CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY

Central Coast Regional Water Quality Control Board

Total Maximum Daily Loads to Address Nutrient Impairment of Franklin Creek within the Carpinteria Salt Marsh Watershed

Santa Barbara County, California

Draft
Water Quality Data Analysis Report

October 2016

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1 PREFACE

The purpose of this Draft Water Quality Data Analysis Report is to present preliminary water quality data that may be used to develop nutrient total maximum daily loads (TMDLs) for Franklin Creek within the Carpinteria Salt Marsh watershed. The "placeholders" within this document highlight content that has yet to be to be developed. These placeholders are intended to assist the reader in understanding the planned structure and content of TMDL documentation. Note that the current content of this draft document is a "work in progress", and thus subject to revision and change during the course of TMDL development.

Franklin Creek is currently contained on the federal Clean Water Act section 303(d) list of impaired waterbodies (303(d) list) due to excessive nitrate concentrations. In addition, water quality data indicate that excessive nutrient inputs into Franklin Creek result in dissolved oxygen supersaturation and excessive algal biomass that are reflective of biostimulatory conditions.

Carpinteria Salt Marsh was placed on the 303(d) list due to nutrients and organic enrichment/low dissolved oxygen in the mid 1990's. However, the basis for these listings is not consistent with the current 303(d) listing criteria contained in the *Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) list*, September 2004, amended February 2015 (Listing Policy). In addition, adequate water quality data for the Carpinteria Salt Marsh is not available to evaluate these impairments in a manner consistent with the Listing Policy. As a result, Carpinteria Salt Marsh TMDLs that specifically addresses nutrients, organic enrichment, and low dissolved oxygen impairments are not proposed at this time. The State Water Resources Control Board (State Water Board) is developing nutrient objectives for California which will provide guidance on addressing these impairments and establishing future nutrient-related TMDLs for the Carpinteria Salt Marsh if necessary.

2 BACKGROUND

The federal Clean Water Act requires every state to evaluate its waterbodies and maintain a list of waters that are impaired either because the water exceeds water quality standards or does not achieve its designated beneficial uses. This is known as California's federal Clean Water Act section 303(d) list of impaired waterbodies (303(d) list). For central coast waterbodies that are on the 303(d) 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 removed from the 303(d) list.

Total maximum daily load (TMDL) is a term used to describe the maximum amount of a pollutant 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.

In practical terms, TMDL projects are plans or strategies to restore clean water, and thus a TMDL report is a type of planning document. The California Water Plan characterizes TMDLs as *"action plans…to improve water quality."*

Central Coast Water Board staff (staff) anticipates that this TMDL project will ultimately result in a basin plan amendment to incorporate TMDLs into the Water Quality Control Plan for the Central Coastal Basin (Basin Plan). Note that data and information contained in this document are a "work in progress" and thus are subject to revision and change during the course of TMDL development.

3 TMDL PROJECT LOCATION

The anticipated TMDL project includes Franklin Creek within the Carpinteria Salt Marsh watershed, located in southeastern Santa Barbara County. Figure 3-1 and Figure 3-2 depict the Carpinteria Salt Marsh watershed, its two named waterbodies, Franklin and Santa Monica Creeks, and several underground drainage conveyances (conduits) in the western portion of the watershed that transport water south, below U.S. Highway 101 and Southern Pacific Railroad, and ultimately into the salt marsh. The Carpinteria Salt Marsh is also known as Carpinteria Marsh, Carpinteria Slough, El Estero, El Estero del la Carpinteria, and Sandyland Cove (Ferren, 1985).

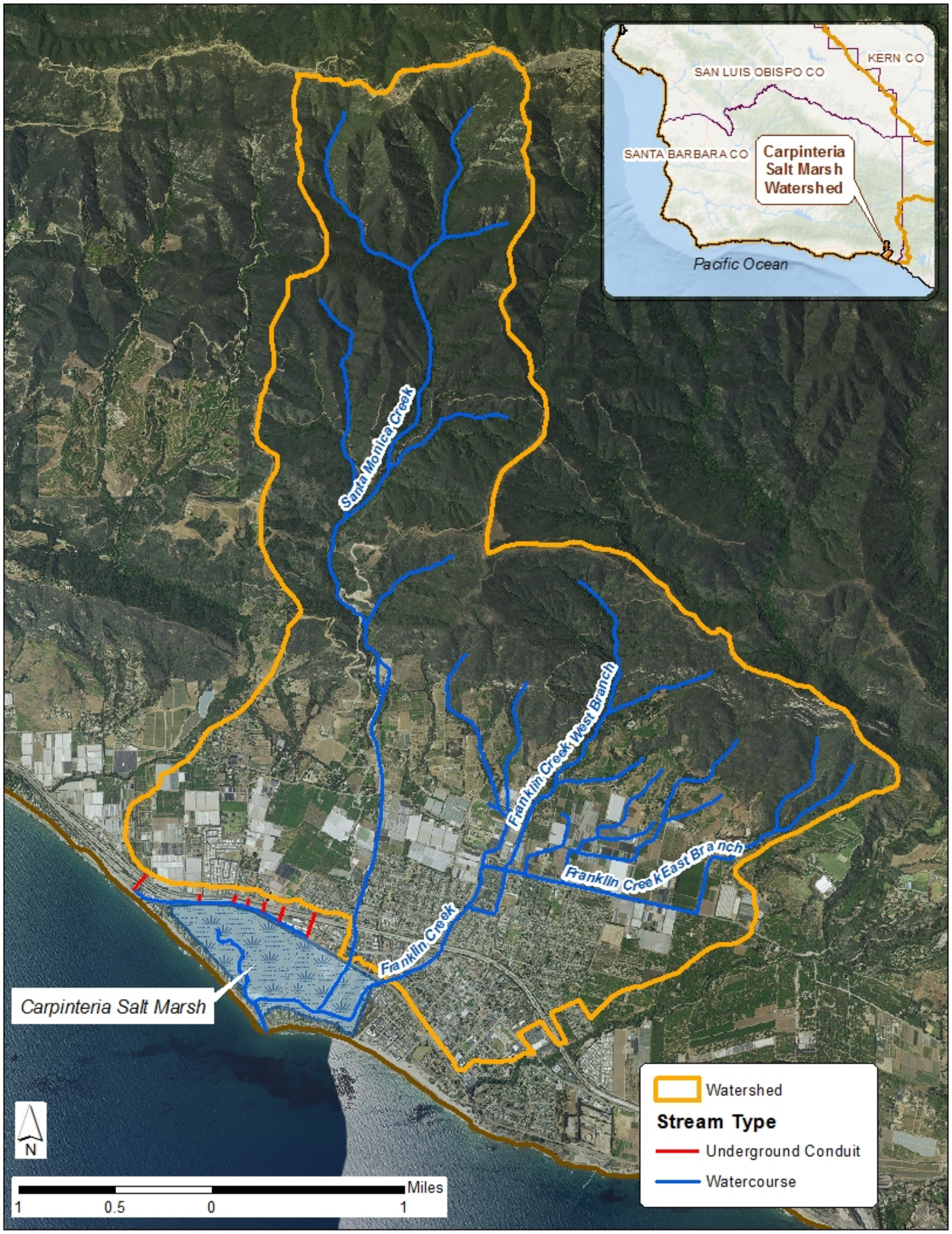

Figure 3-1. Carpinteria Salt Marsh watershed.
Spatial data source for watershed and streams: South Coast Watershed Map (Easterly Section), Santa Barbara County Flood Control and Water Conservation District, 1975.

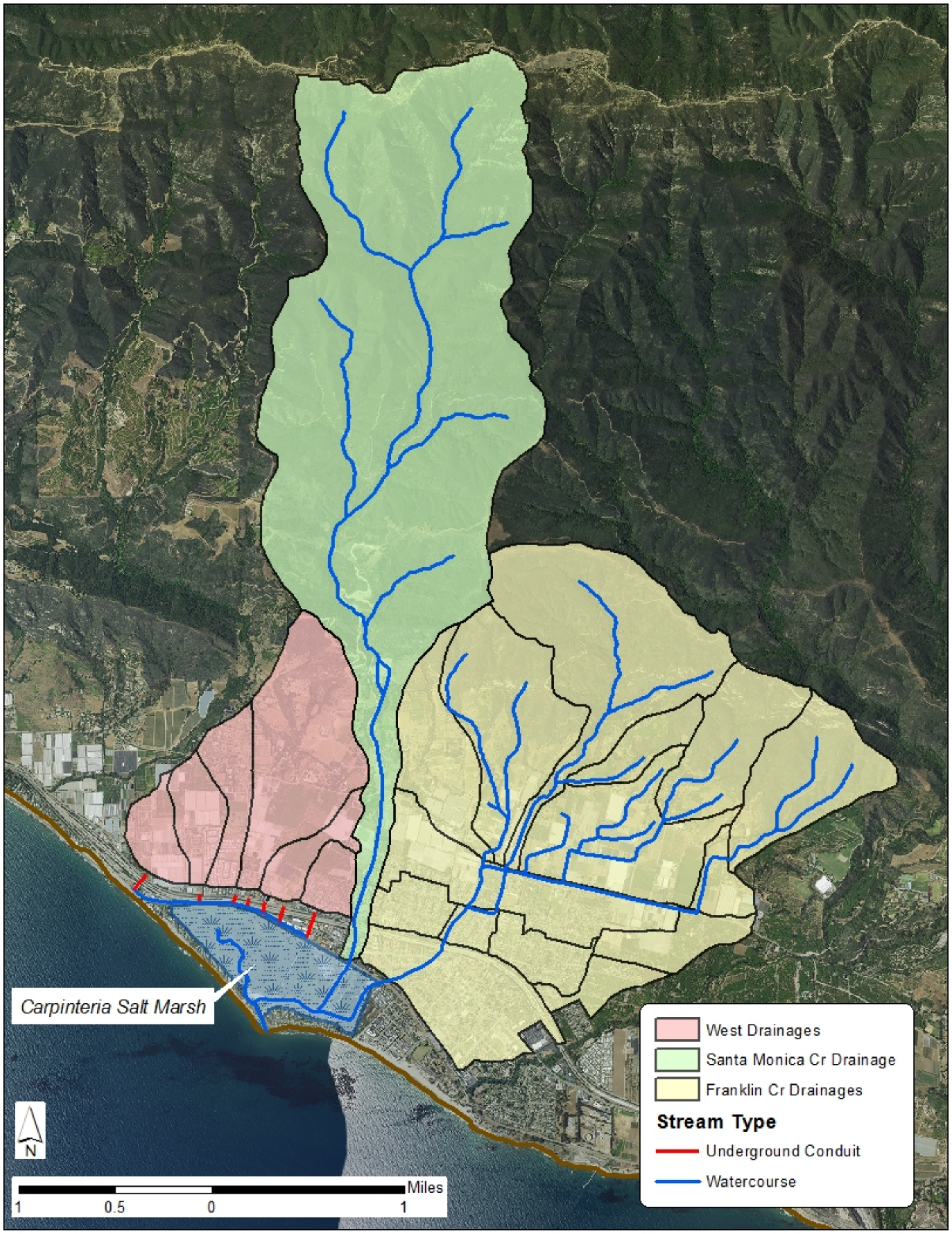

Figure 3-2. Drainages within the Carpinteria Salt Marsh watershed.
Spatial data source for subwatersheds and streams: South Coast Watershed Map (Easterly Section), Santa Barbara County Flood Control and Water Conservation District, 1975.

4 PHYSICAL SETTING

The geographic scope of this TMDL (the project area) is the Franklin Creek watershed[1], which encompasses an area of approximately 5 square miles in southeastern Santa Barbara County (see Figure 3-2). The watershed has a peak elevation of 1,746 feet. Major tributaries to the main channel of Franklin Creek include the East Branch, West Branch, and High School Creek. The upper watershed is primarily National Forest Land and the creek is flanked by urban and agricultural land uses in the lower watershed. The Franklin Creek subwatershed lies within Carpinteria Hydrologic Subarea (315.34).

4.1 Hydrography

Franklin Creek empties into the 230-acre Carpinteria Salt Marsh, an important coastal wetland. There is usually year-round low flow in the concrete lined sections of Franklin Creek due to shallow groundwater and return flows from adjacent urban and agricultural areas.

Due to severe flooding in the 1960s, portions of Franklin Creek were channelized and concrete lined during the late 1960s to mid-1970s. The modification was designed by the U.S. Soil Conservation Service and built by the Santa Barbara Soil Conservation District, Santa Barbara Co. Flood Control District, and the City of Carpinteria. The concrete lined channel under Highway 101 is designed to pass waters of a 100-year flood event. It has been estimated that 200 culverts, storm drains, and outflows discharge into Franklin Creek along the concrete lined section (Page, 1999).

Table 4-1. USGS stream gage in Franklin Creek.

USGS Gage ID	Location Description	Period of Record
11119530	Franklin Creek at Carpinteria	1971-1978

Source: http://waterdata.usgs.gov/nwis/

Table 4-2 and Figure 4-1 show monthly mean discharge in cubic feet per second (cfs) for the USGS gage located at Franklin Creek (USGS 11119530). Monthly flow was calculated by USGS based on mean monthly discharge values for data obtained from October 1, 1970 to September 30, 1978. Mean monthly flow is typically below 0.3 cfs during summer months (June-August) and increases toward the end of the year and through the winter months (November-March).

[1] The terms watershed and drainage are used synonymously throughout this document.

Table 4-2. Monthly mean discharge (cfs) for Franklin Creek near Carpinteria (USGS 11119530, 1970-1978).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1970										0.01	0.827	1.78
1971	0.256	0.557	0.229	0.187	0.232	0.158	0.1	0.1	0.212	0.154	0.099	5.45
1972	0.256	0.188	0.185	0.142	0.12	0.082	0.084	0.099	0.096	0.397	2.31	0.153
1973	3.41	7.58	2.6	0.295	0.298	0.321	0.414	0.329	0.383	0.365	0.595	0.271
1974	3.91	0.245	0.89	0.499	0.18	0.132	0.203	0.258	0.366	0.198	0.162	2.03
1975	0.244	0.886	1.57	0.279	0.298	0.303	0.295	0.156	0.167	0.137	0.183	0.193
1976	0.185	2.88	0.966	0.274	0.237	0.254	0.188	0.282	3.62	0.247	0.326	0.267
1977	1.29	0.231	0.504	0.264	1.12	0.208	0.176	0.214	0.11	0.09	0.103	1.63
1978	4.11	10.8	6.59	0.864	0.304	0.316	0.103	0.237	0.368			
Mean of Monthly Discharge	1.7	2.9	1.7	0.35	0.35	0.22	0.20	0.21	0.67	0.20	0.58	1.5

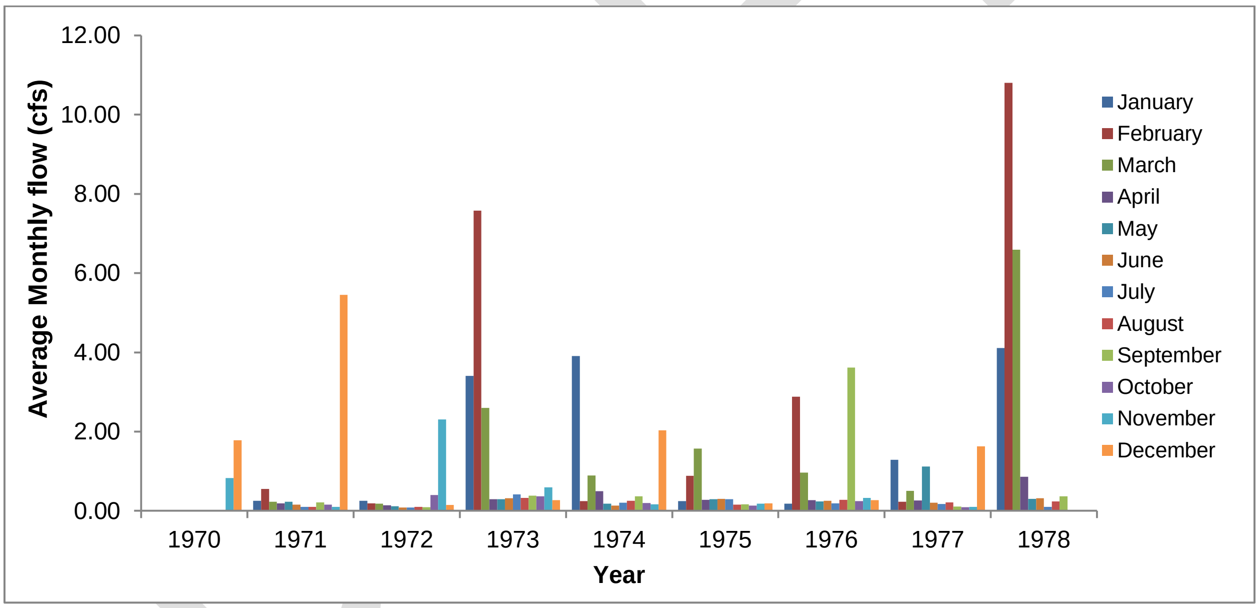

Figure 4-1. Monthly mean discharge (cfs) for Franklin Creek near Carpinteria (USGS 11119530, 1970-1978).

4.2 Land Use/Land Cover

To characterized land use and land cover, staff used Enhanced Historical Land-Use and Land-Cover Data Sets of the U.S. Geological Survey (2006)[2].

[2] Price, C.V., Nakagaki, N., Hitt, K.J., and Clawges, R.C., 2006, Enhanced Historical Land-Use and Land-Cover Data Sets of the U.S. Geological Survey, U.S. Geological Survey Digital Data Series 240. [Digital Dataset] http://pubs.usgs.gov/ds/2006/240.

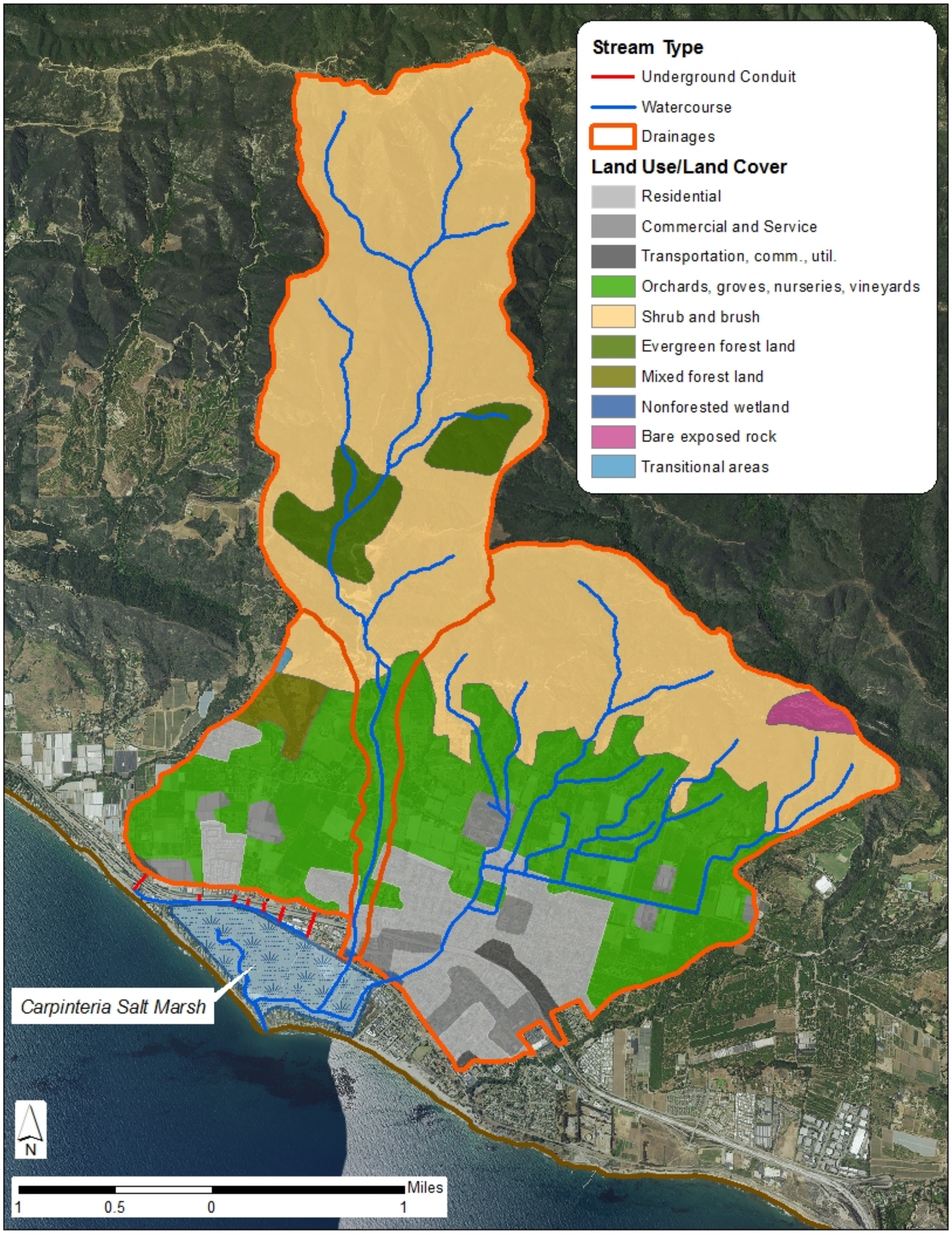

Figure 4-2. Land use and land cover.
Source: Enhanced Historical Land-Use and Land-Cover Data Sets of the U.S. Geological Survey (2006).

Most of the developed land use in the area is characterized by agricultural operations (orchards, vineyards, nurseries, etc.) and urban use (residential, commercial, industrial etc.), whereas most of the undeveloped land cover in the upper watershed is dominated by shrub-brushland with small pockets of forested areas (Figure 4-2, Figure 4-3, and Table 4-3).

Table 4-3. Land use area and percent composition (USGS 2006).

