



CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE

STREAM INVENTORY REPORT

Sproul Creek

INTRODUCTION

A stream inventory was conducted from August 8 to September 21, 2016 on Sproul Creek. The survey began at the confluence with South Fork Eel River and extended upstream 7.4 miles. Stream inventories and reports were also completed for one tributary to Sproul Creek.

The objective of the habitat inventory was to document the habitat available to anadromous salmonids in Sproul Creek. Normally a biological inventory consisting of a mask and snorkel survey would be completed in conjunction with the habitat inventory; however, early rains in the survey area damaged the roads and limited access to the creek. Observations were made from the streambanks using handheld underwater cameras during this inventory and are presented in the "Results" section of this report.

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

Sproul Creek is a tributary to South Fork Eel River, which drains to the Pacific Ocean, located in Humboldt County, California (Map 1). Sproul Creek's legal description at the confluence with South Fork Eel River is T04S R03E S34. Its location is 40.0694° north latitude and 123.8261° west longitude, LLID number 1238261400695. Sproul Creek is a third order stream and has approximately 8.4 miles of blue line stream according to the USGS Garberville 7.5 minute quadrangle. Sproul Creek drains a watershed of approximately 24 square miles. Elevations range from about 320 feet at the mouth of the creek to 1,400 feet in the headwater areas. Redwood and Doug Fir forest dominates the watershed. The watershed is entirely privately owned and is managed for timber production. Vehicle access exists via Highway 101 to Sproul Creek Road west of the town of Garberville.

METHODS

The habitat inventory conducted in Sproul Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi et al. 1998). The 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

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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. Surveyors also take photos to document general habitat conditions (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 Sproul Creek to record measurements and observations. There are eleven components to the inventory form.

1. Flow:

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

2. Channel Type:

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

3. Temperatures:

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". Sproul 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

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the cobble that is surrounded or buried by fine sediment. In Sproul Creek, embeddedness was ocularly estimated. The values were recorded using the following ranges: 0 - 25% (value 1), 26 - 50% (value 2), 51 - 75% (value 3) and 76 - 100% (value 4). Additionally, a value of 5 was assigned to tail-outs deemed not suitable for spawning due to inappropriate substrate like bedrock, log sills, boulders or other considerations.

6. Shelter Rating:

Instream shelter is composed of those elements within a stream channel that provide juvenile salmonids protection from predation, reduce water velocities so fish can rest and conserve energy, and allow separation of territorial units to reduce density related competition for prey. The shelter rating is calculated for each fully-described habitat unit by multiplying shelter value and percent cover. Using an overhead view, a quantitative estimate of the percentage of the habitat unit covered is made. All cover is then classified according to a list of nine cover types. In Sproul 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. 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 Sproul 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 Sproul 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

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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.

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 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 Sproul 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 August 8, 2016 to September 21, 2016, was conducted by Ryan Bernstein (CDFW), Nicole Bejar CDFW), Amidia Fredrick (WSP), David Lam (CDFW), Brian Starks (CDFW) and Silvia Gwozdz (CDFW). The total length of the stream surveyed was 39,089 feet with an additional 711 feet of side channel.

Stream flow was measured near the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 109.86 cfs on October 21st, 2016. This stream flow measurement was taken outside of the duration of the habitat inventory and occurred after significant rainfall. Therefore, this stream flow measurement is not indicative of the flows that occurred during the habitat inventory.

Sproul Creek is an F2 channel type for 10,188 feet of the stream surveyed (Reach 1) and an F3 channel type for 29,612 feet of the stream surveyed (Reach 2). F2 channel types are entrenched meandering riffle/pool channels on low gradients with high width/depth ratios, very stable with boulder-dominant substrates. 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 51° to 64° Fahrenheit. Air temperatures ranged from 54° to 82° Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 38% pool units, 31% flatwater units, 18% dry units, and 14% riffle units (Graph 1). Based on total length of Level II habitat types there were 34% pool units, 33% flatwater units, 29% dry units, and 4% riffle units (Graph 2).

Ten Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were mid-channel pool units, 36%; and dry units, 18% (Graph 3). Based on percent total length mid-channel pool units made up 33%, dry units 29%, and step run units 22%. A total of 172 pools were identified (Table 3). Main channel pools were the most frequently encountered at 98% (Graph 4), and comprised 99% of the total length of all pools (Table 3).

Table 4 is a summary of maximum residual pool depths by pool habitat types. Pool quality for salmonids increases with depth. One-hundred eight of the 172 pools (63%) had a residual depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 172 pool tail-outs measured, 32 had a value of 1 (18.6%); 61 had a value of 2 (35.5%); 50 had a value of 3 (29.1%); 5 had a value of 4 (2.9%); 24 had a value of 5 (14%) (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.

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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 3, and pool habitats had a mean shelter rating of 15 (Table 1). Of the pool types, the main channel pools had a mean shelter rating of 14, while scour pools had a mean shelter rating of 45 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover type in Sproul Creek. Graph 7 describes the pool cover in Sproul Creek. Boulders are the dominant pool cover type followed by large 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 62% of pool tail-outs. Small cobble was the next most frequently observed substrate in 16% of pool tail-outs.

The mean percent canopy density for the surveyed length of Sproul Creek was 92%. Eight percent of the canopy was open. Of the canopy present, the mean percentages of hardwood and coniferous trees were 86% and 14%, respectively. Graph 9 describes the mean percent canopy in Sproul Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 100%. The mean percent left bank vegetated was 100%. The dominant elements composing the structure of the stream banks consisted of 55% cobble/gravel, 17% bedrock, 15% sand/silt/clay, and 13% boulder (Graph 10).

Coho salmon were observed from streambanks during this inventory using handheld underwater cameras. They were observed at several locations throughout the survey, including a pool unit at the end of the survey: coordinates 40.0110° north latitude and -123.8533° west longitude (approximately 39,029 feet upstream from confluence of the South Fork Eel River).

DISCUSSION

Sproul Creek is an F2 channel type for 10,188 feet of the stream surveyed (Reach 1), and an F3 channel type for 29,612 feet of the stream surveyed (Reach 2). The suitability of F2 and F3 channel types for fish habitat improvement structures is as follows: F2 channel types are fair for plunge weirs, single and opposing wing-deflectors, and log cover. F3 channel types 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 August 8, 2016 to September 21, 2016, ranged from 51° to 64° Fahrenheit. Air temperatures ranged from 54° to 82° Fahrenheit. This is a suitable water temperature range for salmonids. However, 60° Fahrenheit, if sustained, is near the threshold stress level 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 33% of the total length of this survey, riffles 4%, pools 34%

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and 29% dry units. One hundred eight of the 172 (63%) 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 for locations where their installation will not be threatened by high stream energy, or where their installation will not conflict with the modification of the numerous log debris accumulations (LDA's) in the stream.

Ninety-three of the 172 pool tail-outs measured had embeddedness ratings of 1 or 2. Fifty-five of the pool tail-outs had embeddedness ratings of 3 or 4. Twenty-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 Sproul Creek should be mapped and rated according to their potential sediment yields, and control measures should be taken.

One hundred thirty-four of the 172 pool tail-outs measured had gravel or small cobble as the dominant substrate. This is generally considered good for spawning salmonids. Thirty-eight of the 172 pool tail-outs had silt, sand, large cobble, boulders or bedrock as the dominant substrate. This is generally considered unsuitable for spawning salmonids.

