

STREAM INVENTORY REPORT

Minnie Creek

INTRODUCTION

A stream inventory was conducted from October 4 to October 6, 2010 on Minnie Creek. The survey began at the confluence with Rancheria Creek and extended upstream 1.7 miles.

The Minnie 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 Minnie 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 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

Minnie Creek is a tributary to Rancheria Creek, a tributary to the Navarro River, which drains to the Pacific Ocean. It is located in Mendocino County, California (Map 1). Minnie Creek's legal description at the confluence with Rancheria Creek is T13N R14W S17. Its location is 38.99342 degrees north latitude and 123.43463 degrees west longitude, LLID number 1234334389935. Minnie Creek is a first order stream and has approximately 2.0 miles of blue line stream according to the USGS Zeni Ridge 7.5 minute quadrangle. Minnie Creek drains a watershed of approximately 3.4 square miles. Elevations range from about 420 feet at the mouth of the creek to 2,300 feet in the headwater areas. Mixed conifer forest dominates the watershed. The watershed is privately owned and is managed for timber production. Vehicle access exists via Highway 128 to Mountain View Road near Philo.

METHODS

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

SAMPLING STRATEGY

The inventory uses a method that samples approximately 10% of the habitat units within the survey reach. All habitat units included in the survey are classified according to habitat type and their lengths are measured. All pool units are measured for maximum depth, depth of pool tail crest (measured in the thalweg), dominant substrate composing the pool tail crest, and

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embeddedness. Habitat unit types encountered for the first time are measured for all the parameters and characteristics on the field form. Additionally, from the ten habitat units on each field form page, one is randomly selected for complete measurement.

HABITAT INVENTORY COMPONENTS

A standardized habitat inventory form has been developed for use in California stream surveys and can be found in the *California Salmonid Stream Habitat Restoration Manual*. This form was used in Minnie 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". Minnie 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.

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5. Embeddedness:

The depth of embeddedness of the cobbles in pool tail-out areas is measured by the percent of the cobble that is surrounded or buried by fine sediment. In Minnie 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 Minnie 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 Minnie 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 Minnie 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.

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10. Large Woody Debris Count:

Large woody debris (LWD) is an important component of fish habitat and an element in channel forming processes. In each habitat unit all pieces of LWD partially or entirely below the elevation of bankfull discharge are counted and recorded. The minimum size to be considered is twelve inches in diameter and six feet in length. The LWD count is presented by reach and is expressed as an average per 100 feet.

11. Average Bankfull Width:

Bankfull width can vary greatly in the course of a channel type stream reach. This is especially true in very long reaches. Bankfull width can be a factor in habitat components like canopy density, water temperature, and pool depths. Frequent measurements taken at riffle crests (velocity crossovers) are needed to accurately describe reach widths. At the first appropriate velocity crossover that occurs after the beginning of a new stream survey page (ten habitat units), bankfull width is measured and recorded in the appropriate header block of the page. These widths are presented as an average for the channel type reach.

BIOLOGICAL INVENTORY

Biological sampling during the stream inventory is used to determine fish species and their distribution in the stream. Fish presence was observed from the stream banks in Minnie Creek. In addition, underwater observations were made at 10 sites using techniques discussed in the *California Salmonid Stream Habitat Restoration Manual*.

DATA ANALYSIS

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

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

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Graphics are produced from the tables using Microsoft Excel. Graphics developed for Minnie 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 October 4 to October 6, 2010, was conducted by P. Scott and L. Ritchey (WSP), and I. Mikus (DFG). The total length of the stream surveyed was 8,902 feet with an additional 109 feet of side channel.

Stream flow was measured near the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 0.3 cfs on October 5, 2010.

Minnie Creek is a G4 channel type for 9,011 feet of the stream surveyed. G4 channels are entrenched “gully” step-pool channels on moderate gradients with low width /depth ratios and gravel-dominant substrates.

Water temperatures taken during the survey period ranged from 53 to 58 degrees Fahrenheit. Air temperatures ranged from 43 to 70 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 43% pool units, 35% riffle units, 21% flatwater units, and 1% not surveyed units (Graph 1). Based on total length of Level II habitat types there were 41% pool units, 34% riffle units, 24% flatwater units, and 1% not surveyed units (Graph 2).

Twelve Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were mid-channel pool units, 34%; low gradient riffle units, 26%; and run units 11% (Graph 3). Based on percent total length, mid-channel pool units made up 33%, low gradient riffle units 28%, and step run units 15%.

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A total of 108 pools were identified (Table 3). Main channel pools were the most frequently encountered at 84% (Graph 4), and comprised 87% of the total length of all pools (Table 3).

Table 4 is a summary of maximum residual pool depths by pool habitat types. Pool quality for salmonids increases with depth. Twenty-nine of the 108 pools (27%) had a residual depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 108 pool tail-outs measured, 29 had a value of 1 (26.9%); 41 had a value of 2 (38%); 27 had a value of 3 (25%); 2 had a value of 4 (1.9%); 9 had a value of 5 (8.3%) (Graph 6). On this scale, a value of 1 indicates the best spawning conditions and a value of 4 the worst. Additionally, a value of 5 was assigned to tail-outs deemed not suitable for spawning due to inappropriate substrate such as bedrock, log sills, boulders, or other considerations.

A shelter rating was calculated for each habitat unit and expressed as a mean value for each habitat type within the survey using a scale of 0-300. Riffle habitat types had a mean shelter rating of 16, flatwater habitat types had a mean shelter rating of 20, and pool habitats had a mean shelter rating of 26 (Table 1). Of the pool types, the scour pools had the highest mean shelter rating at 39. Main channel pools had a mean shelter rating of 24 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover type in Minnie Creek. Graph 7 describes the pool cover in Minnie 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. Gravel was the dominant substrate observed in 60% of the pool tail-outs. Small cobble was the next most frequently observed dominant substrate type and occurred in 18% of the pool tail-outs.

The mean percent canopy density for the surveyed length of Minnie Creek was 82%. Eighteen percent of the canopy was open. Of the canopy present, the mean percentages of hardwood and coniferous trees were 45% and 55%, respectively. Graph 9 describes the mean percent canopy in Minnie Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 79%. The mean percent left bank vegetated was 81%. The dominant elements composing the structure of the stream banks consisted of 50% cobble/gravel, 25% boulder, 13% sand/silt/clay, and 12% bedrock (Graph 10). Coniferous trees were the dominant vegetation type observed in 54% of the units surveyed. Additionally, 45% of the units surveyed had deciduous trees as the dominant vegetation type, and 1% had grass as the dominant vegetation type (Graph 11).

BIOLOGICAL INVENTORY RESULTS

Survey teams conducted a snorkel survey at 10 sites for species composition and distribution in Minnie Creek on October 14, 2010. The water temperature taken during the survey period of

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1000 hours to 1045 hours was 54 degrees Fahrenheit. Air temperatures ranged from 55 to 57 degrees Fahrenheit. The sites were sampled by I. Mikus (DFG), and B. Leonard (WSP).

Ten sites were sampled. The reach sites yielded 95 young-of-the-year steelhead/rainbow trout (SH/RT), 10 age 1+ SH/RT, 4 age 2+ SH/RT, and 18 California roach.

