STREAM INVENTORY REPORT

Mill Creek

INTRODUCTION

A stream inventory was conducted during June 4, 2007 to June 13, 2007 on Mill Creek. The survey began at the confluence with Bull Creek and extended upstream 1.2 miles.

The objective of the habitat inventory was to document the habitat available to anadromous salmonids in Mill Creek.

A biological survey of Mill Creek was last conducted in 2003 to document the presence of juvenile salmonid species. Findings from that survey will also be included in 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

Mill Creek is a tributary to Bull Creek, tributary to the South Fork Eel River, tributary to the Eel River which drains to the Pacific Ocean, located in Humboldt County, California (Map 1). Mill Creek's legal description at the confluence with Bull Creek is T1S R1E S25. Its location is 40.3497 north latitude and 124.0200 west longitude, LLID number 1240200403498. Mill Creek is a second order stream and has approximately 2.5 miles of blue line stream according to the USGS Bull Creek 7.5 minute quadrangle. Mill Creek drains a watershed of approximately 3.0 square miles. Elevations range from about 345 feet at the mouth of the creek to 1,200 feet in the headwater areas. Second growth redwood forest dominates the watershed. The watershed is entirely owned by the State of California and is managed by Humboldt Redwoods State Parks for recreation. Vehicle access exists from Highway 101 at Dyerville, via the Bull Creek-South Fork Honeydew/Mattole Road Exit. Mill Creek Road provides access to the upper basin and Pole Line Road to the lower reaches. All access roads have locked gates controlled by the park.

METHODS

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

Mill Creek

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 Mill 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:

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". Mill 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 Mill 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 unsuited for spawning due to inappropriate substrate like bedrock, log sills, boulders or other considerations.

6. Shelter Rating:

Instream shelter is composed of those elements within a stream channel that provide juvenile salmonids protection from predation, reduce water velocities so fish can rest and conserve energy, and allow separation of territorial units to reduce density related competition for prey. The shelter rating is calculated for each fully-described habitat unit by multiplying shelter value and percent cover. Using an overhead view, a quantitative estimate of the percentage of the habitat unit covered is made. All cover is then classified according to a list of nine cover types. In Mill 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 densiometers as described in the *California Salmonid Stream Habitat Restoration Manual*. Canopy density relates to the amount of stream shaded from the sun. In Mill 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 Mill 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 is used to determine fish species and their distribution in the stream. Fish presence was observed from the stream banks during habitat typing in Mill Creek. Detailed biological sampling was not conducted on Mill Creek during the 2007 survey. Data from a June 25, 2003 electrofishing survey is listed in the Biological Inventory Results section of this report. Electrofishing sampling techniques are discussed in the *California Salmonid Stream Habitat Restoration Manual*.

DATA ANALYSIS

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

- Riffle, Flatwater, and Pool Habitat Types
- Habitat Types and Measured Parameters
- Pool Types
- Maximum Residual Pool Depths by Habitat Types
- Mean Percent Cover by Habitat Type
- Dominant Substrates by Habitat Type

- Mean Percent Vegetative Cover for Entire Stream
- Fish Habitat Inventory Data Summary by Stream Reach (Table 8)
- Mean Percent Dominant Substrate / Dominant Vegetation Type for Entire Stream
- Mean Percent Shelter Cover Types for Entire Stream

Graphics are produced from the tables using Microsoft Excel. Graphics developed for Mill 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 AT THE END OF THE REPORT *

The habitat inventory of June 4, 2007 to June 13, 2007, was conducted by L. Lee and M. Cavin (WSP). The total length of the stream surveyed was 6,226 feet with an additional 199 feet of side channel.

Stream flow was measured near the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 1.3 cfs on June 18, 2007.

Mill Creek is an F4 channel type for 2,553 feet of the stream surveyed (Reach 1), a B3 channel type for 2,006 feet of the stream surveyed (Reach 2), an A2 channel type for 676 feet of the stream surveyed (Reach 3) and an E3 channel type for 1,190 feet of the stream surveyed (Reach 4).

F4 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and gravel-dominant substrates. B3 channels are moderately entrenched, moderate gradient, riffle dominated channels with infrequently spaced pools, very stable plan and profile, stable banks and cobble-dominant substrates. A2 channels are steep, narrow, cascading, step-pool, high energy debris transporting channels associated with depositional soils, and boulder-dominant substrates. E3 channels are a low gradient, meandering riffle/pool streams with low width/depth ratio, little deposition, very efficient and stable, high meander width ratio and cobble-dominant substrates.

Water temperatures taken during the survey period ranged from 48 to 59 degrees Fahrenheit. Air temperatures ranged from 51 to 68 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 47% riffle units, 41% pool units, and 12% flatwater units (Graph 1). Based on total length of Level II habitat types there were 66% riffle units, 24% pool units, and 9% flatwater units (Graph 2).

Nine Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were 31% low gradient riffle units, 27% mid-channel pool units, 12% high gradient riffle units (Graph 3). Based on percent total length, low gradient riffle units made up 53%, mid-channel pool units 14%, and step pool units 9%.

A total of 37 pools were identified (Table 3), 36 were fully sampled. Main channel pools were the most frequently encountered, at 95% (Graph 4), and comprised 96% 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. Ten of the 36 pools (28%) had a residual depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 36 pool tail-outs measured, 4 had a value of 1 (11.1%); 12 had a value of 2 (33.3%); 2 had a value of 3 (5.6%); 18 had a value of 5 (50%); (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 unsuited 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 114, flatwater habitat types had a mean shelter rating of 57, and pool habitats had a mean shelter rating of 73 (Table 1). Of the pool types, the main channel pools had a mean shelter rating of 75, scour pools had a mean shelter rating of 40. (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover types in Mill Creek. Graph 7 describes the pool cover in Mill Creek. Boulders are the dominant pool cover type followed by whitewater.

Table 6 summarizes the dominant substrate by habitat type. Boulders were the dominant substrate observed in 47% of pool tail-outs. Gravel was the next most frequently observed substrate type and occurred in 31% of pool tail-outs (Graph 8).

The mean percent canopy density for the surveyed length of Mill Creek was 86%. Fourteen percent of the canopy was open. Of the canopy present, the mean percentages of hardwood and coniferous trees were 68% and 32%, respectively. Graph 9 describes the mean percent canopy.

For the stream reach surveyed, the mean percent right bank vegetated was 79%. The mean percent left bank vegetated was 83%. The dominant elements composing the structure of the stream banks consisted of 71% sand/silt/clay, 18% cobble/gravel, 9% boulder, and 2% bedrock (Graph 10). Hardwood trees were the dominant vegetation type observed in 51% of the units surveyed. Additionally, 24% of the units surveyed had coniferous trees as the dominant vegetation type, and 15% had grass as the dominant vegetation (Graph 11).

BIOLOGICAL INVENTORY RESULTS

Mill Creek was biologically sampled on June 25, 2003, by the California Department of Fish and Game for fish presence and identification. Using an electrofisher, 51 steelhead trout were captured and identified during the survey. The survey started 400 feet above the confluence with Bull Creek and ended upstream approximately 2,766 feet.

DISCUSSION

Mill Creek is an F4 channel type for the first 2,553 feet of stream surveyed, a B3 channel type for 2,006 feet, an A2 channel type for 676 feet of the stream surveyed and an E3 channel type for 1,190 feet of the stream surveyed. The suitability of F4, B3, A2 and E3 channel types for fish habitat improvement structures is: F4 channels are good for bank-placed boulders and fair for plunge weirs, single and opposing wing-deflectors, channel constrictors and log cover. B3 channels are excellent for plunge weirs, boulder clusters and bank placed boulder, single and opposing wing-deflectors and log cover. A2 channel types are generally not suitable for fish habitat structures because they are high energy streams with stable stream banks, but poor gravel retention capabilities. E3 channel types are good for bank-placed boulders and fair for opposing wing-deflectors.

The water temperatures recorded on the survey days June 4, 2007 to June 13, 2007, ranged from 48 to 59 degrees Fahrenheit. Air temperatures ranged from 51 to 68 degrees Fahrenheit. To make any further conclusions, temperatures would need to be monitored throughout the warm summer months, and more extensive biological sampling would need to be conducted.

