CALIFORNIA DEPARTMENT OF FISH AND GAME
STREAM INVENTORY REPORT

Hale Creek

Report Revised April 14, 2006
Report Completed 2005
Assessment Completed 2000

INTRODUCTION

A stream inventory was conducted during the summer of 2000 on Hale Creek. The inventory was conducted in two parts: habitat inventory and biological inventory. The objective of the habitat inventory was to document the amount and condition of available habitat to fish and other aquatic species with an emphasis on anadromous salmonids in Hale Creek. The objective of the biological inventory was to document the presence and distribution of salmonids and other aquatic species.

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

WATERSHED OVERVIEW

Hale Creek, a tributary of Big Sulphur Creek, a tributary of the Russian River, is located primarily in Sonoma County with headwaters in Mendocino County (see Hale Creek map, Appendix A). The legal description at the confluence with Big Sulphur Creek is T11N, R10W, S10. Its location is 38.817107605346 N. latitude and 122.9518852133 W. longitude, LLID: 1229518388170. Year round vehicle access exists from Highway 101 near Cloverdale, via Geysers Road.

Hale Creek and its tributaries drain a basin of approximately 1.88 square miles. Hale Creek is a second order stream and has approximately 2.78 miles of blue line stream, according to the USGS Asti 7.5 minute quadrangle. Hale Creek has one major tributary which was not surveyed. Summer flow was measured as approximately 0.7 cfs in habitat unit #005. Elevations range from about 604 feet at the mouth of the creek to 3005 feet in the headwaters. Oak woodland dominates the watershed. The watershed is owned entirely by private landowners and is managed for grazing. There are no sensitive species listed within the Hale Creek watershed in the CNPS Inventory or CDFG's Natural Diversity Database**,** but surveyors in 2000 did observe steelhead (*Onchorynchus mykiss),* which are federally listed as threatened, and yellow-legged frogs (*Rana boylii),* which are not listed but considered sensitive by the U.S. Forest Service.

METHODS

The habitat inventory conducted in Hale Creek follows the methodology presented in the California Salmonid Stream Habitat Restoration Manual (Flosi et al. 1998). The AmeriCorps Volunteers that conducted the inventory were trained in standardized habitat inventory methods by the California Department of Fish and Game (CDFG). This inventory was conducted by a two-person team and was supervised by Derek Acomb,

Russian River Basin Planner (CDFG).

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 (1998). This form was used in Hale Creek to record measurements and observations. There are nine components to the inventory form: flow, channel type, temperatures, habitat type, embeddedness, shelter rating, substrate composition, canopy, and bank composition.

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. Flows are also measured or estimated at major tributary confluences.

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 (1998). 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:
Water and air temperatures, and time, are measured by crew members with hand-held thermometers and recorded at each tenth unit typed. Temperatures are measured in Fahrenheit at the middle of the habitat unit and within one foot of the water surface. Temperatures are also recorded using remote temperature recorders which log temperature at set intervals, 24 hours/day.

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. De-watered units are labeled "DRY". Peterson 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 unit lengths were measured. The first occurrence of each unit type and a randomly selected 10% subset of all units were completely sampled (Length, Mean Width, Mean Depth, Maximum Depth and Pool Tail Crest Depth). All measurements are 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 Peterson Creek, embeddedness was visually 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). "Not suitable" (value 5) is assigned to tail-outs deemed unsuited for spawning due to

inappropriate substrate particle size, absence of particulate substrate (e.g. bedrock), 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. Using an overhead view, a quantitative estimate of the percentage of the habitat unit covered is made. All shelter is then classified according to a list of nine shelter types. In Peterson Creek, a standard qualitative shelter value of 0 (none), 1 (low), 2 (medium), or 3 (high) was assigned according to the complexity of the shelter. The shelter rating is calculated for each habitat unit by multiplying shelter value and percent covered. Thus, shelter ratings can range from 0-300, and are expressed as mean values by habitat types within a stream.

7. Substrate Composition:
In all fully measured habitat units, dominant and sub-dominant substrate elements are visually estimated using a list of seven size classes: Silt/Clay, Sand, Gravel, Small Cobble, Large Cobble, Boulder, and Bedrock.

8. Canopy:
Stream canopy density is estimated using modified handheld spherical densiometers as described in the California Salmonid Stream Habitat Restoration Manual (1998). Canopy density relates to the amount of stream shaded from the sun. In Peterson 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. Finally, the total canopy over each habitat unit is visually divided into evergreen and deciduous, and the estimated percentages are recorded.

9. Bank Composition and Vegetation:
Banks may be composed primarily of (1) Bedrock, (2) Boulders, (3) Cobble/Gravel, or (4) Silt/Clay/Sand, and may be covered predominantly with (5) Grass, (6) Brush, (7) Deciduous Trees, (8) Coniferous Trees, or (9) No Vegetation at all. These factors influence the ability of stream banks to withstand winter flows. For each fully measured habitat unit in Peterson Creek, the dominant Bank Composition Type and Vegetation Type of both the right and left banks were chosen from the options above. Additionally, the percentage of vegetal coverage was estimated and recorded for each bank.

BIOLOGICAL INVENTORY

Biological sampling during stream inventory is used to determine fish species present and their distribution in the stream. Biological inventory is conducted using one or more of three basic methods: 1) stream bank observation, 2) underwater observation, and 3) electro-fishing. These sampling techniques are discussed in the California Salmonid Stream Habitat Restoration Manual (1998).

DATA ANALYSIS

Data from the habitat inventory form are entered into Habitat, a dBASE IV data entry program developed by CDFG. This program processes and summarizes the data, and produces the following tables and appendices:

- 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 Hale 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

HISTORICAL STREAM SURVEYS:

There are no historical records of stream surveys conducted by the Department of Fish and Game on Hale Creek prior to 2000.

HABITAT INVENTORY RESULTS

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

The habitat inventory of July 2000 was conducted by Jacob Newell and Teresa Wildfong (AmeriCorps), and Michael Shugars (Intern) with supervision and analysis by CDFG. The survey began at the confluence with Big Sulphur Creek and extended up Hale Creek to the end of anadromous fish passage at a rock falls. The total length of the stream surveyed was 4613 feet, with an additional 220 feet of side channel.

Flow was measured at 0.7cfs during the survey period, in habitat unit #005, with a Marsh-McBirney Model

2000 flowmeter.

This section of Hale Creek has three channel types: from the mouth to 2204 feet a B3; the next 1356 feet an A2 and the upper 1053 feet a B3.

B3 channel types are moderately entrenched, moderate gradient (2-4%), riffle dominated channels with infrequently spaced pools, a very stable plan and profile, stable banks and a predominantly cobble substrate.

A2 channel types are steep (4-10%), narrow, cascading, step-pool streams with a high energy/debris transport associated with depositional soils and a predominantly boulder substrate.

Water temperatures on the survey dates ranged from 62°F to 66°F. Air temperatures ranged from 59°F to 66°F. Summer temperatures were also measured using remote temperature recorders placed in pools (see Temperature Summary graph, Appendix E). A recorder in Reach 1 logged temperatures every two hours from June 2 to June 10, 2000, when the pool dried up. On July 12, the recorder was relocated by surveyors to another pool in Reach 1, where it logged temperatures every two hours until September 19, 2000. The highest temperature recorded in the second location was 70°F in August and the lowest was 57°F in September. The mean of the daily highs was 66°F for the month of July, 64°F for August and 62°F for September.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of **occurrence** there were 42% flatwater units, 39% pool units, 12% dry streambed units, and 7% riffle units. Based on total **length** there were 63% flatwater units, 26% dry streambed units, 9% pool units and 2% riffle units.

Of the 69 habitat units measured, 38% were completely sampled. Ten Level IV habitat types were identified. The data is summarized in Table 2. The most frequent habitat types by percent **occurrence** were step runs at 33%, bedrock scour pools at 14%, mid-channel pools at 12% and dry streambed at 12%. By percent total **length**, step runs made up 58%, dry streambed 26%, runs 4%, and bedrock scour pools 4%.

