California Department of Fish and Game
Petaluma River Watershed
Stream Habitat Assessment Reports

San Antonio Creek

Surveyed 2007

STREAM INVENTORY REPORT

San Antonio Creek
Surveyed: Summer 2007
Report Completed: March 2008

INTRODUCTION

A stream inventory was conducted during 8/20/2007 to 9/5/2007 on San Antonio Creek. The survey began at the confluence with Schultz Slough and extended upstream 9.3 miles.

The San Antonio Creek inventory was conducted in two parts: habitat inventory and biological inventory. The objective of the habitat inventory was to document the habitat available to anadromous salmonids in San Antonio Creek. The objective of the biological inventory was to document the presence and distribution of juvenile salmonid species.

The objective of this report is to document the current habitat conditions and recommend options for the potential enhancement of habitat for Chinook salmon and steelhead trout. Recommendations for habitat improvement activities are based upon target habitat values suitable for salmonids in California's north coast streams.

WATERSHED OVERVIEW

San Antonio Creek flows into Schultz Slough before entering the Petaluma River, which is a tributary to Pacific Ocean, located in Sonoma County, California (Map 1). San Antonio Creek's legal description at the confluence with Schultz Slough is T04N R07W S14. Its location is 38°11'21" north latitude and 122°35'39" west longitude, LLID number 1225943381893. San Antonio Creek is a third order stream and has approximately 62.79 miles of blue line stream according to the USGS National Hydrography Dataset (NHD). San Antonio Creek drains a watershed of approximately 30.95 square miles. Elevations range from about 10 feet at the mouth of the creek to 1,568 feet in the headwater areas. Mixed hardwood forest dominates the watershed. The watershed is primarily privately owned and the land use is mostly considered natural at 84.0 %, agriculture at 15.5% and has very little Urban Development at 0.5%. Vehicle access exists via San Antonio Road.

METHODS

The habitat inventory conducted in San Antonio Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi et al, 1998). The California Department of Fish and Game (DFG) personnel and Watershed Stewards Project/AmeriCorps (WSP) members that conducted the inventory were trained in standardized habitat inventory methods by the California Department of Fish and Game. This inventory was conducted by a two-person team.

SAMPLING STRATEGY

The inventory uses a method that samples approximately 10% of the habitat units within the survey reach. All habitat units included in the survey are classified according to habitat type and their lengths are measured. All pool units are measured for maximum depth, depth of pool tail crest (measured in the thalweg), dominant substrate composing the pool tail crest, and embeddedness. Habitat unit types encountered for the first time are measured for all the parameters and characteristics on the field form. Additionally, from the ten habitat units on each field form page, one is randomly selected for complete measurement. All pools except step-pools are fully sampled.

HABITAT INVENTORY COMPONENTS

A standardized habitat inventory form has been developed for use in California stream surveys and can be found in the *California Salmonid Stream Habitat Restoration Manual*. This form was used in San Antonio Creek to record measurements and observations. There are eleven components to the inventory form.

1. Flow:

Flow is measured in cubic feet per second (cfs) near the bottom of the stream survey reach using a Marsh-McBirney Model 2000 flow meter.

2. Channel Type:

Channel typing is conducted according to the classification system developed and revised by David Rosgen (1994). This methodology is described in the *California Salmonid Stream Habitat Restoration Manual*. Channel typing is conducted simultaneously with habitat typing and follows a standard form to record measurements and observations. There are five measured parameters used to determine channel type: 1) water slope gradient, 2) entrenchment, 3) width/depth ratio, 4) substrate composition, and 5) sinuosity. Channel characteristics are measured using a clinometer, hand level, hip chain, tape measure, and a stadia rod.

3. Temperatures:

Both water and air temperatures are measured and recorded at every tenth habitat unit. The time of the measurement is also recorded. Both temperatures are taken in degrees Fahrenheit at the middle of the habitat unit and within one foot of the water surface.

4. Habitat Type:

Habitat typing uses the 24 habitat classification types defined by McCain and others (1990). Habitat units are numbered sequentially and assigned a type identification number selected from a standard list of 24 habitat types. Dewatered units are labeled "dry". San Antonio Creek habitat typing used standard basin level measurement criteria. These parameters require that the minimum length of a described habitat unit must be equal to or greater than the stream's mean

wetted width. All measurements are in feet to the nearest tenth. Habitat characteristics are measured using a clinometer, hip chain, and stadia rod.

5. Embeddedness:

The depth of embeddedness of the cobbles in pool tail-out areas is measured by the percent of the cobble that is surrounded or buried by fine sediment. In San Antonio Creek, embeddedness was ocularly estimated. The values were recorded using the following ranges: 0 - 25% (value 1), 26 - 50% (value 2), 51 - 75% (value 3) and 76 - 100% (value 4). Additionally, a value of 5 was assigned to tail-outs deemed unsuited for spawning due to inappropriate substrate like bedrock, log sills, boulders or other considerations.

6. Shelter Rating:

Instream shelter is composed of those elements within a stream channel that provide juvenile salmonids protection from predation, reduce water velocities so fish can rest and conserve energy, and allow separation of territorial units to reduce density related competition for prey. The shelter rating is calculated for each fully-described habitat unit by multiplying shelter value and percent cover. Using an overhead view, a quantitative estimate of the percentage of the habitat unit covered is made. All cover is then classified according to a list of nine cover types. In San Antonio Creek, a standard qualitative shelter value of 0 (none), 1 (low), 2 (medium), or 3 (high) was assigned according to the complexity of the cover. Thus, shelter ratings can range from 0-300 and are expressed as mean values by habitat types within a stream.

7. Substrate Composition:

Substrate composition ranges from silt/clay sized particles to boulders and bedrock elements. In all fully-described habitat units, dominant and sub-dominant substrate elements were ocularly estimated using a list of seven size classes and recorded as a one and two, respectively. In addition, the dominant substrate composing the pool tail-outs is recorded for each pool.

8. Canopy:

Stream canopy density was estimated using modified handheld spherical densiometers as described in the *California Salmonid Stream Habitat Restoration Manual*. Canopy density relates to the amount of stream shaded from the sun. In San Antonio Creek, an estimate of the percentage of the habitat unit covered by canopy was made from the center of approximately every third unit in addition to every fully-described unit, giving an approximate 30% sub-sample. In addition, the area of canopy was estimated ocularly into percentages of coniferous or hardwood trees.

9. Bank Composition and Vegetation:

Bank composition elements range from bedrock to bare soil. However, the stream banks are usually covered with grass, brush, or trees. These factors influence the ability of stream banks to withstand winter flows. In San Antonio Creek, the dominant composition type and the dominant

vegetation type of both the right and left banks for each fully-described unit were selected from the habitat inventory form. Additionally, the percent of each bank covered by vegetation (including downed trees, logs, and rootwads) was estimated and recorded.

10. Large Woody Debris Count:

Large woody debris (LWD) is an important component of fish habitat and an element in channel forming processes. In each habitat unit all pieces of LWD partially or entirely below the elevation of bankfull discharge are counted and recorded. The minimum size to be considered is twelve inches in diameter and six feet in length. The LWD count is presented by reach and is expressed as an average per 100 feet.

11. Average Bankfull Width:

Bankfull width can vary greatly in the course of a channel type stream reach. This is especially true in very long reaches. Bankfull width can be a factor in habitat components like canopy density, water temperature, and pool depths. Frequent measurements taken at riffle crests (velocity crossovers) are needed to accurately describe reach widths. At the first appropriate velocity crossover that occurs after the beginning of a new stream survey page (ten habitat units), bankfull width is measured and recorded in the appropriate header block of the page. These widths are presented as an average for the channel type reach.

BIOLOGICAL INVENTORY

Biological sampling during the stream inventory is used to determine fish species and their distribution in the stream. Fish presence was observed from the stream banks in San Antonio Creek. In addition, two sites were electrofished using a Smith-Root Model 12 electrofisher. These sampling techniques are discussed in the *California Salmonid Stream Habitat Restoration Manual*.

DATA ANALYSIS

Data from the habitat inventory form are entered into Stream Habitat 2.0.18, a Visual Basic data entry program developed by Karen Wilson, Pacific States Marine Fisheries Commission in conjunction with the California Department of Fish and Game. This program processes and summarizes the data, and produces the following ten tables:

- Riffle, Flatwater, and Pool Habitat Types
- Habitat Types and Measured Parameters
- Pool Types
- Maximum Residual Pool Depths by Habitat Types
- Mean Percent Cover by Habitat Type
- Dominant Substrates by Habitat Type
- Mean Percent Vegetative Cover for Entire Stream

- Fish Habitat Inventory Data Summary by Stream Reach (Table 8)
- Mean Percent Dominant Substrate / Dominant Vegetation Type for Entire Stream
- Mean Percent Shelter Cover Types for Entire Stream

Graphics are produced from the tables using Microsoft Excel. Graphics developed for San Antonio Creek include:

- Riffle, Flatwater, Pool Habitat Types by Percent Occurrence
- Riffle, Flatwater, Pool Habitat Types by Total Length
- Total Habitat Types by Percent Occurrence
- Pool Types by Percent Occurrence
- Maximum Residual Depth in Pools
- Percent Embeddedness
- Mean Percent Cover Types in Pools
- Substrate Composition in Pool Tail-outs
- Mean Percent Canopy
- Dominant Bank Composition by Composition Type
- Dominant Bank Vegetation by Vegetation Type

HABITAT INVENTORY RESULTS

* ALL TABLES AND GRAPHS ARE LOCATED AT THE END OF THE REPORT *

The habitat inventory of 8/20/2007 to 9/5/2007 was conducted by H. Fett, (DFG) and B. Nedland, and J. Hanson (WSP). The total length of the stream surveyed was 49,188 feet.

