



CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE

STREAM INVENTORY REPORT

Atwell Creek

INTRODUCTION

A stream inventory was conducted from June 6 to June 19, 2017. The survey began at the confluence with Howe Creek and extended upstream 1.9 miles.

The Atwell Creek inventory was conducted in two parts: habitat inventory and biological inventory. The objective of the habitat inventory was to document the habitat available to anadromous salmonids in Atwell Creek. The objective of the biological inventory was to document the presence and distribution of juvenile salmonid species.

The objective of this report is to document the current habitat conditions and recommend options for the potential enhancement of habitat for Chinook and 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. This report was finalized in April, 2018.

WATERSHED OVERVIEW

Atwell Creek is a tributary to Howe Creek, tributary to the Eel River, which drains to the Pacific Ocean, located in Humboldt County, California (Map 1). Atwell Creek's legal description at the confluence with Howe Creek is T01N R01W S03. Its location is 40.4956° north latitude and -124.1690° longitude, LLID number 1241678404957. Atwell Creek is a first order stream and has approximately 3.7 miles of blue line stream according to the USGS Taylor Peak 7.5 minute quadrangle. Atwell Creek drains a watershed of approximately 4.4 square miles. Elevations range from about 140 feet at the mouth of the creek to 1,800 feet in the headwater areas. Hardwood and mixed conifer forest dominates the watershed. The watershed is primarily privately owned and is managed for timber production. Vehicle access exists via Hwy 101 to Blue Slide Road to Howe Creek Road.

METHODS

The habitat inventory conducted in Atwell Creek 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. 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 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. Surveyors also take photos to document general habitat conditions, significant features (landslide, potential barriers, etc.), and end of survey (Appendix II).

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 Atwell Creek to record measurements and observations. There are eleven components to the inventory form.

1. Flow:

Flow is measured in cubic feet per second (cfs) near the bottom of the stream survey reach using a Marsh-McBirney Model 2000 flow meter.

2. Channel Type:

Channel typing is conducted according to the classification system developed and revised by David Rosgen (1994). This methodology is described in the *California Salmonid Stream Habitat Restoration Manual*. Channel typing is conducted simultaneously with habitat typing and follows a standard form to record measurements and observations. There are five measured parameters used to determine channel type: 1) water slope gradient, 2) entrenchment, 3) width/depth ratio, 4) substrate composition, and 5) sinuosity. Channel characteristics are measured using a hand level, hip chain, tape measure, and a stadia rod.

3. Temperatures:

Water and air temperatures are measured and recorded at every tenth habitat unit using a hand-held thermometer. Both temperatures are taken in degrees (°) Fahrenheit and the time of the measurement is also recorded. Air temperatures are recorded within one foot of the water surface, while water temperatures are recorded (where possible) in flowing water within the habitat unit.

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". Atwell Creek habitat typing used standard basin level measurement criteria. These parameters require that the minimum length of a described habitat unit must be equal to or greater than the stream's mean wetted width. All measurements are in feet to the nearest tenth. Habitat characteristics are measured using a clinometer, hip chain, and stadia rod.

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 Atwell Creek, embeddedness was ocularly estimated. The values were recorded using the following ranges: 0 - 25% (value 1), 26 - 50% (value 2), 51 - 75% (value 3) and 76 - 100% (value 4). Additionally, a value of 5 was assigned to tail-outs deemed 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 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 Atwell Creek, a standard qualitative shelter value of 0 (none), 1 (low), 2 (medium), or 3 (high) was assigned according to the complexity of the cover. 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 densimeters as described in the *California Salmonid Stream Habitat Restoration Manual*. Canopy density relates to the amount of stream shaded from the sun. In Atwell Creek, an estimate of the percentage of the habitat unit covered by canopy was made from the center of approximately every third unit in addition to every fully-described unit, giving an approximate 30% sub-sample. In addition, the area of canopy was estimated ocularly into percentages of coniferous or hardwood trees.

9. Bank Composition and Vegetation:

Bank composition elements range from bedrock to bare soil. However, the stream banks are usually covered with grass, brush, or trees. These factors influence the ability of stream banks to withstand winter flows. In Atwell Creek, the dominant composition type and the dominant vegetation type of both the right and left banks for each fully-described unit were selected from the habitat inventory form. Additionally, the percent of each bank covered by vegetation (including downed trees, logs, and rootwads) was estimated and recorded.

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 Atwell Creek. In addition, underwater mask and snorkel 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 Atwell Creek include:

- Riffle, Flatwater, Pool Habitat Types by Percent Occurrence
- Riffle, Flatwater, Pool Habitat Types by Total Length

- Total Habitat Types by Percent Occurrence
- Pool Types by Percent Occurrence
- Maximum Residual Depth in Pools
- Percent Embeddedness
- Mean Percent Cover Types in Pools
- Substrate Composition in Pool Tail-outs
- Mean Percent Canopy
- Dominant Bank Composition by Composition Type
- Dominant Bank Vegetation by Vegetation Type

HABITAT INVENTORY RESULTS

* ALL TABLES AND GRAPHS ARE LOCATED IN APPENDIX I *

The habitat inventory of June 7 to June 19, 2017 was conducted by Kori Roberts (CDFW) and Rachel Karlov (WSP). The total length of the stream surveyed was 9,816 feet with an additional 224 feet of side channel.

A stream flow measurement 1.42 cfs was recorded on June 14, 2017 near the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter.

Atwell Creek is an F3 channel type. F3 channel types are entrenched meandering riffle/pool channels on low gradients with high width/depth ratios, very stable with cobble-dominant substrates.

Water temperatures taken during the survey period ranged from 54° to 59° Fahrenheit. Air temperatures ranged from 58° to 68° Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 34% pool units, 33% riffle units, and 32% flatwater units (Graph 1). Based on total length of Level II habitat types there were 38% flatwater units, 32% riffle units, 29% pool units, and 1% no-survey units (Graph 2).

Nine Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were 33% low gradient riffle units, 32% mid-channel pool units, and 25% run units. Based on percent total length low gradient riffle units made up 32%, mid-channel pool units 27%, and run units 26%.

A total of 91 pools were identified (Table 3). Main channel pools were the most frequently encountered at 95% (Graph 4), and comprised 93% 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. Thirty-two of the 85 pools (38%) had a residual depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 86 pool tail-outs measured, 18 had a value of 1 (20.9%), 59 had a value of 2 (68.6%), and 9 had a value of 3

(10.5%) (Graph 6). On this scale, a value of 1 indicates the highest quality of spawning substrate.

A shelter rating was calculated for each habitat unit and expressed as a mean value for each habitat type within the survey using a scale of 0-300. Riffle habitat types had a mean shelter rating of 0, flatwater habitat types had a mean shelter rating of 19, and pool habitats had a mean shelter rating of 19 (Table 1). Of the pool types, main channel pools had the highest mean shelter rating at 20. Scour pools had a mean shelter rating of 12 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover type in Atwell Creek. Graph 7 describes the pool cover in Atwell Creek. Boulders 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. Small cobble was the dominant substrate, observed in 58% of pool tail-outs. Large cobble was the next most frequently observed dominant substrate type and occurred in 25% of the pool tail-outs.

The mean percent canopy density for the surveyed length of Atwell Creek was 93%. Seven percent of the canopy was open. Of the canopy present, the mean percentages of hardwood and coniferous trees were 60% and 40%, respectively. Graph 9 describes the mean percent canopy in Atwell Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 96%. The mean percent left bank vegetated was 92%. The dominant elements composing the structure of the stream banks consisted of 83% sand/silt/clay, 16% cobble/gravel, and 1% bedrock (Graph 10). Coniferous trees were the dominant vegetation type, observed in 39% of the units surveyed. Additionally, 38% of the units surveyed had deciduous trees as the dominant vegetation type, and 18% had brush as the dominant vegetation type (Graph 11).

BIOLOGICAL INVENTORY RESULTS

Survey teams conducted a mask and snorkel survey at 10 sites for species composition and distribution in Atwell Creek on September 25, 2017 (Table A). The sites were sampled by Kori Roberts and Ryan Bernstein (CDFW).

The survey yielded 64 young-of-the-year (YOY) steelhead trout (SH) and one age 1+ SH.

During the survey, the upstream-most observation of juvenile steelhead trout occurred at 41.4775° north latitude, -124.1486° west longitude, approximately 10,139 feet upstream from the confluence with Howe Creek (Map 1). No coho or Chinook salmon were observed during the biological inventory.

