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Central Coast Watershed Studies

CCoWS

2015 Water Quality

Santa Lucia Preserve, Monterey County, California

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1 Introduction

The Santa Lucia Preserve (SLP) is a 20,000 acre low density development in Monterey County, California. The Santa Lucia Conservancy (SLC) is a non-profit organization established to manage 18,000 undeveloped acres of the SLP. Four streams within the SLP are monitored by the SLC: Las Garzas Creek, San Jose Creek, Potrero Creek and San Clemente Creek (Figure 1). Since the formation of the SLC in 1995 water quality data have been collected intermittently by various organizations.

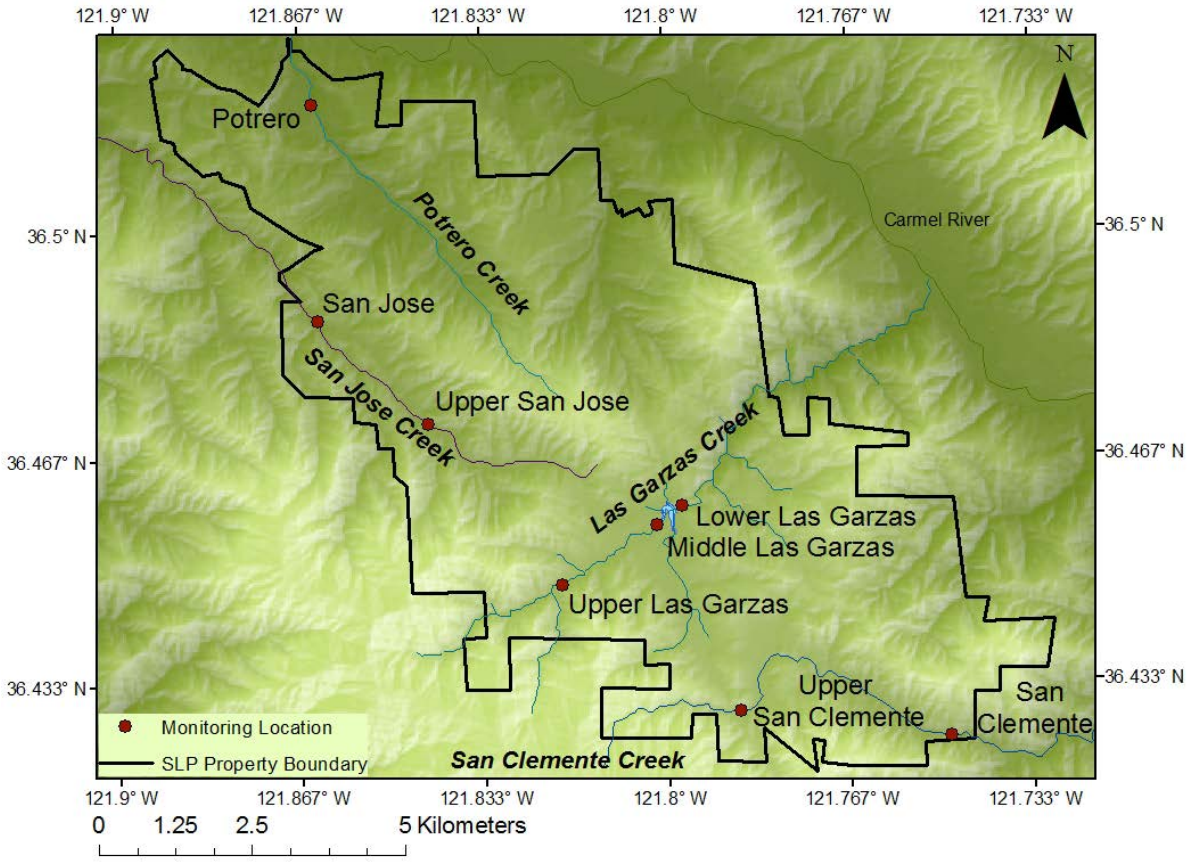

Figure 1: Map of Santa Lucia Preserve showing eight monitoring sites on four streams within the property boundary.

This report presents water quality data collected from eight monitoring sites (Figure 1). The goal of this report is to continue a baseline data set for suspended sediment concentrations, and water nutrient levels. Biannual water quality data collected since August 2009 are presented and compared. Unlike previous reports, this year we discontinued photomonitoring at each the site.

Suspended Sediment and Stream Nutrients

The sediment load in streams is influenced by average and peak precipitation, discharge, geology, anthropogenic impacts, and the size of the drainage basin (Milliman and Syvitski 1992, Walling and Fang 2003). Increased sediment loads might have negative effects on stream habitat for macroinvertebrates, fish spawning and rearing, and other aquatic organisms (EPA 2003, Jha 2003, Smith et al. 2005). Specific levels of suspended sediment concentrations of 500mg/L or higher have shown sublethal stress as well as blood cell count and chemistry changes in Steelhead (Redding and Schreck 1982), and long term concentrations above 1650 mg/L suspended sediment will cause loss of habitat from increased sediment deposition (Coats et al. 1985).

Stream nutrient levels in surface water are naturally influenced by geology, vegetation and climate (Beaulac and Reckhow 1982, Hynes 1983, Clark et al. 2000). Dissolved nitrate plus nitrite as nitrogen (nitrate), dissolved ammonia plus ammonium as nitrogen (ammonia) and dissolved orthophosphate as phosphorus (orthophosphate) are three stream nutrients that are monitored for water quality. Nutrients may be released and levels may increase as a result of development (soil movement) or agriculture (fertilizer application/manure) or from atmospheric deposition (Beaulac and Reckhow 1982, Smith et al. 1999). Forested, undeveloped watersheds mostly have a low and homeostatic nutrient load (Beaulac and Reckhow 1982). In undeveloped watersheds across the United States, Clark et al. (2000) found that the median flow-weighted concentrations were 0.020 mg/L for ammonia as N, 0.26 mg/L for total nitrogen and 0.010 mg/L for orthophosphate as P. The California EPA is in the scoping process to propose nutrient water quality objectives. Nutrients alone do not affect Beneficial Uses protected by the California EPA because various levels of nutrients will cause eutrophication depending on the stream itself ([SWRCB] 2011). Monitoring for nutrient levels and eutrophication in streams will help establish a baseline for the stream in question.

A snapshot of stream suspended sediment load and stream nutrients over the span of years provides a long term measure of watershed conditions for the four streams sampled on the SLP. Precipitation conditions during sampling will affect the magnitude of the resulting sediment and nutrient loads. Biannual sampling in August and March provides one sample during the dry season with low stream discharges and one sample during the wet season with higher stream discharges. Long term monitoring will enable the SLC to detect any negative changes in suspended sediment load or stream nutrients in the future.

1.2 Monitoring Locations

This report presents water quality data collected from eight monitoring sites (Appendix A, Figure 1). There are two monitoring sites on San Clemente Creek. The site named "San Clemente" is 30 meters upstream from the gage, a half mile upstream from the property line. The site named "Upper San Clemente" is 50 meters downstream from the intersection of Robinson Canyon Road and San Clemente Creek, 5 meters upstream of the footbridge.

