

STREAM INVENTORY REPORT

Stewarts Creek

INTRODUCTION

A stream inventory was conducted from July 10 to July 11, 2008 on Stewarts Creek. The survey began at the confluence with the Pacific Ocean and extended upstream 1.5 miles.

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

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

Stewarts Creek is a tributary to the Pacific Ocean, located in Sonoma County, California (Map 1). Stewarts Creek's legal description at the confluence with the Pacific Ocean is T09N R14W S03. Its location is 38.6498 degrees north latitude and 123.3997 degrees west longitude, LLID number 1233984386498. Stewarts Creek is a first order stream and has approximately 1.4 miles of blue line stream according to the USGS Stewarts Point 7.5 minute quadrangle. Stewarts Creek drains a watershed of approximately 0.7 square miles. Elevations range from about 0 feet at the mouth of the creek to 650 feet in the headwater areas. Mixed hardwood and mixed conifer forest dominates the watershed. The watershed is privately owned and is managed for recreation. Vehicle access exists via Highway 1 and Skaggs Springs Road.

METHODS

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

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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 Stewarts 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". Stewarts 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 Stewarts 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.

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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 Stewarts 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 Stewarts 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 Stewarts 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.

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11. Average Bankfull Width:

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

DATA ANALYSIS

Data from the habitat inventory form are entered into Stream Habitat 2.0.19, a Visual Basic data entry program developed by Karen Wilson, Pacific States Marine Fisheries Commission in conjunction with the California Department of Fish and 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 Stewarts 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

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HABITAT INVENTORY RESULTS

* ALL TABLES AND GRAPHS ARE LOCATED AT THE END OF THE REPORT *

The habitat inventory of July 10 to July 11, 2008 was conducted by H. Colton and T. Pool (WSP). The total length of the stream surveyed was 7,723 feet. No data was collected for the first 475 feet of Stewarts Creek. Therefore, the data included in this report is for the 7,248 feet actually surveyed.

Stream flow was not measured on Stewarts Creek.

Stewarts Creek is an unknown channel type for 475 feet of the stream that was not surveyed (Reach 1), an E4 channel type for 3,002 feet of the stream surveyed (Reach 2), and a B4 channel type for 4,246 feet of the stream surveyed (Reach 3). E4 channels are low gradient, meandering riffle/pool streams with low width/depth ratios and little deposition. They are very efficient and stable with a high meander width ratio and gravel-dominant substrates. B4 channels are moderately entrenched, moderate gradient, riffle dominated channel with infrequently spaced pools, very stable plan and profile, stable banks and gravel-dominant substrates.

Water temperatures taken during the survey period ranged from 49 to 50 degrees Fahrenheit. Air temperatures ranged from 50 to 60 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 38% pool units, 30% flatwater units, 16% dry units, 15% riffle units, and 1% culvert units (Graph 1). Based on total length of Level II habitat types there were 38% flatwater units, 27% dry units, 22% pool units, 10% riffle units, and 2% culvert units.

Nine Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were mid-channel pool units, 28%; dry units, 16%; and low gradient riffle units, 15% (Graph 3). Based on percent total length, dry units made up 27%, step-run units 22%, and step-pool units 14%.

A total of 50 pools were identified (Table 3). Main channel pools were the most frequently encountered at 96% (Graph 4), and comprised 98% 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. Six of the 50 pools (12%) had a residual depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 50 pool tail-outs measured, 5 had a value of 2 (10%); 32 had a value of 3 (64%); 13 had a value of 4 (26%) (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.

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A shelter rating was calculated for each habitat unit and expressed as a mean value for each habitat type within the survey using a scale of 0-300. Riffle habitat types had a mean shelter rating of 2, flatwater habitat types had a mean shelter rating of 4, and pool habitats had a mean shelter rating of 6 (Table 1). Of the pool types, the scour pools had the highest mean shelter rating at 8. Main channel pools had a mean shelter rating of 5 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Large woody debris is the dominant cover type in Stewarts Creek. Graph 7 describes the pool cover in Stewarts Creek. Large woody debris is the dominant pool cover type followed by undercut banks.

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 58% of the pool tail-outs. Small cobble was the next most frequently observed dominant substrate type and occurred in 24% of the pool tail-outs.

The mean percent canopy density for the surveyed length of Stewarts Creek was 95%. Five percent of the canopy was open. Of the canopy present, the mean percentages of hardwood and coniferous trees were 13% and 87%, respectively. Graph 9 describes the mean percent canopy in Stewarts Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 90%. The mean percent left bank vegetated was 92%. The dominant elements composing the structure of the stream banks consisted of 95% cobble/gravel, 3% boulder, 2% bedrock, and 1% sand/silt/clay (Graph 10). Grass was the dominant vegetation type observed in 55% of the units surveyed. Additionally, 38% of the units surveyed had coniferous trees as the dominant vegetation type, and 5% had deciduous trees as the dominant vegetation type (Graph 11).

DISCUSSION

The first 475 feet of Stewarts Creek were not surveyed. Stewarts Creek is an E4 channel type for the next 3,002 feet and a B4 channel type for the remaining 4,246 feet. The suitability of E4 and B4 channel types for fish habitat improvement structures is as follows: E4 channel types are good for bank-placed boulders and fair for opposing wing-deflectors. B4 channel types are excellent for low-stage plunge weirs, boulder clusters, bank placed boulders, single and opposing wing-deflectors, and log cover.

The water temperatures recorded on the survey days July 10 to July 11, 2008 ranged from 49 to 50 degrees Fahrenheit. Air temperatures ranged from 50 to 60 degrees Fahrenheit. To make any conclusions, temperatures need to be monitored throughout the warm summer months, and more extensive biological sampling needs to be conducted.

Flatwater habitat types comprised 38% of the total length of this survey, riffles 10%, and pools 22%. Six the 50 (12%) 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

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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 structures that will increase or deepen pool habitat is recommended.

Five of the 50 pool tail-outs measured had embeddedness ratings of 1 or 2. Forty-five of the pool tail-outs had embeddedness ratings of 3 or 4. None of the pool tail-outs had a rating of 5, which is considered unsuitable for spawning. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered to indicate good quality spawning substrate for salmon and steelhead. Sediment sources in Stewarts Creek should be mapped and rated according to their potential sediment yields, and control measures should be taken.

Forty-one of the 50 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 6. 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 large woody debris in Stewarts Creek. Large woody debris is the dominant cover type in pools followed by undercut banks. 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 95%. Reach 2 had a canopy density of 94.9%, Reach 3 had a canopy density of 95.3%. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was 90% and 92%, respectively. In areas of stream bank erosion or where bank vegetation is sparse, planting endemic species of coniferous and hardwood trees, in conjunction with bank stabilization, is recommended.

RECOMMENDATIONS

- 1) Stewarts 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) Assess fish passage for adult and juvenile salmonids for the dam at 507' and the culvert at 730' above the confluence.
- 4) Increase woody cover in the pools and flatwater habitat units. Most of the existing cover in the pools is from large woody debris. Adding high quality complexity with woody cover in the pools is desirable.

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- 5) 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.

Distance (ft):	Habitat unit #:	Comments:
0	0001.00	Start of survey at the Pacific Ocean. No habitat data was collected for the first 475 feet (Reach 1) of Stewarts Creek due to the influence of the Pacific Ocean.
475	0002.00	Start of habitat data collection. The channel is an E4 (Reach 2).
507	0004.00	Dam #01 measures 9' high x 7.5' long x 8.3' wide. The height of the downcut is 1.4 ft. The dam is retaining gravel. It is a potential barrier to juvenile salmonids. There is a concrete retaining wall attached to the dam. It is 6' high and about 30'-40' long, with a 3' wide bottom extending into the channel.
730	0010.00	Culvert #01 measures 7.7' high x 7.1' wide x 16.4' long and is made of concrete. There is no plunge height. The max depth within 5' of the outlet is 2.6'. The culvert has a 2% slope and is in good condition. The culvert is a potential barrier to both juvenile and adult salmonids.
1196	0017.00	Log Debris Accumulation (LDA #01) measures 8.3' high x 25' wide x 75' long and consists of 30-40 pieces of large woody debris (LWD). Water flows through and there are visible gaps in the LDA. The LDA is retaining sand and gravel measuring 1' high x 9.7' wide x 7' long. LDA #02 measures 7.3' high x 18' wide x 31' long and consists of 10 pieces of LWD. Water flows through and there are visible gaps in the LDA. The LDA is retaining sand and gravel measuring 1.2' high x 11' wide x 41' long.
1451	0019.00	LDA #03 measures 4.9' high x 11' wide x 12' long and consists of four pieces of LWD. Water does not flow through and there are no visible gaps in the LDA. The LDA is retaining sand and gravel measuring 1.9' high x 5.6' wide x 22' long.

