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

Larkspur Creek

Surveyed 2009

Report Completed in 2013

STREAM INVENTORY REPORT

Larkspur Creek

Surveyed 2009

INTRODUCTION

A stream inventory was conducted during 8/4/2009 to 8/5/2009 on Larkspur Creek. The survey began at the confluence with Corte Madera Creek and extended upstream 2.3 miles.

The Larkspur Creek inventory was conducted in two parts: habitat inventory and biological inventory. The objective of the habitat inventory was to document the habitat available to anadromous salmonids in Larkspur Creek. The objective of the biological inventory was to document the presence and distribution of juvenile salmonid species.

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

Larkspur Creek is a tributary to Corte Madera Creek, is a tributary to Pacific Ocean, located in Marin County, California (Map 1). Larkspur Creek's legal description at the confluence with Corte Madera Creek is T01N R06W S09. Its location is 37°56'37.2" north latitude and 122°31'35.9" west longitude, LLID number 1225257379437. Larkspur Creek is a second order stream and has approximately 3.23 miles of blue line stream within its catchment boundary according to the USGS National Hydrography Dataset (NHD). Larkspur Creek drains a watershed of approximately 1.84 square miles. Elevations range from about sea level at the mouth of the creek to 1102 feet in the headwater areas. Mixed hardwood forest dominates the watershed. The watershed is primarily privately owned which accounts for 52.7% of the land area. Sixty six percent of the land is considered natural and 34% is urban. Vehicle access exists via HWY 101 to Tamalpais drive and Magnolia avenue.

METHODS

The habitat inventory conducted in Larkspur 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 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 Larkspur 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". Larkspur 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 Larkspur 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 Larkspur 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 densiometers as described in the *California Salmonid Stream Habitat Restoration Manual*. Canopy density relates to the amount of stream shaded from the sun. In Larkspur 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 Larkspur 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 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 observed from the stream banks in Larkspur Creek. In addition, two sites were electrofished using a Smith-Root Model 12 electrofisher. These sampling techniques are discussed in the *California Salmonid Stream Habitat Restoration Manual*.

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 Larkspur Creek include:

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

HABITAT INVENTORY RESULTS

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

The habitat inventory of 8/4/2009 to 8/5/2009, was conducted by T. Macias and A. Villalobos (WSP). The total length of the stream surveyed was 12,121 feet with an additional 47 feet of side channel.

Stream flow was measured near the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter on 8/5/2009 but the flow was too low to be accurate.

Larkspur Creek is a F4 channel type for 12,121 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 57 to 68 degrees Fahrenheit. Air temperatures ranged from 62 to 78 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 24% culvert units, 8% pool units, 18% flatwater units, 23% riffle units and 26% dry units (Graph 1). Based on total length of Level II habitat types there were 9% culvert units, 3% pool units, 10% flatwater units, 20% riffle units and 58% dry units (Graph 2).

Twelve Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were 24% Culvert units, 22% Low Gradient Riffle units and 26% Dry units (Graph 3). Based on percent total length of level IV habitat types there were 9% Culvert units,

20% Low Gradient Riffle units and 58% Dry units.

A total of 7 pools were identified (Table 3). Scour pools were the most frequently encountered, at 71%, and comprised 29% 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. None of the 6 pools (0%) had a residual depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 6 pool tail-outs measured, 1 had a value of 1 (16.7%); 1 had a value of 2 (16.7%); 2 had a value of 3 (33.3%); and 2 had a value of 4 (33.3%) (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 0, flatwater habitat types had a mean shelter rating of 4, and pool habitats had a mean shelter rating of 16 (Table 1). Of the pool types, the Scour pools had a mean shelter rating of 14, and Main Channel pools had a mean shelter rating of 23 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover types in Larkspur Creek. Graph 7 describes the pool cover in Larkspur Creek. Terrestrial vegetation is the dominant pool cover type followed by small woody debris.

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 50% of pool tail-outs, and gravel dominance was observed in 50% of pool tail-outs.

