Phase 5: Regulatory Action Selection

Final Project Report

Total Maximum Daily Load for Nutrients in Los Osos Creek, Warden Creek, and Warden Lake Wetland, San Luis Obispo County, California

DRAFT

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Central Coast Regional Water Quality Control Board
895 Aerovista Place, Suite 101
San Luis Obispo, CA 93401

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1. INTRODUCTION

Los Osos Creek was included on California's section 303(d) list of impaired waters for nutrients. The Clean Water Act requires a Total Maximum Daily Load (TMDL) be developed to restore impaired waterbodies to their full beneficial uses. This report addresses the nitrate portion of the nutrient impairment in the Los Osos Creek watershed and discusses follow-up monitoring to address the remaining impairment to ensure that beneficial uses are protected. This section presents background information on the creek's 303(d) listing, describes the watershed and summarizes this report's outline and content.

1.1. Structure of Document

The following sections are included in this TMDL report:

- Project Definition: Identifies the 303(d) listing for Los Osos Creek and summarizes available information to characterize impairments.
- Water Quality Standards: Identifies the water quality standards applicable to the listing.
- Data Review: Provides an inventory and analysis of available water quality data.
- Nitrate Source Analysis: Identifies potential sources of nitrates in the watershed.
- Nitrate TMDL: Identifies the nitrate TMDL for Warden Creek (a branch of Los Osos Creek), including allocations and considerations of seasonality and margin of safety.
- Monitoring: Discusses follow-up monitoring to track water quality improvements from the nitrate TMDL and to further characterize algal-related and dissolved oxygen impairments in the Warden Creek and Los Osos Creek watersheds.
- Implementation: Discusses potential implementation activities for the nitrate TMDL, including control activities, plans for tracking the progress of implementation and the timeline for implementation activities.

1.2. Project Definition

Los Osos Creek was identified in 1998 as impaired for nutrients and is included on the 2002 303(d) list. The listing does not specify whether it was based on violation of the narrative objective for biostimulatory substances, for violations of objectives for particular nutrients, or a combination.

Algal growth has been observed in the Los Osos Creek watershed; however, documentation between 1993 and 2004 is limited and inconclusive. Nitrate data has been collected in the Los Osos Creek watershed as part of the Morro Bay National Monitoring Program (NMP) and the Morro Bay Volunteer Monitoring Program (VMP) (1995-2004). Warden Creek exhibits the most consistent violations of the numeric objective for nitrate protective of the MUN beneficial use. Other nutrient data, such as phosphate have been collected but neither show exceedances of a standard or no standard exists with which to compare.

In 2002 dissolved oxygen 303(d) listings were added for Los Osos Creek and Warden Creek. Review of available water quality monitoring data from the NMP and VMP (1993-2004) indicate that dissolved oxygen is periodically exceeding the numeric water quality standards at two of the four stations in Los Osos Creek and Warden Creek.

To further characterize the impairments in the creek and identify potential causes, data analyses were conducted to examine relationships between nutrient levels, dissolved oxygen, and algal growth. An additional data analysis objective was to evaluate potential targets that represent "nuisance" concentration, density or extent of algal growth that exceeds the narrative objective (i.e., growths that cause nuisance or adversely affect beneficial uses).

Examination of the historic data set was inconclusive:

- Several data components (canopy, flow) are missing
- Data coverage is insufficient to derive an explicit linkage between nutrient loading and other environmental conditions (e.g., canopy)
- There is no consistent measure of algal density or extent; available information is qualitative
- Multiple factors (not all measured) are contributing to algal productivity including stream canopy, temperature, phosphorus, flow, velocity, tidal influences including backwater and decreased stream velocities (in lower creek).

The conclusions that can be drawn from available data include:

- Nitrates are periodically exceeded. Although the creeks are not listed specifically for nitrates, available NMP and VMP data water quality data show that Los Osos Creek and Warden Creek (a branch of Los Osos Creek) experience violations of the nitrate water quality objective for the municipal and domestic water supply (MUN) use of 10 mg/L nitrate as nitrogen . The upstream station on Warden Creek (TUR) exhibits the most consistent violations supporting the conclusion that the MUN drinking water supply beneficial use is impaired in the Warden Creek branch of Los Osos Creek. Because only one exceedance has occurred at LVR and two exceedances have occurred at SYB (all in 1996), the Los Osos Creek branch of Los Osos Creek is not considered impaired for nitrates.
- DO is occasionally exceeded, but typically in the lower portions of the creek.
- Algae is present but data are primarily anecdotal and do not provide consistent documentation on severity and extent of coverage. Insufficient data are available to determine if and when algae is sufficient density to be perceived as a nuisance and clearly impacting uses in Los Osos Creek, or to identify an appropriate algal target representing use support.
- Although nutrients are elevated and likely to contribute to algal growth, other factors are also contributing to the frequency and severity of algal blooms.

Based on the review of available information the TMDL approach is as follows:

1. Develop a nitrate TMDL for Warden Creek to address the exceedences of the current numeric water quality objectives.
2. Design and implement a systematic program to further assess the relationship between flow, velocity, sunlight, nutrients, algal growth and dissolved oxygen. If warranted a subsequent TMDL will be developed to address exceedances of the narrative biostimulatory objective, and associated algal and dissolved oxygen impairments. This future TMDL could result in further nutrient (TN, Nitrate, or TP) reductions as well as other practices such as riparian corridor restoration.
3. Recommend a resolution to the Regional Board finding that compliance with the Conditional Waiver for Irrigated Agricultural Discharges by owners and operators of irrigated agricultural lands and additional monitoring by Regional Board staff will implement the Los Osos Creek Nutrient TMDL.

The TMDL will be revisited after further monitoring and the TMDL will be revised to include targets and allocations to address the biostimulatory water quality objective and dissolved oxygen, if necessary, or to justify delisting Los Osos Creek for nutrients.

1.3. Watershed Description

Los Osos Creek is located in San Luis Obispo County on the central coast of California. The watershed is in a Mediterranean climate, with warm dry summers and cool wet winters. The geology of the watershed is a mix of igneous, metamorphic and sedimentary rock less than 200 million years old. Average temperature is about 12°C (54°F). Average annual rainfall ranges from 45 cm (18 inches) at the coast to 89 cm (35 inches) on the ridge; most of this rainfall occurs between November and April (sources: Department of Water Resources, 1958; Ernstrom, 1984).

Los Osos Creek has two main branches and drains to the Morro Bay estuary (Figure 1). The Warden Creek branch of Los Osos Creek drains to the east through Los Osos Valley; the Los Osos Creek branch drains to the south through Clark Canyon.

Land use in the Warden Creek watershed is primarily rangeland and cropland and land use in the Los Osos Creek watershed is dominated by woodland with areas of rangeland and urban. Table 1 summarizes the land use in the Los Osos and Warden Creek watersheds.

