (labor + operation)				$877
Contingency (15 % of personnel, material and operating costs)				$3,047
TOTAL ANNUAL OPERATING COST				$24,236

Table 16. Preliminary conceptual cost estimate for program to mitigate the loss of spawning habitat inundated or blocked with the 10,000 acre-foot Chupines Creek Reservoir.

INITIAL COSTS

--LABOR	Number of Days	Number of Hours	Hourly Rate	Total
Biologist	2	16	$20.19	$323
Hydrologist	11	88	$19.23	$1,692
Field Tech	9	72	$12.40	$89
Equipment Operator	9	72	$35.00	$2,520
Laborer	9	72	$9.00	$648
			Subtotal:	$6,076
Staff Benefits at 40%				$2,430
			Total Labor Costs:	$8.507

--MATERIALS AND SUPPLIES	
Read Screenall Mod RD25B	$48,100
500 feet 10" PVC @ $7.00/ft	$3,500
500 feet 12" ABS Flex Pipe @ $5.00/ft	$2,500
500 feet 3" PVC @ $.87/ft	$435
250 gal/min pump, 3 inch discharge	$850
3-inch suction hose	$300
Misc Valves	$250
Misc PVC and ABS connectors	$1,000
Safety Items	$250
Misc tools and supplies	$500
Total Materials and Supplies:	$57,685

--OPERATING EXPENSES	
4-wheel drive tractor with backhoe and load bucket (9 days @ $100.00 per day)	$900
5-yd dump truck (9 days at $160.00 per day)	$1,440
Subcontractor, Helicopter (0 hours @ $500.00/hr.)	$0
Diesel Fuel (90 gal at $1.50/gal)	$135
Gasoline (90 gal at $1.50/gal)	$135
Maintenance supplies, oil, grease, etc.	$200
Mobilization/Demobilization (10% operating costs)	$281
Total Operating Expenses:	$3,091

--CONTINGENCY AND OVERHEAD	
Administrative overhead at 5 % (labor + operation)	$580
Contingency (15 % of personnel, material and operating costs)	$10,392
TOTAL INITIAL COST	$80,255

ANNUAL OPERATING COSTS

--LABOR	Number of Days	Number of Hours	Hourly Rate	Total
Biologist	5.5	44	$20.19	$888
Hydrologist	5.5	44	$19.23	$846
Field Tech	8	64	$12.40	$794
Equipment Operator	3	24	$35.00	$840
Laborer	3	24	$9.00	$216
			Subtotal:	$3,584
Staff Benefits at 40%				$1,434
			Total Labor Costs:	$5,018

--MATERIALS AND SUPPLIES	
Materials on hand, but assume 25% replacement of expendable material cost per year	$2,396
Total Materials and Supplies:	$2,396

--OPERATING EXPENSES	
4-wheel drive tractor with backhoe and load bucket (3 days @ $100.00 per da)	$300
5-yd dump truck (3 days at $160.00 per da)	$480
Diesel Fuel (30 gal at $1.50/gal)	$45
Gasoline (30 gal at $1.50/gal)	$45
Maintenance supplies, oil, grease, etc.	$200
Mobilization/Demobilization (10% operating costs)	$107
Total Operating Expenses:	$1,177

--CONTINGENCY AND OVERHEAD	
Administrative overhead at 5 % (labor + operation)	$310
Contingency (15 % of personnel, material and operating costs)	$1,289
TOTAL ANNUAL OPERATING COST	$10,189

/N/EXCEL/OTHER/DD/TECHMEMO/COS24NLP.XLS

NATIVE AND NATURALIZED VASCULAR PLANTS SEEN IN THE NEW SAN CLEMENTE INUNDATION AREA, ON 26, 28, 29 JUNE, 12 AND 13 JULY, 1989, BY JEFF NORMAN

TREES:

Acer macrophyllum	big-leaf maple
Aesculus californicus	buckeye
Alnus rhombifolia	white alder
Alnus rubra	red alder
Arbutus menziesii	madrone
Juglans hindsii	California black walnut
Lithocarpus densiflorus	tan oak
Pinus ponderosa	ponderosa pine
Pinus radiata	Monterey pine
Platanus racemosa	western sycamore
Populus trichocarpa	black cottonwood
Quercus agrifolia	coast live oak
Quercus chrysolepis	canyon live oak
Quercus lobata	valley oak
Salix coulteri	Coulter willow
Salix hindsiana	sandbar willow
Salix laevigata var. araquipa	red willow
Salix laevigata var. laevigata	red willow
Salix lasiolepis var. lasiolepis	arroyo willow
Sambucus mexicana	blue elderberry
Sequoia sempervirens	coast redwood
Umbellularia californica	California bay

SHRUBS:

Adenostoma fasciculatum	chamise
Amorpha californica var. californica	mock locust
Antirrhinum multiflorum	sticky snapdragon
Arctostaphylos glandulosa ssp. zacaensis f. zacaensis	Eastwood manzanita
Arctostaphylos tomentosa ssp. crustacea	brittleleaf manzanita
Arctostaphylos tomentosa ssp. bracteosa f. bracteosa	Monterey manzanita
Arctostaphylos tomentosa ssp. bracteosa f. hebeclada	Monterey manzanita
Artemisia californica	California sagebrush
Baccharis pilularis var. consanguinea	coyote brush
Baccharis viminea	mule fat
Brickellia californica	California brickelbush
Ceanothus cuneatus	buck brush
Ceanothus ramulosus	coast ceanothus
Ceanothus sorediatus	jimbrush
Cercocarpus betuloides	California hard-tack
Clematis lasiantha	pipe stem
Clematis ligusticifolia	yerba de chivato
Cornus sericea ssp. occidentalis	western red dogwood
Cytisus monspessulanus	French broom
Cytisus scoparius	Scotch broom
Epilobium canum	California fuchsia
Ericameria arborescens	golden fleece
Ericameria ericoides ssp. blakei	mock heather
Eriodictyon californicum	yerba santa

NATIVE AND NATURALIZED VASCULAR PLANTS SEEN IN THE NEW SAN CLEMENTE INUNDATION AREA, ON 26, 28, 29 JUNE, 12 AND 13 JULY, 1989, BY JEFF NORMAN

SHRUBS (cont.):

Eriogonum fasciculatum var. foliolosum	buckwheat brush
Eriophyllum confertiflorum var. confertiflorum	golden yarrow
Galium angustifolium var. angustifolium	narrow-leaved bedstraw
Galium porrigens var. porrigens	climbing bedstraw
Garrya elliptica	coast silk-tassel
Heteromeles arbutifolia	toyon
Holodiscus discolor	cream bush
Keckiella breviflora	bush beard-tongue
Lepechinia calycina	pitcher sage
Lonicera hispidula var. vacillans	hairy honeysuckle
Lonicera interrupta	chaparral honeysuckle
Lotus scoparius var. scoparius f. scoparius	deerweed
Lupinus albifrons var. albifrons	silver lupine
Lupinus albifrons var. douglasii	Douglas' silver lupine
Lupinus arboreus	bush lupine
Mahonia pinnata	California barberry
Marrubium vulgare	white horehound
Mimulus aurantiacus	sticky monkey-flower
Mimulus bifidus ssp. fasciculatus	Santa Lucia sticky monkey-flower
Prunus ilicifolia	holly-leaved cherry
Rhamnus californica ssp. californica	coffeeberry
Rhamnus californica ssp. tomentella	coffeeberry
Rhamnus crocea ssp. crocea	redberry
Rhamnus crocea ssp. ilicifolia	hollyleaf redberry
Ribes amarum	bitter gooseberry
Ribes malvaceum	chaparral currant
Ribes speciosum	garnet gooseberry
Rosa californica	California wild rose
Rosa gymnocarpa	wood rose
Rubus parviflorus	thimbleberry
Rubus ursinus	Pacific blackberry
Salvia mellifera	black sage
Symphoricarpos albus	common snowberry
Symphoricarpos mollis	creeping snowberry
Toxicodendron diversilobum	poison oak

HERBACEOUS SPECIES:

Achillea borealis ssp. californica	common yarrow
Agoseris grandiflora	large-flowered agoseris
Agoseris heterophylla	annual agoseris
Aira caryophyllea	hair grass
Aquilegia formosa var. hypolasia	columbine
Arabis glabra var. glabra	tower mustard
Aralia californica	elk clover
Artemisia douglasiana	mugwort
Artemisia dranunculus	dragon sagewort
Asclepias eriocarpa	Indian milkweed
Avena barbata	slender oat
Baccharis douglasii	Douglas' baccharis
Barbarea verna	winter-cress

NATIVE AND NATURALIZED VASCULAR PLANTS SEEN IN THE NEW SAN CLEMENTE INUNDATION AREA, ON 26, 28, 29 JUNE, 12 AND 13 JULY, 1989, BY JEFF NORMAN

<u>HERBACEOUS</u> <u>SPECIES</u> (cont.):

Bellis perennis	English daisy
Berula erecta	water parsnip
Bloomeria crocea var. aurea	golden stars
Boykinia elata	brook foam
Brassica geniculata	summer mustard
Briza maxima	rattlesnake grass
Brodiaea lutea	golden brodiaea
Brodiaea pulchella	blue dicks
Bromus carinatus	California brome
Bromus mollis	soft chess
Bromus rigidus	ripgut grass
Bromus rubens	red brome
Calochortus albus var. albus	white globe lily
Calochortus luteus	yellow mariposa lily
Calystegia purpurata ssp. solanensis	western morning-glory
Camissonia fruticetorum	primrose
Carex spp.	sedges
Centaurea melitensis	tocalote
Chenopodium ambrosioides	Mexican tea
Chenopodium californicum	soap plant
Chlorogalum pomeridianum	amole
Chrysopsis villosa var. camphorata	hairy golden aster
Cirsium proteanum	red thistle
Cirsium vulgare	bull thistle
Claytonia perfoliata	miner's lettuce
Clarkia lewisii	Lewis' clarkia
Clarkia purpurea	clarkia
Clarkia unguiculata	canyon clarkia
Collinsia sp.	collinsia
Conium maculatum	poison hemlock
Conyza canadensis	horseweed
Cordylanthus rigidus	bird's beak
Corethrogyne filaginifolia var. rigida	corethrogyne
Cortaderia atacamensis	pampas grass
Cryptantha microstachys	Tejon cryptantha
Cryptantha muricata var. muricata	spiny cryptantha
Cynoglossum grande	hound's tongue
Cyperus eragrostis	umbrella sedge
Datisca glomerata	durango root
Daucus pusillus	yerba vibra
Digitalis purpurea	foxglove
Disporum hookeri	fairy bells
Dodecatheon sp.	shooting stars
Dudleya cymosa ssp. minor	Goldman's dudleya
Elymus condensatus	giant wild rye
Elymus glaucus	blue wild rye
Epilobium adencaulon var. parishii	California willow-herb
Epipactis helleborine	helleborine orchis
Erechtites arguta	cut-leaved fireweed
Eremocarpus setigerus	dove weed
Erigeron foliosus var. foliosus	leafy daisy
Eriogonum nudum var. auriculatum	naked buckwheat
Eriogonum gracile	slender woolly eriogonum

NATIVE AND NATURALIZED VASCULAR PLANTS SEEN IN THE NEW SAN CLEMENTE INUNDATION AREA, ON 26, 28, 29 JUNE, 12 AND 13 JULY, 1989, BY JEFF NORMAN

HERBACEOUS SPECIES (cont.):

Erysimum capitatum	Douglas' wallflower
Eschscholzia californica var. californica	California poppy
Eucrpta chrysanthemifolia	common eucrypta
Filago gallica	narrow-leaved filago
Foeniculum vulgare	sweet fennel
Galium aparine	goosegrass
Galium californicum ssp. flaccidum	California bedstraw
Galium parisiense	wall bedstraw
Gernaium bicknelli var. longipes	Bicknell's geranium
Gilia achilleaefolia ssp. achilleaefolia	California gilia
Gilia achilleaefolia ssp. multicaulis	California gilia
Gnaphalium beneolens	fragrant everlasting
Gnaphalium californicum	California everlasting
Gnaphalium chilense	cotton-batting plant
Gnaphalium luteo-album	weedy cudweed
Gnaphalium purpureum	purple cudweed
Habenaria elegans var. elegans	slender habenaria
Helenium puberulum	sneezeweed
Heuchera micrantha var. hartwegii	alum root
Hieracium albiflorum	white-flowered hawkweed
Hieracium argutum var. parishii	yellow-flowered hawkweed
Horkelia frondosa	leafy horkelia
Hypochoeris glabra	smooth cat's ear
Hypochoeris radicata	hairy cat's ear
Juncus spp.	wire rushes
Lactuca serriola	prickly lettuce
Lathyrus latifolius	everlasting pea
Lathyrus vestitus ssp. puberulus	Pacific pea
Layia paniculata	slender layia
Lemna minor	duckweed
Lilium pardalinum	tiger lily
Linanthus liniflorus ssp. pharnacoides	flax-flowered linanthus
Lolium multiflorum	Italian rye
Lotus purshianus	Spanish clover
Lunaria annua	money plant
Lupinus latifolius	broad-leaved lupine (blue and white forms)
Lupinus nanus ssp. nanus	sky lupine
Lupinus succulentus	succulent annual lupine
Madia gracilis	gumweed
Madia madioides	woodland madia
Madia sativa	Chile tarweed
Marah fabaceus	manroot
Medicago lupulina	black medic
Medicago polymorpha var. brevispina	smooth bur clover
Medicago polymorpha var. polymorpha	bur clover
Melilotus albus	white sweet-clover
Melilotus indicus	Indian melilot
Mentha arvensis var. villosa	field mint
Mentha spicata	spearmint
Mentzelia sp.	stickleaf
Microseris lindleyi	blow-wives
Mimulus guttatus ssp. guttatus	seep-spring monkey-flower

NATIVE AND NATURALIZED VASCULAR PLANTS SEEN IN THE NEW SAN CLEMENTE INUNDATION AREA, ON 26, 28, 29 JUNE, 12 AND 13 JULY, 1989, BY JEFF NORMAN

HERBACEOUS SPECIES (cont.):

Monardella villosa var. obispoensis	coyote mint
Monardella villosa var. villosa	coyote mint
Nasturtium officinale	watercress
Navarretia atractyloides	holly-leaved navarretia
Orthocarpus sp.	owl's clover
Osmorhiza brachypoda	California cicely
Petasites palmatus	western coltsfoot
Phacelia imbricata	imbricate phacelia
Phacelia malvaefolia	stinging phacelia
Pholistoma auritum	fiesta flower
Plagiobothrys sp.	popcorn flower
Plantago lanceolata	ribgrass
Plantago major var. major	common plantain
Polygala californica	California milkwort
Polypogon monspeliensis	rabbit's foot grass
Psoralea macrostachya	leather root
Psoralea physodes	California tea
Pterostegia drymarioides	pterostegia
Rafinesquia californica	California chicory
Rorippa curvisiliqua	western yellow-cress
Rumex acetosella	sheep sorrel
Rumex conglomeratus	clustered dock
Rumex crispus	curly dock
Rumex salicifolius	willow dock
Salvia columbariae	chia
Sanicula crassicaulis	gambleweed
Satureja chamissonis	yerba buena
Scirpus sp.	tule
Scrophularia californica	coast figwort
Sedum spathulifolium ssp. anomalum	Pacific stonecrop
Senecio vulgaris	common groundsel
Silene antirrhina	sticky catchfly
Silene gallica	windmill pink
Silybum marianum	milk thistle
Sisymbrium irio	London rocket
Smilacina racemosa var. amplexicaulis	fat Solomon
Smilacina stellata var. sessilifolia	slim Solomon
Solanum nodiflorum	small-flowered nightshade
Solidago californica	California goldenrod
Solidago occidentalis	western goldenrod
Sonchus asper	prickly sow thistle
Sonchus oleraceus	common sow thistle
Spergularia rubra	purple sand spurrey
Stachys bullata	hedge nettle
Stellaria media	common chickweed
Stephanomeria elata	wire lettuce
Stephanomeria virgata ssp. pleurocarpa	tall wire lettuce
Stipa sp.	bunchgrass
Tauschia hartwegii	Hartweg's tauschia
Thalictrum fendleri	Fendler's meadow rue
Thysanocarpus elegans	lace pod
Torilis nodosa	hedge parsley
Trichostema lanceolatum	vinegar weed

NATIVE AND NATURALIZED VASCULAR PLANTS SEEN IN THE NEW SAN CLEMENTE INUNDATION AREA, ON 26, 28, 29 JUNE, 12 AND 13 JULY, 1989, BY JEFF NORMAN

HERBACEOUS SPECIES (cont.):

Trifolium tridentatum	tomcat clover
Trifolium spp.	clovers
Typha sp.	cattail
Urtica holosericea	hoary nettle
Verbascum thapsus	woolly mullein
Verbena lasiostachys var. lasiostachys	western vervain
Veronica anagallis-aquatica	water speedwell
Veronica catenata	broad-fruited water speedwell
Vicia gigantea	giant vetch
Vicia sp.	vetch
Vinca major	periwinkle
Whipplea modesta	yerba de selva
Yucca whipplei ssp. percursa	Spanish bayonet
Zigadenus fremontii var. fremontii	star-lily

FERNS AND FERN ALLIES:

Adiantum jordanii	California maidenhair fern
Dryopteris arguta	wood fern
Equisetum arvense	horsetail
Equisetum x ferrissii	scouring rush
Equisetum hymale var. affine	scouring rush
Equisetum laevigatum	Braun's scouring rush
Equisetum telmateia var. braunii	giant horsetail
Pellaea andromedaefolia	coffee fern
Pellaea mucronata	bird's foot fern
Pityrogramma triangularis	printback fern
Polypodium californicum var. californicum	California polypody
Polystichum munitum ssp. munitum	sword fern
Pteridium aquilinum var. pubescens	western bracken
Selaginella bigelovii	bushy selaginella
Woodwardia fimbriata	chain fern

NATIVE AND NATURALIZED VASCULAR PLANTS SEEN IN NEW LOS PADRES INUNDATION AREA, 6, 8, 9 JUNE, AND 8 SEPT., 1989, BY JEFF NORMAN

TREES:

Acer macrophyllum	big-leaf maple
Aesculus californicus	buckeye
Alnus rhombifolia	white alder
Alnus rubra	red alder
Arbutus menziesii	madrone
Eucalyptus globulus	blue gum
Lithocarpus densiflorus	tan oak
Pinus coulteri	Coulter pine
Pinus ponderosa	ponderosa pine
Pinus radiata	Monterey pine
Platanus racemosa	western sycamore
Populus trichocarpa	black cottonwood
Quercus agrifolia	coast live oak
Quercus chrysolepis	canyon live oak
Quercus kelloggii	black oak
Quercus lobata	valley oak
Robinia pseudo-acacia	black locust
Salix coulteri	coulter willow
Salix hindsiana	sandbar willow
Salix laevigata var. araquipa	red willow
Salix laevigata var. laevigata	red willow
Salix lasiolepis var. lasiolepis	arroyo willow
Sambucus mexicana	blue elderberry
Umbellularia californica	California bay

SHRUBS:

Adenostoma fasciculatum	chamise
Antirrhinum multiflorum	sticky snapdragon
Arctostaphylos glandulosa ssp. zacaensis f. zacaensis	Eastwood manzanita
Arctostaphylos tomentosa ssp. crustacea	brittle-leaf manzanita
✓Arctostaphylos sp.	manzanita
Artemisia californica	California sagebrush
Baccharis pilularis var. consanguinea	coyote brush
Baccharis viminea	mule fat
Brickellia californica	California brickelbush
Ceanothus cuneatus	buck brush
Ceanothus sorediatus	jimbrush
Clematis lasiantha	pipe-stem
Cornus sericea ssp. occidentalis	western red dogwood
Epilobium canum	California fuchsia
Ericameria arborescens	golden fleece
Eriodictyon californicum	yerba santa
Eriogonum fasciculatum var. foliolosum	buckwheat brush
Eriophyllum confertiflorum var. confertiflorum	golden yarrow
Galium angustifolium var. angustifolium	narrow-leaved bedstraw
Galium porrigens var. porrigens	climbing bedstraw
Heteromeles arbutifolia	toyon
Holodiscus discolor	cream bush
Keckiella breviflora	bush beard-tongue
Lonicera hispidula var. vacillans	hairy honeysuckle
Lonicera interrupta	chaparral honeysuckle

NATIVE AND NATURALIZED VASCULAR PLANTS SEEN IN NEW LOS PADRES INUNDATION AREA, 6, 8, 9 JUNE, AND 8 SEPT., 1989, BY JEFF NORMAN

SHRUBS (cont.):

Lotus scoparius var. scoparius f. scoparius	deerweed
Lupinus albifrons var. albifrons	silver lupine
Mahonia pinnata	California barberry
Mimulus aurantiacus	sticky monkey-flower
Mimulus bifidus ssp. fasciculatus	Santa Lucia sticky monkey-flower
Prunus ilicifolia	holly-leaved cherry
Penstemon heterophyllus ssp. australis	chaparral penstemon
Rhamnus californica ssp. californica	coffeeberry
Rhamnus californica ssp. tomentella	coffeeberry
Rhamnus crocea ssp. crocea	redberry
Rhamnus crocea ssp. ilicifolia	hollyleaf redberry
Ribes amarum	bitter gooseberry
Ribes divaricatum	straggly gooseberry
Ribes menziesii var. menziesii ?	canyon gooseberry
Ribes sericeum ?	Santa Lucia gooseberry
Ribes speciosum	garnet gooseberry
Rosa californica	California wild rose
Rosa gymnocarpa	wood rose
Rubus parviflorus	thimbleberry
Rubus procerus	Himalaya-berry
Rubus ursinus	Pacific blackberry
Salvia mellifera	black sage
Symphoricarpos mollis	creeping snowberry
Toxicodendron diversilobum	poison oak

HERBACEOUS SPECIES:

Achillea borealis ssp. californica	common yarrow
Agoseris californica	annual agoseris
Agoseris grandiflora	large-flowered agoseris
Aira caryophyllea	hair grass
Allophyllum divaricatum	divaricate gilia
Allophyllum glutinosum	glutinous allophyllum
Anagallis arvensis	scarlet pimpernel
Anthriscus caucalis	bur-chervil
Aquilegia formosa var. hypolasia	columbine
Arabis glabra var. glabra	tower mustard
Aralia californica	elk clover
Arenaria douglasii	Douglas' sandwort
Artemisia douglasiana	mugwort
Artemisia dranunculus	dragon sagewort
Asclepias eriocarpa	Indian milkweed
Avena barbata	slender oat
Baccharis douglasii	Douglas' baccharis
Barbarea verna	winter-cress
Boykinia elata	brook foam
Brassica geniculata	summer mustard
Briza maxima	rattlesnake grass
Briza minor	little quaking grass
Brodiaea lutea	golden brodiaea

NATIVE AND NATURALIZED VASCULAR PLANTS SEEN IN NEW LOS PADRES INUNDATION AREA, 6, 8, 9 JUNE, AND 8 SEPT., 1989, BY JEFF NORMAN

HERBACEOUS SPECIES (cont.):

Brodiaea pulchella	blue dicks
Bromus carinatus	California brome
Bromus mollis	soft chess
Bromus rigidus	ripgut grass
Bromus rubens	red brome
Calochortus albus var. albus	white globe lily
Calystegia purpurata ssp. solanensis	western morning-glory
Camissonia fruticetorum	primrose
Cardamine oligosperma	hill cress
Carex spp.	sedges
Castilleja affinis	Indian paint brush
Castilleja foliolosa	wooly painted cup
Centaurea melitensis	tocalote
Cerastium glomeratum	mouse-ear chickweed
Chenopodium ambrosioides	Mexican tea
Chlorogalum pomeridianum	amole
Chorizanthe staticoides	Turkish rugging
Chrysopsis villosa var. camphorata	hairy golden aster
Cirsium occidentale	cobweb thistle
Cirsium proteanum	red thistle
Cirsium vulgare	bull thistle
Clarkia cylindrica	band clarkia
Clarkia lewisii	Lewis' clarkia
Clarkia purpurea ssp. purpurea	purple clarkia
Clarkia purpurea ssp. quadrivulnera	four spot
Clarkia unguiculata	canyon clarkia
Claytonia perfoliata	miner's lettuce
Collinsia heterophylla	Chinese houses
Collomia grandiflora	large-flowered collomia
Conyza canadensis	horseweed
Corethrogyne filaginifolia var. rigida	corethrogyne
Cryptantha microstachys	tejon cryptantha
Cryptantha muricata var. muricata	spiny cryptantha
Cyperus eragrostis	umbrella sedge
Datisca glomerata	durango root
Daucus pusillus	yerba vibra
Delphinium parryi	Parry's larkspur
Dodecatheon sp.	shooting star
Dudleya cymosa ssp. minor	Goldman's dudleya
Elymus condensatus	giant wild rye
Elymus glaucus	blue wild rye
Epilobium adenocaulon var. parishii	California willow-herb
Epilobium paniculatum	summer cottonweed
Epipactis gigantea	stream orchis
Erechtites prenanthoides	toothed coast fireweed
Eremocarpus setigerus	dove weed
Erigeron folilosus var. foliolosus	leafy daisy
Eriogonum elongatum	long-stemmed eriogonum
Eriogonum nudum var. auriculatum	naked buckwheat
Eriogonum roseum	virgate eriogonum
Erodium botrys	long-beaked filaree
Erodium cicutarium	red-stemmed filaree
Eschscholzia caespitosa	tufted poppy

NATIVE AND NATURALIZED VASCULAR PLANTS SEEN IN NEW LOS PADRES INUNDATION AREA, 6, 8, 9 JUNE, AND 8 SEPT., 1989, BY JEFF NORMAN

HERBACEOUS SPECIES (cont.):

Eschscholzia californica var. californica	California poppy
Filago californica	California cotton rose
Filago gallica	narrow-leaved filago
Foeniculum vulgare	sweet fennel
Galium aparine	goosegrass
Galium californicum ssp. flaccidum	California bedstraw
Galium parisiense	wall bedstraw
Geranium molle	dove's foot geranium
Gilia capitata ssp. abrotanifolia	blue field gilia
Gnaphalium beneolens	fragrant everlasting
Gnaphalium californicum	California everlasting
Gnaphalium chilense	cotton-batting plant
Gnaphalium luteo-album	weedy cudweed
Gnaphalium purpureum	purple cudweed
Helenium puberulum	sneezeweed
Heracleum lanatum	cow parsnip
Heterotheca grandiflora	telegraph weed
Heuchera micrantha var. hartwegii	alum root
Hieracium argutum var. parishii	yellow-flowered hawkweed
Horkelia frondosa	leafy horkelia
Hypochoeris glabra	smooth cat's ear
Juncus spp.	wire rushes
Lactuca serriola	prickly lettuce
Lathyrus vestitus ssp. puberulus	Pacific pea
Lathyrus vestitus ssp. vestitus	Pacific pea
Layia paniculata	slender layia
Lilium pardalinum	tiger lily
Linanthus liniflorus ssp. pharnacoides	flax-flowered linanthus
Lolium multiflorum	Italian rye
Lomatium utriculatum	bladder parsnip
Lotus crassifolius	broad-leaved lotus
Lotus micranthus	hill lotus
Lotus purshianus	Spanish clover
Lotus strigosus	bishop lotus
Lupinus bicolor ssp. microphyllus	Lindley's annual lupine
Lupinus formosus var. bridgesi	lunara lupine
Lupinus hirsutissimus	stinging lupine
Lupinus latifolius	broad-leaved lupine
Lupinus nanus ssp. nanus	sky lupine
Lupinus succulentus	succulent annual lupine
Madia elegans ssp. elegans	common madia
Madia gracilis	gumweed
Malacothrix clevelandii	Cleveland's malacothrix
Marah fabaceus	manroot
Medicago lupulina	black medic
Medicago polymorpha var. polymorpha	bur clover
Melilotus albus	white sweet-clover
Melilotus indicus	Indian melilot
Micropus californicus	slender cottonweed
Microseris lindleyi	blow-wives
Mimulus cardinalis	scarlet monkey-flower
Mimulus floribundus	floriferous monkey-flower
Mimulus guttatus ssp. guttatus	seep-spring monkey-flower

NATIVE AND NATURALIZED VASCULAR PLANTS SEEN IN NEW LOS PADRES INUNDATION AREA, 6, 8, 9 JUNE, AND 8 SEPT., 1989, BY JEFF NORMAN

HERBACEOUS SPECIES (cont.):

Monardella villosa var. obispoensis	coyote mint
Navarretia atractyloides	holly-leaved navarretia
Orthocarpus purpurascens var. purpurascens	purple owl's clover
Osmorhiza brachypoda	California cicely
Petasites palmatus	western coltsfoot
Phacelia egena	phacelia
Phacelia imbricata	imbricate phacelia
Pholistoma auritum	fiesta flower
Phoradendron tomentosum ssp. villosum	oak mistletoe
Plantago lanceolata	ribgrass
Plectritis sp.	plectritis
Polygala californica	California milkwort
Polygonum aviculare	common knotweed
Polygonum lapathifolium	willow weed
Polypogon monspeliensis	rabbit's foot grass
Psoralea macrostachya	leather root
Psoralea physodes	California tea
Pterostegia drymarioides	pterostegia
Rafinesquia californica	California chicory
Ranunculus californicus var. californicus	California buttercup
Rorippa curvisiliqua	western yellow-cress
Rumex acetosella	sheep sorrel
Rumex conglomeratus	clustered dock
Rumex crispus	curly dock
Rumex salicifolius	willow dock
Salvia columbariae	chia
Salvia spathacea	crimson sage
Sanicula crassicaulis	gamble weed
Satureja chamissonis	yerba buena
Scrophularia californica	coast figwort
Silene antirrhina	sticky catchfly
Silene gallica	windmill pink
Solanum nigrum	black nightshade
Solidago californica	California goldenrod
Sonchus oleraceus	common sow thistle
Spergula arvensis	corn spurrey
Stachys bullata	hedge nettle
Stellaria media	common chickweed
Stephanomeria virgata ssp. pleurocarpa	tall wire lettuce
Tauschia hartwegii	Hartweg's tauschia
Thalictrum fendleri	Fendler's meadow rue
Thysanocarpus elegans	lace pod
Tillaea erecta	sand pygmy
Torilis nodosa	hedge parsley
Trichostema lanceolatum	vinegar weed
Trifolium ciliolatum	tree clover
Trifolium microcephalum	maiden clover
Trifolium obtusiflorum	creek clover
Trifolium tridentatum	tomcat clover
Trifolium variegatum var. variegatum	white-tipped clover
Typha sp.	cattail
Urtica holosericea	hoary nettle
Verbena lasiostachys var. abramsii	western vervain

NATIVE AND NATURALIZED VASCULAR PLANTS SEEN IN NEW LOS PADRES INUNDATION AREA, 6, 8, AND 9 JUNE, AND 8 SEPT., 1989, BY JEFF NORMAN

HERBACEOUS SPECIES (cont.):

Verbena lasiostachys var. lasiostachys	western vervain
Veronica angallis-aquatica	water speedwell
Viola pedunculata	Johnny-jump-up
Wyethia helenoides	woolly mule-ears
Yucca whipplei ssp. percursa	Spanish bayonet
Zigadenus fremontii var. fremontii	star-lily

FERNS AND FERN ALLIES:

Adiantum jordanii	California maidenhair fern
Adiantum pedatum var. aleuticum	five-finger fern
Dryopteris arguta	wood fern
Equisetum arvense	horsetail
Equisetum x ferrissii	scouring rush
Equisetum laevigatum	Braun's scouring rush
Equisetum telmateia var. braunii	giant horsetail
Pellaea andromedaefolia	coffee fern
Pellaea mucronata	bird's foot fern
Pityrogramma triangularis	printback fern
Polypodium californicum var. californicum	California polypody
Polystichum munitum ssp. munitum	sword fern
Pteridium aquilinum var. pubescens	western bracken
Selaginella bigelovii	bushy selaginella
Woodwardia fimbriata	chain fern

ADDITIONS AND CORRECTIONS TO THE LIST OF NATIVE AND NATURALIZED VASCULAR PLANTS OF THE NEW LOS PADRES INUNDATION AREA, AS OF SPRING, 1990.

The following taxa should be eliminated from the list of plants seen in June and September, 1989: Ribes menziesii var. menziesii
Ribes sericeum

The shooting stars, which were not seen early enough last year to determine, were found to be Dodecatheon clevelandii ssp. sanctarum. The plectritis seen last year, likewise too early to identify, was found to be Plectritis congesta ssp. congesta.

In addition to the two taxa listed above, the following should be added to the list, based on field work of 15, 16, 24 and 25 May, 1990:

SHRUBS, SUBSHRUBS, AND WOODY VINES:

Clematis ligusticifolia	yerba de chivato
Dendromecon rigida	bush poppy
Oemleria cerasiformis	oso berry

HERBACEOUS SPECIES:

Amsinckia intermedia	common fiddleneck
Bowlesia incana	bowlesia
Calochortus albus var. rubellus	globe lily
Camissonia hardhamiae	Hardham's camissonia
Cardamine californica	milk maids
Chorizanthe membranacea	pink chorizanthe
Collomia heterophylla	varied-leaved collomia
Cordylanthus rigidus	bird's beak
Cryptantha muricata var. jonesii	cryptantha
Cuscuta californica var. californica	chaparral dodder
Cynoglossum grande	hound's tongue
Delphinium patens ssp. patens	coast larkspur
Disporum hookeri	fairy bells
Erigeron foliosus var. stenophyllus	leafy daisy
Erysimum capitatum	Douglas' wallflower
Euphorbia crenulata	Chinese caps
Euphorbia peplus	petty spurge
Fritillaria lanceolata	checker lily
Galium californicum ssp. californicum	California bedstraw
Calium sp.	anomalous bedstraw
Gilia achilleaefolia ssp. achilleaefolia	California gilia
Gilia achilleaefolia ssp. multicaulis	gilia
Gnaphalium bicolor	Bioletti's cudweed
Habenaria unalascensis	Alaska habenaria
Heuchera micrantha var. pacifica	alum-root
Lasthenia chrysostoma ssp. chrysostoma	goldfields
Linanthus androsaceus ssp. luteolus	shower gilia
Linanthus ciliatus	whisker brush
Lithophragma heterophylla	hill star

ADDITIONS AND CORRECTIONS TO THE LIST OF NATIVE AND NATURALIZED VASCULAR PLANTS OF THE NEW LOS PADRES INUNDATION AREA, AS OF SPRING, 1990.

HERBACEOUS SPECIES (cont.):

Lobelia dunnii var. serrata	Rothrock's lobelia
Lomatium sp.	anomalous lomatium
Lotus oblongifolius	narrow-leaved lotus
Madia elegans ssp. vernalis	madia
(Material seen in the inundation area this season fits the description of the low-elevation ecotype in Munz, 1959. Hoover (1970) finds little other than blooming period to distinguish it from ssp. elegans. Not previously reported from Monterey County.)	
Madia exigua	little tarweed
Madia sativa	Chile tarweed
Matricaria matricarioides	pineapple weed
Mimulus nasutus	snouted monkey-flower
Nemophila heterophylla	variable-leaved nemophila
Nemophila menziesii	baby-blue-eyes
Osmorhiza chilensis	wood cicely
Phacelia distans	common phacelia
Phacelia malvaefolia	stinging phacelia
Plagiobothrys nothofulvus	popcorn flower
Potentilla glandulosa	sticky cinquefoil
Saxifraga californica	California saxifrage
Silene lemmonii	Lemmon's campion
Sisymbrium officinale	hedge mustard
Smilacina racemosa var. amplexicaulis	western Solomon's seal
Thysanocarpus curvipes	hairy fringe pod
Thysanocarpus laciniatus var. crenatus	narrow-leaved fringe pod
Trifolium albopurpureum	rancheria clover
Trifolium gracilentum	pin-point clover
Trifolium variegatum var. pauciflorum	white-tipped clover
Tunica prolifera	wild carnation
(Introduced. Not previously reported from Monterey County.)	
Veronica arvensis	corn speedwell
Veronica persica	Persian speedwell
Vicia benghalensis	vetch
Vicia exigua	slender vetch
Vicia sativa	spring vetch
Viola quercetorum	oak violet
Whipplea modesta	yerba de selva

FERNS AND FERN ALLIES:

Cheilanthes intertexta	coastal lip-fern

NATIVE AND NATURALIZED VASCULAR PLANTS SEEN IN THE SAN CLEMENTE CREEK INUNDATION AREA, ON 14 AND 15 JUNE, AND 12 JULY, 1989, BY JEFF NORMAN

TREES:

Acacia sp.	acacia
Acer macrophyllum	big-leaf maple
Aesculus californicus	buckeye
Alnus rhombifolia	white alder
Alnus rubra	red alder
Arbutus menziesii	madrone
Lithocarpus densiflorus	tan oak
Pinus ponderosa	ponderosa pine
Pinus radiata	Monterey pine
Platanus racemosa	western sycamore
Populus trichocarpa	black cottonwood
Quercus agrifolia	coast live oak
Quercus chrysolepis	canyon live oak
Quercus kelloggii	black oak
Salix coulteri	Coulter willow
Salix laevigata var. araquipa	red willow
Salix laevigata var. laevigata	red willow
Sambucus mexicana	blue elderberry
Sequoia sempervirens	coast redwood
Umbellularia californica	California bay

SHRUBS:

Adenostoma fasciculatum	chamise
Antirrhinum multiflorum	sticky snapdragon
Arctostaphylos glandulosa ssp. zacaensis f. zacaensis	Eastwood manzanita
Arctostaphylos tomentosa ssp. crustacea	brittleleaf manzanita
Artemisia californica	California sagebrush
Baccharis pilularis var. consanguinea	coyote brush
Baccharis viminea	mule fat
Ceanothus somediatus	jimbrush
Cercocarpus betuloides	California hard-tack
Clematis lasiantha	pipe stem
Clematis ligusticifolia	yerba de chivato
Cornus sericea ssp. occidentalis	western red dogwood
Cytisus monspessulanus	French broom
Epilobium canum	California fuchsia
Eriophyllum confertiflorum var. confertiflorum	golden yarrow
Galium angustifolium var. angustifolium	narrow-leaved bedstraw
Galium porrigens var. porrigens	climbing bedstraw
Heteromeles arbutifolia	toyon
Holodiscus discolor	cream bush
Lonicera hispidula var. vacillans	hairy honeysuckle
Lotus scoparius var. scoparius f. scoparius	deerweed
Lupinus albifrons var. albifrons	silver lupine
Lupinus albifrons var. douglasii	Douglas' silver lupine
Mahonia pinnata	California barberry
Mimulus aurantiacus	sticky monkey-flower
Mimulus bifidus ssp. fasciculatus	Santa Lucia sticky monkey-flower
Prunus ilicifolia	holly-leaved cherry

NATIVE AND NATURALIZED VASCULAR PLANTS SEEN IN THE SAN CLEMENTE CREEK INUNDATION AREA, ON 14 AND 15 JUNE, AND 12 JULY, 1989, BY JEFF NORMAN

SHRUBS (cont.):

Rhamnus californica ssp. californica	coffeeberry
Rhamnus crocea ssp. crocea	redberry
Rhamnus crocea ssp. ilicifolia	hollyleaf redberry
Ribes amarum	bitter gooseberry
Ribes menziesii var. menziesii ?	canyon gooseberry
Ribes sericeum ?	Santa Lucia gooseberry
Ribes speciosum	garnet gooseberry
Rosa californica	California wild rose
Rosa gymnocarpa	wood rose
Rubus parviflorus	thimbleberry
Rubus ursinus	Pacific blackberry
Salvia mellifera	black sage
Symphoricarpos albus	common snowberry
Symphoricarpos mollis	creeping snowberry
Toxicodendron diversilobum	poison oak

HERBACEOUS SPECIES:

Achillea borealis ssp. californica	common yarrow
Agoseris grandiflora	large-flowered agoseris
Aira caryophyllea	hair grass
Anagallis arvensis	scarlet pimpernel
Anthriscus caucalis	bur-chervil
Antirrhinum kelloggii	lax snapdragon
Arabis glabra var. glabra	tower mustard
Aralia californica	elk clover
Artemisia douglasiana	mugwort
Avena barbata	slender oat
Avena fatua	fat oat
Baccharis douglasii	Douglas' baccharis
Boykinia elata	brook foam
Brassica geniculata	summer mustard
Brassica nigra	black mustard
Brodiaea lutea	golden brodiaea
Brodiaea pulchella	blue dicks
Bromus carinatus	California brome
Bromus mollis	soft chess
Bromus rigidus	ripgut grass
Bromus rubens	red brome
Calochortus albus var. albus	white globe lily
Calystegia purpurata ssp. solanensis	western morning-glory
Camissonia fruticetorum	primrose
Capsella bursa-pastoris	shepherd's purse
Carduus tenuiflorus	slender-flowered thistle
Carex spp.	sedges
Caulanthus lasiophyllus	California mustard
Cerastium glomeratum	mouse-ear chickweed
Chlorogalum pomeridianum	amole
Chorizanthe douglasii	Douglas' spine flower
Chrysopsis villosa var. camphorata	hairy golden aster
Cirsium proteanum	red thistle (red and white forms)

NATIVE AND NATURALIZED VASCULAR PLANTS SEEN IN THE SAN CLEMENTE CREEK INUNDATION AREA, ON 14 AND 15 JUNE, AND 12 JULY, 1989, BY JEFF NORMAN

HERBACEOUS SPECIES (cont.):

Cirsium vulgare	bull thistle
Claytonia perfoliata	miner's lettuce
Clarkia cylindrica	band clarkia
Clarkia lewisii	Lewis' clarkia
Clarkia unguiculata	canyon clarkia
Collinsia heterophylla	Chinese houses
Conium maculatum	poison hemlock
Conyza canadensis	horseweed
Corethrogyne filaginifolia var. rigida	corethrogyne
Cryptantha corollata	Coast Range cryptantha
Cryptantha micromeres	minute-flowered cryptantha
Cryptantha microstachys	Tejon cryptantha
Cryptantha muricata var. muricata	spiny cryptantha
Cynoglossum grande	hound's tongue
Cyperus eragrostis	umbrella sedge
Datisca glomerata	durango root
Daucus pusillus	yerba vibra
Digitalis purpurea	foxglove
Disporum hookeri	fairy bells
Dudleya cymosa ssp. minor	Goldman's dudleya
Elymus condensatus	giant wild rye
Elymus glaucus	blue wild rye
Emmenanthe penduliflora	whispering bells
Epilobium adenocaulon var. parishii	California willow-herb
Epipacts helleborine	helleborine orchis
Eriogonum nudum var. auriculatum	naked buckwheat
Erodium cicutarium	red-stemmed filaree
Filago californica	California cotton rose
Filago gallica	narrow-leaved filago
Fragaria californica	California strawberry
Galium aparine	goosegrass
Galium californicum ssp. flaccidum	California bedstraw
Geranium bicknelli var. longipes	Bicknell's geranium
Geranium molle	dove's foot geranium
Gilia capitata ssp. abrotanifolia	blue field gilia
Gilia capitata ssp. staminea	range gilia
Gnaphalium beneolens	fragrant everlasting
Gnaphalium californicum	California everlasting
Gnaphalium luteo-album	weedy cudweed
Gnaphalium palustre	lowland cudweed
Habenaria elegans var. elegans	slender habenaria
Heuchera micrantha var. hartwegii	alum root
Hieracium albiflorum	white-flowered hawkweed
Hordeum leporinum	barnyard foxtail
Horkelia frondosa	leafy horkelia
Juncus spp.	wire rushes
Lactuca serriola	prickly lettuce
Lathyrus vestitus ssp. puberulus	Pacific pea
Lilium pardalinum	tiger lily
Lithophragma affine	woodland star
Lolium multiflorum	Italian rye
Lotus purshianus	Spanish clover

NATIVE AND NATURALIZED VASCULAR PLANTS SEEN IN THE SAN CLEMENTE CREEK INUNDATION AREA, ON 14 AND 15 JUNE, AND 12 JULY, 1989, BY JEFF NORMAN

HERBACEOUS SPECIES (cont.):

Lupinus bicolor ssp. pipersmithii	Lindley's annual lupine
Lupinus hirsutissimus	stinging lupine
Lupinus latifolius	broad-leaved lupine
Lupinus nanus ssp. nanus	sky lupine
Lupinus succulentus	succulent annual lupine
Madia gracilis	gumweed
Madia madioides	woodland madia
Marah fabaceus	manroot
Matricaria matricarioides	pineapple weed
Medicago lupulina	black medic
Medicago polymorpha var. brevispina	smooth bur clover
Medicago polymorpha var. polymorpha	bur clover
Mentha arvensis var. villosa	field mint
Microseris lindleyi	blow-wives
Mimulus guttatus ssp. guttatus	seep-spring monkey-flower
Monardella villosa var. villosa	coyote mint
Nasturtium officinale	watercress
Nemophila parviflora	small-flowered nemophila
Nemophila pedunculata	meadow nemophila
Osmorhiza brachypoda	California cicely
Osmorhiza chilensis	wood cicely
Oxalis pilosa	hairy wood sorrel
Petasites palmatus	western coltsfoot
Phacelia imbricata	imbricate phacelia
Pholistoma auritum	fiesta flower
Plantago major var. major	common plantain
Polygala californica	California milkwort
Polypogon monspeliensis	rabbit's foot grass
Psoralea macrostachya	leather root
Psoralea orbicularis	round-leaved psoralea
Psoralea physodes	California tea
Pterostegia drymarioides	pterostegia
Rafinesquia californica	California chicory
Rorippa curvisiliqua	western yellow-cress
Rumex acetosella	sheep sorrel
Rumex conglomeratus	clustered dock
Rumex crispus	curly dock
Rumex salicifolius	willow dock
Salvia columbariae	chia
Sanicula crassicaulis	gambleweed
Satureja chamissonis	yerba buena
Senecio vulgaris	common groundsel
Silene antirrhina	sticky catchfly
Silene gallica	windmill pink
Sisymbrium irio	London rocket
Sisymbrium officinale	hedge mustard
Smilacina stellata var. sessilifolia	slim Solomon
Solanum nodiflorum	small-flowered nightshade
Solidago californica	California goldenrod
Sonchus asper	prickly sow thistle
Sonchus oleraceus	common sow thistle
Spergularia rubra	purple sand spurrey
Stachys bullata	hedge nettle

