



## CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE

### STREAM INVENTORY REPORT

#### Boardman Gulch

#### INTRODUCTION

A stream inventory was conducted from May 18 to June 3, 2015 on Boardman Gulch. The survey began at the confluence with South Fork Big River and extended upstream 1.3 miles.

The Boardman 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 Boardman 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 Chinook salmon, 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

Boardman Gulch is a tributary to South Fork Big River, tributary to Big River, which drains to the Pacific Ocean. It is located in Mendocino County, California (Map 1). Boardman Gulch's legal description at the confluence with South Fork Big River is T16N R15W S14. Its location is 39.2510 degrees north latitude and 123.4973 degrees west longitude, LLID number 1234961392511. Boardman Gulch is a second order stream and has approximately 2.1 miles of blue line stream according to the USGS Greenough Ridge 7.5 minute quadrangle. Boardman Gulch drains a watershed of approximately 1.3 square miles. Elevations range from about 390 feet at the mouth of the creek to 1,000 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 Comptche-Ukiah Road, southeast of Fort Bragg.

#### METHODS

The habitat inventory conducted in Boardman Gulch follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi et al, 1998). The Watershed Stewards Project (WSP) members and California Department of Fish and Wildlife (CDFW) personnel that conducted the inventory were trained in standardized habitat inventory methods by the CDFW. The 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 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 Boardman 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 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". Boardman 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.

**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 Boardman 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 unsuitable 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

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energy, and allow separation of territorial units to reduce density related competition for prey. 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 Boardman 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. The shelter rating is then calculated by multiplying the qualitative shelter value by the percent of the unit covered. Thus, shelter ratings can range from 0-300 and are expressed as mean values by habitat types within a stream.

### 7. Substrate Composition:

Substrate composition ranges from silt/clay sized particles to boulders and bedrock elements. In all fully-described habitat units, dominant and sub-dominant substrate elements were ocularly estimated using a list of seven size classes and recorded as a one and two, respectively. In addition, the dominant substrate composing the pool tail-outs is recorded for each pool.

### 8. Canopy:

Stream canopy density was estimated using modified handheld spherical densiometers as described in the *California Salmonid Stream Habitat Restoration Manual*. Canopy density relates to the amount of stream shaded from the sun. In Boardman 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 Boardman 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.

### 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),

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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 Boardman Gulch. In addition, underwater observations were made at 10 sites using techniques discussed in the *California Salmonid Stream Habitat Restoration Manual*.

### **DATA ANALYSIS**

Data from the habitat inventory form are entered into Stream Habitat 2.0.18, a Visual Basic data entry program developed by Karen Wilson, Pacific States Marine Fisheries Commission in conjunction with the California Department of Fish and Wildlife. This program processes and summarizes the data, and produces the following ten tables:

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

Graphics are produced from the tables using Microsoft Excel. Graphics developed for Boardman 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

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### HABITAT INVENTORY RESULTS

\* ALL TABLES AND GRAPHS ARE LOCATED AT THE END OF THE REPORT \*

The habitat inventory of May 18 to June 3, 2015 was conducted by J. Guzek (WSP), J. Lee (WSP), J. Murphrey (WSP), M. Groff (CDFW), B. Starks (CDFW), and T. Brown (WSP). The total length of the stream surveyed was 6,910 feet.

Stream flow was too low to measure on Boardman Gulch.

Boardman Gulch is a G4 channel type for all 6,910 feet of the stream surveyed. 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 52 to 56 degrees Fahrenheit. Air temperatures ranged from 52 to 67 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 39% riffle units, 36% flatwater units, 21% pool units, 3% dry units, and 1% unsurveyed units (Graph 1). Based on total length of Level II habitat types there were 53% flatwater units, 30% riffle units, 13% pool units, 2% dry units, 1% culvert units and 1% dry units (Graph 2).

Eleven Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were low gradient riffle units, 28%; step run units, 19%; and mid-channel pool units, 19% (Graph 3). Based on percent total length, step run units made up 40%, low gradient riffle units 25%, and run units 14%.

A total of 67 pools were identified (Table 3). Main channel pools were the most frequently encountered at 90% (Graph 4), and comprised 89% 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. Six of the 67 pools (9%) had a residual depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 67 pool tail-outs measured, 10 had a value of 1 (15%); 26 had a value of 2 (39%); 25 had a value of 3 (37%); two had a value of 4 (3%); four had a value of 5 (6%) (Graph 6). On this scale, a value of 1 indicates the highest quality of spawning substrate. Additionally, a value of 5 was assigned to tail-outs deemed unsuitable for spawning due to inappropriate substrate such as bedrock, log sills, boulders, or other considerations.

A shelter rating was calculated for each habitat unit and expressed as a mean value for each habitat type within the survey using a scale of 0-300. Riffle habitat types had a mean shelter rating of 0, flatwater habitat types had a mean shelter rating of 5, and pool habitats had a mean shelter rating of 41 (Table 1). Of the pool types, the main channel pools had the highest mean shelter rating at 43. Scour pools had a mean shelter rating of 17 (Table 3).

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Table 5 summarizes mean percent cover by habitat type. Large woody debris is the dominant cover type in Boardman Gulch. Graph 7 describes the pool cover in Boardman 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 94% of the pool tail-outs. Large cobble was the next most frequently observed dominant substrate type and occurred in 3% of the pool tail-outs.

The mean percent canopy density for the surveyed length of Boardman Gulch was 97%. Three percent of the canopy was open. Of the canopy present, the mean percentages of hardwood and coniferous trees were 62% and 38%, respectively. Graph 9 describes the mean percent canopy in Boardman Gulch.

For the stream reach surveyed, the mean percent right bank vegetated was 88%. The mean percent left bank vegetated was 90%. The dominant elements composing the structure of the stream banks consisted of 78% sand/silt/clay, 17% bedrock, and 6% cobble/gravel (Graph 10). Brush was the dominant vegetation type observed in 44% of the units surveyed. Additionally, 43% of the units surveyed had hardwood trees as the dominant vegetation type, and 14% had coniferous trees as the dominant vegetation type (Graph 11).

### BIOLOGICAL INVENTORY RESULTS

Survey teams conducted a snorkel survey at 10 sites for species composition and distribution in Boardman Gulch on September 10, 2015 (Table A). The sites were sampled by B. Starks and D. Lam (CDFW).

The sample sites yielded one young-of-the-year (YOY) steelhead trout (SH), one age 1+ SH, one coastal/California giant salamander and two unidentified frogs. No coho salmon were observed.

Table A. Summary of results for a fish composition and distribution survey within Boardman Gulch, 2015.

Date	Survey Site #	Habitat Unit #	Habitat Type	Approx. Dist. from mouth (ft.)	Steelhead Trout			Coho Salmon		Additional Aquatic Species Observed
					YOY	1+	2+	YOY	1+	
G4 Channel Type										
09/10/15	1	006	Run	77	0	0	0	0	0	
09/10/15	2	010	Pool	187	1	0	0	0	0	
09/10/15	3	019	Pool	341	0	1	0	0	0	
09/10/15	4	030	Pool	611	0	0	0	0	0	CGS
09/10/15	5	039	Pool	939	0	0	0	0	0	
09/10/15	6	078	Pool	2,108	0	0	0	0	0	FROG
09/10/15	7	081	Pool	2,193	0	0	0	0	0	

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09/10/15	8	084	Pool	2,235	0	0	0	0	0	
09/10/15	9	107	Pool	2,574	0	0	0	0	0	
09/10/15	10	113	Pool	2,728	0	0	0	0	0	

Species Abbreviations: CGS=Coastal/California Giant Salamander; FROG= unidentified frog.

### DISCUSSION

Boardman Gulch is a G4 channel type for the entire length of the survey. The suitability of G4 channel types for fish habitat improvement structures is as follows: G4 channels 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 18 to June 3, 2015 ranged from 52 to 56 degrees Fahrenheit. Air temperatures ranged from 52 to 67 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 53% of the total length of this survey, riffles 30%, and pools 13%. Six of the 67 (9%) pools had a maximum residual depth greater than two feet. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat. In first and second order streams, a primary pool is defined to have a maximum residual depth of at least two feet, occupy at least half the width of the low flow channel, and be as long as the low flow channel width. Installing structures that will increase or deepen pool habitat is recommended.

Thirty-six of the 67 pool tail-outs measured had embeddedness ratings of 1 or 2. Twenty-seven of the pool tail-outs had embeddedness ratings of 3 or 4. Four 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 Boardman Gulch should be mapped and rated according to their potential sediment yields, and control measures should be taken.

