NORTHERN NAPA RIVER WATERSHED PLAN

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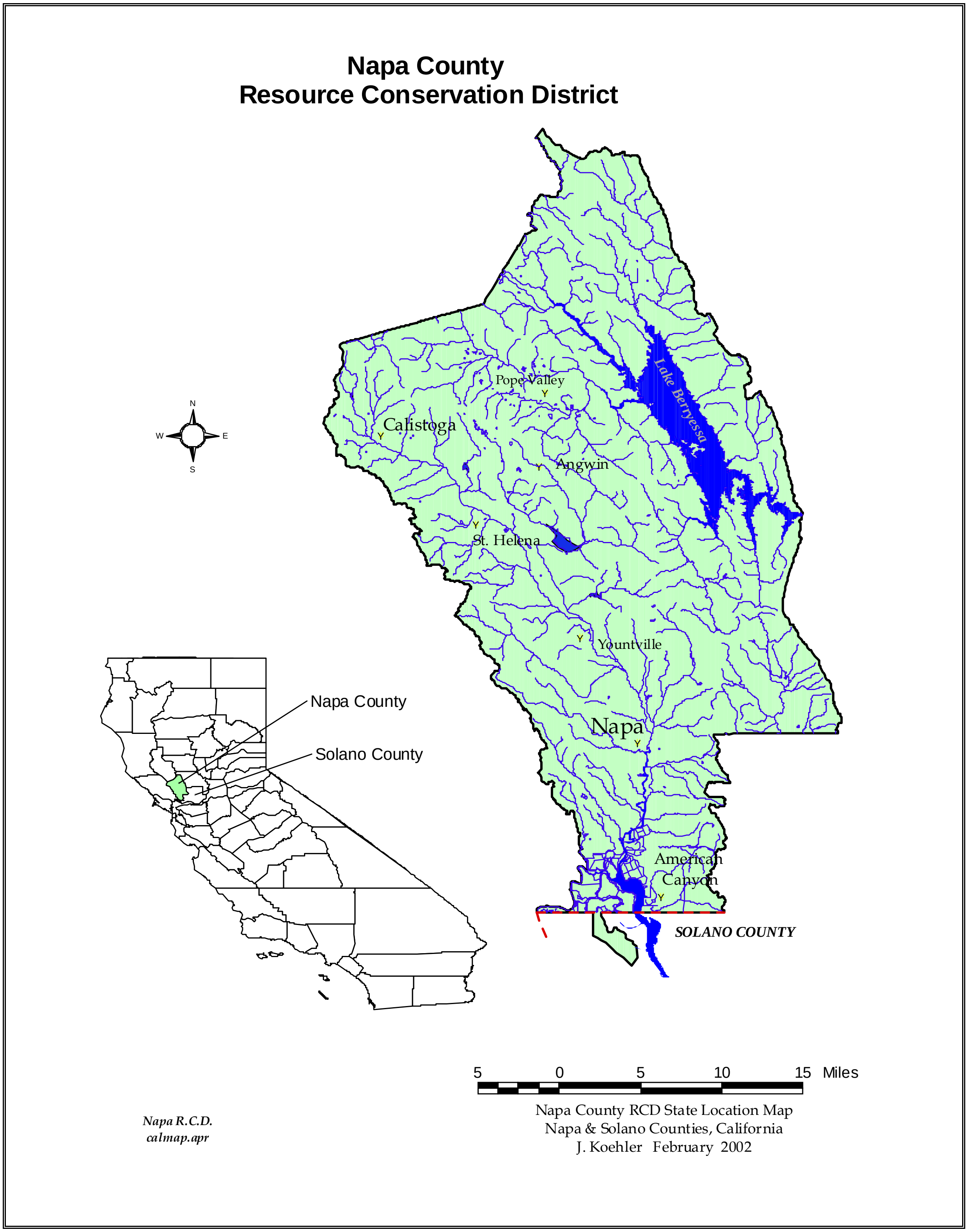


Figure 1 – Napa County RCD boundary within California

1.0 Introduction and Objectives

In June, 2000 the Napa County Resource Conservation District (Napa RCD) was awarded a Salmonid Habitat Restoration grant from the California Department of Fish and Game (CDFG) to fund a study of the northern Napa River watershed. The goal of this study was to develop a Watershed Management Plan for the northern reaches of the Napa River watershed. The Plan, which landowners can implement on their properties, provides both general and site-specific recommendations for restorative actions benefiting salmonids, with emphasis on steelhead trout (*Onchorynchus mykiss*). The Plan is focused on establishing geomorphic and ecological functions, processes, and characteristics to enhance stream habitat conditions for salmonids. Additionally, the Plan prioritizes sites for future project implementation, and makes recommendations for additional specific project planning that will improve fish and wildlife habitat.

This study was the first step in the process of creating a watershed plan encompassing the entire Napa River watershed. In subsequent years, proposals will be submitted for watershed planning in additional geographically related areas in the central and southern portions of the Napa River watershed.

The Napa Valley is an area rich in natural resources which support a diverse array of plants, fish, and wildlife as well as many human activities and land uses. The favorable climate, scenic beauty, and abundance of resources continuously attract a great number of people to the area to live or to visit. This tremendous influx of people has too often come at the expense of the natural environment which has produced the very same conditions people have sought out.

Over the past century, the Napa Valley has been rapidly transformed into a vineyard landscape with grape growing emerging as the primary use of land within the valley. The majority of vineyards have been planted along the Napa River, and all of its 48 tributaries creating both direct and indirect impacts to the aquatic and riparian environments. Additionally, urban sprawl has brought roads and other changes into previously undisturbed areas of the watershed further reducing the remaining areas of undisturbed open space. During the last several decades, agricultural landowners, conservationists, local agencies, and citizen groups have recognized the negative impacts that poor land use decisions have had on these critically sensitive habitats. Through studies such as this one, residents and watershed stakeholders can develop ways to repair the damage done to the environment, and increase awareness of the need for careful planning, development, and usage of the area.

2.0 Project Summary

The Northern Napa River Watershed Plan includes several interlocking components. The following is a list of activities carried out as part of this project by the Napa RCD with it's contractors during 2001. Additional studies and projects by other agencies/groups have been included to supplement the report and expand the usefulness of the final plan.

- **Habitat Typing/ Channel Typing – *Napa RCD***
  Using the "*California Salmonid Restoration Manual*" protocol, seven streams were assessed to determine the quality and quantity of available habitat for steelhead.

- **Water Quality Monitoring – *Napa RCD***
  Streams within the northern watershed were monitored monthly for pH, conductivity, dissolved oxygen, and temperature. Site conditions including flow, and substrate conditions were also documented.
  Benthic Macroinvertebrate Study – *Friends of the Napa River & Napa RCD*
  In April, 2001 the Friends of the Napa River in cooperation with the Napa RCD conducted benthic macroinvertebrate sampling in several streams of the northern Napa River watershed. The study was the second year of an ongoing effort to assess water quality conditions within the watershed. The results of this study are being analyzed, and they will be available by the end of 2002.

- **Salmonid Distribution – *Napa RCD***
  During the habitat-typing surveys, presence and approximate size of fish were documented throughout each stream reach.
  Steelhead Habitat Study – *Friends of the Napa River*
  In the summer of 2001, streams throughout the Napa River watershed were snorkel surveyed for steelhead. Several streams within the northern watershed were included in the surveys and mapped according to relative population densities.

- **Stream Geomorphology – *Stillwater Sciences***
  The RCD contractor, Stillwater Sciences, conducted V* (Pool in-filling) sampling to determine sediment loads within streams. Turbidity measurements during winter flows, bed mobility, and gravel permeability were also conducted in selected watersheds.

3.0 WATERSHED OVERVIEW

3.1 Napa River Watershed

The Napa River watershed covers an area of approximately 426 square miles, and is contained on three sides by mountains to the north, west, and east (see Figure 2). The watershed is typical of the California coastal range with northwest-southeast trending topography. The Napa River runs through the center of the watershed on the valley floor. It drains numerous tributaries on its 55 mile run from high in the headwaters of Mt. St. Helena in the Mayacamas Mountain range to the San Pablo Bay. Along the way it winds through varied landscapes of forested mountain slopes, vineyards, urban areas, open pasture, industrial zones, grasslands, and marshes.

The Napa River watershed supports a great diversity of fish and wildlife, including several federally endangered species and other listed special status species. Historically, large runs of anadromous steelhead trout, coho salmon, and possibly chinook salmon made their way up the Napa River to spawn in its upper reaches and tributaries. Coho salmon are no longer found in the Napa River, and a small remnant population of chinook salmon may use the river to spawn.

Adult chinooks are sited each year in the main-stem river and several tributaries, but it is presently unclear whether these fish represent a genetically reproducing population within the Napa River watershed. Rather, it is likely that these fish are misguided progeny from CDFG planting efforts which release young chinook salmon smolts into upper San Pablo Bay.

Steelhead trout are the most significant salmonid species within the watershed, and their population has been greatly reduced from historical levels. It is estimated that the Napa River watershed supported an approximate population of 8,000 adult steelhead as recently as 100 years ago. The population is currently estimated to be between 200 and 1,000 adult fish based on surveys throughout the watershed. The National Marine Fisheries Service (NMFS) listed steelhead as a threatened species in Napa County in August 1997. However, adult steelhead are still observed spawning in many of the river´s tributaries on a yearly basis, and juvenile steelhead can be seen in the summer months. Despite reduced populations, the Napa River watershed is considered one of the most significant anadromous fish streams within San Francisco Bay.

The Napa River and its many tributaries are home to many other types of fish including several native species: northern pikeminnow, splittail, threespine stickleback, California roach, Sacramento sucker, pacific lamprey, and sculpin. The Napa River also has populations of several introduced fish species including striped bass, bluegill, green sunfish, smallmouth bass, carp, white catfish, brown bullhead, and mosquito fish. Two streams in the Napa River watershed have populations of the federally endangered California freshwater shrimp.

Terrestrial wildlife is also abundant in the watershed. The river and its tributaries are important to many land birds that feed and nest in the riparian zone along the water's edge. Bird species dependent on the river include mallard, green-winged teals, mergansers, wood ducks, herons, egrets, kingfishers, rails, and grebes. Riparian habitat is used by mink, muskrat, raccoon, deer, gray fox, and bobcat. The federally listed northern spotted owl can be found in tributary canyons on the west side of the watershed in forested regions.

3.2 Study Area - Northern Napa River Watershed

The areas addressed in the northern Napa River Watershed Plan include the northern reach of the Napa River from Kimball Dam to the confluence of Mill Creek and northern tributaries including Mill Creek and those above it. The watershed of the study area covers approximately 50.2 square miles and contains 12 tributary blue line streams according to the USGS Calistoga 7.5 minute quadrangle. Most of the streams in the northern watershed are ephemeral; flowing for only part of the year in the lower reaches and retaining water in isolated pools in the higher more protected reaches. The seasonal nature of these streams presents a special set of stresses to aquatic organisms and makes the need to protect them even more important. Small changes in these habitats can have large-scale impacts on the ecosystem, and disrupt the ecological balance which has evolved over time.

The seven specific reaches that were assessed are the main-stem of the Napa River (from Kimball Dam to Mill Creek), Garnett Creek, Diamond Mt. Creek, Cyrus Creek, Dutch Henry Creek, Simmons Creek, and Ritchie Creek (see Figure 3). All of these reaches are known to have steelhead populations based on historical surveys and records. The listed reaches encompass approximately 28 stream miles out of a total of about 70 stream miles of the northern Napa River watershed. Additional streams in the northern watershed were not surveyed due to landowner access problems or because they were completely dry. Nash Creek and Biter Creek were both completely dry at the time of the surveys. Kimball Creek, Blossom Creek, and Mill Creek all had minimal flows and extensive dry reaches during the summer months. They were determined to be unsuitable to support fish by RCD biologist and CDFG staff and were given secondary priority, and they ultimately went unsurveyed. Landowner access could not be obtained for the majority of Jericho Canyon Creek.

3.3 Historical Information

An array of restoration and habitat improvement projects have been undertaken in the northern Napa River watershed. The following projects are a broad representation of the types of improvements made by landowners in the recent past.

- Vineyards and resident landowners have applied for and received funding from the USDA to complete stream bank and erosion control projects along Mill Creek, Dutch Henry Creek, Cyrus Creek, upper Napa River and other streams within the northern watershed. Most projects involved the use of bioengineered structures such as willow revetments and baffles in conjunction with native plant re-vegetation.

- Bothe State Park has removed several small dams on Ritchey Creek, which were determined to be a barrier to migrating steelhead. The park has also done extensive bank stabilization work along Ritchey Creek.

- Landowners along a reach of the upper Napa River have been active in removing *Arundo donax* from the banks. Arundo is damaging to steelhead habitat because it chokes the channel, accelerates erosion, and greatly reduces pool habitat.

Sewage disposal and release information was obtained for the streams within the northern watershed. Visits and calls were made by RCD staff to several agencies including the City of St. Helena, City of Calistoga, and the Regional Water Quality Control Board. No accounts of illegal discharge or untreated sewage disposal were on record.

Stream surveys have been conducted by the CDFG on most of the streams within the northern watershed for the past 50 years or so with varying degrees of regularity. All historical stream survey information is included in the current stream habitat report for each individual stream. Additionally, historical fish-planting information and fisheries studies are also summarized in each stream habitat report.

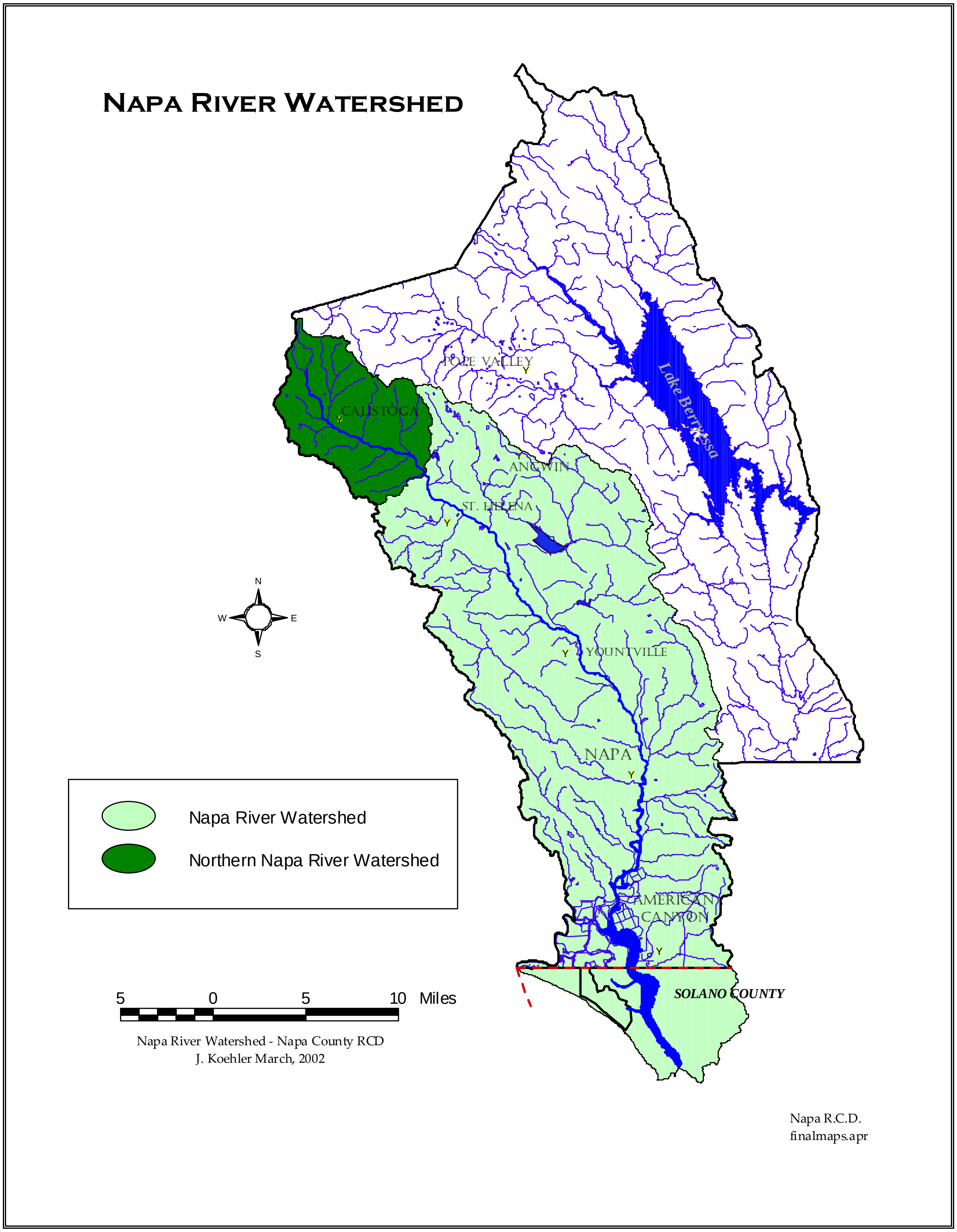


Figure 2 – The relative size and location of the Napa River watershed within Napa County. The darker upper portion delineates the northern watershed study area.

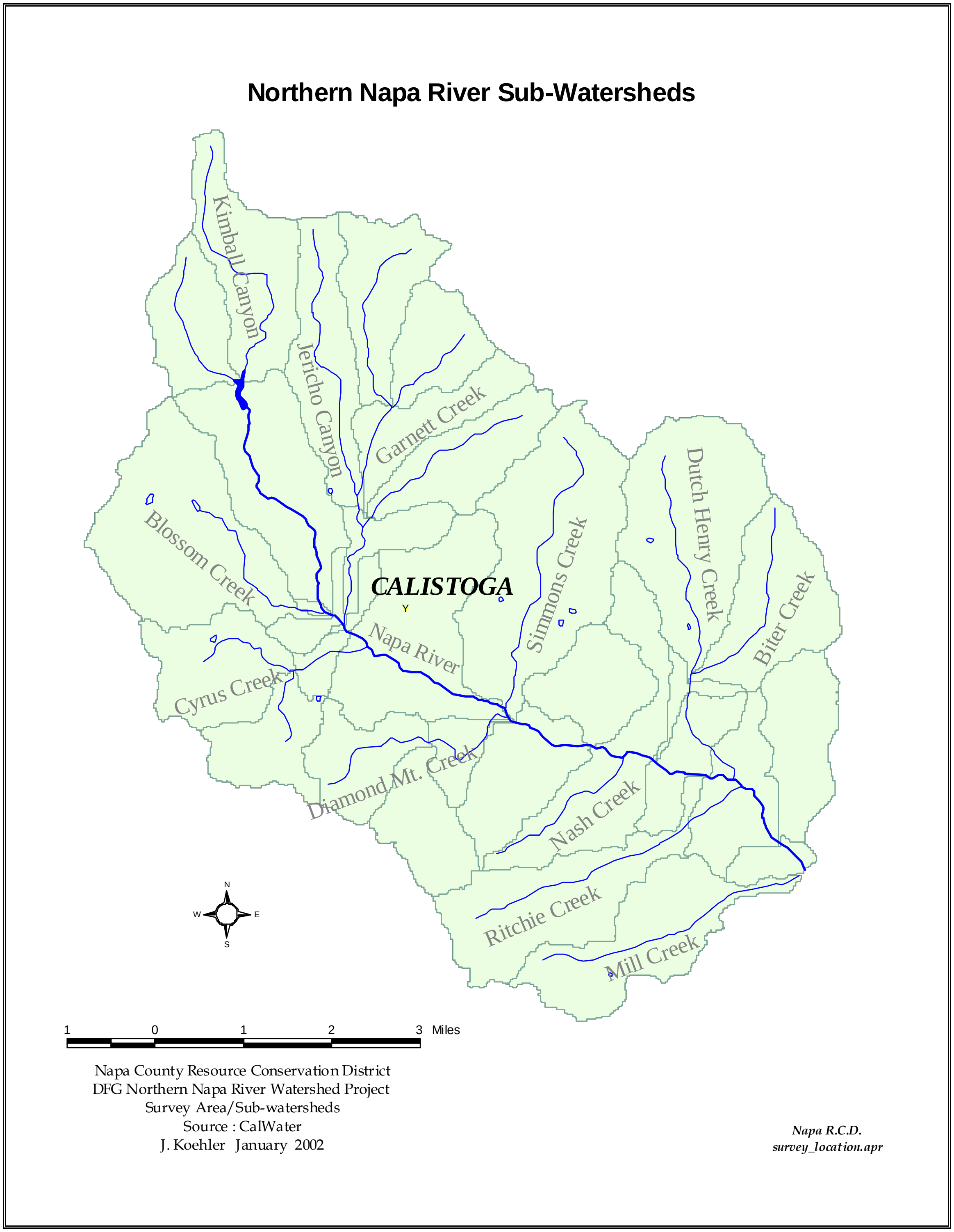


Figure 3 – Subwatersheds within the northern Napa River watershed.

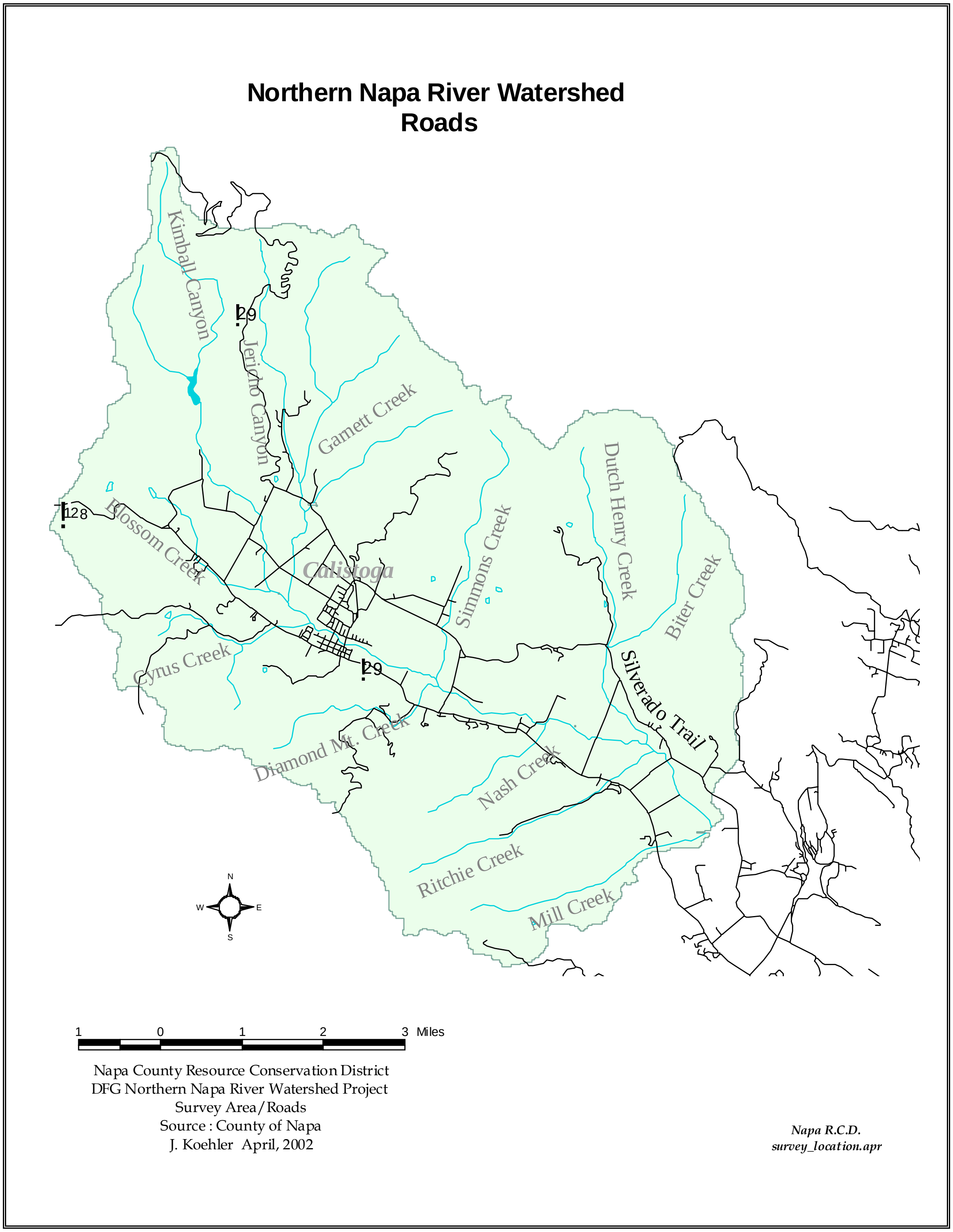


Figure 4 – Main roads and highways within the northern Napa River watershed.

4.0 STEELHEAD TROUT

4.1 Ecology

Rainbow trout (*Onchorynchus mykiss*) occur both as resident fish and as anadromous steelhead, which migrate to and from the ocean. These two very different life histories often occur within the same populations in the same stream. If access to the ocean is available, the steelhead form tends to dominate due to their larger size and increased egg production. However, if the stream contains barriers to upstream migration, steelhead will not return to reproduce, and the resident form will become dominant in the population.

Steelhead grow rapidly in the ocean and reach sizes much larger than resident rainbow trout. After spending one to three years in the ocean, adult fish between 15 to 30 inches in length return to their rearing streams to spawn. Unlike many other salmonids, a steelhead can make this spawning migration several times over its lifetime. However, in ephemeral streams, such as those found in the northern Napa River watershed, low flows during the spawning months (January through April) may prevent anadromous fish from reproducing during a given season.

Natural and manmade barriers to upstream migration are important factors in steelhead distribution and abundance within a stream network. Typically in streams with short or easy migrations many adults return younger and smaller, but may return multiple times to reproduce. In streams with longer more difficult migrations, the larger, stronger adults tend to be most common. The "reproduce early and often" strategy has a distinct advantage in areas that experience severe seasonal variability with droughts, which cut off flow, or floods that destroy spawning nests, called redds. A mixture of adult sizes provides the population with the greatest flexibility, and improves survivability over the long term.

Adult steelhead migration and spawning takes place from January through April, depending on late-season flows. Fish that make the upstream migration early have the advantage that their young emerge sooner and grow larger in the first year of life. However, they are more vulnerable to heavy winter storms, which can destroy redds and wash away young fish. Steelhead that migrate later in the season run the risk of being stranded by reduced flows to carry them back to the ocean. Most populations contain a mixture of early and late spawning fish, which improves the overall odds of success from year to year.

Steelhead spawn by constructing redds (nests) in the gravel substrate typically found in the tail of a pool. The female scoops out a shallow depression with powerful movements of the tail and lays eggs within the redd. Accompanying males then fertilize the eggs, and the female quickly buries the redd with gravel. The egg development rate is highly temperature dependent and takes between one to two months. Eggs hatch in about 31 days at 50˚ F (Flossi et. al., 1998). Like other salmonids, steelhead hatch as alevins with a large attached yolk sac and spend their first one to two weeks in the gravel before emerging into the stream.

Young steelhead spend between one to four years in freshwater; two years is most common in central California coast streams. They feed primarily on aquatic insects and other aquatic invertebrates in fast water feeding lanes (riffles) and grow rapidly if food is abundant. When stream flows are strong enough to support ample aquatic insect populations throughout the year, juvenile steelhead can reach lengths adequate to out-migrate (smolt) in one year. However, in streams with very low summer flows, steelhead grow very little during mid to late summer, and usually require two years or more to grow large enough to migrate to the ocean.

4.2 Limiting Factors

Since steelhead spend part of their life in freshwater and part in saltwater, they face a complex set of environmental and physiological challenges. Over thousands of generations, steelhead have adapted to cope with changes in the natural processes which have shaped their evolutionary path. However, since the introduction of European settlers in the early part of the 1800's steelhead have been subjected to a rapidly changing array of stresses. These factors combined present a significant risk to the long term survivability of steelhead within the Napa River watershed. It is therefore of prime importance to identify these factors within the watershed and implement restoration and planning projects wherever feasible.

4.2a. Migration Barriers

Barriers that prevent steelhead passage can be natural or manmade structures. They may prevent passage under any conditions or only during periods of low flow. Waterfalls, dry reaches, log jams, and other natural barriers exist to some degree in all streams. These represent naturally occurring stream features and are not generally considered for removal or improvement unless extensive. However, many structures that have been built by humans on or in streams have a severe impact on migration and reduce the number of steelhead able to reach habitat above them.

Steelhead, like all anadromous salmonids, migrate both downstream as juvenile smolts and upstream as spawning adults. Unlike other salmonids, however, steelhead are capable of making several spawning migrations throughout their lifetimes. During both migrations, steelhead must be able to remain in good condition if they are to survive to the following year. If adult fish must negotiate many difficult obstacles along the way to spawning habitat, they are less likely to survive the trip back to the ocean. Likewise, if out-migrating smolts are stressed heavily, they have far lower odds of surviving the rigors of saltwater life.