The following chart displays the information yielded from these sites:

2010 Minnie Creek underwater / electrofishing observations.

Date	Survey Site #	Habitat Unit #	Habitat Type	Approx. Dist. from mouth (ft.)	SH/RT			Coho	
					YOY	1+	2+	YOY	1+
F4 Channel Type									
10/14/10	1	002	Pool	38	11	1	0	0	0
	2	021	Pool	642	9	0	0	0	0
	3	024	Pool	701	6	0	0	0	0
	4	025	Pool	734	12	3	0	0	0
	5	028	Pool	783	6	0	0	0	0
	6	033	Pool	979	6	3	1	0	0
	7	038	Pool	1101	5	0	0	0	0
	8	041	Pool	1221	16	0	2	0	0
	9	045	Pool	1300	7	3	1	0	0
	10	046	Pool	1336	17	0	0	0	0

DISCUSSION

Minnie Creek is a G4 channel type for the entire 9,011 feet of stream surveyed. The suitability of G4 channel types for fish habitat improvement structures is as follows: G4 channel types are good for bank-placed boulders and fair for plunge weirs, opposing wing-deflectors, and log cover.

The water temperatures recorded on the survey days October 4 to October 6, 2010, ranged from 53 to 58 degrees Fahrenheit. Air temperatures ranged from 43 to 70 degrees Fahrenheit. This is a suitable water temperature range for salmonids. To make any further conclusions, temperatures need to be monitored throughout the warm summer months, and more extensive biological sampling needs to be conducted.

Flatwater habitat types comprised 24% of the total length of this survey, riffles 34%, and pools 41%. Twenty-nine of the 108 (27%) pools had a maximum residual depth greater than 2 feet. In general, pool enhancement projects are considered when primary pools comprise less than 40%

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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 large wood that will deepen pool habitat is recommended.

Seventy of the 108 pool tail-outs measured had embeddedness ratings of 1 or 2. Twenty-nine of the pool tail-outs had embeddedness ratings of 3 or 4. Nine 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 Minnie Creek should be mapped and rated according to their potential sediment yields, and control measures should be taken.

Eighty-four of the 108 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 26. The shelter rating in the flatwater habitats is 20. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by boulders in Minnie Creek. Boulders are the dominant cover type in pools followed by small woody debris. Log and root wad cover structures in the pool and flatwater habitats would enhance both summer and winter salmonid habitat. Log cover structure provides rearing fry with protection from predation, rest from water velocity, and also divides territorial units to reduce density related competition.

The mean percent canopy density for the stream was 82%. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was 79% and 81%, 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) Minnie Creek should be managed as an anadromous, natural production stream.
- 2) The limited water temperature data available suggest that maximum temperatures are within the acceptable range for juvenile salmonids. To establish more complete and meaningful temperature regime information, 24-hour monitoring during the July and August temperature extreme period should be performed for 3 to 5 years.
- 3) Increase woody cover in the pools and flatwater habitat units. Most of the existing cover in the pools is from boulders. Adding high quality complexity with woody cover in the pools is desirable.

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- 4) 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.

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 Rancheria Creek. The channel is a G4 for the entire length of the survey.
734	0026.00	Log debris accumulation (LDA) #01 contains 10 pieces of large woody debris (LWD) and measures 9' high x 39' wide x 7' long. Water flows through the LDA and there are visible gaps in it. Retained sediment ranges from fines to large cobble and measures 30' wide x 109' long x 6' deep. Fish are present above the LDA.
1139	0040.00	A landslide on the right bank measures 12' long x 25' high.
1366	0048.00	A road crosses the channel. The crossing is a 13' wide x 13.5' high x 58' long railcar bridge.
1472	0051.00	A landslide on the right bank measures 25' wide x 80' high.
2328	0072.00	A dirt road fords the stream.
2963	0091.00	There is a 1.4' high plunge.
3156	0096.00	LDA #02 contains 75-100 pieces of LWD and measures 7' high x 129' wide x 108' long. Water flows through the LDA and there are visible gaps in it. Retained sediment ranges from sand to small cobble and measures 25' wide x 110' long x 3.5' deep. Fish are above the LDA. Tributary #01 enters on the right bank. It contributes to approximately 2% of Minnie Creek's flow. The water temperature downstream of the tributary is 55 degrees Fahrenheit, the water temperature of the tributary is 55 degrees Fahrenheit, and the water temperature upstream of the confluence is 54 degrees Fahrenheit. The slope of the tributary is approximately 90%, making it inaccessible to salmonids.
3917	0114.00	There is a 2' high plunge.

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4108	0121.00	There is a 2' high plunge.
5073	0151.00	Left bank tributary.
5583	0163.00	A dirt road fords the stream.
6043	0173.00	A dirt road fords the stream.
6119	0174.00	Rip-rap stabilizes the right bank.
6574	0185.00	There is a cascade formed by a series of five 1' high plunges.
6630	0188.00	There is a 2.5' high plunge.
6655	0189.00	There are two 2' high plunges in a row.
6725	0191.00	There is a 5' high cascade formed by a 3' high plunge and a 2' high plunge.
6738	0192.00	There is a 2' high plunge.
7513	0214.00	Boulder rip-rap creates a 2.5' plunge.
7537	0215.00	A dirt road fords the stream.
8538	0242.00	LDA #03 contains seven pieces of LWD and measures 5' high x 28' wide x 10' long. Water flows through the LDA and there are no visible gaps in it. Retained sediment ranges from sand to large cobble and measures 8' wide x 24' long x 2' deep. Fish are present above the LDA.
8853	0250.00	End of survey due to LDA #04, the probable end of anadromy. LDA #04 contains 50-75 pieces of LWD and measures 14' high x 71' wide x 49' long. Water does not flow through the LDA and there are no visible gaps in it. Retained sediment ranges from sand to small cobble and measures 28' wide x 75' long x 4' deep. There is a 13' high plunge over the LDA. The flow is subsurface for 40' above the LDA; water is trickling through the sediment below it. No young-of-the-year salmonids were observed in the 1,500' explored above the LDA.

REFERENCES

Flosi, G., Downie, S., Hopelain, J., Bird, M., Coey, R., and Collins, B. 1998. *California Salmonid Stream Habitat Restoration Manual*, 3rd edition. California Department of Fish and Game, Sacramento, California.

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LEVEL III and LEVEL IV HABITAT TYPES

RIFFLE

Low Gradient Riffle	(LGR)	[1.1]	{ 1 }
High Gradient Riffle	(HGR)	[1.2]	{ 2 }

CASCADE

Cascade	(CAS)	[2.1]	{ 3 }
Bedrock Sheet	(BRS)	[2.2]	{24}

FLATWATER

Pocket Water	(POW)	[3.1]	{21}
Glide	(GLD)	[3.2]	{14}
Run	(RUN)	[3.3]	{15}
Step Run	(SRN)	[3.4]	{16}
Edgewater	(EDW)	[3.5]	{18}

MAIN CHANNEL POOLS

Trench Pool	(TRP)	[4.1]	{ 8 }
Mid-Channel Pool	(MCP)	[4.2]	{17}
Channel Confluence Pool	(CCP)	[4.3]	{19}
Step Pool	(STP)	[4.4]	{23}

SCOUR POOLS

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

BACKWATER POOLS

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

ADDITIONAL UNIT DESIGNATIONS

Dry	(DRY)	[7.0]	
Culvert	(CUL)	[8.0]	
Not Surveyed	(NS)	[9.0]	
Not Surveyed due to a marsh	(MAR)	[9.1]	