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Table A. Summary of results for a fish composition and distribution survey within Atwell Creek September 25, 2017

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+	
09/24/17	1	002	Pool	115	3	0	0	0	0	
	2	006	Pool	302	6	0	0	0	0	
	3	010	Pool	487	7	0	0	0	0	
	4	012	Pool	583	5	0	0	0	0	
	5	015	Pool	724	20	0	0	0	0	
	6	019	Pool	1,123	11	0	0	0	0	
	7	023	Pool	1,173	6	1	0	0	0	
	8	025	Pool	1,219	3	0	0	0	0	
	9	027	Pool	1,288	1	0	0	0	0	
	10	264	Pool	10,139	2	0	0	0	0	

DISCUSSION

Atwell Creek is an F3 channel type. The suitability of F3 channel types for fish habitat improvement structures is as follows: F3 channels are good for bank-placed boulders, single and opposing wing-deflectors and fair for plunge weirs, boulder clusters, channel constrictors and log cover.

The water temperatures recorded on the survey days June 7 to June 19, 2017 ranged from 54° to 59° Fahrenheit. Air temperatures ranged from 58° to 68° 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 38% of the total length of this survey, riffles 32%, and pools 29%. Thirty-two of the 85 (38%) pools had a maximum residual depth greater than 2 feet. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat. In first and second order streams, a primary pool is defined to have a maximum residual depth of at least two feet, occupy at least half the width of the low flow channel, and be as long as the low flow channel width. Installing structures that will increase or deepen pool habitat is recommended.

Seventy-seven of the 86 pool tail-outs measured had embeddedness ratings of 1 or 2. Nine 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.

Sixty-one of the 84 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 19. The shelter rating in the flatwater habitats is 19. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by boulders in Atwell Creek. Boulders are the dominant cover type in pools followed by small woody debris. Log and rootwad 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 93%. 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 92%, 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

Atwell Creek 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 Atwell Creek. 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 boulders. Adding high quality complexity with woody cover in the pools is desirable.
- 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.

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 Howe Creek.
0	0001.00	Bridge #001 is the crossing for Howe Creek Road and is 18' high x 16' wide x 73' long. It is an automobile bridge made of metal and is not a barrier to salmonids.

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146	0004.00	Culvert on RB with rip rap.
330	0008.00	Young of the Year (YOY) Steelhead observed throughout the entire surveyed reach.
438	0010.00	Rip rap on LB.
680	0015.00	Tributary #1 enters on the RB bank. It contributes to approximately 1% of Atwell Creek's flow. The water temperature of the tributary was 53° Fahrenheit, the water temperature downstream of the confluence was 53° Fahrenheit, and the water temperature upstream of the confluence was 53° Fahrenheit. The tributary is not accessible to salmonids due to 6' foot jump with very low water that is more like a spring. Fish were not observed in the tributary.
1550	0040.00	RB landslide 20' high x 40' long. LDA #1 is 8' high x 25' wide x 18' long and contains 6 pieces of LWD. Water flows through the LDA and there are visible gaps in it. Sediment is not being retained. Fish were observed above the LDA.
1876.3	0053.00	LDA #2 is 6' high x 22' wide x 15' long and contains 10 pieces of LWD. Water flows through the LDA and there are visible gaps in it. Sediment is not being retained. Fish were observed above the LDA.
1996.3	0055.00	LB landslide 45' high x 45' long.
2220.3	0064.00	LDA #3 is 12' high x 40' wide x 25' long and contains 22 pieces of LWD. Water flows through the LDA and there are no visible gaps in it. Sediment is being retained in the approximate dimensions of 56' wide x 100' long x 10' deep. The sediment ranges in size from silt to gravel. Fish were observed above the LDA.
2305.3	0067.00	Eroded bank 25' long x 20' high.
2402.3	0071.00	RB landslide 30' long x 15' high.
2622.3	0077.00	RB landslide.
3299.3	0093.00	Landslide 70' long x 20' high.
3421.3	0096.00	Becomes more entrenched.
3949.3	0107.00	1ft plunge at head of pool.

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4163.3	0113.00	LDA #4 is 9' high x 35' wide x 45' long and contains 22 pieces of LWD. Water flows through the LDA and there are visible gaps in it. Sediment is not being retained. Fish were observed above the LDA.
4787.3	0133.00	RB landslide.
4851.3	0135.00	Bridge #2 is the crossing for an unnamed road and is 16' high x 11' wide x 35' long. It is a foot bridge (made of metal) and is not a barrier to salmonids.
5037.3	0140.00	Tributary #2 enters on the LB bank. It contributes to approximately 5% of Atwell Creek's flow. The water temperature of the tributary was 56° Fahrenheit, the water temperature downstream of the confluence was 57° Fahrenheit, and the water temperature upstream of the confluence was 57° Fahrenheit. The slope of the tributary is 5%. The tributary is not accessible to salmonids due to being so highly entrenched with lots of large wood and a checked upstream of 50ft. Fish were not observed in the tributary.
5318.3	0145.00	RB land slide 56' long.
5343.3	0146.00	RB landslide 56' long.
5439.3	0150.00	LDA #5 is 6.5' high x 35' wide x 13' long and contains 9 pieces of LWD. Water flows through the LDA and there are visible gaps in it. Sediment is not being retained. Fish were observed above the LDA.
5842.3	0159.00	Plunge one foot over old railroad track, retaining sediment.
6040.3	0166.00	Tributary #3 enters on the RB bank. It contributes to approximately 1% of Atwell Creek's flow. The water temperature of the tributary was 56° Fahrenheit, the water temperature downstream of the confluence was 57° Fahrenheit, and the water temperature upstream of the confluence was 57° Fahrenheit. The slope of the tributary is 5%. The tributary is not accessible to salmonids due to very small and high slope cobble that was only 2' wide. Fish were not observed in the tributary.
6363.3	0173.00	LDA #6 is 6.5' high x 35' wide x 9' long and contains 8 pieces of LWD. Water flows through the LDA and there are visible gaps in it. Sediment is being retained in the approximate dimensions of 4' deep. The sediment ranges in size from silt to small cobble. Fish were observed above the LDA.
6391.3	0174.00	Run under LDA.

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7110.3	0191.00	Pool tail-out is over a log, not bedrock.
7223.3	0194.00	Old landslide on LB.
7502.3	0203.00	RB landslide cont.
7526.3	0204.00	RB landslide cont.
7548.3	0205.00	RB landslide cont.
7568.3	0206.00	RB landslide LB landslide end.
8113.3	0216.00	LDA #8 is 12' high x 30' wide x 30' long and contains 7 pieces of LWD. Water flows through the LDA and there are no visible gaps in it. Sediment is being retained in the approximate dimensions of 20' wide x 35' long x 6' deep. The sediment ranges in size from sand to cobble. Fish were observed above the LDA.
8169.3	0217.00	Couldn't measure pool tail b/c pool is located in the middle of LDA with 4' plunge.
8215.3	0220.00	LDA #9 is 6.5' high x 30' wide x 20' long and contains 12 pieces of LWD. Water flows through the LDA and there are visible gaps in it. Sediment is not being retained. Fish were observed above the LDA.
8989.3	0240.00	Log spanning channel, creating small plunge.
9130.3	0243.01	Side channel becomes dry and doesn't connect to main channel.
9443.3	0253.00	LDA #10 is 8' high x 25' wide x 20' long and contains 9 pieces of LWD. Water flows through the LDA and there are visible gaps in it. Sediment is not being retained. Fish were observed above the LDA.
9498.3	0256.00	RB landslide.
9566.3	0257.00	RB landslide cont.
9596.3	0258.00	RB landslide end. 131' long x 20' high total.
9771.3	0264.00	End of survey due to the channel becoming very pinched in areas due to landslides. Also ended survey due to channel obstruction and long hike. YOY observed beyond this point.

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.

