

Warner Creek



**California Department of Fish and Wildlife
East Marin County
San Francisco Bay Watersheds
Stream Habitat Assessment Reports**

Warner Creek

Surveyed 2009

Report Completed in 2013

Warner Creek

STREAM INVENTORY REPORT

Warner Creek

INTRODUCTION

A stream inventory was conducted during 6/29/2009 to 6/30/2009 on Warner Creek. The survey began at the confluence with Novato Creek and extended upstream 2.8 miles. Stream inventories and reports were also completed for one tributary to Warner Creek (Vineyard Creek).

The objective of the habitat inventory was to document the habitat available to anadromous salmonids in Warner Creek. (Use if no biological inventory was done.)

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

WATERSHED OVERVIEW

Warner Creek is a tributary to Novato Creek, which is a tributary to San Pablo Bay, located in Marin County, California (Map 1). Warner Creek's legal description at the confluence with Novato Creek is T03N R06W S18. Its location is 38°05'59.3" north latitude and 122°34'07" west longitude, LLID number 1225677381000. Warner Creek is a second order stream and has approximately 8.66 miles of blue line stream within its catchment boundary according to the USGS National Hydrography Dataset (NHD). Warner Creek drains a watershed of approximately 5.09 square miles. Elevations range from about 16 feet at the mouth of the creek to 1421 feet in the headwater areas. Grass and mixed conifer forest dominate the watershed. The watershed is primarily privately owned and land use is considered 62% natural and 38% urban. Vehicle access exists via

METHODS

The habitat inventory conducted in Warner Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi et al, 1998). The Watershed Stewards Project/AmeriCorps (WSP) Members that conducted the inventory were trained in standardized habitat inventory methods by the California Department of Fish and Wildlife (CDFW). This inventory was conducted by a two-person team.

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 fully measured. All other habitat unit types

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encountered for the first time in each reach 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 Warner Creek to record measurements and observations. There are eleven components to the inventory form.

1. Flow:

Flow is measured in cubic feet per second (cfs) near the bottom of the stream survey reach using a Marsh-McBirney Model 2000 flow meter.

2. Channel Type:

Channel typing is conducted according to the classification system developed and revised by David Rosgen (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:

Both water and air temperatures are measured and recorded at every tenth habitat unit. The time of the measurement is also recorded. Both temperatures are taken in degrees Fahrenheit at the middle of the habitat unit and within one foot of the water surface.

4. Habitat Type:

Habitat typing uses the 24 habitat classification types defined by McCain and others (1990). 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". Warner 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 are in feet to the nearest tenth. Habitat characteristics are measured using a clinometer, hip chain, and stadia rod.

5. Embeddedness:

The depth of embeddedness of the cobbles in pool tail-out areas is measured by the percent of

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the cobble that is surrounded or buried by fine sediment. In Warner 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) and 76 - 100% (value 4). Additionally, a value of 5 was assigned to tail-outs deemed unsuited for spawning due to inappropriate substrate like bedrock, log sills, boulders or other considerations.

6. Shelter Rating:

Instream shelter is composed of those elements within a stream channel that provide juvenile 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 for prey. The shelter rating is calculated for each fully-described habitat unit by multiplying shelter value and percent cover. Using an overhead view, a quantitative estimate of the percentage of the habitat unit covered is made. All cover is then classified according to a list of nine cover types. In Warner Creek, a standard qualitative shelter value of 0 (none), 1 (low), 2 (medium), or 3 (high) was assigned according to the complexity of the cover. Thus, shelter ratings can range from 0-300 and are expressed as mean values by habitat types within a stream.

7. Substrate Composition:

Substrate composition ranges from silt/clay sized particles to boulders and bedrock elements. In all fully-described habitat units, dominant and sub-dominant substrate elements were ocularly estimated using a list of seven size classes and recorded as a one and two, respectively. In addition, the dominant substrate composing the pool tail-outs is recorded for each pool.

8. Canopy:

Stream canopy density was estimated using modified handheld spherical densimeters as described in the *California Salmonid Stream Habitat Restoration Manual*. Canopy density relates to the amount of stream shaded from the sun. In Warner Creek, an estimate of the percentage of the habitat unit covered by canopy was made from the center of approximately every third unit in addition to every fully-described unit, giving an approximate 30% sub-sample. In addition, the area of canopy was estimated ocularly into percentages of coniferous or hardwood 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 Warner Creek, the dominant composition type and the dominant vegetation type of both the right and left banks for each fully-described unit were selected from the habitat inventory form. Additionally, the percent of each bank covered by vegetation (including downed trees, logs, and rootwads) was estimated and recorded.

10. Large Woody Debris Count:

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Large woody debris (LWD) is an important component of fish habitat and an element in channel forming processes. In each habitat unit all pieces of LWD partially or entirely below the elevation of bankfull discharge are counted and recorded. The minimum size to be considered is twelve inches in diameter and six feet in length. The LWD count is presented by reach and is expressed as an average per 100 feet.

11. Average Bankfull Width:

Bankfull width can vary greatly in the course of a channel type stream reach. This is especially true in very long reaches. Bankfull width can be a factor in habitat components like canopy density, water temperature, and pool depths. Frequent measurements taken at riffle crests (velocity crossovers) are needed to accurately describe reach widths. At the first appropriate velocity crossover that occurs after the beginning of a new stream survey page (ten habitat units), bankfull width is measured and recorded in the appropriate header block of the page. These widths are presented as an average for the channel type reach.

BIOLOGICAL INVENTORY

Biological sampling during the stream inventory is used to determine fish species and their distribution in the stream. Fish presence was not observed from the stream banks in Warner Creek.

DATA ANALYSIS

Data from the habitat inventory form are entered into Stream Habitat 2.0.18, a Visual Basic data entry program developed by Karen Wilson, Pacific States Marine Fisheries Commission in conjunction with the California Department of Fish and Wildlife. This program processes and summarizes the data, and produces the following ten tables:

- Riffle, Flatwater, and Pool Habitat Types
- Habitat Types and Measured Parameters
- Pool Types
- Maximum Residual Pool Depths by Habitat Types
- Mean Percent Cover by Habitat Type
- Dominant Substrates by Habitat Type
- Mean Percent Vegetative Cover for Entire Stream
- Fish Habitat Inventory Data Summary by Stream Reach (Table 8)
- Mean Percent Dominant Substrate / Dominant Vegetation Type for Entire Stream
- Mean Percent Shelter Cover Types for Entire Stream

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

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- Riffle, Flatwater, Pool Habitat Types by Percent Occurrence
- Riffle, Flatwater, Pool Habitat Types by Total Length
- Total Habitat Types by Percent Occurrence
- Pool Types by Percent Occurrence
- Maximum Residual Depth in Pools
- Percent Embeddedness
- Mean Percent Cover Types in Pools
- Substrate Composition in Pool Tail-outs
- Mean Percent Canopy
- Dominant Bank Composition by Composition Type
- Dominant Bank Vegetation by Vegetation Type

HABITAT INVENTORY RESULTS

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

The habitat inventory of 6/29/2009 to 6/30/2009, was conducted by A Villalobos and C Bell (WSP). The total length of the stream surveyed was 14,889 feet.

Stream flow was measured near the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 0.18 cfs on 6/29/2009.

Warner Creek is an F4 channel type for the entire 14,889 feet of the stream surveyed (Reach 1).

F4 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and gravel-dominant substrates.

Water temperatures taken during the survey period ranged from 59 to 79 degrees Fahrenheit. Air temperatures ranged from 65 to 82 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 39% flatwater units, 8% culvert units, 28% pool units, 15% riffle units, and 8% dry units, (Graph 1). Based on total length of Level II habitat types there were 2% no survey units, 50% flatwater units, 4% culvert units, 20% pool units, 11% riffle units, and 13% dry units, (Graph 2).

