

# Watershed-Wide Instream Flow Criteria for the Santa Ana River

California Department of Fish and Wildlife  
Instream Flow Program  
Watershed Criteria Report No. 2026-02



California Department of Fish and Wildlife  
Water Branch  
Instream Flow Program  
Watershed Criteria Report No. 2026-02

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# Introduction

This *Watershed-Wide Instream Flow Criteria* report (Watershed Criteria Report) provides instream flow criteria for the Santa Ana River watershed, based on the best available scientific information, existing and new datasets, and analyses. Its intended audience includes agencies, water managers, non-governmental organizations, and the public.

The Santa Ana River was identified in the “California Salmon Strategy for a Hotter, Drier Future: Restoring Aquatic Ecosystems in the Age of Climate Change” as a priority stream for which the California Department of Fish and Wildlife (Department) must complete an instream flow analysis (Office of Governor Newsom 2024). This directive is consistent with the identification of the Santa Ana River as a watercourse for which minimum flow levels need to be established in order to ensure continued viability of stream-related fish and wildlife resources, in accordance with Public Resources Code section 10001.

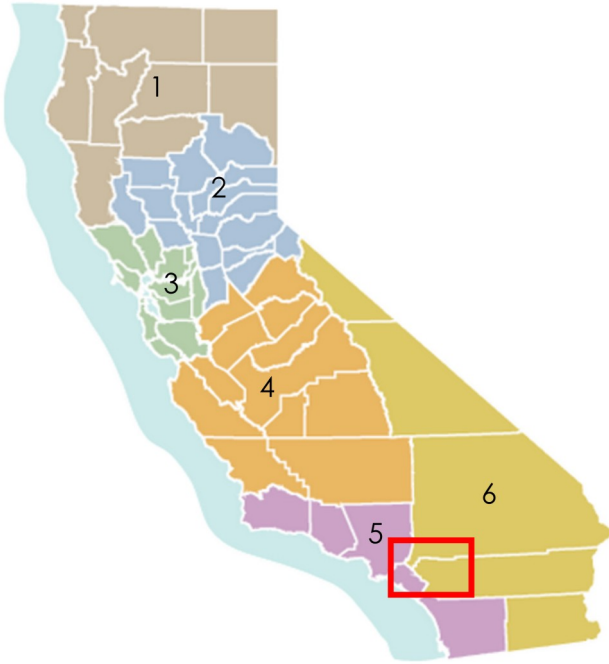
This report presents stream assessments for 30 reaches. An overview of the analyses used to create instream flow regime criteria contained in this document, as well as examples of potential criteria applications, are found in the Department's *Overview of Watershed-Wide Instream Flow Criteria Report Methodology (Overview)* document (CDFW 2024). Reviewing and understanding the information contained in the Overview document is essential to understanding flow criteria contained in this report. Complete background files for this report are maintained in the Department's Headquarters office. This document and the Overview may be found on the Watershed-Wide Instream Flow Criteria webpage (CDFW 2026).

The Department provides this document as a tool for consideration in water management planning. It presents an analytical approach that can be implemented, if appropriate, under the specific circumstances of a watershed, stream, or informational need. This report and the Overview, in and of themselves, should not be considered to provide binding guidelines.



**Santa Ana River**  
SANTA ANA RIVER WATERSHED

# Santa Ana River Watershed



- Located in the Department's Regions 5 and 6
- Spans San Bernardino, Riverside, Orange, and Los Angeles counties
- 2,650-square-mile (mi<sup>2</sup>) drainage area
- Supports Rainbow Trout, Arroyo Chub, Santa Ana Sucker, and Speckled Dace

Figure 1. Map of the Department's Regions.



**Santa Ana River**  
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This report presents streamflow analyses for 30 stream reaches within the Santa Ana River watershed (Figure 2-Figure 5). Instream flow criteria have been developed for nine priority reaches. The common identifiers (COMIDs) that correspond to the numbered reaches are listed in Appendix A.

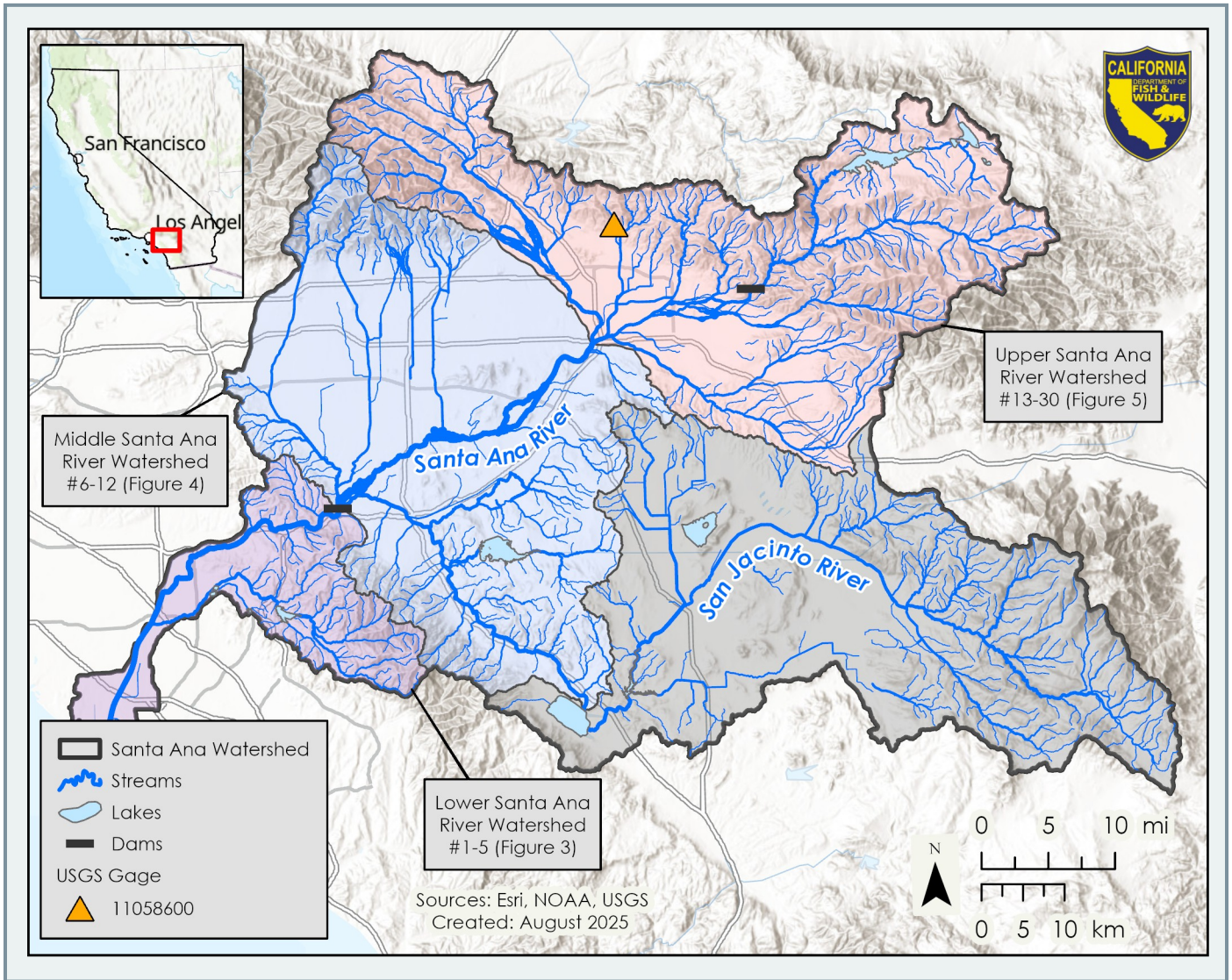


Figure 2. Santa Ana River watershed map. The orange triangle is United States Geological Survey (USGS) gage 11058600.

The following maps display the Santa Ana River subwatersheds (Figure 3-Figure 5). The black numbers indicate reaches that were analyzed in this report. Both tributary and mainstem reaches were included.

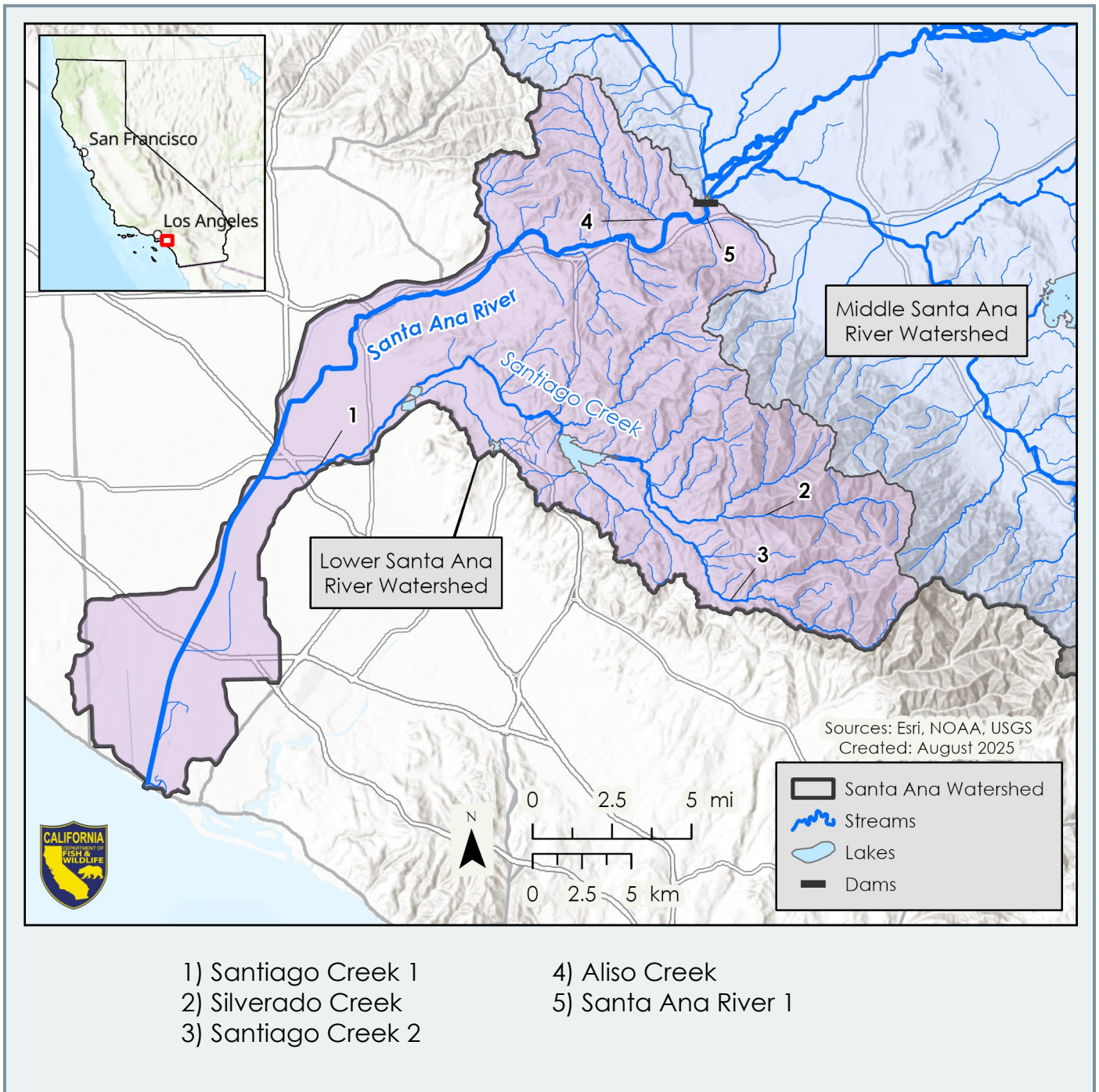


Figure 3. Lower Santa Ana River subwatershed map.

