

Appendix E - Development of Load Duration Curves

1 Load Duration Curves

1.1 *Technical Approach and Methods*

The TMDL for this FIB TMDL Report is expressed as a concentration. However, based on USEPA guidance, we are also providing daily load expressions to supplement our concentration-based TMDLs and allocations. USEPA (2007) recommends that all TMDLs and associated load allocations (LAs) and wasteload allocations (WLAs) include a daily time increment in conjunction with other temporal or concentration-based expressions.

Staff used a load duration curve analysis approach to estimate existing loads and assimilative capacity for fecal coliform in the impaired stream segments in the project area. Load duration curves also allow for the calculation of flow-based daily load expressions. The load duration curve approach involves calculating the allowable loadings over the range of flow conditions expected to occur in the impaired stream by taking the following steps:

1. Develop Flow Records for Key Water Quality Monitoring Stations. A flow duration curve for the impaired segment (or subsegments) is developed using the available flow data. This is done by generating a flow frequency record consisting of ranking all of the observed flows from the least observed flow to the greatest observed flow and plotting those points. Direct flow measurements are not available for all of the water quality monitoring stations addressed in this FIB TMDL Report. This information, however, is important to understanding the relationship between water quality and stream flow. Therefore, to characterize flow in some cases, synthetic flow records were derived from commonly used flow estimation methods. Flow data to support development of flow duration curves were derived for key water quality monitoring sites from USGS daily flow records generally in the following priority; however, the final methodology is subject to best professional judgment:

- i) In cases where a USGS flow gage coincides with, or occurs within one-half mile upstream or downstream of a water quality monitoring station and simultaneous daily flow data matching the water quality sample dates are available, these flow measurements will be used. If flow measurements at a USGS flow gage are missing for some dates on which water quality samples were collected, gaps in the flow record will be filled, or the record extended, by estimating flow based on measured stream flows at a nearby gage. First, the most appropriate nearby stream gage is identified. The station with the strongest flow relationship, as indicated by the highest correlation coefficient (R), or based on similar land use and hydrologic factors, is selected as the index gage. Data from the flow gage with the partial flow record is then compared to the flow record from the index gage using regression analysis. The regression equation is then used to estimate flow at the gage to be filled/extended from flows at the index station. Flows will not be estimated based on regressions with r-squared values less than 0.25, even if that is the best regression. This value was selected based on technical guidance for using regression analysis in estimating flows (USEPA 2007, and

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State of South Carolina DHEC, 2005). R-squared indicates the fraction of the variance in flow explained by the regression.

- ii) In cases where no USGS flow gage data is located within one-half mile upstream or downstream of a monitoring site, but instantaneous flow data is available at the monitoring site, mean daily discharge will be estimated by regressing the instantaneous flow measurements against mean daily values from the most appropriate nearby USGS flow gage. Flows will not be estimated based on regressions with r-squared values less than 0.25, even if that is the best regression.
- iii) In cases where no USGS flow gage data is available within one half mile upstream or downstream of a monitoring site, and no instantaneous flow data are available, but a USGS flow gage is located within the same stream reach (upstream or downstream) of the monitoring site, the Drainage Area Ratio method will be used to estimate mean daily flow at the ungaged site using the USGS flow data that is located along the same stream reach.
- iv) In drainages where there is no USGS flow gage or instantaneous flow data, mean daily flows will be estimated with the modified SWRCB proration drainage area method, using the mean daily flows from the most appropriate USGS flow gage record from a nearby drainage. The modified SWRCB proration drainage area method accounts for spatial variability in precipitation and runoff characteristics that might be expected between different drainages.
- v) For monitoring sites in drainages where there is no USGS flow gage or instantaneous flow data, but a synthetic flow record has been created for a monitoring site within the same stream reach upstream or downstream of the ungaged site, flow statistics will be transferred to the ungaged site from the site with the synthetic flow record by using the Drainage Area Ratio method.

2. Develop Flow Duration Curves. Flow duration curves are graphical representations of the flow regime of a stream at a given site. Flow duration curves serve as the foundation for developing load duration curves. Flow duration curves are a type of cumulative distribution function. The flow duration curve represents the fraction of flow observations that exceed a given flow at the site of interest. The observed flow values are first ranked from highest to lowest, then, for each observation, the percentage of observations exceeding that flow is calculated. The lowest measured flow occurs at an exceedance frequency of 100 percent, indicating that flow has equaled or exceeded this value 100 percent of the time, while the highest measured flow is found at an exceedance frequency of 0 percent. The median flow occurs at a flow exceedance frequency of 50 percent. Flow duration curves can be subjectively divided into several hydrologic flow regime classes. These hydrologic classes facilitate the analytical uses of load duration curves, in terms of water quality response to flow and to pollutant loading conditions.

3. Develop Load Duration Curves. Load duration curves are based on flow duration curves. Load duration curves display the allowable loading capacity (based on the relevant water quality criterion) across the continuum of flow percentiles and also display historical pollutant load observations at the monitoring site. In lieu of flow, the y-axis is expressed in terms of a fecal coliform load (MPN/day). For this FIB TMDL Report, the curve represents the instantaneous sample water quality criterion for fecal coliform (400 MPN/100 ml) expressed in terms of a load

curve by multiplying each flow from the ranked flow record by the applicable water quality criterion and a conversion factor and plotting the resulting points.

4. Plot Observed Loads. Each pollutant data point from observed data is converted to a daily load by multiplying the concentration by the corresponding average daily flow on the day the sample was taken. The load is then plotted on the load duration curve graph. Points plotting above the curve represent exceedances of the water quality objective (i.e., the allowable load, or total maximum daily load). Those plotting below the curve represent compliance with water quality objective and therefore represent compliance with the maximum daily loads.

5. Use Load Duration Curve to Develop Daily Load Expressions. The load duration curve itself can be established as the TMDL. The TMDL would be dynamic and based on flow. Essentially, the loading capacity is the load corresponding to the flow selected along the curve. Alternatively, a static TMDL can be established based on the area beneath the TMDL curve, representing the loading capacity of the stream. The difference between this area and the area representing current loading conditions is the load that must be reduced to meet water quality standards. As noted previously, staff are establishing concentration based TMDLs in accordance with 40 CFR 122.45(f) of the Clean Water Act. However, USEPA recommends supplementing a concentration-based TMDL with a daily load expression, as indicated below:

“For TMDLs that are expressed as a concentration of a pollutant, a possible approach would be to use a table and/or graph to express the TMDL as daily loads for a range of possible daily stream flows. The in-stream water quality criterion multiplied by daily stream flow and the appropriate conversion factor would translate the applicable criterion into a daily target.”*

-- USEPA, 2007 “Options for Expressing Daily Loads in TMDLs”,
 Office of Wetlands, Oceans and Watersheds, June 22, 2007.

* emphasis added

1.2 Development of Flow Duration Curves

See Appendix SMW-2.

1.3 Load Duration Curves

A load duration curve is the allowable loading capacity of a pollutant, as a function of flow. The flow duration curve is transformed into a load duration curve by multiplying the flow by the water quality objective and a conversion factor. The water quality objective that staff selected to calculate the load duration curve was the instantaneous fecal coliform Basin Plan criterion 400 MPN/100 mL. The load duration curve is thus calculated by multiplying the flow at the given flow exceedance percentile, by the instantaneous fecal coliform criteria and unit conversion factors; therefore the loading capacity is:

Water Quality Criterion	Flow	Unit Conversion Factors
↓	↓	⎵

$$\text{Loading Capacity (MPN/day)} = 400 \text{ MPN/100mL} * Q \text{ (cfs)} * 283.2 \text{ 100mL/ft}^3 * 86400 \text{ sec/day}$$

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The load duration method essentially uses an entire stream flow record to provide insight into the flow conditions under which exceedances of the water quality objective occur. Exceedances that occur under low flow conditions are generally attributed to loads delivered directly to the stream such as straight pipes, domestic animals or wildlife with access to the stream, or some other form of direct discharge. Exceedances that occur under high flow conditions are typically attributed to loads that are delivered to the stream in stormwater runoff. Exceedances occurring under during normal flows can be attributed to a combination of runoff and direct deposits.

The load duration curve is derived from the flow duration curves and water quality monitoring data, as outlined in Section 1.1. Points plotting above the curve represent loads deviating from the water quality objective (the allowable load). Those plotting below the curve represent compliance with standards and represent loads below the maximum loading capacity. A generic example of a fecal coliform load duration curve is shown in Figure 1. Points above the curve on the left side of the figure are indicative of fecal coliform exceedances during wet weather conditions (higher flows) and when data points plot above the curve to the right side it indicates fecal coliform exceedances during dry weather conditions (lower flows).

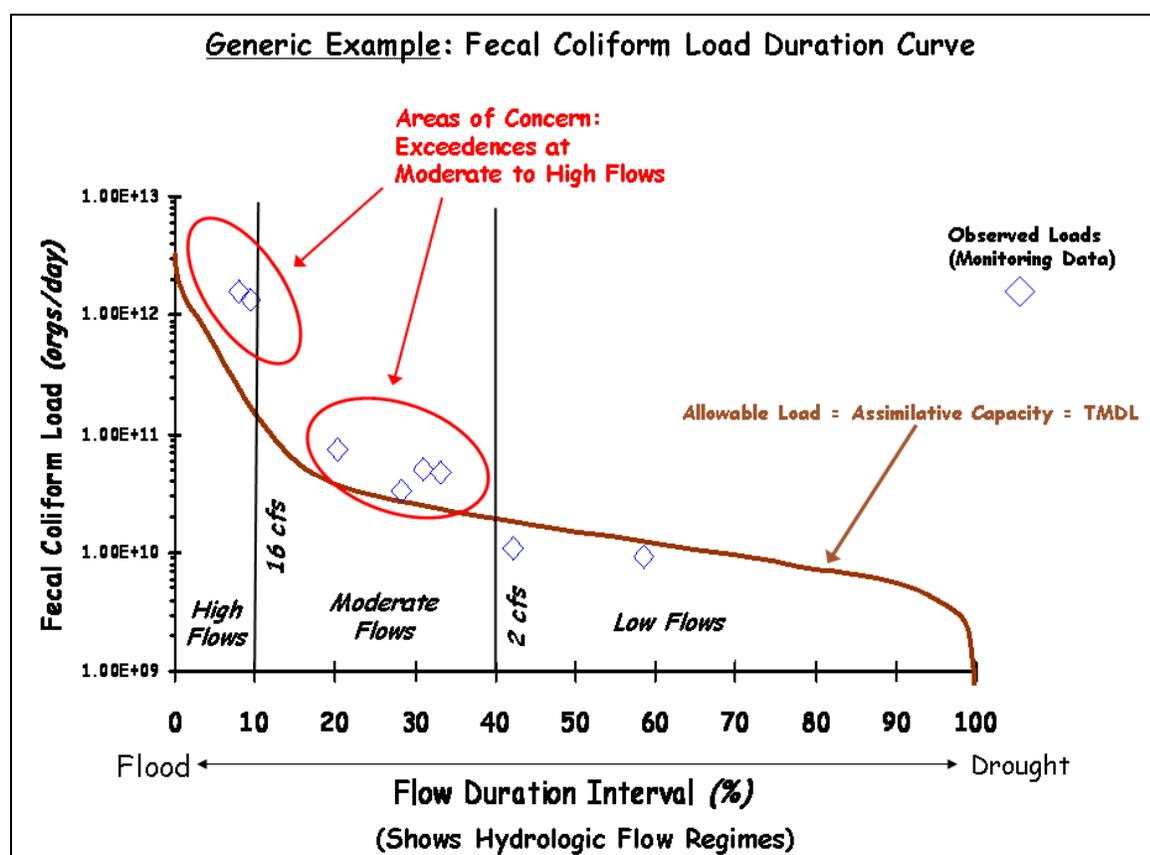


Figure 1: Generic example of fecal coliform load duration curve.