Table 1. Land use categories within the Los Osos Creek watershed (acres/% total)

	Brushland	Woodland	Rangeland	Cropland	Urban	Total
Warden Creek	-	161	5,260	2,911	-	8,332
	0%	2%	63%	35%	0%	100%
Los Osos Creek	278	3,164	1,753	522	962	6,679
	4%	47%	26%	8%	14%	100%

Source: based on UC Santa Barbara GAP data and CDF Wildlife Habitat Relationships, 1998.

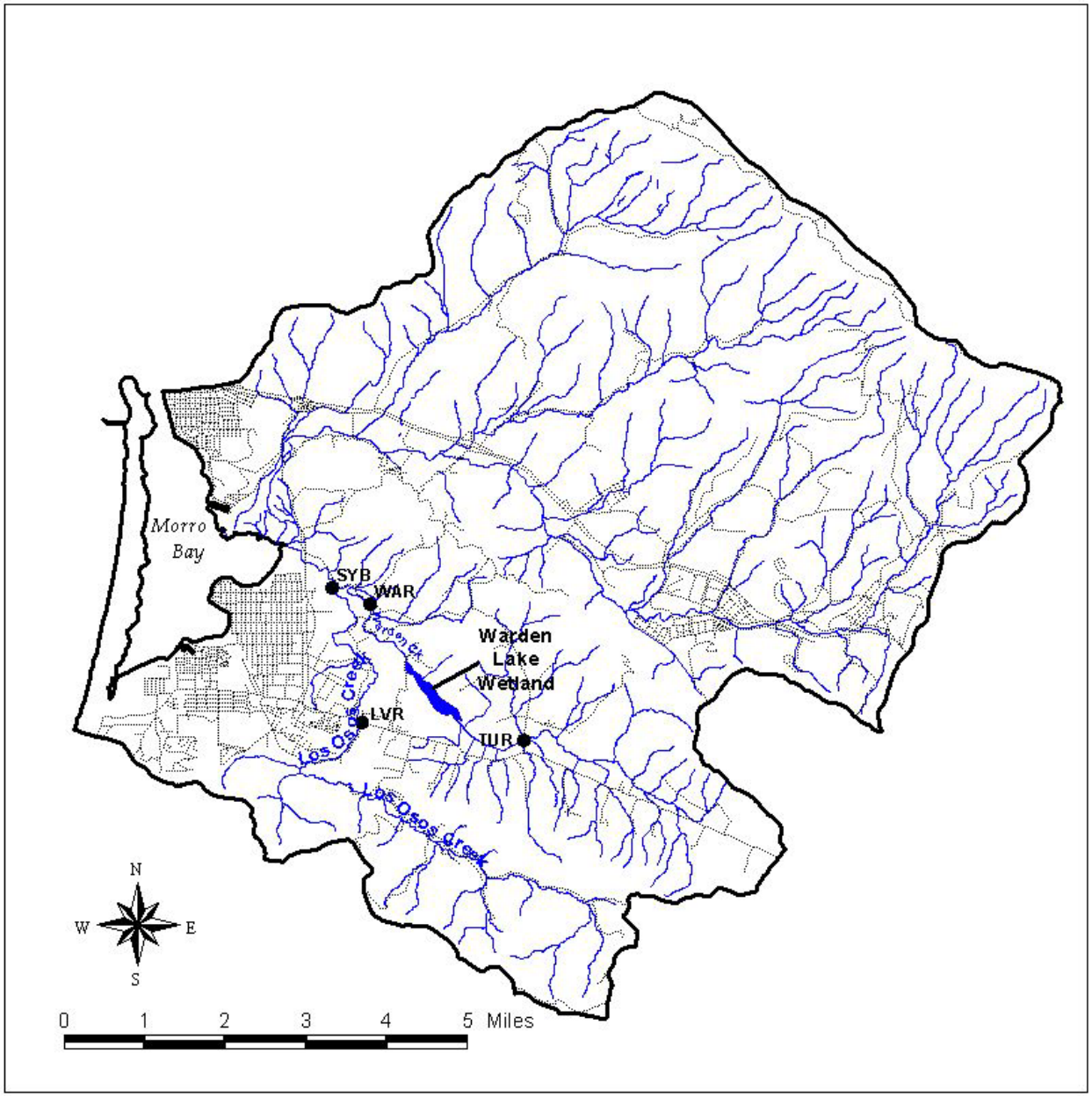

Figure 1. Waterbodies and monitoring sites within the Los Osos Creek watershed.

2. WATER QUALITY STANDARDS

Regional Water Quality Control Boards (Regional Boards) define beneficial uses for waterbodies in their Water Quality Control Plans (Basin Plans). Also included in the Basin Plan are numeric and narrative objectives to be protective of the beneficial uses in each waterbody. The following sections discuss the applicable beneficial uses and water quality objectives related to the 303(d) listing for nutrients in Los Osos Creek.

2.1. Beneficial Uses

Los Osos Creek and Warden Lake Wetland have designated beneficial uses in the Basin Plan. Warden Creek is not specifically listed in the Basin Plan. Table 3 summarizes the designated beneficial uses for Los Osos Creek and Warden Lake Wetland and shows beneficial uses interpreted to apply to Warden Creek. The Basin Plan states that surface waterbodies within the region that do not have beneficial uses designated for them, such as Warden Creek, are assigned the beneficial uses of "municipal and domestic water supply" and "protection of both recreation and aquatic life." Staff interpreted this general statement of beneficial uses to encompass the four Beneficial Uses shown in Table 2 for Warden Creek.

Table 2. Beneficial uses for Los Osos Creek, Warden Creek, and Warden Lake Wetland.

Waterbody	Los Osos Creek	Warden Creek[1]	Warden Lake Wetland[2]
Municipal and Domestic Supply (MUN).	X	X	
Agricultural Supply (AGR)	X		X
Industrial Process Supply (PROC)			
Industrial Service Supply (IND)			
Ground Water Recharge (GWR)	X		X
Water Contact Recreation (REC-1)	X	X	X
Non-Contact Water Recreation (REC-2)	X	X	X
Wildlife Habitat (WILD)	X		X
Cold Fresh Water Habitat (COLD)	X		
Warm Fresh Water Habitat (WARM)	X	X	X
Migration of Aquatic Organisms (MIGR)	X		
Spawning, Reproduction, and/or Early Development (SPWN)	X		X
Preservation of Biological Habitats of Special Significance (BIOL)			
Rare, Threatened, or Endangered Species (RARE)	X		X
Estuarine Habitat (EST)			
Freshwater Replenishment (FRSH)	X		
Navigation (NAV)			
Hydropower Generation (POW)			
Commercial and Sport Fishing (COMM)	X		X
Aquaculture (AQUA)			
Inland Saline Water Habitat (SAL)			
Shellfish Harvesting (SHELL)			

[1] Warden Creek is not specifically listed in the Basin Plan; therefore, two general uses (encompassing four Beneficial Uses) designated for all waterbodies in the Region apply to Warden Creek: Municipal and Domestic Water Supply (MUN) and protection of both recreation and aquatic life (REC-1 REC-2, WARM).