NATIVE AND NATURALIZED VASCULAR PLANTS SEEN IN THE SAN CLEMENTE CREEK INUNDATION AREA, ON 14 AND 15 JUNE, AND 12 JULY, 1989, BY JEFF NORMAN

HERBACEOUS SPECIES (cont.):

Stellaria media	common chickweed
Stephanomeria virgata ssp. pleurocarpa	tall wire lettuce
Thalictrum fendleri	Fendler's meadow rue
Thysanocarpus laciniatus var. crenatus	narrow-leaved fringe pod
Torilis nodosa	hedge parsley
Trifolium incarnarum	crimson clover
Trifolium microcephalum	maiden clover
Trifolium tridentatum	tomcat clover
Trillium chloropetalum var. giganteum	giant wake-robin
Typha sp.	cattail
Urtica holosericea	hoary nettle
Verbena lasiostachys var. lasiostachys	western vervain
Veronica anagallis-aquatica	water speedwell
Veronica arvensis	corn speedwell
Veronica persica	winter speedwell
Vicia sp.	vetch
Whipplea modesta	yerba de selva
Yucca whipplei ssp. percursa	Spanish bayonet
Zigadenus fremontii var. fremontii	star-lily

FERNS AND FERN ALLIES:

Adiantum jordanii	California maidenhair fern
Athyrium filix-femina	lady fern
Dryopteris arguta	wood fern
Equisetum arvense	horsetail
Equisetum x ferrissii	scouring rush
Equisetum hymale var. affine	Braun's scouring rush
Equisetum telmateia var. braunii	giant horsetail
Pellaea andromedaefolia	coffee fern
Pityrogramma triangularis	printback fern
Polypodium californicum var. californicum	California polypody
Polystichum munitum ssp. munitum	sword fern
Pteridium aquilinum var. pubescens	western bracken
Selaginella bigelovii	bushy selaginella
Woodwardia fimbriata	chain fern

NATIVE AND NATURALIZED VASCULAR PLANTS SEEN IN THE CACHAGUA CREEK INUNDATION AREA ON 7 AUG., 1989, BY JEFF NORMAN

TREES:

Acer macrophyllum	big-leaf maple
Aesculus californicus	buckeye
Alnus rhombifolia	white alder
Arbutus menziesii	madrone
Platanus racemosa	western sycamore
Populus trichocarpa	black cottonwood
Quercus agrifolia	coast live oak
Quercus douglasii	blue oak
Quercus lobata	valley oak
Salix hindsiana	sandbar willow
Salix laevigata var. araquipa	red willow
Salix lasiolepis var. lasiolepis	arroyo willow
Sambucus mexicana	blue elderberry
Umbellularia californica	California bay

SHRUBS:

Adenostoma fasciculatum	chamise
Amorpha californica	mock locust
Antirrhinum multiflorum	sticky snapdragon
Artemisia californica	California sagebrush
Baccharis pilularis var. consanguinea	coyote brush
Ceanothus cuneatus	buck brush
Ceanothus sorediatus	jimbrush
Cercocarpus betuloides	California hard-tack
Clematis lasiantha	pipe stem
Clematis ligusticifolia	yerba de chivato
Cornus glabrata	brown dogwood
Cytisus monspessulanus	French broom
Epilobium canum	California fuchsia
Eriophyllum confertiflorum var. confertiflorum	golden yarrow
Galium angustifolium var. angustifolium	narrow-leaved bedstraw
Galium porrigens var. porrigens	climbing bedstraw
Garrya elliptica	coast silk tassel
Heteromeles arbutifolia	toyon
Holodiscus discolor	cream bush
Isocoma veneta var. vernonioides	coastal isocome
Keckiella breviflora	bush beard-tongue
Lonicera interrupta	chaparral honeysuckle
Lotus scoparius var. scoparius f. scoparius	deerweed
Marrubium vulgare	white horehound
Mimulus aurantiacus	sticky monkey-flower
Penstemon heterophyllus ssp. australis	chaparral penstemon
Prunus ilicifolia	holly-leaved cherry
Quercus turbinella ssp. californica	scrub oak
Rhamnus californica ssp. californica	coffeeberry
Rhamnus californica ssp. tomentella	coffeeberry
Rhamnus crocea ssp. crocea	redberry
Rhamnus crocea ssp. ilicifolia	hollyleaf redberry
Ribes divaricatum	straggly gooseberry
Ribes speciosum	garnet gooseberry
Rosa californica	California wild rose

NATIVE AND NATURALIZED VASCULAR PLANTS SEEN IN THE CACHAGUA CREEK INUNDATION AREA ON 7 AUG., 1989, BY JEFF NORMAN

SHRUBS (cont.):

Rosa gymnocarpa	wood rose
Rubus ursinus	Pacific blackberry
Salvia mellifera	black sage
Symphoricarpos albus	common snowberry
Symphoricarpos mollis	creeping snowberry
Toxicodendron diversilobum	poison oak

HERBACEOUS SPECIES:

Agoseris grandiflora	large-flowered agoseris
Aira caryophyllea	hair grass
Amsinckia sp.	fiddleneck
Anagallis arvensis	scarlet pimpernel
Anthriscus caucalis	bur-chervil
Antirrhinum kelloggii	lax snapdragon
Arabis glabra var. glabra	tower mustard
Artemisia douglasiana	mugwort
Artemisia dranunculus	dragon sagewort
Asclepias eriocarpa	Indian milkweed
Avena sp.	wild oat
Brassica geniculata	summer mustard
Brodiaea lutea	golden brodiaea
Brodiaea pulchella	blue dicks
Bromus carinatus	California brome
Bromus mollis	soft chess
Bromus rigidus	ripgut grass
Bromus rubens	red brome
Calochortus albus var. albus	white globe lily
Calycadenia truncata ssp. truncata	rosinweed
Calystegia malacophylla ssp. pedicellata	woolly morning-glory
Carduus pycnocephalus	Italian thistle
Carex spp.	sedges
Castilleja affinis	Indian paint brush
Centaurea melitensis	tocalote
Chenopodium californicum	soap plant
Chlorogalum pomeridianum	amole
Chrysopsis villosa var. camphorata	hairy golden aster
Cirsium proteanum	red thistle
Clarkia lewisii	Lewis' clarkia
Clarkia unguiculata	canyon clarkia
Clarkia spp.	clarkias
Collinsia sp.	collinsia
Collomia grandiflora	large-flowered collomia
Conium maculatum	poison hemlock
Conyza canadensis	horseweed
Cordylanthus rigidus	bird's beak
Corethrogyne filaginifolia var. rigida	corethrogyne
Cuscuta ceanothi	long-flowered dodder
Cyperus eragrostis	umbrella sedge
Datisca glomerata	durango root
Delphinium sp.	larkspur

NATIVE AND NATURALIZED VASCULAR PLANTS SEEN IN THE CACHAGUA CREEK INUNDATION AREA ON 7 AUG., 1989, BY JEFF NORMAN

<u>HERBACEOUS</u> <u>SPECIES</u> (cont.):

Dudleya cymosa ssp. minor	Goldman's dudleya
Elymus condensatus	giant wild rye
Elymus glaucus	blue wild rye
Emmenanthe penduliflora	whispering bells
Epilobium adenocaulon var. parishii	California willow-herb
Eremocarpus setigerus	dove weed
Erigeron foliosus var. foliosus	leafy daisy
Eriogonum elongatum	long-stemmed eriogonum
Eriogonum nudum var. auriculatum	naked buckwheat
Eriogonum roseum	virgate eriogonum
Erodium cicutarium	red-stemmed filaree
Erysimum capitatum	Douglas' wallflower
Euphorbia peplus	petty spurge
Filago californica	California cotton rose
Filago gallica	narrow-leaved filago
Galium aparine	goosegrass
Gilia capitata ssp. abrotanifolia	blue field gilia
Gnaphalium beneolens	fragrant everlasting
Gnaphalium californicum	California everlasting
Helenium puberulum	sneezeweed
Holcus lanatus	velvet grass
Hordeum vulgare	barley
Horkelia frondosa	leafy horkelia
Juncus spp.	wire rushes
Lactuca serriola	prickly lettuce
Lathyrus vestitus ssp. puberulus	Pacific pea
Lolium multiflorum	Italian rye
Lotus purshianus	Spanish clover
Lupinus hirsutissimus	stinging lupine
Lupinus formosus var. bridgesi	lunara lupine
Lupinus nanus ssp. nanus	sky lupine
Lupinus succulentus	succulent annual lupine
Madia gracilis	gumweed
Madia sativa	Chile tarweed
Marah fabaceus	manroot
Medicago lupulina	black medic
Medicago polymorpha var. polymorpha	bur clover
Melilotus albus	white sweet-clover
Mentha spicata	spearmint
Navarretia atractyloides	holly-leaved navarretia
Orthocarpus sp.	owl's clover
Phacelia imbricata	imbricate phacelia
Phacelia nemoralis	shade phacelia
Pholistoma auritum	fiesta flower
Phoradendron tomentosum ssp. villosum	oak mistletoe
Plantago lanceolata	ribgrass
Plectritis sp.	plectritis
Polygonum aviculare	common knotweed
Polypogon monspeliensis	rabbit's foot grass
Psoralea macrostacya	leather root
Psoralea physodes	California tea
Pterostegia drymarioides	pterostegia
Rafinesquia californica	California chicory

NATIVE AND NATURALIZED VASCULAR PLANTS SEEN IN THE CACHAGUA CREEK INUNDATION AREA ON 7 AUG., 1989, BY JEFF NORMAN

HERBACEOUS SPECIES (cont.):

Rumex acetosella	sheep sorrel
Rumex conglomeratus	clustered dock
Rumex crispus	curly dock
Rumex salicifolius	willow dock
Salvia columbariae	chia
Sanicula crassicaulis	gambleweed
Silene gallica	windmill pink
Solanum umbelliferum	blue witch
Solidago californica	California goldenrod
Sonchus oleraceus	common sow thistle
Stachys bullata	hedge nettle
Stephanomeria elata	wire lettuce
Stephanomeria virgata ssp. pleurocarpa	tall wire lettuce
Stipa sp.	bunchgrass
Tauschia hartwegii	Hartweg's tauschia
Thalictrum fendleri	Fendler's meadow rue
Thysanocarpus sp.	lace pod
Torilis nodosa	hedge parsley
Trifolium tridentatum	tomcat clover
Trifolium spp.	clovers
Urtica holosericea	hoary nettle
Verbena lasiostachys var. lasiostachys	western vervain
Wyethia helenoides	woolly mule-ears

FERNS AND FERN ALLIES:

Adiantum jordanii	California maidenhair fern
Dryopteris arguta	wood fern
Equisetum laevigatum	Braun's scouring rush
Pellaea andromedaefolia	coffee fern
Pityrogramma triangularis	printback fern
Polypodium californicum var. californicum	California polypody
Pteridium aquilinum var. pubescens	western bracken
Selaginella bigelovii	bushy selaginella

NATIVE AND NATURALIZED VASCULAR PLANTS SEEN IN THE CHUPINES CREEK INUNDATION AREA ON 23 JUNE, 1989, BY JEFF NORMAN

TREES:

Aesculus californicus	buckeye
Platanus racemosa	western sycamore
Populus trichocarpa	black cottonwood
Quercus agrifolia	coast live oak
Quercus douglasii	blue oak
Quercus lobata	valley oak
Salix laevigata var. araquipa	red willow
Salix lasiolepis var. lasiolepis	arroyo willow
Sambucus mexicana	blue elderberry

SHRUBS:

Adenostoma fasciculatum	chamise
Arctostaphylos tomentosa ssp. crustacea	brittleleaf manzanita
Artemisia californica	California sagebrush
Baccharis pilularis var. consanguinea	coyote brush
Clematis lasiantha	pipe stem
Clematis ligusticifolia	yerba de chivato
Eriophyllum confertiflorum var. confertiflorum	golden yarrow
Galium porrigens var. porrigens	climbing bedstraw
Garrya elliptica	coast silk-tassel
Hazardia squarrosa	sawtooth goldenbush
Heteromeles arbutifolia	toyon
Lonicera hispidula var. vacillans	hairy honeysuckle
Lonicera interrupta	chaparral honeysuckle
Lotus scoparius var. scoparius f. scoparius	deerweed
Marrubium vulgare	white horehound
Mimulus aurantiacus	sticky monkey-flower
Osmaronia cerasiformis	oso berry
Prunus ilicifolia	holly-leaved cherry
Rhamnus californica ssp. californica	coffeeberry
Rhamnus crocea ssp. ilicifolia	hollyleaf redberry
Ribes divaricatum	straggly gooseberry
Ribes speciosum	garnet gooseberry
Rosa californica	California wild rose
Rubus ursinus	Pacific blackberry
Symphoricarpos albus	common snowberry
Symphoricarpos mollis	creeping snowberry
Toxicodendron diversilobum	poison oak

HERBACEOUS SPECIES:

Achillea borealis ssp. californica	common yarrow
Agoseris grandiflora	large-flowered agoseris
Aira caryophyllea	hair grass
Amsinckia sp.	fiddleneck
Anagallis arvensis	scarlet pimpernel
Artemisia douglasiana	mugwort
Artemisia dranunculus	dragon sagewort
Asclepias eriocarpa	Indian milkweed

NATIVE AND NATURALIZED VASCULAR PLANTS SEEN IN THE CHUPINES CREEK INUNDATION AREA ON 23 JUNE, 1989, BY JEFF NORMAN

HERBACEOUS SPECIES (cont.):

Aster radulinus	broad-leaf aster
Avena barbata	slender oat
Baccharis douglasii	Douglas' baccharis
Berula erecta	water parsnip
Brassica geniculata	summer mustard
Brassica nigra	black mustard
Briza minor	little quaking grass
Brodiaea lutea	golden brodiaea
Brodiaea pulchella	blue dicks
Bromus carinatus	California brome
Bromus mollis	soft chess
Bromus rigidus	ripgut grass
Bromus rubens	red brome
Calystegia subacaulis	hill morning-glory
Capsella bursa-pastoris	shepherd's purse
Carduus pycnocephalus	Italian thistle
Carex spp.	sedges
Centaurea melitensis	tocalote
Chenopodium album	white goosefoot
Chenopodium californicum	soap plant
Chlorogalum pomeridianum	amole
Cirsium occidentale	cobweb thistle
Cirsium proteanum	red thistle
Cirsium vulgare	bull thistle
Clarkia unguiculata	canyon clarkia
Clarkia spp.	clarkias
Conium maculatum	poison hemlock
Cotula coronopifolia	brass buttons
Cynodon dactylon	Bermuda grass
Cyperus eragrostis	umbrella sedge
Daucus pusillus	yerba vibra
Elymus condensatus	giant wild rye
Elymus glaucus	blue wild rye
Epilobium adenocaulon var. parishii	California willow-herb
Eremocarpus setigerus	dove weed
Eriogonum angulosum	angle-stemmed buckwheat
Eriogonum elongatum	long-stemmed eriogonum
Erodium botrys	long-beaked filaree
Erodium cicutarium	red-stemmed filaree
Eschscholzia californica var. californica	California poppy
Filago californica	California cotton rose
Filago gallica	narrow-leaved bedstraw
Geranium molle	dove's foot geranium
Gnaphalium californicum	California everlasting
Gnaphalium luteo-album	weedy cudweed
Helenium puberulum	sneezeweed
Hemizonia corymbosa ssp. corymbosa	coast tarweed
Heterotheca grandiflora	telegraph weed
Hordeum leporinum	barnyard foxtail
Hypochoeris glabra	smooth cat's ear
Juncus spp.	wire rushes
Lactuca serriola	prickly lettuce

NATIVE AND NATURALIZED VASCULAR PLANTS SEEN IN THE CHUPINES CREEK INUNDATION AREA ON 23 JUNE, 1989, BY JEFF NORMAN

HERBACEOUS SPECIES (cont.):

Lathyrus vestitus ssp. puberulus	Pacific pea
Lemna minor	duckweed
Lolium multiflorum	Italian rye
Lomatium utriculatum	bladder parsnip
Lupinus densiflorus	gully lupine
Lupinus nanus ssp. nanus	sky lupine
Madia gracilis	gumweed
Malacothrix saxatilis var. arachnoidea	Carmel Valley malacothrix
Malva parviflora	cheeseweed
Marah fabaceus	manroot
Medicago polymorpha var. brevispina	smooth bur clover
Medicago polymorpha var. polymorpha	bur clover
Melilotus indicus	Indian melilot
Mimulus guttatus ssp. guttatus	seep-spring monkey-flower
Nasturtium officinale	watercress
Navarretia atractyloides	holly-leaved navarretia
Navarretia mellita	honey-scented navarreti
Nicotiana bigelovii	Indian tobacco
Phacelia imbricata	imbricate phacelia
Phalaris stenoptera	Harding grass
Plagiobothrys nothofulvus	popcorn flower
Plantago major var. major	common plantain
Polygonum aviculare	common knotweed
Polypogon monspeliensis	rabbit's foot grass
Potentilla glandulosa	sticky cinquefoil
Rafinesquia californica	California chicory
Rumex acetosella	sheep sorrel
Rumex conglomeratus	clustered dock
Rumex crispus	curly dock
Sanicula crassicaulis	gambleweed
Scrophularia californica	coast figwort
Silene gallica	windmill pink
Silybum marianum	milk thistle
Sisymbrium officinale	hedge mustard
Sisyrinchium bellum	blue-eyed grass
Solanum nodiflorum	small-flowered nightshade
Solanum umbelliferum	blue witch
Sonchus asper	prickly sow thistle
Sonchus oleraceus	common sow thistle
Stachys bullata	hedge nettle
Stellaria media	common chickweed
Stephanomeria virgata ssp. pleurocarpa	tall wire lettuce
Stipa sp.	bunchgrass
Tauschia hartwegii	Hartweg's tauschia
Thysanocarpus curvipes	hairy fringe pod
Torilis nodosa	hedge parsley
Trichostema lanceolatum	vinegar weed
Trifolium obtusiflorum	creek clover
Trifolium pratense	red clover
Trifolium spp.	clovers

NATIVE AND NATURALIZED VASCULAR PLANTS SEEN IN THE CHUPINES CREEK INUNDATION AREA ON 23 JUNE, 1989, BY JEFF NORMAN

HERBACEOUS SPECIES (cont.):

Urtica holosericea	hoary nettle
Urtica urens	dwarf nettle
Verbena lasiostachys var. lasiostachys	western vervain
Vicia sp.	vetch
Wyethia helenoides	woolly mule-ears
Xanthium spinosum	spiny clotbur

FERNS AND FERN ALLIES:

Adiantum jordanii	California maidenhair fern
Azolla filiculoides	duckweed fern
Dryopteris arguta	wood fern
Equisetum laevigatum	Braun's scouring rush

APPENDIX 7-B

COMMON, POTENTIAL AND OBSERVED WILDLIFE SPECIES
AT MONTEREY PENINSULA WATER SUPPLY ALTERNATIVE SITES
MONTEREY COUNTY, CALIFORNIA

Common Name	Scientific Name	Site[1] A NLP	B CAC	C SCC	D CHU	E NSC
MAMMALS						
Opossum	Didelphis marsupialis					
Ornate shrew	Sorex ornatus					
Trowbridge's shrew	S. trowbridgii					
California mole	Scapanus latimanus	+		+	+	+
California myotis	Myotis californicus				*	
Western pipistrelle	Pipistrellus hesperus					
Big brown bat	Eptesicus fuscus					
Red bat	Lasiurus borealis					
Hoary bat	L. cinereus					
Pallid bat	Antrozoas pallidus					
Mexican free-tailed bat	Tadarida braziliensis					
Ringtail	Bassariscus astutus					
Raccoon	Procyon lotor	+	+	+		+
Mountain lion	Felis concolor		*	*	*	
Bobcat	Lynx rufus		*	*		
Feral house cat	Felis domesticus					
Gray fox	Urocyon cinereoargenteus	+	+	+	+	+
Kit fox	Vulpes macrotis mutica		*			
Coyote	Canis latrans	+	+	+		+
Longtailed weasel	Mustela frenata			*		
Badger	Taxidea taxus					
Striped skunk	Mephitis mephitis			*		
Spotted skunk	Spilogale putorius					
Merriam's chipmunk	Tamias merriami					
California ground squirrel	Spermophilus beecheyi	+	+	+	+	+
Western Grey squirrel	Sciurus griseus	+		+	+	+
Valley pocket gopher	Thomomys umbrinus	+	+	+	+	+
California pocket mouse	Perognathus californicus					
Heermann's kangaroo rat	Dipodomys heermanni				*	
Western harvest mouse	Reithrodontomys megalotis					
California mouse	Peromyscus californicus	+				
Deer mouse	P. maniculatus					
Brush mouse	P. boylei					
Piñon mouse	P. truei	+	+			
Dusky-footed wood rat	Neotoma fuscipes	+	+	+	+	+
Desert woodrat	N. lepida					
California vole	Microtus californicus					
Norway rat	Rattus norvegicus					
House mouse	Mus musculus					
Blacktail jackrabbit	Lepus californicus				+	
Audobon's cottontail	Sylvilagus audobonii		+			
Brush rabbit	S. bachmani					
Mule deer	Odocoileus hemionus	+	+	+	+	+
Wild boar	Sus scrofa		*	+	*	
		11	14	14	12	9

Common Name	Scientific Name	Site[1] A NLP	B CAC	C SCC	D CHU	E NSC
REPTILES AND AMPHIBIANS						
California tiger salamander	Ambystoma tigrinum californiense			*		
California newt	Taricha torosa	+				
Ensatina	Ensatina eschscholtzi			*		
Pacific slender salamander	Batrachoseps pacificus					
Arboreal salamander	Aneides lugubris					
Western toad	Bufo boreas			+		
Pacific treefrog	Hyla regilla			+	+	
Red-legged frog	Rana aurora			+		+
Foothill yellow-legged frog	R. boylei	+				
Bullfrog	R. catesbeiana			+		+
Western pond turtle	Clemmys marmorata		*	*		+
Western fence lizard	Sceloporus occidentalis	+	+	+	+	+
Side-blotched lizard	Uta stansburiana		+			
Coast horned lizard	Phrynosoma coronatum			+	*	*
Western skink	Eumeces skiltonianus			*		
California whiptail	Cnemidophorus tigris mundus	+		+		+
Southern alligator lizard	Gerrhonotus multicarinatus		*	*	*	
Northern alligator	G. coeruleus					
California legless lizard	Anniella pulchra					
Rubber boa	Charina bottae					
Ringneck snake	Diadophis punctatus					
Sharp-tailed snake	Contia tenuis					
Racer	Coluber constrictor				*	
Striped racer	Masticophis lateralis		*			
Pacific gopher snake	Pituophis melanoleucus			*	*	
Common kingsnake	Lampropeltis getulus	+		*	*	+
Mountain kingsnake	L. zonata					
Common garter snake	Thamnophis sirtalis				*	
Western terrestrial garter snake	T. elegans					
Western aquatic garter snake	T. couchi			*		+
Night snake	Hypsiglena torquata					
Western rattlesnake	Crotalus viridis	+	*	*		
		6	6	16	8	8
BIRDS						
Great blue heron	Ardea herodias			*		
Pied-billed grebe	Podilymbus podiceps					+
Canada goose	Branta canadensis			+		+
Mallard	Anas platyrhynchos			+		+
Wood duck	Aix sponsa			*		
Common merganser	Mergus merganser	+				
Turkey vulture	Cathartes aura	+	+	+	+	+
Osprey	Pandon haliaetus			*		
Black-shouldered kite	Elanus leucurus					
Cooper's hawk	Accipiter cooperi			+		
Sharp-shinned hawk	A. striatus					+
Red-shouldered hawk	Buteo lineatus			*		
Red-tailed hawk	B. jamaicensis			+	+	+
Swainson's hawk	B. swainsoni					
Golden eagle	Aquila chrysaetos			+		

Common Name	Scientific Name	Site[1] A NLP	B CAC	C SCC	D CHU	E NSC
BIRDS						
Bald eagle	*Haliaeetus leucocephalus*					
American kestrel	*Falco sparverius*	+			+	+
Peregrine falcon	*F. peregrinus*			*		*
California quail	*Callipepla californicus*	+	+	+	+	+
Mountain quail	*Oreortyx pictus*	+	+			+
Wild Turkey	*Meleagris gallopavo*			*	*	
Mourning dove	*Zenaidura macroura*	+	+	+	+	+
Band-tailed pigeon	*Columba fasciata*	+	+		+	
Rock dove	*C. livia*				+	
Killdeer	*Charadrius vociferus*	+			+	+
California gull	*Larus californicus*					
Screech owl	*Otus asio*					
Great horned owl	*Bubo virginianus*		+	+	+	
Barn owl	*Tyto alba*					
Northern pygmy owl	*Glaucidium gnoma*					
Long-eared owl	*Asio otus*					
Short-eared owl	*A. flammeus*					
Northern saw-whet owl	*Aegolius acadicus*					
Poor-will	*Phalaenoptilus nuttallii*					
White-throated swift	*Aeronautes saxatalis*					+
Black-chinned hummingbird	*Archilochus alexandri*					
Anna's hummingbird	*Calypte anna*	+				+
Allen's hummingbird	*Selasphorus sasin*					+
Belted kingfisher	*Ceryle alcyon*	+				+
Flicker	*Colaptes auratus*	+	+	+	+	+
Acorn woodpecker	*Melanerpes formicivorus*	+	+	+	+	+
"Red-breasted" sapsucker	*Sphyrapicus varius daggetti*					
Nuttall's woodpecker	*Piciodes nuttallii*	+			+	
Hairy woodpecker	*P. villosus*					
Downy woodpecker	*P. pubescens*					
Ash-throated flycatcher	*Myiarchus cinerascens*	+			+	
Western kingbird	*Tyrannus verticalis*				+	
Western flycatcher	*Empidonax difficilis*	+	+		+	+
Black phoebe	*Sayornis nigricans*	+		+	+	+
Say's phoebe	*S. saya*					
Western woodpewee	*Contopus sordidulus*				+	
Olive-sided flycatcher	*Nuttallornis borealis*					
Horned lark	*Eremphila alpestris*					
Barn swallow	*Hirundo rustica*				+	+
Cliff swallow	*Petrochelidon pyrrhonota*				+	+
Violet-green swallow	*Tachycineta thalassina*	+			+	+
Tree swallow	*Iridoprocne bicolor*					
Rough-winged swallow	*Stelgidopteryx ruficollis*	+				+
Scrub jay	*Aphelocoma coerulescens*	+	+	+	+	+
Stellar's jay	*Cyanocitta stelleri*	+	+	+	+	+
American crow	*Corvus brachyrhynchos*				+	+
Common raven	*C. corax*					
Chestnut-backed chickadee	*Parus rufescens*	+	+	+	+	+
Plain titmouse	*P. inornatus*	+	+		+	+

Common Name	Scientific Name	Site[1]				
		A	B	C	D	E
		NLP	CAC	SCC	CHU	NSC
BIRDS						
Common bushtit	Psaltriparus minimus		+		+	
Wrentit	Chamaea fasciata					
White-breasted nuthatch	Sitta carolinensis				+	
Red-breasted nuthatch	S. canadensis					
Pygmy nuthatch	S. pygmaea					
Brown creeper	Certhia familiaris	+				
Rock wren	salpinctes obsoletus					
Canyon wren	Catherpes mexicanus					
Bewick's wren	Thryomanes bewickii		+		+	
House wren	Troglodytes aedon	+			+	+
Winter wren	T. troglodytes					
American dipper	Cinclus mexicanus					
Mockingbird	Mimus polyglottos				*	
California thrasher	Toxostoma dorsale					
Robin	Turdus migratorius	+			+	
Varied thrush	Ixoreus naevius					
Townsend's solitaire	Myadestes townsendi					
Hermit thrush	Catharus guttata					
Swainson's thrush	C. ustulata					
Western bluebird	Sialia mexicana				+	
Blue-gray gnatcatcher	Polioptila caerulea					+
Water pipit	Anthus spinoletta					
Ruby-crowned kinglet	Regulus calendula					
Phainopepla	Phainopepla nitens					
Cedar waxwing	Bombycilla cedrorum					
Loggerhead shrike	Bombycilla ludovicianus					
Starling	Sturnus vulgaris				+	
Solitary vireo	Vireo solitarius					
Hutton's vireo	V. huttoni					
Warbling vireo	V. gilvus	+			+	+
Orange-crowned warbler	Vermivora celata					
Yellow-rumped warbler	Dendroica coronata					
Yellow warbler	D. petechia	+			+	+
Black-throated gray warbler	D. nigriscens				+	+
Hermit warbler	D. occidentalis					
Townsend's warbler	D. townsendi					
Wilson's warbler	Wilsonia pusilla					+
Common yellowthroat	Geothlypis trichas				+	
Yellow-breasted chat	Icteria virens					
Red-winged blackbird	Agelaius phoeniceus	+				+
Tricolored blackbird	A. tricolor					
Brewer's blackbird	Euphagus cyanocephalus				+	
Brown-headed cowbird	Molothrus ater					
Northern oriole	Icterus galbula bullockii				+	
Hooded Oriole	I. cucullatus					
Western meadowlark	Sturnella neglecta					
Western tanager	Piranga ludoviciana			*		
Black-headed grossbeak	Pheucticus melanocephalus	+			+	+

Common Name	Scientific Name	Site[1]				
		A	B	C	D	E
		NLP	CAC	SCC	CHU	NSC
BIRDS						
Indigo bunting	Passerina cyanea					
Lazuli bunting	P. amoena	+		+		
Purple finch	Carpodacus purpureus					
House finch	C. mexicanus				+	+
Pine siskin	Spinus pinus					
Lesser goldfinch	S. psaltria	+		+	+	+
Lawrence's goldfinch	S. larencei		+	+		
American goldfinch	S. tristis					
Rufous-sided towhee	Pipilo erythrophthalmus	+	+	+	+	+
Brown towhee	P. fuscus	+			+	
Savannah sparrow	Passerculus sandwichensis					
Grasshopper sparrow	Ammodramus savannarum					
Vesper sparrow	Pooecetes gramineus					
Lark sparrow	Chondestes grmmacus				+	
Dark-eyed Junco	Junco hyemalis	+	+	+	+	+
Rufous-crowned sparrow	Aimophila ruficeps					
Chipping sparrow	Spizella passerina					
Black-chinned sparrow	S. atrogularis					
White-crowned sparrow	Zonotrichia leucophrys					
Golden-crowned sparrow	Z. atricapilla					
Fox sparrow	Passerella iliaca					
Lincoln's sparrow	Melospiza lincolnii					
Song sparrow	M. melodia	+	+		+	+
Chestnut-collared longspur	Calcarius ornatus					
House sparrow	Passer domesticus					
		35	19	27	49	42

KEY: +Observed or *reliably reported during field survey.

[1] Sites:
A. New Los Padres - Field Survey, May 28-29, 1989
B. Cachagua Creek - Field Survey, August 7, 1989
C. San Clemente Creek - Field Survey, July 2 and August 6, 1989
D. Chupines Creek - Field Survey, June 23, 1989
E. New San Clemente - Field Survey, July 1-2, 1989

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__________________________________, 1983, Carmel River Watershed Management Plan Working Paper No. 4.5. Riparian Mammals and Herpetofauna of Carmel Valley. An appendix to Working Paper No. 4.

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Dan Wilson, Resident Chupines Creek, personal communications, June 23, 1989.

List of Wildlife Species Observed (visually, orally, or sign) in the Proposed Canada Reservoir Project Study Area

CLASS: AVES

ORDER: CICONIIFORMES

FAMILY: Ardeidae

Great blue heron (*Ardea herodias*)
Great egret (*Casmerodius albus*)

ORDER: ANSERIFORMES

FAMILY: Anatidae

Mallard (*Anas platyrhynchos*)

ORDER: FALCONIFORMES

FAMILY: Cathartidae

Turkey vulture (*Cathartes aura*)

FAMILY: Accipitridae

Black-shouldered kite (*Elanus caeruleus*)
Golden eagle (*Aquila chrysaetos*)
Northern harrier (*Circus cyaneus*)
Red-tailed hawk (*Buteo jamaicensis*)

FAMILY: Falconidae

American kestrel (*Falco sparverius*)

ORDER: GALLIFORMES

FAMILY: Phasianidae

California quail (*Callipepla californica*)

ORDER: CHARARIIFORMES

FAMILY: Charadriidae

Killdeer (*Charadrius vociferus*)

ORDER: COLUMBIIFORMES

FAMILY: Columbidae

Rock dove (*Columba livia*)
Band-tailed pigeon (*Columba fasciata*)
Mourning dove (*Zenaida macroura*)

ORDER: STRIGIFORMES

FAMILY: Tytonidae

Barn owl (*Tyto alba*)

FAMILY: Strigidae

Great horned owl (*Bulo virginianus*)
Northern pygmy owl (*Glaucidium gnoma*)

ORDER: APODIFORMES

FAMILY: Trochilidae

Anna's hummingbird (*Calypte anna*)
Allen's hummingbird (*Selasphorus sasin*)

ORDER: CORACIIFORMES

FAMILY: Alcedinidae

Belted kingfisher (*Ceryle alcyon*)

ORDER: PICIFORMES

FAMILY: Picidae

Acorn woodpecker (*Melanerpes formicivorus*)
Nuttall's woodpecker (*Picoides nuttallii*)
Downy woodpecker (*Picoides pubescens*)
Hairy woodpecker (*Picoides villosus*)
Northern flicker (*Colaptes auratus*)

ORDER: PASSERIFORMES

FAMILY: Tyrannidae

Olive-sided flycatcher (*Contopus borealis*)
Western wood-pewee (*Contopus sordidulus*)
Pacific-slope flycatcher (*Empidonax difficus*)
Black phoebe (*Sayornis nigricans*)
Western kingbird (*Tyrannus verticalis*)

FAMILY: Alaudidae

Horned lark (*Eremophia alpestris*)

FAMILY: Hirundinidae

Violet-green swallow (*Tachycineta thalassina*)
Cliff swallow (*Hirundo pyrrhonota*)
Barn swallow (*Hirundo rustica*)

FAMILY: Corvidae
Steller's jay (*Cyanocitta stelleri*)
Scrub jay (*Aphelocoma coerulescens*)
Common raven (*Corvus corax*)

FAMILY: Paridae
Chestnut-backed chickadee (*Parus rufescens*)
Plain titmouse (*Parus inornatus*)

FAMILY: Aegithalidae
Bushtit (*Psaltriparus minimus*)

FAMILY: Sittidae
Pygmy nuthatch (*Sitta pygmaea*)

FAMILY: Certhiidae
Brown creeper (*Certhia americana*)

FAMILY: Troglodytidae
Bewick's wren (*Thryomanes bewickii*)
House wren (*Troglodytes aedon*)
Winter wren (*Troglodytes troglodytes*)

FAMILY: Muscicapidae
Ruby-crowned kinglet (*Regulus calendula*)
Blue-gray gnatcatcher (*Polioptila cerulea*)
American robin (*Turdus migratorius*)
Wrentit (*Chamaea fasciata*)

FAMILY: Mimidae
Northern mockingbird (*Mimus polyglottos*)
California thrasher (*Toxostoma redivivum*)

FAMILY: Laniidae
Loggerhead shrike (*Lanius ludovicianus*)

FAMILY: Sturnidae
European starling (*Sturnus vulgaris*)

FAMILY: Vireonidae
Warbling vireo (*Vireo gilvus*)
Hutton's vireo (*Vireo huttoni*)

FAMILY: Thraupinae
Western tanager (*Piranga ludoviciana*)

FAMILY: Cardinalinae
Lazuli bunting (*Passerina amoena*)

FAMILY: Emberizidae
Yellow warbler (*Dendroica petechia*)
Black-throated gray warbler (*Dendroica nigresens*)
Wilson's warbler (*Wilsonia pusilla*)
Lark sparrow (*Chondestes grammacus*)
Fox sparrow (*Passerella iliaca*)
Song sparrow (*Melospiza melodia*)
Dark-eyed junco (*Junco hyemalis*)
Chipping sparrow (*Spizella passerina*)
Rufous-sided towhee (*Pipilo erythrophthalmus*)
Brown towhee (*Pipilo fuscus*)

FAMILY: Icteridae
Western meadowlark (*Sturnella neglecta*)
Brewer's blackbird (*Euphagus cyanocephalus*)
Red-winged blackbird (*Agelaius phoeniceus*)

FAMILY: Fringillidae
American goldfinch (*Carduelis tristis*)
Lesser goldfinch (*Carduelis psaltria*)
Purple finch (*Carpodaus purpureus*)
House finch (*Carpodaus mexicanus*)

FAMILY: Passeridae
House sparrow (*Passer domesticus*)

CLASS: AMPHIBIA
ORDER: SALIENTIA
FAMILY: Hylidae
Pacific treefrog (*Hyla regilla*)

CLASS: REPTILIA
ORDER: TESTUDINES
FAMILY: Iguanidae
Western fence Lizard (*Sc loporus occidentalis*)
Side-blotched Lizard (*Uta stansburiana*)

FAMILY: Anguidae

Southern alligator lizard (*Gerrhonotus multicarinatus*)

FAMILY: Colubridae

Gopher snake (*Pituophis melanoleucus*)
Common garter snake (*Thamnophis sirtalis*)
Common kingsnake (*Lampropeltis getulus*)

FAMILY: Viperidae

Western rattlesnake (*Crotalus viridis*)

CLASS: MAMMALIA

ORDER: MARSUPIALIA

FAMILY: Didelphidae

Virginia opossum (*Didelelphis virginiana*)

ORDER: LAGOMORPHA

FAMILY: Leporidae

Black-tailed hare (*Lepus californica*)
Brush rabbit (*Sylvilagus bachmani*)

ORDER: RODENTIA

FAMILY: Sciuridae

California ground squirrel (*Spermophilus beecheyi*)
Western gray squirrel (*Sciurus griseus*)

FAMILY: Geomyidae

Pocket gopher species (*Thomomys* spp.)

FAMILY: Cricetidae

Western harvest mouse (*Reithrodontomys megalotis*)
Deer mouse (*Peromyscus maniculatus*)
Dusky footed woodrat (*Neotoma fuscipes*)
California vole (*Microtus californicus*)

FAMILY: Muridae

Norway rat (*Rattus norvegicus*)
House mouse (*Mus musculus*)

ORDER: CARNIVORA

FAMILY: Canidae

Coyote (*Canis latrans*)
Gray fox (*Urocyon cinereoargenteus*)
Domestic or feral dog (*Canis familiaris*)

FAMILY: Procyonidae

Raccoon (*Procyon lotor*)

FAMILY: Mustelidae

Striped skunk (*Mephitis mephitis*)

FAMILY: Felidae

Mountain lion (*Felis concolor*)
Bobcat (*Felis rufus*)
Domestic or feral cat (*Felis domesticus*)

ORDER: ARTIODACTYLA

FAMILY: Cervidae

Black-tailed Deer (*Odocoileus hemionus*)

CARMEL RIVER BIRD SURVEY

May 1987

Prepared for

MONTEREY PENINSULA WATER MANAGEMENT DISTRICT

and

ENVIRONMENTAL IMPACT PLANNING CORPORATION
319 Eleventh Street
San Francisco, CA. 94103

By

Don & Robin Roberson

June 1987

TABLE OF CONTENTS

CARMEL RIVER BIRD SURVEY

I. INTRODUCTION AND SUMMARY

Between 2-31 May 1987, we surveyed the Carmel River from the San Clemente Dam to the mouth and the two major tributaries of San Clemente Reservoir for birds. The primary purpose of the survey was a search for the endangered Least Bell's Vireo *Vireo bellii pusillus*. We found none. Secondary purposes were to confirm and map specified habitats along the river and to survey the bird populations in those habitats. The results are enumerated below, showing quite extensive riparian habitat and correspondingly healthy bird populations.

II. METHODS

We walked the 18.5 mile stretch of the Carmel River from San Clemente Dam to the river mouth three times, thus surveying in early (2-12 May), mid (15-19 May) and late (28-31 May) May. In addition, nearly a mile of San Clemente Creek upstream from the reservoir and over two miles of the Carmel River upstream from the reservoir were surveyed twice, the latter area's survey including a survey of night birds as well. In all, we walked approximately 62 miles of riparian habitats over a 16 day period, for a total of 74½ hours in the field.

Below the Dam the River was divided into 7 separate stretches (more fully described below). Each stretch was between 2.5 to 3.5 miles in length, except for the one-mile stretch from Hwy 1 to the river mouth lagoon. These stretches, plus the upstream reaches of the Carmel and San Clemente, were surveyed by walking either in or adjacent to the riverbed slowly, keeping a running tally of all birds heard or seen. All surveys were conducted between 6 a.m. and noon (prime time for most bird song) and took between 2 and 4 hours on the average, thus surveyed at a pace just under a mile an hour. This slow pace was often necessitated by the rough terrain; often walking in water, occasionally even chest high or moving slowly through thick riparian habitat sometimes dominated by poison oak or nettles. The terrain was most difficult from the Dam to below Carmel Valley Village; below that point water levels decreased and the river stopped running entirely at either about Schulte Bridge (12 May) or just below Robinson Canyon Bridge (31 May), with only puddles and flow due to groundwater thereafter.

Riparian habitat fringes the entire river thinly and only near the Cal-Am filter plant was the habitat judged wide enough to require some zig-zagging to survey the entire area. At all other points, we believe we surveyed the entire riparian community thoroughly and our surveys often included birds on the edge of the adjacent habitats (especially where cliffs reach the river's edge with oak woodlands or chapparel) or flying over.

About 80% of the birds recorded were heard singing or calling only. The ability to survey by bird song/call is crucial in obtaining acceptable bird surveys in breeding season (Robbins *et al* 1986).

III. BELL'S VIREO SURVEY

The California race (*pusillus*) of the Bell's Vireo (*Vireo bellii*), known as the "Least Bell's Vireo" is one of California's most endangered passerine birds. Once considered common to abundant in riparian ecosystems throughout much of California, it is now reduced to perhaps just 300 breeding pairs (U.S. Fish & Wildlife Service 1986). Destruction of riparian habitat coupled with high rates of parasitism by Brown-headed Cowbird *Molothrus ater* have contributed to this unparalled decline; a full historical summary and statewide survey is in Goldwasser *et al*.(1980). The precipitous decline is unparalled in California ornithology for a songbird, though less serious declines have been documented in other primarily riparian species, such as Yellow-billed Cuckoo *Coccyzus americanus* (Gaines & Laymon

1984), Willow Flycatcher Empidonax traillii, Yellow Warbler Dendroica petechia and Yellow-breasted Chat Icteria virens (e.g., Roberson 1985).

We found no published information showing presence of Bell's Vireo on the Carmel River even in historic times. The Carmel Valley was not indicated as within the range of the species by the classic California survey (Grinnell & Miller 1944) nor by the comprehensive historical summary on Bell's Vireo (Goldwasser et al 1980). No records for the Carmel River are indicated in the most recent in-depth summary of bird distribution in Monterey County (Roberson 1985). It is quite possible the species never nested on the Carmel River.

Nonetheless much apparent habitat exists. Bell's Vireos were known to be common on the Salinas River in southern Monterey County in the first part of this century (Grinnell & Miller 1944) but surveys of the Salinas River sites in the 1970s found them entirely absent (Goldwasser et al 1980). Yet informal surveys by local birders re-discovered the bird around Bradley, on the Salinas River, in 1983, when nesting was documented (Roberson 1985) and their presence was again noted in 1984. However no birds were detected in brief attempts in 1985 and 1986 (pers. obs.). Thus the re-discovery on the Salinas suggested the possibility birds might be present on the Carmel. Williams'(1974)local checklist also listed Bell's Vireo as "accidental" in the Monterey Peninsula area, giving at least the implication that there were some unpublished historic records in the Carmel area.

Bell's Vireo is a summer resident of riparian habitats dominated by a mixture of canopy trees (for feeding) and low riparian growth (for nesting). They still occur in appropriate habitat in warmer interior valleys of coastal counties from Santa Barbara County south, and at some desert oases and canyons. Typical plants required include willows (Salix sp.), mulefat or guamote (Baccharis glutinosa)and wild blackberry (Rubus ursinus). A recent survey at Camp Pendleton, San Diego County, found 100 territorial males and 323 nests, of which nearly 60% were in willows (Salata 1987). The Bradley nest in 1983 was in Baccharis adjacent to willows (pers. obs.). Much willow/Baccharis habitat exists along the Carmel River.

Despite the presence of much apparently suitable habitat observed during this survey, no Bell's Vireos were found. Given the very tenuous status of the Salinas River birds, in an area where they were once common, this finding was not surprising in an area from which there is no historical published records. Furthermore, the southern coastal populations are heavily impacted by cowbird parasitism (Jones 1985, Hays 1986) and one would expect northern coastal populations, if any, to be equally impacted. We found high populations of cowbird on the Carmel River near its mouth; these densities might eliminate any embroyonic Bell's Vireo population in at least the lower 15 miles of the Carmel River.

As Salata noted in his recent experience, "Bell's Vireos are extremely vociferous throughout most of the breeding season" (Salata 1987, p. 3). The persistent loud singing of the male is the best clue to the bird's presence, as they are often difficult to observe in their preferred dense riparian habitat (Goldwasser et al 1980, Salata 1987, pers. obs.). Our surveys took place during what should have been the heig[illegible] of the singing period, as populations just to the south are composed of birds arriving by the end of April (Lehman 1982); May should be the best month to locate the species in Monterey County, if present. Given the persistancy of singing, the loudness and distinctiveness of the song, the narrowness of the riparian habitat and the triple surveys of each appropriate area, we can say with a high degree of confidence that no Bell's Vireos were present in 1987. However, given the disappearance, re-discovery and re-disappearance of the bird on the Salinas River, it may be that birds might be found in another year. We believe the area near and just downstream from the filter plant appears (to human eyes) the best potential vireo habitat, particularly since cowbird numbers were lowest there and become much more abundant farther downstream.

In the final analysis, though, the absence of Bell's Vireo in the Carmel Valley may not be due to lack of habitat (which appears to be present in abundance) or due the density of cowbirds, but could be a result of geography. The range of Bell's Vireo in California is entirely outside the summer fog belt and Bell's Vireo breeds in warm to hot climates (Goldwasser et al 1980). Although we had clear warm weather during early and late May, the middle of the month was dominated by low clouds and fogs extending up the Valley to the Carmel Valley Village. Although we have not undertaken a climatic survey of the area, it is a working hypothesis that the presence of summer fog limits the range of Bell's Vireo in an area with otherwise suitable-appearing habitat.

