SAN DIEGO REGION
IRRIGATED LANDS GROUP

December 18, 2013

Mr. Dat Quach
State Regional Water Quality Board
San Diego Region
2375 Northside Drive, Suite 100
San Diego, CA 92123-4340

Subject: San Diego Region Irrigated Lands Group
SDRWQCB Conditional Waiver No. 4
Monitoring Program Report, Year 1

Dear Mr. Quach:

PW Environmental (PW) prepared this *Monitoring Program Report* on behalf of San Diego Region Irrigated Lands Group (SDRILG). Monitoring and reporting was conducted in accordance with the California Regional Water Quality Control Board, San Diego Region's (SDRWQCB) *Conditional Waiver No. 4 – Discharges from Agriculture and Nursery Operations* (Waiver), and the associated Quality Assurance Project Plan and Monitoring and Reporting Program Plan (with revisions) submitted by SDRILG.

On July 18th and July 19th, 2013, all eight of the sampling locations were visited by either PW or Aquatic Bioassay Consulting Inc. personnel. Of the eight sites, five had sufficient water for sampling purposes. Three of the sites were sampled for water quality bioassessments, and two were sampled for general water quality chemistry. The included report presents results from the first monitoring event under the program

SDRILG trusts this report meets the Waiver requirements. Should you have questions or require clarification regarding this report, please contact the undersigned at 805-525-5563.

Respectively submitted,

San Diego Region Irrigated Lands Group

Bryn S. Home
Project Manager, PW Environmental

Eric Larson
Executive Director, SDRILG

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MONITORING PROGRAM REPORT

SAN DIEGO REGION IRRIGATED LANDS GROUP

December 18, 2013

MONITORING PROGRAM REPORT

December 18, 2013

Prepared by:

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SDRWQCB Conditional Waiver No. 4

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ABC	Aquatic Bioassay Consulting Laboratories, Inc.
AFDW	ash free dry weight
BMI	Benthic Macroinvertebrates
BMP	Best Management Practice
CDFG	California Department of Fish and Game
Chl-a	chlorophyll-a
cm^2	centimeters squared
COC	Chain of Custody
D.O.	Dissolved Oxygen
EMAP	Western Environmental Monitoring and Assessment Program
EPT	Ephemeroptera, Plecoptera, and Trichoptera
FFG	Functional Feeding Group
HA	Hydrologic Area
HAS	Hydrologic Sub Areas
HU	Hydrologic Unit
IBI	Index of Biological Integrity
m^2	meters squared
m^3/s	cubic meters a second
ml	milliliters
mm	millimeter
MPR	Monitoring Program Report
MRPP	Monitoring and Reporting Program Plan
NOI	Notice of Intent
PHab	Physical Habitat
PW	PW Environmental
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
QC	Quality Control
RWB	Reach Wide Benthos
SAFIT	Southwest Association of Freshwater Invertebrate Taxonomists
SDRILG	San Diego Region Irrigated Lands Group
SDRWQCB	San Diego Region Water Quality Control Board
SLR	San Luis Rey Hydrologic Unit; San Luis Rey Watershed
SMC	Southern California Stormwater Monitoring Coalition
SOP	Standard Operating Procedure
STE	Standard Taxonomic Effort
SWAMP	Surface Water Ambient Monitoring Program
TMDL	Total Maximum Daily Loads
USEPA	United States Environmental Protection Agency
Waiver	Conditional Waiver No. 4 – Discharges from Agriculture and Nursery Operations

MONITORING PROGRAM REPORT

SAN DIEGO REGION IRRIGATED LANDS GROUP

1.0 PROJECT PERSONNEL

The SDRILG was formed to comply with the SDRWQCB *Conditional Waiver No. 4 – Discharges from Agriculture and Nursery Operations* (Waiver). Mr. Eric Larson is the Administrator and primary contact for the SDRILG. PW was contracted to assist the SDRILG with the technical requirements of the Waiver. Mr. Bryn Home is the Project Manager for the program.

The SDRILG is responsible for organizing and managing the administrative aspect of the SDRILG while PW manages the technical aspect of the SDRILG. The SDRILG assisted the individual participants in completing and submitting the NOI forms. PW developed the required QAPP and the MRPP, on behalf of the SDRILG. PW is also currently responsible for the oversight of field monitoring and sampling at the selected sites for the SDRILG, and all additional reporting, including MPR. ABC is responsible for the field studies and laboratory work.

ABC will be conducting all field measurements, collecting benthic macroinvertebrates, algae, and chemical water samples, analyzing biological samples, and managing field data. Chemical analysis of collected water and analysis algae samples will be subcontracted out through ABC. All subcontracters utilized are certified by the California Environmental Laboratory Accreditation Program. Mr. Scott Johnson of ABC is the Laboratory Project Manager for this waiver program. The contact information for ABC is:

ABC Laboratories, Inc.
Scott Johnson (805) 643-5621 ext. 11
29 North Olive Street
Ventura, CA 93001

2.0 BACKGROUND

2.1 Introduction

The SDRWQCB is a State of California Agency that regulates water quality within the San Diego Region. The San Diego Region includes the coastal watersheds of San Diego County, the southern portion of Orange County and a small portion of Riverside County. The SDRILG operates throughout the entirety of the San Diego Region.

All eleven Watersheds in the region have impacted waterbodies that appear on the Federal 303(d) list, and listed contaminants include constituents that could be related to agricultural uses. In accordance with section 303(d) of the Clean Water Act, the SDRWQCB is in the process of developing TMDLs for these impacted waterbodies. Currently, TMDLs have been adopted for Chollas Creek, Rainbow Creek, Los Penasquitos Lagoon, and the Shelter Island Yacht Basin, and TMDLs are in progress for areas of the San Diego Bay, the Tijuana River and Estuary, Los Penasquitos Lagoon, Santa Margarita Lagoon, Loma Alta Slough, Buena Vista Lagoon, Agua Hedionda Lagoon, lower Agua Hedionda Creek, San Elijo Lagoon, Famosa Slough and Channel, the shoreline of Buena Vista Creek, the shoreline of Escondito Creek, and the shoreline of Loma Alta. The SDRWQCB also adopted indicator bacteria TMDLs for twenty beaches and creeks in the region, as well as Baby Beach and Shelter Island Shoreline Park.

Water quality impacts associated with agriculture can be primarily traced to discharges resulting from irrigation or stormwater. These discharges may contain pollutants that have been imported or introduced into the irrigation or stormwater; in addition, irrigation practices can mobilize and or concentrate some pollutants. In order to evaluate the potential impacts of discharges from agricultural land on beneficial uses of water bodies within the San Diego Region, the SDRWQCB adopted Conditional Waiver No. 4 (as part of Resolution R9-2007-0104; Waiver) on October 10, 2007, as mandated by State law and policy.

To comply under the Waiver, agricultural and nursery operations were required to form or join a monitoring group or submit an individual NOI by January 1, 2011. In addition to the general conditions listed in the Waiver, dischargers are required to implement monitoring programs to assess the impacts of discharges from irrigated lands. SDRILG's MRPP and QAPP were prepared to address this general condition. As discussed in the MRPP and subsequent revisions, the SDRILG collects samples from the San Luis Rey watershed to represent the group as a whole. This report presents the first years monitoring results under Conditional Waiver No. 4.

2.2 San Luis Rey Hydrologic Unit Description

The San Luis Rey Hydrologic Unit, or San Luis Rey River Watershed (SLR), is located in northern San Diego County and is approximately 560 square miles. It includes the cities of Oceanside and Valley Center, and portions of Fallbrook and Camp Pendleton. Several Native American Reservations are located in the unit. The SLR is bordered to the north by the Santa Margarita HU, and is bordered to the south by the Carlsbad and San Dieguito HU.

The main water body in the watershed is the San Luis Rey River, which is ephemeral and dry in the upper and middle reaches for most of the year. The river extends approximately 55 miles, and ultimately discharges to the Pacific Ocean in Oceanside. The San Luis Rey River originates primarily from the Palomar and Hot Springs Mountains, and is interrupted by Lake Henshaw, Henshaw Dam, and the Escondido Canal. Historically, when water is released from Henshaw Dam the Escondido Canal has diverted approximately 90% of the San Luis Rey River from the lower reaches to the Local Entities of the City of Escondito and the Vista Irrigation District. Flood flow in the river is typically limited to short durations. The majority of the river is unchannelized, except the lower seven miles, which are contained within a channel bounded by earthen levees on both sides and generally contains water year round.

The SLR is unique in the aspect that groundwater and surface water have become an integrated system, and are not hydrologically separate. Groundwater impairments can have an impact on surface water quality, and surface water quality impairments may directly influence groundwater quality. There are six shallow alluvial groundwater aquifers that are currently used for agricultural, industrial, and municipal supplies: Warner, Pauma, Pala, Bonsall, Moosa Canyon, and Mission Basin. Groundwater levels in these areas have a direct effect on surface flows present in the region. Additionally, much of the anthropogenic runoff is supplemented with Colorado River water, which inherently has a higher salt content and can affect both surface water and groundwater conditions.

The SLR is comprised of three hydrologic areas (HA) and eleven hydrologic sub areas (HAS), which were delineated by the SDRWQCB based on drainage patterns. Figure 1 presents the HA and HAS located within the SLR, and Table 1 and Figure 2 present the SDRILG acreage enrolled in each HA.

Figure 1 San Luis Rey Hydrologic Areas and Subareas

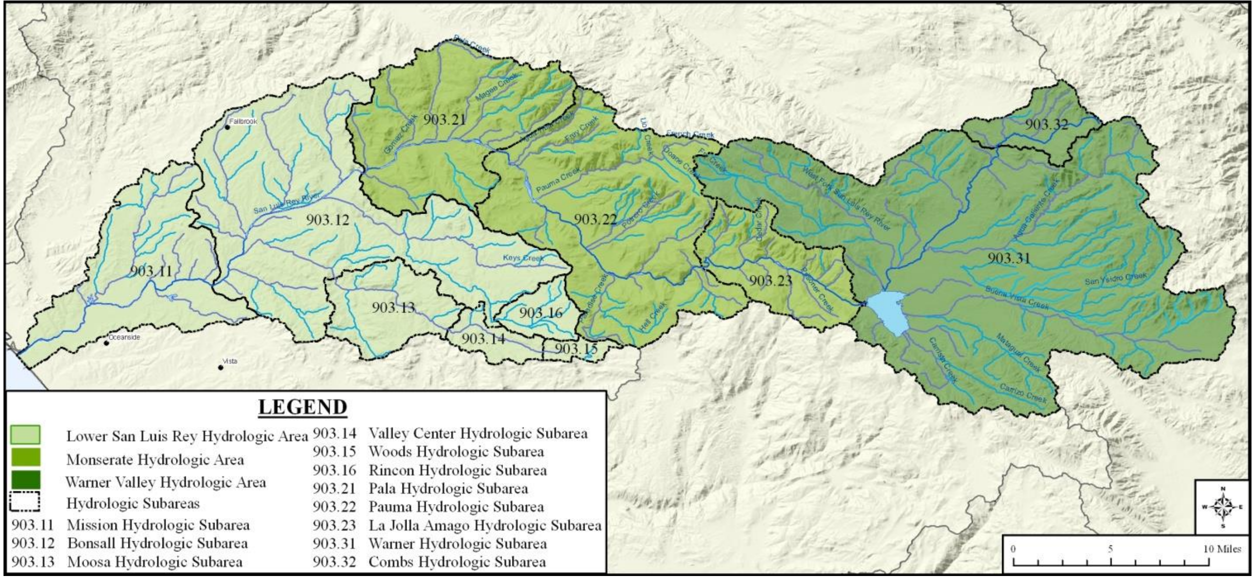
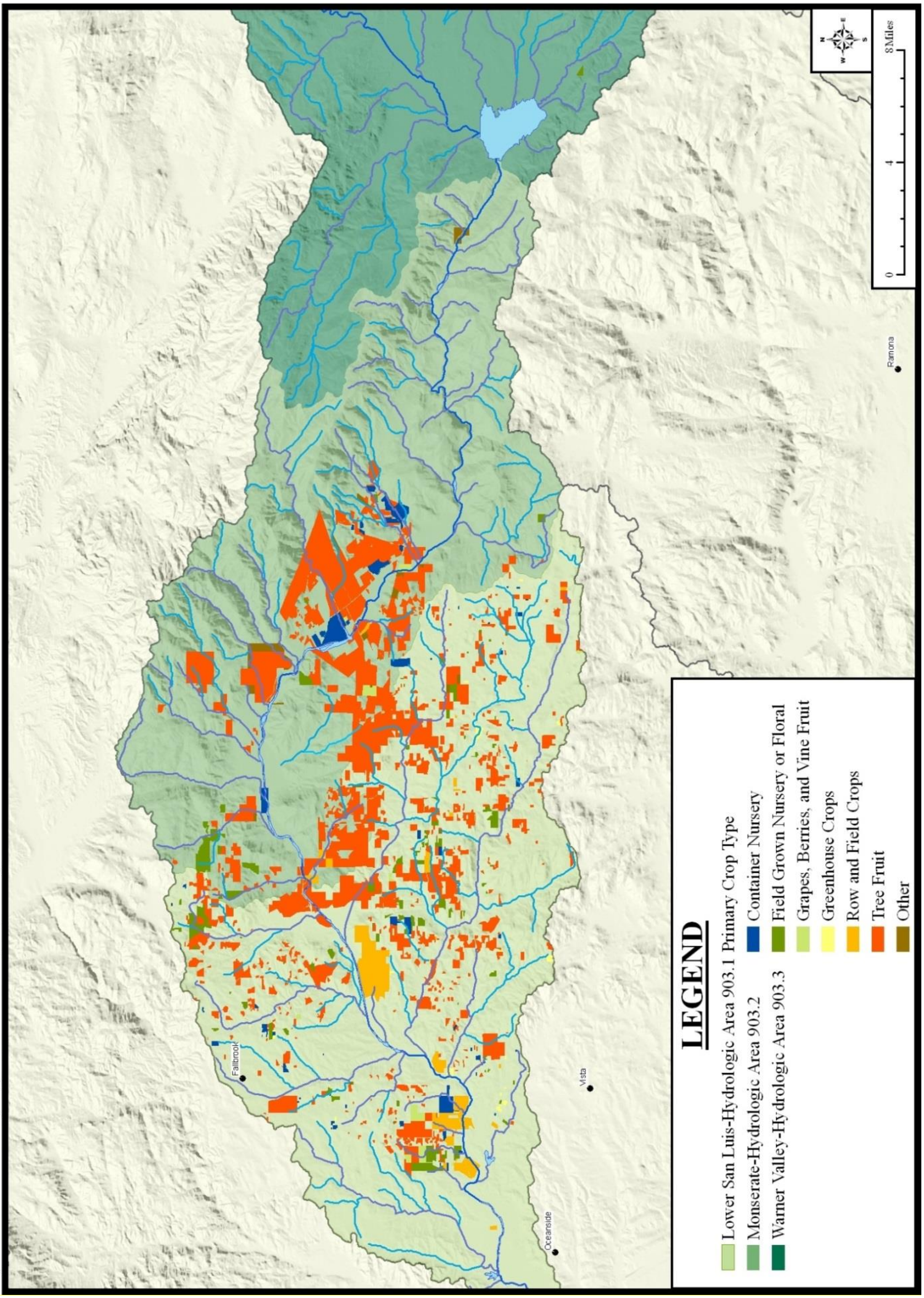


Table 1 SDRILG Distribution in San Luis Rey Hydrologic Unit

Hydrologic Unit	**Hydrologic Area**	**Hydrologic Subarea Code**	**Hydrologic Subarea Name**	**Total Acreage**	**% Acreage**	
San Luis Rey	Lower San Luis Rey	903.11	Mission	2,710.39	7.73%	54.95%
		903.12	Bonsall	13,924.04	39.73%	
		903.13	Moosa	1,784.46	5.09%	
		903.14	Valley Center	312.52	0.89%	
		903.15	Woods	135.99	0.39%	
		903.16	Rincon	389.64	1.11%	
	Monserate	903.21	Pala	5,507.61	15.72%	44.97%
		903.22	Pauma	10,136.12	28.92%	
		903.23	La Jolla Amago	114.87	0.33%	
	Warner	903.31	Warner	28.70	0.08%	0.08%
		903.32	Combs	0.00	0.00%	
				35,044.33		

Figure 3 SDRILG Crop Types, San Luis Rey Hydrologic Area



2.3 Sampling and Analysis

Based on the SDRWQCB response letter to the first version of the MRPP, dated March 20, 2012, and follow up letter dated November 30, 2012, the MRPP was revised and resubmitted on March 22, 2013. The revised MRPP included biological assessments along with water quality samples at seven sites (five primary and two backup) in the SLR. The new biological sampling requirements necessitated access agreements at all of the biological sampling stations, as a 500-foot reach of stream was required and sampling events would intrude onto private and public lands. SDRILG requested access to all of the locations proposed in the MRPP, but was only granted full access to three of the sites.