[2] The beneficial uses designated for the Warden Lake Wetland apply only to the middle reaches of Warden Creek

2.2. Water Quality Objectives

Water quality objectives applicable to the 303(d) listing include the following:

- numeric objectives for the specifically designated beneficial uses in Los Osos Creek and Warden Lake Wetland;
- the numeric objective for nitrate protective of the MUN beneficial use and the general numeric objective for dissolved oxygen applicable to Warden Creek; and
- the general narrative objective for biostimulatory substances applicable to Los Osos Creek, Warden Lake Wetland, and Warden Creek.

Numeric objectives for dissolved oxygen and nitrate are listed in Table 3.

Table 3. Water quality objectives for dissolved oxygen and nitrate

Beneficial Use	Dissolved Oxygen Objective	Nitrate Objective
General	median values should not fall below 85 percent saturation as a result of controllable water quality conditions.	
MUN	N/A	Maximum of 45 mg/l as NO3[1]
AGR	Minimum of 2 mg/L	
COLD	Minimum of 7 mg/L	
WARM	Minimum of 5 mg/L	
SPWN	Minimum of 7 mg/L	

[1]Equivalent to 10 mg/l as N

The general narrative objective for biostimulatory substances states:

> *Waters shall not contain biostimulatory substances in concentrations that promote aquatic growths to the extent that such growths cause nuisance or adversely affect beneficial uses.*

3. DATA REVIEW

This section summarizes the data collected as part of the Morro Bay National Monitoring Program (NMP) and the Volunteer Monitoring Program (VMP). Data include dissolved oxygen and nutrient concentrations and anecdotal information on algal growth in Los Osos Creek and Warden Creek. Data are available in Los Osos Creek and Warden Creek; no data is available in the Warden Lake Wetland.

3.1. Nitrate

Figure 1 shows the locations of monitoring stations on Los Osos Creek (LVR and SYB) and Warden Creek (TUR and WAR). Tables 4 and 5 summarize available nitrate data and Figures 2 and 3 show the observed nitrate concentrations at stations on Los Osos Creek and Warden Creek,

respectively. Although not listed specifically for nitrates, Warden Creek, and Los Osos Creek to a lesser degree, experiences violations of the nitrate water quality objective for the municipal and domestic water supply (MUN). The data summary in Table 5 indicates that approximately 10 percent of all samples collected at the TUR station exceed the water quality objective (WQO) of 10 mg/L as N. As shown in Figure 3, violations at TUR occurred throughout the period of record with consistent violations in recent years (since 2002). Violations at the WAR site occurred primarily in 1996, with data from 1996 to 2000 meeting the WQO. However, recent data are not available at WAR because monitoring was discontinued in 2000 due to limited resources and site accessibility. Data support the conclusion that the MUN use is impaired in the Warden Creek branch of Los Osos Creek. Because only three exceedances have occurred at the Los Osos Creek stations (all in 1996), the Los Osos Creek branch of Los Osos Creek is not considered impaired by nitrates.

Table 4. Summary of nitrate data for Los Osos Creek and Warden Creek

Year	LVR			SYB			TUR			WAR		
	No. of Samples	No. of Exceedances	% of Samples Exceeding	No. of Samples	No. of Exceedances	% of Samples Exceeding	No. of Samples	No. of Exceedances	% of Samples Exceeding	No. of Samples	No. of Exceedances	% of Samples Exceeding
1995	-	-	-	1	0	0%	2	0	0%	2	0	0%
1996	22	1	5%	39	2	5%	39	1	3%	39	6	15%
1997	19	0	0%	39	0	0%	36	3	8%	37	0	0%
1998	20	0	0%	29	0	0%	28	0	0%	26	0	0%
1999	4	0	0%	22	0	0%	23	3	13%	15	0	0%
2000	7	0	0%	34	0	0%	26	5	19%	23	4	17%
2001	6	0	0%	7	0	0%	6	0	0%	-	-	-
2002	-	-	-	7	0	0%	28	1	4%	-	-	-
2003	1	0	0%	15	0	0%	15	5	33%	-	-	-
2004	1	0	0%	4	0	0%	5	2	40%	-	-	-

Table 5. Summary of Observed Nitrate Data in Los Osos Creek and Warden Creek

Station	Start Date	End Date	No. of Samples	Min. (mg/L)	Avg. (mg/L)	Max. (mg/L)	No. Above WQO	% Above WQO
LVR	2/6/96	2/26/04	80	ND	0.59	11.48	1	1%
SYB	11/21/95	4/14/04	197	ND	2.02	27.27	2	1%
TUR	10/10/95	4/8/04	208	ND	4.98	16.00	20	10%
WAR	10/10/95	9/26/00	142	ND	3.86	42.27	10	7%

[1]Non-detectable limits; the detection limit is 1 mg/l as N.

