STREAM INVENTORY REPORT

Freshwater Creek

INTRODUCTION

A stream inventory was conducted from in the summer of 2004 on Freshwater Creek. The survey began approximately 4,000 feet upstream of the confluence with Graham Gulch, at the Pal Camp Road Bridge, and continued upstream 4.8 miles.

The Freshwater 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 Freshwater 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

Freshwater Creek is a tributary to Freshwater Slough, a tributary to Eureka Slough, a tributary to Humboldt Bay, which drains to the Pacific Ocean. It is located in Humboldt County, California (Map 1). Freshwater Creek's legal description at the confluence with Freshwater Slough is T05N R01E S29. Its location is 40.7867 degrees north latitude and 124.0964 degrees west longitude, LLID number 1240963407867. Freshwater Creek is a third order stream and has approximately 33.1 miles of blue line stream, including all tributaries, according to the USGS Arcata South 7.5 minute quadrangle. Freshwater Creek drains a watershed of approximately 30.7 square miles. Elevations range from about three feet at the mouth of the creek to 2,200 feet in the headwater areas. Redwood forest dominates the watershed. The watershed is primarily privately owned and is managed predominantly for timber production. Vehicle access exists via Old Arcata Road to Freshwater-Kneeland Road.

METHODS

The habitat inventory conducted in Freshwater Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi et al, 1998). The California Conservation Corps (CCC) Technical Advisors 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.

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SAMPLING STRATEGY

The inventory uses a method that measures all habitat units within the survey reach, classifying each according to habitat type. Each habitat unit is measured for all the parameters and characteristics on the field form. 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 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 Freshwater 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". Freshwater 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 Freshwater Creek, embeddedness was ocularly estimated. The values were recorded using the following ranges: 0 - 25% (value 1), 26 - 50% (value 2), 51 - 75% (value 3) and 76 - 100% (value 4). Additionally, a value of 5 was assigned to tail-outs deemed unsuited for spawning due to inappropriate substrate like bedrock, log sills, boulders or other considerations.

6. Shelter Rating:

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

7. Substrate Composition:

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

8. Canopy:

Stream canopy density was estimated using modified handheld spherical densiometers as described in the *California Salmonid Stream Habitat Restoration Manual*. Canopy density relates to the amount of stream shaded from the sun. In Freshwater 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 Freshwater Creek, the dominant composition type and the dominant vegetation type of both the right and left banks for each fully-described unit were selected from the habitat inventory form. Additionally, the percent of each bank covered by vegetation (including downed trees, logs, and rootwads) was estimated and recorded.

10. Large Woody Debris Count:

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

11. Average Bankfull Width:

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

BIOLOGICAL INVENTORY

Biological sampling 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 Cloney Gulch. In addition, selected sites were sampled using a Smith-Root Model 12 electrofisher and underwater observations, as discussed in unpublished data from the Juvenile Salmonid Abundance Summer Survey Report, 2004 (Richer, S., McCanne, D. 2004).

DATA ANALYSIS

Data from the habitat inventory form are entered into Stream Habitat 2.0.9, a Visual Basic data entry program developed by Karen Wilson, Pacific States Marine Fisheries Commission in conjunction with the California Department of Fish and Game. This program processes and summarizes the data, and produces the following ten tables:

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

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Graphics are produced from the tables using Microsoft Excel. Graphics developed for Freshwater 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 from July 20 to August 18, 2004 was conducted by Janelle Breton and Cassie Simons (CCC). The total length of the stream surveyed was 25,544 feet with an additional 588 feet of side channel.

Stream flow was measured near the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 0.5 cfs on July 28, 2004.

Freshwater Creek is an F3 channel type for 16,781 feet of the stream surveyed (Reach 1), an F4 channel type for 782 feet of the stream surveyed (Reach 2), an F3 channel type for 976 feet of the stream surveyed (Reach 3), an A2 channel type for 1,083 feet of the stream surveyed (Reach 4), a B3 channel type for 1,061 feet of the stream surveyed (Reach 5), an F4 channel type for 1,761 feet of the stream surveyed (Reach 6), a B3 channel type for 1,729 feet of the stream surveyed (Reach 7), a B2 channel type for 642 feet of the stream surveyed (Reach 8), and an A2 channel type for 729 feet of the stream surveyed (Reach 9). F3 channels are entrenched meandering riffle/pool channels on low gradients with a high width/depth ratio, and cobble dominated substrates. F4 channels have gravel-dominant substrates. A2 channels are steep, narrow, cascading, step-pool, high energy debris transporting channels associated with depositional soils, and boulder dominant substrates. B2 channels are moderately entrenched, with a moderate gradient, riffle dominated channel with infrequently spaced pools, very stable plan and profile, stable banks, and boulder dominant substrates. B3 channels have cobble dominant substrates.