Sixty-four of the 67 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 41. The shelter rating in the flatwater habitats is 5. 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 Boardman 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 structures provide rearing fry with protection from predation, rest from water velocity, and also divide territorial units to reduce density related competition.

The mean percent canopy density for the stream was 97%. The percentage of right and left bank covered with vegetation was 88% and 90%, respectively.

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### RECOMMENDATIONS

Boardman Gulch should be managed as an anadromous, natural production stream.

Recommendations for potential habitat improvement activities are based on target habitat values suitable for salmonids in California's north coast streams. Considering the results from this stream habitat inventory, factors that affect salmonid productivity and CDFW's professional judgment, the following list prioritizes habitat improvement activities in Boardman Gulch. Keep in mind, watershed and stream ecosystem processes, land use alterations, changes in land ownership, and other factors could potentially change the order of these recommendations or create the need to remove/add recommendations in the future.

- 1) Increase woody cover in the pools and flatwater habitat units. Most of the existing cover in the pools is from large woody debris. Adding high quality complexity with woody cover in the pools is desirable.
- 2) 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.
- 3) Suitable size spawning substrate on Boardman Gulch is limited to relatively few reaches. Projects should be designed at suitable sites to trap and sort spawning gravel.
- 4) There are several log debris accumulations present on Boardman Gulch that are retaining large quantities of fine sediment. The modification of these debris accumulations is desirable, but must be done carefully, over time, to avoid excessive sediment loading in downstream reaches.
- 5) 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 three to five years.

### COMMENTS AND LANDMARKS

The following landmarks and possible problem sites were noted. All distances are approximate and taken from the beginning of the survey reach.

Position (ft):	Habitat unit #:	Comments:
0	0001.00	Start of survey at the confluence with South Fork Big River. The channel is a G4 for the entire length of the survey.
49	0005.00	There is a 2.1' high plunge over woody debris and bedrock.
59	0006.00	There is a 2.7' high plunge over bedrock.
173	0010.00	There is a 1.7' high plunge over bedrock.



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600	0030.00	There is a 2.2' high plunge over large woody debris (LWD).
611	0031.00	There is a 0.8' high plunge over woody debris.
972	0043.00	Log debris accumulation (LDA) #01. The left bank is composed of sediment plug upstream of the LDA. The LDA was retaining significantly more sediment in the past, but has blown-out.
1286	0051.00	There is a 3.8' high plunge over bedrock.
1364	0056.00	LDA #02 contains eight pieces of LWD and measures 7' high x 20' wide x 11' long. Water flows through the LDA and there are no visible gaps in it. Retained sediment ranges from silt to sand and measures 20' wide x 10' long x 4' deep. The LDA was retaining significantly more sediment in the past, but it has blown out. Fish were not observed above the LDA.
1612	0067.00	LDA #03 contains seven pieces of LWD and measures 7' high x 7.5' wide x 17' long. The wood has accumulated on top of bedrock sheet. Water flows through the LDA and there are visible gaps in it. Retained silt measures 7' wide x 25' long x 3' deep. There is a 3' to 4' high plunge over bedrock.
1714	0069.00	Dry right bank tributary.
1940	0075.00	Woody debris is accumulating in the channel and retaining sediment.
2316	0092.00	LDA #04 contains seven pieces of LWD and measures 5.5' high x 28' wide x 8' long. Water flows through the LDA and there are visible gaps in it. Retained silt measures 5' wide x 10' long x 4' deep.
2387	0097.00	LDA #05 contains six pieces of LWD and measures 5' high x 10' wide x 3' long. Water does not flow through the LDA; the channel is dry above it. There are no visible gaps in the LDA. Retained silt measures 20' wide x 15' long x 5' deep. There is a 4' high plunge over the LDA.
2406	0098.00	Dry right bank tributary.
2494	0102.00	Dry left bank tributary.
2561	0107.00	LDA #06 contains three pieces of LWD and measures 5' high x 16' wide x 1.5' long. Water flows through the LDA and there are no visible gaps in it. Retained silt measures 12' wide x 4' long x 3' deep. There is a 2.5' high plunge over the LDA.
2822	0119.00	LDA #07 contains four pieces of LWD and measures 4' high x 16' wide x 3.5' long. Water flows through the LDA and there are no visible gaps

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		in it. Retained silt measures 15' wide x 25' long. There is a 2.5' high plunge over the LDA.
2945	0125.00	Dry left bank tributary.
3206	0139.00	LDA #08 contains six pieces of LWD and measures 3.5' high x 18' wide x 5' long. Water flows through the LDA and there are no visible gaps in it. Retained silt measures 18' wide x 20' long x 3' deep.
3217	0140.00	LDA #09 contains two pieces of LWD and measures 5' high x 12' wide x 6' long. Water does not flow through the LDA and there are no visible gaps in it. Retained silt measures 20' wide x 40' long x 5' deep.
3315	0149.00	LDA #10 contains three pieces of LWD and measures 3.5' high x 12' wide x 1.5' long. Water flows through the LDA and there are no visible gaps in it. Retained silt measures 25' wide x 10' long x 3' deep. There is a 3' high plunge over the LDA.
3356	0150.00	There is a 4' high plunge over rootmass retaining sediment.
3810	0178.00	A logging road (L & M Road) crosses the channel. The crossing is a 2.7' high x 3.1' wide x 57' long corrugated metal culvert. The culvert has no plunge at the outlet. The slope of the culvert is 1.9%, it is partially collapsed in the middle, and it is undersized. There is a perched overflow culvert above the culvert on the left bank side of the channel.
4233	0196.00	Large log in channel is retaining sediment.
4262	0198.00	Erosion site on right bank measures 30' high x 30' long.
4340	0201.00	LDA #11 contains two pieces of LWD and measures 5.5' high x 7' wide x 3' long. Water does not flow through the LDA; the channel is dry above it. There are no visible gaps in the LDA. Retained silt measures 7' wide x 30' long x 4' deep. There is a 4' high plunge over the LDA.
5019	0225.00	Dry right bank tributary.
5070	0228.00	Dry right bank tributary.
5704	0262.00	Dry left bank trip.
6115	0285.00	There is a 1.3' high plunge over small woody debris.
6320	0296.00	There is a 2.5' high plunge over silt.
6405	0300.00	LDA #12 contains five pieces of LWD and measures 3' high x 3' wide x 3' long. Water does not flow through the LDA; the channel is dry above

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it. There are no visible gaps in the LDA. Retained silt measures 3' wide x 30' long x 3' deep. There is a 3' high plunge over the LDA.

6503	0305.00	Dry right bank tributary.
6662	0311.00	LDA #13 contains four pieces of LWD and measures 5.5' high x 8' wide x 5' long. Water does not flow through the LDA; the channel is dry above it. There are no visible gaps in the LDA. Retained silt measures 5' wide x 30' long x 5' deep. There is a 5' high plunge over the LDA.
6788	0316.00	LDA #14 contains four pieces of LWD and measures 5' high x 3' wide x 6' long. Water flows through the LDA and there are no visible gaps in it. Retained silt measures 5' wide x 50' long x 4' deep. There is a 3' high plunge over the LDA.
6902	0320.00	End of survey at 8' high plunge over silt.

