

# Ventura River Watershed

# Management Plan



#### Prepared for

Ventura River Watershed Council www.venturawatershed.org info@venturawatershed.org 805/649-6852 x4

#### Prepared by

Lorraine Walter, Ventura River Watershed Coordinator

#### Preferred citation:

Walter, L. Ventura River Watershed Management Plan. Prepared for the Ventura River Watershed Council. March 2015.



The mission of the Ventura River Watershed Council is to facilitate and support efforts by individuals, agencies, and organizations to maintain and improve the health and sustainability of the Ventura River watershed for the benefit of the people and ecosystems that depend upon it.

# **Contents**

	Acknowledgments xix
	Executive SummaryxxviThe Watershed's StoryxxviiA Collective Management StrategyxxxiGoing ForwardxxxiiGoals and Core FindingsxxxiiThe Plan and the Processxxxviii
Part 1	About this Plan 1
1.1	Introduction 2
1.1.1	Watersheds and Watershed Management 3
1.1.2	Plan Organization 6
1.2	Ventura River Watershed Council 8
1.2.1	Participants 9
1.2.2 1.2.2.1 1.2.2.2 1.2.2.3 1.2.2.4	Mission Statement
1.2.3	Council Milestones 27
194	Council Funding

	1.3	The Planning Process	32
	1.3.1	Strengthen Organizational Capacity/ Ensure Committed Leaders	33
	1.3.2	Expand Stakeholder Involvement/ Gather Stakeholder Ideas	35
	1.3.3	Define Plan Purpose, Goals and Objectives, and Values	38
	1.3.4	Educate Participants/Compile Reference Information	39
	1.3.5	Characterize the Watershed	41
	1.3.6	Develop List of Projects and Programs	42
	1.3.7	Develop Implementation Strategy	42
	1.3.8	Approve the Plan	
		Implement the Plan	
Pai	rt 2	Watershed Plan.	
Paı	rt 2	Watershed Plan, Projects, and Programs	45
Pai			
Pai	2.1	Projects, and Programs	46
Pai	2.1	Projects, and Programs  Plan Guiding Framework	46
Par	2.1 2.1.1	Projects, and Programs  Plan Guiding Framework  Purpose and Values	46 47
Par	2.1 2.1.1 2.1.2	Projects, and Programs  Plan Guiding Framework  Purpose and Values  Goals, Objectives, and Findings	46 47 49
Par	2.1 2.1.1 2.1.2 2.1.2.1	Projects, and Programs  Plan Guiding Framework  Purpose and Values  Goals, Objectives, and Findings  Sufficient Local Water Supplies	46 47 49 50
Par	2.1 2.1.1 2.1.2 2.1.2.1 2.1.2.2	Projects, and Programs  Plan Guiding Framework  Purpose and Values  Goals, Objectives, and Findings  Sufficient Local Water Supplies  Clean Water  Integrated Flood Management  Healthy Ecosystems	46495056
Par	2.1 2.1.1 2.1.2 2.1.2.1 2.1.2.2 2.1.2.3	Projects, and Programs  Plan Guiding Framework  Purpose and Values  Goals, Objectives, and Findings  Sufficient Local Water Supplies  Clean Water  Integrated Flood Management  Healthy Ecosystems  Access to Nature	4649505660
Par	2.1 2.1.2 2.1.2.1 2.1.2.2 2.1.2.3 2.1.2.4 2.1.2.5 2.1.2.6	Projects, and Programs  Plan Guiding Framework  Purpose and Values  Goals, Objectives, and Findings  Sufficient Local Water Supplies  Clean Water  Integrated Flood Management  Healthy Ecosystems  Access to Nature  Responsible Land and Resource Management	46 49 56 60 63
Par	2.1 2.1.1 2.1.2 2.1.2.1 2.1.2.2 2.1.2.3 2.1.2.4 2.1.2.5	Projects, and Programs  Plan Guiding Framework  Purpose and Values  Goals, Objectives, and Findings  Sufficient Local Water Supplies  Clean Water  Integrated Flood Management  Healthy Ecosystems  Access to Nature  Responsible Land and Resource Management	464950566063
Par	2.1 2.1.2 2.1.2.1 2.1.2.2 2.1.2.3 2.1.2.4 2.1.2.5 2.1.2.6	Projects, and Programs  Plan Guiding Framework  Purpose and Values  Goals, Objectives, and Findings  Sufficient Local Water Supplies  Clean Water  Integrated Flood Management  Healthy Ecosystems  Access to Nature  Responsible Land and Resource Management	

