

STREAM INVENTORY REPORT

Spooner Creek

INTRODUCTION

A stream inventory was conducted from May 21 to June 5, 2012 on Spooner Creek. The survey began at the confluence with Bottom Creek and extended upstream 1.3 miles.

The Spooner 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 Spooner 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

Spooner Creek is a tributary to Bottom Creek, tributary to Little North Fork Navarro River, tributary to North Branch North Fork Navarro River, tributary to North Fork Navarro River, tributary to the Navarro River, which drains to the Pacific Ocean. It is located in Mendocino County, California (Map 1). Spooner Creek's legal description at the confluence with Bottom Creek is T16N R14W S31. Its location is 39.2082 degrees north latitude and 123.4735 degrees west longitude, LLID number 1234723392082. Spooner Creek is an intermittent stream according to the USGS Bailey Ridge 7.5 minute quadrangle. Spooner Creek drains a watershed of approximately 1.4 square miles. Elevations range from about 540 feet at the mouth of the creek to 940 feet in the headwater areas. Mixed conifer forest dominates the watershed. The watershed is entirely privately owned and is managed for timber production and rural development. Vehicle access exists via a private logging road off of Masonite Industrial Road.

METHODS

The habitat inventory conducted in Spooner 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 (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

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their lengths are measured. All pool units are measured for maximum depth, depth of pool tail crest (measured in the thalweg), dominant substrate composing the pool tail crest, and embeddedness. Habitat unit types encountered for the first time are measured for all the parameters and characteristics on the field form. Additionally, from the ten habitat units on each field form page, one is randomly selected for complete measurement.

HABITAT INVENTORY COMPONENTS

A standardized habitat inventory form has been developed for use in California stream surveys and can be found in the *California Salmonid Stream Habitat Restoration Manual*. This form was used in Spooner 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". Spooner 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 Spooner 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 Spooner 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 Spooner 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 Spooner 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 Spooner Creek. In addition, underwater observations were made at five 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 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

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Graphics are produced from the tables using Microsoft Excel. Graphics developed for Spooner 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 May 21 to June 5, 2012 was conducted by M. Zee, A. Blessing, B. James, and A. Garcia (WSP). The total length of the stream surveyed was 6,734 feet with an additional 20 feet of side channel.

Stream flow was measured near the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 0.13 cfs on May 22, 2012.

Spooner Creek is a G4 channel type for 2,079 feet of the stream surveyed (Reach 1), and a B4 channel type for 4,675 feet of the stream surveyed (Reach 2). G4 channels are entrenched “gully” step-pool channels on moderate gradients with low width/depth ratios, very stable with bedrock-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 52 to 56 degrees Fahrenheit. Air temperatures ranged from 52 to 74 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 47% pool units, 31% flatwater units, 13% dry units, and 8% riffle units (Graph 1). Based on total length of Level II habitat types there were 46% pool units, 34% flatwater units, 16% dry units, and 4% riffle units (Graph 2).

Nine Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were mid-channel pool units, 38%; run units, 18%; and dry units, 13%

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(Graph 3). Based on percent total length, mid-channel pool units made up 31%, step run units 19%, and dry units 16%.

A total of 106 pools were identified (Table 3). Main channel pools were the most frequently encountered at 97% (Graph 4), and comprised 99% of the total length of all pools (Table 3).

Table 4 is a summary of maximum residual pool depths by pool habitat types. Pool quality for salmonids increases with depth. Twenty-three of the 106 pools (22%) had a residual depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 106 pool tail-outs measured, 61 had a value of 1 (57.5%); 37 had a value of 2 (34.9%); six had a value of 3 (5.7%); one had a value of 4 (0.9%); one had a value of 5 (0.9%) (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 31, flatwater habitat types had a mean shelter rating of 10, and pool habitats had a mean shelter rating of 28 (Table 1). Of the pool types, the scour pools had the highest mean shelter rating at 42. Main channel pools had a mean shelter rating of 27 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Small woody debris is the dominant cover type in Spooner Creek. Graph 7 describes the pool cover in Spooner Creek. Small 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 73% of the pool tail-outs. Small cobble and sand were the next most frequently observed dominant substrate types; each occurred in 11% of the pool tail-outs.

The mean percent canopy density for the surveyed length of Spooner Creek was 95%. Five percent of the canopy was open. Of the canopy present, the mean percentages of hardwood and coniferous trees were 38% and 62%, respectively. Graph 9 describes the mean percent canopy in Spooner Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 99%. The mean percent left bank vegetated was 99%. The dominant elements composing the structure of the stream banks consisted of 84% sand/silt/clay, 13% cobble/gravel, 2% bedrock, and 1% boulders (Graph 10). Coniferous trees were the dominant vegetation type observed in 73% of the units surveyed. Additionally, 26% of the units surveyed had deciduous trees as the dominant vegetation type, and 1% had brush as the dominant vegetation type (Graph 11).

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BIOLOGICAL INVENTORY RESULTS

Survey teams conducted a snorkel survey at five sites for species composition and distribution in Spooner Creek on July 31, 2012. The sites were sampled by I. Mikus and M. Groff (CDFW).

In Reach 1, which comprised the first 2,079 feet of stream, five sites were sampled. The reach sites yielded four young-of-the-year steelhead/rainbow trout (SH/RT), one age 1+ SH/RT, and three sculpin.

The following chart displays the information yielded from these sites:

2012 Spooner Creek underwater observations.

| Date | Survey Site # | Habitat Unit # | Habitat Type | Approx. Dist. from mouth (ft.) | SH/RT | | | Coho | |
|--------------------------|---------------|----------------|--------------|--------------------------------|-------|----|----|------|----|
| | | | | | YOY | 1+ | 2+ | YOY | 1+ |
| Reach 1: G4 Channel Type | | | | | | | | | |
| 07/31/12 | 1 | 002 | Pool | 53 | 2 | 0 | 0 | 0 | 0 |
| | 2 | 004 | Pool | 87 | 2 | 0 | 0 | 0 | 0 |
| | 3 | 014 | Pool | 363 | 0 | 0 | 0 | 0 | 0 |
| | 4 | 021 | Pool | 659 | 0 | 0 | 0 | 0 | 0 |
| | 5 | 030 | Pool | 934 | 0 | 1 | 0 | 0 | 0 |

DISCUSSION

Spooner Creek is a G4 channel type for the first 2,079 feet of stream surveyed and a B4 channel type for the remaining 4,675 feet. The suitability of G4 and B4 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. 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 May 21 to June 5, 2012 ranged from 52 to 56 degrees Fahrenheit. Air temperatures ranged from 52 to 74 degrees Fahrenheit. This is a good water temperature range for salmonids. 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 34% of the total length of this survey, riffles 4%, and pools 46%. Twenty-three of the 106 (22%) pools had a maximum residual depth greater than 2 feet. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat. In first and second order streams, a primary pool is defined to have a maximum residual depth of at least two feet, occupy at least half the width of

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the low flow channel, and be as long as the low flow channel width. Installing large wood structures that will deepen pool habitat is recommended.

Ninety-eight of the 106 pool tail-outs measured had embeddedness ratings of 1 or 2. Seven of the pool tail-outs had embeddedness ratings of 3 or 4. One 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.

Eighty-nine of the 106 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 28. The shelter rating in the flatwater habitats is 10. 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 Spooner Creek. Small 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 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 95%. Reach 1 had a canopy density of 96% and Reach 2 had a canopy density of 94%. The percentage of right and left bank covered with vegetation was 99% and 99%, respectively.

RECOMMENDATIONS

- 1) Spooner 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 small woody debris. Adding high quality complexity with woody cover in the pools is desirable.