Stream flow was not measured on San Antonio Creek.

San Antonio Creek is a F5 channel type for 14,699 feet of the stream surveyed (Reach 1), a NA channel type for 11,245 feet of the stream surveyed (Reach 2), a C1 channel type for 3,144 feet of the stream surveyed (Reach 3), a NA channel type for 3,757 feet of the stream surveyed (Reach 4), a F5 channel type for 2,219 feet of the stream surveyed (Reach 5), a NA channel type for 4,822 feet of the stream surveyed (Reach 6), a F4 channel type for 4,779 feet of the stream surveyed (Reach 7), a F1 channel type for 3,363 feet of the stream surveyed (Reach 8), and a B6 channel type for remaining 1,160 feet of the stream surveyed (Reach 9).

F5 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and sand substrates. NA channel types are given to channels where there was no access given by the landowner and was therefore not surveyed. C1 channels are meandering point-bar riffle/pool alluvial channels with broad well defined floodplain on low gradients and bedrock dominant substrates. F4 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and gravel substrates. F1 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and bedrock

substrates. B6 channels are moderately entrenched riffle dominated channels with infrequently spaced pools, very stable plan and profile, stable banks on moderate gradients with low width /depth ratios and silt/clay dominant substrates.

Water temperatures taken during the survey period ranged from 57 to 67 degrees Fahrenheit. Air temperatures ranged from 65 to 87 degrees Fahrenheit.
Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 43% dry units, 26% pool units, 6% culvert units, 21% flatwater units, 2% nosurvey units and 2% riffle units (Graph 1). Based on total length of Level II habitat types there were 50% dry units, 40% nosurvey units, 5% flatwater units, 4% pool units, 1% culvert units, and less than 1% riffle units (Graph 2).

Ten Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were 43% Dry units, 21% Glide units and 9% Lateral Scour Pool - Bedrock Formed units (Graph 3). The most frequent habitat types based on percent total length were: 50% Dry units, 40% Not Surveyed units and 5% Glide units.

A total of 43 pools were identified (Table 3). Scour pools were the most frequently encountered, at 72%, and comprised 70% of the total length of all pools (Graph 4).

Table 4 is a summary of maximum residual pool depths by pool habitat types. Pool quality for salmonids increases with depth. Twenty six of the 43 pools (60%) had a residual depth of two feet or greater (Graph 5). Thirteen of the 43 pools (30%) had a residual depth of three feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 43 pool tail-outs measured, 3 had a value of 1 (7%); 8 had a value of 2 (18.6%); 1 had a value of 3 (2.3%); and 31 had a value of 5 (72.1%) (Graph 6). On this scale, a value of 1 indicates the best spawning conditions and a value of 4 the worst. Additionally, a value of 5 was assigned to tail-outs deemed unsuited for spawning due to inappropriate substrate such as bedrock, log sills, boulders, or other considerations.

A shelter rating was calculated for each habitat unit and expressed as a mean value for each habitat type within the survey using a scale of 0-300. Riffle habitat types had a mean shelter rating of 0, flatwater habitat types had a mean shelter rating of 3 , and pool habitats had a mean shelter rating of 14 (Table 1). Of the pool types, the Scour pools had a mean shelter rating of 14 and Main Channel pools had a mean shelter rating of 15 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Bedrock Ledges are the dominant cover types in San Antonio Creek. Graph 7 describes the pool cover in San Antonio Creek. Bedrock Ledges are the dominant pool cover type followed by aquatic vegetation.

Table 6 summarizes the dominant substrate by habitat type. Graph 8 depicts the dominant substrate observed in pool tail-outs. A silt/clay substrate type was observed in 26% of pool tail-outs and bedrock was observed in 26% of pool tail-outs.

The mean percent canopy density for the surveyed length of San Antonio Creek was 74%. The mean percentages of hardwood and coniferous trees were 100% and 0%, respectively. Twenty six percent of the canopy was open. Graph 9 describes the mean percent canopy in San Antonio Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 48%. The mean percent left bank vegetated was 54%. The dominant elements composing the structure of the stream banks consisted of 16% bedrock, 3% cobble/gravel and 81% sand/silt/clay (Graph 10). Deciduous trees were the dominant vegetation type observed in 63% of the units surveyed. Additionally, 18% of the units surveyed had grass as the dominant vegetation type, and 15% had brush as the dominant vegetation (Graph 11).

BIOLOGICAL INVENTORY RESULTS

Two sites were electrofished for species composition and distribution in San Antonio Creek on August 31, 2007. Water temperatures taken during the electrofishing period ranged from 63 to 73 degrees Fahrenheit. Air temperatures ranged from 79 to 87 degrees Fahrenheit. The sites were sampled by D. Acomb (DFG) and B. Cox (DFG).

In reach one, one site was sampled starting approximately at Habitat Unit 6 and ending Habitat Unit 13. The reach sites yielded one hundred eighteen three-spine stickleback eight bluegill, four bullfrogs, thirty one California roach, seventy nine Sacramento sucker, one sculpin and nineteen western mosquitofish.

In reach 3, one site was sampled starting approximately Habitat Unit 51 and ending at Habitat Unit 63. The reach sites yielded seventy nine three-spine stickleback, twenty one California roach and seventeen western mosquitofish.

The following chart displays the information yielded from these sites:

2007 San Antonio Creek e-fish observations

Date	Site #	Reference Point	Distance From Reference Point (ft.)	Steelhead/ Rainbow Trout			Non Salmonid Species
				0+	1+	2+	
09/31/2007	618	San Antonio Road Bridge	0	0	0	0	118 three-spine stickleback 8 bluegill, 4 bullfrog, 31 California roach, 79 Sacramento sucker, 1 sculpin, 19 western mosquitofish.
9/31/2007	619	D Street Bridge	0	0	0	0	79 three-spine stickleback, 21 California roach, 17western mosquitofish

DISCUSSION

San Antonio Creek is a F5 channel type for the first 14,699 feet of stream surveyed (Reach 1), a NA channel type channel type for the next 11,245 feet (Reach 2), a C1 channel type for 3,144 feet of the stream surveyed (Reach 3), a NA channel type for the next 3,757 feet of the stream surveyed (Reach 4), a F5 channel type for 2,219 feet of the stream surveyed (Reach 5), a NA channel type for the next 4,822 feet of the stream surveyed (Reach 6), a F4 channel type for 4,779 feet of the stream surveyed (Reach 7), a F1 channel type for the next 3,363 feet of the stream surveyed (Reach 8) and a B6 channel type for the remaining 1,160 feet of the stream surveyed (Reach 9).

The suitability of F5 channel types for fish habitat improvement structures is as follows: good for bank-placed boulders; fair for plunge weirs, single and opposing wing-deflectors, channel constrictors and log cover; and poor for boulder clusters. The suitability of C1 channel types for fish habitat improvement structures is as follows: excellent for bank-placed boulders and log cover; and poor for plunge weirs, boulder clusters, and single and opposing wing-deflectors. The suitability of F4 channel types for fish habitat improvement structures is as follows: good for bank-placed boulders; fair for plunge weirs, single and opposing wing-deflectors, channel constrictors and log cover; and poor for boulder clusters. The suitability of F1 channel types for fish habitat improvement structures is as follows: good for bank placed boulders; fair for single wing-deflectors and log cover; and poor for plunge weirs, boulder clusters and opposing wing-deflectors. The suitability of B6 channel types for fish habitat improvement structures is as follows: excellent for bank placed boulders and log cover; good for plunge weirs, single and opposing wing-deflector and channel constrictors; and fair for boulder clusters.

The water temperatures recorded on the survey days 8/20/2007 to 9/5/2007, ranged from57 to 67 degrees Fahrenheit. Air temperatures ranged from 65 to 87 degrees Fahrenheit. To make any further conclusions, temperatures would need to be monitored throughout the warm summer months, and more extensive biological sampling would need to be conducted.

Flatwater habitat types comprised 5% of the total length of this survey, pools 4% and riffles 0%. The pools are relatively deep, with 13 of the 43 (30%) pools having a maximum residual depth greater than 2 feet. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat. In third order streams, a primary pool is defined to have a maximum residual depth of at least three feet, occupy at least half the width of the low flow channel, and be as long as the low flow channel width. Installing structures that will increase or deepen pool habitat is recommended for locations where their installation will not be threatened by high stream energy, or where their installation will not conflict with the modification of the numerous log debris accumulations (LDA's) in the stream.

Eleven of the 43 pool tail-outs measured had embeddedness ratings of 1 or 2. One of the pool tail-outs had embeddedness ratings of 3 or 4. Thirty-one of the pool tail-outs had a rating of 5, which is considered unsuitable for spawning. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered to indicate good quality spawning substrate for salmon and steelhead. Sediment sources in San Antonio Creek should be mapped and rated according to their potential sediment yields, and control measures should be taken.

Thirty-one of the 43 pool tail-outs had silt, sand, large cobble, boulders or bedrock as the dominant substrate. This is generally considered unsuitable for spawning salmonids.

The mean shelter rating for pools was 14. The shelter rating in the flatwater habitats was 3. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by Bedrock Ledges in San Antonio Creek. Bedrock Ledges are the dominant cover type in pools followed by aquatic vegetation. Log and root wad cover structures in the pool and flatwater habitats would enhance both summer and winter salmonid habitat. Log cover structure provides rearing fry with protection from predation, rest from water velocity, and also divides territorial units to reduce density related competition.