Water temperatures taken during the survey period ranged from 54 to 69 degrees Fahrenheit. Air temperatures ranged from 61 to 79 degrees Fahrenheit

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Table 1 summarizes the Level II riffle, flatwater and pool habitat types. Based on frequency of occurrence there were 39% pool units, 31% riffle units, 27% flatwater units, and 3% dry units (Graph 1). Based on total length of Level II habitat types there were 43% pool units, 31% flatwater units, 24% riffle units and 2% dry units (Graph 2).

Sixteen Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were 33% mid-channel pool units, 28% low gradient riffle units and 14% run units (Graph 3). Based on percent total length, 38% were mid-channel pool units, 22% were low gradient riffle units, and 13% were run units.

A total of 170 pools were identified (Table 3). Main channel pools were the most frequently encountered, at 89%, and comprised 92% of the total length of all pools (Graph 4).

Table 4 is a summary of maximum residual pool depths by pool habitat types. Pool quality for salmonids increases with depth. Forty-seven of the 169 pools (28%) measured had a residual depth of three feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 170 pool tail-outs measured, 28 had a value of 1 (16%); 74 had a value of 2 (44%); 30 had a value of 3 (18%); five had a value of 4 (3%); 33 had a value of 5 (19%); (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 28, flatwater habitat types had a mean shelter rating of 33, and pool habitats had a mean shelter rating of 64 (Table 1). Of the pool types, the main channel pools had the highest mean shelter rating at 64. Scour pools had a mean shelter rating of 62 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover type in Freshwater Creek. Graph 7 describes the pool cover in Freshwater Creek. Boulders are 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. Small cobble was observed in 43% of pool tail-outs, and gravel was observed in 25% of pool tail-outs.

The mean percent canopy density for the surveyed length of Freshwater Creek was 83%. Seventeen percent of the canopy was open (Table 7). Of the mean percent canopy density, the mean percentages of hardwood and coniferous trees were 55% and 45%, respectively. Graph 9 describes the mean percent canopy in Freshwater Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 87%. The mean percent left bank vegetated was 88%. The dominant elements composing the structure of the stream banks consisted of 51% cobble/gravel, 21% sand/silt/clay, 16% boulders, and 13% bedrock (Graph 10). Hardwood trees were the dominant vegetation type observed in 51% of the

units surveyed. Additionally, 37% of the units surveyed had coniferous trees as the dominant vegetation type, and 7% had brush as the dominant vegetation (Graph 11).

BIOLOGICAL INVENTORY RESULTS

A biological survey was conducted by the Institute for River Ecosystems in cooperation with the Department of Fish and Game. The sample reach included 25,544 feet. Coho were observed throughout Reaches 1 through 7 and approximately 152 feet into Reach 8, a total distance of 24,345 feet. In this survey trout species were not distinguished and include cutthroat trout and steelhead/rainbow trout, both resident and anadromous forms. Trout were observed throughout the entire sample reach, a total distance of 25,544 (Ricker, S., McCanne, D. Unpublished Data, 2004). Juvenile salmonids were also observed from the stream banks in all nine reaches, a total distance of 25,544 feet in Freshwater Creek.

DISCUSSION

Freshwater Creek is an F3 channel type for the first 16,781 feet of stream surveyed, an F4 channel type for the next 782 feet, an F3 channel type for the next 976 feet, an A2 channel type for the next 1,083 feet, a B3 channel type for the next 1,061 feet, an F4 channel type for the next 1,761 feet, a B3 channel type for the next 1,729 feet, a B2 channel type for the next 642 feet, and an A2 channel type for the remaining 729 feet. The suitability of these channel types for fish habitat improvement structures is as follows: F3 channel types are good for bank-placed boulders and single and opposing wing-deflectors; fair for plunge weirs, boulder clusters, channel constrictors, and log cover. F4 channel types are good for bank-placed boulders; fair for plunge weirs, single and opposing wing-deflectors, channel constrictors, and log cover; and poor for boulder clusters. A2 channel types are generally not suitable for improvement structures. B3 channel types are excellent for plunge weirs, boulder clusters and bank-placed boulders, single and opposing wing-deflectors, and log cover. B2 channel types are excellent for plunge weirs, single and opposing wing-deflectors, and log cover.