In the *Revisions to Monitoring and Reporting Program Plan* letter dated May 31, 2013, SDRILG presented a sampling plan to account for the lack of access at all the sites. SDRILG proposed to sample three locations for the full bioassessment parameters outlined in the MRPP, and to also include five additional locations as grab sample locations to assess general water quality in the area and assist in focusing efforts to obtain sampling rights in the future. Table 2 presents the current monitoring stations that were assessed during this reporting period.

Table 2 Sampling Sites, SDRILG

Sampling Site ID	**Access Status**	**Geographic Coordinates**	**San Luis Rey Hydrologic Sub-Area**	**Sampling River**
Biological Sampling Locations				
SDRILG02	Granted	N 33^o 19’ 36.83” W 117^o 06’ 32.31”	903.21	Couser Canyon
SDRILG03	Granted	N 33^o 17’ 16.57” W 117^o 05’ 00.00”	903.12	Keys Creek
SDRILG05	Granted	N 33^o 17’ 39.04” W 117^o 05’ 13.32”	903.12	Weaver Creek
Chemistry Grab Sample Locations				
SDRILG01	Acceptable for Grab	N 33^o 16’ 56.53” W 117^o 12’ 00.91”	903.12	Moosa Creek
SDRILG06	Acceptable for Grab	N 33^o 15’ 57.51” W 117^o 13’ 58.75”	903.12	Gopher Canyon
SDRILG07	Acceptable for Grab	N 33^o 16’ 24.23” W 117^o 09’ 11.60”	903.12	Moosa Creek Tributary
SDRILG08	Backup, Acceptable for Grab	N 33^o 22’ 7.07” W 117^o 09’ 41.77”	903.12	San Luis Rey Unnamed Tributary
SDRILG09	Backup, Acceptable for Grab	N 33^o 16’ 15.94” W 117^o 05’ 12.42”	903.12	Keys Creek, S. Fork

Complete biological sampling procedures and analysis are presented in the MRPP, prepared by PW, and the *Agricultural Discharge Monitoring Report*, prepared by ABC and included as Appendix A. Table 3 presents the general elements that were covered at all three of the biological sampling locations.

Table 3 Elements of Assessments

ASSESSMENT	ELEMENT	PARAMETER(S)/TEST
BMI	Taxonomic ID	TRC, RWB, MCM, or combo
Algae	Taxonomic ID	Diatoms/Soft community assessment
	Biomass Assessment	Chlorophyll-a, AFDM
	Percent Algal Cover	N/A
	Water Chemistry	NO_2, NO_3, NH_3, TN, SRP, TPHOS, DOC, Cl
BMI and Algae	Water Quality Parameters	Temperature, pH, EC, DO, Alkalinity, Turbidity
	P-Hab	See Table X
Additional, as requested by SDRWQCB	Water Chemistry and Quality Paramters	PN, POC, PP, Sulfate, TDS, TSS
	Site Information	Unshaded Solar Radiation, Days since last scour event

TRC	Targeted Riffle Composite	TPHOS	Phosphorous, Total
RWB	Reachwide Benthos	DOC	Dissolved Organic Carbon
MCM	Margin-Center-Margin	Cl	Chloride
AFDM	Ash Free Dry Mass	EC	Specific Conductivity
N/A	Not Applicable	DO	Dissolved Oxygen
NO2	Nitrite as N	PN	Particulate Nitrogen
NO3	Nitrate as N	POC	Particulate Organic Carbon
NH3	Ammonia as N	PP	Particulate Phosphorus
TN	Nitrogen, Total	TDS	Total Dissolved Solids
SRP	Soluble Reactive Phosphorus	TSS	Total Suspended Solids

Table 4 presents the laboratory analytical suite that was monitored at the five additional grab sample locations, if water was present.

Table 4 – Laboratory Analytical Suite, Grab Samples

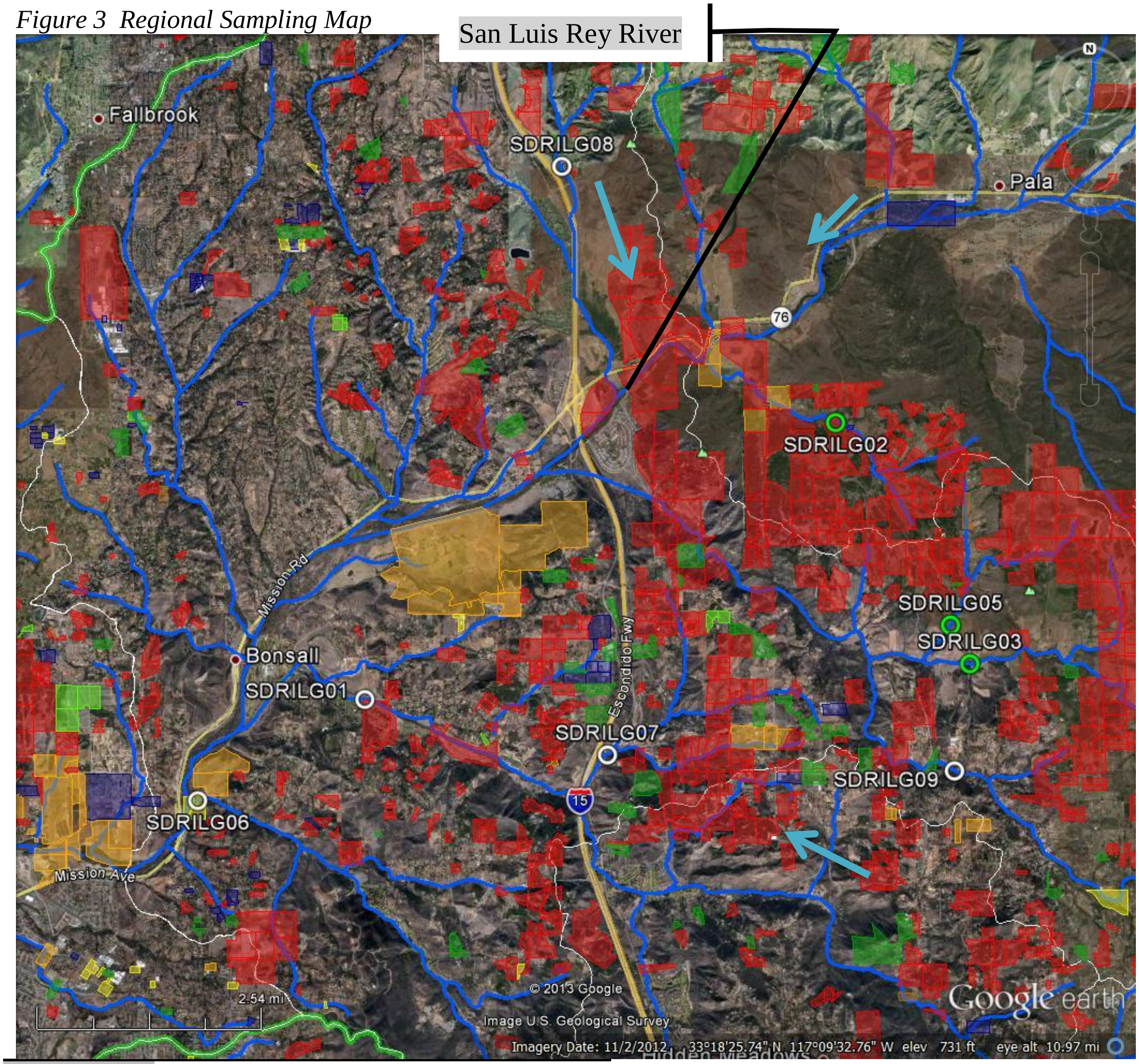
CONSTITUENT	UNITS	FIELD/LABORATORY TEST
Flow	Cubic feet per second	Field Meter
pH	pH units	Field Meter
Temperature	°F	Field Meter
Specific Conductivity	uS/m	Field Meter
Dissolved Oxygen	mg/L	Field Meter
Alkalinity	mEq/L	Field Meter
Turbidity	NTU	Field Meter
Unshaded Solar Radiation	BTU/ft3/day	Data Manuals
Days Since Scour Event	days	Hydrographs/Rainfall Totals
Total Dissolved Solids	mg/L	Laboratory, Method SM2540C
Total Suspended Solids	mg/L	Laboratory, Method SM2540D
Chloride	mg/L	Laboratory. Method EPA 300.0
Ammonium as N	mg/L	Laboratory, Method EPA 350.1
Nitrate as N (NO3)	mg/L	Laboratory, Method EPA 353.2
Nitrite as N (NO2)	mg/L	Laboratory, Method EPA 353.2
Nitrogen Total N	mg/L	Laboratory, by calculation
Particulate Nitrogen	mg/L	Laboratory, Method EPA 351.2
Soluble reactive Phosphorus	mg/L	Laboratory, Method EPA 365.1
Total Phosphorus	mg/L	Laboratory, Method EPA 365.1
Particulate Phosphorus	mg/L	Laboratory, Method EPA 365.1
Sulfate	mg/L	Laboratory, Method EPA 300.0
Particulate Organic Carbon	mg/L	Laboratory, Method SM5310C
Dissolved Organic Carbon	µg/L	Laboratory, Method SM5310C

3.0 SUMMARY OF SAMPLING RESULTS, 2013

On July 18th and July 19th, 2013, all eight of the sampling locations were visited by either PW or ABC personnel. Of the eight sites, five had sufficient water for sampling purposes. Three of the sites were sampled for water quality bioassessments, and two were sampled for general water quality chemistry. All data quality objectives were met for this sampling event. Please note that sampling occurred after a season of low rainfall totals.

A regional map showing sampling locations, agricultural parcels enrolled in the SDRILG, blue stream waters in the region, and crop types in the surrounding area is presented as Figure 3. A complete report of sampling methodology, water quality measurements, physical habitat conditions, benthic macroinvertebrate communities, attached algae communities, and associated IBI scores is presented in the *Agricultural Discharge Monitoring Report*, prepared by ABC and included in Appendix A. The following presents a summary of sampling results and observations at each individual site, with respect to San Diego Basin Plan (Basin Plan) objectives, members of the SDRILG, surrounding land uses, and general watershed characteristics. A discussion of results is presented in Section 4.

Figure 3 Regional Sampling Map



KEY	
🟥	Tree Fruit
🟧	Row and Field Crops
🟩	Field Grown Nursery/Floral
🟩	Grapes, Berries, and Vine Fruit
🟨	Greenhouse
🟦	Container Nursery
🟫	Other
○	Sampling Site and Number. Green for Biological, White for Chemical only
↖	General Flow Direction

3.1 Sampling Site 1-Moosa Creek

Station ID: SDRILG01
Sampling Type: Grab Sample, Water Chemistry
Sub basin: 903.12
Primary Crop Type Draining to Site: Tree Fruit
Secondary Crop Type Draining to Site: Field Grown Nursery/Floral
Stream Type: Third Order, Perennial
Sample site GPS location:
N 33^{o} 16’ 56.53” W 117^{o} 12’ 00.91”

Water Quality Exceedances

Grab samples collected at the site exceeded Basin Plan objectives for: Chloride, Sulfate, Total Dissolved Solids, Total Phosphorous as P, and Total Nitrogen : Total Phosphorous ratios.

Site Description

On July 18th, 2013, running water was observed and sampled. The creek had a low flow, approximated at 0.01 to 0.02 m^3/s. The watershed draining to the area is large, with irrigated cropland, equestrian properties, and large residential properties being the dominant land use near the samplng site. The eastern reaches of the creek also drain areas of Valley Center. The streambed appeared absent of large boulders and contained some live tree roots and vegetation on the banks. The physical habitat of the stream was highly altered, and follows a wide, man-made ditch prior to running through the San Luis Rey Downs Golf and Country Club.

Samples from this site are indicative of runoff from a larger watershed, and are not completely representative of agricultural runoff from the SDRILG.

3.2 Sampling Site 2-Couser Canyon

Station ID: SDRILG02
Sampling Type: Biological
Sub basin: 903.21
Primary Crop Type Draining to Site: Tree Fruit
Stream Type: Second Order, Perennial or Intermittent
Sample site GPS location:
N 33° 19’ 36.83” W 117° 06’ 32.31”

Water Quality Exceedances

Grab samples collected at the site exceeded Basin Plan objectives for: Chloride, Sulfate, Total Dissolved Solids, Ammonia as N, Nitrate as N, and Total Nitrogen : Total Phosphorous ratios.

Biological Metrics

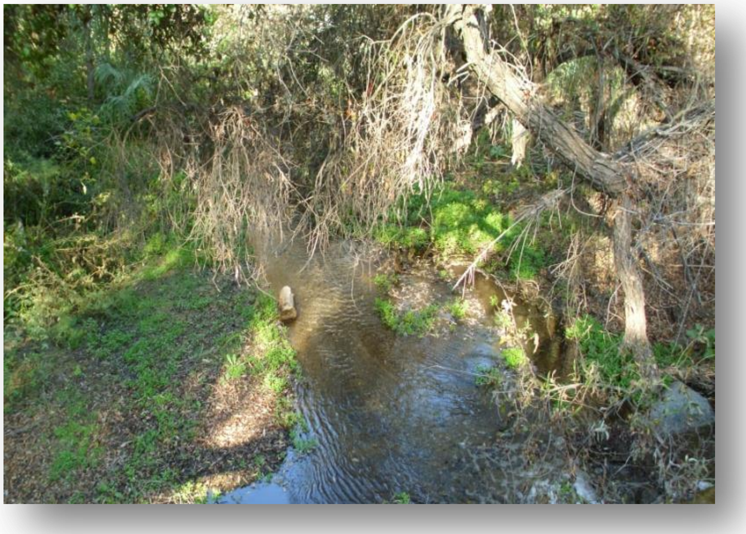
The site supported the most diverse benthic macroinvertebrate community of the three biological sampling sites. The calculated Southern California IBI score for the site was 61, which is classified as good for the region.

A tool to calculate algea IBI scores was not yet published at the time of this report, and will be further evaluated upon release. Preliminary results indicate the site has a better community structure than SDRILG03, and is more impaired by sediment than SDRILG03. The pollution index was similar across all three sites, indicating diatomic species present are somewhat sensitive to pollution.

Site Description

On July 18th, 2013, running water was observed and sampled. The creek had a low flow, approximated at 0.01 to 0.02 m^3/s. The watershed draining to the area is irrigated cropland, with some equestrian properties and houses. The streambed was well covered, had vulnerable banks, and was composed of riffles and glides in a gravel, sand, and fine substrate. The physical habitat of the stream was highly altered, with the riparian zone altered by clearing and landscaping.

Samples from this site are a good representation of runoff from SDRILG members, with the majority of the surrounding sub-watershed enrolled in the group. Tree fruit is the only agricultural use upstream of the sampling location.