Fourteen Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were 20% Run units, 18% Mid-Channel Pool units, and 15% Low Gradient Riffle units, (Graph 3). Based on percent total length, there were 27% Run units, 15% Mid-Channel Pool units, and 17% Glide units.

A total of 57 pools were identified (Table 3). Main Channel pools were the most frequently encountered, at 67%, and comprised 81% of the total length of all pools (Graph 4).

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Table 4 is a summary of maximum residual pool depths by pool habitat types. Pool quality for salmonids increases with depth. Twenty-nine of the 57 pools (51%) had a residual depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 57 pool tail-outs measured, 2 had a value of 1 (3.5%); 11 had a value of 2 (19.3%); 13 had a value of 3 (22.8%); 31 had a value of 4 (54.4%); (Graph 6). On this scale, a value of 1 indicates the best spawning conditions and a value of 4 the worst. Additionally, a value of 5 was assigned to tail-outs deemed unsuited for spawning due to inappropriate substrate such as bedrock, log sills, boulders, or other considerations.

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. Riffle habitat types had a mean shelter rating of 2, flatwater habitat types had a mean shelter rating of 11, and pool habitats had a mean shelter rating of 21 (Table 1). Of the pool types, the Main Channel pools had a mean shelter rating of 21, Scour pools had a mean shelter rating of 21, (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover types in Warner Creek. Graph 7 describes the pool cover in Warner Creek. Root Mass is the dominant pool cover type followed by undercut banks.

Table 6 summarizes the dominant substrate by habitat type. Graph 8 depicts the dominant substrate observed in pool tail-outs. Sand dominance was observed in 35% of pool tail-outs, and gravel dominance was observed in 49% of pool tail-outs.

The mean percent canopy density for the surveyed length of Warner Creek was 82%. The mean percentages of hardwood and coniferous trees were 99% and 1%, respectively. Eighteen percent of the canopy was open. Graph 9 describes the mean percent canopy in Warner Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 54%. The mean percent left bank vegetated was 59%. The dominant elements composing the structure of the stream banks consisted of 18% bedrock, 4% boulder, 78% sand/silt/clay, (Graph 10). Deciduous trees were the dominant vegetation type observed in 66% of the units surveyed. Additionally, 20% of the units surveyed had brush as the dominant vegetation type, and 12% had grass as the dominant vegetation (Graph 11).

BIOLOGICAL INVENTORY RESULTS

No biological inventory was completed for Warner Creek. No salmonids were observed from the banks during the habitat survey.

DISCUSSION

Warner Creek is an F4 channel type for the entire 14,889 feet of stream surveyed. The suitability of F4 channel types for fish habitat improvement structures is as follows: Good for bank placed boulders; Fair for plunge weirs, single and opposing wing-deflectors, channel constrictors, and

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log cover; and Poor for boulder clusters.

The water temperatures recorded on the survey days 6/29/2009 to 6/30/2009, ranged from 59 to 79 degrees Fahrenheit. Air temperatures ranged from 65 to 82 degrees Fahrenheit. To make any further conclusions, temperatures would need to be monitored throughout the warm summer months, and more extensive biological sampling would need to be conducted.

Flatwater habitat types comprised 50% of the total length of this survey, riffles 11%, and pools 20%. The pools are relatively deep, with only 29 of the 57 (51%) pools having a maximum residual depth greater than 2 feet. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat. In first and second order streams, a primary pool is defined to have a maximum residual depth of at least two feet, occupy at least half the width of the low flow channel, and be as long as the low flow channel width.

Installing structures that will increase or deepen pool habitat is recommended for locations where their installation will not be threatened by high stream energy, or where their installation will not conflict with the modification of any log debris accumulations (LDA's) in the stream.

Thirteen of the 57 pool tail-outs measured had embeddedness ratings of 1 or 2. Forty-four of the pool tail-outs had embeddedness ratings of 3 or 4. None of the pool tail-outs had a rating of 5, which is considered unsuitable for spawning. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered to indicate good quality spawning substrate for salmon and steelhead. Sediment sources in Warner Creek should be mapped and rated according to their potential sediment yields, and control measures should be taken.

Twenty-nine of the 57 pool tail-outs had silt, sand, large cobble, boulders or bedrock as the dominant substrate. This is generally considered unsuitable for spawning salmonids.

The mean shelter rating for pools was 21. The shelter rating in the flatwater habitats was 11. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by Boulders in Warner Creek. Root Mass is the dominant cover type in pools followed by undercut banks. Log and root wad cover structures in the pool and flatwater habitats would enhance both summer and winter salmonid habitat. Log cover structure provides rearing fry with protection from predation, rest from water velocity, and also divides territorial units to reduce density related competition.

The mean percent canopy density for the stream was 82%. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was 54% and 59%, respectively. In areas of stream bank erosion or where bank vegetation is sparse, planting endemic species of coniferous and hardwood trees, in conjunction with bank stabilization, is recommended.

GENERAL RECOMMENDATIONS

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

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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.

RECOMMENDATIONS

- 1) Increase woody cover in the pools and flatwater habitat units. Most of the existing cover in the pools is from Boulders. Adding high quality complexity with woody cover in the pools is desirable.
- 2) Where feasible, design and engineer pool enhancement structures to increase the number of pools. This must be done where the banks are stable or in conjunction with stream bank armor to prevent erosion.
- 3) Access for migrating salmonids should be assessed at all road crossings and dams. Particular sites of concern include the Wilson Road Bridge and associates Footbridge, the Sun Road Bridge, the McClay Road Dam site, the private footbridge near Mosswood Court, and the Mill Road in-stream Culvert. All fish passage assessments should be done according to Part 9 of the California Salmonid Stream Habitat Restoration Manual (Flosi et al, 1998). Where needed, crossings should be replaced or modified to improve fish passage.
- 4) Inventory and map sources of stream bank 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. Active and potential sediment sources related to the road system need to be identified, mapped, and treated according to their potential for sediment yield to the stream and its tributaries.
- 5) Warner Creek would benefit from utilizing bio-technical vegetative techniques to re-establish floodplain benches and a defined low flow channel. This would discourage lateral migration of the base flow channel and decrease bank erosion.
- 6) The limited water temperature data available suggest that maximum temperatures are above the acceptable range for juvenile salmonids. To establish more complete and meaningful temperature regime information, 24-hour monitoring during the July and August temperature extreme period should be performed for 3 to 5 years.
- 7) Suitable size spawning substrate on Warner Creek is limited to relatively few reaches. Projects should be designed at suitable sites to trap and sort spawning gravel.
- 8) Increase the canopy on Warner Creek by planting appropriate native vegetation like willow, alder, redwood, and Douglas fir along the stream where shade canopy is not at acceptable levels. The reaches above this survey section should be inventoried and

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treated as well, since the water flowing here is affected from upstream. In many cases, planting will need to be coordinated to follow bank stabilization or upslope erosion control projects.

COMMENTS AND LANDMARKS

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

Position (ft.)	Habitat unit #	Comments
0	0001.00	At the start of the survey there is a possible tidal influence.
549	0003.00	The first bridge is at Diablo Avenue and has a length = 54', a height = 10', and a width = 32'. It is made of concrete and metal and is not retaining gravel and there is no down cutting. This is not a barrier to fish passage because it has a natural bottom.
977	0007.00	There is a couch and urban refuse in the creek.
1,407	0011.00	There is a four inch diameter PVC pipe in the creek paralleling the thalweg.
1,753	0014.00	There is rip rap at the confluence.
1,753	0014.00	There is a tributary on the right bank. It is unnamed and enters Warner Creek. It is flowing. The water temperature downstream is 64F, upstream it is 64F and the temperature of the tributary is 60 F. There were no fish observed.
1,953	0016.00	There is a cement retaining wall.
2,123	0018.00	There is a four inch diameter black corrugated plastic pipe that follows a thalweg.
2,228	0019.00	The retaining walls stop at the beginning of this unit.
2,559	0025.00	There is a bridge at Tamalpais Avenue with a width = 30', a height = 12', and a length = 52'. It is made of cement and is not retaining gravel, and not down cutting. This is not a barrier to salmonids because it has a natural bottom.
2,611	0026.00	Bullfrog tadpoles were observed.
2,848	0027.00	Willow branches are being used to stabilize the right bank.
3,124	0028.00	There are wood stakes standing near the right bank in the stream.
3,257	0030.00	There is an unknown footbridge with a width = 25', a height = 12', and a length = 16'. It is made of wood and is not retaining gravel and not down cutting. This is not a barrier to salmonids because it has natural bottom. There were foot boards missing and broken. This bridge may not be in use.