The mean percent canopy density for the stream was 74%. Reach 1 had a canopy density of 48%, Reach 3 had a canopy density of 81%, Reach 5 had a canopy density of 38%, Reach 7 had a canopy density of 85% and Reach 8 had a canopy density of 90%. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was moderate at 48% and 54%, respectively. In areas of stream bank erosion or where bank vegetation is sparse, planting endemic species of coniferous and hardwood trees, in conjunction with bank stabilization, is recommended.

GENERAL RECOMMENDATIONS

San Antonio Creek should be managed as an anadromous, natural production stream.

Winter storms often bring down large trees and other woody debris into the stream, which increases the number and quality of pools. This woody debris, if left undisturbed, will provide fish shelter and rearing habitat, and offset channel incision. Landowners should be sensitive about the natural and positive role woody debris plays in the system, and encouraged not to remove woody debris from the stream, except under extreme buildup and only under guidance by a fishery professional.

RECOMMENDATIONS

1) Water quantity is an on-going issue in many of the Petaluma River tributaries. Water conservation measures should be explored with the landowners and developed where possible.

2) Inventory and map sources of stream bank erosion and prioritize them according to present and potential sediment yield. Identified sites should then be treated to reduce the amount of fine sediments entering the stream.

3) Active and potential sediment sources related to the road system need to be identified, mapped, and treated according to their potential for sediment yield to the stream and its tributaries.

4) Increase woody cover in the pools and flatwater habitat units. Most of the existing cover in the pools is from Bedrock Ledges. Adding high quality complexity with woody cover in the pools is desirable.

5) Where feasible, design and engineer pool enhancement structures to increase the number of pools. This must be done where the banks are stable or in conjunction with stream bank armor to prevent erosion.

6) Increase the canopy on San Antonio Creek especially in reaches 1 and 5 by planting appropriate native vegetation like willow, alder, redwood, and Douglas fir along the stream where shade canopy is not at acceptable levels. The reaches above this survey section should be inventoried and treated as well, since the water flowing here is affected from upstream. In many cases, planting will need to be coordinated to follow bank stabilization or upslope erosion control projects.

7) The limited water temperature and water quality data available suggest that water quality is unacceptable for juvenile salmonids. To establish more complete and meaningful temperature regime information, 24-hour monitoring during the May through October temperature extreme period should be performed for 3 to 5 years.

8) Suitable size spawning substrate on San Antonio Creek is limited to relatively few reaches. Projects should be designed at suitable sites to trap and sort spawning gravel.

9) There may be sections where the stream is being impacted from cattle trampling the riparian zone. Alternatives should be explored with the grazier and developed if possible.

10) Access for migrating salmonids should be assessed, monitored and improved along the stream, particularly at all road crossings and culverts. Where needed crossings and culverts should be replaced or modified to improve fish passage. Potential barriers noted in the assessment were located at the following locations: Corda Road in reach 5.

COMMENTS AND LANDMARKS

The following landmarks and possible problem sites were noted. All distances are approximate and taken from the beginning of the survey reach.

Position	Habitat Unit #	Comments
0	0001.00	Start of Survey: Start of Survey at confluence with Schultz Slough.
3823	0004.00	Structures: Bridge #1, HWY 101, H.: 11.5ft, W.: 112ft, L.: 118ft, material: concrete, not a possible barrier to salmonids

Position	Habitat Unit #	Comments
5550	0006.00	Structures: Bridge #2, San Antonio Rd., H.: 11ft, W.: 101ft, L.: 32ft, material: concrete, not a possible barrier to salmonids
7143	0014.00	General Comment: One 3+ Steelhead observed.
11211	0026.00	General Comment: unidentified fish observed
12628	0034.00	Structures: Bridge #3 H.: 25ft, W.: 70ft, L.: 16ft, material: concrete, not a possible barrier to salmonids.
12877	0037.00	Tributaries: Tributary #1 at 125 feet into unit on left bank, not flowing, not accessible to fish, checked up the tributary for 100 feet, slope: >10%, no fish observed. Tributary #2 at 494 feet into unit on right bank, not flowing, accessible to fish when flowing, checked up the tributary for 100 feet, slope: ~ 1%, no fish observed.
12877	0037.00	Erosion Site: (Bank) At 1,181feet into unit, concrete bags are being used to stabilize the bank, 25 feet high and 25 feet long.
14582	0040.00	General Comment: Channel type change from F5 to NA, Reach 1 to Reach 2.
25944	0042.00	General Comment: Channel type change from NA to C1, Reach 2 to Reach 3.
26547	0047.00	General Comment: Unidentified fish observed
27705	0059.00	Tributaries: Tributary #3 at 79 feet into unit on right bank, not flowing, accessible to fish when flowing, checked up the tributary for 100 feet, slope: < 2%.
29043	0071.00	General Comment: Channel type change from C1 to NA, Reach change from 3 to 4.
29043	0071.00	Structures: Bridge #4, Point Reyes Rd., H.: 21ft, W.: 75ft, L.: 45ft, material: concrete, not a possible barrier to salmonids.
29088	0072.00	General Comment: Channel type change from NA to F5, Reach change from 4 to 5.
33530	0074.00	Structures: culvert # 1: This is the only culvert on San Antonio. It is located at Corda Road and its dimensions are: 23 feet long, 24 feet wide and 10 feet high. There is instream down-cutting, it's not retaining gravel and there is no maintenance required.
35064	0089.00	General Comment: Channel type change from F5 to NA and Reach change from Reach 5 to Reach 6.
39886	0090.00	General Comment: Channel type change from NA to F4 and reach change from Reach 6 to reach 7.
41178	0093.00	General Comment: California Roach were observed in this pool but no salmonids.
41205	0094.00	Tributaries: This tributary was not flowing for at least 200 feet from the mouth upstream.

Position	Habitat Unit #	Comments
42939	0101.00	Structures: Bridge # 5 - Located at Chileno Valley Road; a Highway bridge 22 feet long, 8 feet high and 26 feet long. The bridge is made out of concrete, and it does not appear to be a possible fish barrier. There is bedrock substrate under the bridge. No fish observed above this road.
42965	0102.00	Structures: There is a ford crossing 688 feet into this unit.
42965	0102.00	Tributaries: Dry Right Bank Tributary 5 is located 908 feet into this unit.
44223	0105.00	Structures: Bridge # 6 is a private ATV bridge. Its dimensions are 19 feet long, 9 feet high, and 5 feet long. It was constructed out of wood planks over metal I beams on cement columns. It does not appear to be a possible fish barrier.
44665	0114.00	General Comment: There is a channel type change here, from a F4 to a F1 and the Reach changed from Reach 7 to Reach 8.
46411	0140.00	General Comment: Debris accumulation at the top of this unit.
47759	0159.00	Structures: Bridge # 7: This is a private bridge with dimensions of 40 feet in length, 9 feet in height, and 11 feet in length. It is made out of wood planks and it does not appear to be a possible fish barrier.
48028	0162.00	General Comment: There is a long straight trench that begins in this unit and there is no canopy. There is a channel type change here, from a F1 to a B6, Reach 8 to Reach 9.
50322	0163.00	General Comment: Beyond HU 162: The B channel ditch continues and it is completely straight. The landowner says that the creek comes out from a lagoon located beyond our access. Beyond that, aerial photos show evidence of a new riparian corridor heading to the headwaters of San Antonio Creek, but access to that point was not granted.
50335	0163.00	End of Survey: The survey ends at the top of this bridge unit.

REFERENCES

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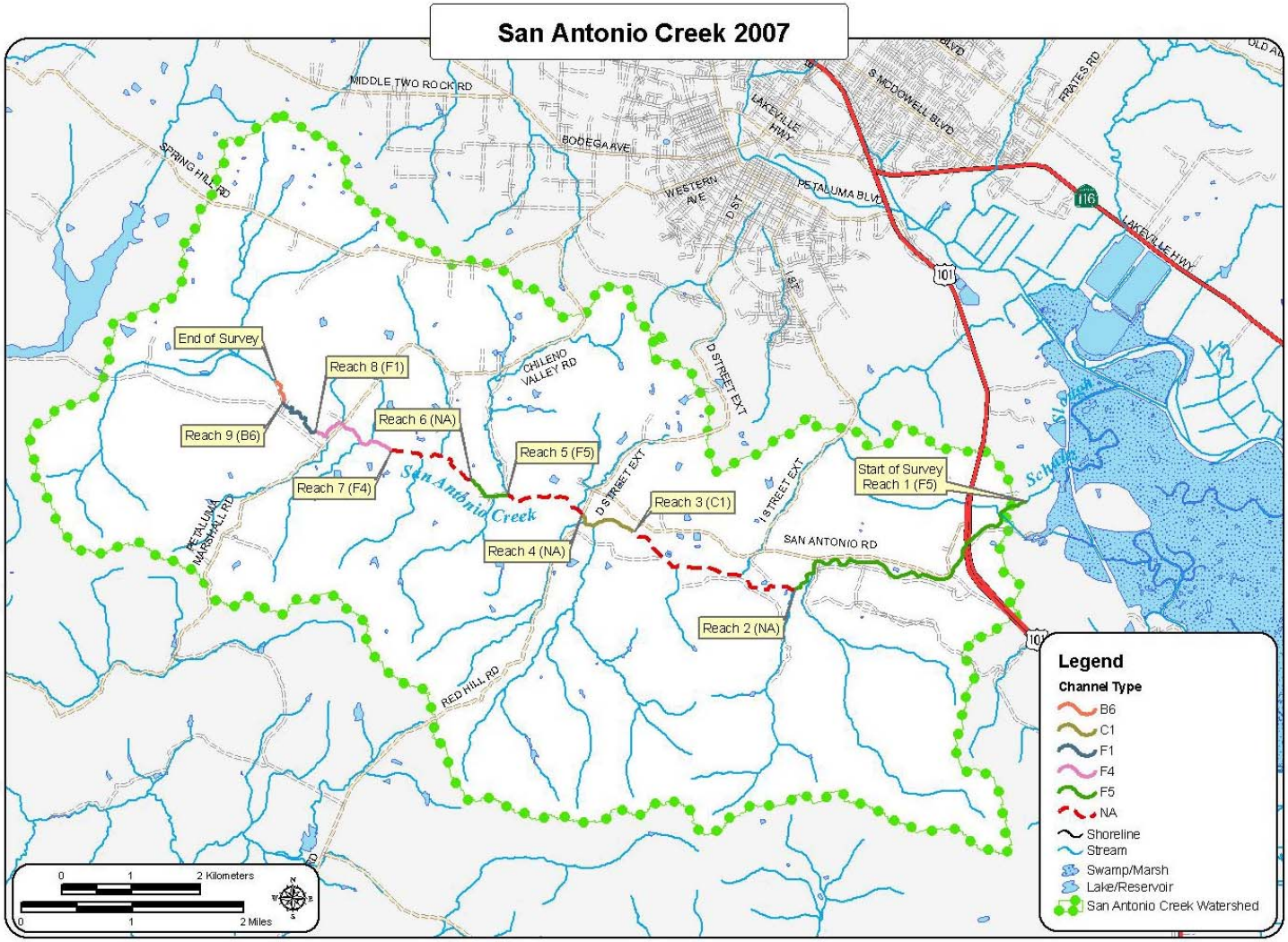
McCain, M., D. Fuller, L. Decker and K. Overton. 1990. Stream habitat classification and inventory procedures for northern California. FHC Currents. No.1. U.S. Department of Agriculture. Forest Service, Pacific Southwest Region.