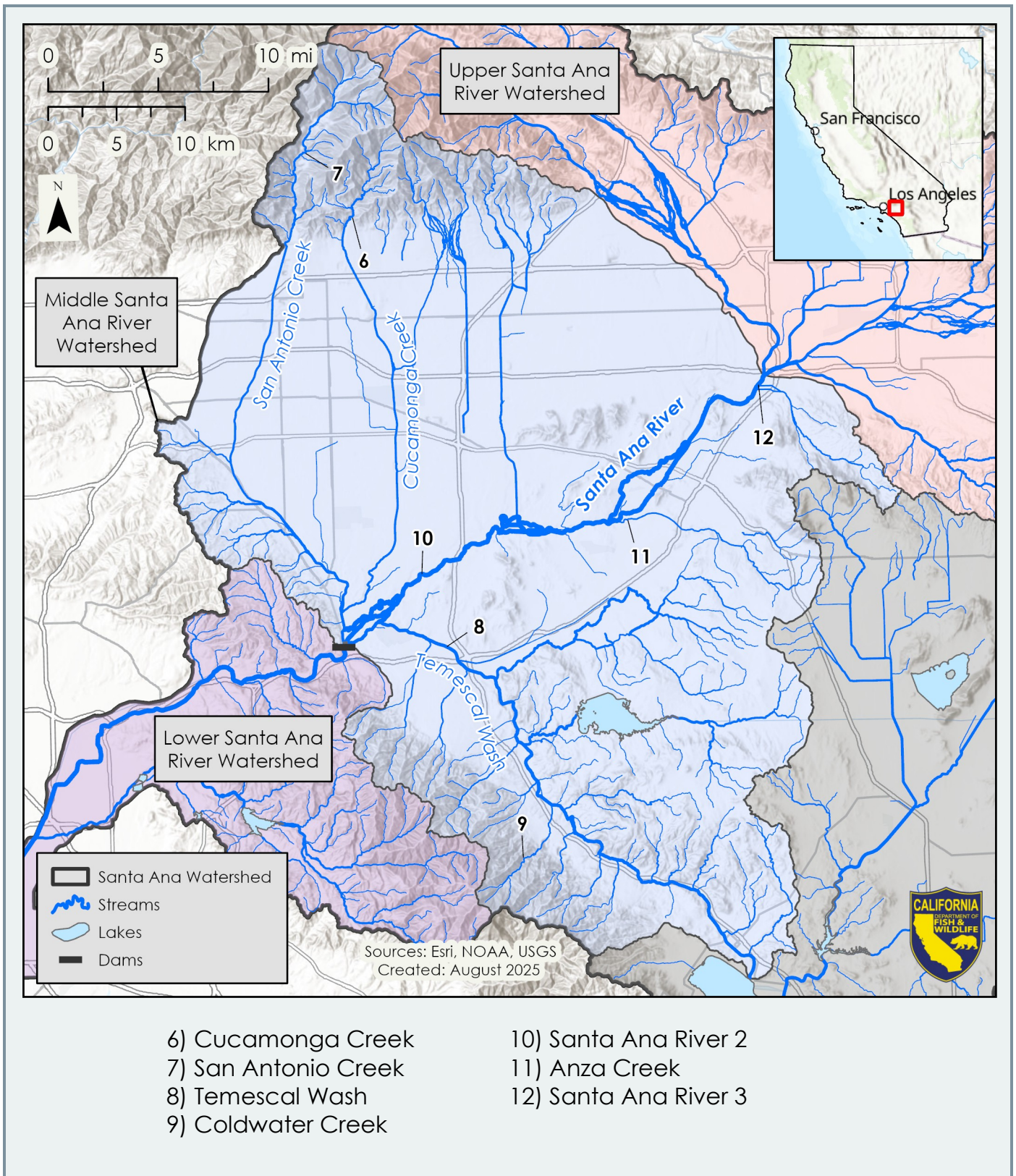


Figure 4. Middle Santa Ana River subwatershed map.

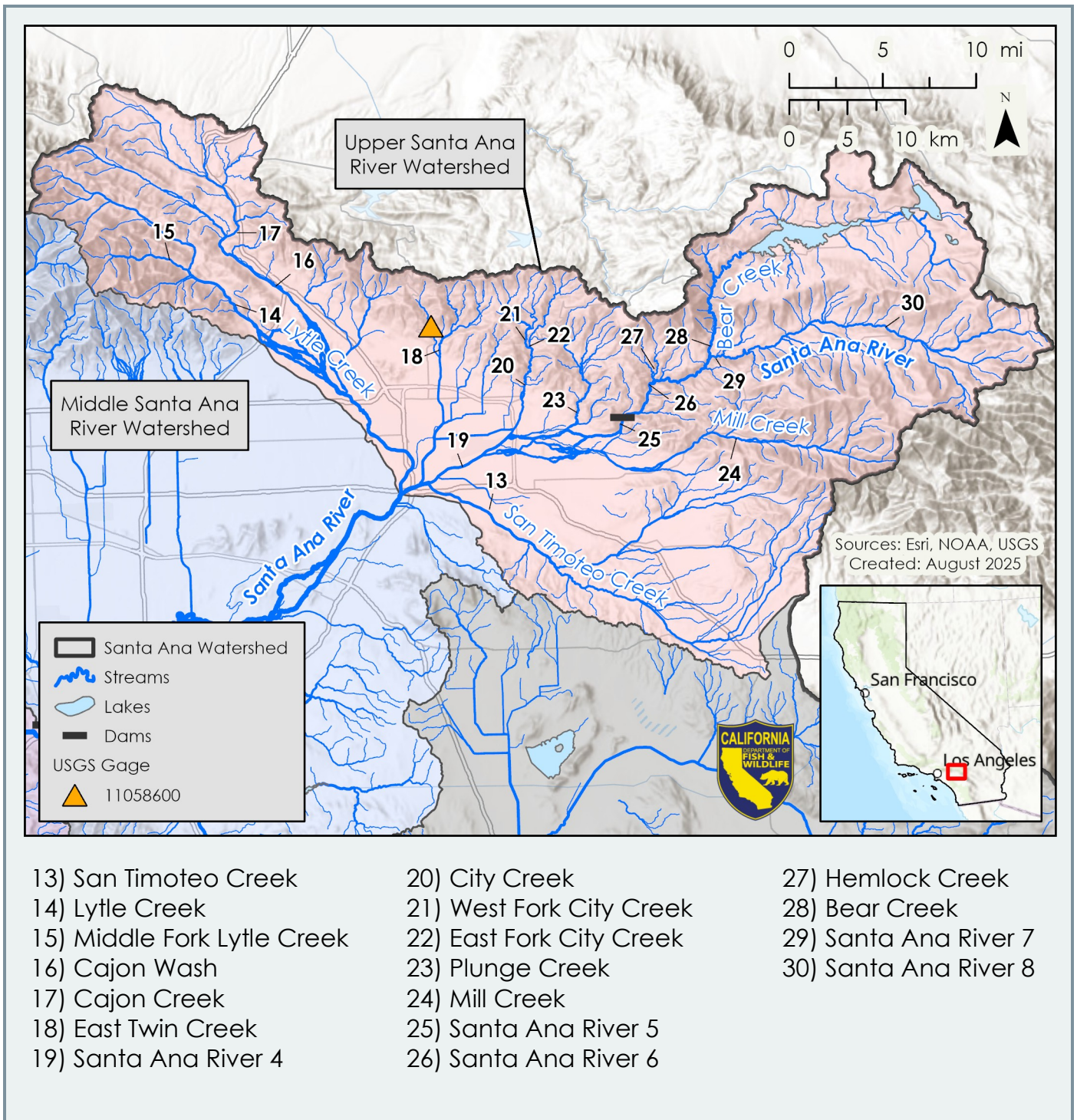


Figure 5. Upper Santa Ana River subwatershed map. The orange triangle is United States Geological Survey (USGS) gage 11058600.

This watershed criteria report includes five distinct analyses (Figure 6). For more details on each analysis see the Overview, which can be found through the Watershed-Wide Instream Flow Criteria webpage (CDFW 2026).

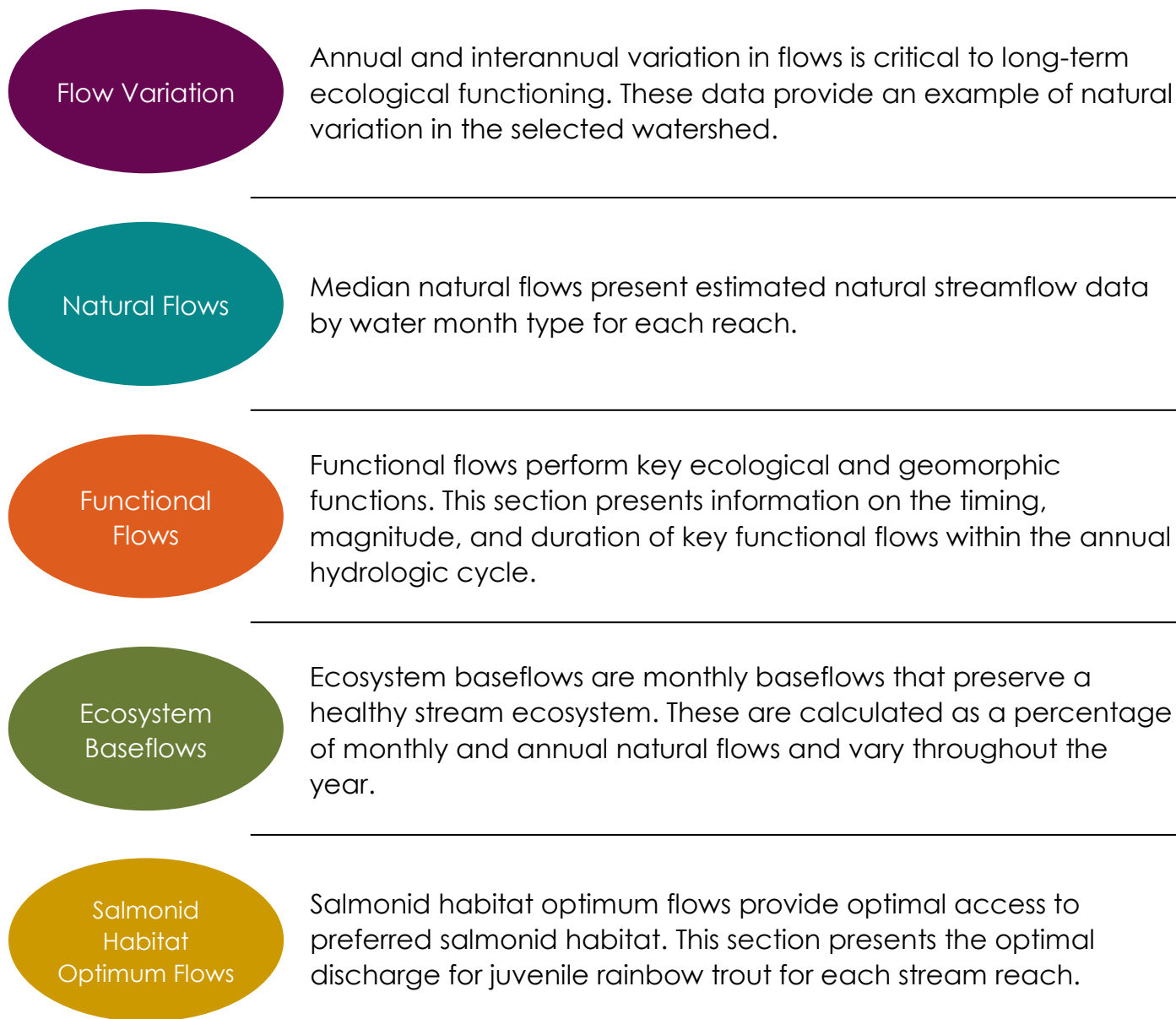


Figure 6. Watershed criteria analyses key.

