

Wilson Creek



**California Department of Fish and Wildlife
Marin County
San Pablo Bay Watershed
Stream Habitat Assessment Reports**

Wilson Creek

Surveyed 2010

Report Completed in 2013

Wilson Creek

STREAM INVENTORY REPORT

Wilson Creek

INTRODUCTION

A stream inventory was conducted during 7/6/2010 to 7/6/2010 on Wilson Creek. The survey began at the confluence with Warner Creek and extended upstream 2.07 miles.

The Wilson Creek inventory was conducted. The objective of the habitat inventory was to document the habitat available to anadromous salmonids in Wilson Creek.

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

Wilson Creek is a tributary to Warner Creek, a tributary to Novato Creek, a tributary to San Pablo Bay, which flows into the Pacific Ocean, located in Marin County, California (Map 1). Wilson Creek's legal description at the confluence with Warner Creek is T03N R07W S13. Its location is 38°06'28.7" north latitude and 122°35'11.6" west longitude, LLID number 1225864381079. Wilson Creek is a first order stream and has approximately 2.07 miles of blue line stream according to the USGS National Hydrography Dataset (NHD). Wilson Creek drains a watershed of approximately 1.69 square miles. Elevations range from about 30 feet at the mouth of the creek to 1,047 feet in the headwaters. Herbaceous/ Grasslands, evergreen, and mixed forests dominates the watershed. The watershed is entirely privately owned land. Vehicle access exists via multiple residential and commercial roadways within the city of Novato.

METHODS

The habitat inventory conducted in Wilson Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi et al, 1998). The California Conservation Corps (CCC) Technical Advisors and 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 encountered for the first time in each reach are measured for all the parameters and

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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 Wilson 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". Wilson 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 the cobble that is surrounded or buried by fine sediment. In Wilson 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

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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 Wilson 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 Wilson 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 Wilson 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:

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

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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.

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 Wilson Creek include:

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

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- 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 7/6/2010 was conducted by Bell C., Griffin A. (WSP). The total length of the stream surveyed was 7,357 feet.

Stream flow was not measured on Wilson Creek.

Wilson Creek is a F4 channel type for 7,357 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 60 to 64 degrees Fahrenheit. Air temperatures ranged from 64 to 70 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 37% dry units, 9% pool units, 26% flatwater units, 25% culvert units, 3% riffle units (Graph 1). Based on total length of Level II habitat types there were 63% dry units, 3% pool units, 27% flatwater units, 5% culvert units and 2% riffle units (Graph 2).

Eight Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were 37% Dry units, 25% Culvert units, and 16% Glide units (Graph 3). The most frequent habitat types based on percent total length were 63% Dry units, 12% Run units, and 15% Glide units.

A total of 8 pools were identified (Table 3). Main Channel pools were the most frequently encountered, at 75%, and comprised 83% of the total length of all pools (Graph 4).

Table 4 is a summary of maximum residual pool depths by pool habitat types. Pool quality for salmonids increases with depth. Two of the 8 pools (25%) had a residual depth of two feet or greater (Graph 5).

Zero of the 8 pools (0%) had a residual depth of three feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 8 pool tail-outs measured, 2 had a value of 2 (25%); 2 had a value of 3 (25%); 4 had a value of 5 (50%) (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

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rating of 0, flatwater habitat types had a mean shelter rating of 8, and pool habitats had a mean shelter rating of 9 (Table 1). Of the pool types, the Main Channel pools had a mean shelter rating of 8, Scour pools had a mean shelter rating of 13 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Aquatic Vegetation is/are the dominant cover types in Wilson Creek. Graph 7 describes the pool cover in Wilson Creek. Bedrock Ledges are the dominant pool cover type followed by aquatic vegetation.

Table 6 summarizes the dominant substrate by habitat type. Graph 8 depicts the dominant substrate observed in pool tail-outs: sand observed in 50% of pool tail-outs, gravel observed in 38% of pool tail-outs.

The mean percent canopy density for the surveyed length of Wilson Creek was 75%. The mean percentages of hardwood and coniferous trees were 99% and 1%, respectively. Twenty five percent of the canopy was open. Graph 9 describes the mean percent canopy in Wilson Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 61%. The mean percent left bank vegetated was 64%. The dominant elements composing the structure of the stream banks consisted of 10% bedrock, 10% boulder, 81% sand/silt/clay, (Graph 10). Hardwood Trees were the dominant vegetation type observed in 88% of the units surveyed. Additionally, 12% of the units surveyed had brush as the dominant vegetation type (Graph 11).

BIOLOGICAL INVENTORY RESULTS

No electrofishing was conducted for Wilson Creek. However, juvenile roach and stickleback were observed from the stream banks of Wilson Creek.

DISCUSSION

Wilson Creek is a F4 channel type for the entire 7,357 feet of stream surveyed. The suitability of F4 channel types for fish habitat improvement structures is as follows:

F4 channels are good for bank-placed boulders, plunge weirs, single and opposing wind-deflectors, channel constrictors, and log cover; but poor for boulder clusters.

The water temperatures recorded on the survey days 7/6/2010 to 7/6/2010, ranged from 60 to 64 degrees Fahrenheit. Air temperatures ranged from 64 to 70 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 27% of the total length of this survey, riffles 2%, and pools 3%. The pools are relatively shallow, with only 2 of the 8 (25%) 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

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installation will not conflict with the modification of the numerous log debris accumulations (LDA's) in the stream.

Two of the 8 pool tail-outs measured had embeddedness ratings of 1 or 2. Two of the pool tail-outs had embeddedness ratings of 3 or 4. Four 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 Wilson Creek should be mapped and rated according to their potential sediment yields, and control measures should be taken.