### 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

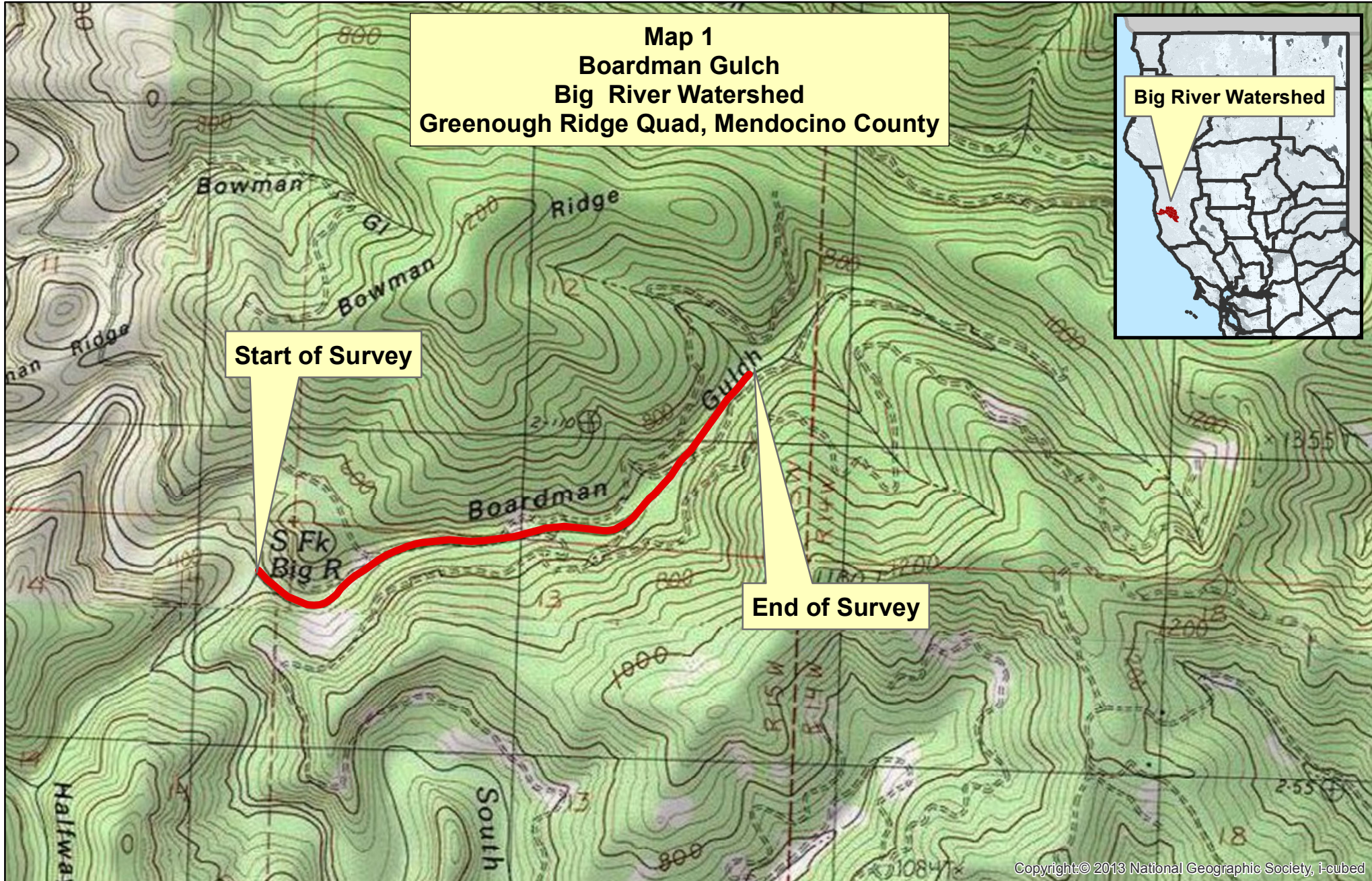
Secondary Channel Pool	(SCP)	[6.1]	{ 4 }
Backwater Pool - Boulder Formed	(BPB)	[6.2]	{ 5 }
Backwater Pool - Root Wad Formed	(BPR)	[6.3]	{ 6 }
Backwater Pool - Log Formed	(BPL)	[6.4]	{ 7 }
Dammed Pool	(DPL)	[6.5]	{13}

#### 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]	



**Map 1**  
**Boardman Gulch**  
**Big River Watershed**  
**Greenough Ridge Quad, Mendocino County**



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G4 Channel Type





Table 1 - Summary of Riffle, Flatwater, and Pool Habitat Types

Stream Name: Boardman Gulch

LLID: 1234961392511

Drainage: Big River

Survey Dates: 5/18/2015 to 6/3/2015

Confluence Location: Quad: GREENOUGH

Legal Description: T16NR15WS14

Latitude: 39:15:04.0N

Longitude: 123:29:46.0

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	0.3	57	57	0.8									
10	0	DRY	3.1	12	120	1.7									
114	11	FLATWATER	35.6	32	3687	53.4	3.1	0.2	0.6	88	10077	21	2420		5
2	0	UNSURVEYED	0.6	16	32	0.5									
67	67	POOL	20.9	14	917	13.3	6.4	0.7	1.4	89	5957	78	5227	68	41
126	18	RIFFLE	39.4	17	2097	30.3	3.0	0.2	0.3	50	6348	9	1189		0
Total Units	Total Units Fully Measured			Total Length (ft.)						Total Area (sq.ft.)		Total Volume (cu.ft.)			
320	96			6910						22382		8837			

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

Stream Name: Boardman Gulch

LLID: 1234961392511

Drainage: Big River

Survey Dates: 5/18/2015 to 6/3/2015

Confluence Location: Quad: GREENOUGH

Legal Description: T16NR15WS14

Latitude: 39:15:04.0N

Longitude: 123:29:46.0W

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 (%)
91	14	LGR	28.4	19	1736	25.1	3	0.1	0.7	59	5360	11	975		0	96
32	3	HGR	10.0	10	320	4.6	4	0.2	0.5	15	468	3	88		2	99
3	1	BRS	0.9	14	41	0.6	2	0.3	0.5	38	115	12	35		0	100
54	4	RUN	16.9	17	934	13.5	3	0.3	0.9	45	2436	10	560		10	98
60	7	SRN	18.8	46	2753	39.8	3	0.2	1.1	113	6788	27	1646		2	99
60	60	MCP	18.8	14	812	11.8	6	0.7	2.6	90	5412	79	4749	69	43	97
1	1	CRP	0.3	19	19	0.3	5	0.8	1.7	95	95	86	86	76	10	97
1	1	LSL	0.3	15	15	0.2	6	0.7	1.6	90	90	72	72	63	15	99
1	1	LSBk	0.3	24	24	0.3	4	0.4	0.8	96	96	58	58	38	5	98
4	4	PLP	1.3	12	47	0.7	6	0.9	1.8	66	264	66	264	57	23	98
10	0	DRY	3.1	12	120	1.7										
1	0	CUL	0.3	57	57	0.8										
2	0	NS	0.6	16	32	0.5										

Total Units  
320

Total Units Fully Measured  
96

Total Length (ft.)  
6910

Total Area (sq.ft.)  
21124

Total Volume (cu.ft.)  
8532

Table 3 - Summary of Pool Types

Stream Name: Boardman Gulch

LLID: 1234961392511

Drainage: Big River

Survey Dates: 5/18/2015 to 6/3/2015

Confluence Location: Quad: GREENOUGH

Legal Description: T16NR15WS14

Latitude: 39:15:04.0N

Longitude: 123:29:46.0W

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
60	60	MAIN	90	14	812	89	6.5	0.7	90	5412	69	4123	43
7	7	SCOUR	10	15	105	11	5.4	0.8	78	545	58	406	17
Total Units 67	Total Units Fully Measured 67				Total Length (ft.) 917					Total Area (sq.ft.) 5957		Total Volume (cu.ft.) 4530	



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

Stream Name: Boardman Gulch

LLID: 1234961392511

Drainage: Big River

Survey Dates: 5/18/2015 to 6/3/2015

Confluence Location: Quad: GREENOUGH

Legal Description: T16NR15WS14

Latitude: 39:15:04.0N

Longitude: 123:29:46.0W

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
60	MCP	90	14	23	40	67	6	10	0	0	0	0
1	CRP	1	0	0	1	100	0	0	0	0	0	0
1	LSL	1	0	0	1	100	0	0	0	0	0	0
1	LSBk	1	1	100	0	0	0	0	0	0	0	0
4	PLP	6	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
67	15	22	46	69	6	9	0	0	0	0

Mean Maximum Residual Pool Depth (ft.): 1.4

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

Stream Name: Boardman Gulch

LLID: 1234961392511

Drainage: Big River

Survey Dates: 5/18/2015 to 6/3/2015

Dry Units: 10

Confluence Location: Quad: GREENOUGH

Legal Description: T16NR15WS14

Latitude: 39:15:04.0N

Longitude: 123:29:46.0W

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
91	14	LGR	0	0	0	0	0	0	0	0	0
32	3	HGR	0	20	0	0	0	0	0	80	0
3	1	BRS	0	0	0	0	0	0	0	0	0
126	18	TOTAL RIFFLE	0	20	0	0	0	0	0	80	0
54	4	RUN	0	8	18	0	25	0	8	40	3
60	7	SRN	10	30	57	0	0	0	0	3	0
114	11	TOTAL FLAT	6	21	41	0	10	0	3	18	1
60	60	MCP	20	22	39	8	0	1	0	8	1
1	1	CRP	60	40	0	0	0	0	0	0	0
1	1	LSL	0	0	100	0	0	0	0	0	0
1	1	LSBk	0	0	100	0	0	0	0	0	0
4	4	PLP	0	3	0	23	0	0	11	0	64
67	67	TOTAL POOL	19	21	38	8	0	1	1	7	5
1	0	CUL									
2	0	NS									
320	96	TOTAL	18	21	37	8	1	1	1	9	4

