

STREAM INVENTORY REPORT

Hartsook Creek

INTRODUCTION

A stream inventory was conducted from June 1 to June 10, 2009 on Hartsook Creek. The survey began at the confluence with the South Fork Eel River and extended upstream 1.3 miles.

The Hartsook 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 Hartsook 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, coho 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

Hartsook Creek is a tributary to the South Fork Eel River, tributary to Eel River, which drains to the Pacific Ocean. It is located in Humboldt County, California (Map 1). Hartsook Creek's legal description at the confluence with the South Fork Eel River is T05S R03E S24. Its location is 40.0125 degrees north latitude and 123.7864 degrees west longitude, LLID number 1237864400125. Hartsook Creek is a first order stream and has approximately 1.45 miles of blue line stream according to the USGS Garberville 7.5 minute quadrangle. Hartsook Creek drains a watershed of approximately 1.0 square miles. Elevations range from about 420 feet at the mouth of the creek to 1,000 feet in the headwater areas. Redwood forest dominates the watershed. The watershed is primarily privately owned and is managed for conservation and recreation. Vehicle access exists via U.S. Highway 101.

METHODS

The habitat inventory conducted in Hartsook Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi et al, 1998). The 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 (DFG). 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

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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.

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 Hartsook 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". Hartsook 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.

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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 Hartsook 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 Hartsook 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 Hartsook 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 Hartsook 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.

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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 Hartsook Creek. In addition, underwater observations were made at 20 sites using techniques discussed in the *California Salmonid Stream Habitat Restoration Manual*.

DATA ANALYSIS

Data from the habitat inventory form are entered into Stream Habitat 2.0.19, 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

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Graphics are produced from the tables using Microsoft Excel. Graphics developed for Hartsook 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 June 1 to June 10, 2009 was conducted by J. Ferreira, J. Coombes, N. Talkington, and M. Groff (WSP), and I. Mikus and S. McSmith (DFG). The total length of the stream surveyed was 6,978 feet with an additional 122 feet of side channel.

Stream flow was measured near the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 0.53 cfs on June 4, 2009.

Hartsook Creek is a B4 channel type for 3,739 feet of the stream surveyed (Reach 1) and an A2 channel type for 3,361 feet of the stream surveyed (Reach 2). B4 channels are moderately entrenched, moderate gradient, riffle dominated channel with infrequently spaced pools, very stable plan and profile, stable banks and gravel-dominant substrates. A2 channels are steep, narrow, cascading, step-pool, high energy debris transporting channels associated with depositional soils, and boulder-dominant substrates.

Water temperatures taken during the survey period ranged from 53 to 59 degrees Fahrenheit. Air temperatures ranged from 55 to 72 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 47% riffle units, 31% pool units, and 21% flatwater units (Graph 1). Based on total length of Level II habitat types there were 63% riffle units, 22% flatwater units, and 12% pool units (Graph 2).

Eleven Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were high gradient riffle units, 30%; low gradient riffle units, 15%; and mid-channel pool units, 14% (Graph 3). Based on percent total length, high gradient riffle units made up 44%, step-run units 15%, and low gradient riffle units 14%.

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A total of 63 pools were identified (Table 3). Main channel pools were the most frequently encountered at 51% (Graph 4), and comprised 62% of the total length of all pools (Table 3).

Table 4 is a summary of maximum residual pool depths by pool habitat types. Pool quality for salmonids increases with depth. Two of the 63 pools (3%) had a residual depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 63 pool tail-outs measured, 24 had a value of 1 (38.1%); 25 had a value of 2 (39.7%); 6 had a value of 3 (9.5%); 2 had a value of 4 (3.2%); 6 had a value of 5 (9.5%) (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 2, flatwater habitat types had a mean shelter rating of 2, and pool habitats had a mean shelter rating of 24 (Table 1). Of the pool types, the scour pools had the highest mean shelter rating at 34. Main channel pools had a mean shelter rating of 15 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover type in Hartsook Creek. Graph 7 describes the pool cover in Hartsook Creek. Boulders are the dominant pool cover type followed by whitewater.

Table 6 summarizes the dominant substrate by habitat type. Graph 8 depicts the dominant substrate observed in pool tail-outs. Gravel was the dominant substrate observed in 63% percent of the pool tail-outs. Small cobble was the next most frequently observed dominant substrate type and occurred in 24% of the pool tail-outs.

The mean percent canopy density for the surveyed length of Hartsook Creek was 88%. Twelve percent of the canopy was open. Of the canopy present, the mean percentages of hardwood and coniferous trees were 83% and 17%, respectively. Graph 9 describes the mean percent canopy in Hartsook Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 92%. The mean percent left bank vegetated was 93%. The dominant elements composing the structure of the stream banks consisted of 53% cobble/gravel, 25% sand/silt/clay, 13% boulder, and 9% bedrock (Graph 10). Brush was the dominant vegetation type observed in 47% of the units surveyed. Additionally, 31% of the units surveyed had deciduous trees as the dominant vegetation type, and 14% had coniferous trees as the dominant vegetation type (Graph 11).

BIOLOGICAL INVENTORY RESULTS

Survey teams conducted a snorkel survey at 20 sites for species composition and distribution in Hartsook Creek on June 11, 2009. The sites were sampled by I. Mikus (DFG).

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In reach 1, which comprised the first 3,739 feet of stream, 10 sites were sampled. The reach sites yielded 10 young-of-the-year steelhead/rainbow trout (SH/RT).

In reach 2, 10 sites were sampled starting approximately 3,790 from the confluence with the South Fork Eel River and continuing upstream 954 feet. The reach sites yielded one age 1+ SH/RT.

The following chart displays the information yielded from these sites:

2009 Hartsook Creek underwater observations.

Date	Survey Site #	Habitat Unit #	Habitat Type	Approx. Dist. from mouth (ft.)	SH/RT			Coho	
					YOY	1+	2+	YOY	1+
Reach 1: B4 Channel Type									
06/11/09	1	5	4.2	137	5	0	0	0	0
	2	7	5.6	250	0	0	0	0	0
	3	23	4.2	706	0	0	0	0	0
	4	32	4.2	1,072	0	0	0	0	0
	5	44	4.2	1,466	5	0	0	0	0
	6	58	4.2	1,717	0	0	0	0	0
	7	64	4.2	1,821	0	0	0	0	0
	8	75	4.2	2,158	0	0	0	0	0
	9	92	5.6	2,729	0	0	0	0	0
	10	100	5.6	3,050	0	0	0	0	0
Reach 2: A2 Channel Type									
06/11/09	11	127	5.6	3,799	0	0	0	0	0
	12	134	5.6	4,047	0	0	0	0	0
	13	136	5.6	4,080	0	1	0	0	0
	14	138	5.6	4,136	0	0	0	0	0
	15	140	5.6	4,165	0	0	0	0	0
	16	142	4.4	4,234	0	0	0	0	0
	17	144	4.2	4,385	0	0	0	0	0
	18	146	5.6	4,549	0	0	0	0	0
	19	149	5.6	4,672	0	0	0	0	0
	20	151	4.4	4,744	0	0	0	0	0

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DISCUSSION

Hartsook Creek is a B4 channel type for the first 3,739 feet of stream surveyed and an A2 channel type for the remaining 3,361 feet. The suitability of B4 and A2 channel types for fish habitat improvement structures is as follows: B4 channel types are excellent for low-stage plunge weirs, boulder clusters, bank placed boulders, single and opposing wing-deflectors, and log cover; A2 channels are generally not suitable for fish habitat improvement projects.

The water temperatures recorded on the survey days June 1 to June 10, 2009 ranged from 53 to 59 degrees Fahrenheit. Air temperatures ranged from 55 to 72 degrees Fahrenheit. To make any conclusions, temperatures need to be monitored throughout the warm summer months, and more extensive biological sampling needs to be conducted.