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1482	0020.00	LDA #04 measures 5' high x 19.9' wide x 17' long and consists of 10 pieces of LWD. Water flows through and there are visible gaps in the LDA. The LDA is retaining gravel and small cobble measuring 0.3' high x 7' wide x 18' long.
1532	0022.00	LDA #05 measures 3.4' high x 11' wide x 4' long and consists of one piece of LWD. Water flows through and there are no visible gaps in the LDA. The LDA is retaining gravel measuring 0.2' high x 7.8' wide x 4.5' long.
1771	0026.00	LDA #06 measures 3.2' high x 6.4' wide x 37' long and consists of two pieces of LWD. Water flows through and there are visible gaps in the LDA. The LDA is retaining gravel measuring 0.4' high x 2.5' wide x 3' long.
2113	0035.00	LDA #07 measures 4.3' high x 7.6' wide x 4.9' long and consists of seven pieces of LWD. Water flows through and there are visible gaps in the LDA. The LDA is retaining gravel and small cobble measuring 1.8' high x 5.1' wide x 13.9' long.
2634	0043.00	LDA #08 measures 6.7' high x 17.3' wide x 25' long and consists of five pieces of LWD. Water does not flow through and there are visible gaps in the LDA. The LDA is retaining gravel and small cobble measuring 1.5' high x 10' wide x 2.3' long.
2659	0044.00	LDA #09 measures 4.8' high x 11' wide x 8.2' long and consists of seven pieces of LWD. Water flows through and there are visible gaps in the LDA. The LDA is retaining gravel measuring 0.8' high x 4.3' wide x 4.9' long.
		LDA #10 measured 3.6' high x 15' wide x 5.6' long and consists of three pieces of LWD. Water flows through and there are visible gaps in the LDA. The LDA is retaining gravel measuring 0.6' high x 15' wide x 5' long.
		LDA #11 measures 6.2' high x 16' wide x 8.5' long and consists of five pieces of LWD. Water flows through and there are visible gaps in the LDA. The LDA is retaining gravel measuring 0.2' high x 7.3' wide x 9.9' long.
3389	0053.00	LDA #12 measures 3.3' high x 7.1' wide x 5.2' long and consists of three pieces of LWD. Water flows through and there are visible gaps in the LDA. The LDA is not retaining sediment.
3477	0054.00	LDA #13 measures 5.7' high x 8.1' wide x 7.2' long and consists of five pieces of LWD. Water flows through and there are visible gaps in the

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LDA. The LDA is retaining gravel measuring 0.5' high x 2.6' wide x 7.3' long.

The channel changes from and E4 to a B4 (Reach 3).

- | | | |
|------|---------|---|
| 4149 | 0067.00 | LDA #14 measures 6.7' high x 26.5' wide x 9.6' long and consists of seven pieces of LWD. Water flows through and there are visible gaps in the LDA. The LDA is retaining gravel measuring 0.7' high x 1.5' wide x 2' long. |
| 4182 | 0068.00 | LDA #15 measures 6.3' high x 11.3' wide x 8.9' long and consists of 10 pieces of LWD. Water flows through and there are visible gaps in the LDA. The LDA is retaining gravel measuring 1.9' high x 5.7' wide x 4.3' long. |
| 4251 | 0070.00 | A retaining wall is built out of culverts/metal pipes. There are ten pipes total with a culvert running through the seventh pipe from the top of the unit. It appears to have concrete apron underneath, extending out approximately one foot. |
| 4502 | 0078.00 | Erosion site on the left bank. |
| 4587 | 0081.00 | LDA #16 measures 6.2' high x 11.3' wide x 10.9' long and consists of 11 pieces of LWD. Water flows through it and there are visible gaps in the LDA. The LDA is retaining gravel and cobble measuring 2' high x 13.9' wide x 6.5' long. |
| 4598 | 0082.00 | Tributary #01 enters on the left bank. The water temperature upstream and downstream of the tributary is 50 degrees Fahrenheit; the water temperature of the tributary is 48 degrees Fahrenheit. The estimated slope of the tributary is four percent. It is inaccessible to salmonids. |
| 4719 | 0084.00 | LDA #17 measures 5.2' high x 14.2' wide x 5.9' long and consists of six pieces of LWD. Water flows through and there are visible gaps in the LDA. The LDA is retaining gravel and cobble measuring 1.4' high x 8.2' wide x 13.3' long. |
| 5027 | 0089.00 | Tributary #02 enters on the right bank. The water temperature upstream and downstream of the tributary is 49 degrees Fahrenheit; the water temperature of the tributary is 48 degrees. The tributary is accessible to fish. Skaggs Springs Road crosses the tributary; the crossing is a 2' diameter culvert. |
| 5210 | 0095.00 | LDA #18 measures 1.6' high x 4.6' wide x 4.2' long and consists of two pieces of LWD. Water flows through and there are visible gaps in the |

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		LDA. The LDA is retaining gravel and cobble measuring 0.8' high x 7' wide x 5.4' long.
5624	0104.00	LDA #19 measures 6.1' high x 15.2' wide x 16.7' long and consists of 13 pieces of LWD. Water flows through and there are visible gaps in the LDA. The LDA is retaining gravel and cobble measuring 0.3' high x 7' wide x 11' long.
6567	0110.00	LDA #20 measures 7.9' high x 13.7' wide x 14.3' long and consists of four pieces of LWD. Water flows through and there are visible gaps in the LDA. The LDA is retaining gravel and cobble measuring 1.2' high x 12.3' wide.
7723	0132.00	End of survey due to a dry, undefined channel.

REFERENCES

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

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LEVEL III and LEVEL IV HABITAT TYPES

RIFFLE

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

CASCADE

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

FLATWATER

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

MAIN CHANNEL POOLS

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

SCOUR POOLS

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

BACKWATER POOLS

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

ADDITIONAL UNIT DESIGNATIONS

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

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

Stream Name: Stewarts Creek

LLID: 1233984386498 Drainage: Gualala River

Survey Dates: 7/10/2008 to 7/11/2008

Confluence Location: Quad: STEWARTS POINT Legal Description: T000R000S00 Latitude: 38:38:59.0N Longitude: 123:23:54.0

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
1	0	CULVERT	0.8	164	164	2.3									
21	0	DRY	16.0	93	1954	27.0									
39	10	FLATWATER	29.8	71	2770	38.2	4.0	0.3	0.6	230	8961	73	2833		4
1	0	NOSURVEY		475	475										
50	50	POOL	38.2	32	1612	22.2	6.9	0.7	1.4	195	9733	170	8313	142	6
20	4	RIFFLE	15.3	37	748	10.3	3.6	0.2	0.9	74	1483	13	260		2
Total Units	Total Units Fully Measured				Total Length (ft.)					Total Area (sq.ft.)			Total Volume (cu.ft.)		
132	64				7723					20177			11405		

