

LOWER SAN DIEGO RIVER WATER QUALITY

WY2024 Annual Water Quality Monitoring Report



*Water primrose (Ludwigia hexapetala) within river channel at Mission Valley Preserve
(WQM Site #2) September, 2024*

A compilation of WQM Data (October 2004 - September 2024)

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Lower San Diego River Water Quality 2005-2024

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Questions regarding the San Diego RiverWatch WQM database or interpretation of results expressed in this and similar LSDR WQ data monitoring reports provided on the SDRPF Online Information Center can be directed to the attention of John Kennedy, by contacting SDRPF at info@SanDiegoRiver.org or the RiverWatch Coordinator.

Section 1 - Introduction

This report provides a summary of monthly values, seasonal patterns and annual trends in water quality monitoring data gathered and evaluated by SDRPF's RiverWatch citizen volunteers. WQM data collected monthly over the past 20 years at all monitoring sites within the Lower San Diego River (LSDR) watershed have been aggregated, in conjunction with hydrologic streamflow data to develop a numeric water quality index (WQI). Basic monthly data regarding individual water quality parameters and river hydrology for each of the sites monitored are maintained in an extensive database file maintained at the SDRPF offices; this annual report examines Water Year 2024 (WY24) data in comparison to previous year results and 20-yr averages henceforth referred to as 'norms'. The LSDR water quality monitoring site locations are shown on **Figure 1-1**.

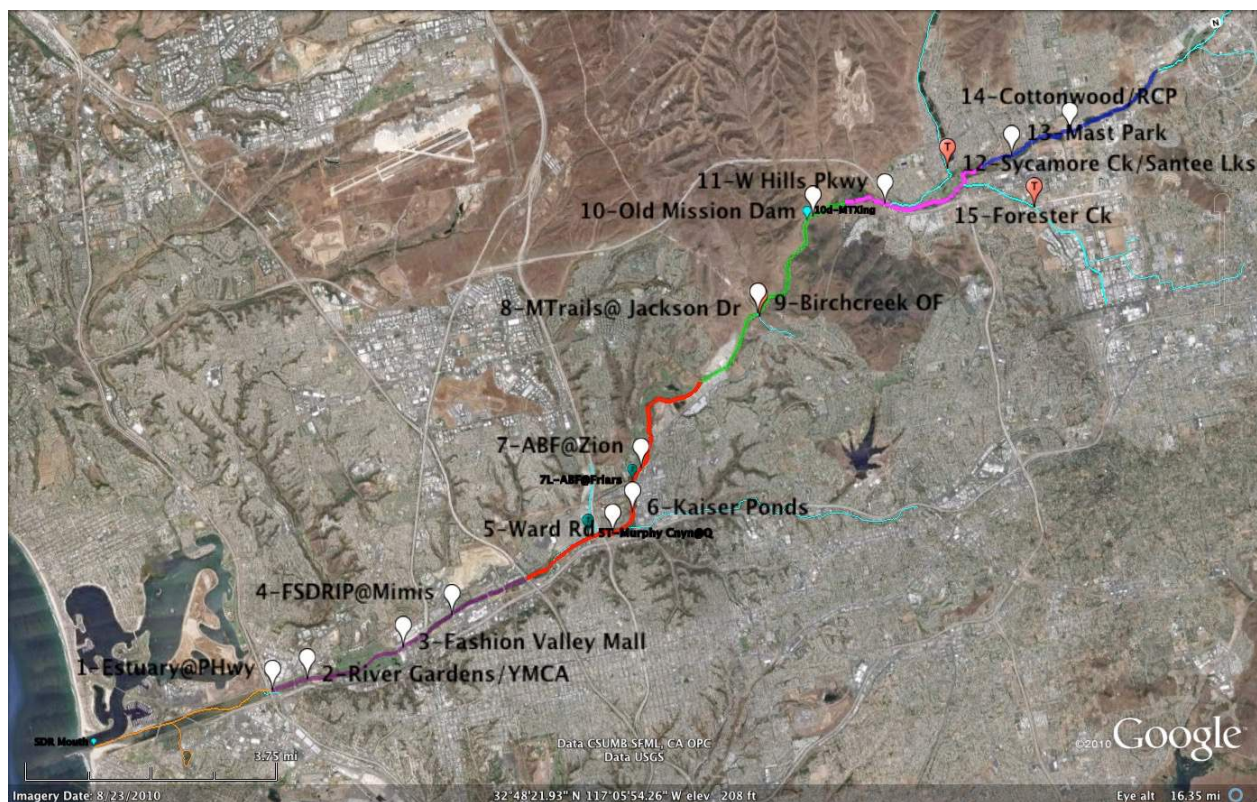


Figure 1-1 LSDR Watershed and Water Quality Monitoring Sites

Color Code for LSDR reaches on Figure 1-1 above: Estuary (orange), Lower Mission Valley (purple), Upper Mission Valley (red), Mission Gorge (green), Lower Santee Basin (pink), Upper Santee Basin (dark blue), Lakeside to El Capitan Reservoir (light green) and principal tributaries (light blue)

The water quality sites on Figure 1-1 and monthly water quality data can be viewed in detail on the SDRPF RiverWatch Online Information Center webpage available at <www.sandiegoriver/river_watch.html>. The portal also contains: San Diego StreamTeam Bio-assessment data, 401 Project information and USGS real-time streamflow data regarding daily peak discharge and gauge height for the two San Diego River gauging stations (Fashion Valley & Mast/W.Hills Pkwy Bridge near Santee). The RiverWatch data portal is updated regularly.

The water quality index (WQI) represents a response to questions and concerns from SDRPF staff and the general public regarding overall health of the lower river system. The index is a numeric (0-100) where increasing values indicate improving water quality. The numerical index incorporates basic physical, chemical and bacteriological water quality data by integrating six parameters: water temperature (Temp), pH, specific conductance (SpC), dissolved oxygen (DO), percent saturation (%DOSat) and streamflow (ADF); through determination of weighted factors for each metric. The resulting values are aggregated to arrive at an overall score for each site, reach, section as well as the entire lower watershed (LSDR). The range in index values, grades, color codes and general conventions utilized are presented in **Table 1.1**.

Table 1.1 LSDR Water Quality Index

SDR WQI (0-100)	Grade	Color Code	Percentile Range	Water Quality Threshold	General
75 or >	A - Very Good	Dark Blue	25%	Well above acceptable WQ criteria	Healthy (>50)
50 - 74	B - Good	Light Blue	25%	Meets all acceptable WQ criteria	
38 - 49	C - Fair	Green	12.5%	Meets many (but not all) WQ criteria	Marginal (25-49)
25 - 37	D - Marginal	Yellow	12.5%	Meets some acceptable WQ criteria	
13 - 24	E - Poor	Brown	12.5%	Below most minimum WQ criteria	Unhealthy (< 25)
0 - 12	F - Very Poor	Pink/ Rose	12.5%	Well below minimum WQ criteria	

Note: The WQI has been developed for inland fresh water quality metrics only; not applicable to estuarine or ocean waters.

In general, sites with WQI values of 50 or above (blue zone) exceed expectations for acceptable water quality and are indicative of relatively ‘healthy’ conditions. Scores between 25 and 49 (yellow zone) describe ‘impaired or ailing’ quality where quantifiable evidence exists regarding failure to meet specific water quality criteria. Waters’ with scores of less than 25 (red zone) do not meet minimum expectations and are considered ‘unhealthy’ and/or stressful to numerous aquatic life forms. For WQ parameters monitored by RiverWatch, the index expresses results relative to those levels necessary to sustain designated beneficial water uses for the LSDR (Hydrologic Area 907.1) based on California Water Quality Standards. Where criteria are non-specific, results are expressed relative to general freshwater objectives established for Southern California inland coastal areas. As such, the index does not apply to estuarine or ocean waters. Fresh water is typically defined as having an overall salt content of less than one percent.

Index values were calculated using two formulas; one involving four metrics (Temp, SpC and DO) monitored by RiverWatch combined with streamflow (ADF); the second with two additional parameters (pH and total coliform counts). The equations used for both formulas (WQI₄ and WQI₆) are presented in Appendix F. Differences between the two determinations were found to be minor, however, the initial determination (WQI₄) provides a broader range in values than the second, as the ‘normalizing’ effects of pH and total coliform values (both of which present less spatial and temporal variance) are excluded. The broader range WQI₄ values are expressed in both the annual and monthly water quality reports. Although specifically developed for the Lower San Diego River, the index can also be applied to other coastal and inland watercourses where the same metrics (i.e., DO, SpC, water temperature and streamflow) are monitored and available on a consistent basis. A technical report comparing relative water quality in three San Diego County watercourses; Los Penasquitos Creek below Poway, Santa Margarita River below Temecula/near Fallbrook, and Lower San Diego River near Santee and in Mission Valley, prepared through the RiverWatch program in 2015, is on file at SDRPF offices.

Section 2 - Spatial Analysis of WY24 Water Quality Metrics

Monthly water quality data collected and recorded at each site by RiverWatch WQM Team volunteers are used to determine averages, seasonal patterns and trends as presented in this annual report and appendices. Supporting USGS streamflow data are also included in the analyses. The annual average water quality values for each of the monitoring sites for WY24 and 'norms' i.e., averaged values over the past 20 years of monthly monitoring, are presented in **Table 2.1**. WY24 values (bold type) equal to or greater than site norms (expressed in italics) are shown in black, whereas values below norms are in red. This year's overall LSDR averages (of all sites) are displayed in bottom two rows of the table.

Table 2.1 Average Annual WQ Metrics for WY24 and 20-yr Norms by Site, Reach and Section

WQM Site	LSDR Reach/Sect.		Temp, oC	SpC, mS/cm	pH	Dissolved Oxygen, mg/L (%Sat)	ADF, cfs	WQI, (Diff) & Grade ^a	
1	L M V	West	19.5/19.7	2.27/2.69	7.80/7.75	6.52(72)/6.12(67)	62/29	43/37 (+6)	C/D+
2			19.4/19.0	2.20/2.63	7.74/7.68	6.18(67)/4.54(48)		45/31 (+14)	C/D
3			19.4/19.2	2.12/2.52	7.75/7.75	5.25(56)/4.56(48)		39/31 (+8)	C/D
4	M M V		19.5/19.5	2.09/2.43	7.81/7.78	6.07(66)/5.97(64)	59/27	44/39 (+5)	C/C
5	18.0/17.2		2.00/2.57	7.73/7.63	5.63(59)/4.84(50)	42/32 (+10)		C/D	
6	U M V		18.8/18.3	1.92/2.55	7.65/7.61	4.33(45)/3.52(36)		33/24 (+9)	D/E+
7	18.4/18.1		1.92/2.41	7.74/7.58	5.84(63)/5.02(53)	44/35 (+9)	C/D		
8	M G	Mid	17.2/17.1	1.54/2.26	8.11/7.72	7.86(81)/7.27(74)	46/20	57/48 (+9)	B/C+
9T ^b			15.5/15.6	3.68/4.61	8.27/7.93	9.62(96)/9.28(94)	<1	40/34 (+6)	C/D
10			17.5/17.5	1.56/2.20	7.76/7.82	6.20(65)/6.86(71)	38/16	43/43 (0)	C/C
11	L S B	East	16.9/16.7	1.66/2.20	7.71/7.59	6.56(68)/6.13(61)		47/38 (+9)	C/C-
12T ^b			15.8/17.4	1.10/1.58	7.73/7.92	6.67(67)/7.07(72)	42/37 (+5)	C/D+	
15T ^b			18.2/17.8	2.25/2.65	7.93/8.03	6.55(70)/7.21(70)	20/9	44/39 (+5)	C/C-
13W ^c	U S B		16.2/15.8	1.13/1.57	7.57/7.62	4.39(45)/3.77(38)	19/8	30/24 (+6)	D/E+
13E			18.3/18.2	1.31/1.86	7.57/7.64	2.61(27)/2.72(28)		19/16 (+3)	E/E
14			19.4/17.9	1.13/1.49	7.82/7.84	5.39(59)/3.65(37)		38/21 (+17)	C-/E
all	LSDR Avg.		18.2/17.9	1.73/2.24	7.70/7.72	5.74(60)/5.30(54)	47/23	40/33 (+7)	C/D
1-16	Dwt Avg ^d		18.1/17.9	1.73/2.25	7.78/7.74	5.88(58)/5.42(51)	45/21	40/33 (+7)	C/D

a) Average annual water quality index values, change (+/-) and resultant WQ letter grade for WY24 (bold) and 20-yr norms (italics); WY24 values below site norms for each metric are in red; values above norms in black.

b) Lower San Diego River water quality monitoring sites located on tributary (T) streams; all others are main channel.

c) Mast Park West site (below Carlton Hill Blvd. bridge) was added in WY21; so yearly 'norms' are less statistically sound.

d) Distance-weighted (Dwt) WQI values are calculated based on reach of each site relative to total length of the lower river.

e) DO > 7.0 mg/L values shown in blue cells; DO < 5 mg/L values are shown in tan cells.