Dams built for water pumping and other uses can present a major barrier to fish migration, both upstream and downstream. For smaller dams steelhead passage is affected by the height of the dam and the size of the jump pool below. Large adult steelhead can usually handle a jump if the depth of the pool below is 1.25 times the height of the jump (Flossi et. al. 1998). If the dam is too large for adult steelhead to jump over, the genetic tendency for anadromous rainbow trout is reduced above the barrier.

Culverts often have a large drop from downcutting below the outlet side that prevents steelhead from passing upstream. If the culvert has riprap boulders or other material below it to prevent downcutting and erosion, the pool below the culvert is usually impacted and can interfere with jumping. Often within the culvert the stream flow is spread out into a shallow sheet of water that is difficult for adult steelhead to swim in. When culverts are steeply inclined, the combination of high flow velocity and shallow depth make them extremely difficult for all but the strongest adult steelhead to traverse.

4.2b. Water Temperature and Quality

Water temperature, particularly during the spring, summer, and fall, is a significant factor that affects habitat quality and availability for steelhead. Water temperatures within a stream are influenced on a seasonal basis by a variety of factors, which include the release of water from upstream reservoirs, air temperature, instream flow, groundwater, shading from riparian vegetation, and other influences.

Steelhead trout are coldwater fish with a relatively narrow range of temperatures necessary for survival. The lower limits of temperature tolerance are probably very seldom present in the streams of the Napa River watershed. However, if water temperatures rise above 20˚ C (68˚ F), steelhead experience physiological stress and increased metabolic demand. Juvenile steelhead are especially sensitive to these fluctuations due to their small size and rapid growth rate.

Exposure of various lifestages of steelhead to elevated water temperatures may result in chronic effects. These include reduced growth rates, reduced overall health, reduced survival rates, and depending on magnitude and duration of the exposure, direct mortality. The actual effects of elevated water temperature on steelhead vary substantially depending on a number of factors including lifestage of steelhead exposed, duration and magnitude of the exposure, food supply, and prevalence of diseases. General temperature guidelines for evaluating summer rearing habitat for juvenile steelhead include average daily temperatures of 20˚ C (68˚ F) or less, with maximum hourly temperatures of 23˚ C (73˚ F).

Temperature affects how much dissolved oxygen (DO) water can hold. As temperature rises, the amount of dissolved oxygen decreases and vice versa. When water holds all the dissolved oxygen it can hold at a given temperature, it is 100% saturated. Steelhead, like all salmonids, require high levels of DO saturation in order to thrive. Streams with DO levels in the 95% - 120% saturation range are considered best for maintaining healthy steelhead.

4.2c. Spawning Habitat

The amount of suitable spawning habitat within a stream can directly determine the ability of that stream to support large populations of steelhead. Adult steelhead need access to spawning gravel in areas free of heavy sedimentation with adequate flow and cool, clear water. Steelhead utilize gravel that is between 0.5 to 6 inches in diameter, dominated by 2 to 3 inch gravel. Typically, steelhead use smaller pockets of spawning gravel than other salmonids, and a lack of available suitable spawning gravel is usually not a major limiting factor (Flossi et. al., 1998). Escape cover for spawning adults is also important, and is usually abundant during the high flow migration period.

Sediment deposition within pools has a deleterious impact on egg development and fry emergence from the spawning gravel. Fine sediment from roads, erosion, or some other upland source smothers eggs within the redd by blocking water and oxygen flow through the nest. Silt and sand in the streambed provide unstable habitats and fill crevices in the gravel and cobble, reducing both aquatic insect and steelhead abundance.

4.2d. Rearing / Overwintering Habitat

Juvenile steelhead spend one to two years in freshwater, and must therefore have adequate year round habitat. Escape or hiding cover, provided by undercut banks, fallen trees, boulders and overhanging vegetation, is an important part of year round rearing habitat for juvenile steelhead, especially for larger yearling fish. Most artificial bank protection including concrete walls, sackrete (stacked bags of concrete), and gabions (wire baskets filled with rocks), provides no protective hiding places for fish. Large riprap boulders (2 foot + diameter) can provide a limited amount of cover when placed in the streambed. However, most smaller riprap, with small crevices between rocks, provides little hiding cover and often fills in with fine sediment and sand.

The amount of shade provided by trees and other vegetation along the stream affects rearing habitat in many ways. Shade from a dense riparian canopy benefits steelhead by blocking sunlight and keeping water temperatures cool during hot summer periods. However, too much shade prevents photosynthesis from occurring within the stream, thus reducing primary production at the base of the aquatic food web. Additionally, in streams with very dense canopies, the lack of sunlight may affect juvenile steelhead's ability to locate food. A balance of approximately 75% to 90% canopy cover is desirable in most streams of the central coast region.

Riparian trees provide a valuable source of complex habitat structure as large woody debris. When limbs are lost or whole trees fall into the stream, it creates cover for juvenile steelhead and can promote formation of large pools through scouring. The tree leaves that drop into the stream also provide a major source of nutrients for aquatic macroinvertebrates.

Fine inorganic sediment from erosion, roads, or other sources can have a significant impact on steelhead rearing habitat. The deposition of fine sediment onto the streambed reduces the amount of aquatic insect habitat, and it smothers algae and other plants which make up the base of the food web. As a consequence, the reductions in macroinvertebrate populations, especially aquatic insects, have direct effects on the availability of food to juvenile steelhead. This is especially critical in the seasonal streams of the central coast region. Since the period of maximum steelhead growth occurs for only a few months of the year, the reduction in food supply during this period has a major impact on smolt size.

Juvenile steelhead spend typically one or two winters in the stream, and therefore overwintering habitat that provides refuge from the winter storms is critical. This habitat is often in the form of deep pools with complexity from undercut banks, large woody debris, backwaters, calm eddies, and other refuges from high storm flows. If juvenile steelhead cannot overwinter safely they may never reach sizes sufficient for migration to the ocean or survive once they do reach the ocean. The abundance of larger, yearling steelhead is a good indicator of the year round habitat quality within a stream.

After spawning in winter most adult steelhead make the return migration to the ocean quickly. However, juvenile steelhead begin the physiological changes for smolting (migrating to the ocean) in late March through May. This late migration allows them to feed longer during the most productive time of the year, growing to sizes which increase the chances for survival. This is also a period of rapidly declining streamflows in California, making the downstream journey over barriers, shallow riffles, and drying stream reaches very risky. For many ephemeral or urbanized central coast streams the outmigration period is a primary limiting factor for steelhead populations. Adult access to good spawning and rearing habitat is unable to compensate for low smolt success during most years. If a stream's lower reaches are completely dry during the outmigration period, it will not support abundant and persistent steelhead populations.

5.0 HABITAT TYPING SURVEY RESULTS AND RECOMMENDATIONS

A total of seven streams including the upper mainstem Napa River were examined for this project, and they can be considered a representative sample of the whole northern watershed. Field surveys were performed by two-person crews using CDFG protocols (Flossi et al., 1998) to assess salmonid habitat. Quantitative inventories of all habitat types (pools, riffles, runs, etc.) were documented for all seven streams, and qualitative observations of habitat conditions were noted.

The process of dynamic segmentation will be done by the CDFG Hopland Research Station during the summer of 2002 (approved by Gail Seymour CDFG Watershed Planner, and Bob Coey, CDFG). Dynamic segmentation uses ArcInfo to route GIS stream coverages and associate them with the stream survey data collected during this study. After the streams undergo the dynamic segmentation process, more refined recommendations based on site-specific locations can be made.

The results of the habitat typing surveys yielded valuable information about the condition of the watershed. By analyzing the combined results for all streams, the most prevalent limiting factors can be identified and general trends and conditions can be established for the watershed as a whole. Ranking these factors on a fisheries priority basis will focus restoration and habitat improvement efforts on those conditions that have the greatest impact on steelhead. The following sections are listed on a fisheries priority basis.

5.1 Pool Habitat

The frequency of pool habitat on all surveyed streams is very low. Pools comprised only 31% of the total stream length on average, which is well below the optimal level of 50% of the total length recommended by the CDFG (Flossi et al.,1998). In addition, most of the pools had limited cover elements such as large and small woody debris, undercut banks, or overhanging vegetation associated with them. Most of the streams had boulders as the main source of pool cover and had very low amounts of large woody debris; only 4% on average of the total cover available was from large woody debris. Pool depth was also deficient throughout the survey with an average of only 30 % of pools having a maximum depth of 2 feet or more.

In first and second order streams, such as those surveyed in this study, primary pools should comprise approximately 40% - 50% of the entire stream length. CDFG recommends pool enhancement projects when primary pools are less than 40% of the total length. A primary pool is considered to have a maximum depth of at least 2 feet, occupy at least half the width of the low flow channel, and be as long as the low flow channel width. Given these criteria, all streams are lacking in pool frequency and most are candidates for pool enhancement projects. Table 1 summarizes the pool data by stream.

Table 1. Pool Summary Characteristics

Stream Name	Pools % Total Length	Primary Pools (≥ 2 ft. deep)	Pool Cover (% LWD)	Dominant Pool Cover
Cyrus Creek	24	13	3	Boulders
Diamond Mt. Creek	16	8	1	Boulders
Dutch Henry Creek	45	26	3	Boulders
Garnett Creek	22	50	3	Undercut Banks
Napa River	43	54	6	Terrestrial Vegetation
Ritchey Creek	32	13	4	Boulders
Simmons Creek	34	45	11	Terrestrial Vegetation
Combined Average	**31%**	**30%**	**4%**	

The lack of pool habitat within the northern Napa River watershed can be attributed to several likely causes. Of primary importance is the withdrawal of water from the streams during critical summer months. This includes both legal and illegal water diversions for irrigation, recreation, and other uses by landowners along the streams.

Sedimentation and pool infilling are another possible cause of reduction in pools, however extensive work by Stillwater Sciences has shown this not to be the case in the streams of the northern watershed (see section 7.0 below).

A lack of large woody debris (LWD) and the associated scouring effects on the streambed is another possible reason for the deficiency. The streams within the northern watershed have very low amounts of LWD. Such woody structure likely plays a major role in pool formation in these boulder/bedrock dominated streams.

Overall, pool habitat for rearing juvenile steelhead within the northern Napa River watershed is greatly deficient and is likely limiting steelhead production. The lack of hydraulic complexity in all surveyed streams suggests that steelhead habitat would be significantly enhanced by the addition of boulders and large woody debris to create and enhance more summer rearing pools.

5.2 Streamflow

During the surveys which took place in June and July 2001, streamflow was extremely low in most streams. The loss of surface flow during the hottest months is not unusual in the central California coast region, and the vast majority of streams in this area are intermittent (dry for part of the year). However, low summer flows can be a significant limiting factor for the steelhead fishery. If pools become isolated, water quality can degrade rapidly due to increased water temperature or reduced levels of dissolved oxygen. The presence of large algae blooms or decaying leafy material will often lead to lethal conditions for steelhead. Additionally, shallow pools make it easier for predators such as birds to capture young steelhead.

Within the northern Napa River watershed, steelhead have evolved with low flow conditions and populations likely vary from year to year based on seasonal rainfall patterns. This delicate balance is sensitive to human activity, and reductions in flow of one cfs or less can have severe impacts during extended dry periods and especially multi-year droughts. Reduced streamflows affect the most productive habitat, riffles, forcing surface flow to disappear completely. Without riffles, aquatic insect populations decline sharply and juvenile steelhead feeding is reduced as a result.

Water diversions during summer low flow conditions, when the stream is most vulnerable, have a direct impact on fish. Historical accounts from the 1940's and 1950's of northern watershed streams (CDFG, USFWS, CDF) describe the seasonal drying of Garnett Creek, Simmons Creek, and others. However, it is not evident that they dried to the same extent that is currently seen. In spite of the fact that seasonal loss of surface flow may be a natural event, the addition of several other stressors to the ecosystem has made this a critical limiting factor to steelhead production. The reduction of shading provided by riparian canopy combined with lack of sufficient pool cover create a very unforgiving setting for juvenile steelhead in pools with little flow.

5.3 Stream Temperature

In general, summer water temperatures for the surveyed streams exceeded the stress threshold of 68˚F for salmonids, and temperature appears to be a problem throughout the study area. Although no continuous monitoring efforts were made, every pool habitat unit was measured during the summer months (June-July). Additional monitoring that continued through the year was conducted in the water quality monitoring program discussed in section 9.0 of this report. The extensive use of automated data loggers in these streams would give a clearer picture of the role temperature plays as a limiting factor in the northern watershed.

Temperatures within streams of the northern Napa River watershed are adequate to support steelhead, but the full temperature regime does not appear to be optimal. Preferred temperatures for juvenile steelhead range between 55˚F and 61˚F. Different optimal temperature ranges have been offered by several researchers, but most agree that the upper limit for steelhead is between 65˚F and 70˚F.

The typical diurnal cycle of warmer water during the afternoon and cooler water during the night and morning has been studied in the streams of the northern watershed. CDFG has documented this cycle in Garnett Creek, Ritchey Creek, and Mill Creek using data loggers in the 1990's. The magnitude of the diurnal range can have a significant impact on aquatic organisms and especially steelhead. Deeper pools tend to have cooler water temperatures and provide greater thermal buffering (reduced temperature fluctuations) than shallow pools. Other factors including springs, groundwater upwelling, and presence of warm-water thermal springs can influence water temperatures. Elevated water temperatures and larger diurnal temperature fluctuations require more abundant food resources for fish survival due to the increase in metabolic rate.

5.4 Sediment

The extensive geomorphology study done by Stillwater Science, included in section 7.0 of this report, goes into greater detail than the limited field assessments done for embeddedness during the stream surveys. Embeddedness ratings were visually estimated using random cobble and gravel from the streambed to get an approximate percentage. Overall, the northern watershed appears to be moderately impacted by fine sediments being deposited within the streams based on these rough estimates, but these preliminary measurements are not sufficient to draw broad conclusions from. More extensive mapping of sediment sources within each individual sub-watershed is necessary to get a complete account of sediment delivery sources and the amount of fine sediment within the streams themselves.

The deposition of fine sediment into streams of the northern watershed is undoubtedly harmful to both fish and aquatic insect populations based on habitat requirements discussed in previous sections. However, the degree to which sedimentation is damaging steelhead habitat in relation to other environmental factors appears to be less. Measurements taken on pool infilling (V*) showed very low impact from sediment in all streams measured. A total of nine reaches within all seven surveyed streams were measured and all were in the less-than-5% category. This suggests that sediment deposition within pools does not appear to be a major limiting factor for steelhead within the northern Napa River watershed. Additionally, sediment does not appear to play a large role in the reduction of pool frequency and quality within these streams.

5.5 Riparian Canopy

Canopy densities were quantified throughout the stream surveys using spherical densiometers to get percentage of cover per measured habitat unit. All streams combined had an average canopy density of 72%, which is generally good since 80% is the desirable percentage for salmonid streams (Flossi et al., 1998). Granted, not all streams had sufficient canopies including the Napa River with only 59% and Cyrus Creek with 62%. In fact, only one surveyed stream, Ritchey Creek in Bothe State Park, had a canopy density greater than 80%.

Riparian trees and their associated canopy are vital to fish and wildlife within the northern watershed streams, and their value should not be understated. Streams with a deficient canopy are far less likely to support large steelhead populations for several interconnected reasons discussed in section 4.0. Trees within the riparian corridors of the northern watershed should be preserved wherever possible to maintain critical biological and physical processes in the stream.

Increasing the amount of trees within the lower reaches of all streams would benefit the steelhead fishery as a whole by improving migration corridors with more cover, shade, and hydraulic complexity. All of the streams within the northern watershed appear to have insufficient canopy densities in the lower reaches to some degree, likely due to residential and agricultural development. The upper reaches are in better condition, but they would still be greatly enhanced by the addition of more riparian tree cover.

5.6 Migration Barriers

Any barrier that prevents or hinders steelhead from reaching spawning habitat or out- migrating to the ocean should be considered for removal or modification. Reach-specific barriers found during stream surveys are discussed in the individual stream reports. All possible migration barriers were noted and locations were associated with habitat unit numbers for future reference and project implementation.

Although several manmade and natural barriers were identified during the course of this study, observed barriers to steelhead migration both upstream and downstream do not appear to be a major limiting factor within the streams of the northern Napa River watershed overall. This is not however the case for the entire Napa River basin as recently documented in the Napa River TMDL study. The TMDL found that the majority of streams in the northern watershed are relatively unobstructed by permanent barriers. However, multiple road crossings do exist throughout the northern streams with the vast majority containing culverts. Some of these culverts undoubtedly pose a potential migration barrier for at least part of the year. More extensive field surveys are needed to identify and prioritize all barriers, including passive culverts, within the northern watershed.

The extensive dry reaches that dominate the lower portions of many streams during early spring present an impassable obstacle for smolts and late spawning adults. Improvements to the lower reaches of all streams through revegetation, riparian tree planting, and the addition of deeper pools would reduce the impacts from these long, dry expanses.

5.7 Conclusions

The northern Napa River watershed is being impacted by a wide array of factors that, in combination, have severely impaired populations of steelhead within its many streams. The habitat provided by streams of the northern watershed is greatly deficient to support large and sustainable populations of steelhead trout. Habitat enhancement and restoration should be actively pursued in the northern watershed to increase the amount of suitable steelhead habitat.

Recommendations for each stream are given in the individual stream reports, and after the streams are dynamically segmented additional reach-specific information will be available.

Historical and recent documentation of fish distribution and densities have established the northern watershed streams as important steelhead habitat. Improvements to this area would likely increase the overall steelhead population within the Napa River system. Ritchey Creek, Mill Creek, and Dutch Henry Creek appear to have significant populations of steelhead and need to be closely monitored to ensure the wellbeing of the fishery. Ongoing fish surveys of these critical streams are recommended.

Most northern watershed streams are highly intermittent with low flows and small isolated pools during summer. These types of streams are more sensitive to impacts from human activity than perennial streams. Further study is needed to determine minimum flow rates during the critical summer months and the effects on juvenile steelhead growth.

A lack of suitable habitat for rearing and overwintering steelhead, particularly the lack of adequate pools, is a major limiting factor to the fishery. Pool enhancement projects should be undertaken throughout the watershed. Additionally, bioengineered structures such as rock weirs and tree revetments can be used in conjunction with stream bank stabilization methods to improve habitat and decrease sediment load.

All streams surveyed had relatively little LWD which is likely a major contributing factor for the deficiency of pools within streams.

The relatively small number of pools within the watershed are lacking complexity and cover. The addition of LWD in key locations would greatly enhance much of the available juvenile rearing habitat. Riparian tree planting would also greatly enhance pool habitat and provide a long term source of wood and leafy organic material.

Migration barriers do not appear to be a major limiting factor within the northern watershed, however more extensive surveys of road crossings and culverts are needed to verify these initial observations. The dry lower reaches of most streams presents a significant barrier both to smolts and outmigrating adults. Flows in these lower reaches should be accurately monitored to determine the exact timing of seasonal drying and the potential impacts on the steelhead fishery.

The availability and quality of spawning gravel and the impacts of sediment within the northern watershed should be closely monitored to detect changes in gravel permeability and pool filling. Fine sediment levels appear to be at a threshold that, if exceeded, may have severe impacts on steelhead egg and fry survivability.

Very little is known about the full water temperature regime of northern watershed streams, but measurements taken during this survey document elevated temperatures throughout most reaches. A water temperature monitoring study should be done to document seasonal and daily fluctuations as well as specific reaches within streams that are being most impacted.

6.0 STREAM REPORTS

6.1 Cyrus Creek

HABITAT INVENTORY REPORT

CYRUS CREEK

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

WATERSHED OVERVIEW

Cyrus Creek is a tributary to the Napa River which flows to San Pablo Bay (Map 1). Cyrus Creek is located in Napa County, California. The legal description for Cyrus Creek at the confluence with the Napa River is T8N R7W S2. Its location is 38˚ 34' 11"north latitude and 122˚ 35' 11" west longitude. Cyrus Creek is a second order stream and has approximately 0.68 miles of blue line stream according to the USGS Calistoga 7.5 minute quadrangle. Cyrus Creek drains a watershed of approximately 3.17 square miles. Elevations range from approximately 400 feet at the confluence to 1000 feet in the headwaters area. The upper section of the watershed has good cover from oak and laurel trees. The middle section of Cyrus Creek, near Hwy. 128, has little riparian canopy and consists largely of grass and low woody plants. The stream has a heavy cover of oak, laurel, and alder near the confluence with the Napa River. The watershed is owned primarily by private landowners and vehicle access exists along Petrified Forest Road and Hwy 128.

HABITAT INVENTORY RESULTS

The habitat inventory of Cyrus Creek, 6/2/2001 - 6/28/2001, was conducted by A. Rowser and V. Gekov with supervision and analysis by the Napa County Resource Conservation District (RCD) staff and the California Department of Fish and Game (DFG). The survey began at the confluence with the Napa River and extended up Cyrus Creek until flow diminished and fish were no longer present. The total length of stream surveyed was 8454 feet, with no additional feet of side channel.

Flows were not measured on Cyrus Creek during the course of this survey.

This section of Cyrus Creek has 6 reaches with 4 distinct channel types: from the mouth to 1632 feet a F4, 70 feet a F3, 2814 feet a F4, 1596 feet a B3, 1276 feet a B3G1 and 1066 feet a B3.

- F4 channel types are entrenched meandering riffle/pool channels on low gradients (<2%) with a high width/depth ratio and predominantly gravel substrate.
- F3 channel types are entrenched meandering riffle/pool channels on low gradients (<2%) with a high width/depth ratio and 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 predominantly cobble substrate.
- G1channel types are characterized as well entrenched "gully" step-pool channels with a low width/depth ratio, a moderate gradient (2-4%) and predominantly bedrock substrate.

Water temperatures ranged from 57ºF to 68ºF. Air temperatures ranged from 61ºF to 84ºF.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of *occurrence* there were 39.5% Pool units, 35.7% Riffle units, 14.0% Dry units and 9.6% Flatwater units **(Graph 1)**. Based on total *length* there were 31.2% Riffle units, 29.4% Dry units, 23.9% Pool units and 14.6% Flatwater units **(Graph 2)**.

A total of 158 habitat units were measured and 30% were completely sampled. Of these, 16 Level IV habitat types were identified. The data is summarized in **Table 2**. The most frequent habitat types by percent *occurrence* were Low Gradient Riffle at 33%, Mid-Channel Pool at 20%, Dry at 14%, Plunge Pool at 6%, Run at 5%, Step Run at 4%, Corner Pool at 4%, Step Pool at 3%, Lateral Scour Pool - Root Wad Enhanced at 3%, Lateral Scour Pool - Log Enhanced at 2%, High Gradient Riffle at 2%, Dammed Pool at 1%, Lateral Scour Pool - Boulder Formed at 1%, Glide at 1%, Backwater Pool - Root Wad Formed at 1% and Bedrock Sheet at 1% **(Graph 3)**. By percent total *length*, Dry at 29%, Low Gradient Riffle at 29%, Mid-Channel Pool at 11%, Step Run at 10%, Run at 4%, Step Pool at 3%, Corner Pool at 3%, High Gradient Riffle at 2%, Dammed Pool at 2%, Plunge Pool at 2%, Lateral Scour Pool - Root Wad Enhanced at 1%, Lateral Scour Pool - Log Enhanced at 1%, Lateral Scour Pool - Boulder Formed at 1%, Glide at 0%, Bedrock Sheet at 0% and Backwater Pool - Root Wad Formed at 0%.

In Cyrus Creek, 63 pools were identified **(Table 3)**. Mid-channel pools were most often encountered at 20%, and comprised 46% of the total length of pools **(Graph 4)**.

Table 4 is a summary of maximum pool depths by pool habitat types. Pool quality for salmonids increases with depth. In Cyrus Creek, 18 of the 63 pools (29%) had a depth of two feet or greater **(Graph 5)**. These deeper pools comprised 36% of the total length of stream habitat.

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 8, Riffles rated 4 and Pools rated 14 **(Table 1)**. Of the pool types, Dammed Pool rated 28, Lateral Scour Pool - Log Enhanced rated 27, Backwater Pool - Root Wad Formed rated 20, Lateral Scour Pool - Root Wad Enhanced rated 17, Lateral Scour Pool - Boulder Formed rated 15, Plunge Pool rated 14, Step Pool rated 13, Corner Pool rated 12 and Mid-Channel Pool rated 11 **(Table 3)**.

Table 5 summarizes fish shelter by habitat type. By percent area, the dominant pool shelter types were Boulders at 37%, Undercut Banks at 29%, Terrestrial Vegetation at 12%, Root Mass at 8%, Small Wood at 4%, Large Wood at 3%, Aquatic Vegetation at 3%, Bedrock at 2% and White Water at 0%.

Table 6 summarizes the dominant substrate by habitat type. In the 53 Low-Gradient Riffles surveyed, the dominant substrate was: Gravel in 4 riffles and Small Cobble in 3 riffles

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 65 pool tail-outs measured, 7 had a value of 1 (11%), 47 had a value of 2 (72%) and 11 had a value of 3 (17%). No 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 6** describes percent embeddedness by percent occurrence.
Fish observed during the survey included some 1+ year old and young-of-year steelhead in relatively small numbers. Other species noted were California Roach (*Hesperoleucus symmetricus*) and possible Sacramento Blackfish (*Orthodon microlepidontus*).

The mean percent canopy density for the stream reach surveyed was 62%. The mean percentages of deciduous and evergreen trees were 42% and 37%, respectively.

For the entire stream reach surveyed, the mean percent right bank vegetated was 40% and the mean percent left bank vegetated was 32%. For the habitat units measured, the dominant vegetation types for the stream banks were: 33% Brush, 26% Deciduous Trees, 13% Grass and 7% Evergreen Trees. The dominant substrate for the stream banks were: 39% Cobble & Gravel, 29% Silt, Clay & Sand, 6% Boulder and 3% Bedrock.

HISTORICAL SURVEY RESULTS

1964 January 17 – Weldon Jones of the CDFG surveyed Cyrus Creek from the confluence with the Napa River to a point approximately ¼ mile from the headwaters. He observed rainbow trout, cottids, and an unknown cyprinid species mostly in bedrock pools. The trout were in good condition and ranged in size from approximately 2.5-4 inches. The number of trout was approximately 5-8 per mile, and the total stream population was estimated to be 400 or less. No fish were sited in reaches below the Calistoga water supply reservoir.

DISCUSSION

Cyrus Creek has 6 reaches: The first 1632 feet is an F4 channel type, then 70 feet a F3, 2814 feet a F4, 1596 feet a B3, 1276 feet a B3G1 and 1066 feet a B3. The suitability of these channel types for fish habitat improvement structures is as follows.

- F4 channel types are good for bank-placed boulders and fair for low-stage weirs, single and opposing wing-deflectors, channel constrictors and log cover.
- 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.

- 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.
- G1 channel types are fair for log cover.

B and F Channel Types: Many site specific projects can be designed within this channel type, especially to increase pool frequency, volume and shelter.

F Channel Types: Any work considered will require careful design, placement, and construction that must include protection for any unstable banks.

B Channel Types: 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.

The water temperatures recorded on the survey days 6/2/2001 - 6/28/2001 ranged from 57º F to 68º F. Air temperatures ranged from 61º F to 84º F. These temperatures, if sustained, are above the threshold stress level (65°F) for salmonids. It is unknown if this thermal regime is typical, but 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.

A barrier to upstream fish migration is located at the Fiege Reservoir which has an approximately twelve foot high dam. The channel is directed around the dam, but it still presents a permanent barrier to spawning salmonids.

Pools comprised 24% 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 Cyrus Creek, the pools are relatively shallo**w** with 29% having a maximum depth of at least two feet. These pools comprised 36% of the total length of stream habitat. However, 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 14. 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 37%, undercut banks at 29%, terrestrial vegetation at 12%, root mass at 8%, small wood at 4%, large wood at 3%, aquatic vegetation at 3%, bedrock at 2% and white water at 0%.

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.

In Cyrus Creek, 7 of the 11 low gradient riffles measured (64%) had either gravel or small cobble as the dominant substrate. This is generally considered good for spawning salmonids.

In Cyrus Creek, 17% of the pool tail-outs measured had embeddedness ratings of either 3 or 4. Only 11% 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 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.

The mean percent canopy for the survey was 62%. This is a low percentage of canopy, since 80 percent is generally considered desirable. Cooler water temperatures are desirable in Cyrus 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. Cyrus Creek would also benefit from increased pool shelter from large woody debris. However, the riparian buffer is thin or absent in several areas along the stream. Riparian removal or vineyard development within the riparian corridor could lead to less stream canopy and channel incision causing bank erosion and higher water temperatures.

RECOMMENDATIONS

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

2) Remove or modify the barrier at Fiege Reservoir to allow for upstream fish passage. This should be given high priority since it is located relatively low on the stream, and completely blocks migrating steelhead from reaching good spawning habitat above the barrier.