# Flow Variation

Flows in the Santa Ana River watershed are variable throughout the year and from year to year. The USGS gage in Waterman Canyon used to visualize flow variation in the upper watershed was selected because it is relatively unimpaired and is representative of hydrologic patterns in the Santa Ana River watershed (Figure 7). The mainstem reaches of the Santa Ana River are highly altered and heavily influenced by water infrastructure projects, therefore mainstem analyses were omitted. It is important to note that the entire Santa Ana River watershed has experienced decades of anthropogenic impacts, including land use changes, water diversions, and water infrastructure which have resulted in changes in hydrologic patterns (USGS, 1977).

The wet and dry seasons in the Santa Ana River watershed are predicted to become more extreme and variable as climate change impacts intensify. Additionally, drought risk may increase as atmospheric conditions favorable to drought occur more frequently and snow pack declines. These shifts, combined with decreasing water supply and increasing demand for surface water and groundwater, may result in higher stress to ecosystems and reduced water availability (Hall et al., 2018). Understanding natural variability and projected future changes to flow patterns can help water users and managers create a flow regime and plan for changes in water availability.

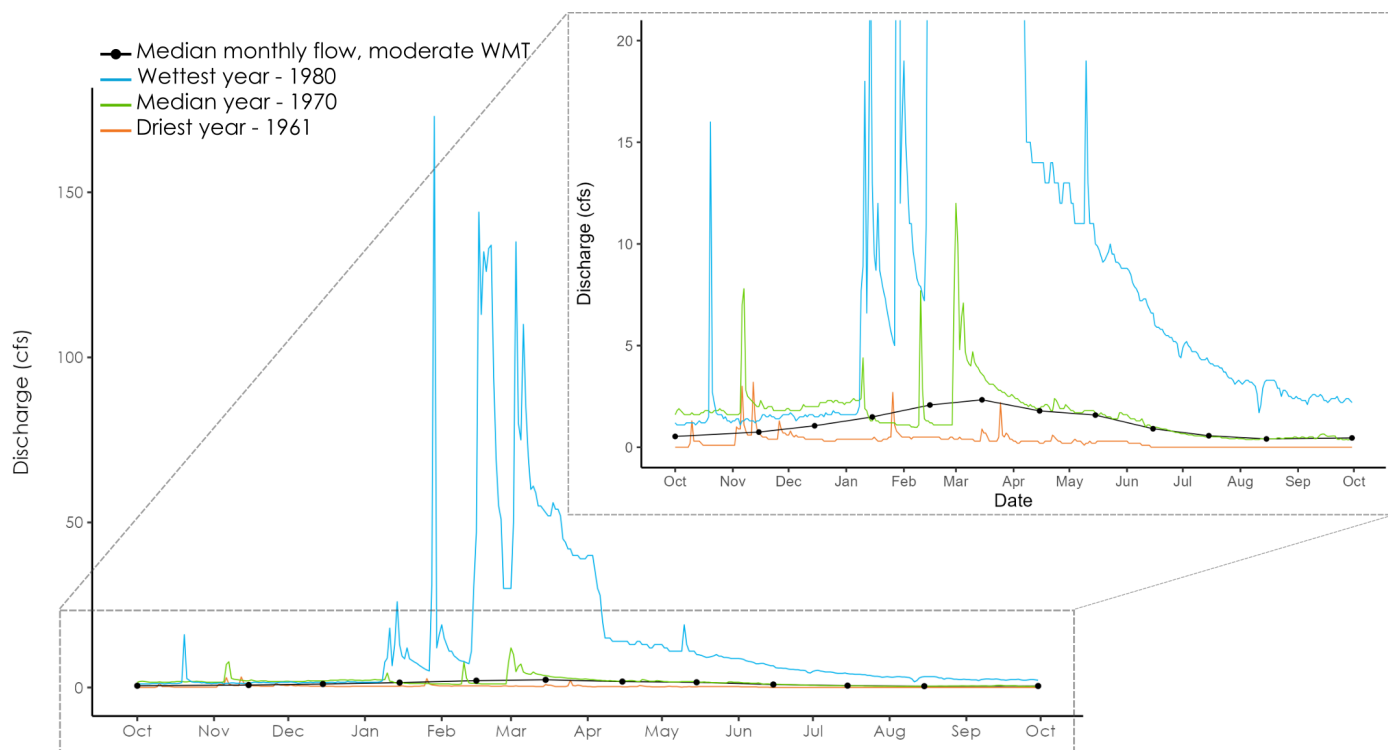


Figure 7. Variation in the Waterman Canyon Creek hydrograph. Mean daily Waterman Creek flows at the USGS gage 11058600, located in the upper Santa Ana River watershed, in the driest, median, and wettest water years on record between water years 1913 and 2024 (USGS 2025). Median monthly flow for a moderate water month type is also included.

# Natural Flows

Natural flows are the stream flows (in cfs) that would be expected with no human influence (data from Zimmerman et al. 2023). This section presents median monthly natural flows for wet, moderate, and dry water month types for each Santa Ana River tributary and mainstem reach analyzed in this report (Table 1). The numbers next to each stream name correspond to the numbers found on the Santa Ana River subwatershed maps (Figure 3-Figure 5).

Table 1. Median natural flows (cfs) by water month type (month type).

## 1) Santiago Creek 1 92.8 mi<sup>2</sup>

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	16	32	56	23	8	3	1	1	<1	<1	1	3
Moderate	2	4	5	3	1	1	<1	<1	<1	<1	<1	1
Dry	1	2	1	1	<1	<1	<1	<1	<1	<1	<1	<1

## 2) Silverado Creek 10.3 mi<sup>2</sup>

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	2	7	9	6	2	2	1	1	1	1	1	1
Moderate	<1	1	2	2	1	1	<1	<1	<1	<1	1	<1
Dry	<1	<1	1	1	1	<1	<1	<1	<1	<1	<1	<1

## 3) Santiago Creek 2 12.7 mi<sup>2</sup>

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	4	10	12	8	3	2	1	1	1	1	<1	1
Moderate	1	2	2	2	1	1	<1	<1	<1	<1	<1	<1
Dry	<1	1	1	1	<1	<1	<1	<1	<1	<1	<1	<1

## 4) Aliso Creek 10.8 mi<sup>2</sup>

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	2	4	7	2	1	<1	<1	<1	<1	<1	<1	<1
Moderate	<1	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Dry	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1

## 5) Santa Ana River 1 2255.7 mi<sup>2</sup>

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	469	764	1,391	1,116	580	323	125	69	52	62	71	191
Moderate	162	235	253	202	174	69	28	24	26	24	26	109
Dry	92	108	112	96	101	47	20	22	23	20	10	64

## 6) Cucamonga Creek 10.3 mi<sup>2</sup>

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	18	28	38	30	18	11	8	6	5	4	5	8
Moderate	6	9	11	8	6	4	3	3	2	2	3	4
Dry	3	4	3	3	3	2	1	1	1	2	2	2

Table 1. Median natural flows (continued).

**7) San Antonio Creek** 17.4 mi<sup>2</sup>

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	48	80	82	78	73	42	24	19	15	12	11	21
Moderate	12	26	25	25	21	13	11	8	7	8	7	8
Dry	6	10	9	9	8	7	6	6	5	6	6	6

**8) Temescal Wash** 975.5 mi<sup>2</sup>

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	95	186	387	291	168	54	16	6	7	12	12	23
Moderate	20	35	44	39	39	14	9	4	3	6	6	10
Dry	9	14	22	28	31	12	8	4	3	6	5	8

**9) Coldwater Creek** 10.2 mi<sup>2</sup>

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	2	3	6	5	2	1	1	<1	<1	<1	<1	<1
Moderate	<1	1	1	1	<1	<1	<1	<1	<1	<1	<1	<1
Dry	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1

**10) Santa Ana River 2** 1005.9 mi<sup>2</sup>

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	354	489	725	900	566	324	161	100	76	73	64	138
Moderate	107	166	187	164	141	66	28	29	30	25	30	63
Dry	60	91	77	84	82	36	17	22	20	16	14	27

**11) Anza Creek** 61.4 mi<sup>2</sup>

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	1	3	5	3	1	1	<1	1	1	<1	<1	1
Moderate	1	1	1	<1	<1	<1	<1	1	1	<1	<1	1
Dry	1	1	<1	<1	<1	<1	<1	<1	1	<1	<1	1

**12) Santa Ana River 3** 725.5 mi<sup>2</sup>

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	342	464	646	872	626	359	183	117	90	79	66	130
Moderate	90	150	182	170	142	72	31	32	41	33	30	54
Dry	44	74	61	82	71	36	17	24	25	20	13	24

**13) San Timoteo Creek** 127.0 mi<sup>2</sup>

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	20	39	77	57	28	14	4	2	1	2	3	7
Moderate	6	10	13	10	7	3	1	<1	<1	1	1	5
Dry	4	5	5	5	4	2	1	<1	<1	1	1	3

Table 1. Median natural flows (continued).

**14) Lytle Creek** 46.2 mi<sup>2</sup>

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	117	150	200	164	158	84	39	28	24	21	18	47
Moderate	28	49	52	49	42	26	17	12	11	13	10	15
Dry	12	18	18	20	17	12	9	7	7	8	6	7

**15) Middle Fork Lytle Creek** 11.5 mi<sup>2</sup>

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	37	47	63	50	38	21	13	9	8	7	5	17
Moderate	10	16	18	18	12	8	6	4	4	4	3	5
Dry	4	6	7	7	5	4	3	3	3	3	2	2

**16) Cajon Wash** 66.7 mi<sup>2</sup>

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	45	64	97	71	43	19	10	7	7	7	12	20
Moderate	12	19	27	23	16	7	4	3	4	4	7	10
Dry	8	9	11	7	7	4	3	3	3	3	5	6

**17) Cajon Creek** 40.7 mi<sup>2</sup>

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	21	35	37	27	13	7	5	4	4	4	5	9
Moderate	6	8	11	9	5	3	3	3	3	3	3	5
Dry	3	4	4	3	3	2	2	2	2	2	2	3

**18) East Twin Creek** 9.1 mi<sup>2</sup>

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	7	12	16	12	7	4	2	2	1	1	1	3
Moderate	2	3	4	3	2	1	1	1	1	1	1	1
Dry	1	1	1	1	1	1	<1	<1	<1	<1	<1	1

**19) Santa Ana River 4** 327.9 mi<sup>2</sup>

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	180	247	274	493	546	321	162	101	75	75	59	74
Moderate	48	74	94	119	117	63	40	31	26	29	27	27
Dry	23	34	34	56	51	25	13	13	15	17	17	10

**20) City Creek** 19.5 mi<sup>2</sup>

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	18	25	37	25	15	9	5	4	3	3	2	6
Moderate	3	7	9	8	6	3	2	1	1	1	2	2
Dry	2	2	2	3	3	2	1	1	1	1	1	1

Table 1. Median natural flows (continued).

