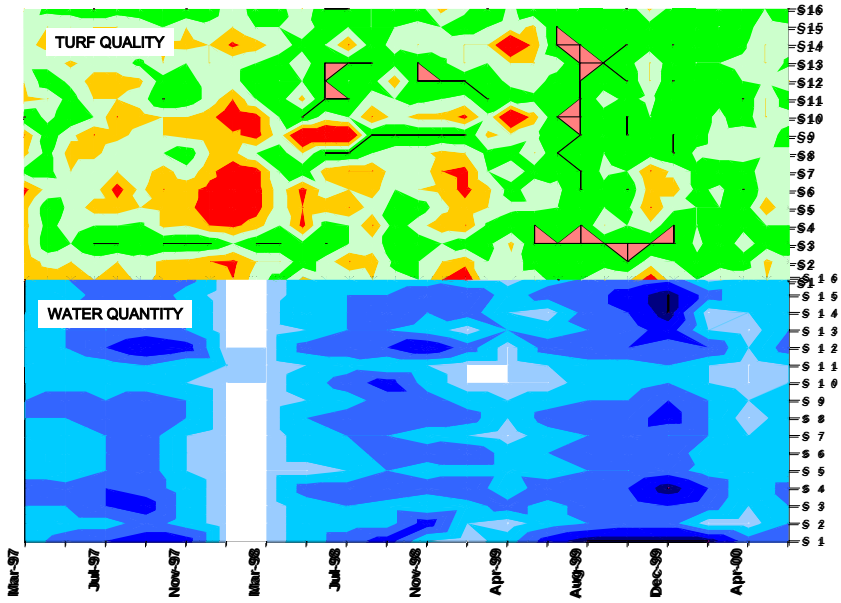
Letter Agreement No. 19139
for
Alternative Irrigation Scheduling Methods



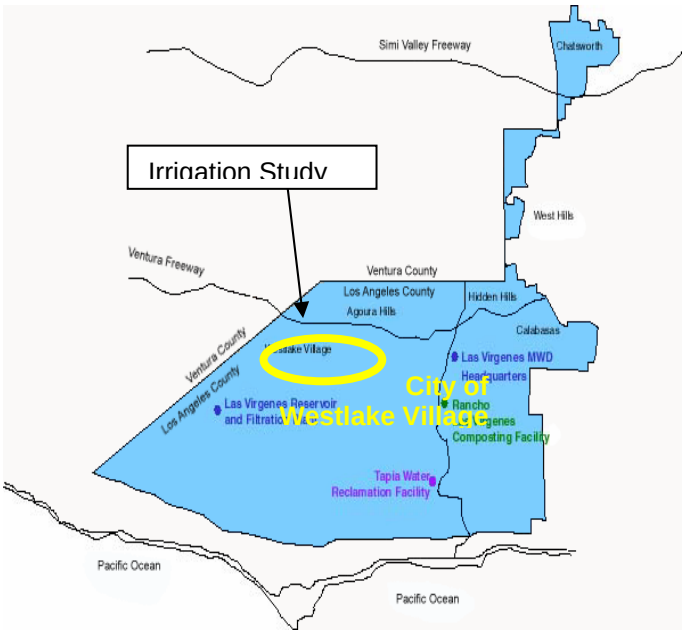
Final Report

Las Virgenes Municipal Water District
in Partnership with
Metropolitan Water District of Southern California

September 2000

EXECUTIVE SUMMARY

The purpose of this project was to compare the efficiency of four different irrigation scheduling techniques: (1) Soil Moisture Sensors (2) Atmometer (3) Reference Plant Evapotranspiration (4) Professional Judgment. Each method was used to irrigate 16 individually metered sites (4 replicates) in the City of Westlake Village. Turf quality was assessed each month by a panel of four-five independent observers.



The project had three phases. Phase 1 involved measuring each site and collecting 12 months water use data prior to the installation of new equipment and/or irrigation scheduling changes. It began in early 1996 and ran through early 1997. In Phase 2, irrigation controllers, environmental sensors and communications were installed. It began in early 1997 and ran through late 1999 due to equipment failures and repairs. Phase 3 (side by side comparison) began in late 1999 and continues.

Water use data highlight irrigation problems that may be (and probably are) typical of grassy road medians. Every site was found to be watered well-beyond actual ETo demands, apparently due to site topography (road medians with grassy crowns) and inappropriate irrigation equipment. Optimal turf quality typically required twice the water actually used by the turf (200% of ETo). Gutters adjacent to street medians take the excess water directly to storm drains, posing a challenge to cities trying to reduce urban runoff.

None of the irrigation scheduling methods proved useful in this regard, although all of the data-referenced methods (e.g. ETo data or soil moisture data) outperformed professional judgment. Soil moisture controlled scheduling is “blind” to irrigation runoff where over-application is necessary to achieve good coverage and penetration. ETo scheduling reduces water use, but underestimates actual plant demand where applied water runs off too quickly or is otherwise misapplied.

The study was interrupted in 1998 by new water quality regulations that prohibited the District from discharging surplus recycled water into Malibu Creek. To comply with these regulations, the district offered financial incentives to encourage recycled water use in spring and fall (thereby reducing the amount of surplus water that previously would have been sent to Malibu Creek). High water use during phase 2 and 3 may therefore be an artifact of these incentives.

INTRODUCTION AND PROJECT HISTORY

About 70 percent of the water served by the Las Virgenes Municipal Water District (LVMWD) is used outdoors for landscape irrigation (North American Residental End Use Study, 1998). The majority of this water is delivered by irrigation systems controlled by timers according to a user-defined schedule. Historically, these schedules are set based on professional judgement, but new tools are available that can either directly set irrigation controllers (e.g. soil moisture sensors) or inform professional judgment. This project was intended to study whether these new methods provide superior irrigation with respect to water conservation.

Appendix A provides a historical overview of the study. Project start-up took much longer than planned due to equipment failures, inconsistent cooperation with the City's landscape contractor, and conflicts with district staff workloads. Some of the equipment failures related to difficulties with the installation and reliable operation of the district's weather station, while others affected on-site equipment such as irrigation controllers and communications. Due to these delays, the district did not begin collecting test data until October 1999. These delays were somewhat mitigated by the fact that 1998 was an unusually wet year, which likely would have skewed the results in favor of the soil moisture sensor treatment.

A more serious problem affecting the project was the renewal of the district's NPDES permit for its water treatment facility. In November 1997 this permit was modified to prohibit the disposal of surplus recycled water in Malibu Creek. No time for compliance was allowed, and violations result in large fines. Therefore, the district had to take immediate steps to reduce the volume of surplus recycled water during the prohibition period (originally May 1 through October 31, later extended to April 15 through November 15). One of these steps was to encourage recycled water use through financial incentives. Users were notified that they would not be charged for any water use in excess of their 1997 baseline year usage. Public agencies in particular took full advantage of these incentives. This directly affected the water use in this study, since the City of Westlake Village owns all the sites.

METHODS

Sixteen street medians planted with turf were divided into four groups irrigated according to one of the following methods (2-4 are referred to as "data referenced" methods elsewhere in this report):

1. Professional Judgment by Landscape Contractor
2. ETo data provided by local weather station
3. Soil Moisture Sensor
4. ETo data provided by local Atmometer

Site locations, landscaped area, submeter locations, irrigation controller descriptions and other relevant irrigation system information are provided in Table 1. All sites were located in the City of Westlake Village (See map). The decision to use street medians as test sites was motivated by their relatively uniform character, which serves to reduce the confounding effects of extraneous variables. All the sites were managed by one owner (City of Westlake Village), which made the project easier to administer. However, the use of street medians had some unanticipated effects on water use (see discussion).

Despite their topographic similarities, many of the sites had sub-standard irrigation systems at the outset of the study, including broken and clogged fittings, dysfunctional controllers, and areas of irregular turf. Accordingly, all sites were brought to a more uniform standard with respect to irrigation heads, system tune, and new controllers. Turf quality was judged by an independent panel throughout the course of the study.

Water use was tracked by the installation of water submeters to each irrigated area with bi-monthly reading of the submeters by district customer service staff during their normal billing routes. For comparisons between sites and treatments, all water use data were converted to a percentage of ETo using average ETo values during each billing cycle. ETo data for this purpose were generated from the district's Calabasas weather station (http://www.lvmwd.dst.ca.us/cons/con3et.html).

Analysis of Variance (ANOVA) was used to identify significant variance in water use between sites within treatments. Student's T-Test was use to identify significant differences in mean water use between treatments. In every case the rejection criterion was based on $P<0.05$ for the probability of observing a particular difference by chance. Separate tests were performed for mean water use between sites (within groups) and between treatments (groups), before and after equipment installation. Statistical analysis by season was not done for post-installation trials due to the small dataset ($N = 3$, or three billing cycles covering January - June 2000).

All data collected during the study are provided in Appendices B and C. Statistical test results are provided in Appendix D.

RESULTS

WATER USE

Regardless of the irrigation method or the project phase (i.e. pre-installation versus post-installation), water use consistently exceeded need, averaging 170 percent of reference plant evapotranspiration (ETo) on an annual basis (Fig. 1). Variability in water use was also quite high throughout the study with the exception of those sites under local Atmometer control, which had no significant variability either before or after the test.

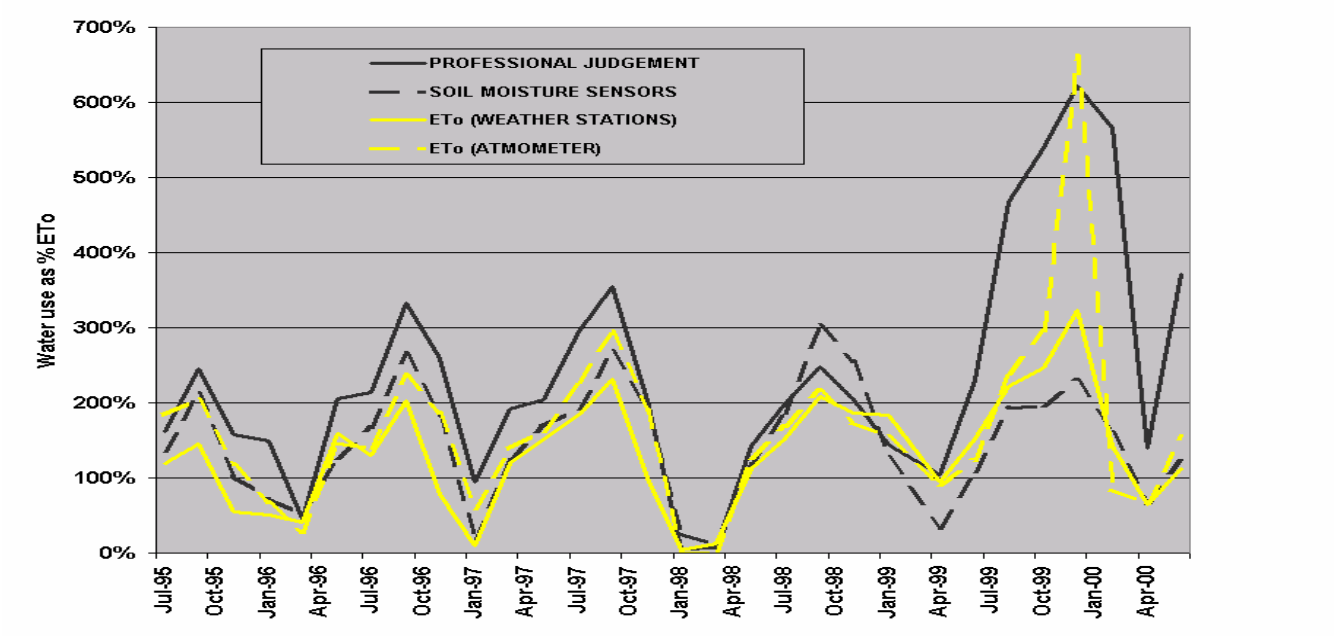


Figure 1. Overall Water Use During the Study as % of Plant ETo

Professional Judgment used significantly more water than any of the data-referenced[1] scheduling methods (Table 2 and 3). This result initially was thought to be due to unusually high water use in Site 5, one of the sites irrigated by Professional Judgment[2]. Site differences were then statistically tested (ANOVA), with significant differences found in Treatment 1 (Professional Judgment), Treatment 2 (Weather Station) and Treatment 3 (Soil Sensor) but not 4 (Atmometer). ANOVA was then applied to the Treatment 4 sites, testing the pre-installation variance against the post-installation variance. No significant difference was found, suggesting that the lower variance in water use should not be attributed to the post-installation irrigation method (Atmometer).

[1] Data referenced irrigation scheduling refers to controller adjustment by an operator using ETo information or other measure of water demand.
[2] Note that the sites were renumbered in the statistical analyses (appendices) for ease of calculation. Site 5 in the field became Site 1 in the analysis.

Given the variance between sites, water use statistics were calculated for each Irrigation Method with and without the highest water-using site in each treatment (Table 2). However, omitting the high use "outliers" did not affect the results; the order of relative water use *efficiency* remained ETo (weather station) > Soil Moisture Sensors > ETo (Atmometer) > Professional Judgment. When tested statistically, this order became ETo (weather station) = Soil Moisture Sensors = ETo (Atmometer) > Professional Judgment (Table 3).

Table 2. Water Use Comparisons. Note all sites prior to 2000 were irrigated by professional judgment. Each category is an average of four sites.

YEAR	BILLING PERIOD	IRRIGATION SCHEDULE METHOD			
		PROFESSIONAL JUDGEMENT	ETo - WEATHER STATION	SOIL MOISTURE SENSOR	ETo - ATMOMETER
1995	4	161%	120%	136%	184%
	5	246%	145%	212%	203%
	6	157%	54%	103%	118%
1996	1	150%	50%	73%	67%
	2	46%	41%	53%	28%
	3	205%	159%	126%	147%
	4	214%	130%	166%	139%
	5	333%	203%	265%	236%
	6	259%	78%	184%	186%
1997	1	95%	10%	18%	58%
	2	191%	120%	124%	139%
	3	204%	152%	169%	162%
	4	294%	184%	192%	227%
	5	355%	231%	268%	295%
	6	202%	100%	189%	191%
1998	1	6%	3%	26%	1%
	2	6%	12%	10%	0%
	3	142%	113%	118%	126%
	4	198%	152%	186%	169%
	5	248%	208%	303%	216%
	6	204%	187%	255%	174%
1999	1	144%	184%	127%	154%
	2	104%	95%	33%	90%
	3	231%	151%	108%	123%
	4	467%	222%	193%	238%
	5	540%	246%	196%	296%
	6	622%	323%	231%	661%
2000	1	566%	143%	160%	85%
	2	140%	64%	65%	66%
	3	371%	113%	122%	155%
Average Water Use		237%	118%	152%	159%
Standard Deviation		153%	63%	72%	72%
Average - Top Using Site Omitted		183%	119%	121%	151%
St. Dev. - Top Using Site Omitted		118%	76%	80%	111%
Average Turf Score (see text)		3.7	3.4	3.7	3.9

Table 3. Water Use Comparisons Before and After Equipment Installation. Note all Pre-Test sites were irrigated by professional judgment. NS=No significant difference.

T-TESTS UNEQUAL VARIANCE, 0.05 REJECTION CRITERIA			
PRE-TEST	SITES 1-4	SITES 5-8	SITES 9-12
SITES 1-4	-		
SITES 5-8	NS	-	
SITES 9-12	NS	NS	-
SITES 13-16	Sites 13-16 better	NS	NS
POST-TEST	PROFESSIONAL JUDGEMENT (Sites 1-4)	ETo WEATHER STATION (Sites 5-8)	SOIL MOISTURE SENSOR (Sites 9-12)
PROFESSIONAL JUDGEMENT (Sites 1-4)	-		
ETo WEATHER STATION (5-8)	ETo Better	-	
SOIL MOISTURE SENSOR (9-12)	Soil Sensor Better	NS	-
ETo ATMOMETER (13-16)	NS	NS	NS

Table 3 used all available data for the “pre-test” (1995 – 1999) comparisons. However, recognizing that these data include summer and fall months not available for the “post-test” phase, a separate analysis was run that was limited only to billing cycles 1-3 (which exclude the summer and fall months). No difference in the result obtained. A third analysis omitted all of the 1998 and equipment failures in 1999 that necessitated occasional switching back to professional judgment occasionally for sites 5-16. No difference in the result obtained.

TURF QUALITY

Turf quality generally improved at all sites during the study, although significant deterioration was observed between November 1997 and February 1998 (Fig. 2). Reference to the judging sheet comments found that the deterioration seen in late 1997 and early 1998 was due at least in part to scalping of the turf at sites 1-12 (November) and 1-16 (post-November through February). However, this period also coincided with a period of low water use (Fig. 3). Statistical tests between judges found no significant differences in their scores; the panel appeared to rank the sites consistently over the course of the study.

Fig. 2. Turf Quality as Assessed by an Independent Panel of 4-5 Judges

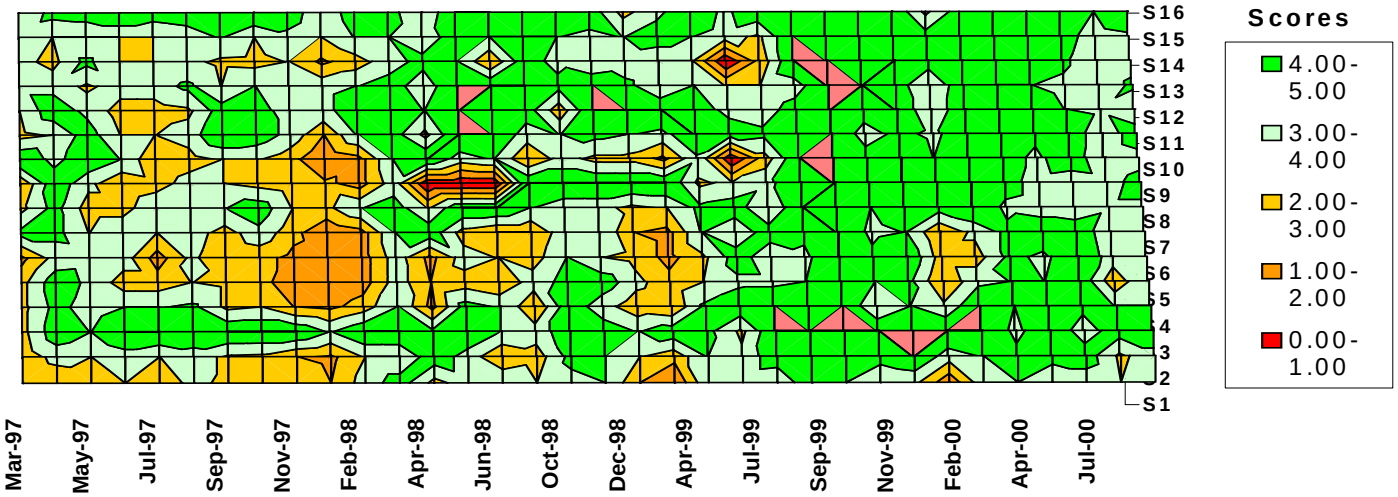
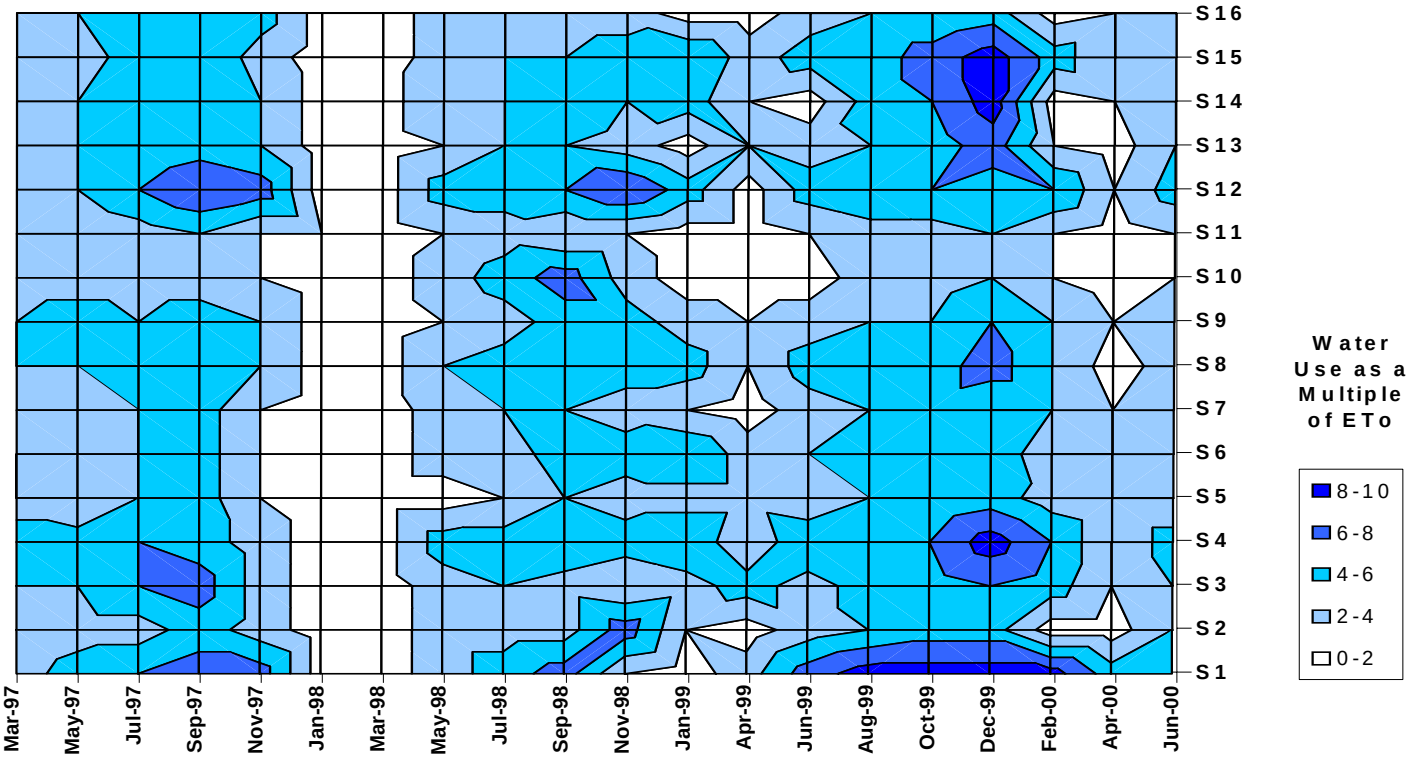
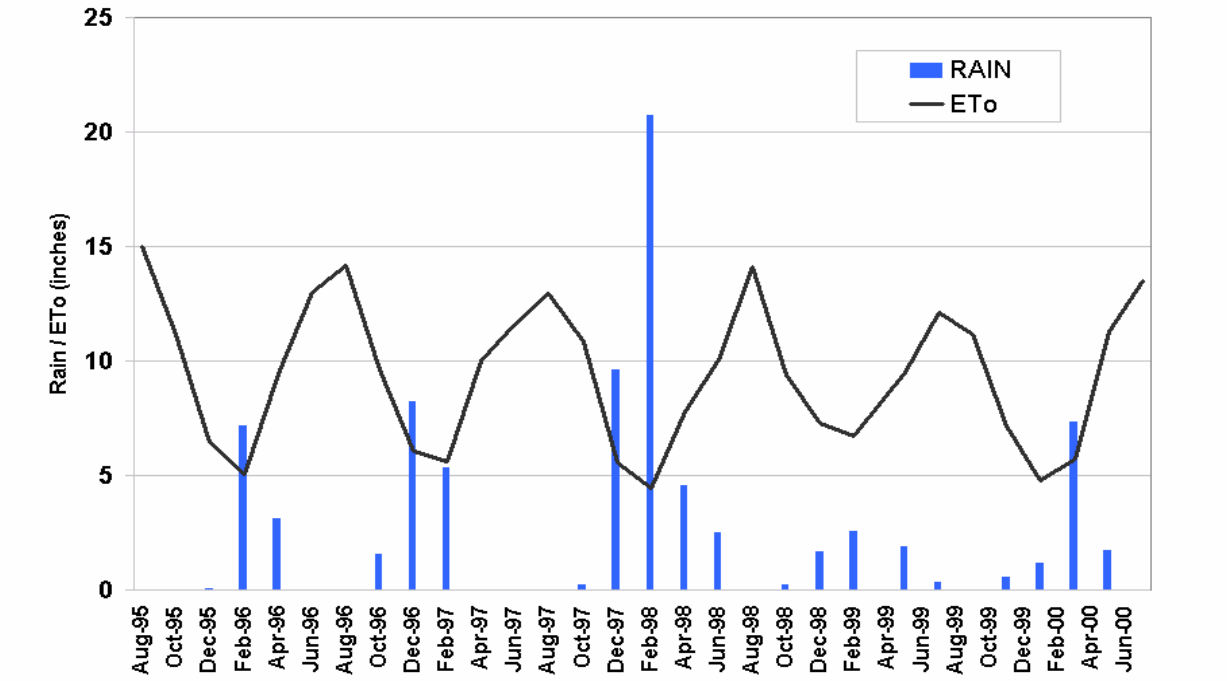


Fig. 3. Water Use as a Multiple of Plant Evapotranspiration (ETo). Each contour represents water use equivalent to 200% ETo.



The apparent under watering represented by the white areas in Figure 3 generally correspond to periods of rainfall (Fig. 4). Theoretically, soil moisture based irrigation should account for this natural irrigation better than the other methods. In practice, the data collected in this study were insufficient to test this.

Fig. 4. Rain events and Plant Evapotranspiration (ETo) during the study



DISCUSSION

Overall, water use appeared very high relative to plant water demand (ETo) at all of the test sites, both before and after the installation of alternative irrigation scheduling systems. This result was surprising, insofar as ETo controlled irrigation scheduling should not have allowed water use in excess of about 110% of ETo. Further investigation found that "ETo controlled" is somewhat of a misnomer. In practice, the linkage between fluctuations in ETo and irrigation is via a percentage adjustment feature on the irrigation controllers. If ETo drops by 20 percent, for example, then the controller reduces volume applied by 20 percent. True ETo based irrigation therefore requires that the actual baseline volume is calibrated to the actual volume required to supply ETo, which in turn is done by measuring the area irrigated and selecting an appropriate ET value for the specific plant species planted there. This was done at the outset of the study

for the ETo referenced test sites, but base flows apparently were reset by on-site managers at higher levels following data interruptions and equipment malfunctions

Another surprising finding was that this over watering did not result in significantly poorer turf quality. On the contrary, it improved with irrigation well in excess of 100% ETo. Further investigation finds that this was due to the irrigation system itself, i.e. much of the excess water was not reaching the turf. This is due to the character of the street medians themselves, specifically their “crown” topography. Water had to be applied in excess of ETo for it to reach the entire site. Other factors also played a role, including poor maintenance of the emitters (height adjustments, clogged or broken emitters, etc.) and infrequent supervision.

Each irrigation method has its pros and cons, some of which were highlighted in this study. For example, the use of weather-station derived ETo data on a website presumes that (1) landscape maintenance staff will download the data and set their irrigation controllers using the data, and (2) that this will be done frequently enough to realize a benefit (at least weekly). The use of atmometers presumes their reliability; in this study some atmometer-scheduled sites repeatedly reverted to professional judgment due to equipment problems. The Weather Station ETo system is fairly robust, insofar as data losses of up to several days can be tolerated given the day-to-day variation is on the order of a few percent (exceptions are when weather fronts pass through the area). However, efficiencies can only be realized if the base flows themselves are set to actual ETo demand, and not reset to some other baseflow during the year. Without this step, ETo controlled irrigation will merely adjust the baseflow in synchrony with ETo fluctuations. If the baseflow is 200 percent of ETo then these adjustments will fluctuate around this value.

It is hard to judge the impact on the study results from the “use more water” incentive program referred to in the Introduction and Executive Summary. On the one hand, these incentives were not offered throughout the term of the test phase (Jan 2000 through July 2000), so water use may have been affected only while discounted water was available. On the other hand, improved turf quality seen at most sites over the course of the study may reflect increased irrigation during the incentive program, even though these incentives were limited to spring and fall. Also, irrigation practices that were altered to take advantage of the incentive program may not have been reset to pre-incentive volumes even after the incentive program ended. This effect would be limited to the “landscape manager irrigated” test plots and those automated irrigation test plots that experienced automation failures (and thus were temporarily irrigated by manager judgment).

SUMMARY AND FUTURE DIRECTIONS

1. This study should not be viewed as a robust test of the four irrigation methods tested, due to the short test period (9 months), equipment malfunctions during the test period, and the potential confounding effects of an incentive program intended to encourage recycled water use.

2. Despite these difficulties, the study yielded the following useful information:

    a. Turf-planted street medians are good candidates for water savings. This study demonstrated remarkably inefficient water use, traceable to their crown topography coupled with spray emitters. This combination guarantees substantial runoff to achieve uniform saturation of turf. Remedies include subsurface irrigation with spray emitters reserved for hard to reach areas, coupled with a reverse-crown topography (swale). The proximity of street medians to gutters and storm drains presents a disproportionate impact on urban runoff, and this also argues for better care in their irrigation.

    b. Data referenced scheduling cannot be merely "grafted" onto an existing irrigation system. Spot checks by staff repeatedly found that irrigation controllers had been reset, soil moisture scheduling had been overridden, and baseflows reset at flows in excess of ETo. In some cases these operator adjustments were warranted given the nature of the particular site. ETo scheduling will under water planted areas served by inefficient irrigation systems.

    c. Even with an efficient irrigation layout and well-serviced equipment, ETo scheduling can still result in inefficient watering if the baseflow is incorrect. This could result from an inaccurate planted area calculation or the use of the wrong ETo value (e.g. misidentified plant species). Most ETo referenced scheduling is done by the percent adjust feature of irrigation controllers.

    d. The study highlights the need to better educate and motivate landscape maintenance contractors. Potential remedies suggested by this study include maintenance contracts that include penalties for over irrigation[3], action by regulatory agencies against property owners for urban runoff[4], and more automation to more closely couple irrigation to efficient watering indices such as ETo and soil moisture[5].

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[3] These have been used successfully in Orange County, California (Tom Ash, personal communication)

[4] Landscape runoff is conditionally exempt under current water quality regulations governing non-stormwater discharges to receiving waters. The condition is that they do not pose a significant risk of water quality impairment, and can be modified or revoked by the Executive Officer of the Regional Water Quality Control Board.

[5] Irvine Ranch Water District is piloting the use of new instrumentation to directly link irrigation controllers with ETo data from on-site weather stations.

APPENDICES

A. Study History

B. Water Use by Site and Date

C. Turf quality – Average Scores by Date and Site

D. Within Treatment ANOVA

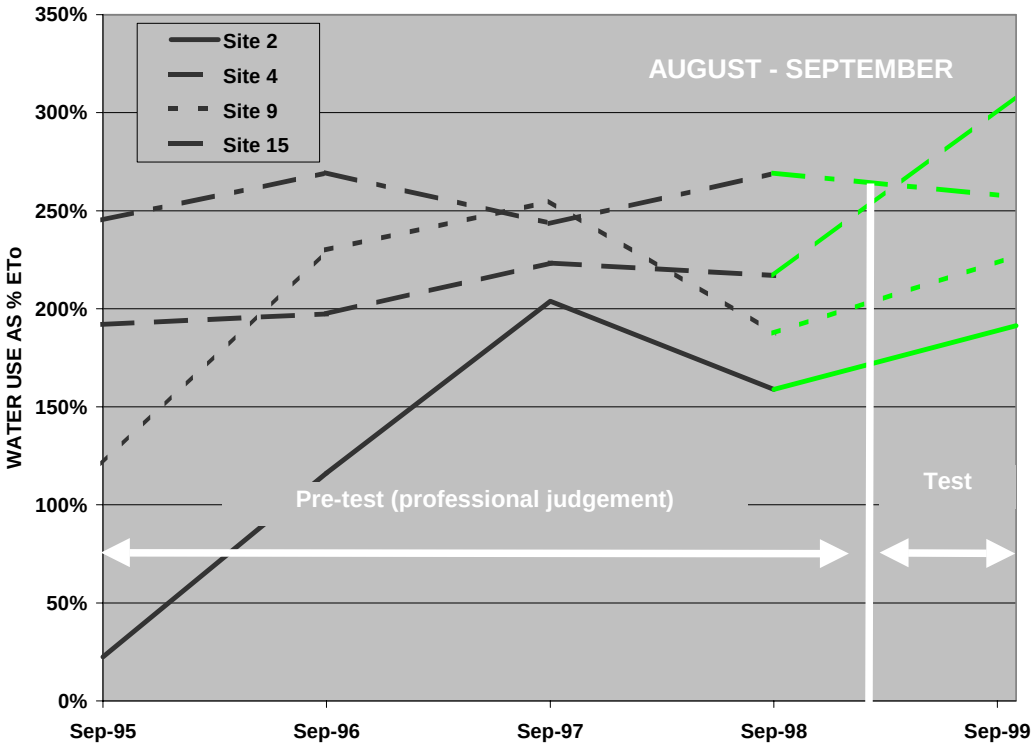
E. Professional Judgment vs Other Methods (ANOVA)

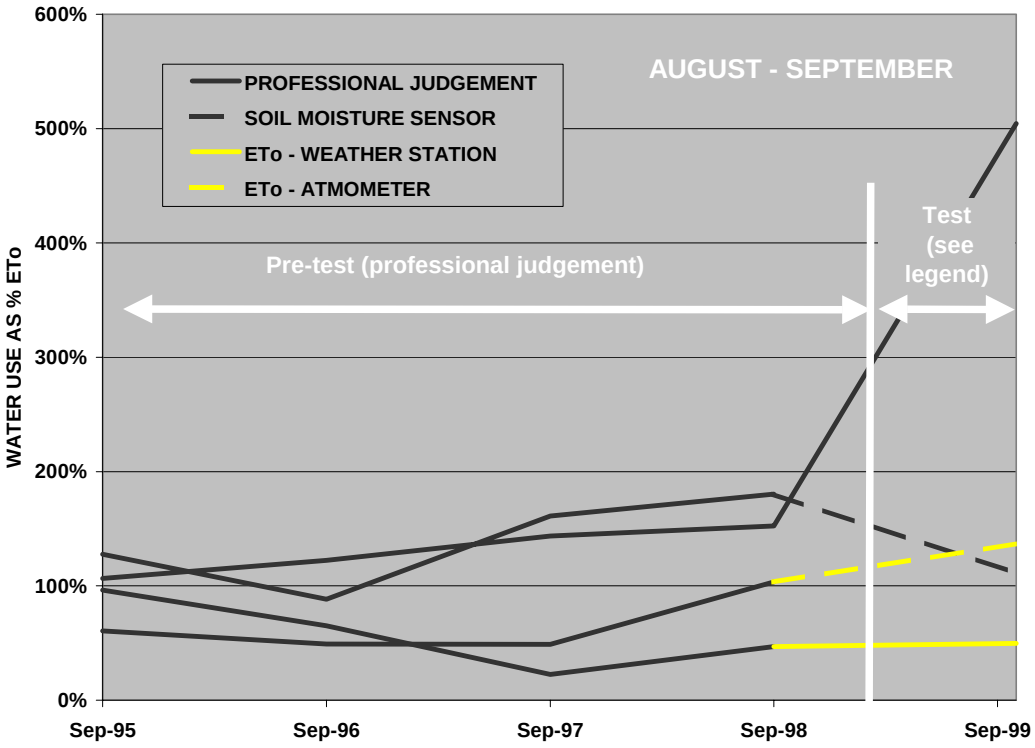
F. ETo Weather Station vs Other Methods (ANOVA)

(Note: ANOVA results for other comparisons are included in E and F)

G. August – September Water Use as ETo % (Graph)

H. January – February Water Use as ETo% (Graph)


350%
300%
250%
200%
150%
100%
50%
0%
WATER USE AS % ETo
Site 2
Site 4
Site 9
Site 15
AUGUST - SEPTEMBER
Pre-test (professional judgement)
Test
Sep-95
Sep-96
Sep-97
Sep-98
Sep-99


AUGUST - SEPTEMBER
PROFESSIONAL JUDGEMENT
SOIL MOISTURE SENSOR
ETo - WEATHER STATION
ETo - ATMOMETER
Pre-test (professional judgement)
Test (see legend)
WATER USE AS % ETo
600%
500%
400%
300%
200%
100%
0%
Sep-95
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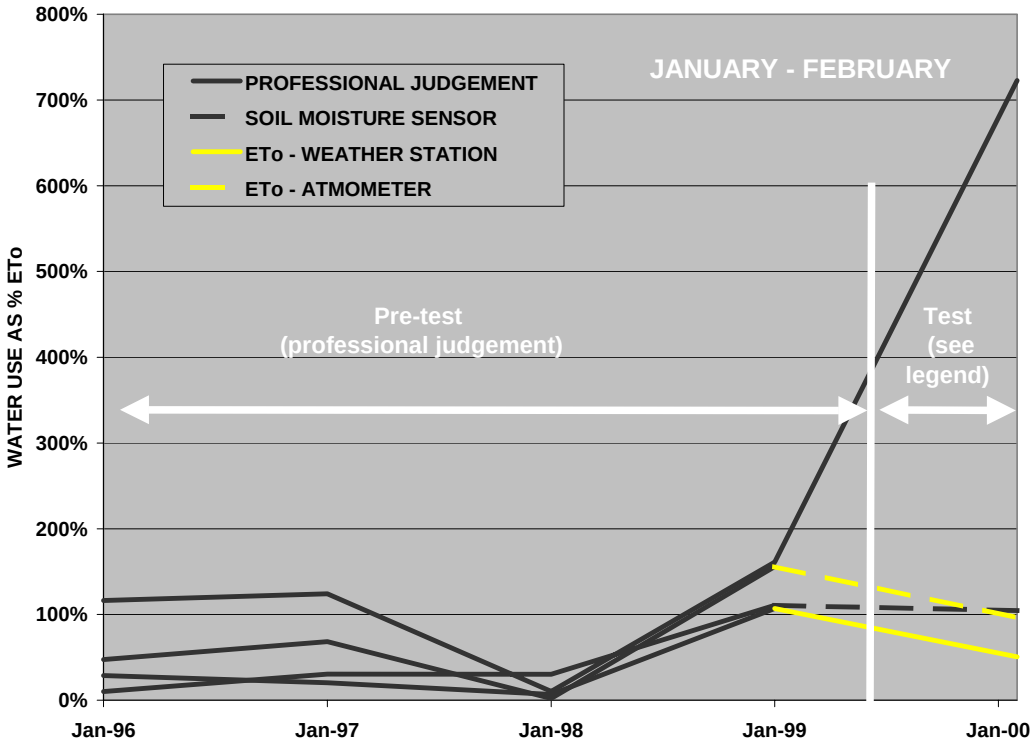
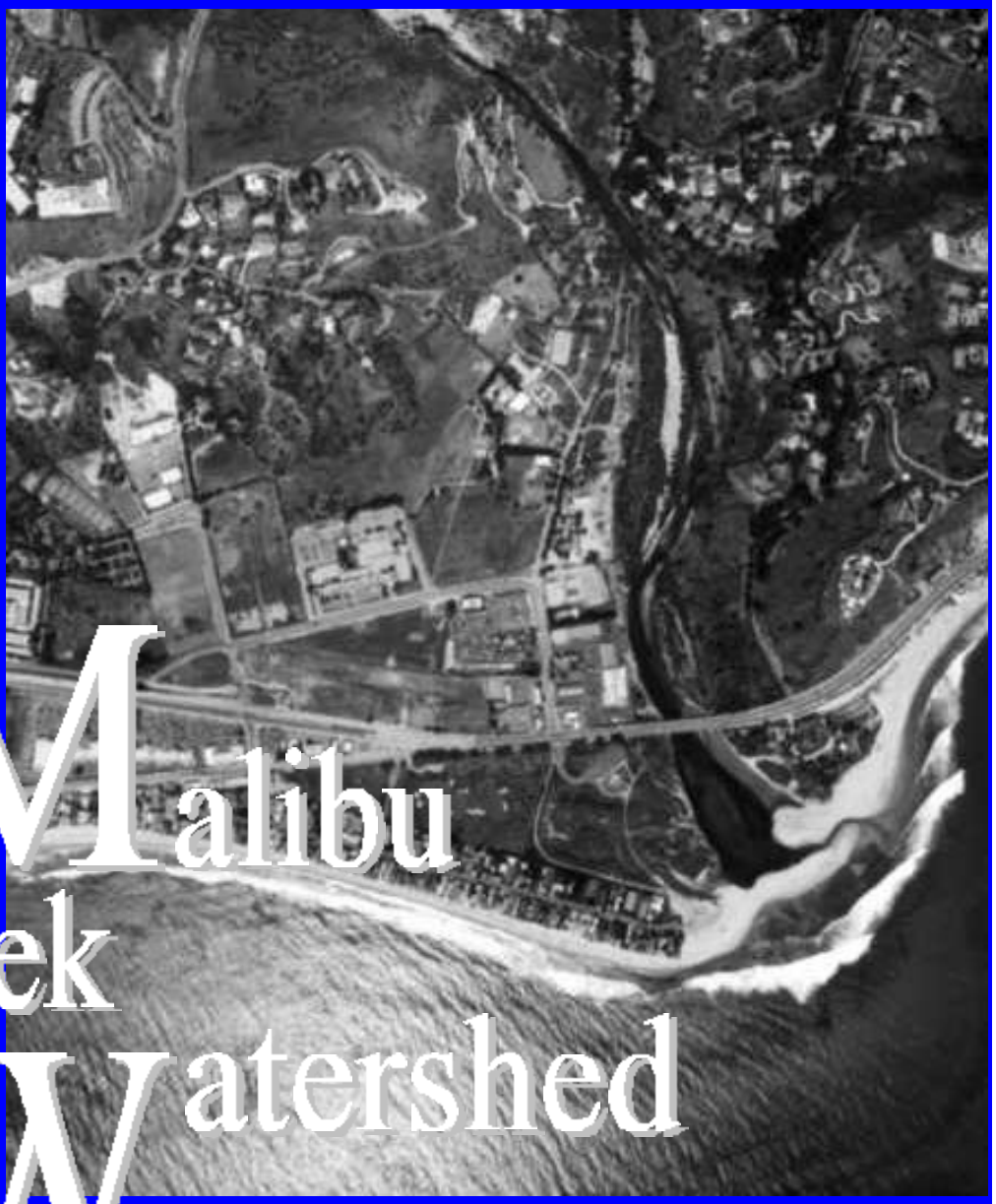
Sep-98
Sep-99


JANUARY - FEBRUARY
PROFESSIONAL JUDGEMENT
SOIL MOISTURE SENSOR
ETo - WEATHER STATION
ETo - ATMOMETER
Pre-test (professional judgement)
Test (see legend)
WATER USE AS % ETo
800%
700%
600%
500%
400%
300%
200%
100%
0%
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00

Making Progress:
Restoration of the



Malibu Creek Watershed

Santa Monica Bay Restoration Project
Malibu Creek Watershed Executive Advisory Council

Final Report
January, 2001

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MALIBU CREEK WATERSHED

Introduction

The 109 mi^2 Malibu Creek watershed is the second largest subwatershed within the larger 414 mi^2 Santa Monica Bay watershed. It provides a wide variety of habitats for countless species (marine, animal and plant) and has long been a popular place for surfers, hikers and other outdoor enthusiasts. Surfrider Beach, famous for its surfing break and visited by 1.2 million people annually, is one of the most popular tourist destinations in the area. The watershed is also home to two federally listed endangered species – the tidewater goby and steelhead trout. As one of the few remaining coastal wetlands in Southern California, Malibu Lagoon is a critical stop-over for migrating birds along the Pacific flyway.

While open space predominates the region, residential and light commercial land uses, orchards, pastures, crops, natural areas and golf courses account for approximately 19% of the area. The watershed encompasses unincorporated portions of Ventura[1] and Los Angeles Counties, and seven cities -- Malibu, Calabasas, Agoura Hills, Thousand Oaks and Westlake Village and small portions of Simi Valley and Hidden Hills. Combined, these communities are home to more than 90,000 residents. Population growth within this region increased at a significant rate during the 1980s (10%), but slowed somewhat during the 1990s (2%). The current growth trend is expected to continue (see Figure 1).

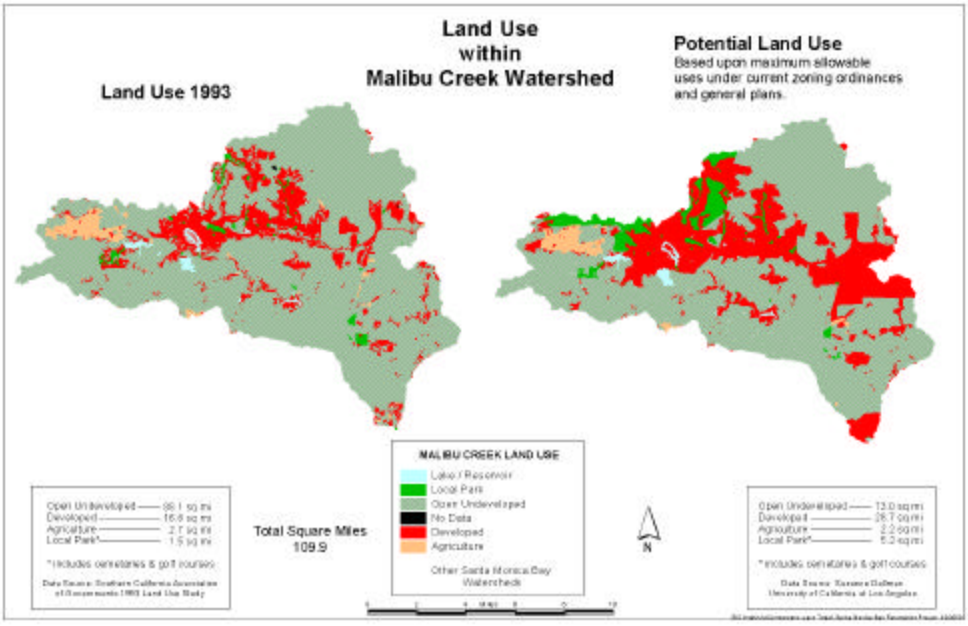

Figure 1. Past and projected land uses in the Malibu Creek Watershed.

[1] Ventura's unincorporated communities include Oak Park, Lake Sherwood and Hidden Valley.

In 1995, the Santa Monica Bay Restoration Project (SMBRP) completed the *Bay Restoration Plan* (BRP) which, among other elements, included a draft action plan for the Malibu Creek Watershed (MCW). The *Malibu Creek Watershed Natural Resource Plan*, released soon afterward by the Natural Resources Conservation Service, addressed watershed resources, water quality and quantity issues, and pollution reduction strategies. It also contained an appendix of 44 action items which paralleled the actions identified in the BRP.

A partial view of the Malibu Creek Watershed and the Pacific Ocean.

These 44 actions, consolidated down from an original list of 111 actions, were developed and agreed upon by watershed stakeholders through a consensus approach organized by the SMBRP. These 44 actions now provide the framework of guiding principles for restoration of the Malibu Creek watershed and comprise the Bay Restoration Plan's Malibu Creek Watershed Action Plan. They focus on six key areas of concern:

- Overall water quality and quantity
- Malibu Lagoon and surfzone
- Solid wastes and other wastes
- Land use
- Habitat protection and restoration
- Coordination and outreach

The entire process undertaken to guide restoration activities in the Malibu Creek watershed served as a subwatershed "pilot program" for Santa Monica Bay and could also serve as a model for other watersheds considering similar efforts. Key elements of this model include convening a stakeholder group, reaching consensus on the issues through stakeholder involvement, identifying the most significant pollutants of concern impacting the watershed's habitats and resources, developing restoration/protection management options, securing funding and ultimately, taking action.

The following report highlights the successes and challenges of this pilot program over the past six years, although some elements began before 1994. It contains four sections:

- ***Section One: Overview***, highlights the structure of stakeholder involvement in the watershed and provides brief summaries on: 1) sources of impairments to water quality, 2) other problematic issues, 3) human health risks and habitat degradation and 4) watershed studies and projects.

- ***Section Two: Action Plan Updat****e*, provides an in-depth update and assessment of the Natural Resource Plan's 44 action items (BRP actions).
- ***Section Three: Key Findings,*** summarizes the key findings of the data presented in Section Two.

- ***Section Four: Moving Forward - Watershed Restoration Priorities***, addresses future restoration priorities and objectives.

Implementation and Oversight Structure

The Malibu Creek Watershed Advisory Board, now called the Executive Advisory Council, was established in the early 1990s to address watershed pollution and restoration issues. Members of the Council include representatives of several local and state agencies, five municipalities, various other organizations and stakeholders, and the public at large (see Table 1.1). Throughout its tenure, the role of this Council has been to oversee, instigate and implement both upper and lower watershed restoration activities. More specifically, the group's role has been to:

- Call attention to watershed service opportunities (including grants, studies, pilot demonstration projects, partnerships, events, etc.);
- Promote/implement watershed protection and restoration projects;
- Help secure funding opportunities such as Proposition A bond funds and US EPA/State 205(j) grants and 319(h)[2]; and
- Oversee subcommittee activities (subcommittees identified below);
- Serve as an information sharing and clearinghouse outlet.

The committee is also a Watershed Implementation Committee that advises the Bay Watershed Council on matters pertinent to this watershed.

To better focus on key watershed issues and to help carry out the mission of the Executive Advisory Council, eight subcommittees have been formed. These subcommittees report back to the Council about their activities/progress during the Council's regularly scheduled bi-monthly meetings.

1. Volunteer Water Quality Monitoring Task Force

The role of this subcommittee is to encourage volunteers to become involved in water quality and habitat monitoring activities. They meet every other month to discuss the latest methods and techniques for providing high quality, reliable data that can be used by stakeholders and decision-makers. The task

Malibu Creek Watershed Executive Advisory Council

Army Corp of Engineers
CA Coastal Commission
CA Department of Fish and Game
CA Department of Parks and Recreation
CA State Coastal Conservancy
CalTrout
City of Agoura Hills
City of Calabasas
City of Malibu
City of Thousand Oaks
City of Westlake Village
Heal the Bay
Las Virgenes Municipal Water District
Los Angeles County Department of Public Works
Los Angeles County Fire Department
Los Angeles County 3rd Supervisoral District
Los Angeles Regional Water Quality Control Board
Malibu Land Coastal Conservancy
Malibu Surfrider/Surfrider Foundation
National Parks Service/Santa Monica Mountains National Recreation Area
Natural Resources Defense Council
Resource Conservation District of the Santa Monica Mountains
Santa Monica Bay Restoration Project
Santa Monica Bay Audubon Society
Santa Monica Mountains Conservancy
Sierra Club
Triunfo Sanitation District
US Environmental Protection Agency
Ventura County
Watershed Community Residents/Stakeholders

* Active members, those organizations with consistent representation at stakeholder meetings, are bolded.

Table 1.1. Malibu Creek Watershed Executive Advisory Council.

[2] US Environmental Protection Agency (EPA)/State grants are provided for water quality planning and implementation activities, respectively.

force has developed a volunteer monitoring program called "*The Stream Team,"* which is now coordinated by Heal the Bay (a local environmental organization), to assess the health of and impacts to stream reaches throughout the watershed**.** Currently, three volunteer groups are monitoring over 16 fixed locations throughout the watershed.

2. Steelhead Recovery Task Force

Originally called the "Rindge Dam" subcommittee, this group's focus has shifted from simply addressing the feasibility of removing Rindge Dam to now looking at all potential/existing barriers impeding steelhead migration to the upper reaches of Malibu, Topanga, Solstice and Arroyo Sequit creeks and their tributary streams.

3. Human Health

The role of this sub-committee is to identify and reduce health risks in the watershed, specifically those associated with recreational use of the creek, lagoon and surfzone. Most recently, they helped design a portion of the Coastal Conservancy/ UCLA study[3] which addressed pathogens.

[This committee's membership overlaps with the *Monitoring and Modeling* and *Lower Malibu Creek and Lagoon Task Force* subcommittees and its activities have been scaled down somewhat as a result.]

4. Monitoring and Modeling Sub-committee

The role of this subcommittee is to design, coordinate and oversee monitoring efforts in the watershed. In April 1999, the subcommittee released the draft *Malibu Creek Watershed Monitoring Program* which has the primary objective of "collecting data and information on pollutants and other problems that impair the formally designated beneficial uses of Malibu Creek and its tributary streams." The report was reviewed by the SMBRP's Technical Advisory Committee and funds are now being sought to implement the plan.

5. Lower Malibu Creek and Lagoon Task Force

The role of the Lower Malibu Creek and Lagoon Task Force has been to: 1) oversee lagoon monitoring and restoration efforts, 2) address the impacts of high water levels, breaching and septic system influences to the lower creek and lagoon and 3) serve as the review committee for the long-awaited Coastal Conservancy/UCLA study. Following the release of the report, the committee has started the process of selecting which creek/lagoon management options to pursue and implement.

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[3] *Lower Malibu Creek and Barrier Lagoon System Resource Enhancement and Management*. Draft Final Report. California State Coastal Conservancy and UCLA, February 1999.

6. Invasive Species Task Force

The Invasive Species Task Force was established in the later part of 1999 and its mission is to identify, assess and initiate removal of invasive plant and animal species in the watershed. Because many exotics are discovered through the efforts of other task forces, members of this task force work closely with them. The group has prioritized two actions: 1) to consult with the Los Angeles County Agriculture Commissioner about making Los Angeles County a "weed management zone" to become eligible for funding, and 2) to contact the Los Angeles County Department of Public Works about eliminating weeds in soil stockpile areas.

7. Flow Reduction Task Force

The Flow Reduction Task Force was formed during the Winter 1999/00. Initial meetings have addressed developing a mission statement and set of goals. The focus of the task force will be on reducing stream flows into impacted streams within the watershed and on reducing residential/community demands for imported water through conservation.

8. Education Task Force

This Task Force was formed in January 2000. At their first scheduled meeting, members began development of a mission statement, goals and a future plan of action. The primary focus of the Task Force will be on educating local residents and stakeholders about the restoration and preservation activities occurring in the Malibu Creek Watershed.

Watershed Impairments and Problematic Issues

The 1994 Water Quality Control Plan (i.e., the Basin Plan) developed by the Los Angeles Regional Water Quality Control Board (LARWQCB or Regional Board) identifies the entire Malibu coastline and Malibu Canyon and Lagoon as "Significant Ecological Areas" (SEAs), and documents 19 existing, intermittent and potential "Beneficial Uses" within the Malibu Creek watershed. However, various causes of impairments (Table 1.2) to this watershed threaten both its SEAs and beneficial uses. Some of the causes are well documented in several publications, including: 1) the Soil Conservation Service's *1995 Malibu Creek Watershed Natural Resources Plan*, 2) the Regional Board's *1997 Santa Monica Bay: State of the Watershed* report and *1994 Water Quality Control Plan,* and 3) the Coastal Conservancy's *1999 Lower Malibu Creek and Barrier Lagoon System Resource Enhancement and Management* report.

Watershed Impairments
Urbanization and Development
Sedimentation and Erosion
Invasive Species
Nutrients
Pathogens and Bacteria
Excess Flows
Problematic Issues
Land Acquisition
Shortfalls in Funding
Inspections and Enforcement

Table 1.2. Watershed impairments and other problematic issues.

Watershed impairments, such as urban runoff, excess nutrients,

pathogens and bacteria, sedimentation and erosion, invasive species, and excess freshwater flows adversely affect habitats, endangered species and human health. A quick summary of these impairments and the issues associated with them are provided here.

Urbanization and Development

As mentioned in the introduction, Malibu Creek watershed's population is growing at a significant rate (as much as 2 percent/year). This rapid growth is concurrent with development activities which contribute pollutant loads (heavy metals, nutrients, bacteria, trash and other inorganic compounds) through contaminated urban runoff, household waste, animal waste, on-site sewage disposal system discharges, illegal dumping and pesticide use. It also leads to greater demand for imported water, resulting in increased subsurface and creek flows and elevated groundwater tables, and ultimately impacting Malibu Lagoon and surfzone.

Sedimentation and Erosion

Much of the Malibu Creek watershed's soils are considered highly erodible. Increased dry weather flows, unstable streambanks, fires, construction sites not properly maintained and poorly-graded hillsides all contribute to the watershed's existing sedimentation and erosion problems. Brush clearing practices and roadside maintenance activities where dirt and debris are left on the side of the road and/or up-slope of creeks also increase sediment loads to receiving waters. These sources eventually reach the lower creek and lagoon and can adversely impact species and spawning grounds sensitive to high turbidity. Sediments also transport particle-binding pollutants, which in turn can affect many of the watersheds habitats and organisms. During seasonal high flow conditions (primarily during the rainy season), the impacts of sedimentation and erosion are especially pronounced.

