CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE

STREAM INVENTORY REPORT

Bunker Gulch

INTRODUCTION

A stream inventory was conducted September 27 to October 10, 2016 on Bunker Gulch. The survey began at the confluence with Hare Creek and extended upstream 1.5 miles.

The Bunker Gulch inventory was conducted in two parts: habitat inventory and biological inventory. The objective of the habitat inventory was to document the habitat available to anadromous salmonids in Bunker Gulch. The objective of the habitat inventory was to document the habitat available to anadromous salmonids in Bunker Gulch.

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

Bunker Gulch is a tributary to Hare Creek which drains to the Pacific Ocean, located in Mendocino County, California (Map 1). Bunker Gulch's legal description at the confluence with Hare Creek is T18N R17W S26. Its location is 39.3879° north latitude and -123.7309° west longitude, LLID number 1237311393877. Bunker Gulch is a first order stream and has approximately 0.38 miles of blue line stream according to the USGS Noyo Hill 7.5 minute quadrangle. Bunker Gulch drains a watershed of approximately one square mile. Elevations range from about 219 feet at the mouth of the creek to 563 feet in the headwater areas. Mixed conifer forest dominates the watershed. The watershed is partly privately owned and partly state forest managed for timber harvest. Vehicle access exists via Highway 20 east from Fort Bragg.

METHODS

The habitat inventory conducted in Bunker Gulch 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 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 Bunker Gulch to record measurements and observations. There are eleven components to the inventory form.

1. Flow:

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

2. Channel Type:

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

3. Temperatures:

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

5. Embeddedness:

The depth of embeddedness of the cobbles in pool tail-out areas is measured by the percent of the cobble that is surrounded or buried by fine sediment. In Bunker Gulch, embeddedness was ocularly estimated. The values were recorded using the following ranges: 0 - 25% (value 1), 26 - 50% (value 2), 51 - 75% (value 3) and 76 - 100% (value 4). Additionally, a value of 5 was assigned to tail-outs deemed unsuitable for spawning due to inappropriate substrate like bedrock, log sills, boulders or other considerations.

6. Shelter Rating:

Instream shelter is composed of those elements within a stream channel that provide juvenile salmonids protection from predation, reduce water velocities so fish can rest and conserve energy, and allow separation of territorial units to reduce density related competition for prey. Using an overhead view, a quantitative estimate of the percentage of the habitat unit covered is made. All cover is then classified according to a list of nine cover types. In Bunker Gulch, a standard qualitative shelter value of 0 (none), 1 (low), 2 (medium), or 3 (high) was assigned according to the complexity of the cover. The shelter rating is then calculated by multiplying the qualitative shelter value by the percent of the unit covered. Thus, shelter ratings can range from 0-300 and are expressed as mean values by habitat types within a stream.

7. Substrate Composition:

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

8. Canopy:

Stream canopy density was estimated using modified handheld spherical densiometers as described in the *California Salmonid Stream Habitat Restoration Manual*. Canopy density relates to the amount of stream shaded from the sun. In Bunker Gulch, an estimate of the percentage of the habitat unit covered by canopy was made from the center of approximately every third unit in addition to every fully-described unit, giving an approximate 30% sub-sample. In addition, the area of canopy was estimated ocularly into percentages of coniferous or hardwood trees.

9. Bank Composition and Vegetation:

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

10. Large Woody Debris Count:

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

11. Average Bankfull Width:

Bankfull width can vary greatly in the course of a channel type stream reach. This is especially true in very long reaches. Bankfull width can be a factor in habitat components like canopy density, water temperature, and pool depths. Frequent measurements taken at riffle crests (velocity crossovers) are needed to accurately describe reach widths. At the first appropriate velocity crossover that occurs after the beginning of a new stream survey page (ten habitat units), 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 Bunker Gulch. In addition, underwater mask and snorkel observations were made at 20 sites using techniques discussed in the *California Salmonid Stream Habitat Restoration Manual*.

DATA ANALYSIS

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

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

Graphics are produced from the tables using Microsoft Excel. Graphics developed for Bunker Gulch include:

- Riffle, Flatwater, Pool Habitat Types by Percent Occurrence
- Riffle, Flatwater, Pool Habitat Types by Total Length
- Total Habitat Types by Percent Occurrence
- Pool Types by Percent Occurrence
- Maximum Residual Depth in Pools
- Percent Embeddedness
- Mean Percent Cover Types in Pools
- Substrate Composition in Pool Tail-outs
- Mean Percent Canopy

- Dominant Bank Composition by Composition Type
- Dominant Bank Vegetation by Vegetation Type

HABITAT INVENTORY RESULTS

* ALL TABLES AND GRAPHS ARE LOCATED IN APPENDIX I *

The habitat inventory of September 27 to October 10, 2016, was conducted by Ryan Bernstein, Nicole Bejar, and Matt Rice (CDFW). The total length of the stream surveyed was 8,161 feet.

Stream flow was not measured during this survey.

Bunker Gulch is a F4 channel type for 8,160 feet of the stream surveyed. F4 channel types are entrenched meandering riffle/pool channels on low gradients with high width/depth ratios, very stable with gravel-dominant substrates.

Water temperatures taken during the survey period ranged from 52° to 57° Fahrenheit. Air temperatures ranged from 54° to 69° Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 34% pool units, 33% flatwater units, 21% riffle units, and 11% dry units (Graph 1). Based on total length of Level II habitat types there were 56% flatwater units, 27% pool units, 10% riffle units, and 7% dry units (Graph 2).

Eight Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were mid-channel pool units, 33%; run units, 20%; low gradient riffle units, 19% (Graph 3). Based on percent total length, step-run units made up 36%, mid-channel pool units 26%, and run units 19%.

A total of 73 pools were identified (Table 3). 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. Twenty-four of the 73 pools (33%) had a residual depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 73 pool tail-outs measured, 23 had a value of 1 (31.5%); 43 had a value of 2 (58.9%); 3 had a value of 3 (4.1%); 4 had a value of 5 (5.5%) (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 0, flatwater habitat types had a mean shelter rating of 4, and pool habitats had a mean shelter rating of 13 (Table 1). Of the pool types, the Scour pools had the highest mean shelter rating of 18, Main channel pools had a mean shelter rating of 12 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Small woody debris is the dominant cover type in Bunker Gulch. Graph 7 describes the pool cover in Bunker Gulch. Small woody debris is 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 most dominant substrate observed in 93% of pool tail-outs, bedrock was the next most frequently observed in 5% of pool tail-outs. The mean percent canopy density for the surveyed length of Bunker Gulch was 98%. Two percent of the canopy was open. Of the canopy present, the mean percentages of hardwood and coniferous trees were 20% and 80%, respectively. Graph 9 describes the mean percent canopy in Bunker Gulch.

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 98% sand/silt/clay, 1% bedrock, 1% boulder, and 1% cobble/gravel (Graph 10).

BIOLOGICAL INVENTORY RESULTS

Survey teams conducted a snorkel survey 20 sites for species composition and distribution in Bunker Gulch on October 25, 2016 (Table A). This snorkel survey was conducted after several significant precipitation events that occurred in mid-October. Water temperatures taken during the survey period of 1040 to 1130 was 52° Fahrenheit. Air temperatures were not taken. The sites were sampled by Brian Starks and Ryan Bernstein (CDFW), and Rachel Karlov (WSP).

The survey yielded 12 young-of-the-year (YOY) steelhead trout (SH), 3 age 1+ SH, and 9 coho salmon.

During the survey, the upstream-most observation of coho salmon occurred at 39.3878° north latitude, -123.4316° west longitude, approximately 178 feet upstream from the confluence with Albion River. The upstream-most observation of steelhead trout occurred at 39.3883° north latitude, -123.7314° west longitude, approximately 2,342 feet upstream from the confluence with Albion River.

Table A. Summary of results for a fish composition and distribution survey within Bunker Gulch, October, 2016.