LU/LC Code	LU/LC Name	West Side Drainage (acres)	West Side Drainage (%)	Santa Monica Cr Drainage (acres)	Santa Monica Cr Drainage (%)	Franklin Cr Drainage (acres)	Franklin Cr Drainage (%)
11	Residential	95.3	12.8	21.2	0.9	426.9	15.0
12	Commercial and Services	43.6	5.8	1.3	0.1	175.7	6.2
14	Transportation, communications and services	3.9	0.5	—	—	37.4	1.3
22	Orchards, groves, vineyards, nurseries	465.6	62.4	137.6	5.7	1,063.9	37.3
32	Shrub-brushland	62.7	8.4	2,016.9	83.3	1,103.5	38.7
42	Evergreen forest land	—	—	240.3	9.9	—	—
43	Mixed forest land	70.6	9.5	—	—	—	—
62	Nonforested wetland	—	—	2.9	0.1	4.3	0.2
74	Bare exposed rock	—	—	—	—	41.1	1.4
76	Transitional areas	4.4	0.6	—	—	—	—
	Drainage Area Total	746.1	100.0	2,420.1	100.0	2,853.6	100.0

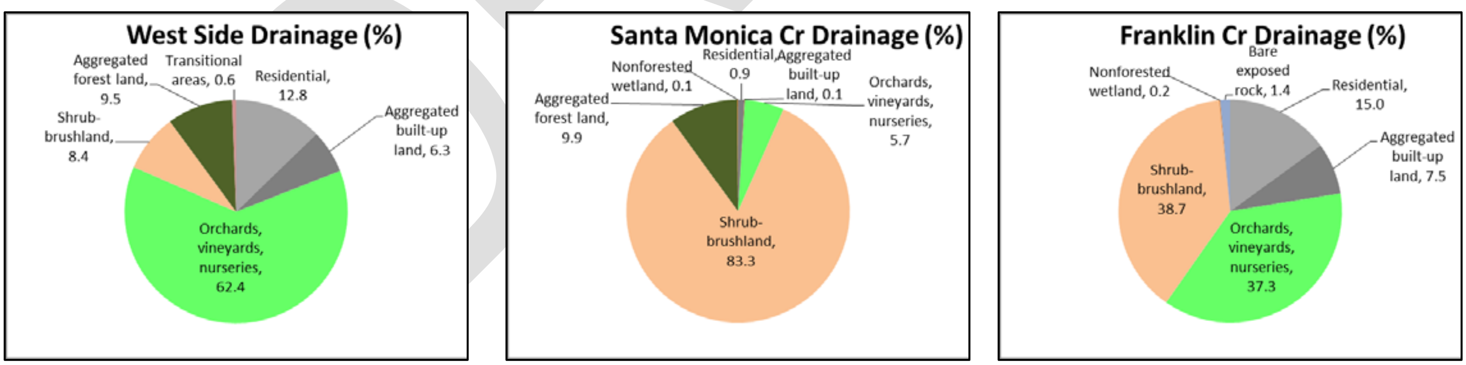

Figure 4-3. Land use land cover of drainages of Carpinteria Salt Marsh watershed.

4.3 Climate

The climate of the watershed is characterized by average annual precipitation ranging from around 18 inches near the coastline to over 30 inches in the Santa Ynez Mountains as depicted in Figure 4-4. Precipitation statistics for Santa Barbara (site 047902) indicate that most of the annual precipitation occurs between October and April[3]. On average, there are 279 sunny days per year in Carpinteria. The July high is 76° degrees Fahrenheit (°F) and the January low is around 43 °F[4].

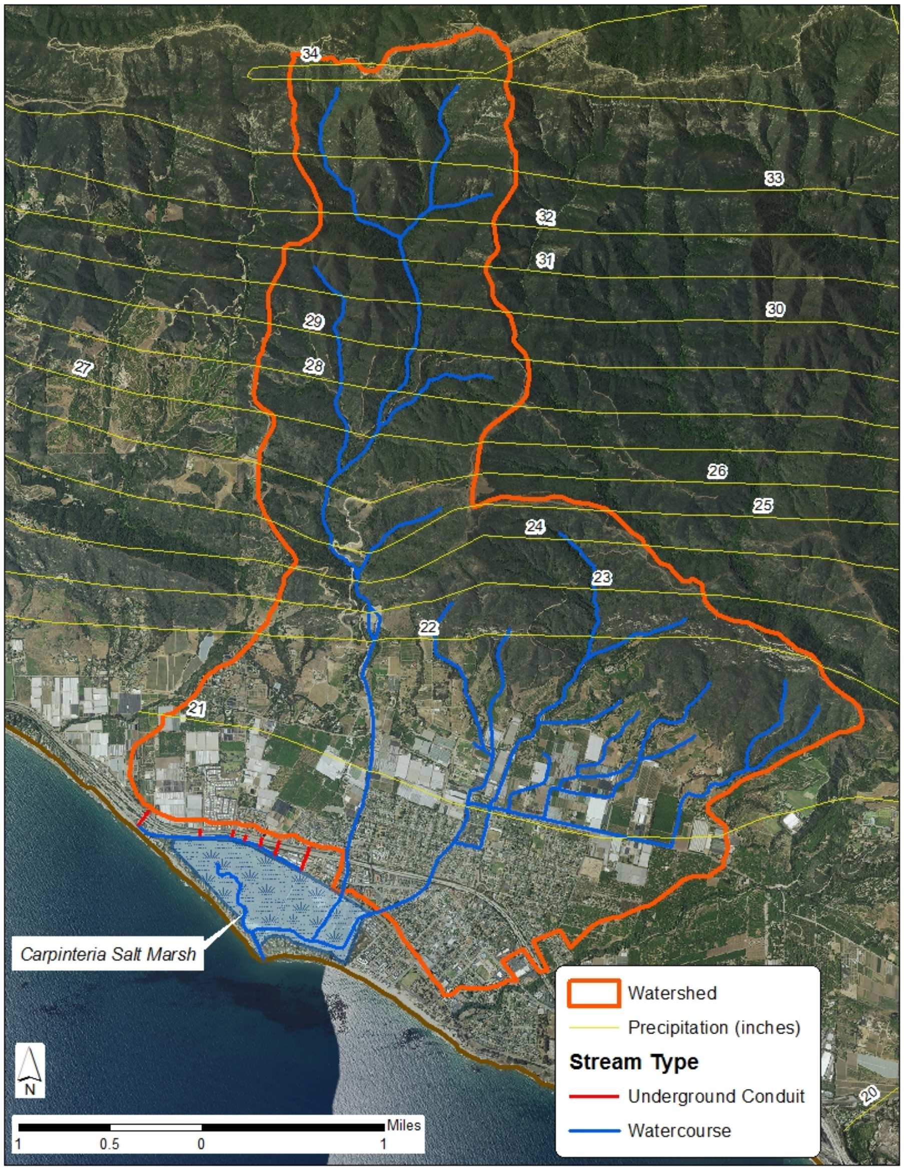

Figure 4-4. Precipitation isohyets (inches).
Source: United States Average Annual Precipitation (1981-2010). The PRISM Climate Group at Oregon State University (2006).

[3]National Oceanic and Atmospheric Administration, Western Regional Climate Center. http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?ca7902. Accessed June 28, 2016.
[4] Sperling's Best Places, 2016. http://www.bestplaces.net/climate/city/california/carpinteria. Accessed June 28, 2016.

4.4 Groundwater (Placeholder)

4.5 Soils (Placeholder)

4.6 Geology (Placeholder)

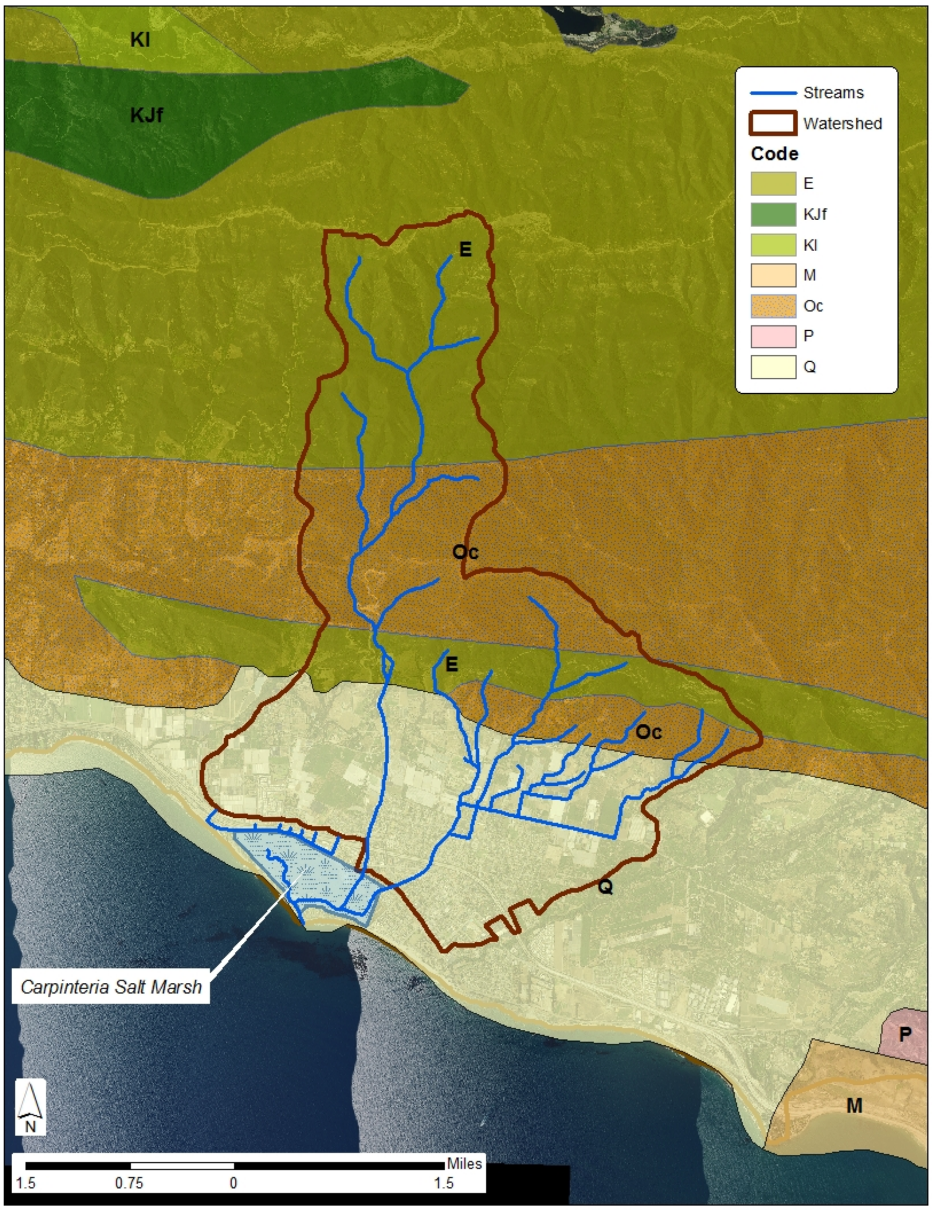

Figure 4-5. Geologic features.
Source: George J. Saucedo, et al., (2000). *GIS Data for the Geologic Map of California*, California Department of Conservation, Division of Mines and Geology, U.S. Geological Survey. Compiled by C.W. Jennings (1997).

Table 4-4. Description of geologic features.

Code	Rock Type	Age	Description
E	Marine Sedimentary Rocks	Eocene	Shale, sandstone, conglomerate, and minor limestone; mostly well consolidated.
KJf	Marine Sedimentary and Metasedimentary Rocks	Cretaceous	Franciscan Complex: Cretaceous and Jurassic sandstone with smaller amounts of shale, chert, limestone, and conglomerate. Includes Franciscan melange, except where separated-see KJf.
Kl	Marine Sedimentary and Metasedimentary Rocks	Cretaceous	Lower Cretaceous sandstone, shale, and conglomerate.
M	Marine Sedimentary Rocks	Miocene	Sandstone, shale, siltstone, conglomerate, and breccia; moderately to well consolidated.
Oc	Nonmarine (Continental) Sedimentary Rocks	Oligocene	Sandstone, shale, and conglomerate; mostly well consolidated.
P	Marine Sedimentary Rocks	Pliocene	Sandstone, siltstone, shale, and conglomerate; mostly moderately consolidated.
Q	Marine and Nonmarine	Quaternary	Alluvium, lake, playa, and terrace deposits; unconsolidated and semi-consolidated. Mostly nonmarine, but includes marine deposits near the coast.

5 WATER QUALITY STANDARDS

TMDLs are requirements pursuant to the federal Clean Water Act. The broad objective of the federal Clean Water Act is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters. Water quality standards are provisions of state and federal law intended to implement the federal Clean Water Act. In accordance with state and federal law, California's water quality standards consist of:

- Beneficial uses, which refer to legally-designated uses of waters of the state that may be protected against water quality degradation (e.g., drinking water supply, recreation, aquatic habitat, agricultural supply, etc.).
- Water quality objectives, which refer to limits or levels (numeric or narrative) of water quality constituents or characteristics that provide for the reasonable protection of beneficial uses of waters of the state.
- Anti-degradation policies, which are implemented to maintain and protect existing water quality, and high quality waters.

Therefore, beneficial uses, water quality objectives, and anti-degradation policies collectively constitute water quality standards. Beneficial uses, relevant water quality objectives pertaining to specific beneficial uses, and anti-degradation requirements that pertain to this TMDL are presented below in Section 5.1, Section 5.2, and Section 5.3, respectively.

5.1 Beneficial Uses

California's water quality standards designate beneficial uses for each waterbody and the scientific criteria to support that use. The Central Coast Water Board is required under both State and Federal Law to protect and regulate beneficial uses of waters of the state.

The Basin Plan specifically identifies beneficial uses for the listed waterbodies included in this project. The beneficial uses for waterbodies within the Carpinteria Salt Marsh watershed are shown in Table 5-1.

Table 5-1. Basin Plan designated beneficial uses.

Beneficial Use	Carpinteria Salt Marsh	Santa Monica Creek	Franklin Creek
Municipal and Domestic Supply (MUN)		X	X
Agricultural Supply (AGR)		X	X
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	X
Cold Fresh Water Habitat (COLD)		X	X
Warm Fresh Water Habitat (WARM)	X	X	X
Migration of Aquatic Organisms (MIGR)	X		X
Spawning, Reproduction, and/or Early Development (SPWN)	X	X	X
Preservation of Biological Habitats of Special Significance (BIOL)	X	X	
Rare, Threatened, or Endangered Species (RARE)	X		X
Estuarine Habitat (EST)	X		
Freshwater Replenishment (FRSH)		X	X
Commercial and Sport Fishing (COMM)	X	X	X

Beneficial uses are regarded as existing whether the waterbody is perennial or ephemeral, or the flow is intermittent or continuous. The beneficial uses of surface waters in the project area are presented below along with relevant water quality objectives pertaining to un-ionized ammonia, nitrite, and nitrate.

5.1.1 Municipal and Domestic Water Supply (MUN)

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.

The nitrate numeric water quality objective protective of the MUN beneficial uses is legally established as 10 mg/L[5] nitrate as nitrogen (see Basin Plan, Table 3-2). This level is established to protect public health.

The Office of Environmental Health Hazard Assessment (OEHHA) developed Public Health Goals (PHGs) for drinking water 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 USEPA's Maximum Contaminant Levels (MCLs) promulgated in 1991.

5.1.2 Agricultural Supply (AGR)

AGR: Uses of water for farming, horticulture, or ranching including, but not limited to, irrigation, stock watering, or support of vegetation for range grazing.

In accordance with the Basin Plan, interpretation of the amount of nitrate which adversely affects the agricultural supply beneficial uses of waters of the state shall be derived from the University of California Agricultural Extension Service guidelines, which are found in Basin Plan Table 3-3. Accordingly, increasing problems for sensitive crops could occur when irrigation water contains nitrate nitrogen concentrations between 5-30 mg/L and severe problems for sensitive crops could occur with irrigation water above 30 mg/L[6].

High concentrations of nitrate in irrigation water can potentially create problems for sensitive crops (e.g., grapes, avocado, citrus, sugar beets, apricots, almonds, cotton) by detrimentally impacting crop yield or quality. For example, according to Ayers and Westcot (1985)[7] grapes are sensitive to high nitrate in irrigation water and may continue to grow late into the season at the expense of fruit production; yields are often reduced and grapes may be late in maturing and have a lower sugar content. Maturity of fruit such as apricot, citrus and avocado may also be delayed and the fruit may be poorer in quality, thus affecting the marketability and storage life. Excessive nitrogen can also trigger and favor the production of green tissue (leaves) over vegetative tissue in sensitive crops. In many grain crops, excess nitrogen may promote excessive vegetative growth producing weak stalks that cannot support the grain weight. According to the

[5] This value is equivalent to, and may be expressed as, 45 mg/L nitrate as nitrogen.

[6] The University of California Agricultural Extension Service guideline values are flexible, and may not necessarily be appropriate due to local conditions or special conditions of crop, soil, and method of irrigation. 30 mg/L nitrate as nitrogen is the recommended uppermost threshold concentration for nitrate in irrigation supply water as identified by the University of California Agricultural Extension Service which potentially cause severe problems for sensitive crops (see Table 3-3 in the Basin Plan). Selecting the least stringent threshold (30 mg/L) therefore conservatively identifies exceedances which could detrimentally impact the AGR beneficial uses for irrigation water.

[7] R.S. Ayers (Soil and Water Specialist, University of California, Davis) and D.W. Westcot (Senior Land and Water Resources Specialist – Central Valley Regional Water Quality Control Board) published in the Food and Agriculture Organization of the United Nations (UN-FAO) Irrigation and Drainage Paper 29 Rev.1.

Draft Conclusions of the Agricultural Expert Panel (SWRCB, 2014), the yield and quality of cotton and almonds will suffer from excess nitrogen. These problems can usually be overcome by good fertilizer and irrigation management. However, regardless of the type of crop, many resource professionals recommend that nitrate in the irrigation water should be credited toward the fertilizer rate[8] especially when the concentration exceeds 10 mg/L nitrate as nitrogen[9]. Should this be ignored, the resulting excess input of nitrogen could cause problems such as excessive vegetative growth and contamination of groundwater[10]. It should be noted that irrigation water that is high in nitrate does not necessarily mean that in contains enough nitrate to eliminate the need for additional nitrogen fertilizer; however, the grower may be able to reduce and replace the amount of fertilizer normally applied with the nitrate present in the irrigation water[11].

Further, the Basin Plan provides water quality objectives for nitrate, which are protective of the AGR beneficial uses for livestock watering. While nitrate (NO_3) itself is relatively non-toxic to livestock, ingested nitrate is broken down to nitrite (NO2^{-}); subsequently nitrite enters the bloodstream where it converts blood hemoglobin to methemoglobin. This greatly reduces the oxygen-carrying capacity of the blood, and the animal suffers from oxygen starvation of the tissues[12]. Death can occur when blood hemoglobin has fallen to one-third normal levels. Resource professionals[13] report that nitrate can reach dangerous levels for livestock in streams, ponds, or shallow wells that collect drainage from highly fertilized fields. Accordingly, the Basin Plan identifies the safe threshold of nitrate as nitrogen for purposes of livestock watering at 100 mg/L[14].

Also noteworthy is that the AGR beneficial uses of surface water not only applies to several stream reaches of the project area, but can also apply to the groundwater resources underlying those stream reaches. The groundwater in some of these reaches is recharged by stream infiltration. Therefore, the groundwater recharge (GWR) beneficial uses of stream reaches provides the nexus between protection of designated AGR beneficial uses of both the surface waters and the underlying groundwater resource.

The Basin Plan also contains a dissolved oxygen water quality objective for the AGR beneficial use whereby dissolved oxygen concentration shall not be reduced below 2.0 mg/L at any time.

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[8] Crediting of irrigation source-water nitrogen may not be a 1:1 relationship as some irrigation water may not be retained entirely within the cropped area.

[9] Colorado State University Extension - Irrigation Water Quality Criteria. Authors: T.A. Bauder, Colorado State University Extension water quality specialist; R.M. Waskom, director, Colorado Water Institute; P.L. Sutherland, United States Department of Agriculture, Natural Resources Conservation Service (USDA/NRCS) area resource conservationist; and J.G. Davis, Extension soils specialist and professor, soil and crop sciences.

[10] University of California, Davis, Farm Water Quality Planning Reference Sheet 9.10. Publication 8066. Author: S. R. Grattan, Plant-Water Relations Specialist, UC Davis.

[11] Monterey County Water Resources Agency – Santa Clara Valley Water District, Fact Sheet 4. *Using the Nitrate Present in Soil and Water in Your Fertilizer Calculations.*

[12] New Mexico State University, Cooperative Extension Service. Nitrate Poisoning of Livestock. Guide B-807.

[13] University of Arkansas, Division of Agriculture - Cooperative Extension. “Nitrate Poisoning in Cattle”. Publication FSA3024.

[14] 100 mg/L nitrate as nitrogen is the Basin Plan’s water quality objective protective of livestock watering, and is based on National Academy of Sciences-National Academy of Engineering guidelines (see Table 3-3 in the Basin Plan).

5.1.3 Ground Water Recharge (GWR)

*GWR: Uses of water for natural or artificial recharge of ground water for purposes of future extraction, **maintenance of water quality**, or halting of saltwater intrusion into freshwater aquifers. Ground water recharge includes recharge of surface water underflow.* (Emphasis added.)

Groundwater recharge (GWR) beneficial uses recognize the fundamental nature of the hydrologic cycle, in that surface waters and groundwater are not closed systems that act independently from each other. Underlying groundwaters are, in effect, receiving waters for stream waters that infiltrate and recharge the subsurface water resource. Most surface waters and groundwaters of the central coast region are designated with both the MUN (drinking water) and AGR (agricultural supply) beneficial uses. The MUN nitrate water quality objective (10 mg/L) therefore applies to *both* the stream waters, and to the underlying groundwater.

The Basin Plan GWR beneficial uses explicitly state that the designated groundwater recharge use of surface waters is to be protected to maintain groundwater quality. Note that surface waters and groundwaters are often in direct or indirect hydrologic communication. As such, where necessary, the GWR beneficial uses of the surface waters need to be protected to support and maintain the MUN or AGR beneficial uses of the underlying groundwater resource. Protection of the groundwater recharge beneficial uses of surface waters has been recognized in State Water Resources Control Board–approved California TMDLs[15]. USEPA also recognizes the appropriateness of protecting designated groundwater recharge beneficial uses in the context of California TMDLs (USEPA 2002, USEPA 2003). The Basin Plan does not specifically identify numeric water quality objectives to implement the GWR beneficial uses, however a situation-specific weight of evidence approach can be used to assess if GWR is being supported, consistent with Section 3.11 of the California Listing Policy (SWRCB, 2004, amended in February 2015).

5.1.4 Water Contact Recreation (REC-1) and Non-Contact Water Recreation (REC-2)

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.

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

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[15] See for example, Los Angeles Regional Water Quality Control Board, Calleguas Creek Nitrogen Compounds TMDL, 2002, Resolution No. 02-017, and approved by the California Office of Administrative Law, OAL File No. 03-0519-02 SR; or Central Coast Regional Water Quality Control Board, TMDLs for Nitrogen Compounds and Orthophosphate in the Lower Salinas River and Reclamation Canal Basin and the Moro Cojo Slough Subwatershed, Resolution No. R3-2013-0008 and approved by the California Office of Administrative Law, OAL File No. 2014-0325-01S.

The relevant Basin Plan water quality objective protective of both water contact and non-contact recreation beneficial uses is the general toxicity objective for all inland surface water, enclosed bays, and estuaries (Basin Plan Chapter 3, Section II.A.2.a). The general toxicity objective is a narrative water quality objective that states:

"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."