REPORT CONTACT INFORMATION

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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

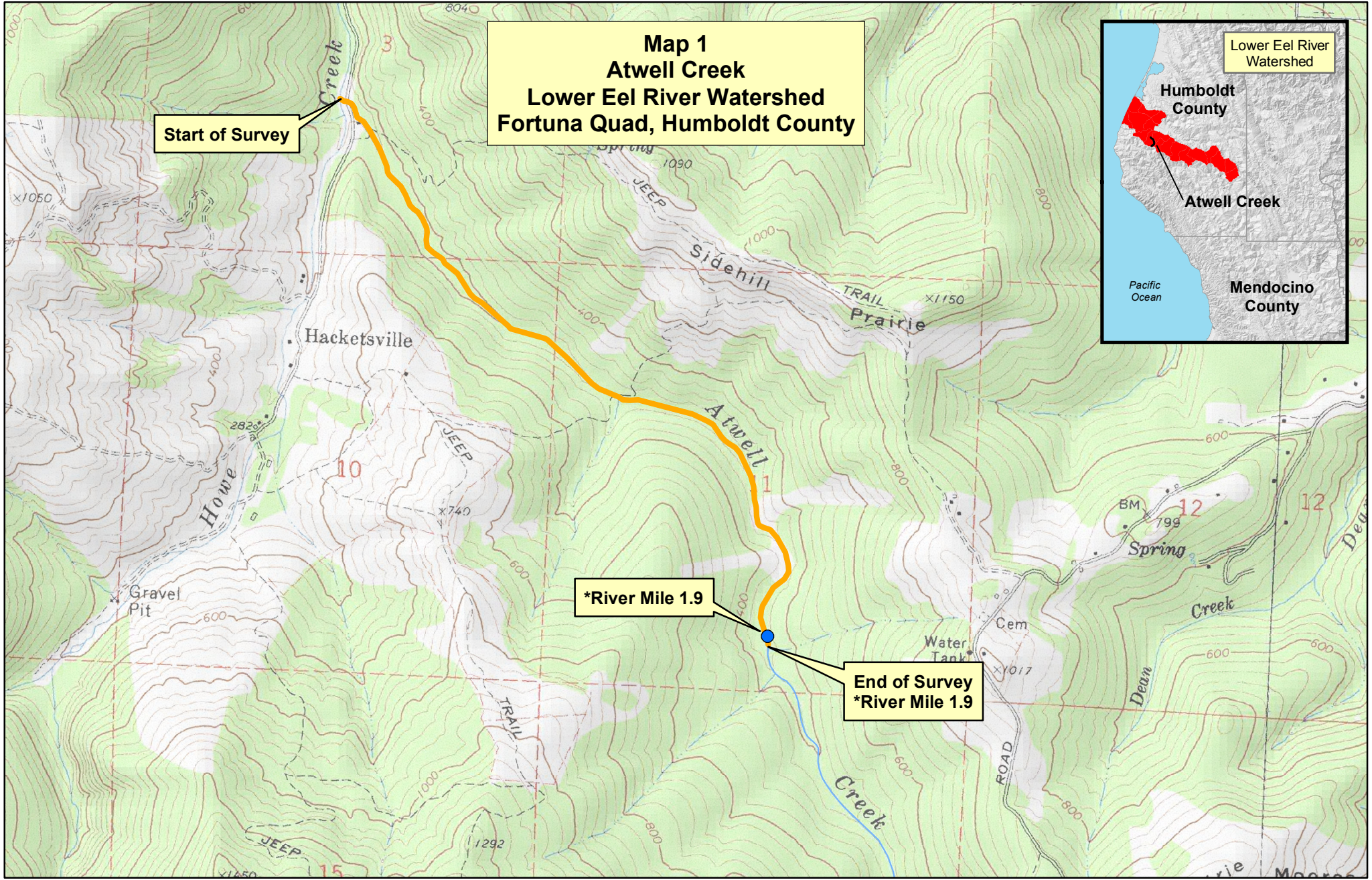
Corner Pool	(CRP)	[5.1]	{ 22 }
Lateral Scour Pool - Log Enhanced	(LSL)	[5.2]	{ 10 }
Lateral Scour Pool - Rootwad Enhanced	(LSR)	[5.3]	{ 11 }
Lateral Scour Pool - Bedrock Formed	(LSBk)	[5.4]	{ 12 }
Lateral Scour Pool - Boulder Formed	(LSBo)	[5.5]	{ 20 }
Plunge Pool	(PLP)	[5.6]	{ 9 }

BACKWATER POOLS

Secondary Channel Pool	(SCP)	[6.1]	{ 4 }
Backwater Pool - Boulder Formed	(BPB)	[6.2]	{ 5 }
Backwater Pool - Rootwad 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]	

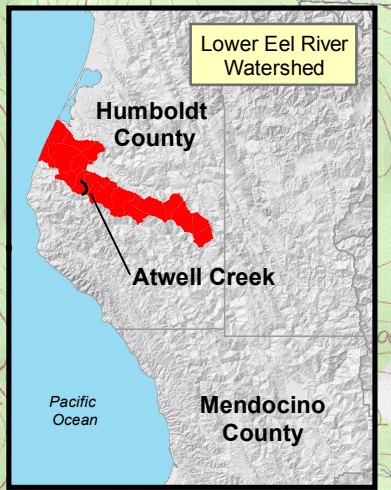


Map 1
Atwell Creek
Lower Eel River Watershed
Fortuna Quad, Humboldt County

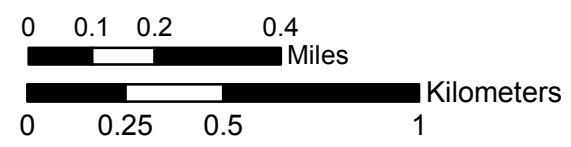
Start of Survey

***River Mile 1.9**

End of Survey
***River Mile 1.9**



- Reach 1: F3 Channel Type
- Atwell Creek
- Last observed juvenile steelhead trout



Coordinate System: NAD 1983 California Teale Albers
Data Sources: CDFW, USGS, CalWater 2.21, CDF 24k

*River Mile indicates distance from the confluence with Howe Creek

APPENDIX I

TABLES AND GRAPHS

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

Stream Name: Atwell Creek

LLID: 1241678404957

Drainage: Eel River - Lower

Survey Dates: 6/7/2017 to 6/19/2017

Confluence Location: Quad: TAYLOR PEAK

Legal Description: T01NR01WS03

Latitude: 40:29:45.0N

Longitude: 124:10:04.0

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
87	11	FLATWATER	32.3	44	3822	38.1	8.6	0.5	1.1	446	38817	213	18534		19
1	0	NOSURVEY	0.4	57	57	0.6									
91	84	POOL	33.8	32	2949	29.4	10.6	0.7	2.6	363	33000	419	36777	297	19
90	9	RIFFLE	33.5	36	3212	32.0	11.7	0.3	0.7	436	39205	165	14828		0
Total Units	Total Units Fully Measured				Total Length (ft.)					Total Area (sq.ft.)			Total Volume (cu.ft.)		
269	104				10040					111022			70139		

Table 2 - Summary of Habitat Types and Measured Parameters

Stream Name: Atwell Creek

LLID: 1241678404957

Drainage: Eel River - Lower

Survey Dates: 6/7/2017 to 6/19/2017

Confluence Location: Quad: TAYLOR PEAK

Legal Description: T01NR01WS03

Latitude: 40:29:45.0N

Longitude: 124:10:04.0W

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 (%)
90	9	LGR	33.5	36	3212	32.0	12	0.3	1.3	436	39205	165	14828		0	94
2	0	POW	0.7	4	8	0.1										
67	9	RUN	24.9	39	2638	26.3	8	0.5	1.7	456	30568	209	14028		22	88
18	2	SRN	6.7	65	1176	11.7	9	0.5	1.3	401	7216	230	4131		8	100
86	79	MCP	32.0	32	2742	27.3	11	0.8	28.7	361	31054	414	34221	324	20	94
1	1	CRP	0.4	36	36	0.4	12	-5.3		432	432	475	475	-2290	5	100
1	1	LSL	0.4	47	47	0.5	10	1.7	3.5	470	470	846	846	799	10	100
2	2	LSR	0.7	34	69	0.7	7	0.7	2.7	242	483	266	531	169	18	99
1	1	PLP	0.4	55	55	0.5	10	1.1	2.7	550	550	660	660	605	10	100
1	0	NS	0.4	57	57	0.6										