All 16 monitoring sites present average annual WQI values for WY24 greater than or equal to the 20-yr norms. Average WY24 water temperatures were slightly above norms at all but three sites (1,9T&12T), resulting in an overall increase of 0.25 oC from the annual average of 17.9 C. Specific Conductance values for WY24 are below norms at all monitoring sites. The overall SpC (LSDR average) for WY24 is 30% below the annual norm of 2.25 mS/cm. DO values are greater than norms at 10 of 16 sites in WY24. Overall this year's average DO value of 5.88 mg/L (58%Sat) is slightly above the annual norm of 5.42 mg/L (51%Sat). This year's annual average DO is 49% above the lowest year (WY14 @ 3.95 mg/L) while 14% below the highest average value of 6.84 mg/L recorded in WY05. Average daily streamflows (ADF) for WY24 (bold, blacktype) were greater at all sites than the 20-yr norms (*shown in italics*).

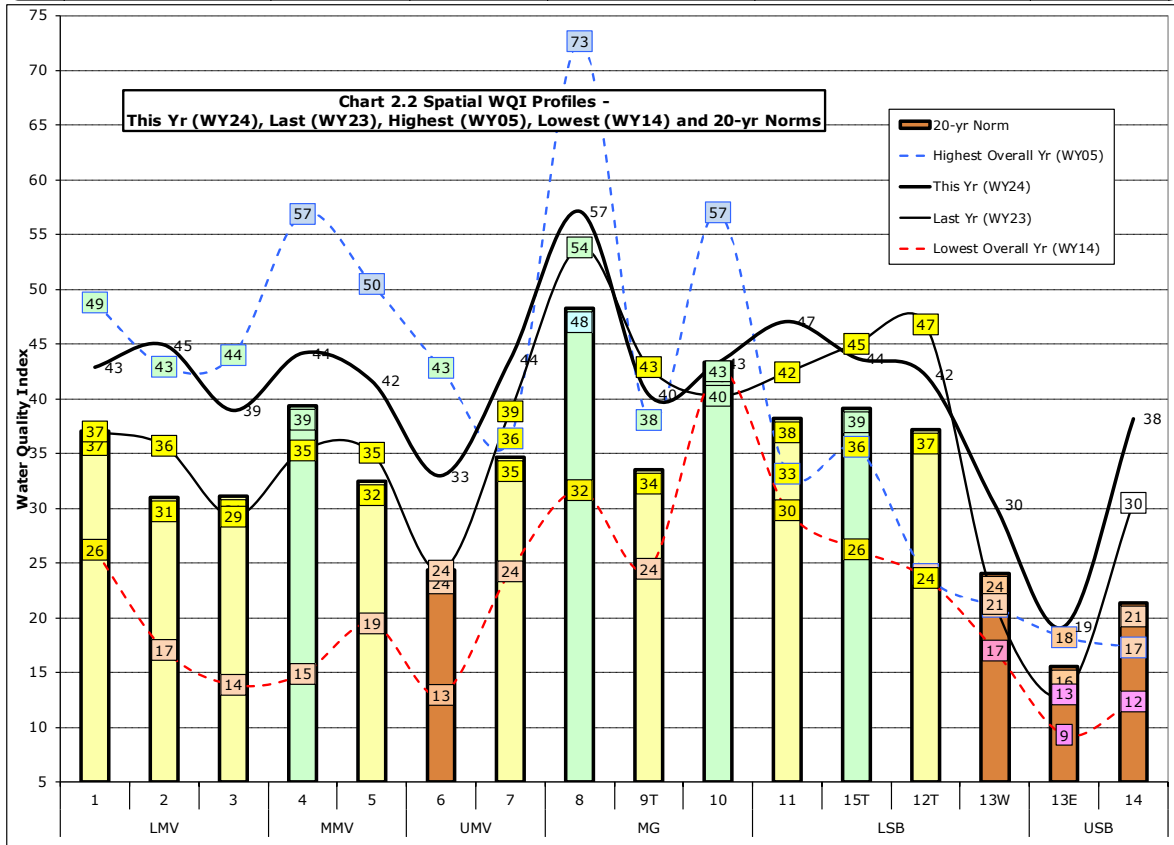
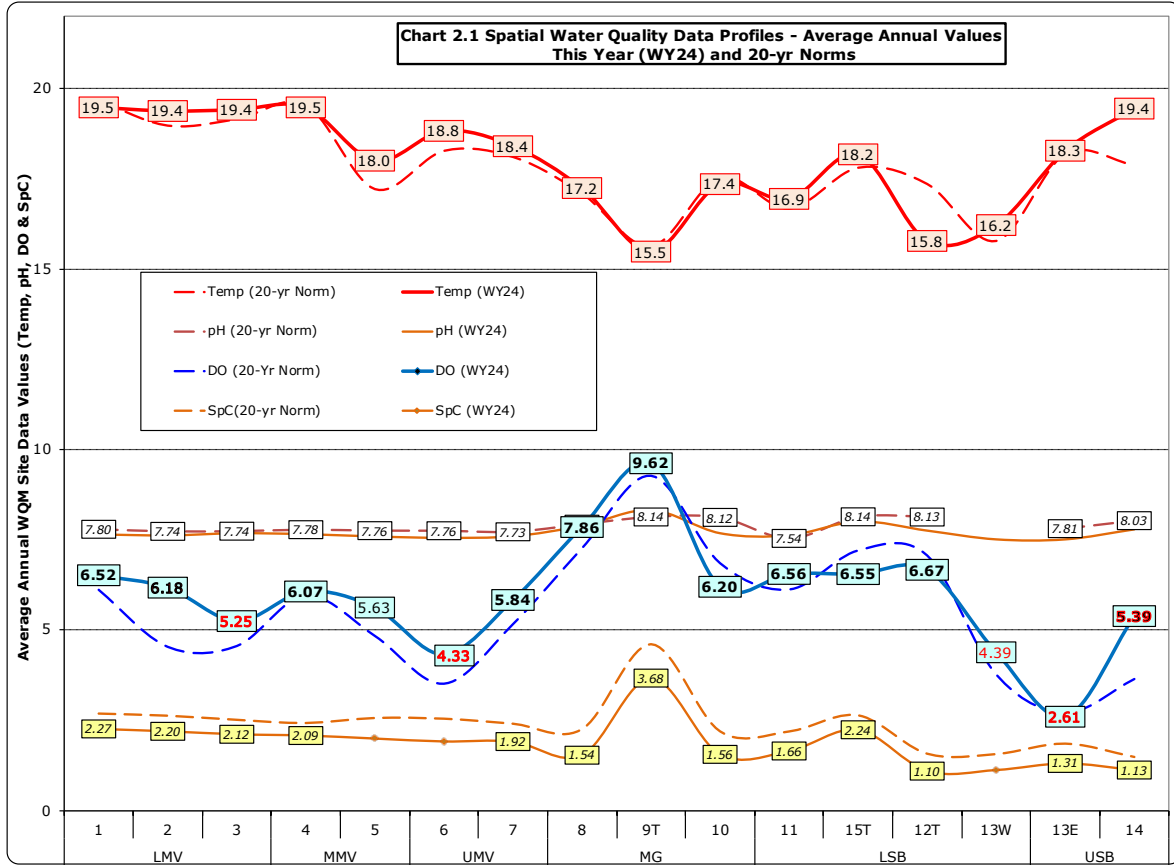
Average annual and monthly min.-max. range water quality metrics for WY24 and 20-yr norms are expressed for the river (LSDR) and by reach/section in **Table 2.2**. All reaches of the lower river present higher water quality index values for this year than the norms. Average annual water temperatures are above norms in four out of five reaches while Specific Conductance (SpC) for all five reaches were below norms. Western and Mid-Reach pH values were above norms while below in the Santee Basin. DO values in all reaches were above norms. Streamflow (ADF) also exceeded 20-yr norms in all reaches and sections in WY24. The greatest improvement in water quality metrics monitored within the lower river watershed occurred in the Mission Valley (sites 1-7) reach. The winter water quality index remained unchanged from the norm at Old Mission Dam (Site 10).

Table 2.2 Water Quality Metrics for WY24 and 20-yr Norms by Range, Reach and Section

Parameter, units		Temp, oC	SpC, mS/cm	pH	Dissolved Oxygen, mg/L (%Sat)	ADF, cfs	WQI, (Difference) and Grade ^a	
LSDR Max. Mo.		24.2/25.2	2.70/4.00	7.90/8.60	8.20(79)/10.4(102)	202/230	55/51 (+5)	B/B-
Winter (D,J,F,M)		13.1/13.4	1.56/1.69	7.73/7.77	7.57(69)/7.17(64)	69/48	48/48 (0)	C+/C
Annual Wt Avg.		18.1/17.9	1.73/2.25	7.78/7.74	5.88(58)/5.42(51)	34/21	40/33 (+7)	C/D
Summer (J,J,A,S)		23.1/22.5	2.29/2.74	7.79/7.72	4.38(47)/3.73(39)	4.4/2.7	25/19 (+6)	D-/E
LSDR Min. Mo.		10.4/9.3	1.00/0.57	7.54/7.07	3.28(34)/1.80(16)	1.7/0.1	18/16 (+2)	E/E
LSDR Individual Reach & Section Averages:								
USB	East	18.7/18.1	1.25/1.74	7.69/7.74	3.53(37)/3.01(31)	12/7.5	26/17 (+7)	D-/E
LSB		17.4/17.3	1.75/2.22	7.66/7.76	6.52(68)/6.49(64)	30/18	45/37 (+8)	C/D+
MG	Mid	16.9/17.0	1.55/2.23	8.05/7.82	7.55(76)/7.45(76)	33/20	50/46 (+4)	B-/C
UMV	West	18.4/17.9	1.95/2.51	7.71/7.61	5.27(55)/4.51(46)	46/29	38/30 (+8)	C-/D
LMV		19.4/19.3	2.17/2.57	7.78/7.74	5.84(63)/5.02(53)	48/30	43/35(+8)	C/D

a) Average annual water quality index value, difference (+/-) from 20-yr norms and resultant WQI letter grades. Current values (bold-face type) and grades below norms (shown in italics) are expressed in red; values and grades above norms are in black.
b) DO > 7.0 mg/L shown in light blue cells; DO < 5 mg/L shown in tan cells.

Spatial water quality values expressed in Tables 2.1 and 2.2 for the LSDR system monitoring sites are presented in **Chart 2.1** (Water Quality Data Profiles) and **Chart 2.2** (Water Quality Index and LSDR Streamflow) on the next page. The overall water quality index for WY24 of 40 (C Fair) is seven points greater than the 20-yr average annual norm of 33. This year's value is 13 points above the lowest average



annual WQI of 22 (E Poor) experienced in WY14. The river's highest overall average annual index of 40 (Fair) occurred in WY05. Two water year's (WY14&WY18) presented an overall average index value in the Poor E (WQI 13-24) range, while two others (WY05&WY11) had values in the Fair C (WQI 38-49) range. Marginal (D) water quality (WQI 25-37) has occurred 13 of the past 19 years (68% of the time).

Average annual water quality values for water temperature, pH, DO and SpC at each monitoring site, river reach and section in order of their location upstream for WY23 and 19-yr norms are presented on **Chart 2.1**. This year's average annual results are shown as heavy solid lines with values listed; blue lines are last year's (WY22) values and the red lines are 19-yr annual averages (or norms) for each site. Average annual water temperatures (solid red line) for WY23 are below (less than) both 19-yr norms (red bars) and last year values (dashed red line) at all 16 monitoring sites. Downstream water temperatures are consistently higher than those monitored upstream. There is little difference in average pH values between sites and from the 19-yr norms (yellow bars). There is also little variance in pH values between upstream and downstream sites. DO values for WY23 (solid black line) are generally above those from last year (dashed black line) and close to the 19-yr norms (blue bars). Average annual DO values at five sites (3,6,13W,13E&14) are below a depletion threshold level of 5 mg/L. Monitored DO and DO%Sat results represent the greatest variation between sites. Lowest values are typically recorded in the Upper Santee Basin and Upper Mission Valley reaches whereas highest values are observed in the Mission Gorge section (sites 8&10). Excluding tributary sites, average annual SpC values generally increase along the mainstem from upstream to downstream, similar to water temperatures. SpC averages for WY23 (solid blue line) are slightly below both norms (brown bars) and last year's values (dashed blue line) at all sites. The greatest variances in this year's spacial metrics both from last year (WY22) and the norms are associated with DO and water temperatures.

The WQI, an aggregate or composite index of water quality monitoring metrics for WY23, the 19-yr norms, the overall best (WY05) and worst (WY14) year results are presented in **Chart 2.2**. As shown by the solid black line (this year's results) in comparison to the colored bars (19-yr norms), the three sites furthest upstream, Mast Park (13E&13W) and Magnolia Ave (14), continue to experience the poorest water quality as does Kaiser Ponds (site 6). On an average annual basis, highest WQI values continue to be associated with the Mission Gorge sites (8&10). The overall WQI profile for WY23 (black line) is generally similar to the 19-yr norms (colored bars) and consistently above last year's (WY22) results (dashed black line). In general WY23 water quality conditions throughout Mission Valley (Upper, Mid and Lower reaches) are noticeably improved from last year's (WY22) results. As evidenced in the past, above normal streamflows tend to reduce degradation thus resulting in improved water quality. WY24 experienced well above normal dry weather flows as well as average annual flow that resulted in an overall improvement in the river water quality index. Lower water temperatures and Specific Conductance values as monitored throughout the water year, combined with slightly higher Dissolved Oxygen levels at nearly all sites resulted in elevated index values.

