Stream Inventory Report

Nolan Creek

Salmon Creek Watershed
Sonoma County, California

Survey: Summer 2003
Final Report: September, 2004
Revised May 2007

California Department of Fish and Game
Central Coast Region
Watershed Restoration Program

2004

CALIFORNIA DEPARTMENT OF FISH AND GAME
STREAM INVENTORY REPORT
Nolan Creek

INTRODUCTION

A stream inventory was conducted during the summer of 2003 on Nolan Creek, a tributary to Salmon Creek in the Salmon Creek watershed. The inventory was conducted in two parts: habitat inventory and biological inventory. The objective of the habitat inventory was to document the amount and condition of available habitat to fish, and other aquatic species with an emphasis on anadromous salmonids in Nolan Creek. The objective of the biological inventory was to document the salmonid and other aquatic species present and their distribution.

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

WATERSHED OVERVIEW

Nolan Creek is located in Sonoma County, California and is a tributary to Salmon Creek. The legal description at the confluence with Salmon Creek is T6N R10W Section Estero Americano. Its location is 38°20'33.81"N latitude and 122°57'45.71'W longitude. Year round vehicle access exists from Joy Road via Bodega Highway.

Nolan Creek and its tributaries drain a basin of approximately 3.1 square miles. Nolan Creek is a maximum 1st order stream and has approximately 3.6 miles of blue line or dashed blue line stream, according to the USGS Valley Ford 7.5 minute quadrangles. Nolan Creek has one major tributary, Thurston Creek, that was surveyed and is discussed in a separate report. Nolan Creek also has 2 minor unnamed tributaries, which were not surveyed. Elevations range from about 120 feet at the mouth of the creek to 689 feet in the headwaters. Grasslands, mixed hardwood, and coniferous forests dominate the watershed. The watershed is primarily privately owned and is managed for rangeland and recreation. Development is rural residential.

Salmonid fish species historically present include coho salmon (***Oncorhynchus kisutch)***and steelhead trout***(Oncorhynchus mykiss).*** Salmonid fish species currently present include steelhead

trout*(Oncorhynchus mykiss)* which is listed as threatened on the federal endangered species list.

METHODS

The habitat inventory conducted in Nolan Creek follows the methodology presented in the California Salmonid Stream Habitat Restoration Manual (Flosi, et al., 1998). The California Department of Fish and Game (DFG) field crew that conducted the inventory was trained in standardized habitat inventory methods by DFG. This inventory was conducted by 2 person teams and was supervised by DFGs North Bay Watershed Restoration Planner, Gail Seymour.

SAMPLING STRATEGY

The inventory uses a method that samples approximately 10% of the habitat units within the survey reach. All habitat units included in the survey are classified according to habitat type and their lengths are measured. All pool units are measured for maximum depth, depth of pool tail crest (measured in the thalweg), dominant substrate composing the pool tail crest, and embeddedness. Habitat unit types encountered for the first time are measured for all the parameters and characteristics on the field form. Additionally, from the ten habitat units on each field form page, one is randomly selected for complete measurement.

HABITAT INVENTORY COMPONENTS

A standardized habitat inventory form has been developed for use in California stream surveys and can be found in the California Salmonid Stream Habitat Restoration Manual. This form was used in Nolan Creek to record measurements and observations. There are nine components to the inventory form: flow, channel type, temperatures, habitat type, embeddedness, shelter rating, substrate composition, canopy, and bank composition.

1. Flow:

Flow is measured in cubic feet per second (cfs) at the bottom of the stream survey reach using standard flow measuring equipment, if available. In some cases flows are estimated. Flows were also measured or estimated at major tributary confluences.

2. Channel Type:

Channel typing is conducted according to the classification system developed and revised by David Rosgen (1985 rev. 1994).

This methodology is described in the California Salmonid Stream Habitat Restoration Manual. Channel typing is conducted simultaneously with habitat typing and follows a standard form to record measurements and observations. There are five measured parameters used to determine channel type: 1) water slope gradient, 2) entrenchment, 3) width/depth ratio, 4) substrate composition, and 5) sinuosity. Channel characteristics are measured using a clinometer, hand level, hip chain, tape measure, and a stadia rod.

3. Temperatures:

Water and air temperatures, and time, are measured by crew members with hand held thermometers and recorded at each tenth unit typed. Temperatures are measured in Fahrenheit at the middle of the habitat unit and within one foot of the water surface.

4. Habitat Type:

Habitat typing uses the 24 habitat classification types defined by McCain and others (1988). Habitat units are numbered sequentially and assigned a type identification number selected from a standard list of 24 habitat types. Dewatered units are labeled dry. Nolan Creek habitat typing used standard basin level measurement criteria. These parameters require that the minimum length of a described habitat unit must be equal to or greater than the stream's mean wetted width. All measurements were in feet to the nearest tenth. All measurements are in feet to the nearest tenth. Habitat characteristics are measured using a hip chain, and stadia rod.

5. Embeddedness:

The depth of embeddedness of the cobbles in pool tail-out reaches is measured by the percent of the cobble that is surrounded or buried by fine sediment. In Nolana Creek, embeddedness was ocularly estimated. The values were recorded using the following ranges: 0 - 25% (value 1), 26 - 50% (value 2), 51 - 75% (value 3), 76 - 100% (value 4). Additionally, a rating of "not suitable" (value 5) was assigned to tail-outs deemed unsuited for spawning due to inappropriate substrate particle size, having a bedrock tail-out, or other considerations.

6. Shelter Rating:

Instream shelter is composed of those elements within a stream channel that provide salmonids protection from predation, reduce water velocities so fish can rest and conserve energy, and allow

separation of territorial units to reduce density related competition. Using an overhead view, a quantitative estimate of the percentage of the habitat unit covered is made. All shelter is then classified according to a list of nine shelter types. In Nolana Creek, a standard qualitative shelter value of 0 (none), 1 (low), 2 (medium), or 3 (high) was assigned according to the complexity of the shelter. The shelter rating is calculated for each habitat unit by multiplying shelter value and percent covered. Thus, shelter ratings can range from 0-300, and are expressed as mean values by habitat types within a stream.

7. Substrate Composition:

Substrate composition ranges from silt/clay sized particles to boulders and bedrock elements. In all fully measured habitat units, dominant and sub-dominant substrate elements were visually estimated using a list of seven size classes which are defined in the California Salmonid Stream Habitat Restoration Manual.

8. Canopy:

Stream canopy density was estimated using modified handheld spherical densiometers as described in the California Salmonid Stream Habitat Restoration Manual. Canopy density relates to the amount of stream shaded from the sun. In Nolan Creek, an estimate of the percentage of the habitat unit covered by canopy was made from the top of approximately every third unit in addition to every fully-described unit, giving an approximate 30% sub-sample. In addition, the area of canopy was estimated visually into percentages of evergreen or deciduous trees.

9. Bank Composition and Vegetation:

Bank composition elements range from bedrock to bare soil. However, the stream banks are usually covered with grass, brush, or trees. These factors influence the ability of stream banks to withstand winter flows. In Nolan Creek, the dominant composition type and the dominant vegetation type of both the right and left banks for each fully measured unit were selected from the habitat inventory form. Additionally, the percent of each bank covered by vegetation, including downed trees, logs and rootwads, was estimated and recorded.

BIOLOGICAL INVENTORY

Biological sampling during stream inventory is used to determine fish species and their distribution in the stream. Biological inventory is conducted using one or more of three basic methods: 1)

stream bank observation, 2) underwater observation, 3) electro fishing. These sampling techniques are discussed in the California Salmonid Stream Habitat Restoration Manual.

BIOLOGICAL INVENTORY

Biological sampling during stream inventory is used to determine fish species and their distribution in the stream. Biological inventory is conducted using one or more of four basic methods: 1) stream bank observation, 2) underwater observation, 3) electro fishing, or 4) seine netting. Methods 1-3 are discussed in the California Salmonid Stream Habitat Restoration Manual. Seine netting is a fish capture technique that involves the use of a one meter square net attached to dowels on two parallel sides. The surveyor pushes the seine through the habitat unit to catch aquatic organisms. At the end of the unit the surveyor scoops up the seine and places all captured organisms in a bucket partially filled with stream water for holding. The water is aerated with a bubbler to maintain dissolved oxygen levels and minimize stress on the organisms. All fish, amphibians, and reptiles in the holding bucket are identified to species, counted and returned to the steam. Data is recorded on an electrofishing field form. Seine netting is used to confirm the presence of a species, particularly salmon and steelhead, and is not intended to quantify a population estimate.