A load duration curve (LDC) considers how flow conditions relate to a variety of pollutant sources, and therefore load duration curves can be useful in differentiating between loading from point and nonpoint sources (see Table 1). For example, in the generic LDC example in Figure 1, excursions above the water quality objective at high to moderate flows appear to suggest that non-point sources and stormwater flows are potential sources.

Table 1. Potential relationship between load duration curve and contributing sources

Contributing Source	Flow Regime-Load Duration Curve		
	High Flow	Moderate Flow	Low Flow
Direct Point Sources (pipe discharge, etc)			H
Direct Delivery (livestock in-stream, wildlife, pets, illegal dumping)		M	H
Failing OSDS		M	H
Sediment Resuspension	H	M	
Stormwater: Impervious areas	H	H	
Combined sewer overflows	H	H	
Overland flow/Bank erosion	H	M	

-Note: Color Shading = Potential relative importance of source area to contribute loads under given hydrologic condition (H=High; M=Medium)
-Figure adapted from USEPA, Bruce Cleland, and Oregon Dept. of Environmental Quality

The load duration curve itself can be established as the TMDL. The TMDL would be dynamic and based on flow. Essentially, the loading capacity is the load corresponding to the flow selected along the curve. Alternatively, a static TMDL can be established based on the area beneath the TMDL curve, representing the loading capacity of the stream. The difference between this area and the area representing current loading conditions is the load that must be reduced to meet water quality standards.

1.3.1 Percent Reduction Goals

Load duration analysis included a “percent reduction” that was calculated for informational purposes only, to illustrate the difference between existing conditions and the loading capacity at the time the streams were sampled. The percent reduction for each impaired segment is provided in section 1.3.2.

A TMDL provides a foundation for identifying, planning, and implementing water quality-based controls to reduce both point and nonpoint source pollution. Though the data used to calculate the percent reductions may be considered “historical”, it provides a representation of the existing FIB loads in the waterbodies over a range of hydrologic conditions. Therefore, the percent reduction *should not be viewed as the TMDL* but rather a goal to work towards in the implementation phase of the TMDL process with the ultimate goal being the restoration and maintenance of in-stream water quality so that beneficial uses are met. The percent reduction can be calculated as:

$$\text{Percent reduction} = [(\text{existing load}) - (\text{allowable load}) / (\text{existing load})] * 100$$

1.3.2 Determination of Loading Capacity and Existing Load

This section presents the load duration curves and estimates of existing loading for impaired waterbodies in the project area. Also presented for each impaired reach are tables displaying the likely major sources of bacterial loading to that waterbody. Based on the source analysis, the estimated relative contribution of each source category is qualified as follows: categories with >20% potential load contributions are defined as a High Contributor; 5%-20% a Moderate Contributor; <5% a Low Contributor.

In accordance with USEPA guidance (USEPA, 2007), and given that the instantaneous fecal coliform criterion states that no more than 10 percent of samples should exceed 400 MPN/100

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ml, it is appropriate to evaluate existing loading as the 90th percentile of observed fecal coliform concentrations.

Staff used guidance from USEPA (2007) in using load duration curves to assess existing loads and flow-based assimilative capacity. Therefore, existing loading is conservatively calculated as the 90th percentile of measured fecal coliform concentrations under each hydrologic flow regime class multiplied by the flow at the middle of the flow exceedance percentile. The 90 percentile of measure loads is a more conservative estimate than using the median. For example, in calculating the existing loading under high flow conditions (flow exceedance percentiles = 0-10% percent), the 5th percentile exceedance flow is multiplied by the 90th percentile of fecal coliform concentrations measured within the 0-10th percentile flow class. Similarly, the middle percentile (25%) of the moderate flow regime was used, to assess existing loads at moderate flow (10-40th percentile flow class). Low flows were handled a little differently. Many project area streams are ephemeral, and flow is not observed 100% of the time. In addition, water quality data is rarely available for the 80 to 100th percentile flows, which correspond either to dry stream bed conditions, or extremely limited flows. Therefore, the existing loading at low flow conditions is multiplied by the flow at the 60th percentile flow.

For a graphical example of how existing loads and flow-based assimilative capacities (TMDLs) are determined, refer to Figure 2.

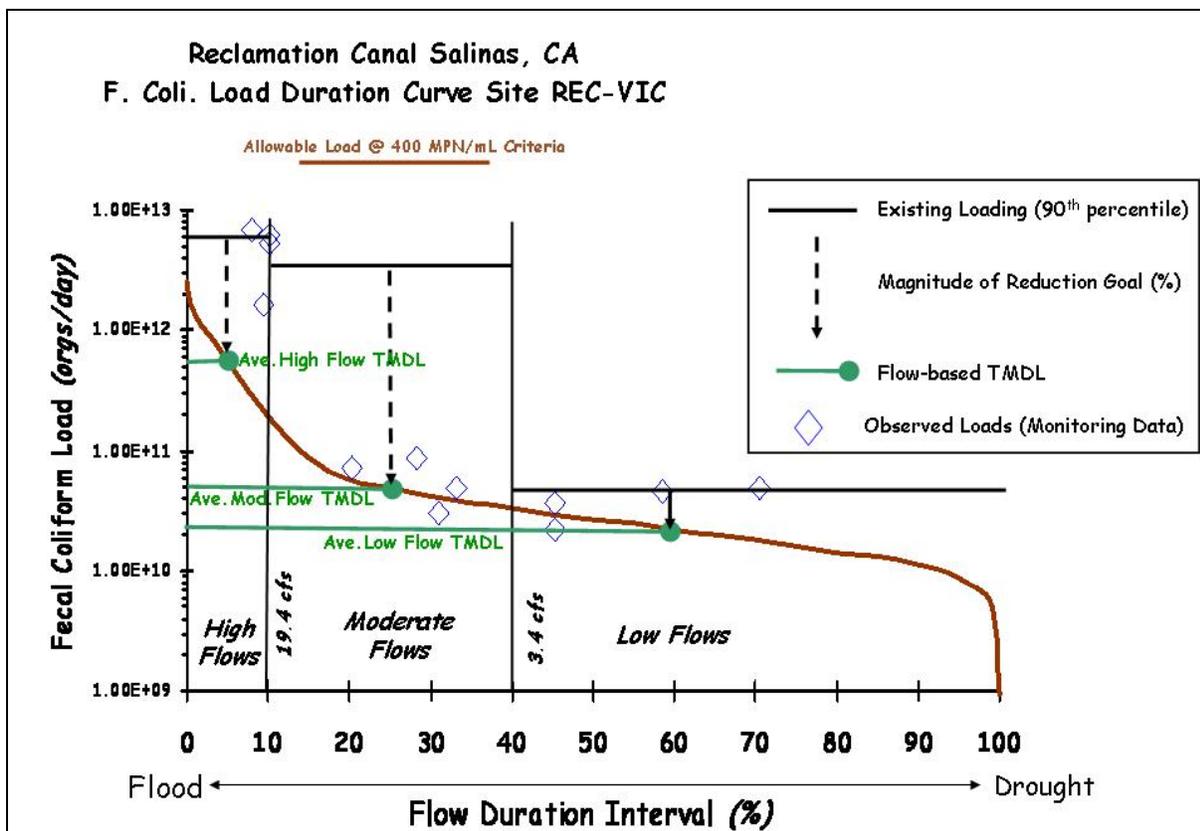


Figure 2. Example assessment of existing load, percent reduction goal, and flow-based TMDLs.

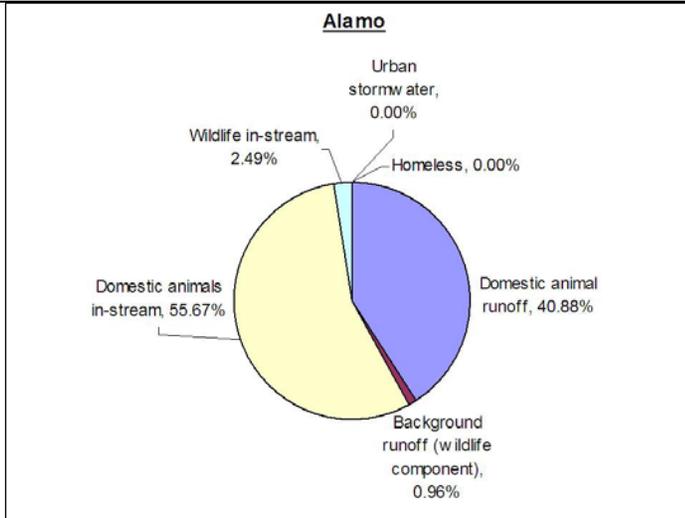
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The load duration curves, and assessment of existing loads and flow based TMDLs for each impaired waterbody in the Project Area are presented in Section 10 in the TMDL FIB Report. The load duration curves are constructed for monitoring points located closest to the downstream confluence, or river mouth of the associated waterbody. This ensures that the loading capacity of the waterbody, and that all or most source contributions in the watershed drainage are potentially represented.

4.1.1.1 Alamo Creek (312ALA)

The load duration curve method was used to determine the percent reduction necessary in the current load for Alamo Creek to meet the 400 MPN/100mL bacteria criterion. Exceedences of the allowable loading capacity at Alamo Creek occur over moderate flow conditions, suggesting input from domestic animals and wildlife. See Table 1.

