

STREAM INVENTORY REPORT

Mill Creek

INTRODUCTION

A stream inventory was conducted from October 14 to October 22, 2013 on Mill Creek. The survey began at the confluence with Navarro River and extended upstream 6.8 miles.

The Mill 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 Mill 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 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

Mill Creek is a tributary to the Navarro River, which drains to the Pacific Ocean. It is located in Mendocino County, California (Map 1). Mill Creek's legal description at the confluence with the Navarro River is T14N R15W S03. Its location is 39.1007 degrees north latitude and 123.5038 degrees west longitude, LLID number 1235025391007. Mill Creek is a second order stream and has approximately seven miles of blue line stream according to the USGS Navarro 7.5 minute quadrangle. Mill Creek drains a watershed of approximately 12.4 square miles. Elevations range from about 110 feet at the mouth of the creek to 1,400 feet in the headwater areas. Mixed hardwood and mixed conifer forest dominates the watershed. The watershed is entirely privately owned and is managed for agriculture and rural development. Vehicle access exists via Highway 128, outside of Navarro, CA.

METHODS

The habitat inventory conducted in Mill Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi et al, 1998). The California Department of Fish and Wildlife (CDFW) personnel that conducted the inventory were trained in standardized habitat inventory methods by the CDFW. 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

Mill Creek

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.

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 Mill 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". Mill 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 Mill Creek, embeddedness was

Mill Creek

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 not suitable 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 Mill 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 Mill 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 Mill 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

Mill Creek

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 Mill Creek. In addition, underwater observations were made at 11 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 2.0.18, a Visual Basic data entry program developed by Karen Wilson, Pacific States Marine Fisheries Commission in conjunction with the California Department of Fish and Wildlife. 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 Mill 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

Mill Creek

- 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 October 14 to October 22, 2013, was conducted by M. Groff and I. Mikus (CDFW). The total length of the stream surveyed was 36,083 feet.

Stream flow was measured near the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 0.13 cfs on October 23, 2013.

Mill Creek is an F4 channel type for 35,214 feet of the stream surveyed (Reach 1), and an A2 channel type for 869 feet of the stream surveyed (Reach 2). F4 channel types are entrenched meandering riffle/pool channels on low gradients with high width/depth ratios 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 44 to 53 degrees Fahrenheit. Air temperatures ranged from 36 to 73 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 35% flatwater units, 32% riffle units, 31% pool units, and 2% dry units (Graph 1). Based on total length of Level II habitat types there were 52% flatwater units, 31% pool units, 15% riffle units, and 2% dry units (Graph 2).

Fourteen Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were low gradient riffle units, 23%; mid-channel pool units, 20%; and run units 19% (Graph 3). Based on percent total length, step run units made up 35%, mid-channel pool units 22%, and run units 17%.

A total of 160 pools were identified (Table 3). Main channel pools were the most frequently encountered at 65% (Graph 4), and comprised 72% 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. One hundred twelve of the 160 pools (70%) had a residual depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 160 pool tail-outs measured, 94 had a value of 1 (58.8%); 53 had a value of 2 (33.1%); 11 had a value of 3 (6.9%); and 2 had a value of 5 (1.2%) (Graph 6). On this scale, a value of 1 indicates the best spawning

Mill Creek

conditions and a value of 4 the worst. Additionally, a value of 5 was assigned to tail-outs deemed not suitable 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 1, and pool habitats had a mean shelter rating of 8 (Table 1). Of the pool types, the scour pools had the highest mean shelter rating at 10. Main channel pools had a mean shelter rating of 6 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Undercut banks are the dominant cover type in Mill Creek. Graph 7 describes the pool cover in Mill Creek. Undercut banks are the dominant pool cover type followed by large woody debris.

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 78% of the pool tail-outs. Small cobble was the next most frequently observed dominant substrate type and occurred in 12% of the pool tail-outs.

The mean percent canopy density for the surveyed length of Mill Creek was 93%. Seven percent of the canopy was open. Of the canopy present, the mean percentages of hardwood and coniferous trees were 66% and 34%, respectively. Graph 9 describes the mean percent canopy in Mill Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 97%. The mean percent left bank vegetated was 96%. The dominant elements composing the structure of the stream banks consisted of 57% sand/silt/clay, 24% bedrock, 15% cobble/gravel, and 4% boulder (Graph 10). Hardwood trees were the dominant vegetation type observed in 54% of the units surveyed. Additionally, 29% of the units surveyed had coniferous trees as the dominant vegetation type, and 14% had brush as the dominant vegetation type (Graph 11).

BIOLOGICAL INVENTORY RESULTS

Survey teams conducted a snorkel survey at 11 sites for species composition and distribution in Mill Creek on October 21, 2013. The sites were sampled by I. Mikus and M. Groff (CDFW).

In reach 1, which comprised the first 35,214 feet of stream, 11 sites were sampled. The reach sites yielded 66 young-of-the-year steelhead/rainbow trout (SH/RT), 11 age 1+ SH/RT, 6 age 2+ SH/RT, 7 coho, 9 three-spine stickleback and 3 sculpin.

The following chart displays the information yielded from these sites:

Mill Creek

2013 Mill 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: F4 Channel Type									
10/21/13	1	66	Pool	7,143	3	0	0	0	0
	2	72	Pool	7,629	8	1	2	0	0
	3	76	Pool	7,922	6	2	1	6	0
	4	95	Pool	9,679	4	0	0	0	0
	5	99	Pool	9,952	5	1	0	0	0
	6	102	Pool	10,248	8	1	1	1	0
	7	111	Pool	10,679	14	2	0	0	0
	8	117	Pool	11,032	2	1	0	0	0
	9	126	Pool	11,978	9	1	1	0	0
	10	231	Pool	21,666	6	1	0	0	0
	11	234	Pool	21,983	1	1	1	0	0

DISCUSSION

Mill Creek is an F4 channel type for the first 35,214 feet of stream surveyed (Reach 1), and an A2 channel type for the remaining 869 feet (Reach 2). The suitability of F4 and A2 channel types for fish habitat improvement structures is as follows: F4 channel types are good for bank-placed boulders and fair for plunge weirs, single and opposing wing-deflectors, channel constrictors, and log cover. A2 channels are generally not suitable for fish habitat improvement projects.

The water temperatures recorded on the survey days October 14 to October 22, 2013, ranged from 44 to 53 degrees Fahrenheit. Air temperatures ranged from 36 to 73 degrees Fahrenheit. This is a good water temperature range for salmonids. To make any further conclusions, temperatures need to be monitored throughout the warm summer months, and more extensive biological sampling needs to be conducted.

Flatwater habitat types comprised 52% of the total length of this survey, riffles 15%, and pools 31%. One hundred twelve of the 160 (70%) pools had a maximum residual depth greater than two 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 that will increase or deepen pool habitat is recommended.

One hundred forty-seven of the 160 pool tail-outs measured had embeddedness ratings of 1 or 2. Eleven of the pool tail-outs had embeddedness ratings of 3 or 4. Two of the pool tail-outs had a

Mill Creek

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 Mill Creek should be mapped and rated according to their potential sediment yields, and control measures should be taken.

One hundred forty-four of the 160 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 8. The shelter rating in the flatwater habitats is 1. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by undercut banks in Mill Creek. Undercut banks are the dominant cover type in pools followed by large woody debris. Log and root wad cover structures in the pool and flatwater habitats would enhance both summer and winter salmonid habitat. Log cover structures provide rearing fry with protection from predation, rest from water velocity, and also divide territorial units to reduce density related competition.

The mean percent canopy density for the stream was 93%. Reach 1 had a canopy density of 93%, Reach 2 had a canopy density of 94%. The percentage of right and left bank covered with vegetation was 97% and 96%, respectively.

RECOMMENDATIONS

- 1) Mill 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) Increase woody cover in the pools and flatwater habitat units. Most of the existing cover in the pools is from undercut banks. Adding high quality complexity with woody cover in the pools is desirable.
- 4) 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.