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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 Bottom Creek. The channel type is a G4. |
| 297 | 0012.00 | There is a 2' high plunge. |
| 343 | 0014.00 | Log debris accumulation (LDA) #01 contains eight pieces of large woody debris (LWD) and measures 6' high x 18' wide x 22' long. Water flows through the LDA and there are visible gaps in it. Retained sediment ranges from silt to cobble and measures 6' wide x 42' long x 2' deep. |
| 703 | 0024.00 | LDA #02 contains six pieces of LWD and measures 5' high x 20' wide x 5' long. The flow is subsurface through the LDA and there are no visible gaps in it. Retained sediment ranges from silt to gravel and measures 5' wide x 22' long x 2' deep. |
| 1117 | 0037.00 | LDA #03 contains 11 pieces of LWD and measures 8' high x 30' wide x 10' long. Water does not flow through the LDA and the channel is dry for 58' above it. There are no visible gaps in the LDA. Retained sediment ranges from silt to gravel and measures 7' wide x 50' long x 3' deep. |
| 1428 | 0045.00 | There is a 3.5' high plunge. |
| 1690 | 0056.00 | LDA #04 contains 10 pieces of LWD and measures 5' high x 12' wide x 21' long. Water flows through the LDA and there are visible gaps in it. The LDA is not retaining sediment. |
| 1732 | 0058.00 | An erosion site on the right bank is contributing silt, sand and gravel to the channel. |
| 1757 | 0059.00 | LDA #05 contains eight pieces of LWD and measures 5' high x 26' wide x 14' long. Water flows through the LDA and there are no visible gaps in it. The LDA is not retaining sediment. |
| 2059 | 0070.00 | The channel changes from a G4 to a B4. |

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| | | |
|------|---------|---|
| 2222 | 0074.00 | LDA #06 contains 10 pieces of LWD and measures 4.5' high x 24' wide x 16' long. Water flows through the LDA and there are visible gaps in it. Retained sediment ranges from silt to gravel and measures 6' wide x 30' long x 1' deep. |
| 2996 | 0102.00 | LDA #07 contains 12 pieces of LWD and measures 3' high x 21' wide x 16' long. Water flows through the LDA and there are visible gaps in it. Retained sediment ranges from silt to gravel and measures 6' wide x 16' long x 1' deep. |
| 3835 | 0119.00 | Small woody debris is accumulating in the channel. |
| 3916 | 0124.00 | There is a 1.5' plunge followed by 2.5' high plunge. LDA #08 contains four pieces of LWD and measures 9' high x 20' wide x 14' long. The flow is subsurface through the LDA and there are no visible gaps in it. Retained sediment ranges from silt to gravel and measures 12' wide x 9' long x 0.5' deep. |
| 4133 | 0135.00 | Tributary #01 enters on the left bank. The first 60' of the stream are dry. The slope of the tributary is approximately 10%. LDA #09 contains seven pieces of LWD and measures 3' high x 17' wide x 17' long. Water does not flow through the LDA and the channel is dry for 20' above it. There are visible gaps in the LDA. Retained sediment ranges from silt to gravel and measures 8' wide x 20' long x 0.5' deep. |
| 4671 | 0150.00 | There is a 1' high plunge. |
| 4788 | 0152.00 | There is a 2' high plunge. |
| 4915 | 0156.00 | There is a 1.8' high plunge. |
| 4961 | 0158.00 | LDA #10 contains five pieces of LWD and measures 8' high x 9' wide x 17' long. Water does not flow through the LDA and the channel is dry for 7' above it. There are no visible gaps in the LDA. Retained sediment ranges from silt to gravel and measures 8' wide x 7' long x 0.5' deep. |
| 5453 | 0179.00 | LDA #11 contains eight pieces of LWD and measures 4' high x 22' wide x 35' long. Water does not flow through the LDA and the channel is dry for 70' above it. There are no visible gaps in the LDA. Retained sediment ranges from silt to gravel and measures 22' wide x 70' long x 3' deep. |
| 6718 | 0223.00 | End of survey at property line due to lack of access. The channel is dry for over 400' upstream of the end of survey point. |

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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: Spooner Creek

LLID: 1234723392082 Drainage: Navarro River

Survey Dates: 5/21/2012 to 6/5/2012

Confluence Location: Quad: BAILEY RIDGE Legal Description: T16NR14WS31 Latitude: 39:12:30.0N Longitude: 123:28:20.0

| 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 |
|--------------------|-----------------------------------|--------------|------------------------|-------------------|---------------------------|------------------|------------------|------------------|----------------------|----------------------------|-------------------------------|----------------------|---------------------------------|---------------------------------|---------------------|
| 30 | 0 | DRY | 13.4 | 36 | 1072 | 15.9 | | | | | | | | | |
| 70 | 8 | FLATWATER | 31.3 | 33 | 2307 | 34.2 | 3.6 | 0.3 | 0.6 | 185 | 12954 | 68 | 4727 | | 10 |
| 106 | 106 | POOL | 47.3 | 30 | 3134 | 46.4 | 6.8 | 0.6 | 1.5 | 202 | 21444 | 174 | 18419 | 130 | 28 |
| 18 | 7 | RIFFLE | 8.0 | 13 | 241 | 3.6 | 4.4 | 0.2 | 0.4 | 54 | 970 | 11 | 204 | | 31 |
| Total Units | Total Units Fully Measured | | | | Total Length (ft.) | | | | | Total Area (sq.ft.) | | | Total Volume (cu.ft.) | | |
| 224 | 121 | | | | 6754 | | | | | 35367 | | | 23350 | | |

Table 2 - Summary of Habitat Types and Measured Parameters

Stream Name: Spooner Creek

LLID: 1234723392082

Drainage: Navarro River

Survey Dates: 5/21/2012 to 6/5/2012

Confluence Location: Quad: BAILEY RIDGE

Legal Description: T16NR14WS31

Latitude: 39:12:30.0N

Longitude: 123:28:20.0W

| 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 (%) |
|---------------|----------------------|--------------|------------------------|-------------------|--------------------|------------------|------------------|------------------|-----------------|--------------------|-------------------------------|----------------------|---------------------------------|---------------------------------|---------------------|-----------------|
| 13 | 5 | LGR | 5.8 | 12 | 161 | 2.4 | 4 | 0.2 | 0.4 | 51 | 662 | 11 | 143 | | 34 | 94 |
| 5 | 2 | HGR | 2.2 | 16 | 80 | 1.2 | 6 | 0.2 | 0.6 | 61 | 306 | 12 | 61 | | 25 | 98 |
| 41 | 4 | RUN | 18.3 | 25 | 1034 | 15.3 | 3 | 0.2 | 0.7 | 41 | 1681 | 9 | 370 | | 18 | 95 |
| 29 | 4 | SRN | 12.9 | 44 | 1273 | 18.8 | 4 | 0.4 | 0.9 | 329 | 9544 | 126 | 3655 | | 3 | 92 |
| 84 | 84 | MCP | 37.5 | 25 | 2080 | 30.8 | 7 | 0.6 | 4 | 169 | 14186 | 144 | 12083 | 108 | 28 | 94 |
| 1 | 1 | CCP | 0.4 | 56 | 56 | 0.8 | 5 | 0.5 | 2 | 302 | 302 | 212 | 212 | 151 | 40 | 94 |
| 18 | 18 | STP | 8.0 | 54 | 967 | 14.3 | 6 | 0.5 | 2.7 | 363 | 6528 | 288 | 5187 | 206 | 26 | 95 |
| 3 | 3 | PLP | 1.3 | 10 | 31 | 0.5 | 10 | 0.9 | 3.8 | 142 | 427 | 313 | 938 | 281 | 42 | 99 |
| 30 | 0 | DRY | 13.4 | 36 | 1072 | 15.9 | | | | | | | | | | 97 |

Total Units
224

Total Units Fully Measured
121

Total Length (ft.)
6754

Total Area (sq.ft.)
33637

Total Volume (cu.ft.)
22648

Table 3 - Summary of Pool Types

Stream Name: Spooner Creek

LLID: 1234723392082

Drainage: Navarro River

Survey Dates: 5/21/2012 to 6/5/2012

Confluence Location: Quad: BAILEY RIDGE

Legal Description: T16NR14WS31

Latitude: 39:12:30.0N

Longitude: 123:28:20.0W

| 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 |
|---------------|----------------------|--------------|------------------------|-------------------|--------------------|------------------|------------------|---------------------------|--------------------|-------------------------------|---------------------------------|-------------------------------------|---------------------|
| 103 | 103 | MAIN | 97 | 30 | 3103 | 99 | 6.7 | 0.5 | 204 | 21017 | 126 | 12698 | 27 |
| 3 | 3 | SCOUR | 3 | 10 | 31 | 1 | 10.3 | 0.9 | 142 | 427 | 281 | 843 | 42 |

| Total Units | Total Units Fully Measured | Total Length (ft.) | Total Area (sq.ft.) | Total Volume (cu.ft.) |
|-------------|----------------------------|--------------------|---------------------|-----------------------|
| 106 | 106 | 3134 | 21444 | 13541 |