There are two monitoring sites on San Jose Creek. The site named "San Jose" is the downstream site located upstream of a cement weir. The site named "Upper San Jose" is located near Lot 46, near Rancho San Carlos Road.

There are three monitoring sites on Las Garzas Creek. The site named "Lower Garzas" is 50 meters downstream from Moore's Lake. The site named "Middle Garzas" is upstream of Moore's Lake, upstream of the culvert. The site named "Upper Garzas" is 50 meters upstream of the intersection of Las Garzas Trail Road and Las Garzas Creek.

There is one monitoring site on Potrero Creek. The site is located in the lower reach of the creek, 50 meters downstream of the gage.

There are two monitoring sites that have not been visited. They are located on Upper Hitchcock Creek and on a tributary of Robinson Canyon Creek.

2 Methods

Suspended Sediment, Stream Discharge and Instantaneous Load Data

A water sample for sediment analysis was taken biannually at each location from March 2009 to November 2015. The suspended sediment concentration (mg/l) was found by filtering the sample and finding the mass of sediment per liter of water. Stream discharge measurements were conducted using standard hydrologic practices. A SonTek Flow Tracker velocity meter was used measure discharge. For low flows, a 3 inch Parshall Flume was used to measure discharge. Instantaneous load concentration (mg/s) was calculated as the product of the stream discharge and suspended sediment concentration.

Stream Nutrients

Water samples were collected biannually from each site from March 2009 to November 2015. Beginning in April 2015, the samples were sent to Monterey Bay Analytic Services (MBAS) analyzed for nutrients with a Lachat QuickChem flow-injection analyzer. The nutrients analyzed were ammonium, nitrate+nitrite and soluble reactive phosphate (SRP) (orthophosphate). This report provides a snapshot of stream nutrient concentrations (ppm) for future comparison and monitoring.

3 Results

Suspended Sediment, Stream Discharge and Instantaneous Load

Eleven sampling events over four years suggest that streams on the SLP carry very little suspended sediment (Table 1, Figures 1 & 2), indicating good aquatic habitat for Steelhead, macroinvertebrates, and other aquatic organisms.

Stream Nutrient Data

Stream nutrient concentrations (ppm) were the same order of magnitude as Clark et al. (2007) in all of the samples from the eleven sampling events (Table 2, Figures 3-22), indicating very good long term water quality at the sampling sites.

4 Discussion

Water quality monitoring parameters indicate that there are no impacts at this time, in keeping with previous monitoring results. Sediment appears higher in April than in previous years due to previously dry conditions in August 2014.

5 Water Quality Data Tables

Table 1: Suspended sediment concentration (mg/l), water discharge (l/s) and instantaneous load concentration (mg/s) from 8 monitoring sites on 4 creeks of the SLP. *Denotes a change in analytic labs where the samples were sent.

Location	Suspended Sediment Concentration (mg/l)	Q (l/s)	Instantaneous Load Concentration (mg/s)
August 2009			
Upper Garzas	NA	dry	NA
Mid Garzas	NA	dry	NA
Lower Garzas	0.023	pool	NA
Potrero	0.208	0.8	0.16
Upper San Clemente	0	0.1	0
San Clemente	0.027	0.7	0.018
Upper San Jose	0	trace	0
San Jose	0	3.1	0
March 2010			
Upper Garzas	0	132.8	0
Mid Garzas	0	239.6	0
Lower Garzas	0	333.4	0
Potrero	0.008	43.5	0.36
Upper San Clemente	0	75.9	0
San Clemente	0	196.2	0
Upper San Jose	0.007	60.8	0.41
San Jose	0	169.2	0
August 2010			
Upper Garzas	0	10.4	0
Mid Garzas	0	8.4	0
Lower Garzas	0	8.0	0
Potrero	0.016	2.2	0.034
Upper San Clemente	0	4.3	0
San Clemente	0	10.8	0
Upper San Jose	0	7.7	0
San Jose	0	23.7	0
March 2011			
Upper Garzas	0.023	639.9	14.785
Mid Garzas	0	185.5	0
Lower Garzas	0	197.7	0
Potrero	0.083	352.8	29.351
Upper San Clemente	0.007	31.4	0.208
San Clemente	0	102.8	0
Upper San Jose	0.041	274.3	11.249
San Jose	0.045	828.4	37.071
August 2011			
Upper Garzas	0	14.5	0
Mid Garzas	0	11.3	0
Lower Garzas	0.008	29.0	0.232
Potrero	0.119	3.3	0.391
Upper San Clemente	0	7.7	0
San Clemente	0	10.5	0
Upper San Jose	0	3.7	0
San Jose	0.008	19.0	0.143
March 2012			
Upper Garzas	0	80.9	0.202
Mid Garzas	0.008	108.2	0.850
Lower Garzas	0.011	139.9	1.534
Potrero	0.010	9.9	0.103
Upper San Clemente	0.001	11.6	0.007
San Clemente	0	57.0	0
Upper San Jose	0	29.7	0.1489
San Jose	0.010	104.1	1.0540
August 2012			
Upper Garzas	dry	dry	NA
Mid Garzas	dry	dry	NA
Lower Garzas	0.016	pool	NA
Potrero	0.064	1.2	0.078
Upper San Clemente	0.017	1.2	0.021
San Clemente	0.040	1.1	0.044
Upper San Jose	0.096	0.4	0.038
San Jose	0.012	7.0	0.081
March 2013			
Upper Garzas	0	8.4	0
Mid Garzas	0	45.6	0
Lower Garzas	0	25.8	0
Potrero	0.028	3.8	0.105
Upper San Clemente	0.014	9.3	0.131
San Clemente	0.004	17.1	0.069
Upper San Jose	0	8.4	0
San Jose	0.001	26.2	0.025
August 2013			
Upper Garzas	dry	dry	NA
Mid Garzas	dry	dry	NA
Lower Garzas	dry	dry	NA
Potrero	0.001	0.8	0.0005
Upper San Clemente	0.003	pool	NA
San Clemente	0	1.0	0
Upper San Jose	dry	dry	NA
San Jose	0.005	2.0	0.010
April 2014			
Upper Garzas	0	24.0	0
Mid Garzas	0.011	22.0	0.231
Lower Garzas	dry	dry	dry
Potrero	0.056	2.7	0.151
Upper San Clemente	0	2.5	0
San Clemente	0	5.3	0
Upper San Jose	0.001	0.0	0
San Jose	0.010	20.3	0.198
August 2014			
Upper Garzas	dry	dry	dry
Mid Garzas	dry	dry	dry
Lower Garzas	dry	dry	dry
Potrero	dry	dry	dry
Upper San Clemente	dry	dry	dry
San Clemente	0.001	0.4	0.000
Upper San Jose	dry	dry	dry
San Jose	0.002	0.5	0.001
April 2015*			
Upper Garzas	2.027	6.031	12.223
Mid Garzas	1.263	20.800	26.269
Lower Garzas	dry	dry	dry
Potrero	11.987	1.976	23.394
Upper San Clemente	0.932	8.100	7.553
San Clemente	1.716	18.400	31.569
Upper San Jose	4.044	2.697	10.906
San Jose	0.783	11.774	9.219
November 2015*			
Upper Garzas	dry	dry	dry
Mid Garzas	dry	dry	dry
Lower Garzas	pool	pool	pool
Potrero	4.258	NA	0.000
Upper San Clemente	dry	dry	dry
San Clemente	0.000	1.491	0.000
Upper San Jose	dry	dry	dry
San Jose	0.399	1.194	0.477

Note: 0 indicates sediment measurement below minimum detection limit

Table 2: Water samples from the monitoring sites were tested for ammonium (ppm), soluble reactive phosphorus (SRP) (orthophosphate) (ppm), and nitrogen as nitrate and nitrite (ppm).