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

Stream Name: Minnie Creek

LLID: 1234334389935

Drainage: Navarro River

Survey Dates: 10/4/2010 to 10/6/2010

Confluence Location: Quad: ZENI RIDGE

Legal Description: T13NR14WS17

Latitude: 38:59:37.0N

Longitude: 123:26:00.0

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
53	5	FLATWATER	21.1	40	2124	23.6	9.0	0.5	0.9	345	18296	182	9663		20
2	0	NOSURVEY	0.8	68	135	1.5									
108	108	POOL	43.0	34	3660	40.6	12.2	0.7	1.7	380	41000	402	43460	290	26
88	10	RIFFLE	35.1	35	3092	34.3	8.7	0.4	0.7	177	15616	64	5654		16
Total Units	Total Units Fully Measured				Total Length (ft.)					Total Area (sq.ft.)			Total Volume (cu.ft.)		
251	123				9011					74912			58776		

Table 2 - Summary of Habitat Types and Measured Parameters

Stream Name: Minnie Creek

LLID: 1234334389935

Drainage: Navarro River

Survey Dates: 10/4/2010 to 10/6/2010

Confluence Location: Quad: ZENI RIDGE

Legal Description: T13NR14WS17

Latitude: 38:59:37.0N

Longitude: 123:26:00.0W

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 (%)
65	6	LGR	25.9	39	2525	28.0	9	0.3	0.8	215	13988	76	4920		16	80
21	3	HGR	8.4	25	529	5.9	9	0.4	0.9	134	2806	49	1030		8	77
2	1	CAS	0.8	19	38	0.4	6	0.5	1.1	83	165	41	83		40	88
28	3	RUN	11.2	28	787	8.7	10	0.5	1	309	8650	144	4032		12	87
25	2	SRN	10.0	53	1337	14.8	8	0.6	1.1	400	9990	240	5994		33	99
86	86	MCP	34.3	35	2968	32.9	12	0.7	3.6	386	33175	413	35525	300	23	82
5	5	STP	2.0	44	219	2.4	13	0.7	2.8	496	2478	469	2344	321	37	87
1	1	CRP	0.4	37	37	0.4	7	0.2	1.1	259	259	104	104	52	20	91
1	1	LSL	0.4	19	19	0.2	16	0.1	1.1	258	258	155	155	26	30	85
3	3	LSR	1.2	37	110	1.2	17	0.9	3.2	549	1646	702	2106	537	80	89
4	4	LSBk	1.6	32	129	1.4	12	0.7	2.1	308	1232	297	1190	206	18	91
8	8	PLP	3.2	22	178	2.0	14	0.7	2.8	244	1952	254	2036	167	38	77
2	0	NS	0.8	68	135	1.5										

Total Units
251

Total Units Fully Measured
123

Total Length (ft.)
9011

Total Area (sq.ft.)
76599

Total Volume (cu.ft.)
59518

Table 3 - Summary of Pool Types

Stream Name: Minnie Creek

LLID: 1234334389935

Drainage: Navarro River

Survey Dates: 10/4/2010 to 10/6/2010

Confluence Location: Quad: ZENI RIDGE

Legal Description: T13NR14WS17

Latitude: 38:59:37.0N

Longitude: 123:26:00.0W

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
91	91	MAIN	84	35	3187	87	11.9	0.7	392	35653	302	27437	24
17	17	SCOUR	16	28	473	13	13.5	0.7	315	5348	227	3855	39

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
108	108	3660	41000	31292

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

Stream Name: Minnie Creek

LLID: 1234334389935

Drainage: Navarro River

Survey Dates: 10/4/2010 to 10/6/2010

Confluence Location: Quad: ZENI RIDGE

Legal Description: T13NR14WS17

Latitude: 38:59:37.0N

Longitude: 123:26:00.0W

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
86	MCP	80	8	9	58	67	14	16	6	7	0	0
5	STP	5	0	0	2	40	3	60	0	0	0	0
1	CRP	1	0	0	1	100	0	0	0	0	0	0
1	LSL	1	0	0	1	100	0	0	0	0	0	0
3	LSR	3	0	0	2	67	0	0	1	33	0	0
4	LSBk	4	0	0	3	75	1	25	0	0	0	0
8	PLP	7	0	0	4	50	4	50	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
108	8	7	71	66	22	20	7	6	0	0

Mean Maximum Residual Pool Depth (ft.): 1.7

Table 5 - Summary of Mean Percent Cover By Habitat Type

Stream Name: Minnie Creek

LLID: 1234334389935

Drainage: Navarro River

Survey Dates: 10/4/2010 to 10/6/2010

Dry Units: 0

Confluence Location: Quad: ZENI RIDGE

Legal Description: T13NR14WS17

Latitude: 38:59:37.0N

Longitude: 123:26:00.0W

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
65	6	LGR	0	2	18	0	10	0	0	70	0
21	3	HGR	0	0	0	0	0	0	8	92	0
2	1	CAS	0	15	0	0	0	0	35	50	0
88	10	TOTAL RIFFLE	0	3	9	0	5	0	8	76	0
28	3	RUN	5	32	0	10	35	0	0	18	0
25	2	SRN	30	10	0	5	10	0	0	33	13
53	5	TOTAL FLAT	18	21	0	8	23	0	0	25	6
86	86	MCP	10	18	13	2	6	0	2	44	5
5	5	STP	0	15	11	0	0	0	10	52	12
1	1	CRP	60	25	0	15	0	0	0	0	0
1	1	LSL	0	10	20	0	30	0	0	40	0
3	3	LSR	8	20	55	5	0	0	0	12	0
4	4	LSBk	4	10	5	8	0	0	0	41	33
8	8	PLP	2	11	1	1	0	0	14	69	2
108	108	TOTAL POOL	9	17	13	2	5	0	3	44	6
2	0	NS									
251	123	TOTAL	9	17	12	2	6	0	3	46	6

Table 6 - Summary of Dominant Substrates By Habitat Type

Stream Name: Minnie Creek

LLID: 1234334389935

Drainage: Navarro River

Survey Dates: 10/4/2010 to 10/6/2010

Dry Units: 0

Confluence Location: Quad: ZENI RIDGE

Legal Description: T13NR14WS17

Latitude: 38:59:37.0N

Longitude: 123:26:00.0W

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
65	6	LGR	0	0	33	33	17	17	0
21	3	HGR	0	0	0	33	67	0	0
2	1	CAS	0	0	0	0	0	100	0
28	3	RUN	0	0	33	33	33	0	0
25	2	SRN	0	0	50	50	0	0	0
86	86	MCP	0	0	78	3	10	3	5
5	5	STP	0	0	80	0	0	20	0
1	1	CRP	0	0	100	0	0	0	0
1	1	LSL	0	0	100	0	0	0	0
3	3	LSR	0	0	100	0	0	0	0
4	4	LSBk	0	0	75	0	25	0	0
8	8	PLP	0	0	63	13	0	25	0

Table 7 - Summary of Mean Percent Canopy for Entire Stream

Stream Name: Minnie Creek

LLID: 1234334389935

Drainage: Navarro River

Survey Dates: 10/4/2010 to 10/6/2010

Confluence Location: Quad: ZENI RIDGE

Legal Description: T13NR14WS17

Latitude: 38:59:37.0N

Longitude: 123:26:00.0W

Mean Percent Canopy	Mean Percent Conifer	Mean Percent Hardwood	Mean Percent Open Units	Mean Right Bank % Cover	Mean Left Bank % Cover
82	55	45	0	79	81