Mill Creek

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 #:	Comments:
0	0001.00	Start of survey at the confluence with Navarro River. The first 493 feet of the stream is dry. Log debris accumulation (LDA) #01 is approximately 7' high x 40' wide x 35' long and contains 20 pieces of large woody debris (LWD). Water does not flow through it as the stream is dry above and below the LDA. There are visible gaps in the LDA. Sediment is being retained by the LDA in the approximate dimensions of 15' wide x 30' long x 1' deep. The sediment is made up of silt and sand. The LDA is a possible barrier to salmonids due to it being a strainer, the creek is also dry above and below the LDA at this time.
493	0002.00	There is a stage plate in the creek. It is currently reading at 2.0'.
4307	0048.00	A section of stream measuring approximately 1,300 feet, was not surveyed.
5858	0052.00	Tributary #01 enters Mill Creek from the left bank. It is not flowing but it does have water. The temperature of the tributary is 48 degrees Fahrenheit. The temperature of Mill Creek above and below the confluence is 46 degrees Fahrenheit. The tributary is accessible to fish, but the first 5' are currently dry and there is a 7' waterfall, 100' upstream from the confluence. The slope of the tributary is an estimated 3% and fish were observed in it.
5858	0052.00	There are remnants of a stream crossing on both banks.
6556	0060.00	Bridge #02 goes across this unit. The bridge is 16' high and is made of an old railcar. It is not a barrier to salmonids.
7077	0067.00	There are concrete abutments on each bank. There is no bridge on the abutments.
7799	0076.00	There is erosion of the right bank. The erosion measures approximately 50' long x 12' high. The erosion is leading to fine substrate entering the creek channel.
9653	0095.00	There is an LWD structure.
9971	0101.00	There is an LWD structure.
10708	0113.00	There is an LWD structure.

Mill Creek

10854	0114.00	There is a seep coming out of the right bank.
10936	0117.00	There is an LWD structure.
11141	0121.00	There is an LWD structure.
11223	0122.00	Bridge #03 is over this unit. The bridge is 10' wide, 11.3' high and 47' long. The bridge is made of an old railcar. Below the bridge on the right bank is vertical wall of bare sediment, measuring 10' high and 15' wide. On the left bank there is boulder rip-rap and bare sediment.
11841	0126.00	Tributary #02 enters Mill Creek from the right bank and is named Meyer Gulch. Meyer Gulch is not flowing and for the first few hundred feet it is mostly dry except for a few isolated pools. There is a culvert near the mouth of Meyer Gulch that is a possible barrier to salmonids. Downstream of the culvert there is a concrete and bedrock dam that may also be a barrier to salmonids.
11841	0126.00	Bridge #04 goes over this unit and it is a railcar bridge. The bridge is not a barrier to salmonids.
11978	0127.00	The stream was not surveyed for approximately 1,590 feet.
13713	0129.00	LDA #02 is 11' high x 40' wide x 15' long. It contains more than 20 pieces of LWD. It appears that a clump of redwoods collapsed off the right bank and captured the majority of the logs in this LDA. Water does not flow through the LDA and there are no visible gaps in it. The LDA is retaining sediment in the estimated dimensions of 15' wide x 200' long x 3' deep. The sediment is mostly composed of silt, sand and gravel. The LDA is a potential barrier to salmonids as there is a 6' plunge on the left side of the LDA. Currently the stream goes dry for 18' above the LDA. The retained sediment shows signs of pigs wallowing in it. There is a dirt road on the right bank.
14517	0140.00	This unit was HU#186 during a 1998 survey.
14628	0142.00	There is a slide on the left bank. The slide is approximately 20' long x 60' high and is contributing sediment ranging in size from silt to cobble. The slide may be caused by or exacerbated by an oak tree that has uprooted from the left bank.
17058	0175.00	Bridge #05 is 10' wide x 11' high x 40' long. It is a railcar bridge with abutments on the left bank.
18373	0193.00	Bridge #06 is over this unit. The bridge is 8' wide x 13.4' high x 46' long. The bridge is made of logs and appears dilapidated.
18373	0193.00	There is an LWD habitat improvement structure.

Mill Creek

19408	0203.00	There is an LWD habitat improvement structure in this unit.
20274	0210.00	A tributary enters Mill Creek from the right bank. The stream is unnamed but is locally referred to as "Little Mill Creek". It is flowing and is contributing to approximately 5% of Mill Creek's flow. The temperature of the tributary is 47 degrees Fahrenheit. The temperature of Mill Creek both upstream and downstream of the tributary is 46 degrees Fahrenheit. The tributary is accessible to fish, its slope is estimated at 3% and fish were observed in the tributary.
20274	0210.00	There is an LWD structure in this unit. A stage plate in this unit reads 1.35'.
21691	0233.00	There is a stage plate in this unit. The plate is out of the water.
21899	0234.00	Bridge #07 is over this unit. The bridge is for Nash Mill Road and is made out of metal. There are remnants of log abutments on the left bank from a crossing that no longer exists. Under the bridge there is bare sediment on each bank, the sediment measures approximately 25' long x 10' high.
22289	0239.00	There is a footbridge over this unit. The bridge is 15' high and is made out of wood and metal pipe. There is a seep on the right bank, where the seep enters Mill Creek there is an orange colored algal bloom.
22368	0240.00	A tributary enters Mill Creek from the right bank. It is flowing and contributing to approximately 2% of Mill Creek's flow. The temperature of the tributary is 49 degrees Fahrenheit. The temperature of Mill Creek downstream and upstream of the tributary is 46 degrees Fahrenheit. The tributary is not accessible to fish as the channel is narrow and there is a 5' plunge with no pool under it. The slope of the tributary is an estimated 4%. No fish were observed in the tributary.
23655	0262.00	The stream was not surveyed for approximately 730 feet.
24425	0264.00	This unit is a bedrock sheet with a 3.3' change in elevation.
24435	0265.00	Bridge #09 is over this unit. The bridge is made of logs and wood planks. The bridge looks dilapidated and out of use.
24620	0270.00	In this unit the stream is flowing under a boulder.
25514	0287.00	There is a seep coming out of the left bank.
26346	0296.00	There is a 2.2' plunge over a log.
26438	0298.00	LDA #03 is approximately 2.5' high x 15' wide x 7' long. There are 5 pieces of LWD making up the LDA. Water is not flowing through the

Mill Creek

LDA, there are visible gaps in it and sediment is being retained by it. The sediment measures an estimated 6' wide x 20' long x 1.5' deep. The sediment ranges in size from silt to gravel. The creek is dry for seven feet above the LDA, creating a juvenile barrier. The LDA also creates a 3' high plunge which is a potential barrier to salmonids.

26765	0310.00	There are the remnants of a possible railroad trestle on the right bank.
27896	0337.00	There is erosion of the left bank. The erosion is estimated at 30' long x 12' high and is contributing silt, sand and gravel to the stream channel.
27967	0339.00	There is a road fording the creek in this unit.
28818	0354.00	A tributary named Red Hill Gulch enters this unit from the left bank. Red Hill Gulch is dry.
30058	0374.00	There is erosion of the left bank that is contributing fine sediment to the creek channel. The erosion is estimated to be 15' long and 6' high.
30113	0377.00	There is erosion of the left bank that is contributing silt to the creek channel. The erosion is estimated at 40' long x 10' high and is occurring below a road.
30563	0390.00	There is erosion of the right bank that is contributing silt to the creek channel. The erosion is estimated at 10' long x 14' high.
30672	0393.00	There is a road fording the creek at this unit. There is also a stage plate reading at 0.9 feet.
31484	0405.00	There is a 2.8' high plunge over a log.
33068	0433.00	There is a "Tea Room" built over the creek, it is supported by two logs that are perpendicular to the channel and resting on either bank.
33764	0445.00	There are wood pillars in the creek, indicating a crossing spanned the channel at one point in time.
34456	0466.00	A road fords the creek through this unit.
34610	0468.00	A fish was observed in this unit.
34835	0474.00	Tributary #05 enters Mill Creek from the right bank, the tributary is named Hungry Hollow Creek. Hungry Hollow Creek is flowing and is contributing to an estimated 60% of Mill Creek's flow. The temperature of Hungry Hollow is 51 degrees Fahrenheit. The temperature of Mill Creek upstream and downstream of the confluence is 50 degrees Fahrenheit. Hungry Hollow is accessible to fish, has an estimated 2-3% slope and fish were observed in it.

Mill Creek

35214	0484.00	The channel type has changed to an A2.
35424	0488.00	A fish was observed in this unit.
35814	0499.00	A fish was observed in this unit.
35945	0507.00	Redwood roots have grown into the channel from each bank and are accumulating boulders and woody debris, creating a 6' high plunge. The creek goes dry for 19' above the plunge.
36083	0514.00	End of survey at a 8.4' high plunge over bedrock. The top of the plunge is a 2.4' drop over a bedrock sheet leading to a vertical 6' plunge. Approximately 120' downstream of this barrier there is a 6' plunge over woody debris and boulders. Upstream of the end of survey barrier there is an LDA with a 5' high plunge and the stream is dry above the LDA. Boulder roughs and woody debris impede fish passage for approximately 100' upstream of the LDA. During a 1000' walk above the end of survey, no fish were observed. The last fish observed was at habitat unit #499.