Flatwater habitat types comprised 9% of the total length of this survey, riffles 66%, and pools 24%. The pools are relatively shallow with only 10 of the 36 (28%) 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 structure that will increase or deepen pool habitat is recommended for Reaches 1 and 2.

Sixteen of the 36 pool tail-outs measured had embeddedness ratings of 1 or 2. Two of the pool tail-outs had embeddedness ratings of 3 or 4. Eighteen 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 Mill Creek should be mapped and rated according to their potential sediment yields, and control measures should be taken.

Nineteen of the 36 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 was 73. The shelter rating in the flatwater habitats was 57. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by boulders in Mill Creek. Boulders are the dominant cover type in pools followed by whitewater. Log and root wad cover structures in the pool and flatwater habitats would enhance both summer and winter salmonid habitat. Log cover structure provides rearing fry with protection from predation, rest from water velocity, and also divides territorial units to reduce density related competition.

The mean percent canopy density for the stream was 86%. Reach 1 had a canopy density of 90.1%, reach 2 had a canopy density of 88.3%, reach 3 had a canopy density of 82.8%, and reach 4 had a canopy density of 77.6%. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was high at 79% and 83%, respectively. In areas of stream bank erosion or where bank vegetation is sparse, planting endemic species of coniferous and hardwood trees, in conjunction with bank stabilization, is recommended.

RECOMMENDATIONS

1) Mill Creek should be managed as an anadromous, natural production stream.

2) In Reach 1 and 2, design and engineer pool enhancement structures to increase the number of pools. This must be done where the banks are stable or in conjunction with stream bank armor to prevent erosion.

3) 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.

4) Inventory and map sources of stream bank erosion and prioritize them according to present and potential sediment yield. Identified sites should then be treated to reduce the amount of fine sediments entering the stream.

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 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	Survey began at the confluence with Bull Creek. Reach 1 begins and is a F4 channel type.
788	0009.00	Log debris accumulation (LDA) #1 was made of 7 pieces of large woody debris (LWD). The LDA measured 7' high x 13' wide x 14' long. Water flowed through visible gaps and the LDA was not retaining sediment. There were fish above the LDA. It was not a barrier to salmonids.
959	0011.00	There was a wooden footbridge that measured 5' wide x 8' high x 37' long.
1435	0014.00	Tributary #1 entered from the left bank. The estimated flow was less than 0.1 cfs, contributing to approximately 5% of Mill Creek's flow. The temperature of the tributary and Mill Creek upstream and downstream was 56 degrees Fahrenheit. This drainage did not appear to be fish accessible for the first 500' due to a slope of 30%. No fish were observed in the tributary.
1648	0018.00	Tributary #2 entered from the right bank. The flow was estimated to be 0.3 cfs and was contributing to 10% of Mill Creek's flow. The temperature of the tributary was 54 degrees Fahrenheit while the temperature of Mill Creek upstream and downstream was 55 degrees Fahrenheit. For at the least the first 500' the tributary does not appear to be fish accessible due to a gradient of 10%. There were no fish observed in the tributary.
1693	0019.00	There was a decommissioned bridge crossing at this habitat unit.
2354	0028.00	This was the first unit of reach 2. The channel type changed from a F4 channel type to a B3.
3227	0041.00	There was erosion on the left bank that measured 180' long x 50' high, and it extended through habitat unit #044.

3739	0053.00	There was an extensive slide on the right bank that stretched the length of the habitat unit (134').
4192	0058.00	LDA #2 was 3.5' high x 21' wide x 6' long and consisted of 4 pieces of LWD. Water did flow through and it had visible gaps. It was retaining silt and sand that measured 28' wide x 27' long x 1' deep. Juvenile fish were seen above the LDA.
4360	0063.00	This was the first habitat unit of reach 3. The channel type has changed from a B3 to an A2.
4398	0064.00	There was a flag from a DFG survey on 05/29/02 marking habitat unit #119.
4527	0066.00	Tributary #3 entered from the right bank. It had an estimated flow of less than 0.5 cfs and was contributing to about 20% of Mill Creek's flow. The tributary's temperature was 53 degrees Fahrenheit, while Mill Creek's temperature upstream and downstream of the tributary was 54 degrees Fahrenheit. The tributary was not accessible to fish due to a 25% slope over the first 600'. Fish were not observed in the tributary. The gradient of the mainstem was 15% for the first 100' of this habitat unit.
4814	0071.00	Tributary #4 entered from the right bank. Its flow was estimated at 0.3 cfs and was contributing to about 5% of Mill Creek's flow. The temperature of the tributary was 56 degrees Fahrenheit. The temperature of Mill Creek upstream and downstream of the tributary was 53 and 54 degrees Fahrenheit, respectively. For the first 300' of the tributary that was explored the slope was about 25%. No fish were observed in the tributary and it was probably not fish accessible due to the slope.
5010	0075.00	LDA #3 was 11' high x 33' wide x 8' long. It had 5 pieces of LWD in it. Water flowed through visible gaps. The sediment retained by the LDA measured approximately 32' wide x 25' long x 5' deep and ranged in size from silt to cobble. Fish were seen upstream of the LDA.
5036	0076.00	This was the first habitat unit of the fourth reach. The channel type has switched from an A2 to an E3.
5251	0081.00	Juvenile salmonids have been observed and continue to be observed throughout the entire survey.
5284	0082.00	LDA #4 was 5' high x 15' wide x 39' long and consisted of 8 pieces of large wood. Water flows through, but there were not any visible gaps. No sediment is currently being retained. Fish have been seen upstream. The first 39' of this habitat unit was covered by the LDA.

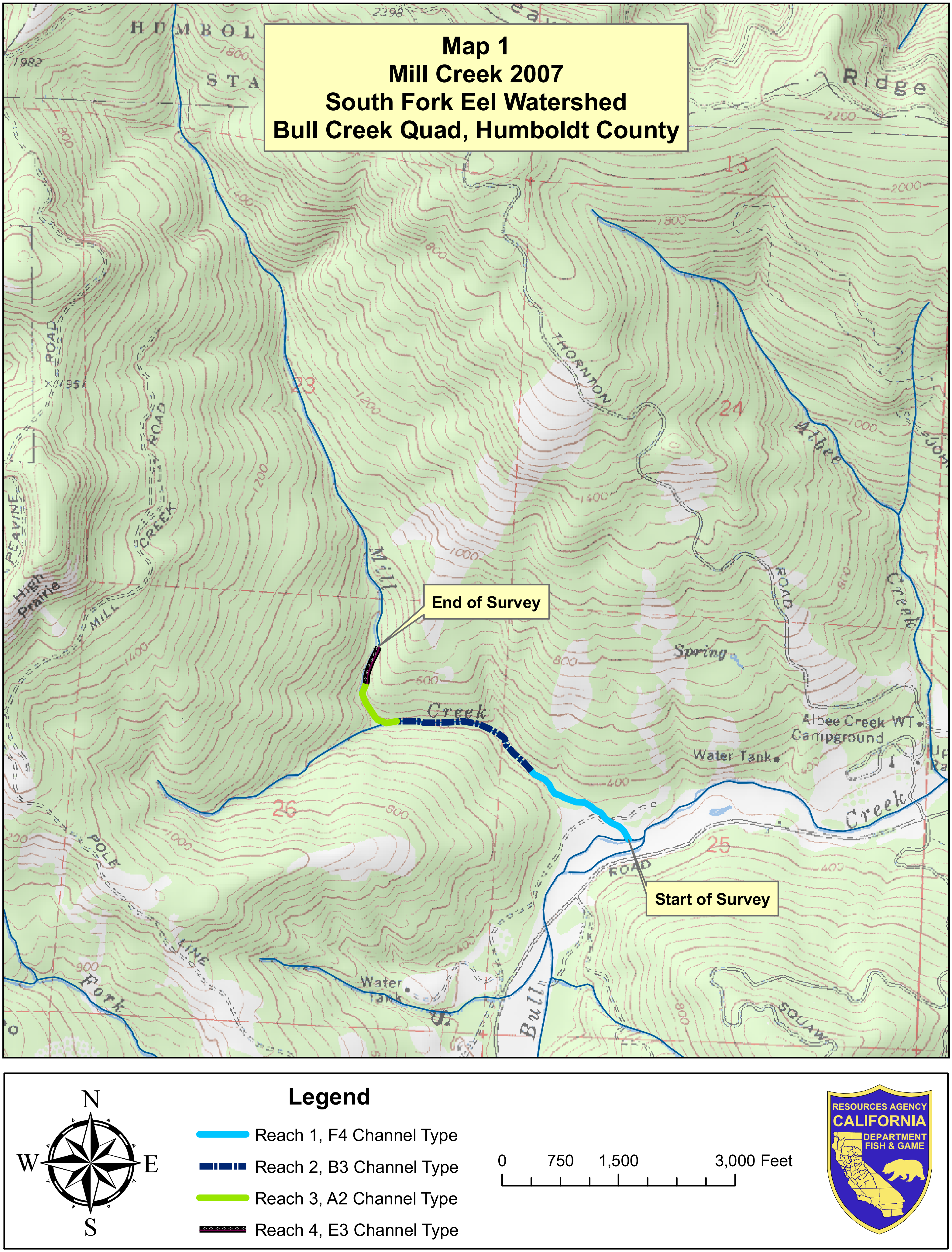
5361	0083.00	Tributary #5 entered from the right bank and was flowing at an estimated 0.3 cfs. The tributary was contributing to about 15% of Mill Creek's flow. The temperature of the tributary was 51 degrees Fahrenheit; the temperature of Mill Creek upstream and downstream from the confluence was 60 and 56 degrees Fahrenheit, respectively. The tributary was not fish accessible due to a 25% slope through the first 350'. No fish were observed in the tributary.
5814	0088.00	LDA #5 was 6' high x 13' wide x 50' long with 7 pieces of LWD. Water flowed through visible gaps large enough to not be a barrier. The LDA was retaining sediment measuring 7' wide x 6' long x 3' deep. The sediment ranged in size from sand to cobble. Fish were observed upstream of the LDA.
6226	0090.00	The end of survey coincided with the beginning of a massive series of log debris accumulations. These extended at least 400' upstream. There is severe erosion on both banks. The LDA's are blocking fish passage and upstream of this habitat unit.

