

STREAM INVENTORY REPORT

Palmer Creek

INTRODUCTION

A stream inventory was conducted from August 16 to August 17, 2011 on Palmer Creek. The survey began at the confluence with Quarry Creek and extended upstream 1.5 miles.

The Palmer 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 Palmer 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

Palmer Creek is a tributary to the Mad River, which drains to the Pacific Ocean. It is located in Humboldt County, California (Map 1). Palmer Creek's legal description at the confluence with the Mad River is T06N R02E S30. Its location is 40.8754 degrees north latitude and 123.9993 degrees west longitude, LLID number 1239983408729. Palmer Creek is a second order stream and has approximately 1.9 miles of blue line stream according to the USGS Blue Lake 7.5 minute quadrangle. Palmer Creek drains a watershed of approximately one square mile. Elevations range from about 85 feet at the mouth of the creek to 1,000 feet in the headwater areas. Mixed hardwood forest and redwood forest dominate the watershed. The watershed is entirely privately owned and is managed for timber production and rangeland. Vehicle access exists via West End Road.

METHODS

The habitat inventory conducted in Palmer Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi et al, 1998). The California Department of Fish and Game (DFG) personnel that conducted the inventory were trained in standardized habitat inventory methods by 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 Palmer 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". Palmer 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 Palmer 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. In Palmer 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. Next, 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. The shelter rating is calculated for each fully-described habitat unit by multiplying shelter value and percent 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 densimeters as described in the *California Salmonid Stream Habitat Restoration Manual*. Canopy density relates to the amount of stream shaded from the sun. In Palmer 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 Palmer 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 Palmer Creek. In addition, 21 sites were electrofished using a Smith-Root Model LR-24 electrofisher. These sampling techniques are discussed in the *California Salmonid Stream Habitat Restoration Manual*.

DATA ANALYSIS

Data from the habitat inventory form are entered into Stream Habitat 2.0.19, 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 Palmer 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 August 16 and August 17, 2011 was conducted by A. Blessing and T. Anderson (DFG). The total length of the stream surveyed was 7,865 feet. A 2,800 foot long section located 1,246 feet upstream from the confluence with the Mad River was not surveyed because access was not secured. The data included in this report are for the 5,065 feet actually surveyed.

Stream flow was not measured on Palmer Creek.

Palmer Creek is an F4 channel type for 1,246 feet of the stream surveyed (Reach 1), the next 2,800 feet of stream was not surveyed (Reach 2), an F4 channel type for 2,518 feet of stream surveyed (Reach 3), and a B4 channel type for 1,301 feet of the stream surveyed (Reach 4). F4 channel types are entrenched meandering riffle/pool channels on low gradients with high 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 45 to 66 degrees Fahrenheit. Air temperatures ranged from 62 to 75 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 38% pool units, 38% flatwater units, 20% riffle units, 2% dry units, and 2% culvert units (Graph 1). Based on total length of Level II habitat types there were 55% flatwater units, 25% dry units, 13% riffle units, 7% pool units, and 1% culvert units (Graph 2).

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Seven Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were step run units, 37%; mid-channel pool units, 32%; and low gradient riffle units 12% (Graph 3). Based on percent total length, step run units made up 54%, dry units 25%, and cascade units 8%.

A total of 25 pools were identified (Table 3). Main channel pools were the most frequently encountered at 84% (Graph 4), and comprised 86% 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 of the 25 pools (4%) had a residual depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 25 pool tail-outs measured, 25 had a value of 2 (100%) (Graph 6). On this scale, a value of 1 indicates the highest quality of spawning substrate.

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 10, flatwater habitat types had a mean shelter rating of 17, and pool habitats had a mean shelter rating of 20 (Table 1). Of the pool types, the scour pools had the highest mean shelter rating at 28. Main channel pools had a mean shelter rating of 19 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Small woody debris is the dominant cover type in Palmer Creek. Graph 7 describes the pool cover in Palmer Creek. Small woody debris is the dominant pool cover type followed by terrestrial vegetation.

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 48% of the pool tail-outs. Sand was the next most frequently observed dominant substrate type and occurred in 40% of the pool tail-outs.

The mean percent canopy density for the surveyed length of Palmer Creek was 98%. Two percent of the canopy was open. Of the canopy present, the mean percentages of hardwood and coniferous trees were 89% and 11%, respectively. Graph 9 describes the mean percent canopy in Palmer Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 100%. The mean percent left bank vegetated was 100%. The dominant elements composing the structure of the stream banks consisted of 65% sand/silt/clay, 27% cobble/gravel, 5% boulder, and 3% bedrock (Graph 10). Brush was the dominant vegetation type observed in 91% of the units surveyed. Additionally, 7% of the units surveyed had deciduous trees as the dominant vegetation type, and 2% had coniferous trees as the dominant vegetation type (Graph 11).

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BIOLOGICAL INVENTORY RESULTS

Survey teams conducted an electrofishing survey at 21 sites for species composition and distribution in Palmer Creek on October 13, 2011. Water temperature taken during the survey period of 1030 to 1400 was 53 degrees Fahrenheit. Air temperature was 65 degrees Fahrenheit. The sites were sampled by E. Helgoth (DFG), and A. Blessing (WSP).

In reach 2, 10 sites were sampled starting approximately 3,036 feet from the confluence with Mad River and continuing upstream 992 feet. The reach sites yielded 56 young-of-the-year SH/RT, seven age 1+ SH/RT, two age 2+ SH/RT, and two three-spine stickleback.

In reach 3, 11 sites were sampled starting approximately 4,451 feet from the confluence with Mad River and continuing upstream 1,116 feet. The reach sites yielded 20 young-of-the-year SH/RT, 5 age 1+ SH/RT, and 1 sculpin.

The following chart displays the information yielded from these sites:

2011 Palmer Creek electrofishing observations.

Date	Survey Site #	Habitat Type	Approx. Dist. from mouth (ft.)	SH/RT			Coho	
				YOY	1+	2+	YOY	1+
Reach 2: Unknown Channel Type								
10/13/11	1	step run	3,036	6	0	1	0	0
10/13/11	2	run	3,100	15	1	0	0	0
10/13/11	3	step run	3,609	16	0	0	0	0
10/13/11	4	pool	3,645	0	0	0	0	0
10/13/11	5	pool	3,693	8	1	1	0	0
10/13/11	6	step run	3,775	4	0	0	0	0
10/13/11	7	pool	3,851	1	2	0	0	0
10/13/11	8	pool	3,881	2	0	0	0	0
10/13/11	9	run	3,976	2	2	0	0	0
10/13/11	10	pool	4,028	2	1	0	0	0
Reach 3: F4 Channel Type								
10/13/11	11	pool	4,451	0	2	0	0	0
10/13/11	12	pool	4,617	2	0	0	0	0
10/13/11	13	pool	4,680	2	1	0	0	0
10/13/11	14	pool	4,924	1	1	0	0	0
10/13/11	15	run	4,991	3	0	0	0	0
10/13/11	16	step run	5,099	0	1	0	0	0

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10/13/11	17	pool	5,322	3	0	0	0	0
10/13/11	18	run	5,378	3	0	0	0	0
10/13/11	19	pool	5,410	2	0	0	0	0
10/13/11	20	run	5,473	2	0	0	0	0
10/13/11	21	run	5,567	2	0	0	0	0

DISCUSSION

Palmer Creek is an F4 channel type for the first 1,246 feet of stream surveyed, an unknown channel type for the next 2,800 feet, an F4 channel type for the next 2,518 feet, and a B4 channel type for the remaining 1,301 feet. The suitability of F4 and B4 channel types for fish habitat improvement structures is as follows: F4 channels are good for bank-placed boulders and fair for plunge weirs, single and opposing wing-deflectors, channel constrictors, and log cover. B4 channels 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 August 16 to August 17, 2011 ranged from 45 to 66 degrees Fahrenheit. Air temperatures ranged from 62 to 75 degrees Fahrenheit. This is a marginal water temperature range for salmonids. Sixty degrees Fahrenheit, if sustained, is near the threshold stress level for salmonids. 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 55% of the total length of this survey, riffles 13%, and pools 7%. One of the 25 (4%) 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 that will increase or deepen pool habitat is recommended.