The water temperatures recorded on the survey days July 20 to August 18, 2004 ranged from 54 to 69 degrees Fahrenheit. Air temperatures ranged from 61 to 79 degrees Fahrenheit. The upper range of these water temperatures if prolonged, are over the threshold of stress level for juvenile 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 31% of the total length of this survey, riffles 24%, and pools 43%. The pools are relatively deep, with 107 of the 169 (63%) pools having 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. Although Freshwater Creek is a third order stream, the portion of Freshwater Creek inventoried is a second order stream. 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.

One-hundred-two of the 169 pool tail-outs measured had embeddedness ratings of 1 or 2. Thirty-four of the pool tail-outs had embeddedness ratings of 3 or 4. Thirty-three of the pool tail-outs had a rating of 5, which is considered not suitable 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 Freshwater Creek should be mapped and rated according to their potential sediment yields, and control measures should be taken.

One-hundred-fifteen of the 169 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 was 64. The shelter rating in the flatwater habitats was 33. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by boulders in Freshwater Creek. Boulders are 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 83%. Reach 1 had a canopy density of 81%, Reach 2 had a canopy density of 81%, Reach 3 had a canopy density of 86%, Reach 4 had a canopy density of 84%, Reach 5 had a canopy density of 88%, Reach 6 had a canopy density of 84%, Reach 7 had a canopy density of 84%, Reach 8 had a canopy density of 92%, and Reach 9 had a canopy density of 89%. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was 87% and 88%, 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) Freshwater Creek should be managed as an anadromous, natural production stream.

2) The limited water temperature data available suggest that maximum temperatures are nearing the threshold stress level range for juvenile salmonids. To establish more complete and meaningful temperature regime information, 24-hour monitoring during the July and August temperature extreme period should be performed for 3 to 5 years.

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

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

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 3.8 road miles from Three Corners at the steel bridge to Palco gate. Left bank consists of rip-rap. Channel type is a F3 (Reach 1).
159	0004.00	Right bank consists of rip-rap.
658	0012.00	Foot bridge.
934	0014.00	Right bank erosion site measures 10' high x 30' long x 2' deep.
1398	0020.00	Humboldt Fish Action Council (HFAC) 2200 meter marker.
1704	0022.00	Left bank erosion site measures 7' high x 70' long x 1' deep contributing sediment.
2585	0032.00	HFAC 2500 meter marker.
2873	0037.00	HFAC 2600 meter marker.
3178	0039.00	HFAC 2700 meter marker.
3946	0047.00	Left bank failure with trees in the creek.
4038	0048.00	Left bank erosion site measures 7' high x 100' long x 1' deep.
4081	0049.00	Right bank log debris accumulation (LDA) with approximately 14 pieces of large wood.
4135	0050.00	HFAC 3000 meter marker at top of unit.
4229	0052.00	Left bank tributary.
4274	0052.02	LDA in side channel with approximately 16 pieces of large wood. Fish habitat improvement structure at top of side channel.
4463	0056.00	Fish habitat improvement structure.

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4584	0057.00	Left bank erosion site measures 9' high x 90' long x 2' deep and is contributing sediment to stream.
4729	0059.00	HFAC 3200 meter marker.
5437	0068.00	Left bank LDA.
5576	0072.00	Left bank erosion site measures 8' high x 20' long x 5' deep.
5842	0075.00	HFAC 3500 meter marker at start of unit.
6120	0078.00	Left bank spring 15' into unit, contributing silt to creek. HFAC 3600 meter marker.
7581	0098.00	Right bank erosion site measures 30' high x 10' long x 10' deep. It is vegetated, but contributing some sediment to creek.
7859	0101.00	Dry and steep left bank drainage.
7948	0103.00	Left bank tributary. Right bank erosion site measures 7' high x 30' long x 2' deep.
8161	0106.00	HFAC 4200 meter marker.
8195	0107.00	Hobo temperature gauge.
8430	0111.00	HFAC 4300 meter marker.
8546	0114.00	Left bank erosion site measures 40' high x 50' long and contributing sediment to creek.
8773	0117.00	HFAC 4400 meter marker.
8979	0121.00	Left bank erosion site measures 6’ high x 40’ long x 1’ deep and is contributing sediment to the channel.
9099	0122.00	HFAC 4500 meter marker.
9099	0122.00	Fish habitat improvement structure.
9447	0129.00	HFAC 4600 meter marker.
9693	0134.00	HFAC 4700 meter marker. Left bank erosion site measures 25’ high x 70’ long x 5’ deep and is contributing sediment to the creek.
9784	0135.00	South Fork Freshwater Creek enters on the left bank with a flow of approximately 0.3 cfs. The temperature of Freshwater creek