IV. HABITAT SURVEY

During our bird surveys, we were asked to observe and help map the various riparian habitats along the Carmel River. We were provided with a Riparian Habitat Classification prepared by Rick Villasenor of Environmental Impact Planning Corporation (Table 1) and asked to "ground-truth" the designation of habitats on large, detailed aerial photos of the river from the filter plant to Hwy 1. We placed polygons arounds sections of habitats on the photos, giving each such section a specific designation. To some extent, these designations merge into the next and lines drawn between designations are approximations at best. The marked up aerials have been returned to Graham Matthews of the Monterey Peninsula Water Management District, who had prepared the original block designations which we observed and compared to the Classifications. We found only minor changes from the original scheme of block designations.

A rough approximation of habitats is shown on Map 1. A very general overview shows mostly Mixed Evergreen Forest/Riparian above the dam with only small patches of purer Riparian Woodland/Thicket, a predominance of the Riparian Woodland/Thicket habitat below the dam to nearly Valley Greens Drive, and mostly Riparian Forest (with taller canopy of cottonwoods) thereafter until the Emergent Vegetation appears around the river mouth lagoon. Various stretches interspersed were best termed Riparian Scrub (many more small patches than shown on Map 1) and Mixed Evergreen Forest/Riparian (mostly oak woodland, but occasionally chaparral) abutted on the river where steep cliffs brought this habitat to the river's edge. Ruderal or non-native habitat included rip-rap banks, planted eucalyptus, and disturbed golf course habitats along the river. We have not designated the surface water or Dry Wash habitats, but these include the entire riverbed proper.

The Riparian Habitat Classifications do not have much use in defining bird habitats, because most species habitats are more clearly defined "micro-habitats" for each major activity; e.g., Acorn Woodpecker is present where there are large dead trees to use for nesting. They are present in the riparian zone where large dead trees, particularly sycamores, are standing, without reference to "scrub", "thickets","woodland" or "forest" designations. They are equally at home and widespread in the adjacent oak woodland component of Mixed Evergreen Forest. In the main bird list, we do attempt to generally place the species within its preferred habitat. Miller (1951) has a standard discussion of California bird habitats.

Despite the "micro-habitat" preference of most species, the generalized "Riparian" designation does have use in defining bird populations. Within the general rubric of Riparian we would include the Riparian Scrub, Northern Riparian Woodland/Thicket and Riparian Forest designations and the riparian edge only of the Mixed Evergreen Forest/ Riparian designation. This generalized Riparian habitat has many species either exclusively or predominately associated or restricted to it. It is a rapidly declining habitat in California, yet crucial for healthy populations of numerous species (Miller 1951, Small 1974, Remsen 1977). This Riparian habitat does occur along the Carmel River for most of its length and, as will be noted in the following bird list, does support good populations of riparian specialist species. We found good numbers of Warbling Vireo *Vireo gilvus* and Yellow Warbler, which have been declining elsewhere in Monterey County and statewide (Roberson 1985) and probably three pairs of Yellow-breasted Chat, whose local populations have declined to near the critical state. These species suffer from the same circumstances that have endangered the Bell's Vireo, namely riparian habitat destruction and cowbird parasitism, so that the presence of these species on the Carmel indicates a comparatively healthy riparian ecosystem. Preservation of this riparian ecosystem should be an important component in any management plan for the Carmel River.

Below we give brief descriptions of the stretches of the Carmel and San Clemente surveyed, indicating an approximation of the mileage covered in each stretch and the habitats encountered. Each such stretch has been labelled with letter from A-I, and these symbols reappear in the bird lists themselves to designate the particular area discussed. In the bird lists, we also indicate which time frame the particular stretch was surveyed by indicating either the 1st, 2nd or 3rd time surveyed. Thus a designation of "C2" indicates this refers to the 2nd time the strech labelled "C" (Dam to Filter Plant) was surveyed. The exact date of this survey appears in the descriptions below.

A: CARMEL RIVER UPSTREAM FROM RESERVOIR (2+ mi.)

A strikingly scenic area with the river flowing in a moderately steep canyon, dominated by Mixed Evergreen Forests with a riparian fringe and few denser patches of willows adjacent to the river. The avifauna is much more reminescent of higher elevations in the Santa Lucia Mnts., e.g. the abundance of Steller's Jay and Mountain Quail (with California Quail restricted to the dense riparian only and to chaparral away from the river). Figure 1 shows one such stretch, including cliffs (left-center) where White-throated Swifts are nesting.

SURVEYS: A1=4 May (Don & Robin); A2=16 May (Don & Robin). (Both times we slept overnight adjacent to the survey area and recorded nightbirds also).

Figure 2 shows the San Clemente Reservoir and Dam, surrounded on all sides by oak woodlands without any riparian fringe. This habitat is inappropriate for Bell's Vireo (Miller 1951, Grinnell & Miller 1944) so was not surveyed, though we did casually note species present when we crossed this habitat and sometimes comment thereon.

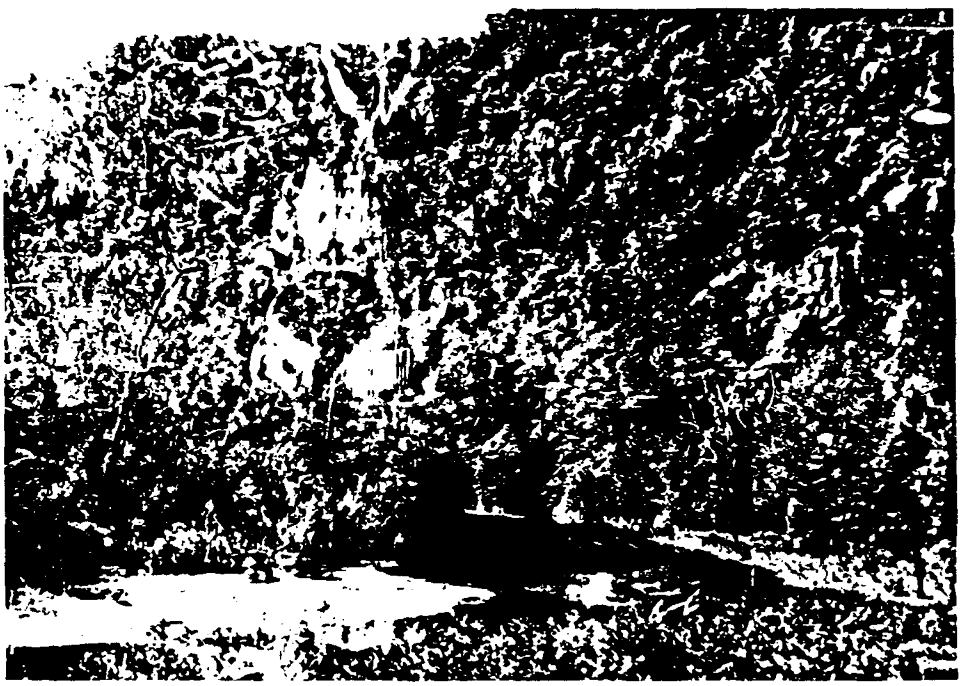
Figure 1: Carmel River about 1½ mi. above reservoir


Figure 2: San Clemente Reservoir encircled by oak woodlands

B: SAN CLEMENTE CREEK UPSTREAM FROM THE RESERVOIR (@1 mile)

A very steep-walled canyon composed entirely of Mixed Evergreen Forest without a true riparian component. There was a small stand of redwoods in the upper reaches of the survey area, and thoughout the undergrowth includes a profusion of ferns. As a potential inundation area, this area was surveyed twice, but it is entirely unsuitable for Bell's Vireo. SURVEYS: B1=2 May (Don); B2=7 May (Don).

(Irrelevent to this project, but interesting nonetheless, was the finding of a Coast Horned Lizard Phrynosoma coronatum at the upper end of the trail leading to San Clemente Creek on 7 May; figure 3).

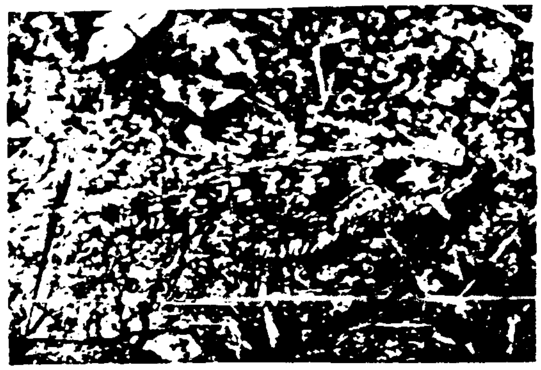

Figure 3: Coast Horned Lizard

C: DAM to FILTER PLANT (2½ miles)

This stretch has two distinct elements, demarcated at the point where the steep closed-in canyon opens up to a broader wide canyon, at a point just about where the San Clemente loop road crosses the Carmel River via a ford. Above this point, the habitat is best termed Mixed Evergreen Forest/Riparian, with many oaks and sycamores lining the canyon, interspersed with steeper slopes of chaparral, and willow patches only here and there along the river, with many alders forming a canopy forest. This "closed-in" canyon habitat is shown in figure 4 and is quite different from the remaining habitats downstream. We found a pair of nesting Dippers in this gorge; Steller's Jay were common and the entire "feel" is of an upper elevation avifauna (though entirely below 500' elevation). Below the ford, the canyon widens (figure 5)

Figure 4: Carmel River below San Clemente Dam

Figure 5: Carmel River above Filter Plant

and becomes dominated by true Northern Riparian Woodland/Thicket. The widening of the canyon seems to demarcate the ranges of several species; European Starling, Brown-headed Cowbird and Scrub Jay, for example, were not found above this line; Steller's Jay and Dark-eyed Junco (essentially montane and closed-cone pine forest birds) were quite scarce below this line.

In the area of the filter plant and just downstream, the riparian growth extends out widely as Riparian Scrub and we criss-crossed this habitat several times. The area just below the filter plant, composed of the Scrub, several Thickets, and some pools surrounded by reeds (and nesting Red-winged Blackbirds), seems the most appropriate habitat on the entire river for Bell's Vireo. Factors other than habitat, though, as discussed above, may be responsible for the absence of the bird here.

SURVEYS: C1=5 May (Don); C2=17 May (Robin); C3=29 May (Don).

D: FILTER PLANT to ROSIE'S BRIDGE (2½ miles)

Actually, this stretch begins (and the previous stretch ends) at a point ¼ mile below the filter plant itself, on the edge of the widest section of Riparian Scrub and described under C, above. The entire stretch has much healthy Riparian Thicket/ Woodland and was surveyed mostly from the stream by wading.

SURVEYS: D1=5 May (Robin); F2=17 May (Don); F3=29 May (Robin).

E: ROSIE'S BRIDGE to GARLAND RANCH (3½ miles)

Another stretch with mostly Riparian Woodland/Thicket, interspersed with some Riparian Scrub and with several splaces where steep cliffs bring Evergreen Forest to nearly river's edge. There are some deep pools skirting around Carmel Valley Village (colonies of Red-winged Blackbirds) near which is some particularly thick Riparian Thicket habitat which supports a pair of Yellow-breasted Chat which were documented as breeding during the survey. This area also apppears quite suitable for Bell's Vireo if they were present in the Carmel Valley. There are several areas where willows are being reintroduced, but as yet there is little bird colonization of this reforestation.

SURVEYS: E1=11 May (Don); E2=18 May (Robin); E3=30 May (Don).

F: GARLAND RANCH to ROBINSON CANYON BRIDGE (2½ miles)

A mixture of Riparian Woodland/Thicket, Riparian Scrub, some reforestation, and extensive Ruderal (non-native) habitats, the latter taking the form of planted stands of eucalyptus and rip-rap and disturbed scrub adjacent to a golf course. Opposite the golf course, just upstream from the Bridge, is a steep cliff with a large colony of Cliff Swallow. When appropriate, the wider Riparian Scrub habitats were criss-crossed on the survey, but in general the area appears too disturbed and too filled with cowbirds to be appropriate Bell's Vireo habitat.

SURVEYS: F1=11 May (Robin); F2=18 May (Don & Rick Villasenor); F3=30 May (Robin).

G: ROBINSON CANYON BRIDGE to VALLEY GREENS DRIVE (3 miles)

At the upper end are some nice stands of Riparian Thicket/Woodland, but sometimes shortly thereafter (by the Schulte Bridge during this May) the streamflow disappeared to be replaced from place to place by pools. Riparian Scrub is found in much of the central stretch, but is slowly replaced by a denser and taller canopy, eventually designated as Riparian Forest, by the time Quail Lodge golf course area is reached.

SURVEYS: G1=12 May (Don); G2=19 May (Robin); G3=31 May (Robin).

H: VALLEY GREENS DRIVE to HIGHWAY 1 BRIDGE (3½ miles)

The upper end of the stretch, from the Quail Lodge golf course to Via Mallorca Drive, is a very attractive strech of Riparian Forest with a tall canopy of cottonwoods, pools of water, and dense undergrowth, supporting a healthy riparian avifauna despite the presence of numbers of cowbirds. The wildness of this area is illustrated by the

presence of a Bobcat Lynx rufus watched hunting amongst the pools and undergrowth on 31 May. Downstream a mixture of Forest and Scrub is interspersed along the Carmel Valley golf course, sometimes with extensive Dry Wash. From the golf course downstream to the Hwy 1 Bridge, the Forest canopy again becomes predominate and comparatively undisturbed.
SURVEYS: H1=12 May (Robin); H2=19 May (Don); H3=31 May (Don).

I: HIGHWAY 1 BRIDGE to RIVER MOUTH LAGOON (1 mile)

Until the emergent vegetation at the lagoon appears, the entire stretch is healthy Riparian Forest with some undergrowth supporting species (e.g. House Wren, Wrentit) not present in the upstream stretches of Riparian Forest. At the river mouth itself is a lagoon used for bathing by gulls and feeding by shorebirds; these species are not considered a part of this riparian survey but were briefly noted. In addition, the coastal scrub on "Cross Hill" just at the mouth was surveyed; it supports the only population of White-crowned Sparrow on the entire river (their range being restricted to coastal scrub in Monterey County; Roberson 1985). There is also a reedy pond with a colony of Red-winged Blackbirds below the Hill which hosted single Virginia's Rail and Common Yellowthroat, riparian species restricted to this coastal pond-type habitat and which may, or may not, be nesting here.

This entire stretch is the one well-known and well-birded stretch of the Carmel River. Over 270 species have been recorded here, including some of the rarest vagrants which have ever occurred in California; e.g. Black-billed Cuckoo, Broad-billed Hummingbird (2nd Northern California record at the time), White-rumped Sandpiper (3rd state record), Buff-breasted and Sharp-tailed Sandpipers, Cerulean, Yellow-throated, Prothonotary and Mourning Warblers (Roberson 1985). The area is surveyed almost daily by birders from mid-August to mid-November, the height of fall migration. Our notes show over 30 hours expended by us in the 60 day stretch 4 Sep-4 Nov in 1986. Assuming that only 20 other birders expend similar efforts (15 hrs/fall migration), an assumption which is likely well-underestimated since the area is birded on weekends heavily by birders from the Bay Area, often in groups up to 20-30 birders, this one-mile stretch of the Carmel receives 330 person-hours of use by recreational birders, whose efforts are adding to the knowledge compiled for use in ornithology as the results are published in American Birds and elsewhere. This 330 person-hours in a mile stretch over a two-month period compares with an estimated 558 person-hours spent fishing per mile for steelhead during the Jan-Feb 1984 season (based on Dettman 1986). As the prime fall migration period is Sep-Oct, a period when no steelhead migration of import is taking place (see Dettman & Kelley 1986), any management plan for the Carmel should take into consideration the access needs of the recreational birdwatcher and field ornithologist. Access to this important stretch of the Carmel has heretofore been available by walking the dry river bed in autumn from the Hwy 1 bridge to the lagoon.

Even during our surveys, other birders were surveying this stretch and did discover two migrants, a Rose-breasted Grosbeak Pheucticus ludovicianus and a Yellow-breasted Chat, which were missed on our surveys of this stretch. Migration is very volatile here, though the healthy breeding populations were reconfirmed each time.
SURVEYS: I1=9 May (Robin); I2=15 May (Don); I3=28 May (Don).

V. BIRD SURVEY RESULTS

We recorded 99 species of birds in, over or immediately adjacent to the riparian habitat on the Carmel River. An additional 5 species (Brown Pelican, Whimbrel, and Heermann's, California and Western Gulls) were recorded at the river mouth lagoon. We obtained positive nesting evidence in the riparian zone or immediately adjacent for 41 species and probable nesting evidence for another 31 species; we believe these 72 species regularly nest on the Carmel (another, Blue-gray Gnatcatcher, nests just above the riparian zone around San Clemente Reservoir, and Rufous-crowned Sparrow probably does as well). Possible nesting evidence was obtained for 5 species. The remaining species were migrants, or, in a few cases, species which nest elsewhere in Monterey County (even the adjacent hills to Carmel Valley) and use the River only for feeding (e.g., Black-crowned Night-Heron) or were simply overflying the Valley (e.g., Turkey Vulture, which also roosts in numbers on the river).

Under each species we present general comments, a complete table of our survey results, and a "birds per mile" figure for each stretch of the river as previously discussed. This "birds per mile" figure is an attempt to give some comparative statistics regarding the population density on the river, rather than an actual population estimate. Observer bias, detection ability, and weather all impact counts in linear surveys; our study was not designed to obtain actual population estimates (see Robbins et al 1986). To obtain the "birds per mile" total we averaged the two highest counts (throwing out low counts which reflect poor weather or detectability during one survey, yet averaging to downplay the effects of migrant individuals or the effects of possible overcounting), then multiply by a "detection factor". This "factor" is a number between 1 and 2 and is a subjectively (but carefully) determined estimate of the detectibility of the species. Swallows, hawks and ducks, for example, we believe are entirely detected, so their factor is simply "1". In contrast, we detect only the singing male Wrentits (quiet females being very difficult to detect in the dense preferred chaparral or thick scrub) so, to make a comparison of the number of Wrentits to, say, Violet-green Swallow, we must multiply the Wrentit count by two to have an objectively comparable population estimate. For many passerine birds, the factors are 1.5 or 1.75, indicating our estimate that most birds recorded are singing males, but some (between ¼ and ½) of the presumed present females are detected as well. Dependent young are not counted in our figures (except to be mentioned under breeding). The averaged count, adjusted by the "factor", is ten divided by the miles (approximate) in that particular stretch to obtain the "birds per mile" figure (rounded to the nearest whole numbler).

We also indicate any nesting evidence obtained, whether Confirmed, Probable or Possible, using standard Breeding Bird Atlas criteria (Table 2). Each such evidence is cross-reference to the stretch of river and the date surveyed. Thus a"FL(C2)" for Common Merganser will be read as "downy young" (FL on Table 2) observed on stretch C (Dam to Filter Plant) on the 2nd survey (17 May).

VI. SPECIES ACCOUNTS

DOUBLE-CRESTED CORMORANT *Phalacrocorax auritus*

Factor: 1

Date	A	B	C	D	E	F	G	H	I

Not in riparian; single immature on San Clemente Resevoir 2 May - a migrant. There is one small nesting colony on the Big Sur coast (Roberson 1985)

GREAT BLUE HERON *Ardea herodias*

These are simply migrants or non-breeding summerers feeding along the river. Nearest nesting colonies are in southern Monterey Co.
Factor: 1

Date	A	B	C	D	E	F	G	H	I
1					2	2	1	1	1
2					2	1	1		
3						3		1	1
Birds/mi.					1	2	1	1	1

GREAT EGRET *Casmerodius albus*

Factor: 1

Simply one migrant; nearest nesting colonies are in the Bay Area or the Central Valley.

Date	A	B	C	D	E	F	G	H	I
1									
2					1				
3									

GREEN-BACKED HERON *Butorides striatus*

Not known to nest on the Carmel (Roberson 1985) but we suspect they could nest here. Factor: 1
BREEDING: Possible (birds as shown, in correct season, appropriate habitat)

Date	A	B	C	D	E	F	G	H	I
1				2	1			2	2
2					3			1	1
3					1	1		1	
Birds/mi.				1	1	1		1	1

BLACK-CROWNED NIGHT-HERON
Nycticorax nycticorax

Date	A	B	C	D	E	F	G	H	I
1					2	3	8	2	
2					12		10	1	2
3	—	—	—	—	7	1	2	1	—
Birds/mi.					3	1	3	1	1

These are simply birds feeding up the river, presumably from their only known nesting colony at Carmel Point. We recorded about equal numbers of adults and immatures. Factor: 1

MALLARD *Anas platyrhynchos*

Date	A	B	C	D	E	F	G	H	I
1	2		5	7	14	32	11	7	6
2	5		7	5	23	18	10	2	10
3	—	—	6	18	6	19	5	—	20
Birds/mi.	2		3	5	5	10	4	1	15

We found evidence of nesting along the entire Carmel, though flocks of birds were non-nesters, including the average of 15 birds on the river mouth lagoon. Factor: 1

BREEDING: Confirmed FL(E1-broods of 3,10,4,5&4 young each; C2; I2- 4 yng; G2- 3 yng; E3-broods of 6 & 9 yng; F3-broods of 12 & 2 yng; H3). Also brood of 8 yng w/female on San Clemente Reservoir 2 May.

CANADA GOOSE *Branta canadensis*

Date	A	B	C	D	E	F	G	H	I
1									2
2					4				
3									

The sightings were of pairs flying up-river, showing characteristics of the large race *moffitti*. These birds have been introduced and are breeding in the upper Carmel Valley; they use the lagoon for feeding. Factor: 1

CINNAMON TEAL *Anas clypeata*

Date	A	B	C	D	E	F	G	H	I
1									5
2									
3									

The group of 5 at the lagoon included
BREEDING:Probable D(I1), however they were not found thereafter and they may simply have been displaying on migration. However, the species could nest here given favorable water conditions and do nest at the Salinas River mouth and elsewhere in Monterey County. Factor: 1

COMMON MERGANSER *Mergus merganser*

Date	A	B	C	D	E	F	G	H	I
1	3	1	3	2					
2	3		4	1	1	1			
3	—	—	1	2	—	—	—	—	—
Birds/mi.	2	1	1	1	1	1			

One of our major findings was the confirmation of nesting on the Carmel by this species, previously unknown. All birds found were females, except for a single male on the Reservoir 2 May. Males do not help in rearing the young. Factor: 1

BREEDING: Confirmed FL(C1-brood of 8 yng; F2-brood of 8 yng; C2-brood of 8 yng; D2-brood of 8 yng), FE=female carrying broken egg (D1); ON(B1-female leaving nesthole in oak above San Clemente Creek).

TURKEY VULTURE *Cathartes aura*

Date	A	B	C	D	E	F	G	H	I
1	4		2	20	1	13	9	1	
2	2		3	5	18	1	20		
3				10	1	3			1

All birds are simply foraging well over the Valley opportunistically; birds/mi. has no relevence for such strategy. They nest in the mountains and foothills surrounding the Carmel Valley.

OSPREY *Pandion haliaetus*

One migrant over the river mouth lagoon 9 May.

BLACK-SHOULDERED KITE *Elanus caeruleus*

Two birds (pair?) seen near Garland Ranch 18 May might represent a pair breeding somewhere in the Carmel Valley, but they were not refound on subsequent surveys and could have been migrants.

SHARP-SHINNED HAWK *Accipiter striatus*

Single migrant near Robinson Canyon on 12 May.

RED-SHOULDERED HAWK *Buteo lineatus*

A riparian hawk evenly distributed along the Carmel.
BREEDING: Confirmed NB(I1), FY(D1).
Factor: 1.5

Date	A	B	C	D	E	F	G	H	I
1				4	1	5	2		3
2	1		3	2	4	1	2	1	2
3	—	—	1	1	5	3	2	1	1
Birds/mi.	1		1	2	2	2	2	1	4

RED-TAILED HAWK *Buteo jamaicensis*

A widespread hawk in many habitats rather evenly distributed along the Carmel. Surprisingly, we did find
BREEDING: Confirmed NE(E2).
Factor: 1

Date	A	B	C	D	E	F	G	H	I
1			1		2	2		3	
2	2		3	1	2	1	3	3	1
3	—	—	2	—	3	3	1	—	—
Birds/mi.	1		1	1	1	1	1	1	1

GOLDEN EAGLE *Aquila chrysaetos*

Single adult over Quail Lodge golf course 19 May. Does not nest in the riparian, but hunts overhead Carmel Valley from nesting sites in the Los Padres Nat'l Forest.

AMERICAN KESTREL *Falco sparverius*

Locally distributed in open areas such as Garland Ranch.
BREEDING: Confirmed NB(E2).
Factor: 1.75

Date	A	B	C	D	E	F	G	H	I
1					1	1			
2				1	2	1			
3	—	—	—	1	1	1	—	—	—
Birds/mi.				1	1	1			

CALIFORNIA QUAIL *Callipepla californica*

Widespread along the lower Carmel, but closely restricted to dense riparian above reservoir, where coexists with Mountain Quail.
BREEDING: Confirmed FL(E1-brood of 6 yng; H2-brood of 2 yng; E3-brood of 2 yng).
Factor 1.25

Date	A	B	C	D	E	F	G	H	I
1			7	7	14	3	36	19	2
2	2		5	11	13	10	23	22	
3	—	—	3	18	28	6	15	7	—
Birds/mi.	1		3	7	8	4	12	7	1

MOUNTAIN QUAIL *Oreortyx pictus*

Common on the Carmel above the Dam, in the dense woods & chaparral (but not in the riparian). A very low elevation (650') for this species.
BREEDING: Probable S(A2)
Factor: 2

Date	A	B	C	D	E	F	G	H	I
1	4								
2	8								
3	—	—	—	—	—	—	—	—	—
Bird/mi.	6								

VIRGINIA RAIL *Rallus limicola*

Single bird in pond below "Cross Hill" at river mouth on 9 May, probably a migrant, but nesting might be looked for here in the future.

KILLDEER *Charadrius vociferus*

Present in most dry washes and pool edges in lower Carmel River, but proof of positive nesting not obtained.
BREEDING: Probable T(all dates)
Factor: 1

Date	A	B	C	D	E	F	G	H	I
1	1				5	14	18	4	1
2	2				6	8	20	3	2
3	—	—	—	—	8	9	12	6	2
Birds/mi.	1				2	5	6	1	1

GREATER YELLOWLEGS *Tringa melanleuca*

Group of 3 migrants at Robinson Canyon Bridge on 11 May.

SPOTTED SANDPIPER *Actitis hypoleucos*

Despite widespread birds, no nesting evidence positive and numbers declined.
BREEDING: Probable T(A2). Factor: 1

Date	A	B	C	D	E	F	G	H	I
1	1				1	2	1		1
2	2					4	1		1
3	—	—	—	—	—	1	—	—	—
	1				1	1	1		1

LEAST SANDPIPER *Calidris minutilla*

A group of 3 breeding-plumaged migrants on the riverbed at the mouth on 15 May.

BAND-TAILED PIGEON *Columba fasciata*

Virtually all pigeons were in large flocks (including the flock of up to 220 at the river mouth) and are best considered post-breeding dispersal birds. These flocks move widely after food post-nesting (the species nests very early) and a "bird/mi." figure would have no meaning, so is deleted.

Date	A	B	C	D	E	F	G	H	I
1				11	18	2		6	141
2				20	37		1	40	220
3				17	24			21	8

MOURNING DOVE *Zenaida macroura*

A common species of the lower Carmel with numbers distributed upstream throughout. Factor: 1
BREEDING: Probable D(A1,2 etc)

Date	A	B	C	D	E	F	G	H	I
1	6		8	10	11	23	31	41	10
2	8		13	7	4	5	31	59	9
3	—	—	13	10	3	16	17	41	12
Birds/mi.	4		5	2	2	8	10	14	11

GREAT HORNED OWL *Bubo virginianus*

Only recorded on the upper Carmel because that was the only night surveying done, though known to occur throughout the Valley.
BREEDING: Probable S(A1,2). Factor: 1

Date	A	B	C	D	E	F	G	H	I
1	2								
2	3								
3	—	—	—	—	—	—	—	—	—
Birds/mi.	1								

NORTHERN PYGMY-OWL *Glaucidium gnoma*

Two calling in the evening of 4 May and another in oak woodlands above this area 16 May seen, indicate they are local residents and BREEDING: Probable S(A1). Another heard below the dam in the early morning 5 May.

LONG-EARED OWL *Asio otus*

One giving an unearthly scream-call repeatedly in the pre-dawn of 4 May along the upper Carmel upstream 1 mile from the Reservoir, suggests possible nesting in this riparian (which looks appropriate) though no nesting in this area is known (Roberson 1985)

WHITE-THROATED SWIFT *Aeronautes saxatalis*

Present and nesting around appropriate cliffs, but forages more widely. Factor: 1
BREEDING: Confirmed ON(A2;F2,3;E3).

	A	B	C	D	E	F	G	H	I
1	4		6		4	5	2	2	3
2	4		2	4	2	2	1		
3	—	—	4	1	10	17	—	2	—
Birds/mi.	1		2	1	2	4	1	1	1

ANNA'S HUMMINGBIRD *Calypte anna*

Commonest on the lower Carmel but widely present throughout. Decrease in numbers late May probably reflects dispersal after end of breeding season. Factor: 1.5
BREEDING: Probable D(E1; G1,2,3).

Date	A	B	C	D	E	F	G	H	I
1	3		3	7	14	9	18	20	9
2	7		10	5	16	11	22	9	11
3	—	—	4	4	2	4	5	4	8
Birds/mi.	4		4	4	6	6	10	6	14

ALLEN'S HUMMINGBIRD *Selasphorus sasin*

Commonest in the lower Carmel, esp. around flowering eucalyptus or willow. One female both times at 650' on upper Carmel is approaching a local elevational record. Factor: 1.5
BREEDING: Probable D(E1,F1,G1,H1).

Date	A	B	C	D	E	F	G	H	I
1	1			1	10	3	18	9	6
2	1			1	5	2	10	14	1
3	—	—	—	3	5	6	5	4	4
Birds/mi.	1			1	3	3	7	5	4

BELTED KINGFISHER Ceryle alcyon

Apparent pairs rather evenly distributed along the entire Carmel. Factor: 1
BREEDING: Confirmed ON,FY(G2); FY(E3).

Date	A	B	C	D	E	F	G	H	I
1	2		3	4	2	4	1		2
2	3		3	3	3	2	2		
3	—	—	3	1	2	4	1	—	—
Birds/mi.	1		1	1	1	2	1		1

ACORN WOODPECKER Melanerpes formicivorus

Restricted along the Carmel to the vicinity of dead trees, particularly sycamores, where colonies exist.
Factor: 1.5
BREEDING: Confirmed NY(H3),ON(G2).

Date	A	B	C	D	E	F	G	H	I
1	2		6	10	16	19	4	4	1
2	2		5	6	16	7	13	6	
3	—	—	6	11	15	11	6	2	—
Birds/mi.	1		4	6	7	9	5	2	1

NUTTALL'S WOODPECKER Picoides nuttallii

Pairs are very evenly distributed throughout the riparian habitat; also common in adjacent oak woodlands.
Factor: 1.5
BREEDING: Probable T(most dates).

Date	A	B	C	D	E	F	G	H	I
1	2		3	1	8		2		1
2	3		1	3	1	2	3	8	1
3	—	—	5	5	2	5	2	3	3
Birds/mi.	2		2	2	2	2	1	2	3

DOWNY WOODPECKER Picoides pubescens

Small numbers evenly distributed, irregularly detected (drumming season having past), with a decided center of population around the Riparian Forest downstream from Valley Greens Drive. Factor: 1.25
BREEDING: Confirmed NY(I2; H2-two different active nest holes with young).

Date	A	B	C	D	E	F	G	H	I
1	1						4	3	1
2			1	1	2	1		12	
3	—	—	2	1	1	—	—	10	2
Birds/mi.	1		1	1	1	1	1	4	1

HAIRY WOODPECKER Picoides villosus

A characteristic species of heavy forest at all elevations, we were surprised to find even this many in the riparian habitat. Factor: 1
BREEDING: Confirmed NY(A2), FY(A1, D2).

Date	A	B	C	D	E	F	G	H	I
1	1			2					
2	2		3				1	1	
3	—	—	5	1	—	—	—	—	—
Birds/mi.	1		2	1			1	1	

NORTHERN FLICKER Colaptes auratus

Rather thinly & evenly distributed, commonest just below dam. Partial to tall trees, dead trees. Factor: 1.25
BREEDING: Confirmed DD(D1-copulation).

Date	A	B	C	D	E	F	G	H	I
1	2	1	6	4	2	1	1	3	
2	3	1	6		2	2	4	2	
3	—	—	2	—	—	2	1	—	—
Birds/mi.	2	1	3	1	1	1	1	1	

OLIVE-SIDED FLYCATCHER Contopus borealias

Only a few calling birds in lower Carmel, which may, or may not, suggest nesting. Factor: 2(assumes nesting)
BREEDING: Probable? S(as shown).

Date	A	B	C	D	E	F	G	H	I
1							2		
2						3	1	1	
3	—	—	—	—	—	1	—	—	—
Birds/mi.						2	1	1	

WESTERN WOOD-PEWEE Contopus sordidulus

Rather common in the Riparian Forest, esp. between the golf courses in the lower Valley; a few upstream also.
Factor: 1.25
BREEDING: Confirmed NB(H1).

Date	A	B	C	D	E	F	G	H	I
1		1		1		1	8	7	
2				3		4	12	21	
3	—	—	1	2	—	1	2	21	2
Birds/mi.		1	1	1		1	4	8	1

WESTERN FLYCATCHER <u>Empidonax difficilis</u>

Very common species in thicker shady and riparian habitats, particularly in the Riparian Forest.
Factor: 1.75
BREEDING: Confirmed FL(H3-2 being fed).

	A	B	C	D	E	F	G	H	I
1	10	2	12	28	8	20	11	50	9
2	12	6	26	18	7	11	23	31	6
3	—	—	28	13	5	15	11	36	9
Birds/mi.	10	7	19	16	4	12	7	22	16

BLACK PHOEBE <u>Sayornis nigricans</u>

Rather evenly distributed along the Carmel, esp. in the vicinity of appropriate nesting structures such as bridges. Factor: 1.25
BREEDING: Confirmed NY(I2-w/3 yng); NE(D3); FL(E3-being fed).

Date	A	B	C	D	E	F	G	H	I
1	1	1	2	3	13	2	9	4	7
2	3		4	3	6	5	7	7	6
3	—	—	6	5	7	9	3	8	1
Birds/mi.	1	1	3	3	4	4	3	3	7

ASH THROATED FLYCATCHER <u>Myiarchus cinerascens</u>

A species of open woodlands and chaparral with only a few scattered, esp. near brushy sections, on the Carmel. Only calling males heard, so Factor: 2
BREEDING: Probable S(most dates, esp A2).

	A	B	C	D	E	F	G	H	I
1			1		3		2		1
2	3			3		2			
3	—	—	1	—	—	1	—	—	—
Birds/mi.	3		1	2	1	1	1		1

WESTERN KINGBIRD <u>Tyrannus verticalis</u>

A single bird seen near filter plant on 5 May was probably a migrant; they are not known to nest in Carmel Valley.

TREE SWALLOW <u>Tachycineta bicolor</u>

Scarce amonst the much more common Violet-green Swallow, and cruising range probably accounted for irregular detection. Factor: 1
BREEDING: Probable N(G1,3; F3 - investigating holes in dead trees).

Date	A	B	C	D	E	F	G	H	I
1					4	5	8	7	1
2			1		2	1	4		6
3	—	—	—	—	—	2	—	3	1
Birds/mi.			1		1	1	2	3	3

VIOLET-GREEN SWALLOW <u>Tachycineta thalassina</u>

A common widespread woodland swallow, though the wandering nature of flocks, sometimes large, skews distributional data. Factor: 1
BREEDING: Confirmed ON(G2,H3).

Date	A	B	C	D	E	F	G	H	I
1	4		8	31	24	27	15	23	10
2	12		5	10	97	45	16	39	4
3	—	—	8	18	19	24	7	38	5
Birds/mi.	4		3	10	17	14	5	11	7

NORTHERN ROUGH-WINGED SWALLOW <u>Stelgidopteryx serripennis</u>

Nesting of this species was previously unpublished for the Carmel River (Roberson 1985) but we found them locally distributed throughout, and confirmed nesting in both sandbanks and in manmade pipes on bridges. Factor: 1
BREEDING: Confirmed ON(A1; I1,3; F1,3; G1; H3).

Date	A	B	C	D	E	F	G	H	I
1	4			8	4	9	9	7	4
2	2		2	5	25	7	14	8	4
3	—	—	1	1	2	1	5	5	2
Birds/mi.	3		1	2	4	3	3	2	4

CLIFF SWALLOW <u>Hirundo pyrrhonota</u>

Locally common in the lower Valley, esp. at the large cliff nesting area just up from Robinson Canyon Bridge (@100-200 active nests). Wandering flocks elsewhere. Factor: 1, possibly underestimated.
BREEDING: Confirmed ON(F2,3); also nests on houses (F2).

Date	A	B	C	D	E	F	G	H	I
1				18	2	3	39		6
2					31	81	38	28	
3	—	—	1	1	11	103	1	4	1
Birds/mi.			1	4	6	33	13	5	4

BARN SWALLOW *Hirundo rustica*

Locally present, esp. near habitation in the lower Carmel. Factor: 1
BREEDING: Confirmed FL(C3).

Date	A	B	C	D	E	F	G	H	I
1			2	8	5	1	8	2	6
2				1	8	8	9		2
3	—	—	2	6	8	1	6	—	2
Birds/mi.			1	3	2	2	3	1	4

STELLER'S JAY *Cyanocitta stelleri*

A common and conspicuous species above and just below the reservoir, in the "montane" cool habitat (but only 500-650' elevation), rapidly becoming scarce downstream. Factor: 1
BREEDING: Confirmed FL(A2), FY(C2,3).

Date	A	B	C	D	E	F	G	H	I
1	5	2	7	4	6	6			
2	13	5	19	2	9	8	2	4	
3	—	—	15	7	3	7	1	1	—
Birds/mi.	5	4	7	2	2	3	1	1	

SCRUB JAY *Aphelocoma coerulescens*

The common jay of the warmer lower Carmel in more typical "upper Sonoran" zone habitat (Miller 1951). None were found above the dam. Factor: 1
BREEDING: Confirmed FL(H1,F3), FS(G3)

Date	A	B	C	D	E	F	G	H	I
1			3	20	14	6	16	19	1
2			2	9	22	8	17	18	2
3	—	—	2	10	29	16	15	23	3
Birds/mi.			1	6	7	5	3	6	2

AMERICAN CROW *Corvus brachyrhynchos*

Apparently feeds or moves along the river in numbers, but no nesting evidence obtained beyond Possible. The numbers at the river mouth are simply feeding flocks moving from beach to fields. Factor 1. BREEDING: Possible

Date	A	B	C	D	E	F	G	H	I
1			2	13	24	9	5		7
2			3	14	46	4	6	1	5
3	—	—	4	18	18	4	—	—	21
Birds/mi.			1	6	10	2	2	1	14

CHESTNUT-BACKED CHICKADEE *Parus rufescens*

A common species throughout the riparian, becoming more abundant in the Riparian Forest near the coast.
Factor: 1

	A	B	C	D	E	F	G	H	I
1	10	2	10	22	37	8	43	97	13
2	11	1	17	31	12	32	33	81	15
3	—	—	16	36	25	17	19	97	18
Birds/mi.	5	2	7	13	9	10	13	28	17

BREEDING: Confirmed FL(K1, I2, C2, H2, D3, G3, H3- numerous family groups w/fledglings being fed; up to 9 sets of 2-4 young/each on the stretch H2).

PLAIN TITMOUSE *Parus inornatus*

Occurs locally in residential areas and stands of large sycamores, though very common in adjacent oak woodland.
Factor: 1
BREEDING: Confirmed FL(D2, G2, F3)

Date	A	B	C	D	E	F	G	H	I
1					12		1		
2				8	10		1		
3	—	—	—	3	21	4	—	—	—
Birds/mi.				2	5	1	1		

BUSHTIT *Psaltriparus minimus*

Common in all riparian habitats, esp. so in the Riparian Forest area.
Factor: 1
BREEDING: Confirmed FL(I1, E2), FY(C2, F2).

Date	A	B	C	D	E	F	G	H	I
1	8	5	15	15	47	50	130	110	16
2	35		40	38	45	67	90	70	26
3	—	—	60	55	60	30	65	80	20
Birds/mi.	11	3	20	19	16	23	37	27	23

WHITE-BREASTED NUTHATCH *Sitta carolinensis*

Local and poorly detected in the vicinity of large oaks or sycamores only. Factor: 2
BREEDING: Probable S(all dates)

	A	B	C	D	E	F	G	H	I
1			1		2				
2				5					
3	—	—	—	—	—	—	—	—	—
Birds/mi.			1	2	1				

PYGMY NUTHATCH Sitta pygmaea

A resident of closed-cone forests, this species is restricted to the pines near the Hwy 1 bridge and near Carmel Valley golf course. Factor: 1.5
BREEDING: Probable T(all dates).

Date	A	B	C	D	E	F	G	H	I
1								1	1
2								2	6
3								2	2
Brids/mi.								1	6

BROWN CREEPER Certhia americana

A species of the "montane" forest, shaded woods above the dam on both the Carmel & San Clemente. Factor: 2
BREEDING: Probable S(all dates).

Date	A	B	C	D	E	F	G	H	I
1	2	1							
2	2	2							
3									
Birds/mi.	2	3							

CANYON WREN Catherpes mexicanus

Singing bird in the canyon at the dam on 4 May and also two non-survey visits. Very likely nests here.

BEWICK'S WREN Thyromanes bewickii

A typical species of chaparral, but also in brushy spots along the river, particularly around Quail Lodge area. Factor: 1.75
BREEDING: Probable S(most dates).

Date	A	B	C	D	E	F	G	H	I
1					8	1	7	5	
2	3			5	2	3	4	16	
3			1	5	4		4	10	1
Birds/mi.	1		1	3	3	1	3	7	1

HOUSE WREN Troglodytes aedon

Most common in lush alder & brush in moist forest below the dam, but a few elsewhere in favored places.
Factor: 1.5
BREEDING: Probable S(most dates).

Date	A	B	C	D	E	F	G	H	I
1	2		13	3	2		1		
2	15	1	19	8		3		1	1
3			14	1	6	1	3		3
Birds/mi.	6	1	10	3	2	1	1	1	3

AMERICAN DIPPER Cinclus mexicanus

A pair found feeding four fledged young along the Carmel just below San Clemente Dam is the first known nesting published for the Carmel (Roberson 1985). Single birds were recorded on each visit thereafter. Photographed.

BLUE-GRAY GNATCATCHER Polioptila caerulea

Recorded in chaparral above proposed inundation zone at the dam and above San Clemente Creek, where probable breeding documented.

WESTERN BLUEBIRD Sialia mexicana

A pair seen investigating holes in dead tree below the filter plant 5 May might have attempted to breed, but were not recorded thereafter. The species is not known to breed in the lower Carmel Valley, though does so commonly in oak woodlands just inland.

SWAINSON'S THRUSH Catharus ustulatus

A common species in the lower Carmel in thicker Riparian Forest habitat.
Factor: 1.5
BREEDING: Probable S(most dates).

Date	A	B	C	D	E	F	G	H	I
1				1		1	7	20	4
2			1	5		7	2	35	7
3				1	1	4	9	37	8
Birds/mi.			1	1	1	3	4	15	11

AMERICAN ROBIN Turdus migratorius

Scattered widely, but seemingly prefers residential gardens and golf course edges. Factor: 1.25
BREEDING: Confirmed NY(I3- 3yng); FY(A2- also broken egg found).

Date	A	B	C	D	E	F	G	H	I
1			2	1	3		4	19	2
2	2			1		3	7	9	1
3			2			2	1	14	4
Birds/mi.	1		1	1	1	1	2	6	4

WRENTIT *Chamaea fasciata*

A characteristic species of chaparral, but also occurring in thickets in the riparian zone. Factor: 2
BREEDING: Probable S(all dates).

Date	A	B	C	D	E	F	G	H	I
1	2		3	3	9	3	14	4	2
2	7		10	5	6	9	10	4	2
3	—	—	7	6	10	5	7	1	1
Birds/mi.	5		9	4	5	6	8	2	4

CEDAR WAXWING *Bombycilla cedrum*

A nesting species of much farther north, these were simply opportunistic feeding flocks remaining from the winter. The data shows the pattern of departure in mid to late May.

Date	A	B	C	D	E	F	G	H	I
1					30	5	210	67	2
2							48	12	47
3									18

EUROPEAN STARLING *Sturnus vulgaris*

A despised introduced pest which usurps nesting holes of native species in dead trees, rather uniformly distributed in the lower Carmel but fortunately scarce above the dam. Factor: 1.
BREEDING: Confirmed FL & NY(F1, H1, I1, C2, E2- 40 fledglings, H2, D3), NB(G2).

Date	A	B	C	D	E	F	G	H	I
1			6	31	67	27	37	39	12
2	1		7	9	78	23	22	23	8
3	—	—	—	11	34	7	4	4	12
Birds/mi.	1		3	8	21	10	10	9	12

HUTTON'S VIREO *Vireo huttoni*

A characteristic species of mixed live oak/pine woods, and recorded in such habitat where it abuts the river, but also a few in the mixed lower riparian zones. Factor: 1.75
BREEDING: Probable S(most dates).

Date	A	B	C	D	E	F	G	H	I
1			5		2	1	3	2	1
2	3			3	1	4	2	3	1
3	—	—	7	4	4	1	—	2	—
Birds/mi.	3		4	2	2	2	1	1	2

WARBLING VIREO *Vireo gilvus*

A species rather restricted to the Riparian Forest/Woodland/Thicket, becoming a bit more common in the lower Carmel. Factor: 1.5
BREEDING: Confirmed FL(G2).