Date	Survey Site #	Habitat Unit #	Habitat Type	Approx. Dist. from mouth (ft.)	Steelhead Trout			Coho Salmon		Additional Aquatic Species Observed
					YOY	1+	2+	YOY	1+	
F4 Channel Type										
10/25/16	1	001	Run	0	2	0	0	1	0	
	2	006	Pool	178	0	0	0	8	0	
	3	008	Pool	204	0	0	0	0	0	
	4	009	Pool	236	5	0	0	0	0	
	5	010	Pool	322	0	1	0	0	0	
	6	014	Pool	440	0	0	0	0	0	

Date	Survey Site #	Habitat Unit #	Habitat Type	Approx. Dist. from mouth (ft.)	Steelhead Trout			Coho Salmon		Additional Aquatic Species Observed
					YOY	1+	2+	YOY	1+	
	7	018	Pool	572	1	0	0	0	0	
	8	021	Run	627	0	0	0	0	0	
	9	024	Pool	789	0	1	0	0	0	
	10	027	Pool	966	1	0	0	0	0	
	11	036	Pool	1,172	0	0	0	0	0	
	12	039	Run	1,316	2	0	0	0	0	
	13	041	Pool	1,440	0	0	0	0	0	
	14	045	Pool	1,490	0	0	0	0	0	
	15	054	Pool	1,622	0	0	0	0	0	
	16	060	Pool	1,846	0	0	0	0	0	
	17	064	Step Run	2,009	0	0	0	0	0	
	18	065	Scour Pool	2,140	0	0	0	0	0	
	19	072	Pool	2,342	1	1	0	0	0	
	20	001	Run	2,508	0	0	0	0	0	

DISCUSSION

Bunker Gulch is an F4 channel type for the entire 8,161 feet of the stream surveyed. The suitability of F4 channel types for fish habitat improvement structures is as follows: F4 channel types are good for bank-placed boulders and fair for plunge weirs, single and opposing wing-deflectors, channel constrictors, and log cover.

The water temperatures recorded on the survey days September 27 to October 10, 2016, ranged from 52° to 57° Fahrenheit. Air temperatures ranged from 54° to 69° 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 56% of the total length of this survey, riffles 10%, and pools 27%. Twenty-four of the 73 (33%) 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.

Sixty-six of the 73 pool tail-outs measured had embeddedness ratings of 1 or 2. Three of the pool tail-outs had embeddedness ratings of 3 or 4. Four of the pool tail-outs had a rating of 5, which is considered unsuitable for spawning. Cobble embeddedness measured to be 25% or less,

a rating of 1, is considered to indicate good quality spawning substrate for salmon and steelhead.

Sixty-nine of the 73 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 13. The shelter rating in the flatwater habitats is 4. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by small woody debris in Bunker Gulch. Small woody debris is 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 98%. The percentage of right and left bank covered with vegetation was 100%and 100%, respectively.

RECOMMENDATIONS

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

1) Increase woody cover in the pools and flatwater habitat units. Most of the existing cover in the pools is from small woody debris. Adding high quality complexity with woody cover in the pools is desirable.

2) The culverts located at 1,884' and 2,536' are in poor condition and should be treated to prevent failure. The culvert at 8,087' is an ongoing potential passage problem. A fish passage assessment should be conducted at all culverts sites. If the assessments find the culverts to be barriers to fish passage they should be replaced with structures that provide unimpeded fish passage or decommissioned. Good water temperature and flow regimes exist in the stream and it offers good conditions for rearing fish.

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 Hare Creek
75	0002.00	Bridge #1 is the crossing for Road 400, and is 10' high x 18' wide x 30' long. It is an automobile bridge (made of wood and concrete) and is not a barrier to salmonids.
95	0003.00	The creek is out of the influence of the confluence with Hare Creek.
191	0007.00	Bedrock sheet makes up substrate of the unit.
236	0009.00	A 1+ salmonid is present.
514	0016.00	Rip rap along right bank of pool.
789	0024.00	Log debris accumulation (LDA) #1 contains 3 pieces of large woody debris (LWD) and measures 6' high x 10' wide x 8' long. Water does not flow through the LDA and there are no visible gaps in it. Retained sediment is all gravel and measures 7' wide x 8' long x 2' deep. Fish were observed above the LDA. LDA may provide a barrier to juvenile salmon, but adults can get through at high flow. Dry area above the LDA.
938	0026.00	Fish observed.
1884	0056.00	Culvert #1 is under Road 400, and is 6.7' high x 6.5' wide x 63' long. It is a corrugated metal pipe (CMP). The culvert's diameter is 6.5', its plunge height is 0', and it has a maximum depth of 0' within 5' of the outlet as it is dry. The slope is estimated 1%, and its condition is poor with rusted sides towards bottom. It is not a possible barrier to juvenile and adult salmonids.
2140	0064.00	Left bank small drainage culvert is 1' wide x 1' long.
2536	0073.00	Culvert #2 is under Road 400, and is 7' high x 7' wide x 6.0' long. It is made of CMP. The culvert's diameter is 7', its plunge height is 0', and it has a maximum depth of 0.4' within 5' of the outlet. The slope is estimated 1%, and its condition is poor. It is not a possible barrier to juvenile and adult salmonids. There is a tree growing out of the culvert

		and the culvert is rusted and has a torn bottom that breaks with every step taken while walking through.
3034	0089.00	Right bank small drainage culvert from road is 1' wide x 1' long and made of plastic.
3226	0093.00	A dry tributary is on the left bank.
3451	0098.00	LDA #2 is 3' high x 16' wide x 6' long and contains 3 pieces of LWD. Water does not flow through the LDA and there are no visible gaps in it. Sediment is being retained in the approximate dimensions of 23' wide x 18' long x 2.5' deep. The sediment is all gravel. The LDA is not a possible barrier to salmonids. Fish were observed above the LDA. There is dry area above the LDA. A lot of sediment is held up behind the LDA. There is a 2.5' plunge into a 3.1' pool over a LWD.
3718	0107.00	Rip Rap on right bank.
3873	0111.00	Right bank small road drainage culvert is 1' wide x 1' long.
6022	0161.00	LDA #4 is 6' high x 5.5' wide x 18' long and contains 6 pieces of LWD. Water does not flow through the LDA and there are visible gaps in it. Sediment is being retained in the approximate dimensions of 10' wide x 4' long x 1' deep. The sediment is all gravel. The LDA is a possible barrier to juvenile salmonids, but at high flows adults can pass through. Fish were observed above the LDA
6482	0177.00	Old timber structures across the creek.
6845	0187.00	Old timber structure across bridge/wood.
7055	0190.00	Fish observed. Start of no access (landowner permission denied).
7233	0191.00	Restart survey.
7286	0192.00	There is a 1' plunge over wood into 1.9' deep waters.
7540	0194.00	Deep water goes under root mass that is in channel.
7551	0195.00	Some sediment is held up above the pool.
7859	0202.00	Large boulders present and right bank is full of small wood.
8025	0205.00	Small woody debris accumulation (SWD).