Because illnesses are considered detrimental physiological responses in humans, the narrative toxicity objective applies to algal toxins. Possible health effects of exposure to blue-green algae blooms and their toxins can include rashes, skin and eye irritation, allergic reactions, gastrointestinal upset, and other effects including poisoning. Note that microcystins are toxins produced by cyanobacteria (blue-green algae) and are associated with algal blooms, elevated nutrients, and biostimulation in surface waterbodies. OEHHA has published peer-reviewed public health action-level guidelines for algal cyanotoxins (microcystins) in recreational water uses; this public health action-level for microcystins is 0.8 μg/L[16] (OEHHA, 2012). This public health action level can therefore be used to assess attainment or non-attainment of the Basin Plan's general toxicity objective and to ensure that REC-1 designated beneficial uses are being protected and supported.

5.1.5 Aquatic Habitat (WARM, COLD, MIGR, SPWN, WILD, BIOL, RARE, EST)

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.

COLD: Uses of water that support cold water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish or wildlife, including invertebrates.

MIGR: Uses of water that support habitats necessary for migration or other temporary activities by aquatic organisms, such as anadromous fish.

SPWN: Uses of water that support high quality aquatic habitats suitable for reproduction and early development of fish.

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.

BIOL: Uses of water that support designated areas or habitats, such as established refuges, parks, sanctuaries, ecological reserves, or Areas of Special Biological Significance (ASBS), where the preservation or enhancement of natural resources requires special protection.

[16] Includes microcystins LR, RR, YR, and LA.

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.

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 waterbodies which would naturally fit the definition if not controlled by tidegates or other such devices.

The Basin Plan water quality objectives protective of aquatic habitat beneficial uses which are most relevant to nutrient pollution[17] are the toxicity objective for un-ionized ammonia, the biostimulatory substances objective, and dissolved oxygen objectives.

For un-ionized ammonia, the Basin Plan General Objective for all Inland Surface Waters, Enclosed Bays and Estuaries states that the discharge of wastes shall not cause concentrations of un-ionized ammonia (NH_3) to exceed 0.025 mg/L (as nitrogen) in receiving waters. Un-ionized ammonia is highly toxic to aquatic life.

For biostimulatory substances, the Basin Plan General Objective for all Inland Surface Waters, Enclosed Bays and Estuaries states that, "*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*." Excessive algal biomass and wide swings in dissolved oxygen concentrations are often indicative of biostimulatory conditions due to excessive nutrients.

Chlorophyll *a* is an algal biomass indicator. The numeric listing criteria to implement the Basin Plan biostimulatory substances objective for purposes of Clean Water Act Section 303(d) Listing assessments is 40 µg/L (Worcester et al., 2010).

For dissolved oxygen, the Basin Plan requires that in waterbodies designated for WARM habitat, dissolved oxygen concentrations shall not be depressed below 5 mg/L and that in waterbodies designated for COLD and SPWN, dissolved oxygen shall not be depressed below 7 mg/L. In addition, peer-reviewed research in California's central coast region (Worcester et al., 2010) has established an upper limit of 13 mg/L for dissolved oxygen to screen for excessive dissolved oxygen saturation indicative of biostimulatory conditions. For monitoring sites within the central coast region that support designated aquatic habitat beneficial uses and do not show signs of biostimulation, dissolved oxygen virtually never exceeded 13 mg/L at any time[18]). Note that the 13 mg/L dissolved oxygen saturation target is not a regulatory standard, but can be used as a TMDL nutrient-response indicator target to assess primary biological response to nutrient pollution.

[17] Nutrients, such as nitrate, do not by themselves necessarily directly impair aquatic habitat beneficial uses. Rather, they cause indirect impacts by promoting algal growth and low dissolved oxygen that impair aquatic habitat uses.

[18] Of 2,399 samples at these reference sites, only about 1% of the samples ever exceeded 13 mg/L DO.

5.1.6 Freshwater Replenishment (FRSH)

FRSH: Uses of water for natural or artificial maintenance of surface water quantity or quality (e.g., salinity) which includes a waterbody that supplies water to a different type of waterbody, such as, streams that supply reservoirs and lakes, or estuaries; or reservoirs and lakes that supply streams. This includes only immediate upstream waterbodies and not their tributaries.

The Basin Plan does not contain specific water quality objectives for the FRSH beneficial use.

5.1.7 Commercial and Sport Fishing (COMM)

COMM: Uses of water for commercial or recreational collection of fish, shellfish, or other organisms including, but not limited to, uses involving organisms intended for human consumption or bait purposes.

The Basin Plan does not contain specific water quality objectives for the COMM beneficial use.

5.2 Summary of Water Quality Objectives & Criteria

The Basin Plan contains specific water quality objectives that apply to nutrients and nutrient-related parameters. In addition, the Central Coast Water Board uses established, scientifically-defensible numeric criteria to implement narrative water quality objectives, and for use in Clean Water Act Section 303(d) Listing assessments. These water quality objectives and criteria are established to protect beneficial uses and are summarized in Table 5-2.

Table 5-2. Summary of Basin Plan water quality objectives and numeric criteria for nutrients and nutrient-related parameters.

Constituent Parameter	Source of Water Quality Objective/Criteria	Numeric Target	Primary Use Protected
Un-ionized Ammonia as Nitrogen	Basin Plan numeric objective	0.025 mg/L	General Objective for all Inland Surface Waters, Enclosed Bays, and Estuaries *(toxicity objective)*
Nitrate as Nitrogen	Basin Plan numeric objective	10 mg/L	MUN, GWR (Municipal/Domestic Supply; Groundwater Recharge)
Nitrate as Nitrogen	Basin Plan numeric criteria (Table 3-3 in Basin Plan)	5 – 30 mg/L *California Agricultural Extension Service guidelines*	AGR (Agricultural Supply – irrigation water) *"Severe" problems for sensitive crops at greater than 30 mg/L* *"Increasing problems" for sensitive crops at 5 to 30 mg/L*
Joint Nitrate/Nitrite as Nitrogen	Basin Plan narrative objective[A]	10 mg/L *California Office of Environmental Health Hazard Assessment Suggested Public Health Goal*	Human Health
Nitrite as Nitrogen	Basin Plan narrative objective[A]	1 mg/L *California Office of Environmental Health Hazard Assessment Suggested Public Health Goal*	Human Health
Dissolved Oxygen	General Inland Surface Waters numeric objective	Dissolved Oxygen shall not be depressed below 5.0 mg/L Median values should not fall below 85% saturation.	General Objective for all Inland Surface Waters, Enclosed Bays, and Estuaries
	Basin Plan numeric objective WARM, COLD, SPWN	Dissolved Oxygen shall not be depressed below 5.0 mg/L (WARM) Dissolved Oxygen shall not be depressed below 7.0 mg/L (COLD, SPWN)	Cold Freshwater Habitat, Warm Freshwater Habitat, Fish Spawning
	Basin Plan numeric objective AGR	Dissolved Oxygen shall not be depressed below 2.0 mg/L	AGR (Agricultural Supply)
Biostimulatory Substances	Basin Plan narrative objective[B]	Nutrient-related constituents that are normally developed based on reach scale characteristics. Values may vary.	General Objective for all Inland Surface Waters, Enclosed Bays, and Estuaries *(biostimulatory substances objective)* -- (e.g., WARM, COLD, REC, WILD, EST)
Chlorophyll *a*	Basin Plan narrative objective[B]	40 µg/L *North Carolina Administrative Code, Title 151, Subchapter 2B, Rule 0211*	Numeric listing criteria to implement the Basin Plan biostimulatory substances objective for purposes of Clean Water Act Section 303(d) Listing assessments
Microcystins *(includes Microcytins LA, LR, RR, and YR)*	Basin Plan narrative objective[B]	*0.8* µg/L *Calif. Office of Environmental Health Hazard Assessment Suggested Public Health Action Level*	REC-1 (water contact recreation), REC-2 (water non-contact recreation)

[A] *The Basin Plan toxicity narrative objective states: "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." (Toxicity Objective, Basin Plan, Chapter 3)*

[B] *The Basin Plan biostimulatory substances narrative objective 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." (Biostimulatory Substances Objective, Basin Plan, Chapter 3)*

5.3 Anti-degradation Policy

In accordance with Section II.A of the Basin Plan, wherever the existing quality of water is better than the quality of water established in the Basin Plan as objectives, **such existing quality shall be maintained** unless otherwise provided by provisions of the state anti-degradation policy. Practically speaking, this means that where water quality is *better* than necessary to support designated beneficial uses, such existing high water quality shall be maintained, and further lowering of water quality is not allowed except under conditions provided for in the anti-degradation policy.

USEPA has also issued detailed guidelines for implementation of federal anti-degradation regulations for surface waters (40 CFR 131.12). To ensure consistency, the State Water Resources Control Board has interpreted Resolution No. 68-16 (i.e., the state anti-degradation policy) to incorporate the federal anti-degradation policy. It is important to note that federal policy only applies to surface waters, while state policy applies to both surface and groundwaters.

USEPA recognizes the validity of using TMDLs as a tool for implementing anti-degradation goals:

> *"Identifying opportunities to protect waters that are not yet impaired: TMDLs are typically written for restoring impaired waters; however, states can prepare TMDLs geared towards maintaining a "better than water quality standard" condition for a given waterbody-pollutant combination, and they can be a useful tool for high quality waters."*
>
> From: USEPA, 2014. Opportunities to Protect Drinking Water Sources and Advance Watershed Goals Through the Clean Water Act: A Toolkit for State, Interstate, Tribal and Federal Water Program Managers. November 2014.

6 WATER QUALITY DATA ANALYSIS

This section provides information pertaining to data sources and the analysis of water quality data used to assess water quality conditions and impairment for this project.

Staff used the following water quality data for waterbodies within the Carpinteria Salt Marsh watershed:

- Central Coast Ambient Monitoring Program (CCAMP) sites 315SMC, 315FRC.
- Irrigated Lands Regulatory Program, Cooperative Monitoring Program (CMP) site 315FMV.
- Santa Barbara Channelkeeper (SBCK) sites CM01, SM01, and FK00.

Water quality data from CCAMP and CMP is presented in Section 6.1 and data provided by SBCK is presented in Section 6.3.

6.1 CCAMP and CMP Water Quality Data

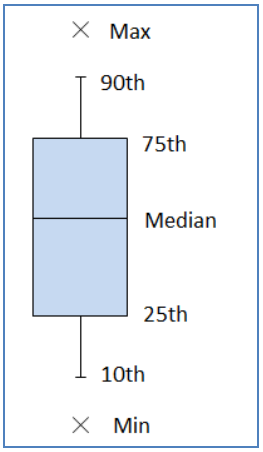
Locations of CCAMP and CMP water quality monitoring sites are shown in Figure 6-1 and a description of site locations are contained in Table 6-1.

Figure 6-1. Locations of CCAMP/CMP monitoring sites.

Table 6-1. CCAMP/CMP water qualtiy monitoring site informaton

Program	Site ID	Site Description
CCAMP	315SMC	Santa Monica Creek at Via Real
CCAMP	315FRC	Franklin Creek at Carpinteria Avenue
CMP	315FMV	Franklin Creek at Meadow View Lane

Staff used scatter plots to represent water quality data over time and box plots to present summary statistics for each monitoring station shown in Figure 6-1. Note that box plot graphics for the various monitoring stations also show the number of samples in parenthesis on the x-axis (see Figure 6-2 for an example).



For box plots, as shown in Figure 6-2, maximum and minimum values are depicted as exes at the top and bottom of the plot, respectively. Values representing the 90th and 10th percentiles are shown as whiskers, while the 75th, 50th (median), and 25th percentiles comprise the box.

Figure 6-2. Explanation of box plots.

6.1.1 Nitrate as nitrogen

The nitrate numeric water quality objective protective of the MUN beneficial use is 10 mg/L nitrate as nitrogen. This level is established to protect public health as discussed in Section 5.1.1.

In accordance with the Basin Plan, interpretation of the amount of nitrate that adversely affects the agricultural supply (AGR) beneficial of waters of the State is derived from the University of California Agricultural Extension Service guidelines, which are found in Basin Plan Table 3-3. Accordingly, severe problems for sensitive crops could occur for irrigation water exceeding 30 mg/L as discussed in Section 5.1.2.

Table 6-2. Summary of CCAMP monitoring results for nitrate as nitrogen (mg/L).

Station	Dates	Count	Count >10	% >10	Count >30	% >30	Max	Min	Median	Mean
315SMC	1/16/01-3/19/02 1/28/08-1/28/09	22	1	4.55	0	0	10.70	0.02	0.04	1.06
315FRC	1/16/01-3/18/03 3/4/04-12/3/14	156	146	93.59	3	1.92	47.87	1.72	21.00	20.68

For Franklin Creek (315FRC), 146 of 156 samples (94%) exceeded the water quality objective for municipal supply (MUN) and 3 of 156 samples (2%) exceeded the water quality guideline for agricultural supply (AGR). For Santa Monica Creek (315SMC), only 1 of 22 samples (4.6%) exceeded the water quality objective for municipal supply. It should be noted that the reduced sample count for Santa Monica Creek is in part due to periods of low to zero flow in the lower watershed where monitoring site 315SMC is located, and because this site is only monitored on a monthly basis in one out of five years. Conversely, Franklin Creek generally experiences year-round flow in the lower watershed (due to shallow groundwater and return flows from adjacent urban and agricultural areas) and is monitored monthly, regardless of the rotating sampling cycle.

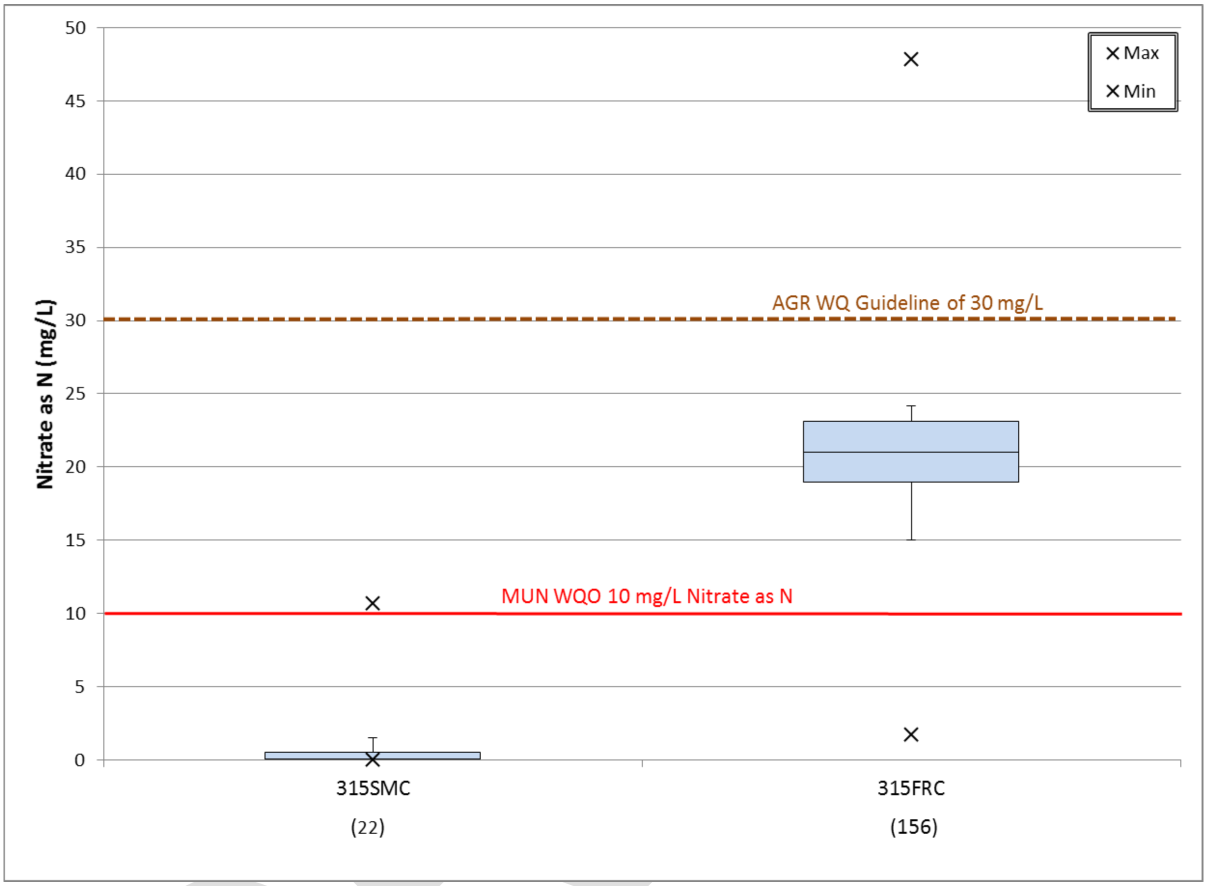


Figure 6-3. Box plots of nitrate as nitrogen (mg/L) concentrations.

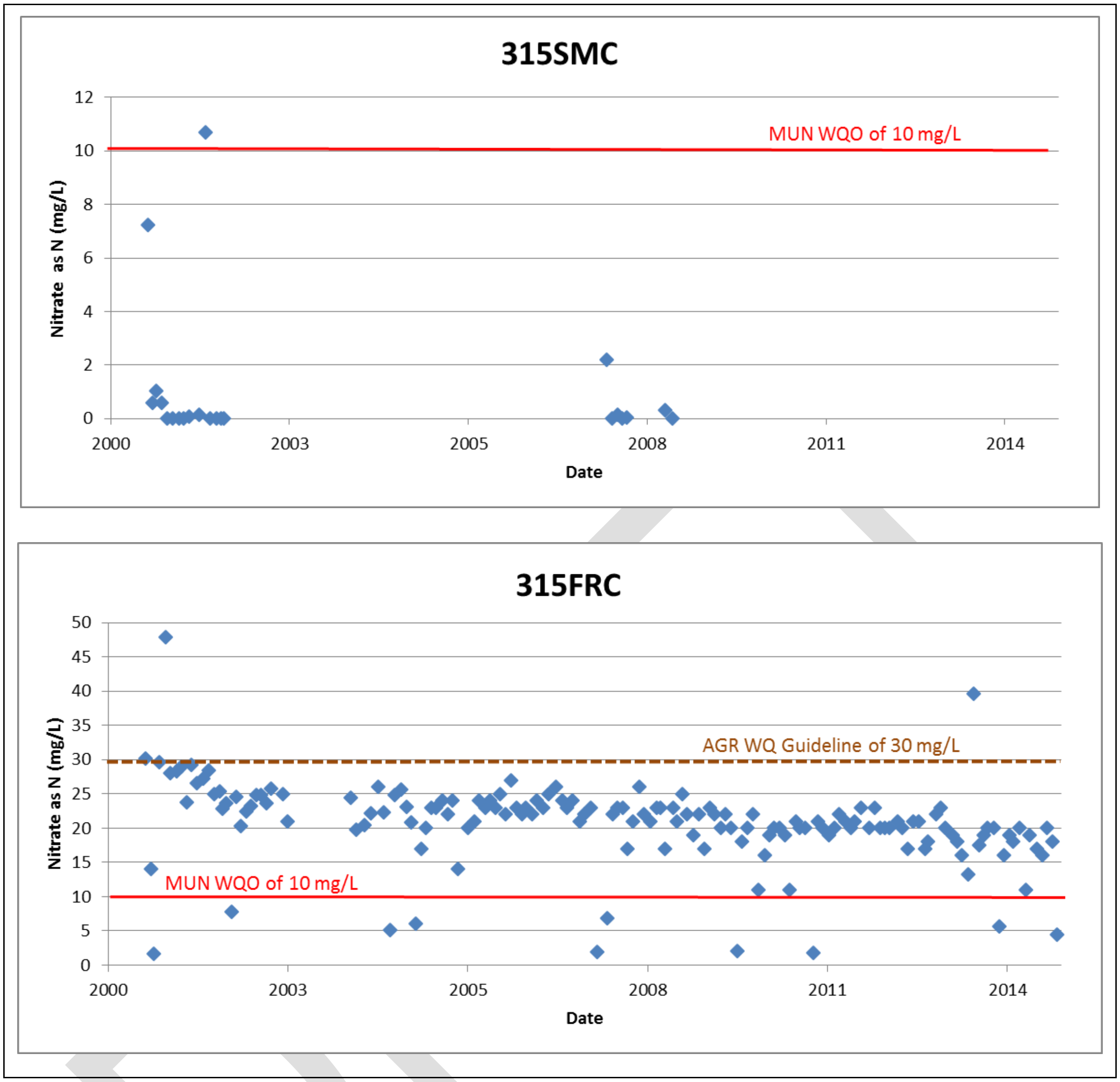


Figure 6-4. Scatter plot of nitrate as nitrogen concentrations (mg/L).
Note that the vertical axis is different for each site.

As shown in the figures above, the MUN beneficial use water quality objective (10 mg/L nitrate as nitrogen) is often exceeded at Franklin Creek monitoring station (315FRC) and rarely exceeded at Santa Monica Creek monitoring station (315SMC). Over the past 14 years, nitrate as nitrogen concentrations at Franklin Creek site 315FRC are nearly twice as great as the water quality objective for the MUN beneficial use with a median value of 21.00 mg/L and a maximum value of 47.87mg/L (Table 6-2).

6.1.2 Joint Nitrate/Nitrite as Nitrogen

OEHHA developed PHGs of 10 mg/L for joint nitrate plus nitrite as nitrogen to protect the MUN beneficial use. The calculation of this PHG is based on the protection of infants from the occurrence of methemoglobinemia as discussed in Section 5.1.1.

Table 6-3. Summary of CCAMP/CMP monitoring results for joint nitrate/nitrite as nitrogen (mg/L).

Station	Dates	Count	Count >10	% >10	Count >30	% >30	Max	Min	Median	Mean
315SMC	1/16/01-3/19/02 1/28/08-1/28/09	22	1	4.6	0	0	10.8	0.03	0.05	1.1
315FMV	1/25/06-6/23/15	106	100	94.3	31	29.2	322	0.3	25.3	28.3
315FRC	1/16/01-3/18/03 3/4/04-12/3/14	156	146	93.6	3	1.9	48.1	1.8	21.2	20.8

For the combined Franklin Creek sites (315FRC and 315FMV), 246 of 262 samples (94%) exceeded the joint nitrate plus nitrite as nitrogen water quality objective for the protection of human health (OEHHA PHGs), and 34 of 262 samples (13%) exceeded the water quality guideline for agricultural supply (AGR). However, it should be noted that the upper Franklin Creek site (315FMV) exceeded the AGR water quality guideline on more occasions than the lower creek site (29% exceedance compared to 1.9% exceedance for 315FMV and 315FRC, respectively). For Santa Monica Creek (315SMC), only 1 of 22 samples (4.6%) exceeded the water quality objective for human health and no samples exceeded the water quality guideline for AGR.