Flatwater habitat types comprised 22% of the total length of this survey, riffles 63%, and pools 12%. Two of the 63 (3%) pools had 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 first and second order streams, a primary pool is defined to have a maximum residual depth of at least two feet, occupy at least half the width of the low flow channel, and be as long as the low flow channel width. Installing structures in Reach 1 the B4 channel type that will increase or deepen pool habitat is recommended.

Forty-nine of the 63 pool tail-outs measured had embeddedness ratings of 1 or 2. Eight of the pool tail-outs had embeddedness ratings of 3 or 4. Six 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.

Fifty-five of the 63 pool tail-outs measured had gravel or small cobble as the dominant substrate. This is generally considered good for spawning salmonids.

The mean shelter rating for pools is 24. The shelter rating in the flatwater habitats is 2. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by boulders in Hartsook Creek. Boulders are the dominant cover type in pools followed by whitewater. 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 88%. Reach 1 had a canopy density of 85%, reach 2 had a canopy density of 94%. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was 92% and 93%, 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.

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RECOMMENDATIONS

- 1) Hartsook Creek should be managed as an anadromous, natural production stream.
- 2) The limited water temperature data available suggest that maximum temperatures are within the acceptable range for juvenile salmonids. To establish more complete and meaningful temperature regime information, 24-hour monitoring during the July and August temperature extreme period should be performed for 3 to 5 years.
- 3) In Reach 1 the B4 channel type, 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.
- 4) Increase woody cover in the pools and flatwater habitat units. Most of the existing cover in the pools is from boulders. Adding high quality complexity with woody cover in the pools is desirable.

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 (ft):	Habitat unit #:	Comment:
0	0001.00	Start of survey at the confluence with the South Fork Eel River. The channel is a B4. Boulder riprap crosses the channel.
32	0002.00	Both banks are eroding due to influence of the South Fork Eel. The right bank is cut 4' high and the left bank is cut 10' high. The erosion on both banks measures 51' long.
127	0005.00	Unstable banks.
137	0006.00	There is boulder rip-rap on the right bank.
241	0007.00	There is boulder rip-rap on both banks.
339	0013.00	Out of the influence of the South Fork Eel River.
431	0016.00	A footbridge crosses the channel. The wooden bridge measures 4' wide x 4.5' high x 23' long.
828	0028.00	U.S. Highway 101 crosses the channel. The concrete culvert measures 4.7' high x 8' wide x 81' long. The culvert has no plunge height and the

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		maximum depth within 5' of the outlet is 0.4'. It has a 4.1 percent slope. The culvert is in good condition.
909	0029.00	There is a seep on the right bank.
1865	0067.00	Tributary #01 enters on the left bank. The tributary is not flowing. The temperature downstream and upstream of the tributary is 54 degrees Fahrenheit; the temperature of the tributary is 53 degrees Fahrenheit. The slope of the tributary is greater than 20%, making it inaccessible to fish.
2364	0083.00	A small woody debris (SWD) accumulation forms a 1.5' high plunge.
2603	0086.00	There is a 0.5' high plunge.
2620	0087.00	There is a dry tributary on the left bank.
2658	0088.00	There is a 2' high plunge.
2894	0096.00	There is erosion on the left bank that measures 19' long x 32' high. It is contributing sediment ranging in size from gravel to boulders.
2894	0096.00	There is a 1.2' high plunge.
3050	0101.00	Log debris accumulation (LDA) #01 contains three pieces of large woody debris (LWD) and measures 3.5' high x 16' wide x 1.5' long. Water flows through and there are visible gaps. Retained sediment ranges from silt to gravel and measures 10' wide x 30' long x 2.5' deep. Fish are present above the LDA.
3198	0105.02	There is a 2.2' high bedrock plunge.
3205	0107.00	The left bank is unstable.
3249	0109.00	LDA #02 contains six pieces of LWD and measures 3.5' high x 16' wide x 6' long. Water flows through. Retained sediment ranges from gravel to cobble. Fish are present above the LDA.
3398	0113.00	LWD is starting to accumulate in the channel.
3696	0124.00	The channel changes from a B4 to an A2.
3696	0124.00	Tributary #02 enters on the right bank. The estimated flow is 0.5 cfs, and it contributes to 40% of the downstream flow. The temperature downstream of the tributary is 54 degrees Fahrenheit, the temperature of the tributary is 55 degrees Fahrenheit, and the temperature upstream of

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the confluence is 55 degrees Fahrenheit. The slope of the tributary is 12%. The tributary is accessible to fish, but no fish are present.

3720	0126.00	There is a of 1.3' high root/boulder plunge.
3790	0127.00	There is a 2.5' high root/cobble plunge.
4014	0132.00	There is a 2.2' high root/boulder plunge.
4072	0136.00	There is a 2' high log plunge.
4126	0138.00	There is a 1.4' high log plunge.
4210	0142.00	There is a 3.6' high plunge.
4373	0144.00	The left bank is terraced. There are 6' of unstable bank.
4895	0155.00	There is a 2.6' high log plunge.
4903	0156.00	There is a 2.2' high SWD plunge.
4962	0157.00	There is a 1.3' high log plunge.
4969	0158.00	There is a dry tributary on the left bank.
4969	0158.00	There is a 3.5' high boulder plunge.
5150	0162.00	There is a 3.8' high bedrock plunge.
5228	0164.00	There is a 1.6' high bedrock plunge.
5260	0166.00	There is a 0.9' high log plunge.
5305	0168.00	There is a 2' high log plunge.
5312	0169.00	There is a seep on the right bank.
5370	0170.00	There is a 0.9' high log plunge.
5422	0174.00	LDA #03 contains eight pieces of LWD and measures 3.5' high x 6' wide x 6' long. Water flows through and there are visible gaps. Retained sediment ranges from silt to cobble and measures 24' wide x 42' long x 4.5' deep. It is a possible barrier to juvenile and adult salmonids because of the high gradient and lack of sufficient jump pool. Fish were not seen above the LDA.

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5470	0175.00	A landslide measuring 100' long x 40' high is contributing sediment & LWD.
5582	0178.00	There is a 2.4' high log plunge.
5619	0179.00	There is a dry tributary on the right bank. It is contributing sediment ranging in size from silt to boulders. A side channel is starting to develop.
5619	0179.00	A landslide on the right bank measuring 50' high is contributing sediment ranging in size from silt to boulders.
5704	0180.00	LDA #04 contains one piece of LWD and measures 3.3' high x 26' wide x 3' long. Water does not flow through and there are no visible gaps. Retained sediment ranges from silt to small cobble and measures 9' wide x 40' long x 3.6' deep. It is a possible barrier to juvenile and adult salmonids because of the 3.3' high plunge over the logs and because of the lack of a sufficient jump pool. Fish were not seen above the LDA.
5752	0182.00	Erosion on the right bank measures 20' high and is contributing sediment ranging in size from silt to gravel.
5912	0185.00	There is a 1.4' high boulder plunge.
6027	0187.00	There is a 2' high log plunge and a 1.5' high boulder plunge.
6110	0189.00	There is a 1.5' high log plunge.
6119	0190.00	A landslide on the right bank measures 50' high and is contributing sediment and LWD.
6292	0191.00	There is a 1.7' high boulder plunge.
6298	0192.00	LDA #05 contains one piece of LWD and measures 4.5' high x 13' wide x 2' long. Water flows through and there are no visible gaps. Retained sediment ranges from sand to cobble and measures 13' wide x 20' long x 4.5' deep. It is a possible barrier to juvenile and adult salmonids because of the 2.5' high plunge over the logs with no jump pool. Fish were not seen above the LDA.
6459	0195.00	Tributary #03 enters on the left bank. The estimated flow is 0.1 cfs, and it contributes to 5% of the downstream flow. The temperature downstream and upstream of the tributary is 54 degrees Fahrenheit; the temperature of the tributary is 56 degrees Fahrenheit. The tributary is not accessible to fish due to its high gradient.