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

Stream Name: Boardman Gulch

LLID: 1234961392511

Drainage: Big River

Survey Dates: 5/18/2015 to 6/3/2015

Dry Units: 10

Confluence Location: Quad: GREENOUGH

Legal Description: T16NR15WS14

Latitude: 39:15:04.0N

Longitude: 123:29:46.0W

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
91	14	LGR	14	0	71	7	7	0	0
32	3	HGR	0	0	100	0	0	0	0
3	1	BRS	0	0	0	0	0	0	100
54	4	RUN	0	0	50	25	0	0	25
60	7	SRN	14	0	71	14	0	0	0
60	60	MCP	20	5	62	7	7	0	0
1	1	CRP	0	0	100	0	0	0	0
1	1	LSL	0	0	100	0	0	0	0
1	1	LSBk	0	0	100	0	0	0	0
4	4	PLP	0	25	50	0	0	0	25

**Table 7 - Summary of Mean Percent Canopy for Entire Stream**

Stream Name: Boardman Gulch LLID: 1234961392511 Drainage: Big River  
Survey Dates: 5/18/2015 to 6/3/2015  
Confluence Location: Quad: GREENOUGH Legal Description: T16NR15WS14 Latitude: 39:15:04.0N Longitude: 123:29:46.0W

Mean Percent Canopy	Mean Percent Conifer	Mean Percent Hardwood	Mean Percent Open Units	Mean Right Bank % Cover	Mean Left Bank % Cover
97	38	62	0	88	90

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: Boardman Gulch

LLID: 1234961392511

Drainage: Big River

Survey Dates: 5/18/2015 to 6/3/2015

Survey Length (ft.): 6910

Main Channel (ft.): 6910

Side Channel (ft.): 0

Confluence Location: Quad: GREENOUGH

Legal Description: T16NR15WS14

Latitude: 39:15:04.0N

Longitude: 123:29:46.0W

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 1

Channel Type: G4

Reach Length (ft.): 6910

Riffle/Flatwater Mean Width (ft.): 3.1

BFW:

Range (ft.): 6 to 15

Mean (ft.): 10

Std. Dev.: 2

Base Flow (cfs.): 0.0

Water (F): 52 - 56

Air (F): 52 - 67

Dry Channel (ft): 120

Canopy Density (%): 97.3

Coniferous Component (%): 37.7

Hardwood Component (%): 62.3

Dominant Bank Vegetation: Brush

Vegetative Cover (%): 88.7

Dominant Shelter: Large Woody Debris

Dominant Bank Substrate Type: Sand/Silt/Clay

Occurrence of LWD (%): 27

LWD per 100 ft.:

Riffles: 2

Pools: 13

Flat: 4

Pools by Stream Length (%): 13.3

Pool Frequency (%): 20.9

Residual Pool Depth (%):

< 2 Feet Deep: 91

2 to 2.9 Feet Deep: 9

3 to 3.9 Feet Deep: 0

>= 4 Feet Deep: 0

Mean Max Residual Pool Depth (ft.): 1.4

Mean Pool Shelter Rating: 41

Pool Tail Substrate (%): Silt/Clay: 1

Sand: 0

Gravel: 94

Sm Cobble: 1

Lg Cobble: 3

Boulder: 0

Bedrock: 0

Embeddedness Values (%): 1. 14.9 2. 38.8 3. 37.3 4. 3.0 5. 6.0

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

Stream Name: Boardman Gulch

LLID: 1234961392511

Drainage: Big River

Survey Dates: 5/18/2015 to 6/3/2015

Confluence Location: Quad: GREENOUGH

Legal Description: T16NR15WS14

Latitude: 39:15:04.0N

Longitude: 123:29:46.0W

**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	18	14	16.7
Boulder	0	0	0.0
Cobble / Gravel	7	4	5.7
Sand / Silt / Clay	71	78	77.6

**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	46	38	43.8
Hardwood Trees	41	41	42.7
Coniferous Trees	9	17	13.5
No Vegetation	0	0	0.0

**Total Stream Cobble Embeddedness Values:** 2

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

StreamName: Boardman Gulch

LLID: 1234961392511

Drainage: Big River

Survey Dates: 5/18/2015 to 6/3/2015

Confluence Location: Quad: GREENOUGH

Legal Description: T16NR15WS14

Latitude: 39:15:04.0N

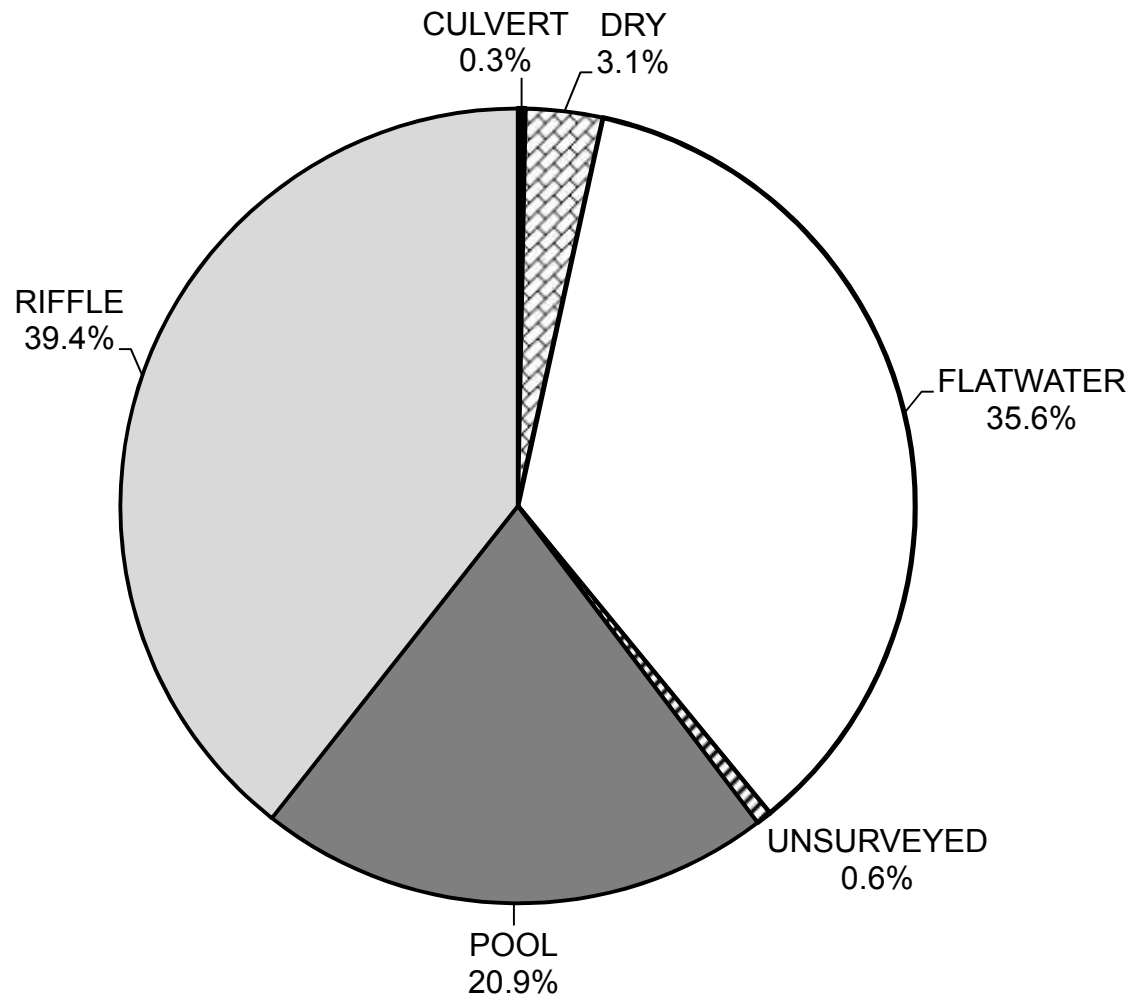
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	<b>Riffles</b>	<b>Flatwater</b>	<b>Pools</b>
<hr/>			
UNDERCUT BANKS (%)	0	6	19
SMALL WOODY DEBRIS (%)	20	21	21
LARGE WOODY DEBRIS (%)	0	41	38
ROOT MASS (%)	0	0	8
TERRESTRIAL VEGETATION (%)	0	10	0
AQUATIC VEGETATION (%)	0	0	1
WHITEWATER (%)	0	3	1
BOULDERS (%)	80	18	7
BEDROCK LEDGES (%)	0	1	5