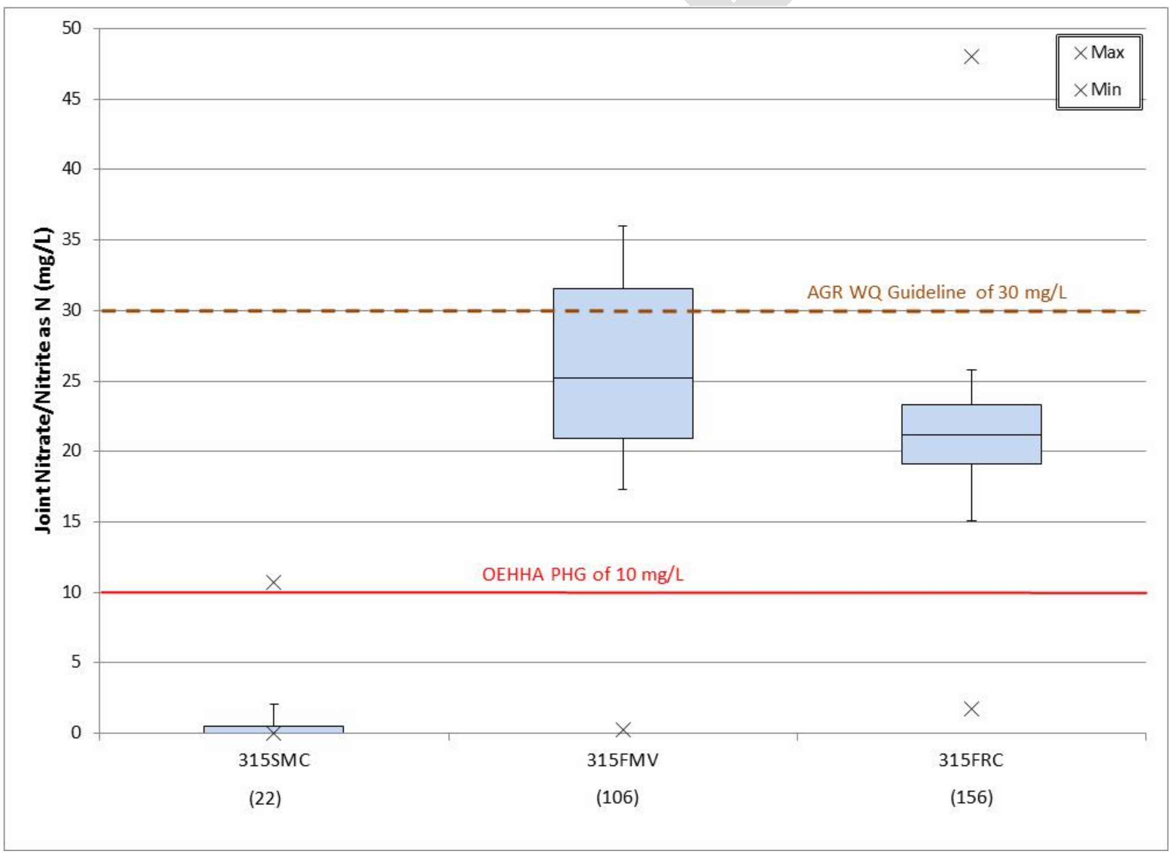


Figure 6-5. Box plots of joint nitrate/nitrite as nitrogen (mg/L) concentrations.
Note: Not shown 315FMV max of 322 mg/L on 5/14/2006.

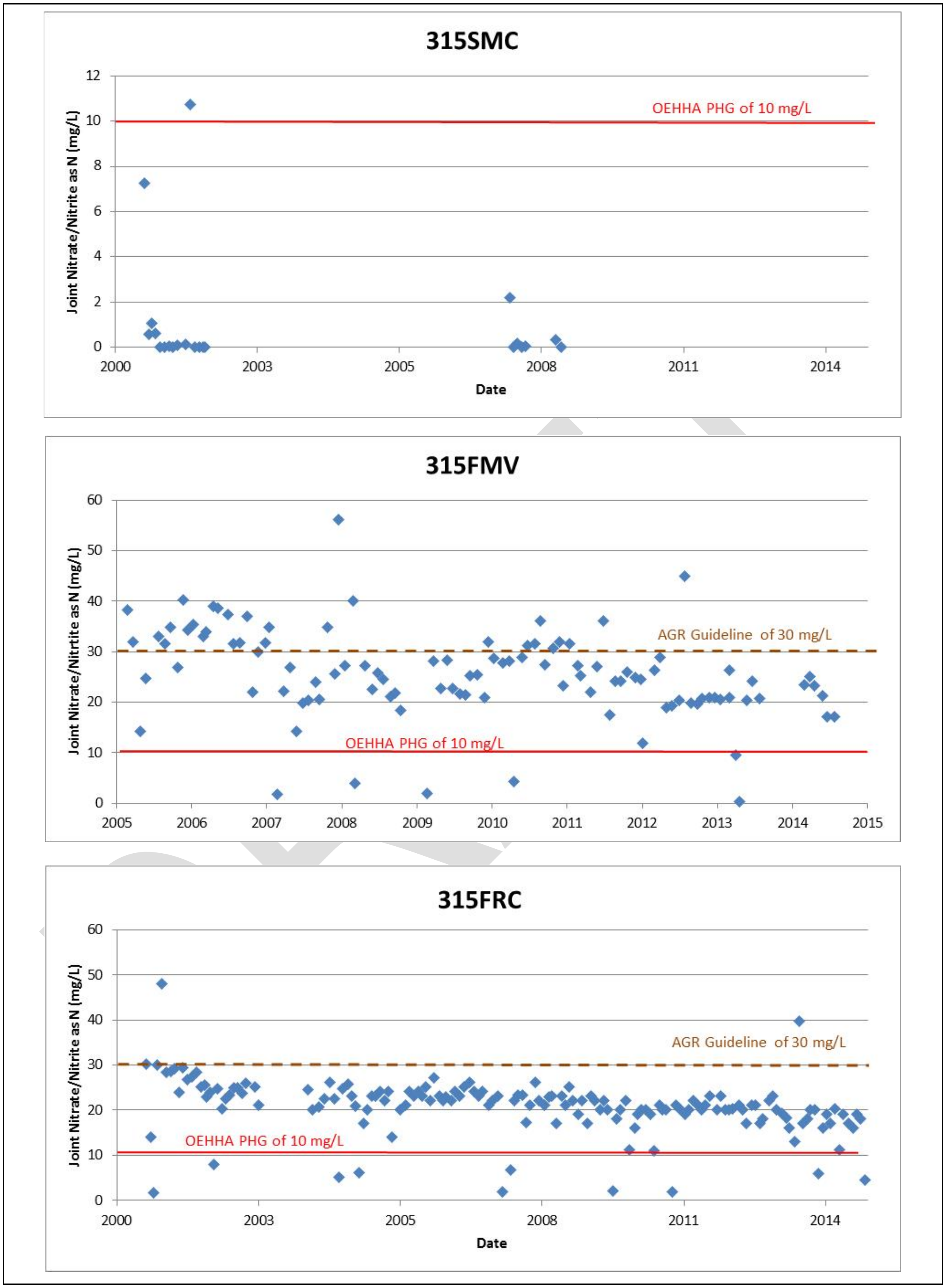


Figure 6-6. Scatter plots of joint nitrate/nitrite as nitrogen (mg/L) concentrations.
Note. Note that the vertical axis is different for Santa Monica Creek and Franklin Creek sites. Not shown 315FMV maximum concentration of 322 mg/L on 5/14/2006.

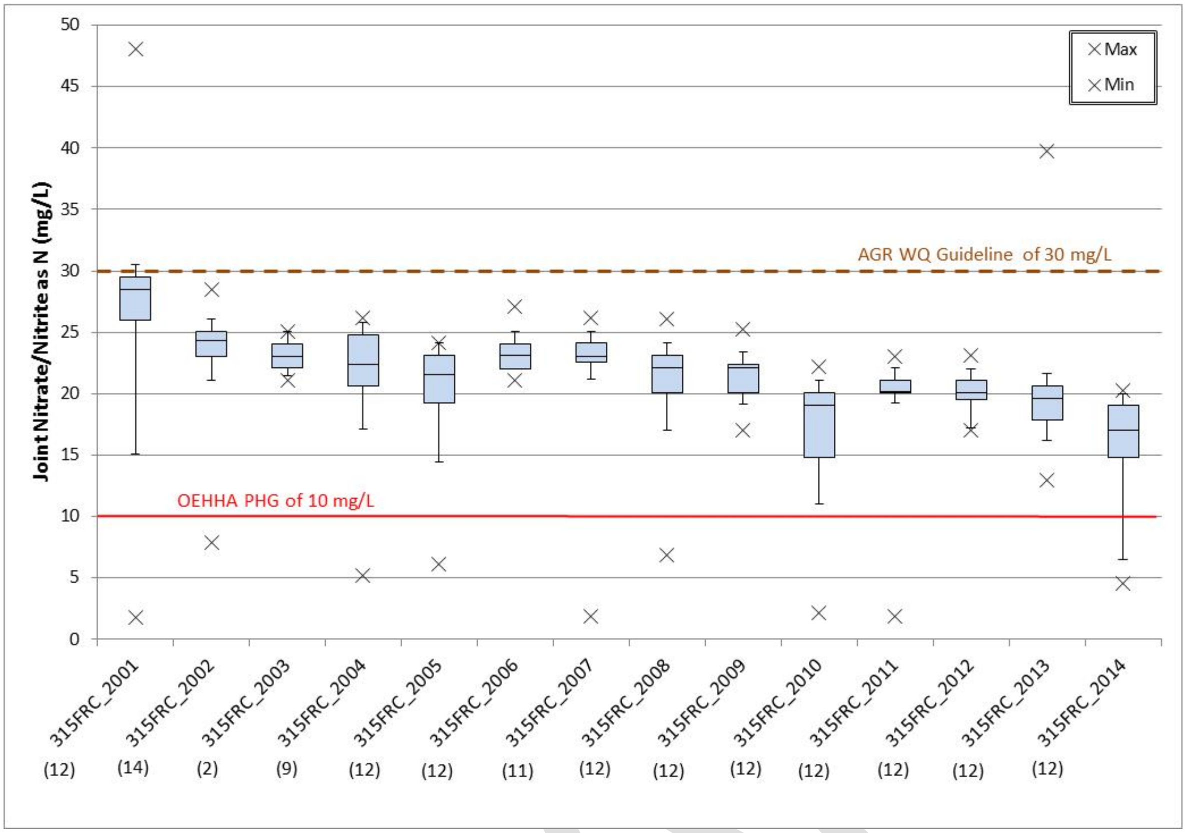


Figure 6-7. Annual box plots of joint nitrate/nitrite concentrations (mg/L) for Franklin Creek site 315FRC.

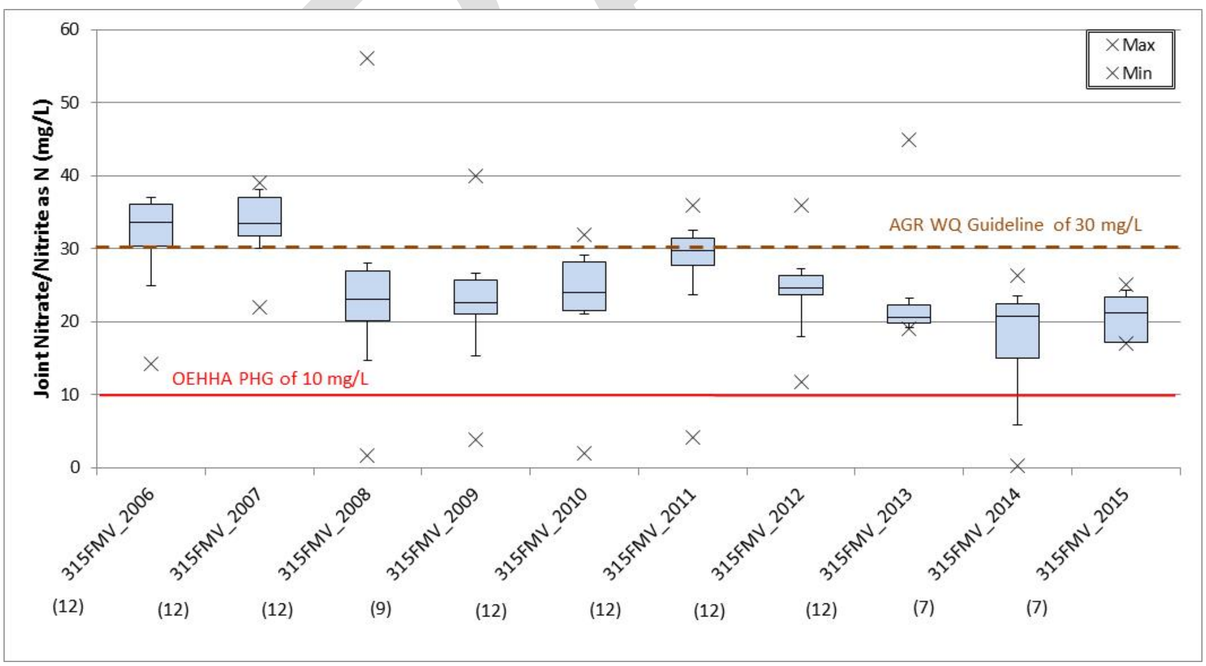


Figure 6-8. Annual box plots of joint nitrate/nitrite concentrations (mg/L) for Franklin Creek site 315FMV.

Note: Not shown 315FMV maximum concentration of 322 mg/L on 5/14/2006.

As shown in the figures above, the PHGs of 10 mg/L for joint nitrate plus nitrite as nitrogen water quality objective is frequently exceeded at Franklin Creek monitoring stations (315FMV and 315FRC), and rarely exceeded at Santa Monica Creek site (315SMC). Joint nitrate plus nitrite concentrations at the two Franklin Creek sites are often at least twice the water quality objective set to protect human health. The upper monitoring station (315FMV) has a median value of 25.10 mg/L joint nitrate plus nitrite as nitrogen and a maximum value of 322 mg/L where the lower monitoring station (315FRC) has a median value of 21.18 mg/L and a maximum value of 48.06 mg/L Table 6-3). Both of these sites are located downstream of cultivated agricultural lands (vineyards, orchards, nurseries etc.).

6.1.3 Un-ionized ammonia as nitrogen

The Basin Plan General Objective for all Inland Surface Waters, Enclosed Bays and Estuaries states that the discharge of wastes shall not cause concentrations of un-ionized ammonia (NH_3) to exceed 0.025 mg/L (as nitrogen) in receiving waters. Staff used this objective to assess water quality impairment as presented below.

Table 6-4. Summary of CCAMP/CMP monitoring results for un-ionized ammonia as nitrogen (mg/L).

Station	Dates	Count	Count >0.025	% >0.025	Median	Mean	Max	Min
315SMC	1/16/01-3/19/02 1/28/08-1/28/09	23	0	0	0.00313	0.00391	0.01900	0.00040
315FMV	1/25/06-6/23/15	101	7	6.9	0.00364	0.09494	8.63360	0.00006
315FRC	1/16/01-12/3/14	159	2	1.26	0.00222	0.00371	0.03719	0.00032

Figure 6-9. Box plots of un-ionized ammonia as nitrogen (mg/L) concentrations.
Note: Not shown 315FMV maximum concentration of 8.6 on 7/26/2011.

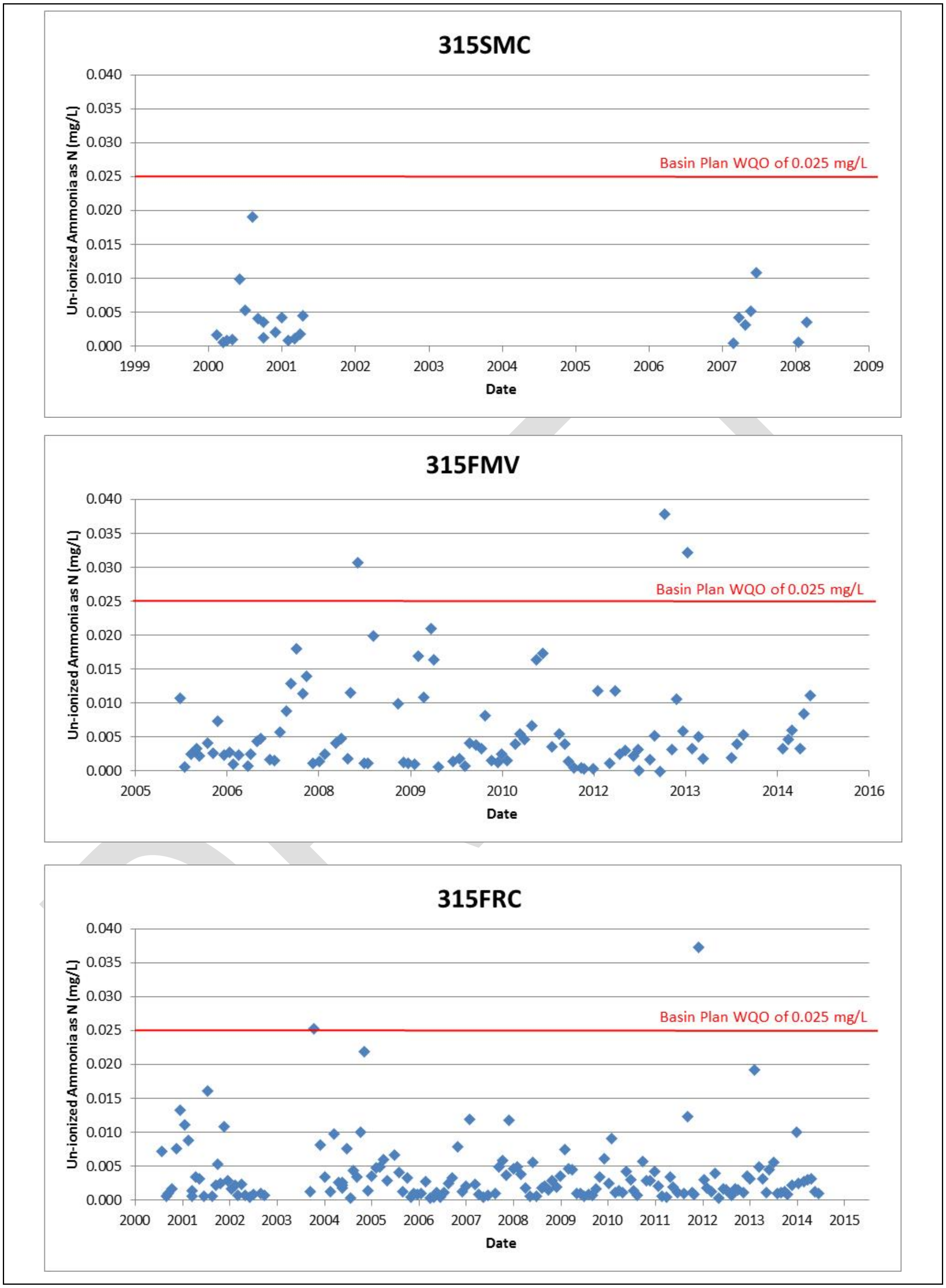


Figure 6-10. Scatter plots of un-ionized ammonia as nitrogen (mg/L) concentrations.
Note: Not shown for 315FMV are concentrations of 0.183151 mg/L on 4/28/08, 0.141003 mg/L on 1/20/2010, 8.6 mg/L on 7/26/2011, and 0.040575 mg/L on 5/29/2012.

Exceedance of the un-ionized ammonia water quality objective for toxicity (0.025 mg/L as nitrogen) occurs much less frequently when compared to nitrate exceedances. The uppermost monitoring station for Franklin Creek (315FMV) recorded the most exceedances with 7 out of 101 samples (7%) exceeding the objective necessary to prevent water column toxicity. Santa Monica Creek site (315SMC) never exceeded the un-ionized ammonia water quality objective.

6.1.4 Dissolved oxygen (mg/L)

As discussed in Section 5.1.5, the Basin Plan requires that in waterbodies designated for WARM habitat, dissolved oxygen concentrations shall not be depressed below 5 mg/L and that in waterbodies designated for COLD and SPWN, dissolved oxygen shall not be depressed below 7 mg/L. In addition, peer-reviewed research in California's central coast region (Worcester et al., 2010) has established an upper limit of 13 mg/L for dissolved oxygen to screen for excessive dissolved oxygen saturation indicative of biostimulatory conditions.

Staff used the above objectives and screening levels to assess dissolved oxygen water quality conditions.

Table 6-5. Summary of CCAMP/CMP monitoring results for dissolved oxygen (mg/L).

Station	Dates	Count	Count < 5 Warm	% < 5 Warm	Count < 7 Cold	% <7 Cold	Count >13	% >13	Median	Mean	Max	Min
315SMC	1/16/01-3/19/02 1/28/08-1/28/09	75	0	0	1	1.33	4	5.33	11.06	11.21	14.45	6.99
315FMV	1/25/06-9/30/15	124	0	0	7	5.65	44	35.48	11.15	12.06	23.90	5.10
315FRC	1/16/01-2/25/15	162	1	0.62	4	2.47	104	64.20	15.29	15.24	28.24	4.71

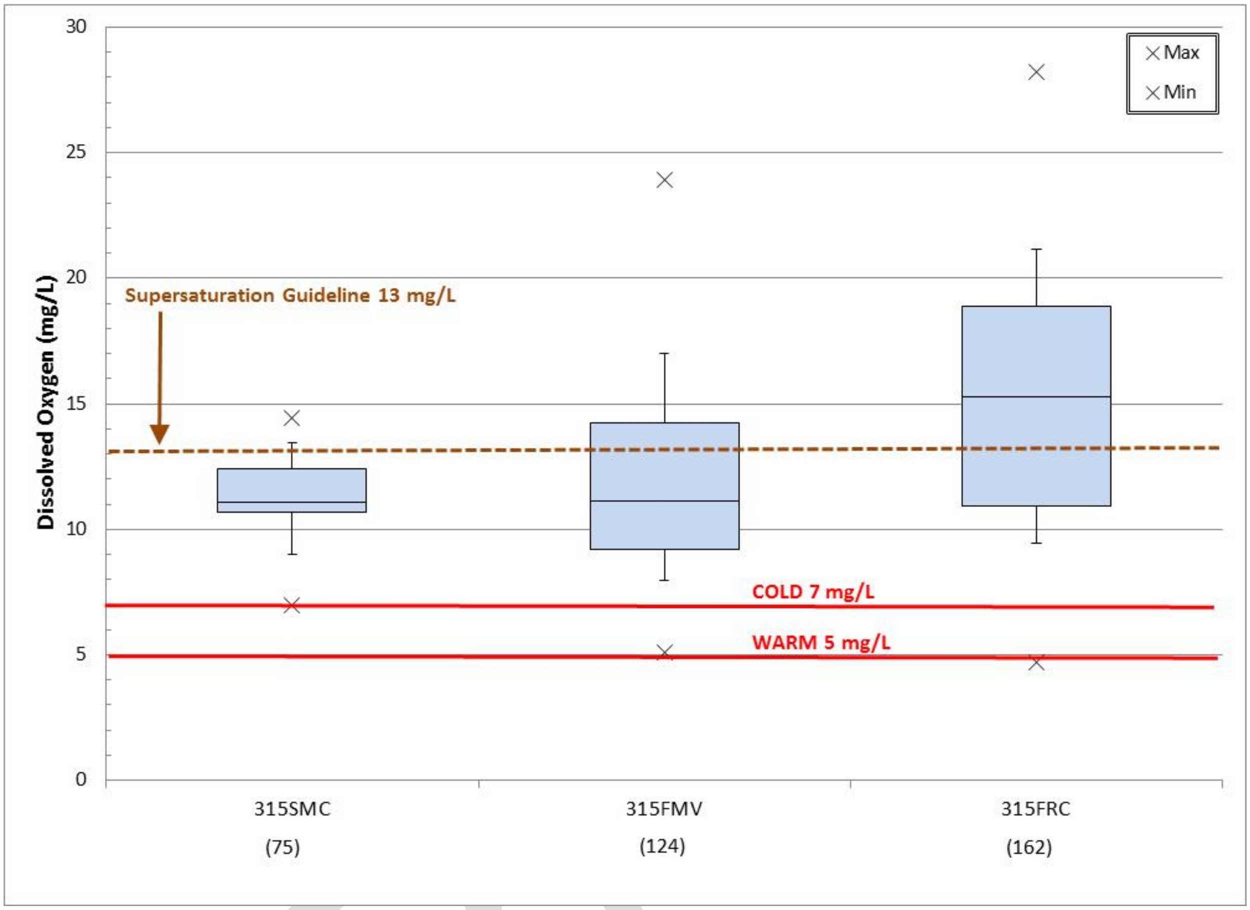


Figure 6-11. Box plots of dissolved oxygen concentrations (mg/L).

