

# STREAM INVENTORY REPORT

## Bear Creek

### INTRODUCTION

A stream inventory was conducted from May 21 to May 30, 2012 on Bear Creek. The survey began at the confluence with South Branch North Fork Navarro River and extended upstream 1.5 miles.

The Bear 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 Bear 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

Bear Creek is a tributary to South Branch North Fork Navarro River, a tributary to North Fork Navarro River, a tributary to the Navarro River, which drains to the Pacific Ocean. It is located in Mendocino County, California (Map 1). Bear Creek's legal description at the confluence with South Branch North Fork Navarro River is T15N R14W S19. Its location is 39.1489 degrees north latitude and 123.4419 degrees west longitude, LLID number 1234405391489. Bear Creek is a first order stream and has approximately 1.2 miles of blue line stream according to the USGS Bailey Ridge 7.5 minute quadrangle. Bear Creek drains a watershed of approximately 1.6 square miles. Elevations range from about 500 feet at the mouth of the creek to 1,300 feet in the headwater areas. Mixed conifer forest dominates the watershed. The watershed is entirely privately owned and is managed for timber production. Vehicle access exists via Masonite Industrial Road.

### METHODS

The habitat inventory conducted in Bear 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 and Watershed Stewards Project/AmeriCorps (WSP) members that conducted the inventory were trained in standardized habitat inventory methods by the CDFW. This inventory was conducted by a two-person team.

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### 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.

### 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 Bear 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". Bear 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

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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 Bear 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 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 Bear 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 Bear 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 Bear Creek, the dominant composition type and the dominant

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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 Bear Creek. In addition, underwater observations were made at six 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 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)

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- 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 Bear 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 May 21 to May 30, 2012 was conducted by B. Leonard (CDFW), B. James (WSP), and A. Blessing (WSP). The total length of the stream surveyed was 7,902 feet.

Stream flow was measured near the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 0.39 cfs on May 24, 2012.

Bear Creek is a G4 channel type for 1,592 feet of the stream surveyed (Reach 1) and a B4 channel type for 6,310 feet of the stream surveyed (Reach 2). G4 channels are entrenched “gully” step-pool channels on moderate gradients with low width/depth ratios and gravel-dominant substrates. 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.

Water temperatures taken during the survey period ranged from 51 to 58 degrees Fahrenheit. Air temperatures ranged from 51 to 70 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 38% riffle units, 33% flatwater units, 28% pool units, and 1% unsurveyed units (Graph 1). Based on total length of Level II habitat types there were 46% flatwater units, 34% riffle units, 19% pool units, and 1% unsurveyed units (Graph 2).

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Ten Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were low gradient riffle units, 34%; mid-channel pool units, 24%; and run units, 20% (Graph 3). Based on percent total length, step run units made up 30%, low gradient riffle units 30%, run units 16%, and mid-channel pool units 16%.

A total of 81 pools were identified (Table 3). Main channel pools were the most frequently encountered at 90% (Graph 4), and comprised 91% 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. Eight of the 81 pools (10%) had a residual depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 81 pool tail-outs measured, 28 had a value of 1 (34.6%); 46 had a value of 2 (56.8%); five had a value of 3 (6.2%); two had a value of 5 (2.5%) (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 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 9, flatwater habitat types had a mean shelter rating of 14, and pool habitats had a mean shelter rating of 39 (Table 1). Of the pool types, the main channel pools had the highest mean shelter rating at 39. Scour pools had a mean shelter rating of 34 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover type in Bear Creek. Graph 7 describes the pool cover in Bear Creek. Small woody debris is 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 81% of the pool tail-outs. Small cobble was the next most frequently observed dominant substrate type and occurred in 11% of the pool tail-outs.

The mean percent canopy density for the surveyed length of Bear Creek was 95%. Five percent of the canopy was open. Of the canopy present, the mean percentages of hardwood and coniferous trees were 60% and 40%, respectively. Graph 9 describes the mean percent canopy in Bear Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 94%. The mean percent left bank vegetated was 95%. The dominant elements composing the structure of the stream banks consisted of 51% sand/silt/clay, 41% cobble/gravel, 5% bedrock, and 3% boulders (Graph 10). Brush was the dominant vegetation type observed in 63% of the units surveyed. Additionally, 26% of the units surveyed had coniferous trees as the dominant vegetation type, and 12% had deciduous trees as the dominant vegetation type (Graph 11).

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### BIOLOGICAL INVENTORY RESULTS

Survey teams conducted a snorkel survey at six sites for species composition and distribution in Bear Creek on August 1, 2012. The sites were sampled by I. Mikus and M. Groff (CDFW).

In Reach 1, which comprised the first 1,592 feet of stream, six sites were sampled. The reach sites yielded one age 1+ steelhead/rainbow trout.

The following chart displays the information yielded from these sites:

2012 Bear 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: G4 Channel Type									
08/01/12	1	006	Pool	212	0	0	0	0	0
	2	009	Pool	290	0	0	0	0	0
	3	013	Run	377	0	1	0	0	0
	4	017	Run	479	0	0	0	0	0
	5	019	Pool	513	0	0	0	0	0
	6	024	Pool	623	0	0	0	0	0

### DISCUSSION

Bear Creek is a G4 channel type for the first 1,592 feet of stream surveyed and a B4 channel type for the remaining 6,310 feet. The suitability of G4 and B4 channel types for fish habitat improvement structures is as follows: G4 channel types are good for bank-placed boulders and fair for plunge weirs, opposing wing-deflectors, and log cover. B4 channel types are excellent for low-stage plunge weirs, boulder clusters, bank placed boulders, single and opposing wing-deflectors, and log cover.

The water temperatures recorded on the survey days May 21 to May 30, 2012 ranged from 51 to 58 degrees Fahrenheit. Air temperatures ranged from 51 to 70 degrees Fahrenheit. This is a suitable 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 46% of the total length of this survey, riffles 34%, and pools 19%. Eight of the 81 (10%) 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

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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 large wood structures that will increase or deepen pool habitat is recommended.

Seventy-four of the 81 pool tail-outs measured had embeddedness ratings of 1 or 2. Five of the pool tail-outs had embeddedness ratings of 3 or 4. Two 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.

Seventy-five of the 81 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 39. The shelter rating in the flatwater habitats is 14. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by boulders in Bear Creek. Small woody debris is 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 95%. Reach 1 had a canopy density of 93% and Reach 2 had a canopy density of 95%. In general, revegetation projects are considered when canopy density is less than 80%. The percentage of right and left bank covered with vegetation was 94% and 95%, 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.

## RECOMMENDATIONS

- 1) Bear 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 small woody debris. Adding high quality complexity with woody cover in the pools is desirable.