Twenty-seven pools were identified (Table 3). Scour pools were most often encountered at 67%, and comprised 67% of the total length of pools.

Table 4 is a summary of maximum pool depths by pool habitat types. Pool quality for salmonids increases with depth. Two of the 27 pools (7%) had a depth of two feet or greater.

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 types had the highest shelter rating at 12. Riffles had the lowest rating with 5 and flatwater rated 7 (Table 1). Of the pool types, the main channel pools had the highest mean shelter rating at 17. Scour pools rated 9 (Table 3).

Table 5 summarizes fish shelter by habitat type. By percent area, the dominant pool shelter types were boulders at 78%, small woody debris at 8%, undercut banks at 6%, and bedrock ledges at 6%.

Table 6 summarizes the dominant substrate by habitat type.

No mechanical gravel sampling was conducted in 2000 surveys due to inadequate staffing levels.

The depth of cobble embeddedness was estimated at pool tail-outs (Graph 6). Of the 26 pool tail-outs measured, nine had a value of 2 (35%), thirteen had a value of 3 (50%), and one had a value of 4 (4%). Three (12%) riffles rated a 5 (unsuitable substrate type for spawning). On this scale, a value of one is best for fisheries. Gravel was the dominant substrate observed at pool tail-outs (Graph 8).

The mean percent canopy density for the stream reach surveyed was 68%. The mean percentages of deciduous and evergreen trees were 20% and 78%, respectively (Graph 9).

For the entire stream reach surveyed, the mean percent right bank vegetated was 11% and the mean percent left bank vegetated was 11%. For the habitat units measured, the dominant vegetation types for the stream banks were: 35% deciduous trees, 31% evergreen trees, 23% grass, 10% bare soil and 2% brush (Graph 11). The dominant substrate for the stream banks were: 46% bedrock, 31% cobble/gravel, 19% boulder and 4% silt/clay/sand (Graph 10).

BIOLOGICAL INVENTORY

JUVENILE SURVEYS:

In November 2000 a biological inventory was conducted to document the fish species composition and distribution at two locations along Hale Creek. Each site was single-pass electro-fished using one Smith Root Model 12 electro-fisher. Fish from each site were counted by species and returned to the stream. Tissue samples were taken from several randomly selected juvenile steelhead for genetic analysis. The observers were Bryan Freele and Michael Shugars.

Site 1 was located in Reach 1, 151 feet upstream of Geysers Road Bridge, and stretched 115 feet upstream. Ninety-one yellow-legged frogs were observed, as well as seven juvenile steelhead ranging from 70-95 mm in fork length.

Site 2 began 2,400 feet upstream of the bridge and continued for 1,030 feet upstream. Sixty yellow-legged frogs were observed, as well as five juvenile steelhead ranging from 60 to 80 mm in fork length.

It should be noted that habitat inventory surveyors observed very large numbers of YOY steelhead in corner pools with no shelter in July. Feral pigs and signs of deer and mountain lion were also observed.

During the habitat inventory, no anadromous salmonids were observed upstream of unit # 068, 4,613 feet above the confluence with Big Sulphur Creek, where a series of rock falls (2-6' high). However, a resident rainbow trout (8" long) was observed above this point.

A summary of historical and recent data collected appears in the table below.

Table 1. Species Observed in Historical and Recent Surveys			
YEARS	**SPECIES**	**SOURCE**	**Native/Introduced**
2000	Steelhead	CDFG	N
2000	Yellow-Legged Frog	CDFG	N

There is no record of hatchery stocking or fish rescue/transfer operations in Hale Creek.

ADULT SURVEYS:

There is no record of adult/carcass surveys on Hale Creek. However, an adult rainbow trout was observed above the end of the 2000 survey.

DISCUSSION

Hale Creek has three channel types: B3 (2204 ft.), A2 (1356 ft.) and B3 (1053 ft.).

There are 3,257 feet of B3 channel type in Reaches 1 and 3. According to the CDFG Salmonid Stream Habitat Restoration Manual, B3 channel types are excellent for low-stage plunge weirs, boulder clusters, bank placed boulders, single and opposing wing-deflectors and log cover. They are also good for medium-stage plunge weirs. B channel types have suitable gradients and the stable stream banks that are necessary for the installation of instream structures designed to increase pool habitat, trap spawning gravels, and provide protective shelter for fish. Many site specific projects can be designed within this channel type, especially to increase pool frequency, volume and shelter.

There are 1,356 feet of A2 channel type in Reach 2. According to the CDFG Salmonid Stream Habitat Restoration Manual, the high energy, steep gradient A2 channel types have stable stream banks and poor gravel retention capabilities and are generally not suitable for instream enhancement structures.

The water temperatures recorded on the survey day July 12, 2000 ranged from 62°F to 66°F. Air temperatures ranged from 59°F to 66°F. The warmest water temperatures were recorded in Reach 1. This temperature regime is favorable to steelhead.

Summer temperatures measured using a remote temperature recorder placed in a shaded pool in Reach 1 ranged from 56° to 70°F. The Temperature Summary graph shows that for much of the summer (July through August) the watershed exhibited temperatures near the optimal for salmonids.

Pools comprised 9% of the total **length** of this survey. 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. In Hale Creek, the pools are relatively shallow with 7% having a maximum depth of at least two feet. These pools comprised 0.1% of the total length of stream habitat. In coastal coho salmon and steelhead streams, it is generally desirable to have primary pools comprise approximately 50% of total habitat length.

The mean shelter rating for pools was 12. However, a pool shelter rating of approximately 80 is desirable. The relatively small amount of pool shelter that now exists is being provided primarily by boulders (78%), small woody debris (8%), undercut banks (6%), and bedrock ledges (6%).Log and root wad cover in the pool and flatwater habitats would improve both summer and winter salmonid habitat. Log cover provides rearing fry with protection from predation, rest from water velocity, and also divides territorial units to reduce density related competition.

Twenty four of the 54 pool tail-outs measured had embeddedness ratings of either 3 or 4. None had a rating of 1. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered best for the needs of salmon and steelhead.

The mean percent canopy for the survey was 68%. This is fair since 80 percent is generally considered desirable.

GENERAL MANAGEMENT RECOMMENDATIONS

Note: Large numbers of steelhead were observed by habitat surveyors in corner pools with no shelter. According to landowners, Hale Creek used to be perennial until some folks upstream tapped a spring for a vineyard. If this water was returned to the stream, Hale would be a more substantial steelhead creek.

Hale Creek should be managed as an anadromous, natural production stream.

Winter storms often bring down large trees and other woody debris into the stream, which increases the number and quality of pools. This woody debris, if left undisturbed, will provide fish shelter and rearing habitat, and offset channel incision. Landowners should be sensitive about the natural and positive role woody debris plays in the system, and encouraged not to remove woody debris from the stream, except under extreme buildup and only under guidance by a fishery professional.

PRIORITY FISHERY ENHANCEMENT OPPORTUNITIES

1) Access for migrating salmonids is a potential problem in Reach 2 and fish passage should be monitored, and improved where possible.

2) Increase the canopy on Hale Creek by planting willow, alder, redwood, and Douglas fir along the stream where shade canopy is not at acceptable levels. The non-anadromous reach above the survey section should be assessed for planting and treated as well, since water temperatures throughout are effected from upstream. In many cases, planting will need to be coordinated to follow bank

stabilization or upslope erosion control projects.

3) Map sources of upslope and in-channel erosion, and prioritize them according to present and potential sediment yield. Identified sites should then be treated to reduce the amount of fine sediments entering the stream. Near-stream riparian planting along any portion of the stream should be encouraged to provide bank stability and a buffering against agricultural, grazing and urban runoff.

4) In Hale Creek, active and potential sediment sources related to the road system need to be mapped, and treated according to their potential for sediment yield to the stream and its tributaries.