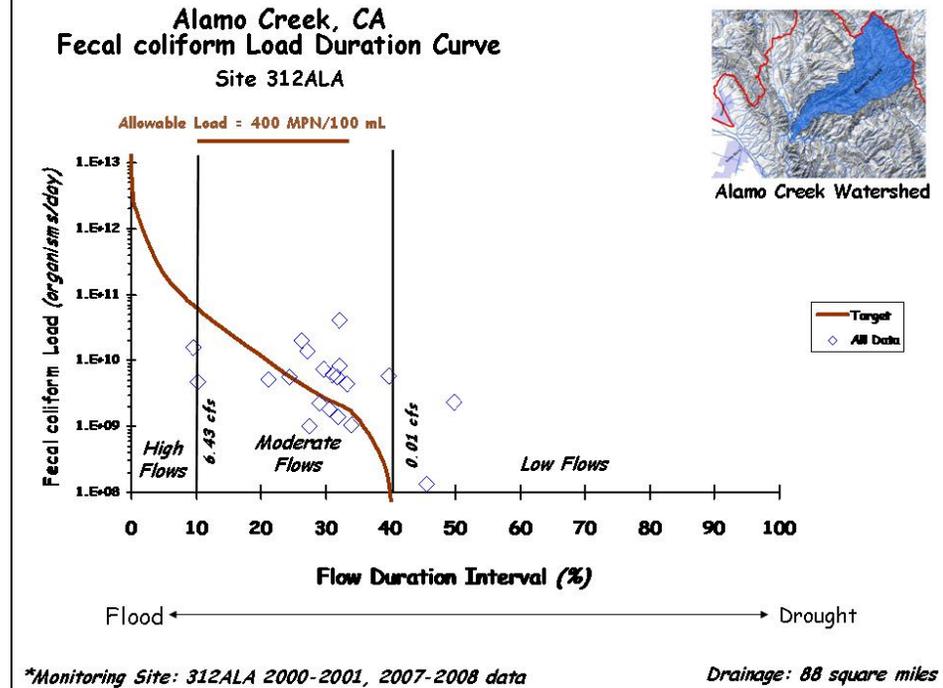
- Monitoring site: 312ALA
- Drainage area: 88 mi²
- Impaired reach length: 7.8 miles
- Est. distribution of fecal coliform available for potential discharge:



Major Sources of Fecal Coliform Loads in Impaired Waterbody:

Category	Source	Estimated Relative Magnitude of Source Contribution
Waste Loads	None Identified	
Nonpoint Sources	Domestic Animals	
	Wildlife/Background	

Low Contributor	
Moderate Contributor	
High Contributor	



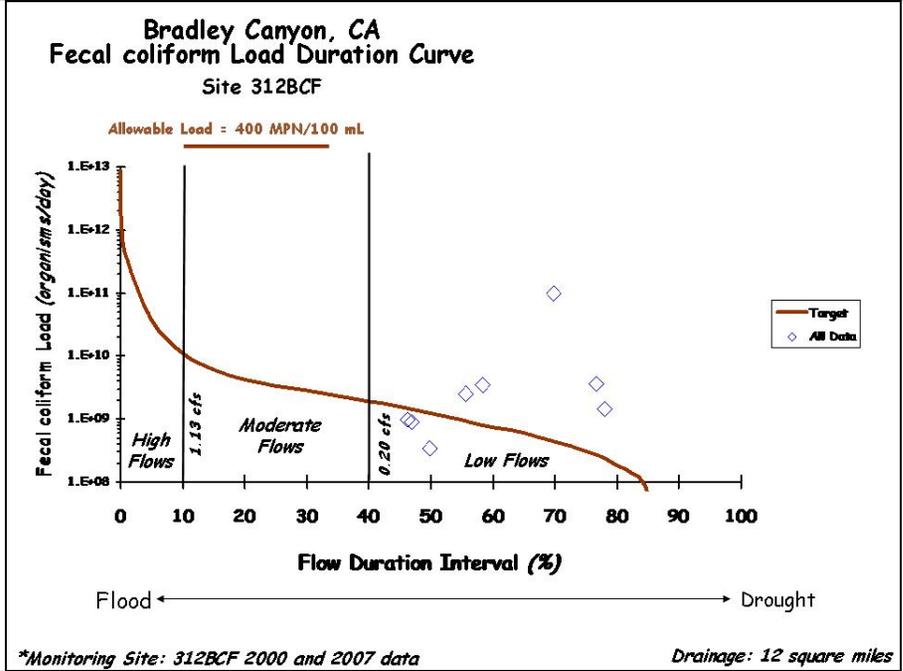
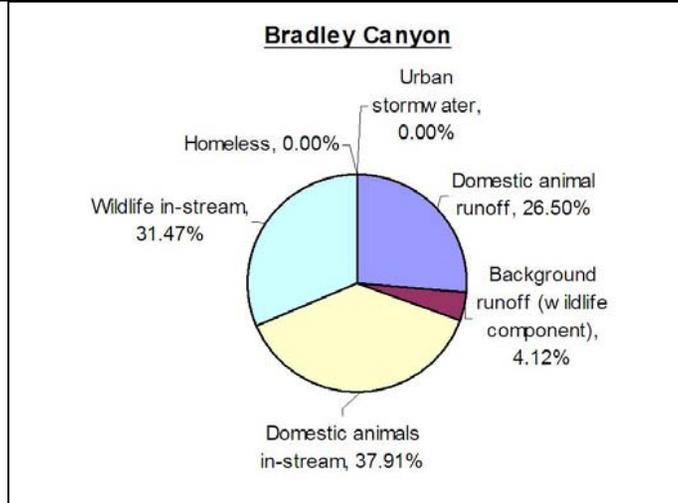
Estimated existing fecal coliform loading for ALA with critical conditions highlighted

Flow Regime	Allowable Load	Estimated Existing Load (90 th percentile)	Percent Reduction Goal
High Flows	2.11E+11	1.57E+10	0
Moderate Flows	5.22E+09	1.62E+10	68%
Low Flows	N/A	N/A	N/A

4.1.1.2 Bradley Canyon Creek (312BCF)

The load duration curve method was used to determine the percent reduction necessary in the current load for Bradley Canyon Creek to meet the 400 MPN/100mL bacteria criterion. Exceedences of the allowable loading capacity at Bradley Canyon Creek occur over low flow conditions, suggesting input from domestic animals and wildlife. See Table 1.

- Monitoring site: 312BCF
- Drainage area: 12 mi²
- Impaired reach length: 17 miles
- Est. distribution of fecal coliform available for potential discharge:



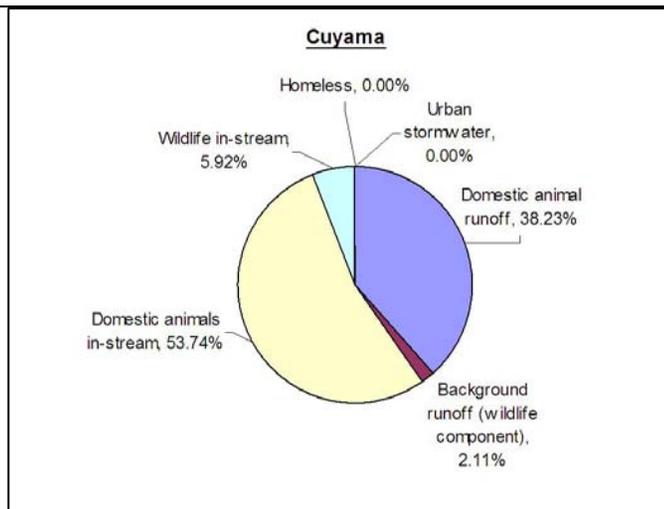
Major Sources of Fecal Coliform Loads in Impaired Waterbody:

Category	Source	Estimated Relative Magnitude of Source Contribution	Estimated existing fecal coliform loading for BCF with critical conditions highlighted			
Waste Loads	None Identified		Flow Regime	Allowable Load	Estimated Existing Load (90 th percentile)	Percent Reduction Goal
Nonpoint Sources	Domestic Animals		High Flows	3.84E+10	N/A	N/A
	Wildlife/Background		Moderate Flows	3.39E+09	N/A	N/A
			Low Flows	7.4E+08	1.3E+10	94%
	Low Contributor					
	Moderate Contributor					
	High Contributor					

4.1.1.3 Cuyama River (312CUY)*

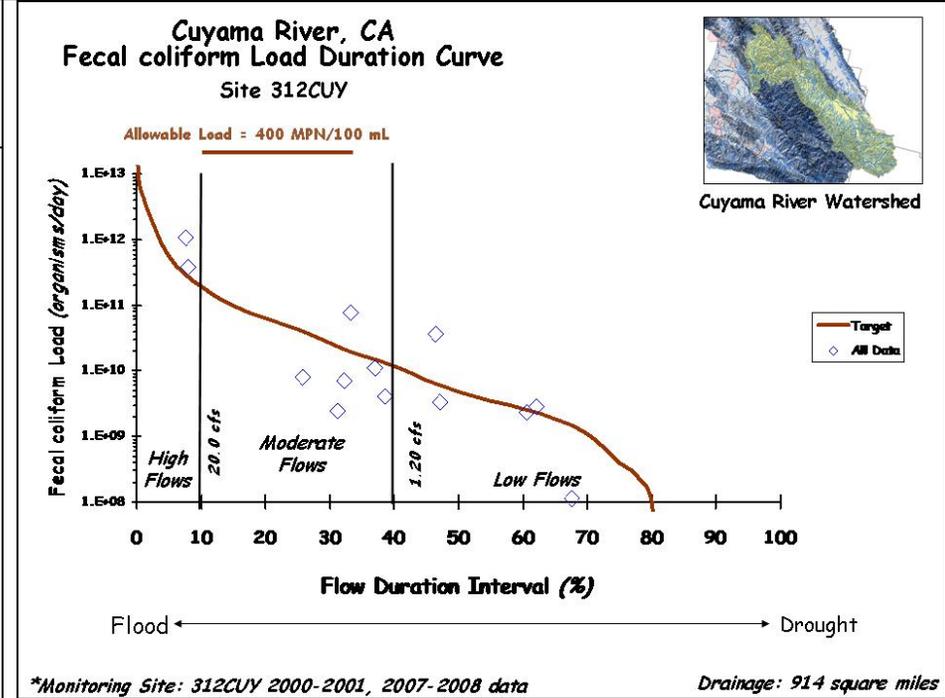
The load duration curve method was used to determine the percent reduction necessary in the current load for Cuyama River to meet the 400 MPN/100mL bacteria criterion. Exceedences of the allowable loading capacity at Cuyama River mostly occur over low flow conditions, suggesting input from domestic animals and wildlife. Other flow regimes also have exceedences, but to a much lesser extent. See Table 1.