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

Stream Name: Spooner Creek LLID: 1234723392082 Drainage: Navarro River
 Survey Dates: 5/21/2012 to 6/5/2012
 Confluence Location: Quad: BAILEY RIDGE Legal Description: T16NR14WS31 Latitude: 39:12:30.0N Longitude: 123:28:20.0W

| 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 |
|---------------|--------------|------------------------|---------------------------------|-----------------------------|-----------------------------------|-------------------------------|-----------------------------------|-------------------------------|-----------------------------------|-------------------------------|----------------------------------|------------------------------|
| 84 | MCP | 79 | 20 | 24 | 46 | 55 | 17 | 20 | 0 | 0 | 1 | 1 |
| 1 | CCP | 1 | 0 | 0 | 0 | 0 | 1 | 100 | 0 | 0 | 0 | 0 |
| 18 | STP | 17 | 1 | 6 | 14 | 78 | 3 | 17 | 0 | 0 | 0 | 0 |
| 3 | PLP | 3 | 1 | 33 | 1 | 33 | 0 | 0 | 1 | 33 | 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 |
|-------------|---------------------------------|-----------------------------|----------------------------------|------------------------------|----------------------------------|------------------------------|----------------------------------|------------------------------|----------------------------------|------------------------------|
| 106 | 22 | 21 | 61 | 58 | 21 | 20 | 1 | 1 | 1 | 1 |

Mean Maximum Residual Pool Depth (ft.): 1.5

Table 5 - Summary of Mean Percent Cover By Habitat Type

Stream Name: Spooner Creek

LLID: 1234723392082

Drainage: Navarro River

Survey Dates: 5/21/2012 to 6/5/2012

Dry Units: 30

Confluence Location: Quad: BAILEY RIDGE

Legal Description: T16NR14WS31

Latitude: 39:12:30.0N

Longitude: 123:28:20.0W

| 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 |
|---------------|----------------------|--------------|-----------------------|------------|------------|------------------|-------------------------|---------------------------|--------------------|-----------------|-----------------------|
| 13 | 5 | LGR | 0 | 33 | 25 | 0 | 3 | 0 | 0 | 38 | 0 |
| 5 | 2 | HGR | 0 | 15 | 0 | 0 | 20 | 0 | 0 | 65 | 0 |
| 18 | 7 | TOTAL RIFFLE | 0 | 26 | 15 | 0 | 10 | 0 | 0 | 49 | 0 |
| 41 | 4 | RUN | 0 | 50 | 0 | 0 | 25 | 0 | 0 | 25 | 0 |
| 29 | 4 | SRN | 0 | 50 | 0 | 0 | 50 | 0 | 0 | 0 | 0 |
| 70 | 8 | TOTAL FLAT | 0 | 50 | 0 | 0 | 33 | 0 | 0 | 17 | 0 |
| 84 | 84 | MCP | 16 | 38 | 16 | 9 | 6 | 4 | 0 | 10 | 0 |
| 1 | 1 | CCP | 20 | 65 | 0 | 5 | 10 | 0 | 0 | 0 | 0 |
| 18 | 18 | STP | 18 | 34 | 14 | 9 | 10 | 6 | 0 | 9 | 1 |
| 3 | 3 | PLP | 33 | 17 | 13 | 13 | 0 | 0 | 7 | 17 | 0 |
| 106 | 106 | TOTAL POOL | 17 | 37 | 16 | 9 | 7 | 4 | 0 | 10 | 0 |
| 224 | 121 | TOTAL | 16 | 37 | 15 | 8 | 8 | 4 | 0 | 12 | 0 |

Table 6 - Summary of Dominant Substrates By Habitat Type

Stream Name: Spooner Creek

LLID: 1234723392082

Drainage: Navarro River

Survey Dates: 5/21/2012 to 6/5/2012

Dry Units: 30

Confluence Location: Quad: BAILEY RIDGE

Legal Description: T16NR14WS31 Latitude: 39:12:30.0N

Longitude: 123:28:20.0W

| 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 |
|---------------|----------------------|--------------|----------------------------|-----------------------|-------------------------|-------------------------------|-------------------------------|--------------------------|--------------------------|
| 13 | 5 | LGR | 0 | 0 | 60 | 20 | 20 | 0 | 0 |
| 5 | 2 | HGR | 0 | 0 | 50 | 50 | 0 | 0 | 0 |
| 41 | 4 | RUN | 0 | 50 | 50 | 0 | 0 | 0 | 0 |
| 29 | 4 | SRN | 25 | 0 | 75 | 0 | 0 | 0 | 0 |
| 84 | 84 | MCP | 18 | 43 | 29 | 10 | 0 | 1 | 0 |
| 1 | 1 | CCP | 0 | 100 | 0 | 0 | 0 | 0 | 0 |
| 18 | 18 | STP | 6 | 50 | 44 | 0 | 0 | 0 | 0 |
| 3 | 3 | PLP | 0 | 67 | 0 | 33 | 0 | 0 | 0 |

Table 7 - Summary of Mean Percent Canopy for Entire Stream

Stream Name: Spooner Creek

LLID: 1234723392082

Drainage: Navarro River

Survey Dates: 5/21/2012 to 6/5/2012

Confluence Location: Quad: BAILEY RIDGE

Legal Description: T16NR14WS31

Latitude: 39:12:30.0N

Longitude: 123:28:20.0W

| Mean Percent Canopy | Mean Percent Conifer | Mean Percent Hardwood | Mean Percent Open Units | Mean Right Bank % Cover | Mean Left Bank % Cover |
|---------------------|----------------------|-----------------------|-------------------------|-------------------------|------------------------|
| 95 | 62 | 38 | 0 | 99 | 99 |

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: Spooner Creek LLID: 1234723392082 Drainage: Navarro River
 Survey Dates: 5/21/2012 to 6/5/2012 Survey Length (ft.): 6754 Main Channel (ft.): 6734 Side Channel (ft.): 20
 Confluence Location: Quad: BAILEY RIDGE Legal Description: T16NR14WS31 Latitude: 39:12:30.0N Longitude: 123:28:20.0W

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 1

| | | |
|---|--|---|
| Channel Type: G4 | Canopy Density (%): 95.9 | Pools by Stream Length (%): 52.7 |
| Reach Length (ft.): 2059 | Coniferous Component (%): 66.9 | Pool Frequency (%): 55.7 |
| Riffle/Flatwater Mean Width (ft.): 4.4 | Hardwood Component (%): 33.1 | Residual Pool Depth (%): |
| BFW: | Dominant Bank Vegetation: Coniferous Trees | < 2 Feet Deep: 77 |
| Range (ft.): 10 to 30 | Vegetative Cover (%): 97.3 | 2 to 2.9 Feet Deep: 18 |
| Mean (ft.): 14 | Dominant Shelter: Small Woody Debris | 3 to 3.9 Feet Deep: 3 |
| Std. Dev.: 7 | Dominant Bank Substrate Type: Sand/Silt/Clay | >= 4 Feet Deep: 3 |
| Base Flow (cfs.): 0.1 | Occurrence of LWD (%): 9 | Mean Max Residual Pool Depth (ft.): 1.6 |
| Water (F): 52 - 54 Air (F): 52 - 64 | LWD per 100 ft.: | Mean Pool Shelter Rating: 27 |
| Dry Channel (ft): 81 | Riffles: 5 | |
| | Pools: 10 | |
| | Flat: 5 | |
| Pool Tail Substrate (%): Silt/Clay: 3 Sand: 0 Gravel: 67 Sm Cobble: 23 Lg Cobble: 8 Boulder: 0 Bedrock: 0 | | |
| Embeddedness Values (%): 1. 51.3 2. 43.6 3. 0.0 4. 2.6 5. 2.6 | | |

