CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY

California Regional Water Quality Control Board
Central Coast Region

Total Maximum Daily Load for Nitrate in Bell Creek Watershed, Santa Barbara County, California

Final Project Report

Prepared
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Adopted by the
California Regional Water Quality Control Board
Central Coast Region
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http://www.waterboards.ca.gov/centralcoast/TMDL/303dandTMDLprojects.htm

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Item No. 9, Attachment 2
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Final Project Report

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LIST OF ACRONYMS AND ABBREVIATIONS

CCAMP	Central Coast Ambient Monitoring Program
CMP	Cooperative Monitoring Program
GIS	Geographic Information System
MCLs	Maximum Contaminant Levels
mg/L	Milligrams per liter
MUN	Municipal and domestic water supply beneficial use
N	Nitrogen
NO_3 as NO_3	Nitrate as nitrate
NO_3 as N	Nitrate as nitrogen
$NO_3 + NO_2$ as N	Nitrate plus nitrite as nitrogen or joint nitrate/nitrite as nitrogen
NPDES	National Pollutant Discharge Elimination System
OEHHA	California Office of Environmental Health Hazard Assessment
PHGs	Public Health Goals
ppm	Parts per million
TMDL	Total Maximum Daily Load
USEPA	United States Environmental Protection Agency
USGS	United States Geologic Survey
Water Board	Regional Water Quality Control Board, Central Coast Region
WDR	Waste Discharge Requirements

EXECUTIVE SUMMARY

The following Nitrate Total Maximum Daily Load (TMDL) Report (TMDL Report) evaluates nitrate loading to Bell Creek in Santa Barbara County.

Total Maximum Daily Load

This TMDL Report presents a TMDL for nitrate in the Bell Creek Watershed. TMDL is a term used to describe the maximum amount of pollutants, in this case, nitrate, that a waterbody can receive and still meet water quality standards. A TMDL study identifies the probable sources of pollution, establishes the maximum amount of pollution a waterbody can receive and still meet water quality standards, and allocates that amount to all probable contributing sources. By "allocating" an amount to a contributing source, we are assigning responsibility to someone, an agency, group, or individuals, to reduce their contribution in order to meet water quality standards.

The federal Clean Water Act requires every state to evaluate its waterbodies and maintain a list of waters that are considered "impaired" either because the water exceeds water quality standards or does not achieve its designated use. For each waterbody on the Central Coast's 303(d) Impaired Waters List, the Central Coast Regional Water Quality Control Board (Central Coast Water Board) must develop and implement a plan to reduce pollutants so that the waterbody is no longer impaired and can be de-listed.

Bell Creek was listed as impaired on the 2008-2010 303(d) list because 15 of 17 samples exceeded the water quality standards for nitrate and 10 of 12 samples exceeded the public health goals for nitrate plus nitrite in drinking water.

Impaired Waterbody

The geographic scope of this project includes the Bell Creek watershed, which encompasses approximately 6.2 square miles in Santa Barbara County.

The watershed is composed primarily of shrubs and grasslands (39%), forested lands (36%), cultivated crops (14%), and low and medium intensity development (5%).

Numeric Targets and Allocations

Numeric targets are water quality targets developed to ascertain when and where water quality objectives are achieved, and hence, when beneficial uses are protected. The numeric target for this TMDL is identical to the Basin Plan numeric water quality objective for nitrate protective of the municipal and domestic supply beneficial use.

Discharges of nitrate from irrigated agriculture exceed the water quality objectives for municipal and domestic supply. Owners and operators of irrigated lands are assigned allocations for nitrate to achieve the TMDL. Responsible parties are assigned allocations for nitrate equal to the numeric targets as represented in the table below.

This TMDL is a concentration-based TMDL equal to the numeric target.

The table below identifies the allocations assigned to responsible parties and the affected waterbodies.

LOAD ALLOCATIONS		
Waterbodies Assigned TMDLs	**Responsible Party Assigned Allocation (Source)**	**Receiving Water Allocation**
• Bell Creek (including all tributaries) State Water Body ID CAR3151001320050531122629	Owners/operators of irrigated agricultural lands in the Bell Creek watershed (Discharges from irrigated lands)	10 mg/L Nitrate as Nitrogen

TMDL Implementation, Monitoring, and TMDL Timeline

Owners and operators of irrigated lands in the project area are required to comply with the conditions and requirements of the *Conditional Waiver of Waste Discharge Requirements For Discharges from Irrigated Lands* (Agricultural Order) and any renewals thereof. Owners and operators are required to comply with the requirements described in the Agricultural Order including:

- Enroll in the Agricultural Order.
- Implement monitoring and reporting requirements described in the Agricultural Order.
    - Current reporting requirements include a description of discharges leaving the growers field, including the concentration of nitrate discharges and the volume of discharge. Reporting requirements also require a description of management practices used to mitigate nitrate loading.
- Implement, and update as necessary, management practices to reduce nitrate loading.
- Maintain existing, naturally occurring, riparian vegetative cover in aquatic habitat areas.
- Develop/update and implement Farm Plans. The Farm Plans should incorporate measures designed to achieve load allocations assigned in this TMDL.
- Properly destroy abandoned groundwater wells.
- Develop, and initiate implementation of an Irrigation and Nutrient Management Plan (INMP) or alternative certified by a Professional Soil Scientist, Professional Agronomist, or Crop Advisor certified by the American Society of Agronomy, or similarly qualified professional.

Owners and operators of irrigated agricultural lands must perform monitoring and reporting in accordance with Monitoring and Reporting Program Orders R3-2012-0011-01, R3-2012-0011-02, and R3-2012-0011-03, as applicable to the operation.

The timeline to achieve this TMDL is by October 2016.

1 INTRODUCTION

1.1 Clean Water Act Section 303(d)

Section 303(d) of the federal Clean Water Act requires every state to evaluate its waterbodies and maintain a list of waters that are considered "impaired" either because the water exceeds water quality standards or does not achieve its designated use. For each water on the Central Coast's "303(d) Impaired Waters List," the California Central Coast Water Board must develop and implement a plan to reduce pollutants so that the waterbody is no longer impaired and can be de-listed. Section 303(d) of the Clean Water Act states:

Each State shall establish for the waters identified in paragraph (1)(A) of this subsection, and in accordance with the priority ranking, the total maximum daily load, for those pollutants which the Administrator identifies under section 1314(a)(2) of this title as suitable for such calculation. Such load shall be established at a level necessary to implement the applicable water quality standards with seasonal variations and a margin of safety which takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality.

The State complies with this requirement by periodically assessing the conditions of the rivers, lakes and bays and identifying them as "impaired" if they do not meet water quality standards. These waters, and the pollutant or condition causing the impairment, are placed on the 303(d) List of Impaired Waters. In addition to creating this list of waterbodies not meeting water quality standards, the Clean Water Act mandates each state to develop TMDLs for each waterbody listed. The Central Coast Water Board is the agency responsible for protecting water quality consistent with the Basin Plan, including developing TMDLs for waterbodies identified as not meeting water quality objectives.

1.2 Project Area

The geographic scope of this TMDL (the project area) encompasses approximately 6.2 square miles of the Bell Creek watershed located in Santa Barbara County (within CalWater22 Planning Watershed 315100103, Ellwood Canyon). The watershed is a south trending drainage that extends from the southern face of the Santa Ynez Mountains to the Pacific Ocean just west of Goleta. Elevations range from a maximum of about 2,800 feet (900 meters), near Brush Peak, to sea level.

1.3 Pollutants Addressed

This project addresses water body impairments due to nitrate.

2 PROBLEM IDENTIFICATION

2.1 Watershed Description

The geographic scope of this TMDL (the project area) encompasses approximately 6.2 square miles (3,943 acres) of the Bell Creek watershed located in Santa Barbara County (Figure 1). The watershed is a south trending drainage that extends from the southern face of the Santa Ynez Mountains to the Pacific Ocean just west of Goleta. Elevations range from a maximum of about 2,800 feet (900 meters), near Brush Peak, to sea level. Bell Creek watershed is within CalWater22 Planning Watershed 315100103 (Ellwood Canyon), and the State Waterbody ID for Bell Creek is CAR315100132005053112262 9.

Figure 1. Bell Creek Watershed and Streams

Most of the land in the watershed is undeveloped and in private ownership. Land use is comprised primarily of shrubs and grasslands (39%), forested lands (36%), cultivated crops (14%), and low and medium intensity development (5%). Figure 2 depicts NLCD[1] land use/land cover within the Bell Creek watershed and Table 1 summarizes the NLCD land use/land cover acreage and percent of the watershed.

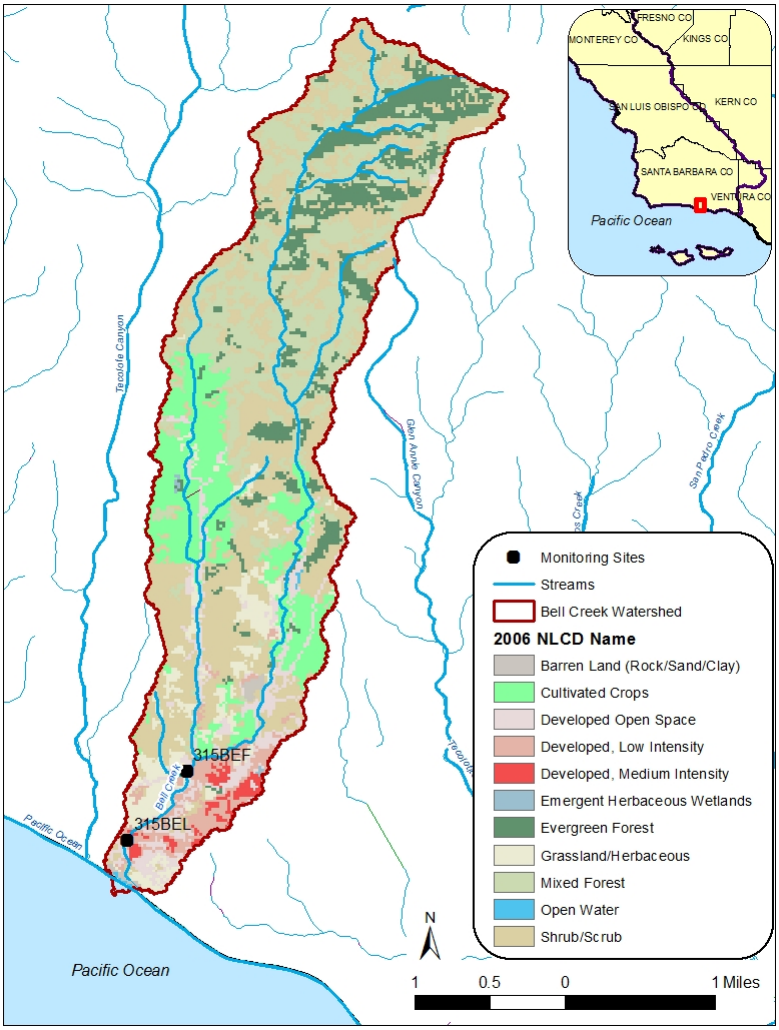

Figure 2. Bell Creek Watershed Land Use/Land Cover (NCLD 2006) and Water Quality Monitoring Sites (315BEL and 315BEF).

[1] National Land Cover Data (NLCD, 2006) provided by the Multi-Resolution Land Characteristics Consortium (MRLC). The Consortium includes multiple federal agencies led by the U.S. Geological Survey (USGS). The NLCD serves as the definitive Landsat-based, 30-meter resolution, land cover database for the Nation.

Table 1. Land Use/Land Cover in the Bell Creek Watershed (NLCD 2006).

NLCD Name	acres	% of watershed
Open Water	4.2	0.1
Developed Open Space	237.5	6.0
Developed, Low Intensity	145.0	3.7
Developed, Medium Intensity	43.6	1.1
Barren Land (Rock/Sand/Clay)	16.0	0.4
Evergreen Forest	454.6	11.5
Mixed Forest	970.5	24.6
Shrub/Scrub	1,280.1	32.5
Grassland/Herbaceous	245.3	6.2
Cultivated Crops	542.2	13.8
Emergent Herbaceous Wetlands	3.3	0.1
	3,942.5	100.0

Cultivated crops are comprised primarily of orchards (avocado, citrus) in the middle portion of the watershed and truck crops (peas, beets, tomatoes) in the lower portion of the watershed. Portions of the upland areas have been used for cattle grazing.

Average annual precipitation within the watershed ranges from around 18 inches near the coastline to around 27.5 inches in the Santa Ynez Mountains[2] as shown in Figure 3. On average, there are 279 sunny days per year in Goleta. The July high is around 74^{o} degrees Fahrenheit (^{o}F) and the January low is 40 ^{o}F[3].

[2] California Department of Forestry and Fire Protection (FRAP, http://frap.cdf.ca.gov).
[3] Best Places, 2013. http://www.bestplaces.net/climate/city/california/goleta. Accessed January 7, 2013.

Figure 3. Average annual rainfall (inches).

Stream gage data is not available for Bell Creek. Therefore, staff has estimated stream flow characteristics based on United States Geological Survey (USGS) gage data for Maria Ygnacio Creek, an adjacent watershed of similar size (6.4 square miles), land use, and physical characteristics. The Maria Ygnacio Creek watershed is located approximately 5 miles west of Bell Creek watershed as shown in Figure 4. Table 2 shows monthly mean discharge in cubic feet per second (cfs) for USGS gage data at Maria Ygnacio Creek (USGS 11119940). USGS calculated the monthly mean discharge values based on data obtained from October 1, 1970 to February, 29, 2012. In the 43-year monitoring period, no flow was frequently observed during the months of June to October.