3) Where feasible, design and engineer pool enhancement structures to increase the number of pools. Cyrus Creek has a very low percentage of pools along its length which is a major limiting factor for viable steelhead populations. Many reaches of the stream have desirable channel types for one or more pool enhancing structures as discussed above.

4) Bank stabilization through increased vegetation should be implemented in several reaches to prevent further erosion, reduce the sediment load into the stream, and provide a more extensive riparian buffer zone. This may include planting native plants, or the use of bioengineered erosion control structures in appropriate areas. Varying degrees of bank erosion and channel incision were present along much of the stream’s length.

5) Increase the riparian canopy by planting native trees. This will provide shade, reduce water temperatures, and create a greater supply of large woody debris to improve pool habitat quality.

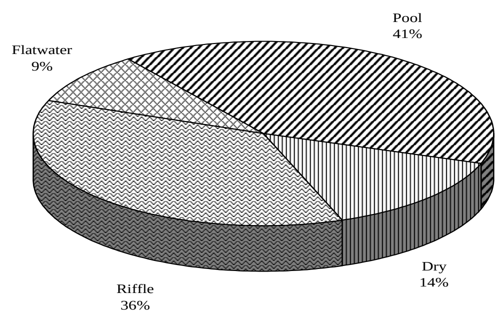
6) The limited water temperature data suggests that Cyrus Creek's maximum temperatures exceed the acceptable range for juvenile salmonids. In order for more meaningful conclusions about the stream's temperature regime, 24 hour temperature monitoring should be done during June through September for several years.

COMMENTS AND LANDMARKS

The following landmarks and possible problem sites were noted during the survey. All distances are approximate and taken from the beginning of the survey reach. These have been filed in electronic and paper format and are available upon request from the Napa RCD.

CYRUS CREEK

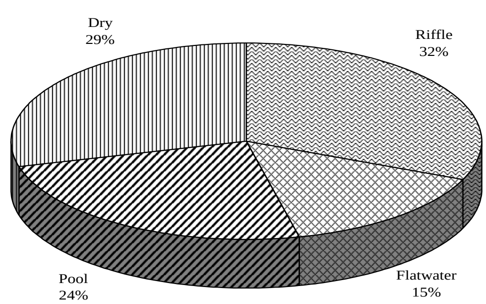
HABITAT TYPES BY PERCENT OCCURRENCE



GRAPH 1

CYRUS CREEK

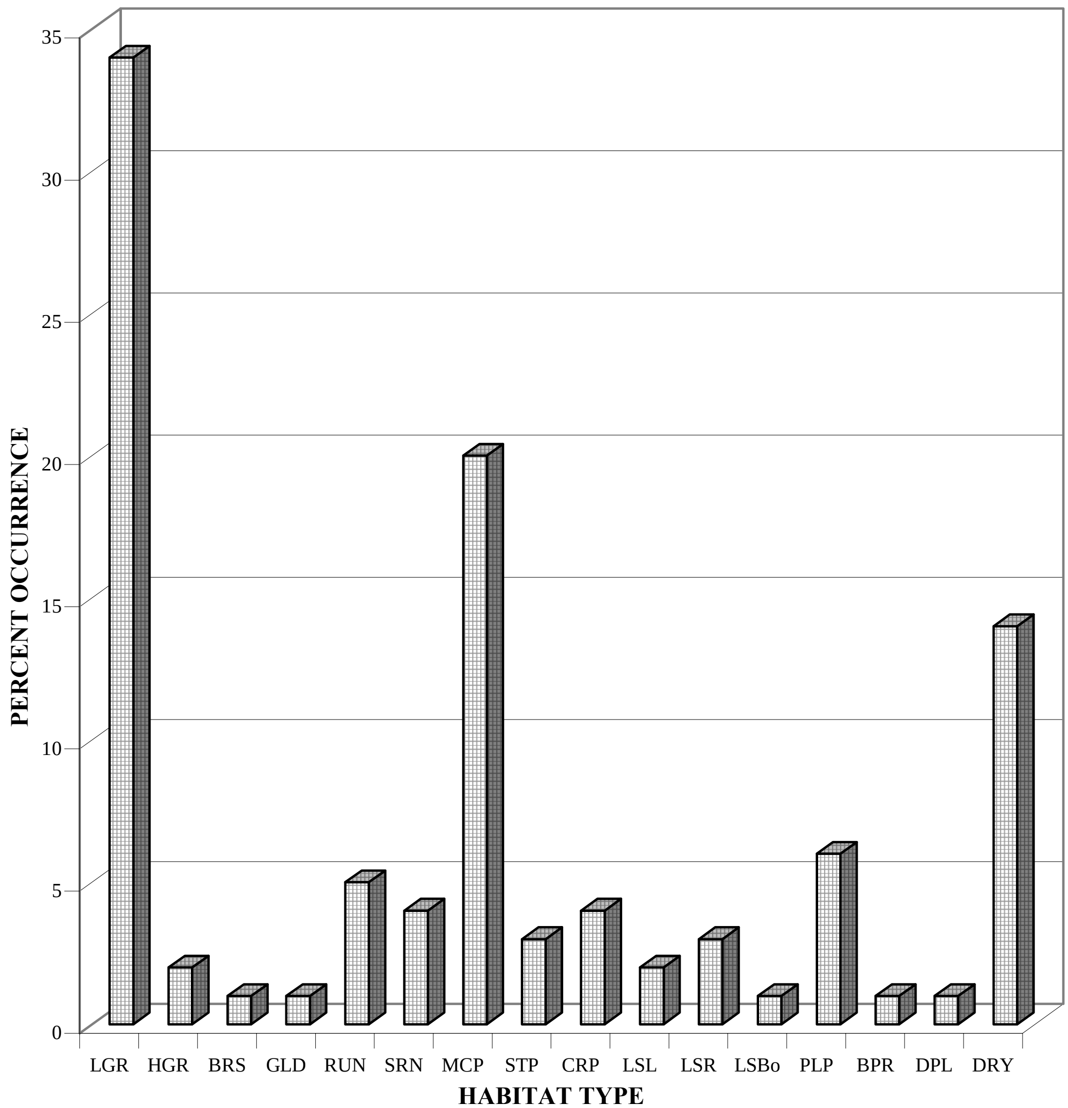
HABITAT TYPES BY PERCENT TOTAL LENGTH



GRAPH 2

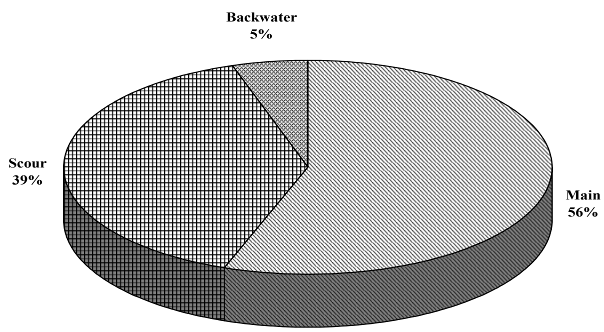
CYRUS CREEK

HABITAT TYPE BY PERCENT OCCURRENCE



GRAPH 3

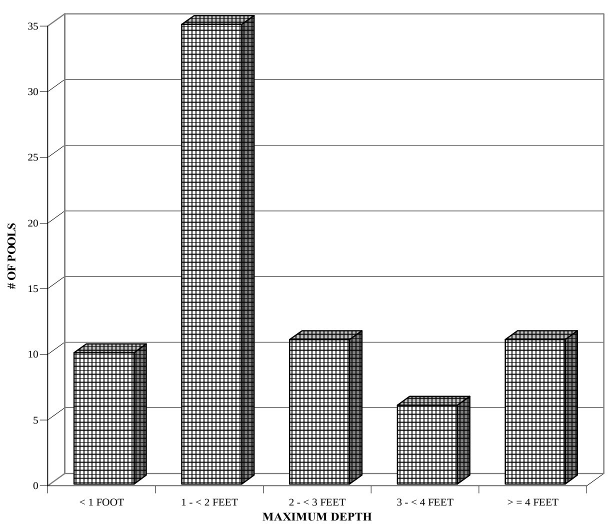
POOL HABITAT TYPES BY PERCENT OCCURRENCE



GRAPH 4

CYRUS CREEK

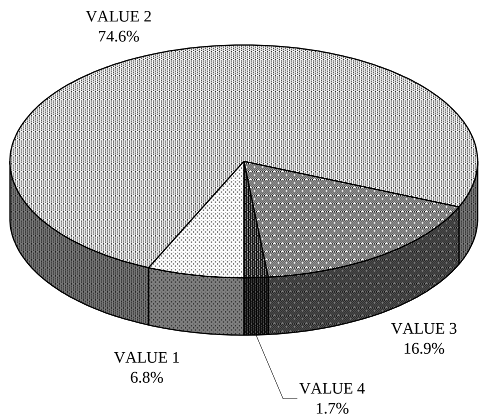
MAXIMUM POOL DEPTHS



GRAPH 5

CYRUS CREEK

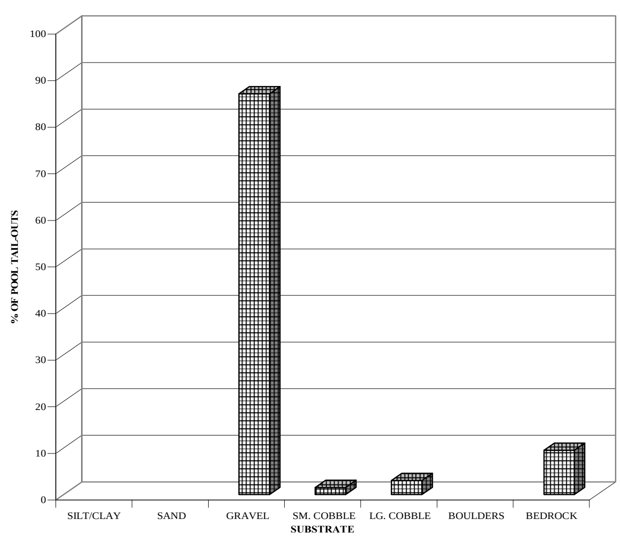
PERCENT EMBEDDEDNESS



GRAPH 6

CYRUS CREEK

SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



GRAPH 8

6.2 Diamond Mt. Creek

HABITAT INVENTORY RESULTS

DIAMOND MT. CREEK

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

WATERSHED OVERVIEW

Diamond Mt. Creek is located in Napa County, California and is a tributary to the Napa River which flows to San Pablo Bay (Map 1). The legal description for Diamond Mt. Creek at the confluence with the Napa River is T8N R6W S Carne Humana Ranchero. Its location is 38˚ 34' 10" north latitude and 122˚ 33' 25" west longitude. Diamond Mt. Creek is a second order stream and has approximately 0.29 miles of blue line stream according to the USGS Calistoga 7.5 minute quadrangle. Diamond Mt. Creek drains a watershed of approximately 4.35 square miles. Elevations range from approximately 300 feet at the confluence to approximately 1700 feet in the headwaters area. The watershed is owned primarily by private landowners, and vehicle access exists along Hwy 128/29 near Dunaweal Lane.

HABITAT INVENTORY RESULTS

The habitat inventory of Diamond Creek, 6/18/2001 - 6/20/2001, was conducted by R. Ananael, A. Rowser and V.Gekov, with supervision and analysis by the Napa County Resource Conservation District (RCD) staff and the California Department of Fish and Game (DFG). The survey began approximately 2000 feet upstream of the confluence with the Napa River and extended up Diamond Creek until flow diminished and the stream was dry. The survey did not start at the confluence with the Napa River due to access complications with the landowner. The total length of stream surveyed was 9247 feet, with no additional feet of side channel.

Flows were not measured on Diamond Creek.

This section of Diamond Creek has 4 reaches with 3 distinct channel types: from the mouth to 1215 feet a G2, 2260 feet a F4, 4658 feet a G2 and 1114 feet a G4.

- 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.

- F4 channel types are entrenched meandering riffle/pool channels on low gradients (<2%) with a high width/depth ratio and a predominantly gravel substrate.

- G4 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 gravel substrate.

Water temperatures ranged from 50º F to 66º F. Air temperatures ranged from 70º F to 89º F.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of *occurrence* there were 53.5% Pool units, 26.8% Dry units and 19.7% Riffle units **(Graph 1)**. Based on total *length* there were 66.4% Dry units, 22.7% Pool units and 10.9% Riffle units **(Graph 2)**.

A total of 74 habitat units were measured and 31% were completely sampled. 15 Level IV habitat types were identified. The data is summarized in **Table 2**. The most frequent habitat types by percent *occurrence* were Dry at 24%, Mid-Channel Pool at 18%, Step Pool at 12%, Low Gradient Riffle at 9%, High Gradient Riffle at 9%, Lateral Scour Pool - Root Wad Enhanced at 5%, Not Surveyed at 4%, Lateral Scour Pool - Bedrock Formed at 4%, Dammed Pool at 4%, Plunge Pool at 3%, Lateral Scour Pool - Boulder Formed at 1%, Corner Pool at 1% and Backwater Pool - Log Formed at 1% **(Graph 3)**. By percent total *length*, Dry at 47%, Not Surveyed at 28%, Step Pool at 9%, High Gradient Riffle at 6%, Mid-Channel Pool at 4%, Low Gradient Riffle at 2%, Lateral Scour Pool - Root Wad Enhanced at 1%, Lateral Scour Pool - Bedrock Formed at 1%, Dammed Pool at 0%, Corner Pool at 0%, Plunge Pool at 0%, Lateral Scour Pool - Boulder Formed at 0% and Backwater Pool - Log Formed at 0%.

In Diamond Mt. Creek, 38 pools were identified **(Table 3)**. Mid-Channel Pool pools were most often encountered at 18%, and comprised 26% of the total length of pools **(Graph 4)**.

Table 4 is a summary of maximum pool depths by pool habitat types. Pool quality for salmonids increases with depth. In Diamond Creek, 3 of the 38 pools (8%) had a depth of two feet or greater **(Graph 5)**. These deeper pools comprised 7% of the total length of stream habitat.

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. Riffles rated 5 and Pools rated 22 **(Table 1)**. Of the pool types, Lateral Scour Pool - Root Wad Enhanced rated 31, Plunge Pool rated 30, Mid-Channel Pool rated 25, Lateral Scour Pool - Bedrock Formed rated 25, Lateral Scour Pool - Boulder Formed rated 20, Corner Pool rated 20, Step Pool rated 16, Dammed Pool rated 15 and Backwater Pool - Log Formed rated 10 **(Table 3)**.

Table 5 summarizes fish shelter by habitat type. By percent area, the dominant pool shelter types were Boulders at 45%, Undercut Banks at 36%, Terrestrial Vegetation at 7%, Root Mass at 4%, Bedrock at 4%, Small Wood at 2%, Large Wood at 1%, White Water at 0% and Aquatic Vegetation at 0%.

Table 6 summarizes the dominant substrate by habitat type.

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 38 pool tail-outs measured, 9 had a value of 1 (24%), 23 had a value of 2 (61%) and 6 had a value of 3 (16%). No riffles rated a 5 (unsuitable substrate type for spawning). On this scale, a value of one is best for fisheries. **Graph 6** describes percent embeddedness by reach. Gravel was the dominant substrate observed at pool tail-outs **(Graph 8)**.

Steelhead were the only fish species observed in all reaches of Diamond Mt. Creek. The majority of fish were young-of-year (yoy) with some 1+ year old and 2+ year old size classes observed. One adult fish was sited in the lower reach and estimated to be approximately 16 inches in length.

The mean percent canopy density for the stream reach surveyed was 73%. The mean percentages of deciduous and evergreen trees were 47% and 53%, respectively. **Graph 9** describes the canopy for the entire survey.

For the entire stream reach surveyed, the mean percent right bank vegetated was 49% and the mean percent left bank vegetated was 59%. For the habitat units measured, the dominant vegetation types for the stream banks were: 35% Brush, 33% Deciduous Trees, 15% Evergreen Trees, 13% Grass and 4% Bare Soil **(Graph 11)**. The dominant substrate for the stream banks were: 46% Cobble & Gravel, 26% Silt, Clay & Sand, 17% Boulder and 11% Bedrock **(Graph 10)**.

HISTORICAL SURVEY RESULTS

No historical habitat surveys or biological inventories could be found for Diamond Mt. Creek with the CDFG or local agencies.

DISCUSSION

Diamond Creek has 4 reaches: The first 1215 feet is a G2channel type, then 2260 feet a F4, 4658 feet a G2 and 1114 feet a G4.

- G2 channel types are fair for log cover.

- G4 channel types are good for bank-placed boulders and fair for low-stage weirs, opposing wing-deflectors and log cover.

- F4 channel types are good for bank-placed boulders and fair for low-stage weirs, single and opposing wing-deflectors, channel constrictors and log cover.

F Channel Types:

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.

A fish migration barrier is located at a cement reservoir located within Diamond Creek on a vineyard property in reach 3. The stream is channelized below the dam's spillway, and is contained by cement and rock lined walls. No young-of-year steelhead were observed above the reservoir, which suggests that the dam presents a permanent barrier to spawning fish. The reach above the reservoir is very suitable spawning habitat.

The water temperatures recorded on the survey days 6/18/2001 - 6/20/2001 ranged from 50ºF to 66ºF. Air temperatures ranged from 70ºF to 89ºF. These temperatures, if sustained, slightly exceed the threshold stress level (65°F) for salmonids. It is unknown if this thermal regime is typical, but 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 16% 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 Diamond Creek, the pools are relatively shallow with only 8% having a maximum depth of at least two feet. These pools comprised 7% of the total length of stream habitat. However, 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 22. 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 45%, Undercut Banks at 36%, Terrestrial Vegetation at 7%, Root Mass at 4%, Bedrock at 4%, Small Wood at 2%, Large Wood at 1%, White Water at 0% and Aquatic Vegetation at 0%.

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.

In Diamond Mt. Creek, 16% of the pool tail-outs measured had embeddedness ratings of either 3 or 4. Only 24% 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 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.

The mean percent canopy for the survey was 73%. This is fair, since 80 percent is generally considered desirable. Overall, the stream would benefit from increasing the amount of trees in the riparian area.

RECOMMENDATIONS

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

2) If feasible, modify the reservoir located on vineyard property to allow for fish passage. This might be accomplished by lowering the spillway elevation and creating a pool beneath with adequate depth for leaping. A fish ladder would be another possible solution.

3) Where feasible, design and engineer pool enhancement structures to increase the number of pools. Diamond Mt. Creek has a very low percentage of pools which are a critical habitat for juvenile steelhead. The reach of Diamond Mt. Creek with a F4 channel type is especially well suited for increasing pool frequency.

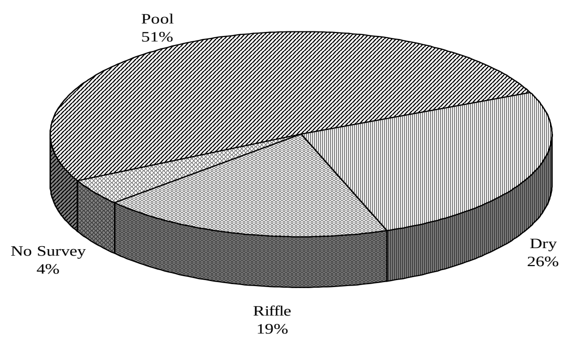
4) The limited water temperature data suggests that Diamond Mt. Creek's maximum temperatures exceed the acceptable range for juvenile salmonids. In order for more meaningful conclusions about the stream's temperature regime, 24 hour temperature monitoring should be done during June through September for several years.

COMMENTS AND LANDMARKS

The following landmarks and possible problem sites along Diamond Mt. Creek were noted during the survey. All distances are approximate and taken from the beginning of the survey reach. These have been filed in electronic and paper format and are available upon request from the Napa RCD.

DIAMOND MT. CREEK

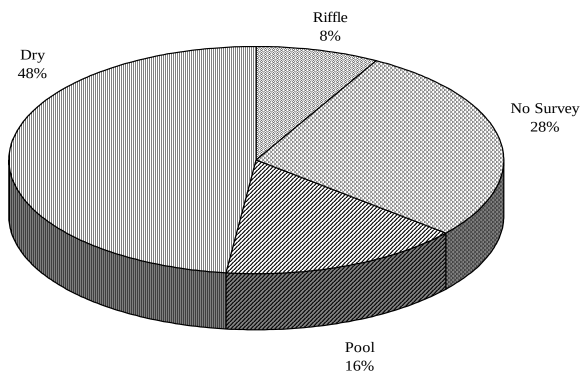
HABITAT TYPES BY PERCENT OCCURRENCE



GRAPH 1

DIAMOND MT. CREEK

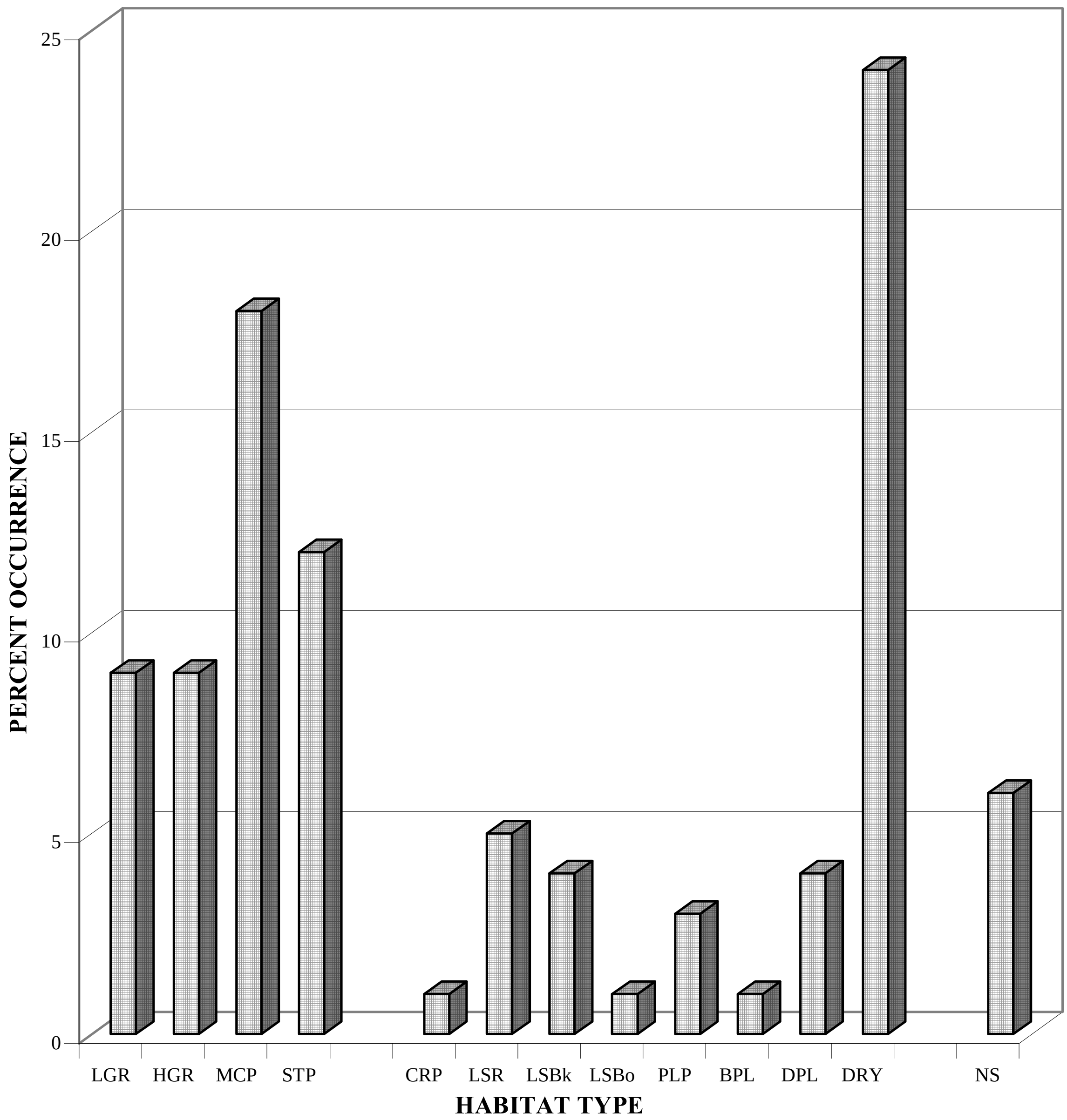
HABITAT TYPES BY PERCENT TOTAL LENGTH



GRAPH 2

DIAMOND MT. CREEK

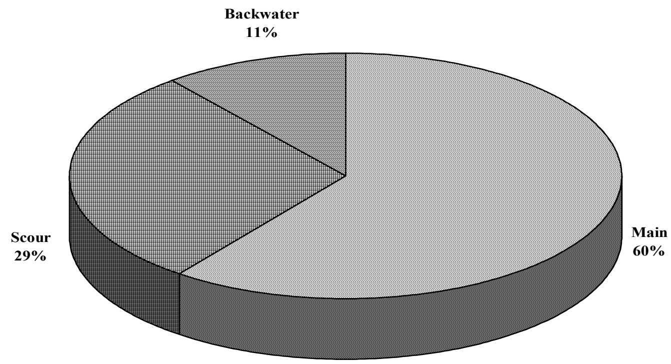
HABITAT TYPE BY PERCENT OCCURRENCE



GRAPH 3

DIAMOND MT. CREEK

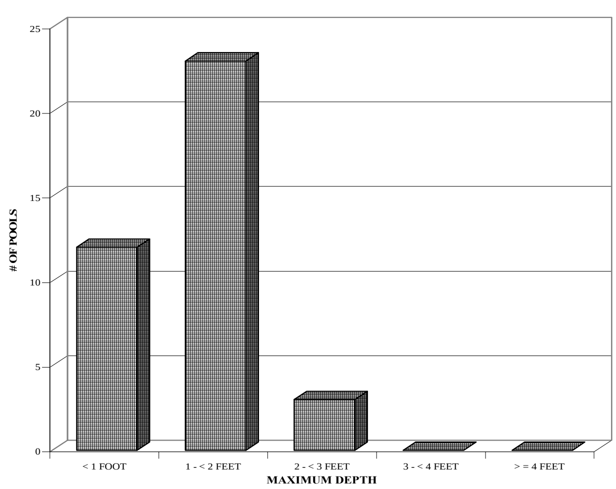
POOL HABITAT TYPES BY PERCENT OCCURRENCE



GRAPH 4

DIAMOND MT. CREEK

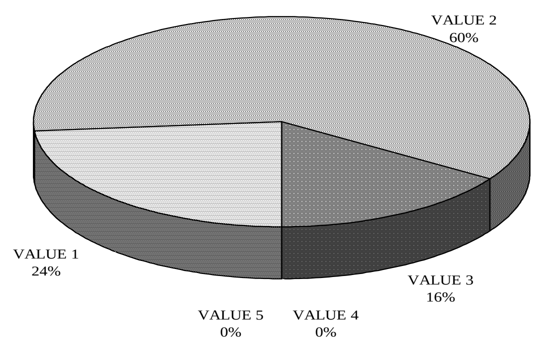
MAXIMUM POOL DEPTHS



GRAPH 5

DIAMOND MT. CREEK

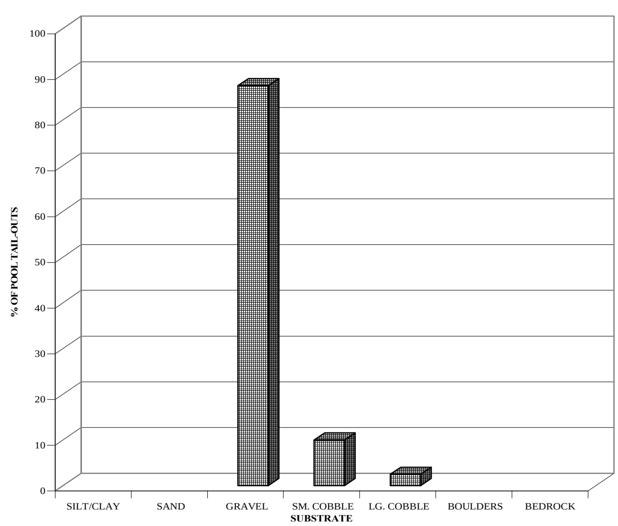
PERCENT EMBEDDEDNESS



GRAPH 6

DIAMOND MT. CREEK

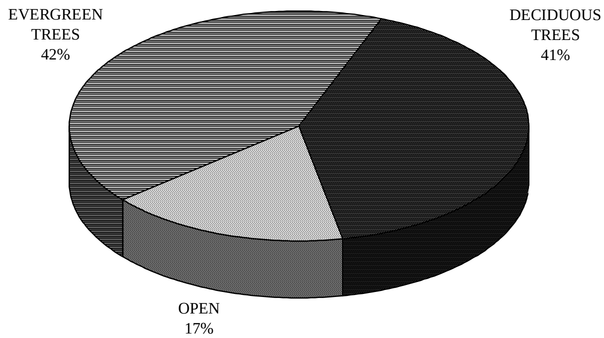
SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



GRAPH 8

DIAMOND MT. CREEK

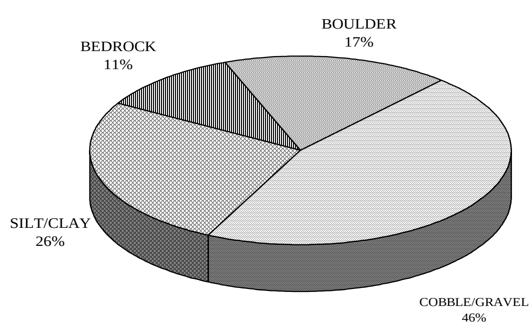
PERCENT CANOPY



GRAPH 9

DIAMOND MT. CREEK

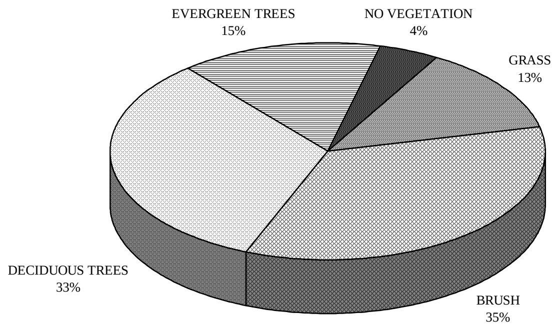
DOMINANT BANK COMPOSITION IN SURVEY REACH



GRAPH 10

DIAMOND MT. CREEK

DOMINANT BANK VEGETATION IN SURVEY REACH



GRAPH 11

6.3 Dutch Henry Creek

HABITAT INVENTORY REPORT

DUTCH HENRY CREEK

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

WATERSHED OVERVIEW

Dutch Henry Creek is located in Napa County, California and is a tributary to the Napa River which flows to San Pablo Bay (Map 1). The legal description for Dutch Henry Creek at the confluence with the Napa River is T8N R6W S-Carne Humana. Its location is 38˚ 33' 10" north latitude and 122˚ 30' 21" west longitude. Dutch Henry Creek is a second order stream and has approximately 4.9 miles of blue line stream according to the USGS Calistoga 7.5 minute quadrangle. Dutch Henry Creek drains a watershed of approximately 5.8 square miles. Elevations range from approximately 240 feet at the confluence to about 2,280 feet in the headwaters area. The upper section flows intermittently in a steep-walled canyon with a fair cover of conifer and brush. As the stream drops in elevation, the canopy becomes patchy, consisting of oak, alder, willow, and bay with long open stretches in between. After Dutch Henry Creek crosses the Silverado Trail, the stream channel is mostly open and shallow for the remaining distance to the confluence; there are a few reaches with good canopy and bank cover, but most are relatively short and sparse. The watershed is owned primarily by private landowners, but road access exists along the Silverado Trail, Larkmead Lane, and a small road that fronts the stream from the Silverado Trail to the headwaters area.

