CALIFORNIA DEPARTMENT OF FISH AND GAME
STREAM INVENTORY REPORT
Morrison Creek
Report Revised April 14, 2006
Report Completed 2005
Assessment Completed 2001

INTRODUCTION

A stream inventory was conducted during the summer of 2001 on Morrison 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 Morrison 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

Morrison Creek is a tributary of the Russian River, located in Mendocino County, California (see Morrison Creek map, Appendix A). The legal description at the confluence with the Russian River is T14N, R12W, Yokaya Rancheria. Its location is 39°04'41.8" N. latitude and 123°09'46.6" W. longitude. Year round vehicle access exists from Highway 101 near Talmage, off of Eastside Rd.

Morrison Creek and its tributaries drain a basin of approximately 9.53 square miles. Morrison Creek is a third order stream and has approximately 7.36 miles of blue line stream, and 9.7 miles of perennial stream, according to the USGS Elledge Peak and Purdy's Gardens 7.5 minute quadrangles. There are no major tributaries to this creek; however there are a few unnamed wet tributaries, which feed this system. Summer flow was measured as approximately 0.16 cfs on July 17, 2001. Elevations range from about 530 feet at the mouth of the creek to 3530 feet in the headwaters. Oak woodland dominates the watershed overall, however the lower watershed is largely agricultural with some grassland zones, the low-mid watershed is a mix of deciduous and chaparral communities and the mid-upper watershed is a chaparral/conifer mix (including Northern Interior Cypress) with zones of grassland and chaparral. Alder and willow dominates the riparian zone. The watershed is owned primarily by private landowners and BLM, and is managed for cattle grazing, vineyard development, recreational use and open forest land. Sensitive plants listed from the CNPS Inventory and DFG's Natural Diversity Database within Morrison Creek watershed are: Rincon Ridge Ceanothus (*Ceanothus confusus*) Serpentine Bunchgrass (Serpentine bunchgrass), the Northern interior Cypress Forest, and Sonoma Manzanita (*Arctostaphylos canescens ssp somomensis*). Morrison Creek is a historical steelhead stream.

METHODS

The habitat inventory conducted in Morrison 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 (DFG). This inventory was conducted by a two-person team and was supervised by Derek Acomb, Russian River Basin Planner (DFG).

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 Morrison 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". Morrison 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 Morrison 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 Morrison 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 Morrison 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 Morrison 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 Morrison 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 is no record of stream surveys conducted by the Department of Fish and Game on Morrison Creek prior to this year. There is one DFG stream inventory from 1979, which recorded low summer flow at 0.25 cfs.

HABITAT INVENTORY RESULTS

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

The habitat inventory of Morrison Creek, July 10, 2001 - September 14, 2001, was conducted by J. Smith (DFG), D. Mitchel (DFG), J. Willing (AmeriCorps) and M. Terry (DFG) with supervision and analysis by California Department of Fish and Game (DFG). The survey began at the confluence with the Russian River and extended up Morrison Creek to the end of survey The total length of stream surveyed was 41,836 feet, with an additional 399 feet of side channel.

A flow of 0.16 cfs was measured on July 17, 2001, at habitat unit #008, 4588' above survey start with a Marsh-McBirney Model 2000 flowmeter.

This section of Morrison Creek has eight reaches with six distinct channel types: from the mouth to 16823 feet an F3, 1278 feet a C3, 4025 feet a B3, 918 feet a B2, 1502 feet a G2, 5864 feet an F2, 1185 feet an F3 and 10241 feet a B3.

F3 channel types are entrenched meandering riffle/pool channels on low gradients (<2%) with a high width/depth ratio and a predominantly cobble substrate.
C3 channel types are low gradient (<2%), meandering, point-bar, riffle/pool, alluvial channels with a broad, well defined floodplain and a predominantly cobble substrate.

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 have a predominantly cobble substrate.

B2 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 have a predominantly boulder substrate.

G2 channel types are characterized as well entrenched "gully" step-pool channels with a low

width/depth ratio, a moderate gradient (2-4%) and a predominantly boulder substrate.

F2 channel types are entrenched meandering riffle/pool channels on low gradients (<2%) with a high width/depth ratio and a predominantly boulder substrate.

Water temperatures on survey dates, July 10, 2001-September 14, 2001, ranged from 58ºF to 80ºF. Air temperatures ranged from 63ºF to 92ºF.

Summer temperatures were also measured using remote temperature recorders placed in pools (see Temperature Summary graphs, Appendix E). A recorder in Reach 1 placed approximately 4600' from the mouth in a left bank pool, logged temperatures every 2 hours from July 10 – October 30, 2001. The highest temperature recorded was 78ºF in July and the lowest was 58ºF in October. The mean of the daily highs was 71.8ºF for the month of July, 73.0ºF for August, 70.5ºF for September and 65.1ºF for October.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of *occurrence* there were 39.1% Flatwater units, 25.9% Pool units, 19.6% Riffle units and 15.2% Dry units. Based on total *length* there were 33.5% Dry units, 32.2% Flatwater units, 11.5% Riffle units and 10.2% Pool units (Graph 2).

There were 514 habitat units measured and 39% were completely sampled. Nineteen Level IV habitat types were identified. The data is summarized in Table 2. The most frequent habitat types by percent *occurrence* were Run at 28%, Dry at 15%, Low Gradient Riffle at 13%, Mid-Channel Pool at 12% and Step Run at 9% (Graph 3). By percent total *length*, Dry at 33%, Run at 20%, Not Surveyed at 13%, Step Run at 11% and Low Gradient Riffle at 9% (Table 2).

There were 133 pools identified (Table 3). Mid-Channel Pool pools were most often encountered at 12% (Graph 3), and comprised 37% 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.

Fourteen of the 133 pools (10.5%) had a depth of three feet or greater (Graph 5).

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. Flatwater units rated 6 and Pools rated 13 (Table 1). Of the pool types, Lateral Scour Pool - Root Wad Enhanced rated 28, Lateral Scour Pool - Boulder Formed rated 17, Corner Pool rated 17, Mid-Channel Pool and Backwater Pool - Boulder Formed both rated 10 (Table 2).

Table 5 summarizes fish shelter by habitat type. By percent area, the dominant pool shelter types were Boulders at 55%, Undercut Banks at 20%, Root Mass at 10% and Bedrock at 5%. Graph 7 describes the pool shelter in Morrison Creek.

Table 6 summarizes the dominant substrate by habitat type. In Low-Gradient Riffles surveyed, the dominant substrate was: Boulders in 49% of the riffles, Small Cobble in 26% of the riffles, Large Cobble in 17% of the riffles, and Bedrock in 6% of the riffles. Of the Pool Tail-outs measured, 59% had Small Cobble as the dominant substrate type, 14% had Gravel as the dominant Substrate, and 13% had Large Cobble as the dominant substrate (Graph 8).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 122 pool tail-outs measured, seventeen had a value of 1 (13%), eighty-three had a value of 2 (68%), nineteen had a value of 3 (16%) and one had a value of 4 (1%). Two of the riffles (2%) rated a 5, which is unsuitable substrate type for spawning. On this scale, a value of one is best for fisheries. Small Cobble was the dominant substrate observed at pool tail-outs. Table 8 describes percent embeddedness by reach.

The mean percent canopy density for the stream reach surveyed was 56.2%. The mean percentages of deciduous and evergreen trees were 31.1% and 25%, respectively. Graph 9 describes the canopy for the entire survey.

For the entire stream reach surveyed, the mean percent right bank vegetated was 97% and the mean percent left bank vegetated was 92% (Table 9). For the habitat units measured, the dominant vegetation types for the stream banks were: 49% Deciduous Trees, 21% Evergreen Trees, 15% Brush, 10% Grass and 6% Bare Soil (Graph 11). The dominant substrate for the stream banks were: 46% Boulder, 24% Bedrock, 21% Cobble & Gravel and 9% Silt, Clay & Sand (Graph 10).

BIOLOGICAL INVENTORY

JUVENILE SURVEYS:

In 2001, a biological inventory was conducted in Morrison Creek to document the fish species composition and distribution at several locations. 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. A random sample of fish was selected from each reach and tissues were taken for genetic analysis. Air temperatures ranged from 60° to 80° F and water temperatures ranged from 54° to 73° F.

The inventory of Site 1 started at habitat unit #006, approx. 4500 feet upstream of the mouth and ended approximately 1710 feet upstream, in habitat unit #030. In riffle, run, glide and pool habitats, no steelhead were found. At least 42 crawfish were observed, along with at least seven Sacramento suckerfish, at least six roach and at least six sculpin. Amphibians included at least 26 rough skin newts and 49 frogs, including yellow-legged, bullfrog, and an unspecified, low number of Pacific Tree Frogs. A small, silver fish, possibly mosquitofish, was observed in large numbers.

The inventory of Site 2 started at habitat unit #359, about 512 feet upstream from a bedrock-formed, left bank, perennial scour pool, and ended approximately 1715 feet upstream. In pool, run and riffle habitats, at least 53 steelhead (ranging from young of year to two plus year old) were observed. No

other fish were observed. Amphibians included at least 39 yellow-legged frogs and at least seven pacific giant salamanders.