- Monitoring site: **312CUY**
- Drainage area: **914 mi²**
- Impaired reach length: **80 miles**
- Est. distribution of fecal coliform available for potential discharge:



Major Sources of Fecal Coliform Loads in Impaired Waterbody:

Category	Source	Estimated Relative Magnitude of Source Contribution
Waste Loads	None Identified	
Nonpoint Sources	Domestic Animals	
	Wildlife/Background	



Estimated existing fecal coliform loading for CUY with critical conditions highlighted

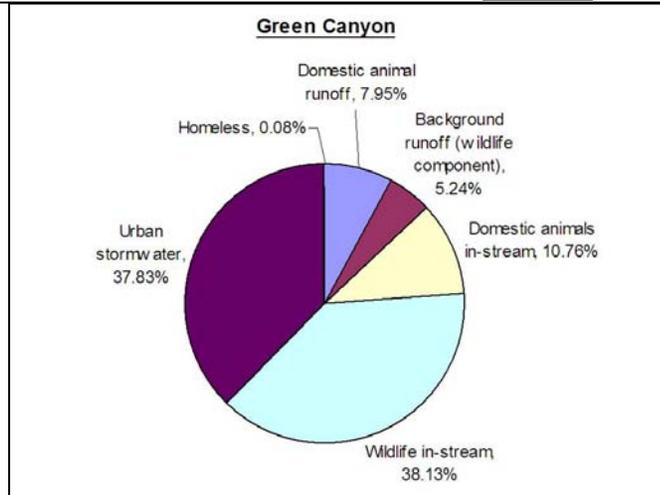
Flow Regime	Allowable Load	Estimated Existing Load (90 th percentile)	Percent Reduction Goal
High Flows	5.78E+11	1.01E+12	43%
Moderate Flows	4.21E+10	4.47E+10	6%
Low Flows	2.64E+09	2.00E+10	87%

*The Cuyama WWTP is in this watershed, however is not called out as a source of FIB to the watershed.

4.1.1.4 Greene Valley Creek (312GVS)/Green Canyon Watershed*

The load duration curve method was used to determine the percent reduction necessary in the current load for Greene Valley Creek to meet the 400 MPN/100mL bacteria criterion. Exceedences of the allowable loading capacity at Greene Valley Creek mostly occur over moderate flow conditions, suggesting input from domestic animals, wildlife, and urban runoff. See Table 1.

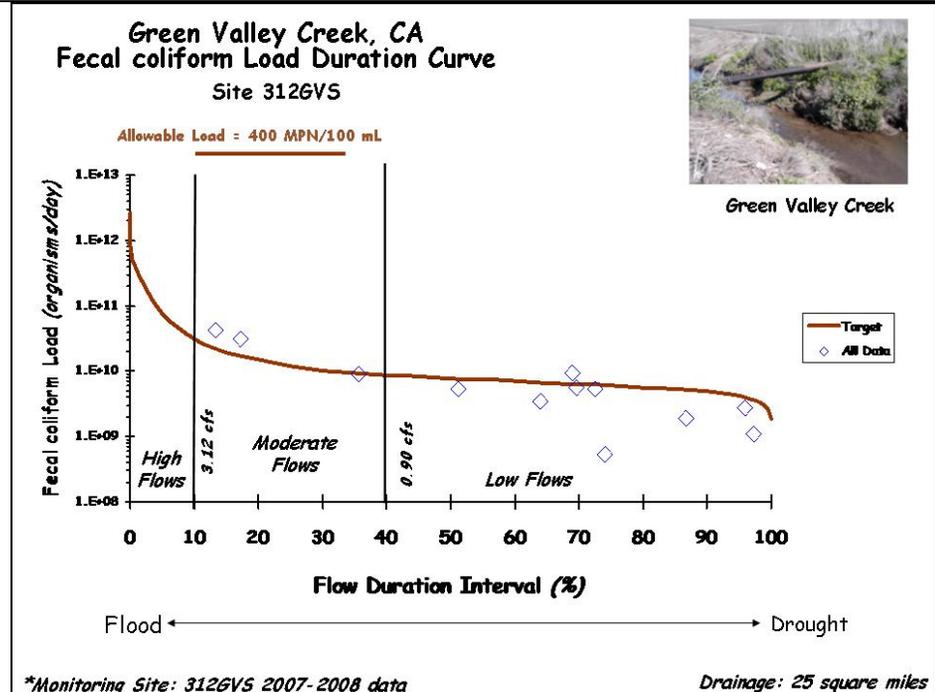
- Monitoring site: **312GVS**
- Drainage area: **25 mi²**
- Impaired reach length: **3.9 miles**
- Est. distribution of fecal coliform available for potential discharge:



Major Sources of Fecal Coliform Loads in Impaired Waterbody:

Category	Source	Estimated Relative Magnitude of Source Contribution
Waste Loads	Urban stormwater	High Contributor
Nonpoint Sources	Domestic Animals	Moderate Contributor
	Wildlife/Background	Moderate Contributor

Low Contributor	Low Contributor
Moderate Contributor	Moderate Contributor
High Contributor	High Contributor



Estimated existing fecal coliform loading for GVS with critical conditions highlighted

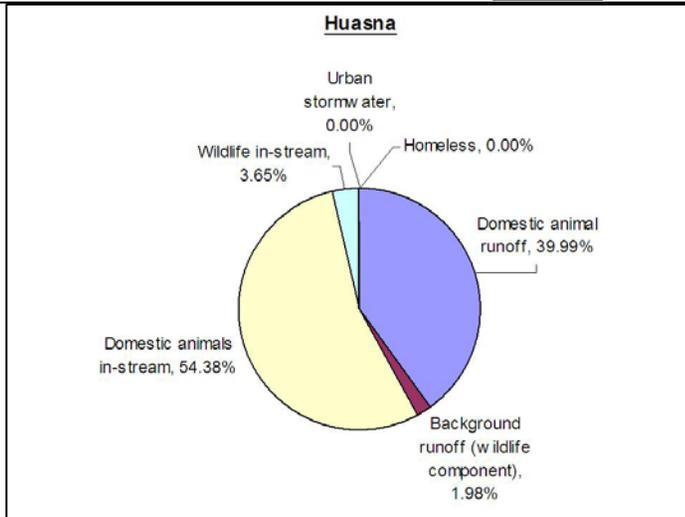
Flow Regime	Allowable Load	Estimated Existing Load (90 th percentile)	Percent Reduction Goal
High Flows	7.93E+10	N/A	N/A
Moderate Flows	1.17E+10	3.96E+10	70%
Low Flows	6.97E+09	6.40E+09	0

*The Santa Maria WWTP/portions of collection system is located within this watershed and may contribute episodically to the FIB loading if there is a spill/leak.

4.1.1.5 Huasna River (312HUA)

The load duration curve method was used to determine the percent reduction necessary in the current load for Huasna River to meet the 400 MPN/100mL bacteria criterion. Exceedences of the allowable loading capacity at Huasna River do not show up on the load duration curve because the exceedences are so low (17%). Of those few exceedences, sources most likely include both domestic animals and wildlife. See Table 1

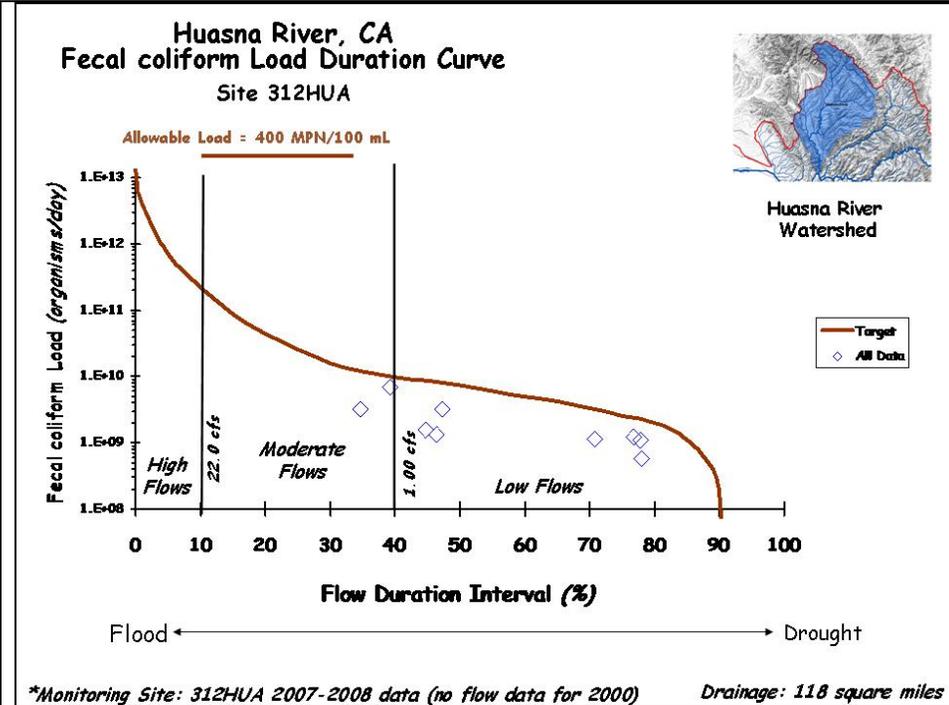
- Monitoring site: **312HUA**
- Drainage area: **118 mi²**
- Impaired reach length: **18 miles**
- Est. distribution of fecal coliform available for potential discharge:



Major Sources of Fecal Coliform Loads in Impaired Waterbody:

Category	Source	Estimated Relative Magnitude of Source Contribution
Waste Loads	None Identified	
Nonpoint Sources	Domestic Animals	High Contributor
	Wildlife/Background	Low Contributor

Low Contributor
 Moderate Contributor
 High Contributor



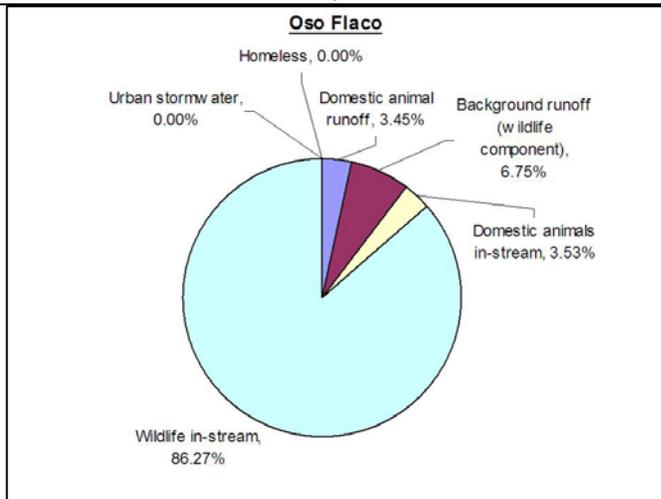
Estimated existing fecal coliform loading for HUA

Flow Regime	Allowable Load	Estimated Existing Load (90 th percentile)	Percent Reduction Goal
High Flows	7.24E+11	N/A	N/A
Moderate Flows	2.54E+10	6.40E+09	0
Low Flows	4.99E+09	2.22E+09	0

4.1.1.6 Little Oso Flaco Creek (312OFN)

The load duration curve method was used to determine the percent reduction necessary in the current load for Little Oso Flaco Creek to meet the 400 MPN/100mL bacteria criterion. Exceedences of the allowable loading capacity at Little Oso Flaco Creek mostly occur over moderate and low flow conditions, suggesting input from wildlife and to a much lesser extent, domestic animals. See Table 1. Note that the pie chart is representative of Oso Flaco Creek and similar land uses are assumed for this subwatershed.