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6459	0195.00	There is a 4' boulder plunge into 0.2' of water.
6621	0198.00	There is a 2.0' high boulder plunge.
6712	0199.00	LWD (2 pieces) and boulders are obstructing the channel. There are no visible gaps. Water flows through small gaps, but not over the obstruction. There is a 4.5' high jump over the blockage. The pool below it measures 1 foot deep x 6 feet long.
6868	0201.00	There is a 3.6' high log plunge.
6978	0201.00	End of survey due to a 19.8% slope over 237 feet. At the end point there is a 7' high bedrock waterfall with no pool below it.

REFERENCES

Flosi, G., Downie, S., Hopelain, J., Bird, M., Coey, R., and Collins, B. 1998. *California Salmonid Stream Habitat Restoration Manual*, 3rd edition. California Department of Fish and Game, Sacramento, California.

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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: Hartsook Creek

LLID: 1237864400125

Drainage: Eel River - South Fork

Survey Dates: 6/1/2009 to 6/10/2009

Confluence Location: Quad: GARBERVILLE

Legal Description: T05SR03ES24

Latitude: 40:00:45.0N

Longitude: 123:47:11.0

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
1	0	CULVERT	0.5	81	81	1.1									
2	0	DRY	1.0	50	101	1.4									
44	11	FLATWATER	21.4	36	1568	22.1	4.9	0.5	0.8	131	5781	57	2511		2
63	63	POOL	30.6	14	863	12.2	7.8	0.6	1.2	101	6387	85	5336	62	24
96	13	RIFFLE	46.6	47	4487	63.2	6.2	0.3	0.6	184	17661	58	5521		2
Total Units 206	Total Units Fully Measured 87			Total Length (ft.) 7100						Total Area (sq.ft.) 29830		Total Volume (cu.ft.) 13368			

Table 2 - Summary of Habitat Types and Measured Parameters

Stream Name: Hartsook Creek

LLID: 1237864400125

Drainage: Eel River - South Fork

Survey Dates: 6/1/2009 to 6/10/2009

Confluence Location: Quad: GARBERVILLE

Legal Description: T05SR03ES24

Latitude: 40:00:45.0N

Longitude: 123:47:11.0W

Habitat Units	Units Fully Measured	Habitat Type	Habitat Occurrence (%)	Mean Length (ft.)	Total Length (ft.)	Total Length (%)	Mean Width (ft.)	Mean Depth (ft.)	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 (%)
31	4	LGR	15.0	33	1027	14.5	7	0.2	0.5	119	3681	24	736		0	89
61	9	HGR	29.6	51	3123	44.0	6	0.3	1.1	213	12991	73	4423		2	89
4	0	CAS	1.9	84	337	4.7										
23	7	RUN	11.2	21	477	6.7	5	0.4	0.9	98	2262	42	956		2	84
21	4	SRN	10.2	52	1091	15.4	5	0.5	1.2	189	3974	84	1768		1	86
28	28	MCP	13.6	15	412	5.8	8	0.6	2.9	111	3113	95	2654	71	9	86
4	4	STP	1.9	31	125	1.8	7	0.6	1.8	192	770	178	712	129	56	95
1	1	CRP	0.5	9	9	0.1	5	0.4	1.3	45	45	32	32	18	25	100
3	3	LSL	1.5	19	58	0.8	8	0.3	1	139	418	81	243	50	30	64
27	27	PLP	13.1	10	259	3.6	8	0.6	1.9	76	2041	63	1696	46	35	93
2	0	DRY	1.0	50	101	1.4										
1	0	CUL	0.5	81	81	1.1										

Total Units
206

Total Units Fully Measured
87

Total Length (ft.)
7100

Total Area (sq.ft.)
29295

Total Volume (cu.ft.)
13220

Stream Name:	Hartsook Creek	LLID:	1237864400125	Drainage:	Eel River - South Fork
Survey Dates:	6/1/2009 to 6/10/2009				
Confluence Location:	Quad: GARBERVILLE	Legal Description:	T05SR03ES24	Latitude:	40:00:45.0N
				Longitude:	123:47:11.0W

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
63	63	863	6387	3929

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

Stream Name: Hartsook Creek

LLID: 1237864400125

Drainage: Eel River - South Fork

Survey Dates: 6/1/2009 to 6/10/2009

Confluence Location: Quad: GARBERVILLE

Legal Description: T05SR03ES24

Latitude: 40:00:45.0N

Longitude: 123:47:11.0W

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
28	MCP	44	7	25	19	68	2	7	0	0	0	0
4	STP	6	2	50	2	50	0	0	0	0	0	0
1	CRP	2	0	0	1	100	0	0	0	0	0	0
3	LSL	5	1	33	2	67	0	0	0	0	0	0
27	PLP	43	6	22	21	78	0	0	0	0	0	0

Total Units	Total < 1 Foot Max Resid. Depth	Total < 1 Foot % Occurrence	Total 1< 2 Foot Max Resid. Depth	Total 1< 2 Foot % Occurrence	Total 2< 3 Foot Max Resid. Depth	Total 2< 3 Foot % Occurrence	Total 3< 4 Foot Max Resid. Depth	Total 3< 4 Foot % Occurrence	Total >= 4 Foot Max Resid. Depth	Total >= 4 Foot % Occurrence
63	16	25	45	71	2	3	0	0	0	0

Mean Maximum Residual Pool Depth (ft.): 1.2

Table 5 - Summary of Mean Percent Cover By Habitat Type

Stream Name: Hartsook Creek

LLID: 1237864400125

Drainage: Eel River - South Fork

Survey Dates: 6/1/2009 to 6/10/2009

Dry Units: 2

Confluence Location: Quad: GARBERVILLE

Legal Description: T05SR03ES24

Latitude: 40:00:45.0N

Longitude: 123:47:11.0W

Habitat Units	Units Fully Measured	Habitat Type	Mean % Undercut Banks	Mean % SWD	Mean % LWD	Mean % Root Mass	Mean % Terr. Vegetation	Mean % Aquatic Vegetation	Mean % White Water	Mean % Boulders	Mean % Bedrock Ledges
31	4	LGR	0	0	0	0	0	0	0	0	0
61	9	HGR	0	15	40	0	0	0	30	15	0
4	0	CAS									
96	13	TOTAL RIFFLE	0	15	40	0	0	0	30	15	0
23	7	RUN	0	0	0	0	0	0	25	75	0
21	4	SRN	0	0	0	0	0	0	0	100	0
44	11	TOTAL FLAT	0	0	0	0	0	0	17	83	0
28	28	MCP	7	8	20	14	3	0	6	42	0
4	4	STP	15	0	5	0	0	0	53	28	0
1	1	CRP	80	20	0	0	0	0	0	0	0
3	3	LSL	17	0	53	0	0	0	0	30	0
27	27	PLP	4	10	16	3	2	0	47	18	0
63	63	TOTAL POOL	8	8	18	7	2	0	28	29	0
1	0	CUL									
206	87	TOTAL	8	8	18	6	2	0	27	31	0

Table 6 - Summary of Dominant Substrates By Habitat Type

Stream Name: Hartsook Creek

LLID: 1237864400125

Drainage: Eel River - South Fork

Survey Dates: 6/1/2009 to 6/10/2009

Dry Units: 2

Confluence Location: Quad: GARBERVILLE

Legal Description: T05SR03ES24

Latitude: 40:00:45.0N

Longitude: 123:47:11.0W

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
31	4	LGR	0	0	75	25	0	0	0
61	9	HGR	0	0	22	33	33	11	0
4	0	CAS	0	0	0	0	0	0	0
23	7	RUN	0	0	71	14	14	0	0
21	4	SRN	0	0	75	25	0	0	0
28	28	MCP	0	4	82	11	0	0	4
4	4	STP	0	0	75	0	0	25	0
1	1	CRP	0	0	100	0	0	0	0
3	3	LSL	0	0	100	0	0	0	0
27	27	PLP	11	0	81	4	0	4	0