Figure 4. Location of USGS gage station at Maria Ygnacio Creek (USGS 11119940).

Table 2. Monthly mean discharge (cfs) for Maria Ygnacio Creek at University Drive near Goleta (USGS 11119940, 1970-2013).

	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Mean of Monthly Discharge	6.2	7.8	7.2	1.6	0.67	0.28	0.21	0.08	0.06	0.20	0.25	1.6

2.2 Beneficial Uses

There are no specifically designated beneficial uses identified in the Basin Plan for Bell Creek. However, the Basin Plan states that surface water bodies within the region that do not have beneficial uses specifically designated for them 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 beneficial uses of MUN, REC-1 and REC-2, along with all beneficial uses associated with aquatic life (WARM, MIGR, SPWN, WILD, RARE, EST). These beneficial uses are shown in Table 3.

Table 3. Basin Plan designated beneficial uses

Waterbody	MUN	REC1	REC2	WARM	MIGR	SPWN	WILD	RARE	EST
Bell Creek	X	X	X	X	X	X	X	X	X

Beneficial uses are regarded as existing whether the water body is perennial or ephemeral, or the flow is intermittent or continuous.

Municipal and Domestic Supply (MUN) - Uses of water for community, military, or individual water supply systems including, but not limited to, drinking water supply. According to State Board Resolution No. 88-63, "Sources of Drinking Water Policy" all surface waters are considered suitable, or potentially suitable, for municipal or domestic water supply except where:

a. TDS exceeds 3000 mg/l (5000 uS/cm electrical conductivity);
b. Contamination exists, that cannot reasonably be treated for domestic use;
c. The source is not sufficient to supply an average sustained yield of 200 gallons per day;
d. The water is in collection or treatment systems of municipal or industrial wastewaters, process waters, mining wastewaters, or storm water runoff; and
e. The water is in systems for conveying or holding agricultural drainage waters.

Water Contact Recreation (REC-1) - Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, white water activities, fishing, or use of natural hot springs.

Non-Contact Water Recreation (REC-2) - Uses of water for recreational activities involving proximity to water, but not normally involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating tidepool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.

*Warm Fresh Water Habitat (WARM) - Uses of water that support warm water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

*Migration of Aquatic Organisms (MIGR) - Uses of water that support habitats necessary for migration or other temporary activities by aquatic organisms, such as anadromous fish.

*Spawning, Reproduction, and/or Early Development (SPWN) - Uses of water that support high quality aquatic habitats suitable for reproduction and early development of fish.

*Wildlife Habitat (WILD) - Uses of water that support terrestrial ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.

*Rare, Threatened, or Endangered Species (RARE) - Uses of water that support habitats necessary, at least in part, for the survival and successful maintenance of plant or animal species established under state or federal law as rare, threatened, or endangered.

*Estuarine Habitat (EST) - Uses of water that support estuarine ecosystems including, but not limited to, preservation or enhancement of estuarine habitats, vegetation, fish, shellfish, or wildlife (e.g., estuarine mammals, waterfowl, shorebirds). An estuary is generally described as a semi-enclosed body of water having a free connection with the open sea, at least part of the year and within which the seawater is diluted at least seasonally with fresh water drained from the land. Included are water bodies which would naturally fit the definition if not controlled by tidegates or other such devices.

* = Aquatic habitat beneficial use.

2.3 Water Quality Objectives

Relevant water quality objectives for this project pertain to the protection of municipal and domestic supply and the prevention of toxic water quality conditions. The applicable water quality objectives for this project include:

2.3.1 Basin Plan Water Quality Objective for Municipal and Domestic Supply (MUN)

The Central Coast Region's Water Quality Control Plan (Basin Plan) contains the following specific water quality objective that applies to the Municipal and Domestic Supply (MUN) beneficial use:

Waters shall not contain concentrations of chemical constituents in excess of the limits specified in California Code of Regulations, Title 22, Article 4, Chapter 15, Section 64435, Tables 2 and 3 as listed in Table 3-2 (Region 3 Basin Plan, p III-3). In Table 3-2, the maximum contaminant level (MCL) for Nitrate (as NO_3) in Domestic or Municipal Supply is 45 milligrams per liter (mg/L).

The MUN water quality objective of 45 mg/L nitrate as nitrate (NO_3 as NO_3) is equivalent to 10 mg/L nitrate as nitrogen (NO_3 as N).

2.3.2 Basin Plan Water Quality Objectives for Toxicity

The Central Coast Region's Water Quality Control Plan (Basin Plan) contains specific water quality objectives that apply to all inland surface waters, enclosed bays and estuaries (CCRWQCB, 1994, pg. III-3).

All waters shall be maintained free of toxic substances in concentrations which are toxic to, or which produce detrimental physiological responses in, human, plant, animal, or aquatic life. Compliance with this objective will be determined by use of indicator organisms, analyses of species diversity, population density, growth anomalies, toxicity bioassays of appropriate duration, or other appropriate methods as specified by the Regional Board.

Survival of aquatic life in surface waters subjected to a waste discharge or other controllable water quality conditions, shall not be less than that for the same water body in areas unaffected by the waste discharge or, when necessary, for other control water that is consistent with the requirements for "experimental water" as described in Standard Methods for the Examination of Water and Wastewater, latest edition. As a minimum, compliance with this objective shall be evaluated with a 96-hour bioassay.

In addition, effluent limits based upon acute bioassays of effluents will be prescribed where appropriate, additional numerical receiving water objectives for specific toxicants will be established as sufficient data become available, and source control of toxic substances is encouraged.

2.3.3 OEHHA Public Health Goals for Drinking Water

The California Office of Environmental Health Hazard Assessment (OEHHA) developed Public Health Goals (PHGs) of 45 mg/L for nitrate (equivalent to 10 mg/L nitrate as nitrogen), 1 mg/L for nitrite as nitrogen, and 10 mg/L for joint nitrate/nitrite (expressed as nitrogen) in drinking water (OEHHA, 1997). The calculation of these PHGs is based on the protection of infants from the occurrence of methemoglobinemia, the principal toxic effect observed in humans exposed to nitrate or nitrite. The PHGs are equivalent to California's current drinking water standards for nitrate (45 mg/L nitrate as nitrate), nitrite (1 mg/L nitrite as nitrogen), and 10 mg/L (joint nitrate/nitrite expressed as nitrogen) which were adopted by the California Department of Health Services (DHS) in 1994 from the U.S. Environmental Protection Agency's (USEPA's) Maximum Contaminant Levels (MCLs) promulgated in 1991.

2.4 Pollutants Addressed

Bell Creek was listed on the 2008-2010 303(d) List for nitrate in accordance with the State Water Resources Control Board Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List, September 2004 (Listing Policy, SWRCB, 2004b). Table 3.1 of the Listing Policy specifies the minimum number of measured exceedances needed to place a water segment on the Section 303(d) list for toxicants (SWRCB, 2004b, pg. 9). Based on results from CCAMP monitoring, Bell Creek exceeded the nitrate Basin Plan water quality objective for the MUN beneficial use in 15 of 17 samples. In addition, based on results from CMP monitoring, joint nitrate/nitrite (expressed as nitrogen) concentrations exceeded the OEHHA PHG's in 10 of 12 samples (see APPENDIX A – Water Quality Data). Both datasets met the minimum number of measured exceedances needed to place Bell Creek on the 303(d) list.

2.5 Data Analysis

This section provides information pertaining to data sources and the results of water quality data used to assess water quality conditions and impairment. Water quality data is also contained in APPENDIX A – Water Quality Data.

Staff used the following data for the development of these TMDLs:

- Central Coast Ambient Monitoring Program (CCAMP) site 315BEL.
- Cooperative Monitoring Program (CMP) site 315BEF.

The two monitoring sites are depicted in Figure 5.

Figure 5. Location of Water Quality Monitoring Stations (315BEL and 315BEF).

2.5.1 Central Coast Ambient Monitoring Program

The Central Coast Ambient Monitoring Program (CCAMP) collected water quality samples from one site (315BEL) in the Bell Creek watershed. CCAMP monitoring site 312BEL is located on Bell Creek at the Bacara Resort Access Road in the lower portion of the watershed (see Figure 5).

CCAMP collected 17 samples between January 2001 and March 2002. Table 4 is a summary of nitrate and nitrite data, joint nitrate/nitrite concentrations (e.g., sum of nitrate plus nitrite), and percent composition of nitrite in the joint nitrate/nitrite concentration. Nitrate concentrations exceeded the MUN water quality objective of 10 mg/l nitrate as N in 15 of the 17 samples.

It is important to note that nitrite generally comprises less than one-half of one percent of the joint nitrate/nitrite concentrations (mean of 0.34%). As a result, staff has concluded that nitrate as nitrogen is comparable to joint nitrate/nitrite as nitrogen concentrations. It is also important to note that nitrite concentrations do not exceed the OEHHA public health goal of 1 mg/L nitrite as nitrogen.

Table 4. Summary of CCAMP Nitrate and Nitrite Results for Site 315BEL.

Site ID	Sample Date	Nitrate as N (mg/L)	Nitrite as N (mg/L)	Joint Nitrate/Nitrite as N (mg/L)	% Nitrite in Joint Nitrate/Nitrite as N
315BEL	01/17/2001	33.483	0.174	33.657	0.517
315BEL	02/13/2001	2.584	0.015	2.599	0.566
315BEL	03/07/2001	3.371	0.020	3.391	0.584
315BEL	04/04/2001	12.112	0.039	12.151	0.321
315BEL	05/08/2001	15.258	0.063	15.321	0.411
315BEL	06/04/2001	19.079	0.063	19.142	0.329
315BEL	07/11/2001	26.742	0.051	26.793	0.190
315BEL	08/07/2001	26.067	0.066	26.133	0.253
315BEL	09/04/2001	26.292	0.063	26.355	0.239
315BEL	09/04/2001	26.292	0.063	26.355	0.239
315BEL	10/08/2001	26.966	0.057	27.023	0.211
315BEL	11/05/2001	26.000	0.080	26.080	0.307
315BEL	12/05/2001	25.800	0.063	25.863	0.244
315BEL	01/03/2002	24.300	0.077	24.377	0.316
315BEL	02/12/2002	25.300	0.033	25.333	0.130
315BEL	03/07/2002	15.700	0.092	15.792	0.583
315BEL	03/27/2002	19.300	0.079	19.379	0.408

Figure 6 is a graph of nitrate concentrations for CCAMP site 315BEL.

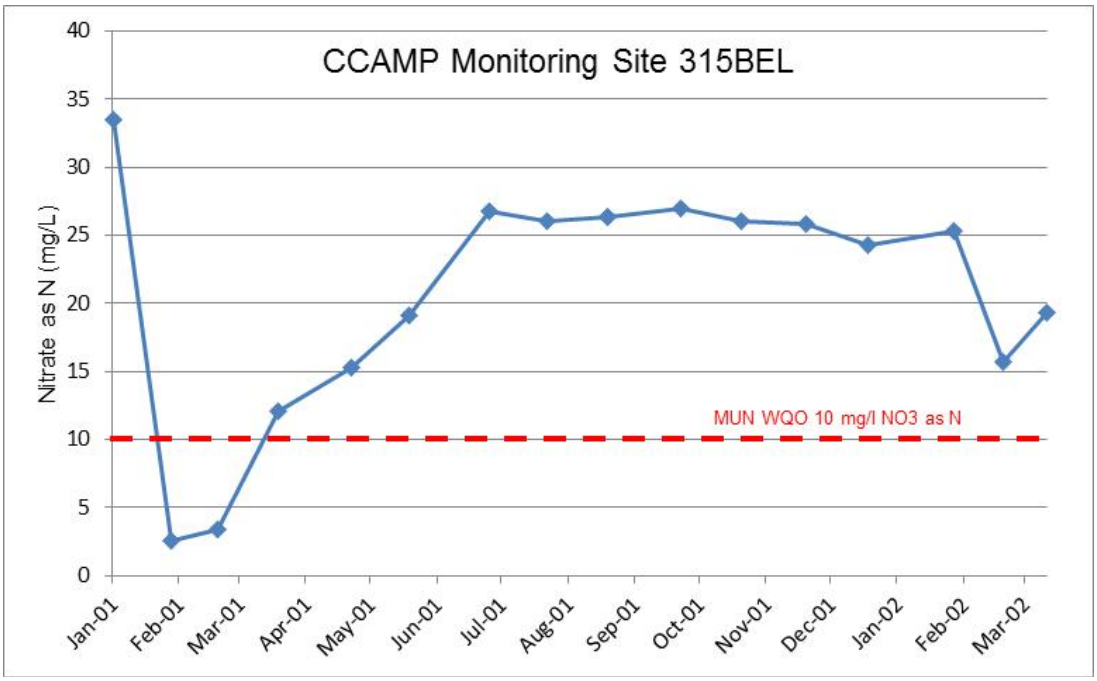

Figure 6. Graph of Nitrate as N (mg/L) for CCAMP Site 315BEL.

2.5.2 Cooperative Monitoring Program (CMP)

The Cooperative Monitoring Program (CMP) collected water quality samples from one site (315BEF) in the Bell Creek watershed. CMP monitoring site 312BEF is located on Bell Creek at Winchester Park, approximately 0.5 miles above CCAMP monitoring site 315BEL (see Figure 5).

CMP collected 12 samples from January to December 2006. Table 5 is a summary of joint nitrate/nitrite (e.g., sum of nitrate plus nitrite) concentration. Joint nitrate/nitrite concentrations exceeded the OEHHA public health goal (PHG) of 10 mg/L joint nitrate/nitrite as nitrogen in 10 of the 12 samples.