Date	A	B	C	D	E	F	G	H	I
1	2		9	5	16	15	16	24	
2	9		14	7	10	15	19	34	4
3	—	—	16	15	12	19	16	28	7
	4		9	6	6	10	9	13	8

ORANGE-CROWNED WARBLER *Vermivora celata*

Rather uniformly distributed in the riparian and oak woodland edge, where there is a brushy understory.
Factor: 1.5
BREEDING: Confirmed FL(G2- being fed).

	A	B	C	D	E	F	G	H	I
1	6	1	12	18	28	12	21	16	
2	16	1	33	22	25	15	14	31	
3	—	—	23	23	27	21	9	13	—
Birds/mi.	8	2	17	17	12	10	9	10	

YELLOW WARBLER *Dendroica petechia*

A riparian specialist that has been impacted statewide by habitat destruction and parasitism by cowbirds, the populations on the lower Carmel are quite healthy, and suggest a comparatively healthy ecosystem in the riparian zone. Factor: 1.5
BREEDING: Probable S(all dates).

Date	A	B	C	D	E	F	G	H	I
1			5	32	14	30	15	25	6
2			12	21	33	22	22	21	5
3	—	—	8	23	16	16	12	17	15
Birds/mi.			6	17	11	16	9	10	16

TOWNSEND'S WARBLER *Dendroica townsendi*

Two late migrants, female-plumaged, were encountered: Quail Lodge area on 12 May and (very late) near Robinson Canyon 19 May.

BLACK-THROATED GRAY WARBLER *Dendroica nigrescens*

A nesting species more usual at higher elevations, it was recorded in the Mixed Evergreen Forest above and below the dam, with a couple individuals singing down as far as Garland Ranch. Factor: 2
BREEDING: Probable S(all dates).

	A	B	C	D	E	F	G	H	I
1	3		3						
2	4		1			1			
3	—	—	1	1	—	—	—	—	—
Birds/mi.	4		2	1		1			

MacGILLIVRAY'S WARBLER *Oporornis tolmiei*

A persistently singing male about 2 miles above the reservoir on the Carmel on 4 May suggested nesting in the appropriate appearing alder/thicket woodland, but not recorded thereafter. There are few Monterey County nesting areas (Roberson 1985) but the site resembled typical breeding habitat.

COMMON YELLOWTHROAT *Geothypis trichas*

A young singing male at the pond below "Cross Hill" at the river mouth was on apparently appropriate breeding habitat 15 May, but not found thereafter, so might have been a migrant. The species does occasionally nest at the Carmel River mouth.

WILSON'S WARBLER *Wilsonia pusilla*

Thinly distributed in all riparian zones, but with a population center in the Riparian Forest of the lower Carmel. Factor: 1.75
BREEDING: Probable S(all dates).

Date	A	B	C	D	E	F	G	H	I
1	1		4		3		3	21	2
2	1		1	2		5		42	6
3	—	—	2	2	5	3	7	10	9
Birds/mi.	1		2	1	2	2	3	14	8

YELLOW-BREASTED CHAT *Icteria virens*

A riparian specialist declining statewide (Remsen 1977), this species thought to be absent from the Carmel since 1960 (when 8 males found; Roberson 1985). We found an apparent three pairs remaining. Factor: 2
BREEDING: Confirmed FY(E2).

Date	A	B	C	D	E	F	G	H	I
1				1	1				
2					1		1		
3	—	—	—	—	1	—	—	—	—
Birds/mi.				1	1		1		

WESTERN TANAGER *Piranga ludoviciana*

A breeding species of the yellow pine forest zone in the Santa Lucia Mnts., all our birds were thought to be migrants (so no "birds/mi. calculated). It is possible, though, that nesting could occur on the upper Carmel down to the reservoir.

Date	A	B	C	D	E	F	G	H	I
1	4			5					
2	3								
3									1

BLACK-HEADED GROSBEAK *Pheucticus melanocephalus*

Evenly distributed along the entire Carmel, preferring areas with taller trees. Factor: 1.5
BREEDING: Confirmed NE(H1), FY(A2).

	A	B	C	D	E	F	G	H	I
1	12	1	14	1	9	5	16	14	3
2	10		8	9	3	9	16	21	2
3	—	—	11	7	8	4	6	17	2
Birds/mi.	8	1	8	5	4	4	8	8	4

LAZULI BUNTING *Passerina amoena*

A bird of scrubby patches, often adjacent to chaparral, and not in the riparian zone; Birds were recorded only in adjacent hillsides; it is probable the lower Carmel individuals were simply migrants. Factor: 2
BREEDING: Probable S(A1,2; C1- suggested nesting only).

Date	A	B	C	D	E	F	G	H	I
1	2		2		1		2		
2	2								1
3	—	—	—	—	—	—	—	—	—
Birds/mi.	2		1		1		1		1

RUFOUS-SIDED TOWHEE Pipilo erythrophthalmus

A species of chaparral adjacent to the riparian and thick brush in the riparian zone, commonest the first few stretches below the dam. Factor: 1.75
BREEDING: Confirmed FY(A2).

	A	B	C	D	E	F	G	H	I
1	1		1		12	2	7		
2	6		10	5	10	2	3	2	
3	—	—	9	13	11	3	1	5	—
Birds/mi.	3		7	6	6	2	3	2	

BROWN TOWHEE Pipilo fuscus

A brush-loving species becoming gradually more common towards the coast. Factor: 1.25
BREEDING: Probable T(H1), S(most date)

Date	A	B	C	D	E	F	G	H	I
1			2	1		6	3	12	2
2				2	3	3	6	14	
3	—	—	6	9	8	1	8	21	4
Birds/mi.			2	3	2	2	3	6	4

RUFOUS-CROWNED SPARROW Aimophila ruficeps

Singing male in brushy, rocky chaparral on slope above dam 5 May stronly suggests breeding here in this appropriate-appearing habitat.

SONG SPARROW Melospiza melodia

The commonest species on the Carmel in the riparian brush, population becoming denser closer to the coast. Factor: 1.5
BREEDING: Confirmed FL(D1, D2, E2, F2, D3, F3).

Date	A	B	C	D	E	F	G	H	I
1	2		11	30	81	45	60	80	16
2	9		22	46	57	47	48	77	23
3	—	—	26	26	66	43	24	53	34
Birds/mi.	4		14	23	32	28	27	34	38

WHITE-CROWNED SPARROW Zonotrichia leucophyrs

Virtually restricted to the coastal scrub on "Cross Hill" at the river mouth, but one was singing upstream one mile at the Hwy 1 bridge.
Factor: 1.25 BREEDING: Probable S(all dates).

	A	B	C	D	E	F	G	H	I
1									5
2									5
3	—	—	—	—	—	—	—	—	6
Birds/mi.									6

DARK-EYED JUNCO Junco hyemalis

A species of montane and cool forests, found in numbers only in the shady forest below the dam and rapidly declining downstream as habitat disappears. Factor: 1.5
BREEDING: Confirmed FL(C2, D2, E2, F3- 4 young).

Date	A	B	C	D	E	F	G	H	I
1	3		4	3					
2	4		16	8	2	2			
3	—	—	20	1	2	2	—	—	—
Birds/mi.	3		10	3	1	1			

RED-WINGED BLACKBIRD Agelaius phoeniceus

Locally common at the scattered breeding ponds in tules, feeding birds elsewhere. Factor: 1
BREEDING: Confirmed NE(E1), FL(E2), FY(I3).

	A	B	C	D	E	F	G	H	I
1			2	1	53	15	20	6	16
2	3			3	38	17	10	6	20
3	—	—	—	—	40	43	5	5	10
Birds/mi.	2		1	1	13	12	5	2	18

BREWER'S BLACKBIRD Euphagus cyanocephalus

Common in the lower Carmel, nesting in the riparian and feeding in open fields. A large roost at Robinson Canyon accounts for the totals in stretch G. Factor: 1
BREEDING: Confirmed FL(I1-being fed, E2, I2, D3).

	A	B	C	D	E	F	G	H	I
1				20	37	9	75	25	16
2				7	34	25	166	28	29
3	—	—	—	4	63	36	195	18	10
Birds/mi.				5	20	12	60	8	22

BROWN-HEADED COWBIRD Molothrus ater

High densities in the riparian zone near the mouth, but fewer upstream may be balanced in the ecosystem.
Factor: 1.75 BREEDING: Confirmed DD(I1-copulation)

Date	A	B	C	D	E	F	G	H	I
1			1		5		12	26	5
2			1	5	7	10	13	32	9
3	—	—		1	3	4	5	15	8
Birds/mi.			1	1	3	5	3	15	15

NORTHERN ORIOLE Icterus galbula

Restricted to large oaks/sycamores and mixed stands with eucalyptus.
Factor: 1.5
BREEDING: Probable S(most dates).

Date	A	B	C	D	E	F	G	H	I
1					3	2	5		
2						1	3	1	
3	—	—	—	1	—	2	—	—	—
Birds/mi.				1	1	1	2	1	

PURPLE FINCH Carpodacus purpureus

Throughout the riparian of the lower Carmel, but commonest in the Riparian Forest nearer the mouth.
Factor: 1.75
BREEDING: Confirmed NB(H3), FS(H3).

Date	A	B	C	D	E	F	G	H	I
1			1	3	14	3	26	13	
2	3			8	11	9	17	26	7
3	—	—	4	4	13	7	6	24	5
Birds/mi.	1		2	4	7	6	13	13	11

HOUSE FINCH Carpodacus mexicanus

Common in open areas in the lower Carmel, using the riparian only to feed (probably). Numbers at the mouth are feeding flocks, not high nesting densities. Factor: 1.25
BREEDING: Probable S(most dates).

Date	A	B	C	D	E	F	G	H	I
1				1	3	4	13	10	28
2				3	6	8	23	42	27
3	—	—	—	—	13	4	10	8	7
Birds/mi.				1	4	3	7	9	34

PINE SISKIN Carduelis pinus

Restricted to mixed pine/riparian habitats, or eucalyptus, near the river mouth. Factor: 1
BREEDING: Possible

Date	A	B	C	D	E	F	G	H	I
1							2		
2							2	8	1
3	—	—	—	—	—	—	—	2	4
Birds/mi.							1	1	3

LESSER GOLDFINCH Carduelis psaltria

Rather evenly distributed throughout in the riparian zone. Factor: 1
BREEDING: Confirmed NE(F1-4 eggs, later NY-4 yng F3), NE(F3-another), NB(I1).

Date	A	B	C	D	E	F	G	H	I
1	4		2	11	14	24	12	15	8
2	6		5	14	6	7	19	18	
3	—	—	24	10	20	16	11	22	10
Birds/mi.	3		5	5	5	8	5	6	9

LAWRENCE'S GOLDFINCH Carduelis lawrencei

Only previously suspected as nesting at the river mouth once before (in 1981-Roberson 1985), we found pairs and proved nesting this year, which may be anomolous. Factor: 1
BREEDING: Confirmed NB(I3), probable FL(J3-with another pair).

	A	B	C	D	E	F	G	H	I
1							4	5	
2				1			7	2	2
3	—	—	—	—	—	—	—	7	3
Birds/mi.				1			2	2	2

AMERICAN GOLDFINCH Carduelis tristis

Restricted to the immediate vicinity of the coast, using riparian of river mouth for feeding, but may not nest in that habitat. Factor: 1
BREEDING: Possible

Date	A	B	C	D	E	F	G	H	I
1									1
2								3	1
3	—	—	—	—	—	—	—	—	1
Birds/mi.								1	1

HOUSE SPARROW Passer domesticus

A denizen of human habitation, esp. around shopping centers; BREEDING: Confirmed NB(H3) at Rio Road shopping center adjacent (but not in) riparian.

Date	A	B	C	D	E	F	G	H	I
1						1		1	1
2								1	
3								1	

Acknowledgements: Henrietta Stern was very helpful in many ways, including obtaining permission for access to private property above and below the dam. Graham Matthews drove us to all the access points prior to the survey and did the bulk of the aerial mapping, which we confirmed in our walks. Rick Villasenor helped with the mapping, prepared the habitat descriptions (Table 1) and supervised the entire project.

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Table 1

RIPARIAN HABITAT CLASSIFICATIONS

1. Surface Water (Aquatic): Pools and River bed.

2. Emergent Vegetation: Annual and perennial herbs occupying permanently wet habitats in the River as well as pools, springs or seeps. Typical species are: Carex spp. (Sedge), Juncus spp. (Rush) Typha latifola (Cat-Tail), Scirpus spp. (Bulrush or Tule) and Equisetum spp (horsetail).

3. Dry Wash: Low annual herbs and grasses that occur in scoured or rocky substrate areas. Often the habitat is covered with mats of dried algae. Common and characteristic plant species include: Brassica spp. (Mustards), Heliotropidum currassivicum (Chinese Pusley), Lactuca scariola (Willow Lettuce), Melilotus albus (White Sweet Clover), Paspalum districhum (Knotgrass), Polypogon monspeliensis (Rabbitfoot Grass), Rumex crispus (Curly Dock), Xanthium spp. (Cocklebur).

4. Riparian Scrub: Dominated by various shrubs and herbs that occupy gravel and point bars and lacks a well-established tree canopy. Scrub consists of low (2-10 feet) shrubs in rocky open areas. Common and characteristic plant species of riparian scrub include: Artemisia douglasiana (Mugwort), Baccharis piluraris (Coyote Bush), Rubus vitifolius (Blackberry), Foeniculum vulgare (Sweet Fennel), Toxicodendron diversilobum (Poison Oak) and Rhamnus californica (Coffeeberry).

5. Northern Riparian Woodland/Thicket: A woodland is dominated by large (30-60 feet high), deciduous trees that occur in a range of densities. Open, scattered trees represent a woodland. The understory also varies from bare ground (due to scouring or poor light penetration) to a dense herb and/or scrub thicket. This habitat type may be divided into associations based upon the dominant tree species. Common and typical tree species include: Cottonwoods (Populus trichocarpa), Willows (Salix spp.), Sycamores (Platanus racemosa) and Alders (Alnus rhombifolia).

A thicket is a dense stand of woody riparian vegetation less than 20 feet in height and is usually dominated by a single species. There is a continuum of size and structural complexity between these two extremes. Common and characteristic plant species of riparian thickets include: Salix lasiandra (Yellow Willow), S. hindsiana (Sandbar Willow), S. laevigata (Red Willow) and Cornus stoloniferous (Dogwood).

6. Riparian Forest: Dominated by large (30-60 feet high), deciduous trees with overlapping canopies. The understory also varies from bare ground (due to scouring or poor light penetration) to a dense herb and/or scrub thicket. This habitat type may be divided into associations based upon the dominant tree species. Common and typical tree species include: Cottonwoods (Populus trichocarpa), Willows (Salix spp.), Sycamores (Platanus racemosa) and Alders (Alnus rhombifolia).

7. Mixed Evergreen Forest/Riparian: In the steep canyon and gorge areas where the river bottom is right next to the adjacent canyon slopes, the riverside vegetation is dominated by oaks (Quercus agrifolia), bay (Umbellularia californica), and California Buckeye (Aesculus californicus). The understory is often characterized by a dense stand of poison oak, wild current (Ribes sp.), coffeeberry and blackberry.

8. Ruderal or Non-Native Communities: Areas along the river that have been disturbed or planted with non-native plant species. Examples would be Eucalyptus groves, grass covered banks, or rock rip-rap areas.

Map 1: Generalized habitats on the Carmel River (width of habitats exaggerated)
Definitions of habitats in table 1

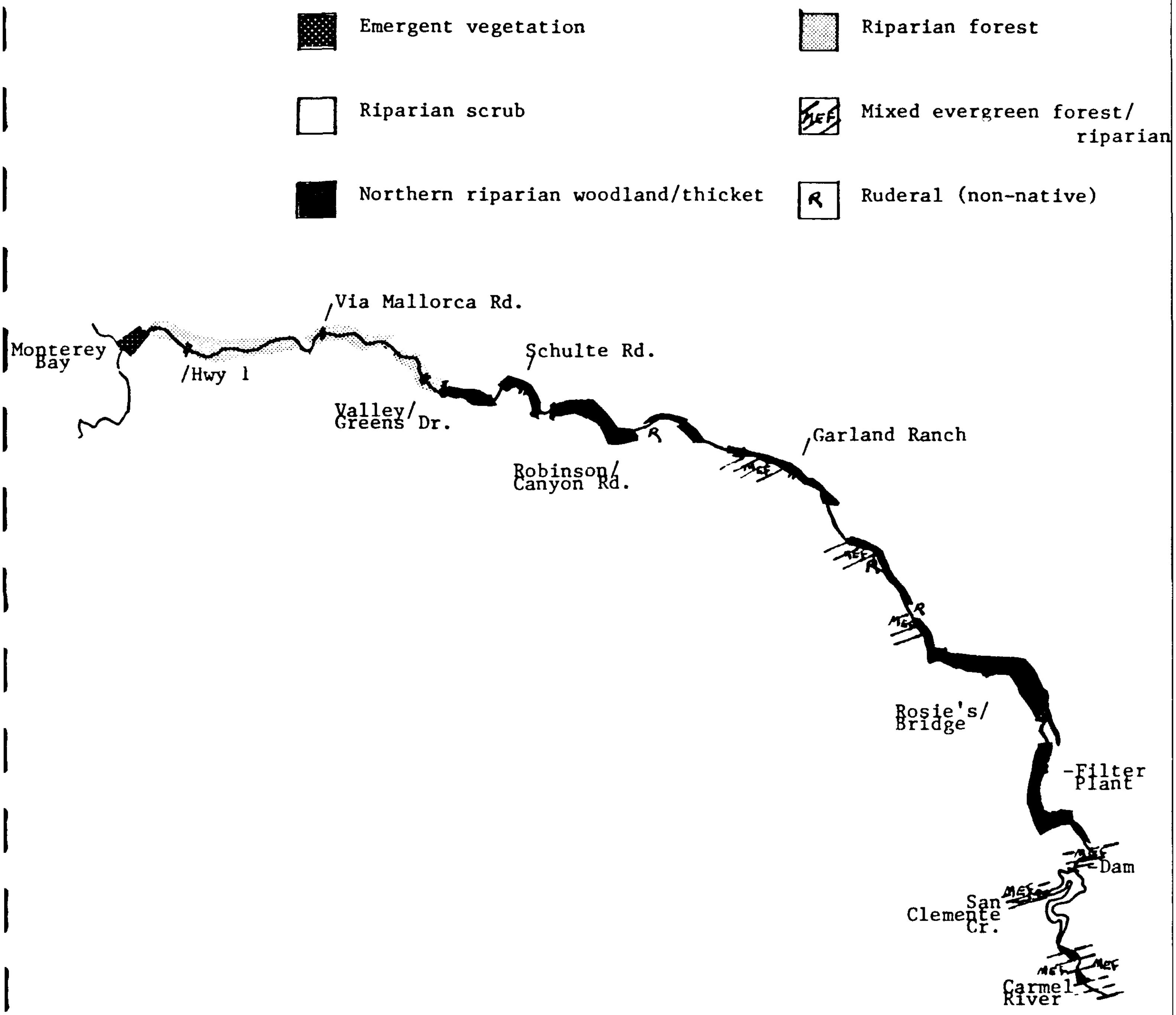

Table 2

CRITERIA FOR POSSIBLE, PROBABLE AND CONFIRMED BREEDING

POSSIBLE BREEDING - this code should be entered in the first column of the Atlas Card (PO).

✓ Bird recorded in the breeding season in possible nesting habitat but no other indication of breeding noted. Take 1 May through 31 July as the breeding season for most species. Summering, non-breeding adults such as gulls in a dump when you know there is no gullery in your block, migrant shorebirds and warblers, should NOT be included.

PROBABLE BREEDING - codes entered in second column (PR).

S Singing male present (or breeding calls heard) on more than one date in the same place. It is a good indication that a bird has taken up residence if the dates are a week or more apart.
T Bird (or pair) apparently holding territory. In addition to singing, chasing of others of the same species often marks territory.
D Courtship and display; or agitated behavior or anxiety calls from adults, suggesting probable presence of nest or young nearby; brood-patch on trapped female or cloacal protuberance on trapped male.
N Visiting probable nest-site.
B Nest building by wrens and woodpeckers. Wrens may build many nests and woodpeckers, although they usually drill only one nesting cavity, may also drill roosting holes.

CONFIRMED BREEDING - codes entered in third column (CO).

DD Distraction display or injury feigning, coition. Agitated behavior and/or anxiety calls are "D" only.
NB Nest building by any species except wrens and woodpeckers.
UN Used nest found. These must be carefully identified if they are to be used. Some nests (like Northern Oriole) are persistent and very characteristic. Others are more difficult to identify correctly.
FE Female with egg in the oviduct.
FL Recently fledged young (including downy young of waterfowl etc.). This code should be used with caution for species such as Starlings and swallows which may move some distance soon after fledging. Recently fledged passerines are still dependent on parents and being fed by them.
FS Adult carrying fecal sac.
FY Adult(s) with food for young. Some birds (gulls, terns and birds of prey) continue to feed their young long after they've fledged and may move considerable distances. Also some birds (like terns) may carry food long distances to young in a neighboring block. Be careful especially on the edge of a block. Care should be taken to avoid confusion with courtship feeding (D).
ON Adult(s) entering or leaving nest-site in circumstances indicating occupied nest. Not generally used for open nesting birds. The correct code would be "N" if you simply see a bird fly into or out of a bush or tree and do not find the nest. It should be used for hole nesters as when a bird enters a hole and remains inside, changes over at a hole or bird leaves hole after having been inside for some time.
NE Nest and eggs or bird setting and not disturbed or egg shells found below the nest. If you find a cowbird egg in a nest, it's NE for cowbird and NE for the host nest.
NY Nest with young or downy young or downy young of waterfowl, quail, waders, etc. If you find a young cowbird with the other young, it's NY for the cowbird and NY for the host species. Since parents often lead down young for considerable distances, care should be taken if such records are close to the edge of the block.

ENTOMOLOGICAL CONSULTING SERVICES, LTD.

Richard A. Arnold, Ph.D.
President

104 Mountain View Ct.
Pleasant Hill, CA 94523

(415) 825-3784
FAX 827-1809

21 July 1991

Mr. Dave Mullen
EIP Associates
150 Spear St.
Suite 1500
San Francisco, CA 94105

RE: San Clemente Dam project

Dear Dave:

At your request, I have conducted a status survey for the endangered Smith's Blue butterfly (*Euphilotes enoptes smithi*), at two of the alternative project sites for the proposed New San Clemente Dam in Monterey County. My status survey was conducted as a follow-up to the habitat assessment surveys that I conducted for EIP Associates on this project in 1989. Because of the presence of occasionally used buckwheat (*Eriogonum* spp.) foodplants at some of the alternative dam sites, one of the recommendations in my 1989 report was that status surveys for the Smith's Blue should be conducted during the butterfly's adult flight season in June and July. I refer you to my 1989 report for general background information on the butterfly and the specific findings of my habitat assessment. The remainder of this letter reports the findings of my status surveys at two of the alternative dam sites, and provides an update on the geographic range of the Smith's Blue butterfly.

My status surveys were conducted during the week of July 14th, 1991. Based on my field studies at other sites in the Carmel Valley, the timing of my surveys coincided with the peak of the butterfly's flight season and flowering period of the buckwheat foodplants.

My surveys were conducted at the New Los Padres Dam and San Clemente Dam sites. Potential foodplants for the Smith's Blue at both sites included *Eriogonum nudum* and *E. fasiculatum*. Although two other buckwheats, *Eriogonum parvifolium* and *E. latifolium*, are the preferred foodplants for the Smith's Blue butterfly, it will occasionally utilize *E. nudum* or *E. fasiculatum*, especially in interior portions of Monterey County. A non-sensitive relative of the Smith's Blue, known as Tilden's Blue (*Euphilotes enoptes tildeni*), is more commonly associated with *E. nudum* and *E. fasiculatum*, especially in interior portions of Monterey County.

Below the inundation line at the New Los Padres Dam site, about 30 specimens of the Tilden's Blue were observed in association with the *E. nudum* and *E. fasiculatum* growing there. No specimens of the Smith's Blue were observed during my surveys. Based on these findings, and because of the more interior location of the New Los Padres Dam site, I doubt that the Smith's

Blue butterfly occurs there. Tilden's Blue replaces Smith's Blue in the interior portions of Monterey County.

Below the inundation line at the New San Clemente Dam site, about 60 specimens of the Tilden's Blue were observed in association with *E. nudum* and *E. fasiculatum*. An additional 22 adults of Tilden's Blue were observed at scattered locations above the inundation line. I also observed one specimen of the Smith's Blue on *E. nudum* above the inundation line on a hilltop immediately west of the canyon created by San Clemente Creek. Because of this observation, I spent extra time at this location searching for the Smith's Blue, but I did not see any other individuals. At other locations in the Carmel Valley, west of the project site, I have occasionally observed adults of Smith's Blue nectaring on *E. nudum* flowers. However this behavior has usually been observed in areas where *E. parvifolium*, a preferred foodplant, is also present. My earlier surveys of the New San Clemente Dam site did not find any stands of *E. parvifolium* and I could not find any at or near the hilltop location where I observed the single Smith's Blue adult. Thus, it is possible that this individual may have been a stray.

Since completing my 1989 surveys of the alternative dam sites, I have been able to conduct additional field studies on the Smith's Blue butterfly in the hills of the Carmel Valley. The results of these studies provide an improved understanding of the geographic range of the Smith's Blue and its non-sensitive relative, the Tilden's Blue (*Euphilotes enoptes tildeni*) in this portion of Monterey County.

As I discussed in my 1989 report, Smith's Blue was previously thought to occur in coastal areas and a few interior areas where coastal sage scrub vegetation grows. Tilden's Blue was previously thought to occur in the interior, rain-shadow areas of the Coast Range. However, new information from my more recent studies in the Carmel Valley suggest that the geographic ranges of these two butterflies overlap extensively in the Carmel Valley and surrounding hills, with *smithi* generally predominating in locations closer to the coast and *tildeni* predominating farther inland. During its 1991 flight season, I have discovered nearly 50 new colonies of the Smith's Blue in the Carmel Valley and surrounding hills between Garland Park and the coast. East of Garland Park, the colonies of blue butterflies on buckwheats tend to be entirely *tildeni*.

If you have any questions about my survey findings, just give me a call to obtain clarification.

Sincerely,

Richard A. Arnold

Richard A. Arnold, Ph.D.
President

SMITH'S BLUE BUTTERFLY

SURVEY OF THE PROPOSED CANADA RESERVOIR SITE

CARMEL VALLEY, CALIFORNIA

MARCH 19, 1990

Prepared by Thomas Reid Associates
Palo Alto, California

SMITH'S BLUE BUTTERFLY
SURVEY OF THE PROPOSED CANADA RESERVOIR SITE
CARMEL VALLEY, CALIFORNIA

A. INTRODUCTION

The proposed Canada Reservoir project site is located on the Eastwood, Morgens, and Monterra properties in Carmel Valley, Monterey County (Figure 1).

Smith's blue butterfly is listed as an endangered species by the United States Fish and Wildlife Service. Because Smith's blue is known from the vicinity of Carmel Valley, a study of the butterfly was undertaken to determine if the proposed Canada Reservoir project would have an impact on the butterfly or its habitat.

The information presented here is based on field work by Robert Langston, and Michael Baumgartner for Thomas Reid Associates in 1989 and on the work of others as reported in the published literature.

B. BACKGROUND ON THE SMITH'S BLUE BUTTERFLY

Smith's blue butterfly is found along the coastal dunes of Monterey County, where the larvae (caterpillar form) feed on two species of buckwheat: the seacliff buckwheat, Eriogonum parvifolium, used to the south, and the coast buckwheat, Eriogonum latifolium, used to the north. While the overall distribution of Smith's blue is smaller than the geographic range of its larval food plants, Carmel Valley is clearly within the present range of the butterfly and thus there is a possibility of finding the Smith's blue wherever the buckwheats occur.

Smith's blue adults are found close to its larval host plants, which also serve as adult nectar sources as well as egg-laying sites for females. The close relationship between the butterfly and its food plant allows Smith's blue to colonize and maintain populations on habitat areas as small as a few acres. Such small populations may frequently go extinct, however, and can only be re-established by migrants from more persistent colonies.

1. Taxonomy

Smith's blue is a small lycaenid butterfly. The adults have a 1 inch wingspan. The wing has a pale grey underside speckled with black dots and a reddish-orange band on the hind-wing border. The topside of the male is a lustrous blue, the female has a brown topside with a band of orange bordering the hind wing (1984 Smith's Blue Butterfly Recovery Plan). Larvae are slug-shaped and vary in color from cream to pale yellow or rose, depending on the color of the flowerhead on which they are feeding.

The species Euphilotes enoptes comprises nine described subspecies, including Smith's blue (Euphilotes enoptes smithi). The following paragraph is a general introduction to the species biology adapted from Langston (1975).

The species group distribution is restricted to western North America, Western Canada and Baja California. Adults are closely associated with their host plants, several species of wild buckwheat, Eriogonum (Polygonaceae). Eggs are deposited on late buds or early flower heads of the buckwheat plants. Young larvae feed solely on the flowerheads of the plant. Each subspecies is generally restricted to one or a few closely related host species of buckwheat. There is only one generation per year. Depending upon subspecies, the adults may fly in early-late spring, early summer, mid-summer or early fall.

Smith's blue (Euphilotes enoptes smithi) was originally described in 1954 by R.H.T. Mattoni from specimens collected at Burns Creek, State Highway 1, Monterey County, California. In 1975, Langston described the butterfly as inhabiting the sand dunes of north Monterey County southward through Big Sur.

The most recent distribution of Smith's Blue is described in the U.S. Fish and Wildlife Service (USFWS) Smith's blue Butterfly Recovery Plan (1984). Figure 2 (taken from the Recovery Plan) shows the known collection locations of Smith's blue through 1983. Note that the Santa Cruz and San Mateo County locations are not considered to be assignable to Euphilotes enoptes smithi.

Robert Langston and Dennis Murphy, Ph.D. (Thomas Reid Associates) conducted a survey of Euphilotes enoptes in 1986 in inland Santa Cruz County for the USFWS to determine the taxonomic status of the insect and its distribution. That study concluded that Euphilotes enoptes found in inland Santa Cruz Co. and San Mateo County are phenotypically intermediate between E. e. smithi and E. e. tildeni.

Two other subspecies of Euphilotes enoptes are found in the greater San Francisco Bay Area. E. e. bayensis is found in the northern San Francisco Bay area: including Marin, Contra Costa, and Solano Counties, ranging northward in Sonoma, Mendocino and Humboldt Counties. E. e. tildeni is also more widespread than smithi: it occurs in the inner coast range foothills and mountains in Santa Clara, Stanislaus, San Benito, Monterey, San Luis Obispo, Kern and Ventura Counties.

2. Ecology

a. Life Cycle

The following is summarized from the Smith's Blue Recovery Plan (USFWS 1984). Smith's blue butterflies are univoltine -- there is only a single generation per year. The butterflies overwinter as pupae, emerging as adults in the late spring or early summer. The males emerge a few days to a week ahead of the females. Once the females emerge, they are quickly mated. All courtship and mating behavior takes place around the buckwheat plants.

The females lay their eggs singly on flower heads of the plants. The larvae hatch in about a week. After hatching the larvae begin eating the flowering heads of the buckwheat. As larvae grow they molt, passing through 5 growing stages (or instars). Following the fifth instar stage the larvae pupate (August - November), and then overwinter in the leaf litter at the base of the plants. Some pupae have been found to overwinter in the dried flower heads of the plant.

b. Larval Food Plants

The Smith's blue is known to use two buckwheat species as larval food plants: seacliff or dune buckwheat, Eriogonum parvifolium, and coast buckwheat, Eriogonum latifolium. In California, Eriogonum parvifolium is found in dunes and hillsides along the California coast from Monterey County south to San Diego

County (Abrams, 1944). The dune buckwheat, Eriogonum parvifolium, is a low spreading shrub with slender leafy branches (Figure 3). It has a single inflorescence; the flower is a pale rose color. Eriogonum latifolium is found in bluffs and dunes along the coast from Oregon south to San Luis Obispo (Munz 1968). It has mostly basal oval leaves (Figure 3), and also has a single white or pale rose inflorescence.

c. Oviposition Suitability

Female butterflies lay their eggs singly on the buds and newly opened flowering heads of buckwheat. Because the plants bloom earlier in the more sheltered aft-dunes, the earliest emerging adults are found flying in these locations. The adults subsequently emerge in the mid-dunes, and ultimately in the more exposed areas of the fore-dunes.

d. Nectaring

Adult Smith's blue butterflies nectar (feed) almost exclusively on buckwheat flowers. Under inclement weather conditions when butterflies do not get sufficient warmth from sunlight to allow flight, adult feeding is also curtailed.

C. SMITH'S BLUE SURVEY AT THE CANADA RESERVOIR SITE

E. latifolium blooms in June and July; E. parvifolium blooms from July through September. Because E. latifolium blooms earlier than E. parvifolium and because the larvae feed on the flowerheads, Smith's blue began to exhibit an earlier adult flight period. Where Smith's blue is associated with E. latifolium, the butterfly flies in June and early July, and where associated with E. parvifolium, the butterfly flies from July to September. Morphologically, the adults fall within the same range of variation from either host.

On July 17, 1989 Victoria Harris and Michael Baumgartner met with Rex Palmer of Biosystems on the proposed Canada Reservoir site. Mr. Palmer had observed some Eriogonum parvifolium plants during vegetation surveys he had conducted for the Environmental Impact Report. Mr. Palmer had only found a few Eriogonum plants in the proposed reservoir inundation area. The plants were all Eriogonum parvifolium. Most of the site is heavily vegetated with thick shrubs, trees, and poison oak. In addition many areas are steep and inaccessible. Eriogonum parvifolium and Smith's blue butterflies are not typically found in this type of habitat.

During the initial site visit on July 17, 1989 the two small patches of Eriogonum parvifolium found along the valley floor road were thoroughly searched for signs of the butterfly (see Figure 4). At the first patch (labeled A on the map) there were about 15 plants scattered along a thickly vegetated road cut. The second patch (B) comprised only three plants. No Smith's blue were observed in either location. On the morning of July 17, prior to our visit to the Canada Reservoir site, three adult Smith's blue were observed in Sand City.

TRA made two more visits to the site, one on August 11th and one on August 17th, both under favorable weather conditions. Additional host plant searches were conducted during both visits. No additional Eriogonum plants were observed. During both visits the same two patches of Eriogonum found along the valley floor road were searched. Robert Langston, our Smith's blue expert, participated in the survey work. It is his belief that there are too few Eriogonum plants on the site to support a colony of Smith's blue butterfly.

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Persons Contacted

Denise Duffy, Duffy and Associates

Chris Nagano, U.S. Fish and Wildlife Service, Office of Endangered Species, Sacramento, CA

Rex Palmer, Biosystems, Inc.

Report Participants

Michael Baumgartner
Victoria Harris
Robert Langston

FIGURE 1
SITE LOCATION

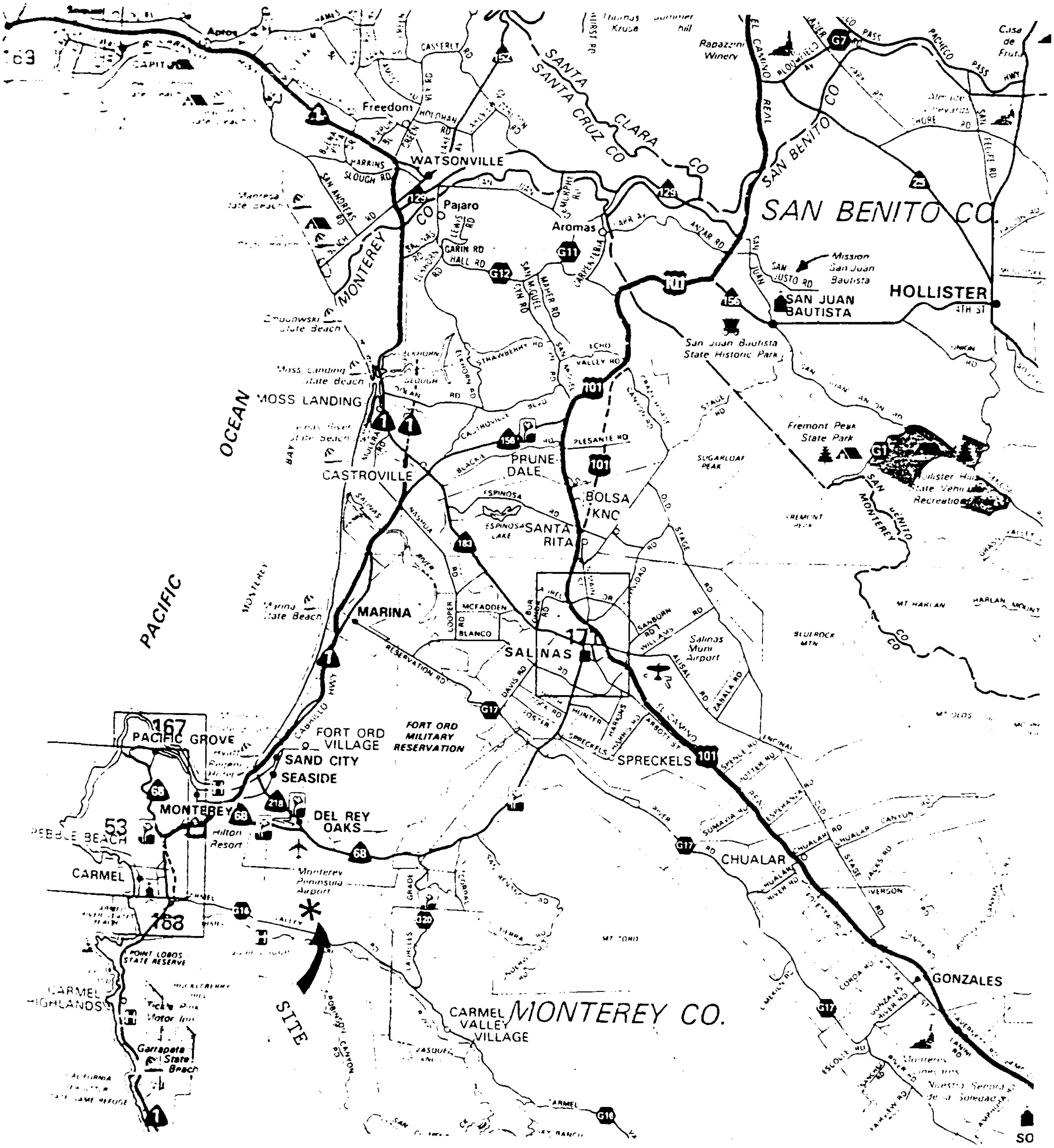


FIGURE 2
KNOWN LOCATIONS OF SMITH'S BLUE BUTTERFLY THROUGH 1983

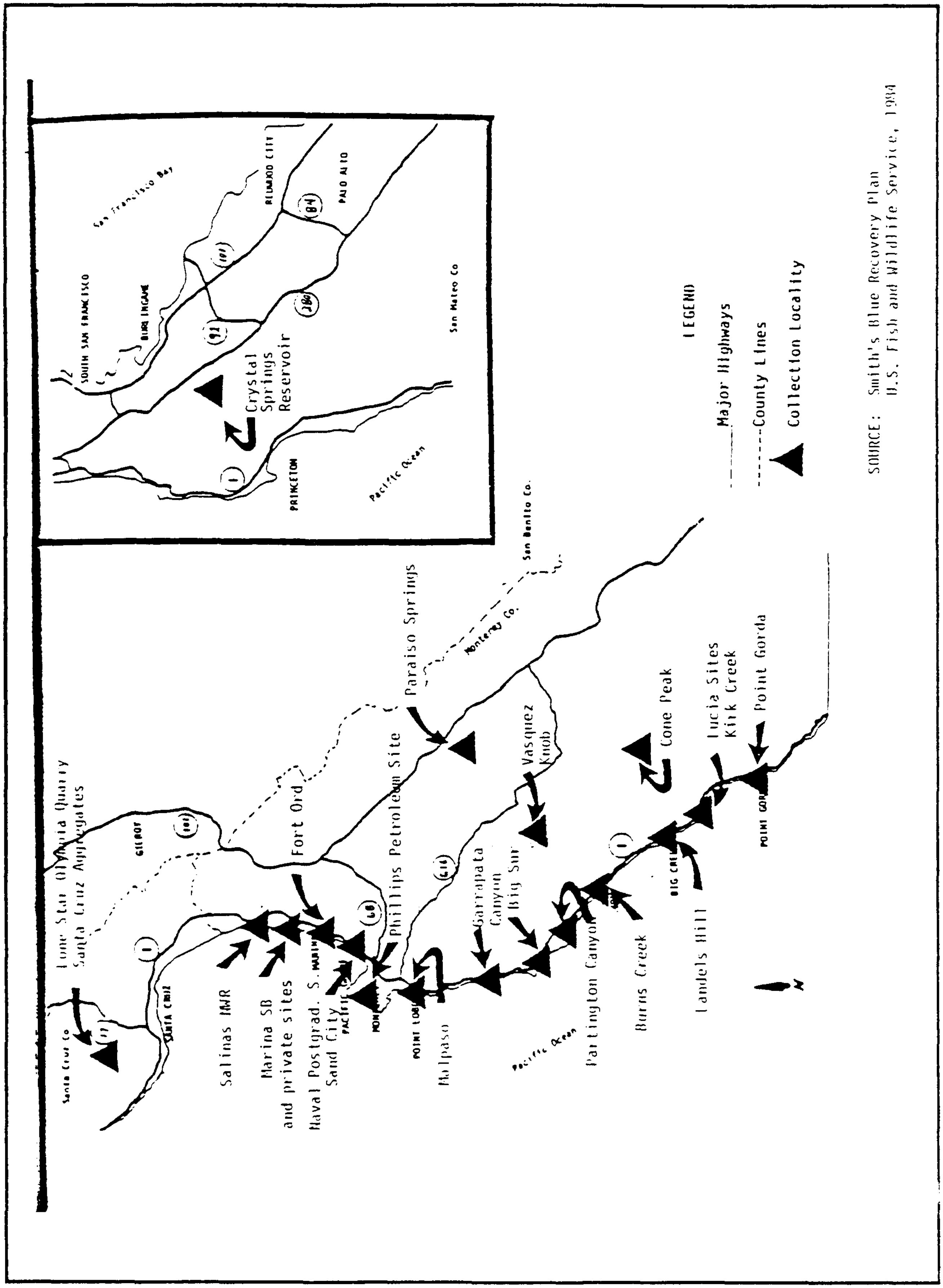
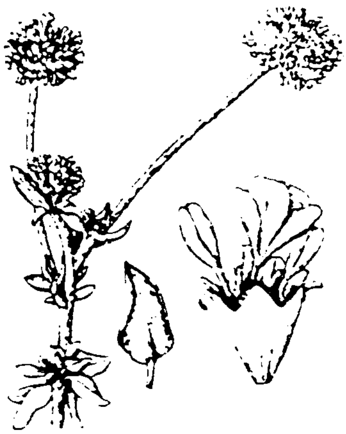


FIGURE 3
ILLUSTRATIONS OF ERIOGONUM HOST PLANTS

PLANTS OF CONCERN



Eriogonum parvifolium

75. Eriogonum parvifòlium Smith. Dune Eriogonum. Fig. 1423

Eriogonum parvifolium Smith in Rees, Cycl. 13: No. 2. 1806.
Eriogonum parvifolium subsp. *lucidum* Howell ex Stokes, Gen. Eriog. 67. 1936.

Low spreading shrub, 3-10 dm. high, with slender densely leafy branches, thinly floccose. Leaves fasciculate at the nodes, round-ovate to oblong-lanceolate, 8–12 mm. long, short-petioled, thick, revolute on the margins, densely white-tomentose beneath, dark green and shining above; heads solitary or racemosely disposed on a simple or umbellately branched peduncle; involucres 4 mm. long, glabrate outside, woolly on the throat within; calyx white or tinged with rose, glabrous, 3–4 mm. long, the lobes obovate; filaments sparsely hairy.

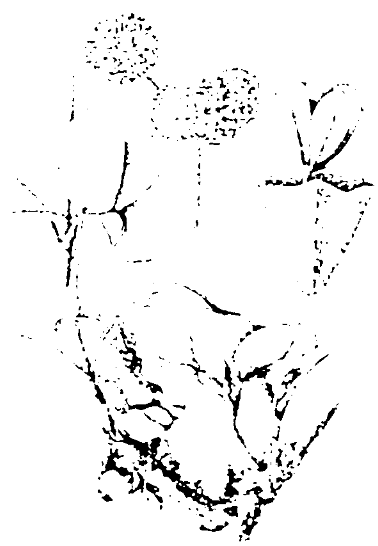
Dunes and hillsides along the coast, mainly Upper Sonoran Zone, Monterey Bay to San Diego County, California. Type locality: California (Menzies), probably Monterey. June–Dec.

70. E... gonum latifòlium Smith. Coast Eriogonum, Tibinagua. Fig. 1418.

Eriogonum latifolium Smith in Rees, Cycl. 13: No. 3. 1809.

Leaves persistent, densely clothing the branches of the low woody caudex, ovate or ovate-oblong, rounded or cordate at base, densely white-woolly beneath, lanate or glabrate above, 2.5–4 cm. long, the margins plane or somewhat crisped; flowering stems leafless, floccose-tomentose, stout, 2–6 dm. high, simple or 2–4-forked, the forks simple or again forked; involucres congested forming a large terminal head or in the forms with forked stems the heads more reduced and occurring in the forks as well as the ends of the branches, shallowly 5-toothed, tomentose, 4 mm. long; calyx white or pale rose, glabrous, 3 mm. long, the lobes obovate, rounded at apex; filaments densely villous at base.