3.3 Sampling Site 3-Keys Creek, North Fork

Station ID: SDRILG03
Sampling Type: Biological
Sub basin: 903.21
Land Use Draining to Site: Large area: mixed agriculture, low density residential, and open space.
Stream Type: Perennial
Sample site GPS location:
N 33^{o} 17’ 16.57” W 117^{o} 05’ 00.00”

Water Quality Exceedances

Grab samples collected at the site exceeded Basin Plan objectives for: Chloride, Sulfate, Total Dissolved Solids, and Total Nitrogen : Total Phosphorous ratios.

Biological Metrics

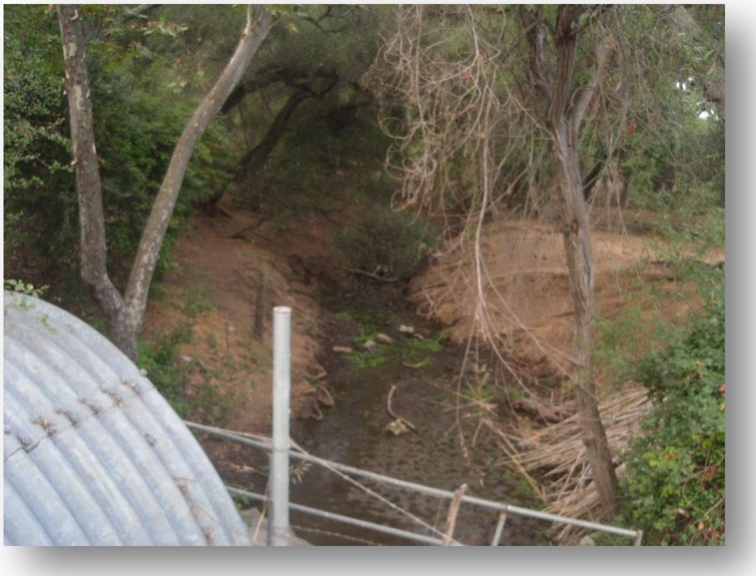
The site supported the least diverse benthic macroinvertebrate community of the three biological sampling sites, and pollution tolerant taxa were abundant. The calculated IBI score for the site was 6, which is classified as very poor for the region.

A tool to calculate algea IBI scores was not yet published at the time of this report, and will be further evaluated upon release. Preliminary results indicate the site the worst community structure of the three sites, and is the least impaired by sediment. The pollution index was similar across all three sites, indicating diatomic species present are somewhat sensitive to pollution.

Site Description

On July 18th, 2013, running water was observed and sampled. The creek had a low flow, approximated at below 0.01 m^3/s. The watershed draining to the area is the largest of the sites, with irrigated cropland, rangeland, open space, and rural housing and the community of Valley Center to the East. The streambed was well covered, had vulnerable banks, and was composed of glides in a gravel, sand, and fine substrate. The physical habitat of the stream was highly altered, with indications of routine cattle crossings in the area.

Samples from this site are indicative of runoff from a larger watershed, and are not completely representative of agricultural runoff from the SDRILG.



3.4 Sampling Site 5-Weaver Creek

Station ID: SDRILG05
Sampling Type: Biological
Sub basin: 903.12
Primary Crop Type Draining to Site: Tree Fruit
Stream Type: Perennial or Intermittent
Sample site GPS location:
N 33^o 17’ 39.04” W 117^o 05’ 13.32”

Water Quality Exceedances

Grab samples collected at the site exceeded Basin Plan objectives for: Chloride, Sulfate, Total Dissolved Solids, Nitrate as N, and Total Nitrogen : Total Phosphorous ratios.

Biological Metrics

The site supported a diverse benthic macroinvertebrate community and supported the most sensitive EPT taxa and most diverse feeding strategy of the sampling sites. The calculated IBI score for the site was 60, which is classified as good for the region.

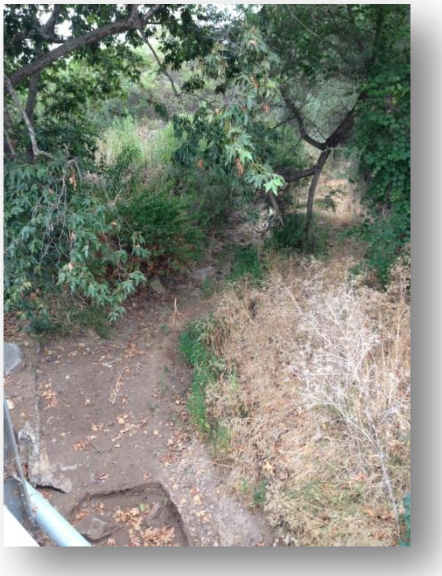
A tool to calculate algea IBI scores was not yet published at the time of this report, and will be further evaluated upon release. Preliminary results indicate the site had the worst community structure of the three sites. The pollution index was similar across all three sites, indicating diatomic species present are somewhat sensitive to pollution.

Site Description

On July 18th, 2013, running water was observed and sampled. The creek had a low flow, approximated at approximated at 0.01 to 0.02 m^3/s. The watershed draining to the area is mixed irrigated cropland, with open space and some rural residential land. The streambed was well covered, had eroded banks, and was composed of riffles and glides in a gravel, sand, and fine substrate. The physical habitat of the stream was highly altered, with indications of routine cattle crossings in the area.

Samples from this site are a good representation of runoff from SDRILG members, with the majority of the surrounding sub-watershed enrolled in the group. Tree fruit is the primary agricultural use upstream of the sampling location.

3.5 Sampling Site 6-Gopher Canyon



Station ID: SDRILG06
Sampling Type: Grab Sample, Water Chemistry
Sub basin: 903.12
Primary Crop Type Draining to Site: Mixed, with open space
Stream Type: Perennial or Intermittent
Sample site GPS location:
N 33^{o} 15’ 57.51” W 117^{o} 13’ 58.75”

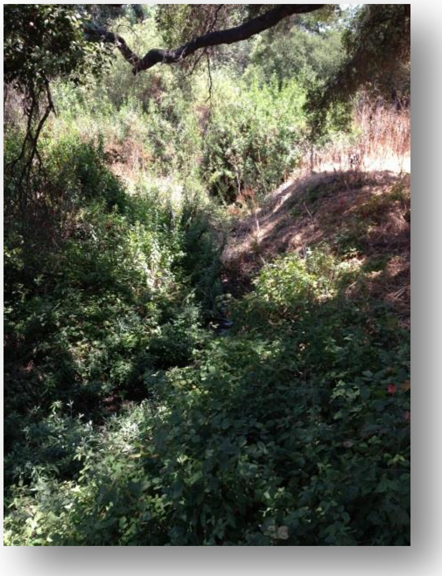
<u>Site Description</u>

No running water was present for sampling during the site visit on July 18, 2013.

During previous site visits, running water was observed with low flow. The watershed draining to the area is mixed equestrian, open space, irrigated avacados, and rural residential land. The streambed had some large boulders on the banks and contained a heavy amount of live tree roots, with understory vegetation.

Samples from this site are indicative of runoff from a medium sized watershed, and are not completely representative of agricultural runoff from the SDRILG.

3.6 Sampling Site 7-Moosa Creek Tributary



Station ID: SDRILG07
Sampling Type: Grab Sample, Water Chemistry
Sub basin: 903.12
Primary Crop Type Draining to Site: Tree Fruit, field crops, and field grown nurseries
Stream Type: Perennial or Intermittent
Sample site GPS location:
N 33° 16’ 24.23” W 117° 09’ 11.60”

Water Quality Exceedances

Grab samples collected at the site exceeded Basin Plan objectives for: Chloride, Sulfate, Total Dissolved Solids, Nitrate as N, Total Phosphorous as P, and Total Nitrogen : Total Phosphorous ratios.

Site Description

On July 18th, 2013, running water was observed and sampled. The creek had extremely low flow, and was not measurable. The watershed draining to the area is primarily agricultural land, with some open space and rural housing interspersed. The streambed appeared absent of large boulders and contained a moderate to heavy amount of vegetation on the banks. Low hanging stream canopy cover was heavy. The streambed is altered downstream of the sampling location, where it passes under Highway 395 and enters a man-made dam consisting of sand bags that pools the creek on the west side of Old Highway 395. The purpose of the pooled area is unclear.

Samples from this site are a good representation of runoff from SDRILG members, with approximately half of the surrounding sub-watershed enrolled in the group. Tree fruit, row and field crops, and field grown nurseries drain to the site.

3.7 Sampling Site 8-Unnamed SLR Tributary

Station ID: SDRILG08
Sampling Type: Grab Sample, Water Chemistry
Sub basin: 903.12
Primary Crop Type Draining to Site: Tree Fruit and field grown nurseries
Stream Type: Intermittent
Sample site GPS location:
N 33^{o} 22’ 07.07” W 117^{o} 09’ 41.77”

<u>Site Description</u>

No running water was present for sampling during the site visit on July 18, 2013.

During previous site visits, running water was observed with low flow. The watershed draining to the area is a smaller watershed and is primarily irrigated cropland. The streambed appeared absent of large boulders and contained a moderate amount of live tree roots and heavy vegetation on the banks. Low hanging stream canopy was heavy.

Samples from this site are a good representation of runoff from SDRILG members and agriculture. Tree fruit and field grown nurseries is the primary agricultural use upstream of the sampling location.

3.8 Sampling Site 9-Keys Creek, South Fork

Station ID: SDRILG09
Sampling Type: Grab Sample, Water Chemistry
Sub basin: 903.12
Primary Crop Type Draining to Site: Mixed
Stream Type: Perennial or Intermittent
Sample site GPS location:
N 33^o 16’ 15.94” W 117^o 05’ 12.42”

Site Description

No running water was present for sampling during the site visit on July 18, 2013.

During previous site visits, running water was observed with low flow and pooling. The watershed draining to the area is primarily the community of Valley Center, which is interspersed with agricultural uses. The streambed contained some amount of live tree roots, with understory vegetation.

Samples from this site are indicative of runoff from a larger watershed, and are not completely representative of agricultural runoff from the SDRILG. This is the most relevant sampling site for a background concentration for the group, with runoff that is heavily influenced by human development.

4.0 DISCUSSION AND CONCLUSIONS

Concentrations of chloride, sulfate, and total dissolved solids were relatively similar across all five of the sampling sites, and all samples exceeded basin plan objectives. These exceedances are a regional issue, and are not directly related to agriculture. Imported water used in the region contains elevated levels of these constituents, and in many cases the imported water exceeds Basin Plan objectives for surface waters. The application of this imported water adds additional salts to the groundwater basin. In the case of the San Luis Rey Hydrologic Unit, groundwater and surface waters are often a connected system, which leads to the observed exceedances. A detailed discussion of this issue can be found in the *An Analysis of Total Dissolved Solids in San Diego County*, prepared for the SDRWQCB by the County of San Diego in March of 2003.

Concentrations of Nitrate as Nitrogen were reported above basin plan objectives at SDRILG02, SDRILG05, and SDRILG07, and were close to basin plan objectives at SDRILG03. The three sampling sites that reported the highest concentrations of Nitrate were the three most heavily influenced by agriculture. The two sites with the highest concentrations of Nitrate (SDRILG02 and SDRILG05) were also sampled for biological metrics. Both of these sites scored values considered “good” on the adjusted IBI score, preliminarily indicating that the elevated Nitrogen concentrations were not greatly impacting stream health. The biological site that was classified as “Very Poor” by IBI scores was the site that had the largest watershed, and was influenced by both agriculture and urban and rural uses. This site reported concentrations of Nitrogen slightly below basin plan objectives. It is worth noting that this sampling event occurred after a period of drought, and discharges at each station were very low. It is currently unknown how this affected both the measured concentrations of nutrients and the standard populations of macroinvertebrates in the streams, as baseline conditions at the sampling sites have yet to be set.

One of the main concerns while sampling during this reporting period was the effect of cattle crossings at two of the biological sampling stations. At SDRILG03, which reported a very low IBI score, the upper reaches of the stream were heavily influenced by cattle, which had turned the streambed to primarily sand, thus reducing the complexity needed to support health stream communities. Cattle crossings were also evident at SDRILG05, but higher banks on the stream made them much less prevalent. This site scored good on the IBI score. Preliminarily it appears that cattle in this area may be also impacting streambed health.

Although attached algae samples were collected successfully at each site, standardized Algae IBI scores have not been developed. Additionally, SWAMP laboratory protocols were still in draft form when the samples were analyzed. Diatom community metics were presented, but not evaluated in depth for this reporting period. Preliminarily it appears that diatom species present at all sites are somewhat sensitive to pollution, and that SDRILG05 reported the best diatom community metrics. Once further tools become available, results will be revisited and discussed in greater detail.

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APPENDIX A

San Diego Region Irrigated Lands Group
San Luis Rey Watershed
Agricultural Discharge Monitoring Report

Aquatic Bioassay and Consulting Laboratories

2013

San Diego Region Irrigated Lands Group
San Luis Rey Watershed
Agricultural Discharge Monitoring Report

Presented by:

Aquatic Bioassay & Consulting

Laboratories, Ventura, CA

805 643 5621

aquatic
bioassay &
consulting
laboratories, inc

November 18, 2013

Mr. Bryn Home
Project Manager
PW Environmental
230 Dove Court
Santa Paula, CA 93060

Dear Mr. Home:

We are pleased to submit the 2013 Agricultural Discharge Monitoring Report for the San Diego Region Irrigated Lands Group. The enclosed report includes the results and interpretations for the annual requirements set forth by the California Regional Water Quality Control Board, San Diego Region, in its *Conditional Waiver No. 4 – Discharges from Agriculture and Nursery Operations*. This report meets all of the requirements set forth in Waiver including data results and quality control requirements.

Please contact me if you have any questions.

Sincerely,

aquatic
bioassay &
consulting
laboratories, inc

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Introduction

Watershed Background

The San Luis Rey River Watershed (SLR) is located in northern San Diego County and covers approximately 560 square miles. It includes the cities of Oceanside and Valley Center, and portions of Fallbrook and Camp Pendleton. Several Native American Reservations are located in the watershed. The SLR is bordered to the north by the Santa Margarita Watershed, and is bordered to the south by the Carlsbad and San Dieguito Watersheds. The arid Mediterranean climate in this region has average temperatures of 65 ° Fahrenheit, average precipitation of 10 to 13 inches per year and a rainy season that runs from November thru February. Precipitation and temperature variations increase with elevation, with precipitation in the mountainous areas reaching up to 45 inches per year. Surface and groundwater flow is from east to west towards the Pacific Ocean.

The main water body in the watershed is the San Luis Rey River, which is ephemeral and dry in the upper and middle reaches for most of the year. The river extends approximately 55 miles, and ultimately discharges to the Pacific Ocean in Oceanside. The San Luis Rey River originates primarily from the Palomar and Hot Springs Mountains, and is interrupted by Lake Henshaw, Henshaw Dam, and the Escondido Canal. Approximately 90% of the water released from Henshaw Dam flows into the Escondido Canal and is diverted to two local entities: the City of Escondido and the Vista Irrigation District. Flood flow in the river is typically limited to short durations. The majority of the river is not channelized, except the lower seven miles, which are contained within a channel bounded by earthen levees on both sides and contains water year round.

The SLR is unique in that groundwater and surface water have become an integrated system and are not hydrologically separated. As a result, groundwater impairments can impact surface water quality and surface water quality impairments can impact groundwater quality. There are six shallow alluvial groundwater aquifers that are currently used for agricultural, industrial, and municipal water supplies: Warner, Pauma, Pala, Bonsall, Moosa Canyon, and Mission Basin. Groundwater levels in these areas have a direct effect on surface flows in the watershed. Additionally, much of the surface water runoff is supplemented with Colorado River water, which inherently has a higher salt content and can affect groundwater conditions.