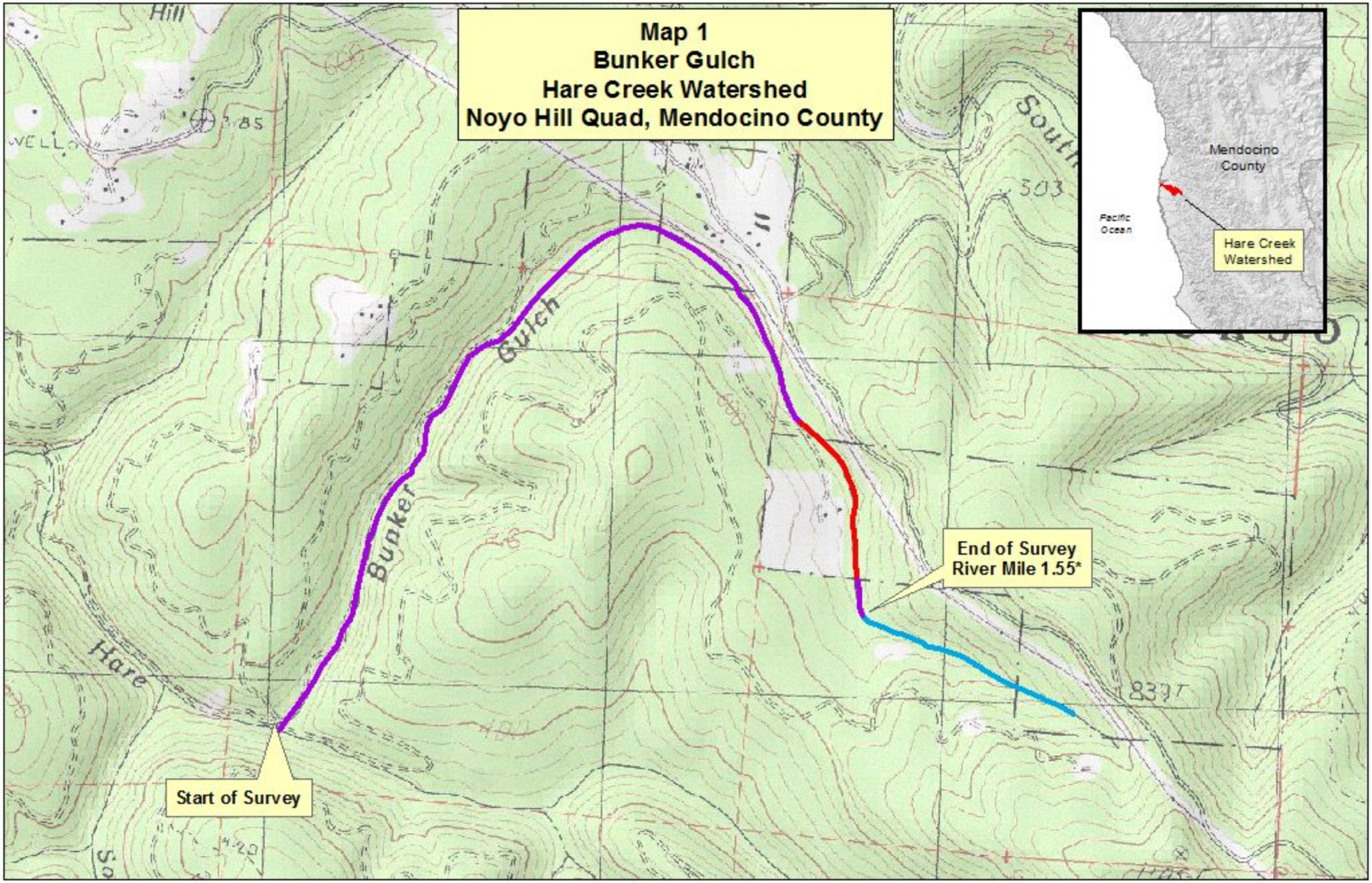
8087	0207.00	Culvert #3 is an unnamed road, and is 3' high x 6' wide x 20' long. It is a CMP. The culvert's diameter is 6', its plunge height is 5', and it has a maximum depth of 0.5' within 5' of the outlet. The slope is estimated 1%, and its condition is good. It is a possible barrier to juvenile and adult salmonids due to the 5' plunge. Above the unit is un-surveyable.
8103	0208.00	Unit is unable to be surveyed due to tough terrain as stream channel is deeply entrenched with high, steep banks (creek >5 feet below the banks with lots of debris). Length is unknown.
8114	0210.00	There is a 5' plunge over wood into 3.4' of water, possible fish barrier due to plunge pool.
8147	0212.00	End of survey due to unsafe conditions (landowners firing guns). No visual observations beyond end of survey due to end of survey circumstances.

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
Bunker Gulch
Hare Creek Watershed
Noyo Hill Quad, Mendocino County
Mendocino County
Pacific Ocean
Hare Creek Watershed
Bunker Gulch
Hare
End of Survey
River Mile 1.55*
Start of Survey
N
W
E
S
Reach 1: F4 Channel Type
Bunker Gulch
Unsurveyed: Private Property
0 0.075 0.15 0.3
Miles
0 0.175 0.35 0.7
Kilometers
CALIFORNIA
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*River Mile indicates distance from confluence with Hare Creek

APPENDIX I

TABLES AND GRAPHS

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

Stream Name: Bunker Gulch LLID: 1237311393877 Drainage: Noyo River

Survey Dates: 9/27/2016 to 10/10/2016

Confluence Location: Quad: NOYO HILL Legal Description: T18NR17WS26 Latitude: 39:23:16.0N Longitude: 123:43:52.0

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
24	0	DRY	11.3	26	612	7.5									
70	10	FLATWATER	33.0	65	4531.7	55.5	6.0	0.3	0.7	282	19766	78	5483		4
1	0	NOSURVEY	0.5	0	0.1	0.0									
73	73	POOL	34.4	30	2187.6	26.8	9.1	0.8	1.8	270	19690	260	18962	235	13
44	6	RIFFLE	20.8	19	829.1	10.2	3.0	0.1	0.3	40	1766	6	247		0

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
212	89	8160.5	41222	24692

Table 2 - Summary of Habitat Types and Measured Parameters

Stream Name: Bunker Gulch LLID: 1237311393877 Drainage: Noyo River

Survey Dates: 9/27/2016 to 10/10/2016

Confluence Location: Quad: NOYO HILL Legal Description: T18NR17WS26 Latitude: 39:23:16.0N Longitude: 123:43:52.0W

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 (%)
41	5	LGR	19.3	19	764	9.4	3	0.1	0.5	46	1868	6	254		0	99
3	1	BRS	1.4	22	65	0.8	1	0.2	0.4	13	39	3	8		0	98
43	5	RUN	20.3	37	1575	19.3	7	0.3	0.9	165	7078	54	2334		5	96
27	5	SRN	12.7	110	2957	36.2	5	0.3	1	400	10804	102	2764		2	99
69	69	MCP	32.5	30	2103	25.8	9	0.8	4	276	19046	263	18123	237	12	98
1	1	LSR	0.5	34	34	0.4	6	0.6	1.4	187	187	131	131	112	20	96
3	3	PLP	1.4	17	51	0.6	9	1.5	3.7	152	457	236	708	221	17	91
24	0	DRY	11.3	26	612	7.5										
1	0	NS	0.5	0	0	0.0										

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
212	89	8160.5	39479	24322

Table 3 - Summary of Pool Types

Stream Name: Bunker Gulch LLID: 1237311393877 Drainage: Noyo River

Survey Dates: 9/27/2016 to 10/10/2016

Confluence Location: Quad: NOYO HILL Legal Description: T18NR17WS26 Latitude: 39:23:16.0N Longitude: 123:43:52.0W

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
69	69	MAIN	95	30	2103	96	9.1	0.8	276	19046	237	16353	12
4	4	SCOUR	5	21	85	4	7.9	1.3	161	644	194	775	18

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
73	73	2187.6	19690	17128

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

Stream Name: Bunker Gulch LLID: 1237311393877 Drainage: Noyo River

Survey Dates: 9/27/2016 to 10/10/2016

Confluence Location: Quad: NOYO HILL Legal Description: T18NR17WS26 Latitude: 39:23:16.0N Longitude: 123:43:52.0W

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
69	MCP	95	4	6	43	62	18	26	3	4	1	1
1	LSR	1	0	0	1	100	0	0	0	0	0	0
3	PLP	4	0	0	1	33	0	0	2	67	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
73	4	5	45	62	18	25	5	7	1	1

