WRPI Final Report 2019: Angeles National Forest, Stream Condition Inventory

Christopher Notto
California State University, Northridge
Kelsha Anderson, Forest Hydrologist
Angeles National Forest
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Acknowledgements

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Executive Summary

For the WRPI USDA Experiential Learning Experience internship of summer 2019, a Stream Condition Inventory was completed on a 643.5-foot reach of Eaton Wash, in Eaton Canyon, within the Angeles National Forest. Data collected includes basic water quality, channel cross sections, longitudinal profile, sediment distribution, and stream bank angle/stability. This data was collected in order to later asses the overall health of the stream habitat. This specific reach was chosen for baseline hydrologic and geomorphic data to be established in a previously unstudied reach.

Introduction

The project that I was placed on for the WRPI Internship during the summer of 2019, was to work with Angeles National Forest Hydrology in order to complete three Stream Condition Inventories (SCI) within watersheds of the Angeles National Forest. Two were completed on the East Fork San Gabriel River, and another completed on Eaton Wash, in Eaton Canyon. The following pages of this document, contain the finished technical report for the SCI conducted for Eaton Wash, in which I took part in all processes of its completion, from data collection, to analyzing collected data, to writing and publishing this technical report.

Angeles National Forest Stream Condition Inventory, Eaton Wash, Eaton Canyon Reach

Technical Report

August 21, 2019

Prepared by: Jamie Seguerra, Christopher Notto, Nicoletta Stork.
Jeremy Lorenzen

Table of Contents

Introduction

A Stream Condition Inventory (SCI) (Frazier et. al, 2005) was completed for Eaton Wash on July 24 through August 1, 2019. The location of this survey is in Eaton Canyon in the Southeast corner of section 2 of Township 1 North, Range 12 West of the Public Land Survey System (PLSS). Drainage area of this reach is 130.5 mi^2 (83,520 acres). The surveyed reach is 643.5 feet.

Physical data were collected, including: thalweg longitudinal profile, monumented riffle cross-sections, sediment particle size distribution, stream cover shading, stream bank stability, stream bank angle, large woody debris count, pool-tail fine sediment and basic water quality measurements.

Project Background

Stream condition inventory (SCI) surveys are useful in diagnosing and monitoring stream health over time to support the mission of land management agencies to maintain and restore functionality of stream and riparian areas. Physical characteristics of the floodplain, stream, and riparian buffer were documented to establish the first SCI at the Eaton Canyon reach of Eaton Wash (*Figure 1*). This particular reach was chosen in order to establish baseline hydrologic and fluvial geomorphic data for a reach of Eaton Wash as a representation of the channel.

The reach is located at the foot of the San Gabriel Mountains and drains into Rio Hondo River. From Mt. Wilson Toll Road. The Eaton Canyon Falls Trail head is heavily trafficked and is about half a mile to the Eaton Canyon Waterfall. Steep canyon walls and loose material running adjacent to the stream cause the trail to cross the stream in several locations.

Site Description

Location

The study site is located on a 643.5-foot reach of Eaton Wash in Eaton Canyon in the Southeast corner of section 2 of Township 1 North, Range 12 West of the Public Land Survey System (PLSS). Eaton Canyon can also be located within the Mount Wilson Quadrangle. Eaton Canyon can also be located on the Mount Wilson Quadrangle, California-Los Angeles Co., 7.5-minute series map. The surveyed reach is a frequently hiked area with several undesignated stream crossing locations leading to the Eaton Canyon Falls.

Flora and Fauna

The dominant observed vegetation in the reach consists of white alder *(Alnus rhombifolia)*, poison oak *(Toxicodendron diversilobum),* flannel bush *(Fremontodendron)*, stinging nettle *(Urtica dioica)*, mule fat (*Baccharis salicifolia*), chaparral yucca (*Hesperoyucca whipplei*)*,* California buckwheat (*Eriogonum fasciculatum*), coast live oak (*Quercus agrifolia*). Aquatic fauna were observed along the reach that include giant waterbug (*Lethocerus americanus*), water strider (*Aquarius remigis*), an unidentified frog, and numerous unidentified tadpoles.