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: Minnie Creek

LLID: 1234334389935

Drainage: Navarro River

Survey Dates: 10/4/2010 to 10/6/2010

Survey Length (ft.): 9011

Main Channel (ft.): 8902

Side Channel (ft.): 109

Confluence Location: Quad: ZENI RIDGE

Legal Description: T13NR14WS17 Latitude: 38:59:37.0N

Longitude: 123:26:00.0W

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

Channel Type: G4

Canopy Density (%): 82.3

Pools by Stream Length (%): 40.6

Reach Length (ft.): 8902

Coniferous Component (%): 55.3

Pool Frequency (%): 43.0

Riffle/Flatwater Mean Width (ft.): 8.8

Hardwood Component (%): 44.7

Residual Pool Depth (%):

BFW:

Dominant Bank Vegetation: Coniferous Trees

< 2 Feet Deep: 73

Range (ft.): 15 to 48

Vegetative Cover (%): 80.1

2 to 2.9 Feet Deep: 20

Mean (ft.): 25

Dominant Shelter: Boulders

3 to 3.9 Feet Deep: 6

Std. Dev.: 9

Dominant Bank Substrate Type: Cobble/Gravel

>= 4 Feet Deep: 0

Base Flow (cfs.): 0.3

Occurrence of LWD (%): 12

Mean Max Residual Pool Depth (ft.): 1.7

Water (F): 53 - 58 Air (F): 43 - 70

LWD per 100 ft.:

Mean Pool Shelter Rating: 26

Dry Channel (ft): 0

Riffles: 4

Pools: 6

Flat: 3

Pool Tail Substrate (%): Silt/Clay: 0 Sand: 0 Gravel: 60 Sm Cobble: 18 Lg Cobble: 7 Boulder: 14 Bedrock: 1

Embeddedness Values (%): 1. 26.9 2. 38.0 3. 25.0 4. 1.9 5. 8.3

Table 9 - Mean Percentage of Dominant Substrate and Vegetation

Stream Name: Minnie Creek

LLID: 1234334389935

Drainage: Navarro River

Survey Dates: 10/4/2010 to 10/6/2010

Confluence Location: Quad: ZENI RIDGE

Legal Description: T13NR14WS17

Latitude: 38:59:37.0N

Longitude: 123:26:00.0W

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	17	13	12.2
Boulder	30	31	24.8
Cobble / Gravel	63	59	49.6
Sand / Silt / Clay	13	20	13.4

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	1	1	0.8
Brush	1	0	0.4
Hardwood Trees	50	60	44.7
Coniferous Trees	71	62	54.1
No Vegetation	0	0	0.0

Total Stream Cobble Embeddedness Values:

