Appendix B
Supplemental Information on Field Methods for the Ventura River Watershed Criteria Report

California Department of Fish and Wildlife

Instream Flow Program

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This appendix provides additional details on data used for flow criteria included in the Watershed Criteria Report for the Ventura River watershed (CDFW 2020a). Field data for both Sensitive Period Indicators (using the Wetted Perimeter Method) and Steelhead Passage Flows (using the Habitat Retention Method) were collected at a set of hydraulic control transects in lower Ventura River and San Antonio Creek. Data collection procedures are described in *Standard Operating Procedure for the Wetted Perimeter Method in California* (CDFW 2020b) and *Standard Operating Procedure for the Habitat Retention Method in California* (CDFW 2018).

Staff surveyed a total of 22 riffle transects on San Antonio Creek and the lower Ventura River. Fifteen of the original riffle transects surveyed for this project were included in the final analysis (Figures B-1 and B-2). These transects were used to develop both Sensitive Period Indicators and Steelhead Passage Flows. The other 12 sites were surveyed and subsequently removed either because the transect was located near non-representative anthropogenic influences or because the streambank or hydraulic control was not clearly defined.

Three additional transects on San Antonio Creek were also used to determine Sensitive Period Indicator flows, also using the Wetted Perimeter Method (WPM) (SA 23, 32, and 95). Water surface slope is used to calculate channel roughness (CDFW 2020b) but was not collected in the field for these three sites. Instead, a geographic information system (GIS) was used to approximate the slope at these sites. Using the Spatial Analyst hydrology toolbox in ArcGIS, flow direction and flow accumulation rasters were created using a 5-meter digital terrain model (DTM) raster. A high resolution USGS National Hydrography Dataset (NHD) stream layer for San Antonio Creek was then overlaid with the DTM and flow accumulation rasters and split at each study transect. To determine the slope, the lowest DTM elevation point along the NHD stream line was located 500 ft upstream and downstream of each transect. In almost all cases, these points coincided with the flow accumulation raster as expected. While these elevations represent the streambed, we use them here as a surrogate for the study site slope calculations.

After analysis, additional sites were removed if identified flows fell outside of single-flow hydraulic modeling threshold recommendations; all modeled flows should be within 40% to 250% of the surveyed flow (Bovee and Milhous 1978). This post-analysis site removal typically only impacted one method or life-stage.

The rationale for each omission is documented in the quality control log stored at the Department Headquarters office. Table B-1 summarizes the final sites included for the Sensitive Period Indicators and Steelhead Passage Flows analysis.

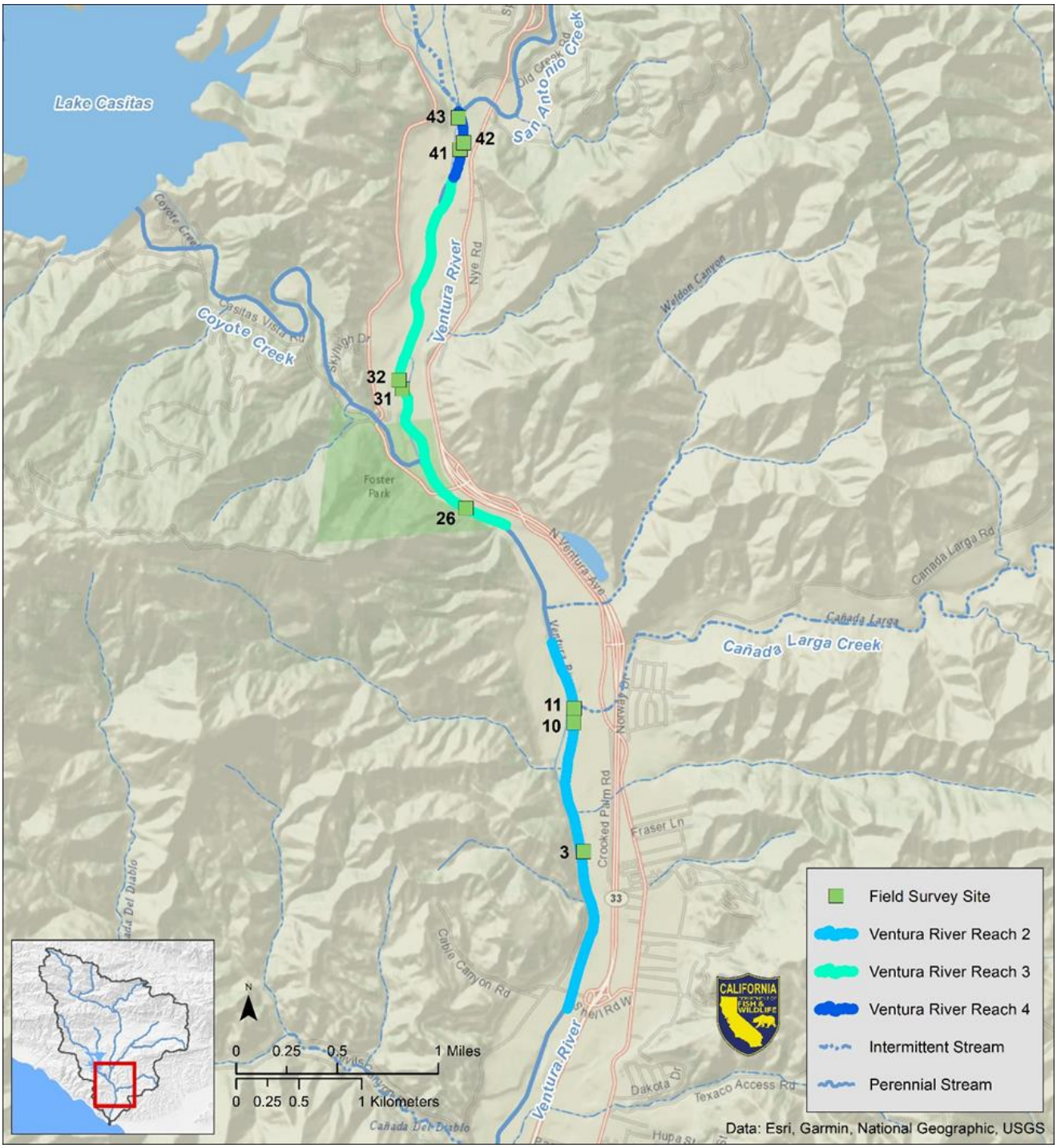

Figure B-1. Final lower Ventura River reaches and riffle transect sites.

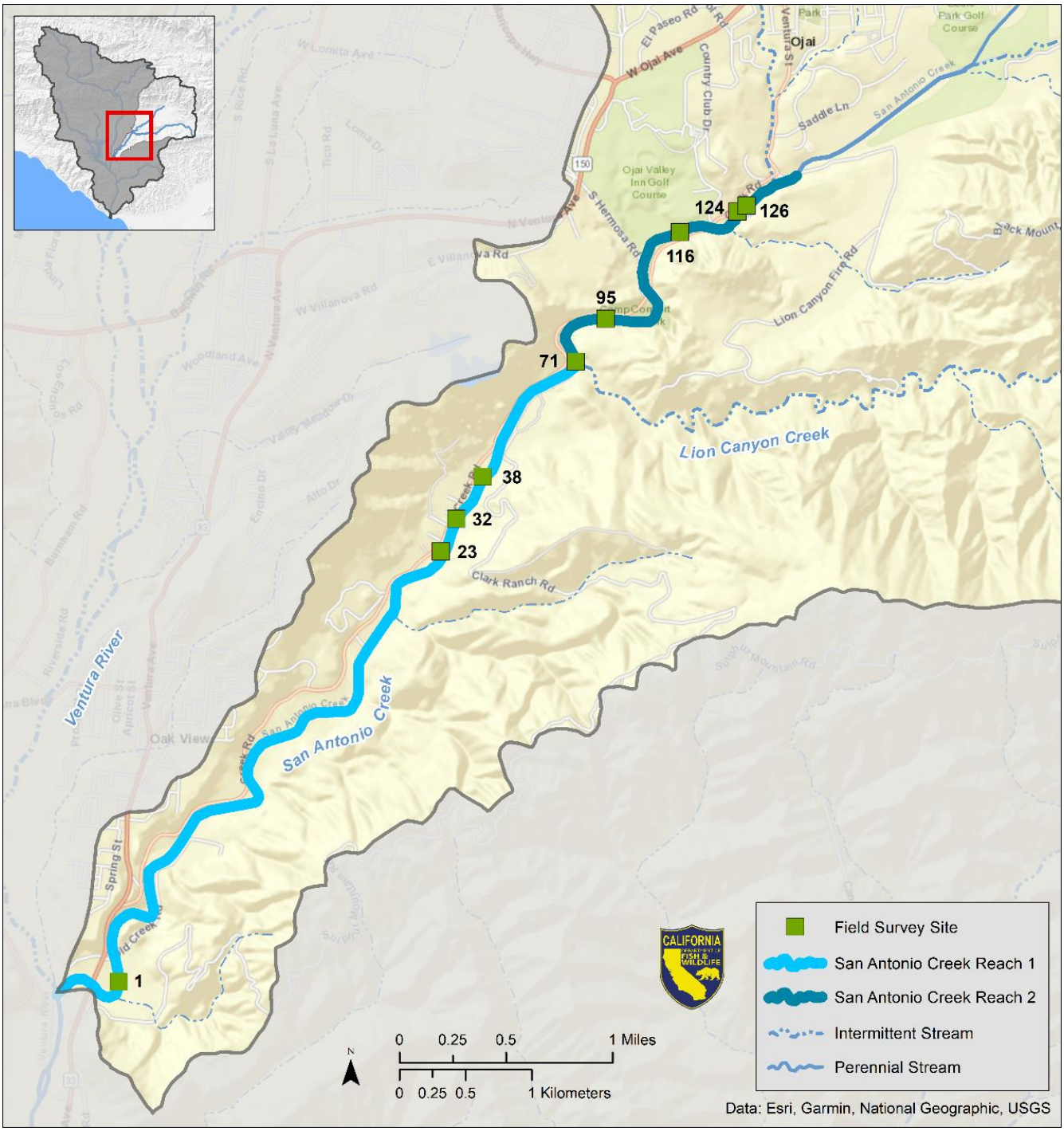

Figure B-2. Final San Antonio Creek reaches and riffle transect sites.

Table B-1. Summary of sites included in the final analysis. X indicates site was included in analysis; - indicates sites removed from analysis for exceeding modeling thresholds, * indicates sites were not evaluated for method.