**21) West Fork City Creek** 9.2 mi<sup>2</sup>

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	9	15	20	13	7	4	2	1	1	1	1	3
Moderate	2	4	5	4	2	1	1	1	1	1	1	1
Dry	1	1	1	2	1	1	<1	<1	<1	<1	<1	1

**22) East Fork City Creek** 6.6 mi<sup>2</sup>

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	8	11	18	12	7	4	3	2	1	1	1	3
Moderate	1	3	4	4	2	1	1	1	<1	1	<1	1
Dry	1	1	1	1	1	1	<1	<1	<1	<1	<1	<1

**23) Plunge Creek** 17.0 mi<sup>2</sup>

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	11	17	23	19	11	7	4	2	2	2	2	4
Moderate	2	4	6	4	4	2	1	1	1	1	1	1
Dry	1	2	2	2	2	1	1	<1	<1	<1	1	1

**24) Mill Creek** 28.4 mi<sup>2</sup>

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	33	39	46	58	72	62	48	29	21	15	12	12
Moderate	11	15	21	28	31	30	21	16	13	10	9	7
Dry	8	8	10	12	12	12	9	7	7	6	6	4

**25) Santa Ana River 5** 209.1 mi<sup>2</sup>

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	139	169	189	335	417	274	114	71	53	51	41	51
Moderate	32	50	75	98	86	55	30	24	18	20	21	19
Dry	16	24	26	37	37	18	11	10	11	13	14	6

**26) Santa Ana River 6** 199.8 mi<sup>2</sup>

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	135	162	193	330	415	270	110	71	52	46	38	51
Moderate	34	50	75	97	85	52	28	22	18	20	20	20
Dry	18	25	27	38	36	17	12	11	11	13	15	8

**27) Hemlock Creek** 3.3 mi<sup>2</sup>

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	3	5	7	6	4	3	2	1	1	1	1	1
Moderate	1	1	2	2	1	1	1	1	<1	<1	<1	<1
Dry	<1	1	1	1	1	<1	<1	<1	<1	<1	<1	<1

Table 1. Median natural flows (continued).

**28) Bear Creek** 88.7 mi<sup>2</sup>

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	53	63	87	158	153	106	43	22	14	14	13	21
Moderate	15	19	31	42	32	20	10	6	5	6	7	9
Dry	9	10	11	15	13	6	4	3	3	4	5	5

**29) Santa Ana River 7** 91.5 mi<sup>2</sup>

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	71	85	93	161	197	137	69	46	31	29	23	24
Moderate	22	29	40	56	45	39	29	18	13	12	14	14
Dry	13	13	15	22	20	12	13	10	8	8	8	7

**30) Santa Ana River 8** 48.3 mi<sup>2</sup>

Month Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wet	32	42	47	79	87	69	36	26	19	15	13	12
Moderate	11	15	18	24	19	19	13	9	7	7	8	8
Dry	6	6	7	11	10	8	7	6	4	5	5	4



**Santa Ana River**  
SANTA ANA RIVER WATERSHED

# Functional Flows

This section presents functional flows in the Santa Ana River watershed, using data from Qiu et al. (2021) and CEFWG (2021). Functional flow metrics were estimated using the modeling approach described by Grantham et al. (2022). The resulting data characterize both the mainstem of the Santa Ana River and its tributaries (Table 2-Table 10). While functional flow timing across the watershed is generally consistent, flow magnitudes vary among reaches (Rodríguez-Iturbe and Valdés 1979). Observed (gaged) functional flows were omitted from this report due to flashy, low-flow conditions in small tributaries with reference gages located in the upper watershed, due to the absence of reference gages along the highly altered mainstem reaches of the Santa Ana River.



**Santa Ana River**  
SANTA ANA RIVER WATERSHED

Table 2. Santa Ana River 1 (reach 5) functional flow metric median values, 10<sup>th</sup>–90<sup>th</sup> percentile in parentheses. Metrics are provided by water year type (i.e., wet, moderate, and dry) and based on modeled functional flows for the Santa Ana River.

<b>Metric</b>	<b>Wet Years</b>	<b>Moderate Years</b>	<b>Dry Years</b>
Fall pulse flow magnitude (cfs)	766 (110–4,640)	484 (61–2,560)	321 (44–1,990)
Fall pulse flow duration (total days per year, when present)	4 (2–9)*	4 (2–9)*	4 (2–9)*
Fall pulse flow start timing	Nov 11 (Oct 10–Dec 1)	Nov 13 (Oct 8–Dec 2)	Nov 9 (Oct 3–Dec 1)
Wet-season baseflow magnitude (cfs)	206 (22–667)	47 (1–159)	25 (<1–108)
Median wet-season flow magnitude (cfs)	822 (209–2,280)	250 (54–769)	119 (18–471)
Wet-season duration (days)	90 (42–160)	109 (38–197)	144 (42–216)
Wet-season start timing	Jan 1 (Nov 26–Jan 27)	Dec 25 (Oct 29–Feb 03)	Nov 19 (Oct 21–Jan 22)
2-year peak flow magnitude (cfs)	5,810 (675–22,700)	5,810 (675–22,700)	5,810 (675–22,700)
2-year peak flow duration (total days per year, when present)	3 (1–16)*	3 (1–16)*	3 (1–16)*
2-year peak flow frequency (events per year, when present)	2 (1–5)*	2 (1–5)*	2 (1–5)*
5-year peak flow magnitude (cfs)	12,400 (1,650–57,900)	12,400 (1,650–57,900)	12,400 (1,650–57,900)
5-year peak flow duration (total days per year, when present)	1 (1–5)*	1 (1–5)*	1 (1–5)*
5-year peak flow frequency (events per year, when present)	1 (1–3)*	1 (1–3)*	1 (1–3)*
Spring recession flow magnitude (cfs)	6,390 (1,120–29,300)	1,620 (226–9,960)	630 (85–4,970)
Spring recession flow duration (days)	75 (27–140)	72 (25–150)	71 (24–163)
Spring recession flow start timing	Apr 7 (Feb 27–Jun 4)	Apr 5 (Feb 21–Jun 13)	Apr 7 (Feb 14–Jun 13)
Spring recession flow rate of change (%)	7 (4–17)*	7 (4–17)*	7 (4–17)*
Dry-season baseflow magnitude (cfs)	49 (<1–199)	20 (<1–75)	14 (<1–59)
Dry-season duration (days)	175 (92–272)	170 (89–268)	160 (77–263)
Dry-season start timing	Jul 9 (Apr 20–Aug 27)	Jul 13 (Apr 30–Aug 30)	Jul 12 (May 4–Sep 4)

\* indicates a metric with inferred ranges that was not modeled by water year type

Table 3. San Antonio Creek (reach 7) functional flow metric median values, 10<sup>th</sup>–90<sup>th</sup> percentile in parentheses. Metrics are provided by water year type (i.e., wet, moderate, and dry) and based on modeled functional flows for San Antonio Creek.

<b>Metric</b>	<b>Wet Years</b>	<b>Moderate Years</b>	<b>Dry Years</b>
Fall pulse flow magnitude (cfs)	22 (6–106)	16 (5–73)	10 (3–44)
Fall pulse flow duration (total days per year, when present)	4 (2–8)*	4 (2–8)*	4 (2–8)*
Fall pulse flow start timing	Nov 2 (Oct 10–Dec 1)	Nov 13 (Oct 9–Dec 3)	Nov 12 (Oct 7–Dec 3)
Wet-season baseflow magnitude (cfs)	14 (5–34)	7 (3–16)	4 (2–8)
Median wet-season flow magnitude (cfs)	58 (26–143)	15 (6–44)	9 (3–17)
Wet-season duration (days)	99 (46–160)	88 (39–146)	98 (40–175)
Wet-season start timing	Jan 2 (Nov 27–Feb 18)	Jan 26 (Dec 7–Feb 24)	Dec 31 (Nov 6–Feb 6)
2-year peak flow magnitude (cfs)	87 (75–421)	87 (75–421)	87 (75–421)
2-year peak flow duration (total days per year, when present)	4 (1–29)*	4 (1–29)*	4 (1–29)*
2-year peak flow frequency (events per year, when present)	2 (1–5)*	2 (1–5)*	2 (1–5)*
5-year peak flow magnitude (cfs)	341 (318–578)	341 (318–578)	341 (318–578)
5-year peak flow duration (total days per year, when present)	2 (1–6)*	2 (1–6)*	2 (1–6)*
5-year peak flow frequency (events per year, when present)	1 (1–3)*	1 (1–3)*	1 (1–3)*
Spring recession flow magnitude (cfs)	280 (82–1,030)	74 (21–227)	22 (8–92)
Spring recession flow duration (days)	114 (64–181)	114 (66–176)	118 (69–178)
Spring recession flow start timing	Apr 11 (Feb 21–May 30)	Apr 11 (Feb 24–May 20)	Apr 17 (Feb 26–May 22)
Spring recession flow rate of change (%)	6 (4–11)*	6 (4–11)*	6 (4–11)*
Dry-season baseflow magnitude (cfs)	7 (3–11)	4 (2–7)	3 (2–4)
Dry-season duration (days)	148 (83–210)	146 (90–205)	138 (79–205)
Dry-season start timing	Jul 31 (Jun 27–Sep 2)	Jul 25 (Jun 14–Sep 1)	Jul 27 (Jun 29–Sep 3)

\* indicates a metric with inferred ranges that was not modeled by water year type

Table 4. Santa Ana River 2 (reach 10) functional flow metric median values, 10<sup>th</sup>–90<sup>th</sup> percentile in parentheses. Metrics are provided by water year type (i.e., wet, moderate, and dry) and based on modeled functional flows for the Santa Ana River.

<b>Metric</b>	<b>Wet Years</b>	<b>Moderate Years</b>	<b>Dry Years</b>
Fall pulse flow magnitude (cfs)	361 (68–1,960)	288 (52–1,270)	123 (20–851)
Fall pulse flow duration (total days per year, when present)	4 (2–9)*	4 (2–9)*	4 (2–9)*
Fall pulse flow start timing	Nov 10 (Oct 9–Nov 30)	Nov 9 (Oct 7–Nov 30)	Nov 10 (Oct 3–Nov 30)
Wet-season baseflow magnitude (cfs)	178 (48–505)	65 (12–183)	44 (3–117)
Median wet-season flow magnitude (cfs)	667 (214–1,770)	161 (44–413)	101 (19–262)
Wet-season duration (days)	92 (45–152)	99 (38–185)	135 (38–211)
Wet-season start timing	Jan 7 (Nov 25–Feb 2)	Dec 24 (Oct 29–Jan 31)	Nov 26 (Oct 22–Jan 25)
2-year peak flow magnitude (cfs)	3,520 (445–9,960)	3,520 (445–9,960)	3,520 (445–9,960)
2-year peak flow duration (total days per year, when present)	3 (1–16)*	3 (1–16)*	3 (1–16)*
2-year peak flow frequency (events per year, when present)	2 (1–5)*	2 (1–5)*	2 (1–5)*
5-year peak flow magnitude (cfs)	9,170 (773–23,500)	9,170 (773–23,500)	9,170 (773–23,500)
5-year peak flow duration (total days per year, when present)	1 (1–5)*	1 (1–5)*	1 (1–5)*
5-year peak flow frequency (events per year, when present)	1 (1–3)*	1 (1–3)*	1 (1–3)*
Spring recession flow magnitude (cfs)	3,540 (1,020–15,400)	852 (161–4,170)	339 (66–1,610)
Spring recession flow duration (days)	85 (40–152)	87 (34–153)	94 (32–174)
Spring recession flow start timing	Apr 8 (Mar 3–May 29)	Apr 11 (Feb 24–Jun 3)	Apr 8 (Feb 22–Jun 8)
Spring recession flow rate of change (%)	7 (4–17)*	7 (4–17)*	7 (4–17)*
Dry-season baseflow magnitude (cfs)	95 (13–274)	42 (2–158)	31 (<1–129)
Dry-season duration (days)	166 (86–248)	161 (87–246)	153 (77–246)
Dry-season start timing	Jul 23 (May 9–Sep 4)	Jul 26 (May 26–Sep 5)	Jul 22 (May 21–Sep 7)

\* indicates a metric with inferred ranges that was not modeled by water year type

Table 5. Santa Ana River 3 (reach 12) functional flow metric median values, 10<sup>th</sup>–90<sup>th</sup> percentile in parentheses. Metrics are provided by water year type (i.e., wet, moderate, and dry) and based on modeled functional flows for the Santa Ana River.

