STREAM INVENTORY REPORT

Bridge Creek

INTRODUCTION

A stream inventory was conducted from June 6 to June 8, 2005 on Bridge Creek. The survey began at the confluence with North Fork Elk River and extended upstream 0.6 miles.

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

The objective of this report is to document the current habitat conditions and recommend options for the potential enhancement of habitat for coho salmon and steelhead trout. Recommendations for habitat improvement activities are based upon target habitat values suitable for salmonids in California's north coast streams.

WATERSHED OVERVIEW

Bridge Creek is a tributary to North Fork Elk River, a tributary to Elk River, a tributary to Humboldt Bay, which drains to the Pacific Ocean. It is located in Humboldt County, California (Map 1). Bridge Creek's legal description at the confluence with North Fork Elk River is T04N R01E S28. Its location is 40.6956 degrees north latitude and 124.0792 degrees west longitude, LLID number 1240793406956. Bridge Creek is a first order stream and has approximately 1.7 miles of blue line stream according to the USGS McWhinney Creek 7.5 minute quadrangle. Bridge Creek drains a watershed of approximately 2.3 square miles. Elevations range from about 100 feet at the mouth of the creek to 960 feet in the headwater areas. Redwood forest dominates the watershed. The watershed is entirely privately owned and is managed for timber production. Vehicle access exists via Highway 101 to Elk River Road Exit (exit 702).

METHODS

The habitat inventory conducted in Bridge 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) 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.

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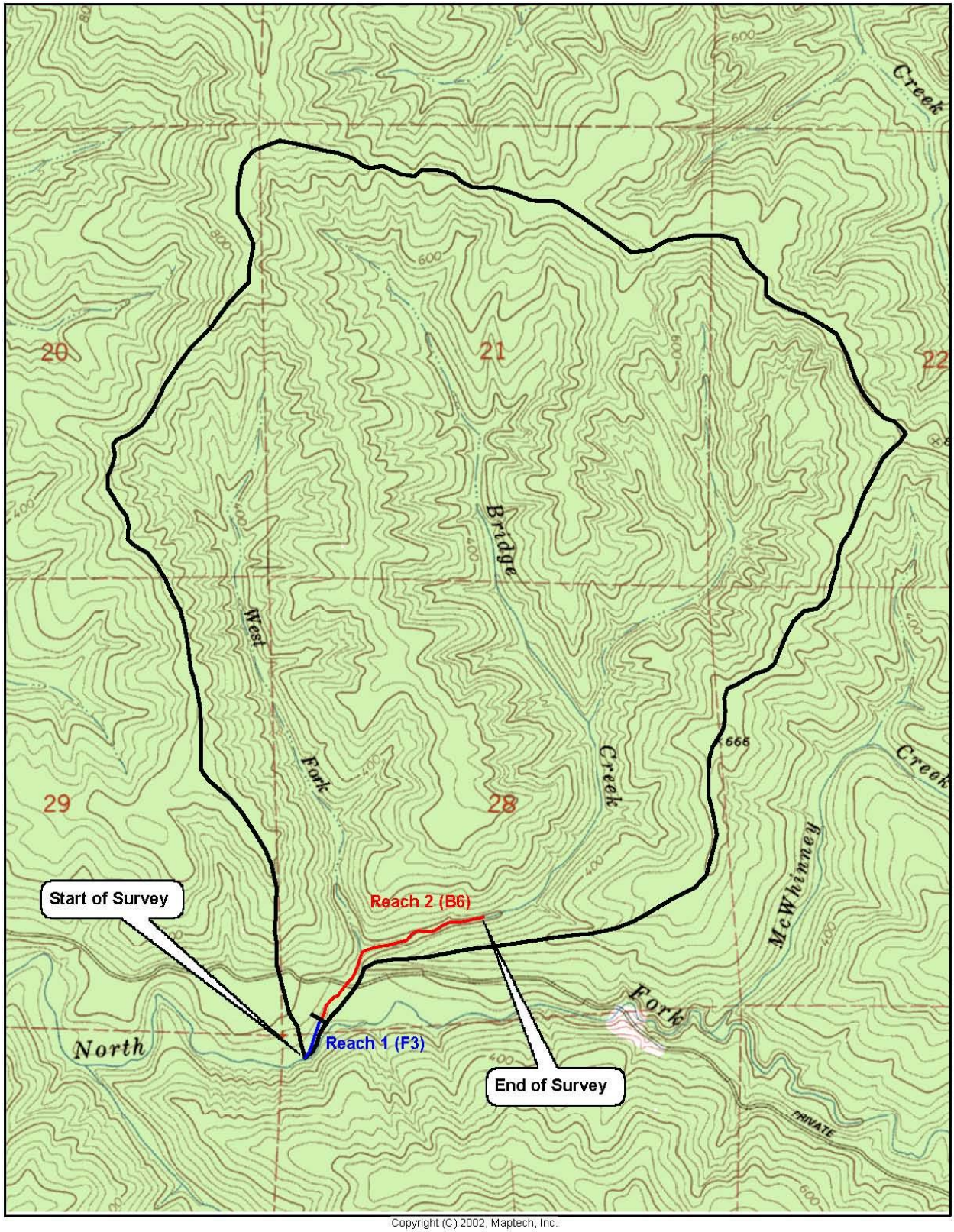
Map 1