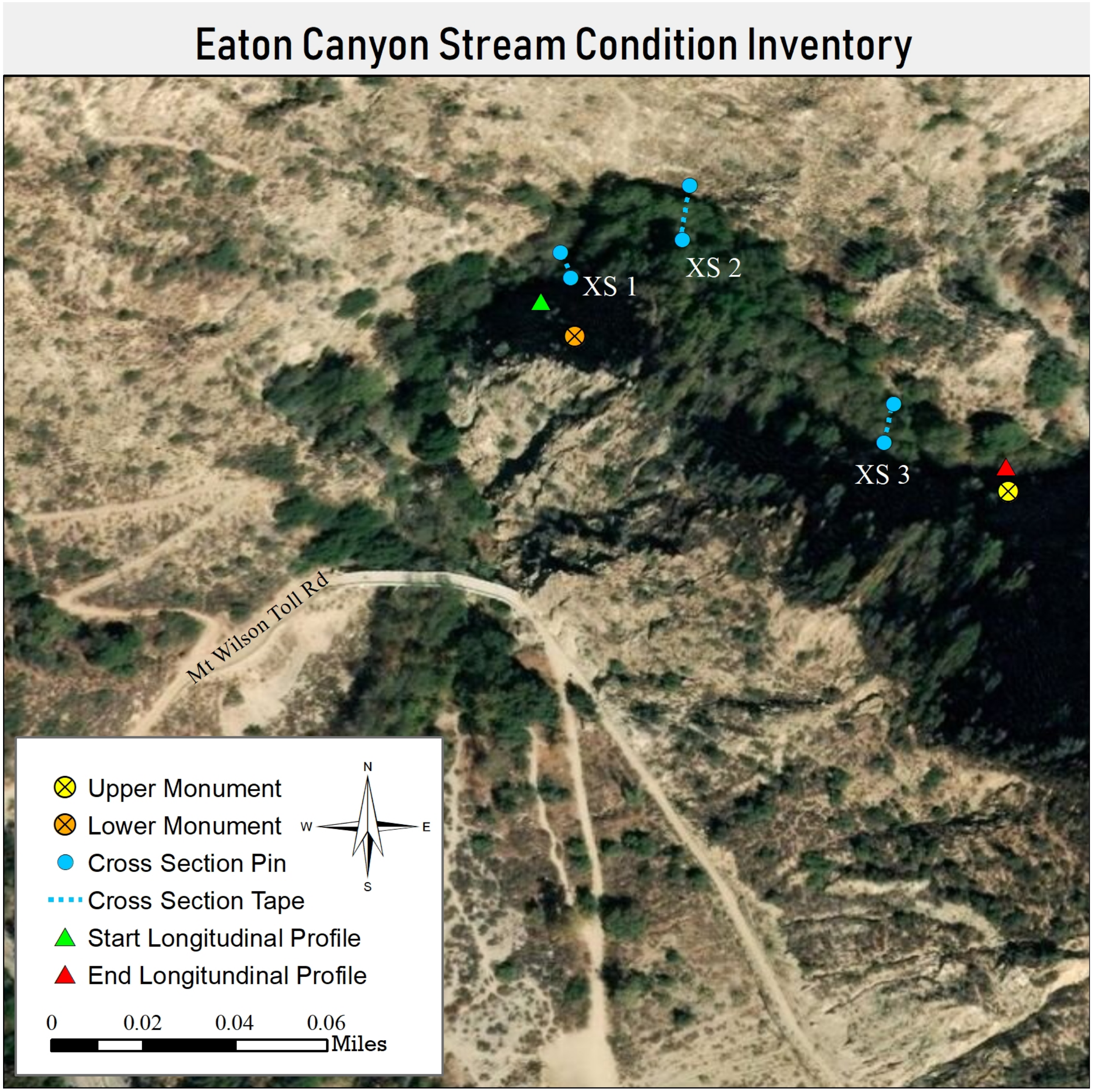


Figure 1: Stream Condition Inventory, Eaton Wash, Eaton Canyon reach.

Methods

Longitudinal Profile

Two permanent benchmark monuments were established: a lower monument near the downstream end of the reach and an upper monument near the upstream end of the reach. GPS coordinates were taken of the lower and upper monument using the Avenza Maps mobile application. The elevation for these monuments were established by plotting their GPS points over a DEM (digital elevation model) derived from lidar source data of one-meter resolution (U.S. Geological Survey, 2018). Longitudinal profile measurements began downstream of cross-section 1 and was tied into the lower monument with a series of turning points. Once the height of the instrument was established, points of elevation were measured in the thalweg, throughout the entire surveyed reach in order to measure streambed morphology and gradient within the reach.

Monumented Channel Cross Sections

Three cross sections were selected to capture the characteristics in the surveyed reach based on the availability of accessible pin locations in the canyon wall and with the concern of hiker safety as a priority. Cross-section 1 was established downstream to capture a riffle section of the reach. Cross-section 2 was established just upstream of cross-section 1 at a riffle where the banks and floodplain were comprised of unstable and unsorted alluvium. Cross-section 3 was established farthest upstream to capture more of the unstable alluvium.

Particle Size Distribution

To obtain a particle size distribution, four pebble counts of 100 samples each were conducted on the surveyed reach; one per cross-section and one pebble count for the survey reach for a total of four pebble counts conducted with 400 samples measured. The cross-section pebble counts were measured in a series of 20 transects perpendicular to flow with five samples measured per transect. The representative reach pebble count was proportionally weighted to match the percentage of "fast" and "slow" water habitat areas with a total of 40 samples measured in "slow" water and 60 samples measured in "fast" water. The b-axis was used to measure the diameter of all samples using a gravelometer.

Shading and Stream Temperature

Riparian vegetation shading plays a key role in regulating stream ecosystems. Canopy cover directly influences stream temperatures by reducing extreme solar radiation and affects the amount and distribution of sunlight reaching the riparian floor. Canopy cover also indirectly provides habitat for aquatic organisms, generates energy, and protects against wind and erosion. Canopy cover estimations were collected with a convex spherical densiometer, Model A (Lemon 1957). The bottom corners of the instrument were taped off, resulting in a total of 17 grid intersects. Each grid intersect represents approximately one percent of the sky. Four directional readings were collected at the thalweg of each of the 50 transects along the longitudinal profile: downstream, left bank, upstream and right bank. Corrected percentages were calculated to adjust for overlapping issues due to the instruments curved mirror. For corrected percentages, the total points from the four readings were multiplied by 1.5, then 1 percent is removed between 30 and 60 percent and 2 percent is removed for averages over 66 percent.

The stream shading survey started at 1:00 p.m. and ended at 3:00 p.m. on July 31, 2019 at the Eaton Canyon reach of Eaton Wash. The instrument was balanced and placed approximately one foot above water. Vegetation such as leaves, branches and cones were accounted for, but bedrock, dirt slopes and buildings were omitted.

Large Woody Debris

In sections of the stream, large pieces of woody debris are present and impacting the channel morphology and in stream flow. These observations were noted in the survey. Large wood was measured and then tallied into length and diameter range classes within the surveyed reach, with criteria being over 0.1 *m* diameter and at least 1.5 *m* in length.

Pool Tail Surface Fine Sediment

To quantify the percentage of fine sediment less than 2mm three grid measurements were made at each pool tail within the survey reach (Bauer and Burton, 1993). The grids use were 14-inch square frames with 49 line-intersections and one corner. Measurements were taken within the wetted stream at the thalweg, left, and right of the thalweg midway between wetted edge and the thalweg. Surface material below grid intersections and one corner is counted if 2mm or less than multiplied by 2 to get a percentage of sediment less than 2mm.

Modified Pfankuch Channel Stability Rating

The Pfankuch rating system was developed to systemize measurements and evaluations of the resistive capacity of mountain stream channels to the detachment of bed and bank materials and to provide information about the capacity of streams to adjust and recover from potential changes in flow and/or increases in sediment production (Pfankuch, 1975). To classify the stream channel stability rating, the following 15 categories were rated (1. landforms, 2. mass wasting, 3. debris jam potential, 4. vegetation bank protection, 5. channel capacity, 6. bank rock content, 7. obstruction to flow, 8. cutting, 9. deposition, 10. rock angularity, 11. brightness, 12.consolidation of particles, 13. bottom size distribution, 14. scouring and deposition and 15. aquatic vegetation) based on stream channel statistics, particle distribution, large woody debris, bank angle and visual inspection of the stream. It is important to note that these ratings can be subjective but are still used as a way to assess overall channel stability.