		downstream and upstream of the tributary was 64 degrees Fahrenheit. The temperature of the tributary was 63 degrees Fahrenheit. See South Fork Freshwater Creek Inventory Report.
9939	0137.00	Flow gage station.
10093	0140.00	Fish habitat improvement structure.
10173	0141.00	Sand bags on left bank for erosion control.
10402	0145.00	Left bank erosion site measures 7’ high x 20’ long x 4’ deep.
10659	0149.00	Right bank erosion site measures 6' high x 40' long x 1' deep, contributing sediment to the creek.
10812	0152.00	HFAC 300 meter marker.
11358	0161.00	LDA with approximately 13 pieces of large wood.
11474	0163.00	HFAC 500 meter marker.
11693	0166.00	LDA measures 5’ high x 50’ wide x 100’ long on the right bank and contains 20 pieces of large wood. It is contributing to left bank erosion site measuring 6’high x 30’ long x 1’ deep.
11916	0170.00	HFAC 600 meter marker.
12031	0173.00	Right bank erosion site measures 9’ high x 25’ long x 1’ deep.
12281	0178.00	Right bank tributary, approximately a 2% gradient, accessible to fish.
12445	0180.00	Fish habitat improvement structure.
12546	0182.00	Juvenile salmonids observed.
12584	0183.00	HFAC 800 meter mark. Left bank tributary. Not accessible to fish.
12790	0187.00	LDA measures 12’ high x 50’ wide x 30’ long and contains 30 pieces of large wood. It is associated with right bank erosion site measuring 6’ high x 50’ long. Fish observed upstream of LDA.
12910	0188.00	HFAC 900 meter mark.
13169	0193.00	Right bank failure measuring 6’ high x 25’ long x 1’ deep.
13303	0195.00	HFAC 1000 meter mark.

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13514	0197.00	Left bank erosion.
13568	0199.00	HFAC 1100 meter mark.
13935	0205.00	HFAC 1200 meter mark.
14023	0206.00	Left bank tributary. The tributary had a water temperature of 60 degrees Fahrenheit. The temperature of Freshwater Creek upstream and downstream of the tributary was 64 degrees Fahrenheit. It is accessible to fish, with a 6% slope. The tributary was dry for the first 10 feet.
14540	0212.00	HFAC 1400 meter mark.
14712	0216.00	LDA mostly on left bank. It is not retaining sediment.
14976	0220.00	Small slide on right bank with massive cutting. The slide measures 14' high x 7' long x 4' deep. Erosion from cutting measures 6' high x 30' long x 4' deep.
15111	0222.00	Left bank erosion site measures 20' high x 20' long x 10' deep. It is mostly vegetated with stabilizing riprap.
15218	0225.00	HFAC 1600 meter marker.
15265	0226.00	Fish habitat improvement structure.
15563	0230.00	HFAC 1700 meter marker.
15708	0233.00	LDA measures 4' high x 40' wide x 3' long and is composed of nine pieces of large wood.
15879	0237.00	LDA measures 8' high x 60' wide x 15' long, with approximately 15 pieces of large woody debris. It is retaining a volume of sediment 2' deep. Right bank erosion site measures 7' high x 40' long.
15966	0239.00	HFAC 1800 meter mark. Juvenile salmonids observed.
16183	0244.00	LDA measures 30' high x 50' wide x 120' long and contains approximately 100 pieces of large woody debris. It is retaining a volume of gravel and cobble measuring 5' dee. Fish were seen upstream of the LDA.
16223	0245.00	HFAC 1900 meter mark.
16250	0246.00	Access point.
16380	0248.00	Juvenile salmonids observed.