Note: Upper and lower red horizontal lines represent dissolved oxygen water quality objectives for COLD (7 mg/L) and WARM (5 mg/L) beneficial uses respectively. Dashed brown horizontal line represents screening level guideline for oxygen supersaturation (13mg/L), above which may be indicative of biostimulatory conditions.

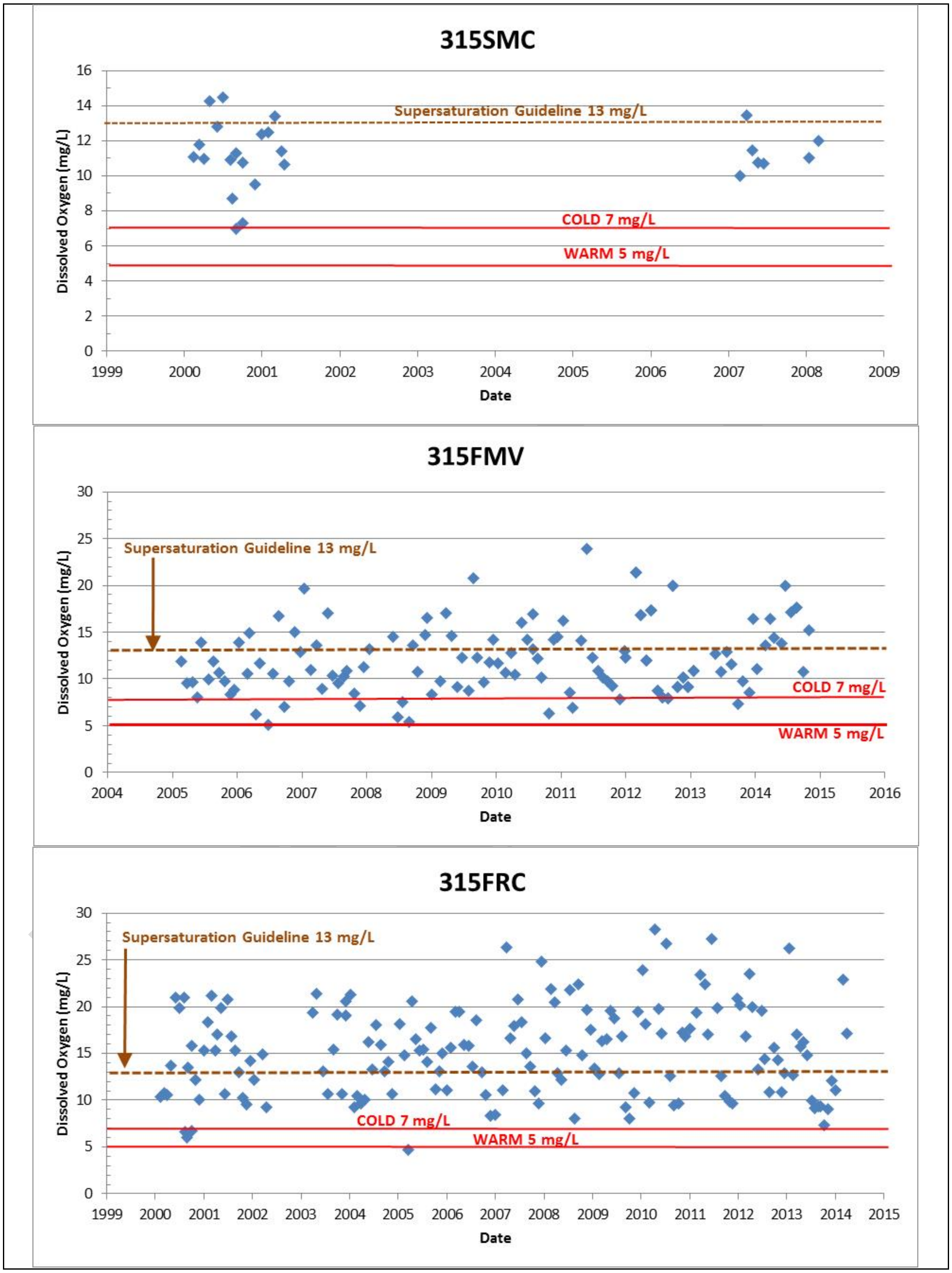


Figure 6-12. Scatter plot of dissolved oxygen concentrations (mg/L).
Note: Upper and lower red horizontal lines represent dissolved oxygen water quality objectives for COLD (7 mg/L) and WARM (5 mg/L) beneficial uses respectively. Dashed brown horizontal line represents screening level guideline for oxygen supersaturation (13mg/L), above which may be indicative of biostimulatory conditions.

Low dissolved oxygen concentrations that are below either the WARM beneficial use water quality objective of 5 mg/L or the COLD beneficial use objective of 7 mg/L are rarely observed at monitoring stations within the Carpinteria Salt Marsh watershed. However, dissolved oxygen supersaturation levels greater than the 13 mg/L screening level are frequently observed at monitoring sites 315FMV and 315FRC. For monitoring site 315FMV the dissolved oxygen supersaturation screening level of 13 mg/L was exceeded in 44 of 124 samples (35%) and for site 315FRC in 104 of 162 samples (64%).

6.1.5 Dissolved oxygen (% saturation)

The Basin Plan General Objective, Chapter 3, Section II.A.2 General Objectives for all Inland Surface Waters, Enclosed Bays and Estuaries states the following: Median values for dissolved oxygen should not fall below 85% saturation as a result of controllable conditions.

Although the Basin Plan does not contain water quality objectives associated with dissolved oxygen supersaturation, U.S. EPA has recommended an upper limit of 110% total dissolved gas saturation to protect fish from gas bubble trauma. Gas bubble trauma is sometimes a fatal condition, which occurs when gas bubbles, primarily nitrogen and/or oxygen, are released into the bloodstream and accumulate in the skin, eyes, and gills of fish. It is usually considered a problem for fish in discharge waters from dams, but can also be associated with biostimulatory conditions (Canadian Council of Ministers of the Environment, 1999; Fidler and Miller, 1994). Edsall and Smith (2008) showed gas bubble trauma could be induced with oxygen supersaturation alone.

Table 6-6. Summary of CCAMP monitoring results for dissolved oxygen saturation (%).

Station	Dates	Count	Mean	Median	Max	Min
315SMC	1/16/01-3/19/02 1/28/08-1/28/09	25	117.7	122.8	154.0	72.9
315FMV	1/25/06-9/30/15	101	128.3	115.8	278.6	52.2
315FRC	1/16/01-2/25/15	163	162.5	160.9	357.7	48.1

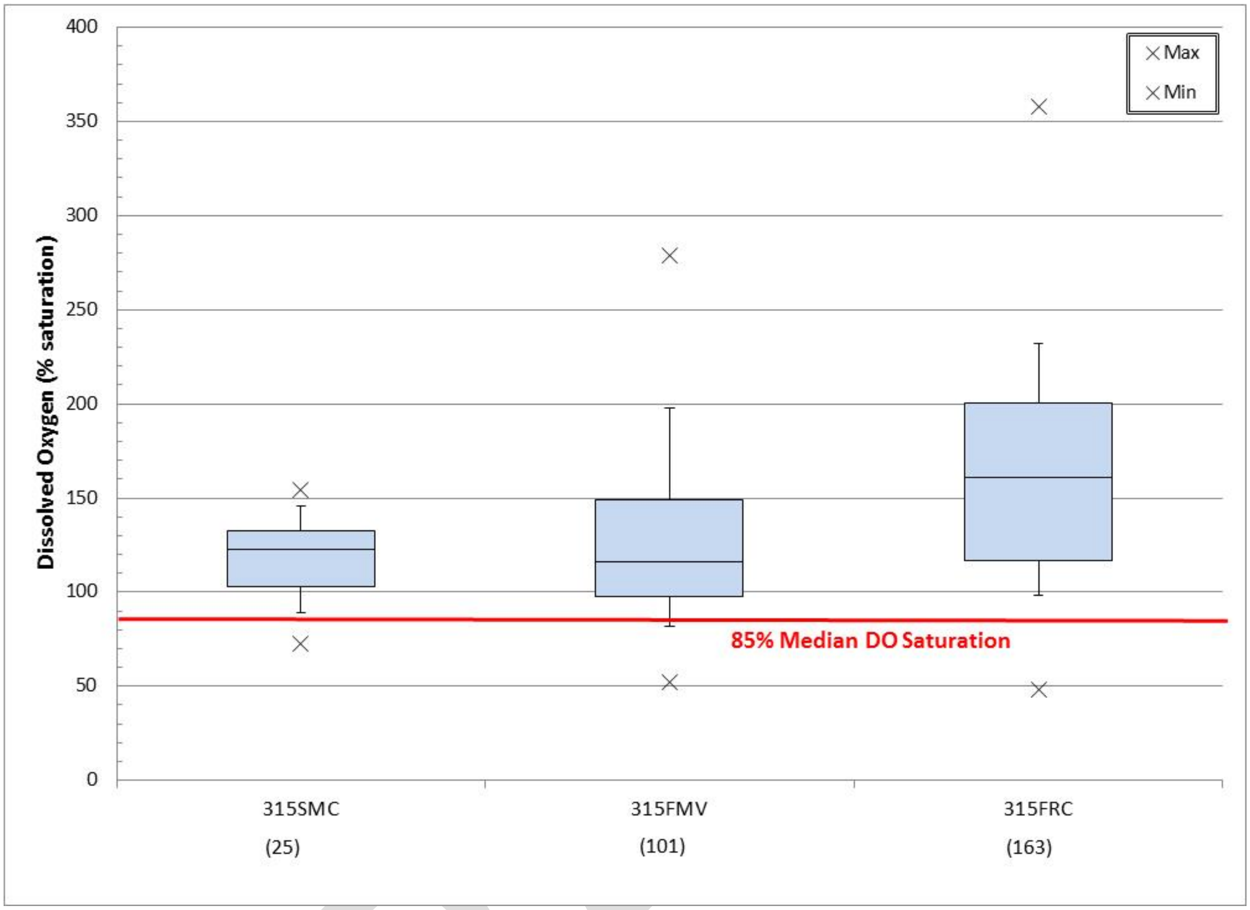


Figure 6-13. Box plots of dissolved oxygen concentrations (% saturation).

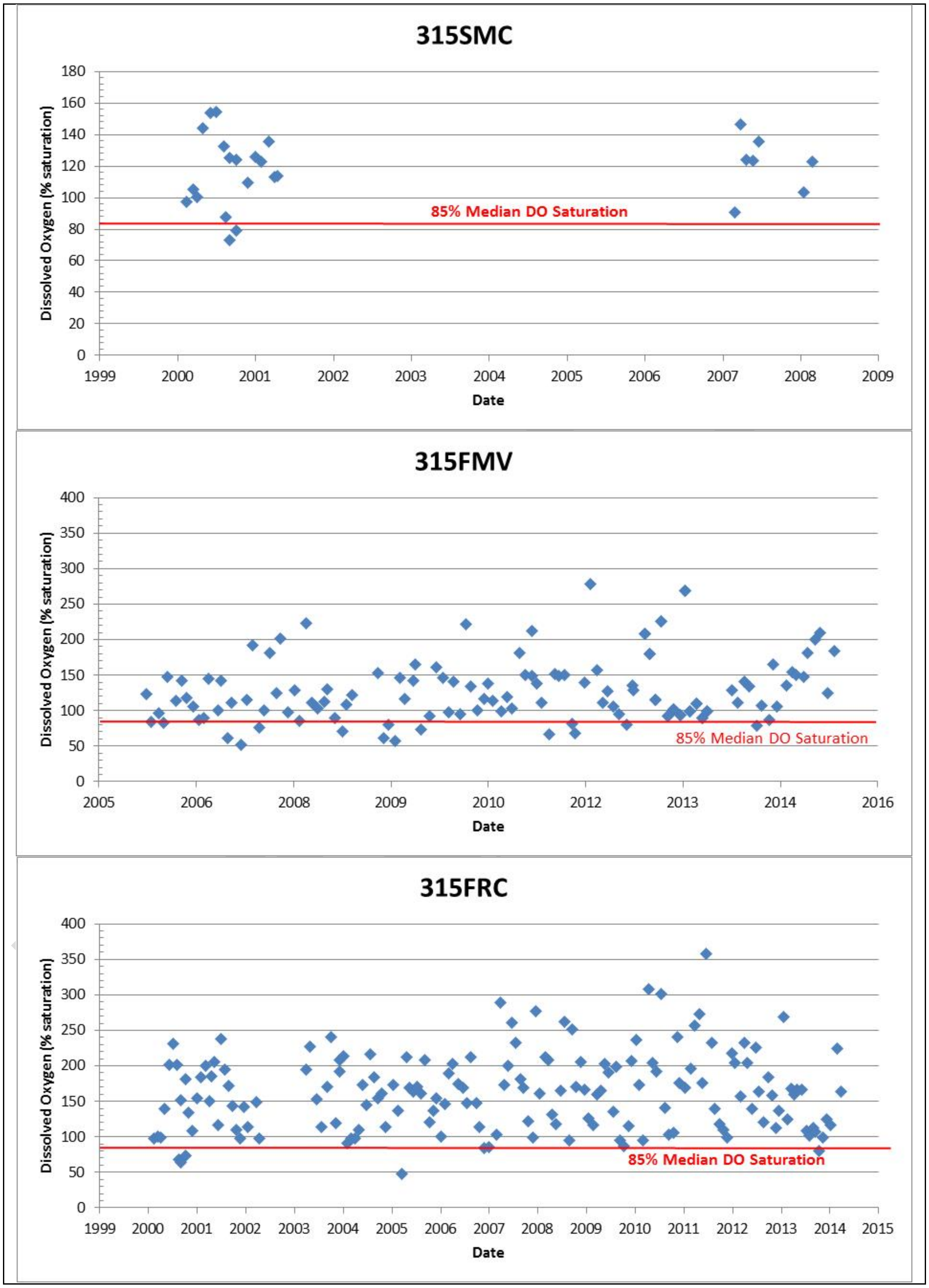


Figure 6-14. Scatter plot of dissolved oxygen saturation (%).

The general water quality objective of 85% median dissolved oxygen saturation is attained for all monitoring sites (see median values in Table 6-6). Single-sample results that exceed (are below) the median water quality objective occur infrequently at Santa Monica Creek site 315SMC and Franklin Creek site 315FRC and most frequently at the upstream Franklin Creek site 315FMV. The U.S. EPA-recommended upper limit of 110% total dissolved gas saturation is most often exceeded at the Franklin Creek sites, suggesting oxygen supersaturation associated with biostimulatory conditions.

6.1.6 Chlorophyll a

Chlorophyll *a* is an algal biomass indicator however, the Basin Plan does not include numeric water quality objectives or criteria for chlorophyll *a*. Staff considered a range of published numeric criteria. The State of Oregon uses an average chlorophyll *a* concentration of greater than 15 micrograms per liter (µg/L) as a criterion for nuisance phytoplankton growth in lakes and rivers[19]. The state of North Carolina has set a maximum acceptable chlorophyll *a* standard of 15 µg/L for cold water (lakes, reservoir, and other waters subject to growths of macroscopic or microscopic vegetation designated as trout waters), and 40 µg/L for warm water (lakes, reservoir, and other waters subject to growths of macroscopic or microscopic vegetation not designated as trout waters)[20]. A chlorophyll *a* concentration of 8 µg/L is recommended as a threshold of eutrophy for plankton in EPA's Nutrient Criteria Technical Guidance Manual for Rivers and Streams (USEPA, 2000a). Central Coast Water Board staff currently uses 40 µg/L as stand-alone evidence to support chlorophyll *a* listing recommendations for the 303(d) list.

Table 6-7. Summary of CCAMP monitoring results for chlorophyll *a* (µg/L) concentrations.

Station	Dates	Count	Count > 40	% > 40	Median	Mean	Max	Min
315SMC	1/16/01-3/4/02 1/28/08-1/28/09	21	0	0	2	3.7	19.5	0.0
315FMV	1/25/06-9/30/15	111	4	3.6	4.3	8.8	65.2	0.0
315FRC	1/16/01-2/25/15	152	6	3.9	3.1	9.0	209.8	0.0

Chlorophyll *a* concentrations exceeding the 40 µg/L criteria are rarely observed at the monitoring sites.

[19] Oregon Administrative Rules (OAR). 2000. Nuisance Phytoplankton Growth. Water Quality Program Rules, 340-041-0150.
[20] North Carolina Administrative Code 15A NCAC 02B .0211(3)(a).

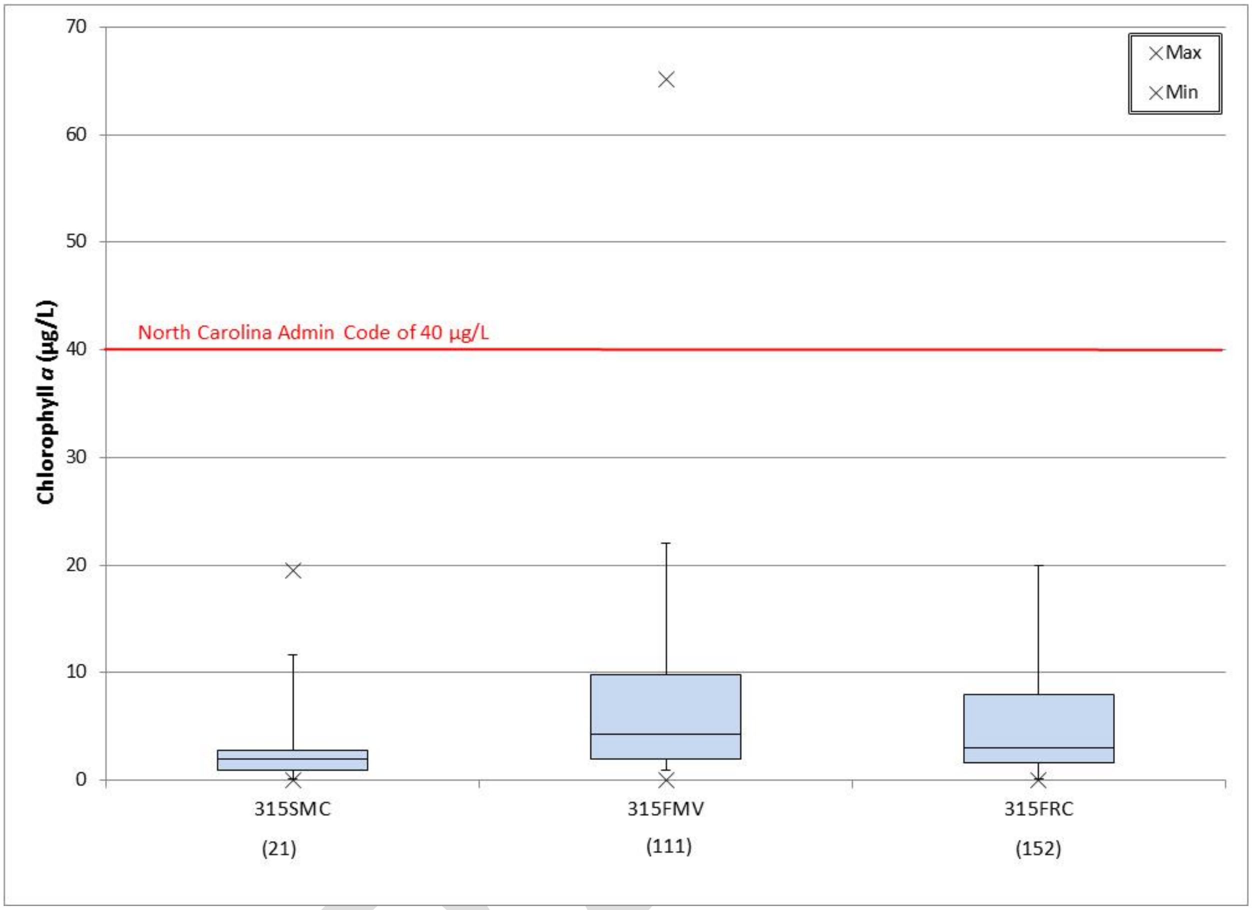


Figure 6-15. Box plots of chlorophyll *a* (µg/L) concentrations.
Note: Not shown for 315FRC is a maximum concentration of 209.8 µg/L.