Location	Ammonium (ppm)	SRP (ppm)	Nitrate + Nitrite (ppm)
August 2009			
Upper Garzas	dry	dry	dry
Mid Garzas	dry	dry	dry
Lower Garzas	0.452	0.020	0.020
Potrero	0.030	0.089	0.039
Upper San Clemente	0.022	0.032	0.035
San Clemente	0.032	0.027	0.076
Upper San Jose	no data	no data	no data
San Jose	0.022	0.045	0.020
March 2010			
Upper Garzas	0.014	0.018	0.013
Mid Garzas	0.016	0.021	0.154
Lower Garzas	0.025	0.016	0.015
Potrero	0.028	0.110	0.068
Upper San Clemente	0.017	0.026	0.010
San Clemente	0.016	0.028	0.017
Upper San Jose	0.021	0.078	0.018
San Jose	0.021	0.062	0.054
August 2010			
Upper Garzas	0.012	0.028	0.014
Mid Garzas	0.012	0.035	0.014
Lower Garzas	0.041	0.046	0.024
Potrero	0.021	0.180	0.046
Upper San Clemente	0.018	0.052	0.007
San Clemente	0.010	0.054	0.032
Upper San Jose	0.041	0.120	0.071
San Jose	0.037	0.093	0.060
March 2011			
Upper Garzas	0.016	0.000	0.052
Mid Garzas	0.020	0.000	0.096
Lower Garzas	0.021	0.000	0.035
Potrero	lab error	lab error	0.123
Upper San Clemente	0.033	0.004	0.033
San Clemente	0.034	0.007	0.041
Upper San Jose	0.031	0.043	0.074
San Jose	0.029	0.048	0.077
August 2011			
Upper Garzas	0.019	0.012	0.009
Mid Garzas	0.025	0.048	0.103
Lower Garzas	0.030	0.037	0.025
Potrero	0.017	0.129	0.022
Upper San Clemente	0.016	0.027	0.012
San Clemente	0.014	0.030	0.067
Upper San Jose	0.011	0.100	0.009
San Jose	0.014	0.092	0.011
March 2012			
Upper Garzas	0.016	0	0.096
Mid Garzas	0.029	0	0.052
Lower Garzas	0.021	0	0.035
Potrero	lab error	lab error	0.123
Upper San Clemente	0.033	0.004	0.033
San Clemente	0.034	0.007	0.041
Upper San Jose	0.031	0.043	0.074
San Jose	0.029	0.048	0.077
August 2012			
Upper Garzas	dry	dry	dry
Mid Garzas	dry	dry	dry
Lower Garzas	0.031	0.023	0.050
Potrero	0.022	0.215	0.054
Upper San Clemente	0.029	0.030	0.047
San Clemente	0.020	0.023	0.121
Upper San Jose	0.016	0.071	0.028
San Jose	0.014	0.057	0.033
March 2013			
Upper Garzas	0.016	0.017	0.028
Mid Garzas	0.021	0.030	0.037
Lower Garzas	0.021	0.023	0.021
Potrero	0.061	0.128	0.106
Upper San Clemente	0.024	0.035	0.034
San Clemente	0.015	0.039	0.029
Upper San Jose	0.019	0.071	0.045
San Jose	0.039	0.097	0.038
August 2013			
Upper Garzas	dry	dry	dry
Mid Garzas	dry	dry	dry
Lower Garzas	dry	dry	dry
Potrero	0.049	0.217	0.075
Upper San Clemente	0.033	0.022	0.048
San Clemente	0.032	0.004	0.135
Upper San Jose	dry	dry	dry
San Jose	0.036	0.023	0.085
April 2014			
Upper Garzas	0.018	0.015	0.024
Mid Garzas	0.019	0.030	0.020
Lower Garzas	dry	dry	dry
Potrero	0.036	0.133	0.072
Upper San Clemente	0.022	0.031	0.020
San Clemente	0.018	0.033	0.027
Upper San Jose	0.023	0.036	0.034
San Jose	0.017	0.067	0.032
August 2014			
Upper Garzas	dry	dry	dry
Mid Garzas	dry	dry	dry
Lower Garzas	dry	dry	dry
Potrero	dry	dry	dry
Upper San Clemente	0.069	0.051	0.052
San Clemente	0.062	0.070	0.142
Upper San Jose	dry	dry	dry
San Jose	0.064	0.076	0.073
April 2015*			
Upper Garzas	0.000	0.000	0.100
Mid Garzas	0.000	0.000	0.100
Lower Garzas	dry	dry	dry
Potrero	0.000	0.000	0.300
Upper San Clemente	0.000	0.000	0.051
San Clemente	0.000	0.000	0.200
Upper San Jose	0.000	0.000	0.200
San Jose	0.000	0.000	0.200
Novembert 2015*			
Upper Garzas	dry	dry	dry
Mid Garzas	dry	dry	dry
Lower Garzas	pool	pool	pool
Potrero	0.000	0.000	0.400
Upper San Clemente	dry	dry	dry
San Clemente	0.000	0.000	0.400
Upper San Jose	dry	dry	dry
San Jose	0.000	0.000	0.300

6 Water Quality Data Figures

Water quality graphs for 2009 through 2015. Values of zero indicate no flow or lab error.