The mean shelter rating for pools is 15. The shelter rating in the flatwater habitats is 3. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by boulders in Sproul Creek. Boulders are the dominant cover type in pools followed by large 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 92%. Reach 1 had a canopy density of 88%, Reach 2 had a canopy density of 93%. The percentage of right and left bank covered with vegetation was 100% and 100%, respectively.

RECOMMENDATIONS

Sproul 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 Sproul 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

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pools is desirable.

- 2) Based on observed conditions pools are likely to become disconnected. Streamflow should be monitored to determine if it is limiting for salmonids.
- 3) 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.
- 4) 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 South Fork Eel River.
537	0007.00	Bridge #7 is the crossing for an unnamed road and is 28' wide x 117' long. It is an automobile bridge (made of pavement) and is not a barrier to salmonids.
2588	0030.00	Bridge #2 is the crossing for an unnamed road and is not a barrier to salmonids. Tributary #1 (Little Sproul) enters on the left bank. It contributes to approximately 5% of Sproul Creek's flow. The water temperature of the tributary was 61 degrees Fahrenheit; the water temperature downstream of the confluence was 62 degrees. The slope is estimated at 3%. Fish are able to access the tributary and salmonids were observed.
5440	0064.00	Significant landslide in area.
6029	0073.00	A dry tributary is on the right bank.
8105	0087.00	Dry side channel.
8147	0088.00	Channel changes from cobble dominated to boulder dominated.
9172	0111.00	Bedrock canyon through habitat unit 114.

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9618	0123.00	End of boulder and high gradient channel.
9715	0124.00	Young-of-the-year (YOY) trout observed.
10680	0135.00	Boulder/log structure with a 2' plunge.
11087	0143.00	Active landslide area, 50' long x 100' high, bringing silt and boulders into channel.
11170	0145.00	There is a tributary on the right bank of this unit.
12315	0157.01	Side channel pool.
13135	0168.00	Tributary #2 (Warden Creek) enters on the left bank. It contributes to approximately 0.5% of Sproul Creek's flow. The water temperature of the tributary was 60 degrees Fahrenheit, the water temperature downstream of the confluence was 60 degrees Fahrenheit, and the water temperature upstream of the confluence was 60 degrees Fahrenheit. The slope of the tributary is estimated 4%. The tributary is accessible to salmonids due to running water. Fish were observed in the tributary. A culvert bridge is 100' from mouth of tributary.
15392	0194.00	Riprap along left bank, goes up to the road.
16303	0209.00	Tributary #3 (unknown tributary) enters on the left bank. It contributes to approximately 1% of Sproul Creek's flow. The water temperature of the tributary was 59 degrees Fahrenheit, the water temperature downstream of the confluence was 60 degrees Fahrenheit, and the water temperature upstream of the confluence was 60 degrees Fahrenheit. The slope of the tributary is estimated 8%. The tributary is accessible to salmonids due to running water. Fish were not observed in the tributary. There is a culvert bridge 100' from mouth, with a 2' plunge over wood 10' from mouth.
16911	0215.00	A dry tributary is on the right bank.
20258	0258.00	Log attached to 20 boulders, forming a 3' high plunge into a plunge pool.
20555	0260.00	Rip Rap boulders with logs attached.
21057	0266.00	Coho salmon observed.
21324	0268.00	Riprap at top of pool.

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21513	0271.00	Tributary #4 (West Fork) enters on the left bank. It contributes to approximately 1% of Sproul Creek's flow. The water temperature of the tributary was 54 degrees Fahrenheit, the water temperature downstream of the confluence was 52 degrees Fahrenheit, and upstream of the confluence was dry. The slope of the tributary is estimated 1%. The tributary is accessible to salmonids. Fish were observed in the tributary.
21572	0272.00	Mainstem Sproul Creek is dry at confluence of West Fork.
22557	0286.00	A dry tributary is on the right bank.
22638	0287.00	Sproul Creek is dry.
26432	0302.00	A dry tributary is on the left bank.
30483	0367.00	Rip Rap along left bank of pool.
32041	0389.00	Tributary #5 (Cox Creek) enters on the right bank. The stream was dry. The slope of the tributary is estimated 2%. The tributary is accessible to salmonids. Fish were observed in the confluence pool of the tributary. No flow except at mouth.
32239	0391.00	Coho observed in unit.
32774	0394.00	There is a 6' high plunge into a 6' deep plunge pool made by bedrock canyon on both sides of banks.
33005	0400.00	Tributary #6 (Unnamed Tributary) enters on the left bank. It is dry and contributes to 0% of Sproul Creek's flow. The water temperature of the tributary was 55 degrees Fahrenheit, the water temperature downstream of the confluence was 56 degrees Fahrenheit, and the water temperature upstream of the confluence was not measured. The slope of the tributary is estimated 0.5%. The tributary is accessible to salmonids. Fish were observed in the tributary in a small isolated pool 15' above the mouth of the tributary. There was no flow. There is a definite change in channel type.
34313	0409.00	A dry tributary is on the right bank.
34367	0410.00	Active pump house and pump.
34489	0411.00	Water pump is placed into this pool and is a permanent structure.

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- 37130 0445.00 Permanent water pump placement. Tributary #7 (unknown tributary) enters on the left bank. It contributes to approximately 2% of Sproul Creek's flow. The water temperature of the tributary was 54 degrees Fahrenheit, the water temperature downstream of the confluence was 55 degrees Fahrenheit, and the water temperature upstream of the confluence was 55 degrees Fahrenheit. The slope of the tributary is estimated 1%. The tributary is accessible to salmonids. Fish were observed in the tributary. 100%
- 38079 0447.00 Isolated confluence pool full of coho salmon due to dry tributary.
- 38089 0448.00 End of survey due to dry channel. Visual observations of 1000' plus of dry channel beyond last habitat unit. From Tributary #7 (HU 445) there was a 926' of dry channel, until an isolated confluence pool (HU 447) due to a dry tributary. The pool was est. 10' long x 8' wide x 1' deep maximum. 15-20 Coho were observed in this pool. The left bank tributary was dry, and 1000' of dry channel occurred after on Sproul. End of Survey was called because of 1000' + of dry channel.