2

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

StreamName: Minnie Creek

LLID: 1234334389935

Drainage: Navarro River

Survey Dates: 10/4/2010 to 10/6/2010

Confluence Location: Quad: ZENI RIDGE

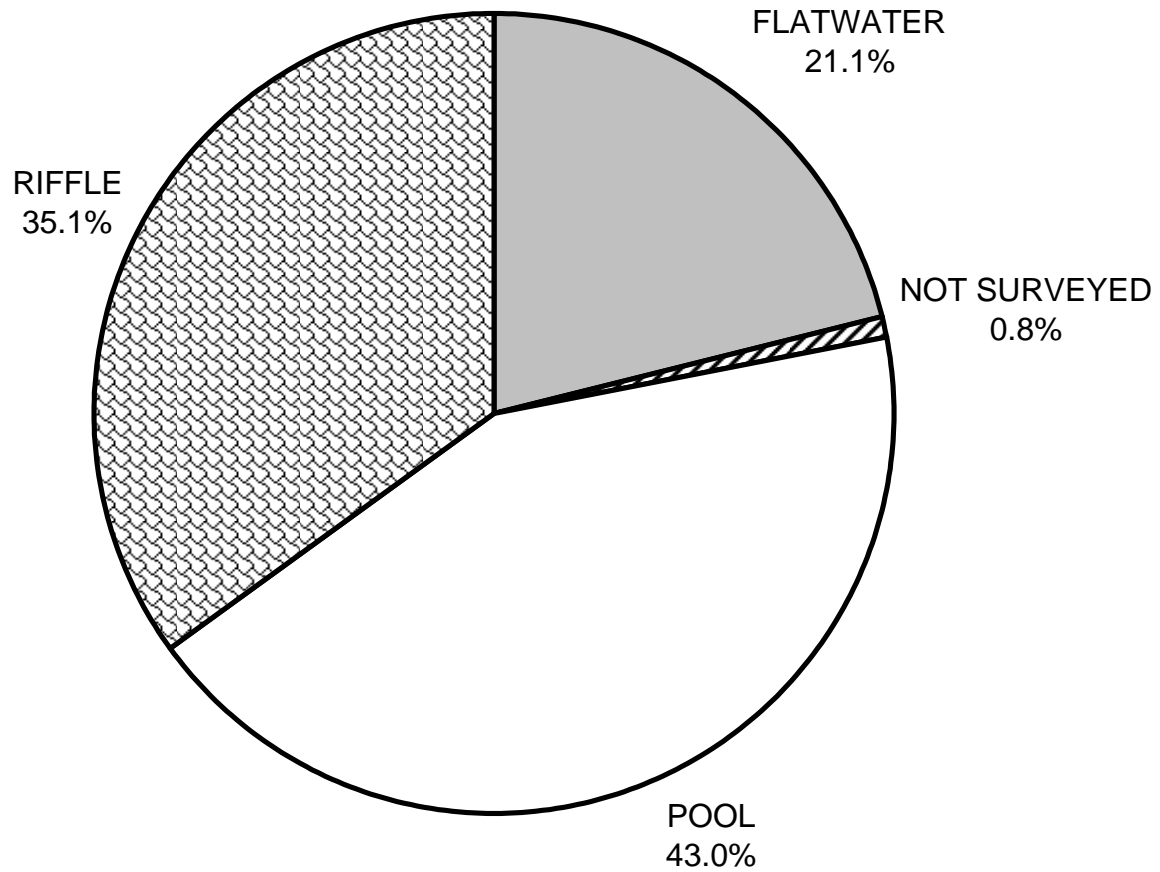
Legal Description: T13NR14WS17

Latitude: 38:59:37.0N

Longitude: 123:26:00.0W

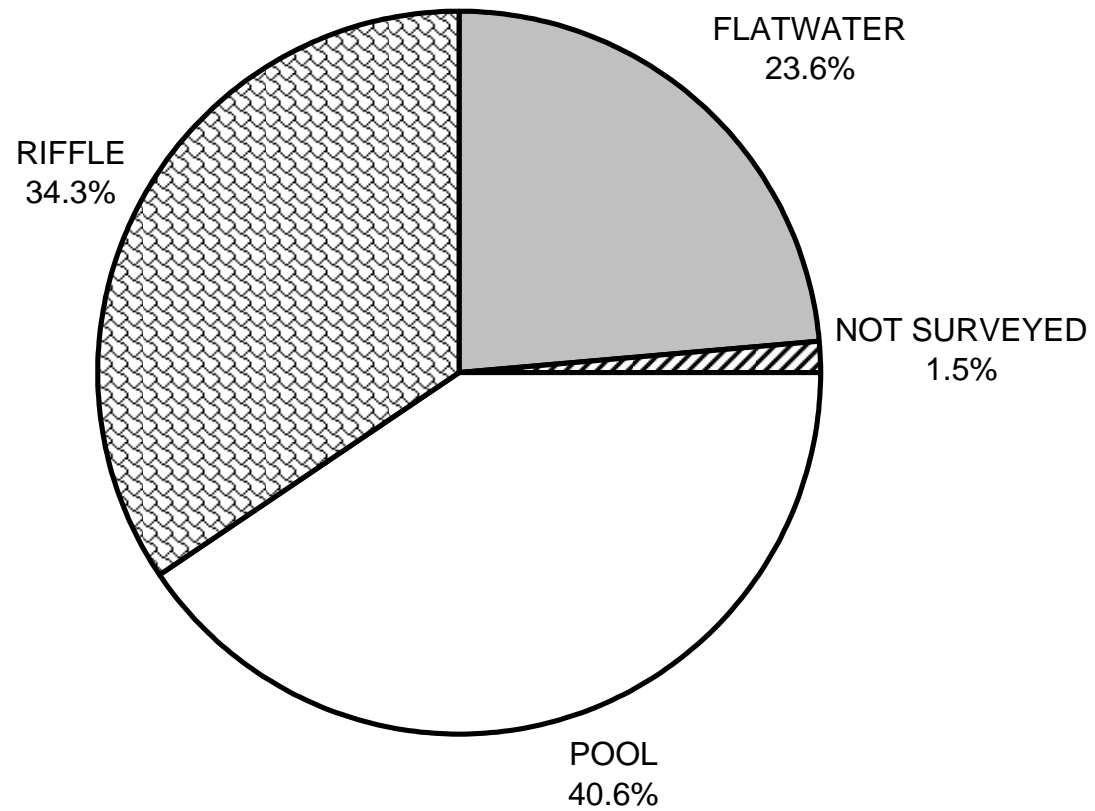
	Riffles	Flatwater	Pools
UNDERCUT BANKS (%)	0	18	9
SMALL WOODY DEBRIS (%)	3	21	17
LARGE WOODY DEBRIS (%)	9	0	13
ROOT MASS (%)	0	8	2
TERRESTRIAL VEGETATION (%)	5	23	5
AQUATIC VEGETATION (%)	0	0	0
WHITEWATER (%)	8	0	3
BOULDERS (%)	76	25	44
BEDROCK LEDGES (%)	0	6	6