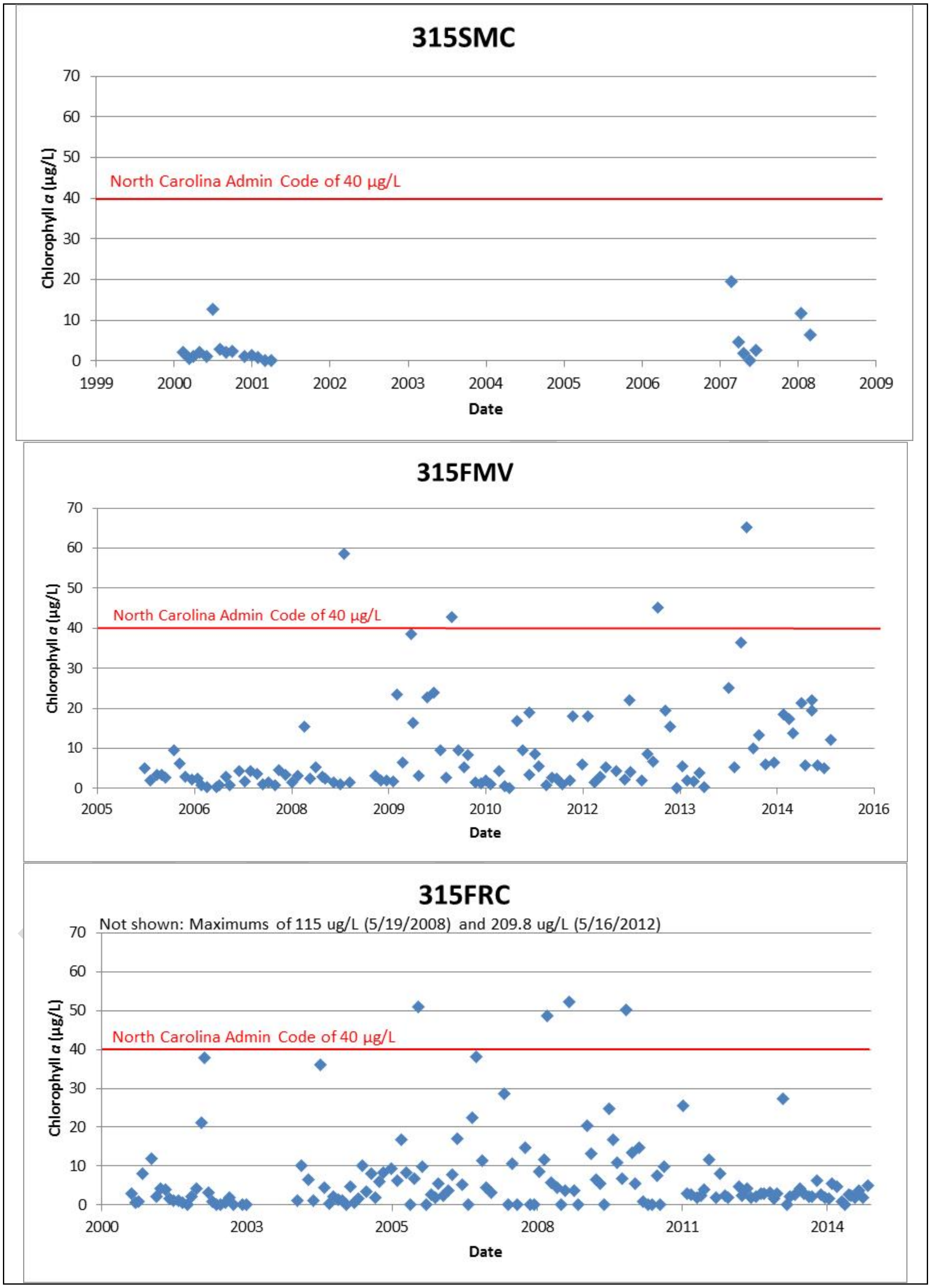


Figure 6-16. Scatter plot of chlorophyll *a* concentrations (µg/L).
Not shown for 315FRC: Maximums of 115 µg/L (5/19/2008) and 209.8 µg/L (5/16/2012).

6.1.7 Floating algae

CCAMP records a visual estimate of floating algae (% coverage) which may be used as an indicator of algal biomass. One or more observations of 50% cover or greater may be used as supporting evidence of potential nutrient over-enrichment and biostimulation (Worcester et al., 2010).

Table 6-8. Summary of CCAMP monitoring results for floating algae (% coverage).

Station	Dates	Count of observations	Count observed floating algae	Count observed floating algae =>50% coverage	Mean algae % coverage	Max algae % coverage
315SMC	1/28/08-1/28/09	7	1	0	1.4	10
315FMV	1/25/06-12/17/13	60	52	30	43	95
315FRC	1/6/05-2/25/15	119	56	13	13.5	85

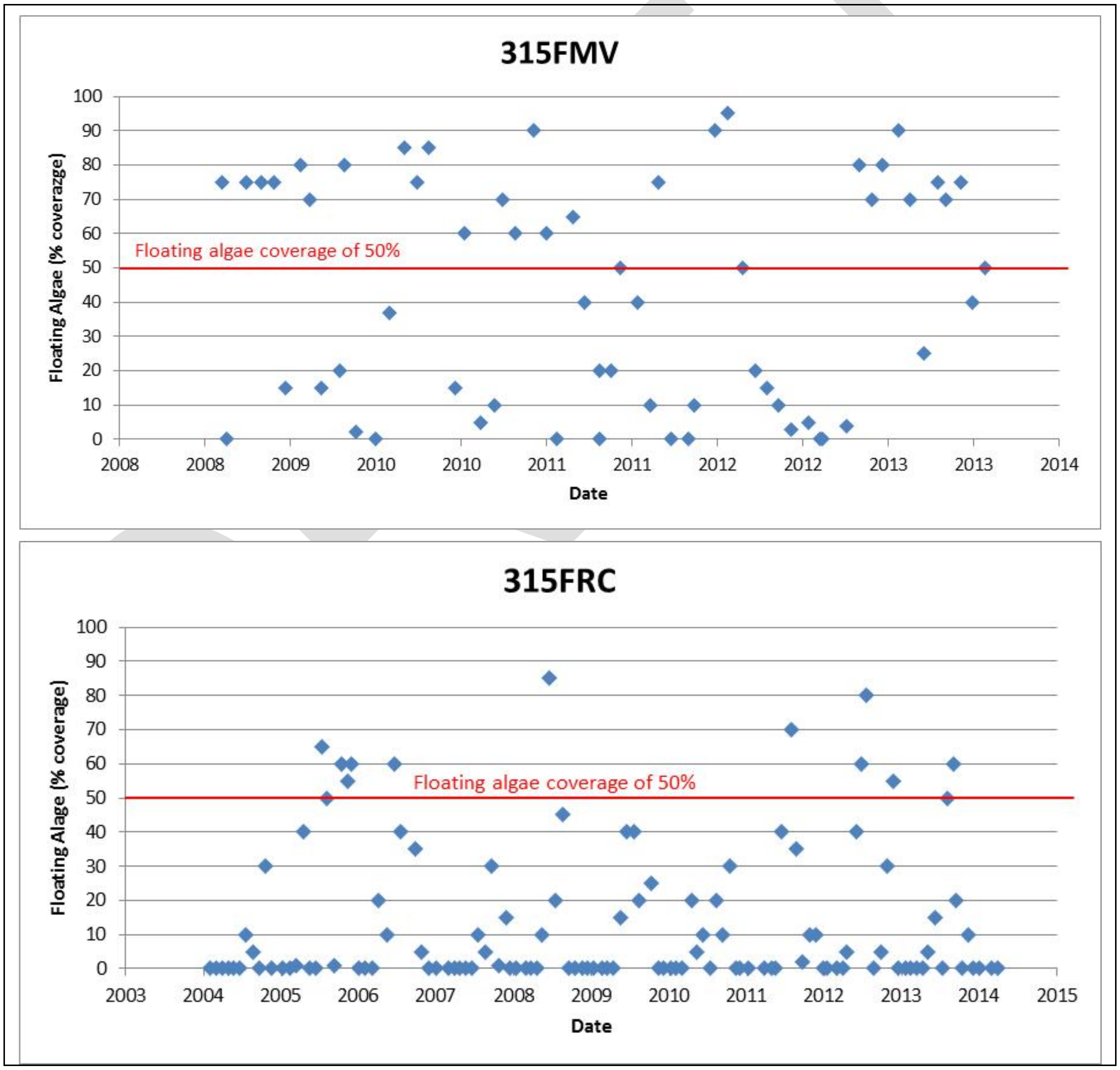


Figure 6-17. Scatter plot of floating algae (% coverage).
Note: Santa Monica Creek site 315SMC not shown due to few observations.

Estimates of floating algae exceeded the 50% coverage in 30 of the 60 observations (50% of observations) for monitoring site 315 FMV and in 13 of 119 observations (11% of observations) for site 315FRC, providing supporting evidence of potential nutrient over-enrichment and biostimulatory conditions.

6.1.8 Orthophosphate as phosphorus (mg/L)

The following data summaries for orthophosphate are provided for informational purposes only. There are no water quality objectives or criteria available for comparison.

Table 6-9. Summary of CCAMP/CMP monitoring results for orthophosphate as phosphorus (mg/L).

Station	Dates	Count	Mean	Median	10th	25th	75th	90th	Max	Min
315SMC	1/16/01-3/19/02 1/28/08-1/28/09	22	0.164	0.022	0.009	0.010	0.052	0.245	1.538	0.007
315FMV	1/25/06-6/23/15	116	0.323	0.137	0.008	0.030	0.296	0.592	6.240	0.002
315FRC	1/16/01-12/3/14	155	0.147	0.054	0.010	0.018	0.165	0.356	1.900	0.003

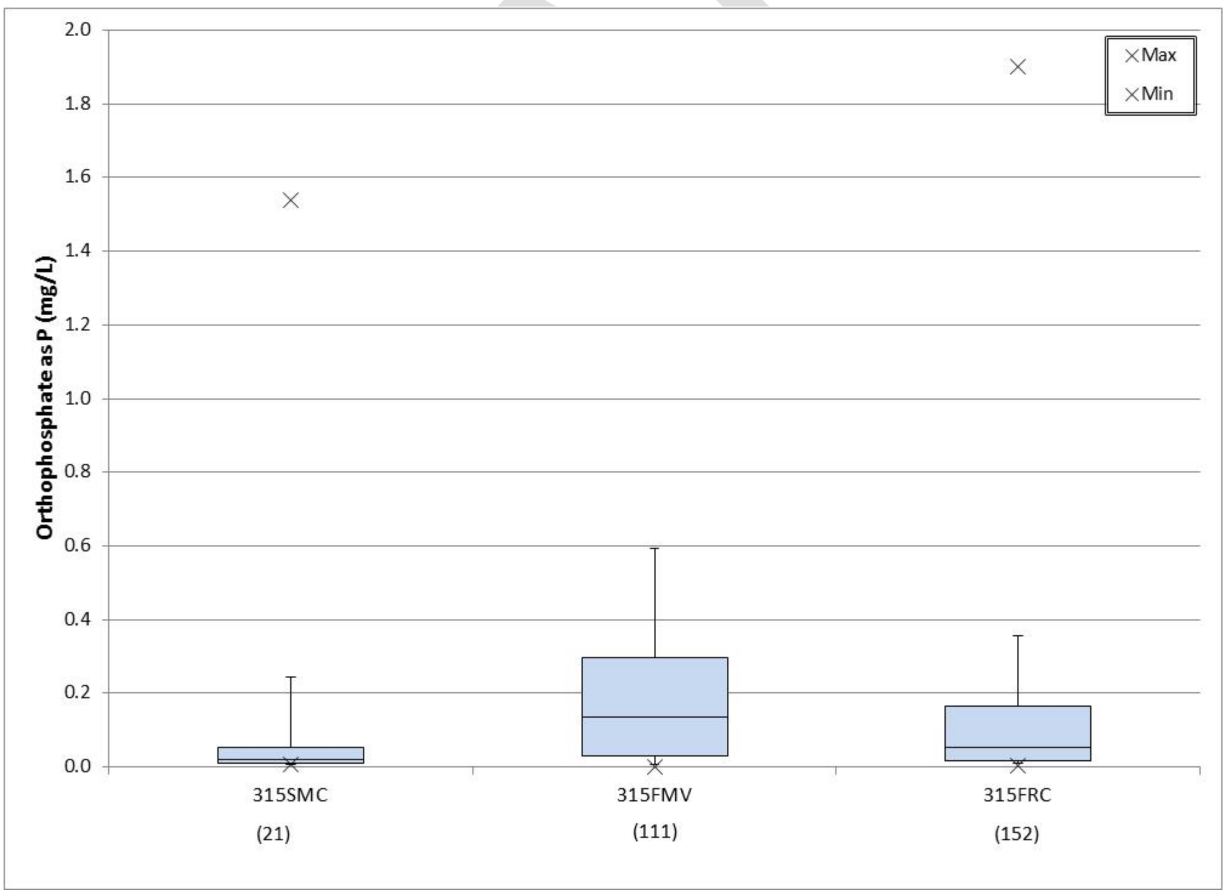


Figure 6-18. Box plots of orthophosphate as phosphorus (mg/L) concentrations.
Not shown for 315FMV: Maximum of 6.24 mg/L on 2/28/2014.

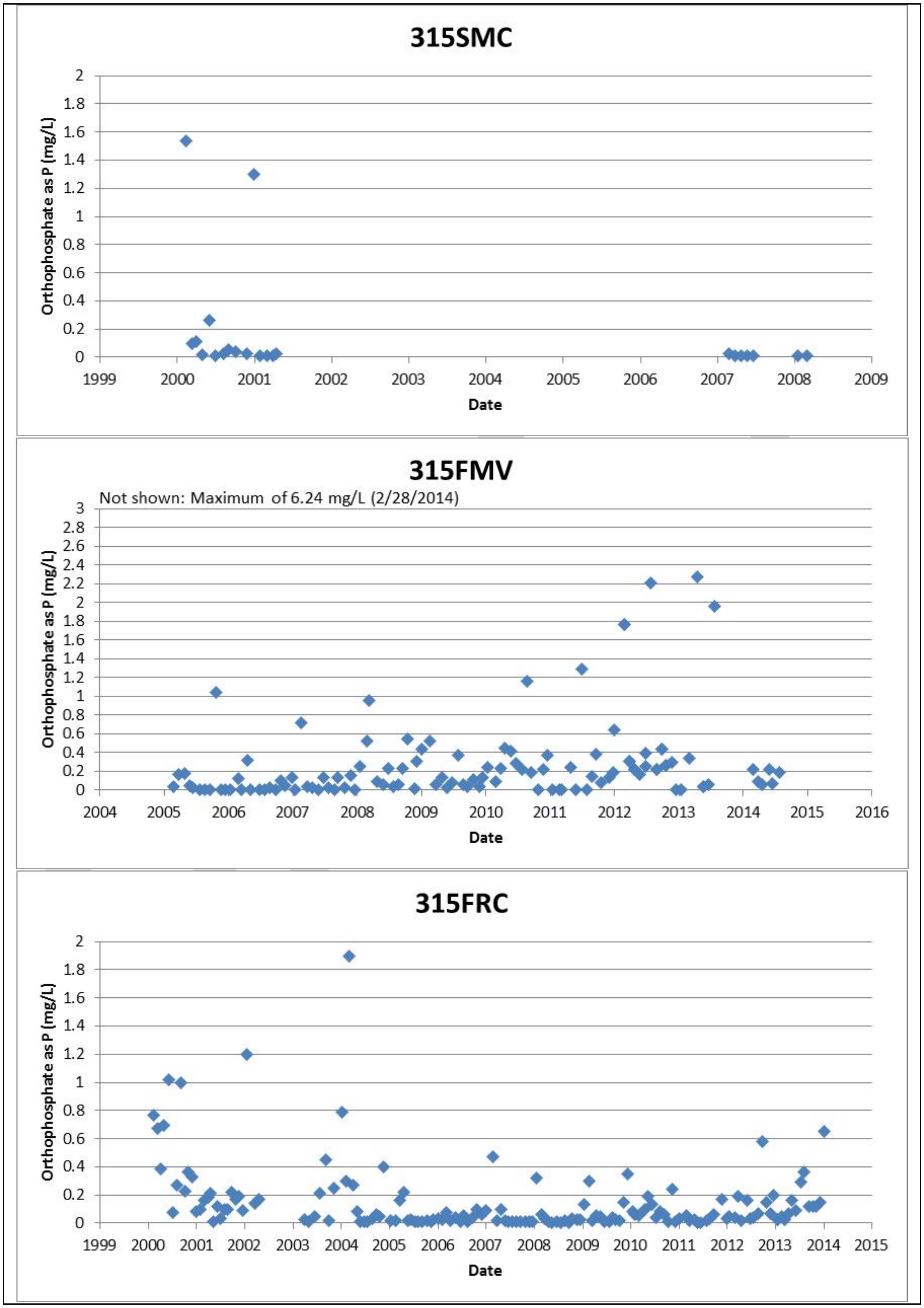


Figure 6-19. Scatter plot of orthophosphate as phosphorus (mg/L) concentrations.

6.1.9 Nitrate wet/dry seasonal trends

Water Board staff categorized nitrate as nitrogen data into wet season (November- April) and dry season (May-October) to evaluate potential seasonal trends. As shown below, seasonal trends for each monitoring site is not evident.

Table 6-10. Summary of seasonal monitoring results for nitrate as nitrogen (mg/L).

Site (Season)	Count	Median	25th	75th	90th	10th	Max	Min	Mean
315SMC (Wet)	15	0.16	0.02	0.81	5.22	0.02	10.70	0.02	1.53
315SMC (Dry)	7	0.02	0.02	0.07	0.11	0.02	0.14	0.02	0.05
315FMV (Wet)	55	26.32	20.90	30.25	35.16	10.45	56.10	0.26	24.75
315FMV (Dry)	51	24.80	20.95	31.55	36.00	19.80	322	17.10	32.14
315FRC (Wet)	77	21	19	23.10	25.16	9.32	30.11	1.72	19.92
315FRC (Dry)	79	21	19	23.15	26.12	16.00	47.87	5.17	21.42

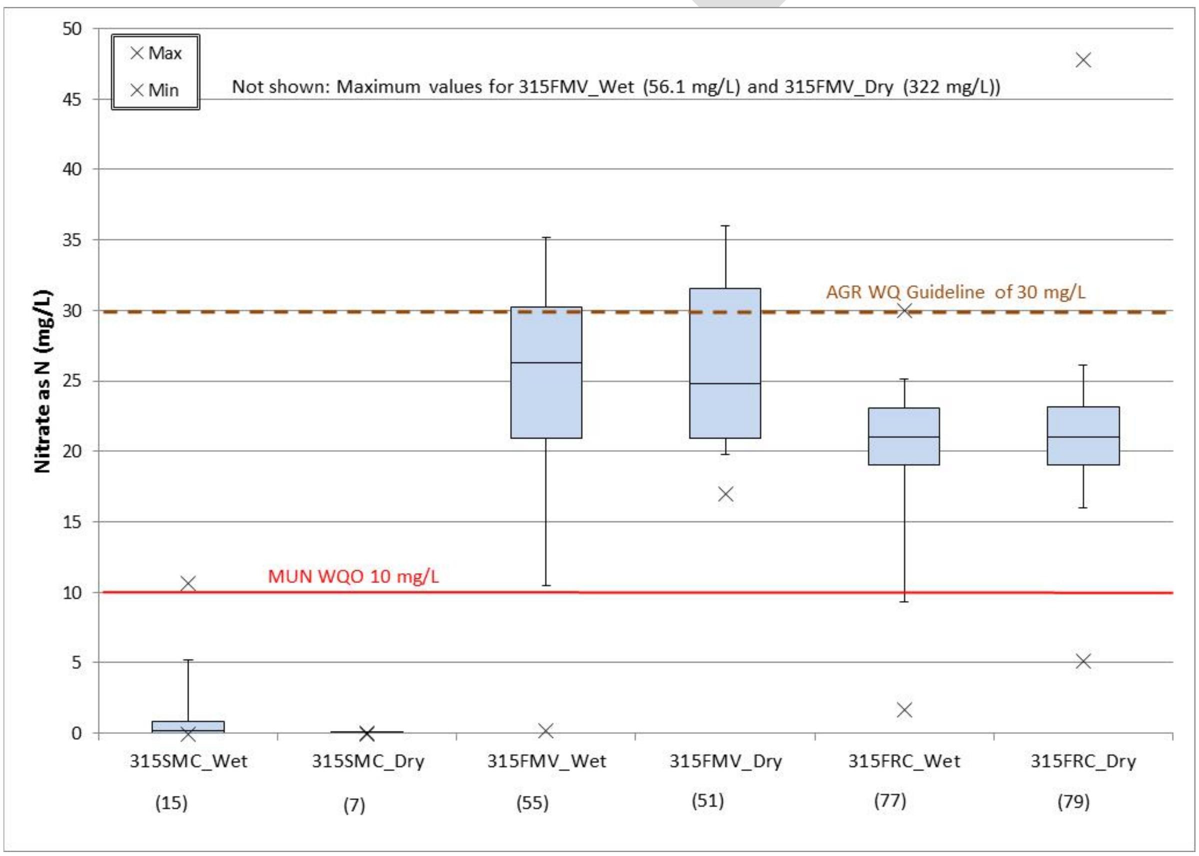


Figure 6-20. Wet and dry season box plots of nitrate as nitrogen concentrations (mg/L).
Note: Wet season (Nov-Apr) and dry season (May-Oct).

6.1.10 Nitrate monthly trends

Water Board staff categorized nitrate as nitrogen data by month for sites 315FMV and 315FRC to evaluate potential monthly trends. As shown below, median values for each site are relatively consistent throughout all months

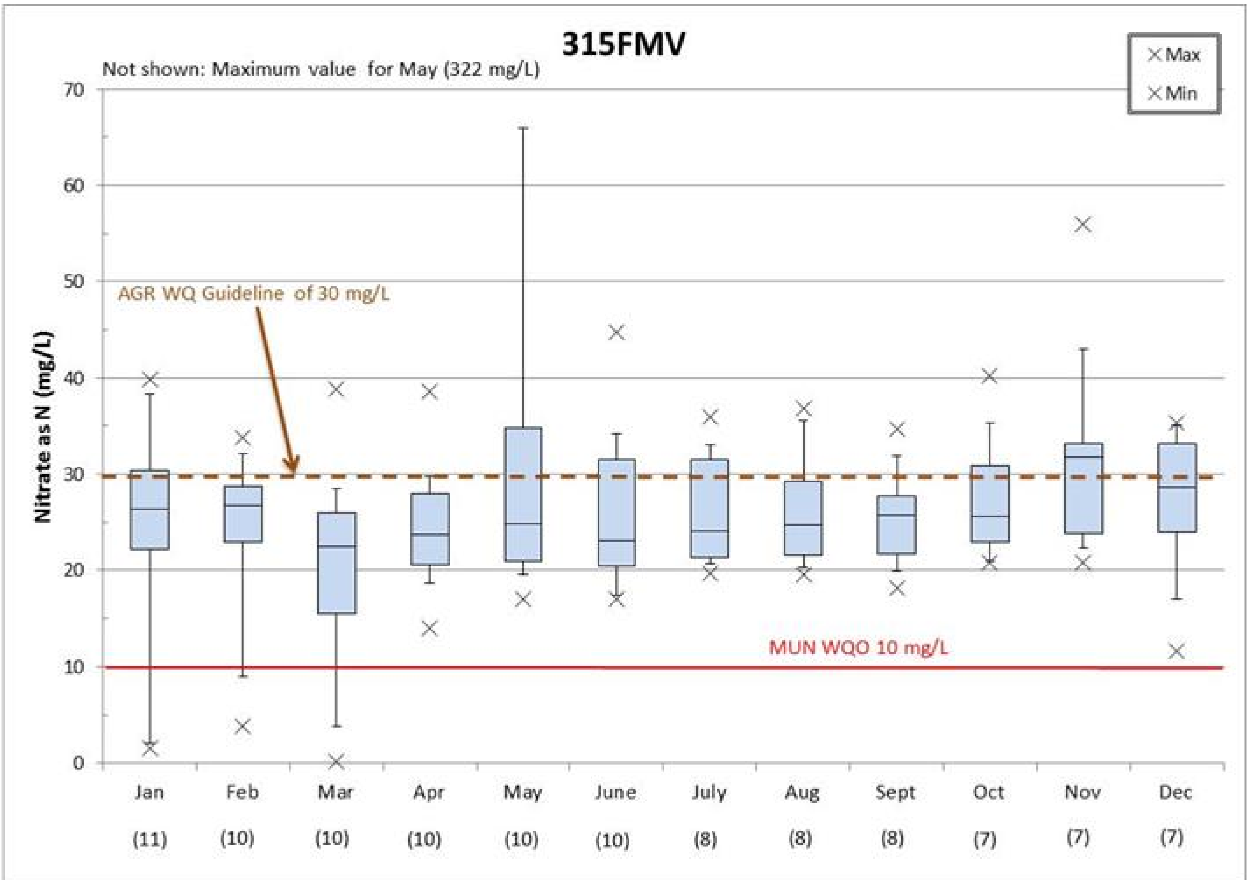


Figure 6-21. Monitoring site 315FMV monthly box plots for nitrate as nitrogen (mg/L).