STREAM REACH: 2

| | | |
|---|--|---|
| Channel Type: B4 | Canopy Density (%): 93.8 | Pools by Stream Length (%): 43.6 |
| Reach Length (ft.): 4675 | Coniferous Component (%): 59.5 | Pool Frequency (%): 43.5 |
| Riffle/Flatwater Mean Width (ft.): 3.5 | Hardwood Component (%): 40.5 | Residual Pool Depth (%): |
| BFW: | Dominant Bank Vegetation: Coniferous Trees | < 2 Feet Deep: 79 |
| Range (ft.): 5 to 25 | Vegetative Cover (%): 99.7 | 2 to 2.9 Feet Deep: 21 |
| Mean (ft.): 13 | Dominant Shelter: Small Woody Debris | 3 to 3.9 Feet Deep: 0 |
| Std. Dev.: 5 | Dominant Bank Substrate Type: Sand/Silt/Clay | >= 4 Feet Deep: 0 |
| Base Flow (cfs.): 0.1 | Occurrence of LWD (%): 15 | Mean Max Residual Pool Depth (ft.): 1.4 |
| Water (F): 52 - 56 Air (F): 52 - 74 | LWD per 100 ft.: | Mean Pool Shelter Rating: 29 |
| Dry Channel (ft): 991 | Riffles: 9 | |
| | Pools: 9 | |
| | Flat: 6 | |
| Pool Tail Substrate (%): Silt/Clay: 1 Sand: 18 Gravel: 76 Sm Cobble: 4 Lg Cobble: 0 Boulder: 0 Bedrock: 0 | | |
| Embeddedness Values (%): 1. 61.2 2. 29.9 3. 9.0 4. 0.0 5. 0.0 | | |

Table 9 - Mean Percentage of Dominant Substrate and Vegetation

Stream Name: Spooner Creek

LLID: 1234723392082

Drainage: Navarro River

Survey Dates: 5/21/2012 to 6/5/2012

Confluence Location: Quad: BAILEY RIDGE

Legal Description: T16NR14WS31

Latitude: 39:12:30.0N

Longitude: 123:28:20.0W

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 | 3 | 2.1 |
| Boulder | 1 | 2 | 1.2 |
| Cobble / Gravel | 23 | 8 | 12.8 |
| Sand / Silt / Clay | 95 | 108 | 83.9 |

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 | 1 | 0.4 |
| Brush | 1 | 1 | 0.8 |
| Hardwood Trees | 38 | 24 | 25.6 |
| Coniferous Trees | 82 | 95 | 73.1 |
| No Vegetation | 0 | 0 | 0.0 |

Total Stream Cobble Embeddedness Values: 2

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

StreamName: Spooner Creek

LLID: 1234723392082

Drainage: Navarro River

Survey Dates: 5/21/2012 to 6/5/2012

Confluence Location: Quad: BAILEY RIDGE

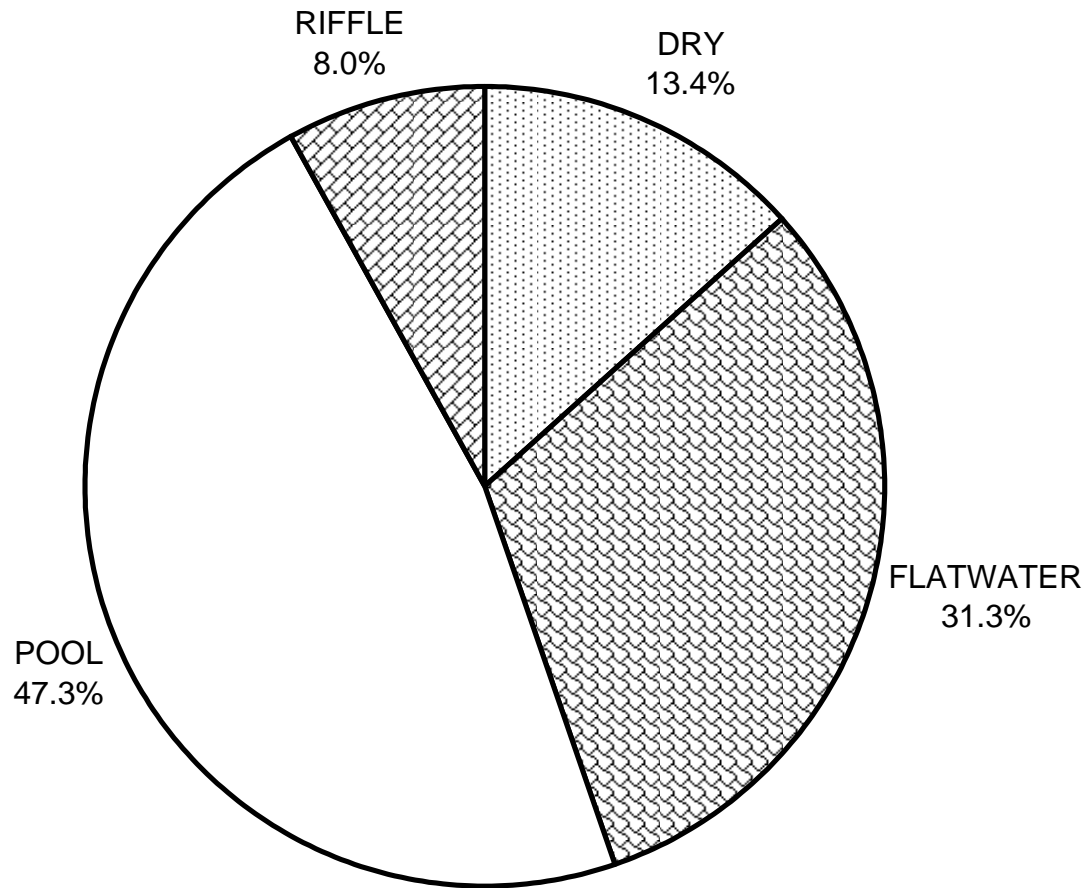
Legal Description: T16NR14WS31

Latitude: 39:12:30.0N

Longitude: 123:28:20.0W

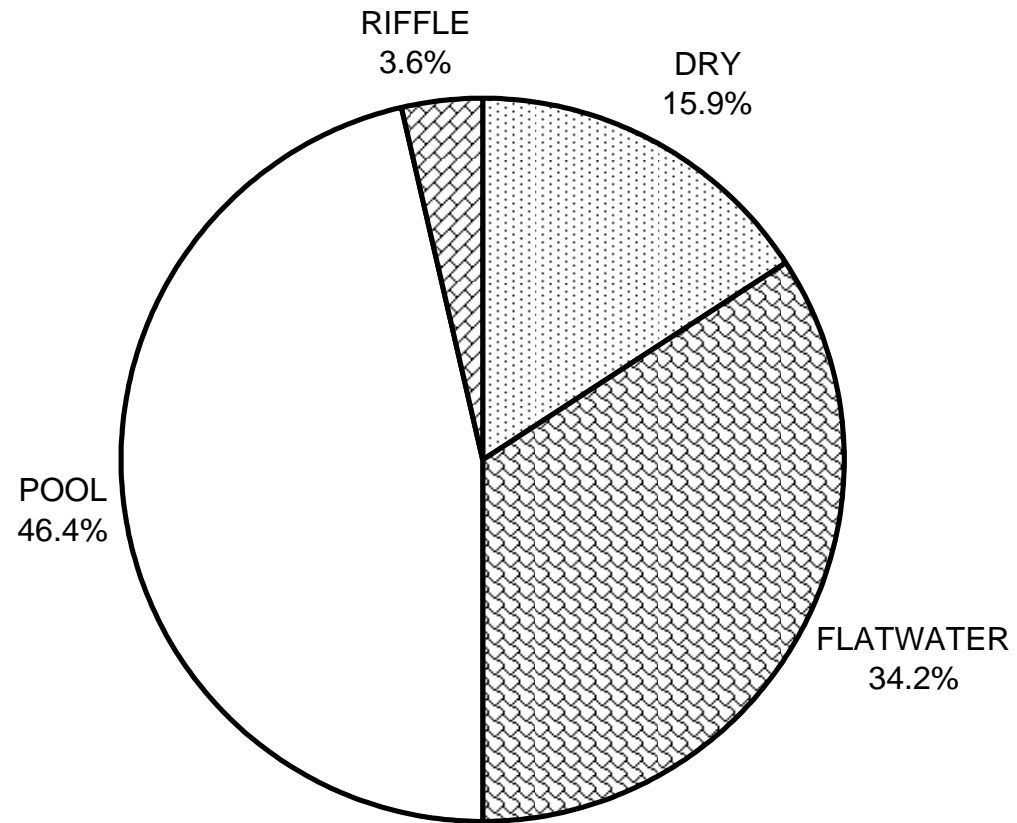
| | Riffles | Flatwater | Pools |
|----------------------------|----------------|------------------|--------------|
| UNDERCUT BANKS (%) | 0 | 0 | 17 |
| SMALL WOODY DEBRIS (%) | 26 | 50 | 37 |
| LARGE WOODY DEBRIS (%) | 15 | 0 | 16 |
| ROOT MASS (%) | 0 | 0 | 9 |
| TERRESTRIAL VEGETATION (%) | 10 | 33 | 7 |
| AQUATIC VEGETATION (%) | 0 | 0 | 4 |
| WHITEWATER (%) | 0 | 0 | 0 |
| BOULDERS (%) | 49 | 17 | 10 |
| BEDROCK LEDGES (%) | 0 | 0 | 0 |