Table 7 - Summary of Mean Percent Canopy for Entire Stream

Stream Name: Hartsook Creek

LLID: 1237864400125

Drainage: Eel River - South Fork

Survey Dates: 6/1/2009 to 6/10/2009

Confluence Location: Quad: GARBERVILLE

Legal Description: T05SR03ES24

Latitude: 40:00:45.0N

Longitude: 123:47:11.0W

Mean Percent Canopy	Mean Percent Conifer	Mean Percent Hardwood	Mean Percent Open Units	Mean Right Bank % Cover	Mean Left Bank % Cover
88	17	83	0	92	93

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: Hartsook Creek		LLID: 1237864400125		Drainage: Eel River - South Fork	
Survey Dates: 6/1/2009 to 6/10/2009		Survey Length (ft.): 7100	Main Channel (ft.): 6978	Side Channel (ft.): 122	
Confluence Location:	Quad: GARBERVILLE	Legal Description: T05SR03ES24	Latitude: 40:00:45.0N	Longitude: 123:47:11.0W	

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 1

Channel Type: B4

Reach Length (ft.): 3696

Riffle/Flatwater Mean Width (ft.): 5.7

BFW:

Range (ft.): 9 to 18

Mean (ft.): 14

Std. Dev.: 2

Base Flow (cfs.): 0.5

Water (F): 53 - 59

Air (F): 56 - 72

Dry Channel (ft): 101

Canopy Density (%): 84.9

Coniferous Component (%): 11.2

Hardwood Component (%): 88.8

Dominant Bank Vegetation: Brush

Vegetative Cover (%): 92.4

Dominant Shelter: Boulders

Dominant Bank Substrate Type: Cobble/Gravel

Occurrence of LWD (%): 12

LWD per 100 ft.:

Riffles: 2

Pools: 5

Flat: 2

Pools by Stream Length (%): 14.9

Pool Frequency (%): 28.6

Residual Pool Depth (%):

< 2 Feet Deep: 94

2 to 2.9 Feet Deep: 6

3 to 3.9 Feet Deep: 0

>= 4 Feet Deep: 0

Mean Max Residual Pool Depth (ft.): 1.3

Mean Pool Shelter Rating: 20

Pool Tail Substrate (%): Silt/Clay: 0

Sand: 0

Gravel: 72

Sm Cobble: 25

Lg Cobble: 3

Boulder: 0

Bedrock: 0

Embeddedness Values (%): 1. 36.1

2. 52.8

3. 8.3

4. 0.0

5. 2.8

STREAM REACH: 2

Channel Type: A2

Reach Length (ft.): 3282

Riffle/Flatwater Mean Width (ft.): 5.2

BFW:

Range (ft.): 7 to 19

Mean (ft.): 11

Std. Dev.: 3

Base Flow (cfs.): 0.5

Water (F): 53 - 55

Air (F): 55 - 64

Dry Channel (ft): 0

Canopy Density (%): 93.7

Coniferous Component (%): 26.8

Hardwood Component (%): 73.2

Dominant Bank Vegetation: Hardwood Trees

Vegetative Cover (%): 92.7

Dominant Shelter: Whitewater

Dominant Bank Substrate Type: Sand/Silt/Clay

Occurrence of LWD (%): 13

LWD per 100 ft.:

Riffles: 3

Pools: 9

Flat: 4

Pools by Stream Length (%): 9.1

Pool Frequency (%): 33.8

Residual Pool Depth (%):

< 2 Feet Deep: 100

2 to 2.9 Feet Deep: 0

3 to 3.9 Feet Deep: 0

>= 4 Feet Deep: 0

Mean Max Residual Pool Depth (ft.): 1.1

Mean Pool Shelter Rating: 31

Pool Tail Substrate (%): Silt/Clay: 0

Sand: 0

Gravel: 52

Sm Cobble: 22

Lg Cobble: 0

Boulder: 26

Bedrock: 0

Embeddedness Values (%): 1. 40.7

2. 22.2

3. 11.1

4. 7.4

5. 18.5

Table 9 - Mean Percentage of Dominant Substrate and Vegetation

Stream Name: Hartsook Creek

LLID: 1237864400125

Drainage: Eel River - South Fork

Survey Dates: 6/1/2009 to 6/10/2009

Confluence Location: Quad: GARBERVILLE

Legal Description: T05SR03ES24

Latitude: 40:00:45.0N

Longitude: 123:47:11.0W

Mean Percentage of Dominant Stream Bank Substrate

Dominant Class of Substrate	Number of Units Right Bank	Number of Units Left Bank	Total Mean Percent (%)
Bedrock	6	9	8.6
Boulder	12	11	13.2
Cobble / Gravel	46	47	53.4
Sand / Silt / Clay	23	20	24.7

Mean Percentage of Dominant Stream Bank Vegetation

Dominant Class of Vegetation	Number of Units Right Bank	Number of Units Left Bank	Total Mean Percent (%)
Grass	7	8	8.6
Brush	46	35	46.6
Hardwood Trees	21	33	31.0
Coniferous Trees	13	11	13.8
No Vegetation	0	0	0.0

Total Stream Cobble Embeddedness Values:

2

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

StreamName: Hartsook Creek

LLID: 1237864400125

Drainage: Eel River - South Fork

Survey Dates: 6/1/2009 to 6/10/2009

Confluence Location: Quad: GARBERVILLE

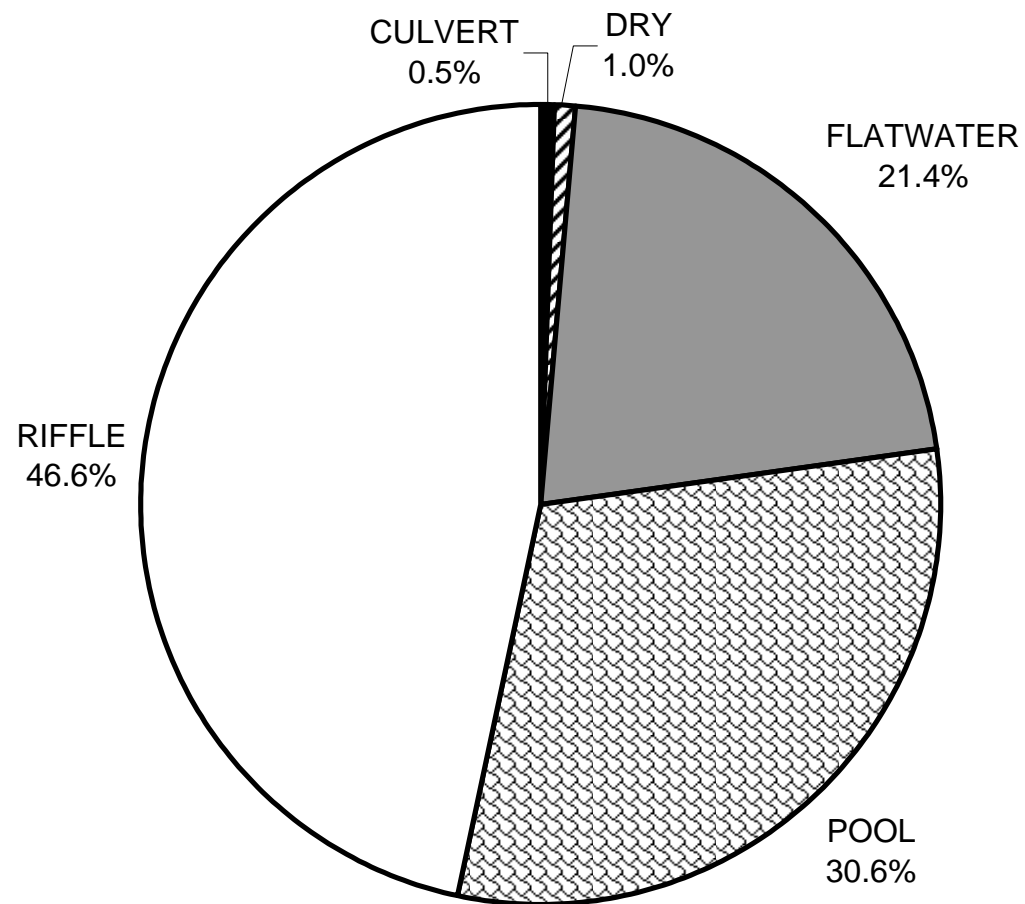
Legal Description: T05SR03ES24

Latitude: 40:00:45.0N

Longitude: 123:47:11.0W

	Riffles	Flatwater	Pools
<hr/>			
UNDERCUT BANKS (%)	0	0	8
SMALL WOODY DEBRIS (%)	15	0	8
LARGE WOODY DEBRIS (%)	40	0	18
ROOT MASS (%)	0	0	7
TERRESTRIAL VEGETATION (%)	0	0	2
AQUATIC VEGETATION (%)	0	0	0
WHITEWATER (%)	30	17	28
BOULDERS (%)	15	83	29
BEDROCK LEDGES (%)	0	0	0

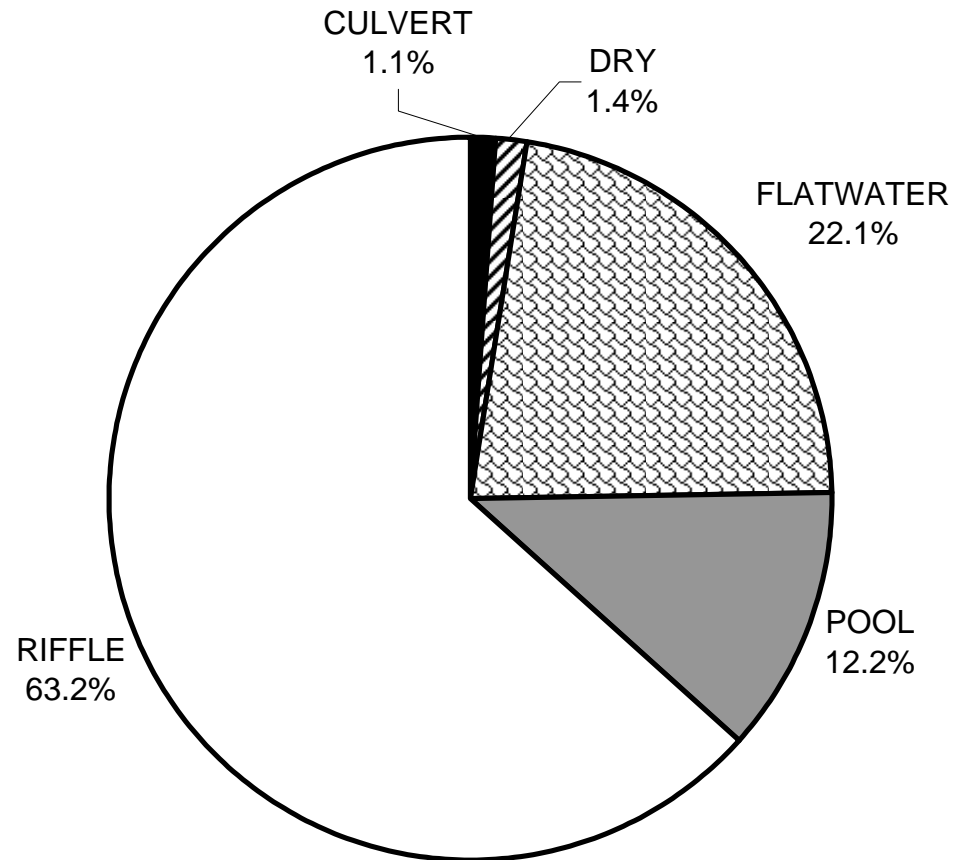
HARTSOOK CREEK 2009 HABITAT TYPES BY PERCENT OCCURRENCE