<b>Metric</b>	<b>Wet Years</b>	<b>Moderate Years</b>	<b>Dry Years</b>
Fall pulse flow magnitude (cfs)	291 (60–1,560)	241 (54–1,020)	104 (18–544)
Fall pulse flow duration (total days per year, when present)	4 (2–8)*	4 (2–8)*	4 (2–8)*
Fall pulse flow start timing	Nov 7 (Oct 8–Nov 30)	Nov 11 (Oct 8–Nov 30)	Nov 10 (Oct 4–Dec 1)
Wet-season baseflow magnitude (cfs)	229 (44–583)	53 (9–167)	38 (4–114)
Median wet-season flow magnitude (cfs)	700 (251–1,920)	150 (38–454)	79 (13–216)
Wet-season duration (days)	94 (50–154)	100 (42–187)	128 (42–206)
Wet-season start timing	Jan 7 (Nov 27–Feb 3)	Dec 31 (Nov 1–Feb 4)	Dec 4 (Oct 22–Jan 31)
2-year peak flow magnitude (cfs)	3,060 (877–17,000)	3,060 (877–17,000)	3,060 (877–17,000)
2-year peak flow duration (total days per year, when present)	4 (1–29)*	4 (1–29)*	4 (1–29)*
2-year peak flow frequency (events per year, when present)	2 (1–5)*	2 (1–5)*	2 (1–5)*
5-year peak flow magnitude (cfs)	9,060 (1,830–17,700)	9,060 (1,830–17,700)	9,060 (1,830–17,700)
5-year peak flow duration (total days per year, when present)	2 (1–6)*	2 (1–6)*	2 (1–6)*
5-year peak flow frequency (events per year, when present)	1 (1–3)*	1 (1–3)*	1 (1–3)*
Spring recession flow magnitude (cfs)	3,080 (1,070–12,900)	568 (134–2,810)	226 (46–1,040)
Spring recession flow duration (days)	83 (42–151)	86 (37–149)	93 (36–161)
Spring recession flow start timing	Apr 16 (Mar 2–May 28)	Apr 15 (Mar 1–May 30)	Apr 16 (Feb 24–Jun 3)
Spring recession flow rate of change (%)	6 (4–11)*	6 (4–11)*	6 (4–11)*
Dry-season baseflow magnitude (cfs)	76 (16–209)	35 (2–118)	24 (<1–91)
Dry-season duration (days)	158 (81–232)	151 (83–223)	142 (74–232)
Dry-season start timing	Jul 26 (May 23–Sep 7)	Aug 1 (Jun 9–Sep 9)	Aug 1 (Jun 3–Sep 9)

\* indicates a metric with inferred ranges that was not modeled by water year type

Table 6. Lytle Creek (reach 14) functional flow metric median values, 10<sup>th</sup>–90<sup>th</sup> percentile in parentheses. Metrics are provided by water year type (i.e., wet, moderate, and dry) and based on modeled functional flows for Lytle Creek.

<b>Metric</b>	<b>Wet Years</b>	<b>Moderate Years</b>	<b>Dry Years</b>
Fall pulse flow magnitude (cfs)	38 (11–166)	29 (10–128)	18 (5–58)
Fall pulse flow duration (total days per year, when present)	4 (2–8)*	4 (2–8)*	4 (2–8)*
Fall pulse flow start timing	Nov 3 (Oct 9–Nov 27)	Nov 13 (Oct 10–Dec 1)	Nov 12 (Oct 7–Dec 1)
Wet-season baseflow magnitude (cfs)	36 (12–76)	17 (7–44)	9 (5–18)
Median wet-season flow magnitude (cfs)	116 (54–284)	43 (17–106)	18 (6–38)
Wet-season duration (days)	97 (48–156)	92 (43–149)	101 (41–177)
Wet-season start timing	Jan 2 (Nov 25–Jan 30)	Jan 5 (Nov 20–Feb 3)	Dec 23 (Oct 31–Jan 22)
2-year peak flow magnitude (cfs)	214 (195–917)	214 (195–917)	214 (195–917)
2-year peak flow duration (total days per year, when present)	4 (1–29)*	4 (1–29)*	4 (1–29)*
2-year peak flow frequency (events per year, when present)	2 (1–5)*	2 (1–5)*	2 (1–5)*
5-year peak flow magnitude (cfs)	885 (607–1,580)	885 (607–1,580)	885 (607–1,580)
5-year peak flow duration (total days per year, when present)	2 (1–6)*	2 (1–6)*	2 (1–6)*
5-year peak flow frequency (events per year, when present)	1 (1–3)*	1 (1–3)*	1 (1–3)*
Spring recession flow magnitude (cfs)	391 (166–1,810)	141 (51–566)	35 (12–135)
Spring recession flow duration (days)	111 (61–178)	104 (62–166)	110 (64–162)
Spring recession flow start timing	Mar 31 (Feb 21–May 26)	Apr 13 (Feb 25–May 24)	Apr 14 (Mar 4–May 21)
Spring recession flow rate of change (%)	6 (4–11)*	6 (4–11)*	6 (4–11)*
Dry-season baseflow magnitude (cfs)	17 (7–27)	9 (5–19)	6 (3–9)
Dry-season duration (days)	152 (84–215)	149 (91–206)	140 (84–204)
Dry-season start timing	Jul 26 (Jun 20–Aug 28)	Jul 25 (Jun 22–Aug 28)	Jul 24 (Jun 26–Aug 26)

\* indicates a metric with inferred ranges that was not modeled by water year type

Table 7. City Creek (reach 20) functional flow metric median values, 10<sup>th</sup>–90<sup>th</sup> percentile in parentheses. Metrics are provided by water year type (i.e., wet, moderate, and dry) and based on modeled functional flows for City Creek.

<b>Metric</b>	<b>Wet Years</b>	<b>Moderate Years</b>	<b>Dry Years</b>
Fall pulse flow magnitude (cfs)	9 (2–48)	8 (2–30)	4 (1–17)
Fall pulse flow duration (total days per year, when present)	4 (2–8)*	4 (2–8)*	4 (2–8)*
Fall pulse flow start timing	Nov 7 (Oct 11–Nov 27)	Nov 9 (Oct 9–Nov 28)	Nov 10 (Oct 4–Nov 30)
Wet-season baseflow magnitude (cfs)	8 (3–25)	3 (1–7)	2 (<1–4)
Median wet-season flow magnitude (cfs)	30 (11–68)	7 (3–17)	3 (1–7)
Wet-season duration (days)	87 (49–141)	99 (46–175)	102 (44–188)
Wet-season start timing	Jan 2 (Dec 7–Jan 24)	Dec 23 (Nov 19–Jan 15)	Dec 22 (Oct 30–Jan 29)
2-year peak flow magnitude (cfs)	82 (24–171)	82 (24–171)	82 (24–171)
2-year peak flow duration (total days per year, when present)	4 (1–29)*	4 (1–29)*	4 (1–29)*
2-year peak flow frequency (events per year, when present)	2 (1–5)*	2 (1–5)*	2 (1–5)*
5-year peak flow magnitude (cfs)	217 (72–560)	217 (72–560)	217 (72–560)
5-year peak flow duration (total days per year, when present)	2 (1–6)*	2 (1–6)*	2 (1–6)*
5-year peak flow frequency (events per year, when present)	1 (1–3)*	1 (1–3)*	1 (1–3)*
Spring recession flow magnitude (cfs)	116 (42–503)	32 (7–140)	10 (2–58)
Spring recession flow duration (days)	82 (46–146)	86 (45–145)	94 (41–159)
Spring recession flow start timing	Mar 25 (Feb 22–Apr 30)	Apr 10 (Feb 22–May 21)	Mar 30 (Feb 20–May 24)
Spring recession flow rate of change (%)	6 (4–11)*	6 (4–11)*	6 (4–11)*
Dry-season baseflow magnitude (cfs)	3 (1–6)	1 (<1–3)	1 (<1–2)
Dry-season duration (days)	185 (116–255)	170 (110–233)	163 (102–232)
Dry-season start timing	Jun 23 (Apr 20–Aug 20)	Jul 9 (May 18–Aug 27)	Jul 16 (May 14–Aug 30)

\* indicates a metric with inferred ranges that was not modeled by water year type

Table 8. Santa Ana River 5 (reach 25) functional flow metric median values, 10<sup>th</sup>–90<sup>th</sup> percentile in parentheses. Metrics are provided by water year type (i.e., wet, moderate, and dry) and based on modeled functional flows for the Santa Ana River.

<b>Metric</b>	<b>Wet Years</b>	<b>Moderate Years</b>	<b>Dry Years</b>
Fall pulse flow magnitude (cfs)	96 (23–524)	100 (28–451)	60 (11–165)
Fall pulse flow duration (total days per year, when present)	4 (2–8)*	4 (2–8)*	4 (2–8)*
Fall pulse flow start timing	Nov 11 (Oct 8–Dec 3)	Nov 12 (Oct 4–Dec 1)	Nov 11 (Oct 2–Dec 3)
Wet-season baseflow magnitude (cfs)	115 (18–243)	30 (4–102)	20 (2–52)
Median wet-season flow magnitude (cfs)	360 (112–797)	88 (13–232)	32 (5–96)
Wet-season duration (days)	100 (52–168)	103 (51–205)	109 (48–214)
Wet-season start timing	Feb 1 (Dec 21–Mar 12)	Jan 27 (Nov 9–Mar 10)	Dec 20 (Oct 18–Mar 4)
2-year peak flow magnitude (cfs)	941 (65–4,350)	941 (65–4,350)	941 (65–4,350)
2-year peak flow duration (total days per year, when present)	4 (1–29)*	4 (1–29)*	4 (1–29)*
2-year peak flow frequency (events per year, when present)	2 (1–5)*	2 (1–5)*	2 (1–5)*
5-year peak flow magnitude (cfs)	2,620 (237–6,030)	2,620 (237–6,030)	2,620 (237–6,030)
5-year peak flow duration (total days per year, when present)	2 (1–6)*	2 (1–6)*	2 (1–6)*
5-year peak flow frequency (events per year, when present)	1 (1–3)*	1 (1–3)*	1 (1–3)*
Spring recession flow magnitude (cfs)	1,450 (601–4,370)	308 (72–1,020)	109 (19–486)
Spring recession flow duration (days)	70 (44–124)	76 (42–134)	84 (42–142)
Spring recession flow start timing	May 22 (Apr 1–Jun 12)	May 9 (Mar 10–Jun 11)	May 2 (Mar 1–Jun 13)
Spring recession flow rate of change (%)	6 (4–11)*	6 (4–11)*	6 (4–11)*
Dry-season baseflow magnitude (cfs)	33 (6–96)	16 (1–51)	9 (<1–35)
Dry-season duration (days)	163 (84–238)	163 (95–236)	158 (89–234)
Dry-season start timing	Jul 31 (Jun 1–Sep 9)	Jul 28 (Jun 4–Sep 11)	Jul 31 (Jun 6–Sep 13)

\* indicates a metric with inferred ranges that was not modeled by water year type

Table 9. Santa Ana River 6 (reach 26) functional flow metric median values, 10<sup>th</sup>–90<sup>th</sup> percentile in parentheses. Metrics are provided by water year type (i.e., wet, moderate, and dry) and based on modeled functional flows for the Santa Ana River.