Section 3 - Temporal Analysis of LSDR WY24 Data

Monthly, seasonal and annual water quality monitoring metrics data and index results for the Lower San Diego River are presented in **Table 3.1** for this year (WY24) with comparison to 20-yr norms (shown italicized). WY24 values above norms are listed in black; values below norms in red. Temporal water quality values in WY24 vary little from the 20-yr norms on an annual basis with the exception of DO and streamflow where this year's values are below norms for all but two months of the water year. The resultant annual average WQI for WY24 is seven points (21%) above the 20-yr norm of 33 and five points higher (14%) than last year's (WY23) value of 35.

Table 3.1 LSDR WQM Metrics for WY24 and 20-yr Norms by Month and Season

Month	Season:	Temp, °C	Sp Cond, mS/cm	pH	Dissolved Oxygen, mg/L (%Sat)		ADF, cfs	WQI Value ^(a) and Grade	
Oct	Fall	20.14/18.60	2.125/2.777	7.72/7.72	4.25/4.02	46/38	4.2/2.3	28/21	D/E
Nov		14.65/14.80	0.998/2.566	7.68/7.73	6.66/5.54	65/48	28/8.1	53/31	B/D
Dec	Winter	11.59/11.72	1.672/1.827	7.54/7.75	6.99/6.95	61/58	15/26	40/42	C/C
Jan		10.38/11.82	1.430/1.711	7.90/7.73	8.13/7.98	77/68	13/57	46/49	C/C+
Feb		13.87/13.74	1.040/1.684	7.81/7.82	8.20/7.37	79/66	202/58	62/48	B/C
Mar		16.62/16.36	1.344/1.528	7.96/7.78	6.99/7.09	69/67	46/53	55/51	B/B-
Apr	Spring	18.16/17.93	1.328/1.845	7.83/7.77	6.60/5.93	67/58	62/30	52/43	B-/C
May		19.69/19.87	1.680/2.170	7.79/7.75	5.21/5.06	51/51	16/11	38/34	C-/D
June	Summer	21.61/21.88	1.888/2.486	7.89/7.77	5.54/4.33	58/45	8.0/4.7	38/26	C-/D-
July		23.75/23.17	2.158/2.694	7.77/7.67	4.46/3.53	49/38	4.9/2.3	29/18	D/E
Aug		24.17/23.32	2.399/2.896	7.79/7.70	4.23/3.44	46/37	3.1/1.3	24/16	E+/E
Sept		22.90/21.54	2.700/2.871	7.72/7.72	3.28/3.49	34/36	1.7/2.5	18/18	E/E
Fall (O&N)		17.40/16.70	1.561/2.671	7.70/7.73	5.46/4.81	56/44	20/5.2	40/26	C/D-
Winter (D,J,F,M)		13.12/13.41	1.372/1.687	7.80/7.77	7.58/7.36	70/65	81/48	50/48	B-/C
Spring (A&M)		18.92/18.90	1.348/2.007	7.81/7.76	5.91/5.51	59/55	35/20	54/38	B/C-
Summer (J,J,A,S)		23.11/22.48	2.286/2.737	7.79/7.72	3.38/3.73	37/39	5.7/2.7	27/20	D/E
Annual (O-S)		18.13/17.90	1.730/2.250	7.78/7.74	5.88/5.42	58/51	38/24	40/33	C/D

a) WQ index values based on RiverWatch physical-chemical metrics combined with USGS streamflow data for East (West Hills Pkwy) and West sections (Fashion Valley). WY24 values/grades (shown in bold type) below 20-yr norms (shown in italics) are in red; those values equal to or above norms are in black.

b) DO > 7.0 mg/L (65% Sat) shown in light blue cells; DO < 5 mg/L (55% Sat) shown in tan cells.

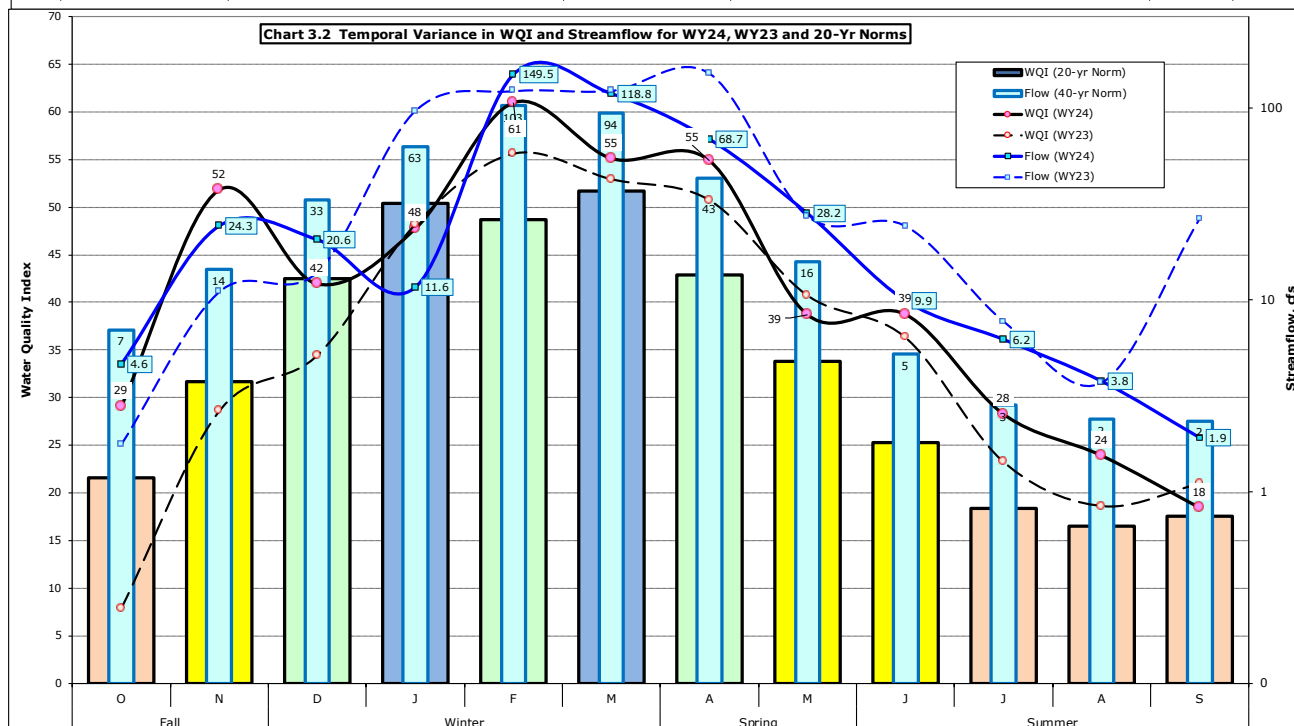
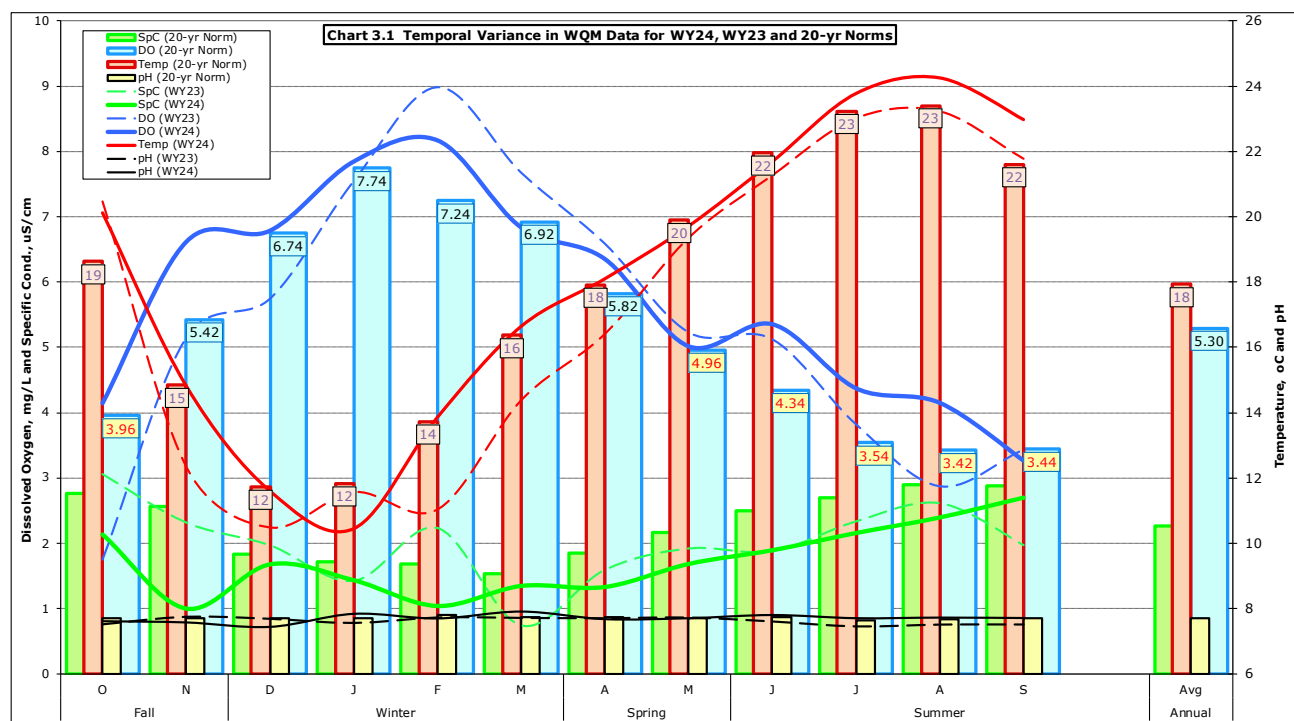
c) WQI color coding as listed in Table 1.1.

Monthly and seasonal variances in water quality monitoring metrics for the past two water years (WYs 24 and 23), displayed as lines, and the 20-yr norms, shown as bars, are expressed in **Chart 3.1** located on the next page. The numeric values presented in the chart are taken from columns 1-4 of Table 3.1. Dissolved oxygen values are highest during the winter months (Dec-March) whereas specific conductivity and water temperatures are greatest during the summer months (June-Sept) extending into early autumn (Oct). The pH values show very little overall temporal variation. However, the broad range in DO, SpC and water temperature metrics, as monitored at nearly all sites throughout the year when considered collectively, provide strong indications of the significant variance in overall water quality. Temporal variance between this year's data (WY24), shown as solid lines, last year's results (dashed lines) and the 20-yr norms (colored bars) show similar patterns in general. The temporal variance in WY24 water quality data match more closely temporal patterns in the 20-yr norms, than do the WY23 values. This year's temporal water quality values are reflective of both normalized monthly occurrences as well as those monitored during previous years, with only slight variances for specific months. Seasonal variances are much the same.

Chart 3.2 provides an overall graphic presenting temporal variance in both streamflow and WQI values throughout WY24 compared to monthly averages for the previous water year (WY23) and the 20-yr norms. As shown in the chart, WQI values for WY24 (heavy black line), also listed in Table 3.1 (far right column), are fairly close to 20-yr norms (colored bars) for most months of the year. The positive correlation between streamflow (both wet weather and dry) and monthly water quality is also evident. Low DO levels throughout the summer and fall months combined with below normal dry-weather flows constitute the primary drivers in index values. In general, water quality for the Lower San Diego River watershed is highest (i.e., Good to Fair grades) when flows are greatest during the Winter months (Dec-March) and poorest (Poor to Very Poor) in Summer (June-Sept) when streamflow and DO values are lowest and water temperatures highest. The overall annual average WQI for the LSDR in WY24 of 40 (C Fair) is seven points above the overall 20-yr average index value of 33 and five points greater than the WY23 index of 35.

Temporal patterns in river water quality data, as expressed in this section of the report, are most evident when considering monthly and seasonal values. The next section of this report examines the same temporal variances in river water quality data extending over the entire 20-year period based on computed 12-mo running average values. Examining the temporal patterns in running averages provides a statistically rational indication of trends in the various data.

LSDR WY24 Water Quality Monitoring Report



Section 4 - LSDR Running Average Water Quality Metrics (WY05-WY24)

Variances in SDRPF monitored water quality metrics for the LSDR, based on data collected by RiverWatch from Sept.'04 through Sept. of 2024, are discussed in this chapter. The metrics include water temperature, specific conductance, pH, dissolved oxygen, streamflow and the water quality index. Twelve month running average values considered with overall best-fit trendline equations represent a rational expression of relative change in values over twenty years of continuous monthly monitoring for each metric.

Table 4.1 presents 12-month running average values for each of the key water quality metrics monitored by RiverWatch. Running averages above norms are listed in black; values below norms are in red. Norms for each metric are expressed in italics in the bottom row of the table. The running average water temperature for WY24 of 18.13oC is 1.4% above norm. The WY24 SpC average of 1.730 mS/cm (23% below norm) is the lowest recorded during the last two decades. Running average pH for WY24 is slightly up from last year to just above the norm. The average DO level for WY24 increased to above the norm for third time in 20 years. Running average daily flow for this year is above the norm. The resultant average LSDR WQI for WY24 is up five points from last year to 21% above the 20-yr norm. A more definitive look at the changes in the LSDR running averages, their range and trendlines for each metric over the past 20-years is provided in the subsequent charts (4.1-4.7) of this section.