Invasive Species

Both non-native plant and animal species in the Malibu Creek watershed have the potential to severely disrupt the natural ecosystem. The presence of non-native species can also be indicators of poor ecosystem health and represent competition for natural resources with native species.

The most significant non-native plant species include the giant reed, castor bean and wild tree tobacco (see Table 2.4 on page 67 for a more complete list of exotic plant species). The most significant non-native aquatic species include the western mosquito fish, yellowfin goby, oriental shrimp and polychaete worms.[4] Bullfrogs, crayfish and large-mouthed bass are also problematic and can be detrimental to southwestern pond turtles, California newts (both considered

[4] *Lower Malibu Creek and Barrier Lagoon System Resource Enhancement and Management*. Draft Final Report. California State Coastal Conservancy/UCLA, February 1999.

special species of concern in California) and Arroyo Chub.

Nutrients

Nutrient entering Malibu Creek watershed's lakes, creeks and streams stem from a variety of point and nonpoint sources including animal waste, surface and groundwater flows, storm drain discharges, septic systems and Tapia Treatment Plant discharges. An overabundance of nutrients from these sources contributes to eutrophication problems in the watershed. Although evidence of eutrophication, specifically low dissolved oxygen and algal mats, is observed in some areas of Malibu Lagoon (Ambrose, et.al., 1999), the Las Virgenes Municipal Water District's (LVMWD or the District) monthly water quality data suggest a significant downward trend in the amount of nutrients present in the watershed's creeks and streams over the past ten years. Although little data has been collected on the watershed's upstream lakes and some reaches of Medea Creek, they also show signs nuisance algae and have been listed on the Regional Board's list of impaired waterbodies.

Pathogens and Bacteria

The presence of pathogens and bacteria in the watershed's creeks, lagoon and surfzone is a significant human health concern. These pollutants come from sources such as:

- Septic systems:[5] Systems not properly maintained and leach fields without adequate filter materials and distance are potential contributors of bacteria and pathogens to groundwater, creeks and the lagoon and surfzone.

- The Tapia Water Reclamation Facility: This facility, jointly owned by the Las Virgenes Municipal Water District and Triunfo Sanitation District, is located adjacent to Malibu Creek approximately 4.5 miles upstream from Malibu Lagoon. This facility treats municipal wastewater primarily from the cities and unincorporated areas of the upper watershed. Tapia has a processing capacity of 16 million gallons per day (mgd), but currently operates at 9 mgd. The tertiary-treated wastewater generated from this facility is either recycled or discharged into the creek, depending on the time of year, demand and/or other circumstances. Concerns have been raised for many years about both the quality and quantity of Tapia's effluent and its impact on the Malibu Creek, Lagoon and surfzone.

- Animal waste: Livestock manure and domestic pet waste not properly disposed of can mix with storm water and/or urban runoff and eventually find its way to the watershed's waterbodies.

[5] The total contribution of pathogens and nutrients from lower watershed septic systems to nearby receiving waters has not been conclusively determined. However, studies are in progress to assess the impacts, if any, septics have on Lower Malibu Creek and Lagoon.

Excess Flows
About 18,000 acre-feet of water is imported into the Malibu Creek watershed each year. Ultimately, this imported water contributes to higher groundwater tables, increased creek flows, more frequent lagoon breaching events and greater volumes of polluted urban runoff entering storm drains and local waterbodies.

Land Acquisition
Much of the undeveloped land (other than parklands) in the Malibu Creek watershed is privately owned and has the potential to be developed. Acquisition of such properties could increase existing wetlands, protect riparian corridors, preserve open space and provide for greater protection of the watershed's sensitive species.

Shortfalls in Funding
Achieving long term restoration, protection and management goals depends, to a large extent, on the availability of funds to carry out these activities. While a significant amount of funding has been secured for watershed activities (Table 1.3, starting on Page 12), much more is needed to accomplish the goals outlined in the Malibu Creek Watershed Plan.

Inspections and Enforcement
Historically, inspections and enforcement activities have not been a priority among key agencies. However, there are a whole host of enforcement activities that, if aggressively conducted, could improve water quality in the watershed. Examples include: 1) routinely monitoring construction sites to ensure that pollution prevention BMPs are properly implemented; 2) periodically inspecting/monitoring septic systems to ensure that they function properly; 3) identifying and prohibiting illicit connections to the storm drain system; and 4) enforcing local ordinances. Enforcement agencies having local authority include the CA Department of Fish and Game, CA Regional Water Quality Control Board, Los Angeles County Department of Health Services and all watershed municipalities.

Effects on Human Health and Habitats

Human Health Impacts
Pathogens and viruses from septic systems, animal waste and polluted runoff all contribute to exceedances of water quality standards and affect the health of swimmers and surfers in Malibu Lagoon and the adjacent surfzone. This area consistently receive bad grades due poor water quality, and signs are posted much of the year warning swimmers about the health risks associated with recreating in these polluted waters.
Habitat Impacts

The pollutants and other causes of impairments listed above impact the Malibu Creek watershed's habitats and resources in a variety of ways. Non-native plant species displace and/or out-compete native species. Imported water demands disrupt the natural ecosystem, ultimately causing high lagoon water levels and contributing to unnatural lagoon breaches (although the long-term effect of this is not fully known[6]). Construction barriers impede native aquatic species abilities to reach upstream habitats and spawning grounds. And, increased pollutant loadings degrade water quality by lowering dissolved oxygen levels, contaminating sediments with heavy metals and other toxins, and increasing turbidity and nuisance algae.

Watershed Studies and Projects

Table 1.3, starting on page 12, highlights key projects, stakeholder groups and partnerships (e.g., the Executive Advisory Council and its sub-committees) who have been instrumental in applying for and securing grant funds for restoration activities throughout the watershed. Specifically, the table highlights 17 Malibu Creek watershed projects that have been successfully implemented, conducted or started over the past eight years. It also showcases: 1) the partnerships vital to successful implementation of restoration activities, 2) the funds that were leveraged or secured ($4+ million), and 3) the variety and types of projects undertaken in both the upper and lower watershed. For example: alternative wastewater discharge options have been studied; streambanks and other sensitive habitats have been restored and/or constructed; endangered species have been reintroduced; pathogen sources have been evaluated; livestock BMPs have been developed/promoted; and water conservation is being addressed.

Additionally, **Section Four: Moving Forward with Restoration Priorities** identifies the *Top 10 Restoration Priorities in the Watershed* as well as a complete list of recommended projects that are considered high priorities for implementation, but in which little or no progress has been made to date. While some actions lack the necessary funds and/or data to be successfully carried out, others are just now becoming priorities in the watershed. In the coming years, they will no doubt become the focus of the Executive Advisory Council's restoration and preservation efforts.

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[6] Two independent studies conducted six years apart actually show a slight increase in the biodiversity in Malibu Lagoon despite several dozen intervening breaching events. These studies include 1) *Malibu Lagoon: A Baseline Ecological Survey*. Resource Conservation District of the Santa Monica Mountains, 1989 and 2) *Enhanced Environmental Monitoring Program at Malibu Lagoon and Malibu Creek*, UCLA, 1995.

Table 1.3. Key watershed projects, studies, stakeholders and partnerships in the Malibu Creek watershed.

Malibu Creek Watershed Restoration Projects/Studies	Funding Source & Amount	
STUDIES AND ASSESSMENTS		
Malibu Creek Discharge Avoidance Study **Timeline:** November, 1997 –January, 2000 **Lead**: LVMWD **Summary**: Assessment of all possible options for disposing of the tertiary-treated wastewater generated by the Tapia treatment plant.	LVMWD	$850,000
Lower Malibu Creek and Barrier Lagoon System Resource Enhancement and Management **Timeline:** August, 1997 - March, 1999 **Lead:** CSCC/MCW Lagoon Task Force (study conducted by UCLA.) **Summary**: Assessment of the lower Malibu Creek watershed and lagoon, and compilation of management alternatives for implementing restoration, protection and management activities.	CSCC EPA LVMWD SMBRP/F	$100,000 $100,000 $46,000 $30,000
Effects of Sand Breaching the Sand Barrier on Biota at Malibu Lagoon **Timeline:** November, 1996 - Current **Lead**: RCDSMM **Summary**: Survey of birds and fish, and monitoring of water quality parameters (ammonia, nitrates, phosphates, DO, turbidity, water temperature, pH, salinity and lagoon water levels).	CalTrans	$47,000
Septic Tracer Study (The "Dye" Study) **Timeline:** August, 1998 - February, 1999 **Lead**: City of Malibu **Summary**: Phase I: Evaluation of the fate transport of pathogens from septic system effluent at one test site (Cross Creek Shopping Center) to groundwater and Malibu Creek and Lagoon. Phase II: Investigation of the potential for septic contamination from residential and commercial properties in the Malibu Civic Center area, near the creek, lagoon and surfzone.	EPA 319(h) Malibu	$60,000 Contribution not calculated
Evaluation of Rindge Dam For Removal **Timeline:** 1999 - Current **Lead**: Steelhead Recovery Task Force, Army Corps of Engineers, State Parks **Summary:** The Army Corp of Engineers conducted a reconnaissance study to determine the level of support among watershed stakeholders in removing Rindge Dam. Based on their findings, they have made plans to conduct a feasibility study on the various alternatives for removing the dam. Currently, they are looking for a funding source to start the study.	Army Corp of Engineers	Staff Time

Table 1.3. Cont'd.

Water Conservation Study **Timeline:** 1997-98 **Lead:** LVMWD and American Water Works Association Research Foundation **Summary:** Implementation of the North American Residential End Use Study, which installed data loggers in 100 homes to gather detailed information on water use. Data is being used to set national standards on appliance efficiency and conservation program planning. The study confirmed toilet flushing as the largest indoor use and provided data on incidence of leaks.	LVMWD AWWARF	$15,000 $421,000
Septic Systems in Malibu **Timeline:** June 1998 - January, 1999 **Lead:** Heal the Bay **Summary:** Estimation of the number of multi-family and commercial septic systems located in the Lower Malibu Creek watershed. Heal the Bay estimates that there are 390 multi-family and commercial septic systems in this area, many of which have not been permitted by the Regional Board. A summary of recommended actions is included in the accompanying report.	Heal the Bay	Staff Time Interns
Framework for Monitoring Enhancement and Action for the Malibu Creek Watershed **Timeline:** January – June, 1998 **Lead:** Heal the Bay, CA State Coastal Conservancy and the Graduate Dept. of Landscape Architecture (CSU Pomona) **Summary:** Watershed assessment and design of a citizen volunteer monitoring program (Stream Team) that collects useable high-quality data that addresses specific issues in the Malibu Creek Watershed and fills data gaps for regional stakeholders. A 150-page easy-to-understand, step-by-step field guide was produced and is used by volunteers to conduct water chemistry and stream walk monitoring activities. The guide also contains educational information about natural processes, issues of concern and the history of urban development in the Malibu Creek watershed.	CSCC	$37,000
3 Endangered Species Protection Studies (Steelhead Trout) **Timeline:** See summaries **Lead:** LVMWD **1) Summary:** April 1998 – June 1999. Recording of temperature data at multiple stations in Malibu Creek for a period of one year and compilation of steelhead trout temperature requirements. The final report (which was submitted to the LARWQCB) found that temperature ranges, while slightly higher than optimal below Rindge Dam, are sufficient to support all states of steelhead trout. **2) Summary:** December, 1997. Compilation of data on the steelhead in Malibu Creek, including original research on steelhead genetics and the recommending of listing steelhead trout as a unique and endangered population. **3) Summary:** November, 1998. Water audit of riparian vegetation in Malibu Creek to determine the minimum flows necessary to sustain steelhead trout while minimizing inflows to the lagoon.	LVMWD LVMWD LVMWD	$10,000 $10,000 Staff time

Table 1.3. Cont'd.

HABITAT/SPECIES RESTORATION PROJECTS		
Tidewater Goby Reintroduction to Malibu Lagoon **Timeline:** April, 1991 **Lead**: RCDSMM; partnership with Heal the Bay **Summary**: Successful re-introduction of 54 tidewater gobies, a federally listed endangered species, into Malibu Lagoon. As many as 1500 gobies were counted in 1998.	State Parks	$23,000
Restoration of Malibu Lagoon Bird Peninsula and Mud Flats **Timeline:** Fall, 1995 - Spring, 1996 **Lead**: RCDSMM **Summary**: In partnership with CA Parks and Recreation, excavation of over 2,200 cubic yards of old fill material within the Lagoon; restoration of aquatic habitat, mud-flat habitat, and high storm flow refuge for the tidewater goby. Post project monitoring of fishes, water quality and invertebrates.	EPA Near Coastal Waters Program Grant CalTrans	$131,695 $30,000 (in-kind services)
Sediment Reduction and Streambank Stabilization – Las Virgenes Creek **Timeline:** 1996 - 1998 **Lead**: RCDSMM **Summary**: Stream bank restoration along 200-foot portion of Las Virgenes Creek to reduce sedimentation; 17,000 cubic yards excavated and new mild slope created along the north bank. Native species planted to prevent future erosion.	EPA 319(h) County of LA (Prop A)	$607,000 (including in-kind services)
DEMONSTRATION PROJECTS AND WATERSHED POLLUTION CONTROL PROGRAMS		
Constructed Wetlands **Timeline:** March, 1998 – Ongoing **Lead:** LVMWD **Summary:** Rehabilitation of an existing percolation pond (on State Parks property) as a constructed wetland to treat Tapia's effluent and to treat urban runoff from the upper watershed.	Prop A funds LVMWD	$260,000 $50,000

Table 1.3. Cont'd.

Livestock Waste Management Pilot Project **Timeline:** 1996 - 1999 **Lead**: RCDSMM **Summary**: The RCDSMM: 1) conducted an extensive research effort to identify all horse owners and corrals in the Malibu Creek watershed; 2) conducted a watershed-wide survey of horse owners to better understand their current management practices and needs 3) hosted a horse manure compost demonstration site; 4) created a video entitled "Horse Management Program." and 5) developed a Stable and Horse Management BMP manual to help reduce point and nonpoint source pollution from livestock waste.	EPA 319(h)	$84,000
Malibu Lagoon Water Level Management Project **Timeline:** September, 1999 - Current **Lead:** CA Department of Parks and Recreation **Summary:** Management of the water level in Malibu Lagoon and disinfection of the water prior to its release to the ocean. As planned, this project should ensure that the lagoon's sandbar remains closed during the dry season (May – October). A Request for Proposals was released by State Parks in September, 1999 seeking a consultant to design a method for water level management of the lagoon. The project should be completed by Summer, 2001.	Prop A funds	$1.2 Million
Urban Runoff Treatment Facilities at Malibu Lagoon **Timeline:** Completed June, 2000 **Lead**: City of Malibu **Summary**: The City of Malibu was awarded Prop A funds to install a Storm-ceptor **J** for the 24-inch Malibu Road Drain (commonly referred to as the Mystery Drain) which discharges directly into Malibu Lagoon. The storm ceptor is designed to remove grease, oil, trash and sediment. The City has also added a disinfection system (as a pilot project) to work in concert with the Storm-ceptor **J** to remove pathogens from the discharge.	Prop A funds Purizer Corp. City of Malibu	$60,000 $600,000 $70,000
Watershed-wide Monitoring Program **Timeline:** April 1999, ongoing **Lead:** Monitoring and Modeling Subcommittee **Summary:** Completion of a draft plan which calls for coordination of existing monitoring programs and addition of supplementary monitoring to create a comprehensive survey of the state of the Malibu Creek watershed.	LVMWD City of LA LAC-DPW Ventura Co EPA 205(j)	$18,000 Beach bacti stations Stream gage Stream gage Application

EPA 319(h) – Environmental Protection Agency Nonpoint Source Implementation grant program
EPA 205(j) - Water Quality Planning grant program
Proposition A funds - Los Angeles County grant funds for storm water control capital projects

SECTION II: ACTION PLAN UPDATE

In order to implement Malibu Creek watershed restoration activities in a more comprehensive and focused manner, in 1994 forty-four action item goals were developed by consensus through a one-year series of facilitated meetings with watershed stakeholders[7]; the process also included identifying implementors responsible for each of the 44 actions. Although no timelines were provided for these restoration activities, there has been and continues to be determination among watershed stakeholders to implement them as soon as technically feasible or financially possible.

This section of the Malibu Creek Watershed report provides complete status updates and assessments for implementation of the 44 actions. They have grouped by topic according to the Action Plan. (see Appendix One for a complete table of these actions).

Overall Water Quality and Quantity Goals

1. ***Protect Beneficial Uses*. Develop and set water quality objectives to prevent point and nonpoint pollutant sources and pathogens from adversely affecting the beneficial uses of the watershed and nearshore environments.**

   The Los Angeles Regional Water Quality Control Board (LARWQCB or Regional Board) is responsible for establishing water quality standards for all Los Angeles and Ventura County waterbodies, including those in the Malibu Creek watershed. The updated *Water Quality Control Plan* (or Basin Plan), prepared by the LARWQCB in 1994, is the guidance document that includes the beneficial use designations within the watershed. Specifically, the Plan:

   - Designates beneficial uses for surface and ground waters;
   - Sets narrative and numerical objectives that must be attained or maintained to protect the designated beneficial uses of and conform to the state's antidegredation policy;
   - Describes implementation programs to protect all waters in the Region; and
   - Incorporates (by reference) all applicable State and Regional Board plans and policies and other pertinent water quality policies and regulations.

[7] A complete summary of the mediation efforts that lead to the development of the Executive Advisory Council and the 44 Action Items can be found in the document, *Comprehensive Malibu Creek Watershed Mediation Effort, Final Report*. May, 1994.

The Basin Plan[8] identifies 19 existing, potential and/or intermittent beneficial use categories for waterbodies in the Malibu Creek watershed (see the 1994 Basin Plan for a complete list). The Plan also sets specific watershed water quality objectives for total dissolved solids (TDS), sulfate, chloride, boron and nitrogen, in addition to general county-wide water quality objectives (ammonia, bacteria, coliform, biochemical oxygen demand (BOD), chemical constituents, chlorine, nitrogen, oil and grease, etc.). The mechanisms used to achieve these water quality objectives include:

- Issuing permits (NPDES, WDRs)[9] with contaminant discharge limits to point source dischargers;
- Requiring cities to prevent/control polluted discharges through implementation of comprehensive urban runoff control programs and best management practices (BMPs) as called for in the 1996 Municipal Storm Water NPDES permit issued by the Los Angeles Regional Water Quality Control Board;
- Requiring cities to adopt local ordinances for the control of nonpoint sources of pollution within their jurisdictions;
- Adopting regional waste discharge requirements for residential septic systems;
- Conducting public education programs to prevent residential sources of pollution (this task is not carried out directly by the Regional Board but is required under the Municipal Storm Water permit).
- Enforcing the California Porter-Cologne Act and the Federal Clean Water Act by conducting routine inspections, issuing fines and/or "Cease and Desist" orders to offenders and requiring cleanup of contaminated sites.
- Initiation of Total Maximum Daily Loads (TMDLs) for pathogens and nutrients for Malibu Creek and Lagoon.
- Following eco-regional (site specific) nutrient criteria development as part of the US Presidential Clean Water Action Plan (http://www.cleanwater.gov/). Under this plan, EPA must develop criteria by 2001 and begin initiation of compliance by 2003.

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[8] The Basin Plan's legal authority is provided under the California Porter-Cologne Act.
[9] National Pollutant Discharge Elimination System (NPDES), Waste Discharge Requirements (WDRs)

2. ***Protect Recreation.*** **Ensure swimming, surfing and fishing without adverse health effects posed by poor water quality. Protect appropriate recreational opportunities such as surfing, swimming, sportfishing, sailing and hiking in the creek, lagoon and surf system as long as it doesn't impact other beneficial uses.**

   This action is a goal rather than an actual action and its success is directly linked to the successful implementation of virtually every other action listed herein.

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3. ***Protect Ecosystem/Endangered Species.***

- **Enhance and protect lagoon, creek, beach and intertidal habitats for threatened and endangered species, native biodiversity and riparian habitat.**
- **Attain and maintain water and sediments of sufficient quality to support a healthy creek, lagoon and surfzone, taking into account interactive impacts.**
- **Prevent any increased input of substances in toxic concentrations into the watershed and surfzone.**
- **Reduce habitat degradation caused by road/bridge building encroachments and dumping of road materials, and adopt ordinances and watershed-wide joint powers agreements to do so.**

Many of the activities that must occur to accomplish the goals of this action are incorporated into the goals of other actions, in particular Eliminate or Reduce Sources (#4), Biological Standards (#5), Reduce Accelerated Sedimentation (#10), Temperature (#12), Restore/Enhance Malibu Lagoon and Surfzone (#20), Malibu Lagoon Bridge (#26), Runoff Reduction (#31), Habitat Protection (#33-38) and Coordinate on a Watershed Basis (#39).

Believed to have vanished from the area some time ago, the federally endangered red-legged frog was recently discovered on the Ahmanson Ranch development site in the northern portion of the Malibu Creek watershed. On that same property, a large patch of 40,000 San Fernando spine flowers was also discovered. Formerly, the flower was believed to be extinct since the 1920s. The fate of these two species is ultimately tied to how the development project proceeds, which, as of the date of this report, has not been determined.

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4. ***Eliminate or Reduce Sources*****. Eliminate or reduce, by sub-watershed area, sources of harmful pathogens, toxic chemicals, sediments and nutrients.**

Pathogens, toxic chemicals, sediments and nutrients are transported to local waterbodies through groundwater, storm water and urban runoff flows. To help minimize the impacts of these pollutants, the County of Los Angeles and its 85 cities are required under the 1996 Municipal Storm Water NPDES permit[10] to control polluted runoff discharges within their jurisdictions. Since approval of this permit, all four Los Angeles County cities in the Malibu Creek Watershed have adopted local ordinances which clearly identify and prohibit activities specifically known to contribute pathogens, toxic chemicals, sedimentation and nutrients to local waterbodies. Such ordinances also give cities the legal authority to immediately enforce these prohibitions. Table 2.1 highlights the measures covered addressed in the local ordinances recently adopted by Malibu, Calabasas, Agoura Hills, Westlake Village and Thousand Oaks.

Storm Water Ordinance Measures
Illicit Connections and Discharges Prohibition against using, maintaining, or continuing any illicit connections to the municipal sewer system.
Littering Prohibition against littering of garbage, refuse, etc. (pollution) on streets, alleys, sidewalks, storm drains, public and private lands, lakes, streams, etc. within the city.
Storm Drain Discharge Prohibitions
• Landscape Debris
• Untreated wash water from gas stations, auto repair facilities, etc.
• Untreated wastewater from mobile car wash, carpet cleaning, steam cleaning, or other mobile service providers
• Wastewater from repair of machinery and equipment which are visibly leaking oil, fluids or antifreeze [to the maximum extent practicable (MEP)]
• Untreated runoff from storage areas containing oil grease and other hazardous materials
• Commercial/municipal swimming pool filter backwash
• Untreated runoff from washing toxic materials from paved or unpaved areas (some exclusions)
• Untreated runoff from washing impervious surfaces in industrial/commercial areas (MEP, some exclusions)
• Wastewater from concrete truck washing
• Runoff containing banned pesticides, fungicides or herbicides
• Disposal of hazardous waste into containers which causes or threatens to cause discharge to the storm drain
Good Housekeeping Provisions
• Prevent chemicals or septic waste from mixing with rain water which may enter city streets or storm drains
• Minimize runoff generated from irrigation
• Prevent machinery/equipment leaks, spills, etc. from mixing with storm runoff
• Regularly sweep parking lots with 25+ spaces to remove pollutants and debris (can consider other effective means)
• Do not discharge food waste to the storm drain system
• Implement BMPs to MEP for fuel and chemical waste, animal waste, garbage, batteries, etc.
Compliance with Industrial, Commercial and Construction NPDES

The County of Ventura and its Malibu Creek watershed communities have taken a similar approach those listed for Los Angeles County to eliminate sources of pollutants. These include: 1) adoption of local ordinances and the legal authority to enforce them; 2) implementation of public education programs; 3) inspections for all auto repair and food/restaurant facilities to ensure compliance; and 4) establishing guidelines for all new developments to incorporate permanent BMPs as part of their design. Calabasas has also installed a continuous

Because many of the storm water ordinance provisions were only recently adopted by these watershed cities, it will take several years

[10] The Municipal Storm Water NPDES Permit was issued by the Regional Water Quality Control Board in July, 1996.

before the water quality testing data collected can show trends in pollution reduction. Clearly, a comprehensive monitoring program is key to determining whether these measures are working.

Watershed cities also conduct public education programs to reduce point and nonpoint sources of pollution, which are addressed in Public Education (#42). And lastly, watershed efforts to reduce pathogens and nutrients are specifically addressed in Reduce Pathogens (#7), Reduce Nutrients (#9) and Septic Systems (#23).

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5. ***Biological Standards***. **Establish viable minimum habitat standards to support native species of locality.**

A whole variety of fish, bird and plant species, some of which are state and/or federally listed as endangered or threatened, depend on healthy watershed resources for their survival. However, these species may have different or even competing needs to survive. For example, fluctuations in the lagoon's water level and regular tidal flushing are needed for birds to be able to access the mud flats, a situation which is achieved by routine breaching of the lagoon's sand berm. The tidewater goby, on the other hand, can be adversely affected by fluctuations in salinity resulting from a breach. Reconciling these needs makes establishing minimum habitat standards a difficult task.

The Coastal Conservancy/UCLA study, *Lower Malibu Creek and Barrier-Lagoon System Resource Enhancement and Management*,[11] evaluated minimum habitat standards in the lower creek and lagoon to better establish biological water quality objectives for several indicator species. The final draft of this report provided information about the physical tolerances of target species for parameters such as temperature, ammonia, pH, dissolved oxygen, nitrate, nitrite, sulfide chlorine and chloride. Two significant conclusions were drawn from Coastal Conservancy/UCLA's research: 1) different species, even desirable species, have quite different tolerances; and 2) while there is much water quality data available, there is little information available about the tolerances of most of the target species to the physical condition of concern.

Separately, the Las Virgenes Municipal Water District (LVMWD)

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[11] *Lower Malibu Creek and Barrier-Lagoon System Resource Enhancement and Management*. Draft Final Report. California State Coastal Conservancy/UCLA, February 1999.

conducted a water audit of riparian vegetation in Malibu Creek to determine the minimum flows necessary to sustain steelhead trout in the creek while at the same time minimizing inflows to the lagoon. It was determined that a minimum of 2-4 cubic feet per second (cfs) would be required at the County gauge station[12] to sustain the steelhead below Rindge Dam. This information was submitted to the National Marine Fisheries Service (NMFS) in 1998 for review. Historical evidence of drought years and groundwater flows and their effect on steelhead will also be considered by NMFS in its final determination of the minimum flow necessary to support steelhead trout.

The County of Los Angeles, Department of Public Works (LAC-DPW) and several other storm water dischargers have organized a regional storm water monitoring coalition whose goal is to establish a monitoring research agenda. Issues being discussed and considered for future research include the use of biological indicators to assess the health of inland and coastal waters in Southern California, and the feasibility of developing bio-criteria. (The coalition only *defines* areas of future research that might be undertaken by interested parties but does not actually conduct research itself.)

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6. ***Monitor Pathogens*. Use appropriate testing techniques to determine the presence of pathogens and test for compliance with established standards. Pathogen testing should be implemented when and where bacteria counts are high.**

Rather than testing directly for pathogens, local agencies routinely test for the presence of pathogens using bacterial indicators such as coliform. Their efforts are highlighted below. Testing for pathogens directly is difficult because there is no rapid method to reliably quantify their presence in water samples. However, direct pathogen testing using one of the methods available has occurred twice in Malibu Creek. These tests were conducted under two studies – the *Enhanced Environmental Monitoring Program at Malibu Lagoon and Malibu Creek* study conducted in 1993-94 by UCLA and the *Lower Malibu Creek and Barrier Lagoon System Resource Enhancement and Management* study conducted by the Coastal Conservancy and UCLA in 1998. It is foreseeable that pathogen testing will occur on a routine basis once methods to detect pathogens directly are improved.

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[12] The County gauge station records stream flow velocities and collects samples for a variety of constituents in Malibu Creek just below the Tapia outfall and Piuma Road.

- During rain events, LAC-DPW samples for bacteria in storm water runoff near Piuma Road (as required under the 1996 Storm Water NPDES permit). The samples collected show that the amount of bacteria present in wet-weather flows are three to four magnitudes greater than the amount present in dry-weather flows. Since the sampling sites are in areas where there is no public contact, notifications are not made to the public. The monitoring results are, however, reported to the Los Angeles Regional Water Quality Control Board annually and available for public review.

- Since bacteria and pathogens represent a human health concern, the Los Angeles County Department of Health Services (DHS) conducts monitoring activities in unincorporated areas of the County and for any city that does not have its own health department. Where high bacteria counts are observed, DHS takes additional samples to identify the source(s) and closes beaches impacted by the discharge. If a source is identified, then enforcement action is taken by DHS or referred to the appropriate agency with legal jurisdiction (e.g., storm drain entry).

- In 1998, the City of Malibu initiated a septic system tracer study (the "dye" study) adjacent to lower Malibu Creek to determine to what extent, if any, septic systems may contribute pathogens to local receiving waters. In conjunction with the LARWQCB, Malibu then conducted an extensive water quality monitoring program within the creek, lagoon and beach area during the later half of 1999 to identify where septic systems may contribute pathogens and/or nutrients to the lagoon and surfzone. A more detailed update on these activities is provided under Septic Systems (#23).

- The City of Calabasas, through its Volunteer Water Quality Monitoring program, started monthly monitoring for total and fecal coliform in 1999 at six sites in Las Virgenes Creek. Although not currently publicized, the City does submit the monitoring information to the Regional Board and plans to make it available on their city website in the near future.

- Both the City of Los Angeles and the Las Virgenes Municipal Water District have considerable data (from weekly monitoring) on bacteria levels in Malibu Creek and the adjacent surfzone. In addition, LVMWD has funded several special studies which use advanced testing methods to detect the presence of pathogens and has pursued research into new detection methods through their industry research

contacts. The District's efforts have resulted in initiation of new studies on available detection methods by the American Water Works Association Research Foundation and the Water Environment Federation.

- Since the Tapia plant began discharging its effluent into Malibu Creek, there have been concerns about its contribution to the presence of pathogens and viruses found in the lower creek and lagoon. LVMWD has monitored Tapia's effluent for more than 15 years and has funded and/or co-funded four independent studies on the quality of its effluent. These studies concluded that there is no significant risk of illness directly associated with Tapia's effluent.

- Several years ago, the SMBRP assisted the Los Angeles County Department of Public Works in testing a new sanitary survey tool to identify the presence of human fecal matter in storm water flows. The goal of the method was to determine whether there was evidence of human waste by extracting coprostanol[13] from storm water runoff samples through a separation process. The expected advantages to this approach were that: 1) identification of human fecal matter could be conducted in the field rather than the lab, and 2) the results would be available in hours rather than days.

  While preliminary lab tests supported the feasibility of this method, field testing proved more difficult. Results of the study showed that field samples did not correlate well to controlled lab samples. Additional drawbacks to this method are: 1) coprostanol testing is considered very expensive (as much as 10x more) when compared to standard bacterial testing, and 2) there is little understanding of the role or impact of other storm water pollutants on the coprostanol extraction process. A significant amount of additional testing will have to be conducted and the cost of conducting field testing will have to decrease considerably before this particular sanitary survey tool will be considered for use in the field.

Although not occurring in this watershed, another sanitary survey method is undergoing preliminary testing in San Diego using DNA identification of human fecal matter to detect pathogen presence. This approach could potentially be considered for use in the Malibu Creek Watershed if results are encouraging.

[13] Coprostanol is a type of sterol found in animal waste in unique ratios, depending on the animal (i.e., human ratios are distinct).

7. ***Reduce Pathogens*. Reduce human pathogen inputs into the watershed.**

Reducing pathogen loads is one of the premiere goals of the Malibu Creek Watershed Plan and it can be accomplished in two ways: 1) by preventing pathogens from reaching Malibu Creek and Lagoon by eliminating them at the source and/or 2) installing treatment controls (i.e., end-of-pipe solutions). Given the potential sources of pathogens (e.g., septic systems, tertiary-treated effluent, polluted urban runoff and illicit connections), they must all be addressed in a comprehensive manner to effectively reduce pathogen inputs into the watershed. To help further this action, the Regional Board will be looking at these sources and establishing a total maximum daily load (TMDL) for pathogens in the Malibu Creek Watershed by March, 2002 (see Watershed Assessment, #44).

Using Proposition A funds, the City of Malibu installed a Storm-ceptor **J** facility with a disinfection device at the end of a 24-inch pipe that drains into Malibu Creek and Lagoon (commonly referred to as the Mystery Drain). Among other constituents, the system will reduce and/or remove pathogens from Mystery Drain discharges. The City is also considering treatment/disinfection devices for the remaining two storm drains discharging into Malibu Lagoon.

Additional efforts to control pathogen inputs from area septic systems are described in Septic Systems (#23). Also, Las Virgenes Municipal Water District's efforts to find alternative uses and/or disposal options for Tapia's effluent (rather than discharging it into Malibu Creek) are described under Water Imports and Discharge (#28).

8. ***Study Nutrients*. Determine and establish achievable nutrient standards to maintain natural populations.**

Several nutrient-based studies and data collection efforts have occurred throughout the watershed for many years, which include:

- Extensive sampling of nutrients was part of the Resource Conservation District of the Santa Monica Mountain's (RCDSMM) *Effects of Breaching on the Biota* study. Water quality parameters such as Ammonia (as nitrogen), nitrates (as nitrogen), and phosphates were sampled in Malibu Lagoon from 1996-98. This data will soon

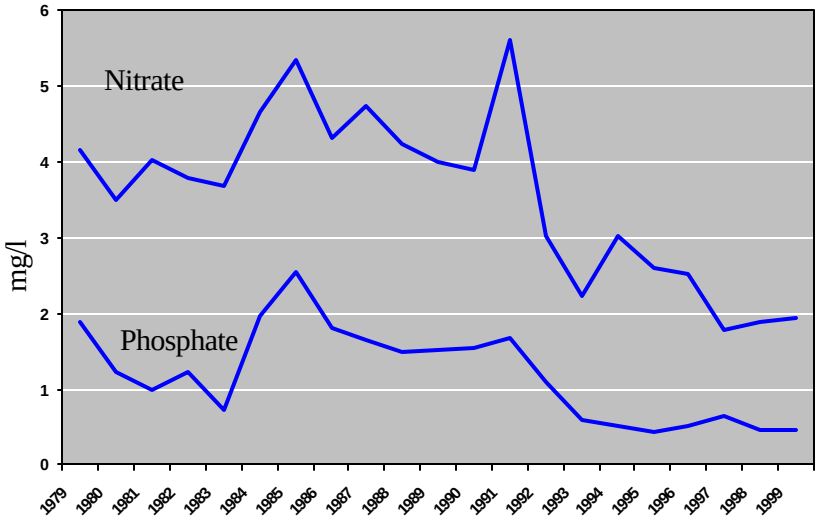

Figure 2. Annual nitrate and phosphate averages at 8-10 stations.

be compiled and available for use to the general public.

- The Las Virgenes Municipal Water District has collected nutrient and phosphate data for more than 20 years at 8-10 stations from the 101 Freeway to Malibu Lagoon. This data, which was also submitted to the LARWQCB suggests decreasing trends in both constituents over the past 20 years. (See Figure 2.)

- In 1979, Dr. David Chapman conducted a study on nutrients. Every month for a period of one year he surveyed algae throughout Malibu Creek and identified algal blooms to the lowest taxonomical level possible (typical species). Using the data collected, Dr. Chapman concluded that: 1) algal mats in Malibu Creek were dominated by *Cladophora*, distributed through the creek where flows were stagnant and shade was lacking, and 2) algal mats were scoured during winter storm events, thus creek algal biomass began afresh each year (i.e., there is no biomass carry over from year to year). His research suggests that the presence of nutrients alone does not govern the amount of or the extent to which algal blooms develop, but rather a collection of factors governs this. A study conducted by LVMWD in 1978 found that algal mats were prevalent in pools and stagnant waters without riparian canopy or shading throughout the watershed. This study supports Chapman's conclusions.

- The Regional Board has established a TMDL unit to set discharge limits for pollutants throughout Los Angeles County. In the Malibu Creek watershed, they will be focusing specifically on nutrient loads, pathogens and coliform. The Regional Board expects to complete the TMDL process for these pollutants by March, 2002.

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9. ***Reduce Nutrients.*** **Reduce nutrient loads into the watershed. Reduce nutrient levels to natural background levels. Encourage the Tapia Treatment Plant to employ state-of-the-art technology to remove nutrients from their discharges.**

Constituent (mg/l)	Creek Background Levels	Tapia Discharge Levels
Nitrates	6-8 mg/l winter 1-4 mg/l summer	15 mg/l, 1999 Annual Average
Phosphorus	Usually no detect or less than 1 mg/l	2.62 mg/l , 1999 Annual Average

Table 2.2. Nitrate and phosphate levels found in Malibu Creek and Tapia discharges. (Data provided by the Regional Water Quality Control Board.)

Tapia's discharges to Malibu Creek contain nitrate and phosphate levels which are higher than typical creek background levels (see Table 2.2). These levels have been identified as possible contributors to the algal blooms that cause lower dissolved oxygen levels in Malibu Creek, although various monitoring results show adequate dissolved oxygen (DO) levels in the creek below Tapia. The Las Virgenes Municipal Water District began voluntary biological nutrient reduction at its Tapia facility in 1992 by decreasing airflow to its aeration basins to reduce nitrate levels, and recently installed mixers to reduce nitrate levels even farther. Overall, the amount of nutrients discharged directly by Tapia has decreased about 35% since 1993.

Additionally, Tapia's wastewater discharge permit, which was re-issued by the Regional Water Quality Control Board in 1997, requires significantly lower nitrate and phosphorus levels than the plant's previous permit required. Specifically, it calls for nitrates to be reduced from 13 milligrams/liter (mg/l) to 10 mg/l and phos-phorus from 6 mg/l to 3 mg/l. To meet these provisions, the Las Virgenes Municipal Water District is studying the effectiveness of percolation beds in removing nutrients from Tapia's effluent. Prior to the permit provisions, however, LVMWD voluntarily imple-mented process changes at the Tapia facility to improve average nitrate and phosphorus removal efficiencies by 25-35%. As men-tioned previously, the permit also prohibits Tapia from releasing its effluent into Malibu Creek from April 15th to November 15th, thereby significantly reducing the amount of nutrients discharged.

As part of its review on the nitrate and phosphorus limits established in Tapia's current permit, the Regional Board is currently analyzing background nutrient levels in Malibu Creek subwatersheds and correlating their effects on biological factors (DO, temperature, pH, etc.). Based on results of the Regional Board's assessment, Tapia may need to further reduce nitrate and phosphorus discharges associated with urban runoff.

The County of Ventura addresses nutrient problems through several programs, including public education targeting pet waste and residential use of fertilizers, education of municipal staff in charge of landscape maintenance, confined animal waste management and storm water discharge prohibitions.

Septic systems also discharge nutrients to the watershed. Septic leach fields which are not sufficiently separated from groundwater, and hydraulic gradients which "pull" septic discharges to local creeks can contribute to the nutrient loadings observed in Malibu Creek and Lagoon. Although the Regional Board is required to issue Waste Discharge Requirements (WDRs) to multi-family and commercial complexes using septic systems, their efforts have lagged in actually identifying and permitting these facilities (see Septics, #23).

Several other programs in the watershed promote nutrient reduction through education, implementation of appropriate BMPs and capital projects. Please see Confined Animals (#18), Septic Systems (#16), Composting, Recycling and Conservation (#29) and Public Education (#42) for related nutrient reduction activities.

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10. ***Reduce Accelerated Sedimentation***. **Historical seasonal sediment flow to beaches should be allowed. Human-augmented sediment discharges into the watershed should be reduced by:**

- **Enforcing erosion control regulations on a subwatershed basis.**
- **Encouraging all cities and the County to adopt ordinances of no net increase in sediment from any development into the watershed.**
- **Adopting watershed-wide ordinances to reduce sediment runoff from private property.**
- **Minimizing the loss of topsoil in developing areas through implementation and enforcement of BMPs.**
- **Eliminating dumping of dirt on road shoulders.**
- **Eliminating massive grading within the watershed.**

All construction activities/developments in Los Angeles County over five acres are required to obtain a Construction NPDES permit from the Regional Board by filing a Notice of Intent (NOI) and identifying appropriate/site-specific BMPs that will be implemented. The BMPs selected must be effective in prohibiting contaminated discharges from leaving a site under construction. The requirements will soon apply to construction and development projects greater than one acre.

Under the 1996 Municipal Storm Water NPDES permit, cities are required to adopt local ordinances which include sediment control/reduction strategies (see Table 2.1 under Eliminate Sources, #4 on 20). Sediment control/reduction strategies implemented within the watershed include the following:

- The City of Calabasas conducts annual reviews of erosion control plans for developers that have open construction sites (exposed soil, no stabilization), open City projects and any project starting during the rainy season. City inspectors also ensure that erosion control measures, which must be identified as a condition for receiving a development permit, are correctly installed and maintained (e.g., sandbags, berms).

- The Cities of Agoura Hills and Westlake Village require developers and new construction projects to implement wet weather control plans during the rainy season (October - April) and enforces them as warranted. State permitted construction sites (those 5 acres or greater) are checked at least once during each rainy season by City inspectors.

- The City of Thousand Oaks requires that: 1) all development projects (except single family residences) disturbing one acre of soil or more prepare a storm water pollution control plan (SWPCP) before receiving a grading permit, 2) new developments incorporate permanent BMPs into their site designs, and 3) erosion control plans be developed for all active projects before the start of the rainy season. Construction inspectors routinely check construction sites for proper implementation of SWPCPs and BMPs.

Additionally, in 1997 the RCDSMM (using Proposition A and US EPA 319(h) grant funds) implemented a sediment reduction and stream bank stabilization project along a 200-ft section of Las Virgenes creek adjacent to Lost Hills Road. Initially, the RCDSMM excavated approximately 17,000 cubic yards of old fill material which had been dumped in the streambed by a previous development project. A new mild streambank slope was then reconfigured using bio-engineering techniques (erosion blankets, geo-grid system, and native re-vegetation). The fill material removed from the site was accepted without charge by the County Sanitation District for cover at the Calabasas landfill. This in-kind contribution, estimated at $500,000 was the single biggest factor in allowing the project to proceed, as funds had not been secured to cover the disposal cost of the fill material. Since its completion in 1998**,** the restored streambank has successfully withstood several storms, become stabilized and is now considered fully restored. Based on the RCDSMM's routine inspection of the stream bank, some components will be modified to increase its long-term stability.

11. ***Fire Regulation-Erosion Control***. **Modify fire regulation practices and weed abatement programs to reduce erosion. One method is to require mowing rather than discing of weed setback zones.**

Since public safety is the primary objective in preventing wild fires, particularly in the Malibu Creek watershed, native habitats located near commercial establishments and residential homes have historically been removed or degraded. However, per the Los Angeles Fire code, the Fire Department has set in motion a progressive, preventative approach to fire safety while promoting native vegetation retention called the *Fuel Modification Program*. Implemented in 1996, this program requires landowners of any new construction or addition of 50% or more square footage to develop a fuel modification plan showing:

- Specific plant pallets
- Plant spacing and arrangement
- An irrigation plan
- Legal documentation of a comprehensive long-term vegetation maintenance program for the property.

Existing and future landowners are required to adhere to the plan's components. Landowners are also required to comply with existing standards for brush clearance to reduce the threat of fire. The standards do, however, recognize the need for erosion control and watershed protection, and therefore allow up to three inches of grass to remain on relatively flat lands and up to 18 inches on slopes otherwise prone to significant erosion.

Cities in the watershed have also adopted policies promoting mowing rather than discing areas likely to erode and promote the use of drought-tolerant plants where possible.

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12. ***Temperature***. **Establish water temperature policies for fisheries.**

The RCDSMM has routinely sampled and accumulated lagoon water temperature data since 1989 as part of all of its Malibu Lagoon projects. Although this relatively long-term data has not yet been used to formulate water temperature policies (no lead agency identified), it is available for use upon request. The Las Virgenes Municipal water district also recorded temperature data continuously for one year at multiple stations in Malibu Creek and compiled temperature requirements for steelhead trout. The RCDSMM's data, along with LVMWD's data and the habitat/species information and assessments contained in the Coastal

Conservancy/UCLA report, could help guide the development of a temperature policy for Malibu Creek and Lagoon.

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13. ***Storm Drains*. Employ appropriate BMPs for storm drains throughout the watershed. Stencil all catch basin inlets (storm drains).**

In 1995 as part of its Gutter Patrol Program, Heal the Bay started stenciling catch basin inlets in the City of Malibu with the message **"NO DUMPING - This Drains to Ocean."** Once the program was completed, they provided city personnel stencils and paint to ensure the longevity of this effort as stencils faded or as new storm drains were installed. Malibu's local residents were also reached with the "No Dumping" message by Heal the Bay through educational door hangers (in the shape of fish), local community events and local newspapers. The same "No Dumping" stencils were provided to other cities in the Malibu Creek Watershed, thus promoting a consistent region-wide message discouraging illegal dumping of materials into storm drains. Storm drain stenciling is now required by all cities under 1996 Municipal Storm Water NPDES permit.

In May 1993, LAC-DPW developed a program to stencil a significant number of catch basins county-wide with the same phrase and logo **"NO DUMPING - This Drains to Ocean.**" Their initial effort included stenciling approximately 72,000 sites. The County then established a periodic re-stenciling schedule whereby three of the nine County areas would be re-stenciled each year (resulting in overall storm drain stenciling maintenance every three years). As part of this program, participating cities in the Malibu Creek watershed are scheduled to be re-stenciled sometime in 1999 (the County only provides stenciling service to those cities who contract with them for catch basin cleaning or who specifically request stenciling services). Cities who choose not to participate in the County's program are required to conduct their own cleaning and stenciling programs and may or may not use the same logo and phrase. In the Malibu Creek watershed, Calabasas and Westlake Village contract with the County for these services. Agoura Hills cleans its own storm drains and removes debris annually prior to the start of the rainy season, but contracts with the County for stenciling of its catch basins. The City of Malibu conducts its own program entirely (as mentioned above).

These watershed cities also conduct regular street sweeping activities to help prevent storm drains from becoming clogged with trash and debris. The City of Calabasas, using Prop A funds, has even installed a state-of-

the art continuous deflection system (CDS) unit into one of its storm drains. CDS units use reverse-angle screens to filter out trash and debris once they enter the device. Initial research has shown these units to be quite successful at removing virtually all trash and debris from the system, and they are reportedly easy to maintain.

As mentioned under Reduce Pathogens (#7), three storm drains, which discharge flows directly into Malibu Lagoon were targeted for treatment by the City of Malibu. Starting in the winter of 2000/01, flows from one of the storm drains will be treated using an oxidan gas disinfection facility to eliminate bacteria and viruses before they reach the lagoon. If the results of this treatment process are successful, the remaining two drains will also receive the same treatment. The demonstration project is being sponsored with Prop A funds and by the City of Malibu, Southern California Edison and Purizer Corp, who is contributing the disinfection facility for the project.

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14. ***Mobile Car Washes*. Regulate mobile car washes to prevent discharges from reaching the creek and lagoon.**

Under the 1996 Municipal Storm Water NPDES Permit, all four Los Angeles County watershed cities have adopted local ordinances prohibiting mobile car washes from discharging runoff to the municipal storm drain system. Enforcement of this provision is limited, and is conducted on an as-needed basis. See Enforcement – General (#40).

The County of Ventura and its watershed communities are not required under their Storm Water NPDES permit to regulate mobile car wash discharges. However, this concern is addressed somewhat through public education and outreach.

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15. ***Illegal Drains*. Eliminate known illegal storm drains entering the watershed.**

The County of Los Angeles Department of Public Works prepared maps and connection inventory reports for 1082 storm drain segments county-side, resulting in discovery of 1838 undocumented connections. Of these, 49 illicit connections were found in the Malibu Creek watershed; 21 of them have since been formally documented and the other 28 are in the process of being documented. Typically, the County investigates all reports of illicit connections and advises the owners of these connections

to either document them or remove them.

Although no illicit discharges (including gray water and septic connections) have been identified to date, the City of Malibu relies on the legal authority provided under its storm water ordinance to eliminate them if and when they are discovered.

Heal the Bay, through its Malibu Creek Stream Team program, conducts extensive surveys along various creeks and streams throughout the watershed. Volunteers who walk segments of the creek document, among other things, discharge points or outfalls that lead directly to the creek/stream. This information can be compared to known discharge points and legal action can be taken when illegal discharge points are discovered.

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16. ***Septic Systems***. **Implement dye study of the septic systems in the vicinity of the lagoon, creek and surfzone. Study all identified systems and replace all malfunctioning systems.**

Please see summary under Septic Systems (#23).

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17. ***Trash/Park Sanitation***. **Maintain sanitary conditions in parklands. Link to education in English and Spanish to prevent trash from impacting local resources. Manage and eliminate the harmful impacts of day use, including campers, picnickers and transients on water quality.**

The California Department of Parks and Recreation (State Parks) has taken several measures to control the spread of trash and debris within its parkland boundaries, including: 1) installing gull/bird proof lids on trash cans, 2) utilizing bilingual employees to enhance educational efforts to Malibu Creek State Park day-use visitors, and 3) periodic removal of transient encampments. However, signs posted in the park are not in both Spanish and English, and their visibility is poor.

Heal the Bay records dump sites during its stream walk activities, which includes parklands. The information collected should be used in determining where to best place trash cans within State Parks boundaries.

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18. ***Confined Animals.*** **Develop BMPs for livestock waste management.**

- **Conduct a survey of existing locations and amounts of animal waste within the watershed.**
- **Prohibit dumping of horse manure along the creek. Enforce set-backs of horse corrals and horse manure storage.**
- **Set limits on the number of livestock per acre to protect resources from overuse by large domestic animals.**

As one component of its EPA 319(h) Nonpoint Source Reduction grant, the RCDSMM conducted an extensive research effort to identify all horse owners and corrals in the Malibu Creek watershed. Their efforts culminated in the development of a Stable and Horse Management BMP manual to help reduce point and nonpoint source pollution from livestock waste. The manual provides information on how to manage horse waste, site planning and design for corrals, drainage and erosion control, etc. The project also included: 1) conducting a watershed-wide survey of horse owners to better understand their current management practices and needs; 2) designing and building a horse manure compost demonstration site as an educational tool for the public; and 3) producing a video entitled "Horse Management Program." These materials are available to the public upon request. However, there is some concern that the message is still not reaching horse owners, or that the owners are not motivated to change their stable locations or practices. For example, Heal the Bay's Stream Team has identified several horse facilities near streams and riparian zones that have poor or non-existent manure management measures. These facilities adversely impact the watershed's creeks and streams.

The County of Los Angeles, Department of Health Services maintains a horse stable monitoring program through biannual inspection of stables with four or more horses throughout the County. These inspections verify that applicable best management practices related to storm water regulations are being implemented and that horse waste is well contained and prevented from reaching the storm drain system. When violations are discovered, the

Department of Health Services takes action to remedy the situation by first working with horse owners. Fines and restrictions are then imposed if that avenue is not effective.

This City of Malibu plans to conduct a survey of horse corrals within the city and will be providing education for proper management of manure once this activity is completed. Additionally, new and re-development projects within the city will be required to provide measures to assure that runoff from corrals does not reach the storm drain system.

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19. ***Household Irrigation Runoff***. **Survey households in upper Medea Creek development to determine reasons and solutions for extraordinary water runoff and report to advisory committee.**

Dry-weather urban runoff from households in the watershed primarily comes from activities such as yard and garden watering, car washing and hosing down driveways and sidewalks. The Metropolitan Water District (MWD) and the Las Virgenes Municipal Water District both offer water conservation education classes for residents addressing such issues as when to water the lawn, what plants are more drought resistant, how to properly install irrigation systems, etc. There are also a host of educational efforts encouraging residents to minimize excessive water use both indoors and outdoors.

However, no official study has been conducted nor report presented detailing reasons for and solutions to the volume of runoff coming from any residential community in the watershed.

20. ***Restore/Enhance Malibu Lagoon and Surfzone*. Restore and/or enhance Malibu Lagoon, including threatened and endangered species.**

Threatened Species
Snowy Plover (*Charadrius alexandrinus*)
Peregrine Falcon (*Falco peregrinus anatum*)

Endangered Species
Brown Pelican (*Pelicanus occidentalis*)
Clapper Rail (*Rallus longirostris obsoletus*) *
CA Least Tern (*Sterna artilarum browni*)
Willow Flycatcher (*Empidonax traillii extimus*)
Bells' Vireo (*Vireo bellii pusillus*) **
Steelhead Trout (*Onchorhyncus mykiss*)
Tidewater Goby (*Eucyclogobius newberryi*)

* Not observed since 1956
** Not recently observed but suspected former nester

Table 2.3. Threatened and endangered species found in the Malibu Creek watershed.

The 13-acre Malibu Lagoon and its surrounding coastal salt marsh, wetlands and surfzone are significant biological resources for both bird and aquatic species, some of which are threatened or endangered (see Table 2.3). The area also represents a vital resting and feeding "stop over" point for many migratory birds, which is especially important given Southern California's few remaining viable habitats along the Pacific flyway.

The avian species listed in Table 2.3 are impacted by a variety of problems in Malibu Creek Lagoon, including: 1) persistently high lagoon water levels which submerge valuable mudflat habitat, 2) human and pet disturbance, 3) poor lagoon water quality, and 4) non-native vegetation. Restoration efforts to improve overall water quality in the lagoon, increase available habitat and limit intrusions have only recently begun. Initial efforts include: 1) the mudflat island created in the lagoon by the RCDSMM through a State Parks grant in 1995, 2) data collection and assessment via several studies and long term projects [see Table 1.3 starting on page 12], and 3) the recent study conducted by the Coastal Conservancy and UCLA on Lower Malibu Creek and Lagoon biota, water quality, hydrology and sources/impacts.

Two primary endangered aquatic species found either currently or historically in the Malibu Creek and Lagoon include steelhead trout and the tidewater goby. The last account of steelhead trout in either Malibu Creek or Lagoon was in 1997, the same year that the species was added to the federal endangered species list. Loss of upstream habitat and spawning grounds are believed to have contributed to its decline and ultimate disappearance in Malibu Creek reaches. Under the guidance of the Santa Monica Mountains Steelhead Trout Recovery Task Force, restoration efforts are just getting underway for this species. The focus of the task force includes assessing the feasibility of removing of Rindge Dam and other creek barriers impeding steelhead migration to upper reaches of the creek.

The tidewater goby, which was added to the federally endangered species list in 1993, was extirpated in Malibu Lagoon in the late 1960's/early 1970's due to the incremental and cumulative effects of environmental stressors such as habitat reduction (resulting from development activities), channelization and destruction of spawning grounds. Prior to the listing, in 1991 restoration efforts had started to both reintroduce and sustain populations of the tidewater goby in Malibu Lagoon. With a grant from the California Department of Parks and Recreation, the Resource Conservation District of the Santa Monica Mountains and Heal the Bay re-introduced 52 tidewater gobies. Seven years later, RCDSMM fish surveyors recorded 1,632 tidewater gobies at four sampling stations in the lagoon. Although the species is nowhere near the point of recovery from a statewide perspective, this number represents a significant improvement for the tidewater goby in Malibu Lagoon. A full report documenting the project, which also includes substantial water quality analysis performed before, during and after the re-introduction, is available from the RCDSMM.

The RCDSMM conducted another lagoon restoration effort in partnership with State Parks and the California Department of Transportation (CalTrans) in 1995. Using *EPA Near Coastal Waters Program* grant funds, a significant portion of Malibu Lagoon was restored by excavating over 2,200 cubic yards of old fill material and creating additional aquatic, mud-flat and high storm flow refugia habitats for birds, tidewater gobies and other aquatic species. Post project monitoring of fishes, water quality, and invertebrates was also performed. This data is available from the RCDSMM.

Malibu Lagoon.

Heal the Bay, through its Stream Team volunteer program, has helped to reduce the volume of trash in the lower creek and lagoon. Since 1998, they have removed over 6 tons of trash. Heal the Bay also serves as the Los Angeles area coordinator for Coastal Cleanup Day, which includes beach clean-up activities at Malibu Lagoon and Surfrider Beach.

State Parks conducts periodic cleanup activities in the lagoon and surfzone area to remove trash and other unwanted materials. Their efforts are helping to preserve the initial restoration efforts conducted by the RCDSMM and others.

Future restoration and enhancement activities are being evaluated by the Lower Malibu Creek and Lagoon Task Force using the Coastal Conservancy/UCLA report recommendations (see Assess Sources/Characteristics, #21, below). A group facilitator is currently helping the task force establish selection criteria and guidelines for voting on the management alternatives outlined in the UCLA report.