<b>Metric</b>	<b>Wet Years</b>	<b>Moderate Years</b>	<b>Dry Years</b>
Fall pulse flow magnitude (cfs)	96 (23–533)	99 (28–529)	59 (12–160)
Fall pulse flow duration (total days per year, when present)	4 (2–8)*	4 (2–8)*	4 (2–8)*
Fall pulse flow start timing	Nov 12 (Oct 8–Dec 3)	Nov 12 (Oct 4–Dec 1)	Nov 1 (Oct 2–Dec 3)
Wet-season baseflow magnitude (cfs)	114 (18–237)	30 (4–97)	18 (2–51)
Median wet-season flow magnitude (cfs)	376 (127–833)	91 (14–231)	31 (5–107)
Wet-season duration (days)	99 (52–171)	102 (51–204)	107 (49–216)
Wet-season start timing	Feb 2 (Dec 17–Mar 13)	Jan 27 (Nov 9–Mar 10)	Dec 20 (Oct 19–Mar 07)
2-year peak flow magnitude (cfs)	899 (68–3,120)	899 (68–3,120)	899 (68–3,120)
2-year peak flow duration (total days per year, when present)	4 (1–29)*	4 (1–29)*	4 (1–29)*
2-year peak flow frequency (events per year, when present)	2 (1–5)*	2 (1–5)*	2 (1–5)*
5-year peak flow magnitude (cfs)	2,570 (226–6,120)	2,570 (226–6,120)	2,570 (226–6,120)
5-year peak flow duration (total days per year, when present)	2 (1–6)*	2 (1–6)*	2 (1–6)*
5-year peak flow frequency (events per year, when present)	1 (1–3)*	1 (1–3)*	1 (1–3)*
Spring recession flow magnitude (cfs)	1,430 (598–4,280)	307 (72–1,040)	115 (20–561)
Spring recession flow duration (days)	70 (44–124)	75 (42–131)	82 (41–140)
Spring recession flow start timing	May 23 (Apr 3–Jun 12)	May 11 (Mar 12–Jun 11)	May 5 (Feb 28–Jun 13)
Spring recession flow rate of change (%)	6 (4–11)*	6 (4–11)*	6 (4–11)*
Dry-season baseflow magnitude (cfs)	33 (6–93)	15 (1–51)	9 (<1–36)
Dry-season duration (days)	169 (91–240)	165 (94–239)	160 (90–235)
Dry-season start timing	Jul 31 (May 30–Sep 10)	Jul 28 (May 31–Sep 11)	Jul 30 (Jun 4–Sep 13)

\* indicates a metric with inferred ranges that was not modeled by water year type

Table 10. Bear Creek (reach 28) functional flow metric median values, 10<sup>th</sup>–90<sup>th</sup> percentile in parentheses. Metrics are provided by water year type (i.e., wet, moderate, and dry) and based on modeled functional flows for Bear Creek.

<b>Metric</b>	<b>Wet Years</b>	<b>Moderate Years</b>	<b>Dry Years</b>
Fall pulse flow magnitude (cfs)	52 (10–348)	38 (9–195)	23 (4–66)
Fall pulse flow duration (total days per year, when present)	4 (2–8)*	4 (2–8)*	4 (2–8)*
Fall pulse flow start timing	Nov 13 (Oct 9–Dec 4)	Nov 13 (Oct 5–Dec 3)	Nov 9 (Oct 3–Dec 3)
Wet-season baseflow magnitude (cfs)	44 (6–103)	10 (1–39)	8 (1–23)
Median wet-season flow magnitude (cfs)	138 (36–354)	28 (5–92)	12 (2–38)
Wet-season duration (days)	91 (48–177)	97 (48–206)	107 (42–215)
Wet-season start timing	Jan 29 (Dec 11–Mar 13)	Jan 22 (Oct 31–Mar 7)	Dec 13 (Oct 18–Mar 9)
2-year peak flow magnitude (cfs)	192 (19–920)	192 (19–920)	192 (19–920)
2-year peak flow duration (total days per year, when present)	4 (1–29)*	4 (1–29)*	4 (1–29)*
2-year peak flow frequency (events per year, when present)	2 (1–5)*	2 (1–5)*	2 (1–5)*
5-year peak flow magnitude (cfs)	728 (71–2,330)	728 (71–2,330)	728 (71–2,330)
5-year peak flow duration (total days per year, when present)	2 (1–6)*	2 (1–6)*	2 (1–6)*
5-year peak flow frequency (events per year, when present)	1 (1–3)*	1 (1–3)*	1 (1–3)*
Spring recession flow magnitude (cfs)	584 (218–1,960)	108 (26–493)	51 (8–273)
Spring recession flow duration (days)	69 (41–126)	77 (39–135)	89 (39–160)
Spring recession flow start timing	May 16 (Mar 20–Jun 10)	May 7 (Mar 3–Jun 10)	May 1 (Feb 14–Jun 13)
Spring recession flow rate of change (%)	6 (4–11)*	6 (4–11)*	6 (4–11)*
Dry-season baseflow magnitude (cfs)	10 (2–35)	6 (0–23)	3 (<1–17)
Dry-season duration (days)	174 (93–245)	172 (95–243)	165 (89–238)
Dry-season start timing	Jul 26 (May 14–Sep 7)	Jul 26 (May 24–Sep 10)	Jul 26 (May 19–Sep 16)

\* indicates a metric with inferred ranges that was not modeled by water year type

# Ecosystem Baseflows

Ecosystem baseflows are the monthly instream flows needed to preserve a healthy stream ecosystem. In wet water month types, median monthly discharge (MMD), derived from natural flow data (Zimmerman et al. 2023), meets or exceeds ecosystem baseflows (Tessmann 1980) for approximately 5–12 months of the water year in tributary reaches and 10–12 months in mainstem reaches across most of the Santa Ana River watershed.

In moderate water month types, median natural flows in the Santa Ana River 5 (Reach 25) may exceed ecosystem baseflows for approximately four months of the water year (Figure 8). This pattern is consistent with conditions observed in other large reaches throughout the watershed.

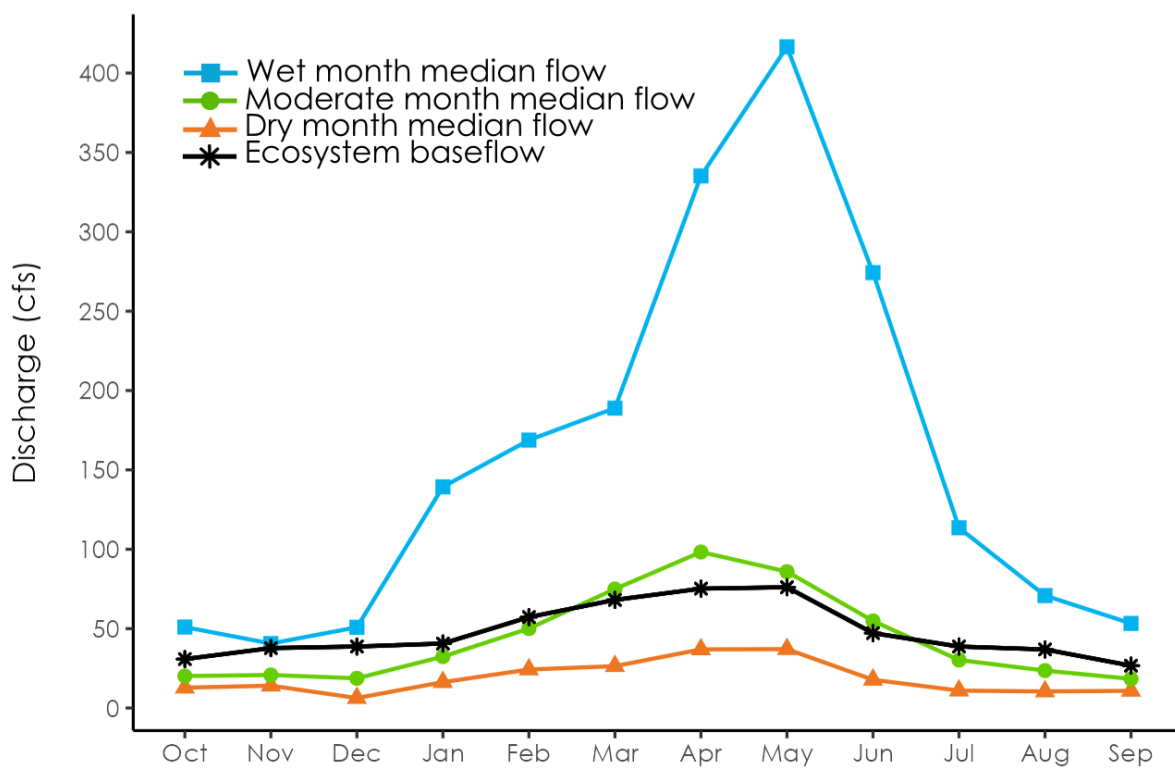


Figure 8. Ecosystem baseflows and median natural flows for wet, moderate, and dry water month types for Santa Ana River 5 (reach 25).

Ecosystem baseflows are monthly flows unique to each Santa Ana River tributary and mainstem reach analyzed in this report (Table 11). The numbers next to each stream name correspond to the numbers found on the Santa Ana River subwatershed maps (Figure 3-Figure 5).

Table 11. Ecosystem baseflows (cfs).

Stream	Drainage Area (mi <sup>2</sup> )	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1) Santiago Creek 1	92.8	15	20	19	6	4	2	1	1	<1	1	2	6
2) Silverado Creek	10.3	2	3	2	1	1	1	1	<1	<1	1	1	1
3) Santiago Creek 2	12.7	3	4	4	2	1	1	1	1	1	1	1	1
4) Aliso Creek	10.8	2	3	2	1	<1	<1	<1	<1	<1	<1	<1	1
5) Santa Ana River 1	2,255.7	347	459	390	227	154	154	46	36	34	65	136	154
6) Cucamonga Creek	10.3	8	11	9	6	4	4	4	3	3	3	4	4
7) San Antonio Creek	17.4	16	20	19	16	13	10	10	10	9	8	10	10
8) Temescal Wash	975.5	98	133	105	53	40	31	9	11	12	21	37	40
9) Coldwater Creek	10.2	1	2	2	1	1	<1	<1	<1	<1	<1	<1	1
10) Santa Ana River 2	1,005.9	171	243	235	165	106	99	69	53	48	52	90	99
11) Anza Creek	61.4	2	3	2	1	1	<1	<1	1	1	<1	1	1
12) Santa Ana River 3	725.5	141	203	210	161	114	91	76	53	51	58	81	91
13) San Timoteo Creek	127	13	23	20	11	7	7	2	1	1	3	6	7
14) Lytle Creek	46.2	37	46	46	34	27	22	22	15	13	14	21	22
15) Middle Fork Lytle Creek	11.5	12	14	14	10	7	7	7	5	5	5	7	7
16) Cajon Wash	66.7	22	32	29	18	12	11	6	4	4	5	12	12
17) Cajon Creek	40.7	11	18	14	8	6	5	3	3	3	4	6	6
18) East Twin Creek	9.1	3	5	4	3	2	2	1	1	1	1	1	2

Table 11. Ecosystem baseflows (continued).