HABITAT INVENTORY RESULTS

The habitat inventory of Dutch Henry Creek, 6/12/2001 - 6/19/2001, was conducted by A.Rowser, V.Gekov, M.Philips with supervision and analysis by Napa Resource Conservation District (RCD) staff and the California Department of Fish and Game (DFG). The survey began at the confluence with the Napa River, and extended up Dutch Henry Creek until flow diminished and the channel was dry for 500+ feet. The total length of stream surveyed was 5521 feet, with an additional 245 feet of side channel.

This section of Dutch Henry Creek has 3 reaches with 3 distinct channel types: from the mouth to 3146 feet a B3, 1580 feet a B2 and 795 feet a A2.

- 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.

- 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.

Flows were not measured on Dutch Henry Creek.

Water temperatures ranged from 50 ºF to 63 ºF. Air temperatures ranged from 67º F to 91º F.

Fish were observed in all reaches of Dutch Henry Creek. Several 1+ and 2+ year old Steelhead were seen, but the majority were young-of- year (yoy). Other species included two native cyprinid species, California Roach (*Hesperoleucus symmetricus*) and Pikeminnow (*Ptychocheilus grandis*), and an unidentified bass species.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of *occurrence* there were 51.9% Pool units, 28.4% Dry units, 13.6% Riffle units and 6.2% Flatwater units **(Graph 1)**. Based on total *length* there were 45.1% Pool units, 39.7% Dry units, 10.2% Riffle units and 5.0% Flatwater units **(Graph 2)**.

A total of 81 habitat units were measured and 33% were completely sampled. Of these, 12 Level IV habitat types were identified. The data is summarized in **Table 2**. The most frequent habitat types by percent *occurrence* were Dry at 28%, Mid-Channel Pool at 21%, Step Pool at 16%, Low Gradient Riffle at 12%, Lateral Scour Pool - Root Wad Enhanced at 6%, Glide at 4%, Corner Pool at 4%, Run at 2%, Plunge Pool at 2%, Lateral Scour Pool - Log Enhanced at 1%, Lateral Scour Pool - Bedrock Formed at 1% and High Gradient Riffle at 1% **(Graph 3)**. By percent total *length*, Dry at 40%, Step Pool at 27%, Mid-Channel Pool at 11%, Low Gradient Riffle at 10%, Glide at 4%, Lateral Scour Pool - Root Wad Enhanced at 3%, Corner Pool at 1%, Run at 1%, Lateral Scour Pool - Log Enhanced at 1%, Lateral Scour Pool - Bedrock Formed at 1%, High Gradient Riffle at 1% and Plunge Pool at 0%.

In Dutch Henry Creek, 42 pools were identified **(Table 3)**. Mid-Channel Pool pools were most often encountered at 21%, and comprised 25% of the total length of pools **(Graph 4)**.

Table 4 is a summary of maximum pool depths by pool habitat types. Pool quality for salmonids increases with depth. In Dutch Henry Creek, 11 of the 42 pools (26%) had a depth of two feet or greater **(Graph 5)**. These deeper pools comprised 20% of the total length of stream habitat.

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. Pools rated 29, Flatwater units rated 17 and Riffles rated 15 **(Table 1)**. Of the pool types, Corner Pool rated 83, Lateral Scour Pool - Log Enhanced rated 40, Lateral Scour Pool - Root Wad Enhanced rated 32, Mid-Channel Pool rated 24, Step Pool rated 17, Lateral Scour Pool - Bedrock Formed rated 10 and Plunge Pool rated 5 **(Table 3)**.

Table 5 summarizes fish shelter by habitat type. By percent area, the dominant pool shelter types were Boulders at 32%, Aquatic Vegetation at 21%, Root Mass at 12%, Small Wood at 10%, Terrestrial Vegetation at 9%, Undercut Banks at 7%, Bedrock at 3%, Large Wood at 3% and White Water at 3%.

Table 6 summarizes the dominant substrate by habitat type. In the 10 Low-Gradient Riffles surveyed, the dominant substrate was: Small Cobble in 1 riffles and Gravel in 1 riffles (Graph 6).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 25 pool tail-outs measured, 7 had a value of 1 (28%), 14 had a value of 2 (56%), 1 had a value of 3 (4%) and 1 had a value of 4 (4%). 2 (8%) 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 6** describes percent embeddedness by reach.
The mean percent canopy density for the stream reach surveyed was 71%. The mean percentages of deciduous and evergreen trees were 61% and 38%, respectively. **Graph 9** describes the canopy for the entire survey.

For the entire stream reach surveyed, the mean percent right bank vegetated was 54% and the mean percent left bank vegetated was 56%. For the habitat units measured, the dominant vegetation types for the stream banks were: 38% Brush, 32% Deciduous Trees, 17% Evergreen Trees and 8% Grass **(Graph 11)**. The dominant substrate for the stream banks were: 55% Cobble & Gravel, 26% Silt, Clay & Sand, 9% Boulder and 4% Bedrock **(Graph 10)**.

HISTORICAL SURVEY RESULTS

No historical habitat surveys or biological inventories could be found for Dutch Henry Creek with the CDFG or other agencies.

DISCUSSION

Dutch Henry Creek has 3 reaches: The first 3146 feet is a B3 channel type, then 1580 feet a B2 and 795 feet a A2. According to the DFG Salmonid Stream Habitat Restoration Manual, the suitability for fish habitat improvement structures within these channel types is as follows:

- 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.

- B2 channel types are excellent for low and medium-stage plunge weirs, single and opposing wing deflectors and bank cover.

- 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.

B Channel Types:
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.

The water temperatures recorded on the survey days 6/12/2001 - 6/19/2001 ranged from 50º F to 63º F. Air temperatures ranged from 67º F to 91º F. This temperature regime is favorable to salmonids. However, it is unknown if this thermal regime is typical. 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 45% 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 Dutch Henry Creek, the pools are relatively shallow with 26% having a maximum depth of at least two feet. These pools comprised 20% of the total length of stream habitat. However, 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 29. 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 32%, Aquatic Vegetation at 21%, Root Mass at 12%, Small Wood at 10%, Terrestrial Vegetation at 9%, Undercut Banks at 7%, Bedrock at 3%, Large Wood at 3% and White Water at 3%. 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.

In Dutch Henry Creek, 2 of the 2 low gradient riffles measured (100%) had either gravel or small cobble as the dominant substrate. This is generally considered good for spawning salmonids.

In the surveyed reach, 8% of the pool tail-outs measured had embeddedness ratings of either 3 or 4. Only 28% 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 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.

The mean percent canopy for the survey was 71%. This is good, since 80 percent is generally considered desirable. However, the riparian buffer is thin or nearly absent in areas with agriculture. Riparian removal and vineyard development within the riparian corridor could all lead to less stream canopy and channel incision causing bank erosion and higher water temperatures.

RECOMMENDATIONS

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

2) Where feasible, design and engineer pool enhancement structures to increase the number of pools. Dutch Henry Creek has a fairly low percentage of pools which provide critical habitat for juvenile steelhead. The majority of Dutch Henry Creek has a B channel type which is especially well suited for increasing pool frequency.

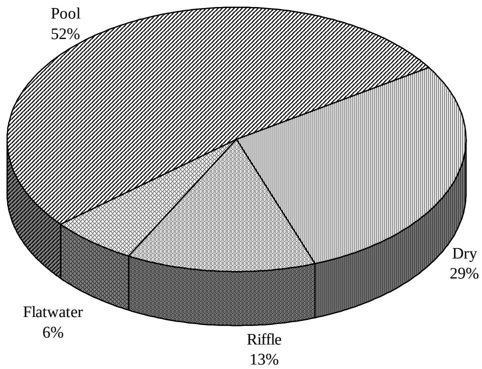
3) Increase woody cover in pool and flatwater habitat units. Most of the existing cover comes from boulders and aquatic vegetation. Adding woody cover to selected habitat units provides shelter in addition to creating complexity and increasing deposition of spawning gravel.

COMMENTS AND LANDMARKS

The following landmarks and possible problem sites along Dutch Henry Creek were noted during the survey. All distances are approximate and taken from the beginning of the survey reach. These have been filed in electronic and paper format and are available upon request from the Napa RCD.

DUTCH HENRY CREEK

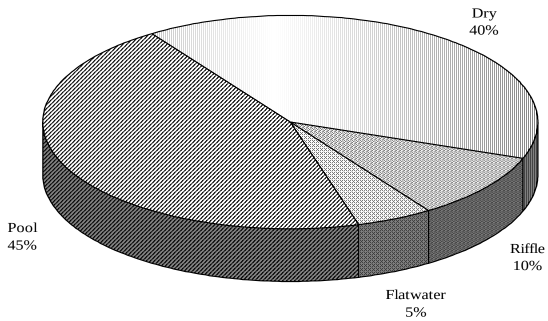
HABITAT TYPES BY PERCENT OCCURRENCE



GRAPH 1

DUTCH HENRY CREEK

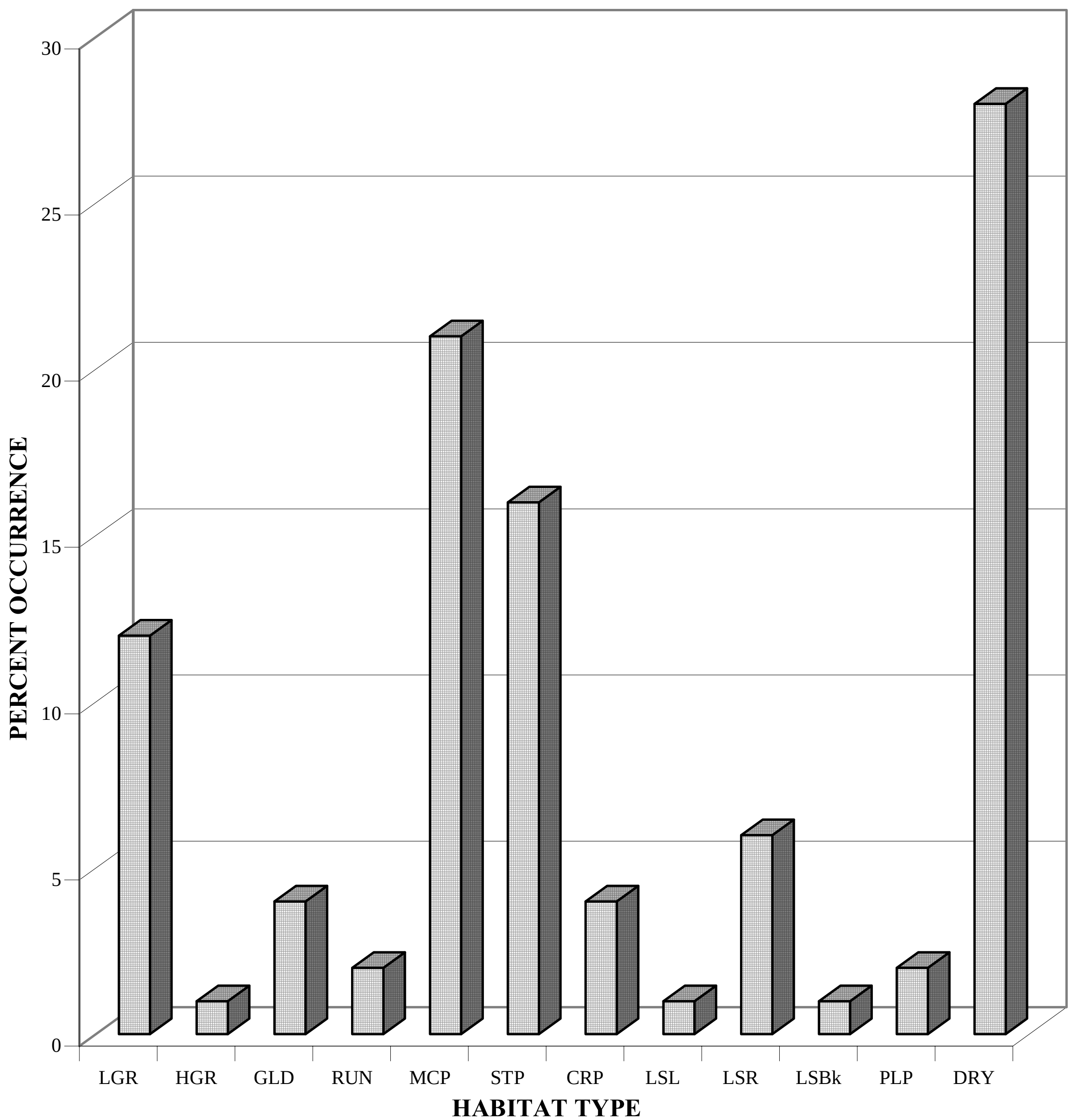
HABITAT TYPES BY PERCENT TOTAL LENGTH



GRAPH 2

DUTCH HENRY CREEK

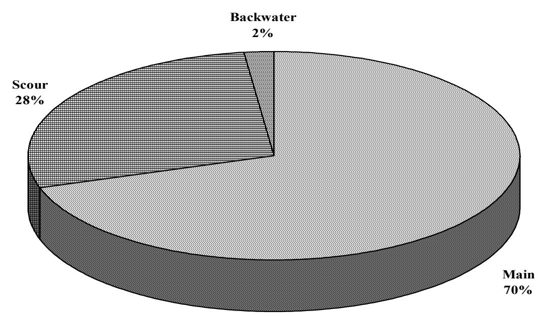
HABITAT TYPE BY PERCENT OCCURRENCE



GRAPH 3

DUTCH HENRY CREEK

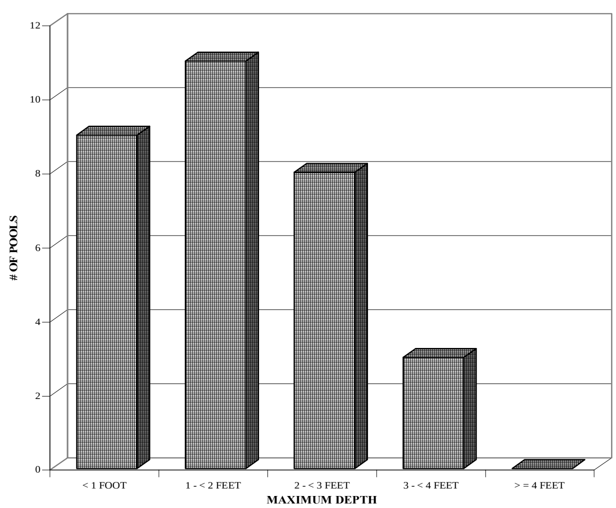
POOL HABITAT TYPES BY PERCENT OCCURRENCE



GRAPH 4

DUTCH HENRY CREEK

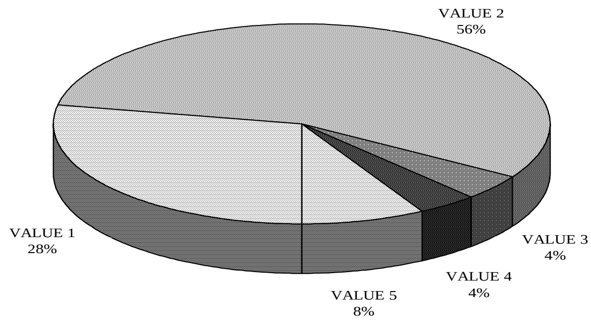
MAXIMUM POOL DEPTHS



GRAPH 5

DUTCH HENRY CREEK

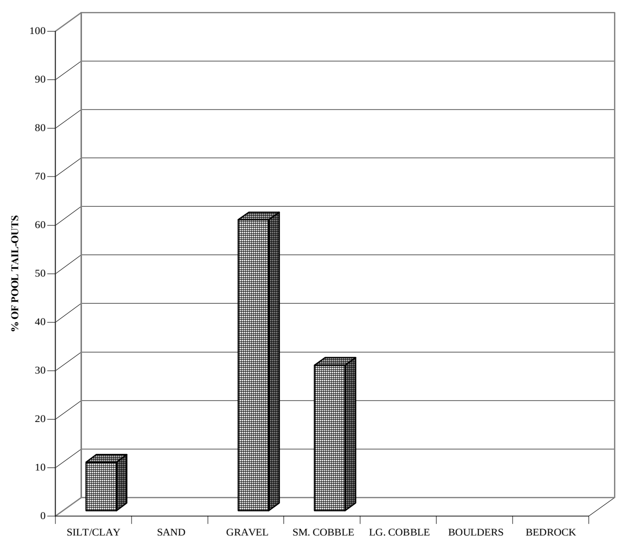
PERCENT EMBEDDEDNESS



GRAPH 6

DUTCH HENRY CREEK

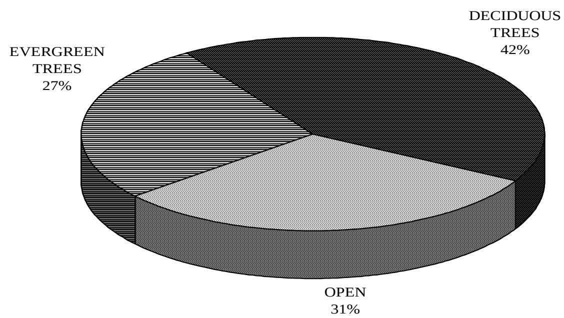
SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



GRAPH 8

DUTCH HENRY CREEK

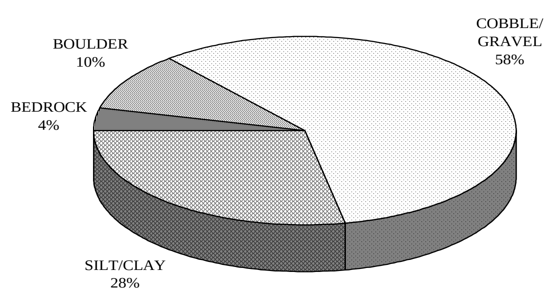
PERCENT CANOPY



GRAPH 9

DUTCH HENRY CREEK

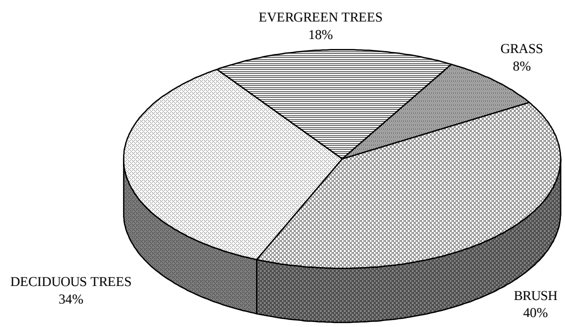
DOMINANT BANK COMPOSITION IN SURVEY REACH



GRAPH 10

DUTCH HENRY CREEK

DOMINANT BANK VEGETATION IN SURVEY REACH



GRAPH 11

6.4 Garnett Creek

HABITAT INVENTORY RESULTS

GARNETT CREEK

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

WATERSHED OVERVIEW

Garnett Creek is located in Napa County, California and is a tributary to the Napa River (Map1).The legal description for Garnett Creek is T9N R7W S36. Its location at the confluence is 38˚ 35' 6" north latitude and 122˚ 35' 29" west longitude. Garnett Creek is a second order stream and has approximately 3.1 miles of blue line stream according to the USGS Calistoga 7.5 minute quadrangle. Garnett Creek drains a watershed of approximately 7.24 square miles. Elevations range from approximately 360 feet at the confluence to approximately 2200 feet in the headwaters area. The Garnett Creek watershed drains the southern slopes of Mt. St. Helena and an area known as The Palisades. The upper reaches flow through steep gradient canyons lined primarily by oak woodland and conifer stands. As the stream descends into the Napa Valley, the watershed consists mostly of oak woodland and grassland with residential areas. The riparian canopy include oaks, alder, willows, maple, and madrone, with Himalayan blackberry, vinca, and several exotic species covering much of the banks. The watershed is owned entirely by private landowners, and vehicle access exists along Hwy 29, Greenwood Road, Palisades Road, and Old Toll Road.

HABITAT INVENTORY RESULTS

The habitat inventory of Garnett Creek, 7/2/2001 - 7/10/2001, was conducted by K.Schoonmaker, and A. Rowser with supervision and analysis by Napa County Resource Conservation District (RCD) staff and California Department of Fish and Game (DFG). The survey began at the confluence with the Napa River and extended up Garnett Creek until flow diminished and the stream channel was dry. The total length of stream surveyed was 12,746 feet, with an additional 114 feet of side channel.

Flows were not measured on Garnett Creek.

This section of Garnett Creek has 5 reaches with 3 distinct channel types: from the mouth to 6203 feet a F3, 551 feet a B3, 175 feet a F3, 2889 feet a B3 and 2928 feet a A3.

• F3 channel types are entrenched meandering riffle/pool channels on low gradients (<2%) with a high width/depth ratio 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.

• A3 channel types are steep (4-10%), narrow, cascading, step-pool streams with a high energy/debris transport associated with depositional soils and a predominantly cobble substrate.

Water temperatures ranged from 60º F to 71º F. Air temperatures ranged from 55º F to 88º F.

Fish were observed in several reaches of Garnett Creek. Relatively few Steelhead were seen and those that were documented may have been resident Rainbow Trout since they were in the 6+ inch size class. Other species included a native cyprinid species, California Roach (*Hesperoleucus symmetricus*) , Threespine Stickleback (*Gasterosteus aculeatus*) , an unidentified bass species, and an unidentified sucker species.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of *occurrence* there were 35.4% Pool units, 26.0% Riffle units, 20.3% Flatwater units and 18.2% Dry units **(Graph 1)**. Based on total *length* there were 42.4% Dry units, 22.7% Flatwater units, 22.4% Pool units and 12.5% Riffle units **(Graph 2)**.

In Garnett Creek, 192 habitat units were measured and 19% were completely sampled. Of the total, 16 Level IV habitat types were identified. The data is summarized in **Table 2**. The most frequent habitat types by percent *occurrence* were Mid-Channel Pool at 23%, Low Gradient Riffle at 21%, Dry at 18%, Run at 9%, Glide at 9%, Step Pool at 4%, High Gradient Riffle at 3%, Lateral Scour Pool - Root Wad Enhanced at 3%, Plunge Pool at 2%, Step Run at 2%, Corner Pool at 2%, Bedrock Sheet at 2%, Trench Pool at 1%, Backwater Pool - Root Wad Formed at 1%, Dammed Pool at 1% and Lateral Scour Pool - Boulder Formed at 1% **(Graph 3)**. By percent total *length*, Dry at 42%, Mid-Channel Pool at 16%, Run at 11%, Low Gradient Riffle at 10%, Glide at 9%, Step Run at 3%, Step Pool at 2%, High Gradient Riffle at 2%, Lateral Scour Pool - Root Wad Enhanced at 2%, Corner Pool at 1%, Bedrock Sheet at 1%, Plunge Pool at 1%, Dammed Pool at 0%, Lateral Scour Pool - Boulder Formed at 0%, Backwater Pool - Root Wad Formed at 0% and Trench Pool at 0%.

A total of 68 pools were identified in Garnett Creek **(Table 3)**. Mid-Channel Pool pools were most often encountered at 23%, and comprised 71% of the total length of pools **(Graph 4)**.

Table 4 is a summary of maximum pool depths by pool habitat types. Pool quality for salmonids increases with depth. In Garnett Creek, 34 of the 68 pools (50%) had a depth of two feet or greater **(Graph 5)**. These deeper pools comprised 61% of the total length of stream habitat.

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. Pools rated 27, Flatwater units rated 23 and Riffles rated 13 **(Table 1)**. Of the pool types, Lateral Scour Pool - Boulder Formed rated 40, Plunge Pool rated 31, Corner Pool rated 30, Mid-Channel Pool rated 27, Step Pool rated 25, Lateral Scour Pool - Root Wad Enhanced rated 23, Dammed Pool rated 20 and Backwater Pool - Root Wad Formed rated 10 **(Table 3)**.

Table 5 summarizes fish shelter by habitat type. By percent area, the dominant pool shelter types were Undercut Banks at 28%, Terrestrial Vegetation at 22%, Aquatic Vegetation at 14%, Root Mass at 13%, Small Wood at 12%, Boulders at 7%, Large Wood at 3%, White Water at 1% and Bedrock at 0%.

Table 6 summarizes the dominant substrate by habitat type. In the 41 Low-Gradient Riffles surveyed, the dominant substrate was: Gravel in 2 riffles.

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 68 pool tail-outs measured, 1 had a value of 1 (1%), 28 had a value of 2 (41%), 33 had a value of 3 (49%) and 1 had a value of 4 (1%). In Garnett Creek, 5 (7%) 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 79%. The mean percentages of deciduous and evergreen trees were 63% and 37%, respectively. **Graph 9** describes the canopy for the entire survey.

For the entire stream reach surveyed, the mean percent right bank vegetated was 71% and the mean percent left bank vegetated was 69%. For the habitat units measured, the dominant vegetation types for the stream banks were: 29% Evergreen Trees, 29% Brush, 19% Grass, 19% Deciduous Trees and 3% Bare Soil **(Graph 11)**. The dominant substrate for the stream banks were: 40% Silt, Clay & Sand, 31% Bedrock, 14% Cobble & Gravel and 14% Boulder **(Graph 10)**.

HISTORICAL SURVEY RESULTS

In June of 1970, a survey of Garnett Creek was done by B. Albert, W. Jones, and J. Thompson of the CDFG. Species observed included steelhead, roach, sticklebacks, green sunfish, and suckers. Steelhead were 2-7 inches in length and densities estimated to be 40/100 feet of stream in upper reaches and 10/100 feet of stream in lower reaches where water was present. No barriers were observed.

In May of 1981, a total of 1,297 yoy steelhead were removed from Garnett Creek by the CDFG using an electrofisher. The surviving 1,189 steelhead were turned over to Napa River Steelhead Unlimited to be reared and released back into the Napa River system. The fish were taken from eight small isolated pools, which dry up in summer, on one private landowner's property.

