S A N D I E G O R I V E R P A R K F O U N D A T I O N

LOWER SAN DIEGO RIVER WATER QUALITY 2012

Water Quality Monitoring Report Appendices sA-sF

Site 1 - Lower Mission Valley (between Pacific Hwy/I-5) Western most reach of LSDR at Estuary

Supporting Water Quality Monitoring Data for the Lower San Diego River

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December 2012

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Lower San Diego River Water Quality - 2012

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Appendix sA - San Diego RiverWatch WQ Monitoring Program

Appendix A provides an overview of SDRPF's RiverWatch water quality monitoring (WQM) program that, over the past 8 years, has been continuously engaged in collecting and evaluating data pertaining to the Lower San Diego River (LSDR) watershed on a monthly basis.

Monitoring Period & Coverage: Monthly monitoring over past 8 years (Oct. 2004 – Nov. 2012) covering the Lower San Diego River and its tributaries extending downstream from Lakeside (river mile 19.8 elev. 340 ft amsl) to the Estuary (river mile 2.96, elev. 4.8 ft amsl) between the I-5/Pacific Hwy. overpasses. The LSDR watershed and monitoring sites are shown on **Figure A.1.**

Monitoring Sites: 15 total - 12 on main course (Mission Valley Section - sites 1-7, Mission Gorge Section - sites 8-10, Santee Basin Section - sites 11-15) plus three tributary stream sites are listed in **Table A.1.** Site locations, river milage, bed elevations and coordinates are provided in **Table A.2.**

Table A.1 LSDR Sections, Reaches and Monitoring Sites

Section/Reach/Tributary	Site #	Comments
Estuary Entrance	1E/1W	Tidal Influence at transition from river to SDR Estuary
Lower Mission Valley (LMV)	2E/W, 3 & 4	4 miles of lower river extending to I-805
Upper Mission Valley (UMV)	5,6 & 7	4-mile stretch from I-805 to Princes View Dr
Mission Valley (West Sites)	1-7	8-mile western portion through Mission Valley
Mid-Section Mission Gorge (MG)	8,9 & 10	5-mile mid-section, Princess View Dr to Kumeyaay Lk
Lower Santee Basin (LSB)	11,12&15	2 mile stretch from Kumeyaay Lk to Carlton Hills Blvd
Upper Santee Basin (USB)	13 & 14	3 mile stretch from Carlton Hills Blvd to Riverford Rd
Santee Basin (SB)	11-15	5-mile eastern section from Kumeyaay Lk to Lakeside
Eastern Portions (East Sites)	8 -15	10-mile eastern/upper 3 reaches (2 sections)
Tributaries:		
Murphy Canyon/Qualcom [a)]	5a	Enters SDR southwest of Qualcom Stadium
Jackson Dr/Birchcreek Outfall [b)]	9	Enters SDR at Sycott Wash (d/s of Site 8)
Santee Lakes/E. Sycamore Cnyn Creek	12	Enters SDR d/s of Carlton Oaks GC (u/s of Site 11)
Forester Creek [c)]	15	Enters SDR at Carlton Oaks GC (u/s of Site 12)
Lower SDR Watershed (LSDR)	1-15	Weighted average of all 5 reaches or all 3 sections

(a) Monthly monitoring discontinued in WY07; nearby Ward Rd bridge site renumbered as 5.
(b) Monthly monitoring initiated in 2008; site also termed Jackson Outfall (OF).
(c) Monthly monitoring at various locations initiated in 2007.

WQ Parameters: Seven measured and recorded parameters (Temp, pH, SC, DO, DO%Sat, NO_3 & PO_4) plus subjective field observations re: environs and characteristics are listed in **Table A.3.** As nutrient testing for NO_3 and PO_4 is carried out at five selected sites; two in West (2 & 6) and three in East (11,14 & 15), respectively, results are not used in performing statistical analyses regarding reaches/sections of the river. Number of datum for each of the five physical-chemical parameters monitored monthly at each site over the 8-yr period (Oct. 04 - Oct. 12) are in the range of 80 to 95. Two other water quality parameters monitored by others at several sites, streamflow from USGS (Poway Office) and coliform counts from SDCoastKeeper, are also recorded for purposes of determining the water quality index.

Table A.2 - LSDR WQM Site Information

Site #	Site Name	u/s mi.	Elev. ft	Location	GIS Coordinates Latitude	Longitude
LMV - Lower Reach W. Mission Valley: I-5 Bridge to I-805 Bridge (Sites 1-4)						
1	Estuary W/E	2.96	6	Between PC Hwy & I-5 on encased sewer main	32.76131	-117.2037
2	River Gardens E/W	3.50	11	W. of YMCA, d/s of Trolly overpass at riffle	32.76230	-117.1944
3	Fashion Valley Mall W	5.08	22	below Town & Country Pedestrian Bridge	32.76517	-117.1687
4	FSDRIP	5.98	36	N. of Mimi's Cafe on Mission Center Rd Bridge	32.76986	-117.1548
UMV - Upper Reach E. Mission Valley: I-805 Bridge to North end of Admiral Baker Field (Sites 5-7)						
5	Ward Rd Bridge	8.89	50	S. of Trolly overpass at Del Rio S intersection	32.78024	-117.1103
6	Kaiser Ponds	9.46	56	E. of Mission SD de Acala at SD Mission Rd	32.78406	-117.1042
7	Admiral Baker Field	9.98	58	L - Lower (below Friars Rd bridge)	32.79038	-117.1031
	ABF - Zion	10.2	62	Z - Terminus of Zion Ave at Riverdale St	32.79304	-117.0998
West (MV) - Mission Valley Section: Estuary to Admiral Baker Field (Sites 1-7) [LMV+UMV]						
MG - Mission Gorge Reach: Quarry Area to Old Mission Dam (Sites 8-10)						
8	Mission Trails at Jackson Dr	13.8	159	at SDCWA down stream of Scycott Crossing	32.82124	-117.0621
9	Jackson Dr/Birchcreek OF	13.9	198	San Marcos area tributary by Jackson Dr. Trail	32.82268	-117.0622
10	Old Mission Dam W/E	15.7	265	Downstream side of Old Mission Dam	32.83977	-117.0433
Mid-Section (MG) - Mission Gorge Section: Quarry Area to Old Mission Dam (Sites 8-10)						
LSB - Lower Reach Santee Basin: W. Hills Pkwy to Carlton Hills Blvd Bridge (Sites 11,12 &15)						
11	West Hills Pkwy	17	300	at/below West Hills Pkwy Bridge	32.83936	-117.0244
12	Carlton Oaks Dr/Santee	18.2	320	Sycamore Ck/Santee Lakes at Carlton Oaks Dr.	32.84431	-117.0064
15	Forester Creek	18.9	336	Forester Ck (tributary) at Prospect Ave.	32.83221	-116.9866
USB - Upper Reach Santee Basin: Carlton Hills Blvd Bridge to Riverford Rd (Sites 13-14)						
13	Mast Park	18.50	330	Pedestrian Bridge behind (N of) Walmart	32.84696	-116.9734
14	Cottonwood Ave/RCP	19.8	340	W of RCP plant at Chubb Ln/Cottonwood Ave	32.84434	-116.9895
East (SB) - Santee Basin Section: West Hills Parkway to Lakeside (Sites 11-15 above) [LSB+USB]						
LSDR - Lower San Diego River Watershed: SD Estuary to Lakeside (Sites 1-15 above) [MV2+MG+SB]						

Reaches (5) - averaged values for combination of adjacent sites excluding tributaries within identified portions of river (LMV, UMV, MG, LSB, USB) .
Sections (3) - averaged values for adjacent reaches (MV = LMV+UMV, MG=MG, SB = LSB+USB
Tributaries (3) – sites located on small creeks/drainages tributary to main stem watercourse.
LSDR – computed values for entire lower watershed (distance-weighted average of all 5 reaches or all 3 sections); average (LMV+UMV+MG+SB) or average (MV2+MG+SB).

Protocol: *East Side* – (Santee Basin & Mission Gorge Sections). The 8 sites within upper three reaches (MG, LSB & USB) typically monitored 3rd Fri. or Sat. of month. *West Side* - (Mission Valley Section). Seven sites within the lower two reaches (LMV & UMV) monitored monthly, typically 3rd Sun. of month.

