

STREAM INVENTORY REPORT

“Powderhouse Gulch”

INTRODUCTION

A stream inventory was conducted from September 2 to September 4, 2008 on an unnamed tributary to Cottaneva Creek commonly known as and hereinafter referred to as Powderhouse Gulch. The survey began at the confluence with Cottaneva Creek and extended upstream 0.6 miles.

The Powderhouse Gulch 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 Powderhouse Gulch. 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

Powderhouse Gulch is a tributary to Cottaneva Creek, which drains to the Pacific Ocean, located in Mendocino County, California (Map 1). Powderhouse Gulch's legal description at the confluence with Cottaneva Creek is T22N R18W S13. Its location is 39.7505° north latitude and 123.8183° west longitude, LLID number 1238182397506. Powderhouse Gulch is an ephemeral stream and has no solid blue line stream according to the USGS Hales Grove 7.5 minute quadrangle. Powderhouse Gulch drains a watershed of approximately 0.14 square miles. Elevations range from about 50 feet at the mouth of the creek to 950 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 Highway 1 near Rockport, north of Fort Bragg.

METHODS

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

SAMPLING STRATEGY

The inventory uses a method that samples approximately 10% of the habitat units within the survey reach. All habitat units included in the survey are classified according to habitat type and

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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 Powderhouse Gulch 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". Powderhouse Gulch 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 Powderhouse Gulch, embeddedness was ocularly estimated. The values were recorded using the following ranges: 0 - 25% (value 1), 26 - 50% (value 2), 51 - 75% (value 3) and 76 - 100% (value 4). Additionally, a value of 5 was assigned to tail-outs deemed unsuited for spawning due to inappropriate substrate like bedrock, log sills, boulders or other considerations.

6. Shelter Rating:

Instream shelter is composed of those elements within a stream channel that provide juvenile salmonids protection from predation, reduce water velocities so fish can rest and conserve energy, and allow separation of territorial units to reduce density related competition for prey. The shelter rating is calculated for each fully-described habitat unit by multiplying shelter value and percent cover. Using an overhead view, a quantitative estimate of the percentage of the habitat unit covered is made. All cover is then classified according to a list of nine cover types. In Powderhouse Gulch, 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 densimeters as described in the *California Salmonid Stream Habitat Restoration Manual*. Canopy density relates to the amount of stream shaded from the sun. In Powderhouse Gulch, 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 Powderhouse Gulch, 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 Powderhouse Gulch. 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 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 Powderhouse Gulch 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 September 2 to September 4, 2008, was conducted by B. Quaglieri and C. Chavez (WSP). The total length of the stream surveyed was 3,348 feet.

Stream flow was measured near the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 0.14 cfs on September 8, 2008.

Powderhouse Gulch is a B4 channel type for 3,348 feet of the stream surveyed (Reach 1). 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 56 to 58 degrees Fahrenheit. Air temperatures ranged from 52 to 66 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 39% flatwater units, 34% pool units, 25% riffle units, 1% no survey units, and 1% dry units (Graph 1). Based on total length of Level II habitat types there were 65% flatwater units, 18% riffle units, 10% pool units, 5% dry units, and 2% no survey units (Graph 2).

Ten Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were step run units, 32%; mid-channel pool units, 20%; and low gradient riffle units, 18% (Graph 3). Based on percent total length, step run units made up 59%, low gradient riffle units 14%, mid-channel pool units 6%, and run units 6%.

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A total of 27 pools were identified (Table 3). Main channel pools were the most frequently encountered at 59% (Graph 4), and comprised 59% 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. Four of the 27 pools (15%) had a residual depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 27 pool tail-outs measured, 15 had a value of 1 (55.6%); 9 had a value of 2 (33.3%); 3 had a value of 3 (11.1%) (Graph 6). On this scale, a value of 1 indicates the best spawning conditions and a value of 4 the worst.

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 2, and pool habitats had a mean shelter rating of 34 (Table 1). Of the pool types, the backwater pools had the highest mean shelter rating at 120. Scour pools had a mean shelter rating of 42 and main channel pools had a mean shelter rating of 23 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Large woody debris is the dominant cover type in Powderhouse Gulch. Graph 7 describes the pool cover in Powderhouse Gulch. Large woody debris is the dominant pool cover type followed by small 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 19% of the pool tail-outs.

The mean percent canopy density for the surveyed length of Powderhouse Gulch was 97%. Three percent of the canopy was open. Of the canopy present, the mean percentages of hardwood and coniferous trees were 34% and 66%, respectively. Graph 9 describes the mean percent canopy in Powderhouse Gulch.

For the stream reach surveyed, the mean percent right bank vegetated was 96%. The mean percent left bank vegetated was 96%. The dominant elements composing the structure of the stream banks consisted of 95% sand/silt/clay and 5% boulder (Graph 10). Hardwood trees were the dominant vegetation type observed in 52.3% of the units surveyed. Additionally, 47.7% of the units surveyed had coniferous trees as the dominant vegetation type (Graph 11).

BIOLOGICAL INVENTORY RESULTS

Eleven sites were snorkel surveyed for species composition and distribution in Powderhouse Gulch on September 10, 2008. Water temperatures taken during the survey period of 0800 to 0930 ranged from 54 to 55 degrees Fahrenheit. The air temperature was 52 degrees Fahrenheit. The sites were sampled by I. Mikus and S. McSmith (DFG).

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In reach 1 eleven sites were sampled, the sampling began 126' from the mouth and ended 2,827' upstream. The reach sites yielded 7 young-of-the-year steelhead/rainbow trout (SH/RT) 12 age 1+ SH/RT, and 2 unknown sculpin species.

The following chart displays the information yielded from these sites:

2008 Powderhouse Gulch underwater observations.

Date	Site #	Hab. Unit #	Hab. Type	Approx. Dist. from mouth (ft.)	Coho		SH/RT		
					YOY	1+	YOY	1+	2+
Reach 1: B4 Channel Type									
09/10/08	1	006	4.2	126	0	0	2	1	0
09/10/08	2	008	4.2	296	0	0	1	1	0
09/10/08	3	010	4.2	352	0	0	0	4	0
09/10/08	4	013	4.2	521	0	0	2	1	0
09/10/08	5	021	5.2	804	0	0	0	0	0
09/10/08	6	032	4.2	1,259	0	0	0	1	0
09/10/08	7	035	5.6	1,346	0	0	0	1	0
09/10/08	8	057	5.6	2,523	0	0	2	1	0
09/10/08	9	061	5.6	2,622	0	0	0	2	0
09/10/08	10	070	5.6	2,864	0	0	0	0	0
09/10/08	11	074	9.0	2,953	0	0	0	0	0

DISCUSSION

Powderhouse Gulch is a B4 channel type for 3,348 feet of the stream surveyed (Reach 1). The suitability of B4 channel types for fish habitat improvement structures is as follows: B4 channel types are excellent for low-stage plunge weirs, boulder clusters, bank placed boulders, single and opposing wing-deflectors, and log cover.

The water temperatures recorded on the survey days September 2 to September 4, 2008, ranged from 56 to 58 degrees Fahrenheit. Air temperatures ranged from 52 to 66 degrees Fahrenheit.

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To make any conclusions, temperatures would need to be monitored throughout the warm summer months, and more extensive biological sampling would need to be conducted.

