

STREAM INVENTORY REPORT

Water Gulch

INTRODUCTION

A stream inventory was conducted from May 5 to May 24, 2011 on Water Gulch. The survey began at the confluence with Chamberlain Creek and extended upstream 1.7 miles.

The Water 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 Water 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

Water Gulch is a tributary to Chamberlain Creek, a tributary to North Fork Big River, tributary to Big River, which drains to the Pacific Ocean. It is located in Mendocino County, California (Map 1). Water Gulch's legal description at the confluence with Chamberlain Creek is T17N R15W S05. Its location is 39.3556 degrees north latitude and 123.5564 degrees west longitude, LLID number 1235550393556. Water Gulch is a first order stream and has approximately 1.1 miles of blue line stream according to the USGS Comptche 7.5 minute quadrangle. Water Gulch drains a watershed of approximately 1.4 square miles. Elevations range from about 300 feet at the mouth of the creek to 800 feet in the headwater areas. Mixed conifer forest dominates the watershed. The watershed is in the Jackson Demonstration State Forest and is managed by the California Department of Forestry and Fire Protection. Vehicle access exists via State Route 20.

METHODS

The habitat inventory conducted in Water Gulch 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 and Watershed Stewards Project/AmeriCorps (WSP) Members that conducted the inventory were trained in standardized habitat inventory methods by the 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 Water 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". Water 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 Water 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 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 Water 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. 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 Water 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 Water 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 Water Gulch. In addition, underwater observations were made at 25 sites using techniques discussed in the *California Salmonid Stream Habitat Restoration Manual*.

DATA ANALYSIS

Data from the habitat inventory form are entered into Stream Habitat 2.0.19, a Visual Basic data entry program developed by Karen Wilson, Pacific States Marine Fisheries Commission in conjunction with the California Department of Fish and Game. This program processes and summarizes the data, and produces the following ten tables:

- Riffle, Flatwater, and Pool Habitat Types
- Habitat Types and Measured Parameters
- Pool Types
- Maximum Residual Pool Depths by Habitat Types
- Mean Percent Cover by Habitat Type
- Dominant Substrates by Habitat Type
- Mean Percent Vegetative Cover for Entire Stream
- Fish Habitat Inventory Data Summary by Stream Reach (Table 8)
- Mean Percent Dominant Substrate / Dominant Vegetation Type for Entire Stream
- Mean Percent Shelter Cover Types for Entire Stream

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Graphics are produced from the tables using Microsoft Excel. Graphics developed for Water 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 May 5 to May 24, 2011, was conducted by M. McGowan, D. Opalacz, K. Christen, and B. Williams (WSP). The total length of the stream surveyed was 9,001 feet with an additional 33 feet of side channel.

Stream flow was measured near the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 0.76 cfs on May 24, 2011.

Water Gulch is an F4 channel type for 1,642 feet of the stream surveyed (Reach 1), a G4 channel type for 573 feet of the stream surveyed (Reach 2), and an F4 channel type for 6,819 feet of the stream surveyed (Reach 3). F4 channel types are entrenched meandering riffle/pool channels on low gradients with high width/depth ratios and gravel-dominant substrates. G4 channels are entrenched “gully” step-pool channels on moderate gradients with low width /depth ratios and gravel-dominant substrates.

Water temperatures taken during the survey period ranged from 48 to 52 degrees Fahrenheit. Air temperatures ranged from 42 to 62 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 54% pool units, 31% flatwater units, and 15% riffle units (Graph 1). Based on total length of Level II habitat types there were 52% pool units, 37% flatwater units, 9% riffle units, and 3% not surveyed due to marsh units (Graph 2).

Twelve Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were mid-channel pool units, 48%; run units, 19%; and low gradient riffle

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units, 13% (Graph 3). Based on percent total length, mid-channel pool units made up 48%, step run units 20%, and run units 17%.

A total of 141 pools were identified (Table 3). Main channel pools were the most frequently encountered at 90% (Graph 4), and comprised 95% 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. Twenty-seven of the 141 pools (19%) had a residual depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 141 pool tail-outs measured, 53 had a value of 1 (37.6%); 52 had a value of 2 (36.9%); 16 had a value of 3 (11.3%); 9 had a value of 4 (6.4%); 11 had a value of 5 (7.8%); (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 6, and pool habitats had a mean shelter rating of 27 (Table 1). Of the pool types, the main channel pools had the highest mean shelter rating at 28. Scour pools had a mean shelter rating of 21. Backwater pools had a mean shelter rating of zero (Table 3).

Table 5 summarizes mean percent cover by habitat type. Undercut banks are the dominant cover type in Water Gulch. Graph 7 describes the pool cover in Water Gulch. Undercut banks are 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 76% 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 Water Gulch was 90%. Ten percent of the canopy was open. Of the canopy present, the mean percentages of hardwood and coniferous trees were 29% and 71%, respectively. Graph 9 describes the mean percent canopy in Water 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 73% sand/silt/clay, 15% bedrock, and 12% cobble/gravel (Graph 10). Coniferous trees were the dominant vegetation type observed in 55% of the units surveyed. Additionally, 23% of the units surveyed had deciduous trees as the dominant vegetation type, and 14% had grass as the dominant vegetation type (Graph 11).

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BIOLOGICAL INVENTORY RESULTS

Survey teams conducted a snorkel survey at 25 sites for species composition and distribution in Water Gulch on July 5, 2011. The water temperature taken during the survey period of 1335 hours to 1640 hours was 75 degrees Fahrenheit. Air temperatures ranged from 70 to 72 degrees Fahrenheit. The sites were sampled by I. Mikus and M. Groff (DFG).

In reach 1, which comprised the first 1,642 feet of stream, 10 sites were sampled. The reach sites yielded 33 young-of-the-year steelhead/rainbow trout (SH/RT), one age 1+ SH/RT, and four age 2+ SH/RT.

In reach 2, four sites were sampled starting approximately 1,741 feet from the confluence with Chamberlain Creek and continuing upstream 370 feet. The reach sites yielded 25 young-of-the-year SH/RT, and two age 1+ SH/RT.

In reach 3, 10 sites were sampled starting approximately 2,448 feet from the confluence with Chamberlain Creek and continuing upstream 5,318 feet. The reach sites yielded six young-of-the-year SH/RT, and one age 1+ SH/RT.

Additionally, one site was sampled upstream of the end of survey point. No fish were observed.

The following chart displays the information yielded from these sites:

2011 Water Gulch underwater observations.

Date	Survey Site #	Habitat Unit #	Habitat Type	Approx. Dist. from mouth (ft.)	SH/RT			Coho	
					YOY	1+	2+	YOY	1+
Reach 1: F4 Channel Type									
07/05/11	1	001	Pool	20	6	0	0	0	0
	2	006	Pool	109	1	0	1	0	0
	3	009	Pool	156	2	0	0	0	0
	4	016	Pool	465	1	1	0	0	0
	5	023	Pool	646	0	0	1	0	0
	6	031	Pool	824	6	0	1	0	0
	7	040	Pool	1,167	5	0	0	0	0
	8	042	Pool	1,285	3	0	1	0	0
	9	046	Pool	1,416	6	0	0	0	0
	10	048	Pool	1,466	3	0	0	0	0
Reach 2: G4 Channel Type									
	11	054	Pool	1,770	1	1	0	0	0

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	12	058	Pool	1,919	10	0	0	0	0
	13	060	Pool	2,021	13	0	0	0	0
	14	063	Pool	2,111	1	1	0	0	0
Reach 3: F4 Channel Type									
	15	071	Pool	2,479	0	0	0	0	0
	16	076	Pool	2,751	0	0	0	0	0
	17	078	Pool	2,796	0	0	0	0	0
	18	187	Pool	6,574	0	0	0	0	0
	19	193	Pool	6,732	0	1	0	0	0
	20	195	Pool	6,793	1	0	0	0	0
	21	202	Pool	6,986	1	0	0	0	0
	22	217	Pool	7,300	0	0	0	0	0
	23	227	Pool	7,630	0	0	0	0	0
	24	232	Pool	7,766	4	0	0	0	0
Upstream of end of survey point:									
	25	--	Pool	--	0	0	0	0	0

DISCUSSION

Water Gulch is an F4 channel type for the first 1,642 feet of the stream surveyed, a G4 channel type for the next 573 feet of the stream surveyed, and an F4 channel type for the remaining 6,819 feet of the stream surveyed. The suitability of F4 and G4 channel types for fish habitat improvement structures is as follows: F4 channel types are good for bank-placed boulders and fair for plunge weirs, single and opposing wing-deflectors, channel constrictors, and log cover. G4 channel types are good for bank-placed boulders and fair for plunge weirs, opposing wing-deflectors, and log cover.

