Fecal Indicator Bacteria TMDL

Technical Report

Final Draft

For the Santa Maria Watershed

in Santa Barbara, San Luis Obispo and Ventura Counties, California

August 2010

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Numerous stakeholders, including agencies, organizations, and individuals who have a special interest in the Cuyama, Santa Maria, Orcutt-Solomon, and Oso Flaco watersheds.

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Appendices common to Santa Maria Watershed TMDL

SMW - Appendix 1 - Watershed Description
SMW - Appendix 2 - Flow Duration Curves

LIST OF ACRONYMS AND ABBREVIATIONS

This report contains numerous acronyms and abbreviations. In general, staff wrote an acronym or abbreviation in parentheses following the first time a title or term was used. Staff wrote the acronym/abbreviation in place of that term from that point throughout this report. The following alphabetical list of acronyms/abbreviations used in this report is provided for the convenience of the reader:

CCAMP	Central Coast Ambient Monitoring Program
CEQA	California Environmental Quality Act
CMP	Cooperative Monitoring Program
E. coli	*Escherichia coli Bacteria*
FIB	Fecal Indicator Bacteria
GIS	Geographic Information System
MPN	Most Probable Number
MRLC	Multi-Resolution Land Characterization
MS4	Municipal Separate Storm Sewer Systems
NLCD	National Land Cover Database
NPDES	National Pollutant Discharge Elimination System
REC-1	Water Contact Recreation
REC-2	Non-Water Contact Recreation
SWMP	Storm Water Management Program
TMDL	Total Maximum Daily Load
UAA	Use Attainability Analysis
USEPA	United States Environmental Protection Agency
USGS	United States Geologic Survey
Water Board	Regional Water Quality Control Board (Region 3)
WDR	Waste Discharge Requirements
WWTP	Waste Water Treatment Plant

1 EXECUTIVE SUMMARY

The following Fecal Indicator Bacteria (FIB) Total Maximum Daily Load (TMDL) Technical Report (FIB TMDL Report) evaluates bacteria loading in waterbodies impaired by fecal coliform, *Escherichia coli (E. coli)* and total coliform in the Santa Maria Watershed. The FIB TMDL Report evaluates what water bodies are affected by these TMDLs, the current concentration of bacteria in various water bodies, estimations on where the bacteria are coming from, responsible parties, and how much their contribution should be reduced. Specific implementation actions and monitoring requirements are not identified in this FIB TMDL Report, but will be addressed in a future Implementation and Monitoring Plan for the Santa Maria Watershed, scheduled to be completed in 2011.

Total Maximum Daily Load

This FIB TMDL Report is a Total Maximum Daily Load for fecal indicator bacteria in the Santa Maria River Watershed. A Total Maximum Daily Load (TMDL) is a term used to describe the maximum amount of a pollutant(s) - in this case, fecal indicator bacteria - that a water body can receive and still meet water quality standards. A TMDL study identifies the probable sources of pollution, establishes the maximum amount of pollution a water body 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 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 water body is no longer impaired and can be de-listed.

Fecal Indicator Bacteria and why bacteria matter in this watershed

Fecal Indicator Bacteria (FIB) are bacteria that originate from the intestines of warm-blooded animals and their presence in the water is used as an indicator of human pathogens. Pathogens are organisms that can cause illness. If a person swims, wades or is otherwise in contact with water that contains pathogens, that person increases their likelihood of getting sick. FIB have been historically used as indicators of human pathogens because bacteria are easier and less costly to measure than pathogens themselves. Additionally, state and federal agencies have standards with which to measure FIB, whereas they do not have standards for the pathogens themselves. The FIB used for this FIB TMDL Report are fecal coliform, total coliform and *E. coli*.

Some implementing parties question whether bacteria indicator organisms function as well as indicators of pathogens in waters affected nonpoint sources of pollution. While there is on-going debate, these indicators are the best available at the time of writing this FIB TMDL Report and they are the ones for which we have standards. Should new indicators become available and new standards put into place, the Water Board will re-evaluate the indicators used for this Project.

The Central Coast Regional Water Quality Control Board is required under both State and Federal Law to protect and regulate the beneficial uses of waters of the state. Recreational contact (swimming, wading and other water contact activities) is a beneficial use of all the above listed water bodies. If water bodies contain elevated concentrations of FIB, and therefore potentially contain pathogenic organisms, the water is unsafe for human contact. Additionally, shellfish collection is a beneficial use of the Santa Maria River Estuary. If the water contains elevated levels of FIB, the shellfish can potentially have high levels of pathogens and ingesting these shellfish may put a person at risk for getting sick, especially when these shellfish are consumed raw. The Water Board must look into the reason these water bodies are exceeding objectives and come up with a solution to improve the situation in order to protect these beneficial uses.

Impaired Waterbodies

The proposed geographic scope includes approximately 1.2 million acres within three counties; San Luis Obispo, Santa Barbara and Ventura. The following waterbodies are impaired for FIB: Alamo Creek, Blosser Channel, Bradley Canyon Creek, Bradley Channel, Cuyama River, Greene Valley Creek, Huasna River, La Brea Creek, Little Oso Flaco Creek, Main Street Canal, Nipomo Creek, Orcutt-Solomon Creek, Oso Flaco Creek[1], Oso Flaco Lake, Santa Maria Estuary, Santa Maria River and Sisquoc River. Not all the waterbodies exhibit the same level of impairment. The waterbodies that exceeded the fecal coliform standards the least, both in the number of times exceeded and the concentration of those samples were Huasna River, La Brea Creek, Little Oso Flaco Creek, Greene Valley Creek and Sisquoc River. Those waterbodies that exceeded the fecal coliform standards the most were Orcutt-Solomon Creek, Main St. Canal, Bradley Canyon, Nipomo Creek and Santa Maria River above the Estuary.

The watershed is primarily comprised of pasture/rangeland (70%), forest (20%), cropland (6%) and built-up areas (4%).

Sources

Sources of FIB come from warm-blooded animals including humans, pets, livestock and birds and other wildlife. Staff connected inputs from source organisms with the land uses they are associated with. Sources identified in this FIB TMDL Report include:

Source Category	Source Organisms	Land Use Category
Urban stormwater	Dogs, cats, human	Urban
Domestic Animals (Cattle, Livestock and Farm Animals)	Examples include: cattle, horses, pigs, goats, sheep, dogs, cats, and chickens	Rangeland; Rural Residential
Spills and Leaks from Sewage Collection System	Human	Urban
Human waste (lack of sanitary facility use)	Human	All
Controllable wildlife (dumpsters and litter)	Examples include: Birds, rodents.	Urban
Natural	Examples include: wild pigs, skunk, opossum, birds (including fowl), and deer.	All

[1] Oso Flaco Creek includes an unnamed tributary at Bonita School Road (CMP site 312BSR).

Sources varied per individual watershed, depending upon the predominant land use in the area.

The table below identifies the allocations assigned to responsible parties and the affected water bodies; this table also illustrated and discussed in section 9.1.

WASTE LOAD ALLOCATIONS		
Water body	**Responsible Party (Source)**	**Receiving Water Allocation**
Santa Maria River[17], Main Street Canal[10], Blosser Channel[2], Bradley Channel[3], Greene Valley Creek[6]	City of Santa Maria (Urban Runoff)	Allocation-1
Nipomo Creek[11]	County of San Luis Obispo (Urban Runoff)	Allocation-1
Orcutt-Solomon[12]	County of Santa Barbara (Urban Runoff)	Allocation-1
Santa Maria River[18]	City of Guadalupe (Urban Runoff)	Allocation-1
Blosser Channel[2], Bradley Channel[3], Greene Valley Creek[6], Main Street[10] and Santa Maria River[17]	City of Santa Maria (Collection System)	Allocation-2
Orcutt-Solomon[12]	Laguna County Sanitation District (Collection System)	Allocation-2
Santa Maria River[18]	City of Guadalupe (Collection System)	Allocation-2
LOAD ALLOCATIONS		
Water Body	**Responsible Party and Source**	**Receiving Water Allocation**
Santa Maria River Estuary[15]	Owners/Operators of land used for/containing domestic animals/livestock (Domestic animals/livestock waste)	Allocation-3
All 17 impaired water bodies[a]	Owners/Operators of land used for/containing domestic animals/livestock (Domestic animals/livestock waste)	Allocation-1
All 17 impaired water bodies[a]	Owners/Operators of properties with human waste discharges due to improper facility use (Human waste)	Allocation-2
Blosser Channel[2], Bradley Channel[3], Greene Valley Creek[6], Main Street[10] and Santa Maria River[16]	Owners/Operators of land where homeless reside (Human waste)	Allocation-2
All 17 impaired water bodies[a]	No responsible party (Natural and Background Sources)	Allocation-1

Allocation-1 = Fecal coliform concentration, based on a minimum of not less than five samples for any 30-day period, shall not exceed a log mean of 200 MPN/100mL, nor shall more than ten percent of total samples during any 30-day period exceed 400MPN/100 mL.
Allocation-2 = Fecal coliform concentration shall not exceed zero; no fecal coliform bacteria load originating from human sources of fecal material is allowed.
Allocation-3 = Total coliform concentration, the median throughout the water column for any 30-day period shall not exceed 70MPN/100 ml, nor shall more than ten percent of the samples collected during any 30-day period exceed 230MPN/100 ml for a five-tube decimal dilution test or 330MPN/100 ml when a three-tube decimal dilution test is used.

Numeric Targets

This FIB TMDL Report proposes that all waterbodies achieve a level of bacteria concentration that is safe for human contact recreation. The following are current standards and are used as numeric targets in this FIB TMDL:

> *Fecal coliform concentration, based on a minimum of not less than five samples for any 30-day period, shall not exceed a log mean of 200/100 mL, nor shall more than ten percent of total samples during any 30-day period exceed 400/100 mL.*
>
> *At all areas where shellfish may be harvested for human consumption, the median total coliform concentration throughout the water column for any 30-day period shall not exceed 70/100 ml, nor shall more than ten percent of the samples collected during any 30-day period exceed 230/100 ml for a five-tube decimal dilution test or 330/100 ml when a three-tube decimal dilution test is used.*

TMDL Technical Report - Implementation and Monitoring Plans to come later

The Santa Maria Watershed contains over 90 water body/pollutant combinations on the 2010 303(d) list of impaired waters. The FIB impairments comprise 17 of these combinations. Staff separated the listings into four groups; FIB, nutrients, pesticides and salts. This FIB TMDL Report is one of the four TMDL Reports being developed by staff for the Santa Maria River Watershed TMDL Project. Water Board staff will develop a master implementation and monitoring plan for the Watershed, encompassing all the impairments in the Watershed.

Timeline

Staff plans to make a draft FIB TMDL Report available to stakeholders in August 2010, prior to a stakeholder meeting. Staff then plans to incorporate stakeholder feedback into the document and submit to USEPA in the fall of 2010. Staff aims to have the Master Implementation and Monitoring Plan before the Central Coast Water Board in late 2011. During this time, stakeholders will have multiple opportunities to comment on the technical TMDLs for other modules as well as provide feedback on the implementation and monitoring plans.

Status

To be included on the Interested Parties List for the Santa Maria Watershed TMDL, please subscribe to our email list by visiting http://www.waterboards.ca.gov/centralcoast/

and clicking on "Email Subscriptions" and then by adding yourself to the Santa Maria Watershed TMDL.

2 PROJECT DEFINITION

Table 1 identifies waterbodies listed as impaired on the draft 2010 303(d) list and waterbodies not listed on the draft 2010 303(d) list but deemed impaired through analysis discussed in this FIB TMDL Report. Note that all waterbodies in the table are assigned TMDLs in this FIB TMDL Report, whether or not they are currently listed as impaired on the 303(d).

Table 1. Listed and unlisted impaired waterbodies that are assigned TMDLs.

WATER BODY	2010 303(d) LISTED? (Y/N)	Calwater Watershed	2010 303(d) list pollutant/ Stressor	Additional pollutant/ stressors to add to 2012 303(d) list	Estimated size affected (miles-unless otherwise noted)	ASSIGNED TMDL (Y/N)?
Alamo Creek	Y	31230071	Fecal coliform	*E. coli*	7.8	Y
Blosser Channel	Y	31210030	Fecal coliform	*E. coli*	0.02	Y
Bradley Canyon Creek	Y	31210030	Fecal coliform	-	17	Y
Bradley Channel	Y	31210030	Fecal coliform	*E. coli*	3.1	Y
Cuyama River[1] (above Twitchell Reservoir)	Y	31230060	Fecal coliform	*E. coli*	80	Y
Greene Valley Creek	N	31210030	-	Fecal coliform *E. coli*	3.9	Y
Huasna River	N	31230082	-	Fecal coliform *E. coli*	18	Y
La Brea Creek	N	31220066	-	Fecal coliform *E. coli*	6.6	Y
Little Oso Flaco Creek	Y	31210030	Fecal coliform	-	1.8	Y
Main Street Canal	Y	31210030	Fecal coliform	*E. coli*	5.1	Y
Nipomo Creek	Y	31210011	Fecal coliform	*E. coli*	9.3	Y
Orcutt-Solomon Creek	Y	31210030	Fecal coliform	*E. coli*	10	Y
Oso Flaco Creek[2]	Y	31210030	Fecal coliform	*E. coli*	6.3	Y
Oso Flaco Lake	N	31210030	-	Fecal coliform *E. coli*	56 acres	Y
Santa Maria Estuary	Y	31210030	Fecal coliform *E. coli* Total coliform	-	5.8 acres	Y
Santa Maria River	Y	31210030	Fecal coliform *E. coli*	-	51	Y
Sisquoc River	N	31210030	-	*E. coli*	66	Y

1 - The impaired length is between Twitchell Reservoir and the Highway 33 Bridge
2 - Impairment of Osos Flaco Creek includes impairment of an unnamed tributary, sampled at site 312BSR at Bonita School Road.

2.1 Beneficial Uses

The Water Board is responsible for protecting water resources from pollution and

The *Water Quality Control Plan for the Central Coast Region* (Basin Plan) describes beneficial uses and water quality objectives. Bacterial indicator organisms, e.g., fecal coliform, total coliform, and *E. coli*, are commonly used for predicting the presence of organisms pathogenic to humans. Elevated levels of fecal coliform or *E. coli* are indication that the water bodies may be unsafe for swimming, fishing or other forms of water contact and non-contact recreation (REC-1 and REC-2) activities. Elevated levels of total coliform[23] are an indication that the waterbodies may be unsafe for shellfish harvesting (SHELL).

The Basin Plan specifically identifies beneficial uses for some of the listed water bodies included in this analysis. The Santa Maria River, Santa Maria Estuary, Cuyama River, Alamo Creek, Orcutt Creek, and Oso Flaco Creek have designated beneficial uses in the Basin Plan. The beneficial uses cited in the Basin Plan are listed in Table 2. Staff interprets Orcutt Creek as being synonymous with Orcutt-Solomon Creek.

The Basin Plan also 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 REC-1 and REC-2, MUN, along with all beneficial uses associated with aquatic life. Therefore, the following waterbodies are assigned the beneficial uses REC-1, REC-2, MUN,and all beneficial uses associated with the aquatic life:

Blosser Channel, Bradley Canyon Creek, Bradley Channel, Greene Valley Creek, Main Street Canal, Nipomo Creek, Little Oso Flaco Creek, Oso Flaco Lake and Sisquoc River were not specifically listed in the Basin Plan and therefore were considered designated with these beneficial uses.

Table 2. Beneficial uses for the Cuyama River, Alamo Creek, Santa Maria River, Santa Maria Estuary, Orcutt Creek and Oso Flaco Creek.

Water body	Alamo Creek	Cuyama River*	Huasna River	Orcutt Creek	Oso Flaco Creek	Santa Maria River	Santa Maria Estuary
Municipal and Domestic Supply (MUN)	X	X	X	X	X	X	
Agricultural Supply (AGR)	X	X	X	X	X	X	
Industrial Process Supply (PROC)		X					

[2] Note that the Department of Public Health also uses fecal coliform in order to determine if shellfish growing in the water are safe to eat.
[3] State Water Resources Control Board is proposing to add a fecal coliform objective to the Ocean Plan with regards to the shellfishing beneficial use. Please see the following link for more information: http://www.waterboards.ca.gov/water_issues/programs/ocean/index.shtml

Water body	Alamo Creek	Cuyama River*	Huasna River	Orcutt Creek	Oso Flaco Creek	Santa Maria River	Santa Maria Estuary
Industrial Service Supply (IND)		X				X	
Ground Water Recharge (GWR)	X	X	X	X	X	X	X
Water Contact Recreation (REC-1)	X	X	X	X	X	X	X
Non-Contact Water Recreation (REC-2)	X	X	X	X	X	X	X
Wildlife Habitat (WILD)	X	X	X	X	X	X	X
Cold Fresh Water Habitat (COLD)	X	X		X		X	
Warm Fresh Water Habitat (WARM)	X	X	X		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	X	X	X	X	X
Estuarine Habitat (EST)				X			X
Freshwater Replenishment (FRSH)		X		X	X	X	
Commercial and Sport Fishing (COMM)	X	X	X	X	X	X	X
Shellfish Harvesting (SHELL)							X

**upstream of Twitchell Reservoir*

2.2 Problem Statement

Alamo Creek, Blosser Channel, Bradley Canyon Creek, Bradley Channel, Cuyama River (above Twitchell Reservoir), Little Oso Flaco Creek, Main Street Canal, Nipomo Creek, Orcutt-Solomon Creek, Oso Flaco Creek, Santa Maria River and the Santa Maria River Estuary are impaired due to fecal coliform concentration exceeding water quality objectives protecting beneficial uses associated with water contact recreation. Additionally, the Santa Maria River and the Santa Maria River Estuary also exceed federal recommendations for *E. coli* concentration protecting beneficial uses associated with water contact recreation. The Santa Maria Estuary exceeds water quality objectives protecting beneficial uses associated with shellfish harvesting.

Greene Valley Creek, Huasna River, La Brea Creek, Oso Flaco Lake and Sisquoc River are not on the 2010 303(d) list but are impaired. Water Board staff will propose these water bodies for listing during the next listing cycle and concluded they should also be assigned TMDLs at this time. In addition, many of the water bodies already listed for fecal coliform also exceed standards for *E. coli*, but are not included on the 2010 303(d) list. Those water bodies include: Alamo Creek, Blosser Channel, Bradley Channel,

Cuyama River, Greene Valley Creek, Huasna River, La Brea Creek, Main Street Canal, Nipomo Creek, Orcutt Creek, Orcutt-Solomon Creek, Oso Flaco Creek, Oso Flaco Lake and Sisquoc River[4].

Table 1 shows the impaired waterbodies and Clean Water Act (CWA) section 303(d) listings.