Basic Water Chemistry

Samples of turbidity, specific conductivity, pH, dissolved oxygen (DO) and water temperature were sampled at each cross-section. Specific conductivity, pH, DO, and water temperature were sampled using a YSI Professional Plus Multiparameter water quality meter. Turbidity was sampled using a Hach TSS portable handheld measurement instrument. Each water quality parameter was sampled within the monumented riffle cross-sections, which totaled three samples across the reach.

Aquatic Fauna

Aquatic fauna measurements were taken at 50 transects along the reach. Transects were located every 12 ft within the surveyed reach. Visual observations were made at each transect to determine presence of aquatic fauna and approximate count.

Bank Angle/Bank Stability

A clinometer was used to determine stream bank angles every 12 ft along the surveyed reach. A section of PVC pipe was situated at the slope and the clinometer was placed along the top of the pipe to determine the angle of the stream bank at each station. Bank stability measurements were based on a ranking scale from 1 to 3 where:

1. Stable: 75% or more cover of living plants and/or other stability components that are not easily eroded.
2. Vulnerable: 75% or more cover of living plants or more cover but have one or more instability indicators
3. Unstable: less than 75% cover and may have instability indicators, often bare or nearly bare banks composed of particle sizes too small or loose to resist erosion at high flows.

Data Presentation

Longitudinal Profile

The longitudinal profile characterizes channel bed gradient, water surface gradient, and depths of riffles, pools, runs, glides, rapids and step pools (*Figure 2*). The average stream gradient is required for delineating stream types. At the broadest resolution level, fluvial geomorphologists recognize fast water (riffles, runs, and glides) and slow water (pools) as the two primary stream habitat unit types. These units are important attributes that explain the characteristics of its base stratification and topography of habitat that supports the life of aquatic organisms.

Stream Gradient for the Eaton Canyon reach was measured at 3.82%. The Eaton Canyon reach had 60% fast water features, while 40% was found to be slow water features (*Figure 2*). The series of sharp breaks along the longitudinal profile are step pool features (station 34 ft, 70.4 ft, 209 ft, 312.5 ft, 335 ft, 470.1 ft, 519 ft, 529 ft, 580 ft) (*Figure 3*). There is one elevation break occurrence that is caused by the presence of an unauthorized artificial dam that has formed a small pool feature.

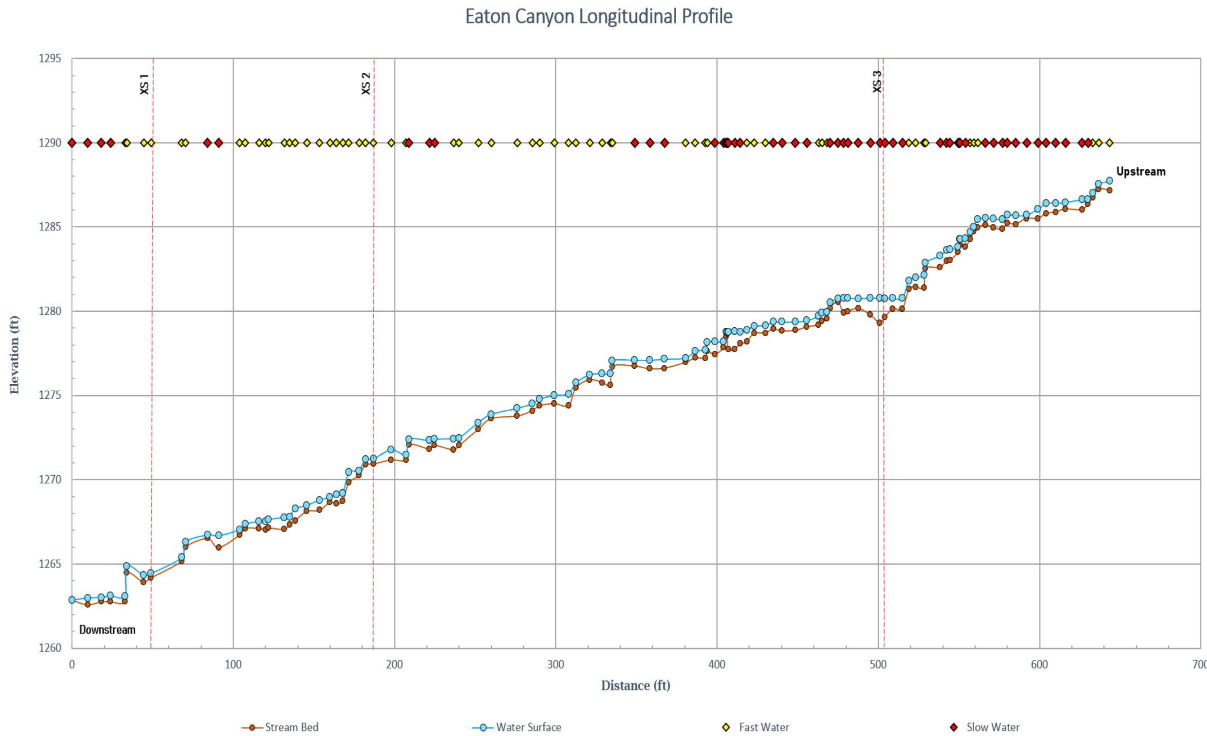


Figure 2: Longitudinal Profile of Eaton Wash, Eaton Canyon reach.

Monumented Channel Cross Sections

Channel cross-section measurements express the physical dimensions of the stream perpendicular to flow. They provide fundamental understanding of the relationships of width and depth, streambed and streambank shape, bankfull stage and floodprone area, etc. Three monumented cross-sections were surveyed within the reach at fast water (riffles, runs, and glides). *Table 1* describes the dimensions of the cross sections while *figures 3-5* depict their shape.

Table 1: Cross Section statistics of Eaton Wash, Eaton Canyon reach.