Flatwater habitat types comprised 65% of the total length of this survey, riffles 18%, and pools 10%. The pools are relatively shallow, with 4 of the 27 (15%) pools having a maximum residual depth greater than 2 feet. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat. In 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.

Twenty-four of the 27 pool tail-outs measured had embeddedness ratings of 1 or 2. Three 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 Powderhouse Gulch should be mapped and rated according to their potential sediment yields, and control measures should be taken.

Twenty-six of the 27 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 was 34. The shelter rating in the flatwater habitats was 2. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by large woody debris in Powderhouse Gulch. Large woody debris is the dominant cover type in pools followed by small woody debris. 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 97%. The percentage of right and left bank covered with vegetation was 96% and 96%, respectively.

RECOMMENDATIONS

- 1) Powderhouse Gulch 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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- 4) 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.
- 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.
- 6) Conduct a fish passage assessment on the Highway 1 culvert at 337 feet.

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 Cottaneva Creek.
33	0003.00	Bridge #01 is a footbridge constructed of wood and measures 8' wide x 2.5' high x 12' long.
113	0006.00	There was young-of-the-year (YOY) observed.
282	0008.00	There was YOY observed.
337	0010.00	Culvert #01 at Highway 1 is in good condition, is constructed of concrete, and measures 4.5 high x 4.5 wide x 52' long x 4.5' in diameter with a plunge height of 0.4' and a maximum height of 2.7' within 5' of the outlet. There is a slope of 2%. A fish passage assessment should be conducted on this culvert.
397	0013.00	Mendocino Redwood Company Bridge (Bridge #02) is constructed of metal and measures 18' wide x 6.3' high x 45' long.
1534	0038.00	A channel type of B4 was taken at this unit.
1577	0039.00	There is a 1.7' plunge.
2030	0056.00	There is a 0.9' plunge.
2501	0058.00	There was YOY observed.
2544	0060.00	There is a 0.9' log plunge.

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- 2820 0069.00 Log debris accumulation (LDA) #01 contains 10 pieces of large woody debris (LWD) and measures 12' high x 8' wide x 14' long with water flowing through and visible gaps. Sediment retention ranges from silt to cobble and measures 6' wide x 10' long x 2.5' deep. No fish were observed above the LDA. There is a 2.5' log plunge.
- 2842 0071.00 Tributary #01, located on the left bank, contributes 5% of the downstream flow to Powderhouse Gulch. The temperature downstream of the confluence was 57 degrees Fahrenheit, the temperature of the tributary was 54 degrees Fahrenheit, and the temperature upstream of the confluence was 57 degrees Fahrenheit. The slope of the tributary was 11% and appears accessible to fish though no fish were observed in the 40' explored up the tributary. There is a 3' cascading plunge from LWD.
- 2898 0074.00 LDA #02 contains 50 pieces of LWD and measures 25' high x 19' wide x 55' long with water flowing through. Sediment retention ranges from silt to boulder and measures 5' wide x 4' long x 1' deep. This LDA serves as a possible barrier to both juvenile and adult salmonids. No fish were observed above the LDA.
- 3327 0080.00 End of survey due to increased gradient, increased number of jumps and LDA barriers, and a change to boulder-dominant substrate. Bridge #03 is constructed of wood and metal and measures 13.8' wide x 17' high x 25' long.

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: 1238182397506

LLID: 1238182397506 Drainage: Rockport

Survey Dates: 9/2/2008 to 9/4/2008

Confluence Location: Quad: HALES GROVE Legal Description: T22NR18WS13 Latitude: 39:45:02.0N Longitude: 123:49:06.0

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	DRY	1.3	163	163	4.9									
31	7	FLATWATER	38.8	70	2185	65.3	3.8	0.3	0.5	402	12452	126	2796		2
1	0	NOSURVEY	1.3	55	55	1.6									
27	27	POOL	33.8	13	350	10.5	6.7	0.5	1.2	86	2316	62	1661	48	34
20	3	RIFFLE	25.0	30	595	17.8	4.0	0.2	0.3	73	1457	16	325		0
Total Units	Total Units Fully Measured				Total Length (ft.)					Total Area (sq.ft.)			Total Volume (cu.ft.)		
80	37				3348					16226			4782		

Table 2 - Summary of Habitat Types and Measured Parameters

Stream Name: 1238182397506

LLID: 1238182397506

Drainage: Rockport

Survey Dates: 9/2/2008 to 9/4/2008

Confluence Location: Quad: HALES GROVE

Legal Description: T22NR18WS13

Latitude: 39:45:02.0N

Longitude: 123:49:06.0W

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 (%)
14	1	LGR	17.5	34	476	14.2	5	0.2	0.2	119	1666	24	333		0	97
6	2	HGR	7.5	20	119	3.6	4	0.3	0.4	50	299	13	75		0	97
5	1	RUN	6.3	41	205	6.1	4	0.3	0.4	60	300	18	90		0	99
26	6	SRN	32.5	76	1980	59.1	2	0.3	0.8	325	8443	153	2658		2	97
16	16	MCP	20.0	13	208	6.2	7	0.5	2.6	95	1517	68	1094	53	23	97
3	3	LSL	3.8	12	36	1.1	5	0.4	1.1	54	163	32	97	24	28	97
1	1	LSR	1.3	16	16	0.5	5	0.4	0.7	80	80	48	48	32	10	96
6	6	PLP	7.5	12	75	2.2	7	0.6	2.2	80	481	65	392	51	53	97
1	1	DPL	1.3	15	15	0.4	5	0.3	0.8	75	75	30	30	23	120	94
1	0	DRY	1.3	163	163	4.9										
1	0	NS	1.3	55	55	1.6										

Total Units
80

Total Units Fully Measured
37

Total Length (ft.)
3348

Total Area (sq.ft.)
13024

Total Volume (cu.ft.)
4817

Table 3 - Summary of Pool Types

Stream Name: 1238182397506

LLID: 1238182397506

Drainage: Rockport

Survey Dates: 9/2/2008 to 9/4/2008

Confluence Location: Quad: HALES GROVE

Legal Description: T22NR18WS13

Latitude: 39:45:02.0N

Longitude: 123:49:06.0W

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
16	16	MAIN	59	13	208	59	7.3	0.5	95	1517	53	851	23
10	10	SCOUR	37	13	127	36	5.9	0.5	72	724	41	411	42
1	1	BACKWATER	4	15	15	4	5.0	0.3	75	75	23	23	120

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
27	27	350	2316	1284

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

Stream Name: 1238182397506

LLID: 1238182397506

Drainage: Rockport

Survey Dates: 9/2/2008 to 9/4/2008

Confluence Location: Quad: HALES GROVE

Legal Description: T22NR18WS13

Latitude: 39:45:02.0N

Longitude: 123:49:06.0W

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
16	MCP	59	7	44	7	44	2	13	0	0	0	0
3	LSL	11	0	0	3	100	0	0	0	0	0	0
1	LSR	4	1	100	0	0	0	0	0	0	0	0
6	PLP	22	1	17	3	50	2	33	0	0	0	0
1	DPL	4	1	100	0	0	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
27	10	37	13	48	4	15	0	0	0	0