Table 2 - Summary of Habitat Types and Measured Parameters

Stream Name: Stewarts Creek

LLID: 1233984386498

Drainage: Gualala River

Survey Dates: 7/10/2008 to 7/11/2008

Confluence Location: Quad: STEWARTS POINT Legal Description: T000R000S00

Latitude: 38:38:59.0N

Longitude: 123:23:54.0W

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 (%)
19	3	LGR	14.5	38	723	10.0	4	0.1	0.4	74	1413	10	189		1	96
1	1	HGR	0.8	25	25	0.3	3	0.3	2.6	74	74	22	22		4	96
11	3	GLD	8.4	47	522	7.2	4	0.4	0.6	111	1219	41	456		5	97
12	3	RUN	9.2	54	653	9.0	4	0.2	0.6	181	2176	22	265		3	96
16	4	SRN	12.2	100	1595	22.0	4	0.3	0.9	355	5685	134	2143		4	91
37	37	MCP	28.2	15	544	7.5	7	0.7	4	103	3798	91	3279	78	5	95
11	11	STP	8.4	93	1028	14.2	6	0.6	1.8	514	5656	427	4700	351	6	97
2	2	PLP	1.5	20	40	0.6	7	1.0	2.2	139	278	167	335	142	8	92
21	0	DRY	16.0	93	1954	27.0										
1	0	CUL	0.8	164	164	2.3										
1	0	NS		475	475											

Total Units
132

Total Units Fully Measured
64

Total Length (ft.)
7723

Total Area (sq.ft.)
20299

Total Volume (cu.ft.)
11388

Table 3 - Summary of Pool Types

Stream Name: Stewarts Creek

LLID: 1233984386498

Drainage: Gualala River

Survey Dates: 7/10/2008 to 7/11/2008

Confluence Location: Quad: STEWARTS POINT

Legal Description: T000R000S00

Latitude: 38:38:59.0N

Longitude: 123:23:54.0W

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
48	48	MAIN	96	33	1572	98	6.9	0.7	197	9455	142	6670	5
2	2	SCOUR	4	20	40	2	7.2	1.0	139	278	142	284	8

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
50	50	1612	9733	6955

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

Stream Name: Stewarts Creek LLID: 1233984386498 Drainage: Gualala River
 Survey Dates: 7/10/2008 to 7/11/2008
 Confluence Location: Quad: STEWARTS POINT Legal Description: T000R000S00 Latitude: 38:38:59.0N Longitude: 123:23:54.0W

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
37	MCP	74	9	24	23	62	4	11	0	0	1	3
11	STP	22	2	18	9	82	0	0	0	0	0	0
2	PLP	4	0	0	1	50	1	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
50	11	22	33	66	5	10	0	0	1	2

Mean Maximum Residual Pool Depth (ft.): 1.4

Table 5 - Summary of Mean Percent Cover By Habitat Type

Stream Name: Stewarts Creek

LLID: 1233984386498

Drainage: Gualala River

Survey Dates: 7/10/2008 to 7/11/2008

Dry Units: 21

Confluence Location: Quad: STEWARTS POINT

Legal Description: T000R000S00

Latitude: 38:38:59.0N

Longitude: 123:23:54.0W

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
19	3	LGR	0	20	80	0	0	0	0	0	0
1	1	HGR	0	0	0	0	0	0	10	90	0
20	4	TOTAL RIFFLE	0	10	40	0	0	0	5	45	0
11	3	GLD	0	0	45	0	5	0	0	0	50
12	3	RUN	0	0	0	0	60	0	0	40	0
16	4	SRN	33	5	23	0	28	0	0	13	0
39	10	TOTAL FLAT	16	3	23	0	30	0	0	16	13
37	37	MCP	24	8	57	4	1	0	0	5	0
11	11	STP	15	9	63	1	5	0	0	6	0
2	2	PLP	25	0	25	0	0	0	25	25	0
50	50	TOTAL POOL	22	8	57	3	2	0	1	6	0
1	0	CUL									
1	0	NS									
132	64	TOTAL	21	7	52	2	6	0	1	9	2

Table 6 - Summary of Dominant Substrates By Habitat Type

Stream Name: Stewarts Creek

LLID: 1233984386498

Drainage: Gualala River

Survey Dates: 7/10/2008 to 7/11/2008

Dry Units: 21

Confluence Location: Quad: STEWARTS POINT

Legal Description: T000R000S00

Latitude: 38:38:59.0N

Longitude: 123:23:54.0W

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
19	3	LGR	0	0	0	100	0	0	0
1	1	HGR	0	0	0	0	0	100	0
11	3	GLD	0	0	33	67	0	0	0
12	3	RUN	0	0	0	100	0	0	0
16	4	SRN	0	25	25	25	0	25	0
37	37	MCP	8	14	24	46	5	3	0
11	11	STP	0	9	27	36	9	18	0
2	2	PLP	0	50	0	50	0	0	0

Table 7 - Summary of Mean Percent Canopy for Entire Stream

Stream Name: Stewarts Creek

LLID: 1233984386498

Drainage: Gualala River

Survey Dates: 7/10/2008 to 7/11/2008

Confluence Location: Quad: STEWARTS POINT

Legal Description: T000R000S00

Latitude: 38:38:59.0N

Longitude: 123:23:54.0W

Mean Percent Canopy	Mean Percent Conifer	Mean Percent Hardwood	Mean Percent Open Units	Mean Right Bank % Cover	Mean Left Bank % Cover
95	87	13	0	90	92

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

Open units represent habitat units with zero canopy cover.

Table 8 - Fish Habitat Inventory Data Summary

Stream Name: Stewarts Creek LLID: 1233984386498 Drainage: Gualala River
 Survey Dates: 7/10/2008 to 7/11/2008 Survey Length (ft.): 7723 Main Channel (ft.): 7723 Side Channel (ft.): 0
 Confluence Location: Quad: STEWARTS POINT Legal Description: T000R000S00 Latitude: 38:38:59.0N Longitude: 123:23:54.0W

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 1

Channel Type: NA	Canopy Density (%):	Pools by Stream Length (%): 0.0
Reach Length (ft.): 475	Coniferous Component (%):	Pool Frequency (%): 0.0
Riffle/Flatwater Mean Width (ft.):	Hardwood Component (%):	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation:	< 2 Feet Deep:
Range (ft.): 12 to 12	Vegetative Cover (%): 0.0	2 to 2.9 Feet Deep:
Mean (ft.): 12	Dominant Shelter:	3 to 3.9 Feet Deep:
Std. Dev.: 0	Dominant Bank Substrate Type:	>= 4 Feet Deep:
Base Flow (cfs.): 0.0	Occurrence of LWD (%):	Mean Max Residual Pool Depth (ft.):
Water (F): 50 - 50 Air (F): 60 - 60	LWD per 100 ft.:	Mean Pool Shelter Rating:
Dry Channel (ft): 0	Riffles:	
	Pools:	
	Flat:	
Pool Tail Substrate (%): Silt/Clay: Sand: Gravel: Sm Cobble: Lg Cobble: Boulder: Bedrock:		
Embeddedness Values (%): 1. 2. 3. 4. 5. 0.0		

STREAM REACH: 2

Channel Type: E4	Canopy Density (%): 94.9	Pools by Stream Length (%): 30.9
Reach Length (ft.): 3002	Coniferous Component (%): 78.2	Pool Frequency (%): 40.4
Riffle/Flatwater Mean Width (ft.): 3.8	Hardwood Component (%): 21.8	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation: Coniferous Trees	< 2 Feet Deep: 100
Range (ft.): 6 to 13	Vegetative Cover (%): 85.9	2 to 2.9 Feet Deep: 0
Mean (ft.): 10	Dominant Shelter: Large Woody Debris	3 to 3.9 Feet Deep: 0
Std. Dev.: 2	Dominant Bank Substrate Type: Cobble/Gravel	>= 4 Feet Deep: 0
Base Flow (cfs.): 0.0	Occurrence of LWD (%): 38	Mean Max Residual Pool Depth (ft.): 1.1
Water (F): 49 - 50 Air (F): 50 - 55	LWD per 100 ft.:	Mean Pool Shelter Rating: 6
Dry Channel (ft): 312	Riffles: 15	
	Pools: 4	
	Flat: 1	
Pool Tail Substrate (%): Silt/Clay: 10 Sand: 0 Gravel: 62 Sm Cobble: 29 Lg Cobble: 0 Boulder: 0 Bedrock: 0		
Embeddedness Values (%): 1. 0.0 2. 9.5 3. 81.0 4. 9.5 5. 0.0		