Staff researched the presence of shellfish harvesting (e.g., clams, oysters, and mussels) in the Santa Maria River Estuary, and found that clams have been harvested in the surf zone historically by the Chumash indians. Their diet consisted largely of seafood and shellfish and their discarded piles of shells, termed "shell middens," can be seen on the Guadalupe-Nipomo Dunes (http://santalucia.sierraclub.org/osoflaco.html). Shellfish harvesting also occurred in present times, with documentation of harvesting of sand crabs for human consumption on the north side of the estuary. Additionally, staff found that while there is no record of shellfish harvesting directly in the estuary itself in present times, there is potential for a more prevalent occurrence of these activities. Discharges from the Santa Maria River exceeded the total coliform water quality criteria for shellfish harvesting and as such, adversely impacted this beneficial use as the estuary is a direct downstream receiving water body of the Santa Maria River. Staff concluded that the shellfish harvesting beneficial use in the estuary is impacted by elevated total coliform levels.

2.3 Water Quality Objectives

The Central Coast Region's Water Quality Control Plan (Basin Plan) contains specific water quality objectives that apply to fecal indicator bacteria (CCRWQCB, 1994, pg. III-3). These objectives are linked to specific beneficial uses such as contact and noncontact recreation and shellfishing.

Water quality objectives are in place to protect the water contact recreation beneficial use and the shellfishing beneficial use. The most stringent water quality objectives for fecal and total coliform apply to the water contact recreation (REC-1) and shellfish (SHELL) beneficial uses, respectively. The Basin Plan contains the following REC-1 and SHELL bacteria objectives for inland surface waters, enclosed bays and estuaries:

> *"Fecal coliform concentration, based on a minimum of not less than five samples for any 30-day period, shall not exceed a log mean of 200/100 mL, nor shall more than ten percent of total samples during any 30-day period exceed 400/100 mL."*
>
> *"At all areas where shellfish may be harvested for human consumption, the median total coliform concentration throughout the water column for any 30-day period shall not exceed 70/100 ml, nor shall more than ten percent of the samples collected during any 30-day period exceed 230/100 ml for a five-tube decimal dilution test or 330/100 ml when a three-tube decimal dilution test is used."*

[4] Sisquoc River exceeds the *E. coli* standard, but does not exceed the fecal coliform water quality objective.

Available datasets often do not contain five samples in a 30-day period, so the portion of the objective that is evaluated is that "no more than ten percent of total samples during any 30-day period exceed 400/100 mL." In instances where fewer than five samples were collected in 30 days, the "ten percent" threshold is exceeded if any one sample exceeds 400/100 mL.

At the time of writing this FIB TMDL Report, State Board staff was reviewing shellfishing standards on many levels[5]. They are considering adding fecal coliform as a standard to the Ocean Plan (geometric mean shall not exceed 14 MPN/100 mL nor shall more than 10% of the samples exceed 43 MPN/100 mL) as well as reviewing the shellfishing beneficial use in general. They are reviewing whether to separate commercial harvesting and recreational collection as separate shellfishing uses. Additionally, they are exploring the possibility of a reference beach approach for recreational shellfish collection. If the State Board makes changes to the Ocean Plan regarding shellfishing, Central Coast Water Board staff will incorporate those changes into this FIB TMDL Report, if appropriate.

Additionally, State Board staff was reviewing *E. coli* bacterial indicator criteria recommendations as appropriate to the level of recreational use. While Water Board staff did not propose numeric targets for *E. coli*, *E. coli* criteria are discussed below.

The proposed total and fecal coliform targets for this project are consistent with the current water quality objectives in the Basin Plan for total and fecal coliform.

The Basin Plan also contains a waste discharge prohibition adopted by the Central Coast Water Board in 1975. The prohibition states:

"*Waste discharges to the following inland waters are prohibited: All surface freshwater impoundments and their immediate tributaries... The Santa Maria River downstream from the Highway One bridge*."

Staff does not recommend changes to this prohibition.

EPA recommended *E. coli* as a better indicator than fecal coliform. Following epidemiological studies conducted by EPA that evaluated the use of several organisms as indicators, including fecal coliforms and *E. coli*, EPA recommended in 1986 the use of *E. coli* for fresh recreational waters because they were <u>better</u> (emphasis added) predictors of acute gastrointestinal illness than fecal coliforms (United States Environmental Protection Agency, *Ambient Water Quality Criteria for Bacteria-1986*, January 1986).

Staff used the log mean of 126 MPN/100mL and the single sample values of 235 MPN/100mL, 409 MPN/100mL, and 575 MPN/100mL to evaluate *E. coli* data, and the water quality objective of 400MPN/100mL to evaluate *E. coli* data in the Data Analysis section.

[5] http://www.waterboards.ca.gov/water_issues/programs/ocean/index.shtml

Table 3. EPA bacterial indicator criteria recommendation

Indicator	Geometric Mean Density (per 100 mL)	Single Sample Maximum Allowable Density (per 100 mL)[a]			
		Designated Beach Area (75th percentile)	**Moderate Full Body Contact Recreation (82nd percentile)**	**Lightly Used Full Body Contact Recreation (90th percentile)**	**Infrequently Used Full Body Contact Recreation (95th percentile)**
E. coli	126[b]	235	298	409	575

Source: U.S. EPA (1986).
a. Calculated using the following: single sample maximum = geometric mean * 10^(confidence level factor * log standard deviation), where the confidence level factor is: 75%: 0.675; 82%: 0.935; 90%: 1.28; 95%: 1.65. The log standard deviation from EPA's epidemiological studies is 0.4 for fresh waters.
b. Calculated to nearest whole number using equation: geometric mean = antilog_{10} [(risk level + 11.74) / 9.40].

3 WATERSHED DESCRIPTION

Please see SMW-Appendix 1 for a description of the Santa Maria Watershed.

4. DATA ANALYSIS

4.1 Data types and criteria used to evaluate impairment

Staff used several threshold values to evaluate data in the Section 4 *Data Analysis.* These were based on existing water quality objectives, as well as other recommended criteria, including the US Environmental Protection Agency's (EPA's) bacterial indicator criteria for *E. coli* as discussed in the Water Quality Objectives section.

Staff reviewed microbial source tracking results from assessments in other watersheds and drew parallels between the other watersheds and Santa Maria and Oso Flaco watersheds (see Section **Error! Reference source not found.** Relationship of Genetic Studies to Land Use).

Staff concluded that the Santa Maria and Oso Flaco watersheds had fecal coliform concentrations exceeding the water contact recreation water quality objectives and total coliform concentrations exceeding the shellfish harvesting water quality objectives, where the Basin Plan designates these respective uses. In the following data analysis, staff identified where and to what degree the problem occurred. In a subsequent section, *Source Analysis*, staff discussed the results of sampling and analysis aimed at tracking the source of the problem.

4.2 Sources of Data and Information Evaluated

Staff relied on data collected by the following entities or programs in preparing this FIB TMDL Report:

- Central Coast Ambient Monitoring Program (CCAMP),
- Cooperative Monitoring Program (CMP),
- Water Board TMDL Program,
- City of Santa Maria,
- County of Santa Barbara's Project Clearwater,
- Morro Bay National Monitoring Program,
- United States Geological Survey flow data,
- Geographic Information System analysis of land uses, and
- Genetic studies.

The following discussion summarizes the monitoring activities and results from these efforts.

4.3 Water Quality Data and Analysis

4.3.1 Central Coast Ambient Monitoring Program and Cooperative Monitoring Program

The Water Board's CCAMP staff conducted monthly total and fecal coliform monitoring from 2000 to 2001 and from 2007 to 2008. Staff conducted additional monthly water quality monitoring at the Santa Maria River at Rancho Guadalupe Dunes Preserve site continuously between these dates. Figure 1 shows the locations of the watersheds and major water bodies. A small tributary, Little Oso Flaco Creek drains to Oso Flaco Creek from the east. Main, Blosser, and Bradley Channels, and Bradley Canyon Creek flow into the Santa Maria River, and ultimately into the Santa Maria Estuary from the south. While all CCAMP site locations are shown in the figures, not all are impaired nor are discussed in this FIB TMDL Report. Appendix A - Data contains the site names and locations of the sampling sites. Impaired water bodies are shown in Table 4.

The Cooperative Monitoring Program (CMP) also collected samples. Some sites are the same as CCAMP's sites. For those sites that differ from CCAMP's sites, please see Figure 2.

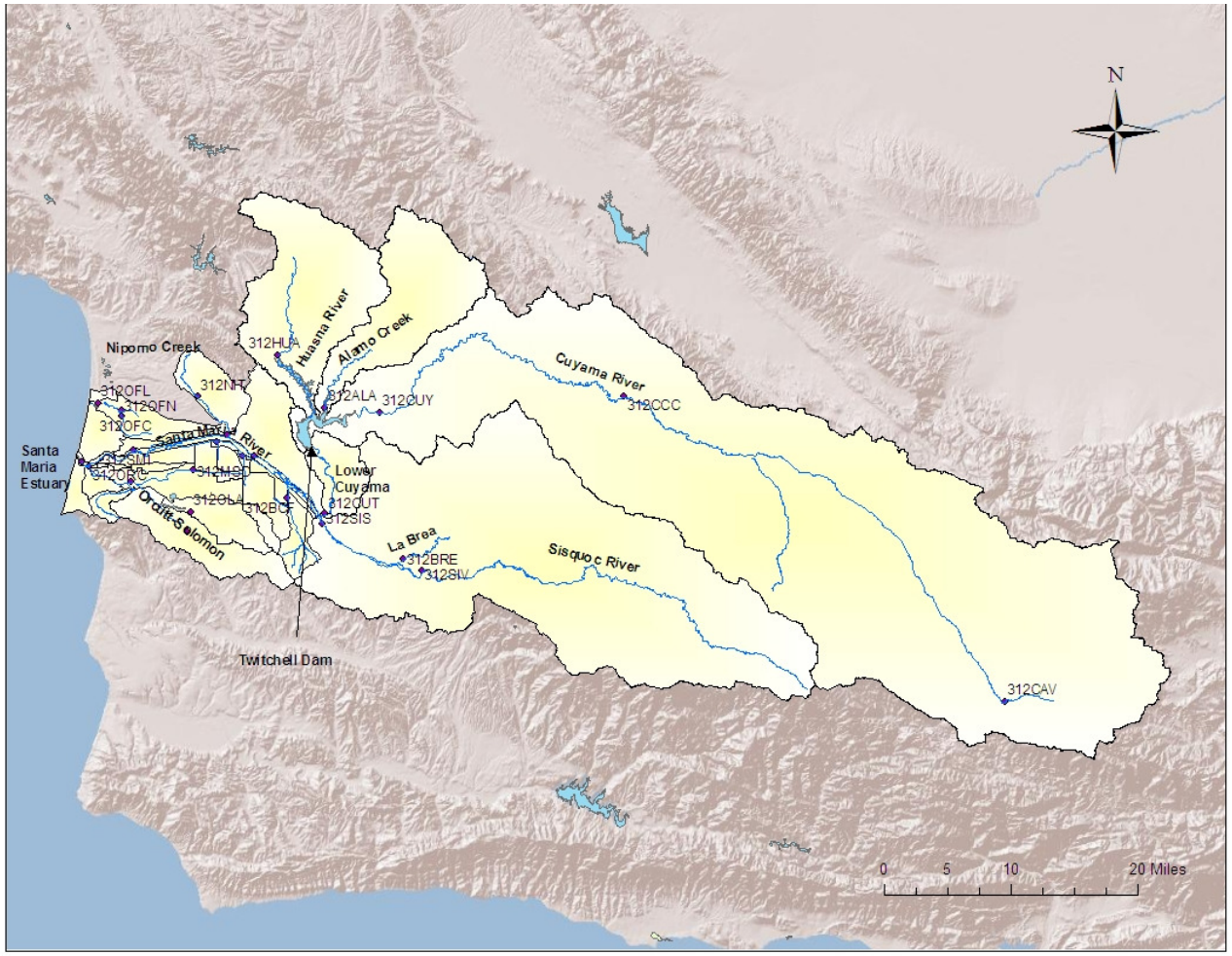

Figure 1. Subwatersheds, water bodies and CCAMP monitoring locations within the Santa Maria Watershed (map under construction)

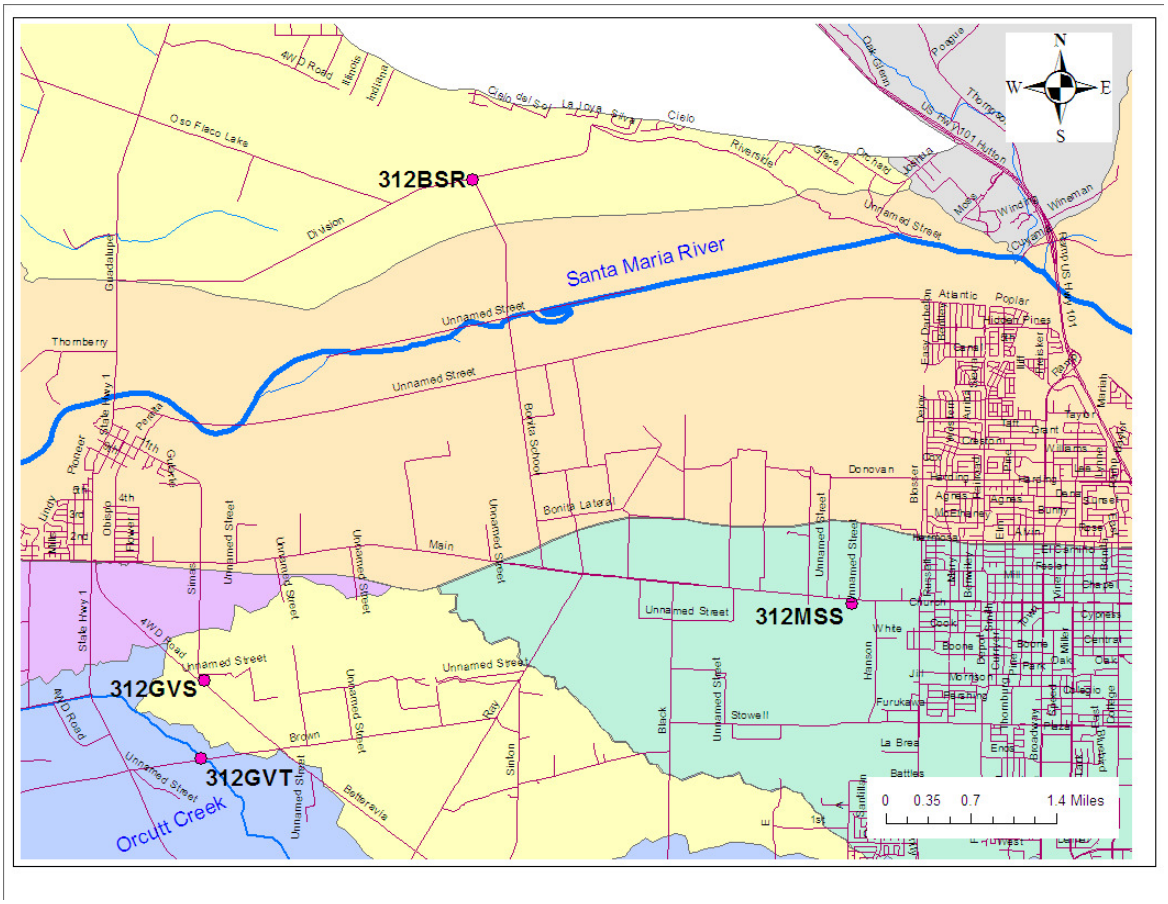

Figure 2. CMP monitoring locations in Oso Flaco, Greene Valley Creek, Orcutt Creek and Main Street Canal (just west of the City of Santa Maria). WILL MAKE NEW MAP

Staff summarized available data collected in waterbodies during the 2000-01 and 2007-08 CCAMP sampling rotations to determine impairment. If a site exceeded the 400 MPN/100 mL for fecal coliform more than 17% of the time, the site was considered impaired[6] (State Board, 2004). These statistics are shown in Table 4 and Table 5. Levels of fecal coliform exceeded the water quality objectives protective of human contact recreation at all sites except two sites on the Cuyama River and two sites on the Sisquoc River, and levels of total coliform exceeded the water quality objective protective of shellfish harvesting 100% of the time in the Santa Maria Estuary. All sites that had fecal coliform exceedances also showed exceedances of *E. coli* with the exception of 312OFN (Little Oso Flaco Creek at train trestle). This site exceeded fecal coliform water quality objectives but did not exceed *E. coli* standards. Conversely, site 312SIV (Sisquoc River upstream of Tepusquet Road) exceeded *E. coli* standards but did not exceed fecal coliform objectives.

[6] Sites were considered impaired based on the "Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List," adopted in 2004, commonly referred to as the Impaired Waters Guidance.

Table 4. Percent exceedances of fecal coliform and total coliform and water quality monitoring sites in the Santa Maria Watershed in 2000-01 and 2007-08.

Water body	Site	Number of samples	Min. (MPN)	Log mean (MPN)	Max. (MPN)	Percent exceedance of Fecal Coliform 400 MPN/100mL	Considered impaired? (Yes or No)
Alamo Creek	312ALA	27	23	242	5,000	37%	Yes
Blosser Channel	312BCD	21	14	641	30,000	57%	Yes
Bradley Canyon Channel	312BCF	10	80	1671	160,000	60%	Yes
Bradley Channel	312BCU	25	6	462	13,000	44%	Yes
La Brea Creek	312BRE	19	2	132	9,000	26%	Yes
Unnamed Tributary to Oso Flaco Creek	312BSR	6	80	554	2,400	50%	Yes
Cuyama River	312CAV	23	1	15	1,100	4%	No
Cuyama River	312CCC	18	1	189	3,600	44%	Yes
Cuyama River	312CUL	3	4	51	1,400	33%	Yes
Cuyama River	312CUT	11	1	41	1,700	9%	No
Cuyama River	312CUY	14	40	394	3,000	50%	Yes
Greene Valley Creek	312GVS	12	30	224	500	25%	Yes
Orcutt Creek	312GVT	12	30	422	24,000	42%	Yes
Huasna River	312HUA	12	26	161	500	17%	Yes
Main Street Canal	312MSD	25	50	1623	28,000	76%	Yes
Main Street Canal	312MSS	11	50	955	5,000	73%	Yes
Nipomo Creek	312NIP	21	130	1030	5,000	67%	Yes
Nipomo Creek	312NIT	14	1	449	9,000	57%	Yes
Oso Flaco Creek	312OFC	24	1	360	35,000	58%	Yes
Oso Flaco Lake	312OFL	27	20	186	1,300	30%	Yes
Little Oso Flaco Creek	312OFN	23	1	152	24,000	26%	Yes
Betteravia Lakes*	312OLA	8	400	1328	17,000	75%	Yes
Orcutt Solomon Creek	312ORB	25	240	1345	90,000	76%	Yes
Orcutt Solomon Creek	312ORC	27	40	756	17,000	63%	Yes
Orcutt Solomon Creek	312ORI	28	20	362	30,000	36%	Yes
Santa Maria River	312SBC	4	110	310	700	25%	Yes
Sisquoc River	312SIS	5	1	19	230	0%	No
Sisquoc River	312SIV	24	1	42	900	8%	No
Santa Maria River above Estuary **	312SMA	96	1	899	24,000	73%	Yes
Santa Maria River	312SMI	17	1	618	8,000	65%	Yes
Water body	Site	Number of samples	Min. (MPN)	Median (MPN)	Max. (MPN)	Percent exceedance of Total Coliform 230 MPN/100mL	Considered impaired? (Yes or No)
Santa Maria Estuary	312SMA	145	240	30000	24,0001	100%	Yes

* Site 312OLA (Betteravia Lakes at Black Road is no longer monitored as it is not representative of Betteravia Lakes. As such, no TMDLs will be established at this site.
** Site 312 SMA is a “coastal confluences” site and is therefore monitored every year.