Monthly **water temperatures**, running averages and trends are shown on **Chart 4.1**. Temperatures are cyclic with warmest temps occurring in Aug. and coolest in Dec. Summertime maximum water temps. are 150% greater than the average annual (norm) of 17.9oC, while the winter lows reach 50% below the 20-yr annual norm. Variance in running average water temperature over the past 20 years falls within the range of 3% above to 3% below the norm. Although monthly variance in max. (red), min. (blue) and average (black) water temperatures for the LSDR are both large and cyclic, the 12-month running average values present minimal variance. A very slight warming trend in running average water temperatures may have occurred over the monitoring period. As shown on the chart, maximum temperature values monitored at all sites seem to have increased slightly (<1 oC), while minimums have remained near constant. A small but discernable increase in average LSDR water temperatures from sub-18.0 oC to slightly above the normative value by (approx. 0.2-0.4 oC) is evident based the data monitored over the past two decades.

Variance in monthly monitored **Specific Conductance (SpC)** values for the LSDR are presented in **Chart 4.2**. Min. (blue) and max. (red) running averages for all sites monitored have varied measurably over the 20-yr period, however, the overall LSDR running average ranged from a low 1.73 mS/cm range (23% below norm) this year to 2.77 mS/cm (22% above) in WY18. The overall trend in maximum SpC for all sections of the river has shown some decline over the last decade of monitoring. The rate of decline in minimums for all sites (blue) has been less, however, the resultant overall average values (black line) have seen a decrease. The river's SpC values increase during periods of extended drought and decline when annual streamflows improve.

Variance in monthly **pH** values are presented in **Chart 4.3**. The overall or general trend in values monitored for the LSDR has been relatively consistent over the last 20 years (WY05-WY24). The initial years (WY05-WY09) of below average pH were due, at least in part, to faulty equipment as monthly minima and maxima values (since WY10) have recorded higher on a consistent basis. Excluding the initial year's, there has been but small variance (<3%) in the overall running average pH from the 20-yr norm of 7.74. The overall trend in pH for the river seems, however, to be slightly positive. Values have increased by an average of about 0.3% per annum since RiverWatch monitoring began, primarily as minima values have risen. It is concluded that the lower river may be very gradually becoming slightly more alkaline (basic) as average flows decline, water temperature grow warmer and increased aerobic respiration occurs.

Table 4.1 - LSDR 12-mo Running Average WQM Metrics (WY05-WY24)

	Temp, oC	SpC, mS/ cm	pH, unit	Dissolv. Oxygen, mg/L (%ofSat)	ADF, cfs	WQI ^(a) Values, Grade & (Diff.)
WY05	17.81	2.061	7.62	6.84 (61%)	58	41 C Fair (+8)
WY06	18.29	2.140	7.39	6.04 (57%)	13	37 D+ Marginal (+4)
WY07	17.62	2.344	7.52	5.95 (58%)	8.6	37 D+ Marginal (+4)
WY08	17.55	2.222	7.90	6.20 (62%)	17	37 D+ Marginal (+4)
WY09	17.65	2.390	7.64	6.20 (62%)	20	37 D Marginal (+4)
WY10	18.03	2.281	7.86	5.35 (50%)	28	34 D Marginal (+1)
WY11	17.76	2.170	7.88	5.76 (53%)	26	38 C- Fair (+5)
WY12	18.00	2.331	7.69	5.41 (49%)	13	33 D Marginal (0)
WY13	17.29	2.433	7.78	5.51 (51%)	8.3	32 D Marginal (-1)
WY14	17.81	2.500	7.67	3.95 (36%)	4.9	22 E Poor (-11)
WY15	18.70	2.177	7.79	4.62 (42%)	9.6	29 D Marginal (-5)
WY16	18.23	2.257	7.75	4.82 (45%)	14	28 D Marginal (-6)
WY17	18.54	2.141	7.80	5.19 (49%)	45	33 D Marginal (0)
WY18	18.09	2.774	7.97	4.41 (42%)	5.4	24 E+ Poor (-9)
WY19	17.74	2.162	7.77	5.11 (48%)	24	32 D Marginal (-1)
WY20	18.29	2.149	7.83	5.52 (52%)	31	34 D Marginal (+1)
WY21	17.23	2.439	7.89	5.37 (50%)	8.2	31 D Marginal (-2)
WY22	18.08	2.306	7.68	4.73 (46%)	9.7	29 D Marginal (-4)
WY23	17.08	1.999	7.70	5.48 (50%)	49	35 D Marginal (+2)
WY24	18.13	1.730	7.78	5.88 (58%)	34.0	40 C Fair (+7)
20-yr Norm	(17.88)	(2.250)	(7.74)	(5.42) ((51%))	(21)	33 (D Marginal)
<p>a) Values based on SDRPF RiverWatch phys-chem monitoring results combined with USGS streamflow records for eastern (West Hills Pkwy) and western (Fashion Valley) gauging stations. Water year values/grades below 20-yr norms (in italics) are in red; those equal to or above norms in black. WY24 values are in bold type.</p> <p>b) LSDR DO < 5 mg/L (< 51% Sat) are shown in light brown cells; years with Poor WQIs (> 25) are in brown.</p>						

The most common cause of higher pH water is less available carbon dioxide caused by elevated rates of aerobic respiration (decomposition) that typically accompany warmer, still waters. Tracking the trend in pH can be a general indicator of the natural process of eutrophication occurring throughout many portions of the lower river. WY24 marks a slight rise in the overall running average pH above the 20-year norm during a year of above average streamflow and less eutrophication.

Running average **dissolved oxygen** (DO) values and monthly minima-maxima are presented in **Chart 4.4**. An overall, but somewhat irregular decline in average as well as min/max values from Oct. 2004 through 2015 is evident. LSDR max. monthly values from WY15 through WY21 increased to near 20-yr norms. The

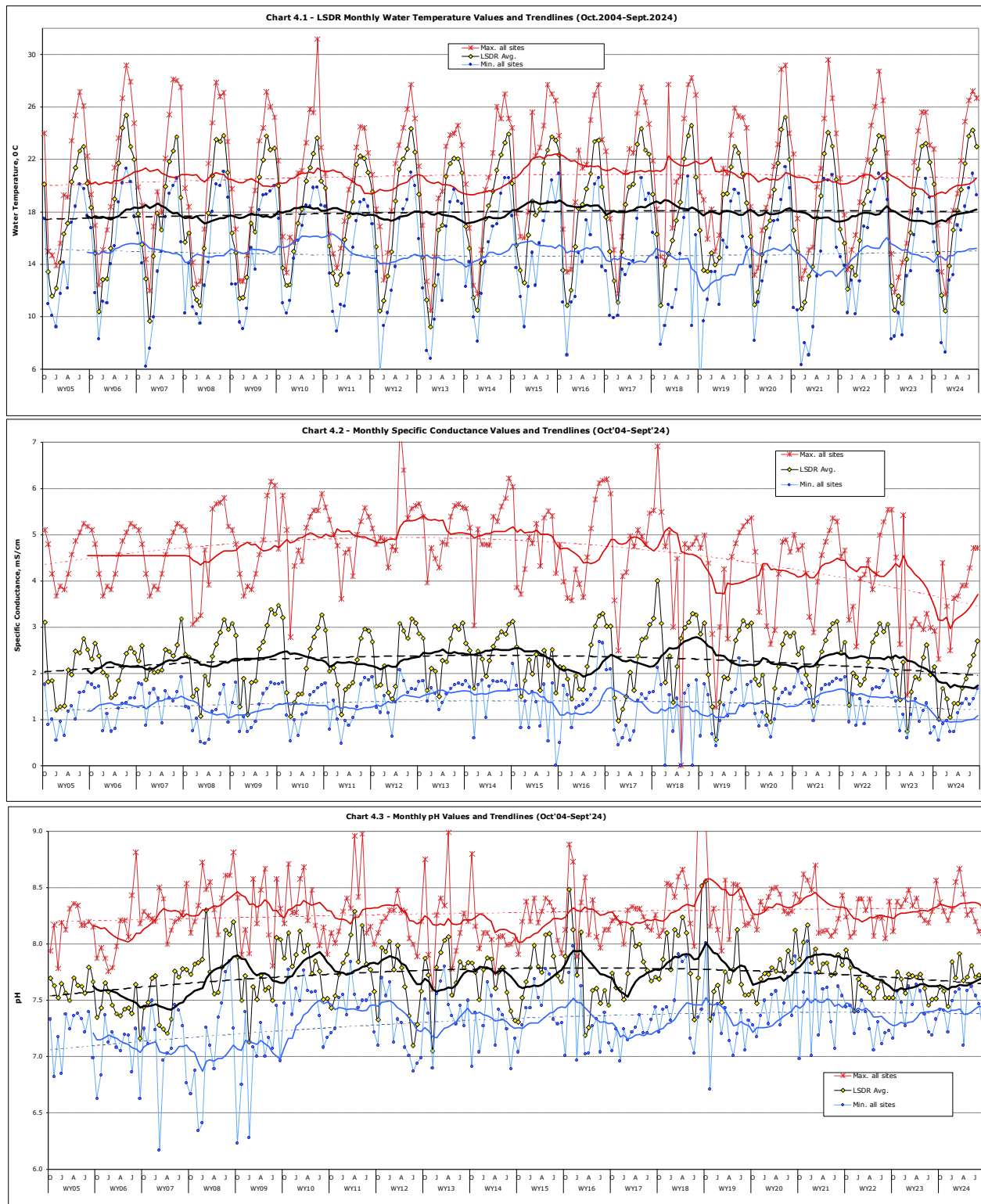
current running average DO value of 5.88 mg/L (Sept 2024) is 8.5% above the 20-yr norm of 5.42 mg/L. Low oxygen levels that have been monitored throughout various reaches and segments of the lower river result from low flow, especially during the dry-weather months, combined with elevated water temperatures and the subsequent rapid decomposition of oxygen demanding organic materials (biomass). With a lack of significant flushing action during recent relatively mild stormflow events from 2013 through 2019, a large amount of decomposing biomass accrued within slow moving portions of the lower river. Overall running average DO values typically increase subsequent to one or more major stormflow events resulting in significant channel flushing, displacement of organic-rich sediments and reduction of poorly-rooted and free-floating invasive aquatic plants*. The trend in overall LSDR DO values has, over the past 20 years, declined in excess of 1.5 mg/L from roughly 7.0 to 5.5 mg/L; representing an average annual decline in DO of 0.075 mg/L since RiverWatch monitoring was initiated. As can also be seen on Chart 4.4, the rate of decline in minimum values is considerably greater than the rate of decline in maxima (3.0% vs 0.5%/yr). Extended periods of low-flow minima at many sites have resulted in lower overall average DO levels. DO averages have over the past two years noticeably increased due to higher streamflows stemming from greater rainfall.

Variances and their trends for total monthly **rainfall** and running average **streamflow** for the Santee Basin (SB) and Mission Valley (MV) sections of the lower river system are expressed in **Chart 4.5**. The trend in average daily streamflow throughout the LSDR watershed fell by a full order of magnitude (from 58 cfs to 5 cfs) between WY05 to WY14, then rose to 45 cfs in WY17. Lowest running average annual streamflow of 7-8 cfs for Mission Valley and 3 cfs for the Santee Basin, occurred in WY14. Due to the distribution and magnitude of rainfall in both WY15 and WY16, running average streamflow rose to 15-20 cfs (Mission Valley) and 8-12 cfs (Santee Basin). Streamflow again fell sharply in WY18 as the watershed received near record low rainfall. With above normal rainfall in WY19 and WY20, streamflows climbed back to above 40-yr norms. Dry weather flows from June through Sept. of WY21 were some of the lowest recorded in the past 4-5 decades. As both WY23 and WY24 witnessed considerably greater total rainfall than in several previous years, streamflows were well above normal. The current running average annual flow of 35 cfs is twice the 40-yr LSDR norm. Significant variance in average annual streamflow, as well as maxima and minima values monitored within the lower river watershed can be expected to persist as rainfall and stormwater runoff remain driving factors.

