STREAM INVENTORY REPORT

Francis Creek

INTRODUCTION

A stream inventory was conducted during 6/2/2003 to 6/20/2003 on Francis Creek. The survey began just off Eugene Street in Ferndale and extended upstream 2.7 miles.

The Francis 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 Francis 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 Chinook salmon, 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

Francis Creek is a tributary to Salt River, which is a tributary to Eel River, which is a tributary to Pacific Ocean, located in Humboldt County, California (Map 1). Francis Creek's legal description at the confluence with Salt River is T03N R02W S35. Its location is 40° 35' 40.0" north latitude and 124° 15' 46.0" west longitude. Francis Creek is a second order stream and has approximately 5.2 miles of blue line stream according to the USGS Ferndale 7.5 minute quadrangle. Francis Creek drains a watershed of approximately 4.6 square miles. Elevations range from about 25 feet at the mouth of the creek to 1,000 feet in the headwater areas. Grass and mixed hardwood and conifer forests dominate the watershed. The watershed is primarily privately owned and is managed for timber production, and rangeland. The watershed is also influenced by urban and suburban development. Francis Creek flows through the town of Ferndale where it is channelized. Vehicle access to the beginning of the habitat assessment survey exists via Main Street in Ferndale to Francis Street and to Eugene Street.

METHODS

The habitat inventory conducted in Francis Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi et al, 1998). The California Conservation Corps (CCC) Technical Advisors and Watershed Stewards Project/AmeriCorps (WSP/AmeriCorps) 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. All pools are fully sampled.

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 Francis 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". Francis 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 Francis 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 such as bedrock, log sills, boulders or other considerations.

6. Shelter Rating:

Instream shelter is composed of those elements within a stream channel that provide 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. 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 Francis 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 Francis 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 Francis 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 Francis Creek. In addition, 21 sites were electrofished using a Smith-Root Model 12 electrofisher. These sampling techniques are discussed in the *California Salmonid Stream Habitat Restoration Manual*.

DATA ANALYSIS

Data from the habitat inventory form are entered into Stream Habitat 1.0.35, 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 Francis 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 6/2/2003 to 6/20/2003, was conducted by Sarah Ganas, Lesley Merrick and Dian Bacigalupi (WSP), T. Tollefson (DFG), and Dan Resnik (CCC). The total length of the stream surveyed was 14,062 feet with an additional 103 feet of side channel.

Stream flow was measured within habitat unit five, 100 feet from the start of survey, with a Marsh-McBirney Model 2000 flowmeter at 1.1 cfs on 06/02/03.

Francis Creek is an F4 channel type for the first 9,114 feet of the stream surveyed (Reach 1) and an A4 channel type for the next 4,948 feet of the stream surveyed (Reach 2). F4 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and gravel-dominant substrates. A2 channels are steep, narrow, cascading, step-pool, high energy debris transporting channels associated with depositional soils, and boulder channels.

Water temperatures taken during the survey period ranged from 53 to 60 degrees Fahrenheit. Air temperatures ranged from 54 to 70 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 20% flatwater units, 41% pool units, 39% riffle units, (Graph 1). Based on total length of Level II habitat types there were 19% flatwater units, 34% pool units, 47% riffle units (Graph 2).

Thirteen Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were 33% mid-channel pool units, 30% low gradient riffle units, 19% run units (Graph 3). Based on percent total length, 34% low gradient riffle units, 29% mid-channel pool units, 18% run units.

A total of 170 pools were identified (Table 3). Main channel pools were the most frequently encountered, at 84%, and comprised 88% 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-one of the 169 pools measured (24%) had a residual depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 169 pool tail-outs measured, 3 had a value of 1 (1.8%); 33 had a value of 2 (19.5%); 72 had a value of 3 (42.6%); 54 had a value of 4 (32%); 7 had a value of 5 (4.1%); (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 like bedrock, log sills, boulders, etc.