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### 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 South Branch North Fork Navarro River. The channel is a G4.
228	0008.00	A logging road crosses the channel. The crossing is a 13.5' wide x 8.2' high x 56' long railcar bridge.
644	0026.00	Log debris accumulation (LDA) #01 contains five pieces of large woody debris (LWD) and measures 4' high x 18' wide x 13' long. Water flows through the LDA and there are no visible gaps in it. Retained sediment ranges from silt to boulders and measures 5' wide x 20' long x 3' deep. Fish were observed above the LDA.
1113	0043.00	Dry tributary on left bank.
1592	0063.00	The channel changes from a G4 to a B4.
2067	0080.00	LDA #02 contains one piece of LWD and measures 5' high x 17' wide x 4' long. Water flows through the LDA and there are no visible gaps in it. Retained sediment ranges from silt to cobble and measures 9' wide x 60' long x 4' deep. Fish were observed above the LDA.
2107	0081.00	Dry tributary on left bank.
2181	0084.00	Inactive slide on the right bank measures approximately 100' long x 80' high. Grass, brush and conifers have established on the old slide.
3074	0120.00	LDA #03 contains four pieces of LWD and measures 6.5' high x 16' wide x 12' long. Water flows through the LDA and there are visible gaps in it. Retained sediment ranges from silt to cobble and measures 10' wide x 35' long x 2' deep. Fish were observed above the LDA.
3282	0129.00	LDA #04 contains seven pieces of LWD and measures 6.5' high x 13' wide x 20' long. Water flows through the LDA and there are no visible gaps in it. Retained sediment ranges from silt to cobble and measures 10' wide x 35' long x 2' deep. Fish were observed above the LDA.
3783	0145.00	LDA #05 contains five pieces of LWD and measures 5.4' high x 25' wide x 21' long. Water flows through the LDA and there are visible

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gaps in it. Retained sediment ranges from silt to gravel and measures 5' wide x 10' long x 1' deep. Fish were observed above the LDA. Left bank erosion site measures approximately 25' high x 60' long. It is contributing silt and gravel to the channel.

3862	0150.00	LDA #06 contains four pieces of LWD and measures 6' high x 19' wide x 27' long. Water flows through the LDA and there are visible gaps in it. The LDA is not retaining sediment. Fish were observed above the LDA. A bank erosion site measures approximately 30' high x 50' long. It is contributing fine sediment, gravel and woody debris to the channel.
4213	0169.00	Fish observed.
4629	0186.00	There is a 2' high plunge over old growth redwood log.
4843	0198.00	LDA #07 contains two pieces of LWD and measures 4' high x 12' wide x 14' long. Water flows through the LDA and there are visible gaps in it. The LDA is not retaining sediment. It is a possible barrier to juvenile and adult salmonids. No fish were observed above the LDA.
5272	0213.00	Tributary #01 enters on the right bank. The water temperature of the tributary was 58 degrees Fahrenheit, the water temperature downstream of the tributary was 57 degrees Fahrenheit, and the water temperature upstream of the confluence was 58 degrees Fahrenheit. The slope of the tributary is approximately 14%. The tributary is accessible to salmonids, but no fish were observed.
5622	0223.00	A logging road crosses the channel. The crossing is a 13.5' wide x 10' high x 51' long railcar bridge.
6554	0249.00	Tributary #02 enters on the left bank. The water temperature of the tributary was 52 degrees Fahrenheit, the water temperature downstream and upstream of the tributary was 53 degrees Fahrenheit. The slope of the tributary is approximately 12%. The tributary is not accessible to salmonids due to a high gradient boulder cascade at the mouth.
6710	0253.00	There is a 5' high plunge over clay wall.
7013	0262.00	LDA #08 consists of three old growth rootwads and measures 8' high x 11' wide x 6' long. Water flows through the LDA and there are no visible gaps in it. Retained sediment ranges from silt to cobble and measures 11' wide x 4' long x 1' deep. It is a possible barrier to juvenile and adult salmonids due to the 6' high plunge over the LDA with no jump pool below.
7324	0275.00	Dry right bank tributary.

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- 7429 0279.00 LDA #09 contains three pieces of LWD and measures 7' high x 22' wide x 5' long. Water flows through the LDA and there are no visible gaps in it. Retained sediment ranges from silt to cobble and measures 18' wide x 10' long x 2' deep. It is a possible barrier to juvenile and adult salmonids.
- 7535 0284.00 A landslide on the right bank measures approximately 100' high x 50' long.
- 7579 0286.00 There is a 1' high plunge over small woody debris.
- 7902 0295.00 End of survey due to high gradient and diminished habitat.

## 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: Bear Creek

LLID: 1234405391489 Drainage: Navarro River

Survey Dates: 5/21/2012 to 5/30/2012

Confluence Location: Quad: BAILEY RIDGE Legal Description: T15NR14WS19 Latitude: 39:08:56.0N Longitude: 123:26:26.0

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
98	9	FLATWATER	33.2	37	3663	46.4	5.0	0.4	0.7	183	17972	63	6187		14
4	0	NOSURVEY	1.4	24	94	1.2									
81	81	POOL	27.5	18	1469	18.6	6.8	0.4	1.2	123	9989	83	6705	55	39
112	18	RIFFLE	38.0	24	2676	33.9	5.7	0.2	0.5	130	14535	30	3371		9
<b>Total Units</b>	<b>Total Units Fully Measured</b>				<b>Total Length (ft.)</b>					<b>Total Area (sq.ft.)</b>			<b>Total Volume (cu.ft.)</b>		
295	108				7902					42497			16263		

**Table 2 - Summary of Habitat Types and Measured Parameters**

Stream Name: Bear Creek

LLID: 1234405391489

Drainage: Navarro River

Survey Dates: 5/21/2012 to 5/30/2012

Confluence Location: Quad: BAILEY RIDGE

Legal Description: T15NR14WS19

Latitude: 39:08:56.0N

Longitude: 123:26:26.0W

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 (%)
100	15	LGR	33.9	23	2343	29.7	5	0.2	0.9	122	12215	27	2708		8	92
10	2	HGR	3.4	24	240	3.0	8	0.3	0.9	196	1956	45	452		13	99
2	1	CAS	0.7	46	93	1.2	5	0.4	0.7	113	225	45	90		15	100
58	4	RUN	19.7	22	1295	16.4	6	0.4	0.9	117	6766	44	2576		6	96
40	5	SRN	13.6	59	2368	30.0	4	0.3	1.2	237	9471	78	3124		20	96
70	70	MCP	23.7	18	1272	16.1	7	0.4	3.1	120	8378	76	5304	49	39	95
3	3	STP	1.0	24	71	0.9	9	0.6	1.9	195	586	184	551	129	40	99
1	1	LSL	0.3	20	20	0.3	7	0.3	1.8	140	140	84	84	42	30	96
2	2	LSBo	0.7	18	35	0.4	6	0.3	1	123	246	58	117	37	3	97
5	5	PLP	1.7	14	71	0.9	9	0.9	2.7	128	640	130	649	98	47	96
4	0	NS	1.4	24	94	1.2										

Total Units  
295

Total Units Fully Measured  
108

Total Length (ft.)  
7902

Total Area (sq.ft.)  
40623

Total Volume (cu.ft.)  
15656

**Table 3 - Summary of Pool Types**

Stream Name: Bear Creek

LLID: 1234405391489

Drainage: Navarro River

Survey Dates: 5/21/2012 to 5/30/2012

Confluence Location: Quad: BAILEY RIDGE

Legal Description: T15NR14WS19

Latitude: 39:08:56.0N

Longitude: 123:26:26.0W

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
73	73	MAIN	90	18	1343	91	6.7	0.4	123	8964	52	3773	39
8	8	SCOUR	10	16	126	9	8.1	0.7	128	1025	76	606	34