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Position (ft.)	Habitat unit #	Comments
3,408	0034.00	There is a corrugated PVC pipe in the stream. On the right bank there is a concrete retaining wall.
3,534	0035.00	On the right bank there is a concrete retaining wall.
3,941	0041.00	There are garbage bags in the creek. On the right and left bank there are concrete retaining walls.
4,499	0051.00	There is a corrugated PVC pipe in the stream.
4,558	0052.00	There is a private footbridge with a width = 33', a height = 17' and a length = 10'. It is made of wood and it is not retaining gravel and not down cutting. This is not a barrier to salmonids because it has a natural bottom.
4,708	0054.00	On the right bank there is a concrete retaining wall.
4,857	0056.00	Wilson Creek is a tributary entering on the right bank. It is not flowing. The water temperature downstream is 70F, upstream it is 70F and the tributary is dry. There were no fish observed. There is rip rap at mouth.
5,378	0062.00	There is a Dam on McClay Road with a length = 21', a height = 1.2', and a width (o) = 2.4', and a width (d) = 14'. This is a flashboard dam. There is gravel is being retained and down cutting is occurring. The height of the downcut is 1.6 ft. From the sill to water height is 0.6 ft. This is a possible barrier to juvenile and adult salmonids. The dam is under the bridge mentioned next.
5,378	0062.00	There is a bridge on McClay Street with a width = 29', a height = 6.5' and a length = 42'. It is made of concrete and gravel is being retained. There is no down cutting occurring. This is a possible barrier to salmonids. This bridge is over the dam previously mentioned.
5,420	0063.00	On the left bank there is a circular corrugated culvert with no flow. The diameter is 1.5 ft. There is new planting on the left bank. This is where the County channel widening Project begins.
5,575	0064.00	On the left bank there are new plantings. On the right bank there is a circular concrete culvert with a diameter of 1.5ft. There is a rock weir present.
5,595	0065.00	On the left bank there is new planting.
5,790	0066.00	On the left bank there is new planting.
5,874	0067.00	On the left and right bank there is new planting. There is dense vegetation in the stream channel which begins in this unit.
6,068	0068.00	There is a rock weir present.
6,082	0069.00	On the left bank there is an unnamed tributary which enters Warner Creek from 2 pipe arch culverts. It is flowing. The water temperature downstream is 72F, upstream it is 77F and the

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Position (ft.)	Habitat unit #	Comments
		tributary temperature is 66 F. There were no fish observed.
6,606	0071.00	There is a hot water discharge pipe in the stream half way through the unit.
6,765	0073.00	There is a rock weir present.
7,220	0076.00	There is a pipe arch culvert on the left bank that is 4 ft. x 3 ft.
7,256	0077.00	There is a bridge on Center Street with a width = 26', a height = 5' and a length = 58'. It is made of concrete and gravel is being retained but there is no down cutting. This is not a barrier to salmonids because it has a natural bottom.
7,389	0079.00	The City stream widening project water is being diverted by a 2 inch pipe.
7,707	0080.00	There is a private footbridge with a width = 30', height = 12' and a length = 5'. It is made of wood and is not retaining gravel. It is not down cutting. This is not a barrier to salmonids because it has a natural bottom.
7,924	0083.00	There is a highly scoured corner area.
8,812	0099.00	There is an old bridge footing on the right and left banks.
8,812	0099.00	There is an unnamed tributary on the right bank. It is not flowing and no fish were observed.
8,965	0102.00	There is a footbridge with a width = 40', a height = 8' and a length = 8'. It is made of wood & steel and is not retaining gravel but down cutting is occurring. This is a possible barrier to salmonids.
9,017	0104.00	There is a bridge on Wilson Road with a width = 10', a height = 6' and a length L = 67'. It is made of concrete and is not retaining gravel. It is not down cutting. This is a possible barrier to salmonids.
9,414	0109.00	There is private footbridge with a width = 70', a height = 11' and a length = 9'. It is made of wood and is not retaining gravel. It is not down cutting and is not a barrier to salmonids because it has a natural bottom.
9,423	0110.00	On the right bank there is a circular culvert.
9,770	0111.00	There is a private footbridge with a width = 33', a height = 9' and a length = 10'. It is made of wood & steel and is not retaining gravel and not down cutting. This is not a barrier to salmonids because it has natural bottom.
10,070	0116.00	There is a private footbridge with a width = 33', a height = 9' and a length = 10'. It is made of wood & metal and is not retaining gravel. It is not down cutting and is not a barrier to salmonids because it has natural bottom.

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Position (ft.)	Habitat unit #	Comments
10,241	0119.00	There is a bridge serving as a private driveway with a width = 34', a height = 6' and a length = 21'. It is made of concrete & metal and is not retaining gravel. It is not down cutting and is not a barrier to salmonids because it has a natural bottom.
10,487	0126.00	There is a meander with a large flood plain on the right bank.
11,648	0147.00	There is a black PVC pipe from a house draining into the creek.
11,722	0148.00	There is a sink and other construction trash in the creek.
12,113	0154.00	There is a bridge over Sun Road with a width = 12', a height = 6' and a length = 45'. It is made of concrete and is not retaining gravel and not down cutting. This is not a barrier to salmonids.
12,158	0155.00	There is household trash in creek.
12,850	0164.00	There is a private footbridge with a width = 36', a height = 8' and a length = 5'. It is made of wood and is not retaining gravel. It is not down cutting and is not a barrier to salmonids because it has natural bottom.
13,331	0172.00	There are right bank willow baffles.
13,594	0179.00	There is a culvert under Mill Road. It is 2 culverts of round concrete both with a height = 6', a width = 6' and a length = 123'. The plunge height is 1.2 ft. and the max depth within 5 ft of outlet is 2.2 ft. It is in good condition but is a possible barrier to salmonids.
13,714	0180.00	There is a rock weir present.
14,852	0200.00	There is a private footbridge with a width = 8', a height = 5' and a length = 17'. It is made of concrete. Gravel is being retained and the concrete bottom is deteriorating. There is down cutting occurring. The height of the downcut is 3ft. This is a possible barrier to salmonids.
14,889	0201.00	End of Survey at a left bank culvert which is too small to crawl through and there is no light passing through it. Could be potentially plugged. It appears to be dry with no water spilling out of the outlet. Crew could not continue surveying upstream.

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REFERENCES

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McCain, M., D. Fuller, L. Decker and K. Overton. 1990. Stream habitat classification and inventory procedures for northern California. FHC Currents. No.1. U.S. Department of Agriculture. Forest Service, Pacific Southwest Region.

Rosgen, D.L., 1994. A Classification of Natural Rivers. *Catena*, Vol 22: 169-199, Elsevier Science, B. V. Amsterdam.