Mean Maximum Residual Pool Depth (ft.): 1.8

Table 5 - Summary of Mean Percent Cover by Habitat Type

Stream Name: Bunker Gulch | LLID: 1237311393877 | Drainage: Noyo River

Survey Dates: 9/27/2016 to 10/10/2016 | Dry Units: 24

Confluence Location: | Quad: NOYO HILL | Legal Description: T18NR17WS26 | Latitude: 39:23:16.0N | Longitude: 123:43:52.0W

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
41	5	LGR	0	0	0	0	0	0	0	0	0
3	1	BRS	0	0	0	0	0	0	0	0	0
44	6	**TOTAL RIFFLE**	0	0	0	0	0	0	0	0	0
43	5	RUN	0	5	95	0	0	0	0	0	0
27	5	SRN	0	20	80	0	0	0	0	0	0
70	10	**TOTAL FLAT**	0	10	90	0	0	0	0	0	0
69	69	MCP	22	41	30	7	0	0	0	0	0
1	1	LSR	0	0	0	100	0	0	0	0	0
3	3	PLP	0	0	100	0	0	0	0	0	0
73	73	**TOTAL POOL**	21	39	32	8	0	0	0	0	0
1	0	NS	0	0	0	0	0	0	0	0	0
212	89	**TOTAL**	20	36	36	8	0	0	0	0	0

Table 6 - Summary of Dominant Substrates By Habitat Type

Stream Name: Bunker Gulch LLID: 1237311393877 Drainage: Noyo River

Survey Dates: 9/27/2016 to 10/10/2016 Dry Units: 24

Confluence Location: Quad: NOYO HILL Legal Description: T18NR17WS26 Latitude: 39:23:16.0N Longitude: 123:43:52.0W

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
41	5	LGR	0	0	100	0	0	0	0
3	1	BRS	0	0	0	0	0	0	100
43	5	RUN	20	0	60	0	0	0	20
27	5	SRN	0	0	80	0	0	0	20
69	69	MCP	14	0	80	1	0	0	4
1	1	LSR	0	0	100	0	0	0	0
3	2	PLP	0	0	100	0	0	0	0

Table 7 - Summary of Mean Percent Canopy for Entire Stream

Stream Name: Bunker Gulch LLID: 1237311393877 Drainage: Noyo River

Survey Dates: 9/27/2016 to 10/10/2016

Confluence Location: Quad: NOYO HILL Legal Description: T18NR17WS26 Latitude: 39:23:16.0N Longitude: 123:43:52.0W

Mean Percent Canopy	Mean Percent Conifer	Mean Percent Hardwood	Mean Percent Open Units	Mean Right Bank % Cover	Mean Left Bank % Cover
98	80	20	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: Bunker Gulch LLID: 1237311393877 Drainage: Noyo River

Survey Dates: 9/27/2016 to 10/10/2016 Survey Length (ft.): 8160.5 Main Channel (ft.): 8160.5 Side Channel (ft.): 0

Confluence Location: Quad: NOYO HILL Legal Description: T18NR17WS26 Latitude: 39:23:16.0N Longitude: 123:43:52.0W

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 1

Channel Type: F4
Reach Length (ft.): 8160.5
Riffle/Flatwater Mean Width (ft.): 4.9
BFW:
Range (ft.): 6 to 13
Mean (ft.): 10
Std. Dev.: 2
Base Flow (cfs.): 0.0
Water (F): 52 - 57 Air (F): 54 - 69
Dry Channel (ft): 612

Canopy Density (%): 97.7
Coniferous Component (%): 80.3
Hardwood Component (%): 19.7
Dominant Bank Vegetation: Coniferous Trees
Vegetative Cover (%): 100.0
Dominant Shelter: Small Woody Debris
Dominant Bank Substrate Type: Sand/Silt/Clay
Occurrence of LWD (%): 20
LWD per 100 ft.:
Riffles: 0
Pools: 4
Flat: 1

Pools by Stream Length (%): 26.8
Pool Frequency (%): 34.4
Residual Pool Depth (%):
< 2 Feet Deep: 67
2 to 2.9 Feet Deep: 25
3 to 3.9 Feet Deep: 7
>= 4 Feet Deep: 1
Mean Max Residual Pool Depth (ft.): 1.8
Mean Pool Shelter Rating: 13

Pool Tail Substrate (%): Silt/Clay: 0 Sand: 0 Gravel: 93 Sm Cobble: 1 Lg Cobble: 0 Boulder: 0 Bedrock: 5

Embeddedness Values (%): 1. 31.5 2. 58.9 3. 4.1 4. 0.0 5. 5.5

Table 9 - Mean Percentage of Dominant Substrate and Vegetation

Stream Name: Bunker Gulch LLID: 1237311393877 Drainage: Noyo River

Survey Dates: 9/27/2016 to 10/10/2016

Confluence Location: Quad: NOYO HILL Legal Description: T18NR17WS26 Latitude: 39:23:16.0N Longitude: 123:43:52.0W

Mean Percentage of Dominant Stream Bank Substrate

Dominant Class of Substrate	Number of Units Right Bank	Number of Units Left Bank	Total Mean Percent (%)
Bedrock	0	1	0.6
Boulder	1	1	1.1
Cobble / Gravel	0	1	0.6
Sand / Silt / Clay	88	86	97.8

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	18	1	10.7
Hardwood Trees	8	24	18.0
Coniferous Trees	63	64	71.3
No Vegetation	0	0	0.0

Total Stream Cobble Embeddedness Values: 2

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

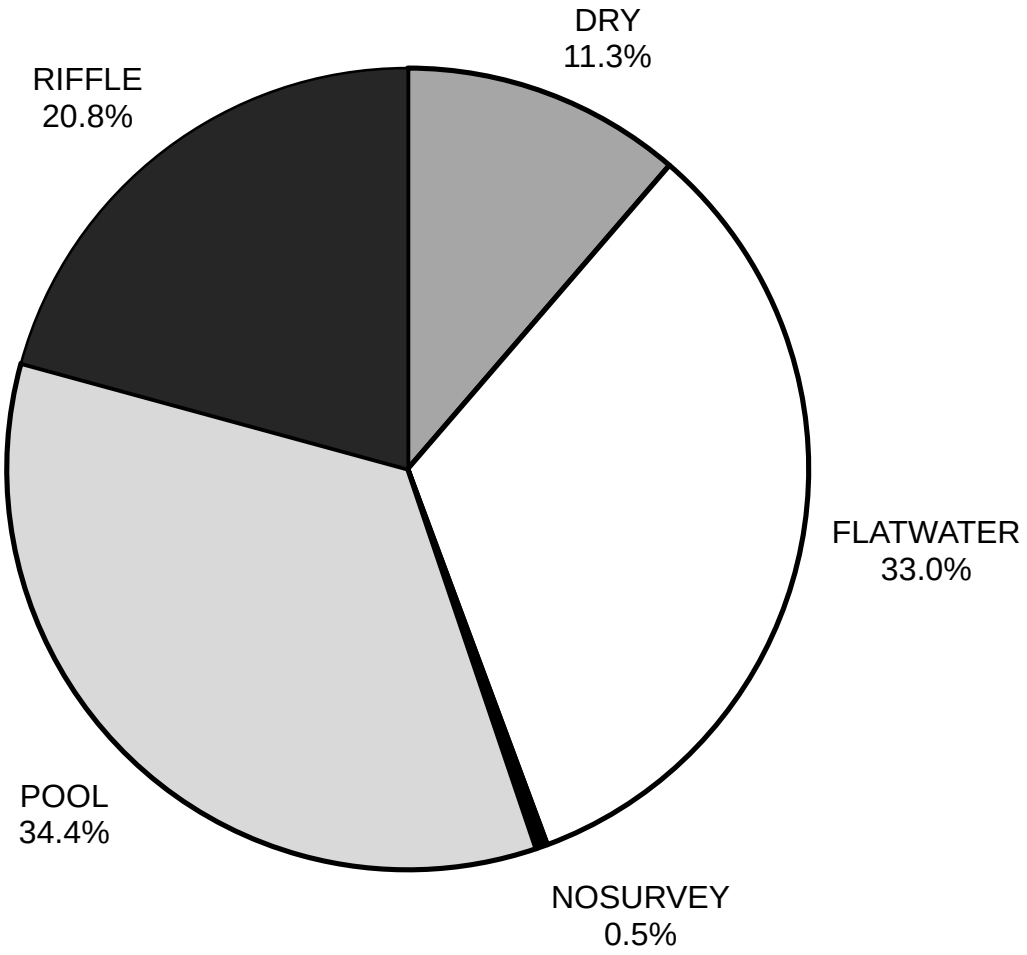
Stream Name: Bunker Gulch | LLID: 1237311393877 | Drainage: Noyo River