5) Where feasible, increase woody cover in the pool and flatwater habitat units along the entire stream. Most of the existing shelter is from vegetation and undercut banks. Adding high quality complexity with larger woody cover is desirable. Combination cover/scour structures constructed with boulders and woody debris would be effective in many flatwater and pool locations in the upper reaches. This must be done where the banks are stable or in conjunction with stream bank armor to prevent erosion. In some areas the material is at hand.

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

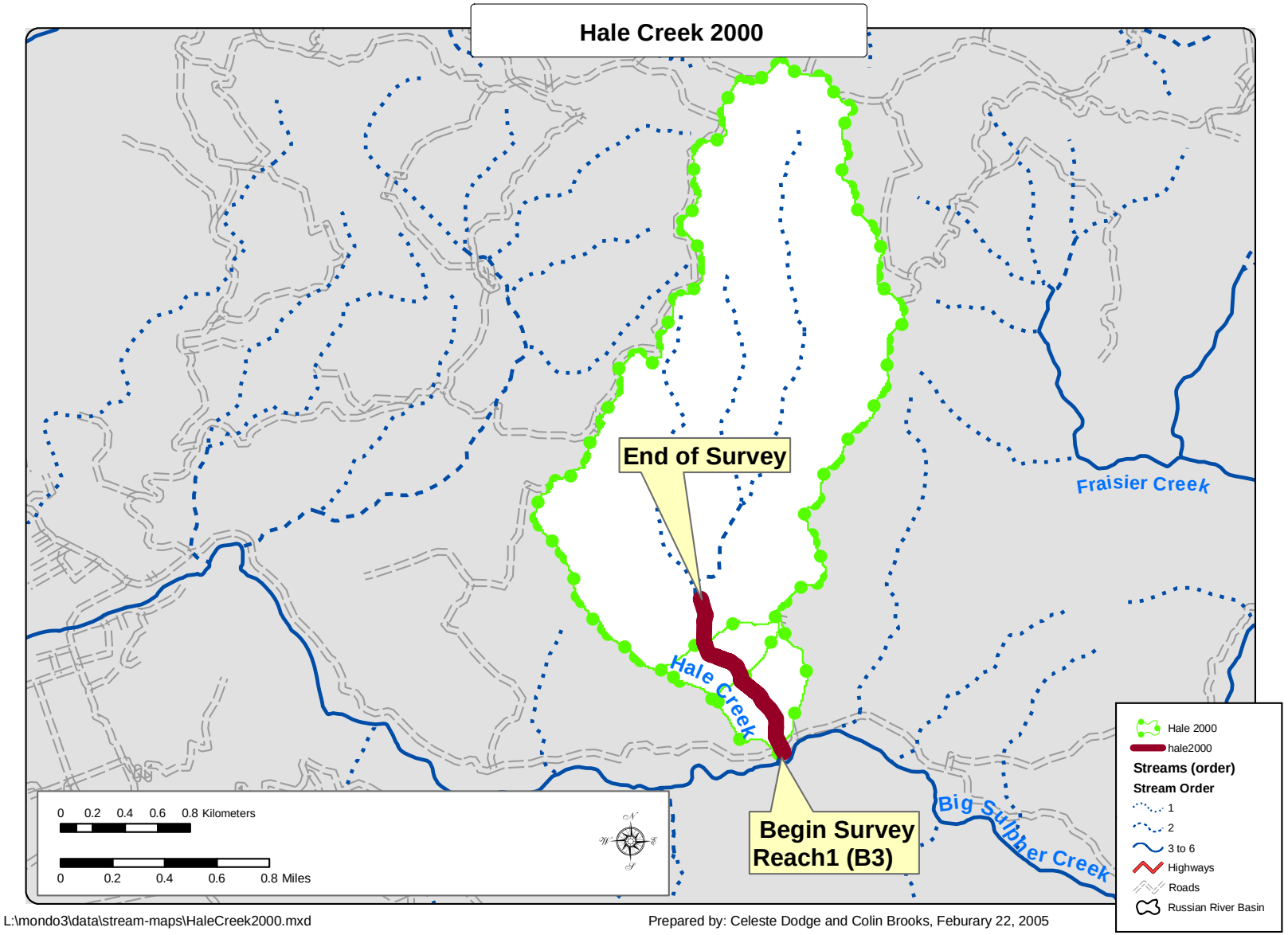
7) If riparian areas are not improved in Hale Creek, temperatures should be monitored to determine if they are having a deleterious effect upon juvenile salmonids. To achieve this, biological sampling is also required.

HALE CREEK SURVEY COMMENTS

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

HABITAT UNIT #	DISTANCE UPSTREAM	COMMENTS
1	160	Mouth 90' wide; 3 separate channels; WP#041(F1).
2	280	Water begins; Algae present; Splits into 2 channels 30' up from beginning of unit.
3	300	2 dozen feral pigs present; 0+, 1+ salmonids present
4	327	Flow reading
5	368	Bridge, see form; WP# 043 (F1)
8	543	1- 1+, 6 - 0+ salmonids.
10	644	Dry Unit
11.1	1054	Dry Unit, Potential rearing pool.
12	909	Hobotemp found in this dry pool. Re-deployed in H.U.#039.
14	1334	Begin water again.

17	1582	WP#049 (F1)
19	1785	Several 1+ salmonids.
22	1963	15 - 1+ salmonids.
23	2072	Fallen deciduous tree.
24	2082	LB dry trib.; RB dry trib.
25	2142	1 dozen 0+ salmonids; New channel type: A2.
28	2213	WP# 044 (F1).
29	2253	Newt and 0+ salmodids.
30	2264	Unit includes several glides inhabited by
33	2515	Rearing salmonids; 40' cliff LB through whole unit; LB narrow gully. 2+ salmonid
36	2569	Hobotemp deployed; Steep, entrenched
39	2730	Canyon: No GPS reading possible. Includes three 2' jumps, with a total of 7'
44	2807	Vertical gain in about 7 horizontal feet. Heavy deposition.
46	2849	Includes 3' and 2' jumps; Fence upper LB; WP# 045 (F1).
49	2890	1+ salmonids; RB steep gully; natural.
50	2903	Steep banks throughout reach.
51	2970	Heavy Silt.
52	2981	Large boulders split flow.
53	3015	LB small gully.
54	3025	5' vertical jump;
55	3030	2 dozen 1+ salmonids; RB gully/dry trib.
56	3215	1+ salmonids; heavy silt.
57	3230	Perched SWD; 1+ salmonids inhabiting runs and shallow, sedimented pools throughout unit.
58	3530	2 dozen 1+ salmonids with no shelter! WP# 046 (F1).
59	3560	New channel type: B3
60	3617	RB wet trib (64 degrees F) WP# 048 (F1); LB small dry trib.
62	4082	Salmonids of all age classes, including one
63	4101	of 0.7' length! RB gully: see notes; Mountain lion scat
64	4221	found near deer corpse. 2+ salmonid of 0.6' length.
65	4229	3' vertical jump.
66	4232	RB dripping spring.
67	4553	End survey, series of
68	4613	rock falls 2-6' high. However, 8" rainbow trout observed 200' upstream WP# 047 (F1).