The inventory of Site 3 started at habitat unit # 482 and ended approximately 912 feet upstream, in habitat unit #492. In riffle, step-run and pool habitats, no steelhead or fish of any type were found. Amphibians, including at least sixteen newts, including rough skin and California newt, at least five pacific giant salamanders and at least fifteen yellow-legged frogs were observed. Two of the frogs observed were likely red-legged frogs, but no positive identification was possible.

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
2001	Steelhead	DFG	N
2001	Sacramento Sucker	DFG	N
2001	Pacific Giant Salamander	DFG	N
2001	Crayfish	DFG	N
2001	Roughskin Newt	DFG	N
2001	Sculpin	DFG	N
2001	Bullfrog	DFG	I
2001	Pacific Tree Frog	DFG	N
2001	Yellow-legged Frog	DFG	N
2001	Roach	DFG	N
2001	Red-legged Frog	DFG	N
2001	Mosquitofish	DFG	I

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

ADULT SURVEYS:

There is no record of adult surveys or carcass surveys having been performed on Morrison Creek, according to DFG current and historical records.

DISCUSSION

Morrison Creek has eight reaches: 16823 feet of F3, 1278 feet of C3, 4025 feet of B3, 918 feet of B2, 1502 feet of G2, 5864 feet of F2, 1185 feet of F3 and 10241 feet of B3.

According to the DFG Salmonid Stream Habitat Restoration Manual, F3 channel types are good for bank-placed boulders as well as single and opposing wing-deflectors. They are fair for low-stage weirs, boulder clusters, channel constrictors and log cover. Many site specific projects can be designed within this channel type, especially to increase pool frequency, volume and shelter. Any work considered will require careful design, placement, and construction that must include protection for any unstable banks.

C3 channel types are excellent for bank-placed boulders and good for low-stage weirs, boulder clusters, single and opposing wing deflectors and log cover. They are fair for medium-stage weirs.

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. Many site specific projects can be designed within this channel type, especially to increase pool frequency, volume and shelter. These 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.

B2 channel types are excellent for low and medium-stage plunge weirs, single and opposing wing deflectors and bank cover. Many site specific projects can be designed within this channel type, especially to increase pool frequency, volume and shelter. These 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.

G2 channel types are fair for log cover.

F2 channel types are fair for low-stage weirs, single and opposing wing-deflectors and log cover. Many site specific projects can be designed within this channel type, especially to increase pool frequency, volume and shelter. Any work considered will require careful design, placement, and construction that must include protection for any unstable banks.

The water temperatures recorded on the survey days July 10, 2001 - September 14, 2001 ranged from 58ºF to 80ºF. Air temperatures ranged from 63ºF to 92ºF. The warmest water temperatures were recorded in Reach 1. These temperatures, if sustained, are above the threshold stress level (65ºF) for salmonids.

Summer temperatures measured using remote temperature recorders placed in pools ranged from 57º to 78ºF for Reach one, the only reach monitored.

The Temperature Summary graph shows that for much of the summer (July through October) the lower watershed exhibited temperatures above the optimal for salmonids.

It is unknown if this thermal regime is typical, but our electrofishing samples found steelhead more frequently in the upper reaches, with cooler sample sites. To make any further conclusions, temperatures need to be monitored for a longer period of time through the critical summer months, and more extensive biological sampling conducted.

Pools comprised 10% of the total length of this survey. In third order streams a primary pool is defined to have a maximum depth of at least three feet, occupy at least half the width of the low flow channel, and be as long as the low flow channel width. In Morrison Creek, the pools are relatively shallow with only 10.5% having a maximum depth of at least two feet. In coastal coho 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 13. 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 at 54%, Undercut Banks at 17%, Root Mass at 14% and Bedrock at 5%. 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.

Ten of the 35 low gradient riffles measured (29%) had either gravel or small cobble as the dominant substrate. This is generally considered good for spawning salmonids. Eighty-six percent of the pool tailouts measured had either Gravel, or Small or Large Cobble as the dominant substrate.

Sixteen percent of the pool tail-outs measured had embeddedness ratings of either 3 or 4. Only 13% 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. In a reach comparison, Reach 8 had the poorest rating.

The higher the percent of fine sediment, the lower the probability that eggs will survive to hatch. This is due to the reduced quantity of oxygenated water able to percolate through the gravel, or because of fine sediment capping the redd and preventing fry emergence. Morrison Creek's sediment sources should be mapped and rated according to their potential sediment yields, and control measures taken.

The mean percent canopy for the survey was 53%. This is a low percentage of canopy, since 80 percent is generally considered desirable. Cooler water temperatures are desirable in Morrison Creek. Elevated water temperatures could be reduced by increasing stream canopy. The large trees required for adequate stream canopy would also eventually provide a long term source of large woody debris needed for instream shelter and bank stability.

However, the riparian buffer is thin or nearly absent in areas with livestock and agricultural

development. Riparian removal, intensive grazing and vineyard development within the riparian corridor could all lead to less stream canopy and channel incision causing bank erosion and higher water temperatures. Specifically, Reach 1 had a canopy of 46% with numerous bank erosion problems. This reach as well as other areas with bank erosion could benefit from bio-technical re-vegetation techniques using native species.

GENERAL MANAGEMENT RECOMMENDATIONS

Morrison 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 portions of Reach 1, therefore, fish passage should be monitored, and improved where possible.

2. Increase the canopy on Morrison Creek by planting willow, alder, redwood, and Douglas fir along the stream where shade canopy is not at acceptable levels. The 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. There are sections in Reach 1 where the stream is being impacted from livestock in the riparian zone. Livestock in streams generally inhibit the growth of new trees, exasperate erosion, and reduce summertime survival of juvenile fish by defecating in the water. Alternatives to limit cattle access, control erosion and increase canopy, should be explored with the landowner, and developed if possible.

4. Reach 1 would benefit from the utilizing bio-technical vegetative techniques to re-establish floodplain benches and a defined low flow channel. This would discourage lateral migration of the base flow channel and decrease bank erosion.

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. 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.

8. In Morrison 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.

9. If riparian areas are not improved in Morrison 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.

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.

Morrison Creek

Position (ft.)	Habitat Unit #	Comments:
0	0001.00	This creek is used as a road from the mouth to the bridge over Eastside Rd. Tire tracks all over the place. Excess Erosion in first 1450' LB + RB. Bridge at 1291' into HU-See Form (WP 030). Cattle in creek from Eastside Rd. through HU 010, and beyond.
4233	0002.00	Small fish such as roach, stickleback and suckers, as well as crawfish and newts. NO SALMONIDS; High algae cover
4269	0003.00	Serious LB erosion at end of unit into next unit
4512	0006.00	Salamander in pool; Pool caused by woody debris. Possible salmonids in pool and many non-salmonids-6" max

4590	0008.00	95% algae cover
4662	0009.00	Salmonids 4"+(Dozens of them)
5118	0011.00	Salmonids(YOY) + Non-Salmmonids 4-6"
5625	0020.00	WP 015
5708	0023.00	Created by rock weir
5912	0027.00	Created by rock weir
5947	0028.00	Erosion LB
6029	0029.00	Pump @ 74'
6162	0030.00	WP 016
6273	0031.00	Non-Salmonids
6659	0034.00	Salmonids(YOY) in shallow pool at end of HU; EROSION LB
7010	0039.00	Salmonid(YOY) + Non-Salmonids
7048	0040.00	WP 017
7172	0043.00	Major Landslide LB: 200-300' long x 70-100' high-SEE NOTEBOOK
7264	0044.00	Rock formed culverts in this HU; 6 small salmonids(YOY)
7380	0046.00	Many non-slamonids and a few Salmonid YOY
7407	0047.00	At 30' there is a 2' jump over bedrock
7481	0048.00	At 10' there is a 2' jump over bedrock

7543	0050.00	WP 001/N39`04'57.6"/W122`08'24.2"
7556	0051.00	A few Salmonids(YOY)
7815	0056.00	Salmonids(YOY) about a dozen of them
8031	0060.00	Metal pipe in stream; WP 002; N39`04'57.6"/W123`08'18.4"
8165	0064.00	RB Extreme Mass Wasting Approx 100' L x 50' H
8205	0065.00	Large boulders in stream; Trib at 86' RB
8353	0067.00	At 58' there is a 1.5' jump over bedrock
8411	0068.00	Many Salmonids(YOY) and many non-salmonids
8447	0069.00	2' jump over boulders at end of HU; WP 003; N39`4'58.1"/W123`8'14.3"
8638	0073.00	This HU is split into 3 channels, but not side channels
8658	0074.00	This HU is split into 3 channels, but not side channels
8682	0074.01	5' jump boulder created
8682	0075.00	At 100' there is a 3-5' jump boulder created
8827	0077.00	WP 004; N39`4'57.3"/W123`8'10.7"
8987	0081.00	WP 005 N39`4'54.6"/W123`8'7.1"(we took GPS here since we could not get one at HU 077; SALMONID YOY
9027	0082.00	Mass Wasting on LB(Landslide)-50' L x 50' H
9316	0085.00	3' jump(boulders)