Three of the 8 pool tail-outs measured had gravel or small cobble as the dominant substrate. This is generally considered good for spawning salmonids.

The mean shelter rating for pools was 9. The shelter rating in the flatwater habitats was 8. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by Aquatic Vegetation in Wilson Creek. Bedrock Ledges are the dominant cover type in pools followed by aquatic vegetation. 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 75%. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was 61% and 64%, 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

Wilson 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.

RECOMMENDATIONS

- 1) 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.
- 2) Increase woody cover in the pools and flatwater habitat units. Most of the existing cover in the pools is from Aquatic Vegetation. Adding high quality complexity with

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woody cover in the pools is desirable.

- 3) Suitable size spawning substrate on Wilson Creek is limited to relatively few reaches. Projects should be designed at suitable sites to trap and sort spawning gravel.
- 4) Access for migrating salmonids should be assessed at all road crossings and dams. No site of particular concern were indentified during the stream inventory survey, however because Wilson Creek is predominately an urban watershed, all in-stream structures, and road access and foot Bridges should be continually assessed. 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.
- 5) 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.
- 6) Increase the canopy throughout Wilson 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 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.
- 7) Wilson 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.
- 8) The limited water temperature data available suggest that maximum temperatures are within 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.

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:
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Position (ft.)	Habitat Unit #	Comments:
0	0001.00	Start of Survey at confluence with Warner Creek.
0	0001.00	Rip rap apron extends 50 feet upstream from start of survey. WP001 N38.10779 W122.58657
190	0004.00	Scotch Broom is thick on right and left banks.
736	0005.00	Culvert #1 is under Center Road. 1 culvert is in good condition and is made of concrete box, with a Height=6', a Width=10', and a Length=58'. The culvert slope=0%. It is not a barrier to juvenile or adult salmonids. WP002 N38.10567 W122.58793
1064	0009.00	English ivy on right bank.
1529	0013.00	Boulders placed instream, potentially for channel stabilization.
1834	0016.00	Bridge #1 is a road bridge with a Length=20', a Height=8', and a Width=29'. It is made of wood and steel, is not retaining gravel, and has no sill. It is not creating downcutting and is not a barrier to salmonids. WP004 N38.10362 W122.58964.
2242	0018.00	Bridge #2 is a road bridge with a Length=21', a Height, and a Width=43'. It is made of cement, not retaining gravel, and has no sill. It is not creating downcut, and is not a barrier to salmonids. No waypoint taken.
2768	0026.00	Roach and stickleback observed.
2782	0027.00	Bridge #3 is private access footbridge with a Length=12', a Height=5', and a Width=9'. It is made of wood, not retaining gravel, and has no sill. It is not creating downcutting and it not a barrier to salmonids. WP006 N38.10290 W122.59153.
2845	0029.00	Bridge #4 is Campbell Court road bridge with a Length=20', a Height=8', and a Width=45'. It is made of cement, not retaining gravel, and has no sill. It is not creating downcutting and is not a barrier to salmonids. No waypoint was taken. Not marked on topo-map.
3015	0031.00	Culvert #2 has a natural bottom and is a pipe arch culvert.

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Position (ft.)	Habitat Unit #	Comments:
3015	0031.00	Culvert #2 in-stream diverting flow under McClay road. Culvert is made of CMP and is in good condition, with a Height=6', a Width=13', and a Length=21'. The culvert slope= 0%. It is not a barrier to juvenile and adult salmonids. WP007 N38.10276 W122.59210
3043	0033.00	Bridge #5 is a Public footbridge with a Length=7', a Height=6', and a Width=31'. It is made of wood and cement, is not retaining gravel, and has no sill. It is not creating downcutting and is not a barrier to salmonids. No waypoint was taken.
3050	0034.00	120 feet into unit left bank brick retaining wall is 7 feet high by 100 feet in length. Right bank has new rip-rap bank stabilization with loose soil piled on top.
3478	0035.00	Bridge #6 is a private access footbridge with a Length=7', a Height=7', and a Width=23'. It is made of wood, is not retaining gravel, and has no sill. It is not creating downcutting and is not a barrier to salmonids. WP008 N38.10340 W122.59348.
3674	0037.00	Bamboo on right bank.
3828	0041.00	Bridge #7 is a private road bridge with a Length=9', a Height=10', and a Width=42'. It is made of wood and steel, is not retaining gravel, and has no sill. It is not creating downcutting and is not a barrier to salmonids. No waypoint was taken.
4010	0045.00	English ivy on left bank.
4384	0048.00	Bridge #8 has a Length=12', a Height=7', and a Width=27', and is made of wood and steel. It is not retaining gravel, and has no sill. WP010. N38.10253 W122.59566. Culvert #3 in-stream. 1 culvert is made of concrete box and is in good condition with a Height=4', a Width=5', and a Length=15'. It has a plunge height= 1'. With a maximum depth at the outlet=1.7'. The culvert slope=0%. It is not a barrier to salmonids. WP012 N38.10220 W122.59598.
4567	053.00	
4853	0057.00	Bridge #9 is a private road bridge with a Length=8', a Height=6', and a Width=19'. It is made of wood, not retaining gravel, and has no sill. It is not creating downcutting and is not a barrier to salmonids. WP013 N38.10169 W122.59646.
5021	0059.00	Bridge #10 is the Shields Lane road bridge with a Length=70', a Height=4', and a Width=13'. It is made of cement, not retaining gravel, and has no sill. It is not creating downcutting and is not a barrier to salmonids. No waypoint was taken.