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.

Mill Creek

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: Mill Creek

LLID: 1235025391007

Drainage: Navarro River

Survey Dates: 10/14/2013 to 10/22/2013

Confluence Location: Quad: NAVARRO

Legal Description: T14NR15WS03

Latitude: 39:06:03.0N

Longitude: 123:30:09.0W

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
10	0	DRY	2.0	65	647	2.0									
179	21	FLATWATER	35.0	95	16997	52.4	6.8	0.5	1.1	556	99597	308	55161		1
3	0	NOSURVEY		1207	3620										
160	160	POOL	31.3	62	9966	30.7	11.8	1.2	2.6	771	123419	1102	176277	995	8
162	19	RIFFLE	31.7	30	4853	14.9	7.3	0.1	0.4	184	29869	26	4166		0
Total Units	Total Units Fully Measured				Total Length (ft.)					Total Area (sq.ft.)			Total Volume (cu.ft.)		
514	200				36083					252884			235605		

Table 2 - Summary of Habitat Types and Measured Parameters

Stream Name: Mill Creek

LLID: 1235025391007

Drainage: Navarro River

Survey Dates: 10/14/2013 to 10/22/2013

Confluence Location: Quad: NAVARRO

Legal Description: T14NR15WS03

Latitude: 39:06:03.0N

Longitude: 123:30:09.0W

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 (%)
118	11	LGR	23.1	33	3857	11.9	7	0.1	0.7	237	27999	33	3882		0	94
42	7	HGR	8.2	23	982	3.0	8	0.1	0.5	127	5346	18	760		0	93
2	1	BRS	0.4	7	14	0.0	0	0.1	0.2	2	4	0	0		0	100
97	12	RUN	19.0	57	5566	17.1	6	0.6	2.1	334	32390	222	21536		1	90
82	9	SRN	16.0	139	11431	35.2	8	0.5	1.5	853	69951	423	34688		0	93
102	102	MCP	20.0	69	7081	21.8	12	1.2	5.9	873	89075	1316	134239	1190	6	94
2	2	STP	0.4	51	102	0.3	10	1.5	5.2	558	1116	1076	2151	1020	3	99
4	4	CRP	0.8	44	175	0.5	12	1.4	5.6	699	2797	1752	7007	1614	13	91
7	7	LSL	1.4	66	463	1.4	12	0.8	2.5	770	5389	683	4778	596	13	93
16	16	LSR	3.1	43	695	2.1	9	0.9	3.2	432	6916	444	7098	396	12	92
14	14	LSBk	2.7	63	879	2.7	11	0.9	3.2	723	10116	757	10598	678	4	93
10	10	LSBo	2.0	43	432	1.3	12	1.1	3.8	541	5411	595	5950	535	15	88
5	5	PLP	1.0	28	139	0.4	18	1.4	4.6	520	2600	891	4456	801	8	98
10	0	DRY	2.0	65	647	2.0										
3	0	NS		1207	3620											

Total Units
514

Total Units Fully Measured
200

Total Length (ft.)
36083

Total Area (sq.ft.)
259108

Total Volume (cu.ft.)
237142

Table 3 - Summary of Pool Types

Stream Name: Mill Creek

LLID: 1235025391007

Drainage: Navarro River

Survey Dates: 10/14/2013 to 10/22/2013

Confluence Location: Quad: NAVARRO

Legal Description: T14NR15WS03

Latitude: 39:06:03.0N

Longitude: 123:30:09.0W

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
104	104	MAIN	65	69	7183	72	12.0	1.2	867	90191	1187	123470	6
56	56	SCOUR	35	50	2783	28	11.4	1.0	593	33228	639	35799	10

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
160	160	9966	123419	159268

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

Stream Name: Mill Creek

LLID: 1235025391007

Drainage: Navarro River

Survey Dates: 10/14/2013 to 10/22/2013

Confluence Location: Quad: NAVARRO

Legal Description: T14NR15WS03

Latitude: 39:06:03.0N

Longitude: 123:30:09.0W

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
102	MCP	64	0	0	26	25	43	42	16	16	17	17
2	STP	1	0	0	1	50	0	0	0	0	1	50
4	CRP	3	0	0	2	50	1	25	0	0	1	25
7	LSL	4	0	0	1	14	6	86	0	0	0	0
16	LSR	10	0	0	8	50	7	44	1	6	0	0
14	LSBk	9	0	0	6	43	7	50	1	7	0	0
10	LSBo	6	0	0	2	20	7	70	1	10	0	0
5	PLP	3	0	0	2	40	0	0	2	40	1	20

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
160	0	0	48	30	71	44	21	13	20	12

Mean Maximum Residual Pool Depth (ft.): 2.6

Table 5 - Summary of Mean Percent Cover By Habitat Type

Stream Name: Mill Creek

LLID: 1235025391007

Drainage: Navarro River

Survey Dates: 10/14/2013 to 10/22/2013

Dry Units: 10

Confluence Location: Quad: NAVARRO

Legal Description: T14NR15WS03

Latitude: 39:06:03.0N

Longitude: 123:30:09.0W

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
118	11	LGR	0	0	0	0	0	0	0	0	0
42	7	HGR	0	0	0	0	0	0	0	0	0
2	1	BRS	0	0	0	0	0	0	0	0	0
162	19	TOTAL RIFFLE	0	0	0	0	0	0	0	0	0
97	12	RUN	0	0	0	50	0	0	0	50	0
82	9	SRN	0	0	0	0	0	0	0	0	0
179	21	TOTAL FLAT	0	0	0	50	0	0	0	50	0
102	102	MCP	29	10	29	2	0	2	0	25	3
2	2	STP	0	0	50	0	0	0	0	0	50
4	4	CRP	84	0	14	3	0	0	0	0	0
7	7	LSL	34	14	34	1	0	0	0	17	0
16	16	LSR	11	28	40	11	10	0	0	0	0
14	14	LSBk	94	2	2	1	0	0	0	1	0
10	10	LSBo	21	18	6	1	1	9	0	39	5
5	5	PLP	8	25	43	0	0	0	0	25	0
160	160	TOTAL POOL	31	13	28	3	2	2	0	19	3
3	0	NS									
514	200	TOTAL	30	13	27	4	2	2	0	19	3

Table 6 - Summary of Dominant Substrates By Habitat Type

Stream Name: Mill Creek

LLID: 1235025391007

Drainage: Navarro River

Survey Dates: 10/14/2013 to 10/22/2013

Dry Units: 10

Confluence Location: Quad: NAVARRO

Legal Description: T14NR15WS03

Latitude: 39:06:03.0N

Longitude: 123:30:09.0W

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
118	11	LGR	0	0	73	18	9	0	0
42	7	HGR	0	0	71	29	0	0	0
2	1	BRS	0	0	0	0	0	0	100
97	12	RUN	0	0	83	8	8	0	0
82	9	SRN	0	0	100	0	0	0	0
102	102	MCP	0	0	96	1	0	0	3
2	2	STP	0	0	100	0	0	0	0
4	4	CRP	0	0	100	0	0	0	0
7	7	LSL	0	14	86	0	0	0	0
16	16	LSR	0	0	100	0	0	0	0
14	14	LSBk	0	0	100	0	0	0	0
10	10	LSBo	0	0	90	10	0	0	0
5	5	PLP	0	0	100	0	0	0	0

Table 7 - Summary of Mean Percent Canopy for Entire Stream

Stream Name: Mill Creek

LLID: 1235025391007

Drainage: Navarro River

Survey Dates: 10/14/2013 to 10/22/2013

Confluence Location: Quad: NAVARRO

Legal Description: T14NR15WS03

Latitude: 39:06:03.0N

Longitude: 123:30:09.0W

Mean Percent Canopy	Mean Percent Conifer	Mean Percent Hardwood	Mean Percent Open Units	Mean Right Bank % Cover	Mean Left Bank % Cover
93	34	66	0	97	96

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: Mill Creek LLID: 1235025391007 Drainage: Navarro River
 Survey Dates: 10/14/2013 to 10/22/2013 Survey Length (ft.): 36083 Main Channel (ft.): 36083 Side Channel (ft.): 0
 Confluence Location: Quad: NAVARRO Legal Description: T14NR15WS03 Latitude: 39:06:03.0N Longitude: 123:30:09.0W

