

LOWER SAN DIEGO RIVER WATER QUALITY

WY17 Supplemental Water Quality Monitoring Report

Appendices D-I



Invasive Aquatic Plant Infestation Lower Mission Valley (Site 2 River Gardens/YMCA)

Supporting Water Quality Monitoring Data for the Lower San Diego River

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LOWER SAN DIEGO RIVER WATER QUALITY WY17 SUPPLEMENTAL REPORT

Appendices D-I

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

Appendix D - LSDR Water Quality Monitoring Metrics 13-yr Summary

Table D.1 WQM Metrics Summary (Annual & Seasonal Averages)														
	WY 5	WY 6	WY 7	WY 8	WY 9	WY10	WY11	WY12	WY13	WY14	WY15	WY16	WY17	13-yr Norm
Annual (October-September):														
ADF, cfs	56	12	8	16	18	30	23	12	8	4	9	13	41	19.2
Temp, °C	17.7	18.3	17.7	17.7	17.7	18.1	17.8	18.0	17.3	17.9	18.7	18.2	18.6	18.0
SpC, uS/cm	2.06	2.14	2.34	2.22	2.39	2.29	2.16	2.34	2.44	2.51	2.19	2.27	2.14	2.27
DO, mg/L	6.62	6.00	5.95	6.26	6.25	5.22	5.53	5.16	5.30	3.87	4.53	4.69	5.08	5.42
DO%Sat,	62	59	60	65	65	55	58	54	54	40	48	49	54	55.7
pH	7.63	7.44	7.53	7.89	7.66	7.84	7.83	7.64	7.77	7.67	7.77	7.71	7.77	7.70
WQI	41	37	36	38	37	35	38	33	32	22	29	29	33	34
Grade	C	D+	D+	C-	D+	D	C-	D	D	E+	D	D	D	D
Summer (June-September) Period:														
ADF, cfs	3.1	3.6	1.2	1.8	1.1	1.7	2.9	1.5	1.1	0.8	5.2	0.6	1.8	2.0
Temp, °C	21.8	23.7	21.8	22.9	22.8	21.9	21.7	22.9	21.7	22.7	22.9	21.9	23.1	22.5
SpC, uS/cm	2.54	2.39	2.66	2.91	3.10	2.89	2.74	2.99	2.96	2.90	2.20	3.07	2.70	2.77
DO, mg/L	4.93	5.17	4.82	5.32	4.94	3.84	3.79	3.64	3.32	2.41	3.68	3.12	2.81	3.98
DO%Sat, %	49	59	52	61	56	44	44	43	38	38	43	36	32	45.8
pH	7.66	7.40	7.75	8.05	7.80	7.66	7.83	7.33	7.78	7.52	7.84	7.53	7.74	7.69
WQIa	25	26	22	25	22	22	22	19	16	11	21	13	18	20
Grade	D-	D-	E	D-	E	E	E	E	E	F	E	E-	E	E
Winter (December-March) Period:														
ADF, cfs	142	18	17	43	49	76	48	19	18	10	17	32	113	46.4
Temp, °C	13.5	12.8	13.8	12.4	13.3	14.2	13.7	12.4	12.4	13.4	15.3	14.1	14.4	13.5
SpC, uS/cm	1.41	1.95	2.00	1.54	1.52	1.39	1.38	1.68	2.01	2.19	1.91	1.73	1.29	1.69
DO, mg/L	9.34	6.84	7.08	7.20	7.57	6.10	7.33	6.67	7.63	5.13	5.28	6.17	7.54	6.91
DO%Sat	84	59	69	69	74	61	71	63	72	49	53	60	75	66.1
pH	7.56	7.52	7.48	7.94	7.49	7.83	7.89	7.93	7.70	7.95	7.81	7.79	7.75	7.74
WQIa	58	46	50	53	55	52	52	43	50	32	36	41	54	48
Grade	B	C	B-	B-	B	B-	B-	C	B-	D	D+	C	B	C

(a) Values in red text are below 13-yr norms; values above norms are in blue text.

Table D.2 WQM Metrics Summary by Section and Reach (WY17/WY16 & 13-yr Norms)

Section	Mission Valley		Mission Gorge	Santee Basin		Watershed
Sites	1-4	5-7	8-10	11,12T &15T	13&14	all (1-15T)
Reach	LMV	UMV	MG	LSB	USB	LSDR ^(a)
Annual (Oct-Sept):						
ADF, cfs	66/20 (29)	59/18 (27)	37/14 (19) ^(b)	30/12 (18)	8/3 (4)	40/13 (19)
Temp, °C	20.0/20.0 (19.3)	18.5/18,2 (17.9)	17.5/17.4 (17.1)	18.2/17.9 (17.5)	18.5/17.6 (18.1)	18.6/18.2 (18.0)
SpC, mS/cm	2.467/2.486 (2.539)	2.357/2.387 (2.522)	2.083/2.213 (2.242)	2.104/2.453 (2.252)	1.697/1.807 (1.790)	2.142/2.269 (2.269)
DO, mg/L	4.74/4.82 (5.10)	4.59/3.09 (4.49)	7.13/7.18 (7.61)	6.25/6.71 (6.71)	2.71/1.62 (3.20)	5.08/4.69 (5.42)
DO %of Sat, %	51/52 (54)	49/32 (46)	73/74/79	66/71/67	17/29/32	54/49 (56)
WQIa	33/35 (35)	32/22 (31)	41/40 (47)	39/37 (38)	18/9 (18)	33/29 (34)
Grade	D/D (D+)	E/E (D)	C/C (C)	C/D+ (C-)	E/F (E)	D/D (D)
WY17 Rating	Marginal	Marginal	Fair	Fair	Poor	Marginal
WY16 Rating	Marginal	Poor	Fair	Marginal	Very Poor	Marginal
WY15 Rating	Poor		Fair		Very Poor	Marginal
WY14 Rating	Poor		Marginal		Very Poor	Poor
13-yr Norm	Marginal	Marginal	Fair		Poor	Marginal
Summer (June-Sept) Period:						
ADF, cfs	3.1/1.1 (3.3)	2.8/1.0 (3.0)	1.5/0.5(1.8) ^(c)	1.1/0.5(1.8)	0.3/0.1(0.3)	1.8/0.6 (2.0)
Temp, °C	24.9/24.5 (24.2)	22.7/21.2 (21.8)	22.7/21.3 (21.8)	21.5/20.8 (21.6)	23.8/21.7 (22.8)	23.1/21.9 (22.5)
SpC, mS/cm	3.234/3.620 (3.217)	3.084/3.354 (3.168)	2.586/2.978 (2.811)	2.590/3.031 (2.628)	2.006/2.358 (2.038)	2.700/3.068 (2.772)
DO, mg/L	1.82/1.11 (3.57)	1.79/2.17 (2.95)	7.13/4.51 (6.42)	6.98/3.35 (5.73)	1.94/2.03 (2.59)	3.87/2.63(4.30)
DO % of Sat, %	22/13 (42)	21/25 (34)	81/51 (73)	38/59	22/24 (29)	45/41 (49)
WQI	20/17 (21)	16/6 (15)	18/18 (29)	23/20 (26)	12/5 (10)	18/13 (20)
Grade	E/E (E)	E/F (E)	E/E (D)	E/E (D-)	F+/F (F)	E/E- (E)
WY17 Rating	Poor	Poor	Poor		Very Poor	Poor
WY16 Rating	Poor	Very Poor	Poor		Very Poor	Poor
WY15 Rating	Poor	Very Poor	Marginal		Very Poor	Poor
WY14 Rating	Very Poor			Poor	Very Poor	

13-yr Norm	Poor		Marginal		Very Poor	Poor
Table D.2 WQM Metrics by Section and Season (Continued)						
Reach	LMV	UMV	MG	LSB	USB	LSDR ^(a)
Winter (Dec-March) Period:						
ADF, cfs	183/ 49 (73)	165/ 44 (57)	103/ 32 (46)	82/ 28 (39)	21/ 47 (9)	113/32 (46)
Temp, °C	15.0/15.3 (14.4)	14.4/14.7 (13.7)	13.2/12.8 (12.7)	14.8/14.8 (13.2)	14.4/ 13.0 (13.5)	14.4/14.1 (13.5)
SpC, mS/cm	1.377/1.765 (1.838)	1.074/1.781 (1.741)	1.374/1.698 (1.606)	1.554/1.990 (1.823)	1.049/1.397 (1.444)	1.286/1.726 (1.691)
DO, mg/L	4.02/3.71 (6.73)	3.69/4.23 (6.41)	8.97/8.89 (9.01)	8.20/6.47 (7.94)	1.77/2.56 (4.32)	5.50/5.32 (7.09)
DO % of Sat, %	41/36 (66)	37/40 (62)	87/83 (86)	84/62 (72)	18/25 (40)	55/50 (68)
WQI	52/ 44 (50)	57/ 38 (47)	67/ 58 (63)	60/52 (51)	32/ 14 (28)	54/41 (48)
Grade	B/ C (B-)	B/ C - (C)	B/B (B)	B/B- (B-)	D/F (D)	B/C (C+)
WY17 Rating	Good		Good		Fair	Good
WY16 Rating	Fair		Good		Poor	Fair
WY15 Rating	Marginal		Good		Very Poor	Marginal
WY14 Rating	Marginal		Good	Fair	Poor	Marginal
13-yr Norm	Good	Fair	Good		Marginal	Fair

WY17/16 WQ metrics below (less than) 13-yr norms shown in red text; values above norms are shown in blue text.