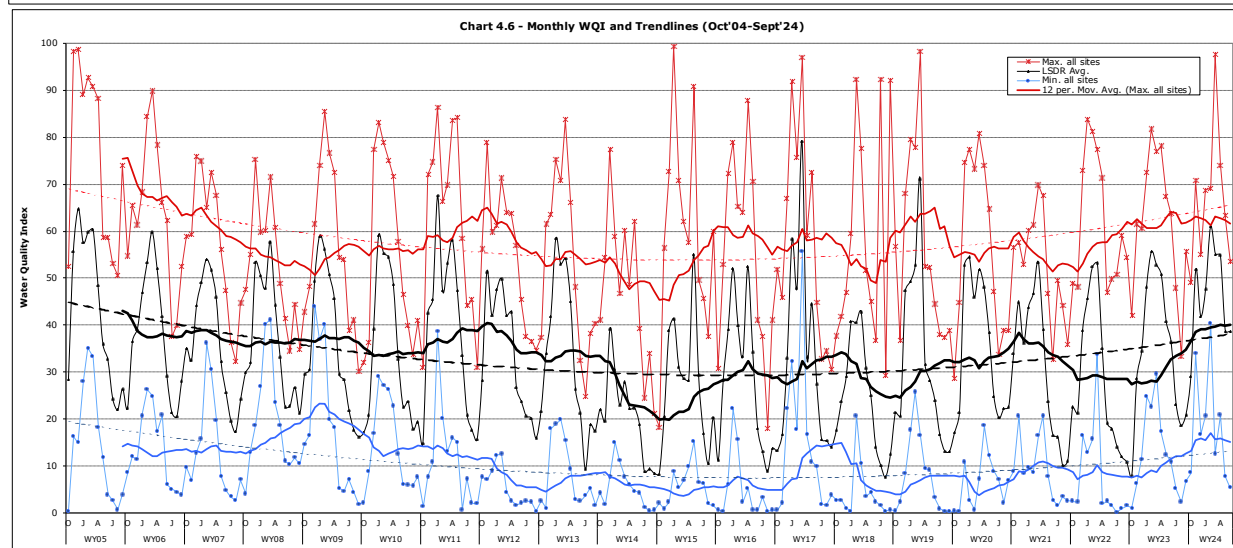
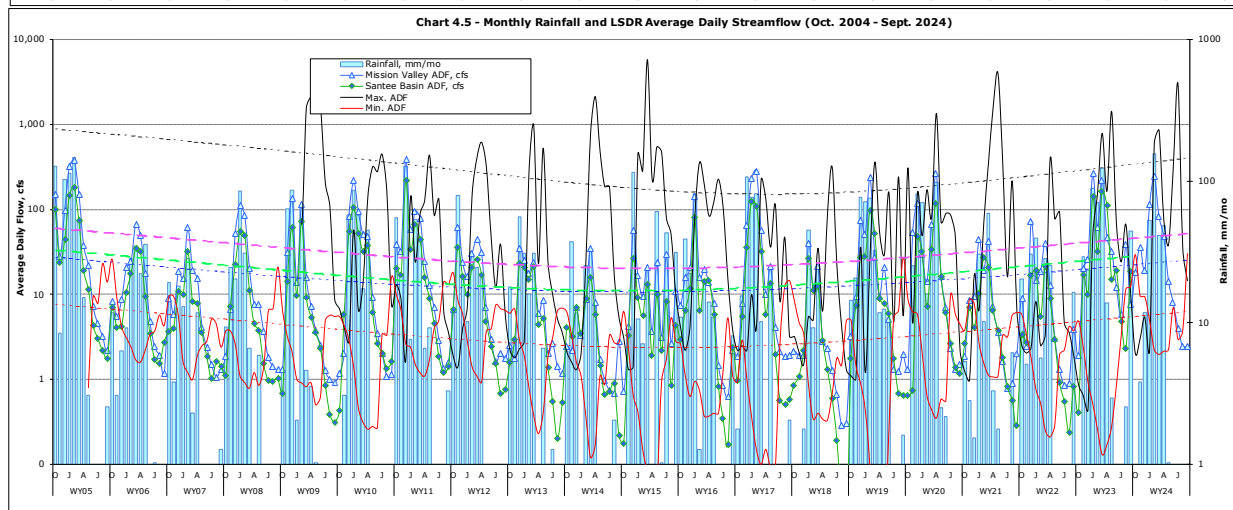
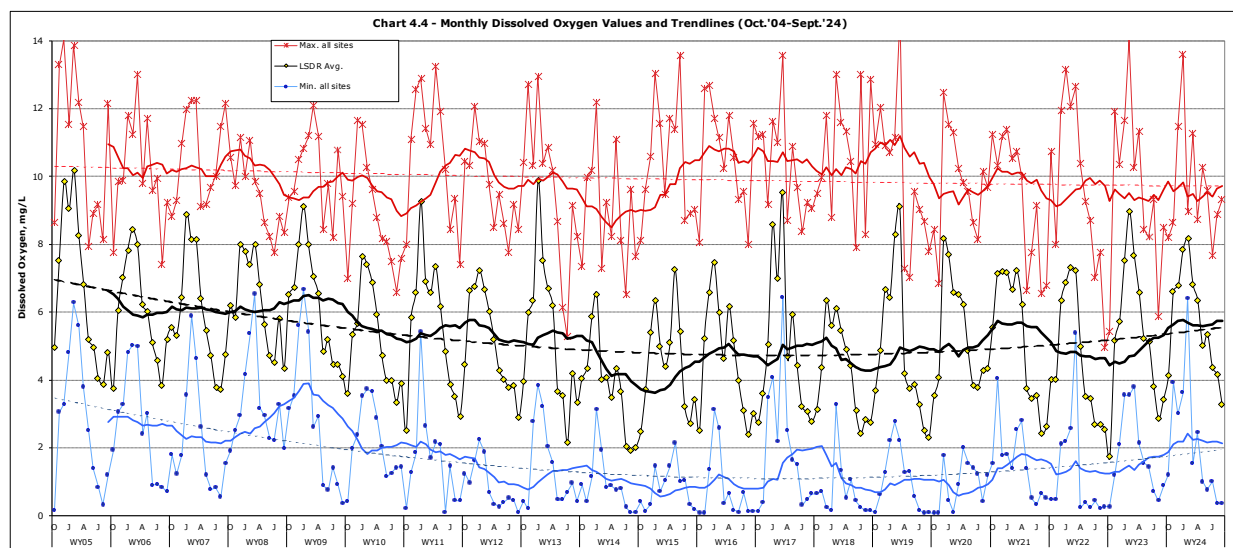
The overall **water quality index** (WQI) for LSDR as well as minimum and maximum running average values for all monitoring sites within the watershed are presented in the last two charts of this section. **Chart 4.6** expresses average, minimum and maximum WQI for the entire LSDR system based on distance (reach) averaging of index values calculated for each monitoring site. The greatest positive variance from norm (blue line) is associated with the Mission Gorge section (sites 8,9&10) whereas the greatest negative variance is found in the Upper Santee Basin (USB) reach. The overall LSDR reach-averaged running average variance from the norm are shown as black lines. The trendlines for each section and overall river system are shown as dashed lines in the same colors.

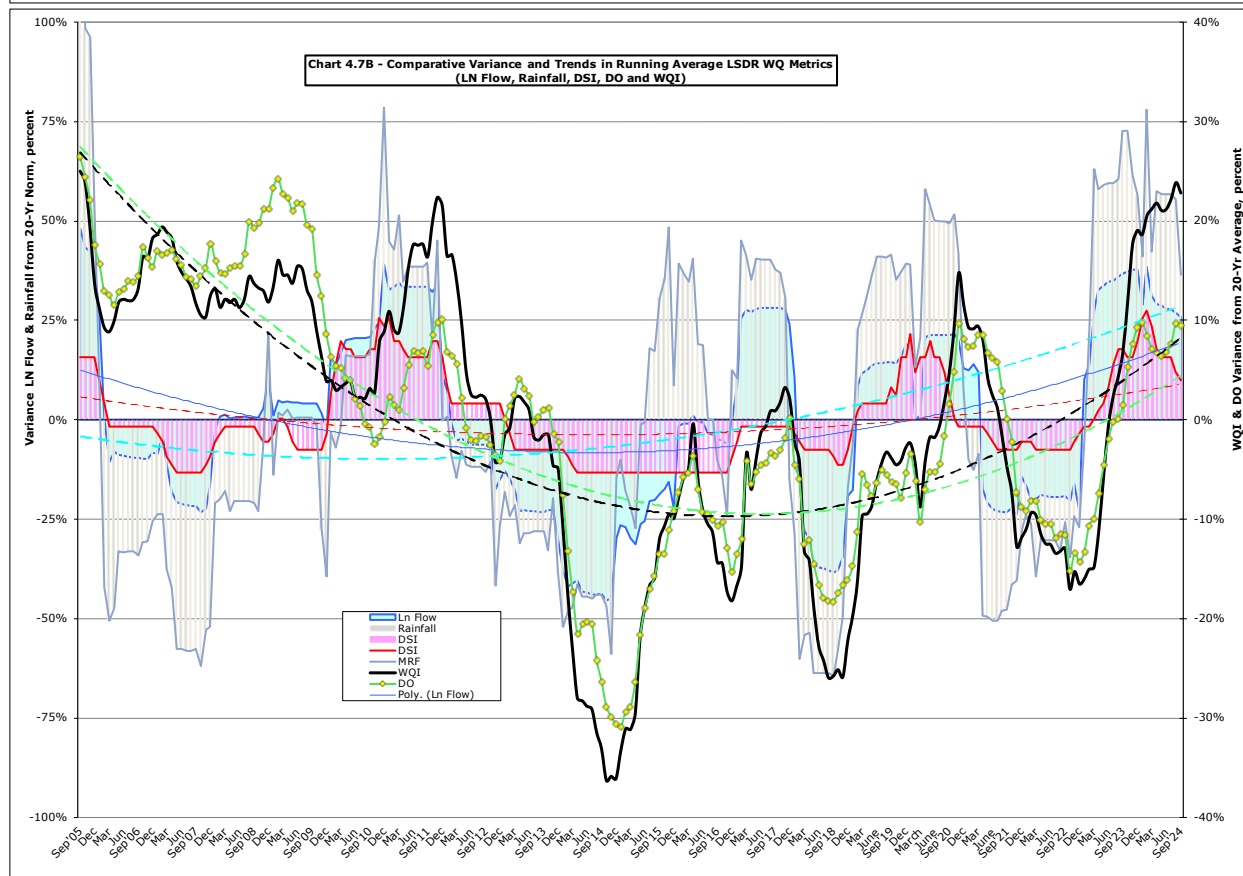
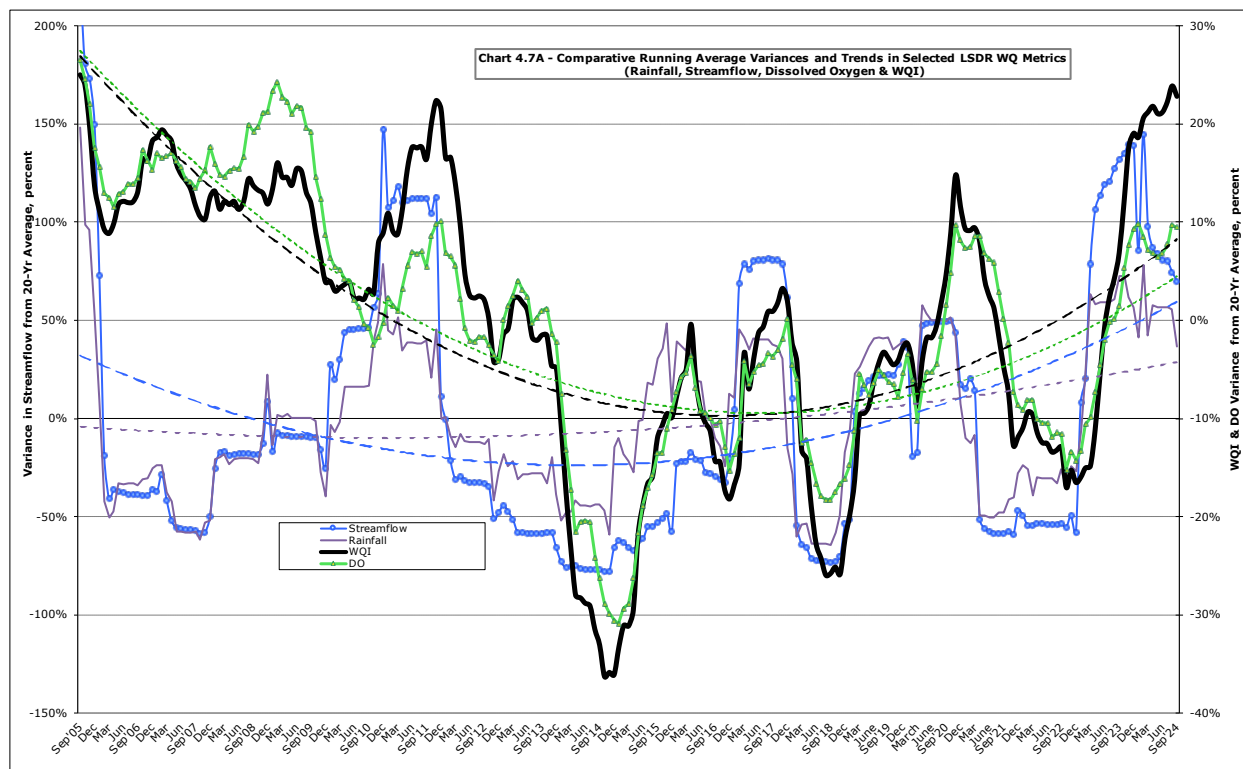
Charts 4.7A&B express four key water quality metrics (rainfall, streamflow, dissolved oxygen and the WQI) as 12-month running average values in percent variance from their respective 20-yr norms. All four metrics are displayed arithmetically on Chart 7A, whereas, rainfall and streamflow values are shown on (natural) log scale in Chart 7B while WQI, DSI, and DO variances remain arithmetic. The strong correlations between variances is evident. The trends in running averages over the past 20 years, shown as dashed lines, for each metric describe the high degree of correlation as well amplify the degree of decline over the initial decade followed by the sporadic partial return to values above norm in wet years. The negative impact from sequential years of well-below normal rainfall and runoff (streamflow) on water quality is clear. Running average variance in index values and trends by individual river reach and river section for all the metrics are examined in the following Section 5.