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
81	81	1469	9989	4379

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

Stream Name: Bear Creek

LLID: 1234405391489

Drainage: Navarro River

Survey Dates: 5/21/2012 to 5/30/2012

Confluence Location: Quad: BAILEY RIDGE

Legal Description: T15NR14WS19

Latitude: 39:08:56.0N

Longitude: 123:26:26.0W

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
70	MCP	86	21	30	44	63	4	6	1	1	0	0
3	STP	4	0	0	3	100	0	0	0	0	0	0
1	LSL	1	0	0	1	100	0	0	0	0	0	0
2	LSBo	2	1	50	1	50	0	0	0	0	0	0
5	PLP	6	0	0	2	40	3	60	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
81	22	27	51	63	7	9	1	1	0	0

Mean Maximum Residual Pool Depth (ft.): 1.2



**Table 5 - Summary of Mean Percent Cover By Habitat Type**

Stream Name: Bear Creek

LLID: 1234405391489

Drainage: Navarro River

Survey Dates: 5/21/2012 to 5/30/2012

Dry Units: 0

Confluence Location: Quad: BAILEY RIDGE

Legal Description: T15NR14WS19

Latitude: 39:08:56.0N

Longitude: 123:26:26.0W

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
100	15	LGR	11	30	1	1	17	0	0	40	0
10	2	HGR	0	5	0	5	0	0	5	85	0
2	1	CAS	0	0	0	0	0	0	0	100	0
112	18	TOTAL RIFFLE	9	24	1	1	13	0	1	51	0
58	4	RUN	0	38	0	0	0	0	24	39	0
40	5	SRN	9	8	21	0	6	0	1	55	0
98	9	TOTAL FLAT	5	21	12	0	3	0	11	48	0
70	70	MCP	17	23	21	12	4	1	6	15	1
3	3	STP	7	7	20	13	3	0	32	18	0
1	1	LSL	30	30	30	10	0	0	0	0	0
2	2	LSBo	85	0	0	0	0	0	0	0	15
5	5	PLP	26	16	11	7	3	0	17	20	0
81	81	TOTAL POOL	18	22	20	12	4	1	8	15	1
4	0	NS									
295	108	TOTAL	16	22	17	9	5	0	7	23	1

**Table 6 - Summary of Dominant Substrates By Habitat Type**

Stream Name: Bear Creek LLID: 1234405391489 Drainage: Navarro River  
 Survey Dates: 5/21/2012 to 5/30/2012 Dry Units: 0  
 Confluence Location: Quad: BAILEY RIDGE Legal Description: T15NR14WS19 Latitude: 39:08:56.0N Longitude: 123:26:26.0W

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
100	15	LGR	0	0	87	13	0	0	0
10	2	HGR	0	0	50	0	0	50	0
2	1	CAS	0	0	100	0	0	0	0
58	4	RUN	0	0	75	25	0	0	0
40	5	SRN	0	0	100	0	0	0	0
70	70	MCP	0	0	96	3	0	1	0
3	3	STP	0	0	100	0	0	0	0
1	1	LSL	0	0	100	0	0	0	0
2	2	LSBo	0	0	100	0	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: Bear Creek

LLID: 1234405391489

Drainage: Navarro River

Survey Dates: 5/21/2012 to 5/30/2012

Confluence Location: Quad: BAILEY RIDGE

Legal Description: T15NR14WS19

Latitude: 39:08:56.0N

Longitude: 123:26:26.0W

Mean Percent Canopy	Mean Percent Conifer	Mean Percent Hardwood	Mean Percent Open Units	Mean Right Bank % Cover	Mean Left Bank % Cover
95	40	60	0	94	95

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: Bear Creek LLID: 1234405391489 Drainage: Navarro River  
 Survey Dates: 5/21/2012 to 5/30/2012 Survey Length (ft.): 7902 Main Channel (ft.): 7902 Side Channel (ft.): 0  
 Confluence Location: Quad: BAILEY RIDGE Legal Description: T15NR14WS19 Latitude: 39:08:56.0N Longitude: 123:26:26.0W

**Summary of Fish Habitat Elements By Stream Reach**

**STREAM REACH: 1**

Channel Type: G4	Canopy Density (%): 93.0	Pools by Stream Length (%): 17.0
Reach Length (ft.): 1592	Coniferous Component (%): 36.4	Pool Frequency (%): 22.6
Riffle/Flatwater Mean Width (ft.): 5.7	Hardwood Component (%): 63.6	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation: Brush	< 2 Feet Deep: 86
Range (ft.): 12 to 27	Vegetative Cover (%): 96.0	2 to 2.9 Feet Deep: 14
Mean (ft.): 18	Dominant Shelter: Small Woody Debris	3 to 3.9 Feet Deep: 0
Std. Dev.: 6	Dominant Bank Substrate Type: Sand/Silt/Clay	>= 4 Feet Deep: 0
Base Flow (cfs.): 0.4	Occurrence of LWD (%): 18	Mean Max Residual Pool Depth (ft.): 1.2
Water (F): 52 - 57 Air (F): 55 - 68	LWD per 100 ft.:	Mean Pool Shelter Rating: 35
Dry Channel (ft): 0	Riffles: 3	
	Pools: 11	
	Flat: 2	
Pool Tail Substrate (%): Silt/Clay: 0 Sand: 14 Gravel: 86 Sm Cobble: 0 Lg Cobble: 0 Boulder: 0 Bedrock: 0		
Embeddedness Values (%): 1. 64.3 2. 35.7 3. 0.0 4. 0.0 5. 0.0		

**STREAM REACH: 2**

Channel Type: B4	Canopy Density (%): 95.2	Pools by Stream Length (%): 19.0
Reach Length (ft.): 6310	Coniferous Component (%): 41.0	Pool Frequency (%): 28.8
Riffle/Flatwater Mean Width (ft.): 5.4	Hardwood Component (%): 59.0	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation: Brush	< 2 Feet Deep: 91
Range (ft.): 6 to 18	Vegetative Cover (%): 94.5	2 to 2.9 Feet Deep: 7
Mean (ft.): 11	Dominant Shelter: Boulders	3 to 3.9 Feet Deep: 1
Std. Dev.: 2	Dominant Bank Substrate Type: Sand/Silt/Clay	>= 4 Feet Deep: 0
Base Flow (cfs.): 0.4	Occurrence of LWD (%): 15	Mean Max Residual Pool Depth (ft.): 1.2
Water (F): 51 - 58 Air (F): 51 - 70	LWD per 100 ft.:	Mean Pool Shelter Rating: 40
Dry Channel (ft): 0	Riffles: 2	
	Pools: 9	
	Flat: 2	
Pool Tail Substrate (%): Silt/Clay: 0 Sand: 4 Gravel: 81 Sm Cobble: 13 Lg Cobble: 1 Boulder: 0 Bedrock: 0		
Embeddedness Values (%): 1. 28.4 2. 61.2 3. 7.5 4. 0.0 5. 3.0		

**Table 9 - Mean Percentage of Dominant Substrate and Vegetation**

Stream Name: Bear Creek

LLID: 1234405391489

Drainage: Navarro River

Survey Dates: 5/21/2012 to 5/30/2012

Confluence Location: Quad: BAILEY RIDGE

Legal Description: T15NR14WS19

Latitude: 39:08:56.0N

Longitude: 123:26:26.0W

**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	5	6	5.1
Boulder	4	2	2.8
Cobble / Gravel	49	40	41.2
Sand / Silt / Clay	50	60	50.9