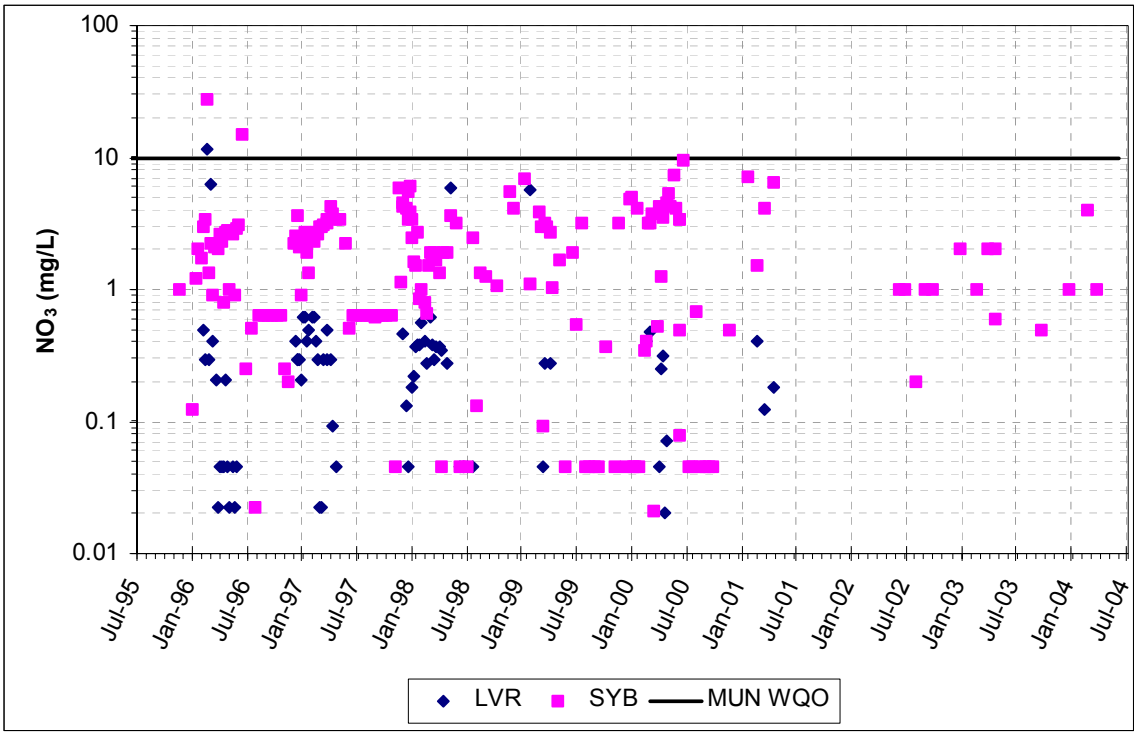

Figure 2. Nitrate levels at LVR and SYB on Los Osos Creek

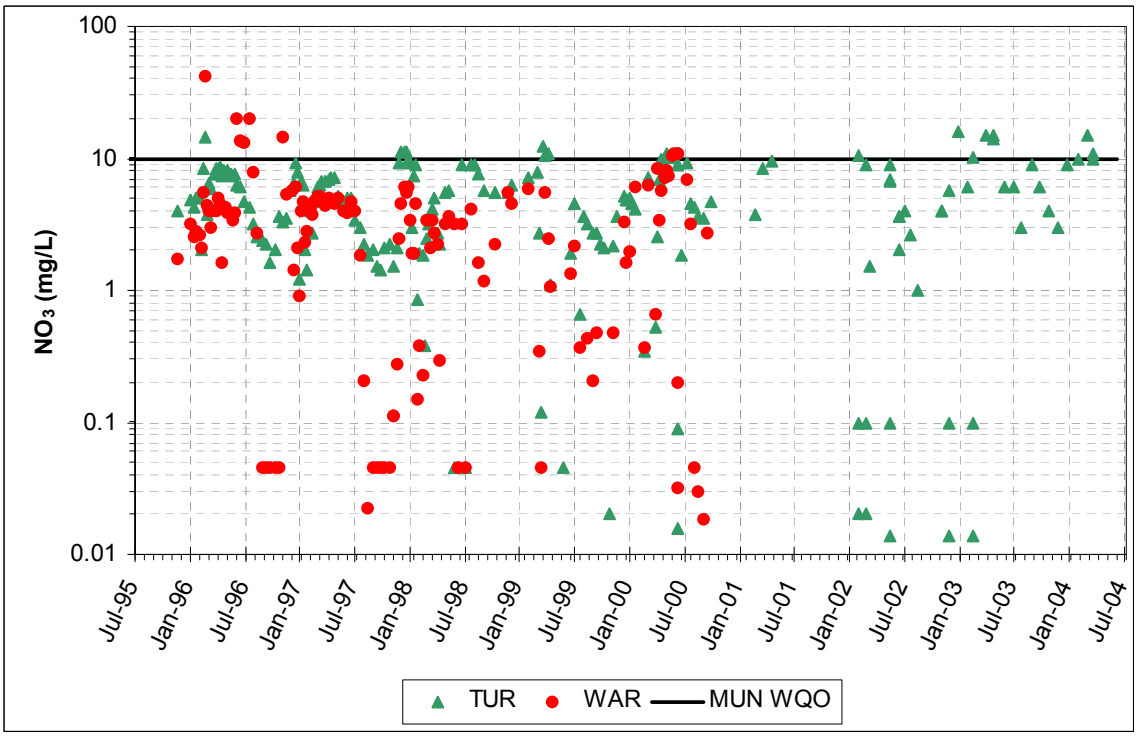

Figure 3. Nitrate levels at TUR and WAR on Warden Creek

3.2. Phosphate

Phosphate data has been collected in the Los Osos watershed. Figure 4 shows the observed phosphate concentrations at stations on Los Osos Creek and Warden Creek. Phosphate concentrations at SYB and WAR are typically higher than those measured at LVR and TUR; although there is no WQO with which to compare the data.

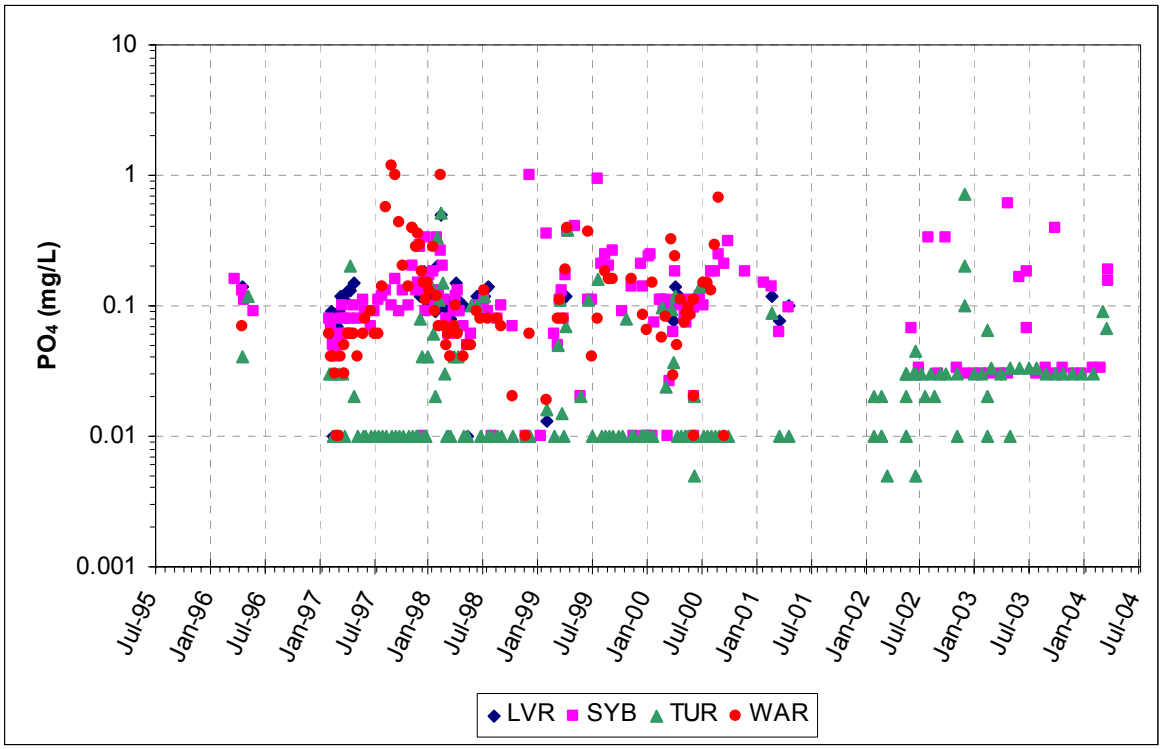

Figure 4. Phosphate levels at LVR and SYB on Los Osos Creek and TUR and WAR on Warden Creek.