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 3

Channel Type: B4	Canopy Density (%): 95.3	Pools by Stream Length (%): 16.1
Reach Length (ft.): 4246	Coniferous Component (%): 94.0	Pool Frequency (%): 36.7
Riffle/Flatwater Mean Width (ft.): 4.0	Hardwood Component (%): 6.0	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation: Grass	< 2 Feet Deep: 79
Range (ft.): 5 to 14	Vegetative Cover (%): 95.1	2 to 2.9 Feet Deep: 17
Mean (ft.): 8	Dominant Shelter: Large Woody Debris	3 to 3.9 Feet Deep: 0
Std. Dev.: 3	Dominant Bank Substrate Type: Cobble/Gravel	>= 4 Feet Deep: 3
Base Flow (cfs.): 0.0	Occurrence of LWD (%): 57	Mean Max Residual Pool Depth (ft.): 1.6
Water (F): 49 - 50 Air (F): 52 - 60	LWD per 100 ft.:	Mean Pool Shelter Rating: 5
Dry Channel (ft): 1642	Riffles: 10	
	Pools: 9	
	Flat: 3	
Pool Tail Substrate (%): Silt/Clay: 7 Sand: 14 Gravel: 55 Sm Cobble: 21 Lg Cobble: 0 Boulder: 0 Bedrock: 3		
Embeddedness Values (%): 1. 0.0 2. 10.3 3. 51.7 4. 37.9 5. 0.0		

Table 9 - Mean Percentage of Dominant Substrate and Vegetation

Stream Name: Stewarts Creek

LLID: 1233984386498

Drainage: Gualala River

Survey Dates: 7/10/2008 to 7/11/2008

Confluence Location: Quad: STEWARTS POINT Legal Description: T000R000S00

Latitude: 38:38:59.0N

Longitude: 123:23:54.0W

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	2	0	1.6
Boulder	3	1	3.1
Cobble / Gravel	58	63	94.5
Sand / Silt / Clay	1	0	0.8

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	37	34	55.5
Brush	0	0	0.0
Hardwood Trees	2	5	5.5
Coniferous Trees	23	25	37.5
No Vegetation	2	0	1.6

Total Stream Cobble Embeddedness Values: 3

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

StreamName: Stewarts Creek

LLID: 1233984386498

Drainage: Gualala River

Survey Dates: 7/10/2008 to 7/11/2008

Confluence Location: Quad: STEWARTS POINT

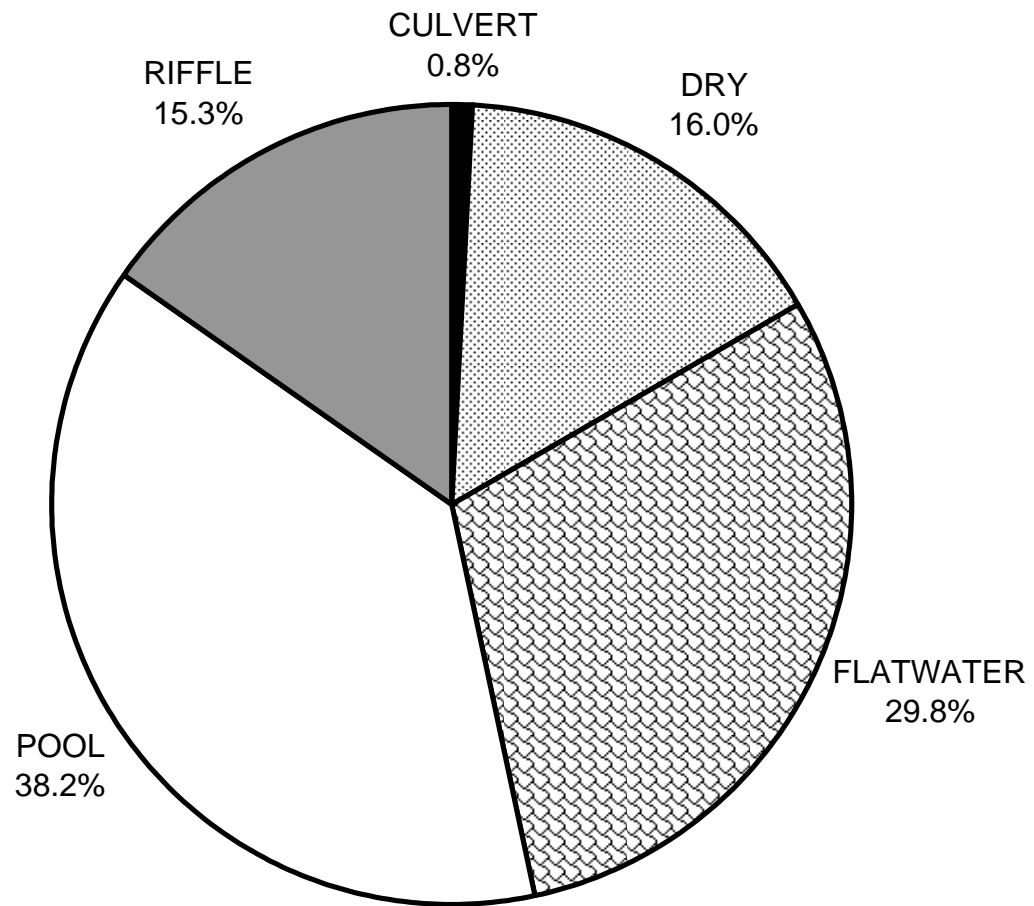
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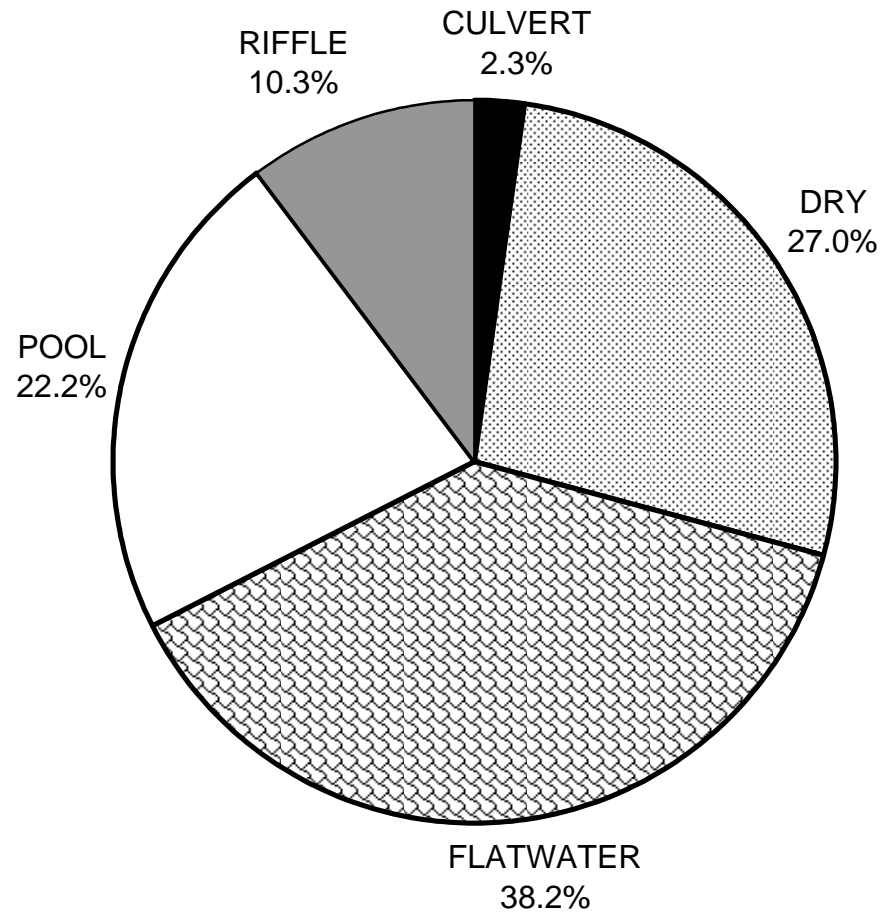
	Riffles	Flatwater	Pools
UNDERCUT BANKS (%)	0	16	22
SMALL WOODY DEBRIS (%)	10	3	8
LARGE WOODY DEBRIS (%)	40	23	57
ROOT MASS (%)	0	0	3
TERRESTRIAL VEGETATION (%)	0	30	2
AQUATIC VEGETATION (%)	0	0	0
WHITEWATER (%)	5	0	1
BOULDERS (%)	45	16	6
BEDROCK LEDGES (%)	0	13	0