The water temperatures recorded on the survey days May 5 to May 24, 2011, ranged from 48 to 52 degrees Fahrenheit. Air temperatures ranged from 42 to 62 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 37% of the total length of this survey, riffles 9%, and pools 52%. Twenty-seven of the 141 (19%) 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

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the low flow channel, and be as long as the low flow channel width. Installing large wood structures that will deepen pool habitat is recommended.

One hundred five of the 141 pool tail-outs measured had embeddedness ratings of 1 or 2. Twenty-five of the pool tail-outs had embeddedness ratings of 3 or 4. Eleven 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.

One hundred twenty-three of the 140 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 27. The shelter rating in the flatwater habitats is 6. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by undercut banks in Water Gulch. Undercut banks are 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 90%. Reach 1 had a canopy density of 89%, Reach 2 had a canopy density of 95%, and Reach 3 had a canopy density of 90%. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was 96% and 96%, 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) Water 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 undercut banks. Adding high quality complexity with woody cover in the pools is desirable.
- 4) Remove the old dam structure at 824 feet to provide unimpeded fish passage.

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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 Chamberlain Creek. The channel is an F4.
20	0002.00	Log stringer bridge is collapsing, causing erosion on the left bank.
94	0006.00	There is a 1.6' high plunge.
139	0009.00	There is a 1.6' high plunge.
619	0023.00	A road crosses the channel. The crossing is a 16.3' wide x 14.1' high x 11' long concrete bridge with concrete abutments forming the left and right banks. A notched log spans the wetted width.
805	0031.00	There is a 1.3' high plunge over concrete base of dam.
824	0032.00	There is an old dam with a 2' wide x 10.1' high x 31.1 foot metal foot bridge. The dam has a concrete base that measures 10' long and concrete wings on each bank. There is a 1.3' high jump onto the concrete base and then a 1.1' high jump off the concrete base to the stream channel above the dam. The depth of the water flowing over the concrete base is 0.1'. The two concrete wings constrict the channel from 30 feet to 5.6 feet.
1042	0037.00	A decommissioned road crosses the channel. There is a log stringer bridge consisting of 5 redwood logs spanning the channel and logs forming the abutments. The bridge measures 13.2' wide x 6' high x 25' long. The road's surface is made of fine sediment and gravel, which have collapsed into the creek in the gaps between the logs.
1642	0051.00	The channel changes from an F4 to a G4.
1919	0059.00	Small woody debris is accumulating in the channel.
2002	0060.00	A potential log debris accumulation (LDA) is retaining sediment.
2177	0065.00	A landslide on the right bank measures approximately 60' high x 15' long is contributing woody debris and sediment to the channel.

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2202	0066.00	Bedrock sheet measuring 5.5' tall x 13' long.
2215	0067.00	The channel changes from a G4 to an F4.
3183	0089.00	There is a root wad in the channel associated with root mass.
3416	0093.00	LDA #01 contains eight pieces of large woody debris (LWD) and measures 6' high x 15' wide x 29' long. Water flows through the LDA and there are no visible gaps in it. Retained sediment ranges from silt to sand and measures 3' wide x 18' long x 3' deep. Fish were observed above the LDA.
3875	0105.00	LDA #02 contains four pieces of LWD and measures 6' high x 14' wide x 22' 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.
4007	0108.00	There is a culvert on the left bank. The bank below it is armored with rip-rap.
4478	0124.00	There is a 1.2' high plunge.
4492	0125.00	There is a culvert on the left bank.
4589	0129.00	A tributary on the right bank is nearly dry. Woody debris is accumulating in the channel.
4940	0139.00	LDA #03 contains seven pieces of LWD and measures 5' high x 20' wide x 12' long. Water flows through the LDA and there are no visible gaps in it. The LDA is not retaining sediment. Fish were observed above the LDA.
5287	0151.00	Woody debris is accumulating in the channel.
5303	0152.00	LDA #04 contains nine pieces of LWD and measures 2' high x 10' wide x 16' long. Water flows through the LDA and there are no visible gaps in it. The LDA is not retaining sediment. Fish were observed above the LDA.
5743	0161.00	There is a 2.5' high plunge.
5756	0161.01	There is a 3' high plunge.
7691	0231.00	An erosion site measures 15' high x 60' long.
7938	0237.00	Tributary #01 enters on the left bank. It contributes to approximately 50% of Water Gulch's flow. The water temperature downstream and

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upstream of the tributary is 50 degrees Fahrenheit; the water temperature of the tributary is 49 degrees Fahrenheit. The slope of the tributary is approximately 2%. The tributary is accessible to salmonids, but no fish were observed.

7984	0238.00	Flow is subterranean at a Humboldt crossing.
8004	0239.00	250' of stream was not surveyed due to a marsh.
8760	0252.00	LDA #05 contains five pieces of LWD and measures 6' high x 8' wide x 17' long. Water flows through the LDA and there are visible gaps in it. Retained sediment ranges from silt to sand and measures 2' wide x 12' long x 10' deep. It is a possible barrier to juvenile and adult salmonids.
8821	0254.00	There is a 4' high waterfall.
9001	0259.00	End of survey due to diminished habitat. There is little flow and the channel is overgrown with brush.

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: Water Gulch

LLID: 1235550393556 Drainage: Big River

Survey Dates: 5/9/2011 to 5/24/2011

Confluence Location: Quad: COMPTCHE Legal Description: T17NR15WS05 Latitude: 39:21:20.0N Longitude: 123:33:18.0

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
80	7	FLATWATER	30.7	42	3320	36.8	6.3	0.7	1.1	318	25478	194	15557		6
1	0	NOSURVEY	0.4	20	20	0.2									
1	0	NOSURVEY_	0.4	250	250	2.8									
141	141	POOL	54.0	33	4657	51.5	6.6	0.8	1.5	220	31030	254	35820	187	27
38	9	RIFFLE	14.6	21	787	8.7	5.2	0.4	0.7	96	3656	38	1461		9
Total Units	Total Units Fully Measured				Total Length (ft.)					Total Area (sq.ft.)			Total Volume (cu.ft.)		
261	157				9034					60164			52838		

Table 2 - Summary of Habitat Types and Measured Parameters

Stream Name: Water Gulch

LLID: 1235550393556

Drainage: Big River

Survey Dates: 5/9/2011 to 5/24/2011

Confluence Location: Quad: COMPTCHE

Legal Description: T17NR15WS05

Latitude: 39:21:20.0N

Longitude: 123:33:18.0W

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 (%)
33	5	LGR	12.6	21	695	7.7	5	0.4	1	115	3786	44	1452		0	87
3	2	HGR	1.1	23	70	0.8	6	0.5	0.8	104	312	48	143		0	98
2	2	BRS	0.8	11	22	0.2	4	0.4	0.8	42	84	15	31		40	84
49	4	RUN	18.8	31	1507	16.7	6	0.7	1.3	235	11521	162	7932		5	93
31	3	SRN	11.9	58	1813	20.1	7	0.6	1.2	430	13319	238	7376		7	91
124	124	MCP	47.5	35	4346	48.1	7	0.8	3.6	233	28936	273	33821	201	28	90
3	3	STP	1.1	20	60	0.7	6	0.4	1.1	114	343	74	222	43	38	95
2	2	CRP	0.8	26	53	0.6	6	0.7	1.6	140	281	141	281	99	10	90
1	1	LSL	0.4	15	15	0.2	5	0.6	1.2	75	75	60	60	45	5	96
2	2	LSR	0.8	13	26	0.3	8	0.6	1.5	97	194	103	207	55	55	93
7	7	PLP	2.7	15	107	1.2	7	1.1	2.5	107	751	135	944	102	16	87
2	2	DPL	0.8	25	50	0.6	10	0.7	1.4	225	450	143	285	120	0	77
1	0	NS	0.4	20	20	0.2										
1	0	MAR	0.4	250	250	2.8										