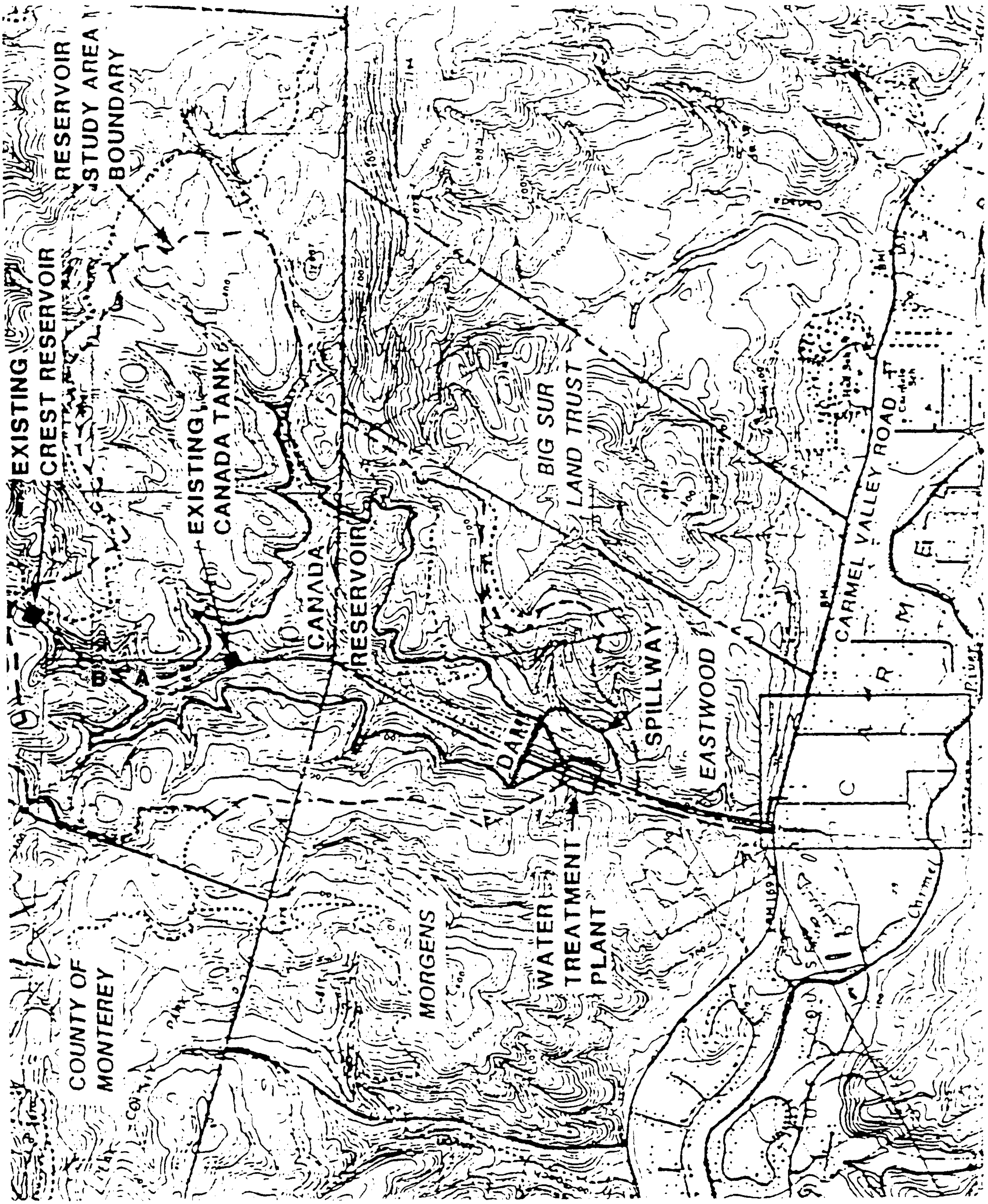
Bluffs and dunes along the coast, Humid Transition Zone; Cape Blanco, Oregon, to Monterey County, California. Type locality: California (Menzies). June–Dec.



Eriogonum latifolium

Source: Illustrated Flora of the Pacific States, Leroy Abrams, 1974

FIGURE 4
SURVEY RESULTS



SMITH'S BLUE BUTTERFLY

HABITAT ASSESSMENT REPORT

FOR THE NEW SAN CLEMENTE

DAM PROJECT IN

MONTEREY COUNTY, CALIFORNIA

Report Prepared For:
Mr. Ric Villasenor
EIP Associates
150 Spear St.
Suite 1500
San Francisco, CA 94105

Report Prepared By:
Richard A. Arnold, Ph.D.
Entomological Consulting Services
104 Mountain View Court
Pleasant Hill, CA 94523
415-825-3784

1 February 1990

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INTRODUCTION

The availability and quality of water for residents of the Monterey Peninsula has been a concern for several years as population numbers have continued to increase in this portion of California. In the not too distant future, current water supplies will not be able to meet projected demands as anticipated population growth continues. For this reason, the Monterey Peninsula Water Management District (MPWMD) is presently considering five locations in the Carmel Valley area as alternative project sites for the new San Clemente dam and reservoir. The five sites are:

a) New San Clemente Dam;
b) San Clemente Creek;
c) Chupines Creek;
d) Cachagua Creek; and
e) New Los Padres Dam.

All five sites occur within the known geographic ranges of the endangered Smith's Blue butterfly *(Euphilotes enoptes smithi)* or the non-endangered Tilden's Blue butterfly *(Euphilotes enoptes tildeni)*. Smith's Blue was recognized as endangered in 1976 by the U.S. Fish & Wildlife Service, pursuant to provisions of the Endangered Species Act of 1973. Tilden's Blue is a close relative.

Aerial photography and botanical surveys by EIP Associates indicate that coastal sage scrub and grassland, habitats known to support the endangered butterfly, occur at or in the vicinity of the five alternative sites. Preliminary findings of the botanical surveys reveal that one or more species of the buckwheat (*Eriogonum*) foodplants of the endangered butterfly grow at these alternative sites currently under consideration. Thus a field survey was conducted to determine the status of the endangered Smith's Blue and assess the suitability of habitat conditions present at all five sites to support the endangered butterfly. If the endangered Smith's Blue butterfly occurs at a site selected for future dam and reservoir development, then the MPWMD would need to comply with provisions of the Endangered Species Act to protect the endangered butterfly and its habitat. This report describes my survey methods, findings, and recommendations.

BACKGROUND INFORMATION

Smith's Blue butterfly *(Euphilotes enoptes smithi)* was described in 1954 from material collected at Burns Creek, near California Highway 1 in Monterey County, California (Mattoni 1954). This subspecies can be distinguished morphologically from other named races of *Euphilotes enoptes* by its wing markings and coloration. When it was originally described as a new subspecies, the butterfly was known from only a handful of sites near Monterey and south of Big Sur.

Since its description, numerous other colonies of Smith's Blue have been discovered, primarily in association with coastal sand dunes around Monterey Bay (Langston 1963, 1965, 1969, and 1975). Due to extensive development and alteration of the sand dune habitat in the Monterey Bay area, the butterfly was recognized by the U.S. Fish & Wildlife Service as endangered in 1976. However, subsequent field work has determined that the butterfly occurs in a variety of habitats, including coastal dunes, inland sandy deposits, coastal sage scrub, and grassland communities, and that its geographic range includes coastal and inland portions of Monterey County and southern Santa Cruz County (Arnold 1983a, 1983b and 1986; Kellner 1989; U.S. Fish & Wildlife Service 1984). A few populations in Santa Cruz and San Mateo County are found in association with serpentine grassland habitats (U.S. Fish & Wildlife Service 1984). Although these serpentine populations have previously been called *smithi* (U.S. Fish & Wildlife Service 1984), they may actually be intermediate between *smithi* and *tildeni* (J. Lane, pers. comm.). Another intermediate population is known from Santa Paula in Ventura County (O. Shields, pers. comm.). Future scientific investigation will be required to determine the real taxonomic identity of these apparently intermediate populations.

The best known populations of the butterfly are from the sand dunes of coastal Monterey County, particularly in the vicinity of Ft. Ord and Marina State Beach. At these sites I have conducted extensive studies on the ecology, natural history, and population dynamics of the butterfly annually since 1977 (see Arnold 1983a, 1983b, and 1986 for summaries of these studies). Additional populations are known from a number of sites south of Big Sur that are characterized by grassland, coastal bluff, or coastal sage scrub communities (Arnold 1986; Kellner 1989). Similarly, other entomologists (Langston 1963 and 1965; B. Walsh, pers. comm.) and I have discovered several populations from inland areas of Monterey County in association with grassland and coastal sage scrub communities. These inland localities include: Laurelles Grade, Paraiso Springs, Vasquez Knob, Cone Peak, and the Hastings Reservation operated by the University of California.

Regardless of the habitat type or geographic location, the Smith's Blue butterfly feeds on one of several perennial species of buckwheat (Polygonaceae: *Eriogonum*), usually *Eriogonum latifolium* or *E. parvifolium* (Arnold 1983a and U.S. Fish & Wildlife Service 1984), but occasionally also on *E. fasiculatum* (O. Shields, pers. comm. and Arnold, pers. observ.), and maybe *E. nudum*. Usage of *E. nudum* is uncertain, due to unverified reports that are not substantiated by voucher specimens of the foodplant and butterfly. Also, the populations from Santa Cruz and San Mateo counties that are apparently intermediate between *smithi* and *tildeni*, were formerly thought to feed on *E. latifolium* (U.S. Fish & Wildlife Service 1984). More recently, these foodplants have been identified as *E. nudum* (J. Lane, pers. comm.).

Both the larval (i.e., caterpillar) and adult life stages of the butterfly feed on the flowers of the buckwheat foodplant. The species of buckwheat foodplant utilized at a particular location seems to be dependent on vegetation and soil conditions. The adult flight season varies depending upon the species of buckwheat utilized, but typically ranges from mid-June until early September. The adult flight season and larval developmental period coincide with flowering of the buckwheat foodplant.

A closely-related butterfly, *Euphilotes enoptes tildeni*, is found in the inner coast ranges of central California, including portions of Monterey County. This subspecies is a denizen of the hot, dry "rain shadow" foothills bordering the San Joaquin Valley. Vegetation growing in these areas is generally dominated by chamise chaparral. The geographic ranges of *tildeni* and *smithi* overlap in inland portions of Monterey County, however the degree of overlap is not well-known at this time. *E. e. tildeni* can be distinguished from the endangered Smith's Blue butterfly by its wing markings and color patterns, although the differences are often subtle due to morphological variation in both subspecies. Like *smithi*, *tildeni* feeds only on buckwheats. It is found primarily in association with *E. nudum*, but has occasionally been reported using *Eriogonum latifollum* and *E. parvifolium*, both perennials, plus the annual, *E. covilleanum* (Howe 1975; Scott 1989).

SURVEY METHODS

Prior to conducting the field reconnaissance, the scientific literature was consulted to identify inland locations in Monterey County known to support either the endangered Smith's Blue or its relative, Tilden's Blue. Several references, cited elsewhere in this report were reviewed. In addition, entomological collections at California Academy of Sciences, California Department of Food & Agriculture, Los Angeles County Museum of Natural History, and University of California's collections at Berkeley, Davis, and Riverside were either visited to review label data or curators provided such data for these butterflies. Also, herbaria at the above-noted institutions were consulted to obtain collection records from Monterey County for the primary and secondary buckwheat foodplants used by the Smith's and Tilden's Blues.

Each alternative reservoir site was visited during August or early September 1989, a period that coincided with the adult flight season and larval activity period of Smith's Blue. Aerial photography, provided by EIP Associates, was used to identify vegetation types and portions of each site that might support the endangered Smith's Blue and its buckwheat foodplants. Surveys concentrated on the inundation portions of each alternative reservior site, as identified on maps provided by EIP Associates. However, if suitable habitat or buckwheat foodplants were found at or near the inundation line, these areas were also surveyed. In addition, Jeff Norman, who conducted botanical surveys of the reservior sites for EIP Associates, identified several buckwheat species during his surveys and mapped their locations.

Habitat suitability for Smith's Blue at each reservior site was evaluated based on:

a) the vegetation types present (coastal sage scrub and grassland preferred by Smith's Blue);

b) the species of *Eriogonum* present; and

c) sightings of larvae or adults of Smith's or Tilden's Blues.

Each of the five alternative sites was surveyed on foot and via four-wheel drive vehicle. As noted earlier, surveys concentrated within the inundation areas, but were not limited to these sectors. Binoculars and a spotting scope were used to scan the vegetation growing on canyon walls that were too steep to traverse by foot.

RESULTS AND DISCUSSION

No specimens (i.e., larvae or adults) of the endangered Smith's Blue butterfly were observed at any of the five alternative reservoir sites. The dominant plant community present at all five alternative sites was chamise chaparral rather than coastal sage scrub, which is favored by the Smith's Blue. Furthermore, preferred foodplants of the endangered butterfly, *Eriogonum parvifolium* and *E. latifolium*, were not observed at the reservoir sites currently under consideration. Also, no secondary buckwheat foodplants were observed at San Clemente Creek, Chupines Creek, and Cachagua Creek, thus it is unlikely that the Smith's Blue would be found at any of these three locations.

However, another occassionally used foodplant of the Smith's Blue, *E. fasiculatum* was observed at both the New Los Padres Dam and New San Clemente Dam sites. At the time of my field visits to both these sites in early September, all flowerheads of *E. fasiculatum* had already dried up as the blooming period was somewhat advanced in 1989 due to the drought. For this reason, I could not find any sign of larvae, larval feeding damage, or adults in association with this buckwheat. Approximately 1,000 *E. fasiculatum* plants were observed at New Los Padres Dam, while about 2,500 plants were observed at the New San Clemente Dam site. As I have previously observed adults of Smith's Blue on *E. fasiculatum* at the nearby Hastings Reservation, it is possible that *E. fasiculatum* at one or both of these reservoir sites may support the butterfly, however this could not be confirmed due to the timing of 1989 field surveys. Nonetheless, the probability of the Smith's Blue inhabiting either of these sites is relatively low due to the presence of Tilden's Blue (see next paragraph) and the presence of chamise chaparral rather than coastal sage scrub or grassland habitats.

Larvae or adults of Tilden's Blue butterfly were observed at all of the alternative reservoir sites except Chupines Creek. At each site the butterfly was associated with *Eriogonum nudum* growing in the chamise chaparral plant community. Other buckwheats observed growing at one or more of the sites included the following annuals: *E. roseum*, *E. elongatum*, *E. gracile*, and *E. angulosum*. None of these buckwheats are known or suspected to be foodplants of the endangered Smith's Blue or the non-endangered Tilden's Blue.

EVALUATION OF IMPACTS AND RECOMMENDATIONS

Chupines Creek does not support any of the buckwheat foodplants of the endangered Smith's Blue butterfly. Thus the butterfly would not be expected to occur there and construction and operation of the proposed water project would not impact the butterfly or its habitat.

Two alternative reservior sites, San Clemente Creek and Cachagua Creek do not support any of the buckwheat foodplants typically utilized by the endangered Smith's Blue butterfly. Although *E. nudum* does grow at these sites, the non-endangered Tilden's Blue butterfly was observed using this foodplant at these localities. For these reasons, the endangered butterfly would not be expected to occur at either of these sites. Thus construction and operation of the reservior should not impact the endangered butterfly or its habitat at either of these sites.

Primary buckwheat foodplants of the Smith's Blue butterfly are also lacking at the New San Clemente Dam and New Los Padres Dam sites. However, *E. fasiculatum*, a secondary foodplant that is occassionally used by the butterfly at other nearby localities, grows at these sites in sufficient numbers to support the butterfly in areas below the inundation line. Status of Smith's Blue associated with *E. fasiculatum*, which had completed its flowering by the time of my 1989 surveys, could not be determined. If the MPWMD selects either the New San Clemente Dam or New Los Padres Dam sites for further consideration, I recommend that a follow-up survey to determine the status of Smith's Blue at these sites should be conducted in July or early August. Based on the findings of the follow-up survey, potential impacts to the butterfly and its habitat can then be assessed more completely.

If subsequent surveys reveal that the endangered Smith's Blue butterfly is present at either of the New San Clemente Dam or New Los Padres Dam sites, then the U.S. Fish & Wildlife Service will need to review the project. Any loss of *E. fasiculatum* foodplants due to project-related activities (ex. inundation) could be interpreted as "take" (i.e., loss of individuals or habitat of an endangered species), a violation of section 9 of the federal Endangered Species Act. On both private and public lands, the Endangered Species Act (Sections 4, 9, & 11) prohibits "taking" of an endangered species, such as the Smith's Blue butterfly. Because the Smith's Blue is closely associated with its buckwheat foodplants, any loss of its primary or secondary foodplants within its geographic range due to grading, inundation, or maintenance of the new dam and reservior is potentially subject to Section 9 enforcement. The federal Endangered Species Act provides two ways to legally resolve a "take" situation: a) the Section 7 consultation process for federal actions; and b) the Section 10(a) permit to allow "incidental take" of an endangered species by private parties.

If any other federal agency is involved in the permitting, funding, construction, or operation of the anticipated water project by the MPWMD, then that agency may request a Section 7 consultation with the U.S. Fish & Wildlife Service. In this situation, a 404 permit, pursuant to the Clean Water Act, will need to be obtained from the U.S. Army Corps. of Engineers, hence the Corps. could request a Section 7 consultation with the U.S. Fish & Wildlife Service regarding the endangered Smith's Blue butterfly issue. As part of the Section 7 consultation process, the U.S. Fish & Wildlife Service prepares a document known as a "biological opinion", which evaluates the impacts of the project on the endangered species and recommends mitigation appropriate to alleviate any impacts. If the Service finds that the project will not jeapordize the survival of the endangered species, then the Service may approve the federal action, which in this case would be the 404 permit.

If no other federal agency is involved in this project, then the MPWMD would need to obtain a Section 10(a) permit from the U.S. Fish & Wildlife Service. However, because of the likely involvement of the U.S. Army Corps. of Engineers, the Section 7 consultation process would take precedence.

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PERSONS CONTACTED

Mr. John Lane, Santa Cruz City Museum, 1305 E. Cliff Dr., Santa Cruz, CA 95062.

Dr. Oakley Shields, 6506 Jerseydale Road, Mariposa, CA 95338.

Mr. Bruce Walsh, Dept. of Zoology, University of Washington, Seattle, WA 98195.

To: Denise A. Duffy
Denise Duffy & Associates
546-A Hartnell Street
Monterey CA 93940

October 22, 1990

From: Gary Ahlborn
BioSystems Analysis, Inc.

Re: Cañada Reservoir Spotted Owl Surveys Results

Introduction

To satisfy an informal request by the California Department of Fish and Game, BioSystems Analysis conducted surveys for the California spotted owl (*Strix o. occidentalis*) in the proposed Cañada Reservoir site. Although the project area would probably be considered marginal habitat for the species, there are records documenting the species occurrence within several miles of the proposed reservoir. After discussing the matter with several other CDFG personnel and authorities on the species BioSystems agreed that field surveys to determine the presence of the owl would be prudent.

Background and Natural History

Status: On 23 July, 1990 a subspecies of the spotted owl, the Northern spotted owl (*S. o. caurina*) was listed as a federally threatened species under the Endangered Species Act, as amended. The California spotted owl (*S. o. occidentalis*) which potentially occurs in the project area has no special legal status, although there is concern for their populations and the species is being monitored. At least one petition has been filed to "list" the California subspecies (Armond Gonzales, CDFG wildlife biologist).

Reasons for Listing: Populations may be declining due to habitat destruction, especially logging of old growth forest and human occupation of habitat. Extensively clear cut areas will not support spotted owls, although some habitat disturbance can be tolerated, provided nearby high quality habitat is available.

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Distribution: Spotted owls range throughout many forested habitats in several areas of California. Population concentrations of the northern subspecies occur in north coast forests, along the South Fork of the Trinity River and into the Yolla Bolly Wilderness, Trinity and Tehama counties, and at Point Reyes National Seashore. The southern subspecies, the California spotted owl, is concentrated along the Western Divide and Greenhorn Mountains in Tulare and Kern counties, in Sequoia National Park, northwest of Yosemite Valley, and in Deep Creek and the Green Valley area in San Bernadino County.

The Northern spotted owl does not occur in coastal habitats south of about San Francisco. The "California spotted owl (*S. o. occidentalis*) is found along the length of the Sierra Nevada from southeastern Shasta County to northeastern Kern County; a second population occurs along California's south coast from Monterey County to San Diego County" (Gould 1985, p.22). The California spotted owl potentially occurs within the proposed Cañada Reservoir site. There are at least nine known occupied territories in Monterey County; one of these are within a few miles to the southeast of the project location.

Habitat Requirements: Spotted owls are generally found in densely forested, shady canyons and dense conifer and/or oak forest; usually multilayered with a high degree of canopy closure. Fairly extensive areas of habitat (40-240 ha; 100-600 ac) are believed to be necessary to support breeding owls (Forsman 1976). Nest sites are usually located on lower slopes of canyons and area usually near a source of water. Nest are usually located in snags and snag-top trees. Roost sites are selected in dense multilayered woodland and forests. Hunting is done from elevated perches, from which spotted owls pounce on prey species. Prey includes small mammals, birds and insects. In the project area the primary prey for the owl is expected to be dusky-footed woodrats (*Neotoma fuscipes*) and western gray squirrel (*Sciurus griseus*).

Objective

BioSystems objective was to conduct surveys to determine the presence of California spotted owls in the proposed project site.

Methods

Habitat occupancy for spotted owls will be determined by following standard sampling protocol being developed by the California Department of Fish and Game. The State will not finalize their suggested sampling guidelines for several more months which would be too late to use for surveys this season. The procedures that we followed were derived from consultation with CDFG personnel. Generally, our survey methods followed Forsman (1975).

Presence of owls was determined by eliciting vocal responses from owls by broadcasting tape recordings of spotted owl calls. A tape recording of "typical" calls was obtained from CDFG. The nocturnal surveys were conducted throughout the project areas judged as appropriate habitat. Although most calling stations were located in the inundation area several adjacent sites were also surveyed. Nighttime surveys were conducted along roads and trails, stopping at 0.8 km (0.5 mi) intervals to call. Recordings were played for 10 to 20 minutes at a given location. Gould (1977) found that owls usually responded within 10 minutes. Calling inventories were completed during the period when owls are responsive.

Results

A total of four nocturnal surveys of the study area were conducted (Table 1). Calling inventories were conducted during on August 13, 19-20, 26-27, and 31-September 1. Individual surveys were separated by at least four days. Approximately, 22.5 hours were spent calling for spotted owls.

No California spotted owls were located. Although great horned owl call were not broadcasted, they were located during every survey period and were found in almost all forested sections of the project area. Four individual owls were seen roosting in a stand of snag-top Monterey pines about 0.5 miles below the American Water Company pumping facility. These owls responded to the spotted calls with typical vocalizations and begging calls. Great horned owls were heard from the oak woodlands in the northeastern and northwestern drainages, and the Monterey pines on the upper east facing slopes of the main drainage. Owls also were located in three drainages east and north of the project area. Barn owls were located on three occasions during two of the surveys. In each case the owls were seen flying over grassland habitat north of the project area.

Based on vegetation structure and topographic features, several portions of the project area appear to provide at least marginal habitat for the California spotted owl. The limited extent and fragmented pattern of appropriate forest stands may be the primary habitat components reducing the value of the project site.

Great horned owls are known to be one of the few predators of spotted owls. While the two species do coexist, the abundance and ubiquitous distribution of great horned owls in the proposed reservoir area, lowers the sites suitability for spotted owls.

Conclusions

BioSystems conducted field surveys to determine the presence of California spotted owls in the proposed Cañada Reservoir project site. No spotted owls were located. Along with negative survey results, observations of habitat conditions, and the configuration of habitats in the landscape indicates that no spotted owls are present in the project area and that habitat is only marginally suitable for the species. BioSystems concludes that no additional surveys for the California spotted owl are necessary.

Table 1. Spotted owl survey timing, effort and results.

	13 Aug	19-20 Aug	26-27 Aug	31 Aug-1 Sept	Total
Hours	4.5	6	7	5	22.5
Approx. no. of stations	12	15	17	11	
Owl Species Observed					
California spotted owl	No	No	No	No	
Great horned owl	Yes	Yes	Yes	Yes	
Barn owl	Yes	Yes	No	No	

Selected References

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Gordon Gould. Pers. Comm. State Spotted Owl Coordinator

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Armond Gonzales. Pers. Comm. Monterey area spotted owl biologist

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Ted Wooster. Pers. Comm. Region 3 Spotted Owl Coordinator.

STATE OF CALIFORNIA—RESOURCES AGENCY GEORGE DEUKMEJIAN, Governor

DEPARTMENT OF FISH AND GAME
1416 NINTH STREET
SACRAMENTO, CALIFORNIA 95814
Planning Branch
(916) 322-2493

RECEIVED
AUG 29 1983
M. P. W. M. D.

August 25, 1983

Monterey Peninsula Water Management District
Fred Adjarian
187 El Dorado Street
Monterey, CA 93940

Dear Mr. Adjarian:

In response to your request of August 16, 1983 we have searched our files for records of occurrences of elements of concern within Carmel Valley, Mount Carmel and Ventura Cones 7½' quads (Monterey County) and have found the following:

Animals:

1. Smith's Blue-Federally Listed Endangered; State Listed Rare

Plants:

✓1. Malacothrix saxatilis var. arachnoidea (CNPS List 2)
✓2. Fritillaria falcata (CNPS List 2)
✓3. Lupinus cervinus (CNPS List 3)
✓4. Galium clementis (CNPS List 3)
5. ✓Raillardella muirii (CNPS List 2) SC 18
✓6. Galium californicum ssp. luciense (CNPS List 2)

In addtional to the above elements, a sensitive element is present. Please contact Ted Wooster, Environmental Services Supervisor, at (707)944-4489 for further information.

Additional comments: Also included is a program description of the Data Base, Element Lists, Field Survey Forms and Instructions.

SPECIAL NOTICE TO DEVELOPERS AND CONSULTANTS

1. A Natural Diversity Data Base Report does not constitute official Department of Fish and Game environmental review of a project under CEQA, NEPA, or other statutory or regulatory authority.

United States Department of the Interior

FISH AND WILDLIFE SERVICE

SACRAMENTO ENDANGERED SPECIES OFFICE
2800 Cottage Way, Room E-1823
Sacramento, California 95825-1846

November 4, 1986

Mr. William C. Angeloni
Chief, Planning/Engineering Division
U.S. Army Corps of Engineers
211 Main Street
San Francisco, California 94105

Subject: Request for List of Endangered and Threatened Species for the Proposed Construction of a Concrete Dam on the Carmel River, Monterey County (Case No. 1-1-87-SP-29)

Dear Mr. Angeloni:

As requested by letter from your agency dated October 6, 1986, you will find attached a list of listed endangered and threatened species (Attachment A) that may be present in the area of the subject project. To the best of our knowledge no proposed species occur within the area. The list is intended to fulfill the requirement of the Fish and Wildlife Service to provide a list of species under Section 7(c) of the Endangered Species Act, as amended. Please see Attachment B for your requirements.

Also for your assistance, we have included a list of candidate species. These species are presently being reviewed by our Service for consideration to propose and list as endangered or threatened. Candidate species have no protection under the Endangered Species Act and are included for your consideration as it is possible the candidates could become formal proposals and be listed during the construction period.

Upon completion of the Biological Assessment (see Attachment B), should you determine that a listed species is likely to be affected (adversely or beneficially), then your agency should request formal Section 7 consultation through our office at the letterhead address. If there are both listed and candidate species (if included in the assessment) that may be affected and if requested, we will informally consult on the candidate species during the formal consultation. However, should the assessment reveal that only candidate species may be affected, then you should consider informal consultation with our office at the letterhead address.

One of the benefits of informal consultation to the consulting agency is to provide the necessary planning alternatives should a candidate species become listed before completion of a project. Informal consultation may also be utilized prior to a written request for formal consultation to exchange information and resolve conflicts with respect to listed species.

If the Biological Assessment is not initiated within 90 days of receipt of this letter, you should informally verify the accuracy of the list with our office.

Should you have any additional questions regarding this list or your responsibilities under the Act, please contact Dr. Jack Williams at (916) 978-4866 or (FTS) 460-4866. Thank you for your interest in endangered species, and we await your assessment.

Sincerely,

Gail C. Kobetich

Gail C. Kobetich
Project Leader

Attachments

cc: Chief, Endangered Species, Portland, OR (FWE-SE; Attn: Ralph Swanson)
Field Supervisor, Ecological Services, Sacramento, CA (ES-S)

ATTACHMENT A

LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES AND CANDIDATE SPECIES THAT MAY OCCUR IN THE AREA OF THE PROPOSED CONSTRUCTION OF A CONCRETE DAM ON THE CARMEL RIVER AT RIVER MILE 18, MONTEREY COUNTY, CALIFORNIA
(Case No. 1-1-87-SP-29)

Listed Species

Birds

✓Least Bell's vireo, *Vireo bellii pusillus* (E)

Habitat value To see if suitable habitat exists.

Proposed Species

None

Candidate Species

Reptiles

Black legless lizard, *Anniella pulchra nigra* (2)

Plants

Eastwood's goldenweed, *Ericameria fasciculata* (1)
Carmel Valley bush-mallow, *Malacothamnus palmeri* var. *involucratus* (2)
Carmel Valley malacothrix, *Malacothrix saxatilis* var. *arachnoidea* (2)

(E)--Endangered (T)--Threatened (CH)--Critical Habitat
(1)--Category 1: Taxa for which the Fish and Wildlife Service has sufficient biological information to support a proposal to list as endangered or threatened.
(2)--Category 2: Taxa for which existing information indicated may warrant listing, but for which substantial biological information to support a proposed rule is lacking.

United States Department of the Interior

FISH AND WILDLIFE SERVICE

SACRAMENTO ENDANGERED SPECIES OFFICE
2800 Cottage Way, Room E-1823
Sacramento, California 95825-1846

OCT 1 4 1987

In Reply Refer To:
1-1-87-I-632

RECEIVED
OCT 2 8 1987
M.P.W.M.D.

Mr. William C. Angeloni
Chief, Planning/Engineering Division
U.S. Army Corps of Engineers
211 Main Street
San Francisco, California 94105-1905

Subject: Biological Assessment for the New San Clemente Dam Project, Monterey, California

Dear Mr. Angeloni:

In response to your letter dated September 16, 1987, we have reviewed the Biological Assessment for the proposed project. We concur with your findings that no listed or candidate species would be affected by the project.

Please contact Peter Sorensen of my staff at FTS 460-4866 if you have any questions.

Sincerely,

for Gail C. Kobetich
Field Supervisor

cc: Field Supervisor, Ecological Services, Sacramento, CA (ES-S)

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Endangered Species Office
2800 Cottage Way, Room E-1823
Sacramento, California 95825-1846

In Reply Refer To:
1-1-89-TA-708

June 15, 1989

Ms. Henrietta Stern
Project Coordinator
Monterey Peninsula Water Management District
187 Eldorado, Suite E
P.O. Box 85
Monterey, California 93940

RECEIVED
JUN 1 9 1989
M.P.W.M.D.

Subject: Species List for the Proposed Alternatives to the New San Clemente Dam Project, Monterey County, California

Dear Ms. Stern:

The attached list replies to your letter of May 1, 1989, requesting information on listed and proposed endangered and threatened species that may occur within the subject project area. Some pertinent information concerning the distribution, life history, habitat requirements, and published references for the listed species is also attached. This information may be helpful in preparing a biological assessment for this project, if one is required.

Information and maps concerning candidate species in California are available from the California Natural Diversity Data Base, a program of the California Department of Fish and Game. Address your request to: Ms. Elaine Hamby, California Department of Fish and Game, Natural Diversity Data Base, 1416 Ninth Street, Sacramento, California 95814 [(916) 324-0562)]. You should also request additional information from the Chief, California Department of Fish and Game, Non-Game Heritage Program (916) 324-8348.

We appreciate your concern for endangered species. If you have further questions, please call Peggie Kohl of our Sacramento Endangered Species Office at (916) 978-4866.

Sincerely,

Gail C. Kobetich
Field Supervisor

Attachments

ATTACHMENT A

LISTED ENDANGERED AND THREATENED SPECIES AND
CANDIDATE SPECIES THAT MAY OCCUR IN THE AREA OF THE PROPOSED
ALTERNATIVES TO THE NEW SAN CLEMENTE DAM PROJECT
MONTEREY COUNTY, CALIFORNIA
(1-1-89-TA-708)

Listed Species

Birds

American peregrine falcon, *Falco peregrinus anatum* (E)
bald eagle, *Haliaeetus leucocephalus* (E)

Invertebrates

Smith's blue butterfly, *Euphilotes enoptes smithi* (E)

Candidate Species

Birds

spotted owl, *Strix occidentalis* (2)

Amphibians

California tiger salamander, *Ambystoma tigrinum californiense* (2)
California red-legged frog, *Rana aurora draytoni* (2)

Reptiles

black California legless lizard, *Anniella pulchra nigra* (2)

Mammals

Pacific western big-eared bat, *Plecotus townsendii townsendii* (2)
greater western mastiff-bat, *Eumops perotis californicus* (2)

Plants

talus fritillary, *Fritillaria falcata* (2)
Santa Lucia bedstraw, *Galium californicum* subsp. *luciense* (2)
Carmel Valley malocothrix, *Malocothrix saxatilis* var. *arachnoidea* (2)

(E)--Endangered (T)--Threatened (CH)--Critical Habitat
(1)--Category 1: Taxa for which the Fish and Wildlife Service has sufficient biological information to support a proposal to list as endangered or threatened.
(2)--Category 2: Taxa for which existing information indicated may warrant listing, but for which substantial biological information to support a proposed rule is lacking.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
FISH AND WILDLIFE ENHANCEMENT
SOUTHERN CALIFORNIA FIELD STATION
Ventura Office
2140 Eastman Avenue, Suite 100
Ventura, California 93003-7786

June 12, 1991

RECEIVED
JUN 17 1991
M.P.W.M.D.

Henrietta Stern
Senior Project Coordinator
Monterey Peninsula Water Management District
Post Office Box 85
Monterey, California 93942-0085

Re: Species List for the Proposed Various Water Supply Alternatives in the Carmel River Basin, Monterey County, California (1-6-91-TA-V227)

Dear Ms. Stern:

This concerns your May 17, 1991, letter that requested the Fish and Wildlife Service (Service) provide an updated list of endangered, threatened, and candidate species of flora and fauna that may be affected by potential reservoir construction sites in the Carmel River Basin, Monterey County, California. The Monterey Peninsula Water Management District requested the updated species list as supplemental information for the preparation of a Draft Environmental Impact Report/Environmental Impact Statement (DEIR/EIS) on a long-term water supply project for Carmel Valley.

Per your request, we have attached a list of endangered and threatened species and candidate species that may occur within the vicinity of the proposed water supply project alternatives. That list, in part, fulfills the requirements of the Service under Section 7(c) of the Endangered Species Act of 1973, as amended (Act). Should this project have a Federal nexus, the Federal lead agency should request a species list update if the project is not initiated within 180 days from this date.

If the project may affect a listed species, the Federal lead agency has the responsibility to prepare a biological assessment if the project is a construction project which may require an EIS. If a biological assessment is not required, the Federal lead agency still has the responsibility to review its proposed activities and determine whether the listed species may be affected.

Project proponents without a Federal nexus should be aware of the prohibitions against the take of a listed species. Section 9 of the Act prohibits the "take" of any listed species. The definition of "take" includes to harass, harm, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct.

"'Harm', in the definition of 'take' in the Act, means an act which actually kills or injures wildlife. Such act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavior patterns, including breeding, feeding, or sheltering (50 CFR 17.3)." Anyone who engages in a take would be subject to prosecution under Section 9 of the Act. Such taking may occur only under the authority of the Service pursuant to Section 7 (through Federal interagency consultation) of the Act, or through a Section 10(a) permit (for non-federal actions), as mandated by the Act.

The Service recommends that any DEIR/EIS conducted for this project also include an analysis of potential effects to any of the candidate species included on the attached list that may be present in the project vicinity. Candidate species have no protection under the Act, but are included for your consideration as it is possible that one or more of these candidates could be proposed and listed before the subject project is completed. Should the DEIR/EIS reveal that candidate species may be adversely affected, you may wish to contact our office for technical assistance. One of the potential benefits from such technical assistance is that by exploring alternatives early in the planning process, it may be possible to avoid conflicts that could otherwise develop, should a candidate species become listed before the project is completed.

We also recommend that a copy of the DEIR/EIS be forwarded to this office for review and/or comment prior to the initiation of any construction activities.

Should you require additional information regarding this matter, please contact Mr. Dennis Carlson of my staff at (805) 644-1766 or at the letterhead address.

Sincerely,

Judy Hohman

Acting Office Supervisor

LISTED ENDANGERED AND THREARENED SPECIES AND CANDIDATE SPECIES THAT MAY OCCUR IN THE AREA OF THE PROPOSED ALTERNATIVES TO THE NEW SAN CLEMENTE DAM PROJECT IN MONTEREY COUNTY, CALIFORNIA

<u>LISTED SPECIES</u>

<u>Birds</u>

American peregrine falcon	<u>Falco peregrinus anatum</u>	(E)
bald eagle	<u>Haliaeetus leucocephalus</u>	(E)

<u>Invertebrates</u>

Smith's blue butterfly	<u>Euphilotes enoptes smithi</u>	(E)

<u>CANDIDATE SPECIES</u>

<u>Birds</u>

southern spotted owl	<u>Strix occidentalis</u>	(C2)

<u>Amphibians</u>

California tiger salamander	<u>Ambystoma tigrinum californiense</u>	(C2)
California red-legged frog	<u>Rana aurora draytoni</u>	(C2)

<u>Reptiles</u>

black legless lizard	<u>Anniella pulchra nigra</u>	(C2)

<u>Mammals</u>

Pacific western big-eared bat	<u>Plecotus townsendii townsendii</u>	(C2)
greater western mastiff-bat	<u>Eumops percotis californicus</u>	(C2)

<u>PLANTS</u>

talus fritillary	<u>Fritillaria falcata</u>	(C2)
Cone Peak bedstraw	<u>Galium californicum spp. luciense</u>	(C2)
Carmel Valley malocothrix	<u>Malocothrix saxatilis var. arachnoidea</u>	(C2)

PLANTS (cont.)

Toro manzanita	*Arctostaphylos montereyensis*	(C2)
Pinnacles buckwheat	*Eriogonum nortonii*	(C3(c))
fragrant fritillary	*Fritillaria liliacea*	(C2)
Santa Cruz microseris	*Microseris decipiens*	(C2)

(E) - Endangered (T) - Threatened (CH) - Critical Habitat
(1) - Category 1: Taxa for which the Fish and Wildlife Service has sufficient biological information to support a proposal to list as endangered or threatened.
(2) - Category 2: Taxa for which existing information indicates may warrant listing, but for which substantial biological information to support a proposed rule is lacking.
(3) - Category 3(c): Taxa more common than previously thought, no longer being considered for a listing proposal at this time.

Riparian Habitat Assessment
ALTERNATIVES OF THE NEW SAN CLEMENTE DAM PROJECT

Prepared for:

MONTEREY PENINSULA WATER MANAGEMENT DISTRICT

Prepared by:

EIP Associates
150 Spear Street, Suite 1500
San Francisco, CA 94105
(415) 546-0600

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INTRODUCTION

This report describes the rationale, approach and results of a "desktop" HEP or Habitat Assessment (HA) that evaluated impacts of the various alternatives for the New San Clemente Dam project on riparian habitat and estimated the acreage of mitigation areas needed. Specifically, the HA was designed to: 1) estimate the project-related losses in habitat value of riparian habitats, and 2) estimate the acreage necessary to replace these habitat values on an in-kind basis.

The location and major features of the project alternatives are indicated in Figures 1 to 7. Much of the information on existing biological resources in the alternative sites was obtained during site visits on August 10 and 11, 1988. The Monterey Peninsula Water Management District (henceforth referred to as "the District") recognizes that further details in project design and mitigation necessitate revised calculations for a project specific mitigation plan.

This study assigns Habitat Suitability Index (HSI) ratings to the riparian cover type to be affected by a project. An HSI of 1.0 means that a particular site has optimal habitat value compared with other patches of that cover type in the general vicinity; usually a good-sized patch of undisturbed natural habitat will have an HSI of 1.0. Riparian habitats of less than optimal value were assigned values ranging from 0.1 to 0.9.

This HA will estimate HSI ratings before the project and at various points in time (Target Years) during the project. From these data, the HA estimates impacts on habitat value per acre. Similarly, a range of HSI ratings were assigned to mitigation sites, before and after implementation of a mitigation plan. The per-acre increase in habitat value and the acreage of mitigation lands needed to offset the project impacts were then calculated.

Because this is a desktop or simplified HEP, it does not include wildlife-habitat models. The HSI ratings were assigned based upon the professional judgment of the HA team members. This HA also simplifies the normal HEP method by assigning only one HSI value to each patch of riparian habitat, rather than separate HSI values to each of several wildlife species using given cover types. The single HSI value takes into account the overall value of a particular habitat patch to the wildlife that typically use that cover type. The HSI values assigned to each assessment site are presented in Table 1.

As is customary for these types of studies, a HA team was selected to make decisions about the approach, assumptions and HSI values to be used. The HA team consisted of the following members:

- Ric Villasenor, EIP Associates.
- Cay Goude, Ecological Services, U.S. Fish and Wildlife Service (FWS).
- Carl Wilcox, Environmental Services, Region 3, California Department of Fish and Game (DFG).
- Harriet Hill, Environmental Protection Specialist, Office of Federal Activities, Environmental Protection Agency (August 10th only).

TABLE 1

RIPARIAN HABITAT VALUES (HSI)
AT ALTERNATIVE PROJECT SITES[1]

Alternative Site	HSI Values TYØ[2]	HSI Values TY100[3]
LOS PODRES ALTERNATIVE		
Danish Creek	0.6	
	0.6	
	0.7	(0.625)[4]
	0.6	
Carmel River	0.7	
	0.8	(0.80)
	0.9	
	0.8	
CACHAGUA CREEK ALTERNATIVE		
Cachagua Creek	0.4	
	0.4	(0.40)
	0.3	
	0.5	
James Creek	0.7	
	0.7	(0.7)
	0.7	
	0.7	
Canejo Creek	0.8	
	0.8	(0.825)
	0.9	
	0.8	
Finch Creek	0.7	
	0.6	(0.65)
	0.6	
	0.7	
CHUPINOS ALTERNATIVE		
Site #1	0.7	
	0.6	(0.67)
	0.7	

TABLE 1 continued

Alternative Site	HSI Values TYØ	TY100
CHUPINOS ALTERNATIVE (continued)		
Site #2	0.3	
	0.4	(0.37)
	0.4	
Site #3	0.4	
	0.4	(0.4)
	0.4	
Site #4	0.7	
	0.7	(0.7)
	0.7	
NEW SAN CLEMENTE ALTERNATIVE		
Downstream of Existing Dam	1.0	
	1.0	(1.0)
	1.0	
Upstream of Existing Dam	0.8	
	0.9	(0.87)
	0.9	
Site #3 (Sedimentation Area)	0.1	
	0.1	(0.2)
	0.4	
San Clemente Creek	1.0	
	0.9	(0.97)
	1.0	
SAN CLEMENTE CREEK		
Lower Dam Site	1.0	
	0.9	(0.97)
	1.0	
Upper Dam Site	1.0	
	0.9	(0.97)
	1.0	

[1] HSI values were determined by the analysis team composed of 3 to 4 individuals.

[2] Target year 0.

[3] Target year 100.

[4] Average HSI value at each assessment site.

SCOPE OF THE STUDY

STUDY AREA

The study area is composed of six alternative dam sites in the Upper Carmel River region of Monterey County (see Figures 1 to 7). The impact areas addressed and evaluated included those portions of riparian habitat within the proposed dam and reservoir sites. Survey and sample sites within each riparian habitat were selected based upon access and representation of the cover type area.

No specific mitigation sites have been selected at this time. It was assumed that the eventual mitigation sites would most likely be degraded riparian habitats with a range of HSI values of 0.2 (very degraded) to 0.5 (somewhat degraded but for which habitat enhancement is promising).

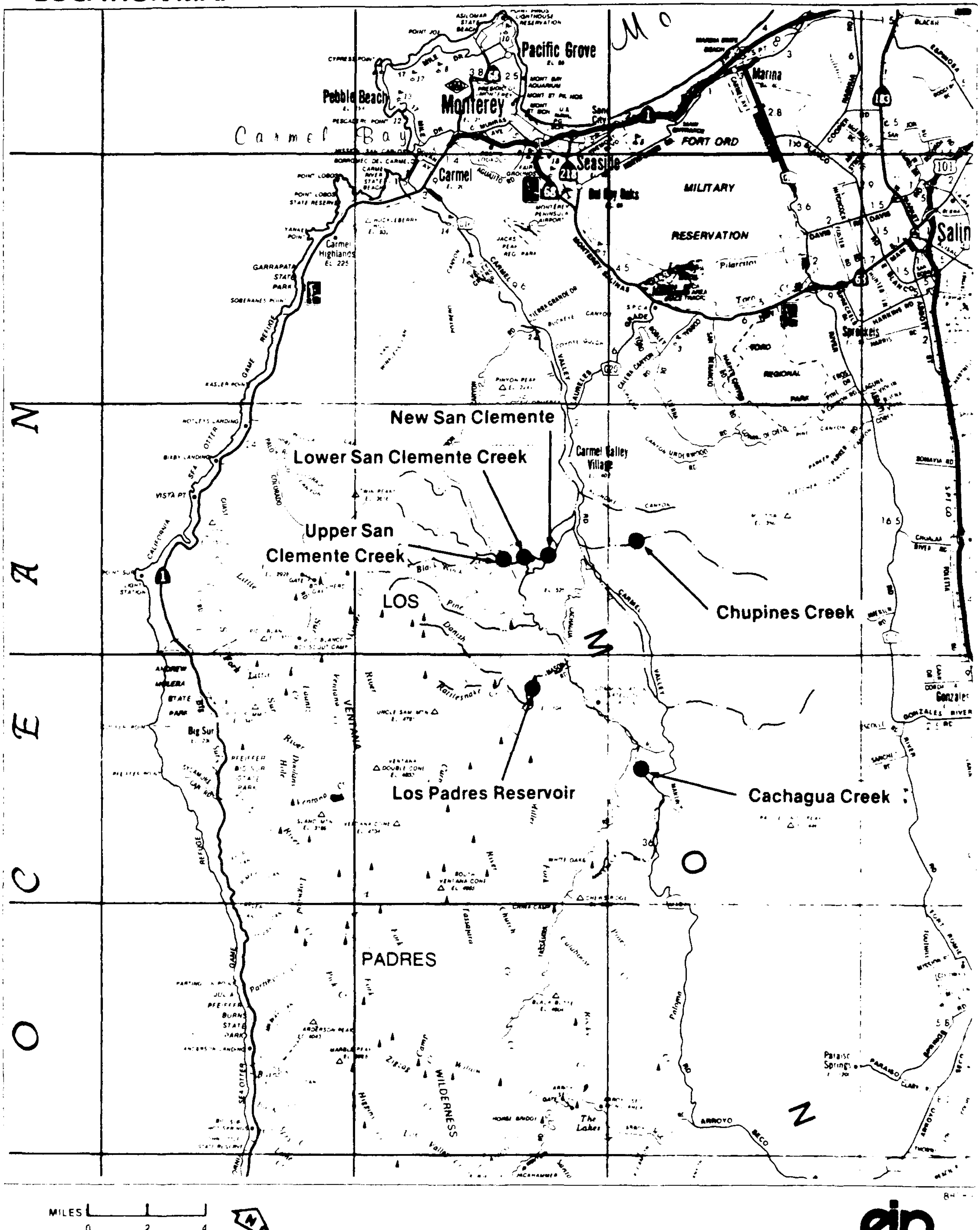
COVER TYPES

This HA addresses the impacts and mitigation . riparian habitats only. Other cover types to be affected by the project are not addressed. These may be included, however, in subsequent assessments if necessary. The reason this assessment focuses upon the riparian cover type is because the interested resource agencies have a policy of no-net-loss of this habitat type and thus require mitigation plans for any loss.