The mean percent canopy density for the surveyed length of Larkspur Creek was 94%. The mean percentages of hardwood and coniferous trees were 87% and 13%, respectively. Six percent of the canopy was open. Graph 9 describes the mean percent canopy in Larkspur Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 38%. The mean percent left bank vegetated was 37%. The dominant elements composing the structure of the stream banks consisted of 21% bedrock, 2% boulder, 4% cobble/gravel, 72% sand/silt/clay, (Graph 10). Hardwood trees were the dominant vegetation type observed in 75% of the units surveyed. Additionally, 18% of the units surveyed had brush as the dominant vegetation type, and 2% had grass as the dominant vegetation (Graph 11).

BIOLOGICAL INVENTORY RESULTS

Two sites were electrofished for species composition and distribution in Larkspur Creek on October 28, 2009. Water temperatures taken during the electrofishing period ranged from 57 to 58 degrees Fahrenheit. Air temperatures ranged from 64 to 70 degrees Fahrenheit. The sites

were sampled by C Bell, T Macias and A Villalobos (WSP), as well as D Acomb and D Resnik (CDFW).

In reach 1, which comprised the entire length of the stream, two sites were sampled. The first site began near the Magnolia Avenue bridge, and extended downstream 150 feet. This site yielded no fish or amphibian species.

The second sampling site began several hundred feet below the crumbling dam near Hatzic Court, and extended to the base of the dam. This site yielded 11 Pacific Giant Salamanders, and no fish species.

The following chart displays the information yielded from these sites:

2009 Larkspur Creek e-fish observations

Date	Site #	Reference Point	Distance From Reference Point (ft.)	Steelhead/ Rainbow Trout			Non Salmonids Name species
				0+	1+	2+	
10/28/2009	754	Magnolia Ave crossing	150	0	0	0	No species

2009 Larkspur Creek e-fish observations

Date	Site #	Reference Point	Distance From Reference Point (ft.)	Steelhead/ Rainbow Trout			Non Salmonids Name species
				0+	1+	2+	
10/28/2009	755	Crumbling dam	n/a	0	0	0	11 Pacific Giant Salamanders

DISCUSSION

Larkspur Creek is an F4 channel type for the entire 12,168 feet of stream surveyed. The suitability of F4 channel types for fish habitat improvement structures is as follows: The channel type is good for bank-placed boulders. It is fair for plunge weirs, single and opposing wing-deflectors, channel constrictors, and log cover. It is poor for boulder clusters.

The water temperatures recorded on the survey days 8/4/2009 to 8/5/2009, ranged from 57 to 68 degrees Fahrenheit. Air temperatures ranged from 62 to 78 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 10% of the total length of this survey, riffles comprised 20%, and pools comprised 3%. The pools are relatively shallow, with none of the 6 (0%) 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.

Two of the 6 pool tail-outs measured had embeddedness ratings of 1 or 2. 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 Larkspur Creek should be mapped and rated according to their potential sediment yields, and control measures should be taken.

Three of the 6 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 16. The shelter rating in the flatwater habitats was 4. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by Boulders in Larkspur Creek. Terrestrial Vegetation is the dominant cover type in pools followed by small woody debris. 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 94%. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was 38% and 37%, 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

Larkspur 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) Access for migrating salmonids should be assessed at all road crossings and dams. Specific sites of concern include the Cain Street and Madera Avenue road bridges, all Private access Road and foot Bridges, and the Dam site located just upstream of Hatzic Court in the town of Larkspur, California. 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.

2) Inventory and map sources of stream bank erosion and associated sites (particularly in lower urbanized reach of Larkspur Creek) 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.

3) 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.

4) 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.

5) Suitable size spawning substrate on Larkspur Creek is limited to relatively few reaches. Projects should be designed at suitable sites to trap and sort spawning gravel.

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) Larkspur 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.