Table A.3 - LSDR Water Quality Monitoring Parameters

WQ Parameter	unit	Comments
Measured monthly at all sites:		
1. Temperature (Temp)	oC	Basic characteristic and WQ driver (Table C.1)
2. pH	-	Degree of acidity (<7.0) or alkalinity (>7.0) (Table C.3)
3. Specific Conductivity (SC)	mS/cm	Measure of ionic content or dissolved solids (Table C.2)
4. Dissolved Oxygen (DO)	mg/L	Good indicator of relative water quality (Table C.4)
5. Percent of DO Saturation (DO%Sat)	%	Good indicator of general water quality (Table C.5)
Sampled/tested monthly at selected sites: (typically 5 - 3 East & 2 West)		
6. Nitrate (NO_3-N)	mg/L	Important nutrient for biological activity
7. Phosphate (PO_4-P)	mg/L	Key nutrient for biological activity
Discontinued on regular basis in 2006:		
8. Turbidity	NTU	Discontinued due to inaccurate/invalid readings
9. Barometric Pressure	mBars	Suspended readings as external data readily available
Environmental Observations recorded at all sites:		
Atypical or notable conditions (scum, discoloration, odors, etc.), trash/debris, homeless encampments, biological activity (aquatic, avian, terrestrial), expansion of invasive species, erosion, scouring, other noteworthy comments re: watercourse, shoreline and adjacent environs.		
General WQ Conditions observed at all sites: (numerical coding added in 2010)		
Weather Condition, Presence of Algae, Clarity, Color, Odor, Flow, Foam, Litter, Odor, Oil and Grease (O&G)		
Parameters measured by others at selected sites		
10. Coliform counts	MPN/ 100mL	SDCoastKeeper data taken at Fashion Valley Rd and Old Mission Dam monitoring sites (Table E.2)
11. Stream Flow	cfs	USGS gauging stations at Fashion Valley and Mast Rd near Santee (Table E.1)

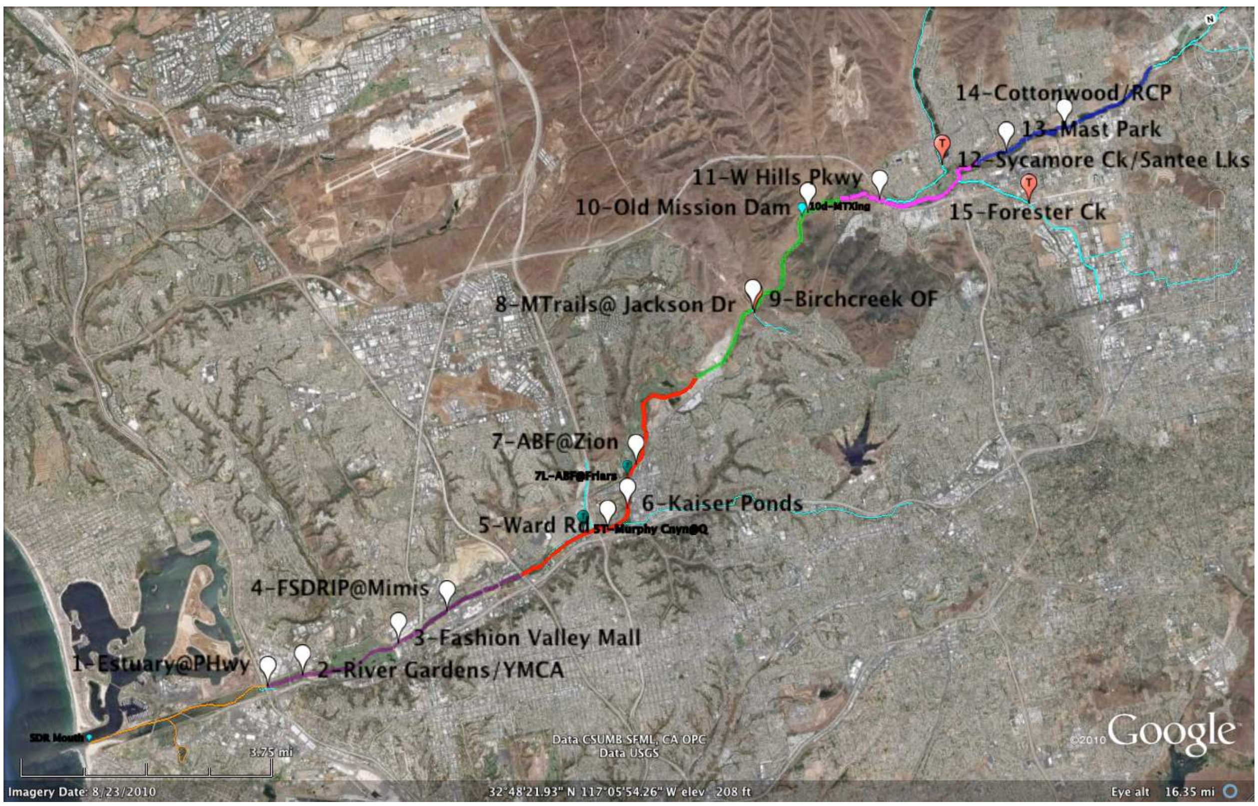
Team Leaders and multiple citizen volunteers (typically 3-8 persons) meet at an appointed site, organize field equipment/transportation, drive to sites, measure physical-chemical water quality using Sonde instrument, note special conditions/observations, collect samples for subsequent testing, return to office, perform nutrient (NO_3 & PO_4) tests, store samples for subsequent laboratory (e.g., sediment toxicity) analyses and clean/check-in/store field equipment.

Data Management: Water quality data are typically managed in a three-step process.
1. *Raw* (source) data - each site, several of which have two monitoring locations (e.g. upstream/ downstream of dam, riffle or crossing), date/time, measured WQ parameters, and non-quantifiable supporting observations and comments.
2. *Compiled* (vetted/proofed) data - provided on Ecolayers w/date, site location, parameter value and additional observations of interest.
3. *Processed* (formatted/aggregated) data - with statistical computations associated with LSDR sites, reaches, sections and tributaries for each WQ parameter of interest including those monitored by others.

Statistical Computations: Various basic statistical values have been calculated from the data.

- Mean – average of a series (sum of values divided by number of values)
- Median – middle value of an ordered series (50% larger - 50% smaller)
- Minimum – lowest or smallest value measured
- Maximum – highest or greatest value measured
- Range – Difference between maximum and minimum values
- 1st Quartile (Q1) – 25% of values smaller - 75% larger
- 2nd Quartile (Q2) – 50% of values larger - 50% smaller (same as median value)
- 3rd Quartile (Q3) – 75% of values smaller - 25% larger
- Variance – sum of the squares of deviation from the mean or average value
- Standard Deviation (SD) – square root of the variance
- Skew – third moment about the mean divided by the standard deviation (SD)
- Coefficient of Variance (CoV)– Variance divided by the mean
- Trend line - Moving average value taken over 12 month period (for LSDR)

Figure A.1 - Lower San Diego River Catchment and WQM Sites



Color Code for LSDR reaches on figure above: Estuary (orange), LMV (purple), UMV (red), MG (dark green), LSB (violet), USB (dark blue), Lakeside (light green), tributaries (light blue). Figure details can be downloaded through Google Earth from SDRPF website/River Monitoring page: file <Fig1.1WQMR.kmz>

Questions regarding the San Diego River WQM database or interpretation of results expressed in these appendices can be directed to the attention of the report's author, John C. Kennedy, through contacting SDRPF at info@SanDiegoRiver.org*, or the RiverWatch Coordinator at 619-297-7380.*

Appendix sB - LSDR Hydrology and Water Quality

Stream flow or discharge, the volume of water moving past a designated location over a fixed period of time, is a primary driver of changes in water quality. Flow, often expressed as cubic feet per second (cfs) or million gallons per day (mgd), constitutes the amount of water moving off a watershed into a watercourse, as affected by weather (increasing during rainstorms and decreasing during dry spells) and changing during different seasons. Flow decreases during summer months when rainfall is minimal, evaporation rates high and actively growing riparian vegetation extracts water from the ground. August and September are typically months of lowest flow. A function of both volume and velocity, stream flow has a major impact on living organisms, watercourse habitats and on overall water quality. Velocity of flow, typically increasing as volume increases, determines the kinds of organisms that live in the system and also affects the amount of silt and sediment thats transported. Fast moving watercourses usually contain higher levels of DO than slow streams, as they are better aerated.

LSDR average daily flow (ADF) values as recorded at the two USGS gauging stations in the lower watershed are expressed in **Table B.1** for both the monitoring period (Oct 2004 - Oct 2012) and the past 46 years (1965-2012) of official records**.** The two averages are in close accord for both stations.

Table B.1 - Lower SDR Average Daily Flows (WY05-WY12)

Season	West - Mission Valley		East - Santee Basin		LSDR [(a)]	
Units [(b)]	cfs	mgd	cfs	mgd	cfs	mgd
Fall (Oct/Nov)	22.1	14	15.4	10	18.8	12
Winter (Dec-Mar)	89.6	58	48.0	31	68.8	44
Spring (April/May)	18.4	12	11.7	8	15.1	10
Summer (June-Sept)	2.4	1.5	1.8	1.2	2.1	1.3
8-Yr Annual Avg. (Oct-Sept)	29.3	24.2	21.1	13.6	29.3	18.9
48-Yr Avg. (1965-2012)	36.3	23.5	21.7	14.0	29.0	18.7
Total Annual Discharge, AF [(c)]	26,320		15,680		20,940	

(a) Lower San Diego River average daily flow represents a mean hydrologic condition based on averaging the two USGS stream gauging station values.
(b) ADF values are expressed in both cubic feet per second (cfs) and million gallons per day (mgd); 1 mgd = 1.547 cfs
(c) Average annual discharge volume expressed in acre-feet (1 AF = 325,900 gallons) between 1965 and 2012.

Correlations between total annual rainfall and ADF considered over the past 99 years of hydrologic record and during the period of SDRPF RiverWatch monitoring for the two lower SDR gauging stations are presented in **Tables B.2 and B.3**, respectively. WY05 was a "Very Wet" hydrologic year, whereas WY07 was "Very Dry". WY06 & 08 were "Dry" years while the past two years (WY09&10) were considered "Normal" in terms of both total annual rainfall and average daily flow. The 8-yr ADF in the East and West is 21 and 37 cfs, respectively; both values are approximately the same as the past 45- as well as 99-yr SDR average daily discharges.

Monthly discharge data (min, max and average daily flow) at the two gauging stations extending from Oct 2004 through Oct 2012 are presented in **Chart B.1.** Average daily flow (ADF) for the lower San Diego River varies from less than 1 cfs during the summer (dry) months to nearly 200 cfs during some winter (wet) seasons in the East (Santee Basin) and up to 380 cfs in the West (Mission Valley) section. ADF values have been trending upward since WY07 as shown by the 12-month moving average.