Measurements	X-Sec 1	X-Sec 2	X-Sec 3
Bankfull width (ft)	39.8	42.65	31.8
Floodprone width (ft)	48.8	82.7	133.5
Entrenchment	1.23	1.94	2.57

Mean bankfull depth (ft)	2.69	2.61	4.97
Maximum bankfull depth (ft)	3.49	3.57	6
Cross-sectional area (ft^3)	107.24	111.32	157.92
Width/Depth	14.77	16.34	6.4

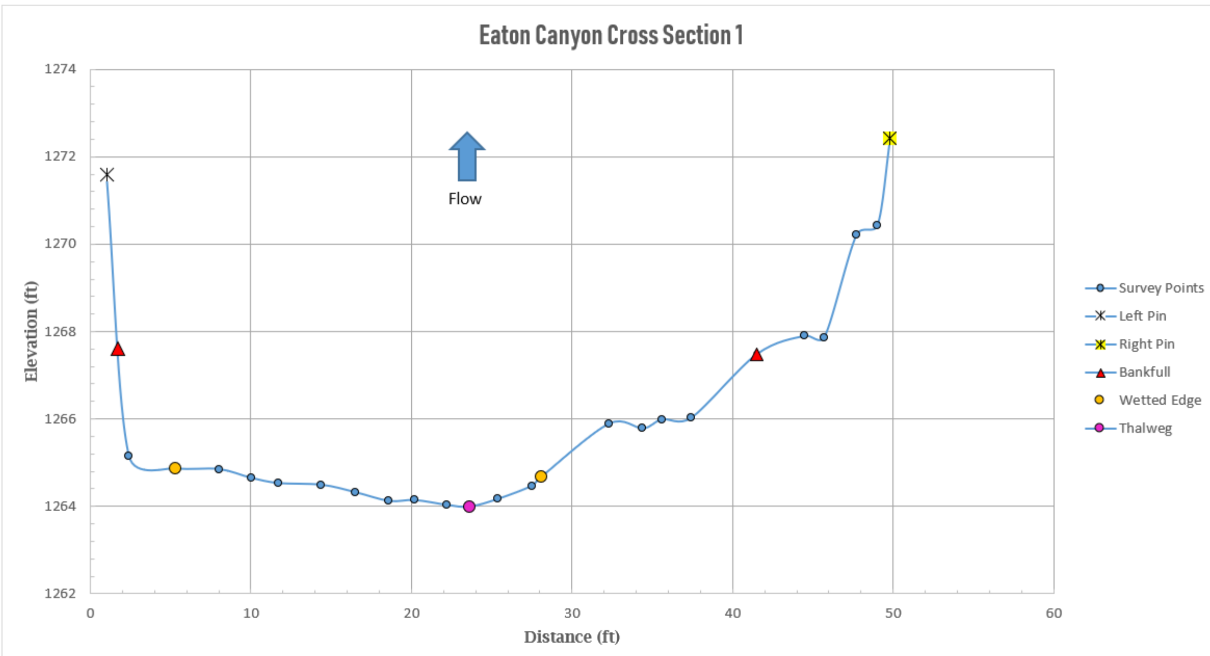


Figure 3: Cross section 1, Eaton Canyon reach.

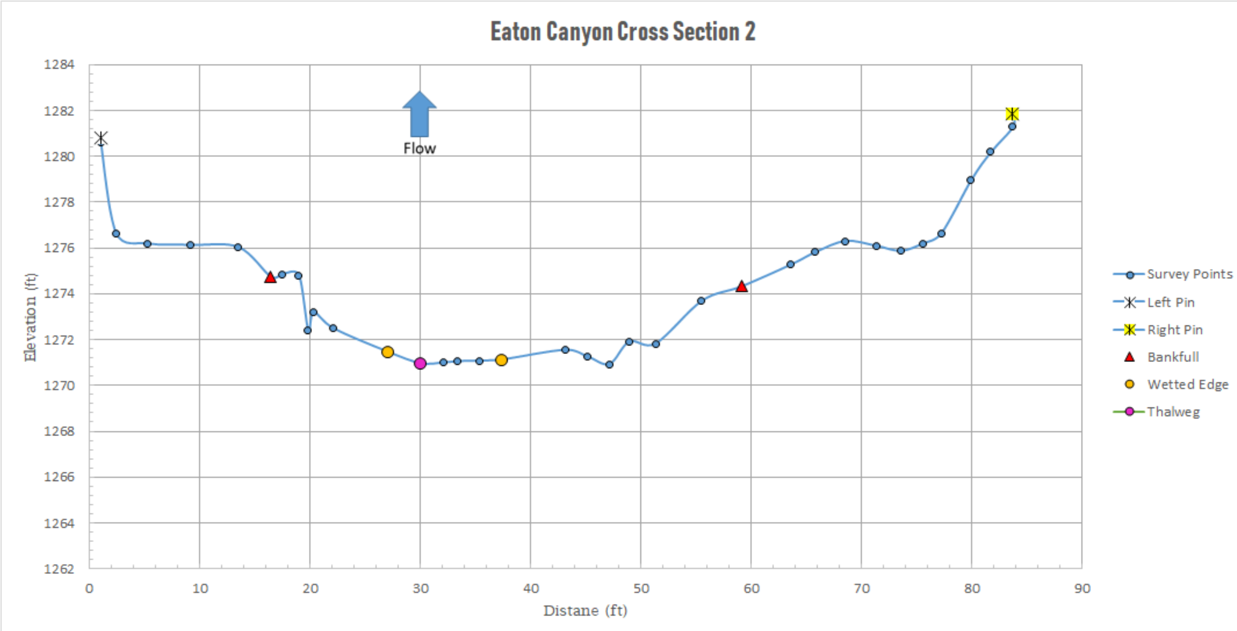


Figure 4: Cross section 2, Eaton Canyon reach.