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16669	0254.00	Left bank erosion site measures 8’ high x 60’ long x 6’ deep.
16781	0256.00	HFAC 2100 meter mark, 30 feet from top of unit. Channel type changes to an F4 (Reach 2).
16950	0257.00	LDA measures 16’ high x 30’ wide x 30’ long, with approximately 20 pieces of large woody debris. It is retaining a volume of sand and gravel measuring 2’ deep. Small woody debris is also being retained. Fish were seen above the LDA.
17215	0260.00	Fish habitat improvement structures on the right and left bank. HFAC 2200 meter mark.
17408	0262.00	LDA measures 9’ high x 50’ wide x 10’ long, with approximately 11 pieces of large wood. It is retaining a volume of sand and gravel measuring 4’ deep. Fish were seen upstream of the LDA.
17499	0264.00	Five foot diameter log is spanning the creek and is three feet from the river bed.
17563	0266.00	LDA on left bank. Channel type changes to an F3 (Reach 3).
17946	0272.00	HFAC 2400 meter mark.
18010	0274.00	Fish habitat improvement structure.
18357	0277.00	HFAC 2500 meter mark. Right bank erosion site measures 7’ high x 60’ long x 1’ deep.
18539	0279.00	Channel type changes to an A2 (Reach 4).
18561	0280.00	LDA on the right bank, not spanning the creek, measures 10’ high x 20’ wide x 15’ long, with approximately eight pieces of large woody debris.
18606	0282.00	Log spanning creek retaining some sediment.
18668	0284.02	HFAC 2600 meter mark.
18690	0286.00	Two foot high plunge.
18822	0288.00	Five foot high plunge.
18948	0291.00	Right bank erosion site measures 15’ high x 20’ long x 5’ deep, 40 feet into the unit, and is contributing fine sediment to the channel.

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19072	0292.00	Right bank erosion site measures 30’ high x 30’ long, vegetated. HFAC 2700 meter mark.
19285	0297.00	Left bank tributary, flowing. The water temperature of Freshwater Creek upstream of the tributary was 58 degrees Fahrenheit, and downstream was 61 degrees Fahrenheit. The tributary temperature was 61 degree Fahrenheit. It is accessible to fish, however no fish were observed. The tributary has a 10% slope measured with a clinometer and is very entrenched, and therefore is probably not accessible to salmonids. Left bank erosion site measures 10’ high x 20’ long and is contributing sediment to the channel.
19327	0298.00	LDA composed of four pieces of large wood. Not retaining sediment.
19492	0302.01	The channel is filled with about 10 large pieces of large woody debris that create a very wide channel.
19492	0303.00	Right bank slide measures 75’ high x 25’ long and is contributing sediment to the creek. Four foot high plunge.
19622	0305.00	Channel type changes to a B3 (Reach 5).
19830	0308.00	LDA measures 8’ high x 80’ wide x 12’ long, with approximately 40 pieces large wood. A volume of gravel is being retained measuring 5’ deep. Fish were seen upstream of LDA.
20096	0315.00	Palco monitoring station.
20120	0316.00	Foot bridge measures 9’ high 10’ long x 4’ wide.
20152	0317.00	ATV trail. End of the Palco monitoring station.
20270	0320.00	Left bank erosion site measures 12’ high x 7’ long. LDA measures 15’ high x 60’ wide x 15’ long, with approximately 15 pieces of large wood. It is retaining a volume of sand, gravel, and cobble measuring 3’ deep. Fish were seen above the LDA.
20430	0321.02	LDA measures 10’ high x 35’ wide x 10’ long, with approximately 16 pieces of large wood. It is retaining a volume of sand and silt measuring 8’ deep. Fish were seen upstream of the LDA. There would be a 5’ plunge if the water flowed over the log jam. Currently the flow is subsurface.
20430	0321.03	LDA measures 15’ high x 65’ wide x 20’ long, with approximately 41 pieces of large woody debris. It is retaining a volume of sand and gravel measuring 4’ deep. Fish were seen upstream.