**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	0	0	0.0
Brush	61	74	62.5
Hardwood Trees	16	10	12.0
Coniferous Trees	31	24	25.5
No Vegetation	0	0	0.0

**Total Stream Cobble Embeddedness Values:** 2

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

StreamName: Bear Creek

LLID: 1234405391489

Drainage: Navarro River

Survey Dates: 5/21/2012 to 5/30/2012

Confluence Location: Quad: BAILEY RIDGE

Legal Description: T15NR14WS19

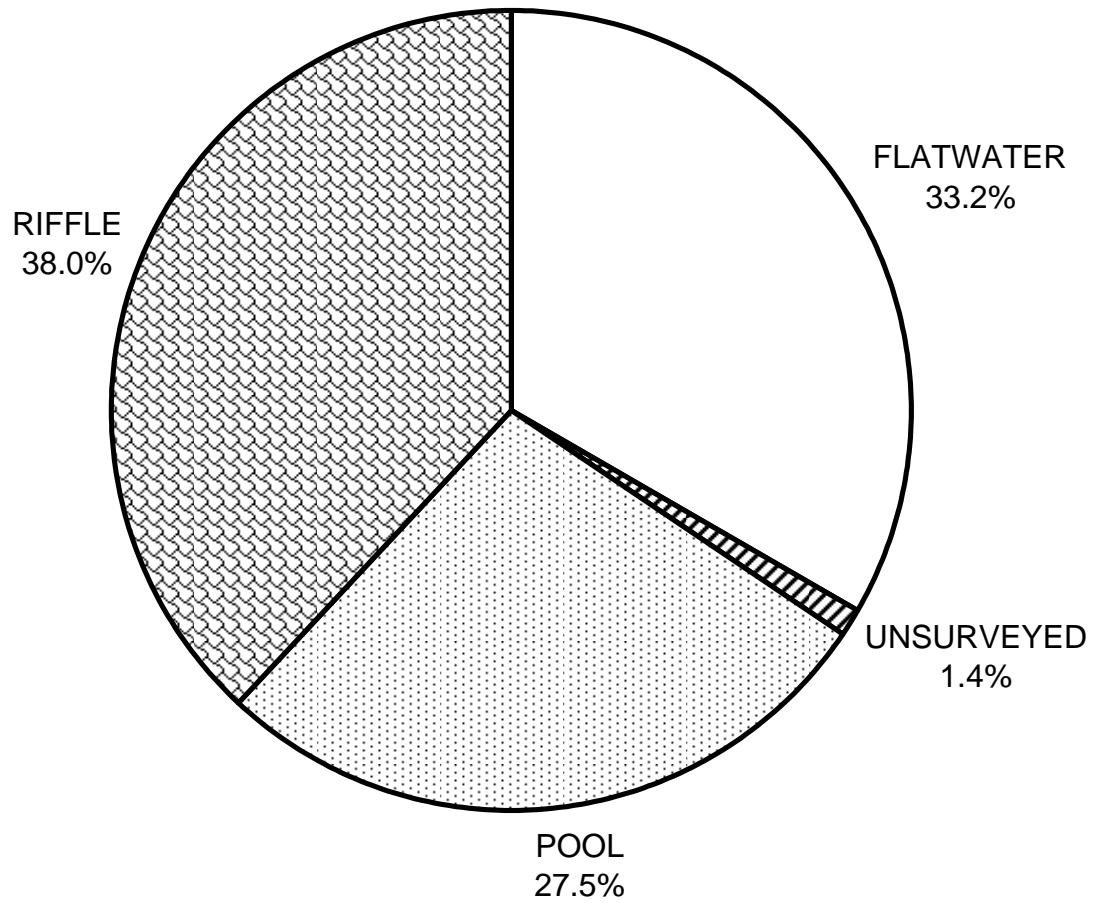
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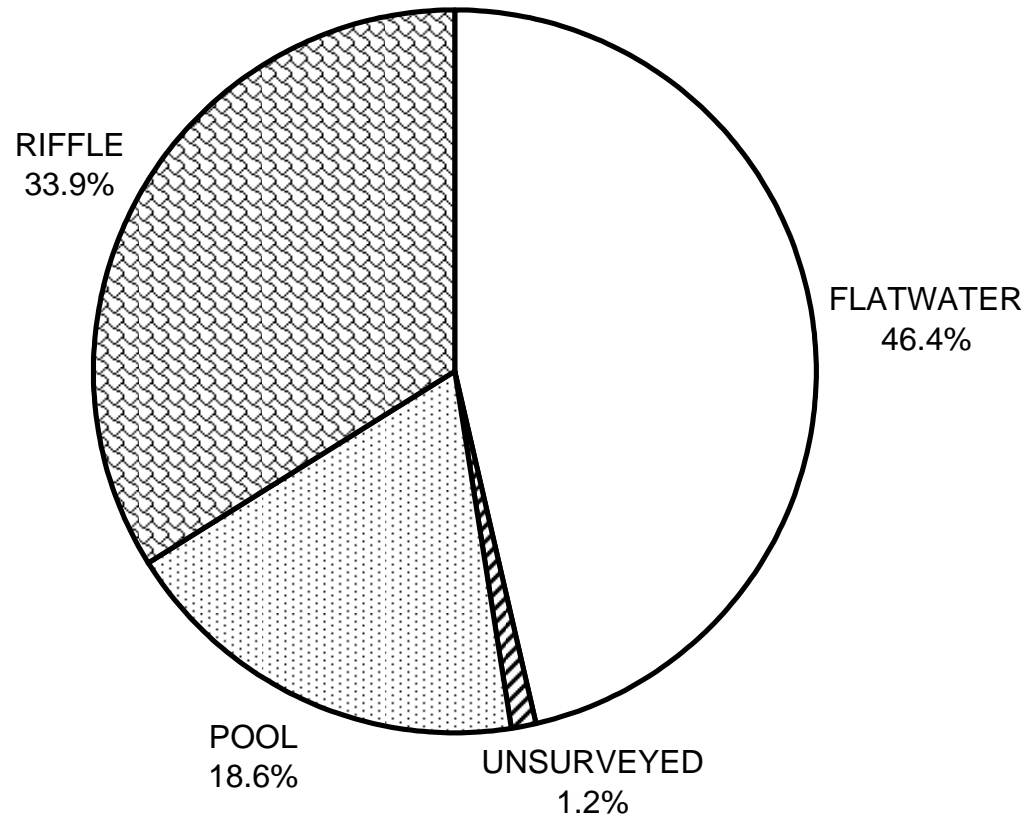
	<b>Riffles</b>	<b>Flatwater</b>	<b>Pools</b>
UNDERCUT BANKS (%)	9	5	18
SMALL WOODY DEBRIS (%)	24	21	22
LARGE WOODY DEBRIS (%)	1	12	20
ROOT MASS (%)	1	0	12
TERRESTRIAL VEGETATION (%)	13	3	4
AQUATIC VEGETATION (%)	0	0	1
WHITEWATER (%)	1	11	8
BOULDERS (%)	51	48	15
BEDROCK LEDGES (%)	0	0	1