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LEVEL III and LEVEL IV HABITAT TYPES

RIFFLE

Low Gradient Riffle	(LGR)	[1.1]	{ 1 }
High Gradient Riffle	(HGR)	[1.2]	{ 2 }

CASCADE

Cascade	(CAS)	[2.1]	{ 3 }
Bedrock Sheet	(BRS)	[2.2]	{24}

FLATWATER

Pocket Water	(POW)	[3.1]	{21}
Glide	(GLD)	[3.2]	{14}
Run	(RUN)	[3.3]	{15}
Step Run	(SRN)	[3.4]	{16}
Edgewater	(EDW)	[3.5]	{18}

MAIN CHANNEL POOLS

Trench Pool	(TRP)	[4.1]	{ 8 }
Mid-Channel Pool	(MCP)	[4.2]	{17}
Channel Confluence Pool	(CCP)	[4.3]	{19}
Step Pool	(STP)	[4.4]	{23}

SCOUR POOLS

Corner Pool	(CRP)	[5.1]	{22}
Lateral Scour Pool - Log Enhanced	(LSL)	[5.2]	{10}
Lateral Scour Pool - Root Wad Enhanced	(LSR)	[5.3]	{11}
Lateral Scour Pool - Bedrock Formed	(LSBk)	[5.4]	{12}
Lateral Scour Pool - Boulder Formed	(LSBo)	[5.5]	{20}
Plunge Pool	(PLP)	[5.6]	{ 9 }

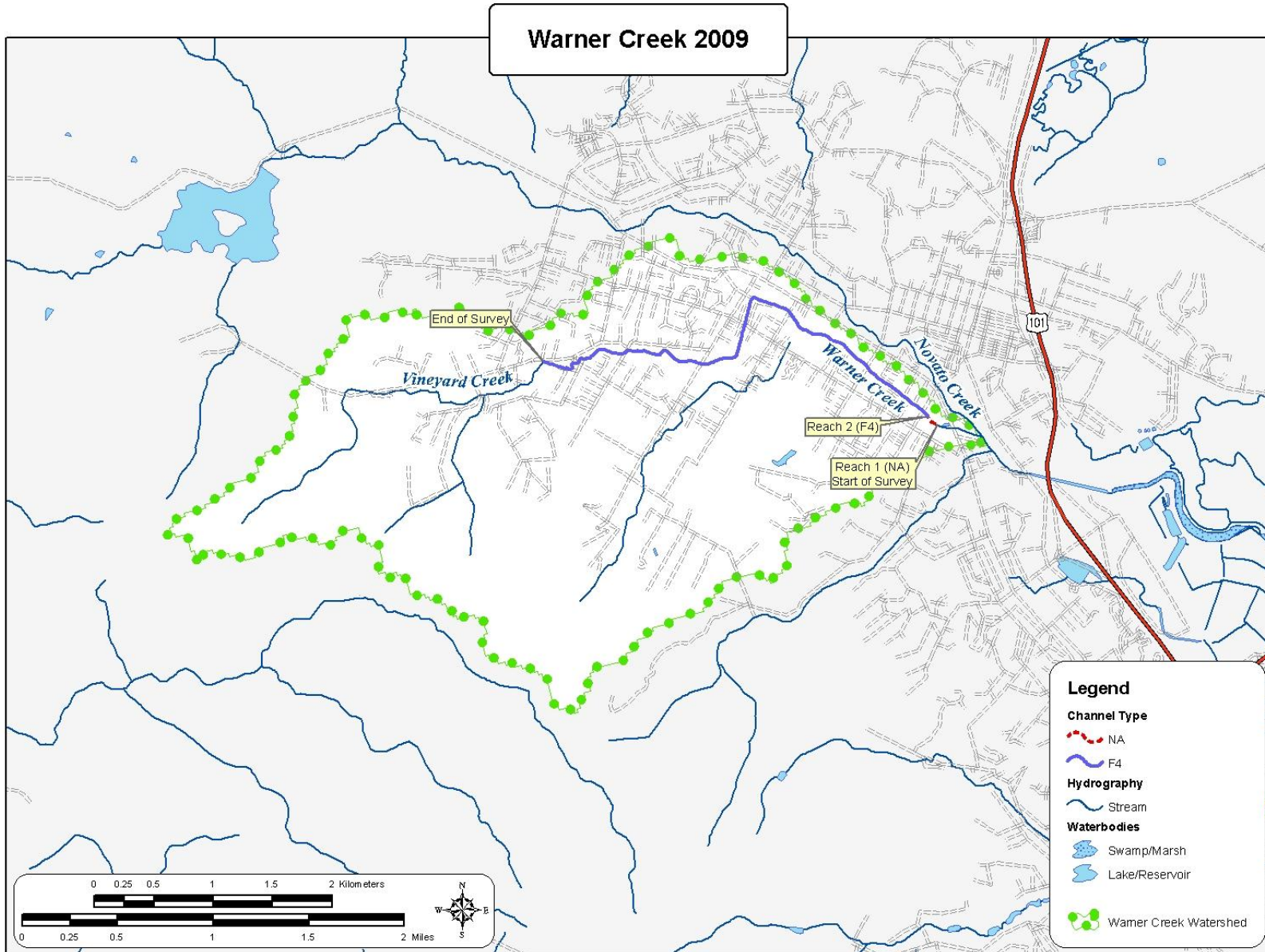
BACKWATER POOLS

Secondary Channel Pool	(SCP)	[6.1]	{ 4 }
Backwater Pool - Boulder Formed	(BPB)	[6.2]	{ 5 }
Backwater Pool - Root Wad Formed	(BPR)	[6.3]	{ 6 }
Backwater Pool - Log Formed	(BPL)	[6.4]	{ 7 }
Dammed Pool	(DPL)	[6.5]	{13}

ADDITIONAL UNIT DESIGNATIONS

Dry	(DRY)	[7.0]	
Culvert	(CUL)	[8.0]	
Not Surveyed	(NS)	[9.0]	
Not Surveyed due to a marsh	(MAR)	[9.1]	

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

Stream Name: Warner Creek

LLID: 1225677381000

Drainage: Novato

Survey 6/29/2009 to 6/30/2009

Confluence Location: Quad: NOVATO

Legal Description: T03NR06WS18

Latitude: 38:05:59.3N

Longitude: 122:34:07.0W

Habitat Units	Units Fully Measured	Habitat Type	Habitat Occurrence (%)	Mean Length (ft.)	Total Length (ft.)	Total Length (%)	Mean Width (ft.)	Mean Depth (ft.)	Mean Max Depth (ft.)	Mean Area (sq.ft.)	Estimated Total Area (sq.ft.)	Mean Volume (cu.ft.)	Estimated Total Volume (cu.ft.)	Mean Residual Pool Vol (cu.ft.)	Mean Shelter Rating
17	1	CULVERT	8.5	34	581	3.9	26.0			1508	25636				
17	0	DRY	8.5	116	1978	13.3									
78	77	FLATWATER	38.8	95	7405	49.7	6.0	0.5	1.1	568	44282	281	21948		11
1	0	NOSURVEY	0.5	325	325	2.2									
57	57	POOL	28.4	53	3026	20.3	9.2	0.9	2.0	499	28440	672	38312	552	21
31	31	RIFFLE	15.4	51	1574	10.6	4.6	0.2	0.4	170	5278	41	1245		2
Total Units	Total Units Fully Measured				Total Length (ft.)						Total Area (sq.ft.)		Total Volume (cu.ft.)		
201	166				14889						103636		61505		

