STREAM INVENTORY REPORT

Willits Creek

INTRODUCTION

A stream inventory was conducted during the summer of 1995 on Willits Creek, the start of the survey was approximately 1,000' above the confluence with Mill Creek. 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 Willits 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.

Adult carcass surveys were conducted on Willits Creek by the California Department of Fish and Game (DFG) from 1987 through 1996. The table below describes the results of those surveys:

Willits Creek Carcass Surveys 1987 - 1996

	Chinook Salmon					Other	
Year	# of Surveys	Live Fish	# of Carcass	Adipose ClipCWT	Redds seen	Coho seen	SH/RT seen
1987	1	218	249	0	0	1	0
1988	2	94	140	13	30	1	0
1989	1	0	4	0	3	0	0
1993	1	0	0	0	1	0	0
1995	1	29	4	0	9	0	0
1996	2	0	0	0	8	0	2

Three carcasses found on the survey of December 6, 1988 had adipose fin clips, but only two coded wire tags (CWT) were found in the snouts. Ten more adipose clipped carcasses were found on the survey of December 20, 1988 with seven coded wire tags retrieved. All of the fish bore CWT # H 6-07-01, brood year 1985, and were from the Silverado facility near Yountville, and

released into Outlet Creek as smolts. The objective of this report is to document the current habitat conditions in Willits Creek, and recommend options for the enhancement of habitat for chinook salmon, coho salmon and steelhead trout.

WATERSHED OVERVIEW

Willits Creek is tributary to the Mill Creek, tributary to Outlet Creek, tributary to the Mainstem Eel River, located in Mendocino County, California. Willits Creek's legal description at the confluence with Mill Creek River is T18N R14W S13. Its location is 39°24'59" north latitude and 123°22'03" west longitude. Willits Creek is a second order stream and has approximately 9.3 miles of blue line stream according to the USGS Willits and Burbeck 7.5 minute quadrangles. Willits Creek drains a watershed of approximately 7.0 square miles. Elevations range from about 1400 feet at the mouth of the creek to 2500 feet in the headwater areas. Redwood/Douglas fir forest dominates the watershed. The watershed is privately owned and is managed for urban residence and recreation. Vehicle access exists via Highway 101 to Sherwood Rd on the northwest side of Willits.

METHODS

The habitat inventory conducted in Willits Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi and Reynolds, 1991 rev. 1994). The Department of Fish and Game Scientific Aide, California Conservation Corps (CCC) Technical Advisor, and Watershed Stewards Project/AmeriCorps (WSP/AmeriCorps) member that conducted the inventory were trained in standardized habitat inventory methods by the California Department of Fish and Game (DFG). Willits Creek personnel were trained in May, 1995, by Ruth Goodfield. A three-person team conducted this inventory.

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 Willits Creek to record measurements and observations. There are nine components to the inventory form.

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 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 (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". Willits 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 sampling form (Hopelain, 1995). Pool tail crest

depth at each pool unit was measured in the thalweg. All measurements were 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 Willits 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 Willits 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 Willits 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 Willits 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 Willits Creek fish presence was observed from the stream banks, and **ONE** site was electrofished using one Smith-Root Model 12 electrofisher, with three passes made. These sampling techniques are discussed in the *California Salmonid Stream Habitat Restoration Manual*.

SUBSTRATE SAMPLING

Gravel sampling is conducted using a 9 inch diameter standard McNeil gravel sampler. Sample sites are identified numerically beginning at the most upstream site in the stream. 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)(Valentine, 1995).

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

Graphics are produced from the tables using Quattro Pro 4. Graphics developed for Willits 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 MONTH September 14, 18, 19, and 20, 1995, was conducted by Jeffrey Jahn (AmeriCorps/WSP), Ruth Goodfield (Scientific Aide), and Brie Darr (CCC). The total length of the stream surveyed was 11,747 feet with an additional 266 feet of side channel.

Flows were not measured on Willits Creek.

Willits Creek is a B4 channel type for the entire 11,747 feet of stream reach surveyed. B4 channels are moderately entrenched, a moderate gradient, riffle dominated channel, with infrequently spaced pools. They have a very stable plan and profile with stable banks, and are gravel dominated.