3.3. Dissolved Oxygen

Table 6 summarizes available dissolved oxygen data and Figures 5 and 6 show the observed dissolved oxygen at stations on Los Osos Creek and Warden Creek, respectively. Table 7 summarizes available percent saturation data on Los Osos Creek and Warden Creek. Dissolved oxygen and percent saturation levels at the downstream station in Los Osos Creek (SYB) and Warden Creek (WAR) fell below the applicable water quality objectives throughout the period of record. (Because monitoring was discontinued at WAR in 2000, recent dissolved oxygen data are not available at this station.) Dissolved oxygen at LVR on Los Osos and TUR on Warden Creek consistently met water quality objectives, with the exception of 1 sample collected at TUR in 2002.

Low dissolved oxygen (along with algal growths) may be impacted by nutrient loading to the streams, but is expected to be primarily influenced by low flow, canopy and shading, temperature, and other environmental conditions; however, sufficient and consistent data are not

available to evaluate the direct causes. In particular, the available data on algal extent and frequency are qualitative and cannot be used to correlate with potential sources or causes.

Table 6. Summary of Dissolved Oxygen Data in Los Osos Creek and Warden Creek

Station	Start Date	End Date	No. of Samples	Min. (mg/L)	Avg. (mg/L)	Max. (mg/L)	Applicable WQO	No. Below WQO	% Below WQO
LVR	1/11/94	2/26/04	113	7.3	9.28	12.32	>7 mg/L	0	0%
SYB	11/21/95	4/14/04	181	2.72	7.90	15.88	>7 mg/L	55	30%
TUR	12/14/93	4/8/04	249	1.57	9.17	17.4	>5 mg/L	1	0%
WAR	12/14/93	9/12/00	199	0.69	6.16	16.687	>5 mg/L	43	22%

Table 7. Summary of Percent Saturation Data in Los Osos Creek and Warden Creek

Station	Start Date	End Date	No. of Samples	Min. (%)	Median (%)	Max. (%)	Applicable WQO (%)	Within WQO
LVR	1/11/94	2/26/04	113	70	94	116	≥85	Y
SYB	11/21/95	4/14/04	178	36	76	199	≥85	N
TUR	12/14/93	4/8/04	248	18	91	189	≥85	Y
WAR	12/14/93	9/12/00	198	7	64	161	≥85	N