Warner Creek

Table 2 - Summary of Habitat Types and Measured Parameters

Stream Name: Warner Creek

LLID: 1225677381000

Drainage: Novato

Survey 6/29/2009 to 6/30/2009

Confluence Location: Quad: NOVATO

Legal Description: T03NR06WS18

Latitude: 38:05:59.3N

Longitude: 122:34:07.0W

Habitat Units	Units Fully Measured	Habitat Type	Habitat Occurrence (%)	Mean Length (ft.)	Total Length (ft.)	Total Length (%)	Mean Width (ft.)	Mean Depth (ft.)	Mean Max Depth (ft.)	Mean Area (sq.ft.)	Estimated Total Area (sq.ft.)	Mean Volume (cu.ft.)	Estimated Total Volume (cu.ft.)	Mean Residual Pool Vol (cu.ft.)	Mean Shelter Rating	Mean Canopy (%)
31	31	LGR	15.4	51	1574	10.6	5.0	0.2	0.9	170	5278	41	1245		2	88
30	29	GLD	14.9	82	2469	16.6	7.0	0.5	1.9	616	18489	328	9854		4	77
41	41	RUN	20.4	99	4066	27.3	5.0	0.5	3.0	516	21147	249	10191		17	86
7	7	SRN	3.5	124	870	5.8	6.0	0.4	1.6	671	4695	279	1950		6	92
1	1	TRP	0.5	148	148	1.0	5.0	1.2	2.0	740	740	1110	1110	888	0	97
36	36	MCP	17.9	64	2290	15.4	9.0	0.9	3.8	615	22131	867	31229	706	23	81
1	1	CCP	0.5	33	33	0.2	16.0	1.2	2.6	528	528	739	739	634	5	91
3	3	CRP	1.5	41	123	0.8	9.0	0.9	2.9	367	1102	382	1145	331	37	100
10	10	LSR	5.0	30	302	2.0	8.0	1.0	2.7	232	2319	234	2344	211	21	95
1	1	LSBk	0.5	28	28	0.2	6.0	0.6	1.6	168	168	118	118	101	10	95
1	1	LSBo	0.5	33	33	0.2	12.0	0.4	1.4	396	396	198	198	158	20	98
4	4	PLP	2.0	17	69	0.5	14.0	0.9	3.4	264	1057	357	1430	294	13	57
17	0	DRY	8.5	116	1978	13.3										61
17	1	CUL	8.5	34	581	3.9	26.0			1508	25636					15
1	0	NS	0.5	325	325	2.2										
Total Units	Total Units Fully Measured				Total Length (ft.)						Total Area (sq.ft.)		Total Volume			
201	166				14889						103684		61552			

Warner Creek

Table 3 - Summary of Pool Habitat Types

Stream Name: Warner Creek

LLID: 1225677381000

Drainage: Novato

Survey 6/29/2009 to 6/30/2009

Confluence Location: Quad: NOVATO

Legal Description: T03NR06WS18

Latitude: 38:05:59.3N

Longitude: 122:34:07.0W

Habitat Units	Units Fully Measured	Habitat Type	Habitat Occurrence (%)	Mean Length (ft.)	Total Length (ft.)	Total Length (%)	Mean Width (ft.)	Mean Residual Depth (ft.)	Mean Area (sq.ft.)	Estimated Total Area (sq.ft.)	Mean Residual Pool Vol (cu.ft.)	Estimated Total Resid. Vol (cu.ft.)	Mean Shelter Rating
38	38	MAIN	67	65	2471	82	9.1	1.0	616	23399	709	26932	21
19	19	SCOUR	33	29	555	18	9.5	0.9	265	5041	239	4539	21
Total Units	Total Units Fully Measured				Total Length (ft.)					Total Area (sq.ft.)		Total Volume (cu.ft.)	
57	57				3026					28440		31471	

Warner Creek

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

Stream Name: Warner Creek

LLID: 1225677381000

Drainage: Novato

Survey 6/29/2009 to 6/30/2009

Confluence Location: Quad: NOVATO

Legal Description: T03NR06WS18

Latitude: 38:05:59.3N

Longitude: 122:34:07.0W

Habitat Units	Habitat Type	Habitat Occurrence (%)	< 1 Foot Maximum Residual Depth	< 1 Foot Percent Occurrence	1 < 2 Feet Maximum Residual Depth	1 < 2 Feet Percent Occurrence	2 < 3 Feet Maximum Residual Depth	2 < 3 Feet Percent Occurrence	3 < 4 Feet Maximum Residual Depth	3 < 4 Feet Percent Occurrence	>= 4 Feet Maximum Residual Depth	>= 4 Feet Percent Occurrence
1	TRP	2	0	0	0	0	1	100	0	0	0	0
36	MCP	63	0	0	20	56	11	31	5	14	0	0
1	CCP	2	0	0	0	0	1	100	0	0	0	0
3	CRP	5	0	0	0	0	3	100	0	0	0	0
10	LSR	18	0	0	4	40	6	60	0	0	0	0
1	LSBk	2	0	0	1	100	0	0	0	0	0	0
1	LSBo	2	0	0	1	100	0	0	0	0	0	0
4	PLP	7	1	25	1	25	1	25	1	25	0	0
Total Units			Total < 1 Foot Max Resid. Depth	Total < 1 Foot % Occurrence	Total 1 < 2 Feet Max Resid. Depth	Total 1 < 2 Feet % Occurrence	Total 2 < 3 Feet Max Resid. Depth	Total 2 < 3 Feet % Occurrence	Total 3 < 4 Feet Max Resid. Depth	Total 3 < 4 Feet % Occurrence	Total >= 4 Feet Max Resid. Depth	Total >= 4 Feet % Occurrence
57			1	2	27	47	23	40	6	11	0	0
Mean Maximum Residual Pool Depth (ft.):			2									

Warner Creek

Table 5 - Summary of Mean Percent Cover By Habitat Type

Stream Name:		Warner Creek		Dry Units:		17		LLID:		1225677381000		Drainage:		Novato	
Survey		6/29/2009 to 6/30/2009		Confluence Location:		Quad:		NOVATO		Legal Description:		T03NR06WS18		Latitude: 38:05:59.3N	
Longitude:		122:34:07.0W		Habitat Units		Units Fully Measured		Habitat Type		Mean % Undercut Banks		Mean % SWD		Mean % LWD	
Mean % Root Mass		Mean % Terr. Vegetation		Mean % Aquatic Vegetation		Mean % White Water		Mean % Boulders		Mean % Bedrock Ledges					
31	25	LGR	0	0	0	0	0	0	0	0	12	0			
31	25	TOTAL RIFFLE	0	0	0	0	0	0	0	0	12	0			
30	22	GLD	3	0	0	2	1	5	0	11	0				
41	28	RUN	2	1	0	5	11	4	0	16	0				
7	6	SRN	0	8	0	0	25	0	0	17	0				
78	56	TOTAL FLAT	2	1	0	3	9	4	0	14	0				
1	1	TRP	0	0	0	0	0	0	0	0	0	0			
36	32	MCP	21	8	0	20	10	10	1	8	3				
1	1	CCP	0	0	0	0	0	0	0	100	0				
3	3	CRP	30	10	0	27	0	0	0	33	0				
10	8	LSR	23	4	8	61	1	0	0	4	0				
1	1	LSBk	100	0	0	0	0	0	0	0	0				
1	1	LSBo	0	0	0	0	0	0	0	100	0				
4	4	PLP	0	25	0	0	0	5	0	70	0				
57	51	TOTAL POOL	20	8	1	24	6	6	0	17	2				
17	0	CUL													
1	0	NS													
201	132	TOTAL	9	4	0	11	6	4	0	15	1				

Warner Creek

Table 6 - Summary of Dominant Substrates By Habitat Type

Stream Name: Warner Creek **Dry Units:** 17 **LLID:** 1225677381000 **Drainage:** Novato
Survey 6/29/2009 to 6/30/2009

Confluence Location: Quad: NOVATO **Legal Description:** T03NR06WS18 **Latitude:** 38:05:59.3N **Longitude:** 122:34:07.0W

Habitat Units	Units Fully Measured	Habitat Type	% Total Silt/Clay Dominant	% Total Sand Dominant	% Total Gravel Dominant	% Total Small Cobble Dominant	% Total Large Cobble Dominant	% Total Boulder Dominant	% Total Bedrock Dominant
31	24	LGR	4	29	50	8	0	8	0
30	28	GLD	46	29	21	0	0	0	4
41	35	RUN	20	43	37	0	0	0	0
7	7	SRN	43	0	57	0	0	0	0
1	1	TRP	0	100	0	0	0	0	0
36	36	MCP	36	47	17	0	0	0	0
1	1	CCP	100	0	0	0	0	0	0
3	3	CRP	0	33	67	0	0	0	0
10	10	LSR	10	80	10	0	0	0	0
1	1	LSBk	100	0	0	0	0	0	0
1	1	LSBo	0	0	100	0	0	0	0
4	4	PLP	25	50	25	0	0	0	0
17	1	CUL	0	100	0	0	0	0	0
1	1	NS	100	0	0	0	0	0	0

Warner Creek

Table 7 - Summary of Mean Percent Canopy for Entire Stream

Stream Name:	Warner Creek	LLID:	1225677381000	Drainage:	Novato
Survey	6/29/2009 to 6/30/2009				
Confluence Location:	Quad: NOVATO	Legal Description:	T03NR06WS18	Latitude:	38:05:59.3N
				Longitude:	122:34:07.0W
Mean Percent Canopy	Mean Percent Conifer	Mean Percent Hardwood	Mean Percent Open Units	Mean Right Bank % Cover	Mean Left Bank % Cover
82	1	99	3	54	59

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

Open units represent habitat units with zero canopy cover.