Water temperatures taken during the survey period ranged from 59 to 69 degrees Fahrenheit. Air temperatures ranged from 74 to 92 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of **occurrence** there were 35% flatwater units, 33% pool units, and 32% riffle units (Graph 1). Based on total **length** of Level II habitat types there were 51% pool units, 31% flatwater units, and 18% riffle units (Graph 2).

Eleven Level IV habitat types were identified (Table 2). The most frequent habitat types by percent **occurrence** were low gradient riffle, 32%; run, 32%; and mid-channel pools, 24% (Graph 3). Based on percent total **length**, mid-channel pools made

up 39%, runs 25%, and low gradient riffles 17%.

A total of 98 pools were identified (Table 3). Main pools were most frequently encountered at 74% and comprised 76% of the total length of all pools (Graph 4).

Table 4 is a summary of maximum pool depths by pool habitat types. Pool quality for salmonids increases with depth. Seventy-seven of the 98 pools (79%) had a depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 86 pool tail-outs measured, 7 had a value of 1 (8%); 19 had a value of 2 (22%); 49 had a value of 3 (57%); and 11 had a value of 4 (13%) (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 41, and riffle habitats had a mean shelter rating of 28 (Table 1). Of the pool types, the backwater pools had the highest mean shelter rating at 56. Main pools had a mean shelter rating of 40 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover type in Willits Creek and are extensive. Large and small woody debris are lacking in nearly all habitat types. Graph 7 describes the pool cover in Willits Creek.

Table 6 summarizes the dominant substrate by habitat type. Gravel was the dominant substrate observed in 6 of the 11 low gradient riffles measured (55%). Small cobble was the next most frequently observed dominant substrate type and occurred in 18% of the low gradient riffles (Graph 8).

The mean percent canopy density for the stream reach surveyed was 89%. The mean percentages of deciduous and coniferous trees were 65% and 24%, respectively. Graph 9 describes the canopy in Willits Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 52%. The mean percent left bank vegetated was also 52%. The dominant elements composing the structure of the stream banks consisted of 6.4% bedrock, 18.1% boulder, 27.7% cobble/gravel, and 47.8% sand/silt/clay (Graph 10). Deciduous trees were the dominant vegetation type observed in 67% of the units surveyed. Additionally, 12.8% had coniferous trees as the dominant vegetation surveyed, including down trees, logs, and root wads (Graph 11).

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BIOLOGICAL INVENTORY RESULTS

One site was electrofished on September 20, 1995, in Willits Creek. Three passes were made. The site was sampled by Ruth Goodfield (DFG) and Jeffrey Jahn (AmeriCorps/WSP).

The site sampled included habitat units 146-150, three riffles, a run, and a pool, approximately 4,564 feet from the beginning of the survey, or 5,564 feet above the confluence with Mill Creek. This site had an area of 522 sq ft and a volume of 261 cu ft. The first pass yielded 11 steelhead, from 63 to 101mm, and a 40mm crayfish. The second pass yielded 11 steelhead, from 56 to 86mm, and two lampreys, 111 and 123mm. The third pass yielded nothing.

GRAVEL SAMPLING RESULTS

No gravel samples were taken on Willits Creek.

DISCUSSION

Willits Creek is a B4 channel type for the entire 11,747 feet of stream surveyed. The suitability of B4 channel types for fish habitat improvement structures is as follows: Excellent for low-stage plunge weirs, boulder clusters and bank placed boulders, single and opposing wing-deflectors, and log cover; good for medium stage plunge weirs.

The water temperatures recorded on the survey days September 14, 18, 19, and 20, 1995, ranged from 59 to 69 degrees Fahrenheit. Air temperatures ranged from 74 to 92 degrees Fahrenheit. This is a good water temperature range for salmonids. However, 69° F, if sustained, is near the threshold stress level for salmonids. This does not seem to be the case here, and Willits Creek seems to have temperatures favorable to 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 31% of the total **length** of this survey, riffles 18%, and pools 51%. The pools are relatively deep, with 77 of the 98 (79%) pools having a maximum 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 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, or where their installation will not conflict with the modification of the numerous log debris accumulations (LDA's) in the stream. The LDA's in the system are retaining needed gravel. Any necessary modifications to them should be done with the intent of metering the gravel out to downstream reaches that will trap the gravel for future spawning use. Therefore, gravel retention features may need to be developed prior to any LDA modification.