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.

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
Mill Creek 2007
South Fork Eel Watershed
Bull Creek Quad, Humboldt County
End of Survey
Start of Survey
Mill
Creek
Albee Creek
Bull
Fork
Ridge
THORNTON ROAD
MILL CREEK ROAD
PEAVINE
High Prairie
POLE LINE
SQUAW
ROAD
Spring
Albee Creek WT Campground
Water Tank
Water Tank
23
24
25
26
13
Legend
Reach 1, F4 Channel Type
Reach 2, B3 Channel Type
Reach 3, A2 Channel Type
Reach 4, E3 Channel Type
0
750
1,500
3,000 Feet
N
S
E
W
RESOURCES AGENCY
CALIFORNIA
DEPARTMENT
FISH & GAME

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

Stream Name: Mill Creek LLID: 1240200403498 Drainage: Eel River - South Fork

Survey Dates: 6/4/2007 to 6/13/2007

Confluence Location: Quad: BULL CREEK Legal Description: T01SR01ES25 Latitude: 40:20:59.0N Longitude: 124:01:12.0

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
11	5	FLATWATER	12.1	54	597	9.3	13.4	0.8	1.3	616	6776	493	5421		57
37	36	POOL	40.7	42	1560	24.3	13.9	0.6	1.6	514	19033	629	23272	359	73
43	13	RIFFLE	47.3	99	4268	66.4	14.3	0.6	1.3	864	37162	446	19170		114

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
91	54	6425	62972	47863

Table 2 - Summary of Habitat Types and Measured Parameters

Stream Name: Mill Creek LLID: 1240200403498 Drainage: Eel River - South Fork

Survey Dates: 6/4/2007 to 6/13/2007

Confluence Location: Quad: BULL CREEK Legal Description: T01SR01ES25 Latitude: 40:20:59.0N Longitude: 124:01:12.0W

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 (%)
28	6	LGR	30.8	122	3423	53.3	16	0.4	1.7	1220	34146	488	13665		85	84
11	4	HGR	12.1	55	608	9.5	12	0.8	1.7	496	5454	373	4100		116	82
4	3	CAS	4.4	59	237	3.7	16	0.7	1.6	645	2579	459	1835		170	88
7	2	RUN	7.7	43	299	4.7	12	0.8	1.5	402	2812	321	2250		15	97
4	3	SRN	4.4	74	298	4.6	14	0.8	1.4	759	3036	607	2428		85	91
25	24	MCP	27.5	36	894	13.9	14	0.7	2.8	463	11569	643	16073	419	60	85
10	10	STP	11.0	60	598	9.3	15	0.4	2	675	6749	667	6667	261	111	85
1	1	LSL	1.1	43	43	0.7	10	0.4	1.6	409	409	368	368	163	40	97
1	1	LSR	1.1	25	25	0.4	12	0.3	1	255	255	179	179	77	40	93

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
91	54	6425	67009	47564

Table 3 - Summary of Pool Types

Stream Name: Mill Creek LLID: 1240200403498 Drainage: Eel River - South Fork

Survey Dates: 6/4/2007 to 6/13/2007

Confluence Location: Quad: BULL CREEK Legal Description: T01SR01ES25 Latitude: 40:20:59.0N Longitude: 124:01:12.0W

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
35	34	MAIN	95	43	1492	96	14.0	0.6	525	18381	373	13040	75
2	2	SCOUR	5	34	68	4	11.0	0.4	332	664	120	240	40

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
37	36	1560	19044	13280

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

Stream Name: Mill Creek LLID: 1240200403498 Drainage: Eel River - South Fork

Survey Dates: 6/4/2007 to 6/13/2007

Confluence Location: Quad: BULL CREEK Legal Description: T01SR01ES25 Latitude: 40:20:59.0N Longitude: 124:01:12.0W

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
24	MCP	67	2	8	13	54	9	38	0	0	0	0
10	STP	28	0	0	9	90	1	10	0	0	0	0
1	LSL	3	0	0	1	100	0	0	0	0	0	0
1	LSR	3	0	0	1	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
36	2	6	24	67	10	28	0	0	0	0

Mean Maximum Residual Pool Depth (ft.): 1.6

Table 5 - Summary of Mean Percent Cover By Habitat Type

Stream Name: Mill Creek LLID: 1240200403498 Drainage: Eel River - South Fork

Survey Dates: 6/4/2007 to 6/13/2007 Dry Units: 0

Confluence Location: Quad: BULL CREEK Legal Description: T01SR01ES25 Latitude: 40:20:59.0N Longitude: 124:01:12.0W

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
28	6	LGR	0	8	16	0	13	13	3	47	0
11	4	HGR	4	6	5	4	0	0	39	43	0
4	3	CAS	0	5	5	0	0	0	33	57	0
43	13	TOTAL RIFFLE	1	7	10	1	6	6	21	48	0
7	2	RUN	3	3	0	0	8	0	3	85	0
4	3	SRN	5	5	5	3	0	0	10	72	0
11	5	TOTAL FLAT	4	4	3	2	3	0	7	77	0
25	24	MCP	8	10	12	20	4	3	6	35	2
10	10	STP	2	6	1	1	9	0	32	51	0
1	1	LSL	0	5	95	0	0	0	0	0	0
1	1	LSR	0	0	0	15	0	0	85	0	0
37	36	TOTAL POOL	6	8	11	14	5	2	15	38	1
91	54	TOTAL	5	8	10	10	5	3	16	44	1

Table 6 - Summary of Dominant Substrates By Habitat Type

Stream Name: Mill Creek LLID: 1240200403498 Drainage: Eel River - South Fork

Survey Dates: 6/4/2007 to 6/13/2007 Dry Units: 0

Confluence Location: Quad: BULL CREEK Legal Description: T01SR01ES25 Latitude: 40:20:59.0N Longitude: 124:01:12.0W

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
28	6	LGR	0	0	33	17	0	50	0
11	4	HGR	0	0	0	0	0	100	0
4	3	CAS	0	0	0	0	0	100	0
7	2	RUN	0	0	50	0	50	0	0
4	3	SRN	0	0	33	0	33	33	0
25	24	MCP	17	21	25	0	4	33	0
10	10	STP	0	10	0	0	10	80	0
1	1	LSL	0	0	0	100	0	0	0
1	1	LSR	0	0	0	0	0	100	0