All of the 25 pool tail-outs measured had embeddedness ratings of 1 or 2. None of the pool tail-outs had embeddedness ratings of 3 or 4. None of the pool tail-outs had a rating of 5, which is considered unsuitable for spawning. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered to indicate good quality spawning substrate for salmon and steelhead. Sediment sources in Palmer Creek should be mapped and rated according to their potential sediment yields, and control measures should be taken.

Fifteen of the 25 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 20. The shelter rating in the flatwater habitats is 17. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by small woody debris in Palmer Creek. Small woody debris is the dominant

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cover type in pools followed by terrestrial vegetation. Log and root wad cover structures in the pool and flatwater habitats would enhance both summer and winter salmonid habitat. Log cover structure provides rearing fry with protection from predation, rest from water velocity, and also divides territorial units to reduce density related competition.

The mean percent canopy density for the stream was 98%. Reach 3 had a canopy density of 97% and Reach 4 had a canopy density of 99%. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was 100% and 100%, 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) Palmer 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) Where feasible, design and engineer pool enhancement structures to increase the number of pools. This must be done where the banks are stable or in conjunction with stream bank armor to prevent erosion.
- 4) 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.
- 5) Active and potential sediment sources related to the road system need to be identified, mapped, and treated according to their potential for sediment yield to the stream and its tributaries.

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 Mad River. The channel is an F4 (Reach 1). The first 1,246 feet of stream are dry.

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1246	0002.00	Approximately 2,800 feet of stream were not surveyed. The channel type is unknown (Reach 2).
2298	NA	West End Road crosses the channel. The crossing is a 3.5' diameter x 35' long corrugated metal culvert. The slope of the culvert is 1.5%. The plunge at the outlet measures 0.2' high; the maximum depth within 5' of the outlet is 2.9' deep. On some areas of the culvert the bottom has rusted through.
4046	0003.00	End of unsurveyed section. The channel is an F4 (Reach 3).
6564	0048.00	The channel changes from an F4 to a B4 (Reach 4).
6925	0054.00	There is a 0.5' high plunge.
7109	0058.00	There is a 0.5' high plunge.
7629	0065.00	End of survey due to a 236' long cascade. The cascade consists of a series of plunges averaging between 3' and 4' high, with no jump pools below. The highest plunge measures 5' at the top of the unit. The slope of the cascade is between 15% and 20%.

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: Palmer Creek

LLID: 1239983408729 Drainage: Blue Lake

Survey Dates: 8/16/2011 to 8/17/2011

Confluence Location: Quad: ARCATA SOUTH Legal Description: T06NR02ES30 Latitude: 40:52:22.0N Longitude: 123:59:54.0

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	1.5	35	35	0.7									
1	0	DRY	1.5	1246	1246	24.6									
25	3	FLATWATER	38.5	110	2762	54.5	6.0	0.4	0.8	537	13428	196	4892		17
1	0	NOSURVEY		2800	2800										
25	25	POOL	38.5	15	374	7.4	7.0	0.4	1.2	112	2809	81	2014	52	20
13	2	RIFFLE	20.0	50	648	12.8	7.0	0.3	0.7	188	2441	68	888		10
Total Units	Total Units Fully Measured			Total Length (ft.)						Total Area (sq.ft.)			Total Volume (cu.ft.)		
66	30			7865						18678			7794		

Table 2 - Summary of Habitat Types and Measured Parameters

Stream Name: Palmer Creek

LLID: 1239983408729

Drainage: Blue Lake

Survey Dates: 8/16/2011 to 8/17/2011

Confluence Location: Quad: ARCATA SOUTH

Legal Description: T06NR02ES30

Latitude: 40:52:22.0N

Longitude: 123:59:54.0W

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 (%)
8	1	LGR	12.3	28	224	4.4	4	0.2	0.4	68	544	14	109		10	100
5	1	CAS	7.7	85	424	8.4	10	0.4	0.9	308	1538	123	615		10	100
1	0	RUN	1.5	24	24	0.5										
24	3	SRN	36.9	114	2738	54.1	6	0.4	0.9	537	12891	196	4697		17	99
21	21	MCP	32.3	15	320	6.3	7	0.5	2.5	113	2377	87	1822	57	19	97
4	4	PLP	6.2	14	54	1.1	8	0.3	1.2	108	432	48	192	26	28	99
1	0	DRY	1.5	1246	1246	24.6										
1	0	CUL	1.5	35	35	0.7										
1	0	NS		2800	2800											

Total Units
66

Total Units Fully Measured
30

Total Length (ft.)
7865

Total Area (sq.ft.)
17781

Total Volume (cu.ft.)
7434

Table 3 - Summary of Pool Types

Stream Name: Palmer Creek

LLID: 1239983408729

Drainage: Blue Lake

Survey Dates: 8/16/2011 to 8/17/2011

Confluence Location: Quad: ARCATA SOUTH

Legal Description: T06NR02ES30

Latitude: 40:52:22.0N

Longitude: 123:59:54.0W

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
21	21	MAIN	84	15	320	86	6.7	0.5	113	2377	57	1199	19
4	4	SCOUR	16	14	54	14	8.1	0.3	108	432	26	106	28

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
25	25	374	2809	1305

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

Stream Name: Palmer Creek

LLID: 1239983408729

Drainage: Blue Lake

Survey Dates: 8/16/2011 to 8/17/2011

Confluence Location: Quad: ARCATA SOUTH

Legal Description: T06NR02ES30

Latitude: 40:52:22.0N

Longitude: 123:59:54.0W

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
21	MCP	84	4	19	16	76	1	5	0	0	0	0
4	PLP	16	0	0	4	100	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
25	4	16	20	80	1	4	0	0	0	0

Mean Maximum Residual Pool Depth (ft.): 1.2

Table 5 - Summary of Mean Percent Cover By Habitat Type

Stream Name: Palmer Creek

LLID: 1239983408729

Drainage: Blue Lake

Survey Dates: 8/16/2011 to 8/17/2011

Dry Units: 1

Confluence Location: Quad: ARCATA SOUTH

Legal Description: T06NR02ES30

Latitude: 40:52:22.0N

Longitude: 123:59:54.0W

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
8	1	LGR	0	0	100	0	0	0	0	0	0
5	1	CAS	0	0	0	0	0	0	30	70	0
13	2	TOTAL RIFFLE	0	0	50	0	0	0	15	35	0
1	0	RUN									
24	3	SRN	2	50	30	2	3	0	7	7	0
25	3	TOTAL FLAT	2	50	30	2	3	0	7	7	0
21	21	MCP	13	45	13	4	25	0	0	0	0
4	4	PLP	0	38	38	0	0	0	5	20	0
25	25	TOTAL POOL	11	44	17	4	21	0	1	3	0
1	0	CUL									
65	30	TOTAL	9	42	20	3	17	0	2	6	0