9367	0087.00	Series of deep pools and 8' max waterfalls, with nice pools below
9444	0088.00	We were denied access to the next approx. 1 mile of creek. This is an A/B type channel, but the channel has not been a long enough stretch so far to re-classify it from the F3 type, and we could not go far enough to verify if the length is long enough to re-classify it. Distance is only an approximation. This unit stretches from the waterfall of the last HU to the first pool we found working backward from the next accessible property. WP 006-N39`4'12.1"/W123`7'26.5"
14744	0089.00	3 salamanders; 4" salmonids(dozen or so) and many non-salmonids
15843	0097.00	4" salmonids in pool formed by root mass; WP 007 N39`4'.2"/W123`7'17.6"
16199	0098.00	Salmonids(2"); large non-salmonids; newts
16492	0099.02	Newts
16632	0101.00	Woody debris causing scour
16777	0105.00	WP 008/N39`3'57.9"/W123`7'12.8
16823	0107.00	4" non-salmonids and salmonid(YOY); CHANNEL TYPE CHANGE (F3---->C3)
17273	0113.00	Salmonids(YOY)
17355	0115.00	WP 009 - N39`3'57.1"/W123`7'8.5"
17713	0120.00	2" salmonids
17940	0124.00	Wet trib at 45' RB; WP010;N39`3'57.1"/W123`7'1.7"
18008	0125.00	WP 011/N39`3'56.7"/W123`7'0.8"
18101	0127.00	Channel type change(C3---->B3)

18487	0132.00	Salmonids(2") and Non-Salmonids(4")
18751	0135.00	WP 012-N 39`3'53.9"/W123`6'56.4"
19289	0141.00	At 90' wet trib WP 013;N39`3'51.1"/W123`6'54.2"
19500	0143.00	Erosion LB
19617	0145.00	Salmonid(YOY); WP 014; N39`3'48.5"/W123`6'53.3"
19649	0146.00	EROSION LB
19937	0151.00	Salamanders; Salmonids(YOY)
20099	0155.00	Salmonids(YOY and YOY+); WP 015;N39`3'48.0"/W123`6'44.6"
20489	0159.00	Salmonids(YOY)
20826	0163.00	EROSION LB
20860	0164.00	EROSION LB
20948	0165.00	EROSION LB; WP 016;N39`3'43.3"/W123`6'42.7"
21188	0168.00	Fully spotted fish(2"-5")
21243	0169.00	Algae cover (70%)
21448	0173.00	Dead Bay/4 pieces/smalls/over 10' long/16" diameter/across channel
21508	0174.00	Algae cover(50%); WP 017; N39`3'41.7"/W123`6'38.1"
21764	0176.00	Salmonids(YOY)
22126	0181.00	Channel Type Change(B3----->B2)
22267	0184.00	WP 018; N39`3'38.3"/N123`6'31.2"

22460	0185.00	Salmonid(YOY)
22542	0186.00	Erosion LB(40' High); 4" Salmonids
22652	0188.00	YOY
23044	0191.00	Channel Type Change(B2----->G2)
23179	0194.00	WP 019; N39`3'39.1"/W123`6'25.9"
23478	0203.00	Salmonids(YOY)-not many
23561	0204.00	WP 020; N39`3'36.5"/W123`6'23.0”
23643	0208.00	4"-6" Spotted Fish; Salmonids(YOY)
23680	0210.00	4' Bedrock Jump at end of HU
23836	0214.00	WP 021/N39`3'36.1"/W123`6'20.3"
24057	0219.00	Salmonids(YOY) and 4"-6" fish(NO I.D.)
24205	0223.00	WP 022/N39`3'34.2"/W123`6'16.3"
24270	0224.00	Large Fish look like Rainbow Trout - 6"-8" long
24390	0228.00	Trib on RB/WP 023(N39`3'34.5"/W123`6'14.9"); 10' jump Boulder formed
24519	0232.00	WP 024/N39`3'36.3"/W123`6'17.1"
24546	0233.00	N39`3'34.7"/W123`6'15.4"
24590	0235.00	YOY
24809	0241.00	5' jumps

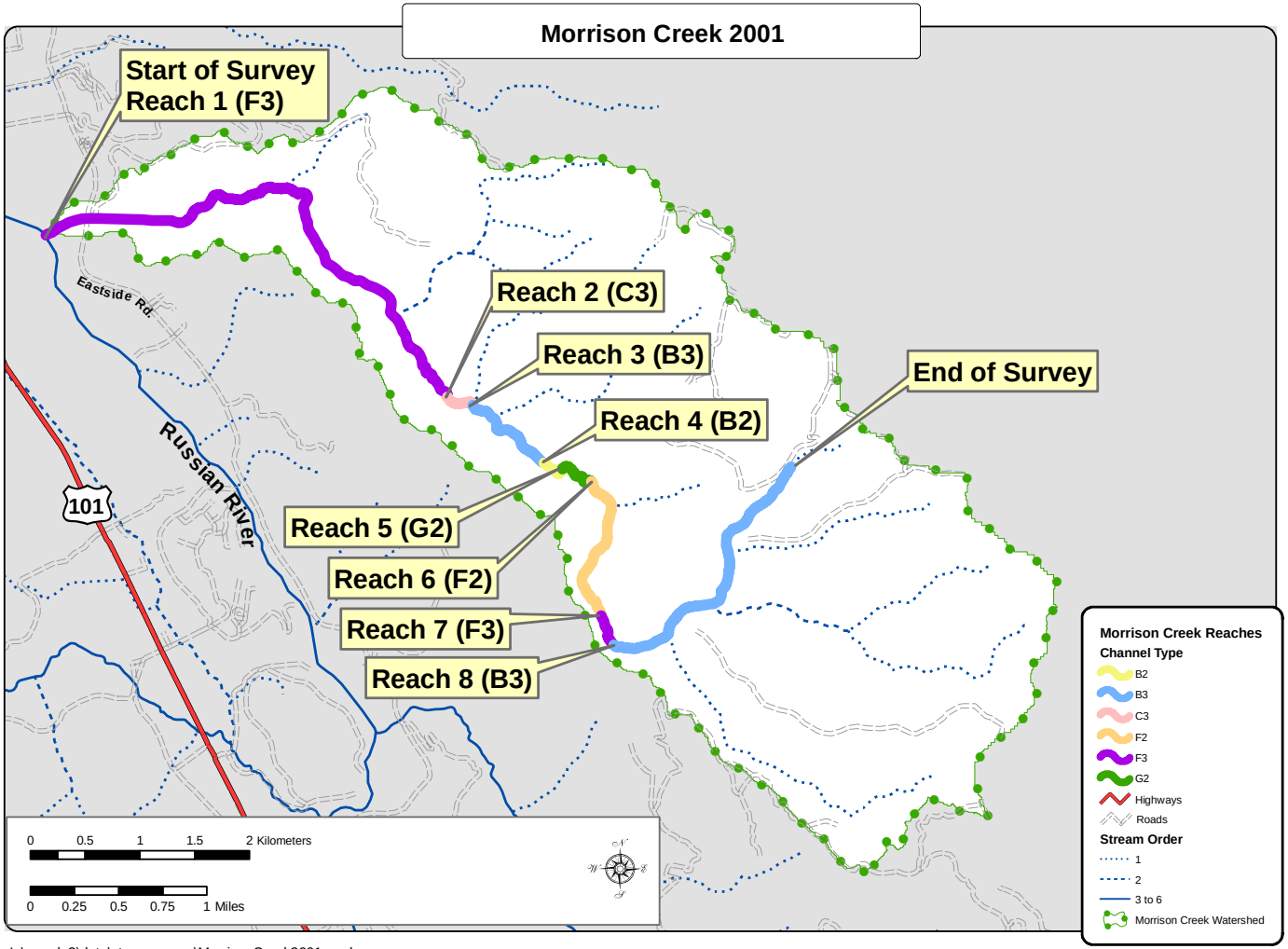
24971	0248.00	Salmonid (2+ yr)
25121	0252.00	N39`3'28"/W123`6'15.6"
25211	0254.00	3" salmonid
25237	0255.00	4 @ 3" Salmonids
25515	0262.00	3" salmonid; N39`3'30.0"/W123`6'6.8"
25531	0263.00	YOY
25673	0267.00	2+ salmonid
25759	0271.00	N39`3'27.3"/W123`6'9.5"
25814	0273.00	RB wet trib-VERY STEEP
25922	0277.00	Lots of fish
26077	0281.00	N39`3'13.9"/W123`6'11.7"
26492	0285.00	5" possible salmonid
26705	0291.00	NO GPS READING POSSIBLE
27104	0301.00	N39`3'6.4"/W123`6'8.4"
27179.3	0306.00	Fish in pool (NO I.D.); Boulder Pool Tail cannot read
27302.3	0311.00	N39`3'35.5"/W123`6'24.0"
27353.3	0318.00	100' bedrock & boulder formed horseshoe turn in creek
27532.3	0321.00	N39`3'14.7"/W123`6'14.1"