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	Start of survey at the bridge on Cain Street just upstream of the confluence. Survey began at this location due to the impinging marine tidal influence at the confluence of Corte Madera Creek and Larkspur Creek.
0	0001.00	Bridge #1 is on Cain Street, a public road. The bridge is made of concrete and its width is 14 ft, its height is 7.5 ft, and its length is 41 ft. There was no downcutting or gravel retention, and water was flowing under the concrete bottom. The height from the water to the sill is 0.2 ft. The bridge poses a possible barrier to salmonids.
130	0005.00	There are intermittent retaining walls on the left and right banks.
380	0006.00	Bridge #2 is a private driveway. It is made of concrete, and the width is 13 ft, the height is 6.5 ft, and the length is 30 ft. There was gravel being retained but there was no downcutting. The bridge is not likely a barrier to salmonids.
483	0008.00	Bridge #3 is a private driveway. It is made of wood, and the width is 21 ft, the height is 6 ft, and the length is 33 ft. There was no gravel retention or downcutting. The bridge is not likely a barrier to salmonids.
1,203	0013.00	Bridge #4 is on Madera Rd, a public road. It is made of wood and concrete, and the width is 12 ft, the height is 6 ft, and the length is 67 ft. The height from the water to the sill is 0.3 ft. There was no downcutting. The bridge is not likely a barrier to salmonids.
1,639	0016.00	Bridge #5 is a private footbridge made of wood. The width is 21 ft, the height is 6.5 ft, and the length is 5 ft. There was no gravel retention or downcutting. The bridge is not likely a barrier to salmonids.
1,811	0019.00	Bridge #6 is a private footbridge made of wood. The width is 19 ft, the height is 6.5 ft, and the length is 6 ft. There was no downcutting or gravel retention. The bridge is not likely a barrier to salmonids.
1,817	0020.00	There is a retaining wall on the right bank.
1,917	0022.00	Bridge #7 is a private footbridge made of wood. The width is 20 ft, the height is 8 ft, and the length is 4 ft. There was no downcutting or gravel retention. The bridge is not likely a barrier to salmonids.
1,983	0024.00	Bridge #8 is a private footbridge made of wood. The width is 14 ft, the height is 7 ft, and the length is 4 ft. There was no downcutting or gravel retention. The bridge is not likely a barrier to salmonids.

Position (ft.)	Habitat Unit #	Comments:
2,115	0027.00	Bridge #9 is a private footbridge made of wood. The width is 14 ft, the height is 4.5 ft, and the length is 4.5 ft. There is a pipe that parallels the bridge 3 to 4 ft above the thalweg. There was no downcutting or gravel retention. The bridge is not likely a barrier to salmonids.
2,163.5	0029.00	Bridge #10 is a private footbridge made of wood. The width is unknown, the height is 5.8 ft, and the length is 4.5 ft. There is a pipe that parallels the bridge 3 to 4 ft above the thalweg. There was no downcutting or gravel retention. The bridge is not likely a barrier to salmonids.
2,222	0031.00	Bridge #11 is a private footbridge made of wood. The width is 15 ft, the height is 6 ft, and the length is 4 ft. There was no downcutting or gravel retention. The bridge is not likely a barrier to salmonids.
2,291	0033.00	Bridge #12 is a private footbridge made of wood. The width is 16 ft, the height is 5.7 ft, and the length is 4 ft. There is a pipe that parallels the bridge 3 to 4 ft above the thalweg. There was no downcutting or gravel retention. The bridge is not likely a barrier to salmonids.
2,328	0035.00	Bridge #13 is a private deck made of wood. The width is 15 ft, the height is 7 ft, and the length is 25 ft. There was no downcutting or gravel retention. The bridge is not likely a barrier to salmonids.
2,382	0037.00	Bridge #14 is on Bridge Rd, a public road. It is made of cement, and the width is 17 ft, the height is 8 ft, and the length 20 ft. There was no downcutting or gravel retention. The bridge is not likely a barrier to salmonids.
2,402	0038.00	There are intermittent retaining walls on the left and right banks.
3,217	0039.00	Bridge #15 is a private footbridge made of wood. The width is 18 ft, the height is 5 ft, and the length is 5 ft. There was no downcutting or gravel retention. The bridge is not likely a barrier to salmonids.
3,222	0040.00	There are intermittent retaining walls on the left and right banks.
4,066	0041.00	Tributary #1 on the right bank, enters Larkspur with a discharge of <1 cubic feet per second (cfs). It also contributes 100% of its flow to the stream. The water temperature downstream was 58F, the tributary temperature was 58F, and upstream was dry. It is not accessible to fish (we checked 25' up the tributary). There were no fish observed while we were there.
4,481	0043.00	Bridge #16 is a private footbridge made of wood. The width is 12 ft, the height is 5 ft, and the length is 3 ft. There was no downcutting or gravel retention. The bridge is not likely a barrier to salmonids.
4,633	0045.00	Bridge #17 is a private footbridge made of wood. The width is 15 ft, the height is 4.5 ft, and the length is 3.5 ft. There was no downcutting or gravel retention. The bridge is not likely a barrier to salmonids.