GRAPH 1

HARTSOOK CREEK 2009

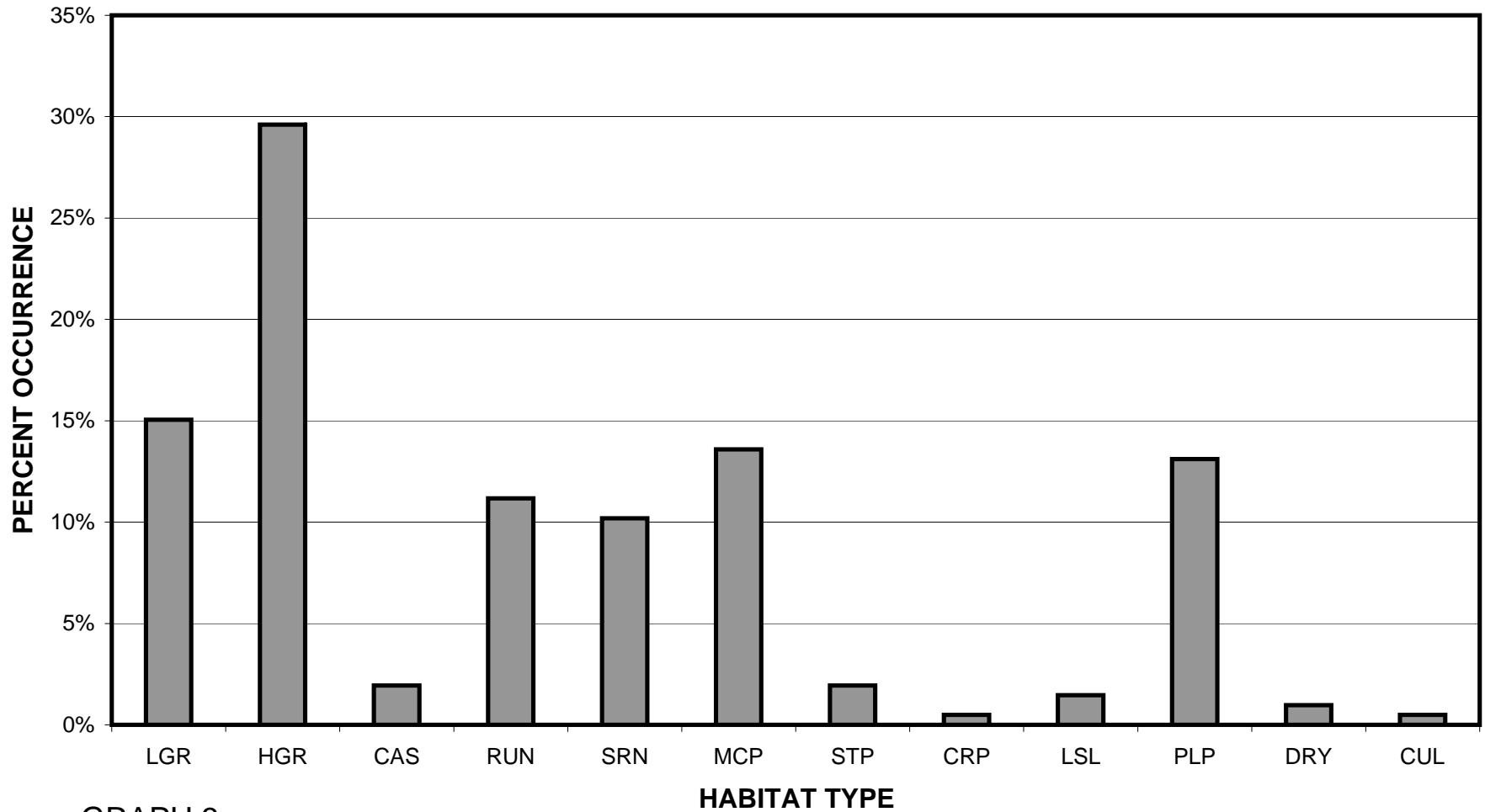
HABITAT TYPES BY PERCENT TOTAL LENGTH



GRAPH 2

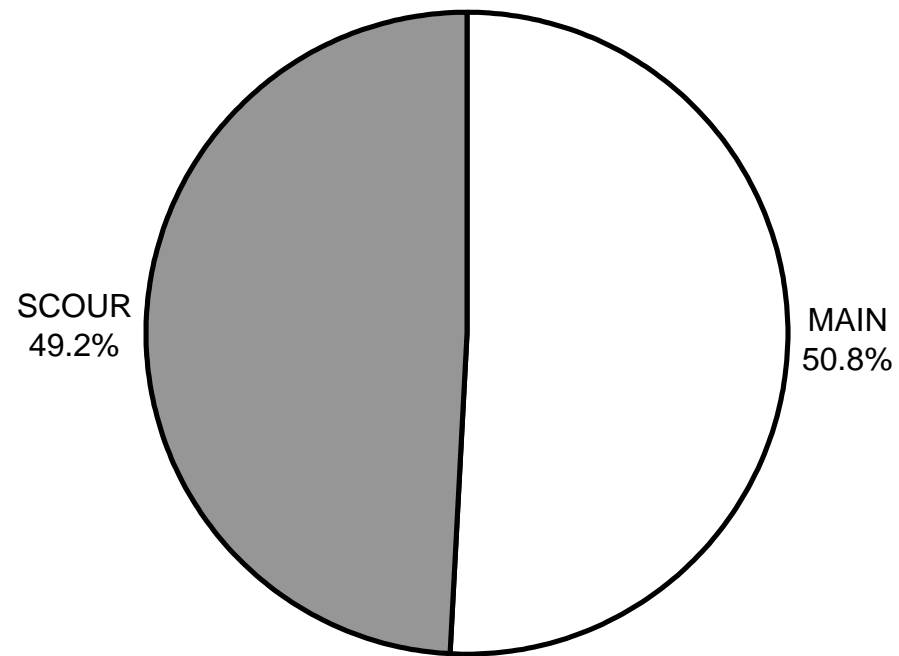
HARTSOOK CREEK 2009

HABITAT TYPES BY PERCENT OCCURRENCE



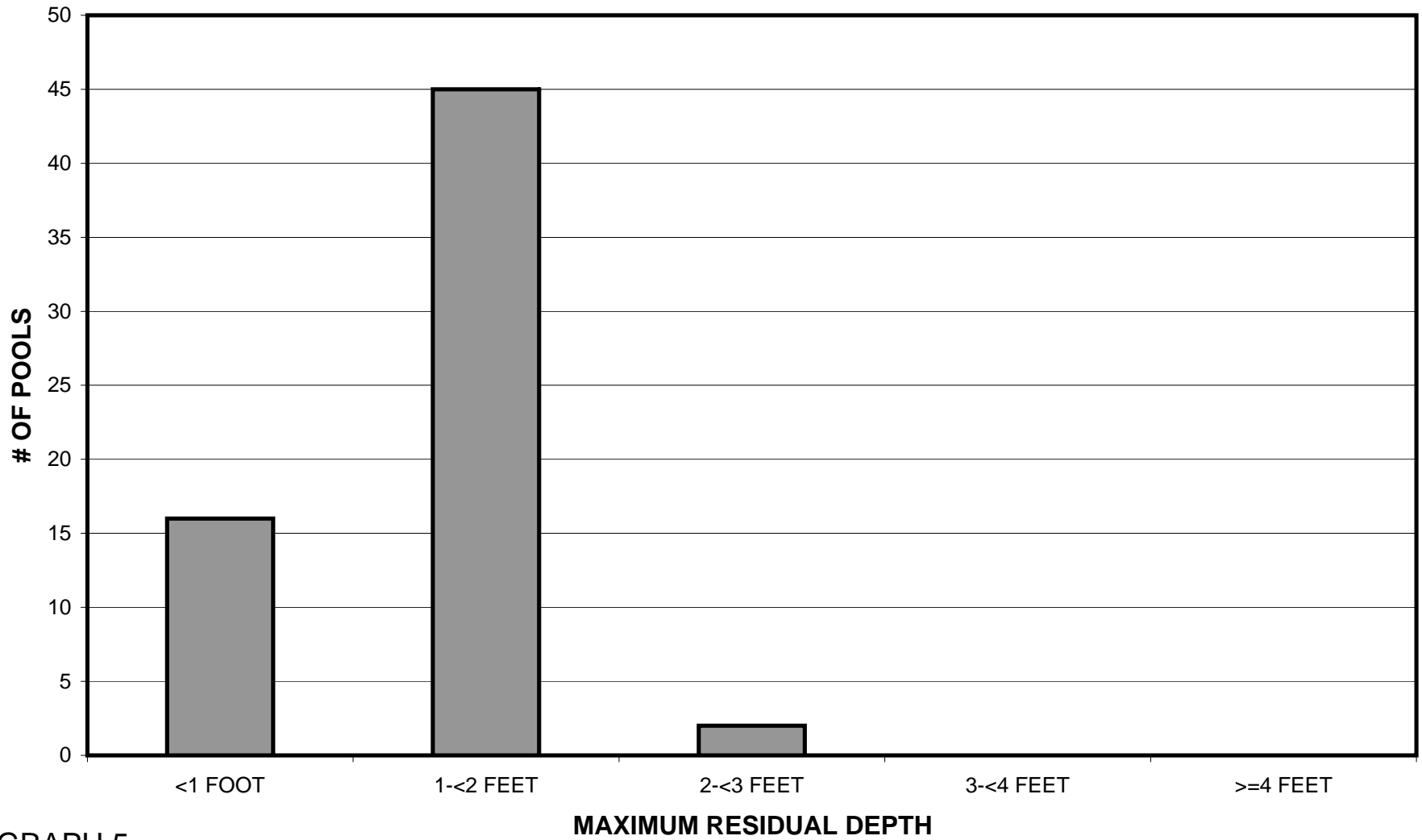