Reach	Riffle Transect	Sensitive Period Indicator	Steelhead Passage Juvenile	Steelhead Passage Adult
Ventura River 2	LV 3	X	X	X
Ventura River 2	LV 10	X	X	X
Ventura River 2	LV 11	-	X	X
Ventura River 3	LV 26	-	-	X
Ventura River 3	LV 31	X	X	X
Ventura River 3	LV 32	X	X	-
Ventura River 4	LV 41	X	X	-
Ventura River 4	LV 42	-	X	X
Ventura River 4	LV 43	X	X	-
San Antonio 1	SA 1	-	X	-
San Antonio 1	SA 23	X	*	*
San Antonio 1	SA 32	X	*	*
San Antonio 1	SA 38	X	-	-
San Antonio 2	SA 71	X	X	-
San Antonio 2	SA 95	X	*	*
San Antonio 2	SA 116	X	X	-
San Antonio 2	SA 124	-	X	X
San Antonio 2	SA 126	-	X	X

Steelhead Passage Flows were assessed using the Habitat Retention Method (CDFW 2018). See the Overview (CDFW 2020c) and Watershed Criteria report (CDFW 2020a; CDFW 2020b) for more details. Sensitive Period Indicator flows were assessed using the WPM (CDFW 2020b). More details on the WPM analysis are provided below. Differences between measured and modeled water surface elevation (WSEL) estimates for all sites were well within the USFWS (1994) physical habitat simulation guidelines of 0.10 ft (Table B-2).

Table B-2. Hydraulic model calibration results by transect.

Reach	Riffle Transect	Survey Flow Calibration Measurement (cfs)	Field Measured WSEL (ft)	HydroCalc Predicted WSEL (ft)	Difference (+/-)
Ventura River 2	LV3	29.7	98.67	98.67	0.00
Ventura River 2	LV10	34.4	95.40	95.41	0.01
Ventura River 2	LV11	34.4	96.70	96.71	0.01
Ventura River 3	LV26	29.1	96.83	96.83	0.00
Ventura River 3	LV31	16.9	99.62	99.62	0.00
Ventura River 3	LV32	16.9	98.46	98.48	0.02
Ventura River 4	LV41	32.6	98.67	98.65	0.02
Ventura River 4	LV42	29.2	94.54	94.56	0.02
Ventura River 4	LV43	27.7	97.28	97.30	0.02
San Antonio 1*	SA 1	11.5	97.56	97.57	0.01
San Antonio 1	SA 23	5.4	96.70	96.70	0.00
San Antonio 1	SA 32	5.4	98.03	98.03	0.00
San Antonio 1	SA 38	2.8	97.90	97.90	0.00
San Antonio 2	SA 71	5.8	97.43	97.47	0.04
San Antonio 2	SA 95	6.3	97.03	97.03	0.00
San Antonio 2	SA116	10.1	96.68	96.68	0.00
San Antonio 2	SA 124	10.1	97.31	97.32	0.01
San Antonio 2	SA126	10.1	97.77	97.79	0.02

The WPM requires a graphical plot to be generated showing the relationship between wetted perimeter and discharge. A sharp reduction in slope (or "breakpoint") indicates a reduction in the rate of increase of wetted channel area with an increase in flow. The Sensitive Period Indicator for each transect is determined by 1) visually identifying the lowest discharge associated with a slope breakpoint on the plot and 2) estimating the discharge at which 50% of the perimeter of the bankfull channel is wetted in streams up to 50 ft wide (Annear et al. 2004; CDFW 2020b). The Sensitive Period Indicator is the larger of these two discharges. For streams up to 50 feet wide, 50% of the bankfull channel must be wetted; for streams wider than 50 feet, 60% of the bankfull channel must be wetted. The cross-section plots with the Sensitive Period Indicator WSEL and wetted perimeter-discharge curves for each site are provided in Figures B-3 to B-26.

* 11.4% of total flow fell within one discharge cell at this site, exceeding the 10% maximum recommended in the IFP Discharge SOP (CDFW 2020d). Given the slight discrepancy and flow conditions, the flow measurement was determined to be adequate for the purposes of this analysis.

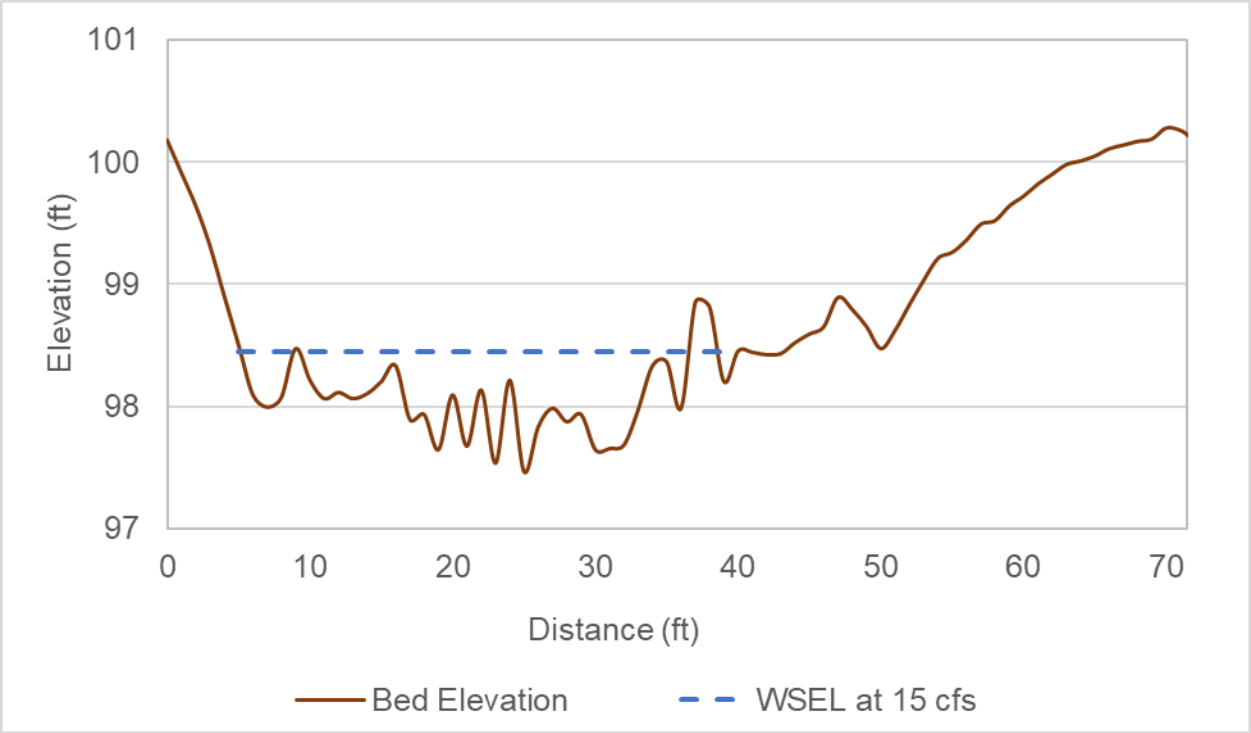

Figure B-3. LV3 (Lower Ventura River VR2 transect) bed and WSEL profile at 15 cfs.

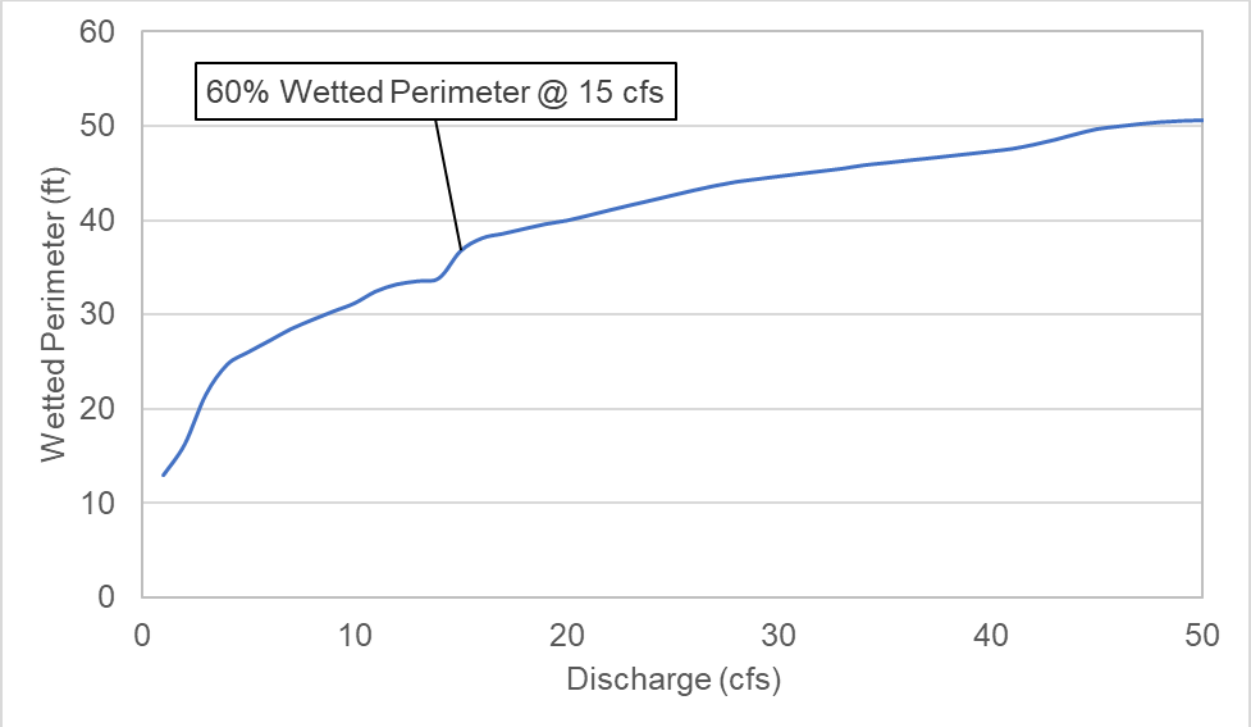

Figure B-4. LV3 (Lower Ventura River VR2 transect) discharge versus wetted perimeter.