Position (ft.)	Habitat Unit #	Comments:
6,361.5	0056.00	Bridge #18 is a private footbridge made of wood. The width is 16 ft, the height is 5 ft, and the length 3.5 ft. There was no downcutting or gravel retention. The bridge is not likely a barrier to salmonids.
6,518	0059.00	Salamanders were observed.
6,577	0062.00	Tributary #2 on the right bank, enters Larkspur with a discharge of <1 cfs. It also contributes an estimated 25% of its flow to the stream. It is a hanging tributary. The water temperature is 58F downstream, 57F upstream, and the tributary temperature is 60F. It is not accessible to fish (we checked 10 ft up the tributary). No fish were observed while we were there.
7,057	0063.00	Dam #1's length is 13 ft, the height is 13 ft, and the entire width is 53 ft. The height from the water to the sill is 12 ft. There were no flashboards present, and there was gravel retention but no downcutting. The dam is a possible barrier to juvenile and adult salmonids.
8,419	0065.00	Bridge #19 is a private footbridge made of steel and wood. The width is 33 ft, the height is 4 ft, and the length is 8 ft. There was no downcutting or gravel retention. The bridge is not likely a barrier to salmonids.
8,600	0068.00	Tributary #3 on the right bank is a dry tributary which enters Larkspur with no discharge and contributes 0% of its flow to the stream. The tributary is accessible to fish (we checked 40 ft up the tributary). No fish were observed while we were there.
8,835	0070.00	Tributary #4 on the right bank is a dry tributary which enters Larkspur with no discharge and contributes 0% of its flow to the stream. The tributary is accessible to fish; however we did not check up the tributary. No fish were observed while we were there.
9,184	0080.00	Salamanders were observed.
10,591	0084.00	Tributary #1 on the left bank is a dry tributary which enters Larkspur with no discharge and contributes 0% of its flow to the stream. It is accessible to fish (we checked 60 ft up the tributary). No fish were observed while we were there.
12,121	0086.00	End of survey at 15 to 20 ft waterfall composed of greywacke. Waterfall is very much likely a barrier to salmonid fish passage upstream. Survey crew could not safely access upstream of waterfall.

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.

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]	