Objectives

Water quality impacts associated with agriculture can be primarily traced to discharges resulting from irrigation or stormwater. These discharges may contain pollutants that have been imported or introduced into the irrigation or stormwater system; in addition, irrigation practices can mobilize and or concentrate some pollutants. In order to evaluate the potential impacts of discharges from agricultural land on beneficial uses of water bodies within the San Diego Region, the San Diego Regional Water Quality Control Board (SDRWQCB) adopted Conditional Waiver No. 4 – Discharges from Agriculture and Nursery Operations (as part of Resolution R9-2007-0104; Waiver) on October 10, 2007, as mandated by State law and policy.

The San Diego Region Irrigated Lands Group (SDRILG) was formed to comply with the waiver. The key questions that will be addressed by SDRILG throughout the life of the program are as follows:

1. Are beneficial uses being protected in waters of the State that receive discharges from members enrolled in the SDRILG, as a result of agricultural activities, and as outlined by water quality conditions stated in the San Diego Basin Plan?
2. Based on monitoring information, what is the extent and magnitude of water quality issues in relation to SDRILG's agricultural activities or the effects of agricultural activities?
3. What contributing sources from agriculture activities are impairing water quality in receiving water bodies?
4. What best management practices (BMPs) is being implemented by SDRILG to reduce impacts, and are these BMPs reducing the impacts from agricultural activities to waters of the State? Where are BMPs being applied?
5. Are water quality conditions improving, staying the same, or declining in receiving water bodies after the implementation of BMPs?

The first year of monitoring and assessment will be focused on providing baseline conditions at sampling sites. This report includes the first year results of water chemistry and bioassessment monitoring conducted for the SDRILG at five sampling locations in the SLR.

This report includes all of the physical, chemical, and biological data collected during the summer 2013 survey, photographic documentation of each site, QA/QC procedures and documentation. Results are summarized and compared, where possible, to existing water quality standards and biological index thresholds. Finally, key findings are summarized and discussed.

Materials and Methods

Sampling Site Descriptions

Five sampling locations were visited in the SLR (Table 1, Figure 1). Water chemistry samples were collected at each of the five sites, while bioassessment samples were collected only at stations SDRILG02 at Couser Canyon, SDRILG03 at Keys Creek and SDRILG05 at Weaver Creek. Each of the sites is located within or downstream of reaches influenced by agricultural runoff. Of the three sites where bioassessment samples were collected, the sites at Keys and Weaver Creeks were dominated by ranch land with large portions of each reach were used as cattle crossings. The Couser Canyon Creek site is located in a residential area where the landscape has been highly altered with non-indigenous plants.

Table 1. Sampling location descriptions in the SLR.

Station	SDRILG01	SDRILG02	SDRILG03	SDRILG05	SDRILG07
Creek	Moosa Creek	Couser Canyon	Keys Creek	Weaver Creek	Moosa Creek Trib.
Sample Date	18-Jul-13	19-Jul-13	18-Jul-13	18-Jul-13	18-Jul-13
Sample Time	11:20	7:05	8:25	10:40	12:10
Latitude (N)	33.28240	33.32716	33.28786	33.29300	33.27324
Longitude (W)	-117.20042	-117.10957	-117.08332	-117.08788	-117.15324
Sampling	Water Quality	Water Quality Bioassessment	Water Quality Bioassessment	Water Quality Bioassessment	Water Quality

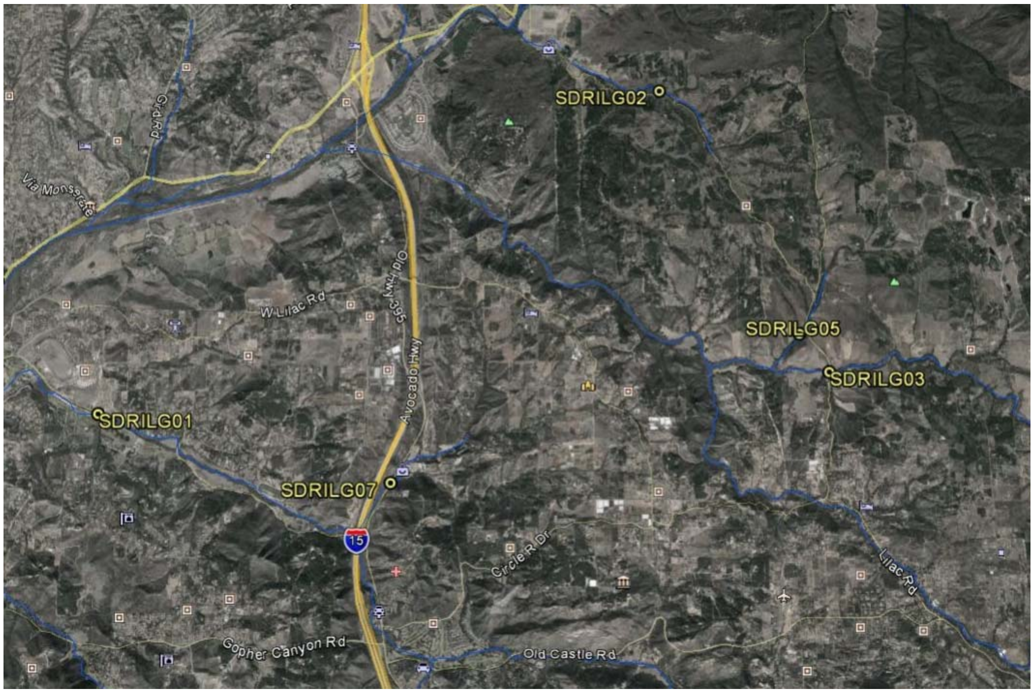

Figure 1. BMI sampling locations in the San Luis Rey Watershed (SLR).

Water Chemistry

In Situ Water Quality

Water dissolved oxygen (DO), pH, salinity, specific conductivity and temperature were measured using a hand held YSI Professional Plus water quality meter that was pre-calibrated before sampling. A water sample was collected for alkalinity and analyzed using the USEPA's Titrometric (pH 4.5) 3101 method in the laboratory.

Discharge was measured on a single transect, using a hand held flow meter, following the velocity area method specified in the Surface Water Ambient Monitoring Program (SWAMP) bioassessment protocol (Ode 2007).

Water Chemistry

Sample water for chemistry analysis was collected using a pre-cleaned HDPE bucket and poured into bottles provided by the chemistry laboratory. Samples were immediately placed on wet ice and delivered to PHYSIS Environmental Laboratories, Inc., Anaheim, CA. Samples were analyzed according to EPA or Standard Methods procedures (Appendix A, Table 13). Particulate organic carbon (POC), particulate phosphorus (PP), particulate nitrogen (PN) and total nitrogen (TN) were calculated by equations presented in Appendix A, Table 12.

A field duplicate was collected at station SDRILG05 for all constituents. Relative Percent Difference (RPD) was calculated using the following equation:

$$RPD= \left| \frac{(X_1-X_2)}{(X_1+X_2)/2} \right| *100$$

Where:

X_1: is the concentration of the original sample

X_2: is the concentration of the duplicate sample

Collection of Benthic Macroinvertebrates

BMI samples were collected at stations SDRILG02, SDRILG03, and SDRILG05 in strict adherence to the SWAMP bioassessment protocols (Ode et al. 2007). At each station, a 150 meter (m) reach was measured and 11 transects were established equidistance apart from the downstream to upstream end of the reach. If access to the full 150 m reach was not possible due to obstacles (i.e. bridges or abutments), the total reach length was divided by 11 and transects were established as above. At each site the SWAMP Worksheet was used to collect all of the necessary station information and physical habitat data.

BMI samples were collected, starting with the downstream transect and working upstream, following the Reach Wide Benthos (RWB) Margin Center Margin (MCM) sampling protocol:

1. At the most downstream transect, a single location was sampled margin of the right bank.
   On the second upstream transect, a sample was collected 50% of the distance from the right

wetted width and, on the third transect, on the margin of the left bank. This process was repeated until each of the 11 transects had been sampled.

a) All samples of the benthos were collected within a 0.09 m^2 area upstream of a 0.03 m wide, 0.5 mm mesh D-frame kick-net.

b) Sampling of the benthos was performed manually by rubbing cobble and boulder substrates in front of the net, followed by disturbing the upper layers of substrate to dislodge any remaining invertebrates.

c) The duration of sampling ranged from 60-120 seconds, depending on the amount of boulder and cobble-sized substrate that required rubbing by hand; complex substrates require a greater amount of time to process.

2. The 11 samples (per station) were combined into a single composite sample that represented a 0.99 m^2 area of the total reach sampled. The composited samples were transferred into separate two liter wide-mouth plastic jars containing approximately 300 ml of 95% ethanol.

BMI samples were then delivered to Aquatic Bioassay & Consulting Laboratories in Ventura, CA for identification and enumeration.

Collection of Attached Algae

Stream attached algae collection was conducted at stations SDRILG02, SDRILG03, and SDRILG05 in strict adherence to the SWAMP bioassessment protocols (Fetscher *et al*. 2009). Attached algae samples were collected simultaneously with and a meter directly above where the BMIs were collected. The collection procedure is variable depending on the substrate found at the collection point but all samples are composited together into a wash bucket for further processing.

1. If the substrate type is removable and is in a depositional habitat (e.g. fine gravel, silt or sand) and has an exposed area of less than 12.6 cm², then a PVC delimiter, which is plastic coring device with an internal diameter of 4 cm, is used to collect the loose substrate up to 1 cm deep. Then a metal spatula is placed directly underneath the PVC delimiter to collect the loose material.
2. If the habitat type is erosional (e.g. cobble or a piece of wood) and removable then a rubber delimiter, which is comprised of bicycle tire with a reinforced hole of the desired area, is used to isolate a 12.6 cm² area of algae. The delimiter is wrapped around the object collected and a toothbrush is used to scrub the algae from the surface.
3. If the surface substrate cannot be removed (e.g. concrete, bedrock or large boulder), then a “syringe scrubber” is used to collect the algae from the surface underwater. Once the collection area has been scrubbed clean, the syringe plunger is retracted and the scrubber is removed and rinsed into the wash bucket.

Once algae samples from all 11 transect are collected and composited into the wash bucket, they are processed in the field. There are four different indicators targeted at each site, chlorophyll a (Chl-a), ash free dry mass (AFDM), diatoms and soft-bodied algae. For Chl-a and AFDW a 25 ml of composite sample are filtered through glass fiber pre-filters using a hand pump. The volume filtered may be decreased if it becomes impossible to filter. The filter is placed in a petri dish, covered in aluminum foil and placed on dry ice until analyzed.

Diatom samples were prepared by combining 40 ml of composite water and 10 ml of 10% neutral buffered formalin preservative to a 50 ml centrifuge tube. The tube was covered in foil and placed on wet ice for future identification. Soft-bodied algae samples were prepared by adding 45 ml of composite water and 5 ml of 5% glutaraldehyde solution to a 50 ml centrifuge tube, covered in foil and placed on wet ice for identification.

Diatoms and soft-bodied algae samples were then sent to Rhithron Associates, Inc. in Missoula, MT for identification and enumeration. AFDM and Chl-a were sent to Sierra Environmental in Reno, NV for analysis.

Sample Analysis/Taxonomic Identification of Benthic Macroinvertebrates (BMIs)

Benthic macroinvertebrate identifications were made using standard taxonomic keys to SAFIT Level I according to the Southwest Association of Freshwater Invertebrate Taxonomists (SAFIT), Standard Taxonomic Effort List (Richards and Rogers 2006). Identifications were rolled up to the appropriate taxonomic level for the calculation of biological metrics used in the SoCal-IBI. Samples entering the lab were processed as follows:

600 organisms were sub-sampled from the composite sample using a Katon tray and then sorted into major taxonomic groups. All remnants were stored for future reference. The 600 organisms were identified to the genus level for most insects, and order or class for non-insects. As new species to the survey area were identified, examples of each were added to the voucher collection. The voucher collection includes at least one individual of each species collected and ensures that naming conventions can be maintained and changed as necessary into the future.

The taxonomic QA/QC procedures followed for this survey included:

1. Sorting efficiencies were checked on all samples and a minimum required sorting efficiency was 95% (i.e. no more than 5% of the total number of organisms sorted from the grids could be left in the sub-sample) was maintained. At least 10% of all processed material from each sample was inspected by the laboratory supervisor for the aforementioned efficiency. Sorting efficiency results were documented on each station’s sample tracking sheet.
2. Once identification work was completed, Aquatic Bioassay taxonomists conduct QC as follows:
    a. Ten percent of all stations sampled were randomly selected for internal QC by another Aquatic Bioassay taxonomist. Samples were checked for both enumeration and identification accuracy, which must both pass a 95% efficiency criteria. Discrepancies were resolved and the database was updated.
    b. One sample was sent to the California Department of Fish and Wildlife (CDFW) offices in Chico California for an external QA/QC check. Samples were sorted by species into individual vials that included an internal label. Any discrepancies in counts or identification found by the CDFG taxonomists were discussed, and then resolved. All data sheets were corrected and, when necessary, bioassessment metrics were updated.
3. It is a requisite of our QC program that all staff members involved in taxonomy belong to SAFIT, an organization dedicated to the standardization of freshwater organism naming conventions.

Sample Analysis/Taxonomic Identification of Attached Algae

Samples for algal analysis were completed by the Rhithron Associates, Inc. located in Missoula, MT. Laboratory identification procedures for soft algae and diatoms followed SWAMP Draft protocols (Kociolek *et. al* 2011; Stancheva and Sheath, 2011) and are summarized as follows:

Qualitative Soft Algae Analysis

Using a dissecting scope, analysts performed a qualitative scan to identify as many macroalgal taxa as possible. Specimens were identified to species or lowest practical taxonomic level, and then photos were taken for all determined taxa.

Quantitative Soft Macroalgae Analysis

Using a dissecting scope, analysts processed samples to determine the representative portion of macroalgae (and mosses, vascular plant tissues or roots if present). Bio-volumes were determined by original water displacement. Specimens were identified to species or lowest practical taxonomic resolution.

Quantitative Soft Microalgae Analysis

Using a compound microscope, analysts enumerated 300-500 natural units of soft microalgae. Specimens were identified to species or lowest practical taxonomic resolution. Bio-volumes were calculated using appropriate literature (ie. Hildebrand *et al*.) for measurement designations. Photos were taken of all taxa to compile a synoptic reference collection.

Diatom Analysis

Samples were prepared using the Nitric Acid diatom cleaning method. Cleaned diatom material was diluted to acceptable counting ranges and mounted onto slides. Completed slides were delivered to the processing analyst. Samples were enumerated to 600 valves and identified to the species, or lowest practical taxonomic resolution. Photos were taken of all taxa and a synoptic reference collection was made.

Identification Quality Control

Internal QC protocols included re-identification of the digital synoptic reference collection.

Data Development and Analysis

Benthic Macroinvertebrate Biological Metrics

As species were identified and counted they were included in an Excel data sheet and then imported into the Aquatic Bioassay BMI database system. The data were checked for errors using automated data checkers for duplicates, misspelled taxa names, etc. All biological metrics, figures and tables were then automatically generated. These bioassessment metrics were then used to assess the spatial and temporal distributions of the BMI community or were used to calculate the SoCal-IBI (Ode and Rhen

2005). The following metrics were calculated and their responses to impaired conditions are listed in Table 2:

Community Richness Measures: includes taxa richness which is a measure of the total number of species found at a site. This relatively simple index can provide much information about the integrity of the community. Few taxa at a site indicate that some species are being excluded, while a large number of species indicate a more healthy community. EPT taxa are the number of all of the mayflies (Ephemeroptera), caddisflies (Trichoptera), and stoneflies (Plecoptera) present at a location. These families are generally sensitive to impairment and when present, are usually indicative of a healthier community than if any or all are absent. Increases in the numbers of Coleopteran (beetles) and/or predator taxa are indicative of healthier stream conditions and both are used to calculate the SoCal-IBI.