It is important to note that data for the individual constituents (either nitrate or nitrite) was not obtained as part of the CMP effort; therefore a direct comparison to the MUN water quality objective for nitrate as nitrogen is not available. However, staff has concluded that joint nitrate/nitrite as nitrogen concentrations are comparable to nitrate as nitrogen concentrations (see previous section 2.5.1 above). As a result staff has concluded that the MUN water quality objective of 10 mg/l nitrate as nitrogen was exceeded in 10 of the 12 samples.

Figure 7 is a graph of the joint nitrate/nitrite concentrations for CMP site 315BEF.

Table 5. Summary of CMP Joint Nitrate/Nitrite Results for Site 315BEF.

Site ID	Sample Date	Joint Nitrate/Nitrite as N (mg/L)
315BEF	01/25/2006	23.2
315BEF	02/22/2006	27.8
315BEF	03/29/2006	3.38
315BEF	04/26/2006	6.68
315BEF	05/14/2006	13
315BEF	06/27/2006	38.8
315BEF	07/26/2006	32.6
315BEF	08/22/2006	43.5
315BEF	09/26/2006	29.5
315BEF	10/25/2006	33.3
315BEF	11/15/2006	24.2
315BEF	12/13/2006	33

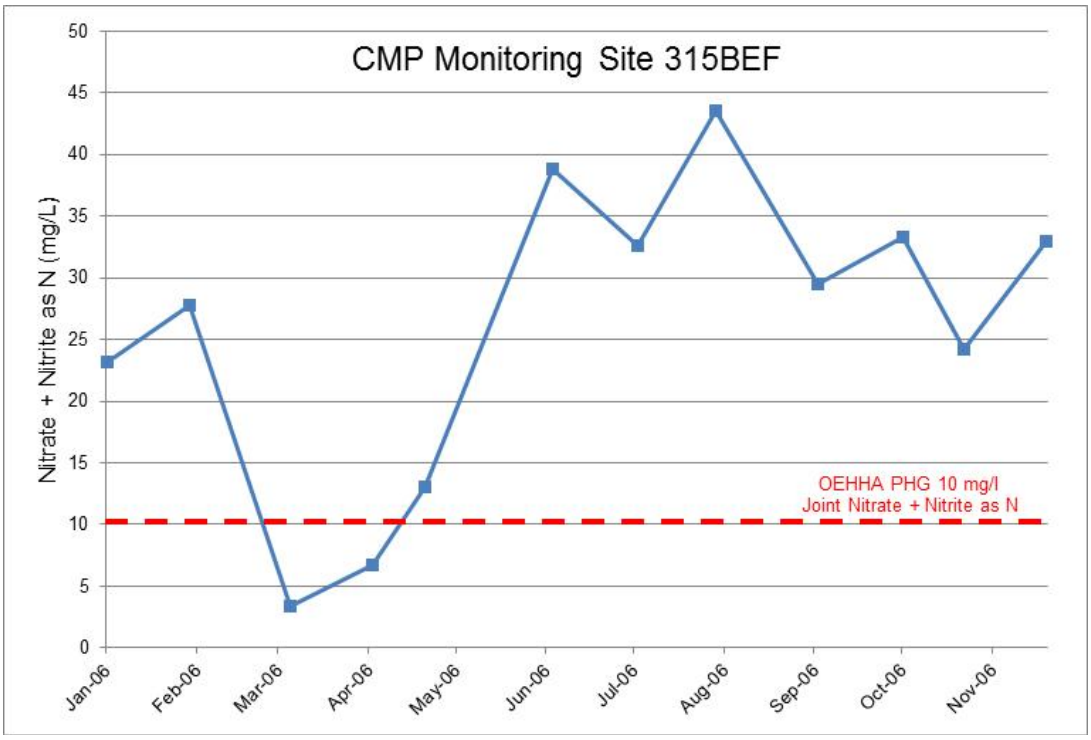

Figure 7. Graph of Joint Nitrate/Nitrite as Nitrogen (mg/L) for CMP Site 315BEF.

2.5.3 Problem statement

Bell Creek is impaired due to exceedance of the MUN water quality objective for nitrate. This project identifies the causes of impairment and describes solutions to achieve water quality objectives and protection of beneficial uses.

3 NUMERIC TARGETS

This section describes the numeric targets used to develop the TMDL. Numeric targets are water quality targets developed to ascertain when and where water quality objectives are achieved, and hence, when beneficial uses are protected.

3.1 Water Column Numeric Targets

Staff selected water column numeric target values for nitrate as a direct measure of water quality conditions for the protection of municipal and domestic supply (MUN) beneficial use. The Basin Plan numeric water quality objective for nitrate (as nitrogen) is 10 mg/L; therefore the nitrate target is set at the Basin Plan water quality objective as follows:

- *Receiving water column nitrate must not exceed 10 mg/L-N.*

4 SOURCE ANALYSIS

4.1 Introduction: Source Assessment Using STEPL Model

Excessive levels of nitrogen may reach surface waters as a result of human activities (USEPA, 1999). In this TMDL project report, nutrient source loading estimates were accomplished using the US Environmental Protection Agency's STEPL model. STEPL (Spreadsheet Tool for Estimating Pollutant Load) allows the calculation of nutrient loads from different land uses and source categories. STEPL provides a Visual Basic (VB) interface to create a customized, spreadsheet-based model in Microsoft (MS) Excel. STEPL calculates watershed surface runoff; nutrient loads, including nitrogen, phosphorus based on various land uses and watershed characteristics. For preliminary source assessment purposes, STEPL was used to estimate nutrient loads at the project area-scale. STEPL has been used previously in USEPA-approved TMDLs to estimate source loading[4].

[4] For example, see USEPA, 2010: Decision Document for Approval of White Oak Creek Watershed (Ohio) TMDL Report. February 25, 2010; and Indiana Dept. of Environmental Management, 2008. South Fork Wildcat Creek Watershed Pathogen, Sediment, and Nutrient TMDL.

For source assessment purposes, STEPL was used to estimate nutrient loads at the project area-scale. STEPL could also be used to allow for subwatershed-scale loading estimates. The annual nutrient loading estimate in STEPL is calculated based on the runoff volume and the pollutant concentrations in the runoff water as influenced by factors such as the land use distribution, precipitation data, soil characteristics, groundwater inputs, and management practices. Additional details on the model can be found at: http://it.tetratech-ffx.com/stepl/.

To estimate nitrate loads, STEPL requires area estimates for the following four land use classifications; urban, cropland, pastureland, and forest. Staff aggregated the NLDC land use/land cover classification to derive land use acreage required for STEPL as shown in Table 6.

Table 6. Aggregation of NLCD land use/land cover classifications for STEPL

NLCD Name	acres	STEPL Land Use Classification
Open Water	4.2	Forest
Developed Open Space	237.5	Urban
Developed, Low Intensity	145.0	Urban
Developed, Medium Intensity	43.6	Urban
Barren Land (Rock/Sand/Clay)	16.0	Forest
Evergreen Forest	454.6	Forest
Mixed Forest	970.5	Forest
Shrub/Scrub	1,280.1	Forest
Grassland/Herbaceous	245.3	Pastureland
Cultivated Crops	542.2	Cropland
Emergent Herbaceous Wetlands	3.3	Forest
Aggregated STEPL Land Use Classification		
STEPL Land Use Classification	**Acres**	
Urban	426.1	
Cropland	542.2	
Pastureland	245.3	
Forest	2728.8	

STEPL input parameters used in this nitrate source assessment is shown in Table 7 and the spreadsheet results are presented in APPENDIX B – STEPL Spreadsheets. It should be emphasized that nutrient load estimates calculated by STEPL are estimates and subject to uncertainties; actual loading at the local stream-reach scale can vary substantially due to numerous factors over various temporal and spatial scales.

Table 7. STEPL input data.

Input Category	Input Data	Sources of Data
Mean Annual Rainfall	18.68 inches/year	Santa Maria WSO Airport as provided in STEPL
Mean Rain Days/Year	42.3 days/year	Santa Maria WSO Airport as provided in STEPL
Weather Station (for rain correction factors)	0.865 Mean Annual Rainfall- 0.418 Mean Rain Days/Yr	Santa Maria WSO Airport as provided in STEPL
Land Cover	NLCD (see Table 6)	Aggregated NLCD land use/ land cover as represented in Table 6
Urban Land Use Distributions (impervious surfaces categories)	STEPL default values	STEPL
Septic system discharge and failure rate data	18 Systems 2.43 persons/system 2% failure rate	Estimated 18 systems based on 2010 NAIP Imagery. Population per system = 2.43 persons/system (National Average contained in STEPL). Failure rate of 2% (Typical range between 1 and 5%/year. De Walle, 1981 as cited in USEPA Preventing Septic system Failure)
Hydrologic Soil Group (HSG)	HSG "D"	HSG based on SSURGO soil data for TMDL project area
Soil N and P concentrations (%)	N = 0.10%	• N (%) – estimated national median value from information in GWLF User's Manual, v. 2.0 (Cornell University, 1992 - http://www.avgwlf.psu.edu/Downloads/GWLFManual.pdf).
NRCS reference runoff curve numbers	STEPL default values	NRCS default curve numbers provided in STEPL
Nutrient concentration in runoff (mg/L)	1.5 – 2.5 mg/L (urban) 13.8 mg/L (cropland) 1.26 mg/L (grazing land) 0.2 mg/L (forest)	• Urban lands –Used STEPL default values that contain a range of N runoff concentrations based on specific urban land use type (e.g., commercial, industrial, residential. Transportation, etc.). • N Concentration data for farmland from Southern California Coastal Water Research Project, Technical Report 335 (Nov. 2000), Appendix C. • N mean concentration for rangeland/pasture from USDA MANAGE database http://www.ars.usda.gov/Research/docs.htm?docid=11079 • Forest N and P runoff concentration: used STEPL default values
Nutrient concentration in shallow groundwater (mg/L).	1.52 mg/L (ag and urban) 1.44 mg/L (grazing lands) 0.11 mg/L (forest)	• NO3-N (ag and urban) – mean value for project area using USGS GWAVA model dataset . http://water.usgs.gov/GIS/metadata/usgswrd/XML/gwava-s_out.xml • NO3-N (grazing Lands and forest N default values from STEPL

Staff ran the STEPL model for the Bell Creek watershed.

4.1.1 Urban Runoff

Urban runoff can be a contributor of nutrients to waterbodies. Within residential areas, potential controllable nutrient sources can include lawn care fertilizers, grass clippings, organic debris from gardens and other greenwaste, trash, and pet waste (Tetratech, 2004). Many of these pollutants enter surface waters via runoff without undergoing treatment. Impervious cover characterizes urban areas and refers to roads, parking lots, driveways, asphalt, and any surface cover that precludes the infiltration of water into the soil. Pollutants deposited on impervious surface have the potential of being entrained by discharges of water from storm flows, wash water, or excess lawn irrigation, etc. and routed to storm sewers, and potentially being discharged to surface water bodies.

There is a wealth of data, both nationwide and from the central coast region, that characterizes nitrate-nitrogen concentrations in urban runoff (see Figure 8). These data (438 total samples) illustrate that nitrate concentrations in urban runoff virtually never exceed the 10 mg/L nitrate as nitrogen water quality objective protective of the MUN beneficial use. In fact, the central coast-specific urban runoff data (Santa Cruz and Monterey County) shown in Figure 8 infrequently exceed nitrate-N concentrations of 2 mg/L.

Less than five percent of the Bell Creek watershed is urbanized; 3.7% is low intensity development and 1.1% of this is medium intensity development. Low intensity development means that 20-49 percent of the surface area is impervious and medium intensity development means that 50-79 percent of the surface area is imperious. Using the weighted averages of impervious surfaces, about 0.4% of the watershed contributes urban runoff from impervious surfaces in developed areas.

Staff concludes that discharges of nitrate-nitrogen from urban lands to Bell Creek are zero, or negligible, and are not causing or contributing to impairment from nitrate-nitrogen.

States are to establish TMDLs at levels necessary to attain and retain numeric and narrative water quality standards.[5] As will be discussed in the following section, discharges from agricultural lands are the single source causing impairment of water quality standards for protection of the MUN beneficial use. Therefore, wasteload allocations for urban stormwater are not needed to retain and maintain water quality standards addressed in this TMDL.