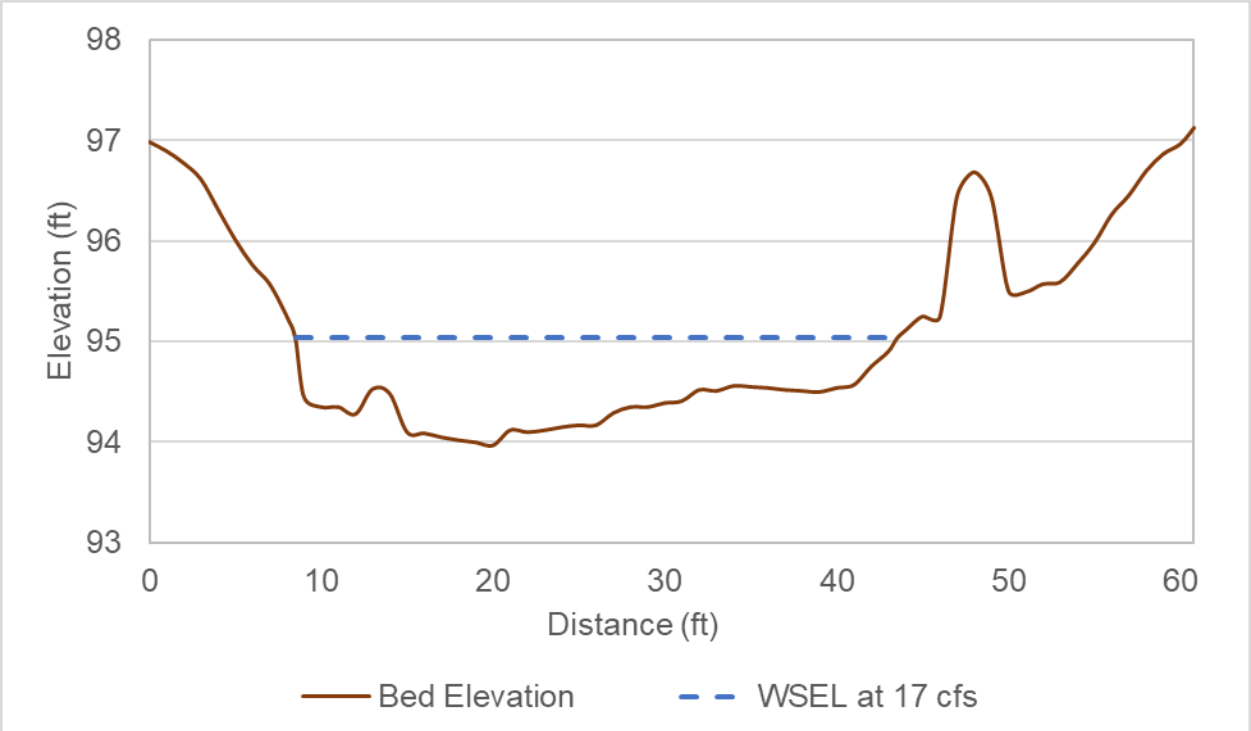

Figure B-5. LV10 (Lower Ventura River VR2 transect) bed and WSEL profile at 17 cfs.

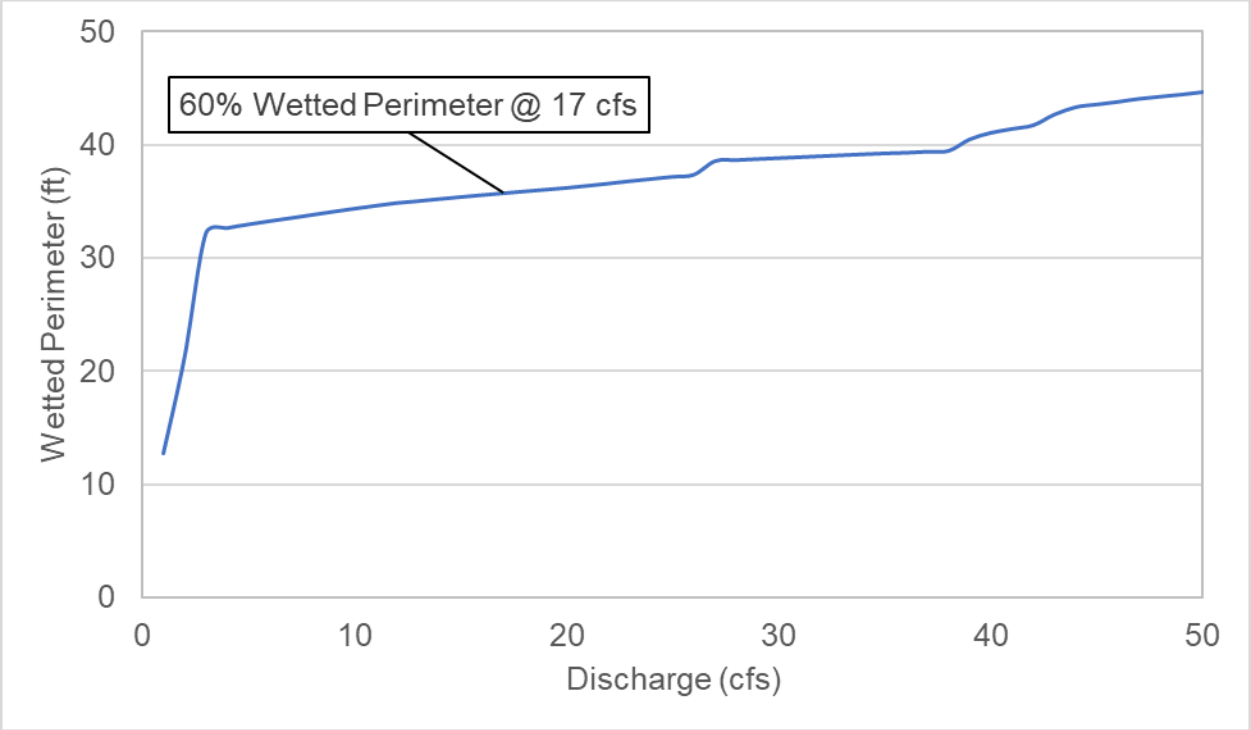

Figure B-6. LV10 (Lower Ventura River VR2 transect) discharge versus wetted perimeter.

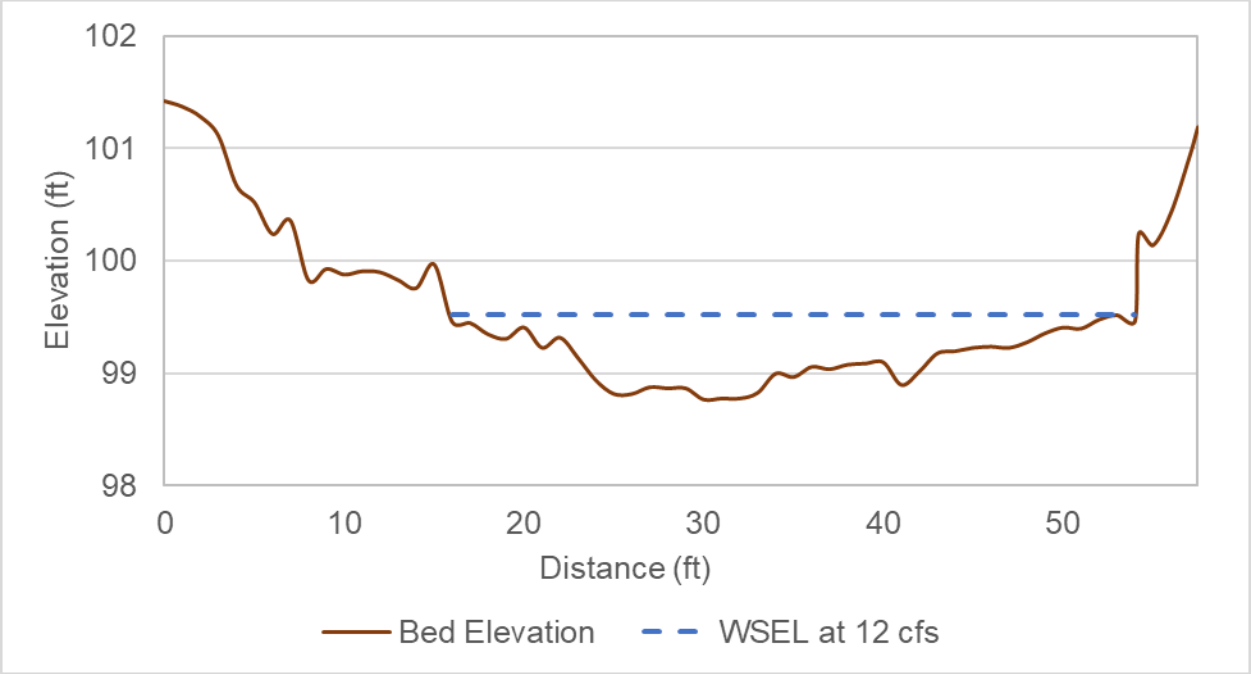

Figure B-7. LV31 (Lower Ventura River VR3 transect) bed and WSEL profile at 12 cfs.

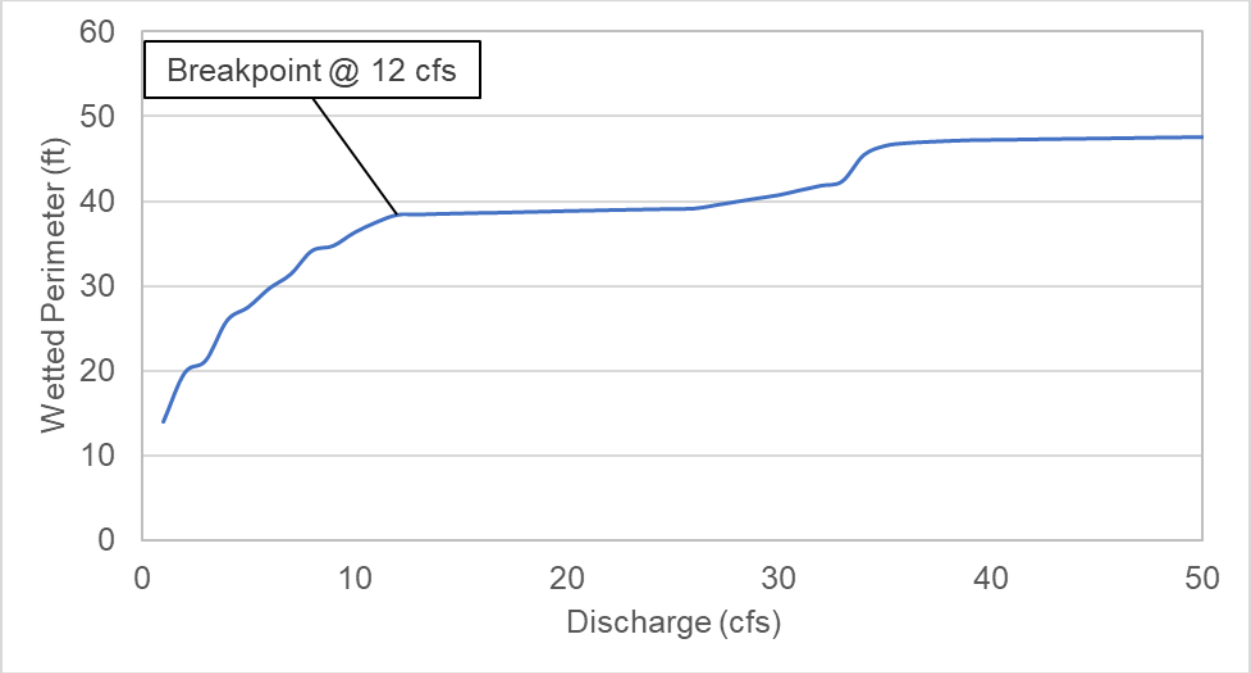

Figure B-8. LV31 (Lower Ventura River VR3 transect) discharge versus wetted perimeter.