Table B.2 - Rainfall and Long-Term Average Daily Flow (1914-2012)

Type	# of Years	Percent of Total Years		Total Annual Rainfall (a)			Average Daily Flow, cfs		
				inches	mm	Avg., mm	East (b)	West (c)	LSDR
Very Wet	3	3%	30%	>20	>500	580	105	175	142
Wet	10	10%		15-20	380-499	430	75	125	102
Above Norm (d)	17	17%		12-15	300-379	340	40	68	54
Normal	38	39%	39%	8-12	200-299	245	14	24	18
Dry	25	26%	31%	5-8	125-199	160	10	16	14
Very Dry	5	5%		<5	<125	100	8	14	12
Annual Avg.	98	100%		10.2		260	26	43	35

a) Total annual rainfall from 1 October through September 31.
b) Santee Basin USGS Stream Gauge Station # 11022480 at Mast Road
c) Mission Valley USGS Stream Gauge Station # 11023000 at Fashion Valley Mall; incomplete data prior to 1968.
d) Above normal annual rainfall (12-15 in/yr) resulting in LSDR average daily flows from 25 to 75 cfs.

Table B.3 - Annual Rainfall and Average Daily Flow (WY05-WY12)

(Type of Year)	Annual Rainfall		Variance (a)	ADF, cfs			Variance (d)
	mm	inches		East (b)	West (c)	LSDR	
WY05 (Very Wet)	574	22.60	121%	50.9	100.4	76	117%
WY06 (Dry)	136	5.36	-48%	10.7	17.5	14	-60%
WY07 (Very Dry)	98	3.85	-62%	7.2	12.8	10	-70%
WY08 (Dry)	183	7.20	-30%	13.3	25.0	19	-45%
WY09 (Below Normal)	232	9.15	-11%	15.0	27.2	21	-40%
WY10 (Normal)	269	10.60	4%	25.1	42.5	34	3%
WY11 (Above Normal)	323	12.70	24%	36.3	61.9	49	23%
WY12 (Dry)	201	7.9	-23%	10.3	12.0	11	-68%
8-Yr Average (05-12)	254	10.0	-2%	21.1	40.0	32	-11%
30-Yr Norm ('83-12)	262	10.3	1%	25	39	32	-9%
99-Yr Average	260	10.2	0%	26	43	35	0%

(a) Percent difference from long term average annual rainfall (260 mm/yr or 10.24 in/yr); black-above, red-below.
b) Santee Basin USGS Stream Gauge Station at Mast Rd.
c) USGS Stream Gauge Station at Fashion Valley Mall; incomplete data prior to 1965.
d) Percent difference from long-term average annual daily flow (i.e., 26 cfs at Santee and 43 cfs in Mission Valley).

Monthly and seasonal average annual flows and rainfall over the monitoring period for both stations are shown in **Chart B.2.** The seasonal flow patterns describe range, variance and correlation in monthly ADF and rainfall over the past 8 years. Winter season streamflow within the lower watershed is 100-to-250 times greater than summer, dry season flow. Average annual, winter and summer flows and rainfall for each of the water years are presented in **Chart B.3.** Highest flows during the monitoring period at both gauging stations were recorded in WY05 (very wet year); the lowest in WY07 (very dry year). Water years (WY06&08) witnessed below normal rainfall and runoff/streamflow. WY10 witnessed near normal rainfall and average river discharge. WY11 was an above normal year whereas WY12 was below normal in terms of both total rainfall and average daily flow.

Appendix sC - LSDR Monthly WQM Site Data

Table C.1(W) West Section Water Temperatures (WY12/WY11)

Site #	1	2	3	4	5	6	7
Reach	Lower Mission Valley				Upper Mission Valley		
Oct	20.1/20.1	19.6/20.0	20/20.1	20.8/20.4	18.9/18.4	20.2/19.3	19.7/19.6
Nov	18.2/15.7	15.6/15.7	15.5/15.9	15.5/15.6	14.8/15.5	15.0/15.5	15.1/15.5
Dec	16.9/14.6	11.4/14.5	11.1/14.7	11.2/14.8	10.8/14.1	10.8/13.9	11.1/14.1
Jan	12.3/13.7	12.5/13.3	12.5/13.4	12.2/13.3	11.2/12.3	11.8/12.9	11.5/12.8
Feb	14.1/13.5	13.6/13.5	13.7/15.2	13.6/12.6	13.0/13.1	13.2/13.2	13.1/12.9
Mar	13.8/17.1	13.4/17.3	13.4/17.3	13.4/17.2	13.0/15.9	12.9/16.7	12.0/16.5
Apr	19.7/19.7	20.0/19.7	20.2/19.6	20.0/19.5	19.4/18.8	20.0/19.3	20.0/19
May	22.6/19.9	22.6/20.2	22.7/20	23.1/20.2	21.4/19.8	22.3/20.4	21.7/19.9
Jun	24.0/21.9	23.4/22.2	23.5/22.7	24.4/22.9	21.5/21.5	22.6/22.6	22.8/22.5
Jul	25.3/23.1	24.2/23.5	24.2/23.8	25.7/24.5	21.5/21.1	22.8/23.1	23.8/21.8
Aug	27.7/23.2	25.7/22.8	26.4/23	27.3/24.4	22.7/20.2	24.3/22.1	25.6/22.7
Sept	25.0/21.3	23.5/21.3	23.8/21.5	25.1/22.5	20.3/19.0	22.0/20.6	23.1/21.7
WY Avg [b]	**20.0/18.7**	**18.8/18.7**	**18.9/18.9**	**19.4/19.0**	**17.4/17.5**	**18.2/18.3**	**18.3/18.3**

a) All values expressed in ^oC.
b) Water Year 2012/2011 values are based on averaging of monthly data (Oct- Sept).

Table C.1(E) Middle and East Section Water Temperatures (WY12/WY11)

Site	8	9	10	11	12	13	14	15
Reach	Mission Gorge			Lower Santee Basin		Upper Santee Basin		LSB [c]
Oct	19.0/19.3	19/0/19.8	19.8/20.2	18.6/19.5	20.7/19.7	19.6/19.9	19.6/20.5	19.9/20.9
Nov	15.1/14.9	13.4/13.3	15.2/15.5	15.2/15.3	16.2/16.3	15.1/15.2	15.6/15.5	15.2/15.7
Dec	9.1/12.3	5.7/10.4	9.5/12.5	9.2/12.3	11.6/13.7	10.3/13.1	10.1/12.9	9.3/12.6
Jan	10.2/11.8	9.3/8.9	10.6/12.1	10.8/11.8	12.8/13.0	10.8/13.6	11.1/12.3	10.4/9.9
Feb	12.3/13.2	10.3/10.9	12.9/13.4	12.1/12.8	14.9/14.3	13.3/13.5	13.1/13.4	13.7/12.1
Mar	16.5/15.3	13.5/10.8	17.3/15.8	15.5/14.7	18.1/17.2	15.9/16.5	16.3/15.7	16.3/13.0
Apr	16.4/16.3	13.8/13.3	18.6/17.0	16.7/15.6	21.7/18.3	19.4/17.4	18.6/17.4	18.4/15.0
May	20.6/17.3	17.5/15.3	22.2/18.2	18.5/17.0	21.0/19.3	21.3/18.8	21.0/18.6	21.4/17.8

Site	8	9	10	11	12	13	14	15
Jun	20.9/21.1	18.2/17.3	22.7/22.6	19.6/19.5	21.3/21.0	22.0/22.2	22.0/21.8	23.6/20.6
Jul	21.2/21.8	18.9/18.7	23.1/23.5	20.6/20.2	21.5/21.0	22.7/22.7	22.9/22.8	25.8/22.3
Aug	21.6/21.7	21.0/18.9	24.2/23.3	22.9/20.7	- /21.5	24.5/21.7	24.2/22.7	25.4/23.1
Sep	21.7/20.9	20.0/18.4	23.0/21.6	21.0/20.0	- /22.4	23.3/22.4	22.4/21.7	23.2/21.8
WY Avg [b]	**17.1/17.2**	**14.9/14.7**	**18.3/18.0**	**16.7/16.6**	**18.0/18.1**	**18.2/18.0**	**18.2/17.9**	**18.6/17.1**

a) All values expressed in oC.
b) Water Year 2012/2011 values are based on averaging of monthly data (Oct- Sept).
c) Tributary discharges within the Lower Santee Basin reach just upstream of Carlton Hills Golf course.