[5] 40CFR130.7(c)(1)

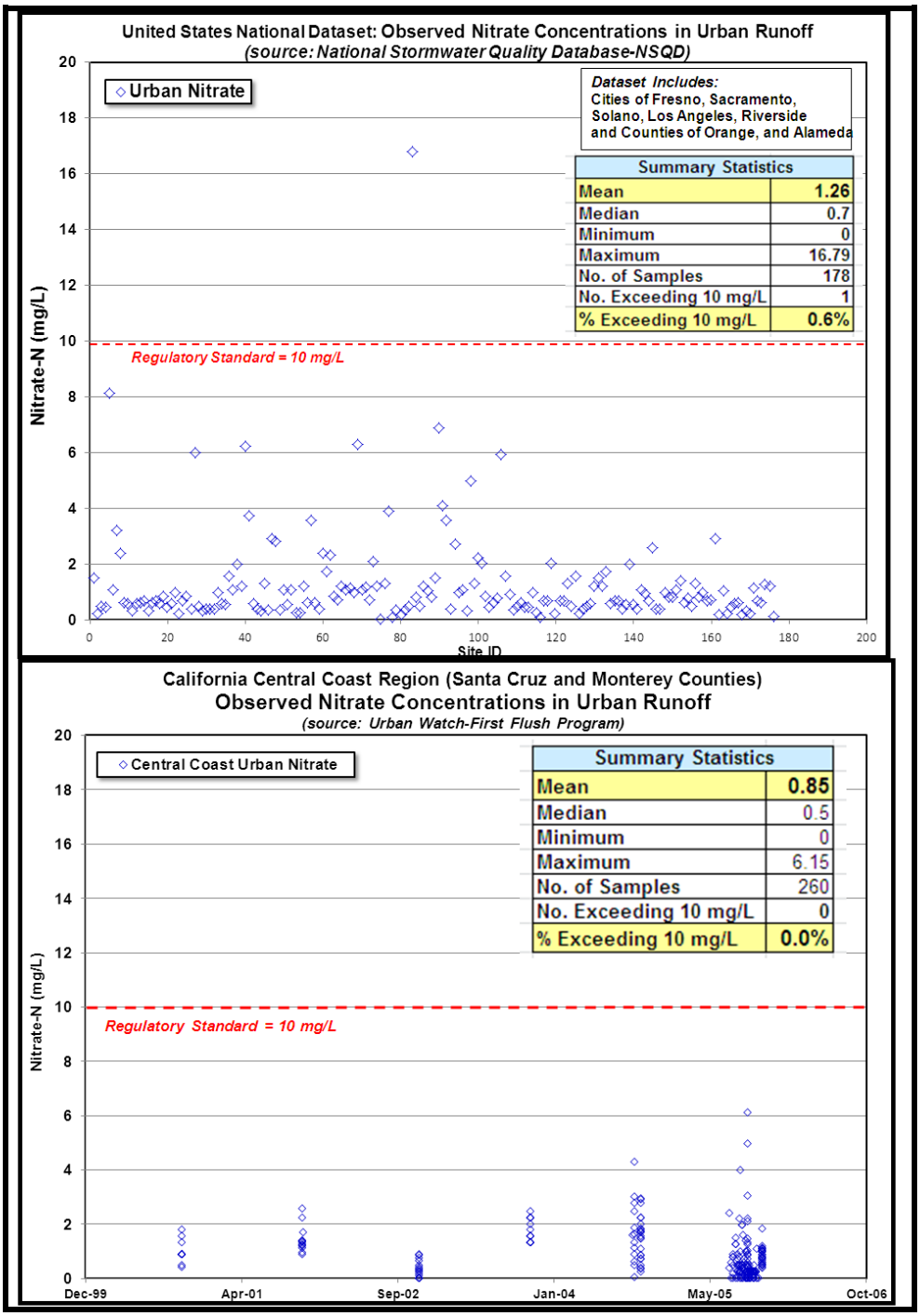

Figure 8. Nitrate concentration in urban runoff: national, California, and central coast regional data.

Using the parameter inputs identified in Section 4.1 the estimated annual nutrient load from urban runoff in the project area as calculated by STEPL is shown in Table 8.

Table 8. Urban Annual Load (lbs./year)

Source	N Load (lb/yr)
Urban	1,922

4.1.2 Agricultural Sources

Fertilizers or manure applied to cropland can constitute a significant source of nutrient loads to waterbodies. The primary concern with the application fertilizers on crops or forage areas is that the application can exceed the uptake capability of the crop. If this occurs, the excess nutrients become mobile and can be transported to either nearby surface waters, the groundwater table, or the atmosphere (Tetratech, 2004).

Figure 9 illustrates temporal trends of fertilizer sales in Santa Barbara County. It is important to recognize that fertilizer sales in a county does not necessarily mean those fertilizers were actually applied in that same county. Recorded sales in one county may actually be applied on crops in other, nearby counties. However, Krauter et al. (2002) reported fertilizer application estimates that were obtained from surveys, county farm advisors and crop specialists; these data indicated that in the Central Coast region, county fertilizer recorded sales correlated well with estimated in-county fertilizer applications (within 10 percent). Also, it is important to recognize that not all fertilizing material is sold to or applied to farm operations. The California Department of Food and Agriculture reports that for the annual period July 2007 to June 2008, non-farm entities purchased about 2.6% of fertilizing materials sold in Santa Barbara County[6].

[6] California Department of Food and Agriculture, Fertilizing Materials Tonnage Report, January – June 2008, pg. 10.

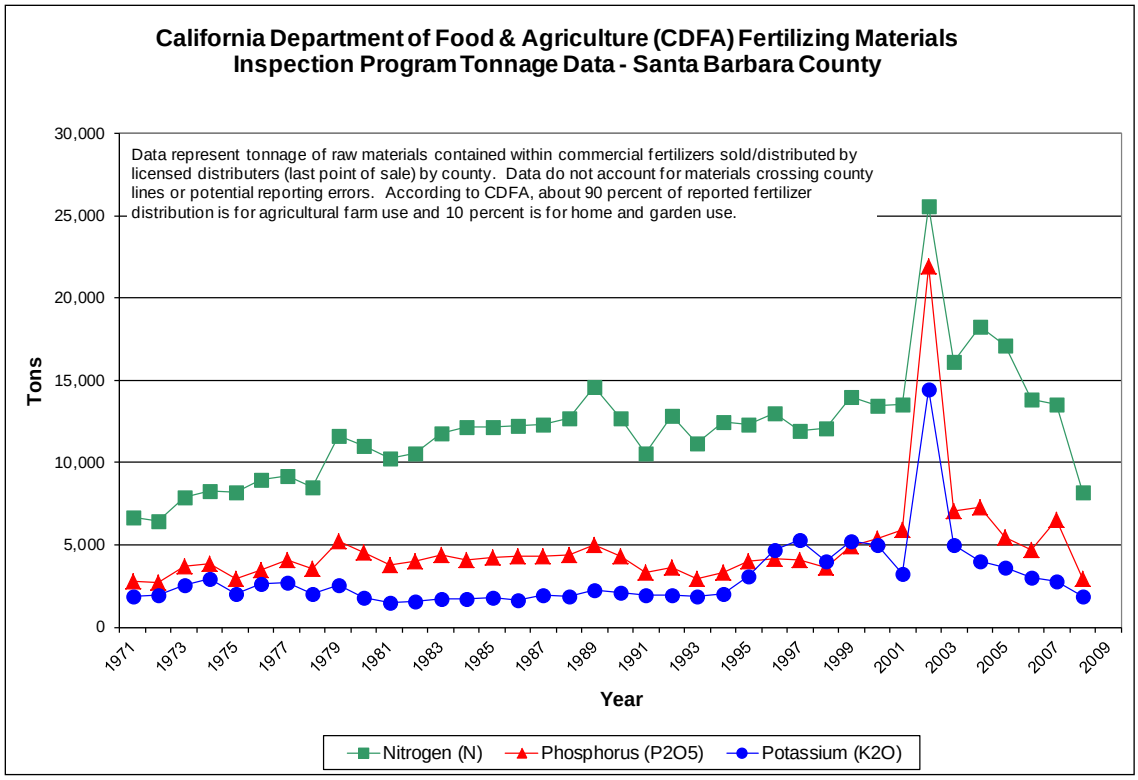

Figure 9. Fertilizer sales in Santa Barbara County.

California fertilizer application rates on specific crop types are available from the U.S. Department of Agriculture, National Agricultural Statistics Service (NASS), as shown in Table 9.

Table 9. California fertilizer application rates.

Crop	Application Rate per Crop Year in California (pounds per acre)			Source
	Nitrogen	Phosphate	Potash	
Tomatoes	243	133	174	2007 NASS report
Sweet Corn	226	127	77	2007 NASS report
Rice	124	46	34	2007 NASS report
Avocado	63	25	45	2009 NASS report
Lemon	67	39	59	2009 NASS report
Cotton	123	74	48	2008 NASS report
Barley	73	19	7	2004 NASS report
Oats[1]	64	35	50	2006 NASS report
Head Lettuce	200	118	47	2007 NASS report
Cauliflower	232	100	43	2007 NASS report
Broccoli	216	82	49	2007 NASS report
Celery	344	114	151	2007 NASS report
Asparagus	72	20	46	2007 NASS report
Spinach	150	60	49	2007 NASS report
Strawberries[2]	155	88	88	University of Delaware Ag, Nutrient Recommendations on Crops webpage

[1] insufficient reports to publish fertilizer data for P and potash; used national average from 2006 NASS report for P and K.
[2] median of ranges, calculated from table 1, table 4, and table 5 @ http://ag.udel.edu/other_websites/DSTP/Orchard.htm

Based on staff observations in the project area, cropland in the Bell Creek watershed is comprised primarily of orchards (avocado, citrus) with a smaller portion of truck crops (peas, beets, tomatoes) grown in the lower part of the watershed.

The estimated annual nutrient load from cropland in the project area as calculated by STEPL is shown in Table 10.

Table 10. Cropland Annual Load (lbs./year)

Source	N Load (lb/yr)
Cropland	26,736

4.1.3 Grazing Lands

Livestock and other domestic animals that spend significant periods of time in or near surface waters can contribute significant loads of nitrogen and phosphorus because they use only a portion of the nutrients fed to them and the remaining nutrients are excreted (Tetratech, 2004). For example, in a normal finishing diet, a yearling cattle will retain only between 10 percent and 20 percent of the nitrogen and phosphorus it is fed. The rest of the nutrients are excreted as waste, and are thus available for runoff into nearby waterbodies or into the groundwater (Koelsch and Shapiro, 1997 as reported in Tetratech, 2004).

The estimated annual nutrient load from grazing lands in the project area as calculated by STEPL is shown in Table 11.

Table 11. Grazing Lands Annual Load (lbs./year)

Source	N Load (lb/yr)
Grazing Lands	1,655

4.1.4 Forest and Undeveloped Lands

The estimated annual nutrient load from forest in the project area as calculated by STEPL is shown in Table 12. Note that the load from these lands represent loading from natural sources of nitrate.

Table 12. Forest Annual Load (lbs./year)

Source	N Load (lb/yr)
Forest	1,627

4.1.5 Onsite Disposal Systems (OSDS)

The estimated annual nitrate load from OSDS (i.e., septic systems) to surface waters in the project area as calculated by STEPL is shown in Table 13. Staff used National Agricultural Imagery Program (NAIP, 2010) aerial imagery to identify approximately 18 OSDS within the Bell Creek watershed. Based on this information, staff has concluded that OSDS discharges to surface waters within the project area are inconsequential. While the impacts of OSDS to underlying groundwater may be locally significant, researchers have concluded that at the basin-scale and regional-scale of agricultural valleys, OSDS impacts to groundwater are relatively insignificant as compared to agricultural fertilizer impacts (University of California-Davis, 2012).

The estimated annual nitrate load from OSDS in the project area as calculated by STEPL is shown in Table 13.

Table 13. OSDS Annual Load (lbs./year)

Source	N Load (lb/yr)
OSDS	11

4.1.6 Groundwater

Shallow groundwater provides the base flows to streams and can be a major source of surface water flows during the summer season. Therefore, dissolved nutrients in groundwater can be important nitrate source during dry periods. Ground water contamination from nitrate can occur from various sources, including septic systems, fertilizer application, animal waste, waste-lagoon sludge, and soil mineralization (USEPA, 1999).

The estimated annual nitrate load from groundwater in the project area as calculated by STEPL is shown in Table 14.

Table 14. Groundwater Annual Load (lbs./year)

Source	N Load (lb/yr)
Groundwater	470

4.2 Summary of Sources

It is worth reiterating that these are estimates for the TMDL project area. It is understood that there will be substantial variation due to temporal or local, site specific conditions. More information will be collected during TMDL implementation to assess controllable sources of nitrate. Table 15 and Figure 10 summarize estimated loads of nitrate based on information provided in Section 4.1.

Table 15. Summary of Estimated Loads

Sources	N Load (lb/yr)
Urban	1,922
Cropland	26,736
Grazing lands	1,655
Forest	1,627
Septic (OSDS)	11
Groundwater	470
Total	32,421

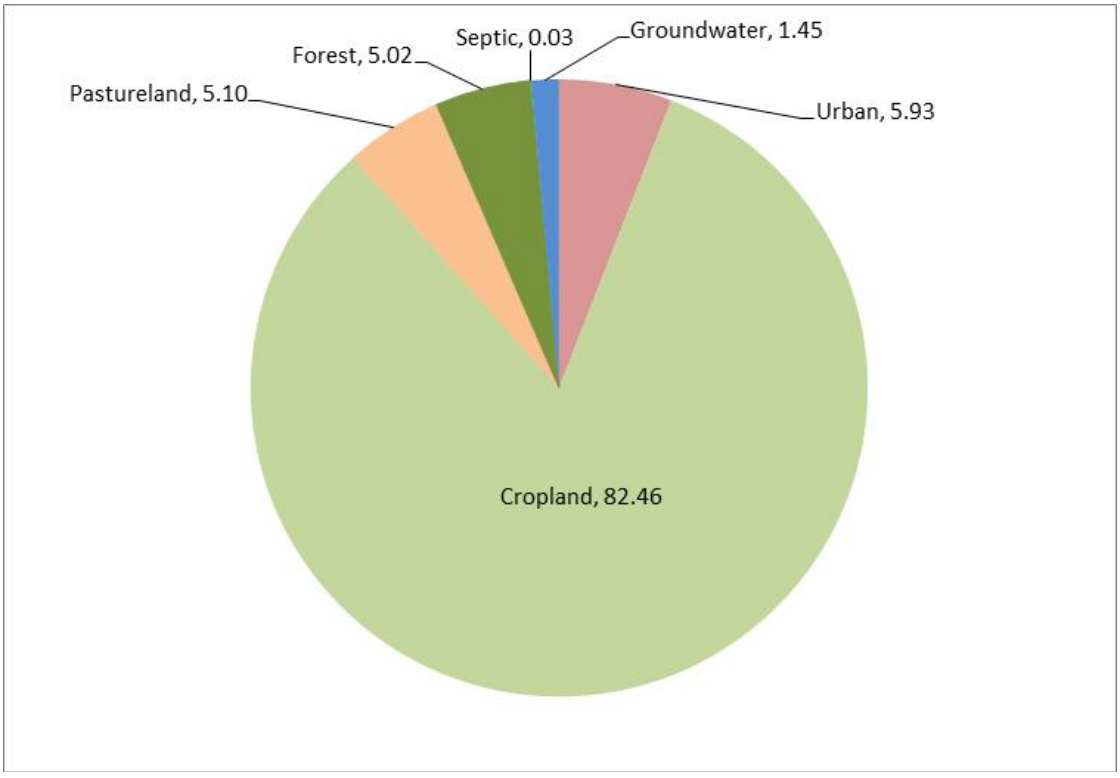

Figure 10. Summary of estimated nitrate loads (%).