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]	

APPENDIX I

TABLES AND GRAPHS

Stream Name:	Sproul Creek	LLID:	1238261400695	Drainage:	Eel River - South Fork
Survey Dates:	8/8/2016 to 9/21/2016				
Confluence Location:	Quad: GARBERVILLE	Legal Description:	T04SR03ES34	Latitude:	40:04:10.0N
				Longitude:	123:49:34.0

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
82	0	DRY	17.9	140	11503	28.9									
142	14	FLATWATER	31.0	94	13308	33.4	10.4	0.4	0.9	479	68086	233	33095		3
172	172	POOL	37.6	78	13459	33.8	16.6	1.3	2.8	1483	255141	2756	474097	2562	15
62	6	RIFFLE	13.5	25	1530	3.8	9.8	0.2	0.5	220	13613	53	3263		0
Total Units	Total Units Fully Measured				Total Length (ft.)						Total Area (sq.ft.)		Total Volume (cu.ft.)		
458	192				39800						336840		510455		

Table 2 - Summary of Habitat Types and Measured Parameters

Stream Name: Sproul Creek

LLID: 1238261400695

Drainage: Eel River - South Fork

Survey Dates: 8/8/2016 to 9/21/2016

Confluence Location: Quad: GARBERVILLE

Legal Description: T04SR03ES34

Latitude: 40:04:10.0N

Longitude: 123:49:34.0W

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 (%)
56	5	LGR	12.2	24	1342	3.4	8	0.2	0.7	163	9110	23	1279		0	98
6	1	HGR	1.3	31	188	0.5	18	0.4	0.6	504	3024	202	1210		0	70
77	8	RUN	16.8	57	4408	11.1	11	0.4	1.2	534	41098	240	18511		3	91
65	6	SRN	14.2	137	8900	22.4	9	0.5	1.6	407	26463	223	14513		3	91
165	165	MCP	36.0	80	13180	33.1	16	1.3	7.9	1508	248844	2789	460265	2590	15	93
3	3	CCP	0.7	31	92	0.2	23	1.5	4.6	907	2720	1773	5320	1754	0	100
1	1	STP	0.2	68	68	0.2	16	1.3	3.8	925	925	1387	1387	1202	5	100
1	1	LSL	0.2	24	24	0.1	8	1.2	2.3	192	192	230	230	230	100	55
2	2	PLP	0.4	48	95	0.2	26	2.8	5.8	1230	2460	3447	6894	3363	18	99
82	0	DRY	17.9	140	11503	28.9										94

Total Units
458

Total Units Fully Measured
192

Total Length (ft.)
39800

Total Area (sq.ft.)
334836

Total Volume (cu.ft.)
509609

Table 3 - Summary of Pool Types

Stream Name: Sproul Creek

LLID: 1238261400695

Drainage: Eel River - South Fork

Survey Dates: 8/8/2016 to 9/21/2016

Confluence Location: Quad: GARBERVILLE

Legal Description: T04SR03ES34

Latitude: 40:04:10.0N

Longitude: 123:49:34.0W

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
169	169	MAIN	98	79	13340	99	16.5	1.3	1494	252489	2566	433738	14
3	3	SCOUR	2	40	119	1	19.7	2.2	884	2652	2319	6956	45
Total Units	Total Units Fully Measured			Total Length (ft.)						Total Area (sq.ft.)	Total Volume (cu.ft.)		
172	172			13459						255141	440694		

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

Stream Name: Sproul Creek

LLID: 1238261400695

Drainage: Eel River - South Fork

Survey Dates: 8/8/2016 to 9/21/2016

Confluence Location: Quad: GARBERVILLE

Legal Description: T04SR03ES34

Latitude: 40:04:10.0N

Longitude: 123:49:34.0W

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
165	MCP	96	3	2	61	37	45	27	30	18	26	16
3	CCP	2	0	0	1	33	1	33	0	0	1	33
1	STP	1	0	0	0	0	0	0	1	100	0	0
1	LSL	1	0	0	0	0	1	100	0	0	0	0
2	PLP	1	0	0	0	0	0	0	0	0	2	100

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
172	3	2	62	36	47	27	31	18	29	17

Mean Maximum Residual Pool Depth (ft.): 2.7

Table 5 - Summary of Mean Percent Cover By Habitat Type

Stream Name: Sproul Creek

LLID: 1238261400695

Drainage: Eel River - South Fork

Survey Dates: 8/8/2016 to 19/21/2016

Dry Units: 82

Confluence Location:

Quad: GARBERVILLE

Legal Description: T04SR03ES34

Latitude: 40:04:10.0N

Longitude: 123:49:34.0W

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
56	5	LGR	0	0	0	0	0	0	0	0	0
6	1	HGR	0	0	0	0	0	0	0	0	0
62	6	TOTAL RIFFLE	0	0	0	0	0	0	0	0	0
77	8	RUN	0	0	0	0	0	0	0	100	0
65	6	SRN	0	0	0	0	0	0	0	100	0
142	14	TOTAL FLAT	0	0	0	0	0	0	0	100	0
165	165	MCP	8	14	24	5	0	0	0	32	17
3	3	CCP	0	0	0	0	0	0	0	0	0
1	1	STP	0	0	0	0	0	0	100	0	0
1	1	LSL	0	0	20	80	0	0	0	0	0
2	2	PLP	0	0	15	0	0	0	0	35	50
172	172	TOTAL POOL	8	14	24	4	0	0	2	29	16
458	192	TOTAL	9	13	22	5	0	0	2	33	16

Table 6 - Summary of Dominant Substrates By Habitat Type

Stream Name: Sproul Creek

LLID: 1238261400695

Drainage: Eel River - South Fork

Survey Dates: 8/8/2016 to 9/21/2016

Dry Units: 82

Confluence Location: Quad: GARBERVILLE

Legal Description: T04SR03ES34

Latitude: 40:04:10.0N

Longitude: 123:49:34.0W

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
56	5	LGR	0	0	20	20	40	20	0
6	1	HGR	0	0	0	0	100	0	0
77	8	RUN	0	0	25	13	25	38	0
65	6	SRN	0	0	0	0	83	17	0
165	164	MCP	12	1	38	7	26	15	0
3	3	CCP	33	0	67	0	0	0	0
1	1	STP	0	0	0	0	0	0	100
1	1	LSL	0	0	100	0	0	0	0
2	2	PLP	0	50	0	0	0	50	0

Table 7 - Summary of Mean Percent Canopy for Entire Stream

Stream Name: Sproul Creek

LLID: 1238261400695

Drainage: Eel River - South Fork

Survey Dates: 8/8/2016 to 9/21/2016

Confluence Location: Quad: GARBERVILLE

Legal Description: T04SR03ES34

Latitude: 40:04:10.0N

Longitude: 123:49:34.0W

Mean Percent Canopy	Mean Percent Conifer	Mean Percent Hardwood	Mean Percent Open Units	Mean Right Bank % Cover	Mean Left Bank % Cover
92	14	86	0	100	100

Note: Mean percent conifer and hardwood for the entire reach are means of canopy components from units with canopy values greater than zero.

Open units represent habitat units with zero canopy cover.

Table 8 - Fish Habitat Inventory Data Summary

Stream Name: Sproul Creek

LLID: 1238261400695

Drainage: Eel River - South Fork

Survey Dates: 8/8/2016 to 9/21/2016

Survey Length (ft.): 39800

Main Channel (ft.): 39089

Side Channel (ft.): 711

Confluence Location: Quad: GARBERVILLE

Legal Description: T04SR03ES34

Latitude: 40:04:10.0N

Longitude: 123:49:34.0W

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 1

Channel Type: F3

Reach Length (ft.): 9931

Riffle/Flatwater Mean Width (ft.): 11.5

BFW:

Range (ft.): 19 to 48

Mean (ft.): 33

Std. Dev.: 8

Base Flow (cfs.): 109.9

Water (F): 51 - 64

Air (F): 59 - 82

Dry Channel (ft): 2915

Canopy Density (%): 88.8

Coniferous Component (%): 7.8

Hardwood Component (%): 92.2

Dominant Bank Vegetation: Hardwood Trees

Vegetative Cover (%): 100.0

Dominant Shelter: Boulders

Dominant Bank Substrate Type: Cobble/Gravel

Occurrence of LWD (%): 3

LWD per 100 ft.:

Riffles: 0

Pools: 0

Flat: 0

Pools by Stream Length (%): 35.4

Pool Frequency (%): 32.4

Residual Pool Depth (%):

< 2 Feet Deep: 33

2 to 2.9 Feet Deep: 31

3 to 3.9 Feet Deep: 14

>= 4 Feet Deep: 22

Mean Max Residual Pool Depth (ft.): 2.8

Mean Pool Shelter Rating: 16

Pool Tail Substrate (%): Silt/Clay: 0

Sand: 0

Gravel: 42

Sm Cobble: 22

Lg Cobble: 8

Boulder: 17

Bedrock: 11

Embeddedness Values (%): 1. 19.4

2. 38.9

3. 19.4

4. 0.0

5. 22.2

STREAM REACH: 2

Channel Type: F3

Reach Length (ft.): 29158

Riffle/Flatwater Mean Width (ft.): 8.7

BFW:

Range (ft.): 2 to 46

Mean (ft.): 30

Std. Dev.: 8

Base Flow (cfs.): 109.9

Water (F): 51 - 63

Air (F): 54 - 75

Dry Channel (ft): 8588

Canopy Density (%): 93.6

Coniferous Component (%): 16.7

Hardwood Component (%): 83.3

Dominant Bank Vegetation: Hardwood Trees

Vegetative Cover (%): 100.0

Dominant Shelter: Large Woody Debris

Dominant Bank Substrate Type: Cobble/Gravel

Occurrence of LWD (%): 15

LWD per 100 ft.:

Riffles: 1

Pools: 2

Flat: 1

Pools by Stream Length (%): 33.3

Pool Frequency (%): 39.2

Residual Pool Depth (%):

< 2 Feet Deep: 39

2 to 2.9 Feet Deep: 26

3 to 3.9 Feet Deep: 19

>= 4 Feet Deep: 15

Mean Max Residual Pool Depth (ft.): 2.7

Mean Pool Shelter Rating: 15

Pool Tail Substrate (%): Silt/Clay: 2

Sand: 0

Gravel: 68

Sm Cobble: 14

Lg Cobble: 7

Boulder: 8

Bedrock: 1

Embeddedness Values (%): 1. 18.4

2. 34.6

3. 31.6

4. 3.7

5. 11.8

Table 9 - Mean Percentage of Dominant Substrate and Vegetation

Stream Name: Sproul Creek

LLID: 1238261400695

Drainage: Eel River - South Fork

Survey Dates: 8/8/2016 to 9/21/2016

Confluence Location: Quad: GARBERVILLE

Legal Description: T04SR03ES34

Latitude: 40:04:10.0N

Longitude: 123:49:34.0W

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	30	37	17.4
Boulder	26	23	12.8
Cobble / Gravel	108	102	54.7
Sand / Silt / Clay	28	30	15.1

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	1	0	0.3
Hardwood Trees	170	166	87.5
Coniferous Trees	21	26	12.2
No Vegetation	0	0	0.0

Total Stream Cobble Embeddedness Values:

3

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

Stream Name: Sproul Creek

LLID: 1238261400695

Drainage: Eel River-South Fork

Survey Dates: 8/8/2016 to 9/21/2016

Confluence Location:

Quad: GARBERVILLE

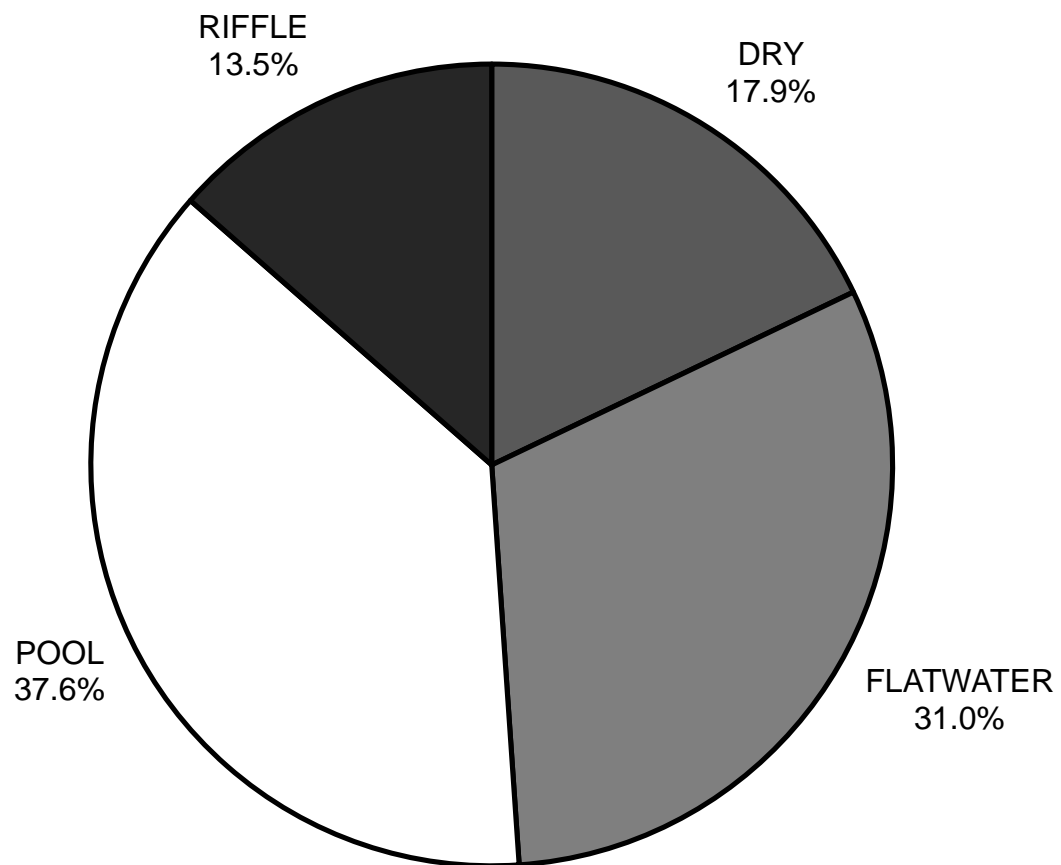
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Longitude: 123:49:34.0W