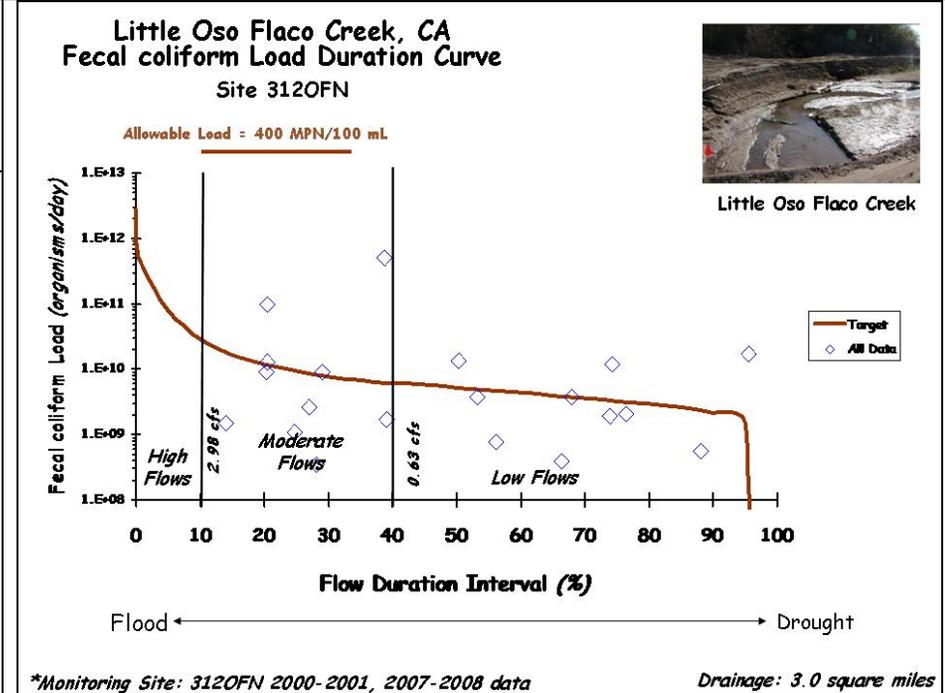
- Monitoring site: 312OFN
- Drainage area: 3.0 mi²
- Impaired reach length: 1.8 miles
- Est. distribution of fecal coliform available for potential discharge: (assume same as Oso Flaco Creek)



Major Sources of Fecal Coliform Loads in Impaired Waterbody:

Category	Source	Estimated Relative Magnitude of Source Contribution
Waste Loads	None Identified	
Nonpoint Sources	Domestic Animals	
	Wildlife/Background	

Low Contributor
 Moderate Contributor
 High Contributor



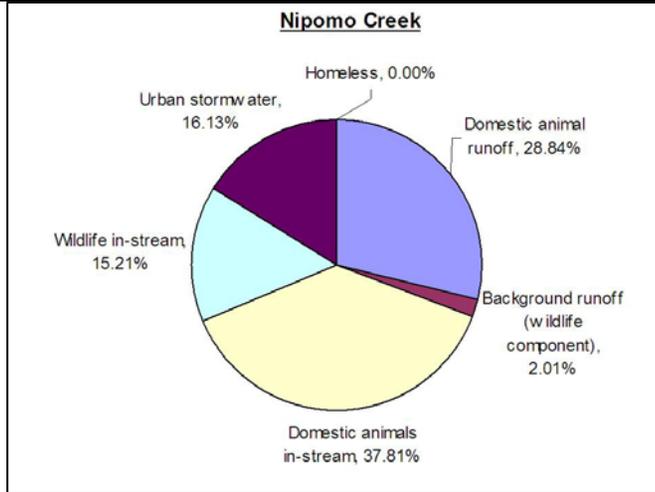
Estimated existing fecal coliform loading for OFN with critical conditions highlighted

Flow Regime	Allowable Load	Estimated Existing Load (90 th percentile)	Percent Reduction Goal
High Flows	8.08E+10	N/A	N/A
Moderate Flows	9.31E+09	1.40E+11	93%
Low Flows	4.32E+09	1.33E+10	68%

4.1.1.7 Nipomo Creek (312NIP)*

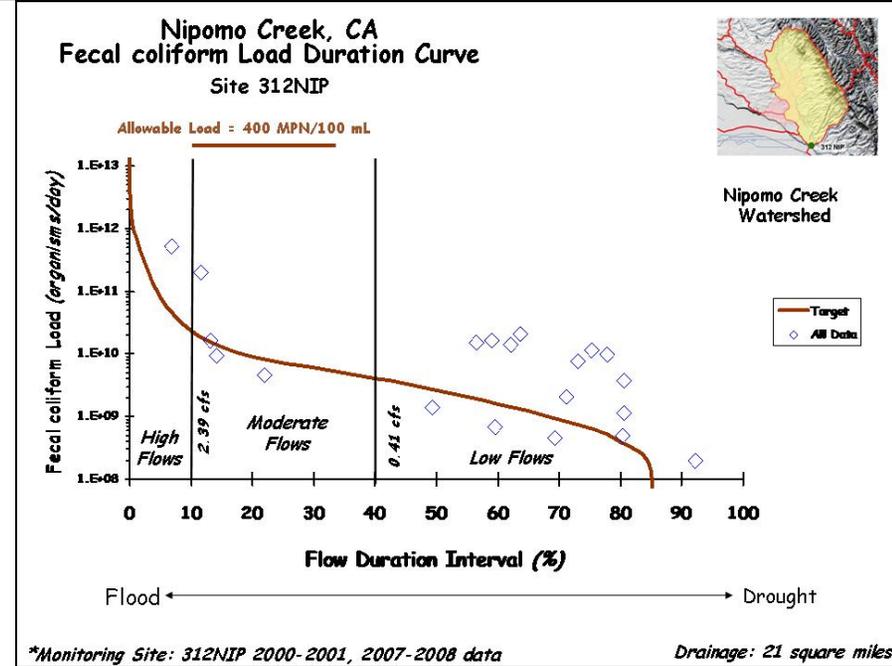
The load duration curve method was used to determine the percent reduction necessary in the current load for Nipomo Creek to meet the 400 MPN/100mL bacteria criterion. Exceedences of the allowable loading capacity at Nipomo Creek mostly occur over all flow conditions, suggesting input from all sources including domestic animals, wildlife and urban runoff. See Table 1.

- Monitoring site: 312NIP
- Drainage area: 21 mi²
- Impaired reach length: 9.3 miles
- Est. distribution of fecal coliform available for potential discharge:



Major Sources of Fecal Coliform Loads in Impaired Waterbody:

Category	Source	Estimated Relative Magnitude of Source Contribution
Waste Loads	Urban Stormwater	
Nonpoint Sources	Domestic Animals	
	Wildlife/Background	
	Low Contributor	
	Moderate Contributor	
	High Contributor	



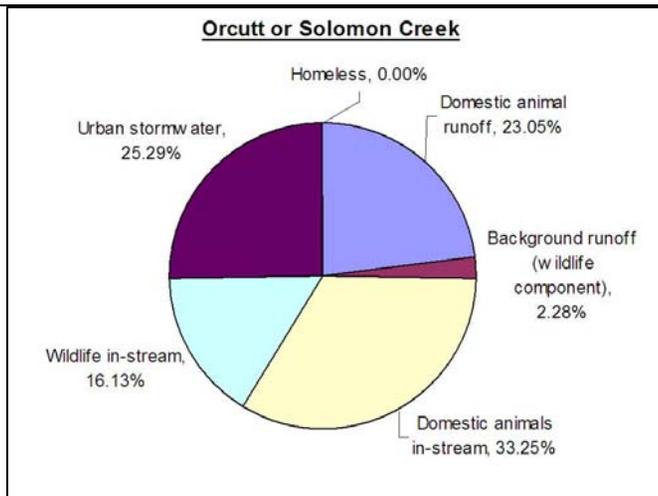
Flow Regime	Allowable Load	Estimated Existing Load (90 th percentile)	Percent Reduction Goal
High Flows	8.12E+10	5.21E+11	84%
Moderate Flows	7.16E+09	1.45E+11	95%
Low Flows	1.56E+09	1.57E+10	90%

*The Nipomo WWTP is in this watershed, however is not called out as a source of FIB to the watershed.

4.1.1.8 Orcutt-Solomon Creek (312ORC)*

The load duration curve method was used to determine the percent reduction necessary in the current load for Orcutt-Solomon Creek to meet the 400 MPN/100mL bacteria criterion. Exceedences of the allowable loading capacity at Orcutt-Solomon Creek mostly occur over moderate and low flow conditions, suggesting input from domestic animals, wildlife and urban stormwater. See Table 1.