STEWARTS CREEK 2008 HABITAT TYPES BY PERCENT OCCURRENCE



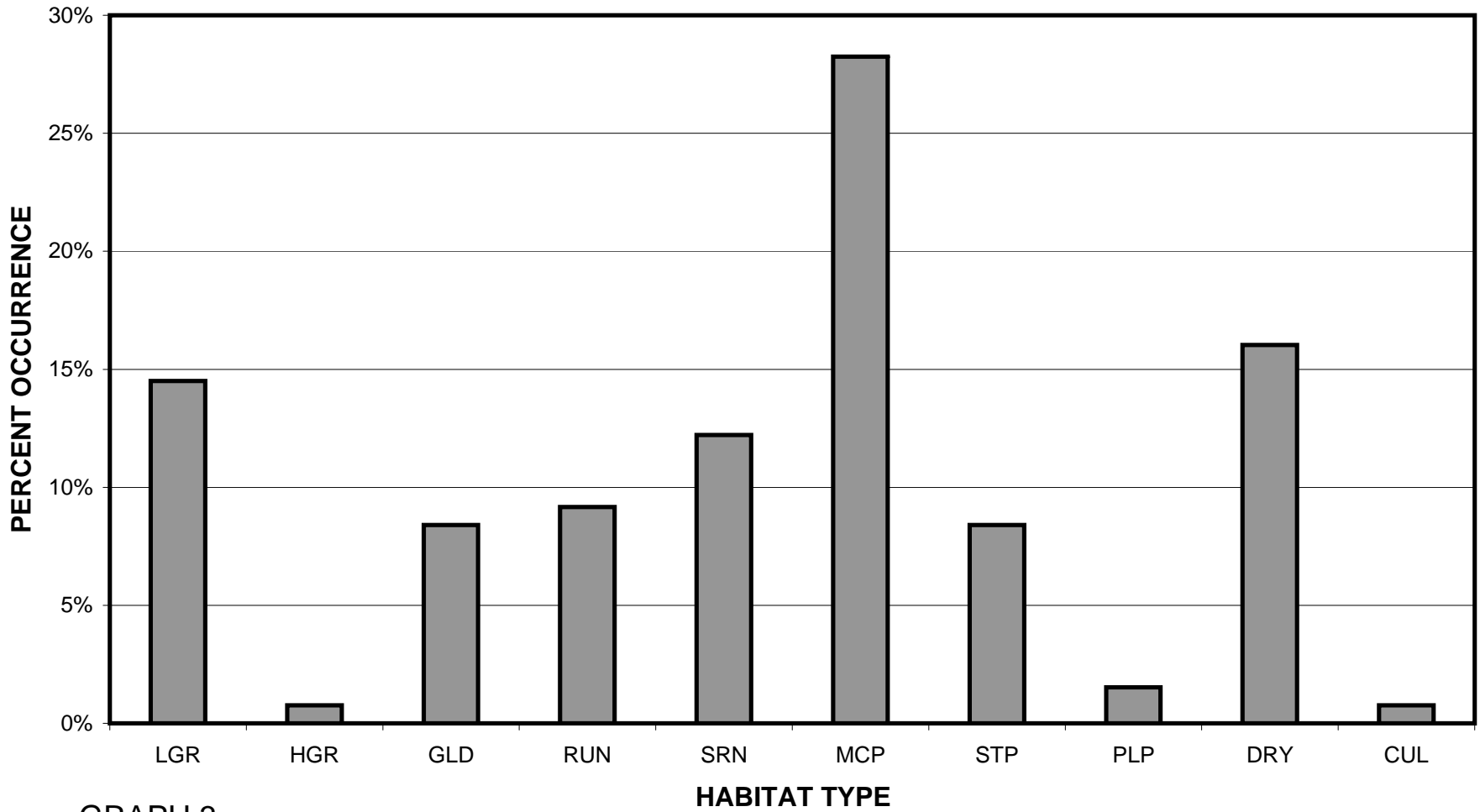
GRAPH 1

STEWARTS CREEK 2008 HABITAT TYPES BY PERCENT TOTAL LENGTH



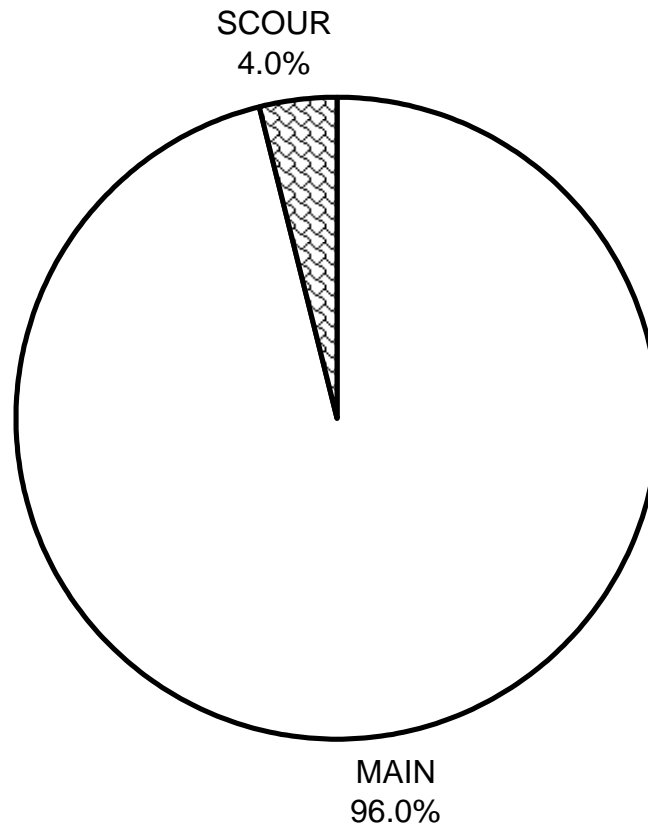
GRAPH 2

STEWARTS CREEK 2008 HABITAT TYPES BY PERCENT OCCURRENCE



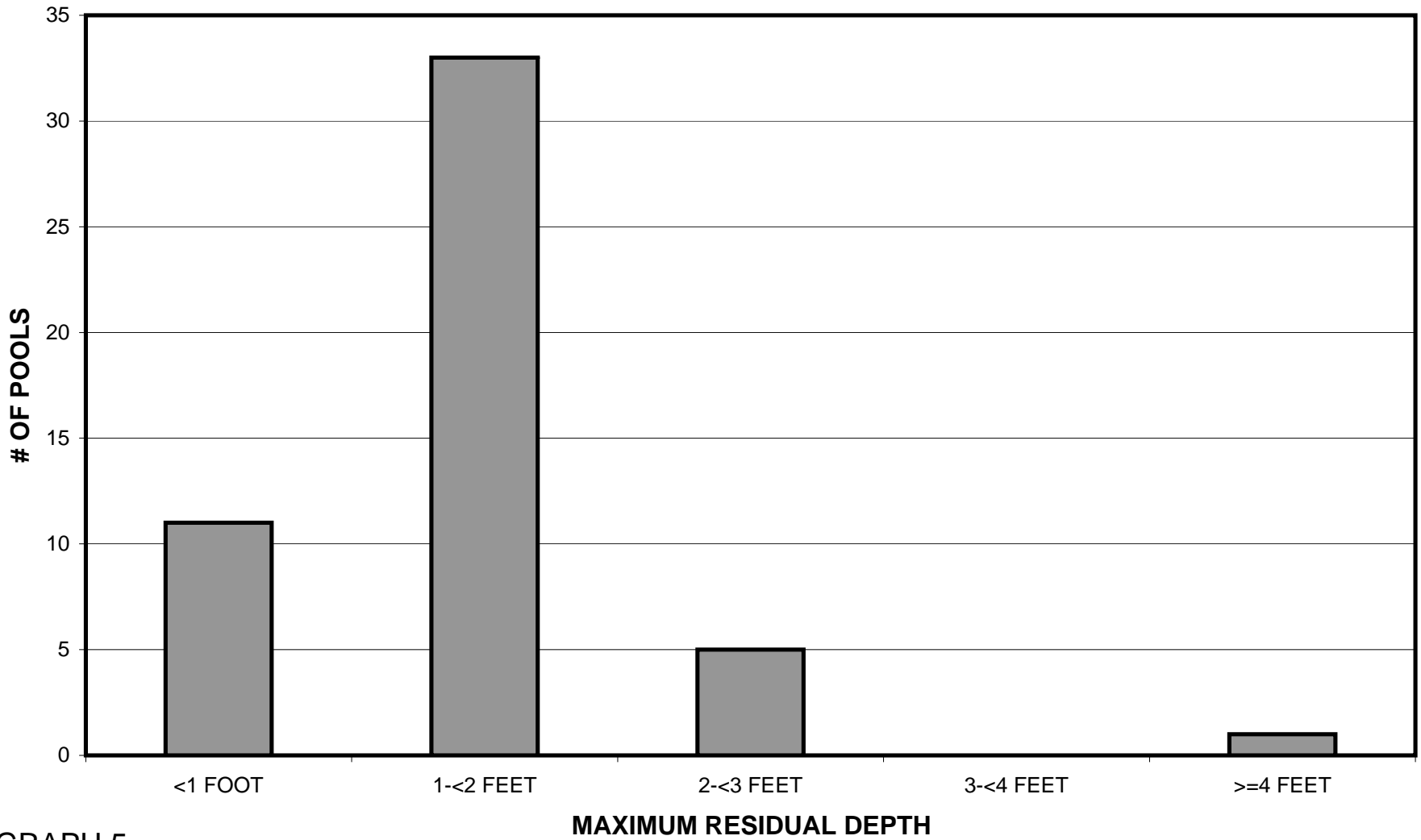
GRAPH 3