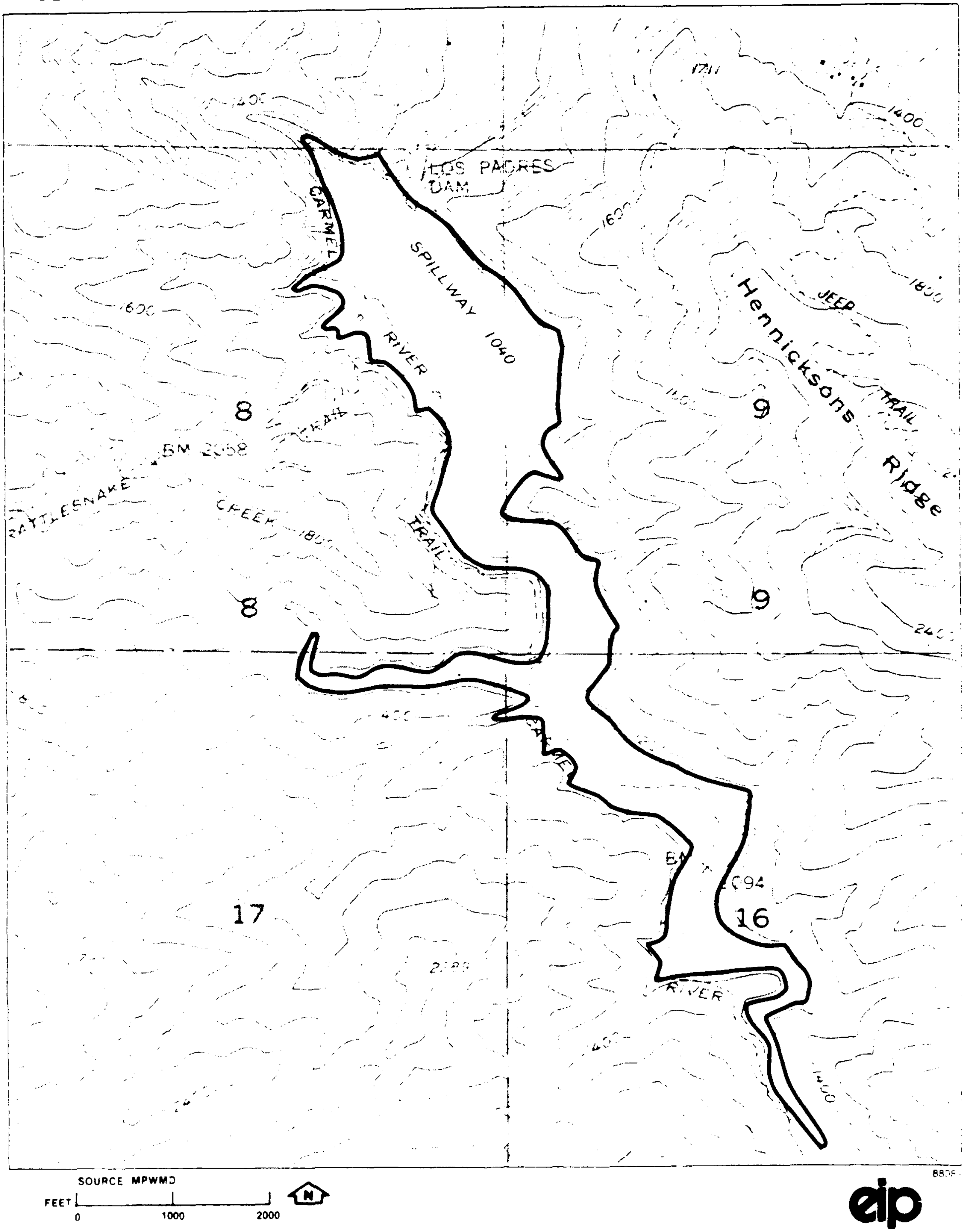
Time Period and Target Years

This assessment addresses a time period of 100 years, or the life of the project, from Target Year 0 (TY0) when project construction begins, until Target Year 100 (TY100). A third Target Year (TY35) was used to signify when the mitigation sites are expected to reach a given level of maturity (HSI = 0.7). Straight line projections were used in estimating the development of the habitats over time (see Figure 8).

LOCATION MAP **FIGURE 1**

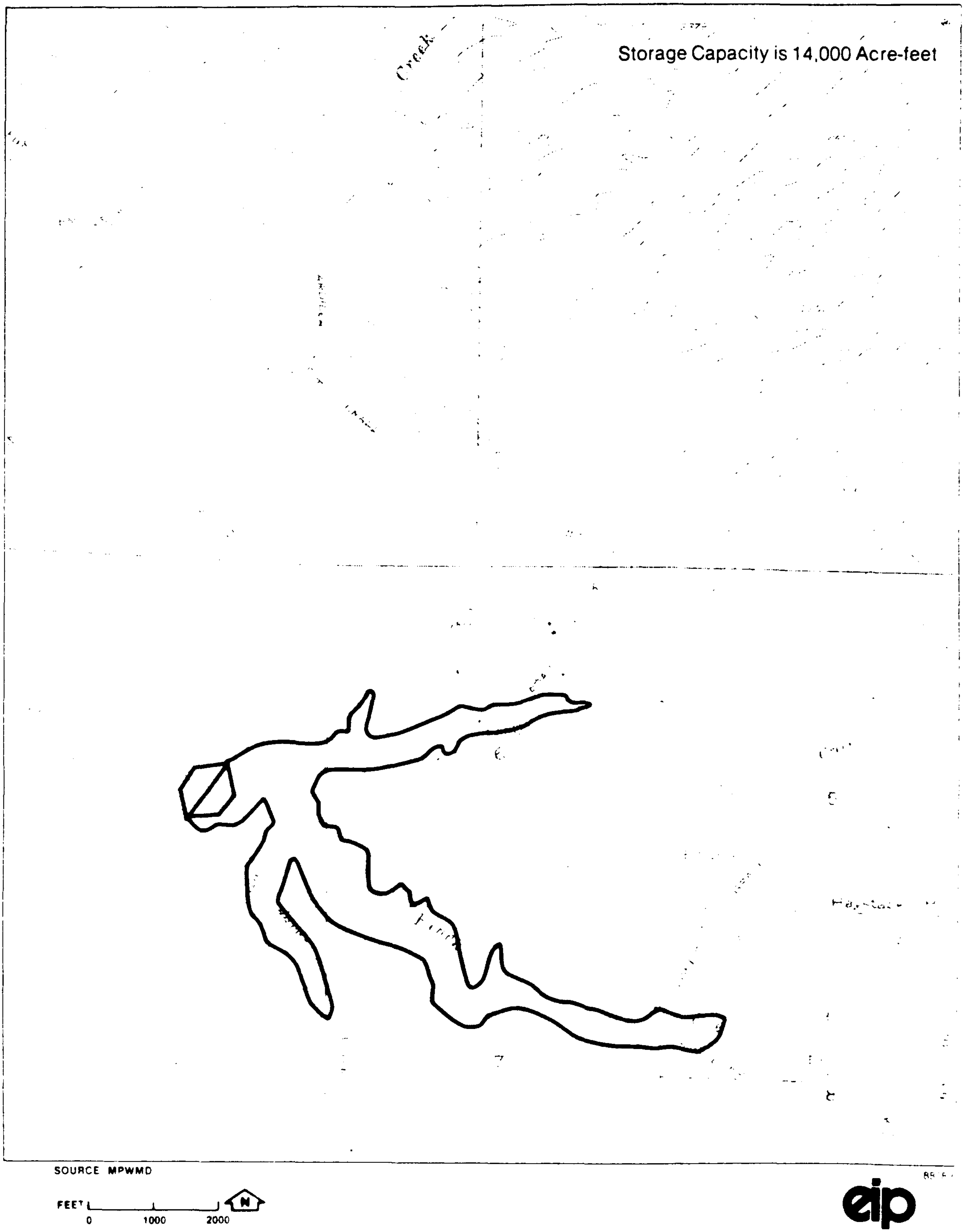


INUNDATION AREA FOR SPILLWAY - ELEVATION 1160 FT. **FIGURE 2**

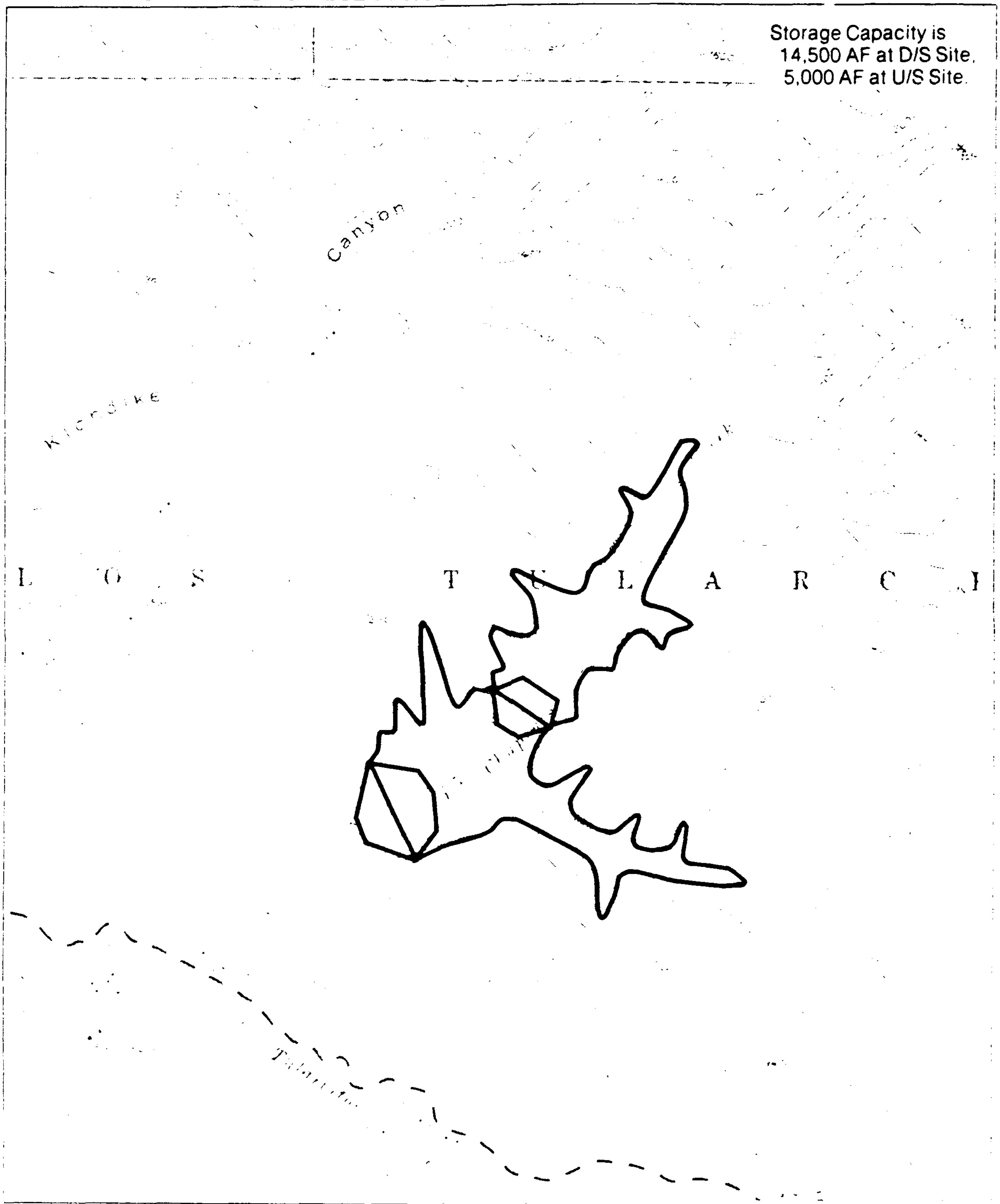


CACHAGUA CREEK SITE - ELEVATION 1480

FIGURE 3



CHUPINES CREEK SITE - ELEVATION 800 FT. **FIGURE 4**

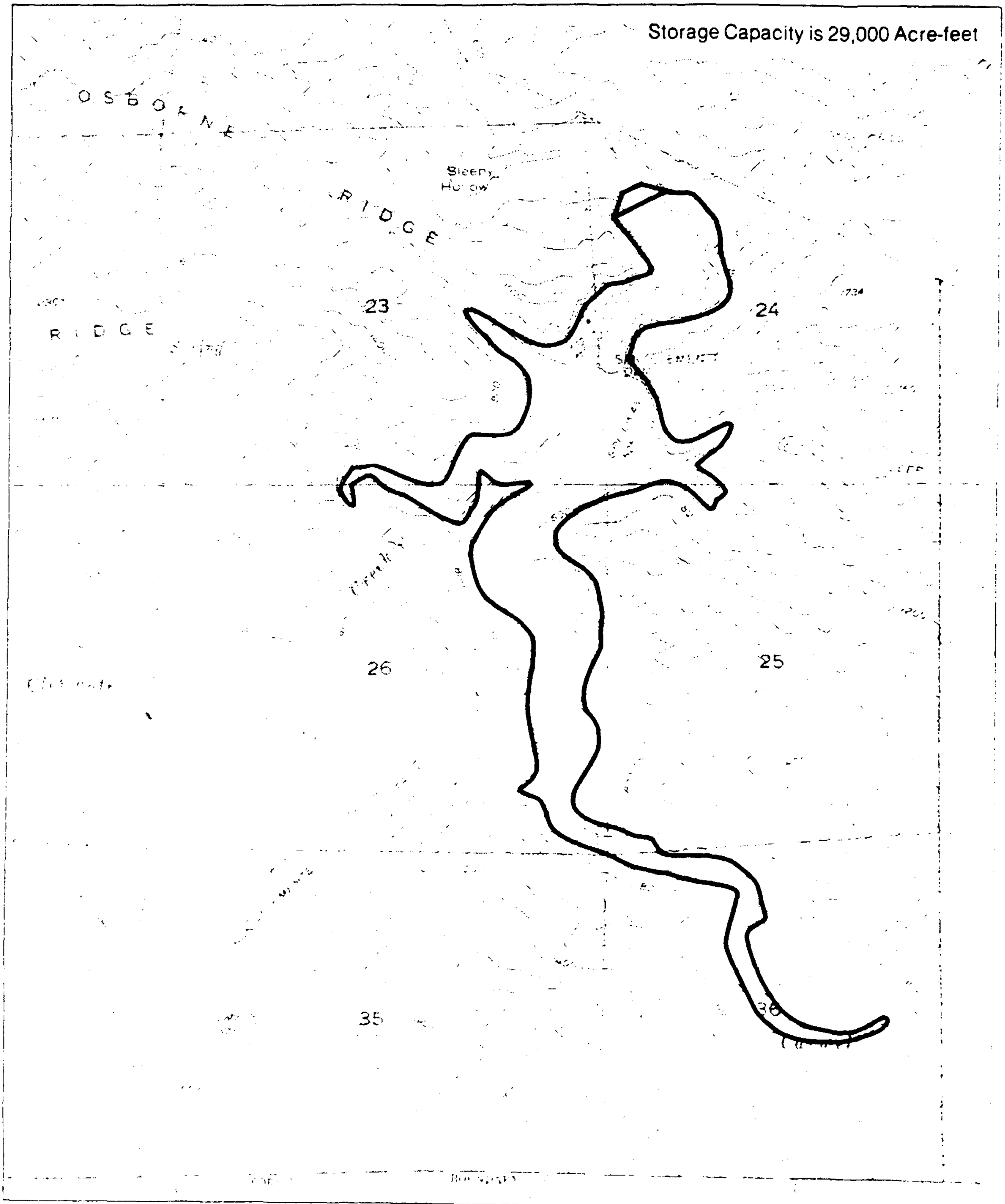


SOURCE MPWMD

FEET 0 1000 2000

NEW SAN CLEMENTE SITE - ELEVATION 662 FT.

FIGURE 5



SOURCE MPWMD

FEET 0 1000 2000

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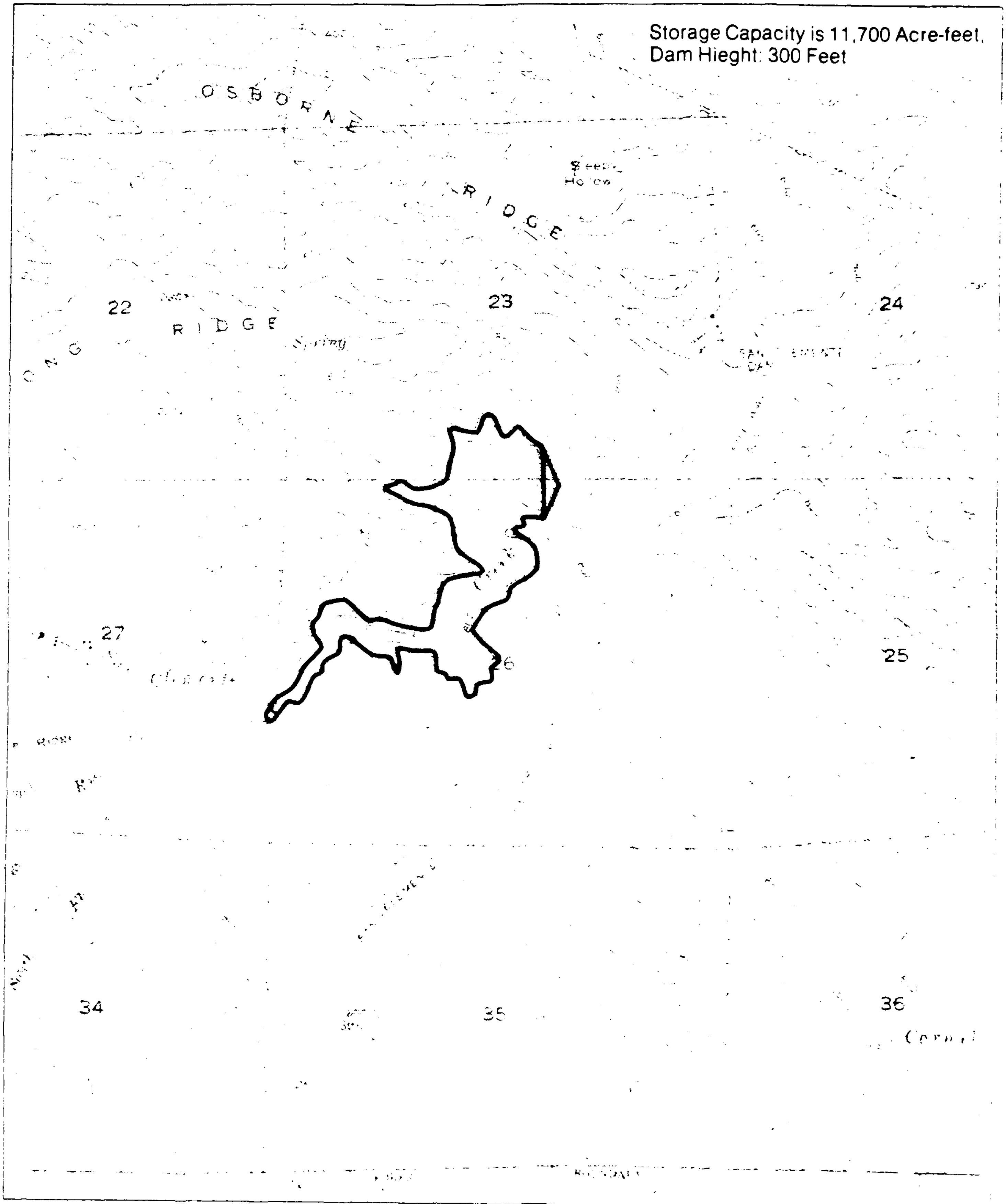
SAN CLEMENTE CREEK - DOWNSTREAM SITE

FIGURE 6



SOURCE MPWMD

FEET 0 1000 2000

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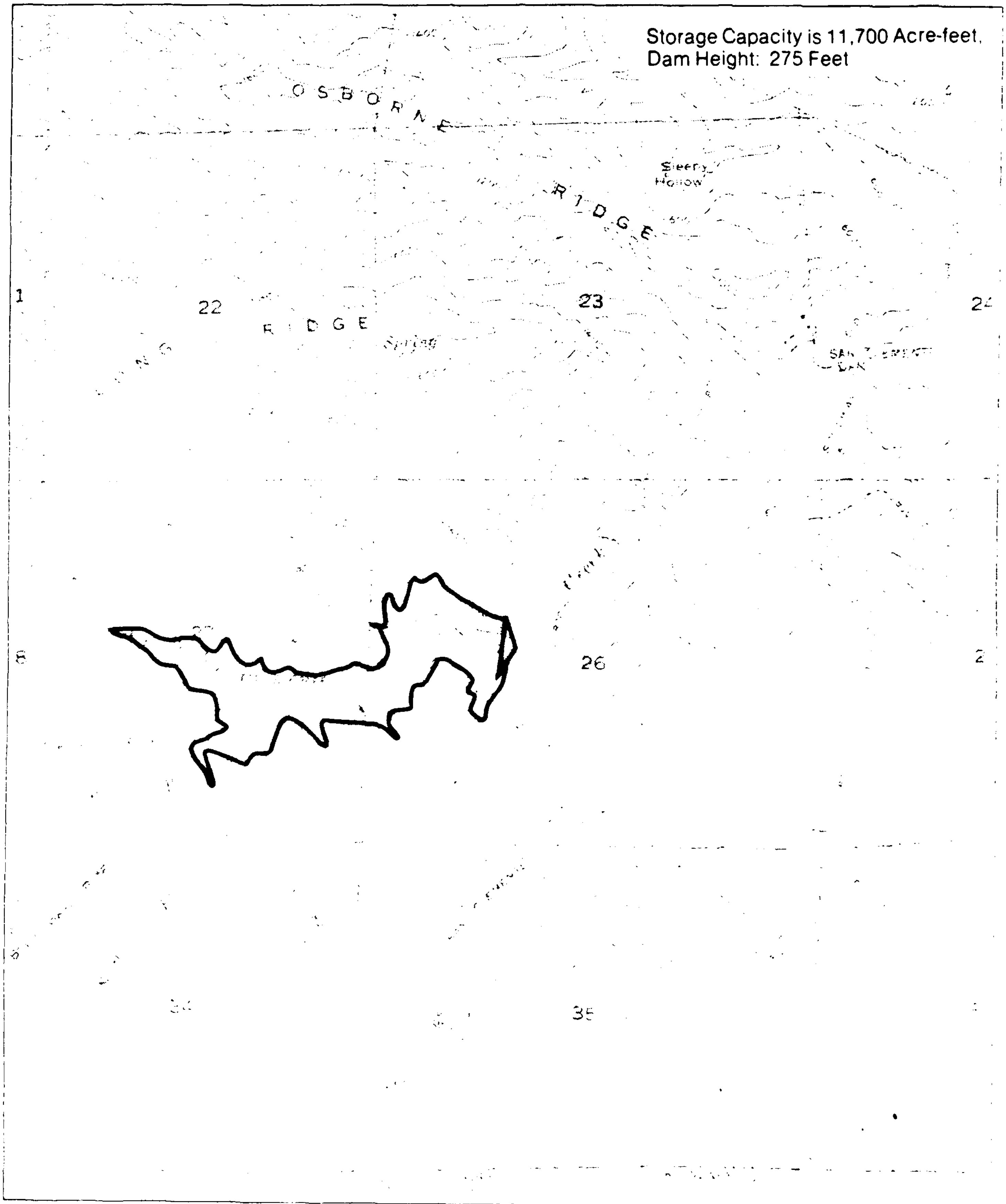
SAN CLEMENTE CREEK - UPSTREAM SITE

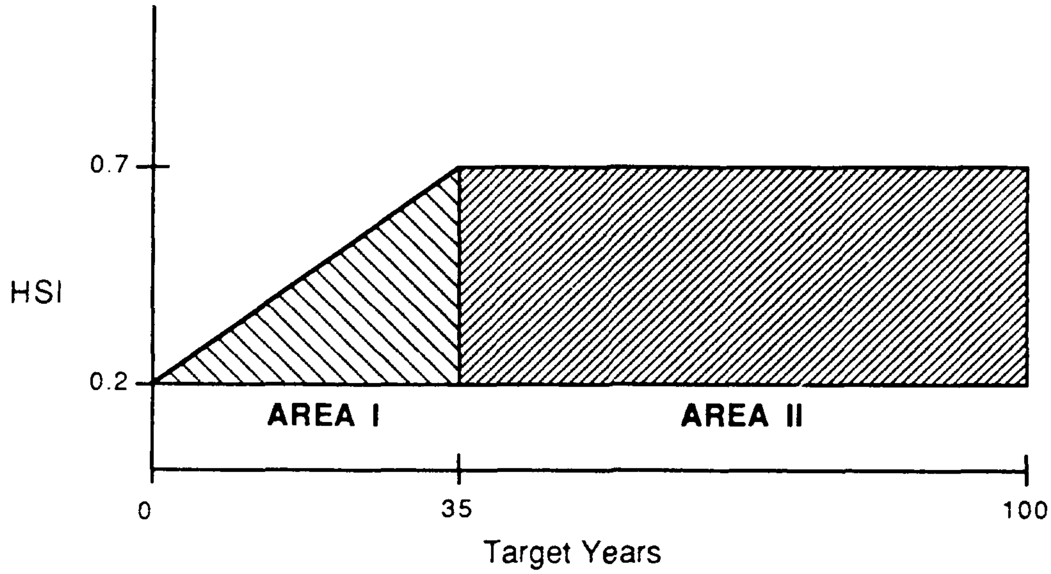
FIGURE 7



SOURCE MPWMD

FEET 0 1000 2000

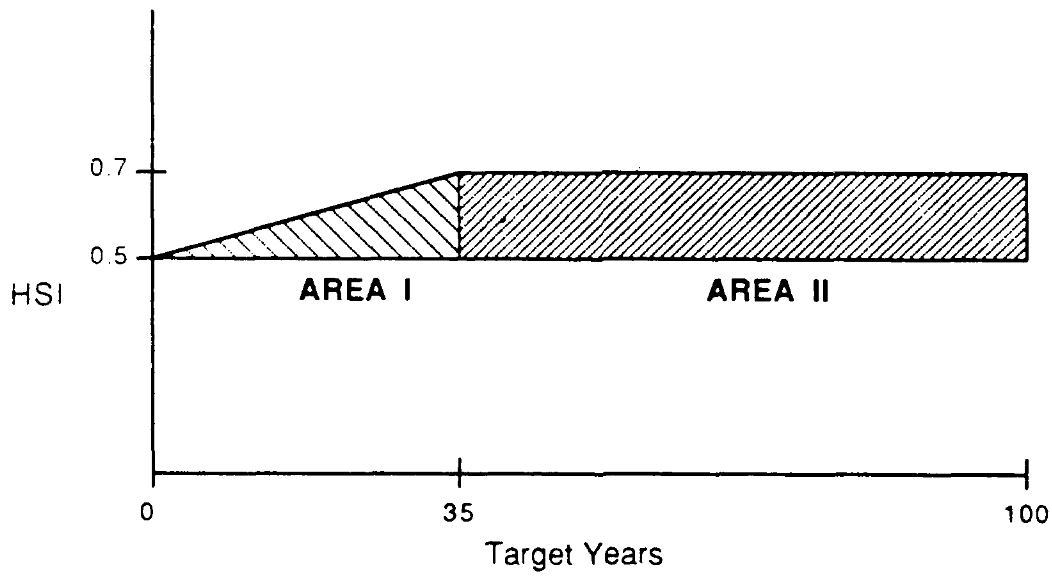
RIPARIAN MITIGATION SITES (CONCEPTUAL) — FIGURE 8



AREA I: $\frac{0.5 \times 35}{2} = 8.75$

AREA II: $0.5 \times 65 = 32.50$

AVERAGE ANNUAL HU / ACRE: $\frac{32.50 + 8.75}{100} = .41$



AREA I: $\frac{0.2 \times 35}{2} = 3.5$

AREA II: $0.2 \times 65 = 13$

AVERAGE ANNUAL HU / ACRE: $\frac{3.5 + 13}{100} = .165$

LEGEND

Projected Changes in Habitat Value (HSI)

Over the Life of the Project (TY 100)

SOURCE EIP ASSOCIATES

EXISTING CONDITIONS

Riparian habitats in the Central Coast region of California are generally characterized by vegetation that can withstand periods of inundation and are closely associated with areas where the groundwater table is relatively shallow. The vegetation composition may range from forests with dense tree canopies to scrub type communities with little or no tree overstory.

Riparian forest is dominated by large deciduous trees (30 to 60 feet tall) with overlapping canopies. The dominant tree species are cottonwood (Populus trichocarpa) with sycamores (Plantanus racemosa) and willows (Salix sp.) scattered throughout. The understory varies from bare ground or low herbaceous cover (due to recent scouring), to a dense scrub thicket of either alder (Alnus rhombifolia), immediately along the banks, or common brush species such as poison oak (Toxicodendron diversilobum) and blackberry (Rubus vitifolius).

Riparian woodland or thickets are the most common and extensive riparian habitat type in the study areas. A woodland is also dominated by large trees; however, unlike the forest type, the canopies do not overlap, and there is a wide range of tree densities. The most common tree species are identical to the forest type. A thicket is very similar to the woodland type except that these are typically dense stands of one or two tree species less than 20 feet in height. Common and dominant species of the thicket type are red willow (Salix laevigata), sandbar willow (Salix hindsiana), cottonwood, and alder. There is a continuum of size and structural complexity between the woodland and thicket types.

Riparian scrub is also a common habitat type in the study areas. It is most often, however, very limited in extent in any given site. This habitat type is most common on gravel bars. It lacks a well-established tree canopy and is dominated by low shrubs two-ten feet in height. Common and characteristic plant species in this habitat type include mugwort (Artemisia douglasiana), coyote bush (Baccharis pilularis), blackberry, mule fat (Baccharis viminea), and sweet fennel (Foeniculum vulgare).

Additional riparian habitat types are scattered throughout the river valleys to a much smaller degree. Dry washes and barren gravel bars represent areas that have recently been scoured by the river and all that has developed is low herbaceous growth. There are numerous examples of this habitat type in the river bed areas. Emergent vegetation occurs in and along the shallow borders of deep pools with permanent surface water. Typical plant species include sedges (*Carex* spp.), rushes (*Juncus* spp.), bulrush, and cat-tail (*Typha* spp.). At those points where the river bed is closest to the valley walls, the mixed evergreen forest-riparian type, similar to the upper river area, occurs. Remnants of this type also occur on the upper alluvial terraces.

For purposes of this analysis, all of these various riparian plant communities were combined into one generic cover type, i.e. riparian habitat.

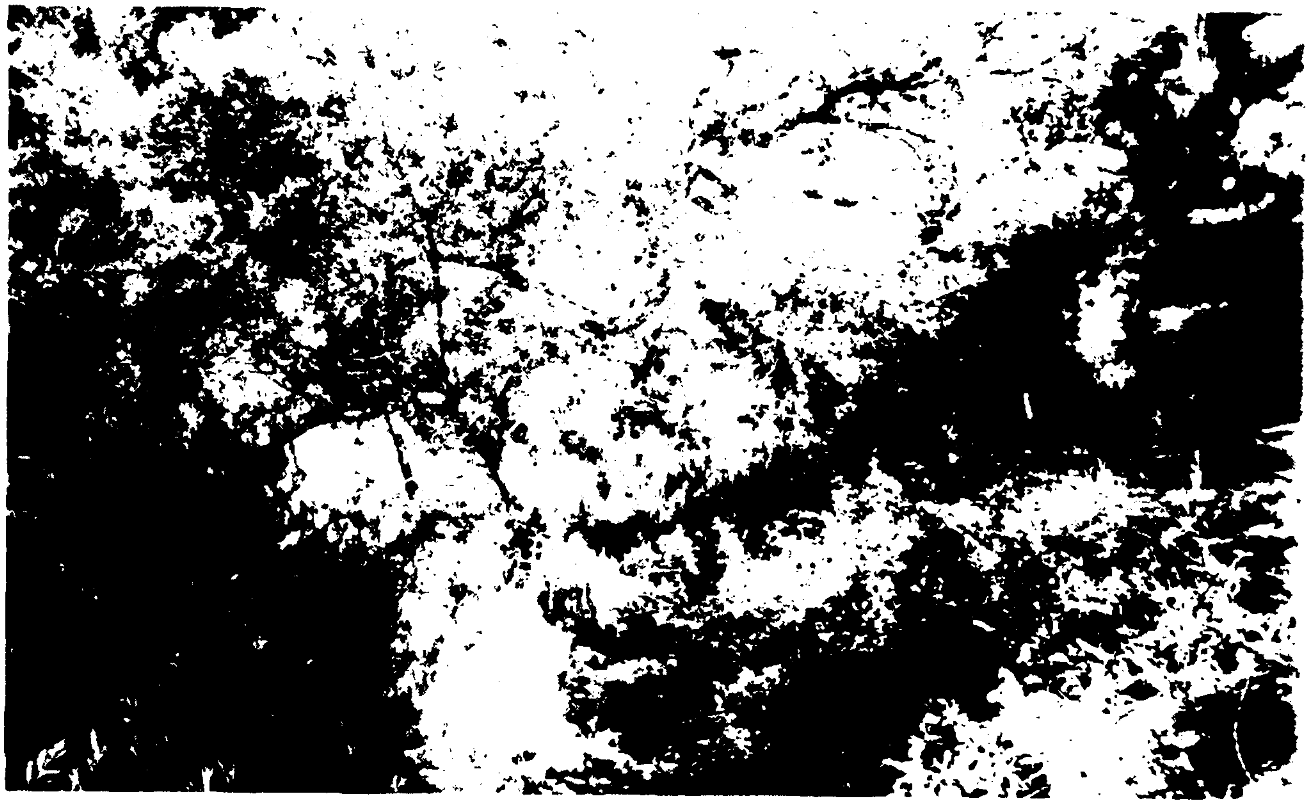
The wildlife habitat value of riparian corridors is relatively high. The high density of mature trees and the abundance of dense undergrowth enhance habitat value for many songbirds (especially insectivores), small mammals, reptiles, and amphibians. The numerous large, old trees, especially valley oaks, provide dead limbs for cavity-nesting birds.

The following is a brief description of the riparian habitats within each Project Alternative.

Los Podres Site

Two evaluation sites were taken for this project alternative, Danish Creek and the Carmel River upstream of the existing reservoir. Danish Creek is dominated by alder with little vegetative understory and was completely dry at the time of the survey. The Carmel River is typical of a Riparian Woodland with alder thickets, barren gravel bars and scattered sycamore and oaks (see Figure 9). Water pooling areas as well as flowing water habitats occur along its length.

A. Carmel River above Los Padres Dam.



B. Cachagua Creek at the proposed dam site.

SOURCE EIP ASSOCIATES

Cachagua Creek Site

Four evaluation sites were used for this project alternative; Cachagua Creek, James Creek, Canejo Creek and Finch Creek. Cachagua Creek is narrow (estimated 30 feet) with Cachagua Road running along its southern bank. The riparian vegetation is dominated by brushy species with scattered oaks, sycamores and willows (see Figure 9). James Creek and Canejo Creek have similar habitats with dense willow and oak canopies. These creeks range in width from 40 to 75 feet. Finch Creek is wider than James and Canejo Creeks (approximately 90 to 120 feet), with a similar tree canopy. Grazing activities, however, have reduced the understory cover (see Figure 10).

Chupinos Creek Site

Four evaluation sites were used for this project alternative. The habitat values range from good productive sites with dense understories and open to closed tree canopies (see Figure 10), to degraded sites where heavy grazing bars have all but eliminated the understory vegetation, leaving scattered large oak and sycamore trees. The creeks range in width from 75 to 200 feet wide.

New San Clemente Site

Four evaluation sites were used for this project alternative; downstream of the existing San Clemente Dam, upstream of the existing Dam, an area where the habitat has been significantly degraded due to sediment deposition, and San Clemente Creek.

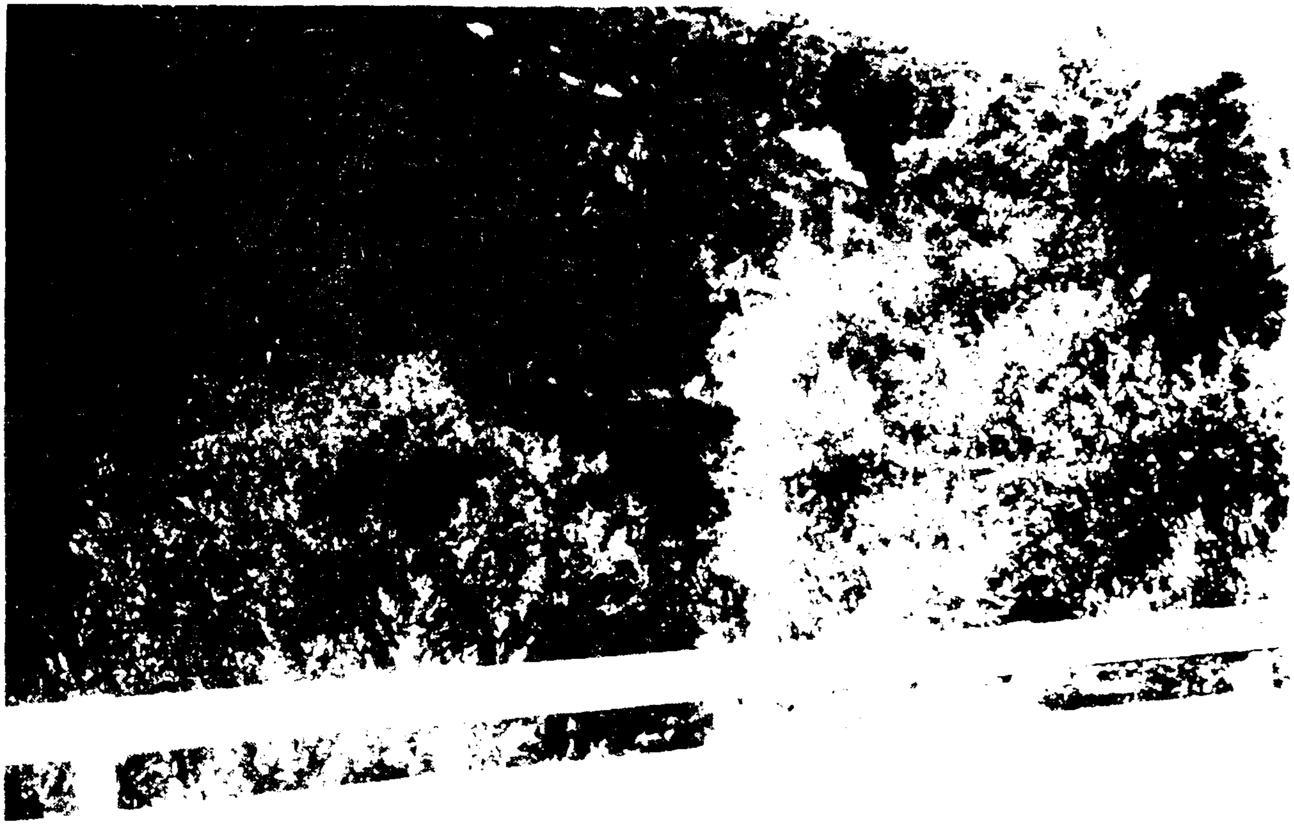
The riparian habitats downstream of the existing dam to the proposed new dam site are composed of a dense tree canopy and underbrush layer. This habitat is as close to a mature riparian forest as that on any of the alternative sites.

The riparian habitat upstream of the existing dam is very similar to that described upstream of the Los Podres site.

A small area (approximately 3 acres) on the Carmel River above the existing San Clemente Dam is a sedimentation site that has been significantly degraded due to the

SITE PHOTOS

FIGURE 10



A

B

eip

deposition of sediments from a tributary drainage. Many of the mature sycamore trees have been damaged and the original understory has been replaced with weedy, invasive species.

The lower portion of San Clemente Creek supports a narrow band of dense riparian growth. Although this area is small in comparison to habitats on the Carmel River, it is of good to excellent quality.

Lower & Upper San Clemente Dam Site

Evaluation of these alternatives was done from the access road along the entire length of the creek. The riparian habitats are similar to those described for the New San Clemente Dam site above.

IMPACTS AND MITIGATION

EXPECTED IMPACTS

Estimates of the acreage of impact on riparian habitats was done with the use of a planimeter and 1:600 color aerial photographs, or by estimating habitat areas. These acreage figures represent the best information currently available. If there are significant changes in the dam size and area of inundation, the acreages may need to be recalculated. The calculated riparian habitat acreage for each alternative site is provided in Table 2.

MITIGATION

Specific mitigation sites have not been identified at this time. It is assumed that these sites would be degraded riparian habitats on the Carmel River and other water courses in the region. These degraded mitigation sites are assumed to have habitat values ranging from 0.2 to 0.5.

These sites will be planted with riparian trees native to the locality and appropriate for the local site conditions. In the project area, we assume that planted riparian trees would reach a habitat value of 0.7 in 35 years, with broad canopies, full seed production, substantial amounts of dead wood (for cavity-nesters), and many trees exceeding 50 feet in height and 12 inches in diameter (at breast height).

TABLE 2

EXISTING RIPARIAN HABITAT UNITS (HU)

Alternative Site	Riparian Habitat Acreage	Existing HU Per Acre (HSI)[1]	HU to Be Lost[2]
Los Podres Alternative			
Danish Creek	2.5	0.625	1.56
Carmel River	14.2	0.80	11.36
	16.7		12.92
Cachagua Creek Alternative			
Cachagua Creek	1.4	0.40	0.56
James Creek	4.6	0.70	3.22
Canejo Creek	7.5	0.825	6.16
Finch Creek	19.3	0.65	12.55
	32.8		22.49
Chupinos Alternative			
Site #1	2.4	0.67	1.62
Site #2	8.2	0.37	3.05
Site #3	8.2	0.40	3.30
Site #4	4.9	0.70	3.39
	23.8		11.36
New San Clemente Alternative			
Downstream of Existing Dam	17.6	1.00	17.60
Upstream of Existing Dam	35.1	0.87	30.54
Site #3 (Sedimentation Area)	3.0	0.20	0.60
San Clemente Creek	5.8	0.97	5.59
	61.5[3]		54.33
(San Clemente Creek Alternatives)			
Lower Dam Site Alternative	14.7	0.97	14.26
Upper Dam Site Alternative	11.0	0.97	10.67

[1] Average HSI values from Table 1.

[2] HSI X Acreage.

[3] This is a higher value than was previously reported in the Draft EIR/EIS because it includes all habitats inclusive of gravel beds, ponds, etc., whereas the DEIR/EIS reported only riparian vegetation.

ASSUMPTIONS

1. For purposes of this analysis, the project life is 100 years.

2. Existing habitat values (HSI) at the degraded riparian mitigation sites are expected to range from 0.2 to 0.5.

3. There will be no significant changes in habitat values or acreages of the riparian habitats at the alternative project sites that would be displaced if the project were built.

4. Habitat values and acreages at the mitigation sites will remain the same over time.

5. Impacts on the riparian habitats will occur at Target Year 0 (TY0), i.e. when project construction is initiated and result in the loss of all riparian habitat values.

6. Mitigation plans will be designed to replace riparian habitats on an in-kind basis and will begin with project construction (TY0).

7. The planted riparian habitat at the mitigation site(s) will reach maturity or full habitat value in 35 years, in a straight-line projection.

8. Because of the uncertainty of mitigation success, it is assumed habitats at the mitigation site will not achieve a maximum value of 1.0.

9. Endangered species and fish habitat is not included in this analysis.

RESULTS AND DISCUSSION

The results of the HA study are summarized in Tables 2 and 3. Impacts on habitat value were expressed in Habitat Units (HU); an HU of 1.0 for a particular cover type is equivalent to a one-acre site with optimal habitat value (HSI = 1.0). Thus, the value of a particular site in HUs is simply the acreage of the site multiplied by its HSI. In this study, all impacts were assumed to take place at the beginning of the project (TY0), simplifying the impact calculations. The results indicate that the greatest number of HU loss would occur with the New San Clemente Alternative (54.33 HU). A good portion of this impact is due to the large area of riparian habitat to be removed (61.5 acres) and the relatively high habitat values of these riparian areas. The next highest impact would occur at the Cachagua site primarily because this shallow reservoir would inundate a relatively large amount of riparian habitat. The Los Podres site had a relatively low impact because much of the inundation area includes the existing reservoir and thus the riparian habitat acreage to be lost would be relatively low.

The mitigation analysis first determined the average habitat value expected for mitigation sites with HSI values of 0.2 and 0.5 through the 100-year study period, based on the graphs in Figure 8. The average habitat value is expressed in average annual habitat units per acre and is equivalent to the average HSI over the 100-year period. The next step calculated the mitigation acreage needed to fully replace the HUs of each cover type to be lost, presented in Table 3. For example, in the Los Podres Alternative the total HUs that would be lost (12.92) was divided by the average annual HU per acre that would be gained over the 100-year life of the project at a highly degraded site (0.41) to determine that the mitigation site would have to be 31.5 acres. This is approximately a 2:1 ratio of mitigation area to impact area.