Total Units
261

Total Units Fully Measured
157

Total Length (ft.)
9034

Total Area (sq.ft.)
60051

Total Volume (cu.ft.)
52753

Table 3 - Summary of Pool Types

Stream Name: Water Gulch

LLID: 1235550393556

Drainage: Big River

Survey Dates: 5/9/2011 to 5/24/2011

Confluence Location: Quad: COMPTCHE

Legal Description: T17NR15WS05

Latitude: 39:21:20.0N

Longitude: 123:33:18.0W

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
127	127	MAIN	90	35	4406	95	6.5	0.7	231	29279	197	25074	28
12	12	SCOUR	9	17	201	4	6.6	0.9	108	1301	89	1064	21
2	2	BACKWATER	1	25	50	1	10.0	0.7	225	450	120	240	0

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
141	141	4657	31030	26378

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

Stream Name: Water Gulch

LLID: 1235550393556

Drainage: Big River

Survey Dates: 5/9/2011 to 5/24/2011

Confluence Location: Quad: COMPTCHE

Legal Description: T17NR15WS05

Latitude: 39:21:20.0N

Longitude: 123:33:18.0W

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
124	MCP	88	24	19	75	60	22	18	3	2	0	0
3	STP	2	0	0	3	100	0	0	0	0	0	0
2	CRP	1	0	0	2	100	0	0	0	0	0	0
1	LSL	1	0	0	1	100	0	0	0	0	0	0
2	LSR	1	0	0	2	100	0	0	0	0	0	0
7	PLP	5	0	0	5	71	2	29	0	0	0	0
2	DPL	1	0	0	2	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
141	24	17	90	64	24	17	3	2	0	0

Mean Maximum Residual Pool Depth (ft.): 1.5

Table 5 - Summary of Mean Percent Cover By Habitat Type

Stream Name: Water Gulch

LLID: 1235550393556

Drainage: Big River

Survey Dates: 5/9/2011 to 5/24/2011

Dry Units: 0

Confluence Location: Quad: COMPTCHE

Legal Description: T17NR15WS05

Latitude: 39:21:20.0N

Longitude: 123:33:18.0W

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
33	5	LGR	0	0	0	0	0	0	0	0	0
3	2	HGR	0	0	0	0	0	0	0	0	0
2	2	BRS	0	0	0	0	0	0	100	0	0
38	9	TOTAL RIFFLE	0	0	0	0	0	0	100	0	0
49	4	RUN	77	20	3	0	0	0	0	0	0
31	3	SRN	0	40	0	0	0	0	40	20	0
80	7	TOTAL FLAT	58	25	3	0	0	0	10	5	0
124	124	MCP	37	22	21	2	8	2	1	3	4
3	3	STP	0	43	17	0	0	0	23	17	0
2	2	CRP	45	50	0	5	0	0	0	0	0
1	1	LSL	0	0	100	0	0	0	0	0	0
2	2	LSR	0	20	35	45	0	0	0	0	0
7	7	PLP	29	13	0	6	1	0	49	1	1
2	2	DPL									
141	141	TOTAL POOL	34	22	20	3	7	2	5	3	3
1	0	NS									
1	0	MAR									
261	157	TOTAL	35	22	19	3	7	2	6	3	3

Table 6 - Summary of Dominant Substrates By Habitat Type

Stream Name: Water Gulch

LLID: 1235550393556

Drainage: Big River

Survey Dates: 5/9/2011 to 5/24/2011

Dry Units: 0

Confluence Location: Quad: COMPTCHE

Legal Description: T17NR15WS05

Latitude: 39:21:20.0N

Longitude: 123:33:18.0W

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
33	6	LGR	0	0	67	33	0	0	0
3	2	HGR	0	0	0	50	50	0	0
2	2	BRS	0	0	0	0	0	0	100
49	4	RUN	0	0	50	50	0	0	0
31	3	SRN	0	0	67	33	0	0	0
124	124	MCP	14	10	70	4	0	0	2
3	3	STP	33	0	33	33	0	0	0
2	2	CRP	0	50	50	0	0	0	0
1	1	LSL	0	0	100	0	0	0	0
2	2	LSR	0	0	100	0	0	0	0
7	7	PLP	29	14	57	0	0	0	0
2	2	DPL	0	0	100	0	0	0	0

Table 7 - Summary of Mean Percent Canopy for Entire Stream

Stream Name: Water Gulch

LLID: 1235550393556

Drainage: Big River

Survey Dates: 5/9/2011 to 5/24/2011

Confluence Location: Quad: COMPTCHE

Legal Description: T17NR15WS05

Latitude: 39:21:20.0N

Longitude: 123:33:18.0W

Mean Percent Canopy	Mean Percent Conifer	Mean Percent Hardwood	Mean Percent Open Units	Mean Right Bank % Cover	Mean Left Bank % Cover
90	71	29	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: Water Gulch LLID: 1235550393556 Drainage: Big River
 Survey Dates: 5/9/2011 to 5/24/2011 Survey Length (ft.): 9034 Main Channel (ft.): 9001 Side Channel (ft.): 33
 Confluence Location: Quad: COMPTCHE Legal Description: T17NR15WS05 Latitude: 39:21:20.0N Longitude: 123:33:18.0W

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 1

Channel Type: F4	Canopy Density (%): 89.0	Pools by Stream Length (%): 47.3
Reach Length (ft.): 1642	Coniferous Component (%): 58.3	Pool Frequency (%): 52.0
Riffle/Flatwater Mean Width (ft.): 7.0	Hardwood Component (%): 41.7	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation: Hardwood Trees	< 2 Feet Deep: 85
Range (ft.): 8 to 15	Vegetative Cover (%): 95.0	2 to 2.9 Feet Deep: 15
Mean (ft.): 12	Dominant Shelter: Undercut Banks	3 to 3.9 Feet Deep: 0
Std. Dev.: 2	Dominant Bank Substrate Type: Bedrock	>= 4 Feet Deep: 0
Base Flow (cfs.): 0.8	Occurrence of LWD (%): 6	Mean Max Residual Pool Depth (ft.): 1.4
Water (F): 48 - 52 Air (F): 42 - 60	LWD per 100 ft.:	Mean Pool Shelter Rating: 14
Dry Channel (ft): 0	Riffles: 1	
	Pools: 1	
	Flat: 1	
Pool Tail Substrate (%): Silt/Clay: 0 Sand: 0 Gravel: 58 Sm Cobble: 23 Lg Cobble: 0 Boulder: 0 Bedrock: 19		
Embeddedness Values (%): 1. 26.9 2. 53.8 3. 3.8 4. 0.0 5. 15.4		