1. Community Composition Measures: includes the percent EPT index, sensitive EPT index, percent non-insect taxa, percent non-insect individuals, and the Shannon Diversity index. The percent EPT index is the proportion of the abundance at a site that is comprised of mayflies (Ephemeroptera), stoneflies (Plecoptera) and caddisflies (Trichoptera). An increase in EPT taxa at a site indicates improving water quality conditions. The percent sensitive EPT index is similar except it includes only those EPT taxa whose tolerance values range from 0 to 3. These taxa are very sensitive to impairment and when present, can be indicative of better water quality conditions. Percent non-insect taxa are a measure of all non-insect phyla represented at a site and when elevated, generally indicate poorer water quality conditions.

   The Shannon Diversity index is similar to numbers of taxa; however, it contains an evenness component as well. For example, two samples may have the same numbers of species and the same numbers of individuals; however, one station may have most of its numbers concentrated into only a few species while a second station may have its numbers evenly distributed among its species. The diversity index would be higher for the latter station and considered to be in better condition.

2. Community Tolerance/Intolerance Measures: includes metrics that reflect the overall sensitivity of the BMI population to stress. The SoCal-IBI uses both the percent intolerant individuals and percent tolerant taxa to evaluate the overall sensitivity of organisms to pollution and habitat impairment. Each species is assigned a literature cited tolerance value ranging from 0 (highly intolerant) to 10 (highly tolerant). The percent intolerant individuals is calculated by multiplying the tolerance value of each species with a tolerance value ranging from 0 to 2, by its abundance, and then dividing that value by the total abundance for the site. The percent tolerant taxa are similar except that only species with tolerance values ranging from 8 to 10 are included and total numbers of taxa, instead of individuals, are used to derive the proportion. A site with many tolerant organisms present is considered to be less pristine or more impacted by human disturbance than one that has few tolerant species. Of note is that the tolerance values for each species were developed in different parts of the United States and can therefore be region specific. Also, different organisms can be tolerant to one type of disturbance, but highly sensitive to another. For example, an organism that is highly sensitive to sediment deposition may be very insensitive to organic pollution. With these drawbacks in mind, the tolerance measures generally depict disturbances in a stream that, when coupled with other metrics, can provide good water quality information regarding a stream reach.

   Percent dominance reflects the proportion of the total abundance at a site represented by the most abundant species. For example, if 100 organisms are collected at a site and species A is the most abundant with 30 individuals, the percent dominance index score for the site is 30%. The benthic environment tends to be healthier when the dominance index is low, which indicates that more than just a few taxa make up the majority of the community. Finally the percentage of a population that includes members of the families Chironomidae (midge flies), Hydropsychidae (caddis flies) and/or Baetidae (mayflies) are more tolerant of stressed conditions.

3. Community Functional Feeding Group (FFG): includes indices that provide information regarding the balance of feeding strategies represented in an aquatic assemblage. The combined feeding strategies of the organisms in a reach provide information regarding the form and transfer of energy in the habitat. When the feeding strategy of a stream system is out of balance it can be inferred that the habitat is stressed. For the purposes of this study, species were grouped by feeding strategy as percent collectors and filterers, percent collectors, percent filterers, percent grazers, percent predators, and percent shredders. Percentages of each of these groups will increase in response to stress, except percent shredders which will generally decrease.

Table 2. Bioassessment metrics used to describe characteristics of the BMI community.

BMI Metric	Description	Response to Impairment
Community Richness Measures		
Taxa Richness	Total number of individual taxa	Decrease
EPT Taxa	Number of taxa in the Ephemeroptera (mayfly), Plecoptera (stonefly) and Trichoptera (caddisfly) insect orders	Decrease
Cumulative EPT Taxa	Total number of different taxa in the Ephemeroptera (mayfly), Plecoptera (stonefly), and Trichoptera (caddisfly) insect orders collected from all replicates.	Decrease
Number of Coleoptera Taxa	Number of taxa from the insect order Coleoptera (beetles)	Decrease
Number of Predator Taxa	Number of taxa from the predator functional feeding group	Decrease
Community Composition Measures		
EPT Index (%)	Percent composition of mayfly, stonefly and caddisfly larvae	Decrease
Sensitive EPT Index (%)	Percent composition of mayfly, stonefly and caddisfly larvae with tolerance values between 0 and 3	Decrease
Shannon Diversity	General measure of sample diversity that incorporates richness and evenness (Shannon and Weaver 1963)	Decrease
Percent Non-Insect Individuals	Percent of organisms in sample that are not in the Class Insecta	Increase
Percent Non-insect Taxa	Percent of taxa in sample that are not in the Class Insecta	Increase
Community Tolerance Measures		
Percent Hydropsychidae	Percent composition of caddisflies in the more tolerant family Hydropsychidae	Increase
Percent Baetidae	Percent composition of mayflies in the more tolerant family Baetidae	Increase
Mean Tolerance Value	Value between 0 and 10 weighted for abundance of individuals designated as pollution tolerant (higher values) and intolerant (lower values)	Increase
Percent Intolerant Organisms	Percent of organisms in sample that are highly intolerant to impairment as indicated by a tolerance value of 0, 1 or 2	Decrease
Percent Tolerant Taxa	Percent of taxa in sample that are highly tolerant to impairment as indicated by a tolerance value 8, 9, 10	Increase
Percent Dominant Taxa	Percent composition of the single most abundant taxon	Increase
Percent Chironomidae	Percent of organisms in the dipteran family Chironomidae	Increase
Community Feeding Group Measures		
Percent Collector-Gatherers (CG)	Percent of macrobenthos that collect or gather fine particulate matter	Increase
Percent Collector-Filterers (CF)	Percent of macrobenthos that filter fine particulate matter	Increase
Percent CG + CF	Percent of macrobenthos that belong to either the CG or CF functional feeding groups	Increase
Percent Scrapers	Percent of macrobenthos that graze upon periphyton	Increase
Percent Shredders	Percent of macrobenthos that shreds coarse particulate matter	Decrease

Southern California Index of Biological Integrity (SoCal-IBI)

The IBI is a multi-metric technique that employs seven biological metrics that were each found to respond to a habitat and/or water quality impairment at sites from Monterey, California to the Mexican Border. Each of the seven biological metrics measured at a site are converted to an IBI score then summed and adjusted to a scale of 0 to 100. These cumulative scores can then be ranked accordingly:

"very good" (80-100), "good" (60-79), "fair" (40-59), "poor" (20-39) and "very poor" (0-19) habitat conditions (Table 4). The threshold limit for this scoring index is 39.

Despite the fact that rankings can be identified as "fair," sites with scores above 39 are within two standard deviations of the mean reference site conditions in southern California and are not considered to be impaired. Sites with scores below 39 are considered to have impaired conditions. The metric scoring ranges established for the SoCal-IBI, listed in
Table 3.

The SoCal-IBI is based on the calculation of biological metrics from a group of 500 organisms from a composite sample collected at each stream reach. Since 600 organisms are identified from each sample, the abundance data were reduced to 500 using Monte Carlo randomization. This technique was validated by Ode et al. (2005).

Table 3. Scoring ranges for the seven metrics included in the Southern California IBI and the cumulative IBI score ranks.

Metric Score	Coleoptera Taxa	EPT Taxa		Predator Taxa	Percent Collector Individuals		Percent Intolerant Individuals		Percent Non-Insect Taxa	Percent Tolerant Taxa
	All Sites	6	8	All Sites	6	8	6	8	All Sites	All Sites
10	>5	>17	>18	>12	0-59	0-39	25-100	42-100	0-8	0-4
9		16-17	17-18	12	60-63	40-46	23-24	37-41	9-12	5-8
8	5	15	16	11	64-67	47-52	21-22	32-36	13-17	9-12
7	4	13-14	14-15	10	68-71	53-58	19-20	27-31	18-21	13-16
6		11-12	13	9	72-75	59-64	16-18	23-26	22-25	17-19
5	3	9-10	11-12	8	76-80	65-70	13-15	19-22	26-29	20-22
4	2	7-8	10	7	81-84	71-76	10-12	14-18	30-34	23-25
3		5-6	8-9	6	85-88	77-82	7-9	10-13	35-38	26-29
2	1	4	7	5	89-92	83-88	4-6	6-9	39-42	30-33
1		2-3	5-6	4	93-96	89-94	1-3	2-5	43-46	34-37
0	0	0-1	0-4	0-3	97-100	95-100	0	0-1	47-100	38-100
Cumulative Adjusted SoCal-IBI Scores (adjusted to a 100 point scale)										
	Very Poor			Poor		Fair		Good		Very Good
	0-19			20-39		40-59		60-79		80-100

Note: Three metrics have separate scoring ranges for the two Omernik Level III ecoregions in southern coastal California region (6 = chaparral and oak woodlands, 8 = southern California mountains).

Attached Algae Biological Metrics

Soft-bodied algae and diatom community structure can be used to assess many aspects of stream water quality including the effects of nutrient loading and other contaminants (dissolved metals and organics). Currently, the Southern California Coastal Water Research Project (SCCWRP) scientists are working on creating algal indices similar to the one used for BMIs to assess anthropogenic impacts. The algal "IBI" has been finalized (Fetscher et al. 2013), but the automated analysis tools necessary to correctly calculate this index are not yet available. As a result, this multi-metric analysis is not included in this report. However, diatom metrics have been used across the United States to determine anthropogenic impacts. The following metrics were calculated and their responses to impaired conditions are listed in Table 4:

1. Community Structure Measures: includes species richness, Shannon Diversity index, and dominant taxa. These metrics are described above, in Benthic Macroinvertebrate Biological Metrics.

2. Sediment Measures: includes species of diatoms that are abundant in reaches with unstable habitats (Bahls 1993; Barbour et al. 1999). An increase of percent relative abundance of Navicula, Nitzschia, and Surirella are indicative of an increase in siltation. Motile species of diatoms are able to hold their position in the water column and are associated with sedimentation. Species of diatoms are assigned motility ratings of highly motile, moderately motile, not motile and variable motility. Motile taxa are the percentage of highly motile and moderately motile diatom taxa found at a site. An increase in sediment measures indicates an increase in impairment.

3. Organic Nutrient Measures: includes pollution index, nitrogen heterotroph taxa, polysaprobous taxa and low DO measures. (Lange-Bertalot 1979; Van Dam *et al.* 1994). The pollution tolerance index classifies species tolerance to organic pollution. Each species is assigned a value ranging from 1 (most tolerant to pollution) to 3 (sensitive to pollution). The pollution tolerance index is calculated by multiplying the tolerance value by its abundance, and then dividing that value by the total abundance for the site.

   Heterotroph taxa are the percent relative abundance of facultative heterotrophs and obligate nitrogen heterotrophs. Diatom taxa are assigned nutrient uptake values of: 1. Nitrogen autotroph tolerating very small concentrations of organic nitrogen; 2. Nitrogen autotroph tolerating elevated concentrations of organic nitrogen; 3. Facultative nitrogen heterotroph; and 4. Obligate nitrogen heterotroph.

   Polysaprobous taxa are the percent relative abundance of alpha-meso/polysaprobous and polysaprobous diatoms. Diatom taxa are assigned values of: 1. Oligosaprobous; 2. beta-mesosaprobous; 3. Alpha-mesosaprobous; 4. Alpha-meso/polysaprobous; and 5. Polysaprobous. Taxa groups 4 and 5 are indicative of decomposing organic nutrients.

   Low DO taxa is the relative abundance of low and very low oxygen demand diatoms. Diatom taxa are assigned values from 1 (continuously high DO; ~ 100% saturation) to 5 (very low; ~10% saturation).

4. Inorganic Nutrients: includes nitrogen autotroph taxa and eutraphentic taxa (Van Dam *et al.* 1994). Nitrogen autotrophs taxa are the percent relative abundance of nitrogen autotrophs (see nutrient uptake values above; groups 1 and 2). A decrease in nitrogen autotrophs generally indicates poorer water quality conditions. Eutraphentic taxa is the percent relative abundance of eutraphentic and hyper-eutraphentic diatoms that prefer nutrient enriched, eutrophic waters.

5. Metals: includes disturbance taxa, metals tolerant taxa and abnormal cells (Barbour *et al.* 1999; Teply and Bahls, 2005, McFarland *et al.* 1997). Disturbance taxa are the percent relative abundance of *Achnanthidium minutissimum*. *A.minutissimum* is a cosmopolitan species found in streams with a recent scour event, acid mine drainage, or other toxic pollution. Metals tolerant taxa are the percent relative abundance of species known to tolerate elevated concentrations of heavy metals. Abnormal cells is the percent relative abundance of diatom cells that have anomalies. This metric has been positively correlated to heavy metal contamination in streams.

Table 4. Diatom metrics used to describe characteristics of the diatom community.

Group	Metric	Description	Response to Impairment
Community Structure			
Diversity	Shannon H (log2)	Shannon Diversity Index using log base 2	Decrease
Diversity	Species Richness	Total number of species counted (during proportional count)	Decrease
Dominance	Dominant Taxon Percent	Percent relative abundance of the dominant species counted	Increase
Sediment			
Siltation	Siltation Taxa Percent	Percent relative abundance of Navicula (Cavinula + Craticula + Diadesmis + Dickieia + Fallacia + Geissleria + Hippodonta + Luticola + Navicula + Placoneis + Sellophora + Proshkina + Kobayasiella + Aneumastus) + Nitzschia (Nitzschia + Simonsonia + Tryblionella) + Surirella	Increase
Motility	Motile Taxa Percent	Percent relative abundance of highly motile and moderately motile diatom taxa (with raphes, but not highly motile)	Increase
Organic Nutrients			
Pollution	Pollution Index	Aggregate index based on pollution tolerance, with three classes: species most tolerant to pollution (1), species tolerant of pollution (2) and species sensitive to pollution (3)	Decrease
Heterotrophism	Nitrogen Heterotroph Taxa Percent	Percent relative abundance of facultative heterotrophs and obligate nitrogen heterotrophs	Increase
Saprobity	Polysaprobous Taxa Percent	Percent relative abundance of alpha-mesosaprobous, alpha-meso/polysaprobous, and polysaprobous diatoms	Increase
Oxidation	Low DO Taxa Percent	Percent relative abundance of low and very low oxygen demand diatoms	Increase
Inorganic Nutrients			
Autotrophism	Nitrogen Autotroph Taxa Percent	Percent relative abundance of nitrogen autotroph (tolerates small concentrations of organic N) and nitrogen autotroph (tolerates elevated concentrations of organic N)	Decrease
Trophic State	Eutraphentic Taxa Percent	Percent relative abundance of eutraphentic and hypereutraphentic diatoms	Increase
Metals			
Disturbance	Disturbance Taxa Percent	Percent relative abundance of Achnanthidium minutissimum (new name) or Achnanthes minutissima in a sample	Increase
Metals Tolerance	Metals Tolerant Taxa Percent	Percent relative abundance of species known to tolerate elevated concentrations of heavy metals	Increase
Abnormality	Abnormal Cells Percent	Percent relative abundance of cells exhibiting teratogenic effects	Increase

Results

Sampling Site Descriptions

Five sampling locations were visited in the San Luis Rey watershed (SLR) on July 18th and 19th, 2003 (Table 1, Figure 1). Photographs of each site are displayed in Appendix C, Figure 6. Sampling occurred within the bioassessment index period for southern California (May to July), but following 6 months of dry weather and during drought conditions.

Data QA/QC

The data collected for the July survey met all QC requirements of the program. The sampling crew passed all field audit requirements of the Southern California Stormwater Monitoring Coalitions (SMC) administered by the Southern California Coastal Water Research Project (SCCWRP) prior to sampling in May 2013. Water chemistry results met all laboratory data quality objectives (DQOs) for accuracy, precision and sensitivity, in addition to method detection limit requirements. Benthic macroinvertebrate (BMI) identifications met the requirements of the Aquatic Bioassessment Laboratories (ABL) QC audit for enumeration, accuracy and precision. Attached algae identifications met all internal QC criteria, but were not sent to external QC since this program has not yet been established.