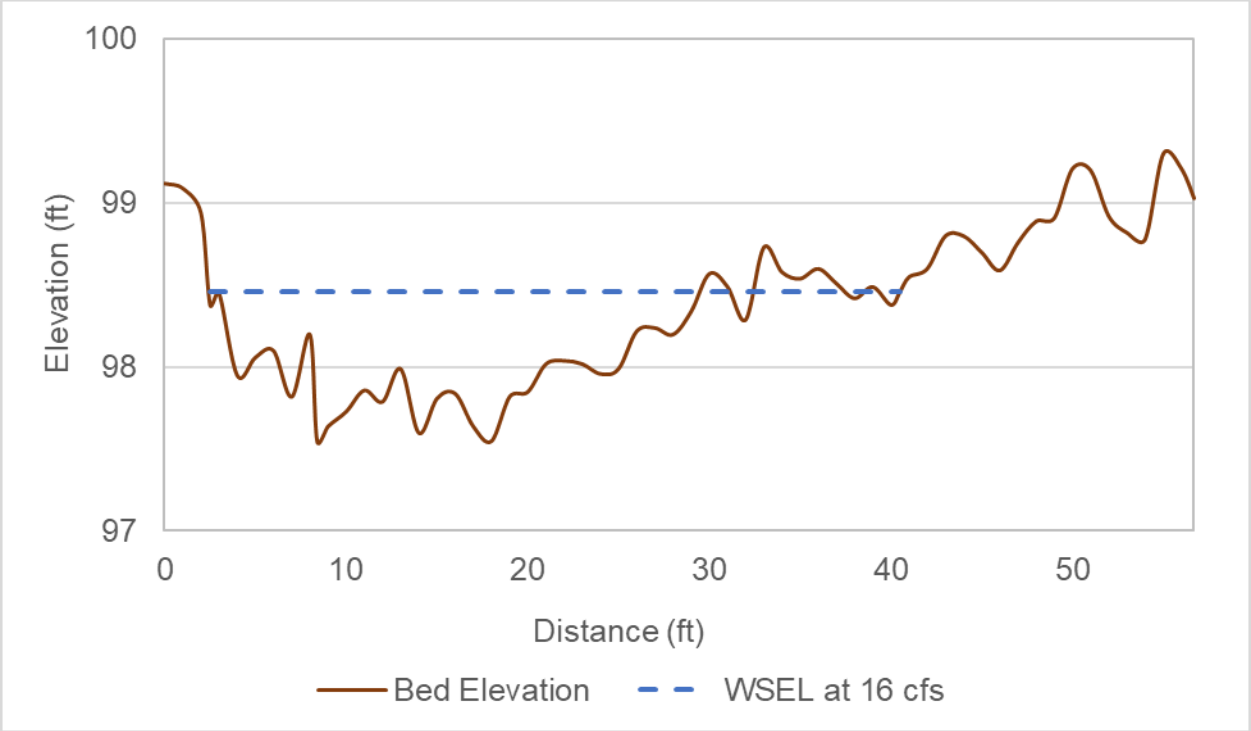

Figure B-9. LV32 (Lower Ventura River VR3 transect) bed and WSEL profile at 16 cfs.

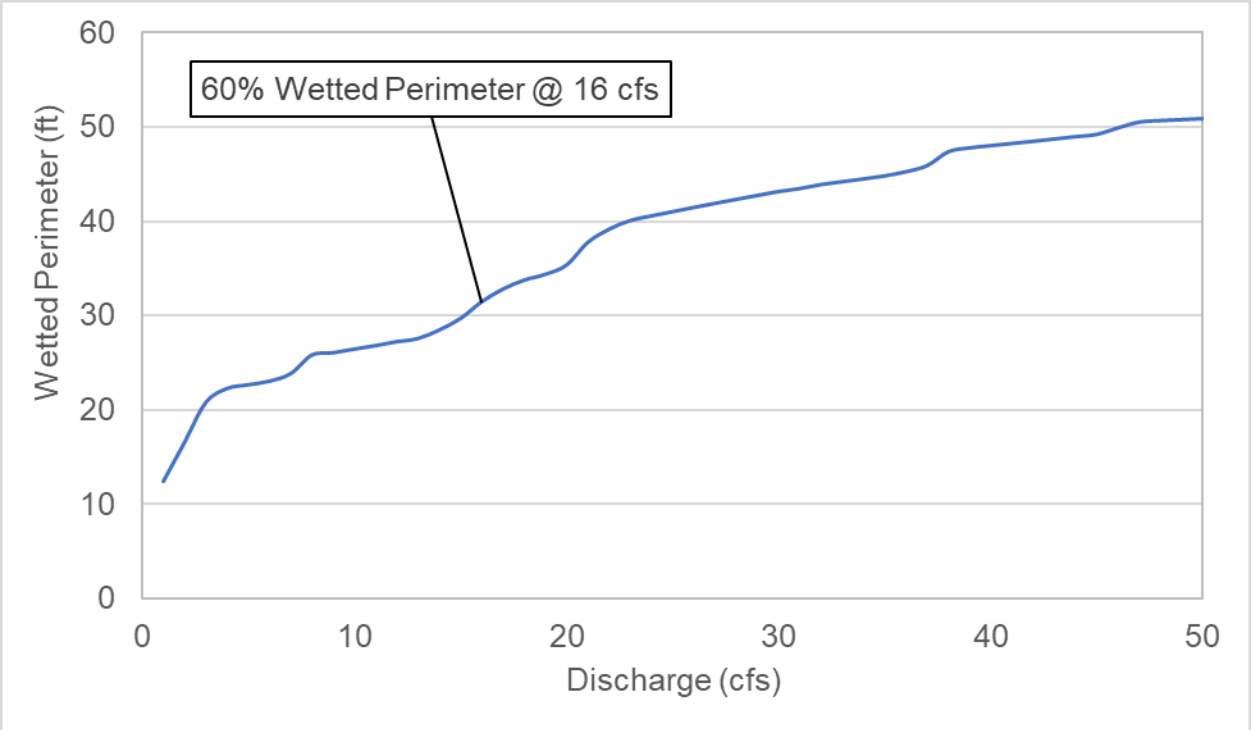

Figure B-10. LV32 (Lower Ventura River VR3 transect) discharge versus wetted perimeter.

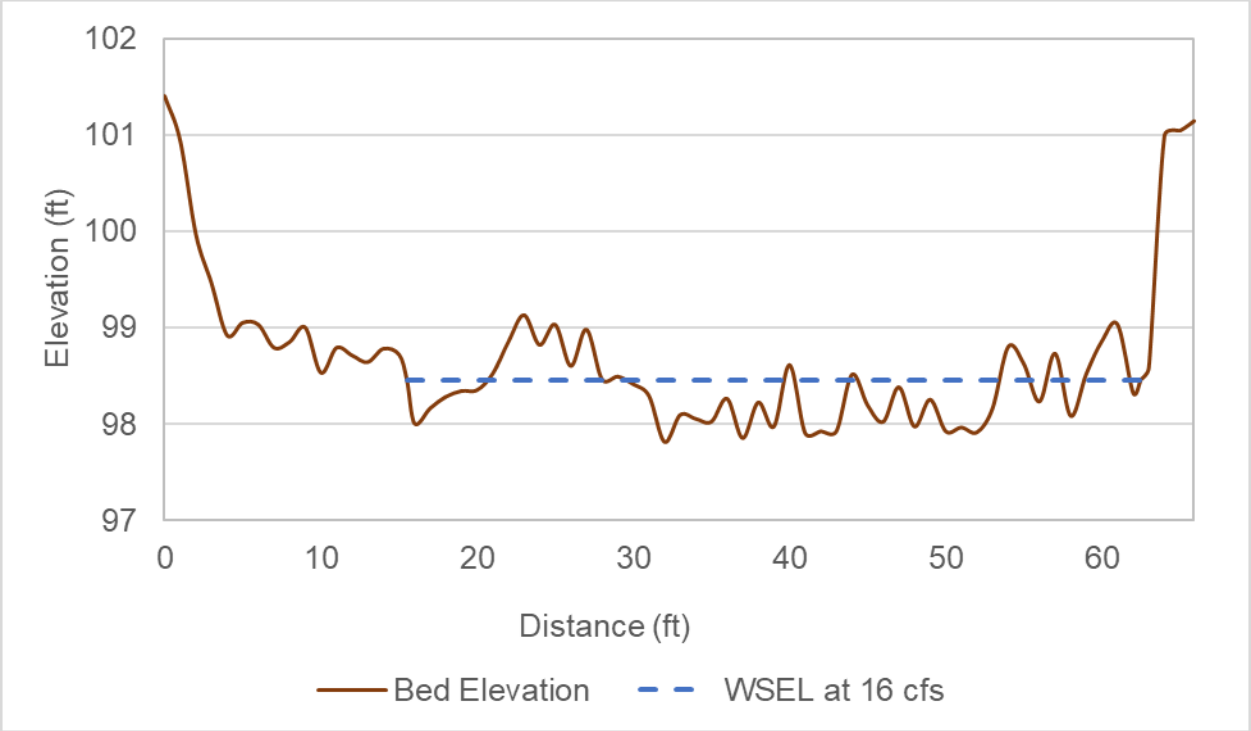

Figure B-11. LV41 (Lower Ventura River VR4 transect) bed and WSEL profile at 16 cfs.

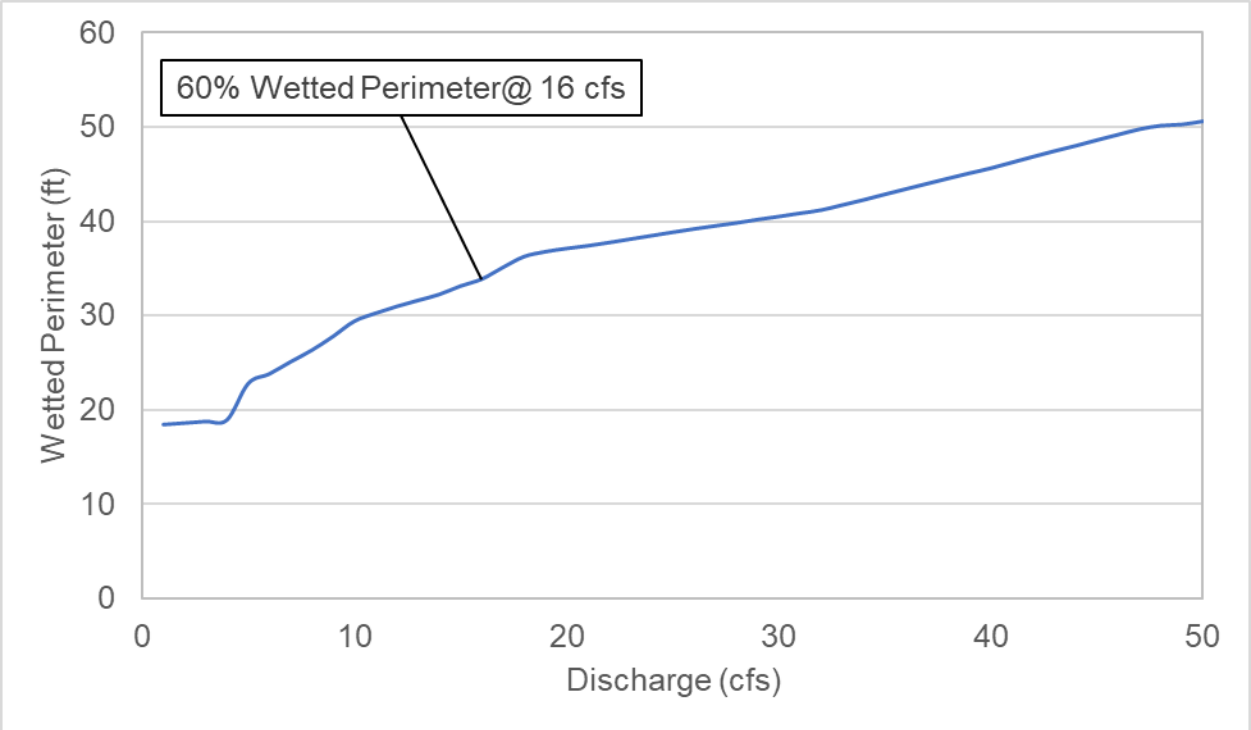

Figure B-12. LV41 (Lower Ventura River VR4 transect) discharge versus wetted perimeter.