2.3	Campaigns	. 92
2.3.1	The Campaign Approach	. 93
2.3.2	River Connections Campaign	. 95
2.3.2.1	The Issue	
2.3.1.2	Targets	. 96
2.3.2.3	Highlights from Existing Projects, Programs, and Practices	111
2.3.2.4	Proposed Projects and Programs	111
2.3.2.5	Organizations	113
2.3.3	Resiliency through Infrastructure and Policy Campaign	114
2.3.3.1	The Issue	
2.3.3.2	Targets	
2.3.3.3	Highlights from Existing Projects, Programs, and Practices	118
2.3.3.4	Proposed Projects and Programs	126
2.3.3.5	Organizations	129
2.3.4	Extreme Efficiency Campaign	130
2.3.4.1	The Issue	130
2.3.4.2	Targets	131
2.3.4.3	$\label{thm:lights} \mbox{Highlights from Existing Projects, Programs, and Practices} \ . \ .$	131
2.3.4.4	Planned Projects and Programs	134
2.3.4.5	Organizations	135
2.3.5	Watershed-Smart Landscapes and Farms	
	Campaign	
	The Issue	
2.3.5.2	Targets	
2.3.5.3	Highlights from Existing Projects, Programs, and Practices	
2.3.5.4	Proposed Projects and Programs	
2.3.5.5	Organizations	
2.3.6	Arundo-Free Watershed Campaign	
2.3.6.1	The Issue	
2.3.6.2	Targets	
2.3.6.3	Highlights from Existing Projects, Programs, and Practices	
2.3.6.4	Proposed Projects and Programs	
2.3.6.5	Organizations	153

	2.3.7	Healthy San Antonio Creek Campaign	154
	2.3.7.1	The Issue	154
	2.3.7.2	Targets	155
	2.3.7.3	Highlights from Existing Projects, Programs, and Practices	156
	2.3.7.4	Proposed Projects and Programs	165
	2.3.7.5	Organizations	166
	2.4	Complete List of Priority Projects	
		and Programs	. 168
	2.4.1	Priority Project and Program List Development	t . 169
	2.4.2	Priority Projects and Programs	171
Par	t 3	<b>Watershed Characteristics</b>	185
- u			100
	3.1	Overview and Quick Facts	. 186
	3.1.1	Quick Facts	188
	3.2	Physical Features	. 196
	3.2.1	Climate	197
	3.2.1.1	Climate Zones	
	3.2.1.2	Air Temperature	197
	3.2.1.3	Rainfall	199
	3.2.1.4	Local Climate Monitoring	207
	3.2.1.5	Key Data and Information Sources/Further Reading	208
	3.2.2	Geology and Soils	209
	3.2.2.1	Landform Zones	209
	3.2.2.2	Soils	219
	3.2.2.3	Petroleum	221
	3.2.2.4	Faults	222
	3.2.2.5	Geologic and Seismic Hazards	224
	3.2.2.6	Key Data and Information Sources/Further Reading	228

3.2.3	Geomorphology and Sediment Transport.	229
3.2.3.1	Sediment Production and Transport	229
3.2.3.2	Fluvial Geomorphology – Rivers Sculpting Landform	233
3.2.3.3	Impediments to Sediment Transport	237
3.2.3.4	Beach and Delta Sediments	239
3.2.3.5	Key Data and Information Sources/Further Reading	245
3.3	Hydrology	246
3.3.1	Surface Water Hydrology	247
3.3.1.1	Drainage Network	247
3.3.1.2	Streamflow	269
3.3.1.3	Surface Water Diversions, Dams and Reservoirs	288
3.3.1.4	Streamflow Monitoring	293
3.3.1.5	Key Data and Information Sources/Further Reading	296
3.3.2	Flooding	298
3.3.2.1	Flood Frequency and Intensity	299
3.3.2.2	Flood Hazard Zones	304
3.3.2.3	Types of Floods and Where They Occur	306
3.3.2.4	Flood Protection Infrastructure	323
3.3.2.5	Flood Monitoring	329
3.3.2.6	Key Data and Information Sources/Further Reading	330
3.3.3	Groundwater Hydrology	331
3.3.3.1	Unconfined and Confined Aquifers	334
3.3.3.2	Recharge and Discharge	
3.3.3.3	Groundwater Basins	341
3.3.3.4	Key Data and Information Sources/Further Reading	351
3.4	Water Supplies and Demands	354
3.4.1	Water Suppliers and Managers	355
3.4.1.1	Types of Suppliers	355
3.4.1.2	Major Urban Water Suppliers	356
3.4.1.3	Mutual Water Companies	361
3.4.1.4	Private Wells and Diversions	362
3.4.1.5	Water Management Organizations	362
3.4.1.6	Key Data and Information Sources/Further Reading	364