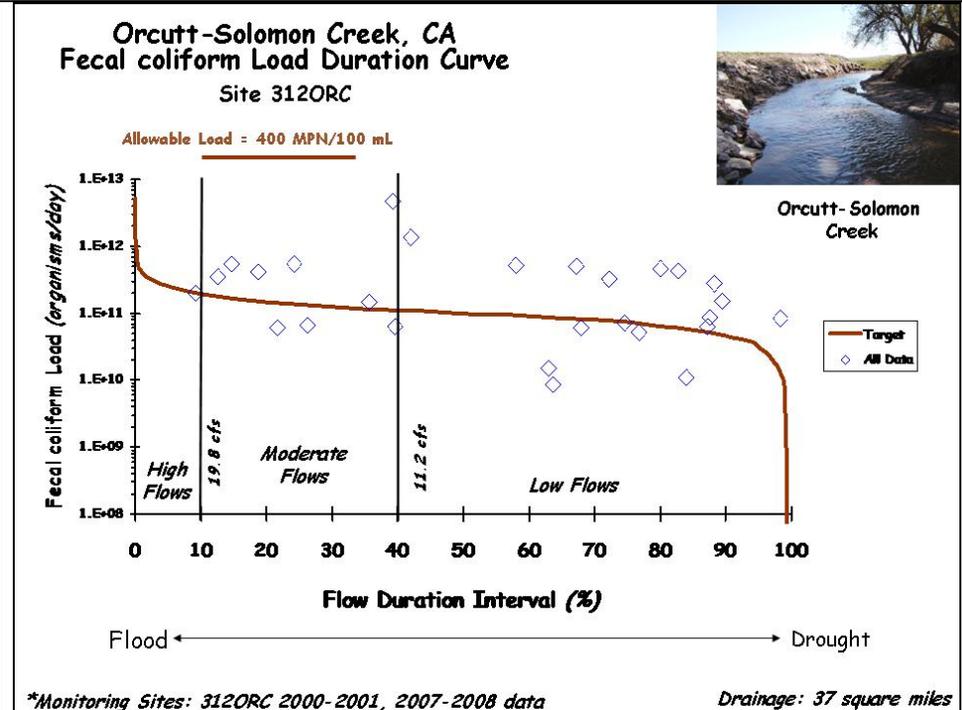
- Monitoring site: 312ORC
- Drainage area: 37 mi²
- Impaired reach length: 10 miles
- Est. distribution of fecal coliform available for potential discharge:



Major Sources of Fecal Coliform Loads in Impaired Waterbody:

Category	Source	Estimated Relative Magnitude of Source Contribution
Waste Loads	Urban Stormwater	High Contributor
Nonpoint Sources	Domestic Animals	High Contributor
	Wildlife/Background	Moderate Contributor

Low Contributor
 Moderate Contributor
 High Contributor



Estimated existing fecal coliform loading for ORC with critical conditions highlighted

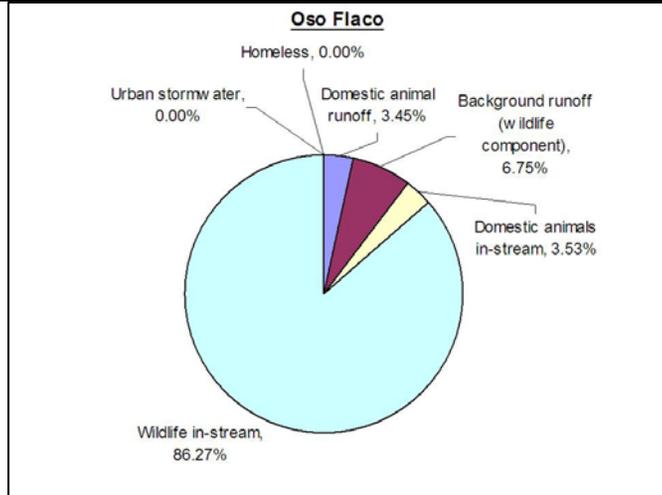
Flow Regime	Allowable Load	Estimated Existing Load (90 th percentile)	Percent Reduction Goal
High Flows	2.59E+11	1.99E+11	0
Moderate Flows	1.35E+11	1.38E+12	90%
Low Flows	9.06E+10	5.10E+11	82%

*A portion of the Laguna WWTP collection system is within this watershed and may contribute episodically to FIB loading if there is a spill/leak.

4.1.1.9 Oso Flaco Creek (312OFC)

The load duration curve method was used to determine the percent reduction necessary in the current load for Oso Flaco Creek to meet the 400 MPN/100mL bacteria criterion. Exceedences of the allowable loading capacity at Oso Flaco Creek mostly occur over moderate and low flow conditions, suggesting input mostly from wildlife and to a much lesser extent, domestic animals. See Table 1.

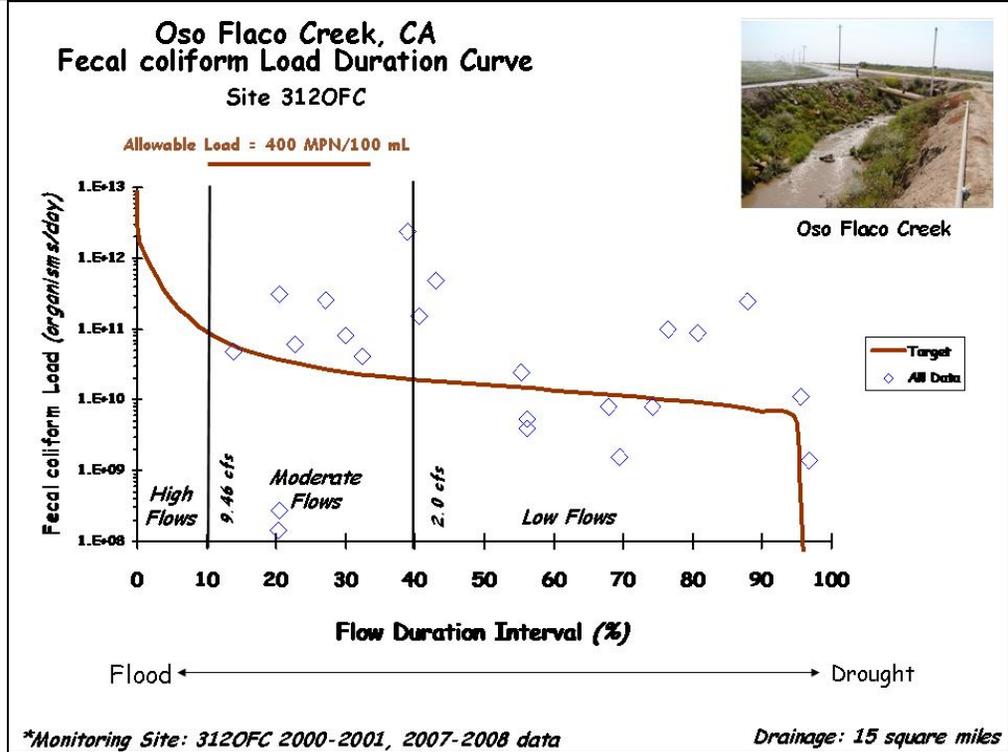
- Monitoring site: **312OFC**
- Drainage area: **15 mi²**
- Impaired reach length: **6.3 miles**
- Est. distribution of fecal coliform available for potential discharge:



Major Sources of Fecal Coliform Loads in Impaired Waterbody:

Category	Source	Estimated Relative Magnitude of Source Contribution
Waste Loads	None Identified	
Nonpoint Sources	Domestic Animals	
	Wildlife/Background	

Low Contributor
 Moderate Contributor
 High Contributor



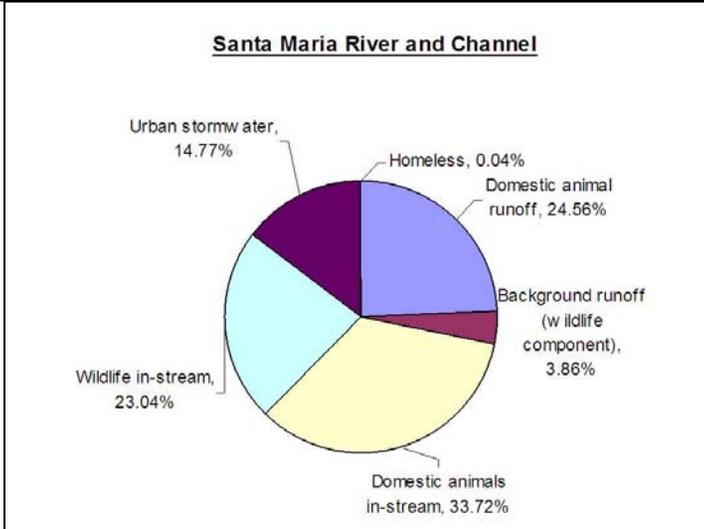
Estimated existing fecal coliform loading for OFC with critical conditions highlighted

Flow Regime	Allowable Load	Estimated Existing Load (90 th percentile)	Percent Reduction Goal
High Flows	2.57E+11	N/A	N/A
Moderate Flows	2.95E+10	5.19E+11	94%
Low Flows	1.35E+10	2.27E+11	94%

4.1.1.10 Santa Maria River - above Estuary (312SMA)*

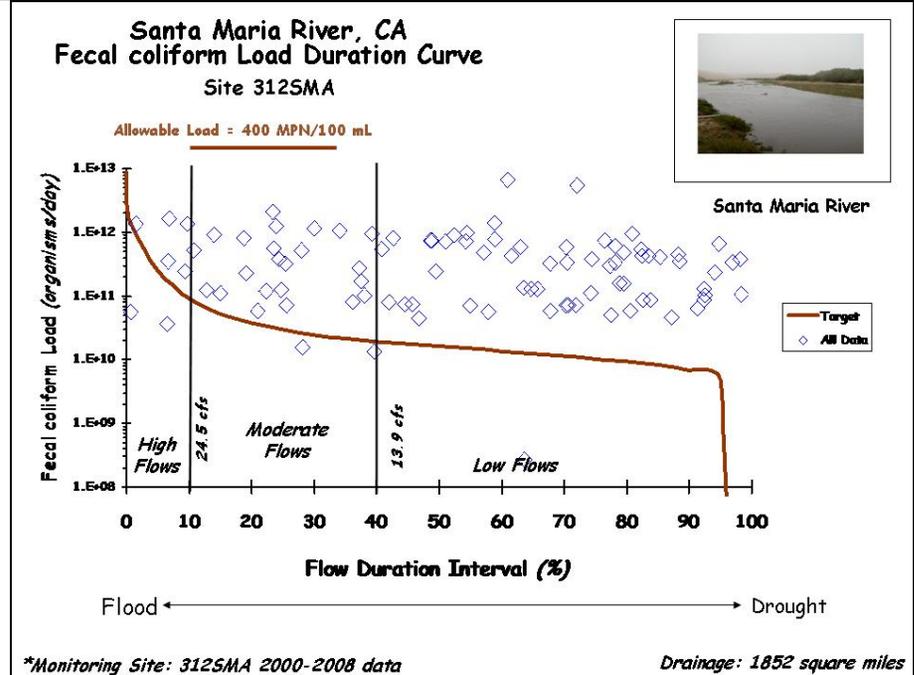
The load duration curve method was used to determine the percent reduction necessary in the current load for the Santa Maria River to meet the 400 MPN/100mL bacteria criterion. Exceedences of the allowable loading capacity at the Santa Maria River occur over all flow conditions, suggesting input from domestic animals, wildlife and urban stormwater. See Table 1.