Table C.2(W) West Section Specific Conductivity (WY12/WY11)

Site #	1	2	3	4	5	6	7
Reach		Lower Mission Valley				Upper Mission Valley	
Oct	3.27/5.23	2.76/3.14	2.98/2.56	3.12/3.67	3.54/3.67	3.53/3.82	2.84/3.28
Nov	14.6/1.62	1.36/1.64	1.32/1.50	1.36/0.78	1.49/2.16	1.26/2.30	1.67/2.32
Dec	13.1/2.34	1.66/2.28	1.50/2.16	1.45/1.77	1.37/2.20	1.15/2.26	1.29/2.41
Jan	3.46/2.06	2.69/2.06	2.55/2.06	2.60/2.03	2.32/1.96	2.45/1.86	2.41/1.88
Feb	1.46/0.64	1.49/0.625	1.54/0.58	1.59/0.52	1.37/0.49	1.25/0.49	1.14/0.65
Mar	1.12/1.86	0.86/1.88	0.75/1.87	0.80/1.86	0.79/1.82	0.77/1.70	0.63/1.74
Apr	2.06/1.92	2.02/1.90	1.87/1.78	1.71/1.69	1.59/1.67	1.40/1.52	1.57/1.67
May	3.80/1.94	3.56/1.87	3.46/1.76	3.36/2.00	3.48/2.37	2.97/2.27	3.24/2.08
Jun	6.88/3.64	3.50/2.74	3.44/2.69	3.27/2.61	3.42/2.61	3.05/2.48	3.23/2.48
Jul	9.97/8.91	3.43/3.21	3.41/3.18	3.18/3.10	3.35/3.23	3.13/2.94	3.21/3.06
Aug	12.3/8.99	3.70/3.59	3.69/3.69	3.40/3.26	3.42/3.54	3.52/3.54	3.01/3.69
Sep	12.6/7.18	3.87/3.75	3.83/3.66	3.44/3.27	3.74/3.65	3.95/3.78	2.92/3.41
WY Avg [b]	**7.04/3.86**	**2.58/2.39**	**2.53/2.29**	**2.44/2.21**	**2.49/2.45**	**2.37/2.41**	**2.26/2.39**

a) All values expressed in milli-Siemen/cm.
b) Water Year 2012/2011 values are based on averaging of monthly data (Oct- Sept).

Table C.2(E) Middle and East Section Specific Conductivity (WY12/WY11)

Site	8	9	10	11	12	13	14	15
Reach		Mission Gorge			Lower Santee Basin		Upper Santee Basin	LSB [c]
Oct	2.63/2.61	5.14/5.59	2.64/2.64	2.61/2.71	2.0/2.44	2.18/2.17	1.91/1.79	2.65/2.69
Nov	1.88/2.42	4.79/5.32	1.90/2.41	2.02/2.44	1.96/2.12	1.74/1.86	1.63/1.48	2.71/2.76

Site	8	9	10	11	12	13	14	15
Dec	1.99/2.25	4.93/5.0	2.02/2.26	2.12/2.28	1.66/1.95	1.79/1.75	1.48/1.41	2.73/2.5
Jan	1.99/1.63	4.88/4.76	1.99/1.65	2.07/1.72	1.51/1.0	1.81/1.33	1.53/1.25	2.57/2.94
Feb	1.64/1.1	4.29/3.61	1.66/1.23	1.81/1.69	1.42/1.18	1.60/1.44	1.56/1.52	2.65/2.57
Mar	1.99/1.56	4.74/4.61	2.01/1.53	2.03/1.63	0.73/0.98	1.76/1.30	1.55/1.22	2.70/2.82
Apr	1.66/1.67	4.65/4.68	1.84/1.67	1.84/1.77	1.38/0.88	1.50/1.78	1.38/1.38	2.73/2.82
May	2.98/1.45	7.43/4.11	3.09/1.49	3.19/1.81	2.33/1.03	2.47/1.62	2.08/1.53	4.29/2.57
Jun	2.79/2.21	6.39/5.0	2.87/2.25	2.94/2.31	2.42/1.28	2.24/1.88	1.84/1.67	3.63/2.88
Jul	2.60/3.59	5.35/5.29	2.65/2.65	2.69/2.58	2.5/1.83	2.01/2.07	1.59/1.76	2.97/2.9
Aug	5.51/2.9	5.57/5.58	2.79/2.93	2.74/2.9	- /1.94	2.10/2.18	1.67/1.9	2.96/2.96
Sep	3.71/2.74	5.62/5.39	2.93/2.65	2.80/2.87	- /1.86	2.26/2.17	1.64/1.91	2.80/2.83
WY Avg [b]	**2.61/2.18**	**5.32/4.91**	**2.37/2.11**	**2.41/2.23**	**- /1.54**	**1.96/1.80**	**1.66/1.57**	**2.95//2.77**

a) All values expressed in milli-Siemens/cm.
b) Water Year 2012/2011 values are based on averaging of monthly data (Oct- Sept).
c) Tributary discharges within the Lower Santee Basin reach just upstream of Carlton Hills Golf Course.

Table C.3(W) West Section pH (WY12/WY11)

Site #	1	2	3	4	5	6	7
Reach	Lower Mission Valley				Upper Mission Valley		
Oct	8.10/7.64	7.95/7.47	8.04/7.48	7.60/7.46	7.73/7.47	7.46/7.55	7.13/7.21
Nov	7.80/7.68	8.00/7.63	8.0/7.6	8.00/7.73	7.90/7.55	8.10/7.51	8.20/7.78
Dec	7.66/7.84	7.95/7.71	7.58/7.71	7.88/7.75	7.85/7.77	7.87/7.52	7.78/7.82
Jan	7.93/7.96	7.92/7.86	7.89/7.89	7.87/7.88	7.84/7.88	7.90/7.8	8.05/7.7
Feb	7.73/7.75	7.69/7.72	7.76/7.73	7.62/7.7	7.46/7.72	7.53/7.8	7.13/7.98
Mar	8.48/7.93	8.28/7.85	8.33/7.84	7.94/8.04	8.12/8.03	7.94/8.13	8.10/8.11
Apr	7.80/8.03	7.67/7.81	7.72/7.89	7.65/7.88	7.59/7.87	7.62/7.89	7.31/7.82
May	7.39/7.76	7.31/7.62	7.24/7.77	7.27/7.74	7.08/7.77	7.50/7.8	7.22/7.79
Jun	7.58/7.5	7.47/8.08	7.39/7.94	7.37/7.95	7.09/8.07	7.27/7.88	7.07/7.7
Jul	7.76/7.9	7.62/7.8	7.53/7.8	7.46/7.9	7.09/7.7	7.03/7.9	6.92/7.8
Aug	7.76/7.78	7.40/7.75	7.74/7.71	7.89/7.76	7.27/7.75	7.47/7.76	7.29/7.67
Sep	8.13/7.77	7.90/7.55	8.16/7.55	8.20/7.62	7.94/7.51	7.87/7.52	7.41/7.33
WY Avg [b]	**7.84/7.80**	**7.76/7.74**	**7.78/7.74**	**7.73/7.78**	**7.58/7.76**	**7.63/7.76**	**7.47/7.73**

a) All values are unit-less. b) Water Year 2012/2011 based on averaging monthly results (Oct- Sept).

Table C.3(E) Middle and East Section pH (WY12/WY11)

Site	8	9	10	11	12	13	14	15
Reach	Mission Gorge			Lower Santee Basin		Upper Santee Basin		LSB [c]
Oct	7.23/7.71	7.35/8.1	7.35/7.85	7.23/7.46	7.48/7.64	7.1/7.3	7.23/7.63	7.35/7.63
Nov	8.0/7.88	7.9/8.01	8.1/7.92	7.7/7.41	8.1/7.9	7.7/7.25	7.9/7.46	8.1/7.94
Dec	7.81/8.0	7.88/8.1	8.11/7.98	7.54/7.78	8.23/8.11	7.93/7.57	8.14/7.86	8.1/8.06
Jan	7.87/8.17	8.2/8.17	8.3/7.98	7.66/7.55	8.26/8.29	8.04/7.8	8.2/7.82	8.2/8.23
Feb	8.06/8.0	7.96/8.41	8.3/8.33	7.9/7.37	8.23/8.1	8.2/7.94	8.2/8.06	8.18/8.3
Mar	7.8/8.23	7.88/8.23	8.15/8.24	7.33/7.9	8.11/8.32	7.85/7.93	8.06/8.17	8.06/8.28
Apr	7.86/8.34	7.79/8.39	8.21/8.58	7.3/7.55	8.24/8.85	7.98/8.73	8.3/8.96	8.02/8.66
May	7.87/7.8	8.12/8.14	7.86/8.42	7.08/7.43	8.0/8.29	7.87/7.76	8.29/8.01	8.1/8.21
Jun	7.53/8.18	7.91/8.28	7.77/8.25	7.01/7.7	7.9/8.98	7.37/8.46	7.82/8.6	8.05/8.37
Jul	7.18/7.5	7.69/8.0	7.67/8.0	6.94/7.59	7.8/7.7	6.87/7.8	7.35/7.9	8.0/8.1
Aug	6.94/7.75	7.84/7.8	7.84/8.0	7.58/7.55	- /7.62	6.98/7.68	7.42/8.09	7.53/8.15
Sep	6.99/7.67	7.96/8.0	7.57/7.94	7.44/7.22	- /7.82	7.25/7.53	7.63/7.85	7.55/7.76
WY Avg [b]	**7.59/7.94**	**7.87/8.14**	**7.94/8.12**	**7.39/7.54**	**8.03/8.13**	**7.60/7.81**	**7.88/8.03**	**7.94/8.14**

a) All values are unit-less.
b) Water Year 2011 values are based on averaging of monthly data (Oct- Sept).
c) Tributary discharges within the Lower Santee Basin reach just upstream of Carlton Oaks Golf course.