DISCUSSION

Garnett Creek has 5 reaches: The first 6203 feet is an F3 channel type, then 551 feet a B3, 175 feet a F3, 2889 feet a B3 and 2928 feet a A3.

- 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.

• 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.

• A3 channel types are good for bank-placed boulders and fair for low-stage weirs, opposing wing-deflectors and log cover.

B and F Channel Types:
Many site specific projects can be designed within this channel type, especially to increase pool frequency, volume and shelter.

F Channel Types:
Any work considered will require careful design, placement, and construction that must include protection for any unstable banks.

B Channel Types:
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.

The water temperatures recorded on the survey days 7/2/2001 - 7/10/2001 ranged from 60 ºF to 71ºF. Air temperatures ranged from 55º F to 88º F. These temperatures, if sustained, are above the threshold stress level (65°F) for salmonids. To make any further conclusions, temperatures need to be monitored for a longer period of time through the critical summer months, and\or more extensive biological sampling conducted.

In Garnett Creek, 2 of the 2 low gradient riffles measured (100%) had either gravel or small cobble as the dominant substrate. This is generally considered good for spawning salmonids.

Pools comprised 22% 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 Garnett Creek, the pools are relatively deep with 50% having a maximum depth of at least two feet. These pools comprised 61% of the total length of stream habitat. 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 27. 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 Undercut Banks at 28%, Terrestrial Vegetation at 22%, Aquatic Vegetation at 14%, Root Mass at 13%, Small Wood at 12%, Boulders at 7%, Large Wood at 3%, White Water at 1% and Bedrock at 0%. 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.

In Garnett Creek, 50% of the pool tail-outs measured had embeddedness ratings of either 3 or 4. Only 1% 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 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. In Garnett Creek, 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 79%. This is very good, since 80 percent is generally considered desirable.

RECOMMENDATIONS

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

2) Increase woody cover in the pools and flatwater habitat units. The existing cover is deficient in many areas, and adding complexity with large woody debris would greatly enhance habitat quality.

3) Active and potential sediment sources related to the road system and other factors need to be identified, mapped, and treated according to their potential for sediment yield to the stream and its tributaries. Garnett Creek has a high level of embeddedness in much of the surveyed area.

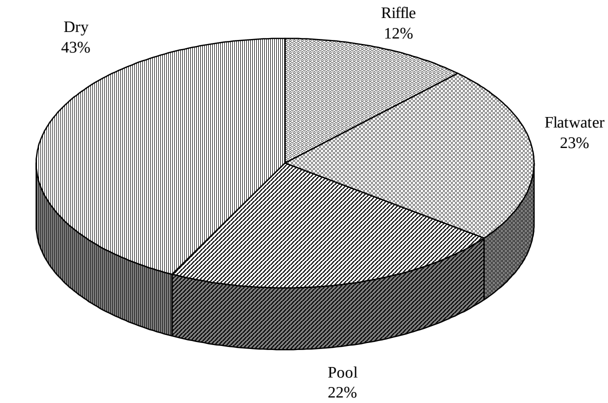
4) The limited water temperature data suggests that Garnett Creek's maximum temperatures exceed the acceptable range for juvenile salmonids. In order for more meaningful conclusions about the stream's temperature regime, 24 hour temperature monitoring should be done during June through September for several years.

COMMENTS AND LANDMARKS

Landmarks and possible problem sites along Dutch Henry Creek were noted during the survey. These have been filed in electronic and paper format and are available upon request from the Napa RCD.

GARNETT CREEK

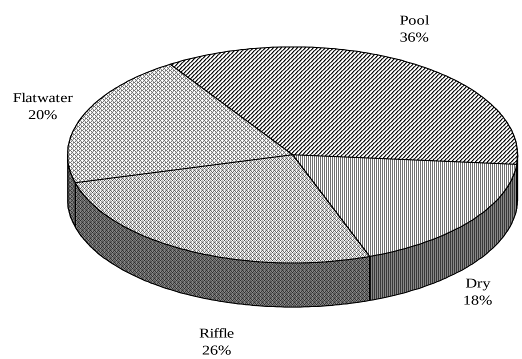
HABITAT TYPES BY PERCENT TOTAL LENGTH



GRAPH 2

GARNETT CREEK

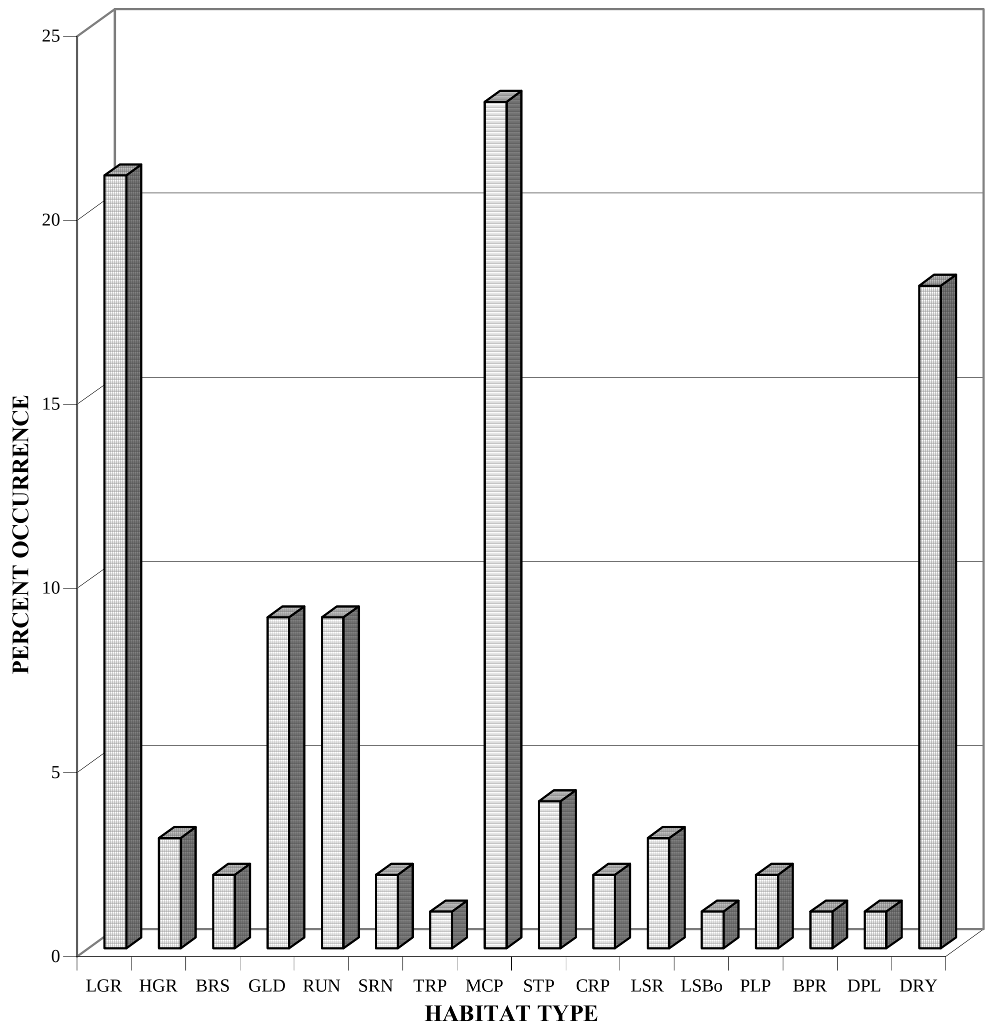
HABITAT TYPES BY PERCENT OCCURRENCE



GRAPH 1

GARNETT CREEK

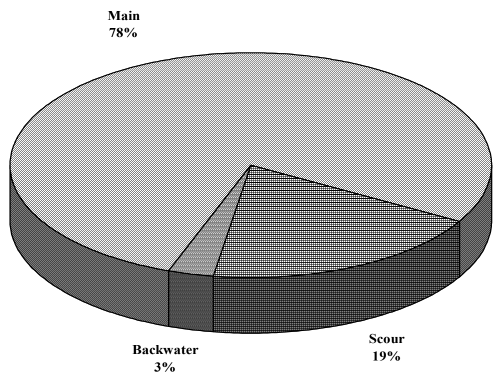
HABITAT TYPE BY PERCENT OCCURRENCE



GRAPH 3

GARNETT CREEK

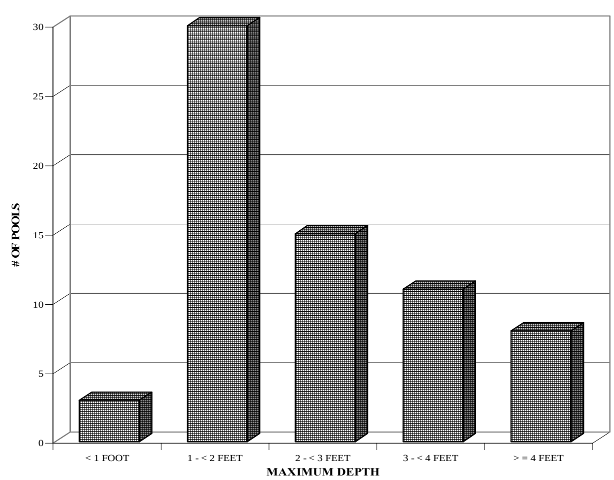
POOL HABITAT TYPES BY PERCENT OCCURRENCE



GRAPH 4

GARNETT CREEK

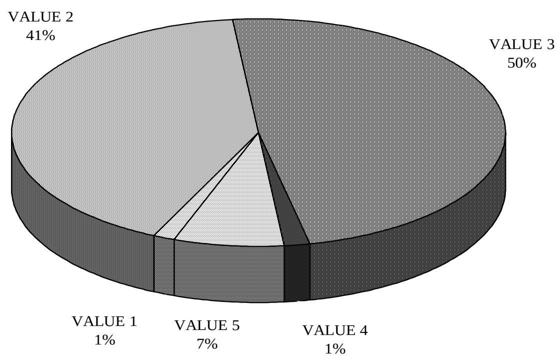
MAXIMUM POOL DEPTHS



GRAPH 5

GARNETT CREEK

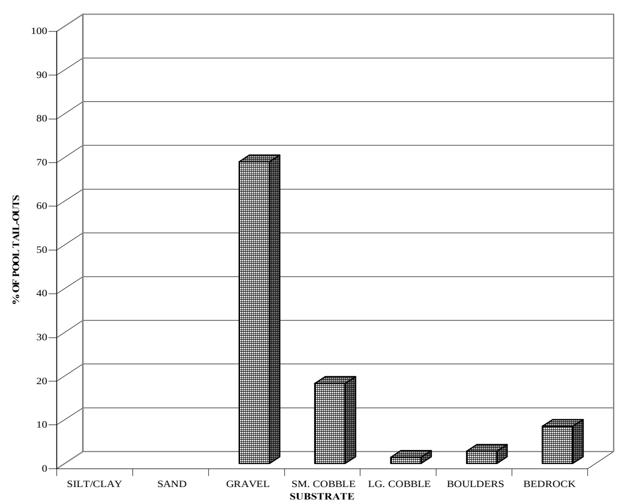
PERCENT EMBEDDEDNESS



GRAPH 6

GARNETT CREEK

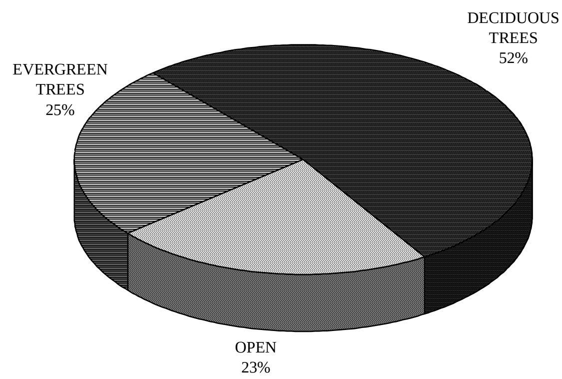
SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



GRAPH 8

GARNETT CREEK

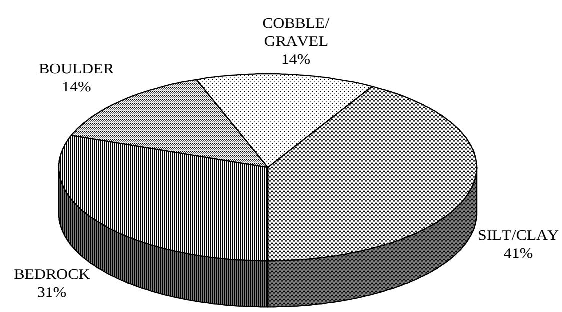
PERCENT CANOPY



GRAPH 9

GARNETT CREEK

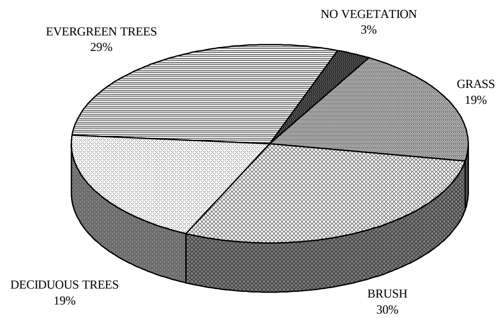
DOMINANT BANK COMPOSITION IN SURVEY REACH



GRAPH 10

GARNETT CREEK

DOMINANT BANK VEGETATION IN SURVEY REACH



GRAPH 11

6.5 Napa River

HABITAT INVENTORY RESULTS

UPPER NAPA RIVER

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

WATERSHED OVERVIEW

The Napa River is located in Napa County, California and flows to San Pablo Bay (Map 1). The legal description for the Napa River at the starting point of the survey near the confluence of Ritchie Creek is T8N R6W S Rancho Carne Humana. This location is 38˚ 33' 24" north latitude and 122˚ 30' 26" west longitude. The upper Napa River is a fourth order stream and has approximately 11.94 miles of blueline stream according to the USGS Calistoga 7.5 minute quadrangle. The upper Napa River drains a watershed of approximately 44.3 square miles. Elevations range from approximately 250 feet at the confluence of Ritchie Creek to approximately 560 feet in the Tubbs Lane Bridge area. The watershed is owned primarily by private landowners, with vehicle access along Hwy. 29, the Silverado Trail, Bale Lane, and Tubbs Lane.

HABITAT INVENTORY RESULTS

The habitat inventory of Napa River, 7/18/2001 - 8/2/2001, was conducted by A. Rowser, M. Phillips with supervision and analysis by Napa County Resource Conservation District (RCD) staff, and California Department of Fish and Game (DFG). The survey began at the confluence with a tributary, Ritchie Creek, and extended up Napa River to the Tubbs Lane Bridge. The total length of stream surveyed was 35,879 feet, with an additional 189 feet of side channel.

Flows were not measured on Napa River.

The upper section of the Napa River has 1 reach with 1 distinct channel type: from the start of surveying to 35,879 feet it has a F3 channel type.

- F3 channel types are entrenched meandering riffle/pool channels on low gradients (<2%) with a high width/depth ratio and a predominantly bedrock/boulder,cobble/gravel/sand/silt/clay substrate.

Water temperatures ranged from 59ºF to 74ºF. Air temperatures ranged from 59ºF to 78ºF.

Fish were observed throughout the survey of the upper Napa River. Steelhead were seen, but may have been resident Rainbow Trout since they were in the 6+ inch size class. Other species included a native cyprinid species, California Roach (*Hesperoleucus symmetricus*) , Threespine

Stickleback (*Gasterosteus aculeatus*) , an unidentified bass species, and an unidentified sucker species.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of *occurrence* there were 42.7% Pool units, 36.8% Flatwater units, 13.0% Riffle units and 7.6% Dry units **(Graph 1)**. Based on total *length* there were 42.8% Pool units, 40.7% Flatwater units, 9.7% Dry units and 6.8% Riffle units **(Graph 2)**.

A total of 371 habitat units were measured and 15% were completely sampled. 16 Level IV habitat types were identified. The data is summarized in **Table 2**. The most frequent habitat types by percent *occurrence* were Mid-Channel Pool at 26%, Glide at 21%, Run at 15%, Low Gradient Riffle at 13%, Dry at 8%, Lateral Scour Pool - Log Enhanced at 6%, Lateral Scour Pool - Root Wad Enhanced at 5%, Corner Pool at 3%, Step Pool at 1%, Channel Confluence Pool at 1%, Lateral Scour Pool - Boulder Formed at 1%, Edgewater at 0%, Not Surveyed at 0%, Dammed Pool at 0%, Plunge Pool at 0% and Lateral Scour Pool - Bedrock Formed at 0% **(Graph 3)**. By percent total *length*, Mid-Channel Pool at 27%, Glide at 24%, Run at 17%, Dry at 10%, Low Gradient Riffle at 7%, Lateral Scour Pool - Log Enhanced at 6%, Lateral Scour Pool - Root Wad Enhanced at 4%, Corner Pool at 3%, Step Pool at 1%, Lateral Scour Pool - Boulder Formed at 1%, Channel Confluence Pool at 0%, Dammed Pool at 0%, Plunge Pool at 0%, Lateral Scour Pool - Bedrock Formed at 0%, Edgewater at 0% and Not Surveyed at 0%.

In this section of the upper Napa River, 158 pools were identified **(Table 3)**. Mid-Channel Pool pools were most often encountered at 26%, and comprised 63% of the total length of pools **(Graph 4)**.

Table 4 is a summary of maximum pool depths by pool habitat types. Pool quality for salmonids increases with depth. In the Napa River, 86 of the 158 pools (54%) had a depth of three feet or greater **(Graph 5)**. These deeper pools comprised 61% of the total length of stream habitat.

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. Pools rated 51, Flatwater units rated 31 and Riffles rated 10 **(Table 1)**. Of the pool types, Lateral Scour Pool - Log Enhanced rated 59, Lateral Scour Pool - Root Wad Enhanced rated 55, Lateral Scour Pool - Boulder Formed rated 55, Step Pool rated 53, Mid-Channel Pool rated 50, Corner Pool rated 42, Lateral Scour Pool - Bedrock Formed rated 40, Channel Confluence Pool rated 35, Plunge Pool rated 20 and Dammed Pool rated 20 **(Table 3)**.

Table 5 summarizes fish shelter by habitat type. By percent area, the dominant pool shelter types were Terrestrial Vegetation at 33%, Undercut Banks at 19%, Small Wood at 15%, Root Mass at 14%, Boulders at 7%, Large Wood at 6%, Aquatic Vegetation at 5%, Bedrock at 1% and White Water at 0%.

Table 6 summarizes the dominant substrate by habitat type. In the 48 Low-Gradient Riffles surveyed, the dominant substrate was: Gravel in 4 riffles and Small Cobble in 1 riffles.

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 153 pool tail-outs measured, 4 had a value of 1 (3%), 14 had a value of 2 (9%), 121 had a value of 3 (79%) and 10 had a value of 4 (7%). Only 4 (3%) riffles rated a 5 (unsuitable substrate type for spawning). On this scale, a value of one is best for fisheries. **Graph 6** describes percent embeddedness by reach. Gravel was the dominant substrate observed at pool tail-outs **(Graph 8)**.

The mean percent canopy density for the stream reach surveyed was 59%. The mean percentages of deciduous and evergreen trees were 68% and 17%, respectively. **Graph 9** describes the canopy for the entire survey.

For the entire stream reach surveyed, the mean percent right bank vegetated was 55% and the mean percent left bank vegetated was 59%. For the habitat units measured, the dominant vegetation types for the stream banks were: 52% Deciduous Trees, 16% Evergreen Trees, 9% Brush, 5% Grass and 1% Bare Soil **(Graph 11)**. The dominant substrate for the stream banks were: 49% Silt, Clay & Sand, 27% Cobble & Gravel and 8% Boulder **(Graph 10)**.

<u>HISTORICAL SURVEY RESULTS</u>

In January of 1959, a survey of the Napa River was done by C. K. Fisher of the CDFG. No fish were observed due primarily to turbidity.

In June of 1961, J. S. Day of the CDFG surveyed a stretch of the upper Napa River from one mile north of Calistoga downstream to Bale Lane. Fish species observed included Roach, Squawfish (Northern Pikeminnow), Carp, Green Sunfish, Coastal Rainbow Trout (Both resident and anadromous), Sculpins, Sticklebacks, Suckers, and Largemouth Bass. Success of Rainbow Trout was notably poor in relation to other species. The survey notes that this section of stream represented primarily a migration route for salmonids and not necessarily viable spawning or rearing habitat.

In 1969, the CDFG-Region 3 performed an extensive survey of Steelhead to quantify the juvenile populations within the drainage. They conclude that the Napa River between Blossom Creek and Kimball Reservoir has the favorable characteristics of a tributary stream, and should be considered as such. The report estimates that the summer nursery habitat in the upper Napa River above Blossom Creek supported a standing crop of 600 to 2500 juvenile steelhead.

In 1970, a brief review of the upper Napa River was made by W. Jones of the CDFG. The survey found 15 steelhead per 100 feet of stream. Other species observed included Smallmouth Bass, Green Sunfish, Catfish, Bullhead, and Carp.

In June of 1982, a fisheries flow requirement study was performed on the Napa River by W. G. Cox and J. P. Ellison of the CDFG. The report makes recommendations for flow requirements of juvenile and adult Steelhead.

In December of 1983, J. Emig of the CDFG documented Chinook salmon in the Napa River near Bale Lane. Near Dunaweal Lane, 6-7 salmon spawning in a riffle were observed by a fisherman. Other observations were noted in the lower reaches of the river and tributaries.

DISCUSSION

The surveyed portion of the upper Napa River represents 1 reach with 35,879 feet of F3 channel type. 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. Any work considered will require careful design, placement, and construction that must include protection for any unstable banks. Many site specific projects can be designed within this channel type, especially to increase pool frequency, volume and shelter.

The water temperatures recorded on the survey days 7/18/2001 - 8/2/2001 ranged from 59ºF to 74ºF. Air temperatures ranged from 59ºF to 78ºF. The warmest water temperatures were recorded in the lower section of the survey.

These temperatures, if sustained, are above the threshold stress level (65°F) for salmonids. To make any further conclusions, temperatures need to be monitored for a longer period of time through the critical summer months, and\or more extensive biological sampling conducted.

Pools comprised 43% of the total **length** of this survey. In third and fourth 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 Napa River, the pools are moderately deep with 54% having a maximum depth of at least three feet. These pools comprised 61% of the total length of stream habitat. 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 51. However, a pool shelter rating of approximately 80 is desirable. The moderate amount of pool shelter that now exists is being provided primarily by Terrestrial Vegetation at 33%, Undercut Banks at 19%, Small Wood at 15%, Root Mass at 14%, Boulders at 7%, Large Wood at 6%, Aquatic Vegetation at 5%, Bedrock at 1% and White Water at 0%. 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.

In the upper Napa River, 5 of the 6 low gradient riffles measured (83%) had either gravel or small cobble as the dominant substrate. This is generally considered good for spawning salmonids.

Within the survey reach, 86% of the pool tail-outs measured had embeddedness ratings of either 3 or 4. Only 3% 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 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. In the upper Napa River, 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 59%. This is a relatively low percentage of canopy, since 80 percent is generally considered desirable. Cooler water temperatures are desirable in the surveyed reach of the upper Napa River. 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 agricultural and urban development. Riparian removal and vineyard development within the riparian corridor could all lead to less stream canopy and channel incision causing bank erosion and higher water temperatures.

RECOMMENDATIONS

1) The upper Napa River should be managed as an anadromous, natural production stream with significant migration and spawning habitat.

2) Active and potential sediment sources related to the road system and other factors need to be identified, mapped, and treated according to their potential for sediment yield to the stream and its tributaries. The upper Napa River has a high level of embeddedness in much of the surveyed reach, and treatments to reduce the delivery of fines into the river should be considered.

3) Increase woody cover in the pools and flatwater habitat units. The existing cover is deficient in most of the surveyed reach, and adding complexity with large woody debris would greatly enhance habitat quality.

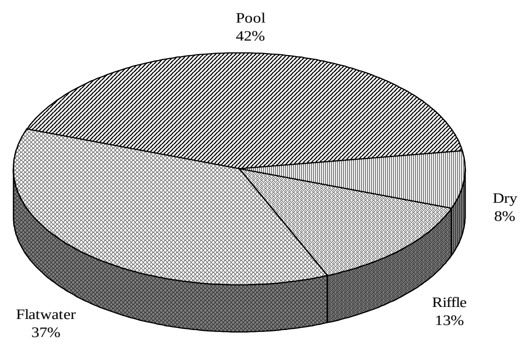
4) The limited water temperature data suggests that the upper Napa River’s maximum temperatures exceed the acceptable range for juvenile salmonids. The temperature regime recorded during this survey creates favorable conditions for introduced warm-water species, which compete for resources and prey upon juvenile salmonids. In order for more meaningful conclusions about the stream’s temperature regime, 24 hour temperature monitoring should be done during June through September for several years.

COMMENTS AND LANDMARKS

Landmarks and possible problem sites along the upper Napa River were noted during the survey. These have been filed in electronic and paper format and are available upon request from the Napa RCD.