Survey Dates: 9/27/2016 to 10/10/2016

Confluence Location: | Quad: NOYO HILL | Legal Description: T18NR17WS26 | Latitude: 39:23:16.0N | Longitude: 123:43:52.0W

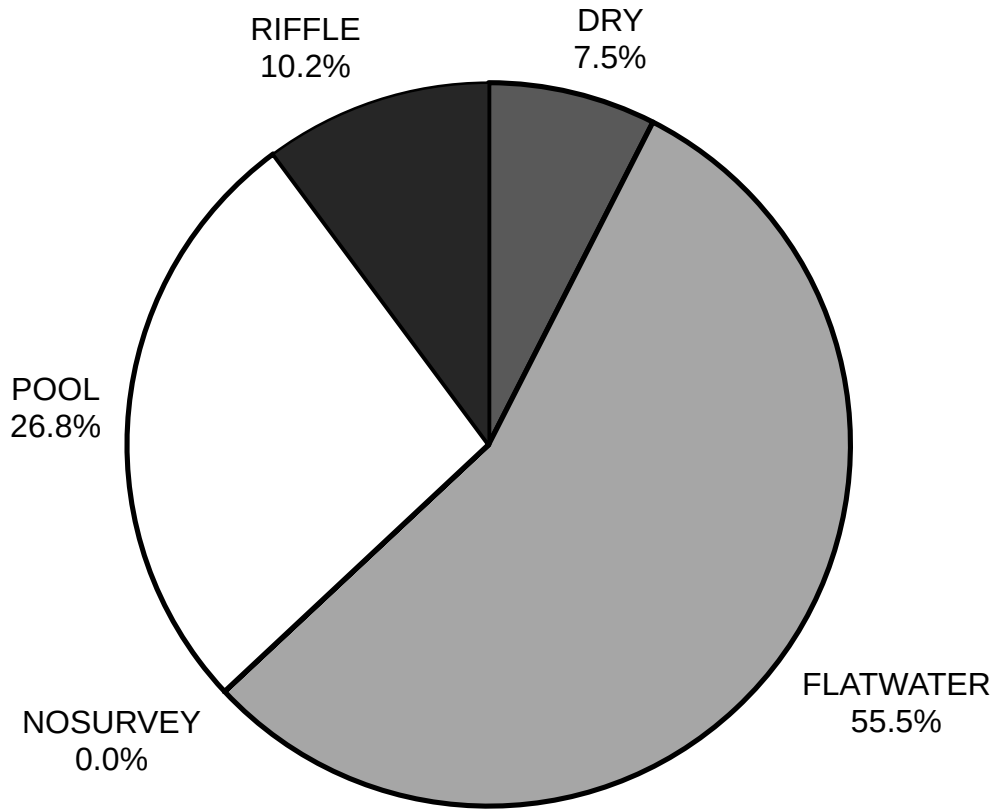
	Riffles	Flatwater	Pools
UNDERCUT BANKS (%)	0	0	21
SMALL WOODY DEBRIS (%)	0	10	39
LARGE WOODY DEBRIS (%)	0	90	32
ROOT MASS (%)	0	0	8
TERRESTRIAL VEGETATION (%)	0	0	0
AQUATIC VEGETATION (%)	0	0	0
WHITEWATER (%)	0	0	0
BOULDERS (%)	0	0	0
BEDROCK LEDGES (%)	0	0	0