Table 6 - Summary of Dominant Substrates By Habitat Type

Stream Name: Palmer Creek

LLID: 1239983408729

Drainage: Blue Lake

Survey Dates: 8/16/2011 to 8/17/2011

Dry Units: 1

Confluence Location: Quad: ARCATA SOUTH

Legal Description: T06NR02ES30

Latitude: 40:52:22.0N

Longitude: 123:59:54.0W

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
8	1	LGR	0	0	100	0	0	0	0
5	1	CAS	0	0	0	0	0	100	0
1	0	RUN	0	0	0	0	0	0	0
24	3	SRN	0	0	100	0	0	0	0
21	21	MCP	0	71	29	0	0	0	0
4	4	PLP	0	50	50	0	0	0	0

Table 7 - Summary of Mean Percent Canopy for Entire Stream

Stream Name: Palmer Creek

LLID: 1239983408729

Drainage: Blue Lake

Survey Dates: 8/16/2011 to 8/17/2011

Confluence Location: Quad: ARCATA SOUTH

Legal Description: T06NR02ES30

Latitude: 40:52:22.0N

Longitude: 123:59:54.0W

Mean Percent Canopy	Mean Percent Conifer	Mean Percent Hardwood	Mean Percent Open Units	Mean Right Bank % Cover	Mean Left Bank % Cover
98	11	89	0	100	100

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: Palmer Creek LLID: 1239983408729 Drainage: Blue Lake
 Survey Dates: 8/16/2011 to 8/17/2011 Survey Length (ft.): 7865 Main Channel (ft.): 7865 Side Channel (ft.): 0
 Confluence Location: Quad: ARCATA SOUTH Legal Description: T06NR02ES30 Latitude: 40:52:22.0N Longitude: 123:59:54.0W

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 1

Channel Type: F4	Canopy Density (%):	Pools by Stream Length (%): 0.0
Reach Length (ft.): 1246	Coniferous Component (%):	Pool Frequency (%): 0.0
Riffle/Flatwater Mean Width (ft.):	Hardwood Component (%):	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation:	< 2 Feet Deep:
Range (ft.): 9 to 9	Vegetative Cover (%): 0.0	2 to 2.9 Feet Deep:
Mean (ft.): 9	Dominant Shelter:	3 to 3.9 Feet Deep:
Std. Dev.: 0	Dominant Bank Substrate Type:	>= 4 Feet Deep:
Base Flow (cfs.): 0.0	Occurrence of LWD (%):	Mean Max Residual Pool Depth (ft.):
Water (F): 51 - 51 Air (F): 63 - 63	LWD per 100 ft.:	Mean Pool Shelter Rating:
Dry Channel (ft): 1246	Riffles:	
	Pools:	
	Flat:	
Pool Tail Substrate (%): Silt/Clay: Sand: Gravel: Sm Cobble: Lg Cobble: Boulder: Bedrock:		
Embeddedness Values (%): 1. 2. 3. 4. 5. 0.0		

STREAM REACH: 2

Channel Type: NA	Canopy Density (%):	Pools by Stream Length (%): 0.0
Reach Length (ft.): 2800	Coniferous Component (%):	Pool Frequency (%): 0.0
Riffle/Flatwater Mean Width (ft.):	Hardwood Component (%):	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation:	< 2 Feet Deep:
Range (ft.): 9 to 9	Vegetative Cover (%): 0.0	2 to 2.9 Feet Deep:
Mean (ft.): 9	Dominant Shelter:	3 to 3.9 Feet Deep:
Std. Dev.: 0	Dominant Bank Substrate Type:	>= 4 Feet Deep:
Base Flow (cfs.): 0.0	Occurrence of LWD (%):	Mean Max Residual Pool Depth (ft.):
Water (F): 51 - 51 Air (F): 63 - 63	LWD per 100 ft.:	Mean Pool Shelter Rating:
Dry Channel (ft): 0	Riffles:	
	Pools:	
	Flat:	
Pool Tail Substrate (%): Silt/Clay: Sand: Gravel: Sm Cobble: Lg Cobble: Boulder: Bedrock:		
Embeddedness Values (%): 1. 2. 3. 4. 5. 0.0		

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 3

Channel Type: F4	Canopy Density (%): 97.3	Pools by Stream Length (%): 12.5
Reach Length (ft.): 2518	Coniferous Component (%): 2.6	Pool Frequency (%): 43.5
Riffle/Flatwater Mean Width (ft.): 5.3	Hardwood Component (%): 97.4	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation: Brush	< 2 Feet Deep: 95
Range (ft.): 7 to 16	Vegetative Cover (%): 99.8	2 to 2.9 Feet Deep: 5
Mean (ft.): 10	Dominant Shelter: Small Woody Debris	3 to 3.9 Feet Deep: 0
Std. Dev.: 3	Dominant Bank Substrate Type: Sand/Silt/Clay	>= 4 Feet Deep: 0
Base Flow (cfs.): 0.0	Occurrence of LWD (%): 17	Mean Max Residual Pool Depth (ft.): 1.2
Water (F): 45 - 66	Air (F): 62 - 75	LWD per 100 ft.:
Dry Channel (ft): 0		Riffles: 3
		Pools: 4
		Flat: 1
Pool Tail Substrate (%): Silt/Clay: 0	Sand: 35	Gravel: 55
	Sm Cobble: 10	Lg Cobble: 0
	Boulder: 0	Bedrock: 0
Embeddedness Values (%): 1. 0.0	2. 100.0	3. 0.0
	4. 0.0	5. 0.0

STREAM REACH: 4

Channel Type: B4	Canopy Density (%): 99.4	Pools by Stream Length (%): 4.6
Reach Length (ft.): 1301	Coniferous Component (%): 40.0	Pool Frequency (%): 27.8
Riffle/Flatwater Mean Width (ft.): 8.0	Hardwood Component (%): 60.0	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation: Brush	< 2 Feet Deep: 100
Range (ft.): 8 to 18	Vegetative Cover (%): 100.0	2 to 2.9 Feet Deep: 0
Mean (ft.): 15	Dominant Shelter: Large Woody Debris	3 to 3.9 Feet Deep: 0
Std. Dev.: 4	Dominant Bank Substrate Type: Sand/Silt/Clay	>= 4 Feet Deep: 0
Base Flow (cfs.): 0.0	Occurrence of LWD (%): 29	Mean Max Residual Pool Depth (ft.): 1.1
Water (F): 45 - 50	Air (F): 62 - 65	LWD per 100 ft.:
Dry Channel (ft): 0		Riffles: 5
		Pools: 13
		Flat: 3
Pool Tail Substrate (%): Silt/Clay: 0	Sand: 60	Gravel: 20
	Sm Cobble: 20	Lg Cobble: 0
	Boulder: 0	Bedrock: 0
Embeddedness Values (%): 1. 0.0	2. 100.0	3. 0.0
	4. 0.0	5. 0.0