Water Quality Measurements

The number of days since last scour event was not provided since it is based on a calculation that requires multiple years of data. Since this was the first sampling event for any of these sites, this parameter will begin to be included in the coming year. Un-shaded solar radiation was taken from the Technical Approach to Develop Nutrient Numeric Endpoints for California (Crager *et al.* 2006).

In Situ Water Quality Measurements

Of the water quality measurements collected in-situ, alkalinity, dissolved oxygen and pH were similar among sites and did not exceed any Basin Plan thresholds (Table 5). Specific conductance was elevated at each of the five sites, ranging from 2,167 to 2,978 uS/cm. Salinity reflected the high conductivity ranging from 1.11 to 1.56 ppt. Temperature was greatest at the two lower watershed sites on Moosa Creek (21 and 24°C, respectively) and lower at the upper watershed bioassessment sites (range = 15.6 to 17.9°C) where the canopy cover was better and shading of the streambed was greater. Turbidity was low across all sites (range = 1.15 to 6.75 NTU). Discharge was either un-measurable due to extremely low flow at Keys (SDRIL07) and Moosa Creeks (SDRILG03) or just flowing at the other three sites (range = 0.01 to 0.02 m^3/sec).

Chemistry

The high conductivity measured at each of the three sites mentioned above was reflected in the elevated concentrations of chloride, sulfate and total dissolved solids (TDS). Each of these constituents exceeded the Basin Plan threshold at each of the five sites. Nearly 100% of the nitrogen measured was in the form of nitrate. Ammonia was low across sites, except at Couser Canyon (SDRILG02) (0.06 mg/L) which exceeded the Basin Plan threshold (0.025 mg/L). Nitrate exceeded the Basin Plan threshold (10 mg/L) at all sites (range = 9.39 to 18.26 mg/L), except Moosa Creek (SDRIL01). Total phosphorus exceeded the Basin Plan threshold (0.1 mg/L) at the Moosa Creek stations (SDRILG01 and SDRILG07). The ratio of total nitrogen to total phosphorus exceeded the Basin Plan threshold (10 : 1) at each site (range = 49 to 325). The lowest proportions were found in the lower watershed at the Moosa Creek stations.

Algae Biomass

Both ash free dry mass and chlorophyll a where similar among the three sites where bioassessment samples were collected.

Table 5. Water quality concentrations for sites in the SLR. Concentrations are compared to San Diego Region Basin Plan Water Quality Objectives (WQO) where possible. Greyed concentrations indicate exceedance of WQO threshold.

		Station					San Diego Basin Plan
Parameter	**Units**	**SDRILG01**	**SDRILG07**	**SDRILG03**	**SDRILG05**	**SDRILG02**	
General Habitat							
Days Since Scour Event[1]	Days	--	--	--	--	--	
Unshaded Solar Radiation	cal/cm^2/day	634	634	634	634	634	
In Situ Water Quality							
Alkalinity as CaCO3	mg/L	336	269	270	259	205	
Dissolved Oxygen	mg/L	6.79	7.60	7.93	8.91	7.99	5 mg/L
pH	NA	7.64	8.10	7.57	8.08	7.56	
Salinity	ppt	1.50	1.28	1.56	1.24	1.11	
Specific Conductivity	µS/cm	2884	2471	2978	2395	2167	
Temperature	°C	23.84	21.11	15.60	17.90	17.30	
Turbidity	NTU	1.15	2.98	1.24	6.75	2.79	20 NTU
Discharge	m^3/sec	0.02	ND	ND	0.01	0.01	
General Chemistry							
Chloride	mg/L	417	330	455	326	255	250 mg/L
Sulfate	mg/L	545	533	694	539	517	250 mg/L
Total Dissolved Solids	mg/L	1955	1693	2141	1743	1545	500 mg/L
Total Suspended Solids	mg/L	1.4	12.7	8.0	12.9	34.0	
Chlorophyll a	µg/L	ND	6	48	8	19	
Dissolved Organic Carbon	mg/L	4.3	7.2	4.8	4.8	4.1	
Particulate Organic Carbon	mg/L	0.3	0.4	0.4	0.2	0.4	
Total Organic Carbon	mg/L	4.6	7.6	5.2	5.0	4.5	
Ammonia as N	mg/L	ND	ND	0.02	ND	0.06	0.025 mg/L
Nitrate as N	mg/L	5.18	10.97	9.39	15.13	18.26	10 mg/L
Nitrite as N	mg/L	0.05	ND	0.07	0.03	0.02	1 mg/L
Total Kjeldahl Nitrogen	mg/L	0.5	0.8	0.6	0.6	0.6	
Particulate Nitrogen	mg/L	0.50	0.80	0.58	0.60	0.54	
Total Nitrogen	mg/L	5.73	11.77	10.06	15.76	18.88	
Orthophosphate as P	mg/L	0.37	0.32	0.22	0.23	0.23	
Dissolved Phosphorus as P	mg/L	0.11	0.16	0.03	0.05	0.04	
Total Phosphorus as P	mg/L	0.12	0.19	0.03	0.07	0.09	0.1 mg/L[2]
Particulate Phosphorus	mg/L	0.007	0.028	0.000	0.022	0.044	
Total Nitrogen: Total Phosphorus		49	62	325	235	220	10 : 1
Algae Measures							
Ash Free Dry Mass	mg/cm^2	---	---	23.98	22.23	18.01	
Chlorophyll a	µg/cm^2	---	---	14.67	16.76	9.70	

1. Days since scouring event will be calculated once there are multiple years of data available.
2. Not to be exceeded more than 10% of samples.

Physical Habitat Conditions

Physical habitat conditions were assessed at the three bioassessment sites using the SWAMP (2007) phab protocols and are presented in Table 6. Average wetted width (range = 1.1 to 1.6 m) and average depth (range = 4.0 to 4.6 cm) were nearly identical at each of the three sites. None of the sites had good bank stability. The banks at SDRILG03 and SDRILG02 were mostly vulnerable (68% and 86%, respectively), while at SDRILG05 they were 95% eroded. Vegetative canopy cover was nearly 100% at each site. Microalgae was not found at any site and macroalgae was found only at SDRILG03 (20%) and SDRILG02 (34%). Macrophyte presence ranged from 10.5% at SDRILG05 to 39% at SDRILG03. CPOM (course particulate organic material) was more prevalent at SDRILG05 (56.8%) and SDRILG02 (45.6%), compared to SDRILG03 (28.6%).

Streambed substrates were composed mostly of gravel (range = 11% to 22%), sand (range = 33% to 62%) and fines (range = 9% to 21%) at all three stations, except at SDRILG02 where roots (other) were also prevalent (24%). Flow habitats were composed of riffles and glides at both SDRILG05 and SDRILG02 (approximately 50% each at both sites), while SDRILG03 was almost entirely glides (96%). The percent slope ranged from low gradient at SDRILG03 (0.4%) and SDRILG05 (1.1%) to high gradient at SDRILG02 (3.3%).

The physical habitat conditions at each of the three bioassessment sites are highly altered. In the cases of Keys and Weaver Creeks, the banks and streambeds have been altered by cattle which routinely use the streambed as a crossing. The Couser Canyon site is located beside the road in a residential area where the riparian zone has been cleared and landscaped.

Benthic Macroinvertebrate Communities

Ranked abundances of the top ten species collected at each site are presented in Table 7 and the taxa abundance lists can be found in Appendix B, Table 14. Station SDRILG03 located on Keys Creek was dominated by Ostracods (seed shrimp) (64%), followed by two amphipods (*Ramellogammarus*, 8.4%; *Hyalella*, 4.6%), segmented worms (Oligochaeta, 6.6%) and a midge fly (*Culicoides*, 6.6%). Station SDRILG05 located on Weaver Creek was more diverse with five species accounting for 75% of the population; two caddisflies (Lepidostoma and Hydropsyche) making up 24% and 19.6% of the population, respectively, followed by a snail (Physa, 19.2%) and midge flies (Chironomidae, 9%). Finally, station SDRILG02 on Couser Canyon Creek was the most diverse with abundances spread evenly among the five species accounting for 73% of the population and included two mayflies (*Tricorythodes explicatus*, 20.4% and *Baetis*, 15.2%), Ostrocods (15.2%), midge flies (12.4%) and amphipods (12%).

Biological Metrics

Reviewing of the BMI biological metrics shows that that of the three streams sampled, Couser Canyon Creek (SDRILG02) and Weaver Creek (SDRILG05) supported the most diverse, healthy communities, while the Keys Creek (SDRILG03) had much less diversity and more pollution tolerant species (Table 8). Detailed information regarding each of the biological metrics and their response to impairment can be found in the Data Analysis section of the Methods (Table 2

Table 2).

Keys Creek was represented by low taxonomic richness (n = 11), only one EPT taxa, no Coleopteran (beetles) taxa, large numbers of non-insect individuals (88%) and a low Shannon Diversity score (H' = 1.34). As mentioned above, Ostracods dominated the population (dominance = 64%) and pollution tolerant taxa were abundant (70%). Finally, the feeding strategy at this site lacked diversity and was dominated by collectors and filterers (88%).

Weaver Creek had high numbers of taxa (n = 27), eight EPT taxa and predator taxa, and two beetles, all indicative of a healthy community. This site has the greatest number of sensitive EPT taxa (30%), lowest numbers of non-insect individuals (29%) and a relatively good Shannon Diversity score (H' = 2.31). Finally, this site had the lowest average tolerance value of the three sites (4.5) indicating more pollution tolerant species and a wider range of feeding strategies present including collectors (12.6%), filterers (21.8%), grazers (21%), predators (13.2%) and shredders (27.2%).

Couser Canyon Creek had the greatest numbers of taxa (n = 34), predator taxa (n = 12) and Coleopteran taxa (beetles) (n = 4) of each of the three sites. Although this site lacked the high percentages of EPT taxa (15%) and sensitive EPT taxa (7%) found at Weaver Creek, the percentages of non-insects (23%) was low and the Shannon Diversity score (H' = 2.8) was the greatest of the three sites. The high diversity at this site was reflected in the lowest dominance (18%) of the three sites and a good mixture of feeding strategies with collectors (43%) and predators (30%) making up the majority of feeding types.

Southern California Index of Biological Integrity (So CA IBI)

The So CA IBI scores for the three sites ranged from 6 (very poor) at Keys Creek to 60 and 61 (good) at Weaver and Couser Creeks, respectively (Table 9, Figure 2). The score at Keys Creek was far below the So CA IBI impairment threshold (39). This site lacked EPT, predator and Coleopteran taxa and was dominated by non-insect and tolerant taxa. Weaver and Couser Creeks had similar ranked scores for EPT taxa, % non-insect taxa and % tolerant taxa, while Weaver Creek had a better score for % intolerant taxa, Couser Creek had better scores for predator taxa and Coleopteran taxa.

Table 6. Physical habitat scores and characteristics for reaches in the SLR.

Physical Habitat Characteristics	**SDRILG03**	**SDRILG05**	**SDRILG02**
Average Wetted Width (m)	1.6	1.5	1.1
Average Depth (cm)	4.3	4.0	4.6
Bank Stability:			
% Stable	0.0	0.0	0.0
%Vulnerable	68.2	5.0	86.4
% Eroded	31.8	95.0	13.6
Vegetative Canopy Cover (%)	94.0	96.6	90.2
Microalgae Mean Thickness (mm)	None	None	None
Macroalgae Presence (%)	20.0	0.0	34.0
Macrophyte Presence (%)	39.0	10.5	19.4
CPOM (%)	28.6	56.8	45.6
Substrate Size Class (%)			
Bedrock	0.0	0.0	0.0
Boulder	0.0	0.0	2.9
Cobble	1.0	3.2	4.8
Gravel	17.1	22.1	11.4
Sand	60.0	62.1	33.3
Fines	14.3	9.5	21.0
Wood	3.8	1.1	2.9
Other	3.8	2.1	23.8
Flow Habitats (%):			
Cascade/Fall	0.0	0.0	0.5
Rapid	0.0	0.0	0.0
Riffle	3.5	48.3	57.5
Run	0.0	0.0	0.0
Glide	96.5	51.7	42.0
Pool	0.0	0.0	0.0
Dry	0.0	0.0	0.0
Slope (%)	0.4	1.1	3.3

Table 7. Ranked taxonomic abundance of the top 10 organisms collected during BMI surveys at each station within the SLR watershed.

SDRILG03			SDRILG05			SDRILG02		
Species	% of Total Abund	Cumulative % Abund	Species	% of Total Abund	Cumulative % Abund	Species	% of Total Abund	Cumulative % Abund
Ostracoda	64.0	64.0	Lepidostoma	24.0	24.0	Tricorythodes explicatus	20.4	20.4
Ramellogammarus	8.4	72.4	Hydropsyche	19.6	43.6	Ostracoda	15.2	35.6
Oligochaeta	6.6	79.0	Physa	19.2	62.8	Baetis	13.4	49.0
Culicoides	6.6	85.6	Chironomidae	9.0	71.8	Chironomidae	12.4	61.4
Hyalella	4.6	90.2	Turbellaria	5.0	76.8	Hyalella	12.0	73.4
Chironomidae	4.6	94.8	Bezzia/Palpomyia	3.8	80.6	Simulium	6.8	80.2
Turbellaria	3.4	98.2	Malenka	2.8	83.4	Fallceon quilleri	4.6	84.8
Physa	1.0	99.2	Helicopsyche	1.8	85.2	Turbellaria	3.4	88.2
Bezzia/Palpomyia	0.4	99.6	Argia	1.8	87.0	Sperchon	2.6	90.8
Baetis	0.2	100.0	Hydroptila	1.6	88.6	Caloparyphus/Euparyphus	2.6	93.4

Table 8. BMI metrics for each of the sample locations in San Luis Rey Watershed.

Biological Metric	SDRILG03 Keys Crk	SDRILG05 Weaver Crk	SDRILG02 Couser Crk
Community Richness Measures			
Taxonomic Richness	11	27	34
EPT Taxa	1	8	7
Predator Taxa	3	8	12
Coleoptera Taxa	0	2	4
Community Composition Measures			
EPT Index (%)	0.2	52.2	15.4
Sensitive EPT Index (%)	0.0	30.4	0.4
Percent Non-Insect Taxa	63.6	29.6	23.5
Percent Non-Insect Individuals	88.2	29.4	36.8
Shannon Diversity	1.34	2.31	2.8
Community Tolerance Measures			
% Dominant Taxa	64.0	24.2	17.7
AverageTolerance Value	7.1	4.5	6.2
Percent Intolerant Individuals (0-2)	0.0	27.0	2.0
Percent Tolerant Individuals (8-10)	69.8	23.8	33.0
Percent Tolerant Taxa (8-10)	36.4	22.2	17.6
Percent Hydropsychidae	0.0	19.6	2.4
Percent Baetidae	0.2	0.2	1.6
Percent Chironomidae	4.6	9.0	16.4
Community Feeding Group Measures			
Percent Collectors and Filterers	88.4	34.4	47.3
Percent Collectors	88.4	12.6	43.4
Percent Filterers	0.0	21.8	3.9
Percent Grazers	1.0	21.0	6.8
Percent Predators	10.4	13.2	29.7
Percent Shredders	0.2	27.2	0.2

Table 9. Southern California IBI scores and ratings for sites sampled in the San Luis Rey watershed.