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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 except step-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 Bridge 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". Bridge 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 Bridge Creek, embeddedness was ocularly estimated. The values were recorded using the following ranges: 0 - 25% (value 1), 26 - 50% (value 2), 51 - 75% (value 3) and 76 - 100% (value 4). Additionally, a value of 5 was assigned to tail-outs deemed not suitable for spawning due to inappropriate substrate like bedrock, log sills, boulders or other considerations.

6. Shelter Rating:

Instream shelter is composed of those elements within a stream channel that provide juvenile salmonids protection from predation, reduce water velocities so fish can rest and conserve energy, and allow separation of territorial units to reduce density related competition for prey. The shelter rating is calculated for each fully-described habitat unit by multiplying shelter value and percent cover. Using an overhead view, a quantitative estimate of the percentage of the habitat unit covered is made. All cover is then classified according to a list of nine cover types. In Bridge 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 Bridge 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 Bridge 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.

DATA ANALYSIS

Data from the habitat inventory form are entered into Stream Habitat 2.0.17, 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 Bridge 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

The habitat inventory of June 6 to June 8, 2005 was conducted by M. Liggett (WSP), M. Erkel (WSP), A. Renger (DFG), and D. Resnik (CCC). The total length of the stream surveyed was 3,016 feet with an additional 25 feet of side channel.

Stream flow was measured near the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 0.27 cfs on June 7, 2005.

Bridge Creek is an F3 channel type for 496 feet of the stream surveyed (Reach 1) and a B6 channel type for the remaining 2,545 feet of the stream surveyed (Reach 2). F3 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and cobble-dominant substrates. B6 channels are moderately entrenched riffle dominated channels with infrequently spaced pools, very stable plan and profile, stable banks on moderate gradients with low width /depth ratios and silt/clay dominant substrates.

Water temperatures taken during the survey period ranged from 50 to 54 degrees Fahrenheit. Air temperatures ranged from 52 to 56 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 52% pool units, 24% riffle units, 22% flatwater units, and 1% was not surveyed (Graph 1). Based on total length of Level II habitat types there were 64% pool units, 18% riffle units, 16% flatwater units, and 1% unsurveyed (Graph 2).

Seven Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were 45% mid-channel pool units, 24% low gradient riffle units, and 22% run units (Graph 3). Based on percent total length, 59% where mid-channel pool units, 18% where low gradient riffle units, and 16% where run units.