Mean Maximum Residual Pool Depth (ft.): 1.2

Table 5 - Summary of Mean Percent Cover By Habitat Type

Stream Name: 1238182397506

LLID: 1238182397506

Drainage: Rockport

Survey Dates: 9/2/2008 to 9/4/2008

Dry Units: 1

Confluence Location: Quad: HALES GROVE

Legal Description: T22NR18WS13

Latitude: 39:45:02.0N

Longitude: 123:49:06.0W

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
14	5	LGR	0	0	0	0	0	0	0	0	0
6	2	HGR	0	0	0	0	0	0	0	0	0
20	7	TOTAL RIFFLE	0	0	0	0	0	0	0	0	0
5	2	RUN	0	0	0	0	0	0	0	0	0
26	9	SRN	17	50	0	0	33	0	0	0	0
31	11	TOTAL FLAT	17	50	0	0	33	0	0	0	0
16	16	MCP	15	28	24	12	7	0	0	13	0
3	3	LSL	0	0	100	0	0	0	0	0	0
1	1	LSR	0	50	0	50	0	0	0	0	0
6	6	PLP	12	16	63	0	0	0	10	0	0
1	1	DPL	0	20	75	5	0	0	0	0	0
27	27	TOTAL POOL	11	23	43	9	4	0	2	8	0
1	0	NS									
80	45	TOTAL	12	26	38	8	7	0	2	7	0

Table 6 - Summary of Dominant Substrates By Habitat Type

Stream Name: 1238182397506

LLID: 1238182397506

Drainage: Rockport

Survey Dates: 9/2/2008 to 9/4/2008

Dry Units: 1

Confluence Location: Quad: HALES GROVE

Legal Description: T22NR18WS13

Latitude: 39:45:02.0N

Longitude: 123:49:06.0W

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
14	6	LGR	0	0	83	17	0	0	0
6	2	HGR	0	0	50	0	50	0	0
5	2	RUN	0	0	100	0	0	0	0
26	7	SRN	0	0	86	14	0	0	0
16	16	MCP	50	31	19	0	0	0	0
3	3	LSL	33	67	0	0	0	0	0
1	1	LSR	0	100	0	0	0	0	0
6	6	PLP	33	67	0	0	0	0	0
1	1	DPL	100	0	0	0	0	0	0

Table 7 - Summary of Mean Percent Canopy for Entire Stream

Stream Name: 1238182397506

LLID: 1238182397506

Drainage: Rockport

Survey Dates: 9/2/2008 to 9/4/2008

Confluence Location: Quad: HALES GROVE

Legal Description: T22NR18WS13

Latitude: 39:45:02.0N

Longitude: 123:49:06.0W

Mean Percent Canopy	Mean Percent Conifer	Mean Percent Hardwood	Mean Percent Open Units	Mean Right Bank % Cover	Mean Left Bank % Cover
97	66	34	0	96	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: 1238182397506 LLID: 1238182397506 Drainage: Rockport
 Survey Dates: 9/2/2008 to 9/4/2008 Survey Length (ft.): 3348 Main Channel (ft.): 3348 Side Channel (ft.): 0
 Confluence Location: Quad: HALES GROVE Legal Description: T22NR18WS13 Latitude: 39:45:02.0N Longitude: 123:49:06.0W

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 1

Channel Type: B4	Canopy Density (%): 96.7	Pools by Stream Length (%): 10.5
Reach Length (ft.): 3348	Coniferous Component (%): 65.5	Pool Frequency (%): 33.8
Riffle/Flatwater Mean Width (ft.): 3.9	Hardwood Component (%): 34.5	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation: Hardwood Trees	< 2 Feet Deep: 85
Range (ft.): 7 to 14	Vegetative Cover (%): 96.2	2 to 2.9 Feet Deep: 15
Mean (ft.): 10	Dominant Shelter: Large Woody Debris	3 to 3.9 Feet Deep: 0
Std. Dev.: 2	Dominant Bank Substrate Type: Sand/Silt/Clay	>= 4 Feet Deep: 0
Base Flow (cfs.): 0.1	Occurrence of LWD (%): 25	Mean Max Residual Pool Depth (ft.): 1.2
Water (F): 56 - 58 Air (F): 52 - 66	LWD per 100 ft.:	Mean Pool Shelter Rating: 34
Dry Channel (ft): 163	Riffles: 1	
	Pools: 8	
	Flat: 2	
Pool Tail Substrate (%): Silt/Clay: 0 Sand: 4 Gravel: 78 Sm Cobble: 19 Lg Cobble: 0 Boulder: 0 Bedrock: 0		
Embeddedness Values (%): 1. 55.6 2. 33.3 3. 11.1 4. 0.0 5. 0.0		

Table 9 - Mean Percentage of Dominant Substrate and Vegetation

Stream Name: 1238182397506

LLID: 1238182397506

Drainage: Rockport

Survey Dates: 9/2/2008 to 9/4/2008

Confluence Location: Quad: HALES GROVE

Legal Description: T22NR18WS13

Latitude: 39:45:02.0N

Longitude: 123:49:06.0W

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	0	0	0.0
Boulder	3	1	4.5
Cobble / Gravel	0	0	0.0
Sand / Silt / Clay	41	43	95.5

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	0	0	0.0
Hardwood Trees	23	23	52.3
Coniferous Trees	21	21	47.7
No Vegetation	0	0	0.0

Total Stream Cobble Embeddedness Values: 2

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

StreamName: 1238182397506

LLID: 1238182397506

Drainage: Rockport

Survey Dates: 9/2/2008 to 9/4/2008

Confluence Location: Quad: HALES GROVE

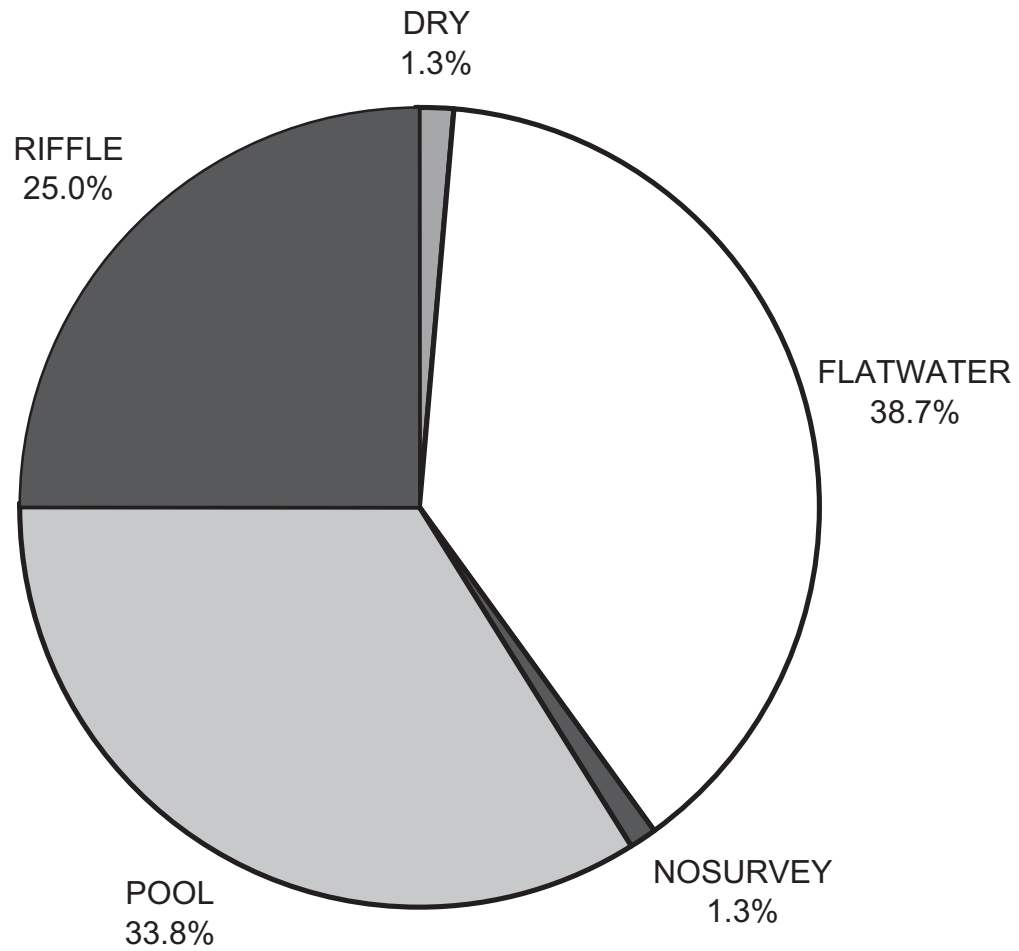
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Longitude: 123:49:06.0W