4.3 Conclusions from Source Analysis

Staff concludes that discharges of nitrate from agricultural lands are the sole source of nitrate causing impairment.

5 LOADING CAPACITY AND ALLOCATIONS

5.1 Introduction

TMDLs are "[t]he sum of the individual waste load allocations for point sources and load allocations for nonpoint sources and natural background. TMDLs can be expressed in terms of either mass per time, toxicity, or other appropriate measure" in accordance with Code of Federal Regulations, Title 40, §130.2[i].

Staff proposes the establishment of concentration-based TMDLs in accordance with this provision of the Clean Water Act.

5.2 Loading Capacity (TMDL)

The TMDLs are set equal to the loading capacity. The loading capacity for the Bell Creek watershed is the amount of nitrate that can be assimilated without exceeding the water quality objectives. The allowable nitrate water column concentration that will achieve the water quality objectives for the municipal and domestic supply (MUN) beneficial use is equal to the numeric target.

The loading capacity, or Total Maximum Daily Load, for nitrate is a receiving water column concentration-based Total Maximum Daily Load and is applicable to each day of all seasons as indicated in Table 16.

Table 16. Concentration-based TMDL for nitrate

Impaired Waterbody Assigned TMDL	TMDL
	Nitrate as Nitrogen
Bell Creek (including all tributaries)	10 mg/L

5.3 Linkage Analysis

The goal of the linkage analysis is to establish a link between pollutant loads and desired water quality. This, in turn, ensures that the loading capacity specified in the TMDLs will result in attaining the desired water quality. For these TMDLs, this link is established because the load allocations are equal to the numeric targets, which are the same as the TMDLs. Therefore, reductions in nitrate loading will result in achieving the water quality standards.

5.4 Load Allocations

Table 17 shows load allocations assigned to responsible parties. The allocations are equal to the TMDLs. The allocations are receiving water allocations.

Table 17. Load allocations

LOAD ALLOCATIONS	
Responsible Party Assigned Allocation (Source)	**Receiving Water Allocation**
Owners/operators of irrigated agricultural lands in the Bell Creek Watershed (Discharges from irrigated lands)	10 mg/L Nitrate as Nitrogen
Natural Sources	10 mg/L Nitrate as Nitrogen

5.5 Margin of Safety

This TMDL incorporates an implicit margin of safety. The water column nitrate numeric target is derived from promulgated USEPA MCLs and OEHHA PHGs protocols. Therefore the loading capacity has the same conservative assumptions used in these procedures.

5.6 Critical Conditions, Seasonal Variation

A critical condition is the combination of environmental factors resulting in the water quality standard being achieved by a narrow margin, i.e., that a slight change in one of the environmental factors could result in exceedance of the water quality standard. Such a phenomenon could be significant if the TMDL were expressed in terms of load, and the allowed load was determined on achieving the water quality standard by a narrow margin. However, this TMDL is expressed as a concentration, which is equal to the desired water quality condition. Consequently, there are no critical conditions and the TMDL is applicable during all seasons.

Note that there is a general trend towards higher concentration during the dry season (see Figure 6 and Figure 7). Load allocations do not account for seasonal variation since the allocations are based on the water quality objective for nitrate, which is a concentration and applicable during all seasons. However, implementing parties will focus management efforts towards the dry season.

6 IMPLEMENTATION AND MONITORING

6.1 Introduction

This TMDL is being implemented by the Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands (Agricultural Order); this includes the order currently in effect and renewals or modifications thereof. Central Coast Water Board staff will conduct a review of implementation activities when monitoring and reporting data is submitted as required by the Agricultural Order. Central Coast Water Board staff will pursue modification of Agricultural Order conditions or other regulatory means (e.g. waste discharge requirements), as necessary, to address remaining impairments during the TMDL implementation phase.

Note that the current Agricultural Order requires dischargers to comply with applicable TMDLs. If the Agricultural Order did not provide the necessary requirements to implement this TMDL, staff would propose modifications of the Agricultural Order in order to achieve this TMDL. Staff has concluded that the current Agricultural Order provides the requirements necessary to implement this TMDL. Therefore, no new requirements are proposed as part of this TMDL.

Note that the Agricultural Order states that compliance is determined by: a) management practice implementation and effectiveness, b) treatment or control measures, c) individual discharge monitoring results, d) receiving water monitoring results, and e) related reporting. The Agricultural Order also requires that dischargers comply by implementing and improving management practices and complying with the other conditions, including monitoring and reporting requirements, which is consistent with the Nonpoint Source Pollution Control Program (NPS Policy, 2004). Finally, the Agricultural Order states that dischargers shall implement management practices, as necessary, to improve and protect water quality and to achieve compliance with applicable water quality objectives. Therefore, compliance with this TMDL is demonstrated through compliance with the Agricultural Order, which provides several avenues for demonstrating compliance, including management practices that improve water quality that lead to ultimate achievement of water quality objectives.

The Agricultural Order should prioritize implementation and monitoring efforts in stream reaches or areas where:

1) Water quality data and land use data indicate the largest magnitude of nutrient loading and/or impairments;
2) Reductions in nutrient loading, reductions in-stream nutrient concentrations, and/or implementation of improved nutrient management practices that will have the greatest benefit to human health in receiving waters
3) Crops that are grown that require high fertilizer inputs (see for example Table 9);
4) Other information such as proximity to water body; soils/runoff potential; irrigation and drainage practices, or relevant information provided by stakeholders, resource professionals, and/or researchers indicate a higher risk of nitrate impacts to

receiving waters.

Based on information developed for this project report, staff anticipates that the following areas will require high priority mitigation efforts:

- Bell Creek, including unnamed tributaries that drain Ellwood Canyon and Winchester Canyon

6.2 Implementation Requirements for Dischargers from Irrigated Agricultural Lands

Implementing parties must comply with the Conditional Waiver of Waste Discharge Requirements for Irrigated Lands (Order R3-2012-0011) and the Monitoring and Reporting Programs in accordance with Orders R3-2012-0011-01, R3-2012-0011-02, and R3-2012-0011-03., or its renewals or replacements to meet load allocations and achieve the TMDL. The requirements in these orders, and their renewals or replacements in the future, will implement the TMDLs and rectify the impairments addressed in this TMDL.

Current requirements in the Agricultural Order that will achieve the load allocations include:

a. Implement, and update as necessary, management practices to reduce nutrient loading.
b. Maintain existing, naturally occurring, riparian vegetative cover in aquatic habitat areas.
c. Develop/update and implement Farm Plans.
d. Properly destroy abandoned groundwater wells.
e. Develop, and initiate implementation of an Irrigation and Nutrient Management Plan (INMP) or alternative certified by a Professional Soil Scientist, Professional Agronomist, or Crop Advisor certified by the American Society of Agronomy, or similarly qualified professional.

6.2.1 Monitoring and Reporting Requirements

Owners and operators of irrigated agricultural lands must perform monitoring and reporting in accordance with Monitoring and Reporting Program Orders R3-2012-0011-01, R3-2012-0011-02, and R3-2012-0011-03, as applicable to the operation.

Recommended receiving water monitoring sites are:

- 315BEL (CCAMP site)
- 315BEF (CMP site)

6.2.2 Determination of Compliance with Load Allocations

Load allocations will be achieved through a combination of implementation of management practices and strategies to reduce nitrogen compound loading, and water quality monitoring. Flexibility to allow owners/operators from irrigated lands to demonstrate compliance with load allocations is a consideration; additionally, staff is aware that not all implementing parties are necessarily contributing to or causing surface water impairment. However, it is important to recognize that impacting shallow groundwater with nutrient pollution may also impact surface water quality via baseflow loading contributions to the creek.

To allow for flexibility, Water Board staff will assess compliance with load allocations using one or a combination of the following:

A. attaining the load allocations in the receiving water;
B. demonstrating quantifiable receiving water mass load reductions;
C. owners/operators of irrigated lands may be deemed in compliance with load allocations by implementing management practices that are capable of achieving load allocations identified in this TMDL;
D. owners/operators of irrigated lands may provide sufficient evidence to demonstrate that they are and will continue to be in compliance with the load allocations; such evidence could include documentation submitted by the owner/operator to the Executive Officer that the owner/operator is not causing waste to be discharged to impaired waterbodies resulting or contributing to violations of the load allocations.

6.3 Timeline and Milestones

The discharge of nitrate at toxic levels is a serious water quality problem. As such, implementation should occur at an accelerated pace to achieve the allocations and TMDL in the shortest time-frame feasible.

The target date to achieve the allocations, numeric targets, and TMDL in the impaired waterbodies addressed in this TMDL is October 1, 2016. This date coincides with the time schedule of milestones described in Table 4 of the Agricultural Order. Additionally, staff concludes that the TMDL is achievable by this date because the results of best management practices will be realized quickly. Best management practices will benefit water quality quickly because groundwater is not significantly contributing to surface water nitrate loading; the soils in the watershed are shallow, with low permeability, and groundwater nitrate concentration is less than 4.4 mg/L-N. Also, available information suggests that a relatively low number of agricultural operations are contributing to the impairment.

Water Board staff will reevaluate impairments caused by nitrate when monitoring data is submitted and during renewals of the Agricultural Order. Water Board staff will propose modifications of the Agricultural Order or other regulatory mechanisms, if necessary, to address remaining impairments.

6.4 Cost Estimate

Existing regulatory requirements are sufficient to attain water quality standards for nitrate in the project area. The Regional Board is not approving any new activity, but merely finding that ongoing activities and regulatory requirements are sufficient. Therefore, this TMDL is not a "project" that requires compliance with the California Environmental Quality Act (California Public Resources Code § 21000 et seq.) and the Central Coast Water Board is not directly undertaking an activity, funding an activity or issuing a permit or other entitlement for use by this action (Public Resources Code § 21065; 14 Cal. Code of Regs. §15378).

6.5 Existing Implementation Efforts

Some growers in the Bell Creek watershed are enrolled in the Agricultural Order. Therefore, these growers have met requirements aimed at addressing impaired waters. At the time of this document preparation, some growers were not yet enrolled in the Agricultural Order. Staff has ongoing efforts to enroll these growers in the Order.

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APPENDIX A – WATER QUALITY DATA

CCAMP Data – Nitrate as N for Site 315BEL

Station Code	Sample Date	Sample Time	Analyte Name	Unit	Result
315BEL	01/17/2001	15:10	Nitrate as N	mg/l	33.483
315BEL	02/13/2001	12:50	Nitrate as N	mg/l	2.584
315BEL	03/07/2001	12:05	Nitrate as N	mg/l	3.371
315BEL	04/04/2001	11:05	Nitrate as N	mg/l	12.112
315BEL	05/08/2001	12:43	Nitrate as N	mg/l	15.258
315BEL	06/04/2001	12:03	Nitrate as N	mg/l	19.079
315BEL	07/11/2001	11:42	Nitrate as N	mg/l	26.742
315BEL	08/07/2001	12:33	Nitrate as N	mg/l	26.067
315BEL	09/04/2001	10:50	Nitrate as N	mg/l	26.292
315BEL	09/04/2001	12:45	Nitrate as N	mg/l	26.292
315BEL	10/08/2001	11:54	Nitrate as N	mg/l	26.966
315BEL	11/05/2001	12:27	Nitrate as N	mg/l	26.000
315BEL	12/05/2001	11:32	Nitrate as N	mg/l	25.800
315BEL	01/03/2002	12:43	Nitrate as N	mg/l	24.300
315BEL	02/12/2002	12:36	Nitrate as N	mg/l	25.300
315BEL	03/07/2002	10:49	Nitrate as N	mg/l	15.700
315BEL	03/27/2002	12:05	Nitrate as N	mg/l	19.300

CCAMP Data – Nitrite as N for Site 315BEL

Station Code	Sample Date	Sample Time	Analyte Name	Unit	Result
315BEL	01/17/2001	15:10	Nitrite as N	mg/l	0.174
315BEL	02/13/2001	12:50	Nitrite as N	mg/l	0.015
315BEL	03/07/2001	12:05	Nitrite as N	mg/l	0.020
315BEL	04/04/2001	11:05	Nitrite as N	mg/l	0.039
315BEL	05/08/2001	12:43	Nitrite as N	mg/l	0.063
315BEL	06/04/2001	12:03	Nitrite as N	mg/l	0.063
315BEL	07/11/2001	11:42	Nitrite as N	mg/l	0.051
315BEL	08/07/2001	12:33	Nitrite as N	mg/l	0.066
315BEL	09/04/2001	10:50	Nitrite as N	mg/l	0.063
315BEL	09/04/2001	12:45	Nitrite as N	mg/l	0.063
315BEL	10/08/2001	11:54	Nitrite as N	mg/l	0.057
315BEL	11/05/2001	12:27	Nitrite as N	mg/l	0.080
315BEL	12/05/2001	11:32	Nitrite as N	mg/l	0.063
315BEL	01/03/2002	12:43	Nitrite as N	mg/l	0.077
315BEL	02/12/2002	12:36	Nitrite as N	mg/l	0.033
315BEL	03/07/2002	10:49	Nitrite as N	mg/l	0.092
315BEL	03/27/2002	12:05	Nitrite as N	mg/l	0.079

CMP Data – Joint Nitrate/Nitrite as N for Site 315BEF

Site Tag	Sample Date	Sample Time	Analyte Name	Unit	Result
315BEF	01/25/2006	12:40:00	Nitrate/Nitrite as N	mg/L	23.2
315BEF	02/22/2006	10:20:00	Nitrate/Nitrite as N	mg/L	27.8
315BEF	03/29/2006	10:45:00	Nitrate/Nitrite as N	mg/L	3.38
315BEF	04/26/2006	10:05:00	Nitrate/Nitrite as N	mg/L	6.68
315BEF	05/14/2006	13:35:00	Nitrate/Nitrite as N	mg/L	13
315BEF	06/27/2006	11:40:00	Nitrate/Nitrite as N	mg/L	38.8
315BEF	07/26/2006	11:05:00	Nitrate/Nitrite as N	mg/L	32.6
315BEF	08/22/2006	11:20:00	Nitrate/Nitrite as N	mg/L	43.5
315BEF	09/26/2006	10:15:00	Nitrate/Nitrite as N	mg/L	29.5
315BEF	10/25/2006	08:50:00	Nitrate/Nitrite as N	mg/L	33.3
315BEF	11/15/2006	09:50:00	Nitrate/Nitrite as N	mg/L	24.2
315BEF	12/13/2006	12:05:00	Nitrate/Nitrite as N	mg/L	33

APPENDIX B – STEPL SPREADSHEETS

STEPL Spreadsheets for Bell Creek Watershed

STEPL Input Sheet: Values in RED are required input. Change worksheets by clicking on tabs at the bottom. You entered 1 subwatershed(s).