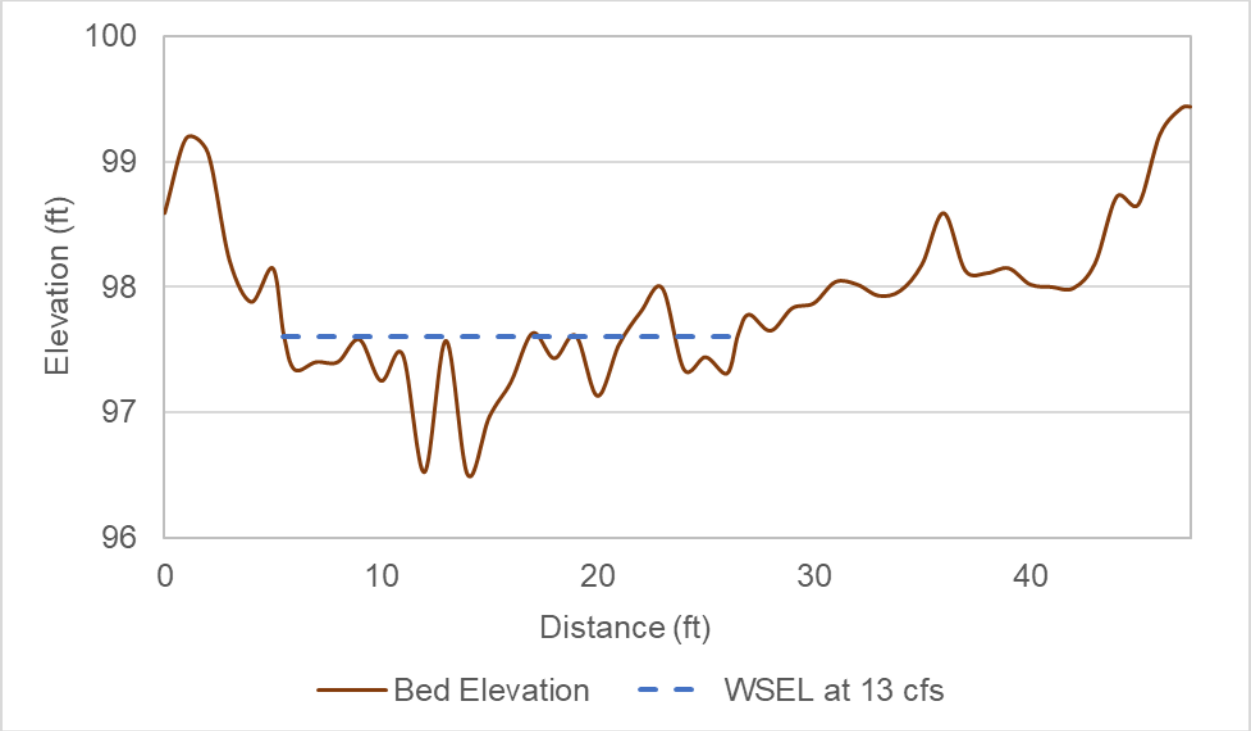

Figure B-13. LV43 (Lower Ventura River VR4 transect) bed and WSEL profile at 13 cfs.

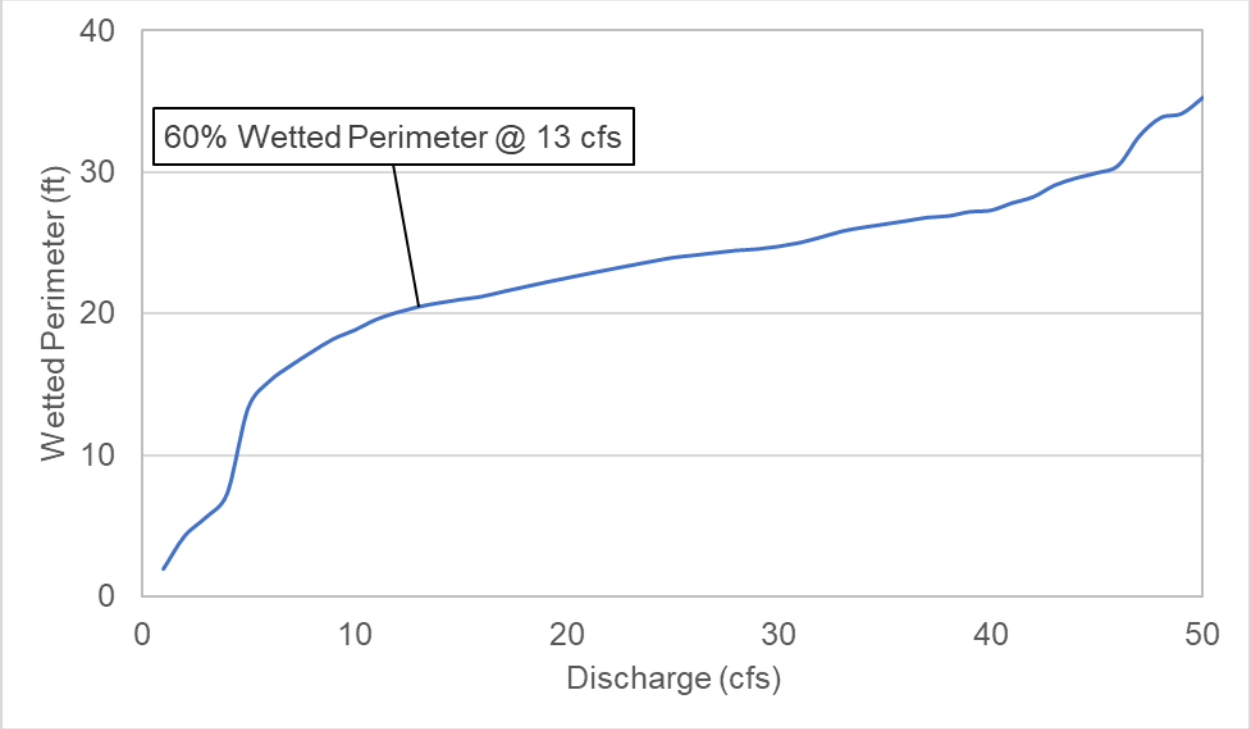

Figure B-14. LV43 (Lower Ventura River VR4 transect) discharge versus wetted perimeter.

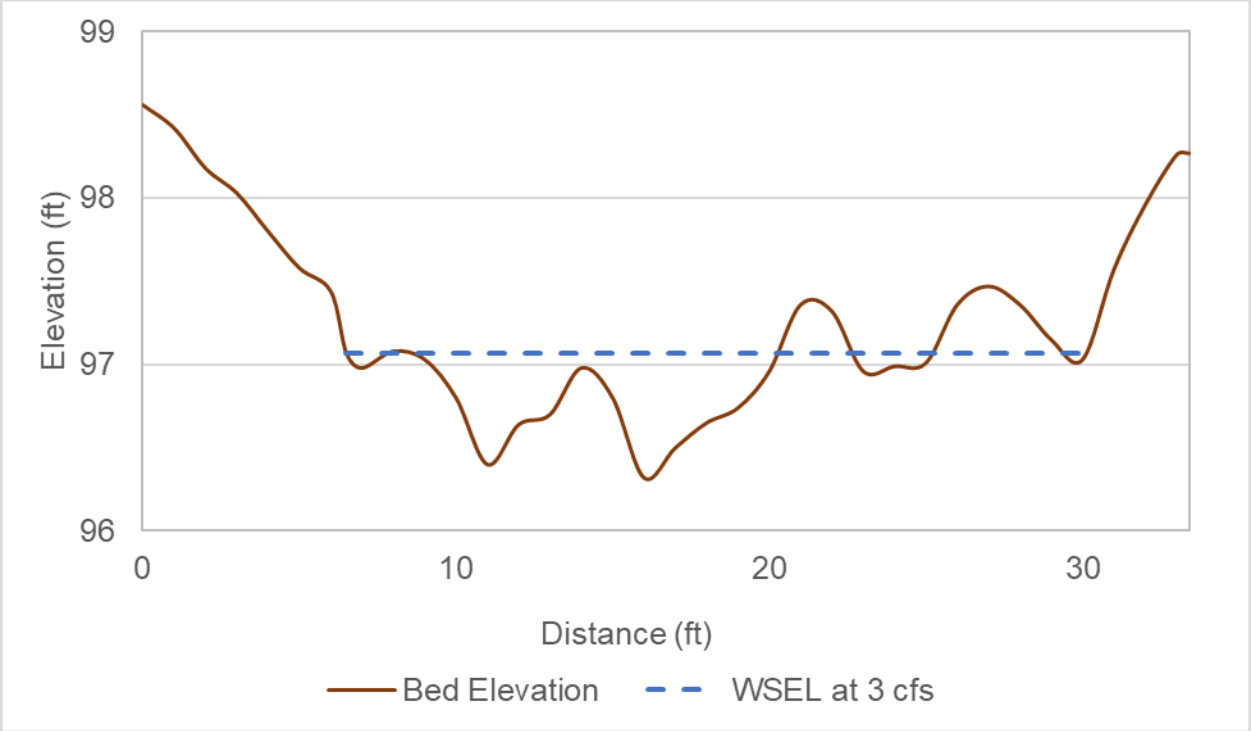

Figure B-15. SA23 (San Antonio Creek SA1 transect) bed and WSEL profile at 3 cfs.