Warner Creek

Warner Creek

Table 8 - Fish Habitat Inventory Data Summary

Stream	Warner Creek	LLID: 1225677381000	Drainage	Novato
Survey Dates:	6/29/2009 to 6/30/2009	Survey Length (ft.):	14889	Main Channel (ft.): 14889 Side
Channel (ft.):	0			
Confluence Location:	Quad NOVATO	Legal Description:	T03NR06WS18	Latitude: 38:05:59.3N
Longitude:	122:34:07.0W			

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 1

Channel Type:	F4	Canopy Density (%):	81.6	Pools by Stream Length	20.3
Reach Length (ft.):	14889	Coniferous Component (%):	1.0	Pool Frequency (%):	
	28.4				
Riffle/Flatwater Mean Width (ft.):	5.6	Hardwood Component	99.0	Residual Pool Depth (%):	
BFW:		Dominant Bank	Hardwood Trees	< 2 Feet Deep:	49.1
Range (ft.):	8.50 to 22.00	Vegetative Cover (%):	56.1	2 to 2.9 Feet Deep:	40.4
Mean (ft.):	14.29	Dominant	Boulders	3 to 3.9 Feet Deep:	10.5
Std. Dev.:	3.01	Dominant Bank Substrate	Sand/Silt/Clay	>= 4 Feet Deep:	0.0
Base Flow (cfs):	0.18	Occurrence of LWD (%):	0.4	Mean Max Residual Pool	
Depth	2.04				
Water (F):	59 - 79	Air (F):	65 - 82	LWD per 100 ft.:	Mean Pool Shelter
Dry Channel (ft.):	1978			Riffles:	0
				Pools:	0
				Flat:	0
Pool Tail Substrate (%):	Silt/Clay: 14.0	Sand: 35.1	Gravel: 49.1	Sm Cobble: 0.0	Lg Cobble: 1.8
Bedrock:	0.0			Boulder	0.0
Embeddedness Values (%):	1. 3.5	2. 19.3	3. 22.8	4. 54.4	5. 0.0

Warner Creek

Table 9 -Mean Percentage of Dominant Substrate and Vegetation

Stream Name: Warner Creek

LLID: 1225677381000

Drainage: Novato

Survey 6/29/2009 to 6/30/2009

Confluence Location: Quad: NOVATO

Legal Description: T03NR06WS18

Latitude: 38:05:59.3N

Longitude: 122:34:07.0W

Mean Percentage of Dominant Stream Bank Substrate

Dominant Class of Substrate	Number of Units Right Bank	Number of Units Left Bank	Total Mean Percentage (%)
Bedrock	19	16	18.0
Boulder	5	3	4.1
Cobble/Gravel	0	0	0.0
Sand/Silt/Clay	73	78	77.8

Mean Percentage of Dominant Stream Bank Vegetation

Dominant Class of Vegetation	Number of Units Right Bank	Number of Units Left Bank	Total Mean Percentage
Grass	15	8	11.9
Brush	18	21	20.1
Hardwood	61	67	66.0
Coniferous	2	0	1.0
No Vegetation	1	1	1.0

Total Stream Cobble Embeddedness Values: 3

Warner Creek

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

Stream Name: Warner Creek

LLID: 1225677381000 **Drainage:** Novato

Survey 6/29/2009 to 6/30/2009

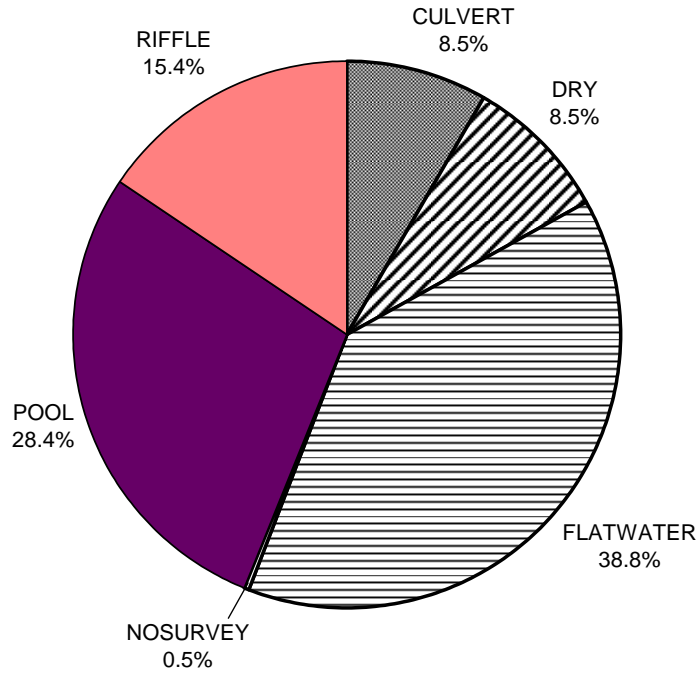
Confluence Location: Quad: NOVATO

Legal Description: T03NR06WS18 **Latitude:** 38:05:59.3N **Longitude:** 122:34:07.0W

	Riffles	Flatwater	Pools
UNDERCUT BANKS (%)	0	2	20
SMALL WOODY DEBRIS (%)	0	1	8
LARGE WOODY DEBRIS (%)	0	0	1
ROOT MASS (%)	0	3	24
TERRESTRIAL VEGETATION	0	9	6
AQUATIC VEGETATION (%)	0	4	6
WHITEWATER (%)	0	0	0
BOULDERS (%)	12	14	17
BEDROCK LEDGES (%)	0	0	2