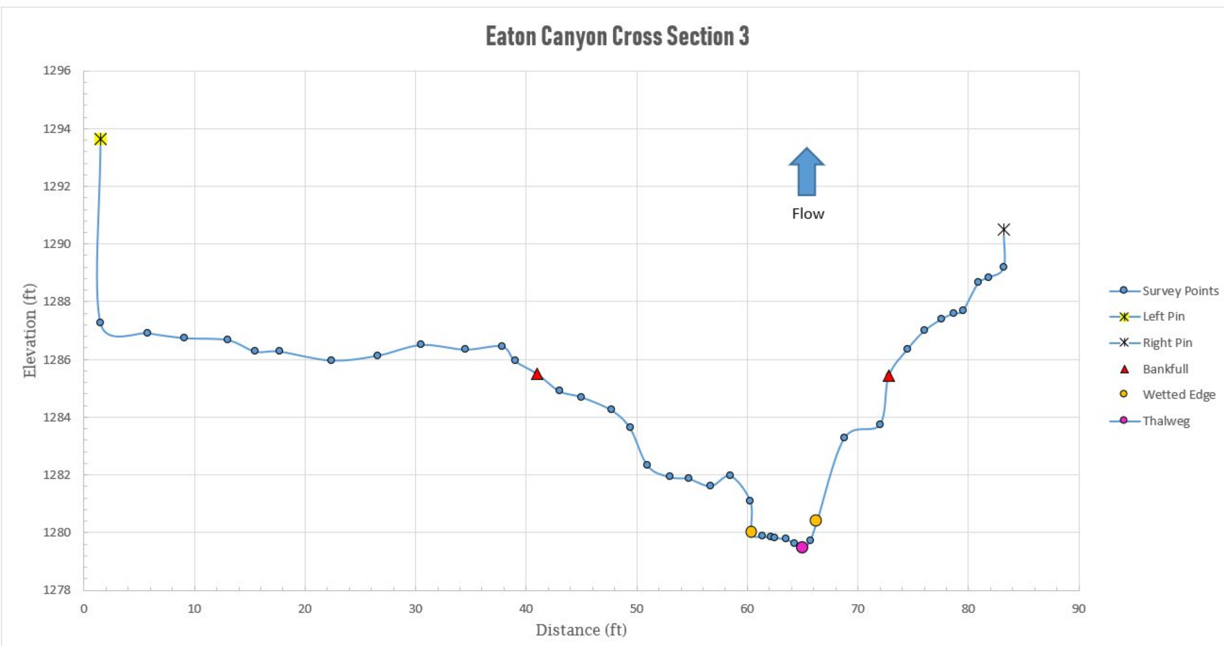


Figure 5: Cross section 3, Eaton Canyon reach.

Particle Size Distribution

Streambed materials are key elements in the formation and maintenance of channel morphology. These materials influence channel stability, resistance to scour during high flow events, and also act as a supply of sediment to be routed and sorted throughout the channel. The amount and frequency of bedload transport can be critically important to fish spawning and other aquatic organisms that use stream substrate for cover, breeding, or foraging. Particle size distribution can change over time as a result of management activities and/or natural disturbances.

Particle size distribution surveys were conducted at each of the three cross-sections and along the longitudinal profile to represent the studied reach (*Table 2*). *Figure 6* shows that particle size distribution is similar among the three cross sections. "Weighted particle size distribution" was collected according to the amount of fast versus slow water within the reach. In other words, 60% of particles were collected from "fast" water while 40% were collected from "slow" water.

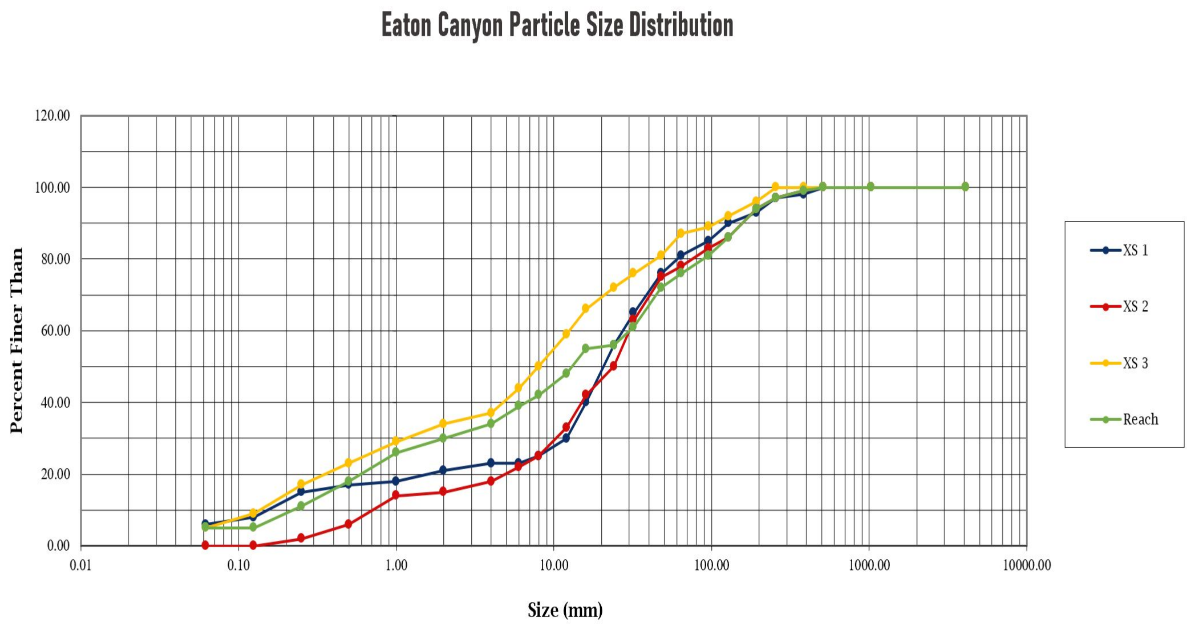


Figure 6: Particle size distribution analysis, Eaton Canyon.

D50 (diameter of the 50th percentile finer than) is the median particle size in the streambed used to classify stream type and can also provide a minimum estimate of the shear stress necessary to initiate general movement of mixed-size sediment (Rosgen, 2006; Elliot, 2002). D84 (84th percentile particle size) among the Weighted particle size distribution is used in part to estimate Manning's roughness coefficient. Manning's roughness coefficient is then used in part to estimate bankfull velocity and discharge. Percentiles for all three cross-section pebble counts and the weighted reach pebble count can be found in *Table 2*.

Table 2: Grain size statistics, Eaton Canyon.

Percentiles	X-Sec 1	X-Sec 2	X-Sec 3	Weighted

D16 (mm)	0.38	2.67	0.23	0.43
D35 (mm)	14.00	12.89	2.67	4.40
D50 (mm)	21.0	22.10	8.40	13.14
D84 (mm)	88.00	106.67	56.00	115.20
D95 (mm)	224.00	213.33	176.00	213.33

Shading and Stream Temperature

Stream temperature has impacts on health, behavior, and survival of aquatic organisms and is strongly influenced by streamside shading. Streamside vegetation is a primary source of energy to most streams. *Table 3* summarizes the stream shading along the surveyed reach of Eaton Wash. The results showed an average total density of 89.27% for the entire reach.

Table 3: Stream shading statistics, Eaton Wash, Eaton Canyon reach.