Metric	**SDRILG03** **Keys Crk**	**SDRILG05** **Weaver Crk**	**SDRILG02** **Couser Crk**
EPT Taxa	0	4	4
Predator Taxa	0	5	9
Coleoptera Taxa	0	4	7
% Non-Insect Taxa	0	4	6
% Intolerant Individuals	0	10	1
% Tolerant Taxa	1	5	6
% Collector Individuals	3	10	10
Total	**4**	**42**	**43**
Adjusted Total (1.43)	**6** **Very Poor**	**60** **Good**	**61** **Good**

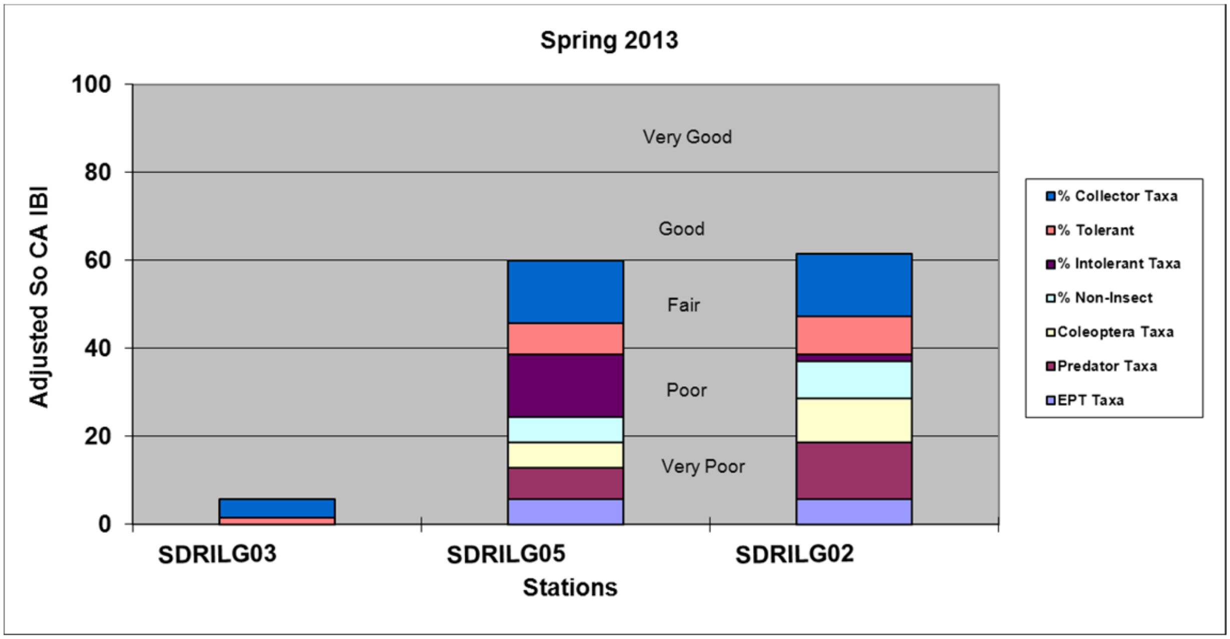

Figure 2. Southern California IBI Scores for sites in the San Luis Rey Watershed. Histogram bars are divided by the proportion that each biological metric contributed to the total score.

Attached Algae Communities

The taxa abundance lists for both the diatoms and soft bodied algae collected during this survey are presented in Appendix B, Table 15 and Table 16, respectively. The SWAMP laboratory protocols for attached algae used for this program were still in draft form when the samples for this program were analyzed. Also, the Algae IBI had only recently been published at the time of this writing and the automated tool necessary to make this calculation were not yet available. As a result, below we present only the results for the diatom community metrics from each site since these metrics have been in use for a long period of time and there is a wide body of literature supporting their use (Bahls 1993; Barbour et al. 1999; Lange-Bertalot 1979; Van Dam *et al.* 1994; Barbour *et al.* 1999; Teply and Bahls, 2005) (Table 10). In the coming year, as these tools become available, the results will be expanded to include the soft bodied algae and all of the results will be discussed in greater detail. Detailed information regarding each of the diatom biological metrics used here and their response to impairment can be found in the Data Analysis section of the Methods (Table 4).

The diatom community structure metrics showed that diversity, species richness and dominance were better at Weaver Creek (SDRILG05) and Couser Canyon Creek (SDRILG02), compared to Keys Creek (SDRILG03) (Table 10). Both sediment metrics indicate that Weaver Creek is more impaired for siltation and motile taxa, followed by Couser Canyon Creek and then Keys Creek. For organic nutrient metrics, the pollution index is similar across sites (range = 2.19 to 2.55) and indicates that the diatom species present are somewhat sensitive to pollution.

Table 10. Diatom metrics for each of the sample locations in San Luis Rey Watershed.

		Station		
Group	**Metric**	**SDRILG03**	**SDRILG05**	**SDRILG02**
Community Structure				
Diversity	Shannon H (log2)	3.79	4.89	4.53
Diversity	Species Richness	41.00	67.00	53.00
Dominance	Dominant Taxon Percent	29.83	11.17	14.17
Sediment				
Siltation	Siltation Taxa Percent	17.50	50.17	34.17
Motility	Motile Taxa Percent	23.17	63.83	52.67
Organic Nutrients				
Pollution	Pollution Index	2.55	2.19	2.20
Heterotrophism	Nitrogen Heterotroph Taxa Percent	11.50	21.33	13.83
Saprobity	Polysaprobous Taxa Percent	31.00	41.17	54.50
Oxidation	Low DO Taxa Percent	3.83	10.83	13.00
Inorganic Nutrients				
Autotrophism	Nitrogen Autotroph Taxa Percent	81.67	61.33	74.00
Trophic State	Eutraphentic Taxa Percent	70.33	64.83	68.83
Metals				
Disturbance	Disturbance Taxa Percent	0.00	0.00	0.00
Metals Tolerance	Metals Tolerant Taxa Percent	5.67	5.00	13.17
Abnormality	Abnormal Cells Percent	0.33	0.17	0.00

Summary & Discussion

- Five sampling locations were visited and successfully sampled for water quality, physical habitat and biological condition in the SLR on July 18th and 19th, 2013.
- The data quality objectives for each phase of the program were met.
- The sampling period was characterized by very low discharge at each of the sampling locations following eight months of dry weather and drought conditions.
- Conductivity was very high at all five of the water quality sites (range = 2,167 to 2,978 uS/cm).
- Dissolved oxygen, pH and turbidity were all within normal ranges.
- Of the water quality parameters measured, several exceeded thresholds in the San Diego Basin plan:
    - Chloride, sulfate and total dissolved solids exceeded Basin Plan thresholds at each of the five sites.
    - Ammonia was low across sites, except at Couser Canyon (SDRILG02) (0.06 mg/L) which exceeded the Basin Plan threshold (0.025 mg/L).
    - Nitrate exceeded the Basin Plan threshold (10 mg/L) at all sites (range = 9.39 to 18.26 mg/L), except Moosa Creek (SDRIL01).
    - Total phosphorus exceeded the Basin Plan threshold (0.1 mg/L) at the Moosa Creek stations (SDRILG01 and SDRILG07).
    - The ratio of total nitrogen to total phosphorus exceeded the Basin Plan threshold (10 : 1) at each site (range = 49 to 325).
- The biological condition of the three bioassessment sites based on the So CA IBI ranged from 6 (very poor) at Keys Creek to 60 and 61 (good) at Weaver and Couser Creeks, respectively. The score at Keys Creek was far below the So CA IBI impairment threshold (39).
    - The upper sampling reach at Keys Creek was dominated by the effects of its use as a cattle crossing. As a result, the streambed was composed mostly of sand and had little of the instream complexity that is necessary to support healthy BMI communities.
    - Cattle use was also evident at Weaver Creek where the biological condition was good based on the So CA IBI. The streambed at this site is highly incised with high banks on either side making it less suitable as a cattle crossing. As a result, the streambed had good instream complexity which might explain the good biological condition score.
    - The high So CA IBI score at Couser Creek was somewhat surprising considering the highly modified riparian zone and its location near the road. Good water quality conditions and streambed complexity probably played a role in the good biological condition score at this site.
- Attached algae were successfully collected and analyzed at the three bioassessment sites. The SWAMP laboratory protocols for attached algae used for this program were still in draft form when the samples for this program were analyzed. Also, the Algae IBI had only recently been published at the time of this writing and the automated tool necessary to make this calculation were not yet available. As a result only the results for the diatom community metrics from each site are presented since these metrics have been in use for a long period of time and there is a wide body of literature supporting their use. In the coming year, as these tools become available, the results will be expanded to include the soft bodied algae and all of the results will be discussed in greater detail.

- Diatom community metrics showed that diversity, species richness and dominance were better at Weaver Creek (SDRIL05), however sediment metrics indicate that Weaver Creek is more impaired for siltation and motile taxa. Organic nutrient metrics and the pollution index are similar across sites indicating that diatom species present are somewhat sensitive to pollution.
- This report includes the results for single samples for water chemistry and biology. As specified in the Ag Waiver program (SWRCB 2013), decisions regarding this program can only be made after several samples have been collected over a multi-year time frame to ensure the natural variability of these stream systems are taken into account.

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Appendix A: Nutrient Calculations, Field Duplicate Results, Methods and Detection Limits

Table 11. Nutrient calculations and constituents for sites in the San Luis Rey Watershed.

	Station				
Parameter	**SDRILG01**	**SDRILG07**	**SDRILG03**	**SDRILG05**	**SDRILG02**
Particulate Organic Carbon (mg/L)					
Total Organic Carbon	4.6	7.6	5.2	5.0	4.5
Dissolved Organic Carbon	4.3	7.2	4.8	4.8	4.1
Difference	**0.3**	**0.4**	**0.4**	**0.2**	**0.4**
Particulate Phosphorus (mg/L)					
Total Phosphorus as P	0.117	0.191	0.031	0.067	0.086
Dissolved Phosphorus as P	0.110	0.163	0.033	0.045	0.042
Difference	**0.007**	**0.028**	**0.000**	**0.022**	**0.044**
Particulate Nitrogen (mg/L)					
Total Kjeldahl Nitrogen	0.5	0.8	0.6	0.6	0.6
Ammonia as N	0.00	0.00	0.02	0.00	0.06
Difference	**0.50**	**0.80**	**0.58**	**0.60**	**0.54**
Total Nitrogen (mg/L)					
Total Kjeldahl Nitrogen	0.5	0.8	0.6	0.6	0.6
Nitrate as N	5.18	10.97	9.39	15.13	18.26
Nitrite as N	0.05	0.00	0.07	0.03	0.02
Sum	**5.73**	**11.77**	**10.06**	**15.76**	**18.88**

Table 12. Field duplicate results for site SDRIL05 in the San Luis Rey Watershed.

		Station & Field Duplicate SDRILG05		Relative Percent Difference
Parameter[1.]	Units	1	2	
Ammonia as N	mg/L	0.025	0.025	0.00
Chloride	mg/L	326.4	327.9	0.46
Chlorophyll a	µg/L	8	1	155.56
Dissolved Organic Carbon	mg/L	4.8	4.7	2.11
Nitrate as N	mg/L	15.13	14.94	1.26
Nitrite as N	mg/L	0.03	0.03	0.00
Orthophosphate as P	mg/L	0.232	0.229	1.30
Particulate Nitrogen	mg/L	0.6	0.6	0.00
Particulate Organic Carbon	mg/L	0.2	0.3	40.00
Particulate Phosphorus	mg/L	0.022	0.01	75.00
Dissolved Phosphorus as P	mg/L	0.045	0.046	2.20
Total Phosphorus as P	mg/L	0.067	0.056	17.89
Sulfate	mg/L	538.6	533.8	0.90
Total Dissolved Solids	mg/L	1743	1735	0.46
Total Kjeldahl Nitrogen	mg/L	0.6	0.6	0.00
Total Nitrogen	mg/L	15.76	15.57	1.21
Total Organic Carbon	mg/L	5	5	0.00
Total Suspended Solids	mg/L	12.9	15.5	18.31

1. Half of the reporting limit was used in calcultations for samples with Non-Detects (ND).

Table 13. Chemistry minimum detection limits (MDL) reporting limits (RL), units and Method

Parameter	**Unit**	**Method**	**MDL**	**RL**
Ammonia as N	mg/L	SM 4500 NH3 D	0.02	0.05
Chloride	mg/L	EPA 300.0	0.01	0.05
Chlorophyll a	ug/L	SM 10200 H-2b	NR	2 - 4
Dissolved Organic Carbon	mg/L	EPA 415.3	0.062	0.5
Nitrate as N	mg/L	EPA 300.0	0.01	0.05
Nitrite as N	mg/L	SM 4500-NO2 B	0.01	0.05
Orthophosphate as P	mg/L	EPA 300.0	0.0022	0.01
Particulate Organic Carbon	mg/L	Calculated[1.]	---	---
Particulate Phosphorus	mg/L	Calculated[1.]	---	---
Dissolved Phosphorus as P	mg/L	SM 4500-P E	0.016	0.05
Total Phosphorus as P	mg/L	SM 4500-P E	0.016	0.05
Sulfate	mg/L	EPA 300.0	0.01	0.05
Total Dissolved Solids	mg/L	SM 2540 C	0.1	5
Total Kjeldahl Nitrogen	mg/L	EPA 351.2	0.06	0.4
Particulate Nitrogen	mg/L	Calculated[1.]	---	---
Total Nitrogen	mg/L	Calculated[1.]	---	---
Total Organic Carbon	mg/L	EPA 415.3	0.062	0.5
Total Suspended Solids	mg/L	SM 2540 D	0.5	0.5
Ash Free Dry Mass	mg/cm2	SM 2540 B	NR	1
Chlorophyll a	ug/cm2	SM 10200 H-2b	NR	20 - 40

NR- Not Reported

1. Calculated result, no MDL or RL

Appendix B: BMI and Attached Algae Taxa Lists and Metrics

Table 14. 2013 BMI metrics taxa list for sites in the San Luis Rey Watershed.

Identified Taxa	**Tol Val (TV)**	**Func Feed Grp**	**SDRILG03**	**SDRILG05**	**SDRILG02**
Insecta Taxa					
Ephemeroptera					
Baetis	5	cg	1	1	2
Caenis	7	cg			1
Fallceon	4	cg			6
Odonata					
Argia	7	p		9	7
Coenagrionidae	9	p		1	29
Hetaerina americana	6	p		2	
Libellulidae	9	p			1
Plecoptera					
Malenka	2	sh		14	
Trichoptera					
Helicopsyche	3	sc		9	
Hydropsyche	4	cf		98	12
Hydroptila	6	ph		8	50
Hydroptilidae	4	ph		2	4
Lepidostoma	1	sh		120	1
Nectopsyche	3	om		8	1
Wormaldia	3	cf		1	
Coleoptera					
Anacaena	5	p			2
Helichus	5	sh		2	
Helochares	5	p			2
Heterelmis obesa	4	cg		3	11
Zaitzevia	4	sc			7
Diptera					
Atylotus/Tabanus	5	p			1
Bezzia/Palpomyia	6	p	2	19	21
Caloparyphus/Euparyphus	8	cg			12
Ceratopogonidae	6	p		1	1
Chironomidae	6	cg	23	45	82
Culicoides	6	p	33		6
Dasyhelea	6	cg		2	7
Dixa	2	cg		1	3
Empididae	6	p			1
Ephydridae	6				12
Meringodixa chalonensis	2	cg			6
Neoplasta	6	p		1	2
Pericoma/Telmatoscopus	4	cg			1
Sciomyzidae	6	p			1
Simulium	6	cf		3	1
Tipula	4	om		3	23

Table 14. Continued

Identified Taxa	Tol Val (TV)	Func Feed Grp	SDRILG03	SDRILG05	SDRILG02
Non-Insecta Taxa					
Oligochaeta	5	cg	33	4	8
Ostracoda	8	cg	320	7	73
Turbellaria	4	p	17	25	48
Amphipoda					
Hyalella	8	cg	23		
Ramellogammarus	4	cg	42		
Basommatophora					
Physa	8	sc	5	96	26
Decapoda					
Procambarus clarkii	8	sh	1		
Hoplonemertea					
Prostoma	8	p		3	7
Trombidiformes					
Arrenurus	5	p			5
Atractides	8	p		2	
Sperchon	8	p		3	11
Veneroida					
Corbicula	8	cf			6
Pisidium	8	cf		7	
TOTAL			**500**	**500**	**500**

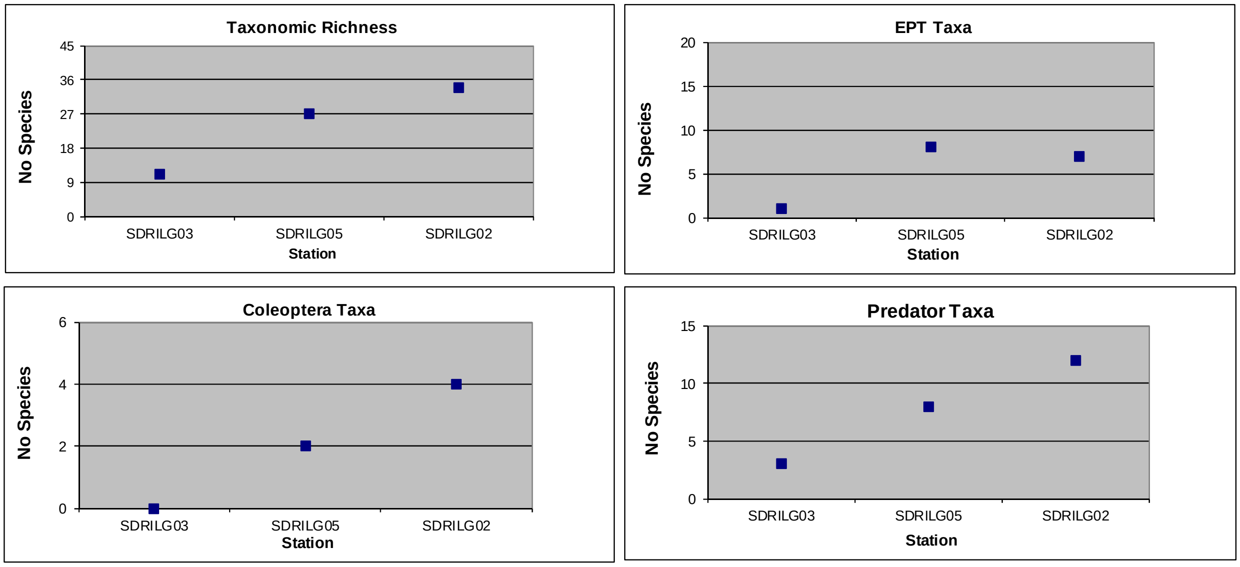

Figure 3. Community richness measures for sites in the San Luis Rey Watershed.