STEWARTS CREEK 2008 POOL TYPES BY PERCENT OCCURRENCE



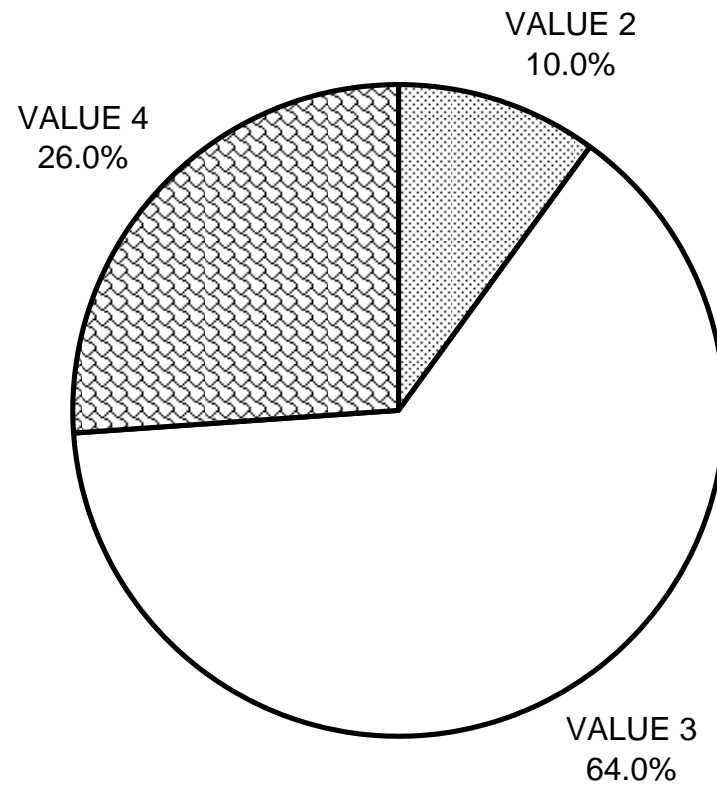
GRAPH 4

STEWARTS CREEK 2008 MAXIMUM DEPTH IN POOLS



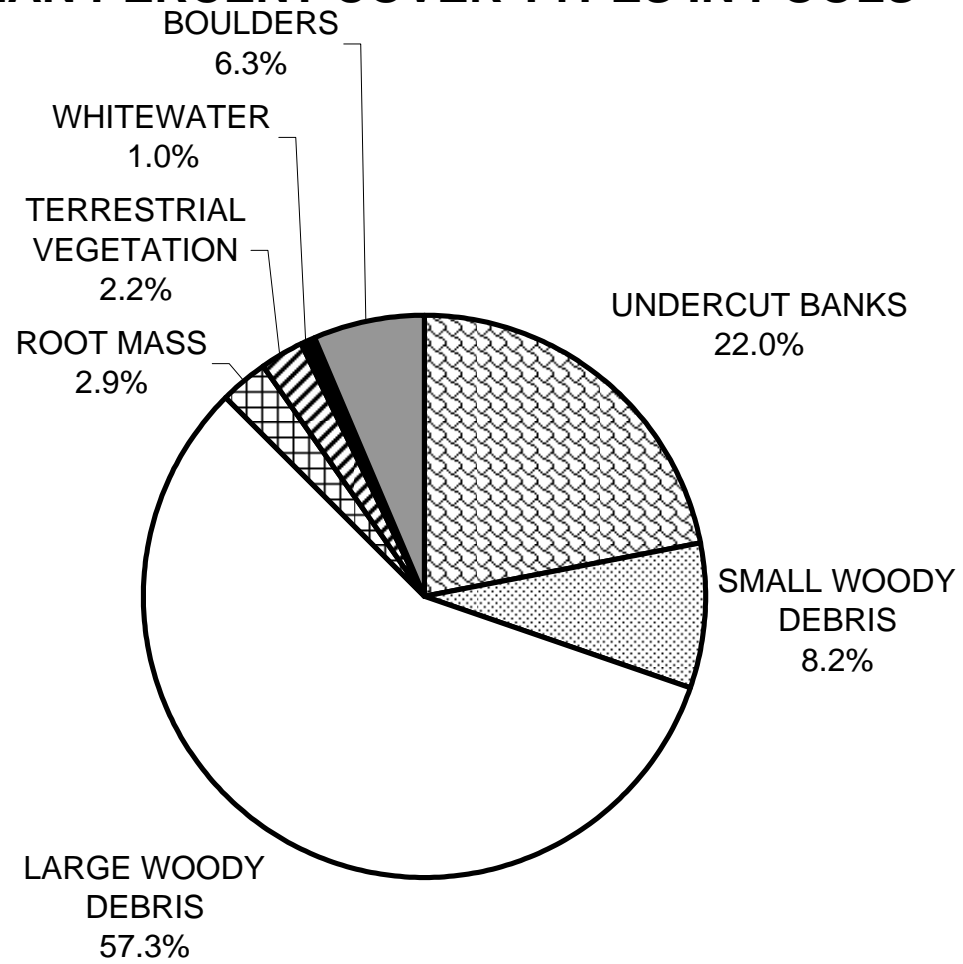
GRAPH 5

STEWARTS CREEK 2008 PERCENT EMBEDDEDNESS



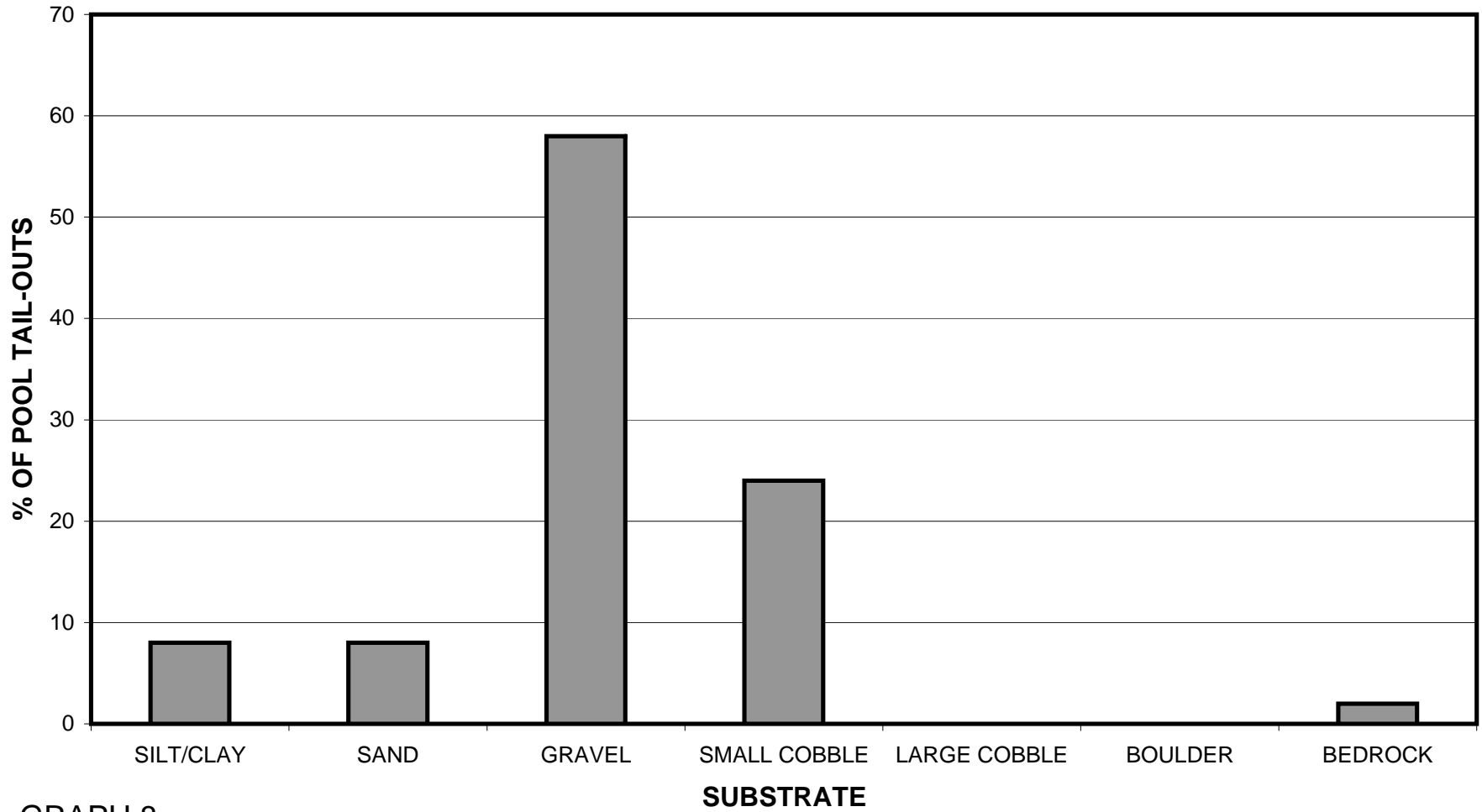
GRAPH 6

STEWARTS CREEK 2008 MEAN PERCENT COVER TYPES IN POOLS