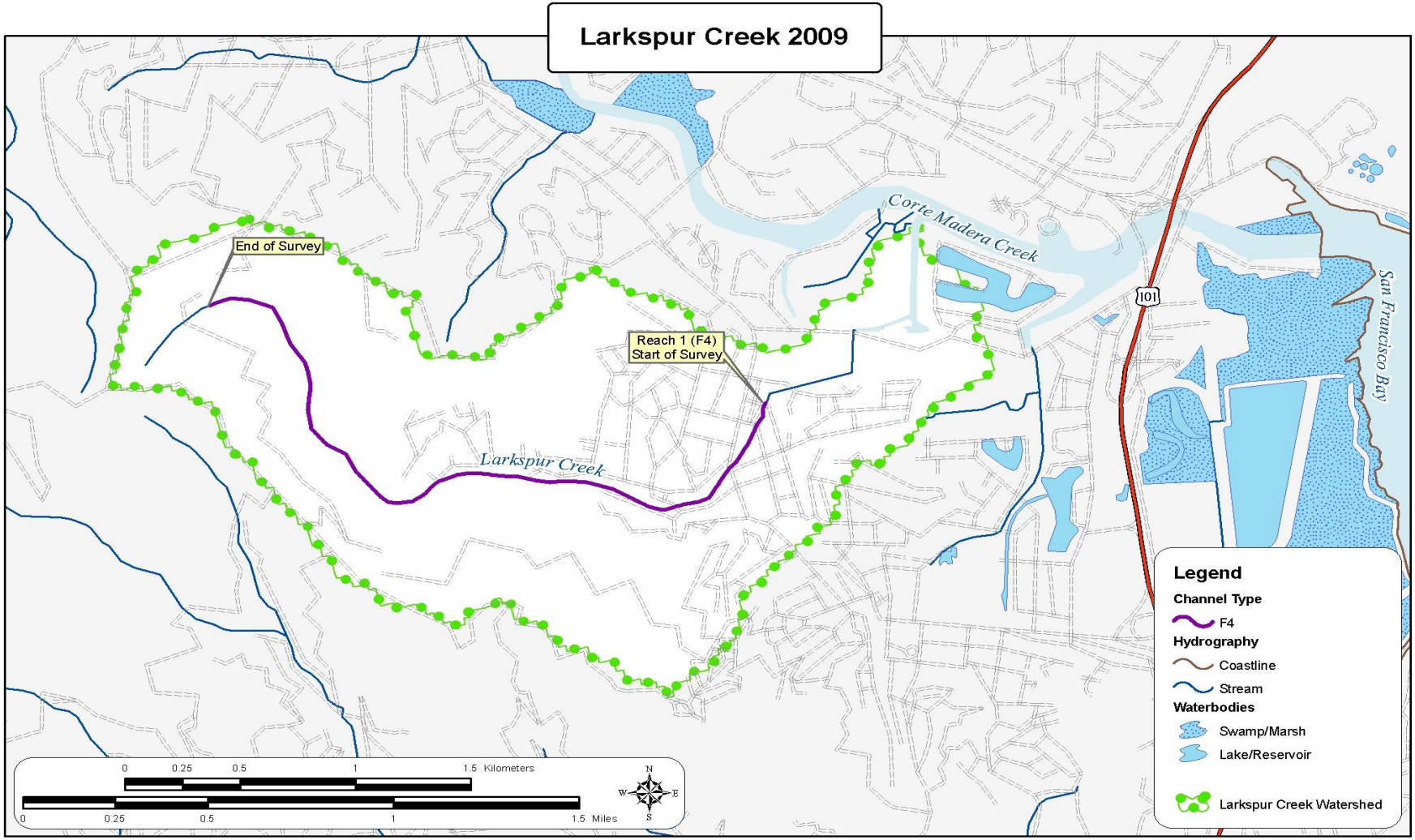

Larkspur Creek 2009
End of Survey
Reach 1 (F4)
Start of Survey
Larkspur Creek
Corte Madera Creek
101
San Francisco Bay
Legend
Channel Type
F4
Hydrography
Coastline
Stream
Waterbodies
Swamp/Marsh
Lake/Reservoir
Larkspur Creek Watershed
0 0.25 0.5 1 1.5 Kilometers
0 0.25 0.5 1 1.5 Miles
N
W
E
S
\\DFG\Watershed_Overview\BayBridges\2009\LarkspurCreek_2009.mxd
Prepared by: Scott Webb, April 2010

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

Stream Name: Larkspur Creek **LLID:** 1225257379437 **Drainage:** San Rafael

Survey 8/4/2009 to 8/5/2009

Confluence Location: **Quad:** SAN RAFAEL **Legal Description:** T01NR06WS09 **Latitude:** 37:56:37.0N **Longitude:** 122:31:33.0W

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
21	0	CULVERT	24.1	54	1129	9.3									
23	0	DRY	26.4	306	7042	57.9									
16	16	FLATWATER	18.4	72	1158	9.5	4.4	0.3	0.7	287	4588	47	700		4
7	7	POOL	8.0	55	382	3.1	6.9	0.5	1.2	280	1959	100	597	84	16
20	19	RIFFLE	23.0	123	2457	20.2	2.8	0.1	0.5	243	4860	40	792		0