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 1

Channel Type: F4	Canopy Density (%): 93.1	Pools by Stream Length (%): 28.0
Reach Length (ft.): 35214	Coniferous Component (%): 32.8	Pool Frequency (%): 31.9
Riffle/Flatwater Mean Width (ft.): 7.4	Hardwood Component (%): 67.3	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation: Hardwood Trees	< 2 Feet Deep: 28
Range (ft.): 13 to 49	Vegetative Cover (%): 96.5	2 to 2.9 Feet Deep: 46
Mean (ft.): 24	Dominant Shelter: Undercut Banks	3 to 3.9 Feet Deep: 13
Std. Dev.: 8	Dominant Bank Substrate Type: Sand/Silt/Clay	>= 4 Feet Deep: 13
Base Flow (cfs.): 0.1	Occurrence of LWD (%): 14	Mean Max Residual Pool Depth (ft.): 2.6
Water (F): 44 - 52 Air (F): 36 - 73	LWD per 100 ft.:	Mean Pool Shelter Rating: 8
Dry Channel (ft): 613	Riffles: 1	
	Pools: 2	
	Flat: 1	
Pool Tail Substrate (%): Silt/Clay: 0 Sand: 0 Gravel: 78 Sm Cobble: 12 Lg Cobble: 3 Boulder: 3 Bedrock: 5		
Embeddedness Values (%): 1. 59.1 2. 32.5 3. 7.1 4. 0.0 5. 1.3		

STREAM REACH: 2

Channel Type: A2	Canopy Density (%): 93.8	Pools by Stream Length (%): 12.7
Reach Length (ft.): 869	Coniferous Component (%): 46.5	Pool Frequency (%): 19.4
Riffle/Flatwater Mean Width (ft.): 4.9	Hardwood Component (%): 53.5	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation: Coniferous Trees	< 2 Feet Deep: 83
Range (ft.): 15 to 18	Vegetative Cover (%): 99.0	2 to 2.9 Feet Deep: 0
Mean (ft.): 16	Dominant Shelter: Boulders	3 to 3.9 Feet Deep: 17
Std. Dev.: 1	Dominant Bank Substrate Type: Sand/Silt/Clay	>= 4 Feet Deep: 0
Base Flow (cfs.): 0.1	Occurrence of LWD (%): 8	Mean Max Residual Pool Depth (ft.): 1.8
Water (F): 51 - 53 Air (F): 57 - 59	LWD per 100 ft.:	Mean Pool Shelter Rating: 4
Dry Channel (ft): 34	Riffles: 1	
	Pools: 6	
	Flat: 2	
Pool Tail Substrate (%): Silt/Clay: 0 Sand: 0 Gravel: 83 Sm Cobble: 17 Lg Cobble: 0 Boulder: 0 Bedrock: 0		
Embeddedness Values (%): 1. 50.0 2. 50.0 3. 0.0 4. 0.0 5. 0.0		

Table 9 - Mean Percentage of Dominant Substrate and Vegetation

Stream Name: Mill Creek

LLID: 1235025391007

Drainage: Navarro River

Survey Dates: 10/14/2013 to 10/22/2013

Confluence Location: Quad: NAVARRO

Legal Description: T14NR15WS03

Latitude: 39:06:03.0N

Longitude: 123:30:09.0W

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	50	46	24.0
Boulder	4	12	4.0
Cobble / Gravel	33	27	15.0
Sand / Silt / Clay	113	115	57.0

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	1	0	0.3
Brush	26	29	13.8
Hardwood Trees	110	105	53.8
Coniferous Trees	54	62	29.0
No Vegetation	9	4	3.3