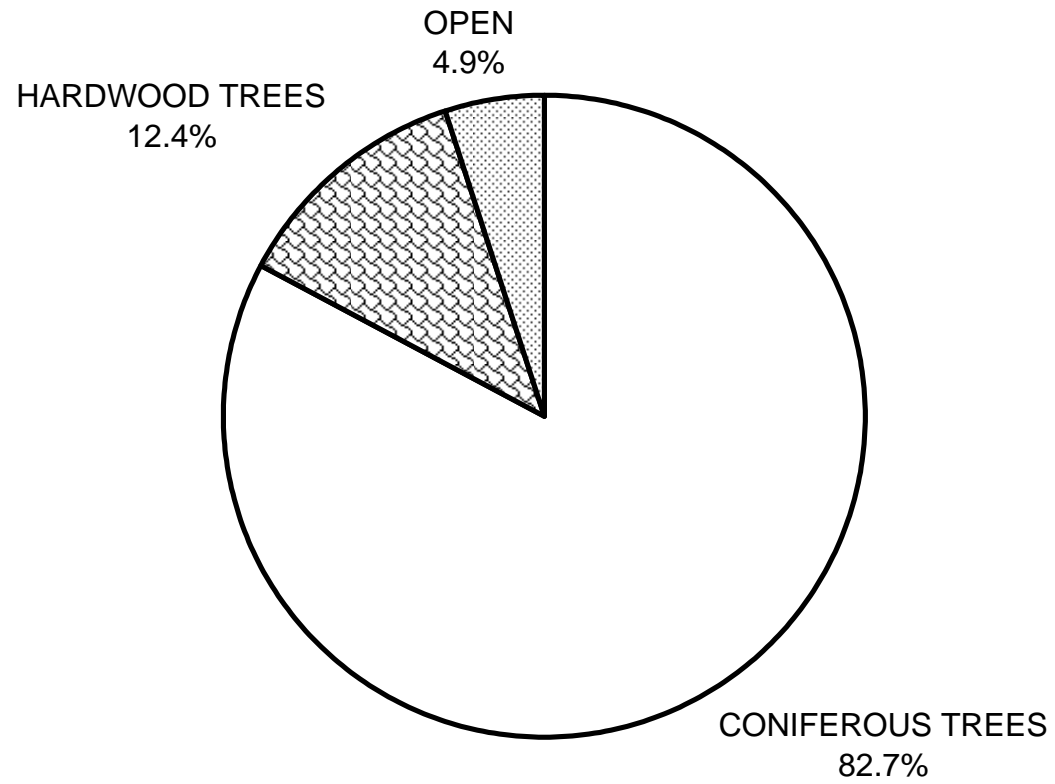
GRAPH 7

STEWARTS CREEK 2008 SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



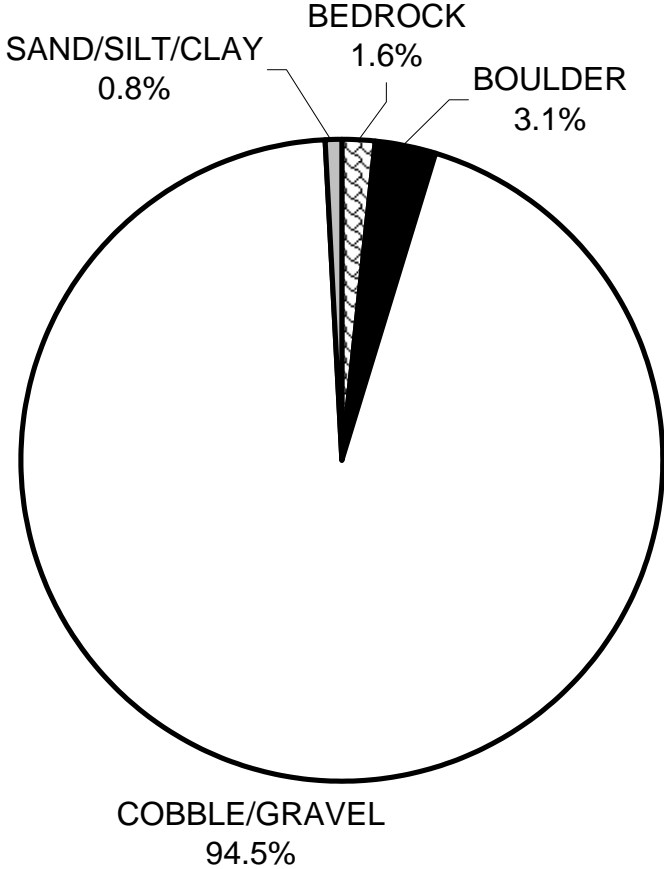
GRAPH 8

STEWARTS CREEK 2008 MEAN PERCENT CANOPY



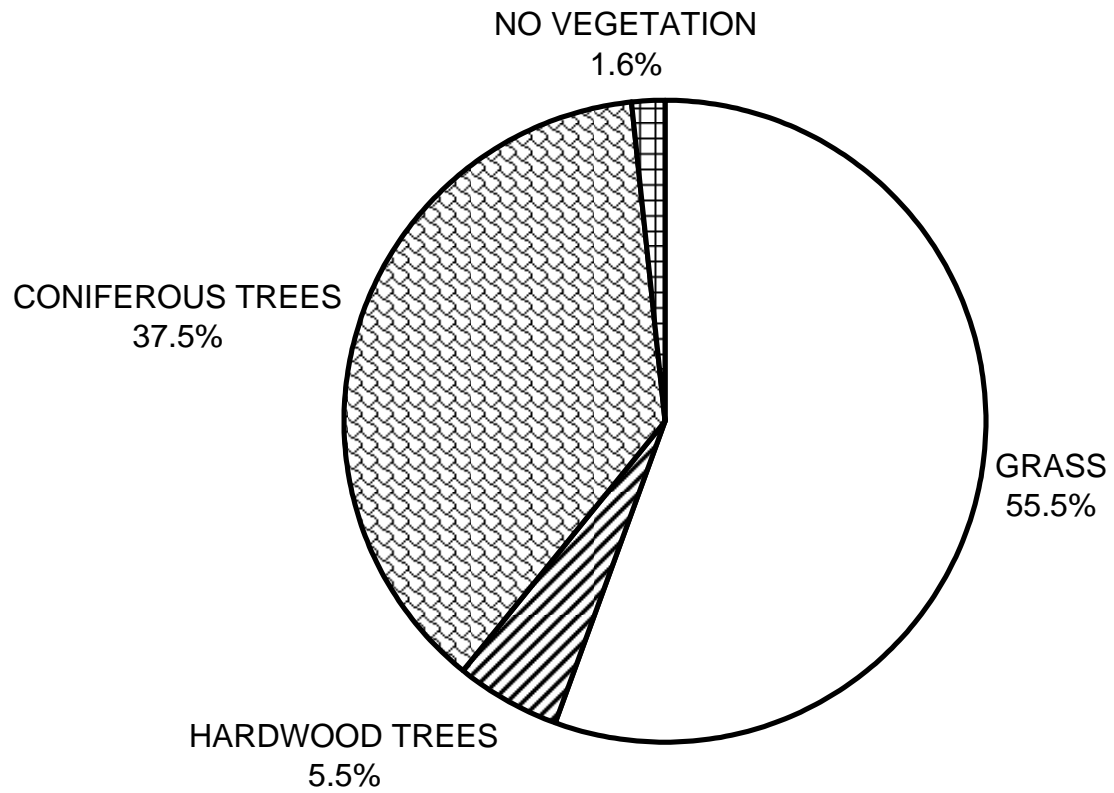
GRAPH 9

**STEWARTS CREEK 2008
DOMINANT BANK COMPOSITION IN SURVEY REACH**