Table 5: Percent exceedance of *E. coli* and water quality monitoring sites* in the Santa Maria Watershed in 2000-01 and 2007-08.

Water body	Site	Number of samples	Min. (MPN)	Log mean (MPN)	Max. (MPN)	Percent exceedance of *E. coli* 235 MPN/100mL	Considered impaired? (Yes or No)
Alamo Creek	312ALA	12	9	92	770	25%	Yes
Blosser Channel	312BCD	10	9	197	3,200	40%	Yes
Bradley Channel	312BCU	11	10	190	2,100	36%	Yes
La Brea Creek	312BRE	5	13	115	2,200	40%	Yes
Unnamed Tributary to Oso Flaco Creek	312BSR	6	30	108	410	17%	Yes
Cuyama River	312CAV	9	3	27	520	11%	No
Cuyama River	312CCC	5	10	112	1,700	40%	Yes
Greene Valley Creek	312GVS	12	17	131	520	33%	Yes
Orcutt Creek	312GVT	12	1	90	960	42%	Yes
Huasna River	312HUA	9	48	146	780	22%	Yes
Main Street Canal	312MSD	12	10	771	20,000	83%	Yes
Main Street Canal	312MSS	11	10	214	2,700	55%	Yes
Nipomo Creek	312NIP	6	220	1030	9,800	83%	Yes
Oso Flaco Creek	312OFC	8	1	136	12,000	38%	Yes
Oso Flaco Lake	312OFL	12	74	231	730	42%	Yes
Little Oso Flaco Creek	312OFN	8	20	80	410	13%	No
Orcutt-Solomon Creek	312ORB	12	230	913	2,900	92%	Yes
Orcutt-Solomon Creek	312ORC	12	1	270	3,000	67%	Yes
Orcutt-Solomon Creek	312ORI	12	1	107	5,100	25%	Yes
Sisquoc River	312SIV	8	10	62	790	25%	Yes
Santa Maria River above Estuary	312SMA	48	1	644	6,700	81%	Yes

*Sample sites that had less than 5 samples were not included in this table.

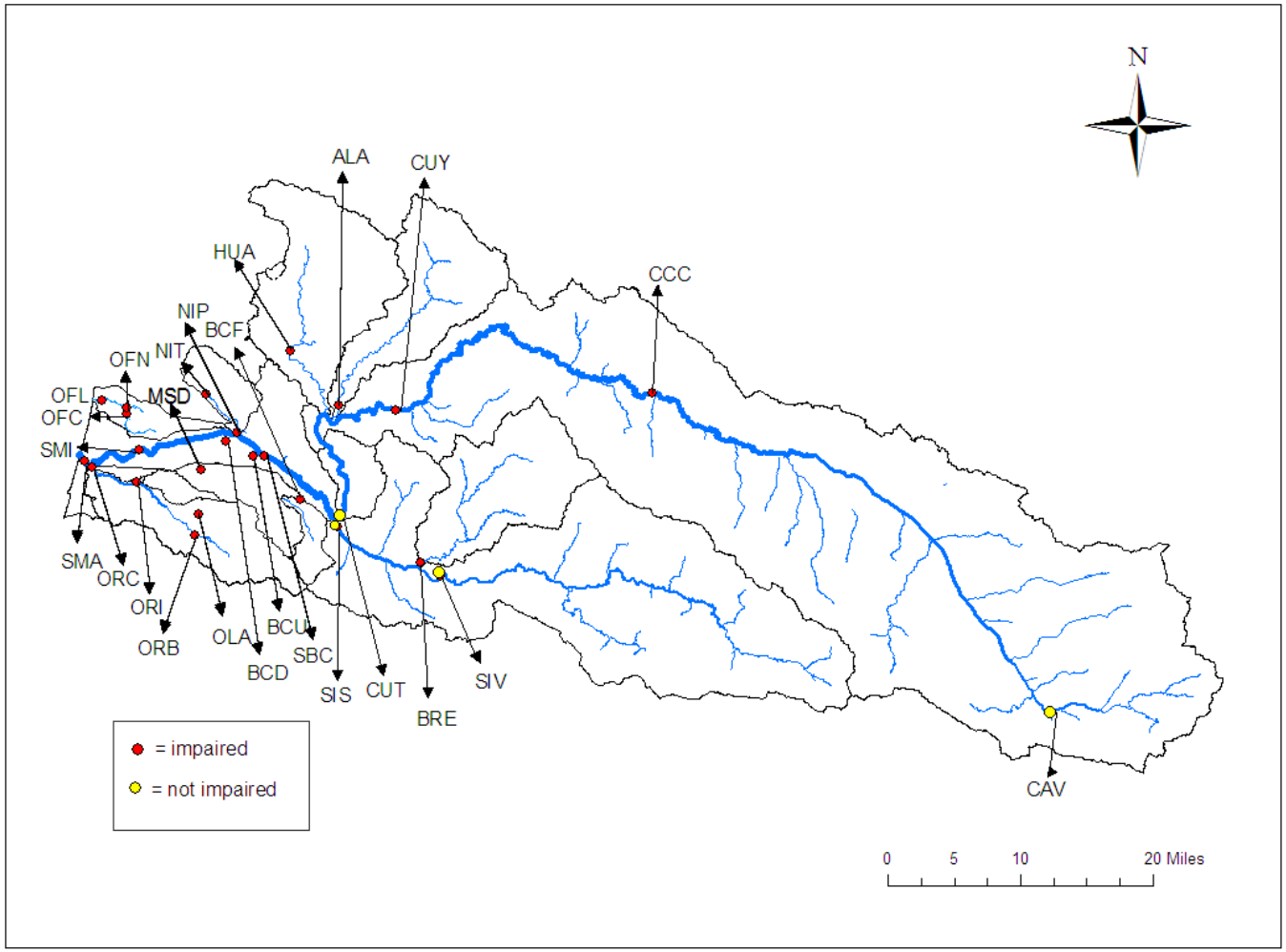

Figure 3. Map of watershed with CMP and CCAMP stations showing impairment (red sites show impairment, yellow sites are not impaired)MAKE NEW MAP (SIV is impaired)

Staff evaluated CCAMP water quality data collected on each listed water body in order to determine impairment. These data, along with a determination of impairment, are shown in Table 4 and Table 5. The estimated percentages of each land use in each watershed are discussed in more detail in the *Land Use Data* Section, and sources are described in more detail in the *Source Analysis* Section. In Appendix B - Data Analysis, staff displayed CCAMP data using time series graphs and/or a Standard-Exceedances Evaluation depending on the data analysis tools and amount of data available.

4.3.2 Water Board TMDL monitoring

Water Board staff designed and implemented a plan for sampling and analyzing additional water column grab samples for total coliform and *E. coli*. The protocols for sample collection and analysis of pathogens are detailed in the quality assurance study plan for the project (Water Board, 2004). The objective of the additional monitoring was to evaluate relative bacterial contributions from urban and irrigated agricultural areas. The plan included wet and dry season sampling for bacteria.

Staff conducted field monitoring in December 2004, and February, March, and May 2005. Staff abandoned further sampling because the dry weather sampling did not yield any data due to the lack of flowing water and staff concluded that any additional storm event samples collected later in 2005 would not provide information to further differentiate sources. Table 6 displays a summary of data collected from various sources and locations in the Oso Flaco and Santa Maria watersheds.

Table 6. Summary of storm events sites and *E. coli* concentrations within the Oso Flaco and Santa Maria Watersheds, December 2004, and February, March, and May 2005.

Watershed/ Water body	Site(s)	Primary land use/location within drainage area	# of samples	Min. (MPN/100mL)	Log mean. (MPN/100 mL)	Max. (MPN/100 mL)
Oso Flaco / Oso Flaco Creek						
	312NMRUS; 312NMR; 312NMRDS	Rural residential runoff from Nipomo Mesa via stormwater collection system on Division Road	11	1203.3	1,997	>2419
	312BSR	Rural residential runoff and agricultural runoff in drainage/tributary to Oso Flaco Creek	6	36	444	>2419
	312OFC	Oso Flaco Creek downstream of confluence with drainage/tributary	5	157.6	298	613
Santa Maria/ Bradley Channel						
	312BCAgF1; 312BCAgF2; 312BCSD1; and 312BCSD2	Irrigated agricultural runoff from field and via surface drains	6	196.8	452	687
	312BCUUS	Receiving water within Bradley Channel Upstream of Urban inputs (City of Santa Maria); South of Jones @ Hwy 101	4	108	605	2419
	312BCUDS	Receiving water within Bradley Channel Downstream of Urban inputs (City of Santa Maria);; Western Avenue North	4	307	1,074	>2419

The log mean at all sites exceeded 126 MPN/100mL. Note that staff compared levels to receiving water criteria and water quality objectives (see US Environmental Protection Agency's bacterial indicator criteria recommendations in the Water Quality Objectives section) for the purpose of evaluating potential sources.

Urban runoff

Urban runoff and samples taken downstream of urban areas had higher levels of *E. coli* than any other sites sampled, with all samples exceeding 126 MPN/100 mL. All samples taken from Bradley Channel downstream of the City of Santa Maria were higher than samples taken from Bradley Channel upstream of the City of Santa Maria. Additionally, there was often a wide range in the level of *E. coli* detected throughout the sampling period, with higher values found earlier in the wet season than later. For example, *E. coli* concentrations found upstream of the City of Santa Maria ranged from 2,419 MPN/100 mL in February to 108 MPN/100 mL in May 2005.

The Nipomo Mesa discharged stormwater to a stormwater collection system during storm events. This discharge flowed through drainages adjacent to irrigated agriculture, which ultimately reached Oso Flaco Creek. Samples taken of rural/urban runoff from the Nipomo Mesa always exceeded the criteria for *E. coli*, and were consistently higher than samples taken downstream in a drainage/tributary receiving both urban and agricultural runoff. Figure 4 shows *E. coli* concentrations during storm events. As mentioned previously, staff found that the Nipomo Mesa did not discharge flow during the dry season, the time of impairment. Staff concluded that the Nipomo Mesa was not

contributing fecal coliform to Oso Flaco Creek based on the evidence that while discharges during the wet season from the Nipomo Mesa were elevated above water quality objectives, fecal coliform levels in Oso Flaco Creek during the wet season were within water quality objectives.

Please see Section 5.5.2 for more discussion regarding urban stormwater sources.

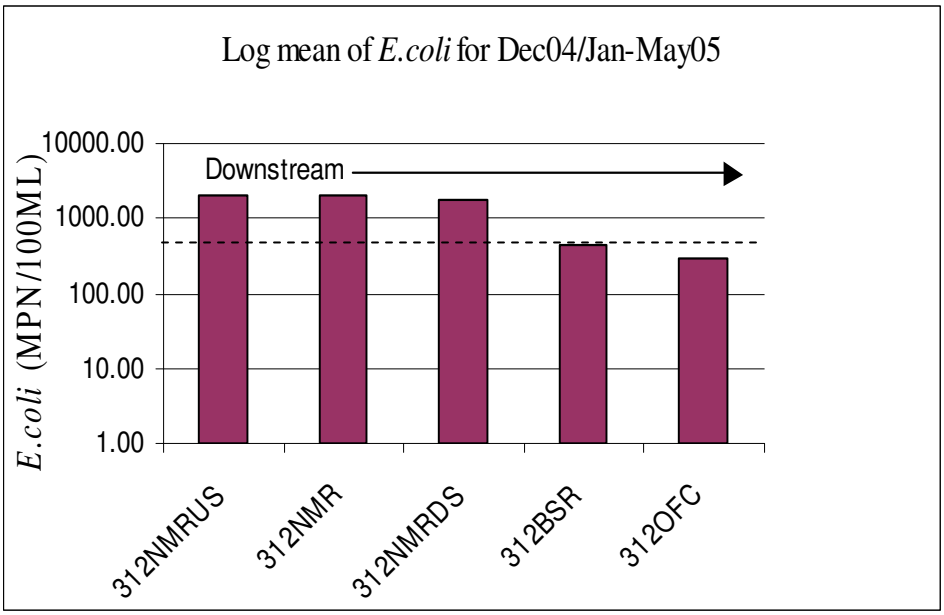

Figure 4. Log mean of *E. coli* (MPN) during storm events at monitoring sites in the Oso Flaco Watershed December 2004 to May 2005.

Agricultural runoff

Sampling of irrigated agriculture runoff was limited spatially and temporally, with only two storms sampled from one type of crop operation. Samples taken from surface drains along with runoff directly from the agricultural field had an *E. coli* log mean of 452 MPN/100 mL (Table 6).

Flow in Bradley Channel upstream from the City of Santa Maria was almost exclusively from irrigated agriculture runoff, but did receive some urban inputs. Concentrations of *E. coli* upstream were elevated, with four of six samples exceeding all of the *E. coli* criteria (Table 6).

Water Board staff also sampled soils in May 2005. *E. coli* concentrations in sediment collected from Bradley Channel and Oso Flaco Creek were 517 MPN/100 mL and 133 MPN/100 mL respectively.

The pathogenic O157:H7 species of *E. coli* were found in other watersheds in the Central Coast Region that have similar land uses to the Santa Maria. As a result, staff also sent eight samples from four sites to the U.S. Department of Agriculture laboratory in Albany, California for speciation for the O157:H7 *E. coli.* All samples were negative for O157:H7.

Staff found that *E. coli* concentrations in agricultural runoff were elevated above criteria, but were significantly lower than the receiving water concentrations and runoff from urban areas. Please see Section 5.4.2 for more discussion about agricultural sources.

4.3.3 City of Santa Maria storm event monitoring

The City of Santa Maria began collecting data during storm events in 2004. City of Santa Maria staff chose three monitoring stations to characterize land use contributions: (1) Prell Basin, (2) Hobbs Basin, and (3) Main St, Channel North and South. Prell Basin primarily collected stormwater from agricultural areas to the east and was representative of flows which entered the City of Santa Maria. Hobbs Basin collected urban runoff and during overflows, discharged to a channel along Stowell Road and eventually flowed to the Santa Maria River. This sample site was representative of urban flows leaving the City of Santa Maria. The Main Street Channel consisted of two channels that ran on along Main Street and combined to become the Unit 2. Ditch, and discharged to the Santa Maria River.

Table 7 shows a summary of concentrations collected between 2004 and 2006. Fecal coliform levels in the North and South Channels of the Main Street Canal exceeded fecal coliform water quality objectives and were higher than those measured elsewhere. Concentrations measured in stormwater runoff from Prell and Hobbs Basins also exceeded fecal coliform water quality objectives. While the sample size of data from the City of Santa Maria limits the ability to draw strong conclusions, staff concluded that the data suggested that urban runoff was contributing to elevated fecal coliform concentrations in the Santa Maria watershed. The City plans to continue stormwater monitoring efforts indefinitely, with a minimum of three sampling events per wet season. Additional sampling will provide information to further characterize urban inputs. Please see Section 5.5.2 for more discussion regarding stormwater sources.

Table 7. Summary of fecal coliform concentrations collected in drainages by the City of Santa Maria.

Site/Location	No.	Min. (MPN/100mL)	Log mean. (MPN/100mL)	Max. (MPN/100mL)
Prell Basin / West of Highway One and South of Nicholson Street	5	500	1,226	2,400
Hobbs Basin / South of Stowell Road and West of A Street	4	500	2,527	17,000
Main St. Channel North and South / West Main and Hansen Lane which combine to become the Unit Two Ditch	10	900	8,666	160,000

4.3.4 Orcutt-Solomon Creek storm event monitoring

The County of Santa Barbara's Project Clean Water sponsors studies to help identify sources of pollution that lead to beach closures and to develop an understanding of how those pollutants move through the environment. Project Clean Water conducted water quality monitoring in Orcutt-Solomon Creek during nine storm events between February 2000 and February 2003. Site locations are shown in Figure 5. Site OR1 is the same as

CCAMP site ORI, which was monitored on a monthly basis by CCAMP. Results are displayed in Figure 6 and Table 8.

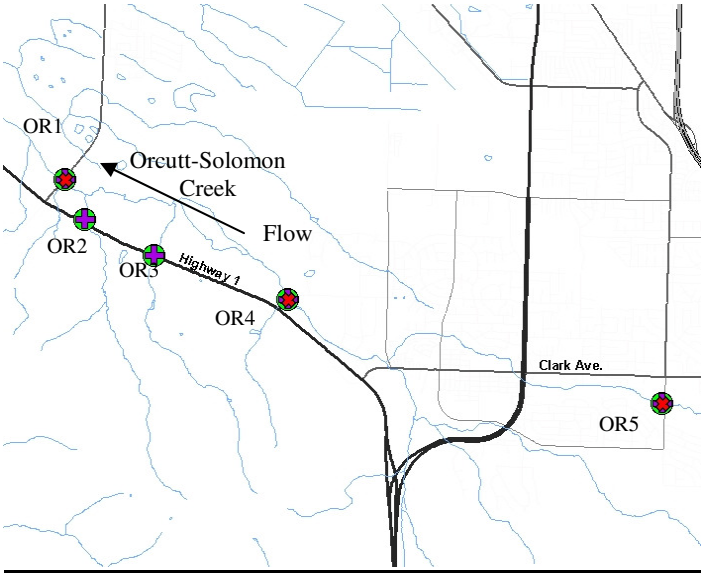

Figure 5. Project Clean Water sampling sites on Orcutt-Solomon Creek.