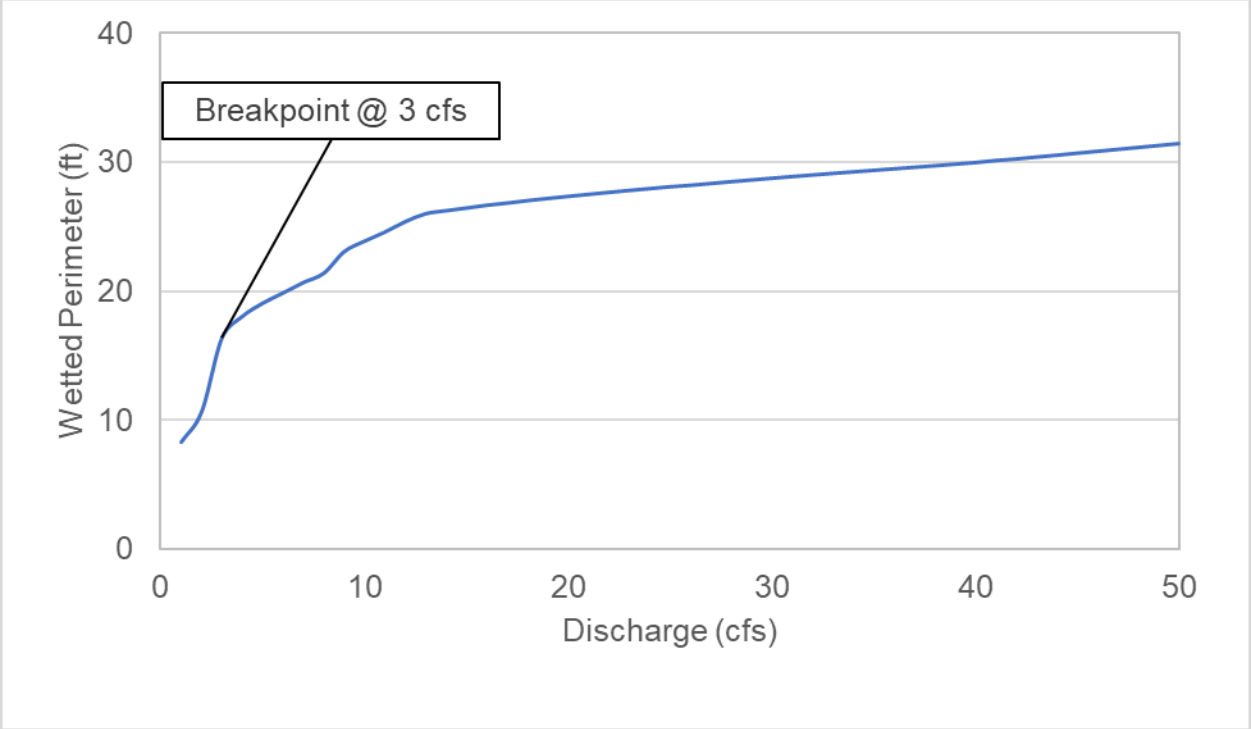

Figure B-16. SA23 (San Antonio Creek SA1 transect) discharge versus wetted perimeter.

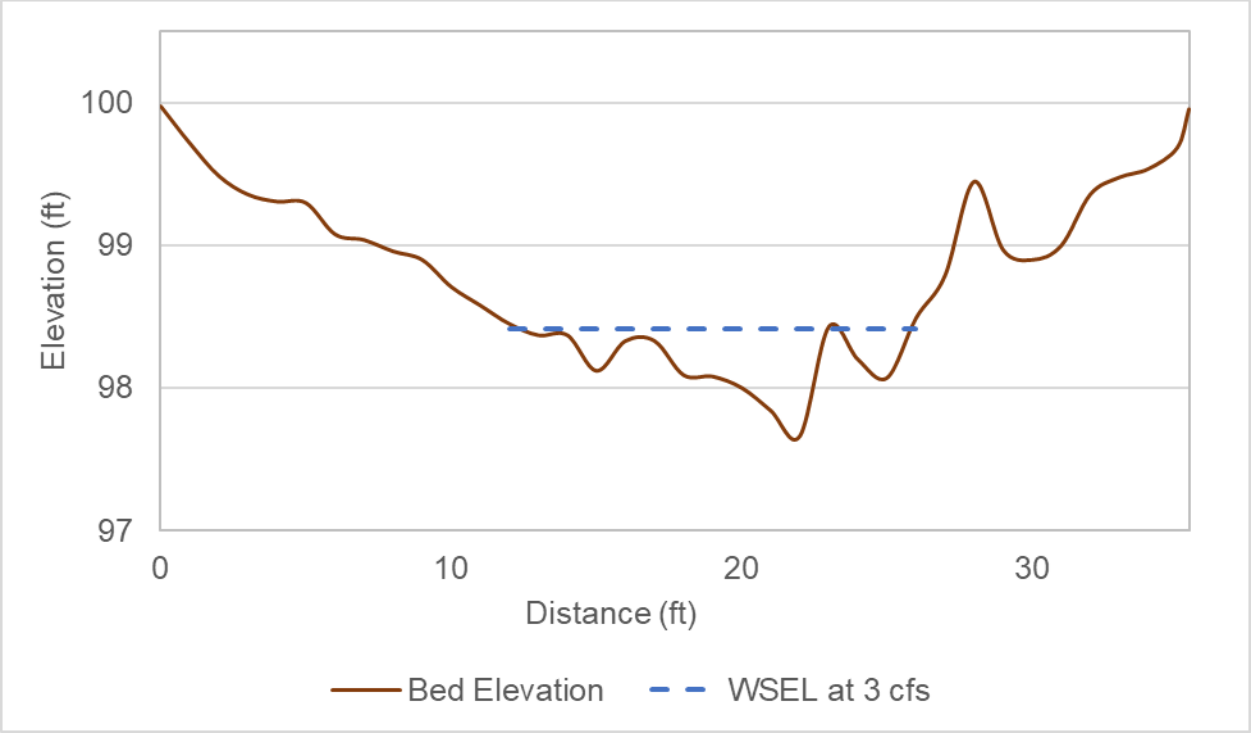

Figure B-17. SA32 (San Antonio Creek SA1 transect) bed and WSEL profile at 3 cfs.

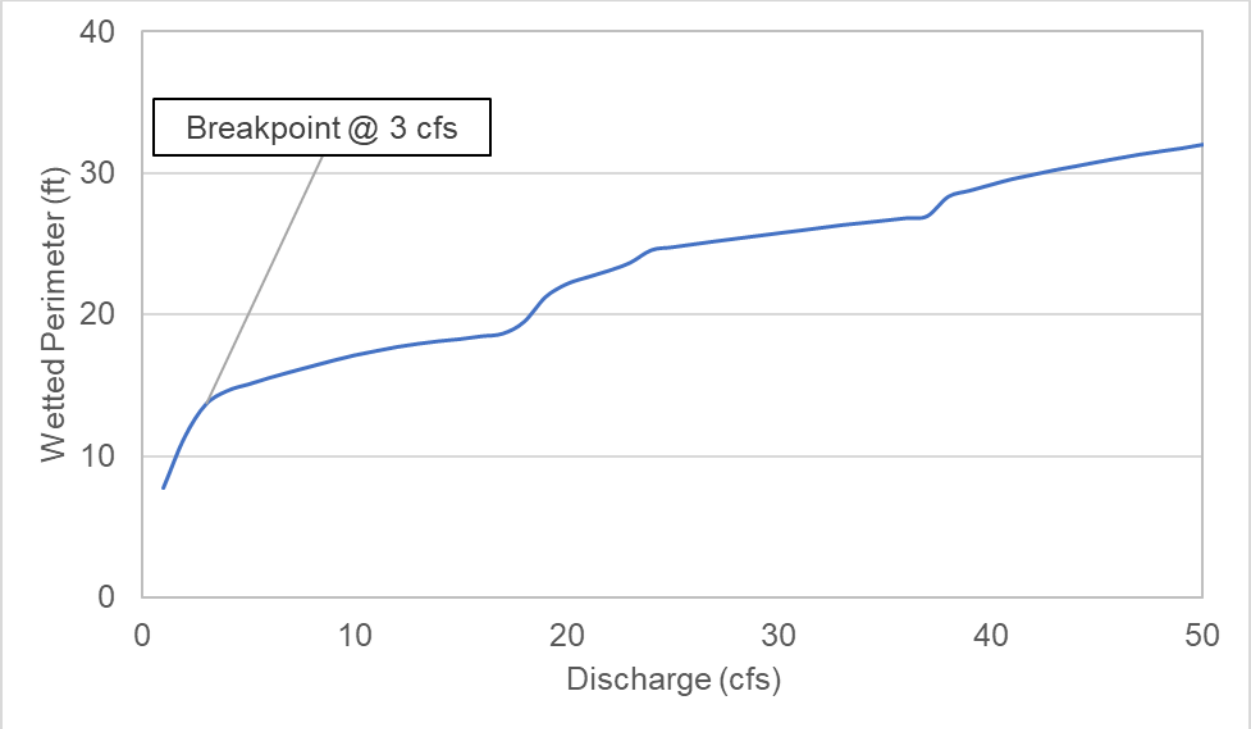

Figure B-18. SA32 (San Antonio Creek SA1 transect) discharge versus wetted perimeter.

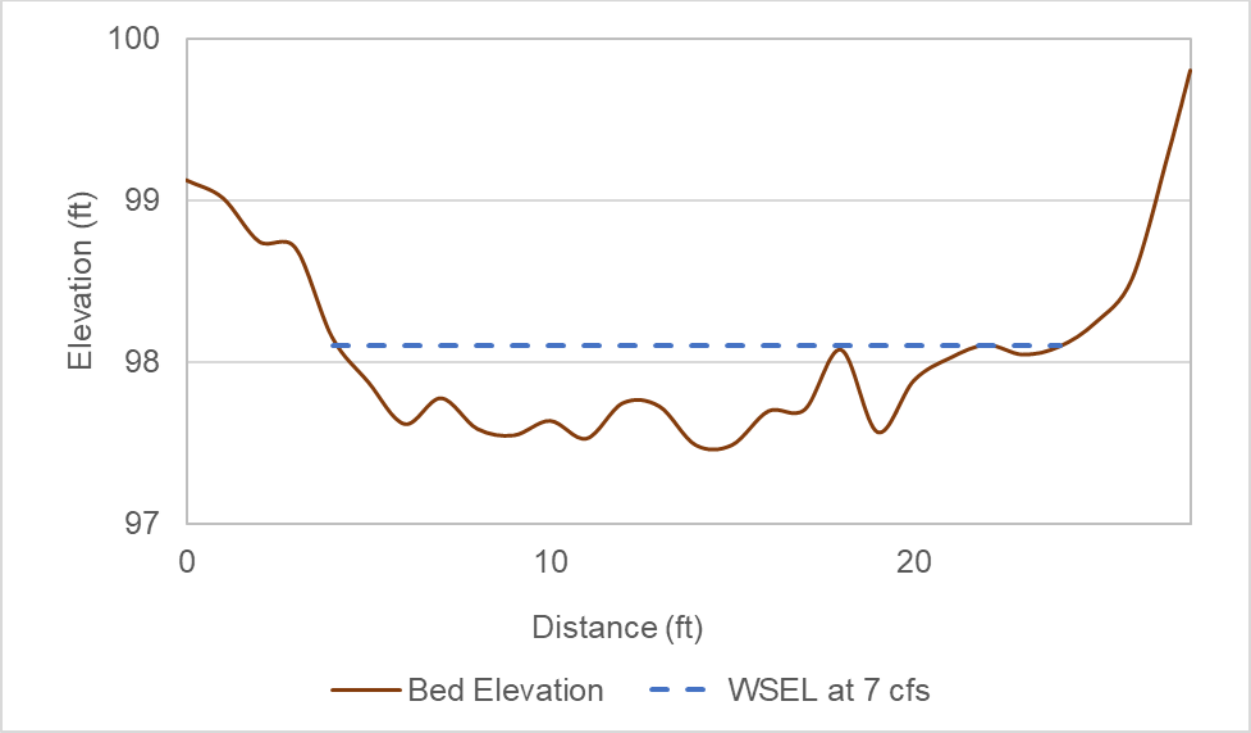

Figure B-19. SA38 (San Antonio Creek SA1 transect) bed and WSEL profile at 7 cfs.