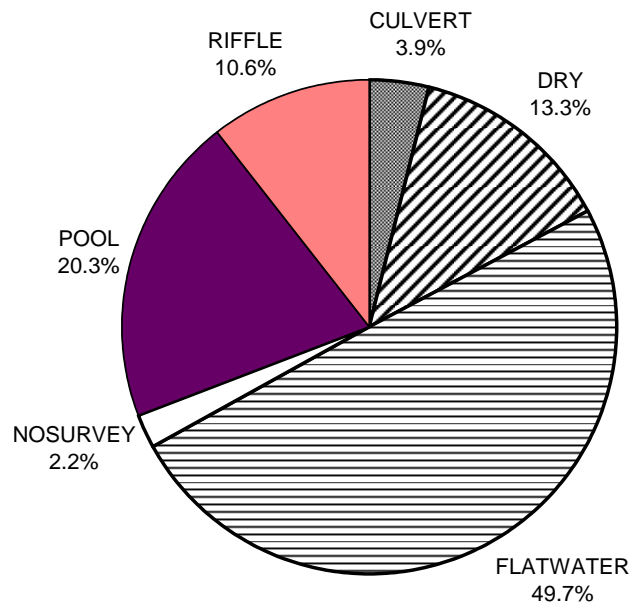
Warner Creek

**WARNER CREEK 2009
HABITAT TYPES BY PERCENT OCCURRENCE**



GRAPH 1

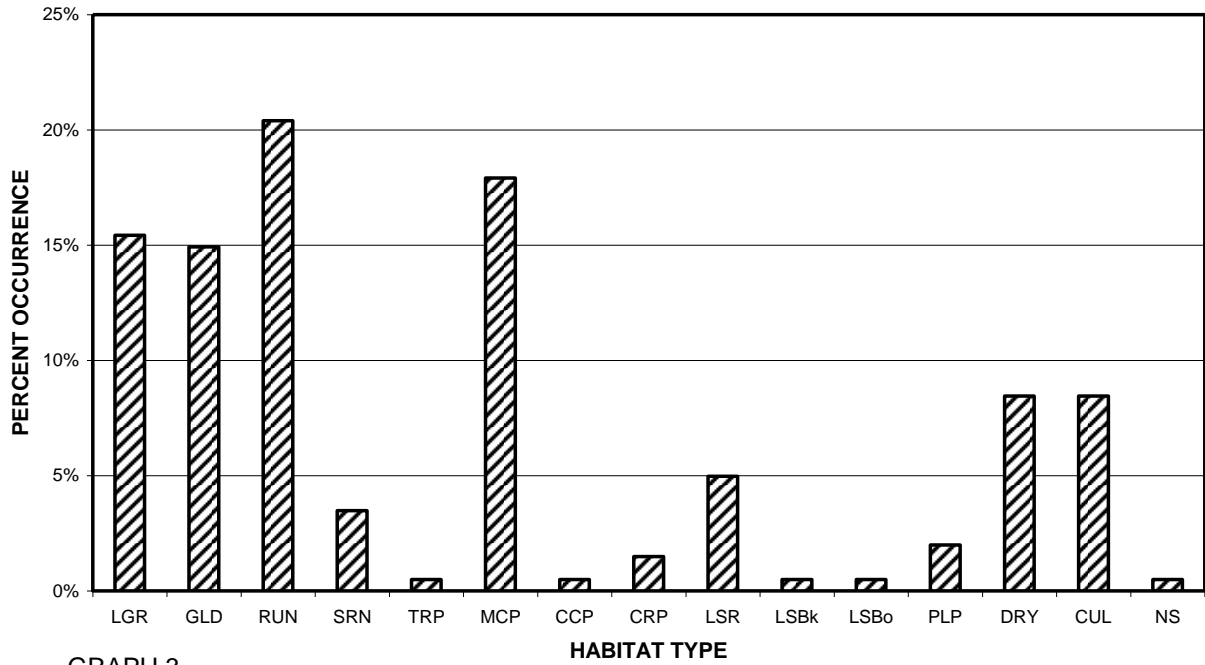
**WARNER CREEK 2009
HABITAT TYPES BY PERCENT TOTAL LENGTH**



GRAPH 2

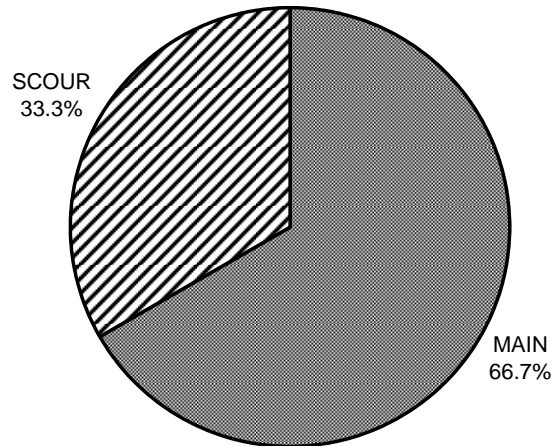
Warner Creek

**WARNER CREEK 2009
HABITAT TYPES BY PERCENT OCCURRENCE**



GRAPH 3

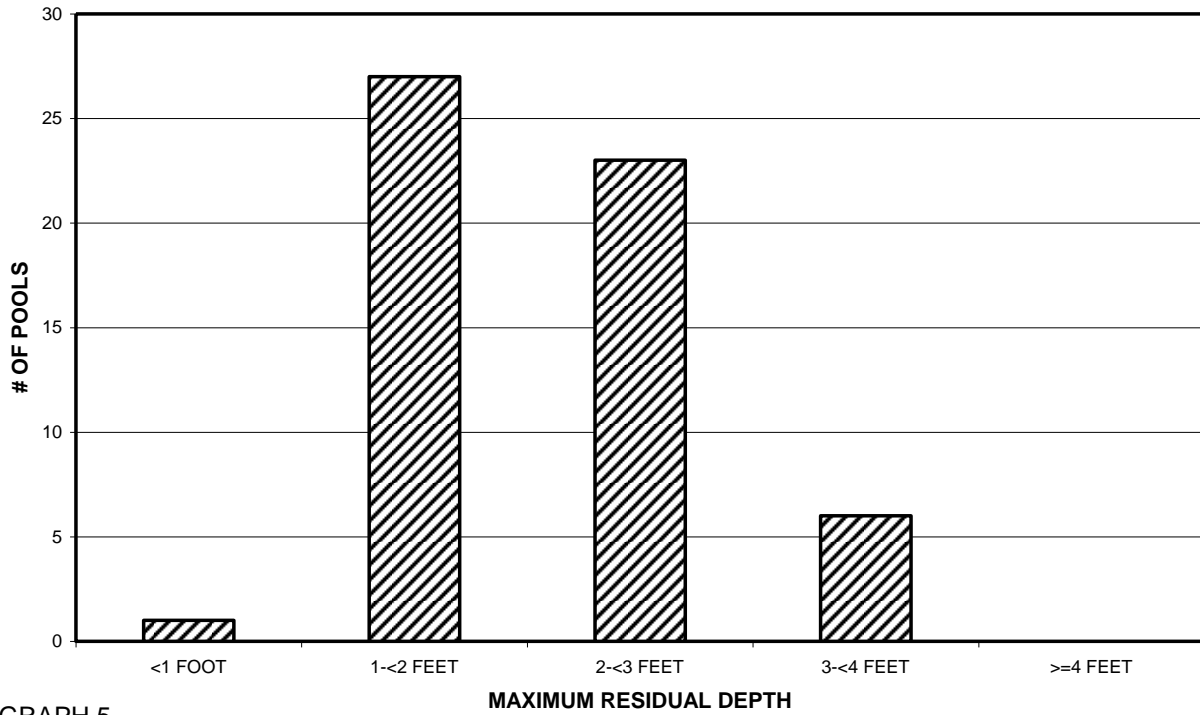
**WARNER CREEK 2009
POOL TYPES BY PERCENT OCCURRENCE**