(a) Weighted average of all reaches within the Lower SDR watershed.

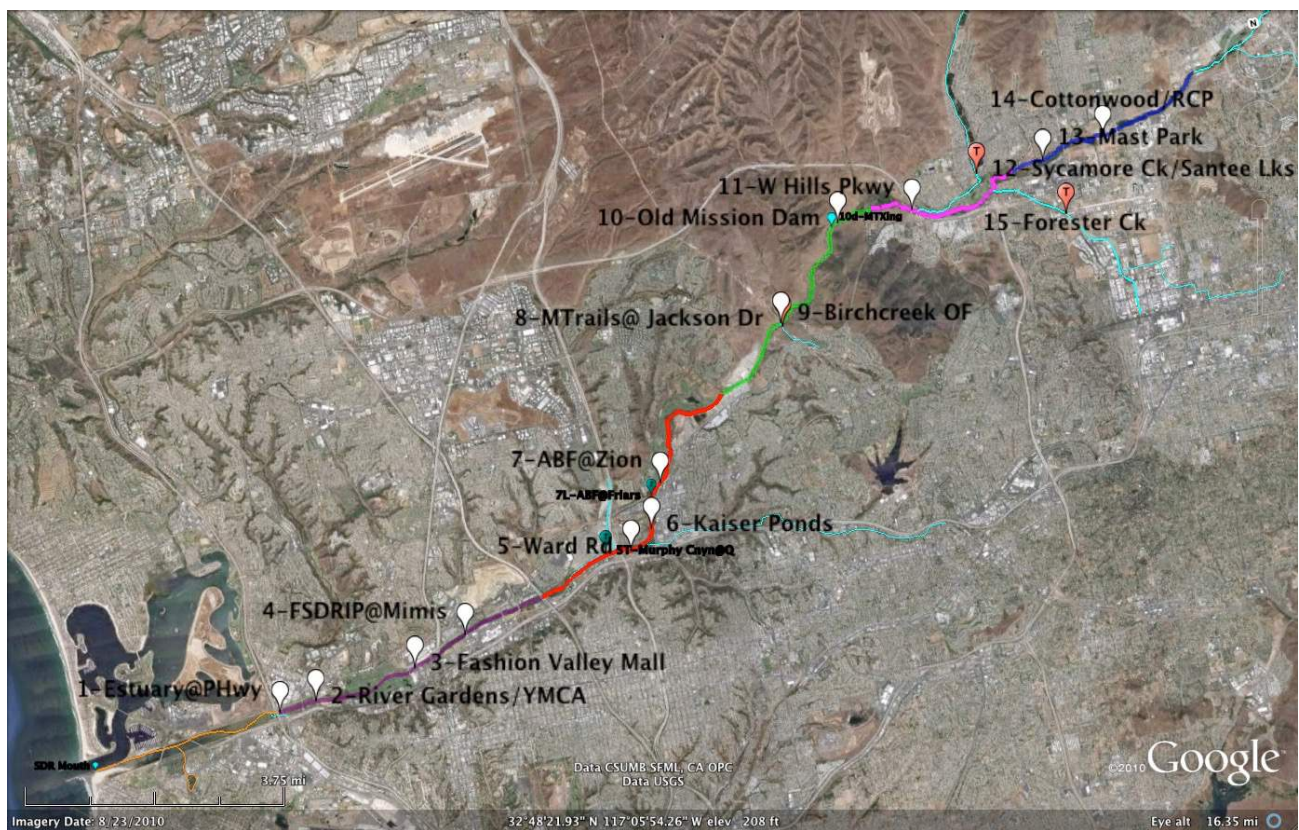
(b) Stream flow based on river channel gains and losses averaged between Santee Basin and Mission Valley.

Appendix E - San Diego RiverWatch WQ Monitoring Program

Appendix E provides an overview of SDRPF's RiverWatch water quality monitoring (WQM) program that, over the last 13 years, has been engaged in collecting and assessing data pertaining to the Lower San Diego River (LSDR) watershed on a continuous monthly basis.

Monitoring Period & Coverage: Monthly monitoring over past 13 years (Oct. 2004 – Sept. 2017) 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. 5.8 ft amsl) under the I-5/ Pacific Hwy. overpasses. The LSDR watershed and monitoring sites are shown on **Figure E.1**.

Figure E.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>

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 E.1**.

Table E.1 LSDR Sections, Reaches and Monitoring Sites

Section/Reach/Tributary	Site #s	Comments
Estuary Entrance	1E/1W	Tidal influence at transition from river to 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)	8,9T & 10	5-mile mid-section, Princess View Dr to Kumeyaay Lk
Lower Santee Basin (LSB)	11,12T&15T	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)	11-15T	5-mile eastern section from Kumeyaay Lk to Lakeside
Eastern Sections (East Sites)	8 -15T	10-mile eastern/upper 3 reaches (2 sections)
Tributaries:		
Murphy Canyon/Qualcom ^{a)}	5a	Enters LSDR southwest of Qualcomm Stadium
Jackson Dr/Birchcreek Drain ^{b)}	9T	Enters LSDR at Sycott Wash (d/s of Site 8)
Santee Lakes/E. Sycamore Cnyn Ck	12T	Enters LSDR at Carlton Oaks GC (u/s of 15T)
Forester Creek ^{c)}	15T	Enters LSDR at Carlton Oaks GC (d/s of 12T)
Lower SDR Watershed (LSDR)	1-15T	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 Dr: Outfall (OF).

(c) Monthly monitoring initiated in 2007 with adjusted site location in 2009 and again in 2017 back to original location.

WQ Parameters: Seven measured and recorded parameters (Temp, pH, SpC, DO, DO%Sat, NO₃ & PO₄) plus subjective field observations re: environs and characteristics are listed in **Table E.2**. As nutrient testing for NO₃ and PO₄ is carried out at five selected sites; two in West (2 & 6) and three in East (11,14 & 15T), 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 13-yr period (Oct. 04 - Sept. 17) are in the range of 100 to 120. 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 computing the water quality index.

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 E.2 - LSDR Water Quality Monitoring Parameters

WQ Parameter	unit	Comments
<i>Measured monthly at all sites:</i>		
1. Temperature (Temp)	°C	Basic characteristic and WQ driver (see Table G.1)
2. pH	-	Degree of acidity (<7.0) or alkalinity (>7.0) (see Table G.3)
3. Specific Conductivity (SpC)	mS/cm	Measure of ionic content or dissolved solids (see Table G.2)
4. Dissolved Oxygen (DO)	mg/L	Good indicator of relative water quality (see Table G.4)
5. Percent of DO Saturation (DO%Sat)	%	Good indicator of general water quality (see Table G.5)
<i>Sampled/tested monthly at selected sites: (typically 5 - 3 East & 2 West)</i>		
6. Nitrate (NO ₃ -N)	mg/L	Important nutrient for biological activity
7. Phosphate (PO ₄ -P)	mg/L	Key nutrient for biological activity
<i>Discontinued on regular basis in 2006:</i>		
8. Turbidity	NTU	Discontinued due to probe replacement
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. Special note as to invasive aquatic plant growth on water surface.		
<i>General WQ Conditions observed at all sites: (numerical coding added in 2010)</i>		
Weather Condition, Presence of Algae, Clarity, Color, Odor, Flow, Foam, Litter, Odor, Oil and Grease (O&G), e		
<i>Parameters measured by others at selected sites</i>		
10. Stream Flows	cfs	USGS gauging stations at Fashion Valley and Mast Rd near Santee (see Table H.1)
11. Coliform counts: (Escheria-coli, Enterococcus, Total Coliform bacteria)	MPN/ 100mL	SD CoastKeeper data taken at Fashion Valley Rd and Old Mission Historic Dam monitoring sites (see Table H.2)