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21. ***Assess Sources/Characteristics.***

- **Conduct a thorough and definitive study of lagoon water quality, identify all pollution sources, and develop a remediation plan strategy.**
- **Develop a comprehensive picture of the hydrology, circulation, biota of the lower creek and lagoon and surfzone for policy decision making.**
- **Perform quarterly toxic chemical tests in Malibu Lagoon and surfzone.**

In 1997, the California State Coastal Conservancy contracted with UCLA to conduct the *Lower Malibu Creek and Barrier-Lagoon System Resource Enhancement and Management Study*. The goal of this study was to provide the information and analyses needed for rational, scientifically-based decisions about the management and enhancement of Lower Malibu Creek and Lagoon. The three key objectives of the study were to: 1) compile and synthesize relevant existing information, 2) collect new information to fill critical data gaps, and 3) recommend management and enhancement strategies.

The draft report, which was completed in February 1999, provides information on the hydrology and morphodynamics, biological resources, water quality objectives, effects of eutrophication, management of pathogens and wetlands restoration alternatives for lower Malibu Creek and Lagoon. The report culminates with a list of management alternatives for policy makers to consider when undertaking or planning future restoration efforts. Comments on the draft report were submitted by various watershed stakeholders in May/June, 1999 and have been incorporated into the final report. Already, the Executive Advisory Council and Lower Malibu Creek and Lagoon Task Force members are

using this and other data collected by the RCDSMM (see below) to proceed with developing a remediation strategy for the creek, lagoon and surfzone. As a preliminary step, a facilitator/mediator has been retained by the task force to promote consensus among stakeholders in selecting and implementing various management actions identified in the final report.

Additional data on Malibu Lagoon was collected by the RDCSMM over several years. They have more than ten years of water quality survey data available that includes information on: 1) fish species diversity, densities, seasonal and relative abundance; 2) bird species diversity, seasonal relative abundance and specific area usage; and 3) pre and post- sand barrier breaching abundance and usage (for fish and birds). Two reports in particular, *Malibu Lagoon: A Baseline Ecological Survey (1989)* and *The Tidewater Goby (Eucyclogobius newberryi), Reintroduction of a Geographically Isolated Fish Species into Malibu Lagoon (1993)*, provide a significant amount of water quality and biotic elements data. The RCDSMM also initiated a two-year study in November, 1996 entitled *Effects of Breaching the Sand Barrier on the Biota at Malibu Lagoon*. As part of this study, fishes and birds were surveyed, lagoon water levels were recorded and extensive water quality data was collected for ammonia (as nitrogen), nitrates (as nitrogen), phosphates, dissolved oxygen, turbidity, water temperature, pH and salinity. Data collection was completed in 1998 and is available for review from the RCDSMM.

Other Malibu Creek/Lagoon biota and water quality data have been collected over the past few years, primarily through projects requiring and/or conducting monitoring programs. These include:

- Construction of the new Pacific Coast Highway bridge (CalTrans);
- RCDSMM's *EPA Near Coastal Waters Grant*;
- *Enhanced Monitoring Program on Lower Malibu Creek and Lagoon*[14];
- Installation of groundwater monitoring wells in Malibu Lagoon State Beach (City of Malibu/State Parks); and
- The RCDSMM's ongoing Marine Sciences Environmental Education Programs at Malibu Lagoon.

Collectively, this relatively long-term data is useful in understanding the comprehensive picture of Malibu Lagoon's dynamic water quality

[14] This study was conducted by Rich Ambrose, et.al. (UCLA) in 1995 and funded by the Las Virgenes Municipal Water District ($110,000).

changes as well as providing insight into the character of the lagoon's biota.

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22. ***Illegal Drains***. **Eliminate known illegal storm drains entering the lagoon and particularly investigate sources emptying into the unclaimed storm drain.**

A number of drain pipes exist that discharge flow directly into Malibu Lagoon. The largest, a 24-inch pipe known as the Mystery Drain, carries runoff from the Malibu Road catch basins adjacent to Webb Way and from private catch basins in the Malibu Colony area (this drain is not considered "illegal" by the City of Malibu). As mentioned under Reduce Pathogens (#7), the City of Malibu was awarded Prop A funds to install a Storm-ceptor **J** near the end of the Mystery Drain to remove grease, oil, trash and sediment. The City has a long-term goal of eliminating "Mystery Drain" flows to Malibu Lagoon by redirecting the discharge through a new ocean outlet at the western end of the Malibu Colony. However, due to the complexities of permitting a new ocean outlet and private property issues, this project has not yet been scheduled.

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23. ***Septic Systems***. **Implement dye study of the septic systems in the vicinity of the lagoon and surfzone. Study all identified septic systems and replace all malfunctioning septic systems.**

Septic systems in the lower watershed have long been suspected of contributing pathogens and nutrients to the Malibu Creek, lagoon and surfzone. However, identifying all sources and reducing pathogen/nutrient loading have proven to be among the most challenging issues facing watershed stakeholders.

There are an estimated 390 multi-family and commercial complexes using septic systems in the City of Malibu. Although these users are required to obtain discharge permits from the Regional Board, only 11 complexes had filed for and received discharge permits by 1999 to operate their septic systems.[15] Single family residential septic systems, estimated at 3,800, are not required to apply for a discharge permit from the Regional Board.

Many of Malibu's 4190 septic systems are suspected of contributing

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[15] *Omission Accomplished: The Lack of a Regional Water Board Enforcement Program, 1992-1997*. Heal the Bay. January, 1998.

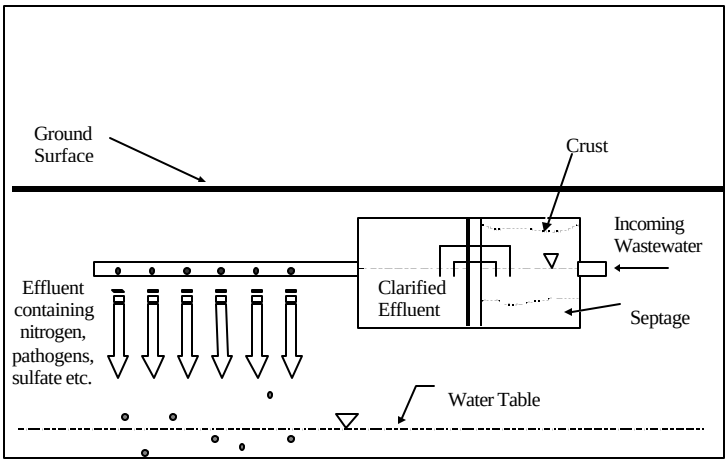

Figure 3. Septic system flow diagram.

pathogens and nutrients to the poor water quality conditions documented in Malibu Creek and Lagoon[16]. They are suspected contributors because septic effluent is released through subsurface discharge pipes into leach fields near the creek, lagoon and surfzone(see Figure 3). This effluent contains pathogens and nutrients which, under the right conditions, can be mobilized in groundwater. The City of Malibu and other enforcement agencies have historically lacked sufficient data to assess whether septic systems actually contribute pathogens and nutrients to nearby receiving waters, and monitoring of homeowner septic maintenance and/or replacement activities has not been conducted.

Several studies over the past few years have been carried out to determine the sources and amounts of pathogens/nutrients contributing to the lagoon and surfzone's degraded water quality. One such study, conducted by the Coastal Conservancy/UCLA, was completed in March 1999. While the report does suggest that nearby septic systems provide nutrients and pathogens to the lower Malibu Creek and Lagoon, how much is not clear. It recommends that more testing be conducted. (The study also included five different sampling events over a nine-month period to identify the presence of specific viruses in the lagoon and surfzone, but none were detected.)

Using consultants, the City of Malibu recently completed an extensive, two-phase study addressing the impacts of septic systems on Malibu Creek, lagoon and surfzone. In 1998 under Phase I, 11 groundwater monitoring wells were installed in strategic locations throughout the study area[17] to evaluate the potential of pathogens to be transported from septic effluent to groundwater and ultimately the creek, lagoon and surfzone. Biophage[18] tracers were used to determine this link. The results of the

[16] Septic discharges occur underground in a leach field. The potential mobility of contaminants found the leach field are influenced by groundwater level and hydraulic gradient (direction and flow velocity).

[17] Two wells were installed between residential septic leach fields and the lagoon, one in the Malibu Lagoon parking lot, seven in the vicinity of the commercial leach field nearest to Malibu Creek and one on Cross Creek Road up-gradient from the other test sites.

[18] A biophage is a genetically synthesized virus that is physically identical to an enteric virus but is non-pathogenic.

first phase indicated two findings[19]:

- Under simulated breach conditions when the groundwater table was at least 2 feet below the leach field, the biophage tracer (PRD-1) did not appear in any samples taken from the monitoring wells. However, bromide (another tracer) did appear in groundwater samples directly below the septic leach field, indicating that there is a hydraulic connection.

- Groundwater that first intersected the leach field and then was subsequently drawn down (simulating breach conditions) showed that both the biophage (MS-2) and bromide were transported beyond the leach field boundary.

Based on these findings, two conclusions were drawn. First, if at least two feet of unsaturated soil can be maintained between the bottom of a leach field and the top of the groundwater table, then there is little concern regarding pathogen transport. However, if the groundwater intersects the bottom of the leach field, then there is cause for concern that pathogens will be transported in the direction of the creek, lagoon and surfzone.

In 1999, a follow-up study (Phase II) was conducted by Malibu in partnership with the Los Angeles Regional Water Quality Control Board to identify potential sources of pathogens in the study area. The City and Regional Board participated in both the design of the study parameters and sampling events. Groundwater, surface water, sediments and storm drain discharge samples were collected and analyzed for coliform (total, fecal, e-coli, enterrococcus), BOD, MBAS (a marker for detergent), nitrogen compounds (NO_3, NO_2, organic N) and phosphates. The samples were collected under different hydraulic conditions – during lagoon closure, breaching and open tidal action. Results of the study have been compiled and are available in the report, *Study of Water Quality in the Malibu Area, City of Malibu, California, Phase II*. Major findings of this report include:

- The discharges from three storm drains into Malibu Lagoon are contaminated with coliform bacteria, but the majority of coliform bacteria (99%) comes from Malibu Creek's upstream sources.
- The height of the groundwater table is influenced by the state of the

[19] *Study of Potential Water Quality Impacts on Malibu Creek and Lagoon From On-Site Septic Systems*. Prepared for the City of Malibu by URS Greiner Woodward Clyde. June, 1999.

lagoon (breached vs. bermed). Following a lagoon breach, concentrations of bacteria and nutrients found in the corresponding leach field area mobilize in the groundwater but attenuate over distance traveled.
- Samples taken from the wells located between the Colony and Malibu Lagoon suggest possible impacts from septic systems.

Also based on the monitoring results of the Phase II study, the Regional Board concluded in an August, 2000 report[20] that:

- Septic systems contribute to groundwater pollution in the Malibu Valley due primarily to insufficient separation between the groundwater table and septic leach fields.
- There is a hydraulic connection between groundwater in the Malibu Valley and local surface waters as evidenced by the correlation between groundwater movement and Malibu Creek and Lagoon water levels.
- The nutrients and pathogens/bacteria discharged by Malibu Valley septic systems adversely impact Surfrider Beach.

The Phase II monitoring data confirmed, and study participants agree that if groundwater levels intersect the bottom of a septic leach field near Malibu Creek, then there is cause for concern that pathogens will be transported over longer distances, potentially reaching the Malibu Creek, Lagoon and surfzone.

There is disagreement over some of the conclusions drawn from the Phase I and II studies. Local regulatory agencies feel that additional factors must be considered before making any determination about the impact of septic effluent on Malibu Creek, lagoon and surfzone. Specifically, the geology of the site, direction of groundwater flow, time of day monitoring is conducted and the volume of effluent treated through the system must all be considered. At the time the *Making Progress: Restoration of the Malibu Creek Watershed* report was released, the project design, data collected and all conclusions drawn from the Phase II study had not been peer reviewed or evaluated by outside sources.

Although Malibu has not established an exact count of all private sewage disposal systems (PSDS) within its jurisdiction, the City has begun implementing programs, ordinances and other measures to assure the safe operation of on-site wastewater treatment systems. In 1999, the City adopted modifications to the Plumbing Code addressing or calling for

[20] *Preliminary Results of the Malibu Technical Investigation.* Los Angeles Regional Water Quality Control Board. August 18, 2000.

minimum tank sizes, appropriate flow rates, secondary treatment, filtering systems and more restrictive design criteria for new commercial and multi-family developments. The City has also seen problem septic systems in Malibu remedied through the use of advanced treatment systems. And, while no specific program requirements have been set, Malibu is also considering several strategies to further monitor and control septic system discharges. These include:

- Establishing a *Pumping Records Registration Program*;
- Developing an ordinance which would require mandatory retrofit to ultra low flow and low consumption fixtures/plumbing devices in all occupancy structures;
- Developing an ordinance requiring mandatory installation of grey water systems for all new construction;
- Adopting a contractor/plumber designed registration program; and
- Establishing an on-site, septic system inspection program.

In January 2000, the Santa Monica Bay Restoration Project convened a *Septics Management Task Force*[21] to develop a set of recommendations for how to better manage this potential nonpoint source of pollution. These recommendations, which include local permitting and inspection/monitoring of single family septic systems, were presented to various agencies and stakeholders during the fall of 2000 and will be adopted in the beginning of 2001 by the SMBRP's Bay Watershed Council. Once adopted, it will be the responsibility of the appropriate agencies to begin implementation of these measures.

The Ventura Regional Sanitation District, utilizing US EPA 319(h) grant funds, is planning a demonstration of off-the-shelf advanced individual disposal systems capable of treating household wastewater to less than 10 mg/l of total nitrogen. The results of this demonstration will certainly be useful to planners, agencies and septic system users in the Malibu Creek Watershed.

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24. ***Lagoon/Water Level Breaching***. **Evaluate options for regulating lagoon levels without artificial breaching of the lagoon. Prevent unnatural breaching of the creek/lagoon.**

[21] Participating agencies include the SMBRP, Heal the Bay, Supervisor Zev Yaroslavsky's office, City of Malibu, State Department of Health Services, Los Angeles Regional Water Quality Control Board, City of Los Angeles, and Los Angeles County Departments of Health Services, Regional Planning and Public Works.

Until 1997, State Parks was informally permitted the authority to institute breaching activities when Malibu Lagoon's waters reached a certain level. However, at the urging of local resource agencies who were concerned about the impacts of artificial breaches on the lagoon's sensitive aquatic species (i.e., tidewater gobies), the California Coastal Commission (CCC) and Army Corp of Engineers halted all breaching activities until a study could be conducted to assess the overall impact to the system. Exceptions were granted only when public health was threatened, (e.g., when lagoon waters reached levels that caused malfunctions/backups of nearby residential and commercial septic systems).

The RCDSMM conducted a study, *Effects of Breaching on the Biota*, which looked at how breaching affects many species found in the lagoon. They concluded that there is definitely a negative impact on these species when breaches occur.

There are, however, periodic artificial breaches spearheaded by the "shovel brigade," i.e., persons who feel that high water levels combined with poor lagoon water quality directly impact human health at a popular surf area. The shovel brigade takes it upon themselves to "control" where the breach occurs when the lagoon's water level is so high that a natural breach is imminent. This group digs a channel at the western-most edge of the lagoon to prevent the sand that is washed out from piling up at the first break point and adversely altering the shape of the waves for surfing.

In August 1999, State Parks issued a *Request for Proposals* for the design and construction of a system that will help manage the lagoon's water level during the dry season without adversely affecting fish and wildlife (e.g., tidewater gobies, steelhead trout). Until a system is approved and constructed, artificial breaching will not be permitted unless public health and safety are threatened.

25. ***Public Notices.***

- **Breaching / Public Health: Regular notices to inform the public and agencies about breaching times of lagoons.**

  As a standard practice, State Parks informs the public and other concerned parties each time a mechanical/artificial breach of the lagoon is to be performed. In addition to notifying key agencies such as the Coastal Commission, State Parks notifies local newspapers. The Los Angeles County Department of Health Services and LA County Lifeguards posts beach closure signs and warn beach-goers near the breach point.

- **Encourage Los Angeles newspapers to publish weekly monitoring bacteria results at beach entrances**.

  In 1990**,** Heal the Bay launched the first-ever *Beach Report Card*. **J** Using water quality data from samples collected by the Los Angeles County Department of Health Services, County Sanitation District of Los Angeles County (CSDLAC) and the City of Los Angeles Environmental Monitoring Division at Hyperion, Heal the Bay interpreted bacteria results and established a grading/reporting system (A-F) that the general public could easily understand. Initially, beach grades were published on a monthly basis for 61 beaches throughout Los Angeles. Grades are now provided for over 250 beaches in Los Angeles, Orange, Ventura and Santa Barbara Counties via local newspapers, marine shops surf and dive shops and on local weather stations. Grades are also posted on Heal the Bay's website, which has undergone improvements to better inform the public about how the beaches are monitored and the health risks associated with swimming in the Bay.

  Four of the 250 beaches graded are located in Malibu – 3 locations near Surfrider Beach and one at Malibu Pier. Whenever the lagoon is breached, Surfrider Beach receives an "F" grade (based on water quality data). However, the data showed excellent water quality during the four summer months of 1999 when the lagoon was not breached.

- **Implement public notification and education programs about potential health problems at beaches.**

  In 1995, the Santa Monica Bay Restoration Project conducted a comprehensive epidemiological study to assess the correlation between contaminated storm drain discharges and incidence of swimmer illness[22].

[22] Other organizations and agencies providing funding and support for this study include the

Revised beach warning signs.

Results of this study showed, conclusively, that there is a significant increase in occurrence of illnesses among swimmers who swim within 100 feet of flowing, dry-weather storm drains. Immediately following the release of this study, new warning signs were created and permanently posted directly in front of flowing storm drains, calling attention to the dangers associated with swimming in urban-runoff contaminated waters. The results of the study also triggered revisions to the County's Beach Closure and Health Warning Protocol, which now requires posting the new warning signs and notifying the public of beach closures in a timely fashion and on a more regular basis. Four years later, the results of this study are still used as a guidance tool by the media, environmental organizations and others to inform the public of the risks associated with swimming in front of flowing storm drains.

Following the Epidemiological Study, Heal the Bay initiated, helped draft and advocated for passage of a bill that would require California's popular beaches (i.e., more than 50,000 visitors annually) which receive storm drain discharges to: 1) conduct routine water quality monitoring for three bacterial indicators, and 2) inform the public when established bacterial thresholds have been exceeded by posting warning signs or closing the beach. The bill (AB411), which was passed in October 1997, also requires local health agencies to set up a hotline to inform the public of all beaches currently closed, posted or otherwise restricted. Heal the Bay also utilizes volunteer speakers through its *Speaker's Bureau* program to help educate over 25,000 people every year about: 1) sources of sewage to the bay, 2) the potential health problems associated with swimming in contaminated waters, and 3) where and when to swim in Bay waters. The program targets schools, corporations and community groups.

State Water Resources Control Board, City of Los Angeles, Beach Cities Health District, City of Santa Monica, Los Angeles County Department of Public Works, Los Angeles Regional Water Quality Control Board, Chevron Companies, Las Virgenes Municipal Water District, Milken Family Foundation, Heal the Bay and the US Environmental Protection Agency.

26. ***Malibu Lagoon/Bridge***. **CalTrans should set up a mitigation fund to cover the costs of any impacts to Malibu Lagoon and the surfzone resulting from the reconstruction of Malibu's Pacific Coast Highway Bridge.**

Within one year of completing the Pacific Coast Highway bridge across Malibu Creek and Lagoon, CalTrans provided State Parks approximately $110,000 for salt marsh restoration activities. State Parks used these funds to remove exotic plant species in the area just below the bridge and revegetated it using native plants. CalTrans also provided $98,830 to the Resource Conservation District of the Santa Monica Mountains over a five year period (1996-2000) for tidewater goby monitoring and restoration activities (including funds for the *Effects of Sand Breaching the Sand Barrier on Biota* study; see Lagoon/Water Level Breaching, #24).

27. ***Landfill***. **Expand the understanding of the impact of the Calabasas landfill on water quality and especially ensure that Calabasas landfill installs monitoring wells which they were directed to construct in 1990; report monitoring results of findings to the advisory committee.**

In cooperation with the County Sanitation Districts of Los Angeles County (CSDLAC), the National Park Service (NPS) prepared an environmental assessment (EA) on the issuance of a special use permit for continued operation of the landfill. The EAs preferred alternative included issuance of a permit with 13 conditions to mitigate the impacts of the landfill on park resources and visitor enjoyment. These conditions include: 1) off-site preservation of 100 acres of habitat along the US 101 freeway corridor, 2) $40,000/year wildlife fund for wildlife habitat research, 3) native plant restoration of landfill slopes, 4) alternative grading concept plans, and 5) development of an interpretive wayside exhibit addressing solid waste management and environmental issues. The five year permit was issued in November, 1998 and implementation of its 13 conditions began immediately afterward.

As part of the condition of approving the permit, CSDLAC purchased off-site land to permanently mitigate the loss of habitat. The 107-acre parcel purchased (referred to as the Albert Abrams property) is located on the south side of Agoura Road, west of Liberty Canyon Road and is a vital link to the wildlife corridor.

A groundwater study is also being conducted at the landfill to further define the extent of the landfill's effect on groundwater. In August and October 1999, eight piezometers were installed in the area to obtain geologic and hydrogeologic data. The information gathered will be used by the County Sanitation District to: 1) acquire those portions of the Lower Cheeseboro Canyon that contain surface or subsurface contamination and 2) design a water quality corrective action program. Routine post-rainfall surface water testing continues to show no adverse impact to surface water quality resulting from landfill operations.

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28. ***Water Imports and Discharge***. **Maximize environmentally acceptable use of reclaimed wastewater (household and treatment plant) and grey water, and reduce the importation of potable water. Encourage use of reclaimed water for irrigation of landscaping and community open space. Price reclaimed water more competitively.**

Harmoniously implement water conservation efforts and grey water ordinances between cities. Ultimate long-term goal of no-waste discharges into waters used for recreation and/or for sources of food.

The Las Virgenes Municipal Water District provides 65,000 residential customers, nearly 75% of the watershed's residents, with approximately 18,000 acre-ft of imported water each year. Several other water agencies also supply an additional 10,000 acre-ft of potable water to upper watershed customers; these agencies include Callegus Municipal Water District, Triunfo Sanitation District, Oak Park Water Co., California Water Services Company, Lake Sherwood Community Services District and Hidden Valley Mutual Water Company. The amount of water returned by these residents to the Tapia facility for tertiary treatment is about 11,200 acre-ft, of which 5,000 acre-ft is recycled and beneficially used for irrigation. The greatest demand for Tapia's recycled water is for irrigation purposes, usually from mid-June to mid-September, when temperatures are higher. Moderate, but highly variable demand is observed in the "shoulder" periods of May through mid-June and mid-September through October, with much lower demand for the remaining six months of the year. During peak demand, 100% of Tapia's daily volume of recycled water is distributed to users and potable water is often used to supplement the supply. To keep spring and fall surplus water out of Malibu Creek, each year the District installs and then dismantles (to allow mowing and discing) over 35 miles of temporary irrigation pipes for surplus disposal via off-site spray fields. The District has even expanded recycled water incentives, giving surplus water away for free to its existing customers. It is also seeking state and federal co-funding to connect new customers that are currently too far away to serve economically. Combined, these programs/approaches have enabled the District to keep Tapia's effluent out of the creek from mid-April through mid-November.

The Las Virgenes Municipal Water District has also passed ordinances requiring the use of recycled water anywhere state law allows and the distribution system can reach. Price incentives are used to encourage use of reclaimed water. The District also uses a tiered rate structure to discourage waste and runoff of potable water (i.e., the unit rate increases with excess use). Other water conservation efforts are highlighted under Composting, Recycling and Conservation (#29).

In November of 1997, the Regional Board renewed the Tapia Water Reclamation Facility's NPDES permit and included new effluent discharge prohibitions. The new permit prohibits Tapia from discharging

its effluent into Malibu Creek from April 15th through November 15th. In 1998, during the first summer of prohibition, Tapia was unable to store or find alternative uses for its effluent and violated the permit several times during that period. Reasons for the violation include: 1) lower recycled water demands, and 2) the limited time period given for LVMWD to evaluate and implement creek discharge avoidance alternatives. However, LVMWD is seeking permanent alternatives to discharging into the creek. They hired consultants and engaged stakeholders to conduct a study which would identify and assess both short- and long-term options for using, storing and/or disposing of the effluent. The resulting report, entitled the *Malibu Creek Discharge Avoidance Study*, identified a whole range of discharge alternatives for LVMWD to consider. An Environmental Impact Report (EIR) was subsequently developed for four project alternatives and seven other potential project alternatives.[23] The results of this report were provided to the Regional Board in late 1999.

At the municipal level, several cities have also taken measures to promote and/or require recycled water use. For example:

- Calabasas' local city ordinance encourages use of reclaimed water for landscape irrigation purposes and planting of drought tolerant native species within its jurisdiction. The City's Landscape Manager also provides technical assistance to residents who want information on efficient water usage by reviewing "plant palettes" for individual homeowners. Commercial development projects within the city require significant water budget calculations and plan checks prior to plan approval. A similar water budget program was instituted for individual homeowners originally, but because of the significant costs associated with developing a water allocation and budget plan, that program has been significantly reduced and is now limited to the elements mentioned above. The City's Planning Department, in conjunction with the Environmental Commission, has developed an Environmental Connection Handbook which addresses many topics such as water conservation, native plants and xeriscape. This handbook is available to residents who request it.

- The Cities of Agoura and Westlake Village endorse water conservation and reuse, and utilizes reclaimed water in all city parks, along the freeway, on street medians and on parkways wherever

[23] The four project alternatives included: 1) Deliver raw sewage to the City of Los Angeles sewer system; 2) Discharge recycled water to the Los Angeles river drainage basin; 3) Expand recycled water system; and 4) Store excess recycled water in the Las Virgenes Valley Basin.

available. Projects are routinely conditioned to utilize reclaimed water, such as landscaping projects along Kanan Road, Agoura Hills Road and along the 101 Freeway in these cities.

- The City of Malibu produced the *Grey Water Handbook* to help eliminate illegal disposal of grey water by encouraging residents to use it for irrigation. The city also modified the Plumbing Code to allow disposal through the use of sub-surface irrigation.

- The Triunfo Sanitation District endorses water conservation and promotes reclaimed wastewater reuse to its customers. These customers, which include the communities of Oak Park, North Ranch, Lake Sherwood and Westlake Village, use reclaimed wastewater on road medians and park grounds, and at schools and homeowners association developments. The City of Thousand Oaks and the County of Ventura also routinely condition projects to use recycled wastewater.

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29. ***Composting, Recycling, Conservation***. **Implement improved recycling efforts. Maximize treatment and reuse potential of all aspects of the watershed's waste disposal operations (septic, sewer, sludge farming, and landfill operations).**

- **Encourage composting and other forms of recycling for waste management.**
- **Encourage recycling and reuse efforts to reuse water, household hazardous waste, plastics, paper, glass, cardboard, tin and aluminum.**

Several different agencies, municipalities and organizations are both responsible for and committed to accomplishing the goals of this action. Together, these combined efforts aggressively promote recycling and conservation throughout the upper and lower watershed.

- LAC-DPW and Ventura County both conduct a variety of county-wide outreach programs on composting, recycling and conservation which target residents and businesses. Program components include:
  - Operating residential curbside recycling program for single and multiple family dwellings in most unincorporated areas. In addition to providing collection services, they provide educational brochures to residents to help increase their level of awareness about recycling issues.
  - Conducting Household Hazardous Waste Roundups in

partnership with cities throughout the County. In 1998, Agoura Hills, Malibu, Calabasas, Hidden Hills and Westlake Village participated in roundups that resulted in collection of 24,246 lbs. of waste.

- Producing and distributing of Public Service Announcements (PSAs) and educational advertisements/brochures.
- Hosting free workshops and events to educate residents about green waste recycling, composting and gardening techniques to reduce water use. This program also promotes the recycling of Christmas trees each year.
- Partnering with local agencies to provide household hazardous waste roundups for their residents on a regular basis.

LAC-DPW and Ventura County promote participation in recycling programs through radio PSAs, web sites, local newspapers, fliers, city hall offices, chambers of commerce and libraries. When roundups are scheduled in a particular city, a banner is often hung across a road in a prominent section of town advertising the event. Both Counties also offer semi-annual *Green Gardening* workshops for the general public which include non-toxic gardening suggestions and composting information/supplies.

- The Las Virgenes Municipal Water District promotes composting and conservation efforts through:

  - The *Rancho Composting Facility*, which recycles all of Tapia's biosolids into garden compost. The compost is then sold in nurseries instead of being sent to the Calabasas landfill. The District has also installed two advanced energy fuel cells at the composting facility to convert methane gas generated from wastewater processing into electricity. The cells are now fully operational and generate power for use and sale.
  - A pilot incentive program, which was launched during FY 1998/99 for customers willing to replace all of their toilets with ultra low flow toilets (ULFT). This program tripled the number of ULFT retrofits in one year from 300 to 900.
  - The District co-sponsored *North American Residential End Use Study*, which installed data loggers in 100 homes to gather detailed information on water use. The data is being used to set national standards on appliance efficiency and conservation program planning. The study confirmed that toilet flushing is the single largest indoor use and provided data on leak incidence. Other water conservation practices promoted by LVMWD are

addressed under Public Education: Conservation (#30).

- The City of Malibu, jointly with LAC-DPW, maintains a permanent used oil drop-off site at its City Hall. The City also hosts monthly "Household Hazardous Waste Roundups" for collection of water-based paint, batteries and oil/oil filters, and bi-annual roundups for other chemicals. Malibu promotes its recycling efforts through the City's quarterly newsletter and distributes oil recycling containers and literature through a partnership with a local automotive retailer. Using these collection avenues, local residents recycled approximately 1143 gallons of used motor oil during the fiscal year 1997/98.

- Calabasas recently began offering curbside recycling for green waste and mixed recyclables to local residents. The City also provides: 1) the Environmental Connection Handbook which promotes reducing/reusing/recycling, composting and correct disposal of household hazardous waste, and 2) monthly used oil, paint, batteries, and antifreeze recycling opportunities.

- The City of Agoura Hills offers residents several opportunities to recycle their waste and conserve water. They: 1) conduct a curbside recycling program for paper, metals, and glass (initiated in 1991); 2) conduct a Christmas Tree recycling program each year; 3) initiated yard waste and household hazardous waste collection programs in 1995, and 4) adopted a Water Efficient Landscape/Irrigation ordinance in 1992 to reduce the amount of water being used for landscape/irrigation purposes. The City also began using rubberized asphalt in all overlay programs. During fiscal year 1998/99, the City used over 15,000 recycled tires in the overlay program.

- The City of Thousand Oaks offers weekly curbside pickup of green waste for recycling and bi-weekly pickup for paper, glass and metals.

- State Parks ensures, through its waste hauler contracts, that recycling bins are provided for the public to use when visiting Malibu Creek State Park and Malibu Lagoon State Beach.

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30. ***Public Education - Conservation*. Develop individual support for conservation practices through education, training and workshops which would reduce sediment and storm water runoff from private property.**

Only the activities undertaken by the Las Virgenes Municipal Water District promoting water conservation are addressed here. Other implementor's conservation programs are part of ongoing, wide-scale and multi-issue public education programs and are addressed under Public Education (#42).

The Las Virgenes Municipal Water District conducts a variety of water conservation programs and outreach projects throughout the year, which include:

- Bilingual "Protector del Aqua" classes emphasizing water conservation for local landscape maintenance companies.
- Distribution of educational fliers promoting water conservation to service area residents (in partnership with the Triunfo Sanitation District).
- A comprehensive website (www.lvmwd.dst.ca.us) with easy-to-find water conservation tips and information.
- *The Current Flow*, a quarterly newsletter with periodic information about water conservation and recycling information.
- Participation in local events, such as fairs and farmers markets.
- Classroom presentations and facility tours.
- Water efficiency tours to help residents reduce the amount of water needed for landscape irrigation.

31. ***Runoff Reduction***. **Develop land use decision-making approaches (including land use zoning and ordinances) to reduce point and nonpoint sources of pollution. Specifically, new developments within the watershed should employ on-site reuse of reclaimed water so that there is no net increase of water into the watershed. Develop and implement: 1) guidelines for minimizing and mitigating ecological disturbances related to point and nonpoint water flows into "unimproved" coastal streams; and 2) watershed-wide ordinances which would reduce storm water runoff from private property.**

Riparian corridor in the Malibu Creek Watershed.

In January 2000, the Los Angeles Regional Water Quality Control Board approved strict discharge standards for new developments in all of Los Angeles County. The Regional Board's Executive Officer then issued the new requirements in March, 2000. Specifically, the policy states that all new development projects meeting certain criteria must retain and/or treat the first ¾-inch of rainfall from any storm on-site (i.e., it must not reach the storm drain system). The policy will have a greater impact on newly developing regions than on existing, high density regions. Several cities in the County have appealed this ruling to the State Water Resources Control Board.

The City of Calabasas requires that new developments maintain a certain percentage of pervious surface, depending on what type of construction project is designed. For example, parking lots are required to maintain 30% perviousness. However, in some areas of the City, soils are high in clay content and hence expansive so pervious requirements are challenging. Development projects are thus evaluated on a case-by-case basis. Mitigation measures are required for those sites that do not, or cannot incorporate the pervious surface element into their plans.

The Cities of Agoura Hills and Westlake Village adopted their storm water and urban pollution control ordinances in 1997. As mentioned under Eliminate or Reduce Sources (#4), this ordinance gives Agoura

Hills and Westlake Village legal authority to enforce BMP requirements to reduce point and nonpoint sources of pollution, including site-specific measures for construction projects to minimize ecological disturbances.

The City of Malibu primarily addresses the problem of increased urban runoff from new development through setting limits on impervious surfaces under its zoning ordinance. The criteria for commercial developments includes: 1) devoting 40% of the lot area to landscaping, 2) devoting an additional 25% of the lot area to open space, and 3) limiting the floor area ratio to 15%. The criteria for residential developments includes limiting the use of impermeable surfaces to 30-45% of the total site area. Where downstream flooding and/or erosion is a potential concern, the City also requires developments to provide on-site retention of runoff volumes equal to predevelopment rates.

Recently, the Las Virgenes Municipal Water District, with support from the Metropolitan Water District of Southern California and the US Bureau of Reclamation, installed computerized irrigation controllers on street medians to regulate the amount of water used for irrigation. These controllers were tested against other controllers in the City of Westlake Village. The District also installed advanced plant ETo **J** sensor stations with real-time telemetry which measure the amount of water used by local plants each day. This daily data is linked to the LVMWD website (http://lvmwd.dst.ca.us) and can be accessed by all residents who use irrigation controllers for outdoor irrigation to refine their irrigation schedules. The ultimate goal in providing this data is to reduce: 1) the amount of water needed for irrigation by end users and 2) runoff from street medians. Nearly all large water users such as golf courses, schools, and cities could benefit significantly from the information provided by the ETo **J** sensors. In the coming year, the District will begin to educate the top 20% of its largest users about the sensor data to help them understand its benefits, how to access the data and how to make corresponding changes in their irrigation practices.

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32. ***Recreational Use Impacts.*** **Reconcile demands for public access and resource protection regarding trails and roads.**

There is a need to protect watershed habitats and resources while at the same time allowing these lands to be used for recreational purposes. To better balance these needs, the City of Calabasas outlined a comprehensive Las Virgenes Canyon subwatershed study in 1999 which included: 1) developing a master plan for Las Virgenes creek and 2)

outlining issues to be addressed, such as wildlife corridors, potential for recreation and public access, and engineering requirements for flood control. The information collected under this study will be used to develop a priority list of projects to accomplish riparian habitat improvements for both wildlife and residents. The City has submitted three major grant applications to secure enough funds to both initiate the study and to start working on some of the project's components. The SWRCB 205(j) Watershed Planning Grant application received funding to initiate this study; the Federal EPA EMPACT Grant application was initially denied but resubmitted with changes; and the Water and Watersheds Research Grant application was denied.

In addition to installing interpretive signs next to the parking lot at Malibu Creek State Beach, the RCDSMM incorporated a public access trail into its Malibu Lagoon restoration project (highlighted under Restore/Enhance Malibu Lagoon and Surfzone, #20). Visitors can now walk directly to the shores of the lagoon near Pacific Coast Highway via a walk bridge and get an up close look at the lagoon's mud flats, birds and aquatic habitat.

While State Parks provides public access to almost all of its natural resource areas, the agency does limit access in employee housing areas, areas that have been revegetated, nesting areas for sensitive/endangered species and any area considered unsafe.

33. ***Land Purchases***. **Purchase high priority watershed protection areas**.

There are several key parcels of land that, if acquired by a non-profit organization or a state or local government agency, would greatly benefit overall restoration and protection goals throughout the watershed. Although none have yet been purchased, State Parks has identified several of these parcels in an internal report.

One such prominent site in the lower watershed is the golf course area adjacent to Malibu Lagoon (on the north side) and the vacant parcel next to it. This land was once part of the lagoon and has the potential to be restored as additional habitat for native species and birds migrating along the Pacific flyway. Other identified parcels include 160 privately owned, undeveloped acres located just north of the Cold Canyon Road northern loop; the Cross Creek Plaza; Ahmanson Ranch; and land near Lake Sherwood in the Hidden Valley area.

The National Park Service, in partnership with local scientists, planners and resource management professionals developed a set of objective, scientifically credible conservation criteria as a basis for deciding which lands in the Santa Monica Mountains were the highest priority for acquisition and protection. Using geographical information system (GIS) tools, lands high in resource value were identified, gaps in knowledge were identified, and maps identifying significant natural, cultural and recreational areas were produced. Land management agencies are using this data to set priorities for land protection within the Santa Monica Mountains and surrounding areas.

The City of Malibu is investigating the possibility of land acquisition for a constructed wetland in the Civic Center. If acquired, the land would provide for wetland treatment of Malibu Creek's flows and a year-round source of water for the existing seasonal wetland located on the north side of the Civic Center Way (west of Stuart Ranch Rd).

The Malibu Coastal Conservancy, a community-based, non-profit organization whose mission is to facilitate acquisition and restoration of open space and environmentally sensitive lands, has also focused its attention on acquiring the open space considered part of the Malibu Wetlands.

34. ***Buffer Zones***. **Develop and mandate site specific buffer zones for sensitive areas.**

Within its park boundaries, State parks has identified areas where buffer zones could be established or improved to protect sensitive areas. One such site is located in Tapia Park. Here, State Parks redesigned the road system to better protect the riparian forest adjacent to Malibu Creek.

The Las Virgenes Municipal Water District, the City of Calabasas and the Santa Monica Mountains Conservancy co-funded ($3,000,000) the purchase of approximately 700 acres of open space adjacent to the District's Rancho Composting facility as a buffer zone against urban encroachment. The City of Calabasas also instituted a development code requiring builders to ensure a 100-ft development setback (or other distance to be determined by a qualified biologist) from watercourses within their jurisdiction.

The City of Agoura Hills has established open space zones for its hillside areas and has adopted County designated "Significant Ecological Area" (SEAs) to help protect local natural resources.

35. ***Habitat Fragmentation***. **Develop and implement land use policy that will eliminate any additional habitat fragmentation. Support existing corridors between isolated open lands and establish alternatives where feasible.**

Together, the National Park Service and State Parks have encouraged and funded habitat linkage studies within Malibu Creek State Park. Through a grant from the National Park Foundation, Canon USA, the Southwest Parks and Monuments Association, California State Parks and the National Park Service, a cooperative research effort was launched in 1996 to address critical concerns associated with carnivores. Because carnivores play a critical role in ecosystem functions and are indicators of ecosystem health, this long-term research will try to determine how urban growth and encroachment impacts carnivore habitat. Components of the study include: 1) radio telemetry to evaluate home range requirements, habitat needs and movement patterns for bobcats, coyotes, badgers and gray foxes, and 2) remote camera surveys to evaluate overall carnivore distribution patterns and to assess population sizes of marked animals. Results of the project will be incorporated into park planning and resource management activities to promote wildlife conservation in the

Santa Monica Mountains. Data on animal movement and critical habitat areas will also be used to guide park planning actions, land protection strategies and habitat restoration efforts.

The City of Calabasas established Open Space Districts through a section of its development code. These districts are intended to prohibit or limit developments in areas: 1) with important environmental resources, 2) with potential hazards, and/or 3) to maintain open space for wildlife habitat.

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36. ***Fish Barriers*. Remove barriers to fish migration, especially Rindge Dam.**

Rindge Dam.

Rindge Dam, which was constructed in 1924, is a 100-ft dam located on Malibu Creek approximately 2.5 miles upstream of Malibu Lagoon. By the late 1950s, the dam had significantly filled with sediment and no longer functioned as intended. The Army Corps of Engineers estimates that 800,000 – 1,600,000 cubic yards of sediment are trapped behind the dam wall today.

Starting in the mid/late 1990s, interest in removing Rindge Dam gained momentum and has since resulted in the formation of the Steelhead Recovery Task Force under the Malibu Creek Watershed Executive Advisory Council. Since its inception, the focus of this task force has expanded from just assessing the feasibility of removing Rindge Dam to addressing all creek barriers prohibiting steelhead trout[24] from reaching valuable upstream spawning grounds. Heal the Bay, through its Stream Team activities, has surveyed 15 miles of Malibu Creek and mapped all barriers to fish passage in the watershed. While Malibu Creek remains the primary focus, several other creeks (Topanga, Solstice and Arroyo Sequit) are also being surveyed and documented for obstructions to steelhead migration.

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[24] Steelhead trout was added to the federal list of endangered species in August, 1998. See Restore/Enhance Malibu Lagoon and Surfzone (#20) for additional information.

Site Statistics	Rindge Dam is located approximately 2.5 miles upstream of Malibu Lagoon. The site selected for construction was the eastern end of a segment of the creek which runs west to east, where the canyon walls narrowed and the geology was most favorable for attaining structural strength and stability.		
Design and Construction	Rindge Dam was constructed in 1924 and the adjacent spillway was completed in 1926. The dam was constructed in a constant arc radius design using Belgian cement and steel railroad rails for reinforcement. Its original purpose was to provide water for irrigation of ranch lands in the Santa Monica Mountains.		
Capacity	The original reservoir capacity of the dam was 574 acre-ft (186 million gallons of water). By about 1956, the capacity had reduced to 50 acre-ft due to increased sediment deposits. By 1965, the reservoir was completely filled with sediment. It is estimated that Rindge Dam now holds approximately 10 million gallons of water within its sediment base.		
Customer Base (No. of Customers,	**Year**	**Commercial Users**	**Irrigation Users**

Steelhead Recovery Task Force efforts led directly to the Army Corps of Engineers (Corps) involvement in assessing the feasibility of the alternatives presented for removing Rindge Dam. In early 1999, the Corps concluded an initial reconnaissance study which determined that there was enough support among watershed stakeholders to move forward with a feasibility study. Among other things, the study also concluded that removal of Rindge Dam and other Malibu Creek barriers would allow steelhead to access an estimated 4630 ft^2 of spawning habitat and 2 linear miles of rearing habitat within the Malibu Creek watershed.

The Corps is now planning a full-scale feasibility study which will assess various removal/mitigation alternatives, associated costs, timelines and federal interest. Potential alternatives include: 1) dam removal, 2) installation of conduits through the dam and reservoir, and 3) construction of a fish ladder.

Despite these efforts, the feasibility of steelhead's survival in the upper watershed has been questioned by some who cite high temperatures, variable creek flows, contaminated discharges and other barriers as detrimental to the survival of the species. Although historical flow data indicates that Malibu Creek was an intermittent stream, several fish biologists looked at recent water quality/quantity data and found that current upper and lower creek conditions would not be detrimental to steelhead trout.

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37. ***Exotic Vegetation***. **Support control of the intrusion of exotic plants into the wilderness areas of the watershed.**

Controlling the spread of exotic vegetation in the watershed is, at best, a daunting task that requires endless effort and resources. More than 20 species have significantly impacted the Malibu Creek watershed and other

coastal regions, and their impact is cumulative. Table 2.4 highlights the watershed's most significant non-native plant species. Some plants (grasses) have even changed the soil structure, making it nearly impossible for native species to grow.

Exotic Plant Species Found in the Malibu Creek Watershed

Common Name	Scientific Name
Black Mustard	*Brassica nigra*
Castor Bean	*Ricinus Communis*
Eucalyptus	*Eucalyptus sp.*
Euphorbia (false caper)	*Euphorbia terracina*
Giant Reed	*Arundo Donax*
Horehound	*Marubium vulgare*
Harding Grass	*Phalaris aquatica*
Ice Plant	*Carpobrotus edulis*
Italian Thistle	*Carduus pycnocephalus*
Mediterranean Mustard	*Hirschfeldia incana*
Milk Thistle	*Silybum marianum*
Myoporum	*Myoporum laetum*
Pepper Grass	*Lepidium latifolium*
Ripgut	*Bromus diandrus*
Smilo Grass	*Piptatherum miliaceum*
Star Thistle	*Centaurea melitensis*
Sweet Fennel	*Foeniculum vulgare*
Tree of Heaven	*Ailanthus altissima*
White Sweet Clover	*Melilotus albus*
Wild Tree Tobacco	*Nicotiana glauca*
Yellow Star Thistle	*Centaurea solstitialis*

Table 2.4. Exotic plant species found in the Malibu Creek watershed.

One of the most prolific exotic plant species found in lower and upper Malibu Creek Watershed is A*rundo donax* (also known as giant reed). This reed can grow as much as 2.5 inches per day and reach a maximum height of 27 feet. Its growth rate and rapid defense mechanism make it nearly impossibly to eradicate once an area has been invaded. The plant spreads primarily during floods when it is uprooted from upstream locations and transplanted further downstream. *Arundo donax* soaks up huge amounts of water, rapidly replaces native riparian habitats, obstructs wildlife access to waterways and is an extreme fire hazard. Data collected by Heal the Bay's Stream Team shows that there is an enormous amount of *Arundo donax* in Malibu Creek, just below Malibu Creek State Park. Efforts are currently underway to remove it from a 2.5-mile reach of Malibu Creek, between Rindge Dam and Malibu Lagoon. Once removed, native species will be planted as necessary to create a healthy riparian canopy in areas disturbed by this invasive plant.[25]

State Parks, Mountains Restoration Trust and Stream Team volunteers have identified and recorded non-natives throughout the watershed. Stream Team volunteers are even using global positioning system (GPS) devices and field guides which have plant identification keys to identify the

[25] This is a cooperative project between the National Park Service, Santa Monica Mountains National Recreation Area (NPS), California Department of Parks and Recreation, Malibu Creek State Park; and Mountains Restoration Trust.

exact locations of several non-native plants found in riparian zones.

With assistance from the Los Angeles County Fire Department, State Parks has initiated four prescribed burns since 1996 to help control proliferation of milk thistle, an exotic species found on the parklands. They also manually remove, on a regular basis, substantial stands of yellow star thistle, sweet fennel, Arundo, Euphorbia and other exotic plants on the parklands.

Weed Warriors, a volunteer group coordinated by the California Native Plant Society and recruited by word of mouth, has removed invasive exotic vegetation (e.g., castor bean, ice plant, Arundo) from public lands throughout the Santa Monica Mountains since the mid-1980s. Some of their restoration locations include Sycamore Canyon, Cold Creek, Malibu Creek State Park, Lower Malibu Creek and Lagoon, and Bluff Park. The number of volunteers and volunteer hours recruited for restoration activities varies from location to location, but usually ranges somewhere between 1000-2000 hours each year. The frequency of restoration activities ranges from monthly to yearly, depending on the site. However, Weed Warrior's efforts to remove non-native vegetation are significantly boosted immediately after a fire when re-sprouting, non-native plants are small and easy to remove. Heal the Bay has even begun to advertise Weed Warrior event dates in their monthly volunteer newsletter *Sea Stars*. Because Weed Warrior volunteers do not use heavy or powered equipment, they generally choose areas where a native remnant population still exists. This approach increases the success of their efforts because it improves the opportunity for native re-colonization once the exotics are removed.

The City of Malibu reviews all new development plans to ensure that invasive, non-native species are not planted. The City maintains and provides, upon request, a list of prohibited plants to applicants and landscape architects. City personnel also make recommendations on what types of native species to plant. However, the City does not require existing exotics to be removed unless it is required as mitigation for a project, or unless the plants are targeted by the County Fire Department as part of a fuel modification plan to reduce the threat of fire. The City's Environmental Review Board will consider measures to increase the public's awareness about exotic vegetation in their workplan to the City Council in February, 2000.

Most recently, a new sub-committee has been formed under Malibu Creek Executive Advisory Council – the *Invasive Species Task Force*.

Its mission is to identify, assess and initiate removal of invasive species in the watershed.

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38. ***Wetlands*. Maintain, restore, create and enhance wetlands (natural and created).**

The Southern California Coastal Wetlands Inventory, which was established as part of Governor Wilson's *1993 Wetlands Conservation Strategy*, identifies 39 coastal wetlands between the Point Conception and Mexican border. Malibu Lagoon is included in that inventory. The overall goal of the strategy has been to identify regional and statewide wetland restoration and enrichment opportunities. Information for each wetland in the inventory includes: 1) a map of the site's historic perimeter, 2) a map of the site's vegetative communities, and 3) a site profile documenting the wetland's physical and biological characteristics. A comprehensive summary of Malibu Lagoon's inventory information can be found on the internet at http://ceres.ca.gov/wetlands/geo_info/so_cal.html.

Locally, the City of Malibu completed a wetlands delineation for the Civic Center area. Only one site was identified as an existing wetland – a sump area approximately four acres in size which is located north of Civic Center Way and west of Stuart Ranch Road. The City is also considering plans for a constructed wetland/creek paralleling Civic Center Way. The wetland/creek would secure a connection between Malibu Creek and the existing wetland (pond) area to provide: 1) additional biological treatment for dry weather flows and 2) storm water detention in the event of flooding in the Civic Center area.

The Malibu Coastal Land Conservancy helped the City of Malibu secure a $150,000 grant from the Federal Emergency Management Act (FEMA) flood insurance plan to develop a city-wide flood mitigation plan. The plan will: 1) identify areas with repetitive flood damage claims, 2) develop appropriate mitigation measures, and 3) evaluate wetlands restoration as a potential flood mitigation measure in the Civic Center area.

In March 1998, the Las Virgenes Municipal Water District began rehabilitating a percolation pond as a constructed wetland. The pond, once rehabilitated, could be used to polish Tapia's effluent and to treat urban runoff flowing from the upper watershed. However, there is some debate about what the constructed wetland is to be used for during the

Tapia's summer discharge prohibition period each year.

39. ***Coordinate on a Watershed Basis.*** **Create and implement a regional and subwatershed approach to the coordination of land use and water quality decisions for ongoing implementation concerns and to reduce unnecessary overlaps of ordinances and streamline regulations.**

- **Develop guidelines to reconcile the attainment of water quality objectives and resource protection with other, possibly conflicting public service goals, such as fire protection, flood control, and geologic stability.**

  The Resource Conservation District of the Santa Monica Mountains and other members of the Malibu Creek Executive Advisory Council have coordinated with the Los Angeles County Department of Public Works to establish new flood control channel clearing guidelines – guidelines that would preserve the maximum amount of habitat possible while ensuring public safety. As a result, new protocols were established for evaluating the necessary BMPs for each channel clearance site in the Malibu Creek Watershed. The protocols are now being used by FLORA as a model to inventory channel habitats and to develop recommendations for channel clearing in the Los Angeles River watershed.

  LAC-DPW has also improved its BMP practices related to infrastructure construction, maintenance and repair of roads, culverts, bridges, etc. (as called for in the 1996 Municipal Storm Water NPDES permit). These measures help to minimize impacts on local habitats and reduce erosion and sedimentation problems common to these types of activities.

  Please also see responses to Fire Regulation-Erosion Control (#11) and Recreational Use Impacts (#32).

- **Build support for the implementation of the mediation recommendations (research studies, ordinances, joint agreements, etc.) among agency staff and non-agency stakeholders who are working on management plans which affect the watershed – RCD/SCS Natural Resource Plan, SMBRP Comprehensive Conservation Management Plan, LA County NPDES storm water permit, City of Malibu Wastewater Management Plan, General Plans of area cities and the LA County 101 Corridor/Cities Area Plan Update.**

  Several efforts which either build support for, encourage or mandate the implementation of management plan actions/recommendations have been highlighted throughout this report. In summary, these include:

- Formation of the Malibu Creek Executive Advisory Council and its subcommittees;
- The 1996 Municipal Storm Water NPDES permit requirements;
- Local municipal ordinances;
- Public education programs;
- Water quality improvement and habitat restoration pilot projects in the watershed; and
- The availability of Prop A bond funds.

■ **Establish mechanisms, including joint powers authorities (JPAs), watershed commissions, special districts or other cooperative efforts for the integration of efforts aimed at coordinating, planning, and/or implementation where multi, general-purpose jurisdictions exist.**

The Cities of Agoura Hills, Westlake Village, Malibu, Calabasas and Thousand Oaks formed a joint powers authority (JPA) called the Council of Governments (COG). The JPA's governing board consists of one representative from each city and one ex-officio member representing the County of Los Angeles. The governing board then established a technical advisory committee (TAC) to review and make recommendations to the board as necessary. The COG meets monthly to review the TACs recommendations and to set priorities for the watershed as a whole. The formation of the COG has had several beneficial results, including:

- Creation of an operating budget to leverage city funds.
- Increased representation on regional committees in organizations such as the Southern California Association of Governments (SCAG) and the Metropolitan Transportation Authority (MTA).
- Adoption of priorities for the sub-region (transportation, open space preservation, watershed management, pollution reduction and public education).
- Securing funds totaling over $150,000 to study and set regional priorities.
- Promoting legislation that would provide incentives for property owners to donate land for open space.

■ **Develop and field test interactive models to facilitate systems-based watershed planning and management decisions.**

This action has not occurred. The National Park Service has been identified as the oversight agency, but there is no formal lead.

■ **Identify and create appropriate financing options which work and are**

cost effective, including joint financing options so duplication is avoided.

Although no formal source of funding has been established or identified to coordinate watershed planning efforts, agency stakeholders have been quite successful in securing funds to conduct many of the actions called for in the various watershed plans. Table 1.3, starting on page 12 in **Section One: Overview**, summarizes many of the watershed's major restoration projects and studies.

The Joint Powers Authority mentioned above could also be a mechanism for joint financing of watershed projects.

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40. ***Enforcement - General***. **Develop effective means to enforce pollutant reduction programs.**

Local ordinances, developed by watershed cities under the 1996 Municipal Storm Water NPDES permit, have proved to be a creative mechanism for establishing and enforcing local pollution prohibitions. For example, local ordinances now call for developers to implement appropriate, site specific BMPs regardless of the size of their construction site; restaurants must not allow food waste to reach the storm drain system, mobile car washers must comply with wastewater discharge restrictions. Cities are also required to conduct "educational site visits" for businesses regulated under the Storm Water NPDES permit program. Although these visits are not used to enforce pollution reduction programs, city personnel use the opportunity to help businesses understand the rules and regulations governing polluted discharges.

Enforcement of the cities' storm water ordinance prohibitions is primarily passive in nature. Most city personnel do not "patrol" the streets looking for violators, but rather rely on calls/complaints to 1-888-CLEAN LA or to the city directly, or through "seeing" the violation take place. Calabasas also uses the sheriff's department to identify violators, and Thousand Oaks routinely inspects restaurants, automotive repair facilities and constructions sites for compliance. Once violations are discovered, specific steps are taken to resolve them. The City of Westlake Village, for example, employs verbal, written and even prosecution measures to enforce pollution control measures. Enforcement activities do occur through city inspector programs for some industrial/commercial and construction sites, but this is not the case for every facility due to the educational site visits mentioned above.

The City of Malibu and the Los Angeles County Department of Health Services conduct enforcement activities relating to illicit connections and malfunctioning septic systems in the Malibu Creek watershed. However, they are unable to provide staff to conduct these activities on a regular basis and thus rely on tips and complaints from the public to help identify and respond to such problems. Malibu has implemented a 24-hour Emergency Response Program in partnership with the County Sheriff and Fire Departments for septic spills and overflows. The City and the County Sheriff, Fire, and Health Departments are also notified to respond to 911 calls made by the public reporting any spills. In the event of a spill, both the City and County Fire Department are equipped to prevent spills from entering storm drains and take further action as needed. Code enforcement actions follow where necessary.

The Los Angeles County Department of Health Services approves the design aspect of septic systems but does not inspect them or regulate their maintenance and upkeep. Septic system installation permits are issued by LAC-DPW's Building and Safety division as part of an overall building permit of a site. Once installed, the Heath Services department only addresses septic system problems where public health is threatened and, like the City of Malibu, relies on complaints and tips to take enforcement action against violators.