BUNKER GULCH 2016
HABITAT TYPES BY PERCENT OCCURRENCE



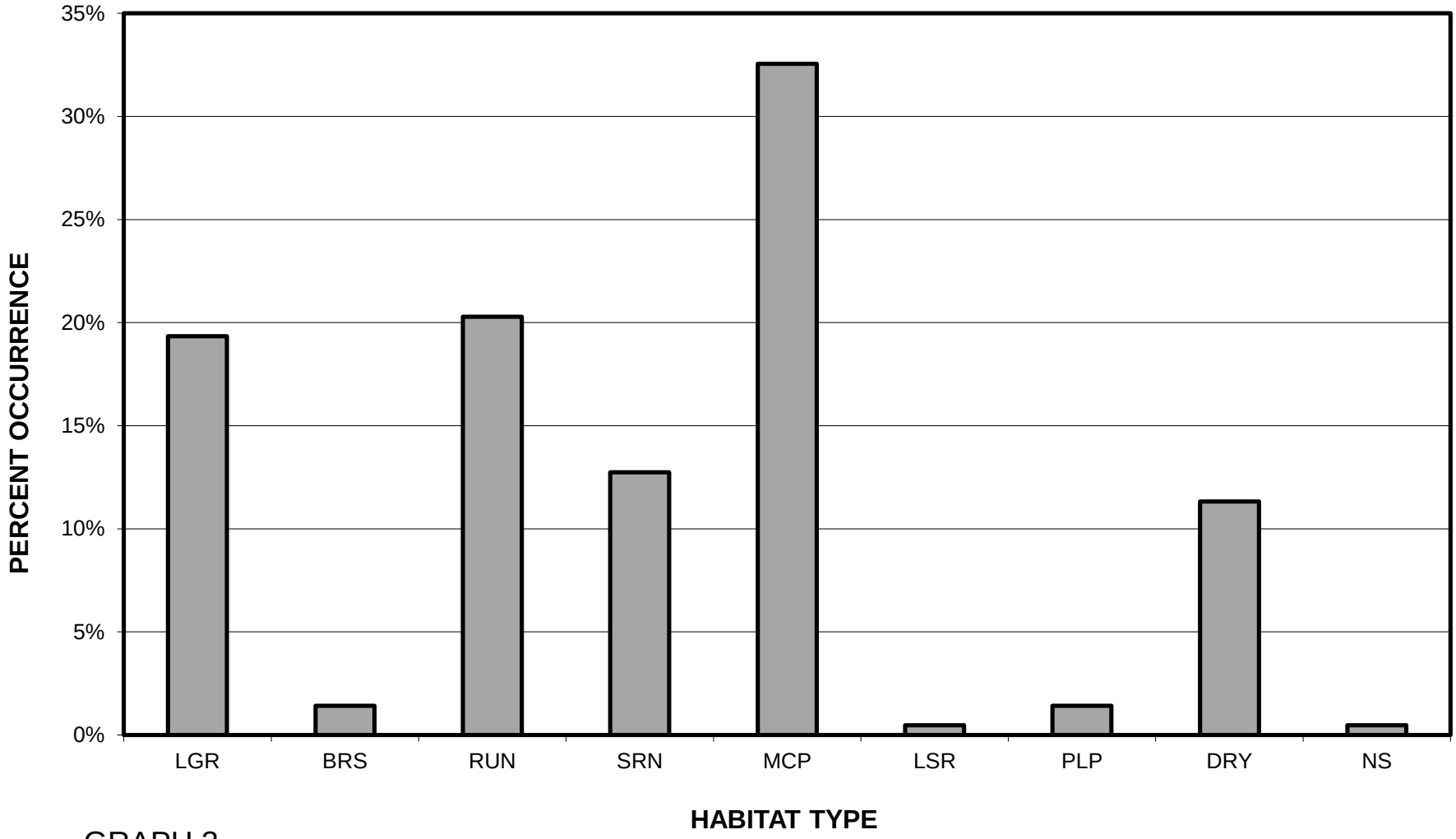
GRAPH 1

BUNKER GULCH 2016
HABITAT TYPES BY PERCENT TOTAL LENGTH



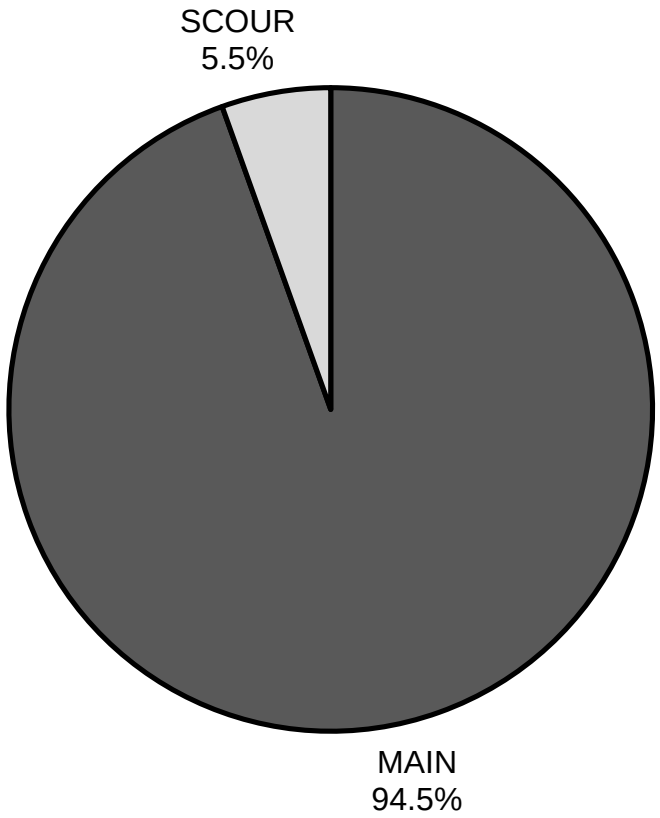
GRAPH 2

BUNKER GULCH 2016
HABITAT TYPES BY PERCENT OCCURRENCE



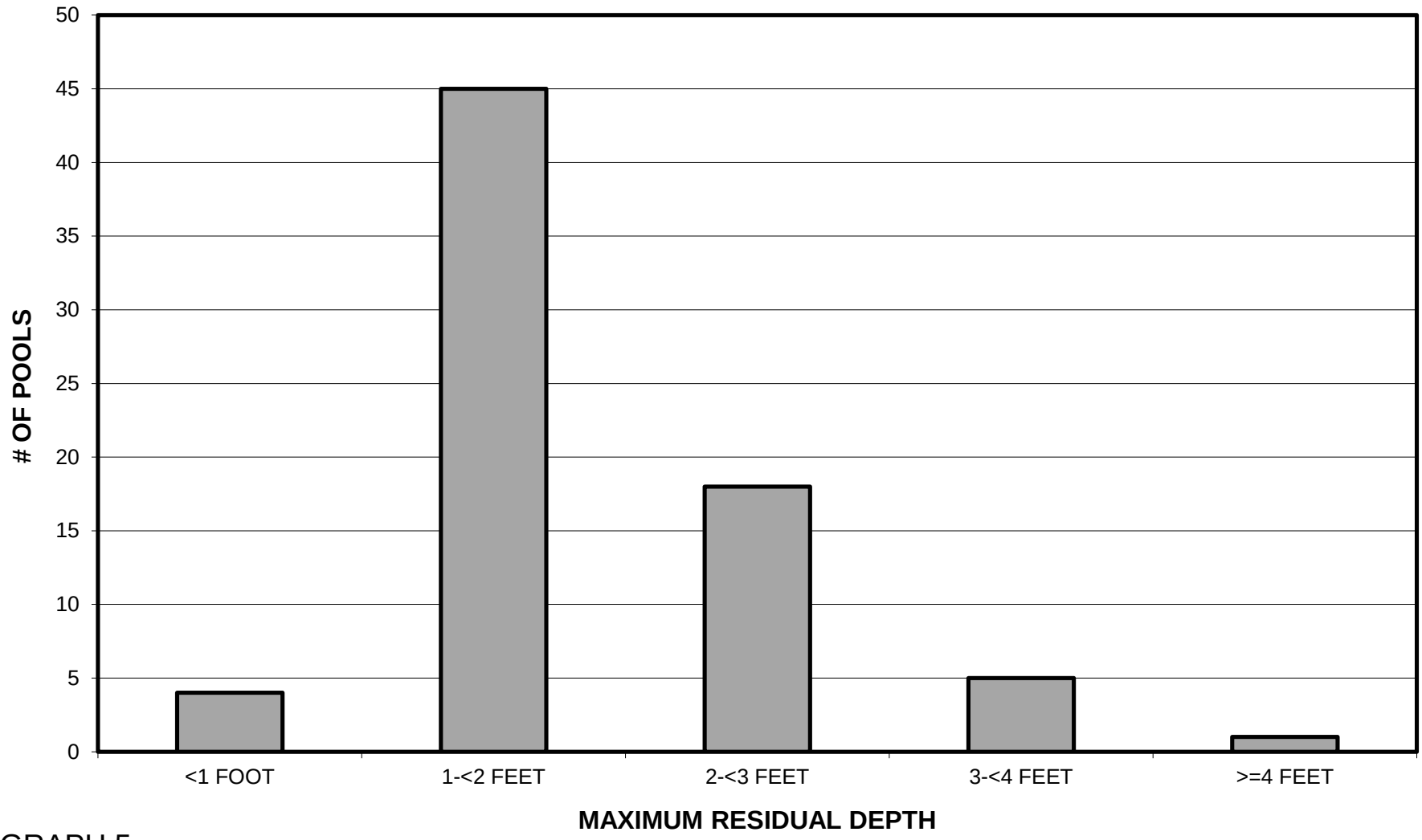
GRAPH 3

BUNKER GULCH 2016
POOL TYPES BY PERCENT OCCURRENCE



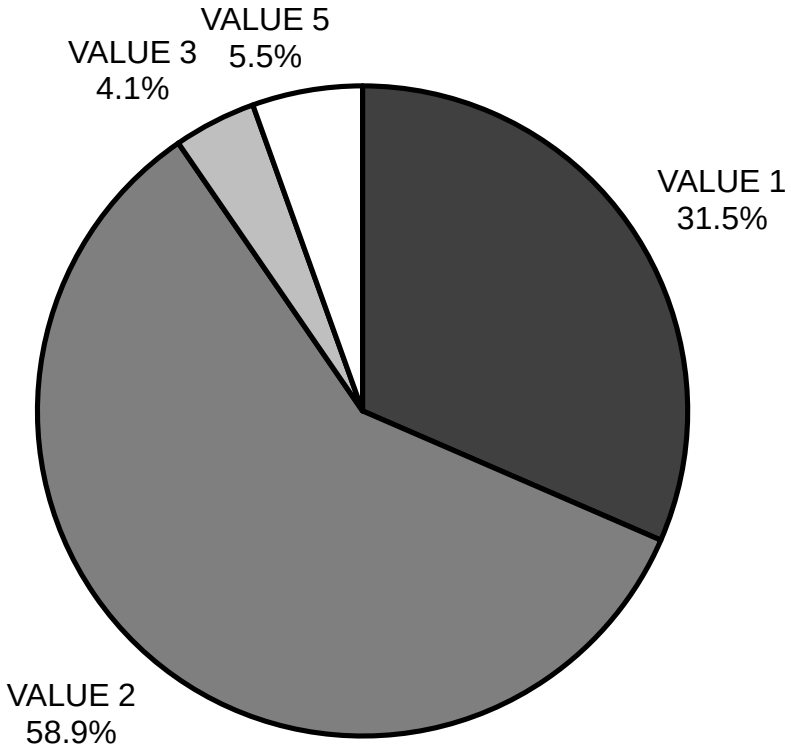
GRAPH 4

BUNKER GULCH 2016