- Monitoring site: 312SMA
- Drainage area: 1852 mi²
- Impaired reach length: 51 miles
- Est. distribution of fecal coliform available for potential discharge:



Major Sources of Fecal Coliform Loads in Impaired Waterbody:

Category	Source	Estimated Relative Magnitude of Source Contribution
Waste Loads	Urban Stormwater	High Contributor
Nonpoint Sources	Domestic Animals	Moderate Contributor
	Wildlife/Background	Low Contributor



Estimated existing fecal coliform loading for SMA with critical conditions highlighted

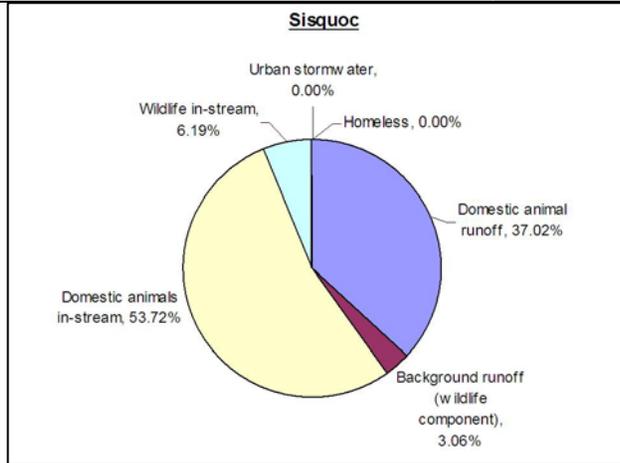
Flow Regime	Allowable Load	Estimated Existing Load (90 th percentile)	Percent Reduction Goal
High Flows	3.20E+11	1.50E+12	79%
Moderate Flows	1.36E+11	1.13E+12	88%
Low Flows	1.12E+11	7.95E+11	86%

*The Guadalupe WWTP is within this watershed and may contribute to FIB loading in the case of a spill or leak.

4.1.1.11 Sisquoc River (312SIS) (*impaired for E. coli only*)

The Sisquoc River is not impaired by fecal coliform but was shown here as an example of an unimpaired site for fecal coliform. Note that Sisquoc (site 312SIV) does exceed the *E. coli* objective by 25%. Based on the pie chart below, probably sources include both domestic animals and wildlife. See Table 1.

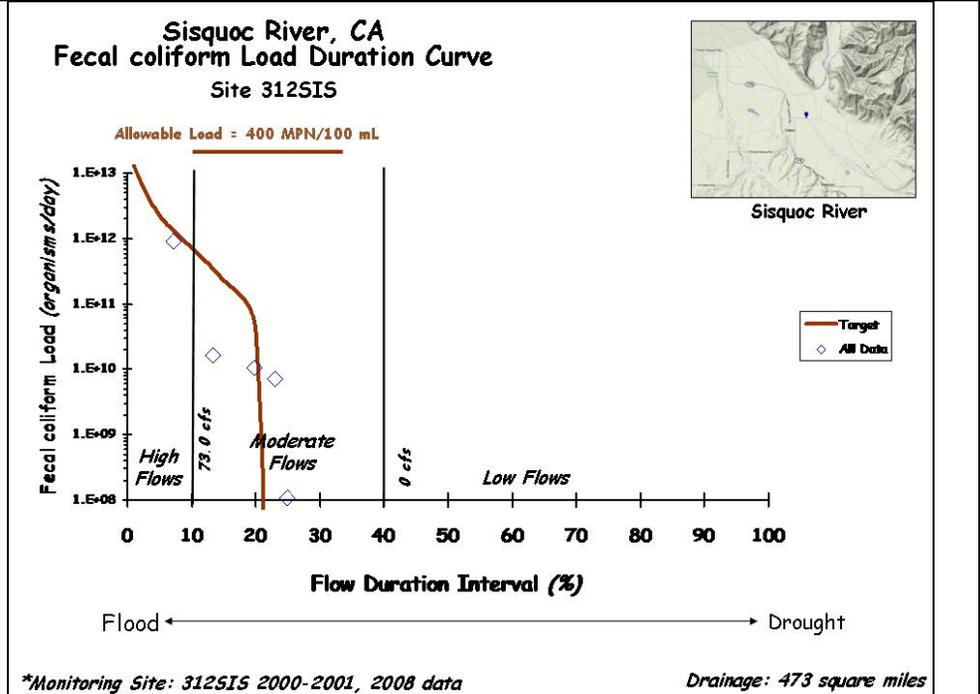
- Monitoring site: 312SIS
- Drainage area: 473 mi²
- Impaired reach length: N/A
- Est. distribution of fecal coliform available for potential discharge:



Major Sources of Fecal Coliform Loads in Impaired Waterbody:

Category	Source	Estimated Relative Magnitude of Source Contribution
Waste Loads	None Identified	
Nonpoint Sources	Domestic Animals	
	Wildlife/Background	

Low Contributor
 Moderate Contributor
 High Contributor



Estimated existing fecal coliform loading for SIS

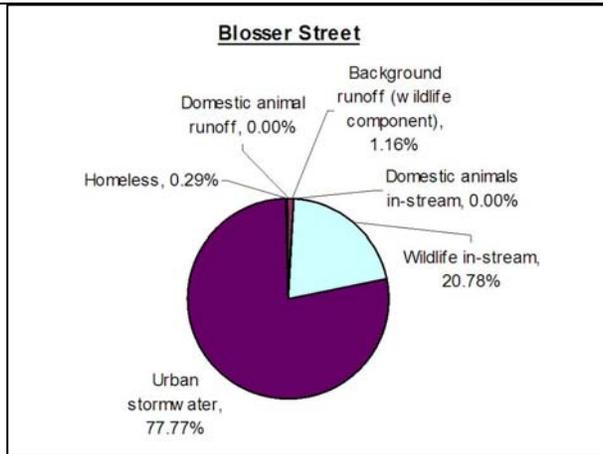
Flow Regime	Allowable Load	Estimated Existing Load (90 th percentile)	Percent Reduction Goal
High Flows	2.3E+12	9.28E+11	0
Moderate Flows*	2.25E+11	1.45E+10	0
Low Flows	N/A	N/A	N/A

*this moderate flow uses the 15th percentile instead of the 25th in the other tables.

4.1.1.12 Urban Channels: Blosser Channel (312BCD)* **

The load duration curve method was used to determine the percent reduction necessary in the current load for Blosser Ditch to meet the 400 MPN/100mL bacteria criterion. Exceedences of the allowable loading capacity at Blosser Ditch occur over all flow conditions, suggesting input from urban stormwater, wildlife and to a lesser extent, homeless persons. See Table 1.

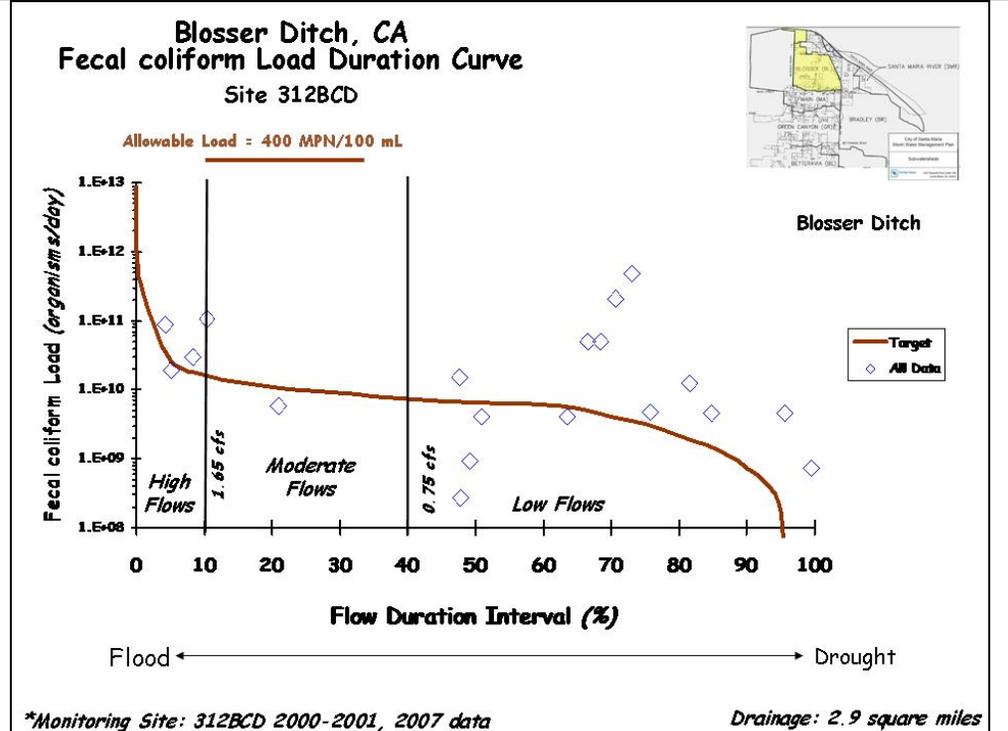
- Monitoring site: 312BCD
- Drainage area: 2.9 mi²
- Impaired reach length: 2 miles
- Est. distribution of fecal coliform available for potential discharge:



Major Sources of Fecal Coliform Loads in Impaired Waterbody:

Category	Source	Estimated Relative Magnitude of Source Contribution
Waste Loads	Urban Stormwater	High Contributor
Nonpoint Sources	Domestic Animals	Moderate Contributor
	Wildlife/Background	Moderate Contributor
	Homeless persons	Low Contributor

Low Contributor
 Moderate Contributor
 High Contributor



*Monitoring Site: 312BCD 2000-2001, 2007 data

Drainage: 2.9 square miles

Estimated existing fecal coliform loading for BCD with critical conditions highlighted

Flow Regime	Allowable Load	Estimated Existing Load (90 th percentile)	Percent Reduction Goal
High Flows	2.73E+10	7.55E+10	64%
Moderate Flows	9.72E+09	9.57E+10	90%
Low Flows	6.17E+09	1.31E+11	95%

* Sampling site BCD is just outside the watershed area delineated as Blosser Street, however, the sampling site does drain Blosser Street and also drains Bradley Channel as well. The above information only reflects Blosser Street Watershed, but it is in fact combined with runoff from Bradley Channel as shown below (4.1.1.13). Staff will take this into account when designing the Implementation and Monitoring Plan.