IMPACT INVENTORY & ANALYSIS

Problems such as migration barriers, streambed erosion, poor water quality or temperatures are noted in the comments and landmarks section. In some cases measurements are taken, an analysis of what caused the problem is made and restoration potential and alternatives are recommended.

DATA ANALYSIS

Data from the habitat inventory form are entered into Habitat for data storage and analysis. Habitat is a Visual Basic extension to Microsoft Access, developed by Zebulon Young, University of California, Berkeley. This program processes and summarizes the data, and produces the following tables and appendices:

- Summary of riffle, flatwater, and pool habitat types
- Summary of habitat types and measured parameters
- Summary of pool types
- Summary of maximum pool depths by pool habitat types
- Summary of shelter by habitat types
- Summary of dominant substrates by habitat types

- Summary of fish habitat elements by stream reach

Graphics are produced from the tables using Microsoft Excel. Graphics developed for Nolan Creek include:

- Level II habitat types by % occurrence
- Level II habitat types by % total length
- Level IV habitat types by % occurrence
- Level I pool habitat types by % occurrence
- Maximum depth in pools
- Percent embeddedness estimated in pool tail-outs
- Mean percent cover types in pools
- Substrate composition in pool tail-outs
- Mean percent canopy
- Dominant bank composition in survey reach
- Dominant bank vegetation in survey reach

HISTORICAL STREAM SURVEYS:

The Department of Fish and Game has not conducted previous surveys of Nolan Creek.

HABITAT INVENTORY RESULTS FOR NOLAN CREEK

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

The habitat inventory of Nolan Creek, 7/15/2003 - 7/17/2003, was conducted by M. Terry and J. Facendini with supervision and analysis by California Department of Fish and Game (DFG). The survey began at the confluence with Salmon Creek and extended up Nolan Creek to the forks/end of landowner access permission/end of anadromous fish passage at 33'rock falls. The total length of stream surveyed was 12,383 feet, with 0 feet of side channel.

A flow of .014 cfs was measured on 7/23/03 at habitat unit 192, 12,376' above survey start with a Marsh-McBirney Model 2000 flowmeter.

The surveyed section of Nolan Creek has 4 reaches with 4 distinct channel types: from the mouth to 4,494 feet an **F5**; 4,494 feet to 9,536 (5,042 feet) an **F3**; 9,536 feet to 11,081 feet (1,545 feet) a **B3;** and 11,081 feet to 12,383 feet (1,302 feet) an **F1**.

F5 channel types are entrenched meandering riffle/pool channels on low gradients (<2%) with a high width/depth ratio and a predominantly sand substrate. F3 is cobble dominated substrate and F1 is bedrock dominated 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.

Water temperatures on the survey days ranged from 54°F to 66°F. Air temperatures ranged from 50°F to 80°F.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of ***occurrence*** there were 33.6% Flatwater units, 28.4% Pool units, 22.0% Riffle units and 15.9% Dry units (Graph 1). Based on total ***length*** there were 40.3% Flatwater units, 22.5% Pool units, 18.8% Dry units and 18.4% Riffle units (Graph 2).

Two hundred thirty two habitat units were measured and 45% were completely sampled. Twelve 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 25%, Low Gradient Riffle at 20%, Glide at 20%, Dry at 16%, Run at 12%, Step Run at 2%, Bedrock Sheet at 2%, Lateral Scour Pool - Log Enhanced at 1%, Lateral Scour Pool - Boulder Formed at 1%, Corner Pool at 1%(Graph 3). By percent total ***length***, Glide at 20%, Mid-Channel Pool at 20%, Dry at 19%, Low Gradient Riffle at 17%, Run at 16%, Step Run at 4%, Bedrock Sheet at 1%, Lateral Scour Pool - Boulder Formed at 1%, Corner Pool at 1%, Trench Pool at 1%.

Sixty six pools were identified (Table 3). Mid-Channel Pool pools were most often encountered at 25% of all habitat types (Table 2) and comprised 87% of the total length of pools.

Table 4 is a summary of maximum pool depths by pool habitat types. Pool quality for salmonids increases with depth. Thirty five of the 66 pools (53%) had a depth of two feet or greater (Graph 5). These deeper pools comprised 13% 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 23, Riffles rated 1 and Flatwater units rated 8 (Table 1). Of the pool types, Lateral Scour Pool - Log Enhanced rated 55, Mid-Channel Pool rated 23, Lateral Scour Pool - Root Wad Enhanced rated 20, Lateral Scour Pool - Boulder Formed rated 15 and Corner Pool rated 8 (Table 2).

Table 5 summarizes fish shelter by habitat type. By percent area, the dominant pool shelter types were Terrestrial Vegetation

at 31%, Small Wood at 22%, Undercut Banks at 13%, Aquatic Vegetation at 12%, Bedrock at 7%, Boulders at 6%, Large Wood at 4%, and Root Mass at 4%. Graph 7 describes the pool shelter in Nolan Creek.

Table 6 summarizes the dominant substrate by habitat type. In the 13 of the 46 Low-Gradient Riffles surveyed, the dominant substrate was: Gravel in 9 riffles, Small Cobble in two riffles, Sand in one riffle and Bedrock in one riffle.

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 66 pool tail-outs measured, 29 had a value of 2 (44%), 29 had a value of 3 (44%) and 1 had a value of 4 (2%) (Graph 6). Seven (11%) 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). No mechanical gravel sampling was conducted in 2003 surveys due to inadequate staffing levels.

The mean percent canopy density for the stream reach surveyed was 56%. The mean percentages of deciduous and evergreen trees were 63% and 37%, respectively (Table 7). Graph 9 describes the canopy for the entire survey and Table 9 describes the canopy by reach.

For the entire stream reach surveyed, the mean percent right bank vegetated was 19% and the mean percent left bank vegetated was 14%(Table 7). For the habitat units measured, the dominant vegetation types for the stream banks were: 29% Deciduous Trees, 27% Grass, 22% Brush, 11% Bare Soil and 11% Evergreen Trees(Table 8 and Graph 11). The dominant substrate for the stream banks were: 43% Silt, Clay & Sand, 42% Cobble & Gravel, 10% Bedrock and 4% Boulder (Table 8 and Graph 10).

BIOLOGICAL INVENTORY

JUVENILE SURVEYS:

Department of Fish and Game has not conducted previous biological inventories of Nolan Creek and there are not records of hatchery releases or fish rescues in the Salmon Creek watershed. A biological inventory was conducted in 2003. During the stream habitat inventory surveyors observed few juvenile salmonids as well as other unidentified non-salmonid fish.

On 8/6/03, a biological inventory was conducted at 2 sites on Nolan Creek to document fish species presence at the site sampled. The sites were electrofished. Fish from the sites were counted by

species, and returned to the stream. At site 1, the air temperature ranged from 57°F to 66°F and the water temperature ranged from 60°F to 64°F. The observers were Justin Smith and Mike Shugars (DFG). At site 2, the air temperature ranged from 66°F to 67°F and the water temperature ranged from 61°F to 62°F. The observers were Justin Smith and Mike Shugars (DFG).

The Site 1 inventory began at 0830 hours at unidentified bridge on Bodega Highway (38°20'53.6'N latitude/122°57'48.5"W longitude) and ended upstream at 1000 hours. The distance sampled was not recorded. Habitat types sampled were cascades, runs, step-runs, and mid-channel pools. Twenty-eight steelhead were observed.

The Site 2 inventory began at 1515 hours at first bridge on Joy Road after turning onto Joy Road from Bodega Highway and ended upstream at 1630 hours. The distance sampled was not recorded. Habitat types sampled were low gradient riffles, glides, runs, and mid-channel pools. Fifteen steelhead were observed (29 young of the year; 14 1+).