Table 7 - Summary of Mean Percent Canopy for Entire Stream

Stream Name: Mill Creek LLID: 1240200403498 Drainage: Eel River - South Fork

Survey Dates: 6/4/2007 to 6/13/2007

Confluence Location: Quad: BULL CREEK Legal Description: T01SR01ES25 Latitude: 40:20:59.0N Longitude: 124:01:12.0W

Mean Percent Canopy	Mean Percent Conifer	Mean Percent Hardwood	Mean Percent Open Units	Mean Right Bank % Cover	Mean Left Bank % Cover
86	32	68	0	79	83

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: Mill Creek LLID: 1240200403498 Drainage: Eel River - South Fork

Survey Dates: 6/4/2007 to 6/13/2007 Survey Length (ft.): 6425 Main Channel (ft.): 6226 Side Channel (ft.): 199

Confluence Location: Quad: BULL CREEK Legal Description: T01SR01ES25 Latitude: 40:20:59.0N Longitude: 124:01:12.0W

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 1

Channel Type: F4
Reach Length (ft.): 2354
Riffle/Flatwater Mean Width (ft.): 14.0
BFW:
Range (ft.): 19 to 25
Mean (ft.): 21
Std. Dev.: 2
Base Flow (cfs.): 1.3
Water (F): 52 - 56 Air (F): 52 - 63
Dry Channel (ft): 0

Canopy Density (%): 90.1
Coniferous Component (%): 40.3
Hardwood Component (%): 59.7
Dominant Bank Vegetation: Hardwood Trees
Vegetative Cover (%): 79.0
Dominant Shelter: Root masses
Dominant Bank Substrate Type: Sand/Silt/Clay
Occurrence of LWD (%): 22
LWD per 100 ft.:
Riffles: 1
Pools: 4
Flat: 1

Pools by Stream Length (%): 24.5
Pool Frequency (%): 46.4
Residual Pool Depth (%):
< 2 Feet Deep: 50
2 to 2.9 Feet Deep: 50
3 to 3.9 Feet Deep: 0
>= 4 Feet Deep: 0
Mean Max Residual Pool Depth (ft.): 1.9
Mean Pool Shelter Rating: 47

Pool Tail Substrate (%): Silt/Clay: 0 Sand: 0 Gravel: 67 Sm Cobble: 25 Lg Cobble: 8 Boulder: 0 Bedrock: 0

Embeddedness Values (%): 1. 25.0 2. 66.7 3. 8.3 4. 0.0 5. 0.0

STREAM REACH: 2

Channel Type: B3
Reach Length (ft.): 2006
Riffle/Flatwater Mean Width (ft.): 14.3
BFW:
Range (ft.): 25 to 33
Mean (ft.): 26
Std. Dev.: 2
Base Flow (cfs.): 1.3
Water (F): 48 - 56 Air (F): 51 - 58
Dry Channel (ft): 0

Canopy Density (%): 88.3
Coniferous Component (%): 28.5
Hardwood Component (%): 71.5
Dominant Bank Vegetation: Hardwood Trees
Vegetative Cover (%): 79.0
Dominant Shelter: Boulders
Dominant Bank Substrate Type: Sand/Silt/Clay
Occurrence of LWD (%): 7
LWD per 100 ft.:
Riffles: 3
Pools: 3
Flat: 3

Pools by Stream Length (%): 17.3
Pool Frequency (%): 31.4
Residual Pool Depth (%):
< 2 Feet Deep: 82
2 to 2.9 Feet Deep: 18
3 to 3.9 Feet Deep: 0
>= 4 Feet Deep: 0
Mean Max Residual Pool Depth (ft.): 1.4
Mean Pool Shelter Rating: 78

Pool Tail Substrate (%): Silt/Clay: 0 Sand: 0 Gravel: 9 Sm Cobble: 0 Lg Cobble: 0 Boulder: 91 Bedrock: 0

Embeddedness Values (%): 1. 9.1 2. 0.0 3. 0.0 4. 0.0 5. 90.9

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 3

Channel Type: A2
Reach Length (ft.): 676
Riffle/Flatwater Mean Width (ft.): 13.8
BFW:
Range (ft.): 24 to 33
Mean (ft.): 29
Std. Dev.: 4
Base Flow (cfs.): 1.3
Water (F): 53 - 54 Air (F): 52 - 61
Dry Channel (ft): 0

Canopy Density (%): 82.8
Coniferous Component (%): 33.5
Hardwood Component (%): 66.5
Dominant Bank Vegetation: Hardwood Trees
Vegetative Cover (%): 88.8
Dominant Shelter: Boulders
Dominant Bank Substrate Type: Sand/Silt/Clay
Occurrence of LWD (%): 2
LWD per 100 ft.:
Riffles: 2
Pools: 1
Flat:

Pools by Stream Length (%): 42.6
Pool Frequency (%): 46.2
Residual Pool Depth (%):
< 2 Feet Deep: 100
2 to 2.9 Feet Deep: 0
3 to 3.9 Feet Deep: 0
>= 4 Feet Deep: 0
Mean Max Residual Pool Depth (ft.): 1.3
Mean Pool Shelter Rating: 76

Pool Tail Substrate (%): Silt/Clay: 0 Sand: 0 Gravel: 0 Sm Cobble: 17 Lg Cobble: 0 Boulder: 83 Bedrock: 0
Embeddedness Values (%): 1. 0.0 2. 16.7 3. 0.0 4. 0.0 5. 83.3

STREAM REACH: 4

Channel Type: E3
Reach Length (ft.): 1190
Riffle/Flatwater Mean Width (ft.): 14.0
BFW:
Range (ft.): 18 to 24
Mean (ft.): 20
Std. Dev.: 3
Base Flow (cfs.): 1.3
Water (F): 53 - 59 Air (F): 61 - 68
Dry Channel (ft): 0

Canopy Density (%): 77.6
Coniferous Component (%): 24.6
Hardwood Component (%): 75.4
Dominant Bank Vegetation: Hardwood Trees
Vegetative Cover (%): 78.9
Dominant Shelter: Boulders
Dominant Bank Substrate Type: Sand/Silt/Clay
Occurrence of LWD (%): 5
LWD per 100 ft.:
Riffles: 2
Pools: 4
Flat: 3

Pools by Stream Length (%): 25.1
Pool Frequency (%): 46.7
Residual Pool Depth (%):
< 2 Feet Deep: 71
2 to 2.9 Feet Deep: 29
3 to 3.9 Feet Deep: 0
>= 4 Feet Deep: 0
Mean Max Residual Pool Depth (ft.): 1.5
Mean Pool Shelter Rating: 106

Pool Tail Substrate (%): Silt/Clay: 0 Sand: 0 Gravel: 29 Sm Cobble: 29 Lg Cobble: 14 Boulder: 29 Bedrock: 0
Embeddedness Values (%): 1. 0.0 2. 42.9 3. 14.3 4. 0.0 5. 42.9

Table 9 - Mean Percentage of Dominant Substrate and Vegetation

Stream Name: Mill Creek LLID: 1240200403498 Drainage: Eel River - South Fork

Survey Dates: 6/4/2007 to 6/13/2007

Confluence Location: Quad: BULL CREEK Legal Description: T01SR01ES25 Latitude: 40:20:59.0N Longitude: 124:01:12.0W

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	1	1	1.9
Boulder	5	5	9.3
Cobble / Gravel	9	10	17.6
Sand / Silt / Clay	39	38	71.3

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	5	11	14.8
Brush	6	5	10.2
Hardwood Trees	29	26	50.9
Coniferous Trees	14	12	24.1
No Vegetation	0	0	0.0