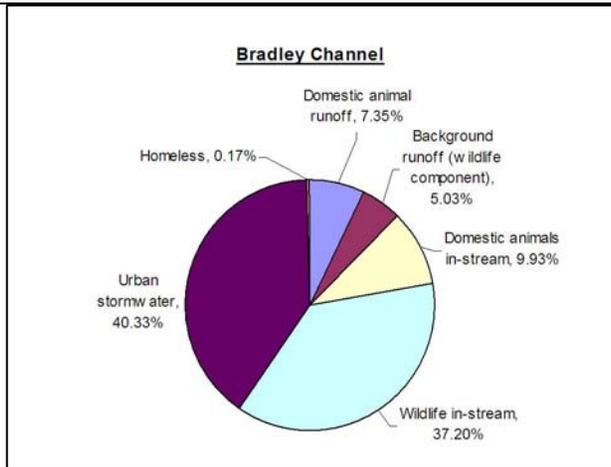
TMDLs for FIB in the Santa Maria Watershed
Appendix E - Load Duration Curves

**The collection system for the Santa Maria WWTP is located within this watershed and may contribute episodically to FIB loading.

4.1.1.13 Urban Channels: Bradley Channel (312BCU)*

The load duration curve method was used to determine the percent reduction necessary in the current load for Bradley Channel to meet the 400 MPN/100mL bacteria criterion. Exceedences of the allowable loading capacity at Bradley Channel occur over moderate and low flow conditions, suggesting input from urban stormwater, wildlife, domestic animals, and to a lesser extent, homeless persons. See Table 1.

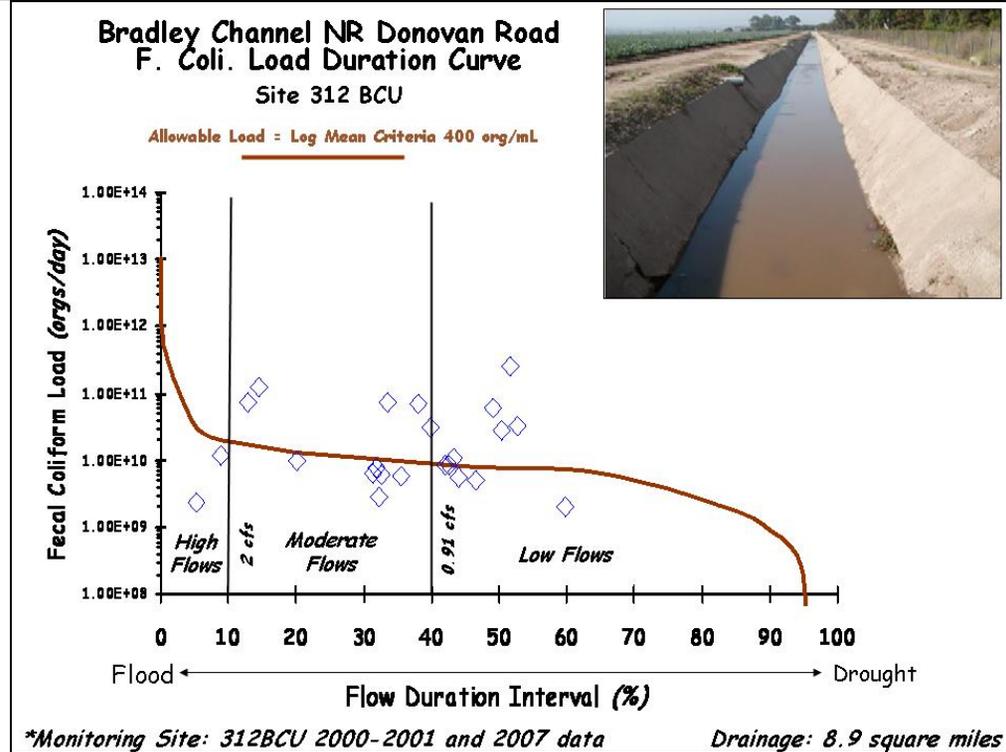
- Monitoring site: 312BCU
- Drainage area: 8.9 mi²
- Impaired reach length: 3.1 miles
- Est. distribution of fecal coliform available for potential discharge:



Major Sources of Fecal Coliform Loads in Impaired Waterbody:

Category	Source	Estimated Relative Magnitude of Source Contribution
Waste Loads	Urban Stormwater	High Contributor
Nonpoint Sources	Domestic Animals	Moderate Contributor
	Wildlife/Background	Moderate Contributor
	Homeless	Low Contributor

Low Contributor
 Moderate Contributor
 High Contributor



Estimated existing fecal coliform loading for BCU with critical conditions highlighted

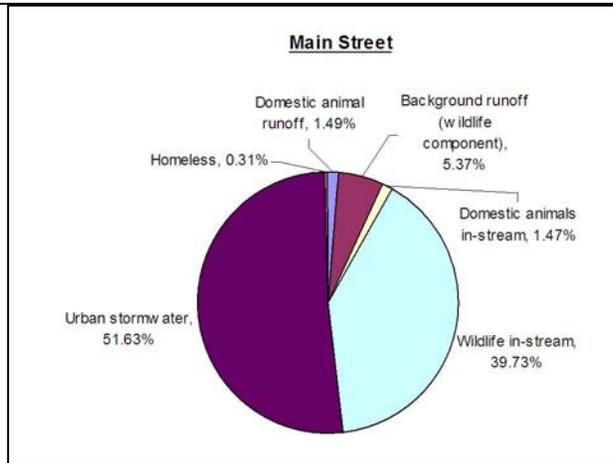
Flow Regime	Allowable Load	Estimated Existing Load (90 th percentile)	Percent Reduction Goal
High Flows	3.30E+10	1.09E+10	0
Moderate Flows	1.17E+10	7.41E+10	84%
Low Flows	7.46E+09	7.90E+10	91%

*The collection system for the Santa Maria WWTP is located within this watershed and may contribute episodically to FIB loading.

4.1.1.14 Urban Channels: Main Street Canal* ** (312MSD)

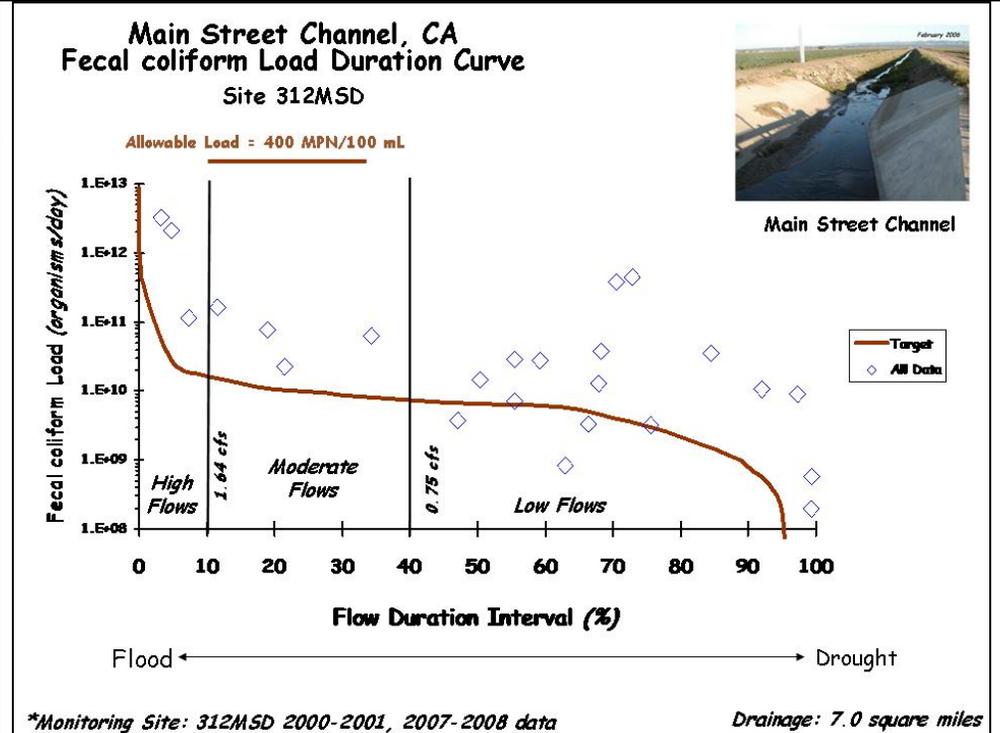
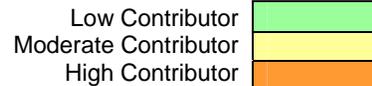
The load duration curve method was used to determine the percent reduction necessary in the current load for Main Street Canal to meet the 400 MPN/100mL bacteria criterion. Exceedences of the allowable loading capacity at Main Street Canal occur over all flow conditions, suggesting input from urban stormwater, wildlife and to a lesser extent, domestic animals and homeless persons. See Table 1.

- Monitoring site: 312ALA
- Drainage area: 7.0 mi²
- Impaired reach length: 5.1 miles
- Est. distribution of fecal coliform available for potential discharge:



Major Sources of Fecal Coliform Loads in Impaired Waterbody:

Category	Source	Estimated Relative Magnitude of Source Contribution
Waste Loads	Urban Stormwater	High Contributor
Nonpoint Sources	Domestic Animals	Moderate Contributor
	Wildlife/Background	Moderate Contributor
	Homeless	Low Contributor



Estimated existing fecal coliform loading for MSD with critical conditions highlighted

Flow Regime	Allowable Load	Estimated Existing Load (90 th percentile)	Percent Reduction Goal
High Flows	2.69E+10	3.06E+12	99%
Moderate Flows	9.63E+09	1.40E+11	93%
Low Flows	6.11E+09	1.43E+11	96%

*This sampling site and stream gauge may not be completely representative of the entire Main Street Canal Watershed area and may only represent the more southern portion of it. Staff will take this into account when designing the Implementation and Monitoring Plan.

**The collection system for the Santa Maria WWTP is located within this watershed and may contribute episodically to FIB loading.