Stream Shading Statistics	
Canopy Cover	**Cover %**
High	100%
Low	65%
Average	89.27%

Large Woody Debris

Large wood is important to the morphology of many streams; it influences channel width and meander patterns, provides for storage and bedload, and is often most important in pool formation in streams. Large wood is also an important component of instream cover for fish, as well as providing habitat for aquatic insects and amphibians. The Eaton Canyon reach had the highest occurrence of woody debris with 1.5 to 5 m of length and 0.1 to 0.3 m diameter. A majority of the other class sizes had zero occurrences (*Table 4*). Additional class sizes were between a length of 5 to 10 m and diameters ranging from 0.1 to 0.6 m.

Table 4: Large woody debris class size tally.

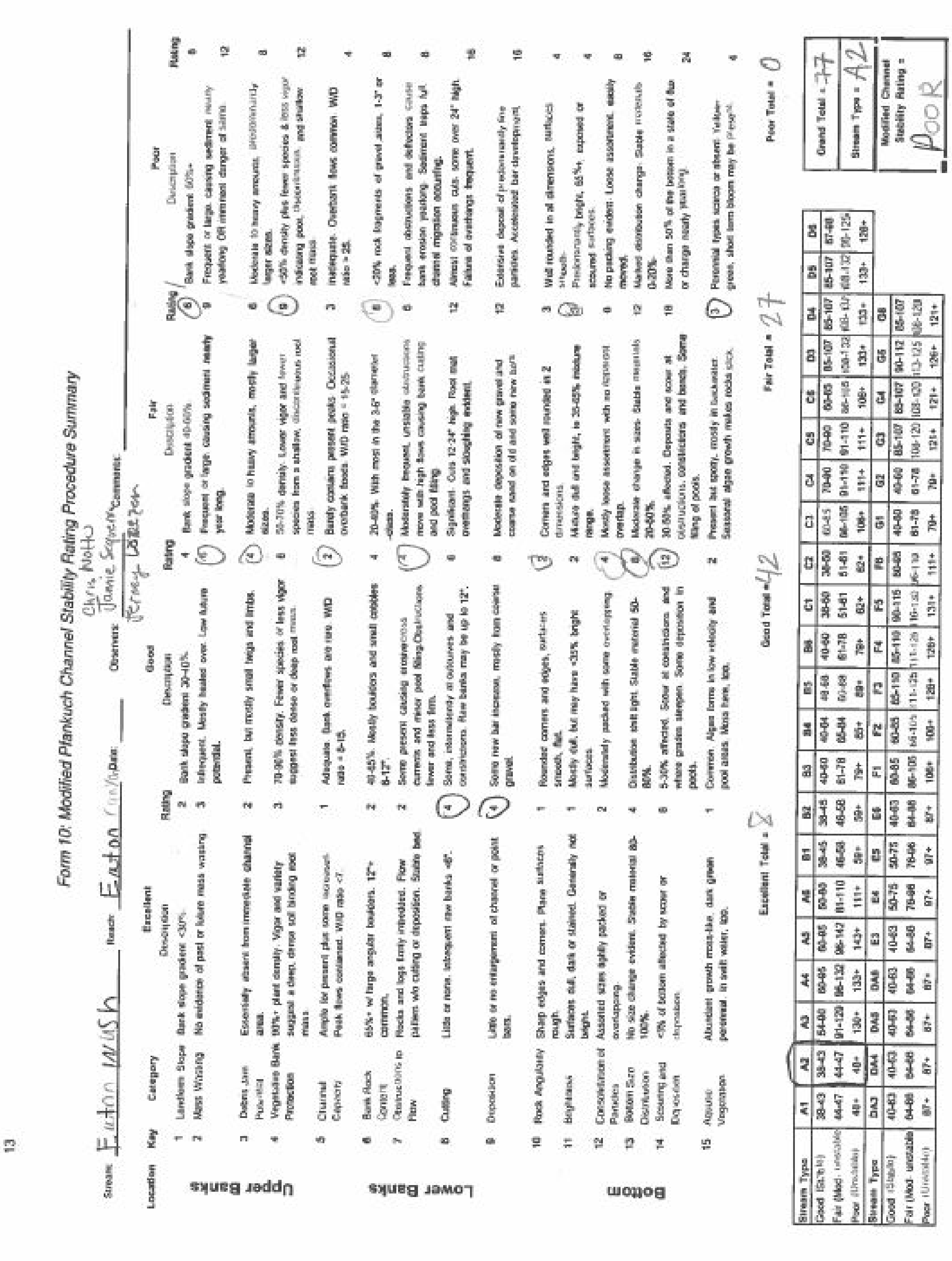
Size Class (m)	Diameter 0.1 to 0.3	Diameter 0.3 to 0.6	Diameter 0.6 to 0.8	Diameter ≥ 0.8
Length 1.5 to 5	14	1	0	0
Length 5 to < 10	1	2	0	0
Length 10 to < 15	0	0	0	0
Length ≥ 15	0	0	0	0

Pool Tail Surface Fine Sediment

Watershed and streambank disturbance often result in increased sediment input to streams. Increased fine particles in the stream substrate can impair aquatic food production and decrease survival of young fish. Particles of 2 *mm* or less are the principal barriers, although particles up to 8 *mm* have resulted in increased mortality (Bauer and Burton, 1993). Average fine count for this reach is 42.66% in pools.

Modified Pfankuch Channel Stability Rating

The Pfankuch rating system was developed to systemize measurements and evaluations of the resistive capacity of mountain stream channels to the detachment of bed and bank materials and to provide information about the capacity of streams to adjust and recover from potential changes in flow and/or increases in sediment production (Pfankuch, 1975). Although these ratings can be fairly subjective, they are still used as a way to identify key problem features. Modified Pfankuch rating for the surveyed reach is poor (unstable) based on stability rating scores for an A2 stream type (*Figure 7*) (Rosgen, 2001).