27762.3	0327.00	Heavy Erosion RB-See Photo; 100' high and the length of the entire unit-no down cutting(?)
27920.3	0328.00	YOY
27994.3	0331.00	N39`3'9.4"/W123`6'15.9"
28886.3	0343.00	Erosion LB
29524.3	0351.00	Erosion RB for 100'; N39`2'58.1"/W123`6'13.0"
29650.3	0352.00	Possible salmonids-2" long
29898.3	0356.00	Possible salmonids-6@2"long
29943.3	0359.00	Dry Trib RB
29975.3	0361.00	NO GPS POSSIBLE
30410.3	0367.00	Dry Trib RB @ 600'; Channel Change(F2---->F3)
31258.3	0369.00	Lots of slamonids up to 6" long
31342.3	0371.00	N39`2'46.1"/W123`6'4.5"
31424.3	0372.00	Salmonids YOY, 2+
31595.3	0373.00	Channel Type Change(F3---->B3)
31857.3	0377.00	Salmonids
31965.3	0379.00	Salmonid YOY
32053.3	0381.00	N39`2'45.4"/W123`5'56.2"
32114.3	0383.00	Debris Accumulation (H6/L4/W10/ret.gravel-NO/Scour pool-NO/Fish obs(?)/Downcutting-NO/Erosion-NO)Boulder influenced

32286.3	0386.00	Salmonids
32305.3	0387.00	Dry trib RB
33479.3	0391.00	N39`2'52.5"/W123`5'44.6"
33600.3	0393.00	Huge erosion LB
34154.3	0401.00	N39`2'56.8"/W123`5'40.6"
34165.3	0402.00	Dry Trib @ 100' ; Major erosion LB
34682.3	0411.00	WP 032/N39`2'58.9"/W123`5'35.9"
35084.3	0415.00	7-10 2+ yr Steelhead and a 3+ year steelhead
35125.3	0417.00	2 YOY and a 1+ yr Steelhead
35228.3	0419.00	LB Trib; Dry for a few hundred feet
35289.3	0421.00	N39`03'2.5"/W123`5'30.8"
35812.3	0426.00	Many salmonids(YOY/1+ yr/3+ yr) and Juvenile salamander
36628.3	0431.00	NO GPS POSSIBLE
36666.3	0433.00	LB Trib at 200'/RB Trib at 300'
37271.3	0437.00	LB Trib at start of this HU
38254.3	0453.00	2+ yr Steelhead
38411.3	0455.00	Couple of steelhead
38574.3	0459.00	Steelhead observed

40024.3	0475.00	Spring RB @ 145'
40198.3	0477.00	Gully at LB at end of unit
40395.3	0482.00	A lot of step pools 1 ft deep; Heavy erosion RB; At 175' into unit(5' high jump)
41219.3	0491.00	N39`3'40.3"/W123`5'4.6"
41589.3	0496.00	Newts
41779.3	0505.00	General Comment: Leads to road running thru creek; END OF SURVEY

APPENDIX A: MAP



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Prepared by: Celeste Dodge and Colin Brooks, March 28, 2005

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

Stream Name: Morrison Creek LLID: 1231629390782 Drainage: Russian River - Upper

Survey Dates: 7/10/2001 to 9/14/2001

Confluence Location: Quad: ELLEDGE PEAK Legal Description: T000R000S00 Latitude: 39:04:42.0N Longitude: 123:09:46.0W

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
78	0	DRY	15.2	181	14136.3	33.5									
201	108	FLATWATER	39.1	68	13613.5	32.2	7.5	0.6	1.0	447	89945	264	52986		6
1	0	NOSURVEY	0.2	5300	5300	12.5									
133	129	POOL	25.9	32	4316.5	10.2	8.9	1.2	2.0	305	40607	506	65759	429	13
101	78	RIFFLE	19.6	48	4869	11.5	8.2	0.4	0.7	396	39954	204	20039		

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
514	315	42235.3	170506	138784

Table 2 - Summary of Habitat Types and Measured Parameters

Stream Name: Morrison Creek LLID: 1231629390782 Drainage: Russian River - Upper

Survey Dates: 7/10/2001 to 9/14/2001

Confluence Location: Quad: ELLEDGE PEAK Legal Description: T000R000S00 Latitude: 39:04:42.0N Longitude: 123:09:46.0W

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 (%)
68	61	LGR	13.2	56	3802	9.0	9	0.4	1.5	469	31906	235	15696			50
23	10	HGR	4.5	32	729	1.7	6	0.4	1.1	89	2045	36	822			63
6	4	CAS	1.2	27	161	0.4	11	0.7	2	158	947	107	482			72
4	3	BRS	0.8	44	177	0.4	4	0.9	1.4	238	952	239	955			49
13	13	GLD	2.5	40	523	1.2	7	0.7	1.6	371	4826	223	2903		10	44
143	84	RUN	27.8	59	8508	20.1	8	0.5	1.7	493	70463	289	41367		7	53
45	11	SRN	8.8	102	4583	10.9	6	0.5	1.5	192	8640	115	5185		5	71
63	63	MCP	12.3	25	1591	3.8	8	1.0	4.7	234	14729	325	20494	280	10	56
1	1	CCP	0.2	23	23	0.1	10	1.0	1.8	157	157	188	188	157	5	95
2	2	STP	0.4	46	92	0.2	6	1.3	1.7	151	302	375	375	305	5	73
6	5	CRP	1.2	62	374	0.9	8	2.0	3.4	523	3137	1122	6731	1022	17	58
18	16	LSR	3.5	45	812	1.9	10	1.4	3.6	478	8610	829	13991	742	28	67
14	14	LSBk	2.7	41	571	1.4	9	1.0	3.2	393	5497	643	8357	450	6	49
20	19	LSBo	3.9	35	707	1.7	12	1.6	3.6	385	7694	746	14916	641	17	58
4	4	PLP	0.8	16	62	0.1	10	1.5	3.4	154	617	378	1511	298	8	73
3	3	SCP	0.6	18	55	0.1	5	0.7	1.8	109	328	123	368	93	8	38
2	2	BPB	0.4	15	30	0.1	6	1.3	2.8	90	180	136	272	97	10	60
78	0	DRY	15.2	181	14136	33.5										57
1	0	NS	0.2	5300	5300	12.5										

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
514	315	42235	161028	134614

Table 3 - Summary of Pool Types

Stream Name: Morrison Creek LLID: 1231629390782 Drainage: Russian River - Upper

Survey Dates: 7/10/2001 to 9/14/2001

Confluence Location: Quad: ELLEDGE PEAK Legal Description: T000R000S00 Latitude: 39:04:42.0N Longitude: 123:09:46.0W

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
66	66	MAIN	50	26	1706	40	8.1	1.0	230	15187	279	18107	10
62	58	SCOUR	47	41	2526	59	10.2	1.4	408	25325	633	37911	17
5	5	BACKWATER	4	17	85	2	5.4	0.9	102	508	94	472	9

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
133	129	4316.5	41020	56490

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

Stream Name: Morrison Creek LLID: 1231629390782 Drainage: Russian River - Upper

Survey Dates: 7/10/2001 to 9/14/2001

Confluence Location: Quad: ELLEDGE PEAK Legal Description: T000R000S00 Latitude: 39:04:42.0N Longitude: 123:09:46.0W

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
63	MCP	48	4	6	33	52	22	35	2	3	2	3
1	CCP	1	0	0	1	100	0	0	0	0	0	0
1	STP	1	0	0	1	100	0	0	0	0	0	0
6	CRP	5	0	0	0	0	3	50	3	50	0	0
18	LSR	14	1	6	7	39	8	44	2	11	0	0
13	LSBk	10	2	15	4	31	5	38	2	15	0	0
19	LSBo	15	0	0	6	32	8	42	5	26	0	0
4	PLP	3	0	0	2	50	1	25	1	25	0	0
3	SCP	2	0	0	3	100	0	0	0	0	0	0
2	BPB	2	1	50	0	0	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
130	8	6	57	44	48	37	15	12	2	2

Mean Maximum Residual Pool Depth (ft.): 2

Table 5 - Summary of Mean Percent Cover By Habitat Type

Stream Name: Morrison Creek LLID: 1231629390782 Drainage: Russian River - Upper

Survey Dates: 7/10/2001 to 9/14/2001 Dry Units: 78

Confluence Location: Quad: ELLEDGE PEAK Legal Description: T000R000S00 Latitude: 39:04:42.0N Longitude: 123:09:46.0W

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
68	0	LGR									
23	0	HGR									
6	0	CAS									
4	0	BRS									
101	0	TOTAL RIFFLE									
13	1	GLD	50	50	0	0	0	0	0	0	0
143	3	RUN	0	0	0	0	0	0	0	100	0
45	3	SRN	0	0	0	0	0	0	0	100	0
201	7	TOTAL FLAT	7	7	0	0	0	0	0	86	0
63	54	MCP	24	1	0	5	2	0	0	60	4
1	1	CCP	0	0	0	0	0	0	0	95	5
2	1	STP	0	0	0	0	0	0	0	100	0
6	3	CRP	100	0	0	0	0	0	0	0	0
18	15	LSR	24	12	7	50	1	0	0	6	0
14	9	LSBk	0	0	11	0	0	0	0	56	33
20	18	LSBo	6	3	0	3	0	4	0	79	0
4	4	PLP	13	0	0	4	0	0	0	71	13
3	3	SCP	40	0	0	0	0	0	0	60	0
2	2	BPB	0	0	0	0	0	0	0	100	0
133	110	TOTAL POOL	20	2	2	10	1	1	0	55	5
1	0	NS									
514	117	TOTAL	20	3	2	9	1	1	0	57	5