Table 9 - Mean Percentage of Dominant Substrate and Vegetation

Stream Name: Palmer Creek

LLID: 1239983408729

Drainage: Blue Lake

Survey Dates: 8/16/2011 to 8/17/2011

Confluence Location: Quad: ARCATA SOUTH

Legal Description: T06NR02ES30

Latitude: 40:52:22.0N

Longitude: 123:59:54.0W

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	1	1	3.3
Boulder	1	2	5.0
Cobble / Gravel	10	6	26.7
Sand / Silt / Clay	18	21	65.0

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	0	0	0.0
Brush	27	28	91.7
Hardwood Trees	3	1	6.7
Coniferous Trees	0	1	1.7
No Vegetation	0	0	0.0

Total Stream Cobble Embeddedness Values: 2

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

StreamName: Palmer Creek

LLID: 1239983408729

Drainage: Blue Lake

Survey Dates: 8/16/2011 to 8/17/2011

Confluence Location: Quad: ARCATA SOUTH

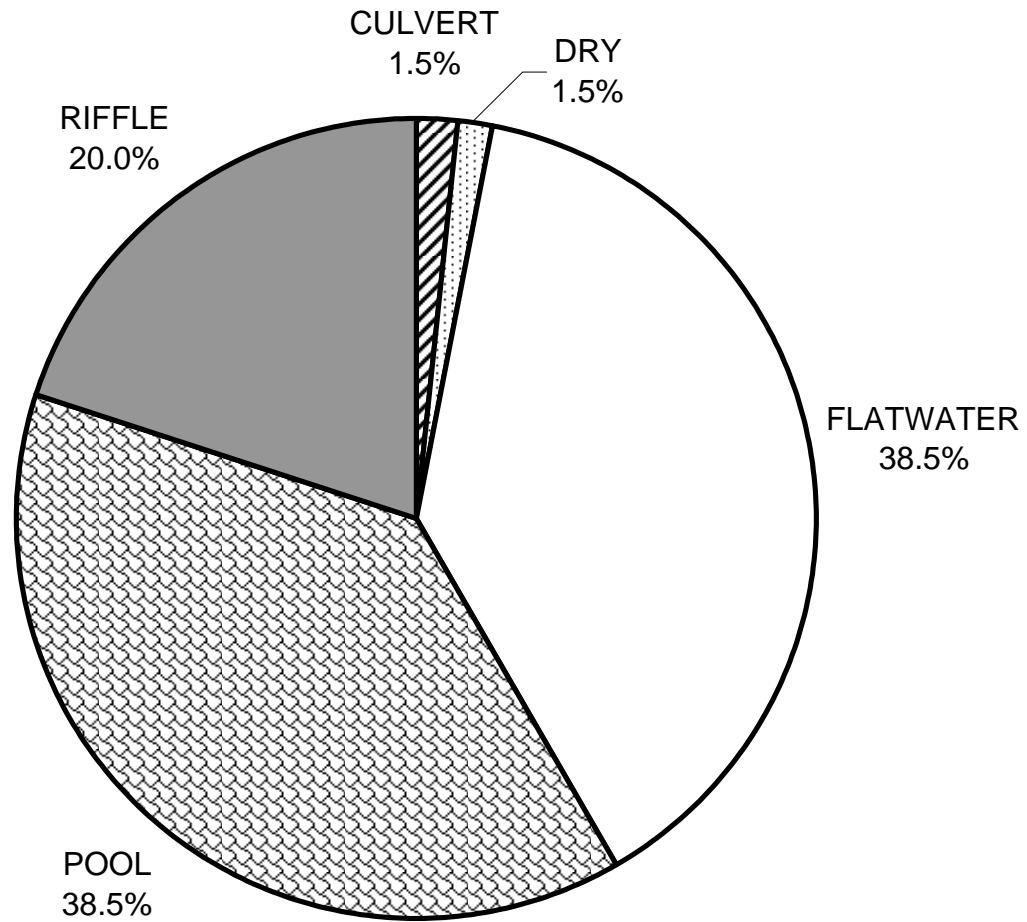
Legal Description: T06NR02ES30

Latitude: 40:52:22.0N

Longitude: 123:59:54.0W

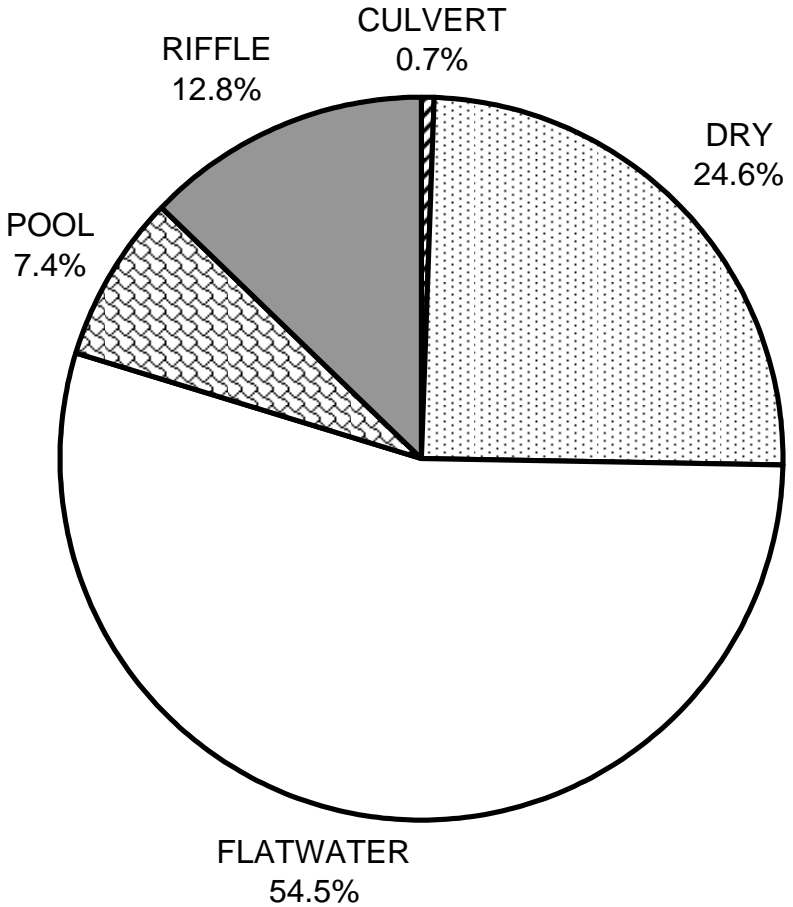
	Riffles	Flatwater	Pools
UNDERCUT BANKS (%)	0	2	11
SMALL WOODY DEBRIS (%)	0	50	44
LARGE WOODY DEBRIS (%)	50	30	17
ROOT MASS (%)	0	2	4
TERRESTRIAL VEGETATION (%)	0	3	21
AQUATIC VEGETATION (%)	0	0	0
WHITEWATER (%)	15	7	1
BOULDERS (%)	35	7	3
BEDROCK LEDGES (%)	0	0	0