# BOARDMAN GULCH 2015

## HABITAT TYPES BY PERCENT OCCURRENCE

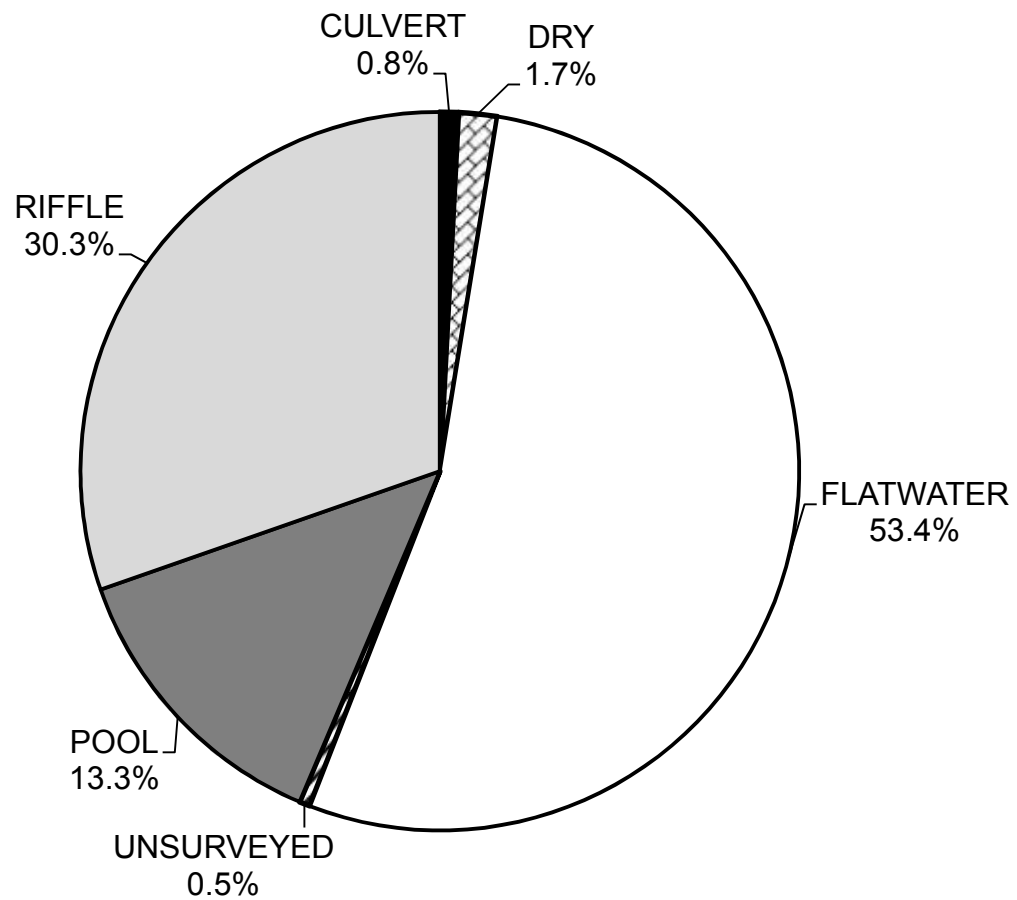


GRAPH 1



# BOARDMAN GULCH 2015

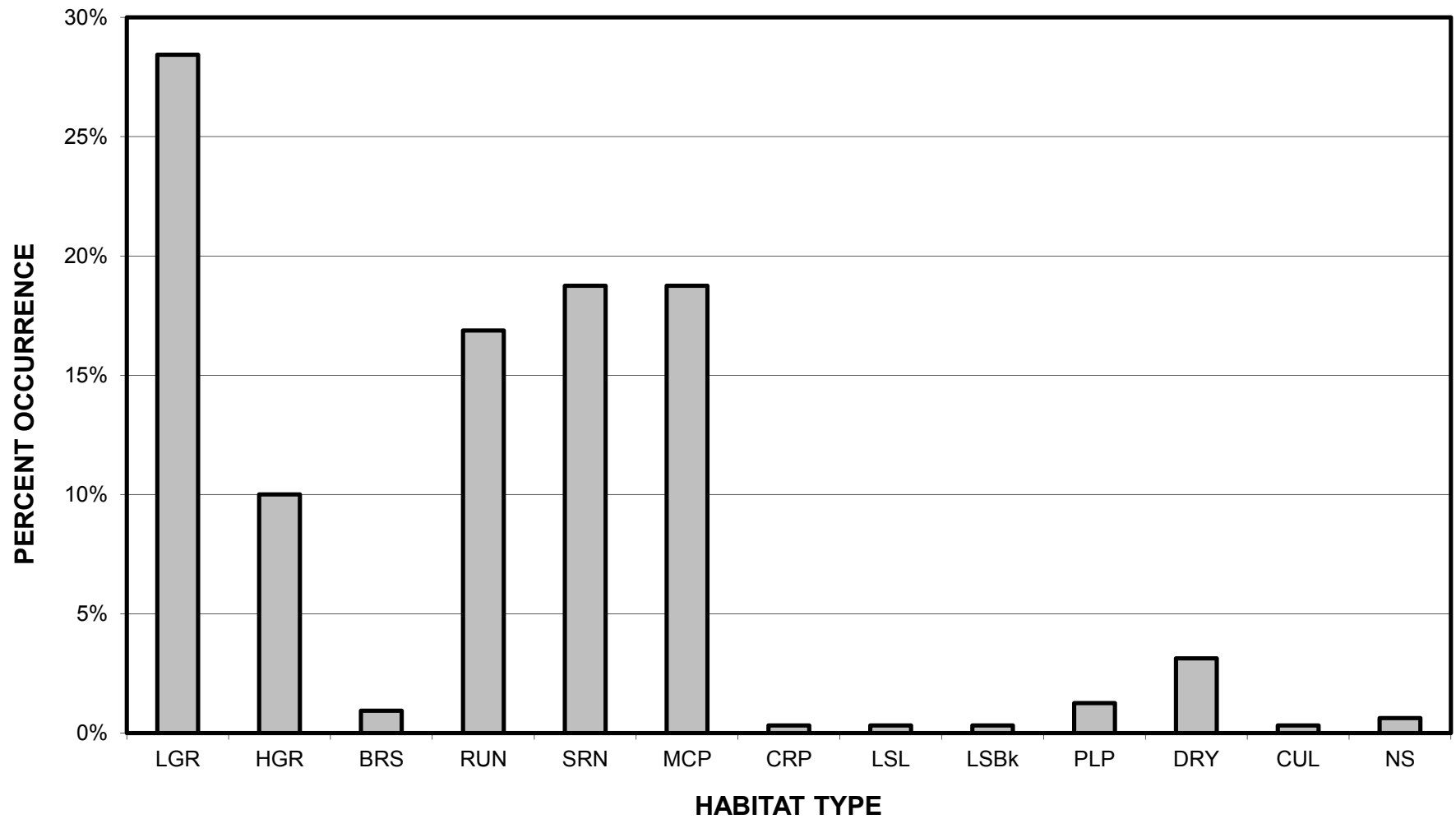
## HABITAT TYPES BY PERCENT TOTAL LENGTH