Team Leaders and multiple citizen volunteers (3-8) meet at an appointed location, organize field equipment/transportation, drive to sites, measure physical-chemical water quality using the YSI Sonde meter, note special conditions/observations, collect samples for subsequent testing, return to office, perform nutrient (NO₃ & PO₄) tests, store samples for subsequent laboratory 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/running average values taken over 12-month period

Appendix F - LSDR Hydrology and Water Quality

Stream flow or discharge, is the volume of water moving past a designated location over a fixed period of time. It constitutes a primary driver of changes in water quality. Often expressed as cubic feet per second (cfs) or million gallons per day (mgd), flow is 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 each season. River flow rapidly decreases during summer months when rainfall is minimal, evaporation rates high and riparian vegetation extracts water from the ground. August and September, the last two months of summer and the water year, are typically months of lowest flow. A function of both volume and velocity, stream flow has a major impact on living organisms, riparian habitat, benthic conditions and 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 transported. Fast moving waters usually contain much higher levels of DO than sluggish flows, 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 F.1** for both the 13-yr monitoring period (Oct 2004 - Sept 2017) and over the past 53 years (1965-2017) of official record. The average daily flow values are in close accord for both stations; river discharge over the past 13 years is about 11 percent below the 53-year norm in Mission Valley and 18% below the Santee norm. WY17 discharge is 60% greater than the 53-yr norm at the Fashion Valley Site and 26% above the norm at Santee. River discharge on average for WY17 is 48 percent greater than the long-range norm and 64 percent in excess of the 13 year norm.

Correlations between total annual rainfall and ADF over the past 53 years of hydrologic record and during the period of SDRPF RiverWatch monitoring for the two lower SDR gauging stations are presented in **Tables F.2 and F.3**, respectively. WY05 was a “Very Wet” (>20”) hydrologic year, whereas WY07 was “Very Dry”(<5”). WY17, WY15 and WY11 were each “Above Normal” rainfall years (12-15”) while WY09 and WY10 (8-12”) were considered “Normal” in terms of total annual rainfall. The 13-yr ADF in the East and West sections are 18 and 32 cfs, respectively; the values are 15-20 percent below long-range LSDR average daily discharges. WY17 total rainfall (12.72 inches) was 28% above the long-range average while average daily flow for the year was 41% above the long-range norm (53-yr average) of 28 cfs.

Monthly discharge data (min, max and average daily flow) for the two USGS gauging stations extending from Oct. 2004 through Sept. 2017 are plotted in **Chart F.1**. Average daily flow (ADF) for the Lower San Diego River varies from less than 0.2 cfs (0.1 mgd) during the summer (dry) months to nearly 220 cfs (142 mgd) during several winter (wet) periods in the East (Santee Basin) and up to 390 cfs (252 mgd) in the West (Mission Valley) section. Running average ADF values, trending downward in WY12-WY14 increased in WY15, fell in WY16 then increased again in WY17 as expressed on **Charts F.1 and F.3**. The seasonal flux is shown on **Chart F.2**.

Table F.1 - Lower SDR Average Daily Flows (WY05-WY17)

(a) Lower San Diego River average daily flow represents a mean hydrologic condition based on averaging the two USGS gauging station flow values.

(b) ADF values are expressed in both cubic feet per second (cfs) and million gallons per day (mgd); 1 cfs = 0.646 mgd.

(c) Annual discharge volume expressed in acre-feet (1 AF = 325,900 gallons); WY17 and 53-Yr averages.

Table F.2 - Rainfall and Long-Term Average Daily Flow (1914-2017)

Type	# of Years	Percent of Total Years		Total Annual Rainfall ^(a)			Average Daily Stream Flow, mgd		
				inches	mm	Avg., mm	East ^(b)	West ^(c)	LSDR
Very Wet	3	3%	31%	>20	>500	580	68	113	92
Wet	10	10%		15-20	380-499	430	48	81	66
Above Norm ^(d)	18	18%		12-15	300-379	340	26	44	35
Normal	40	38%	38%	8-12	200-299	250	10	18	15
Dry	26	26%	31%	5-8	125-199	160	7	12	10
Very Dry	6	6%		<5	<125	100	5	9	7
Total/ An. Avg	103	100%		9.85		250	16	25	21

a) Total annual rainfall from 1 October through September 31.

b) Santee Basin USGS Stream Gauge Station #11022480 at Mast Road in Santee.

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 in the 25-50 mgd range.

Table F.3 - Annual Rainfall and Average Daily Flow (WY05-WY17)

(Type of Year)	Annual Rainfall		Variance ^(a)	ADF, cfs/ (mgd)			Variance ^(d)
	mm	inches		East ^(b)	West ^(c)	LSDR	
WY05 (Very Wet)	574	22.60	127%	50.9 (33)	100 (65)	71.5 (46)	152%
WY06 (Dry)	152	6.00	-40%	10.7 (7)	17.5 (11)	13.6 (9)	-52%
WY07 (Very Dry)	98	3.85	-61%	7.2 (5)	12.8 (8)	9.5 (6)	-67%
WY08 (Dry)	183	7.20	-28%	13.3 (9)	25.0 (16)	18.2 (12)	-36%
WY09 (Below Normal)	232	9.15	-8%	15.0 (10)	27.2 (18)	20.1 (13)	-29%
WY10 (Normal)	282	11.10	12%	25.1 (16)	42.5 (27)	32.4 (21)	14%
WY11 (Above normal)	323	12.70	28%	43.3 (28)	61.9 (40)	46.9 (30)	65%
WY12 (Dry)	201	7.91	-20%	10.1 (8)	19.0 (12)	14.9 (10)	-48%
WY13 (Very Dry)	166	6.55	-34%	8.2 (5)	10.9 (7)	9.1 (6)	-68%

Site #	Site Name	u/s mi.	Elev . ft.	Location	GIS Coordinates Lat. Long.	
LMV - Lower Reach W Mission Valley: I-5 Bridge to I-805 Bridge (Sites 1-4)						
1	Estuary W/E	2.96	6	between PCH & I-5 on encased sewer main	32.76131	-117.20373
2	River Gardens E/W	3.5	11	W of YMCA, d/s of Trolley at riffle	32.7623	-117.1944
3	Fashion Valley Mall W	5.08	22	below Town & Country Pedestrian Bridge	32.76517	-117.16869
4	FSDRIP	5.98	36	N of Mimi's on Mission Center Rd Bridge	32.76986	-117.15482
UMV - Upper Reach E Mission Valley: I-805 Bridge to N end of Admiral Baker Field (Sites 5-7)						
5	Ward Rd Bridge	8.89	50	S. of Trolley overpass at Del Rio S intersection	32.78024	-117.11029
6	Kaiser Ponds	9.46	56	E. of Mission SD de Acala at SD Mission Rd	32.78406	-117.10419
7	Admiral Baker Field ABF - Zion Rd	9.98	58	L - Lower (below Friars Rd bridge)	32.79038	-117.10314
		10.2	62	Z - Terminus of Zion Ave at Riverdale St	32.79304	-117.09984
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 @ Jackson Dr	13.82	159	SDCWA downstream of Scycott Crossing	32.82124	-117.06205
9T	Jackson Dr/Birchcreek OF	13.86	198	San Marcos area tributary by Jackson Dr. Trail	32.82268	-117.06224
10	Old Mission Dam W/E	15.65	265	Downstream side of Old Mission Dam	32.83977	-117.04332
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 Bridge (Sites 11,12 &15)						
11	West Hills Pkwy	17.03	300	at/below West Hills Pkwy Bridge	32.83936	-117.02436
12T	Carlton Oaks Dr/Santee	18.23	320	W Sycamore Ck/Santee Lakes @ Carlton Oaks Dr.	32.84431	-117.00635
15T	Forester Creek	18.86	334	Forester Ck (tributary) at Rapture Ln.	32.83221	-116.98658
USB - Upper Reach Santee Basin: Carlton Hills Bridge to Riverford Rd (Sites 13-14)						
13	Mast Park	18.50	330	Pedestrian Bridge behind (N of) Walmart	32.84696	-116.97335
14	Cottonwood Ave/RCP	19.84	340	E of RCP plant at Chubb Ln./Magnolia	32.84434	-116.98947
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]						

WY14 (Very Dry)	129	5.06	-49%	4.3 (3)	6.1 (4)	5.1 (3)	-82%
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WY15 (Above normal)	302	11.91	20%	7.1 (5)	15.2 (10)	10.5 (7)	-63%
WY16 (Dry)	208	8.20	-18%	12.2 (8)	24.4 (16)	15.6 (10)	-45%
WY17 (above normal)	323	12.72	28%	27.7 (18)	57.3 (37)	40.0 (26)	41%
13-yr Average (05-17)	244	9.61	-3%	18.1 (12)	30.0 (19)	23.6 (15)	-23%
100-yr Average	252	9.92	0%	21.8/(14)	36.7 (24)	28.4/(18)	0%

a) Percent difference from 100-yr average annual rainfall (253 mm/yr or 9.95 in/yr); black-above, red-below average.

b) Santee Basin USGS Stream Gauge Station 00067556 at Mast Rd., Santee.

c) USGS Stream Gauge Station 00459999 at Fashion Valley Mall; incomplete data prior to 1965.