13

Form 10: Modified Pfankuch Channel Stability Rating Procedure Summary

Stream: Eaton Wash Reach: Eaton Canyon Date: ____ Observers: Chris Notto, Jamie Sequeira, Jeremy Lorenzen Comments: ____

Location	Key	Category	Excellent Description	Rating	Good Description	Rating	Fair Description	Rating	Poor Description	Rating
Upper Banks	1	Landform Slope	Bank slope gradient <30%.	2	Bank slope gradient 30-40%.	4	Bank slope gradient 40-60%.	(6)	Bank slope gradient 60%+	8
	2	Mass Wasting	No evidence of past or future mass wasting	3	Infrequent. Mostly healed over. Low future potential.	(6)	Frequent or large, causing sediment nearly year long.	9	Frequent or large, causing sediment nearly yearlong OR imminent danger of same.	12
	3	Debris Jam Potential	Essentially absent from immediate channel area.	2	Present, but mostly small twigs and limbs.	(4)	Moderate to heavy amounts, mostly larger sizes.	6	Moderate to heavy amounts, predominantly larger sizes.	8
	4	Vegetative Bank Protection	90%+ plant density. Vigor and variety suggest a deep, dense soil binding root mass.	3	70-90% density. Fewer species or less vigor suggest less dense or deep root mass.	6	50-70% density. Lower vigor and fewer species from a shallow, discontinuous root mass.	(9)	<50% density plus fewer species & less vigor indicating poor, discontinuous, and shallow root mass.	12
	5	Channel Capacity	Ample for present plus some increases. Peak flows contained. W/D ratio <7.	1	Adequate. Bank overflows are rare. W/D ratio = 8-15.	(2)	Barely contains present peaks. Occasional overbank floods. W/D ratio = 15-25.	3	Inadequate. Overbank flows common. W/D ratio > 25.	4
Lower Banks	6	Bank Rock Content	65%+ w/ large angular boulders. 12"+ common.	2	40-65%. Mostly boulders and small cobbles 6-12".	4	20-40%. With most in the 3-6" diameter class.	(6)	<20% rock fragments of gravel sizes, 1-3" or less.	8
	7	Obstructions to Flow	Rocks and logs firmly imbedded. Flow pattern w/o cutting or deposition. Stable bed.	2	Some present causing erosive cross currents and minor pool filling. Obstructions fewer and less firm.	(4)	Moderately frequent, unstable obstructions move with high flows causing bank cutting and pool filling.	6	Frequent obstructions and deflectors cause bank erosion yearlong. Sediment traps full, channel migration occurring.	8
	8	Cutting	Little or none. Infrequent raw banks <6".	(4)	Some, intermittently at outcurves and constrictions. Raw banks may be up to 12".	6	Significant. Cuts 12-24" high. Root mat overhangs and sloughing evident.	12	Almost continuous cuts, some over 24" high. Failure of overhangs frequent.	16
	9	Deposition	Little or no enlargement of channel or point bars.	(4)	Some new bar increase, mostly from coarse gravel.	8	Moderate deposition of new gravel and coarse sand on old and some new bars.	12	Extensive deposit of predominantly fine particles. Accelerated bar development.	16
Bottom	10	Rock Angularity	Sharp edges and corners. Plane surfaces rough.	1	Rounded corners and edges, surfaces smooth, flat.	(2)	Corners and edges well rounded in 2 dimensions.	3	Well rounded in all dimensions, surfaces smooth.	4
	11	Brightness	Surfaces dull, dark or stained. Generally not bright.	1	Mostly dull, but may have <35% bright surfaces.	2	Mixture dull and bright, ie 35-65% mixture range.	(3)	Predominantly bright, 65%+, exposed or scoured surfaces.	4
	12	Consolidation of Particles	Assorted sizes tightly packed or overlapping.	2	Moderately packed with some overlapping.	(4)	Mostly loose assortment with no apparent overlap.	6	No packing evident. Loose assortment, easily moved.	8
	13	Bottom Size Distribution	No size change evident. Stable material 80-100%.	4	Distribution shift light. Stable material 50-80%.	(8)	Moderate change in sizes. Stable materials 20-50%.	12	Marked distribution change. Stable materials 0-20%.	16
	14	Scouring and Deposition	<5% of bottom affected by scour or deposition.	6	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.	(12)	30-50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools.	18	More than 50% of the bottom in a state of flux or change nearly yearlong.	24
	15	Aquatic Vegetation	Abundant growth moss-like, dark green perennial. In swift water, too.	1	Common. Algae forms in low velocity and pool areas. Moss here, too.	2	Present but spotty, mostly in backwater. Seasonal algae growth makes rocks slick.	(3)	Perennial types scarce or absent. Yellow-green, short term bloom may be present.	4

Excellent Total = 8 Good Total = 42 Fair Total = 27 Poor Total = 0

Stream Type	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6	C1	C2	C3	C4	C5	C6	D3	D4	D5	D6
Good (Stable)	38-43	38-43	54-90	60-95	60-95	50-80	38-45	38-45	40-60	40-64	48-68	40-60	38-50	38-50	60-85	70-90	70-90	60-85	85-107	85-107	85-107	67-98
Fair (Mod. unstable)	44-47	44-47	91-129	96-132	96-142	81-110	46-58	46-58	61-78	65-84	69-88	61-78	51-61	51-61	86-105	91-110	91-110	86-105	108-132	108-132	108-132	99-125
Poor (Unstable)	48+	48+	130+	133+	143+	111+	59+	59+	79+	85+	89+	79+	62+	62+	106+	111+	111+	106+	133+	133+	133+	126+

Stream Type	DA3	DA4	DA5	DA6	E3	E4	E5	E6	F1	F2	F3	F4	F5	F6	G1	G2	G3	G4	G5	G6
Good (Stable)	40-63	40-63	40-63	40-63	40-63	50-75	50-75	40-63	60-85	60-85	85-110	85-110	90-115	80-95	40-60	40-60	85-107	85-107	90-112	85-107
Fair (Mod. unstable)	64-86	64-86	64-86	64-86	64-86	76-96	76-96	64-86	86-105	86-105	111-125	111-125	116-130	96-110	61-78	61-78	108-120	108-120	113-125	108-120
Poor (Unstable)	87+	87+	87+	87+	87+	97+	97+	87+	106+	106+	126+	126+	131+	111+	79+	79+	121+	121+	126+	121+

Grand Total = 77

Stream Type = A2

Modified Channel Stability Rating = POOR

18

08/12

Figure 7: Modified Pfankuch Channel Stability Rating field data form, Eaton Wash, Eaton Canyon reach.

Basic Water Chemistry

Water quality measurements across parameters were consistent between cross sections with the only notable exception in turbidity (0.76 NTU) for cross section 2 exhibiting a low value (Table 6).

Table 6: Basic Water Chemistry of Eaton Canyon Reach across 3 monumented riffle cross-sections.