Rosgen, D.L., 1994. A Classification of Natural Rivers. Catena, Vol 22: 169-199, Elsevier Science, B. V. Amsterdam.



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Prepared by: Scott Webb, December 2007

LEVEL III and LEVEL IV HABITAT TYPES

RIFFLE			
Low Gradient Riffle	(LGR)	[1.1]	{ 1}
High Gradient Riffle	(HGR)	[1.2]	{ 2}
CASCADE			
Cascade	(CAS)	[2.1]	{ 3}
Bedrock Sheet	(BRS)	[2.2]	{24}
FLATWATER			
Pocket Water	(POW)	[3.1]	{21}
Glide	(GLD)	[3.2]	{14}
Run	(RUN)	[3.3]	{15}
Step Run	(SRN)	[3.4]	{16}
Edgewater	(EDW)	[3.5]	{18}
MAIN CHANNEL POOLS			
Trench Pool	(TRP)	[4.1]	{ 8 }
Mid-Channel Pool	(MCP)	[4.2]	{17}
Channel Confluence Pool	(CCP)	[4.3]	{19}
Step Pool	(STP)	[4.4]	{23}
SCOUR POOLS			
Corner Pool	(CRP)	[5.1]	{22}
Lateral Scour Pool - Log Enhanced	(LSL)	[5.2]	{10}
Lateral Scour Pool - Root Wad Enhanced	(LSR)	[5.3]	{11}
Lateral Scour Pool - Bedrock Formed	(LSBk)	[5.4]	{12}
Lateral Scour Pool - Boulder Formed	(LSBo)	[5.5]	{20}
Plunge Pool	(PLP)	[5.6]	{ 9 }
BACKWATER POOLS			
Secondary Channel Pool	(SCP)	[6.1]	{ 4 }
Backwater Pool - Boulder Formed	(BPB)	[6.2]	{ 5 }
Backwater Pool - Root Wad Formed	(BPR)	[6.3]	{ 6 }
Backwater Pool - Log Formed	(BPL)	[6.4]	{ 7 }
Dammed Pool	(DPL)	[6.5]	{13}
ADDITIONAL UNIT DESIGNATIONS			
Dry	(DRY)	[7.0]	
Culvert	(CUL)	[8.0]	
Not Surveyed	(NS)	[9.0]	
Not Surveyed due to a marsh	(MAR)	[9.1]	

Table 1 - Summary of Riffle, Flatwater, and Pool Habitat Types

Stream Name: San Antonio Creek **LLID:** 1225943381893 **Drainage:** Petaluma River

Survey Dates: 8/20/2007 to 9/5/2007

Confluence Location: Quad: PETALUMA **Legal Description:** T04NR07WS14 **Latitude:** 38:11:21.0N **Longitude:** 122:35:39.0W

Habitat Units	Units Fully Measured	Habitat Type	Habitat Occurrence (%)	Mean Length (ft.)	Total Length (ft.)	Total Length (%)	Mean Width (ft.)	Mean Depth (ft.)	Mean Max Depth (ft.)	Mean Area (sq.ft.)	Estimated Total Area (sq.ft.)	Mean Volume (cu.ft.)	Estimated Total Volume (cu.ft.)	Mean Residual Pool Vol (cu.ft.)	Mean Shelter Rating
9	0	CULVERT	5.5	32	289	0.6									
70	0	DRY	42.9	348	24370	49.5									
35	9	FLATWATER	21.5	74	2577	5.2	4.8	0.5	1.0	168	5888	79	2779		3
3	0	NOSURVEY	1.8	6608	19824	40.3									
43	43	POOL	26.4	48	2065	4.2	9.3	1.3	2.5	443	19044	663	28519	636	14
3	2	RIFFLE	1.8	21	63	0.1	3.0	0.1	0.2	65	194	6	19		0

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
163	54	49188	25126	31317

Table 2 - Summary of Habitat Types and Measured Parameters

Stream Name: San Antonio Creek **LLID:**1225943381893 **Drainage:** Petaluma River

Survey Dates: 8/20/2007 to 9/5/2007

Confluence Location: Quad: PETALUMA **Legal Description:** T04NR07WS14 **Latitude:** 38:11:21.0N **Longitude:** 122:35:39.0W

Habitat Units	Units Fully Measured	Habitat Type	Habitat Occurrence (%)	Mean Length (ft.)	Total Length (ft.)	Total Length (%)	Mean Width (ft.)	Mean Depth (ft.)	Mean Max Depth (ft.)	Mean Area (sq.ft.)	Estimated Total Area (sq.ft.)	Mean Volume (cu.ft.)	Estimated Total Volume (cu.ft.)	Mean Residual Pool Vol (cu.ft.)	Mean Shelter Rating	Mean Canopy (%)
3	2	LGR	1.8	21	63	0.1	3.0	0.1	0.2	65	194	6	19		0	91
35	9	GLD	21.5	74	2577	5.2	5.0	0.5	1.4	168	5888	79	2779		3	72
12	12	MCP	7.4	52	623	1.3	8.0	1.5	4.0	428	5131	755	9056	731	15	44
11	11	CRP	6.7	46	510	1.0	9.0	1.3	4.0	459	5047	729	8016	695	10	81
1	1	LSL	0.6	47	47	0.1	11.0	0.8	1.5	517	517	517	517	414	25	97
2	2	LSR	1.2	42	84	0.2	6.0	0.8	1.5	229	457	183	366	172	30	85
15	15	LSBk	9.2	49	732	1.5	10.0	1.2	5.0	484	7256	660	9893	632	13	83
1	1	LSBo	0.6	47	47	0.1	7.0	1.2	2.0	329	329	395	395	395	20	88
1	1	PLP	0.6	22	22	0.0	14.0	0.9	2.1	308	308	277	277	277	20	71
70	0	DRY	42.9	348	24370	49.5										76
9	0	CUL	5.5	32	289	0.6										
3	0	NS	1.8	6608	19824	40.3										

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
163	54	49188	25126	31317

Table 3 - Summary of Pools Types

Stream Name: San Antonio Creek **LLID:** 1225943381893 **Drainage:** Petaluma River

Survey Dates: 8/20/2007 to 9/5/2007

Confluence Location: **Quad:** PETALUMA **Legal Description:** T04NR07WS14 **Latitude:** 38:11:21.0N **Longitude:** 122:35:39.0W

Habitat Units	Units Fully Measured	Habitat Type	Habitat Occurrence (%)	Mean Length (ft.)	Total Length (ft.)	Total Length (%)	Mean Width (ft.)	Mean Residual Depth (ft.)	Mean Area (sq.ft.)	Estimated Total Area (sq.ft.)	Mean Residual Pool Vol (cu.ft.)	Estimated Total Resid. Vol (cu.ft.)	Mean Shelter Rating
12	12	MAIN	28	52	623	30	7.8	1.5	428	5131	731	8774	15
31	31	SCOUR	72	47	1442	70	9.8	1.2	449	13913	599	18565	14

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
43	43	2065	19044	27339

Table 4 - Summary of Maximum Residual Pool Depths By Pool Habitat Types

Stream Name: San Antonio Creek **LLID:** 1225943381893 **Drainage:** Petaluma River

Survey Dates: 8/20/2007 to 9/5/2007

Confluence Location: Quad: PETALUMA **Legal Description:** T04NR07WS14 **Latitude:** 38:11:21.0N **Longitude:** 122:35:39.0W

Habitat Units	Habitat Type	Habitat Occurrence (%)	< 1 Foot Maximum Residual Depth	< 1 Foot Percent Occurrence	1 < 2 Feet Maximum Residual Depth	1 < 2 Feet Percent Occurrence	2 < 3 Feet Maximum Residual Depth	2 < 3 Feet Percent Occurrence	3 < 4 Feet Maximum Residual Depth	3 < 4 Feet Percent Occurrence	>= 4 Feet Maximum Residual Depth	>= 4 Feet Percent Occurrence
15	LSBk	35	0	0	6	40	5	33	1	7	3	20
12	MCP	28	0	0	4	33	2	17	4	33	2	17
11	CRP	26	0	0	4	36	4	36	2	18	1	9
2	LSR	5	0	0	2	100	0	0	0	0	0	0
1	LSBo	2	0	0	0	0	1	100	0	0	0	0
1	PLP	2	0	0	0	0	1	100	0	0	0	0
1	LSL	2	0	0	1	100	0	0	0	0	0	0