3.4.2	water Supplies	365
3.4.2.1	Current Supply Sources	365
3.4.2.2	Potential Future Supply Sources	387
3.4.2.3	Supply Variability	391
3.4.2.4	Key Data and Information Sources/Further Reading	397
3.4.3	Water Demands	399
3.4.3.1	Current Water Demands	399
3.4.3.2	Future Water Demands	410
3.4.3.3	Water Demand Management	420
3.4.3.4	Key Data and Information Sources/Further Reading	427
3.5	Water Quality	428
3.5.1	Surface Water Quality	429
3.5.1.1	Surface Water Quality Impairments	429
3.5.1.2	Other Impairments	443
3.5.1.3	Stormwater Runoff	445
3.5.1.4	Key Waterbodies	447
3.5.1.5	Surface Water Quality Regulations	448
3.5.1.6	Surface Water Quality Monitoring	456
3.5.1.7	Key Data and Information Sources/Further Reading	461
3.5.2	Groundwater Quality	465
3.5.2.1	Groundwater Quality Regulations	
3.5.2.2	Water Quality by Basin	468
3.5.2.3	Nitrate	469
3.5.2.4	Groundwater Quality Monitoring	
3.5.2.5	Key Data and Information Sources/Further Reading	473
3.5.3	Wastewater Quality	475
3.5.3.1	Sewer Systems	476
3.5.3.2	Septic Systems	483
3.5.3.3	Key Data and Information Sources/Further Reading	484
3.5.4	Drinking Water Quality	485
3.5.4.1	Drinking Water Standards	485
3.5.4.2	Watershed Sanitary Surveys	486
3.5.4.3	Ordinances and Resolutions to Protect Lake Water Quality	487
3.5.4.4	Key Data and Information Sources/Further Reading	491

3.6	<b>Ecosystems and Access to Nature</b> 492
3.6.1.1 3.6.1.2 3.6.1.3 3.6.1.4 3.6.1.5 3.6.1.6	Habitats and Species493Upland Habitats496Wetland and Riparian Habitats502Sensitive/Special Status Habitat534Habitat Connectivity/Wildlife Movement537Species541Key Data and Information Sources/Further Reading555
3.6.2.1 3.6.2.2 3.6.2.3 3.6.2.4 3.6.2.5 3.6.2.6	Steelhead557Life History Highlights559Current Populations and Conditions560Recovery and Management578Steelhead Surveys and Monitoring587History of Steelhead and Fish Stocking591Key Data and Information Sources/Further Reading598
3.6.3	Matilija Dam Ecosystem Restoration Project 601
3.6.3.1 3.6.3.2	Matilija Dam Ecosystem Restoration Project Highlights 604 Key Data and Information Sources/Further Reading 611
3.6.4	Access to Nature 612
3.6.4.1 3.6.4.2 3.6.4.3	Inventory of Nature-Based Recreation Facilities and Activities
3.7	Land Use and Demographics 656
3.7.1	Political Boundaries and Communities 657
3.7.2.1 3.7.2.2 3.7.2.3 3.7.2.4	Demographics659Population659Employment and Income663Housing665Key Data and Information Sources/Further Reading666
3.7.3	Land Use 667
3.7.3.1 3.7.3.2	Agriculture
3.7.3.3	Protected Lands
3.7.3.4 3.7.3.5	Local Land Use Policies

# Part 4 **References and Supporting Materials**

699

4.1	Acronyms	700
4.2	Glossary	705
4.3	References	712
4.4	Appendices	730
4.4.1	Plan Public Scoping Meeting Summary, October 3, 2012	731
4.4.1.1	Best Ideas	
4.4.1.2	Biggest Concerns	740
4.4.1.3	Questions	
4.4.1.4	Public Scoping Meeting Outreach	746
4.4.2	Tier 1S and Tier2 Projects and Programs	747
4.4.3	Rainfall Data: 1873 to 2012	755
4.4.4	Water Year Types Based on Runoff at Foster Park	760
4.4.5	Our Most Damaging Flood: 1969	762
4.4.6	Foster Park Monthly Streamflow	765
4.4.7	Past Floods In Brief	768
4.4.8	Storm Event Peak Flows at Foster Park: 1933-2013	773
4.4.9	Ventura River Mainstem Flood Risk Areas	778
4.4.10	Robles Diversion Data	780
4.4.11	Ongoing Surface Water Quality Monitoring Programs in Ventura River Watershed	782
4.4.12	Southern California Steelhead DPS Recovery Action Table for Ventura River Sub-Watersheds	784

4.4.13	Summary of Historical Fish Stocking 7	'87
4.4.14	Other Local Water- and Watershed-Related	
	Plans 7	'89
4.4.14.1	General	<sup>7</sup> 89
4.4.14.2	Water Supply 7	'90
4.4.14.3	Water Quality 7	'91
4.4.14.4	Flood Management 7	<sup>7</sup> 92
4.4.14.5	Resource Management/Ecosystem Protection 7	<sup>7</sup> 92
4.4.14.6	Public Access Plans	'95
4.4.14.7	Hazard/Emergency Response Plans 7	'96
4.4.14.8	Watershed Management Plans (surrounding watersheds) 7	'97

