STREAM INVENTORY REPORT

HARE CREEK

INTRODUCTION

A stream inventory was conducted during the summer of 1995 on Hare Creek to assess habitat conditions for anadromous salmonids. The 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 Hare Creek. The objective of the biological inventory was to document the presence and distribution of juvenile salmonid species. There is no known record of adult spawning surveys having been conducted on Hare Creek.

The objective of this report is to document the current habitat conditions, and recommend options for the potential improvement 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

Hare Creek is tributary to the Pacific Ocean, located in Mendocino County, California (Figure 1). Hare Creek's legal description at the confluence with the Pacific Ocean is T18N R18W S13. Its location is 39E25N020 north latitude and 123E48N420 west longitude. Hare Creek is a third order stream and has approximately 10.7 total miles of blue line stream according to the USGS Fort Bragg, Noyo Hill, and Mathison Peak 7.5 minute quadrangles. Hare Creek drains a watershed of approximately 10.0 square miles. Summer base runoff is approximately 3.3 cubic feet per second (cfs) at the mouth. Elevations range from sea level at the mouth of the creek to 1000 feet in the headwater areas. Redwood and Douglas fir forest dominates the watershed, but there are areas of urbanization, small-scale agriculture, and coastal chaparral near the mouth. The watershed is primarily located within Jackson Demonstration State Forest, and is managed for timber production. The remainder is privately owned. Vehicle access exists via California Department of Forestry and Fire Protection (CDF) Road 400.

METHODS

The habitat inventory conducted in Hare Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi and Reynolds, 1991 rev. 1994). 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). Hare Creek personnel were trained in May, 1995, by Gary Flosi. 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 (Hopelain, 1994). 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. Habitat unit types encountered for the first time are further 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 Hare Creek to record measurements and observations.

1. Flow:

Flow is measured in cubic feet per second (cfs) at the bottom of the stream survey reach using standard flow measuring equipment, if available. In some cases flows are estimated.

2. Channel Type:

Channel typing is conducted according to the classification system developed and revised by David Rosgen (1985 rev. 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.

3. Temperatures:

Both water and air temperatures are measured and recorded at 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 (1988). 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". Hare 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. Channel dimensions were measured using hip chains, range finders, tape measures, and stadia rods. All units were measured for mean length; additionally, the first occurrence of each unit type and a randomly selected 10% subset of all units were sampled for all features on the field form (*Sampling Levels for Fish Habitat Inventory*,

Hopelain, 1995). Pool tail crest depth at each pool unit was measured in the thalweg. All measurements were taken in feet to the nearest tenth.

5. Embeddedness:

The depth of embeddedness of the cobbles in pool tail-out reaches is measured by the percent of the cobble that is surrounded or buried by fine sediment. In Hare 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), 76 - 100% (value 4). Additionally, a rating of "not suitable" (NS) was assigned to tail-outs deemed unsuited for spawning due to inappropriate substrate particle size, having a bedrock tail-out, 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 Hare 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.

8. Canopy:

Stream canopy density was estimated using modified handheld spherical densiometers as described in the *California Salmonid Stream Habitat Restoration Manual*, 1994. Canopy density relates to the amount of stream shaded from the sun. In Hare 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 deciduous 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 Hare Creek, the dominant composition type (options 1-4) and the dominant vegetation

type (options 5-9) 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 was estimated and recorded.

BIOLOGICAL INVENTORY

Biological sampling during stream inventory is used to determine fish species and their distribution in the stream. In Hare Creek fish presence was observed from the stream banks, and seven sites were electrofished using one Smith-Root Model 12 electrofisher. These sampling techniques are discussed in the *California Salmonid Stream Habitat Restoration Manual*.

SUBSTRATE SAMPLING

In Hare Creek gravel samples were taken using the methodology as described in *Stream Substrate Quality for Salmonids: Guidelines for Sampling, Processing, and Analysis*, Valentine, 1995. Gravel sampling is conducted using a 9 inch diameter standard McNeil gravel sampler. Gravel samples are separated and measured to determine respective percent volume using five sieve sizes (25.4, 12.5, 4.7, 2.37, and 0.85 mm.

LARGE WOODY DEBRIS (LWD) STREAM AND RIPARIAN INVENTORY

In Hare Creek a large woody debris (LWD) stream and riparian inventory was conducted using the methodology as described in the *California Salmonid Stream Habitat Restoration Manual*. Data from the LWD Inventory Form are entered into a dBASE 4.2 data entry program developed by Inland Fisheries Division, California Department of Fish and Game. The Hare Creek LWD Inventory Report is included in this report as Appendix B.