Total Units
269

Total Units Fully Measured
104

Total Length (ft.)
10040

Total Area (sq.ft.)
109978

Total Volume (cu.ft.)
69720

Table 3 - Summary of Pool Types

Stream Name: Atwell Creek

LLID: 1241678404957

Drainage: Eel River - Lower

Survey Dates: 6/7/2017 to 6/19/2017

Confluence Location: Quad: TAYLOR PEAK

Legal Description: T01NR01WS03

Latitude: 40:29:45.0N

Longitude: 124:10:04.0W

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
86	79	MAIN	95	32	2742	93	10.7	0.8	361	31054	324	26444	20
5	5	SCOUR	5	41	207	7	9.2	-0.2	387	1935	-110	-548	12
Total Units	Total Units Fully Measured				Total Length (ft.)				Total Area (sq.ft.)			Total Volume (cu.ft.)	
91	84				2949				32989			25896	

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

Stream Name: Atwell Creek

LLID: 1241678404957

Drainage: Eel River - Lower

Survey Dates: 6/7/2017 to 6/19/2017

Confluence Location: Quad: TAYLOR PEAK

Legal Description: T01NR01WS03

Latitude: 40:29:45.0N

Longitude: 124:10:04.0W

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
80	MCP	94	8	10	43	54	18	23	8	10	3	4
1	CRP	1	1	100	0	0	0	0	0	0	0	0
1	LSL	1	0	0	0	0	0	0	1	100	0	0
2	LSR	2	0	0	1	50	1	50	0	0	0	0
1	PLP	1	0	0	0	0	1	100	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
85	9	11	44	52	20	24	9	11	3	4

Mean Maximum Residual Pool Depth (ft.): 2.6

Table 5 - Summary of Mean Percent Cover By Habitat Type

Stream Name: Atwell Creek

LLID: 1241678404957 Drainage: Eel River - Lower

Survey Dates: 6/7/2017 to 6/19/2017 Dry Units: 0

Confluence Location: Quad: TAYLOR PEAK Legal Description: T01NR01WS03 Latitude 40:29:45.0N Longitude: 124:10:04.0W

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
90	7	LGR	0	0	0	0	0	0	0	100	0
90	7	TOTAL RIFFLE	0	0	0	0	0	0	0	100	0
2	0	POW									
67	8	RUN	0	15	11	28	0	13	0	33	0
18	2	SRN	0	0	0	0	0	0	0	100	0
87	10	TOTAL FLAT	0	11	8	21	0	10	0	50	0
86	78	MCP	5	23	17	9	9	2	2	33	0
1	1	CRP	0	100	0	0	0	0	0	0	0
1	1	LSL	0	0	100	0	0	0	0	0	0
2	2	LSR	20	10	20	35	0	0	0	15	0
1	1	PLP	0	100	0	0	0	0	0	0	0
91	83	TOTAL POOL	5	24	18	9	9	2	2	30	0
1	0	NS									
269	100	TOTAL	5	23	17	9	8	2	2	33	0

Table 6 - Summary of Dominant Substrates By Habitat Type

Stream Name: Atwell Creek

LLID: 1241678404957

Drainage: Eel River - Lower

Survey Dates: 6/7/2017 to 6/19/2017

Dry Units: 0

Confluence Location: Quad: TAYLOR PEAK

Legal Description: T01NR01WS03

Latitude: 40:29:45.0N

Longitude: 124:10:04.0W

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
90	9	LGR	0	0	0	44	44	11	0
2	0	POW	0	0	0	0	0	0	0
67	10	RUN	0	30	20	30	20	0	0
18	2	SRN	0	0	0	0	50	50	0
86	77	MCP	10	44	4	19	22	0	0
1	1	CRP	100	0	0	0	0	0	0
1	1	LSL	100	0	0	0	0	0	0
2	2	LSR	0	100	0	0	0	0	0
1	1	PLP	0	100	0	0	0	0	0

Table 7 - Summary of Mean Percent Canopy for Entire Stream

Stream Name: Atwell Creek

LLID: 1241678404957

Drainage: Eel River - Lower

Survey Dates: 6/7/2017 to 6/19/2017

Confluence Location: Quad: TAYLOR PEAK

Legal Description: T01NR01WS03

Latitude: 40:29:45.0N

Longitude: 124:10:04.0W

Mean Percent Canopy	Mean Percent Conifer	Mean Percent Hardwood	Mean Percent Open Units	Mean Right Bank % Cover	Mean Left Bank % Cover
93	40	60	0	96	92

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: Atwell Creek

LLID: 1241678404957

Drainage: Eel River - Lower

Survey Dates: 6/7/2017 to 6/19/2017

Survey Length (ft.): 10040

Main Channel (ft.): 9816

Side Channel (ft.): 224

Confluence Location: Quad: TAYLOR PEAK

Legal Description: T01NR01WS03 Latitude: 40:29:45.0N

Longitude: 124:10:04.0W

Summary of Fish Habitat Elements By Stream Reach**STREAM REACH: 1**

Channel Type: F3

Canopy Density (%): 93.5

Pools by Stream Length (%): 29.4

Reach Length (ft.): 9816

Coniferous Component (%): 39.7

Pool Frequency (%): 33.8

Riffle/Flatwater Mean Width (ft.): 10.0

Hardwood Component (%): 60.3

Residual Pool Depth (%):

BFW:

Dominant Bank Vegetation: Coniferous Trees

< 2 Feet Deep: 62

Range (ft.): 12 to 37

Vegetative Cover (%): 93.8

2 to 2.9 Feet Deep: 24

Mean (ft.): 24

Dominant Shelter: Boulders

3 to 3.9 Feet Deep: 11

Std. Dev.: 7

Dominant Bank Substrate Type: Sand/Silt/Clay

>= 4 Feet Deep: 4

Base Flow (cfs.): 1.4

Occurrence of LWD (%): 14

Mean Max Residual Pool Depth (ft.): 2.6

Water (F): 54 - 59 Air (F): 58 - 68

LWD per 100 ft.:

Mean Pool Shelter Rating: 19

Dry Channel (ft): 0

Riffles: 0

Pools: 6

Flat: 2

Pool Tail Substrate (%): Silt/Clay: 0 Sand: 0 Gravel: 14 Sm Cobble: 58 Lg Cobble: 25 Boulder: 1 Bedrock: 1

Embeddedness Values (%): 1. 20.9 2. 68.6 3. 10.5 4. 0.0 5. 0.0

Table 9 - Mean Percentage of Dominant Substrate and Vegetation

Stream Name: Atwell Creek

LLID: 1241678404957

Drainage: Eel River - Lower

Survey Dates: 6/7/2017 to 6/19/2017

Confluence Location: Quad: TAYLOR PEAK

Legal Description: T01NR01WS03

Latitude: 40:29:45.0N

Longitude: 124:10:04.0W

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	2	0.9
Boulder	0	0	0.0
Cobble / Gravel	18	16	15.9
Sand / Silt / Clay	89	89	83.2

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	2	1	1.4
Brush	26	12	17.8
Hardwood Trees	39	43	38.3
Coniferous Trees	39	44	38.8
No Vegetation	0	6	2.8