# **List of Figures**

Figure 3.1.1.1	Location Map	188
Figure 3.1.1.2	Subwatersheds Map	190
Figure 3.2.1.2.1	Historical Average Minimum and Maximum Temperature Dates: Matilija Dam - 1905–2011, Ojai - 1905–2012,	
	Oxnard - 1923-2003	198
Figure 3.2.1.3.1	Average Monthly Rainfall, 1906–2011 (Matilija Dam,	
	Ojai, Ventura)	200
Figure 3.2.1.3.2	Precipitation Map	202
Figure 3.2.1.3.3	Ojai Historical Rainfall	203
Figure 3.2.1.3.4	Effects of El Niño on Rainfall in Ventura.	204
Figure 3.2.1.3.5	Wet and Dry Periods in the Ventura River Watershed, 1892–2013	205
Figure 3.2.2.1.1	3D Watershed Map	
- Figure 3.2.2.1.2	Elevation Map	
Figure 3.2.2.1.4	The Monterey Formation Map	214
Figure 3.2.2.1.5	Geology Map	215
Figure 3.2.2.2.1	Soils - Hydrologic Groups Map	220
Figure 3.2.2.4.1	Major Faults Map	223
Figure 3.2.2.5.1	Liquefaction Potenial Map	226
Figure 3.2.3.1.1	Alluvial Fans Map, East Ojai Valley	232
Figure 3.2.3.4.1	Santa Barbara Littoral Cell	240
Figure 3.3.1.1.1	Drainage Network Map	248
Figure 3.3.1.1.2	Ventura River Dry Reach	252
Figure 3.3.1.1.3	San Antonio Creek Subwatershed Map	263
Figure 3.3.1.2.1	Where the Rain Went, 1997–2007	270
Figure 3.3.1.2.2	Gaining and Losing Streams	271
Figure 3.3.1.2.3	Map of Wells in Upper Ventura River Basin	273
Figure 3.3.1.2.4	Effects of Pumping on an Unconfined Aquifer that Discharges to a Stream	276
Figure 3.3.1.2.5	Where Streamflow Went, 1997-2007	
Figure 3.3.1.2.6	Monthly Average Streamflow at Foster Park,	
	Water Years 1930-2013	280

Figure 3.3.1.2.7	Annual Average Streamflow at Foster Park, Water Years 1930–2013	. 281
Figure 3.3.1.2.8	Average Streamflow at Foster Park, June-September, Water Years 1960-2012	. 281
Figure 3.3.1.2.9	Cumulative Distribution of Daily Average Flows at Foster Park, Sept. 1926–Oct. 2012	. 284
Figure 3.3.1.2.10	Total Annual Streamflow Volume and Ojai Rainfall, Water Years 1930–2012	. 284
Figure 3.3.1.2.11	Flood Hydrograph at Foster Park, December 2004 to January 2005	. 286
Figure 3.3.1.3.1	Median Number of Days of Water Diversion via Robles Diversion & Median Volume of Water Diverted, Monthly: Water Years 1960–2013	. 291
Figure 3.3.2.1.1	Annual Peak Flow at Foster Park, 1933-2013	. 299
Figure 3.3.2.1.2	Select Flow Monitoring Locations Map	. 302
Figure 3.3.2.2.1	Repetitive Loss Structures Map	. 304
Figure 3.3.2.2.2	Flood Hazard Zone Map	. 305
Figure 3.3.2.3.1	1969 Flood Damages Map	. 311
Figure 3.3.2.3.3	East Ojai 100-Year (1% AEP) Floodplain Map	. 313
Figure 3.3.2.3.4	Casitas Dam Evacuation Map	. 322
Figure 3.3.2.4.1	Levees in the Ventura River Watershed Map	. 324
Figure 3.3.2.4.2	Dams and Debris Basins Map	. 327
Figure 3.3.2.5.1	VCWPD's Advanced Hydrologic Prediction System Website	. 329
Figure 3.3.3.1	Groundwater Illustrated	. 332
Figure 3.3.3.2	Groundwater Basins Map	. 333
Figure 3.3.3.1.1	Unconfined and Confined Groundwater Aquifers	. 335
Figure 3.3.3.2.1	Aquifer Recovery, March-April 2014, Ventura River Water District Well #2	. 338
Figure 3.3.3.2.2	Groundwater Level and Streamflow, Water Years 2001–2014	. 339
Figure 3.3.3.2.3	Ojai Valley Basin Monitoring Well Hydrograph, 1949 to 2013	. 340
Figure 3.3.3.3.1	Map of Santa Ana Fault Crossing Ventura River	. 344
Figure 3.3.3.3.2	Ventura River, Robles Diversion to Foster Park, Summer Conditions	. 347
Figure 3.3.3.3.3	Comparison of Upper Ventura River Groundwater Conditions 1957–1958 (upper) and 1968–1970 (lower)	. 348
Figure 3.4.1.2.1	Major Urban Water Suppliers Map	. 357
Figure 3.4.1.2.2	Golden State Water Company Annual Water Use by Source	. 359
Figure 3.4.2.1.1	Average Annual Water Production by Source	. 365
Figure 3.4.2.1.2	Surface Water Key Infrastructure Map	. 366
Figure 3.4.2.1.3	Groundwater Basins Map	. 372