Water Quality: YSI Pro Professional (SN: 17J102064 / Cable MN: 18F100289)				
Measurement	X-Sec 1	X-Sec 2	X-Sec 3	Reach Average
Turbidity	1.24 NTU	0.76 NTU	1.17 NTU	1.06 NTU
Sp. Conductivity	351.7 µS/cm	344.8 µS/cm	352.0 µS/cm	349.5 µS/cm
pH	7.58	7.55	7.66	7.60
DO	72.9%	78.9%	72.0%	75%
Water temp.	19.2°	19.3°	20.1°	19.53°

Aquatic Fauna

Unidentified tadpoles, and two California tree frogs (Pseudacris cadaverina) were observed and noted while surveying for aquatic fauna.

Bank Angle/Bank Stability

Bank angles were measured every 12 ft along the reach, at left and right bank using a clinometer. Forty-three bank locations were measured for a total of 86 samples. The stream is predominantly unstable (51.16%), with 23.26% of the bank considered stable and 25.58% considered vulnerable (*Table 7*). The left and right banks had equal proportions of stable bank (23.26%) while the right bank (53.49%) had slightly more unstable bank than the left (48.84%).

Table 7: Bank Angle Stability

Bank	Total # of Banks	Total Bank Angle Av.	% Stable (1)	% Vulnerable (2)	% Unstable (3)
Right Bank	43	152.70	23.26%	23.26%	53.49%
Left Bank	43	152.14	23.26%	27.91%	48.84%
All Banks	86	152.42	23.26%	25.58%	51.16%

Stream Type Discussion

Given results from the particle distribution analysis, longitudinal profile, and cross section, it is determined the reach is a Rosgen stream type **A2 (**see *Table 8***)**. These streams are steep, structural controlled slopes with colluvial deposition in narrow and confined valleys (Rosgen, 1998). The channel type exhibits step/pool features. Predominantly boulder, with lesser amounts of cobble, gravel and sand and some bedrock sporadically spaced. This stream type is entrenched (< 1.4), displaying low sinuosity (<1.2) and low width/depth ratio (<12) with a slope between 0.04-0.10 (Rosgen, 1998). Width/depth ratio in this stream type can be > 12 with the presence of large boulders that add to the channel and bank stability (Rosgen, 1998). Noticeable differences occurred during the classification of Eaton Canyon that differed from the defined Rosgen parameters. There were slight differences in slope and sinuosity from expected values while width/depth ratio and entrenchment ratio had a large variation. Although, reach statistics more closely resemble a B type channel, morphological channel descriptions were weighted more heavily in the determination of the classification. Due to the discrepancy between the classifications there is likely undetermined factors affecting the consistency of the resulting channel parameters.

This stream type has the following generalized management interpretations (Rosgen, 2-31):

- Very low sensitivity to disturbance
- Excellent recovery potential
- Very low sediment supply
- Very low streambank erosion potential
- Negligible vegetation controlling influence

Table 8: Reach Statistics.

Reach Statistics	
Entrenchment Ratio	1.91
W/D Ratio	14.30
Valley slope %	5.10
Sinuosity	1.33
Stream slope %	3.82
Reach length (*ft*)	643.5
Valley length (*ft*)	482.23
Mean bankfull width (*ft*)	38.08
Mean bankfull depth (*ft*)	4.35

References

Dunne, T. and L. Leopold. 1978. Water in Environmental Planning. San Francisco, CA; W.H. Freeman and Company. ISBN-13: 978-0716700791

Elliot, J. 2002. Bed-Material Entrainment Potential, Roaring Fork River at Basalt, Colorado. US Geological Survey. Denver, Colorado. Water-Resources Investigations Report 02–4223

Frazier, J.W., K.B. Roby, J.A. Boberg, K. Kenfield, J.B. Reiner, D.L. Azuma, J.L. Furnish, B.P. Staab, and S.L. Grant. 2005. Stream Condition Inventory Technical Guide, Version 5.0. USDA Forest Service, Pacific Southwest Region- Ecosystem Conservation Staff. Vallejo, CA.

Harrison, S. 2016. St. Francis Dam Collapse Left a Trail of Death and Destruction. LA TIMES.MAR 19, 2016. Web.

Leopold, L.B., M.G. Wolman, and J.P. Miller. 1964. Fluvial Processes in Geomorphology. W.H. Freeman and Company, San Francisco, California. ISBN-13: 978- 0486685885

National Fish and Wildlife Foundation, 2017. *Angeles National Forest Copper, Ranch, and Sayre Fires Restoration Strategy* (pp. 1-24, Rep.). doi: http://www.nfwf.org/angelesfire/Documents/ANF_RestorationStrategy_Final_03_14_17.pdf

Pfankuch, D.J. 1975. Stream reach inventory and channel stability evaluation. USDAFS No. R1-75-002, GPO No.696-260/200). Washington, D.C.: US Government Printing Office.

Pitlick, J. Cui, Y. Wilcock, P. 2008. Manual for Computing Bed Load Transport using BAGS (Bedload Assessment for Gravel-bed Streams) Software. National Stream Systems Technology Center.

Rosgen, Dave, Lee Silvey. 1998. Field Guide for Stream Classification. Wildland Hydrology. Pagosa Springs, CO. ISBN 0-9653289-1-0.

Rosgen, D. L. 2001. A Stream Channel Stability Assessment Methodology. Proceedings of the Seventh Federal Interagency Sedimentation Conference.

Rosgen, D.L. 2006. Watershed Assessment of River Stability and Sediment Supply (WARSSS). Wildland Hydrology. Fort Collins, CO. ISBN-13: 978-09791308.

U.S. Geological Survey, 20180904, USGS NED one meter x43y379 CA LosAngeles 2016 IMG 2018: U.S. Geological Survey.

Wolman, M. and J.P. Miller. 1960. Magnitude and Frequency of forces in geomorphic processes. Journal of Geology 68: 54-74.

SCI Equation Glossary

Entrenchment Ratio = flood prone area width / bankfull width
Width/depth ratio = bankfull width / bankfull mean depth
Valley Gradient = (End of reach-beginning of reach) / valley length
Sinuosity = stream length / valley length
Stream Gradient = (End of reach-beginning of reach) / stream length
Percent stream slope = stream gradient x 100
Percent Valley Slope = valley gradient x 100
Cross Section Area = mean bankfull depth x bankfull width
Floodprone elevation = thalweg elevation + 2x bankfull depth
Meander width ratio = belt width / bankfull width