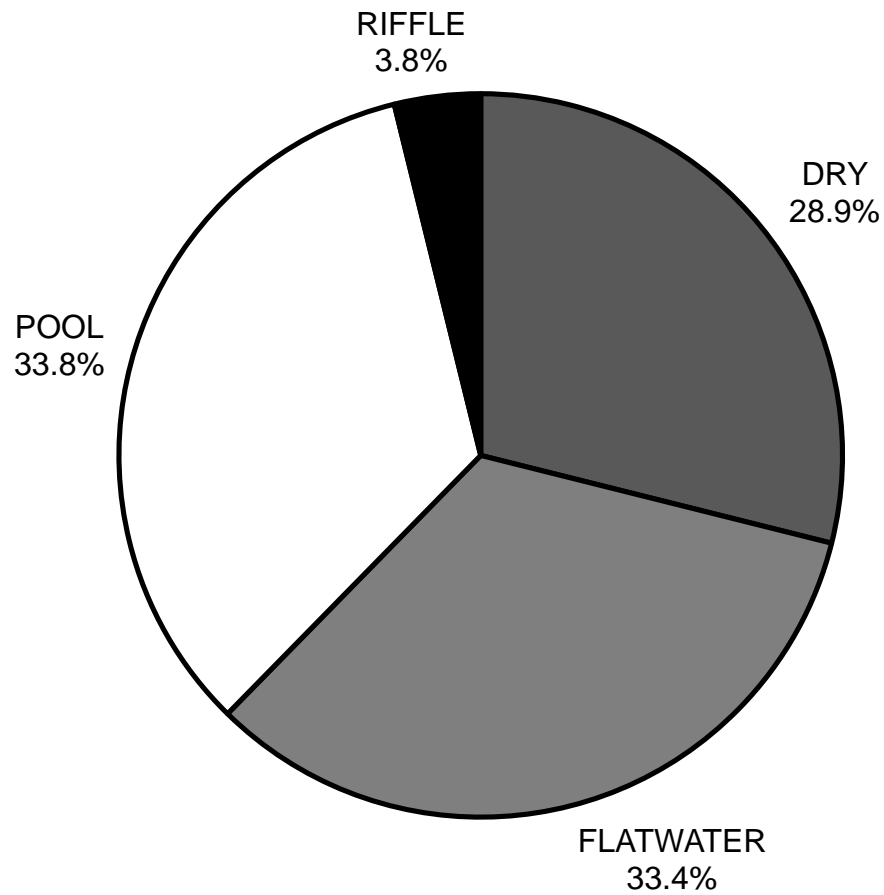
	Riffles	Flatwater	Pools
UNDERCUT BANKS (%)	0	0	8
SMALL WOODY DEBRIS (%)	0	0	14
LARGE WOODY DEBRIS (%)	0	0	24
ROOT MASS (%)	0	0	5
TERRESTRIAL VEGETATION (%)	0	0	0
AQUATIC VEGETATION (%)	0	0	0
WHITEWATER (%)	0	0	2
BOULDERS (%)	0	100	31
BEDROCK LEDGES (%)	0	0	17

SPROUL CREEK 2016 HABITAT TYPES BY PERCENT OCCURRENCE



GRAPH 1

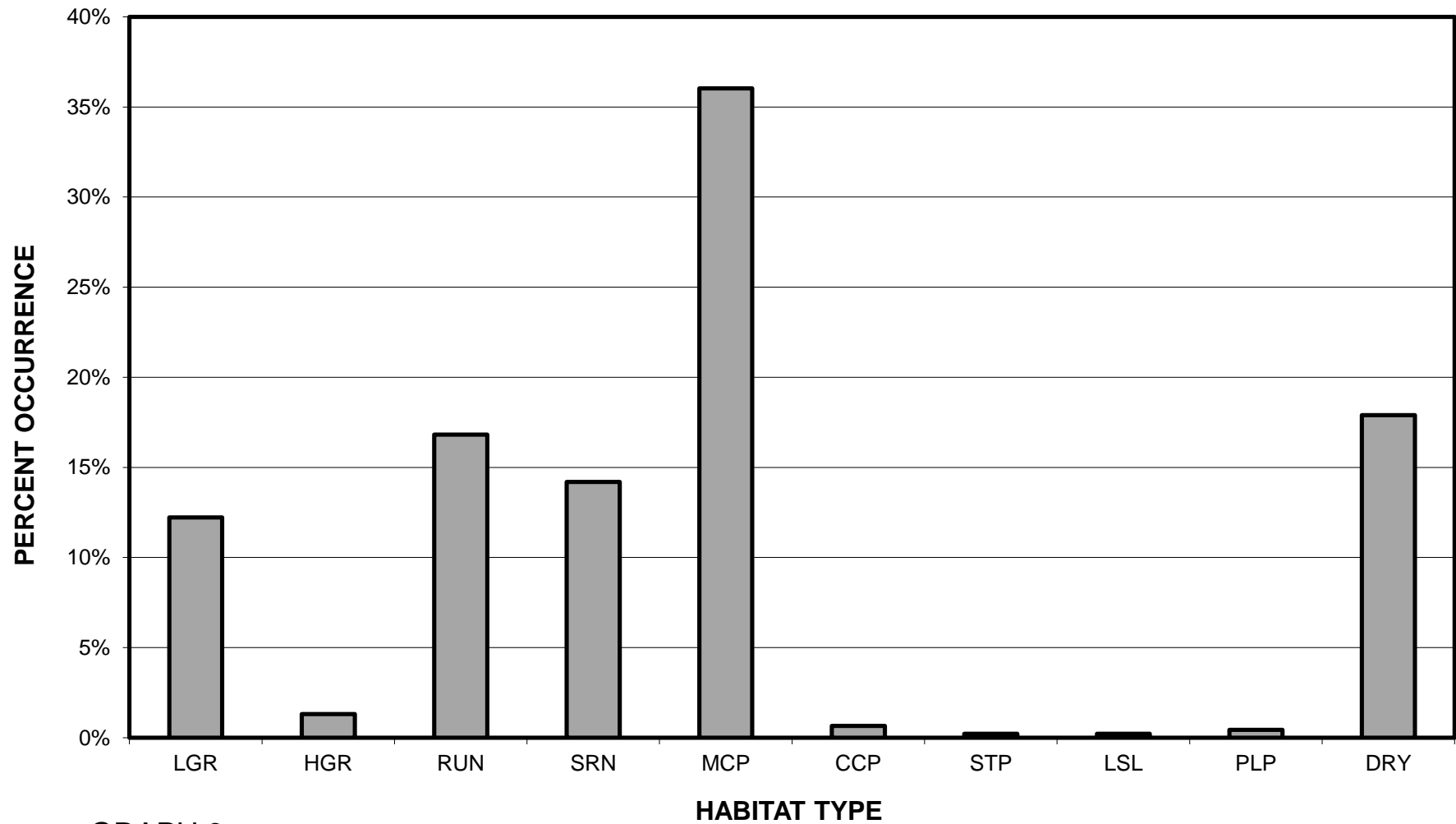
SPROUL CREEK 2016
HABITAT TYPES BY PERCENT TOTAL LENGTH