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 12 , flatwater habitat types had a mean shelter rating of 13 , and pool habitats had a mean shelter rating of 32 (Table 1). Of the pool types, the scour pools had a mean shelter rating of 30, main channel pools had a mean shelter rating of 33, backwater pools had a mean shelter rating of 5, (Table 3).

Table 5 summarizes mean percent cover by habitat type. Small woody debris is the dominant cover types in Francis Creek. Graph 7 describes the pool cover in Francis 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. A silt/clay substrate type was observed in 13% of pool tail-outs, gravel was observed in 83% of pool tail-outs.

The mean percent canopy density for the surveyed length of Francis Creek was 87%. The mean percentages of hardwood and coniferous trees were 95% and 5%, respectively. Thirteen percent of the canopy was open. Graph 9 describes the mean percent canopy in Francis Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 58%. The mean percent left bank vegetated was 59%. The dominant elements composing the structure of the stream banks consisted of 3% bedrock, 3% boulder, 22% cobble/gravel, 72% sand/silt/clay, (Graph 10). Deciduous trees were the dominant vegetation type observed in 78% of the units surveyed. Additionally, 11% of the units surveyed had brush as the second most dominant vegetation type (Graph 11).

BIOLOGICAL INVENTORY RESULTS

Twenty-one sites were electrofished for species composition and distribution in Francis Creek on August 18, 2003. Water temperature taken during the electrofishing period was 61 degrees

Fahrenheit. Air temperature was 62 degrees Fahrenheit. The sites were sampled by Lesley Merrick, Corby Hines, Elizabeth Pope (WSP) and Trevor Tollefson (DFG).

In reach one, 10 sites were sampled between habitat units 0007 and 0294. The sites yielded 10 Sacramento pikeminnow, 2 threespine sticleback, 1 young-of-year trout which was either a steelhead rainbow trout or cutthroat trout, 10 age 1+ cutthroat trout, and 7 age 2+ cutthroat trout.

In reach two, 11 sites were sampled between habitat units 0310 and 0397. The sites yielded 6 young-of-year trout which were either steelhead, rainbow trout, or cutthroat trout, 3 age 1+ cutthroat trout, 2 age 2+ cutthroat trout, and 1 age 3+ cutthroat trout.

Figure 1. Francis Creek 2003 - Electrofishing observations

Date	Site Number	Habitat Unit	Habitat Type	Aprox. Dist from mouth (ft)	Pike Minnow	Stickle-back	Trout YOY	Cutthroat trout 1+	Cutthroat trout 2+	Cutthroat trout 3+
Reach 1- F4 Channel Type										
8/18/2003	1	7	5.3	100	2	0	0	1	2	0
8/18/2003	2	14	5.3	250	2	1	1	0	1	0
8/18/2003	3	17	4.2	345	6	0	0	0	1	0
8/18/2003	4	123	4.2	3,590	0	0	0	2	1	0
8/18/2003	5	126	4.2	3,680	0	1	0	0	0	0
8/18/2003	6	134	5.3	3,957	0	1	0	0	0	0
8/18/2003	7	178	4.2	5,300	0	0	0	1	1	0
8/18/2003	8	180	4.2	5,384	0	0	0	2	0	0
8/18/2003	9	277	4.2	8,350	0	0	0	1	0	0
8/18/2003	10	294	4.2	8,970	0	0	0	1	1	0
Reach 2- A2 Channel Type										
8/18/2003	11	310	3.3	9,346	0	0	0	1	0	0
8/18/2003	12	320	4.2	9,769	0	0	0	0	1	0
8/18/2003	13	322	4.2	9,883	0	0	0	0	0	0
8/18/2003	14	329	4.2	10,224	0	0	0	1	0	0
8/18/2003	15	332	3.3	10,300	0	0	6	0	1	0
8/18/2003	16	336	5.6	10,660	0	0	0	1	0	1
8/18/2003	17	354	5.6	11,802	0	0	0	0	0	0
8/18/2003	18	372	4.2	12,850	0	0	0	0	0	0
8/18/2003	19	384	4.2	13,401	0	0	0	0	0	0
8/18/2003	20	388	5.6	13,500	0	0	0	0	0	0
8/18/2003	21	397	5.6	13,770	0	0	0	0	0	0