Total Units			Total < 1 Foot Max Resid. Depth	Total < 1 Foot % Occurrence	Total 1< 2 Feet Max Resid. Depth	Total 1< 2 Feet % Occurrence	Total 2< 3 Feet Max Resid. Depth	Total 2< 3 Feet % Occurrence	Total 3< 4 Feet Max Resid. Depth	Total 3< 4 Feet % Occurrence	Total >= 4 Feet Max Resid. Depth	Total >= 4 Feet % Occurrence
43			0	0	17	40	13	30	7	16	6	14

Mean Maximum Residual Pool Depth (ft.): 2.5

Table 5 - Summary of Mean Percent Cover By Habitat Type

Stream Name: San Antonio Creek **LLID:** 1225943381893 **Drainage:** Petaluma River

Survey Dates: 8/20/2007 to 9/5/2007 **Dry Units:** 70

Confluence Location: **Quad:** PETALUMA **Legal Description:** T04NR07WS14 **Latitude:** 38:11:21.0N **Longitude:** 122:35:39.0W

Habitat Units	Units Fully Measured	Habitat Type	Mean % Undercut Banks	Mean % SWD	Mean % LWD	Mean % Root Mass	Mean % Terrestrial Vegetation	Mean % Aquatic Vegetation	Mean % White Water	Mean % Boulders	Mean % Bedrock Ledges
3	2	LGR	0	0	0	0	0	0	0	0	0
3	2	TOTAL RIFFLE	0	0	0	0	0	0	0	0	0
35	9	GLD	0	0	0	17	11	6	0	0	0
35	9	TOTAL FLAT	0	0	0	17	11	6	0	0	0
12	12	MCP	13	7	8	5	23	20	0	0	0
11	11	CRP	12	17	11	5	2	7	0	4	15
1	1	LSL	0	10	90	0	0	0	0	0	0
2	2	LSR	0	0	13	13	25	50	0	0	0
15	15	LSBk	1	2	5	0	2	16	0	12	43
1	1	LSBo	0	0	0	0	50	0	0	50	0
1	1	PLP	0	0	100	0	0	0	0	0	0
43	43	TOTAL POOL	7	7	12	3	10	15	0	6	19
9	0	CUL									
3	0	NS									
163	54	TOTAL	5	6	9	5	10	13	0	5	15

Table 6 - Summary of Dominant Substrates By Habitat Type

Stream Name: San Antonio Creek **LLID:** 1225943381893 **Drainage:** Petaluma River

Survey Dates: 8/20/2007 to 9/5/2007 **Dry Units:** 70

Confluence Location: **Quad:** PETALUMA **Legal Description:** T04NR07WS14 **Latitude:** 38:11:21.0N **Longitude:** 122:35:39.0W

Habitat Units	Units Fully Measured	Habitat Type	% Total Silt/Clay Dominant	% Total Sand Dominant	% Total Gravel Dominant	% Total Small Cobble Dominant	% Total Large Cobble Dominant	% Total Boulder Dominant	% Total Bedrock Dominant
3	2	LGR	0	0	0	50	0	0	50
35	10	GLD	40	20	0	0	0	0	40
12	12	MCP	58	25	8	0	0	0	8
11	11	CRP	18	27	0	0	0	0	55
1	1	LSL	0	0	0	0	0	0	100
2	2	LSR	0	50	0	0	0	0	50
15	15	LSBk	7	27	0	7	0	0	60
1	1	LSBo	0	100	0	0	0	0	0
1	1	PLP	100	0	0	0	0	0	0

Table 7 - Summary of Mean Percent Canopy for Entire Stream

Stream Name: San Antonio Creek **LLID:** 1225943381893 **Drainage:** Petaluma River

Survey Dates: 8/20/2007 to 9/5/2007

Confluence Location: **Quad:** PETALUMA **Legal Description:** T04NR07WS14 **Latitude:** 38:11:21.0N **Longitude:** 122:35:39.0W

Mean Percent Canopy	Mean Percent Conifer	Mean Percent Hardwood	Mean Percent Open Units	Mean Right Bank % Cover	Mean Left Bank % Cover
74	0	100	1	48	54

Note: Mean percent conifer and hardwood for the entire reach are means of canopy components from units with canopy values greater than zero.

Open units represent habitat units with zero canopy cover.

Table 8 - Fish Habitat Inventory Data Summary

Stream Name: San Antonio Creek LLID: 1225943381893 Drainage: Petaluma River
Survey Dates: 8/20/2007 to 9/5/2007 Survey Length (ft.): 49188 Main Channel (ft.): 49188 Side Channel (ft.): 0
Confluence Location: Quad: PETALUMA Legal Description: T04NR07WS14 Latitude: 38:11:21.0N Longitude: 122:35:39.0W

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 1

Channel Type: F5
Reach Length (ft.): 14699
Riffle/Flatwater Mean Width (ft.): 4.0
BFW:
Range (ft.): 24 to 55
Mean (ft.): 35.93
Std. Dev.: 11.42
Base Flow (cfs):
Water (F): 62 Air (F): 67 - 87
Dry Channel (ft.): 13778

Canopy Density (%): 48.1
Coniferous Component (%): 0.0
Hardwood Component (%): 100.0
Dominant Bank Vegetation: Hardwood Trees
Vegetative Cover (%): 71.3
Dominant Shelter: Aquatic Vegetation
Dominant Bank Substrate Type: Sand/Silt/Clay
Occurrence of LWD (%): 13.7
LWD per 100 ft.:
Riffles:
Pools: 1
Flat: 0

Pools by Stream Length (%): 2.9
Pool Frequency (%): 25.0
Residual Pool Depth (%):
< 2 Feet Deep: 50.0
2 to 2.9 Feet Deep: 40.0
3 to 3.9 Feet Deep: 10.0
>= 4 Feet Deep: 0.0
Mean Max Residual Pool Depth (ft.): 2.05
Mean Pool Shelter Rating: 26

Pool Tail Substrate (%): Silt/Clay: 20.0 Sand: 40.0 Gravel: 30.0 Sm Cobble: 10.0 Lg Cobble: 0.0 Boulder: 0.0 Bedrock: 0.0
Embeddedness Values (%): 1. 10.0 2. 30.0 3. 0.0 4. 0.0 5. 60.0

STREAM REACH: 2

Channel Type: NA
Reach Length (ft.): 11245
Riffle/Flatwater Mean Width (ft.):
BFW:
Range (ft.): to
Mean (ft.):
Std. Dev.:
Base Flow (cfs):
Water (F): Air (F):
Dry Channel (ft.):

Canopy Density (%):
Coniferous Component (%):
Hardwood Component (%):
Dominant Bank Vegetation:
Vegetative Cover (%):
Dominant Shelter:
Dominant Bank Substrate Type:
Occurrence of LWD (%):
LWD per 100 ft.:
Riffles:
Pools:
Flat:

Pools by Stream Length (%):
Pool Frequency (%):
Residual Pool Depth (%):
< 2 Feet Deep:
2 to 2.9 Feet Deep:
3 to 3.9 Feet Deep:
>= 4 Feet Deep:
Mean Max Residual Pool Depth (ft.):
Mean Pool Shelter Rating:

Pool Tail Substrate (%): Silt/Clay: Sand: Gravel: Sm Cobble: Lg Cobble: Boulder: Bedrock:
Embeddedness Values (%): 1. 2. 3. 4. 5.

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 3

Channel Type: C1
Reach Length (ft.): 3144
Riffle/Flatwater Mean Width (ft.): 7.5
BFW:
Range (ft.): 31 to 42
Mean (ft.): 35.33
Std. Dev.: 4.78
Base Flow (cfs):
Water (F): 62 Air (F): 67 - 77
Dry Channel (ft.): 2002

Canopy Density (%): 81.1
Coniferous Component (%): 0.0
Hardwood Component (%): 100.0
Dominant Bank Vegetation: Hardwood Trees
Vegetative Cover (%): 71.6
Dominant Shelter: Terrestrial Veg.
Dominant Bank Substrate Type: Sand/Silt/Clay
Occurrence of LWD (%): 0.0
LWD per 100 ft.:
Riffles:
Pools: 0
Flat: 0

Pools by Stream Length (%): 15.6
Pool Frequency (%): 20.0
Residual Pool Depth (%):
< 2 Feet Deep: 16.7
2 to 2.9 Feet Deep: 33.3
3 to 3.9 Feet Deep: 33.3
>= 4 Feet Deep: 16.7
Mean Max Residual Pool Depth (ft.): 2.75
Mean Pool Shelter Rating: 22

Pool Tail Substrate (%): Silt/Clay: 16.7 Sand: 0.0 Gravel: 33.3 Sm Cobble: 0.0 Lg Cobble: 0.0 Boulder: 16.7 Bedrock: 33.3
Embeddedness Values (%): 1. 0.0 2. 33.3 3. 0.0 4. 0.0 5. 66.7

STREAM REACH: 4

Channel Type: NA
Reach Length (ft.): 3757
Riffle/Flatwater Mean Width (ft.):
BFW:
Range (ft.): to
Mean (ft.):
Std. Dev.:
Base Flow (cfs):
Water (F): Air (F):
Dry Channel (ft.):

Canopy Density (%):
Coniferous Component (%):
Hardwood Component (%):
Dominant Bank Vegetation:
Vegetative Cover (%):
Dominant Shelter:
Dominant Bank Substrate Type:
Occurrence of LWD (%):
LWD per 100 ft.:
Riffles:
Pools:
Flat:

Pools by Stream Length (%):
Pool Frequency (%):
Residual Pool Depth (%):
< 2 Feet Deep:
2 to 2.9 Feet Deep:
3 to 3.9 Feet Deep:
>= 4 Feet Deep:
Mean Max Residual Pool Depth (ft.):
Mean Pool Shelter Rating:

Pool Tail Substrate (%): Silt/Clay: Sand: Gravel: Sm Cobble: Lg Cobble: Boulder: Bedrock:
Embeddedness Values (%): 1. 2. 3. 4. 5.