Table 6 - Summary of Dominant Substrates By Habitat Type

Stream Name: Morrison Creek LLID: 1231629390782 Drainage: Russian River - Upper

Survey Dates: 7/10/2001 to 9/14/2001 Dry Units: 78

Confluence Location: Quad: ELLEDGE PEAK Legal Description: T000R000S00 Latitude: 39:04:42.0N Longitude: 123:09:46.0W

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
68	35	LGR	0	0	3	26	17	49	6
23	10	HGR	0	0	10	0	0	70	20
6	4	CAS	0	0	0	0	0	50	50
4	3	BRS	0	0	0	0	0	0	100
13	10	GLD	0	10	40	30	0	20	0
143	52	RUN	0	0	12	19	15	46	8
45	10	SRN	0	0	0	0	0	90	10
63	22	MCP	0	0	45	9	9	18	18
1	1	CCP	0	0	0	0	0	100	0
2	2	STP	0	0	0	0	0	0	100
6	5	CRP	0	0	40	60	0	0	0
18	9	LSR	0	11	0	33	22	22	11
14	5	LSBk	0	0	40	20	20	20	0
20	15	LSBo	0	0	27	27	0	47	0
4	4	PLP	0	0	0	0	0	50	50
3	2	SCP	0	50	50	0	0	0	0
2	2	BPB	0	0	0	0	0	50	50

Table 7 - Summary of Mean Percent Canopy for Entire Stream

Stream Name: Morrison Creek LLID: 1231629390782 Drainage: Russian River - Upper

Survey Dates: 7/10/2001 to 9/14/2001

Confluence Location: Quad: ELLEDGE PEAK Legal Description: T000R000S00 Latitude: 39:04:42.0N Longitude: 123:09:46.0W

Mean Percent Canopy	Mean Percent Conifer	Mean Percent Hardwood	Mean Percent Open Units	Mean Right Bank % Cover	Mean Left Bank % Cover
56	44	55	1	25	21

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: Morrison Creek LLID: 1231629390782 Drainage: Russian River - Upper

Survey Dates: 7/10/2001 to 9/14/2001

Confluence Location: Quad: ELLEDGE PEAK Legal Description: T000R000S00 Latitude: 39:04:42.0N Longitude: 123:09:46.0W

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	47	50	23.9
Boulder	95	93	46.3
Cobble / Gravel	44	40	20.7
Sand / Silt / Clay	17	20	9.1

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	19	22	10.1
Brush	25	34	14.5
Hardwood Trees	107	90	48.5
Coniferous Trees	46	39	20.9
No Vegetation	6	17	5.7

Total Stream Cobble Embeddedness Values: 2

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

StreamName: Morrison Creek LLID: 1231629390782 Drainage: Russian River - Upper

Survey Dates: 7/10/2001 to 9/14/2001

Confluence Location: Quad: ELLEDGE PEAK Legal Description: T000R000S00 Latitude: 39:04:42.0N Longitude: 123:09:46.0W

	Riffles	Flatwater	Pools
UNDERCUT BANKS (%)		7	20
SMALL WOODY DEBRIS (%)		7	2
LARGE WOODY DEBRIS (%)		0	2
ROOT MASS (%)		0	10
TERRESTRIAL VEGETATION (%)		0	1
AQUATIC VEGETATION (%)		0	1
WHITEWATER (%)		0	0
BOULDERS (%)		86	55
BEDROCK LEDGES (%)		0	5

Table 8 - Fish Habitat Inventory Data Summary

Stream Name: Morrison Creek LLID: 1231629390782 Drainage: Russian River -
Survey Dates: 7/10/2001 to 9/14/2001 Survey Length (ft.): 42235. Main Channel (ft.): 41836. Side Channel (ft.): 399
Confluence Location: Quad: ELLEDGE PEAK Legal Description: T000R000S00 Latitude: 39:04:42.0N Longitude: 123:09:46.0W

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 1

Channel Type: F3
Reach Length (ft.): 16823
Riffle/Flatwater Mean Width (ft.): 7.3
BFW:
Range (ft.): to
Mean (ft.):
Std. Dev.:
Base Flow (cfs):
Water (F): 0 - 80 Air (F): 63 - 88
Dry Channel (ft.): 5761

Canopy Density (%): 45.9
Coniferous Component (%): 20.7
Hardwood Component (%): 79.3
Dominant Bank Vegetation: Hardwood Trees
Vegetative Cover (%): 29.7
Dominant Shelter: Boulders
Dominant Bank Substrate Type: Boulder
Occurrence of LWD (%): 1.4
LWD per 100 ft.:
Riffles:
Pools:
Flat:

Pools by Stream Length (%): 7.0
Pool Frequency (%): 24.5
Residual Pool Depth (%):
< 2 Feet Deep: 30.8
2 to 2.9 Feet Deep: 53.8
3 to 3.9 Feet Deep: 15.4
>= 4 Feet Deep: 0.0
Mean Max Residual Pool Depth (ft.): 2.31
Mean Pool Shelter Rating: 15

Pool Tail Substrate (%): Silt/Clay: Sand: Gravel: Sm Cobble: Lg Cobble: Boulder: Bedrock:
Embeddedness Values (%): 1. 16.7 2. 58.3 3. 25.0 4. 0.0 5. 0.0

STREAM REACH: 2

Channel Type: C3
Reach Length (ft.): 1278
Riffle/Flatwater Mean Width (ft.): 6.8
BFW:
Range (ft.): to
Mean (ft.):
Std. Dev.:
Base Flow (cfs): 0
Water (F): 65 - 68 Air (F): 72 - 74
Dry Channel (ft.): 27

Canopy Density (%): 63.5
Coniferous Component (%): 0.0
Hardwood Component (%): 100.0
Dominant Bank Vegetation: Hardwood Trees
Vegetative Cover (%): 26.3
Dominant Shelter: Undercut Banks
Dominant Bank Substrate Type: Cobble/Gravel
Occurrence of LWD (%): 0.0
LWD per 100 ft.:
Riffles:
Pools:
Flat:

Pools by Stream Length (%): 33.8
Pool Frequency (%): 40.0
Residual Pool Depth (%):
< 2 Feet Deep: 0.0
2 to 2.9 Feet Deep: 75.0
3 to 3.9 Feet Deep: 25.0
>= 4 Feet Deep: 0.0
Mean Max Residual Pool Depth (ft.): 2.73
Mean Pool Shelter Rating: 20

Pool Tail Substrate (%): Silt/Clay: Sand: Gravel: Sm Cobble: Lg Cobble: Boulder: Bedrock:
Embeddedness Values (%): 1. 0.0 2. 85.7 3. 14.3 4. 0.0 5. 0.0

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 3

Channel Type: B3
Reach Length (ft.): 4025
Riffle/Flatwater Mean Width (ft.): 10.0
BFW:
Range (ft.): to
Mean (ft.):
Std. Dev.:
Base Flow (cfs): 0
Water (F): 67 - 72 Air (F): 73 - 85
Dry Channel (ft.): 0

Canopy Density (%): 42.3
Coniferous Component (%): 32.5
Hardwood Component (%): 67.5
Dominant Bank Vegetation: Hardwood Trees
Vegetative Cover (%): 12.8
Dominant Shelter: Undercut Banks
Dominant Bank Substrate Type: Cobble/Gravel
Occurrence of LWD (%): 10.0
LWD per 100 ft.:
Riffles:
Pools:
Flat:

Pools by Stream Length (%): 17.9
Pool Frequency (%): 22.2
Residual Pool Depth (%):
< 2 Feet Deep: 33.3
2 to 2.9 Feet Deep: 58.3
3 to 3.9 Feet Deep: 8.3
>= 4 Feet Deep: 0.0
Mean Max Residual Pool Depth (ft.): 2.1
Mean Pool Shelter Rating: 12

Pool Tail Substrate (%):	Silt/Clay:	Sand:	Gravel:	Sm Cobble:	Lg Cobble:	Boulder:	Bedrock:
Embeddedness Values (%):	1. 18.2	2. 72.7	3. 9.1	4. 0.0	5. 0.0		

STREAM REACH: 4

Channel Type: B2
Reach Length (ft.): 918
Riffle/Flatwater Mean Width (ft.): 9.5
BFW:
Range (ft.): to
Mean (ft.):
Std. Dev.:
Base Flow (cfs): 0
Water (F): 70 - 70 Air (F): 83 - 83
Dry Channel (ft.): 0

Canopy Density (%): 51.7
Coniferous Component (%): 46.7
Hardwood Component (%): 53.3
Dominant Bank Vegetation: Hardwood Trees
Vegetative Cover (%): 10.0
Dominant Shelter: Boulders
Dominant Bank Substrate Type: Boulder
Occurrence of LWD (%): 0.0
LWD per 100 ft.:
Riffles:
Pools:
Flat:

Pools by Stream Length (%): 15.5
Pool Frequency (%): 20.0
Residual Pool Depth (%):
< 2 Feet Deep: 0.0
2 to 2.9 Feet Deep: 100.0
3 to 3.9 Feet Deep: 0.0
>= 4 Feet Deep: 0.0
Mean Max Residual Pool Depth (ft.): 2.45
Mean Pool Shelter Rating: 5

Pool Tail Substrate (%):	Silt/Clay:	Sand:	Gravel:	Sm Cobble:	Lg Cobble:	Boulder:	Bedrock:
Embeddedness Values (%):	1. 0.0	2. 100.0	3. 0.0	4. 0.0	5. 0.0		