GRAPH 2

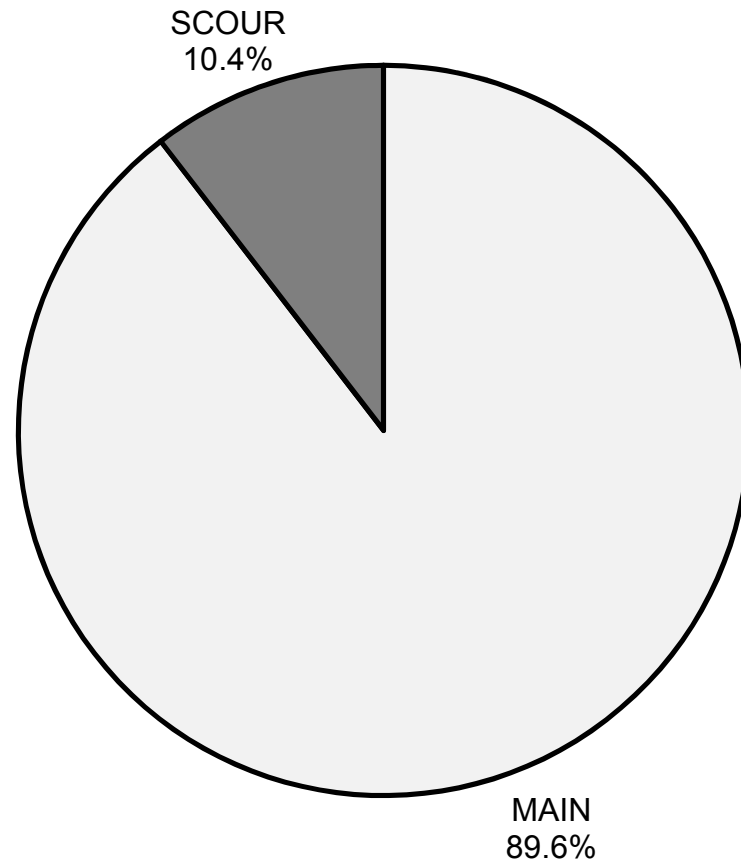
# BOARDMAN GULCH 2015

## HABITAT TYPES BY PERCENT OCCURRENCE



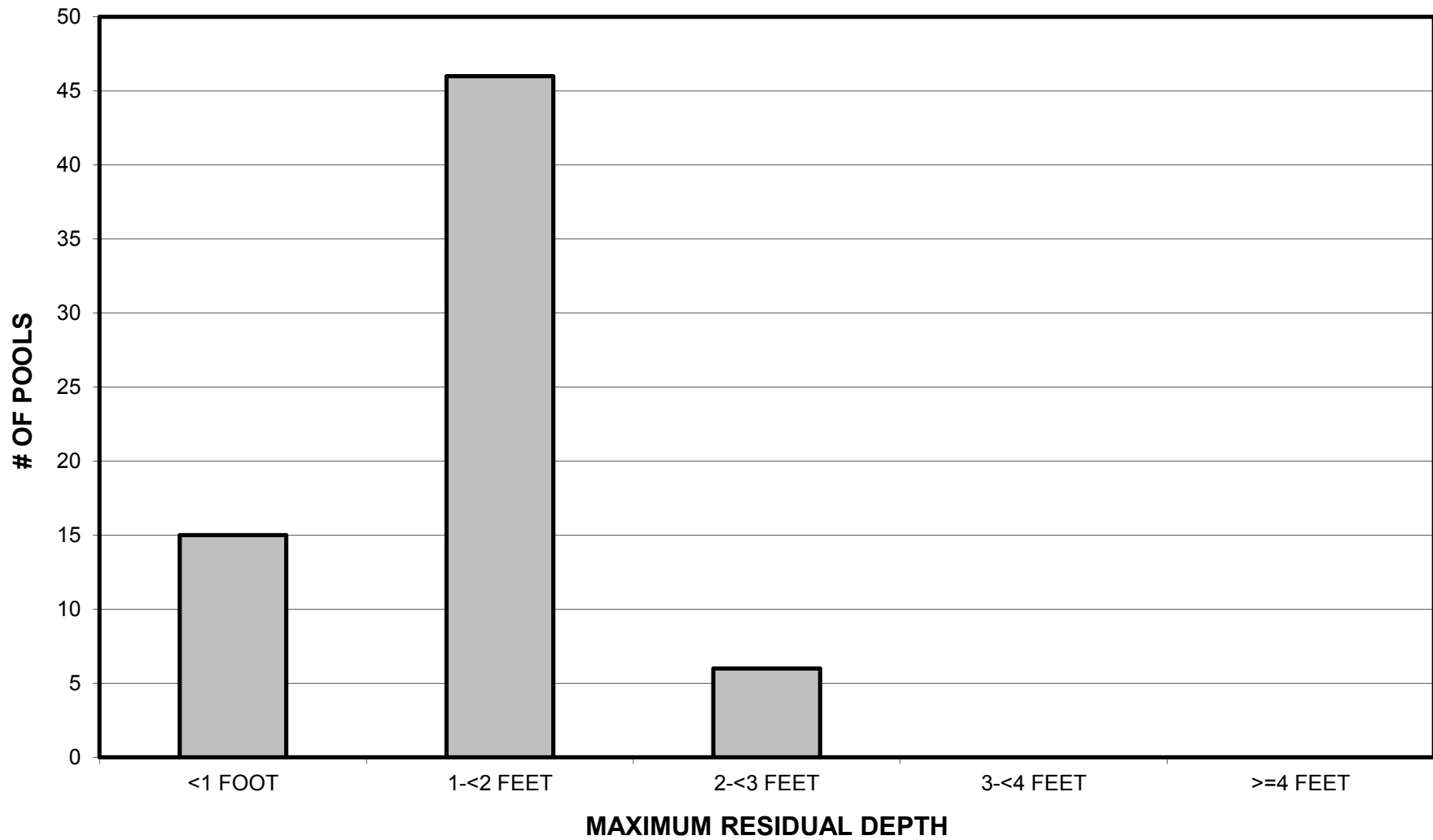
GRAPH 3

**BOARDMAN GULCH 2015  
POOL TYPES BY PERCENT OCCURRENCE**



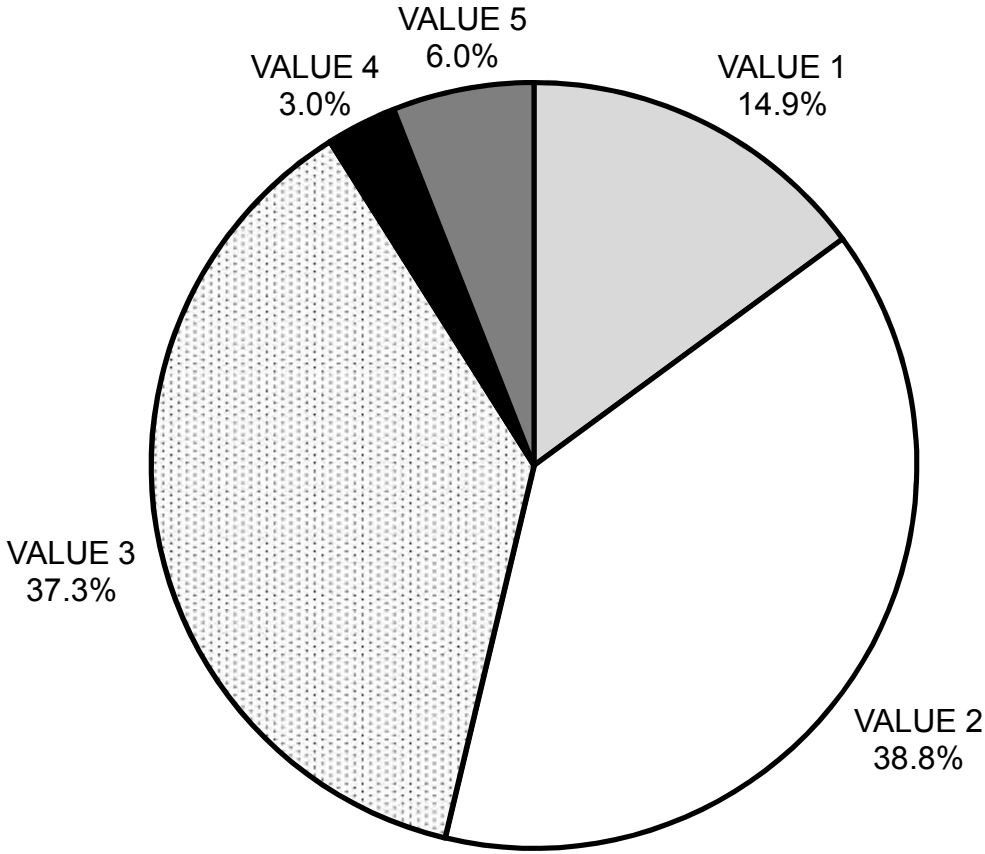
GRAPH 4

# BOARDMAN GULCH 2015 MAXIMUM DEPTH IN POOLS



GRAPH 5

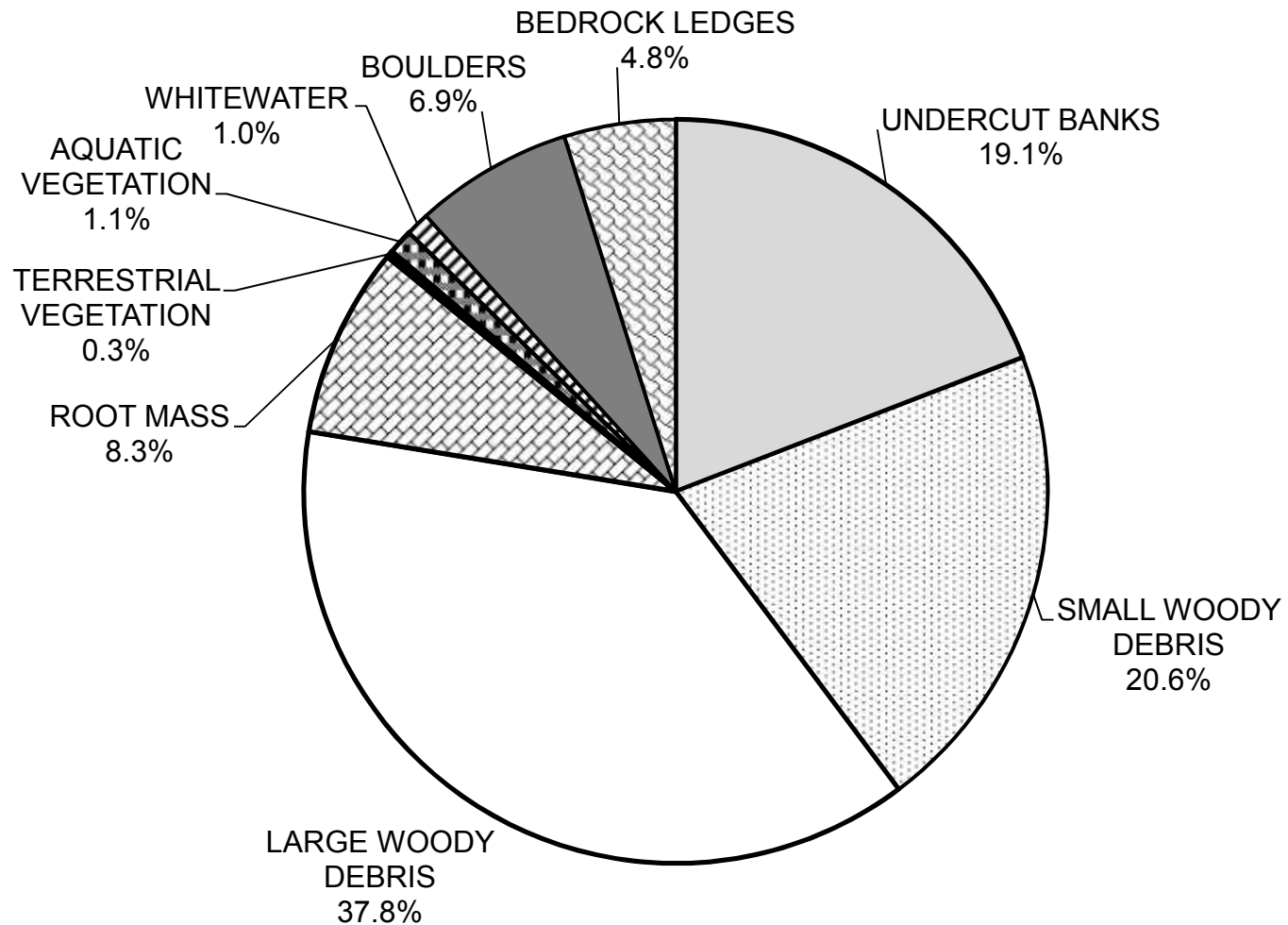
**BOARDMAN GULCH 2015  
PERCENT EMBEDDEDNESS**