Table C.4(W) West Section Dissolved Oxygen (WY12/WY11)

Site #	1	2	3	4	5	6	7
Reach	Lower Mission Valley				Upper Mission Valley		
Oct	4.46/5.17	3.30/1.97	2.29/1.09	5.13/1.90	4.03/2.28	2.56/0.22	3.49/2.65
Nov	7.60/6.64	5.85/6.62	5.97/6.06	7.42/6.76	6.55/4.50	5.21/2.7	8.52/7.9
Dec	6.15/8.11	6.36/6.67	6.74/6.65	7.23/6.79	6.41/5.50	5.71/3.69	7.39/7.94
Jan	6.99/11.86	7.50/10.13	8.02/10.48	9.17/9.96	7.75/9.70	7.40/10.11	9.05/10.78
Feb	6.39/7.30	6.04/7.21	7.62/7.43	9.70/7.85	7.11/7.88	6.57/5.79	6.88/8.76
Mar	6.66/6.66	6.01/5.98	6.33/5.98	6.67/7.19	7.11/7.04	7.12/8.38	7.75/8.35
Apr	5.15/6.30	4.14/5.44	3.65/5.81	7.29/8.31	5.04/6.51	7.38/8.11	5.86/8.37
May	4.18/4.66	3.08/4.20	1.86/3.36	3.08/6.18	2.79/5.88	4.27/6.7	4.06/7.09
Jun	4.96/6.30	2.69/5.40	1.90/3.92	3.67/5.51	2.78/4.12	3.14/4.31	4.71/4.23

Site #	1	2	3	4	5	6	7
Jul	5.73/5.74	2.30/2.35	1.93/2.66	4.25/1.69	2.77/2.97	2.00/2.5	5.36/2.25
Aug	6.64/5.80	1.71/2.32	4.39/2.64	6.95/3.61	2.74/2.73	0.45/0.99	5.95/2.34
Sep	6.29/5.08	4.30/2.00	2.29/1.77	6.23/4.04	3.35/2.74	0.10/0.78	3.25/2.6
WY Avg [b]	**5.93/6.64**	**4.44/5.02**	**4.42/4.82**	**6.40/5.82**	**4.87/5.15**	**4.33/4.52**	**6.02/6.11**

a) All values expressed in milligrams/liter.

Table C.4(E) Middle and East Section Dissolved Oxygen (WY12/WY11)

Site	8	9	10	11	12	13	14	15
Reach	Mission Gorge			Lower Santee Basin		Upper Santee Basin		LSB [c]
Oct	8.07/4.08	10.37/8.01	7.14/3.83	6.00/4.08	5.33/5.49	1.22/0.29	2.27/2.24	5.33/3.04
Nov	10.4/9.86	10.1/11.1	9.78/9.04	8.25/6.60	9.76/6.50	0.96/1.52	2.99/1.28	7.19/7.95
Dec	10.5/11.3	12.3/12.57	9.07/9.09	8.33/7.37	8.67/9.37	1.64/1.82	3.44/3.16	7.52/8.4
Jan	9.9/11.95	11.11/12.9	8.54/9.83	8.35/8.36	7.45/8.65	2.25/5.44	3.28/8.26	7.04/9.8
Feb	9.24/9.35	10.8/11.41	8.50/7.07	5.96/7.96	7.31/7.2	1.86/2.62	5.54/6.23	6.89/7.41
Mar	8.30/8.89	9.75/11.2	7.50/7.8	6.52/7.63	6.99/8.42	0.67/1.71	3.06/3.8	7.11/8.1
Apr	7.82/10.74	8.39/13.23	6.87/9.41	6.37/8.61	6.47/9.25	0.34/2.14	3.36/4.86	5.64/9.45
May	6.57/10.36	9.23/11.83	8.30/7.47	5.09/7.58	6.54/9.67	0.26/2.09	2.85/2.98	7.82/6.72
Jun	6.44/8.02	8.52/10.09	7.10/6.53	4.71/5.78	6.25/7.97	0.39/0.11	2.40/1.95	7.76/6.27
Jul	6.31/7.27	7.80/9.31	5.90/6.08	4.33/5.16	6.01/6.16	0.51/1.44	1.95/1.83	7.70/7.22
Aug	3.43/6.2	9.30/7.17	3.20/5.4	6.33/4.45	- /5.45	0.61/0.44	1.76/1.20	6.33/9.36
Sep	1.42/5.42	8.25/7.27	0.96/3.9	4.85/4.26	- /5.34	0.09/0.43	2.33/1.50	3.95/2.35
WY Avg [b]	**7.36/8.62**	**9.66/9.82**	**6.91/7.12**	**6.26/6.49**	**7.07/7.63**	**0.90/1.67**	**2.94/3.27**	**6.69/7.17**

a) All values expressed in milligrams/liter.
b) WY12/11 Avg. values are based on averaging of monthly data (Oct- Sept).
c) Tributary discharges within the Lower Santee Basin reach just upstream of Carlton Oaks Golf course.

Table C.5(W) West Section Dissolved Oxygen Percent Saturation (WY12/WY11)

Site #	1	2	3	4	5	6	7
Reach	Lower Mission Valley				Upper Mission Valley		
Oct	49/58	36/22	25/12	58/22	44/24	28/2	38/29
Nov	85/67	59/67	60/62	75/68	66/45	51/28	85/80
Dec	62/80	58/67	61/66	66/67	58/54	51/36	67/78

Site #	1	2	3	4	5	6	7
Jan	66/114	71/97	76/100	86/95	71/91	71/95	83/102
Feb	63/70	58/69	74/70	94/74	68/75	63/55	65/83
Mar	64/69	57/63	61/63	64/75	67/72	67/87	72/86
Apr	56/69	46/60	41/64	80/91	55/71	81/88	55/91
May	49/51	36/46	22/37	36/69	33/65	51/75	47/79
Jun	61/71	32/63	23/46	45/65	32/47	37/50	55/50
Jul	72/67	28/28	24/32	53/21	32/34	23/29	63/26
Aug	88/69	21/27	57/31	88/43	32/30	6/11	74/27
Sep	84/58	48/23	27/20	77/47	38/30	1/8	38/29
WY11 Avg [b]	**67/70**	**46/53**	**46/50**	**68/61**	**50/53**	**44/47**	**62/63**

a) All values expressed in percent.
b) Water Year 2011 values are based on averaging of monthly values (Oct- Sept).

Table C.5(E) Middle and East Section Dissolved Oxygen Percent Saturation (WY12/WY11)

Site	8	9	10	11	12	13	14	15
Reach	Mission Gorge			Lower Santee Basin		Upper Santee Basin		LSB [c]
Oct	87/45	110/89	79/44	65/45	59/61	14/3	25/25	59/41
Nov	104/98	99/108	99/91	83/67	101/67	10/15	31/13	74/81
Dec	90/106	98/114	79/86	75/70	80/91	15/18	31/30	66/84
Jan	88/111	98/113	77/94	76/78	71/83	21/53	29/79	64/87
Feb	87/89	99/105	81/69	56/76	73/71	18/26	53/61	67/69
Mar	85/89	95/102	80/79	66/76	72/88	7/17	34/38	73/79
Apr	83/109	84/128	75/98	67/87	75/100	4/23	36/51	62/96
May	69/109	101/120	98/84	56/79	75/106	3/23	34/32	90/69
Jun	70/92	93/108	84/77	52/64	73/91	5/1	28/23	83/71
Jul	70/84	85/94	70/72	49/58	70/68	6/17	23/22	75/81
Aug	40/71	105/80	38/66	75/51	- /61	8/5	22/14	78/111
Sep	17/62	95/80	12/45	56/48	- /63	1/5	21/17	53/27
WY Avg [b]	**74/89**	**97/103**	**73/76**	**65/67**	**75/79**	**9/17**	**31/34**	**70/75**

a) All values expressed as percent.
b) Water Year 2012/11 values are based on averaging of monthly (Oct- Sept) data.
c) Tributary discharges within the Lower Santee Basin reach just upstream of Carlton Oaks Golf course.

Appendix sD
WY11 LSDR WQM Data by Others

U.S. Geological Survey (USGS) stream flow values (mean daily discharge in cubic feet per second) presented in **Table D.1** for the two Lower San Diego River gauging stations are provisional data subject to revision. Processing and review of the 2012 data is typically completed in December with subsequent approval for publication. The two stations are managed by the Poway South Field Office. Data for the San Diego River gauging stations as well as other streams and rivers throughout California are available via URL at http://waterdata.usgs.gov/nwis/dv?.

Table D.1 USGS Stream Flow Data (WY12 and WY11)

	Fashion Valley (Sta. 11023000)				Santee Basin (Sta. 11022480)			
Month	Min.	Max.	ADF_3 [a]	ADFm [b]	Min.	Max.	ADF_3 [a]	ADFm [b]
Oct	1.3/1.8	82/450	3.2/2.3	3.6/39	1.1/1.7	29/249	4.1/1.8	5.5/20
Nov	1.9/6.7	361/281	19/61	29/33	2.5/4.0	206/193	15/4.4	33/17
Dec	9/11	187/5800	22/24	15/388	7.7/5.0	128/2770	9.0/5.3	16/219
Jan	8/24	84/227	20/26	13/58	6.8/14	46/146	7.0/17	10/34
Feb	9/17	121/544	41/203	20/96	6.5/13	83/438	12/79	14/67
Mar	9/27	227/474	172/29	26/79	8.1/19	160/323	6.4/21	26/44
Apr	9/10	104/81	15/19	23/25	6.6/8.3	58/25	11/13	17/16
May	3.9/7.2	15/51	5.0/21	6.4/13	2.9/5.9	7.6/28	6.3/9.6	7.5/9.0
Jun	2.2/4.2	3.8/10	2.8/6	2.9/6.9	1.7/2.7	3.0/6.5	3.3/4.4	3.0/4.5
Jul	1.3/2.2	2.2/4.1	1.5/2.9	1.6/2.9	0.9/1.4	1.8/2.6	1.6/1.9	1.5/1.9
Aug	1.4/1.5	2.4/2.5	2.0/1.6	2.0/1.4	0.7/1.1	1.0/1.3	0.6/1.1	0.7/1.2
Sep	1.2/1.2	2.1/5.1	1.5/1.3	1.5/1.6	0.6/0.9	2.0/3.9	0.5/2.2	0.8/1.4
WY Avg.			**25/33**	**12/62**			**6.5/13**	**11/36**

a) Average daily flow during 3-day period of water quality monitoring.
b) Average daily flow for month.

