STREAM INVENTORY REPORT

Grassy Creek

INTRODUCTION

A stream inventory was conducted during from September 14 to September 20, 2005 on Grassy Creek. The survey began at the confluence with Essex Pond and extended upstream 2.3 miles.

The Grassy 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 Grassy 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

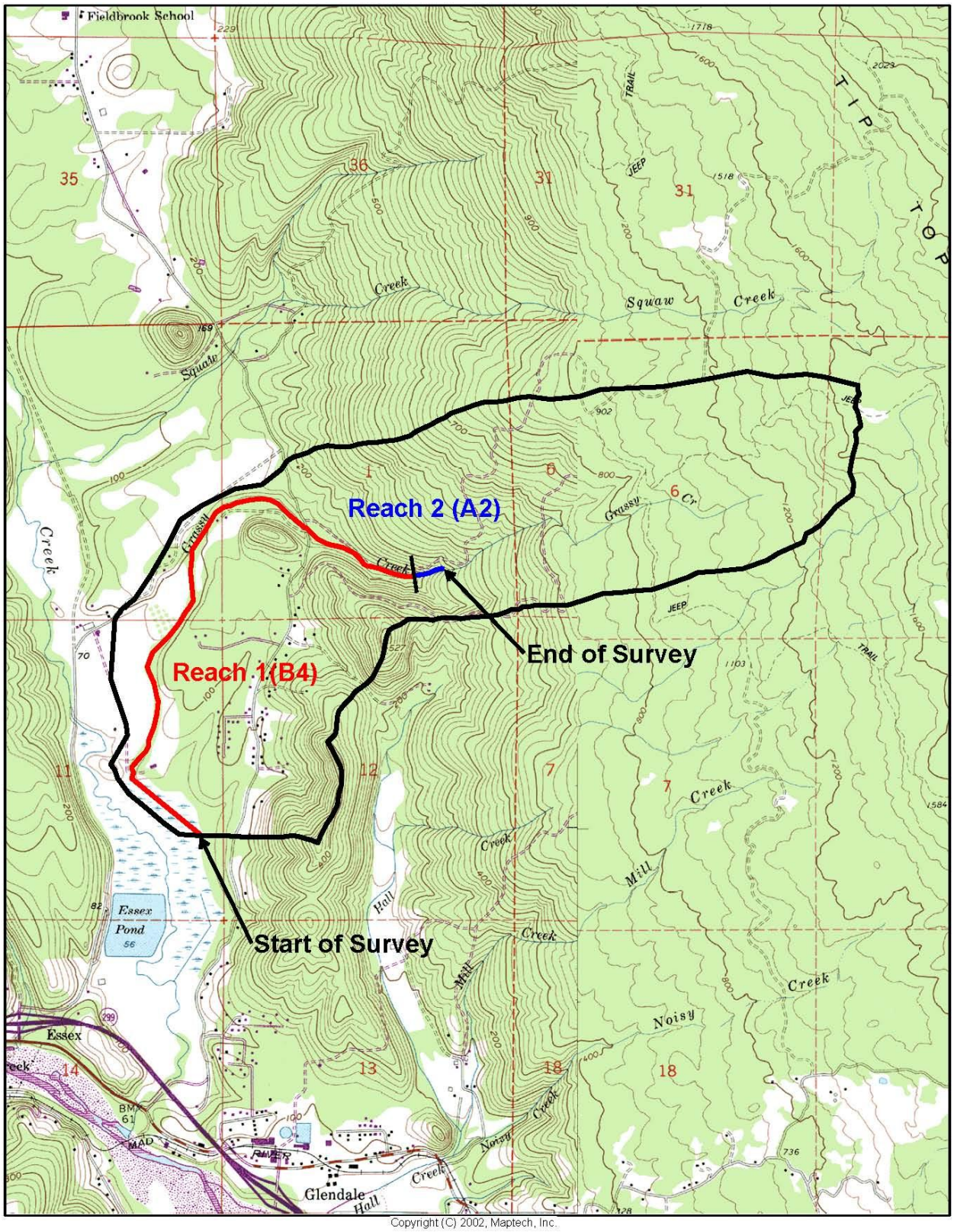
Grassy Creek is a tributary to Essex Pond, a tributary to Lindsay Creek, a tributary to the Mad River, which drains to the Pacific Ocean. It is located in Humboldt County, California (Map 1). Grassy Creek's legal description at the confluence with Essex Pond is T06N R01E S11. Its location is 40.9189 degrees north latitude and 124.0289 degrees west longitude, LLID number 1240288409189. Grassy Creek is a first order stream and has approximately 3.1 miles of blue line stream according to the USGS Arcata North 7.5 minute quadrangle. Grassy Creek drains a watershed of approximately 1.6 square miles. Elevations range from about 0 feet at the mouth of the creek to 1,175 feet in the headwater areas. Redwood forest dominates the watershed. The watershed is primarily entirely privately owned and is partially managed for timber and livestock production. Vehicle access exists via 299 East to the Essex Exit, take Fieldbrook Road north to Grass Creek Road.