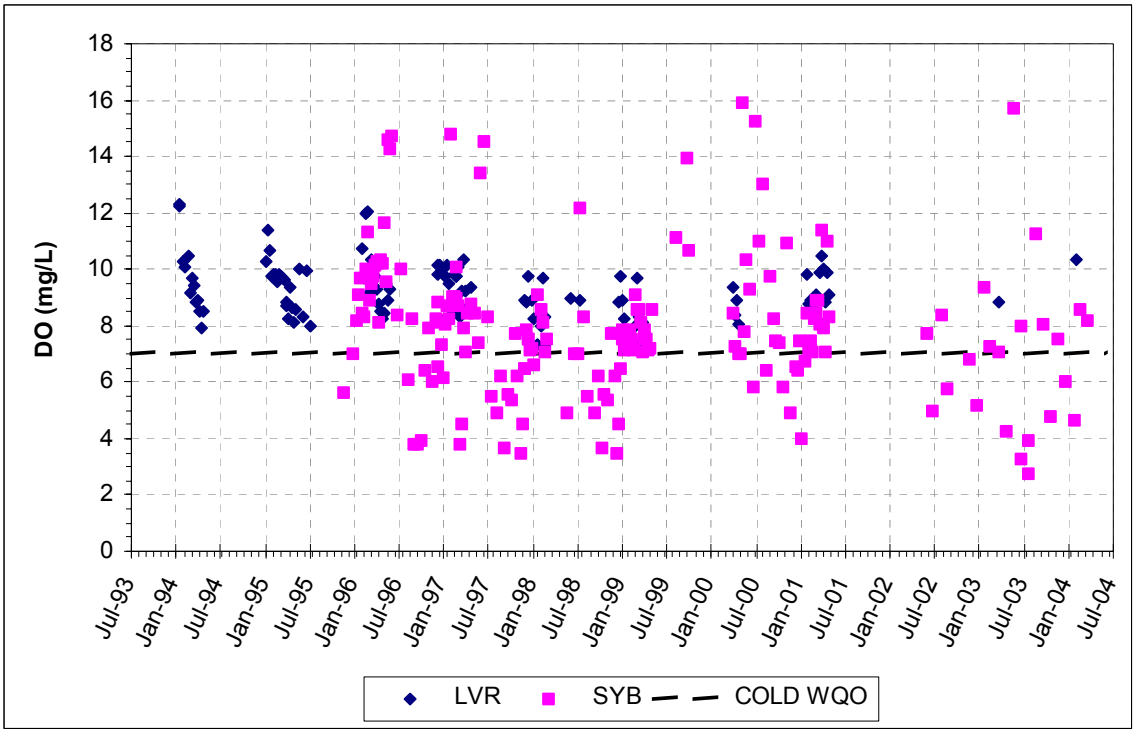

Figure 5. Dissolved oxygen levels at LVR and SYB on Los Osos Creek

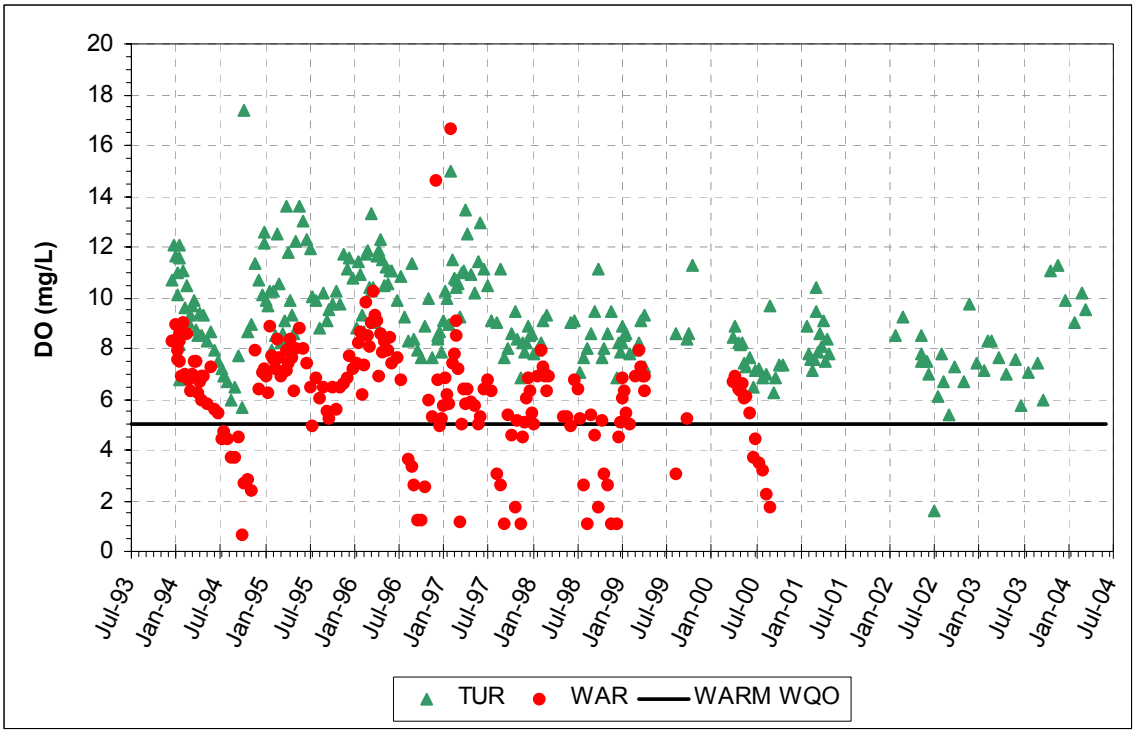

Figure 6. Dissolved oxygen levels at TUR and WAR on Warden Creek

3.4. Algal Growth

As part of the NMP and VMP, staff and volunteers have periodically documented the presence of algae in field notes and, in some cases, photographs at SYB and TUR since 2000. Algal data are primarily anecdotal and do not provide consistent documentation on severity and extent of coverage and affect on use, making it difficult to clearly identify the impact of algal growth on uses in Los Osos Creek or to identify an appropriate algal target representing use support.

On the upper reaches of Warden Creek (TUR), staff and volunteers documented the presence of algae on six occasions and photographed algae on four occasions between May 2002 and August 2004. At SYB, photographs have been taken of scarcely scattered floating mats of algae (possibly from the Morro Bay estuary) and few observations of algal growth have been made between May 2000 and August 2004. At WAR, 100 percent cover of aquatic vegetation (duckweed) was documented on four occasions between June and August 2000.

Information documents the presence of algal growth, but does not demonstrate violation of the biostimulatory objective (i.e., prohibits concentrations that "promote aquatic growths to the extent that such growths cause nuisance or adversely affect beneficial uses"). However, data are also not sufficient enough to confirm use support. Further information collected using a consistent methodology of quantitatively evaluating or scoring the creek's algal conditions is necessary to evaluate the algal growth, frequency, and impacts.

3.5. Data Summary

Data indicate that nitrate levels are violating the WQO in Warden Creek. Dissolved oxygen levels do not meet WQOs at two stations in Los Osos and Warden Creeks and support WQOs at the other two stations. Algal growth has been documented but documentation is not sufficient to determine the extent and severity of the algae and whether it impacts designated uses. Data analyses are inconclusive in establishing a relationship between nutrients, dissolved oxygen and algal growth. While algae and corresponding low dissolved oxygen are likely exacerbated by nutrient loading, they are likely driven by low flow, canopy conditions, temperature and other environmental conditions.

Further monitoring will be conducted to evaluate the dissolved oxygen and algal conditions in the creeks and to identify causes or sources of the impairments and appropriate targets that will support uses. TMDLs to address dissolved oxygen and exceedances of the narrative biostimulatory objective as evidenced by algae in Los Osos Creek and Warden Creek will be written, if necessary, when the additional data are collected. Because data show an impairment by nitrates, a TMDL has been developed for nitrates in Warden Creek.

4. NITRATE SOURCE ANALYSIS

This section identifies potential sources of nitrates to Warden Creek.

Geographic information system (GIS) land use coverages (based on University of California Santa Barbara land use/land cover data and California Department of Fish and Game Wildlife Habitat Relationships, 1998) were used to determine the land use distribution in the Warden Creek watershed and evaluate potential sources of nitrates. Table 8 shows land use categories in the Warden Creek watershed. Figure 7 shows a landuse map of the watershed.

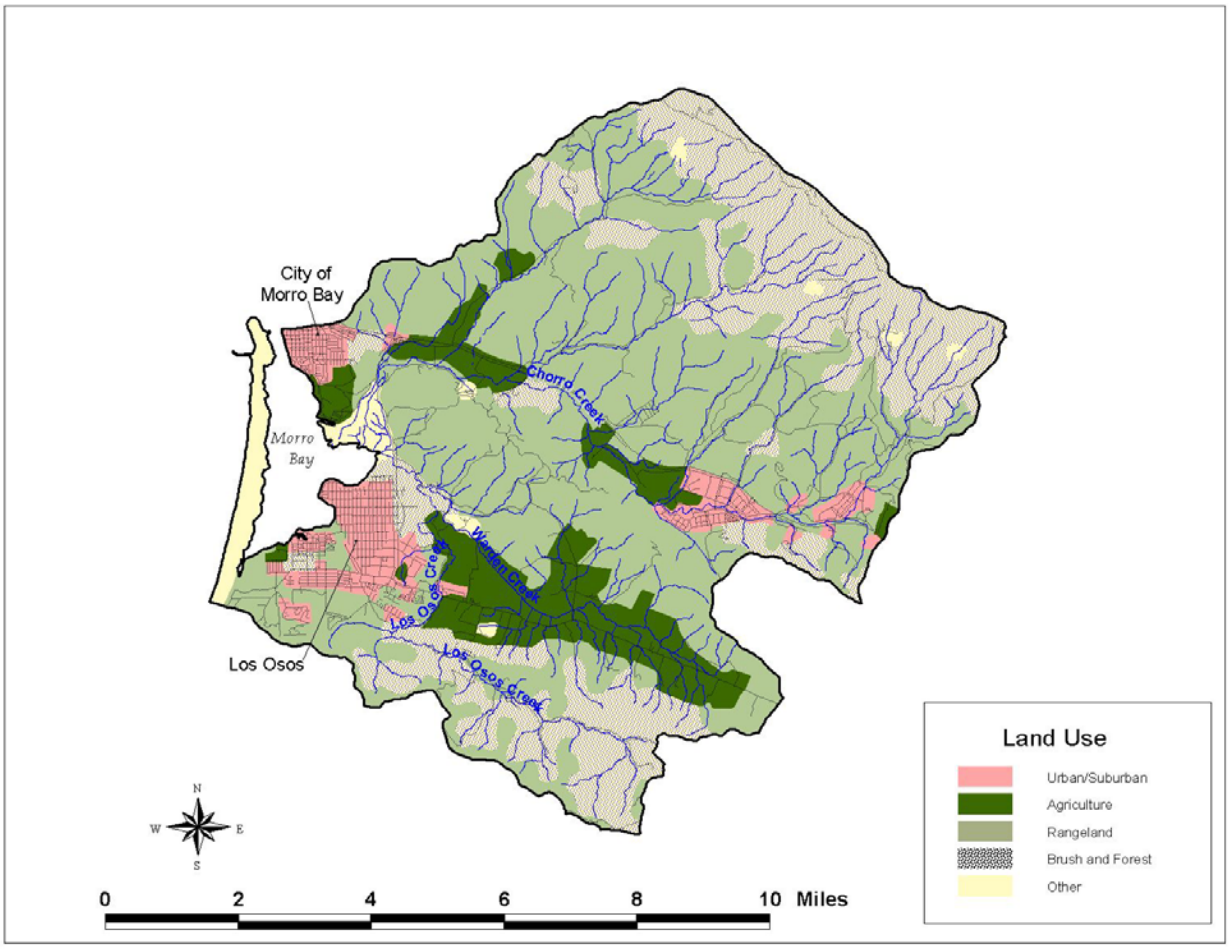

Figure 7. Landuse map of the watershed.