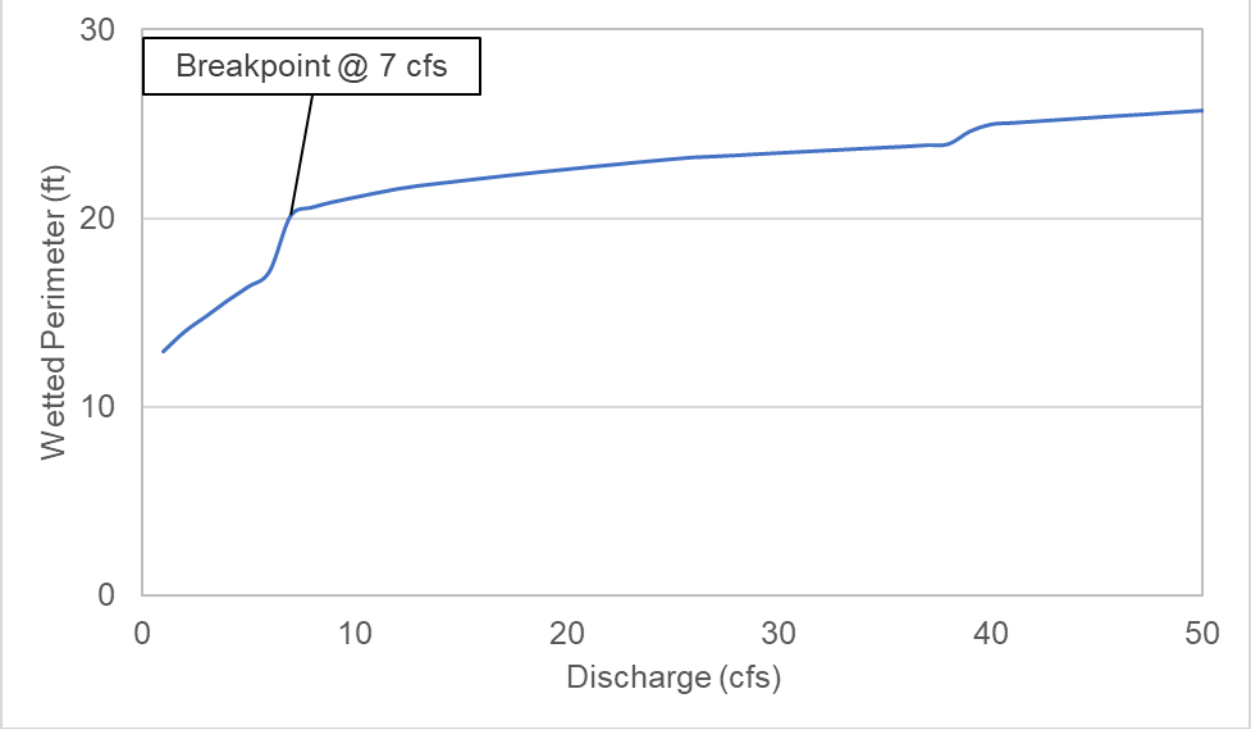

Figure B-20. SA38 (San Antonio Creek SA1 transect) discharge versus wetted perimeter.

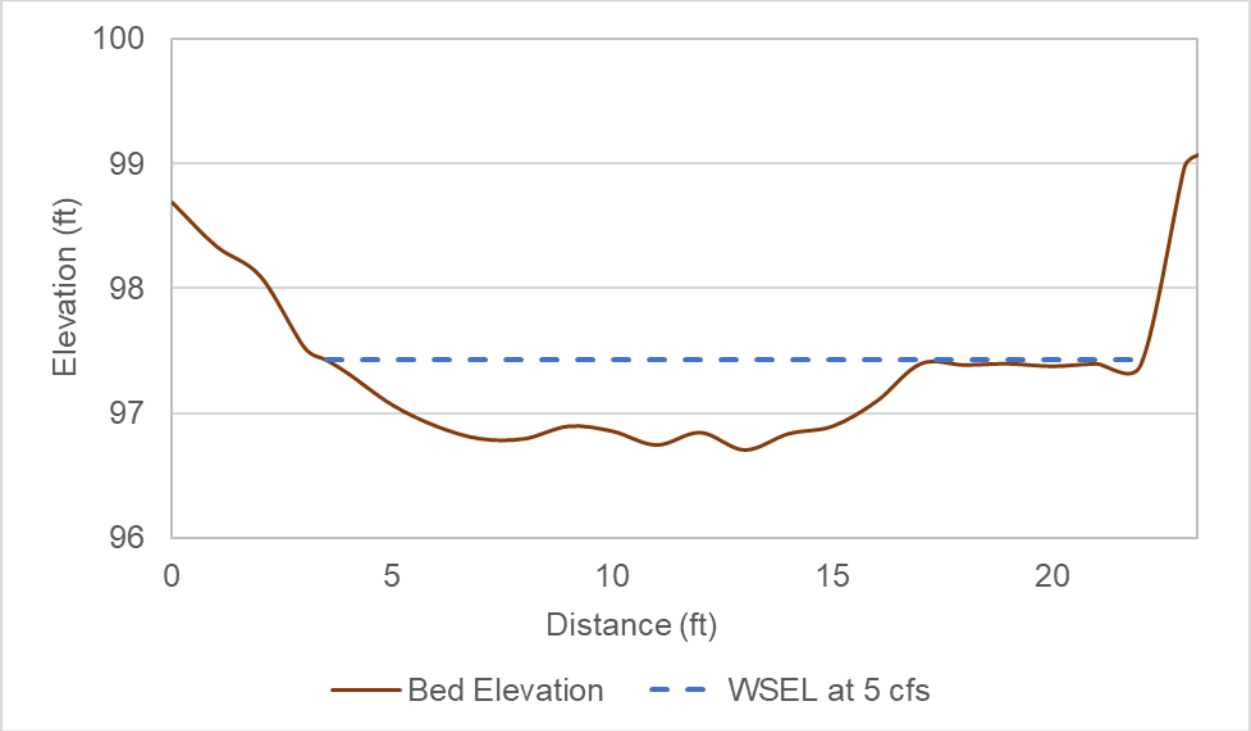

Figure B-21. SA71 (San Antonio Creek SA2 transect) bed and WSEL profile at 5 cfs.

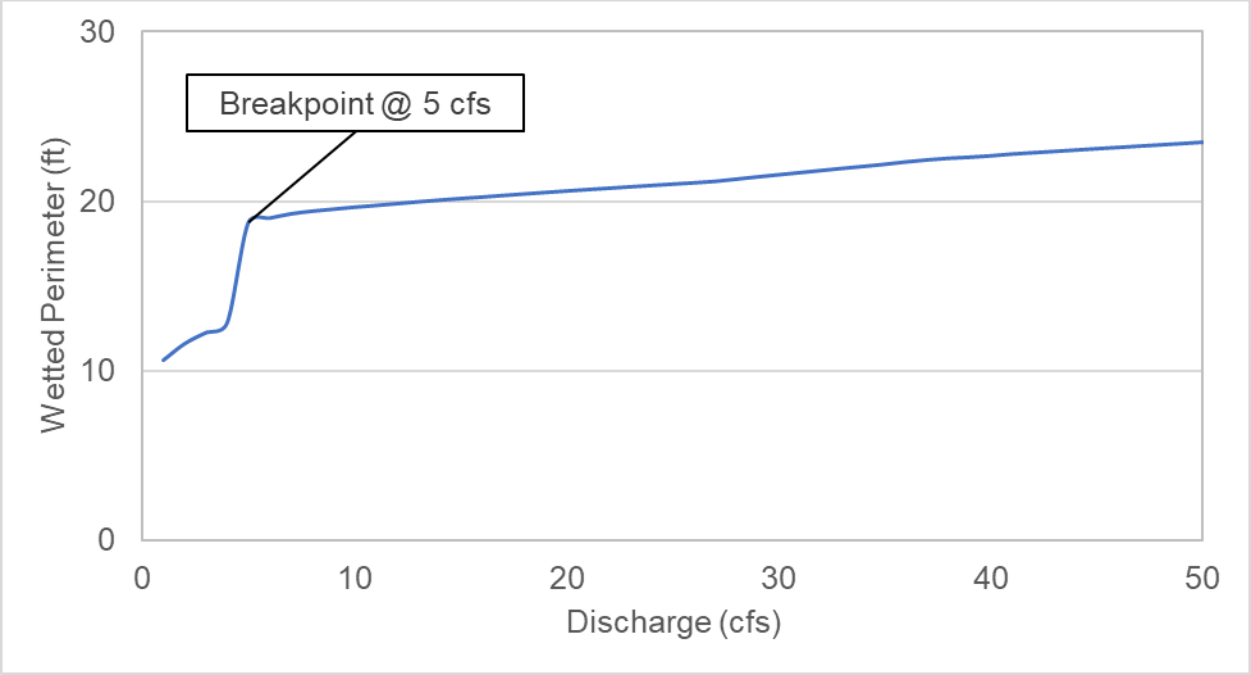

Figure B-22. SA71 (San Antonio Creek SA2 transect) discharge versus wetted perimeter.