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
87	42	12168	11406	2089

Table 2 - Summary of Habitat Types and Measured Parameters

Stream Name: Larkspur Creek **LLID:** 1225257379437 **Drainage:** San Rafael

Survey 8/4/2009 to 8/5/2009

Confluence Location: Quad: SAN RAFAEL **Legal Description:** T01NR06WS09 **Latitude:** 37:56:37.0N **Longitude:** 122:31:33.0W

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 (%)
19	18	LGR	21.8	128	2436	20.0	3.0	0.1	1.3	256	4860	42	793		0	94
1	1	CAS	1.1	21	21	0.2	1.0	0.1	0.6	13	13	1	1		0	95
2	2	GLD	2.3	21	42	0.3	4.0	0.3	1.0	94	187	28	56		0	99
9	9	RUN	10.3	63	569	4.7	4.0	0.3	1.0	215	1934	58	520		1	92
5	5	SRN	5.7	109	547	4.5	5.0	0.3	0.9	493	2467	31	123		10	92
1	1	MCP	1.1	21	21	0.2	8.0	0.6	1.1	168	168	118	118	101	30	96
1	1	STP	1.1	250	250	2.1	4.0			1000	1000				15	94
1	1	LSL	1.1	39	39	0.3	8.0	0.6	1.1	312	312	218	218	187	5	100
3	3	LSR	3.4	18	53	0.4	6.0	0.5	1.1	96	289	62	185	52	20	100
1	1	PLP	1.1	19	19	0.2	10.0	0.3	1.8	190	190	76	76	57	5	100
23	0	DRY	26.4	306	7042	57.9										93
21	0	CUL	24.1	54	1129	9.3										93

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume
87	42	12168	11419	2091

Table 3 - Summary of Pool Habitat Types

Stream Name: Larkspur Creek **LLID:** 1225257379437 **Drainage:** San Rafael

Survey 8/4/2009 to 8/5/2009

Confluence Location: **Quad:** SAN RAFAEL **Legal Description:** T01NR06WS09 **Latitude:** 37:56:37.0N **Longitude:** 122:31:33.0W

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
2	2	MAIN	29	136	271	71	6.0	0.6	584	1168	101	101	23
5	5	SCOUR	71	22	111	29	7.2	0.5	158	791	80	400	14

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
7	7	382	1959	501

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

Stream Name: Larkspur Creek **LLID:** 1225257379437 **Drainage:** San Rafael

Survey 8/4/2009 to 8/5/2009

Confluence Location: **Quad:** SAN RAFAEL **Legal Description:** T01NR06WS09 **Latitude:** 37:56:37.0N **Longitude:** 122:31:33.0W

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 Occurence	3 < 4 Feet Maximum Residual Depth	3 < 4 Feet Percent Occurrence	>= 4 Feet Maximum Residual Depth	>= 4 Feet Percent Occurrence
1	MCP	17	0	0	1	100	0	0	0	0	0	0
0	STP	0	0	0	0	0	0	0	0	0	0	0
1	LSL	17	0	0	1	100	0	0	0	0	0	0
3	LSR	50	1	33	2	67	0	0	0	0	0	0
1	PLP	17	0	0	1	100	0	0	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
6	1	17	5	83	0	0	0	0	0	0

Mean Maximum Residual Pool Depth (ft.): 1

Table 5 - Summary of Mean Percent Cover By Habitat

Stream Name: Larkspur Creek **Dry Units:** 23 **LLID:** 1225257379437 **Drainage:** San Rafael

Survey 8/4/2009 to 8/5/2009

Confluence Location: **Quad:** SAN RAFAEL **Legal Description:** T01NR06WS09 **Latitude:** 37:56:37.0N **Longitude:** 122:31:33.0W