SPOONER CREEK 2012 HABITAT TYPES BY PERCENT OCCURRENCE



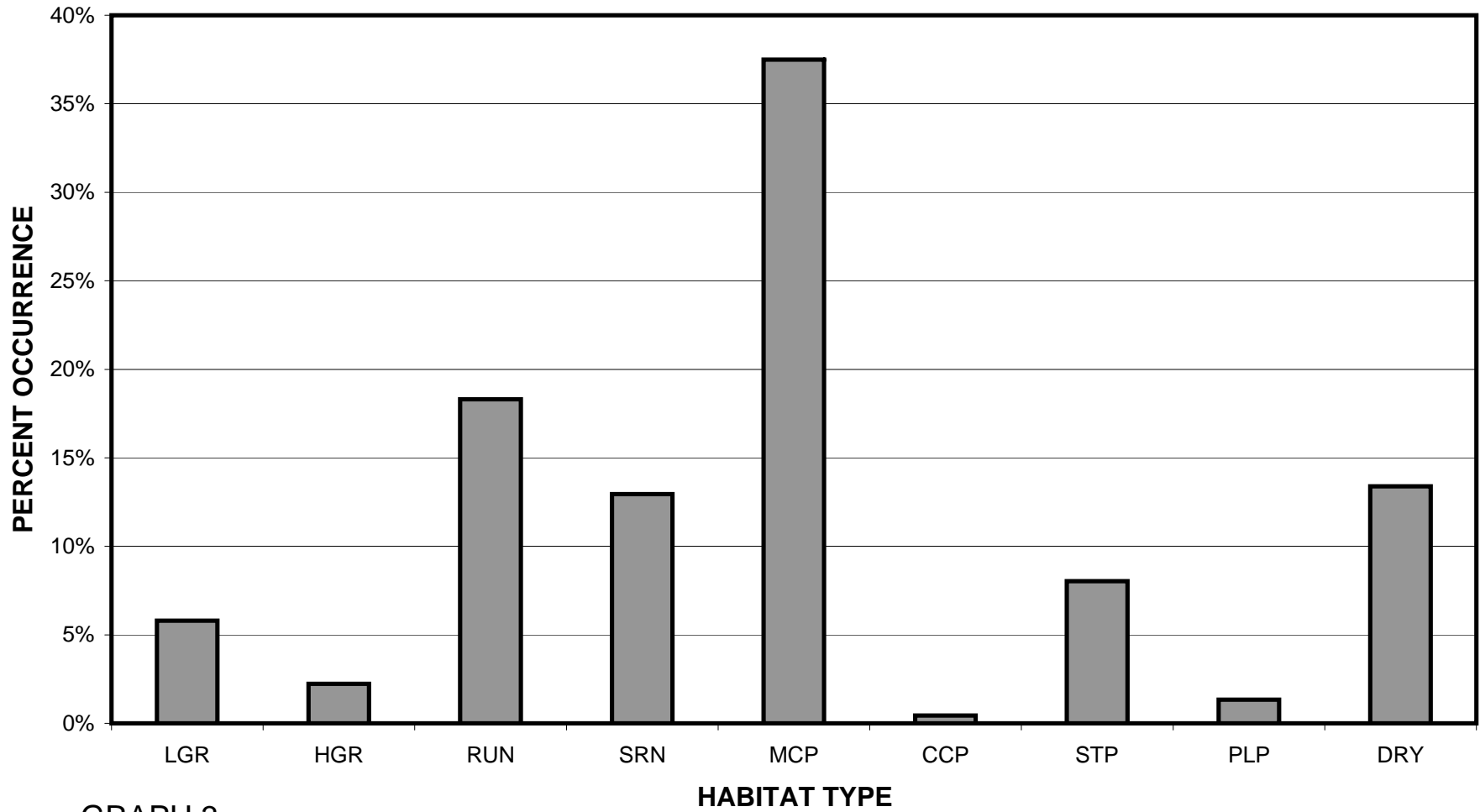
GRAPH 1

SPOONER CREEK 2012 HABITAT TYPES BY PERCENT TOTAL LENGTH



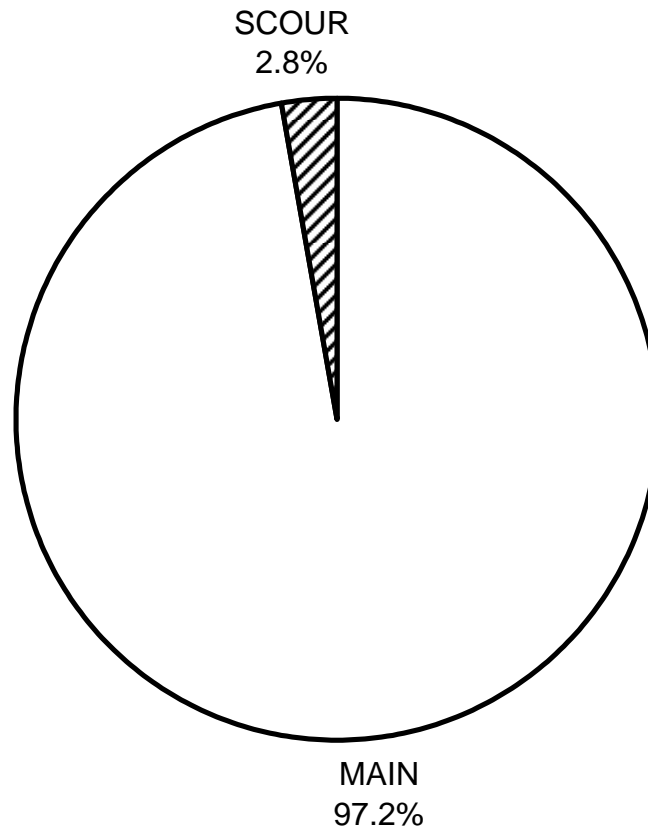
GRAPH 2

SPOONER CREEK 2012 HABITAT TYPES BY PERCENT OCCURRENCE



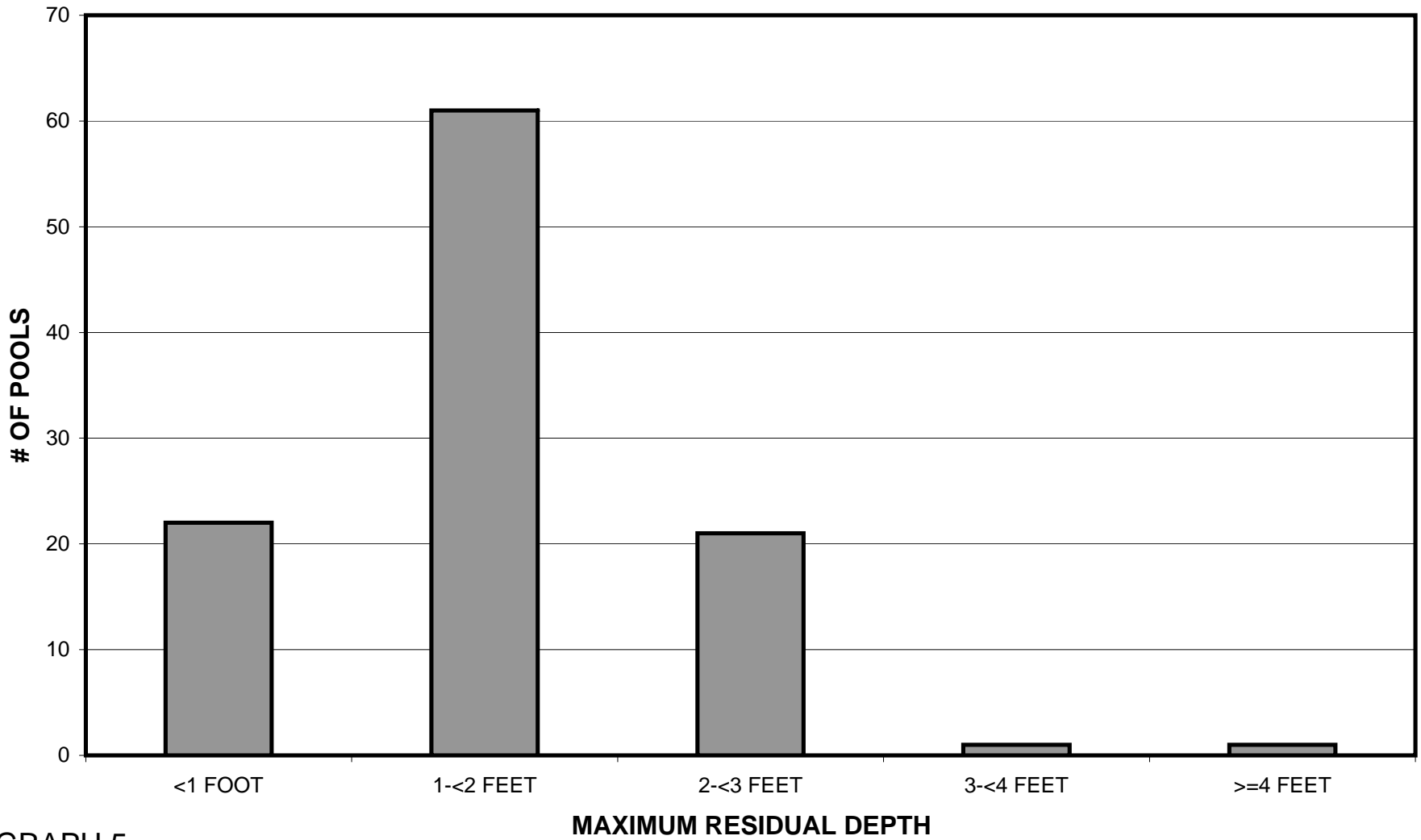
GRAPH 3