NAPA RIVER

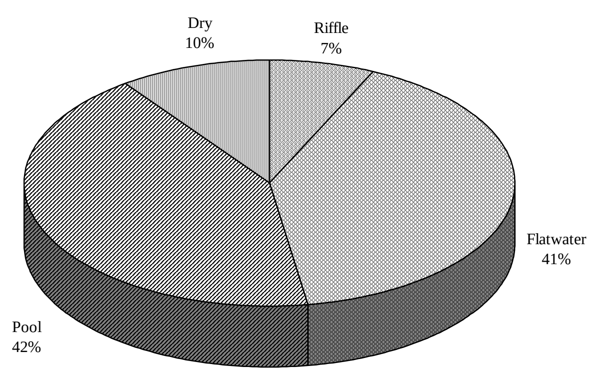
HABITAT TYPES BY PERCENT OCCURRENCE



GRAPH 1

NAPA RIVER

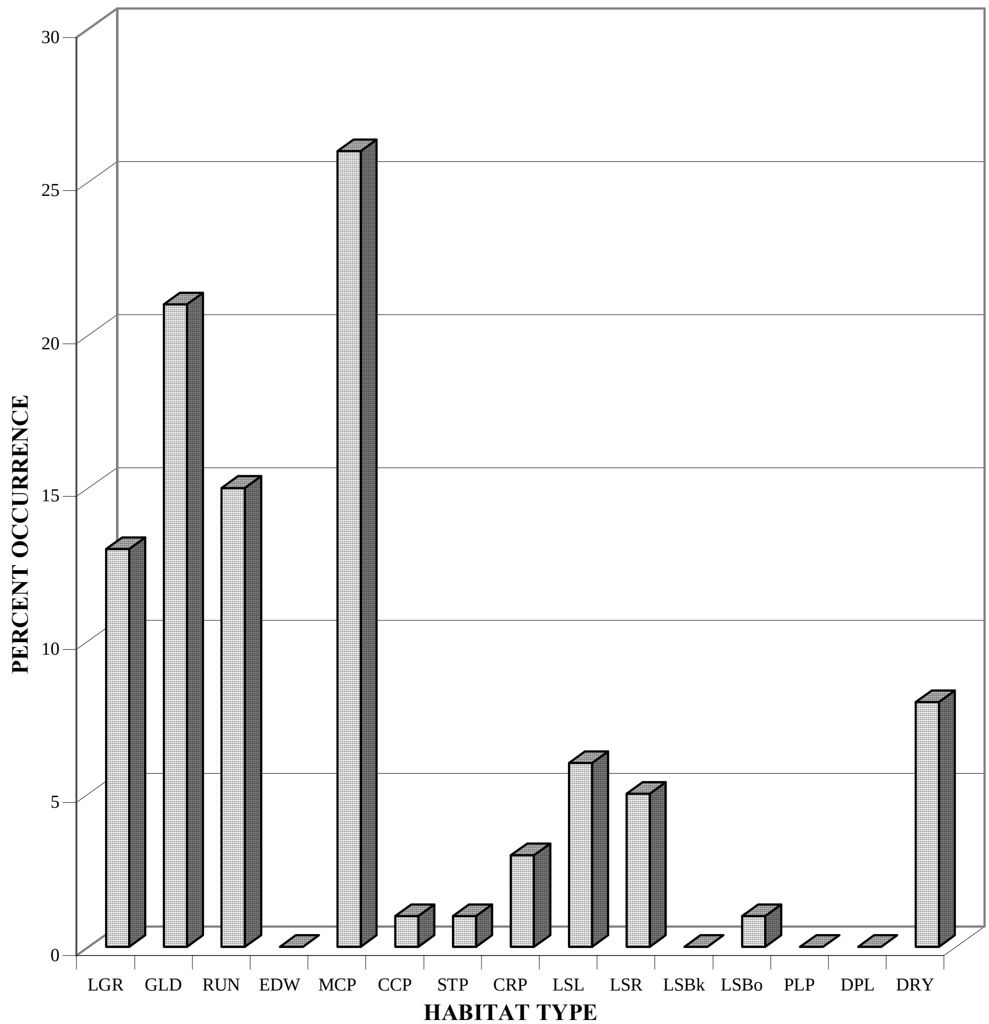
HABITAT TYPES BY PERCENT TOTAL LENGTH



GRAPH 2

NAPA RIVER

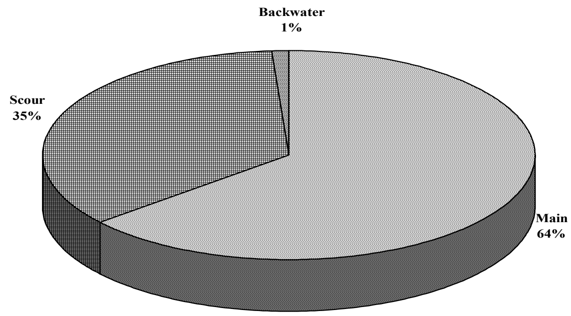
HABITAT TYPE BY PERCENT OCCURRENCE



GRAPH 3

NAPA RIVER

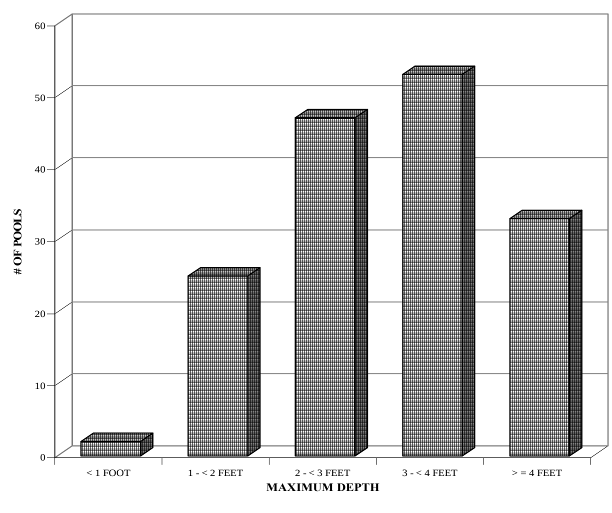
POOL HABITAT TYPES BY PERCENT OCCURRENCE



GRAPH 4

NAPA RIVER

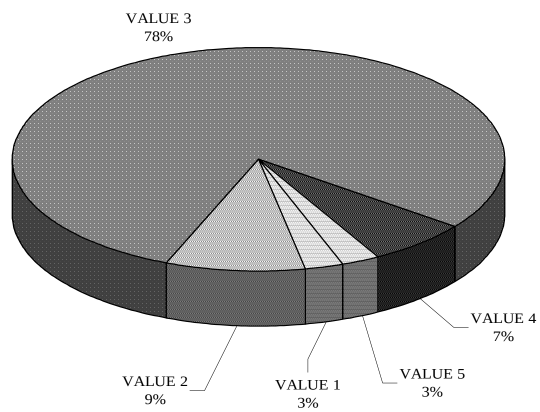
MAXIMUM POOL DEPTHS



GRAPH 5

NAPA RIVER

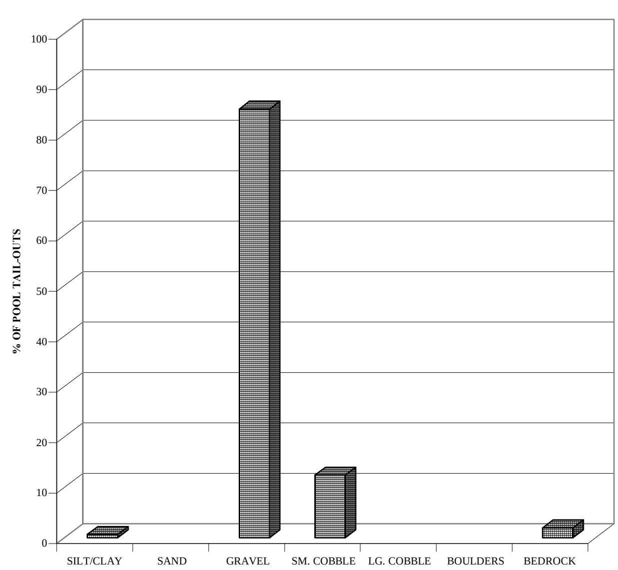
PERCENT EMBEDDEDNESS



GRAPH 6

NAPA RIVER

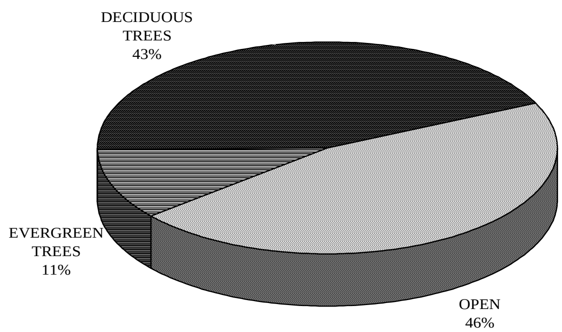
SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



GRAPH 8

NAPA RIVER

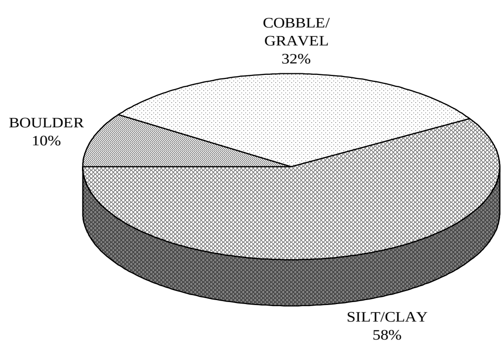
PERCENT CANOPY



GRAPH 9

NAPA RIVER

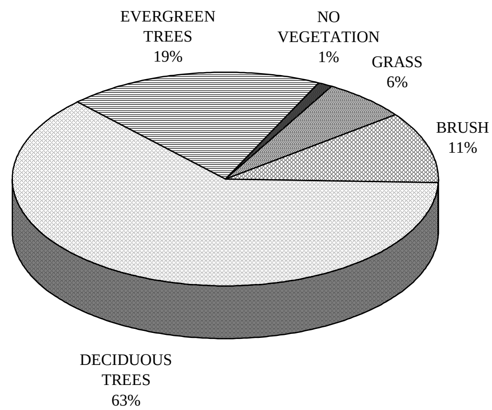
DOMINANT BANK COMPOSITION IN SURVEY REACH



GRAPH 10

NAPA RIVER

DOMINANT BANK VEGETATION IN SURVEY REACH



GRAPH 11

6.6 Ritchey Creek

HABITAT INVENTORY RESULTS

RITCHEY CREEK

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

WATERSHED OVERVIEW

Ritchey Creek is located in Napa County, California and is a tributary to the Napa River which flows to San Pablo Bay (Map 1). The legal description for Ritchey at the confluence with the Napa River is T8N R6W S10. It's location is 38˚ 33' 28" north latitude and 122˚ 30' 28" west longitude. Ritchey Creek is a second order stream and has approximately 3.2 miles of blue line stream according to the USGS Calistoga 7.5 minute quadrangle. Ritchey Creek drains a watershed of approximately 4.82 square miles. Elevations range from approximately 275 feet at the confluence to approximately 1400 feet in the headwaters area. Much of the watershed is owned by private landowners, however the majority of the stream corridor is contained within Bothe State Park.

HABITAT INVENTORY RESULTS

The habitat inventory of Ritchey Creek, 6/25/2001 - 7/17/2001, was conducted by M. Phillips, A. Rowser and M. Phillips, R. Anadel with supervision and analysis by Napa County Resource Conservation District (RCD) staff and California Department of Fish and Game (DFG). The survey began at the confluence with the Napa River and extended up Ritchey Creek until flows diminished and fish were no longer present. The total length of stream surveyed was 16,821 feet, with an additional 102 feet of side channel.

Flows were not measured on Ritchey Creek.

This section of Ritchey Creek has 4 reaches with 4 distinct channel types: from the mouth to 8,943 feet a F3, 422 feet a B4, 3,124 feet a F2 and 4,332 feet a A2.

- F3 channel types are entrenched meandering riffle/pool channels on low gradients (<2%) with a high width/depth ratio and a predominantly cobble substrate.

- B4 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 gravel 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.

- 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.

Steelhead were seen throughout the surveyed length of Ritchey Creek. Most fish were in the y.o.y. and 1 year + size class, but several larger fish were observed including a 21 inch adult steelhead stranded in a pool. Roach and sculpins were also numerous.

Water temperatures ranged from 57º F to 72º F. Air temperatures ranged from 59º F to 102º F.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of *occurrence* there were 46.9% Pool units, 23.9% Flatwater units, 23.3% Riffle units and 2.3% Dry units **(Graph 1)**. Based on total *length* there were 42.6% Flatwater units, 30.9% Pool units, 20.1% Riffle units and 5.1% Dry units **(Graph 2)**.

A total of 306 habitat units were measured and 26% were completely sampled. Of that total, 19 Level IV habitat types were identified. The data is summarized in Table 2. The most frequent habitat types by percent *occurrence* were Step Run at 22%, Mid-Channel Pool at 17%, Step Pool at 13%, High Gradient Riffle at 12%, Low Gradient Riffle at 10%, Plunge Pool at 5%, Lateral Scour Pool - Root Wad Enhanced at 4%, Lateral Scour Pool - Boulder Formed at 2%, Dry at 2%, Lateral Scour Pool - Bedrock Formed at 2%, Run at 2%, Bedrock Sheet at 2%, Dammed Pool at 1%, Corner Pool at 1%, Lateral Scour Pool - Log Enhanced at 1%, Backwater Pool - Boulder Formed at 0%, Pocket Water at 0%, Glide at 0% and Backwater Pool - Root Wad Formed at 0% **(Graph 3)**. By percent total *length*, Step Run at 41%, Step Pool at 19%, High Gradient Riffle at 10%, Low Gradient Riffle at 9%, Mid-Channel Pool at 7%, Dry at 5%, Lateral Scour Pool - Root Wad Enhanced at 1%, Plunge Pool at 1%, Bedrock Sheet at 1%, Run at 1%, Lateral Scour Pool - Bedrock Formed at 1%, Lateral Scour Pool - Boulder Formed at 1%, Glide at 0%, Dammed Pool at 0%, Lateral Scour Pool - Log Enhanced at 0%, Corner Pool at 0%, Backwater Pool - Boulder Formed at 0%, Pocket Water at 0% and Backwater Pool - Root Wad Formed at 0%.

In Ritchy Creek, 150 pools were identified **(Table 3)**. Mid-Channel pools were most often encountered at 17%, and comprised 22% of the total length of pools **(Graph 4)**.

Table 4 is a summary of maximum pool depths by pool habitat types. Pool quality for salmonids increases with depth. In Ritchey Creek, 19 of the 150 pools (13%) had a depth of two feet or greater **(Graph 5)**. These deeper pools comprised 12% of the total length of stream habitat.

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. Pools rated 31, Flatwater units rated 30 and Riffles rated 13 **(Table 1)**. Of the pool types, Lateral Scour Pool - Log Enhanced rated 53, Lateral Scour Pool - Root Wad Enhanced rated 49, Lateral Scour Pool - Boulder Formed rated 36, Step Pool rated 34, Lateral Scour Pool - Bedrock Formed rated 31, Dammed Pool rated 27, Corner Pool rated 27, Plunge Pool rated 26, Mid-Channel Pool rated 25 and Backwater Pool - Root Wad Formed rated 10 **(Table 3)**.

Table 5 summarizes fish shelter by habitat type. By percent area, the dominant pool shelter types were Boulders at 49%, Small Wood at 15%, Undercut Banks at 14%, White Water at 6%, Root Mass at 4%, Large Wood at 4%, Terrestrial Vegetation at 3%, Bedrock at 3% and Aquatic Vegetation at 0%.
Table 6 summarizes the dominant substrate by habitat type. In the 30 Low-Gradient Riffles surveyed, the dominant substrate was: Small Cobble in 2 riffles and Gravel in 2 riffles
The depth of cobble embeddedness was estimated at pool tail-outs. Of the 140 pool tail-outs measured, 36 had a value of 1 (26%), 64 had a value of 2 (46%), 36 had a value of 3 (26%) and 4 had a value of 4 (3%). No riffles rated a 5 (unsuitable substrate type for spawning). On this scale, a value of one is best for fisheries. **Graph 6** describes percent embeddedness by reach. Gravel was the dominant substrate observed at pool tail-outs **(Graph 8)**.

The mean percent canopy density for the stream reach surveyed was 85%. The mean percentages of deciduous and evergreen trees were 28% and 70%, respectively. **Graph 9** describes the canopy for the entire survey.

For the entire stream reach surveyed, the mean percent right bank vegetated was 65% and the mean percent left bank vegetated was 63%. For the habitat units measured, the dominant vegetation types for the stream banks were: 41% Evergreen Trees, 28% Deciduous Trees, 21% Brush, 5% Grass and 1% Bare Soil **(Graph 11)**. The dominant substrate for the stream banks were: 43% Silt, Clay & Sand, 40% Cobble & Gravel, 9% Bedrock and 4% Boulder **(Graph 10)**.

HISTORICAL SURVEY RESULTS

In 1964, the CDFG reported on a call they made to Bothe State Park to rescue steelhead jumping at the base of a small diversion dam on Ritchey Creek. Two adult steelhead between 20 and 26 inches were relocated above the dam by DFG biologists. The state park officials noted that up to ten steelhead had been observed below the dam. The report recommended removal or modification of the dam to allow for fish passage.

In 1967, the CDFG performed a flow analysis of the weir located ¼ mile upstream of the Hwy. 29 bridge within Bothe State Park. The study found flows during the winter months of about ½ foot over the weir (~29 c.f.s.).

In 1967, a stream inventory of Ritchey Creek was made by the CDFG. The report noted three dams, which were possible barriers, within the stream. Populations of salmonids were estimated to be about 25 fish per 100 feet of stream near the mouth and about 5 fish per 100 feet of stream above the 8 foot high diversion dam. Numerous Roach and Sculpins were noted.

In 1969, the CDFG conducted a fish survey of Ritchey Creek. The report concluded that Ritchey Creek provided 0.5 miles of summer nursery habitat downstream from the concrete diversion dam with ~52 fish per 100 feet of stream. It provided approximately 1.5 miles of nursery habitat above the dam with ~ 71 fish per 100 feet of stream. The estimated standing crop was 7,000 juvenile steelhead.

In 1973, a stream inventory report of Ritchey Creek was made by the CDFG. The report noted five diversions, two log jams, and four dams. The steelhead populations were estimated at about 15 fish per 100 feet of stream in lower reaches and about 40 fish per 100 feet of stream in the higher reaches.

In 1978, a stream inventory report of Ritchey Creek was made by the CDFG. Silt and algae was noted in most pools. Fish populations were estimated to be approximately 5 fish per100 feet of stream.

In June of 1981, two employees of the CDFG walked on foot approximately 0.8 miles of Ritchey Creek in order to locate stranded steelhead. The survey was dry, and no fish were seen.

In May of 1984, a stream inventory report of Ritchey Creek was made by the CDFG. A fish plant of steelhead was made to Ritchey Creek in April, 1984. Juvenile steelhead were observed in all reaches of the survey and were between 1-6 inches in length. The survey notes that the dam in Bothe State Park was modified by another structure below it to allow for fish passage during moderate and higher winter flows. The report recommended stocking steelhead in the upper reaches of the stream.

In December of 1989, F. Gray and S. Matsuoka of the CDFG did an electrofishing survey of Ritchey Creek within Bothe State Park. A total of 37 fish were caught; seven rainbow trout and 30 sculpin.

In July of 1993, the California Department of Parks and Recreation in cooperation with the CDFG removed the small dam in Ritchey Creek within Bothe State Park. The purpose of the dam removal was to allow for the passage of migrating salmonids.

DISCUSSION

Ritchey Creek has 4 reaches: from the mouth to 8,943 feet, it is a F3 channel type, then 422 feet a B4, 3,124 feet a F2 and 4,332 feet a A2.

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.

- B4 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.

- F2 channel types are fair for low-stage weirs, single and opposing wing-deflectors and log cover.

- The high energy, steep gradient A2 channel type have stable stream banks and poor gravel retention capabilities and are generally not suitable for instream enhancement structures.

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

B Channel Types
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.

F Channel Types
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 6/25/2001 - 7/17/2001 ranged from 57º F to 72º F. Air temperatures ranged from 59º F to 102º F. The warmest water temperatures were recorded in Reach 1 near the confluence with the Napa River. These temperatures, if sustained, are above the threshold stress level (65°F) for salmonids. It is unknown if this thermal regime is typical, but 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 32% 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 Ritchey Creek, the pools are relatively shallow with 13% having a maximum depth of at least two feet. These pools comprised 12% of the total length of stream habitat. However, in coastal steelhead streams, it is generally desirable to have primary pools comprise approximately 50% of total habitat length.

The mean shelter rating for pools was 30. 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 49%, Small Wood at 15%, Undercut Banks at 14%, White Water at 6%, Root Mass at 4%, Large Wood at 4%, Terrestrial Vegetation at 3%, Bedrock at 3% and Aquatic

Vegetation at 0%. 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.

In Ritchey Creek, 4 of the 4 low gradient riffles measured (100%) had either gravel or small cobble as the dominant substrate. This is generally considered good for spawning salmonids.

A total of 29% of the pool tail-outs measured had embeddedness ratings of either 3 or 4. Only 26% 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 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. In Ritchey Creek, 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 85%. This is very good, since 80 percent is generally considered desirable.

However, the lower reach below Hwy 29 had a deficient canopy with several bank erosion problems. Although reach 1 serves primarily as a migration corridor to the upper spawning and rearing habitat, it would still benefit from increased shade and a riparian buffer zone. This reach as well as other areas with bank erosion could be enhanced with bioengineering and revegetation techniques using native plants and trees

RECOMMENDATIONS

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

2) Active and potential sediment sources related to the road system and other factors need to be identified, mapped, and treated according to their potential for sediment yield to the stream and its tributaries. Ritchey Creek has a moderately high level of embeddedness in much of the surveyed area.

3) Bank stabilization through increased vegetation should be implemented in the lowest reach to prevent erosion, reduce the sediment load into the stream, and provide a more extensive riparian buffer zone. This may include planting native plants, or the use of bioengineered erosion control structures in appropriate areas.

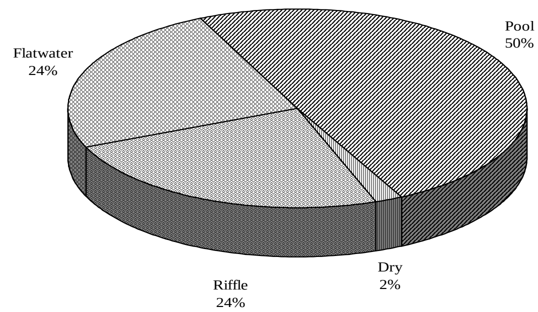
4) Increase the riparian canopy by planting native trees in reach 1. This will provide shade, reduce water temperatures, and create a greater supply of large woody debris to improve pool habitat quality in the lower reach.

COMMENTS AND LANDMARKS

Landmarks and possible problem sites along the upper Napa River were noted during the survey. These have been filed in electronic and paper format and are available upon request from the Napa RCD.

RITCHEY CREEK

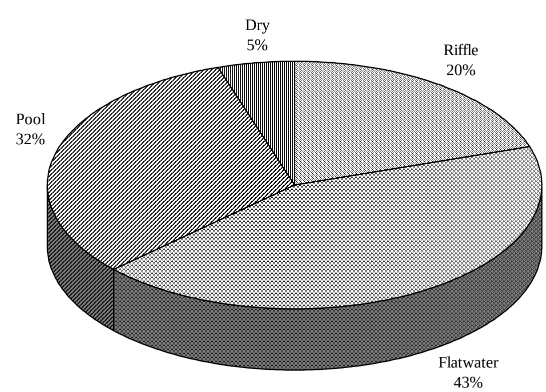
HABITAT TYPES BY PERCENT OCCURRENCE



GRAPH 1

RITCHEYCREEK

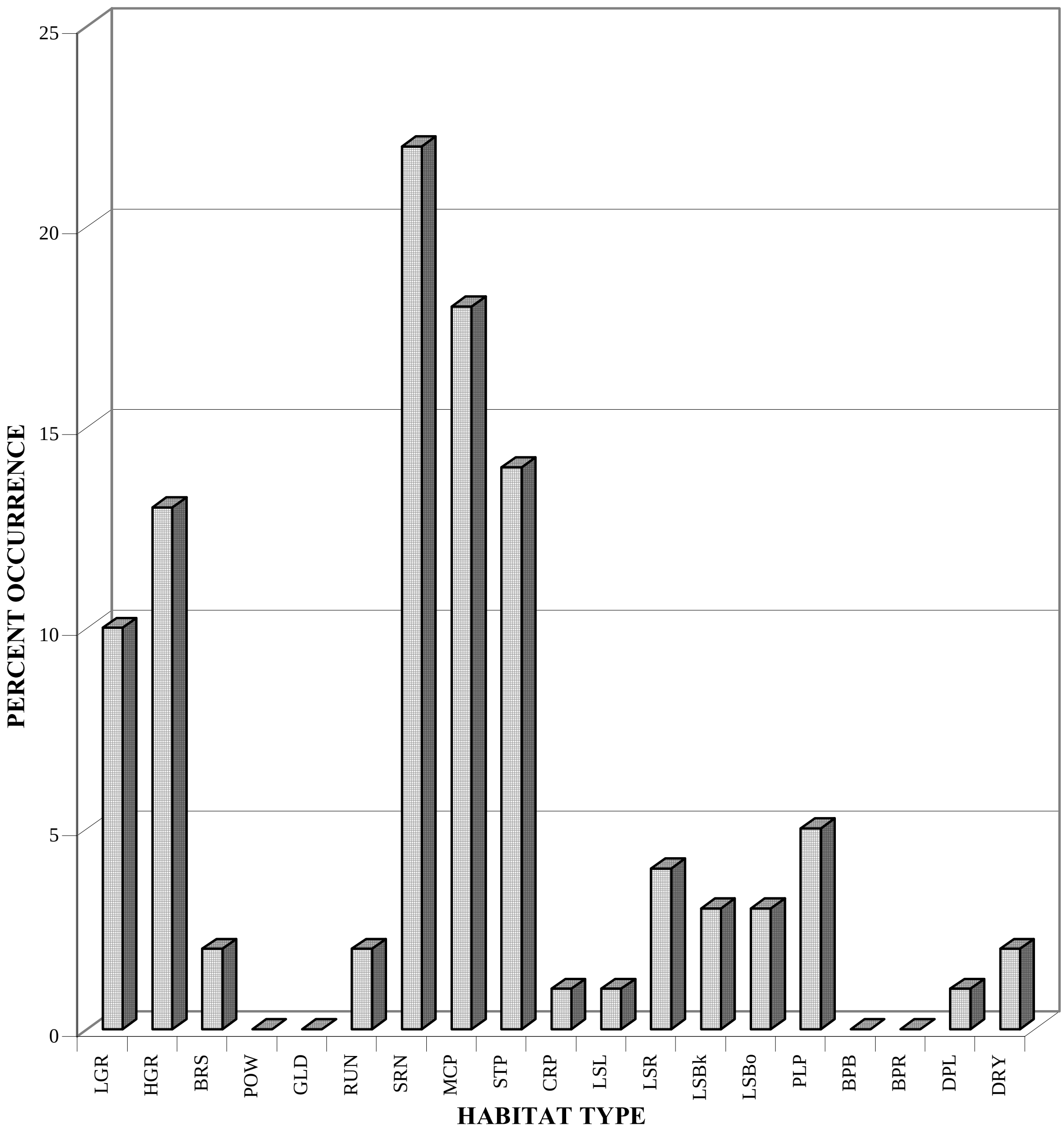
HABITAT TYPES BY PERCENT TOTAL LENGTH



GRAPH 2

RITCHEY CREEK

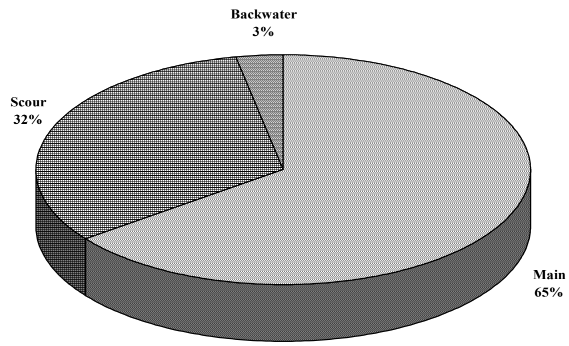
HABITAT TYPE BY PERCENT OCCURRENCE



GRAPH 3

<u>**RITCHEY CREEK**</u>

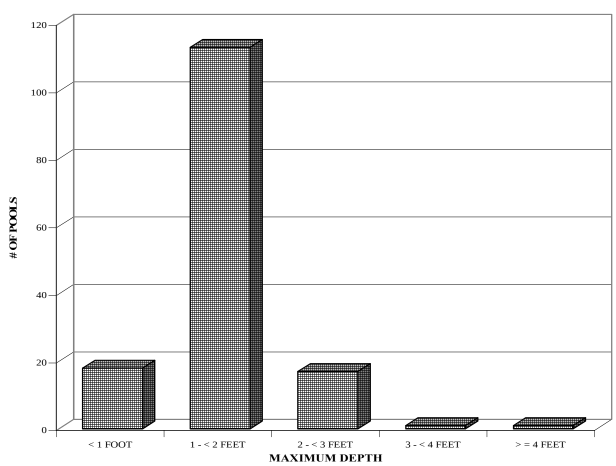
POOL HABITAT TYPES BY PERCENT OCCURRENCE



GRAPH 4

<u>**RITCHEY CREEK**</u>

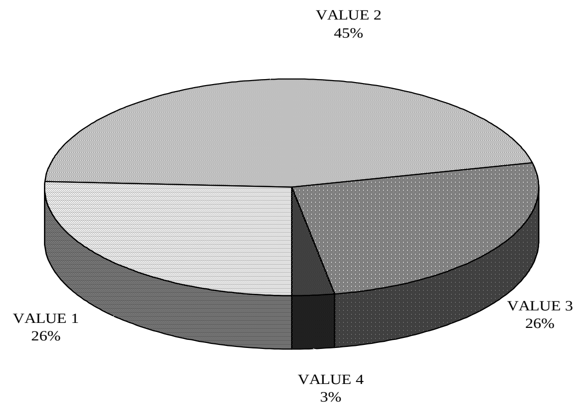
MAXIMUM POOL DEPTHS



GRAPH 5

RITCHEYCREEK

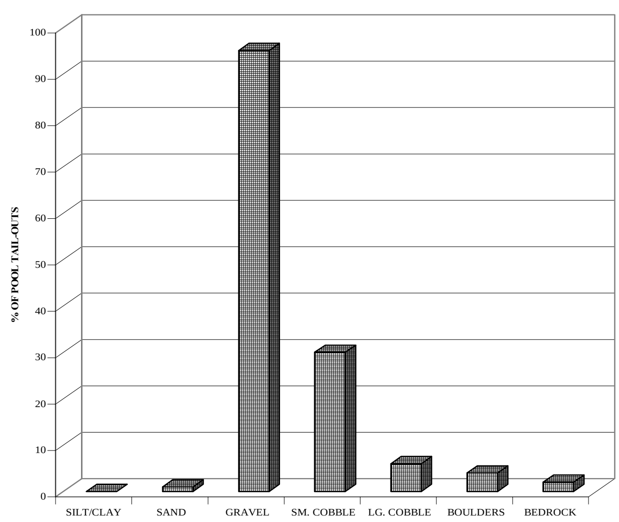
PERCENT EMBEDDEDNESS



GRAPH 6

RITCHEY CREEK

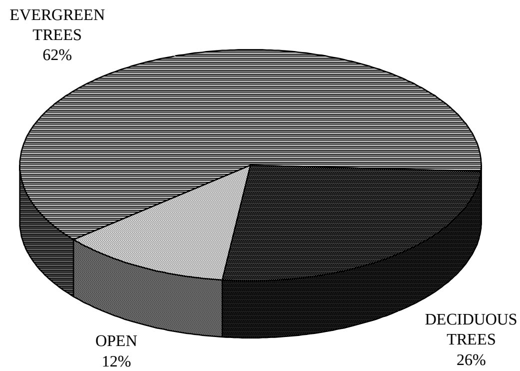
SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



GRAPH 8

RITCHEY CREEK

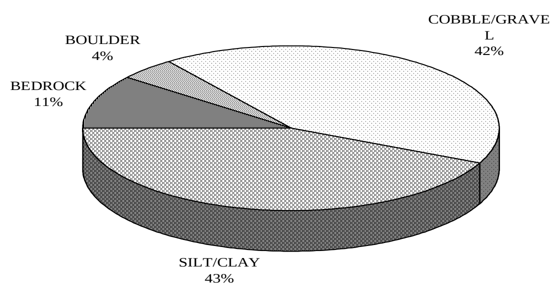
PERCENT CANOPY



GRAPH 9

RITCHEY CREEK

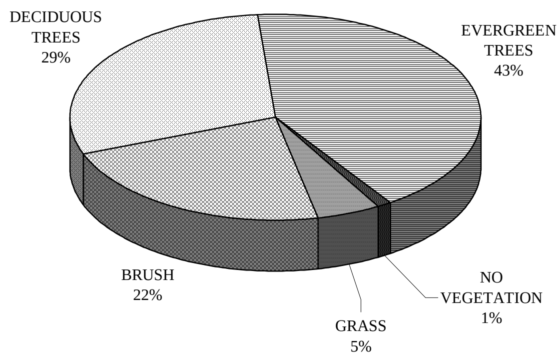
DOMINANT BANK COMPOSITION IN SURVEY REACH



GRAPH 10

RITCHEY CREEK

DOMINANT BANK VEGETATION IN SURVEY REACH



GRAPH 11

6.7 Simmons Creek

HABITAT INVENTORY RESULTS

SIMMONS CREEK

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

WATERSHED OVERVIEW

Simmons Creek is located in Napa County, California and is a tributary to the Napa River which flows to San Pablo Bay (Figure 2). The legal description for Simmons Creek at the confluence with the Napa River is T8N R6W S6. It's location is 38˚ 33' 50" north latitude and 122˚ 33' 19" west longitude. Simmons Creek is a second order stream and has approximately 3.5 miles of blue line stream according to the USGS Calistoga 7.5 minute quadrangle. Simmons Creek drains a watershed of approximately 4.1 square miles. Elevations range from approximately 320 feet at the confluence to approximately 1680 feet in the headwaters area. There are five small lakes within the watershed with about 0.009 square miles of surface area. Much of the watershed is owned by private landowners, and vehicle access exists along the Silverado Trail and Dunaweal Lane.