Total Stream Cobble Embeddedness Values: 3

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

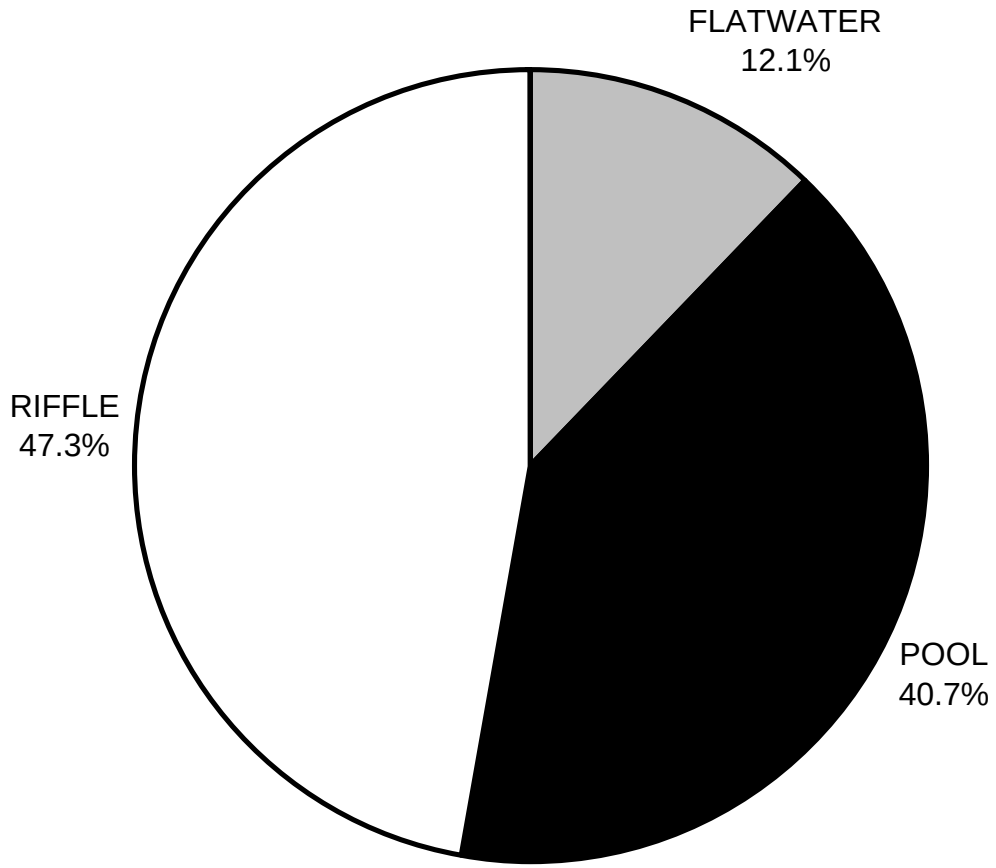
StreamName: Mill Creek LLID: 1240200403498 Drainage: Eel River - South Fork

Survey Dates: 6/4/2007 to 6/13/2007

Confluence Location: Quad: BULL CREEK Legal Description: T01SR01ES25 Latitude: 40:20:59.0N Longitude: 124:01:12.0W

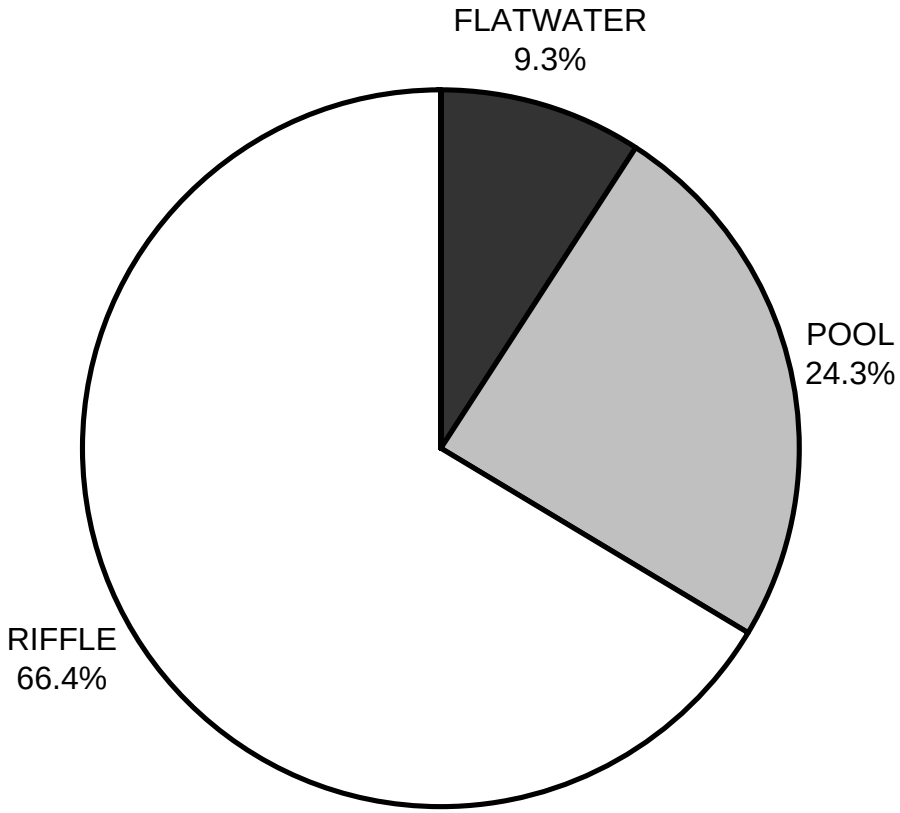
	Riffles	Flatwater	Pools
UNDERCUT BANKS (%)	1	4	6
SMALL WOODY DEBRIS (%)	7	4	8
LARGE WOODY DEBRIS (%)	10	3	11
ROOT MASS (%)	1	2	14
TERRESTRIAL VEGETATION (%)	6	3	5
AQUATIC VEGETATION (%)	6	0	2
WHITEWATER (%)	21	7	15
BOULDERS (%)	48	77	38
BEDROCK LEDGES (%)	0	0	1