SPOONER CREEK 2012 POOL TYPES BY PERCENT OCCURRENCE



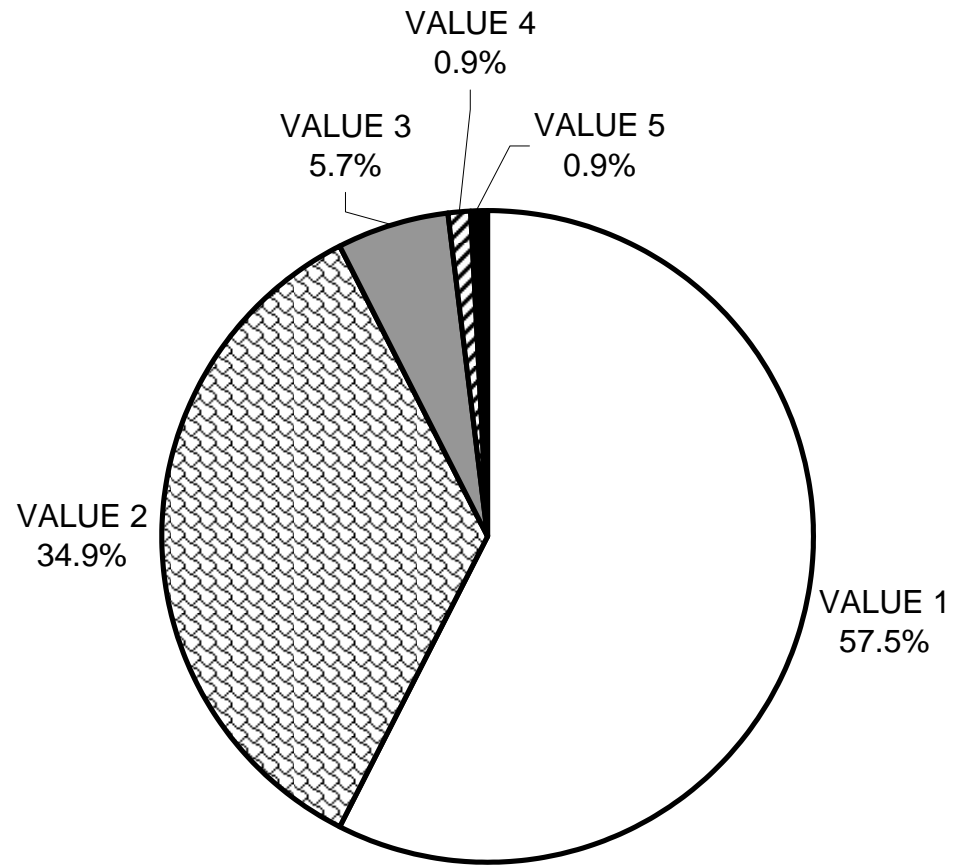
GRAPH 4

SPOONER CREEK 2012 MAXIMUM DEPTH IN POOLS



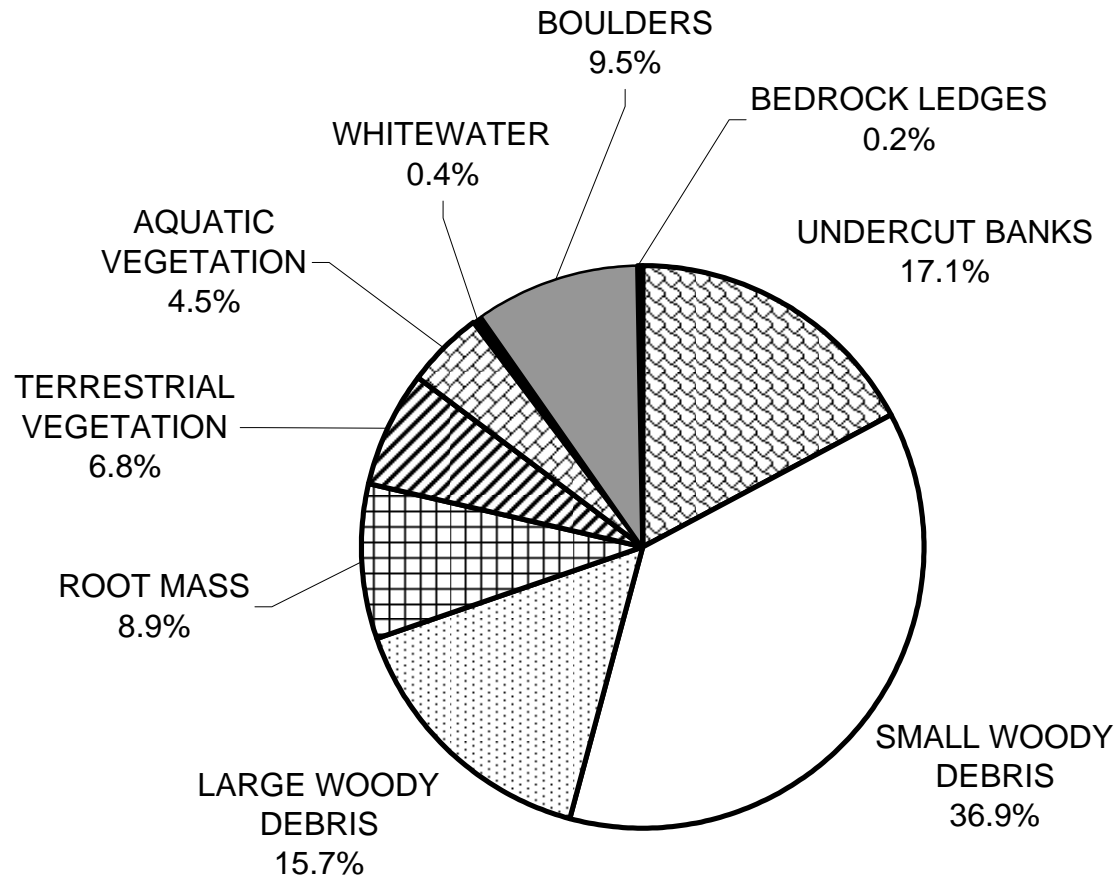
GRAPH 5

SPOONER CREEK 2012 PERCENT EMBEDDEDNESS



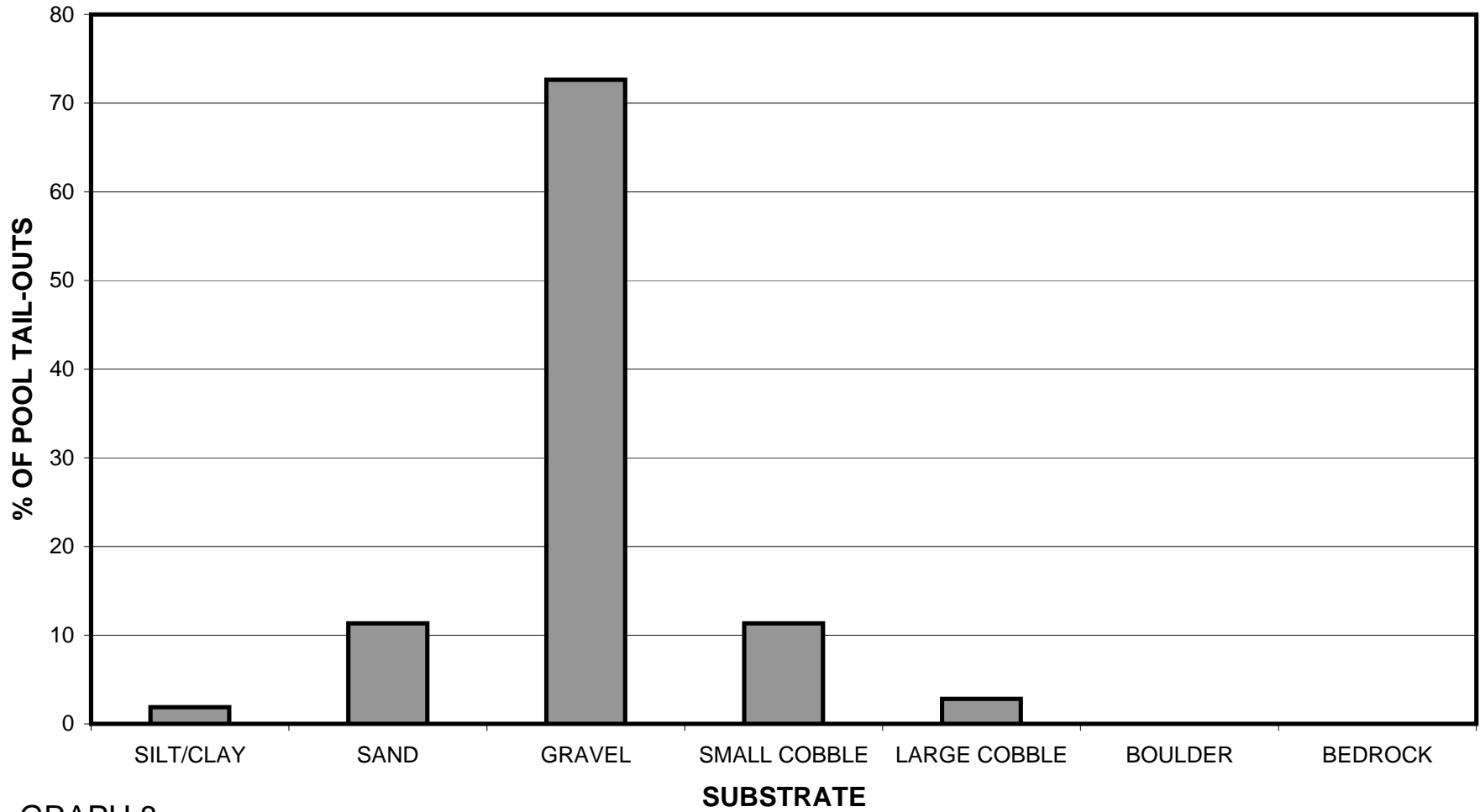
GRAPH 6

SPOONER CREEK 2012 MEAN PERCENT COVER TYPES IN POOLS