Species Observed in Recent Survey			
YEARS	**SPECIES**	**SOURCE**	**NATIVE/ INTRODUCED**
2003	STEELHEAD TROUT *(Oncorhynchus mykiss)*	DFG	N
2003	SCULPIN OR COTTOIDS *(Cottus sp.)*	DFG	N
2003	THREESPINE STICKLEBACK (Gasterosteus aculeatus williamsoni)	DFG	N
2003	CALIFORNIA FRESHWATER SHRIMP (Syncaris pacifica)	DFG	N
2003	CALIFORNIA OR VENUS ROACH *(Hesperoleucus symmetricus)*	DFG	N

DISCUSSION FOR NOLAN CREEK

Nolan Creek has 4 reaches: from the mouth to 4,494 feet an **F5**; 4,494 feet to 9,536 (5,042 feet) an **F3**; 9,536 feet to 11,081 feet (1,545 feet) a **B3;** and 11,081 feet to 12,383 feet (1,302 feet) an **F1**.

There are 4,494 feet of **F5** channel type in Reach 1. According to the DFG Salmonid Stream Habitat Restoration Manual, F5 channel types are good for bank-placed boulders and fair for low-stage weirs, single and opposing wing-deflectors, 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.

There are 5,042 feet of **F3** channel type in Reach 2. 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.

There are 1,545 feet of **B3** channel type in Reach 3. According to the DFG Salmonid Stream Habitat Restoration Manual, B3/4 channel types are excellent for low-stage plunge weirs, boulder clusters, bank placed boulders, single and opposing wing-deflectors and log cover. They are also good for medium-stage plunge weirs.
Many site specific projects can be designed within this channel type, especially to increase pool frequency, volume and shelter. These channel types have suitable gradients and the stable stream banks that are necessary for the installation of instream structures designed to increase pool habitat, trap spawning gravels, and provide protective shelter for fish.

There are 1,302 feet of **F1** channel type in Reach 4. According to the DFG Salmonid Stream Habitat Restoration Manual, F1 channel types are good for bank-placed boulders and fair for single wing-deflectors and log cover. Many site specific projects can be designed within this channel type, especially to increase pool frequency, volume and shelter. Any work considered will require careful design, placement, and construction that must include protection for any unstable banks.

The water temperatures recorded on the survey days 7/15/2003 - 7/17/2003 ranged from 54°F to 60°F. Air temperatures ranged from 50°F to 80°F. The warmest water temperatures were recorded in Reach 2. This temperature regime is favorable to salmonids.

Pools comprised 23% 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 Nolan Creek, the pools are relatively deep with 53% having a maximum depth of at least two feet. These pools comprised 13% 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 26. 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 31%, Small Wood at 22%, Undercut Banks at 13%, Aquatic Vegetation at 12%, Bedrock at 7%, Boulders at 6%, Large Wood at 4%, and Root Mass at 4% 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.

Eleven of the thirteen low gradient riffles measured (85%) had either gravel or small cobble as the dominant substrate. This is generally considered good for spawning salmonids.

Forty-five percent 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. In a reach comparison, Reaches 2 and 3 had the best ratings and Reaches 1 and 4 had the poorest ratings.

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 Reaches 1, 2 and 3 of Nolan 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 54%. This is a low percentage of canopy, since 80 percent is generally considered desirable. The riparian buffer is thin or nearly absent in areas with livestock. Riparian removal from intensive grazing within the riparian corridor could lead to less stream canopy and channel incision causing bank erosion and higher water temperatures. Reach 1 had a mean canopy density of 19% with bank

erosion problems. This reach as well as other areas with bank erosion could benefit from bio-technical re-vegetation techniques using native species. 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.

Ten major large woody debris accumulations which have the potential for becoming barriers or causing erosion were identified. Two major erosion sites were also noted.

SURVEYORS' OVERVIEW

The water quality in the lower section of Nolan Creek is degraded due to algae blooms and livestock feces. Livestock have full access to creek. Substrate in the lower section is primarily sand with a minimal amount of gravel. There is virtually no canopy – only a few willows.

The middle reach is fenced and there is no visible sign of livestock in the creek. Willow is dominant along the riparian zone.

The upper portion is vegetated with a mix of deciduous and evergreen trees. Upon reaching the first barrier, a 16' bedrock waterfall (Habitat Unit 226), the water temperature drastically increased upstream and no salmonids were observed. The end of anadromy was a 33 foot waterfall at Habitat Unit 232.

Throughout Nolan Creek, a small number of steelhead (mainly young of the year and a few 1+) and a larger number of warm-water unidentified fish (possibly stickleback and roach) were observed. No newts or crayfish were observed throughout. Unidentified frogs were present throughout.

GENERAL MANAGEMENT RECOMMENDATIONS

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

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

fishery professional.

PRIORITY FISHERY ENHANCEMENT OPPORTUNITIES

1) In the lower part of Reach 1, there is concentrated cattle access to the creek. There may also be some cattle presence in Reach 2. Livestock in streams generally inhibit the growth of new trees, exacerbate erosion, and reduce summertime survival of juvenile fish by defecating in the water. Alternatives to limit cattle access, control erosion and increase canopy should be explored with the landowner, and developed if possible.

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

3) Increase the canopy on Nolan Creek by planting willow, alder, redwood, and Douglas fir along the stream where shade canopy is not at acceptable levels (portions of Reach 1). The non-anadromous reach above the survey section should be assessed for planting and treated as well, since water temperatures throughout are affected from upstream. In many cases, planting will need to be coordinated to follow bank stabilization or upslope erosion control projects.

4) There are several log debris accumulations present on Nolan Creek that have the potential for causing bank erosion. The modification of these debris accumulations is not recommended at this time but they should be monitored, especially one in Reach 2 at Habitat Unit 154 and another in Reach 3 at Habitat Unit 190. If modification becomes necessary, it must be done carefully to preserve existing habitat provided by the woody debris.

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

6) Where feasible, increase woody cover in the pool and flatwater habitat units along the entire stream. Most of the existing shelter is from terrestrial vegetation and small woody debris.

Adding high quality complexity with larger woody cover is desirable. Combination cover/scour structures constructed with boulders and woody debris would be effective in many flatwater and pool locations throughout the stream. This must be done where the banks are stable (Reach 3) or in conjunction with stream bank armor to prevent erosion (Reach 1, 2,and 4). In some areas the material is at hand.

7) Where feasible, design and engineer pool enhancement structures to increase the number of pools in the upper reaches. This must be done where the banks are stable (Reach 3) or in conjunction with stream bank armor to prevent erosion (Reach 2).

8) Conduct gravel sampling. Results of future sampling may indicate the need for structures to decrease channel incision, recruit and trap spawning gravel, and expand redd distribution in the stream.

9) If riparian areas are not improved in Reach 1, temperatures in these lower sections of Nolan Creek should be monitored to determine if they are having a deleterious effect upon juvenile salmonids. To achieve this, biological sampling is also required.

COMMENTS AND LANDMARKS

The following landmarks and possible problem sites were noted. All locations (footage) are approximate and taken from the beginning of the survey.