# BEAR CREEK 2012 HABITAT TYPES BY PERCENT OCCURRENCE



GRAPH 1

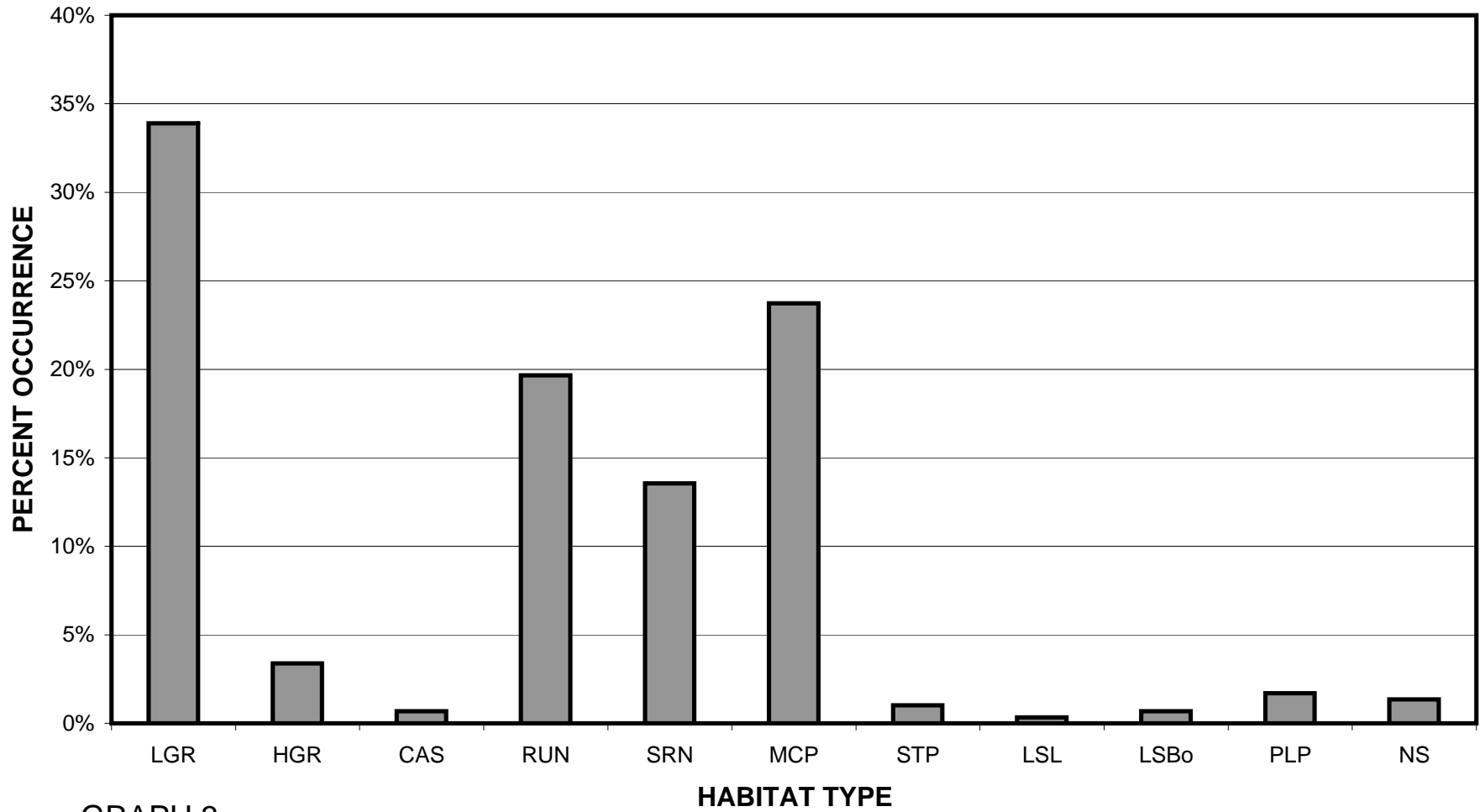
# BEAR CREEK 2012 HABITAT TYPES BY PERCENT TOTAL LENGTH