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
19	12	LGR	0	0	0	0	0	0	0	8	0
1	1	CAS	0	0	0	0	0	0	0	0	0
20	13	TOTAL RIFFLE	0	0	0	0	0	0	0	8	0
2	1	GLD	0	0	0	0	0	0	0	0	0
9	6	RUN	0	0	0	0	0	0	0	17	0
5	4	SRN	0	8	0	18	0	0	0	0	0
16	11	TOTAL FLAT	0	3	0	6	0	0	0	9	0
1	1	MCP	20	0	0	0	80	0	0	0	0
1	1	STP	0	0	0	20	80	0	0	0	0
1	1	LSL	0	100	0	0	0	0	0	0	0
3	3	LSR	10	3	33	20	0	0	0	0	0
1	1	PLP	0	0	0	0	0	0	0	100	0
7	7	TOTAL POOL	7	16	14	11	23	0	0	14	0
21	0	CUL									
87	31	TOTAL	2	5	3	5	5	0	0	10	0

Table 6 - Summary of Dominant Substrates By Habitat Type

Stream Name: Larkspur Creek **Dry Units:** 23 **LLID:** 1225257379437 **Drainage:** San Rafael

Survey 8/4/2009 to 8/5/2009

Confluence Location: **Quad:** SAN RAFAEL **Legal Description:** T01NR06WS09 **Latitude:** 37:56:37.0N **Longitude:** 122:31:33.0W

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
19	12	LGR	0	100	0	0	0	0	0
1	1	CAS	0	0	0	0	0	0	100
2	1	GLD	0	100	0	0	0	0	0
9	6	RUN	17	67	0	0	0	0	17
5	5	SRN	0	80	20	0	0	0	0
1	1	MCP	0	0	100	0	0	0	0
1	1	STP	0	100	0	0	0	0	0
1	1	LSL	0	100	0	0	0	0	0
3	3	LSR	0	100	0	0	0	0	0
1	1	PLP	0	100	0	0	0	0	0
21	1	CUL	0	100	0	0	0	0	0

Table 7 - Summary of Mean Percent Canopy for Entire Stream

Stream Name: Larkspur Creek **LLID:** 1225257379437 **Drainage:** San Rafael

Survey 8/4/2009 to 8/5/2009

Confluence Location: **Quad:** SAN RAFAEL **Legal Description:** T01NR06WS09 **Latitude:** 37:56:37.0N **Longitude:** 122:31:33.0W

Mean Percent Canopy	Mean Percent Conifer	Mean Percent Hardwood	Mean Percent Open Units	Mean Right Bank % Cover	Mean Left Bank % Cover
94	13	87	0	38	37

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

Open units represent habitat units with zero canopy cover.

Table 8 - Fish Habitat Inventory Data Summary

Stream Larkspur Creek LLID: 1225257379437 Drainage San Rafael

Survey Dates: 8/4/2009 to 8/5/2009 Survey Length (ft.): 12168 Main Channel (ft.): 12121 Side Channel (ft.): 47

Confluence Location: Quad SAN RAFAEL Legal Description: T01NR06WS09 Latitude: 37:56:37.0N Longitude: 122:31:33.0W

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 1

Channel Type: F4

Reach Length (ft.): 12121

Riffle/Flatwater Mean Width (ft.): 3.5

BFW:

Range (ft.): 7.00 to 18.00

Mean (ft.): 12.88

Std. Dev.: 3.18

Base Flow (cfs): N/A

Water (F): 57 - 68 Air (F): 62 - 78

Dry Channel (ft.): 7042

Canopy Density (%): 93.9

Coniferous Component (%): 12.6

Hardwood Component 87.4

Dominant Bank Hardwood Trees

Vegetative Cover (%): 37.4

Dominant Boulders

Dominant Bank Substrate Sand/Silt/Clay

Occurrence of LWD (%): 3.2

LWD per 100 ft.:

Riffles: 2

Pools: 1

Flat: 1

Pools by Stream Length 3.1

Pool Frequency (%): 8.0

Residual Pool Depth (%):

< 2 Feet Deep: 100.0

2 to 2.9 Feet Deep: 0.0

3 to 3.9 Feet Deep: 0.0

>= 4 Feet Deep: 0.0

Mean Max Residual Pool Depth 1.18

Mean Pool Shelter 16

Pool Tail Substrate (%): Silt/Clay: 0.0 Sand: 50.0 Gravel: 50.0 Sm Cobble: 0.0 Lg Cobble: 0.0 Boulder 0.0 Bedrock: 0.0