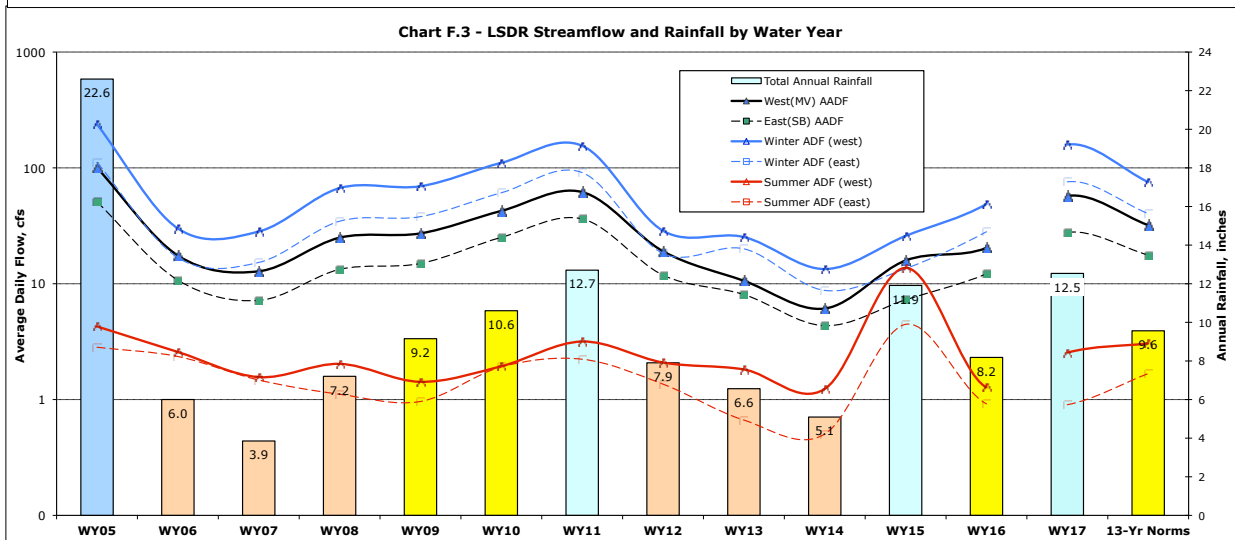
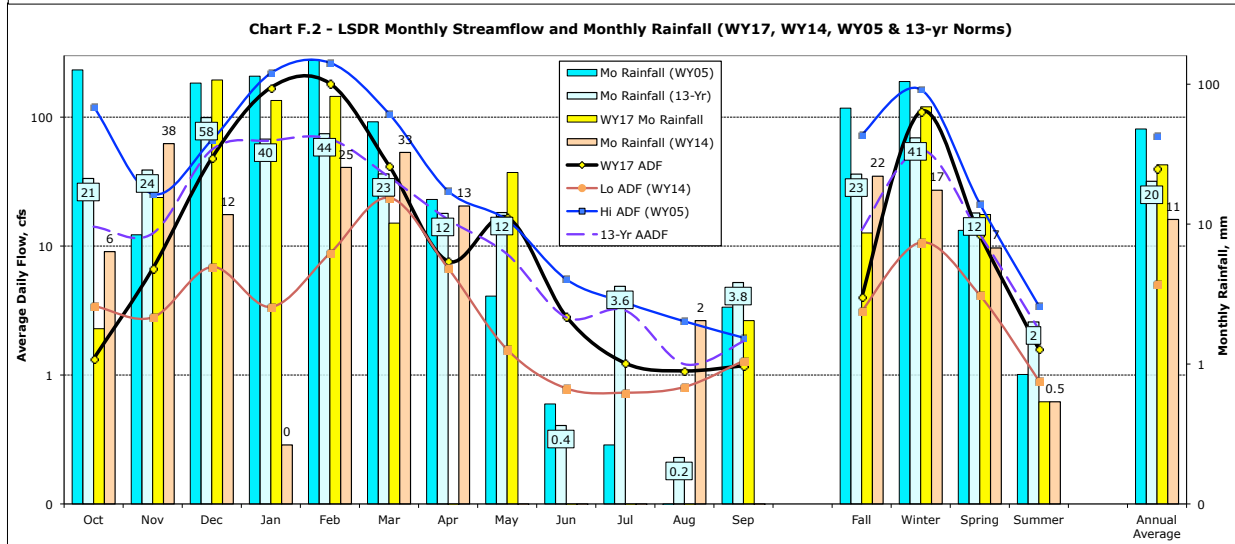
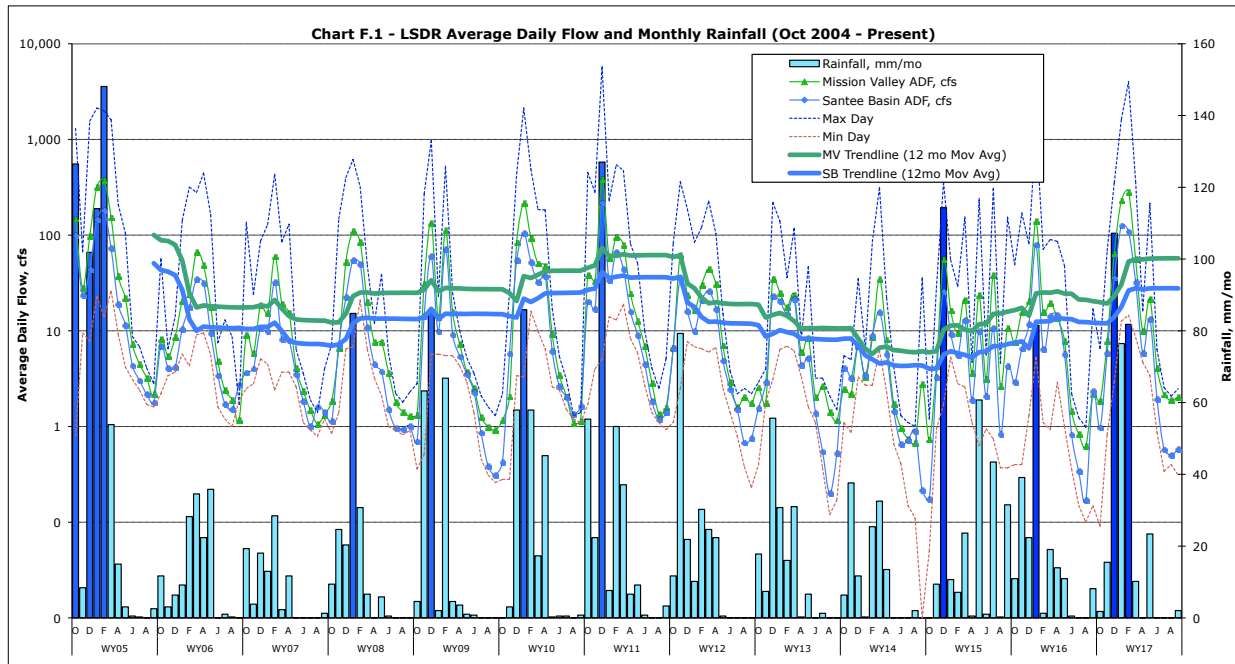
d) Percent difference from average annual daily flow (i.e., 32 cfs / 21 mgd).