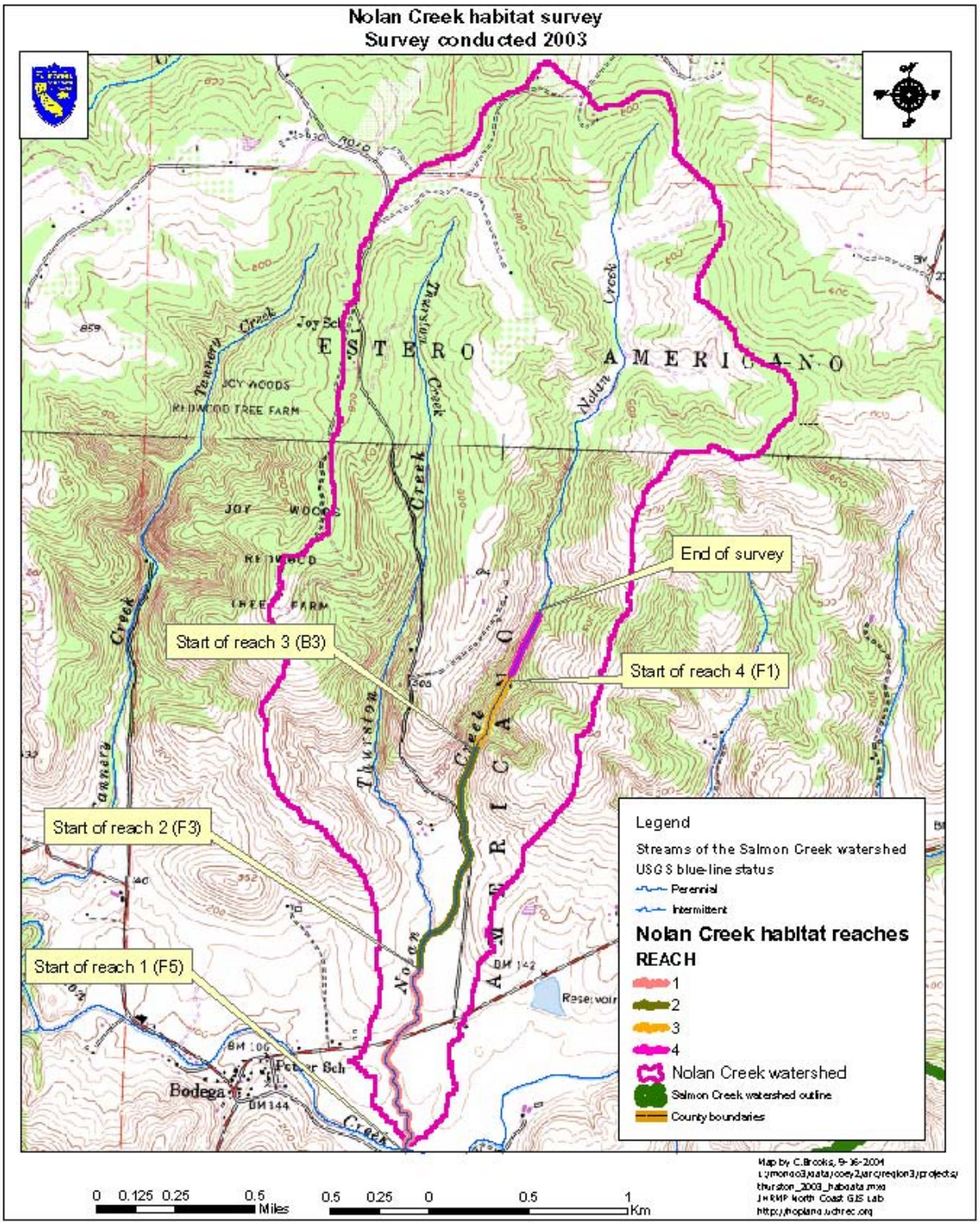
Location (feet)	Notes
0	Start of Survey at confluence with Salmon Creek.
0-3,598	Livestock access throughout first reach to 3,598 feet upstream from start of survey.
158	Fence across creek at 67' into unit
233	Erosion Left bank;
285	debris accumulation (see form);
363	cattle presence in creek
425	Waypoint 002
445	Debris accumulation on Right bank;
738	Waypoint 003
993	Non- salmonids;
1,040	Waypoint 004

Location (feet)	Notes
1,098	Non- salmonids;
2,070	algae; Waypoint 005
2,290	algae; non-salmonids;
2,825	Bodega Hwy bridge, Waypoint 007 (see form); downstream of bridge cement bags on Left bank
3,125	10-20 Young of the year Steelhead; , Waypoint 008
3,224	marshlike, lots of grass growing in creek.
3,268	cattle presence in creek
3,365	2 + Steelhead; Erosion Left bank
3,406	non-salmonids observed
3,598	Waypoint 009
3,990	6 Young of the year Steelhead
4,854	CHANNEL CHANGE to F3
5,231	Confluence pool w/ Thurston Creek; tributary temp 58 degrees F, confluence temp 60 degrees F
5,252	Debris accumulation (see form); 2' jump
5,300	Tributary Right bank at end of unit
5,441	Waypoint 012
5,729	Debris accumulation (see form); *H
5,931	Erosion Left bank
5,957	Erosion Left bank
6,127	cattle path or deer trail; Waypoint 013
6,234	Appears channelized
6,372	Young of the year Steelhead; 1+ Steelhead; non-salmonids
6,411	*HL; debris accumulation (see form)
6,539	bridge marker in creek
6,628	Waypoint 014
6,954	Erosion Right bank; boulder enhanced pool
7,041	Joy Road bridge (see form); fence Right bank
7,168	*H
7,307	*H; Advised by landowner of Mountain Lion den nearby
7,456	gully Left bank
7,524	erosion Left bank
7,601	shotgun culvert Right bank, riprap under culvert
7,661	Waypoint 016
7,702	*HL; game trail Left bank; plunge pool in high flow
7,785	Unidentified fish
7,972	Erosion on left bank
7,997	Waypoint 017; *H
8,023	Erosion on left bank
8,048	*HC; erosion Left bank
8,077	erosion Left bank
8,115	dry tributary Left bank
8,204	Erosion Right bank; DRY
8,231	dry tributary Right bank; erosion Right bank
8,288	erosion Right bank

Location (feet)	Notes
8,336	Waypoint 018
8,389	erosion Left bank
8,407	3 Young of the year Steelhead
8,464	Young of the year Steelhead (6+); driveway Right bank
8,554	erosion Right bank
8,696	debris accumulation - 2' jump
8,886	algae; Waypoint 019; Young of the year Steelhead (12+)
8,943	erosion Left bank; Young of the year Steelhead
9,313	erosion Left bank and Right bank; algae bloom
9,536	debris accumulation Left bank; erosion Right bank
9,625	CHANNEL CHANGE TO B3; gully Right bank; Waypoint 020
9,687	erosion Right bank
9,771	fence
9,896	debris accumulation Right bank
9,933	gully Right bank; Waypoint 021
9,981	*HL, log enhanced scour
10,022	Young of the year Steelhead (12+)
10,059	debris accumulation Right bank; 2 dozen Young of the year Steelhead; sculpin
10,263 to 11,891	Fence on left bank
10,340	Two 1+ Steelhead; gully Right bank; erosion Right bank
10,540	Dry tributary Right bank
10,696	Erosion Left bank/Right bank
10,750	Erosion Left bank and Right bank
10,891	*C; debris accumulation (see form); dry tributary Left bank; fence Left bank
11,257	CHANNEL CHANGE TO F1
11,306	4' JUMP
11,622	Boulder enhanced pool; 1+ Steelhead (2+)
11,726	Debris accumulation
11,756	Gully on right bank
11,891	Waypoint 023
12,003 to 12,383	Fence Right bank
12,094	plunge pool in high flows; 16' jump
12,121	algae
12,145	no fish; water temp 66 degrees F; fence Right bank
12,383	fence Right bank; algae; water temp 70 degrees F; BARRIER - 33' waterfall; END OF SURVEY - Waypoint 024

REFERENCES

Flosi, G., Downie, S., Hopelain, J., Bird, M., Coey, R., and Collins, B. 1998. California Salmonid Stream Habitat Restoration Manual, 3rd edition. California Department of Fish and Game, Sacramento, California.


Nolan Creek habitat survey
Survey conducted 2003
End of survey
Start of reach 3 (B3)
Start of reach 4 (F1)
Start of reach 2 (F3)
Start of reach 1 (F5)
Legend
Streams of the Salmon Creek watershed
USGS blue-line status
Perennial
Intermittent
Nolan Creek habitat reaches
REACH
1
2
3
4
Nolan Creek watershed
Salmon Creek watershed outline
County boundaries
Bodega
ESTERO AMERICANO
0 0.125 0.25 0.5 Miles
0.5 0.25 0 0.5 1 Km

LEVEL III and LEVEL IV HABITAT TYPE KEY:

HABITAT TYPE	LETTER	NUMBER
RIFFLE		
Low Gradient Riffle	[LGR]	1.1
High Gradient Riffle	[HGR]	1.2
CASCADE		
Cascade	[CAS]	2.1
Bedrock Sheet	[BRS]	2.2
FLATWATER		
Pocket Water	[POW]	3.1
Glide	[GLD]	3.2
Run	[RUN]	3.3
Step Run	[SRN]	3.4
Edgewater	[EDW]	3.5
MAIN CHANNEL POOLS		
Trench Pool	[TRP]	4.1
Mid-Channel Pool	[MCP]	4.2
Channel Confluence Pool	[CCP]	4.3
Step Pool	[STP]	4.4
SCOUR POOLS		
Corner Pool	[CRP]	5.1
Lateral Scour Pool - Log Enhanced	[LSL]	5.2
Lateral Scour Pool - Root Wad Enhanced	[LSR]	5.3
Lateral Scour Pool - Bedrock Formed	[LSBk]	5.4
Lateral Scour Pool - Boulder Formed	[LSBo]	5.5
Plunge Pool	[PLP]	5.6
BACKWATER POOLS		
Secondary Channel Pool	[SCP]	6.1
Backwater Pool - Boulder Formed	[BPB]	6.2
Backwater Pool - Root Wad Formed	[BPR]	6.3
Backwater Pool - Log Formed	[BPL]	6.4
Dammed Pool	[DPL]	6.5

Nolan Creek — Drainage: Salmon Creek

Table 1 - SUMMARY OF RIFFLE, FLATWATER, AND POOL HABITAT TYPES — Survey Dates: 07/15/03 to 07/17/03

Confluence Location: QUAD: Valley Ford LEGAL DESCRIPTION:T6N R10W Bodega — LATITUDE: 38.20381' LONGITUDE:122.574571'

HABITAT UNITS	UNITS FULLY MEASURED	HABITAT TYPE	HABITAT PERCENT OCCURRENCE	MEAN LENGTH (ft.)	TOTAL LENGTH (ft.)	PERCENT TOTAL LENGTH	MEAN WIDTH (ft.)	MEAN DEPTH (ft.)	MEAN AREA (sq.ft.)	ESTIMATED TOTAL AREA (sq.ft.)	MEAN VOLUME (cu.ft.)	ESTIMATED TOTAL VOLUME (cu.ft.)	MEAN RESIDUAL POOL VOL (cu.ft.)	MEAN SHELTER RATING
51	13	RIFFLE	22	45	2273	18	3.5	0.2	158	8074	66	3389	0	1
78	17	FLATWATER	34	64	4989	40	5.6	0.6	339	26426	206	16066	0	8
66	56	POOL	28	42	2787	23	7.5	1.0	301	19860	325	21479	284	23
37	0	DRY	16	63	2334	19	0.0	0.0	0	0	0	0	0	0

TOTAL UNITS	TOTAL UNITS	TOTAL LENGTH (ft.)	TOTAL AREA (sq. ft.)	TOTAL VOL. (cu. ft.)
232	86	12383	54359	40934

Nolan Creek — Drainage: Salmon Creek

Table 2 - SUMMARY OF HABITAT TYPES AND MEASURED PARAMETERS — Survey Dates: 07/15/03 to 07/17/03

Confluence Location: QUAD: Valley Ford LEGAL DESCRIPTION:T6N R10W Bodega LATITUDE: 38.20381' LONGITUDE:122.574571'

HABITAT UNITS #	UNITS FULLY MEASURED	HABITAT TYPE	HABITAT OCCURRENCE %	MEAN LENGTH ft.	TOTAL LENGTH ft.	TOTAL LENGTH %	MEAN WIDTH ft.	MEAN DEPTH ft.	MAXIMUM DEPTH ft.	MEAN AREA sq.ft.	TOTAL AREA EST. sq.ft.	MEAN VOLUME cu.ft.	TOTAL VOLUME EST. cu.ft.	MEAN RESIDUAL POOL VOL cu.ft.	MEAN SHELTER RATING	MEAN CANOPY %
46	10	LGR	20	46	2129	17	4	0.2	1.5	171	7866	69	3190	0	1	71
5	3	BRS	2	29	144	1	3	0.3	1.1	101	506	55	274	0	0	51
46	9	GLD	20	54	2475	20	6	0.6	1.3	273	12539	188	8633	0	8	56
27	5	RUN	12	75	2016	16	5	0.5	1.8	437	11794	199	5363	0	5	55
5	3	SRN	2	100	498	4	5	0.7	1.4	408	2042	299	1494	0	10	75
1	1	TRP	0	84	84	1	3	0.2	0.5	252	252	50	50	0	0	90
58	49	MCP	25	42	2415	20	8	1.1	5.8	306	17727	341	19772	293	23	54
2	1	CRP	1	46	92	1	7	0.9	1.6	342	683	307	615	273	8	48
2	2	LSL	1	27	54	0	8	1.2	2.0	164	328	181	363	0	55	78
1	1	LSR	0	42	42	0	7	0.9	2.0	294	294	265	265	235	20	90
2	2	LSBo	1	50	100	1	7	0.7	15.0	288	575	207	415	144	15	63
37	0	DRY	16	63	2334	19	0	0.0	0.0	0	0	0	0	0	0	27

TOTAL UNITS	TOTAL UNITS	LENGTH (ft.)	AREA (sq.ft)	TOTAL VOL. (cu.ft)
232	86	12383	54607	40433

Nolan Creek — Drainage: Salmon Creek

Table 3 - SUMMARY OF POOL TYPES — Survey Dates: 07/15/03 to 07/17/03

Confluence Location: QUAD: Valley Ford LEGAL DESCRIPTION:T6N R10W Bodega LATITUDE: 38.20381' LONGITUDE:122.574571'

HABITAT UNITS	UNITS FULLY MEASURED	HABITAT TYPE	HABITAT PERCENT OCCURRENCE	MEAN LENGTH (ft.)	TOTAL LENGTH (ft.)	PERCENT TOTAL LENGTH	MEAN WIDTH (ft.)	MEAN DEPTH (ft.)	MEAN AREA (sq.ft.)	TOTAL AREA EST. (sq.ft.)	MEAN VOLUME (cu.ft.)	TOTAL VOLUME EST. (cu.ft.)	MEAN RESIDUAL POOL VOL. (cu.ft.)	MEAN SHELTER RATING
59	50	MAIN	89	42	2499	90	7.5	1.1	305	17979	336	19822	293	23
7	6	SCOUR	11	41	288	10	6.9	0.9	269	1880	237	1657	214	25

TOTAL UNITS	TOTAL UNITS	TOTAL LENGTH (ft.)	TOTAL AREA (sq.ft.)	TOTAL VOL. (cu.ft.)
66	56	2787	19860	21479

Nolan Creek — Drainage: Salmon Creek

Table 4 - SUMMARY OF MAXIMUM POOL DEPTHS BY POOL HABITAT TYPES — Survey Dates: 07/15/03 to 07/17/03

Confluence Location: QUAD: Valley Ford LEGAL DESCRIPTION:T6N R10W Bodega LATITUDE: 38.20381' LONGITUDE:122.574571'

UNITS MAX DPTH MEASURED	HABITAT TYPE	HABITAT PERCENT OCCURRENCE	<1 FOOT MAXIMUM DEPTH	<1 FOOT PERCENT OCCURRENCE	1-<2 FT. MAXIMUM DEPTH	1-<2 FOOT PERCENT OCCURRENCE	2-<3 FT. MAXIMUM DEPTH	2-<3 FOOT PERCENT OCCURRENCE	3-<4 FT. MAXIMUM DEPTH	3-<4 FOOT PERCENT OCCURRENCE	>=4 FEET MAXIMUM DEPTH	>=4 FEET PERCENT OCCURRENCE
1	TRP	2	1	100	0	0	0	0	0	0	0	0
58	MCP	88	1	2	25	43	25	43	5	9	2	3
2	CRP	3	0	0	2	100	0	0	0	0	0	0
2	LSL	3	0	0	1	50	1	50	0	0	0	0
1	LSR	2	0	0	0	0	1	100	0	0	0	0
2	LSBo	3	0	0	1	50	0	0	0	0	1	50

TOTAL UNITS
66

Nolan Creek — Drainage: Salmon Creek

Table 5 - Summary of Shelter by Habitat Type — Survey Dates: 07/15/03 to 07/17/03

Confluence Location: QUAD: Valley Ford LEGAL DESCRIPTION:T6N R10W Bodega LATITUDE: 38.20381' LONGITUDE:122.574571'