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Section 5 - WQ Index by Site, Reach and Section (WY05 through WY24)

Annual and seasonal LSDR WQI values are presented in **Table 5.1** by river reach, section, and overall (LSDR) for each water year (WY05-WY24) of monitoring. Values and grades above norms are listed in black; values below italicized norms (bottom row) are shown in red. The WY24 values, expressed in bold font, have increased from last year's results for all reaches and sections of the Lower River. Overall the LSDR average annual WQI rose five points from last year's value of 35 to seven points above the 20-year norm of 32.8. The overall annual WQI average that remained in the Marginal grade (D) for the past five water years reached the grade of Fair © in WY24. In addition to annual averages the seasonal range as represented by winter highs and summer lows are also presented by reach, section and overall. WY24 winter (D-M) WQIs are greater than last year's within all but one reach (USB) while this past summer's (J-S) index values are higher in all reaches as well as overall.

The running averages and variances in monthly index values, for each reach of the lower watershed are presented in the series of charts (5.1 through 5.6) on pages 19 and 21 of this section. Trends in values taken over the monitoring period are shown as dashed lines based on best-fit, using second-order polynomial equations. The range in trendlines between the highest (red) and lowest (blue) sites located within each reach are also expressed.

Table 5.1 - Average Annual and Seasonal WQI by Reach and Section (WY05-WY24)

	LMV Reach	MMV Reach	UMV Reach	West (MV) Section	MG Section	LSB Reach	USB Reach	East (SB) Section	LSDR Overall Avg.	
WY05	48	54	40	46	65	31	18	24	41	C (high)
WY06	39	47	30	37	54	34	21	28	37	D+
WY07	36	43	23	33	50	40	27	34	37	D+
WY08	38	39	28	35	46	39	33	36	37	D+
WY09	38	37	30	34	46	39	31	35	37	D+
WY10	36	36	31	34	48	37	17	27	34	D
WY11	39	39	39	39	56	44	15	29	38	C-
WY12	35	38	35	35	48	39	9	24	33	D
WY13	37	38	32	35	45	35	11	23	32	D
WY14	18	17	19	18	37	28	10	19	22	E (low)
WY15	24	22	23	23	46	43	10	27	29	D
WY16	35	30	22	29	40	37	8	23	28	D
WY17	34	34	33	33	41	40	19	29	33	D
WY18	26	28	21	24	33	29	11	20	24	E+
WY19	36	37	30	34	42	35	14	24	32	D
WY20	37	37	34	36	45	41	14	28	34	D
WY21	31	33	28	31	40	38	17	28	31	D
WY22	29	31	25	28	39	32	16	24	29	D
WY23	34	35	32	34	47	43	19	31	35	D
WY24	43	43	38	41	50	45	26	35	40	C
20yr Norm	(35)	(36)	(30)	(33)	(46)	(38)	(17)	(27)	(33)	(Marginal)
<u>Winter</u>	<u>LMV</u>	<u>MMV</u>	<u>UMV</u>	<u>MV</u>	<u>MG</u>	<u>LSB</u>	<u>USB</u>	<u>SB</u>	<u>LSDR Overall</u>	
WY05	63	72	61	64	87	44	33	39	58	B (high)
WY06	54	63	49	52	61	40	29	35	48	C+
WY07	49	54	41	46	63	56	40	48	50	B-
WY08	56	52	47	52	55	52	52	52	52	B-

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WY09	57	53	49	53	62	54	49	52	54	B
WY10	54	55	54	54	66	54	28	41	51	B-
WY11	57	55	57	56	67	54	27	40	52	B-
WY12	48	52	50	49	60	45	14	29	43	C
WY13	58	56	55	56	68	49	21	35	50	B-
WY14	26	25	26	26	55	39	15	27	31	D (low)
WY15	33	31	27	31	59	53	11	32	36	D+
WY16	44	42	38	41	57	52	14	33	41	C
WY17	53	55	60	55	64	61	35	48	54	B
WY18	38	40	37	38	58	41	16	29	38	C-
WY19	58	58	57	57	69	58	29	43	54	B
WY20	54	55	57	55	64	54	19	37	49	C+
WY21	47	48	44	47	58	51	20	35	44	C
WY22	47	50	48	47	62	46	32	39	47	C Fair
WY23	47	49	48	48	60	56	30	42	48	C Fair
WY24	50	53	55	52	59	53	38	45	51	B-
<i>20yr Norm</i>	<i>(50)</i>	<i>(51)</i>	<i>(48)</i>	<i>(49)</i>	<i>(63)</i>	<i>(51)</i>	<i>(27)</i>	<i>(39)</i>	<i>(48)</i>	<i>(C Fair)</i>
Summer	LMV	MMV	UMV	MV	MG	LSB	USB	SB	LSDR Overall	
WY05	31	36	18	28	46	21	5	13	25	D-
WY06	23	31	8	19	45	31	18	24	26	D-
WY07	23	31	7	19	35	24	13	19	22	E
WY08	23	28	16	22	33	25	17	21	24	E+
WY09	21	21	14	18	32	25	16	20	22	E
WY10	21	22	16	20	33	26	9	17	21	E
WY11	23	21	16	20	38	30	5	18	22	E
WY12	22	23	18	20	25	27	4	16	20	E
WY13	18	23	11	16	20	23	5	14	16	E
WY14	10	10	12	10	12	16	9	12	12	F+
WY15	15	12	14	14	35	37	9	23	21	E
WY16	18	14	7	13	17	20	5	12	13	E-
WY17	20	20	16	18	20	22	11	17	18	E
WY18	12	14	6	10	9	19	8	14	11	F (low)
WY19	23	19	10	18	23	22	3	13	16	E
WY20	25	24	17	22	30	29	10	20	22	E
WY21	14	16	10	13	14	18	10	14	14	E-
WY22	17	19	12	15	8	19	7	13	13	E-
WY23	27	24	15	22	39	37	10	23	25	D-
WY24	32	29	17	27	39	37	11	24	27	D (high)
<i>20yr Norm</i>	<i>(21)</i>	<i>(22)</i>	<i>(13)</i>	<i>(18)</i>	<i>(28)</i>	<i>(26)</i>	<i>(9)</i>	<i>(17)</i>	<i>(20)</i>	<i>(E Poor)</i>

Table 5.1 WQI Letter/Color Code: A (>75) Very Good (dark blue), B (50-74) Good (light blue), C (38-49) Fair (green), D (25-37) Marginal (yellow), E (13-24) Poor (brown), and F (0-12) Very Poor (pink). WQI values below 20-yr norms (bottom row in italics and parenthese) are in red for the same reach/section of the river; values at or above norms are in black. Overall LSDR WQI values are distance-weighted averages.

As shown in **Chart 5.1** on page 20, average annual WQI values associated with the **Lower Mission Valley Reach** (Sites 1-3) have varied from a high of 50 (B-Good) in WY05 to a low of 18 (E Poor) in WY14. The general trend in running average WQI for this lower-most reach, as well as the individual monitoring sites, declined from the mid 40's (C Fair) in WY05 to below 25 (E Poor) by WYs14-15. The running

average WQI (*black line*) recovered to the mid-30's during WYs16-17, declined to the mid 20's in WY18, rose back up in WY's19-20, to again fall below 30 in WY22. WY23 and WY24 signify two years of overall recovery. Site 3 (FVM) the *blue line* has since WY11 exhibited the lowest running average WQI, while Site 1 (Estuary at I5 *brown line*) has consistently witnessed the highest values for the Lower Mission Valley reach. The most significant decline in the WQI for the reach and at all three sites occurred in WY14. The running average index for this reach declined from the mid-40's to the present lower-30's (an approximate 10% decline) over the 20-year monitoring period.

As shown in **Chart 5.2**, the range in monthly WQI values for the **Mid-Mission Valley Reach** (Sites 4&5) are similar to those in Lower Mission Valley, although somewhat slightly more elevated. Site 4 (FSDRIP at Mission Center Rd, *blue line*) presents the highest WQI values of all seven Mission Valley sites. Site 5 (Ward Rd bridge, *red line*) is commonly five to eight points lower, although in recent years index differences are somewhat less (3-5). The patterns of improvement and decline in index values over time are very similar to the three Lower Mission Valley sites. Highest values (grade B Good) were in WYs05-06 while minimums (grade E Poor) occurred in WY14.

As shown in **Chart 5.3**, the range in monthly WQI values for the **Upper Mission Valley Reach** (Sites 6&7) of the river are similar to those in Lower and Mid-Mission Valley, although less variable. Site 6 (Kaiser Ponds outlet at Mission Valley Rd, *green line*) has continuously presented lowest running average WQI values since 2017, while Site 7 (Admiral Baker Field at Zion, *blue line*), situated just upstream of the ponds, has presented higher values on an extended basis since mid-2008. The highest average annual WQI reading of 65 (A Very Good) for the Upper Mission Valley reach occurred in WY05, whereas the lowest reading of 19 (E Poor) was in WY14.. The overall Upper Mission Valley trend since 2006 has been negative (in decline) as growth of invasive aquatic plants and increase in biomass has proliferated throughout much of this reach during extended periods of low flow. The rate of decline in running average index in this reach over 20 years is about two percent/yr, decreasing from 40 in WY05 to the present value of 32. Significant recovery in this reach is problematic without improved channel maintenance due to the extensive accrual of biomass, deep ponding and insufficient stormflow flushing.

Overall running average WQI for the **Mission Gorge Reach** (Sites 8-10) of the river, as shown in **Chart 5.4** on pg 22, has also declined, especially during WY12 through WY14. Highest annual WQI values of 63 (B Good) occurred in WY05, contrasted with a low of 33 (C Marginal) in WY18. In general running average WQI values for this reach are the highest of all five reaches with an average WQI of 46 (B Good). The trend in Mission Gorge WQI values (*black line*) are, however, comparable to those in the Mission Valley reaches. General decline in index values from WY06 through WY09, followed by a slight upturns in WY10 and WY11, and a more significant decline in subsequent water years to a low of 33 (D Marginal) in early WY15. WY17 witnessed an overall nine-point recovery in the running average WQI. The index for this reach fell during the second half of WY18 to a record low of 33. WY19 saw recovery to 42 and to 44 by the end of WY20 then back down to 39 by the end of WY22. The overall index has declined 26 points (from 65 down to 40) over 20 years in this section of the river. The running average index value has remained below the norm of 46 since WY13. Site 8 (Mission Trails Crossing) has shown the most steady positive trend in index value over the two decades of monitoring.

The **Lower Santee Basin Reach** (Sites 11, 15T, 12T and 13W) WQI values and running averages are shown on **Chart 5.5**. The range from winter month highs in the 50-70 range (B Good) to summer lows in the 10-15 range (E Poor) are fairly common. Water quality improved in this reach from WY06 through WY11, then declined in subsequent water years, reaching a running average low of 27 (D- low-Marginal) in 2015, before recovering to the mid-40s (C Fair) throughout WY16 and low 40's in WY17. The previous low was surpassed by one point in both August and September of WY18. WY19 witnessed partial recovery to the mid 30's reaching 41 in 2020, 42 in WY21 but falling to 37 this year.. Completion of the Forester Creek enhancement project (expressed by the *blue line*) extending from Prospect Ave. to Mission Gorge Rd. has

had a significant impact on overall river quality (*black line*) in the Lower Santee Basin portion of the river system. With above normal rainfall experienced in WY19 and WY20, the Lower Santee Basin running average index improved to values comparable to those experienced in WY07 through WY11. The overall change in the index between WY05 and WY24 is roughly one percent per annum. This reach of the river has shown the least amount of change in index values over time.

Chart 5.6 presents monthly and running average WQI values for the **Upper Santee Basin Reach** (Sites 13E & 14) of the river. This reach presents the poorest water quality values of all sections of the lower river system. Monthly values have seldom exceeded 20 (E Poor) since the summer of 2011 and are often less than 12 (F+ Very Poor) throughout all but the wet-weather, winter months. The running average WQI for this reach has declined from highs above 30 (D Marginal) in WY09 to continuously between 10 and 12 (F Very Poor) during the five year period (WY12-WY16). WY17 saw a noticeable increase (ten points) in the running average index from early in the year reaching 18 (E-Poor) in September, however WY18 witnessed a reversal with a steady decline toward previous lows. WY19 witnessed partial recovery to prior highs, especially at site 14. The greatest variability has been associated with site 13, Mast Park East (*green line*). The reach index has fallen 88% (from 32 in WY to 17) over the last 12 years presenting the greatest decline in running average values of all reaches. Advanced eutrophication within multiple ponds and backwaters within and upstream of Mast Park has lead to high levels of oxygen depletion recorded throughout the year. Hypoxic conditions ($DO < 2.5$ mg/L) are common at Site 13E (Walmart Ponds) in all but high runoff months of the year.