GRAPH 2

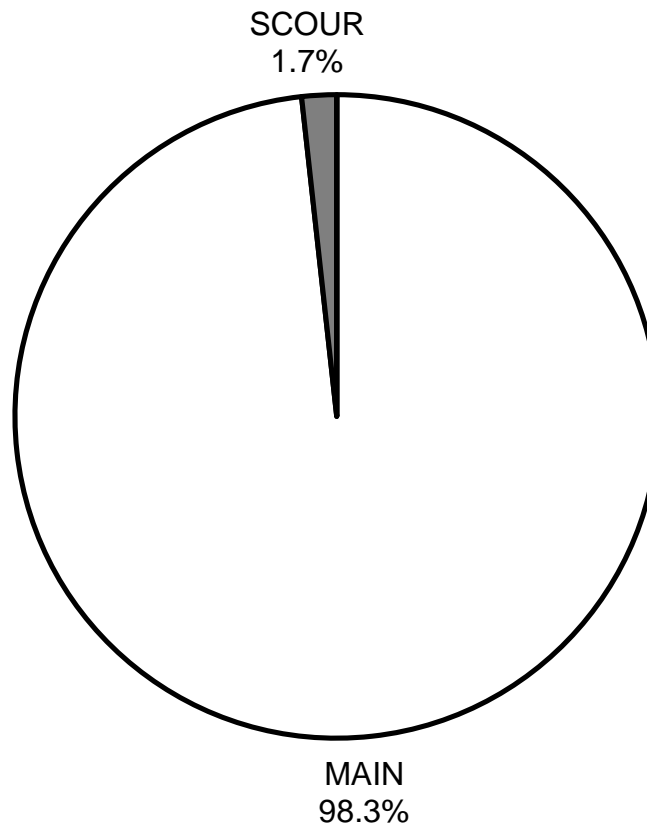
SPROUL CREEK 2016

HABITAT TYPES BY PERCENT OCCURRENCE



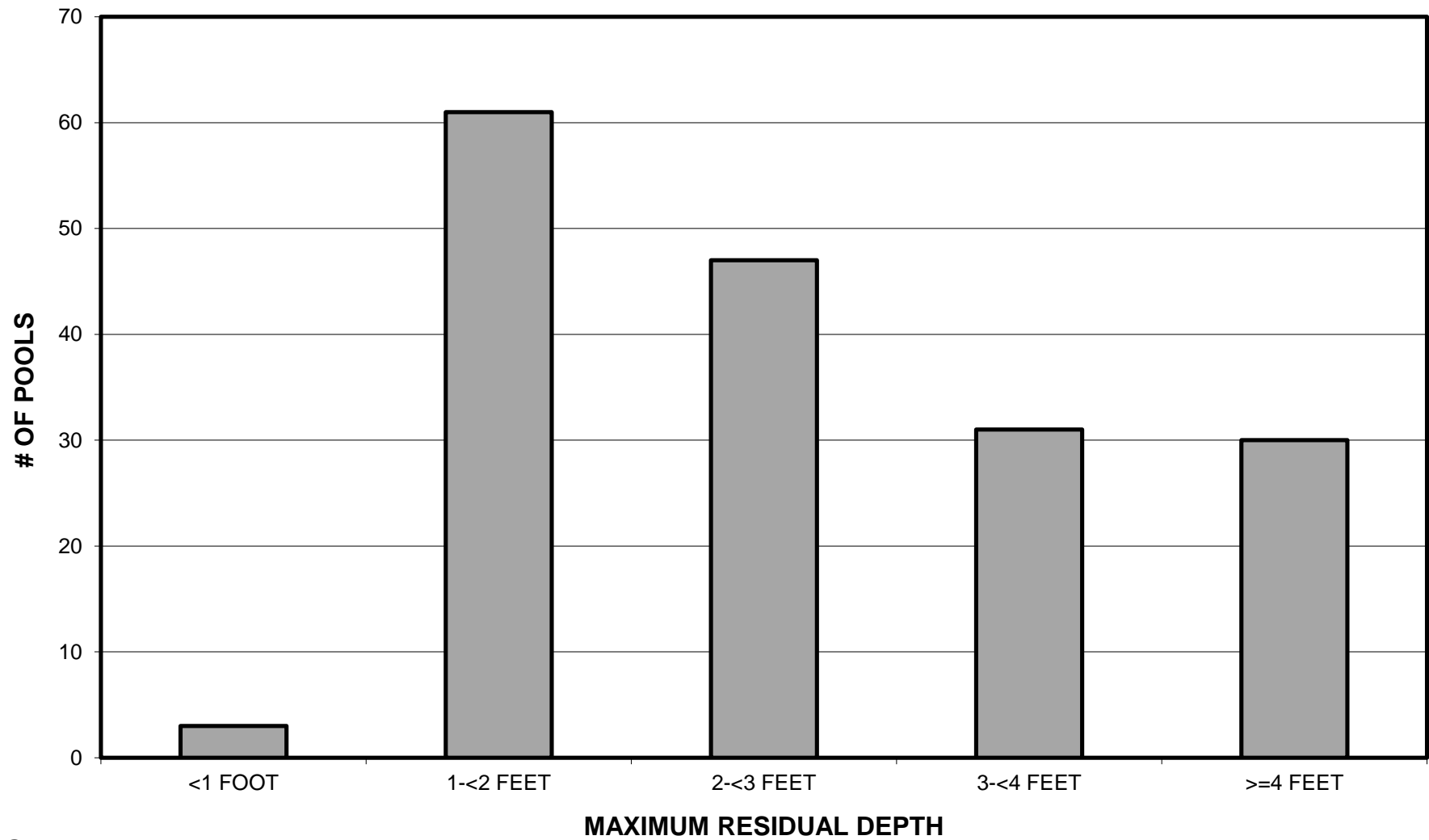
GRAPH 3

**SPROUL CREEK 2016
POOL TYPES BY PERCENT OCCURRENCE**



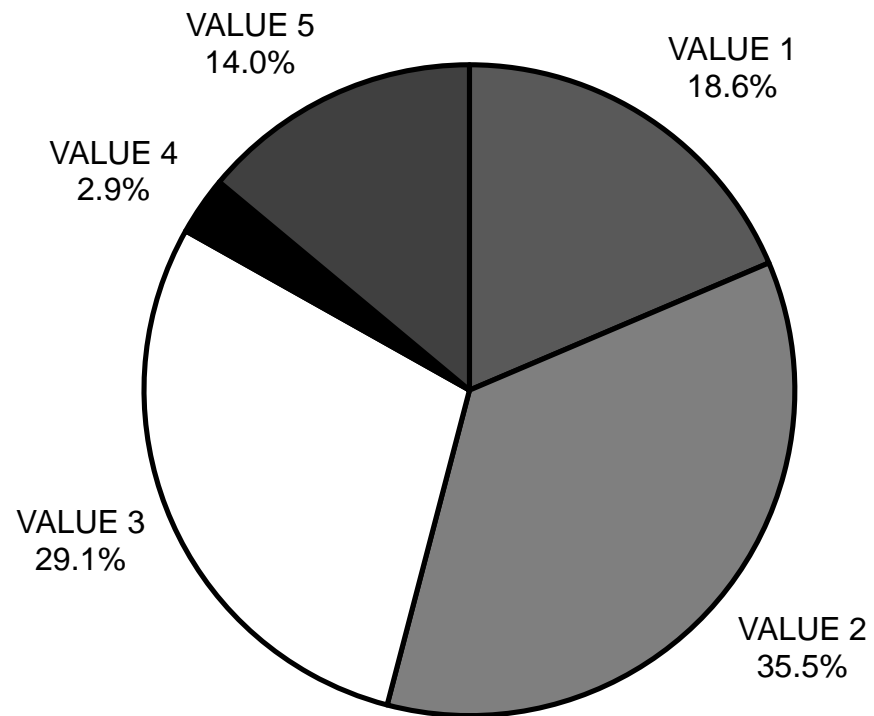
GRAPH 4

SPROUL CREEK 2016 MAXIMUM DEPTH IN POOLS



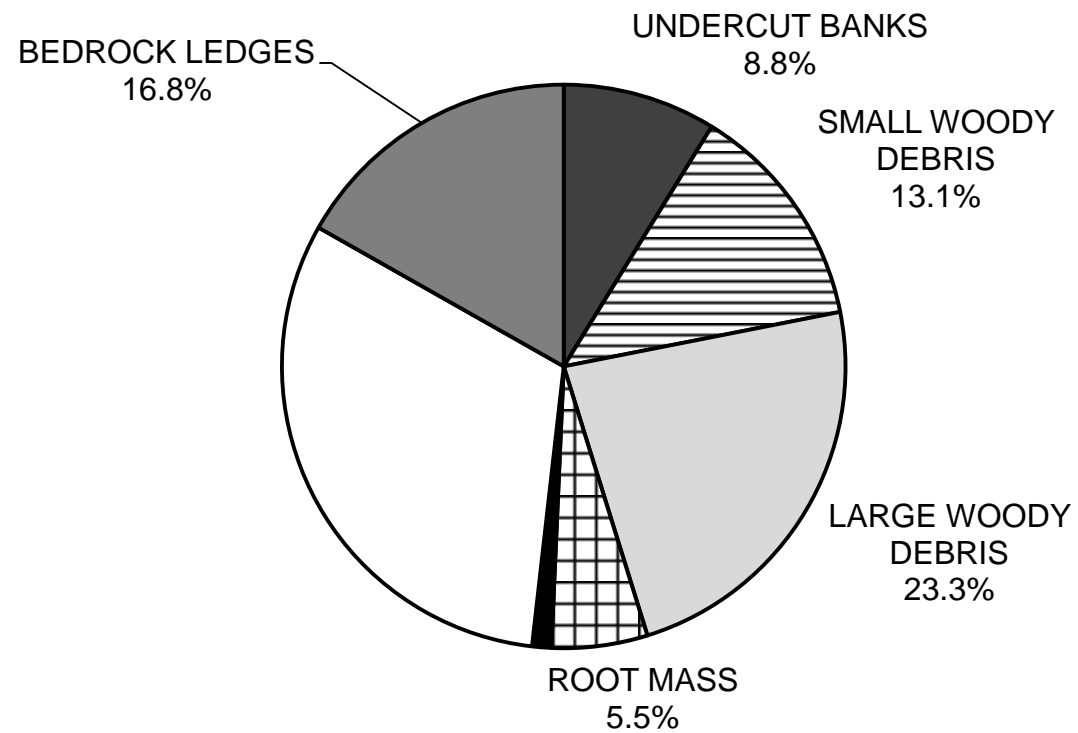
GRAPH 5

SPROUL CREEK 2016 PERCENT EMBEDDEDNESS



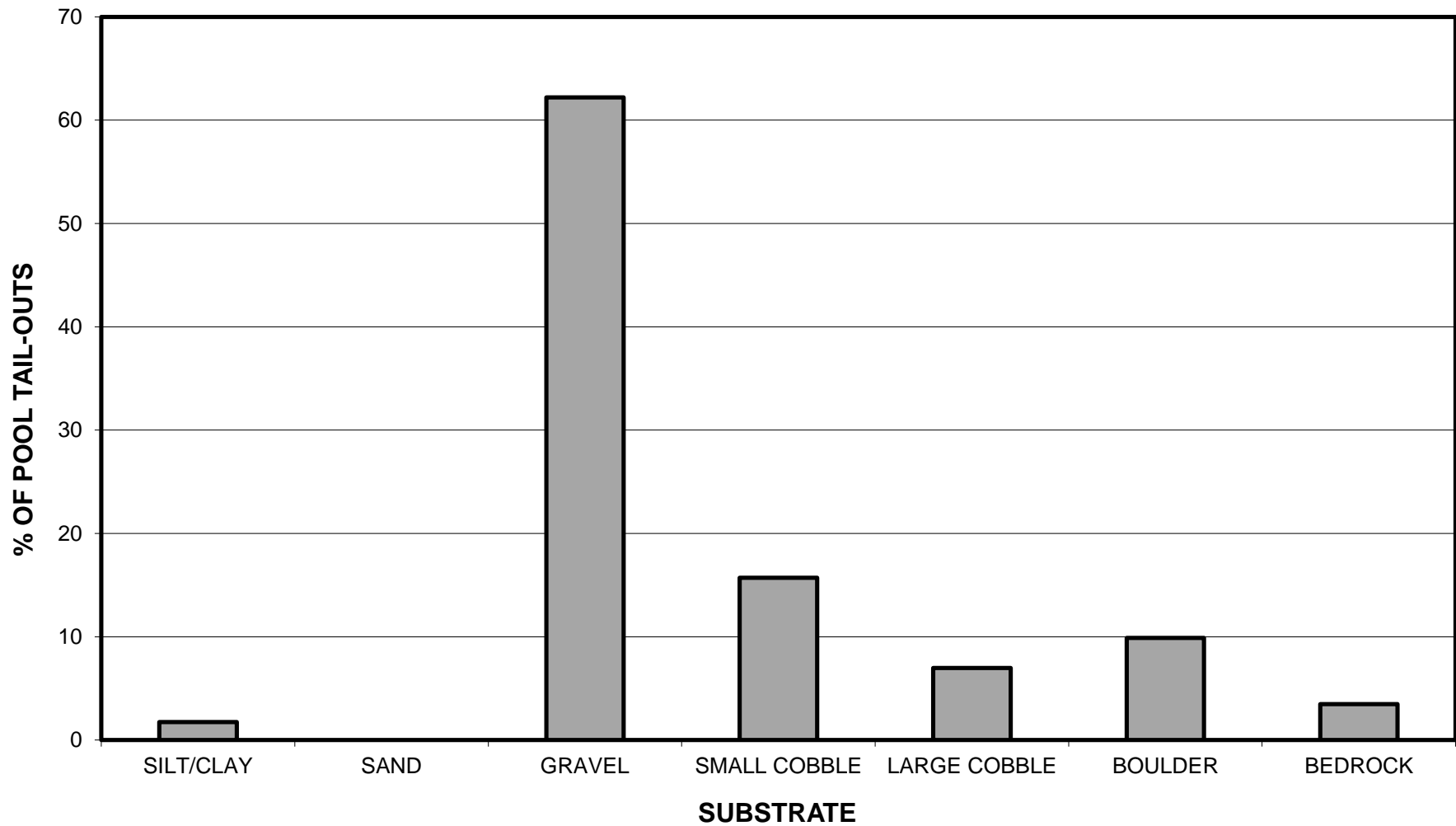
GRAPH 6