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Prepared by: Celeste Dodge and Colin Brooks, Feburary 22, 2005

APPENDIX B: TABLES

Table 1 - Summary of Riffle, Flatwater, and Pool Habitat Types

Stream Name: Hale Creek

LLID: 1229518388170

Drainage: Russian River - Middle

Survey Dates: 7/12/2000 to 7/12/2000

Confluence Location: Quad: ASTI Legal Description: T000R000S00 Latitude: 38:49:01.0N Longitude: 122:57:06.0W

Habitat Units	Units Fully Measured	Habitat Type	Habitat Occurrence (%)	Mean Length (ft.)	Total Length (ft.)	Total Length (%)	Mean Width (ft.)	Mean Depth (ft.)	Mean Max Depth (ft.)	Mean Area (sq.ft.)	Estimated Total Area (sq.ft.)	Mean Volume (cu.ft.)	Estimated Total Volume (cu.ft.)	Mean Residual Pool Vol (cu.ft.)	Mean Shelter Rating
8	1	DRY	11.6	156	1249	25.8	60.0	0.0							0
29	11	FLATWATER	42.0	106	3068	63.5	7.5	0.3	0.6	328	9517	123	3233		7
27	27	POOL	39.1	16	427	8.8	7.4	0.7	1.3	96	2601	81	2103	66	12
5	2	RIFFLE	7.2	18	89	1.8	11.0	0.6	1.1	148	740	78	390		5

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
69	41	4833	12858	5726

Table 2 - Summary of Habitat Types and Measured Parameters

Stream Name: Hale Creek

LLID: 1229518388170

Drainage: Russian River - Middle

Survey Dates: 7/12/2000 to 7/12/2000

Confluence Location: Quad: ASTI Legal Description: T000R000S00 Latitude: 38:49:01.0N Longitude: 122:57:06.0W

Habitat Units	Units Fully Measured	Habitat Type	Habitat Occurrence (%)	Mean Length (ft.)	Total Length (ft.)	Total Length (%)	Mean Width (ft.)	Mean Depth (ft.)	Max Depth (ft.)	Mean Area (sq.ft.)	Estimated Total Area (sq.ft.)	Mean Volume (cu.ft.)	Estimated Total Volume (cu.ft.)	Mean Residual Pool Vol (cu.ft.)	Mean Shelter Rating	Mean Canopy (%)
5	2	CAS	7.2	18	89	1.8	11	0.6	1.2	148	740	78	390		5	83
2	2	GLD	2.9	30	60	1.2	5	0.4	0.6	143	285	49	98			93
4	2	RUN	5.8	52	209	4.3	7	0.2	0.3	300	1200	60	240			53
23	7	SRN	33.3	122	2799	57.9	8	0.3	1.2	389	8954	168	3312		7	72
8	8	MCP	11.6	16	124	2.6	10	0.8	2.4	111	887	109	871	91	18	78
1	1	STP	1.4	16	16	0.3	7	0.8	1.1	67	67	60	60	54	15	85
10	10	LSBk	14.5	20	197	4.1	5	0.5	1.5	95	954	65	652	51	6	72
6	6	LSBo	8.7	12	72	1.5	8	0.5	1.6	91	545	62	308	42	13	84
2	2	PLP	2.9	9	18	0.4	8	1.5	2.2	74	148	106	211	98	13	35
8	1	DRY	11.6	156	1249	25.8	60	0.0		0	0				0	24

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
69	41	4833	13780	6143

Table 3 - Summary of Pool Types

Stream Name: Hale Creek

LLID: 1229518388170

Drainage: Russian River - Middle

Survey Dates: 7/12/2000 to 7/12/2000

Confluence Location: Quad: ASTI

Legal Description: T000R000S00

Latitude: 38:49:01.0N

Longitude: 122:57:06.0W

Habitat Units	Units Fully Measured	Habitat Type	Habitat Occurrence (%)	Mean Length (ft.)	Total Length (ft.)	Total Length (%)	Mean Width (ft.)	Mean Residual Depth (ft.)	Mean Area (sq.ft.)	Estimated Total Area (sq.ft.)	Mean Residual Pool Vol (cu.ft.)	Estimated Total Resid.Vol. (cu.ft.)	Mean Shelter Rating
9	9	MAIN	33	16	140	33	9.8	0.8	106	954	87	782	17
18	18	SCOUR	67	16	287	67	6.3	0.6	91	1647	54	921	9

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
27	27	427	2601	1703

Table 4 - Summary of Maximum Residual Pool Depths By Pool Habitat Types

Stream Name: Hale Creek

LLID: 1229518388170

Drainage: Russian River - Middle

Survey Dates: 7/12/2000 to 7/12/2000

Confluence Location: Quad: ASTI Legal Description: T000R000S00 Latitude: 38:49:01.0N Longitude: 122:57:06.0W

Habitat Units	Habitat Type	Habitat Occurrence (%)	< 1 Foot Maximum Residual Depth	< 1 Foot Percent Occurrence	1 < 2 Feet Maximum Residual Depth	1 < 2 Feet Percent Occurrence	2 < 3 Feet Maximum Residual Depth	2 < 3 Feet Percent Occurrence	3 < 4 Feet Maximum Residual Depth	3 < 4 Feet Percent Occurrence	>= 4 Feet Maximum Residual Depth	>= 4 Feet Percent Occurrence
8	MCP	31	1	13	6	75	1	13	0	0	0	0
1	STP	4	0	0	1	100	0	0	0	0	0	0
10	LSBk	38	3	30	7	70	0	0	0	0	0	0
5	LSBo	19	2	40	3	60	0	0	0	0	0	0
2	PLP	8	0	0	1	50	1	50	0	0	0	0

Total Units	Total < 1 Foot Max Resid. Depth	Total < 1 Foot % Occurrence	Total 1< 2 Foot Max Resid. Depth	Total 1< 2 Foot % Occurrence	Total 2< 3 Foot Max Resid. Depth	Total 2< 3 Foot % Occurrence	Total 3< 4 Foot Max Resid. Depth	Total 3< 4 Foot % Occurrence	Total >= 4 Foot Max Resid. Depth	Total >= 4 Foot % Occurrence
26	6	23	18	69	2	8	0	0	0	0

Mean Maximum Residual Pool Depth (ft.): 1.2

Table 5 - Summary of Mean Percent Cover By Habitat Type

Stream Name: Hale Creek LLID: 1229518388170 Drainage: Russian River - Middle

Survey Dates: 7/12/2000 to 7/12/2000 Dry Units: 8

Confluence Location: Quad: ASTI Legal Description: T000R000S00 Latitude: 38:49:01.0N Longitude: 122:57:06.0W

Habitat Units	Units Fully Measured	Habitat Type	Mean % Undercut Banks	Mean % SWD	Mean % LWD	Mean % Root Mass	Mean % Terr. Vegetation	Mean % Aquatic Vegetation	Mean % White Water	Mean % Boulders	Mean % Bedrock Ledges
5	2	CAS	0	0	0	0	0	0	0	100	0
5	2	TOTAL RIFFLE	0	0	0	0	0	0	0	100	0
2	0	GLD									
4	0	RUN									
23	3	SRN	0	0	0	0	0	0	0	100	0
29	3	TOTAL FLAT	0	0	0	0	0	0	0	100	0
8	8	MCP	7	0	0	3	0	0	0	89	1
1	1	STP	0	0	0	0	0	0	0	100	0
10	8	LSBk	13	19	0	0	0	0	0	50	19
6	6	LSBo	0	10	0	0	0	0	0	90	0
2	2	PLP	0	0	0	0	0	0	0	100	0
27	25	TOTAL POOL	6	8	0	1	0	0	0	78	6
69	31	TOTAL	5	7	0	1	0	0	0	79	5

Table 6 - Summary of Dominant Substrates By Habitat Type

Stream Name: Hale Creek LLID: 1229518388170 Drainage: Russian River - Middle

Survey Dates: 7/12/2000 to 7/12/2000 Dry Units: 8

Confluence Location: Quad: ASTI Legal Description: T000R000S00 Latitude: 38:49:01.0N Longitude: 122:57:06.0W

Habitat Units	Units Fully Measured	Habitat Type	% Total Silt/Clay Dominant	% Total Sand Dominant	% Total Gravel Dominant	% Total Small Cobble Dominant	% Total Large Cobble Dominant	% Total Boulder Dominant	% Total Bedrock Dominant
5	2	CAS	0	0	50	0	0	50	0
2	2	GLD	0	50	0	0	50	0	0
4	2	RUN	0	0	50	0	0	50	0
23	6	SRN	0	0	0	0	50	33	17
8	3	MCP	0	67	33	0	0	0	0
1	1	STP	0	0	0	0	0	100	0
10	3	LSBk	0	67	0	33	0	0	0
6	4	LSBo	0	50	25	25	0	0	0
2	1	PLP	0	0	0	100	0	0	0

Table 7 - Summary of Mean Percent Canopy for Entire Stream

Stream Name: Hale Creek LLID: 1229518388170 Drainage: Russian River - Middle

Survey Dates: 7/12/2000 to 7/12/2000

Confluence Location: Quad: ASTI Legal Description: T000R000S00 Latitude: 38:49:01.0N Longitude: 122:57:06.0W

Mean Percent Canopy	Mean Percent Conifer	Mean Percent Hardwood	Mean Percent Open Units	Mean Right Bank % Cover	Mean Left Bank % Cover
68	78	20	2	11	11

Note: Mean percent conifer and hardwood for the entire reach are means of canopy components from units with canopy values greater than zero.