The monthly and running average variation in WQI values for the three main sections of the lower river (i.e., Santee Basin, Mission Gorge and Mission Valley) and the overall **Lower San Diego River** system (distance-weighted average of all monitoring sites) are presented in **Chart 5.7**. WQI running average values recovered from WY14 lows in all three sections of the lower river system during WY15 through WY17. Values noticeably declined in WY18 then rebounded (to WYs13/16 levels) in WYs19/20. WYs21/22 again experienced declines in all three sections of the lower river followed by recovery in WYs23/24. The Mission Gorge section changed least, while the upstream section (Santee Basin) the most. The current LSDR running average WQI of 40 (C Fair) is 21 percent above the 20-yr norm of 33. WQI values typically increase when streamflows exceed annual averages and aquatic growth abatement measures are effectively implemented (or possibly occur through natural flushing) for specific reaches of the river. Higher minimum index values during the dry summer months often result in positive gradients for 12-mo. running averages within a single water year, especially the case in the Mission Gorge section. Without human intervention, however, overall negative trends in WQI values can be expected to reoccur for many portions of the lower river due to natural processes of organics deposition and eutrofication.

Low DO levels are primarily the result of extensive and persistent eutrophication from buildup of organic-rich detritus combined with restricted water movement within various portions of the lower river, especially in deeper pools and slack water. Until the spread of creeping water primrose (*Ludwigia hextapetala*, *et.al.*)^a and several other invasive aquatics are effectively managed and the affects of eutrophication controlled, water quality of the lower river system can be expected to remain significantly below that monitored and experienced in those portions where improved circulation, mixing and re-oxygenation occurs naturally.

High specific conductance levels are primarily the result of extended below average dry weather streamflow intensified during drought conditions. Low streamflow also effects river water temperatures; where, in general, less flow results in higher temp values under equivalent ambient air temperature and sunlight levels. The variance in pH shows a definite cyclic pattern with little discernable decadal trends, irrespective of individual site, reach or section of the river. Both surface and ground waters of the lower river system act as a natural buffer to fluctuations in pH at individual sites.

Chart 5.1 - Lower Mission Valley Reach (Sites 1-3) Monthly & Running Average WQI

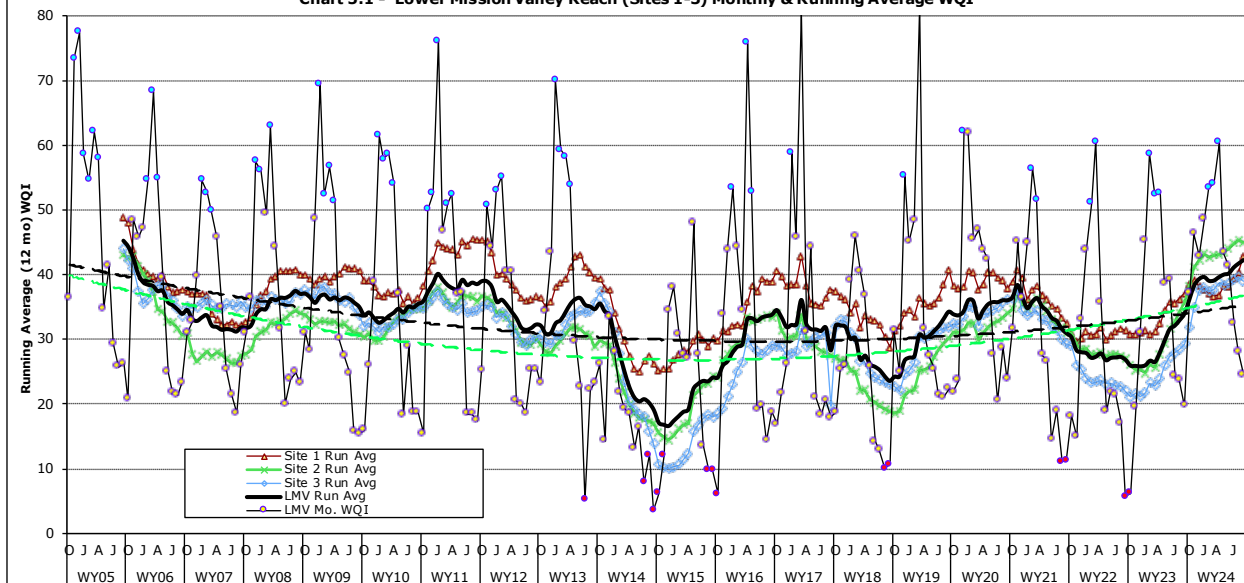


Chart 5.2 - Mid-Mission Valley Reach (Sites 4&5) Monthly and Running Average WQI

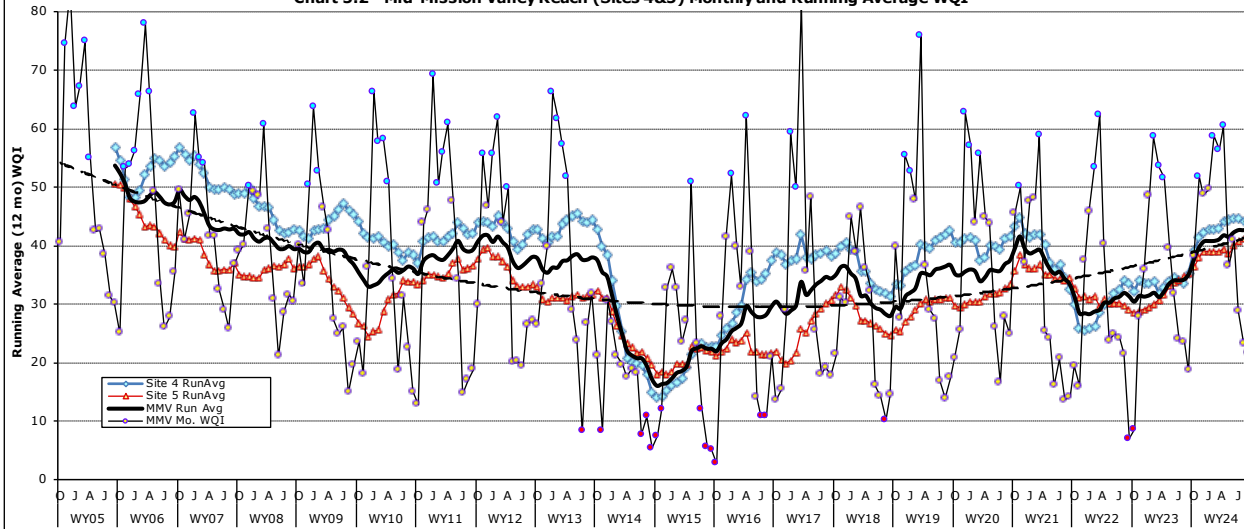
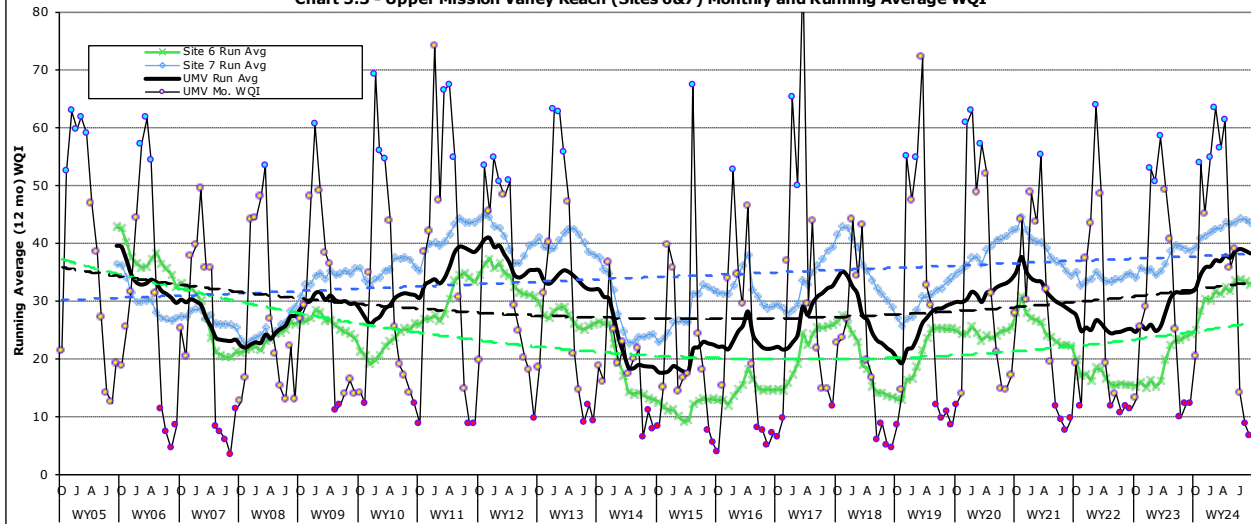
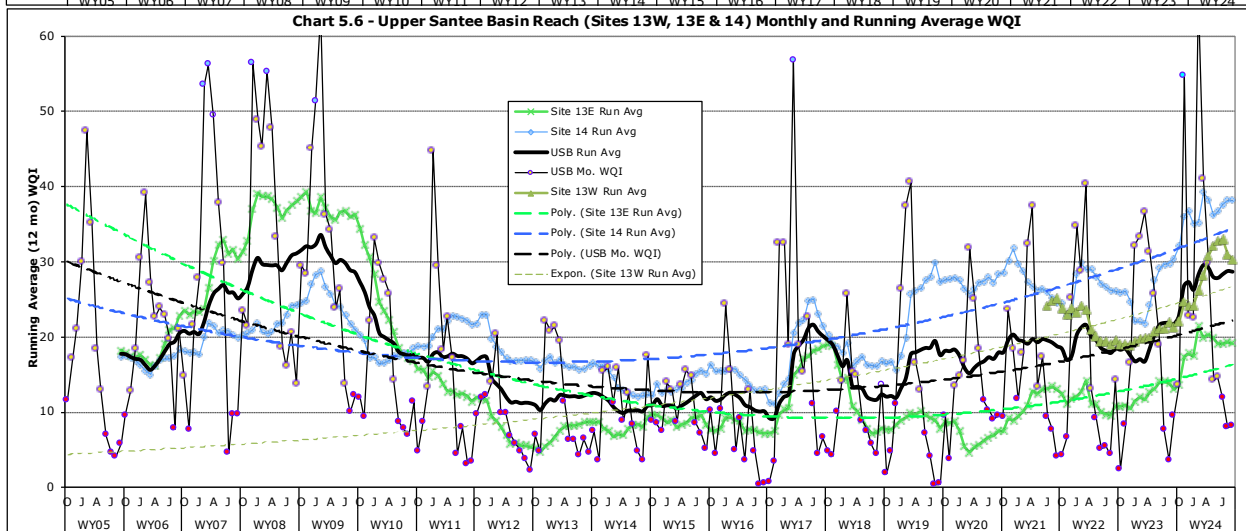
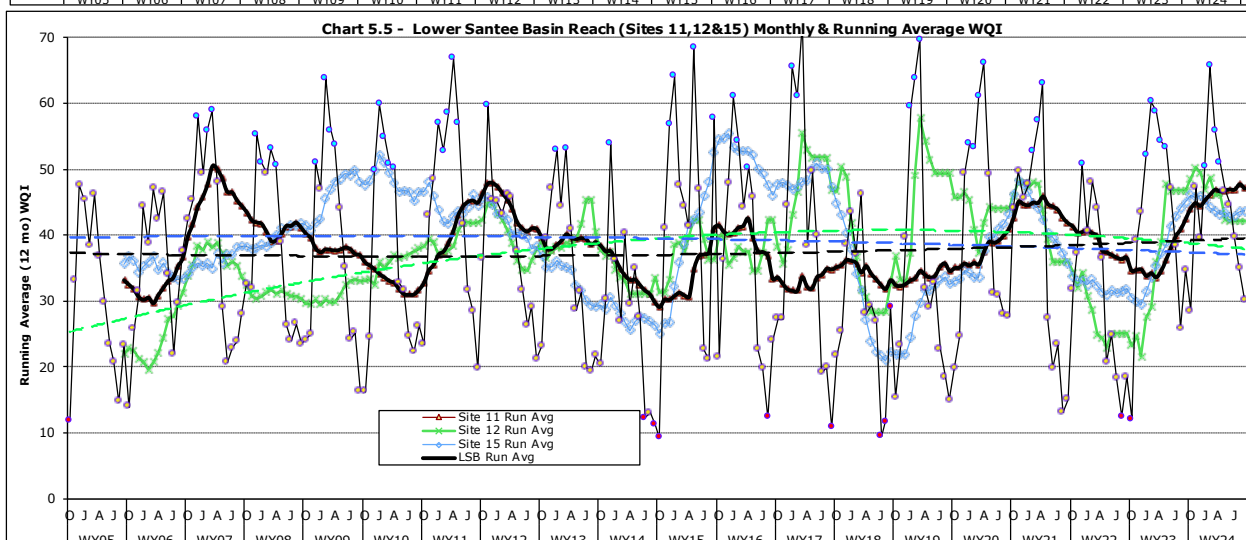
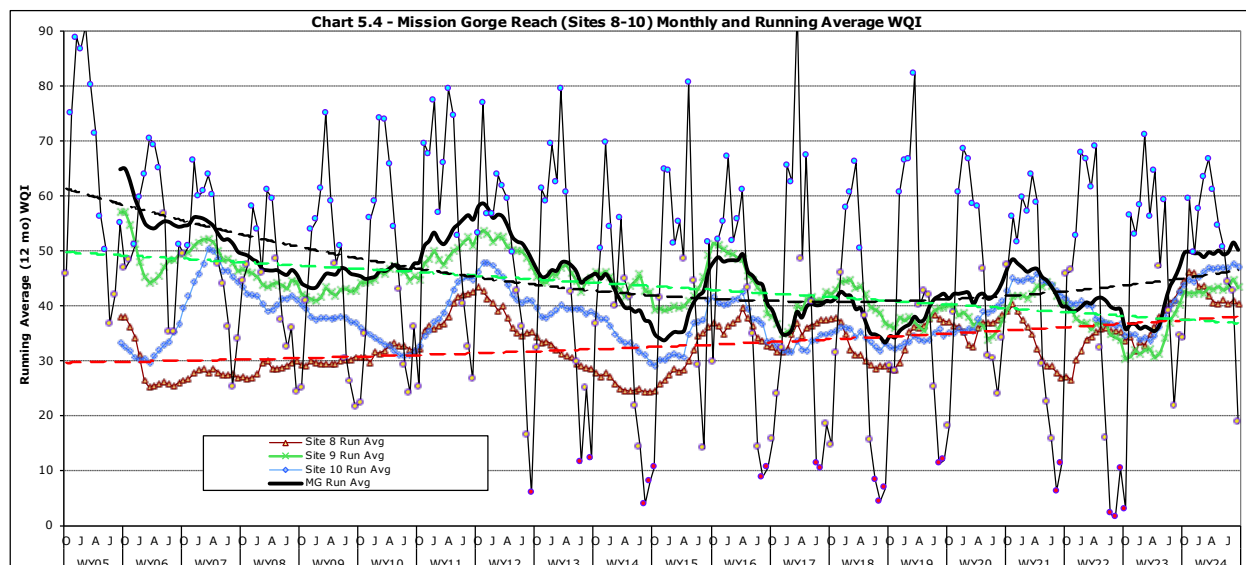
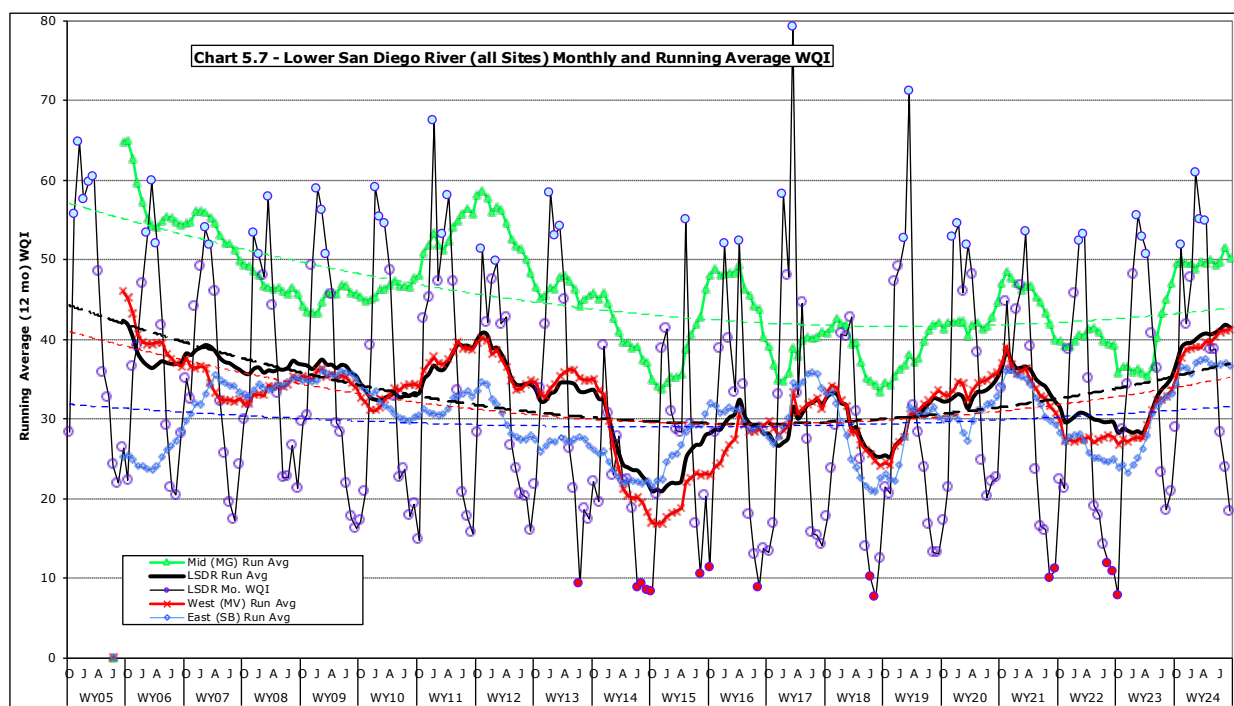