UNITS MEASURED	UNITS SHELTER MEASURED	HABITAT TYPE	% TOTAL UNDERCUT BANKS	% TOTAL SWD	% TOTAL LWD	% TOTAL ROOT MASS	% TOTAL TERR. VEGETATION	% TOTAL AQUATIC VEGETATION	% TOTAL WHITE WATER	% TOTAL BOULDERS	% TOTAL BEDROCK LEDGES
46	12	LGR	0	0	0	0	0	0	0	0	100
5	3	BRS	0	0	0	0	0	0	0	0	0
46	13	GLD	7	14	6	0	66	0	0	6	0
27	8	RUN	2	21	0	0	77	0	0	0	0
5	4	SRN	0	0	0	0	0	0	0	100	0
1	1	TRP	0	0	0	0	0	0	0	0	0
58	58	MCP	14	21	4	3	32	12	0	7	7
2	2	CRP	15	15	0	0	35	35	0	0	0
2	2	LSL	0	60	31	0	10	0	0	0	0
1	1	LSR	0	0	0	0	70	30	0	0	0
2	2	LSBo	0	40	0	60	0	0	0	0	0
37	0	DRY	0	0	0	0	0	0	0	0	0
ALL HABITAT TYPES 232	106		11	19	4	3	32	9	0	14	8
POOLS ONLY 66	66		13	22	4	4	31	12	0	6	7

Nolan Creek | Drainage: Salmon Creek

Table 6 - SUMMARY OF DOMINANT SUBSTRATES BY HABITAT TYPE | Survey Dates: 07/15/03 to 07/17/03

Confluence Location: QUAD: Valley Ford LEGAL DESCRIPTION:T6N R10W Bodega | LATITUDE: 38.20381' LONGITUDE:122.574571'

TOTAL HABITAT UNITS	UNITS SUBSTRATE MEASURED	HABITAT TYPE	% TOTAL SILT/CLAY DOMINANT	% TOTAL SAND DOMINANT	% TOTAL GRAVEL DOMINANT	% TOTAL SM COBBLE DOMINANT	% TOTAL LG COBBLE DOMINANT	% TOTAL BOULDER DOMINANT	% TOTAL BEDROCK DOMINANT
46	13	LGR	0	8	69	15	0	0	8
5	3	BRS	0	0	0	0	0	67	33
46	12	GLD	0	58	42	0	0	0	0
27	8	RUN	0	25	63	0	0	0	13
5	5	SRN	0	0	20	0	20	0	60
1	1	TRP	0	0	100	0	0	0	0
58	57	MCP	18	60	16	0	0	2	5
2	2	CRP	50	50	0	0	0	0	0
2	2	LSL	0	50	50	0	0	0	0
1	1	LSR	0	100	0	0	0	0	0
2	2	LSBo	0	50	50	0	0	0	0
37	4	DRY	0	25	75	0	0	0	0

Nolan Creek

Table 7. Summary of Mean Percent Vegetative Cover for Entire Stream

Mean Percent Canopy	Mean Percent Evergreen	Mean Percent Deciduous	Mean Right bank % Cover	Mean Left Bank % Cover
55.66	36.73	63.49	18.57	14.33

Table 8. Nolan Creek

Mean Percentage of Dominant Substrate

Dominant Class of Substrate	Number Units Right Bank	Number Units Left Bank	Percent Total Units
Bedrock	13	7	9.66
Boulder	4	5	4.35
Cobble/Gravel	43	45	42.51
Silt/clay	44	46	43.48

Mean Percentage of Dominant Vegetation

Dominant Class of Vegetation	Number Units Right Bank	Number Units Left Bank	Percent Total Units
Grass	24	32	26.67
Brush	25	22	22.38
Deciduous Trees	33	27	28.57
Evergreen Trees	14	9	10.95
No Vegetation	9	15	11.43

TABLE 9 - FISH HABITAT INVENTORY DATA SUMMARY

STREAM NAME: Nolan Creek
SAMPLE 07/15/2003 to 07/17/2003
SURVEY LENGTH:
MAIN 12383 ft. SIDE CHANNEL: 0 ft.
LOCATION OF STREAM MOUTH:
USGS Quad Map: Valley Ford Latitude: 38.203381′
Legal Description: T6N R10W Bodega Longitude: 122.574571′

SUMMARY OF FISH HABITAT ELEMENTS BY STREAM REACH

STREAM REACH 01 (Units 1-73)

Channel Type: F5	Mean Canopy Density: 19 %
Main Channel 4494 ft.	Evergreen: 4 %
Side Channel Length: 0 ft.	Deciduous: 96 %
Riffle/Flatwater Mean Width: 5.5 ft.	Pools by Stream: 41 %
Pool Mean Depth: 1.1 ft.	Pools >=2 ft. Deep: 70 %
Base Flow: not measured	Pools >=3 ft. Deep: 10 %
Water: 58-66°F Air: 50-78°F	Mean Pool Shelter: 23
Dom. Bank Grass	Dom. Shelter: Terrestrial Veg.
Bank Vegetative Cover: 15 %	LOD Pool Shelter: 0 %
Dom. Bank Substrate: Silt/Clay/Sand	Dry Channel: 2123 ft.

Embeddedness Value: 1. 0% 2. 48% 3. 29% 4. 0% 5. 24%

STREAM REACH 02 (Units 74-181)

Channel Type: F3	Mean Canopy Density: 70 %
Main Channel: 5042 ft.	Evergreen: 26 %
Side Channel Length: 0 ft.	Deciduous: 74 %
Riffle/Flatwater Mean Width: 4.2 ft.	Pools by Stream: 21 %
Pool Mean Depth: 0.9 ft.	Pools >=2 ft. Deep: 41 %
Base Flow: not measured	Pools >=3 ft. Deep: 7 %
Water: 54-60°F Air: 50-74°F	Mean Pool Shelter: 24
Dom. Bank Veg.: Deciduous Trees	Dom. Shelter: Terrestrial Veg.
Bank Vegetative Cover: 20 %	LOD Pool Shelter: 19 %
Dom. Bank Substrate: Silt/Clay/Sand	Dry Channel: 211 ft.

Embeddedness Value: 1. 0% 2. 52% 3. 45% 4. 0% 5. 3 %

STREAM REACH 03 (Units 182-205)

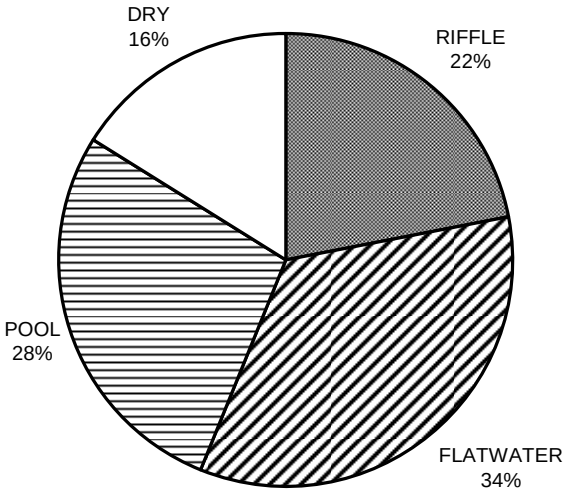
Channel Type: B3	Mean Canopy Density: 78 %
Main Channel 1545 ft.	Evergreen 81 %
Side Channel Length: 0 ft.	Deciduous 21 %
Riffle/Flatwater Mean Width: 6.8 ft.	Pools by Stream 31 %
Pool Mean Depth: 0.8 ft.	Pools >=2 ft. Deep: 33 %
Base Flow: not measured	Pools >=3 ft. Deep: 11 %
Water: 56-60°F Air: 64-80°F	Mean Pool Shelter 25
Dom. Bank Deciduous Trees	Dom. Shelter: Small Woody Debris

Bank Vegetative Cover: 11 % LOD Pool Shelter: 41 %
Dom. Bank Substrate: Cobble/Gravel Dry Channel: 0 ft.
Embeddedness Value: 1. 0% 2. 25% 3. 75% 4. 0 % 5. 0%

STREAM REACH 04 (Units 206-232)