PALMER CREEK 2011 HABITAT TYPES BY PERCENT OCCURRENCE



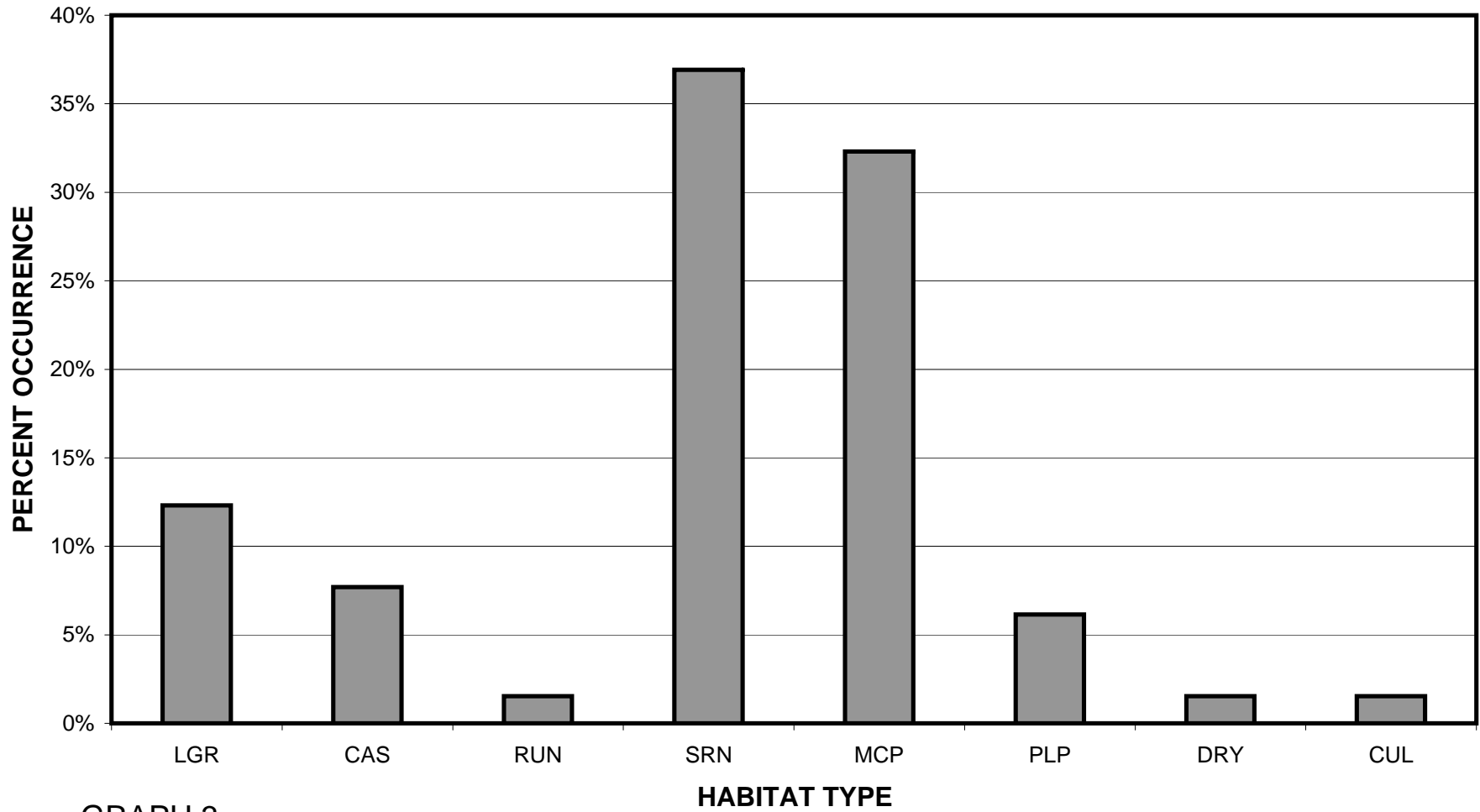
GRAPH 1

**PALMER CREEK 2011
HABITAT TYPES BY PERCENT TOTAL LENGTH**



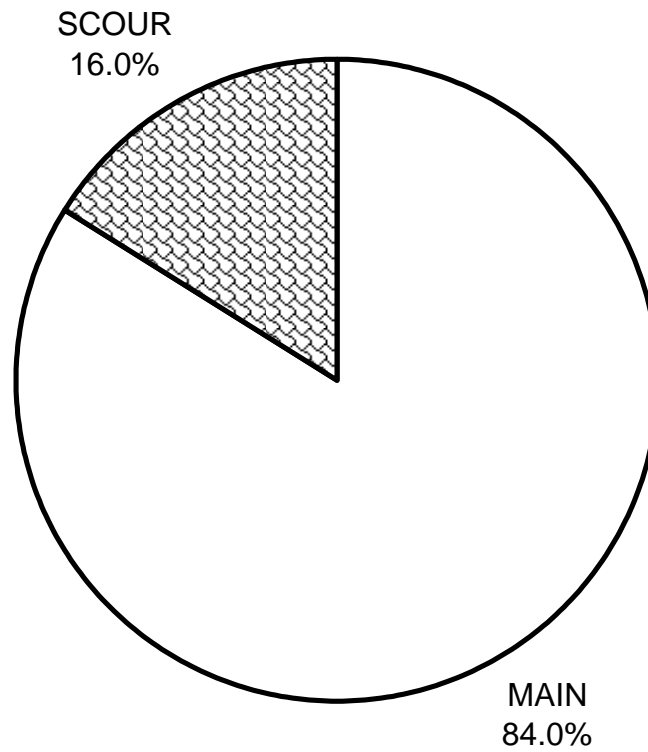
GRAPH 2

PALMER CREEK 2011 HABITAT TYPES BY PERCENT OCCURRENCE



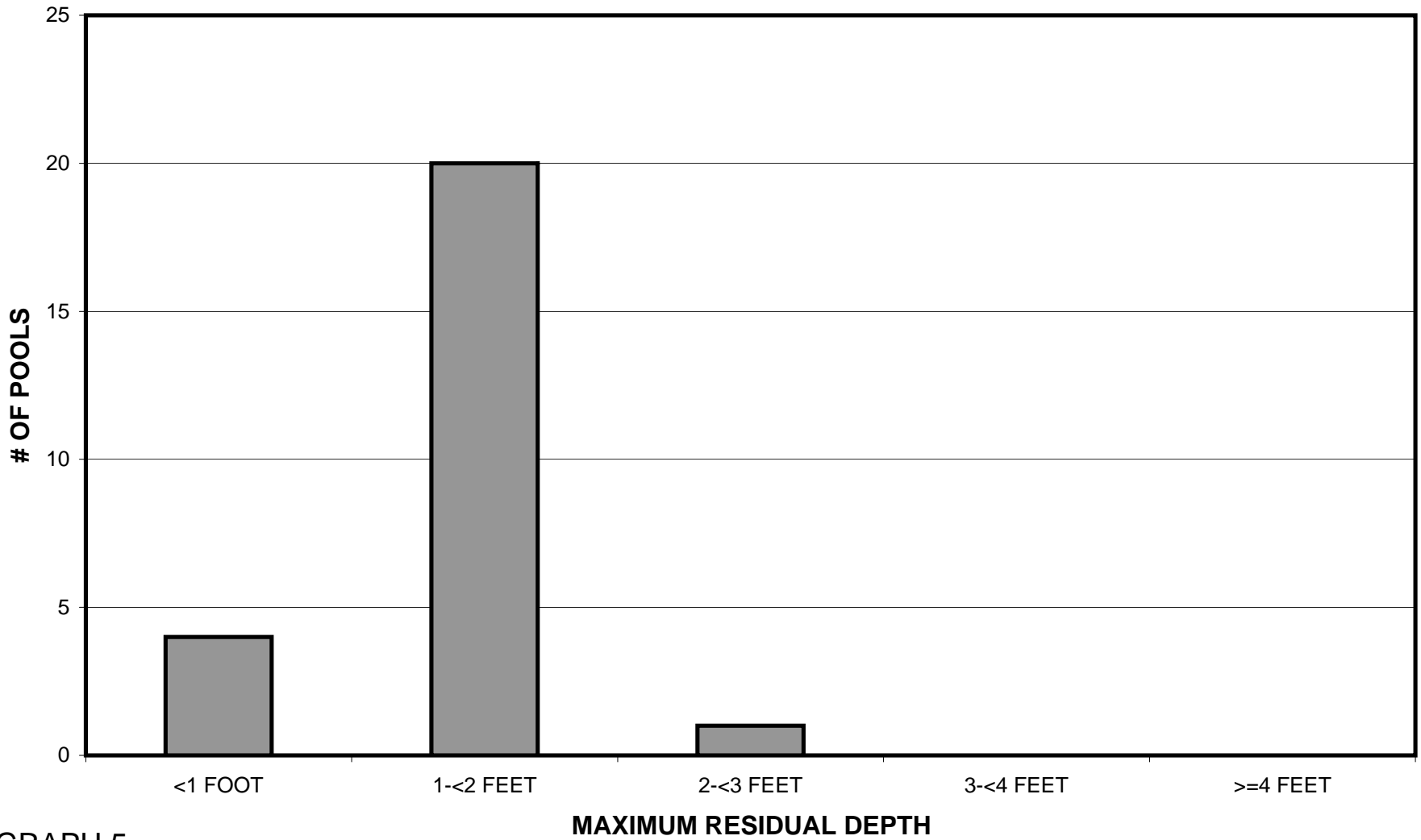
GRAPH 3