Open units represent habitat units with zero canopy cover.

Table 9 - Mean Percentage of Dominant Substrate and Vegetation

Stream Name: Hale Creek LLID: 1229518388170 Drainage: Russian River - Middle

Survey Dates: 7/12/2000 to 7/12/2000

Confluence Location: Quad: ASTI Legal Description: T000R000S00 Latitude: 38:49:01.0N Longitude: 122:57:06.0W

Mean Percentage of Dominant Stream Bank Substrate

Dominant Class of Substrate	Number of Units Right Bank	Number of Units Left Bank	Total Mean Percent (%)
Bedrock	11	13	46.2
Boulder	6	4	19.2
Cobble / Gravel	7	9	30.8
Sand / Silt / Clay	2	0	3.8

Mean Percentage of Dominant Stream Bank Vegetation

Dominant Class of Vegetation	Number of Units Right Bank	Number of Units Left Bank	Total Mean Percent (%)
Grass	5	7	23.1
Brush	1	0	1.9
Hardwood Trees	7	11	34.6
Coniferous Trees	9	7	30.8
No Vegetation	4	1	9.6

Total Stream Cobble Embeddedness Values: 3

Table 10 - Mean Percent of Shelter Cover Types For Entire Stream

StreamName: Hale Creek LLID: 1229518388170 Drainage: Russian River - Middle

Survey Dates: 7/12/2000 to 7/12/2000

Confluence Location: Quad: ASTI Legal Description: T000R000S00 Latitude: 38:49:01.0N Longitude: 122:57:06.0W

	Riffles	Flatwater	Pools
UNDERCUT BANKS (%)	0	0	6
SMALL WOODY DEBRIS (%)	0	0	8
LARGE WOODY DEBRIS (%)	0	0	0
ROOT MASS (%)	0	0	1
TERRESTRIAL VEGETATION (%)	0	0	0
AQUATIC VEGETATION (%)	0	0	0
WHITEWATER (%)	0	0	0
BOULDERS (%)	100	100	78
BEDROCK LEDGES (%)	0	0	6

APPENDIX C - FISH HABITAT INVENTORY DATA SUMMARY

Stream Name: Hale Creek LLID: 1229518388170 Drainage: Russian River

Survey Dates: 7/12/2000 to 7/12/2000 Survey Length (ft.): 4833 Main Channel (ft.): 4613 Side Channel (ft.): 220

Confluence Location: Quad: ASTI Legal Description: T000R000S00 Latitude: 38:49:01.0N Longitude: 122:57:06.0W

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 1

Channel Type: B3
Reach Length (ft.): 2204
Riffle/Flatwater Mean Width (ft.): 5.0
BFW:
Range (ft.): to
Mean (ft.):
Std. Dev.:
Base Flow (cfs): 0.7
Water (F): 63 - 66 Air (F): 64 - 65
Dry Channel (ft.): 1029

Canopy Density (%): 56.1
Coniferous Component (%): 83.2
Hardwood Component (%): 16.8
Dominant Bank Vegetation: Grass
Vegetative Cover (%): 10.9
Dominant Shelter: Boulders
Dominant Bank Substrate Type: Cobble/Gravel
Occurrence of LWD (%): 0.0
LWD per 100 ft.:
Riffles:
Pools:
Flat:

Pools by Stream Length (%): 7.4
Pool Frequency (%): 33.3
Residual Pool Depth (%):
< 2 Feet Deep: 100.0
2 to 2.9 Feet Deep: 0.0
3 to 3.9 Feet Deep: 0.0
>= 4 Feet Deep: 0.0
Mean Max Residual Pool Depth (ft.): 0.93
Mean Pool Shelter Rating: 7

Pool Tail Substrate (%): Silt/Clay: 0.0 Sand: 0.0 Gravel: 87.5 Sm Cobble: 0.0 Lg Cobble: 12.5 Boulder: 0.0 Bedrock: 0.0
Embeddedness Values (%): 1. 0.0 2. 12.5 3. 75.0 4. 12.5 5. 0.0

STREAM REACH: 2

Channel Type: A2
Reach Length (ft.): 1356
Riffle/Flatwater Mean Width (ft.): 9.7
BFW:
Range (ft.): to
Mean (ft.):
Std. Dev.:
Base Flow (cfs): 0.7
Water (F): 62 - 66 Air (F): 59 - 66
Dry Channel (ft.): 0

Canopy Density (%): 79.0
Coniferous Component (%): 77.0
Hardwood Component (%): 23.0
Dominant Bank Vegetation: Hardwood Trees
Vegetative Cover (%): 9.6
Dominant Shelter: Boulders
Dominant Bank Substrate Type: Bedrock
Occurrence of LWD (%): 0.0
LWD per 100 ft.:
Riffles:
Pools:
Flat:

Pools by Stream Length (%): 16.4
Pool Frequency (%): 46.9
Residual Pool Depth (%):
< 2 Feet Deep: 93.3
2 to 2.9 Feet Deep: 6.7
3 to 3.9 Feet Deep: 0.0
>= 4 Feet Deep: 0.0
Mean Max Residual Pool Depth (ft.): 1.33
Mean Pool Shelter Rating: 15

Pool Tail Substrate (%): Silt/Clay: 0.0 Sand: 0.0 Gravel: 26.7 Sm Cobble: 53.3 Lg Cobble: 13.3 Boulder: 6.7 Bedrock: 0.0
Embeddedness Values (%): 1. 0.0 2. 46.7 3. 40.0 4. 0.0 5. 13.3

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 3

Channel Type: B3
Reach Length (ft.): 1053
Riffle/Flatwater Mean Width (ft.): 8.0
BFW:
Range (ft.): to
Mean (ft.):
Std. Dev.:
Base Flow (cfs): 0.7
Water (F): 63 - 63 Air (F): 65 - 65
Dry Channel (ft.): 0

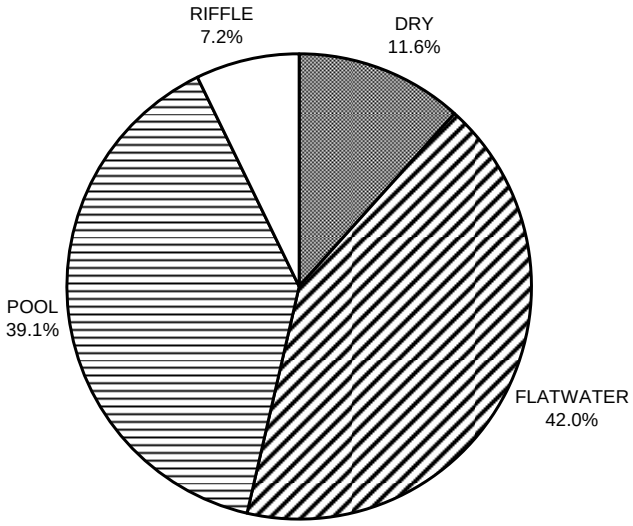
Canopy Density (%): 73.0
Coniferous Component (%): 80.0
Hardwood Component (%): 20.0
Dominant Bank Vegetation: Coniferous Trees
Vegetative Cover (%): 16.7
Dominant Shelter: Boulders
Dominant Bank Substrate Type: Boulder
Occurrence of LWD (%): 0.0
LWD per 100 ft.:
Riffles:
Pools:
Flat:

Pools by Stream Length (%): 3.9
Pool Frequency (%): 33.3
Residual Pool Depth (%):
< 2 Feet Deep: 66.7
2 to 2.9 Feet Deep: 33.3
3 to 3.9 Feet Deep: 0.0
>= 4 Feet Deep: 0.0
Mean Max Residual Pool Depth (ft.): 1.66
Mean Pool Shelter Rating: 12

Pool Tail Substrate (%): Silt/Clay: 0.0 Sand: 0.0 Gravel: 66.7 Sm Cobble: 0.0 Lg Cobble: 0.0 Boulder: 33.3 Bedrock: 0.0
Embeddedness Values (%): 1. 0.0 2. 33.3 3. 33.3 4. 0.0 5. 33.3

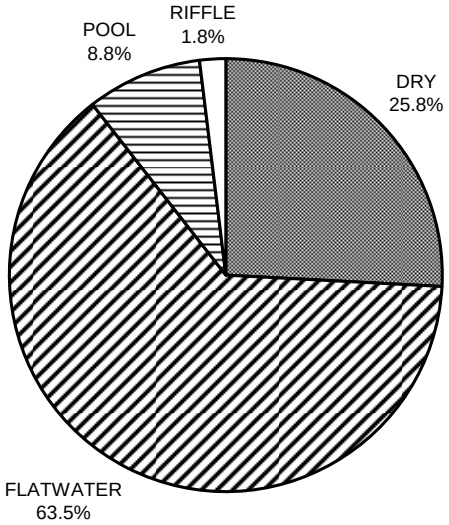
APPENDIX D: GRAPHS

HALE CREEK 2000
HABITAT TYPES BY PERCENT OCCURRENCE



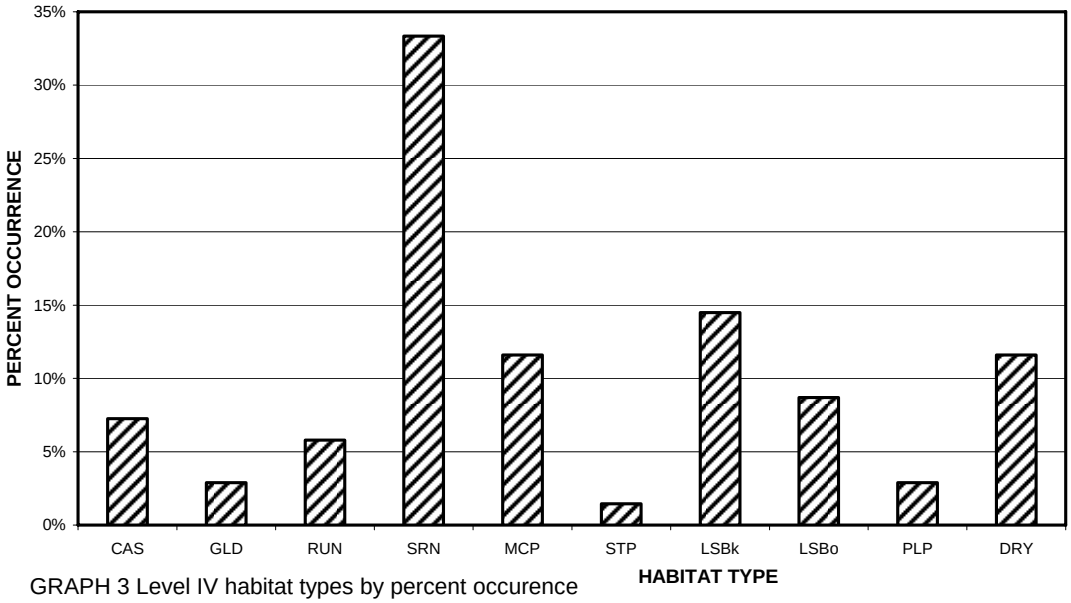
GRAPH 1 Level II habitat types by percent occurence

HALE CREEK 2000
HABITAT TYPES BY PERCENT TOTAL LENGTH



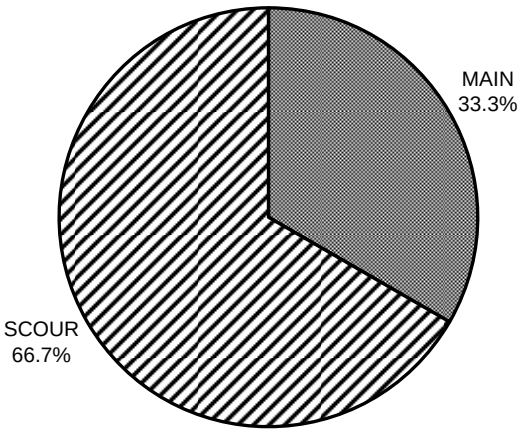
GRAPH 2 Level II habitat types by percent total length

HALE CREEK 2000
HABITAT TYPES BY PERCENT OCCURRENCE



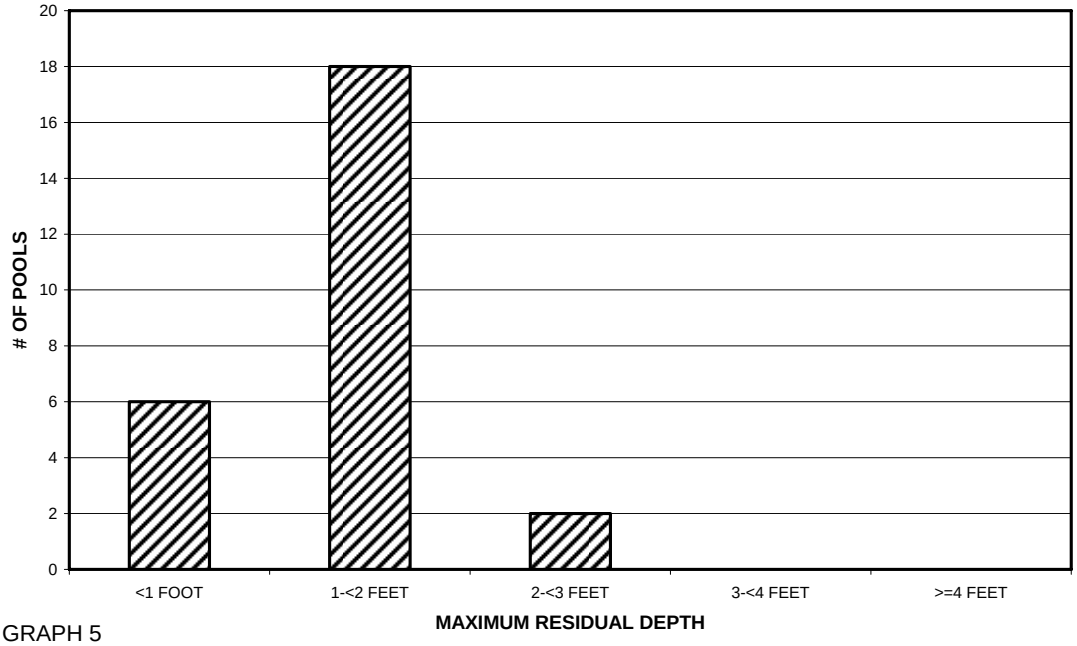
GRAPH 3 Level IV habitat types by percent occurence