HABITAT INVENTORY RESULTS

The habitat inventory of Simmons Creek, 6/20/2001 - 6/21/2001, was conducted by T.Adams, M. Phillips with supervision and analysis by Napa County Resource Conservation District (RCD) staff and California Department of Fish and Game (DFG). The survey began at the confluence with the Napa River and extended up Simmons Creek to the end of landowner access permission. The total length of stream surveyed was 1643 feet, with no additional feet of side channel.

Flows were not measured on Simmons Creek.

This section of Simmons Creek has 1 reaches with 1 distinct channel types: from the mouth to 1,643 feet it has a F3 channel type.

- F3 channel types are entrenched meandering riffle/pool channels on low gradients (<2%) with a high width/depth ratio and a predominantly bedrock/boulder,cobble/gravel/sand/silt/clay substrate.

Water temperatures ranged from 63º F to 67º F. Air temperatures ranged from 72º F to 89º F.

During this limited survey of Simmons Creek, no salmonids were observed. The only fish were roach present in several pools.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of *occurrence* there were 46.5% Pool units, 34.9% Flatwater units, 16.3% Riffle units and 2.3% Dry units. Based on total *length* there were 40.5% Flatwater units, 36.8% Pool units, 16.6% Riffle units and 6.1% Dry units **(Graph 2)**.

A total of 44 habitat units were measured and 32% were completely sampled. Of that total, 11 Level IV habitat types were identified. The data is summarized in **Table 2**. The most frequent habitat types by percent *occurrence* were Mid-Channel Pool at 20%, Step Run at 18%, Low Gradient Riffle at 16%, Glide at 11%, Corner Pool at 11%, Run at 5%, Lateral Scour Pool - Log Enhanced at 5%, Backwater Pool - Root Wad Formed at 5%, Step Pool at 2%, Lateral Scour Pool - Root Wad Enhanced at 2% and Dry at 2% **(Graph 3)**. By percent total *length*, Step Run at 25%, Low Gradient Riffle at 16%, Mid-Channel Pool at 15%, Glide at 11%, Corner Pool at 9%, Dry at 6%, Lateral Scour Pool - Root Wad Enhanced at 4%, Step Pool at 3%, Lateral Scour Pool - Log Enhanced at 2%, Run at 2% and Backwater Pool - Root Wad Formed at 2%.

In this reach of Simmons Creek, 20 pools were identified **(Table 3)**. Mid-Channel Pool pools were most often encountered at 20%, and comprised 43% of the total length of pools **(Graph 4)**.

Table 4 is a summary of maximum pool depths by pool habitat types. Pool quality for salmonids increases with depth. In Simmons Creek, 9 of the 20 pools (45%) had a depth of two feet or greater **(Graph 5)**. These deeper pools comprised 54% of the total length of stream habitat.

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 5 and Pools rated 31 **(Table 1)**. Of the pool types, Mid-Channel Pool rated 42, Lateral Scour Pool - Log Enhanced rated 35, Backwater Pool - Root Wad Formed rated 30, Corner Pool rated 23, Lateral Scour Pool - Root Wad Enhanced rated 10 and Step Pool rated 5 **(Table 3)**.

Table 5 summarizes fish shelter by habitat type. By percent area, the dominant pool shelter types were Terrestrial Vegetation at 26%, Aquatic Vegetation at 19%, Root Mass at 18%, Small Wood at 16%, Large Wood at 11%, Undercut Banks at 7%, White Water at 3%, Boulders at 0% and Bedrock at 0%.

Table 6 summarizes the dominant substrate by habitat type. In the 7 Low-Gradient Riffles surveyed, the dominant substrate was small cobble.

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 16 pool tail-outs measured, 5 had a value of 2 (31%), 9 had a value of 3 (56%) and 2 had a value of 4 (13%). No riffles rated a 5 (unsuitable substrate type for spawning). On this scale, a value of one is best for fisheries. **Graph 6** describes percent embeddedness by reach. Small cobble was the dominant substrate observed at pool tail-outs **(Graph 8)**.

The mean percent canopy density for the stream reach surveyed was 78%. The mean percentages of deciduous and evergreen trees were 80% and 18%, respectively. **Graph 9** describes the canopy for the entire survey.

For the entire stream reach surveyed, the mean percent right bank vegetated was 75% and the mean percent left bank vegetated was 49%. For the habitat units measured, the dominant vegetation types for the stream banks were: 61% Brush, 36% Deciduous Trees and 4% Grass **(Graph 11)**. The dominant substrate for the stream banks were: 79% Silt, Clay & Sand and 21% Cobble & Gravel **(Graph 10)**.

HISTORICAL SURVEY RESULTS

No historical habitat surveys or biological inventories could be found for Simmons Creek with the CDFG or local agencies.

DISCUSSION

The surveyed portion of Simmons Creek has 1 reach, which consists of 1,643 feet of F3 channel type. 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.

The water temperatures recorded on the survey days 6/20/2001 - 6/21/2001 ranged from 63º F to 67º F. Air temperatures ranged from 72º F to 89º F. These temperatures, if sustained, are above the threshold stress level (65°F) for salmonids. It is unknown if this thermal regime is typical. To make any further conclusions, temperatures need to be monitored for a longer period of time through the critical summer months, and\or more extensive biological sampling conducted.

Pools comprised 34% 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 Simmons Creek, the pools are moderately deep with 45% having a maximum depth of at least two feet. These pools comprised 54% of the total length of stream habitat. 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 31. 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 Terrestrial Vegetation at 26%, Aquatic Vegetation at 19%, Root Mass at 18%, Small Wood at 16%, Large Wood at 11%, Undercut Banks at 7%, White Water at 3%, Boulders at 0% and Bedrock at 0%. 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.

In this limited survey of Simmons Creek, the only low gradient riffle measured (100%) had either gravel or small cobble as the dominant substrate. This is generally considered good for spawning salmonids. However, this lower reach of the stream probably does not represent spawning and rearing habitat for salmonids, but rather as a migration corridor to and from the upper reaches.

In the surveyed reach of Simmons Creek, 69% of the 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 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. In this lower reach of Simmons Creek, 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 78%. This is good, since 80 percent is generally considered desirable.

RECOMMENDATIONS

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

2) If feasible, conduct a more extensive inventory of habitat conditions along the entire stream in order to assess the quality of spawning and summer rearing habitat available to salmonids. This surveyed reach is most likely used primarily as a migration corridor to and from more suitable habitat in higher reaches.

3) Active and potential sediment sources related to the road system and other factors need to be identified, mapped, and treated according to their potential for sediment yield to the stream and its tributaries. Simmons Creek has a high level of embeddedness in the surveyed reach.

4) The limited water temperature data suggests that Simmons Creek's maximum temperatures exceed the acceptable range for juvenile salmonids. In order for more meaningful conclusions about the stream's temperature regime, 24 hour temperature monitoring should be done during

June through September for several years. Additional temperature data should be collected in the upper reaches.

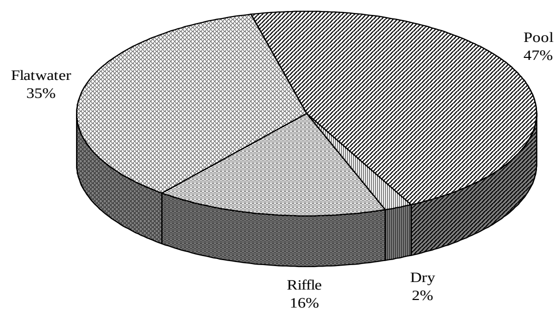
5) Increase woody cover in the pools and flatwater habitat units. The existing cover is deficient in many areas, and adding complexity with large woody debris would greatly enhance habitat quality.

COMMENTS AND LANDMARKS

Landmarks and possible problem sites along Simmons Creek were noted during the survey. These have been filed in electronic and paper format and are available upon request from the Napa RCD.

SIMMONS CREEK

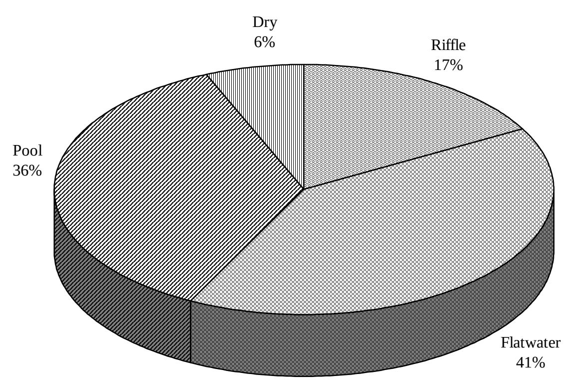
HABITAT TYPES BY PERCENT OCCURRENCE



GRAPH 1

SIMMONS CREEK

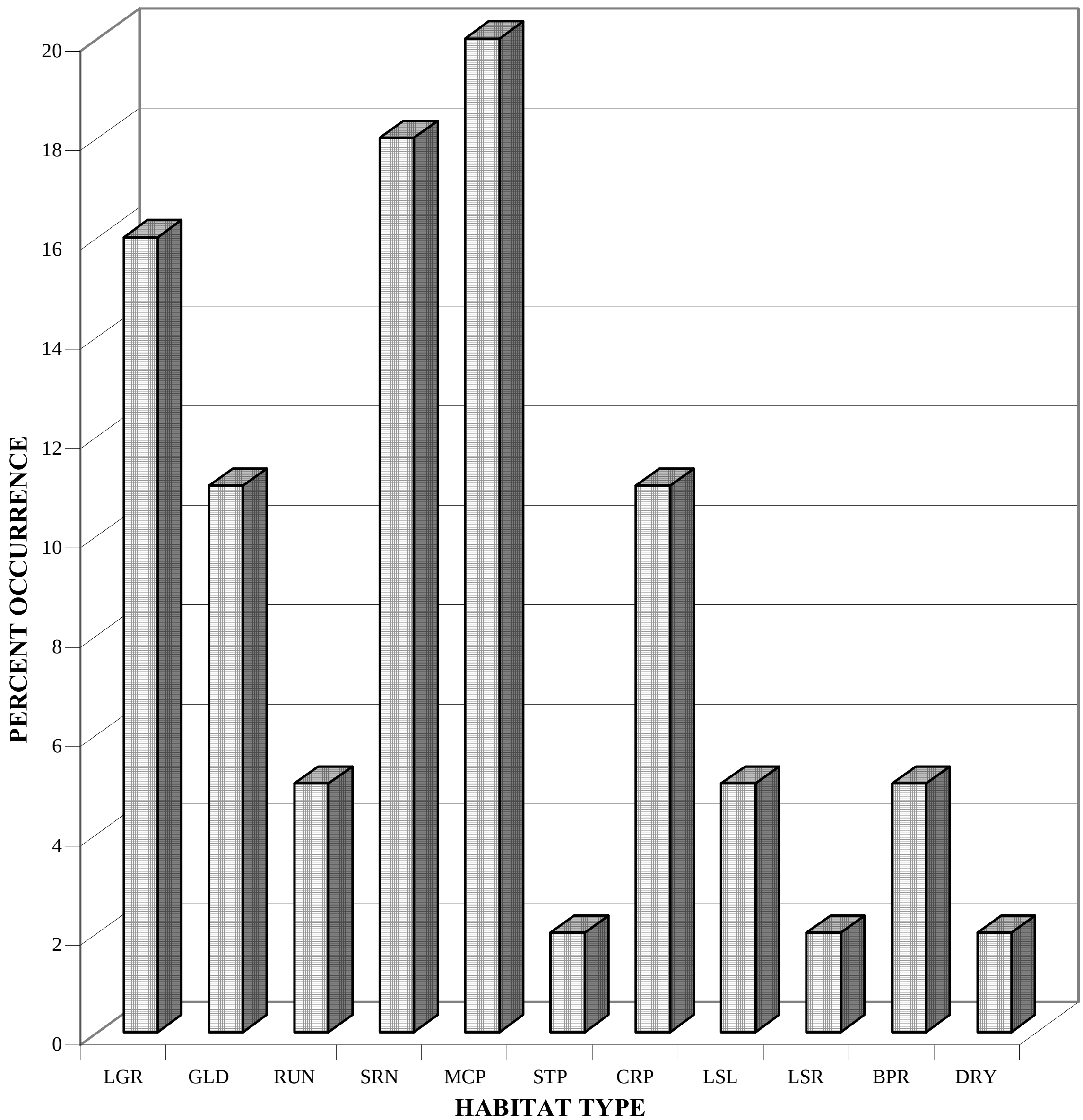
HABITAT TYPES BY PERCENT TOTAL LENGTH



GRAPH 2

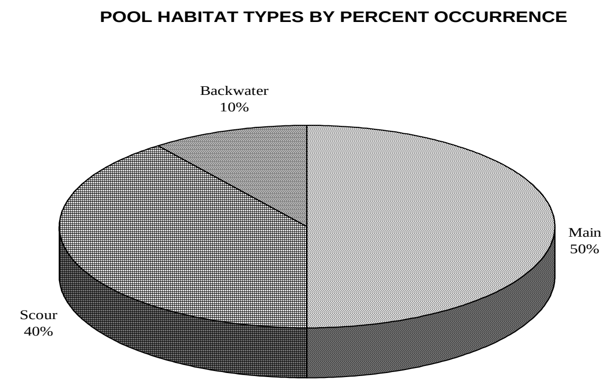
SIMMONS CREEK

HABITAT TYPE BY PERCENT OCCURRENCE



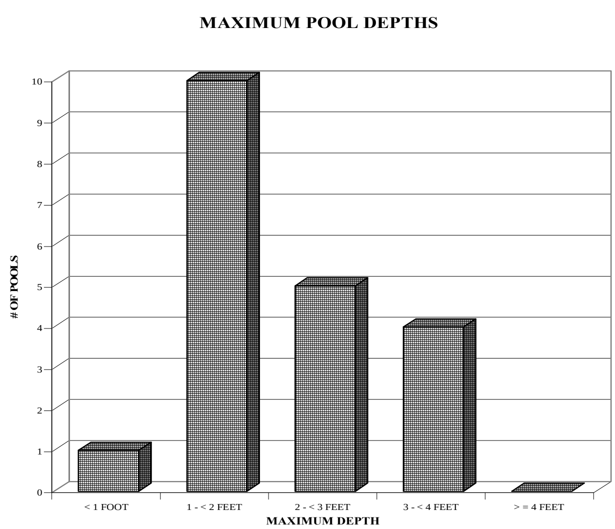
GRAPH 3

SIMMONS CREEK



GRAPH 4

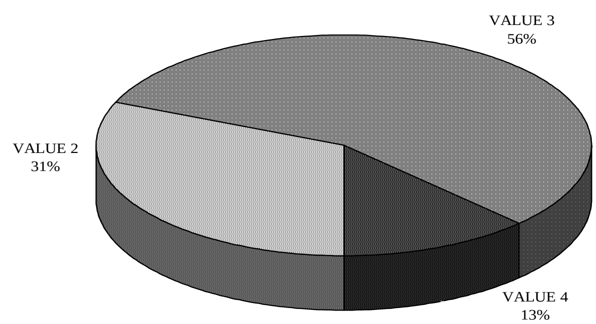
SIMMONS CREEK



GRAPH 5

SIMMONS CREEK

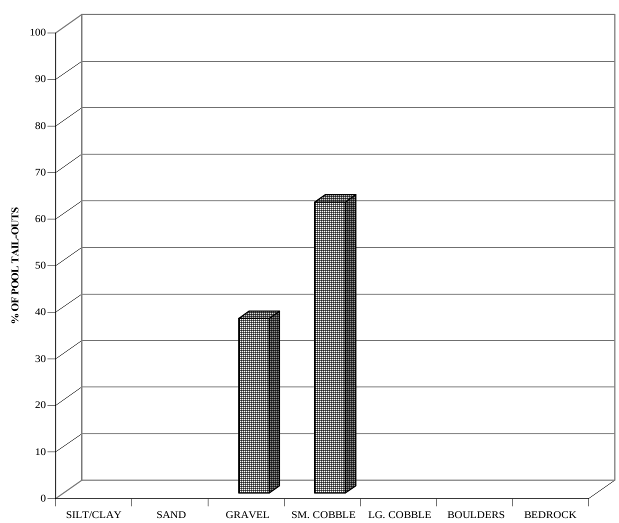
PERCENT EMBEDDEDNESS



GRAPH 6

SIMMONS CREEK

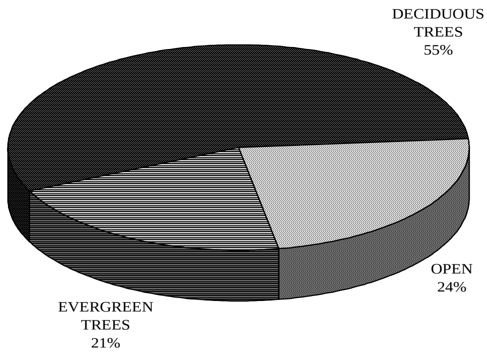
SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



GRAPH 8

SIMMONS CREEK

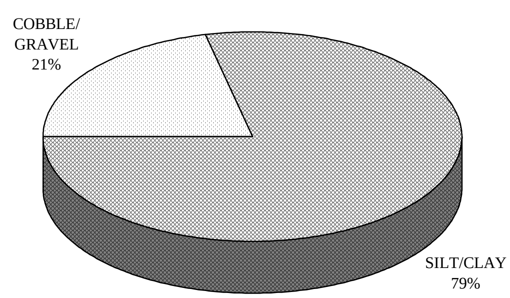
PERCENT CANOPY



GRAPH 9

SIMMONS CREEK

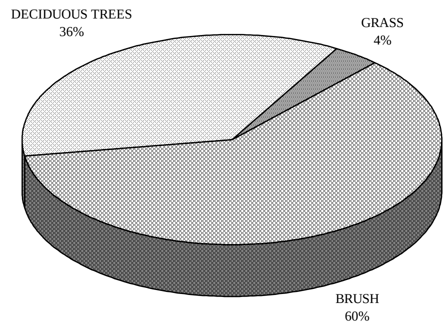
DOMINANT BANK COMPOSITION IN SURVEY REACH



GRAPH 10

SIMMONS CREEK

DOMINANT BANK VEGETATION IN SURVEY REACH



GRAPH 11

7.0 SEDIMENTATION STUDY *(STILLWATER SCIENCE)*

7.1 Turbidity

The impact of turbidity on salmonids and other aquatic species is a major concern in watersheds where land use activities have increased fine and/or total sediment supply to channels. Effects of increased turbidity, including reduced feeding efficiency and disrupted territorial behavior, can occur at relatively low turbidity levels. These changes have the potential to impact the population dynamics of affected species primarily by reducing growth rates.

The Napa Valley is heavily developed for agricultural and residential land uses. Hillslope erosion has been identified as a clear concern for many stakeholders in the watershed. Based on initial information review and field reconnaissance surveys conducted in summer 2000, we hypothesized that feeding opportunities for juvenile steelhead during the rainy season (particularly in the late fall and early spring when temperatures are not too cold to inhibit feeding and growth) have been reduced by elevated turbidity levels. Reduced growth may affect subsequent survival (see juvenile summer growth study description below for discussion of possible mechanisms). If prolonged high turbidity occurred only after infrequent flood events (e.g., flood events with a recurrence interval of 5 years or greater), then high turbidity would probably not have a significant impact on steelhead production in the Napa River basin. We hypothesized that to be deleterious, prolonged high turbidity would have to occur after relatively common storms. To assess whether turbidity levels at commonly occurring flows could be sufficiently elevated (i.e., at levels above a threshold of 20 NTUs [nephalometric turbidity units, a common measure of turbidity], a conservative estimate where prey capture efficiency by steelhead would become impacted), we measured turbidity under winter baseflow conditions immediately following four storms in 2001 and one larger storm in 2002, to see if these storms cause a chronic reduction in steelhead feeding efficiency. During water year 2001, we conducted turbidity monitoring at a total of 24 sites (Figure ES-4); 19 sites were sampled to fully characterize the recessional limb of 4 different storms, and the remaining 5 sites were sampled for fewer storms. Turbidity was re-measured at 22 of the 24 original sites in a limited sampling effort to capture conditions after a larger storm event during water year 2002, which was much wetter than 2001.

Our results indicate that feeding opportunities were probably not lost for more than one or two days following even the largest storms (based on the 20 NTU estimate). Therefore, turbidity probably did not pose a significant limitation to feeding by steelhead during the period studied (Figure ES-5). No sediment source analysis was done, hence we do not know if potential significant sources of fine sediment and clays (dirt roads, freshly ploughed agricultural fields, etc.) were exposed during the period of measurement. Within the narrow time frame of this study, no turbidity effects were found, despite our examination of 17 tributaries and 7 sites on the mainstem Napa River. This suggests that there is not a permanently elevated chronic source of sediment causing deleterious turbidity levels. However, our results reflect conditions during only two water years and may not have captured the effects of episodic or rare phenomena such as periods with higher rates of land conversion or road construction or infrequently occurring natural events, such as landslides or extremely large storms.

7.2 Pool Filling

If the total and/or fine sediment load (sand and fine gravels) is high relative to transport capacity of a channel, large deposits of fine bed material (predominantly sand and very fine gravels) may accumulate in pools. Reduction in pool volume caused by fine sediment deposition is biologically important because it has the potential to reduce the amount of juvenile rearing habitat for salmonids and other native fish and aquatic wildlife. Reductions in pool depth, in addition to reducing the total quantity of juvenile rearing habitat, may also adversely affect thermal and velocity refugia that are often associated with deep pools, as well as reduce areas used for cover to avoid predators.

Reconnaissance surveys of tributaries throughout the Napa River basin did not find substantial evidence of pool filling by fine sediment. Extensive anecdotal evidence of fine sediment loading exists, however, and we tested the hypothesis that pool filling by elevated fine sediment loading caused by recent changes in land use activities is not a pervasive problem in the Napa River basin. The V* index is a standard measure of pool filling with fine sediment that provides a means of assessing morphologic response to fine sediment delivery. We used a modified V* approach to develop a rapid assessment index of pool filling.

We surveyed pool filling during 2001-2002 at 29 reaches in 18 tributaries to the Napa River (Figure ES-4). Our results indicated a median basinwide level of pool filling of only 2 percent and confirmed the initial reconnaissance observations that pool filling was not high in the Napa River basin: 25 of the 29 reaches had index values of <10 percent (21 were less than 5 percent), probably well within the expected range of natural variability. One reach on Dry Creek had a value between 10–20 percent, and only three reaches (two on Carneros Creek and one on Sulphur Creek) had values >20 percent. Further study is needed to establish the causes of the few high values since they may be due either to natural or anthropogenic sediment sources located upstream of the survey sites.

7.3 Gravel Permeability

The key factor determining survival of salmonids during egg incubation through fry emergence is the presence of sufficient flow of cool, clean water through the spawning gravels to ensure delivery of dissolved oxygen and elimination of metabolic wastes. When a high percentage of fine sediment is deposited in or on the streambed, gravel permeability (or flow rate of water through the gravels) can be reduced by a substantial amount. Reduction of gravel permeability results in progressively less oxygen and greater concentrations of metabolic wastes around incubating eggs and alevins (newly hatched fish larvae or sac-fry) as they develop within the streambed in the pore spaces between gravels, resulting in higher mortality. Permeability is the only descriptor of spawning gravel quality that (1) is known to directly affect salmonid survival during egg incubation through fry emergence, and (2) is affected directly by fine sediment deposition. Measured permeability rates can be converted into an index of predicted mortality rates for salmonid egg incubation through emergence life history stage using relationships established from field observations and experiments.

Initial observations made during field reconnaissance during summer 2000 suggested that the amount of fine sediments present at potential spawning sites was typically low. Considering the potential importance of spawning gravel quality as a limiting factor, and conditions observed at reconnaissance sites, we tested the hypothesis that gravel permeability was not impaired by fine sediment in Napa River tributaries. We measured permeability at 29 reaches in 17 tributaries during field surveys conducted in 2001-2002 (Figure ES-4). Measured permeability values at 29 potential spawning sites for steelhead trout in Napa River tributaries were lower than those typically found in steelhead streams considered "good" quality: the median predicted mortality index value was 55 percent, with 3 of 29 sites having mortality index values greater than 75 percent and no sites having mortality index values lower than 25 percent. Permeability measured at three potential chinook/steelhead spawning sites on the mainstem were comparable to the results for the tributaries, with mortality index values of 33, 54, and 57 percent. We concluded that our original hypothesis, that streambed permeability at potential spawning sites was typically sufficient to support high egg survival, is incorrect, and that fine sediment loading may be a widespread problem in the Napa River watershed. Further study is needed to establish the causes of the high fine sediment loading to stream channels. However, existing data on fish distribution and abundance (including snorkel surveys conducted throughout most of the basin in 2001 by Friends of the Napa River and data we collected during summer 2001 in Dry and Ritchie creeks) indicate that a number of Napa River tributaries appear to be relatively well-seeded with juvenile steelhead. Empirical and theoretical evidence suggests that spawning gravel quality and quantity are rarely the primary factors limiting population levels of species such as steelhead and resident trout, but they may be important contributing factors. The relative importance of reduced permeability as compared to factors such as the availability of rearing habitat for juveniles is discussed in the context of a limiting factors analysis below (Section V).

7.4 Bed Mobility

Movement of spawning gravels at high flows can cause redd scour, resulting in displacement and mortality of eggs. Human land management practices have the potential to influence the frequency of mobilization of the channel bed. For example, construction of roads along major tributaries can significantly increase peak flows in small channels and increase the frequency of bed mobilizing flows. Furthermore, the construction of levees or artificially reinforced banks tend to confine and increase the depth of high flows, increasing shear forces acting on particles in the channel bed. Downstream of dams, bed mobility may be greatly reduced. This in turn may lead to changes in aquatic invertebrate species composition and abundance and an overall reduction of food available to fish. It may also lead to an accumulation of fine sediment in the streambed.

During reconnaissance and extensive surveys conducted in summer and fall of 2000, we saw extensive bars and riffles of finer, and presumably readily mobilized, sediment in the mainstem Napa River. As a result, we hypothesized that gravels in the mainstem that are potentially suitable for spawning tend to be mobile under relatively frequent flows (i.e., flows with a recurrence interval of less than 1 year), leading to a high likelihood that salmonid redds created in any given year would experience mechanical scour, likely resulting in high mortality of eggs and larvae. As opposed to the mainstem, observations in the tributaries found that the channel bed was typically much more coarse (gravel to cobble sized particles predominate), and therefore, we did not predict increased bed mobility in the tributaries.

We conducted studies in the mainstem Napa River in two reaches, near the cities of Calistoga and St. Helena (Figure ES-3), to test this hypothesis by calculating the boundary shear stress required to mobilize the existing channel bed in potential spawning riffles. We found that in a typical year, the spawning gravels would probably be mobilized many times per spawning-incubation period (December-February) at both locations. While more field studies would be required to determine the depth of scour (and therefore the extent of scour impacts on eggs), it appears that salmonid redds built in these gravels may be sufficiently scoured to cause high egg and larval mortality, substantially impairing the ability of chinook salmon and steelhead to successfully spawn in the mainstem Napa River.