Figure 3.4.2.1.4	Wells in the Upper Ventura River Groundwater  Basin Map	375
Figure 3.4.2.1.5	Wells in the Ojai Valley Groundwater Basin Map	377
Figure 3.4.2.1.6	Wells in the Upper Ojai Groundwater Basin Map	378
Figure 3.4.2.1.7	Wells in the Lower Ventura River Groundwater Basin Map	379
Figure 3.4.2.1.8	Model of Lake Casitas During Repeat of Critical Dry Period	381
Figure 3.4.2.3.1	Average Monthly Rainfall, Ojai	391
Figure 3.4.2.3.2	Variation in Average Annual Runoff [by Water Year Types]	392
Figure 3.4.2.3.3	Volume of Water Diverted via Robles Diversion, Water Years 1960–2013	393
Figure 3.4.2.3.4	Minimum and Maximum Lake Casitas Storage Volume	394
Figure 3.4.2.3.5	Upper Ventura River Basin Monitoring Well Hydrograph, 1949–2013	394
Figure 3.4.2.3.6	Ojai Valley Basin Monitoring Well Hydrograph, 1949-2013	395
Figure 3.4.2.3.7	Upper Ojai Basin Monitoring Well Hydrograph, 1972–2013	395
Figure 3.4.2.3.8	Monitoring Well Locations Map	396
Figure 3.4.2.3.9	Ojai Basin Groundwater Model, 2014 Predictive Simulations	396
Figure 3.4.3.1.1	CMWD Water Deliveries by Month, 2010	400
Figure 3.4.3.1.2		
Figure 3.4.3.1.3	Per Capita Water Use, 1999-2009	403
Figure 3.4.3.1.4	Water Demand by Sector	409
Figure 3.4.3.2.1	CMWD Annual Water Deliveries, Water Years 1976–2013	411
Figure 3.4.3.2.2	CMWD Annual Water Deliveries and Rainfall, Water Years 1976–2013	412
Figure 3.4.3.2.3	VRWD Annual Groundwater Pumping, Fiscal Years 1989–2013	412
Figure 3.5.1.1.1	Water Quality Impairments Map	430
Figure 3.5.1.1.2	Total Nitrogen (TN) Contribution Estimated by Source	435
Figure 3.5.1.1.3	Average and Median E. coli Concentrations in the Watershed, 2001–2011	438
Figure 3.5.1.6.1	Surface Water Quality Monitoring Locations	457
Figure 3.5.2.1	Groundwater Basins Map	466
Figure 3.5.2.3.1	Maximum Nitrate Concentrations Observed in Wells, 1980-2008	471
Figure 3.5.3.1.1	Sewer and Septic Systems Map	477

Figure 3.5.4.3.1	Lake Casitas Protected Lands Map	490
Figure 3.6.1.1	Protected Lands Map	494
Figure 3.6.1.1.1	Vegetation Communities Map	497
Figure 3.6.1.2.1	Wetlands & Riparian Habitats Map	505
Figure 3.6.1.3.1	Critical Habitat Map	535
Figure 3.6.1.4.1	Regional Wildlife Corridors Map	540
Figure 3.6.2.2.1	Annual Peak Flow at Foster Park, 1933-2013 (Water Years)	563
Figure 3.6.2.2.2	Priority Barriers to Fish Passage Map	567
Figure 3.6.2.3.1	Steelhead Recovery Planning Area Map, Southern California Coast	579
Figure 3.6.3.1.1	Matilija Dam Ecosystem Restoration Project Design Features Map	608
Figure 3.6.3.1.2	Map of Arundo donax Infested Areas Prior to Removal Efforts	610
Figure 3.6.4.1.1	Los Padres National Forest Area Map	615
Figure 3.6.4.2.1	Trails & Recreation Areas – Map Detail Reference	633
Figure 3.6.4.2.2	Trails & Recreation Areas – Up Highway 33 [Detail Map 1]	634
Figure 3.6.4.2.3	Trails & Recreation Areas – Ojai Front Country [Detail Map 2]	639
Figure 3.6.4.2.4	Trails & Recreation Areas – Ventura River and Ojai Meadow Preserves (Detail Map 3)	
Figure 3.6.4.2.5		
Figure 3.6.4.2.6		
Figure 3.7.1.1	Government Jurisdictions Map	658
	Ventura River Watershed Location Map	
	Population Density Map	
Figure 3.7.2.1.2	Spanish Speaking Households Map	662
Figure 3.7.2.2.1	Median Household Income Map	664
Figure 3.7.3.1	Existing Land Uses Map	668
Figure 3.7.3.1.1	Agricultural Crops Map	671
Figure 3.7.3.1.2	Important Farmland Inventory Map	672
Figure 3.7.3.2.1	Oil Wells Map	682
Figure 3.7.3.3.1	Protected Lands Map	688
Figure 3.7.3.3.2	Land Conservancy's Areas of Interest Map	689
Figure 3.7.3.4.1	Ventura County Area Plans Map	692