Also included in Table 8 are available nitrate loading rates used to estimate loadings in the watershed. The loading rates are based on the Pollutant Mass Emissions to the Coastal Ocean of California (Southern California Coastal Water Research Project et al, 2000), reported as mass emission fluxes (kg/km^2/year, converted to lbs/acre/year). Agricultural areas were considered *cropland* and open areas as *rangeland and woodland* to apply loading rates to available land use information. Table 8 summarizes the estimated nitrate loads based on the loading rates and land use areas in the watershed, with cropland contributing 86 percent of the total load. This information indicates that the primary source of nitrates to Los Osos Creek is croplands. Elevated nitrate levels have also been found adjacent to croplands, further supporting this conclusion. The NMP study in the Morro Bay watershed demonstrated that nitrate in the creek was not reduced significantly even though rangeland Best Management Practices (BMPs) were implemented. This suggests that rangeland nitrate loading is not causing increases in the nitrate concentration. Therefore, rangeland is not treated as a source in this TMDL analysis.

Although this analysis provides estimates of nitrate loading, it does not predict the instream nitrate levels, which ultimately measure maintenance of water quality objectives. Therefore, the loading estimates were only used to identify the potential nonpoint sources of nitrates and to illustrate the relative magnitudes of the sources. The estimates will be helpful in prioritizing

control efforts and focusing source reductions, but because they do not provide a direct link to the instream conditions, they are not used in calculating the TMDL.

Table 8. Land use, nitrate loading rates and loading estimates in the Warden Creek watershed

Land use	Area (Acres)	% of Total Area	Nitrate Loading Rate (lbs/ac/year)	Estimated Load (lbs/year)	% of Total Load
Woodland	161	2%	1.4	225	0%
Rangeland	5,260	63%	1.4	7,364	14%
Cropland	2,911	35%	15.4	44,829	86%
Total	8,332	100%		52,419	100%

Source: based on UC Santa Barbara GAP data and CDF Wildlife Habitat Relationships, 1998.

5. NITRATE TMDL

The TMDL represents the loading capacity of a waterbody—the amount of a pollutant that the waterbody can assimilate and still support beneficial uses. The TMDL is the sum of allocations for nonpoint and point sources and any allocations for a margin of safety. TMDLs are often expressed as a mass load of the pollutant but can also be expressed as a unit of concentration (40 CFR 130.2(i)).

The nitrate TMDL for the Warden Creek branch of Los Osos Creek is set at a maximum concentration for nitrate of 10 mg/l-N in receiving water to protect the MUN beneficial use. The allocations, which include background levels, are also equal to the numeric targets. Expressing the TMDL as a nitrate concentration equal to the WQO provides a direct measure of the nitrate levels in the watershed to compare with water quality objectives and provides a measurable target for sources to monitor and with which to comply. Requiring the responsible parties for nitrate loading to reduce nitrate discharges to the numeric target of 10 mg/l-N establishes a direct link between the TMDL target and sources.

Load allocations of 10 mg/l-N are assigned to each source, including background and all watershed landuses (e.g., cropland and rangeland). Cropland landowners and operators are given an allocation which requires a reduction from the existing load. Therefore, implementation will consist of compliance with the Conditional Waivers of Waste Discharge Requirements for Discharges from Irrigated Lands in the Central Coast Region (discussed in Section 7). Rangeland is given the same allocation, but it is presumed equal to the existing load. As such, there are no additional requirements for rangeland landowners or operators.

Seasonality is not a determining factor in the TMDL because the TMDL is equal to the nitrate WQO, which must be met at all times. In addition, existing data indicate that WQO violations occur during both wet and dry seasons.

Staff has not identified any point source discharges that contribute to the impairment so no wasteload allocation is necessary.

The margin of safety for this TMDL is implicitly included through the use of the nitrate WQO as the TMDL. The WQO was established using conservative assumptions. Additionally, it is likely that rangeland is loading nitrate less than an amount resulting in 10 mg/l nitrate as N because in-stream nitrate levels in the vicinity of rangeland have been below 10 mg/l and rangeland has not proven to be a source of nitrate.

6. MONITORING

This section discusses the planned and recommended monitoring in the Los Osos Creek watershed. Monitoring will include continued water quality monitoring to measure the progress of the creeks in meeting the nitrate TMDL target and also additional studies and monitoring to further evaluate the unconfirmed algal growth impairment.

6.1. Follow-up Monitoring for Nitrate TMDL

Monitoring will be performed by the Morro Bay Volunteer Monitoring Program (VMP) in Warden Creek at TUR to ensure that the numeric target is met. In addition, staff will pursue re-instating monitoring further downstream on Warden Creek at or near WAR to evaluate progress towards TMDL achievement. This additional site will provide better representation of freshwater creek conditions as the location is not tidally influenced and will provide better spatial coverage to evaluate progress toward attainment of the nitrate TMDL in Warden Creek. The Regional Board will provide quality assurance support by means of 15 percent duplicate laboratory sample analysis as resources allow. Additionally, monitoring for nitrate by landowners, as required according to the Monitoring and Reporting Program set forth in the conditional waivers, will provide information for this TMDL. Landowners have the option of performing individual monitoring or participating in a cooperative monitoring program. Regional Board staff will review data every three years to determine compliance with the TMDL. If the executive officer determines additional monitoring is needed, he shall request it pursuant to Section 13267 of the California Water Code.

6.2. Additional Monitoring to Characterize Algal Growth and Dissolved Oxygen

In addition to monitoring conducted to evaluate nitrate concentrations in Warden Creek, the Regional Board will conduct further monitoring to investigate and obtain information to determine causes of algal blooms and dissolved oxygen conditions that may be causing impairments to aquatic life and recreation (flow, DO, temperature, total nitrogen, total phosphorous, nitrate, phosphate, algal biomass, chlorophyll, benthics). Regional Board staff will develop a monitoring plan to address the remaining impairment to ensure that beneficial uses are protected, as soon as protocols to meet the objectives of monitoring are developed, or in conjunction with the first three-year review. Key questions to be answered by the monitoring program are described below.

Staff will pursue establishing an additional monitoring site (LOC) on the downstream reaches of Los Osos Creek in addition to the previously mentioned monitoring sites. The additional sites will provide better representation of freshwater conditions, spatial coverage, and help to provide a comprehensive assessment of the progress toward attainment of water quality objectives throughout the watersheds. The sites may be modified for adequate assessment preferably by cooperation from agencies, organizations and landowners.