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Position (ft.)	Habitat Unit #	Comments:
5385	0064.00	Bridge #11. Pvt. footbridge. L=7' H=7' W=26'. Made of wood/steel. Retaining gravel, no. Height water to sill, na. Downcut, no. Not a barrier. WP015 N38.10075 W122.59761.
5503	0066.00	English ivy on right bank.
5717	0071.00	English ivy on left bank.
5717	0071.00	Right bank tributary #1 is unnamed and enters Wilson Creek. It is flowing with discharge <1, and contributes 30% of flow to the receiving stream. Water temperatures downstream, upstream and within the tributary= 64F. The survey crew checked 200' up and found it was accessible to fish with a slope= 2%. Stickleback observed. WP017 N38.09955 W122.59841
6216	0074.00	Bridge #12 is a private access footbridge with a Length=4', a Height=8', And a Width=37'. It is made of wood, is not retaining gravel, and has no sill. It is not creating downcutting and is not a barrier to salmonids. WP018 N38.09956 W122.59914.
6286	0076.00	Bridge #13 is road bridge with a Length=20', a Height=6', and a Width=49'. It is made of steel, is not retaining gravel, and has no sill. It is not creating downcutting and is not a barrier to salmonids. No Waypoint was taken.
6457	0078.00	Bridge #14 is a private road with a Length=13', a Height=7', and a Width=35'. It is made of wood and steel, is not retaining gravel, and has no sill. It is not creating downcut and is not a barrier to salmonids. No waypoint was taken.
6657	0080.00	Bridge #15 is a private road with a Length=14', a Height=8', and a Width=32'. It is made of wood and steel, is not retaining gravel, and has no sill. It is not downcutting and is not a barrier to salmonids. WP019 N38.09875 W122.60009.
6671	0081.00	English ivy on both banks.
6841	0082.00	Culvert #4 in-stream diverting flow under private road. 1 culvert made of concrete, round pipes is in good condition, with a Height=6', a Width=6', and a Length=26'. The diameter= 6'.The culvert slope =0%. It is not a barrier to salmonids. No waypoint taken.

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Position (ft.)	Habitat Unit #	Comments:
6986	0084.00	Culvert #5 in stream diverting flow under private road. 1 culvert made of concrete box is in good condition, with a Height=6', a Width=5', And a Length=14'.The culvert slope=0%. It is not a barrier to adult salmonids but is a potential barrier to juvenile salmonids. WP020 N38.09801 W122.60051
7246	0086.00	Bridge #16 is a private road bridge with a Length=12', a Height=8', and a Width=40'. It is made of wood and steel, not retaining gravel, and has no sill. It is not creating downcut and is not a barrier to salmonids. No waypoint was taken.
7311	0088.00	Bridge #17 is a private road bridge with a Length=12', a Height=6', and a Width=27'. It is made of wood, not retaining gravel, and has no sill. It is not creating downcutting and is not a barrier to salmonids. No waypoint was taken.
7357	0089.00	End of survey due to lack of access upstream.

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.