This sheet is composed of eight input tables. The first four tables require users to change initial values. The next four tables (initially hidden) contain default values users may choose to change.

Step 1: Select the state and county where your watersheds are located. Select a nearby weather station. This will automatically specify values for rainfall parameters in Table 1 and USLE parameters in Table 4.

Step 2: (a) Enter land use areas in acres in Table 1; (b) enter total number of agricultural animals by type and number of months per year that manure is applied to croplands in Table 2;
(c) enter values for septic system parameters in Table 3; and (d) if desired, modify USLE parameters associated with the selected county in Table 4.

Step 3: You may stop here and proceed to the BMPs sheet. If you have more detailed information on your watersheds, click the Yes button in row 10 to display optional input tables.

Step 4: (a) Specify the representative Soil Hydrologic Group (SHG) and soil nutrient concentrations in Table 5; (b) modify the curve number table by landuse and SHG in Table 6;
(c) modify the nutrient concentrations (mg/L) in runoff in Table 7; and (d) specify the detailed land use distribution in the urban area in Table 8.

Step 5: Select BMPs in BMPs sheet. **Step 6**: View the estimates of loads and load reductions in Total Load and Graphs sheets.

Show optional input tables? Yes No ☑ Treat all the subwatersheds as parts of a single watershed ☑ Groundwater load calculation

State	County	Weather Station (for rain correction factors)
California	Santa Barbara	CA SANTA MARIA WSO ARPT

1. Input watershed land use area (ac) and precipitation (in)

									Rain correction factors 0.865	0.418	
Watershed	Urban	Cropland	Pastureland	Forest	User Defined	Feedlots	Feedlot Percent Paved	Total	Annual Rainfall	Rain Days	Avg. Rain/Event
W1	426.1	542.2	245.3	2729	0	0	0-24%	3942.6	18.68	42.3	0.914

2. Input agricultural animals

Watershed	Beef Cattle	Dairy Cattle	Swine (Hog)	Sheep	Horse	Chicken	Turkey	Duck	# of months manure applied
W1	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	

3. Input septic system and illegal direct wastewater discharge data

Watershed	No. of Septic Systems	Population per Septic System	Septic Failure Rate, %	Wastewater Direct Discharge, # of People	Direct Discharge Reduction, %
W1	18	2.43	2	0	0

4. Modify the Universal Soil Loss Equation (USLE) parameters

Watershed	Cropland					Pastureland					Forest				
	R	K	LS	C	P	R	K	LS	C	P	R	K	LS	C	P
W1	62.886	0.269	9.274	0.200	0.998	62.886	0.269	9.274	0.040	1.000	62.886	0.269	9.274	0.003	1.000

Optional Data Input:

5. Select average soil hydrologic group (SHG), SHG A = highest infiltration and SHG D = lowest infiltration

Watershed	SHG A	SHG B	SHG C	SHG D	SHG Selected	Soil N conc.%	Soil P conc.%	Soil BOD conc.%
W1	○	○	○	◉	D	0.100	0.080	0.200

Optional Data Input:

5. Select average soil hydrologic group (SHG), SHG A = highest infiltration and SHG D = lowest infiltration

Watershed	SHG A	SHG B	SHG C	SHG D	SHG Selected	Soil N conc.%	Soil P conc.%	Soil BOD conc.%
W1	○	○	○	◉	D	0.100	0.080	0.200

6. Reference runoff curve number (may be modified)

SHG	A	B	C	D
Urban	83	89	92	93
Cropland	67	78	85	89
Pastureland	49	69	79	84
Forest	39	60	73	79
User Defined	50	70	80	85

6a. Detailed urban reference runoff curve number (may be modified)

Urban\SHG	A	B	C	D
Commercial	89	92	94	95
Industrial	81	88	91	93
Institutional	81	88	91	93
Transportatic	98	98	98	98
Multi-Family	77	85	90	92
Single-Famil	57	72	81	86
Urban-Cultiv	67	78	85	89
Vacant-Devel	77	85	90	92
Open Space	49	69	79	84

7. Nutrient concentration in runoff (mg/l)

Land use	N	P	BOD
1. L-Croplan	**13.81**	**0.64**	**4**
1a. w/ manur	8.1	2	12.3
2. M-Croplan	**13.81**	**0.64**	**6.1**
2a. w/ manur	12.2	3	18.5
3. H-Croplan	**13.81**	**0.64**	**9.2**
3a. w/ manur	18.3	4	24.6
4. Pasturelar	**1.26**	**0.3**	**13**
5. Forest	**0.2**	**0.1**	**0.5**
6. User Defin	**0**	**0**	**0**

7a. Nutrient concentration in shallow groundwater (mg/l) (may be modified)

Landuse	N	P	BOD
Urban	1.52	0.079	0
Cropland	1.52	0.079	0
Pastureland	1.44	0.063	0
Forest	0.11	0.009	0
Feedlot	6	0.07	0
User-Defined	0	0	0

8. Input or modify urban land use distribution

Watershed	Urban Area (ac.)	Commercial %	Industrial %	Institutional %	Transportation %	Multi-Family %	Single-Family %	Urban-Cultivated %	Vacant (developed)	Open Space %	Total % Area
W1	426.1	15	10	10	10	10	30	5	5	5	100

9. Input irrigation area (ac) and irrigation amount (in)

Watershed	Total Cropland (ac)	Cropland: Acres Irrigated	Water Depth (in) per Irrigation - Before BMP	Water Depth (in) per Irrigation - After BMP	Irrigation Frequency (#/Year)
W1	542.2	0	0	0	0

Input Ends Here.

Total Load This is the summary of annual nutrient and sediment load for each subwatershed. This sheet is initially protected.

a. Nutrient load from runoff (lb/year) without BMPs

Watershed	Cropland			Pastureland			Forest			User Defined			Total		
	N	P	BOD	N	P	BOD	N	P	BOD	N	P	BOD	N	P	BOD
W1	13157.8	609.8	3811.1	423.9	100.9	4373.7	600.2	300.1	1500.4	0.0	0.0	0.0	14181.9	1010.8	9685.2
Total	13157.8	609.8	3811.1	423.9	100.9	4373.7	600.2	300.1	1500.4	0.0	0.0	0.0	14181.9	1010.8	9685.2

b. Nutrient load reduction in runoff with BMPs (lb/year)

Watershed	Cropland			Pastureland			Forest			User Defined			Total		
	N	P	BOD	N	P	BOD	N	P	BOD	N	P	BOD	N	P	BOD
W1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

1. Total load by subwatershed(s)

Watershed	N Load (no BMP)	P Load (no BMP)	BOD Load (no BMP)	Sediment Load (no BMP)	N Reduction	P Reduction	BOD Reduction	Sediment Reduction	N Load (with BMP)	P Load (with BMP)	BOD (with BMP)	Sediment Load (with BMP)	%N Reduction	%P Reduction	%BOD Reduction	%Sed Reduction
	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	%	%	%	%
W1	32420.9	14008.7	48958.5	4003.1	0.0	0.0	0.0	0.0	32420.9	14008.7	48958.5	4003.1	0.0	0.0	0.0	0.0
Total	32420.9	14008.7	48958.5	4003.1	0.0	0.0	0.0	0.0	32420.9	14008.7	48958.5	4003.1	0.0	0.0	0.0	0.0

c. Nutrient and sediment load by land uses with BMP (lb/year)

Watershed	Urban				Cropland				Pastureland				Forest			
	N	P	BOD	Sediment	N	P	BOD	Sediment	N	P	BOD	Sediment	N	P	BOD	Sediment
W1	1921.7	298.8	7555.9	88326.3	26735.8	11472.2	30967.1	6788995.9	1654.8	1085.6	6835.4	615420.9	1627.2	1121.7	3554.4	513498.9
Total	1921.7	298.8	7555.9	88326.3	26735.8	11472.2	30967.1	6788995.9	1654.8	1085.6	6835.4	615420.9	1627.2	1121.7	3554.4	513498.9

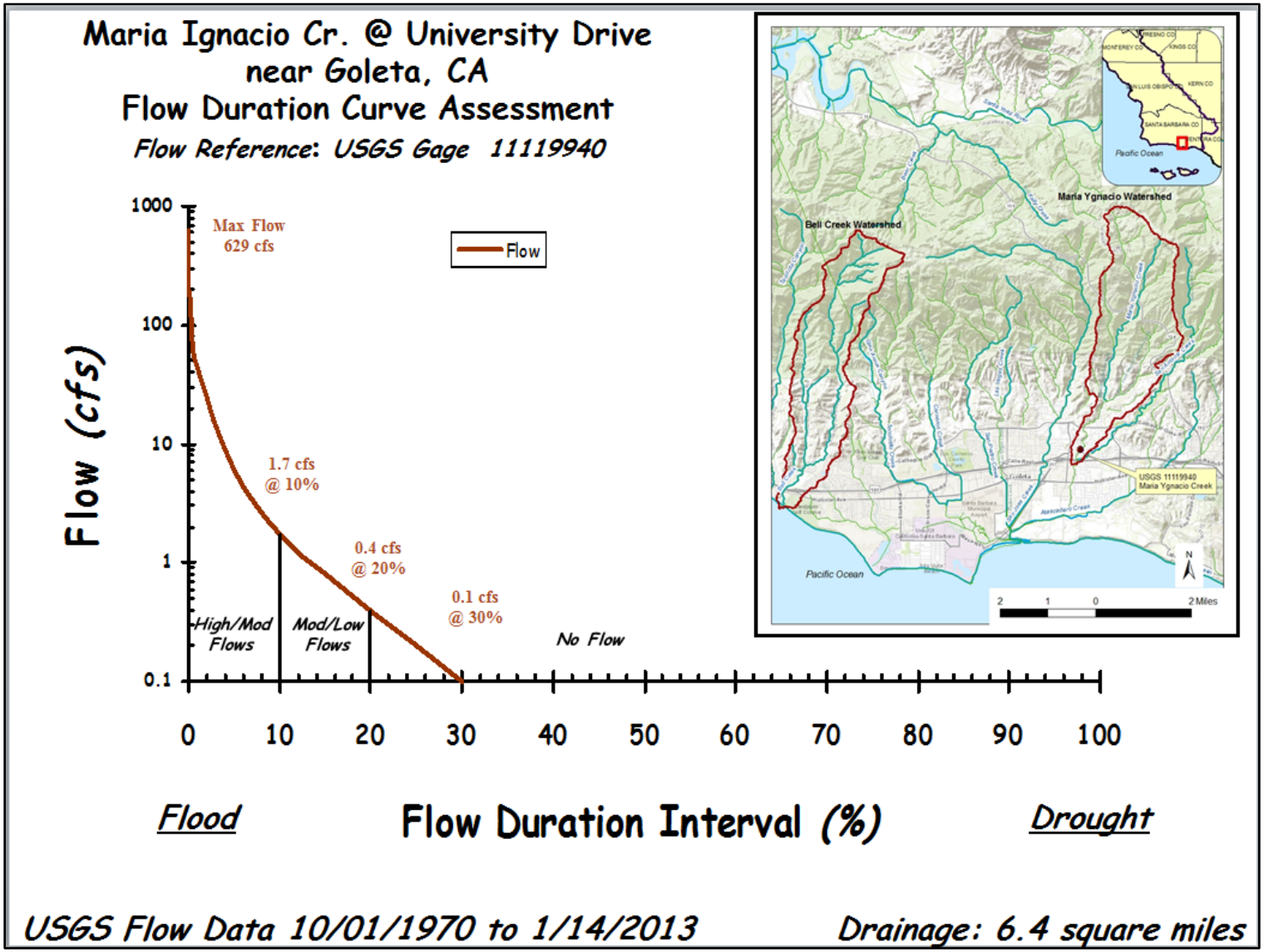
d. Load from groundwater by land uses with BMP (lb/year)