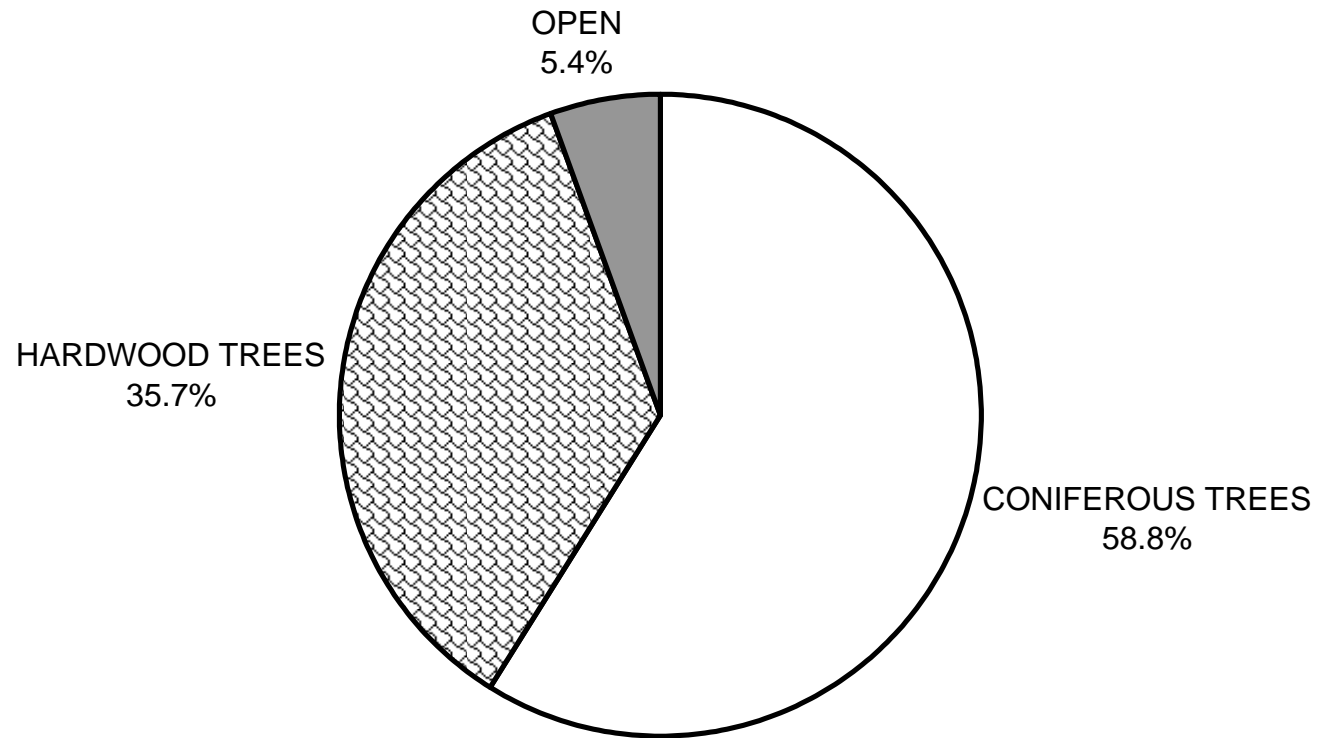
GRAPH 7

SPOONER CREEK 2012 SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



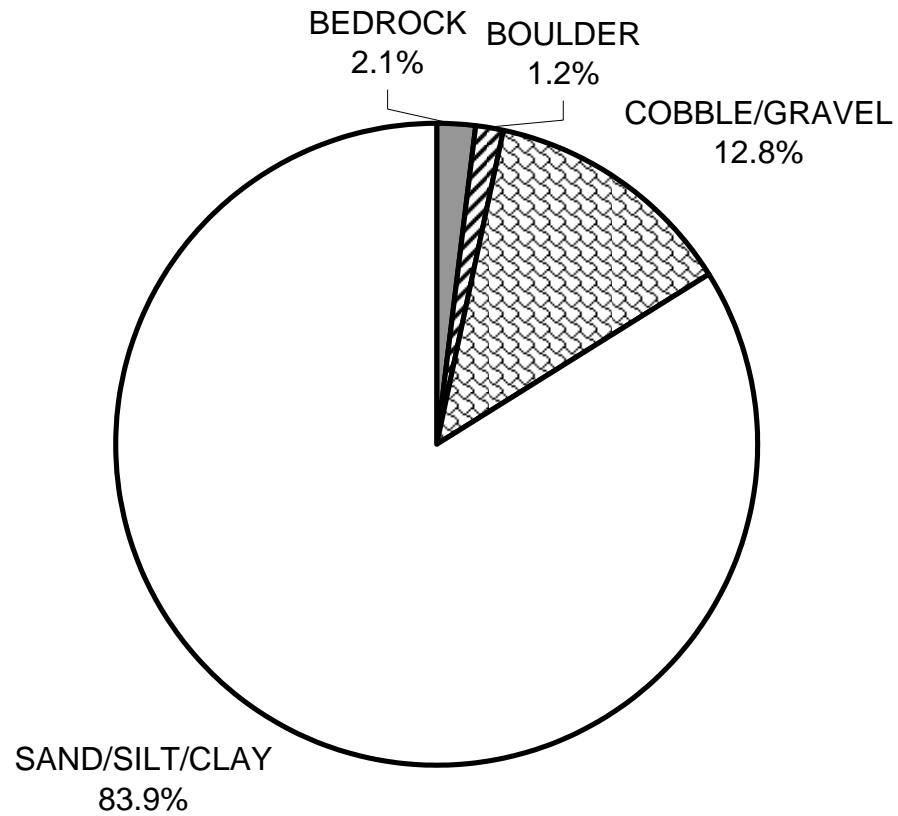
GRAPH 8

SPOONER CREEK 2012 MEAN PERCENT CANOPY



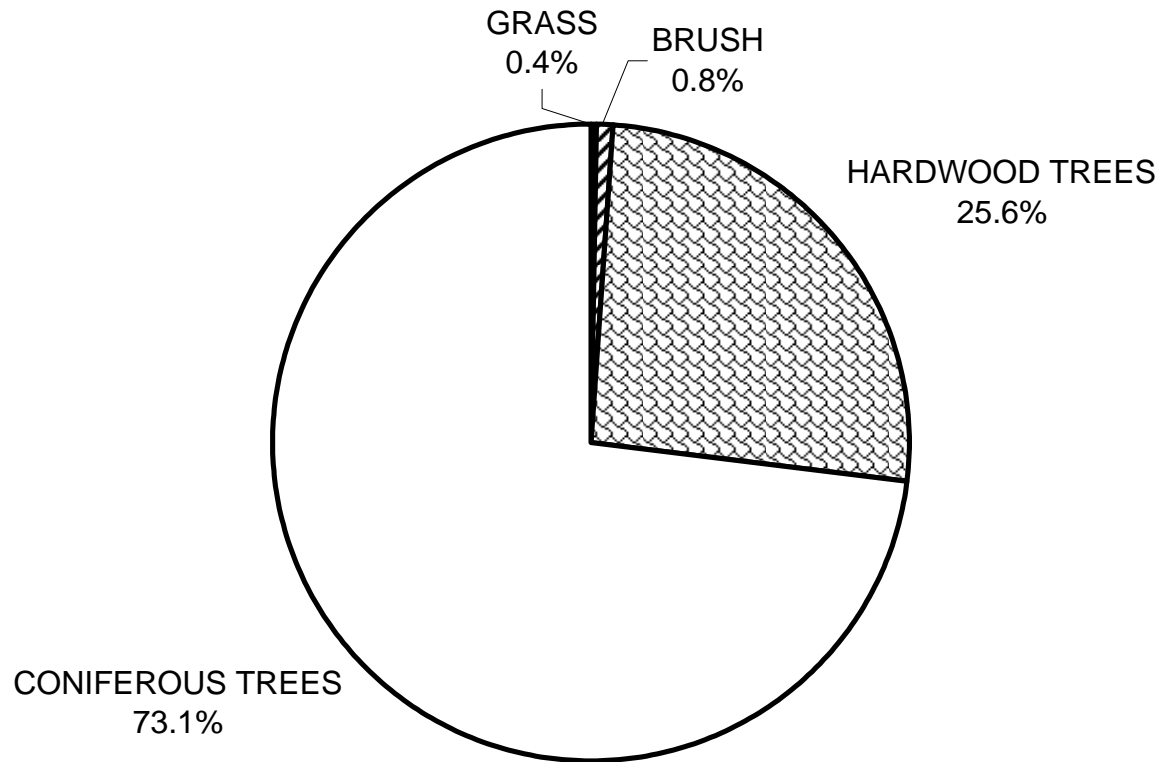
GRAPH 9

SPOONER CREEK 2012 DOMINANT BANK COMPOSITION IN SURVEY REACH