**PALMER CREEK 2011
POOL TYPES BY PERCENT OCCURRENCE**



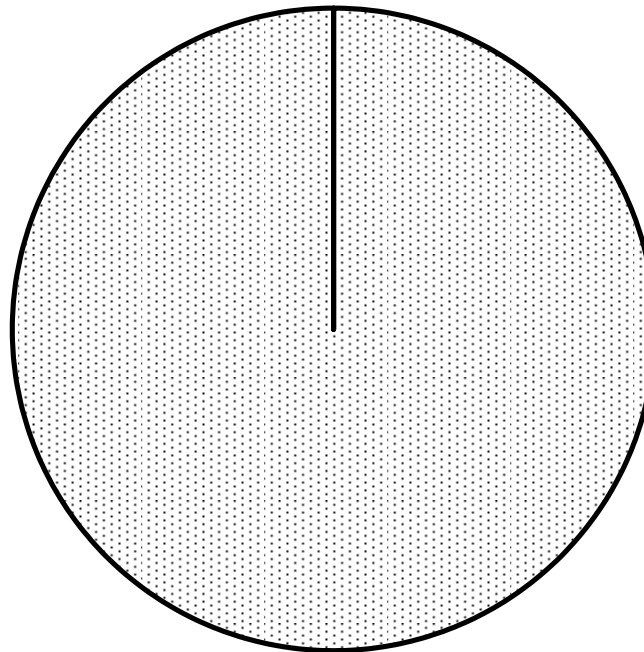
GRAPH 4

PALMER CREEK 2011 MAXIMUM DEPTH IN POOLS



GRAPH 5

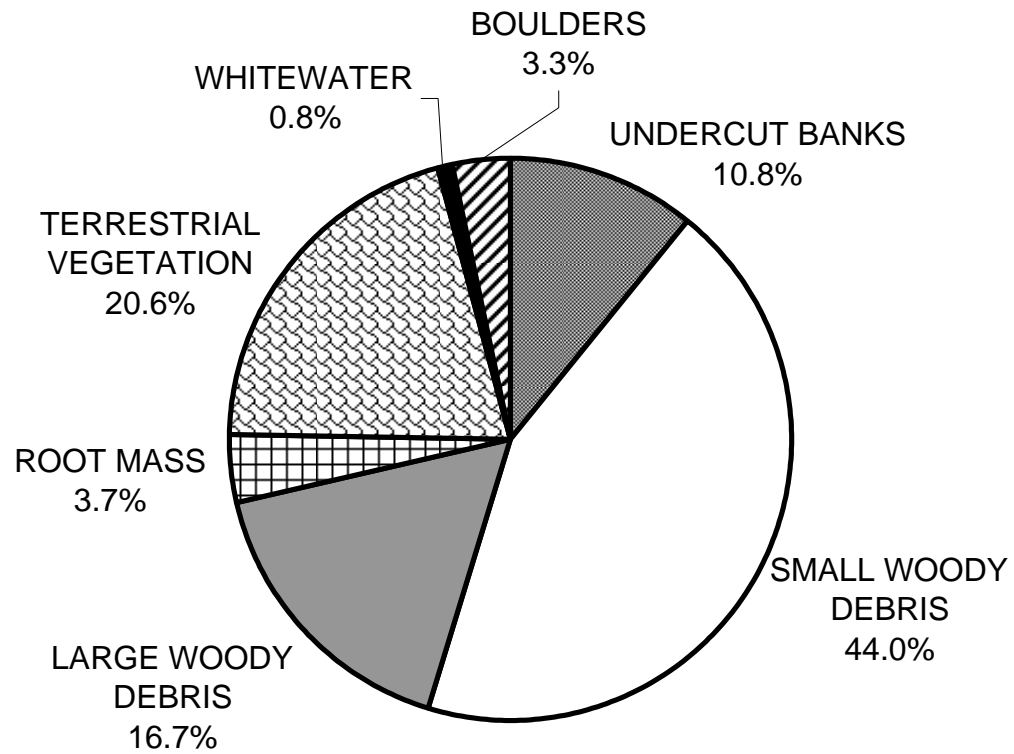
PALMER CREEK 2011 PERCENT EMBEDDEDNESS



VALUE 2
100.0%

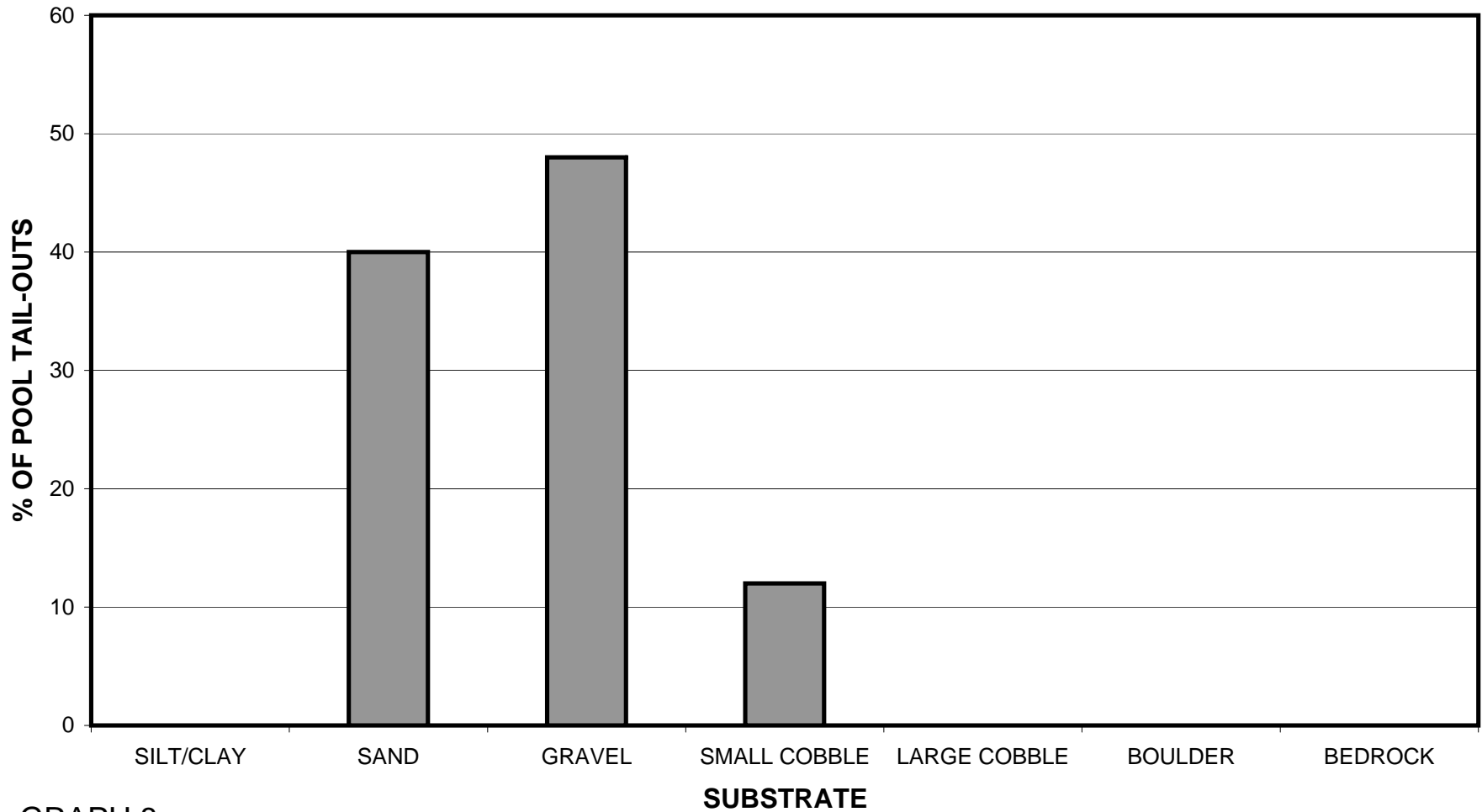
GRAPH 6

PALMER CREEK 2011 MEAN PERCENT COVER TYPES IN POOLS