DISCUSSION

Francis Creek is a F4 channel type for the first 9,114 feet of stream surveyed and an A4 channel type for the next 4,948 feet. The suitability for fish habitat improvement structures for F4 channel types is: good for bank placed boulders; fair for plunge weirs, single and opposing wing-deflectors, channel constrictors, log cover; poor for boulder clusters. The suitability for fish habitat improvement structures for A4 channels is: good for bank placed boulders; fair for plunge weirs, opposing wing deflectors, and log cover; poor for boulder clusters.

The water temperatures recorded on the survey days 6/2/2003 to 6/20/2003, ranged from 53 to 60 degrees Fahrenheit. Air temperatures ranged from 54 to 70 degrees Fahrenheit. This is a good temperature range for salmonids. To make any further conclusions, temperatures would need to be monitored throughout the warm summer months, and more extensive biological sampling would need to be conducted.

Flatwater habitat types comprised 19% of the total length of this survey, riffles 47%, and pools 34%. The pools are relatively shallow, with only 41 of the 170 (24%) pools having 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 the low flow channel, and be as long as the low flow channel width. Installing structures that will increase or deepen pool habitat is recommended for locations where their installation will not be threatened by high stream energy.

Thirty-six of the 169 pool tail-outs measured had embeddedness ratings of 1 or 2. One-hundred-twenty-six of the pool tail-outs had embeddedness ratings of 3 or 4. Seven 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 Francis Creek should be mapped and rated according to their potential sediment yields, and control measures should be taken.

One-hundred-forty-one of the 169 pool tail-outs measured had gravel as the dominant substrate. This is generally considered good for spawning salmonids.

The mean shelter rating for pools was 32. The shelter rating in the flatwater habitats was 13. 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 Francis 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 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 87%. Reach 1 had a canopy density of 89%, Reach 2 had a canopy density of 80%. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was at 58% and 59%, 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) Francis 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) Where feasible, design and engineer pool enhancement structures to increase the number of pools. This must be done where the banks are stable or in conjunction with stream bank armor to prevent erosion.

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

5) 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.

6) 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.

7) There are sections where the stream is being impacted from cattle activity in the riparian zone. Alternatives should be explored with the grazier and developed if possible.

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	The survey began at green metal bridge just off Eugene street in Ferndale.
90	0006.00	Right bank erosion, 20' long x 20'high x 15' deep

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Position (ft.)	Habitat Unit #	Comments:
100	0007.00	Electro-fishing site #1
253	0014.00	Channel type determined to be a F4. Electro-fishing site #2
345	0017.00	Electro-fishing site #3
938	0037.00	Unnamed tributary #1 enters from left bank. The flow was estimated to be less than 0.3 cfs. Water temperature of the tributary was 56° F. The temperature of Francis Creek both above and below the tributary was 54°F.
958	0038.00	Concrete armoring on right and left bank
1400	0053.00	Right bank erosion, 20' high x 10' deep x 74' long.
1716	0064.00	Log debris accumulation (LDA) 9' high x 12' wide x 20' long is composed of trees from both banks that have fallen across creek. The LDA is storing silt and clay 14' wide x 24' long x 2'deep.
2003	0072.00	LDA, 9' high x 12' wide x 10' long, composed of two trees fallen from right bank.
2081	0074.00	Small right bank tributary
2273	0081.00	Right bank erosion, 20' high x 30' long x 10' deep
3163	0110.00	Barbed wire fence crosses the stream, and cattle cross the stream in this area.
3479	0119.00	Cattle crossing stream
3590	0123.00	Electro-fishing site #4
3680	0126.00	Electro-fishing site #5
3957	0134.00	Electro-fishing site #6
4120	0139.00	Steel flatcar railroad bridge 13' wide x 5' high x 29' long crosses Francis Creek.
4268	0143.00	Unnamed tributary #2 enters Francis Creek from the left bank. Flow in Unnamed tributary #2 was estimated to be 0.1 cfs. The water temperature of Francis Creek above the tributary is 56°F and below the tributary the temperature is 54°F. The temperature of the tributary is 54°F. The tributary appears accessible to fish.