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 5

Channel Type: F5
Reach Length (ft.): 2219
Riffle/Flatwater Mean Width (ft.): 4.0
BFW:
Range (ft.): 28 to 28
Mean (ft.): 28
Std. Dev.: 0
Base Flow (cfs):
Water (F): 62 Air (F): 65 - 65
Dry Channel (ft.): 1827

Canopy Density (%): 37.8
Coniferous Component (%): 0.0
Hardwood Component (%): 100.0
Dominant Bank Vegetation: Grass
Vegetative Cover (%): 43.3
Dominant Shelter: Small Woody Debris
Dominant Bank Substrate Type: Sand/Silt/Clay
Occurrence of LWD (%): 1.7
LWD per 100 ft.:
Riffles:
Pools: 1
Flat: 0

Pools by Stream Length (%): 9.6
Pool Frequency (%): 31.3
Residual Pool Depth (%):
< 2 Feet Deep: 40.0
2 to 2.9 Feet Deep: 20.0
3 to 3.9 Feet Deep: 20.0
>= 4 Feet Deep: 20.0
Mean Max Residual Pool Depth (ft.): 2.72
Mean Pool Shelter Rating: 4

Pool Tail Substrate (%): Silt/Clay: 100. Sand: 0.0 Gravel: 0.0 Sm Cobble: 0.0 Lg Cobble: 0.0 Boulder: 0.0 Bedrock: 0.0
Embeddedness Values (%): 1. 0.0 2. 0.0 3. 0.0 4. 0.0 5. 100.0

STREAM REACH: 6

Channel Type: NA
Reach Length (ft.): 4822
Riffle/Flatwater Mean Width (ft.):
BFW:
Range (ft.): to
Mean (ft.):
Std. Dev.:
Base Flow (cfs):
Water (F): Air (F):
Dry Channel (ft.):

Canopy Density (%):
Coniferous Component (%):
Hardwood Component (%):
Dominant Bank Vegetation:
Vegetative Cover (%):
Dominant Shelter:
Dominant Bank Substrate Type:
Occurrence of LWD (%):
LWD per 100 ft.:
Riffles:
Pools:
Flat:

Pools by Stream Length (%):
Pool Frequency (%):
Residual Pool Depth (%):
< 2 Feet Deep:
2 to 2.9 Feet Deep:
3 to 3.9 Feet Deep:
>= 4 Feet Deep:
Mean Max Residual Pool Depth (ft.):
Mean Pool Shelter Rating:

Pool Tail Substrate (%): Silt/Clay: Sand: Gravel: Sm Cobble: Lg Cobble: Boulder: Bedrock:
Embeddedness Values (%): 1. 2. 3. 4. 5.

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 7

Channel Type: F4
Reach Length (ft.): 4779
Riffle/Flatwater Mean Width (ft.): 3.7
BFW:
Range (ft.): 19 to 24
Mean (ft.): 21.92
Std. Dev.: 2.47
Base Flow (cfs):
Water (F): 58 - 67 Air (F): 69 - 77
Dry Channel (ft.): 4208

Canopy Density (%): 84.5
Coniferous Component (%): 0.0
Hardwood Component (%): 100.0
Dominant Bank Vegetation: Hardwood Trees
Vegetative Cover (%): 22.5
Dominant Shelter: Large Woody Debris
Dominant Bank Substrate Type: Bedrock
Occurrence of LWD (%): 8.9
LWD per 100 ft.:
Riffles: 0
Pools: 0
Flat: 0

Pools by Stream Length (%): 4.7
Pool Frequency (%): 25.0
Residual Pool Depth (%):
< 2 Feet Deep: 33.3
2 to 2.9 Feet Deep: 33.3
3 to 3.9 Feet Deep: 0.0
>= 4 Feet Deep: 33.3
Mean Max Residual Pool Depth (ft.): 2.86
Mean Pool Shelter Rating: 8

Pool Tail Substrate (%): Silt/Clay: 0.0 Sand: 33.3 Gravel: 33.3 Sm Cobble: 0.0 Lg Cobble: 0.0 Boulder: 0.0 Bedrock: 33.3
Embeddedness Values (%): 1. 33.3 2. 0.0 3. 0.0 4. 0.0 5. 66.7

STREAM REACH: 8

Channel Type: F1
Reach Length (ft.): 3363
Riffle/Flatwater Mean Width (ft.): 3.5
BFW:
Range (ft.): 14 to 23
Mean (ft.): 18.5
Std. Dev.: 3.87
Base Flow (cfs):
Water (F): 57 - 58 Air (F): 77 - 83
Dry Channel (ft.): 1408

Canopy Density (%): 90.2
Coniferous Component (%): 0.0
Hardwood Component (%): 100.0
Dominant Bank Vegetation: Hardwood Trees
Vegetative Cover (%): 44.0
Dominant Shelter: Large Woody Debris
Dominant Bank Substrate Type: Sand/Silt/Clay
Occurrence of LWD (%): 13.3
LWD per 100 ft.:
Riffles: 0
Pools: 1
Flat: 0

Pools by Stream Length (%): 20.9
Pool Frequency (%): 33.3
Residual Pool Depth (%):
< 2 Feet Deep: 43.8
2 to 2.9 Feet Deep: 25.0
3 to 3.9 Feet Deep: 18.8
>= 4 Feet Deep: 12.5
Mean Max Residual Pool Depth (ft.): 2.55
Mean Pool Shelter Rating: 10

Pool Tail Substrate (%): Silt/Clay: 18.8 Sand: 12.5 Gravel: 18.8 Sm Cobble: 6.3 Lg Cobble: 0.0 Boulder: 0.0 Bedrock: 43.8
Embeddedness Values (%): 1. 0.0 2. 18.8 3. 6.3 4. 0.0 5. 75.0

STREAM REACH: 9

Channel Type: B6
Reach Length (ft.): 1160
Riffle/Flatwater Mean Width (ft.):
BFW:
Range (ft.): 16 to 16
Mean (ft.): 16
Std. Dev.: 0
Base Flow (cfs):
Water (F): 58 - 58 Air (F): 83 - 83
Dry Channel (ft.): 1147

Canopy Density (%):
Coniferous Component (%):
Hardwood Component (%):
Dominant Bank Vegetation:
Vegetative Cover (%): 0.0
Dominant Shelter:
Dominant Bank Substrate Type:
Occurrence of LWD (%):
LWD per 100 ft.:
Riffles:
Pools:
Flat:

Pools by Stream Length (%): 0.0
Pool Frequency (%): 0.0
Residual Pool Depth (%):
< 2 Feet Deep:
2 to 2.9 Feet Deep:
3 to 3.9 Feet Deep:
>= 4 Feet Deep:
Mean Max Residual Pool Depth (ft.):
Mean Pool Shelter Rating:

Pool Tail Substrate (%): Silt/Clay: Sand: Gravel: Sm Cobble: Lg Cobble: Boulder: Bedrock:
Embeddedness Values (%): 1. 2. 3. 4. 5.

Table 9 -Mean Percentage of Dominant Substrate and Vegetation

Stream Name: San Antonio Creek **LLID:** 1225943381893 **Drainage:** Petaluma River

Survey Dates: 8/20/2007 to 9/5/2007

Confluence Location: **Quad:** PETALUMA **Legal Description:** T04NR07WS14 **Latitude:** 38:11:21.0N **Longitude:** 122:35:39.0W

Mean Percentage of Dominant Stream Bank Substrate

Dominant Class of Substrate	Number of Units Right Bank	Number of Units Left Bank	Total Mean Percentage (%)
Bedrock	10	7	15.7
Boulder	0	0	0.0
Cobble/Gravel	2	1	2.8
Sand/Silt/Clay	42	46	81.5

Mean Percentage of Dominant Stream Bank Vegetation

Dominant Class of Vegetation	Number of Units Right Bank	Number of Units Left Bank	Total Mean Percentage (%)
Grass	10	9	17.6
Brush	8	8	14.8
Hardwood Trees	34	34	63.0
Coniferous Trees	0	0	0.0
No Vegetation	2	3	4.6

Total Stream Cobble Embeddedness Values: 4

Table 10 - Mean Percent of Shelter Cover Types for Entire Stream

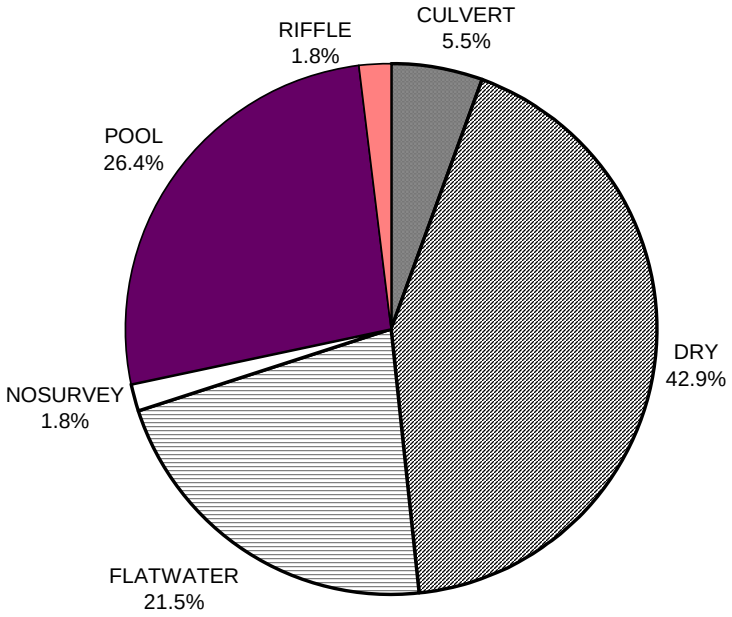
Stream Name: San Antonio Creek **LLID:** 1225943381893 **Drainage:** Petaluma River