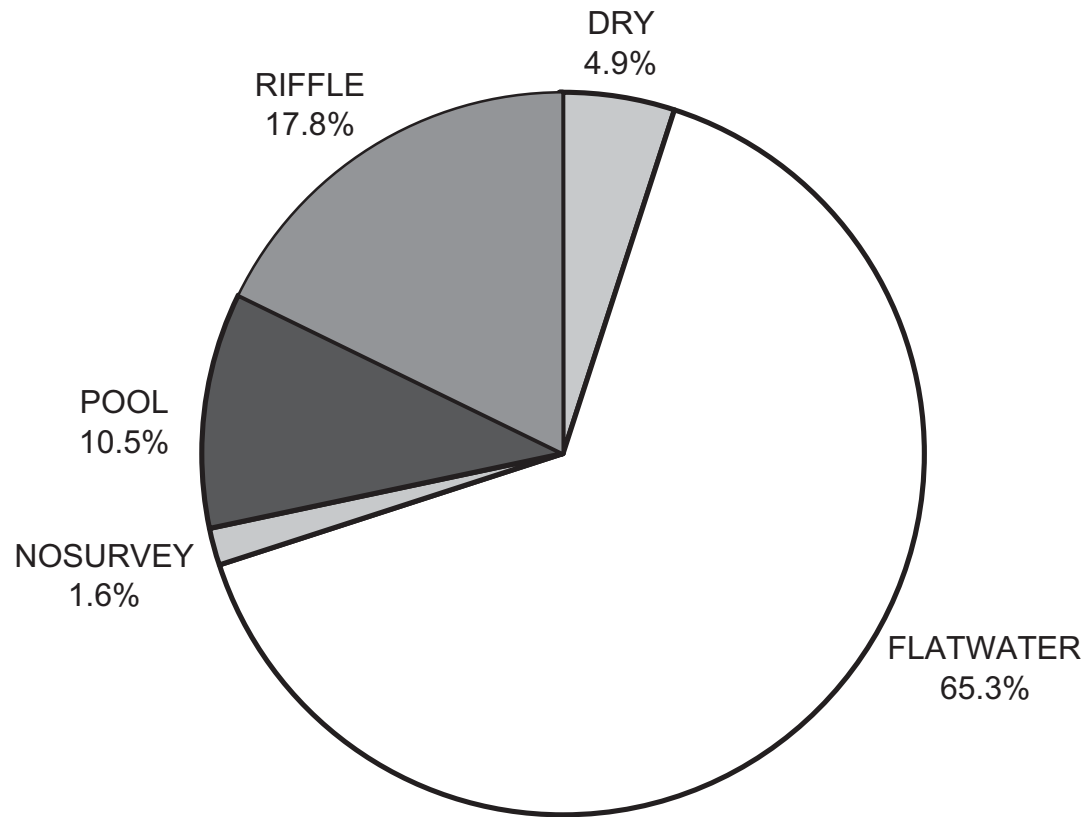
	Riffles	Flatwater	Pools
UNDERCUT BANKS (%)	0	17	11
SMALL WOODY DEBRIS (%)	0	50	23
LARGE WOODY DEBRIS (%)	0	0	43
ROOT MASS (%)	0	0	9
TERRESTRIAL VEGETATION (%)	0	33	4
AQUATIC VEGETATION (%)	0	0	0
WHITEWATER (%)	0	0	2
BOULDERS (%)	0	0	8
BEDROCK LEDGES (%)	0	0	0