MAXIMUM DEPTH IN POOLS



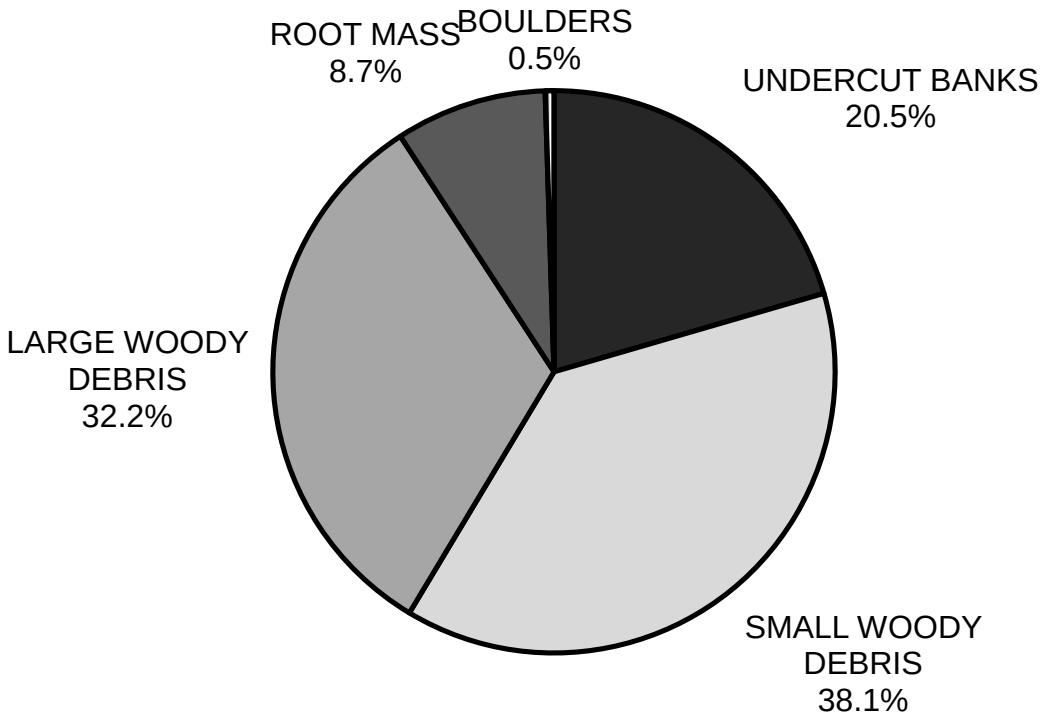
GRAPH 5

BUNKER GULCH 2016
PERCENT EMBEDDEDNESS



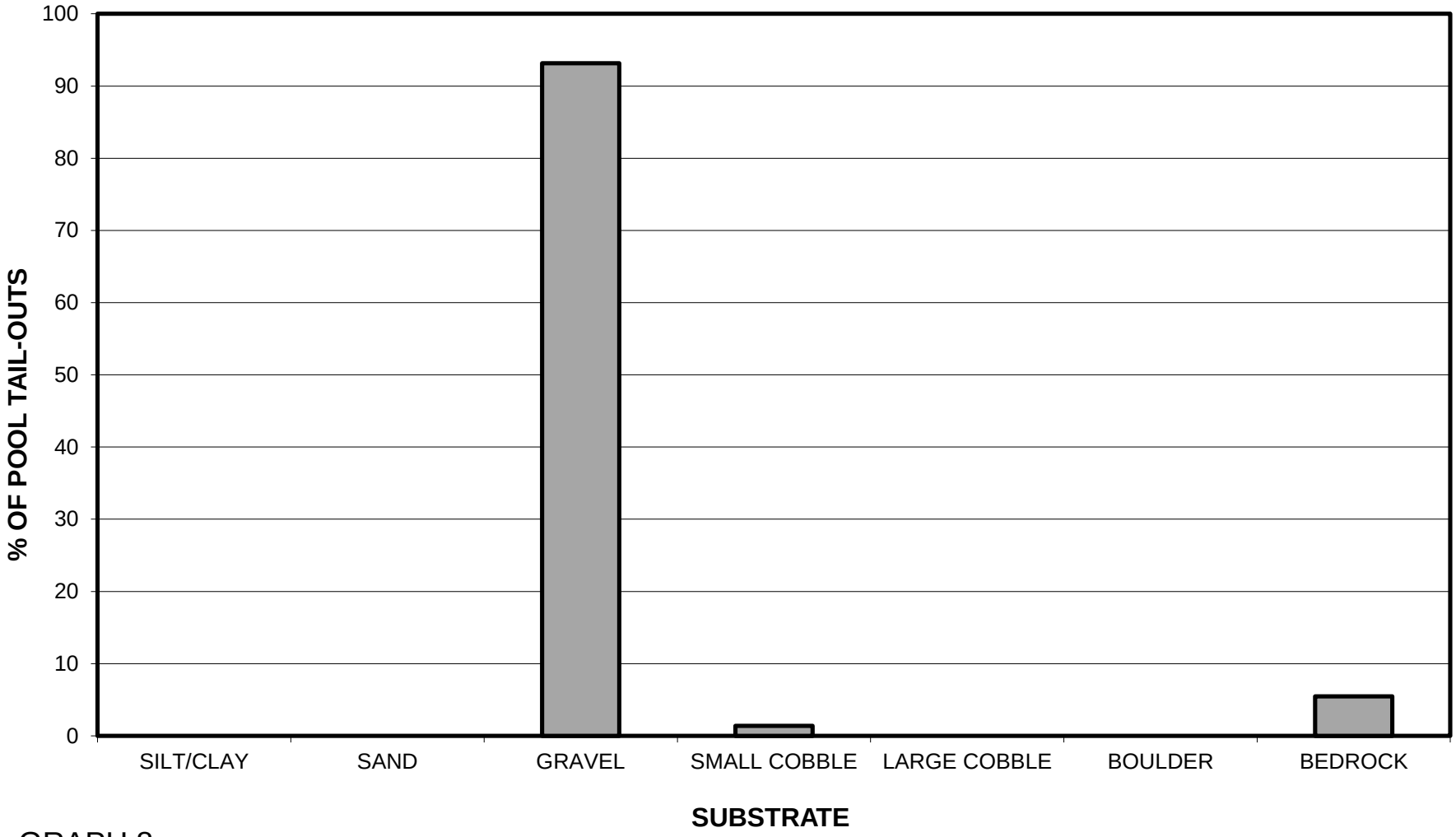
GRAPH 6

BUNKER GULCH 2016
MEAN PERCENT COVER TYPES IN POOLS



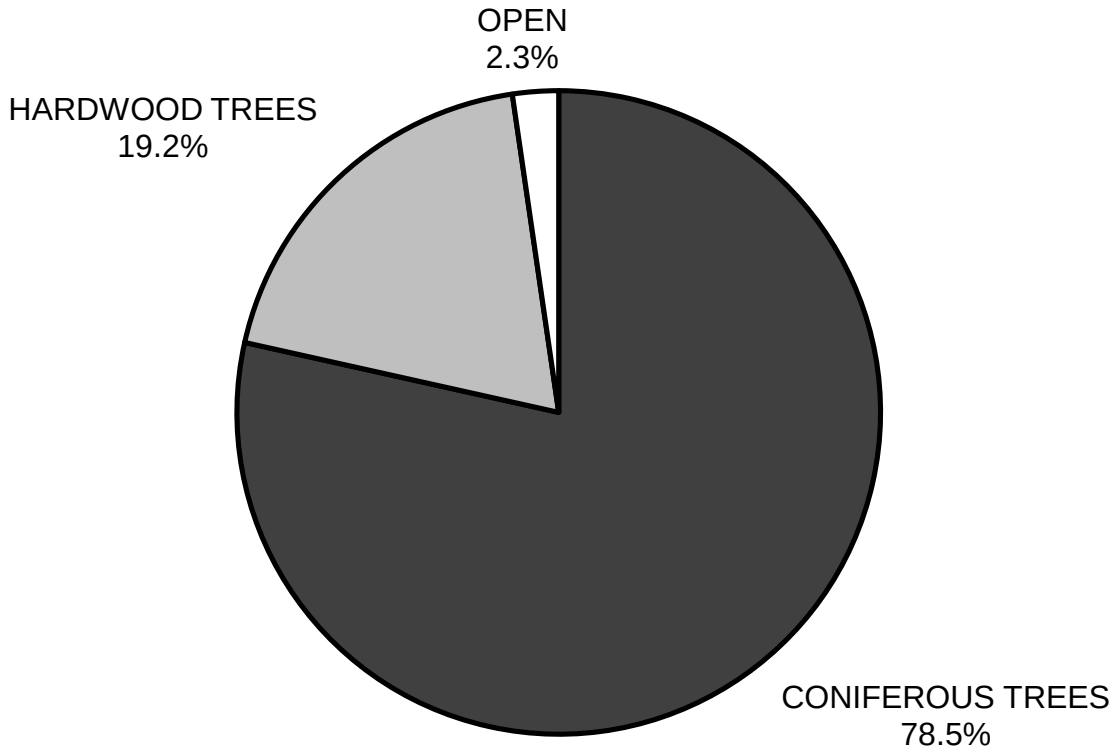
GRAPH 7

BUNKER GULCH 2016
SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



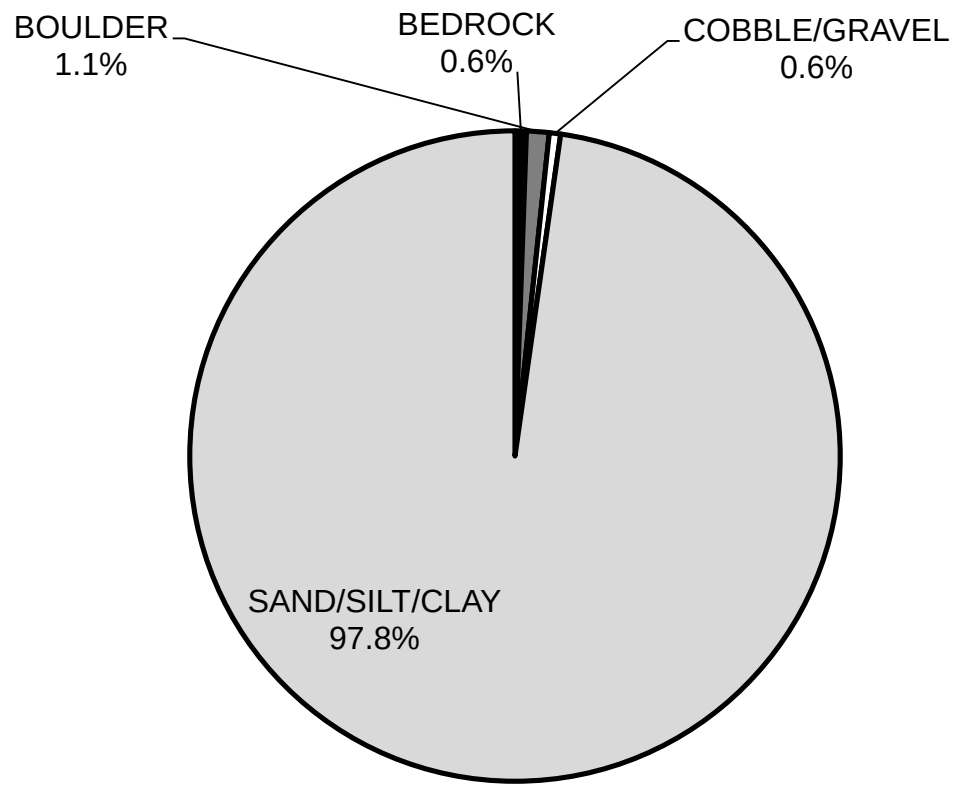
GRAPH 8

BUNKER GULCH 2016
MEAN PERCENT CANOPY