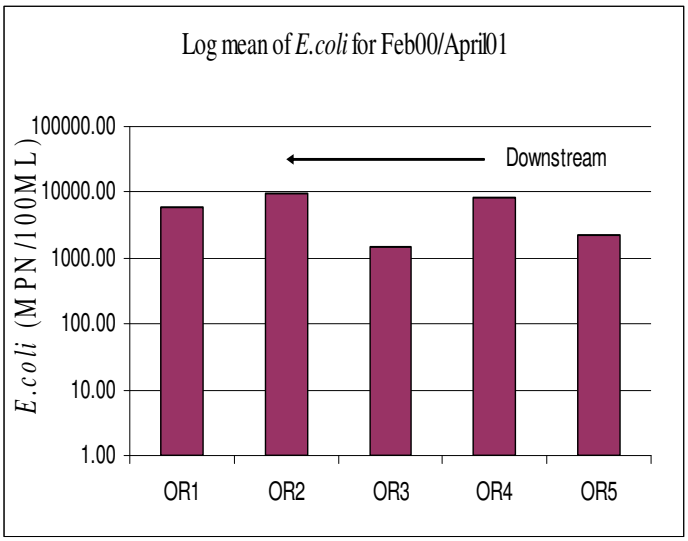

Figure 6. Log mean of *E. coli* on Orcutt-Solomon Creek.

Table 8. Summary of *E. coli* levels in Orcutt-Solomon Creek during storm events.

Station	Drainage area primary land uses	No.	Min. (MPN)	Log mean. (MPN)	Max. (MPN)
OR1	rangeland and irrigated agricultural	9	1,014	6,057	38,730

OR2	rangeland and irrigated agricultural	5	74	9,453	1,046,200
OR3	golf course	4	17	1,474	72,700
OR4	rangeland and urban/ rural residential	6	776	8,171	92,080
OR5	urban and commercial	9	31	2,257	155,310

Log mean of *E. coli* levels at stations OR1, OR2 and OR4 were higher than those found at stations OR3 and OR5. Station OR3 drained a golf course and Station OR5 drained urban land uses. All sites exceed the log mean of 126 MPN/100 mL. Although the data presented is limited, the magnitude of exceedance of target FIB concentrations leads staff to consider that stormwater events produce elevated FIB concentrations. This being the case, implementation focusing on non-point sources and stormwater is prudent. This will be discussed further in the implementation section of the report. Please see Section 5.5.2 for more discussion regarding stormwater sources.

4.4 Flow Data

The United States Geological Survey (USGS), the County of Santa Barbara, CCAMP, and the CMP collected flow data in the project area. The USGS collected data at several locations in the Santa Maria River. Table 8 shows mean monthly flow data. USGS mean monthly flow values are shown in

Figure 7.

Table 9. Flows (cfs) in the Santa Maria River, Cuyama River, and the Sisquoc River (1940-1999).

	Time period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Santa Maria River at Guadalupe	**1940-1987**	60	74	137	76	3.1	0.02	0.01	0	0.09	0.03	0.71	11
Cuyama River (Below Twitchell Dam)	**1958-1983**	27	26	65	33	80	97	94	83	62	31	27	26
Sisquoc River (near Sisquoc)	**1943-1999**	83	179	151	97	35	13	5.3	2.7	2.6	2.7	6.8	27

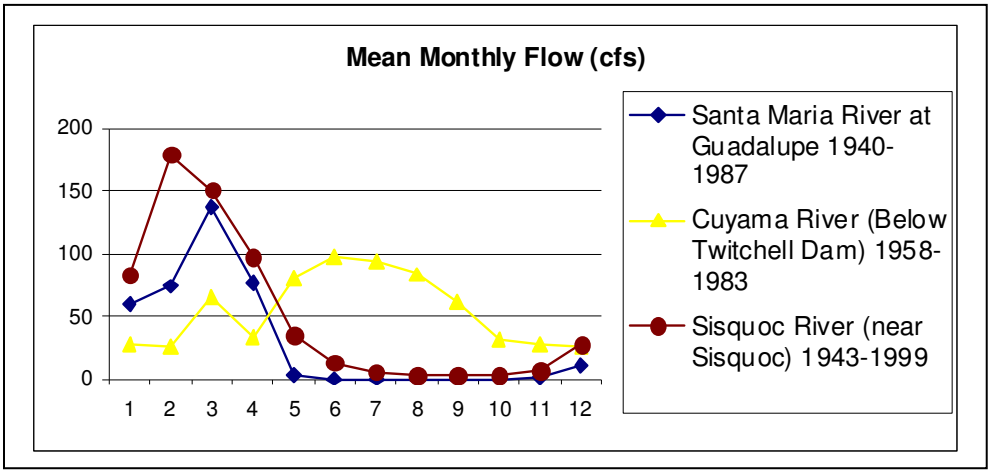

Figure 7. Flow (cfs) in the Santa Maria, Cuyama, and Sisquoc River Watersheds (USGS). Flow (cfs) and months of the year.

In addition, staff developed flow duration curves. Please see SMA-Appendix 2 - Flow Duration Curves for more details about flow in the subwatersheds of the Santa Maria River Watershed.

4.5 Land Use Data

Water Board staff used spatial data for the following purposes: delineation of watershed boundaries; compilation of land use tables; land cover as it relates to fecal coliform production and runoff (e.g. BLSC and WTM spreadsheets); preparation of orientation maps and presentation of hydrologic and transportation networks. Staff used watershed areas to describe the condition of the watershed and to interpret the relative effects of land use on bacteria levels. Staff used the Santa Barbara County Flood Control and Water Conservation District 1985 map (Ernst Wiedmann) along with the City of Santa Maria staff in order to determine subwatershed boundaries.

Water Board staff used the National Land Cover Database 2001 (NLCD) land cover classifications. The categories (shown in
Figure 8) included the following: cultivated crops (irrigated agriculture), developed land, pasture/hay (rangeland), barren land and forest land.

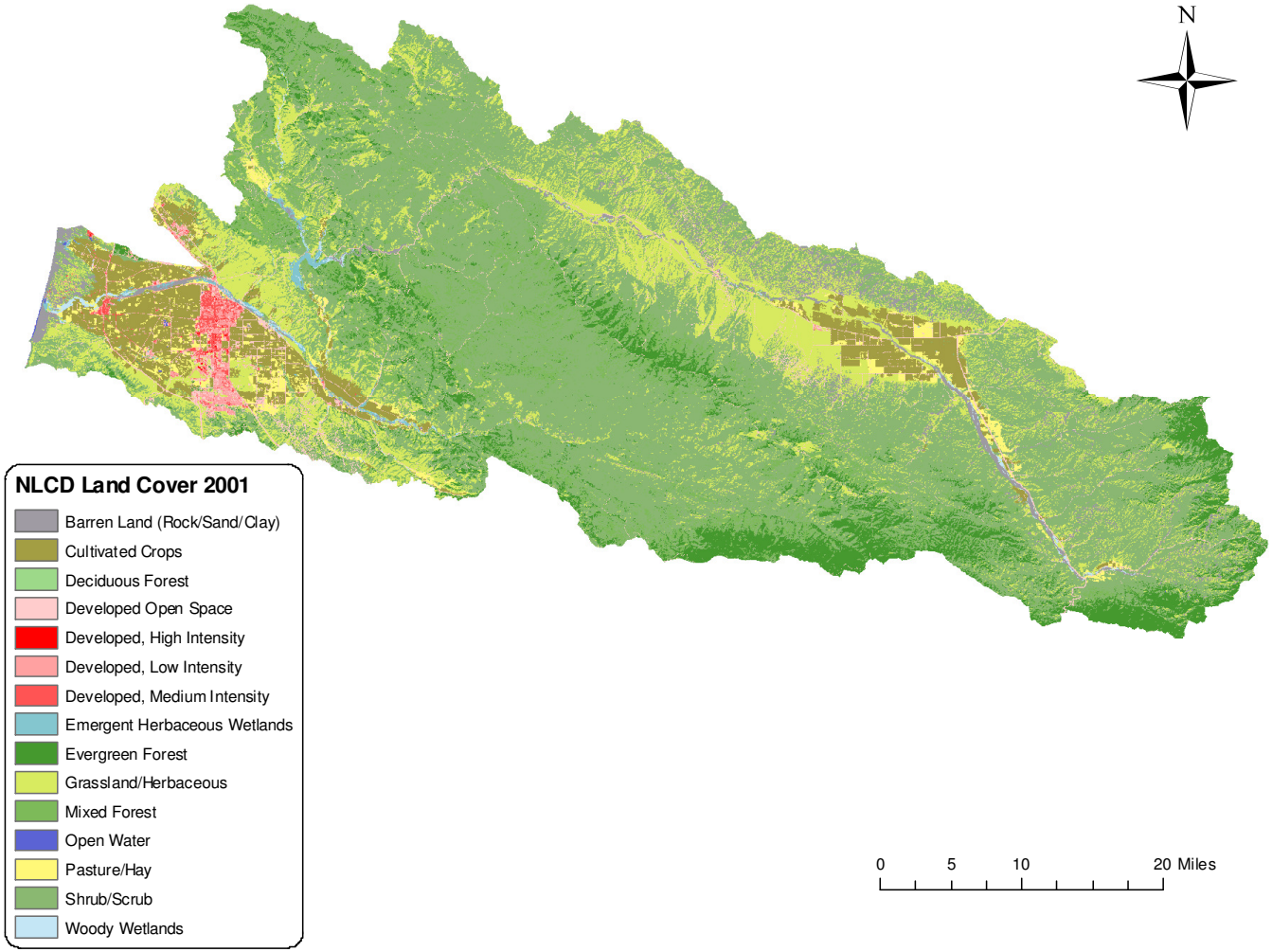

Figure 8. Land cover in the Santa Maria River Watershed. Will make a new map

Table 10. Estimated land cover (acres) reported by subwatersheds in the Oso Flaco and Santa Maria Watersheds (NLCD 2001).

	Land cover					
Watershed	Forest	Cropland	Pasture/Range	Barren Land (Rock/Sand/Clay)	Built up	Open Water
Alamo	6,830	565	48,194	4	776	4
Betteravia Area	75	2,603	3,257	6	5,336	3
Blosser Street	0	9	13	0	1,974	3
Bradley Canyon	91	2,349	4,175	0	1,064	1
Bradley Channel	3	4,107	1,524	11	1,740	9
Corralitos Canyon	99	2	2,669	0	151	0
Cuyama	83,162	23,447	439,621	26,761	11,931	13
Lower Cuyama	3,036	951	10,097	5	337	0
Green Canyon	18	9,002	3,390	10	3,380	54
Guadalupe Area	0	1,304	266	0	276	0
Guadalupe Dunes	114	116	6,667	3,810	409	27
Huasna	21,959	1,317	50,972	301	1,487	0
Ineffective Watershed Area	7	12	2,278	114	99	0
Main Street	0	2,227	134	1	1,224	0
Nipomo Creek	236	3,551	7,884	3	1,704	0
Orcutt or Solomon Creek	1,662	3,746	14,772	1	3,347	26
Oso Flaco	392	6,294	1,652	40	1,041	66
Santa Maria River	3,175	8,999	17,945	38	2,795	5
Santa Maria River Channel	13	2,422	1,135	1,345	690	28
Sisquoc	78,573	7,436	210,787	823	4,854	12
Total	199,445	80,457	827,433	33,275	44,615	252

Table 11. Estimated land cover (percent) reported by subwatersheds in the Oso Flaco and Santa Maria Watersheds (NLCD 2001).

	Land Cover					
Watershed	Forest	Cropland	Pasture/Range	Barren Land (Rock/Sand/Clay)	Built up	Open Water
Alamo	12%	1%	85%	0%	1%	0%
Betteravia Area	1%	23%	29%	0%	47%	0%
Blosser Street	0%	0%	1%	0%	99%	0%
Bradley Canyon	1%	31%	54%	0%	14%	0%
Bradley Channel	0%	56%	21%	0%	24%	0%
Corralitos Canyon	3%	0%	91%	0%	5%	0%
Cuyama	14%	4%	75%	5%	2%	0%
Lower Cuyama	21%	7%	70%	0%	2%	0%
Green Canyon	0%	57%	21%	0%	21%	0%
Guadalupe Area	0%	71%	14%	0%	15%	0%
Guadalupe Dunes	1%	1%	60%	34%	4%	0%
Huasna	29%	2%	67%	0%	2%	0%
Ineffective Watershed Area	0%	0%	91%	5%	4%	0%
Main Street	0%	62%	4%	0%	34%	0%
Nipomo Creek	2%	27%	59%	0%	13%	0%
Orcutt or Solomon Creek	7%	16%	63%	0%	14%	0%
Oso Flaco	4%	66%	17%	0%	11%	1%
Santa Maria River	10%	27%	54%	0%	8%	0%
Santa Maria River Channel	0%	43%	20%	24%	12%	0%
Sisquoc	26%	2%	70%	0%	2%	0%

Table 10 and Table 11 display land uses in each subwatershed. Rangeland represented the majority of the watershed at 70%, with forest being second (17%) followed by cropland at 7%.

4.6 Data Analysis Summary

Staff concluded the following from the data presented above:

- Impaired sites

Table 12 summarizes which water bodies are impaired, the affected length (or area) and which fecal indicator showed impairment.

Table 12. Summary of impaired water bodies and the fecal indicator bacteria with which they are impaired.

Water body	Description of length	Estimated Size Affected (miles, unless otherwise noted)	Calwater Watershed	Pollutant/ Stressor
Alamo Creek	All reaches	7.8	31230071	Fecal coliform *E. coli*
Blosser Channel	All reaches	0.02	31210030	Fecal coliform *E. coli*
Bradley Canyon Creek[1]	All reaches	17	31210030	Fecal coliform
Bradley Channel	All reaches	3.1	31210030	Fecal coliform *E. coli*
Cuyama River (above Twitchell Reservoir)	Downstream of Cuyama River @ Highway 33 (312CAV) and upstream of the reservoir (312CUT)	80	31230060	Fecal coliform *E. coli*
Greene Valley Creek	All reaches	3.9	31210030	Fecal coliform *E. coli*
Huasna River	All reaches	18	31230082	Fecal coliform *E. coli*
La Brea Creek	All reaches	6.6	31220066	Fecal coliform *E. coli*
Little Oso Flaco Creek	All reaches	1.8	31210030	Fecal coliform
Main Street Canal	All reaches	5.1	31210030	Fecal coliform *E. coli*
Nipomo Creek	All reaches	9.3	31210011	Fecal coliform *E. coli*
Orcutt-Solomon Creek	All reaches	10	31210030	Fecal coliform *E. coli*
Oso Flaco Creek[2]	All reaches	6.3	31210030	Fecal coliform *E. coli*
Oso Flaco Lake	All reaches	56 acres	31210030	Fecal coliform *E. coli*
Santa Maria Estuary	All reaches	5.8 acres	31210030	Fecal coliform *E. coli* Total coliform
Santa Maria River	From the estuary (312SMA) to Bull Canyon Road (312SBC)	51	31210030	Fecal coliform *E. coli*
Sisquoc River	All reaches	66	31210030	*E. coli*

1 - Only three samples were taken for *E. coli* at this site, therefore impairment could not be determined for *E. coli*.
2 - Includes an unnamed tributary to Oso Flaco Creek, sampled at station (312BSR).

Seasonality

- Fecal coliform concentrations in Alamo Creek were elevated year-round with higher levels during the wet-season;
- Fecal coliform levels in the Cuyama River were elevated year-round;
- The Santa Maria River was impaired by fecal coliform year-round, with concentrations higher during the dry-season;
- The channels (Main, Bradley and Blosser) draining to the Santa Maria River were impaired by fecal coliform year-round;
- Nipomo Creek, Bradley Canyon Creek, and Orcutt-Solomon Creek were impaired by fecal coliform year-round;
- Fecal coliform levels in La Brea Creek were elevated in the spring (April, May and June), with no exceedances at other times.
- Fecal coliform levels were highest during the dry season in Oso Flaco Creek.

Concentrations of FIB with respect to land use

- *E. coli* concentrations in runoff from an irrigated agriculture area were elevated, but concentrations were much lower than those found in discharges from urban areas and in receiving water.
- *E. coli* concentrations downstream of urban areas were higher than concentrations upstream, and higher than those draining agriculture.
- Discharges from the rural residential area of Nipomo Mesa and agricultural discharges are elevated, but they did not cause exceedances in Oso Flaco Creek during storm-events.
- Urban stormwater discharges from the rural residential area of Nipomo Mesa to Oso Flaco watershed did not occur during dry periods and were diluted during wet periods due to flow in Oso Flaco Creek.
- *E. coli* concentrations in runoff to Orcutt-Solomon Creek from rangeland, irrigated agriculture, and rural residential land uses were higher than those draining urban/commercial and a golf course.
- Data indicate that elevated levels of bacteria are found at locations draining primarily rangeland, and that this land use can contribute significant levels of bacteria.
- Staff considered rangeland, urban/commercial, irrigated agriculture, and rural residential (low intensity urban) land uses as having contributed fecal coliform to the listed water bodies in this project.

5 SOURCE ANALYSIS

The purpose of the Source Analysis is to identify sources and assist in allocating appropriate responsibility for actions needed to reduce these sources. Water Board staff relied on information presented in the *Data Analysis* section and considered the following:

- monitoring efforts to isolate specific causes of high bacteria loads,
- relationships between seasonal conditions and bacteria levels,
- connections between land use and bacteria concentrations,
- connections between facilities and bacterial levels, and
- uncontrollable, natural sources.

This section provides information on the potential influence of channel characteristics,land uses, permitted facilities and other entities on bacterial concentrations, and identifies the sources.

5.1 Influence of Channel Characteristics on Bacteria Concentrations

Staff evaluated several aspects of the hydrology and specific channel characteristics to determine if and how these might influence bacteria concentrations. The hydrology of the Santa Maria River and listed water bodies within the watershed and of the Oso Flaco watershed have been significantly altered by people. Based on a Geographic Information System (GIS) analysis of digital elevations and multiple field visits and discussion with both the City of Santa Maria and Santa Barbara County Flood Control, staff observed that creek channels have been moved and watershed areas are highly modified. Within the City of Santa Maria, staff observed that some water body segments consisted of concrete-lined channels dominated by urban runoff during rainfall events. Additionally, staff determined that creeks in other parts of the Santa Maria watershed and in the Oso Flaco watershed lacked riparian cover that may lead to increased temperatures and a warm benthic environment conducive to bacteriological reproduction and naturalization. Furthermore, staff observed slow flowing, and stagnant water in low elevations.

Staff reviewed studies related to the influence of natural sources and conditions on bacterial levels. Research conducted by the County of Santa Cruz, Environmental Health Services, indicated that much of the bacteria that cause beach postings can come from natural sources, including algae and kelp (2004). Byappanahalli, et al (2003) found that macro-alga *Cladophora glomerata* found in streams and lakes worldwide, provided a suitable environment for indicator bacteria to persist for extended periods and to reproduce under natural conditions. Another study found that pulp and paper mill water systems (wood products) support the growth of various coliforms, especially Klebsiella Spp., Escherichia coli, Enterobacter spp., and Citrobacter spp. due to their thermotolerance (Gauthier, et. al.).