# **List of Tables**

Table 2.2.1	List of Accomplishments, 2011 to 2013	31
Table 2.4.2.1	Tier 1L Priority Projects and Programs	71
Table 3.1.1.1	Ventura County's Major Watersheds18	38
Table 3.1.1.2	Quick Facts18	39
Table 3.2.1.2.1	Historical Average Minimum and Maximum Temperature 19	38
Table 3.2.1.2.2	Average Annual Temperature (°F)19	38
Table 3.2.1.3.1	Rainfall Average and Median (inches/year)20	)0
Table 3.2.2.5.1	Earthquake Magnitude and Exceedances within a 50-Mile Radius of Matilija Dam22	24
Table 3.2.2.5.2	Magnitude 7 and Greater Earthquakes within a 100-Mile Radius of Matilija Dam22	25
Table 3.2.3.4.1	Estimated Sediment Supply Delivered to the Coast from Rivers and Streams	/I O
	of the Santa Barbara Littoral Cell	12
Table 3.3.1.1.1	Summary of Primary Drainages in the Ventura River Watershed24	47
Table 3.3.1.2.1	Factors Affecting Streamflow	79
Table 3.3.1.2.2	Monthly Average Streamflow (cfs) at Foster Park, Water Years 1930–2013	30
Table 3.3.1.2.3	Storm Peak Flow Estimates Based on Modeling28	32
Table 3.3.1.2.4	Annual Average Streamflow at Foster Park, Water Years 1930–201328	33
Table 3.3.1.2.5	Annual Peak Flows at Foster Park, Water Years 1933-2013 28	33
Table 3.3.1.3.2	Diversion via Robles Diversion, Water Years: 1960-2013 29	91
Table 3.3.1.4.1	Streamflow Gauges in the Ventura River Watershed, 2013 29	94
Table 3.3.2.1.1	Ventura River Flood Flows Greater than 15,000 cfs, 1933–2011	00
Table 3.3.2.1.2	Presidentially Declared Major Flood Disasters in Ventura County	J1
Table 3.3.2.1.3	Flood Flows (cfs) by Flood Category on Various Drainages 30	
Table 3.3.2.1.4	Significant Coastal Floods in the Watershed	3
Table 3.3.2.3.1	Regulated Dams in the Ventura River Watershed 32	
Table 3.3.2.4.1	Levees in the Ventura River Watershed	25
Table 3.3.2.4.2	Debris Basins in the Ventura River Watershed	26

Table 3.6.3.1.2	Matilija Dam Removal Downstream Flood
	Mitigation Measures
Table 3.6.4.1.1	Public Preserves in the Ventura River Watershed 618
Table 3.6.4.1.2	Campgrounds
Table 3.6.4.1.3	Parks and Recreation Areas620
Table 3.6.4.1.4	Trails in the Watershed620
Table 3.6.4.1.5	Viewpoints
Table 3.7.2.1.1	Population
Table 3.7.2.2.1	Watershed Income Data, 2008 and 2012
Table 3.7.2.2.2	Jobs by Sector in the Watershed, 2012 665
Table 3.7.2.3.1	Housing Data, 2008 and 2012
Table 3.7.2.3.2	Ventura County 2014 Homeless Count Data 666
Table 4.4.1.1	Tier 1S Priority Projects and Programs
Table 4.4.1.2	Tier 2 Priority Projects and Programs
Table 4.4.3.1	Rainfall Data 1873-2012755
Table 4.4.1	Water Year Types Based on Annual Average Runoff at Foster Park760
Table 4.4.6.1	Monthly Mean Flow (cfs) near Foster Park (USGS Stream Flow Gauge # 11118500), Water Years 1930–2013
Table 4.4.8.1	Storm Event Peak Flows, Foster Park (Station 608), 1933–2013773
Table 4.4.10.1	Monthly Diversions at the Robles Diversion Facility, in Acre Feet by Water Year
Table 4.4.11.1	Ongoing Surface Water Quality Monitoring Programs in Ventura River Watershed782
Table 4.4.12.1	Southern California Steelhead DPS Recovery Action Table for Ventura River Sub-Watersheds
	(Monte Arido Highlands BPG)

# **Acknowledgments**

This Ventura River Watershed Management Plan was produced over the course of two and a half years under the direction of the Ventura River Watershed Council and represents the combined effort of numerous people and organizations. Many, many individuals contributed to the development of the plan in large and small ways. Those who played a central role over the course of the project are called out below in "Core Development Team," others are listed in "Technical Reviewers/Editors/Contributors."

This is your plan. Thank you!