GRAPH 2

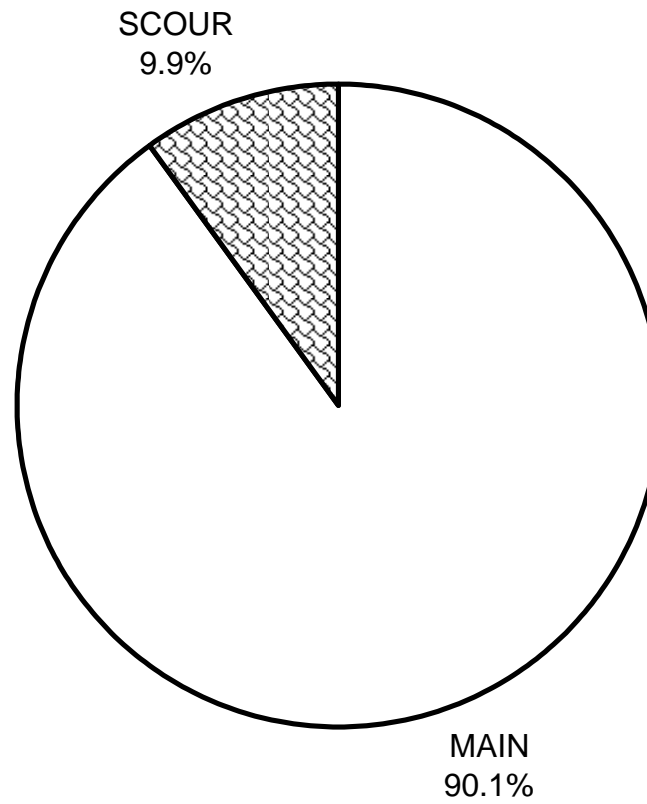


# BEAR CREEK 2012 HABITAT TYPES BY PERCENT OCCURRENCE



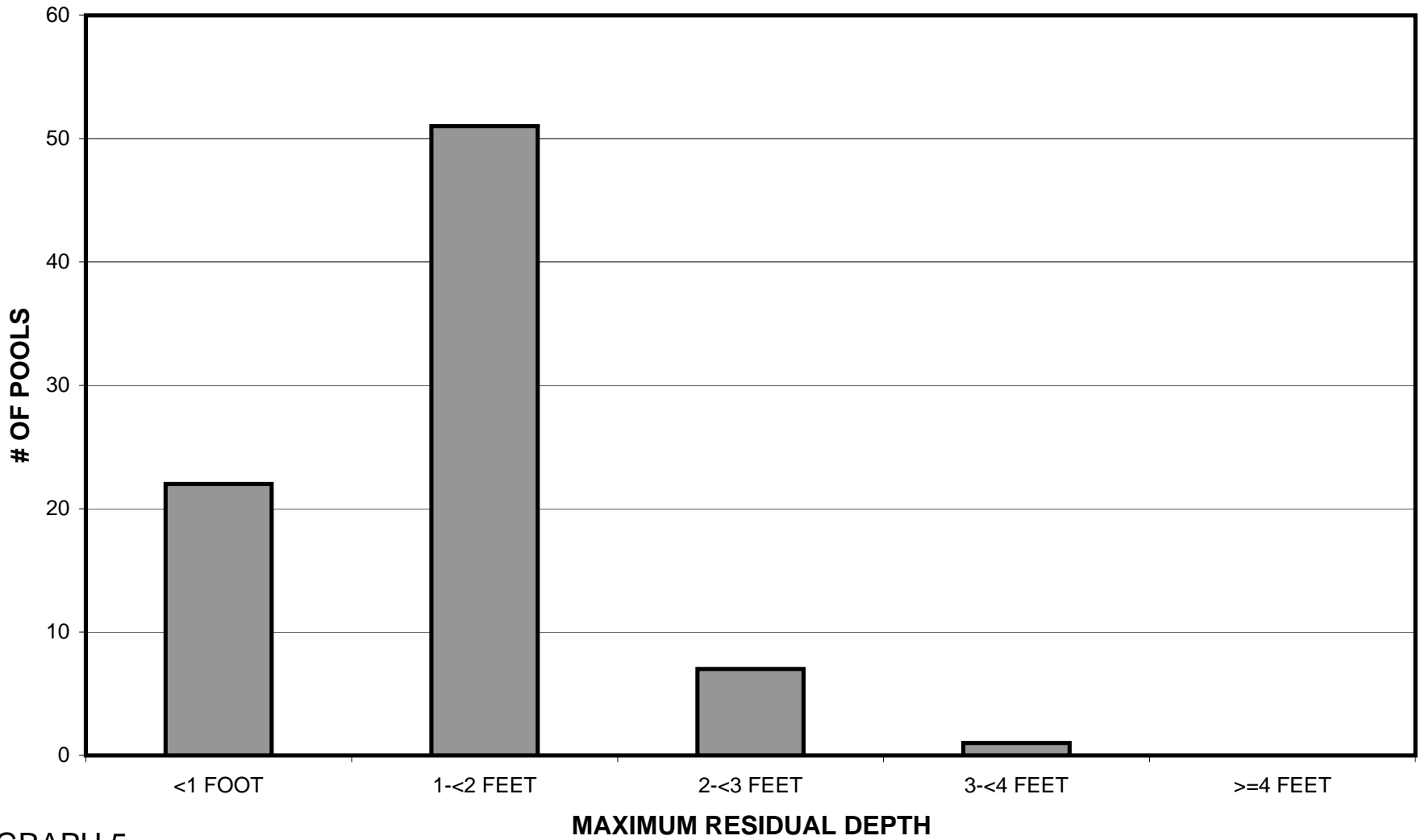
GRAPH 3

# BEAR CREEK 2012 POOL TYPES BY PERCENT OCCURRENCE



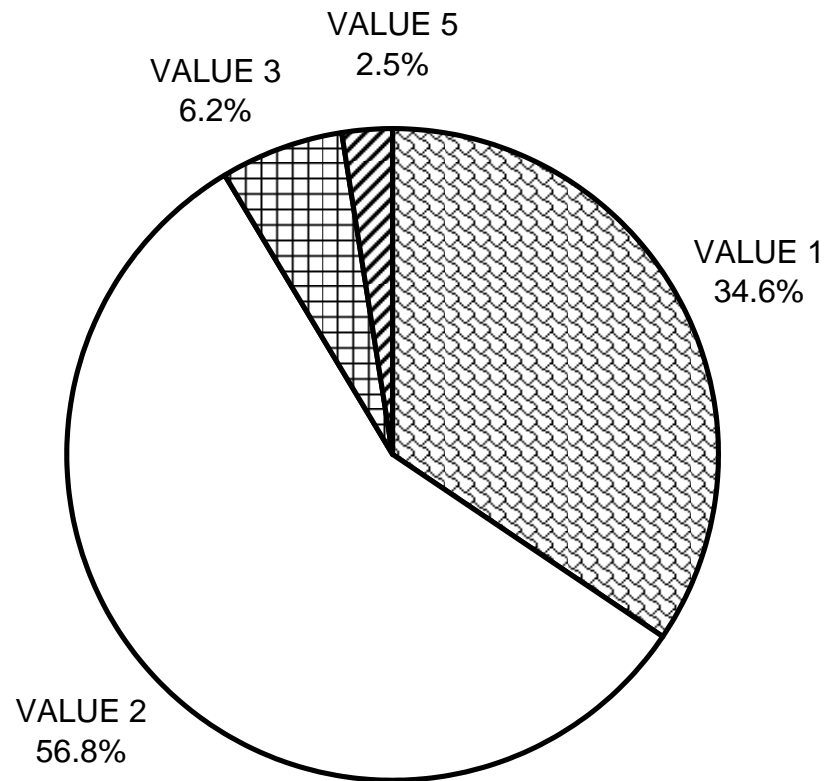
GRAPH 4

# BEAR CREEK 2012 MAXIMUM DEPTH IN POOLS



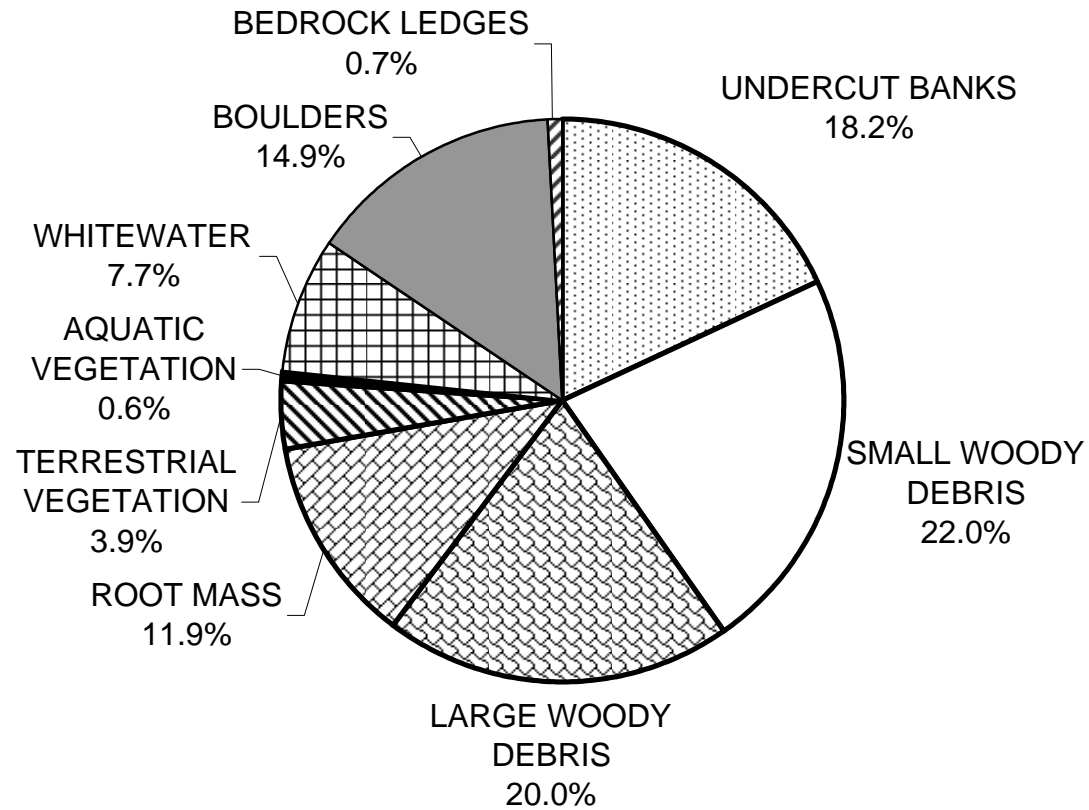
GRAPH 5