STREAM REACH: 2

Channel Type: G4	Canopy Density (%): 94.8	Pools by Stream Length (%): 30.5
Reach Length (ft.): 573	Coniferous Component (%): 55.0	Pool Frequency (%): 43.8
Riffle/Flatwater Mean Width (ft.): 5.3	Hardwood Component (%): 45.0	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation: Hardwood Trees	< 2 Feet Deep: 86
Range (ft.): 10 to 10	Vegetative Cover (%): 98.0	2 to 2.9 Feet Deep: 14
Mean (ft.): 10	Dominant Shelter: Boulders	3 to 3.9 Feet Deep: 0
Std. Dev.: 0	Dominant Bank Substrate Type: Bedrock	>= 4 Feet Deep: 0
Base Flow (cfs.): 0.8	Occurrence of LWD (%): 2	Mean Max Residual Pool Depth (ft.): 1.4
Water (F): 49 - 51 Air (F): 56 - 59	LWD per 100 ft.:	Mean Pool Shelter Rating: 26
Dry Channel (ft): 0	Riffles: 0	
	Pools: 3	
	Flat: 3	
Pool Tail Substrate (%): Silt/Clay: 0 Sand: 0 Gravel: 86 Sm Cobble: 14 Lg Cobble: 0 Boulder: 0 Bedrock: 0		
Embeddedness Values (%): 1. 42.9 2. 28.6 3. 28.6 4. 0.0 5. 0.0		

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 3

Channel Type: F4	Canopy Density (%): 89.6	Pools by Stream Length (%): 54.3
Reach Length (ft.): 6786	Coniferous Component (%): 76.2	Pool Frequency (%): 55.4
Riffle/Flatwater Mean Width (ft.): 5.3	Hardwood Component (%): 23.8	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation: Coniferous Trees	< 2 Feet Deep: 80
Range (ft.): 8 to 11	Vegetative Cover (%): 96.0	2 to 2.9 Feet Deep: 18
Mean (ft.): 10	Dominant Shelter: Undercut Banks	3 to 3.9 Feet Deep: 3
Std. Dev.: 1	Dominant Bank Substrate Type: Sand/Silt/Clay	>= 4 Feet Deep: 0
Base Flow (cfs.): 0.8	Occurrence of LWD (%): 19	Mean Max Residual Pool Depth (ft.): 1.6
Water (F): 50 - 52	Air (F): 44 - 62	LWD per 100 ft.:
Dry Channel (ft): 0	Riffles: 1	Pools: 6
	Flat: 2	
Pool Tail Substrate (%): Silt/Clay: 9	Sand: 0	Gravel: 80
	Sm Cobble: 8	Lg Cobble: 0
	Boulder: 0	Bedrock: 2
Embeddedness Values (%): 1. 39.8	2. 33.3	3. 12.0
	4. 8.3	5. 6.5

Table 9 - Mean Percentage of Dominant Substrate and Vegetation

Stream Name: Water Gulch

LLID: 1235550393556

Drainage: Big River

Survey Dates: 5/9/2011 to 5/24/2011

Confluence Location: Quad: COMPTCHE

Legal Description: T17NR15WS05

Latitude: 39:21:20.0N

Longitude: 123:33:18.0W

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	20	26	14.6
Boulder	0	0	0.0
Cobble / Gravel	20	18	12.1
Sand / Silt / Clay	117	113	73.2

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	25	19	14.0
Brush	12	15	8.6
Hardwood Trees	40	31	22.6
Coniferous Trees	80	92	54.8
No Vegetation	0	0	0.0