Total Stream Cobble Embeddedness Values: 2

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

StreamName: Mill Creek

LLID: 1235025391007

Drainage: Navarro River

Survey Dates: 10/14/2013 to 10/22/2013

Confluence Location: Quad: NAVARRO

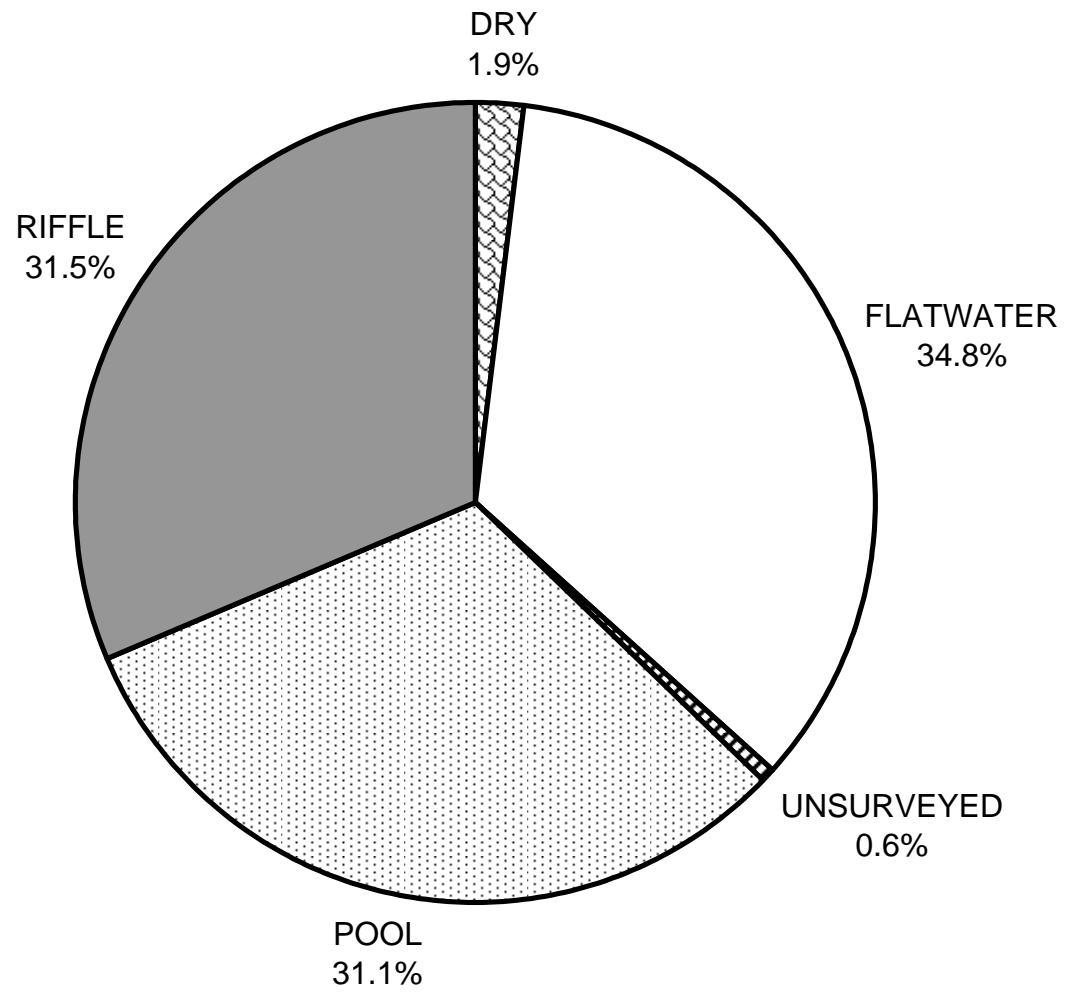
Legal Description: T14NR15WS03

Latitude: 39:06:03.0N

Longitude: 123:30:09.0W

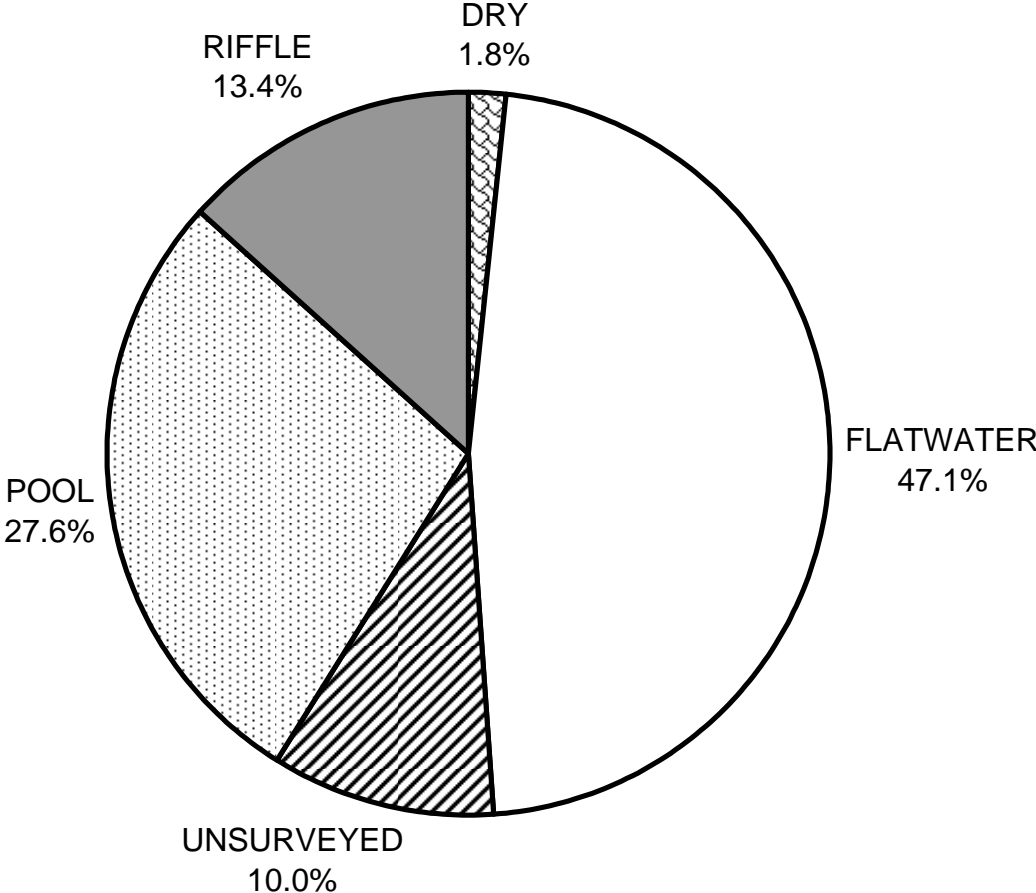
	Riffles	Flatwater	Pools
UNDERCUT BANKS (%)	0	0	31
SMALL WOODY DEBRIS (%)	0	0	13
LARGE WOODY DEBRIS (%)	0	0	28
ROOT MASS (%)	0	50	3
TERRESTRIAL VEGETATION (%)	0	0	2
AQUATIC VEGETATION (%)	0	0	2
WHITEWATER (%)	0	0	0
BOULDERS (%)	0	50	19
BEDROCK LEDGES (%)	0	0	3

MILL CREEK 2013 HABITAT TYPES BY PERCENT OCCURRENCE



GRAPH 1

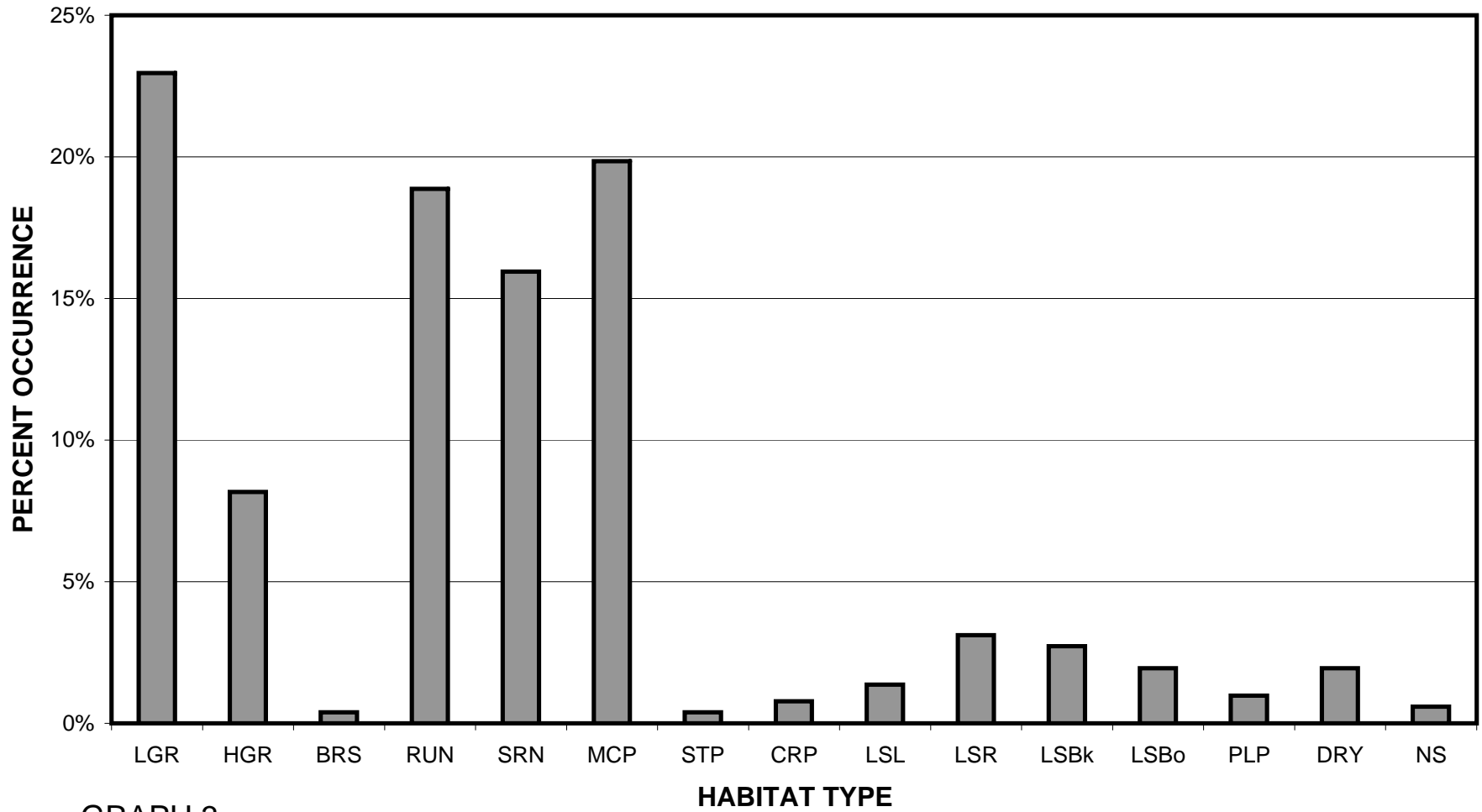
**MILL CREEK 2013
HABITAT TYPES BY PERCENT TOTAL LENGTH**