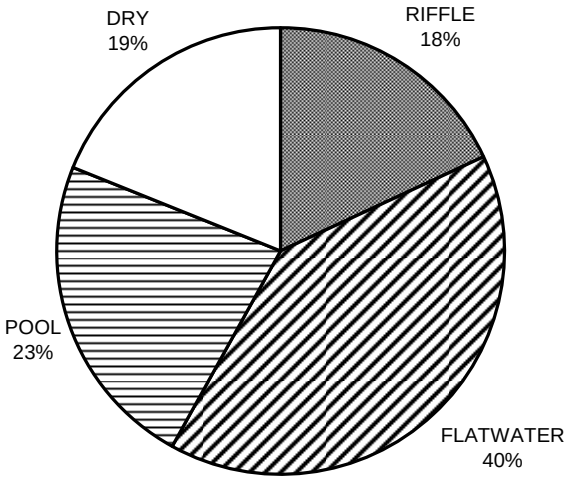
Channel Type: F1 Mean Canopy Density: 74 %
Main Channel: 1302 ft. Evergreen: 78 %
Side Channel Length: 0 ft. Deciduous: 20 %
Riffle/Flatwater Mean Width: 3.8 ft. Pools by Stream: 24 %
Pool Mean Depth: 1.4 ft. Pools >=2 ft. Deep: 75 %
Base Flow: not measured Pools >=3 ft. Deep: 38 %
Water: 58-60°F Air: 72-78°F Mean Pool Shelter: 46
Dom. Bank Veg.: Grass Dom. Shelter: Boulders
Bank Vegetative Cover: 13 % LOD Pool Shelter: 0 %
Dom. Bank Substrate: Silt/Clay/Sand Dry Channel: 0 ft.
Embeddedness Value: 1. 0% 2. 25 % 3. 50 % 4. 13 % 5. 13 %

NOLAN CREEK
HABITAT TYPES BY PERCENT OCCURRENCE



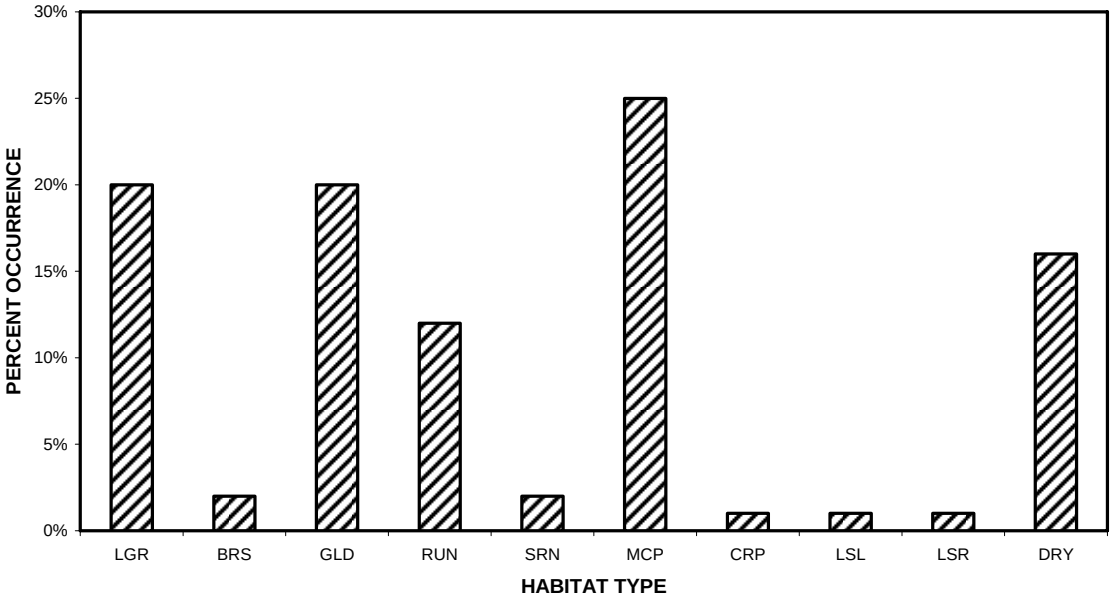
GRAPH 1. Level II habitat types by percent occurrence.

NOLAN CREEK
HABITAT TYPES BY PERCENT TOTAL LENGTH



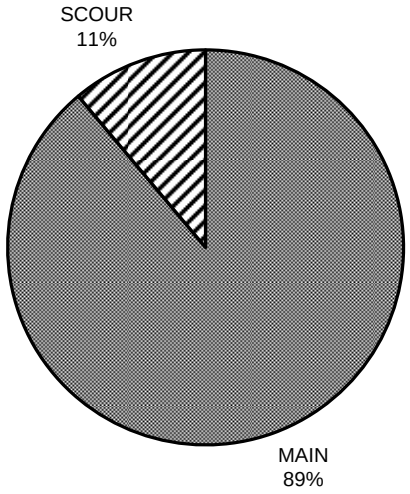
GRAPH 2. Level II habitat types by percent total length.

NOLAN CREEK
HABITAT UNIT TYPES BY PERCENT OCCURRENCE

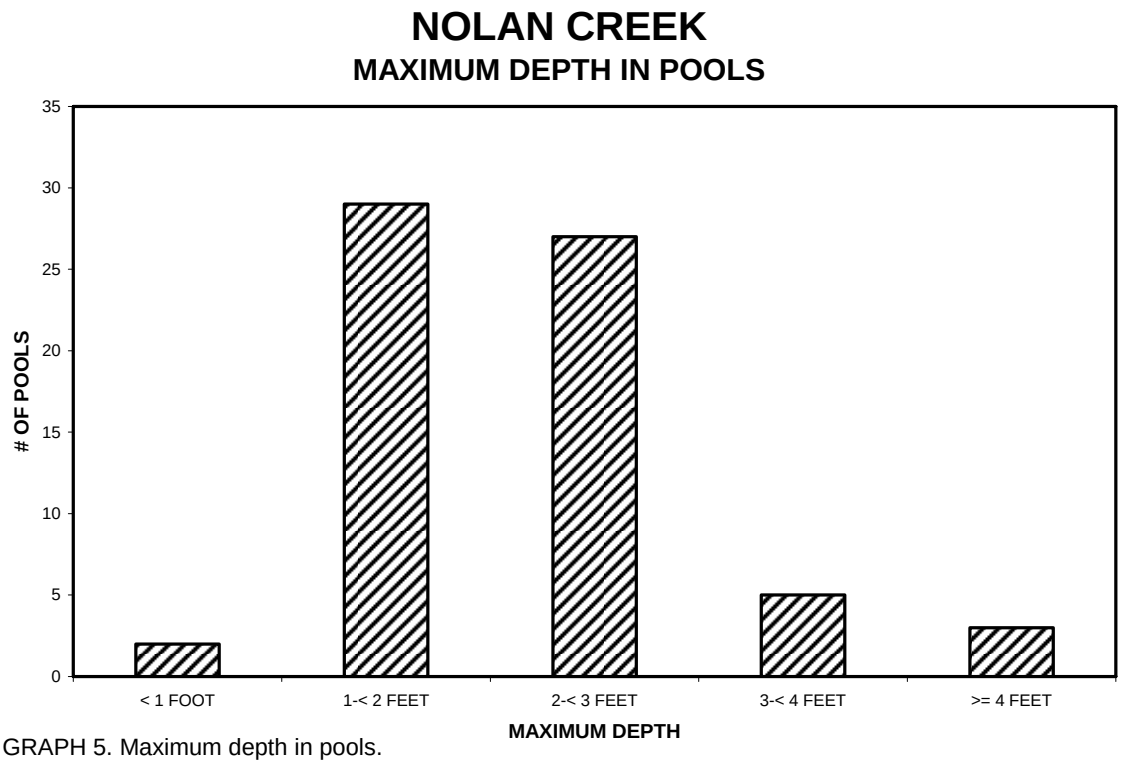


GRAPH 3. Level IV habitat unit types by percent occurrence.

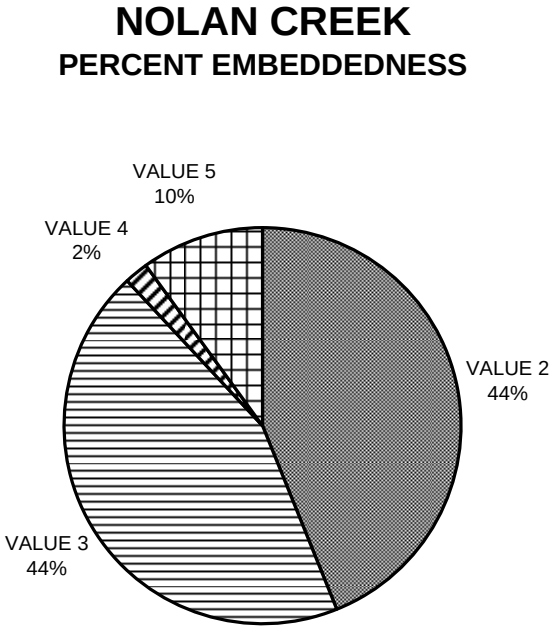
NOLAN CREEK
POOL HABITAT TYPES BY PERCENT OCCURRENCE



GRAPH 4. Level I pool habitat types by percent occurrence.