HALE CREEK 2000
POOL TYPES BY PERCENT OCCURRENCE



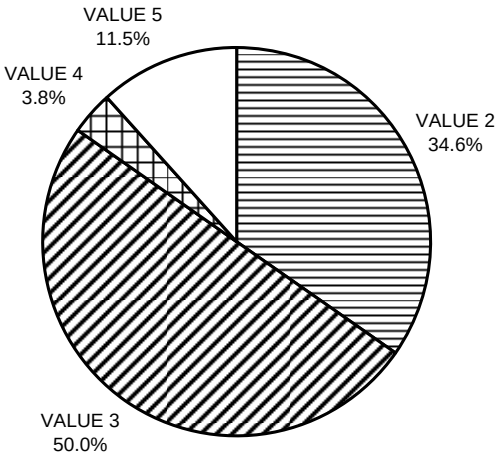
GRAPH 4 Level I pool types by percent occurence

HALE CREEK 2000
MAXIMUM DEPTH IN POOLS



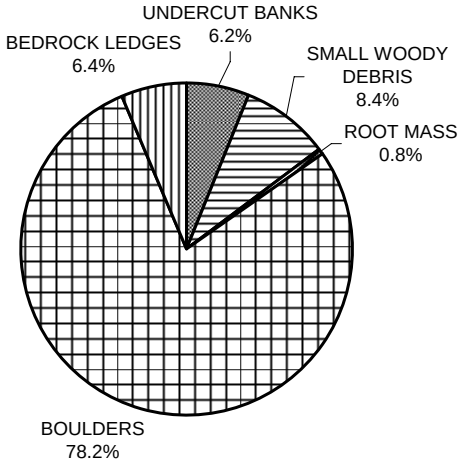
GRAPH 5

HALE CREEK 2000
PERCENT EMBEDDEDNESS



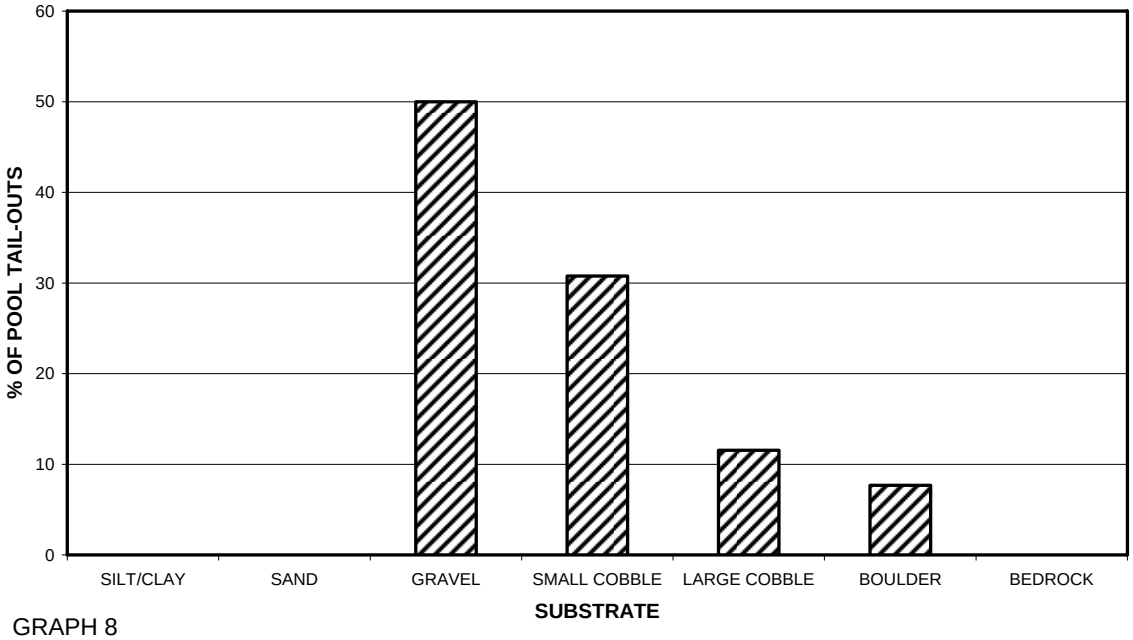
GRAPH 6

HALE CREEK 2000
MEAN PERCENT COVER TYPES IN POOLS



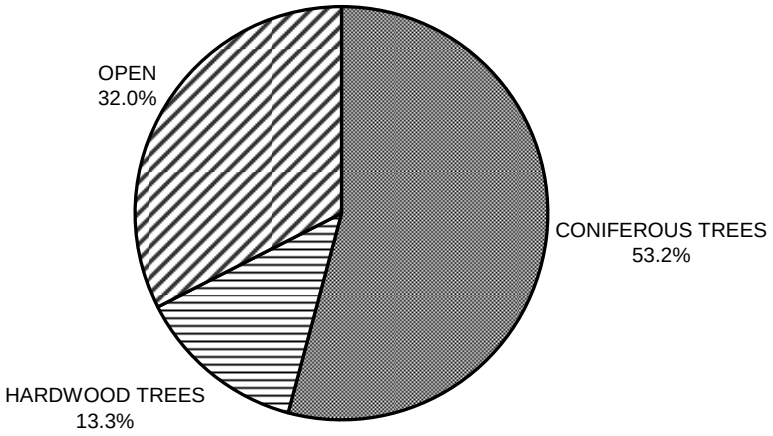
GRAPH 7

HALE CREEK 2000
SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



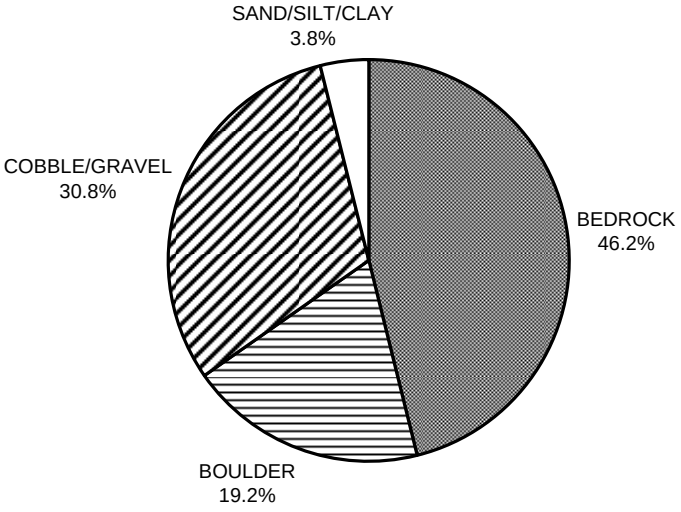
GRAPH 8

HALE CREEK 2000
MEAN PERCENT CANOPY



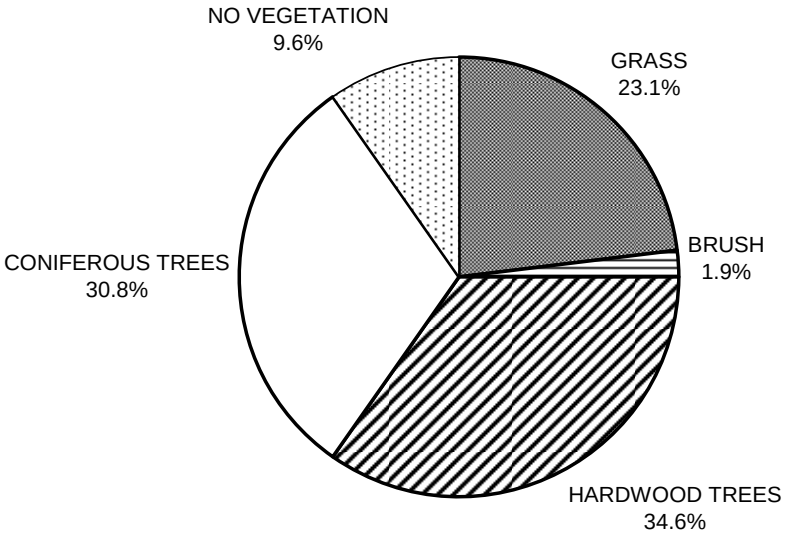
GRAPH 9

HALE CREEK 2000
DOMINANT BANK COMPOSITION



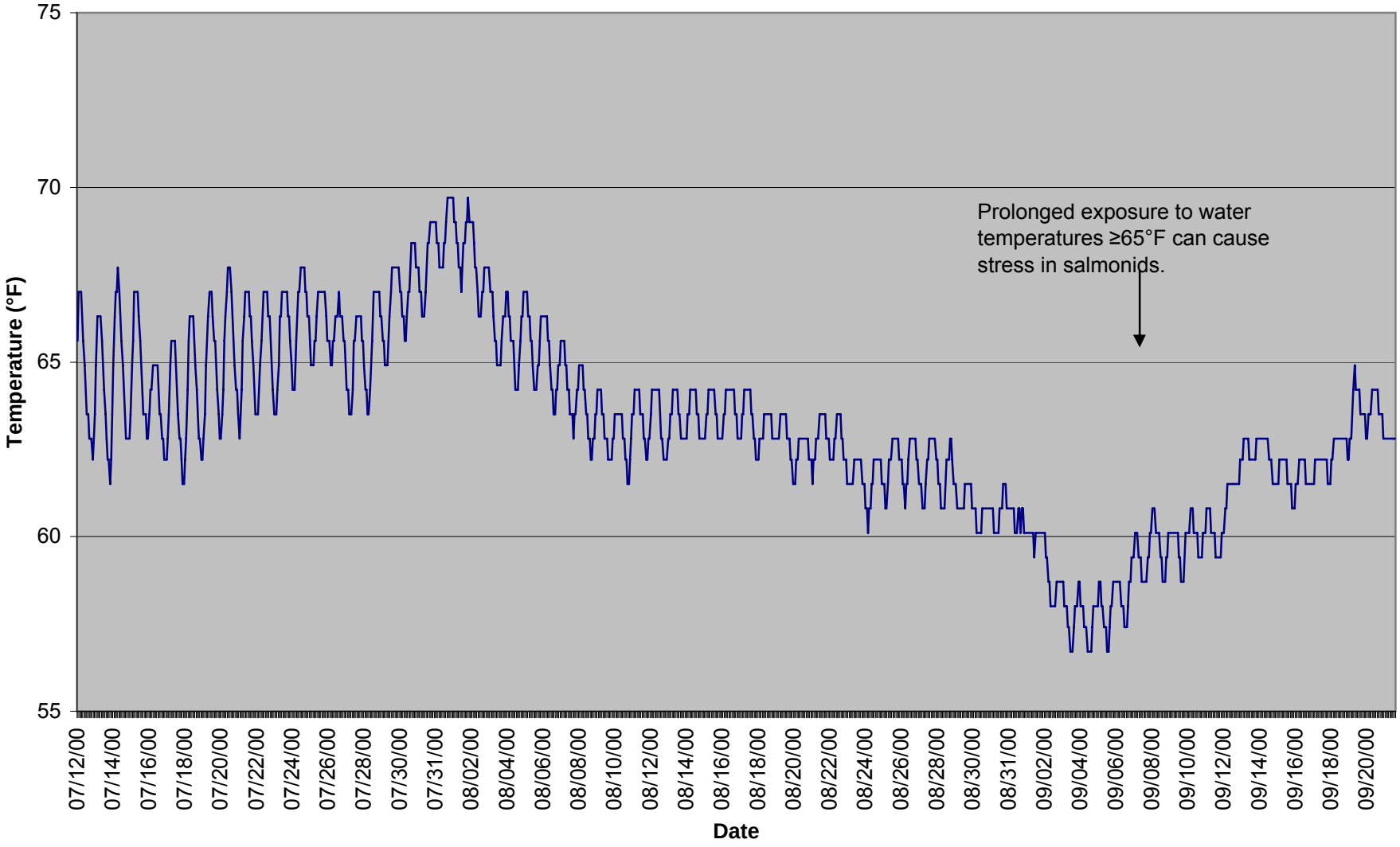
GRAPH 10

HALE CREEK 2000
DOMINANT BANK VEGETATION



GRAPH 11

Hale Creek


75
70
65
60
55
Temperature (°F)
Prolonged exposure to water temperatures ≥65°F can cause stress in salmonids.
07/12/00
07/14/00
07/16/00
07/18/00
07/20/00
07/22/00
07/24/00
07/26/00
07/28/00
07/30/00
07/31/00
08/02/00
08/04/00
08/06/00
08/08/00
08/10/00
08/12/00
08/14/00
08/16/00
08/18/00
08/20/00
08/22/00
08/24/00
08/26/00
08/28/00
08/30/00
08/31/00
09/02/00
09/04/00
09/06/00
09/08/00
09/10/00
09/12/00
09/14/00
09/16/00
09/18/00
09/20/00
Date

Watershed Hydroid **423** Hale Creek

Hydrologic Sub-Areas covered by the watershed:

Name:	LLId: (1:24k)	County:
Hale Creek	1229518388170	Mendocino/Sonom

Tributary to Big Sulphur Creek
Tributary to Russian River
Tributary to

Location: **T:** 11N **R:** 10W **S:** 10 **Latitude:** 38.8171076053467 **Longitude** 122.9518852133

Hydrologic Boundary Delineation: Watershed boundaries were delineated using the Watershed Point tool in ArcHydro, running under ArcMap 8.3 (ArcInfo version). A 1:24k stream network was "burned" into the underlying DEM to enforce hydrologic routing.