MILL CREEK 2007
HABITAT TYPES BY PERCENT OCCURRENCE



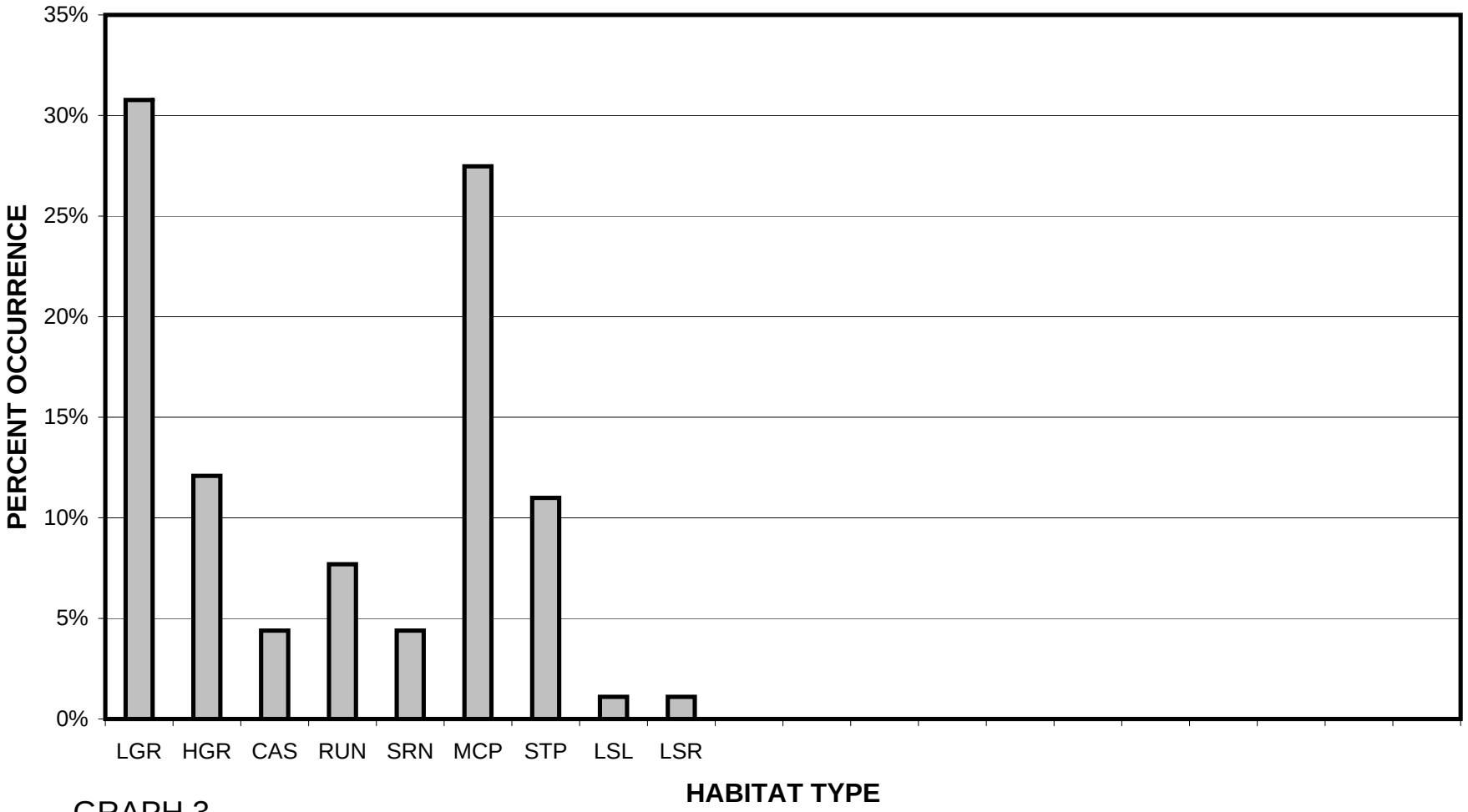
GRAPH 1

MILL CREEK 2007
HABITAT TYPES BY PERCENT TOTAL LENGTH



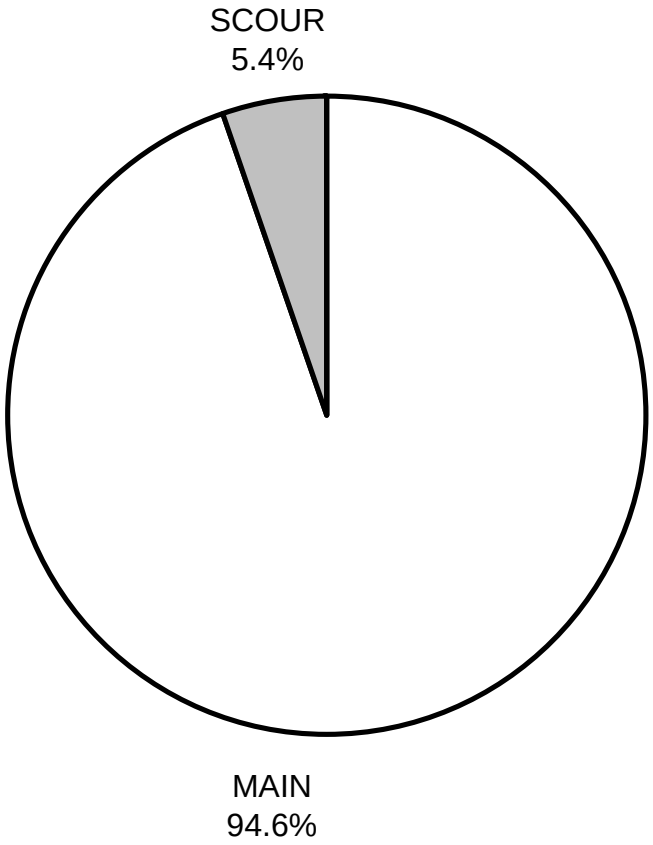
GRAPH 2

MILL CREEK 2007
HABITAT TYPES BY PERCENT OCCURRENCE



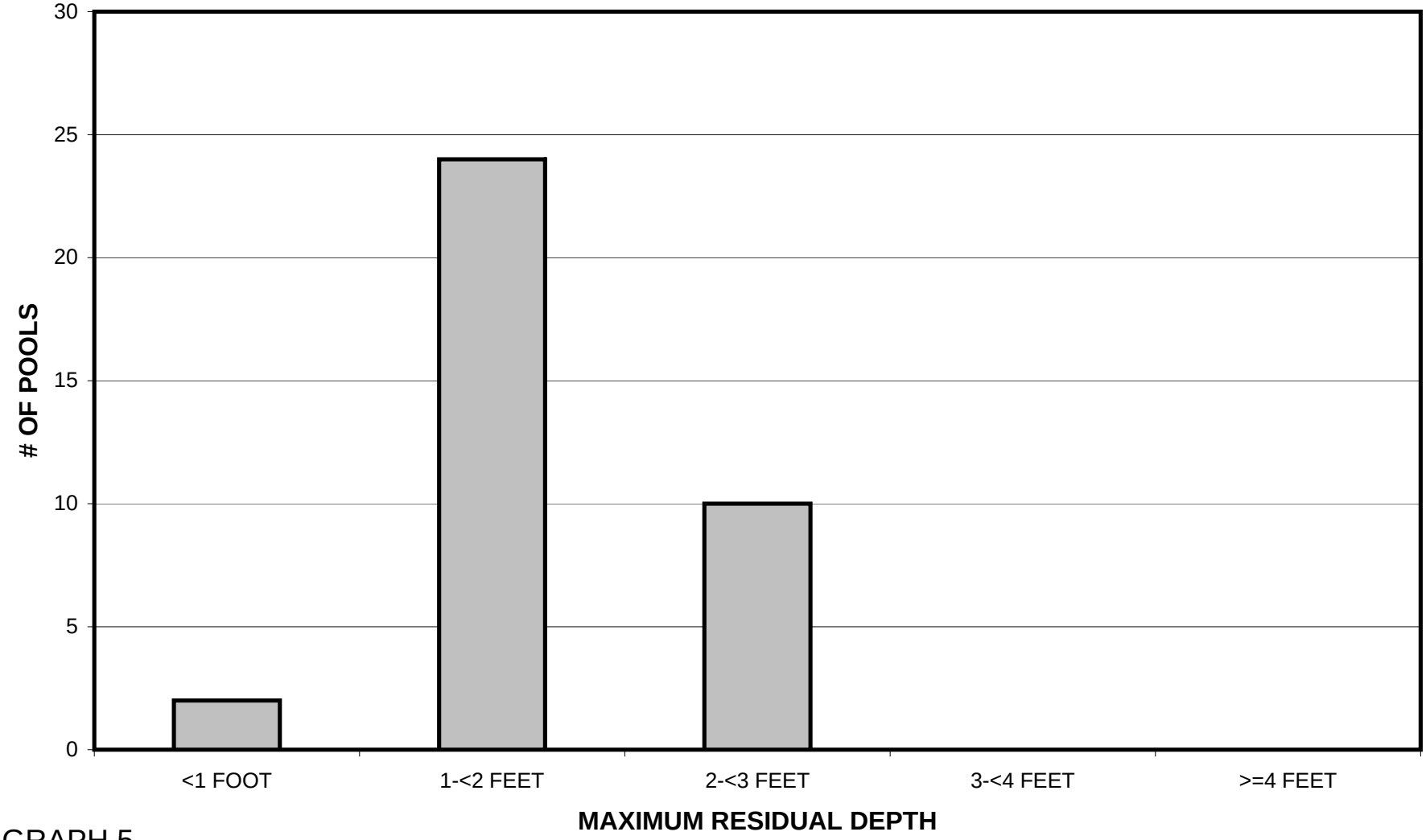
GRAPH 3

MILL CREEK 2007
POOL TYPES BY PERCENT OCCURRENCE