Survey Dates: 8/20/2007 to 9/5/2007

Confluence Location: Quad: PETALUMA **Legal Description:** T04NR07WS14 **Latitude:** 38:11:21.0N **Longitude:** 122:35:39.0W

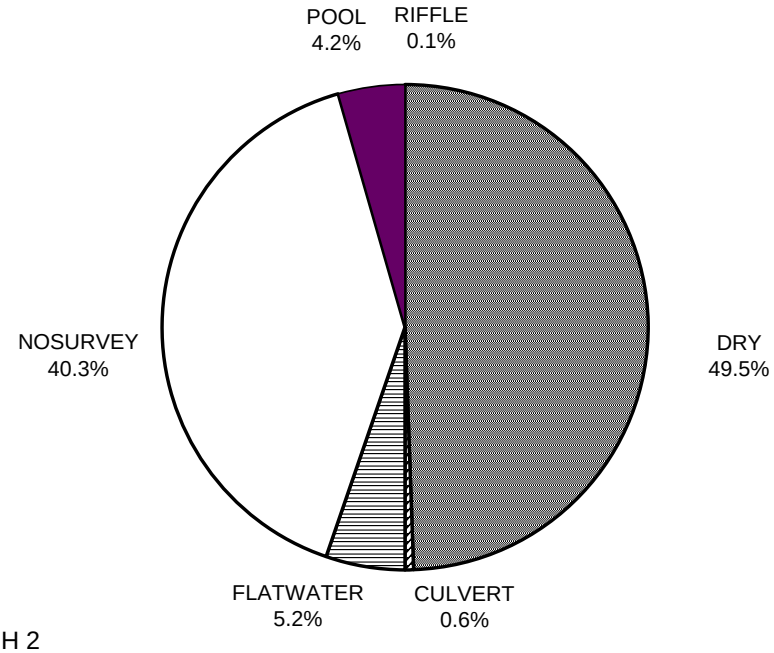
	Riffles	Flatwater	Pools
UNDERCUT BANKS (%)	0	0	7
SMALL WOODY DEBRIS (%)	0	0	7
LARGE WOODY DEBRIS (%)	0	0	12
ROOT MASS (%)	0	17	3
TERRESTRIAL VEGETATION (%)	0	11	10
AQUATIC VEGETATION (%)	0	6	15
WHITEWATER (%)	0	0	0
BOULDERS (%)	0	0	6
BEDROCK LEDGES (%)	0	0	19