MINNIE CREEK 2010 HABITAT TYPES BY PERCENT OCCURRENCE



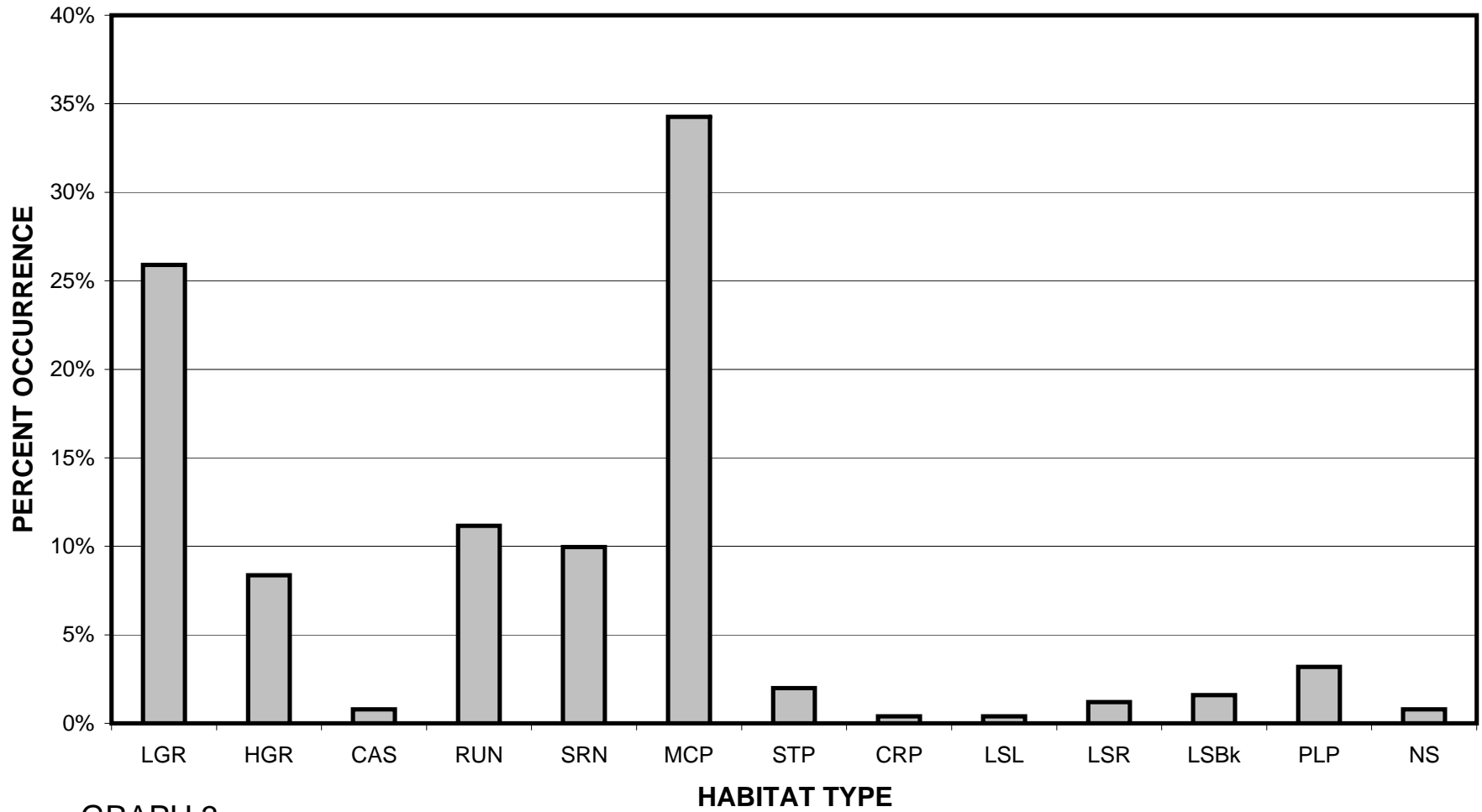
GRAPH 1

MINNIE CREEK 2010 HABITAT TYPES BY PERCENT TOTAL LENGTH



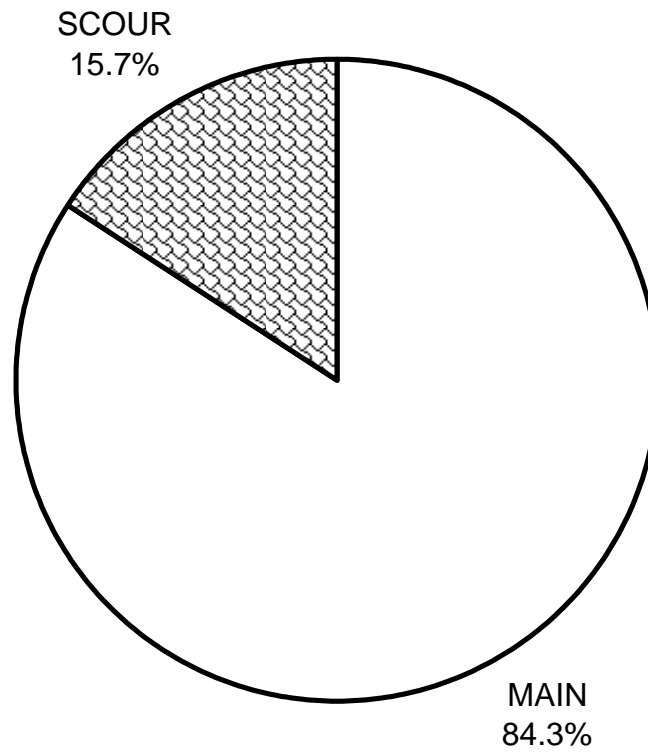
GRAPH 2

MINNIE CREEK 2010 HABITAT TYPES BY PERCENT OCCURRENCE



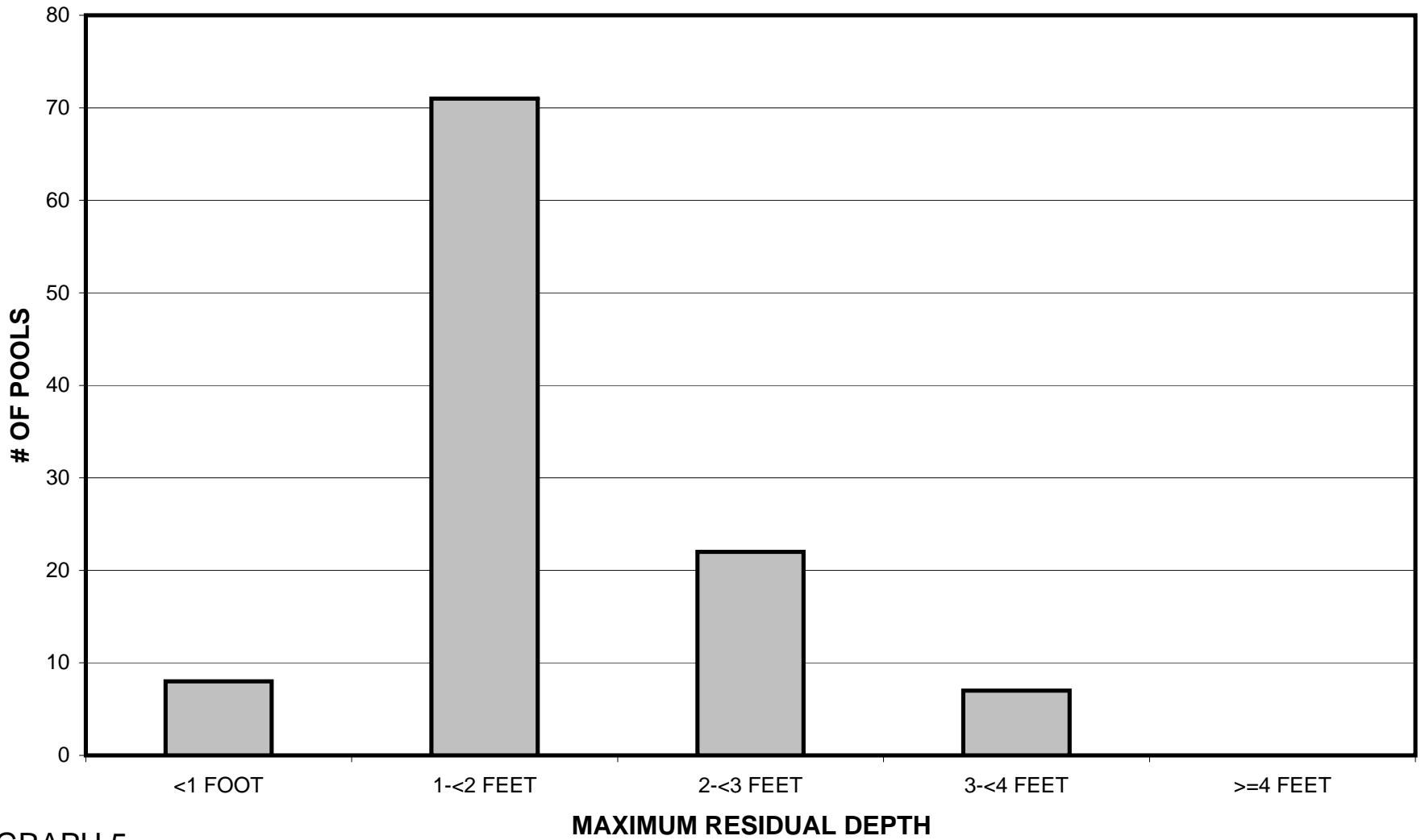
GRAPH 3

**MINNIE CREEK 2010
POOL TYPES BY PERCENT OCCURRENCE**