Total Stream Cobble Embeddedness Values: 2

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

StreamName: Water Gulch

LLID: 1235550393556

Drainage: Big River

Survey Dates: 5/9/2011 to 5/24/2011

Confluence Location: Quad: COMPTCHE

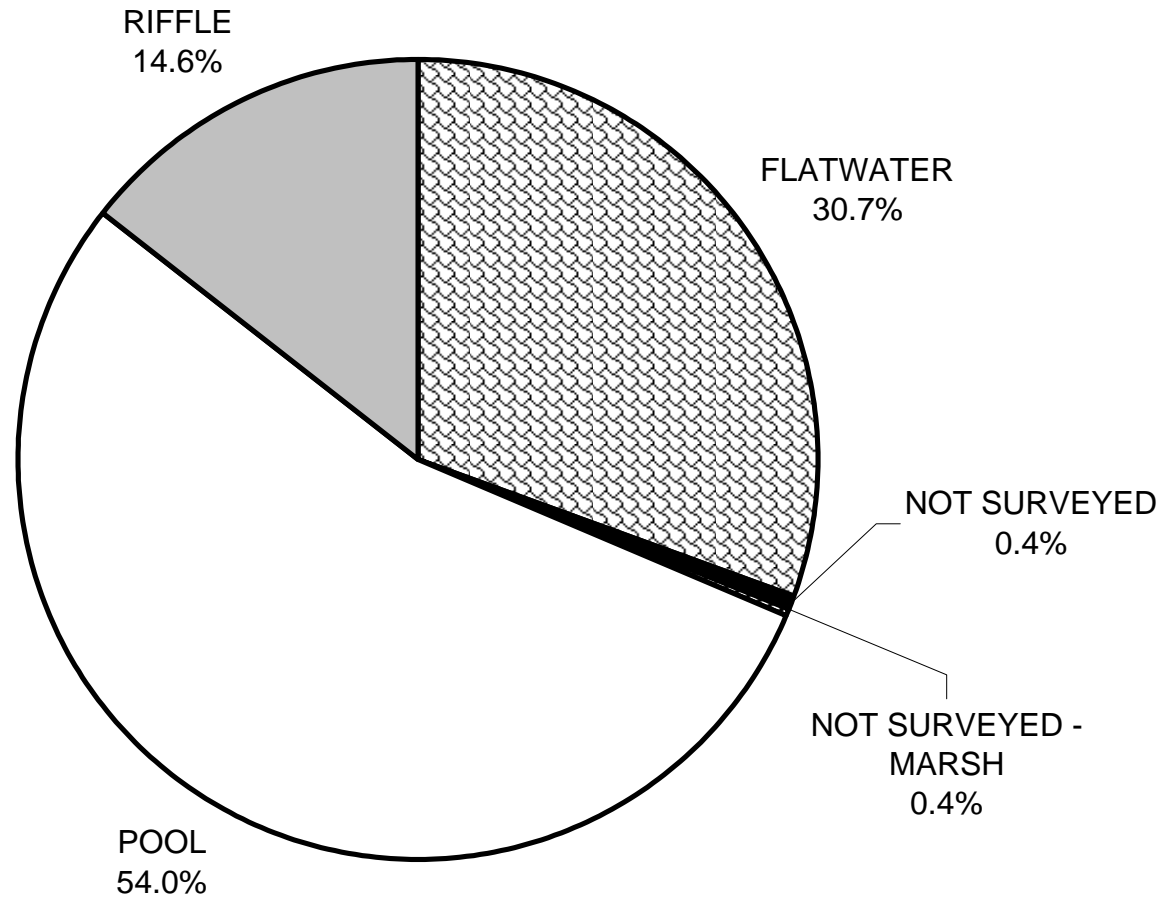
Legal Description: T17NR15WS05

Latitude: 39:21:20.0N

Longitude: 123:33:18.0W

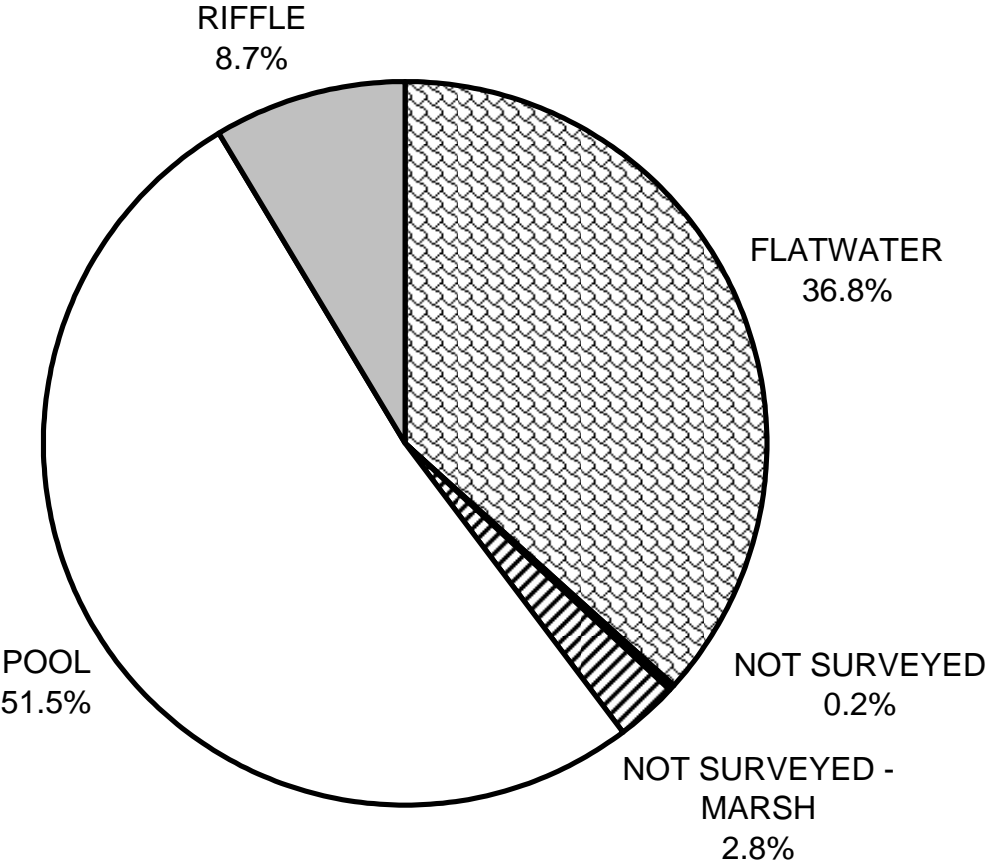
	Riffles	Flatwater	Pools
UNDERCUT BANKS (%)	0	58	34
SMALL WOODY DEBRIS (%)	0	25	22
LARGE WOODY DEBRIS (%)	0	3	20
ROOT MASS (%)	0	0	3
TERRESTRIAL VEGETATION (%)	0	0	7
AQUATIC VEGETATION (%)	0	0	2
WHITEWATER (%)	100	10	5
BOULDERS (%)	0	5	3
BEDROCK LEDGES (%)	0	0	3

WATER GULCH 2011 HABITAT TYPES BY PERCENT OCCURRENCE



GRAPH 1

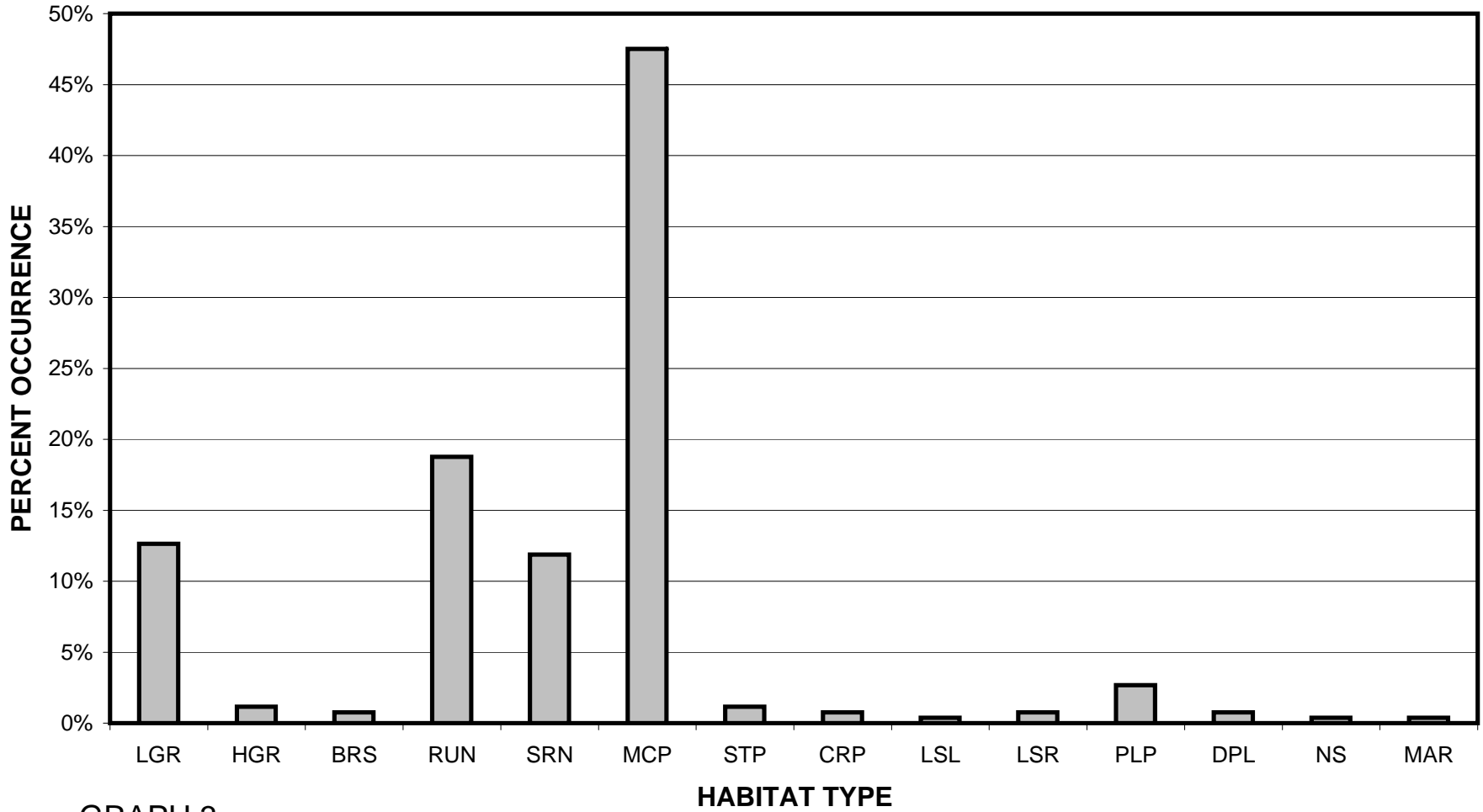
**WATER GULCH 2011
HABITAT TYPES BY PERCENT TOTAL LENGTH**