1238182397506 2008
HABITAT TYPES BY PERCENT OCCURRENCE



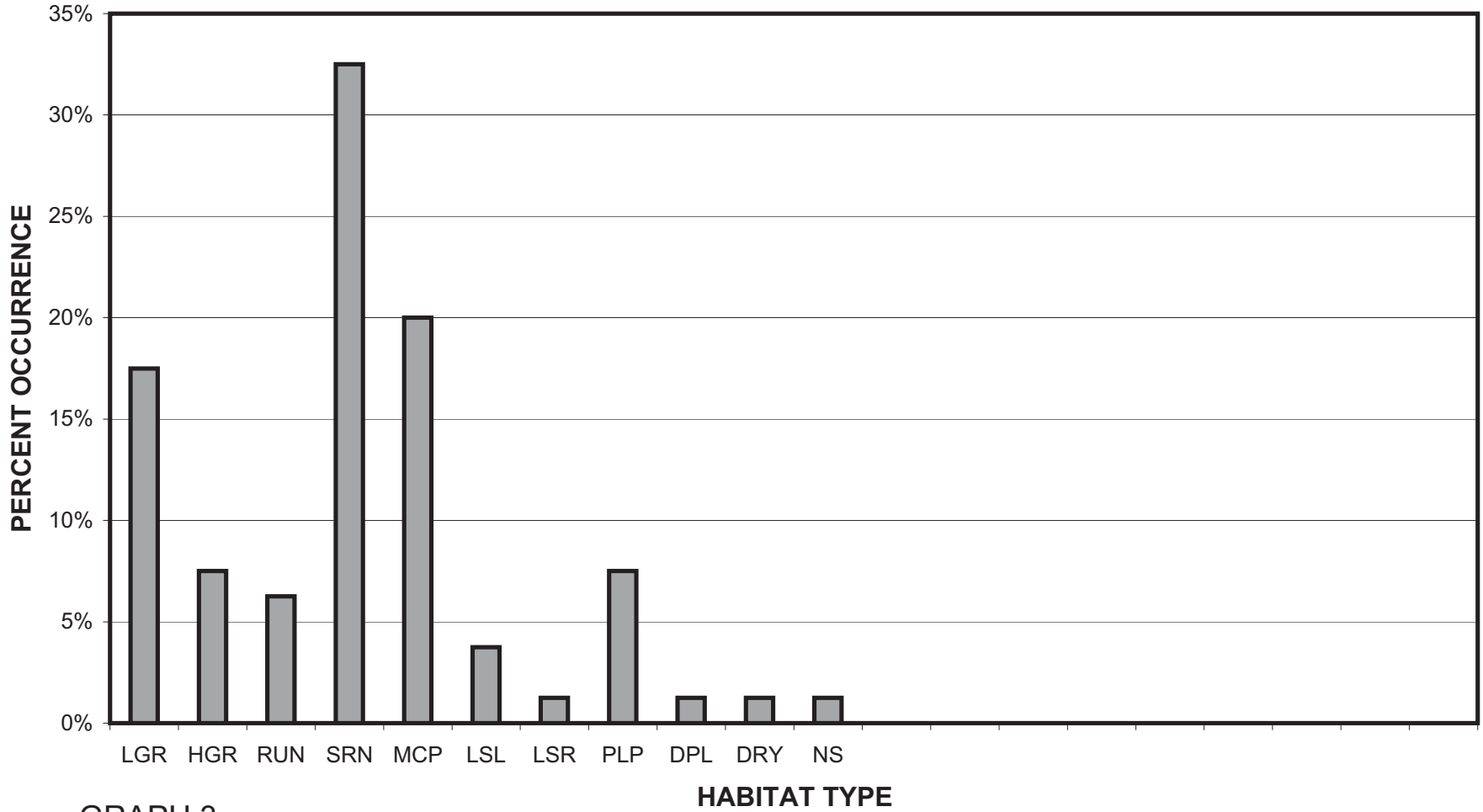
GRAPH 1

1238182397506 2008
HABITAT TYPES BY PERCENT TOTAL LENGTH



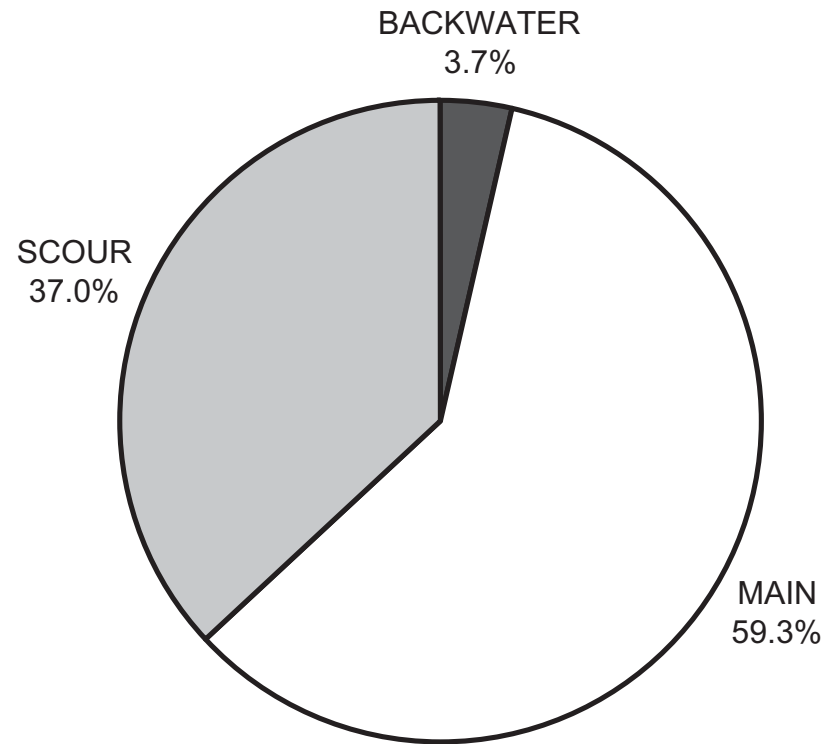
GRAPH 2

1238182397506 2008
HABITAT TYPES BY PERCENT OCCURRENCE



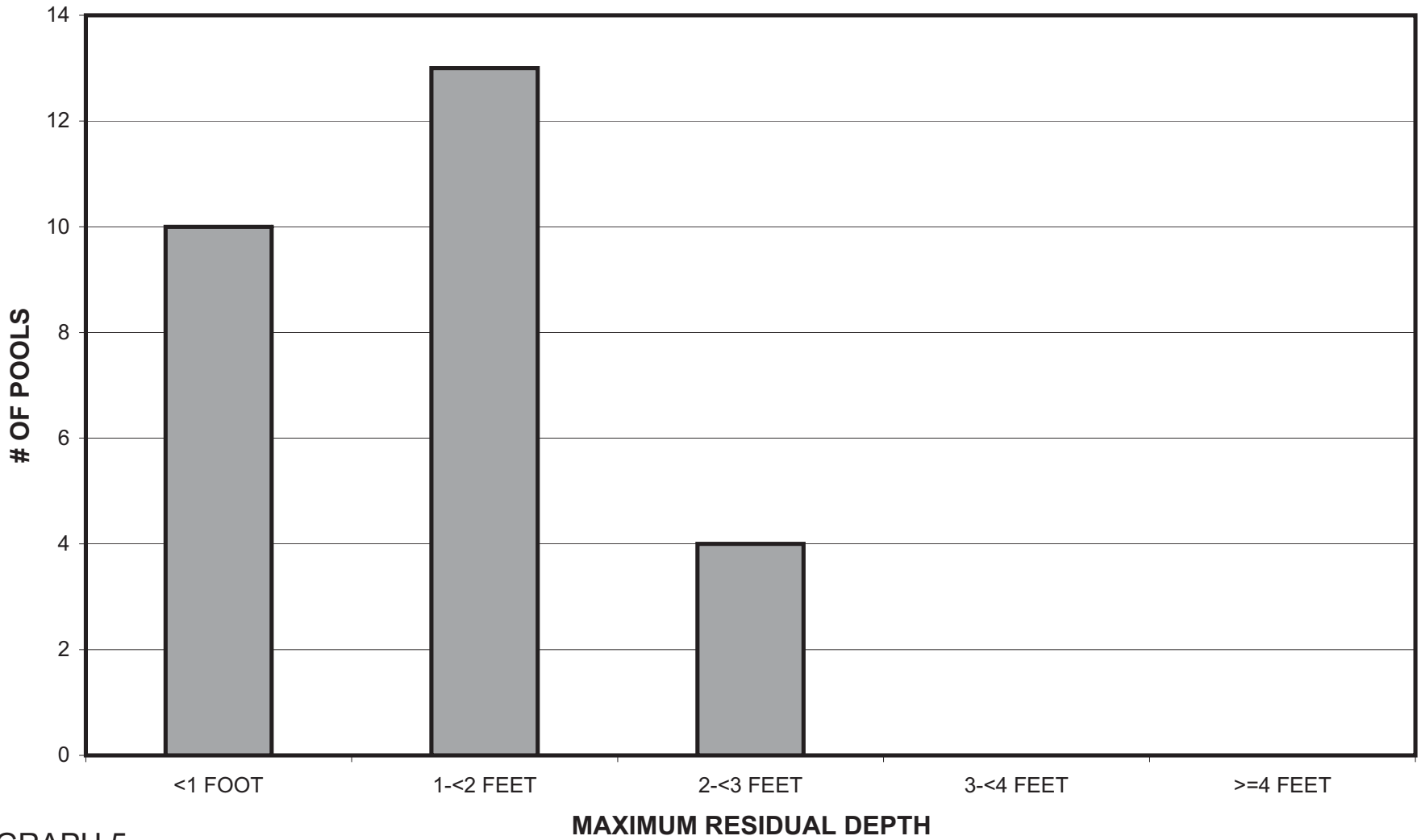