Position (ft.)	Habitat Unit #	Comments:
4959	0166.00	Culvert that enters from left bank, 20’ long x 18” diameter; has a 2 foot plunge from the culvert to the creek. The culvert is a possible barrier to fish passage entering the tributary.
5300	0178.00	Electro-fishing site #7
5384	0180.00	Electro-fishing site #8
5405	0181.00	LDA, 7' high x 24' wide x 8' long is composed of five pieces of large woody debris. The LDA is retaining silt 10' wide x 30' long x 3' deep.
5405	0181.00	Bridge, 12' wide x 4.5' high x 10' long crosses Francis Creek. The bridge is made of concrete with earth fill and logs on top, and has a natural channel bottom.
5767	0195.00	Livestock have access to both banks
5872	0199.00	Livestock trail across the creek
6246	0212.00	Livestock crossing in creek
6444	0218.00	Unnamed tributary #3 enters Francis Creek from the left bank. Flow estimated to be less than 0.5 cfs. The temperature of the tributary was 55°F. The water temperature of Francis Creek above tributary was 60°F and 58°F below the tributary.
6607	0225.00	Lamprey were seen digging a redd.
6637	0227.00	Lamprey were seen digging a redd
7181	0245.00	Small spring in creek bed
7344	0249.00	Unnamed tributary #4 enters Francis Creek from the right bank. The tributaries flow estimated to be less than 0.5 cfs. The temperature of the tributary and of Francis Creek both upstream and downstream of the tributary was 54°F.
7405	0251.00	Left bank erosion, 30' long x 30' high x 20' deep
7514	0254.00	Left bank erosion, 10' long x 25' high x 10' deep
7741	0263.00	Old vehicle stuck in creek
7806	0265.00	Old vehicle on right bank

Position (ft.)	Habitat Unit #	Comments:
8148	0274.00	Four unknown fish observed from bank.
8203	0275.00	Left bank tributary #5 enters Francis Creek. Flow was estimated to be less than 0.1 cfs. The water temperature of the tributary was 53°F. The temperature of Francis Creek upstream of the tributary was 54° F, and the temperature downstream of the tributary was 53°F.
8350	0277.00	Electro-fishing site #9
8361	0278.00	Large maple fell from left bank across channel.
8970	0294.00	Electro-fishing site #10
9008	0296.00	The channel type changes from F4 to A4.
9346	0310.00	Electro-fishing site #11
9473	0313.00	Right bank unnamed tributary #6 enters Francis Creek. There was no water in the tributary. Slope measured to be 19%.
9769	0320.00	Electro-fishing site #12
9883	0322.00	Electro-fishing site #13
10224	0329.00	Electro-fishing site #14
10298	0332.00	Right bank tributary # 7 enters Francis Creek. Flow estimated to be less than 0.1cfs, and slope estimated to be 18%. The tributary is accessible to fish and the temperature was 54°F. The temperature of Francis Creek was 57°F upstream of the tributary and 56°F downstream. Electro-fishing site #15
10660	0336.00	Electro-fishing site #16
10963	0343.00	LDA, 8' high x 40' wide x 15' long has created a steep drop. The LDA is retaining silt 45' wide x 75' long x 8' deep. Not a barrier.
11381	0348.00	Right bank tributary # 8 enters Francis Creek. Flow estimated at 0.1 cfs and the slope estimated at 10%. The tributary was accessible to fish and the water temperature was 54°F. The temperature of Francis Creek was 58°F upstream of the tributary and 56°F downstream.
11656	0351.00	LDA, 9' high x 30' wide x 15' long, retaining gravel and silt 30' wide x 45' long x 9' deep. Not a barrier to salmonids