In its report, "*Omission Accomplished: The Lack of a Regional Water Board Enforcement Program, 1992-1997*," Heal the Bay strongly criticized the Regional Board's enforcement activities relating to: 1) sewage, oil and hazardous substance spills; 2) industrial storm water violations; 3) illicit connections and poorly maintained or failing septic systems; and 4) NPDES and WDR permit violations. Since the *Omission Accomplished* report was released in 1998, the Regional Board's enforcement activities have significantly increased as has its budget to conduct these activities. A complete summary of the LARWQCB's enforcement activities are documented in quarterly reports which are available to the public.

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41. ***Enforcement - Camping***. **Enforce existing camping restrictions within the watershed.**

When necessary, State Parks removes transient encampments from state park property. They also patrol parklands for illegal campsites on a

regular basis and take appropriate action when such sites are encountered.

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42. ***Public Education*. Emphasize and encourage ongoing public education.**

- **Create a nonpoint source pollution education program for watershed occupants.**
- **Develop a *Adopt-A-Watershed* program that is watershed-wide.**
- **Implement effective education programs about the need for urban and non-urban preservation of open space and buffer zones.**

Educational Websites

www.ci.thousand-oaks.ca.us
www.ci.calabasas.ca.us
www.ci.malibu.ca.us
www.ci.agoura-hills.ca.us
www.co.la.ca.us
www.healthebay.org
www.laaudubon.org
www.lvmwd.dst.ca.us
www.ocd.ucla.edu
www.smbay.org
www.surfrider/SFMalibu/

Several watershed-based public education programs were addressed under Composting/Recycling/Conservation (#29) and Public Education: Conservation (#30). In addition to those outreach activities, many more are highlighted here.

- For more than 14 years, the RCDSMM has conducted field-based, year-round Marine Science Programs for students at Malibu Lagoon and Malibu Creek State Park. These programs are active, hands-on and participatory, emphasizing estuarine ecology, water quality and watershed dynamics. The programs further stress the problems caused by urbanization on wildlands, and provide solutions and watershed protection activities that students can incorporate into their daily lives.

The RCDSMM also produced the *Stable and Horse Management BMP Manual* for use by local horse owners and commercial stables (discussed previously under #18, Confined Animals). Complimenting this particular effort, Quint Cities[26] worked with the RCDSMM to create a companion handout entitled *Best Management Practices for Stable and Horse Management*. Both are available to horse owners and commercial stable facilities in the Malibu Creek watershed.

- State Parks gives lectures to teachers in the Los Angeles Unified School District on the values of and need to preserve open space. They have also incorporated open space and watershed protection themes into State Park nature walks, school presentations and campfire programs.

[26] Quint Cities is a consortium of Malibu Creek watershed cities which includes Malibu, Agoura Hills, Westlake Village, Thousand Oaks and Calabasas.

- The City of Agoura Hills has actively targeted local residents since 1993 with educational information on conservation, sediment reduction and nonpoint source pollution prevention. Their endeavors include: 1) sponsoring local advertising campaigns; 2) distributing fliers at community events and at City Hall; 3) sending mailers to local schools; 4) writing about conservation practices in the City newsletter (circulated to 8,000 residents); 5) contracting with the Department of Health Services to educate restaurant employees about BMPs; and 6) conducting educational industrial/commercial site visits. The City also created an Open Space Task Force in 1998 which subsequently developed the *Open Space Preservation Plan* (released Fall, 1999).

- The City of Calabasas has implemented several educational programs addressing open space and buffer zone preservation which are supported by City Council members and CTV (a local cable access channel which serves as a source of environmental information). The City promotes: 1) the availability of biking trails via regional biking fliers; 2) the use of the City's parks through quarterly distribution of recreation booklets; and 3) the use of native, low water use plants (providing technical assistance on plant selection).

  While the *Open Space/Buffer Zone Preservation* concept has City support, there are no specific guidelines for private property owners to follow and actual implementation of this concept is primarily left to the developer's discretion. However, the Transportation Department is in the process of developing a master plan for trails in the city which will require most large developments to dedicate portions of their property to open space, and the City does prohibit new development activities within 100 yards of creeks and streambanks.

  Although the process has been slow, Calabasas also initiated an *Adopt-A-Creek* program to raise awareness about local riparian habitats. As envisioned, the program will be structured to accommodate various levels of public interest, from people who just want to clean up trash to people who want to restore a creek bank on their property or who want to help monitor the health of stream habitats.

- The City of Malibu has plans to implement a pollution prevention advertising campaign using the City's local cable TV channel, starting in November, 1999. The 30-second public service announcements will address how to prevent pollutants from reaching and entering the

storm drain system, ultimately polluting local streams and the ocean.

- The City of Thousand Oaks circulates a monthly newsletter, *On the City Scene*, to its residents which highlights a local recycling hotline number, composting and disposal opportunities, hazardous waste collection services, etc. Residents are also encouraged to visit the city's website for up-to-date information on city events.

- In 1995, the County of Los Angeles Department of Public Works initiated a Five-year Storm Water Urban Runoff educational program, targeting residents throughout the entire County. The campaign provided information about various types of nonpoint source pollution such as used motor oil, pet waste, pesticides and herbicides, etc. All cities in Los Angeles County have been invited to join this effort and nearly all have accepted that offer, including the four Los Angeles County cities in the Malibu Creek watershed. Complimenting this five year campaign and building on its own efforts, LAC-DPW also launched the *Storm Water Urban Runoff* campaign and the *Used Oil Recycling* media campaign in 1999.

- Several of the Las Virgenes Municipal Water District's Malibu Creek watershed education programs are highlighted under Composting, Recycling, Conservation (#29) and Public Education – Conservation (#30). Additionally, the District has conducted educational outreach about sensible irrigation practices and the values of landscaping with native species. For example:

  - *Demonstration Gardens* were planted at District Headquarters, along Las Virgenes Road and in Gates Canyon Park. The gardens demonstrate the use of both native and non-native low water use plants.

  - Soil moisture sensors were installed at Gates Canyon Park and Grape Arbor Park in the City of Calabasas.

  - Landscaping software was developed in 1995 and is now routinely distributed by the District. It was also provided to local cities for their building permit plan checks. The software advocates for the landscape ordinance by helping residents understand the water needs for various types of plants and encouraging them to use drought-resistant, native species when landscaping their property.

- Irrigation technical training is intermittently provided (in partnership with local cities) which addresses: 1) basic irrigation principles, 2) irrigation system adjustment, repair and trouble shooting, 3) basic and advanced controller programming and 4) irrigation scheduling.

- Heal the Bay has offered its *Speakers Bureau* program since 1989. This program, comprised of specially trained volunteers, educates local communities and businesses, school children, special interest groups and other interested parties about storm water pollution issues and how each person can make a difference. Heal the Bay's speakers are available upon request and reach out to 25,000 people in Southern California annually.

  In 1998, Heal the Bay launched the *Stream Team* program (mentioned several times throughout this report), which trains and educates volunteers about specific water quality and environmental health issues in the Malibu Creek watershed. Already, The program has trained over 75 volunteers to help measure water quality and to conduct surveys on pollution sources and degraded habitats throughout the watershed. Heal the Bay also participates in the Eco-Heros program. The program has educated over 360 students about the effects of nutrients, sediments, urban runoff, and other water quality impacts to Malibu Creek and its tributaries.

Businesses are also being targeted with educational outreach by a variety of agencies. For example:

- LAC-DPW visits industrial and commercial establishments to educate owners and employees about implementation of on-site best management practices.
- The Los Angeles County Department of Health Service conducts a mandatory training program for restaurants about implementation of storm water BMPs and making modifications to activities known to contaminate urban runoff.

- Through the SMBRP's Public Involvement and Education (PIE) Fund, Quint Cities produced five pollution prevention brochures targeting: 1) painting contractors, 2) landscape and pool maintenance personnel, 3) contractors and site supervisors, 4) horse owners and 5) residents and homeowners. These brochures are available at the permitting counters in each city.

43. ***Watershed Monitoring***. **Develop and implement a coordinated and integrated watershed monitoring program.**

- **Create a centralized database of water quality and resource data accessible to all parties.**
- **Develop a coordinated GIS database network, including a detailed land use map with all septic systems and storm drains, which is accessible to all parties.**

Although no centralized database has yet been created to house water quality and resource data, data collected by various agencies and studies is made available to all interested parties upon request. Many of these watershed monitoring efforts undertaken by watershed stakeholders have been highlighted throughout this report, including:

- Table 1.3, Watershed Restoration Studies/Projects (pgs. 12-15);
- Biological Standards (#5);
- Monitor Pathogens (#6);
- Study Nutrients (#8);
- Temperature (#12);
- Assess Sources/Characteristics (#21);
- Septic Systems (#23); and
- Irrigation Runoff Reduction (#31).

Other specific efforts are summarized here.

- In April 1999, the Monitoring and Modeling sub-committee (formed under the Executive Advisory Council) completed a draft plan calling for a coordinated watershed-wide monitoring program. Its recommendations include adding supplemental monitoring efforts to better establish a comprehensive survey of the state of the Malibu Creek Watershed. Implementation of this action is dependent on the availability of funds to carry it out.

- Through an agreement with two non-profit groups, the Natural Resource Defense Council and Environment Now, the Las Virgenes Municipal Water District contracted with UCLA to conduct a study entitled "*Enhanced Environmental Monitoring Program at Malibu Lagoon and Malibu Creek*." During the study, monitoring was conducted over a two year period from 1993-1995 and the data was analyzed to assess the effects of Tapia's effluent on Malibu Creek and Lagoon. Coincidentally, the study occurred both during one of the biggest fires in history and during an extremely wet year.

The report, released in 1995 and containing more than 100 pages of data, found no conclusive evidence of direct impact of Tapia's effluent on Malibu Creek, Lagoon and local habitats.

- As mentioned under Public Education (#42), Heal the Bay launched a Malibu Creek watershed volunteer monitoring program called *Stream Team* and completed their first water quality training program September, 1998. Participants in the program now sample water at 7 fixed stations throughout the watershed on a monthly basis. Two of these sites, which are minimally impacted by upstream activities, have been designated "reference sites." Another two sites overlap with the RCDSMM/City of Calabasas monitoring sites to assure the quality of data being collected. The monitoring locations are recorded using GPS devices, and the data collected is then organized using GIS capabilities. Observations and data collected include: 1) location of discharge points and outfalls, 2) presence of unstable bank conditions, 3) evidence of artificial streambank modifications, 4) impacting land uses, 5) presence of exotic/invasive vegetation, 6) possible barriers to fish migration, and 7) evidence of illegal dumping. A 150-page illustrated field guide was also developed for Heal the Bay's Stream Team activities by graduate students from the Cal State Pomona Landscape Architecture program. The guide includes step-by-step procedures for water quality monitoring.

  Heal the Bay recently started Phase 2 of this volunteer program, which includes: 1) volunteer training to continue monitoring efforts for years to come, 2) professional assessment of benthic macroinvertebrates (conducted by the CA Department of Fish and Game), and 3) the addition of enterococcus to the list of water quality parameters currently measured. Heal the Bay plans to make Stream Team data available on their website.

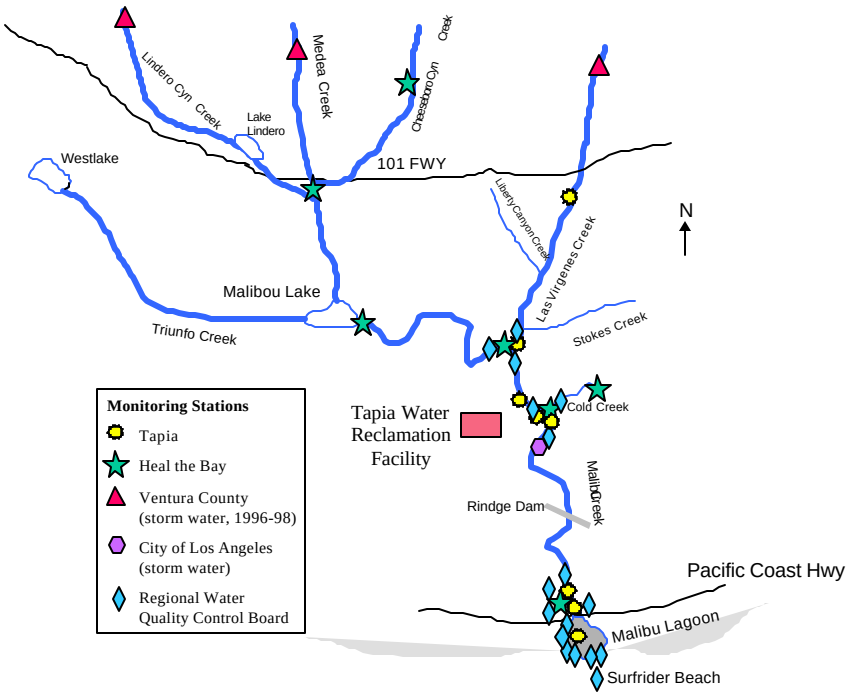

Figure 4. Current monitoring stations in the Malibu Creek watershed.

Heal the Bay has also started creation of a database for monitoring data taken in the Malibu Creek watershed (see Figure 4) and is using GPS to accurately locate other agency/monitoring group and rain gauge stations. To date, the monitoring sites for Calabasas, RCDSMM and the LVMWD have been logged. Ultimately, Heal the Bay plans to become a clearinghouse for all of the monitoring data collected.

Other monitoring data available to the public include: 1) water quality, biological monitoring and surveys of Malibu Lagoon, conducted by RCDSMM (see Assess Sources/Characteristics, #20); 2) volunteer monitoring in the upper watershed, sponsored by the City of Calabasas; and 3) coliform bacteria monitoring in the surf zone, conducted by the Malibu Chapter of Surfrider.

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44. ***Watershed Assessment*. Identify, by subwatershed area, sources of harmful pathogens, toxic chemicals, sediments and nutrients.**

- **Expand an understanding of the hydrology of the watershed and nearshore bathymetry. Agree on needed research on what appropriate and attainable seasonable flows should be for Malibu Creek, Lagoon and nearshore areas.**

At the request of the National Marine Fisheries Service (NMFS), LVMWD conducted a study in 1998 to determine the minimum creek flow needed to sustain steelhead trout populations. Using their own outdoor water audit method and plant types/water needs information collected from the National Park Service and UCLA, the District concluded that a minimum flow (in dry years in late October) of 2-4 cubic feet per second (cfs) recorded at the County gauge station was necessary to ensure at least 1 cfs of flow below Rindge Dam (one cfs is the flow criteria established by NMFS to sustain steelhead trout).

- **Identify and apply suitable models to help target and prioritize pollution prevention, reduction and abatement measures.**

  This action, a fundamental component of several other actions, is summarized in Protect Beneficial Uses (#1), Assess Sources/Characteristics (#21), Runoff Reduction (#31), Habitat Fragmentation (#35), Coordinate on a Watershed Basis (#39) and Monitoring Efforts (#43).

- **Raise funding for and implement study on the health effects of urban runoff on surfers, incorporating Surfrider Beach into the design.**

  In 1995, the Santa Monica Bay Restoration Project conducted an epidemiological study ("Epi Study") to assess the health effects of those who swim directly in front of flowing storm drains. Malibu's Surfrider Beach was one of three locations used in this study. Results of the study showed, conclusively, that there is a significant increase of occurrence in illnesses among those swimming within 100 feet of flowing storm drains. A complete summary of this study is provided under Public Notices (#25).

  Some watershed stakeholders would like to see another epi study conducted that specifically assesses the health-related impacts of surfers using Surfrider Beach. However, the Human Health subcommittee reviewed this possibility with Dr. Charles Gerba (University of Arizona) and concluded that: 1) there were not enough users that could be interviewed in one season to give the study statistical validity, and 2) it's also not clear who would serve as the "control" group for such a study.

- **Establish a Total Maximum Daily Load (TMDL) model for all inputs to the watershed.**

  The Regional Board has been charged with determining how much of a pollutant can be assimilated into a water body without impairing its health and function, i.e., establishing a TMDL. This process, although required in the Clean Water Act for more than a decade, has only just begun. The Regional Board has established a TMDL unit to set discharge limits for pollutants throughout Los Angeles County. In the Malibu Creek watershed, TMDLs are to be developed for nutrients and pathogens/coliform by March, 2002.

- **Develop a research agenda to expand understanding about impacts of land use practices in the watershed.**

  The LVMWD hopes to coordinate its GIS use with data collected from Heal the Bay and others to better understand land use impacts in the watershed. One such application would be to overlay stream location data with district water use data and storm drain locations to better determine where runoff control and treatment efforts would have the greatest impact.

PROGRESS AT A GLANCE

Malibu Creek Watershed Action Plan

MINIMAL	MODERATE	SUBSTANTIAL
WATER QUALITY		**POLICY AND RESEARCH (B-/C+)** **IMPLEMENTATION (D)**
	POLICY AND RESEARCH	
	(1) Develop and set water quality objectives (5) Establish biological (habitat) standards* (8) Determine nutrient standards (21) Assess lagoon characteristics* (27) Landfill impacts on water quality (44) Watershed assessment	(6) Monitor pathogens
	IMPLEMENTATION	
(7) Reduce pathogens (9) Reduce nutrients (23) Manage septic system discharges (40) Enforce Pollution Reduction Programs	(4) Eliminate sources of pathogens, toxic chemicals, sediments and nutrients (10) Reduce accelerated sedimentation* (13) Storm drain stenciling and other BMPs (14) Regulate mobile car washes (15) Eliminate illegal drains (17) Control trash on parklands* (18) Implement confined animal BMPs*	
REDUCING EXCESS FLOWS (WATER QUANTITY)		**(D)**
(19) Household irrigation runoff survey (31) Runoff reduction measures	(28) Maximize use of reclaimed (recycled) water	
MANAGING SOLID WASTE		**(B-)**
	(17) Control trash on parklands* (18) Implement confined animal BMPs*	(29) Implement composting, recycling and conservation measures*
LAND USE		**(C-)**
(34) Create/maintain buffer zones for sensitive areas*	(10) Reduce accelerated sedimentation* (18) Implement confined animal BMPs* (32) Public access and resource protection* (35) Habitat fragmentation* (41) Enforce camping restrictions	(11) Fire regulation and erosion control*
HABITAT RESTORATION AND PROTECTION		**(D-)**
(5) Establish biological (habitat) standards* (12) Establish water temperature policies (24) Regulate lagoon water levels (32) Public access and resource protection* (33) Purchase high priority land areas (34) Buffer zones for sensitive areas* (36) Remove barriers to fish migration (37) Control exotic vegetation in wilderness (38) Maintain, restore and create wetlands	(10) Reduce accelerated sedimentation* (20) Restore Malibu Lagoon (21) Assess lagoon characteristics* (35) Habitat fragmentation*	(11) Fire regulation and erosion control* (26) Mitigate impacts of PCH Bridge reconstruction on Malibu Lagoon
COORDINATION AND OUTREACH		**(A-)**
	(18) Implement confined animal BMPs* (30) Promote water conservation (43) Develop and implement coordinated monitoring program	(25) Post public notices (29) Implement composting, recycling and conservation measures* (39) Coordination efforts (42) Public education programs

SECTON III: KEY FINDINGS

Over the past decade, an enormous amount of energy has been invested into making restoration of the Malibu Creek watershed a reality. These efforts have ranged from establishing an Executive Advisory Council and contributing countless hours for stakeholder meetings to creating a set of restoration priority actions and implementing them. And, while not all of the 44 actions identified in this report have been fully, or even partially implemented, there has been a measure of progress towards achieving their stated objectives. Table 3.1 highlights ten of the most significant accomplishments towards watershed restoration. This list represents the efforts of the entire stakeholder group through its partnerships, review committees, creative funding sources, technical support and hands-on restoration activities.

Section III summarizes the key findings of **Section II: Action Plan Update**. More specifically, it evaluates progress made to achieve the goals of the Malibu Creek Watershed Plan in relation to the key issues of concern in this watershed, i.e., water quality and quantity, solid waste, land use practices, habitats and coordination/outreach efforts. The preceding page provides a snapshot of the results of this assessment, i.e., how well the Plan's 44 actions have been implemented and whether they have made minimal, moderate or substantial progress.[27] Because some actions address multiple issues, they are assessed in each section of relevance. For example, implementing confined animal BMPs affects water quality, solid waste disposal and land use issues, hence a separate summary has been provided in each of these sections.

The reader should keep in mind that as this report is being written, new programs are beginning which

"TOP TEN"
Watershed Restoration Accomplishments

1. Formation and collaboration of the Malibu Creek Watershed Executive Advisory Council, and development of the Action Plan for Restoration.
2. Successful reintroduction of the tidewater goby, a federally listed endangered species, back into Malibu Lagoon.
3. Implementation of the Volunteer Water Quality Monitoring Program.
4. Implementation of the Santa Monica Bay Epidemiological Study linking swimmer illness with poor water quality near flowing storm drains.
5. Completion of the L*ower Malibu Creek and Barrier Lagoon System Resource Management* report addressing the hydrological dynamics of the lower watershed.
6. Restoration of aquatic habitat, mudflat habitat and high flow storm refuge for the tidewater goby in Malibu Lagoon which includes excavation of over 2,200 cubic yards of old fill material. Post-project monitoring of fishes, water quality and invertebrates.
7. Streambank restoration along a 200-foot section of Las Virgenes Creek using bio-technical erosion control techniques.
8. Installation of a storm drain disinfection facility to treat contaminated flows from the Mystery Drain into Malibu Lagoon.

Table 3.2. "Top Ten" watershed restoration accomplishments.

[27] Based on the information provided in Section Two: Action Plan Update, each action was evaluated by members of the Malibu Creek Executive Advisory Council on a scale of one to five according to how well it has met its intended goal(s). The scores submitted for each action were combined, the average taken and the results correlated to a rating of minimal, moderate or substantial progress (similar to a grade point average).

address some of the issues that have made no progress and/or have received very little attention before this time. For example: 1) the Santa Monica Bay Restoration Project has convened a Septics Management Task Force to develop recommendations for septic system placement, management, monitoring and replacement frequency and 2) the Lower Malibu Creek and Lagoon Task Force is addressing the feasibility of a constructed wetland in the Malibu Civic Center area. Although mentioned, these new efforts are not being evaluated in terms of their contribution towards successful implementation of the plan's 44 action items.

Note: For your reference, the numbers located next to each of the following summaries in this section correspond to the same actions discussed in **Section II: Action Plan Update**.

Goal: Improve Water Quality to Protect Beneficial Uses

Eighteen of the Malibu Creek Watershed Plan's actions address water quality issues, accounting for more than 40% of the Plan's total number of actions. Improving water quality key to the overall success of watershed restoration and protection efforts. For review purposes, these eighteen actions have been divided into two major categories – *Policy & Research* and *Implementation*. The actions in the first category, Policy & Research, have achieved moderate success over the last five years as many studies and coordinated assessment efforts have been conducted to improve our understanding of the state of water quality in the watershed. On the other hand, implementation efforts designed to improve water quality have lagged significantly since the Plan was adopted in 1994. Below is an in-depth assessment of both how much and how little has been done towards understanding and improving water quality in the Malibu Creek watershed.

WATER QUALITY: POLICY and RESEARCH

Substantial Progress

Monitor Pathogens

Moderate Progress

Develop and Set Water Quality Objectives
Establish Minimum Biological Standards
Determine Nutrient Standards
Assess Lagoon Characteristics
Landfill Impacts on Water Quality
Watershed Assessment

Policy & Research Activities

Seven of this section's 18 actions address *Policy and Research* needs in the Malibu Creek watershed. Overall, they have achieved moderate success, with a one notable highlight. A summary of their relative success is provided here.

Substantial Progress

Monitor for Pathogens and Bacteria (#6)

The most significant progress made in addressing key water quality impairments in the Malibu Creek watershed has been in monitoring for bacteria and pathogens. Monitoring for indicator bacteria (i.e., total and fecal coliform) helps to determine whether human pathogens are present Malibu's local waterways and if the waters pose any health risks. Such monitoring has been conducted in the Malibu Creek watershed on a regular basis by several agencies and organizations for more than a decade, and includes data from samples taken during both the wet and dry seasons. Additionally, two separate studies have been conducted in the past seven years in Malibu Creek to directly test for pathogens. Because this type of testing is prohibitively expensive, it has not been conducted on a more regular basis.

Our understanding of the location and amount of bacteria and pathogens present in the watershed has significantly increased due to these studies and monitoring efforts. Collectively, the data gathered conclusively shows that bacteria (and mostly likely pathogens) have been and continue to be a significant water quality problem throughout the watershed. While the data is exhaustive in highlighting the extent of the bacteria/pathogen problem, unfortunately, it does not always pinpoint the source(s) of contamination and their relative contribution(s). The next step towards decreasing pathogen loads is to identify these sources and systematically prevent them from reaching local waterways.

Moderate Progress

Six actions under *Water Quality: Policy and Research* have been implemented with moderate success. These include:

- Develop and set water quality objectives to protect beneficial uses;
- Establish biological (habitat) standards for native species;
- Determine nutrient standards;
- Assess Malibu Lagoon's characteristics;
- Assess the impacts of landfill operations on water quality; and
- Conduct watershed assessment.

Develop and Set Water Quality Objectives to Protect Beneficial Uses (#1)

The Regional Board is charged with the task of developing and setting water quality objectives for waterbodies in the Malibu Creek Watershed, and they have experienced relative success in areas such as: 1) establishing discharge limits for point sources through the permitting process, 2) adopting the 1996 Storm Water Municipal NPDES Permit, and 3) creating a TMDL unit to begin establishing additional water quality objectives for impaired water bodies in the region. However, limits have not been established for non-point source discharges (storm drains, rainfall runoff, landscape irrigation, etc). To control pollutants generated from non-point sources, the Regional Board has created a TMDL unit which is currently in the process of establishing discharge limits for the watershed's primary pollutants of concern – pathogens and nutrients. However, this process is slow. Limits are not expected to be set for pathogens and nutrients until 2001 and not at all for other pollutants such as oil and grease, trash and debris, and heavy metals. Despite the significant limitations placed on Tapia treatment plant discharges, other sources of pathogens and nutrients still adversely impact the beneficial uses of the watershed's receiving waters.

Establish Minimum Biological (Habitat) Standards (#5)

Several habitat restoration activities, such as establishing mud flats in Malibu Lagoon, determining minimum flows to support steelhead populations, and removing exotic species, have resulted in some progress towards improving habitat to support native species. However, establishing water quality objectives based on biological standards has not been as successful. As the Coastal Conservancy/UCLA report states, "while there is much water quality data available, there is little information available about the tolerances of most of the target species to the physical condition of concern." Setting water quality standards is a difficult task without appropriate background information. To come up with sound water quality objectives which take into concern local species needs, their tolerances must be known. Then, where competing needs exist, they should be prioritized for protection, and a balance maintained that supports the most native species possible. More information is needed on the tolerances of native species before this action can be fully implemented.

Determine Nutrient Standards (#7)

Our understanding about the amount of and impacts resulting from nutrient loadings in the watershed is also quite comprehensive, due mostly to the long-term research data collected by several key agencies. Although monitoring efforts have provided a clear picture of the extent of the problem, there is much debate over how to control nutrient loadings, and what discharge limits would be most appropriate given various watershed dynamics such as canopy cover, stream velocity, still pools, water temperatures, etc.

Recently, the Regional Board's TMDL unit has begun to assess the nutrient data available and are in the process of establishing limits for nutrients in the Malibu Creek. Efforts to control/reduce nutrients are discussed under *Water Quality: Implementation*, below.

Assess Malibu Lagoon Characteristics (#21)

A portion of this action has been quite successfully accomplished but some additional steps need to be taken to complete the action as a whole. The Coastal Conservancy/ UCLA study, along with other long term monitoring efforts, provides a quite comprehensive picture of the hydrology, circulation, and biota of the lower creek and lagoon, as well as management recommendations on how to improve/protect the area. Next steps include identifying all the potential and existing sources of pollution/contamination and then developing a remediation strategy to improve the lagoon and surfzone's water quality based on these sources. The Lower Malibu Creek and Lagoon Task Force is currently in the process of ranking the UCLA study's management recommendations and will soon release an action plan of

priorities based on the report's recommendations. Completion of the CSCC/UCLA study represents a significant step towards assessing Malibu Lagoon's characteristics.

Assess Impacts of Landfill Operations on Water Quality (#27)

The County Sanitation District of Los Angeles County is the primary agency responsible for landfill operations. Measures to mitigate the impacts of landfill operations (e.g., research, land acquisition, native plant restoration) were approved and adopted in 1998 and are currently being implemented and/or planned for the near future (see page 51). For example, the results of an on-going groundwater monitoring study of the land directly below and surrounding the landfill will direct upcoming restoration and watershed protection efforts. While still too early to assess the benefits all of these measures will have on water quality, those already being implemented represent progress in the right direction.

Conduct Watershed Assessment (#44)

This action contains four subsets which address sources of pathogens, toxic chemicals, sediments and nutrients. As a group, they have been given a moderate rating, although individually some have been very successful, while others have not.

- The first sub-action, which calls for determining adequate seasonal flows for Malibu Creek, Lagoon and nearshore areas, has achieved minimal success. Only one study has been conducted to correlate minimum creek flow requirements with habitat needs (steelhead trout). Although Tapia no longer discharges flows during the dry season, discharge of imported water upstream and higher groundwater tables have permanently altered the creek's flow regime, which is now perennial rather than intermittent or seasonal. How best to address this issue is a daunting task because it requires the resolution of some related controversies (e.g., year-round diversion of Tapia effluent, diverting urban runoff, minimizing import water demands, retaining runoff on-site).

- The second sub-action calls for conducting a study on the health effects of urban runoff on surfers and swimmers. The SMBRP Epidemiological Study, conducted in 1995, did exactly this and was completed with great success. The results of the study showed conclusively the link between contaminated urban runoff and swimmer illness. Based on these results, several measures were taken to inform the public about health risks and to provide alternatives about where and when to swim in the Bay. The results of the study have also been referenced in developing bathing standards at both the state and federal levels.

- The third action, which calls for establishing TMDLs for all inputs into the watershed, has been only marginally implemented. Although the Regional Board has established a TMDL unit, limits for the watershed's pollutants of concern (nutrients and pathogens) will not be established until March of 2002. Furthermore, the Regional Board has no immediate plans to undertake additional TMDLs for the Malibu Creek Watershed for constituents such as heavy metals, trash and debris and other contaminants associated with urban runoff.

  Establishing TMDL limits for impaired water bodies is designed to help improve water quality over the long run, however, the effects of this process will not be immediately evident. Once TMDLs for nutrients and pathogens are established, it will take additional time to change and/or improve how permits are issued to implement appropriate control measures.

- The last action, which calls for developing a research agenda to expand understanding about the impacts of land use practices in the watershed, has made no significant progress. Several agencies have stated their desire to use GIS applications towards understanding land use impacts, but funds and staff time to implement this action have not been forthcoming. Watershed cities are addressing development issues through their municipal master plans, but these efforts are not comprehensive and do not consider the watershed as a whole. The formation of the regional Council of Governments may help bring the need for true watershed planning to the attention of those responsible for the development activities occurring in each city.

Water Quality – Policy and Research Grade: **B-/C+**

Water Quality - Implementation

Eleven water quality actions are considered as "on-the-ground" implementation efforts. Collectively, their success has been somewhat limited, as the call-out box on the next page shows. It is interesting to note that no actions in this section have been rated as substantial. An assessment of their relative success is provided here.

Moderate Progress

Seven of this section's 11 actions have achieved moderate success. These include:

WATER QUALITY: IMPLEMENTATION

Moderate Progress

Eliminate Sources of Pathogens, Toxic Chemicals, Sediments & Nutrients
Reduce Accelerated Sedimentation
Stenciling and Other Storm Drain BMPs
Regulate Mobile Car Wash Discharges
Eliminate Illegal Drains
Control Trash on Parklands
Implement Confined Animal BMPs

Minimal Progress

Reduce Pathogens
Reduce Nutrients
Manage Septic System Discharges
Enforce Pollution Reduction Programs

- Eliminate or reducing sources of harmful pathogens, toxic chemicals, sediments and nutrients;
- Reduce accelerated sedimentation;
- Implement stenciling and other storm drain BMPs;
- Regulate mobile car wash discharges;
- Eliminate illegal drains;
- Control trash on parklands; and
- Implement confined animal BMPs.

Eliminate Sources of Harmful Pathogens, Toxic Chemicals, Sediments and Nutrients (#4)

Passage of the 1996 Municipal Storm Water NPDES permit is key to the progress achieved in implementing this action. It represents the first critical step in implementing this action successfully. The permit not only requires cities to address sources of contaminated runoff, it also requires that they secure the authority to enforce such control measures. Municipal ordinances have now been adopted by every city covered under the storm water permit which stipulate storm drain discharge prohibitions.

However, enforcement actions taken to control contaminated discharges have not been significant since the ordinances were adopted. Cities, lacking personnel and funding to effectively enforce discharge prohibitions, rely on citizen complaints, site visits and educational programs to carry out this action. And, while city personnel do conduct site visits, they lack the staff resources to make return visits on a regular basis. For example, a parcel of land being developed is visited, on average, only once during its construction phase. This is inadequate because the condition of a construction site change dramatically over the course of its development.

More specific information on reducing and/or eliminating pathogens, sedimentation and nutrients are addressed below.

Reduce Accelerated Sedimentation (#10)

Six components are listed under this action and, together, they provide a comprehensive plan for reducing human-induced sedimentation. The components include enforcing erosion control measures, preventing sediment

runoff from development projects, adopting erosion control ordinances, implementing BMPs to minimize topsoil loss, preventing roadside dumping of dirt and eliminating massive grading practices.

Mechanisms, such as local ordinances, educational pamphlets and site visits, and construction NPDES permits do bring awareness about sedimentation issues to developers and residents. Cities also require and review erosion control plans for planned and active construction sites, and they require BMPs to be implemented to minimize sedimentation problems. These actions, while proactive and a good start, have not clearly reduced human induced sedimentation into the watershed. Due to limited resources, city personnel are unable to effectively ensure that the BMPs will be implemented over the entire duration of construction. Roadside dumping of dirt has proved virtually impossible to control, and topsoil losses from residential sites remains a concern in developing and newly developed residential neighborhoods.

Implement Stenciling and Other Storm Drain BMPs (#13)

Storm drain stenciling efforts have been well implemented throughout the watershed. Most watershed cities contract with the County of Los Angeles Department of Public Works to conduct this task approximately every three years (Malibu stencils its own storm drains). The stencils are one of the methods used to make residents aware of where storm drain flows eventually end up.

Unfortunately, it's still not uncommon to find catch basins clogged with urban-generated trash and debris, and contaminated discharges are still making their way into the storm drain system. Street sweeping and catch basin cleaning frequencies vary among cities, as do the storm drain cleaning techniques used. However, it's not clear that street sweeping frequency is related to need in the watershed cities. The fact that there is very little data available supporting the benefits of street sweeping has resulted in municipal reluctance to do more on this issue, and no studies have adequately linked land use activities with the volume of trash collected to better determine what frequency would be most cost effective.

Regulate Mobile Car Wash Discharges (#14)

Mobile car wash operators are required under municipal ordinances to ensure that their discharges do not reach local storm drains. Because mobile car wash operations have not been found to be a significant source of water quality impairments to the Malibu Creek watershed, they are not heavily monitored by municipal staff unless complaints are filed. Beyond adopting local ordinances, there is little effort given to address/prevent mobile car wash discharges.

Eliminate Illegal Drains (#15)
Of the 1,838 illicit connections found in Los Angeles County, only 49 were located in the Malibu Creek watershed. The County has already formally documented 21 of these illicit connections and is in the process of documenting the remaining 28. Although there is nothing remaining to accomplish under this action, it only received a moderate rating due to completing documentation of the remaining storm drains.

Control Trash on Parklands (#17)
Efforts to reduce or eliminate the amount of trash from parklands reaching Malibu Creek have been only moderately successful. While State Parks does provide trash receptacles on its property, some of them are either not properly placed to maximize use among visitors, or there simply aren't enough trash cans to hold all that is discarded on a typical weekend day by park visitors. More and better placement of trash cans and bilingual signs are needed to help decrease the amount of trash and debris making its way into Malibu Creek.

Implement Confined Animal BMPs (#18)
[This action primarily addresses horse owners in the Malibu Creek Watershed, most of which are located in the City of Malibu. There are not a significant amount of other types of livestock in this region.]

The Resource Conservation District has made a tremendous effort to monitor, educate and raise awareness among horse owners about the impacts of horse waste on water quality. Unfortunately, changes in manure management measures have not been widely observed since this outreach program began a few years ago. The region's larger stables do implement BMPs designed to control manure and keep it from reaching nearby streams. However, many private horse owners with corrals located near streams do not necessarily have the land or resources to reconstruct their corrals away from adjacent streams. Additionally, municipal ordinances and the Los Angeles County health code are either not adequate or are not being sufficiently enforced to prevent horse manure from contaminating runoff. Horse waste is still observed in and around stream banks and riparian corridors, and in many creek/stream reaches. More attention on enforcing local ordinances and public health codes is needed to ultimately correct this problem.

Minimal Progress

There has been only minimal progress for four *Water Quality:*

Implementation actions. These include:

- Reduce human pathogen inputs;
- Reduce nutrients;
- Manage septic system discharges; and
- Enforce pollution reduction programs.

Reduce Human Pathogen Inputs (#7)

Historically, efforts to implement this action focused on eliminating Tapia Treatment Plant discharges into Malibu Creek while other diffuse or nonpoint sources were not aggressively pursued. These efforts resulted in the Regional Board passing a revised discharge prohibition eliminating flows during the dry season. It was a significant step towards reducing public fear about adverse health effects associated with tertiary treated discharges into Malibu Lagoon. However, bacteria counts are still higher than health code standards allow and Surfrider beach still consistently receives "F" grades during breaching events. Identifying and preventing other sources of pathogen inputs has not been given significant attention until very recently. These potential sources include septic systems, storm drain discharges and livestock wastes. Because programs to address these sources are just getting underway, this action received a minimal rating. It is too early to assess whether all the various sources of pathogens can be effectively controlled.

Reduce Nutrients (#9)

Excess nutrients are a wide-spread concern throughout the watershed both above and below the Tapia treatment plant. Although many studies have documented the extent of nutrient problems watershed-wide, little has been done to determine the extent of all the possible sources contributing to the excess nutrients found in the watershed. And, despite the discharge prohibition of Tapia effluent during the dry season, the amount of nutrients found in the lower creek and lagoon are still too high and cannot be accounted for, making it nearly impossible to develop a plan of action for reducing nutrient inputs. Until all sources of nutrients have been identified, this action cannot be effectively implemented.

Manage Septic System Discharges (#23)

It is widely believed that septic system discharges contribute to the poor water quality observed in the lower creek and lagoon, but studies recently performed to ascertain the degree of pathogen contributions coming from septic systems are considered inconclusive, and funds to conduct extensive groundwater monitoring have been nearly impossible to secure.

How best to manage septic system discharges has proven to be quite controversial. Homeowners are leery of government intervention, fearing that any changes to current systems would cost them thousands of dollars. City leaders have been reluctant to impose additional restrictions on local homeowners or to suggest construction of a centralized sewer system in Malibu. The SMBRP's Septics Management Task Force is in the process of developing recommendations for how to manage septic discharges to better protect water quality in areas such as Malibu. These recommendations will require action by both state agencies and local municipalities.

Ultimately, very little progress has been made towards actually eliminating or reducing the impacts of septic system discharges on water quality. The actual number of installed septic systems in Malibu has not been determined or mapped, and only a small percentage of systems have been recently replaced

Enforce Pollution Reduction Programs (#40)

Enforcing pollution reduction programs is carried out at several levels of government – local, state and federal. Cities have been required to adopt ordinances, and the State Water Resources Control Board and the US Environmental Protection Agency have the ultimate responsibility to ensure that water quality is protected. Both the State and municipalities use enforcement as a means to achieve this goal. Although these mechanisms are in place, almost no enforcement programs have been effectively implemented. Cities, lacking personnel and other resources to conduct all the enforcement that would be necessary within their jurisdictions, have done so only passively. And, until recently the Los Angeles Regional Water Quality Control Board has had an extremely poor enforcement record regarding oil and other hazardous substance spills, sewage spills, and storm water and other NPDES permit violations. However, since 1998 enforcement actions have taken place within the Malibu Creek watershed.

Water Quality — Implementation Grade: D

Goal: Reduce Excess Flows into Malibu Creek

The goal of the following three actions is to reduce excess flows into Malibu Creek. These actions intent to: 1) reduce imported water demands and runoff volumes, and 2) maximize the use of recycled wastewater. Collectively, they have been poorly implemented, with moderate progress in only one instance.

REDUCING EXCESS FLOWS

Moderate Progress

Maximize Use of Reclaimed Water

Minimal Progress

Household Irrigated Runoff Survey
Runoff Reduction Measures

Moderate Progress

Maximize Use of Reclaimed (Recycled) Water (#28)

The Las Virgenes Municipal Water District, the lead agency responsible for promoting reclaimed water use in the watershed, has made significant strides in its efforts to recycle tertiary treated wastewater back to the communities that generate it. Efforts which include getting ordinances passed to require the use of recycled water where feasible and pricing recycled water more competitively have resulted in almost half (44%) of the total volume of wastewater generated by upstream communities being reused rather than discharged to Malibu Creek. Some of the alternatives proposed in the *Malibu Creek Discharge Avoidance Study* are also being implemented to maximize use of recycled water. For example, the District has: 1) increased the number of private end users during the prohibition, effectively doubling the non-creek disposal capacity of Tapia's tertiary treated effluent and 2) sought funding opportunities to help pay for the infrastructure needed to reach distant but potential end users.

Unfortunately, the demand for recycled water is not constant throughout the year and thus less wastewater is recycled in the fall, winter and spring months than during the summer and shoulder months. As a result, excess flows are still discharged to Malibu Creek during the rainy season (November 15th – April 15th). Implementing alternative disposal options during this time has proved more difficult to address and has thus been fairly slow. Still, the District's commitment to exploring several of the discharge alternatives identified in the report and to ultimately find a permanent alternative to discharging effluent into Malibu Creek is a positive step towards maximizing use of recycled water.

Watershed cities have also supported this action by passing ordinances requiring the use of recycled water for landscape irrigation along freeway corridors, in city parks, and other areas where feasible. Such requirements

help solve two problems simultaneously – they reduce the amount of wastewater discharged into Malibu Creek during the rainy season and decrease demand for imported water.

Minimal Progress

Household Irrigation Runoff Survey (#19)

The intent of this action was to conduct a survey which would: 1) provide insight as to why such large volumes of runoff are coming from residential developments and 2) develop an awareness campaign based on the survey results to decrease these excess runoff volumes. Although there are several public education campaigns promoting water conservation at the residential level, no household survey has been conducted to determine why excess flows are coming from residential areas. Without the insights that such a survey could provide, it will be difficult to plan an educational awareness campaign specifically targeting those activities most likely to contribute to excessive household-generated runoff.

Runoff Reduction Measures (#31)

Measures designed to reduce the amount of runoff coming from residential and commercial properties have only recently been adopted by local and state agencies. For example: 1) in the last few years watershed cities have passed ordinances calling for more pervious surfaces in new developments; 2) in January 2000, the Regional Board adopted a measure requiring on-site storm water retention or treatment for the first ¾-inches of rain from each storm; and 3) the Las Virgenes Municipal Water District recently installed irrigation sensors to improve irrigation practices to minimize excess flow. Because these measures have been only recently adopted and implemented, whether or not their implementation will prevent increased runoff or actually lead to reductions in runoff remains to be shown. And, because two of the three efforts mentioned above only apply to new and substantial redevelopment projects, the effects of this measure will not be clear until new, isolated developments can be evaluated for runoff reduction. Finally, beyond the public education/outreach efforts implemented, other immediate efforts to reduce runoff in the Malibu Creek Watershed are not widely observed.

***Reducing Excess Flows Grade*: D**

Goal: Improve Management of Solid Waste

MANAGING SOLID WASTE

Substantial Progress

Composting, Recycling & Conservation

Moderate Progress

Control Trash on Parklands
Implement Confined Animal BMPs

The three actions addressing solid waste concerns in the Malibu Creek watershed have achieved relative success, overall rating at high end of moderate. The ultimate goal of these actions is to prevent trash and other forms of solid waste from reaching and adversely impacting watershed creeks, riparian corridors and habitats. A summary of how well these actions are being implemented is provided below.

Substantial Progress

Composting, Recycling and Conservation Measures (#29)
Combined, watershed agencies and municipalities have conducted an enormous amount of outreach promoting the values of composting, recycling and water conservation. They have also provided many opportunities for residents to participate in recycling and conservation efforts through programs like curbside recycling, household hazardous waste roundups, permanent used oil drop-off sites and workshops. While not necessarily cost-effective, these efforts have been successful in increasing public awareness of the need to recycle household waste and have led directly to the increased volumes of residential solid waste collected each year.

Moderate Progress

Two actions have made moderate progress in controlling specific types of waste found in the watershed. These include:

- Reducing the amount of trash found on local parklands; and
- Implementing confined animal BMPs for waste reduction.

Control Trash on Parklands (#17)
Local parks in the Santa Monica Mountains receive a large number of visitors every weekend, particularly to Malibu Creek State Park and Malibu State Beach and Lagoon. Much of the trash found in nearby creeks and the lagoon ultimately comes from park visitors. Whether it is left on the ground, placed in on-site receptacles but then raided by birds or blown out by the wind, too much trash is reaching the creek. State Parks has made moderate progress in its efforts to control the proliferation of trash on its properties through: 1) the installation of new and additional bird proof receptacles in areas of the park

most frequented by the public, 2) posting bilingual signs encouraging visitors to use the receptacles provided and 3) utilizing Spanish-speaking employees to enhance its educational efforts. Although these approaches have been somewhat successful, they could be improved by installing even more bird-proof trash receptacles within State Parks boundaries and placing them in the most popular areas of the parks. State Parks' efforts could also be enhanced by improving the visibility and location of its bilingual signs.

Implement Confined Animal BMPs (#18)

While ensuring proper management and disposal of the solid waste generated by large domestic animals is a daunting task, some key steps towards accomplishing this goal have been taken. The *Horse and Stable Management BMP Manual* and a video created by the RCDSMM provides very specific information on how to manage horse waste. A horse manure composting demonstration site was also created to reinforce the benefits of managing horse manure through composting. These educational tools are very informative and are available to horse owners and the general public. However, as stated in the action summary, it is not clear that this information is in fact reaching enough horse owners. While large stable operations do implement good manure management measures, smaller stables where only a few horses are kept need more focused attention to help them properly manage animal waste.

***Managing Solid Waste Grade*: B-**

Goal: Improve Land Use Management in the Watershed

LAND USE MANAGEMENT

Substantial Progress

Fire Regulation & Erosion Control

Moderate Progress

Reduce Accelerated Sedimentation
Implement Confined Animal BMPs
Public Access & Resource Protection
Habitat Fragmentation
Enforce Camping Restrictions

Minimal Progress

Buffer Zones for Sensitive Areas

Seven actions address land use issues in the Malibu Creek Watershed. Of the five that fall within the range of moderate progress, several of them were actually rated "low moderate." The intent of these actions is to ensure that smart land use decisions are made to protect valuable habitats throughout the watershed. Such planning ranges from improving habitat fragmentation to controlling pollution caused by certain land use activities. In the Malibu Creek watershed, current conventional zoning requirements do not adequately protect riparian habitats, creeks and streams. Below is a detailed summary of how effectively these actions have been implemented.

Substantial Progress

Fire Regulation and Erosion Control (#11)

Only one action, Fire Regulation and Erosion Control, is considered to have made substantial progress in the Land Use category. Four years ago, the Los Angeles County Fire Department implemented a new program, called the *Fuel Modification Program*, to improve fire safety measures for residential and commercial developments. Recognizing the need to also control unnecessary erosion from residential properties, the Fire Department included in its new program standards which allow grass to remain on flat lands and slopes prone to erosion. Additionally, watershed cities now recognize the benefits of mowing, rather than discing, weed setback zones likely to erode and promote the use of drought-resistant, native plants in new landscape plans. These measures highlight the increased awareness among city and county agencies about the sources and importance of balancing erosion control with fire regulation needs.

Moderate Progress

Five actions under *Land Use* have realized moderate success although three of them are considered low-moderate. These five actions include:

- Reduce accelerated sedimentation caused by human activities;
- Implement confined animal BMPs (low-moderate);
- Balance public access and resource protection (low-moderate);
- Eliminate habitat fragmentation (low-moderate); and
- Enforce camping restrictions on parklands.

Reduce Human-based Accelerated Sedimentation (#10)

Efforts to reduce human-based accelerated sedimentation include: 1) passing local ordinances for development projects and enforcing these measures, 2) minimizing the loss of topsoil, 3) preventing roadside dumping of dirt, and 4) eliminating massive grading. Some of these actions have realized greater success than others. For example, in the past few years local ordinances addressing sedimentation control measures have been passed by all watershed cities, which is a milestone achievement. Furthermore, the Regional Board requires all development projects greater than five acres to obtain a Construction NPDES permit and to implement sedimentation control measures. However, enforcing these ordinances and BMP requirements has been relatively inadequate. With few exceptions, on average city inspectors are visiting construction sites required to implement sedimentation control BMPs only once during the rainy season, and the Regional Board lacks sufficient staff resources to conduct regular inspections of large development projects to ensure that pollution control BMPs are being implemented. The mechanisms to control and/or reduce accelerated sedimentation are in place, but enforcement of these measures is not readily occurring.

Implement Confined Animal BMPs (#18)

Among other things, this action calls for setting limits on the number of livestock per acre to protect resources from overuse by large animals, such as horses. Malibu has established limits based on the location of a parcel within the city. The County of Los Angeles Department of Health Services also inspects stables with four or more horses on a yearly basis to determine whether appropriate BMPs are being implemented and to ensure that horse waste is well contained and prevented from reaching creeks. Their surveys confirm that there is definitely a problem with manure waste management in the watershed. Although horse owners are required to ensure that no manure-contaminated runoff reaches adjacent streams and that no stalls are within 50 feet of a stream bank, enforcement of these measures is minimal due to DHS's limited staff resources. Some horse owners simply have not implemented adequate setback zones and pollution control BMPs, and their horse waste is still reaching and polluting adjacent streams in the Malibu Creek watershed.

Balance Public Access and Resource Protection (#32)
The steps needed to accomplish this action are not well defined, and thus what has been reported in Section II of this report is limited. Only a few plans have specifically addressed both resource protection and public access issues. These include the Resource Conservation District's restoration efforts in Malibu Lagoon and the upcoming Las Virgenes Canyon sub-watershed study. A more comprehensive plan focusing on how to minimize the impacts of residents, hikers, horseback riders and campers on the watershed's creeks, streams and sensitive habitats would be a good starting point towards balancing public access needs with resource protection goals.

Eliminate Habitat Fragmentation (#35)
Steps to improve and/or maintain continuous habitats for native species in the watershed have been somewhat limited in scope, and city master plans have focused on other regional impacts of population growth. However, the City of Calabasas' designation of *Open Space Districts* is a creative approach towards reducing habitat fragmentation, and other cities should be encouraged to designate similar districts within their own jurisdictions.

Also, the study initiated by the National Park Service and the California Department of Parks and Recreation four years ago has proved to be a key step in understanding the impacts that habitat fragmentation can have on native species. Over the next several years, the data gathered will be very useful in guiding park planning and habitat preservation efforts.

Enforce Camping Restrictions (#41)
Transient camping is not a significant problem in the Malibu Creek watershed, or on State Parks properties, and thus efforts to control it are minimal. As stated in Section II, State Parks personnel does patrol parklands and takes action as necessary.

Minimal Progress

Create/Maintain Buffer Zones for Sensitive Areas (#34)
While a few agencies have created buffer zones to protect sensitive habitats and prevent urban encroachment within their agency boundaries, the majority of the watershed's sensitive habitats are not well protected. Watershed cities have lagged in their efforts to protect sensitive habitats and setback requirements called for under municipal ordinances are inadequate to protect riparian habitats and stream corridors from development activities. Development projects located too close to stream and riparian corridors lead directly to increased sedimentation, spreading of invasive species and

increased trash and debris. Better efforts at the municipal level should be made towards creating adequate buffer zones in the watershed.

***Land Use Management Grade*: C-**

Goal: Restore and Protect the Watershed's Habitats

A total of 15 actions address the need for habitat protection and restoration in the Malibu Creek Watershed. These actions range from purchasing land containing sensitive habitats to preventing sedimentation and the proliferation of exotic species. As the chart to the left shows, collectively low-to-moderate success has been achieved towards restoring, enhancing and protecting the watershed's habitats and resources.

WATERSHED HABITATS

Substantial Progress

Fire Regulation & Erosion Control
Mitigate Impacts of PCH
Bridge Reconstruction

Moderate Progress

Reduce Accelerated Sedimentation
Restore Malibu Lagoon
Assess Lagoon Characteristics
Habitat Fragmentation

Minimal Progress

Establish Minimum Biological Standards
Establish Water Temperature Policies
Regulate Lagoon Water Levels
Public Access & Resource Protection
Purchase High Priority Land Areas
Buffer Zones for Sensitive Areas
Control Exotic Vegetation in Wilderness
Remove Barriers to Fish Migration
Maintain/Restore/Create Wetlands

Substantial Progress

Of the 15 actions in this section, only two have achieved substantial progress in protecting the watershed's habitats. They include:

- Fire regulation and erosion control; and
- Mitigate the impacts of Pacific Coast Highway bridge reconstruction on habitats.

Fire Regulation & Erosion Control (#11)
Development and implementation of the Fire Department's *Fuel Modification Program* was a significant achievement in reconciling public safety with resource and habitat protection. The program's grass height allowances, planting requirements and long-term vegetation maintenance plan help to minimize the erosion and sedimentation caused by excessive brush clearance and mowing practices. Combined, these measures are improving habitats located near developments and are helping to prevent the downstream impacts resulting from uncontrolled erosion and sedimentation.

Mitigate the Impacts of PCH Bridge Reconstruction (#26)
CalTrans established a mitigation fund to help improve various habitats around the Pacific Coast Highway bridge which crosses Lower Malibu Creek and Lagoon. Three very successful projects in the lower watershed were implemented as a result of this mitigation fund: 1) salt marsh restoration (State Parks); 2) five year monitoring of the tidewater goby (RCDSMM); and 3) the *Effects of Sand Breaching the Sand Barrier on Biota* study (RCDSMM). Because CalTrans has met its mitigation requirements, this action is considered fully and successfully completed. Additional lower creek and lagoon restoration efforts are addressed in several other actions throughout this report.

Moderate Progress

Four of this section's 15 actions have achieved moderate progress towards protecting the watershed's habitats. These include:

- Reduce accelerated sedimentation;
- Restore Malibu Lagoon;
- Assess lagoon characteristics; and
- Eliminate habitat fragmentation.

Reduce Human-based Accelerated Sedimentation (#10)
Efforts to control human-induced sedimentation from urbanized areas have been moderately successful, due primarily to: 1) increased public education efforts focused on developers and contractors, 2) adoption of local ordinances by watershed municipalities and 3) enforcement of construction-related BMPs. These efforts could also be improved through enhanced enforcement activities, mowing rather than discing areas likely to erode and educational outreach specifically targeting residential communities about the need for smart landscaping to protect the watershed's habitats from neighborhood-based sedimentation.

Restore Malibu Lagoon (#20)
The components essential to restoring Malibu Lagoon are numerous and complex. Already, a significant amount of attention has been given to the "need" to restore the lagoon, and many studies have been conducted over the years to help assess the extent of the problems associated with the area. This increased level of understanding about the impacts earned this action a moderate rather than minimal ranking. It is a critical first step towards any restoration plan. However, until now actual restoration efforts have been piecemeal, such as increasing the available habitat for migratory birds and the tidewater goby, restoring the salt marsh area, removing trash and debris, and construction of a storm water treatment and disinfection facility at the end of the mystery drain. A comprehensive plan must be developed detailing all of the steps needed for full restoration.

As mentioned in the body of the report, the Lower Malibu Creek and Lagoon Task Force is currently in the process of prioritizing the alternatives contained in the UCLA report and developing a restoration plan. Although not complete at the time of this report, their efforts are aggressively moving along. Once priorities are developed, the group will start seeking funds to implement those measures chosen.

Assess Malibu Lagoon Characteristics (#21)
The primary objectives in assessing Malibu Lagoon's characteristics are to evaluate and establish water quality criteria and habitat needs. The complement to this activity lies in determining how those characteristics actually affect/impact habitats. As

mentioned under both *Establishing Minimum Biological (habitat) Standards* and *Restore Malibu Lagoon* above, several studies have occurred to increase our understanding of the biological condition of the Lagoon, including the degree to which habitats are impaired. However, not all species have been considered in the characterization and there are still gaps in data which need to be filled — in particular, the physical tolerances of key species and the degree to which pollutants adversely affect these species. For this reason, the progress made under this action is considered moderate.