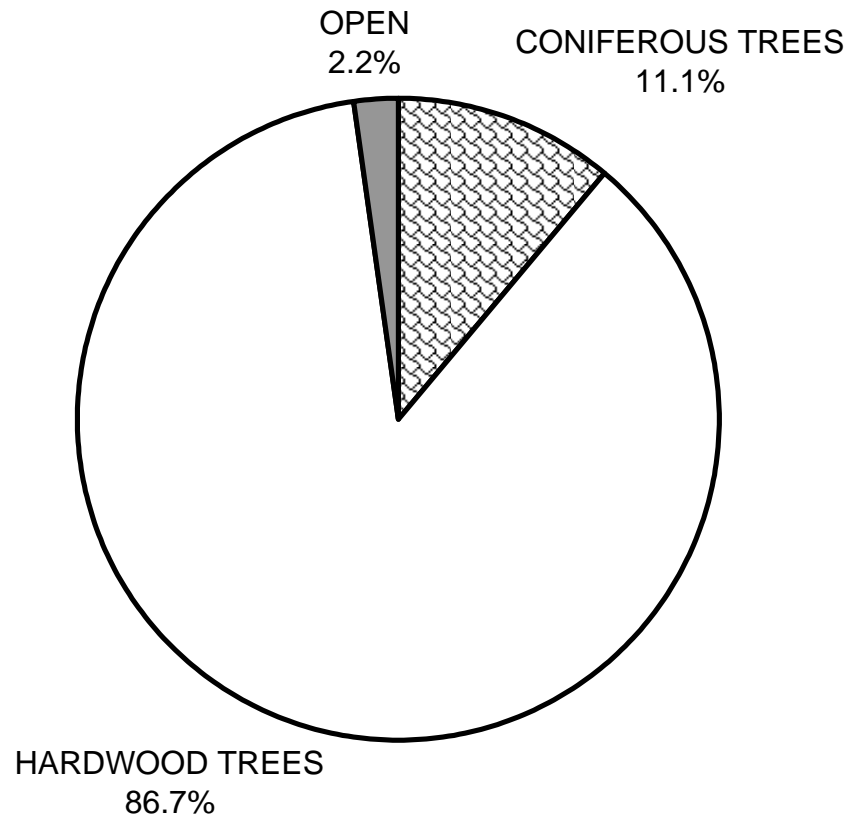
GRAPH 7

PALMER CREEK 2011 SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



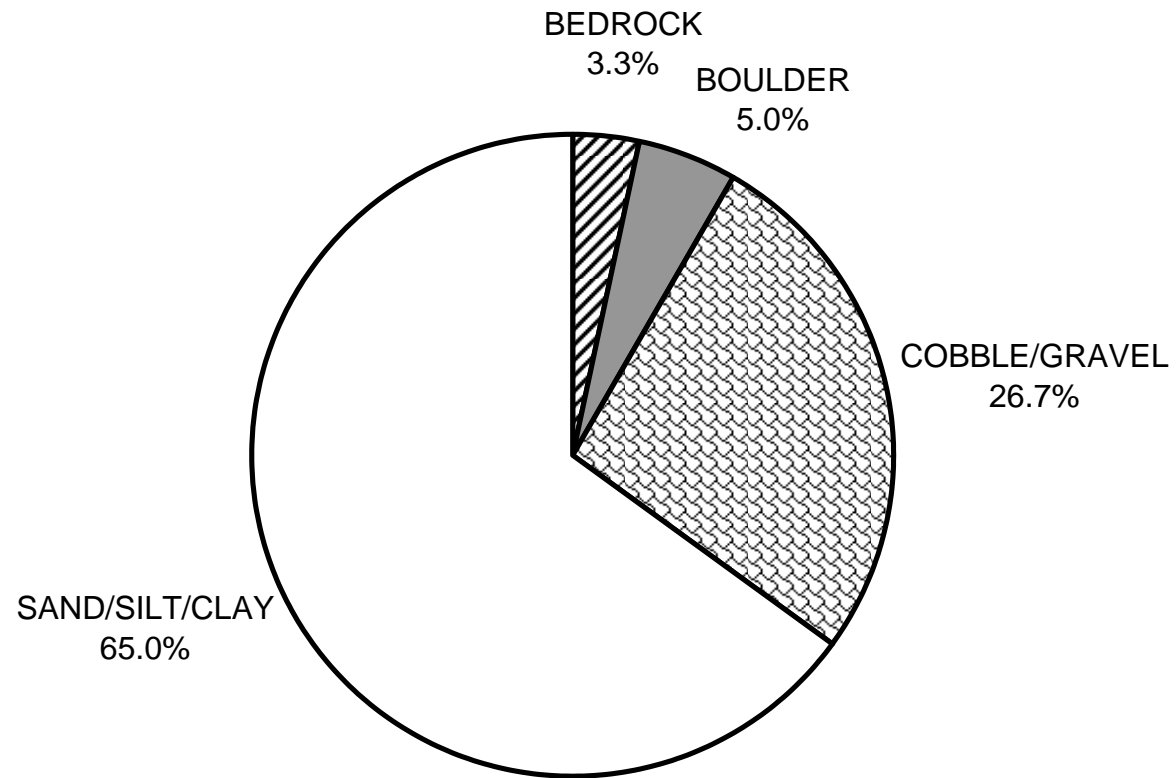
GRAPH 8

PALMER CREEK 2011 MEAN PERCENT CANOPY



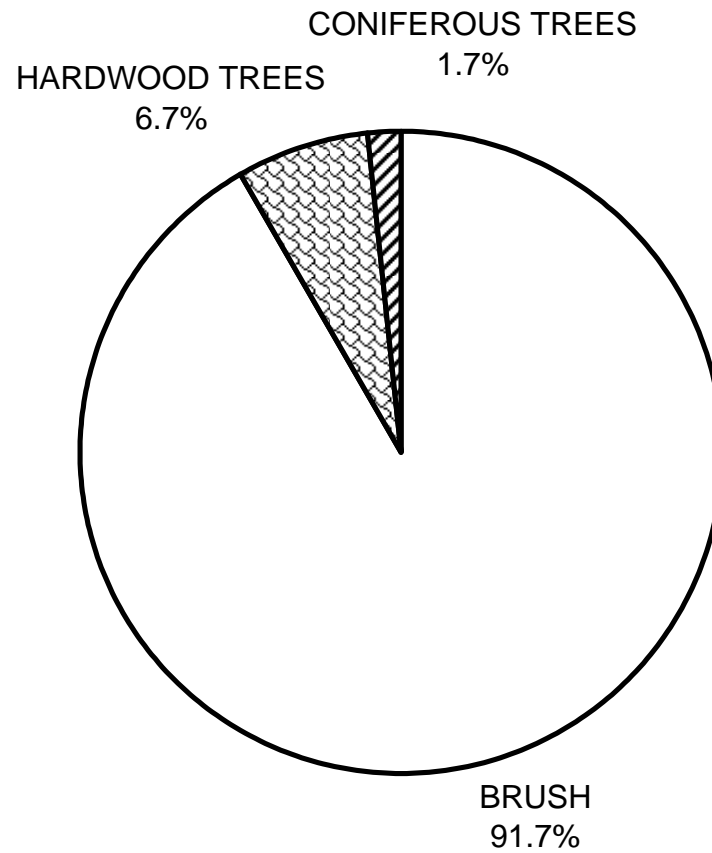
GRAPH 9

PALMER CREEK 2011 DOMINANT BANK COMPOSITION IN SURVEY REACH