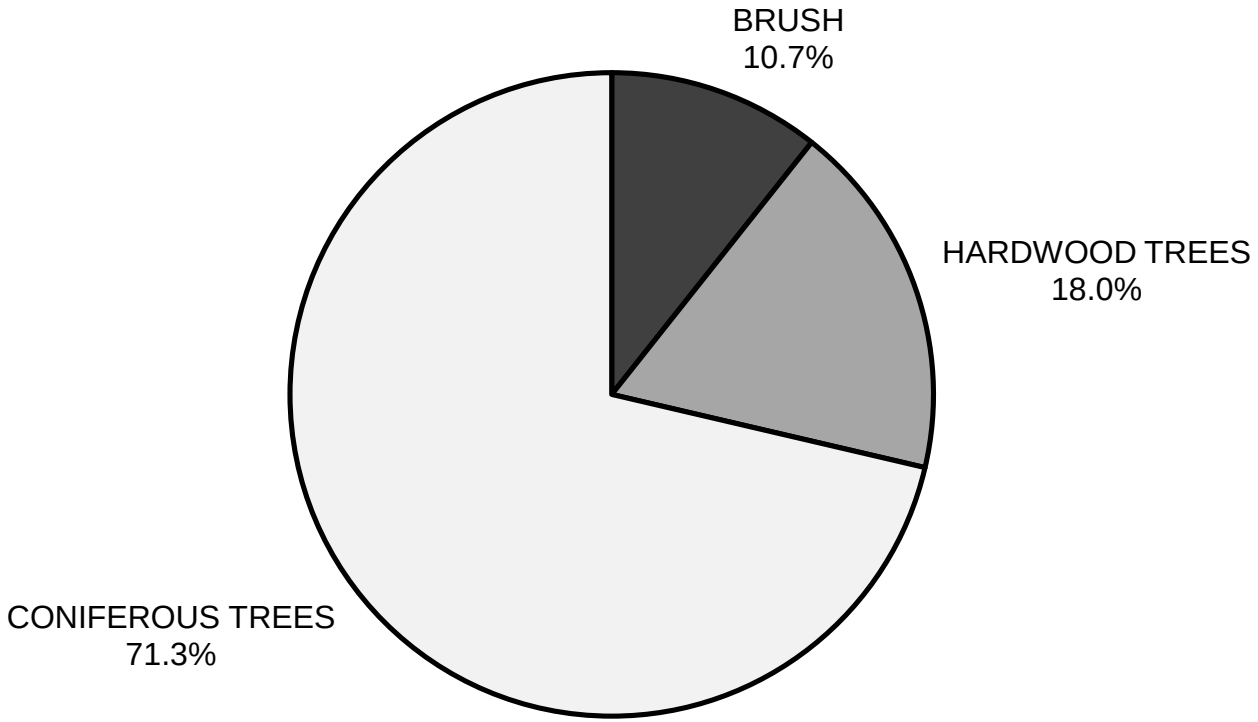
GRAPH 9

BUNKER GULCH 2016
DOMINANT BANK COMPOSITION IN SURVEY REACH



GRAPH 10

BUNKER GULCH 2016
DOMINANT BANK VEGETATION IN SURVEY REACH



GRAPH 11

APPENDIX II

STREAM INVENTORY PHOTOS

Photo 1: Habitat Unit #56, Culvert runs through Bunker Gulch and under road 400,it is not a barrier to salmonids. Photo taken on 9/28/2016

Photo 2: Habitat Unit #73, rusted culvert with a tree inside of it. Photo taken on 9/28/2016