A total of 43 pools were identified (Table 3). Main channel pools were the most frequently encountered, at 91%, and comprised 96% 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. Twenty of the 41 pools (49%) had a residual depth of two feet or greater (Graph 5).

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The depth of cobble embeddedness was estimated at pool tail-outs. Of the 42 pool tail-outs measured, one had a value of 1 (2%); five had a value of 2 (12%); nine had a value of 3 (21%); 21 had a value of 4 (50%); six had a value of 5 (14%); (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 27, flatwater habitat types had a mean shelter rating of 63, and pool habitats had a mean shelter rating of 108 (Table 1). Of the pool types, the main channel pools had a mean shelter rating of 116, backwater pools had a mean shelter rating of 33, and scour pools had a mean shelter rating of 10 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Large woody debris is the dominant cover types in Bridge Creek. Graph 7 describes the pool cover in Bridge Creek. Large woody debris is the dominant pool cover type followed by small woody debris.

Table 6 summarizes the dominant substrate by habitat type. Graph 8 depicts the dominant substrate observed in pool tail-outs. Gravel was the dominant substrate observed in 52% of pool tail-outs measured, and a silt/clay substrate type was the dominant substrate observed in 31% of pool tail-outs.

The mean percent canopy density for the surveyed length of Bridge Creek was 92%. Eight percent of the canopy was open. Of the mean percent canopy density, the mean percentages of hardwood and coniferous trees were 17% and 83%, respectively. Graph 9 describes the mean percent canopy in Bridge Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 92%. The mean percent left bank vegetated was 86%. The dominant elements composing the structure of the stream banks consisted of 97% sand/silt/clay, 2% cobble/gravel, and 1% bedrock (Graph 10). Coniferous trees were the dominant vegetation type observed in 63% of the units surveyed. Additionally, 20% of the units surveyed had grass as the dominant vegetation type, and 11% had brush as the dominant vegetation (Graph 11).

DISCUSSION

Bridge Creek is an F3 channel type for the first 496 feet of stream surveyed and a B6 channel type for the remaining 2,520 feet. The suitability of F3 channel types for fish habitat improvement structures is as follows: good for bank-placed boulders and single and opposing wing-deflectors; fair for plunge weirs, boulder clusters, channel constrictors, and log cover. The suitability of B6 channel types for fish habitat improvement structures is as follows: excellent for bank-placed boulders and log cover; good for plunge weirs, single and opposing wing-deflectors and channel constrictors; and fair for boulder clusters.

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The water temperatures recorded on the survey days June 6 to June 8, 2005 ranged from 50 to 54 degrees Fahrenheit. Air temperatures ranged from 52 to 56 degrees Fahrenheit. 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 16% of the total length of this survey, riffles 18%, and pools 64%. One percent was not surveyed. The pools are relatively deep, with 20 of the 41 (49%) 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. 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.

Six of the 42 pool tail-outs measured had embeddedness ratings of 1 or 2. Thirty of the pool tail-outs had embeddedness ratings of 3 or 4. Six 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 Bridge Creek should be mapped and rated according to their potential sediment yields, and control measures should be taken.

Twenty-three of the 42 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 108. The shelter rating in the flatwater habitats was 63. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by large woody debris in Bridge Creek. Large woody debris is the dominant cover type in pools followed by small 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 92%. Reach 1 had a canopy density of 92%, Reach 2 had a canopy density of 92%. 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 92% and 86%, respectively.

RECOMMENDATIONS

1) Bridge 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) There are several log debris accumulations present on Bridge Creek that are retaining large quantities of fine sediment. The modification of these debris accumulations is desirable, but must be done carefully, over time, to avoid excessive sediment loading in downstream reaches.