GRAPH 3

1238182397506 2008
POOL TYPES BY PERCENT OCCURRENCE



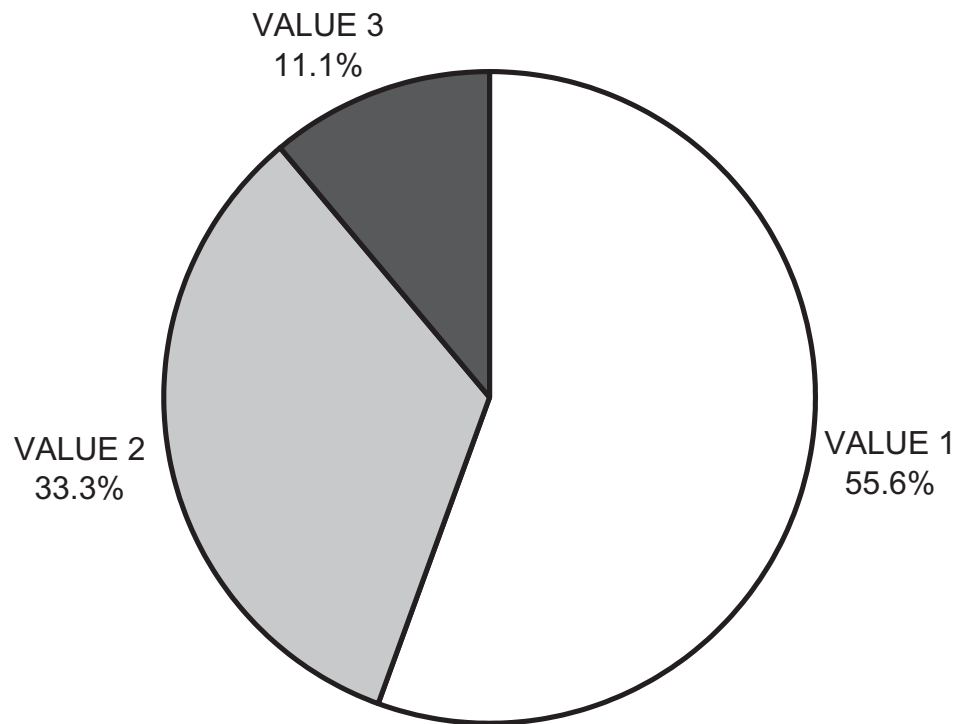
GRAPH 4

1238182397506 2008
MAXIMUM DEPTH IN POOLS



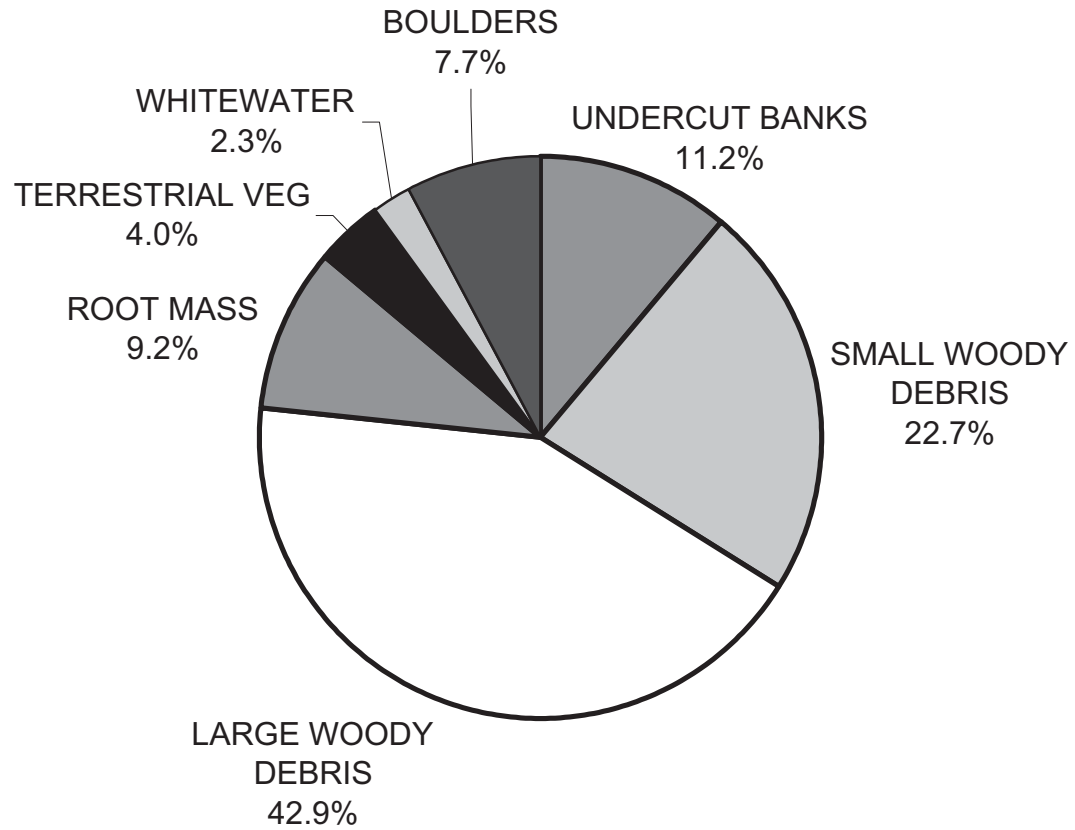
GRAPH 5

1238182397506 2008
PERCENT EMBEDDEDNESS



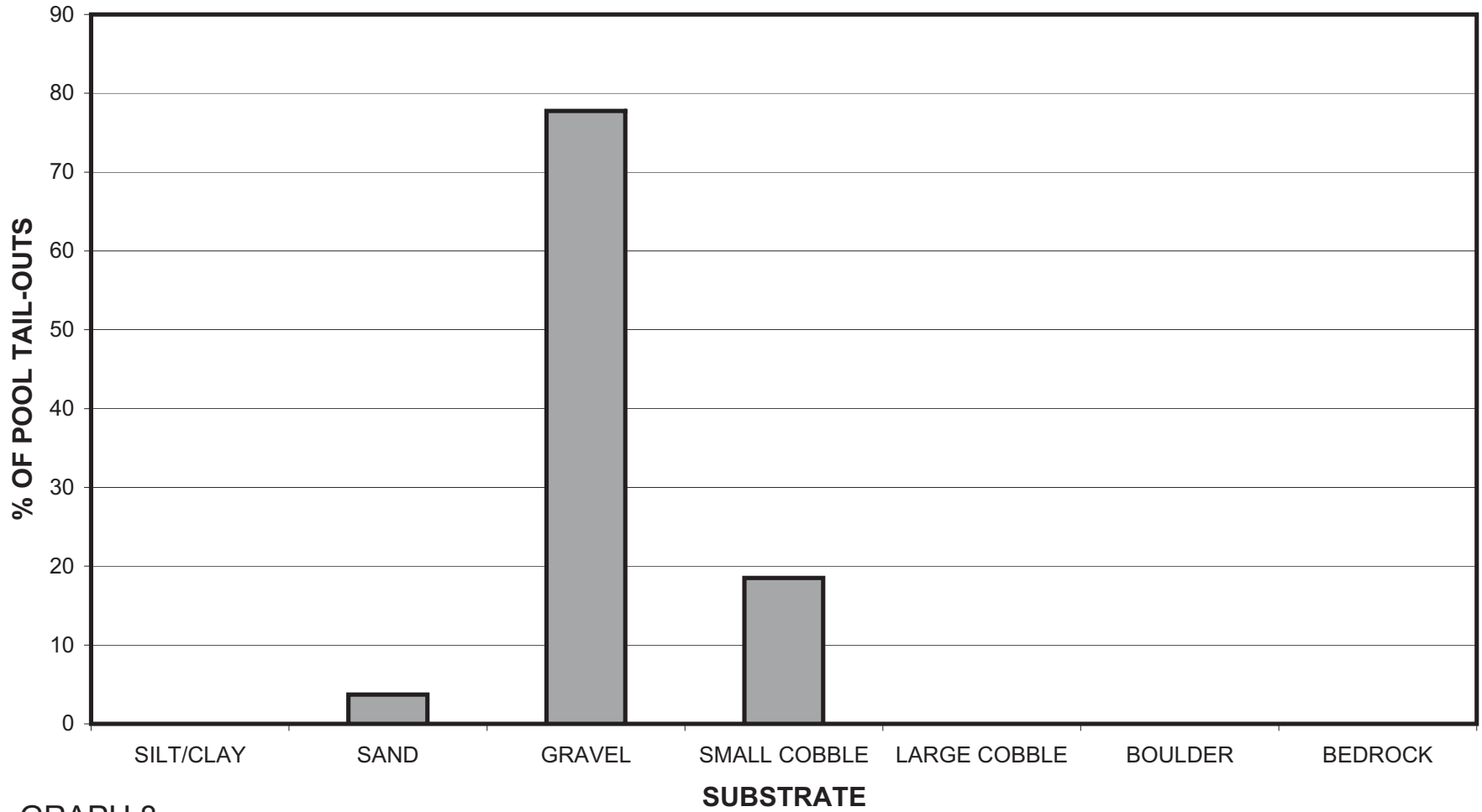
GRAPH 6