Total Stream Cobble Embeddedness Values: 2

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

StreamName: Atwell Creek

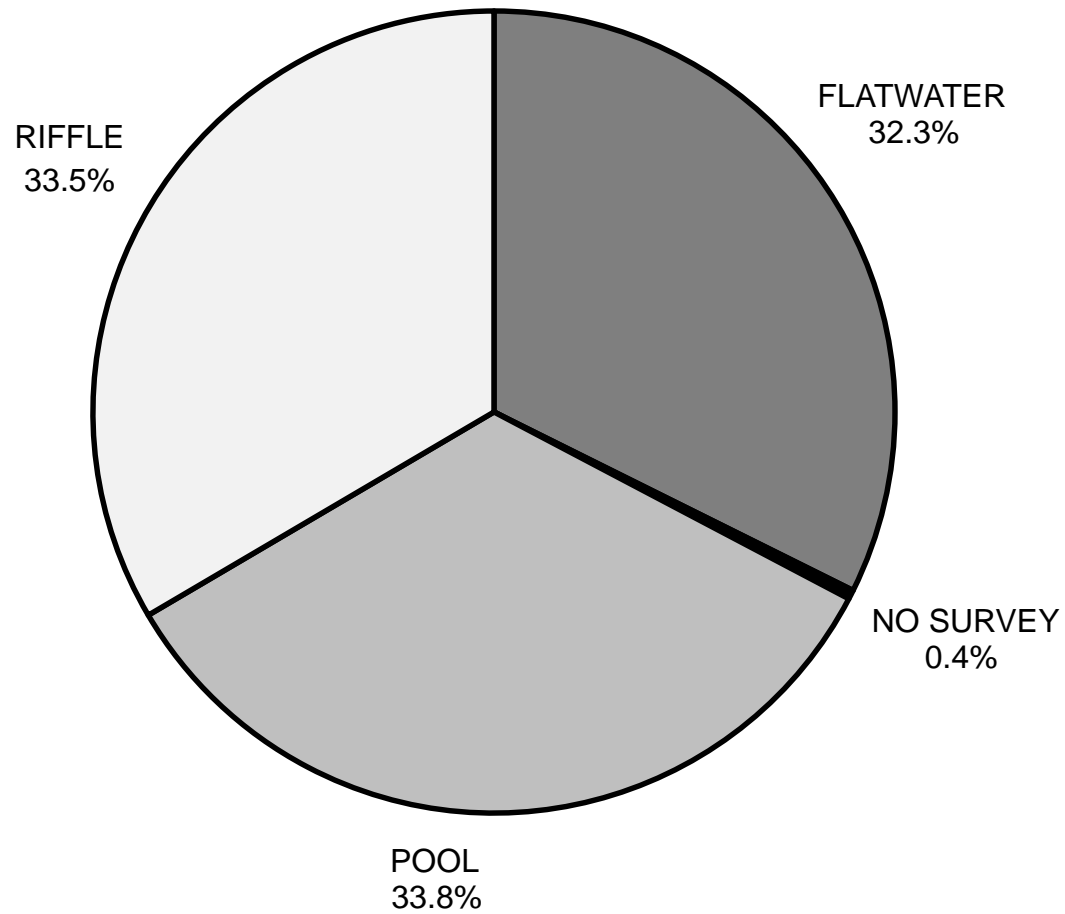
LLID: 1241678404957 Drainage: Eel River-Lower

Survey Dates: 6/7/2017 to 6/19/2017

Confluence Location: Quad: TAYLOR PEAK Legal Description: T01NR01WS03 Latitude: 40:29:45.0N Longitude: 124:10:04.0W

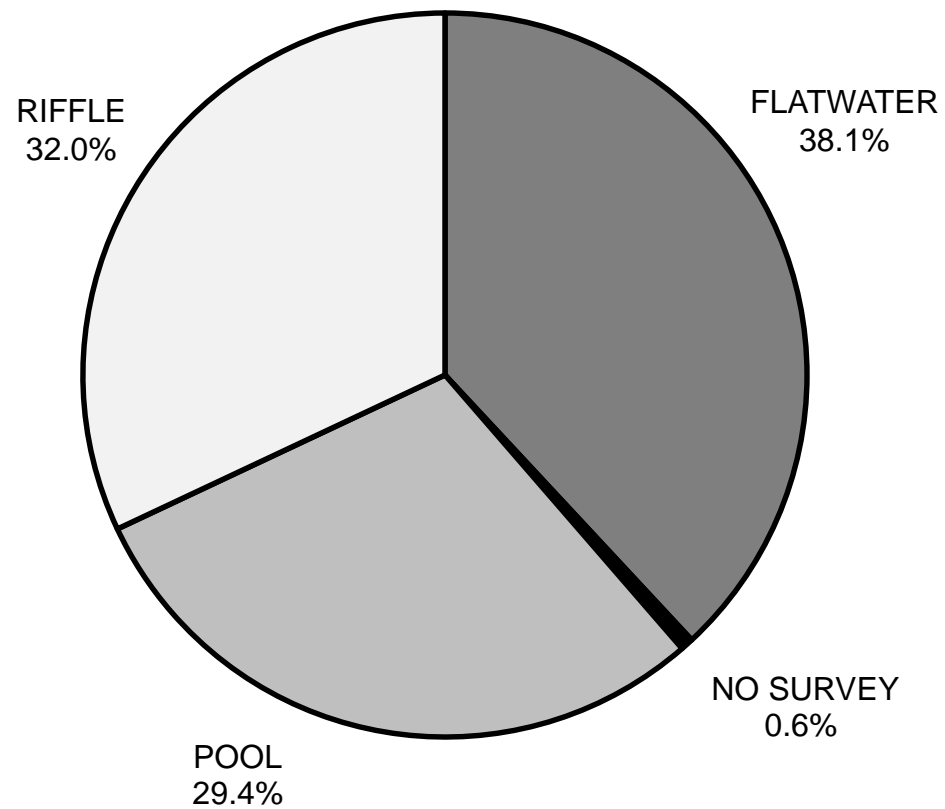
	Riffles	Flatwater	Pools
UNDERCUT BANKS(%)	0	0	5
SMALL WOODY DEBRIS (%)	0	11	24
LARGE WOODY DEBRIS (%)	0	8	18
ROOT MASS (%)	0	21	9
TERRESTRIAL VEGETATION (%)	0	0	9
AQUATIC VEGETATION (%)	0	10	2
WHITEWATER (%)	0	0	2
BOULDERS (%)	100	50	30
BEDROCK LEDGES (%)	0	0	0