GRAPH 2

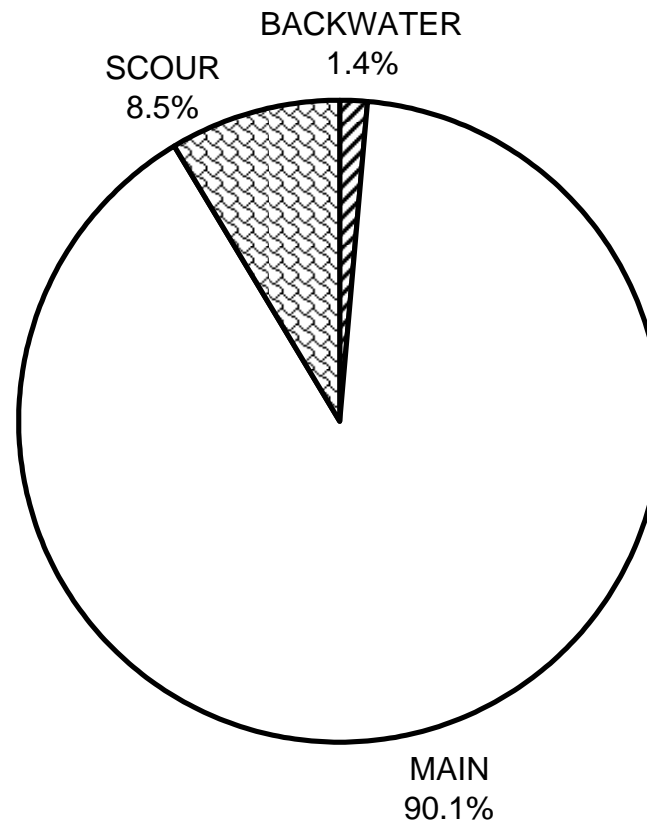
WATER GULCH 2011

HABITAT TYPES BY PERCENT OCCURRENCE



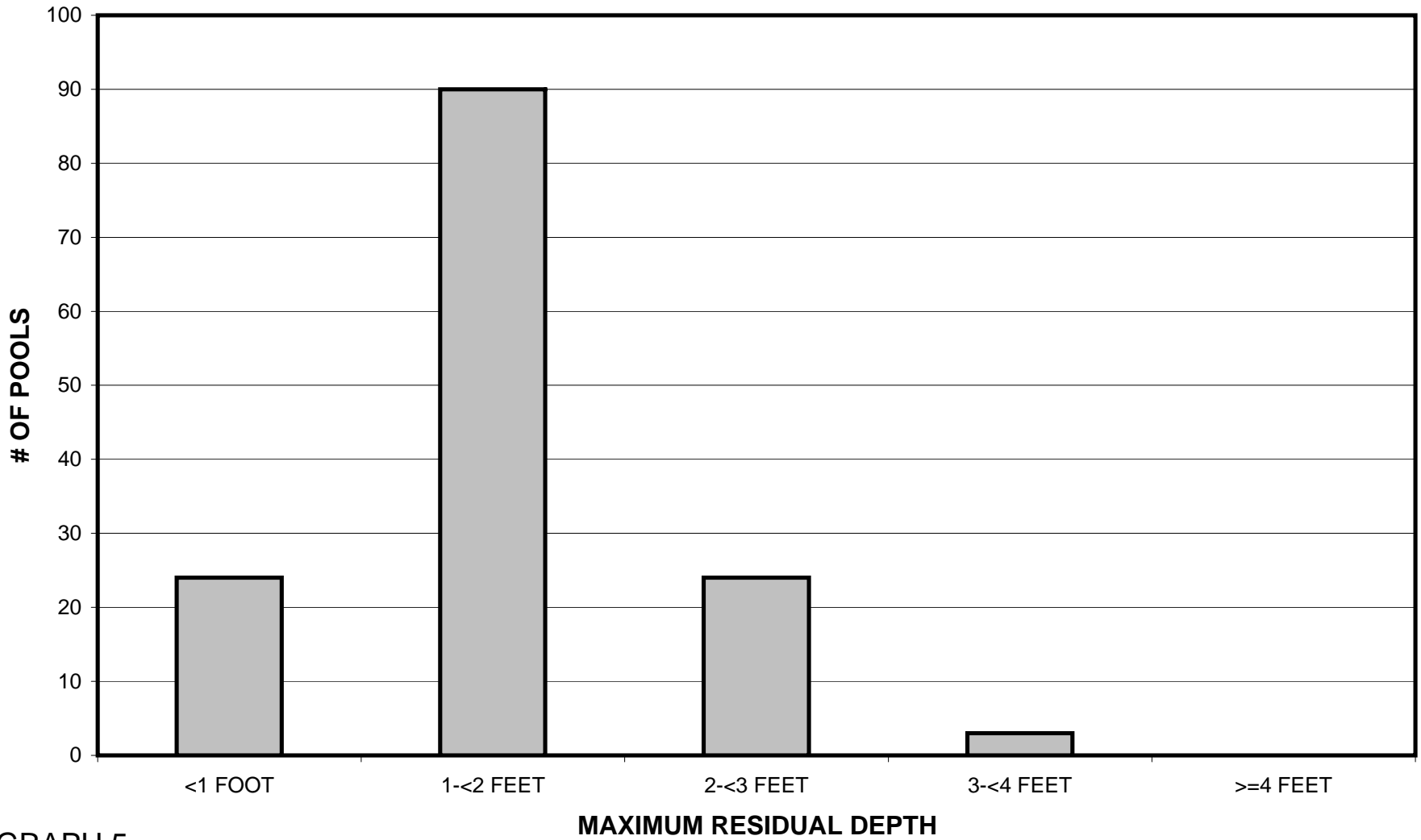
GRAPH 3

WATER GULCH 2011 POOL TYPES BY PERCENT OCCURRENCE



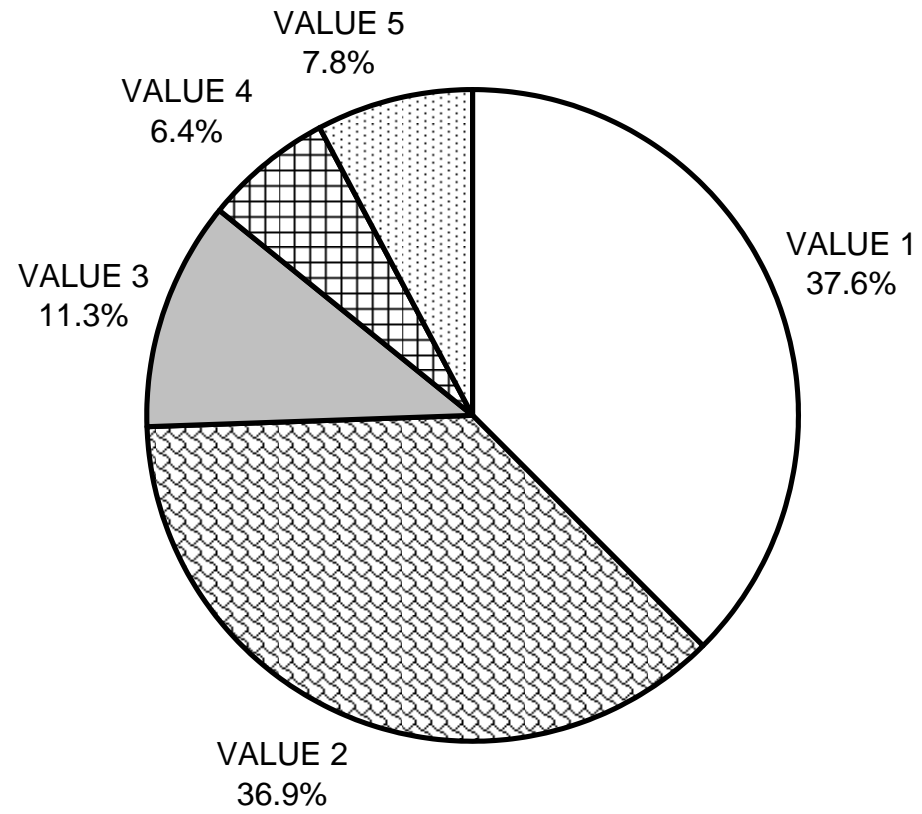
GRAPH 4

WATER GULCH 2011 MAXIMUM DEPTH IN POOLS