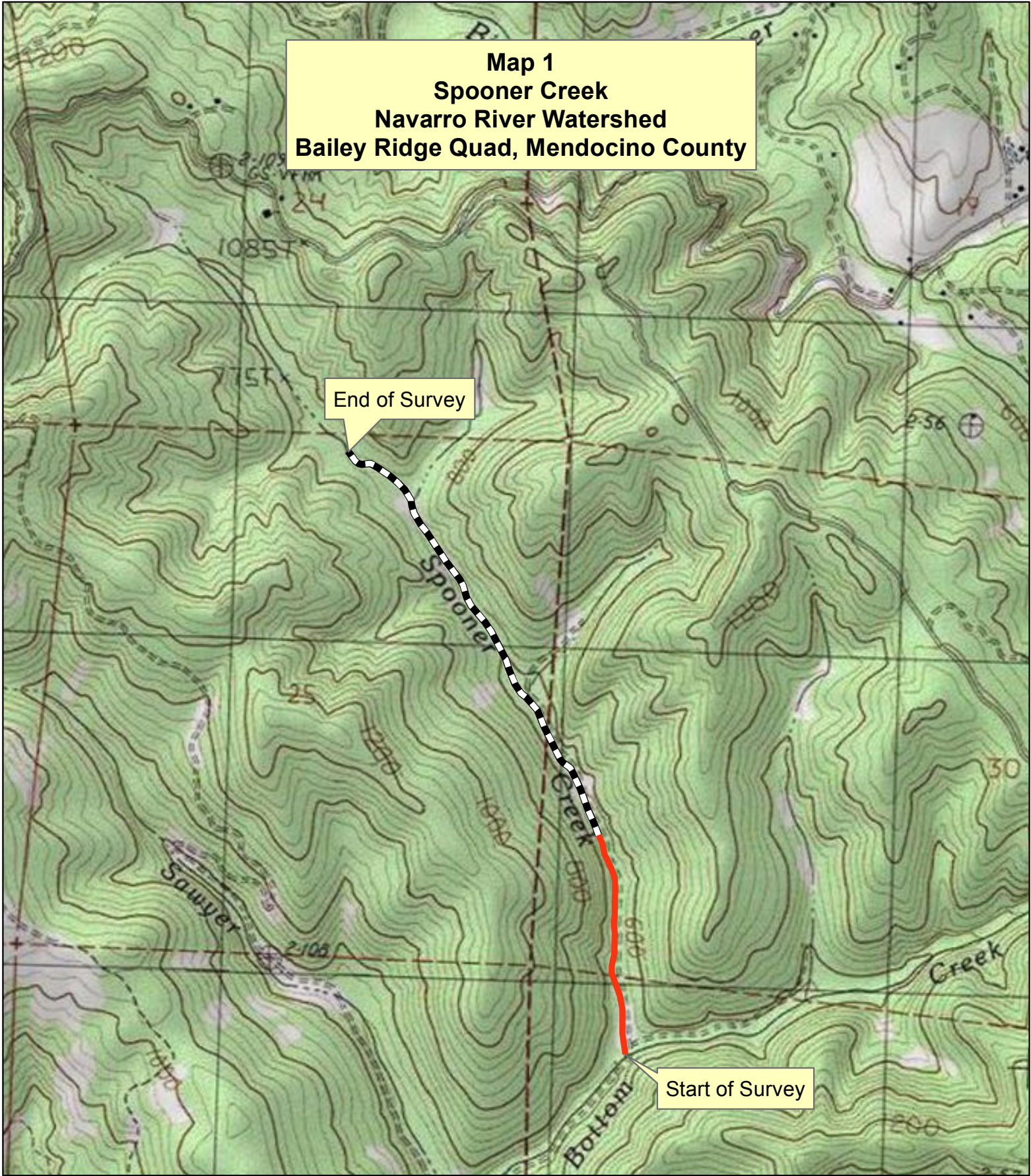
GRAPH 10

SPOONER CREEK 2012 DOMINANT BANK VEGETATION IN SURVEY REACH



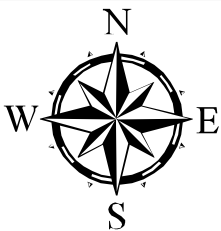
GRAPH 11

Map 1
Spooner Creek
Navarro River Watershed
Bailey Ridge Quad, Mendocino County



End of Survey

Start of Survey



- Reach 1, Channel Type G4
- - - Reach 2, Channel Type B4