Storm Event Date	Water Year	Peak Flow	Number of Storms per Year/s
Jan 12th	2000-'01	352	~1/ year
Feb 11th	2000-'01	380	~1/ year
Feb 25th	2000-'01	952	~1/ year
Mar 3rd	2000-'01	2702	~4/ 5-years
Jan 2nd	2001-'02	3292	~3/ 4-years

Table 1: This table shows the dates on which peak flows occurred, at the St. Helena gage, for the storms sampled in this study (flow at the St. Helena gage was used as a general indicator of flow status of the basin as a whole). Sampling was performed on the receding limb of the hydrograph of these storms approximately 1, 2, 4 and 8 days following the peak flow at the St. Helena gage (See Figure 1a-g and Table 2 for results).

	January 04, 2002		January 11, 2002	
Tributary	Flow (average) (CFS)	Turbidity (NTU)	Flow (CFS)	Turbidity (NTU)
Cyrus Creek at Route 128	586.6	11.65	220	8.76
Dutch Henry Creek at Route 29, above Biter Creek	586.6	4.63	213	2.80
Mill Creek at Route 29	586.6	10.8	220	7.25
Napa River at Zinfandel Lane	586.6	18.7	219	8.19
Ritchie Creek at Route 29	586.6	11.6		
Biter Creek at Route 29			212	3.10
Carneros Creek at			225	6.34

Duhig Road & Ramal Road				
Carneros Creek at Route 121			225	18.2
Dry Creek at Route 29, near Darms Lane			220	4.06
Garnett Creek at Route 29			218	3.79
Milliken Creek			211	4.54
Napa River at Deer Park Road			211	7.16
Napa River at Oak Knoll Road			209	11.3
Napa River at Tubbs Road			219	4.26
Napa River at Yountville Crossing			210	9.18
Redwood Creek at Redwood Drive			223	8.04
Simmons Canyon Creek			213	6.54
Soda Creek at Silverado Trail			210	2.68
Sulpher Creek at Pope Street			218	3.70
York Creek at Route 29			219	7.46

Table 2: Turbidity data collected in a limited field effort conducted on receding limb of a large storm that occurred January 2nd 2002 (see Table 1). These results indicate low turbidities values that are consistent with the results of turbidity sampling conducted in the spring of 2001 (see Figures 1a-g) a year that experienced significantly less rainfall.

Table 3. Summary of Permeability and Pool Infilling Sampling Results in the Northern Napa River Basin.

Stream Name	Reach Name	Latitude	Longitude	Pool Infilling					Spawning Gravel Quality		
				Pool #	Date	Pool Area (m^2)	Pool Volume (m^3)	Percent Pool Infilling	Spawning Patch #	Permeability (cm/hr)	Mortality Index
Cyrus Cr.	500 Petrified Forest Rd. (upstream of Fiege Reservoir)	N38 34’ 25.8”	W122 36’ 14.7”	1	1/15/02	77	44	0.00%	A	9486	0.4626532
				2	1/15/02	135	135	0.48%	B	4961	0.5591068
				3	1/15/02	104	77	0.07%			
				4	1/15/02	66	40	0.00%			
				5	1/15/02	63	59	0.00%			
				6	1/15/02	120	104	0.00%			
Cyrus Cr.	Shaw-Williams & Franz Valley Rd. intersection	N38 34’ 53.2”	W122 36’ 33.3”	1	1/15/02	99	86	4.82%	A	10077	0.45366
				2	1/15/02	71	94	1.13%	B	1066	0.7879157
				3	1/15/02	69	41	0.60%	C	2161	0.682765
				4	1/15/02	110	73	2.03%			
				5	1/15/02	177	141	0.67%			
Diamond Mountain Cr.	1440-1450 Diamond Mountain Rd.	N38 33’ 53.8”	W122 34’ 09.2”	1	1/16/02	198	264	0.14%	A	6822	0.5117073
				2	1/16/02	130	173	1.26%	B	6415	0.5208605
				3	1/16/02	63	50	0.00%			
				4	1/16/02	92	123	3.28%			
				5	1/16/02	104	104	0.16%			
				6	1/16/02	112	75	0.06%			
Diamond Mountain Cr.	HWY 128 & Diamond Mountain Rd. intersection	N38 33’ 57.6”	W122 33’ 45.2”	1	1/16/02	184	306	2.67%	A	1856	0.7054046
				2	1/16/02	163	206	0.05%	B	2587	0.6559918
				3	1/16/02	82	93	0.00%	C	2306	0.6731015
				4	1/16/02	188	151	0.08%			

Stream Name	Reach Name	Latitude	Longitude	Pool Infilling					Spawning Gravel Quality		
				Pool #	Date	Pool Area (m^2)	Pool Volume (m^3)	Percent Pool Infilling	Spawning Patch #	Permeability (cm/hr)	Mortality Index
				5	1/16/02	170	192	0.03%			
				6	1/16/02	141	141	0.00%			
Dutch Henry Cr.	Dutch Henry Canyon Rd. & Lommel Rd. intersection (at Bridge)	N38 34' 38.0"	W122 31' 6.6"	1	1/17/02	134	178	2.30%	A	1279	0.7608095
				2	1/17/02	264	211	0.92%	B	27810	0.3026071
				3	1/17/02	94	75	4.85%			
Dutch Henry Cr.	US of Larkmead Bridge	N38 34' 3.0"	W122 31' 8.6"	1	1/17/02	338	338	0.53%	3	9661	0.4599332
									4		
									5	4758	0.5653237
Garnett Cr.	Mile 39 on HWY 29	N38 36' 15.7"	W122 35' 16.8"	1	1/15/02	817	1634	0.31%	A	7810	0.4915818
				2	1/15/02	353	353	0.00%	B	1163	0.7749568
				3	1/15/02	283	565	0.46%	C	10979	0.4409035
				4	1/15/02	942	1068	0.00%			
Mill Cr.	In Park - beside mill, US of HWY 128/29 bridge	N38 32' 27.9"	W122 30' 28.8"	2	1/16/02	113	188	0.00%	A	3798	0.5988562
				3	1/16/02	104	104	0.65%	B	18876	0.3602678
				4	1/16/02	88	106	9.00%			
				5	1/16/02	71	71	0.20%			
Mill Cr.	In Park 500 feet upstream of foot bridge	N38 32' 25.7"	W122 30' 34.7"	1	1/16/02	181	337	0.00%	A	6647	0.5155742
				2	1/16/02	59	98	0.00%	B	6201	0.5259091
				3	1/16/02	157	209	0.19%			
				4	1/16/02	66	84	0.48%			
				5	1/16/02	39	21	0.00%			
				6	1/16/02	124	82	0.04%			

Stream Name	Reach Name	Latitude	Longitude	Pool Infilling					Spawning Gravel Quality		
				Pool #	Date	Pool Area (m^2)	Pool Volume (m^3)	Percent Pool Infilling	Spawning Patch #	Permeability (cm/hr)	Mortality Index
				7	1/16/02	71	48	2.16%			
Ritchey Cr.	In Park – near top of camp circle – below 1st cabin on trail	N38 32’ 52.4”	W122 31’ 42.1”	1	1/17/02	196	196	0.61%			
				2	1/17/02	198	290	9.03%			
				3	1/17/02	85	85	8.93%			
				4	1/17/02	173	219	4.20%			
				5	1/17/02	101	121	0.22%			
				6	1/17/02	102	109	0.00%			
Ritchey Cr.	In Park – next to park restrooms at trail crossing	N38 32’ 56.7"	W122 31' 30.5"	1	1/17/02	164	142	2.27%	1	6676	0.5149264
				2	1/17/02	38	18	2.22%	2	349	0.9540653
				3	1/17/02	94	63	0.95%	A	4806	0.5638301
				4	1/17/02	44	35	0.57%	B	1483	0.7387888
				5	1/17/02	55	73	0.54%	C	2519	0.6599553
Napa River	Napa River at Bale Lane Bridge	N38 33' 26.1"	W122 30' 18.9"	N/A					A	3062	63.08
				N/A					B	10920	44.15
Napa River	At Dunaweal Lane	N38 34' 7.5"	W122 33' 15.8"	N/A	1/17/02				A	4574	57.10
Napa River	At Larkmead Lane Bridge	N38 33' 38.7"	W122 31' 14.2"	N/A	1/17/02				A	23885	32.51
				N/A	1/17/02				B	23013	33.06

8.0 STEELHEAD DISTRIBUTION STUDY

The following summary report for the Friends of the Napa River steelhead study includes several streams in the northern watershed. The study was done by Ecotrust with assistance from the Napa RCD. As a result of the surveys Mill Creek, Ritchey Creek, and Dutch Henry Creek were all found to have high steelhead presence relative to other sub-watersheds of the Napa River. The maps at the end of the report were generated using dynamically segmented GIS coverages, which show steelhead densities throughout the watershed.

ecotrust

Whole-basin Snorkel Count for Steelhead Trout in the Napa Watershed, California (Year 2001)

Dr. T. C. (Charley) Dewberry, Restoration Ecologist, Ecotrust
(in collaboration with the Friends of the Napa River)

Introduction

Little information is currently known about the abundance and distribution of salmonids in the Napa basin. No systematic basin-wide surveys have been conducted. Historically, the Napa basin was highly regarded as a steelhead trout (*Oncorhynchus mykiss*) stream. Coho and Chinook salmon were also present. Recently, California Fish and Game (DFG) has identified five creeks (Napa, Redwood, Milliken, Sarco, and Tulocay) within the City of Napa as important migration corridors and or spawning or rearing areas for steelhead trout. Also, during the, California Fish and Game surveyed the steelhead in Dry Creek, a major tributary of Napa River (DFG, unpublished information).

Chinook salmon also spawn in the basin during high water years. However, these fish are not considered a native. They are thought to originate from plantings by DFG in the San Francisco Bay (DFG, unpublished information).

One of the most important data sets for the Napa River basin is the distribution and abundance of juvenile salmonids in a basin. This information is critical for identifying the current salmonid life histories that are found in the basin and locating them spatially. Not all parts of the landscape are equal for the salmonids. Some areas are critically important while other areas are of lesser importance. Without knowing where the critically important areas are, it is not possible to prioritize aquatic restoration priorities or adequately manage the salmonids within the basin. This is particularly important for steelhead trout that are currently listed under the Endangered Species Act.

Also without this information it is very difficult to determine the effects of current land use decisions on the salmonids. This is important as Napa County is trying to assess the adequacy of current land use restrictions to protect aquatic resources within the basin. For example, agricultural and residential development on steep slopes within the basin is now a focus of concern. Without knowing where the fish are and their abundance, it is not possible to determine the effects of current development on the fish, nor guess at future affects.

During the summer of 2001, Ecotrust and Friends of the Napa River in cooperation with RCD conducted a whole-basin snorkel survey in the Napa basin. The objective of the survey was to determine the distribution and abundance of salmonids in the basin.

Method for the Napa Basin Steelhead Survey

The method selected for conducting the 2001 Napa whole-basin snorkel survey is a modified Hankin-Reeves (1988) survey. This technique is fast and efficient and is recognized as the standard survey technique throughout the U.S by most state and federal agencies. Our specific modification is also used by the Oregon Department of Fish and Wildlife in the coastal streams of western Oregon.

The Hankin-Reeves (1988) standard survey technique is based on classifying the streams into a number of habitat types and randomly sampling each of the habitat types. In our survey we used three habitat classes: riffles, pools, and glides. We defined these stream units as follows: riffles are areas of deposition formed during high flows, pools are areas of stream scour during these high flows, and glides or runs represent reaches which are neither riffles or pools. All habitat units must be longer than the stream is wide (an exception is made for riffles in certain channel types) and all habitat units must be demarcated by a break. For instance unless there is a break a glide unit is never followed upstream by a pool unit. The reason for this is if the glide were snorkeled most of the fish would immediately move from the glide into the pool as the diver began at the downstream end of the glide. By defining units based on breaks it minimizes the problem of fish moving out of the habitat unit being snorkeled. The lengths and widths of the habitat units are estimated visually. We snorkeled one in ten of each of these habitat types. The length and width of habitat units that are snorkeled are measured. The survey is conducted by moving upstream from the mouth or the first occurrence of permanent pools in the system. The survey continues upstream until the steelhead disappear or a barrier to spawning migration is reached.

Steelhead were classified into three categories: young-of-the-year or 0's, 1+ fish, and 2+ fish. The year class was determined by the size of the fish. There is very little overlap among these classes.

All stream reaches within the Napa Basin were snorkeled except those above dams. Snorkeling was also limited to reaches where we could obtain permission from the land owners.

The data are entered into an Excel spread sheet. Areas of each of the habitat units are calculated from the length and width estimates. The density of steelhead is then calculated for each habitat unit dove. The habitat units are then given a density status: not present, 0-0.5 steelhead/m^2, 0.5-1.0 steelhead/m^2, > 1.0 steelhead/m^2. The density status of reaches was determined by extrapolating the habitat unit data to reaches. The results are mapped using ArcView GIS software to illustrate the distribution of the steelhead within the basin. The estimates will be used to compare with subsequent years estimates obtained by the same method to document the trends in the steelhead populations and to locate the areas within the basin that are critical to the salmonids.

There are a number of reasons why we elected not use a calibrated estimate determined by electrofishing. The major reason is that electrofishing kills a large number of fish even if all the fish are released alive. Carl Schreck (OSU Fisheries Cooperative Unit) has found (published and unpublished results) that up to 40% of salmonids released alive die within a week of being released. In addition, electrofishing also breaks the backs of a number of fish. Later these fish are often observed during snorkel surveys.

Electrofishing also is considerably slower than snorkeling and it takes a crew of at least two or three people. Electrofishing is also a method that has its own set of sampling problems.

In some instances estimates obtained by electrofishing are less accurate that those obtained by snorkeling. This is particularly true in larger pools and in pools with cover.

Results

During the summer of 2001, all stream reaches assessable to steelhead trout where private land permission was granted were surveyed. At total of 101 km (62 miles) of stream channels were snorkeled (See attached map).

Steelhead trout were found through out the basin in tributary streams of Napa River. Of the 101 km surveyed, steelhead trout were found in 50% of the length of streams surveyed. Steelhead trout are currently widely distributed within the basin. They are found in most foothill tributaries of the Napa River where they have access. They are absent from the valley floor tributaries and the mainstem of the Napa River.

Of the 101 km of streams sampled, the densities of the steelhead were as follows: in 50% they were not present; in 28% steelhead densities were low; in 13% steelhead densities were medium; and in 9% steelhead densities were high. Steelhead densities were mostly low throughout the basin. In general, the high densities were found in the foothills on the west side of the valley.

At this time we are unable to determine if the steelhead are more prevalent on the west side of the valley because of natural or human actions in the basin. The majority of the larger tributaries on the east side of the basin have dams that prevent steelhead passage above them. Also, the dams change the physical, chemical, and biological characteristics of downstream reaches. There are also a number of natural waterfalls. Therefore, considerable potential habitat for steelhead is currently not accessible to them.

In summary, Steelhead trout are widely distributed within the basin, mostly in the foothill tributaries. During the 2001 survey, steelhead densities were higher in the westside of the basin than the eastside.

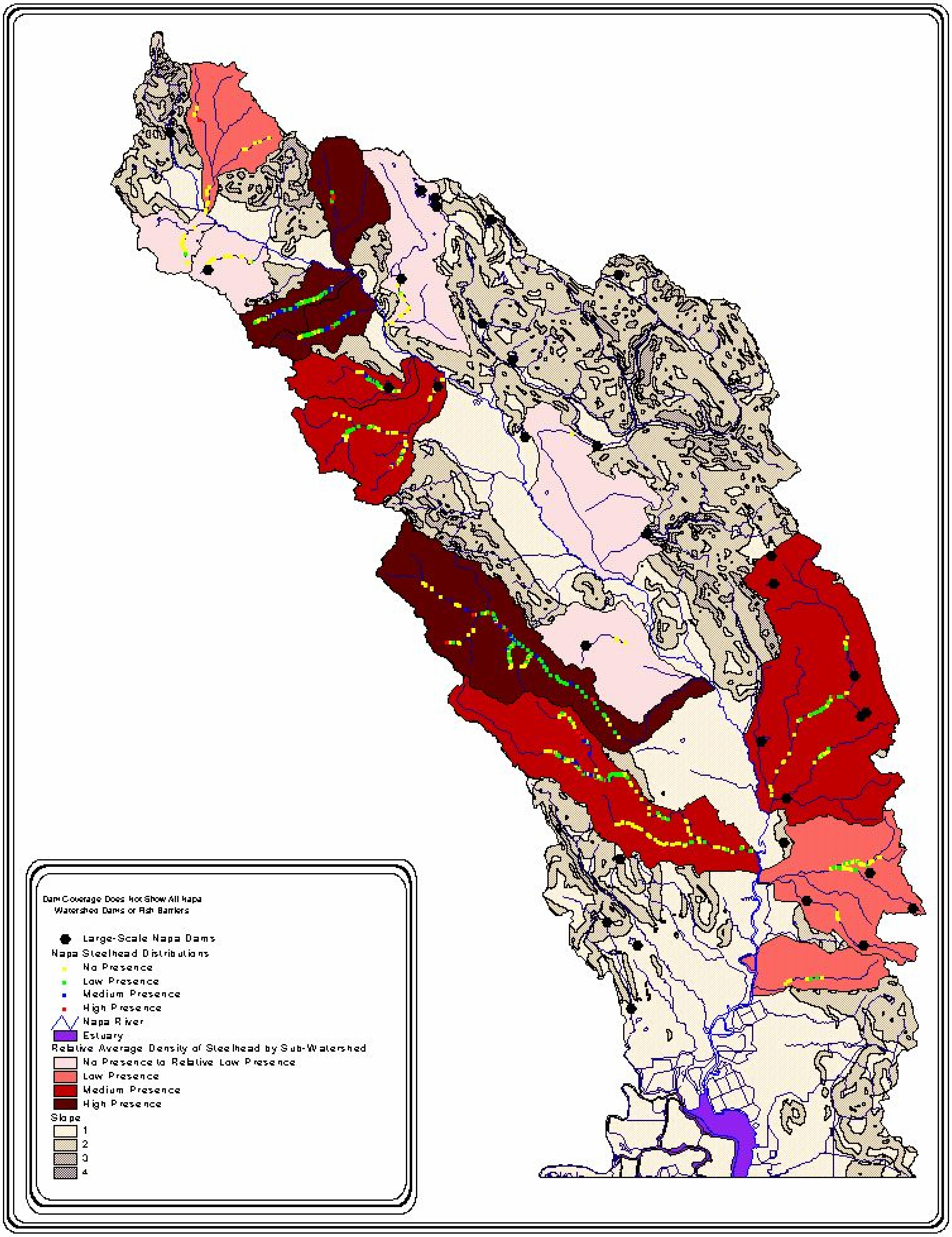


Figure 5 - *Friends of the Napa River* map showing relative steelhead densities by sub-watershed in relation to slope within the Napa River watershed.

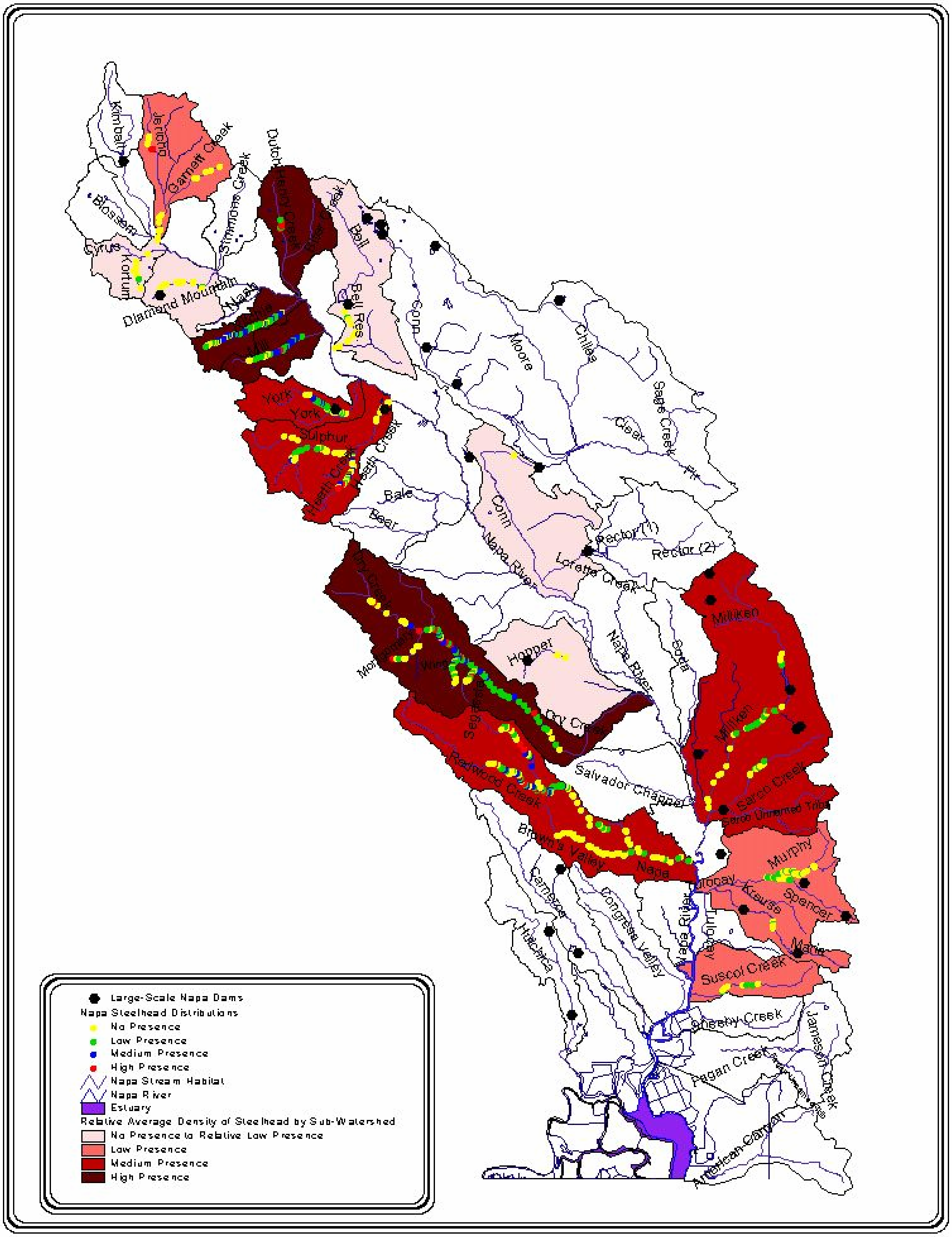


Figure 6 - *Friends of the Napa River* map showing steelhead presence within streams of the Napa River watershed and relative densities by sub-watershed.

9.0 WATER QUALITY MONITORING

Water quality monitoring was conducted at multiple sites on six streams in the northern Napa River watershed including the upper main-stem of the river. The data collected for these six waterways supplemented a larger water quality program of volunteer monitors and RCD employees encompassing the entire Napa River watershed. A standardized form was used to record values for several parameters and qualitative habitat conditions. The four main parameters measured were water temperature, dissolved oxygen, conductivity, and pH. General site conditions such as flow, water appearance, and substrate condition were also documented.

The most critical water quality parameters measured during this study were stream temperature and dissolved oxygen. All monitoring sites, with the exception of Ritchey Creek in Bothe State Park, experienced temperatures above the stress threshold of 68˚F (20˚C) for salmonids. However, since the temperature was only measured about once a month, it does not accurately describe the full temperature regime within a stream reach. The highest temperatures occurred during the hottest months of July through September. More extensive thermal monitoring with continuous data logging devices, such as Hobo temp loggers (Onset Corporation), would be very instructive in getting an accurate account of temperature fluctuations within streams. By placing several loggers throughout a stream, the full temperature regime that steelhead are experiencing could be chronicled and specific reaches within a stream could be identified for improvement.

Since most of the monitoring sites were in the lower reaches of the streams, a lack of riparian canopy in these areas is likely contributing to elevated water temperature. Reduced flows also can have a substantial impact on temperature creating warmer reaches with minimal surface movement. Elevated water temperatures create an increased metabolic strain on juvenile fish, especially salmonids as discussed in section 4.2b. The amount of growth during these periods can be stunted severely, resulting in smaller fish with lower survival rates. When these smaller fish out-migrate to the ocean, they experience much lower survival to maturity due to their disadvantageous smaller size.

Waterways with elevated temperatures contain less dissolved oxygen for fish and aquatic invertebrates. This condition can be a limiting factor to growth, and if persistent, may be fatal to salmonids. Steelhead trout do best in waters with levels of dissolved oxygen saturation between 95% and 120%. In most stream environments, a balanced amount of riffles and pools ensures that water is oxygenated through agitation and through aquatic plant respiration. However, in most streams of the northern watershed, dissolved oxygen measurements taken in pools during summer months were low. The reduction in hydraulic complexity within these streams is reflected by a reduction in agitation and hence lower levels of dissolved oxygen.

Water quality data collected during the course of this study and in prior years as part of the larger RCD monitoring program are shown in the end of this section. This assemblage of data represents a limited snapshot of water quality within selected streams of the upper watershed. It is intended to continue for several years to establish a baseline for future reference. In conjunction with rapid bioassessment studies using macroinvertebrates, these data can give an accurate measure of water quality in the streams. Through continued monitoring, changes in parameters critical to salmonids can be documented and recognized quickly.

Below is a list of sites that were monitored for varying amounts of time based on availability of volunteers and presence of water. Several monitoring locations dried up completely during the summer months, and alternate sites along the same stream were found whenever possible.

Stream Name	Site Code	MonitoringDuration
Cyrus Creek	CS1, CS2	9/22/00 – 7/19/01
Dutch Henry Creek	DH1	9/22/00 – 7/19/01
Garnett Creek	GN1, GN2	12/15/00 – 7/19/01
Upper Napa River	NR4	7/18/96 – 7/19/01
	NR5	10/29/96 – 6/27/01
	NR14	6/5/96 – 8/14/00
	NR15	6/3/96 – 7/19/01
	NR20	6/9/99 – 7/19/01
	NR21	6/9/99 – 8/14/00
Ritchey Creek	RCH1	9/22/00 – 2/18/01
Simmons Creek	SM1	9/22/00 – 7/19/01

Ongoing monitoring of the northern watershed should continue, and the use of benthic macroinvertebrates as water quality indicators should also be incorporated wherever feasible. Benthic macroinvertebrates yield a much broader picture of water quality conditions since they experience the full range of environmental variables on a continuous basis. Additionally, the relatively short life cycles of most aquatic invertebrates allows for rapid indication of changes within the stream environment.

Beginning in 2000 the Friends of the Napa River in cooperation with Ecotrust and the Napa RCD has been conducting annual benthic macroinvertebrate sampling throughout the Napa River watershed. Sampling will continue for five years without site duplication to arrive at an accurate estimation of water quality This sampling effort is based on a random selection of streams and includes several streams within the northern watershed. The results of the 2000 and 2001 study are currently being analyzed, and they will be available by the end of 2002.

10.0 DOCUMENTATION OF *Arundo donax*

Arundo donax is an invasive exotic plant species commonly referred to as giant reed. *Arundo* is native to warmer tropical and temperate regions from the Mediterranian Sea to the lower Himalyas. *Arundo* readily invades riparian habitats, chokes riversides and stream channels, and interrupts surface water flow. The long fibrous stems of the plant provide little habitat for riparian wildlife and do not supply any woody debris for instream habitat and pool cover. Additionally, dense stands of *Arundo* redirect the flow within a stream channel, and frequently cause severe opposite-bank erosion.

Within the northern Napa River watershed, several stands of *Arundo* were documented during the stream surveys. *Arundo* is an increasing problem within the watershed, and the Napa County Flood Control District has an active eradication program in place. The level of infestation remains relatively widespread throughout the Napa River watershed. Ongoing removal and eradication of *Arundo* in the watershed is necessary to prevent it from becoming a larger problem than it currently is.

Table 2 – Summary of documented stands of *Arundo donax* in the streams surveyed for the northern Napa River watershed project.

Stream Name	**Number of *Arundo* Stands**	**Reach**	**Opposite-Bank Erosion**	**Choking Channel**
1. Upper Napa River	38	All	47% (18)	53% (20)
2. Garnett Creek	7	Lower	71% (5)	57% (4)
3. Simmons	1	Lower	0%	100% (1)
4. Ritchey Creek	1	Lower	0%	0%
5. Diamond Mt. Creek	0			
6. Dutch Henry Creek	0			
7. Cyrus Creek	0			

All stands of *Arundo* seen during stream surveys, were referenced to specific habitat units within each reach according to CDFG protocol for future work locating priority sites. These sites are cataloged at the Napa RCD office and are available upon request.

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