Position (ft.)	Habitat Unit #	Comments:
11692	0352.00	Left bank tributary # 9 enters Francis Creek. The water temperature of the tributary was 56°F. The water temperature of Francis Creek both above and below the tributary was 55°F. The slope of the tributary estimated to be 15%.
11802	0354.00	Electro-fishing site #17
11901	0358.00	Right bank tributary # 10 enters Francis Creek. The tributary slope estimated to be 50% and the flow estimated to be less than 0.1 cfs. The temperature of the tributary was 54°F. The water temperature of Francis Creek both above and below the tributary was 55°F.
12427	0359.00	Right bank erosion, 600' long x 100' high x 75' deep
12458	0360.00	LDA, 20'high x 65' wide x 75' long is made of four pieces of large woody debris. The LDA is storing sediment 60' wide, 30' long, and 20' deep. There are gaps in the LDA with water flowing through. Possible barrier to juvenile salmon
12850	0372.00	Electro-fishing site #18
13049	0374.00	Right bank tributary # 11 enters Francis Creek. The tributary has a 30% slope and contributes 50% of flow. The water temperature of the tributary was 56°F. The temperature of Francis Creek both above and below the tributary was 57°F.
13186	0379.00	Bridge and 48” culvert washed out in creek.
13401	0384.00	Electro-fishing site #19
13500	0388.00	Electro-fishing site #20
13539	0390.00	Small LDA crosses the creek.
13770	0397.00	Electro-fishing site #21
13914	0404.00	LDA, 15' high x 30' wide x 30' long, made of eleven pieces of large woody debris. The LDA retains silt and large cobbles 15' wide x 30' long x 8' deep. The LDA may be a barrier to adult and juvenile salmonids.
14062	0411.00	End of survey. The survey ended at a 5' + plunge. A root wad sticking out of plunge blocks a direct jump from the pool. If the water level was higher this jump is potentially passable but 200' upstream there is another probable barrier.

REFERENCES

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

LEVEL III and LEVEL IV HABITAT TYPES

RIFFLE			
Low Gradient Riffle	(LGR)	[1.1]	{ 1}
High Gradient Riffle	(HGR)	[1.2]	{ 2}
CASCADE			
Cascade	(CAS)	[2.1]	{ 3}
Bedrock Sheet	(BRS)	[2.2]	{24}
FLATWATER			
Pocket Water	(POW)	[3.1]	{21}
Glide	(GLD)	[3.2]	{14}
Run	(RUN)	[3.3]	{15}
Step Run	(SRN)	[3.4]	{16}
Edgewater	(EDW)	[3.5]	{18}
MAIN CHANNEL POOLS			
Trench Pool	(TRP)	[4.1]	{ 8 }
Mid-Channel Pool	(MCP)	[4.2]	{17}
Channel Confluence Pool	(CCP)	[4.3]	{19}
Step Pool	(STP)	[4.4]	{23}
SCOUR POOLS			
Corner Pool	(CRP)	[5.1]	{22}
Lateral Scour Pool - Log Enhanced	(LSL)	[5.2]	{10}
Lateral Scour Pool - Root Wad Enhanced	(LSR)	[5.3]	{11}
Lateral Scour Pool - Bedrock Formed	(LSBk)	[5.4]	{12}
Lateral Scour Pool - Boulder Formed	(LSBo)	[5.5]	{20}
Plunge Pool	(PLP)	[5.6]	{ 9 }
BACKWATER POOLS			
Secondary Channel Pool	(SCP)	[6.1]	{ 4 }
Backwater Pool - Boulder Formed	(BPB)	[6.2]	{ 5 }
Backwater Pool - Root Wad Formed	(BPR)	[6.3]	{ 6 }
Backwater Pool - Log Formed	(BPL)	[6.4]	{ 7 }
Dammed Pool	(DPL)	[6.5]	{13}
ADDITIONAL UNIT DESIGNATIONS			
Dry	(DRY)	[7.0]	
Culvert	(CUL)	[8.0]	
Not Surveyed	(NS)	[9.0]	
Not Surveyed due to a marsh	(MAR)	[9.1]	