GRAPH 2

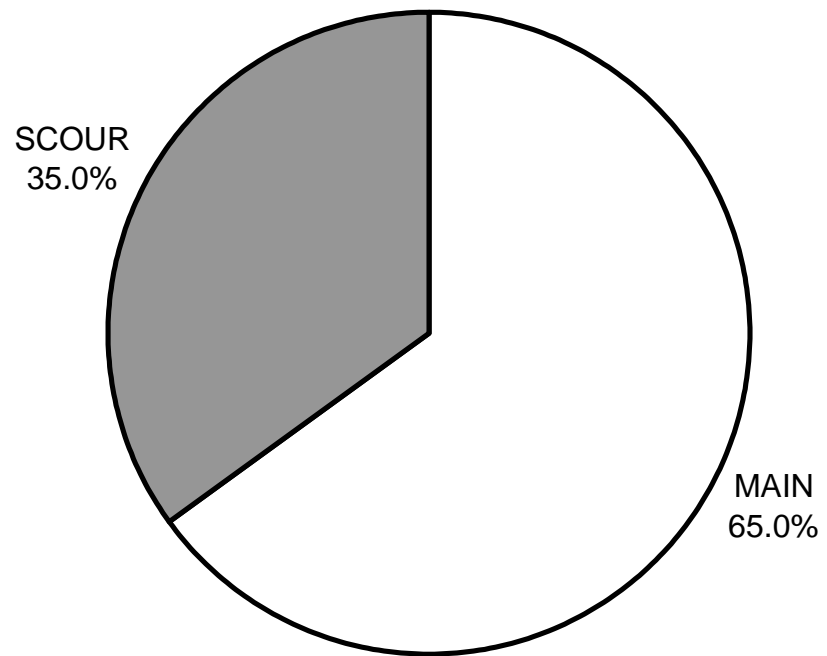
MILL CREEK 2013

HABITAT TYPES BY PERCENT OCCURRENCE



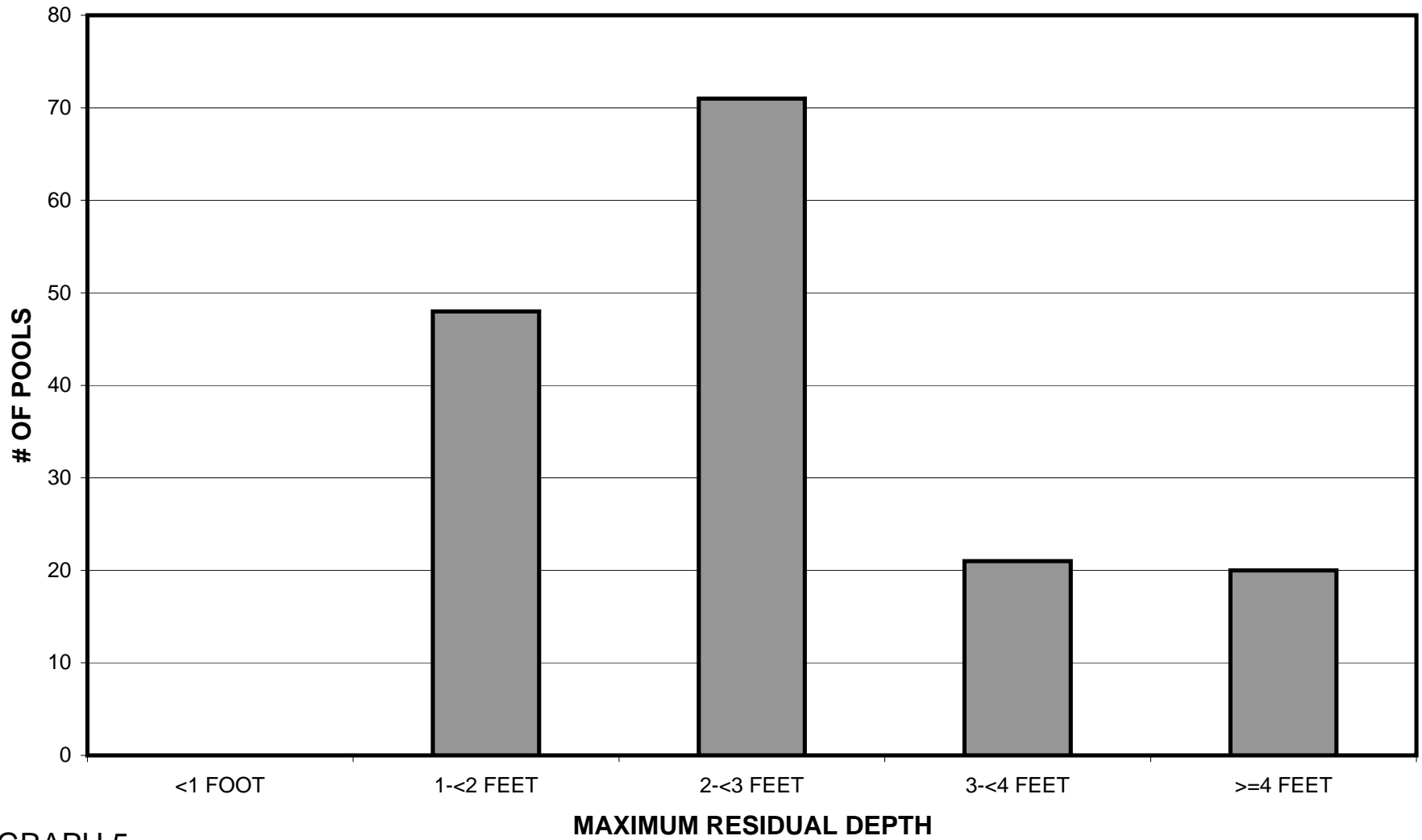
GRAPH 3

**MILL CREEK 2013
POOL TYPES BY PERCENT OCCURRENCE**



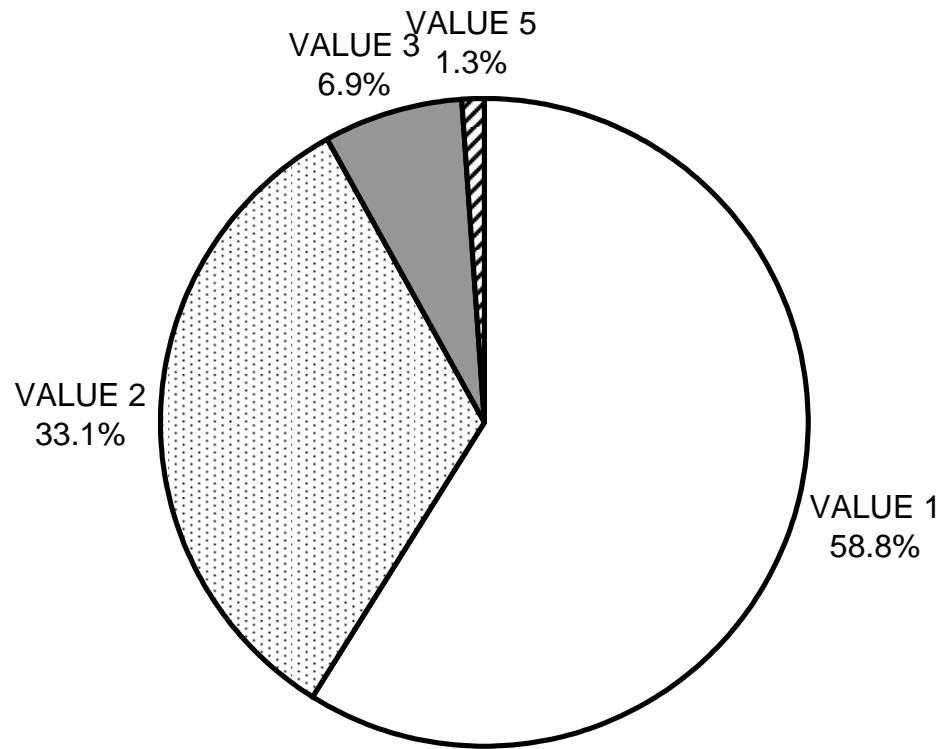
GRAPH 4

MILL CREEK 2013 MAXIMUM DEPTH IN POOLS



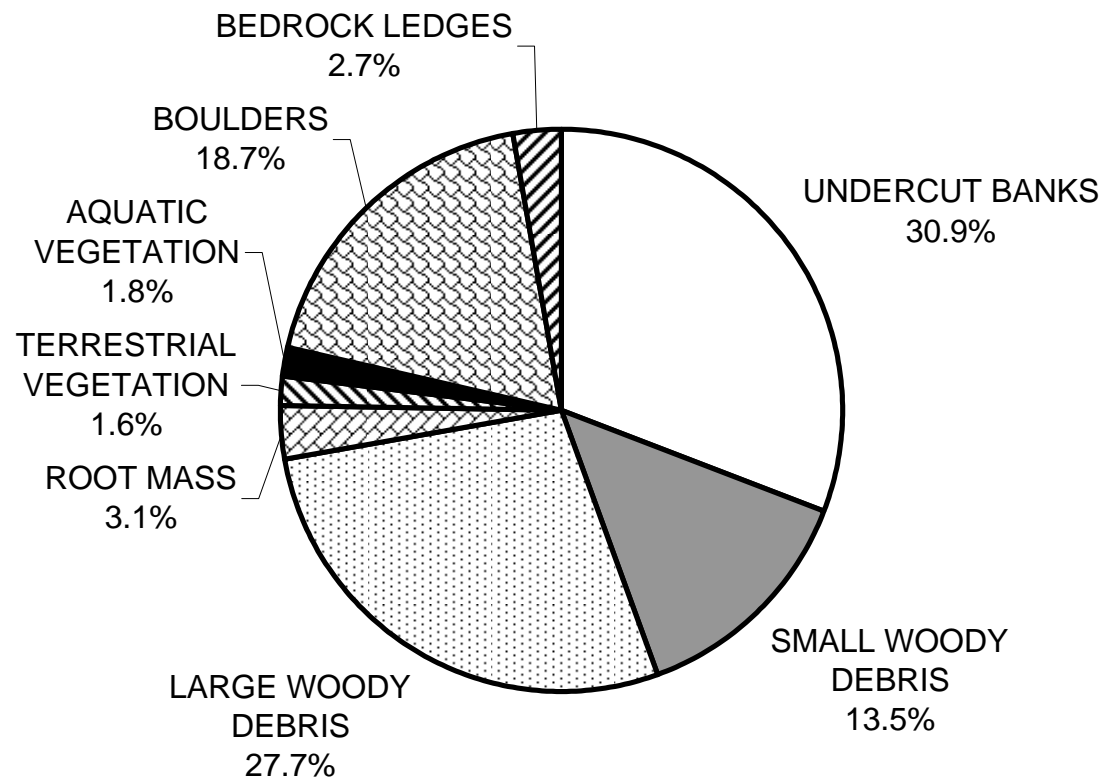
GRAPH 5