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 5

Channel Type: G2
Reach Length (ft.): 1502
Riffle/Flatwater Mean Width (ft.): 8.7
BFW:
Range (ft.): to
Mean (ft.):
Std. Dev.:
Base Flow (cfs): 0
Water (F): 63 - 70 Air (F): 80 - 92
Dry Channel (ft.): 0

Canopy Density (%): 56.8
Coniferous Component (%): 38.3
Hardwood Component (%): 61.8
Dominant Bank Vegetation: Hardwood Trees
Vegetative Cover (%): 17.8
Dominant Shelter: Boulders
Dominant Bank Substrate Type: Bedrock
Occurrence of LWD (%): 0.0
LWD per 100 ft.:
Riffles:
Pools:
Flat:

Pools by Stream Length (%): 31.4
Pool Frequency (%): 33.3
Residual Pool Depth (%):
< 2 Feet Deep: 28.6
2 to 2.9 Feet Deep: 28.6
3 to 3.9 Feet Deep: 35.7
>= 4 Feet Deep: 7.1
Mean Max Residual Pool Depth (ft.): 2.63
Mean Pool Shelter Rating: 9

Pool Tail Substrate (%):	Silt/Clay:	Sand:	Gravel:	Sm Cobble:	Lg Cobble:	Boulder:	Bedrock:
Embeddedness Values (%):	1. 16.7	2. 41.7	3. 41.7	4. 0.0	5. 0.0		

STREAM REACH: 6

Channel Type: F2
Reach Length (ft.): 5864.3
Riffle/Flatwater Mean Width (ft.): 8.8
BFW:
Range (ft.): to
Mean (ft.):
Std. Dev.:
Base Flow (cfs): 0
Water (F): 62 - 67 Air (F): 68 - 88
Dry Channel (ft.): 3775.3

Canopy Density (%): 56.3
Coniferous Component (%): 54.5
Hardwood Component (%): 45.5
Dominant Bank Vegetation: Grass
Vegetative Cover (%): 8.1
Dominant Shelter: Boulders
Dominant Bank Substrate Type: Boulder
Occurrence of LWD (%): 3.1
LWD per 100 ft.:
Riffles:
Pools:
Flat:

Pools by Stream Length (%): 11.8
Pool Frequency (%): 26.9
Residual Pool Depth (%):
< 2 Feet Deep: 75.8
2 to 2.9 Feet Deep: 21.2
3 to 3.9 Feet Deep: 0.0
>= 4 Feet Deep: 3.0
Mean Max Residual Pool Depth (ft.): 1.62
Mean Pool Shelter Rating: 11

Pool Tail Substrate (%):	Silt/Clay:	Sand:	Gravel:	Sm Cobble:	Lg Cobble:	Boulder:	Bedrock:
Embeddedness Values (%):	1. 12.1	2. 78.8	3. 6.1	4. 3.0	5. 0.0		

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 7

Channel Type: F3
Reach Length (ft.): 1185
Riffle/Flatwater Mean Width (ft.): 3.0
BFW:
Range (ft.): to
Mean (ft.):
Std. Dev.:
Base Flow (cfs): 0
Water (F): 61 - 64 Air (F): 70 - 75
Dry Channel (ft.): 864

Canopy Density (%): 63.0
Coniferous Component (%): 85.0
Hardwood Component (%): 15.0
Dominant Bank Vegetation: Coniferous Trees
Vegetative Cover (%): 25.0
Dominant Shelter: Undercut Banks
Dominant Bank Substrate Type: Cobble/Gravel
Occurrence of LWD (%): 0.0
LWD per 100 ft.:
Riffles:
Pools:
Flat:

Pools by Stream Length (%): 5.7
Pool Frequency (%): 16.7
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.): 1
Mean Pool Shelter Rating: 5

Pool Tail Substrate (%): Silt/Clay: Sand: Gravel: Sm Cobble: Lg Cobble: Boulder: Bedrock:
Embeddedness Values (%): 1. 0.0 2. 100.0 3. 0.0 4. 0.0 5. 0.0

STREAM REACH: 8

Channel Type: B3
Reach Length (ft.): 10241
Riffle/Flatwater Mean Width (ft.): 3.4
BFW:
Range (ft.): to
Mean (ft.):
Std. Dev.:
Base Flow (cfs): 0
Water (F): 58 - 63 Air (F): 72 - 88
Dry Channel (ft.): 3709

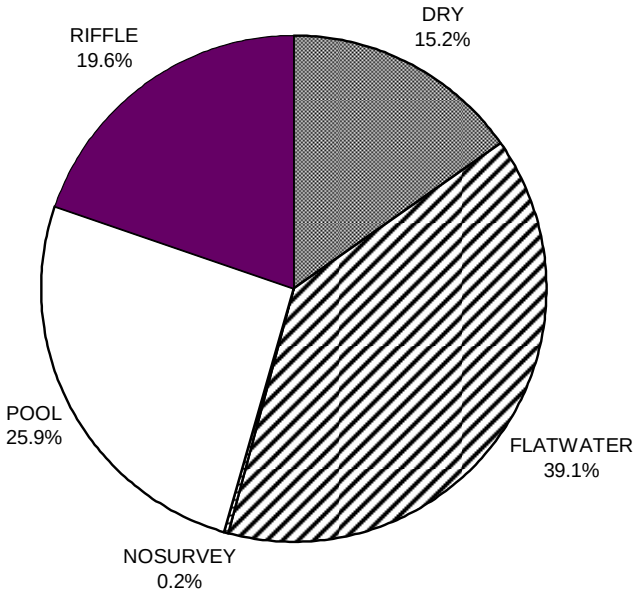
Canopy Density (%): 70.5
Coniferous Component (%): 76.4
Hardwood Component (%): 23.6
Dominant Bank Vegetation: Hardwood Trees
Vegetative Cover (%): 23.3
Dominant Shelter: Boulders
Dominant Bank Substrate Type: Boulder
Occurrence of LWD (%): 0.0
LWD per 100 ft.:
Riffles:
Pools:
Flat:

Pools by Stream Length (%): 5.2
Pool Frequency (%): 24.1
Residual Pool Depth (%):
< 2 Feet Deep: 68.8
2 to 2.9 Feet Deep: 25.0
3 to 3.9 Feet Deep: 6.3
>= 4 Feet Deep: 0.0
Mean Max Residual Pool Depth (ft.): 1.81
Mean Pool Shelter Rating: 16

Pool Tail Substrate (%): Silt/Clay: Sand: Gravel: Sm Cobble: Lg Cobble: Boulder: Bedrock:
Embeddedness Values (%): 1. 13.3 2. 70.0 3. 13.3 4. 0.0 5. 3.3