# **Funding**

Development of this plan was funded by a California Department of Conservation Watershed Coordinator Grant and a US Bureau of Reclamation WaterSMART Cooperative Watershed Management Program Grant. Grant-matching funds were provided by Ventura County Watershed Protection District, City of Ventura, Casitas Municipal Water District, Ojai Valley Sanitary District, Ojai Valley Land Conservancy, Ventura Hillsides Conservancy, and Surfrider Foundation. The California Coastal Conservancy provided funding for development of a number of the plan's maps.

## **Core Development Team**

#### Leaders

**Lorraine Walter**, Ventura River watershed coordinator, managed the project, facilitated the planning process, and was the principal researcher, author, and photographer.

Lisa Brenneis, consultant, provided essential support throughout the plan's development. Lisa brought her "information architect" skills to the project, along with development editing, graphic design, photography, and layout skills. To the extent that the plan is interesting, clear, and comprehensible by lay readers, Lisa deserves the credit.

## **Technical Advisors**

Many people provided technical expertise on different parts of the plan, but several people remained "on call" as technical advisors throughout the entire plan's development.

**Al Leydecker**, PhD biologist, promptly responded to many technical questions on statistics, Excel charts, chemistry, water quality, climate, and so much more. He fixed charts, provided data, and explained many complex processes so they could be translated for a general audience.

**David Panaro**, professional geologist, answered questions on geology, groundwater basins, hydrology, faults, and the local water supply. He checked math, translated technical terms, and offered helpful Ventura County historical context.

**Paul Jenkin**, Surfrider Foundation, with his long history of work on behalf of the watershed, was always available to answer a question on some aspect of the watershed or its history.

### **Editors**

A few people provided detailed editing of many parts of the plan.

**Bruce Kuebler**, Ventura River Water District board member, edited each section with the eye of a pragmatic water supply manager and engineer. His questions and cautions pushed us to greater accuracy and balance.

**Bill O'Brien**, NexGen Engineering, offered technical review of many sections and his consistent, heartfelt belief in the plan's value.

Mary Kitschwar Logan, biologist and master editor, brought an exceedingly keen eye to our grammar, consistency, efficiency, and scientific terms.

**Ann Rosecrance**, chemist and upholder of precision, checked math, figure numbers, grammar, and made many useful and pragmatic suggestions.

**Jill Forman**, volunteer, was always available on short notice to give a section a quick check for punctuation, grammar, and common sense.

**Doug Adrianson**, editor, got us on the right track with his copyediting of early plan sections.

## Layout

**David Van Ness**, compositor extraordinaire, provided professional layout of the document. He graciously worked with a very short timeline, sending drafts in the wee hours of the night, or from Budapest, to keep on the schedule.

## **Photos**

The list of those who provided photographs for the plan is considerable. See the photo credits included with each image. With a few exceptions, photos without a credit were taken by Lorraine Walter.

**Santa Barbara Channelkeeper** deserves special thanks for providing a significant number of the photos in the plan. Snapshots taken during their many hours in local stream channels during all seasons of the year provided an eye on the watershed we would not otherwise have had.

**Shelah Wilgus** generously provided expert preparation of many photos for layout, as well as several photo-illustrated maps.

## Research/General Support

**Lauren Cole**, assistant, helped with research, editing, map development, and project coordination.

**Rosalie Schubert**, intern, helped with research and map development.

**Shirley Warren**, assistant, helped keep documents organized and indexed, and helped with various research tasks.

#### Administration

Ojai Valley Land Conservancy (OVLC), as host to the watershed coordinator during the plan's development, contributed essential administrative support services. Brian Stark, executive director, served as general advisor, software/technology support, GIS instructor, and counselor. Marti Reid, office manager, suffered through grant budget tracking and reporting. Many thanks to the enormous support and encouragement of all of the OVLC staff.

# Maps

Maps in the Ventura River Watershed Map Atlas series were produced by **Stephanie Ding**, GIS Specialist, with GreenInfo Network. Stephanie makes lovely maps, with considerable grace and patience.

# **Technical Reviewers/Editors/Contributors**

The following individuals contributed data, comments, technical input, perspective, analysis, research, or other resources to the plan's development.

\*Special thanks to these persons for their significant contribution to specific sections.

\*Mark Allen, Normandeau Environmental Consultants Emily Ayala, Friends Ranch

\*Arne Anselm, Ventura County Watershed Protection District

Russ Baggerly, Board member, Ojai Valley Groundwater Mgmt. Agency, Casitas Municipal Water District, Ojai Valley Sanitary District