# BEAR CREEK 2012 PERCENT EMBEDDEDNESS



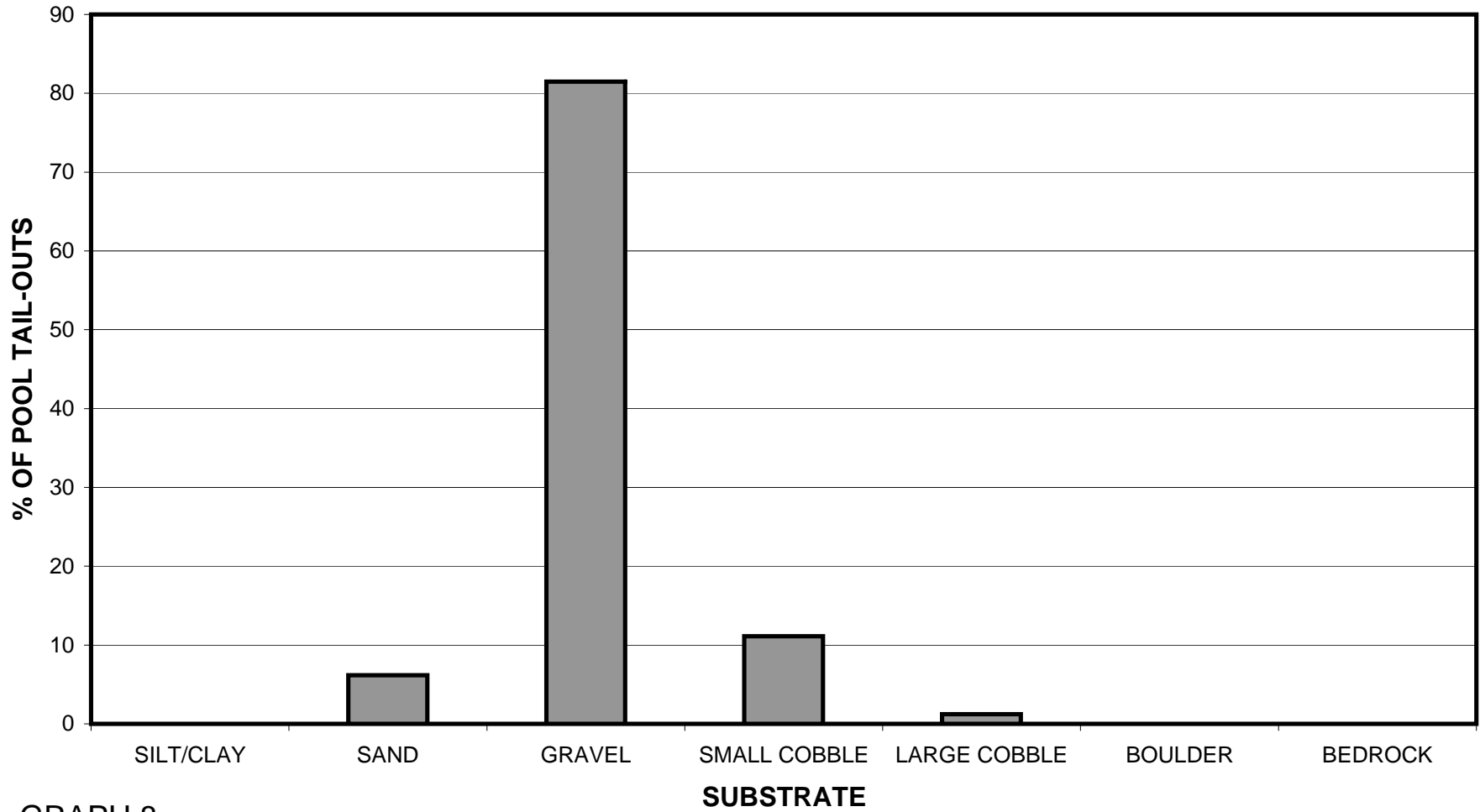
GRAPH 6

# BEAR CREEK 2012 MEAN PERCENT COVER TYPES IN POOLS



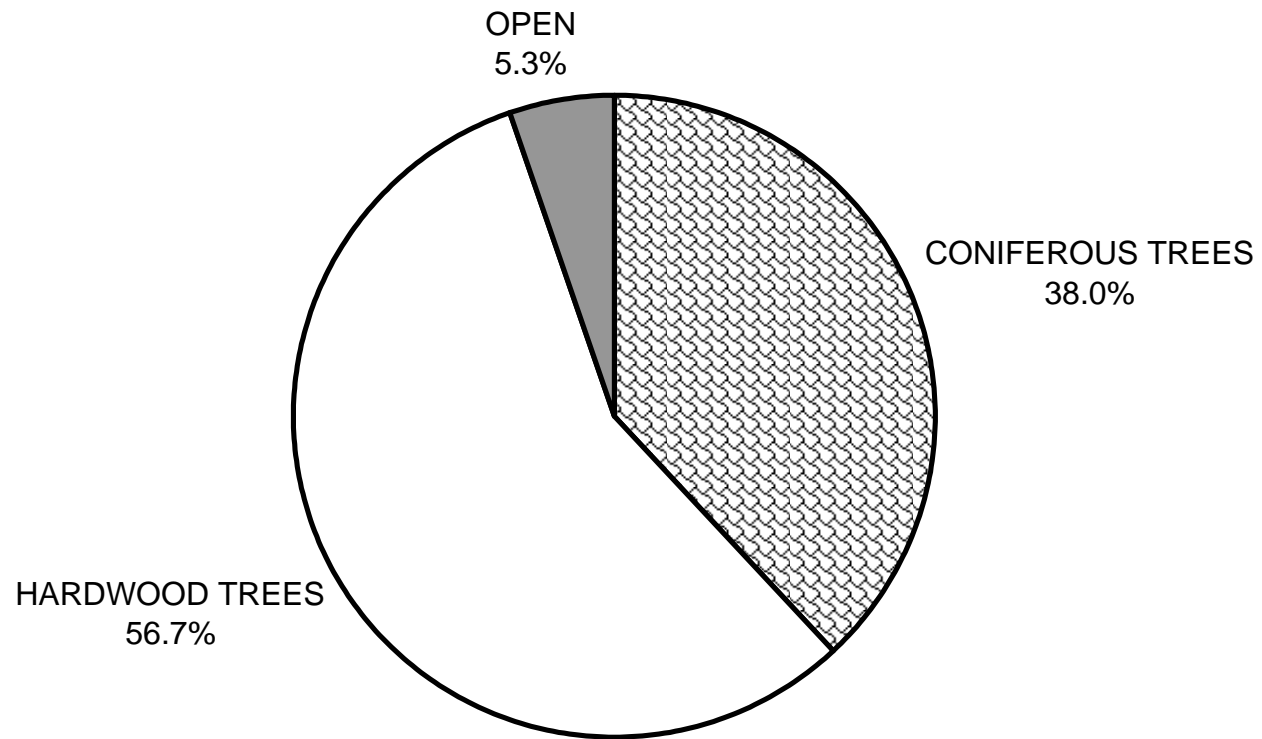
GRAPH 7

# BEAR CREEK 2012 SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



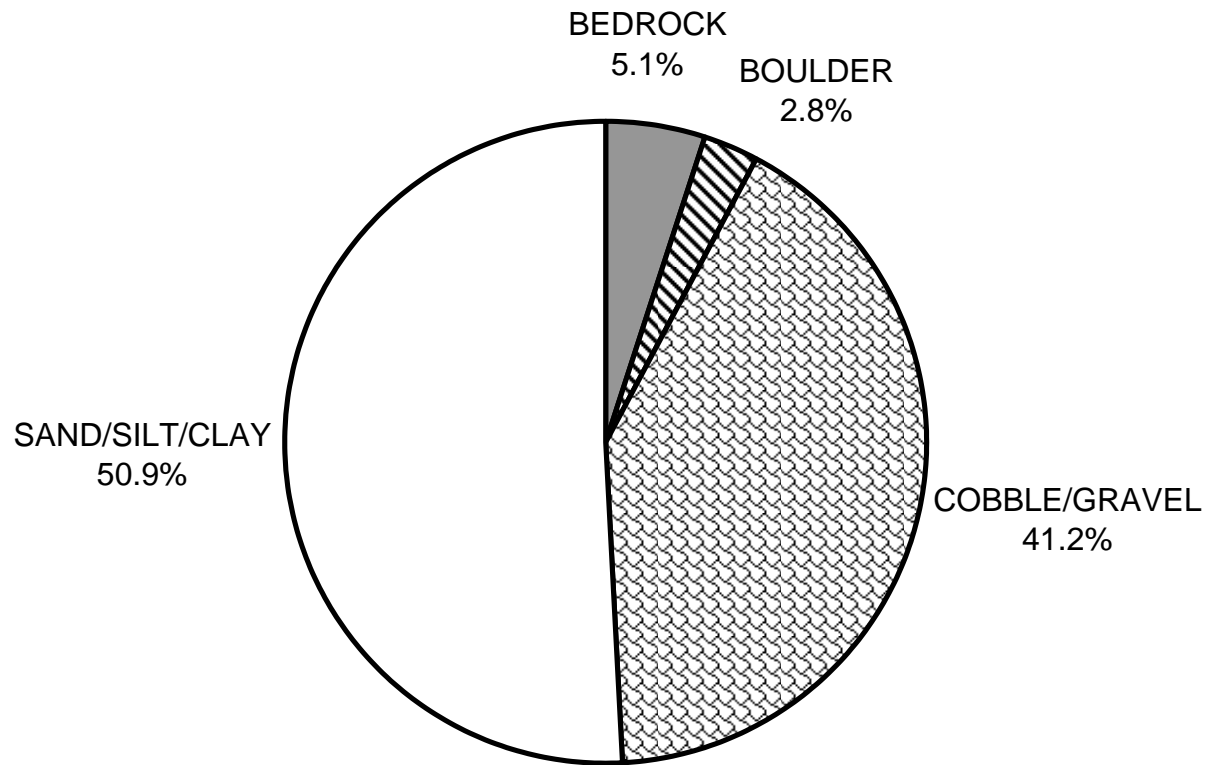
GRAPH 8

# BEAR CREEK 2012 MEAN PERCENT CANOPY



GRAPH 9