Monthly and seasonal average annual flows (lines) and rainfall (bars/columns) over the monitoring period for both stations are shown in **Chart F.2**. The seasonal flow patterns express range, variance and positive correlation in monthly ADF and rainfall over the past 13 years. Winter season streamflow within the lower watershed is several hundred times greater than summer, dry-season flow.

Average annual, winter and summer flows and rainfall for each of the last 13 water years are expressed graphically in **Chart F.3**. Highest flows during the monitoring period at both gauging stations were recorded in WY05 (very wet year); the lowest in WY14 (very dry year). Water years '06, '07, '08, '12, '13, and '14 were all below normal, witnessing both below average rainfall and runoff/streamflow. WY09 witnessed near normal rainfall and river discharge. Water years '11, '15 and '17 were slightly above normal years in terms of total annual rainfall (verticle bars) and average daily streamflow (lines). Lowest total annual rainfall occurred in WY07, whereas lowest average annual streamflow, both upstream at Santee and downstream in Mission Valley occurred in WY14 following three years of well below normal rainfall. In WY17, total annual rainfall amounting to 12.72 inches was 21% above the 13-yr norm (9.3 inches) while average annual streamflow was 69% above the 13-yr norm and 41% above the 53-year average.

Season Units ^(b)	West - Mission Valley		East - Santee Basin		LSDR ^(a)	
	cfs	mgd	cfs	mgd	cfs	mgd
Fall (Oct-Nov)	4 85	3.1	3.45	2.2	4.0	2.6
Winter (Dec-Mar)	159.	102.7	75.8	49.0	110.5	20.3
Spring (April-May)	17.8	11.5	9.6	6.2	12.2	7.8
Summer (June-Sept)	2.55	1.6	0.93	0.6	1.6	1.0
Annual Avg. (WY17)	57.3	37.0	27.7	17.9	40.0	25.8
13-yr Annual Avg. (2005-2017)	32.0	20.7	18.1	11.7	23.6	15.2
53-yr Annual Avg. (1965-2017)	36.0	23.3	22.0	14.2	27.0	17.4
Annual Discharge, AFY ^(c)	41,440 / 26,095		20,050 / 15,920		32,255 / 19,490	

Lower San Diego River WY17 Water Quality Monitoring Report Appendices D-I



Appendix G - LSDR Monthly WQM Site Data

Table G.1(W) West Section Water Temperature (WY17 Data)

Site #	1	2	3	4	5	6	7
Reach	Lower Mission Valley				Upper Mission Valley		
Oct	17.1	19.1	19.7	20.0	15.3	17.2	17.3
Nov	16.1	16.2	16.9	17.5	14.0	14.5	14.3
Dec	13.8	13.7	13.6	13.4	13.0	13.5	13.3
Jan	11.5	11.3	11.1	11.3	10.9	11.1	10.8
Feb	15.6	15.0	14.8	14.6	14.4	14.3	14.4
Mar	20.1	19.9	19.9	19.9	18.9	19.5	19.2
Apr	22.5	22.2	22.7	22.8	19.9	21.7	21.3
May	22.4	22.2	22.5	22.5	21.0	21.6	21.8
Jun	24.4	23.8	24.4	25.5	21.9	24.0	22.7
Jul	27.4	25.6	26.0	27.5	22.5	24.4	25.1
Aug	26.4	24.0	24.3	25.2	20.8	22.9	23.3
Sept	23.7	23.1	23.4	24.2	20.3	22.4	22.4
Avg.	20.1 (19.5)	19.7(19.0)	19.9(19.2)	20.4(19.7)	17.8(17.2)	18.9(18.3)	18.8(18.0)

a) All values expressed in °C; WY17 values greater than 13-yr norms (in parentheses) are shown in red; below in blue.

b) Water Year results are based on straight (unweighted) averaging of monthly data (Oct- Sept); temps > 24C in yellow cells.

Table G.1(E) Middle and East Section Water Temperature (WY17 Data)

Site	8	9T	10	11	12T	13	14	15T
Reach	Mission Gorge			Lower Santee Basin		Upper Santee Basin		LSB ^c
Oct	18.5	13.5	17.4	16.1	22.6	17.7	-	16.2
Nov	16.1	10.1	13.3	14.5	17.3	14.6	-	16.0
Dec	11.2	9.9	10.7	11.8	13.9	11.9	15.0	15.1
Jan	10.6	10.1	11.0	11.0	11.8	11.4	11.3	11.8
Feb	14.8	13.6	15.1	15.1	16.1	15.1	15.1	16.0
Mar	17.4	13.2	17.8	17.0	20.8	18.5	17.3	21.0

Site	8	9T	10	11	12T	13	14	15T
Apr	18.7	14.0	19.3	17.2	21.8	18.8	16.9	22.0
May	18.8	14.3	19.2	17.4	22.2	18.8	18.8	22.0
Jun	22.8	17.5	23.6	22.6	-	23.5	-	23.5
Jul	23.9	20.6	25.8	21.2	-	24.5	26.3	23.8
Aug	-	18.9	-	20.0	-	22.9	25.1	21.5
Sep	21.9	19.4	23.3	20.2	-	22.3	24.7	21.5
Avg^b	17.7(17.1)	14.6(15.9)	17.9(17.2)	17.0(16.7)	19.0(17.8)	18.3(18.5)	18.9(17.2)	19.2(18.1)

a) All values expressed in °C; WY17 values greater than 13-yr norms are shown in red; below in blue.

b) Water year WY17 and 13-yr values are based on straight (unweighted) averaging monthly data (Oct-Sept).

c) Forester Creek discharges within the Lower Santee Basin reach downstream of Carlton Hills Golf course.

Table G.2(W) West Section Specific Conductivity (WY17 Data)

Site #	1	2	3	4	5	6	7
Reach	Lower Mission Valley				Upper Mission Valley		
Oct	10.640	3.710	3.420	2.960	4.060	4.180	3.160
Nov	12.670	3.560	3.230	3.410	4.040	4.180	3.080
Dec	16.500	1.610	1.660	1.440	1.040	0.910	0.770
Jan	1.130	1.040	1.030	1.060	1.110	1.000	1.060
Feb	2.150	1.090	0.970	0.850	0.650	0.670	0.600
Mar	1.900	1.880	1.830	1.810	1.790	1.640	1.650
Apr	2.670	2.630	2.580	2.530	2.550	2.340	2.320
May	1.690	1.630	1.590	1.660	1.750	1.480	1.810
Jun	13.910	2.614	2.604	2.210	2.828	2.349	2.661
Jul	14.831	3.326	3.244	3.261	2.915	2.965	3.273
Aug	15.400	3.538	3.485	3.336	3.255	3.363	3.148
Sep	8.960	3.640	3.550	3.030	3.410	3.710	3.130
Avg^b	8.54/7.86	2.52/2.59	2.43/2.50	2.33/2.49	2.45/2.54	2.40/2.56	2.22/2.46

a) All values expressed in milli-Siemens/cm; values >4.0 are in yellow cells, values < 2.0 uS/cm are in blue cells.

b) Water Year 2017 values greater than 13 yr norms are in red; blue values below.

Table G.2(E) Middle and East Section Specific Conductivity (WY17 Data)

Site	8	9T	10	11	12T	13	14	15T
Reach	Mission Gorge			Lower Santee Basin		Upper Santee Basin		LSB ^c
Oct	3.160	6.200	2.270	3.030	2.070	2.620	—	2.600
Nov	2.790	5.890	2.820	2.890	2.090	2.610	—	2.600
Dec	1.560	3.590	1580	1.730	1.910	1.550	1.270	1.800
Jan	0.870	2.130	0.910	0.950	0.458	0.680	0.610	2.500
Feb	1.580	4.110	1.610	1.690	1.020	1.170	1.000	2.500
Mar	1.440	4.190	1.440	1.530	0.880	0.960	0.990	2.000
Apr	1.960	4.970	2.000	2.060	0.560	1.560	1.320	1.900
May	1.400	4.740	1.910	1.980	0.750	1.510	1.280	2.200
Jun	2.330	5.100	2.358	2.352	—	1.866	—	2.914
Jul	2.775	4.958	2.623	2.401	—	2.195	1.537	3.003
Aug	—	4.800	—	2.106	—	2.349	1.444	3.000
Sep	4.530	5.470	2.830	2.730	1.580	2.410	1.580	2.900
Avg ^b	2.22/2.26	4.68/4.95	2.03/2.22	2.12/2.22	1.26/1.68	1.79/1.91	1.23/1.50	2.50/2.72

a) All values expressed in milli-Siemens/cm; WY17 values greater than 13-yr norms are in red, below in blue.

b) Water Year 2017 and 13-yr values based on averaging of monthly data (Oct-Sept); cells in blue <2.0, cells in yellow >4 uS/cm

c) Forester Creek discharges within the Lower Santee Basin enter SDR at west end of Carlton Hills Golf Course.