DATA ANALYSIS

Data from the habitat inventory form are entered into Habitat, a dBASE 4.2 data entry program developed by Tim Curtis, Inland Fisheries Division, California Department of Fish and Game. This program processes and summarizes the data, and produces the following six tables:

- Riffle, flatwater, and pool habitat types
- Habitat types and measured parameters
- Pool types
- Maximum pool depths by habitat types
- Dominant substrates by habitat types
- Mean percent shelter by habitat types

Hare Creek

Graphics are produced from the tables using Lotus 1,2,3. Graphics developed for Hare Creek include:

- Riffle, flatwater, pool habitats by percent occurrence
- Riffle, flatwater, pool habitats by total length
- Total habitat types by percent occurrence
- Pool types by percent occurrence
- Total pools by maximum depths
- Embeddedness
- Pool cover by cover type
- Dominant substrate in low gradient riffles
- Percent canopy
- Bank composition by composition type
- Bank vegetation by vegetation type

HABITAT INVENTORY RESULTS

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

The habitat inventory of August 21 through September 12, 1995, was conducted by Heidi Hickethier and Craig Mesman (CCC). The total length of the stream surveyed was 51,598 feet with an additional 2,167 feet of side channel.

Flow was measured at the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 3.3 cfs on September 13, 1995.

Hare Creek is an F5 channel type for the first 8,822 feet of stream surveyed and an F4 channel type for the remaining 42,776 feet. F-type channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios. F5 channels have sand-dominant substrates, while F4 channels are gravel-dominant.

Water temperatures ranged from 52 to 59 degrees Fahrenheit. Air temperatures ranged from 56 to 73 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of **occurrence** there were 42% pool units, 32% flatwater units, and 25% riffle units (Graph 1). Based on total **length** of Level II habitat types, there were 38% pool units, 49% flatwater units, and 13% riffle units (Graph 2).

Twenty Level IV habitat types were identified (Table 2). The most frequent habitat types by percent **occurrence** were low-gradient riffles, 23%; mid-channel pools, 19%; and runs, 18% (Graph 3). Based on percent total **length**, step runs made up 28%, runs 20%, and mid-channel pools 18%.

A total of 501 pools were identified (Table 3). Main channel pools were most frequently encountered at 49% and comprised 51% of the total length of all pools (Graph 4).

Table 4 is a summary of maximum pool depths by pool habitat type. Depth is an indicator of pool quality. One hundred and forty-two of the 501 pools (28%) had a depth of three feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 381 pool tail-outs measured, 32 had a value of 1 (8.4%); 130 had a value of 2 (34.1%); 198 had a value of 3 (52.0%); and 21 had a value of 4 (5.5%)(Graph 6). On this scale, a value of 1 indicates the highest quality of spawning substrate.

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. Pool habitat types had a mean shelter rating of 44, and flatwater habitats had a mean shelter rating of 17 (Table 1). Of the pool types, the main channel pools had the highest mean shelter rating at 52, and backwater pools had a mean shelter rating of 47 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Terrestrial vegetation is the dominant cover type in Hare Creek. Graph 7 describes the pool cover in Hare Creek.

Table 6 summarizes the dominant substrate by habitat type. Gravel was the dominant substrate observed in 27 of the 30 low gradient riffles measured (90%). Small cobble was the next most frequently observed dominant substrate type and occurred in 7% of the low gradient riffles (Graph 8).

The mean percent canopy density for the stream reach surveyed was 93%. The mean percentages of deciduous and coniferous trees were 20% and 80%, respectively. Graph 9 describes the canopy in Hare Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 95%. The mean percent left bank vegetated was 96%. The dominant elements composing the structure of the stream banks consisted of 7.0% bedrock, 1.5% boulder, 46.7% cobble/gravel, and 44.8% sand/silt/clay (Graph 10). Grass was the dominant vegetation type observed in 68% of the units surveyed. Additionally, 3% of the units surveyed had deciduous trees as the dominant vegetation type, and 4% had coniferous trees as the dominant vegetation, including down trees, logs, and root wads (Graph 11).

BIOLOGICAL INVENTORY RESULTS

Seven sites were electrofished on September 12 and 13, 1995, in Hare Creek. The units were sampled by Craig Mesman and Heidi Hickethier (CCC).

Hare Creek

The first site sampled included habitat units 67-69, a log-enhanced lateral scour pool/run/corner pool combination approximately 4,623 feet from the mouth of Hare Creek. This site is within the F5 channel type reach and had a length of 198 feet. The unit yielded one 0+ coho, six 0+ steelhead, eight 1+ steelhead, seventeen sculpin, three three-spine stickleback, and one Pacific lamprey ammocete.