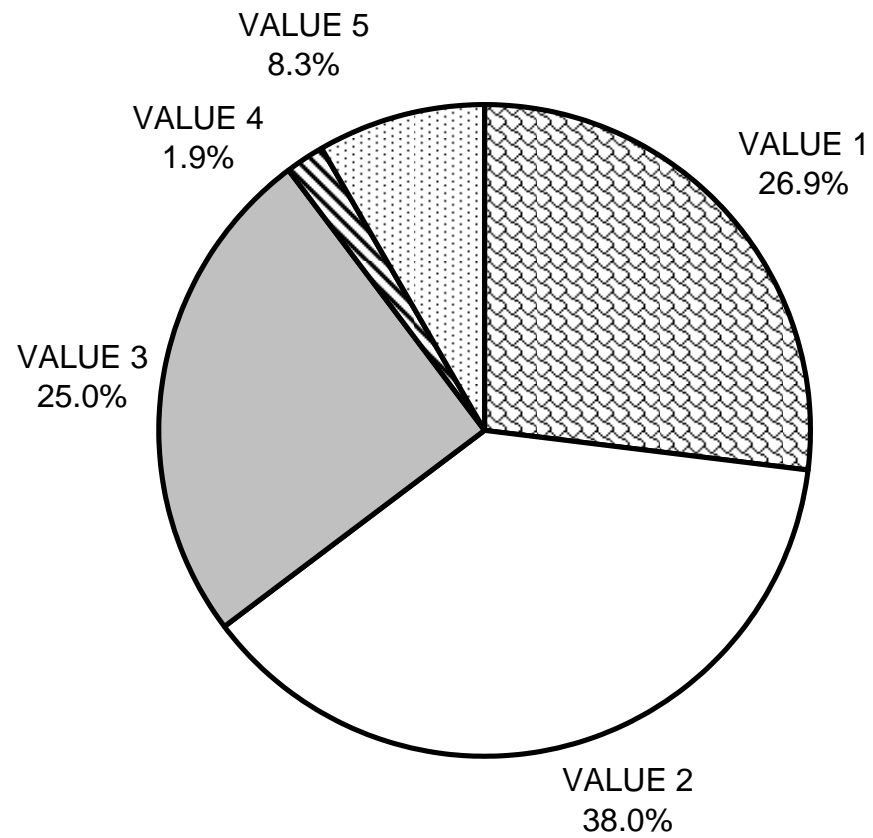
GRAPH 4

MINNIE CREEK 2010 MAXIMUM DEPTH IN POOLS



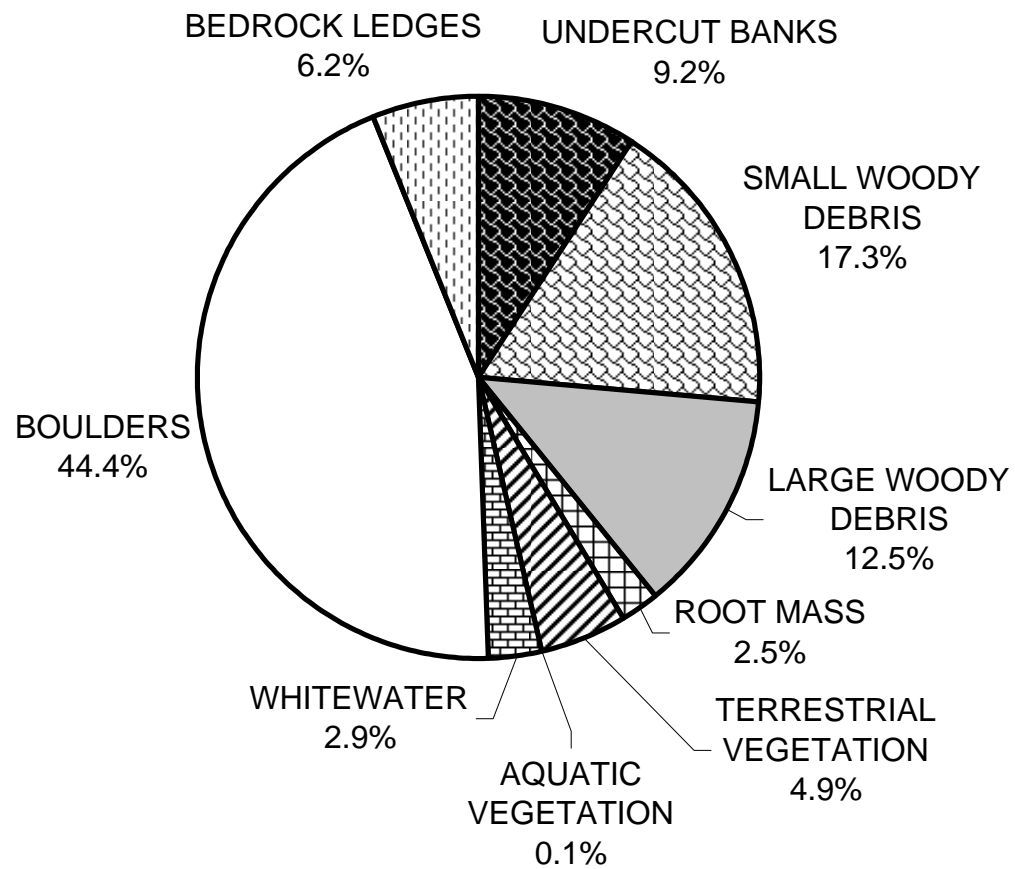
GRAPH 5

MINNIE CREEK 2010 PERCENT EMBEDDEDNESS



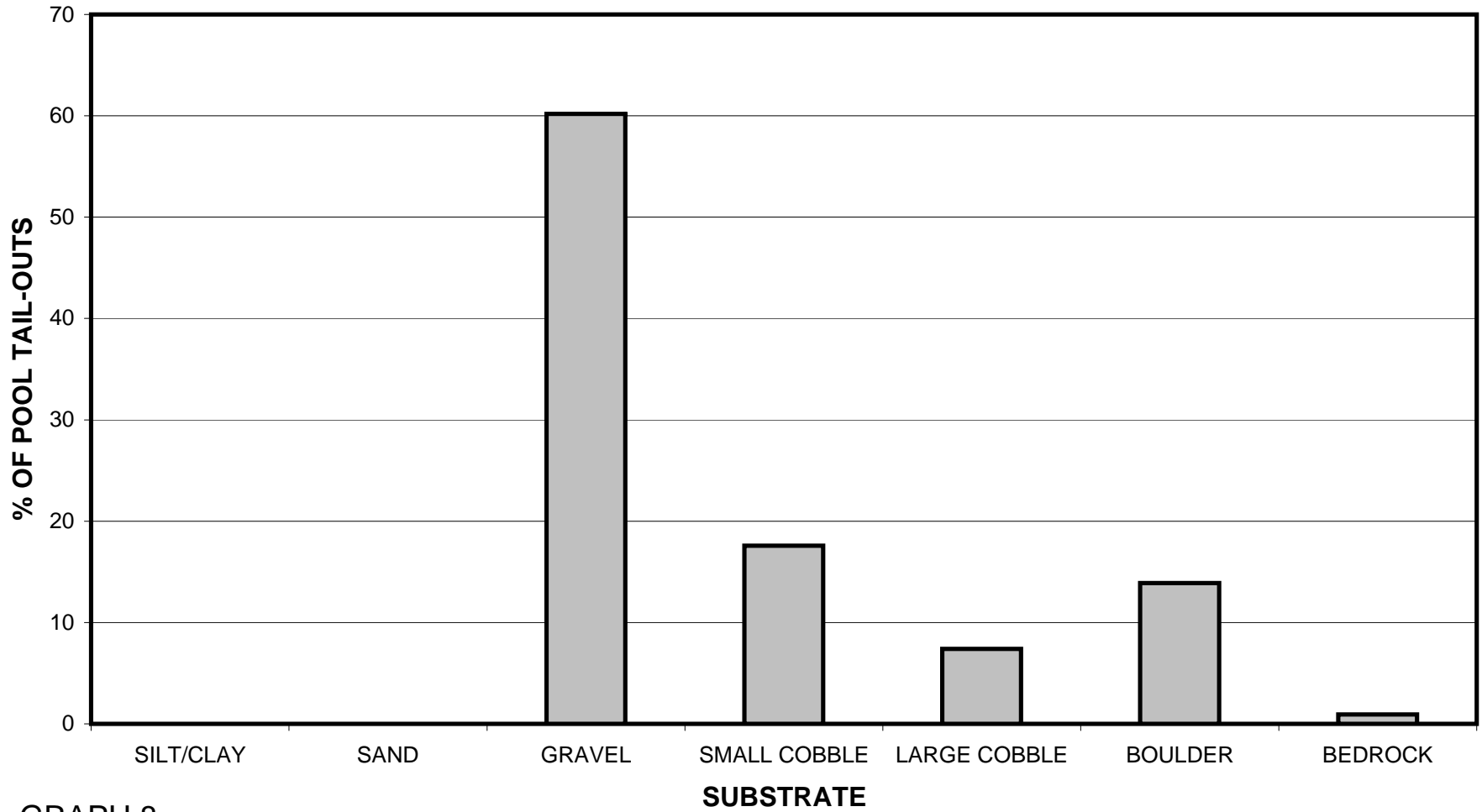
GRAPH 6

MINNIE CREEK 2010 MEAN PERCENT COVER TYPES IN POOLS



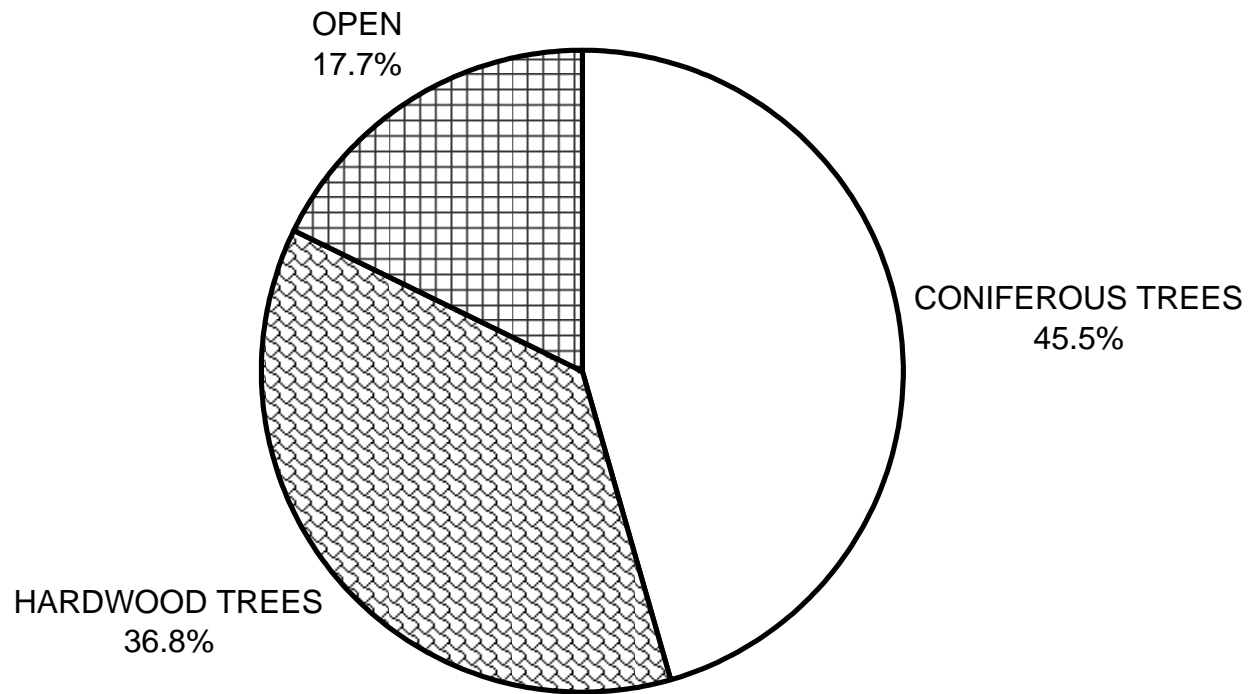
GRAPH 7