SAN ANTONIO CREEK 2007
HABITAT TYPES BY PERCENT OCCURRENCE



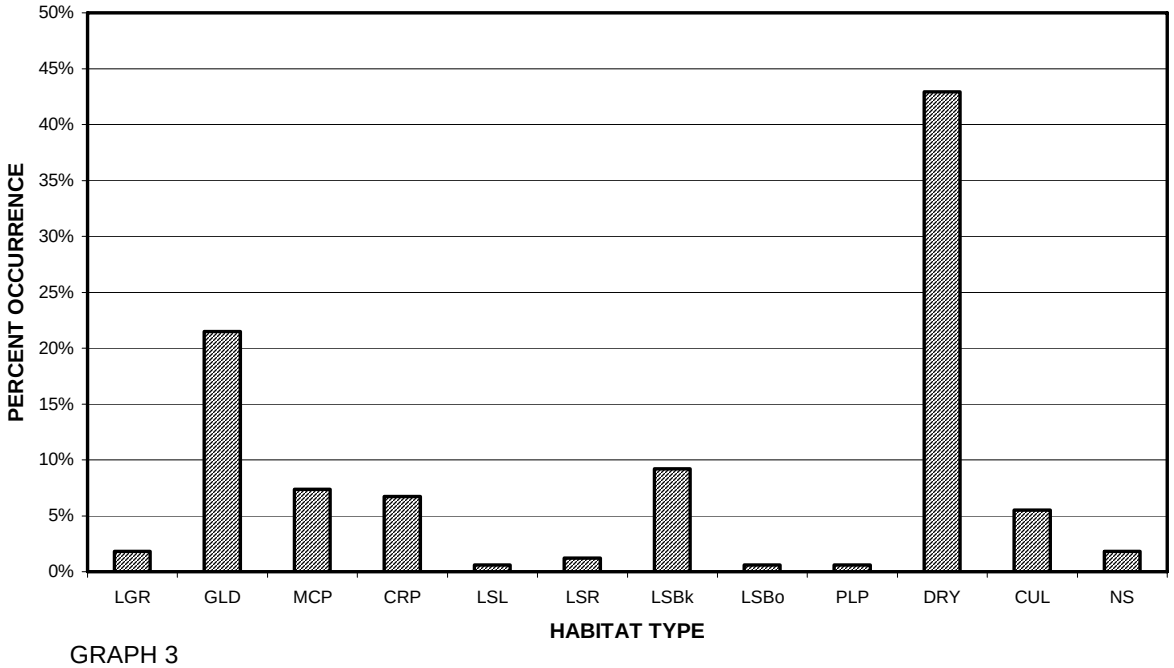
GRAPH 1

SAN ANTONIO CREEK 2007
HABITAT TYPES BY PERCENT TOTAL LENGTH



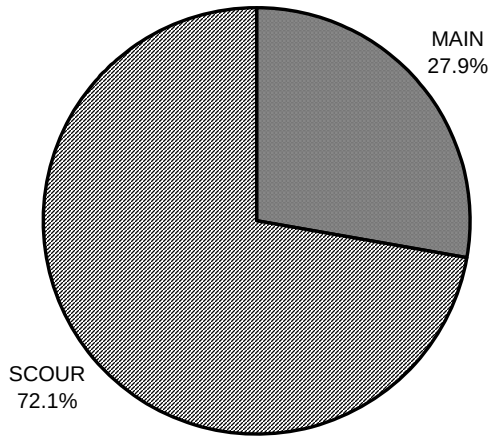
GRAPH 2

SAN ANTONIO CREEK 2007
HABITAT TYPES BY PERCENT OCCURRENCE

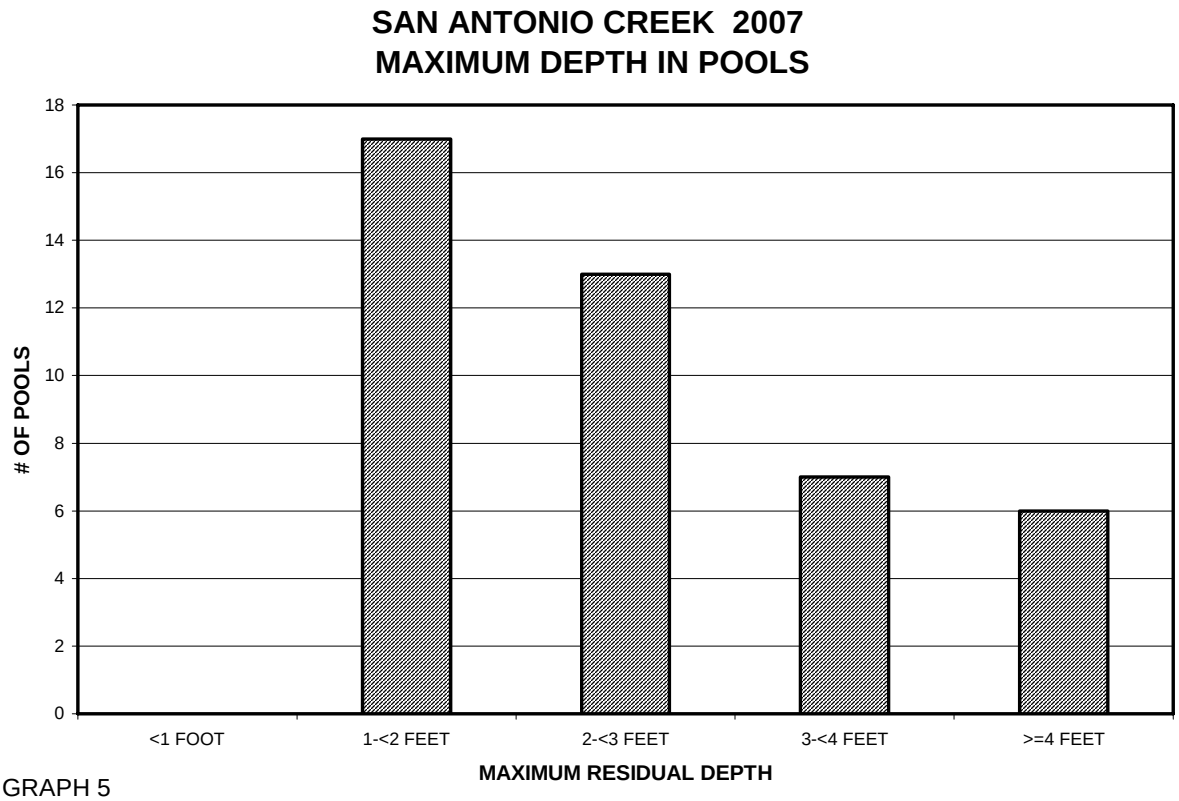


GRAPH 3

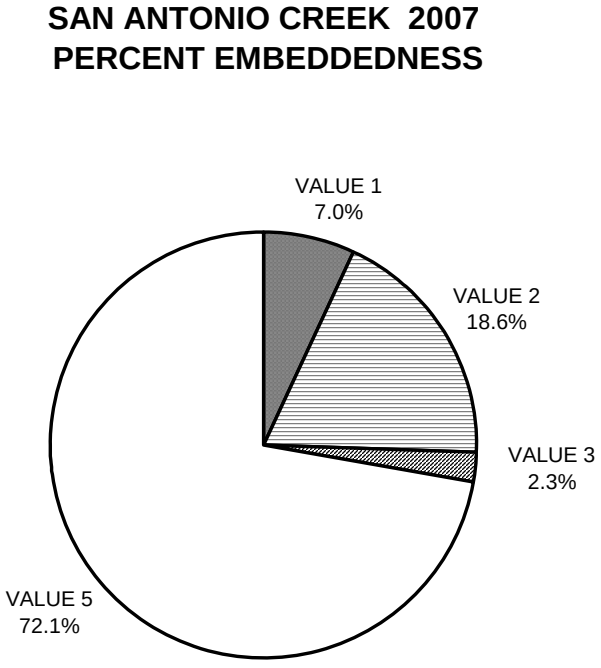
SAN ANTONIO CREEK 2007
POOL TYPES BY PERCENT OCCURRENCE



GRAPH 4

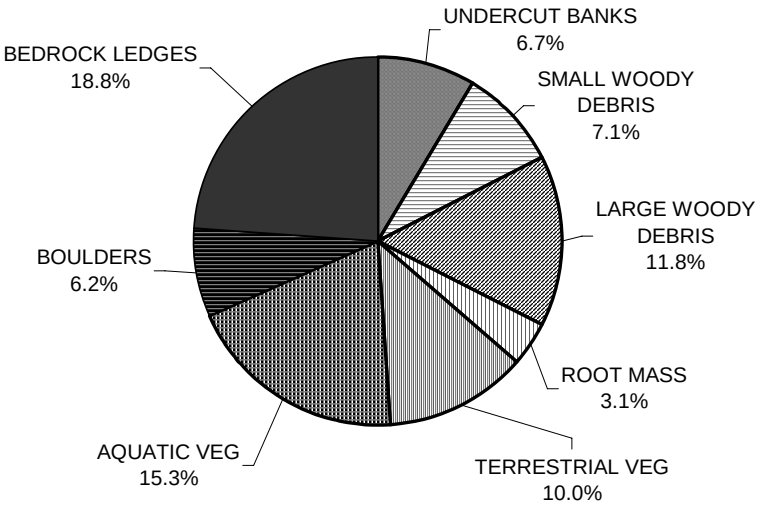


GRAPH 5



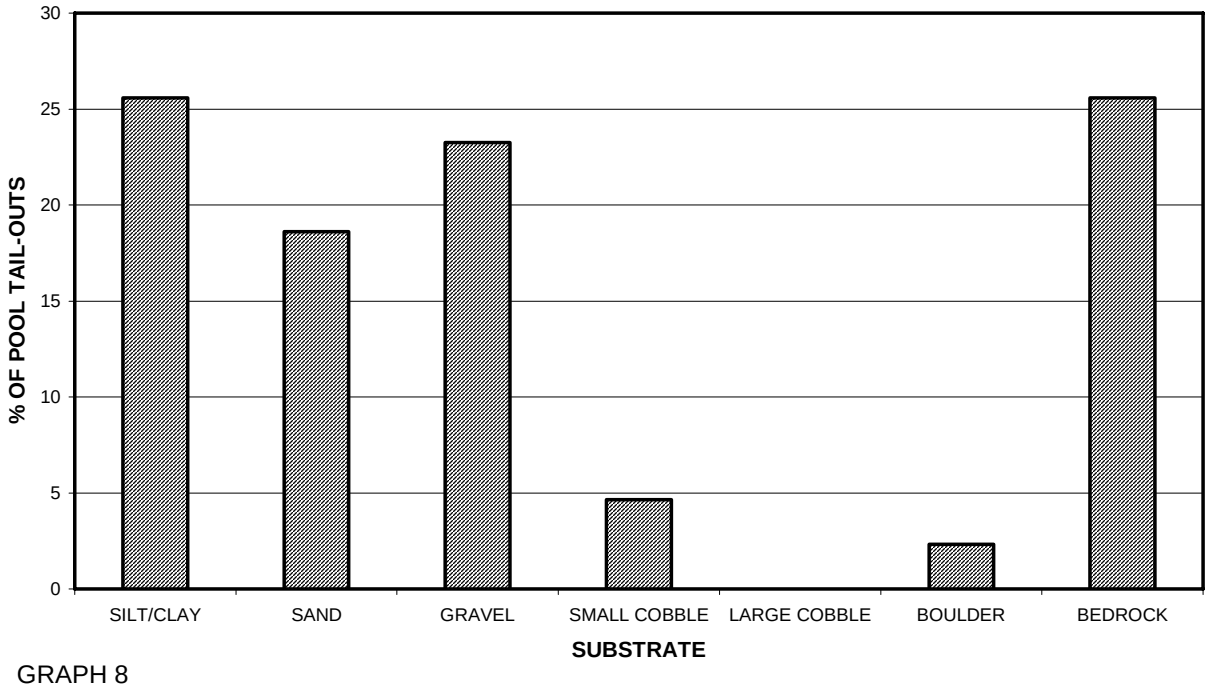
GRAPH 6

SAN ANTONIO CREEK 2007
MEAN PERCENT COVER TYPES IN POOLS



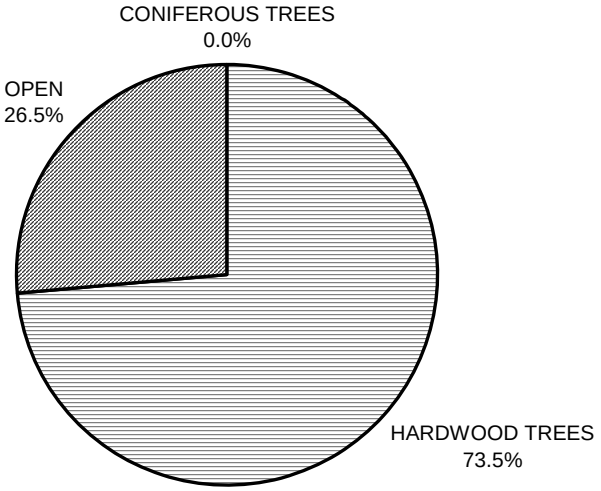
GRAPH 7

SAN ANTONIO CREEK 2007
SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



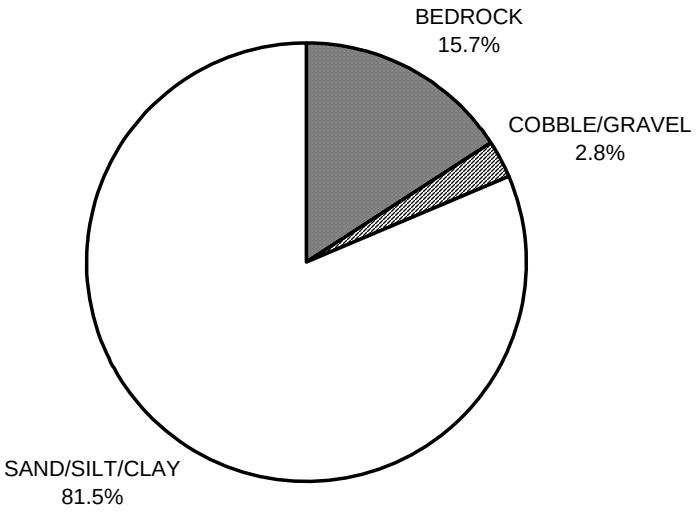
GRAPH 8

SAN ANTONIO CREEK 2007
MEAN PERCENT CANOPY



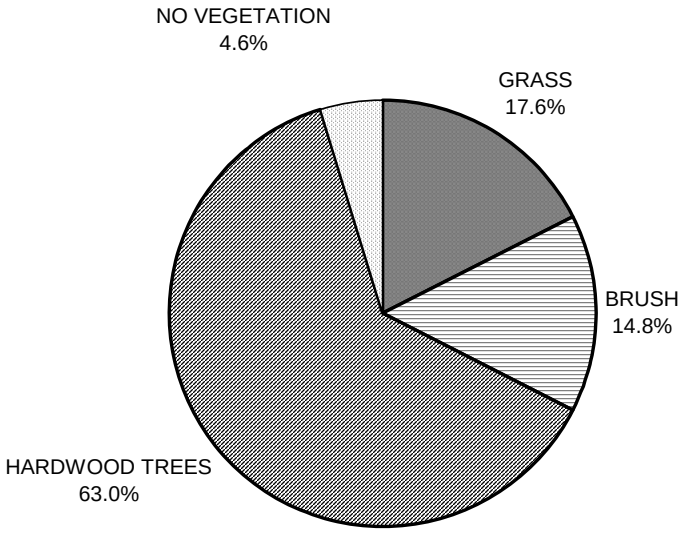
GRAPH 9

SAN ANTONIO CREEK 2007
DOMINANT BANK COMPOSITION IN SURVEY REACH



GRAPH 10

SAN ANTONIO CREEK 2007
DOMINANT BANK VEGETATION IN SURVEY REACH



GRAPH 11