Sixty of the 86 pool tail-outs measured had embeddedness ratings of 3 or 4. Only 7 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 Willits 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 41. The shelter rating in the flatwater habitats was slightly lower at 23. A pool shelter rating of approximately 100 is desirable. The relatively small amount of cover that now exists is being provided primarily by boulder rip-rap in all habitat types. Additionally, undercut banks contribute a small amount. 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.

Eight of the 11 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 89%. This is a relatively high percentage of canopy. In general, re-vegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was moderate at 52% for each. 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.

RECOMMENDATIONS

Willits Creek

1) Willits Creek should be managed as an anadromous, natural production stream.

2) Increase woody cover in the pools and flatwater habitat units. Most of the existing cover is from boulder rip-rap. Adding high quality complexity with woody cover is desirable and in some areas the material is locally available.

3) There are at least two sections where the stream is being impacted from cattle trampling the riparian zone and defecating in the water. Alternatives should be explored with the grazier and developed if possible.

4) Inventory and map sources of stream bank erosion and prioritize them according to present and potential sediment yield. Identified sites, like the site at 3319', should then be treated to reduce the amount of fine sediments entering the stream.

5) 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.

6) 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.

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 1000' above the confluence with Mill Creek. Channel type is B4.
286'	Cattle dung on the right bank (RB).
345'	Erosion on the RB.
833'	Cattle dung in the creek.
945'	Large debris accumulation on the RB, 60'L x 9'W x 12'H.
1217'	Log across the creek retaining gravel.

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1491' Dry tributary enters from the RB.

1584' Erosion on the RB.

1668' Erosion on the left bank (LB).

1952' Small 1' culvert on the LB.
1974' Dry tributary enters from the LB.

2660' Cattle dung in the creek for the next 330'.

2678' Ford across the creek.

2837' Dry tributary enters from the RB.

3035' Barbed wire across the fence.

3253' Log across the creek retaining gravel.

3277' A dry tributary enters from the RB.

3319' Erosion on the RB.

3471' Footbridge, erosion on the RB.

3573' Flash dam.

3642' Dirt road on both sides of the creek. Boulder rip-rap on the LB.

4017' Boulder rip-rap on both banks.

4300' Boulder steps, restoration work.

4407' Boulder rip-rap on the LB.

4549' A spring enters from the LB.

4929' Boulder rip-rap on the RB.

5284' Ford across the stream.

5327' Footbridge.

5506' Rip-rap on the LB.

5921' A tributary enters from the RB.

6112' Boulder and cement rip-rap on the RB.

7000' Cement and wood dam creates a summer lake at Brooktrails. Depth is 11' at the dam, all other measurements are estimated.

8070' Footbridge.

8232' Boulder rip-rap on the LB.
8262' A 15" culvert enters from the LB.

8594' Clover Road car bridge.

8735' Railroad car bridge.

8946' A dry tributary enters from the RB.

9138' Flash board dam in place retaining water. Railroad car bridge and footbridge present.

9218' Brooktrails golf course on the RB. Boulder rip-rap on the LB.

9456' Boulder rip-rap on the RB. Footbridge. Golfcourse on both banks.

9575' High stage weir.

9780' Boulder rip-rap on LB.

9899' Footbridge. Both banks have boulder rip-rap.

9935' Rip-rap on the RB. Golfcourse on the LB.

10181' Footbridge. Golfcourse on both banks.

10498' Log cover structures.

10615' Footbridge.

10794' Boulder rip-rap on the LB.

10860' Footbridge.

10949' Boulder rip-rap on the RB.

11144' Dry tributary enters from the RB. Boulder rip-rap on both banks. Log weir structures present.

11250' Dry tributary enters from the LB.

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11680' Wetland vegetation. Car bridge.

11747' A dam with a cement spillway creates Lake Emily. An employee from Brooktrails informed surveyors that steelhead have been observed attempting to get up the spillway in previous years. End of survey.

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