MILL CREEK 2013 PERCENT EMBEDDEDNESS



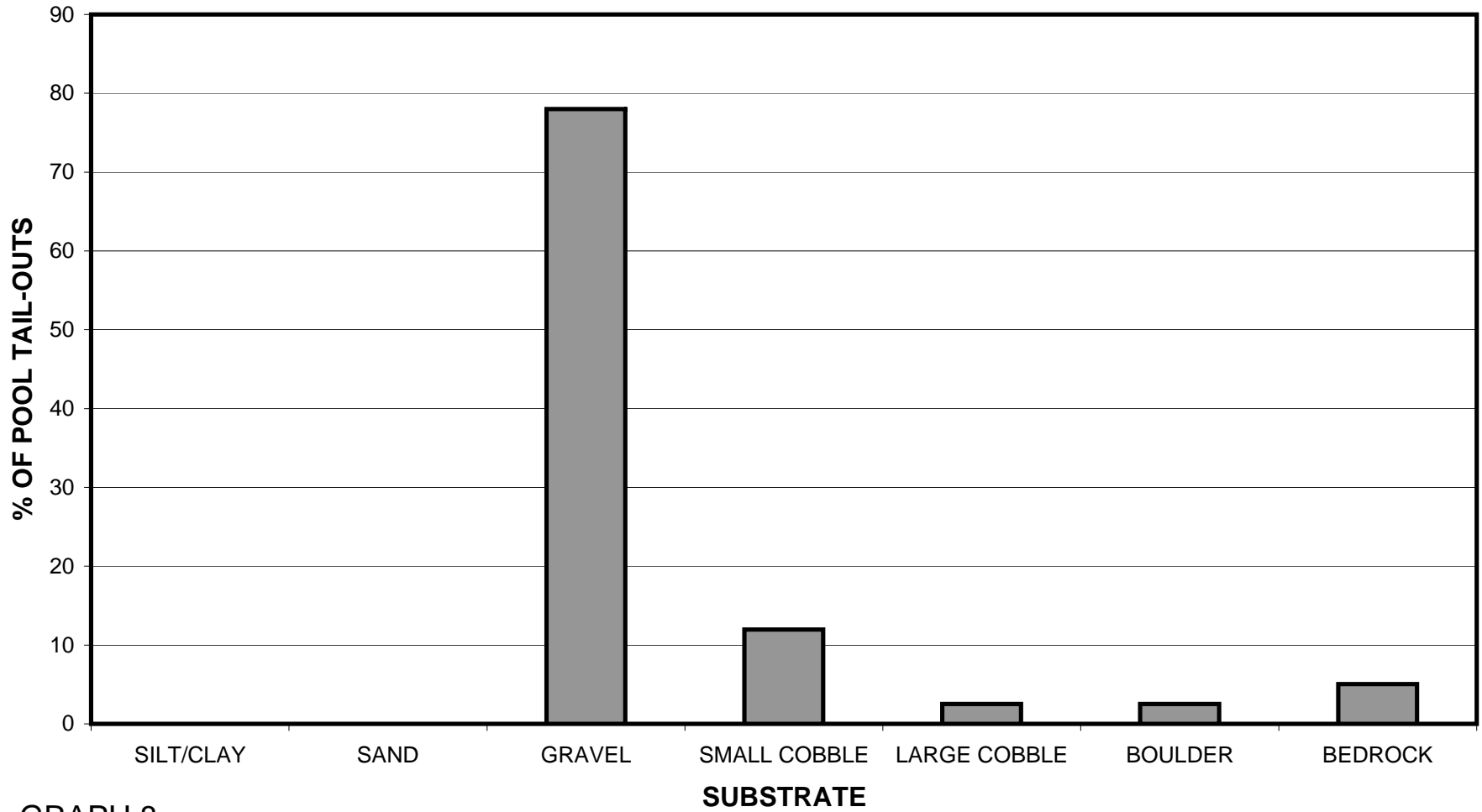
GRAPH 6

MILL CREEK 2013 MEAN PERCENT COVER TYPES IN POOLS



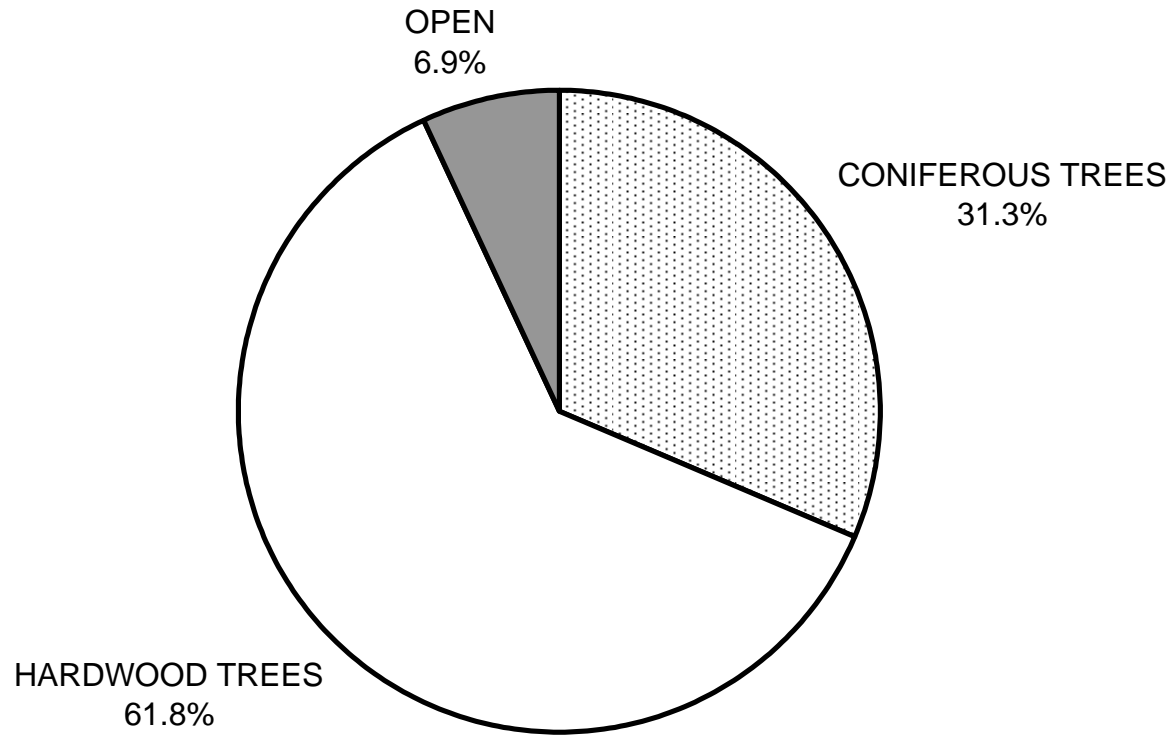
GRAPH 7

MILL CREEK 2013 SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



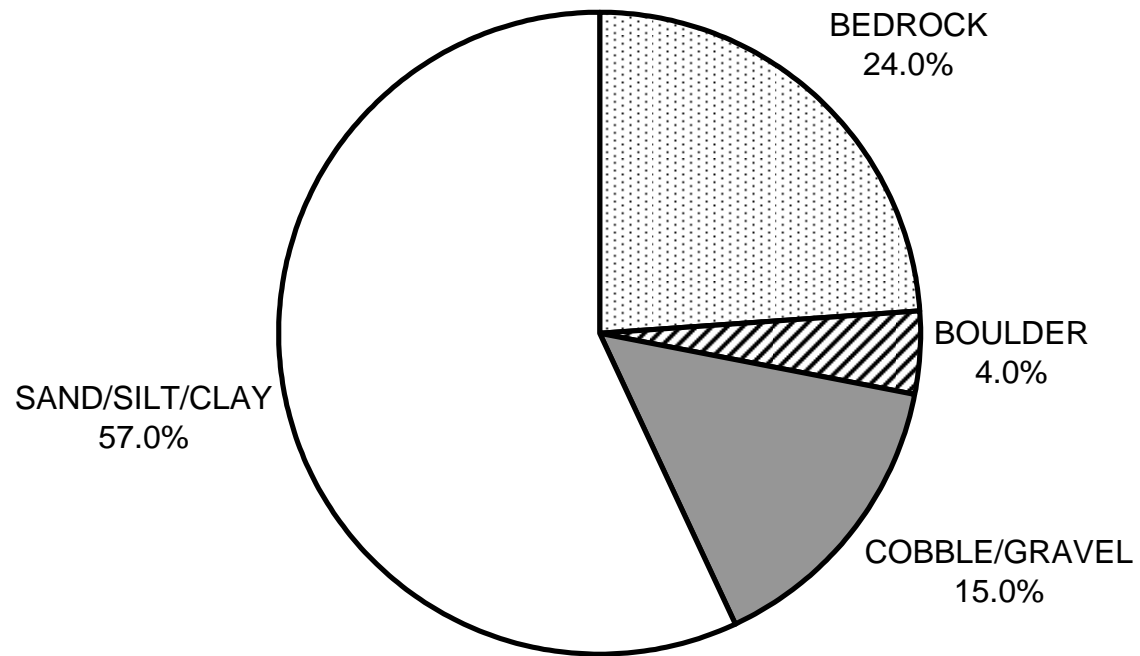
GRAPH 8

MILL CREEK 2013 MEAN PERCENT CANOPY



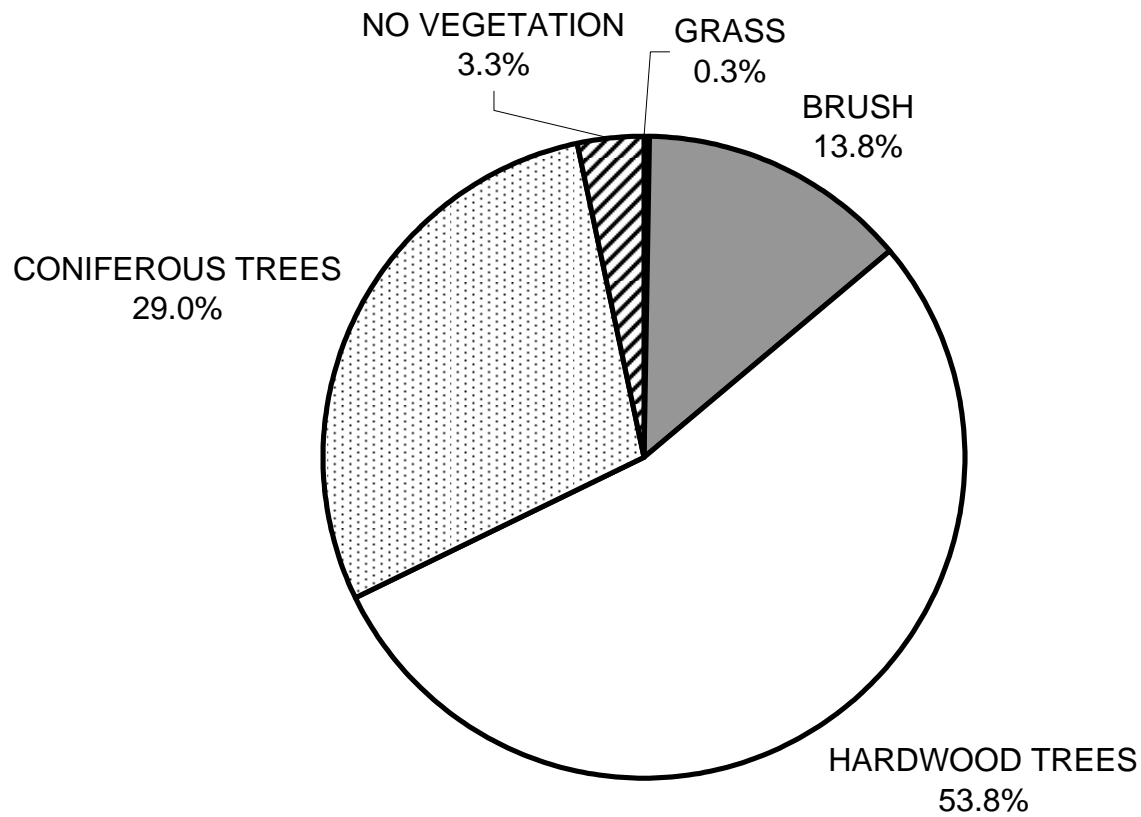