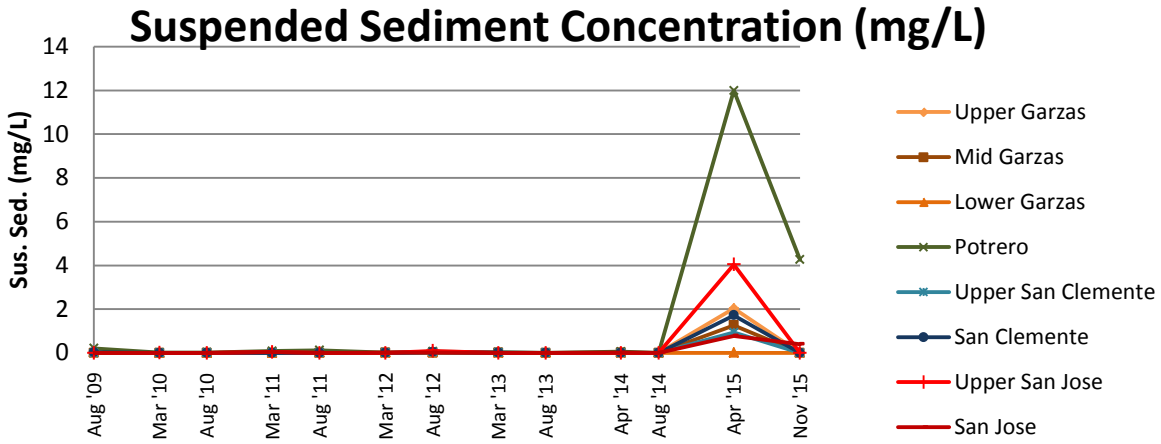

Figure 2: Suspended Sediment Concentration (mg/L) from 8 monitoring sites on 4 creeks of the SLP.

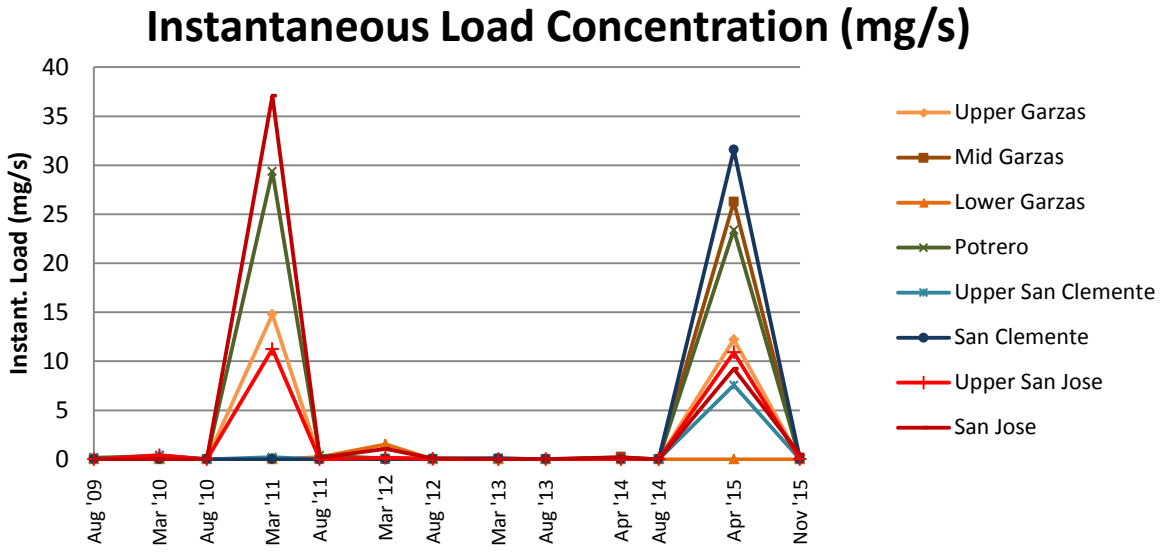

Figure 3: Instantaneous Load Concentration (mg/s) from 8 monitoring sites on 4 creeks of the SLP.

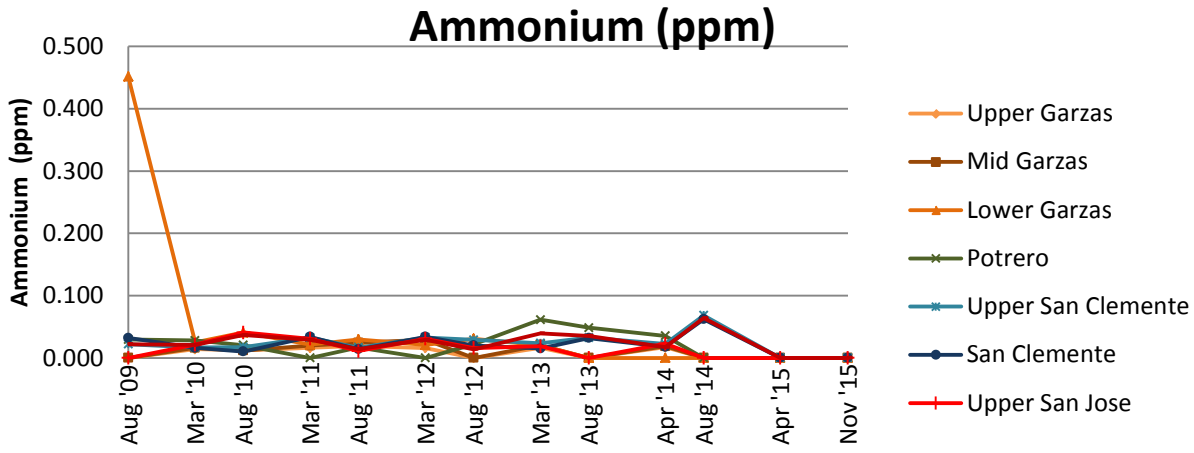

Figure 4: Ammonium (ppm) from 8 monitoring sites on 4 creeks of the SLP.

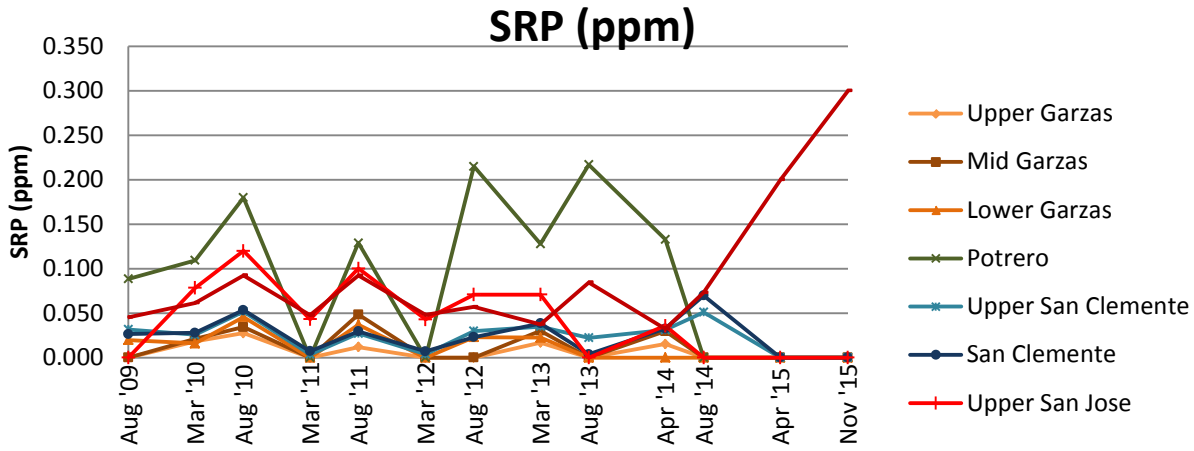

Figure 5 : Soluble Reactive Phosphorus (ppm) from 8 monitoring sites on 4 creeks of the SLP