The results presented can be useful in assessing the implications of changes in the project design or final mitigation plan. For example, it is likely that some combination of riparian mitigation sites would be used, rather than just one of a given habitat value. In this case, it would be easy to calculate the necessary acreages using the data in Table 3.

TABLE 3

RIPARIAN MITIGATION REQUIREMENT CALCULATIONS

Los Podres Alternative

A.[1] 12.92 HU to be lost/0.41 average annual HU per acre = 31.5 acres

B.[1] 12.92 HU to be lost/0.165 average annual HU per acre = 78.3 acres

Cachagua Creek Alternative

A. 22.49 HU to be lost/0.41 average annual HU per acre = 54.9 acres

B. 22.49 HU to be lost/0.165 average annual HU per acre = 136.3 acres

Chupinos Creek Alternative

A. 11.36 HU to be lost/0.41 average annual HU per acre = 27.7 acres

B. 11.36 HU to be lost/0.165 average annual HU per acre = 68.9 acres

New San Clemente Alternatives

A. 54.33 HU to be lost/0.41 average annual HU per acre = 132.5 acres

B. 54.33 HU to be lost/0.165 average annual HU per acre = 329.3 acres

Lower San Clemente Creek Alternative

A. 14.26 HU to be lost/0.41 average annual HU per acre = 34.8 acres

B. 14.26 HU to be lost/0.165 average annual HU per acre = 86.4

Upper San Clemente Creek Alternative

A. 10.67 HU to be lost/0.41 average annual HU per acre = 26.0 acres

B. 10.67 HU to be lost/0.165 average annual HU per acre = 64.7 acres

[1]A = Assumes mitigation or replacement sites have an HSI value of 0.2.

[2]B = Assumes mitigation or replacement sites have an HSI value of 0.5.

Similarly, if the HA team determines that adjustments must be made in the HSI values or the acreages of impact, the results could be recalculated without difficulty. This HA report can provide the basic framework for future calculations.

DRAFT

RIPARIAN HABITAT MITIGATION PLAN
FOR THE
MONTEREY PENINSULA WATER SUPPLY PROJECT

Prepared by

Graham Matthews and Associates

and

Ambessaw Assegued, MPWMD Riparian Projects Coordinator

Monterey Peninsula Water Management District

July 1991

PREFACE

This Draft Riparian Habitat Mitigation Plan is a joint effort of Graham Matthews and Associates, a consultant to the Monterey Peninsula Water Management District, and Ambessaw Assegued, the District's Riparian Projects Coordinator. It provides more detailed information on the riparian mitigation plan that is proposed to mitigate for riparian habitat that would be inundated by one of several reservoir projects analyzed in the Supplemental Draft EIR/EIS. The acreages denoted in this Plan are based on a Habitat Assessment performed by EIP Associates in consultation with state and federal resource agency staff. The acreages used in the Final Riparian Habitat Mitigation Plan will be based on a more detailed Habitat Evaluation Procedure developed by the U.S. Fish and Wildlife Service.

Matthews (1991) authored the initial versions of this document, which was later amended or expanded in some sections by Assegued. Sections written by Matthews that were not amended include: Introduction, Objectives, Background Information, Existing Watershed Conditions, Existing Riparian Vegetation in Carmel Valley, Project Alternatives, Habitat Evaluation Procedure, Mitigation Sites, Details of Land Acquisition, Description of Existing Conditions at the Proposed Mitigation Sites, Operation and Maintenance, Cost Estimates and References. Sections significantly revised or developed by Assegued include: Restoration Program, Revegetation Plan, Riparian Forest Habitat, Riparian Woodland Habitat, Riparian Thicket Habitat, Riparian - Mixed Evergreen Forest Habitat, Fresh Water Marsh Habitat, Monitoring Program, Performance Standards and Monitoring Reports.

Much of the background information in this report is taken from Kondolf (1982), Matthews (1987) and Stern (1987). Those reports reference numerous other studies concerning the Carmel River; the interested reader is referred to them for additional information.

DRAFT

RIPARIAN HABITAT MITIGATION PLAN FOR THE MONTEREY PENINSULA WATER SUPPLY PROJECT

INTRODUCTION

The Monterey Peninsula Water Management District (MPWMD) has proposed the construction of new water supply facilities for the Monterey Peninsula. The purpose of the proposed water supply project is to (a) provide water supply for increased drought protection for existing and future water users, and (b) to meet projected municipal demand associated with planned growth within the jurisdictions of the MPWMD. A variety of alternatives have been considered and the most promising, along with the No Project alternative, were selected for evaluation in a project Environmental Impact Statement/Report (EIS/EIR). Of the ten alternatives under consideration, four would involve construction of a new dam and reservoir at two sites on the Carmel River, three would involve a new dam and reservoir on Carmel River tributaries, one would involve an offstream reservoir, one is a non-dam alternative involving construction of a desalination plant, and one is the No Project alternative.

Federal and state law prescribes that when a development action causes adverse change to a habitat, such as inundation by a reservoir, the applicant must consider ways to avoid, minimize, or compensate for the loss of environmental resources. Specifically, the MPWMD must develop a mitigation plan that will compensate for the loss of various types of habitat due to inundation by the reservoirs or the associated construction activities such as quarrying or road construction.

OBJECTIVES

The objective of this riparian habitat mitigation plan is to describe in detail the steps necessary to compensate for the loss of riparian habitats due to project construction and reservoir inundation for the seven alternatives involving such activities. The plan includes locations of mitigation sites, details of land acquisition, descriptions of site grading, the planting program including species composition, irrigation system design, operation and maintenance requirements, and preliminary cost estimates.

BACKGROUND INFORMATION

The U.S. Army Corps of Engineers, the U.S. Fish and Wildlife Service (USFWS), the

Environmental Protection Agency (EPA), and the California Department of Fish and Game (CDFG) are the primary federal and state agencies that participate in the development and review of a mitigation plan. Each provides guidance for establishing appropriate mitigation goals. Though their policies are similar, the USFWS process is the most complex. It generally involves a formal procedure known as HEP (Habitat Evaluation Procedure), which is used to document the quality and quantity of existing habitat for certain wildlife species. The HEP may be performed at various levels of complexity. In contrast, CDFG policy typically concerns only the acreage necessary to mitigate different types of habitat.

Agencies rate habitat based on their value to people, fish, or wildlife. The USFWS selects evaluation species to ascribe a numerical Resource Category to each habitat type. Resource categories range from 1 (unique and irreplaceable) to 4 (common, low value). The USFWS chose migratory and resident birds and small mammals to classify the riparian habitat in this area. Riparian habitats were rated as Resource Category 2 as limited acreage exists in California. The USFWS Mitigation Policy and Goals (F.R. 46(15): 7644-7663, January 23, 1981) for a Category 2 resource is "no net loss of in-kind habitat value". Thus, the MPWMD must enhance existing, poor habitat at other sites along the Carmel River to achieve the same habitat value as determined by the HEP for the riparian vegetation to be inundated.

The general CDFG policy for riparian habitats may be summarized as "for each acre lost or degraded, two acres of equivalent habitat must be established or enhanced". Twice the mitigation acreage is required due to the difference in quality between lost and enhanced habitat (e.g. inundation of mature riparian community as compared to replacement with newly planted saplings). The extra acreage compensates for the time it takes for the revegetated area to mature.

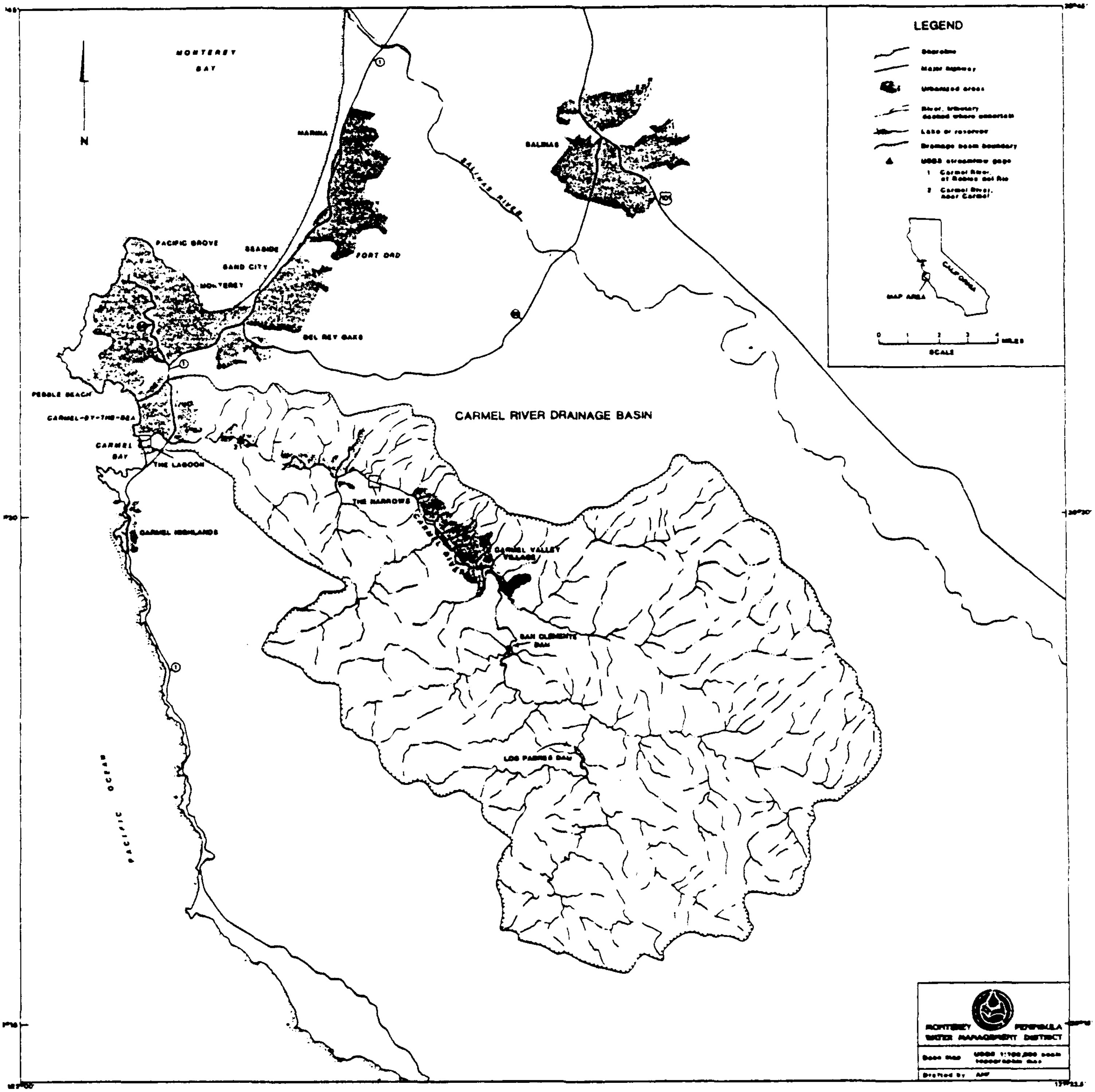
EXISTING WATERSHED CONDITIONS

The 36-mile Carmel River drains a rugged basin of 255 square miles on the Central California coast, and enters the Pacific Ocean at Carmel Bay (Figure 1). In its upper 21 miles, the river runs through steep canyons that contain limited amounts of alluvial material, while in its lower 15 miles, the river traverses an alluvial valley up to one mile wide near the mouth. The river gradient decreases from .007 (ft/ft) near Carmel Valley Village (River mile 14.4) to .002 (ft/ft) at the Highway One bridge (River mile 1.1).

The upper watershed is relatively undeveloped and a large portion lies within the Ventana Wilderness of the Los Padres National Forest. The lower watershed is more developed with much of the population centered around Carmel Valley Village. Residential and commercial development, including several golf courses, has also occurred from the river mouth to the Narrows (River mile 9.6) in the past two decades.

Precipitation occurs almost entirely as rain, with over 90% falling between November and April. Streamflow occurs in response to this seasonal rainfall, and significant flows are restricted to these months. Orographic effects are pronounced with annual precipitation varying from 14 inches in the northeast portion of the basin to over 40 inches in the high peaks (up to 5000 feet) of the southern part of the watershed.

FIGURE 1 CARMEL RIVER WATERSHED



The historic mean annual flow at two USGS gages (one at Robles del Rio, river mile 14.4, and one at "near Carmel", river mile 3.6) are 73,900 AF/yr and 86,000 AF/yr, respectively. Average monthly discharge for February at the "near Carmel" station is 380 cubic feet per second (cfs) compared to 0 cfs in July or August, when the river typically dries up due to groundwater pumping. Peak discharge at the Robles del Rio gage is estimated to be about 9,000 cfs for a 10-year event and 25,000 cfs for a 100-year event. The short USGS streamflow record precludes any definitive flood frequency analysis.

There have been three major floods on the Carmel River in historic times. The largest, estimated to be on the order of the standard project flood by the U.S. Army Corps of Engineers (COE), occurred in 1862 and probably exceeded 35,000 cfs at Robles del Rio. In 1911, a better documented flood occurred, estimated to approximate the 100-year event. Another large flood occurred in 1914, although few records exist describing it. The largest flood since 1914 occurred in April 1958 and was estimated to be about 14,000 cfs at Highway One or about a 20-year flood.

Kondolf (1982) mapped major historical changes in the river channel which occurred during the flood events described above. The 1911 flood caused channel shifts of up to one-quarter mile and left a wide flood terrace. In the absence of subsequent major floods and following the completion of San Clemente Dam in 1921, the river developed a dense riparian forest, a narrow incised channel, and became increasingly sinuous. Aerial photography shows little change between 1939 and 1965 indicating the river had achieved a condition of "dynamic equilibrium". Beginning in the 1960s, residential and later commercial development began encroaching in the riparian corridor. As water demand grew, more groundwater was pumped. As a result of increased pumping and the 1976-77 drought, large amounts of riparian vegetation died, and in subsequent moderate storm flows many reaches of the river have become unstable.

In 1983, the MPWMD developed the Carmel River Management Program (CRMP) in response to property owner requests for assistance in dealing with accelerated erosion problems. The CRMP began revegetation projects in 1985, and more comprehensive erosion control projects in 1987. These projects focus on reestablishing optimal channel geometry and restoring riparian vegetation along the riverbanks. The program is limited to a very narrow strip along the channel as a result of the delineation of the assessment zone boundaries, and does not include the entire riparian corridor.

In 1985, as a result of permit conditions for the operation of large, new Cal-Am groundwater production wells, riparian vegetation within the impact zone of the wells began to be irrigated. In 1988, during the second dry year in succession, these sprinkler systems were converted to drip irrigation and additional areas of riparian vegetation were included. In 1989 and 1990 following more dry years, the riparian irrigation systems were continually expanded and by the date of this report, the majority of riparian vegetation between river mile 0.5 and river mile 9.3 is now being irrigated.

EXISTING RIPARIAN VEGETATION IN CARMEL VALLEY

The riparian vegetation along the Carmel River has been extensively studied since 1981 (Matthews, 1987). Research has included the historical extent of the riparian vegetation, its species composition, and detailed measurements of plant physiology particularly concerning irrigation requirements and plant response to water stress caused by fluctuating water tables. The following classification scheme and descriptions of the riparian plant communities are based on the work of EIP (1987).

In the alluvial portion of the Carmel River, there are three distinctive types of riparian vegetation: riparian forest, riparian woodland or thickets, and riparian scrub. In the steep canyons where most of the projects are located, the habitat is frequently a riparian-mixed evergreen forest. These types are described below in more detail.

Riparian Forest

The riparian forest is dominated by large deciduous trees (30 to 60 feet tall) with overlapping canopies. The dominant tree forming the tallest canopy is the black cottonwood (Populus trichocarpa). Occasional sycamores (Plantanus racemosa) are scattered throughout. Underneath the cottonwoods are tree and shrub varieties of willow (Salix sp.) ranging from 5 to 40 feet. White alder (Alnus rhombifolia) may be an important component in areas with a continuous surface flow, while dogwood (Cornus occidentalis) may be found in drier reaches. The brush understory is typically composed of poison oak (Toxicodendron diversilobum), coffeeberry (Rhamnus californica), wild current (Ribes sp.), blackberry (Rubus vitifolius), and stinging nettle (Urtica holosericea).

The riparian forest is found almost continuously from the Carmel River lagoon to river mile 5.2. Upstream from this area, it appears only in scattered remnants of the riparian forests of the 1940s.

Riparian Woodland or Thicket

These habitats are the most common and extensive type found along the river. Like the riparian forest, a woodland is dominated by large trees; however, in this type the canopies do not overlap, and there is a wide range of tree densities. The most common tree species are identical to the forest type described previously.

A thicket is very similar to a woodland except that this community is typically comprised of dense stands of one or two tree species and is less than 20 feet in height. Common and dominant species of this habitat type are red willow (Salix laevigata), sandbar willow (Salix hindsiana), cottonwood, and alder. There is a continuum of size and structure complexity between the woodland and thicket habitat types. Much of the riparian woodland and thicket habitat along the alluvial portion of the river are remnants of once-extensive riparian forests which have been degraded since the 1960s. Large fluctuations in the seasonal water table due to groundwater pumping make it difficult for some species to regenerate, and, as a result, when mature trees die due to water stress, disease, or old age the overlapping canopy of the forest quickly became discontinuous.

Riparian Scrub

This is a common vegetation type between river mile 13 and river mile 17 where a braided channel pattern exists or has existed in the past. It is frequently found on gravel bars or on the low islands between channels. It is found almost exclusively in coarse-grained alluvial deposits that other riparian species cannot tolerate. It lacks a well-established tree canopy and is dominated by low shrubs 2 to 10 feet in height. Common and characteristic plant species in this habitat type include sandbar willow, mule fat (Baccharis viminea), coyote bush (Baccharis pilularis), blackberry, mugwort (Artemisia douglasiana), and sweet fennel (Foeniculum vulgare).

Riparian - Mixed Evergreen Forest

This habitat type is limited to the immediate bottom of the steep canyons along the upper Carmel River. In these locations, the floor of the canyon is at most 100 to 150 feet wide, with steep sides, and is composed of shallow alluvial deposits. The vegetation structure is extremely variable ranging from a typical forest community with a tree overstory and a brush and herbaceous understory, to open stands of scattered trees with little understory, to dry washes with very little vegetation cover.

The dominant tree species are sycamore, black cottonwood, white alder, and willows of the riparian community ; and oak (Quercus agrifolia), bay (Umbellularia californica), and California buckeye (Aesculus californicus) of the mixed evergreen community. The brush understory is typically composed of poison oak, coffeeberry, blackberry, wild current, and stinging nettle.

Current Status of Riparian Vegetation

As noted earlier, much of the riparian vegetation in the lower alluvial reaches of the river has been substantially impacted by groundwater pumping, drought, vegetation removal and erosion since the 1960s (McNiesh, 1989). Streamflow releases from the Los Padres Reservoir (river mile 24.0) and the San Clemente Reservoir (river mile 18.6) maintain a base flow in the river as far downstream as the Narrows (river mile 9.6), except for a one mile reach between river mile 12.5 and 13.5 where the river flows subsurface. The releases are generally able to maintain the existing riparian vegetation in a healthy condition where there is surface flow. Downstream of the Narrows, however, where most of the groundwater is pumped, water levels may drop 40 feet over the course of the summer in a normal year and up to 100 feet after several dry years in succession.

PROJECT ALTERNATIVES

Ten different alternatives for the Monterey Peninsula Water Supply Project are being evaluated in the EIS/EIR. These include four mainstem reservoir projects, three tributary reservoir projects, one offstream reservoir project, one non-dam project (desalinaiton) and the No Project alternative. Table 1 shows relevant project characteristics and Figure 2 shows the location of the

Table 1

MONTEREY PENINSULA WATER SUPPLY PROJECT

Summary of Alternatives

Alternative	Size (AF)	Spillway Crest Elev. (feet, AMSL)	Reservoir Area (acres)	Inundated Riparian (acres)
New Los Padres	24,000	1,120	273.3	39.0
New Los Padres	16,000	1,090	225.0	25.2
New Los Padres	9,000	1,050	156.4	22.1
New San Clemente	23,000	643	300.0	61.5
Cachagua Creek	6,000	1,434	108.8	32.8
San Clemente Ck	11,000	885	124.3	12.0
Chupines Creek	10,500	762	172.6	21.4
Canada Project	25,000	504	-na-	4.4
Desalination	7mgd	--	---	---
No Project	--	--	---	---

NOTES: (1) Project size and elevation data from MPWMD

(2) Reservoir area and riparian inudation from EIP, memo of 19 Jan 1990.

(3) Canada Project inundation figures from Biosystems Analysis, Inc. memo of 9 July 1990. Figures include riparian inundation along Carmel River from diversion facility.

LOCATIONS OF PROPOSED RESERVOIR ALTERNATIVES FIGURE 2

SOURCE: USGS 1:250,000 MONTEREY

MILES 0 2.5 5

N

88089

various alternatives within the Carmel River watershed.

HABITAT EVALUATION PROCEDURE

As noted previously, the USFWS Habitat Evaluation Procedure (HEP) is a method to quantify the impacts of proposed projects on existing habitats and to determine the amount of mitigation acreage necessary. The HEP may be completed at various levels of complexity ranging from simple, using an index of habitat suitability for all wildlife, to moderately complex, using wildlife "word models" and evaluation species, to highly complex, using mathematical models. For the purposes of the Draft EIS/EIR, given the large number of alternatives, the MPWMD and resource agencies agreed to follow the simplest form of HEP, otherwise known as a Habitat Assessment (HA), as described in Appendix 9-E of the Supplemental Draft EIR/EIS.

The HA requires the selection of a team to make decisions regarding approach, assumptions, and Habitat Suitability Index (HSI) values used. The team was composed of professional biologists representing the USFWS, CDFG, EPA, and EIP Associates (EIP, the MPWMD consultant). The study assigned HSI values to each section of riparian habitat within alternative project areas and to existing conditions at proposed mitigations sites. Future habitat values after revegetation at the mitigation sites were also estimated. The single HSI value estimates the habitat value of a given area of vegetation for all wildlife that typically uses that cover type (EIP,1988). For the purposes of the HA, all of the various riparian plant communities previously described were combined into a generic cover type, i.e. "riparian vegetation". Field work for the HA at proposed project sites was completed in August 1988, except for the Canada Alternative which was evaluated in June 1990. The proposed mitigation sites were evaluated by the team in July 1989. Tables 2 and 3 present the acreage and habitat units that would be lost for each project alternative and the existing and future habitat values at the various proposed mitigation sites. The Habitat Units (HU) are obtained by multiplying the HSI value by the number of acres.

Following the selection of a preferred alternative, the MPWMD intends to complete a more detailed HEP on that specific project. It is possible that some of the details or acreages that follow will change due to that work. In addition, the inundated acreage of riparian vegetation shown in Table 2 for each project only considers habitat within the inundation area of the reservoir, while other project activities such as quarrying and road construction may also cause the loss of additional riparian habitat. Several of the alternatives include quarry areas with the inundation area, and for several of the alternatives the exact quarry sites have not yet been determined. The riparian habitat impacted by these other construction activities is not expected to be significant compared to the impacts caused by inundation. The detailed HEP prepared on the selected alternative will address this issue and modify the acreages as necessary.

MITIGATION SITES

Initially, the MPWMD chose 16 locations covering 156 acres as potential mitigation sites. These sites primarily consisted of degraded or unvegetated locations adjacent to the Carmel River on recent (1911) flood terraces generally no more than 10-15 feet above the low water level. Since

TABLE 2

MONTEREY PENINSULA WATER SUPPLY PROJECT

Existing Habitat Values and Minimum Mitigation Acreage for Project Alternatives

Alternative	Inundated Riparian (acres)	Lost Habitat Units	Min Mitigation (acres)
New Los Padres (24,000 AF)	39.0	30.45	50.5
New Los Padres (16,000 AF)	25.2	20.95	32.4
New Los Padres (9,000 AF)	22.1	17.66	27.3
New San Clemente	61.5	54.33	112.0
Cachagua Creek	32.8	14.83	22.9
San Clemente Creek	12.0	11.64	18.0
Chupines Creek	21.4	10.55	16.3
Canada Project	4.4	3.47	6.3
Desalination	-NA-	-NA-	-NA-
No Project	-NA-	-NA-	-NA-

NOTES: (1) Riparian inundation values from EIP memo of 19 January 1990.

(2) Lost Habitat Units from EIP (1988).

(3) Minimum mitigation acreage calculated based on usage of maximum acreage (42.3 acres) in Rancho Don Juan portion of Garland Ranch Regional Park with AAHU value of 0.648 from EIP memo of 18 August 1989 and balance of acreage (up to 63.6 acres) from main portion of Garland Park with AAHU of 0.37 and up to 6 additional acres at an AAHU of 0.55 from the De Dampierre addition to Garland Park.

(4) Canada Project Habitat Units from Biosystems Analysis, Inc. report of 9 July 1990. Mitigation acres calculated assuming AAHU of 0.55, for sites in the vicinity of the diversion.

TABLE 3

MONTEREY PENINSULA WATER SUPPLY PROJECT

Habitat Values at Proposed Riparian Mitigation Sites

Mitigation Site	Habitat Values: Existing HSI	Habitat Values: Max Future HSI	Habitat Values: AAHU	Mitigation acres available
Rancho Don Juan				
*Eucalyptus Grove	0	0.7	0.648	5.9
*Agricultural Flds	0	0.7	0.648	25.6
*East Pasture	0	0.7	0.648	10.8
				42.3
Garland Park				
*main area	0.3	0.7	0.37	43.2
*Upper level	0.3	0.7	0.37	15.6
				58.8
De Dampierre				
*MPRPD land	0.1	0.7	0.555	7.1
*Trail/Saddle	0.1	0.7	0.555	1.4
				8.5

NOTES: (1) Habitat values from EIP memo of 18 August 1989.

(2) See text for explanation of acronyms.

similar undisturbed areas support healthy riparian forests, it appeared reasonable that these types of sites could serve as successful mitigation sites. All of these sites were visited and existing habitat values estimated by the HA team. Following the site visit, calculations were made to determine the Average Annual Habitat Units (AAHU) that could be expected at each site. Target Years (TY) of 5, 10, 25, and 100 were used in the analysis. The maximum HSI value that a mitigation site could achieve over the project life was assumed to be 0.7. Furthermore, it was assumed that one-half of the 0.7 HSI value would be obtained in the first five years, that by TY10 the value of the sites would increase by an additional one quarter of the difference between the existing value and the maximum of 0.7, and that by TY25 the maximum HSI value would be achieved and would continue through TY100 (EIP, 1989).

After comparing the total AAHU (AAHU times acreage) at each site with the habitat units lost for each alternative, it became clear that all of the alternatives, except the New San Clemente alternative (23 NSC), could be completely mitigated using only land that was within the Garland Ranch Regional Park. (Another 2.4 acres from a site other than Garland Ranch would be needed for the 23 NSC alternative). This is publicly owned land administered by the Monterey Peninsula Regional Park District (MPRPD). The advantages of locating the mitigation sites within the Park include:

(1) The ability to acquire an easement to install and maintain the revegetation sites, particularly since the Park District is interested in seeing habitat restoration completed within the Park.

(2) The concentration of mitigation acreage at one location would not only make the installation and maintenance of the site more efficient, but will also increase the habitat values. Research by Williams (1983) regarding usage of riparian habitat by avian species along the Carmel River showed that the number of species and the numbers of a given species dramatically increased in areas where the riparian corridor was at least several hundred feet wide. Apparently, the wider riparian zones more effectively filter out the impacts of adjacent suburban development, road noise, and other types of disturbances.

(3) The Park District has indicated that it will allow the MPWMD to maintain a small field office on site so that monitoring and maintenance will be much more easily undertaken.

(4) The primary portion of the Park to be used for mitigation consists of former agricultural fields that currently have no riparian habitat value and, therefore, give the MPWMD the ability to obtain the greatest increase in habitat units and thus requires the fewest acres to allow no net loss in habitat value. The former fields also appear to have excellent soils which would provide adequate nutrients to foster riparian vegetation establishment.

Figure 3 shows the location of the Garland Ranch Regional Park and the proposed mitigation sites. The Park contains river frontage from river mile 10.3 to 11.5.

DETAILS OF LAND ACQUISITION

In 1989 the MPWMD began negotiating with the Park District to obtain an easement for sufficient land to mitigate for the impacts of the proposed project alternatives on riparian habitat. The Board of Directors of both the Park District and the MPWMD conceptually approved such an agreement in 1989. A draft agreement was prepared in early 1990, and following the approval of this Riparian Habitat Mitigation Plan by both Boards of Directors, the agreement will be formally recorded. The agreement will allow the MPWMD to purchase a 63 acre easement for riparian habitat mitigation for $375,000. The agreement will also include an option for an additional 32 acres should this amount be necessary. The MPWMD would only be obligated to complete the purchase if the voters approve a bond issue for a specific water supply project in the Carmel River watershed which requires a riparian mitigation plan.

DESCRIPTION OF EXISTING CONDITIONS AT THE PROPOSED MITIGATION SITES

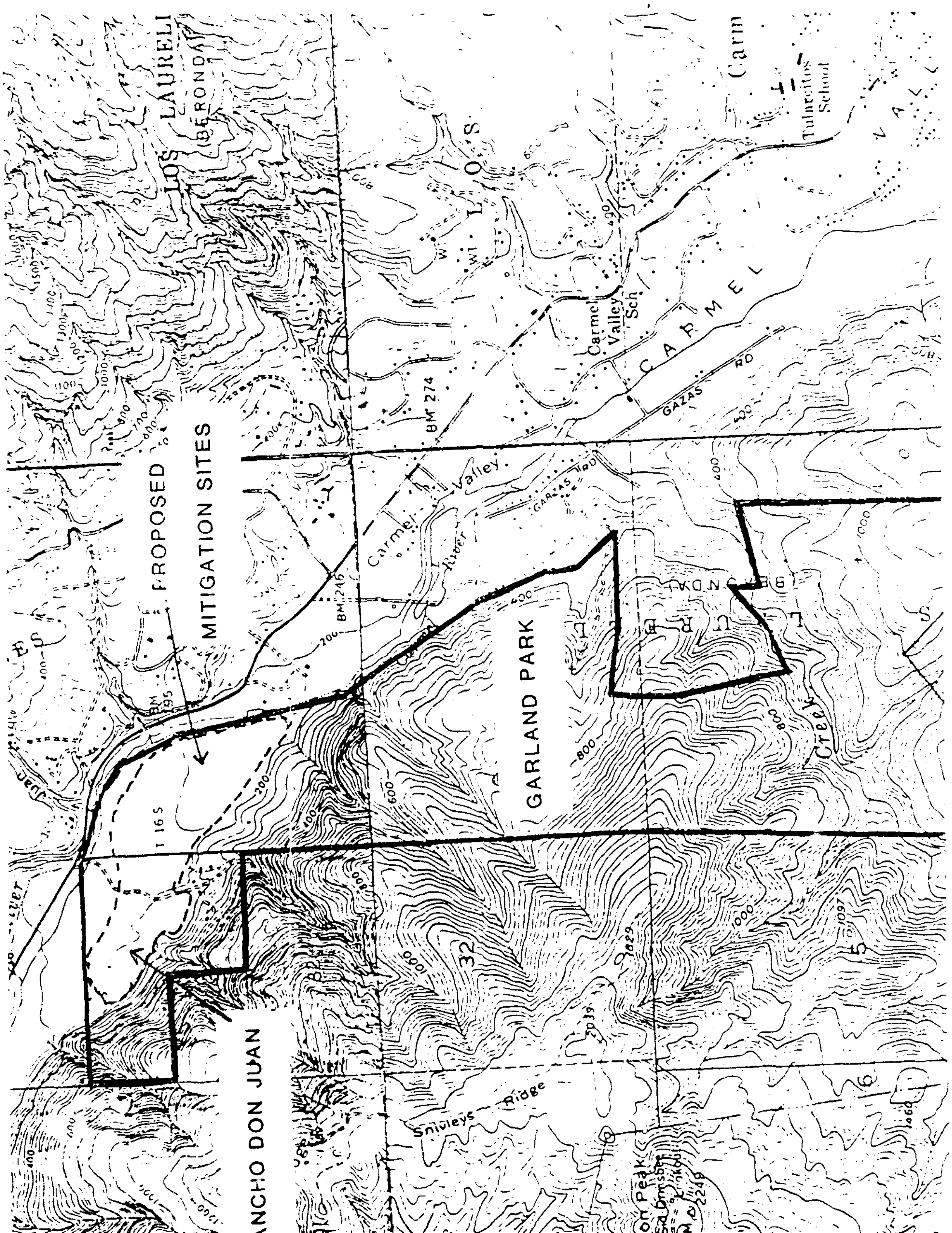
The Garland Ranch Regional Park and its recent addition to the west, the 145 acre Rancho Don Juan, form one of the major areas of open space within the Carmel River floodplain that would be suitable for riparian habitat mitigation. A study of historical aerial photographs show that the floodplain portion of the park was formerly densely covered with riparian forest. Land clearing, grazing, and the 1976-77 drought have contributed to a substantial decline of the riparian vegetation in the last 25 years. The agricultural lands on Rancho Don Juan appear on the earliest aerial photographs taken in 1939, and since the ranchhouse was built in the 1920's that land was probably cleared during that time. The eucalyptus trees located along the northwest edge of the cultivated area were probably planted at that time as a wind break.

Areas suitable for riparian habitat mitigation include the eucalyptus grove, the cultivated fields, an area known as the east pasture which contains an old riding ring, and the floodplain area around the visitor center in the original portion of the park. Each of these areas is described below. Most of the features described in the following paragraphs can be seen on the enlarged aerial photographs attached to this report as Plates 1 and 2.

The eucalyptus grove is composed of several hundred mature trees ranging in size from one foot to five feet diameter at breast height (DBH) and covers an area of approximately 6 acres. The largest trees are 80-100 feet tall. There are also numerous small saplings in the grove and these are spreading into the river channel. The removal of these non-native invasive trees and their replacement with riparian forest would not only greatly improve the extent of habitat in this area, but would also remove trees that could create a serious hazard by impeding flow during the next significant flood. In 1980 and 1983 moderate stormflows came very close to undercutting several of the large trees. Within the grove is an old irrigation well that provided water to the cultivated areas. At some point, several hundred cubic yards of Monterey Formation siltstone fragments and soil was dumped among the trees and graded. This material is not suitable for the growth of riparian vegetation and would need to be removed.

The cultivated fields cover an area of approximately 30 acres. This area was last used for row

FIGURE 3 VICINITY OF PROPOSED MITIGATION SITES



crops in the mid 1980s, although in the last few years it was used to grow hay. The area is currently bare except for weeds. The soil is a Tujunga fine sand which would be an excellent growing medium for riparian species.

The east pasture contains about 16 acres including a small amount of remnant riparian mostly along the access road and closer to the river channel. This area also includes the old barn which is on a higher terrace, and only about 11 acres are suitable for riparian revegetation. Along the east side of the pasture is a row of pine trees and a few eucalyptus on what was formerly the property boundary between Rancho Don Juan and Garland Ranch Regional Park. This area is slightly lower than the agricultural fields and shows evidence that riverflow crossed this parcel during the 1958 flood (about a 20-year event). Auger holes showed that the fine sands and silts are about 1.5 to 2 feet deep at which point a cobble layer is reached. The pasture also contains an old riding ring and a well that provides domestic supply to the ranch facilites up the hill, which are intended to become the future site of administrative offices of the Park District, and perhaps a musueum of local history.

The floodplain area in the original portion of Garland Ranch Regional Park contains about 64 acres suitable for riparian mitigation. Prior to 1911 the Carmel River flowed through a channel along the southern edge of this floodplain, and a small remnant of this channel still exists. During the 1911 flood, the channel moved almost to its present location. There is an elevated (4 to 5 feet above rest of floodplain) area in the center of the floodplain of about 15 acres. Photographs show that this entire floodplain area was covered in riparian forest in the 1940s and 1950s. Now, only scattered sycamores, cottonwoods, and willows remain.

RESTORATION PROGRAM

The goals of the restoration plan are to result in no net loss of in-kind habitat value by (1) establishing riparian habitats at the mitigation site that are ecologically and visually similar and/or equal to the riparian habitat that will be inundated by construction of a new dam and reservoir, (2) promoting wildlife habitat values that are similar and/or equal to those that will be lost by inundation and (3) begining a process of ecological succession to return the mitigation site to a stable ecosystem which will require minimum or no human input once vegetation has been established.

The restoration plan will focus on revegetation of the dominant canopy cover and the associated understory species for each of the vegetation community types described above. Although the understory vegetation and the less dominant plant species in each community type are expected to quickly invade the mitigation area through natural colonization, revegetation of the understory will still be undertaken to hasten its recovery and establishment.

A biologist or a revegetation specialist, whose qualifications are acceptable to the resource agencies, will supervise all phases of the restoration program from initial revegetation through the end of the monitoring program.

REVEGETATION PLAN

Planting Design

Design considerations will be based upon naturally occurring conditions of the riparian forest floor where plant communities are concentrated in patches, with few individuals occurring as dominant plant species.

In an attempt to re-create the three distinctive riparian vegetation types described above -- riparian forest, riparian woodland or thicket, riparian-mixed evergreen forest -- the planting design will incorporate the installation of plant species identified in association with these community types in distinct plant community type patches or planting cells. This clumped or contiguous distribution is expected to facilitate the establishment of a mosaic of habitat types.

Vegetation community type patches or planting cells (basins) for each plant community type will be established by creating a microrelief of depressions and rises, which will form the planting basins with characteristic berms constructed around the edges. The dimensions of these planting basins will not exceed 215 feet in width, 215 feet in length and 1.5 feet in depth. The planting cells will be laid contiguously, with minimum clearance of 15 feet between each other. The shape of each cell shall be irregular and sinuous, ranging from oval to rectangular (figures 4 & 4A).

Irrigation application to parent plants installed in patches is expected to create optimum soil moisture conditions for the maintenance of seedlings and dispersal by runners and rhizomes. This contiguous design is also expected to facilitate species interrelationship and interdependency, as well as creating edaphic conditions that will increase habitat value of the mitigation site.

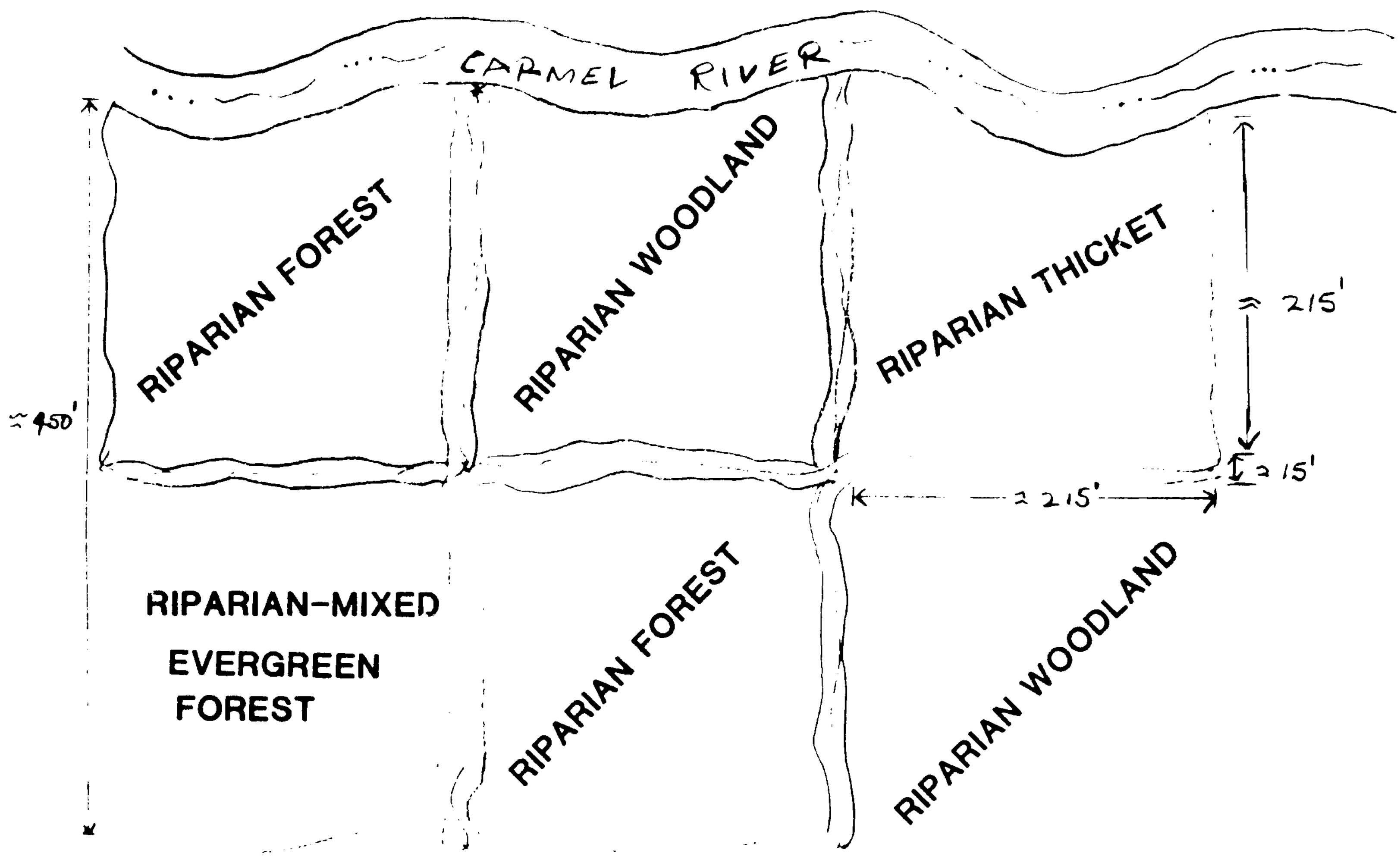
Dominant overstory trees will be planted as individuals or in single species groves. Understory shrubs and groundcover species will be planted within and between open areas connecting the groves. Planting density will be no less than 500 tree/shrubs per acre at 10 foot centers and, for herbaceous species, 2,000 plants per acre at 5 foot centers.

Plant Protection

During implementation of the mitigation project, and wherever visible, existing riparian vegetation within the mitigation area will be protected from potential injury by equipment and vehicle incursion. Protection of native vegetation will include mature willows, cottonwoods, sycamores, oaks and bay trees that are found scattered across the Garland Park flood plain. No disturbance shall occur to within 5 feet of the canopy dripline of any tree designated for protection. Plant protection will include construction of temporary fencing and flagging. A qualified biologist or a revegetation specialist will mark native vegetation designated for protection.

Site Preparation

Prior to the installation of plant materials, soil samples will be collected from the mitigation



SCHEMATIC ARRANGEMENT OF PLANTING CELLS
FOR PLANT COMMUNITY TYPES PLAN VIEW

FIGURE 4

CROSS SECTION OF THE PLANTING CELLS AND THE VEGETATION COMMUNITY TYPES

RIPARIAN-MIXED EVERGREEN FOREST	RIPARIAN FOREST	RIPARIAN WOODLAND	RIPARIAN THICKET
cottonwood	cottonwood	cottonwood	cottonwood
alder	sycamore	sycamore	willows
willows	willows	willows	
sycamore	alder	alder	
bay			
buckeye			

FIGURE 4A

area to evaluate the soil characteristics and soil conditions. Laboratory analysis of chemical and physical characteristics including pH values, electrical conductivity (EC) measurements, organic matter content and sediment texture will be conducted. Result of soil tests will be used to determine appropriate soil amendments or treatments necessary prior to planting.

To construct the plant community patches or planting cells described above, a track laying tractor with a blade, a grader, a backhoe and a scraper can be used to clear and prepare the area for planting. A ridger mount on the tractor can be used to create the berms of the basins. The soil shall then be scarified to reduce compaction and promote water infiltration, seed germination and root penetration.

In the 5.9-acre site of the mitigation area known as the eucalyptus grove, and along the former east property of Rancho Don Juan, all non-native trees, primarily consisting of eucalyptus and pine will be removed. Removal of stumps will be undertaken using tractor mount backhoe.

The duff layer beneath the eucalyptus grove to within the top six inches of the soil surface and the Monterey Formation fill material described above will be removed by scraping. The planting cells will be constructed and the soil shall then be scarified to reduce compaction and promote water infiltration, seed germination and root penetration.

Propagule Materials

Seeds, pole cutting and nursery grown container-stock propagules will be used to establish riparian vegetation overstory, understory and groundcover. Propagule material will be collected from the general vicinity of the Carmel River Valley, to the extent possible, and can be augmented by other sources located within Monterey County.

Seed collection and propagation will be performed either by MPWMD or can be contracted to a local native plant nursery. It is expected that sufficient quantities of seeds can be collected from the Carmel Valley to satisfy the demand for this mitigation project. The biologist or revegetation specialist will determine the appropriate seeds designated for collection and the time of year to be collected.

Seed propagation and other container-stock plant materials shall be started at least 140 days prior to the start of the revegetation project, to allow for plant rooting and growth.

Nursery stock plant container can be any of the following kinds and sizes: dee pots (2.5" x 10" plastic tubes), tree bands (2" x 7" plastic container), tree pots (4" x 4" x 13" plastic containers) or 1-gallon pots.

Pole cuttings will be collected during the winter dormant seasons. Pole cuttings will be installed in augured holes, having at least 8 inches in width, typically with tillage no less than 65 percent of the distance to the average summer groundwater level, when known, or 6 feet deep, minimum. Auguring can be replaced with trenching if site conditions warrant it. A tractor with a backhoe mount can be used to dig planting holes to the required depth and to backfill the holes once pole cuttings are installed.

Pole cuttings shall be no larger than 1.5 and no less than 0.5 inches in diameter. Pole cutting length can vary depending upon the depth of the augured holes. However, cutting sizes will be such that no less than 15 and no more than 24 inches shall protrude above the ground surface.