GRAPH 4

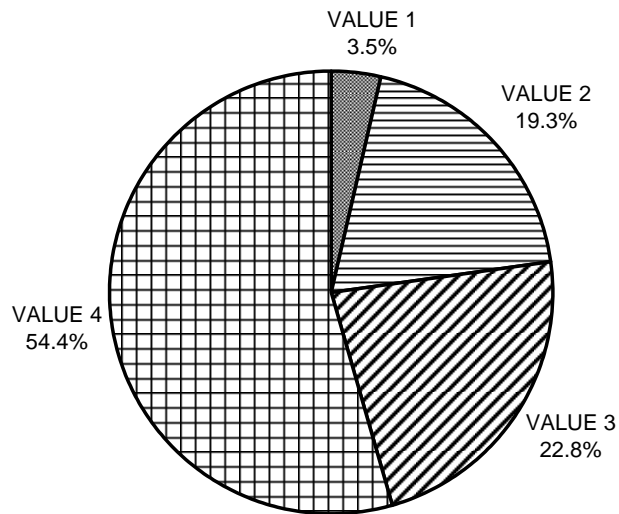
Warner Creek

**WARNER CREEK 2009
MAXIMUM DEPTH IN POOLS**



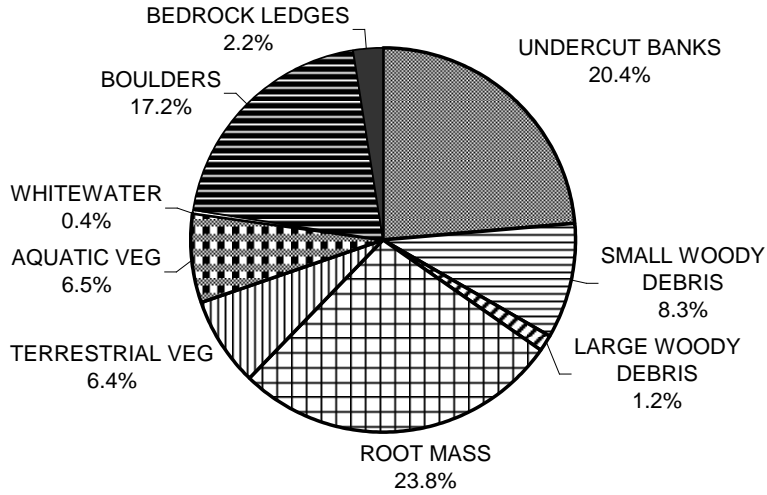
GRAPH 5

**WARNER CREEK 2009
PERCENT EMBEDDEDNESS**



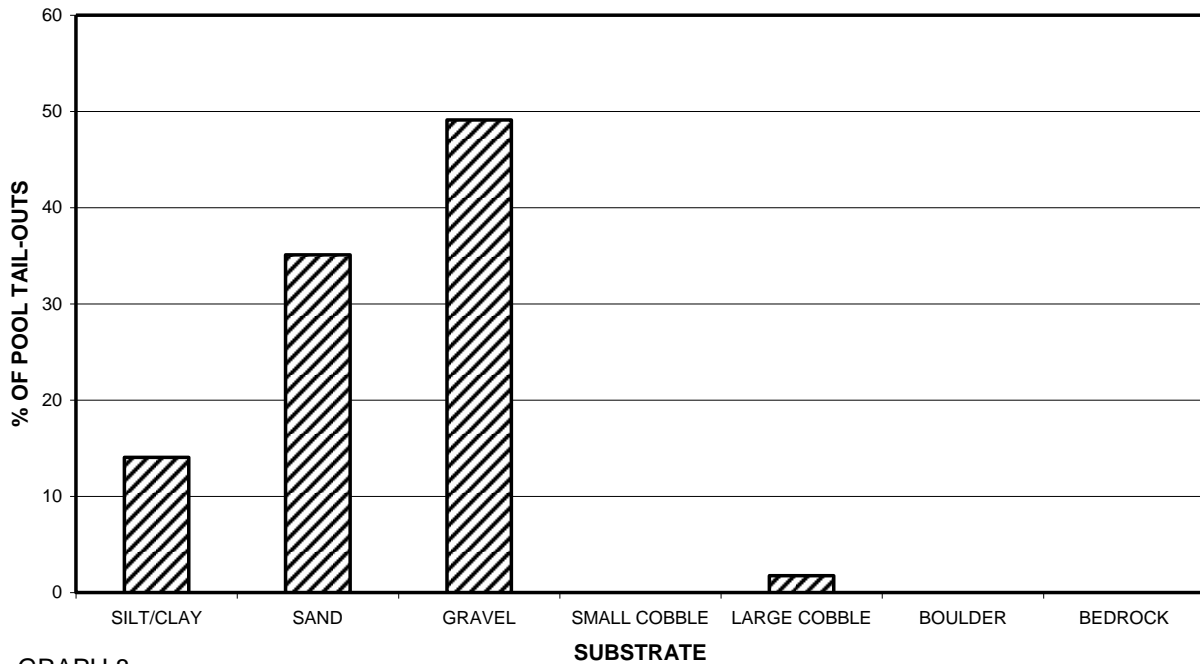
GRAPH 6

**WARNER CREEK 2009
MEAN PERCENT COVER TYPES IN POOLS**



GRAPH 7

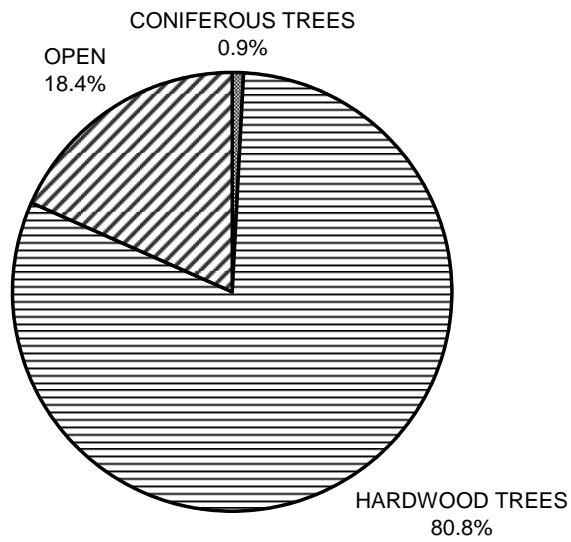
**WARNER CREEK 2009
SUBSTRATE COMPOSITION IN POOL TAIL-OUTS**



GRAPH 8

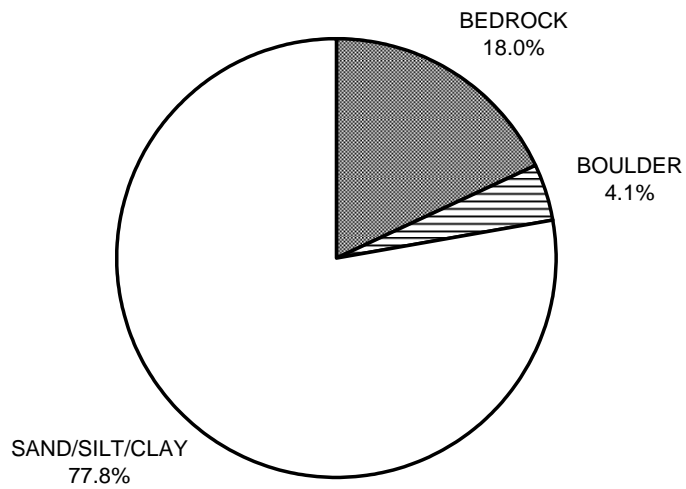
Warner Creek

**WARNER CREEK 2009
MEAN PERCENT CANOPY**



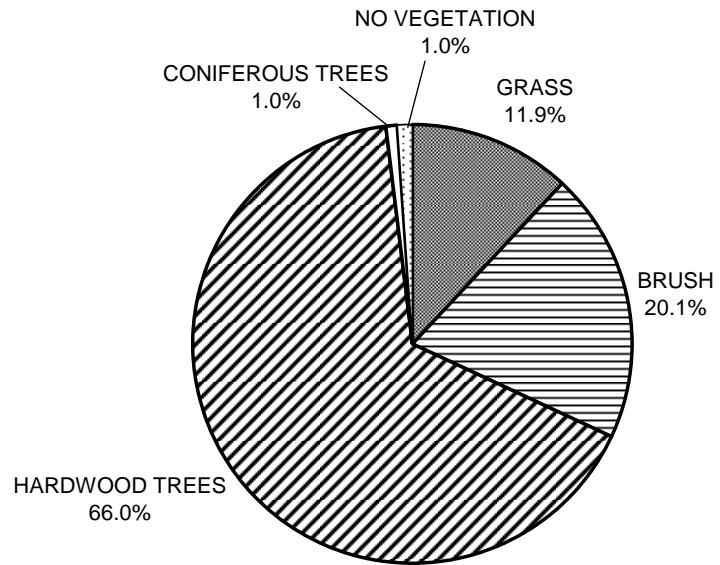
GRAPH 9

**WARNER CREEK 2009
DOMINANT BANK COMPOSITION IN SURVEY REACH**



GRAPH 10

**WARNER CREEK 2009
DOMINANT BANK VEGETATION IN SURVEY REACH**



GRAPH 11