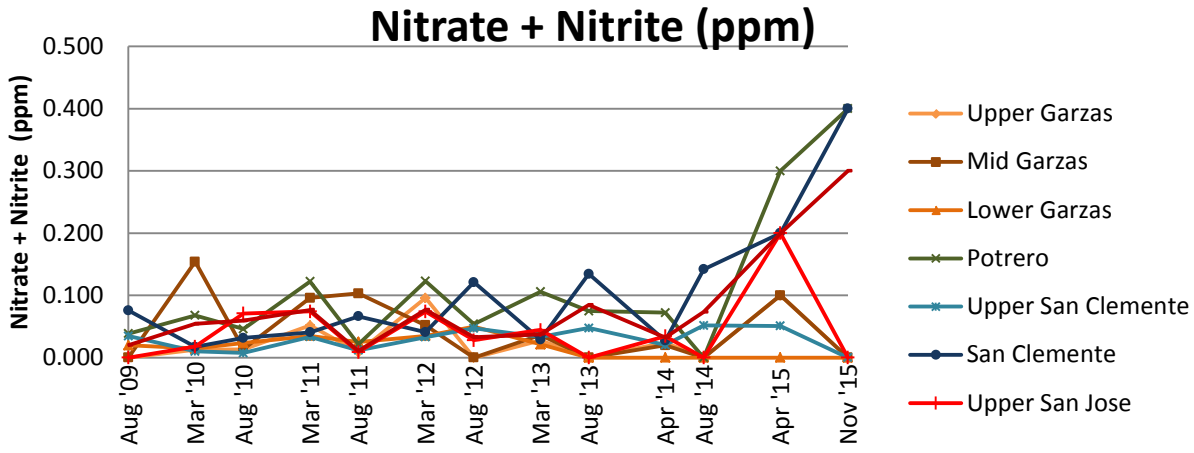

Figure 6: Nitrate and Nitrite (ppm) from 8 monitoring sites on 4 creeks of the SLP.

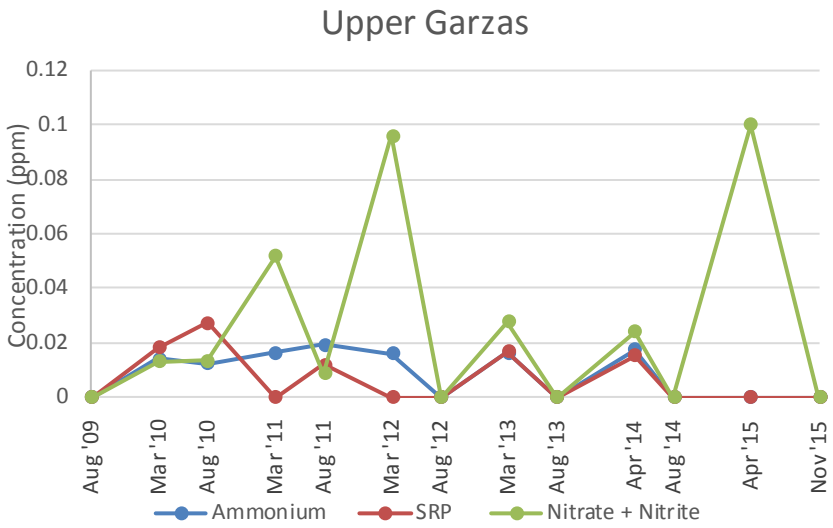

Figure 7. Ammonium, soluble reactive phosphorus, and nitrate/nitrite concentrations for Upper Garzas.

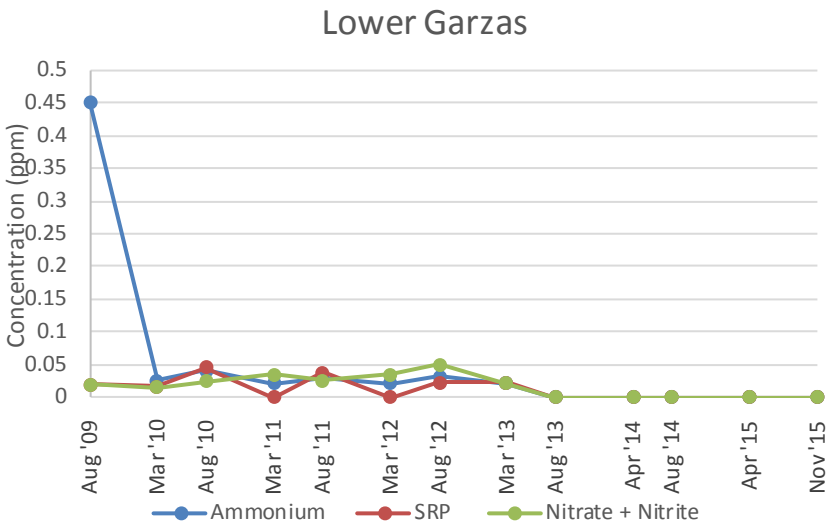

Figure 8. Ammonium, soluble reactive phosphorus, and nitrate/nitrite concentrations for Lower Garzas

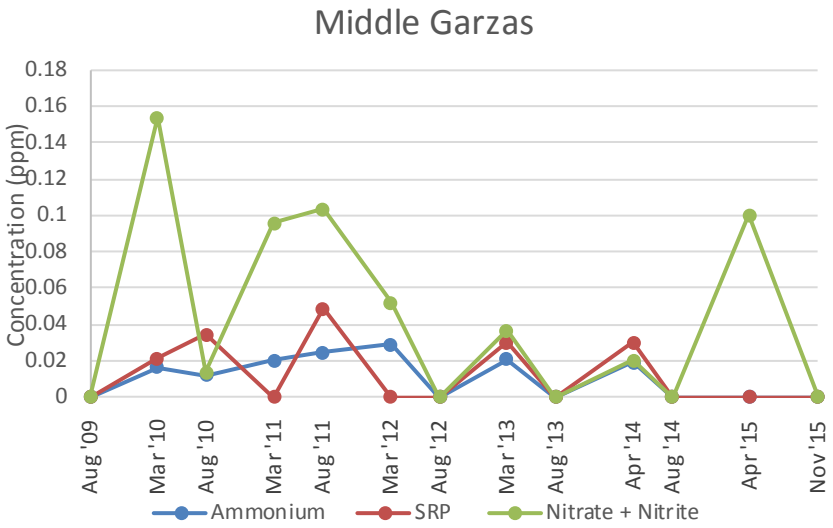

Figure 9. Ammonium, soluble reactive phosphorus, and nitrate/nitrite concentrations for Middle Garzas.