Staff concluded that instream channel conditions (the presence of elevated temperatures, algae, fine silt and other in-stream materials) may have contributed to increased bacterial

concentrations. Staff concluded that these conditions may contribute to elevated fecal coliform concentrations in-stream, allowing the bacteria to increase in population due to favorable environmental conditions, but the extent of the influence from these factors is unknown. Some of these naturalized[7] conditions may be considered more natural or background conditions, while others may be more of a result of the anthropogenic influence on stream channels.

5.2 Inventory of Fecal Coliform Producers

Fecal coliforms are produced by all warm-blooded animals. Staff compilee population estimates and fecal coliform produced by each animal type in the Project Area. Table 13 summarizes the inventory of major producers of fecal coliform in the project area. It is important to recognize there is uncertainty in these numbers; they are estimates based on census statistics and estimated wildlife population densities. Livestock numbers are taken from the U.S. Department of Agriculture's (USDA) National Agricultural Statistics Service Census database, the Santa Barbara and San Luis Obispo General Plans (2009) and from the Ventura County Farm Bureau. At the time this FIB TMDL Report was written, the most recent version of the USDA Agricultural Census available online was for 2007.

Livestock numbers (see Appendix C for calculations) were derived using a USEPA-recognized estimation method, which includes using U.S. Department of Agriculture county data on livestock, and land use information (USEPA, 2001). Per the USEPA-recognized methodology, it was assumed that livestock are evenly distributed throughout all rangeland/pasture/grassland in the counties. To obtain an average animal geographic density, the number of livestock in San Luis Obispo, Santa Barbara and Ventura Counties were obtained from the USDA Agricultural Census database, and divided by the amount of rangeland/pasture in the counties. This yielded an average county-wide animal density per acre. This average density/acre value was then multiplied by the acreage of rangeland/pasture/grassland in the project area, and also by the acreage amounts among the various subwatersheds to obtain the livestock numbers shown in Table 13.

The number of people in the watershed was estimated from block group data in the U.S. Census Bureau 2000 Decennial Census. The estimated number of people with Onsite Disposal Systems (OSDS, or septic tanks) is included from the 1990 Census. Unfortunately, household sewage disposal information was not included in the 2000 Census. Using data from 1990 may result in marginally underestimating the number of housing units/people using OSDS. In an attempt to make the 1990 OSDS census data more current, an upward adjustment was made to the 1990 Census numbers, assuming a 1% growth rate/year in the number of housing units with OSDS. The 1% growth rate/year comes from a Statewide OSDS survey conducted by Chico State University (2003). The number of people living in sewered households was simply the total number of people in the project area, minus the number of people with OSDS or other sewage disposal means. The number of homeless was estimated from the City of Santa Maria's Housing Elements Update (2006).

[7] "Naturalized" in this instance means bacteria that increase in population (colony size) in the stream channel instead of coming directly from the intestinal track of a mammal.

Most communities do not have data on the number of households that own dogs or cats. Therefore the numbers of dogs, cats, and horses in the project area were estimated from the American Veterinary Medical Association's U.S. Pet Ownership and Demographics Sourcebook (AMVA, 2007), in conjunction with housing data from the U.S. Census Bureau. Staff used household-to-pet ratios reported by AMVA to estimate the number of pets in the Project Area and associated watersheds. For example, AMVA (2007) reports that 37.2% of households own dogs. The average number of dogs owned by these households is 1.7. Therefore, the number of dogs can be estimated by the following calculation: number of dogs = (total number of households in area of interest) x 0.372 (i.e., the ratio of households that own dogs) x 1.7.

Wildlife populations are estimated from animal population densities available from California Department of Fish and Game and other Agency or scientific sources shown in Table 13. Using these numbers, a habitat density (animals/square mile or animals/acre) were derived, and it was assumed that the distribution of animals was spread uniformly across all suitable habitat. The distribution, habitat requirements, seasonality, and habitat ranges of wildlife shown in Table 13 were corroborated utilizing the California Department of Fish and Game's Wildlife Habitat Relation System

Table 13: Inventory of fecal coliform producers in the Santa Maria Watershed

Category	Sub-category	Estimated Population	Source of Population Estimate	Fecal Coliform Produced per individual/day (cfu)
Livestock	Cattle	32,344	USDA Census of Agriculture (2002), additionally, County general plans regarding grazing land.	5.49E+10
	Horses	5,875	USDA Census of Agriculture (2002)[A]	4.20E+08
	Sheep/lamb	2,731	USDA Census of Agriculture (2002)[A]	1.2 E+10
	Hogs	191	USDA Census of Agriculture (2002) [A]	1.1 E+10
	Chicken	2,887	USDA Census of Agriculture (2002) [A]	1.40E+08 (layers) 8.90E+07(broilers)
	Goats	2,561	USDA Census of Agriculture (2002) [A]	Assume equal to sheep
Humans	Sewered	112,302	US Census Bureau (2000) AB 885 On-site Wastewater Treatment Systems Program DEIR (2008)	2.0 E+09
	OSDS	12,339	US Census Bureau (2000) AB 885 On-site Wastewater Treatment Systems Program DEIR (2008)	
	Homeless	750	County of Santa Barbara, Continuum of Care (2009)	
Pets	Dogs	27,464	AMVA Pet Ownership Statistics (2007)	4.50E+08
	Cats	30,956	AMVA Pet Ownership Statistics (2007)	4.50E+08
Wildlife	Deer	10,871	California Dept. Fish and Game[C]	3.5 E+08
	Feral Pig	3,030	Calif. Dept. Fish and Game[D]	1.1 E+10
	Coyotes	1,375	Gese et al. (1989); Babb et al. (1989)	4.50E+08
	Raccoons	9,143	Calif. Dept. Fish and Game[D]	5.0 E+07
	Opossum	8,840	Kissell and Kennedy (1992)[E]	Assume equal to Raccoon
	Skunk	9,446	Ontario Ministry of Natural Resources (1987)[F]	2.50E+07 Muskrat value, assume

				skunk=muskrat
	Wild Turkey	13,749	Calif. Dept. Fish and Game[G]	9.3 E+07
	Pheasant	0	Calif. Dept Water Resources-IEPH	Assume equal to turkey
	Duck (peak season)	1,642	Estimated from Calif. Depart. of Fish and Game (2008)[I]	2.40E+09
	Geese (peak season)	164	Assume = approx. 10% of Duck population, based on Calif. DFG Waterfowl Hunt Results Report (2007), which indicates Geese harvest is typically around 10% of Duck harvest[J]	8.00E+08
	Other unknown bird	1,642	Reliable estimates of numbers for other birds were not available. To attempt to account for the fecal coliform bacteria that would be produced by other birds, an equivalency to all duck in the project area was assumed.	Assume equivalency to all duck in project area.
	Other wildlife	10,871	Reliable estimates of numbers for other wildlife were not available. To attempt to account for the fecal coliform bacteria that would be produced by other wildlife, an equivalency to all deer in the project area was assumed.	Assume equivalency to all deer in project area.

Population Inventory and Habitat Sources
A: USDA, National Agricultural Statistics Service
http://www.nass.usda.gov/Census/Create_Census_US_CNTY.jsp
B: US Census Bureau website - http://factfinder.census.gov
C: California Dept. of Fish and Game - http://www.dfg.ca.gov/wildlife/hunting/deer/docs/habitatassessment/part4.pdf
D: California Dept. of Fish and Game - Game http://www.dfg.ca.gov/biogeodata/cwhr/cawildlife.aspx
E: Kissel and Kennedy, 1992. Ecological Relationships of Co-occurring Populations of Opossums and Raccoons. Journal of Mammalogy, vol. 73, pp. 808-813.
F. Ontario Ministry of Natural Resources. Wildlife Research Service, 1987. Wildfurbearer Management and Conservation in North America, Chapter 45, Striped, Spotted, Hooded and Hog-Nosed Skunk.
G.: California Dept. of Fish and Game - http://www.dfg.ca.gov/wildlife/hunting/uplandgame/docs/turkplan_04.pdf
H: Interpreted from Cal. DWR Interagency Ecological Program - http://www.iep.ca.gov/suisun_eco_workgroup/workplan/report/wildlife/pheasant.html
I. California Dept. of Fish and Game, 2008 Waterfowl Breeding Population Survey. http://www.dfg.ca.gov/news/news08/08045.html
J. California Dept. of Fish and Game, Waterfowl Hunt Comparison Report. http://www.dfg.ca.gov/wildlife/waterfowl/shoot/ComparisonTables/docs/HT_CMP07.pdf
K. Literature references for Fecal Coliform production, see Appendix C, BSLC references sheet.

Figure 9 shows the relative proportions of fecal coliform produced by animal species in the project area. Figure 10 shows fecal coliform production by animal source group. It is important to note, that Figure 9 and Figure 10 represent the total amount of fecal coliform produced, not the amount delivered to surface waters. The estimates of the proportion of fecal coliforms potentially delivered to surface waters will be detailed in subsequent sections.

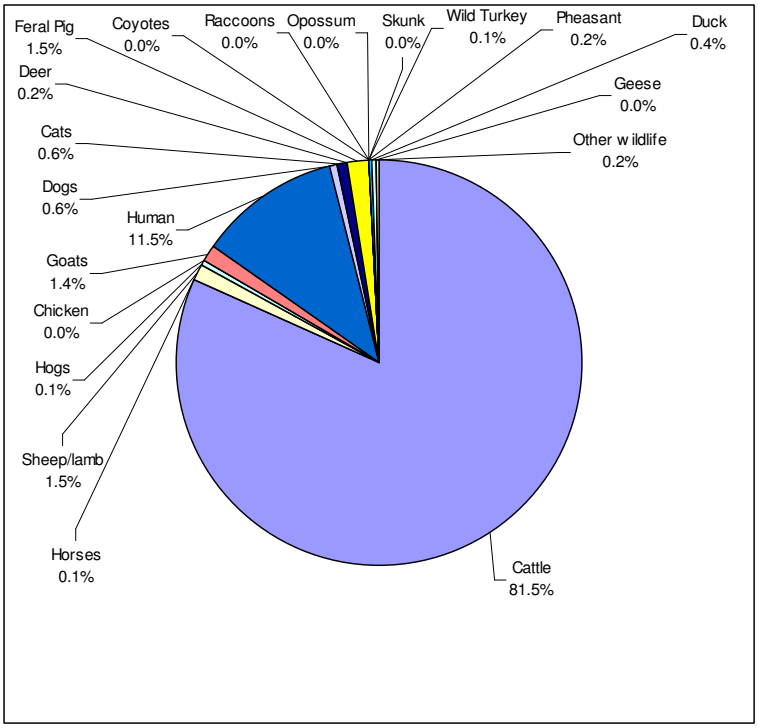

Figure 9: Estimated fecal coliform produced by animal species in project area.

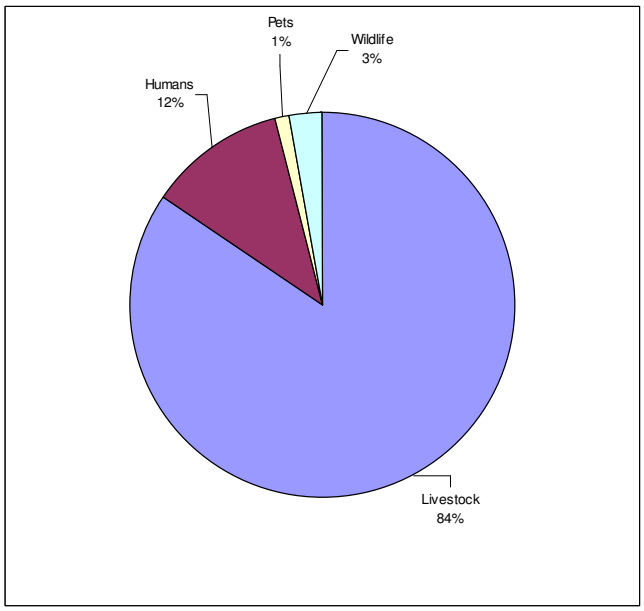

Figure 10: Estimated fecal coliform produced by source group in project area.

5.3 Delivery Potential of Fecal Indicator Bacteria (FIB) to Surface Water

To estimate the relative proportion of FIB delivered to surface waters from the various fecal coliform sources in the project area, two spreadsheet tools, and some simplifying assumptions were used, to assess potential load contribution estimates.

For each of the subwatersheds in the Project Area, the relative load to land and load to stream contribution of fecal coliform nonpoint sources were estimated with the Bacteria Source Load Calculator (BSLC) spreadsheet, available from the Virginia Tech University Center for TMDL Studies. BSLC characterizes how bacterial loads are spatially and temporally distributed in the watershed from user input, and processes the source data to calculate 1) non-point source fecal coliform loads to land; and 2) fecal coliform loads to stream from direct in-stream deposition. The BSLC spreadsheet calculations and input parameters are included in Appendix C.

BSLC itself does not simulate die-off once bacteria reach the land surface. However, attenuation of bacteria prior to runoff into streams was incorporated by comparing the fecal coliform totals deposited on land, to reasonable area loading rates found in published literature (Horner, 1992 as reported in Shaver et al., 2007; New Jersey Dept. of Environmental Protection, 2008). Although these literature-based loading coefficients are gross approximations, and have not been estimated for the climate and conditions of the Santa Maria Project Area, previous staff work (Salinas Fecal Coliform TMDL, March 2010) led staff to conclude that these loading coefficients were appropriate for this Project area. Horner's loading rates used here for forest and cropland is 4.86E+08 cfu/acre/year; for grassland/pasture/rangeland the loading rate is 1.94E+09 cfu/acre/year.

Staff used the BSLC calculated fecal coliform loads deposited to land in conjunction with predicted runoff loads using the Horner literature loading rate values. This allowed staff to approximate attenuation of fecal coliform prior to runoff to surface waters. This is identified as the delivery potential of fecal coliform in Table 4-2. Simply put the delivery potential is the percentage, or the fractional amount, of fecal coliform from a given source that might ultimately end up in a surface water. The fractional amount of fecal coliform produced and potentially delivered to surface water were estimated by multiplying the total fecal coliform produced from sources in the BSLC spreadsheets (Appendix C), by the estimated delivery potential (right hand column) in Table 14. The delivery potential itself is simply calculated as a percentage from the ratio of the predicted fecal coliform runoff load (using Horner's areal loading rates), to the total fecal coliform deposited to land from the BSLC spreadsheet calculations.

In contrast to delivery potentials for overland runoff, direct livestock/wildlife defecation into a stream channel was assumed to have a 100% delivery potential, because all fecal coliforms are discharged directly into the surface water, with no opportunity for attenuation.

Table 14. Delivery potential of fecal coliform: Fraction (%) of total fecal coliform produced by nonpoint sources that is available for potential runoff or discharge to surface water.

	Total Acres In Project Area	**Total Fecal Coliform Produced** (MPN/year)*	**Estimated Fecal Coliform Runoff Load per acre** (MPN/acre/year) (from Horner, 1992)**	**Estimated Total Runoff Load Potential** (Runoff Load/acre) x (Total Acres) = MPN/year	**Delivery Potential:** % of Total Fecal Coliform Potentially Available for Runoff/Discharge to Surface Water***
Crops	80,457	1.58E+15	4.86E+08	3.91E+13	**2.5%**
Pasture Grassland Rangeland	827,433	5.40E+17	1.94E+09	1.61E+15	**0.3%**
Forest	232,720	4.29E+15	4.86E+08	1.13E+14	**2.6%**
Direct In-Stream Defecation	-	2.95E+15	-		**100%**

*from BSLC spreadsheet calculations: total amount of fecal coliform deposited to land or stream for all identified livestock and wildlife species.
** Horner (1992) as reported in Shaver et al., 2007.
*** Derived by dividing (Estimated Total Runoff Load Potential) by (Total Fecal Coliform Produced): for example, Forest Delivery Potential = (9.37E+12) / (1.27E+15) = 0.7%

Delivery potentials (i.e., the fractional amount of total fecal coliform produced that is available for potential runoff) have been used similarly in other State and USEPA-approved TMDLs. (Minnesota Pollution Control Agency, 2002; Minnesota State University, 2007). It is important to note that the delivery potentials identified in Table 14 come with a degree of uncertainty. The amount of fecal material delivered from any land use source will vary depending on numerous factors. The delivery potential ratios in Table 14 should be considered gross screening-level approximations of the "averaged" fractional amounts of fecal material potentially available for delivery to surface waters. This is an important distinction, because there remains substantial uncertainty about the exact relationship between FIB loads observed in overland runoff, and the water column FIB loads observed in streams. In many reported studies, it is not clear whether the monitored overland flow ultimately discharges to a waterway or simply infiltrates into the soil at some point down the hill slope. The uncertainty associated with delivery hinders quantification of the overland flow contribution to FIB loading of streams (Collins, et al. 2005).

Therefore, the goal of estimating the delivery potential of fecal coliform from identified sources in the Project Area, is to derive a reasonable estimate of the relative source contributions. This estimation is an empirically-driven way to estimate the relative importance and magnitude of various sources relative to each other. Once the proportionality of fecal coliform contribution from various sources to impaired surface waters are estimated, then the fractional contribution of each source can then be calibrated to actual observed loads (water quality monitoring data). Water quality monitoring data is a measure of actual stream loads that has none of the uncertainty pertaining to the assumptions about how overland runoff loads relate to actual stream loads.

By calibrating the estimated fractional proportions of source contributions developed in section 5.2, to actual observed stream loads, it is possible to establish numeric load and allocation expressions. USEPA recognizes existing loads can be established through the

calibration of modeled or empirically estimated bacteria source contributions to water quality monitoring data (USEPA, 2001).

Similarly, a screening level assessment of the amounts of fecal coliform from point sources (i.e., MS4 runoff) that are *potentially* available for discharge to impaired surface waters were estimated using the Watershed Treatment Model, V.3.1 (WTM). WTM is a spreadsheet tool developed by the Center for Watershed Protection for the U.S. Environmental Protection Agency. It is primarily designed for rapid assessment of load parameters and treatment options appropriate for urban subwatersheds. WTM uses the Simple Method (Schueler, 1987), a USEPA-recognized empirical methodology of calculating loads from urban stormwater runoff. The WTM assessment establishes the potential proportional load contribution from each point source (i.e., the relative magnitude and importance of each source), and this information was subsequently calibrated to the observed loads to estimate source contributions to existing loads, and allocations as stated previously.

Delivery potentials were also assigned to urban runoff, to assess and quantify the relative source contributions (Table 15). The delivery potential of urban runoff was assumed to be 100%, since the effluent data comes from end-of-pipe storm outfall monitoring, and therefore presumably represents effluent concentration that is *directly* discharging into surface water.

Table 15. Delivery potential of fecal coliform: fraction (%) of total fecal coliform produced by point sources that is available for potential runoff or discharge to surface water.