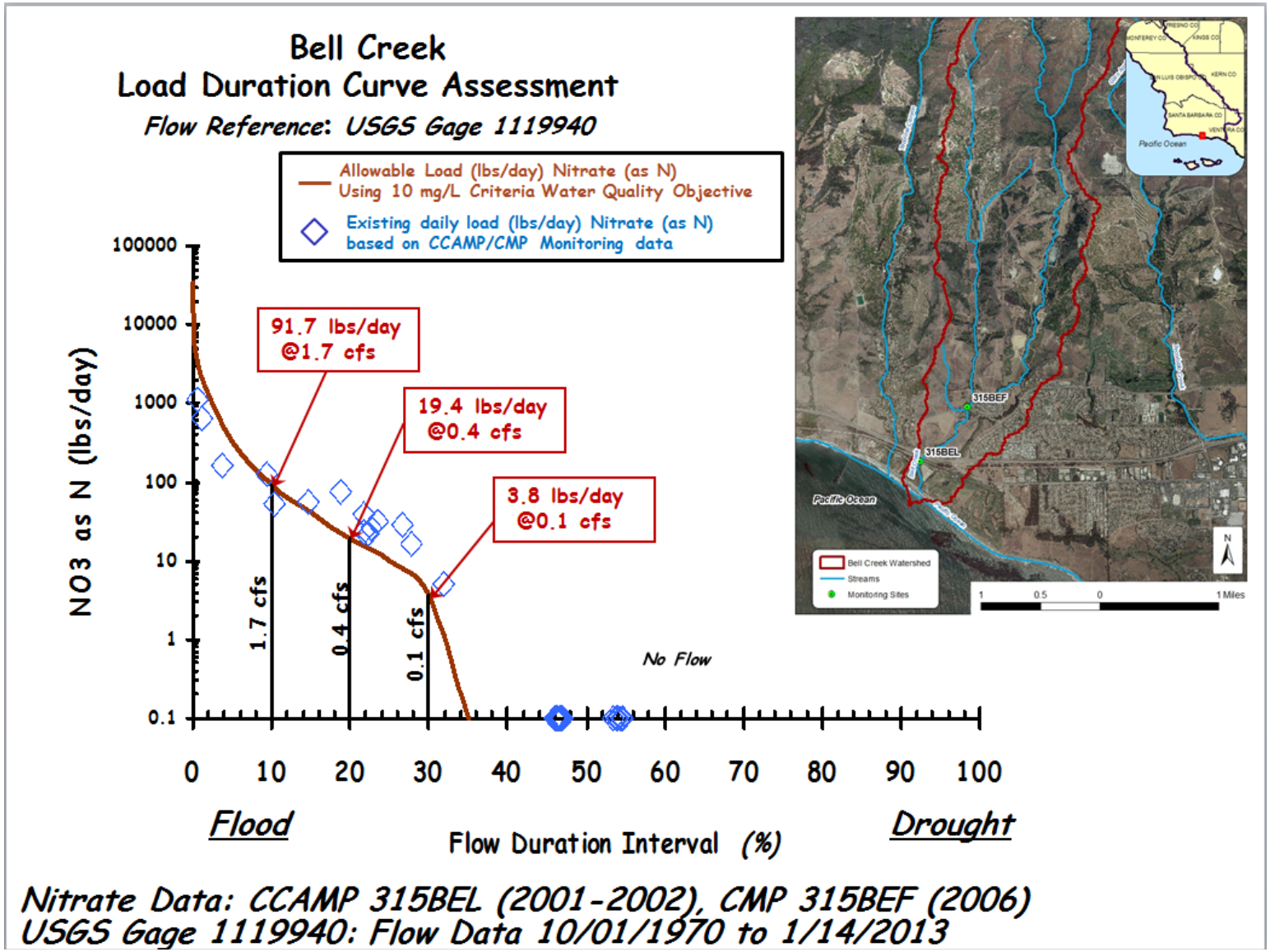
Watershed	Urban				Cropland				Pastureland				Forest			
	N	P	BOD	Sediment	N	P	BOD	Sediment	N	P	BOD	Sediment	N	P	BOD	Sediment
W1	64.9	3.4	0.0		226.1	11.8	0.0		96.9	4.2	0.0		82.4	6.7	0.0	
Total	64.9	3.4	0.0	0.0	226.1	11.8	0.0	0.0	96.9	4.2	0.0	0.0	82.4	6.7	0.0	0.0

2. Total load by land uses (with BMP)

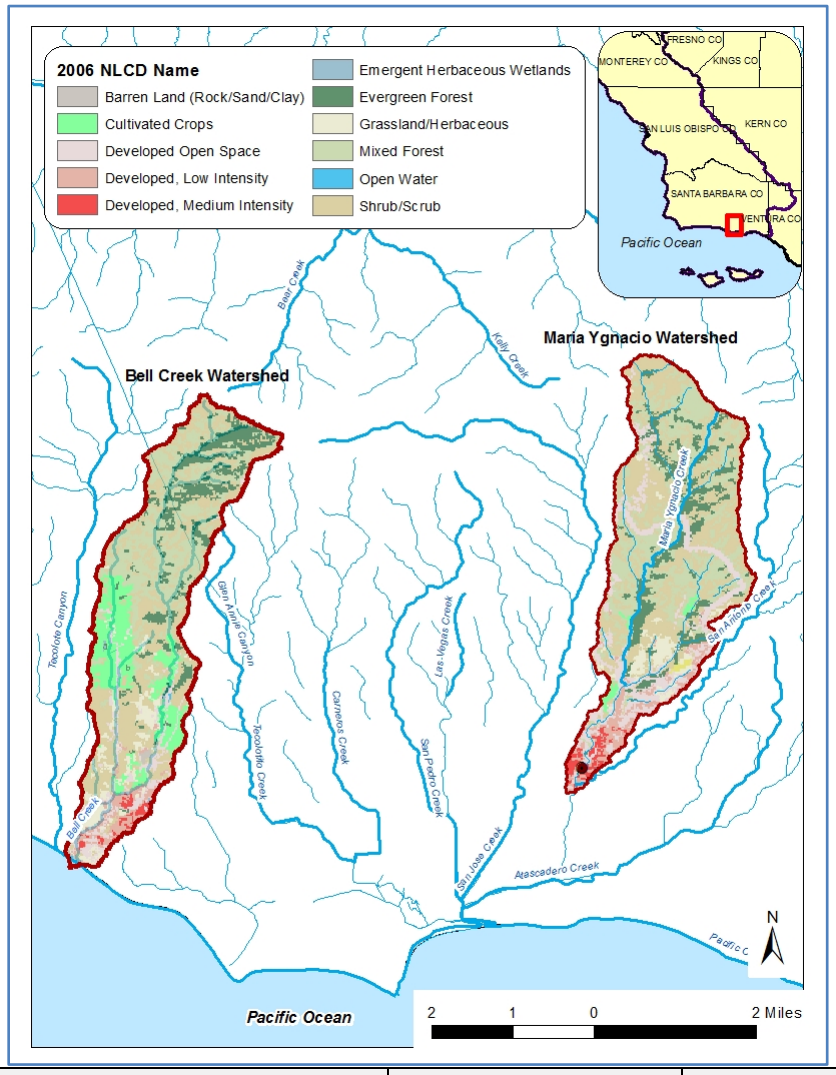
Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (t/yr)
Urban	1921.65	298.77	7555.90	44.16
Cropland	26735.76	11472.17	30967.07	3394.50
Pastureland	1654.75	1085.60	6835.37	307.71
Forest	1627.17	1121.69	3554.43	256.75
Feedlots	0.00	0.00	0.00	0.00
User Defined	0.00	0.00	0.00	0.00
Septic	11.19	4.38	45.70	0.00
Gully	0.00	0.00	0.00	0.00
Streambank	0.00	0.00	0.00	0.00
Groundwater	470.33	26.11	0.00	0.00
Total	32420.86	14008.72	48958.47	4003.12