Table G.3(W) West Section pH (WY17 Data)

Site #	1	2	3	4	5	6	7
Reach	Lower Mission Valley				Upper Mission Valley		
Oct	7.90	7.69	7.80	7.76	7.72	7.61	7.35
Nov	7.83	7.70	7.77	7.76	7.53	7.54	7.24
Dec	7.61	7.51	7.51	7.36	7.30	7.17	6.96
Jan	7.71	7.58	7.71	7.65	7.55	7.52	7.29
Feb	7.64	7.61	7.55	7.50	7.47	7.44	7.42
Mar	8.19	7.97	8.21	8.08	8.07	8.12	8.11

Site #	1	2	3	4	5	6	7
Apr	8.02	7.97	7.98	8.04	7.90	7.76	7.85
May	8.02	7.85	7.98	7.84	7.79	7.98	8.18
Jun	7.65	8.10	7.97	7.91	7.89	7.83	7.77
Jul	7.93	7.60	8.24	7.92	7.68	7.63	7.45
Aug	7.86	7.54	7.85	7.84	7.56	7.68	7.42
Sep	7.80	7.50	7.83	7.84	7.55	7.68	7.53
Avg ^b	7.85/7.72	7.72/7.66	7.86/7.73	7.79/7.76	7.66/7.60	7.66/7.60	7.55/7.54

a) All values are unit-less.

b) WY17 and 13-yr values based on averaging monthly results (Oct-Sept); annual averages less than 13-yr norms listed in red.

Table G.3(E) Middle and East Section pH (WY17 Data)

Site	8	9T	10	11	12T	13	14	15T
Reach	Mission Gorge			Lower Santee Basin		Upper Santee Basin		LSB ^c
Oct	7.05	8.00	8.13	7.29	8.23	7.74	—	8.21
Nov	7.45	8.00	7.90	7.29	8.14	7.51	—	7.97
Dec	7.85	8.19	7.93	7.53	7.63	7.82	—	—
Jan	7.65	7.91	7.74	7.24	7.89	7.38	7.38	8.00
Feb	7.88	8.07	7.92	7.15	8.26	7.80	7.90	8.30
Mar	7.82	7.96	8.09	7.22	8.08	8.16	8.33	8.30
Apr	7.95	8.02	8.32	7.26	7.88	8.02	8.17	8.20
May	7.74	8.01	8.19	7.37	7.98	7.93	8.31	8.30
Jun	7.21	8.15	7.93	7.64	—	7.81	7.90	7.41
Jul	7.21	8.15	7.93	7.64	—	7.81	7.90	7.41
Aug	—	8.11	—	7.59	—	7.44	8.12	7.70
Sep	7.44	8.09	8.26	7.52	7.97	7.49	7.97	7.75
Avg ^b	7.57/7.64	8.06/7.76	8.03/7.79	7.40/7.54	8.01/7.89	7.74/7.65	8.00/7.80	7.96/8.05

a) All values are unit-less.

b) WY17 and 13-yr values are based on averaging of monthly data (Oct-Sept); averages less than 13yr norms shown in red.

c) Forester Creek discharges within the Lower Santee Basin reach just upstream of Carlton Oaks Golf course.

Table G.4(W) West Section Dissolved Oxygen (WY17 Data)

Site #	1	2	3	4	5	6	7
Reach	Lower Mission Valley				Upper Mission Valley		
Oct	5.89	2.31	0.91	3.56	1.25	0.28	2.04
Nov	5.76	3.59	2.90	3.68	1.86	0.40	3.27
Dec	4.25	3.49	4.61	3.99	4.23	4.27	5.69
Jan	9.13	8.96	8.98	8.89	9.38	9.18	10.75
Feb	7.16	7.24	7.96	7.52	7.70	6.29	8.50
Mar	10.24	9.21	9.70	10.61	9.37	10.06	11.19
Apr	3.80	3.85	3.89	5.81	3.84	2.51	5.38
May	4.78	4.99	5.22	6.92	4.85	5.53	5.56
Jun	5.42	1.51	2.94	4.77	3.32	2.45	4.23
Jul	7.35	1.25	2.63	3.57	2.81	0.31	4.90
Aug	7.62	1.29	3.14	4.07	2.52	1.14	4.03
Sep	5.84	0.80	2.38	3.67	2.11	0.64	3.27
Avg^b	6.44/6.10	4.04/4.49	4.60/4.64	5.59/6.16	4.44/4.80	3.59/3.68	5.73/4.99

a) All values expressed in milligrams/liter; WY17 and 13-yr averages less than 4 mg/L shown in red and cells highlighted in yellow.

Table G.4(E) Middle and East Section Dissolved Oxygen (WY17 Data)

Site	8	9T	10	11	12T	13	14	15T
Reach	Mission Gorge			Lower Santee Basin		Upper Santee Basin		LSB ^c
Oct	0.92	9.69	4.68	3.81	5.17	0.14	—	11.17
Nov	2.55	11.16	6.76	4.57	5.16	0.75	—	10.36
Dec	6.96	7.05	4.44	5.09	6.32	4.07	4.02	9.18
Jan	11.62	11.41	9.16	8.31	11.00	4.24	4.09	10.24
Feb	9.76	10.96	8.35	6.82	9.02	2.19	2.44	10.11
Mar	11.01	13.66	11.90	8.27	11.10	6.44	6.46	9.51

Site	8	9T	10	11	12T	13	14	15T
Apr	6.71	8.09	5.60	3.87	5.99	2.92	2.56	8.71
May	9.14	10.70	8.14	6.30	7.38	2.65	1.65	9.05
Jun	6.02	9.74	7.57	5.47	—	2.98	—	5.01
Jul	1.31	8.46	3.14	4.34	—	4.14	1.49	3.98
Aug	—	9.30	—	4.31	—	0.48	2.90	4.33
Sep	1.58	9.07	6.17	3.07	2.49	1.73	2.49	2.17
Avg^b	6.14/7.51	9.94/9.09	6.90/7.17	5.35/6.13	7.07/7.10	2.73/3.20	3.12/3.25	7.63/7.30

a) All values expressed in milligrams/liter; WY17 values less than 4 mg/L are expressed in red and cells highlighted in yellow.

b) WY17 and 13-yr values are based on averaging of monthly data (Oct-Sept).

c) Tributary discharges within the Lower Santee Basin reach enter at west end of Carlton Oaks Golf Course.

Table G.5(W) West Section DO Percent Saturation (WY17 Data)

Site #	1	2	3	4	5	6	7
Reach	Lower Mission Valley				Upper Mission Valley		
Oct	62	25	10	40	13	3	21
Nov	59	37	30	39	18	4	32
Dec	42	34	45	39	41	41	55
Jan	85	83	83	82	86	84	98
Feb	73	73	80	75	76	62	84
Mar	115	103	108	118	102	111	123
Apr	45	45	46	68	44	29	62
May	56	58	61	81	55	64	64
Jun	66	18	36	59	38	29	50
Jul	93	15	33	45	33	4	60
Aug	95	15	38	50	29	13	48
Sep	70	9	28	44	24	7	38
Avg	72 (67)	43 (47)	50 (49)	62 (67)	47 (49)	38 (38)	61 (52)

a) All values expressed in percent; WY17 and 13-yr values (in parentheses) less than 45% are expressed in red highlighted in yellow

Table G.5(E) Middle and East Section DO Percent Saturation (WY17 Data)

Site	8	9T	10	11	12T	13	14	15T
Reach	Mission Gorge			Lower Santee Basin		Upper Santee Basin		LSB ^c
Oct	10	94	49	39	61	1	—	115
Nov	26	100	65	45	54	7	—	106
Dec	64	63	40	48	62	38	38	88
Jan	106	102	84	76	103	39	38	96
Feb	98	107	84	69	93	22	25	104
Mar	116	132	127	87	126	70	68	108
Apr	73	79	62	41	69	32	27	101
May	100	106	89	67	86	29	18	105
Jun	71	103	90	64	—	36	—	60
Jul	16	96	39	50	—	50	19	48
Aug	—	101	—	48	—	6	36	50
Sep	18	100	73	34	30	20	30	25
Avg ^b	63 (77)	99 (93)	73 (75)	56 (61)	76 (73)	29 (33)	33 (33)	84 (75)

a) All values expressed as percent; WY17 and 13-yr values (in parentheses) less than 45% Sat are shown in red and cells highlighted in yellow.

b) Water Year 2017 and 13-yr values are based on averaging of monthly (Oct-Sept) data.

c) Tributary discharges within the Lower Santee Basin enter SDR at west end of Carlton Oaks golf course.