1238182397506 2008
MEAN PERCENT COVER TYPES IN POOLS



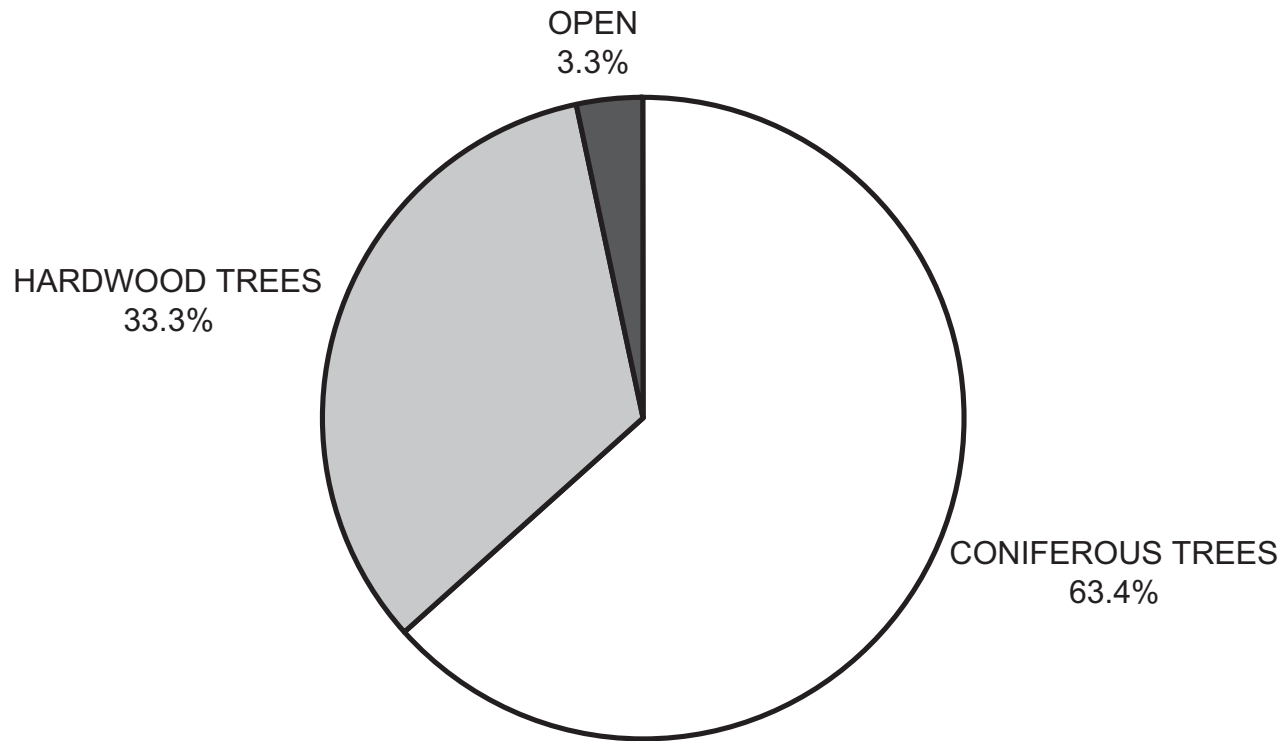
GRAPH 7

1238182397506 2008
SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



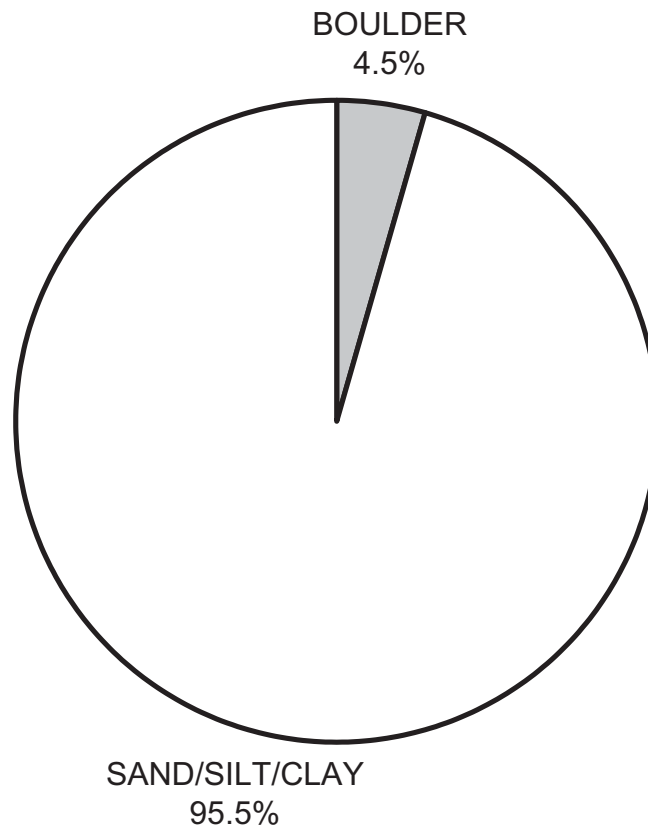
GRAPH 8

1238182397506 2008
MEAN PERCENT CANOPY



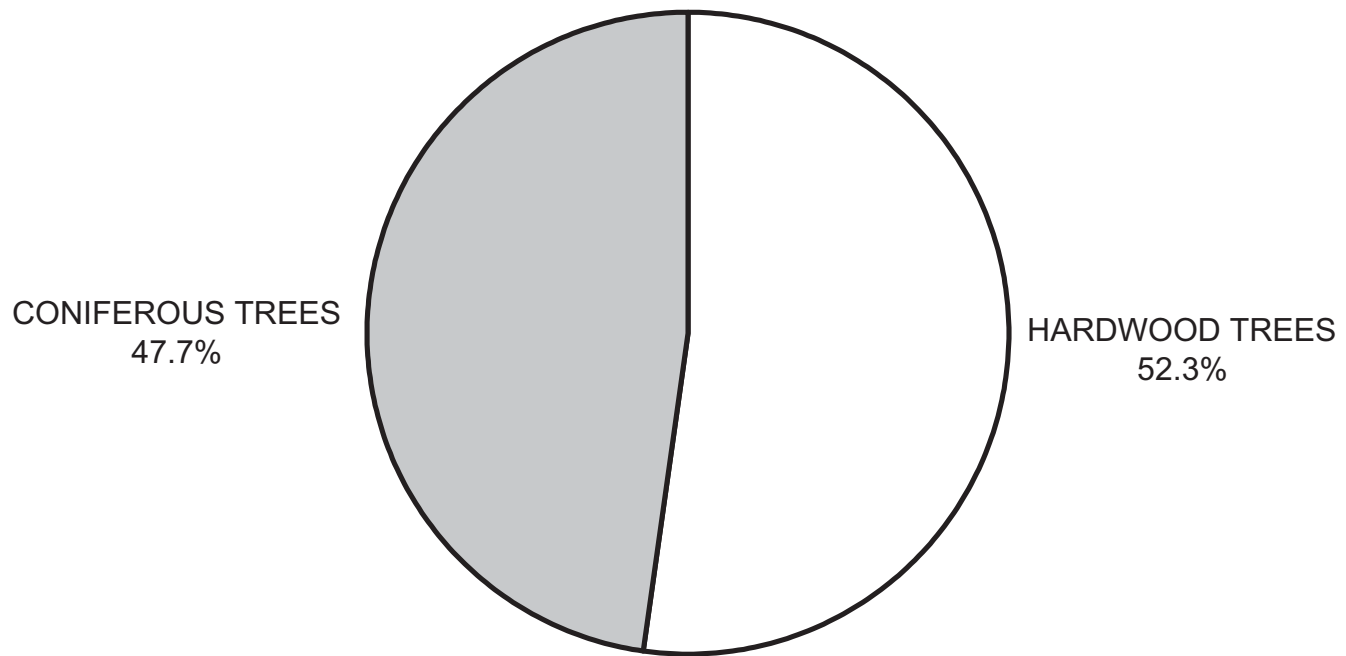
GRAPH 9