Rick Bandelin, Ventura County Environmental Health

\*Mark Bandurraga, Ventura County Watershed Protection District

Mary Bergen, Board member, Casitas Municipal Water District

\*Shirley Birosik, Regional Water Quality Control Board – Los Angeles

\*Rick Bisaccia, Ojai Valley Land Conservancy

Elaine Blok, National Wetlands Inventory

Dana Bogdanich, Resource Conservation District of Ventura County

Kathy Bremer, Friends of Ventura River

\*Erin Brown, South Coast Habitat Restoration

Peter Brown, City of Ventura

\*Mark Capelli, National Marine Fisheries Service

Omar Castro, Ventura Water

Larry Catlett, Senior Canyon Mutual Water Company

Tully Clifford, Ventura County Watershed Protection District

\*Neil Cole, Casitas Municipal Water District

Jerry Conrow, Ojai Basin Groundwater Management Agency

Barbara Council, Ventura County Watershed Protection District

Alasdair Coyne, Keep the Sespe Wild

Diane Cross, US Forest Service, Ojai Ranger District

Christina Danko, biologist

\*Jeff Dorrington, Ventura County Watershed Protection District

\*Jenna Driscoll, Santa Barbara Channelkeeper

Dashiell Dunkell, Ventura Hillsides Conservancy

\*Diana Engle, Larry Walker and Associates

Greg Gamble, Ojai Valley Land Conservancy

Greg Grant, City of Ojai

Blair Greimann, US Bureau of Reclamation

Katie Haldeman, Resource Conservation District of Ventura County

Cynthia Hartley, Surfrider Foundation

Tom Hicks, Tom Hicks Attorney at Law

Laura Hocking, Ventura County Planning Division

Scott Holder, Ventura County Watershed Protection District

Mike Hollebrands, Meiners Oaks Water District

\*Brian Holly, *BioResource Consultants* 

Zia Hosseinipour, Ventura County Watershed Protection District

Anna Huber, R.A. Atmore & Sons, Inc.

Gerhardt Hubner, Ventura County Watershed Protection District

\*Lynn Jensen, Ventura County Coalition of Labor, Agriculture and Business

Gerard Kapuscik, Ventura County Watershed Protection District

Jordan Kear, Kear Groundwater

Steve Kennedy, Ventura County Fire Department

Jim Kentosh, Meiners Oaks Water District Board of Directors

Jeffrey Lambert, City of Ventura

Louise Lampara, Aera Energy

Mary Landis, Ventura Water

Evan Lashley, David Magney Environmental Consulting

\*Scott Lewis, Casitas Municipal Water District

Pam Lindsey, Ventura County Watershed Protection District

Theresa Lubin, Ventura County Parks Department

\*David Magney, David Magney Environmental Consulting

Murray McEachron, United Water Conservation District

Susan McMahon, Casitas Municipal Water District

Marty Melvin, Resource Conservation District of Ventura County
Karen Mendoza, Ventura County Watershed Protection District
Ron Merckling, Casitas Municipal Water District
\*Mary Meyer, California Department of Fish & Wildlife
Gregory Mongano, US Bureau of Reclamation

Jose Moreno, Ventura County Watershed Protection District

Kioren Moss, Moss & Associates

\*Ewelina Mutkowska, Ventura County Watershed Protection District
Jenny Newman, Regional Water Quality Control Board – Los Angeles
Brad Newton, Newton Geo-Hydrology Consulting Services
Steve Offerman, Ventura County Supervisor Steve Bennett's Office

\*Jeff Palmer, Ojai Valley Sanitary District
Tania Parker, Ojai Valley Land Conservancy

\*Ben Pitterle, Santa Barbara Channelkeeper

Derek Poultney, Ventura Hillsides Conservancy

Daniel Raducanu, California State Parks

\*Bert Rapp, Ventura River Water District

Bruce Rindahl, Ventura County Watershed Protection District

Charlie Robinson, US Forest Service, Ojai Ranger District

Lynn Rodriguez, Watersheds Coalition of Ventura County

Rene Roth, Ojai Valley Green Coalition

\*Susan Rungren, Ventura Water

\*Peter Sheydayi, Ventura County Watershed Protection District
Darrell Siegrist, Ventura County Environmental Health Division

\*Greg Schnaar, Daniel B. Stephens Associates

Ron Sheets, Ojai Valley Sanitary District

\*Bruce Smith, Ventura County Planning Division (retired)
Chris Stephens, Ventura County Resource Management Agency

Martha Symes, Ventura County Watershed Protection District

Melinda Talent, Ventura County Environmental Health Division

\*Jill Taylor, California Conservation Corps

Rod Thompson, Sisar Mutual Water Company

Brian Trushinski, Ventura County Watershed Protection District
Diane Underhill, Friends of Ventura River
CeCe Vandermeer, Ojai Valley Groundwater Management Agency
Sergio Vargas, Ventura County Watershed Protection District

\*Rick Viergutz, Ventura County Watershed Protection District

Gerald Weeks, Ventura County Public Works Transportation Division Jennifer Welch, Ventura County Planning Division

<sup>\*</sup>Karen Waln, Ventura Water

<sup>\*</sup>Steve Wickstrum, Casitas Municipal Water District

<sup>\*</sup>Mike Williams, Ventura Cattlemen's Association

Danielle Yaconelli, California Conservation Corps

Dale Zurawski, Farm Bureau of Ventura County