GRAPH 6

# BOARDMAN GULCH 2015

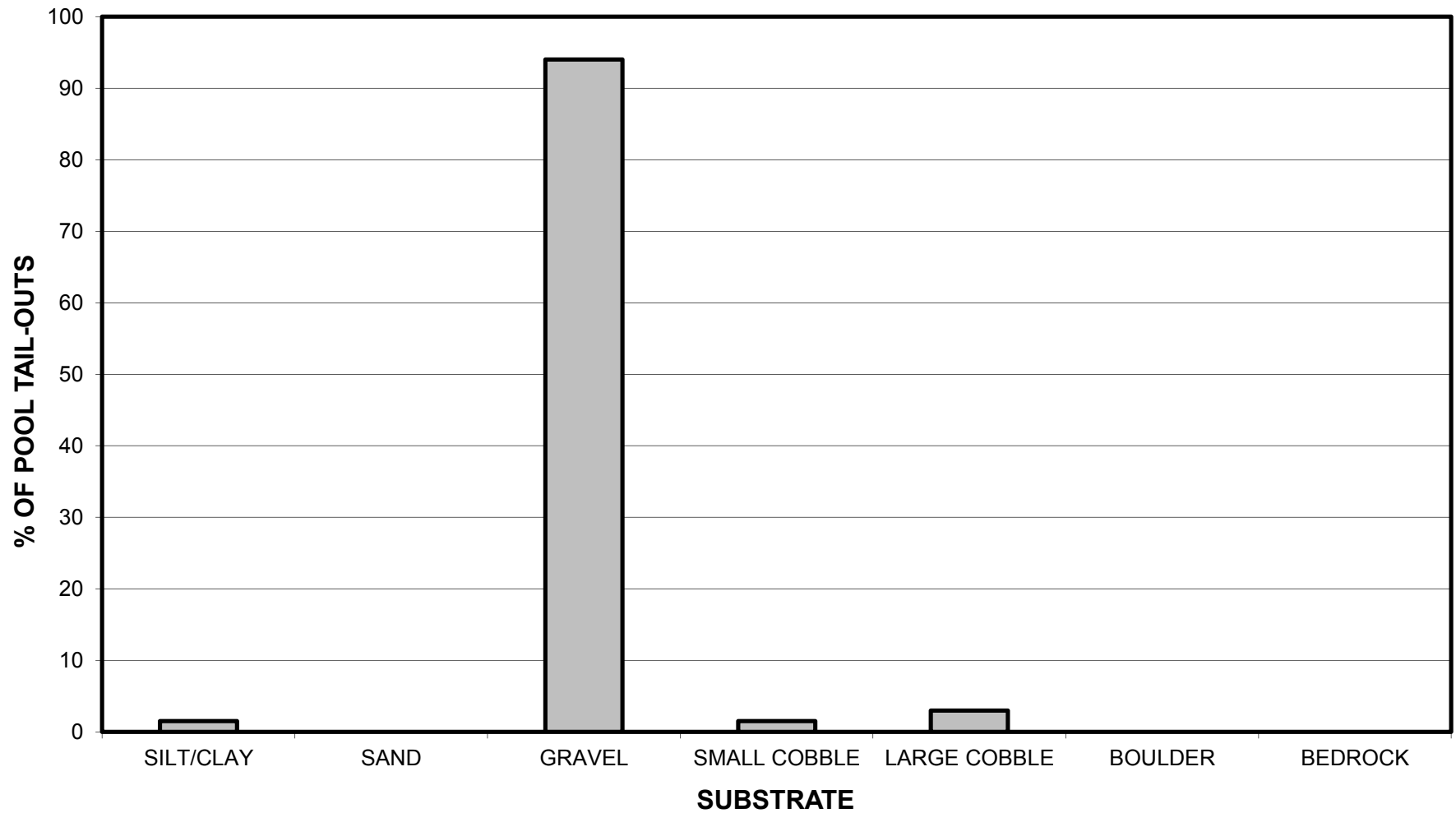
## MEAN PERCENT COVER TYPES IN POOLS



GRAPH 7

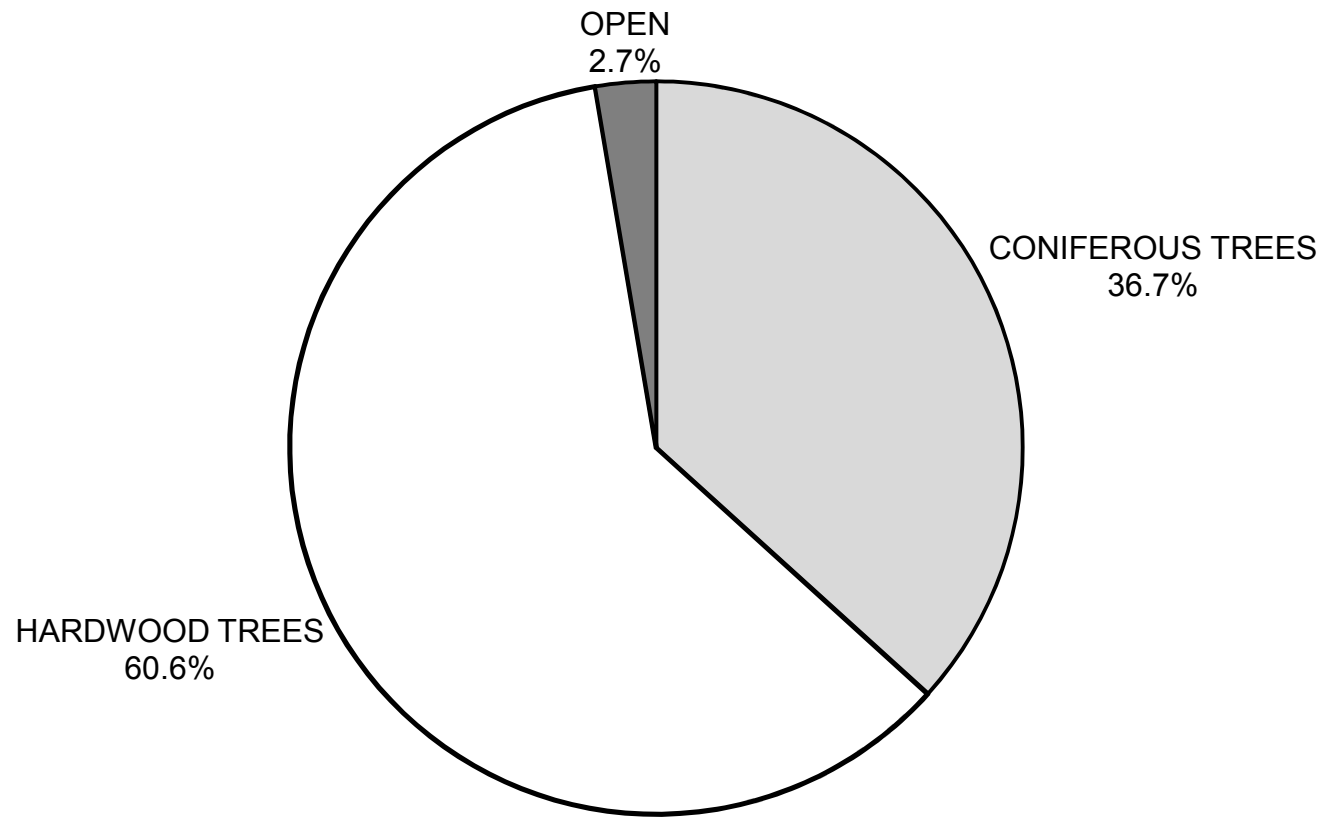
# BOARDMAN GULCH 2015

## SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



GRAPH 8

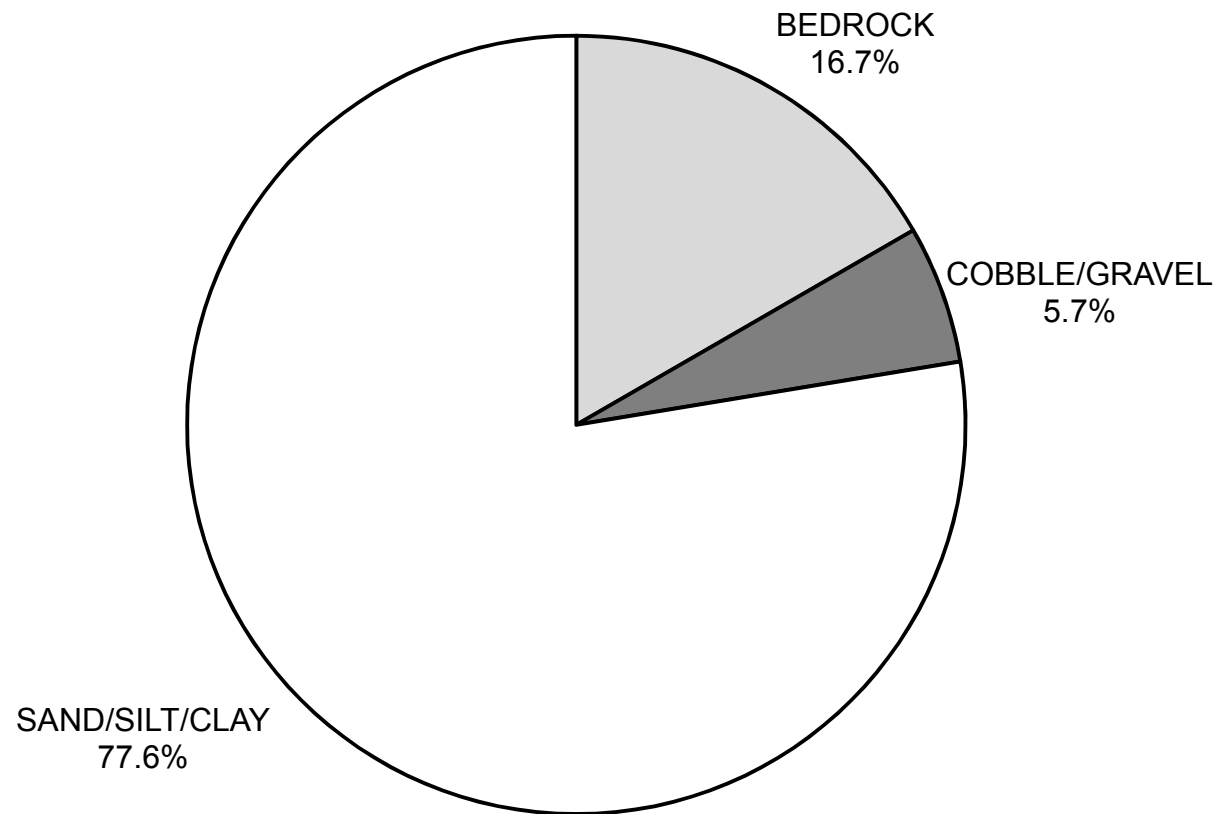