METHODS

The habitat inventory conducted in Grassy 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.

Grassy Creek

Map 1



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 Grassy 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". Grassy 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 Grassy 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 Grassy 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 Grassy 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 Grassy 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 Grassy Creek. In addition, seven 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 2.0.19, a Visual Basic data entry program developed by Karen Wilson, Pacific States Marine Fisheries Commission in conjunction with the California Department of Fish and 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 Grassy 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 September 14 to September 20, 2005 was conducted by J. Freewoman (WSP), S. McSmith (WSP), and I. Mikus (WSP). The total length of the stream surveyed was 11,914 feet with no side channel.

Stream flow was estimated to be 0.1 cfs during the survey period.

Grassy Creek is a B4 channel type for 11,397 feet of the stream surveyed (Reach 1) and an A2 channel type for 517 feet of the stream surveyed (Reach 2). B4 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 gravel dominant substrates. A2 channels are steep, narrow, cascading, step-pool, high energy debris transporting channels associated with depositional soils, and boulder dominant substrates.

Water temperatures taken during the survey period ranged from 54 to 60 degrees Fahrenheit. Air temperatures ranged from 50 to 64 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 42% pool units, 25% flatwater units, 19% riffle units, 14% dry units, and 1% culvert units (Graph 1). Based on total length of Level II habitat types there were 33% dry units, 25% flatwater units, 28% pool units, and 13% riffle units (Graph 2).

Ten Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were 40% mid-channel pool units, 15% low gradient riffle and 14% dry units, (Graph 3). Based on percent total length there were 33% dry units, 27% mid-channel pool units and 14% step run units.

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A total of 72 pools were identified (Table 3). Main channel pools were the most frequently encountered, at 96%, and comprised 97% 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-four of the 71 pools (34%) had a residual depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 71 pool tail-outs measured, 28 had a value of 1 (39%); 32 had a value of 2 (45%); nine had a value of 3 (13%); two had a value of 4 (3%); (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 2, flatwater habitat types had a mean shelter rating of 18, and pool habitats had a mean shelter rating of 45 (Table 1). Of the pool types, the main channel pools had the highest mean shelter rating at 45. Scour pools had a mean shelter rating of 25 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Root mass is the dominant cover type in Grassy Creek. Graph 7 describes the pool cover in Grassy Creek. Root mass 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 69% of pool tail-outs. Small cobble was the next most frequently observed substrate type; it occured in 24% of pool tail-outs.

The mean percent canopy density for the surveyed length of Grassy Creek was 91%. The mean percentages of hardwood and coniferous trees were 65% and 35%, respectively. Nine percent of the canopy was open. Graph 9 describes the mean percent canopy in Grassy Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 97%. The mean percent left bank vegetated was 99%. The dominant elements composing the structure of the stream banks consisted of 98% sand/silt/clay, 1% bedrock, and 1% boulders (Graph 10). Hardwood trees were the dominant vegetation type observed in 76% of the units surveyed. Additionally, 15% of the units surveyed had coniferous trees as the dominant vegetation type, 9% was dominated by brush and 1% had grass as the dominant vegetation (Graph 11).

BIOLOGICAL INVENTORY RESULTS

Seven sites were electrofished for species composition and distribution in Grassy Creek on October 24, 2005 and October 25, 2005. Water temperatures taken during the electrofishing period ranged from 52 to 60 degrees Fahrenheit. Air temperatures ranged from 44 to 62 degrees Fahrenheit. The sites were sampled by J. Freewoman and C. Pollastrini (WSP) and Allan Renger

(DFG).

In Reach 1, which comprised the first 11,341 feet of stream, five sites were sampled. The reach sites yielded: sixty-four young-of-the-year (YOY) coho salmon and twelve three-spine stickleback.