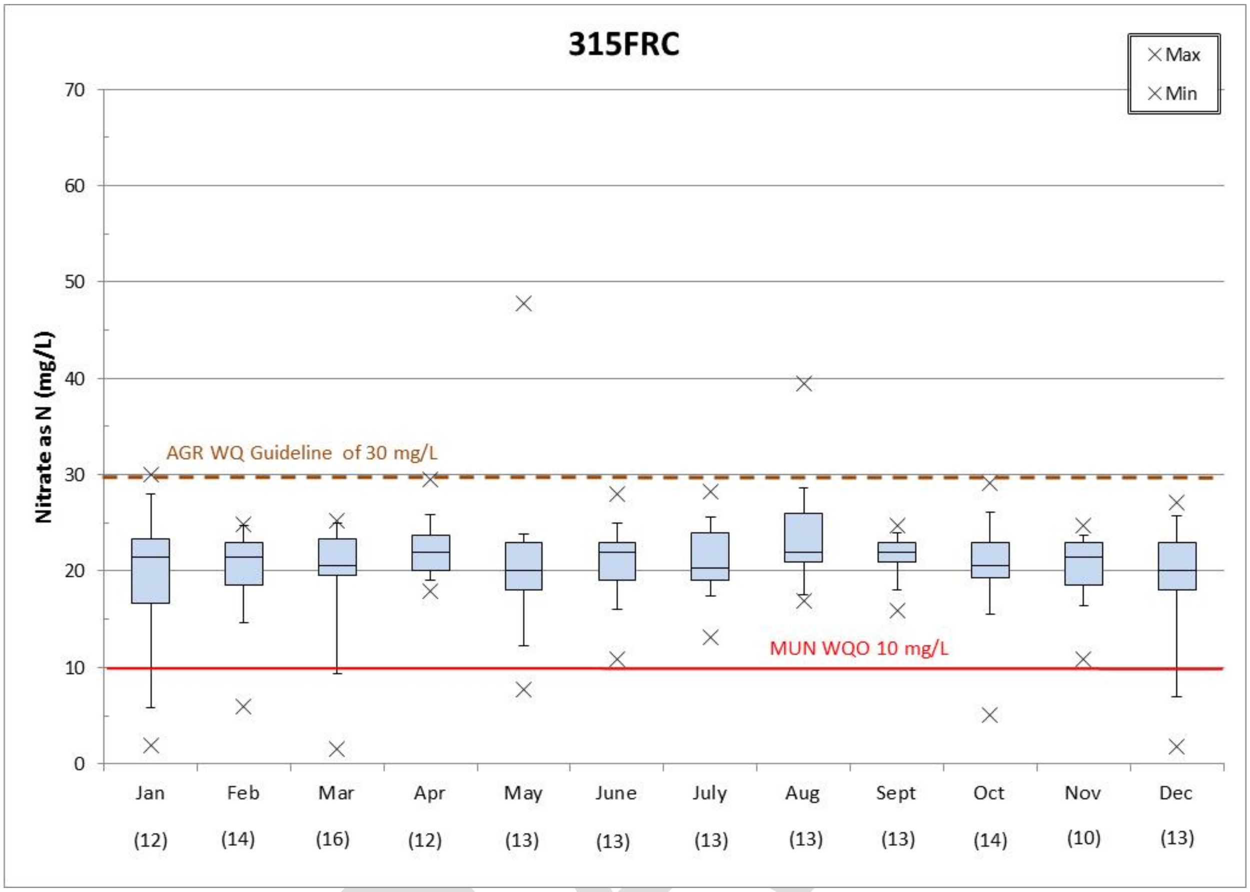


Figure 6-22. Monitoring site 315FRC monthly box plots for nitrate as nitrogen (mg/L).

6.1.11 Photo Documentation of CCAMP/CMP Monitoring Sites

August 2012 (upstream)


July 2013 (upstream)


July 2013 (downstream)


August 2014 (downstream)

Figure 6-23. Photos of Franklin Creek monitoring site 315FMV.
Photo credits: Tetra Tech, Inc. staff

Figure 6-24. Photos of Franklin Creek monitoring site 315FRC.
Photo credits: CCAMP staff

6.2 Santa Barbara Channelkeeper Water Quality Data

Locations of Santa Barbara Channelkeeper (SBCK) water quality monitoring sites are shown in Figure 6-25 and a description of site locations are contained in Table 6-11. Note that SBCK monitoring site CMO1 represents a culvert discharge south of Highway 101 and north of the railroad (see Figure 6-26 for photograph of monitoring site CM01). Water from the Highway 101 culvert then enters a railroad culvert before discharging into the Carpinteria Salt Marsh. Staff is currently investigating the origin of this culvert discharge due to extremely high nitrate concentrations.

Figure 6-25. Locations of SBCK monitoring sites.

Table 6-11. Description of SBCK monitoring site locations.

Program	Site ID	Site Description	Locational Notes
SBCK	CM01	Carpinteria Marsh at Railroad	Culvert discharge location
SBCK	SM01	Santa Monica Creek at Via Real	Same as CCAMP site 315SMC
SBCK	FK00	Franklin Creek at Carpinteria Avenue	Same as CCAMP site 315FRC


Figure 6-26. Photo of SBCK site CM01.
Photo Credit: Water Board staff on December 1, 2015.

6.2.1 SBCK nitrate as nitrogen (mg/L)

Table 6-12. Summary of SBCK monitoring results for nitrate as nitrogen (mg/L).

Station	Dates	Count	Count >10	% >10	Count >30	% >30	Median	Mean	Max	Min
CM01	4/30/11 - 10/30/12	12	9	75.0	9	75.0	51.7	52.9	122.6	0.0
SM01	4/30/11 - 6/20/12	10	1	10.0	0	0	0.0	2.1	21.0	0.0
FK00	3/7/10 - 10/30/12	12	10	83.3	0	0	20.3	18.1	25.8	0.0

For the Carpinteria Marsh culvert site (CM01), 9 of 12 samples (75%) exceeded the water quality objective for municipal supply (MUN) and the water quality guideline for agricultural supply (AGR). For Santa Monica Creek (SM01), 1 of 10 samples (10%) exceeded the water quality objective for municipal supply. Finally, for Franklin Creek (FK00), ten of 12 samples (83%) exceeded the water quality objective for municipal supply (MUN).

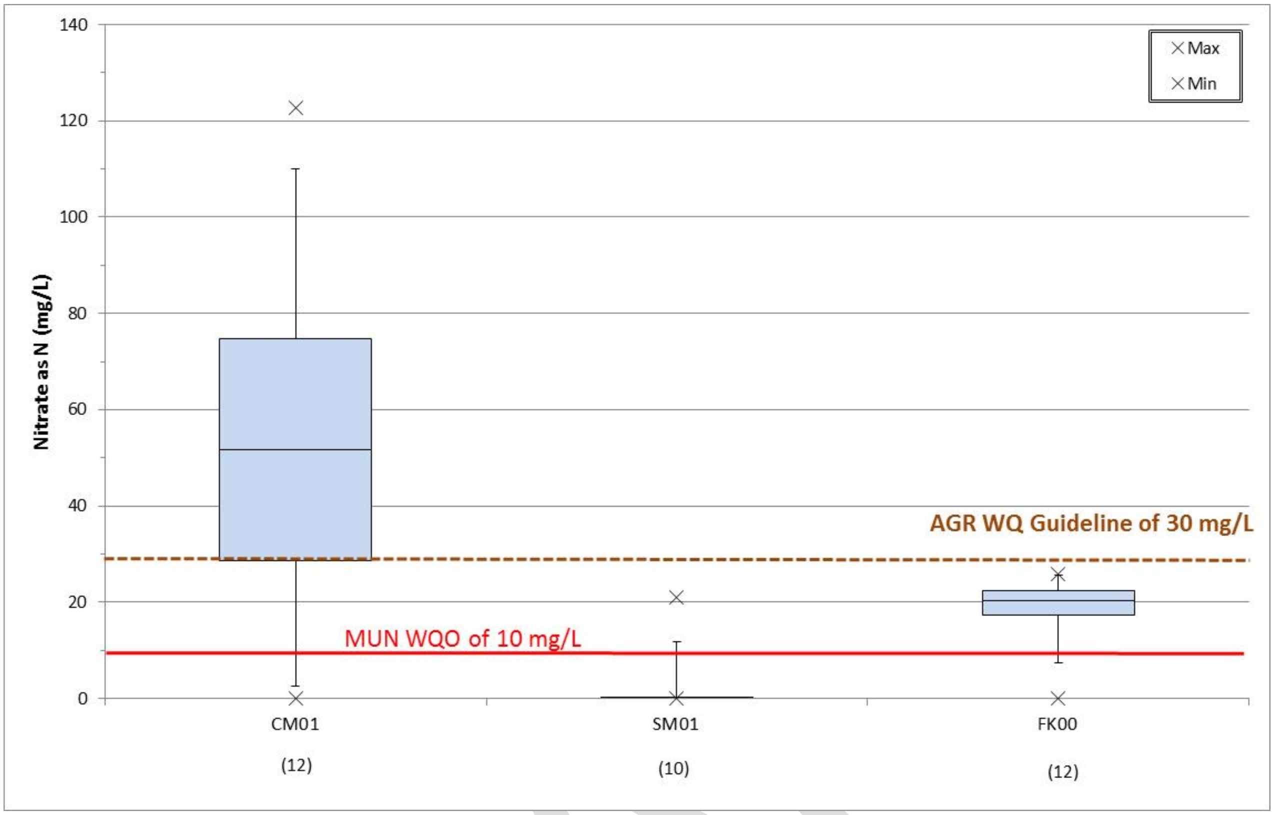


Figure 6-27. Box plots of SBCK nitrate as nitrogen concentrations (mg/L).

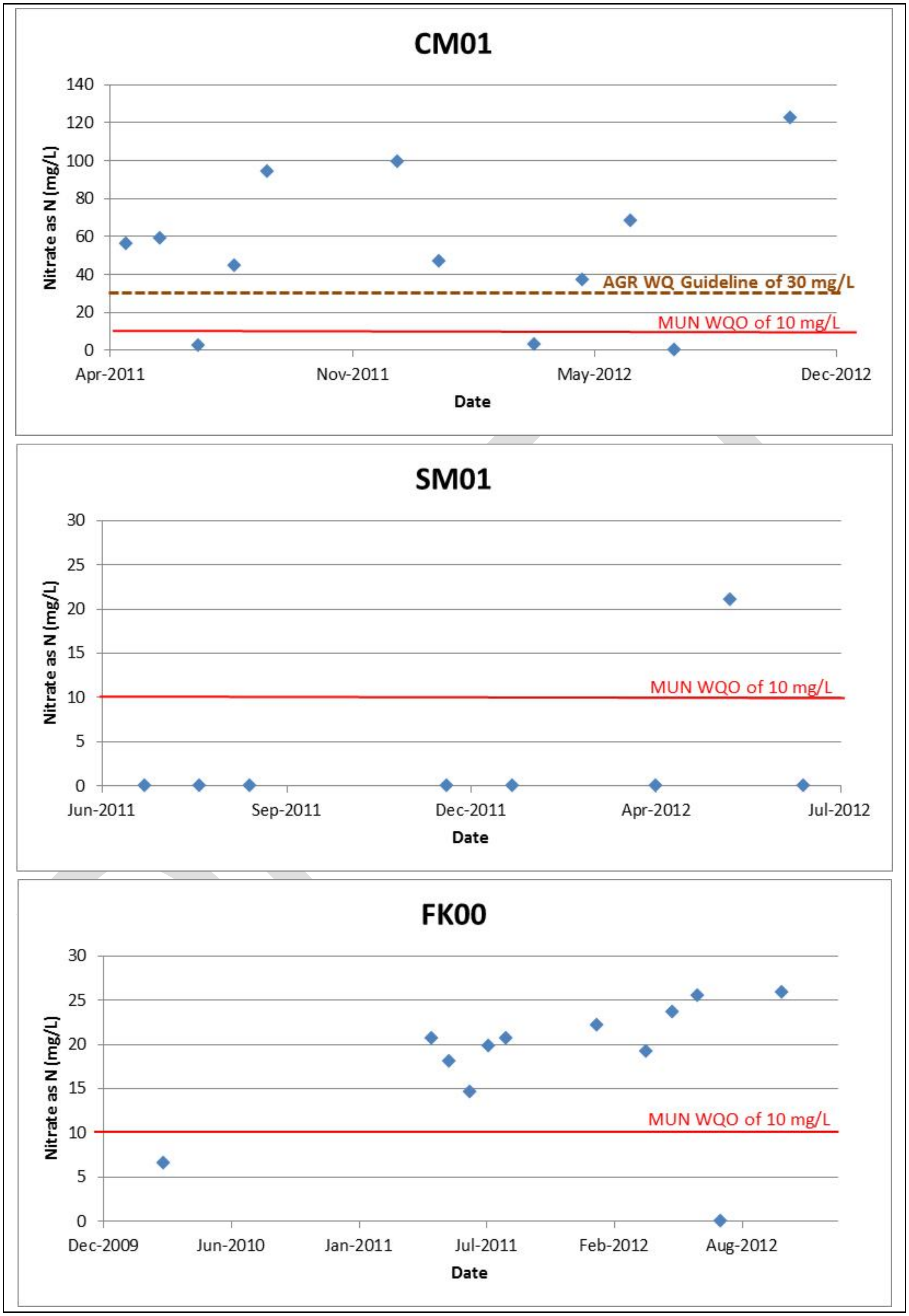


Figure 6-28. Scatter plot of SBCK nitrate as nitrogen concentrations (mg/L).
Note. Note that the vertical axis is different for the marsh and creek sites.

As shown in the figures above, the MUN beneficial use water quality objective (10 mg/L nitrate as nitrogen) is often exceeded at the Carpinteria Marsh culvert site (CM01) and Franklin Creek (FK00) monitoring stations, and only once exceeded at Santa Monica Creek site (SM01). Though the frequency of exceedances occurred more often for the Franklin Creek site (83% compared to 75% for FK00 and CM01 respectively), the magnitude of exceedances of nitrate as nitrogen concentrations was much greater for the marsh culvert site (median value 51.7 mg/L, maximum value 122.6 mg/L) compared to the creek site (median value 20.3 mg/L, maximum value 25.8 mg/L) suggesting a higher input at the marsh culvert site (Table 6-12 and Figure 6-27). Furthermore, when an exceedance was measured, the nitrate as nitrogen concentrations at the Carpinteria Marsh culvert site (CM01) were at least three times greater than the water quality objective for the MUN beneficial use (Figure 6-28).

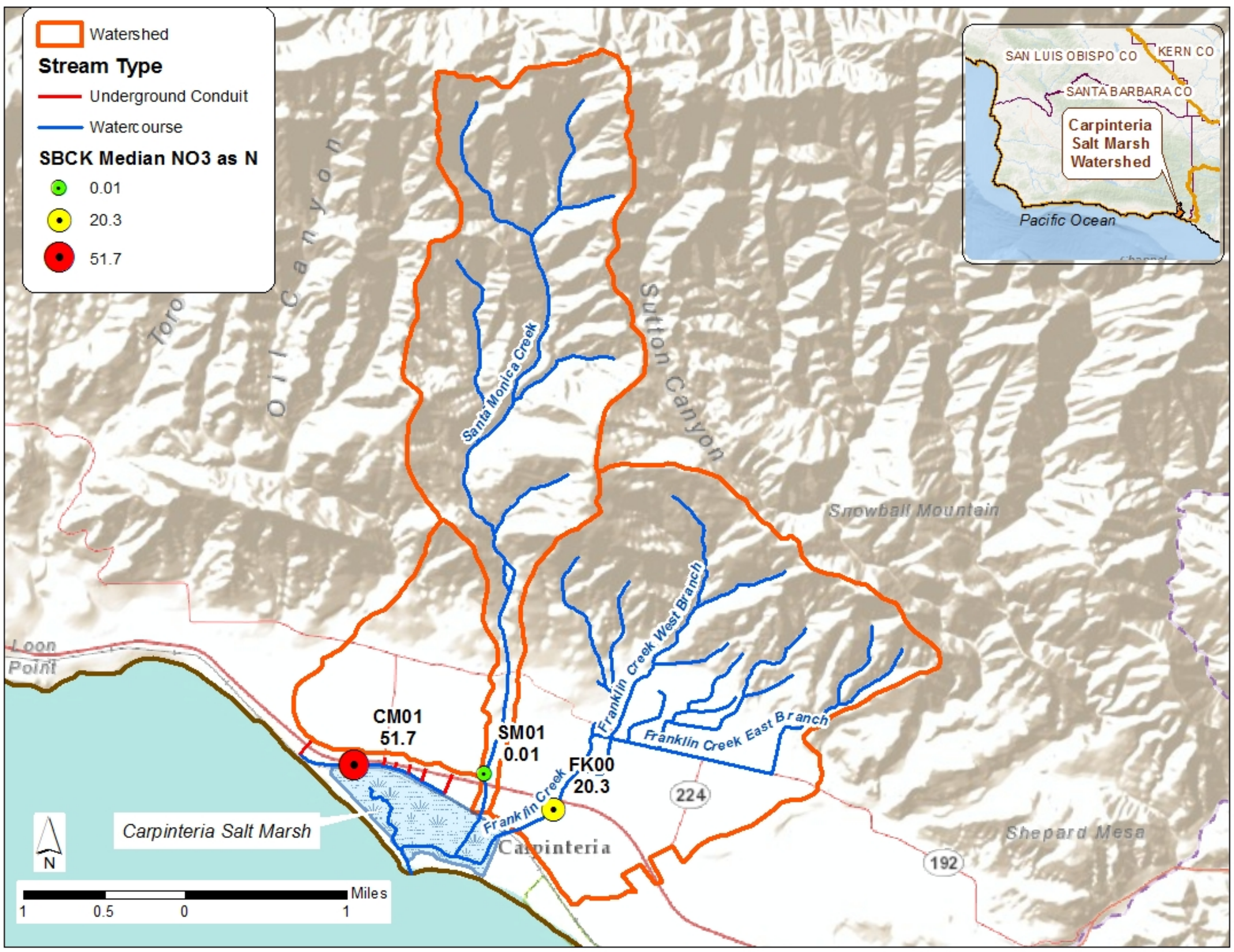


Figure 6-29. Median nitrate as nitrogen concentrations for SBCK monitoring sites.

6.2.2 SBCK dissolved oxygen concentrations (mg/L)

Staff evaluated dissolved oxygen conditions based on water quality objectives for COLD (no less than 7 mg/L), WARM and SPWN (no less than 5 mg/L), and the oxygen saturation guideline (Worcester et al., 2010) of no greater than 13 mg/L. For more information on the dissolved oxygen evaluation criteria see Sections 5.1.5 and 6.1.4.

Table 6-13. Summary of SBCK monitoring results for dissolved oxygen (mg/L).

Station	Dates	Count	Count < 5 Warm	% < 5 Warm	Count < 7 Cold	% <7 Cold	Count >13	% >13	Median	Mean	Max	Min
CM01	1/16/01-3/19/02 1/28/08-1/28/09	42	7	16.67	14	33.33	4	9.52	8.55	8.71	20.8	1.87
SM01	1/25/06-9/30/15	27	0	0	1	3.70	4	14.81	11.45	10.85	15.2	6.85
FK00	1/16/01-2/25/15	46	1	2.17	7	15.22	31	67.39	16.59	15.80	36.2	0.37

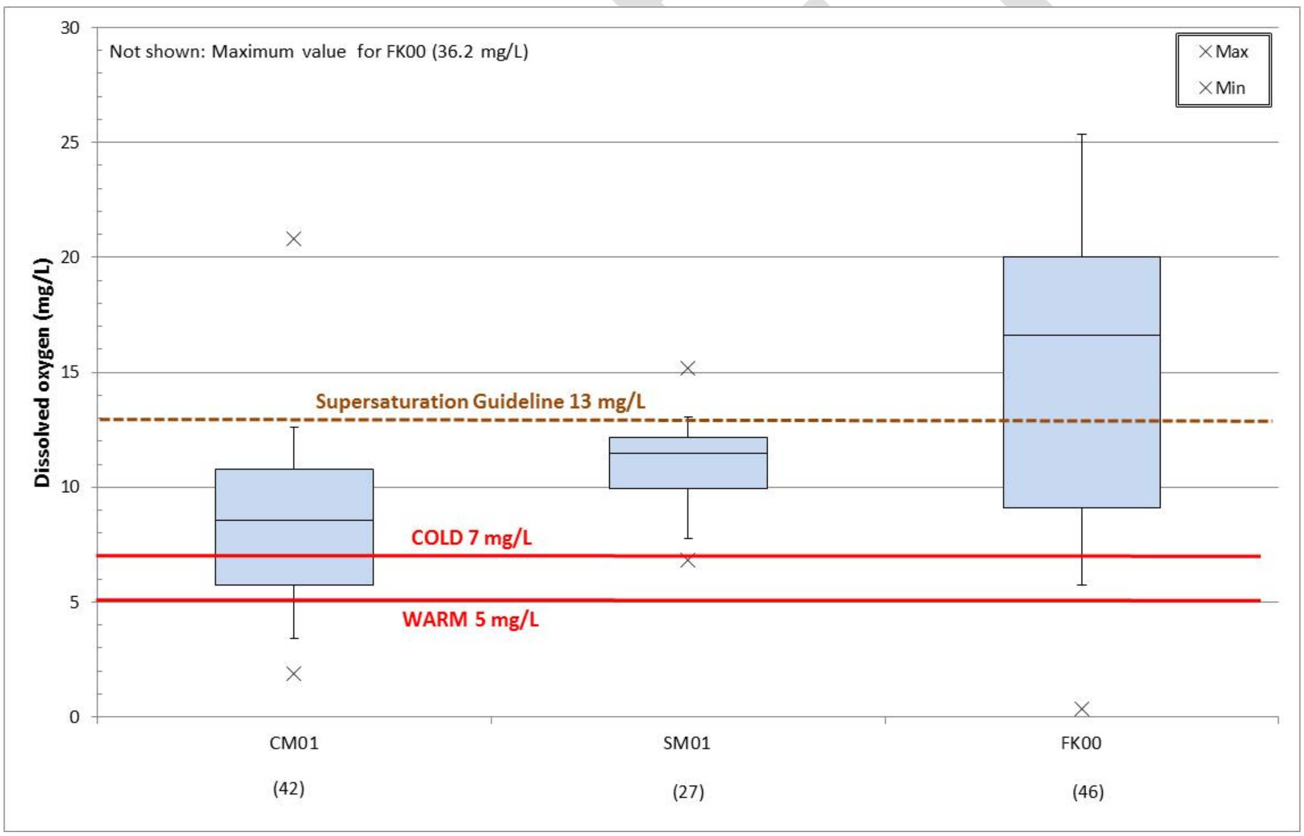


Figure 6-30. Box plots of SBCK dissolved oxygen concentrations (mg/L).