Eliminate Habitat Fragmentation (#35)

While the threat of habitat fragmentation does exist in the Malibu Creek Watershed, the fact that nearly 80% of the watershed is open space helps lessen that threat. The studies undertaken to evaluate the impacts of urban encroachment on habitats and to address critical concerns of carnivores are being used to direct and promote wildlife conservation efforts. Cities, recognizing the need for open space and habitat linkage preservation, are starting to incorporate these concepts into their master plans and to identify land parcels most desirable for acquisition to meet this goal. If acquired, the parcels identified by State Parks will also help reduce habitat fragmentation. And lastly, the on-going educational and awareness efforts targeting city planners and permitting departments should help guide habitat preservation efforts.

Minimal Progress

Nine actions, more than one-half of the total under *Habitats*, have made little or no implementation progress. These include:

- Establish minimum biological (habitat) standards;
- Establish water temperature policies for fisheries;
- Regulate lagoon water levels;
- Public access and resource protection;
- Purchase high priority lands for watershed protection;
- Develop buffer zones for sensitive areas;
- Control exotic vegetation in the wilderness;
- Remove barriers to fish migration; and
- Maintain, restore and create wetlands.

Establish Minimum Biological (habitat) Standards (#5)

Because of the monitoring efforts of many organizations, including the RCDSMM, Las Virgenes Municipal Water District and Coastal Conservancy/UCLA study, there is a greater understanding of the biological condition of the watershed's target and endangered species. However, no studies have been conducted to comprehensively assess the range of tolerances of these species. Although it may prove impossible to

actually optimize the habitat needs for each of the target species, particularly in the lower creek and lagoon area, establishing their minimum needs would provide a good starting point from which to set biological standards.

Establish Water Temperature Policies (#12)

Despite the Las Virgenes Municipal Water District's temperature data for steelhead trout and Resource Conservation District's decade-long Malibu Lagoon temperature data, no recommendations have been made about what the optimum water temperature should be for habitats and species in the Malibu Creek watershed. And, no studies have been conducted to determine the temperature tolerances of the watershed's local key/indicator species.

In its thermal plan, the State sets temperature limits for industrial and treatment plant discharges such as Tapia's effluent. However, such discharges into the Malibu Creek watershed are not a concern because they are well below the limits established by the State. Of greater importance to aquatic species such as steelhead trout is the overall quality of the water, its flow characteristics and whether there is sufficient habitat (e.g., deep pools, upstream spawning grounds) to support native populations.

Notwithstanding the lack of effort, it's not clear that establishing a water temperature policy is needed for Malibu Creek given its current state.

Regulate Lagoon Water Levels (#24)

Perhaps one of the most difficult issues facing the Lower Malibu Creek and Lagoon area has been how to regulate water levels in the lagoon. The unnaturally high water levels found in the lagoon during the dry season affect the hydraulic gradient in and around the lagoon, and this alteration causes many problems. Nearby septic systems become backed up, pollutants become more mobile in groundwater, bacteria counts increase, lagoon salinity decreases and mudflats (bird habitat) disappear. The need to regulate or control lagoon water levels is of critical concern for these and other reasons.

Prop A funds ($1,275,000) were awarded to State Parks and the City of Malibu in 1998 to develop a project to regulate lagoon water levels. Because Malibu is no longer participating in this effort, State Parks has taken on the leadership role in solving this problem. However, progress has been extremely slow. State Parks released a *Request for Proposals* in September, 1999 seeking a sound water level management plan/design and since that time several management alternatives have been discussed. However, a preferred alternative has not been selected and no project has been implemented as of yet. For this reason, this action has been given a minimal rating.

Public Access and Resource Protection (#32)
A balance must be maintained between allowing public access to open space while protecting sensitive habitats in the watershed. Unfortunately, this action has not received much attention until recently. Recognizing the need for balance, State Parks and a few watershed cities have begun to implement resource protection measures such as establishing access trails, erecting informative signs and outlining critical measures to be addressed (e.g., wildlife corridors and recreational needs) in city master plans. Still, local habitats are not adequately protected from community recreational activities. For example, allowing public access to the mud flats in Malibu Lagoon jeopardizes bird safety because some visitors bring their dogs and allow them to roam off-leash. Riparian habitats are trampled on by horses and hikers who may not realize that they are in sensitive areas. And, trash is left on the ground in parks which further impacts wildlife and aquatic habitats. Implementing measures that would *fully* protect sensitive habitats is not a popular idea as it would most likely require prohibiting public access completely. Therefore, a more attention must be given to this action and a plan developed that adequately balances public access with resource protection needs.

Purchase High Priority Land for Watershed Protection (#33)
This action has made little progress on three accounts. First, there has not been a comprehensive, publicly available assessment of which lands within the entire watershed would be the most desirable to acquire from a water quality/habitat prospective. Secondly, there has been little effort made to actually acquire key parcels, or to secure the funds to do so. And thirdly, there has not been an abundance of willing sellers. Obtaining some parcels which have long been sought after, such as the golf course adjacent to Malibu Lagoon, has proved impossible thus far. This action, in some sense, has found itself in a "catch 22" scenario. A seller isn't willing to open discussions about selling his/her land unless funds are available to purchase it, and government agencies will not allocate funds unless the landowner is a willing seller.

Additionally, the few parcels that have been identified as desirable for acquisition have not been selected as part of a greater watershed protection effort. Rather, they represent singular potential restoration opportunities. As an example, the City of Malibu is assessing the feasibility of acquiring land for a constructed wetland in the Civic Center area. While this is an important location, it has not been officially prioritized as the most important parcel for acquisition in Malibu. A comprehensive plan which prioritized parcels for acquisition and determines the likelihood of obtaining them would eliminate this problem.

Develop Buffer Zones for Sensitive Areas (#34)
With a few exceptions, little attention has been given to the importance of creating buffer zones and to identifying sensitive zones throughout the watershed which are in

need of buffer areas for protection. And, local ordinances for buffer zone setbacks (up to 100 feet) are inadequate to protect streams and creeks within the watershed. A few buffer zone areas have been identified on State Parks property and land has been purchased near the Rancho composting facility, but this falls far short of protecting many of the sensitive areas throughout the 109 mi^2 watershed. Although the creation or designation of open space zones should help protect sensitive areas contained in these zones, its benefits will not be realized unless there is a real commitment from the watershed's cities to designate open space zones. Like the recommendation to prioritize land parcels for acquisition, a comprehensive survey of significant ecological areas should be conducted and a priority list developed which is specific to the habitat protection needs of the Malibu Creek watershed.

Remove Barriers to Fish Migration (#36)

Efforts to address this action started several years after adoption of the Bay Restoration Plan and the Natural Resources Plan, and began with the formation of the Steelhead Recovery Task Force. In Malibu Creek, there are two primary obstacles impeding steelhead's migration to upper reaches of the creek. These include the Arizona crossing at Cross Creek and Rindge Dam.

Arizona Crossing at Cross Creek

A few years ago, there were discussions about removing this particular obstacle to steelhead migration. However, plans have all but been dropped because funding was never secured to alter the crossing. Only recent passage of Prop 12 has sparked new interest regarding how the crossing could be changed to benefit steelhead trout migration upstream.

Rindge Dam

Although Rindge Dam has not been removed, the fact that the Army Corp of Engineers has conducted a reconnaissance study to confirm local support for the project was a very positive initial step. However, a feasibility study (which has yet to start) needs to be conducted to assess the various restoration alternatives. The Army Corps has appropriated $400,000 for this feasibility study and State Parks will be providing the necessary matching funds. Current cost estimates to remove Rindge Dam, based on several alternatives already proposed, range between $10-30 million. Still, it remains to be seen which restoration alternatives will actually be presented and whether enough funds will then be secured for the alternative ultimately selected.

Maintain, Restore and Create Wetlands (#38)

The majority of interest in maintaining, restoring and creating wetlands has been in the lower watershed, in areas including Malibu Lagoon and the Civic Center area. With the exception of the LVMWD's rehabilitation of a percolation pond as a constructed wetland and some restoration of Malibu Lagoon, no other wetland restoration efforts

have been implemented. Part of the reason for this stems from a lack of funds to start such a project. Also, there is some controversy over just which areas are considered "historic wetlands" and can be rehabilitated, and which areas can even be restored given current development obstacles.

Control Exotic Vegetation in the Wilderness (#37)

As mentioned in the body of the report, controlling the spread of exotic vegetation in the watershed is an overwhelming and endless task, and the resources needed to conduct this activity successfully haven't been available. While there are certainly some vigilant efforts by State Parks, Weed Warriors and other volunteer groups, the problem is so great, and some species so prolific, that it seems that it will be all but impossible to permanently remove exotic species. Also, the success of removing one particular invasive species, Arundo donax, is reduced because the target areas for removal are downstream from other upstream patches of Arundo. Unfortunately, the funds made available for this activity limited the geographical area from which Arundo could be removed.

The newly formed Invasive Species Task Force plans to start addressing the need to identify, assess and initiate removal of many types of invasive species. Perhaps their efforts, along with the availability of Prop 12 bond funds will lead to more successful removal of exotics.

Restore and Protect Watershed Habitats Grade: D-

Goal: Improve Coordination & Outreach Among Watershed Stakeholders

COORDINATION and OUTREACH

Substantial Progress

Posting Public Notices
Composting, Recycling & Conservation
Coordination Efforts
Public Education Programs

Moderate Progress

Implement Confined Animal BMPs
Promote Water Conservation
Coordinated Monitoring Program

Overall, the 7 actions designed to improve ***Coordination and Outreach*** have been quite successfully implemented. The goals and objectives of these actions has been: 1) to improve communication and coordination efforts among stakeholders, public agencies and the general public, 2) to better educate the public about sources of pollution and what they can do to minimize the impacts of pollution on the watershed's resources, and 3) to combine monitoring resources to better understand watershed dynamics and impacts. Following is an assessment of progress achieved in meeting the goals of these actions.

Substantial Progress

Some of the more notable achievements have been in the areas of:

- Posting public notices regarding lagoon breaching, and publishing bacteria monitoring results and potential human health concerns;
- Promoting composting, conservation and recycling programs in the watershed through curbside recycling programs, household hazardous waste roundups, educational brochures, PSAs and workshops (just to name a few);
- Coordinating restoration and protection efforts on a watershed basis; and
- Implementing public education programs.

Post Public Notices (#25)

Public access to and understanding of information available on the quality of water in Malibu Creek and Lagoon has dramatically increased in the last five years. This is due to a number of factors, including: 1) regular and frequent posting of Heal the Bay's Beach Report Card through multiple venues, 2) improvements in bacterial monitoring, and 3) local newspaper coverage. The results of the Santa Monica Bay Restoration Project's *Epidemiological Study* also helped improve the protocol for advising the public of health risks associated with swimming in contaminated waters. While the public is made aware of the health risks associated with swimming in the ocean within three days after a rain event through the media, the study provided the information needed to scientifically back up the recommendations and led to revisions in the County's Beach Closure and Health Warning protocol. The study also

led to passage of AB 411, which requires local health agencies to set up a hotline informing the public of closed, posted or restricted beaches. Together, these actions have effectively improved the public's awareness about the water quality and risks associated with swimming in shoreline waters adjacent to Malibu Creek and Lagoon.

Composting, Recycling and Conservation Programs (#29)
As mentioned under **Managing Solid Waste** (starting on page 99), an enormous amount of energy has gone into promoting composting, recycling and conservation awareness among watershed residents. All watershed cities offer some sort of recycling program, whether it be curb-side pickup, roundup events or permanent drop-off sites. Additionally, these recycling opportunities are promoted through city newsletters, public service announcements, local cable channels and city banners. The need for water conservation is also promoted through educational workshops, fliers, newsletters and bill inserts. Combined, these efforts have increased the public's awareness for the need to recycle and conserve.

Coordination Efforts (#39)
The formation of the Malibu Creek Watershed Council has led directly to many of the achievements highlighted in this report. The continued involvement of participating organizations listed in Table 1.1 on page 5 has also led to a better understanding of the dynamics of the watershed and has provided a reliable mechanism for restoring habitats, assessing water quality and protecting species in a constructive, cohesive manner. While implementation has been slow for many actions, it would have been virtually impossible to achieve the progress already made without the long-term commitment of council members working together.

The progress made to coordinate activities among different agencies with seemingly conflicting goals has also been a milestone achievement, which should serve as a model for other watersheds. In particular, reconciling brush clearing needs (fuel modification), flood control and roadside maintenance with preservation of habitats has led to revisions of past practices and establishment of new guidelines within the County Fire and Public Works Departments. The 1996 Municipal Storm Water NPDES permit has also proven to be another avenue for coordinating efforts between the County and cities in the Malibu Creek watershed. Although the activities called for in the permit are mandatory on an individual city basis, cities have realized and been motivated by the cost savings associated with forming partnerships. In particular, the formation of the Council of Governments (see Coordinate on a Watershed Basis, #39) reinforces the advantages of creating such partnerships.

Public Education Programs (#42)
Public education programs targeting watershed residents and businesses have been broad in both message and approach. Many new outreach avenues have become successful realities in recent years, including use of the internet, creation and circulation of city/utility newsletters, use of real-time data, increased numbers of roundups and collection events, and an ever-growing number of hands-on programs and activities (e.g., student field trips, residential gardening workshops, volunteer opportunities, commercial site visits, municipal training and workshop classes, etc.). Additionally, several public education programs have successfully targeted very specific user groups. Examples include: 1) the Resource Conservation District of the Santa Monica Mountains' *Stable and Horse Management BMP Manual*; 2) the Las Virgenes Municipal Water District's water conservation classes for landscape maintenance companies; and 3) State Parks' lectures for teachers on the values of and need to preserve open space.

Moderate Progress

Moderate progress has been achieved in areas such as:

- Implement confined animal BMPs;
- Promote water conservation practices; and
- Implement coordinated monitoring programs

Implement Confined Animal BMPs (#18)
The RCDSMM conducted an extensive survey to identify the horse owners and corrals in the Malibu Creek watershed. They then used the information to produce pollution prevention educational materials for this target group. While the outreach materials are very informative, it's not clear that they are effectively reaching horse owners and are leading directly to changes in habit among them. Many corrals are still placed too close to streams and creeks, management of horse waste is still not closely regulated and people are still riding their horses in adjacent creeks. More outreach using the tools now available is still needed.

Promote Water Conservation (#30)
Because virtually all of the water used by watershed residents is imported, conservation measures are vitally important to both protecting and sustaining natural habitats. The LVMWD has implemented several educational approaches to promote water conservation measures which would reduce the amount of water used by households, including: 1) installation of ultra low-

flow toilets, 2) workshops promoting low water use plants and landscape, and 3) distribution of educational materials promoting water conservation. However, the watershed's population continues to increase and even more must be done to encourage households to install ultra low-flow toilets (the single largest indoor use of water), and to more closely monitor landscape irrigation needs and other activities which cause excessive runoff.

Coordinated Monitoring Programs (#43)

There is an enormous amount of recent and historic monitoring data available for waterbodies in the Malibu Creek watershed, and significant steps have been taken towards collectively integrating the watershed's monitoring activities. Independent studies and routine monitoring activities have also enhanced our understanding of the major pollution issues. However, this data has yet to become available through a centralized, user-friendly database, and it has never been analyzed as a whole. Heal the Bay has only recently received funding for and started to create a database of the monitoring activities of key agencies. And, although the Monitoring and Modeling Subcommittee released a plan detailing a coordinated, watershed-wide monitoring program, it has yet to be implemented. Its implementation depends on securing the funds needed to carry out each component of the plan. Future progress will require adequate resources to realize the goals of the coordinated monitoring plan developed.

Coordination and Outreach Grade: A-

SECTON IV:
MOVING FORWARD WITH RESTORATION PRIORITIES

Significant achievements have been made over the past decade to restore the Malibu Creek watershed. Still, much remains to be done to improve its water quality, habitats and living resources.

This chapter provides a summary of priority watershed restoration and protection activities which will advance the Malibu Creek watershed Action Plan.

The 29 priorities listed (Table 4.2) are based on the assessment of progress contained in this report. From this list, the Malibu Creek Watershed Executive Advisory Council has identified a list of "Top Ten" priorities (Table 4.1). How well and how extensively these actions are implemented will depend on many things, including: 1) availability of funds to carry out programs, 2) policy changes and/or legislation, 3) availability of research data to move actions forward, 4) ability to acquire land, and most importantly, 5) ensuring stakeholder involvement.

This Top-Ten list is not intended to be static or even an exhaustive list of all the watershed's priorities. It is anticipated that priorities will change as actions are implemented and new issues arise.

"TOP TEN"
Watershed Restoration Priorities

1. Map all existing and potential sources of pollution in the watershed. Implement measures to pinpoint sources of pollution in both the upper and lower watershed.
2. Acquire key parcels of land for habitat protection.
3. Remove Arundo donax from the entire watershed.
4. Review general land use practices and past practices for each city and for unincorporated areas in the watershed to predict the impacts on public health, natural and aquatic resources, and recreational benefits.
5. Reduce sedimentation and erosion along stream banks, roadways and at construction sites.
6. Implement the coordinated watershed-wide monitoring plan developed by the Monitoring and Modeling sub-committee and develop a centralized database for the monitoring data.
7. Synthesize water quality data to establish minimum standards for native species of locality and identify where gaps in data still exist.
8. Develop/revise monitoring plan to address data gaps.
9. Develop a plan to identify, remove and prevent exotic plant and animal species from impacting the watershed.
10. Help/Encourage watershed cities to develop uniform development plans and ordinances which would:
    - Set slope minimums for hillside building and construction activities.
    - Establish native plant vegetation requirements
    - Prevent disturbances to natural drainage channels
    - Retain runoff on-site to the maximum extent practicable (including use of pervious surfaces)
    - Prevent sediment loadings to creeks/streams both

Table 4.1. "Top Ten" watershed restoration priorities.

MOVING FORWARD ON WATERSHED RESTORATION PRIORITIES **(Table 4.2)**	**Issues to be Addressed**					
	Improve Water Quality	Reduce Excess Flow	Reduce Health Risks	Improve Land Use Management	Habitat Restoration and Protection	Enforcement and Education
Policy and Planning						
1. Revise/modify/update the Malibu Creek Watershed Restoration Plan.	☑	☑		☑	☑	☑
2. Develop a plan to better balance public access needs with habitat/resource protection.					☑	
3. Prioritize land parcels for acquisition that promote water quality and critical habitat protection.	☑				☑	
4. Develop procedural guidelines to address unconventional pollutants as they are discovered.	☑		☑		☑	
5. Review and improve current land use practices for each city and unincorporated areas in the watershed to predict land use impacts on public health, natural and aquatic resources and recreational benefits.	☑		☑	☑	☑	
6. Develop and implement better enforcement programs. Specifically address: • BMP implementation at construction sites; • Polluted discharges from restaurants and gas stations; • Improper grading practices; • Pervious surface requirements; and • Buffer zone setbacks	☑	☑	☑	☑	☑	☑

MOVING FORWARD ON WATERSHED RESTORATION PRIORITIES **(Table 4.2)**	Issues to be Addressed					
	Improve Water Quality	Reduce Excess Flow	Reduce Health Risks	Improve Land Use Management	Habitat Restoration and Protection	Enforcement and Education
7. Encourage watershed municipalities to integrate a watershed planning perspective into General Plans and local ordinances. Concepts to be considered include: • Setting slope minimums for hillside building/construction; • Establishing native plant vegetation requirements; • Preventing disturbing natural drainage channels; • Minimizing habitat fragmentation; • Retaining runoff on-site to the max. extent practicable (including pervious surfaces requirements for new and substantial redevelopment projects); • Preventing sediment loadings to creeks/streams both during and after construction; • Cumulative watershed-based review of development projects; • Setting standards for streets, sidewalks, driveways and parking lots; • Establishing 200-ft buffer-zone standards near sensitive habitats; and • Establishing setback standards for corrals and stables located near creek and stream banks.	☑	☑		☑	☑	
Watershed Studies and Research						
8. Map all existing and potential sources of pollution in the watershed and use measures to pinpoint exact sources of these pollutants. In particular, identify all sources and relative contributions of pathogens and nutrients.	☑		☑		☑	
9. Identify and develop a monitoring program to fill gaps in data where they exist throughout the watershed.	☑	☑		☑	☑	☑
10. Establish TMDLs for pollutants of concern in the Malibu Creek watershed.	☑	☑	☑		☑	
11. Establish minimum biological standards (habitat needs) for native species. Consider the physical tolerances of birds, plants and aquatic species.					☑	
12. Evaluate the impacts of breaching on Malibu Lagoon aquatic species and birds. Design a lagoon water level management plan based on this research.					☑	

MOVING FORWARD ON WATERSHED RESTORATION PRIORITIES **(Table 4.2)**	**Issues to be Addressed**					
	Improve Water Quality	Reduce Excess Flow	Reduce Health Risks	Improve Land Use Management	Habitat Restoration and Protection	Enforcement and Education
13. Determine appropriate seasonal flows into Malibu Creek and Lagoon. Evaluate the feasibility of treating creek and storm drain flows before they reach Malibu Lagoon and consider alternative uses for excess flows.		☑				
14. Assess/determine the impacts of nearby septic system effluent on lower Malibu Creek and Lagoon.	☑	☑	☑			
15. Conduct a household irrigation survey to better determine reasons for excess runoff from residential property.		☑				
Habitat Restoration and Other "On the Ground" Activities						
16. Regulate Malibu Lagoon water levels while minimizing the impacts to local habitats and species.	☑				☑	
17. Prevent/reduce sedimentation along stream banks, roadways and at construction sites.	☑			☑	☑	☑
18. Identify locations for and create buffer zones for sensitive habitats watershed-wide. Promote the need for buffer zones at the municipal, county and state level.				☑	☑	
19. Remove exotic plant, aquatic and animal species in the watershed. Prioritize the most prolific and invasive species for removal first.					☑	
20. Remove barriers to fish migration, particularly in the lower watershed, and enhance fish habitats.					☑	
21. Improve and increase wetlands habitat in the lower watershed.					☑	
22. Enhance bird habitats in Lower Malibu Creek and Lagoon. Consider: • Preventing human and pet intrusion; • Placement of informative/warning signs; • Education of lifeguards and beach-goers; • Removal of invasive species, planting of native species; • Trash can lids; and • Appropriate lagoon water levels.	☑				☑	☑

MOVING FORWARD ON WATERSHED RESTORATION PRIORITIES **(Table 4.2)**	**Issues to be Addressed**					
	Improve Water Quality	Reduce Excess Flow	Reduce Health Risks	Improve Land Use Management	Habitat Restoration and Protection	Enforcement and Education
23. Reduce trash inputs into the watershed. Consider: • Requiring outdoor, bird-proof lids in parks, and at beaches and restaurants/shopping centers. • Installing more trash cans where needed in parklands and at beaches. • Promoting/expanding comprehensive recycling programs for paper cardboard, plastics, aluminum and glass • Establishing a permanent recycling center for all watershed residents. • Posting bilingual informative signs in areas most frequently visited.					☑	☑
24. Reduce sources of nutrients, pathogens and bacteria into the watershed. Specifically: • Implement livestock BMPs for horse owners. See #7 above. • Implement siting, monitoring, maintenance, replacement requirements and inspection programs for septic systems. Establish discharge standards for septic system effluent. • Storm drain discharges: identify and eliminate sources entering storm drains (on-going). • Promote year-round diversion of Tapia effluent from Malibu Creek; improve nutrient removal process; and maximize reuse potential.	☑		☑			☑
25. Identify and eliminate illicit connections on a regular basis.	☑		☑	☑		
26. Reduce impacts of landfill operations on nearby habitats. Implement mitigation measures where necessary.					☑	
27. Develop and conduct both general and focused education programs watershed-wide. Specifically, improve outreach to: • Homeowners about: 1) sources of household waste and their impacts to water quality, and 2) the need for water conservation and runoff reduction. • Contractors and developers about how their activities adversely impact water quality and habitats. Incorporate information on smart developing/designs to retain storm water runoff on site. • Horse and other livestock owners about how animal waste impacts water quality, and ways to minimize this source of pollution. • Septic system users (commercial and residential) about the need for and importance of maintaining appropriately functioning septic systems.	☑		☑			☑

MOVING FORWARD ON WATERSHED RESTORATION PRIORITIES **(Table 4.2)**	**Issues to be Addressed**					
	Improve Water Quality	Reduce Excess Flow	Reduce Health Risks	Improve Land Use Management	Habitat Restoration and Protection	Enforcement and Education
28. Promote/mandate water conservation practices by: 1) using native, drought-tolerant plants, 2) installing ultra low flow toilets and irrigation sensors, 3) providing price incentives to reduce water usage, 4) incorporating storm water retention designs into all new construction plans and 5) distributing recycled water to the maximum extent practicable.		☑				
29. Implement the coordinated Malibu Creek Watershed Monitoring Program (developed by the Monitoring and Modeling subcommittee) and develop a centralized database for the monitoring data.	☑					☑

Acronyms

BMPs	Best Management Practices
BRP	Bay Restoration Plan (Santa Monica Bay Restoration Project)
BOD	Biochemical Oxygen Demand
CalTrans	California Department of Transportation
CCC	California Coastal Commission
CDS	Continuous Deflection System
cfs	Cubic feet per second
COG	Council of Governments
CSDLAC	County Sanitation Districts of Los Angeles County
DHS	Los Angeles County Department of Health Services
DO	Dissolved Oxygen
EA	Environmental Assessment
EIR	Environmental Impact Report
EPA	U.S. Environmental Protection Agency
EPA 319(h)	U.S. EPA Nonpoint Source Reduction Grant Program
EPA 205(j)	U.S. EPA Water Quality Planning Grant Program
GIS	Geographical Information System
GPS	Global Positioning System
JPA	Joint Powers Authority
LAC-DPW	Los Angeles County Department of Public Works
LARWQCB	Los Angeles Regional Water Quality Control Board
LVMWD	Las Virgenes Municipal Water District
MCW	Malibu Creek Watershed
MEP	Maximum Extent Practicable
mg/l	Milligrams per liter
MTA	Metropolitan Transportation Authority
MWD	Metropolitan Water District
NMFS	National Marine Fisheries Service
NOI	Notice of Intent
NO_2, NO_3, N	Nitrogen Compounds
NPDES	National Pollutant Discharge Elimination System
NPS	National Parks Service
PIE	Public Involvement and Education
PSA	Public Service Announcement
PSDS	Private Septic Disposal System
RCDSMM	Resource Conservation District of the Santa Monica Mountains
Regional Board	Los Angeles Regional Water Quality Control Board
SCAG	Southern California Association of Governments
SEAs	Significant Ecological Areas
SCS	Soil Conservation Service
SMBRP	Santa Monica Bay Restoration Project
State Parks	California Department of Parks and Recreation

SWRCB	State Water Resources Control Board
RCDSMM	Resource Conservation District of the Santa Monica Mountains
TAC	Technical Advisory Committee
TDS	Total Dissolved Solids
TMDL	Total Maximum Daily Load
UCLA	University of California, Los Angeles
ULFT	Ultra Low Flow Toilets
WDR	Waste Discharge Requirements

Definitions

Best Management Practices	Activities, practices, facilities and/or procedures that when implemented to their maximum efficiency will prevent or reduce pollutants in discharges.
Bathymetry	The science of measuring the depths of the ocean, seas, etc.
Benthic	Organisms living on or in the sea floor.
Bio-criteria	Narrative descriptions or numerical values that are used to describe the reference condition of aquatic biota inhabiting waters of a designated aquatic life use. These criteria are used to determine if waters are affected by chemical pollution or other factors.
Biosolids	The solids portion of human waste removed through primary treatment of wastewater. Formerly called sludge.
BOD	Bio-chemical Oxygen Demand. The amount of dissolved oxygen needed to decompose organic matter in wastewater. A high BOD indicates an impaired waterbody with little oxygen remaining for aquatic life.
Breach (lagoon)	Naturally or artificially breaking open the sand barrier that separates Malibu Lagoon from Santa Monica Bay.
Carnivore	Any of an order of fanged, flesh-eating mammals including the dog, bear, cat and seal.
Catch Basin	A sieve-like device at the entrance to a storm drain system to stop matter from entering which could block up the system.
Clean Water Act (CWA)	The Federal Water Pollution Control Act enacted in 1972 by public law and amended by the Water Quality Act of 1987. The Clean Water Act prohibits the discharge of pollutants to waters of the United States unless said discharge is in accordance with an NPDES permit.
Coliform	Relating to, resembling or being the aerobic bacillus normally found in the colon of humans and animals. A coliform count is often used as an indicator or fecal contamination of water supplies.

Delineation (wetlands)	Identification and/or outline an area which encompasses wetlands.
DO	Dissolved Oxygen. The amount of oxygen present in water. A low DO indicates an impaired waterbody with little oxygen remaining to support aquatic life.
Enterococcus	Any of a genus (streptococcus) of non-motile, usually parasitic, gram positive bacteria occurring in the intestinal tract that may be a cause of disease when found in other parts of the body.
Eutrophication	The process in which a nutrient-rich waterbody becomes degraded due to decreased levels of oxygen caused by excessive growth of bacteria. High eutrophication indicates an impaired waterbody with little or no oxygen remaining to support aquatic life.
Extirpate	To remove or destroy completely; exterminate; abolish.
Grey Water	Wastewater discharged from household sinks, showers, washing machines, dishwashers, etc. that does not come into contact with human waste.
Hydrology	The science dealing with the waters of the earth, their distribution on the surface and underground, and the cycle involving evaporation, precipitation, flow to the seas, etc.
Illicit Connection	Any discharge to the storm drain system that is prohibited under local, state or federal statutes, ordinances, codes or regulations. This includes all non-storm water discharges except discharges pursuant to an NPDES permit and discharges that are exempted or conditionally exempted in accordance with section II of the 1996 Municipal Storm Water NPDES permit.
Macroinvertebrate	Larger animals without backbones or spines (e.g., shrimp, lobster).
MBAS	Methyl Buyl Activated Substances. Soap and/or detergent compounds which indicate human inputs into a waterbody. MBAS markers are often found in grey water discharges.

Morphodynamics	(Definition for this report only). The constantly changing hydrological conditions associated with the Lower Malibu Creek and Lagoon estuarine system; particular attention is given to the morphodynamics of sand bar formation and breaching occurrences, tidal regime, wave climate and creek flows.
Nonpoint Source Discharge	Discharge resulting from widespread, diffuse, or unidentifiable sources of contaminants that comes from more than one point which cannot be controlled or easily monitored.
NPDES	National Pollutant Discharge Elimination System. A permit issued by the US Environmental Protection Agency, State Water Resources Control Board or California Regional Water Quality Control Boards pursuant to the Clean Water Act that authorizes discharges to waters of the United States and requires the reduction of pollutants or sets pollutant limits in the discharges.
Nutrients	Elements necessary for plant growth. Nitrogen and phosphorus are the most common elements. Excess nutrients in waterbodies can stimulate plant and algae growth.
Pathogen	Any agent, especially a microorganism, able to cause disease.
pH	A symbol for the degree of acidity or alkalinity of a solution, which ranges from 0 to 14. A neutral substance will have a pH value of 7, which is the value of distilled water. Lower number are acidic and higher numbers are alkaline (basic).
Piezometer	Any of various instruments used in measuring pressure or compressibility (e.g., to measure water pressure)
Point Source Discharge	Discharge from single, known sources, such as publicly owned treatment works (POTWs) or industrial facilities, from which contaminants enter a waterbody.
Porter Cologne Act	An Act passed by the California legislature in 1967, to provide for the orderly and efficient administration of the water resources of the state. Periodic amendments have been made since its original adoption date.
Potable	Fit to drink; drinkable.
Primary Treatment	A treatment process in which the solids portion of wastewater is

	allowed to settle out before the remaining effluent is discharged. This process does not remove suspended and colloidal matter.
Proposition A Funds	Bond funds totaling $8 million which were approved by Los Angeles County voters in 1994 And 1998. These funds are specifically earmarked for capital improvement projects to prevent or reduce urban runoff pollution from entering Santa Monica Bay and its watershed.
Riparian Habitats	Those habitats located adjacent to or living on the bank of a lake, pond, river, creek or stream.
Secondary Treatment	A biological treatment process in which effluent that has received primary treatment is further processed to remove about 85% of the BOD and suspended solids present (e.g., trickle filters or anaerobic digestion) before being discharged.
Sedimentation	The deposit or formation of sediment. Increased sedimentation into waterbodies can increase turbidity and smother natural spawning grounds.
Spawning Grounds	A location where eggs, sperm or young (offspring) are produced or deposited.
Storm-ceptor J	An in-situ, non-mechanical device which is positioned to receive and separate out trash and other debris found in storm drain flows before they reach receiving waters.
Taxonomical	Classification of plants and animals into natural, related groups based on some common factor of each, as structure, embryology or biochemistry.
Telemetry	Transmission of measurements of physical phenomena, such as temperature, to a distant recorder or observer.
Tertiary Treatment	A treatment process in which effluent that has received both primary and secondary treatment is further processed to remove nutrients and most of the remaining suspended solids before being discharged.

Turbidity	Muddy or cloudy water from having the sediment stirred up. Increased turbidity reduces the amount of light that can penetrate through the water column.
US EPA 205(j) Grant Funds	United States Environmental Protection Agency. Under section 205(j) of the Clean Water Act, grant funds are provided for water quality planning and assessment projects designed to prevent or reduce the release of pollutants into waters of the United States.
US EPA 319(h) Grant Funds	United States Environmental Protection Agency. Under section 319(h) of the Clean Water Act, grant funds are provided for nonpoint source implementation projects to reduce, prevent or eliminate water pollution and to enhance water quality for waters of the United States.
WDR	Waste Discharge Requirement. Waste discharge conditions adversely affecting waters of the state are regulated by the State and Regional Water Quality Control Boards under the Porter-Cologne Act. Permits, called Waste Discharge Requirements, are issued for discharges not covered under the federal NPDES permit (usually for non-surface water discharges).
Xeriscape	Dry landscaping.

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    - City of Agoura Hills
    - City of Calabasas
    - City of Malibu
    - City of Thousand Oaks
    - City of Westlake Village
    - County of Los Angeles, Fire Department
    - County of Los Angeles, Department of Health Services
    - County of Los Angeles, Department of Public Works
    - Heal the Bay
    - Las Virgenes Municipal Water District
    - Los Angeles Regional Water Quality Control Board
    - Malibu Lands Coastal Conservancy
    - National Park Service, Santa Monica Mountains National Recreation Area
    - Resource Conservation District of the Santa Monica Mountains
    - Santa Monica Audubon
    - Supervisor Zev Yaroslavsky's Office
    - Triunfo Sanitation District
    - Ron Rindge
    - Victoria Wikle

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Total Maximum Daily Loads for Nutrients
Malibu Creek Watershed

US Environmental Protection Agency
Region 9

Established by:

_____ **_____**

Catherine Kuhlman **Date**
Acting Director
Water Division
EPA Region 9

Table of Contents

1. Introduction

This document describes the Total Maximum Daily Loads (TMDLs) for nutrient compounds for the Malibu Creek watershed, which includes Malibu Lagoon, Malibu Creek and its tributaries, and four urban lakes. The nutrient compounds addressed in these TMDLs are nitrogen and phosphorus. Malibu Creek and three of its tributaries (Las Virgenes Creek, Medea Creek, and Lindero Creek) exceed the water quality objectives (WQOs) for nuisance effects such as algae, odors, and scum (RWQCB, 1996). Additionally, Malibu Lagoon and four urban lakes (Lindero, Westlake, Sherwood, and Malibou) within the watershed exceed the WQOs for nutrient related effects (i.e., ammonia, dissolved oxygen, or eutrophication). The TMDLs identify the amounts of nitrogen and phosphorous that can be discharged to the water bodies in the Malibu Creek watershed without causing violations of applicable water quality standards, and allocate allowable nutrient loads among different discharge sources.

These TMDLs comply with 40 CFR 130.2 and 130.7, Section 303(d) of the Clean Water Act and U.S. Environmental Protection Agency (EPA) guidance for developing TMDLs in California (U.S. EPA, 2000). This document summarizes the information used by the EPA and the California Regional Water Quality Control Board, Los Angeles Region (Regional Board) to develop TMDLs for nitrogen and phosphorus compounds. The TMDLs are expressed differently for summer and winter conditions because flows, nutrient loads, and nutrient effects vary substantially in different seasons. In this document, the term "summer" is defined as the period between April 15-November 15 and "winter" is defined as the period between November 16-April 14. These two seasonal periods are distinguished in order to account for:

- the winter period in which the Tapia Water Reclamation Facility (WRF) is authorized to discharge most of its treated effluent, which results in substantial differences in flows and nutrient loads between summer and winter, and
- rainfall and runoff patterns (most rainfall and precipitation-related nutrient loading occurs during the winter period).

TMDLs are being established for the following segments within the Malibu Creek Watershed which have been included on the Section 303(d) list as impaired due to effects of nutrients: Lake Sherwood, Westlake Lake, Lake Lindero, Las Virgenes Creek, Lindero Creek, Medea Creek, Malibou Lake, Malibu Creek, Malibu Lagoon. In addition, we have determined that it is necessary to set load allocations and wasteload allocations to limit nutrient discharges to upstream, hydrologically-connected segments within the watershed in order to achieve compliance with water quality standards in the downstream impaired segments for which TMDLs are being established. Allocations are being established for sources that discharge to all of the waters that are tributary to Malibu Creek and Lagoon, including the following upstream water bodies: Hidden Valley Creek, Triunfo Creek, Potrero Canyon Creek, Palo Comado Creek, Cheesebro Creek, Stokes Creek, and Cold Creek. There is some evidence that water quality is impaired due to nutrient effects in some of these upstream tributaries and we believe the loading reductions that will occur pursuant to the load and wasteload allocations established in these TMDLs should be sufficient to address potential nutrient-related impairment in these tributaries. Figure A-1 shows all waterbodies in the Malibu watershed and impaired waters addressed in

these TMDLs. Figure A-2 shows the subwatersheds within Malibu Creek watershed as several impaired waters have been grouped together in these TMDLs. (see Appendix for figures)

a. Regulatory Background

Section 303(d) of the Clean Water Act (CWA) requires that each State "shall identify those waters within its boundaries for which the effluent limitations are not stringent enough to implement any water quality standard applicable to such waters." The CWA also requires states to establish a priority ranking for waters on the 303(d) list of impaired waters and establish TMDLs for such waters.

The elements of a TMDL are described in 40 CFR 130.2 and 130.7 and Section 303(d) of the CWA, as well as in U.S. Environmental Protection Agency guidance (U.S. EPA, 1991 and 2000a). A TMDL is defined as the "sum of the individual waste load allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources and natural background" (40 CFR 130.2) such that the capacity of the waterbody to assimilate pollutant loading (the Loading Capacity) is not exceeded. A TMDL is also required to account for seasonal variations and include a margin of safety to address uncertainty in the analysis (USEPA, 2000a).

The Environmental Protection Agency has oversight authority for the 303(d) program and is required to review and either approve or disapprove the TMDLs submitted by states. In California, the State Water Resources Control Board (State Board) and the nine Regional Boards are responsible for preparing lists of impaired waterbodies under the 303(d) program and for preparing TMDLs, both subject to EPA approval. If EPA does not approve a TMDL submitted by a state, EPA is required to establish a TMDL for that waterbody. The Regional Boards also hold regulatory authority for many of the instruments used to implement the TMDLs, such as the National Pollutant Discharge Elimination System (NPDES) and state-specified Waste Discharge Requirements (WDRs).

The State of California identified over 700 waterbody-pollutant combinations in the Los Angeles Region where TMDLs would be required (SWRCB, 1998; RWCQB 1996, 1998). These are referred to as "listed" or "303(d) listed" waterbodies. A schedule for development of TMDLs in the Los Angeles Region was established in a consent decree (Heal the Bay Inc., et al. v. Browner C 98-4825 SBA) approved on March 22, 1999. For the purpose of scheduling TMDL development, the decree combined the more than 700 waterbody-pollutant combinations into 92 TMDL analytical units.

These TMDLs address Analytical Unit 50 specified in the Consent Decree, which consists of Malibu Lagoon, segments of the Malibu Creek and tributaries, and urban lakes impaired by nutrient compounds and effects that appear to be caused by those compounds. The nutrient impairments include ammonia and nutrients (nitrogen and phosphorus) and nuisance effects (dissolved oxygen, algae, scum, and odor). Table 1 identifies the listed waterbodies, the nutrient-related impairments for which each is listed, and the number of linear miles of waterbody in Analytical Unit 50 impaired by each. The consent decree schedule requires that these TMDLs be approved or established by EPA by March 22, 2003. EPA is establishing these

TMDLs at the request of the Regional Board and in order to meet its obligations under the consent decree, because the State was unable to establish these TMDLs in time to meet the consent decree deadlines.

This report presents the nutrient TMDLs and summarizes the analyses performed by EPA and the Regional Board to develop these TMDLs.

Table 1. Malibu Creek Watershed 303(d) listed Waterbodies for Nutrients
(streams = linear miles listed; lakes = acres listed)

Waterbody	Algae	Eutrophy	Scum/ Odors	Ammonia	Organic enrichment	Dissolved Oxygen
Lake Sherwood	213	213		213	213	213
Westlake Lake	186	186		186	186	186
Lake Lindero	14	14	14		14	
Las Virgenes Creek	11.25		11.25			11.25
Lindero Creek	6.56		6.56			
Medea Creek	7.56					
Malibou Lake	69	69			69	69
Malibu Creek	8.43		8.43			
Malibu Lagoon		33				

b. Environmental Setting: The Malibu Creek Watershed

These TMDLs addresses nutrient-related impairments for waterbodies within the Malibu Creek watershed (Table 1). There are a number of waterbodies which were not listed or were not assessed during the 303(d) listing process but were included in the modeling effort since they are hydrologically connected to the impaired waterbodies. These include Hidden Valley Creek, Triunfo Creek, Potrero Canyon Creek, Palo Comado Creek, Cheesebro Creek, Stokes Creek, and Cold Creek. Three of the seven lakes in the Malibu Creek watershed (Lake Eleanor, Las Virgenes Reservoir, and Century Lake) were not addressed in this analysis because they were not listed as impaired and they were not crucial to understanding the hydrology of the watershed.

The Malibu Creek watershed, located about 35 miles west of Los Angeles, California, includes several streams, lakes, and a lagoon that are on the 303(d) list for algae/nutrient impairments. The watershed is 109 square miles and extends from the Santa Monica Mountains and adjacent Simi Hills to the Pacific coast at Santa Monica Bay. Several creeks and lakes are located in the upper portions of the watershed, and these ultimately drain into Malibu Creek at the downstream end of the watershed. Historically, there is little flow in the summer months; much of the natural flow that does occur in the summer in the upper tributaries comes from springs and seepage areas. Malibu Creek drains into Malibu Lagoon, a 13-acre tidal lagoon, which in turn drains into Santa Monica Bay when the entrance to the lagoon is open.

Lake Sherwood is a 213-acre private lake located in the 10,864-acre Hidden Valley subwatershed. Although the lake itself is surrounded by a residential community, it receives the drainage from mostly agricultural and undeveloped lands in its drainage area. The lake is hydraulically connected to a bowl-shaped groundwater aquifer, which is an additional source of summer flows. Fishing, boating and swimming are allowed at the lake and there is a golf course at the west end of the lake. Lake Sherwood was listed as impaired due to problems associated

with high algal abundances, organic enrichment, eutrophic conditions and low dissolved oxygen in the lake. Lake water quality was also listed for ammonia toxicity suggesting that excess nitrogen may be the cause of the eutrophication. The lake has a maximum depth of 30 feet. The average lake inflow rate is 2.66 cfs and the residence time is 493 days (Lund *et al*., 1994). The lake discharges to Potrero Creek.

Westlake Lake is a 186-acre man-made lake, which was constructed in 1976 to provide a private setting for homes and to provide opportunities for boating and fishing to the residents of Westlake Lake. Like Lake Sherwood, Westlake Lake is listed for algae, eutrophic conditions and ammonia toxicity. The primary source of water to Westlake Lake is Potrero Creek that contains flow from Lake Sherwood as well as drainage from Potrero Creek watershed (NRCS, 1995). The lake also receives drainage from the surrounding mountains in the Westlake subwatershed as well as six storm drains (Lund et al., 1994). The lake has a maximum depth of 18 feet. The average lake inflow rate is 9.97 cfs. A minimum flow of 1 cfs is required to be discharged in the summer months for fish. The lake residence time is 40 days (Lund *et al*., 1994). Flows from Westlake Lake are discharged into Triunfo Creek.

Both Lindero Creek and Lake Lindero are listed for algae and eutrophic conditions. In addition Lake Lindero is listed for organic enrichment and scum/odors. Lake Lindero is a small urban lake that was constructed in 1964. Because flows in the upper reaches of Lindero Creek are relatively small, the main sources of water are runoff from the adjacent lots, a golf course and the streets. Residential areas make up about 37% of the land use pattern in the 5,460-acre Lindero Creek subwatershed. Another 6% is commercial and industrial. The rest is undeveloped or vacant land. The 13.6 acre lake has a maximum depth of 20 feet. The average lake inflow rate is 1.51 cfs with a residence time of 30 days (Lund *et al*., 1994). Water exits the lake spillway to the lower Lindero Creek and eventually flows to Medea Creek.

Medea Creek has a total length of 7.56 miles. Land use in the Medea Creek subwatershed contains a mix of open space area (61%), residential use (31%) and commercial use (3%). Medea Creek also receives drainage from the subwatersheds associated with Palo Comado Creek and Cheeseboro Creek.

Malibou Lake is listed for both algae and eutrophic conditions. Malibou Lake receives the drainage from most of the subwatersheds in the upper portion of the watershed. The lake has a drainage area of 64 square miles which represents almost 60% of the entire watershed. Water flows from Triunfo and Medea Creek into the lake. The lake was constructed in 1922 for swimming, boating and fishing by members and guests of the Malibou Lake Mountain Club, Ltd. The maximum depth of this 69-acre lake is about 20 feet (Lund *et al*., 1994). Malibou Lake has mud bottom that is dredged on a continual basis because of sediment loadings from upstream sources. The outflow from the lake discharges into Malibu Creek.

Malibu Creek is listed for algae and scum/foam. The 10-mile creek runs from Malibu Lake to Malibu Lagoon and has an estimated winter mean flow of about 15 cfs and a dry weather average base flow of 2.5 cubic feet per second (cfs). The predominant land use in the Malibu Creek subwatershed is open space (94%). Residential uses make up 1% percent of the subwatershed acreage and commercial/industrial uses make up 3% of the total land use. The

Tapia Water Reclamation Facility (Tapia WRF) is located in this subwatershed and contributes significant flow in the winter months. Malibu Creek also receives flow from Las Virgenes Creek, Cold Creek and Stokes Creek.

Las Virgenes Creek is listed for algae, eutrophic conditions, and low dissolved oxygen. Eleven miles in length, the creek receives drainage from a 12,456-acre area. The land use in the Las Virgenes Creek subwatershed is predominantly open space (83%). Residential land use accounts for 6% of the land use area. Commercial/industrial land use accounts for another 3%. The proposed Ahmanson Ranch development is located in the upper watershed. This proposed project would add 1,097 acres of residential land use and 390 acres of golf course to the land use mix in the watershed. Neither Stokes Creek nor Cold Creek are listed for nutrient related impairments. Both creeks flow through relatively undeveloped areas and water quality in these creeks is presumed to be high.

Malibu Lagoon, located at the bottom of the watershed, is listed for eutrophic conditions. The lagoon is at the receiving end of the drainage from all upstream subwatersheds. Water quality problems occur especially in the summer months when the lagoon is closed. During the winter months higher flows can cause the lagoon to breach, flushing out much of the water and sediments. Land use in the 681-acre Malibu Lagoon subwatershed consists of a mix of open space (34%), residential areas (36%), and commercial uses (15%).

c. TMDL ELEMENTS

Guidance from USEPA (2000a) identifies seven elements of a TMDL. Sections 2 through 8 of this document are organized such that each section describes one of the elements, with the analysis and findings of these TMDLs for that element. The seven elements are:

1. Problem Statement. This section reviews the evidence used to include the water body on the 303(d) list, and summarizes existing conditions using that evidence along with any new information acquired since the listing. For these TMDLs, the problem encompasses nutrients, which result in excessive algae proliferation and related effects. The problem identification reviews: those reaches that fail to support all designated beneficial uses, the beneficial uses that are not supported for each reach, the water quality objectives (WQOs) designed to protect those beneficial uses and, in summary, the data and information regarding the decision to list each reach, such as the number and severity of exceedances observed.

2. Numeric Targets. For these TMDLs, the numeric targets are based on the numeric and narrative water quality objectives in the Basin Plan. Load reductions and pollutant allocations in the TMDL are developed to ensure that these numeric targets for the impaired waterbodies are met.

3. Source Assessment. This step is a quantitative estimate of point sources and non-point sources of nutrient compounds into the Malibu Creek watershed. The source assessment considers seasonality and flow.

4. Linkage Analysis. This analysis demonstrates how the sources of nutrient compounds (nitrogen and phosphorus) in the waterbody are linked to the observed conditions in the impaired waterbody. The linkage analysis includes an assessment of critical conditions, which are periods when the changing pollutant sources and changing assimilative capacity of the waterbody combine to produce either extreme impairment conditions or conditions especially resistant to improvement. Separate TMDLs may be defined for each critical condition/season.

5. TMDLs and Pollutant Allocations. The total loading capacity for each waterbody is determined. The TMDL is set at the loading capacity. Each pollutant source is allocated an allowed quantity of nitrogen and phosphorus compounds that it may discharge. Allocations are designed such that the waterbody will not exceed numeric targets for any of the compounds or effects in any of its reaches. Point sources are given waste load allocations, and non-point sources are given load allocations. Allocations need to consider worst-case conditions, so that the pollutant loads may be expected to remove the impairment under critical conditions.

6. Implementation Recommendations. This section describes the plans, regulatory tools, or other mechanisms by which the waste load allocations and load allocations may be achieved.

7. Monitoring Recommendations. These TMDLs recommend monitoring the waterbody to ensure that the Waste Load Allocations and Load Allocations are achieved and remove the impairment so that numeric targets are no longer exceeded and that the nutrient-related effects intended to be addressed by these TMDLs also are removed.

2. Problem Statement

Excessive algae in the Malibu Creek watershed has resulted in several waterbodies not supporting their designated beneficial uses associated with aquatic life and recreation (RWQCB, 1996). Algal biomass can lead to impairment of swimming and wading activities. In addition, the proliferation of algae can result in loss of invertebrate taxa through habitat alteration (Biggs, 2000). Algal growth in some instances has produced algal mats in the lakes (Lund et al., 1994), creeks (Ambrose et al., 1995, Kamer et al., 2002, CH2MHill, 2000, Heal the Bay, 2002), and lagoon (Ambrose et al., 2000); these mats may result in eutrophic conditions where dissolved oxygen concentration is low (Briscoe, et al., 2002), and negatively affect aquatic life in the waterbody (Ambrose et al., 2000). The decay of these mats may also cause problems with scum and odors that affect recreational uses of the affected waterbody. In addition, the concentration of ammonia, a nitrogen compound, has been present in concentrations exceeding objectives designed to protect aquatic life (RWQCB, 1996).

This section provides a review of the data used by the Regional Board to list the waterbodies within the Malibu Creek watershed for nutrient-related impacts. Where appropriate the data has been updated with more recent information. As the Regional Board's listing decisions are based on impairments to water quality, and TMDLs are designed to attain water quality standards, it is appropriate to begin this section with a discussion of the applicable water quality standards.

a. Applicable Water Quality Standards

California state water quality standards consist of the following elements: 1) beneficial uses, 2) narrative and/or numeric water quality objectives and 3) an antidegradation policy. In California, beneficial uses are defined by the Regional Water Quality Control Boards (Regional Boards) in the Water Quality Control Plans (Basin Plans). Numeric and narrative objectives are specified in each Region's Basin Plan, designed to be protective of the beneficial uses in each waterbody in the region. The Water Quality Control Plan for the Los Angeles Region (Basin Plan, 1994) defines 14 beneficial uses for the Malibu Creek watershed. These uses are identified as existing (E), potential (P), or intermittent (I) uses. We have identified ten of the beneficial uses that are sensitive to nutrient compounds and related effects, such that protecting these uses will serve to protect all others too. Therefore this document focuses discussion on these ten use designations: REC1, REC2, WARM, COLD, EST, MAR, WILD, RARE, MIGR, and SPWN. Table 2 contains the beneficial use designations relevant to this TMDL.

Table 2. Malibu Creek Watershed Beneficial Uses

	RECREATION		AQUATIC LIFE USE SUPPORT							
	REC1	REC2	WILD	WARM	RARE	COLD	MIGR	SPWN	EST	MAR
Malibu Lagoon	E	E		E	E		E	E	E	E
Malibu Creek	E	E	E	E	E	E	E	E		
Las Virgenes Creek	E	E	E	E	E	P	P	P		
Malibou Lake	E	E	E	E	E					
Lower Medea Creek	I	I	E	I	E	P				
Upper Medea Creek	E	E	E	E						
Lindero Creek	I	I	E	I						
Lake Lindero	I	I	E	I						
Westlake Lake	E	E	E	E						
Lake Sherwood	E	E	E	E						

Recreational uses for body contact (REC1) and secondary contact (REC2) apply to all the listed waterbodies as existing, potential or intermittent. These uses apply even if access is prohibited to portions of the waterbody. Objectives designed to protect human health (e.g., bacterial objectives) and the aesthetic qualities of the resource (e.g., visual, taste and odors) are appropriate to protect recreational uses of the river.

The use designation for warm water fish (WARM) exists in most of the impaired creeks, with the exception of Medea Creek (Reach 1), and Lindero Creek. This use designation does not apply to the lakes, or the lagoon. The cold-water fisheries designated use (COLD) applies to Malibu Creek, Cold Creek, and Las Virgenes Creek. The Wildlife use designation (WILD) is for the protection of fish and wildlife. This use applies to all impaired waterbodies within the Malibu Creek watershed.

Ammonia. The Basin Plan establishes numeric objectives for ammonia which are protective of fish (COLD), (WARM) and wildlife (WILD) (see Plan Tables 3-1 through 3-4). The numeric objectives for ammonia in the Basin Plan were updated by the Regional Board in April 2002. The objective for chronic exposure is based on a four-day average concentration. The objective for acute toxicity is based on a one-hour average concentration. These objectives are expressed as a function of pH and temperature because un-ionized ammonia (NH_3) is toxic to fish and other aquatic life.

Dissolved Oxygen. Adequate dissolved oxygen levels are required to support aquatic life. Dissolved oxygen requirements are dependent on the beneficial uses of the waterbody for the Malibu Creek watershed. The Basin Plan states *"At a minimum (see specifics below) the mean annual dissolved oxygen concentrations of all waters shall be greater than 7 mg/l, and no single determinations shall be less than 5.0 mg/l except when natural conditions cause lesser concentrations.*"

In addition, the Basin Plan states, *"the dissolved oxygen content of all surface waters designated as WARM shall not be depressed below 5 mg/l as a result of waste discharges."* The WARM designation applies to all listed waters except Lake Lindero.

The Basin Plan also states, *"the dissolved oxygen content of all surface waters designated as both COLD and SPAWN shall not be depressed below 7 mg/l as a result of waste discharges."* The COLD and SPAWN designation applies to Malibu Lagoon, Malibu Creek, and Lake Lindero. COLD and SPAWN also apply as a potential use for Las Virgenes Creek.

Nitrogen (Nitrate, Nitrite). Nitrogen requirements are dependent on the beneficial uses of the waterbody for the Malibu Creek watershed. Excess nitrogen in surface waters also leads to excessive aquatic growth and can contribute to elevated levels of nitrate in groundwater as well. The Basin Plan states, "*Waters shall not exceed 10 mg/L nitrogen as sum of nitrate-nitrogen and nitrite-nitrogen, 10 mg/L nitrate-nitrogen (NO_3-N), 45 mg/L nitrate or 1 mg/L as nitrite-nitrogen (NO_2-N).*" The Basin Plan also states *10 mg/L nitrogen [sum of nitrate-nitrogen and nitrite-nitrogen] is the water quality objective for Malibu Creek watershed* (see Plan Table 3-8)*.*"

Biostimulatory Substances: Nutrients. The Basin Plan addresses excess aquatic growth in the form of a narrative objective for nutrients. Excessive nutrient (e.g. nitrogen and phosphorous) concentrations in a waterbody can lead to nuisance effects such as algae, odors, and scum. The objective specifies, *"waters shall not contain biostimulatory substances in concentrations that promote aquatic growth to the extent that such growth causes nuisance or adversely affects beneficial uses."* To implement this narrative objective, we have evaluated available data, studies, and other information to estimate the levels of nitrogen and phosphorus that can be present without causing violations of this objective.