MINNIE CREEK 2010 SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



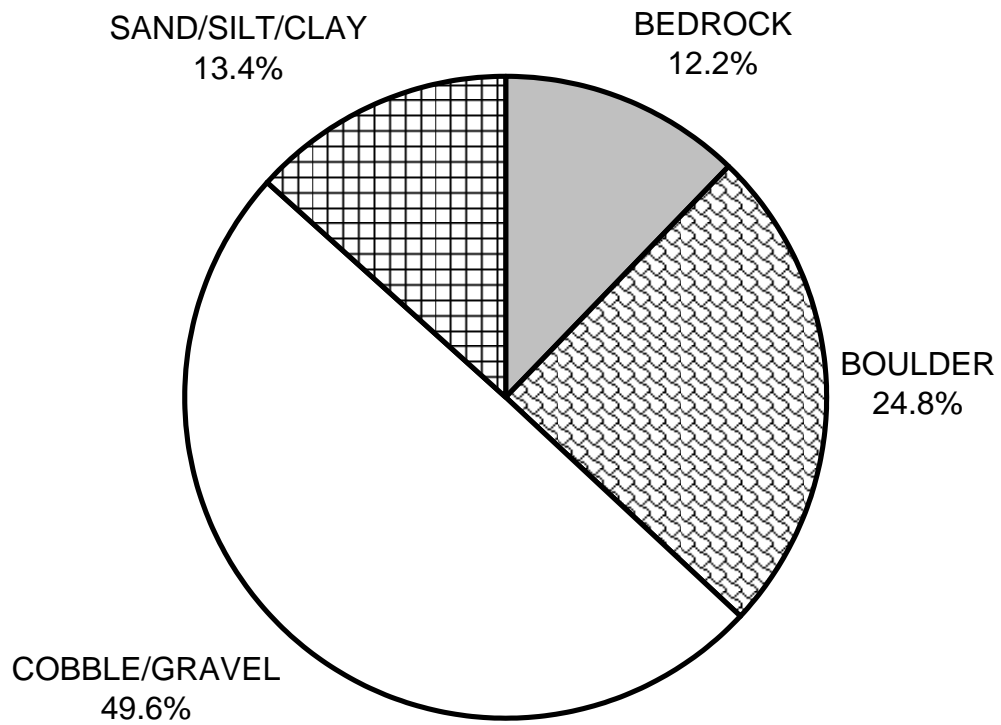
GRAPH 8

MINNIE CREEK 2010 MEAN PERCENT CANOPY



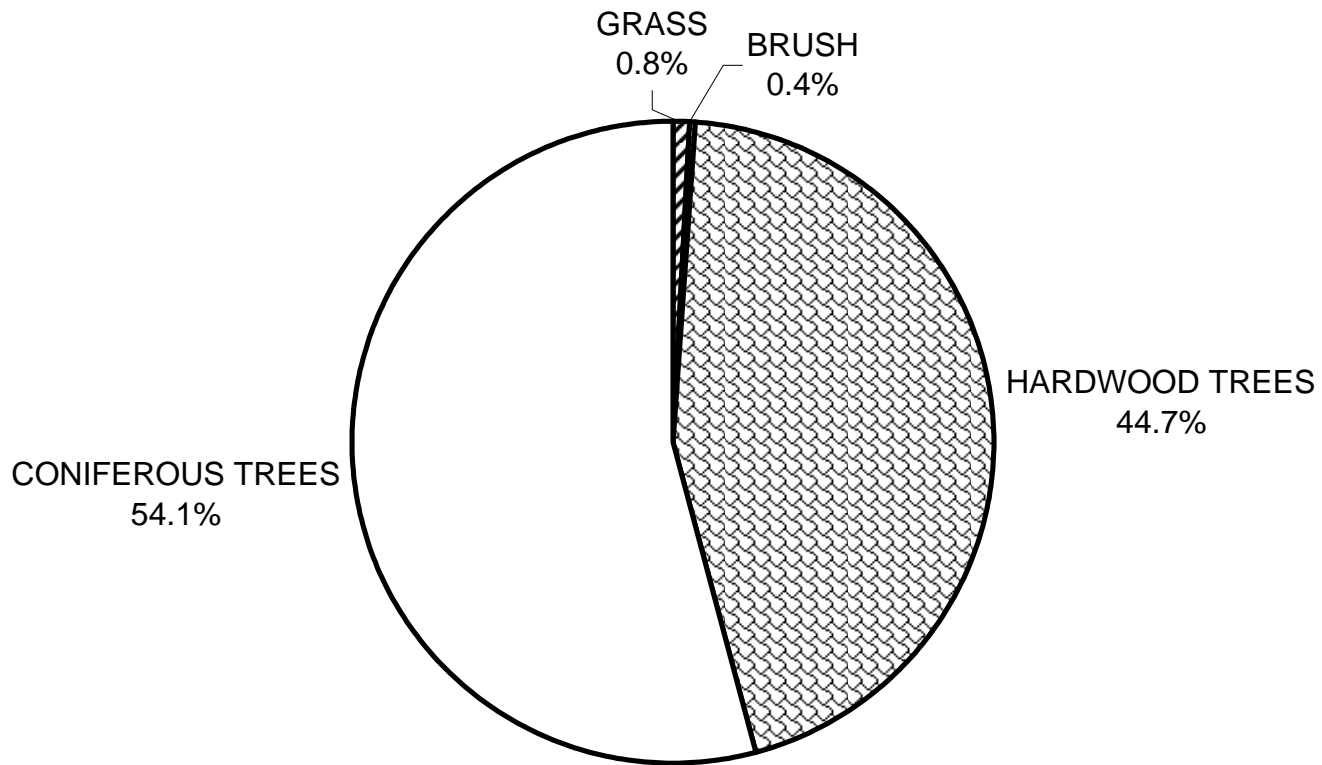
GRAPH 9

MINNIE CREEK 2010 DOMINANT BANK COMPOSITION IN SURVEY REACH



GRAPH 10

MINNIE CREEK 2010 DOMINANT BANK VEGETATION IN SURVEY REACH



GRAPH 11