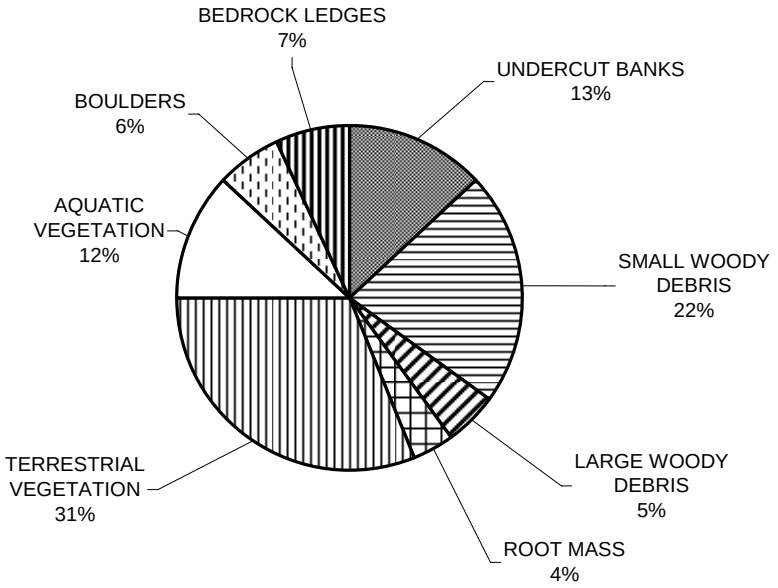


GRAPH 5. Maximum depth in pools.



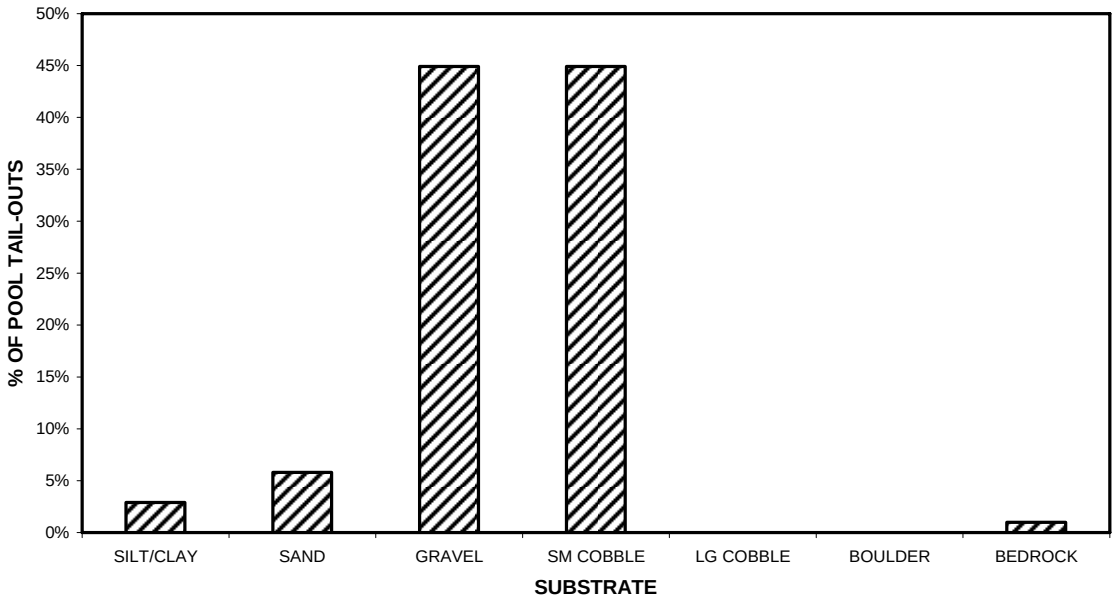
GRAPH 6. Percent embeddedness estimated at pool tail-outs.

NOLAN CREEK
MEAN PERCENT COVER TYPES IN POOLS



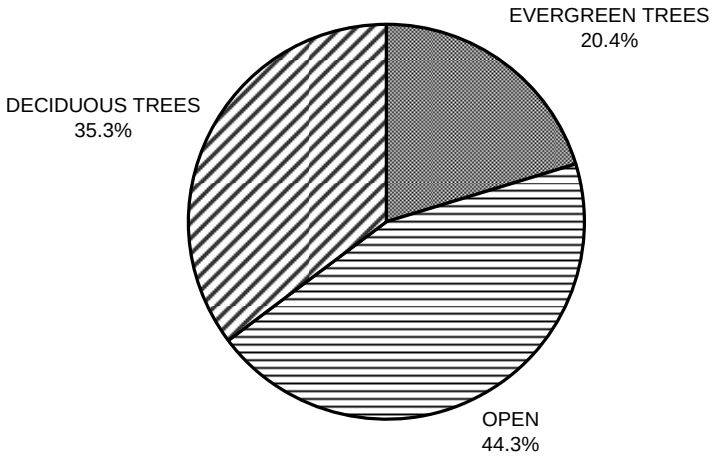
GRAPH 7. Mean percent cover types in pools.

NOLAN CREEK
SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



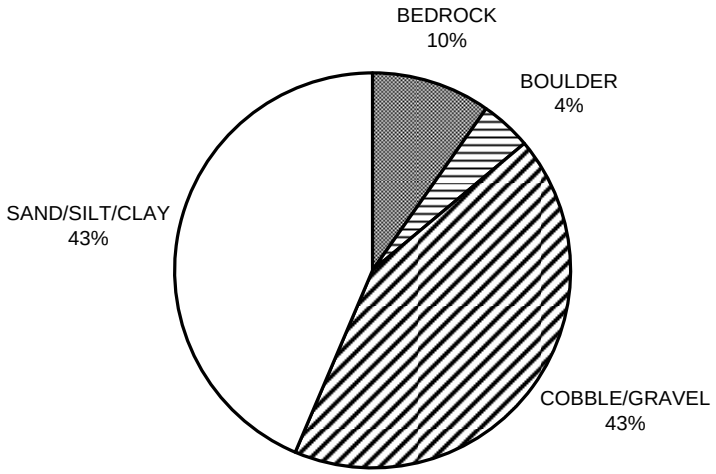
GRAPH 8. Substrate composition in pool tail-outs.

NOLAN CREEK
MEAN PERCENT CANOPY



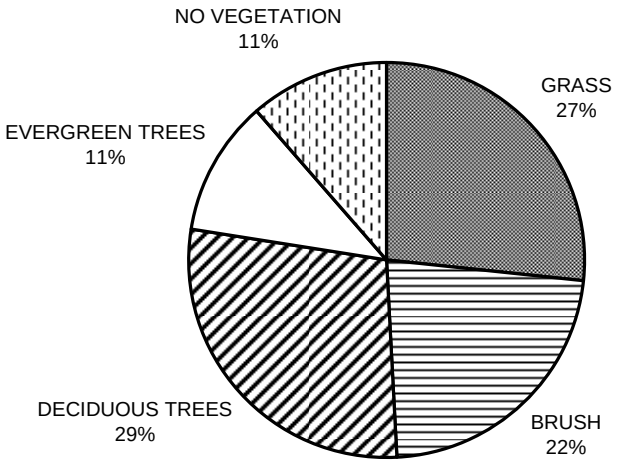
GRAPH 9. Mean percent canopy.

NOLAN CREEK
DOMINANT BANK COMPOSITION IN SURVEY REACH



GRAPH 10. Dominant bank composition in survey reach.

NOLAN CREEK
DOMINANT BANK VEGETATION IN SURVEY REACH



GRAPH 11. Dominant bank vegetation in survey reach.