In Reach 2, two sites were sampled starting approximately 573 feet from the end of Reach 1 and continuing upstream 156 feet. The reach sites yielded: five age 1+ steelhead/rainbow trout (SH/RT), one age 2+ SH/RT, and two YOY coho salmon.

The following chart displays the information yielded from these sites:

2003 Grassy Creek e-fish observations.

Date	Site #	Hab. Unit #	Hab. Type	Approx. Dist. from mouth (ft.)	Coho		SH/RT		
					YOY	1+	YOY	1+	2+
Reach 1 B4 Channel Type									
10/24/05	1	003	4.2	912	12	0	0	0	0
10/24/05	2	013	4.2	2088	16	0	0	0	0
10/25/05	3	140	4.2	10266	13	0	0	0	0
10/25/05	4	151	4.2	11014	19	0	0	0	0
10/25/05	5	159	4.2	11326	4	0	0	0	0
Reach 2 A2 Channel Type									
10/25/05	1	161	3.4	11,397	2	0	0	2	0
10/25/05	2	166	4.2	11,581	0	0	0	3	1

DISCUSSION

Grassy Creek is a B4 channel type for the first 11,397 feet of stream surveyed and an A2 channel type for the next 517 feet. The suitability of B4 channel types for fish habitat improvement structures is as follows: excellent for low-stage plunge weirs, boulder clusters, bank placed boulders, single and opposing wing deflectors and log cover. A2 channel types are typically unsuitable for habitat improvement structures.

The water temperatures recorded on the survey days September 14 through September 20, 2005 ranged from 54 to 60 degrees Fahrenheit. Air temperatures ranged from 50 to 64 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 25% of the total length of this survey, riffles 13%, pools 28% and dry units 33%. The pools are relatively shallow, with only 24 of the 71 (34%) 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. Installing structures that will increase or deepen pool habitat is recommended for Reach 1.

Sixty of the 71 pool tail-outs measured had embeddedness ratings of 1 or 2. Eleven of the pool tail-outs had embeddedness ratings of 3 or 4. None 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 Grassy Creek should be mapped and rated according to their potential sediment yields, and control measures should be taken.

Sixty-six of the 71 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 45. The shelter rating in the flatwater habitats was 18. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by root mass in Grassy Creek. Root mass 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 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 91%. Reach 1 had a canopy density of 90%. Reach 2 had a canopy density of 99%. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was 97% and 99%, 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) Grassy 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 in the pools is from root mass. Adding high quality complexity with woody cover in the pools is desirable.

5) Replace the county road culvert at 9,095 with a structure that will meet DFG/NMFS fish passage criteria.

6) There are sections where the stream is being impacted from cattle 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	001	Start of survey at Essex Pond. There is evidence of livestock traffic going through the creek. Channel type is a B4.
912	003	First electrofishing site.
1,767	009	Wood footbridge measures 12' wide x 26' long x 7' high.
2,088	013	Second electrofishing site.
3,986	048	Log debris accumulation (LDA) measures 6’ high x 24' wide x 7' long. The stream goes dry above the LDA. It is made up of six pieces of large wood.
4,085	050	Livestock are contributing to erosion in the stream channel and on the banks.
4,476	059	Livestock traffic throughout the bottom third of the stream.
6,941	110	A small wood boat covers 50% of this pool.
7,065	113	Left bank seep.
7,117	114	Right bank erosion.

7,845	131	LDA measures 5' high x 21' wide x 5' length. Composed of six pieces of large wood.
9,095	132	Culvert at the county road, rectangular in shape and is made out of cement with wood baffles. The culvert measures 6' high x 8' wide x 31' long. There is a 6.3' high plunge from the outlet to the stream bed. This culvert does not meet DFG/NMFS fish passage criteria.
10,266	140	Third electrofishing site.
10,430	143	LDA measures 4.5' high x 25' wide x6' long. Composed of six pieces of large wood.
11,014	151	Fourth electrofishing site.
11,326	159	Fifth electrofishing site.
11,397	161	Channel type changes to an A2. Reach 2, first electrofishing site.
11,515	163	Stream gradient of 33% over 18 feet.
11,533	164	2.8' high plunge.
11,541	165	Stream gradient >20%.
11,581	166	Reach 2, second electrofishing site.
11,652	168	Probable end of anadromous fish habitat due to a plunge/falls height of 8.0 feet.
11,914	170	End of survey, gradient is very high (>20%) and continues like this for an undetermined distance upstream.

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]	