# BOARDMAN GULCH 2015 MEAN PERCENT CANOPY



GRAPH 9

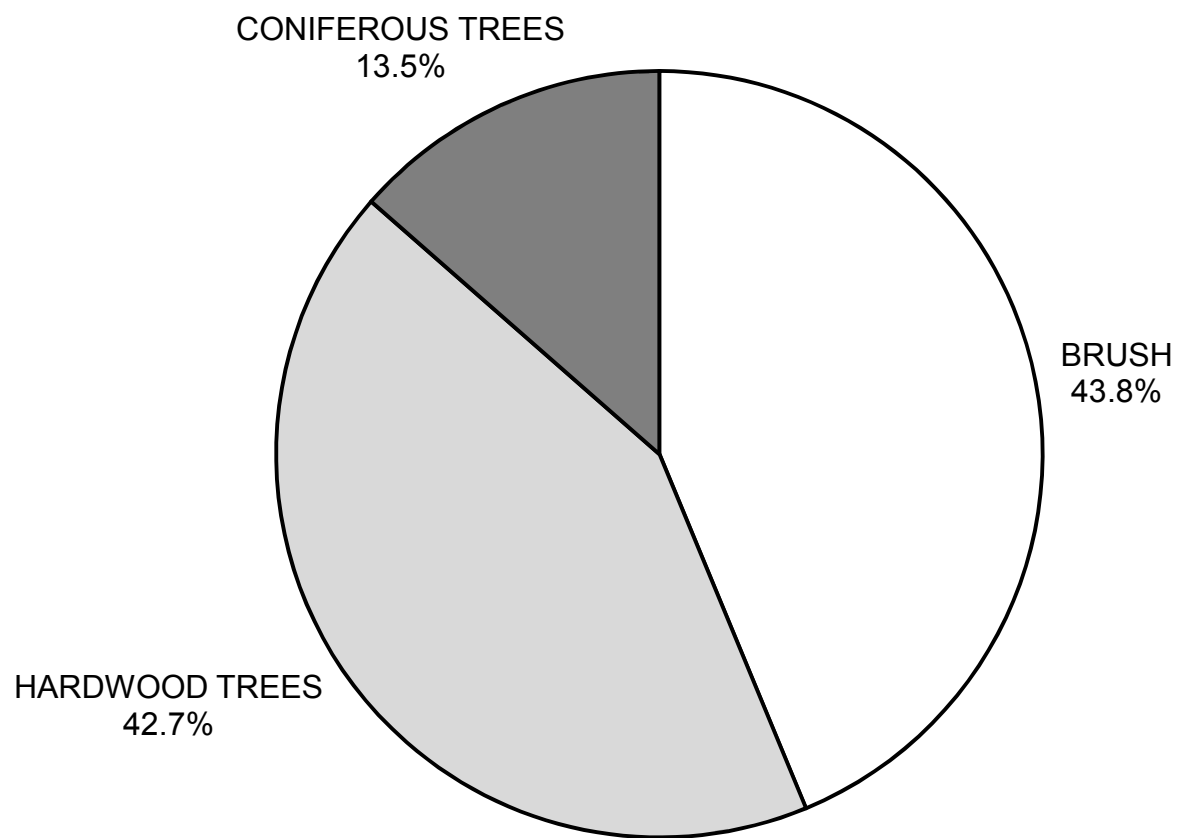


**BOARDMAN GULCH 2015**  
**DOMINANT BANK COMPOSITION IN SURVEY REACH**



GRAPH 10

**BOARDMAN GULCH 2015**  
**DOMINANT BANK VEGETATION IN SURVEY REACH**



GRAPH 11