GRAPH 5

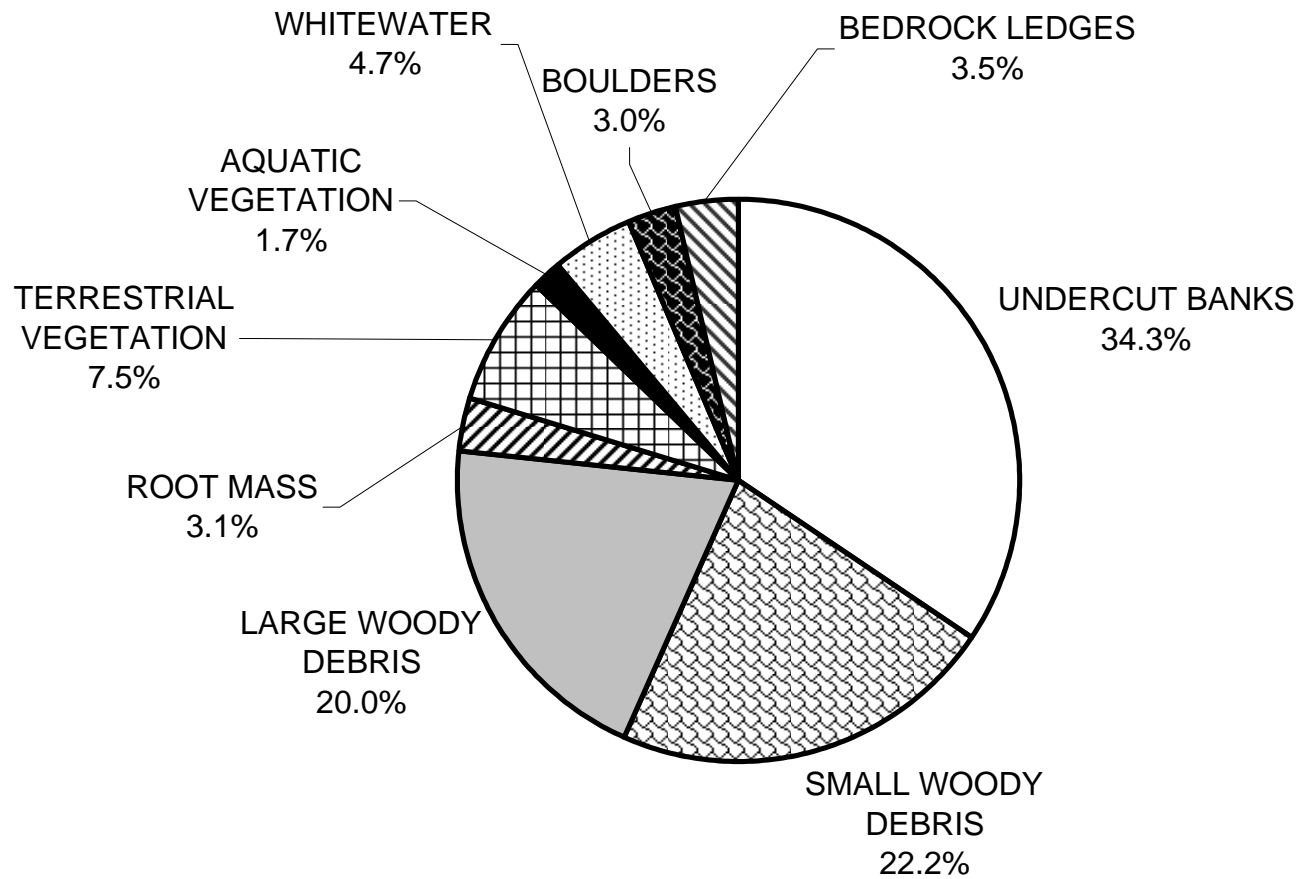
WATER GULCH 2011 PERCENT EMBEDDEDNESS



GRAPH 6

WATER GULCH 2011

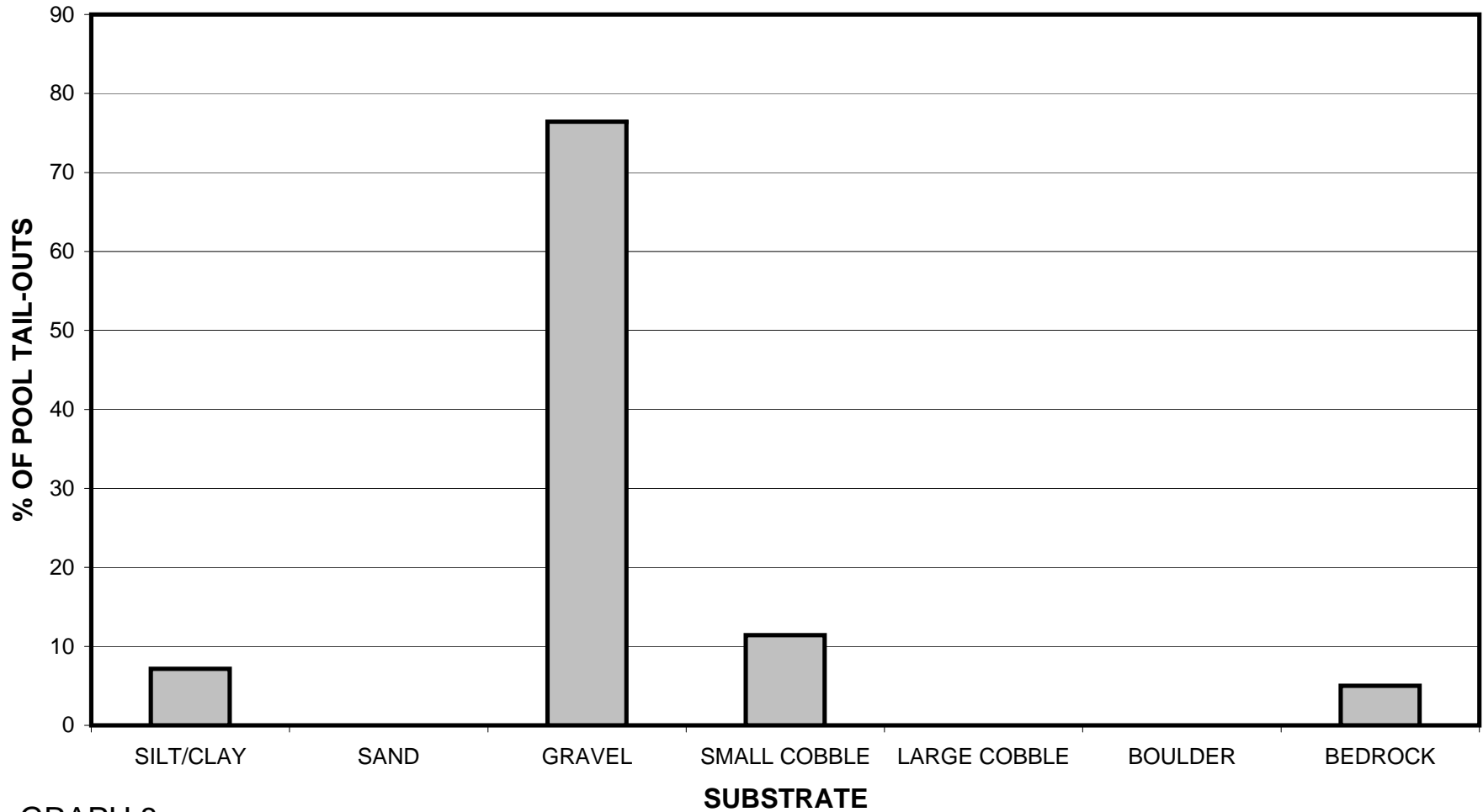
MEAN PERCENT COVER TYPES IN POOLS



GRAPH 7

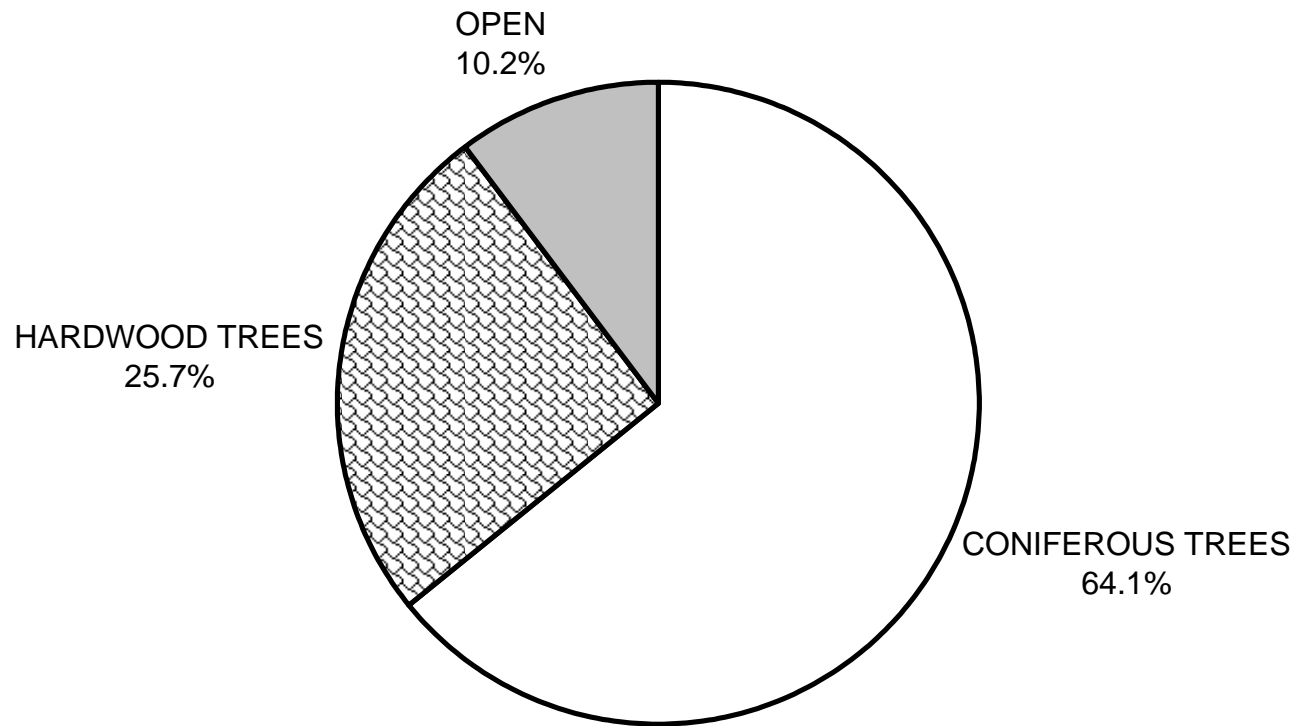
WATER GULCH 2011

SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