Floating Materials: Scum/Foam. The Basin Plan expresses a narrative objective for floating material requiring that the waters should be free of floating material, including foams and scum *"in concentrations that cause nuisance or adversely affect beneficial uses."*

b. Assessment of existing conditions relative to numeric and narrative standards

This section describes conditions in the Malibu Creek watershed, which resulted in the inclusion of waterbodies as impaired on the 1996 Water Quality Assessment (WQA) which formed the basis for the 1996 and 1998 303(d) listings. We also have incorporated new information that was gathered as part of the submittal process for the 2002 303(d) listing process.

Ammonia as Nitrogen. Lake Sherwood and Westlake Lake are the only two waterbodies within the Malibu Creek watershed identified on the 1996 303(d) list as impaired due to ammonia concentrations. The data reviewed for the assessment were collected as part of a Regional Board study entitled, "Evaluation of Water Quality for Selected Lakes in the Los Angeles Hydrological Basin." (Lund et al., 1994). The data were collected between July 1992 and March 1993.

Table 3. Ammonia Concentrations (mg/l) for Lake Sherwood and Westlake Lake

Waterbody Name	Number of samples	Mean (Std Dev)	Range
Lake Sherwood	59	0.99 (1.28)	0.10 – 6.00
Westlake Lake	52	0.35 (0.35)	0.10 – 1.34

These data were evaluated against the updated ammonia criteria in the Basin Plan. Relative to the acute criteria, two of the Lake Sherwood samples exceeded the criteria (3%), and none (0%) of the Westlake Lake samples exceeded the criteria. Relative to the chronic criteria, seven of the Lake Sherwood samples (12%) exceeded the criteria and one of the Westlake Lake samples (2%) exceeded the criteria. There is no more recent data to assess the lakes for ammonia.

We also evaluated the available ammonia data for streams in the Malibu Creek watershed collected by Tapia as part of their NPDES monitoring program from 1991 to 1999. These data represent close to 800 samples. As can be seen in Table 4 below, the ammonia concentrations in the river were generally low. The median concentrations were typically below 0.1 mg/l. Ninety percent of the samples had concentrations below 0.2 mg/l.

Table 4. Summary of ammonia data from Tapia (1991 to 1999)

	Lower Las Virgenes Creek	Upper Malibu Creek	Middle Malibu Creek	Middle Malibu Creek	Lower Malibu Creek	Lower Malibu Creek	Malibu Lagoon	Malibu Lagoon
Station	R6	R9	R1	R2	R13	R3	R4	R11
Count	84	98	96	100	108	108	100	102
Average	0.07	0.03	0.15	0.21	0.05	0.05	0.07	0.06
Median	0.04	0.03	0.06	0.13	0.04	0.04	0.04	0.04
90^{th} percentile	0.09	0.06	0.20	0.21	0.10	0.08	0.12	0.12
Max	1.20	0.18	1.00	4.00	0.23	0.90	1.00	0.53

In the 2002 303(d) listing process, the Regional Board staff re-evaluated the monthly ammonia data collected between November 1988 to December 2000 from Malibu Creek, Cold Creek, Cheeseboro Creek, Medea Creek and Malibu Lagoon relative to the toxicity standard corrected for temperature and pH. When adjusted for pH there were no exceedances of the acute criteria in any of these reaches. There were also no exceedances of the chronic criteria adjusted for temperature and pH in any of the rivers. In summary there is some limited evidence of ammonia toxicity in the lakes and no data to suggest that the streams or lagoons are experiencing ammonia toxicity.

Dissolved Oxygen. Las Virgenes Creek was listed in the 1996 WQA as impaired due to depressed dissolved oxygen concentrations that do not meet the recommended water criteria for protection of fresh water aquatic life. This assessment was based on a total of eleven data points sampled over a two-week period in the fall of 1995. Six of the eleven data points were below 7 mg/l. To supplement this assessment, we reviewed data collected by Tapia WRF as part of their NPDES monitoring program of the data from January 1994 to June 1999. These data represent close to 2000 samples.

Table 5. Summary of dissolved oxygen concentrations (mg/l) from Tapia stations (1994-1999)

	Lower Las Virgenes Creek	Upper Malibu Creek	Middle Malibu Creek	Middle Malibu Creek	Lower Malibu Creek	Lower Malibu Creek	Malibu Lagoon	Malibu Lagoon
Station	R6	R9	R1	R2	R13	R3	R4	R11
Count	210	200	248	248	247	242	227	247
Average	7.12	7.64	9.57	8.79	9.27	11.66	12.38	10.87
Median	6.95	7.85	9.70	8.75	9.20	11.50	11.60	10.70
Minimum	4.3	3	5	5.9	6.8	5.3	7.1	0
# <5 mg/l	1	4	0	0	0	0	0	1

Based on these data there does not appear to be a problem with dissolved oxygen concentrations in the Las Virgenes Creek, Malibu Creek or the Lagoon. One criticism of the monitoring effort is that the sampling begins in the upper watershed and ends later in the day at the lagoon. Since DO concentrations are typically higher in the afternoon, this time differential might bias the results. To assess the potential for this bias the Regional Board contracted with SCCWRP to perform a pre-dawn survey at 17 sites in the watershed on September 22-23, 2001 (Briscoe et al, 2002). DO concentrations were less than 7.0 mg/l at 6 of 17 sites. These were generally sites

with more developed land use. The average DO was greater than 5.0 mg/l at all sites except Malibu Lagoon where DO concentrations were very low (1.2 mg/l). The diel pattern for in-stream DO concentrations is a natural occurrence and there is insufficient evidence to suggest the DO concentrations in these streams are depressed as a result of waste discharges. On the other hand there is ample evidence that eutrophic conditions in the lagoon can lead to low DO values (Ambrose et al., 1995, Briscoe et al., 2002). Therefore we conclude that the data indicate that Malibu Lagoon does not meet applicable DO objectives. Available data for streams within the watershed are inconclusive as to whether DO objectives are attained in these streams.

The lakes study (Lund et al., 1994) suggested that there might be impairments in three lakes due to low DO. The waters of Sherwood Lake were generally anoxic below the hypolimnion (3 meters) from April to October. Westlake Lake was weakly stratified, but had low DO at depths below 4 meters in the summer. Malibu Lake was generally anoxic below 2.5 meters (April through October). No DO problems were observed in the relatively shallow Lake Lindero.

Biostimulatory Substances: Algae. For the 1996 WQA, impairment decisions were based on observations for the presence of these nuisance effects (also known as aesthetic stressors). Algae observed in "high" amounts were considered to be an exceedance of the narrative standard for floating material and biostimulatory substance. The results of observations made between 1991 and 1995 are summarized below (Table 6). Malibu Creek and three of its tributaries (Las Virgenes Creek, Lindero Creek, and Medea Creek) were listed as impaired due to observations of excessive algal growth.

Table 6. Summary of algae data in 1996 WQA listing.

Stream Reach	# of Observations	High amounts of algae
Malibu Creek	28	4
Las Virgenes Creek	15	5
Lindero Creek R1	2	2
Lindero Creek R2	7	4
Medea Creek R2	8	3

To supplement this data we analyzed the long-term data set from Tapia on percent algal cover in various reaches of Malibu Creek and Las Virgenes Creek (summarized in Table 7). We also reviewed data that was submitted from Heal the Bay (discussed below).

Table 7. Summary of Percent algal coverage for Tapia Data set (1983 to 1999)

All Seasons	**Number of samples**	**Median**	**#>30%**	**%>30%**
Las Virgenes	426	12.5	77	18%
Upstream of Tapia (R9)	393	12.5	140	36%
Immediately above Tapia discharge (R1)	442	12.5	118	27%
Immediately below Tapia (R2)	439	12.5	26	6%
County Gaging Station (R13)	444	12.5	57	13%
Malibu Canyon area (R3)	422	12.5	124	29%
Cross Creek Road (R4)	407	12.5	80	20%
Lagoon (R11)	434	12.5	39	9%
Summer Months (May - Oct)	**Number of samples**	**Median**	**# >30%**	**%>30%**
Las Virgenes	240	12.5	65	27%
Upstream of Tapia (R9)	210	31.25	105	50%
Immediately above Tapia discharge (R1)	251	12.5	95	38%
Immediately below Tapia (R2)	247	12.5	24	10%
County Gaging Station (R13)	252	12.5	37	15%
Malibu Canyon area (R3)	241	12.5	95	39%
Cross Creek Road (R4)	220	12.5	74	34%
Lagoon (R11)	248	12.5	32	13%
Winter Months (Nov - Apr)	**Number of samples**	**Median**	**#>30%**	**%>30%**
Las Virgenes	186	12.5	12	6%
Upstream of Tapia (R9)	183	12.5	35	19%
Immediately above Tapia discharge (R1)	191	12.5	23	12%
Immediately below Tapia (R2)	192	0	2	1%
County Gaging Station (R13)	192	12.5	20	10%
Malibu Canyon area (R3)	181	12.5	29	16%
Cross Creek Road (R4)	187	12.5	6	3%
Lagoon (R11)	186	0	7	4%

To assist in determining where and when algae were present at levels that cause violations of applicable water quality standards, the Regional Board applied algae assessment guidelines based on a New Zealand Study in the 2002 Section 303(d) listing process (Biggs, 2000). Based on its interpretation of the Biggs report, the Regional Board recommended that waters be considered impaired by algae if algae cover exceeded 30% in more than 10% of available samples. In its comments on EPA's draft TMDLs, the Regional Board also recommended application of this assessment criterion in considering seasonal variations in algae problems as part of TMDL development.

As indicated in Table 7, high algal abundances (i.e., greater than 30% cover) can be observed at many sites on a relatively frequent basis. These data also suggest that high algal abundances are most predominant in the summer months as all eight sites had coverages greater than 30% in 10% of the samples. During the winter months four of the sites had exceedance frequencies at or greater than 10%. The percentage of observations exceeding the 30% target was substantially lower in winter than summer at all eight sites.

As part of the 2002 303 (d) assessment, Regional Board staff analyzed data from 1997 to 1999, a subset of the data summarized above. These data reflect more accurately the recent condition. The patterns are basically similar with the exception that the percent coverage values have

increased over this three year time period (CH2MHill, 2000). Although there are some instances in which the % algal cover exceeded 30% in the winter months, the problem is predominantly a dry-weather phenomenon.

We believe it was appropriate to apply the Biggs guidelines in the screening-level exercise entailed by the Section 303(d) listing process; however, it is unclear whether it is appropriate to apply Biggs' recommended guidelines in the manner suggested by the Regional Board to develop the Malibu Creek TMDLs for nutrients to address algal impacts. Based on our review of the Biggs report cited by the State, we believe it is appropriate to consider the Biggs guidelines in the TMDLs but to apply them in a manner somewhat different than applied by the State in the listing process.

We note that Biggs recommended a threshold of 30% cover for filamentous (floating) algae greater than 2 cm in length and a threshold of 60% cover for bottom algae greater than 0.3 cm thick. Biggs did not recommend application of a 10% frequency of exceedance for these cover algae guidelines as suggested by the State. Biggs recommended application of the algae cover guidelines "during summer low flows" and noted that the aesthetics/recreation guidelines are "only expected to be applied over the summer months". Biggs generally recommended evaluation of mean nutrient and biomass levels over relatively long averaging periods (monthly, seasonally, or annually).

Based on these considerations, EPA re-evaluated the Tapia algae data on a seasonal basis and evaluated both the mean values and the range of values at each sampling locations. We compared the seasonal mean values to the guidelines recommended by Biggs for filamentous algae (30%). The Tapia data set is based primarily on floating algae and indicates that mean algal cover at most stations is closer to 30% in the summer than in the winter months.

We also analyzed the data submittal from Heal the Bay that provided data from seven creek stations in the watershed (Cheeseboro Creek, 2 in Cold Creek, 2 in Malibu Creek, Las Virgenes Creek and Medea Creek) (See Appendix Figure A-3 which indicates the seasonal averages and range of values for each station). The data for floating algae was compared to the 30% threshold. The data for mat algae was compared to the 60% threshold. Based on Heal the Bay's floating algae data, average cover is generally less than 30% in both summer and winter. Assessment of the mat algae data indicates average cover near 60% at most sites in the summer. The winter values for mat algae are somewhat less than in the summer.

Our review of available, taken together, indicates that there is evidence of algal impairment in Malibu Creek throughout the year. Our review of the algae data available for Malibu Creek and Lagoon indicates algae are clearly present at levels of concern during the summer season (as defined in the TMDL) throughout the Malibu Creek watershed, and present at levels of potential concern during the winter months at several watershed locations. EPA believes these data support the decision to focus this TMDL primarily on algae impairment in the summer season and secondarily on algae problems in the winter season.

To better quantify the extent of algae coverage and the associated impact on the beneficial uses within the watershed, studies were conducted by SCCWRP and the University of California at

Santa Barbara to address existing data gaps in the knowledge of the spatial extent of algal coverage, and chlorophyll-a data, as well as, the species of algae present and which conditions limit the growth of algae in the streams.

The Chlorophyll-*a* (Chl-*a*) concentrations were generally below 50 mg/l at sites in Cold Creek, Palo Comado Creek and Triunfo. The Chl-*a* concentrations were higher (greater than 100 mg/l) at more developed sites such as Lindero Creek, Medea Creek and Malibu Creek. These sites also had higher percent cover of macroalgae and diatom films. In general the concentrations were higher in October than in August 2001. (see Appendix, Figures A-4, A-5)

The information used to list the lakes as impaired comes from observations by Lund et al. (1994) that suggested that there were problems with algae in all four lakes and macrophytes in Malibu, Sherwood and Lindero. There is no more recent data to evaluate the listing.

In conclusion, there is evidence of algal impairment in Malibu Creek throughout the year. Our review of the algae data available for Malibu Creek, Malibu Lagoon, and the tributaries indicates algae are clearly present at levels of concern during the summer at many locations in the Malibu Creek watershed, and present at levels of potential concern during the winter months at several watershed locations.

Floating Materials: Scum. As indicated in Table 4, Malibu Creek, Las Virgenes Creek, and Lindero Creek R2 are listed on the 1996 305(b) water quality assessment as impaired due to observations of scum and foam. These waterbodies are "Not Supporting" the Basin Plan narrative standard for floating materials. The beneficial uses that are affected by this impairment relate to recreation. The data for the observations were collected between 1991 and 1995. For the most part the observations of scum and odors correspond to areas of high algal abundance.

Table 9. Scum/Odor Observations

River Reach	# of Observations	High
Malibu Creek	23	3
Las Virgenes Creek	15	5
Lindero Creek R2	7	2

Summary of assessment. High levels of algae in the lagoon and streams have the potential to cause problems with DO, aquatic life and aesthetics. The percent algal cover is often greater than 30% in Malibu Creek, Las Virgenes Creek and Medea Creek. Total chlorophyll concentrations can be greater than 100 mg/l in the reaches of the more developed watersheds (Malibu Creek, Medea Creek and Lindero Creek). There is no demonstration that algae in these reaches is affecting dissolved oxygen concentration. However, taken together, the data on the types of algae in the watershed, the coverage of the mats, and total chlorophyll a concentrations observed indicate that streams are near conditions where one would expect eutrophy. These conditions appear to be more predominant in the summer months. This is consistent with the lakes study (Lund et al., 1994) that suggested that nutrients from runoff contribute to algae and macrophytes result in anoxic conditions concentrations in the summer season.

3. Numeric Targets

The streams, lakes and lagoon in the Malibu Creek watershed are 303(d) listed for exceedance of narrative criteria associated with excessive algal and periphyton growth, and associated water quality problems. The pollutants responsible for these conditions are nitrogen and phosphorus, thus the numeric targets for nitrogen and phosphorus are defined and used to calculate the TMDL, as discussed below. Other numeric targets are also developed for in-stream parameters such as dissolved oxygen, ammonia, algal cover and biomass. These other targets serve as indicators of the desired condition for the waterbody. EPA expects these indicators will provide a useful reference in determining the effectiveness of the TMDL in attaining water quality standards, although they are not directly enforceable by EPA.

a. Dissolved oxygen (DO)

The target for the mean annual dissolved oxygen concentration is 7 mg/l for all waters in the Malibu watershed (Table 10). A more restrictive target is required for Lake Lindero, Las Virgenes Creek and Malibu Lagoon to protect existing and potential uses associated with cold-water fisheries and spawning. The Basin Plan standard for waters designated as WARM is that no single determination be below 5.0 mg/l as a result of waste discharges. Recognizing that diel fluctuations in DO are a natural occurrence, we propose that 7.0 mg/l minimum for waters with uses associated with cold water fisheries and spawning be interpreted as an average daily value.

Table 10. Summary of numeric targets for dissolved oxygen

Waterbody	Annual average	Minimum conc. (mg/l)
Malibu Lagoon	7	7
Malibu Creek	7	7
Las Virgenes Creek	7	7
Lindero Creek Reach 1and 2	7	5
Medea Creek Reach 1 and 2	7	5
Malibou Lake	7	5
Lake Lindero	7	7
Westlake Lake	7	5
Lake Sherwood	7	5

b. Ammonia toxicity

Numeric targets for ammonia are based on the water quality standards in the Basin Plan and are set for the two lakes listed on the Section 303(d) list as well as for Malibu Creek itself in order to provide an additional indicator of whether future nutrient reductions result in attainment of ammonia objectives in the Creek. The acute criteria are dependent on pH and the chronic criteria are dependent on pH and temperature. Data on pH and temperature for the creeks and lagoon are based on long-term temperature and pH data collected by Tapia between 1998 and 1995. Targets for lakes are based on data from July 1992 to March 1993 (Lund et al., 1994). The target values for the acute criteria were calculated using the 90^{th} percentile of pH and the 50^{th} percentile of temperature and pH for the chronic criteria.

Table 11. Targets for ammonia toxicity for listed waterbodies

Waterbody	Target NH4 Acute criteria	Target NH4 Chronic criteria
Malibu Creek	2.59 mg/l	1.75 mg/l
Lake Sherwood	6.7 mg/l	2.1 mg/l
Westlake Lake	8.5 mg/l	1.5 mg/l

c. Algae/Chlorophyll *a*

The Regional Board has not established numeric values for nuisance levels of aquatic growth such as algae. These TMDLs establish numeric targets for percent algal cover and algal biomass for the entire Malibu Creek watershed.

Percent cover (Algae). The Regional Board has used 30% cover (with greater than 10 frequency) as an indicator for evaluating excessive nuisance algae for listing purposes based on recommendations from Biggs (2000). We will use 30% algal cover for floating algae (filamentous algae greater than 2 cm in length) and 60% algal cover for bottom algae (diatoms and blue green algae mats greater than 0.3 cm in thickness) expressed seasonal mean as targets in this TMDL for the creeks and lagoon. EPA believes these targets are more consistent with the recommendations found in the Biggs report.

Algal biomass- Chlorophyll a (Chl-a). There is relatively little information on targets for algal biomass in streams or lagoons. Studies by Dodds et al., 1988 suggested that a mean of 70 mg/m^2 Chl-*a* and a maximum of 200 mg/m^2 Chl-*a* might be used as a dividing point between mesotrophic and eutrophic conditions. Others have suggested values between 50 and 100 mg/m^2 Chl-*a* as targets for the mean and values between 100 and 200 mg/m^2 as targets maximum Chl-*a*. In these TMDLs, we use 50 mg/m^2 for the mean and 150 mg/m^2 for the maximum as numeric targets for in-stream chlorophyll-a concentration. This is based on our review of the data for Malibu Creek watershed which indicates that streams in undeveloped areas are generally below 50 mg/m^2 Chl-*a* and that values in developed areas are frequently above 150 mg/m^2 Chl-*a* (Kamer et al., 2002). The value of 150 mg Chl-*a*/m^2 is within biomass range of "critical level[s] for an aesthetic nuisance" as provided by EPA (1999a). The target for lakes of 10 ug/l Chl-*a* is based on EPA guidance (EPA, 1999a).

Table 12. Summary of numeric targets for algae

Waterbody Type	Chlorophyll-*a*	Algae (% coverage)
Lakes	10 ug/l	30
Streams	150 mg/m^2	30 for floating algae, 60 for bottom algae
Lagoon	150 mg/m^2	30 for floating algae, 60 for bottom algae

d. Nitrogen and Phosphorus

EPA is applying numeric targets for nutrients during two seasons. During the summer (April 15-November 15), total N (nitrate-nitrite) and total P targets are 1.0 and 0.1 mg/l respectively for all water bodies.

In the winter months (November 16-April 14), the total N target is 8 mg/l (nitrate-nitrite) for all water bodies. No total P target is applied during the winter months. Table 13 summarizes these targets for each season and each waterbody type. The basis for these targets is discussed below.

EPA stresses that these numeric target values are proposed only for waters in the Malibu Creek watershed. The inclusion of these numeric target values for Malibu watershed is not intended to reflect any judgements about the numeric targets needed for other nutrient TMDLs needed in California.

Table 13. Summary of numeric targets for nitrogen and phosphorus as monthly averages

Waterbody Type	Summer (April 15 to Nov. 15)		Winter (Nov. 16 to April 14)
	Total Nitrogen (mg/l)	Total Phosphorous (mg/l)	Total Nitrogen (mg/l)
Lakes	1.0	0.1	8.0
Streams	1.0	0.1	8.0
Lagoon	1.0	0.1	8.0

e. Basis for Summer Nitrogen and Phosphorus Numeric Targets

Streams At the present time there are no numeric nutrient criteria for general waters of California. States are being asked to develop nutrient criteria and Regional Board 4 staff is participating in the EPA and State work groups to development eco-regional specific nutrient criteria. Although studies are underway in a number of watersheds, the deadline for development and implementation of nutrient criteria is several years away.

EPA concluded that it is necessary to set numeric targets more stringent than the existing numeric objectives for total nitrogen in order to ensure attainment of the narrative objective that addresses Biostimulatory Substances. Our review of available data, studies, and information indicate that the numeric objectives are not sufficiently protective during the summer months when algae problems are most pronounced.

In the 1970s there was a recommendation of the use of 0.1 mg/l as a standard for total phosphorous, and many States and some Regional Boards have adopted this as a nutrient standard. Others (including San Diego Regional Board) have also used this number to develop a nitrogen value of 1 mg/l assuming a 10:1 nitrogen to phosphorous (N:P) ratio. EPA and NOAA have recommended values of 0.1 to 1.0 mg/l for nitrogen and 0.01 to 0.1 mg/l for phosphorous as guidelines for evaluating eutrophic conditions in coastal estuaries (NOAA/EPA 1988). Dodds et al. (1998) suggested thresholds of 1.5 mg/l nitrogen and 0.075 mg/l for distinguishing between mesotrophic and eutrophic conditions in streams based on a review of stream data from various locations around the world. However based on the work of Kamer et al. (2002) these values have little predictive power in explaining the patterns in algal abundance or biomass within the Malibu Creek watershed.

There is uncertainty as to what factors control algal abundances in the Malibu Creek watershed (Ambrose et al., 1995, CH2MHill, 2000, Ambrose et al., 2000, Kamer et al., 2002). Working in a number of creeks within the Malibu Creek watershed, Kamer et al. (2002) found that total phosphorus could explain 70% of the variability in benthic Chlorophyll a, and the combination

of total phosphorus plus light could explain 68% of the variability in total chlorophyll a concentration. However their data on nitrogen to phosphorus (N:P) ratios were inconclusive suggesting that both N and P may be limiting or alternately that neither N nor P were limiting. Their experiments in the field were also inconclusive, some tests suggesting nitrogen limitation at undeveloped sites and P limitation at the more developed sites. They indicated that there might be other factors such as light and flow that may help to better explain the patterns in algal abundances. The nutrient limitation studies that have been done in the streams are equivocal for setting numeric targets.

Studies were inconclusive in large part due to the destruction of a large number of nutrient diffusers within the field. A follow-up nutrient diffuser study was conducted in the fall of 2002 and the final results are expected to be available by mid-2003. This study is expected to provide more definitive data regarding the relationship between nutrients and algal impairment. The Regional Board should carefully consider the results of this study, which may provide a basis for determining whether the TMDLs need to be revised.

Some efforts have been made to use N:P ratios to identify limiting nutrients in the lagoon. The N:P ratios reported by Ambrose et al. (1995) varied widely with time. The results suggested that averaged over the course of the year the upstream area near the Malibu Creek inlet tended to be more phosphorus limited (general norm for streams) while the central and downstream areas tended to be more nitrogen limited (the general norm of coastal waters). Ambrose et al. (2000) suggested that N was probably more limiting than P based on N:P ratios . However, others (CH2MHill, 2000) have pointed out that although the N:P ratios are suggestive of nitrogen limitation there is very little positive relationship between chemical concentrations and algal abundances in the lagoon. Indeed, in the summer time there is a negative relationship as algae take up nutrients. In addition, a review of the Tapia data indicates that reductions in Tapia loadings in the summer have not had any measurable effect on reducing algal abundances in the Lagoon.

Therefore, when establishing a numeric target to control algal biomass and chlorophyll a concentrations, it is important to consider the factors limiting algal growth. No single study element was identified as the factor most likely limiting algal growth (Ambrose et al., 2000; Kamer et al, 2002). In the absence of conclusive information on limiting factors, the EPA will target both nitrogen and phosphorus for the summer period. The target values (Table 13) and the rationale used to develop these targets are presented below. However, it is anticipated that the limiting condition will be determined prior to full implementation of these TMDLs. Studies are underway to: 1) assess the dissolved oxygen levels within the watershed, 2) assess the level of impairment due to excessive algae, and 3) evaluate the relationship between nutrient water quality and aquatic life impacts. After these determinations, the Regional Board may need to revise these TMDLs.

EPA has utilized the reference waterbody approach to develop numeric targets for impaired streams and lakes within the Malibu watershed. This approach is described in EPA guidance (EPA 2000a, 2000b). For streams, the reference approach involves using relatively undisturbed stream segments to serve as examples of background nutrient concentrations (EPA 2000). Data were reviewed from three locations upstream of the Tapia treatment plant where we have long-

term data sets (see Figure A-1 and Table 14). The stations are located in Upper Malibu Creek (R9), Middle Malibu Creek (R1) and Lower Las Virgenes Creek (R6).

Table 14. Median Concentration Values (mg/l) from Tapia Monitoring stations (1991 to 1999)

NUTRIENT COMPOUND	Upper Malibu Creek (R9)	Middle Malibu Creek (R1)	Lower Las Virgenes Creek (R6)	Proposed Target
NO3-N	0.1	0.8	2.61	
TN	0.71	1.51	3.41	1.0
PO4-P	0.08	0.11	0.23	
TP				0.1

The concentrations for both nitrogen and phosphorus at the Upper Malibu Creek and Middle Malibu Creek stations were much lower than at the Las Virgenes Creek station. Data from stations R9 and R1 are believed to be more appropriate for setting target values using the reference approach. Based on data from these stations, the proposed targets are 1.0 mg/l for total nitrogen and 0.1 mg/l as a target for total phosphorus for the summer period. These values are consistent with EPA coastal values (NOAA/EPA 1998) and similar to the values for the eutrophic/mesotrophy proposed by Dodds et al. (2000) (1.5 mg/l TN and 0.075 mg/l TP).

Lakes. Lund et al. (1994) was the primary data source for establishing reference conditions for the lakes. This study evaluated trophic status, including nutrients and effects, for twenty-three lakes within the Los Angeles Region and was the same study used to list the four lakes in the Malibu Creek watershed as impaired. Ideally, reference conditions (nitrogen and phosphorus) are concentrations representative of lake conditions in the absence of anthropogenic pollution sources. However, since most lakes have been impacted by human activity to some measure, reference conditions represent the least impacted or most attainable lake conditions for a specific region (EPA, 2000b). Based on the evaluation, Crystal Lake, an alpine lake in the Los Angeles National Forest, was the least impaired. Nutrient concentrations at Crystal Lake were low, and these concentrations are felt to represent the most attainable nutrient and effects target.

Table 15. Summary of nutrient concentrations (mg/l) for five lakes (adapted from Lund et al., 1994)

Nutrient	Lake Sherwood	Westlake Lake	Malibu Lake	Lake Lindero	Crystal Lake	Proposed Lake Targets
NO3	0.5	0.3	0.5	0.4	<0.1	
NH4	0.8	0.4	0.1	0.1	0.2	
TKN	1.7	1.3	1.2	1.1	0.2	
TN	2.23	1.69	1.78	1.58	<0.3	1.0
TP	0.25	0.16	0.14	0.13	<0.1	0.1
PO4	0.25	0.16	0.13	0.09	<0.1	
Chl-*a*	16	14	44	23	4	

The proposed targets for these TMDLs are 1.0 mg/l for total N and 0.1 mg/l for total P for the summer period. The TP value of 0.1 mg/l is based on concentration at Crystal Lake. The TN value of 1.0 mg/l is derived from the Crystal Lake TP value assuming an N:P ratio of 10 to 1 ratio. The lake report (Lund et al., 1994) indicated that there were excessively high nitrogen values at Lake Sherwood, Westlake, Malibu Lake and Lake Lindero and high phosphorus values

at Sherwood Lake and Lake Lindero. They suggested that Lake Sherwood and Westlake Lake were both N and P limited and that Malibou Lake and Lake Lindero might be P limited. Compliance with these targets will result in significant improvements in nitrogen concentrations in all four lakes, significant improvement in phosphorus concentrations in Sherwood Lake and Westlake Lake and minor improvements in phosphorus concentrations in Malibou Lake and Lake Lindero.

Lagoon. Targets for the Lagoon were derived from the EPA/NOAA guidance for estuaries (NOAA/EPA 1988). The targets are 1.0 mg/l for nitrogen and 0.1 mg/l phosphorus for the summer period. We used the high-end range for these values because of the uncertainty regarding which factors are limiting algal abundances. For comparison, average lagoon values during the summer were 1.39 mg/l for nitrogen and 0.49 mg/l (Ambrose et al., 2000). The average winter concentrations measured by Ambrose et al were 4.0 mg/l for nitrogen and 0.63 mg/l for phosphorus.

f. Basis for Winter Season Nitrogen Numeric Targets

The Regional Board's Basin Plan includes a numeric objective for Malibu Creek of 10 mg/l of nitrogen (sum of nitrate-nitrogen and nitrite-nitrogen). As discussed in the problem statement, Section 2, there is clear evidence of algae problems in the summer months and some evidence of algae problems in the winter months. In EPA's judgment, it would be unwarranted to apply the summer season numeric target values for nitrogen and phosphorus at this time given the significant uncertainty concerning the existence and degree of algae problems as well as the uncertainty concerning the relationship between algae growth and nutrient levels in the winter months. However, EPA has concluded that it is necessary and appropriate to set numeric targets for total nitrogen because the Basin Plan specifies numeric objectives for total nitrogen that apply throughout the year and because there is some evidence of algae problems in the winter. To account for these uncertainties, EPA is setting numeric targets for the winter months that are less stringent than the nitrogen targets selected for the summer season but more stringent than the Basin Plan numeric objective for total nitrogen. EPA is incorporating a 20% explicit margin of safety in the winter season numeric targets for total nitrogen in order to help address uncertainty concerning algal growth problems in winter and to ensure that the 10 mg/l numeric objective is met in all waterbodies during the winter months. Therefore, the numeric targets for the winter season are 8 mg/l for the streams, lakes, and lagoon.

4. Source Assessment

An inventory of possible sources of nutrients to the waterbody was compiled, and both simple methods and computer modeling were used to estimate nutrient loads for those sources. Provided below is a description of the sources and a summary of the load estimates. For more detailed information on the source assessment, please refer to the modeling report (Tetra Tech, 2002). The Tetra Tech analysis provided both annual and summer loading estimates for nitrogen and phosphorus. The summer analysis covered May 1 to October 31 and included storm events during that period.

For purposes of allocations among nutrient sources, federal regulations distinguish between allocations for point sources regulated under NPDES permits (for which wasteload allocations are established) and nonpoint sources not regulated through NPDES permits (for which load allocations are established) (see 40 CFR 130.2).

Sources of nutrient discharges to waters in the Malibu Creek watershed that are regulated in whole or in part through NPDES permits include direct discharges from the Tapia WRF and urban stormwater discharges regulated under municipal stormwater permits. As discussed further in the allocation section below, for some source categories, it is difficult to distinguish between discharges regulated under stormwater permits and discharges that are not subject to permit requirements. In the source assessment section, source categories are discussed based on the physical characteristics of the discharge rather than their regulatory status.

Nutrient loads for storm water runoff were estimated by using the Hydrodynamic Simulation Program Fortran, a computer model (Tetra Tech, 2002). Loads from nonpoint sources discussed in this section were estimated using simple mass balance calculations.

The major categories of nutrient sources in the Malibu Creek watershed are:

- direct and indirect discharges from Tapia WRF
- septic systems
- runoff from residential and commercial areas
- runoff and erosion from undeveloped areas
- runoff associated with agricultural/livestock
- golf course irrigation and fertilization
- groundwater
- atmospheric deposition

a. Tapia Water Reclamation Facility (WRF)

There are two types of discharges from the Tapia WRF operated by the Las Virgenes Municipal Water District (LVMWD). Direct discharges include discharges of treated effluent directly to Malibu Creek and effluent discharges to percolation beds and then to Malibu Creek. Indirect discharges include loads associated with effluent irrigation and sludge disposal, which may reach water bodies through surface runoff or subsurface flows.

Direct discharges. The discharges from Tapia WRF and the percolation beds were calculated from TWRF monitoring data and represented in the linkage analysis as a direct discharge into middle Malibu Creek.

The Tapia WRF was built in 1965 (RWQCB, 1997). The facility has been expanded several times over the years as increasing urbanization and population growth in the watershed has increased wastewater flows. The plant capacity was expanded from 10 mgd to 16.1 mgd in 1994 (RWQCB, 1997). In 1984, the plant was converted from secondary to tertiary treatment. Currently, discharge to Malibu Creek is not allowed during the summer season when the sand

berm forms and closes off the entrance to Malibu Lagoon from the ocean. Regional Board Order No. 97-135 was adopted on November 3, 1997, and requires a discharge prohibition to the creek from April 15 through November 15 (RWQCB, 2000). Previously, discharges to Malibu Creek were fairly low during the season, when there is demand for the reclaimed wastewater. The mean summer effluent discharge rates during April to September ranged from <0.1 to 0.6 mgd. In comparison, the mean discharge rates during the winter months (October to February) were approximately 8 to 10 mgd (LVMWD, 1996-2000).

The treated effluent from Tapia has one of two end destinations. The effluent is either reclaimed for irrigation and industrial uses, or is discharged to streams. Effluent is discharged to Malibu Creek or Las Virgenes Creek through discharge points 001 and 002 (Table 16). No discharge is currently routed to the percolation ponds. The 004 discharge point was eliminated in 1999.

Table 16. Tapia Effluent Discharge Points

Discharge No.	Description	Subwatershed	Receiving Water
1	Primary outfall pipe	Middle Malibu Creek	Malibu Creek
2	Reservoir No. 2 outfall	Lower Las Virgenes Creek	Las Virgenes Creek

The primary discharge outfall into Malibu Creek is Discharge No. 001, which is located about 0.3 mile upstream of the confluence with Cold Creek (about 5 miles upstream of the lagoon). Discharge No. 002 flows into lower Las Virgenes Creek, and is used to release surplus effluent from Las Virgenes Reservoir No. 2, which is used for distribution of the reclaimed water system.

The effluent concentrations of nutrients discharged to Malibu Creek from 1992 to 2000 for phosphate-P concentrations ranged from 1.9 to 2.9 mg/l, and averaged 2.6 mg/l. Nitrate-N was the dominant nitrogen species, with concentrations ranging from 8 mg/l to 19 mg/l, and averaging 14 mg/l. Nitrite-N was negligible and was generally below the detection limit of 0.01 mg/l. Ammonia-N was generally below the detection limit of 0.2 mg/l. Organic-N concentrations ranged from 0.4 mg/l to 0.8 mg/l, and averaged 0.6 mg/l. The total nitrogen concentration averaged 14.6 mg/l, and the N/P ratio of the effluent was 5.6. (LVMWD, 1993-2000).

The nutrient loads discharged to Malibu Creek from Tapia were estimated from the monthly flow and concentration measurements collected by the Las Virgenes Municipal Water District for their NPDES monitoring reports (LVMWD, 1993-2000). The discharge prohibition was initiated in water year 1998.

Table 17. Annual nitrogen and phosphorus loadings from Tapia (1992-1999)

Year	1992	1993	1994	1995	1996	1997	1998	1999
Total Nitrogen	155,058	128,284	114,527	137,788	92,365	79,208	185,407	95,788
Total Phosphorus (PO_4)	46,728	39,032	18,295	19,623	15,833	9,092	29,620	16,104

The facility represents 30% of the nitrogen and 48% of the phosphorus loadings to the Malibu Creek watershed on an annual basis. Prior to the discharge prohibition, Tapia loadings represented 4.6% of the summer season loadings for nitrogen and 8% of the summer season loadings for phosphorus.

Indirect Discharges of Reclaimed Wastewater and Sludge Disposal. The Las Virgenes Municipal Water District (LVMWD) sells approximately 4,000 acre-feet per year of reclaimed wastewater from its Tapia WRF that is used for irrigating open space and landscaping (Abramson et al., 1998). In addition, Tapia composts the solid wastes from its treatment facility into fertilizer at their Rancho Las Virgenes Compost Facility (LVMWD, 1994; RWQCB, 1997; Abramson et al., 1998). Another portion of the sludge from Tapia is digested and pumped to their Rancho Las Virgenes Farm for subsurface injection. The sludge is used to fertilize the oat, barley, Sudan grass, silage corn, and Sudan hybrid crops that are grown during the various seasons at the 91-acre site (RWQCB, 1997). While these practices make good use of the reclaimed wastewater, they are essentially the same as fertilization and will add nonpoint sources of nutrients if the nutrient application rates are higher than the plant uptake rates. The excess nutrients will migrate to waterways through shallow groundwater flows, or increase the nutrient loads in surface runoff during storms (Tetra Tech, 2002).

Tables 18 and 19 present total loads of nitrogen and phosphorus, respectively, produced by effluent irrigation in the Malibu Creek Watershed. During model calibration, net loading of nitrogen was reduced to 25% of total produced loads due to plant uptake and soil retention, except for Tapia percolation beds that have no adjustments since they flow into Malibu Creek. During calibration, net phosphorus loads were reduced to 10% of total produced loads due to plant uptake and soil retention, except for the Tapia percolation beds that have no adjustments since they flow into Malibu Creek. In contrast to the common assumption that phosphorus is relatively immobile in soils, phosphorus loads from effluent irrigation were necessary to explain the observed concentrations in the waterways.

Table 18. Annual Nitrogen Loads associated with effluent irrigation in the Malibu Creek Watershed

Source	1992	1993	1994	1995	1996	1997	1998	1999
Triunfo Sanitation District	21,109	9,120	17,762	21,588	50,743	53,342	38,652	63,649
Western Las Virgenes Municipal Water District	117,522	75,110	80,883	98,653	80,737	94,253	81,021	100,741
Calabasas	46,673	38,975	56,946	60,743	60,080	50,754	46,498	60,749
Las Virgenes Valley	4,865	8,294	11,854	10,947	10,988	6,534	5,613	9,795
Rancho Las Virgenes	4,018	2,632	2,324	925	2,591	2,375	1,820	3,487
Rancho Las Virgenes Composting	0	0	0	0	0	0	148	150
Tapia Percolation Beds	46,585	20,185	69,882	91,645	69,745	72,300	0	0
Malibu Creek Park	0	0	0	0	0	0	0	40
Tapia Spray Fields and Wastewater Reclamation Facility	2,320	825	2,742	1,165	719	27,796	148	150
Tapia Yard	27,576	19,854	21,177	21,113	24,131	0	0	0
TOTAL	272,660	176,988	265,564	308,774	301,730	309,351	175,898	240,760

Table 19. Annual Phosphorus Loads associated with effluent irrigation in the Malibu Creek Watershed

Source	1992	1993	1994	1995	1996	1997	1998	1999
Triunfo Sanitation District	6,568	2,504	2,768	2,456	8,569	10,137	5,987	10,667
Western Las Virgenes Municipal Water District	36,704	21,302	12,374	11,721	13,637	14,793	14,563	17,221
Calabasas	14,554	10,981	8,978	7,204	10,241	8,063	8,395	10,747

Las Virgenes Valley	1,535	2,688	2,003	1,023	1,880	868	1,028	1,703
Rancho Las Virgenes	1,218	1,248	338	52	439	390	351	580
Rancho Las Virgenes Composting	0	0	0	0	0	0	25	25
Tapia Percolation Beds	14,348	5,902	10,741	12,372	11,972	8,741	0	0
Malibu Creek Park	0	0	0	0	0	0	0	10
Tapia Spray Fields and Wastewater Reclamation Facility	722	293	511	106	145	4,086	25	25
Tapia Yard	8,356	6,115	3,898	2,774	3,678	0	0	0
TOTAL	85,997	53,026	43,605	39,703	52,557	49,075	32,372	42,977

Table 20. Sludge injection loads at Rancho Las Virgenes Farm

Year	Sludge biosolids loading (ton/yr)	Total Nitrogen load (lb/yr)	Total Phosphorus Load (lb/yr)	Net Nitrogen Load to waters (lb/yr)
1997	307	49,120	6,140	24,560
1998	90	14,400	1,800	7,200
1999	1	160	20	80

Effluent irrigation and sludge injection are estimated to contribute 9% of the annual nitrogen load and 6% of the annual phosphorus load (Tetra Tech, 2002). These sources are estimated to contribute 15% of the nitrogen and 13% of the phosphorus loadings (Tetra Tech, 2002) during the summer season.

b. Septic Systems

Septic systems can be significant sources of nutrients, even when they are well sited and functioning properly, since they introduce nutrients to shallow groundwater that may eventually enter surface waters. Nitrogen is particularly mobile in groundwater, while phosphorus has a tendency to be adsorbed by the soils.

Except for the city of Malibu, most of the medium to high-density residential developments in the watershed are on sewer systems. However, septic systems are still used in lower density rural residential areas and in a few communities. The total number of septic systems in the watershed was estimated at 2,300 in the mid-1990s (NRCS, 1995).

The City of Malibu has about 6,000 septic systems, of which about 200 are estimated to be within the watershed boundaries based on information compiled by the Regional Board (RWQCB, 2000a). An estimated 70,000 to 80,000 gallons of septic effluent per day are discharged from about 20 commercial septic systems in shopping centers and commercial areas in the vicinity of Malibu Lagoon. Several hundred thousands of gallons per day are estimated to be discharged from private residences in the Malibu area of the lower watershed. Septic system discharges within the Malibu city limits (including areas outside of the watershed) are estimated to range from 840,000 to 1,200,000 gallons per day.

Although anecdotal reports indicate that illicit "greywater" discharges are a source of nutrient loads in areas where septic systems are utilized (LACDHS, 2001), the extent of the loading could not be quantified from available data.

Table 21 presents the total annual nutrient loads generated from septic systems in the Malibu Creek watershed. It was assumed that normal operating septic systems would remove 50 percent of the nitrogen and 90 percent of the phosphorous, that short-circuited systems would remove none of the nitrogen and 30% of the phosphorous, and that failing systems would not remove any of the nitrogen or phosphorous. The septic system nutrient loads were then adjusted to account for grass uptake, which resulted in about 13 percent removal for both nitrogen and phosphorus.

Table 21. Total Annual Nutrient Loads (lbs/yr) Generated from Septic Systems

Subwatershed	Total number of septics	Normal Septics	Failed Septics	Short-Circuited Septics	Commercial Septics	Total effluent flow (gal/day)	Nitrogen Load (lbs/yr)	Phosphorus Load (lbs/yr)
Hidden Valley Creek	625	500	125			171,250	30,879	5,147
Potrero Cyn Creek								
Westlake Lake	60	48	12			16,440	2,957	493
Upper Lindero Creek								
Lower Lindero Creek								
Upper Medea Creek								
Palo Comado Creek								
Cheeseboro Creek								
Lower Medea Creek	110	88	22			30,140	5,439	905
Triunfo Creek	820	656	164			224,680	40,515	6,753
Upper Malibu Creek	95	76	19			26,030	4,709	781
Upr L.Virgenes Crk								
Lwr L.Virgenes Crk	50	40	10			13,700	2,482	412
Stokes Creek	85	68	17			23,290	4,198	701
Middle Malibu Creek	50	40	10			13,700	2,482	412
Cold Creek	300	240	60			82,200	14,819	2,471
Lower Malibu Creek	5	4	1			1,370	256	40
Malibu Lagoon								
Above Lagoon	170	136	34			46,580	8,395	1,398
Adjacent to Lagoon	30			30		8,220	1,497	248
Commercial near lagoon	20				20	75,000	13,542	2,256
Total	**2420**	**1896**	**474**	**30**	**20**	**732,600**	**132,094**	**22,017**

Note: The Regional Board report (2000a) provided descriptions of various septic categories. Normal systems represent the majority of the septic systems that are properly sited and are functioning according to normal design standards. Failing systems represent septic systems that are not operating properly due to a variety of reasons. Failing systems include systems that have backed up or that have surfacing effluent, as well as systems that routinely have poorly functioning leach fields. Estimates of septic system failure rates ranged from 20 to 30 percent in the Malibu Creek watershed. A 20 percent maximum failure rate was assumed for the modeling, and was applied to each subwatershed that has septic systems. Short-circuited systems represent septic systems that are sited close to waterways and that have very shallow groundwater tables so that little nutrient or pathogen removal takes place. This category was used for the residential septic systems in Malibu Colony and the commercial septic systems in the Cross Creek shopping center that have been shown to influence Malibu Lagoon.

We estimate that on an annual basis septic systems contribute about 10% of the nitrogen loadings and 10% of the phosphorus loadings. During the summer season septic systems contribute about 22% of the nitrogen and 21% of phosphorus loadings. We understand that the City of Malibu is conducting a risk assessment to accurately characterize the impact of septic systems on groundwater in the Lower Malibu Creek and Malibu Lagoon watershed (City of Malibou, 2001). Data from this study will provide greater certainty on the estimates of actual loadings from septic systems to the creek and lagoon.

c. Runoff from Residential and Commercial Areas

Runoff from residential and commercial areas can be important sources of nutrients and bacteria. Most of the major residential and commercial areas are in the cities of Westlake Village,

Thousand Oaks, Agoura Hills, Calabasas, and Malibu. Lower density residential areas are scattered in many areas of the watershed, and include the communities around Lake Sherwood and Malibou Lake, the Hidden Valley area, the Palo Comado Creek area east of Agoura Hills, and the community of Monte Nido. The potential nutrient sources include fertilizer used for lawns and landscaping; organic debris from gardens, landscaping, and parks; phosphorus in detergents used to wash cars or driveways; trash such as food wastes; domestic animal waste; and human waste from areas inhabited by homeless. Human and domestic animal waste are also sources of bacteria. These pollutants build up, particularly on impervious surfaces, and are washed into the waterways through storm drains when it rains. These loads are typically highest during the first major storms after extended dry periods, when the pollutants have accumulated.

Activities such as watering lawns and landscaping, washing cars, and washing parking lots and driveways can contribute pollutants between storms. A portion of the nutrients from all of the above sources will also infiltrate into the soils of pervious areas, and may enter the waterways through shallow groundwater flows (Tetra Tech, 2002).

On an annual basis runoff from developed land areas contributes 13% of the total nitrogen load and 10% of the total phosphorus loads. During the summer season these land uses contribute 19% of the nitrogen loadings and 17% of the phosphorus loadings.

d. Runoff from Undeveloped Areas

More than 75% of the Malibu Creek watershed is undeveloped land (open space) consisting primarily of chaparral, scrub, and woodlands, with smaller areas of grasslands and forests. Runoff from these areas contributes nutrients to the waterways in both particulate and soluble forms. Particulate forms generally predominate and are introduced through the erosion of soils that contain organic litter from the overlying vegetation. Soluble nutrients are released during litter decomposition and may enter the waterways as a component of surface runoff or through shallow groundwater transport.

In addition, wildlife wastes may contribute to the nutrient loads from the large undeveloped portions of the watershed. The abundance of wildlife varies among the different habitat and vegetation types. Approximately 50 species of mammals and 380 species of birds occur in the watershed (NRCS, 1995). The important mammals include mule deer, hares, rabbits, squirrels, foxes, bobcats, badgers, ring-tailed cats, weasels, coyotes, raccoons, skunks, mountain lions, and a variety of small rodents (rats, mice, gophers, voles).

Waterfowl are important components of the Malibu Lagoon ecosystem, and may also contribute nutrients and bacteria to the various lakes in the watershed. Waterfowl were considered as a separate loading source only for Malibu Lagoon, since birds may be an important source of nutrients in the lagoon (Warshall et al., 1992). Waterfowl loads were not evaluated for the lakes since bird counts were not available. Table 22 presents the annual nutrient loads produced by waterfowl near Malibu Lagoon.

Table 22. Nutrient loadings (lbs) produced by waterfowl in Malibu Lagoon (Reference: Topanga-Las Virgenes Resource Conservation District)

Month	Bird Population	Nitrogen (lbs/mo)	Phosphorus (lbs/mo)
January	1000	237	85
February	1500	290	104
March	1630	293	105
April	400	54	19
May	300	42	15
June	320	43	16
July	230	105	38
August	200	42	15
September	400	54	19
October	750	105	38
November	780	297	107
December	1100	209	75
Annual Total (lbs/yr)		**1771**	**637**

Runoff from undeveloped land contributes 20% of the nitrogen and 17% of the phosphorus on an annual basis. The percent contribution during the summer is 9% for nitrogen and 11% for phosphorus. Birds contribute a relatively small fraction of the annual nitrogen load (0.3%) and phosphorus load (0.7%). The summer contribution is also a small percentage (0.5%) about 2% of phosphorus. The effects of birds and may be more significant on a local scale.

e. Agriculture/Livestock

Most of the agricultural activity in the Malibu Creek watershed is concentrated in the Hidden Valley area and consists primarily of pastures and grazing. Smaller agricultural areas are found in parts of the Stokes Creek, Lower Las Virgenes Creek, and Triunfo Creek subwatersheds. Orchards or vineyards occur in a few areas of the Triunfo Creek, Hidden Valley, Lower Malibu Creek, and Malibu Lagoon subwatersheds. Agricultural lands introduce nutrients to waterways through both surface runoff and erosion during storms and through shallow groundwater flows. The nutrient sources include fertilizers applied during cultivation; organic litter from the plants, grasses, or trees; erosion of the surface soils; waste accumulation from grazing animals; and soluble nutrients released during the decomposition and mineralization of plant litter and animal waste.

Manure produced by horses, cattle, sheep, goats, birds, and other wildlife in the Malibu Creek watershed are sources of both nutrients and bacteria. These loads can be introduced directly to the receiving waters in the case of waterfowl or cattle wading in streams, or they may occur as nonpoint sources during storm runoff. Horses are the most prevalent livestock in the watershed. Although horses are scattered throughout much of the watershed, most of the horses are concentrated in a few areas. These are Hidden Valley, the Palo Comado Creek area east of Agoura Hills, the Triunfo Creek and Lower Medea Creek areas in the vicinity and upstream of Malibou Lake, and the Cold Creek area around the community of Monte Nido. Cattle grazing is confined primarily to the Hidden Valley area in the upper western portion of the watershed. Approximately 250 cattle are estimated to reside in this area. Approximately 200 sheep and goats reside in the Ahmanson Ranch and pasture area north and east from the Rancho Las Virgenes. In the past years, cattle grazing also has occurred on the Rancho Las Virgenes

property of the upper Las Virgenes Creek subwatershed. The Natural Resources Conservation Service study provided the above estimates (NRCS, 1995).

Tables 23 and 24 present gross nutrient loads from horse and livestock manure, respectively, in the Malibu Creek watershed. The horse loads are reduced by forty percent for input into the model, due to collection of horse manure from stables, except for Hidden Valley subwatershed where there are many open pastures. Additionally, loads were reduced by twenty percent for horses and thirty percent for cows and sheep because these percentages were assumed to occur as urine and instead contribute nutrients to shallow groundwater (ASAE, 1998). Because horse and livestock loads occur as non-point sources in the model, there is a buildup of the nutrients during the dry periods and thus reduced contribution of the nutrients to the stream reaches during these periods.

Table 23- Gross Annual Horse Nutrient Loads

Subwatershed	Number of Horses	Total N (lbs/yr)	Total P (lbs/yr)
Hidden Valley Creek	920	100,740	23,842
Portereo Canyon Creek	40	4,380	1,037
Westlake Lake			
Upper Lindero Creek			
Lower Lindero Creek	5	548	131
Upper Medea Creek	20	2,190	518
Palo Comado Creek	100	10,950	2,592
Cheeseboro Creek			
Lower Medea Creek	140	15,330	3,628
Triunfo Creek	160	17,520	4,146
Upper Malibu Creek			
Upper Las Virgenes Creek	15	1,643	391
Lower Las Virgenes Creek	5	548	131
Stokes Creek	45	4,928	1,168
Middle Malibu Creek	30	3,285	777
Cold Creek	115	12,593	2,982
Lower Malibu Creek			
Malibu Lagoon	100	10,950	2,592
Total	**1695**	**185,603**	**43,928**

Table 24. Gross Annual Other Livestock Nutrient Loads

Subwatershed	Cattle	Sheep/Goats	Total N (lbs/yr)	Total P (lbs/yr)
Hidden Valley Creek	250		24,820	6,716
Upper Las Virgenes Creek	15		1,489	402
Upper Las Virgenes Creek		200	1,840	380
Total	**265**	**200**	**28,149**	**7,501**

On an annual basis, agriculture/livestock contribute about 5% of nitrogen and about 2% of annual phosphorus. During the summer season the percent contribution increases to about 8% for nitrogen and about 4% for phosphorus.

f. Golf Courses

Golf courses can be major sources of nutrients since the typical fertilization and watering rates are generally much greater than the amounts utilized by the golf course grasses. The excess nutrients accumulate in the soils and can be transported to waterways in shallow groundwater flows and stormwater runoff. Most of the golf courses are adjacent to waterways. Both Lake Sherwood and Lake Lindero have golf courses just upstream of the lakes, and Westlake Lake has a golf course about 0.6 miles northeast of the lake. In addition, two golf courses are located in the upper portions of the Westlake and Upper Lindero Creek watersheds near perennial or intermittent streams. There is also a small private golf course on the west side of Malibu Lagoon in the Malibu Colony area.

Table 25 presents golf course total nutrient loads and those remaining after grass uptake. During model calibration, it was assumed that fifty percent of the net nitrogen loads and ten percent of the net phosphorus loads reached the waterways because of reductions from processes such as plant uptake and soil retention (Reed et al., 1988). For the Hidden Valley golf course, it was assumed that 100% of the net nitrogen load and twenty percent of the net phosphorus load reached Lake Sherwood because the golf course is adjacent to the lake. In contrast to the common assumption that phosphorus is relatively immobile in soils, phosphorus loads from golf courses were necessary to explain the observed concentrations in the waterways.

Table 25. Golf Course Total and Net Nutrient Loads (lbs/yr) after Grass Uptake

Subwatershed	**Adjacent Tributary**	**Total acres**	**Gross N Loading (lbs/yr)**	**Gross P Loading (lbs/yr)**	*Net N Loading* (lbs/yr)	*Net P Loading* (lbs/yr)
Hidden Valley Creek	Lake Sherwood	150.6	47,172	20,604	15,552	14,568
Westlake (2 courses)	Westlake Tributary Triunfo Creek Trib	199.2	66,708	27,996	24,876	20,016
Upper Lindero Creek (2 courses)	Lake Lindero Upper Lindero Creek	103.6	32,556	14,196	10,800	10,044
Malibu Lagoon	Malibu Lagoon	10.5	3,288	1,440	1,080	1,020
Total			149,724	64,236	52,308	45,648

On an annual basis, golf course contributes 5% of the total nitrogen and 7% of the total phosphorus loadings. During the summer the percentages increase to 9% for nitrogen and 16% for phosphorus.

g. Groundwater

Shallow groundwater provides the base flows to the streams and is a major source of water during the summer season. Therefore, dissolved nutrients in groundwater can be important sources during dry periods. The nutrient concentrations in groundwater depend on the nature of the soils, geology, vegetation type and coverage, and nutrient sources such as septic systems and fertilization (Flowers, 1972).