APPENDIX C – LOAD DURATION CURVE ASSESSMENT

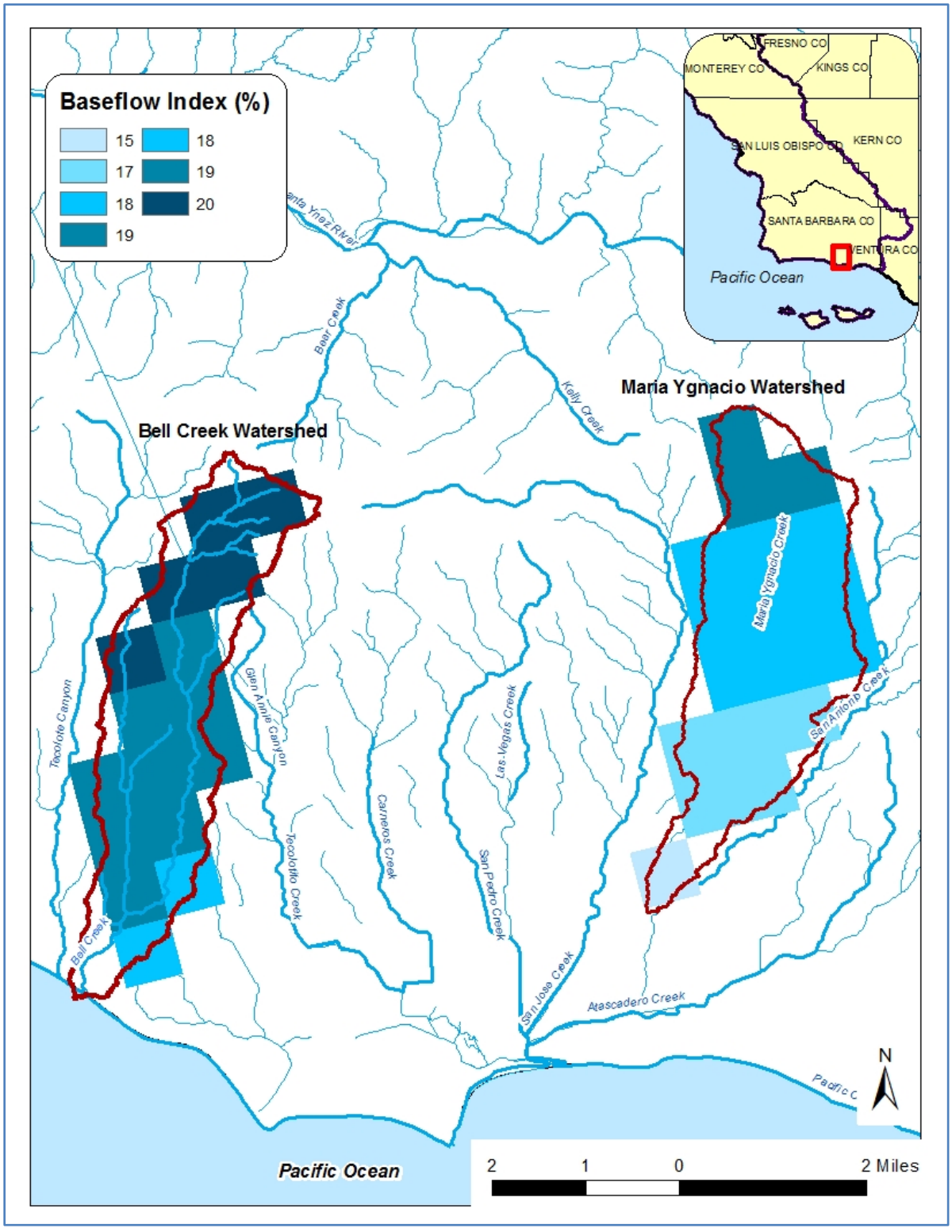


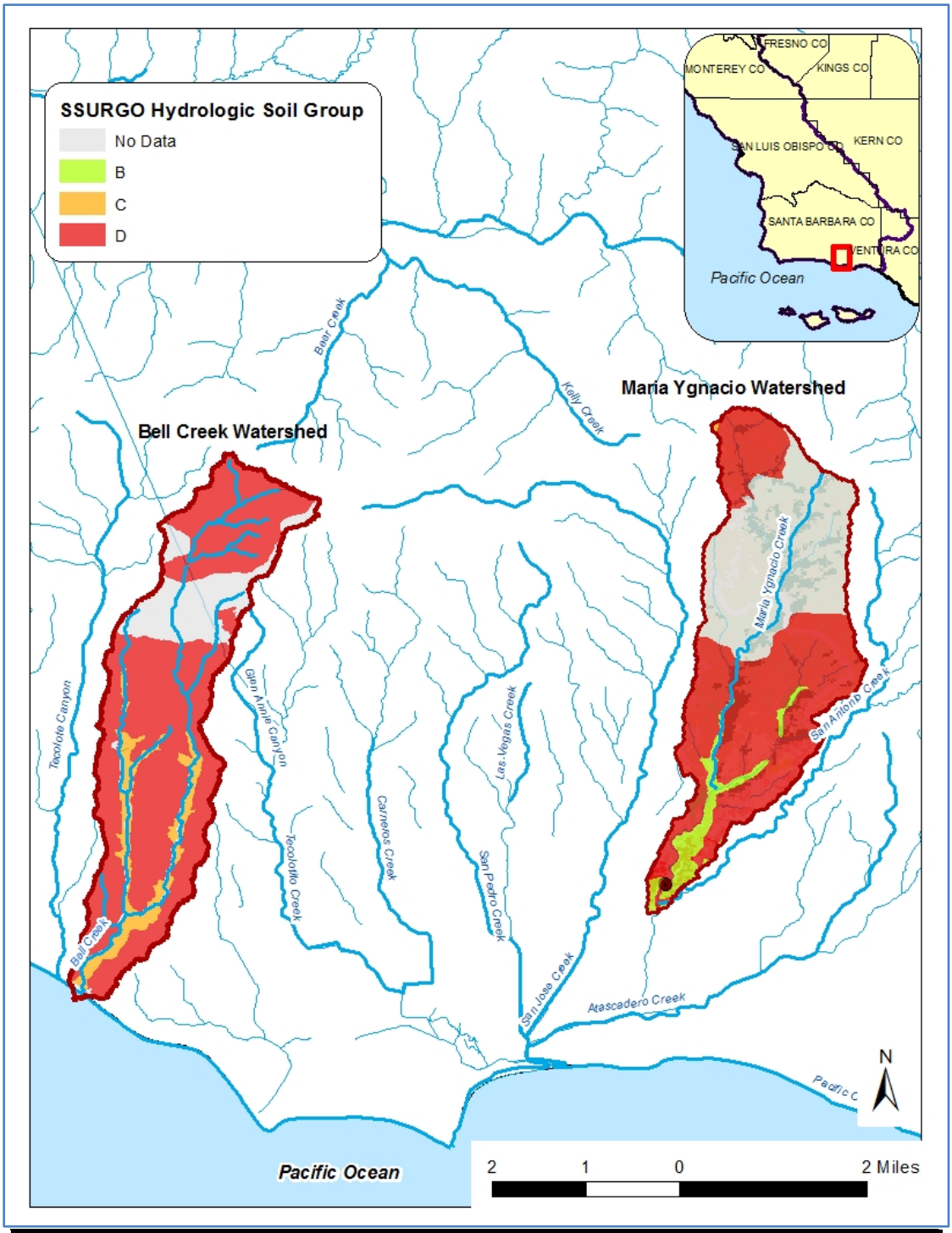

Bell Creek
Load Duration Curve Assessment
Flow Reference: USGS Gage 1119940
Allowable Load (lbs/day) Nitrate (as N)
Using 10 mg/L Criteria Water Quality Objective
Existing daily load (lbs/day) Nitrate (as N)
based on CCAMP/CMP Monitoring data
91.7 lbs/day
@1.7 cfs
19.4 lbs/day
@0.4 cfs
3.8 lbs/day
@0.1 cfs
1.7 cfs
0.4 cfs
0.1 cfs
No Flow
NO3 as N (lbs/day)
100000
10000
1000
100
10
1
0.1
0
10
20
30
40
50
60
70
80
90
100
Flood
Flow Duration Interval (%)
Drought
315BEF
315BEL
Pacific Ocean
Bell Creek Watershed
Streams
Monitoring Sites
1 Miles
Nitrate Data: CCAMP 315BEL (2001-2002), CMP 315BEF (2006)
USGS Gage 1119940: Flow Data 10/01/1970 to 1/14/2013

APPENDIX D – SUPPLEMENTAL FIGURES



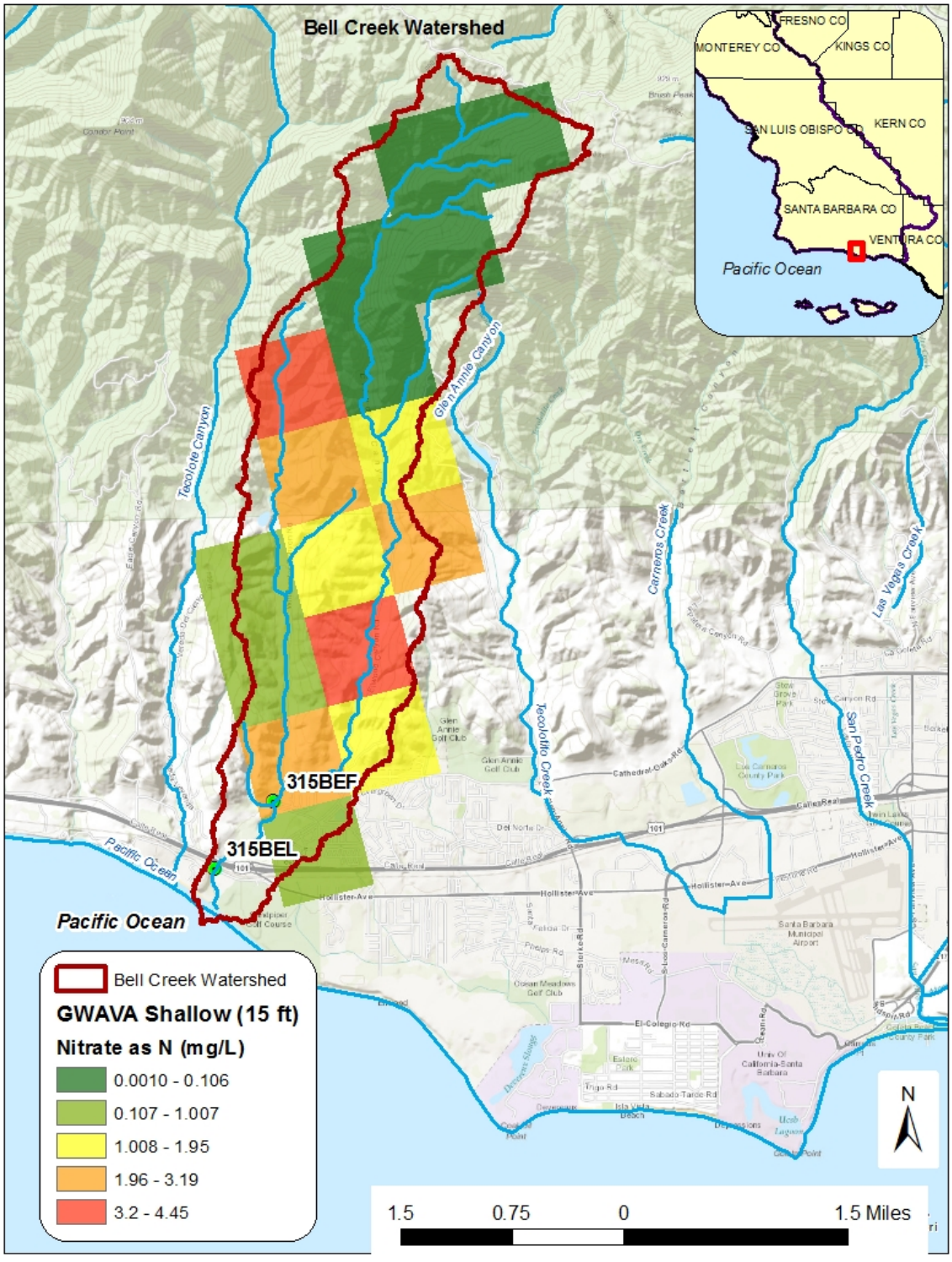
NLCD CODE	NLCD NAME	% Bell Cr Watershed	% Maria Ygnacio Watershed
11	Open Water	0.1	--
21	Developed Open Space	6.0	14.3
22	Developed, Low Intensity	3.7	5.0
23	Developed, Medium Intensity	1.1	1.7
31	Barren Land (Rock/Sand/Clay)	0.4	--
42	Evergreen Forest	11.5	11.8
43	Mixed Forest	24.6	27.2
52	Shrub/Scrub	32.5	34.8
71	Grassland/Herbaceous	6.2	3.9
81	Pasture/Hay	--	0.3
82	Cultivated Crops	13.8	1.0
95	Emergent Herbaceous Wetlands	0.1	--

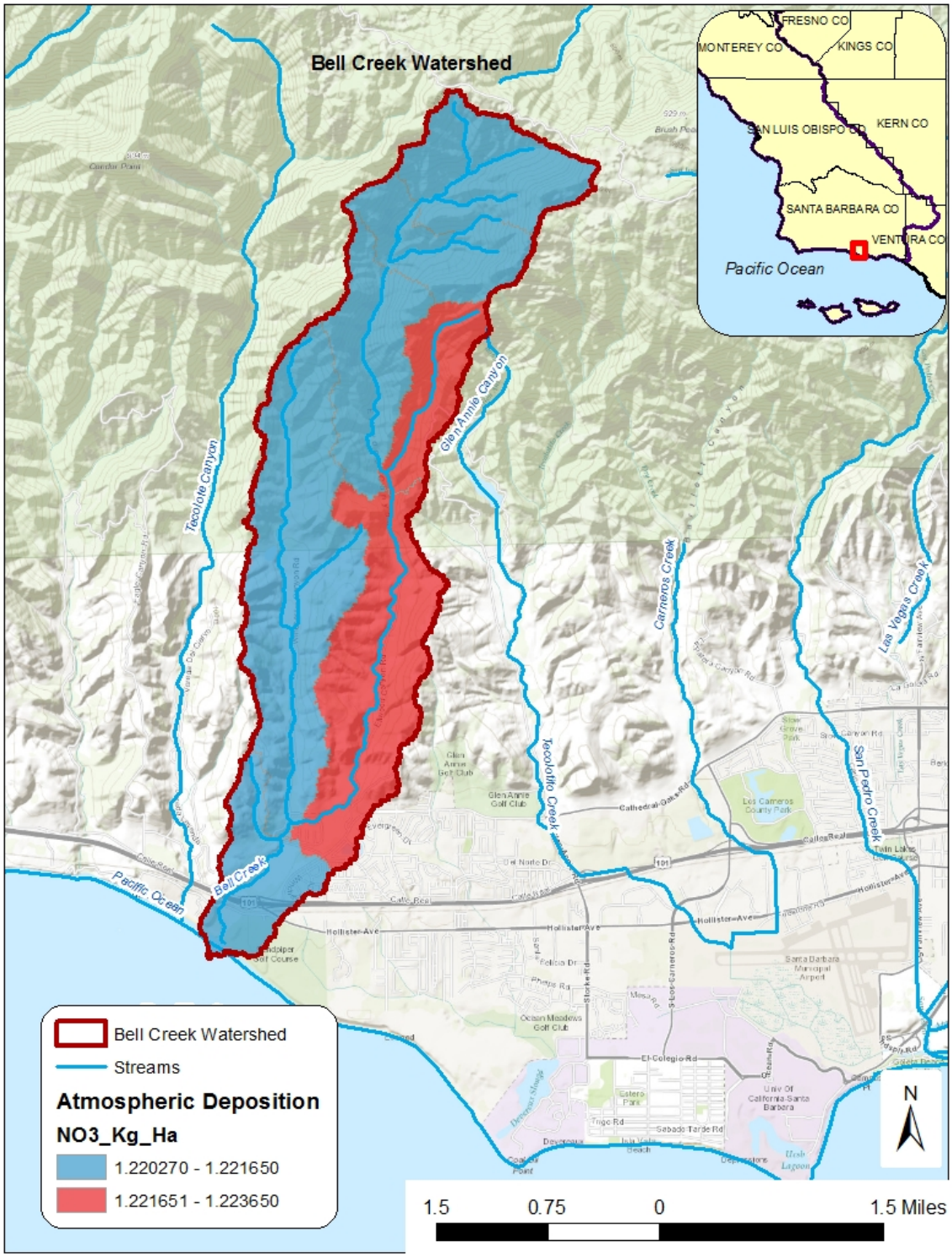

Baseflow Index (%)
15
17
18
19
18
19
20
FRESNO CO
MONTEREY CO
KINGS CO
SAN LUIS OBISPO CO
KERN CO
SANTA BARBARA CO
VENTURA CO
Pacific Ocean
Santa Ynez River
Bear Creek
Kelly Creek
Bell Creek Watershed
Maria Ygnacio Watershed
Maria Ygnacio Creek
San Antonio Creek
Tecolote Canyon
Glen Annie Canyon
Tecolotito Creek
Carneros Creek
Las Vegas Creek
San Pedro Creek
San Jose Creek
Bell Creek
Atascadero Creek
Pacific Ocean
N
2
1
0
2 Miles



Hydrologic Soil Group Descriptions:	
A	Well-drained sand and gravel; high permeability
B	Moderate to well-drained; fine to moderately course texture; moderate permeability
C	Poor to moderately well-drained; moderately fine to fine texture; slow permeability
D	Poorly drained; clay soils, or shallow soils over nearly impervious layers(s)

Note: There are no class A soils in the Project Area.


Bell Creek Watershed
FRESNO CO
MONTEREY CO
KINGS CO
KERN CO
SAN LUIS OBISPO CO
SANTA BARBARA CO
VENTURA CO
Pacific Ocean
Glen Annie Canyon
Tecolote Canyon
Carneros Creek
Las Vegas Creek
Tecolotito Creek
San Pedro Creek
315BEF
315BEL
Pacific Ocean
Bell Creek Watershed
GWAVA Shallow (15 ft)
Nitrate as N (mg/L)
0.0010 - 0.106
0.107 - 1.007
1.008 - 1.95
1.96 - 3.19
3.2 - 4.45
N
1.5
0.75
0
1.5 Miles


Bell Creek Watershed
FRESNO CO
KINGS CO
MONTEREY CO
KERN CO
SAN LUIS OBISPO CO
SANTA BARBARA CO
VENTURA CO
Pacific Ocean
Tecolote Canyon
Glen Annie Canyon
Carneros Creek
Las Vegas Creek
Tecolotito Creek
San Pedro Creek
Bell Creek
Pacific Ocean
Glen Annie Golf Club
Los Carneros County Park
Cathedral Oaks Rd
Calle Real
Hollister Ave
Santa Barbara Municipal Airport
Ocean Meadows Golf Club
El Colegio Rd
Univ Of California-Santa Barbara
Isla Vista Beach
Goleta Beach
Bell Creek Watershed
Streams
Atmospheric Deposition
NO3_Kg_Ha
1.220270 - 1.221650
1.221651 - 1.223650
N
1.5
0.75
0
1.5 Miles