The second site included habitat units 828-832, a mid-channel pool, run, and three riffles located approximately 44,460 feet above the creek mouth. This and the remaining sites are located within the F4 channel type reach. This site had a length of 91 feet. The site yielded two 0+ coho and four 0+ steelhead.

The third site sampled included habitat units 985-992, a series of pools, step runs, and riffles located approximately 48,642 feet above the creek mouth. The site had a length of 278 feet. The site yielded nineteen 0+ steelhead, three 1+ steelhead, one 2+ steelhead, and two Pacific giant salamanders.

The fourth site sampled included habitat units 1002-1011, a series of pools, runs, and riffles located approximately 49,216 feet above the creek mouth. The site had a length of 234 feet. The site yielded two 1+ steelhead.

The fifth site sampled included habitat units 1013-1030, a series of pools, runs, and riffles located approximately 49,475 feet above the creek mouth. The site had a length of 301 feet. The site yielded one 1+ steelhead and one tailed frog.

The sixth site sampled included habitat units 1072-1080, a series of pools, runs, and riffles located approximately 50,566 feet above the creek mouth. The site had a length of 176 feet. The site yielded two 1+ steelhead, one 2+ steelhead, and four Pacific giant salamanders.

The seventh site sampled included a series of pools located approximately 51,628 feet above the creek mouth and upstream of the surveyed reach. No fish were sampled.

GRAVEL SAMPLING RESULTS

McNeil sediment samples in Hare Creek, as well as in South Fork Hare Creek, Bunker Gulch, and Walton Gulch, were taken by Craig Mesman and Heidi Hickethier (CCC) at 30 sites on September 20 through October 2, 1995. The methods used to collect and analyze these samples and the results obtained are discussed in Appendix A of this report.

LARGE WOODY DEBRIS (LWD) STREAM AND RIPARIAN INVENTORY RESULTS

The results of the LWD stream and riparian inventory are discussed in Appendix B of this report.

DISCUSSION

Hare Creek is an F5 channel type for the first 8,822 feet of stream surveyed and an F4 for the remaining 42,776 feet. The suitability of F4 and F5 channel types for fish habitat improvement structures is as follows: good for bank-placed boulders; fair for low-stage weirs, single and opposing wing deflectors, channel constrictors, and log cover; and poor for medium-stage weirs and boulder clusters.

The water temperatures recorded on the survey days August 21 through September 12, 1995, ranged from 52 to 59 degrees Fahrenheit. Air temperatures ranged from 56 to 73 degrees Fahrenheit. This is a good water temperature range for salmonids. To make any further conclusions, temperatures would need to be monitored for several years throughout the warm summer months, and more extensive biological sampling would need to be conducted.

Flatwater habitat types comprised 49% of the total **length** of this survey, riffles 13%, and pools 38%. The pools are relatively shallow, with only 142 of the 501 pools (28.3%) having a maximum depth greater than 3 feet. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat. In third order streams, a primary pool is defined to have a maximum depth of at least three 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.

Two hundred nineteen of the 381 pool tail-outs measured had embeddedness ratings of 3 or 4. Only 32 had a 1 rating. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered to indicate good quality spawning substrate for salmon and steelhead. In Hare Creek, sediment sources should be mapped and rated according to their potential sediment yields, and control measures should be taken.

The mean shelter rating for pools was low with a rating of 44. The shelter rating in the flatwater habitats was lower at 17. A pool shelter rating of approximately 100 is desirable. The relatively small amount of cover that now exists is being provided primarily by terrestrial vegetation in all habitat types. Log and root wad cover structures in the pool and flatwater habitats are needed to improve 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.

Twenty-nine of the 30 low gradient riffles measured had gravel or small cobble as the dominant substrate. This is generally considered good for spawning salmonids.

The mean percent canopy density for the stream was 92%. This is a relatively high percentage of canopy. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was high at 95% and 96%, respectively. In areas of stream bank erosion or where bank vegetation is not at acceptable levels, planting endemic species of coniferous and deciduous trees, in conjunction with bank stabilization, is recommended.

No coho were sampled or observed above unit 880, approximately 45,976 feet upstream from the survey start. Steelhead were observed through unit 1080, approximately 50,472 feet from the survey start. No fish migration barriers were encountered between unit 1080 and the end of the surveyed reach, suggesting that the entire 51,598 feet of stream surveyed are available to anadromous fish.