Information on nitrate concentrations in groundwater is available from detection monitoring programs at the Rancho Las Virgenes Farm and the Calabasas Landfill. Background nitrate concentrations can be estimated from the monitoring locations that are either upgradient of the

sites, or that have been determined to be unimpacted by the site operations. The average nitrate nitrogen concentration at the upgradient wells was 1.58 mg/l during 1997 to 2000 (CSDLC, 2000). The range at these wells was 0.05 to 12.3 mg/l. In the impacted area downgradient of Rancho Las Virgenes Farm, the average nitrate nitrogen concentration in monitoring wells was 153 mg/l, and the range was 0.3 to 370 mg/l (Tetra Tech, 2002). See Table 26 for groundwater summary data.

Table 26. Nitrate Concentrations in Groundwater

Well location - Watershed	Sample Period	No. of wells with data	No. of analyses	Average NO_3-N (mg/l)
Malibu Creek	Pre-1973	40	46	1.9
Malibu Creek	Pre-1973	20	53	1.6
Las Virgenes	Pre-1973	6	7	1.6
Lindero Canyon	Pre-1973	14	17	3.4
Triunfo Canyon	Pre-1973	6	7	0.9
Russell Valley	Pre-1973	4	16	3.25
Sherwood	Pre-1973	21	40	1.3
Up gradient RLV Farm	1997-2000	3	58	1.58
Down gradient RLV Farm	1997-2000	5	49	153.4

Background nutrient loads from the shallow groundwater were estimated using flow rates simulated by HSPF and the average nitrate concentration (1.0 mg/l) from the upgradient well datasets from Rancho Las Virgenes Farm and the Calabasas landfill. The concentration of phosphorus was estimated at 0.13 mg/l. The concentration was based on the measurements in some upstream tributaries during base flow periods (Tetra Tech, 2002). It is not known whether these "background" groundwater nutrient levels are naturally occurring or are also influenced by anthropogenic inputs. We estimate that on an annual basis, groundwater loadings represent about 6% of the nitrogen and phosphorus to the watershed. During the summer season groundwater loadings represent about 9% of the nitrogen and about 12% of the phosphorus.

g. Atmospheric Deposition

Atmospheric deposition rates for nitrogen in the Malibu Creek watershed were estimated from recent measurements and modeling conducted by Ambrose et al., 2000 and the Southern California Coastal Water Research Project (SCCWRP).

The total nutrient loads from atmospheric deposition can be substantial since they are applied to the whole watershed. However, much of these nutrients are taken up and cycled by plants in the large vegetated areas of the watershed, so only a small portion of the deposited nutrients actually enters the waterways. In urbanized or agricultural areas, other activities such as fertilization or detergent use provide larger loads on a per unit area basis. Therefore, atmospheric deposition of nutrients was considered as a separate nonpoint source loading category only to the surfaces of receiving waters. Atmospheric deposition to land was included in the total nutrient build-up and washoff parameters that were defined for each land use and vegetation type that was modeled with HSPF (Tetra Tech, 2002). Table 27 summarizes the atmospheric deposition loads to Malibu Lagoon and the four study lakes.

Table 27. Nutrient loads from atmospheric deposition

Waterbody	Surface area (acres)	Nitrogen Load (lb/yr)	Phosphorus Load (lb/yr)
Lake Sherwood	163	3602	43.7
Westlake Lake	95	2100	25.5
Lake Lindero	12	265	3.2
Malibou Lake	55	1216	14.7
Malibu Lagoon	13	287	3.5

In summary, direct atmospheric deposition accounts for about 1% of the total nitrogen and a much smaller fraction (0.1%) of the total phosphorus on an annual basis. Atmospheric deposition contributes a larger percentage of the summer period loadings representing about 5% of the nitrogen and 0.5% of the phosphorus.

h. Sediments

Nutrient loads from sediment release and aquatic plant decomposition were considered for the four lakes and Malibu lagoon. Nitrogen and phosphorus loadings from Malibu Lagoon sediments were based on measurements and estimates performed by UCLA (Ambrose et al., 1995 and 2000). Nitrogen and phosphorus release rates from the sediments of the four lakes were estimated using typical release rates measured in other lakes (Tetra Tech, 2002 and references therein).

Estimates of nutrient loads associated with sediments are relatively minor on a watershed basis (about 3% of the annual nitrogen and about 4% of the total phosphorus). In places like Malibu Lagoon and perhaps Malibou Lake, the release from the sediments may have a major effect on nitrogen and phosphorus concentrations. We estimate that in the summer, when the algae problem is the worst, sediments account for about 16% of the nitrogen and phosphorus loaded to the lagoon. Although there is ample evidence that sediments are scoured out of the lagoon during heavy winter storms (Ambrose et al., 2000), little is known about how much of the annual nitrogen and phosphorus loads to Malibu Lagoon are deposited and retained in the sediments.

i. Tidal Inflow

Tidal inflow loads of nutrients were calculated from estimated tidal inflow rates from the UCLA study (Ambrose et al., 2000) and nutrient concentrations in coastal waters measured during the Malibu Technical investigation (RWQCB, 2000). The concentrations were averaged from measurements at all beach surf zone stations. The average concentration for phosphorus was 0.03 mg/l. and 0.47 mg/l for nitrogen.

Tidal inflow accounts for 4% of the annual nitrogen and 2% of the annual phosphorus loadings for the entire watershed. During the summer season, tidal inflow accounts for 5% of the nitrogen loads and about 3% of the phosphorus loads. These loadings affect the lagoon only.

j. Dry Weather Storm Drain Loads to Malibu Lagoon

Three major storm drains discharge to Malibu Lagoon. The Civic Center drain collects runoff from much of the floodplain, nearby hillsides, and the Civic Center area northwest of the lagoon

(Warshall et al., 1992; Ambrose et al., 2000) and discharges to Malibu Creek near the entrance to Malibu Lagoon. The Cross Creek Road drains the Cross Creek Plaza shopping center and surrounding commercial areas, and discharges to Malibu Lagoon next to the highway. The Malibu Colony drain collects runoff from the areas around Malibu Colony Plaza and Malibu Road and discharges into the western edge of the lagoon.

Dry weather nutrient loads from the two drains were calculated in the UCLA study using measured nutrient concentrations in washwater from the commercial parking lots (16 mg/l N and 0.36 mg/l P), estimates of the amount of wash water used, and the acreages of the washed commercial areas determined from field observations (Ambrose et al., 2000). From a watershed basis, the loadings from these sources were almost negligible. They represent less than 0.1% of the total annual nitrogen and 0.01% of the total annual phosphorus. Even on a local scale the contribution is small representing less than half a percent of the summer nitrogen load and 0.1% of the summer phosphorus load from the Malibu Lagoon subwatershed.

k. Summary of source assessment

Based on watershed modeling study (Tetra Tech, 2002) the following conclusions are provided. On an annual basis, Tapia WRF contributes a large percentage of the nitrogen and phosphorus loadings. High nitrogen and phosphorus loadings are also associated with wet-weather runoff associated with commercial and residential land uses and also with wet-weather runoff from undeveloped areas (see Appendix, Figure A-6). The loadings during the summer (defined by Tetra Tech as May to October) are at least an order of magnitude lower, partly due to the Tapia discharge prohibition, but primarily due to the decrease in runoff associated with large storms. During the summer, sources like septic systems, golf course irrigation and fertilization, and urban runoff provide a greater percentage of the load (see Appendix, Figure A-7). Sources and associated loadings are not distributed evenly throughout the watershed, so that reductions made at local scales (subwatersheds) are likely to have immediate effects on water quality even though they may represent a small fraction of the overall loadings to the watershed. Distribution of estimated loads for each nutrient by watershed are shown in Tables A-1 through A-4 (see Appendix).

5. Linkage Analysis: Linking Sources with Water Quality Targets

Information on sources of pollutants provides one part of the TMDL analysis. To determine whether those pollutants impair a waterbody, it is also necessary to determine the assimilative capacity of the receiving water under critical conditions. This section describes the methods used to determine the nutrient loadings that can be assimilated by the receiving waters and ensure attainment of the numeric targets (described in Section 2). In this section, we also describe the approaches for defining the critical conditions and developing an appropriate Margin of Safety (MOS) to ensure that water quality standards will be met. (Reminder these nutrient TMDLs define summer as April 15 to November 15 and winter as November 16 to April 14.)

To assist in analyzing these TMDLs, EPA and its contractors used receiving water quality models to estimate pollutant loads and predict the nutrient concentrations in the various streams, lakes, and lagoon in the watershed. The models assisted in the analysis of linkages between sources of pollutants to in-stream water quality concentrations and impacts in receiving waters (rivers, lakes and lagoon). The models also assisted in evaluating the relationship between pollutant loads and the in-stream water quality targets for the listed reaches (Tetra Tech, 2002).

The Hydrodynamic Simulation Program FORTRAN (HSPF) model selected for the watershed loading analyses includes a receiving water model applicable to both streams and well-mixed lakes. The HSPF model includes different forms of the limiting nutrients for algal growth (phosphorus and nitrogen), nutrient cycles, phytoplankton, and other water quality variables such as dissolved oxygen and biochemical oxygen demand (BOD). HSPF was selected since it could be linked directly with the watershed and stream-modeling framework and would apply to both rivers and the lagoon system.

The BATHTUB model was used to develop the linkage between loadings to the lakes, nutrient concentrations and algal biomass. BATHTUB also uses mass balance models to predict phosphorus and nitrogen concentrations in the water column as functions of loading rates, outflow (flushing) loss rates, and internal loss rates. Phytoplankton concentrations were estimated based on steady-state relationships that include processes such as photosynthesis, settling, respiration, grazing mortality, and flushing (Tetra Tech, 2002).

a. Critical conditions and seasonality

EPA has reviewed available monitoring data and has concluded the most critical time period for impairment is during the summer months when the potential for eutrophication and hypoxia are the greatest. Based on comparison of impairments in surface waters and local rainfall data, the "summer" time period corresponds to April 15 to November 15. For the lakes, this is the period when the percent algal coverage and biomass appear to be the greatest (see Problem Statement section). The summer also reflects the critical period for exceedance of the ammonia toxicity standard because of higher lake temperatures. For Malibu Lagoon, the algae problem appears greatest during the summer months since the lagoon is impounded and the streams have areas of little flow which allows algal growth to proliferate due to minimal flushing combined with

longer daylight levels and warmer waters. Therefore, TMDLs are being established for both nutrients—total Nitrogen and total Phosphorus during the summer in all water bodies.

Some evidence of excessive algae also exists in streams and lakes during the winter months (November 16 to April 14). However the percent algae coverage is much less in the winter than during the summer months and given the fairly high degree of subjectivity for making these algae assessments, there is uncertainty regarding the degree of impairment. As previously discussed several studies within the watershed have not clarified the issue of nutrient limitation nor direct effect of nutrients on algae growth. EPA is establishing only nitrogen TMDLs for the winter months because the Basin Plan contains a numeric objective for total nitrogen which the TMDLs must meet, and because the need for phosphorus TMDLs during the winter has not been firmly established.

The best information currently available to EPA indicates that exceedances of standards during the summer period are not exacerbated by nutrient discharges during the winter period that might remain in the system during summer (CH2MHill, 2000). Therefore, EPA has concluded that it is not necessary to reduce the loading capacity estimates (particularly during the wetter winter period) to account for potentially delayed effects during summer associated with winter nutrient discharges.

Summer. For the summer season, the loading capacity was calculated by determining the median flow value at the Malibu Creek gaging station (below Cold Creek, LACPWD site #F130-R) during the summer season and multiplying that median flow by the concentration-based numeric targets for total nitrogen and total phosphorous and a units correction factor to yield daily loading capacities. The loading capacity estimate is based on median flow values for the 1998-2001 period, which is the period following the imposition of new permit requirements for the direct Tapia WRF discharge that essentially prohibit discharge from Tapia between April 15-November 15. EPA concluded that it is appropriate to base the loading capacity estimate on median flow because summer season nutrient effects in the Malibu Creek watershed are principally associated with algae growth which occurs over relatively long time periods (more than a week) that are best represented by the median flow values rather than mean flows. EPA also rejected the 90^{th} percentile flow level (2.5 cfs) because that flow level does not account for periodic wet weather-related loads in the summer season which could cause substantial nutrient loads. Applying the 90^{th} percentile flow would result in TMDLs that are more stringent than necessary to implement the applicable water quality standards and that may not be attainable. The selection of summer median flows as the appropriate critical flows is also based on the consideration that the TMDL addresses algae growth in several lakes and the Malibu Lagoon, which are less sensitive to short term variations in flows and nutrient loads than are most streams.

The long-term median summer flow value was approximately 5.2 cfs. This value was multiplied by the numeric target values of 1.0 mg/l total nitrogen and 0.1 mg/l total phosphorus and an appropriate correction factor to yield loading capacity estimates of 77.1 lbs/day of total nitrogen and 7.7 lbs/day of total phosphorus for the summer season. These loading capacities are expressed as average daily values yet can be easily converted to monthly or summer values by multiplying by the appropriate number of days.

Winter. For the winter season, EPA considered applying a similar mass load based approach to calculating loading capacities for nitrogen. However, because flows and loads vary much more in Malibu Creek during the winter season in response to much more frequent wet weather events, EPA concluded that it would be more appropriate to identify concentration-based loading capacities (which are more sensitive to variations in flow levels) than to estimate mass based loading capacities based on simplified critical flow estimates. Based on these considerations, the winter season loading capacity for nitrogen is 8 mg/l of nitrate-N plus nitrite-N for all water bodies in the watershed, which is equivalent to the numeric target for total nitrogen in the winter season.

6. TMDLs and Pollutant Allocations

a. TMDLs

These TMDLs are set equivalent to the loading capacities (i.e., the assimilative capacities) for the water bodies addressed in these TMDLs. The loading capacity calculations were discussed in the preceding section. Table 28 summarizes the TMDLs.

Table 28: TMDLs for Nitrogen and Phosphorus

Season	Total Nitrogen	Total Phosphorus
Summer (April 15- November 15)	27 lbs/day	2.7 lbs/day
Winter (November 16- April 14)	8 mg/l*	n/a

* nitrate-N+nitrite-N

b. Allocations

Consistent with the TMDLs defined above, EPA has defined allocations for each pollutant source for the winter and summer seasons. Each pollutant source is allocated a quantitative load of nitrogen and phosphorus compounds for summer and nitrogen for winter. Allocations are designed such that each waterbody will not exceed the seasonal TMDLs, and not exceed numeric targets for any of the nutrient compounds or effects in any of the listed reaches. Consequently each waterbody will attain water quality standards. As required by EPA regulations, the TMDL is the sum of the wasteload allocations and load allocations, including natural background.

Point sources are given wasteload allocations, and non-point sources are given load allocations. The direct discharges from the Tapia WRF are regulated through an NPDES permit; therefore, this source is assigned wasteload allocations in this TMDL. In addition, EPA recognizes that discharges of stormwater and other runoff from some urbanized areas in the watershed are regulated pursuant to the Los Angeles and Ventura County municipal stormwater permits. Discharges in the following allocation categories likely include some discharges regulated through these stormwater permits:

- Runoff from developed lands,
- Golf courses,
- Dry weather urban runoff, and
- other source categories.

EPA was unable to specifically distinguish the amounts of pollutant loads from each of these allocation categories associated with areas regulated by the stormwater permits. Therefore, allocations for the source categories other than the direct Tapia WRF discharge are termed load allocations in these TMDLs. If it is later determined that nutrient loads associated with any of these load allocation categories are actually subject to regulation through NPDES permits, these allocations are to be considered wasteload allocations for purposes of implementing the permitting provisions of 40 CFR 122.44(d).

Tables 29, 30, 31 identify the specific wasteload and load allocations proposed for total nitrogen and total phosphorus during the summer and winter periods. Details concerning the calculation of these allocations are discussed below.

Table 29. Summer nitrogen allocations by source category

Source Category	Existing Loads (lbs/day)	% of existing load	Target Reduction (%)	Load Allocation (lbs/day, except Tapia)
Wasteload Allocations				
Tapia Direct Discharge	19	5%	100%	0*
Load Allocations				
Septic Systems	91	22%	93	6
Effluent Irrigation/Sludge	61	15%	100	0
Runoff from developed areas	26	6%	90	3
Golf Course Fertilization	37	9%	100	0
Agriculture/Livestock	32	8%	90	3
Dry Weather Urban Runoff	52	13%	90	5
Runoff from undeveloped land	37	9%	90	4
Other	56	14%	85	8
Total	**411**	**100%**	**93%**	**27**

Existing Loads determined from Tetra Tech, 2002
Developed areas = sum of commercial/industrial, high/medium density residential, low density residential, and rural residential.
Undeveloped areas = sum of vacant, chaparral/sage scrub, grasslands, and woodlands.
Other = sum of atmospheric deposition, lagoon drains, birds, tidal inflow, groundwater, and sediment release.
*See text for discussion of Tapia allocation.

Table 30. Summer phosphorus allocations by source category

Source Category	Existing Loads (lbs/day)	% of existing load	Target Reduction (%)	Load Allocation (lbs/day, except Tapia)
Wasteload Allocations				
Tapia Discharge	3.5	8	100	0*
Load Allocations				
Septic Systems	8.9	21	90	0.9
Effluent Irrigation/Sludge	5.3	13	100	0
Runoff from developed lands	2.6	6	90	0.3
Golf Course Fertilization	6.6	16	100	0
Agriculture/Livestock	1.7	4	90	0.2
Dry Weather Urban Runoff	4.6	11	90	0.5
Runoff from undeveloped lands	4.8	11	90	0.5
Other	4.1	10	90	0.6
Total	**42.3**	**100%**	**94%**	**2.7**

Existing Loads determined from Tetra Tech, 2002
Other footnotes see Table 29
*See text for discussion of Tapia allocation

Table 31. Winter concentration-based nitrogen allocations by source category

Source Category	Existing Loads (lbs/6 mo)	% of Existing Load	Daily Load Allocation (mg/l)*
Wasteload Allocations			
Tapia Discharge	187,508	34%	8
Load Allocations			
Septic Systems	47,285	9%	8
Effluent Irrigation/Sludge	44,298	8%	0
Runoff from Developed Areas	59,030	11%	8
Golf Course Fertilization	27,141	5%	8
Agriculture/Livestock	27,343	5%	8
Dry Weather Urban Runoff	8,500	2%	8
Runoff from undeveloped land	123,933	22%	8
Other	27,637	5%	8
Total	**552,675**	**100%**	**8**

*nitrate-N+nitrite-N
Existing Loads determined from Tetra Tech, 2002
Other footnotes see Table 29

Waste Load Allocations

Tapia's Direct Discharge. Seasonal wasteload allocations are proposed for Tapia. Order No. 99-142 prohibits discharge from Tapia to Malibu Creek from April 15 to November 15, with minor exceptions during storm flow events and minimal (<2.5 cfs) stream flow conditions. The summer Tapia WLA is set at zero; however, this WLA is not intended to negate these exceptions. We understand that to date, Tapia has not had to discharge in the summer, and we expect that such discharges would be very sporadic in the future. We believe these discharges will have an insignificant effect on average summer loads and that it is therefore unnecessary to account for them in the cumulative loading allowed under the TMDL. The State should ensure that these discharges do not result in exceedances of any applicable water quality standards.

During the winter period, Tapia's wasteload allocation is 8 mg/l total nitrogen, equal to the numeric target established in the TMDL It will be necessary for Tapia to reduce nitrogen loads from their historical levels of about 14 mg/l by approximately 43% to meet the new winter wasteload allocation.

These wasteload allocations apply during wet and dry weather conditions during the respective summer and winter periods. EPA proposes these allocations be set as average daily values, to be averaged over no more than a one-month period.

Load Allocations

Load allocations (LAs) are set based on source categories evaluated in the source analysis. This approach of setting LAs for different source categories is consistent with the requirements of 40 CFR 130.2(g), which authorizes establishment of LAs as "gross allotments". The LAs apply to all discharges from these source categories to listed segments and to upstream, hydrologically

connected segments within the Malibu Creek watershed. This means that LAs apply both to discharges to segments for which TMDLs are being established, as well as to discharges to segments that are tributary to the segments for which TMDLs are established. It is necessary and appropriate to set LAs for discharges to the upstream tributaries in order to meet water quality standards in the downstream-impaired segments in the Malibu Creek watershed. These upstream tributaries flow into and contribute to impairment of Section 303(d)-listed segments. TMDLs and associated LAs and WLAs must be set at levels that will implement applicable water quality standards for the listed water bodies (40 CFR 130.7(c)(1)).

Effluent irrigation and sludge disposal. The waste discharge requirements issued by the Regional Board that regulate effluent irrigation and sludge disposal prohibit application of effluent or sludge at levels that would result in pollutant discharges to receiving waters (RWQCB Order No. 87-86, 94-055). The effluent irrigation waste discharge requirements require application of reclaimed water at agronomic rates that do not result in percolation of nutrients to groundwater. Based on these requirements, the load allocations for discharges to surface waters associated with effluent irrigation and sludge disposal during both the winter and summer periods are zero. We understand that sludge is no longer being applied and the only on-going nutrient applications in this category are associated with effluent irrigation. If reclaimed water is used for irrigation consistent with the requirements of the existing waste discharge requirements, there should be no nutrient loading to surface waters associated with this activity.

Septic Systems. The load allocations for this source category are set at levels that will require large reductions in nutrient loading from septic tanks throughout the watershed. Implementation of the load allocation will probably necessitate aggressive actions to identify and repair all septic systems that do not function properly. The highest priority for implementation is to ensure that discharges from commercial septic systems do not cause nutrient discharges to surface waters, particularly in the Malibu Lagoon area. We expect that actions taken to address septic systems will provide improvements in discharge quality throughout the year; therefore, the winter LAs should be met if the summer LAs are met.

Urban runoff. Although runoff from commercial and residential areas can contribute large loads of nitrogen and phosphorus to the system on an annual basis, the critical time period is the summer period. In addition, work by Kamer et al. (2002) indicates there are higher algal problems in developed urban areas. The summer load allocations would necessitate large reductions in nutrient loads from this source category. We expect that measures implemented to reduce urban runoff will provide improvements in discharge quality during dry periods throughout the year. Because total nitrogen levels in wet weather stormwater runoff are usually below the proposed WLA, we do not expect that extensive work will be needed to address wet weather nutrient loads from this source category.

Golf Course. The load allocation for golf course irrigation in the summer is zero. The goal is to allow effluent irrigation only for fertilization in amounts that plants can utilize. In practice we would assume that once implemented these practices would be applied year round, so that substantial nutrient reductions may also be obtained during the winter period. It is unknown whether additional controls will be needed to implement the winter LA for this source category. Reduction in the excess nutrients from golf course fertilization in the Hidden Valley, Westlake,

and Lindero Creek subwatersheds will particularly improve water quality in Lake Sherwood, Westlake Lake and Lake Lindero.

Agriculture/Livestock. Load reductions of approximately 90% of excess nutrients from agriculture and livestock discharges during the summer are established for the Malibu Creek watershed. The goal is to effectively eliminate runoff of manure from stables and to minimize nutrient contaminated runoff both from stables and manure piles. In practice we would assume that once implemented these practices would be applied year round, so that substantial nutrient reductions may also be obtained during the winter period. It is unknown whether additional controls will be needed to implement the winter LA for this source category.

Runoff from undeveloped land. The load allocations provide for reductions of 90% in nutrient loading from undeveloped land areas. These reductions are needed in order to set TMDLs that will meet applicable water quality standards. It is reasonable to provide for some nutrient loading reductions from undeveloped land because nutrient loadings from these lands are likely affected by some controllable factors including atmospheric deposition of nutrients onto land surfaces as well illicit dumping of trash and other material that could yield nutrient loads. Moreover, runoff from some undeveloped areas is channeled to developed areas that are expected to benefit from runoff management practices that should reduce nutrient concentrations. Therefore, actions to control nutrient loads from developed areas should result in some reduction in runoff from undeveloped land areas.

Other sources. This source category includes direct atmospheric deposition to water surfaces, discharges from stormdrains to Malibu Lagoon, fecal material from birds, tidal inflow, groundwater releases, and sediment releases. EPA acknowledges that the proposed load reductions are aggressive (90% in summer). However, we believe these reductions should be feasible because:

- actions to reduce nutrient inputs from other anthropogenic sources should eventually bring about substantial reductions in loadings from groundwater and sediment, and
- direct stormdrain discharges to Malibu Lagoon can be effectively eliminated during the summer season.

c. Margin of safety

The Clean Water Act and federal regulations require that TMDLs provide a margin of safety to account for uncertainty concerning the relationship between pollution controls and water quality responses (see 40 CFR 130.7(c)(1)). The Malibu Creek watershed nutrient TMDLs provide both implicit and explicit margins of safety to account for several types of uncertainty in the analysis. This section discusses analytical factors that are uncertain and describes how the TMDL provides the requisite margin of safety.

Relationship between algae growth and nutrient loading. Although there is strong evidence of excessive algal growth in summer and some evidence of excessive algal growth in winter, the degree of algae-related impairment in winter and the degree to which nitrogen, phosphorus, or both are limiting factors in algae production throughout the year are uncertain.

The summer season TMDLs and allocations account for this uncertainty by setting conservative numeric target values for total nitrogen and total phosphorus. Our review of the available data suggests that there is a closer relationship between nutrient levels and algae production in summer than was observed in the winter. Attainment of these conservative summer target values should ensure that nitrogen and phosphorus are not critical limiting factors in algae production and should result in reductions in algae growth.

The winter season numeric targets, associated TMDLs and allocation are less stringent than the summer because available data and research studies do not clearly demonstrate that nutrient levels are likely to cause excessive algae growth. The TMDLs are designed to ensure implementation of the Basin Plan numeric objective for total nitrogen while acknowledging uncertainty concerning winter algae problems and associated attainment of the narrative objective for biostimulatory effects. The TMDLs account for this winter period uncertainty by incorporating a 20% margin of safety (setting the nitrogen numeric target at 8 mg/l instead of 10 mg/l, which is the applicable numeric objective).

Nutrient loading during the winter period, stream flows, and nutrient loading capacity vary more during the winter period than the summer period because most precipitation related changes in runoff, loads, and flows occurs during the winter period. Winter period loads and flows change quickly in response to unpredictable precipitation events. High velocity stream flows are likely to scour filamentous algae and carry it out of the watershed; these high flows also flush nutrient compounds through the watershed and into the ocean. We are accounting for the uncertainty associated with winter season variability in loads, flows, and loading capacity by setting the winter season TMDLs and allocations on a concentration basis instead of a mass-loading basis.

Studies are currently underway to improve our understanding of the relationship between nutrient levels in the watershed and algal growth. EPA strongly recommends that these studies be completed and additional studies carried out if necessary to characterize the limiting factors that control algae growth in the Malibu Creek watershed. These studies need to focus both on the winter and summer periods. Additional study is needed to reconcile conflicting data and research concerning the degree to which algae growth in the winter period is causing impairment and violation of narrative water quality objectives. Based on results from these studies, the State should consider reviewing and, if necessary, revising the TMDLs, allocations, and/or implementation provisions.

Uncertainty in nutrient loading estimates. Although we used established methods for estimating nutrient loads from different sources including relatively sophisticated modeling tools, it is not certain that these estimates are accurate. To help account for this uncertainty, the watershed loadings were based on a four-year period (1992 -1995) that included a wide range of hydrologic variability, and was coincidentally weighted more toward wet years. This approach yields conservatively high runoff estimates from different land uses.

We also made conservative assumptions in the estimation of loadings from septic systems, effluent irrigation, and golf course runoff. All of the excess nitrogen loads (87%) not utilized by plants from septic systems near Malibu Lagoon were assumed to enter the lagoon. Similarly

conservative estimates were made in estimating phosphorus delivery from septic systems. Approximately 10 percent of the phosphorus loads from effluent irrigation and golf course fertilization were assumed to enter waterways, an assumption that is conservative because it is usually assumed that phosphorus compounds are highly sorbed to particles and therefore relatively immobile in soils.

These conservative loading estimates were used to estimate the percentage reductions needed to attain the individual allocations during the summer period. Use of conservatively high runoff estimates results in conservative percent reduction estimates for each source category (i.e., implementation of these percentage reductions is highly likely to result in attainment of the individual allocations and the TMDLs).

Additional studies of loadings from nonpoint source categories would be warranted in the future to better characterize loadings during wet weather periods from polluted runoff as well as loads associated with septic system operation.

d. Summary of pollutant allocations

These TMDLs establish seasonal waste load allocations for the Tapia WRP. Seasonal load allocations are established for several source categories including effluent irrigation, commercial/multi-family septic systems in Malibu Lagoon, urban runoff, golf course runoff, livestock/agricultural runoff, and other land uses. During the summer period, large reductions in loads from all anthropogenic sources are needed. During the winter, substantial reductions in Tapia's discharge and modest reductions from other source categories are needed in nitrogen loading to ensure attainment of the concentration-based allocations. Actual reductions attained in winter should be greater since in practice a number of the load reduction efforts proposed in the implementation recommendations (below) are likely to result in year round reductions rather than just summer season reductions.

There is uncertainty in *some* aspects of the TMDL analysis. Implicit and explicit margins of safety are provided to account for these uncertainties. Additional monitoring and studies currently underway and recommended below should help address these areas of uncertainty and provide a basis for considering whether TMDL revisions are warranted.

7. Implementation Recommendations

This section describes the plans, regulatory tools, or other mechanisms by which the waste load allocations and load allocations may be achieved. The main responsibility for water quality management and monitoring resides with the State. EPA fully expects the State to develop implementation and monitoring measures for these TMDLs. Following are EPA's recommendations for implementing these TMDLs.

a. Implementing waste load allocations to permitted point source dischargers

Tapia Water Reclamation Facility. EPA anticipates that the WLAs established in these TMDLs will be implemented through the NPDES permit for the Tapia Water Reclamation Facility. It appears that Tapia needs to substantially decrease nutrient loads in order to meet both its existing winter period effluent limitations and its WLA. The Regional Board will need to determine whether the permit needs to be modified to be consistent with the WLAs and when the modifications would occur. When the permit is next revised, we recommend inclusion of re-opener language that provides to review of the permit if necessary following completion of monitoring and research studies designed to further characterize nutrient and algae issues in the watershed and determine the need for further reductions in nutrient loading from Tapia.

b. Implementing Load Allocations to nonpoint sources.

Effluent Irrigation. The usage of reclaimed water is regulated under water reclamation requirements contained in Regional Board Resolutions 87-86 and 94-055. This should be modified if necessary to be consistent with these TMDLs.

Septic Systems. The highest priority for implementation actions in this source category is commercial septic systems. In particular, actions are needed to ensure that commercial septic systems located in the Malibu Lagoon subwatershed, specifically in the areas of the Malibu Colony Plaza, Cross Creek Plaza, and Malibu Civic Center do not contribute to nutrient loading to the Lagoon. These systems may have been improperly sited and appear to be located adjacent to the lagoon, in a groundwater table with historic levels that do not allow as least 10 feet between the groundwater and septic system.

These commercial septic systems were the focus of Regional Board Resolution 98-023. This resolution provided direction to the Executive Officer to require the submittal of Reports of Waste Discharge for all discharges from multi-family and commercial septic systems located in the Malibu Creek watershed. Therefore, EPA's understanding is that a mechanism for implementation for the septic system Waste Load Allocations (WLAs) derived from these TMDLs has already been established. EPA anticipates that the WLAs developed for these TMDLs will be established as WDR permit limits for the individual septic systems. In addition, the WDRs have specific prohibitions on septic systems within 10 feet of the highest historical groundwater levels. The actual implementation date on the WLAs will depend on implementation schedules established by the Regional Board.

Septic systems that are poorly sited will have options available for meeting the LAs under these TMDLs. One possible method of compliance is pretreatment via Nitrogen Reduction Systems (NRS) of effluent to remove nutrients prior to leachfield discharge (USEPA, 1999b). The principal treatment mechanism for these systems would be biological nitrification-denitrification.

Golf Course Irrigation. Golf courses and users of recycled water can implement management practices to minimize the potential for nutrients entering surface water. Potential management practices may include:

- Applications of fertilizers and recycled water at agronomic rates to ensure that the total nitrogen and phosphorus loads do not exceed the daily vegetative requirements of the turf.

- Use of irrigation systems that will minimize the potential for application of excess recycled water that would result in surface runoff.

- The design of recycled water irrigation systems to cease operation under anticipated storm events.

Some of the management strategies outlined above have been proposed by the Ahmanson Ranch Specific Area Plan for implementation in the master planed community for Ahmanson Ranch (VCRMA, 2002). The BMPs outlined above are administrative BMPs, which will involve changes in operational practices, but not necessarily result in capital expenditure.

Horses and Livestock. Load reductions are proposed for horse stables and livestock pastures. It is estimated that 40% of the manure is already removed from stables. Additional manure management measures will be needed to implement the allocations. Additional BMPs may also be necessary to mitigate the impacts from this source category. For examples, measures could be taken to keep animals away from the streams in Hidden Valley and other tributaries, and manure could be removed more frequently from stables. It is important to ensure that manure from stables is managed properly throughout the year and that animal waste is not allowed to runoff into streams at any time.

8. Monitoring Recommendations

Follow-up monitoring and evaluation is recommended to validate the TMDL, and to assess whether the implementation measures are adequate to attain water quality standards.

a. Water quality monitoring

A watershed-scale monitoring program should be established at key compliance points along the river. Samples should also be collected at the upstream and downstream ends of the listed tributaries. Sample results should be compared to the numeric in-stream targets identified in Section 2c for dissolved oxygen, ammonia, nitrate, total nitrogen, percent algal cover and Chlorophyll *a*.

Much of this data is already being collected as part of the Tapia WRP monitoring program. However there is only limited data available for the upper portion of the watershed and selected tributaries of Malibu Creek. EPA recommends that these watersheds be surveyed in order to more fully understand the natural conditions, and how the impaired waterbodies compare to natural conditions. Heal the Bay has a network of monitoring stations throughout the watershed including a number of potential reference sites. These sites should be considered in future monitoring and assessment plans for the watershed.

The Malibu Creek Advisory Committee, Modeling and Monitoring Subcommittee has developed a Watershed-Wide Monitoring Program (1999). The program addresses the watershed-scale monitoring needed to evaluate the effectiveness of the TMDLs. The data could be used to provide further verification of the model and refine the TMDLs as appropriate.

b. Pollutant source monitoring

Monitoring of pollutant sources is needed to ensure that required reductions are being achieved and if necessary, to refine the allocations presented in these TMDLs.

Treated and reclaimed wastewater. Tapia WRP should continue to monitor effluent concentrations of nitrogen and phosphorus for the purpose of verifying loads to the watershed. Tapia WRP should also continue to monitor the quality and quantity of reclaimed water used in the system. Special monitoring should be conducted to evaluate the quantity and quality of reclaimed water that re-enters the system via surface runoff or through groundwater.

Septic systems. According to the Regional Board, the WDRs will have a monitoring program component to estimate concentrations from the septic systems. In addition, we recommend special studies be conducted for better certainty in the number of septic systems and the distribution of the systems within the Malibu Creek watershed.

Horses and livestock. Monitoring is needed to ensure that recommended load reductions are being achieved. This could be established through random inspections of horse and livestock facilities.

Monitoring of urban sources. A special monitoring program should be established to evaluate effectiveness of actions to reduce both dry and wet weather urban runoff.

c. Special studies—Recommendations

There are uncertainties in the numeric target and winter wet season impact of source loading from the treatment plant to Malibu Lagoon. The following studies are recommended to address these uncertainties.

Extent of algal impairment. EPA recommends studies to investigate the current extent of impairment due to excessive algal growth in the creek by surveying algal biomass and species composition at multiple sites within the creek. This data will provide information regarding the present degree of excessive algal biomass in the stream as well as determining any relationships between land uses, water column nutrient concentrations, and resulting impacts on stream periphyton biomass and communities.

Limiting factor analysis. EPA recommends further study to assess whether total nitrogen or total phosphorus or other parameters such as flow and light limit algal growth in the Malibu Creek watershed. This information will assist Regional Board staff in determining watershed specific nutrient targets which are linked to algal nutrient requirements.

Fate of nutrients in Malibu Lagoon. These TMDLs are based on the assumption that the summer nutrient concentrations control algal abundances. Another critical assumption is that summer period nutrient concentrations are related to summer period loadings. This may not be the case in the Lagoon where some fraction of the total nitrogen and phosphorus loadings may be retained in the sediments and ultimately serve as a source of nutrients during summer periods when algae is more abundant. Thus, EPA recommends a study to determine if the expected upstream reductions in nutrient loadings do not result in desired improvements in water quality in the lagoon.

d. Summary of TMDL Monitoring

The TMDL monitoring program should be designed to provide information that will assure that water quality objectives are being met throughout the watershed and to refine the source loading estimates. These efforts will provide information on the success of the TMDLs to address the nutrient related problems in the creek, lagoon and listed tributaries. Information generated by this program may be used by the Regional Board to revise the TMDLs, NPDES permits, WDRs, and other control actions if necessary.

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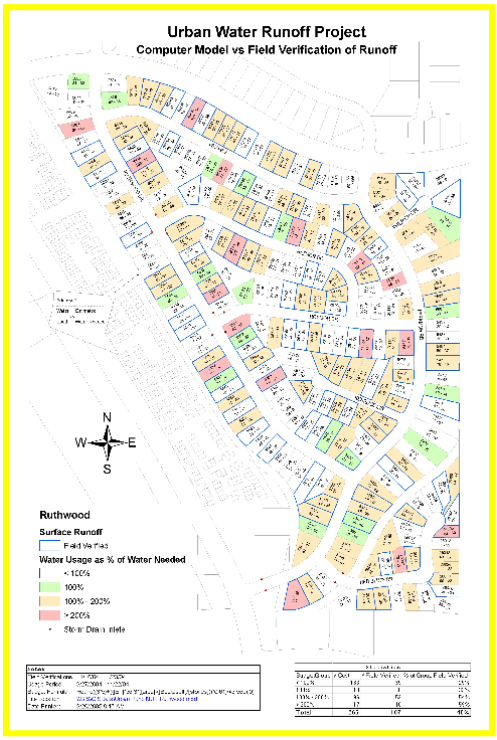
Urban Runoff Reduction Project for Malibu Creek
Agreement No. 03-167-554-0
Prop. 13



Progress report #4

Covering April 1 – June 30th, 2005

LAS VIRGENES MUNICIPAL WATER DISTRICT

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September 15, 2005

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Subject: Prop. 13 Progress report #4 – Urban Runoff Reduction Project for Malibu Creek – Agreement No. 03-167-554-0

Dear Mr. Jay,

I am pleased to submit our fourth progress report and 3rd invoice for the subject agreement. This report covers the period 4/1/05 through 6/30/05.

I spoke with your staff upon receipt of your letter of September 2nd regarding the need for timely reporting, advising them of our anticipated delay in the submission of this report. We have since reassigned some of the project tracking functions to other staff, and I believe this will not be an issue in the future. The project itself remains on schedule.

Highlights from this period include completion of Task 3 (compilation of runoff data), and successful field validation of our information systems approach to locating urban runoff "hotspots."

Note that Task 1 (Project Administration) has spent 100% of the contract allocation although it is 62.5% complete. We will complete the remainder of this task using District funds. Also note Task 2 has been completed well under budget. We will be requesting transfer of the remaining funds for this task to Task 5 to maximize the funds available for the actual runoff reduction effort.

Please call me at me at 818 / 251-2145 or rorton@lvmwd.com if you have any questions regarding these submittals

Sincerely,

Randal Orton, Ph.D., D. Env.
Resource Conservation Administrator

Attachments –Invoice #3, Progress report #4

c. J. Mundy
A. Post
J. Reinhart
S. Harris

INVOICE #3 – Revised

FROM: Dr. Randal Orton
Resource Conservation Administrator
Las Virgenes Municipal Water District
4232 Las Virgenes Road
Calabasas, CA 91302-1994

August 2, 2005
Revised October 4, 2005
Revised October 19, 2005

TO: Program Analyst (ORIGINAL)
State Water Resources Control Board-DFA
1001 I Street, 14th Floor
Sacramento, CA 95814

CONTRACT # 03-167-554-0

FOR BILLING PERIOD: 4/1/05 – 6/30/05

EXHIBIT "B" - BUDGET

		Total Prop13 Budget	Expenditures to Date	Expenditures Current	Percent of Task to Date Completed
1	Project Mgmt	$788	$788.00	$229.24	62.5%
2	Project Assessment and Evaluation Plan	$4,827	$933.09	$0.00	100%
3	Compilation of Urban Runoff Data	$8,614	$8,614.00	$7,325.77	100%
4	Verification of High Runoff Locations	$35,407	$9,518.57	$7,977.22	100%
5	Customer Intervention	$56,774	$47.55	$0.00	4%
6	Public Outreach	$15,691	$124.53	$0.00	10%
7	Draft/Final Report	$113	$0.00	$0.00	0%
	TOTALS	$122,214	$20,025.74	$15,532.23	

TOTAL DUE THIS INVOICE **$15,532.23**

[redacted]

[redacted]

Progress Report #4 – Revised

Reporting Period: 4/1/05 to 6/30/05
Contract No. 03-167-554-0
Project Name: URBAN RUNOFF REDUCTION PROJECT

Project Director: _____
Dr. Randal Orton 818 /251-2145 RORTON@LVMWD.COM

TASK	SUB-TASK	DELIVERABLE	DUE DATE	% Complete	Date Submitted
1.0		**PROJECT ADMINISTRATION**		**62.5%**	
	1.2	Progress Reports	On-going	62.5%	
	1.5	Contract Summary Form	7/1/04	100%	7/12/04
	1.6	Subcontractor Documentation	Not applicable – no subcontractors		
	1.7	Expenditure/Invoice Projections	Bi-annual	50%	5/9/05
	1.8	Project Survey Form	3/31/06		
2.0		**PROJECT ASSESSMENT & EVALUATION PLAN**		**100%**	
	2.1	Project Assessment and Evaluation Plan	12/31/04	0%	**4/25/05**
3.0		**COMPILATION OF URBAN RUNOFF DATA**		**100%**	
	3.7	GIS color-coded Map Overlay	3/31/05	100%	10/19/05
	3.8	Electronic Database of Customer Addresses	3/31/05	100%	10/19/05
4.0		**VERIFICATION OF HIGH RUNOFF LOCATIONS**		**100%**	
	4.2	Photo documentation	1/15/06	100%	
	4.4	Electronic Database of Street Addresses Observed	1/15/06	100%	
5.0		**CUSTOMER INTERVENTION**		**4%**	
	5.6	Written Landowner Agreements	1/15/06	10%	
	5.8	500 water audtis	1/15/06	2%	
	5.9	Electronic Database of Street Addresses receiving Water Audits and Post-intervention Water Use	1/15/06	0%	
6.0		**PUBLIC OUTREACH**		**10%**	
	6.1	Outreach Materials	1/15/06	15%	
	6.2	Advertisements, Articles,Press Releases, PowerPoint Presentations	1/15/06	8%	
7.0		**DRAFT AND FINAL PROJECT REPORT**	**3/1/06**	**0%**	
	7.2	Draft Project Report	1/15/06	0%	
	7.3	Final Project Report	3/1/06	0%	

List of Deliverables by Subtask No. included in this Quarterly Progress Report:

- Task 1, Subtask 1.2: Fourth Progress Report
- Task 3, Subtask 3.7: Map of projected runoff
- Task 4, Subtask 4.4: Addresses of field-verified runoff locations

List of Deliverables by Subtask No. to be included in draft report:

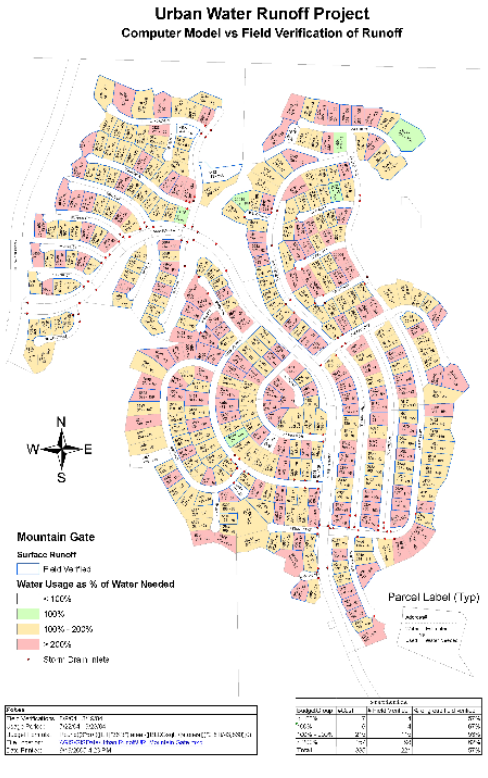
- Task 2, Subtask 2.1: Project Assessment
- Task 3, Subtask 3.7: Final map of projected runoff
- Task 3, Subtask 3.8: Database of projected runoff
- Task 4, Subtask 4.2: Photodocumentation of runoff
- Task 4, Subtask 4.4: Final Database of runoff locations
- Task 5, Subtask 5.8: Homeowner agreements (if necessary)
- Task 5, Subtask 5.9: Copies of water audit reports
- Task 5, Subtask 5.10: Final database of participating addresses and post-intervention water use
- Task 6, Subtask 6.1,2: Copies of all outreach materials

Narrative

Task 1. Project administration is ongoing, however project management costs increased significantly due, in part, to the need to consult legal counsel on customer data privacy issues. However, costs in excess of the contract cap have not been billed against the grant. As this cap has been reached, future expenditures for this Task will be funded by the District.

Task 2. The Project Assessment Plan was completed in the last reporting period.

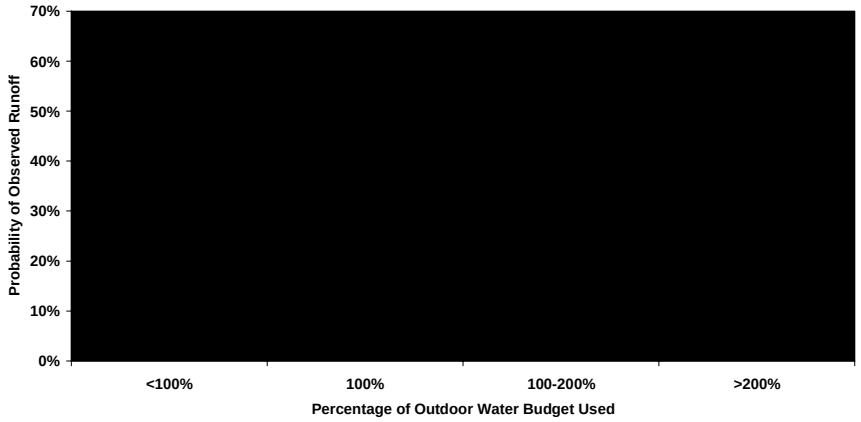
Task 3 and 4. The "100% complete" shown on the Invoice and task summary is based on our completion of the maps and address lists for urban runoff locations throughout the urbanized areas of the Malibu Creek watershed (see attached maps), as specified in the grant contract. Note that these tasks were completed substantially under budget. Partway through the project we developed a faster means of surveying neighborhoods for runoff by using our staff water meter readers to record runoff in addition to the personnel we had previously been using for this task. This effectively increased the staff available for this task about 4-fold. This was also less costly for the grant funds, as we were able to "piggy-back" this task onto their existing duties temporarily.



We would like to transfer the remaining funds for these tasks to Task 5, to maximize the financial incentive for residents to participate in the program.

The maps developed per these tasks combine data from several sources (water use billing data, weather station plant ET data, parcel map data, field data on observed runoff, stormdrain location data) to show the location and distribution of irrigation runoff in the watershed. The data are site-specific for the period shown, corresponding to the two-month billing cycle for residential water use. Runoff verified in the field is shown by a blue outline surrounding the parcel where it was observed. Over-irrigation is shown by the color of each parcel's shading, corresponding to no shading (less than 100% of plant demand, i.e. underwatering), green (100% of plant demand), yellow (100-200% of plant demand) and red (>200% of plant demand). The summary statistics shown on each map provide detailed information on the number of homes with runoff, the number of homes irrigating at each of the four irrigation categories (i.e. red, yellow, green), and the number of homes in each irrigation category that also had observed runoff. Overall, the probability of runoff approximately doubles from a category "green" home to a category "red" home (Fig. 1). Additional maps of other communities in the watershed are attached at the end of the report ("Deliverables")

Fig. 1. Probability of Runoff vs % of Water Budget Used



Inspection of the maps shows that over-irrigation is significantly more prevalent in some communities than others. Also, monitoring over several seasons (not shown) finds that over-watering is much more common in fall, and uncommon in spring.

Our work this quarter completes the information gathering and compilation for the entire urbanized area of the watershed, which completes the project's contractural obligation for these tasks. However, the District will continue both field surveillance and water budget calculations for several additional quarters to better understand seasonal differences in runoff locations and quantities, which will also help target the customers we will contact in Task 5. We will also recalculate water budgets for these future surveillance efforts, as these also change due to annual variation in weather. This additional work will be mapped and submitted in the project Final Report.

Task 5. With the completion of the informational tasks (3 and 4), our focus will shift in subsequent quarters to contacting customers identified as runoff sources and helping them irrigate more efficiently. This intervention step is sensitive, as legally the District cannot compel their participation in the project, and must instead highlight the environmental and financial benefits to the customer and appeal to their sense of

environmental sensitivity and civic duty. This task was delayed due to the need to review the project's intervention and outreach approach with respect to the law regarding customer information privacy issues.

Also this quarter our City of Calabasas partner sampled urban runoff into Las Virgenes Creek and this is being processed at CRG Labs.

Next quarter we plan to finalize the customer intervention strategy for a target date of mid-October to launch the intervention effort. This coincides with the peak runoff season identified through Tasks 3 and 4.

The very small value for the "percent completed" shown in the Invoice for this task was based on the fact that work to date for this task has been limited to preliminary work, as discussed above, necessary to begin the main body of work, which is contacting customers, visiting their properties, adjusting their irrigation systems, and processing rebates for additional improvements they make to their irrigation systems recommended by staff. The precise value shown (4%) is *not* based on funds spent versus funds budgeted as for the other tasks. Rather, it is based on my best professional judgment as to the relative percentages of work performed versus work remaining. I will base this value on funds expended versus budgeted once we move into the main body of work for this task, as we will gain better experience with the actual cost and pace of this task.

Task 6. As for Task 5, we have not worked on this Task this quarter beyond presenting a project update on Tasks 3 and 4 to the Malibu Creek Watershed Executive Advisory Council. The estimate of 10% completion is also based on best professional judgement as for Task 5.

Task Summary

TASK 1. Project Administration (62.5% complete)

This task requires quarterly progress reports, contract summary form, contractor documentation, and expenditure/invoice projections.

- Progress reports were submitted July 12th & November 15th, 2004, May 9th, 2005 and September 15th (this report).
- Next quarter we will submit the 5th quarterly report.
- Expenditure Projection through 9/30/05 below.

TABLE 1. EXPENDITURE PROJECTIONS		
Period Ending	6/30/2005	9/30/2005
Task 1: Project Mgmt	$788.00	$788.00
Task 2: Project Assessment and Evaluation Plan	$933.09	933.09
Task 3: Compilation of Urban Runoff Data	$8,614.00	$8,614.00
Task 4: Verification of High Runoff Locations	$9,518.57	$18,474.18
Task 5: Customer Intervention	$47.55	$38,410.78
Task 6: Public Outreach	$124.53	$7,907.77
Task 7: Draft/Final Report	$0.00	$0.00
TOTAL	$20,025.74	$75,127.82

TASK 2. Project Assessment and Evaluation Plan (100% complete).

This task requires preparation of a project assessment and evaluation plan, due 12/31/05.

- This Plan was submitted in April 2005. We also continued to collect and store pre-project water use data for use in the assessment.

- Next quarter we will continue to collect and store pre-project water use data, and post-project water use data.

TASK 3. Compilation of Urban Runoff Data (100% complete)

This task requires collection and compilation of water use data from Customer Billing System and identification of potential runoff addresses via comparision of actual water use with estimated outdoor demand.

- This quarter we completed computerized water budgets for the Liberty Canyon subwatershed and other communities in the Malibu Creek watershed.

TASK 4. Verification of High Runoff Locations (100% complete)

This task requires field verification and quantification of runoff from addresses identified as potential runoff locations in Task 3.

- This quarter we completed this task for the Malibu Creek watershed using a combination of meter reading staff, conservation staff and temporary employees.

- GIS maps were produced showing runoff locations throughout the project area (attached).

TASK 5. Customer Intervention (4% complete)

This task requires district contact of runoff addresses, requesting their participation in program, offering free on-site water audit and water budget, identification of any irrigation equipment or schedule deficiencies, and follow-up monitoring of water use of both participating and non-participating runoff addresses.

- Little progress this reporting period due to the need to review the project's compliance with customer information privacy protections. This review

required modification of some of the original intervention and public outreach approaches.

- Next quarter we hope to finalize and gain board approval of the project intervention phase, contacting addresses where runoff was confirmed and providing on-site irrigation system checks for respondents.

TASK 6. Public Outreach (10% complete)

This task requires public outreach explaining the project and the need to reduce urban runoff by free district water audits (see Task 5) via newspaper ads, community newsletters, presentations at Home Owners Association meetings and other venues, and address-specific outreach per Task 5.

- See Task 5 description.
- We reported on Task 3 and 4 results to the Malibu Creek Advisory Council Monitoring Subcommittee.

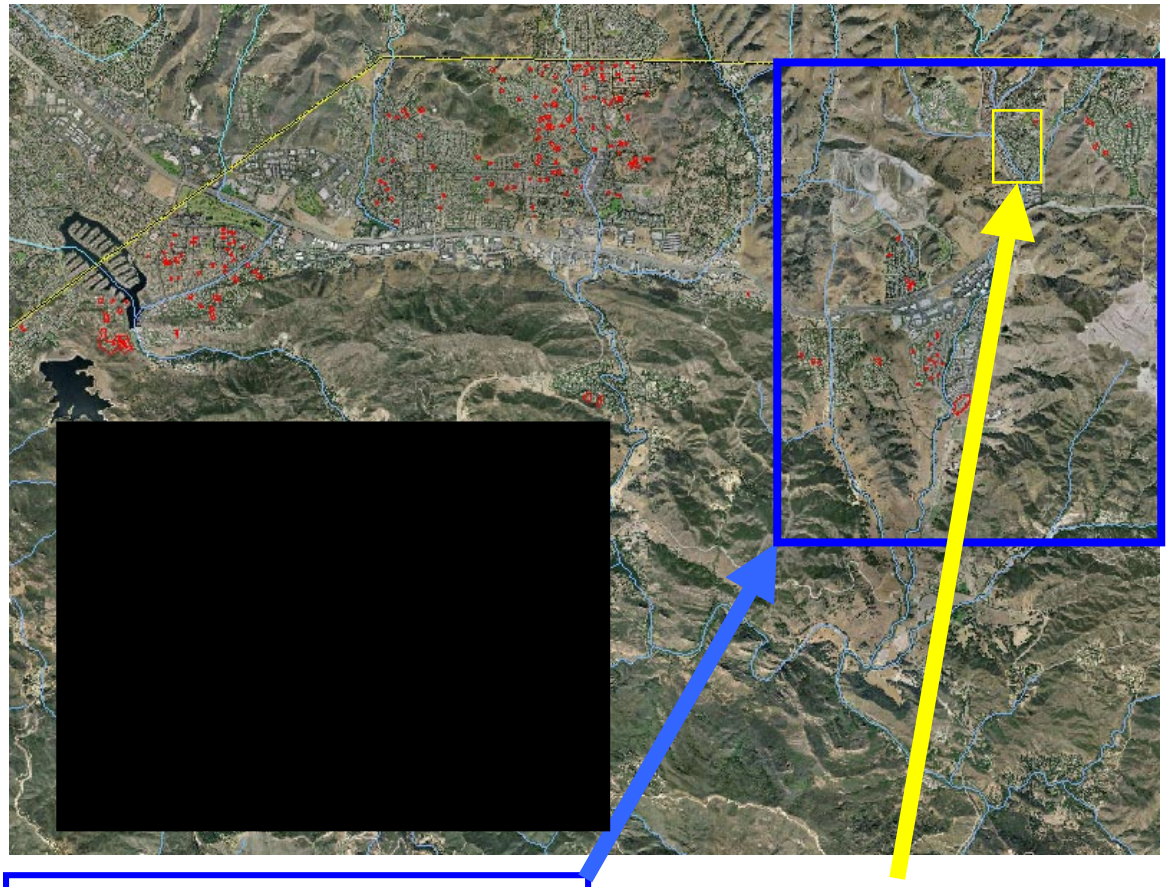
TASK 7. Draft and Final Report

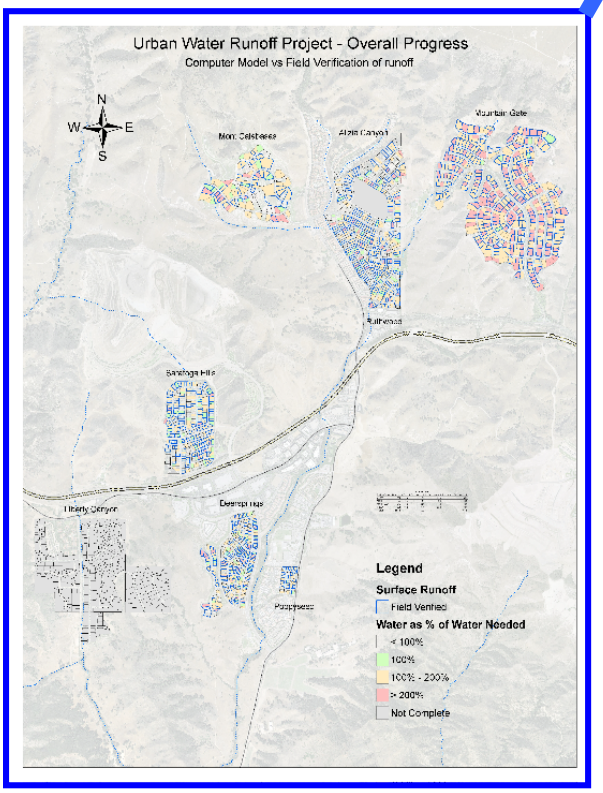
This task requires submittal of a draft and final report containing all data collected during the project, maps of runoff locations, lists of contacted addresses, lists of participating addresses, comparisons of pre- and post-project water use for participating and non-participating addresses and a discussion of project impacts and efficacy.