**BEAR CREEK 2012  
DOMINANT BANK COMPOSITION IN SURVEY REACH**



GRAPH 10

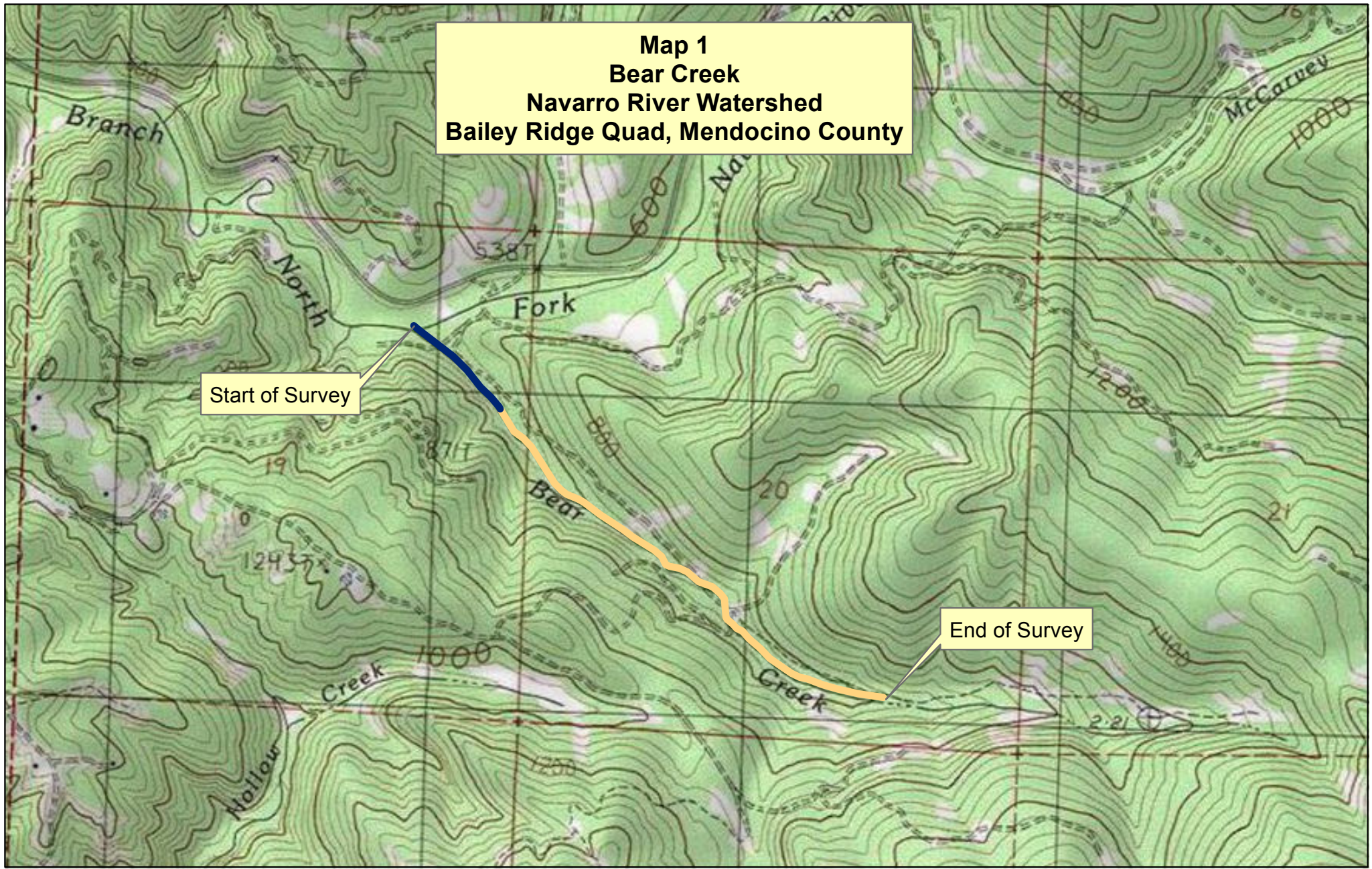




**BEAR CREEK 2012  
DOMINANT BANK VEGETATION IN SURVEY REACH**



GRAPH 11

**Map 1**  
**Bear Creek**  
**Navarro River Watershed**  
**Bailey Ridge Quad, Mendocino County**



-  Reach 1, G4 Channel Type
-  Reach 2, B4 Channel Type