Appendix H - WY17 LSDR WQM Data by Others

U.S. Geological Survey (USGS) stream flow values (mean daily discharge in cubic feet per second) presented in **Table H.1** for the two Lower San Diego River gauging stations are 'provisional' data subject to future revision. Processing and review of 2017 data is typically completed by January of the next year 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 H.1 USGS Stream Flow Data (WY17/WY16 Values)

	Fashion Valley (Sta. 11023000)				Santee Basin (Sta. 11022480)			
Month	Min.	Max.	ADF ₃ ^a	ADFm ^b	Min.	Max.	ADF ₃ ^a	ADFm ^b
Oct	1.0/2.4	6.5/49	1.3/4.7	1.8/7.5	0.1/0.4	9.1/36	0.9/1.2	1.0/2.9
Nov	1.3/2.4	69/170	1.5/3.6	7.9/16	0.8/0.4	51/77	0.9/1.5	5.9/6.5
Dec	2.4/5.0	353/81	87/13.8	65/20	2.9/1.3	228/64	87/3.3	36/11.9
Jan	27/10.0	1630/ 1350	90/30.3	230/140	12.6/ 5.3	848/ 780	113/23.0	126/80
Feb	21/7.0	4000/ 71	197/11.0	284/16	14.6/ 1.1	1210/ 36	15/5.2	109/6.4
Mar	16.8/5.1	363/90	27.4/11.0	56/19	8.5/0.9	178/94	21/5.4	32/14.2
Apr	5.8/3.0	16/86	7.5/9.4	10/14	4.7/2.9	8/91	5.6/21.0	5.9/14.7
May	5.1/2.0	216/48	8.9/3.3	22/7.9	3.4/1.0	184/77	5.7/1.4	13.2/5.8
Jun	2.5/1.0	6.4/2.2	3.2/1.4	4.1/1.4	0.9/ 0.4	3.4/1.5	1.3/0.5	2.0/0.8
Jul	1.8/0.6	2.6/1.2	2.0/0.8	2.2/0.8	0.3/ 0.2	0.8/0.7	0.5/0.3	0.6/0.3
Aug	1.7/0.4	2.1/1.0	1.8/0.6	1.9/0.6	0.4/0.1	0.7/0.4	0.5/0.1	0.5/0.2
Sept	1.8/0.4	2.5/17	2.0/1.5	2.0/2.2	0.3/0.2	2.3/33	0.4/0.3	0.6/2.3
WY Avg			35.8/7.6	57.3/20.4			21.0/5.3	27.7/12.2

a) Average daily flow over the antecedent 3-day period of water quality monitoring.

b) Average daily flow for entire month (30 days).

c) WY17 streamflow values lower (less) than WY16 results are shown in red.

Average daily flows in WY17 were up 53% (9.6 cfs) in the eastern portion of the lower watershed and 80% (25 cfs) in the western portion from 13-yr norms. LSDR discharge in WY17 amounted to 41,420 AF compared to 4,415 AF in WY14 (recent year of lowest flow) and 14,750 AFY last year. Annual average discharge over the past 13 years of record is 23,150 AF. Average annual streamflow for WY17 amounted to 142% of the 53-year norm for LSDR. The summer season (June-Sept) of last year (WY16) presented one of the lowest periods of continuous dry weather flow recorded at Fashion Valley in the past several decades. This year (WY17) summer flows were considerably above seasonal norms due to late rain fall (May) and replenishment of local area shallow aquifers.

San Diego CoastKeeper (SDCK) coliform count values (in MPN/100mL) from the organization's San Diego River monitoring stations for WY17, WY16 and WY15 are presented in **Table H.2**. Sampling results from 2009 through Sept 2017 for seven 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.sdcoastkeeper.org/learn/swimmable/san-diego-water-quality.html>.

Table H.2 San Diego CoastKeeper Coliform Count Data (WY17/16/15 Values)

	Fashion Valley Road (SDG-010)			Old Mission Historical Dam (SDG-020)		
Month	EColi (a)	Enterocci(b)	TCB (c)	EColi (a)	Enterocci (b)	TCB (c)
Oct	74/109/ 213	63/95/108	1198/1565/ 1423	-/30/10	-/305/132	-/708/301
Nov	528/41/ 1236	10/146/ 345	2723/496/ 19,863	-/31/98	-/31/52	-/288/ 3076
Dec	185/1017/ 4352	158/3555/ 6488	2809/24,192 /24,192	-/12,033/ 4352	-/14,136/ 6488	-/24,192/ 24,192
Jan	1119/134/ 4350	1726/52/ 2750	24,192/1850 /12,033	-/86/10	-/109/52	-/2035/2310
Feb	171/20/20	52/20/63	2987/2489/ 3130	-/20/31	-/30/63	-/3255/836
Mar	369/10/41	218/10/41	12,033/1137 /867	-/31/41	/20/63	-/504/980
Apr	20/85/253	51/386/52	512/7215/ 1515	-/41/52	-/20/30	-/2310/784

	Fashion Valley Road (SDG-010)			Old Mission Historical Dam (SDG-020)		
May	75/84/ 1850	109/588/ 2909	425/5475/ 3448	-/20/20	-/52/74	-/1145/657
June	-/109/134	-/63/160	-/ 2613/3654	-/86/1130	-/10/3076	-/529/24192
July	295/31/-	134/31/-	5794/3076/ -	-/10/20	-/52/31	-/1296/2142
Aug	185/20/63	52/10/20	1467/3968/ 2014	-/20/20	-/269/10	-/960/1067
Sept	181/6028/ 318	31/436/ 805	1198/24,192 /9804	-/496/134	-/97/51	-/ 24,192/2310
WY Avg.	291/640/ 1361	237/449/ 1496	5031/6522/ 7295	-/ 10,075/537	-/1261/915	-/5118/5503
Summer	78/3094/ 172	162/135/ 328	2016/8462/ 5157	-/153/326	-/107/792	-/6744/7428
Winter	369/295/ 2191	399/409/ 2336	7543/7417/ 37,130	-/ 3574/1109	-/3574/1667	-/7497/7080
Values Exceeding Threshold, %	18/18/27	36/45/64	18/27/18	-/18/18	-/27/27	-/9/18

- a) *Escherichia coli* (*E. coli*) bacteria expressed in MPN/100m; counts exceeding 406 MPN/100ml threshold shown in red text.
b) *Enterococcus (faecalis)* bacteria expressed in MPN/100mL; counts exceeding 100 MPN/100ml threshold shown in red text.
c) Total Coliform bacteria (common) expressed in MPN/100mL; counts above 10,000 MPN/100ml level are shown in red text.
d) Percent of total annual samples with values above threshold limits.