Chart 5.3 - Upper Mission Valley Reach (Sites 6&7) Monthly and Running Average WQI





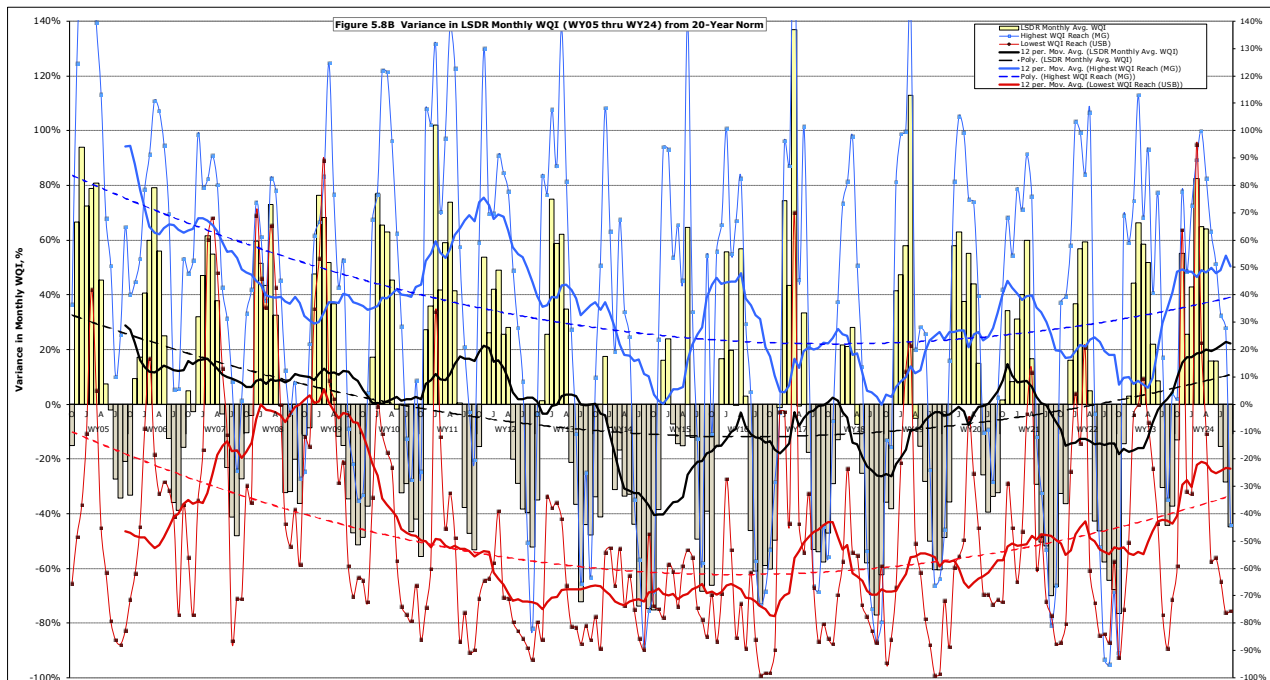
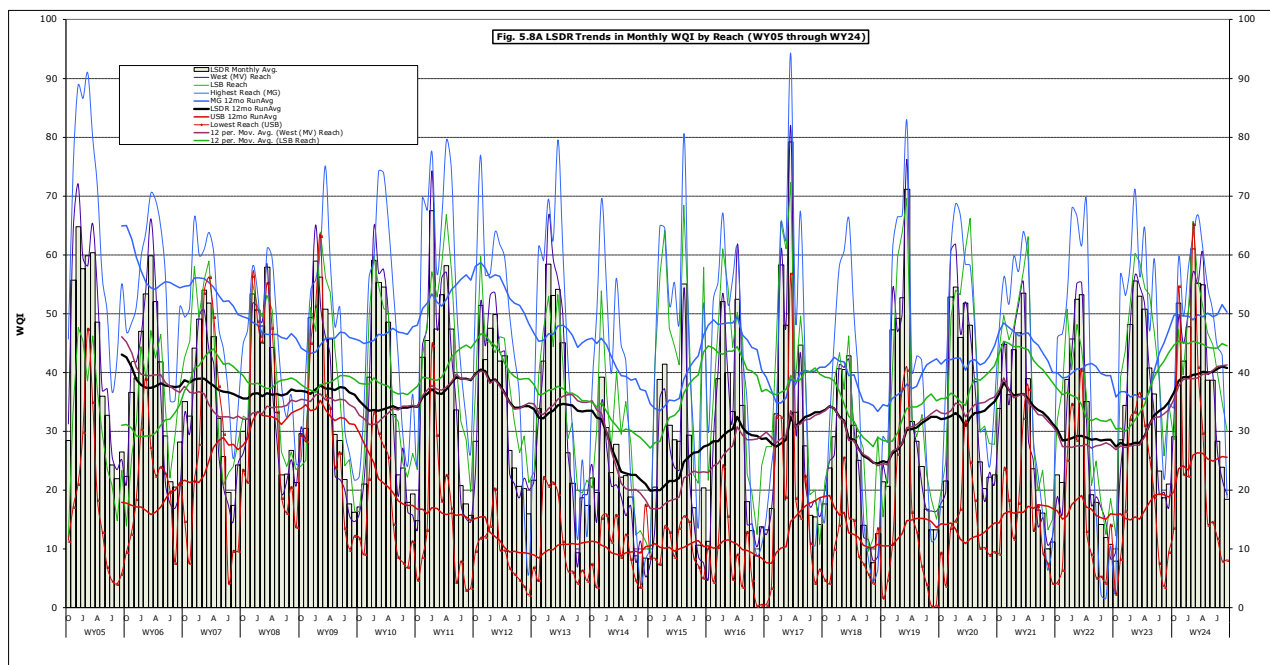


Variances from norm as shown in the chart above are an accurate indicator of the relative change in overall (LSDR) phys-chemical water quality considered over the entire 20-yr period of monitoring. Highest LSDR index values and associated greatest positive variance from norms occurred in the initial year of monitoring (WY05), followed by unsteady, fluctuating declines in index values over the next decade extending through 2014. Since 2015 there has been a similarly unsteady, fluctuating increase in running average index values extending through WY24. The Mission Gorge (green) section of the river has consistently shown highest index values, while the Santee Basin (blue) section is, in most years, the lowest. WY25 water quality conditions will continue to be highly dependent on total rainfall and resultant streamflows. Another above average year of precipitation will likely result in a higher running average index values whereas a dry year will very likely result in measurable declines in LSDR water quality.

Charts 5.8A and 5.8B presented on the following page summarize the differences in running average WQI values over the past two decades by individual reach and overall (in A) as well as the range from minimum to maximum expressed as variance from the overall 20-year LSDR norm (in B). The primary driver of annual changes in water quality within the watershed, as expressed in Chapter 4 (refer to Charts 4.7A&B) is rainfall and resultant runoff to the lower river (streamflow).

Footnote (a) from page 20.

Ludwigia peploides, *L. grandiflora*, *L. hexapetala* are members of a highly productive emergent aquatic perennial native to the Americas and likely Australia (USDA-ARS, 1997). It was introduced in France in 1830 and rapidly became one of the most damaging invasive plants there. It is a perennial herb (a dicot) termed marsh purslane; a member of family ORAGRACEAE. from California Invasive Plant Council (CALIPC) website. More recently it was introduced to areas beyond its native range in the U.S. where it is often considered a noxious weed (INVADERS, 2009; Peconic Estuary Program, 2009). {continued on next page}



a) *L. grandiflora*, et. al. are adaptable and tolerate a wide variety of habitats where they can transform ecosystems both physically and chemically. It sometimes grows in nearly impenetrable mats; can displace native flora and interfere with flood control and drainage systems, clog waterways and adversely impact both navigation and recreation. The plant also has ‘allelopathic’ properties that can lead to dissolved oxygen crashes, the accumulation of sulphide and phosphate, ‘dystrophic crises’ and ‘intoxicated’ ecosystems (Dandelot et al., 2005). Its common name is “floating water primrose”; it produces a distinctive small yellow or white flower during its bloom cycle (May-Nov.). *Ludwigia*, the green plant extending across Walmart Pond (site 13E) shown on this report’s cover photo, is now pervasive throughout most of the lower reaches of the river.

(AWQRpt.page JCK 10/01/24)