1238182397506 2008
DOMINANT BANK COMPOSITION IN SURVEY REACH



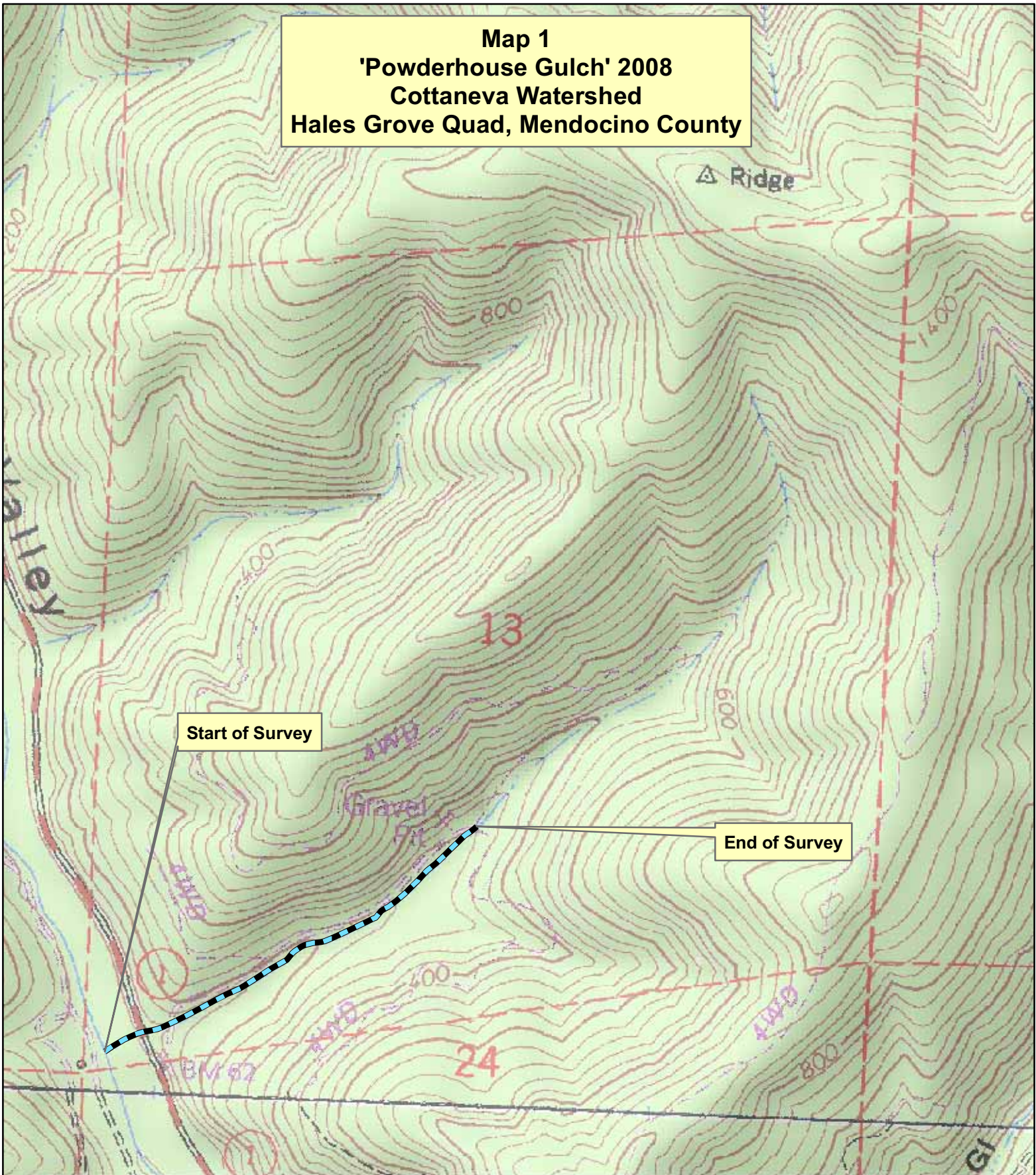
GRAPH 10

1238182397506 2008
DOMINANT BANK VEGETATION IN SURVEY REACH




GRAPH 11

Map 1
'Powderhouse Gulch' 2008
Cottaneva Watershed
Hales Grove Quad, Mendocino County



Legend

 Reach 1, B4 Channel Type