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	001	Start of survey at confluence of Bridge Creek and North Fork Elk River.
326	011	Log debris accumulation (LDA) measures 10' high x 30' wide x 15' long. The LDA is composed of 17 pieces of large wood. A volume of silt is being retained measuring 20' wide x 40' long x 3' high. Salmonid juveniles were observed above.
394	013	Young-of-year salmonids observed from the bank.
458	015	Steel flatcar bridge on the main haul road measures 15' wide x 15' high x 40' long.
497	016	Channel type change from F3 to B6. Start of Reach 2.
658	018	Bridge composed of a wooden railroad trestle measuring 15' wide x 100' high x 150' long.
739	020	LDA measures 12' high x 20' wide x 8' long. The LDA is composed of eight pieces of large wood. A volume of silt is being retained measuring 15' wide x 10' long x 6' high. Fish were observed above.
796	021	The flow goes subsurface due to stored sediment from the LDA in Habitat Unit #020. LDA measures 10' high x 25' wide x 45' long. The LDA is composed of 19 pieces of large wood. No sediment is being retained and fish were observed above.
968	025	LDA measures 15' high x 30' wide x 50' long. The LDA is composed of 37 pieces of large wood. A volume of silt is being retained measuring 6' wide x 25' long x 8' high. Fish were observed above.
1,050	027	LDA measures 12' high x 25' wide x 73' long. The LDA is composed of 34 pieces of large wood. A volume of silt, sand, and gravel is being

		retained measuring 5’ wide x 25’ long x 1’ high. Fish were observed above.
1,218	031	LDA measures 15’ high x 20’ wide x 33’ long. The LDA is composed of 13 pieces of large wood. A volume of silt is being retained measuring 5’ wide x 15’ long x 2’ high. Fish were observed above.
1,336	036	Tributary enters from the right bank. LDA measures 10’ high x 30’ wide x 40’ long. The LDA is composed of 21 pieces of large wood. A volume of silt, sand, and gravel is being retained measuring 15’ wide x 20’ long x 5’ high. Fish were observed above.
1,373	038	LDA measures 18’ high x 25’ wide x 50’ long. The LDA is composed of 20 pieces of large wood. A volume of silt is being retained measuring 6’ wide x 25’ long x 5’ high. Fish were observed above.
1,423	039	5’ high plunge.
1,525	043	LDA measures 15’ high x 40’ wide x 106’ long. The LDA is composed of 53 pieces of large wood. A volume of silt, sand, and gravel is being retained measuring 7’ wide x 40’ long x 3’ deep. Fish were observed above. The LDA extends up to Habitat Unit #046.
1,700	048	LDA measures 25’ high x 30’ wide x 196’ long. The LDA is composed of 127 pieces of large wood. A volume of silt is being retained measuring 20’ wide x 7’ deep. Fish were observed above. The LDA in this unit extends into Habitat Unit #049.
2,088	057	LDA measures 10’ high x 20’ wide x 134’ long. The LDA is composed of 22 pieces of large wood. A volume of silt is being retained measuring 10’ wide x 15’ long x 3’ deep. Fish were observed above.
2,383	061	Flow goes subsurface 15' into unit.
2,644	070	LDA measures 10’ high x 15’ wide x 25’ long. The LDA is composed of 25 pieces of large wood. A volume of silt is being retained. Fish were observed above.
2,860	079	LDA measures 5’ high x 35’ wide x 25’ long. The LDA is composed of 21 pieces of large wood. A volume of silt, sand, gravel and cobble is being retained measuring 20’ wide x 10’ long x 2’ deep. No fish were observed above.
3,017	081	End of survey due to no fish being observed above the LDA at 2,860’.

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.

McCain, M., D. Fuller, L. Decker and K. Overton. 1990. Stream habitat classification and inventory procedures for northern California. FHC Currents. No.1. U.S. Department of Agriculture. Forest Service, Pacific Southwest Region.

Rosgen, D.L., 1994. A Classification of Natural Rivers. Catena, Vol 22: 169-199, Elsevier Science, B. V. Amsterdam.

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]	