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 }

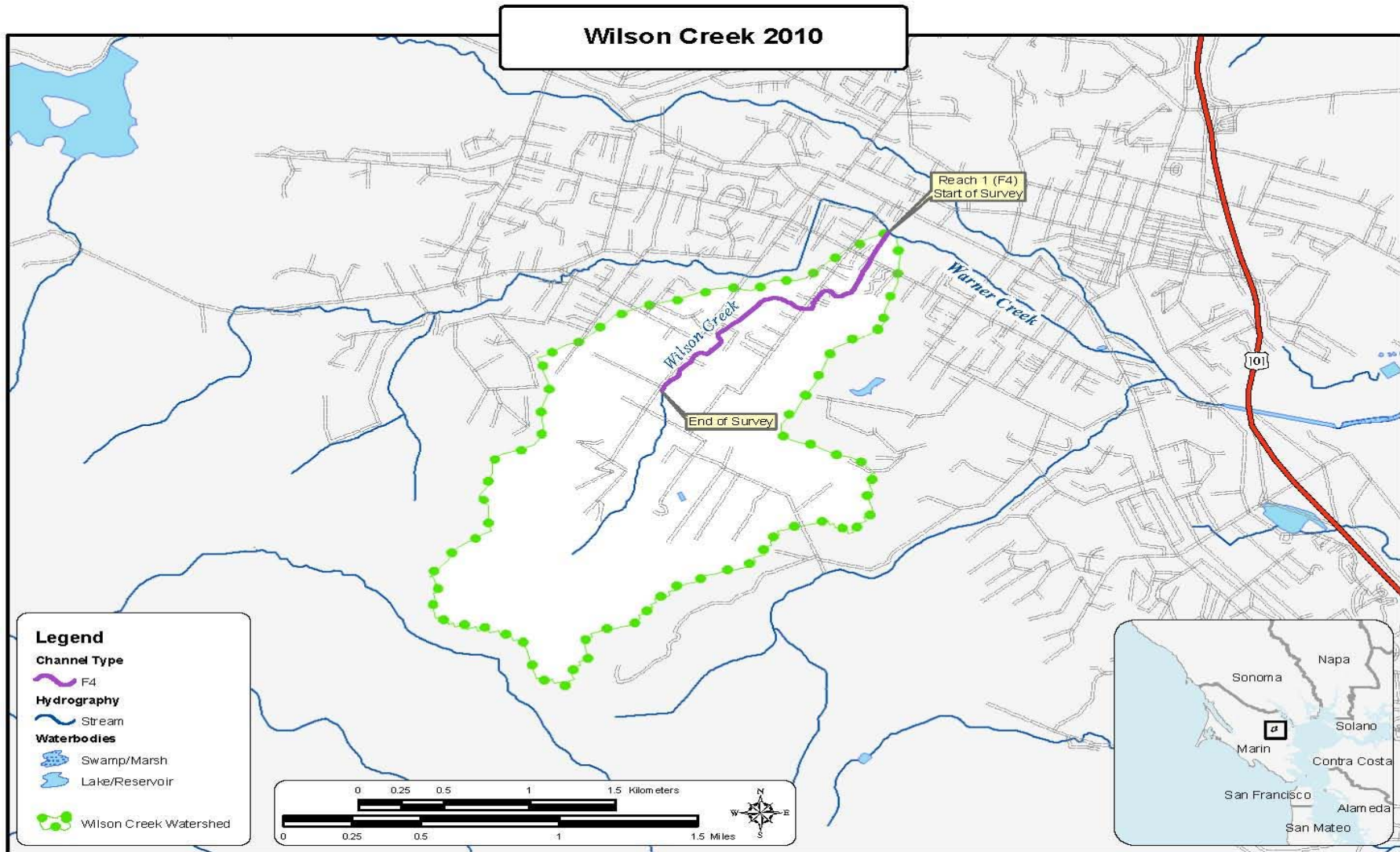
BACKWATER POOLS

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: Wilson Creek

LLID: 1225864381079

Drainage: Novato

Survey 7/6/2010 to 7/6/2010

Confluence Location: Quad: NOVATO

Legal Description: T03NR07WS13

Latitude: 38:06:28.7N

Longitude: 122:35:11.6W

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
22	0	CULVERT	24.7	18	402	5.5									
33	0	DRY	37.1	140	4607	62.6									
23	23	FLATWATER	25.8	85	1952	26.5	5.1	0.5	0.9	448	10303	204	4702		8
8	8	POOL	9.0	27	218	3.0	6.9	0.9	1.6	183	1463	146	1166	140	9
3	3	RIFFLE	3.4	59	178	2.4	3.0	0.2	0.4	102	305	23	68		0
Total Units	Total Units Fully Measured				Total Length (ft.)						Total Area (sq.ft.)		Total Volume (cu.ft.)		
89	34				7357						12071		5937		

Wilson Creek

Table 2 - Summary of Habitat Types and Measured Parameters

Stream Name: Wilson Creek

LLID: 1225864381079

Drainage: Novato

Survey 7/6/2010 to 7/6/2010

Confluence Location: Quad: NOVATO

Legal Description: T03NR07WS13

Latitude: 38:06:28.7N

Longitude: 122:35:11.6W

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 (%)
2	2	LGR	2.2	84	169	2.3	4.0	0.3	0.8	146	293	34	67		0	81
1	1	BRS	1.1	9	9	0.1	2.0	0.1	0.1	13	13	1	1		0	85
14	14	GLD	15.7	78	1099	14.9	5.0	0.5	1.4	423	5921	190	2654		8	83
9	9	RUN	10.1	95	853	11.6	5.0	0.4	1.4	487	4382	228	2048		6	79
6	6	MCP	6.7	30	180	2.4	6.0	0.8	2.0	194	1161	136	815	131	8	73
1	1	LSR	1.1	24	24	0.3	5.0	0.8	1.4	120	120	96	96	96	20	88
1	1	PLP	1.1	14	14	0.2	13.0	1.3	2.5	182	182	255	255	237	5	75
33	0	DRY	37.1	140	4607	62.6										82
22	0	CUL	24.7	18	402	5.5										49
Total Units	Total Units Fully Measured				Total Length (ft.)						Total Area (sq.ft.)		Total Volume			
89	34				7357						12071		5937			

Wilson Creek

Table 3 - Summary of Pool Habitat Types

Stream Name: Wilson Creek

LLID: 1225864381079

Drainage: Novato

Survey 7/6/2010 to 7/6/2010

Confluence Location: Quad: NOVATO

Legal Description: T03NR07WS13

Latitude: 38:06:28.7N

Longitude: 122:35:11.6W

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
6	6	MAIN	75	30	180	83	6.2	0.8	194	1161	131	787	8
2	2	SCOUR	25	19	38	17	9.0	1.0	151	302	166	333	13
Total Units	Total Units Fully Measured				Total Length (ft.)					Total Area (sq.ft.)		Total Volume (cu.ft.)	
8	8				218					1463		1119	

Wilson Creek

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

Stream Name: Wilson Creek

LLID: 1225864381079

Drainage: Novato

Survey: 7/6/2010 to 7/6/2010

Confluence Location: Quad: NOVATO

Legal Description: T03NR07WS13

Latitude: 38:06:28.7N

Longitude: 122:35:11.6W

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
6	MCP	75	0	0	5	83	1	17	0	0	0	0
1	LSR	13	0	0	1	100	0	0	0	0	0	0
1	PLP	13	0	0	0	0	1	100	0	0	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
8			0	0	6	75	2	25	0	0	0	0

Mean Maximum Residual Pool Depth (ft.): 2

Wilson Creek

Table 5 - Summary of Mean Percent Cover By Habitat

Stream Name:		Wilson Creek		Dry Units:		33		LLID:		1225864381079		Drainage:		Novato	
Survey		7/6/2010 to 7/6/2010		Legal Description:		T03NR07WS13		Latitude:		38:06:28.7N		Longitude:		122:35:11.6W	
Confluence Location:		Quad: NOVATO		Habitat Type		Mean % Undercut Banks		Mean % SWD		Mean % LWD		Mean % Root Mass		Mean % Terr. Vegetation	
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				
2	2	LGR	0	0	0	0	0	0	0	0	0				
1	1	BRS	0	0	0	0	0	0	0	0	0				
14	9	GLD	11	9	0	0	2	17	0	17	0				
9	5	RUN	0	0	0	0	0	20	0	0	0				
6	6	MCP	0	0	0	0	7	27	0	17	17				
1	1	LSR	60	0	0	40	0	0	0	0	0				
1	1	PLP	0	0	0	0	0	0	0	0	100				
22	0	CUL													