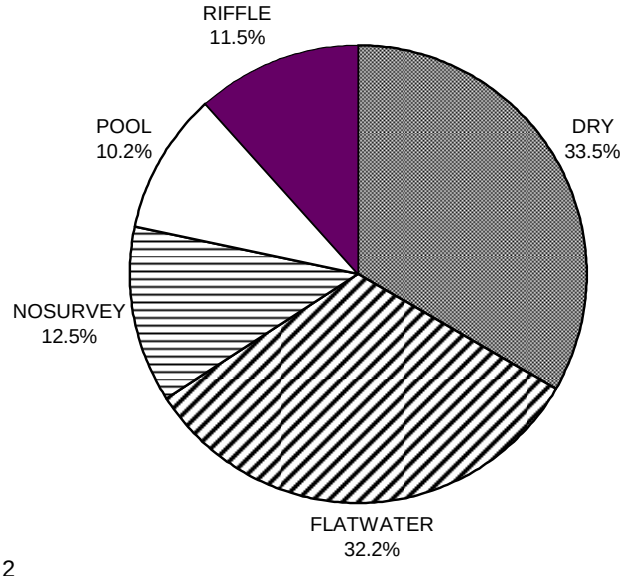
Appendix D: Graphs

MORRISON CREEK 2001
LEVEL II HABITAT TYPES BY PERCENT OCCURRENCE



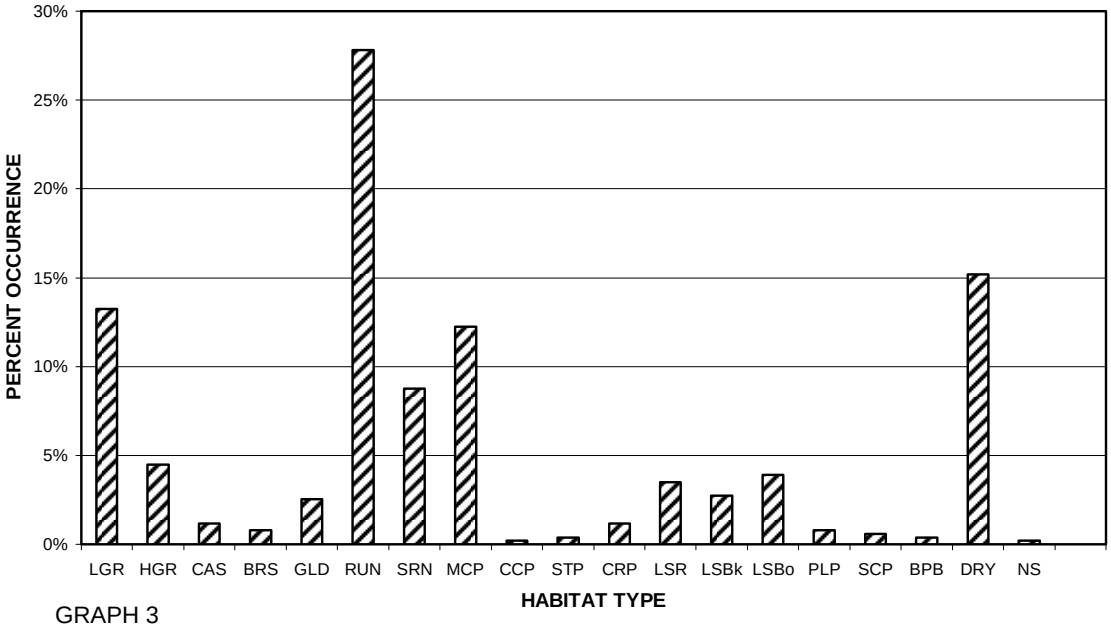
GRAPH 1

MORRISON CREEK 2001
LEVEL II HABITAT TYPES BY PERCENT TOTAL LENGTH



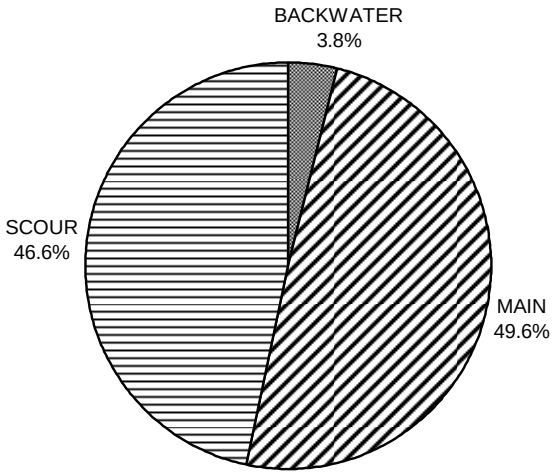
GRAPH 2

MORRISON CREEK 2001
LEBVEL IV HABITAT TYPES BY PERCENT OCCURRENCE



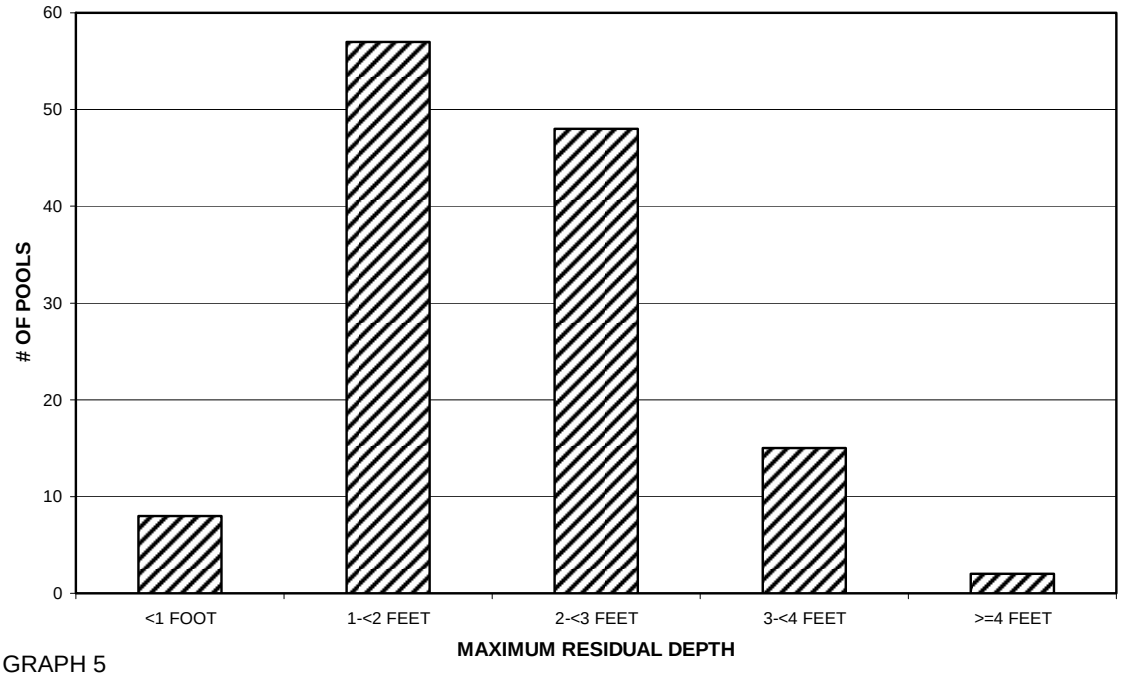
GRAPH 3

MORRISON CREEK 2001
LEVEL I POOL TYPES BY PERCENT OCCURRENCE



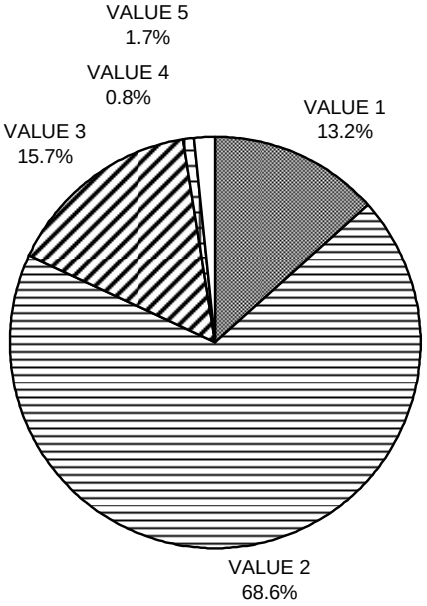
GRAPH 4

MORRISON CREEK 2001
MAXIMUM DEPTH IN POOLS



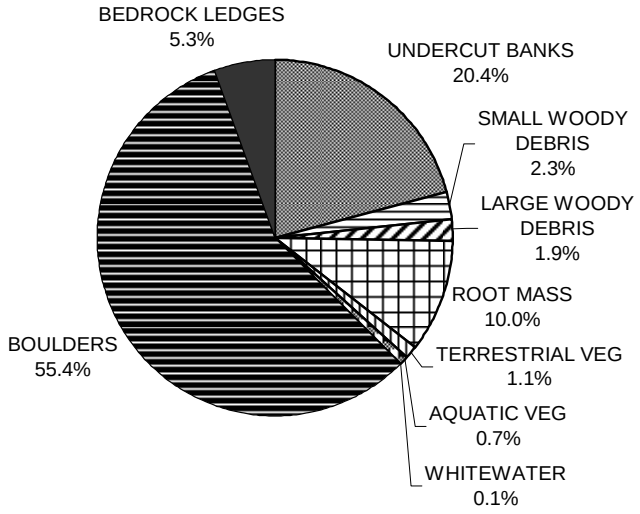
GRAPH 5

MORRISON CREEK 2001
PERCENT EMBEDDEDNESS



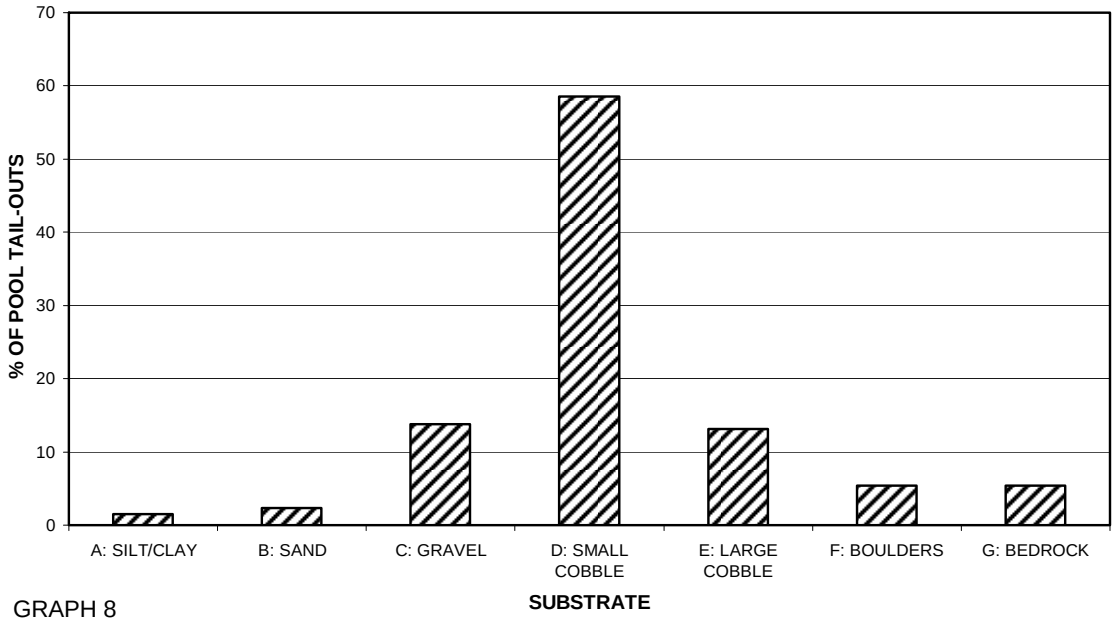
GRAPH 6

MORRISON CREEK 2001
MEAN PERCENT COVER TYPES IN POOLS



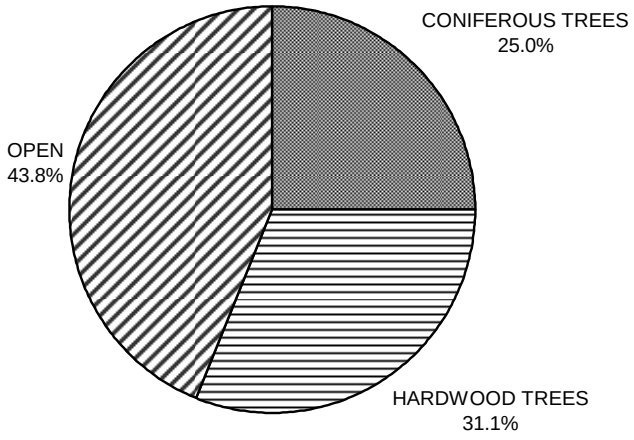
GRAPH 7

MORRISON CREEK 2001
SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



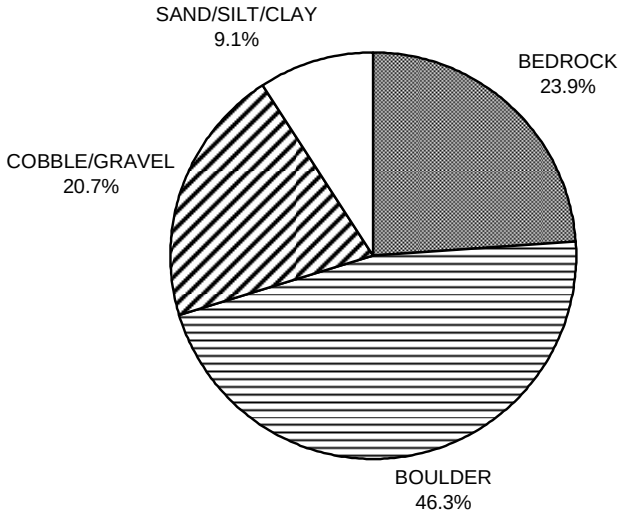
GRAPH 8

MORRISON CREEK 2001
MEAN PERCENT CANOPY



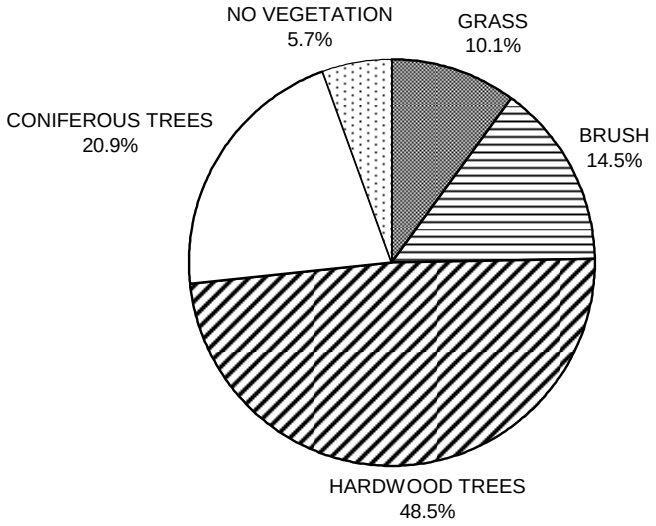
GRAPH 9

MORRISON CREEK 2001
DOMINANT BANK COMPOSITION IN SURVEY REACH



GRAPH 10

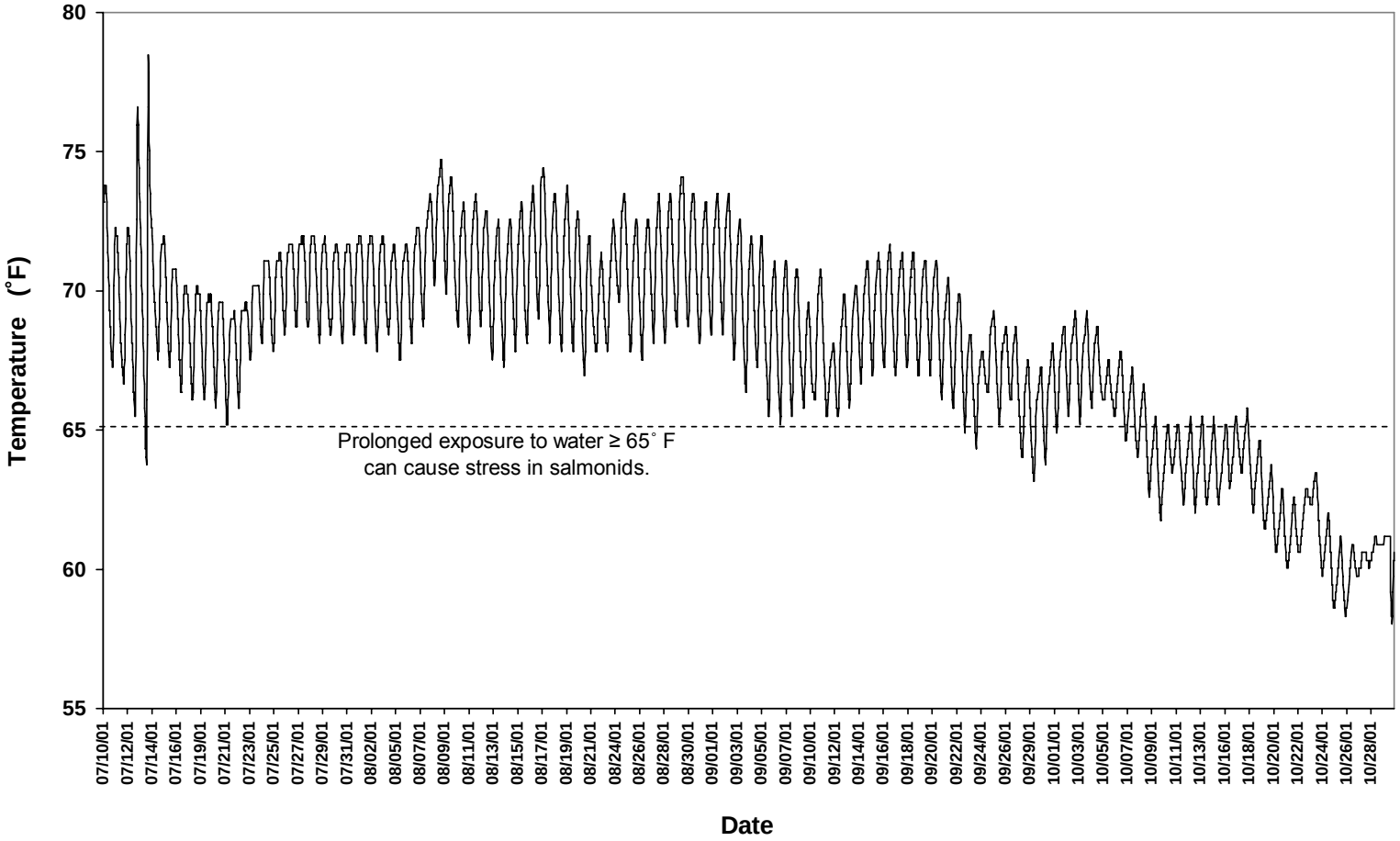
MORRISON CREEK 2001
DOMINANT BANK VEGETATION IN SURVEY REACH



GRAPH 11

APPENDIX E:

Morrison Creek Water Temperatures



Watershed Hydroid **439** Morrison Creek

Hydrologic Sub-Areas covered by the watershed:

Name:	LLId: (1:24k)	County:
Morrison Creek	1231629390782	Mendocino

Tributary to Russian River