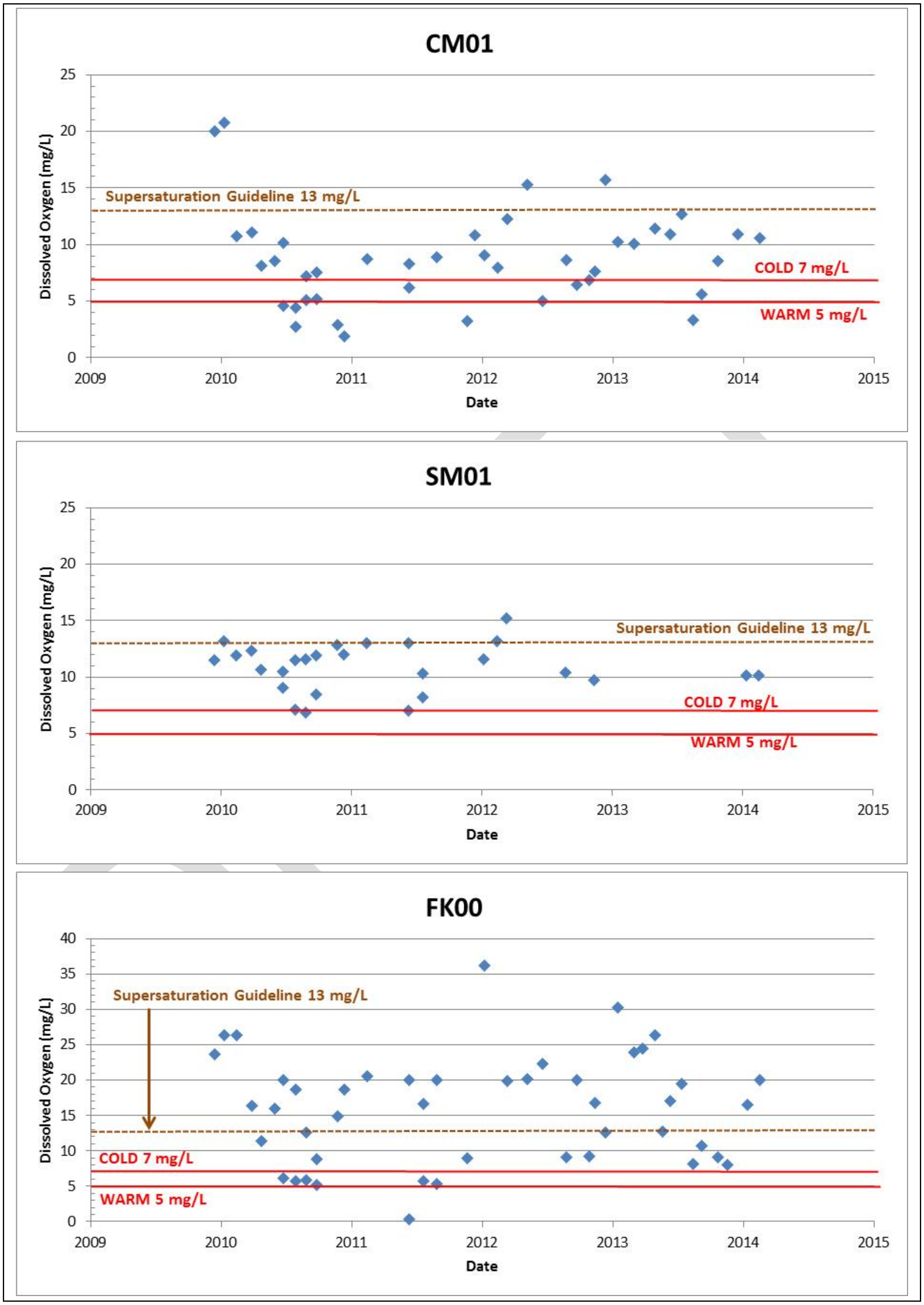


Figure 6-31. Scatter plot of SBCK dissolved oxygen concentrations (mg/L).

Low dissolved oxygen concentrations that do not meet (are below) both the WARM beneficial use water quality objective of 5 mg/L and the COLD beneficial use objective of 7 mg/L are observed at the Carpinteria Marsh culvert site CM01 whereby 7 out of 42 samples (17%) do not meet (are below) the WARM objective of 5 mg/L and 14 out of 42 samples (33%) do not meet (are below) the COLD objective of 7 mg/L. Franklin Creek site FK00 does not meet (is below) the COLD beneficial use objective of 7 mg/L for 7 out of 46 samples (15%).

Dissolved oxygen supersaturation levels greater than the 13 mg/L screening level guideline are frequently observed at Franklin Creek monitoring site FK00 where 31 out of 46 samples (67%) exceeded this screening level.

6.2.3 SBCK dissolved oxygen (% saturation)

The Basin Plan General Objective, Chapter 3, Section II.A.2 General Objectives for all Inland Surface Waters, Enclosed Bays and Estuaries states the following: Median values for dissolved oxygen should not fall below 85% saturation as a result of controllable conditions.

Although the Basin Plan does not contain water quality objectives associated with dissolved oxygen supersaturation, U.S. EPA has recommended an upper limit of 110% total dissolved gas saturation to protect fish from gas bubble trauma (see Section 6.1.5).

Table 6-14. Summary of SBCK monitoring results for dissolved oxygen saturation (%).

Station	Dates	Count	Count <85	% <85	Median	Mean	Max	Min
CM01	11/13/10-11/15/14	43	17	39.5	94.5	96.4	239.9	19.0
SM01	11/13/10-1/17/15	28	3	10.7	115.7	122.9	296.7	73.0
FK00	11/13/10-12/13/14	44	7	15.9	181.3	176.1	396.6	3.8

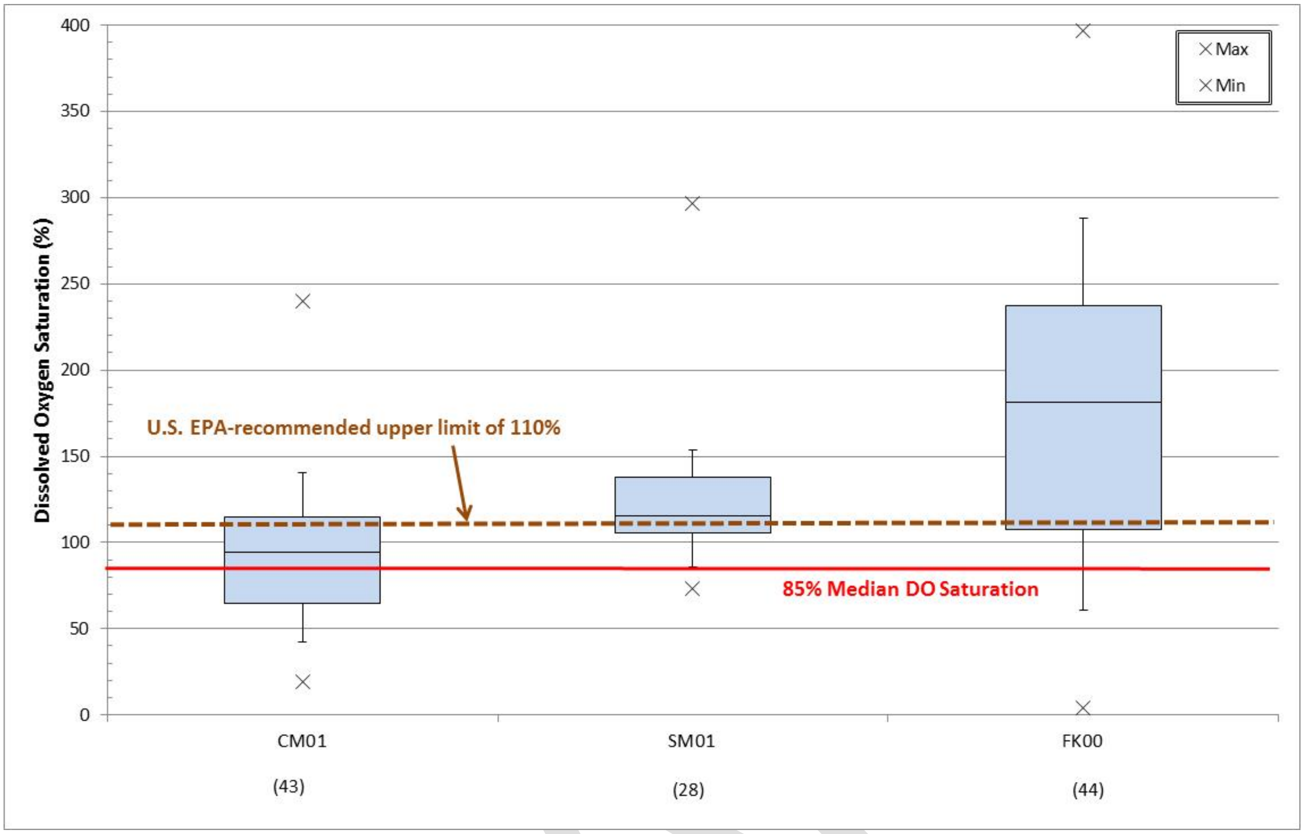


Figure 6-32. Box plots of SBCK dissolved oxygen concentrations (% saturation).

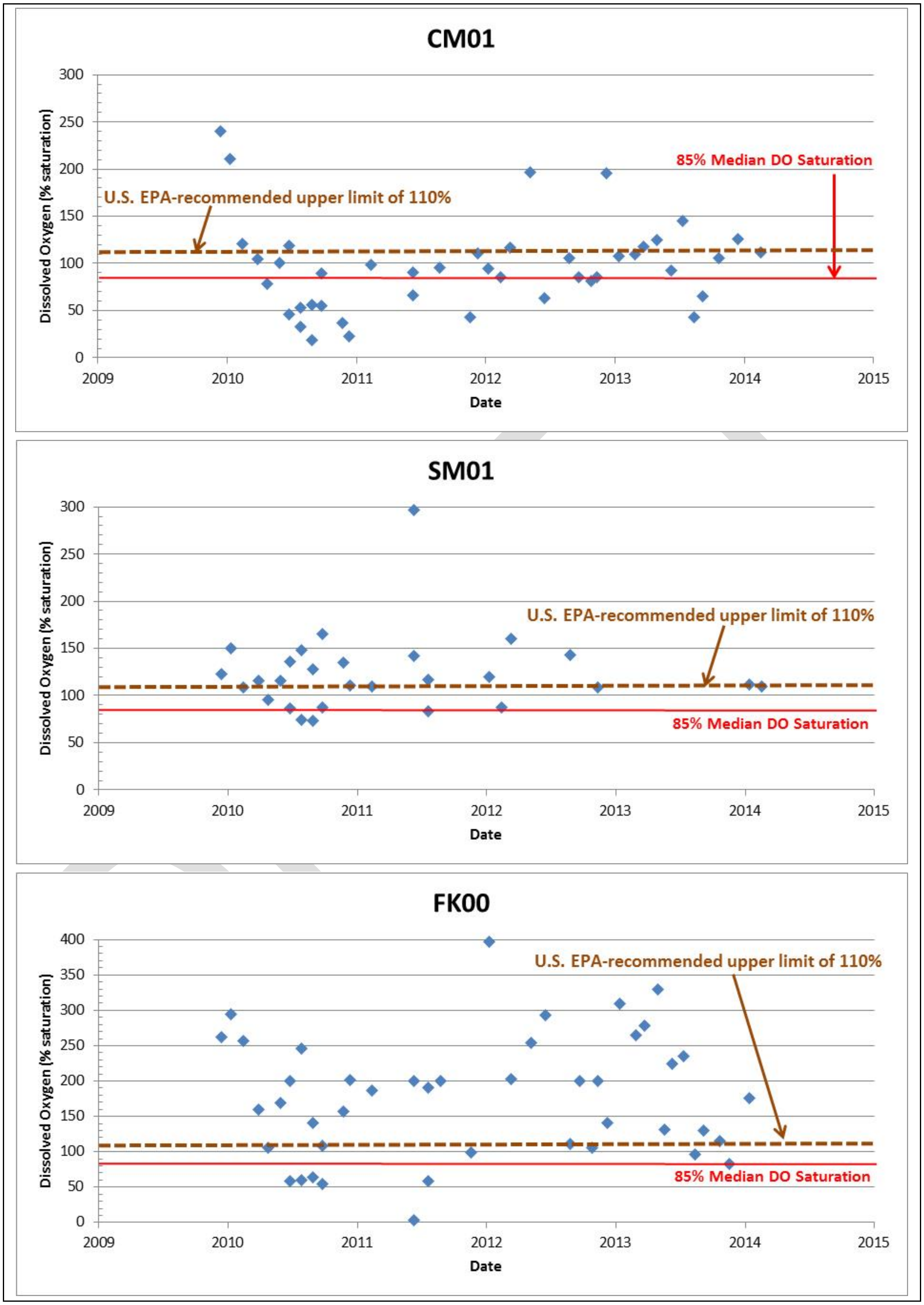


Figure 6-33. Scatter plot of SBCK dissolved oxygen concentrations (mg/L).

The general water quality objective of 85% median dissolved oxygen saturation is attained for all monitoring sites (see median values in Table 6-14). However all three sites maintain single-sample results that exceed (are below) the water quality objective. The U.S. EPA-recommended upper limit of 110% total dissolved gas saturation is most often exceeded at the Franklin Creek site FK00, suggesting oxygen supersaturation associated with biostimulatory conditions.

6.3 Groundwater Quality (Placeholder)

Water Board staff obtained nitrate groundwater quality data from the irrigated lands regulatory program (ILRP) and from the groundwater ambient monitoring and assessment program (GAMA).

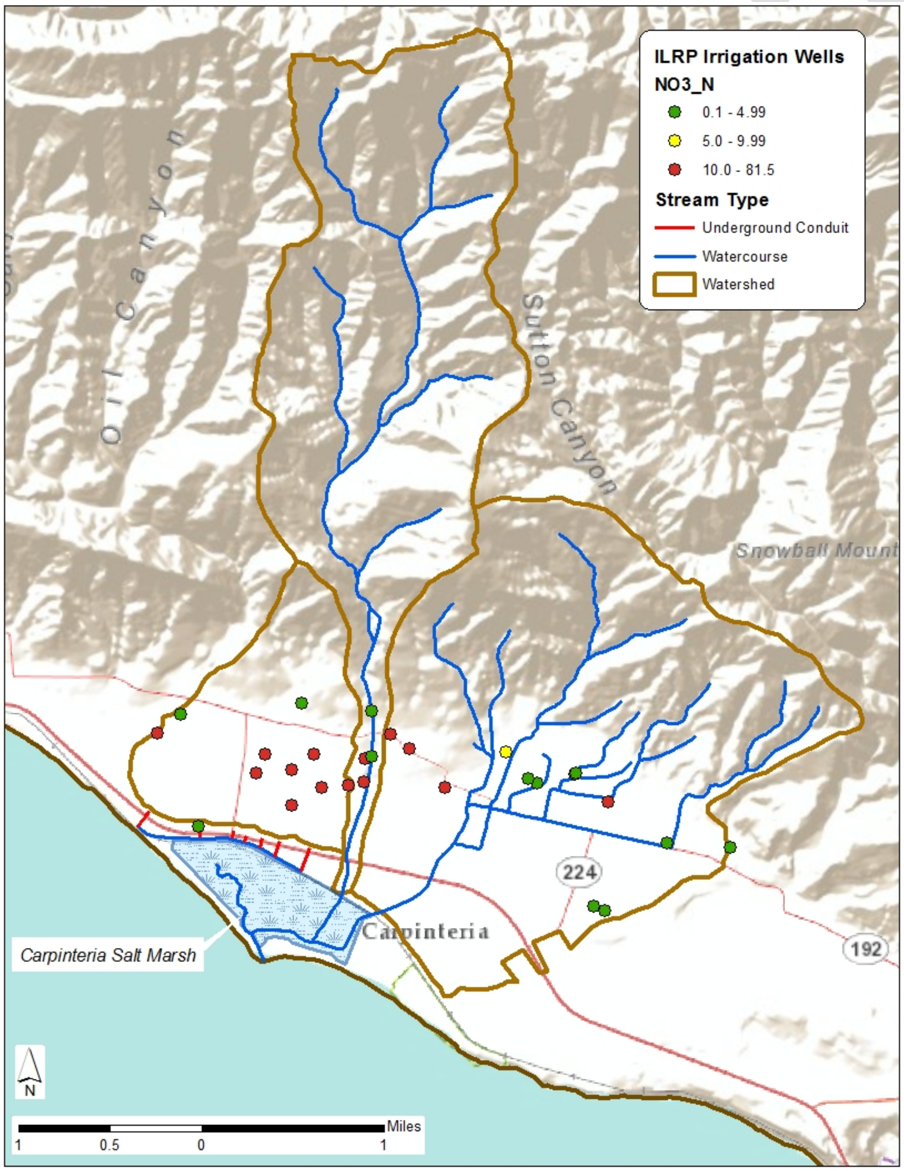


Figure 6-34. Maximum groundwater nitrate concentrations (ILRP).

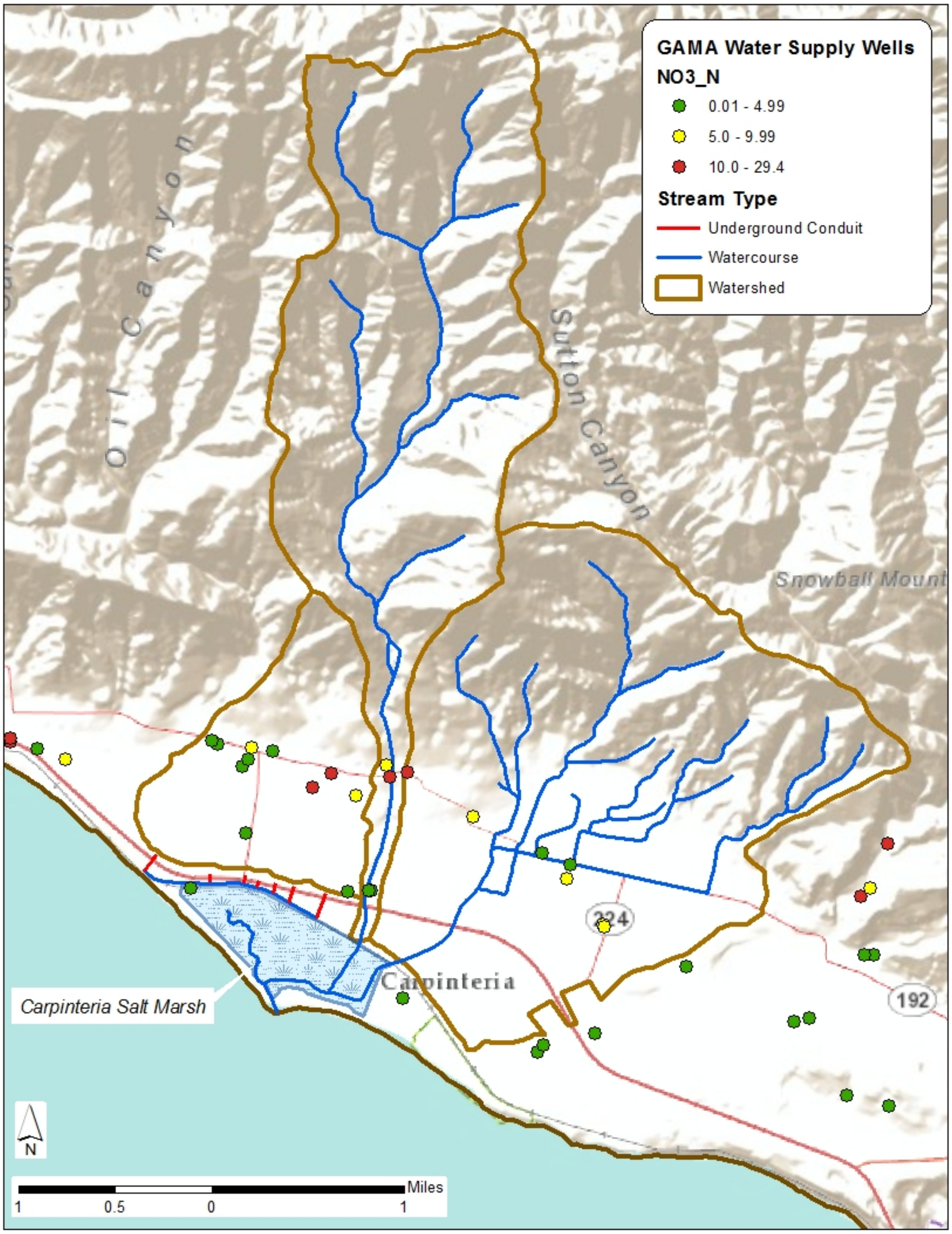


Figure 6-35. Maximum groundwater nitrate concentrations (GAMA).

7 WATER QUALITY NUMERIC TARGETS (PLACEHOLDER)

8 SOURCE ANALYSIS (PLACEHOLDER)

9 TOTAL MAXIMUM DAILY LOADS AND ALLOCATIONS (PLACEHOLDER)

10 IMPLEMENTATION STRATEGY (PLACEHOLDER)

11 PUBLIC PARTICIPATION (PLACEHOLDER)

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