The additional monitoring throughout the Warden Creek and Los Osos Creek watersheds is necessary to confirm and further characterize potential impairments in Los Osos Creek by algal growth and low dissolved oxygen. Monitoring will be designed to answer the following key questions:

- What is the frequency and duration of the occurrence of algal growth? (I.e., Is algal growth persistent?)
- What is the extent of the algal growth (e.g., spatial distribution)?
- Does algal growth impair uses (e.g., visual/aesthetic, aquatic life, recreation)?
- What are contributing factors to algal growth and low dissolved oxygen? What are the shade, temperature, and flow conditions during times of impairment and attainment?

A key element of the additional monitoring will be consistent and quantifiable documentation of algal growth and corresponding conditions in the creeks. It is important to document algae using a consistent methodology and to quantify, to the extent possible, the severity and coverage of the algae growth. Corresponding water quality (e.g., dissolved oxygen, nutrients, etc.) and physical data (e.g., shading conditions, temperature, flow, etc.) should be collected at times of algal documentation to build a database of environmental conditions during times of algal growth and also clear conditions. In addition, periodic biological monitoring should be conducted to assess use support. The combination of consistent chemical and physical data supported by biological data will facilitate the determination of whether there are impairments from algae and low dissolved oxygen, their impact on uses and potential causes.

Recommended procedures and documents to be used for documenting (written and photographic) algal growth and related indicators (e.g., water color, fish behavior, etc.) will be developed three years following TMDL adoption.

In addition, Regional Board staff are involved in a state-wide effort to establish protocols for determining causes of algal blooms and dissolved oxygen conditions that may be causing impairments, and proposing control options, where reduction of nutrient loading alone is unlikely to generate a response in the waterbody.

Staff will implement the monitoring plan and collect data for three years; staff believes this period of data collection will be sufficient to make a definitive assessment of whether there are exceedances of the narrative biostimulatory objective in the Los Osos Creek watershed. Regional Board staff will review the continuing and expanded monitoring results every three years. At each three-year review, Regional Board staff will determine whether these studies result in improved information by which to evaluate whether there are exceedances of the narrative biostimulatory objective and, if so, to set numeric targets for such impairment. Staff

will also review the TMDL to determine if revisions are necessary. Regional Board staff will present any necessary revisions of this TMDL (problem statement, numeric targets, implementation plan, etc.) to the Regional Board for approval, or, if appropriate, a separate TMDL for overall nutrient or biostimulatory substance impairment to address the algal growth and corresponding low dissolved oxygen. However, if protection of beneficial uses is demonstrated (i.e., the data do not show exceedances of the biostimulatory objective and the nitrate objectives are attained) then Regional Board staff will propose de-listing of the waterbody for nutrient impairments.

7. IMPLEMENTATION

Implementation relies on irrigated agricultural (cropland) landowners and operators implementing agricultural management measures independently or in cooperation with partnering agencies and organizations. Cropland landowners will implement management measures pursuant to the Conditional Waivers of Waste Discharge Requirements for Discharges from Irrigated Lands in the Central Coast Region (conditional waivers). The conditional waivers require completion of a Farm Water Quality Plan, implementation of nutrient management measures, monitoring and reporting.

In addition to implementation required as part of the TMDL pursuant to the conditional waivers on cropland, rangeland landowners will continue to implement management measures on a voluntary basis to maintain their existing load.

Regional Board staff expects implementation to be effective because of existing efforts by numerous agencies and organizations. The University of California Cooperative Extension (UCCE) and the United States Department of Agriculture's Natural Resources Conservation Service (NRCS) are carrying out complementary strategies to improve the availability and relevance of technical information to farmers as part of the Agriculture Water Quality Program. UCCE and NRCS have developed, compiled and are extending the Farm and Ranch Water Quality Planning Short Courses to Watershed Working Groups. The Coalition of Central Coast County Farm Bureaus formed agricultural Watershed Working Groups and has provided technical assistance to help farmers and ranchers develop and implement farm and rangeland Water Quality Management Plans.

During the Short Course, irrigated agriculture producers and ranchers receive information on water quality regulations and techniques for self-assessment of nonpoint source pollution problems, management goals for nutrients, methods for recognizing practices that are already in place that protect water quality, management practices that may be selected for local conditions and crop types, and practice evaluation methods. Most of the practices presented in the short course are drawn from the NRCS list of Conservation Practices that have been developed and evaluated over the past 65 years and are endorsed by the EPA as Best Management Practices (BMPs).

A Ranch Water Quality Short Course was held in 1999 and a Farm Water Quality Short Course was held in 2002 for landowners in the Los Osos and Chorro watersheds. To date, 75% of

landowners (twenty-one) in the watersheds have attended either the Farm or Ranch Short Course. Of the participants, 50% have implemented Water Quality Plans developed as part of the Short Courses. BMPs implemented include, but are not limited to the following: vegetative buffers and riparian fencing. Sixteen landowners have received training and monitoring kits to conduct water quality evaluations. Since 1999, the San Luis Obispo County Farm Bureau has hosted five Los Osos/Chorro watershed working group meetings (pers, comm., Fitzhugh, December, 2003). The Coastal San Luis Resource Conservation District (RCD), through Project Clearwater, is working with landowners to provide technical support and cost-sharing financial assistance to implement BMPs. The Morro Bay National Estuary Program (NEP), NRCS, SWRCB, California Coastal Conservancy, and other entities have provided cost-sharing funds to landowners to implement BMPs. In addition, the NEP is partnering with numerous public and private entities to restore riparian habitat, purchase stream-side parcels and develop conservation easements.

7.1. Measuring Progress

Regional Board staff will conduct a review to evaluate implementation efforts every three years. Regional Board staff will utilize information submitted pursuant to the conditional waivers to evaluate efforts on croplands. Regional Board staff will rely on information generated by the Coastal San Luis Resource Conservation District, University of California Cooperative Extension, San Luis Obispo County Farm Bureau, Morro Bay National Estuary Program, and/or Natural Resources Conservation Service as part of existing and future projects (i.e. Clean Water Act Section 319(h) grants) to determine that existing rangeland efforts continue.

Regional Board staff may conclude and articulate in the review that ongoing implementation efforts may be insufficient to ultimately achieve the allocations and numeric target. If this occurs, Regional Board staff will recommend revisions to the implementation plan. Regional Board staff may conclude and articulate in the three-year review that to date, implementation efforts and results are likely to result in achieving the allocations and numeric target, in which case existing and anticipated implementation efforts should continue. If allocations and numeric targets are being met, Regional Board staff will recommend the waterbody be removed from the 303(d) list.

7.2. Timeframe

Regional Board staff proposes a ten-year timeframe to achieve the TMDL. The timeframe for TMDL completion is based primarily on the expectation that nearly all cropland discharges will have completed Farm Water Quality Plans and be implementing BMPs by the end of the first waiver cycle (5 years). Water quality benefits resulting from implementing nutrient-control management measures (e.g., grass swales and riparian buffers, etc.) may take a few years to be realized. Regional Board staff believes 10 years is a reasonable timeframe to implement management measures and reduce nitrate levels consistent with the allocations and the numeric target.