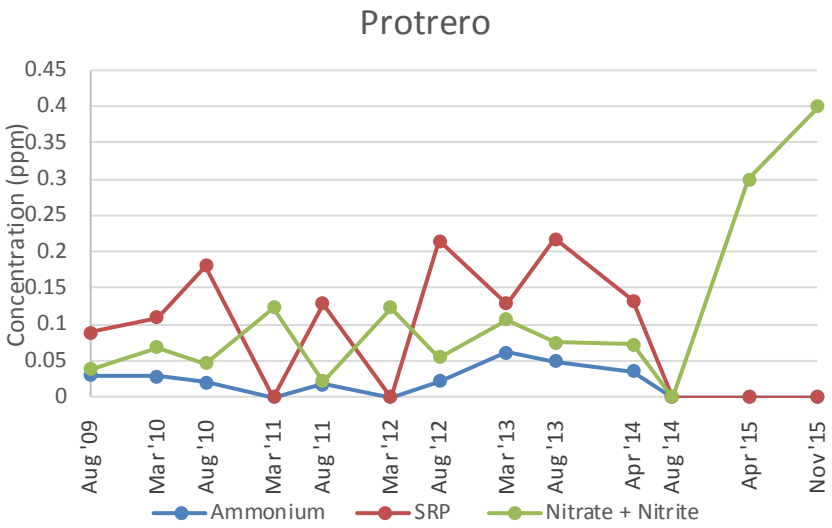

Figure 10. Ammonium, soluble reactive phosphorus, and nitrate/nitrite concentrations for Protrero.

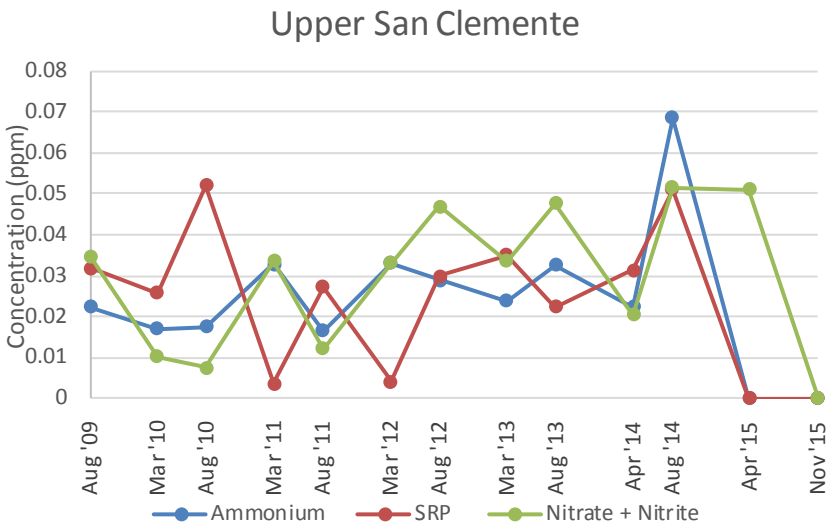

Figure 1. Ammonium, soluble reactive phosphorus, and nitrate/nitrite concentrations for Upper San Clemente.

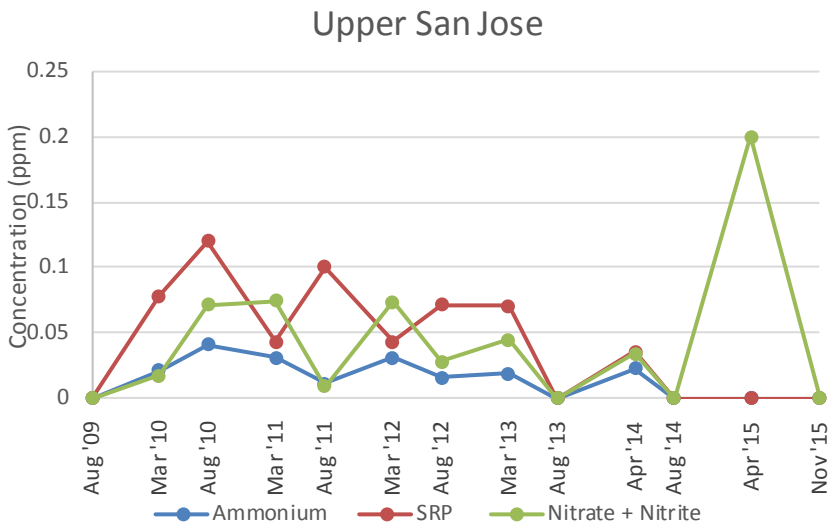

Figure 2. Ammonium, soluble reactive phosphorus, and nitrate/nitrite concentrations for Upper San Jose.

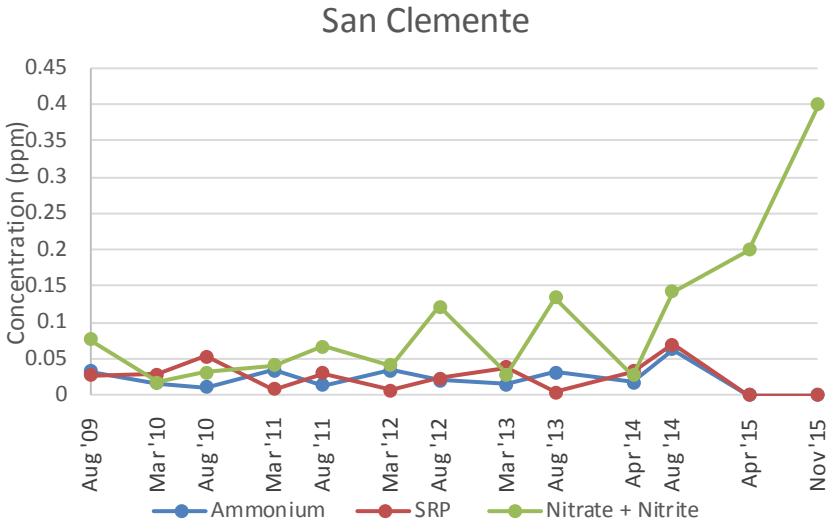

Figure 3. Ammonium, soluble reactive phosphorus, and nitrate/nitrite concentrations for San Clemente.

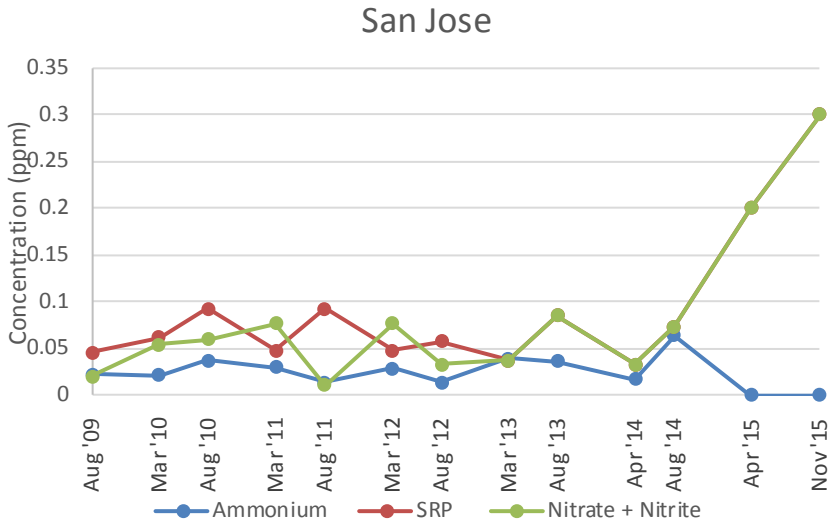

Figure 4. Ammonium, soluble reactive phosphorus, and nitrate/nitrite concentrations for San Jose.