Tributary to
Tributary to

Location: **T:** 14N **R:** 12W **S:** 15 **Latitude:** 39.0782777179666 **Longitude** 123.162930865599

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: 3 **Total Length:** 7.36 Miles 11.86 Km

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

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

Drainage Area: 2469 Hectares; 6102 Acres; 9.53 sq. mi.

Elevations: Mouth: 531 feet; Headwaters: 3530 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): Steelhead

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

Federal:	State:	Local:	Private:
4314.3 acres	0.0	0.0	1787.8
70.70 %	0.00 %	0.00 %	29.30 %

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:
42.62 acres	1376.98	691.42	162.62	0.00
0.7 %	22.6 %	11.3 %	2.7 %	0.0 %

Shrub:	Herbaceous:	Barren/rock:	Water:
3575.13	236.91	5.86	3.55
58.6 %	3.9 %	0.1 %	0.1 %

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

Watershed HydroId **439** Morrison Creek

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

Quad Name	USGS Code
PURDYS GARDENS	39123A1
ELLEDGE PEAK	39123A2

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

Scientific Name	Common Name
Ceanothus confusus	Rincon Ridge ceanothus
Serpentine Bunchgrass	Serpentine Bunchgrass
Northern Interior Cypress Forest	Northern Interior Cypress Forest
Arctostaphylos canescens ssp. sonomen	Sonoma manzanita

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	99.92
Lakeport	551355	Upper Cache Creek	0.08