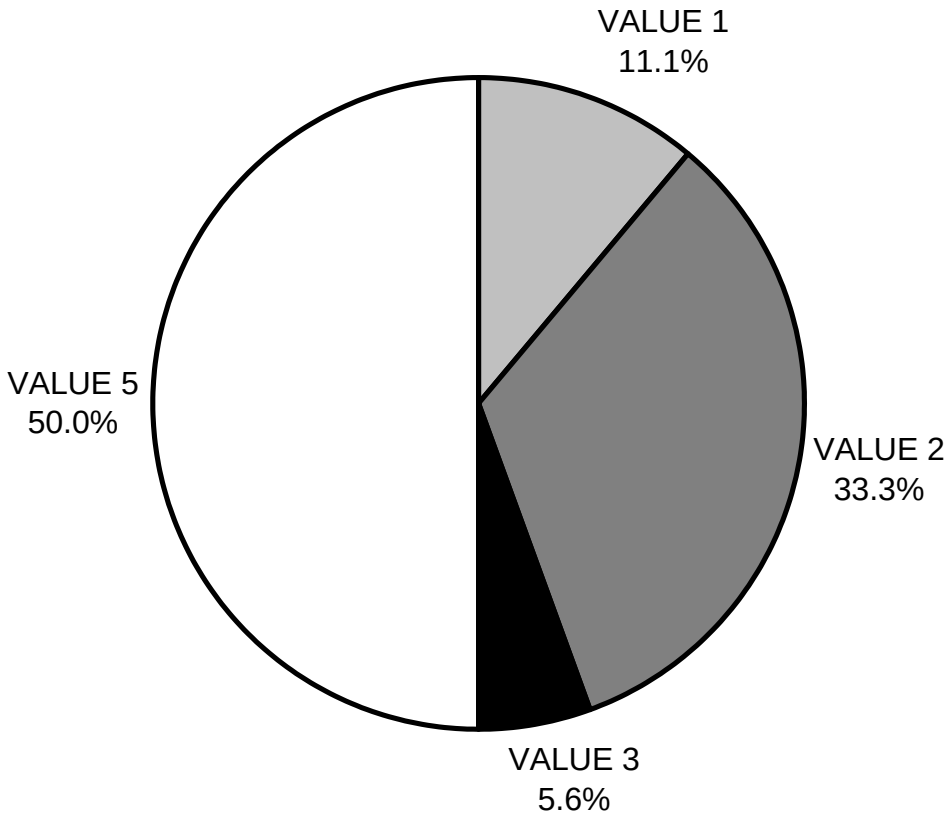
GRAPH 4

MILL CREEK 2007
MAXIMUM DEPTH IN POOLS



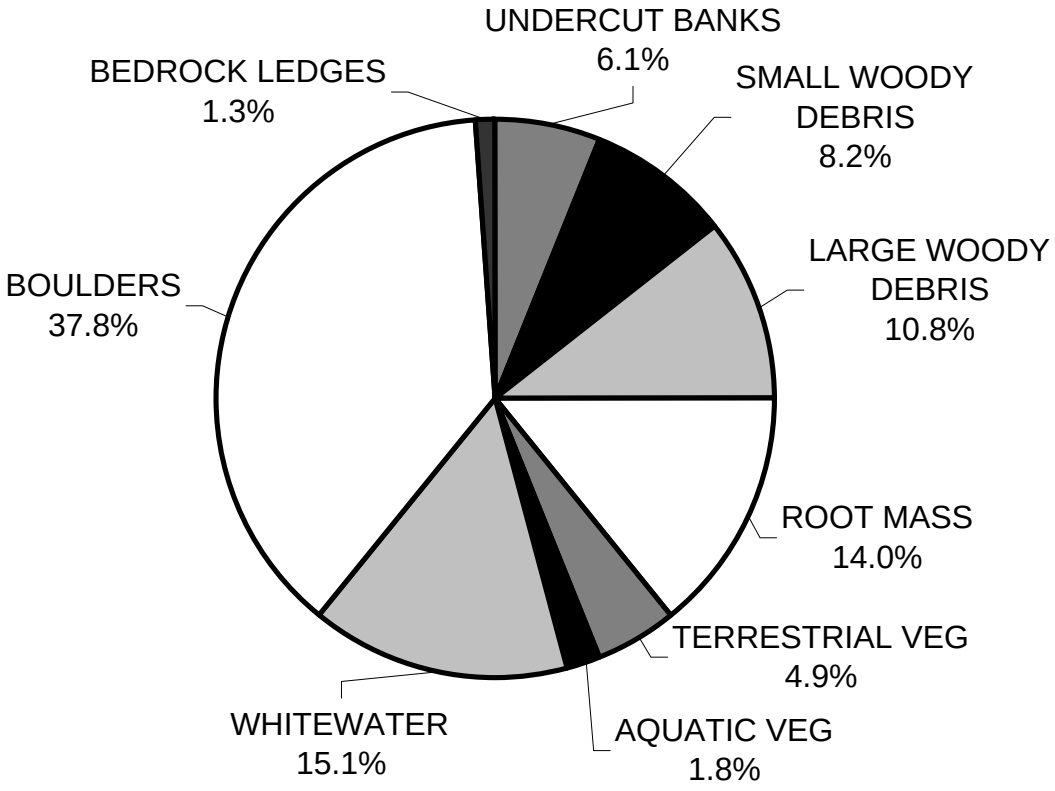
GRAPH 5

MILL CREEK 2007
PERCENT EMBEDDEDNESS



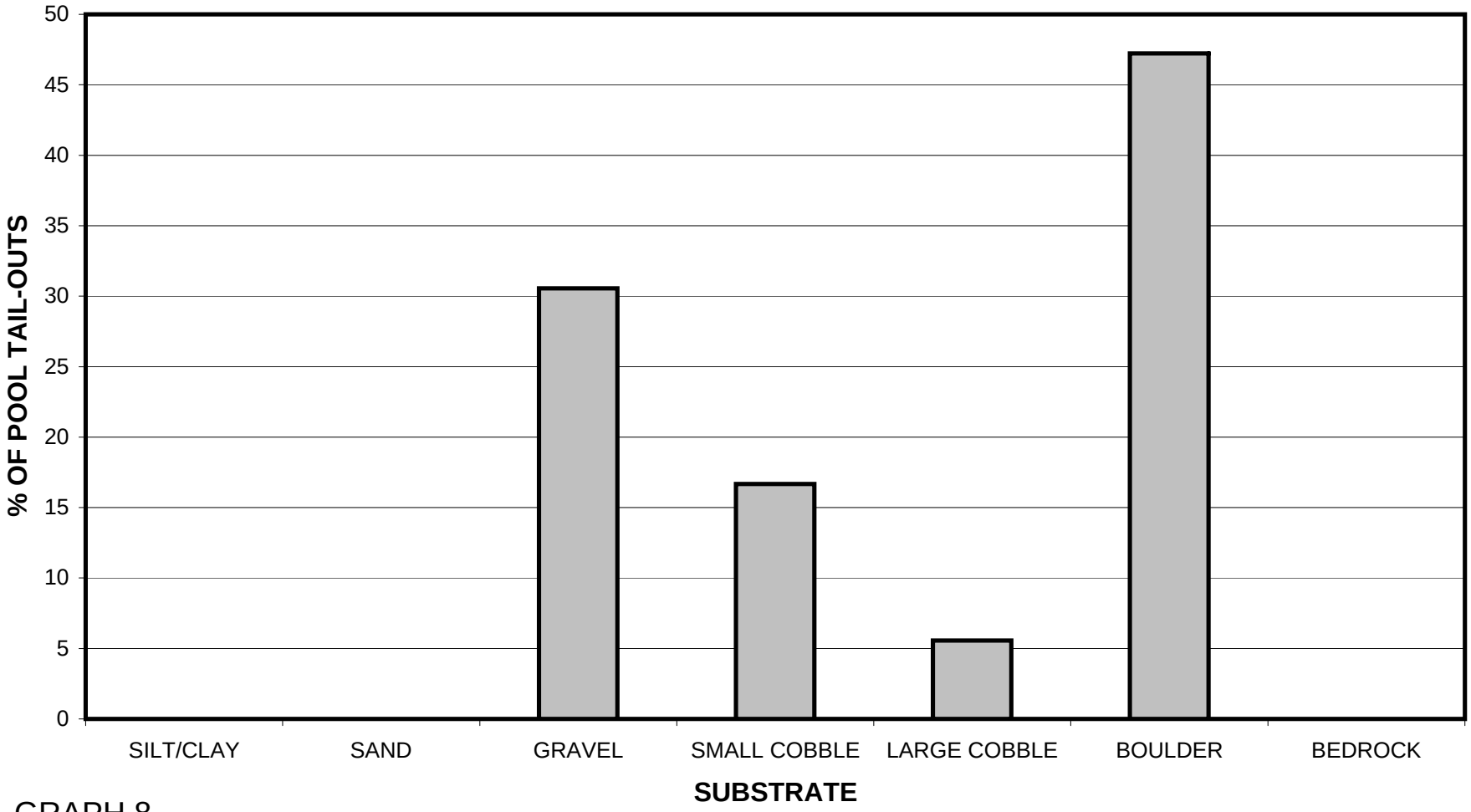
GRAPH 6

MILL CREEK 2007
MEAN PERCENT COVER TYPES IN POOLS



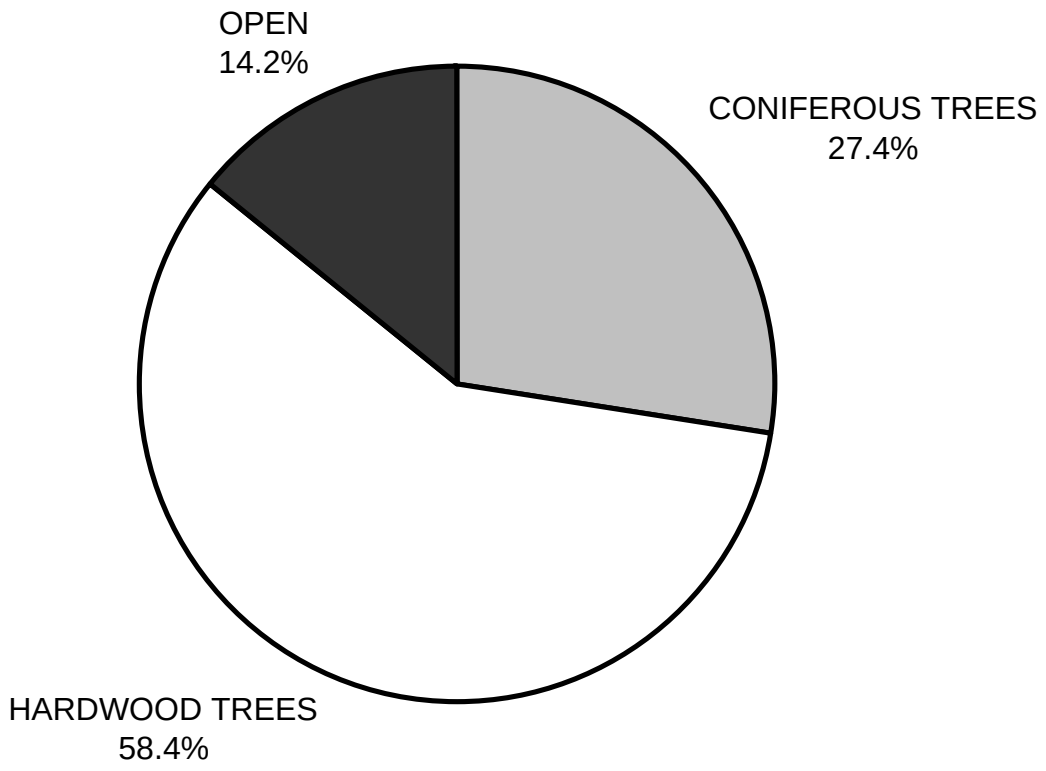
GRAPH 7