Wilson Creek

Table 6 - Summary of Dominant Substrates By Habitat Type

Stream Name: Wilson Creek

Dry Units: 33

LLID: 1225864381079

Drainage: Novato

Survey 7/6/2010 to 7/6/2010

Confluence Location: Quad: NOVATO

Legal Description: T03NR07WS13 **Latitude:** 38:06:28.7N

Longitude: 122:35:11.6W

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
2	2	LGR	0	0	50	0	0	50	0
1	1	BRS	0	0	0	0	0	0	100
14	10	GLD	0	100	0	0	0	0	0
9	3	RUN	0	100	0	0	0	0	0
6	6	MCP	17	83	0	0	0	0	0
1	1	LSR	0	100	0	0	0	0	0
1	1	PLP	0	100	0	0	0	0	0
22	0	CUL	0	0	0	0	0	0	0

Wilson Creek

Table 7 - Summary of Mean Percent Canopy for Entire Stream

Stream Name: Wilson Creek

LLID: 1225864381079

Drainage: Novato

Survey 7/6/2010 to 7/6/2010

Confluence Location: Quad: NOVATO

Legal Description: T03NR07WS13

Latitude: 38:06:28.7N

Longitude: 122:35:11.6W

Mean Percent Canopy	Mean Percent Conifer	Mean Percent Hardwood	Mean Percent Open Units	Mean Right Bank % Cover	Mean Left Bank % Cover
75	1	99	0	61	64

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.

Wilson Creek

Table 8 - Fish Habitat Inventory Data Summary

Stream	Wilson Creek	LLID: 1225864381079	Drainage	Novato
Survey Dates:	7/6/2010 to 7/6/2010	Survey Length (ft.): 7357	Main Channel (ft.): 7357	Side Channel (ft.): 0
Confluence Location:	Quad NOVATO	Legal Description: T03NR07WS13	Latitude: 38:06:28.7N	Longitude: 122:35:11.6W

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 1

Channel Type:	F4	Canopy Density (%):	75.2	Pools by Stream Length	3.0		
Reach Length (ft.):	7357	Coniferous Component (%):	0.8	Pool Frequency (%):	9.0		
Riffle/Flatwater Mean Width (ft.):	4.9	Hardwood Component	99.2	Residual Pool Depth (%):			
BFW:		Dominant Bank	Hardwood Trees	< 2 Feet Deep:	75.0		
Range (ft.):	9.00 to 14.00	Vegetative Cover (%):	62.5	2 to 2.9 Feet Deep:	25.0		
Mean (ft.):	11.44	Dominant	Aquatic Vegetation	3 to 3.9 Feet Deep:	0.0		
Std. Dev.:	1.26	Dominant Bank Substrate	Sand/Silt/Clay	>= 4 Feet Deep:	0.0		
Base Flow (cfs):		Occurrence of LWD (%):	0.0	Mean Max Residual Pool Depth	1.63		
Water (F):	0 - 64	Air (F):	64 - 70	LWD per 100 ft.:			
Dry Channel (ft.):	4607	Riffles:	0	Mean Pool Shelter	9		
		Pools:	0				
		Flat:	0				
Pool Tail Substrate (%):	Silt/Clay: 12.5	Sand: 50.0	Gravel: 37.5	Sm Cobble: 0.0	Lg Cobble: 0.0	Boulder: 0.0	Bedrock: 0.0
Embeddedness Values (%):	1. 0.0	2. 25.0	3. 25.0	4. 0.0	5. 50.0		

Wilson Creek

Table 9 -Mean Percentage of Dominant Substrate and Vegetation

Stream Name: Wilson Creek **LLID:** 1225864381079 **Drainage:** Novato
Survey 7/6/2010 to 7/6/2010
Confluence Location: Quad: NOVATO **Legal Description:** T03NR07WS13 **Latitude:** 38:06:28.7N **Longitude:** 122:35:11.6W

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	2	2	9.5
Boulder	2	2	9.5
Cobble/Gravel	0	0	0.0
Sand/Silt/Clay	17	17	81.0

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	0	0	0.0
Brush	2	3	11.9
Hardwood	19	18	88.1
Coniferous	0	0	0.0
No Vegetation	0	0	0.0