	Estimated Mean Effluent Concentration	**Source of Effluent Concentration Estimate**	**Delivery Potential:** % of Total Fecal Coliform Potentially Available for Runoff/Discharge to Surface Water
Urban Runoff	3455 MPN/100mL	Average concentration of four sampling stations*within the City of Santa Maria between 2005-2006	**100%**

* N-Main St. Channel, S-Main St. Channel, Hobbs Basin and Prell Basin.

5.4 Sources of Bacteria (non-permitted sources)

This section discusses the influence of activities associated with various land uses on fecal coliform. *Natural*, uncontrollable sources (e.g. wildlife; as described in Section Natural and Background Sources) can originate from each of the land uses discussed below.

5.4.1 **Domestic Animal Discharges (Including Cattle and Other Livestock, Including Pets)**

Staff considers cattle to be a source of fecal indicator bacteria to the impaired waterbodies. Bacterial sources from open spaces that are grazed, in part, originate from cattle feces entering the water body.

Staff estimated that there are approximately 32,344 head of cattle in the Santa Maria Watershed. Livestock numbers were obtained from the U.S. Department of Agriculture's (USDA) National Agricultural Statistics Service Census database[8], by Santa Barbara, San Luis Obispo and Ventura County's general plans and by GIS using NLCD landcover (2001). At the time this FIB TMDL Report was written, the most recent version of the USDA Agricultural Census available online was for 2007.

Livestock numbers were derived using a USEPA-recognized estimation method, which includes using U.S. Department of Agriculture county data on livestock, and land use information (USEPA, 2001). Per the USEPA-recognized methodology, it was assumed that livestock are evenly distributed throughout all rangeland/pasture/grassland in the counties. To obtain an average animal geographic density, the number of livestock in San Luis Obispo, Santa Barbara and Ventura counties were obtained from the USDA Agricultural Census database, and divided by the amount of rangeland/pasture in their respective counties. This yielded an average county-wide animal density per acre. This average density/acre value was then multiplied by the acreage of rangeland/pasture/grassland in the project area, and also by the acreage amounts among the various subwatersheds to obtain the livestock numbers shown in Table 13.

According to the land use analysis, land available for grazing (including pasture/hay, grassland/herbaceous, shrub/scrub) covered the majority (70%) of total Project Area, some of it in large contiguous areas.

Staff observed cattle grazing adjacent to and within impaired water bodies in the project area and evidence of cattle present at numerous locations, included on the Cuyama River, Alamo Creek, Santa Maria River, and Orcutt-Solomon Creek. Staff observed strong odors, cattle waste and hoof prints on multiple CCAMP sampling events in Santa Maria River at Highway One (312SMI) and above the estuary (312SMA) as well as in Alamo Creek (312ALA) and Cuyama River at Cottonwood Creek (312CCC). At each of these sites cattle were grazing in the creek channel year-round.

There have been some improvements with regards to cattle's access to the Santa Maria River Estuary. For example, in 2007, staff photo-documented cattle waste in drainages and cattle grazing (10-20 head) in and directly adjacent to riparian areas and waterbodies during reconnaissance visits in March and September. Figure 11 shows cattle grazing in the Santa Maria Estuary in 2007. Currently (2010), cattle are now excluded from the Santa Maria Estuary by a fence that crosses the Santa Maria River (see Figure 12). This fence does break away during high flows and occasionally some cattle make their way towards the Estuary when the fence is down. However, when the landowner is contacted regarding their cattle in the Estuary, they are responsive and the cattle are returned east of the fence. Cattle have access to the areas east (upstream) of the Estuary.

[8] http://www.agcensus.usda.gov/

Figure 11. Cattle grazing in the Santa Maria River Estuary. September 2007

Figure 12. Fence that excludes cattle from the Santa Maria Estuary (fence is approximately on the border between the Estuary and the Santa Maria River), May 20, 2010.

Staff also evaluated the results of special studies that were designed to evaluate water quality responses to grazing activities. In the Morro Bay watershed study (National Monitoring Program, 2003), Water Board staff collected fecal coliform data to evaluate the effectiveness of cattle management practices. The data demonstrated fecal coliform in the creeks significantly changed when cattle were excluded from the creek. This data indicated that cattle were a source of fecal coliform. The type of management measures implemented (e.g. rotational grazing, cattle exclusion, off-stream water sources) can influence fecal coliform loading.

Results of genetic fingerprinting studies in other watersheds of the Central Coast Region indicated cattle as a source of fecal coliform (Water Board 2005, California Polytechnic State University 2002). Staff determined that the results of these studies could be transferred to this project as the land uses and traditional grazing management practices were similar. Staff concluded cattle contributed to exceedances of water quality objectives. Staff will address this source in the Implementation Plan.

Small livestock operations on rural residences, such as those for horses, chickens and other farm animals may also contribute bacteria. There is evidence from other similar watersheds on the Central Coast supporting the conclusion that fecal coliform from animals such as horses and livestock that are in proximity to a water body, travels to the respective water body through stormwater runoff.

In 2006, Ecology Action, through their Livestock and Land Management Program, and the Santa Cruz Resource Conservation District, evaluated manure management in Santa Cruz, San Benito and Santa Clara counties (Ecology Action, Manure Management Survey Results, 2006). The Program concluded that without adequate manure management practices (e.g. storing, hauling, application practices) pathogens in manure can run into waterbodies.

Staff observed domestic animals (e.g. horses) on rural residential areas adjacent to impaired reaches that were likely discharging waste (e.g. Cuyama River, Bradley Canyon Creek, Nipomo Creek, Orcutt-Solomon Creek) during several field visits. Figure 13 shows horses grazing adjacent to the Cuyama River. Staff estimated that there are approximately 5,875 horses[9] in the Santa Maria Watershed.

[9] The number of horses was calculated using the same equation as for cattle (see Appendix C - BLSC)

Figure 13. Horses grazing adjacent to the Cuyama River, March 2007

Based on the inventory of fecal coliform producers in the Project Area outlined in Section 5.2, the estimated livestock inventory by subwatershed is shown in Table 16.

Table 16. Estimated livestock inventory by watershed

Subwatershed	Cattle	Chickens			Horses	Sheep	Hogs	Goats
		Layers	Broilers	Broiler Breeders				
Alamo	2,659	168	3	43	370	370	11	290
Betteravia Area	106	4	3	0	25	4	1	8
Blosser Street	0	0	0	0	0	0	0	0
Bradley Canyon	135	5	3	0	28	5	1	9
Bradley Channel	49	4	3	0	24	4	1	8
Corralitos Canyon	87	2	1	0	11	2	1	4
Cuyama	16,961	1,677	112	160	3,620	1,380	103	1,257
Lower Cuyama	376	15	4	2	55	24	2	26
Green Canyon	110	9	6	0	53	9	2	18
Guadalupe Area	9	1	1	0	7	1	0	2
Guadalupe Dunes	319	18	1	4	44	37	1	31
Huasna	2,812	180	4	46	397	397	12	311

Ineffective Watershed Area	74	2	1	0	10	2	0	3
Main Street	4	2	1	0	10	2	0	3
Nipomo Creek	435	39	1	10	87	87	3	68
Orcutt or Solomon Creek	479	14	9	0	80	13	4	26
Oso Flaco	91	27	1	7	60	60	2	47
Santa Maria River	680	38	10	6	137	64	5	68
Santa Maria River Channel	50	7	1	2	21	15	1	13
Sisquoc	6,833	164	100	0	937	154	42	311

Using the BSLC spreadsheet tool, and delivery assumptions outlined in Section 5.3, the estimated annual load proportion is shown for each watershed in Table 17.

BSLC contains default literature-based values and assumptions for the amount of fecal coliform various livestock produce, the fraction of livestock that have access to streams and drainages, and the amount of time they spend daily or seasonally in riparian zones. Staff input to the BSLC spreadsheet model included project area-specific land use data, an assumption that up to 25% of cattle in the project area have some degree of access to streams, ditches, ephemeral drainage features, and/or riparian areas (assumed same percentage as the Draft Salinas Fecal Coliform TMDL March 2010), and additional data on livestock that the BSLC default model does not account for (i.e., hogs). The total amount of fecal coliform available for potential discharge is obtained by multiplying the total amount of livestock fecal coliform deposited to pasture/rangeland or stream (from BLSC spreadsheets), and multiplying it by the delivery potential (%) shown in Table 17.

Table 17. Estimated annual fecal coliform from domestic animals available for potential runoff or discharge into surface waters.

	Domestic Animal Fecal Coliform Available for Potential Runoff/Discharge (MPN/year)		**Total Fecal Coliform Available**
Subwatershed	Pasture/Rangeland	Direct In-stream Defecation	
Alamo	2.15E+14	2.93E+14	**5.08E+14**
Betteravia Area	8.21E+12	1.17E+13	**1.99E+13**
Blosser Street	0	0	**0.00E+00**
Bradley Canyon	1.04E+13	1.49E+13	**2.53E+13**
Bradley Channel	4.00E+12	5.40E+12	**9.40E+12**
Corralitos Canyon	6.61E+12	9.59E+12	**1.62E+13**
Cuyama	1.33E+15	1.87E+15	**3.20E+15**
Lower Cuyama	2.92E+13	4.14E+13	**7.06E+13**
Green Canyon	8.96E+12	1.21E+13	**2.11E+13**
Guadalupe Area	7.60E+11	9.92E+11	**1.75E+12**
Guadalupe Dunes	2.55E+13	3.52E+13	**6.07E+13**
Huasna	2.28E+14	3.10E+14	**5.38E+14**
Ineffective Watershed Area	5.61E+12	8.16E+12	**1.38E+13**

	Domestic Animal Fecal Coliform Available for Potential Runoff/Discharge (MPN/year)		Total Fecal Coliform Available
Subwatershed	Pasture/Rangeland	Direct In-stream Defecation	
Main Street	4.45E+11	4.41E+11	**8.86E+11**
Nipomo Creek	3.66E+13	4.80E+13	**8.46E+13**
Orcutt or Solomon Creek	3.66E+13	5.28E+13	**8.94E+13**
Oso Flaco	9.80E+12	1.00E+13	**1.98E+13**
Santa Maria River	5.41E+13	7.50E+13	**1.29E+14**
Santa Maria River Channel	4.50E+12	5.51E+12	**1.00E+13**
Sisquoc	5.19E+14	7.53E+14	**1.27E+15**

Staff acknowledges the work done by California Cattleman's Association, Conservation Districts, Natural Resource Conservation Districts, University of California Cooperative Extension, US Fish and Wildlife Services and rangeland managers within the Santa Maria River Watershed. These entities have provided and attended educational courses, provided research and funding assistance to rangeland managers, and have reportedly implemented rangeland management practices to improve water quality. The California Cattlemen's Association has crafted a draft Nonpoint Source Grazing management strategy, containing information and strategies to manage pollutant loads from lands with domestic animals.

Given the information presented above, staff concluded that livestock and farm animals were source categories of indicator bacteria in surface waters of the Santa Maria Watershed, with the exception of Blosser Channel. Sources of indicator bacteria falling into these categories included cattle, horses, goats, pigs, sheep, and other commercial and non-commercially raised animals, including pets. Actions to control these sources will be included in the Implementation Plan.

5.4.2 Manure (Irrigated Agriculture)

Water Board staff considered possible contributions from irrigated agricultural land use activities (including land applications and use of sanitary facilities). Cropland comprises approximately 7% of the total project area. Staff discusses the use of sanitary facilities in a subsequent section Human Waste (Lack of sanitary facility use). Staff determined that land applications of manure were not a significant enough source of fecal coliform to the watershed to be assigned an allocation.

Staff evaluated the use of applied materials on irrigated agricultural lands. Conventional agricultural operations typically use inorganic fertilizers rather than land-applied manure. Some irrigated agricultural operations may apply non-sterile manure or other incompletely composted organic materials for fertilizer or soil amendment that can contain bacteria.

Staff spoke with agricultural organizations (the Southern San Luis Obispo and Northern Santa Barbara Agricultural Watershed Coalition and the Cachuma Resource Conservation District). Staff determined the application of raw manure and use of

organic compost containing animal feces was rare and that many growers used synthetic fertilizers. Furthermore, organic compost must be certified to be commercially sold. When compost is created from organic materials containing animal feces, producers use methods such as "turning under" the compost pile, restricting the size of the pile, and taking periodic temperature readings to ensure that bacteria are minimized. Additionally, irrigated agriculture owners and operators take measures to address pathogen management and prevent food borne illnesses.

Staff concluded land applications of organic materials (manure) were not occurring at a level warranting inclusion as a source of bacteria.

5.4.3 Human Waste (Lack of sanitary facility use)

Bacterial contributions can originate from human sources. This can occur on a multitude of land uses. For example, staff found that in agricultural areas field workers do not always use portable toilets provided by land owners and operators during field operations. County of San Luis Obispo and Water Board staff conducting field work observed evidence of field workers not using the portable facilities. Private citizens and County of San Luis Obispo staff photo-documented human waste in Nipomo Creek adjacent to an agricultural operation (August 19, 2007). The County of San Luis Obispo issued a Notice of Violation of Health and Safety Code Section 5411 to land owners and operators for unlawful discharge of sewage or other waste on September 5, 2007. Water Board staff documented human waste on Greene Valley in 2007. Water Board Staff observed a field worker not using sanitary facilities in the Santa Maria watershed in January 2008. Additionally, private citizens observed human waste by in Oso Flaco Creek adjacent to agricultural operations and notified staff.

Existing regulations require toilet facilities be provided for food crop harvesting operations to prevent crop contamination. Agricultural growers and their associates are keenly aware of the food-safety issues, including the potential impact to human health and the impact of marketing produce. Local health officers, the county agricultural commissioners, and/or the State Department of Health Services are responsible for enforcement. County of San Luis Obispo, Environmental Health staff has responded to one complaint in the Project Area in three years.

Staff observed porta-potties located in proximity to field workers during numerous field reconnaissance events. Trucks equipped with trailers move the porta-potties as the workers move. Staff viewed this as evidence that in most cases, the portable toilets were used

Staff concluded that untreated human waste discharges are occurred in Nipomo Creek, Orcutt-Solomon Creek, Green Canyon, Santa Maria River, and Oso Flaco Creek watersheds. However, direct and indirect loading of human waste in agricultural areas is not widespread.

5.4.4 Discharge from Irrigated Agriculture

Many irrigated agricultural sites contribute runoff to waterbodies and/or drainage channels in the Santa Maria Watershed. Some of this water is runoff from crop irrigation

and some of it is the release of groundwater. Runoff from these sites may contain elevated levels of nutrients and fine sediments and when deposited into a channel that often has no riparian cover, these discharges may contribute to conditions for bacterial populations to increase (see Section 5.1).

Although there were instances where runoff from irrigated agriculture had concentrations of fecal indicator bacteria higher than the standard, staff could not identify a source of this fecal coliform. Because there is no controllable source organism that staff can identify from agricultural fields, staff concluded irrigated agriculture is not a source of fecal indicator bacteria contributing to exceedance of water quality objectives. However, it is possible that improvements to channelized drainage areas, including buffers and/or riparian cover, may decrease the concentration of naturalized fecal indicator bacteria populations[10]. Finally, although not identified as a significant source for this TMDL, owners of irrigated lands are responsible for surface water loading from all controllable sources of fecal indicator bacteria on their lands.

5.4.5 Potential Influence of Onsite Sewage Disposal Systems on Bacteria Concentrations

Human sources of bacteria can originate from failing onsite sewage disposal systems (septic systems) often in rural residential areas. Onsite sewage disposal systems generally provide a safe and effective means of handling domestic sewage needs in rural areas. However, many septic systems are located near water bodies where there is evidence of elevated bacteria levels and may impact uses of the water bodies. Staff evaluated whether onsite sewage disposal systems are a source in San Luis Obispo, Santa Barbara and Ventura Counties.

An important factor for an onsite sewage disposal system to function effectively is sufficient depth of unsaturated soil below the leachfield where filtering and breakdown of wastewater constituents can take place. Without adequate separation distance to the water table, groundwater becomes vulnerable to contamination with pathogenic bacteria and viruses, as well as other wastewater constituents (Cuesta Engineering Corporation, 2003).

Within the Nipomo Creek and Oso Flaco watersheds there are some rural residences not on collection systems adjacent to impaired reaches. In the Nipomo Creek watershed, there were documented physical problems with surfacing septage and other septic system failures. For example, small lot sizes, coliform and nitrate in supply wells near leachfields, and historic incidence of typhoid resulted in a prohibition zone and requirements for individual sewage disposal systems to connect to a wastewater treatment plant.

The Nipomo Community Services District operates the wastewater treatment plant that was constructed following the discharge prohibition established for the most densely developed portions of the community. Many of the individual sewage disposal systems within the prohibition zone were connected to the sewage treatment plant. Systems within the prohibition zone that are not yet connected may be contributing fecal coliform loads due to several environmental factors (e.g. close in proximity to the water body,

[10] Bacteria are often filtered out when they pass through a vegetated buffer (enter reference).

elevated groundwater without adequate separation distance to the water table, older residences/systems, higher density of homes). At the time of this FIB TMDL Report writing, 38 properties still needed to connect to the sewage treatment plant. Fourteen homes connected to the sewer between August 2007 and February 2010 (Nipomo CSD, Feb. 2010).
Sanitary surveys have not yet been completed in San Luis Obispo County, except for a few locations not in the Project Area. Staff did not personally observe failing onsite sewage disposal systems. To determine whether or not onsite sewage disposal systems were a source, staff evaluated available information as discussed below.

Staff reviewed suitability and potential of a soil type for specific uses, including septic tank absorption fields (Soil Survey, San Luis Obispo County, California Coastal Part, 1984). In the Oso Flaco area, some onsite sewage disposal systems would not function properly due to the water table and poorly drained soils. In some places, depth to groundwater is 10-20 inches (U.S. Department of Agriculture, 1984). In the Nipomo watershed, septic tank absorption fields may not function properly due to slow permeability.

Staff spoke with three business owners of septic tank pumping services in the community. According to these business owners, most onsite sewage disposal system owners did not know how to maintain their system. While they did not note any generalized problem areas, they indicated that individual systems are problematic throughout the project area.

Staff did not find evidence of specific onsite sewage disposal systems failures, but could not demonstrate that individual failures were not occurring. As such, staff could not definitively conclude that onsite sewage disposal systems failures on residences adjacent to impaired water bodies is a source of fecal coliform to the listed waterbodies within San Luis Obispo County.