MILL CREEK 2007
SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



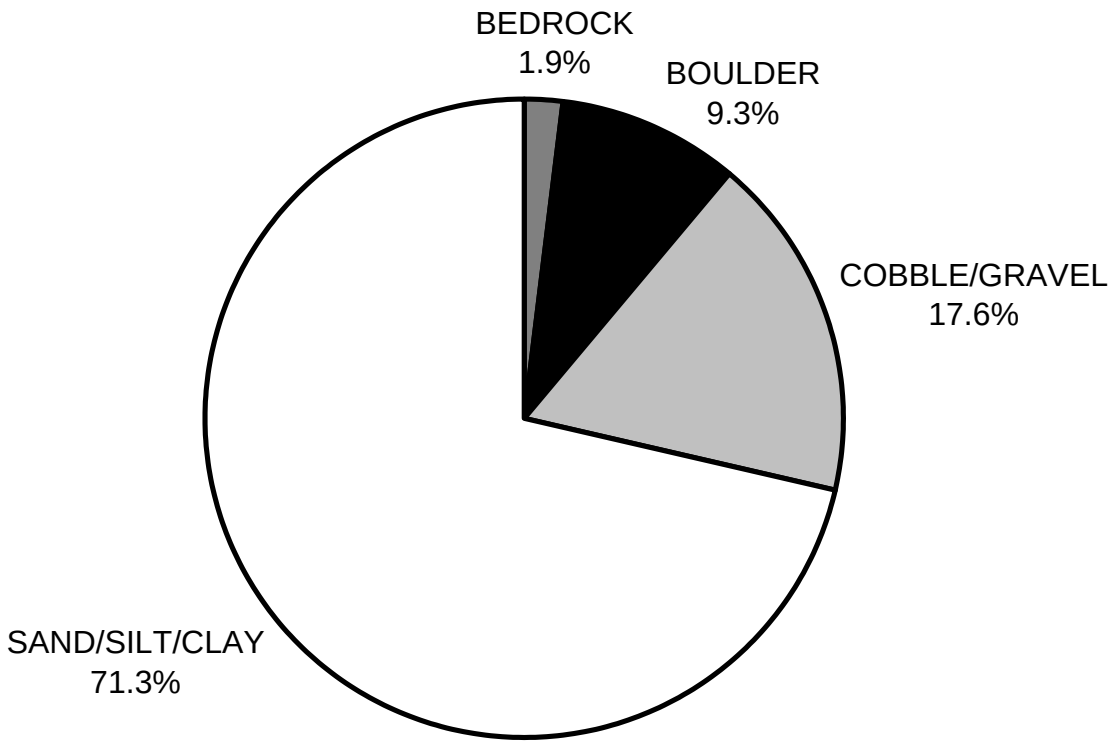
GRAPH 8

MILL CREEK 2007
MEAN PERCENT CANOPY



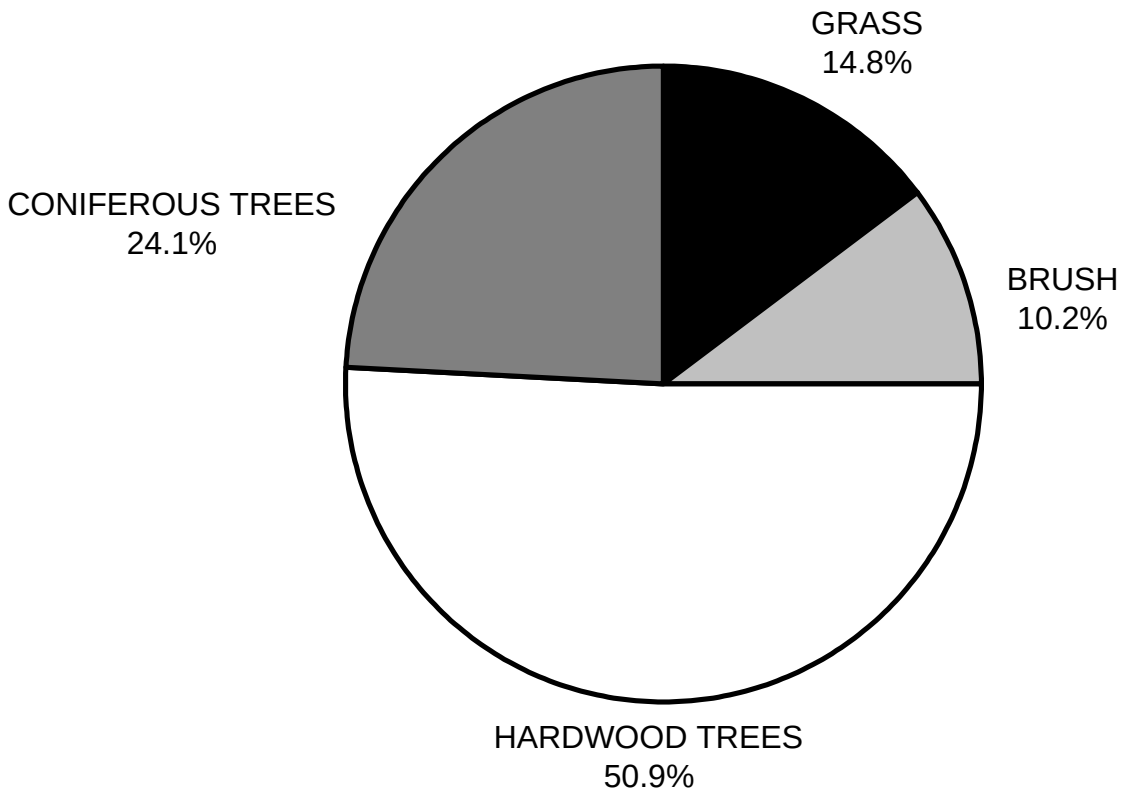
GRAPH 9

MILL CREEK 2007
DOMINANT BANK COMPOSITION IN SURVEY REACH



GRAPH 10

MILL CREEK 2007
DOMINANT BANK VEGETATION IN SURVEY REACH



GRAPH 11