Total Stream Cobble Embeddedness Values: 4

Wilson Creek

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

Stream Name: Wilson Creek

LLID: 1225864381079 **Drainage:** Novato

Survey 7/6/2010 to 7/6/2010

Confluence Location: Quad: NOVATO

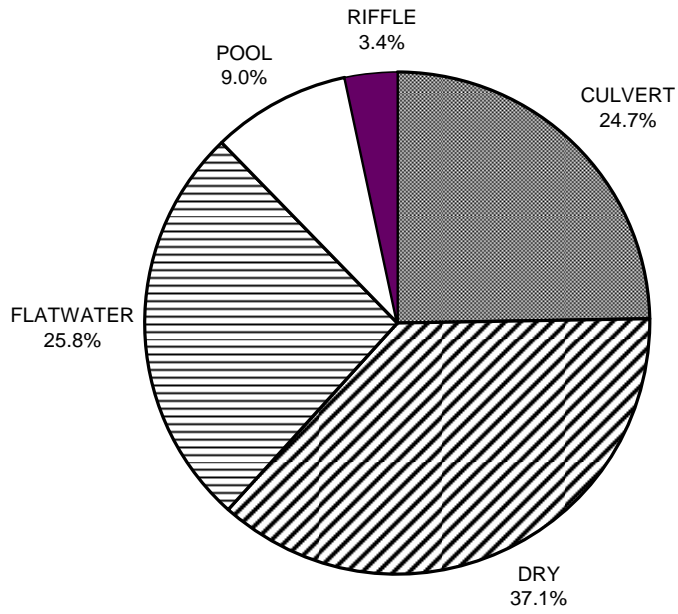
Legal Description: T03NR07WS13

Latitude: 38:06:28.7N

Longitude: 122:35:11.6W

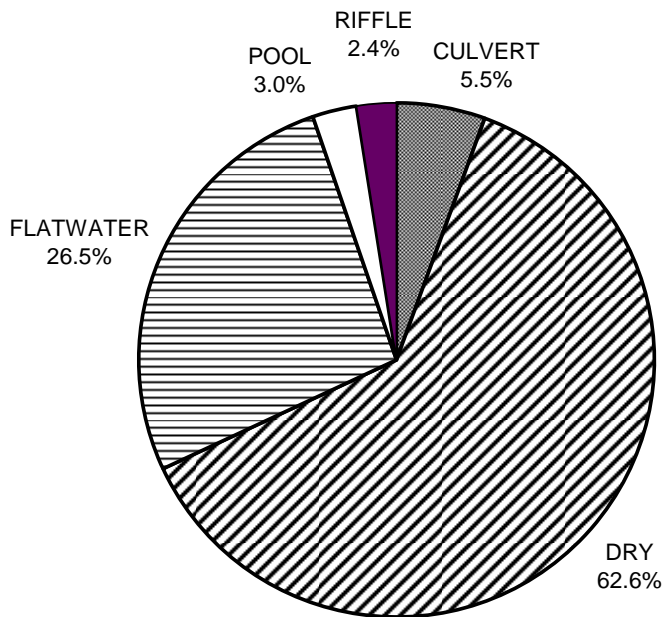
	Riffles	Flatwater	Pools
UNDERCUT BANKS (%)	0	7	8
SMALL WOODY DEBRIS (%)	0	6	0
LARGE WOODY DEBRIS (%)	0	0	0
ROOT MASS (%)	0	0	5
TERRESTRIAL VEGETATION	0	1	5
AQUATIC VEGETATION (%)	0	18	20
WHITEWATER (%)	0	0	0
BOULDERS (%)	0	11	13
BEDROCK LEDGES (%)	0	0	25