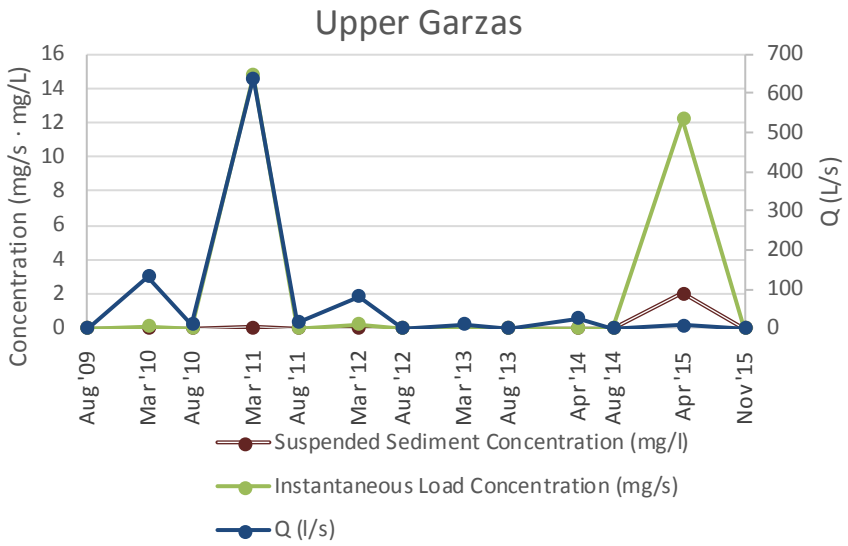

Figure 5. Suspended sediment (mg/L), instantaneous load concentration (mg/s), and water discharge (L/s) for Upper Garzas.

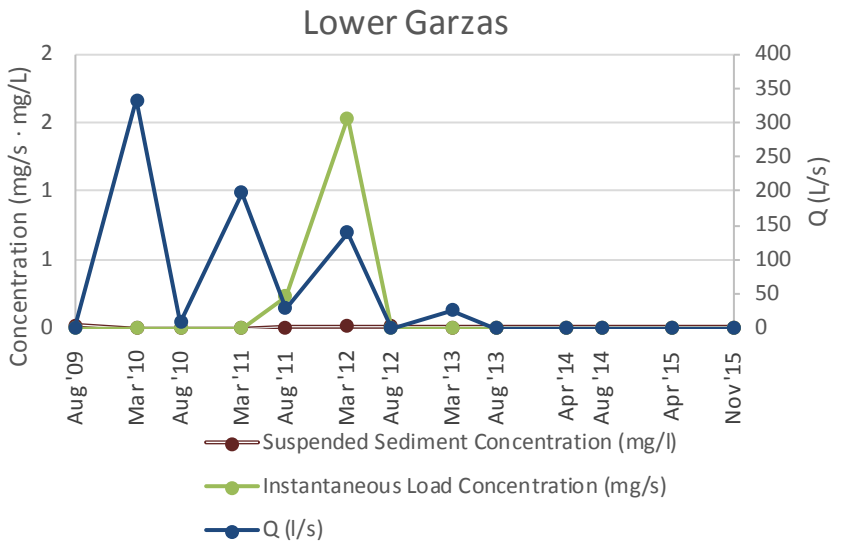

Figure 6. Suspended sediment (mg/L), instantaneous load concentration (mg/s), and water discharge (L/s) for Lower Garzas.

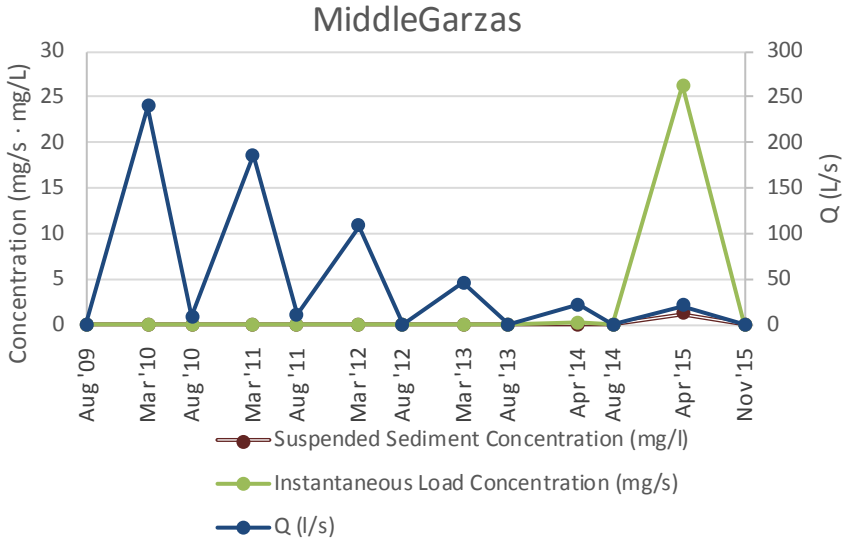

Figure 7. Suspended sediment (mg/L), instantaneous load concentration (mg/s), and water discharge (L/s) for Middle Garzas.

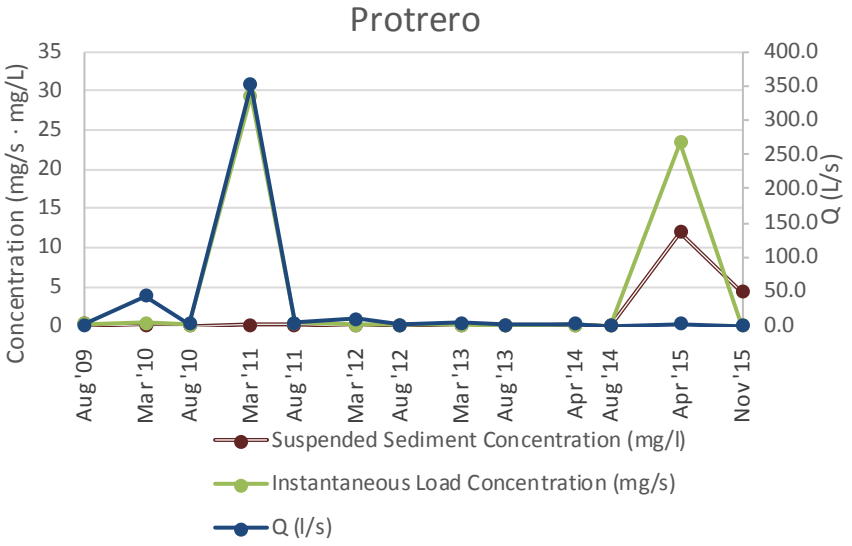

Figure 8. Suspended sediment (mg/L), instantaneous load concentration (mg/s), and water discharge (L/s) for Protrero.