ATWELL CREEK 2017 HABITAT TYPES BY PERCENT OCCURRENCE



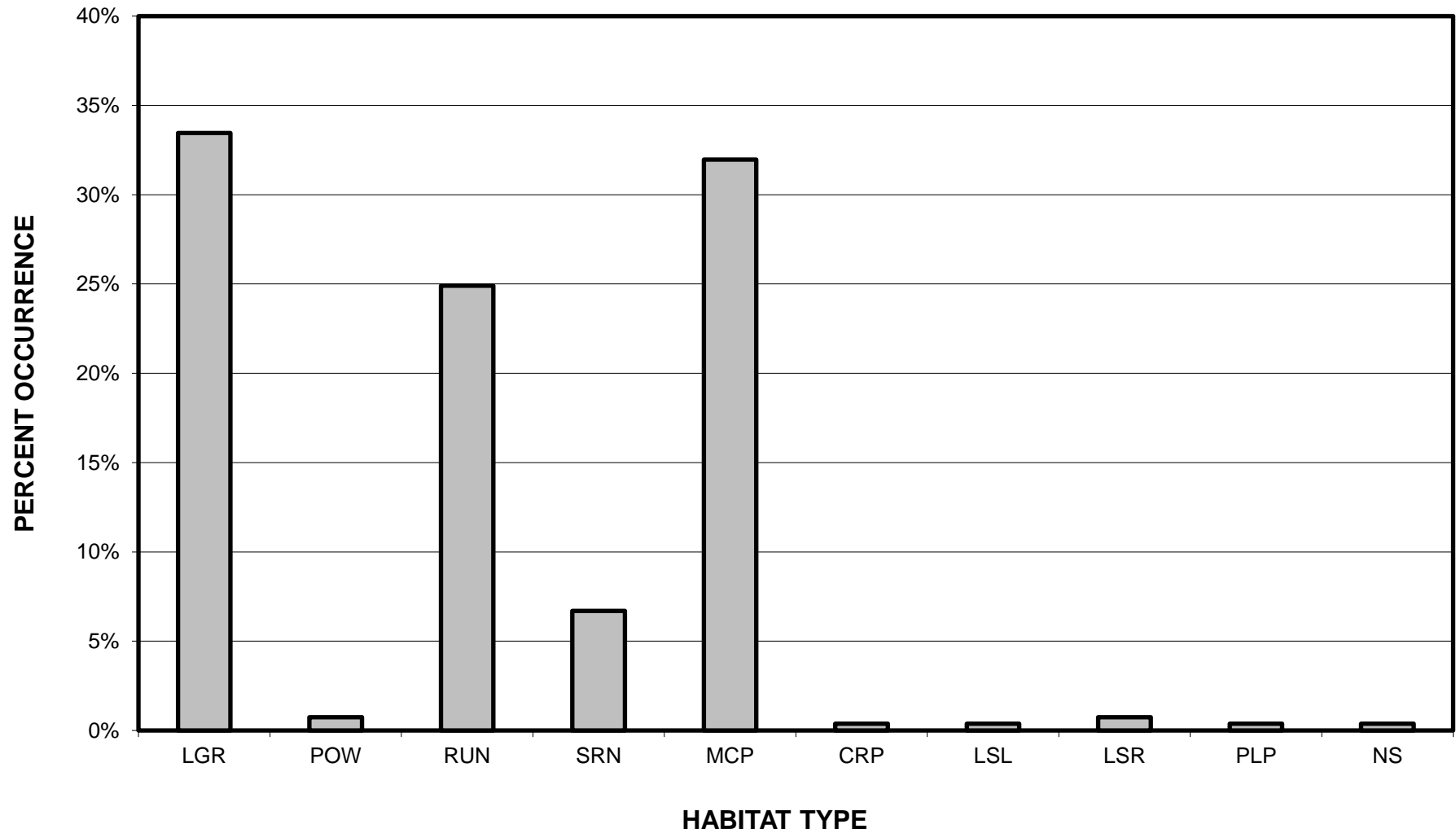
GRAPH 1

ATWELL CREEK 2017
HABITAT TYPES BY PERCENT TOTAL LENGTH



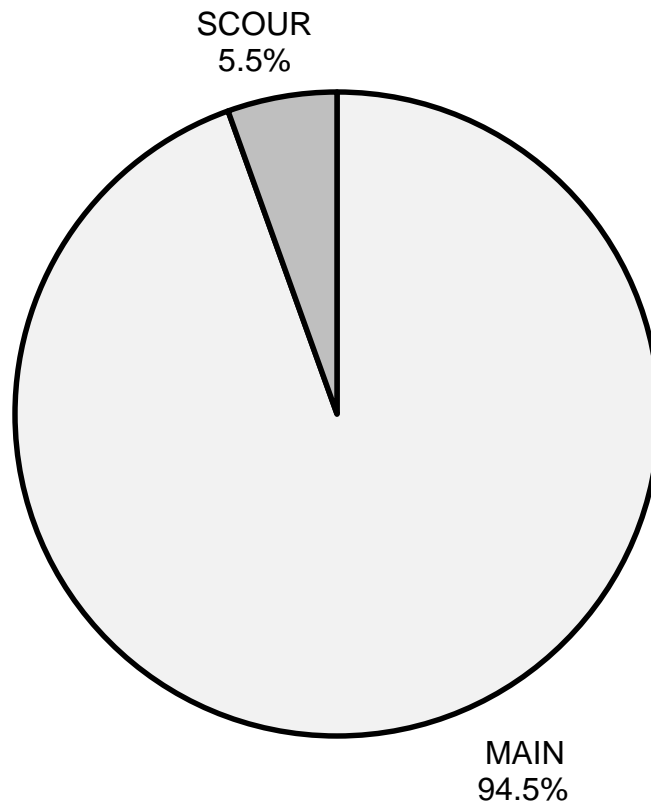
ATWELL CREEK 2017

HABITAT TYPES BY PERCENT OCCURRENCE

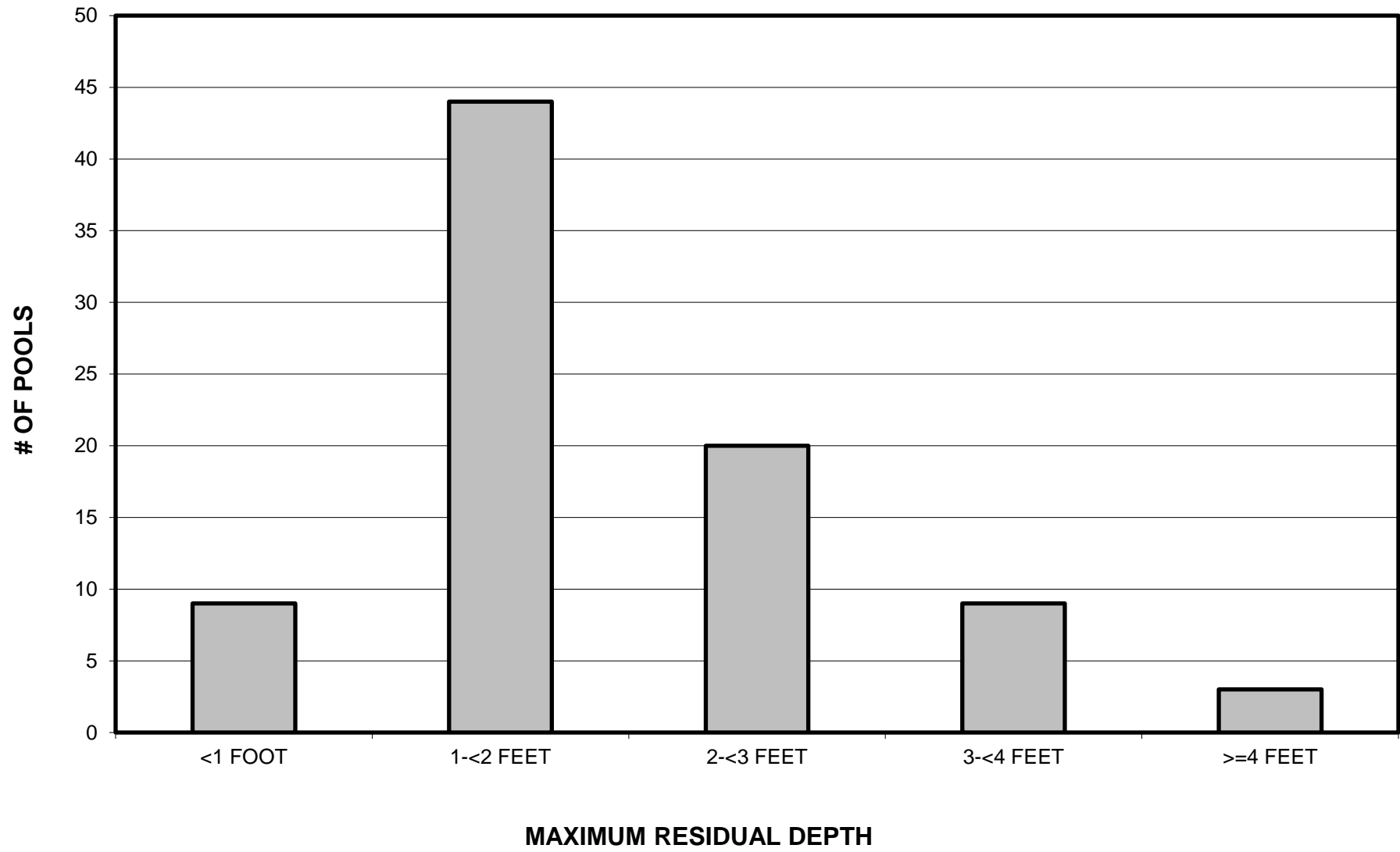


GRAPH 3

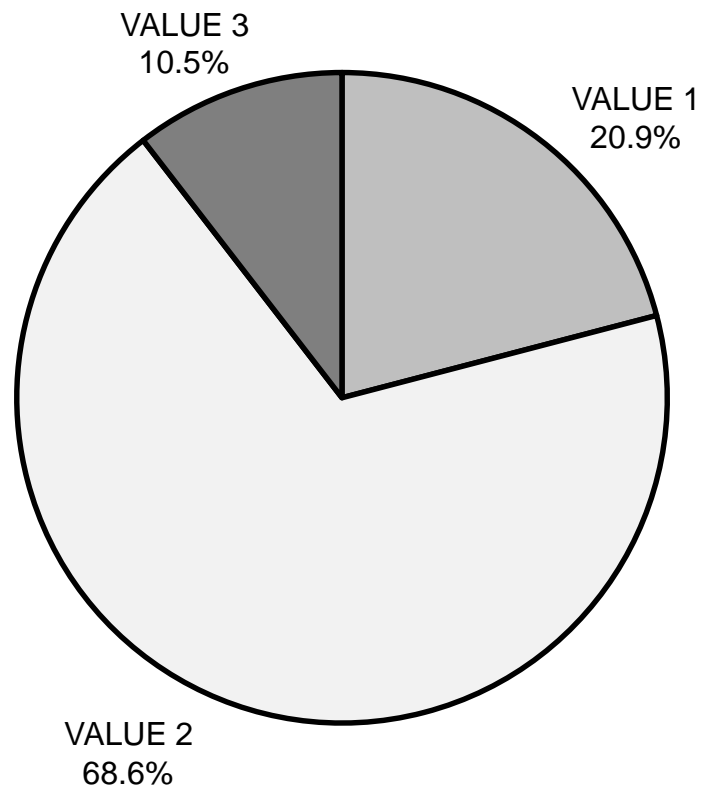
**ATWELL CREEK 2017
POOL TYPES BY PERCENT OCCURRENCE**