RECOMMENDATIONS

1) Hare 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 is from terrestrial vegetation. Adding high quality complexity with woody cover is desirable and in some areas the material is locally available. In particular, large wood should be placed in a manner to increase backwater areas to produce winter holdover habitat.

4) 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.

5) Where feasible, design and engineer pool enhancement structures to increase the number of pools or deepen existing pools. This must be done where the banks are stable or in conjunction with stream bank armor to prevent erosion.

6) Inventory and map sources of stream bank erosion and prioritize them according to present and potential sediment yield. Identified sites, like the site at 46,323', should then be treated to reduce the amount of fine sediments entering the stream.

PROBLEM SITES AND LANDMARKS

The following landmarks and possible problem sites were noted. All distances are approximate and taken from the beginning of the survey reach.

0' Begin survey approximately 300 feet from the confluence with the Pacific Ocean. Channel type is F5.

Hare Creek

1253' State Highway 1 concrete arch bridge.

1503' Log raft 8' wide x 40 ' long. Not a barrier and no gravel retained (NBNG).

2803' Log and debris accumulation (LDA) 3' high x 15' wide x 15' long. NBNG.

4000' Debris raft 14' wide x 70' long. NBNG.

4373' Left bank tributary. Estimated flow <0.1 cubic feet per second (cfs). Not accessible to anadromous fish (NAF).

5040' LDA 5' high x 20' wide x 30' long. NBNG.

5069' Debris raft.

5343' Right bank seep.

6743' Right bank seep.

7210' Right bank tributary. Estimated flow <0.1 cfs. NAF.

7727' Right bank seep.

7753' Debris raft 3' high x 20' wide x 60' long. NBNG.

8070' Right bank seep.

8529' Left bank seep.

8562' Left bank seep causing erosion 7' high x 10' long. Contributing fines.

8662' Left bank seep.

8822' Channel type changes to F4.

9112' Right bank seep.

9136' LDA 3' high x 25' wide x 100' long. NBNG.

10702' Left bank tributary. Estimated flow <0.1 cfs. NAF.

11202' Right bank tributary. Estimated flow <0.1 cfs. NAF.

Hare Creek

11569' LDA 5' high x 35' wide x 50' long. NBNG.

12233' Left bank tributary. Estimated flow <0.1 cfs. NAF.

12482' Left bank seep.

12571' Left bank tributary. Estimated flow <0.1 cfs. NAF.

12606' Left bank tributary. Estimated flow <0.1 cfs. NAF.

13008' LDA 4' high x 40' wide x 45' long. NBNG.

13857' Right bank seep.

14602' Standing relic trestle pilings.

14985' Left bank tributary. Estimated flow <0.4 cfs. Accessible to fish.

15035' LDA 6' high x 20' wide x 15' long. NBNG.

15159' Motorcycle and all terrain vehicle crossing.

15963' Standing relic railroad trestle.

15975' Relic right bank cribbing 6' high x 40' long.

16471' Debris accumulation.

16720' Right bank tributary. Estimated flow <0.4 cfs. NAF.

17630' Down trees retaining sediment. Not a barrier.

18342' Left bank seep.

18363' Left bank seep. Southern seep salamander observed in the seep on the margin of Hare Creek.

19047' Covington Gulch enters right bank.

19064' Partial LDA.

20099' Left bank tributary. Estimated flow <0.6 cfs. NAF.

Hare Creek

20562' Right bank seep.

21839' Left bank tributary. Estimated flow <0.2 cfs. Accessible to fish.

21985' Right bank seep.

22316' LDA 4' high x 25' wide x 15' long. NBNG.

22654' Two foot diameter corrugated metal pipe (CMP) culvert. No outfall.

23140' Right bank tributary. Estimated flow <0.2 cfs. NAF.

23522' Two foot diameter CMP culvert. Some outfall.

24087' CMP culvert. Estimated outfall <0.1 cfs. NAF.

24351' Two foot diameter CMP culvert. Estimated outfall <0.1 cfs.

24784' Left bank seep.

24991' Left bank tributary. Estimated flow <0.6 cfs.

25904' Right bank tributary. Estimated flow <0.1 cfs. NAF.

26395' Right bank rip-rapped.

27359' Right bank tributary. Estimated flow <0.1 cfs. NAF.

28132' Left bank tributary. Estimated flow <0.1 cfs. NAF.

28221' LDA 8' high x 30' wide x 50' long retaining sediment 2' deep at base. Right bank erosion.

29186' Left bank tributary. Estimated flow <0.3 cfs. NAF.

29410' Right bank rip-rapped.

29773' LDA 4' high x 30' wide x 20' long. NBNG.