San Diego CoastKeeper (SDCK) coliform count values (in MPN/100 mL) from the organization's two San Diego River monitoring stations for 2012 and 2011 are presented in **Table D.2**. Monitoring results for 2009 through 2011 for selected San Diego area watersheds, including the lower San Diego River (HSU 907.1), can be accessed via the organization's URL website at: http//www.sdwatersheds.org/wiki/Main-Page.

Table D.2 San Diego CoastKeeper Coliform Count Data WY12 and WY11

	Fashion Valley Road (SDG-010)			Old Mission Historical Dam (SDG-020)		
Month	EColi [a]	Enterocc [b]	TCB [c]	EColi [a]	Enterocc [b]	TCB [c]
Oct	110/350	90/320	2490/17330	160/150	10/100	6870/3280
Nov	150/30	- /20	2600/1150	360/990	- /1050	4610/5480
Dec	- /200	- /190	- /2,880	- /310	- /730	- /24190
Jan	- /30	- /50	- /5170	- /150	- /130	-/5480
Feb	30/10	- / -	1250/1010	10/90	- /210	1010/1500
Mar	240/40	1220/60	2140/820	- /50	- /290	- /1870
Apr	40/930	30/30	480/30	70/2250	70/50	1160/70
May	160/50	30/60	1040/840	10/120	30/50	930/2420
June	30/20	40/30	2190/1110	30/480	680/320	1140/2910
July [d]	30/*40*	90/*50*	1330/*560*	10/*20*	150/*20*	680/*650*
Aug	50/200	- /40	1400/650	20/20	-/10	670/14140
Sept	-	- /10	- /3870	- /50	- /10	- /3450
WY MCC [e]	**80/150**	**60/90**	**1630/3630**	**40/390**	**50/250**	**1580/5100**
Summer	60/ -	33/ -	1990/ -	20/ -	100/ -	1160/ -
Winter	80/ -	190/-	1350/ -	80/ -	30/ -	2470/ -

a) Escherichia-coli (E.coli) bacteria expressed in MPN/100mL
b) Enterococcus (faecalis) bacteria expressed in MPN/100mL
c) Total Coliform bacteria (common) expressed in MPN/100mL.
d) WQ monitoring was not performed during July 2011; values (in italics) are July 2010 monitoring results.
e) Mean coliform counts for WY12/WY11 calculated by RiverWatch for comparative purposes only; values are neither endorsed nor validated by the San Diego CoastKeeper organization.

Appendix sE
Water Quality Indexing

Decision-makers, non-technical water managers, numerous vested watershed stakeholders as well as the general public usually have neither time nor training to study and understand detailed technical assessments of water quality data. Over the last several decades numerous indexes have been developed to summarize water quality data in an easily expressed and readily understood format. Water quality professionals are often resistant to any automated, uncritical summarization represented by such indexes; there are sound reasons to use results with caution. Often scientists and water resource professionals prefer to provide no answer rather than an imperfect answer that can lead to misunderstanding. Layman and many decision makers, however, prefer an imperfect answer to no answer at all. Using an index may not be the optimal way to fully understand large-scale water quality issues, but it does provide a reasonable tool for gaining insight. Professionals can appreciate the need for imperfect answers and conversely others need to recognize and accept an answer's limitations.

Water quality indexing was first proposed and demonstrated in the 1970s, however, prior to the personal computer, calculations were fairly labor-intensive so the technique was not widely used or accepted by many monitoring agencies. As use and limitations were commonly misunderstood, the potential of using an index for communicating water quality status and trends was often overlooked. Evaluation of water quality in terms of raw data can be very misleading and confusing not only for the layman but also to stakeholders with diverse and sometimes conflicting perspectives. It is typically difficult for individuals interested in water quality to interpret reams of raw data in order to gain an understanding of water quality conditions. This quest often results in faulty conclusions regarding water quality status and watershed management practices. An index is simply an attempt to integrate complex analytical data and generate a single number expressing the relative degree of impairment of a water body at a given point in time or given locale. The underlying objective of the exercise is to enhance communications with the general public, interested stakeholders, public agencies and increase citizen awareness of water quality conditions.

By design indexes contain less information than the raw data they summarize; many uses of water quality data cannot be met with an index. An index is generally most useful for comparative purposes (e.g., what river sites or reaches have particularly poor water quality?) and for temporal questions (e.g., how is the water quality at present relative to what is has been in the past?). Indexes are less suited to specific questions. Site-specific decisions need to be based on analysis of original water quality data. Basically, an index can be a useful tool for "communicating water quality information to the lay public and to legislative decision makers," it is not, however "a complex predictive model for technical and scientific application". This index was developed as a mechanism to summarize and report routine monitoring data to interested parties. SDRPF's RiverWatch team does not monitor biological constituents or toxic substances, thus issues related to public health, body contact recreation and aquatic life are not effectively addressed by the index.

Besides being general in nature (i.e., imprecise), there are several reasons that an index may fail to accurately communicate water quality information. First, most indexes are based on pre-identified sets of water quality constituents. For example, a specific site may show a good WQI score, and yet have water quality impaired by other constituents not included in the index. Another reason, data aggregation can mask, normalize or over-emphasize short-term water quality issues. A satisfactory WQI at a particular site or reach does not necessarily mean that water quality is or always was satisfactory. A good score, however, does at least indicate that inferior water quality for those constituents evaluated is not chronic during the period included for the index.

The index has been developed for the purpose of providing a simple and concise expression of regularly monitored physical-chemical and bacteriological water quality data compiled by the SDRPF RiverWatch Team as well as several other monitoring groups; it is intended to aid in assessment of the Lower San Diego River watershed primarily for non-body contact recreational uses and environmental enhancement. It constitutes a mechanism to compare averages, variances and trends in normalized values over time (temporally) and by relative location (spatially) within the watershed. The index allows anyone to easily interpret large amounts of aggregated data and relate overall water quality variation to changes, be they from natural causes or man-made impairments. The WQI is used to identify general water quality trends over the past 8 years of monitoring and potential problem areas within the SDR watershed. Such patterns and locations can then be screened and evaluated in greater detail through direct observation of pertinent site-specific data by public agencies and water quality professionals entrusted with protection and enhancement. Used in this manner, the index provides a supplemental metric for evaluating effectiveness of the many San Diego River water quality improvement programs and also assist responsible agencies and organizations in establishing priorities for watershed management.

Running average LSDR WQI values from WY05 through WY12 are expressed by river reach and river section on **Charts E.1 and E.2**, respectively. **Chart E.1** also presents overall LSDR monthly WQI values over the 8-year period. Both seasonal patterns and trends in WQI values can be seen. **Chart E.2** provides the range (max-min) in monthly WQI values as well as average monthly streamflow. The water quality fluctuations over time in individual reaches, sections and the overall (average) Lower San Diego River expressed on both a running average basis and the annual cycle can be observed. The Upper Santee Basin reach (Sites 13 & 14) presents lowest index values since March of 2010, whereas the Mission Gorge (middle section) reach consistently presents highest values. There has been a general decline in overall water quality, as evidenced by the WQI values, since November of last year. The running (12-mo) average index value fell by 7 units (20 percent) from high of 40 (11% above the 8-yr mean) in November of last year to a current (Oct. '12) low of 33 (-8% below the 8-yr mean) over the past 11 months.

Chart E.3 presents a temporal summary of variances in the water quality index values profiled on a monthly, seasonal and average annual water year basis for each river reach and the overall LSDR average. These variances are compared to changes in streamflow on the same basis. The positive correlations are evident, i.e., increase in average daily flow results in improved water quality. Low flows throughout the summer period result in poorest water quality.

Chart 3.4 provides a spatial profile of average annual WQI by river monitoring site, reach and section for this year (WY12), last (WY11) and the 8-yr winter, summer and annual averages. The sites are in chronological order ascending upstream. The current (WY12) average annual WQI values shown in green are below those from last year (WY11) shown in red at all monitoring sites. The WQI values for WY12 are also below the 8-yr averages (yellow bars) at 10 out of the 15 monitoring sites. For the 3 consecutive year, Site 13 (Mast Park) has consistently shown lowest water quality values.