Appendix I - Water Quality Indexing

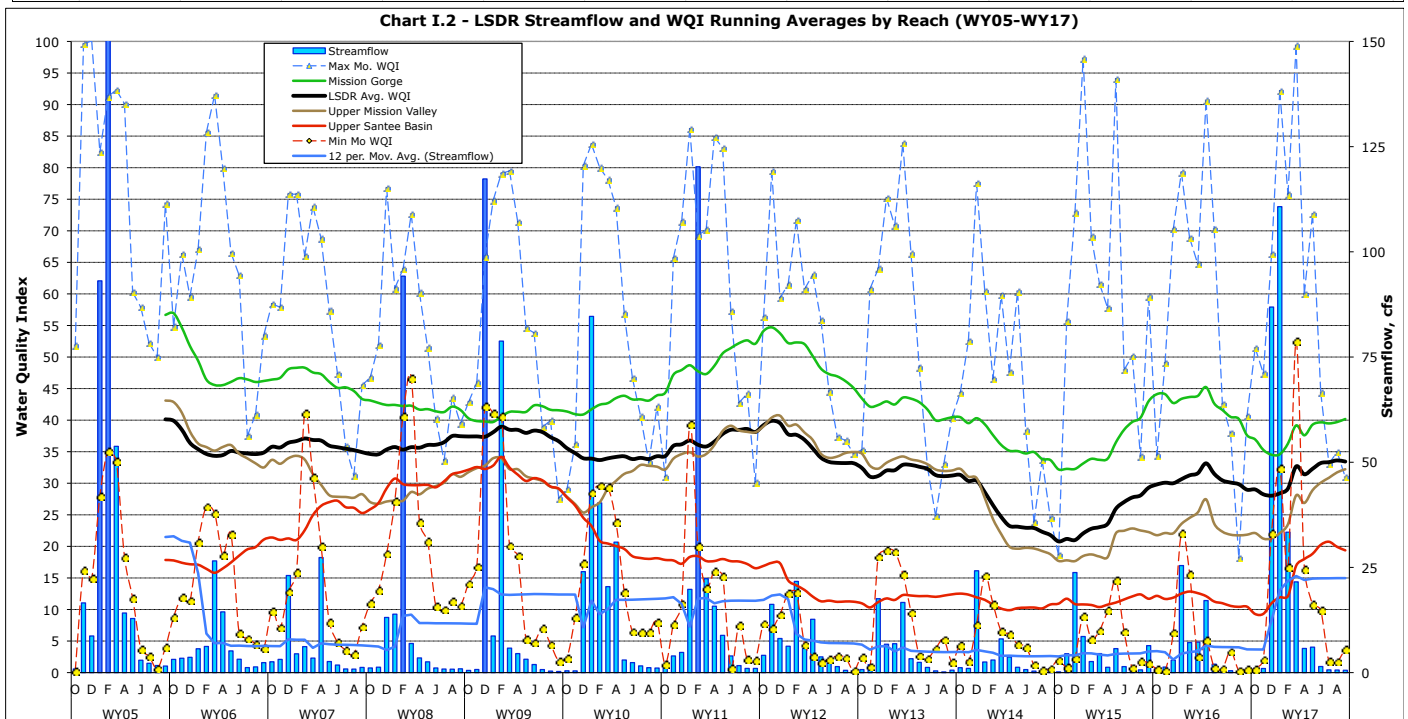
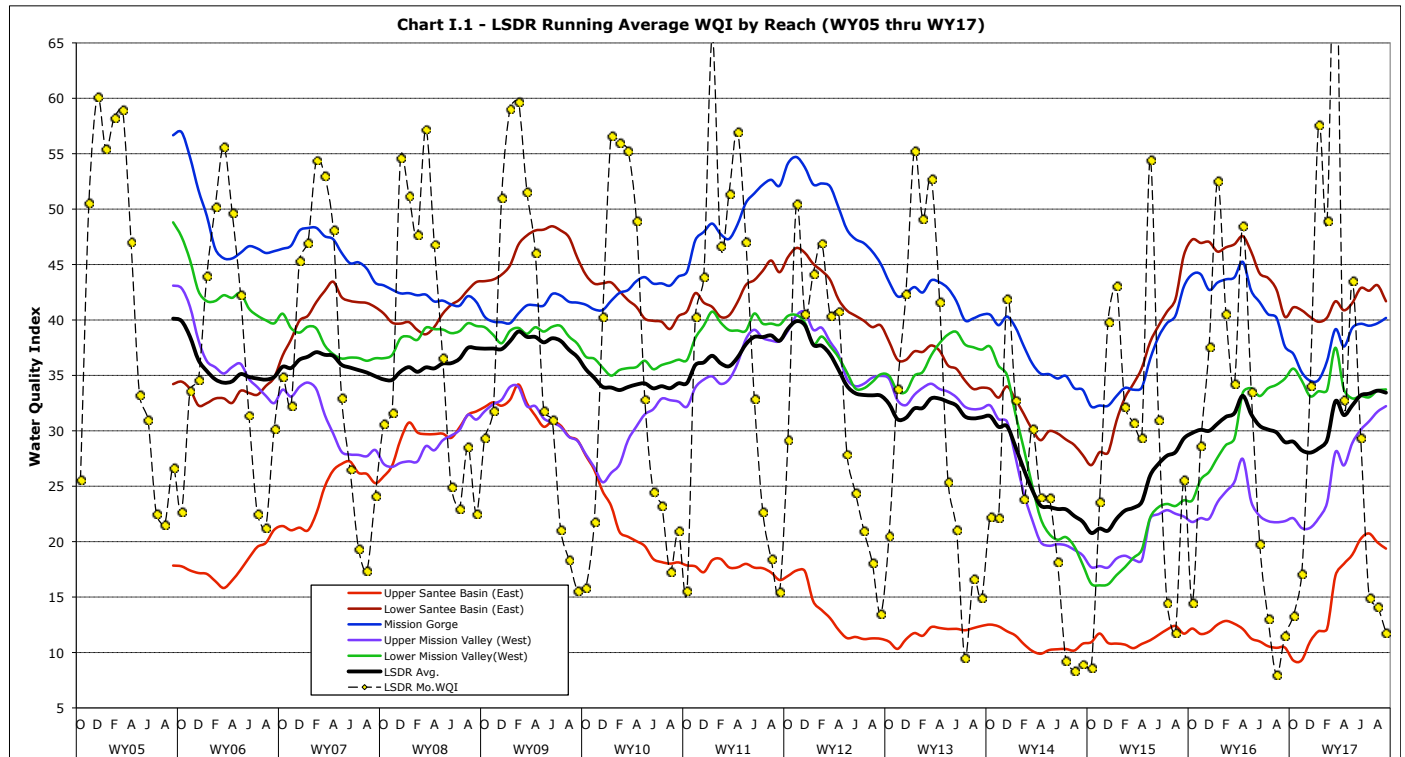
The LSDR WQM index has been developed for the purpose of providing a simple and concise expression of regularly monitored physical-chemical and bacteriological water quality data compiled by the SDRPF RiverWatch Team as well as several others listed in Appendix H. The index is intended to aid in assessment of the Lower San Diego River watershed primarily for non-body contact recreational uses and environmental enhancement. As designed, the parameter 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 one to interpret large amounts of aggregated data and relate overall water quality variations to changes, be they from natural causes or man-made impairments. The WQI has been used to identify general water quality trends over the past 13 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 many San Diego River water quality improvement programs and also assist responsible agencies and organizations in establishing priorities and updating policies for watershed management.

Running average LSDR WQI values from WY05 through WY17 are expressed by river reach and river section on **Charts I.1 and I.2**, respectively. **Chart I.1** presents overall LSDR monthly WQI values over the 13-year period. Cyclic seasonal patterns expressed in monthly results and trends described by running averages in WQI values are apparent for each reach of the river. **Chart I.2** provides the range (max-min) in monthly WQI values, the running averages by river section as well as monthly streamflows over the 13 year monitoring period. The water quality fluctuations over time in individual reaches, sections and the overall (average) Lower San Diego River expressed on both running average and seasonal cycle bases can be observed. The Upper Santee Basin reach (Sites 13&14) demonstrates the lowest index values since March of 2010, whereas the Mission Gorge (middle section) reach consistently shows the highest index values. It can also be noted (in both charts) that there has been an overall decline in water quality of the river, as evidenced by the WQI values, beginning in 2012. The overall LSDR running (12-mo) average index value fell 19 points from a high of 40 (20% above the 12-yr norm) to 21 over a 24-month period. The current (Sept 31, 2017) running average WQI of 31, up two points from the end of the last water year, is 5% below the 13-yr norm of 33 and trending upward.

Chart I.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 the five river reaches and the overall LSDR average. These variances can be visually compared to changes in streamflow on the same basis. The positive correlations are evident, i.e., increased average daily flow results in improved water quality. Low flow throughout the summer period results in poorest water quality. This year's below average dry-weather flows extending from mid-May through mid-November resulted in a small improvement in overall water quality from WY16.

Chart I.4 provides a spatial profile of average annual WQI by river monitoring site, reach and section for this year (WY17), compared to the best year (WY05), the worst (WY14) and the 13-yr

winter, summer and annual norms. The sites are in chronological order ascending upstream. The current (WY17) average annual WQI values for each site shown in black are above annual norms at two sites (15T and 12T) and considerably below the norms at ten other sites. The sites with poorest water quality for WY17 include Kaiser Ponds (6), Mast Park (13) and Cottonwood/RCP (14). For the fifth consecutive year, the Upper Santee Basin reach (Sites 13 & 14) has experienced the poorest water quality in the Lower SDR watershed. The Mission Gorge reach (sites 8, 9T and 10) continues to demonstrate best overall water quality.



Lower San Diego River WY17 Water Quality Monitoring Report Appendices D-I