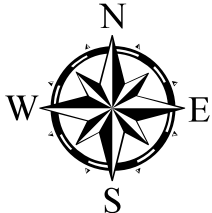
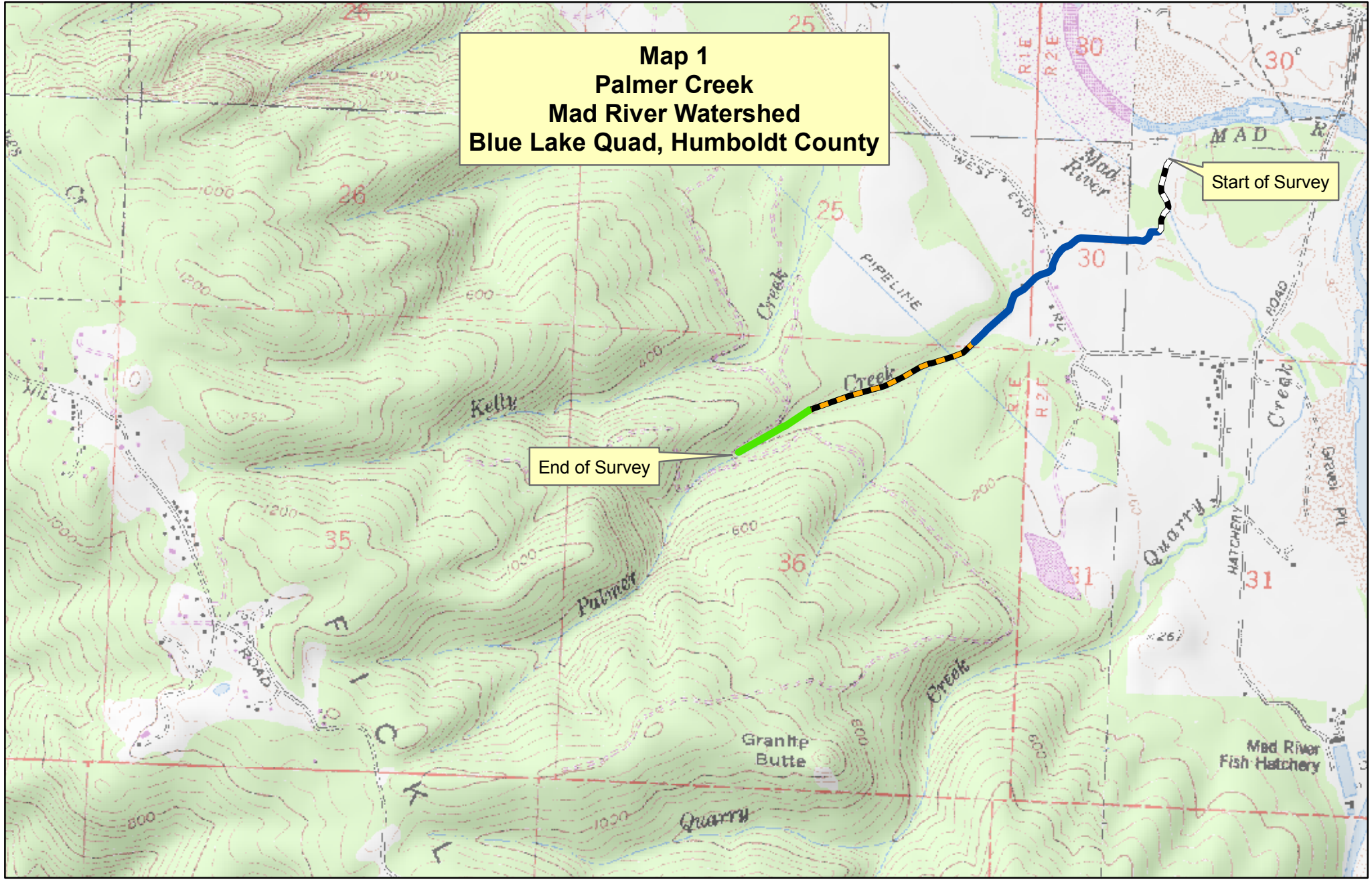
GRAPH 10

PALMER CREEK 2011 DOMINANT BANK VEGETATION IN SURVEY REACH



GRAPH 11

**Map 1
Palmer Creek
Mad River Watershed
Blue Lake Quad, Humboldt County**



Legend

- Reach 1, F4 Channel Type
 Reach 3, F4 Channel Type
- Reach 2, Unsurveyed
 Reach 4, B4 Channel Type