Stream	Drainage Area (mi <sup>2</sup> )	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
19) Santa Ana River 4	327.9	59	87	99	103	104	63	55	52	38	44	51	55
20) City Creek	19.5	8	11	11	7	4	4	3	2	2	2	3	4
21) West Fork City Creek	9.2	4	6	6	3	2	2	1	1	1	1	2	2
22) East Fork City Creek	6.6	3	4	5	3	2	2	1	1	1	1	1	2
23) Plunge Creek	17	5	7	7	4	3	3	2	1	1	1	2	3
24) Mill Creek	28.4	10	12	13	15	16	14	11	10	10	10	10	10
25) Santa Ana River 5	209.1	41	57	68	75	76	47	39	37	27	31	38	39
26) Santa Ana River 6	199.8	41	56	67	75	74	47	38	36	26	30	38	38
27) Hemlock Creek	3.3	1	2	2	1	1	1	1	1	1	1	1	1
28) Bear Creek	88.7	18	25	29	32	29	18	16	13	8	9	15	16
29) Santa Ana River 7	91.5	20	26	33	38	37	26	20	20	18	19	20	20
30) Santa Ana River 8	48.3	10	12	15	17	19	14	10	10	9	10	10	10



**Santa Ana River**  
SANTA ANA RIVER WATERSHED

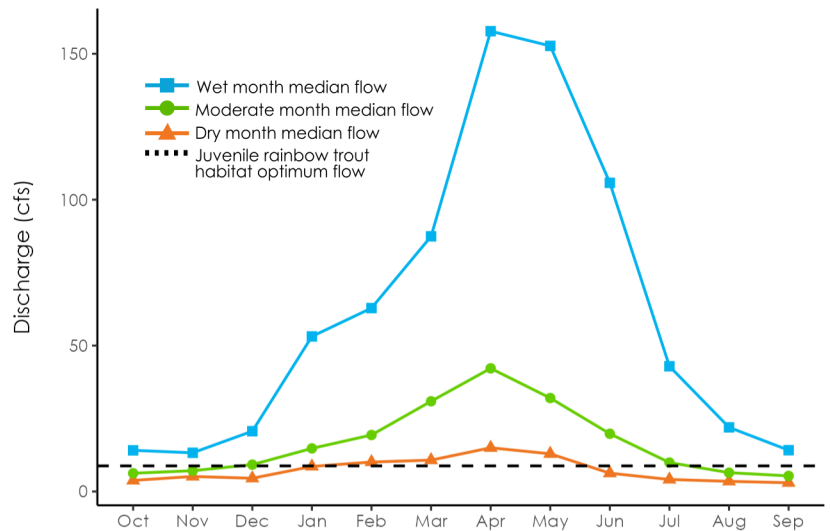
# Salmonid Habitat Optimum Flows

Salmonid habitat optimum flows (optimum flows) maximize usable habitat for juvenile rainbow trout (Hatfield and Bruce 2000). Each stream analyzed has one optimum flow value, and while these values may vary between streams, the overall patterns in the watershed are the same. Natural flows often meet or exceed optimum flows during the winter months in moderate and wet conditions, and typically remain below optimum flows during the summer and fall months in moderate and dry month types (Figure 9).

In drainages with altered flow, the time period when flows are below the juvenile rainbow trout optimum flows may have a longer or shorter duration than shown here (Figure 9, Table 12).

## Santa Ana River Tributaries

Juvenile rainbow trout optimum flows and median natural flows for wet, moderate, and dry water month types shown for a representative tributary (Bear Creek, reach 28).



## Mainstem Santa Ana River

Juvenile rainbow trout optimum flows and median natural flows for wet, moderate, and dry water month types for a representative mainstem reach (Santa Ana River 6, reach 26).

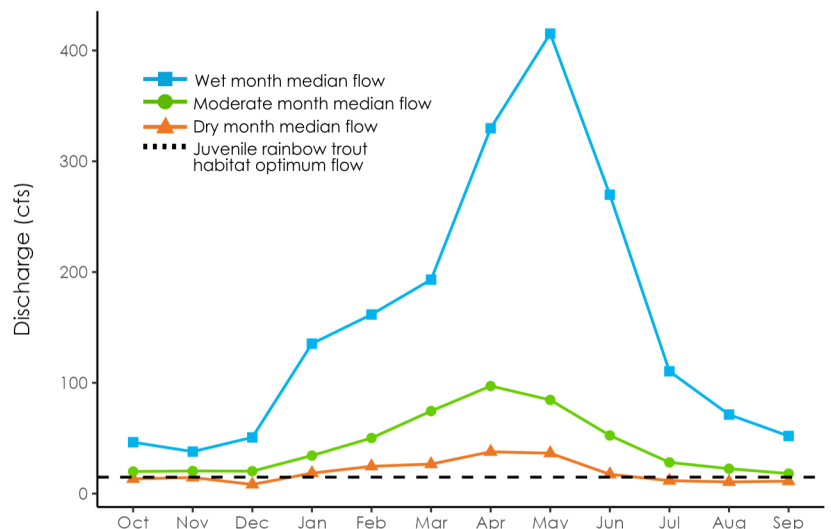


Figure 9. Juvenile trout optimum flows and median natural flows.

Generally, the surface flow required to meet the juvenile rainbow trout optimum flows increases as the drainage area increases. This section groups juvenile rainbow trout optimum flows by drainage size category (i.e., tributaries and the Santa Ana River) (Table 12). The numbers next to each stream name correspond to the numbers found on the Santa Ana River subwatershed maps (Figure 3-Figure 5).

Table 12. Juvenile rainbow trout optimum flows (by drainage area).

### Santa Ana River Tributaries

Stream	Drainage Area (mi <sup>2</sup> )	Juvenile Rainbow Trout Optimum Flow (cfs)
9) Coldwater Creek	10.2	1
15) Middle Fork Lytle Creek	11.5	5
7) San Antonio Creek	17.4	7
24) Mill Creek	28.4	7
14) Lytle Creek	46.2	11
28) Bear Creek	88.7	9

### Mainstem Santa Ana River

Stream	Drainage Area (mi <sup>2</sup> )	Juvenile Rainbow Trout Optimum Flow (cfs)
30) Santa Ana River 8	48.3	7
29) Santa Ana River 7	91.5	10
26) Santa Ana River 6	199.8	15

# Flow Criteria

Flow criteria provide a set of flow values that may be used to develop a flow regime for a location within a watershed. Using results from the Functional Flows section of this Watershed Criteria Report, flow criteria have been developed for Santa Ana River 1, San Antonio Creek, Santa Ana River 2, Santa Ana River 3, Lytle Creek, City Creek, Santa Ana River 5, Santa Ana River 6, and Bear Creek reaches (Table 13–Table 21). While the flow criteria presented in this section were developed for specific locations within the Santa Ana River watershed, patterns and timings of flows throughout the watershed are consistent, and a similar process to the one outlined below could be followed to develop criteria for other locations within the watershed. Flow criteria presented in this section are provided as a tool for consideration in water management planning. While criteria are not formal flow recommendations, they may be used to develop flow recommendations. These criteria should not be relied upon for legal compliance and do not ensure project success. The Department may revise instream flow criteria for the Santa Ana River and its tributaries based upon any new scientific information that may become available.

Flow criteria were developed for nine locations within the Santa Ana River watershed for three water year types (i.e., wet, moderate, and dry) using functional flow results from Table 2–Table 10. These locations were selected based on priorities identified by the Department's Region 6. In each case, criteria represent median functional flow metric values by water year type. Median values are commonly used to represent water availability in other instream flow methods, such as habitat duration time series analysis. Median flows would be met or exceeded in 50% of years under natural conditions, and represent a useful potential long-term management target. While medians were used to establish criteria, in the driest years flows may be closer to 10th percentile functional flow values, and in the wettest years may be closer to the 90th percentile values. Criteria are presented for each season corresponding to functional flow metrics, with additional detail provided during the spring to more specifically capture changes in flows during the transition period between the wet season and dry season. Note, the length of the spring recession varies by water year type.

Table 13. Flow criteria (in cfs) for Santa Ana River 1 (reach 5). Criteria are provided for each functional flow season and are stratified by water year type (i.e., wet, moderate, and dry).

<b>Water Year Type</b>	<b>Wet Season</b> Nov-Apr	<b>Spring Recession</b> Week 1	<b>Spring Recession</b> Week 2	<b>Spring Recession</b> Week 3	<b>Spring Recession</b> Week 4	<b>Spring Recession</b> Week 5	<b>Spring Recession</b> Week 6	<b>Dry Season</b> Jul-Jan
Wet	206 <sup>†</sup>	665	396	236	140	84	53	49 <sup>‡</sup>
Moderate	47 <sup>†</sup>	202	120	72	43	25	-	20 <sup>‡</sup>
Dry	25 <sup>†</sup>	96	57	34	20	14	-	14 <sup>‡</sup>

<sup>†</sup> Approximately every two years, protect at least two peak flow events of 5,810 cfs as they occur. Approximately every five years, protect at least one peak flow event of 12,400 cfs as it occurs.

<sup>‡</sup> In November, allow a fall pulse event of at least 492 cfs.

- The length of the recession varies by water year type. The recession lasts for six weeks in wet years, and five weeks in moderate and dry years. The rate of change for wet, moderate, and dry years is 7% per day.

Table 14. Flow criteria (in cfs) for San Antonio Creek (reach 7). Criteria are provided for each functional flow season and are stratified by water year type (i.e., wet, moderate, and dry).

<b>Water Year Type</b>	<b>Wet Season</b> Dec-Apr	<b>Spring Recession</b> Week 1	<b>Spring Recession</b> Week 2	<b>Spring Recession</b> Week 3	<b>Spring Recession</b> Week 4	<b>Spring Recession</b> Week 5	<b>Dry Season</b> Jul-Jan
Wet	14 <sup>†</sup>	48	31	20	12	8	7 <sup>‡</sup>
Moderate	7 <sup>†</sup>	12	8	5	-	-	4 <sup>‡</sup>
Dry	4 <sup>†</sup>	7	5	3	-	-	3 <sup>‡</sup>

<sup>†</sup> Approximately every two years, protect at least two peak flow events of 87 cfs as they occur. Approximately every five years, protect at least one peak flow event of 341 cfs as it occurs.

<sup>‡</sup> In November, allow a fall pulse event of at least 16 cfs.

- The length of the recession varies by water year type. The recession lasts for five weeks in wet years, and three weeks in moderate and dry years. The rate of change for wet, moderate, and dry years is 6% per day.

Table 15. Flow criteria (in cfs) for Santa Ana River 2 (reach 10). Criteria are provided for each functional flow season and are stratified by water year type (i.e., wet, moderate, and dry).