Installation of Irrigation System

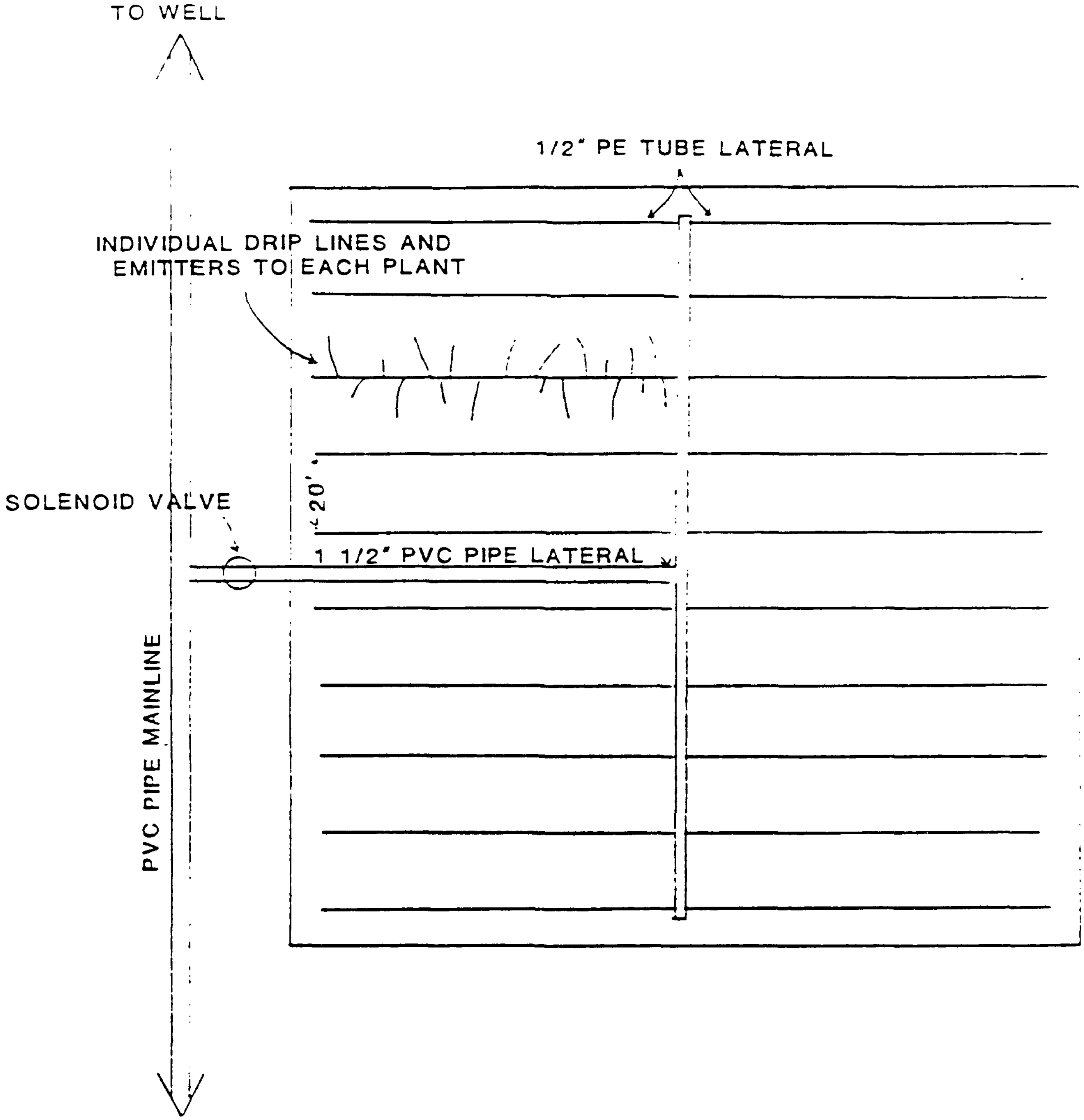
Prior to any actual planting, some components of the irrigation system should be installed, including well drilling, underground electrical service, filters, PVC pipe mainlines and laterals, and soil moisture and water level monitoring tubes. It should be noted that each project alternative would require different amounts of these materials due to the acreage differences of the specific mitigation plans. For example, the alternatives requiring greater mitigation acreage would require two irrigation wells while the smaller would only require one. The individual amounts are included in the cost estimates prepared for each alternative.

All sizes of mitigation areas will require the drilling and installation of at least one irrigation well. The location and number of wells varies depending on the mitigation acreage. The well or wells would be small, no more than a 6" or 8" casing and a production of 100-120 gallons per minute (gpm). The pumps would be sized to meet the system demand so that a pressure tank system is not necessary. Although the water quality in the vicinity of Garland Ranch Regional Park is quite good such that only simple filtering is required, it is recommended that an automatic filtering/backwashing system be installed in order to obtain the highest quality water for the drip system. This will reduce the maintenance requirements and potential clogging problems over the long term. All of these components would easily fit in a 20' x 20' enclosure. The enclosure would be designed, painted, and screened with riparian plantings to blend in with the riparian vegetation as closely as possible. Electrical service would be underground from the nearest existing line. A small access road to the well facilities should remain for future maintenance.

The irrigation system itself will consist of buried PVC mainlines starting at about 3" diameter at the well and decreasing with distance. The mainline would feed a buried PVC lateral system (Figure 4) which would feed polyethylene (PE) tube and finally drip tubing with emitters to the individual plants. The flow rate of the emitters would be varied to match the irrigation needs of the individual plant due to size or species. The PE tube and drip tubing would not be buried to allow location ofleaks, but efforts will be made to minimize visual impacts until the understory vegetation naturally covers the tubing. The lateral system would be laid out in about one acre blocks, each controlled by an electric solenoid valve wired to a master control panel in the well enclosure. This would enable much more precise control of the irrigation schedule should certain areas require additional water due to differing soil texture conditions or different species compositions. In addition, the MPWMD weather station in Garland Ranch Regional Park could be integrated with the irrigation system to schedule irrigation sessions based upon measured evapotranspiration rates.

It is recommended that the specific mitigation plan for each alternative include access tubes to measure depth to water and soil moisture, similar to existing MPWMD practice at other locations. This data collection effort will assist in making the irrigation system function efficiently, and would provide information to evaluate and monitor the success of the mitigation

FIGURE 5 SCHEMATIC OF TYPICAL IRRIGATION LAYOUT IN A ONE ACRE MITIGATION BLOCK



program. The access tubes should be placed in transects perpendicular to the river and be relatively equidistant. The tubes would not need to be more than 25 feet deep and would be installed flush with the ground surface in standard monitor well locking enclosures. These tubes should be installed at the time of the well drilling. They will all be surveyed to a common datum.

RIPARIAN FOREST HABITAT

To fulfill the mitigation requirements of the selected dam project and to compensate for the loss of riparian forest habitat, a vegetation community consisting of the plant species and composition described as riparian forest plant community type will be established at the mitigation site. The exact acreage and number of plants for this community type can not be ascertained at this time. Once the final project alternative is selected, a detailed mitigation plan will address the required number of plants for this habitat type.

The riparian forest habitat is dominated by the deciduous black cottonwood (*Populus trichocharpa*). To re-create overlapping canopies of black cottonwood, characteristic of this habitat type, the cottonwood propagules will be spaced evenly, in rectangular or circular planting method. Planting patterns will attempt to create a uniform density of overstory vegetation in each planting cell designated for the establishment of riparian forest habitat.

The habitat conditions, including plant species composition and density of an existing, relatively undisturbed riparian forest area will be located in the Carmel River Valley and will be used as the "model" for re-creating this community type.

The appropriate propagules for each species will be collected and planted during the planting window of November through February. Both rooted and container stock propagules will be used. Newly installed plant materials will be irrigated during the growing season with a drip irrigation system that will apply at least 10 gallons of water per week for a minimum of three years. Under normal environmental conditions, adequate root growth should occur by the end of this period, allowing trees to survive and grow without supplemental water. The revegetation area will be weeded as necessary to reduce competition and to maintain their vigor.

The following list of plant species name and percent composition contains those species of plants which have been identified as components of the Carmel Valley riparian forest habitat and are designated appropriate for this revegetation program. The plant species listed are native Monterey County (in particular, to lower Carmel Valley), will provide high wildlife value (food, shelter) and have maximum potential for recreating the riparian forest.

Plant Species Name	Plants/ac	Percent
Trees		
Acer negundo ssp. californicum	10	3
Alnus rhombifolia	25	5
Populus trichcarpa	125	25
Salix laevigata	40	8
S. lasiandra	40	8
S. lasiolepis	50	10
S. hindsiana	10	2
Sambucus mexicana (orbiculata)	25	5
Shrubs		
Ribes spp.	25	5
Rhamnus californica	40	8
Rosa california	20	4
Rubus vitigolius	40	8

Herbaceous
(seeds in lb/ac and plants/ac to be determined for final mitigation plan)

Artemisia douglasiana
Epilobium sp.
Urtica holosericea

RIPARIAN WOODLAND HABITAT

To fulfill the mitigation requirements of the selected dam project and to compensate for the loss of riparian woodland habitat, a vegetation community consisting of the plant species and composition described as riparian woodland plant community type will be established at the mitigation site. The exact acreage and number of plants for this community type can not be ascertained at this time. Once the final project alternative is selected, a detailed mitigation plan will address the required number of plants for this habitat type.

The riparian woodland habitat is dominated by the deciduous black cottonwood (*Populus trichocharpa*) and large willow (*Salix spp.*) trees, but without the overlapping canopies of the riparian forest and with range of tree densities. To re-create the character of this habitat type throughout the planting cells designated for the establishment of riparian woodland habitat, cottonwood propagules will be planted at random and will be spaced unevenly, with willow species interspersed around the cottonwoods. Planting patterns will attempt to create irregular densities of overstory vegetation in each planting cell.

The habitat conditions, including plant species composition and density, of an existing relatively undisturbed riparian woodland area will be located in the Carmel River Valley and will be used as the "model" for re-creating this plant community type.

The appropriate propagules for each species will be collected and planted during the planting window of November through February. Both rooted and container stock propagules will be used. Newly installed plant materials will be irrigated during the growing season with a drip irrigation system that will apply at least 10 gallons of water per week for a minimum of three years. Under normal environmental conditions, adequate root growth should occur by the end of this period, allowing trees to survive and grow without supplemental water. The revegetation area will be weeded as necessary to reduce competition and to maintain their vigor.

The following list of plant species name and percent composition contains those species of plants which have been identified as components of the Carmel Valley riparian woodland habitat and are designated appropriate for this revegetation program. The plant species listed are native Monterey County (in particular, to lower Carmel Valley), will provide high wildlife value (food, shelter) and have maximum potential for recreating the riparian woodland.

Plant Species Name	Plants/ac	Percent
Trees		
Acer negundo ssp. californicum	10	3
Alnus rhombifolia	25	5
Populus trichcarpa	125	25
Salix laevigata	40	8
S. lasiandra	40	8
S. lasiolepis	50	10
S. hindsiana	10	2
Sambucus mexicana (orbiculata)	25	5
Shrubs		
Ribes spp.	25	5
Rhamnus californica	40	8
Rosa california	20	4
Rubus vitigolius	40	8

Herbaceous
(seeds in lb/ac and plants/ac to be determined for final mitigation plan)

Artemisia douglasiana
Epilobium sp.
Urtica holosericea

RIPARIAN THICKET HABITAT

To fulfill the mitigation requirements of the selected dam project and to compensate for the loss of riparian thicket habitat, a vegetation community consisting of the plant species and composition described as riparian thicket plant community type will be established at the mitigation site. The exact acreage and number of plants for this community type can not be ascertained at this time. Once the final project alternative is selected, a detailed mitigation plan will address the required number of plants for this habitat type.

The riparian thicket habitat is dominated by dense stands of cotton wood and willow species which are typically less than 20 feet in height. Recognizing that there is a continuum of size and structural complexity between the woodland and thicket type of plant communities, the revegetation effort will attempt to re-create the character of this habitat type by congregating plants in dense groves of one or two species within the planting cells designated for the establishment of riparian thicket habitat. Propagules will be planted in regular patterns and will be spaced evenly throughout the planting cells.

The habitat conditions, including plant species composition and density, of an existing relatively undisturbed riparian thicket habitat area will be located in the Carmel River Valley and will be used as the "model" for re-creating this plant community type.

The appropriate propagules for each species will be collected and planted during the planting window of November through February. Both rooted and container stock propagules will be used. Newly installed plant materials will be irrigated during the growing season with a drip irrigation system that will apply at least 10 gallons of water per week for a minimum of three years. Under normal environmental conditions, adequate root growth should occur by the end of this period, allowing trees to survive and grow without supplemental water. The revegetation area will be weeded as necessary to reduce competition and to maintain their vigor.

The following list of plant species name and percent composition contains those species of plants which have been identified as components of the Carmel Valley riparian forest habitat and are designated appropriate for this revegetation program. The plant species listed are native Monterey County (in particular, to lower Carmel Valley), will provide high wildlife value (food, shelter) and have maximum potential for recreating the riparian thicket habitat.

Plant Species Name	Plants/ac	Percent
Trees		
Acer negundo ssp. californicum	25	5
Alnus rhombifolia	25	5
Populus trichcarpa	125	25
Salix laevigata	40	8
S. lasiandra	40	8
S. lasiolepis	40	8

S. hindsiana	60	12
Sambucus mexicana (orbiculata)	20	4

Shrubs

Ribes spp.	25	5
Rhamnus californica	40	8
Rosa california	20	4
Rubus vitigolius	40	8

Herbaceous
(seeds in lb/ac and plants/ac to be determined for final mitigation plan)

Artemisia douglasiana
Epilobium sp.
Urtica holosericea

RIPARIAN - MIXED EVERGREEN FOREST HABITAT

To fulfill the mitigation requirements of the selected dam project and to compensate for the loss of riparian - mixed evergreen forest habitat, a vegetation community consisting of the plant species and composition described as riparian - mixed evergreen forest plant community type will be established at the mitigation site. The exact acreage and number of plants for this community type can not be ascertained at this time. Once the final project alternative is selected, a detailed mitigation plan will address the required number of plants for this habitat type.

The riparian - mixed evergreen forest habitat is composed of variable densities of riparian and evergreen trees forming overstory canopies in some stands, and open-canopy stands of scattered trees. the dominant tree species are sycamore, black cottonwood, white alder and willows of the riparian community; oak, ba and buckeye of the evergreen community. This character of the riparian - mixed evergreen forest type will be re-created by installing stands of specific tree species in smaller groves along with understory shrubs and groundcover to create closed canopy forests; and by installing individual trees in association with characteristic understory vegetation to create open-canopy forest habitat. Components of the riparian and evergreen vegetation will be interspersed with each other in the planting cell designated for the establishment of the riparian - mixed evergreen forest plant community type.

The habitat conditions, including plant species composition and density, of an existing relatively undisturbed riparian - mixed evergreen forest habitat area will be located in the Carmel River Valley and will be used as the "model" for re-creating this plant community type. Although the topography and slope characteristics of this habitat type will not be recreated at the mitigation site, attempt will be made to re-establish the riparian and evergreen component of this community.

The appropriate propagules for each species will be collected and planted during the planting window of November through February. Both rooted and container stock propagules will be used. Newly installed plant materials will be irrigated during the growing season with a drip irrigation system that will apply at least 10 gallons of water per week for a minimum of three years. Under normal environmental conditions, adequate root growth should occur by the end of this period, allowing trees to survive and grow without supplemental water. The revegetation area will be weeded as necessary to reduce competition and to maintain their vigor.

The following list of plant species name and percent composition contains those species of plants which have been identified as components of the Carmel Valley riparian habitat and are designated appropriate for this revegetation program. The plant species listed are native Monterey County (in particular, to lower Carmel Valley), will provide high wildlife value (food, shelter) and have maximum potential for recreating the riparian - mixed evergreen forest.

Plant Species Name	Plants/ac	Percent
Trees		
Acer negundo ssp. californicum	50	10
Aesculus californicus	40	7
Alnus rhombifolia	25	5
Populus trichcarpa	50	10
Quercus agrifolia	25	5
Salix laevigata	30	6
S. lasiandra	30	6
S. lasiolepis	30	6
S. hindsiana	40	8
Sambucus mexicana (orbiculata)	35	7
Umbellularia californica	20	4
Shrubs		
Ribes spp.	25	5
Rhamnus californica	40	8
Rosa california	20	4
Rubus vitigolius	40	8

Herbaceous
(seeds in lb/ac and plants/ac to be determined for final mitigation plan)

Artemisia douglasiana
Epilobium sp.
Urtica holosericea

FRESH WATER MARSH HABITAT

It is recognized that the mitigation for this habitat type is contingent upon the failure of the anticipated establishment of a fresh water marsh habitat described in Chapter 9, Section 9.2.1 of the MPWMD Water Supply Project Supplemental Draft EIR/EIS. In the event that mitigation for the loss of fresh water marsh becomes necessary, the restoration plan presented below will be implemented.

To fulfill the mitigation requirements of the selected dam project and to compensate for the loss of fresh water marsh habitat, a vegetation community consisting of the plant species and composition described as fresh water marsh plant community type will be established at the mitigation site. The exact acreage and number of plants for this community type can not be ascertained at this time. Once the final project alternative is selected, a detailed mitigation plan will address the required number of plants for this habitat type.

The fresh water marsh habitat is typically composed of obligate wetland species including varies species of sedges, cattail, tule, rushes, horsetail and other associated plants.

The elevations of fresh water marsh area located in the immediate vicinity of the mitigation site will be used to determine the proper elevations to specify the grading requirements to create the fresh water marsh. Under natural conditions, it can be expected that marsh vegetation can be established by natural colonization. However, the uncertainty surrounding extreme fluctuations of the ground water level in the Carmel Valley will probably necessitate excavation of the marsh surface to just below the average summer low flow level in the river.

The marsh will be located at the lowest elevation of the mitigation site and adjacent to the Carmel River. Hydrologic connection between the created marsh and the river will be established by constructing an inlet channel at the upstream end and outlet channel at the downstream end of the new marsh. The sides of the marsh will be long, broad and gentle slopes to maximize the surface area for marsh vegetation establishment. The top of the slopes will be revegetated with riparian plant species.

The fresh water marsh will have tules and cattails that will form the overstory with other species typically forming the understory. Two methods of revegetation will be used. Revegetation in this area will primary consist of planting with rhizomatous plugs from marsh vegetation collected from adjacent wetlands. Plugs, including parts of stems, rhizomes and roots will be collected by hand, transported and installed a the mitigation site. Whenever possible, seeds will also be collected and dispersed by hand. Planting and seed broadcasting will take place in late fall or early winter to take advantage of winter rains. Seed dispersal should take place following planting activities. No irrigation is planned for this area since groundwater levels and inundation by surface river water is expected to provide sufficient soil moisture throughout most of the year.

Across the marsh surface, a horizontal gradation of vegetation zonation will be established, segregating those species that tolerate regular inundations at the lowest elevations and those that require less frequent flooding arranged at the higher elevations of the marsh slopes.

The habitat conditions, including plant species composition and density, of an existing relatively undisturbed fresh water marsh habitat area will be located in the Carmel River Valley and will be used as the "model" for re-creating this plant community type.

The following list of plant species name and percent composition contains those species of plants which have been identified as components of the Carmel Valley fresh water marsh habitat and are designated appropriate for this revegetation program.

Plant Species Name	Plants/ac	Percent
Carex spp.	400	20
cyperus spp.	300	15
Juncus spp.	200	10
Equisetum spp.	400	20
Scipus spp.	500	25
Thypha spp.	200	10

OTHER CONSIDERATIONS

Given the park setting where the proposed mitigation sites are located, it is reasonable to assume that some interface between the public use of the park and the riparian habitat will occur. This concept is addressed in the draft agreement for the mitigation acreage easement as follows: " The easement shall be for the purposes of riparian habitat mitigation; provided, however that such easement shall not interfere with the reasonable use of the property as a regional park ". This plan recognizes that a number of trails and paths exist within the proposed mitigation areas, and the design presented here is fully compatible with the existing network. The MPWMD and the Park District staff should work together to design an additional nature trail meandering through a portion of the site, however, all other areas should remain undisturbed. The MPWMD and Park District should cooperatively develop interpretive signs to provide an educational experience for the public. The signs could tell the reader about riparian vegetation, its importance as habitat, the various species and their life cycle, etc.

Temporary fencing should be installed around the mitigation sites during the construction period and following the initial planting for a period of up to 2 years. This will prevent trampling of the plantings by hikers and horses, digging by dogs and perhaps browsing by animals, depending on the height of the fence. The fencing could be removed earlier if conditions warrant.

OPERATION AND MAINTENANCE

Operation and maintenance in the first 3-5 years is perhaps the single most important factor in the success of the program. Without adequate operation of the irrigation system and maintenance of the equipment and plantings, the project will be, at best, partially successful. The staffing requirements for this program depend on which alternative is ultimately constructed, and will depend on the findings of a subsequent HEP and Final Mitigation Plan. The largest alternative would probably require two full-time personnel. The smaller projects would probably require a full-time person for the first year and perhaps half-time after that. The moderate size projects would require two persons for the first year, and one full-time thereafter. Tasks performed by these individuals would include maintenance of the irrigation equipment such as checking for leaks weekly by walking the entire mitigation area, inspecting and servicing filtration equipment, and seasonal system flushing. Other tasks would include replanting of unsuccessful plants and performing monitoring activities described in the next section.

MONITORING PROGRAM

The monitoring program objectives are as follows: (1) address the mitigation requirements as set forth by the Monterey Peninsula Water Supply Project EIR/EIS and ensure compliance with its requirements, (2) ensure the establishment of suitable wildlife habitat at the mitigation area, (3) evaluate the degree of success attained in reaching the Performance Standards outlined below, and identify required remedial actions to be taken, if necessary, and (4) use the information gained from the monitoring program to develop design criteria that could be used in planning future mitigation and restoration plans. All monitoring activities shall be performed by qualified biologist or riparian specialist.

This monitoring program calls for the coordinated quantitative and qualitative assessment of soil attributes, vegetation establishment and recovery, wildlife (avifauna), groundwater characteristics and recreation use on the newly restored riparian habitat. The results of monitoring these resources shall be used to prepare a detailed description of the types of habitats and wildlife values that will be created. The monitoring program shall be in place for five years after the completion of the revegetation project. The project monitoring period assumes normal progress towards meeting the performance standard described below. This period will be extended if warranted, based on yearly progress evaluations.

The overall approach of the monitoring program will be to quantify vegetation establishment and wildlife populations on sampling grids to be located on selected areas at the mitigation site. These grids will serve as the permanent stations for collecting all data throughout the life of the monitoring program.

Vegetation Monitoring

Vegetation monitoring shall be conducted using a permanent quadrat method. Data will be collected on species composition and structure, height, basal areas (indicative of dominance and relative importance of species), areal spread of crowns (foliage volume), percent cover, rates of self-colonization (regeneration) and mortality rates.

Each vegetation type will be stratified and each stratum will be sampled separately with an appropriate size plot (quadrat). The smaller plots, used to sample groundcover, shall be "nested" within the larger size plots used to sample trees and shrubs. Trees can be satisfactorily sampled in 10 x 10 meter size plots, shrubs 4 x 4 meter size plots, and groundcover herbs in 1 x 1 meter plots. By separating the data into distinct size classes, various strata levels can be distinguished.

Species:Area curves will be constructed to determine the number of quadrats in each grid. Distribution of quadrats in each grid shall be spaced evenly and as widely as possible along a transect line. Transect lines will be placed in regular intervals across the greatest extent of the monitoring grids.

Standard surveying equipment shall be used to establish the permanent sampling grids, quadrats and transects. Permanent markings of the sampling areas will be made by driving metal pipes or other scrap metal into the ground, leaving a few inches protruding and by spray-painting the extended piece with colored paint.
Data collection shall occur in July of each monitoring year. Vegetation maps will be prepared for each sample grid and species composition and structure, height, basal areas, areal spread of crowns (foliage volume), percent cover, rates of self-colonization (regeneration) and mortality rates will be recorded.

The data obtained will be compared to a reference monitoring grids, which will serve as standards of comparison and to asses whether the mitigation site have been successfully restored. In general, reference monitoring grids shall be located in naturally revegetated areas with similar vegetation, and be representative of the geology, soil, slope, elevation, precipitation and community types as those found in the mitigation area. In addition, the reference and mitigation areas will not be separated by too great a distance.

Quantitative characteristics, obtained by the permanent quadrat method, indicating number of individuals, their sizes and the space they occupy will be analyzed. Plant species lists and descriptive statistics for each vegetation type will be presented in annual reports.

Wildlife Monitoring

Wildlife use of the mitigation site will be monitored to determine and document the value of the restored area as enhancement to wildlife habitat. The primary objective of the wildlife monitoring program will be to relate bird use to habitat availability on and adjacent to the mitigation site. Data will be collected only on bird populations because they represent the most numerous and most visible wildlife found in the Carmel River Valley. Observations of amphibians, reptiles, insects and mammals will be recorded if encountered during monitoring visits. Samples will be collected in December to characterize winter populations; spring sampling will be conducted in April, May and June to document use by breeding species, late winter residents and spring migrants. Direct count of birds on each monitoring grid (see vegetation monitoring) will be recorded using the method described below.

Bird counts will be conducted within 2-3 hours of sunrise. To minimize the effect of disturbance by the observer, the observer shall move quietly and remain out of view of the birds. The observer shall move systematically through the entire grid such that every part shall receive equal coverage. When a bird or flock of birds are encountered, the species, number of individuals, location, habitat use and activity are recorded. Maps illustrating the location of vegetation types and grid cells will be used to identify the location and vegetation type being used.

Soil Attributes Monitoring

Soil characteristics, including salinity levels, pH values, organic matter content and soil structure will be analyzed by laboratory method. Soil samples will be gathered from permanent monitoring stations that will be established in each monitoring grid.

To obtain information on environmental conditions that can be correlated to the newly installed vegetation, data on several parameters, including elevation, aspect, slope, topography, soil moisture status, depth to water table and distance to the surface water (Carmel River channel) will be recorded.
The results of this soil monitoring data will be used to assess the management of the mitigation area and to document the changes in the physical and chemical character of the soil throughout the life of the monitoring period.

Groundwater Characteristics Monitoring and Piezometer Installation

The success of the establishment of riparian habitat at the mitigation site is dependent upon the physical and chemical characteristic of the groundwater. Groundwater monitoring wells (piezometers) will be installed within the monitoring grids and periodic data will be collected and analyzed.

Data will be collected on depth to groundwater underlaying the mitigation area, seasonal groundwater fluctuations and laboratory chemical analysis of groundwater samples to determine levels of concentrations of TDS (total dissolved solids) found. The information gained from this groundwater monitoring shall be used to assess the management needs of the mitigation area.

Recreation Use Monitoring

Recreation use on and around the mitigation area will be monitored to determine types of use on or adjacent areas of the mitigation site, number of users, duration of use and effects of use on the restored area and its resources. Special attention shall be given to evidence that human use had affected the newly created habitats. Qualitative data will be collected during any project related site visits. The following recreation activities will be recorded systematically: (1) hiking, (2) picnicking, (3) wildlife observation and (4) other activity.

Photo Monitoring

The objective of this monitoring task is to use photographs (1) for permanent record keeping and to aid in the selection of sample sites, (2) to monitor change in the shape of the mitigation area and (3) to document changes in the habitat development, types and distribution. Existing areal photographs taken before and after the implementation of the restoration project will be assessed. Periodically, ground level photography and slides will be taken from permanent photo points and fixed compass orientation at approximately 5.5 feet above ground level.

PERFORMANCE STANDARDS

Well defined performance standards are established to provide success criteria that will establish the degree to which the goals of the mitigation plan are satisfactorily met. Performance standards will be based on initial measurements to be taken from the reference site, thereby establishing "target" habitat conditions. These target habitat conditions, with examples of the community types, different types of ranges, the varying conditions under which they may exist, the specific stands of vegetation and the wildlife habitats they support will be adequately documented. Based on this information, the performance standard for the mitigation project will be established.

In general, the performance standard for newly planted woody vegetation (trees and shrubs) will be set at a 10 percent annual mortality rate for each monitoring year. The overall survival rate of 50 percent, five years from initial planting, shall be the success criteria. Each planting area shall maintain a minimum survival density of one tree per 1,000 square feet, or that area will be replanted, even when the overall survival standards outlined above are met.

If these objectives are not met, the cause of failure to meet the performance standards will be determined and the lost plants will be replaced each year until the objectives are achieved.

The performance standard for the groundcover (herbs) vegetation at the mitigation site will be dominance (greater than 90 percent) in both cover and species composition by obligate riparian species at the end of the five monitoring years. Percent cover and species composition will be determined using the permanent quadrat methods described above. If these objectives are not met, the causes of failure to meet the performance standards will be determined and the lost plants will be replanted with appropriate species until the objectives are met.

MONITORING REPORTS

Annual monitoring reports will be prepared by MPWMD for subsequent submittal to resource agencies. These reports will contain the monitoring results, present summary of data analysis findings, make recommendations for remedial actions to be taken and will evaluate the results with respect to meeting the performance standards.

A final monitoring report will be prepared at the end of the five-year monitoring period. It will include a summary of all the previous years' monitoring results, a detailed analytical treatment of the available data, an assessment of the monitoring program, and will make conclusions and recommendations.

COST ESTIMATES

Preliminary cost estimates have been prepared for the various mitigation project sizes relating to the eight project alternatives that would require mitigation. These cost estimates are considered reasonable approximations of actual costs that would be incurred for project construction in 1990. The numbers are purposely conservative, that is costs are likely to be lower than those shown, and are based on rough material take-offs. Once a specific project has been selected and a full HEP conducted, a final Riparian Habitat Mitigation Plan may be prepared with detailed designs, complete material take-offs, construction specifications, and more accurate cost estimates.

Table 4 summarizes the mitigation plan cost estimates for each project alternative. The estimated cost per acre ranges from $18,600 to $33,600 including land acquisition costs based upon the draft agreement between the MPWMD and the MPRPD. These estimates are only for project construction and do not include operation and maintenance costs. Operation and maintenance costs have been roughly estimated as follows: $45,000 per year for the smaller projects, and up to $90,000 per year for the 23,000 AF New San Clemente alternative. These O & M costs include full and part-time personnel, replacement plant material costs, and irrigation system maintenance costs. The cost of hiring consultants to perform the habitat evaluation and wildlife census are not included.

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APPENDIX 11-A

OZONE HOURLY AVERAGES EXCEEDING STATE OR FEDERAL AMBIENT AIR QUALITY STANDARDS

	Salinas		Monterey		Aptos		Hollister		Scotts Valley		Carmel Valley		Santa Cruz II		Gonzales		Davenport	
Year	Days	Hours	Days	Hours	Days	Hours	Days	Hours	Days	Hours	Days	Hours	Days	Hours	Days	Hours	Days	Hours
Hourly Average of Greater Than 0.09 ppm (State Standard)																		
1978	7	10	0	0	1	1	4	13	0[1]	0	–	–	–	–	–	–	–	–
1979	0	0	0	0	0	0	3	3	–	–	0[2]	0	–	–	–	–	–	–
1980	1	3	1	1	4	9	12	32	5[1]	8	4	10	–	–	–	–	–	–
1981	0	0	0	0	0	0	7	24	3	3	0	0	–	–	–	–	–	–
1982	0	0	1	1	0	0	1	1	0	0	0	0	–	–	–	–	–	–
1983	0	0	0	0	1	1	4	9	–[1]	–	1	2	–	–	–	–	–	–
1984	0	0	0	0	0	0	6	8	–	–	1	1	–	–	–	–	–	–
1985	0	0	–	–	–	–	11	20	–	–	1	2	2	6	–	–	–	–
1986	0	0	–	–	–	–	1	1	–	–	0	0	0	0	0[3]	0	–	–
1987	0	0	–	–	–	–	7	15	–	–	0	0	0	0	0	0	0	0
1988	0	0	.	.	.	.	4	5	.	.	0	0	0	0	0	0	0	0
1989	0	0	.	.	.	.	1	1	.	.	3	7	0	0	.	.	1	2
Hourly Average Greater Than 0.12 ppm (Federal Standard																		
1978	0	0	0	0	0	0	0	0	0[1]	0	–	–	–	–	–	–	–	–
1979	0	0	0	0	0	0	0	0	–	–	0[2]	0	–	–	–	–	–	–
1980	0	0	0	0	0	0	1	3	0[1]	0	1	2	–	–	–	–	–	–
1981	0	0	0	0	0	0	2	4	0	0	0	0	–	–	–	–	–	–
1982	0	0	0	0	0	0	0	0	0	0	0[1]	0	–	–	–	–	–	–
1983	0	0	0	0	0	0	0	0	–	–	0	0	–	–	–	–	–	–
1984	0	0	0	0	0	0	0	0	–	–	0	0	–	–	–	–	–	–
1985	0	0	–	–	–	–	0	0	–	–	0	0	0	0	–	–	–	–
1986	0	0	–	–	–	–	0	0	–	–	0	0	0	0	0	0	–	–
1987	0	0	–	–	–	–	0	0	–	–	0	0	0	0	0	0	0	0
1988	0	0	.	.	.	.	0	0	.	.	0	0	0	0	0	0	0	0
1989	0	0	.	.	.	.	0	0	.	.	1	1	0	0	.	.	0	0

[1] Closed 3/16/78, reopened 7/1/80, closed 9/30/82.
[2] Closed 3/31/76, reopened 3/7/79.
[3] Opened 9/86.

APPENDIX 11-B

RECORDED VIOLATIONS OF THE PM_{10} CALIFORNIA AAQS IN THE NORTH CENTRAL COAST AIR BASIN 1986 THROUGH 1989

Station	Date	Concentration (ug/m^3)
Hollister	February 25, 1986	52
Santa Cruz	April 21, 1987	58
Salinas	June 2, 1987	52
Santa Cruz	September 6, 1987	54
Hollister	September 6, 1987	50
Salinas	September 18, 1987	52
Santa Cruz	September 30, 1987	52
Hollister	September 30, 1987	58
Santa Cruz	October 6, 1987	82
Salinas	October 6, 1987	54
Hollister	October 18, 1987	53
Santa Cruz	November 11, 1987	52
Santa Cruz	January 26, 1988	50
Santa Cruz	August 25, 1988	56
Santa Cruz	September 30, 1988	52
Santa Cruz	October 30, 1988	50
Salinas	December 5, 1988	51
Hollister	December 5, 1988	58
Santa Cruz	December 5, 1988	64
Hollister	January 28, 1989	58
Santa Cruz	June 21, 1989	51
Salinas	June 21, 1989	54
Salinas	December 12, 1989	51
Salinas	January 5, 1990	56

Source: MPUAPCD

APPENDIX 11-C

CONSTRUCTION ACTIVITIES

Alternative	Acres Cleared	Paved Rd. From CV	Paved Rd. Within Project Area	Unpaved Rd. Within Project Area	Distance From Quarry	Volume Material Hauled	Volume Foundation Excavation	Volume Waste Hauled	RCC Placed (CY)	Steel (Tons)	Cement (Tons)
24 NLP	260	17	1	5	1.5	1,200,000	535,000	450,000	665,000	490	37,100
16 NLP/D	225	17	1	5	1.5	1,000,000	480,000	425,000	470,000	420	26,000
9 NLP/D	140	17	1	5	1.5	800,000	441,000	400,000	284,000	350	16,500
23 NSC	420	3.2	1	4	1	950,000	520,000	500,000	461,000	425	29,000
6 CAC/D	116	13	6	3	4.5	1,250,000	460,000	300,000	1,508,000 Earth Fill	1,000	4,000
11 SCC	340	3.2	4	3	1	1,100,000	640,000	700,000	510,000	700	32,500
10 CHU	200	3	2	3	2	2,026,000	431,000	400,000	2,100,000 Earth Fill	170	2,000
25 CAN	275	8	1	2	1	--	--	--	--	--	--

APPENDIX 11-D

MAJOR EQUIPMENT DELIVERIES TO THE PROJECT SITE

Cement:	Between 16,000 and 37,000 tons of cement must be hauled to the site from Salinas or San Jose which equates to between three and eight trucks per day during the 10-month construction period.
Structural Steel:	Between 170 and 1,000 tons of structural steel must be delivered to the site which is equivalent to between 0.7 and four truckloads per month during the construction period.
Lumber:	Some 50,000 board feet of lumber weighing about 112 tons would be needed for each alternative, which is about six truckloads.
Explosives Quarrying:	About 240 tons of dynamite would be needed during the excavation and quarrying. This would equal about one truck per month.
Mobilization Truck:	Mobilization for the construction phase of the project would involve many trips hauling in heavy equipment, the aggregate plant, the batch plant, the warehouses, trailers and other support facilities.
Fuel:	The operation of the diesel construction equipment will require about four fuel trucks per month for each project.
Wood:	Any merchantable wood including firewood would have to be hauled away from the project site. Assuming all of the clearing would be done in the first construction season, the amount of merchantable wood ranges from _______ to _______ tons. Assuming small private trucks were to haul the wood away this would equal about _____ trips per day over the six month clearing and grubbing period.

Note:

Certain projects have unique components. For example, San Clemente Creek and Chupines Creek would require materials for a pumping plant. It was also assumed that the actual truck trips would exceed those listed here by 20 percent.

APPENDIX 11-E

ACREAGE TO BE CLEARED FOR EACH ALTERNATIVE

Alternative	Reservoir Site	Acreage to be Cleared
24 NLP	24,000	260
16 NLP/D	16,000	225
9 NLP/D	9,000	140
23 NSC	23,000	420
6 CAC	6,000	116
11 SCC	11,000	340
10 CHU	10,500	200
25 CAN	25,000	275

Source: Bechtel, 1989; Converse, 1986.

APPENDIX 11-F

SUMMARY OF PARTICULATE EMISSION YIELDS REPORTED FROM WILDLAND FUELS

Fuel Type	Lab/Field Experiment	Particulates (lbs. per Ton of Fuel Burned) Type of Fire: Heading	Backing	Reference
Logging residues (Western)	Field	26-207		Sandberg (1974a)
	Laboratory		6-24	Sandberg (1974a)
	Field	=80		Radke et al (1978)
	Laboratory		4	Fritschen et al (1970)
Landscape refuse	Laboratory		24	Feldstein et al (1963)
Grassburning	Field		16	Bouebel et al (1969)
Live understory (Australia)	Field	14-40		Vines et al (1971)
	Laboratory	28-40		Vines et al (1971)
(Southern)	Field		15-30	Ward et al (1976)
	Laboratory		24-97	Ryan (1974)
Pine litter (Southern)	Field		45-55	Ward et al (1976)
	Laboratory		6-29	Ryan and McMahon (1976)
	Laboratory	22-125		Ryan and McMahon (1976)

APPENDIX 11-G

SUMMARY OF AVERAGE EMISSION FACTORS SUGGESTED FOR FOREST FUELS FOR CONSISTENCY

Geographic	Fuel Type	Particu-lates	Hydro-carbons	CO	SOx	NOx	Reference
Nationwide	Open burning						USEPA (1972)
	– Agric. field	17	20	100	Neg.	2	
	– Landscape	17	20	60	Neg.	2	
	– Wood	17	4	50	Neg.	2	
National	Prescribed burn	17	24	140	Neg.	4	Yamate (1973)
National	Prescribed burn	50					Ward et al (1976)
	Wildfires	150					
	Litter (backfires)	26-50					
	Logging debris	28-107					
Northwest	Prescribed burn	17-67	10-40	20-500	Neg.	2-6	Cook et al (1978)

Source: Sandberg, et. al., 1979.

APPENDIX 11-H

EMISSION FACTORS AND EMISSION ESTIMATES FOR OFF-SITE PAVED ROADS

Using Equation $e = k \frac{sL}{0.7}$

where e = emission factor, ib/VMT
k = base emission factor, ib/VMT
s = surface silt content
L = total road surface dust loading, g/ft
p = exponent, dimensionless

The roadway surfaces are divided into three categories:

Major streets/highways	sL = 0.516 g/ft
Collector streets	sL = 1.32
Local streets	sL = 2.02

The base emission factors and exponents are:

TSP	k = 0.0208	p = 0.9
PM_{10}	k = 0.0081	p = 0.8

Emission Factors:	TSP	PM10
Major streets/highways	0.016	0.0064
Collector streets	0.035	0.013
Local streets	0.053	0.018

APPENDIX 11-I

UNPAVED ROAD FUGITIVE DUST EMISSION FACTORS

Using the Equation $E = k(5.9) \; \frac{s}{12} \times \frac{S}{30} \times \frac{W^{0.7}}{3} \times \frac{w^{0.5}}{4} \times \frac{365\text{-}p}{365}$

where k = Particle size multiplier for PM_{10}=0.36 for TSP=1.0
s = Silt content of road surface, 10%
S = Mean vehicle speed, 20 mph
W = Mean vehicle weight, 15 tons
w = Mean number of wheels, 8 wheels
p = Number of days with at least 0 01 precipitation for this area, 50

Emission Factors: PM_{10}: 10.17 lbs/VMT

TSP: 28.25 lbs/VMT

APPENDIX 11-J

ESTIMATED VEHICULAR FUGITIVE DUST EMISSIONS

Off-Site Paved Roads[1]

Alternative TSP	PM$_{10}$ Car/Truck (VMT)	MAJOR Car/Truck (VMT)	COLLECTOR Car/Truck (VMT)	LOCAL Tons/Day	
24 NLP, 16 NLP/D, 9 NLP/D	20/70 (3050)	16/16 (1840)	36/36 (4140)	0.166	0.059
23 NSC	20/70 (3050)	16/16 (1840)	4/4 (460)	0.069	0.026
6 CAC/D	20/70 (2070)	16/16 (1616)	28/28 (3220)	0.130	0.046
11 SCC	20/70 (3050)	16/16 (1840)	4/4 (460)	0.069	0.026
10 CHU	20/70 (2070)	16/16 (1616)	6/6 (690)	0.063	0.023
25 CAN	12/72	8/8	N/A	0.024	0.009

On-Site Unpaved Roads[2]

Alternative Location	Unpaved Roads (Miles)	Vehicle Miles (Miles/Day)	PM$_{10}$ Tons/Day	TSP Tons/Day
24 NLP, 16 NLP/D, 9 NLP/D	5/1.5	300	1.526	4.238
23 NSC	4/1	200	1.017	2.825
6 CAC	3/1	175	0.890	2.472
11 SCC	3/1	175	0.890	2.472
10 CHU	3/3	500	2.543	7.062
25 CAN	3/1	175	0.890	2.472

[1]Assume 100 cars, 15 trucks for RCC dams. Assume 100 cars, 1 truck for Earthfill dams.

[2]Miles of unpaved roads within project area and length of haul from quarry are speculative at this point, without detailed investigations of potential borrow/quarry sites. These would probably represent worst case scenarios.

APPENDIX 11-K

EMISSION FACTORS FOR AGGREGATE PROCESSING

	TSP (Lbs/Tons)	PM_{10} (Lbs/Tons)	
Process Sources			
Primary Crushing (wet)	0.018	0.001	
Primary Crushing (dry)	0.28	0.017	
Open Dust Sources			
Screening (flat screens)	0.16	0.12	
Bulk Loading	0.056	0.0024	
Active Storage Piles			
– Active Day	13.2	6.3	lb/acre/day
– Inactive Day	3.5	1.7	lb/acre/day

APPENDIX 11-L

EMISSION ESTIMATES FOR STATIONARY SOURCES

Uncontrolled Aggregate Processing[3]

Alternative	Aggregate (CY)	Processed (Tons)	TSP (Tons)	PM_{10} (Tons)
24 NLP	1,200,000	2,400,000	616	178
16 NLP/D	1,000,000	2,000,000	510	148
9 NLP/D	800,000	1,600,000	410	118
23 NSC	950,000	1,900,000	488	141
6 CAC/D	1,250,000	2,500,000	625	177
11 SCC	1,100,000	2,200,000	565	163
10 CHU	2,026,000	4,050,000	1,010	285
25 CAN	N/A			

Concrete Batch Plant Operation[4]

Alternative	Amount RCC (CY)	Placed Particulate (Tons)	Emissions (Tons/Day)
24 NLP	668,000	66.8	(0.223)
16NLP/D	470,000	47.0	(0.15)
9 NLP/D	284,000	28.4	(0.095)
23 NSC	461,000	46.1	(0.154)
6 CAC/D	–	–	–
11 SCC	510,000	51.0	(0.170)
10 CHU	–	–	–
25 CAN	–	–	–

[3]Emissions calculated assuming dry crushing.
Storage pile sizes were estimated as follows: New San Clemente 5 acres, Chupines/Cachagua 1 acre, New Los Padres (24k) 6 acres, (9k) 4 acres, San Clemente Creek 5.5 acres.
For RCC dams assume 500 active, 120 inactive storage days. For Earthfill assume 800 active, 220 inactive.

[4]These estimates using EMFAC7C Emission Factors (0.20 lb/CY) which were estimated for normal concrete batch plant mix of 500 lb of cement per CY concrete. Since the majority of the emissions are from cement dust, and RCC mix only contains 100 lb of cement per CY of mix, these figures are too high by up to a factor of 5. The earthfill type dams will only require small amounts of concrete. Construction period assumed to be 10 months for RCC placement.

APPENDIX 11-M

POSSIBLE FUGITIVE DUST EMISSION REDUCTIONS BY SOURCE CATEGORY

Source		Category
(1) Off-Site Paved Roads	–	Transporting workers from a central staging area will reduce the dust emissions from vehicle movement over paved roads by an estimated 75 percent.
	–	Trucks delivering materials cannot be controlled.
(2) On-Site Paved Roads	–	Daily or greater waterings and weekly cleaning with a vacuum sweeper will yield a greater than 50 percent reduction and when combined by the reduced vehicle traffic from (1) above, the reduction should be on the order of 90 percent.
(3) On-Site Unpaved Roads	–	Sufficient watering to eliminate visible dust clouds during dry periods, probably at least twice daily, would yield an estimated 80 percent.
(4) Aggregate Processing	–	Spray systems at transfer points have been shown to be 70-95 percent effective.
	–	Spray systems at storage pile areas have been shown to be 80 to 90 percent effective.
	–	Chemical stabilization agents on inactive storage piles have been shown to be 95 percent effective.
(5) Concrete Batch Plant Operation	–	Using wet suppression techniques at appropriate points could yield an estimated 50 percent reduction in emissions.