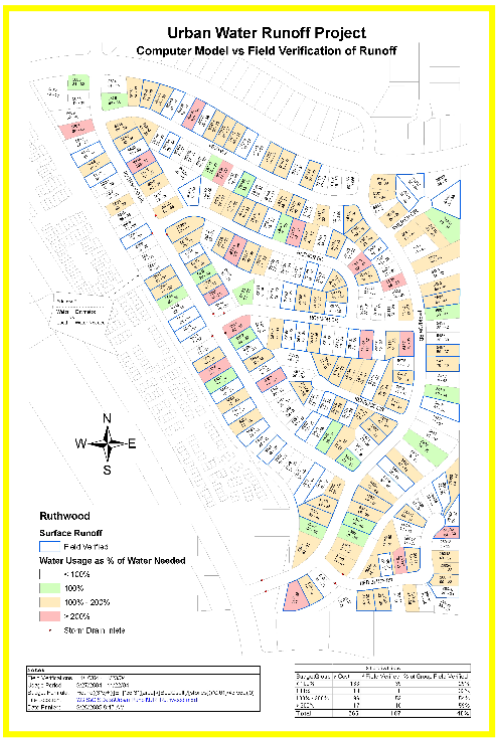
Task 3.7 (Compilation of Urban Runoff data) and Task 4.4 (Verification of runoff) deliverables.

Please note: These maps are intermediate workproducts and are not intended for public release or public dissemination.

GIS / photomapper workproduct showing homes with observed irrigation runoff (red parcels) in the Malibu Creek watershed.

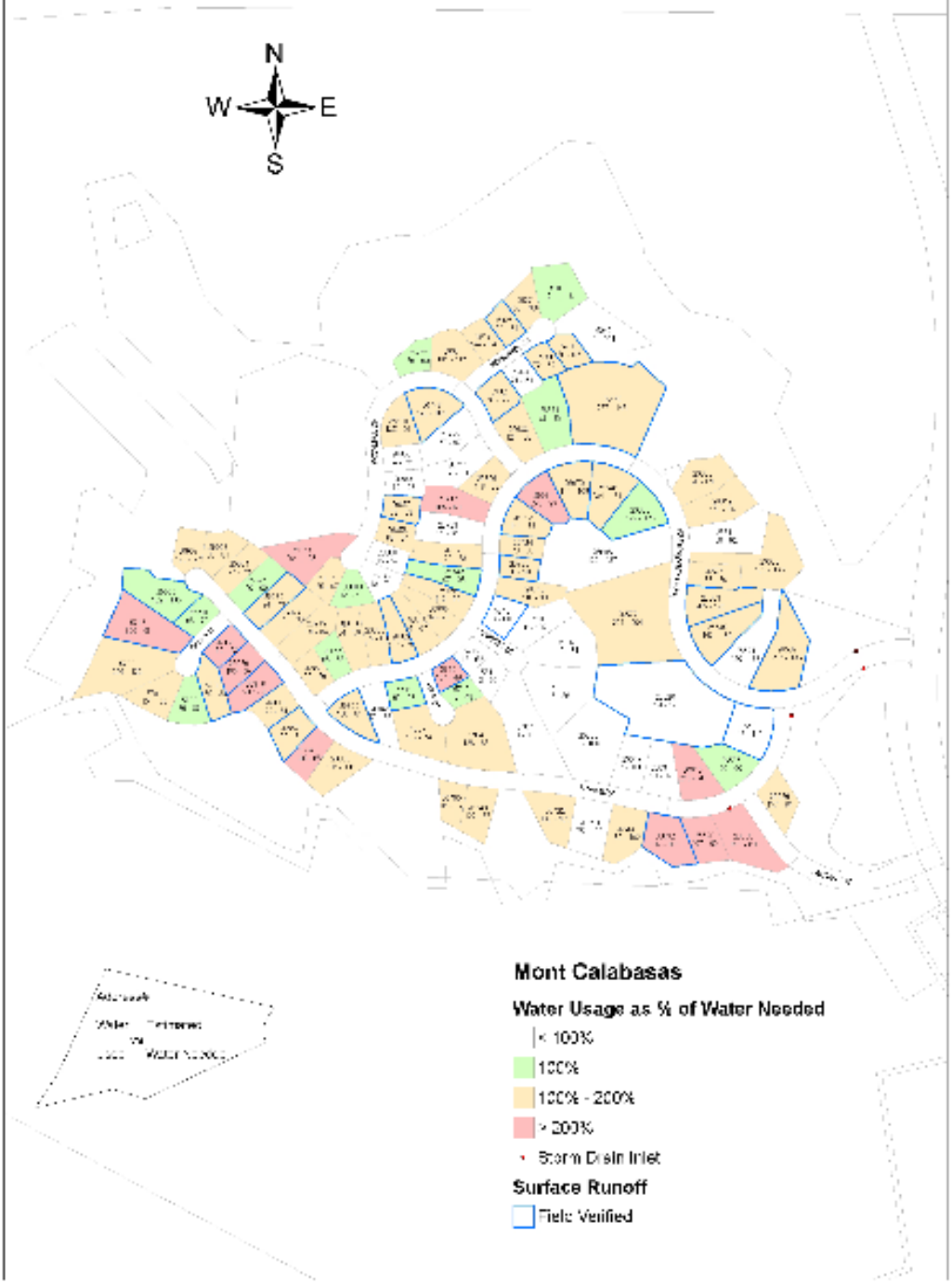






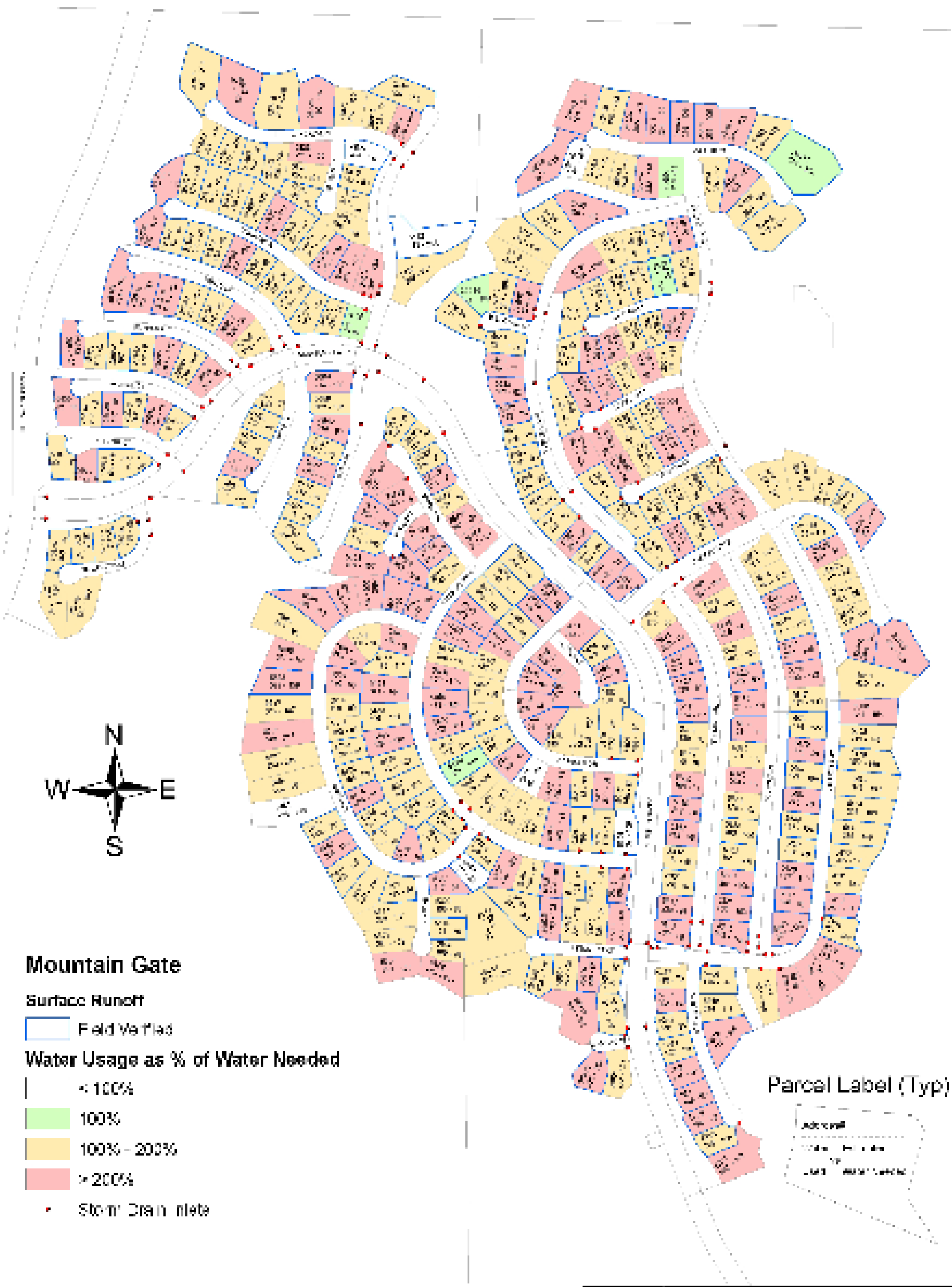
Urban Water Runoff Project

Computer Model vs Field Verification of runoff



Urban Water Runoff Project

Computer Model vs Field Verification of Runoff



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Field Verifications:	[illegible]
Usage Period:	[illegible]
Budget Formula:	[illegible]
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Date Printed:	[illegible] PM

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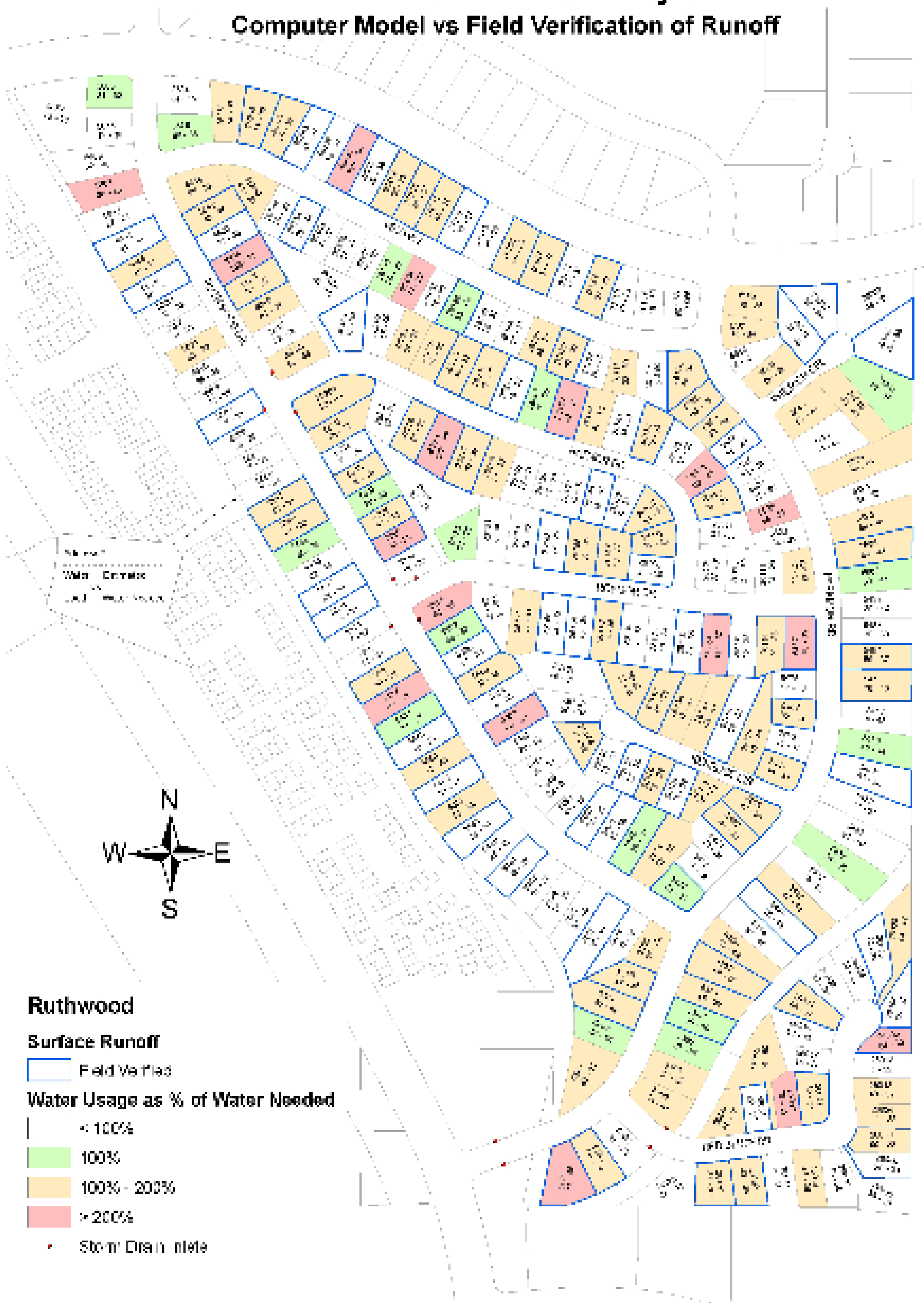
100%	6	4	67%
100% - 200%	[illegible]	[illegible]	[illegible]
> 200%	[illegible]	[illegible]	[illegible]
Total	[illegible]	[illegible]	[illegible]

Urban Water Runoff Project

Computer Model vs Field Verification of Runoff

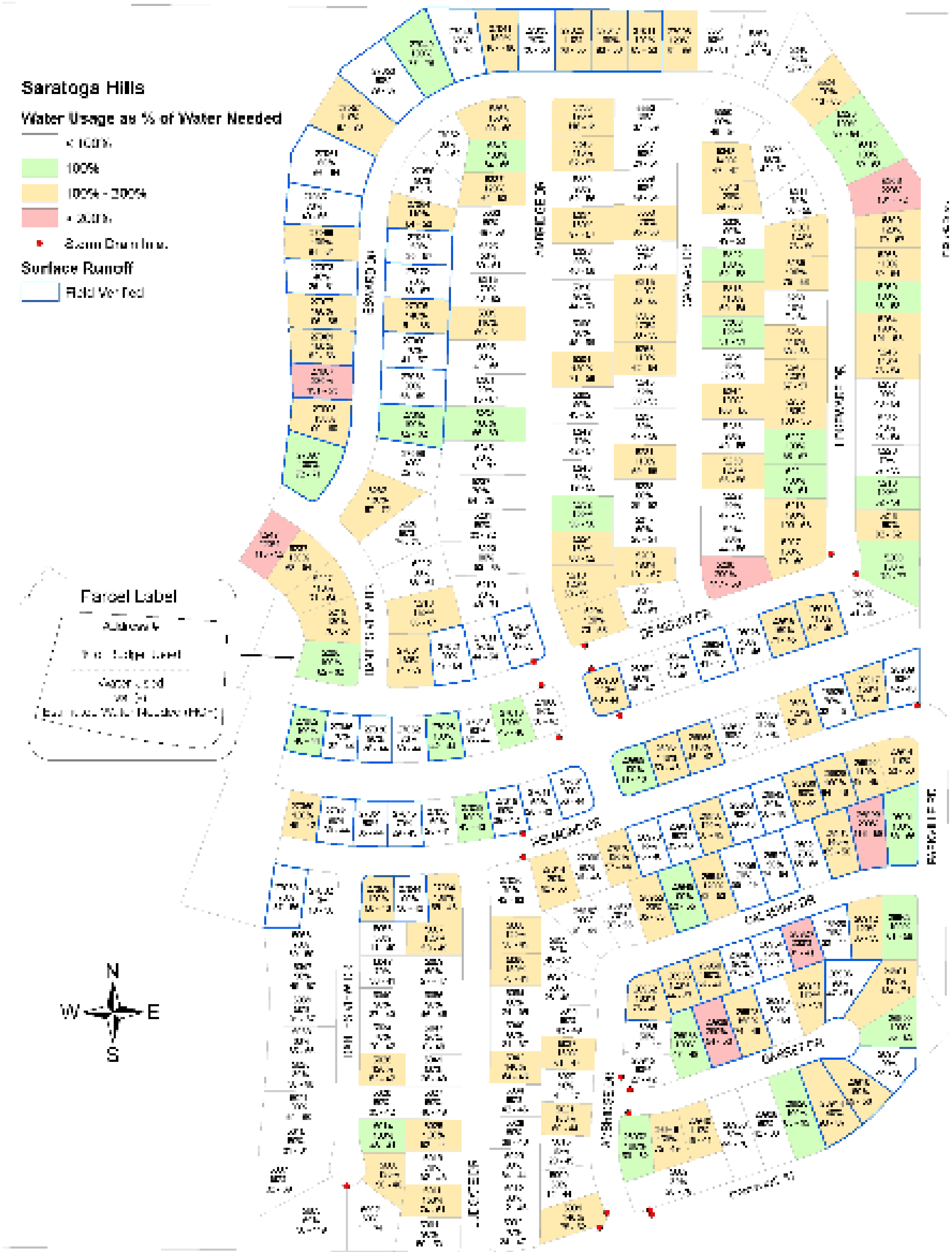


Notes	
Field Verification	[illegible]
Usage Period	6/27/2004 - 11/22/04
Usage Formula	[illegible]
File Location	[illegible]
Date Printed	[illegible]

Statistics			
UsageGroup	# Cust	# Field Verified	% of Group Field Verified
< 100%	[illegible]	36	25%
100%	11	1	[illegible]
100% - 200%	94	60	64%
> 200%	17	10	59%
Total	263	107	40%

Urban Water Runoff Project

Computer Model vs Field Verification of Runoff



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Budget Formula	[illegible]
File Location	[illegible]
Date Printed	[illegible]

BudgetGroup	# Cust	# Field Verified	% of Group Field Verified
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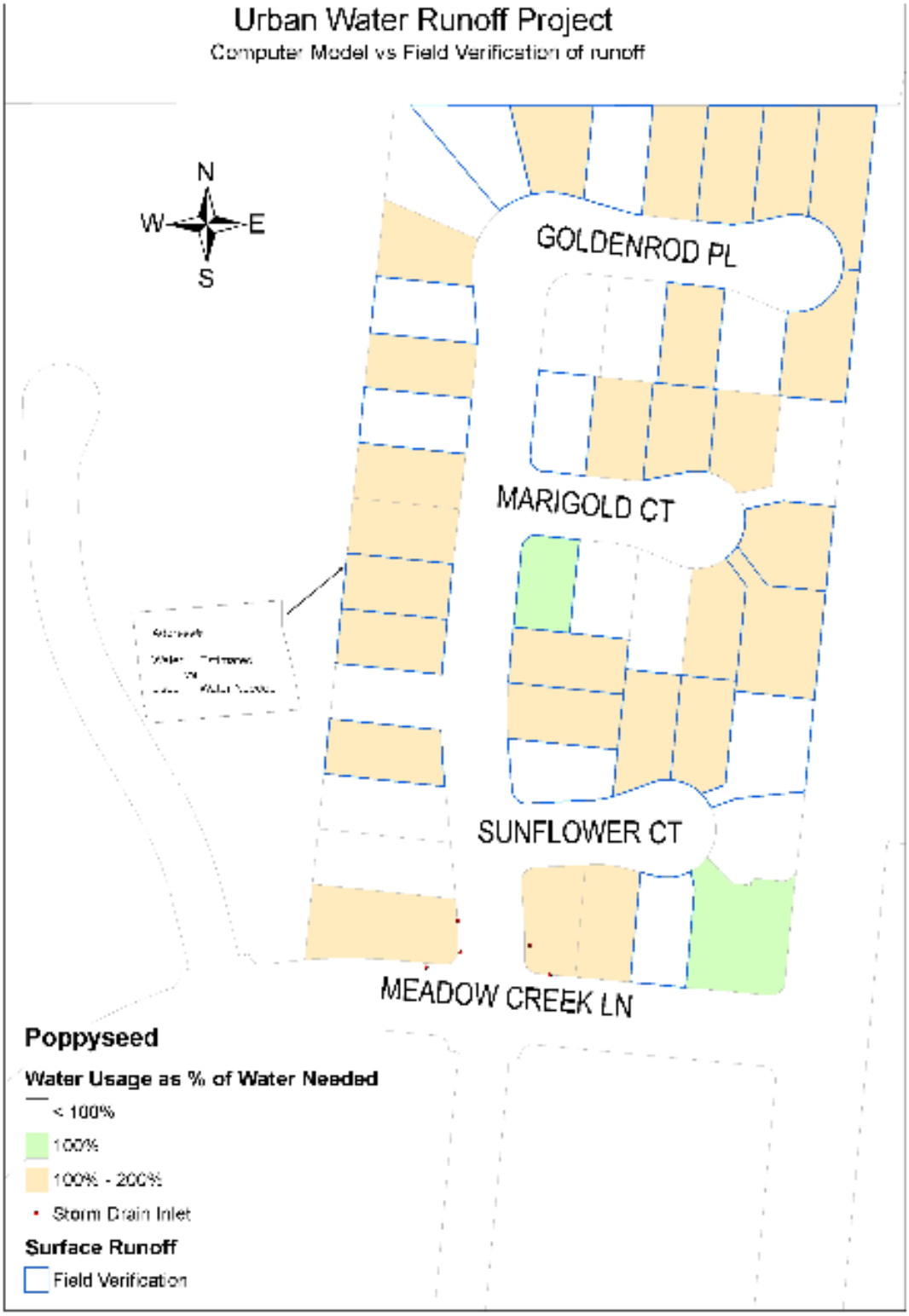
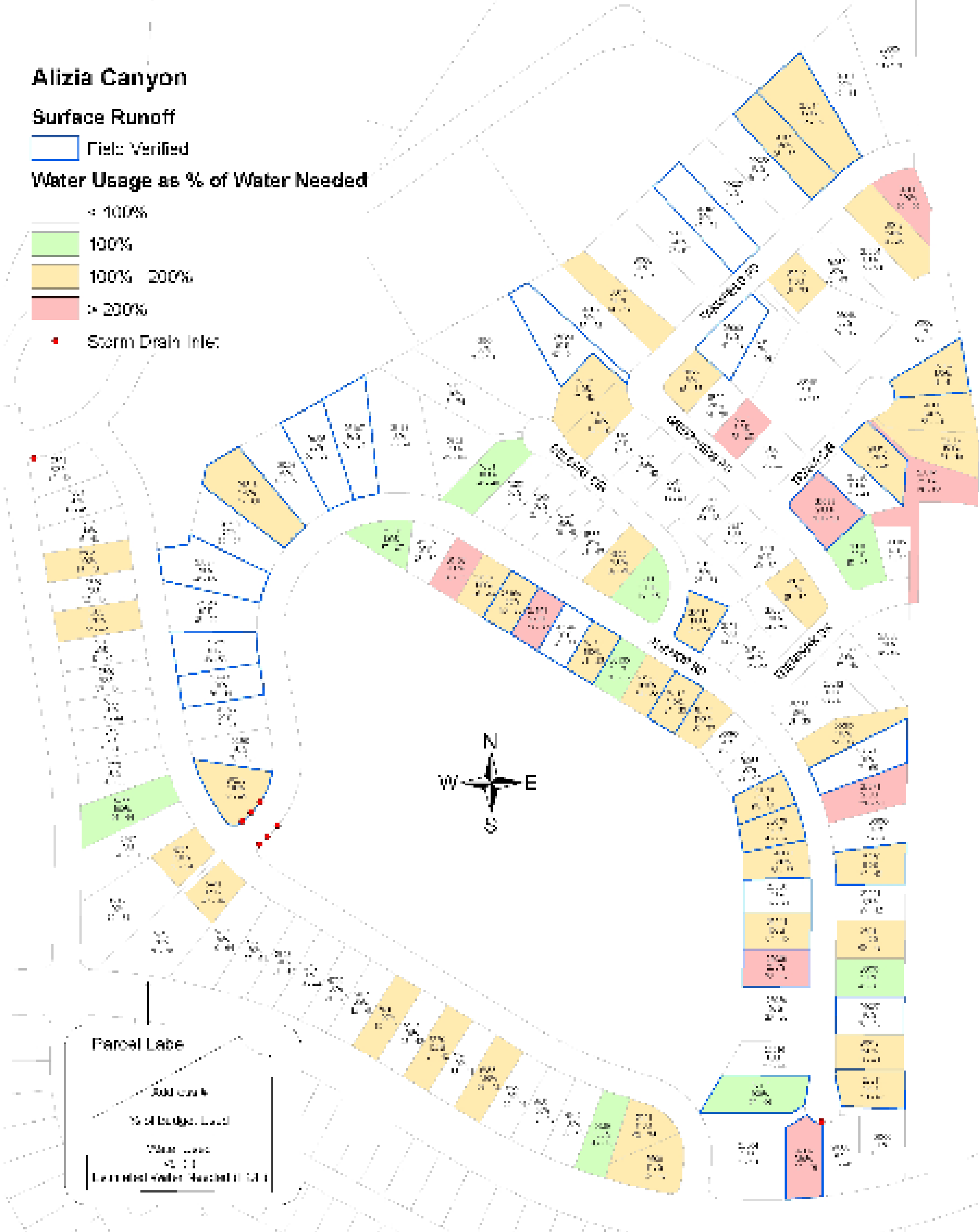
100%	[illegible]	4	26%
100% - 200%	[illegible]	[illegible]	[illegible]
> 200%	7	4	57%
Totals	270	71	26%


Urban Water Runoff Project
Computer Model vs Field Verification of runoff
N
W
E
S
GOLDENROD PL
MARIGOLD CT
SUNFLOWER CT
MEADOW CREEK LN
Poppyseed
Water Usage as % of Water Needed
< 100%
100%
100% - 200%
Storm Drain Inlet
Surface Runoff
Field Verification

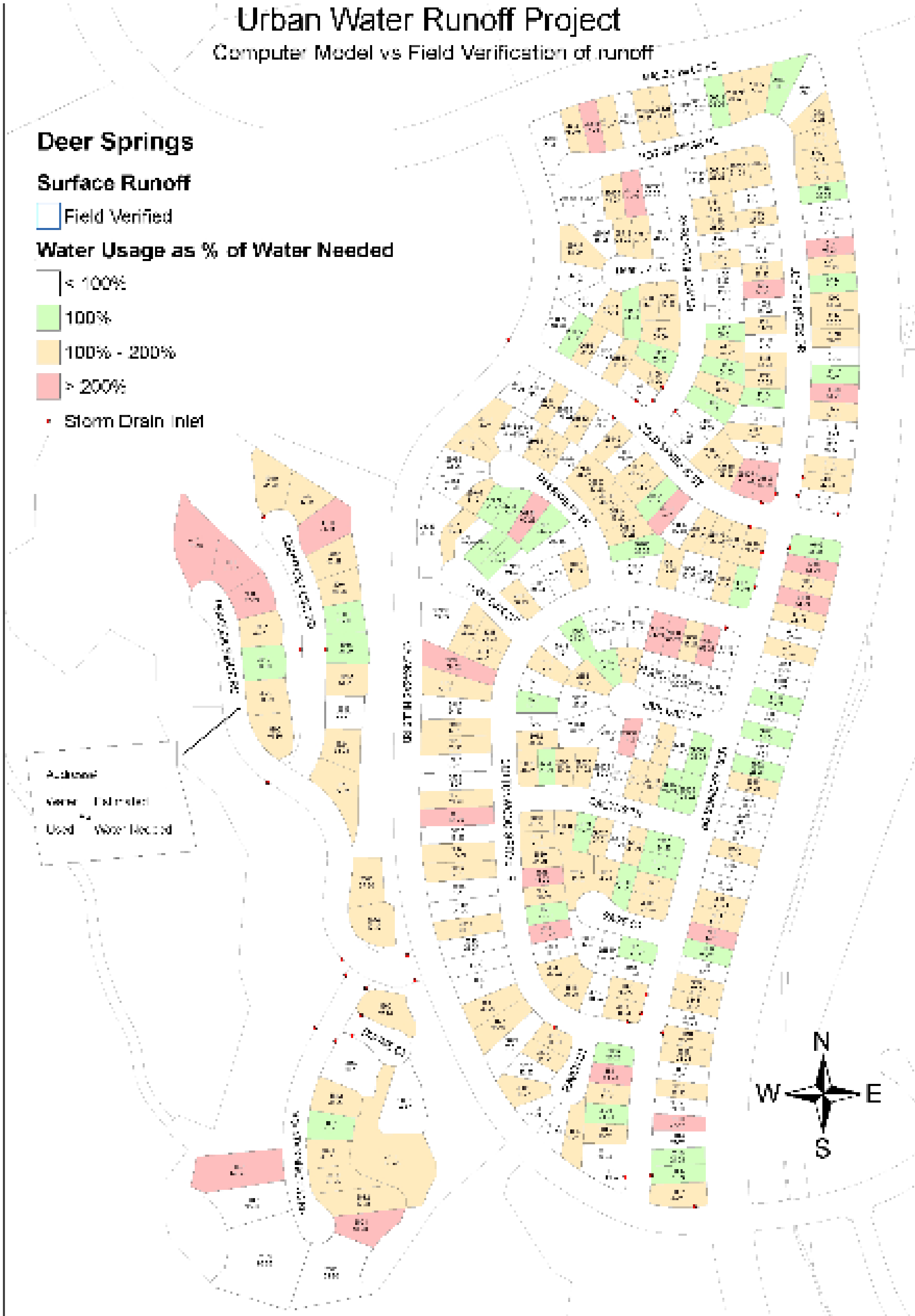
Urban Water Runoff Project

Computer Model vs Field Verification of runoff



Notes	
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

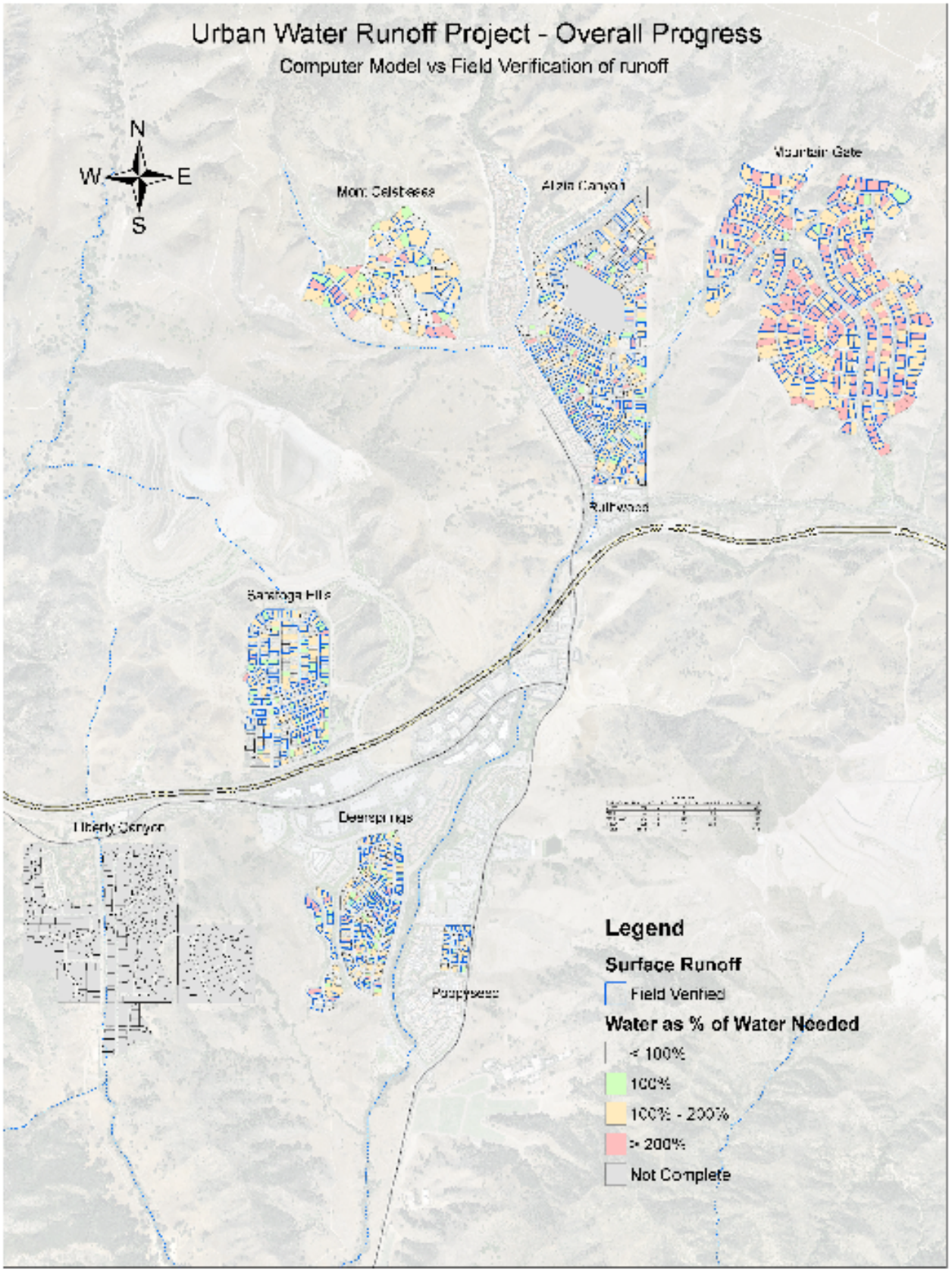
Statistics			
[illegible]	[illegible]	[illegible]	[illegible]
< 100%	[illegible]	[illegible]	[illegible]
100%	[illegible]	[illegible]	[illegible]
100% - 200%	[illegible]	[illegible]	[illegible]
> 200%	[illegible]	[illegible]	[illegible]
Totals	[illegible]	[illegible]	[illegible]



Notes	
Field Verification	[illegible]
Usage Period	[illegible]
Budget Formula	[illegible]
File Location	[illegible]
Date Printed	[illegible]

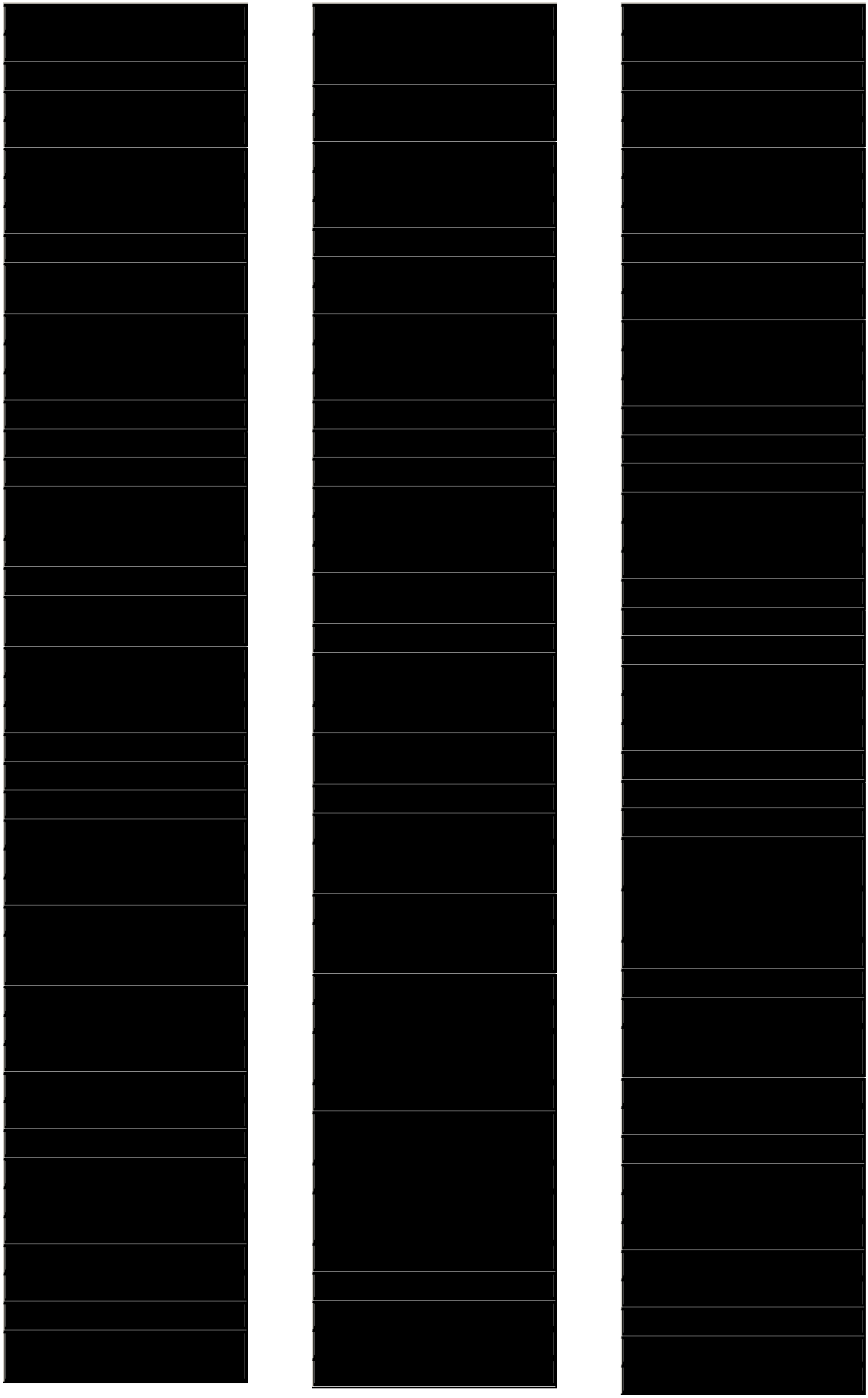
Statistics

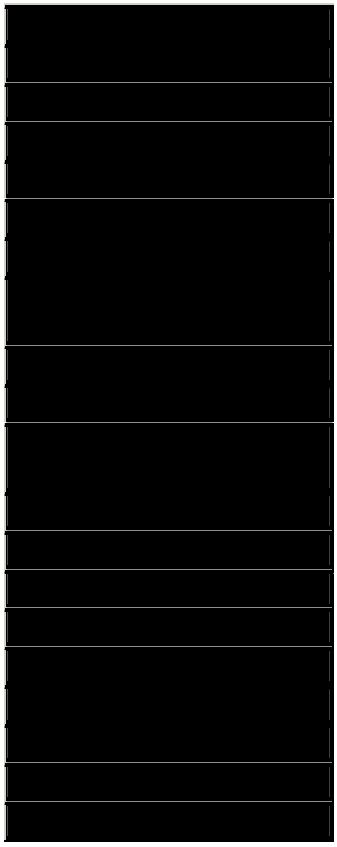
Budget Group	# Cust	# Field Verified	% of group field verified
< 100%	[illegible]	11	26%
100%	46	17	37%
100% - 200%	141	[illegible]	40%
> 200%	[illegible]	[illegible]	62%
Totals	[illegible]	[illegible]	40%


Urban Water Runoff Project - Overall Progress
Computer Model vs Field Verification of runoff
N
W
E
S
Mountain Gate
Legend
Surface Runoff
Field Verified
Water as % of Water Needed
< 100%
100%
100% - 200%
> 200%
Not Complete

Address list – observed runoff, 3rd and 4th billing cycle

[redacted]




PROPOSITION 13
URBAN WATER CONSERVATION PROGRAM

Urban Water Conservation Capital Outlay Grant Contract E67011

FINAL REPORT

Multifamily Ultra-Low Flush Toilet (ULFT) and Residential High Efficiency Clothes Washer (HECW) Rebate Program

September 2004

Contact: Dr. Randal Orton
(818) 251-2145
rorton@lvmwd.dst.ca.us

September 13, 2004

Mr. Phil Anderson
Department of Water Resources
PO Box
Sacramento, CA 94236-0001

Subject: ULFT Contract E67011 - Final Report and Invoice

Dear Mr. Anderson,

On behalf of the Las Virgenes Municipal Water District and its customers, I am pleased to submit the attached final report and invoice for our Urban Water Conservation Capital Outlay Grant Contract E67011. The project met its targets ahead of schedule and has now been completed, and I thank you and your staff for your role.

I am also pleased to report that the project significantly exceeded its target of retrofitting 500 High Efficiency Clothes Washers (HECWs) and 500 Ultra-Low Flush Toilets (ULFTs) due to the efforts of our staff to reduce installation costs. We ultimately retrofitted 500 HECWs and over 1,400 ULFTs, for a project lifetime water savings of over 540 acre-feet, or 80 percent higher than originally projected.

I hope you enjoy the final report. Please contact me at 818 / 251-2145 or rorton@lvmwd.com if you have any questions, and thank you again for your assistance with our water conservation efforts.

Sincerely,

Randal Orton, Ph.D., D.Env.
Resource Conservation Administrator

Enclosure

c. A. Post

Contents

Acknowledgements

The Las Virgenes Municipal Water District would like to acknowledge the following people and organizations who supported this project:

Organizations

Malibu Creek Executive Advisory Council
Santa Monica Bay Restoration Commission
Heal The Bay
City of Agoura Hills
City of Calabasas
City of Westlake Village

Project Staff

Randal Orton, Ph.D., Project Manager
Scott Harris, Water Conservation & Reuse Supervisor
Tom Hawes, Resource Conservation Specialist
Carole Mix, Customer Service / Public Outreach Assistant
Deborah Low, Public Affairs Associate
Deborah Peters, Communications & Media Coordinator

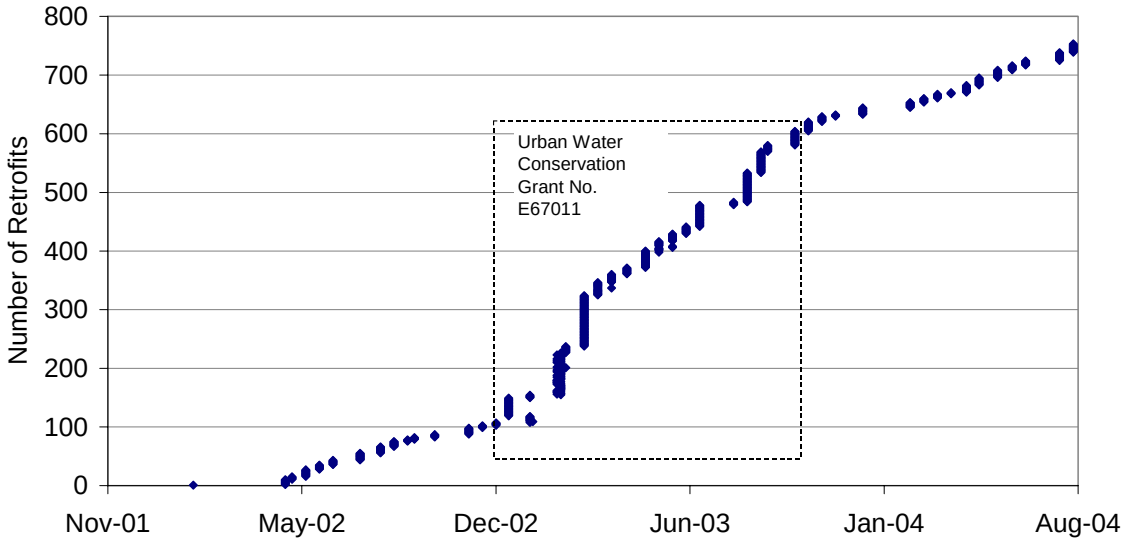
1. PROJECT SUMMARY

This project used $145,000 in Prop. 13 funds to augment existing rebates offered by the Las Virgenes Municipal Water District for Ultra-Low Flow Toilets (ULFT) and High Efficiency Clothes Washer (HECW) retrofits. The ULFT project targeted multifamily residences and home owner associations (HOAs) that had not participated in the district's rebate program due to installation costs and insufficient financial incentives. The HEWC project objective was to accelerate HEWC retrofits by offering local financial incentives greater than those available regionally. The goal of both projects was to reduce demands on the CalFed source watersheds, while simultaneously reducing by an equivalent amount the volume of water imported into the Malibu Creek watershed. By focusing on indoor conservation, the project also simultaneously reduced the volume of wastewater treated and released by the Tapia Water Reclamation Facility into Malibu Creek. Accelerating the rate of retrofits of indoor water appliances results in earlier – and thus larger – reductions in the long-term total volume of non-native water entering the watershed. Furthermore, by offering a larger financial incentive, the district was able to limit rebate eligibility to the highest tier of efficient clothes washers, yielding higher per-retrofit water savings.

All project objectives were met or exceeded:

- The project exceeded its target of 500 ULFT retrofits by 228 percent, for a total of 1144 ULFTs retrofitted.
- The project met its target of 500 HECW retrofits, and significantly accelerated the retrofit rate (Fig. 1).

Fig. 1. HECW retrofits accelerated during the Project term



- The project will yield water savings of 540 acre-feet over the 10 year life of the retrofitted fixtures, 80 percent higher than originally projected.

- The project provided an unexpected opportunity to simultaneously retrofit 866 showers with low-flow showerheads and 1480 faucet aerators at a large apartment complex, resulting in additional water savings.

- Local economic benefit exceeds $422,000 in present value dollars in avoided (conserved) water costs.

- Environmental benefits include reduced demands on State Water Project water and an equivalent reduction of non-native flows into Malibu Creek equivalent to the avoided imported water (540 AF, or approximately 176 million gallons over the working life of the retrofitted appliances).

2. Project Task List and result (Table 1)

	Task	Result
1	Secure Supplemental Funding (Prop. 13) – DWR recommendations	Prop. 13 Grant contract No. E67011 for $145,000
2	Draft Letter Agreement with MWD for 500 ULFT and HECW retrofits	MWD-LVMWD Agreement No. 52999
3	Prepare Public Outreach materials in coordination with local cities	Sample flyer, ads enclosed.
4	Advertise Rebate Availability	
5	Begin accepting and processing rebate applications	Began 11/02, ended 3/03
6	Installation verification (10% onsite)	Installations verified - See attached database

3. Monitoring and Assessment

Monitoring and assessment procedures consist of database tracking of all rebates to residents, including surveys of information relevant to water use and conservation programs such as household size, number of bathrooms, pre-existing retrofits, etc. (Appendix 1 – **also available electronically by contacting Dr. Randal Orton at rorton@lvmwd.com**). Installations were verified by staff via on-site inspections and cross-checking of the district's ULFT and HECW database to ensure that installed ULFTs and HECWs are replacing less efficient devices.

Environmental benefits of reduced discharges of surplus recycled water derived from indoor water use will also be tracked via stream gaging on Malibu Creek and water level instrumentation in Malibu Lagoon. While natural hydrological variability will tend to mask immediate creek flow reductions attributable to this project, monitoring of the long-term mean flows should provide feedback on this project and other projects intended to restore native creek flows. This effort is on-going.

4. Benefit Summary

Quantified Benefits – Water Savings. The local economic benefits of the project are as follows:

- HECW retrofits yield water savings of 0.226 acre-feet per HECW (CUWCC memo dated 5/1/00 re savings estimates from THELMA and BERN, KS studies, and assume a 14 year lifespan). For 500 HECW retrofits this equates to a total water savings of 113 AF

- Multifamily ULFT retrofits yield water savings of 0.374 acre-feet per retrofit over the estimated 10 year lifespan of the ULFT (CUWCC estimate). For 1140 ULFT retrofits (640 over the original estimate of 500) this equates to a total savings of 426.1 AF.

- Incidentally retrofitted showerhead and faucet aerators. While not included in the saved water figures above and elsewhere in the report (due to quantification complexities), the additional conserved water from 1480 showerheads and 886 faucet aerators makes the total value of 540 AF for retrofitted toilets and washes a very conservative estimate of water saved due to this project.

b. Quantified Benefits – Economic.

Quantified local benefits of the project consist of reduced water costs to those citizens who participated in this retrofit program, and reduced water purchase costs to the water district. Using the total water savings of 540 AF and taking the mid-point pricing for retail water (assuming average elevation zone and pricing tiers) yields a collective economic benefit (present value) to these cities in reduced water bills of $422,055 (Table 2).

Table 2. Estimated vs. Actual Benefits – Water Savings and Economic Benefits

	Annual Water Savings (Original Estimate -AF)		Annual Water Savings (Actual - AF)		Benefit (Original Estimate)		Benefit (Actual)	
Year	HECWS	ULFTS	HECWS	ULFTS	HECWs	ULFTs	HECWs	ULFTs
1	11.3	13.35	11.3	30.44	$4,870	$5,754	$4,870	$13,119
2	11.3	13.35	11.3	30.44	$5,163	$6,099	$5,163	$13,906
3	11.3	13.35	11.3	30.44	$5,472	$6,465	$5,472	$14,740
4	11.3	13.35	11.3	30.44	$5,801	$6,853	$5,801	$15,625
5	11.3	13.35	11.3	30.44	$6,149	$7,264	$6,149	$16,562
6	11.3	13.35	11.3	30.44	$6,518	$7,700	$6,518	$17,556
7	11.3	13.35	11.3	30.44	$6,909	$8,162	$6,909	$18,609
8	11.3	13.35	11.3	30.44	$7,323	$8,652	$7,323	$19,726
9	11.3	13.35	11.3	30.44	$7,763	$9,171	$7,763	$20,909
10	11.3	13.35	11.3	30.44	$8,228	$9,721	$8,228	$22,164
11		13.35		30.44		$10,304		$23,494
12		13.35		30.44		$10,923		$24,903
13		13.35		30.44		$11,578		$26,398
14		13.35		30.44		$12,273		$27,981
Project subtotals	113	186.9	113	426.1	$64,194	$120,918	$64,194	$275,692
Project grand totals		299.9		539.1		$185,112		$422,055

This contrasts with approximately $185,122 in avoided costs according to the original proposal[1].

b. Unquantified Benefits. Other benefits, more difficult to quantify include:

- Drought protection**.** Because there are no local water resources and because the area is quite arid, the communities participating in this project are particularly susceptible to drought impacts. This project will decrease our vulnerability to drought in direct proportion to the water savings listed above by reducing demand.

- Watershed protection. Because all drinking water is imported and local water resources are not used, background flows in Malibu Creek have risen in recent decades, resulting in more frequent breaches of Malibu Lagoon, which in turn releases poor quality lagoon water onto Surfrider Beach, a premier surfing location[2]. For this reason, the goal of restoring native flows in Malibu Creek is a priority action item in the Malibu Creek Management Area Plan (WMAP). This project advanced this goal by reducing the quantity of water imported into the watershed. That is why this project had the full support of the Malibu Creek Executive Advisory Council and its affiliated stakeholders, such as Heal The Bay, Malibu Chapter Surfriders, Audubon Society, etc.

5. Relationship of Benefits to CalFed goals – 100%

Because 100% of the water delivered by the applicant, Las Virgenes Municipal Water District is imported from the State Water Project, the benefits identified above – reduction in demand on Calfed water equivalent to 540 AF - transfer directly and entirely to the CalFed source waters. This is in contrast to ULFT/HECW programs in other Los Angeles County cities, most of which derive their water from multiple sources, which means the above benefits would be discounted for these other agencies in direct proportion to their reliance on other sources.

6. Costs and Funds requested

Funds requested under this contract are the same as those originally requested ($145,000). These funds were used entirely for retrofit rebates direct to participating residents (100% pass-through). Reimbursement for other costs (i.e. direct labor, advertising, overhead) are not billed against this contract, per the original grant application and scope of work.

Other project costs were not significantly different from those originally budgeted (Table 3) except for staff time for public outreach, which was somewhat higher than anticipated because the district had to modify its outreach to HOA's and multi-family customers to secure their participation. This was done by traveling to prospective customers in

[1] Table 2 quantifies project benefits and costs in terms of present value using the 6% discount rate specified in the contract RFP. Benefits are based on water saved (conserved) with savings distributed evenly over 10 years for ULFTs and 14 years for HECWs. The value of an acre-foot of avoided water demand is based on $431/AF, which is the current wholesale purchase price for this area from the MWD of Southern California (MWD).

[2] Malibu Creek flows have also risen relative to pre-import flows because, prior to imports, local surface and groundwaters were substantially diverted for consumptive use (mainly irrigation) and because the decade preceding the imports was unusually dry. That is, pre-import creek flows were unnaturally low.

person (usually at their board meetings for HOA's and property managers for multi-family units) to promote the program, and this increased costs relative to the original estimate for staff time.

Total project costs were approximately $252,367, slightly higher than the original budget estimate of $248,185

Table 3. Original vs Actual Costs

COST CATEGORY	Project Cost (original estimate)	Project Cost (actual)	Request (invoice against E67011)
Land Purchase/Easement	$0	$0	$0
Planning/Design/Engineering	$0	$0	$0
Materials/Installation – ULFT rebates	$75,000	$75,000	$45,000
Structures	$0	$0	$0
Equipment Purchases / Rentals	$0	$0	$0
Environmental Mitigation / Enhancement	$0	$0	$0
Construction/Administration/Overhead			
Customer Service Representative – 40 hrs @ 19.35/hr x 1.15 (benefit rate)	$890	$6,169	$0
Resource Conservation Specialist -- 40 hrs @23.85/hr x 1.15 (benefits)	$1,097		$0
Resource Conservation Administrator – 8 hrs @40.20/hr x 1.25 (benefits)	$403	$403	$0
Public Affairs Associate 22 hrs @31.42/hr x 1.15 (benefits)	$795	$795	$0
Project/Legal/License Fees	$0	$0	$0
Contingency	$0	$0	$0
Other			
HECW rebates – 500 @ $300 each	$150,000	$150,000	$100,000
Advertising and public outreach	$20,000	$20,000	$0
TOTAL COSTS	$248,185	$252,367	$145,000

7. Discussion, post-Project Monitoring, and other Follow-up

The project's success was due in large part to the fact that the administrative procedures were already long in place as part of the District's existing ULFT and HECW rebate programs. That is, the project was limited to an augmentation of an existing program. This is also true of the project's monitoring and assessment elements, as the District already had in place procedures for tracking post ULFT and HECW retrofit water use. Another very successful approach was to contact companies that retrofit ULFTs *en masse* and negotiate with them for lower installation costs. This stretched the available grant dollars significantly, enabling the retrofitting of 1140 ULFTs instead of the 500 originally budgeted.

Difficulties encountered during the project were related to the early reluctance of potential customers such as landlords and apartment management companies to

participate in the program. This reluctance delayed the multi-family ULFT retrofit project by nearly six months. This problem was ultimately solved by adjusting the outreach and project advertisement approach from relatively passive mailers, flyers and newspaper ads, and instead contacting and visiting these parties directly. This approach, in turn, was enabled by the district's new billing system, which allowed staff to easily identify the largest potential multi-family customers and minimize the staff labor cost of visiting a large number of small apartment complexes. By concentrating on very large housing complexes, staff were also able to arrange for the retrofitting of other inside plumbing fixtures with more efficient devices, such as low flow showerheads and faucet aerators, simultaneously with the ULFT installations.

Following the conclusion of the project, the water use of participating customers will be tracked with the district billing system. Early results of this monitoring already show reduced water use, as would be expected for a plumbing fixture retrofit program. This reduction should be more apparent as we approach the winter billing period, which is less dominated by outdoor water use. The district will also be exploring new funding sources to continue this enhanced rebate program.

Project Outreach. Las Virgenes Municipal Water District Board President Ann Dorgelo (rght) with President of a local Home Owners Association who participated in the ULFT retrofit rebate program. Aside from recognizing project participants, press from these events served to advertise the program.

Appendix 1. Sample of the Project Assessment Database (hard copy). Databases may be obtained in electronic form by contacting the district at rorton@lvmwd.com.