Staff also could not definitely conclude that onsite sewage disposal systems failures on residences adjacent to impaired water bodies are a source of fecal coliform to the listed waterbodies within Santa Barbara County. Santa Barbara County Environmental Health Services hired Questa Engineering Corporation to conduct the Septic System Sanitary Survey of Santa Barbara County (2003). This effort was a survey and compilation of previously existing information on septic systems in the county, not a scientific study to delineate the discharge of pollutants entering ground water that flows into surface water. The survey was not intended to isolate or evaluate the functioning status or impact from individual septic systems. The purpose of this survey was to collect and consolidate pertinent data regarding onsite sewage disposal systems, assess the associated impact on public health and water quality, and develop recommendations on ways to address certain types of problems or specific problem areas. The study focused on areas that encompass the heaviest concentrations of septic systems and the areas of potentially greatest concern from a public health and water quality perspective. These included several small subdivisions (including Foxenwood Estates and Lake Marie Estates) in the Orcutt-Solomon Creek subwatershed.

The areas evaluated also provided the basis for presenting the full range of conditions and problems that need to be addressed in regard to septic system usage throughout Santa Barbara County. The Sanitary Survey included a series of recommendations to

address septic system problems in Santa Barbara County. Recommendations included various general management measures that can be implemented by the County Environmental Health Services to address certain types of problems or situations, as well as more specific measures applicable to the individual Focus Areas examined in the study. Researchers assessed data and evaluated information to identify and prioritize areas for further study of the onsite systems.

Using the data collected in the study, an overall problem assessment was made for each of the identified septic system Focus Areas, including impacts on both surface water quality and groundwater quality. According to the study, the soils in the Orcutt area were generally moderate to well drained; however, locally, permeability and septic system suitability could be restricted due to accumulation of finer-grained sediments or high water table conditions. Researchers assigned a “low” and “low/medium” rating to the Focus Areas that had many older systems and some localized problems due to restrictive (slowly permeable) subsoils within the Orcutt-Solomon Creek subwatershed, and concluded there was little or no existing or prior evidence of water quality impacts that would implicate septic systems. Orcutt Creek Sampling stations overlap/supplement Project Clean Water sampling near Foxenwood estates.

Based on the information available and discussed above, staff concluded that onsite sewage disposal systems are not a source of fecal coliform causing impairment in the listed water bodies.

5.4.6 Natural and Background Sources

Natural sources of pathogens include wildlife such as birds, rodents, squirrels, skunk, deer, and any other animals present in a watershed that produce fecal matter that may enter surface waters. Natural sources also include in-stream reproduction of bacteria, as discussed previously in Section 5.1.

Natural sources are a source of fecal coliform on each of the land uses present in the project area. Staff concluded this source contributed to fecal coliform loading in each of the listed water bodies. Natural sources, however, are uncontrollable, and staff does not propose implementation actions to reduce loading.

Staff distinguishes “natural sources” from “controllable” wildlife sources, which are those sources attracted to or influenced by human activity, such as littering or leaving trash receptacles accessible to wildlife. Staff discusses controllable wildlife sources in subsequent sections.

5.5 Influence of Permitted Facilities and Entities on Bacteria Concentrations

5.5.1 Entities Subject to Discharge Permits

5.5.1.1 Sanitary Sewer Collection Systems

Four of the sanitary sewer collection systems in the Santa Maria watershed are authorized to discharge treated municipal wastewater to land according to their waste discharge requirements. Discharge of municipal wastewater to surface water bodies is prohibited. These discharges percolate to groundwater and are filtered in the soil column. One of the sanitary sewer collection systems holds an NPDES permit and is authorizes to discharge secondarily treated effluent to Salsbury Creek, which is approximately ¾ miles away from the Cuyama River. The following entities are responsible for operating the sanitary sewer collection systems, within the Santa Maria watershed:

Waste Discharge Requirements (discharge to land)

- the City of Santa Maria
- the City of Guadalupe
- the Laguna County Sanitation District
- the Nipomo Community Services District

NPDES (discharge to a surface water)

- the Cuyama Community Services District.

Wastewater from collection systems can reach surface waters from sewer line overflows (spills) or leaks. Sanitary sewer overflows are overflows from sanitary sewer systems of domestic wastewater, as well as industrial and commercial wastewater, depending on the pattern of land uses in the area served by the sanitary sewer system. Sanitary sewer overflows typically contain high levels of pathogenic organisms.

Staff evaluated information provided by permitting staff at the Water Board, information provided by agency staff, and spill reports from each of the sanitary districts. Each of the sanitary districts has a Collection System Management Plan and Sewer System Management Plan.

Staff reviewed spills reported to CIWQS from 2001 to 2007 for each of the entities listed above. One spill was reported from the City of Guadalupe that reached the Santa Maria River. Two spills were reported from the Nipomo Community Services District that did not reach a water body; no spills were reported within the Cuyama Community Services District. Staff concluded that spills within the Cuyama Community Services District and Nipomo Community Services District were not a source of fecal indicator bacteria.

The City of Guadalupe had another spill in 2008 (2,500 gallons reached a wetland). Historical files indicate past spills may have gone unreported. For example, there are many violations for failures to provide a long-term corrective plan and schedule, and failure to submit a collection system management plan[11]. Based on the uncertainty of submitting reports, staff concluded that spills may likely go unreported as well.

Spills were reported frequently within two districts: the City of Santa Maria and the Laguna County Sanitation District. Spills within the City of Santa Maria, however, were

[11] Violations for failure to provide long-term corrective plan and schedule *only* include: 4/30/2007, 3/31/2007, 2/28/2007, 10/31/2006]
Violations for failure to submit collection system management plan *only* include: 9/30/2006
Violation for both of the above include: 1/31/2008, 12/31/2007, 11/30/2007, 10/31/2007, 7/31/2007, 6/30/2007, 5/31/2007,1/31/2007

relatively small (less than 1,500 gallons) with three that discharged to a storm drain or were contained within a Santa Barbara County flood control channel. Staff could not determine from some of the spill reports if the discharge within the storm drain was carried to surface water. However, there was potential for the spill to travel to surface water either through stormwater or other water sources. The remainder of spills within the City of Santa Maria were contained on land.

Staff also spoke with City of Santa Maria agency staff in January 2008 regarding the condition of the collection system within the city. City of Santa Maria staff described problems within the public collection system that included, but were not limited to (1) dysfunctional lines in alleys due lack of slope necessary to move effluent, (2) collection system reaches that could not be accessed via road ways, and (3) spills from a public collection system reach discharged into River Oaks Lake, a drainage basin and park located in the Northeast section of the City of Santa Maria.

Water Board staff concluded that the City of Santa Maria has made progress in addressing issues including the use of a video camera to detect collection system problems. However, collection system integrity issues remain, and must be addressed.

Water Board staff also found reports of spills from private sewer laterals within the City of Santa Maria. However, from the data reported, staff determined that none of the private sewer lateral spills were discharged to a water body.

Several spills (public spills and spills from private sewer laterals) occurred within the Laguna County Sanitation District, with one large public spill exceeding 19,000 gallons in 2007. These are identified in Table 18. Despite developing an improved maintenance program in 2007, staff concluded spills within the Laguna County Sanitation District were likely a source of fecal coliform to the impaired water bodies.

Staff also reviewed events reported to CIWQS under the statewide general order per Sanitary Sewer Overflows (SSO) search since May 2007. Spills were reported as occurring within these two districts. Spills within the Laguna County Sanitation District discharged to storm drains. To reiterate from above, there is the potential for sewage to flow or be carried to surface water once it reaches a storm drain.

Staff concluded that the effluent discharged to land from each of the wastewater treatment plants was not contributing fecal coliform; however, spills from the Laguna County Sanitation District's Collection System, City of Santa Maria Collection System and potentially unreported spills and leaks from the City of Guadalupe likely contributed to fecal coliform loading to surface waters.

Table 18. Number of spills and range of spill volume within the Laguna Sanitation District.

Year	Number of Spills	Range of Spill Volume (in gallons)	Private Sewer Lateral or Public system spill?	Was a Surface Water body Affected?*
2007	**6**	**1,500 – 19,000**	**Unclear in database; at least two were public system spills**	**All but one spill were discharged to a storm drain or retention basin.**

Year	Number of Spills	Range of Spill Volume (in gallons)	Private Sewer Lateral or Public system spill?	Was a Surface Water body Affected?*
2006	7	200- 12,000	Public and private	While some reports indicated a surface water body was not affected, others indicated spill reached a storm drain.
2005	6	200 – 1,000	Likely all public	One spill was isolated along a curb. All other spills were discharged to a storm drain.
2004	15	200 – 77,000	Public and private	One spill reached Orcutt Creek. One spill reached Orcutt Creek Basin. Six spills reached storm drains. Seven spills did not affect a water body.
2003	5	100 – 3,000	Public and private	Two spills discharged to land. One spill flowed to drainage inlet and two to storm drains.
2002	10	100 - 300	Public and private	Two spills were contained within channel cut for effluent irrigation piping and one of those spread to a broccoli field. One spill discharged to land. Three discharged to storm drains and three reports did not indicate the final destination of the spill.
2001	8	180 - 3743	Public and private	One to Orcutt Creek, one to Solomon Creek, three spill discharged to storm drain

* If a spill was carried to a storm drain, staff cannot determine if the spill continued to a surface water body or not; however, if a spill flows to a storm drain, staff determined there is potential for the spill to continue to a water body.

5.5.1.2 Permitted Facilities and Low Threat Discharges

The Water Board issues Waste Discharge Requirements (WDRs) for several facilities in the Santa Maria and Oso Flaco watersheds. Several facilities (e.g. onsite systems for schools, food processing plants, Cuyama Dairy) are permitted to discharge to land. These facilities are authorized to discharge treated wastewater to land where fecal indicator bacteria are to be filtered from the discharge in the soil column. None of the facilities discharge to surface waters. These discharges percolate to groundwater and are filtered in the soil column. Staff discussed these facilities with Water Board permitting staff and determined they were in compliance with their permit requirements and as such, staff concluded that they were not a source of fecal coliform to impaired waters in the Project Area.

Permitted discharges to surface waters also include water supply discharges, fire hydrant testing, and vegetable cooling (ice melt), none of which are likely sources of fecal coliform bacteria in the listed water bodies. These facilities are enrolled under the General NPDES Permit for Discharges with Low Threat to Water Quality, Fruit and Vegetable Processing Waste, Order No. R3-2004-0066; and fire hydrant testing or flushing; General National Pollutant Discharge Elimination System Permit for Discharges with Low Threat to Water Quality, Order No. R3-2006-0063, NPDES No. CAG 993001. Staff discussed these facilities and their permit compliance with Water Board permitting staff and concluded that they were not a source of fecal coliform to impaired waters in the Project Area.

5.5.2 Municipalities Subject to Storm Water Permits

Storm drain discharges transfer fecal coliform to surface waterbodies. Lateral pipes that connect private properties to a sanitary sewer collection system (discussed previously in Section 5.5.1) can leak. Sewage can be transferred to stormdrains and surface water through sewer laterals leaking onto a sidewalk or into a gutter. The discharge can either be carried via stormwater in the wet season or through other water sources in the dry season.

Discharges also contain urban runoff that has the potential to contain animal waste. Pet waste enters waterways through conveyance by stormwater from the location where it is deposited, including trails frequented by people hiking with their pets (e.g. along the Santa Maria River levee), stray or feral animals, and residences adjacent to waterways.

Urban runoff may also contain bird, rodent, and other wildlife waste. Dumpster leachate can also contain animal and human waste (e.g. diapers). Staff considers these sources controllable to some extent. Wildlife frequent locations such as dumpsters and trash receptacles in urban, rural and littered areas (such as along Creeks) as feeding sites. Wildlife waste may travel to storm drains or surface waters when storms occur or when other forms of urban runoff are present, such as car washing or irrigation. Furthermore, in other watersheds, such as the Soquel Lagoon Watershed, microbial source tracking data suggests that rodents and other wildlife contribute fecal coliform to surface waters in areas of urban land use (Central Coast Regional Water Quality Control Board, 2006).

As discussed previously in Section 4.3.2 Water Board TMDL monitoring, staff conducted additional water column grab samples for total coliform and *E. coli*. A primary objective of the monitoring was to evaluate relative bacterial contributions from urban stormwater. Staff determined that urban runoff samples taken downstream of urban areas had higher levels of *E. coli* than those upstream of urban areas and any other sites sampled.

The City of Santa Maria has stormwater discharges that are currently regulated with NPDES municipal stormwater permits. The City has a recent Storm Water Management Plan (January 2009) and conducts regular monitoring. See Appendix A for these data.

Water Board staff used the WTM spreadsheet, as mentioned in section 5.3, to obtain estimates of the amount of fecal coliform produced in an urban area. Staff concluded that there were six drainage areas that encompassed a portion of Santa Maria City. Those areas were: Blosser Street, Main Street, Green Canyon, Betteravia Area, Bradley Channel and the Santa Maria River (lower east side). Staff assumed an area-weighted impervious cover of 26.8% for the City of Santa Maria's urban areas (see draft TMDL for Fecal Coliform in Lower Salinas River, March 2010 for an in-depth discussion on this method). Essentially, staff used an average concentration of bacteria (obtained by averaging storm water samples within the City of Santa Maria), a percentage of impervious surface and an annual rainfall number in order to come up with an estimated average annual fecal coliform available for potential discharge.

There are homeless persons within the City of Santa Maria. According to a report (Continuum of Care, January 2009) written by Santa Barbara County, an estimated 750 people are homeless in the City of Santa Maria. Staff did not include the Orcutt, Nipomo or Guadalupe area as having a homeless population because based on conversations with individuals who work in the area, there are not many - if any - homeless persons in these areas. Staff did not observe homeless encampments or activities during reconnaissance visits to the area. In order to calculate an estimate of the contribution from homeless persons in the area, staff took the total number of homeless (750) and assumed an equal distribution throughout the urban watersheds of Santa Maria including Betteravia Area, Blosser Street, Bradley Channel, Green Canyon, Main Street, and Santa Maria River. Staff took these numbers, multiplied them by a delivery potential of 0.1% and came up with an annual total fecal coliform number available for potential discharge[12]. Staff assumed a low-end delivery potential because presumably some of the homeless population uses sanitary facilities.

While the likely magnitude of annual loads from this source appear to be very small compared to other fecal coliform sources identified in this Section, staff concluded that the relatively higher pathogenic risk associated with untreated human waste merited including unsheltered homeless as a source within the urban stormwater section within the City of Santa Maria.

Certain activities take place within the City limits, but are not under the City's jurisdiction. Examples include the circus and fairs, both of which contain animals that may contribute FIB loading into the City's stormwater system. There are also larger animals including llamas and horses that may reside in private citizen's backyards. Water Board staff will address these issues in the Implementation and Monitoring Plan.

Additionally, staff acknowledges that the urban stormwater within the City of Santa Maria and that exiting the City is often a mix of agricultural runoff as well as urban stormwater. Staff has worked with and will continue to work with City staff, the County of Santa Barbara and with the growers to help better understand the drainage in the area during the implementation phase of the TMDL.

Based on information discussed above, staff concluded that stormwater was contributing to impairment due to fecal coliform in the project area.

5.6 Source Analysis Summary

Table 19 shows the summary of identified sources of indicator bacteria in the Project Area. Staff listed the sources by source category and the estimated proportional magnitude of FIB loads by watershed in Table 20. The estimates are based on the amount of fecal indicator bacteria that are available to potentially be discharged to surface waters from various sources.

The estimated magnitude of identified sources varies by watershed, as graphically shown in Appendix D - Annual FIB Contribution and in Table 20. As noted previously, there are

[12] Example calculation: 125 persons/subwatershed * 7.30E+11 fecal coliform produced/person/year * 0.1% delivery potential = 9.13E+10 total fecal coliform available for potential discharge on a subwatershed basis.

uncertainties associated with such estimates. The estimated population and/or densities of fecal coliform sources are approximations based on census data, scientific literature, or indirect evidence. The delivery potentials of fecal coliform used from section 5.3 are approximations, derived from literature values for loading rates or best professional judgment. The amount of fecal material delivered from any one source will vary depending on numerous factors. Because of this uncertainty, these are estimates only as the actual loading from each source is unknown. That said, however, in making these estimates staff employed methods and techniques that are recognized by USEPA or other agencies to develop approved TMDLs.

It is important to note that sources were identified in each individual subwatershed in an effort to ascertain the controllable sources occurring within that particular drainage. However, this does not preclude potential loading to a particular subwatershed, from upgradient sources outside the subwatershed's drainage boundaries. For example, there are no domestic animals mentioned in Blosser St. subwatershed, however, this area does receive upstream drainage from both Bradlely Channel and Bradley Canyon, which both have a domestic animal component. Also, Betteravia Area does not contain a listed water body within its subwatershed, but does drain into a subwatershed with an impaired water body.

Staff did not assess the impact of loads from these upgradient sources because observed bacteria loads (water quality monitoring data) are typically only representative of the baseline conditions of a relatively small portion of drainage catchments upstream of the monitoring site. Simply put, observed FIB data is representative of conditions in the proximity of a sampling station (i.e., at the subwatershed scale). This is because bacteria flowing from the upper reaches of a large watershed (on the scale of hundreds of square miles) may have little impact on the water body downstream, due to die off and attenuation. When transport time frames of more than a few days are involved, die off make linkage of sources and concentrations difficult. Staff did not have sufficient flow velocity, travel time, attenuation, and die off information to evaluate the water quality impact of upstream source loads coming from outside the individual subwatershed drainages.

Finally, it is important to emphasize that the estimated relative magnitude of potential source contributions is calculated on an annualized basis. These represent annual loads from the entire watershed drainage. Loads that appear to be of a nominally small magnitude on an annualized basis (e.g., homeless) could be more consequential on different temporal scales or localized conditions. Additionally, spills/leaks from collection systems/waste water treatment plant are not included in these graphs because these contributions are episodic in nature and may occur twice one year and then not at all the next.

Staff concluded that the following sources and source categories contributed to impairment of the listed water bodies based on the data presented. Table 19 shows sources associated with the various land uses considered in the analysis. These are not listed in order on the whole because each subwatershed had a different make-up of what the largest contribution of fecal coliform was. See Appendix D - Annual FIB Contribution for a graphical display of these sources and Table 20 for a numeric justification.

Table 19. Sources of fecal indicator bacteria to Santa Maria and Oso Flaco Watersheds.

Source Category	Source Organisms	Land Use Category
Urban (stormwater)	Dogs, cats, human	Urban
Domestic Animals (Cattle, Livestock and Farm Animals)	Examples include: cattle, horses, pigs, goats, sheep, dogs, cats, and chickens	Rangeland; Rural Residential
Spills and Leaks from Sewage Collection System	Human	Urban
Human waste (lack of sanitary facility use)	Human	All
Controllable wildlife (dumpsters and litter)	Examples include: Birds, rodents.	Urban
Natural	Examples include: wild pigs, skunk, opossum, birds (including fowl), and deer.	All

Table 20. Summary table of estimated annual fecal coliform from all sources available for potential runoff or discharge into surface waters (MPN/year).