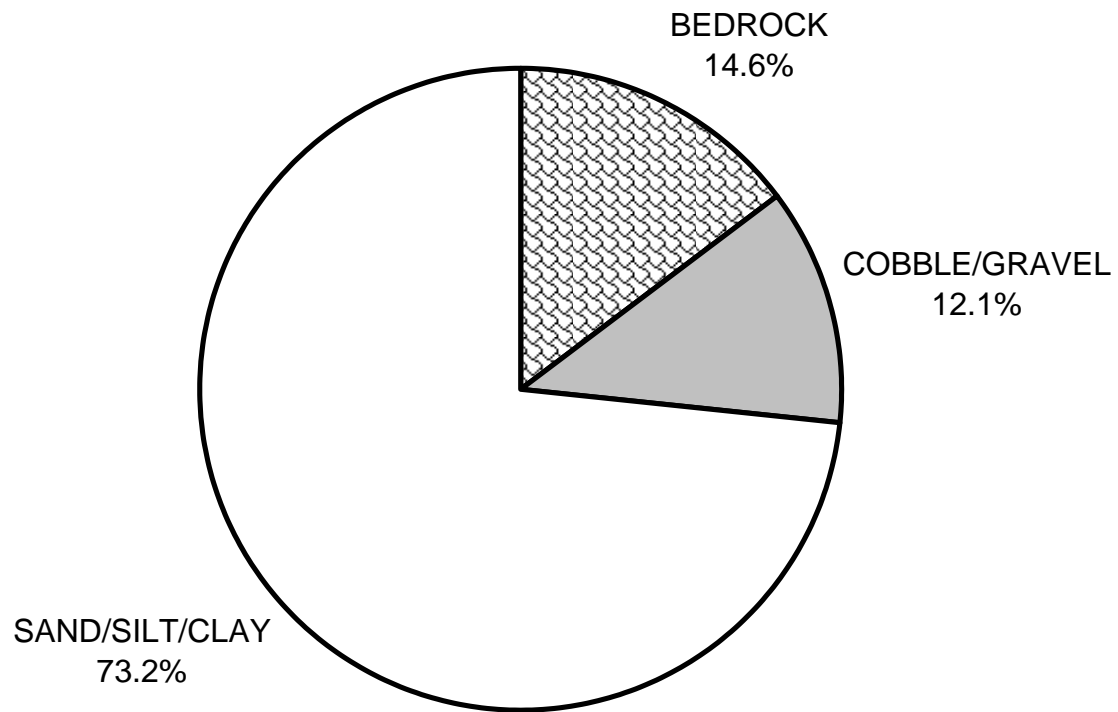
GRAPH 8

WATER GULCH 2011 MEAN PERCENT CANOPY



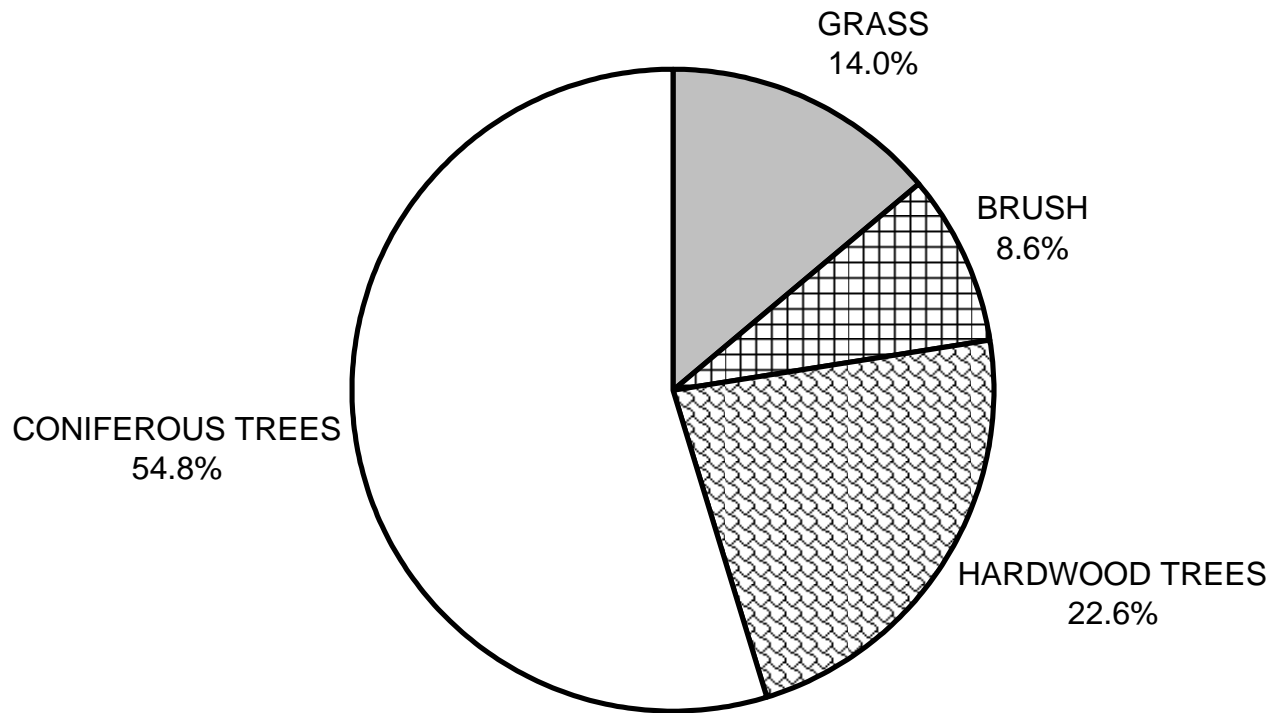
GRAPH 9

**WATER GULCH 2011
DOMINANT BANK COMPOSITION IN SURVEY REACH**



GRAPH 10

WATER GULCH 2011 DOMINANT BANK VEGETATION IN SURVEY REACH



GRAPH 11