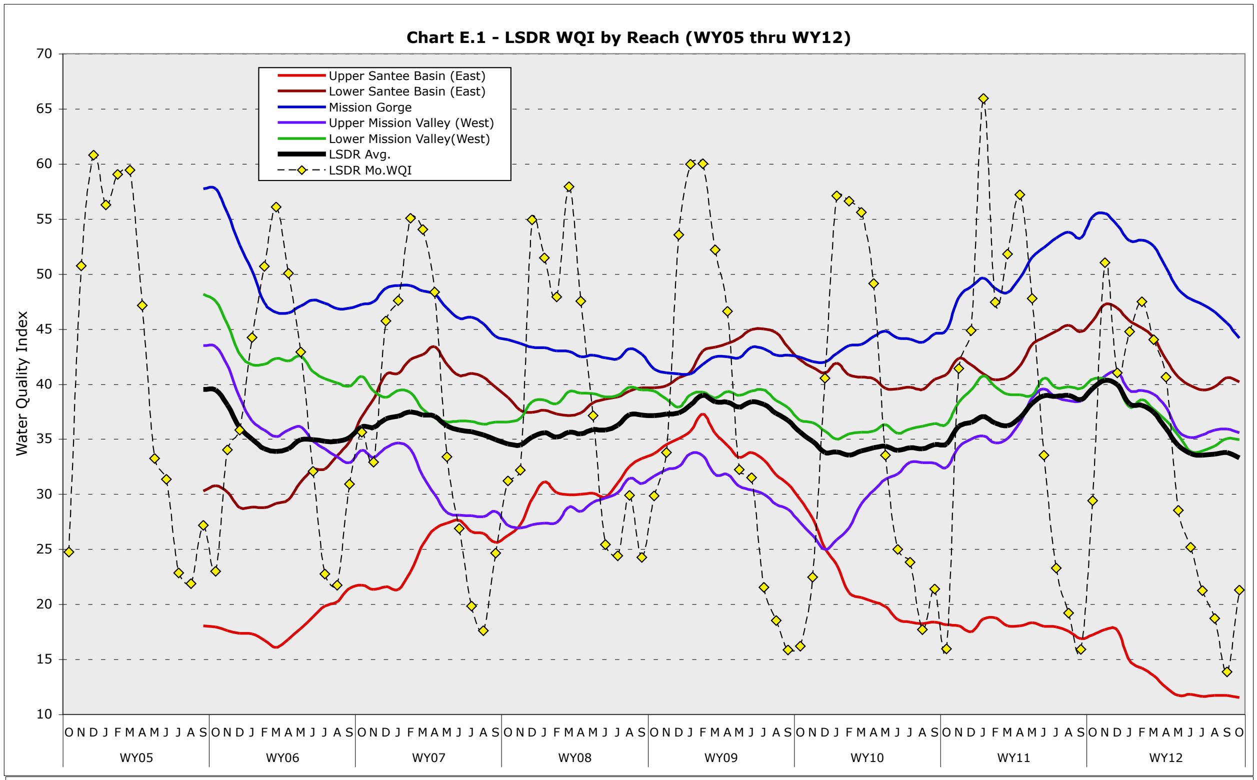


Chart E.1 - LSDR WQI by Reach (WY05 thru WY12)
Upper Santee Basin (East)
Lower Santee Basin (East)
Mission Gorge
Upper Mission Valley (West)
Lower Mission Valley(West)
LSDR Avg.
LSDR Mo.WQI
Water Quality Index
WY05
WY06
WY07
WY08
WY09
WY10
WY11
WY12

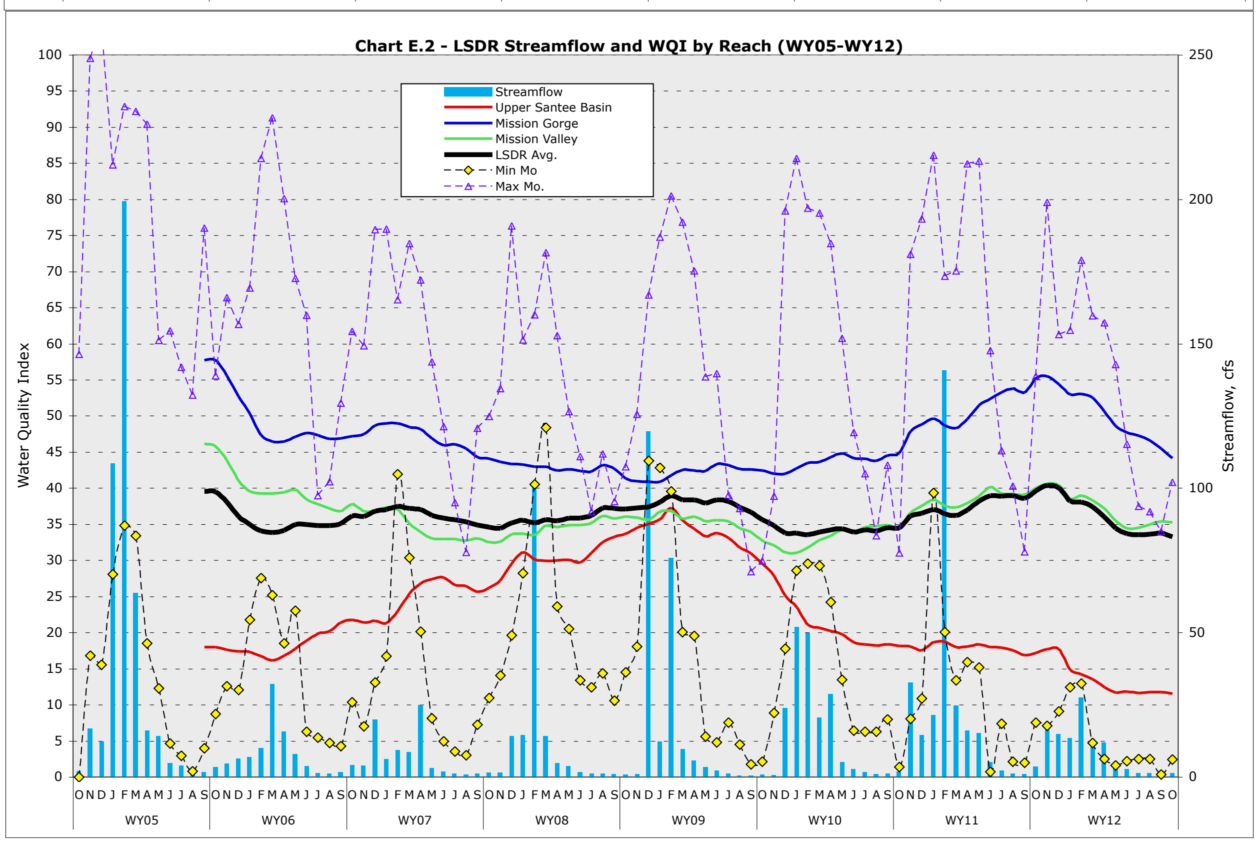


Chart E.2 - LSDR Streamflow and WQI by Reach (WY05-WY12)
Streamflow
Upper Santee Basin
Mission Gorge
Mission Valley
LSDR Avg.
Min Mo
Max Mo.
Water Quality Index
Streamflow, cfs
WY05
WY06
WY07
WY08
WY09
WY10
WY11
WY12

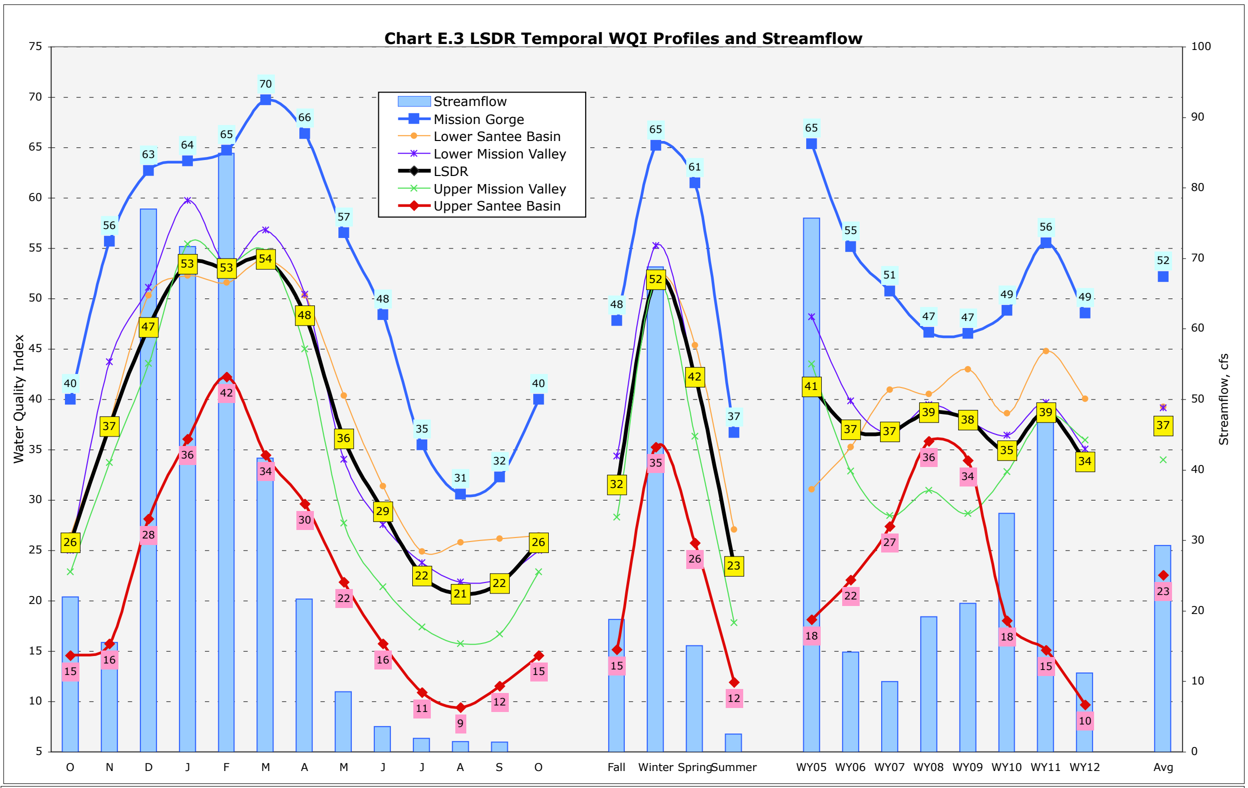


Chart E.3 LSDR Temporal WQI Profiles and Streamflow
Streamflow
Mission Gorge
Lower Santee Basin
Lower Mission Valley
LSDR
Upper Mission Valley
Upper Santee Basin
Water Quality Index
Streamflow, cfs
O N D J F M A M J J A S O
Fall Winter Spring Summer
WY05 WY06 WY07 WY08 WY09 WY10 WY11 WY12
Avg