GRAPH 3

**HARTSOOK CREEK 2009
POOL TYPES BY PERCENT OCCURRENCE**



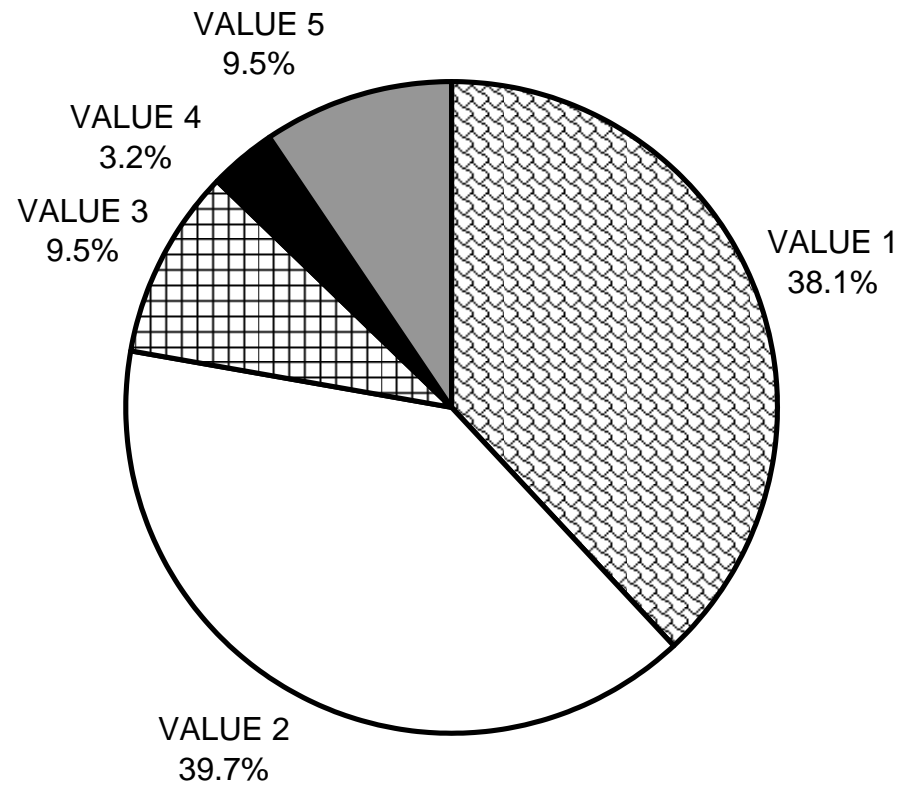
GRAPH 4

HARTSOOK CREEK 2009 MAXIMUM DEPTH IN POOLS



GRAPH 5

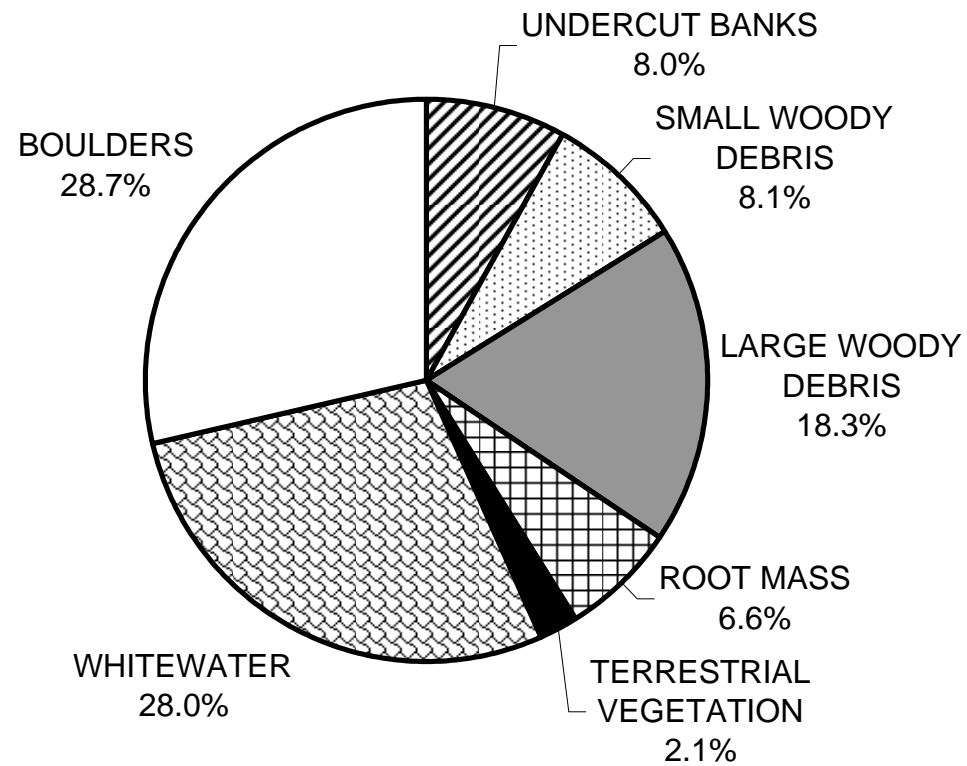
HARTSOOK CREEK 2009 PERCENT EMBEDDEDNESS