Listed Water Bodies	Urban Stormwater	OSDS	WWTP collection systems[1]	Runoff-Domestic Animal Waste	Background Runoff	Domestic Animals In-stream	Wildlife In-stream	Homeless Persons	Naturalized bacteria[2]	Total
Alamo Creek	0	0	0	2.15E+14	5.04E+12	2.93E+14	1.31E+13	0	unknown	5.27E+14
Blosser Channel	2.49E+13	0	potential	0	3.72E+11	0	6.65E+12	9.13E+10	unknown	3.20E+13
Bradley Canyon Creek	0	0	0	1.04E+13	1.62E+12	1.49E+13	1.24E+13	0	unknown	3.93E+13
Bradley Channel	2.19E+13	0	potential	4.00E+12	2.74E+12	5.40E+12	2.02E+13	9.13E+10	unknown	5.44E+13
Cuyama River (above Twitchell Reservoir)	0	0	0	1.33E+15	7.33E+13	1.87E+15	2.06E+14	0	unknown	3.48E+15
Greene Valley Creek	4.26E+13	0	potential	8.96E+12	5.90E+12	1.21E+13	4.30E+13	9.13E+10	unknown	1.13E+14
Huasna River	0	0	0	2.28E+14	1.13E+13	3.10E+14	2.08E+13	0	unknown	5.70E+14
La Brea Creek	Included as part of the Sisquoc River subwatershed									
Little Oso Flaco Creek	Included as part of Oso Flaco subwatershed									
Main Street Canal	1.54E+13	0	potential	4.45E+11	1.61E+12	4.41E+11	1.19E+13	9.13E+10	unknown	2.99E+13
Nipomo Creek	2.04E+13	0	0	3.66E+13	2.54E+12	4.80E+13	1.93E+13	0	unknown	1.27E+14
Orcutt-Solomon Creek	4.02E+13	0	potential	3.66E+13	3.62E+12	5.28E+13	2.56E+13	0	unknown	1.59E+14
Oso Flaco Creek	0	0	0	9.80E+12	1.92E+13	1.00E+13	2.45E+14	0	unknown	2.84E+14
Oso Flaco Lake	Included as part of the Oso Flaco subwatershed									
Santa Maria Estuary	Included as part of the Santa Maria River subwatershed									
Santa Maria River	3.52E+13	0	potential	5.86E+13	9.22E+12	8.05E+13	5.50E+13	9.13E+10	unknown	2.39E+14
Sisquoc River	0	0	0	5.19E+14	4.29E+13	7.53E+14	8.68E+13	0	unknown	1.40E+15
TOTAL	2.006E+14	0	0	2.5E+15	1.794E+14	3.45E+15	7.66E+14	4.57E+11	0	7.05E+15
% OF TOTAL	3%	0%	0%	35%	3%	49%	11%	0%	0%	100%

1 - MPN/year not given in this column because discharges are episodic in nature and therefore difficult to accurately measure on a yearly basis.

2 - MPN/year not given in this column because the numeric measurement of how this area would contribute is not quantifiable at this point.

For a graphical display of this information, please see the pie charts in Appendix E - Load Duration Curves.

6 CRITICAL CONDITIONS AND SEASONAL VARIATION

Critical conditions occur when the prescribed load allocation results in achieving the water quality standard by a narrow margin. The condition is considered critical because any unknown factor regarding environmental conditions or the calculation of the load allocation could result in not achieving the water quality standard. Therefore, critical conditions are particularly important with load-based allocations and TMDLs. However, this TMDL is a concentration-based TMDL. As such, the numeric targets and allocations *are the* concentrations equal to the water quality objectives. Therefore, there exists no uncertainty as to whether the allocations and TMDLs will result in achieving water quality objectives.

Although uncertainties are accounted for in the concentration-based TMDL approach, it is nevertheless important to identify what some of the uncertainties are.

The ability to definitively differentiate the origin of the sources from each land use type and from the uncontrollable sources is the chief uncertainty in the TMDLs. Furthermore, there is uncertainty regarding the amount and relative contribution of bacterial loading from sources originating from certain land uses, particularly from rural residential areas and irrigated agriculture. Continued monitoring of discharges and receiving waters will provide valued information during the implementation phase of the TMDL.

Staff determined that there was a pattern of seasonal variation based on review of the exceedance monitoring data. While exceedances were found at all sites year-round, some sites were more variable and elevated during the dry season[13], some sites during the wet season[14], while others year-round.

The following waterbodies had higher fecal coliform levels during the dry season than the wet season:

- Santa Maria River,
- Santa Maria Estuary,
- Huasna River,
- La Brea Creek,
- Sisquoc River (for *E. coli*),
- Oso Flaco Creek and the unnamed tributary, and
- Little Oso Flaco Creek.

The following water body had higher fecal coliform levels during the wet season than the dry season:

[13] The “dry season” is defined as April 1 - October 31.
[14] The “wet season” is defined as November 1 - March 31.

- Alamo Creek.

The following waterbodies had high fecal coliform levels measured in both wet and dry seasons:

- Orcutt-Solomon Creek,
- Nipomo Creek,
- Bradley Channel,
- Blosser Channel,
- Greene Valley
- Main Street Canal, and
- Cuyama River.

The following water body had high total coliform levels year-round:

- Santa Maria Estuary.

Staff concluded fecal coliform (or *E. coli*) standards were exceeded year-round, even though some sites exhibited more seasonal trends. Consequently, allocations and future implementation actions need to be assigned year-round to resolve impairment, rather than seasonally.

7 NUMERIC TARGETS

The Basin Plan contains fecal coliform and total coliform water quality objectives. These water quality objectives are in place to protect the water contact recreational beneficial use and the shellfishing beneficial use.

The numeric target used to develop the TMDLs and allocations for the Santa Maria Watershed is:

> *Fecal coliform concentration, based on a minimum of not less than five samples for any 30-day period, shall not exceed a log mean of 200 MPN per 100 mL, nor shall more than 10 percent of samples collected during any 30-day period exceed 400 MPN per 100 mL.*

The numeric target used to develop the TMDL and alloctions for the Santa Maria River Estuary is:

> *At all areas where shellfish may be harvested for human consumption, the median total coliform concentration throughout the water column for any 30-day period shall not exceed 70/100mL, nor shall more than ten percent of the samples collected during any 30-day period exceed 230/100mL for a five-tube decimal dilution test or 330/100 mL when a three-tube decimal dilution test is used.*

8 LINKAGE ANALYSIS

The goal of the linkage analysis is to establish a link between pollutant loads and water quality. This, in turn, supports that the loading capacity specified in these TMDLs will result in attaining the numeric targets. For these TMDLs, this link is established because the allocations (allowed pollutant load, expressed as a concentration) *are* the numeric target concentrations, which *are* the same as the TMDLs.

Hence, the link is established as the expressed allowed pollutant loads are the water quality standards.

9 TMDL CALCULATION AND ALLOCATIONS

A Total Maximum Daily Load (TMDL) is the amount of a pollutant that a water body can receive while still achieving water quality standards. TMDLs can be expressed as loads (mass of pollutant calculated from concentration multiplied by the volumetric flow rate), or as a concentration. TMDLs can be expressed in terms of either mass per time, toxicity or other appropriate measure [40 CFR §130.2(I)]. Concentration-based TMDLs are logical for this TMDL because the public health risks associated with recreating in contaminated waters is measured with organism concentration, and pathogens are not readily controlled on a mass basis. Therefore, staff proposes establishing concentration-based TMDLs for total and fecal coliform in the impaired water bodies in accordance with the Clean Water Act.

9.1 TMDLs and Allocations

TMDLs

The TMDLs are the same set of concentrations as were proposed in the numeric targets section for total and fecal coliform. The TMDLs are set at a concentration equal to the water quality standard concentrations. Staff concluded that these concentrations of total and fecal coliform represent the maximum loads that can be discharged to these waterbodies and still meet water quality standards.

The TMDLs for the listed water bodies are:

> *Fecal coliform concentration, based on a minimum of not less than five samples for any 30-day period, shall not exceed a log mean of 200 per 100 mL, nor shall more than 10 percent of samples collected during any 30-day period exceed 400 per 100 mL.*

The Santa Maria Estuary has an *additional* TMDL as follows:

> *At all areas where shellfish may be harvested for human consumption, the median total coliform concentration throughout the water column for any 30-day period shall not exceed 70/100 ml, nor shall more than ten percent of the samples collected during any 30-day period exceed 230/100 ml for a five-tube decimal dilution test or 330/100 ml when a three-tube decimal dilution test is used.*

ALLOCATIONS

Staff assigned allocations for fecal coliform to responsible parties discharging to upstream receiving waters (shown in Table 21).

The allocation to background (including natural sources from birds) is also the receiving water fecal and total coliform concentration equal to the TMDL. The parties responsible for the allocation to controllable sources are not responsible for the allocation to natural sources.

Should all control measures be in place and total and fecal coliform levels in the impaired reaches of the watershed and total coliform levels in the estuary remain high, staff may investigate or require investigations (e.g., genetic studies to isolate sources or other appropriate monitoring) to determine if the high level of fecal and/or total coliform is due to uncontrollable sources or other controllable sources not previously identified. Responsible parties may demonstrate that controllable sources of fecal and/or total coliform are not contributing to exceedance of water quality objectives in receiving waters. If this is the case, staff may consider re-evaluating the targets and allocations. For example, staff may propose a site-specific objective to be approved by the Central Coast Water Board. The site-specific objective may be based on evidence that natural, or background sources alone are the cause of exceedances of a TMDL.

The TMDLs are considered achieved when the numeric targets are consistently met.
Permitted discharges to surface waters such as water supply discharges, fire hydrant testing, and vegetable cooling (ice melt) were meeting allocations because these sources were discharging at levels meeting water quality objectives (fecal coliform numeric targets). These dischargers are enrolled under the General NPDES Permit for Discharges with Low Threat to Water Quality:

- Fire hydrant testing or flushing; Order No. R3-2006-0063, NPDES No. CAG 993001
- Fruit and Vegetable Processing Waste, Order No. R3-2004-0066

Table 21. Allocations to responsible parties.

WASTE LOAD ALLOCATIONS		
Water body	**Responsible Party and Source NPDES/WDR number**	**Receiving Water Allocation**
Santa Maria River[17], Main Street Canal[10], Blosser Channel[2], Bradley Channel[3], Greene Valley Creek[6]	City of Santa Maria Urban Runoff Storm Water General Permit NPDES No. CAS000004	Allocation-1
Nipomo Creek[11]	County of San Luis Obispo Urban Runoff Storm Water General Permit NPDES No. CAS000004	Allocation-1
Orcutt-Solomon[12]	County of Santa Barbara Urban Runoff Storm Water General Permit NPDES No. CAS000004	Allocation-1
Santa Maria River[18]	City of Guadalupe Urban Runoff Storm Water General Permit (Pending)	Allocation-1
Blosser Channel[2], Bradley Channel[3], Greene Valley Creek[6], Main Street[10] and Santa Maria River[17]	City of Santa Maria Collection System Statewide General WDR for Sanitary Sewer Systems WQO No. 2006-0003	Allocation-2
Orcutt-Solomon[12]	Laguna County Sanitation District Collection System Statewide General WDR for Sanitary Sewer Systems WQO No. 2006-0003	Allocation-2
Santa Maria River[18]	City of Guadalupe Collection System Statewide General WDR for Sanitary Sewer Systems WQO No. 2006-0003	Allocation-2

LOAD ALLOCATIONS		
Water Body	**Responsible Party and Source**	**Receiving Water Allocation**
Santa Maria River Estuary[15]	Owners/Operators of land used for/containing domestic animals/livestock Domestic animals/livestock waste not draining to MS4s	Allocation-3
All 17 impaired water bodies[a]	Owners/Operators of land used for/containing domestic animals/livestock Domestic animals/livestock waste not draining to MS4s	Allocation-1
All 17 impaired water bodies[a]	Owners/Operators of properties with human waste discharges due to improper facility use Human waste	Allocation-2
Blosser Channel[2], Bradley Channel[3], Greene Valley Creek[6], Main Street[10] and Santa Maria River[16]	Owners/Operators of land where homeless reside Human waste	Allocation-2
All 17 impaired water bodies[a]	No responsible party Natural and Background Sources	Allocation-1
Allocation-1 = Fecal coliform concentration, based on a minimum of not less than five samples for any 30-day period, shall not exceed a log mean of 200 MPN/100mL, nor shall more than ten percent of total samples during any 30-day period exceed 400MPN/100 mL. Allocation-2 = Fecal coliform concentration shall not exceed zero; no fecal coliform bacteria load originating from human sources of fecal material is allowed. Allocation-3 = Total coliform concentration, the median throughout the water column for any 30-day period shall not exceed 70MPN/100 ml, nor shall more than ten percent of the samples collected during any 30-day period exceed 230MPN/100 ml for a five-tube decimal dilution test or 330MPN/100 ml when a three-tube decimal dilution test is used.		

[a] All 17 impaired water bodies includes the water bodies listed below:

[1]Alamo Creek: all reaches of Alamo Creek
[2]Blosser Channel: all reaches of Blosser Channel
[3]Bradley Channel: all reaches of Bradley Channel
[4]Bradley Canyon Creek: all reaches of Bradley Canyon Creek
[5]Cuyama River: Cuyama River upstream of Twitchell reservoir up to sampling station 312CAV (Cuyama River at Hwy 33)
[6]Greene Valley Creek: all reaches of Greene Valley Creek
[7]Huasna River: all reaches of Huasna River
[8]La Brea Creek: all reaches of La Brea Creek
[9]Little Oso Flaco Creek: all reaches of Little Oso Flaco Creek
[10]Main Street Canal: all reaches of Main Street Canal
[11]Nipomo Creek: all reaches of Nipomo Creek
[12]Orcutt-Solomon Creek: all reaches of Orcutt-Solomon Creek
[13]Oso Flaco Creek: all reaches of Oso Flaco Creek, including an unnamed tributary to Oso Flaco Creek at sampling station 312BSR at Bonita School Road)
[14]Oso Flaco Lake: Oso Flaco Lake
[15]Santa Maria Estuary: all reaches of the Santa Maria Estuary

[16]Santa Maria River: all reaches of the Santa Maria River
[17]Santa Maria River: all reaches that drain the City of Santa Maria
[18]Santa Maria River: all reaches that drain the City of Guadalupe
[19]Sisquoc River: all reaches of the Sisquoc River

9.2 Margin of Safety

The TMDL requires a margin of safety component that accounts for the uncertainty about the relationship between the pollutant loads and the quality of the receiving water (CWA 303(d)(1)(C)). For this project, a margin of safety has been established implicitly through the use of protective numeric targets, which are, in this case, the water quality objectives for water contact recreational and shellfish harvesting beneficial uses.

The total and fecal coliform TMDLs for the water bodies in this project are the Water Board's Basin Plan objectives. The Basin Plan states that, "controllable water quality shall conform to the water quality objectives..." When other conditions cause degradation of water quality beyond the levels or limits established as water quality objectives, controllable conditions shall not cause further degradation of water quality" (Basin Plan, p. III-2). Because the allocation for controllable sources is set at the numeric targets, if achieved, these allocations will achieve the water quality objectives in the receiving water. Thus, in this TMDL there is no uncertainty that controlling the load from controlled sources will positively affect water quality by reducing the fecal indicator indicator bacteria contribution.

However, in certain locations there is a possibility that non-controllable, or, natural sources will themselves occur at levels exceeding water quality objectives. And while it is controllable water quality conditions ("actions or circumstances resulting from man's activities" (Basin Plan, p. III-2)) that must conform to water quality objectives, receiving water quality will contain discharge from both controllable and natural sources.

Reporting and monitoring will indicate whether the allocations from controllable sources are met, thereby minimizing any uncertainty about the impacts of loads on the water quality.

10 LOAD DURATION CURVES

The TMDLs and allocations for this project are concentration based (see Section 9). However, in order to get a more thorough picture of <u>what</u> sources may be contributing to exceedances and <u>when</u> the exceedances are occurring (e.g. high, moderate or low flows), staff calculated load duration curves. (See Appendix E for more information on staff's development of load duration curves and the load duration curves themselves.) These load duration curves will be useful for helping to inform the Implementation and Monitoring Plan.

Staff used the load duration curves, the Bacteria Source Load Calculator (BLSC), Watershed Treatment Model (WTM) along with an assumed potential relationship between the load duration curves to gain a better understanding of what sources of fecal coliform were potentially contributing to exceedances and when in each subwatershed.

11 PUBLIC PARTICIPATION

Staff's goals of stakeholder involvement in the Santa Maria and Oso Flaco watersheds were for stakeholders to learn about existing implementation efforts and available information (e.g. water quality data), to communicate TMDL project status, to coordinate additional data collection, and to gain support for the potential implementation strategies and to develop additional monitoring activities, thus improving water quality and measuring improvements.

The primary framework for stakeholder involvement to date has been email and phone correspondence, staff participation in an existing group's meetings (e.g. a farm water quality short-course) and focused meetings to request specific information (e.g. water quality data) or to answer specific questions (e.g. regarding implementation approaches).

Staff has attended and presented information at several meetings in the Santa Maria Watershed Project Area. In September 2003, Water Board staff provided an update of TMDL initiation at a farm water quality short course. In March 2005, Water Board staff held a meeting to request cooperation from landowners to monitoring individual discharges, and to provide an update on the TMDLs. In August 2006, Water Board staff participated in an Agricultural Coalition Workshop. In December 2006, Water Board staff held a CEQA scoping meeting and Public Workshop to gather information and to provide an update on the TMDLs. In January 2006, Water Board staff presented information related to grazing lands and regulatory options for ranchers.

In June 2006, Water Board staff requested review and comments from the public on a preliminary FIB TMDL Report. Staff specifically asked whether the data analyses for the TMDL components included all available data and information, supported the conclusions drawn, and questioned whether there was input and ideas on implementation strategies. Staff incorporated these comments into this FIB TMDL Technical Report. Staff also incorporated comments on the project received in December 2006 and February 2007 as part of CEQA scoping into this FIB TMDL Technical Report.

Staff submitted the FIB TMDL Technical Report to scientific peer review in June 2008. Staff conducted an additional CEQA scoping meeting in October 2008 regarding environmental impacts of actions to protect the Santa Maria Estuary and the shellfish harvesting beneficial use.

In February 2010, staff conducted a stakeholder outreach meeting to inform stakeholders of the watershed approach we will be taking with all the listings in the Santa Maria Watershed. The outreach meeting was also an opportunity for the stakeholders to ask questions and provide feedback on the process.

In April, May and June 2010, staff met with the City of Santa Maria, the County of Santa Barbara (both Flood Control and Project Cleanwater) and a grower in order to properly delineate drainage areas within the Santa Maria Watershed.

Staff plans to circulate a copy of the FIB TMDL Technical Report in early August 2010 and hold another stakeholder outreach meeting in late August 2010.

12 REFERENCES

RECHECK ALL REFERENCES HERE WITH THOSE CITED

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