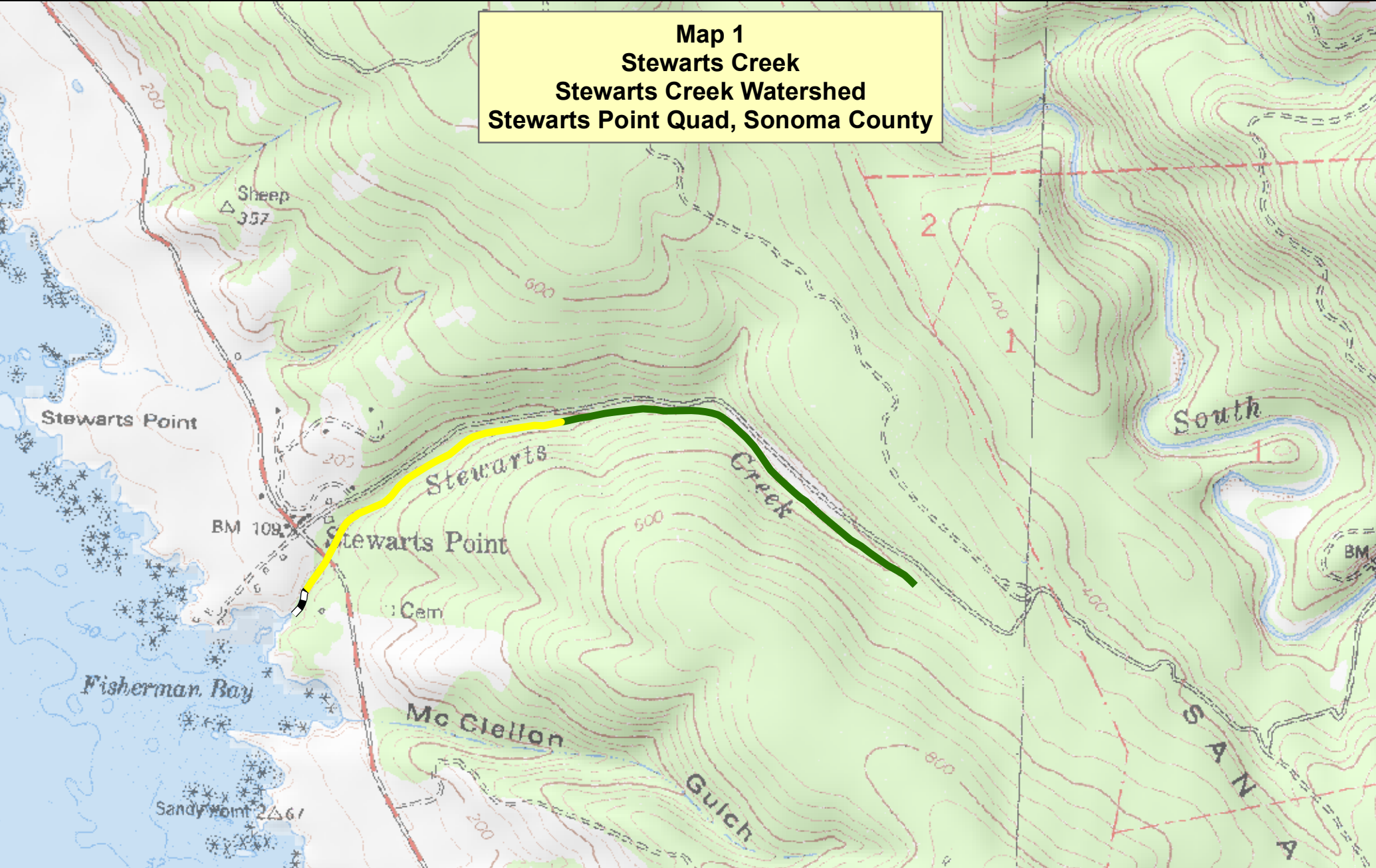
GRAPH 10

STEWARTS CREEK 2008 DOMINANT BANK VEGETATION IN SURVEY REACH






GRAPH 11

Map 1
Stewarts Creek
Stewarts Creek Watershed
Stewarts Point Quad, Sonoma County



Legend

-  Reach 1, Not Surveyed
-  Reach 2, B4 Channel Type
-  Reach 3, B4 Channel Type