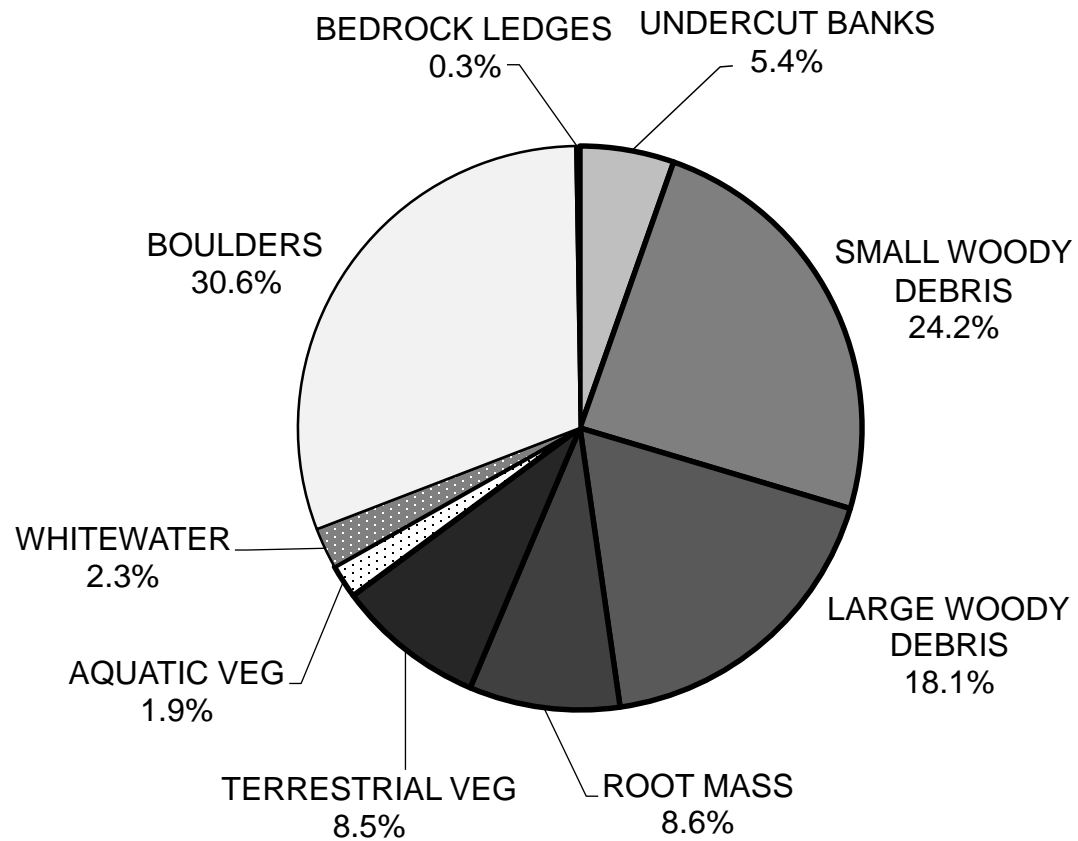
ATWELL CREEK 2017 MAXIMUM DEPTH IN POOLS