SPROUL CREEK 2016 MEAN PERCENT COVER TYPES IN POOLS



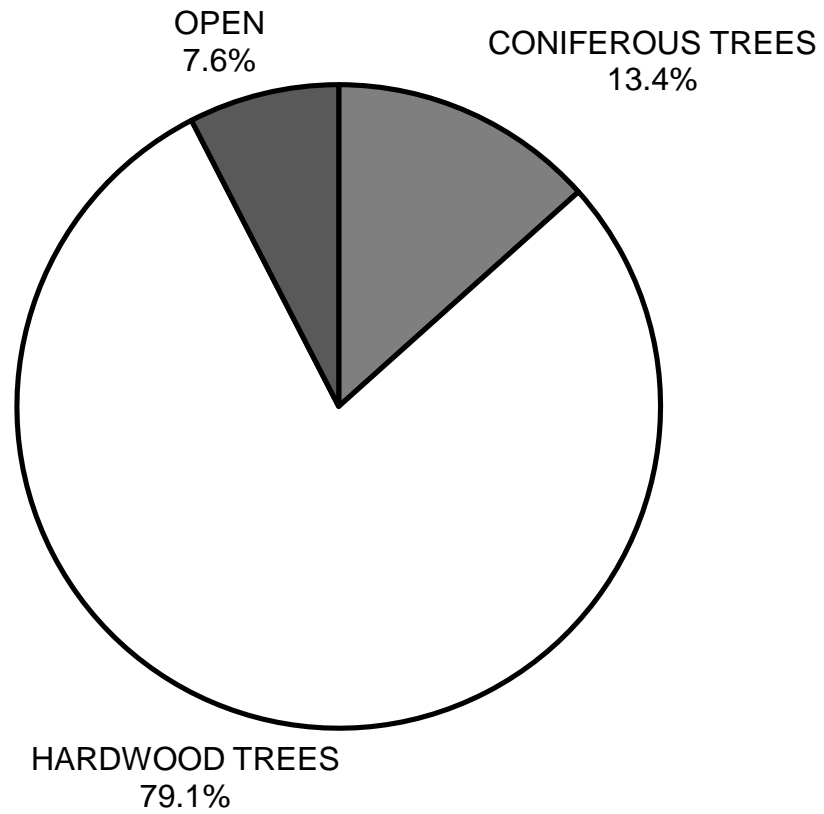
GRAPH 7

SPROUL CREEK 2016 SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



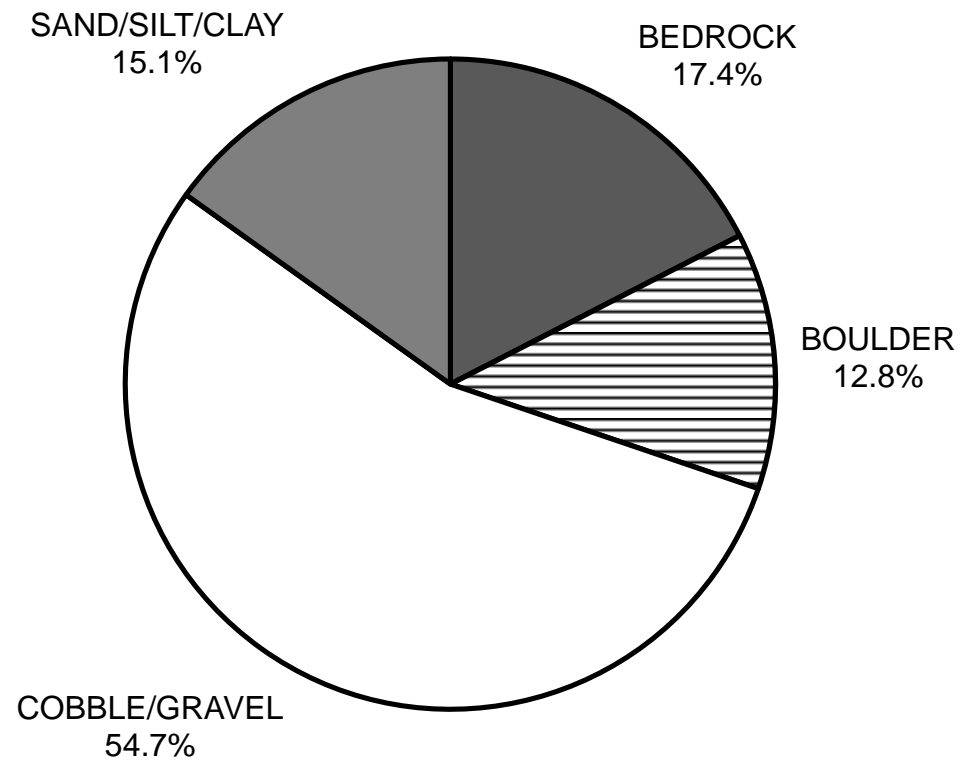
GRAPH 8

SPROUL CREEK 2016 MEAN PERCENT CANOPY



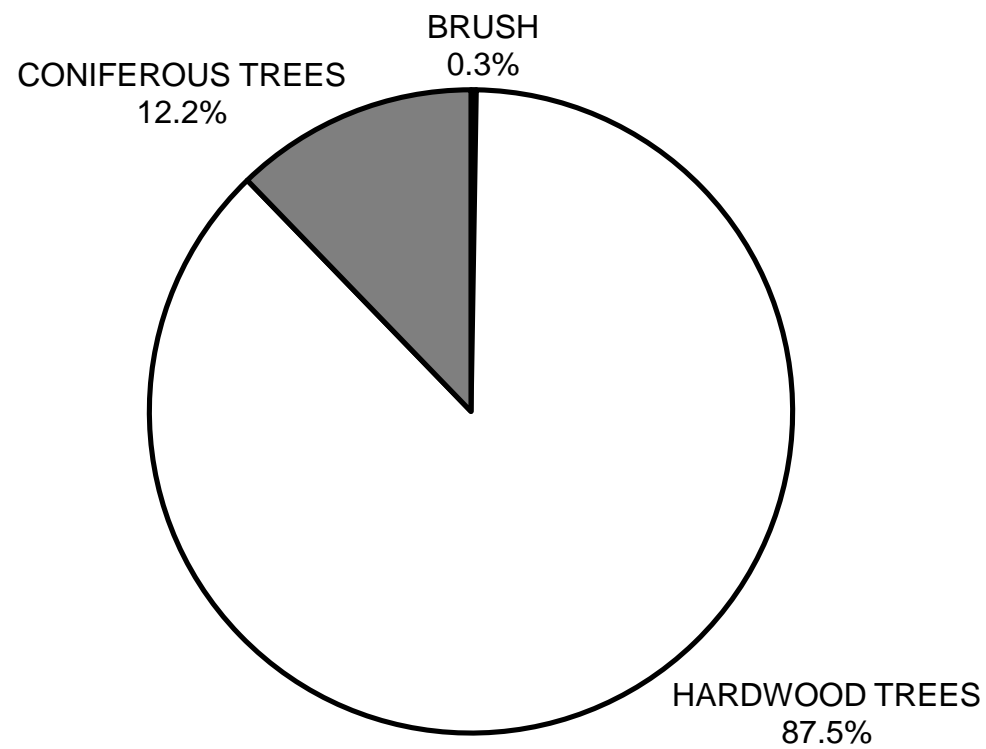
GRAPH 9

SPROUL CREEK 2016
DOMINANT BANK COMPOSITION IN SURVEY REACH



GRAPH 10

SPROUL CREEK 2016
DOMINANT BANK VEGETATION IN SURVEY REACH



GRAPH 11

APPENDIX II

STREAM INVENTORY PHOTOS



Photo 1: Landslide at habitat unit #64. (Photo taken 8/29/16)



Photo 2: Sproul Creek, between Little Sproul Creek and West Fork Sproul Creek. (Photo taken 9/1/16)



Photo 3: Pool with bedrock sheet at habitat unit #292. (Photo taken 9/14/16).



Photo 4: End of survey at habitat unit #448 due to the creek going dry. Young of the year coho salmon observed in pool (Photo taken 9/21/16).