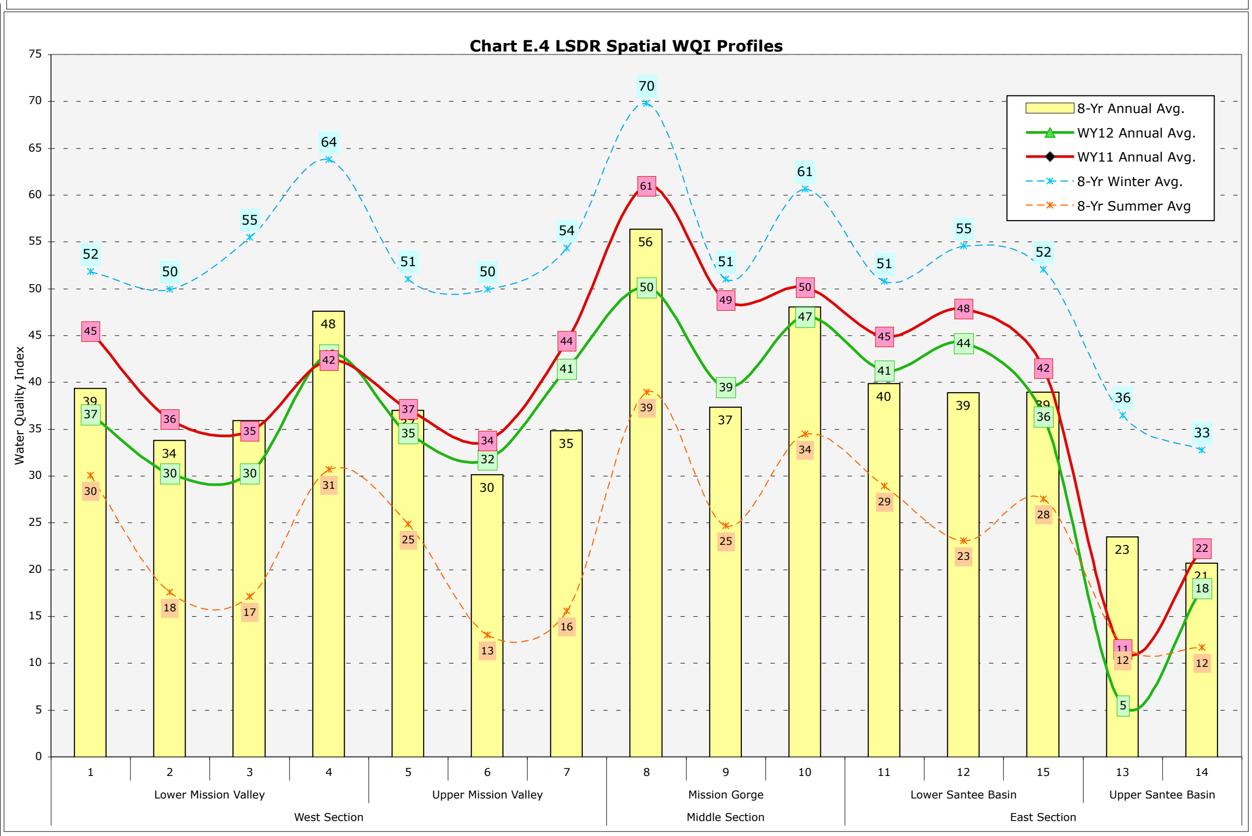


Chart E.4 LSDR Spatial WQI Profiles
8-Yr Annual Avg.
WY12 Annual Avg.
WY11 Annual Avg.
8-Yr Winter Avg.
8-Yr Summer Avg
Water Quality Index
1 2 3 4 5 6 7 8 9 10 11 12 15 13 14
Lower Mission Valley
Upper Mission Valley
Mission Gorge
Lower Santee Basin
Upper Santee Basin
West Section
Middle Section
East Section

Appendix sF
LSDR Water Quality Monitoring Data Summary Sheets

Table F.1 WQM Data Summary (Annual & Seasonal Averages)

	WY05	WY06	WY07	WY08	WY09	WY10	WY11	WY12	8-Yr Avg.
Annual (October-September):									
ADF, cfs	76	14	10	19	21	34	49	11	32
Temp, ºC	17.7	18.3	17.7	17.7	17.7	18.1	17.8	18.0	17.8
SpC, uS/cm	2.125	2.175	2.409	2.313	2.486	2.357	2.204	2.380	2.306
DO, mg/L	6.84	5.87	5.91	6.31	6.20	5.40	5.82	5.59	5.99
DO%Sat, %	67	58	59	65	65	57	61	58	61
pH	7.58	7.33	7.70	8.08	7.72	7.72	7.84	7.51	7.69
MCC, #/100mL	-	-	-	-	440	600	420		480
WQI	41	37	37	39	38	35	39	34	37
Grade	C+	C	C	C	C	C-	C	D+	C
Summer (June-September) Period:									
ADF, cfs	3.6	2.5	1.5	1.6	1.2	1.9	2.7	1.7	2.1
Temp, ºC	21.8	23.7	21.8	22.9	22.8	21.9	21.7	22.9	22.5
SpC, uS/cm	2.612	2.470	2.759	3.059	3.239	3.031	2.852	3.121	2.893
DO, mg/L	5.11	5.02	4.85	5.45	4.94	3.94	4.03	4.00	4.67
DO%Sat, %	53	56	52	63	56	46	46	47	52
pH	7.58	7.33	7.70	8.08	7.72	7.72	7.84	7.51	7.69
MCC, #/100mL	-	-	-	-	350	90	260		230
WQIa	26	27	22	26	22	22	23	20	23
Grade	D-	D	E	D-	E	E	E+	E	E+
Winter (December-March) Period:									
ADF, cfs	175	23	22	51	54	86	123	17	66
Temp, ºC	13.5	12.8	13.8	12.4	13.3	15.7	13.7	12.4	13.5
SpC, uS/cm	1.437	1.953	2.028	1.562	1.552	1.369	1.324	1.687	1.614
DO, mg/L	9.55	6.72	6.97	7.17	7.45	6.35	7.66	7.24	7.39
DO%Sat	89	60	67	68	73	64	75	68	70
pH	7.74	7.61	7.65	7.88	7.49	8.13	8.02	7.98	7.81
MCC, #/100mL	-	-	-	-	560	1480	470		840
WQIa	59	47	51	53	56	52	53	44	52
Grade	B	C+	B-	B-	B	B-	B-	C	B-

a) Percent change in this year's value (WY11) from last year (WY10).

(b) Percent change in this year's value (WY11) from first year (WY05).
(c) Percent change in this year's value (WY11) above (+) or below (-) 7-yr Average.
d) Values in red represent years of below average water quality.

Table F.2 WQM Data Summary (8-Yr Spatial Averages)

Section	Mission Valley		Mission Gorge	Santee Basin		**Watershed**
Sites	1-4	5-7	8-10	11,12 &15	13&14	**all (1-15)**
Reach	LMV	UMV	MG	LSB	USB	**LSDR [(a)]**
Annual (Oct-Sept):						
ADF, cfs	37	32	23 [(b)]	21	15	**31**
Temp, ºC	19.23	17.68	17.01	17.19	18.07	**17.84**
SC, mS/cm	2.541	2.545	2.164	2.168	1.697	**2.295**
DO, mg/L	5.67	4.93	7.80	6.49	5.82	**6.05**
DOSat, %	60	51	81	67	62	**61**
pH	7.70	7.55	7.66	7.81	7.67	**7.66**
MCC, #/100mL	430	-	540	-	-	**480**
WQIa	38	33	54	43	28	**41**
Grade	C	D+	B-	C+	D	**C**
Rating	Fair	Marginal	Good	Fair	Marginal	**Fair**
Summer (June-Sept) Period:						
ADF, cfs	2.4	2.0	1.3 [(c)]	1.6	1.2	**2.2**
Temp, ºC	24.25	21.54	21.67	21.97	22.74	**22.37**
SC, mS/cm	2.986	2.902	2.547	2.370	1.841	**2.635**
DO, mg/L	4.13	3.20	6.66	5.46	4.86	**4.71**
DOSat, %	48	36	75	60	57	**52**
MCC, #/100mL	240	-	220	-	-	**230**
WQIa	20	16	41	34	17	**28**
Grade	E	E	C	C-	E	**D**
Rating	Poor		Fair		Poor	**Marginal**
Winter (Dec-March) Period:						
ADF, cfs	93	75	55	50	25	**75**
Temp, ºC	14.57	13.85	12.88	13.01	13.64	**13.59**
SC, mS/cm	2.135	2.185	1.795	1.968	1.547	**1.968**
DO, mg/L	7.16	6.58	8.81	7.53	6.78	**7.32**
DOSat, %	72	64	85	73	66	**70**
MCC, #/100mL	740	-	940	-	-	**840**
WQIa	58	53	65	53	40	**56**
Grade	B	B-	B	B-	C	**B**
Rating	Good				Fair	**Good**

(a) Weighted average of all reaches within the Lower SDR watershed.
(b) Stream flow based on averaged river gains and losses between Santee Basin and Mission Valley.
(c) During periods when surface water is evident; intermittent dry-weather conditions.