<b>Water Year Type</b>	<b>Wet Season</b> Nov-Apr	<b>Spring Recession</b> Week 1	<b>Spring Recession</b> Week 2	<b>Spring Recession</b> Week 3	<b>Spring Recession</b> Week 4	<b>Dry Season</b> Jul-Jan
Wet	178 <sup>†</sup>	540	321	191	114	95 <sup>‡</sup>
Moderate	65 <sup>†</sup>	130	78	48	-	42 <sup>‡</sup>
Dry	44 <sup>†</sup>	82	49	33	-	31 <sup>‡</sup>

<sup>†</sup> Approximately every two years, protect at least two peak flow events of 3,520 cfs as they occur. Approximately every five years, protect at least one peak flow event of 9,170 cfs as it occurs.

<sup>‡</sup> In November, allow a fall pulse event of at least 281 cfs.

- The length of the recession varies by water year type. The recession lasts for four weeks in wet years, and three weeks in moderate and dry years. The rate of change for wet, moderate, and dry years is 7% per day.

Table 16. Flow criteria (in cfs) for Santa Ana River 3 (reach 12). Criteria are provided for each functional flow season and are stratified by water year type (i.e., wet, moderate, and dry).

<b>Water Year Type</b>	<b>Wet Season</b> Dec-Apr	<b>Spring Recession</b> Week 1	<b>Spring Recession</b> Week 2	<b>Spring Recession</b> Week 3	<b>Spring Recession</b> Week 4	<b>Spring Recession</b> Week 5	<b>Dry Season</b> Jul-Jan
Wet	229 <sup>†</sup>	582	370	236	150	95	76 <sup>‡</sup>
Moderate	53 <sup>†</sup>	125	79	50	36	-	35 <sup>‡</sup>
Dry	38 <sup>†</sup>	66	42	27	-	-	24 <sup>‡</sup>

<sup>†</sup> Approximately every two years, protect at least two peak flow events of 3,060 cfs as they occur. Approximately every five years, protect at least one peak flow event of 9,060 cfs as it occurs.

<sup>‡</sup> In November, allow a fall pulse event of at least 228 cfs.

- The length of the recession varies by water year type. The recession lasts for five weeks in wet years, four weeks in moderate years, and three weeks in dry years. The rate of change for wet, moderate, and dry years is 6% per day.

Table 17. Flow criteria (in cfs) for Lytle Creek (reach 14). Criteria are provided for each functional flow season and are stratified by water year type (i.e., wet, moderate, and dry).

<b>Water Year Type</b>	<b>Wet Season</b> Dec-Apr	<b>Spring Recession</b> Week 1	<b>Spring Recession</b> Week 2	<b>Spring Recession</b> Week 3	<b>Spring Recession</b> Week 4	<b>Spring Recession</b> Week 5	<b>Dry Season</b> Jul-Jan
Wet	36 <sup>†</sup>	96	61	39	25	18	17 <sup>‡</sup>
Moderate	17 <sup>†</sup>	36	23	14	10	-	9 <sup>‡</sup>
Dry	9 <sup>†</sup>	15	10	7	-	-	6 <sup>‡</sup>

<sup>†</sup> Approximately every two years, protect at least two peak flow events of 214 cfs as they occur. Approximately every five years, protect at least one peak flow event of 885 cfs as it occurs.

<sup>‡</sup> In November, allow a fall pulse event of at least 27 cfs.

- The length of the recession varies by water year type. The recession lasts for five weeks in wet years, four weeks in moderate years, and three weeks in dry years. The rate of change for wet, moderate, and dry years is 6% per day.

Table 18. Flow criteria (in cfs) for City Creek (reach 20). Criteria are provided for each functional flow season and are stratified by water year type (i.e., wet, moderate, and dry).

<b>Water Year Type</b>	<b>Wet Season</b> Dec-Apr	<b>Spring Recession</b> Week 1	<b>Spring Recession</b> Week 2	<b>Spring Recession</b> Week 3	<b>Spring Recession</b> Week 4	<b>Spring Recession</b> Week 5	<b>Spring Recession</b> Week 6	<b>Dry Season</b> Jun-Dec
Wet	8†	25	16	10	6	4	3	3‡
Moderate	3†	6	4	2	1	1	-	1‡
Dry	2†	2	2	1	-	-	-	1‡

† Approximately every two years, protect at least two peak flow events of 82 cfs as they occur. Approximately every five years, protect at least one peak flow event of 217 cfs as it occurs.

‡ In November, allow a fall pulse event of at least 7 cfs.

- The length of the recession varies by water year type. The recession lasts for six weeks in wet years, and five weeks in moderate years, and three weeks in dry years. The rate of change for wet, moderate, and dry years is 6% per day.

Table 19. Flow criteria (in cfs) for Santa Ana River 5 (reach 25). Criteria are provided for each functional flow season and are stratified by water year type (i.e., wet, moderate, and dry).

<b>Water Year Type</b>	<b>Wet Season</b> Dec-May	<b>Spring Recession</b> Week 1	<b>Spring Recession</b> Week 2	<b>Spring Recession</b> Week 3	<b>Spring Recession</b> Week 4	<b>Spring Recession</b> Week 5	<b>Spring Recession</b> Week 6	<b>Dry Season</b> Jul-Dec
Wet	115 <sup>†</sup>	299	190	121	77	49	35	33 <sup>‡</sup>
Moderate	30 <sup>†</sup>	73	47	30	19	-	-	16 <sup>‡</sup>
Dry	20 <sup>†</sup>	27	17	11	-	-	-	9 <sup>‡</sup>

<sup>†</sup> Approximately every two years, protect at least two peak flow events of 941 cfs as they occur. Approximately every five years, protect at least one peak flow event of 2,620 cfs as it occurs.

<sup>‡</sup> In November, allow a fall pulse event of at least 85 cfs.

- The length of the recession varies by water year type. The recession lasts for six weeks in wet years, and four weeks in moderate years, and three weeks in dry years. The rate of change for wet, moderate, and dry years is 6% per day.

Table 20. Flow criteria (in cfs) for Santa Ana River 6 (reach 26). Criteria are provided for each functional flow season and are stratified by water year type (i.e., wet, moderate, and dry).

<b>Water Year Type</b>	<b>Wet Season</b> Dec-May	<b>Spring Recession</b> Week 1	<b>Spring Recession</b> Week 2	<b>Spring Recession</b> Week 3	<b>Spring Recession</b> Week 4	<b>Spring Recession</b> Week 5	<b>Spring Recession</b> Week 6	<b>Dry Season</b> Jul-Dec
Wet	114 <sup>†</sup>	312	199	127	81	51	36	33 <sup>‡</sup>
Moderate	30 <sup>†</sup>	76	48	31	19	15	-	15 <sup>‡</sup>
Dry	18 <sup>†</sup>	26	16	10	-	-	-	9 <sup>‡</sup>

<sup>†</sup> Approximately every two years, protect at least two peak flow events of 899 cfs as they occur. Approximately every five years, protect at least one peak flow event of 2,570 cfs as it occurs.

<sup>‡</sup> In November, allow a fall pulse event of at least 82 cfs.

- The length of the recession varies by water year type. The recession lasts for six weeks in wet years, and five weeks in moderate years, and three weeks in dry years. The rate of change for wet, moderate, and dry years is 6% per day.

Table 21. Flow criteria (in cfs) for Bear Creek (reach 28). Criteria are provided for each functional flow season and are stratified by water year type (i.e., wet, moderate, and dry).

<b>Water Year Type</b>	<b>Wet Season</b> Dec-May	<b>Spring Recession</b> Week 1	<b>Spring Recession</b> Week 2	<b>Spring Recession</b> Week 3	<b>Spring Recession</b> Week 4	<b>Spring Recession</b> Week 5	<b>Spring Recession</b> Week 6	<b>Dry Season</b> Jul-Dec
Wet	44 <sup>†</sup>	115	73	46	30	19	12	10 <sup>‡</sup>
Moderate	10 <sup>†</sup>	23	15	9	7	-	-	6 <sup>‡</sup>
Dry	8 <sup>†</sup>	10	6	4	3	-	-	3 <sup>‡</sup>

<sup>†</sup> Approximately every two years, protect at least two peak flow events of 192 cfs as they occur. Approximately every five years, protect at least one peak flow event of 728 cfs as it occurs.

<sup>‡</sup> In November, allow a fall pulse event of at least 38 cfs.

- The length of the recession varies by water year type. The recession lasts for six weeks in wet years, and four weeks in moderate and dry years. The rate of change for wet, moderate, and dry years is 6% per day.

The timing of the wet season was approximated using the median start dates for each water year type (i.e., wet, moderate, dry) using functional flow results from Table 2–Table 10. The wet-season baseflow magnitudes represent flows between storm events; however, following peak flow events (e.g., winter storms), flows should be much higher than the criteria presented in Table 13–Table 22. Additionally, 2- and 5-year peak flow events, respectively, should be allowed to pass through the watershed. Refer to Table 2–Table 10 for specific recommended frequencies and durations of these peak events for each water year type. The end of the wet season for each water year type was determined by the median start date of the spring recession.

The median wet-season flow magnitude was used to represent spring high flows that immediately precede the recession period. This metric represents an elevated flow relative to baseflows occurring early in the wet season, as storm events saturate the system by the spring. The median spring recession rate for each water year type was used to calculate a daily decrease in flows, which were then averaged by week for the duration of the recession. The duration of the recession was determined by applying a daily rate of change in flows until the median dry-season baseflow magnitude was reached. The length of the recession varies across water year types due to differences in start magnitudes, rates of change, and the magnitude of dry-season baseflows.

The dry-season baseflow magnitude was used to establish flow criteria for the dry season. Baseflows will likely be higher at the beginning of the dry season than at the end of the dry season, but the median flow over the entire dry season should match the listed criteria. Additionally, fall pulse events should occur annually in November. Specific magnitudes and durations by water year type for the fall pulse flows can be found in Table 2–Table 10. The end of the dry season for each water year type was determined by the median start date of the wet season.



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**Anza Creek**  
SANTA ANA RIVER WATERSHED

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All photos in this document were taken by the Southern California Coastal  
Water Research Project. Cover photo is of the Santa Ana River.



# Appendix A

Table A-1 presents each reach analyzed in this report with the associated NHDPlus COMIDs. The stream reaches were delineated using NHDPlus Version 2 medium-resolution mapping.<sup>1</sup> The COMIDs were used to identify and download natural flow estimates for each selected reach.

Table A-1. Reach delineation.

Stream	COMID	Stream	COMID
1) Santiago Creek 1	22563210	16) Cajon Wash	24843838
2) Silverado Creek	22561262	17) Cajon Creek	22554630
3) Santiago Creek 2	22563272	18) East Twin Creek	22555342
4) Aliso Creek	22560708	19) Santa Ana River 4	948070563
5) Santa Ana River 1	22563116	20) City Creek	22555756
6) Cucamonga Creek	22555310	21) West Fork City Creek	22555238
7) San Antonio Creek	22554788	22) East Fork City Creek	22555232
8) Temescal Wash	22560716	23) Plunge Creek	22555860
9) Coldwater Creek	22563268	24) Mill Creek (upper watershed)	22558920
10) Santa Ana River 2	22563072	25) Santa Ana River 5	22558244
11) Anza Creek	22560430	26) Santa Ana River 6	948070525
12) Santa Ana River 3	22558150	27) Hemlock Creek	22558304
13) San Timoteo Creek	22557960	28) Bear Creek	22555476
14) Lytle Creek	22554826	29) Santa Ana River 7	22555478
15) Middle Fork Lytle Creek	22557786	30) Santa Ana River 8	22559662

<sup>1</sup> USEPA and USGS (2012). National Hydrography Dataset Plus (NHDPlus) medium resolution version 2. U.S. Environmental Protection Agency (USEPA) and the U.S. Geological Survey (USGS). Accessed: March 2025.