GRAPH 9

**MILL CREEK 2013
DOMINANT BANK COMPOSITION IN SURVEY REACH**



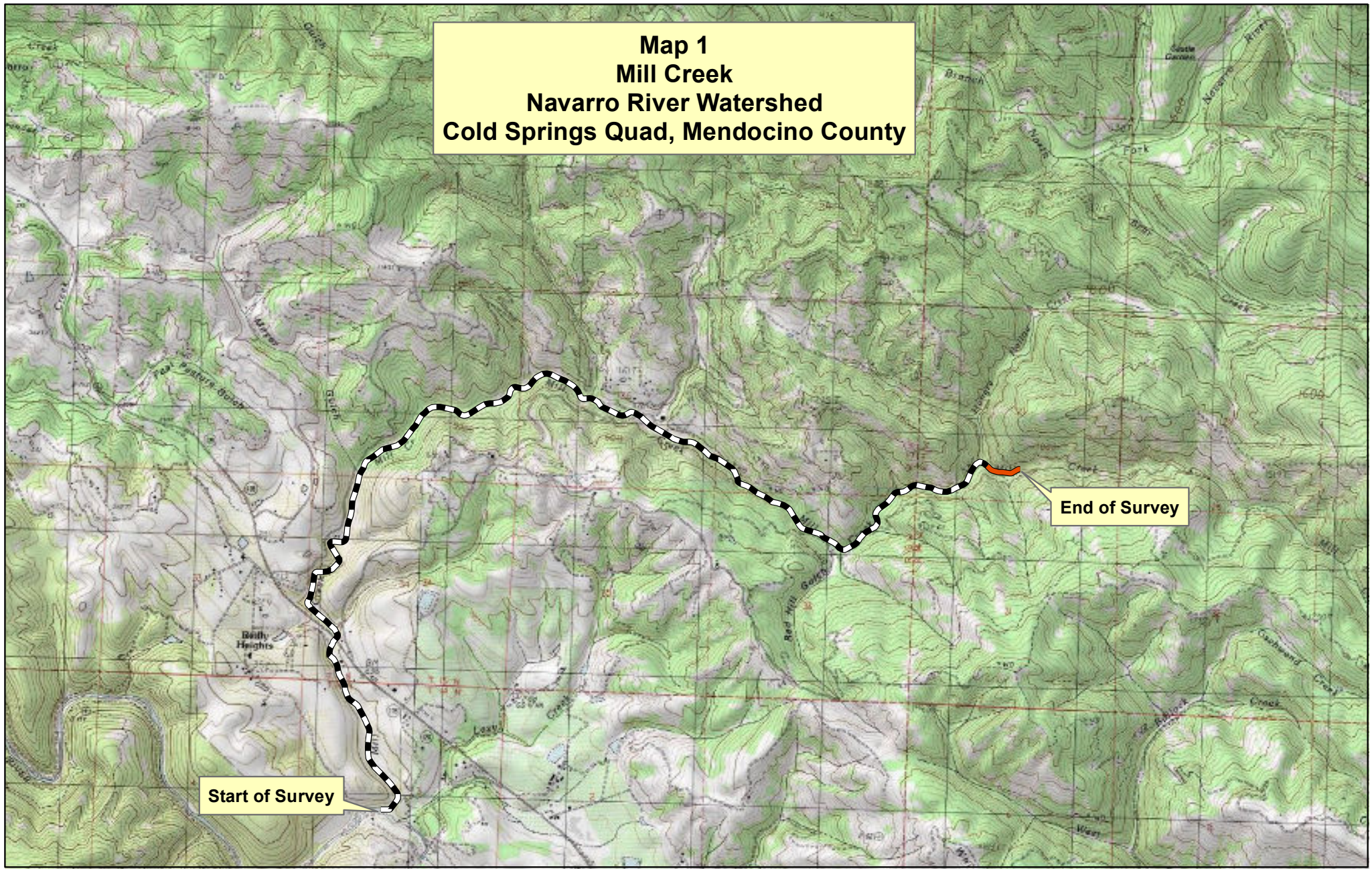
GRAPH 10

MILL CREEK 2013 DOMINANT BANK VEGETATION IN SURVEY REACH



GRAPH 11



Map 1
Mill Creek
Navarro River Watershed
Cold Springs Quad, Mendocino County



Start of Survey

End of Survey



-  Reach 1, Channel Type F4
-  Reach 2, Channel Type A2