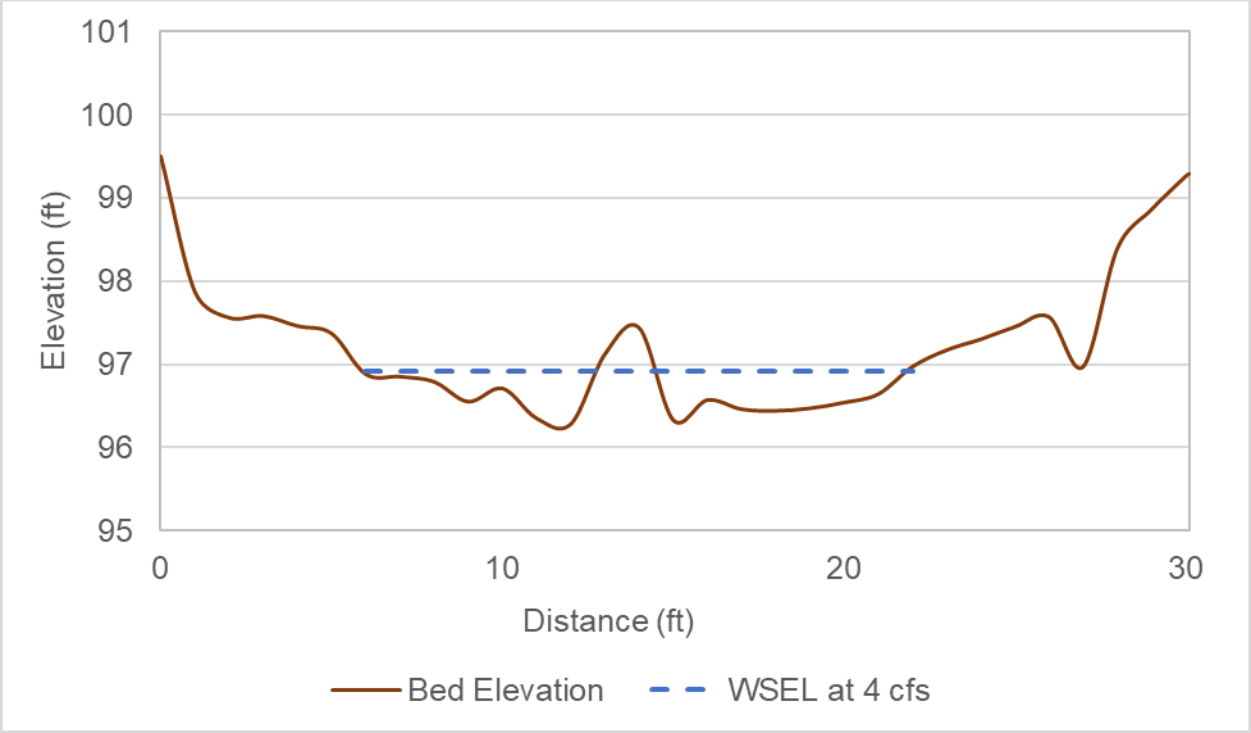

Figure B-23. SA95 (San Antonio Creek SA2 transect) bed and WSEL profile at 4 cfs.

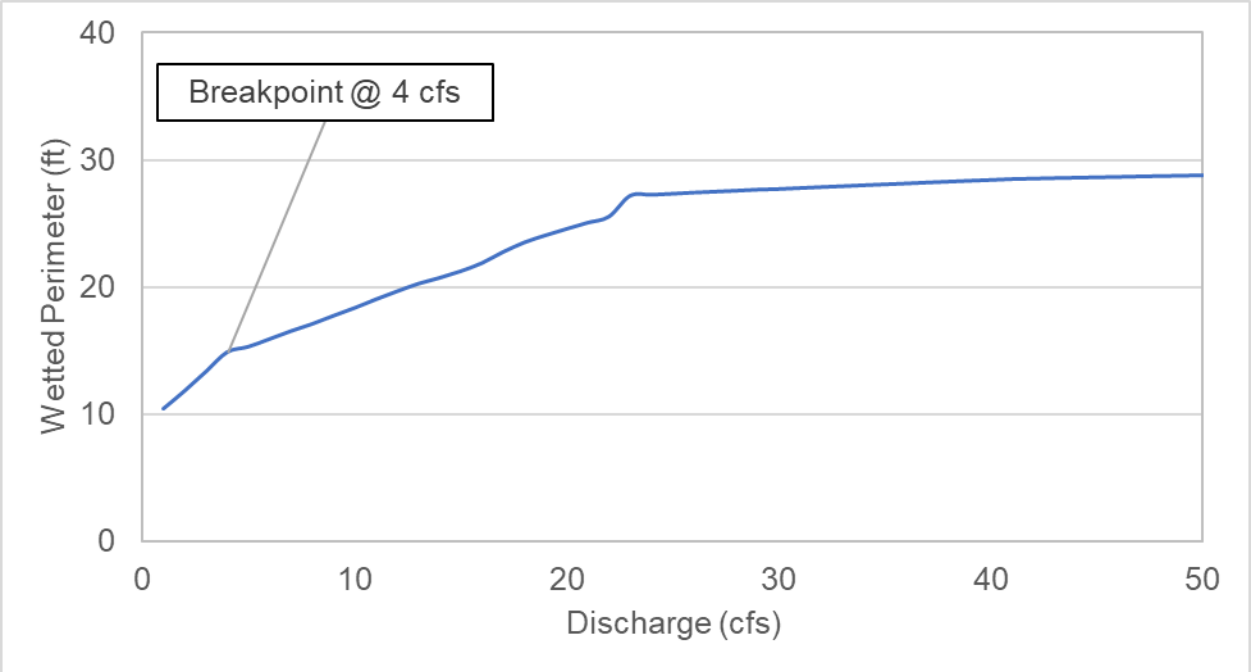

Figure B-24. SA95 (San Antonio Creek SA2 transect) discharge versus wetted perimeter.

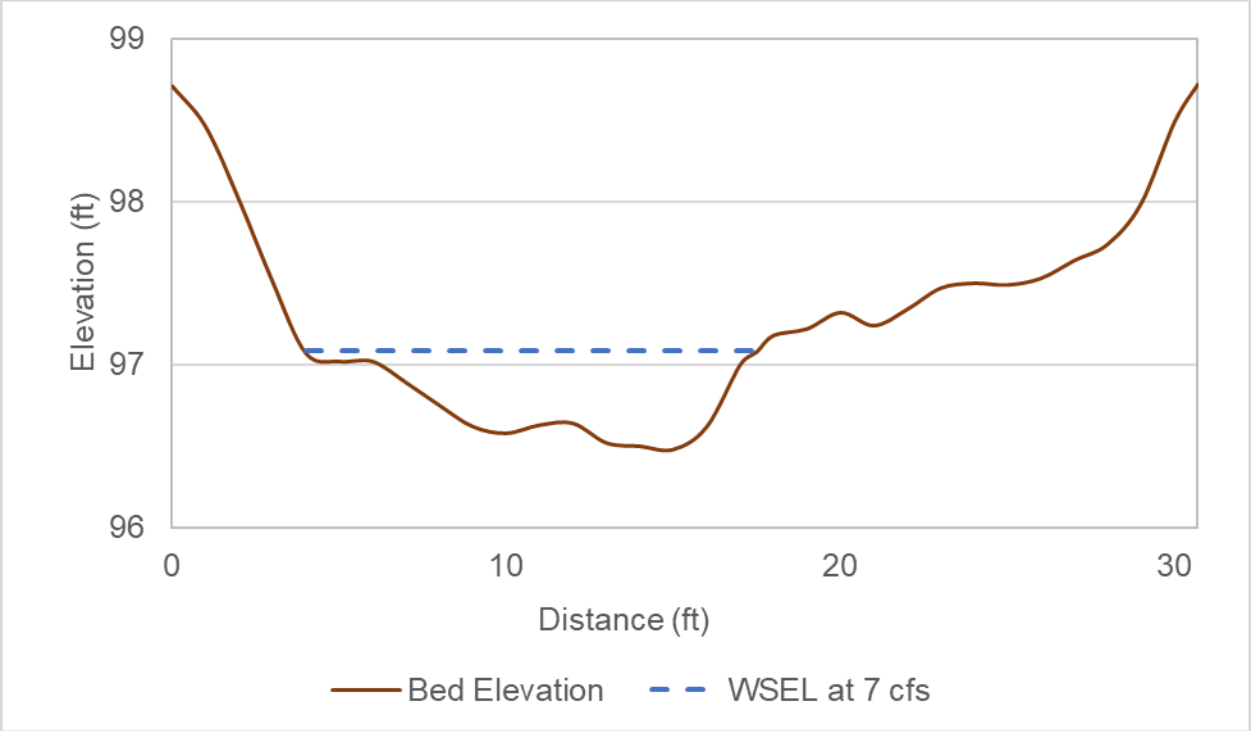

Figure B-25. SA116 (San Antonio Creek SA2 transect) bed and WSEL profile at 7 cfs.

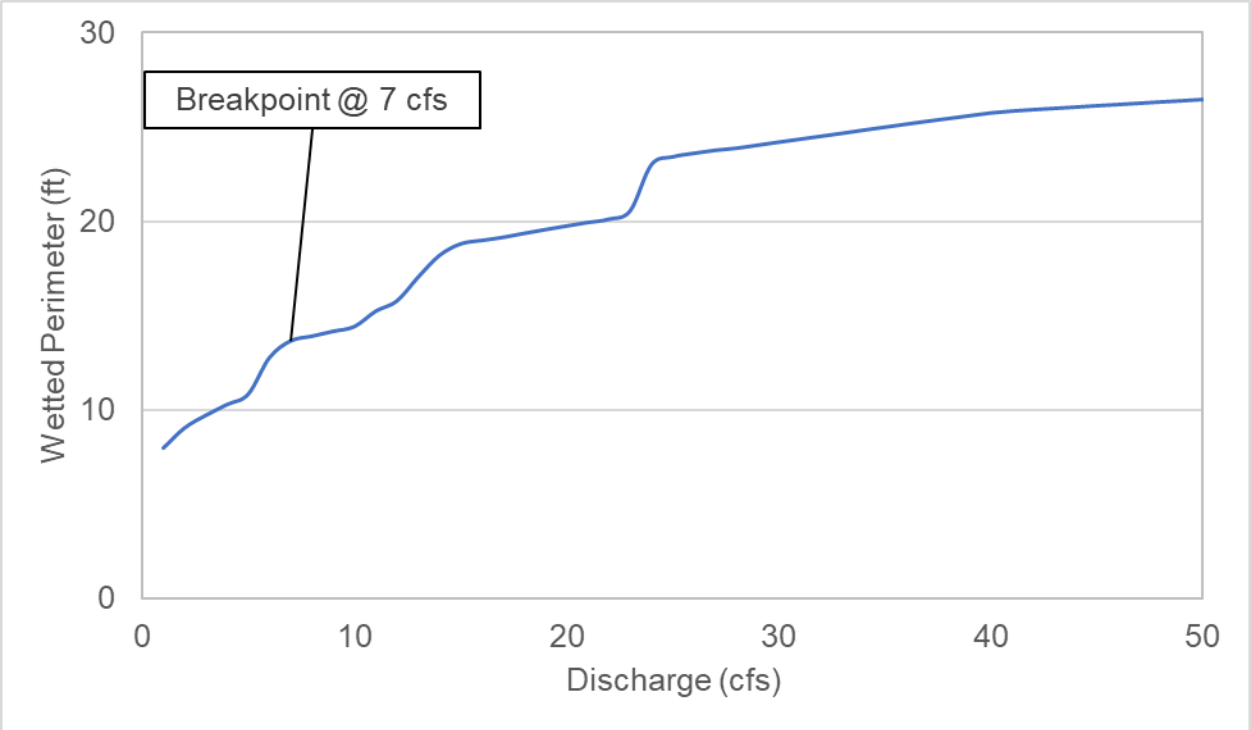

Figure B-26. SA116 (San Antonio Creek SA2 transect) discharge versus wetted perimeter.

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