GRAPH 6

HARTSOOK CREEK 2009

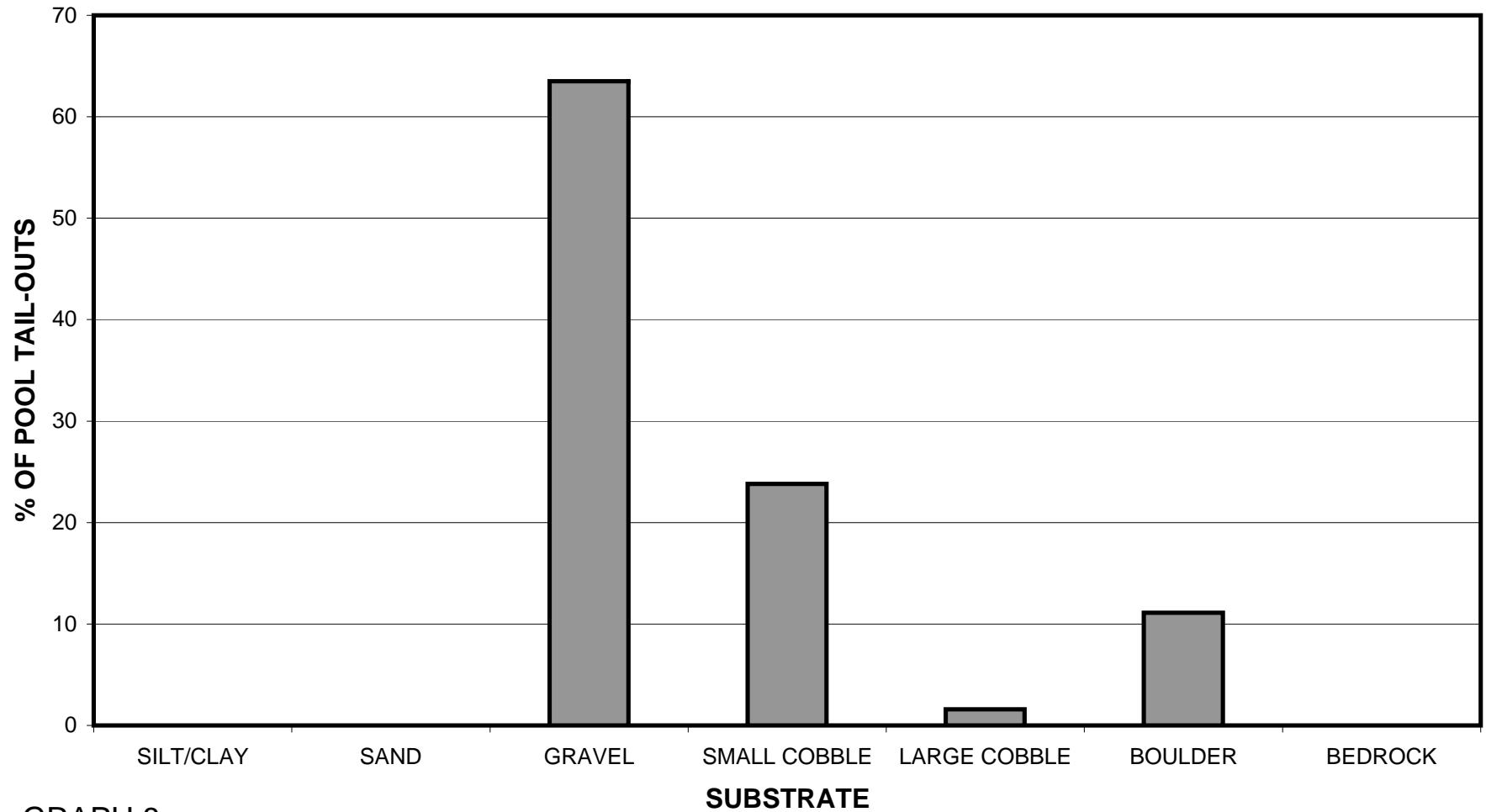
MEAN PERCENT COVER TYPES IN POOLS



GRAPH 7

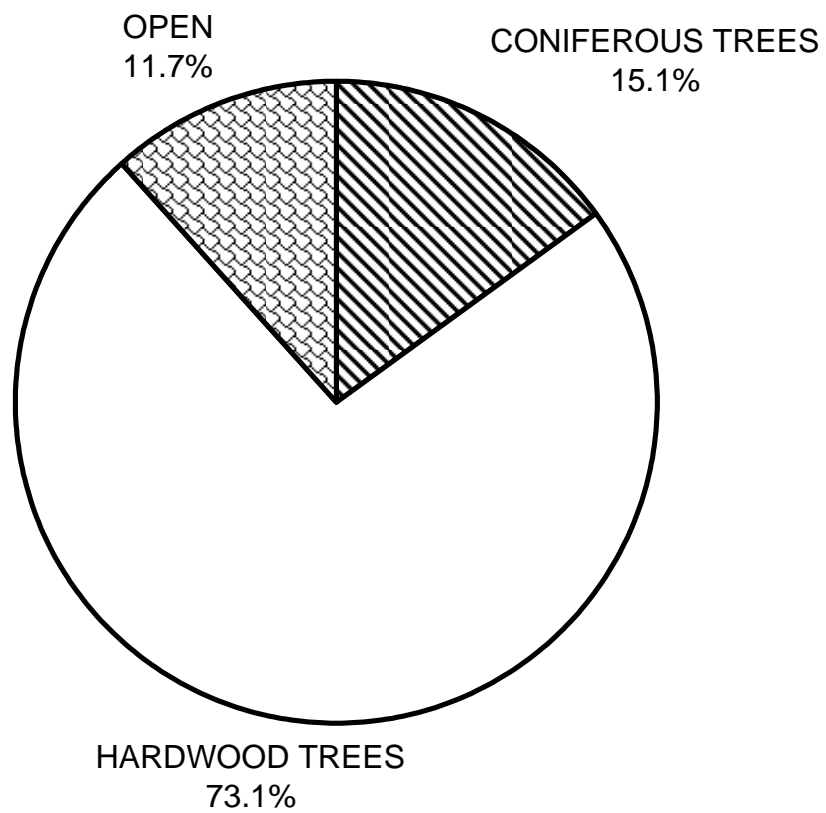
HARTSOOK CREEK 2009

SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



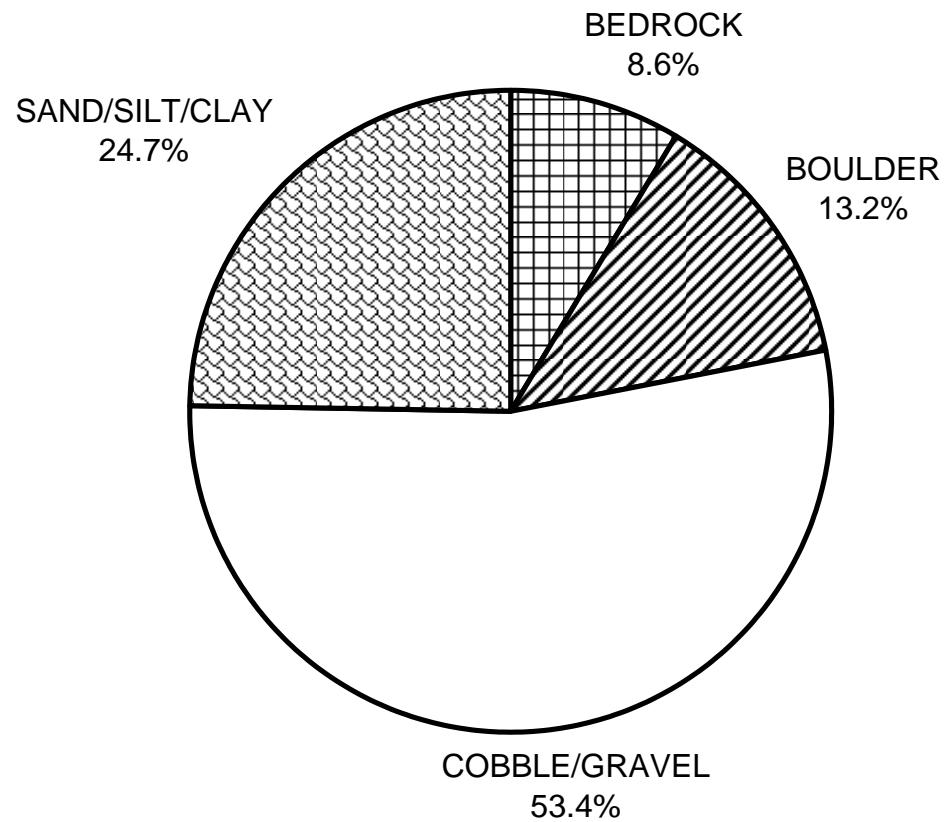
GRAPH 8

HARTSOOK CREEK 2009 MEAN PERCENT CANOPY



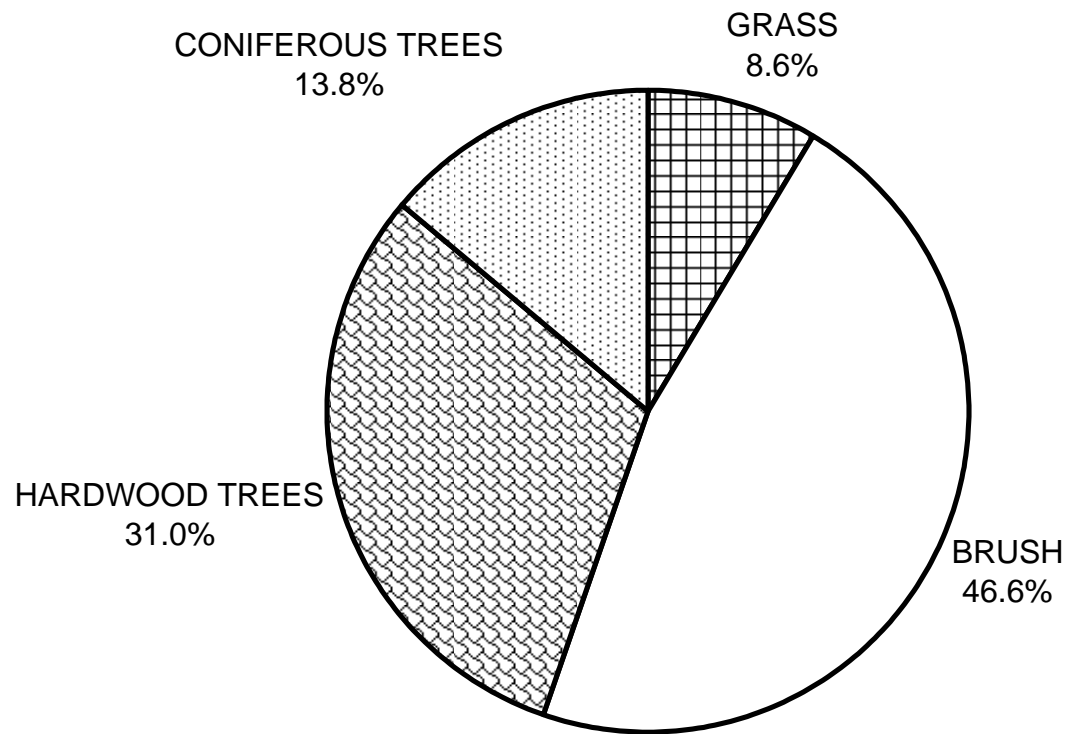
GRAPH 9

**HARTSOOK CREEK 2009
DOMINANT BANK COMPOSITION IN SURVEY REACH**



GRAPH 10

HARTSOOK CREEK 2009 DOMINANT BANK VEGETATION IN SURVEY REACH



GRAPH 11

Map 1
Hartsook Creek
South Fork Eel River Watershed
Garberville Quad, Humboldt County



Legend

- Reach 1, B4 Channel Type
- Reach 2, A2 Channel Type

0 700 1,400 Feet