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20430	0322.00	Left bank tributary, wet but not flowing, enters 49 feet into the unit, not accessible to fish.
20513	0323.00	HFAC 3100 meter marker.
20683	0329.00	LDA measures 25’ high x 40’ wide x 80’ long, with approximately 85 pieces of large woody debris. It is retaining a volume of sand and gravel measuring 3’ deep. Juvenile salmonids were seen upstream. Channel type changes to an F4 (Reach 6).
20740	0330.00	Left bank slide 75’ into the unit, measures 30’ high x 55’ long and is actively eroding. There is also a right bank slide measuring 40’ high x 30’ long.
20871	0332.00	LDA 57’ into the unit, measures 10’ high x 40’ wide x 20’ long, with approximately seven pieces of large wood. It is retaining a volume of gravel and cobble measuring 5’ deep.. Flow is subsurface through the LDA.
20941	0333.00	Old railroad ties in creek.
21011	0335.00	Juvenile salmonids observed.
21212	0339.00	HFAC 3300 meter marker.
21352	0340.00	LDA measures 9’ high x 65’ wide x 40’ long, with approximately 35 pieces of large wood. It is retaining a volume of gravel and cobble measuring 4’ deep. Fish were seen upstream of the LDA.
21419	0342.00	LDA with approximately 11 pieces of large wood on the right bank, not spanning the channel.
21536	0345.00	HFAC 3400 meter marker.
22033	0356.00	HFAC 3600 meter marker. LDA measures 25’ high x 90’ wide x 90’ long, with approximately 100 pieces of large wood. It is retaining a volume of sediment measuring 20’ wide x 300’ long x 4-15’ deep. Right bank side channel is a possible way for fish to get around this LDA.
22162	0357.00	The unit is dry from the sediment retention of the LDA at 22033.
22184	0358.00	Right bank erosion site measures 10’ high x 10’ long x 5’ deep. Additional right bank erosion 40 feet into unit measures 10’ high x 10’ long x 5’ deep.

Freshwater Creek

22281	0360.00	Left bank tributary contributing approximately 15% to the flow of Freshwater Creek. The temperature of Freshwater Creek upstream and downstream of the tributary was 61 degrees Fahrenheit. The water temperature of the tributary was 59 degree Fahrenheit. It has a slope of 4% measured with a hand level. Salmonids observed in the tributary.
22405	0361.00	Left bank tributary, dry at the confluence, but flowing above, has a 4% slope measured with a hand level. Salmonids observed in the tributary.
22444	0362.00	HFAC 3700 meter marker. Channel type changes to a B3 (Reach 7).
23045	0374.00	Five foot diameter log spans the channel. Right bank tributary enters 25 feet into unit, which is dry and entrenched.
23125	0376.00	Right bank erosion site measures 17’ high x 20’ long x 10’ deep and is contributing sediment to the channel.
23136	0377.00	HFAC 3900 meter marker.
23205	0378.00	Right bank slide measures 50’ high x 60’ long x 40’ deep and is actively contributing sediment to the channel.
23287	0379.00	At top of unit there is a 9.5 foot high plunge. LDA measures 9’ high x 55’ wide x 25’ long, with 21 pieces of large wood. It is retaining a volume of sand and gravel measuring 20’ wide x 70’ long x 4’ deep. Fish were seen above the LDA.
23399	0382.00	There is a three foot plunge at the top of the unit. Left bank erosion site measures 26’ high x 12’ long x 10’ deep.
23445	0383.00	Right bank erosion site measures 50’ high x 37’ long x 25’ deep, with 15 pieces of large wood. Long, loose LDA retaining sediment ranging in size from gravel to cobble. Not a barrier to fish.
23582	0385.00	Right bank erosion site measures 35’ high x 47’ long x 17’ deep and is actively contributing sediment to the channel.
23896	0389.00	HFAC 4100 meter marker.
24193	0395.00	HFAC 4200 meter marker. Channel type changes to a B2 (Reach 8).
24426	0400.00	HFAC 4300 meter marker. LDA measures 16’ high x 50’ wide x 40’ long, with approximately 30 pieces of large wood. It is retaining a volume of sand and gravel measuring 40’ wide x 100’ long x 8’ deep. No coho were observed above this LDA, but other salmonids were seen.
24815	0406.00	HFAC 4400 meter marker. Channel type changes to an A2 (Reach 9).

24885	0408.00	Four foot plunge.
25039	0411.00	LDA measures 10’ high x 30’ wide x 20’ long, with approximately 15 pieces of large wood. It is retaining a volume of sediment measuring 6’ deep. Four foot high plunge.
25154	0413.00	HFAC 4500 meter marker.
25244	0417.00	Right bank tributary enters 20 feet into the unit, dry.
25406	0421.00	4.5’ high plunge.
25424	0422.00	4.5’ high plunge. Right bank erosion site measures 20’ high x 25’ long x 7’ deep.
25544	0424.00	End of survey due to a 20 foot waterfall.

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.

Richer, S., McCanne, D., 2004. Unpublished data from the *Juvenile Salmonid Abundance Summer Survey Report 2004.* Anadromous Fisheries Research and Monitoring Program (AFRAMP), California Department of Fish and Game and Institute for River Ecosystems (IRE), Humboldt State University, Arcata, 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]	