**WILSON CREEK 2010
HABITAT TYPES BY PERCENT OCCURRENCE**



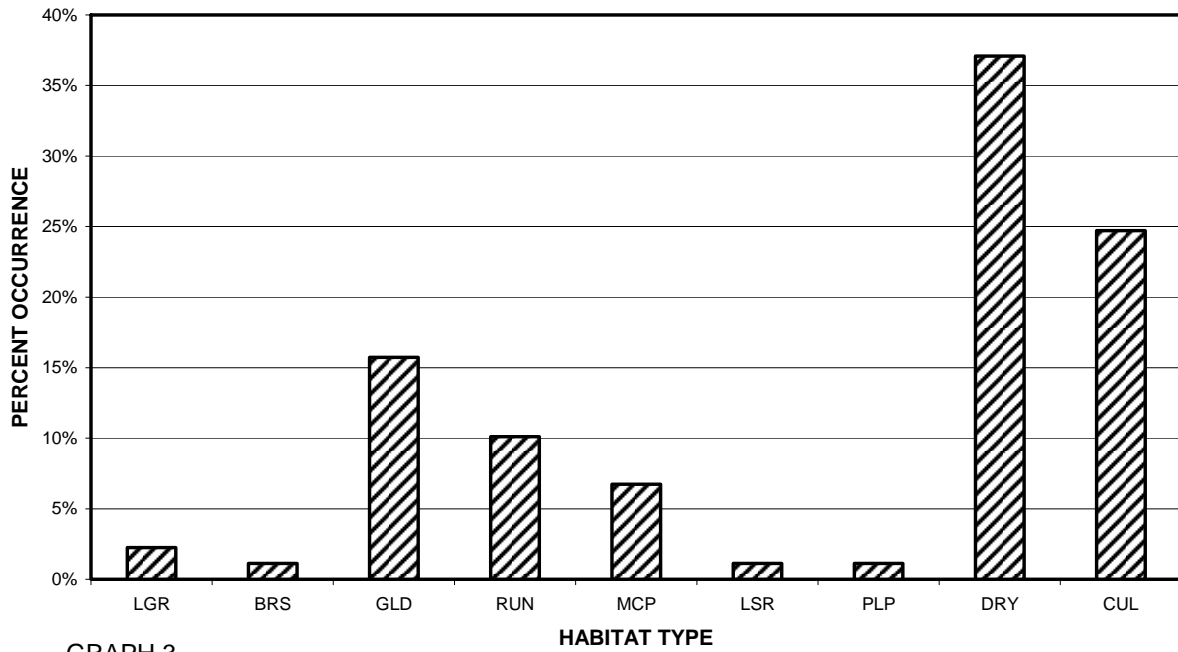
GRAPH 1

**WILSON CREEK 2010
HABITAT TYPES BY PERCENT TOTAL LENGTH**



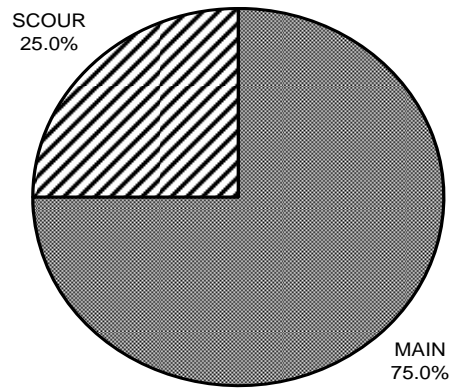
GRAPH 2

WILSON CREEK 2010 HABITAT TYPES BY PERCENT OCCURRENCE



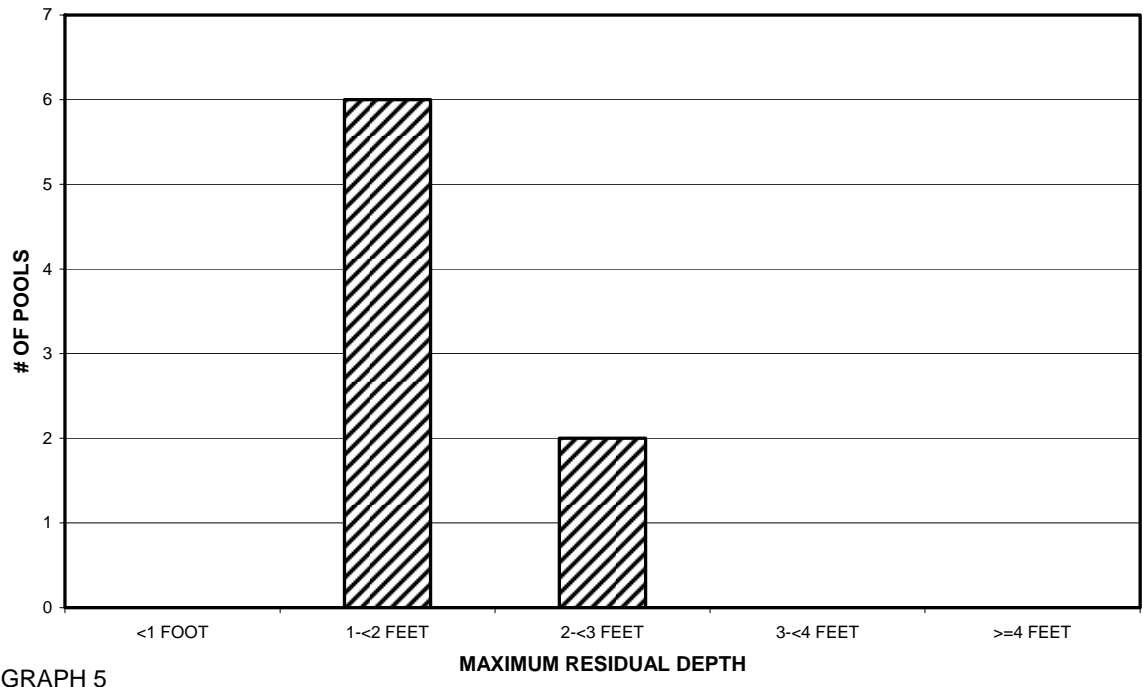
GRAPH 3

WILSON CREEK 2010 POOL TYPES BY PERCENT OCCURRENCE



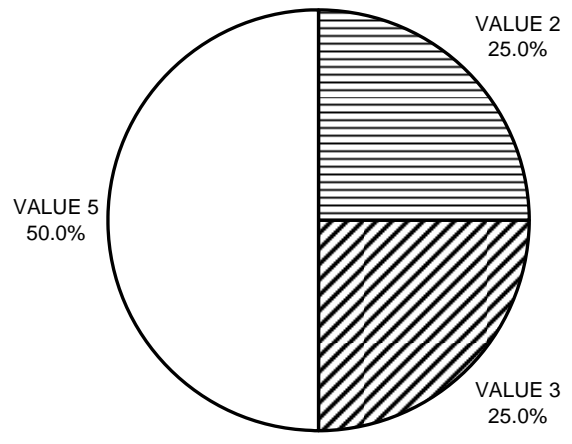
GRAPH 4

WILSON CREEK 2010 MAXIMUM DEPTH IN POOLS



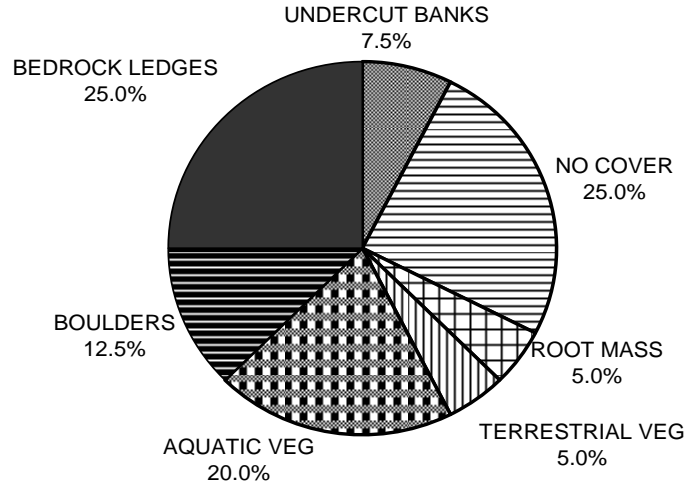
GRAPH 5