30902' Right bank tributary enters through culvert. Estimated flow <0.2 cfs. Coho observed in tributary.

31108' Right bank cribbing.

Hare Creek

31571' Two foot diameter right bank culvert. Estimated outfall <0.1 cfs. NAF.

33711' Walton Gulch enters right bank (see separate report).

34034' Bridge 18' wide x 14' long x 9' clearance.

34743' Left bank tributary. Estimated flow <0.1 cfs.

37408' South Fork Hare Creek enters left bank (see separate report).

37878' Down tree retaining sediment 2' deep. Not a barrier.

38035' Right bank tributary enters through 2' diameter CMP culvert. Estimated flow <0.1 cfs. NAF.

38782' Bunker Gulch enters right bank (see separate report).

40266' Foot bridge.

41895' Left bank tributary. Estimated flow <0.2 cfs. Young-of-the-year salmonids observed in the first 100' of the tributary.

42973' Right bank tributary. Estimated flow <0.2 cfs. Accessible to fish.

44174' Right bank seep.

45373' Right bank 2' diameter culvert. No outfall.

45601' Right bank rip-rapped.

45731' Left bank seep.

45961' End of vehicle access.

46222' Right bank erosion 15' high x 50' long.

46323' Left bank erosion 20' high x 10' long contributing fines.

46411' LDA 8' high x 20' wide x 25' long. Possible collapsed bridge. NBNG.

46464' Log retaining sediment 3' deep. Not a barrier.

47110' LDA 6' high x 18' wide retaining sediment 6' deep at base. Possible barrier.

Hare Creek

47419' Left bank seep.

47537' LDA 7' high x 25' wide. NBNG.

47591' Old bridge.

47721' LDA 7' high x 20' wide x 60' long. NBNG.

47964' Left bank tributary. Estimated flow <0.1 cfs. NAF.

48374' Root wad and logs retaining sediment 5' deep. Not a barrier.

48663' Left bank seep.

48708' Left bank tributary. Estimated flow <0.1 cfs. NAF.

49013' Dry right bank tributary.

49417' LDA retaining gravel 4' deep at base. Not a barrier.

50042' Logs retaining sediment 2' deep. Not a barrier.

50287' Left bank tributary. Estimated flow <0.1 cfs. Accessible to fish.

50880' Intermittent left bank tributary. Accessible to fish.

51223' Old foot bridge with 4' clearance.

51543' Dry left bank tributary.

51598' End of survey due to increased gradient, increasing number of potential fish migration barriers, and lack of habitat.

REFERENCES

Flosi, G., and F. Reynolds. 1994. California salmonid stream habitat restoration manual, 2nd edition. California Department of Fish and Game, Sacramento, California.

Hopelain, J. 1995. Sampling levels for fish habitat inventory, unpublished manuscript. California Department of Fish and Game, Inland Fisheries Division, Sacramento, California.

Valentine, B. 1995. Stream substrate quality for salmonids: guidelines for sampling, processing, and

analysis, unpublished manuscript. California Department of Forestry and Fire Protection, Santa Rosa, California.

LEVEL III and LEVEL IV HABITAT TYPE KEY

HABITAT TYPE	LETTER	NUMBER
RIFFLE		
Low Gradient Riffle	[LGR]	1.1
High Gradient Riffle	[HGR]	1.2
CASCADE		
Cascade	[CAS]	2.1
Bedrock Sheet	[BRS]	2.2
FLATWATER		
Pocket Water	[POW]	3.1
Glide	[GLD]	3.2
Run	[RUN]	3.3
Step Run	[SRN]	3.4
Edgewater	[EDW]	3.5
MAIN CHANNEL POOLS		
Trench Pool	[TRP]	4.1
Mid-Channel Pool	[MCP]	4.2
Channel Confluence Pool	[CCP]	4.3
Step Pool	[STP]	4.4
SCOUR POOLS		
Corner Pool	[CRP]	5.1
Lateral Scour Pool - Log Enhanced	[LSL]	5.2
Lateral Scour Pool - Root Wad Enhanced	[LSR]	5.3
Lateral Scour Pool - Bedrock Formed	[LSBk]	5.4
Lateral Scour Pool - Boulder Formed	[LSBo]	5.5
Plunge Pool	[PLP]	5.6
BACKWATER POOLS		
Secondary Channel Pool	[SCP]	6.1
Backwater Pool - Boulder Formed	[BPB]	6.2
Backwater Pool - Root Wad Formed	[BPR]	6.3
Backwater Pool - Log Formed	[BPL]	6.4
Dammed Pool	[DPL]	6.5