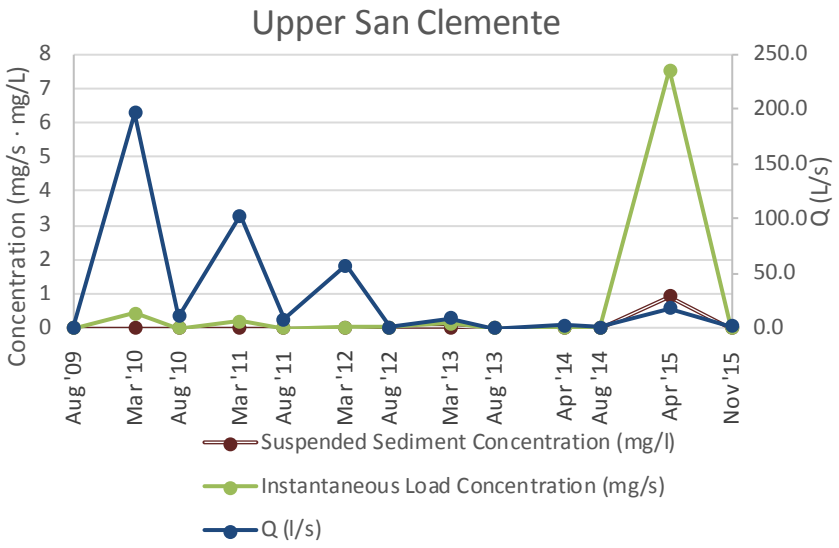

Figure 9. Suspended sediment (mg/L), instantaneous load concentration (mg/s), and water discharge (L/s) for Upper San Clemente.

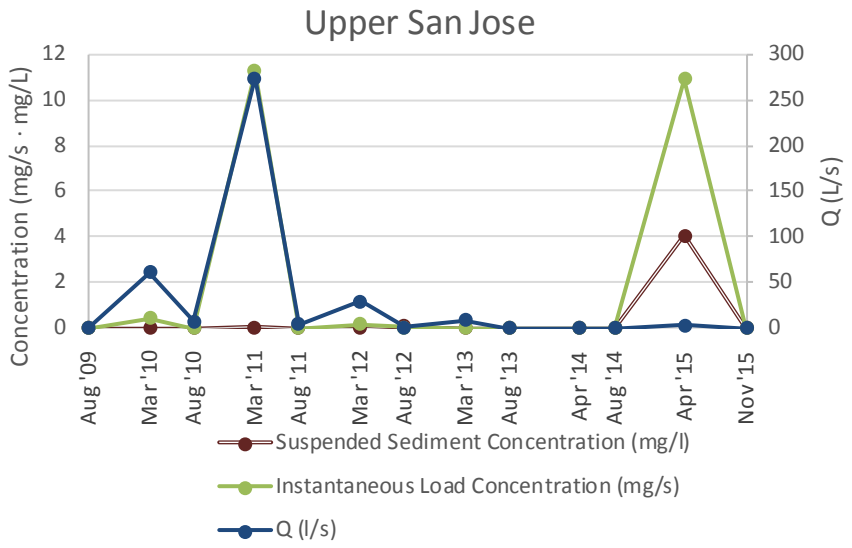

Figure 20. Suspended sediment (mg/L), instantaneous load concentration (mg/s), and water discharge (L/s) for Upper San Jose.

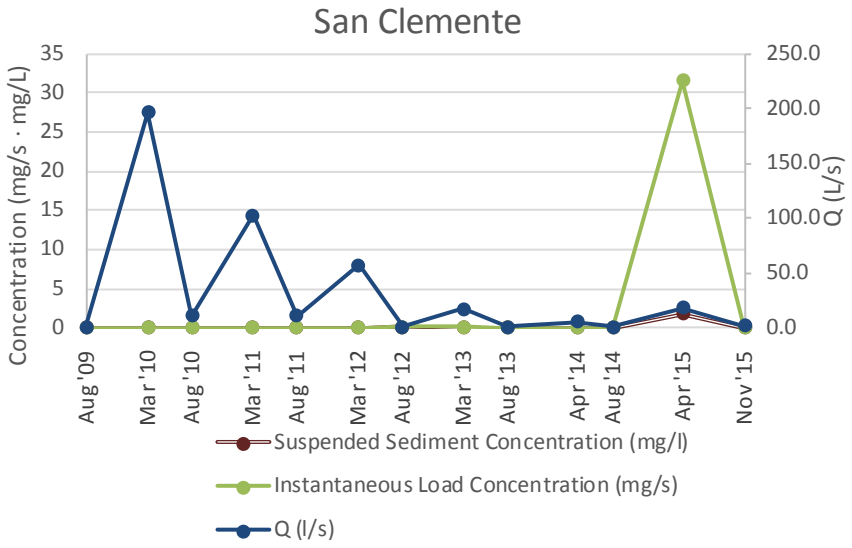

Figure 10. Suspended sediment (mg/L), instantaneous load concentration (mg/s), and water discharge (L/s) for San Clemente.

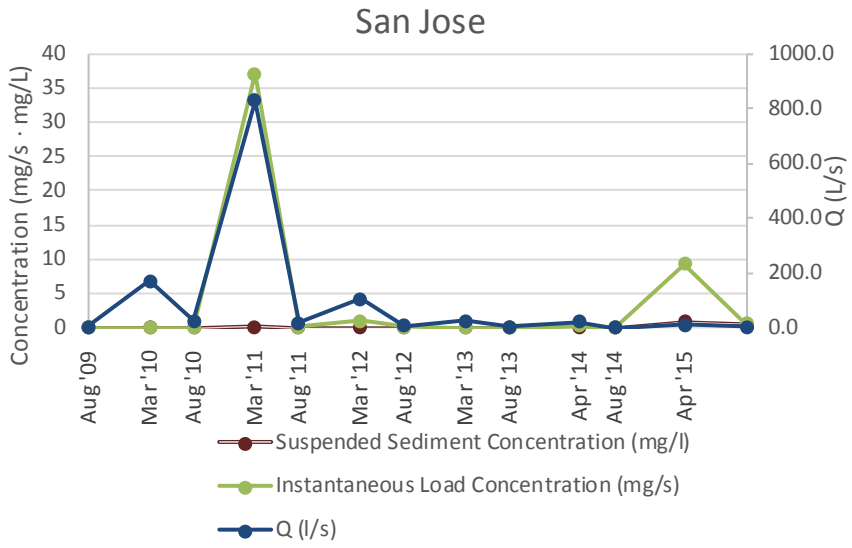

Figure 11. Suspended sediment (mg/L), instantaneous load concentration (mg/s), and water discharge (L/s) for San Jose.

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