Aerial Photos (Source): For Mendocino County watersheds, 1993 USGS DOQQs are available in the Teale Albers, NAD27 projection. For Sonoma County watersheds, 2000 County-created orthophotos in the State Plane, NAD83 projection are also available.

Stream Order: 2

Note: Stream order is by Strahler method, recorded in CDF-NCWAP "nchydro1" 1:24k streams layer.

Total Length: 2.78 Miles / 4.48 Km

Note: Length is for the USGS blue-line 1:24,000 stream.

Drainage Area: 488 Hectares / 1207 Acres / 1.88 sq. mi.

Elevations: Mouth: 604 feet; Headwaters: 3005 feet

Note: Headwaters elevation is the highest elevation found in the watershed.

Lakes in Watershed: Number: 0 Surface area: 0 sq. mi.

Note: Source for lakes data is the USGS-DFG 1:100k lakes layer "lakes.shp"

Fish Species (as indicated by historical salmonid streams layer created by Bob Coey): None

Ownership, for the watershed, in acres (and % of total watershed):

Federal:	State:	Local:	Private:
0.0 acres	0.0	0.0	1206.6
0.00 %	0.00 %	0.00 %	100.00 %

Note: Source for owneship data is 2002 DFG-CCR "ccr_public_lands.shp" GIS layer.

Major Land Uses in the Watershed, in acres (and % of total watershed)

Mixed hardwood/conifer:	Hardwood:	Conifer:	Agriculture:	Urban:
68.57 acres	640.15	0.00	37.06	0.00
5.7 %	53.1 %	0.0 %	3.1 %	0.0 %

Shrub:	Herbaceous:	Barren/rock:	Water:
103.93	343.01	0.00	12.97
8.6 %	28.4 %	0.0 %	1.1 %

Note: Land use areas were calculated using the 1994 CDF-USFS "Calveg" GIS layer.

Watershed HydroId **423** Hale Creek

USGS 7.5' Topographic Quads completely or partially in the watershed:

Quad Name	USGS Code
ASTI	38122G8

Endangered/Threatened/Sensitive Species: (California Natural Diversity Database, May 5, 2003 version)

Hydrologic Sub-Areas covered by the watershed

Hydrologic Sub-Area Name:	ID code (RBUAS)	Hydrologic Area Name	% of watershed in this HSA
Ukiah	111431	Upper Russian River	0.01
Sulphur Creek	111426	Middle Russian River	99.07
Geyserville	111425	Middle Russian River	0.92