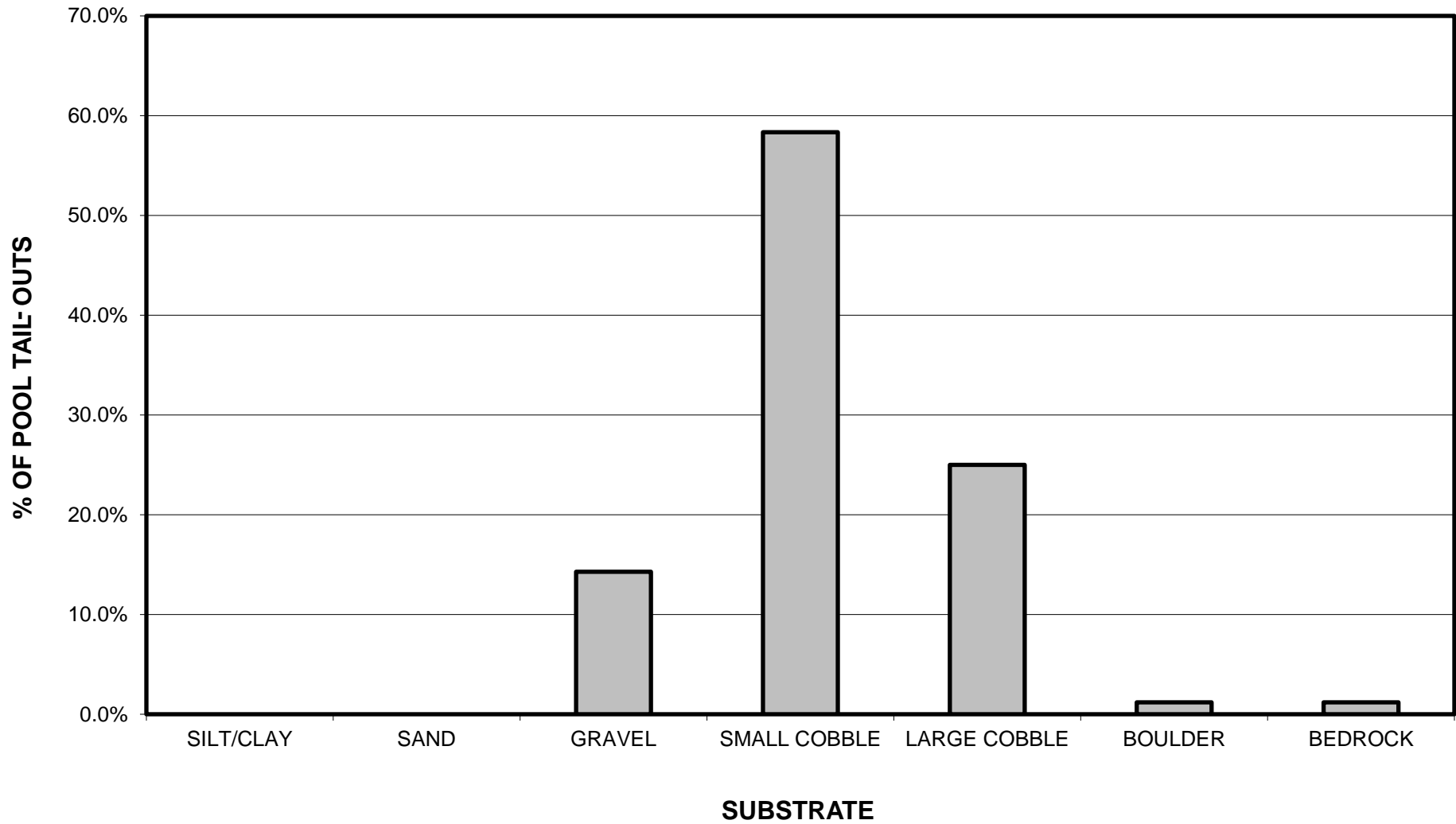
ATWELL CREEK 2017 PERCENT EMBEDDEDNESS



ATWELL CREEK 2017 MEAN PERCENT COVER TYPES IN POOLS

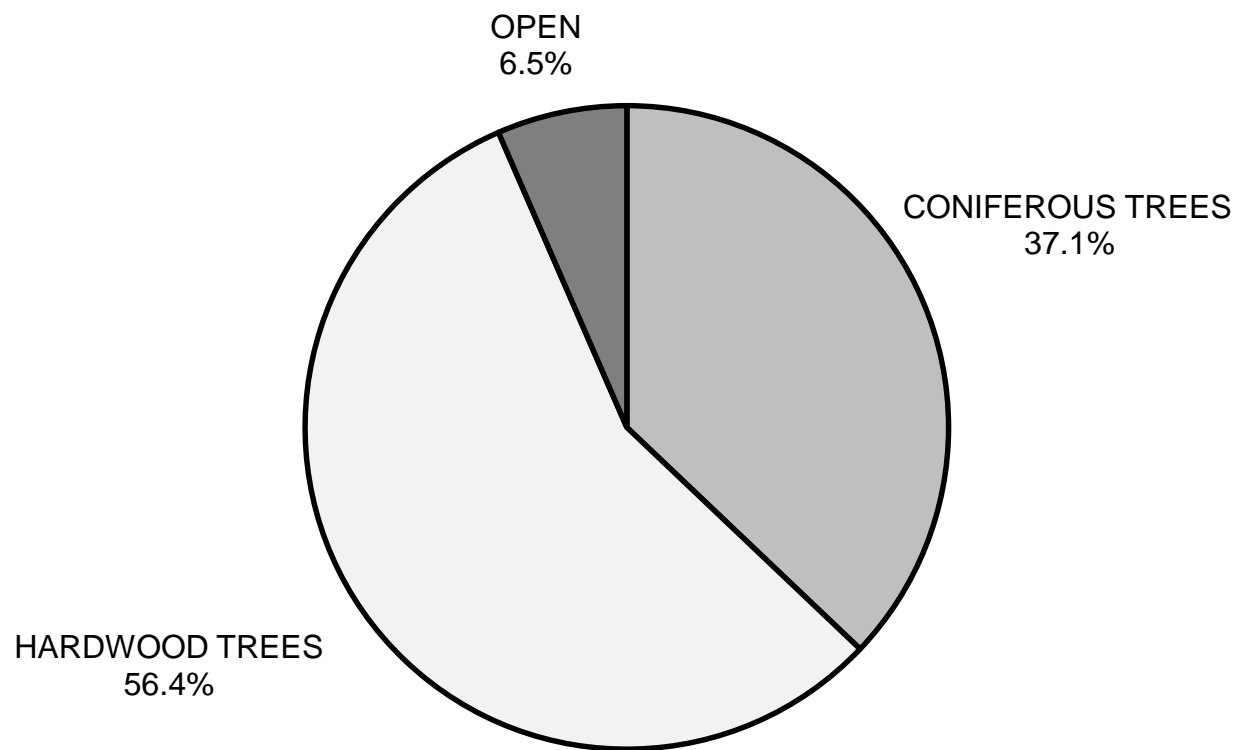


ATWELL CREEK 2017 SUBSTRATE COMPOSITION IN POOL TAIL-OUTS

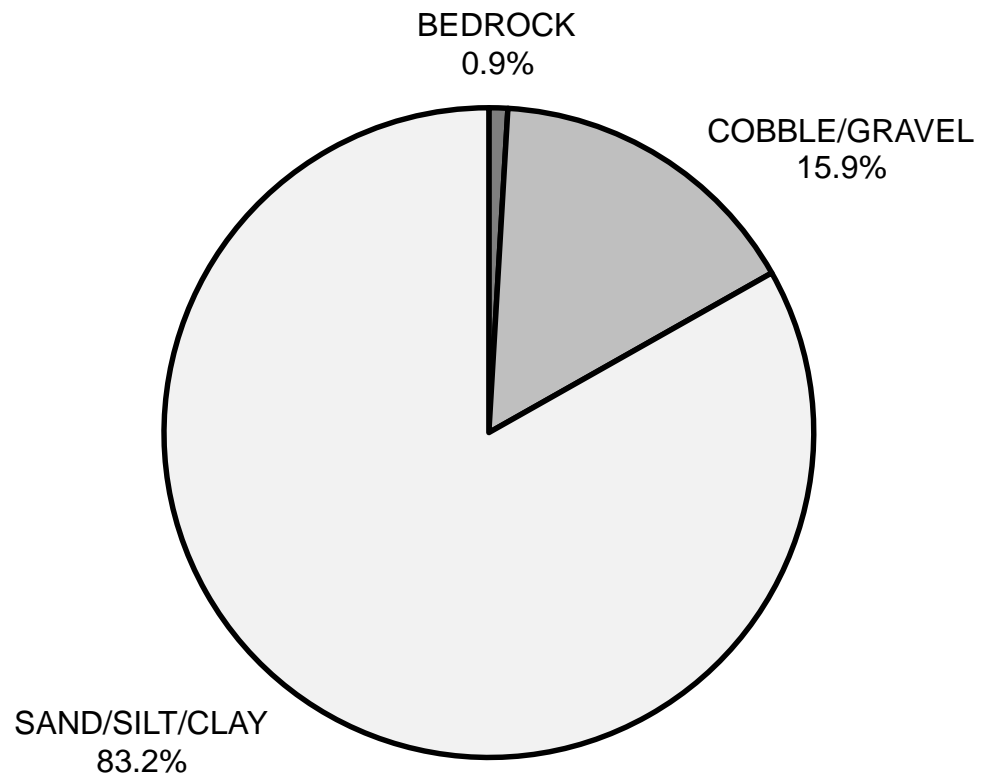


GRAPH 8

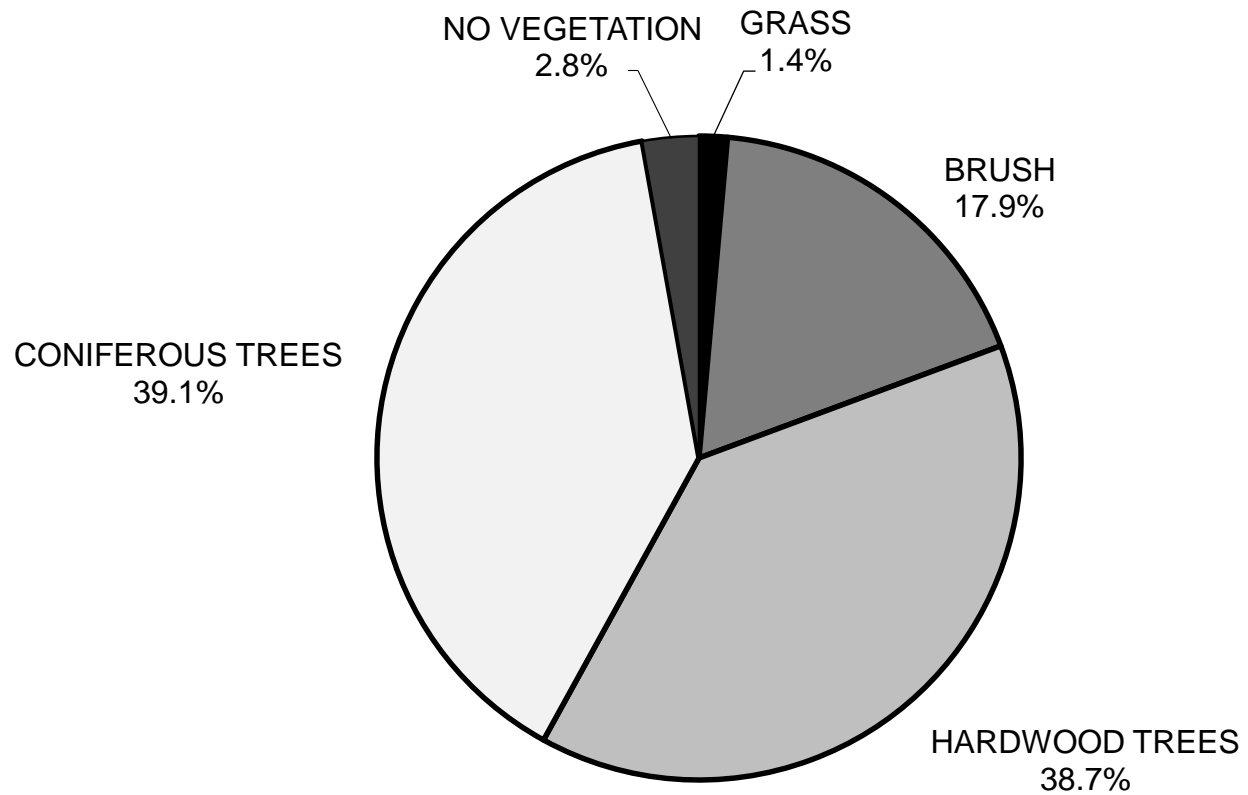
ATWELL CREEK 2017 MEAN PERCENT CANOPY



ATWELL CREEK 2017
DOMINANT BANK COMPOSITION IN SURVEY REACH



**ATWELL CREEK 2017
DOMINANT BANK VEGETATION IN SURVEY REACH**



APPENDIX II

STREAM INVENTORY PHOTOS



Photo 1: A pool followed by a riffle at habitat units #012 and #013, 547' upstream of the start of survey. Kori Roberts pictured. (Photo taken 6/07/2017)



Photo 2: Large debris accumulation #6 and landslide at habitat unit #173, 6,527' upstream of start of survey. (Photo taken 6/12/2017)



Photo 3: Landslide at unknown distance from start of survey. (Photo taken 6/12/17)