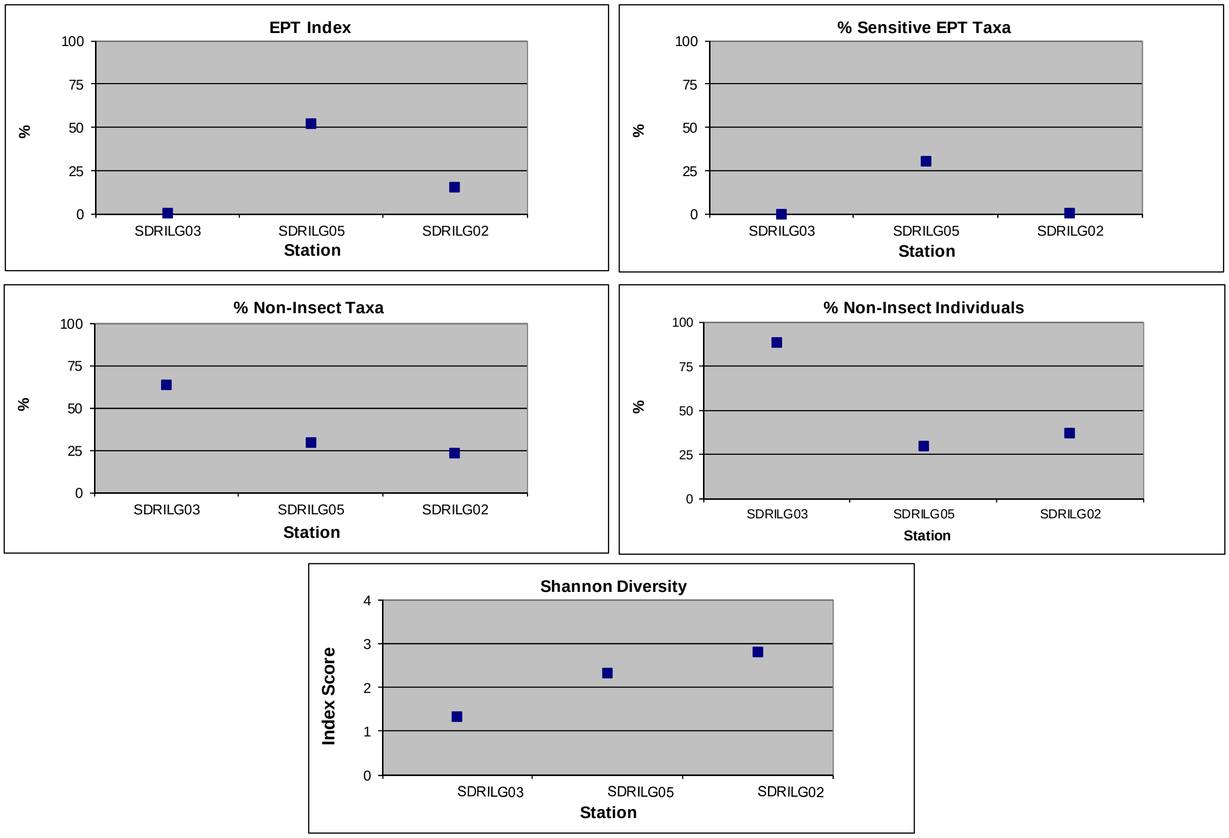

Figure 4. Community composition measures for sites in the San Luis Rey Watershed.

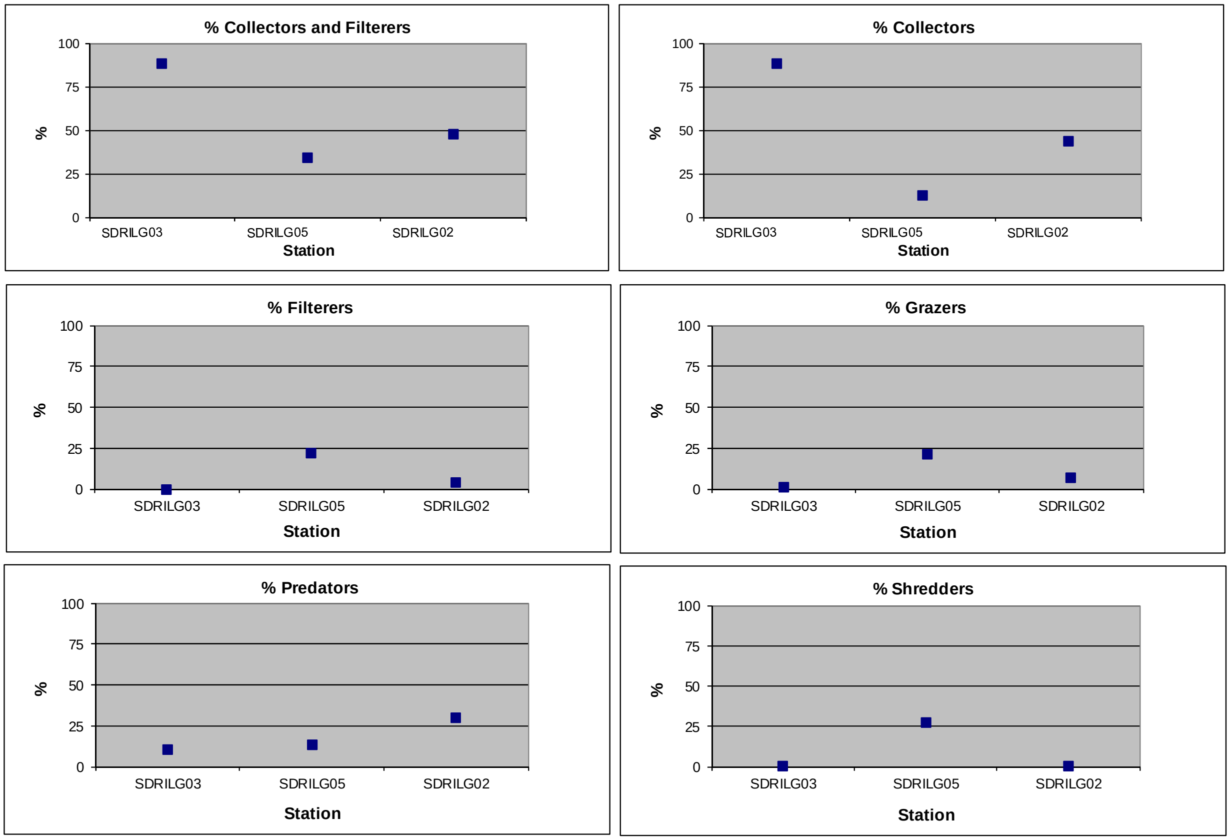

Figure 5. Functional Feeding Group measures for sites in the San Luis Rey Watershed.

Table 15. 2013 BMI soft-bodied algae taxa list for the San Luis Rey Watershed.

						Station	
Sample Type	**Phylum**	**Class**	**Species**	**Unit**	**SDRILG02**	**SDRILG03**	**SDRILG05**
Epiphyte	Chlorophyta	Chlorophyceae	Characium pringsheimii	Count		37	
	Cyanobacteria	Cyanophyceae	Xenococcus sp 1	Count		23	
			Heteroleibleinia	Count		130	
			Chamaesiphon incrustans	Count		11	
Macroalgae	Chlorophyta	Ulvophyceae	Cladophora glomerata	um3/cm2		1.13131E+11	
			Rhizoclonium cf crassipellitum	um3/cm2		40404040404	
Microalgae	Chlorophyta		Chlorophyta 1	um3/cm2		772558	
		Chlorophyceae	Stigeoclonium lubricum	um3/cm2			148875
			Oedogonium sp 1	um3/cm2		4383676	
			Scenedesmus communis	um3/cm2	2796		
			Scenedesmus dimorphus	um3/cm2	9185		5385
			Scenedesmus ellipticus	um3/cm2	12042		7061
		Ulvophyceae	Cladophora glomerata	um3/cm2		16897359762	
			Rhizoclonium cf crassipellitum	um3/cm2		36389054	
	Cyanobacteria	Cyanophyceae	Cyanophyceae 11	um3/cm2	1021		
			Cyanophyceae 3	um3/cm2		1407539	
			Xenococcus sp 1	um3/cm2		557076	
			Oscillatoria sp 1	um3/cm2		2181294	
			Phormidium sp 1	um3/cm2	80337		66240
			Phormidium sp 2	um3/cm2		1959597	
			Schizothrix sp 1	um3/cm2	74479		
			Heteroleibleinia	um3/cm2	214742	300846	578656
			Leptolyngbya sp 1	um3/cm2	148877		113930
			Leptolyngbya sp 2	um3/cm2		751194	
			Pseudanabaena sp 1	um3/cm2	1470	18601	5774
			Chamaesiphon incrustans	um3/cm2	24942	88725	
			Merismopedia glauca	um3/cm2			
	Euglenozoa	Euglenophyceae	Euglena sp 1	um3/cm2	202475	1598618	296793
	Rhodophyta	Florideophyceae	Chantransia sp 1	um3/cm2			1546179
Qualitative	Chlorophyta	Ulvophyceae	Cladophora glomerata	Count		P	
			Rhizoclonium cf crassipellitum	Count		P	

P= present in sample, but not counted.

Table 16. 2013 BMI diatom algae taxa list for the San Luis Rey Watershed.

		Station		
Species	**Unit**	**SDRILG02**	**SDRILG03**	**SDRILG05**
Achnanthidium	Count		2	
Achnanthidium minutissimum	Count	11	43	3
Amphora copulata	Count	1	2	7
Amphora inariensis	Count	2		2
Amphora ovalis	Count		4	
Amphora pediculus	Count	63	18	32
Bacillaria paradoxa	Count	4	2	5
Caloneis bacillum	Count			3
Cocconeis pediculus	Count	2		
Cocconeis placentula	Count	12	46	25
Cocconeis placentula var euglypta	Count	6		2
Cocconeis placentula var lineata	Count	38	179	54
Cocconeis pseudolineata	Count	4	18	13
Cosmioneis incognita	Count			1
Cyclotella meneghiniana	Count	2		7
Denticula	Count			4
Denticula kuetzingii	Count	4		
Encyonopsis microcephala	Count	2		
Entomoneis paludosa	Count	11	1	9
Eolimna minima	Count	7		12
Fallacia	Count	8		1
Fallacia pygmaea	Count		6	2
Fallacia sublucidula	Count			2
Gomphonema	Count	2	12	
Gomphonema exilissimum	Count		2	
Gomphonema mexicanum	Count			2
Gomphonema parvulum	Count	1	10	4
Gyrosigma acuminatum	Count	3		2
Halamphora coffeaeformis	Count			1
Halamphora montana	Count			2
Halamphora veneta	Count	20	5	15
Hantzschia	Count			1
Hippodonta hungarica	Count	7	17	65
Lemnicola hungarica	Count			1
Mayamaea atomus	Count		3	1
Melosira varians	Count	13	2	8
Navicula	Count	11	3	13
Navicula caterva	Count		2	25
Navicula cryptocephala	Count			2
Navicula erifuga	Count	8	5	13
Navicula goersii	Count			4
Navicula gregaria	Count	38		28
Navicula lanceolata	Count			2
Navicula salinicola	Count	3	3	1
Navicula tenelloides	Count	6		
Navicula veneta	Count	22	8	8

Table 16. Continued

		Station		
Species	**Unit**	**SDRILG02**	**SDRILG03**	**SDRILG05**
Nitzschia	Count	13	1	5
Nitzschia angustata	Count	1		
Nitzschia angustatula	Count		2	4
Nitzschia communis	Count	3		
Nitzschia commutata	Count	3		2
Nitzschia debilis	Count	2		
Nitzschia desertorum	Count	2		
Nitzschia frustulum	Count	1	4	8
Nitzschia inconspicua	Count	54	32	67
Nitzschia liebethruthii	Count	2		
Nitzschia linearis	Count	1		1
Nitzschia microcephala	Count		3	15
Nitzschia palea	Count		2	
Nitzschia paleacea	Count		4	
Nitzschia perminuta	Count			1
Nitzschia solita	Count		2	
Nitzschia supralitorea	Count		3	4
Nitzschia terrestris	Count			2
Nitzschia valdestriata	Count			2
Parlibellus protracta	Count	2		
Placoneis placentula	Count			2
Planothidium delicatulum	Count			2
Planothidium frequentissimum	Count	85	86	45
Planothidium lanceolatum	Count	69	15	13
Planothidium rostratum	Count			2
Pleurosira laevis	Count	4		2
Pseudostaurosira parasitica	Count	2		
Reimeria sinuata	Count	2		
Rhoicosphenia abbreviata	Count	24	42	24
Rhopalodia constricta	Count		2	1
Rossithidium nodosum	Count			2
Sellaphora pupula	Count	1		
Sellaphora seminulum	Count	2		
Stauroneis smithii	Count	1		1
Staurosira construens	Count	7		2
Surirella	Count	2		1
Surirella brebissonii	Count		1	1
Surirella brightwellii	Count		1	
Surirella ovalis	Count	2	1	
Surirella robusta	Count			1
Synedra ulna	Count			2
Tabularia fasciculata	Count		4	
Tryblionella	Count	2	2	2
Tryblionella apiculata	Count	2		3
Tryblionella calida	Count			1

Appendix C – Photos of Sampling Sites

SDRILG02 – Facing upstream

SDRILG02 – Facing downstream

SDRILG03 – Facing upstream

SDRILG03 – Facing downstream

SDRILG05 – Facing Upstream

SDRILG05 – Facing downstream

Figure 6. Sampling location photos of the bioassessment sampling sites within the San Luis Rey watershed.