WILSON CREEK 2010 PERCENT EMBEDDEDNESS



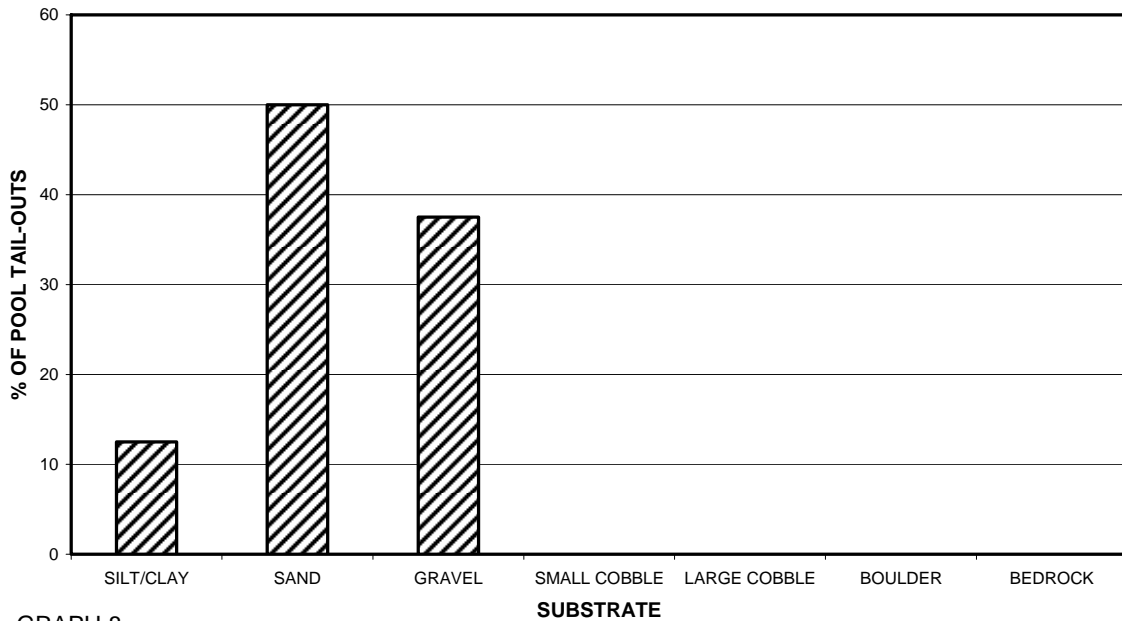
GRAPH 6

WILSON CREEK 2010 MEAN PERCENT COVER TYPES IN POOLS



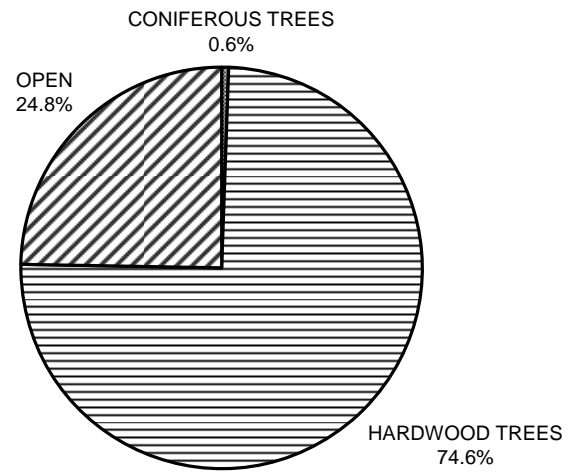
GRAPH 7

WILSON CREEK 2010 SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



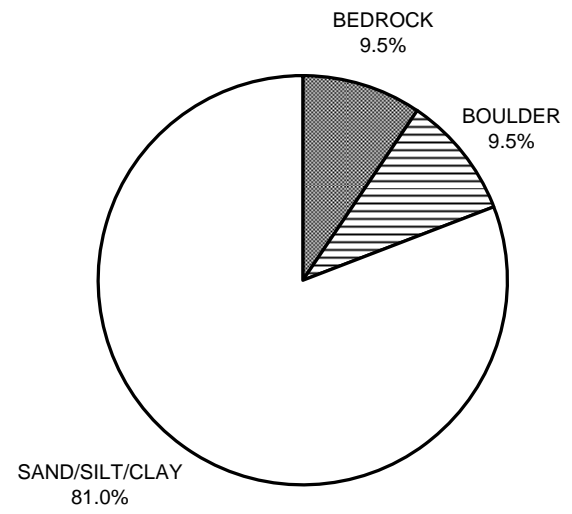
GRAPH 8

**WILSON CREEK 2010
MEAN PERCENT CANOPY**



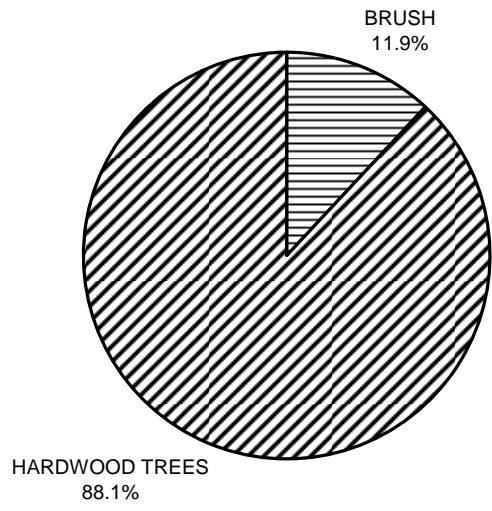
GRAPH 9

**WILSON CREEK 2010
DOMINANT BANK COMPOSITION IN SURVEY REACH**



GRAPH 10

**WILSON CREEK 2010
DOMINANT BANK VEGETATION IN SURVEY REACH**



GRAPH 11