Embeddedness Values (%): 1. 16.7 2. 16.7 3. 33.3 4. 33.3 5. 0.0

Table 9 -Mean Percentage of Dominant Substrate and Vegetation

Stream Name: Larkspur Creek **LLID:** 1225257379437 **Drainage:** San Rafael

Survey 8/4/2009 to 8/5/2009

Confluence Location: **Quad:** SAN RAFAEL **Legal Description:** T01NR06WS09 **Latitude:** 37:56:37.0N **Longitude:** 122:31:33.0W

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	10	7	21.3
Boulder	1	1	2.5
Cobble/Gravel	1	2	3.8
Sand/Silt/Clay	28	30	72.5

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	1	1	2.5
Brush	7	7	17.5
Hardwood	30	30	75.0
Coniferous	0	0	0.0
No Vegetation	2	2	5.0

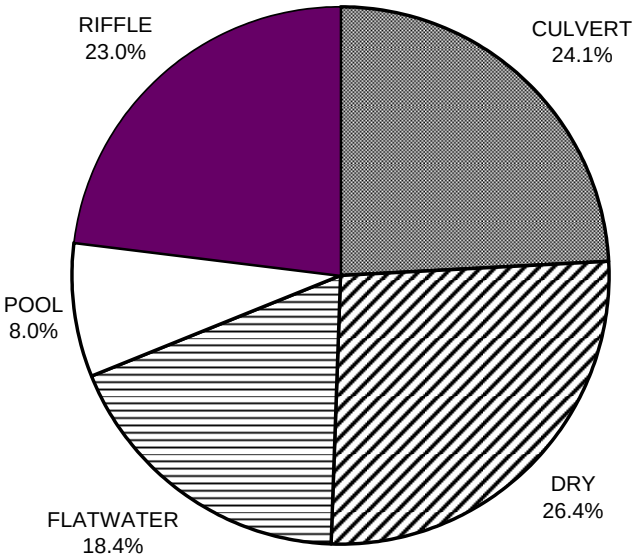
Total Stream Cobble Embeddedness Values: 3

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

Stream Name: Larkspur Creek **LLID:** 1225257379437 **Drainage:** San Rafael
Survey 8/4/2009 to 8/5/2009
Confluence Location: **Quad:** SAN RAFAEL **Legal Description:** T01NR06WS09 **Latitude:** 37:56:37.0N **Longitude:** 122:31:33.0W

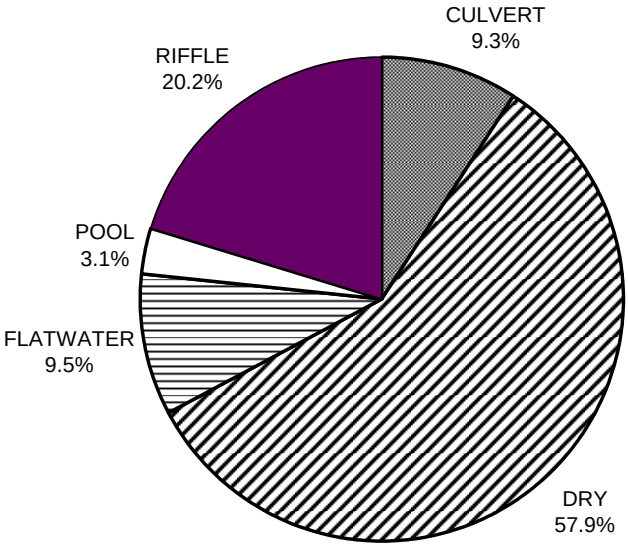
	Riffles	Flatwater	Pools
UNDERCUT BANKS (%)	0	0	7
SMALL WOODY DEBRIS (%)	0	3	16
LARGE WOODY DEBRIS (%)	0	0	14
ROOT MASS (%)	0	6	11
TERRESTRIAL VEGETATION	0	0	23
AQUATIC VEGETATION (%)	0	0	0
WHITEWATER (%)	0	0	0
BOULDERS (%)	8	9	14
BEDROCK LEDGES (%)	0	0	0

LARKSPUR CREEK 2009
HABITAT TYPES BY PERCENT OCCURRENCE



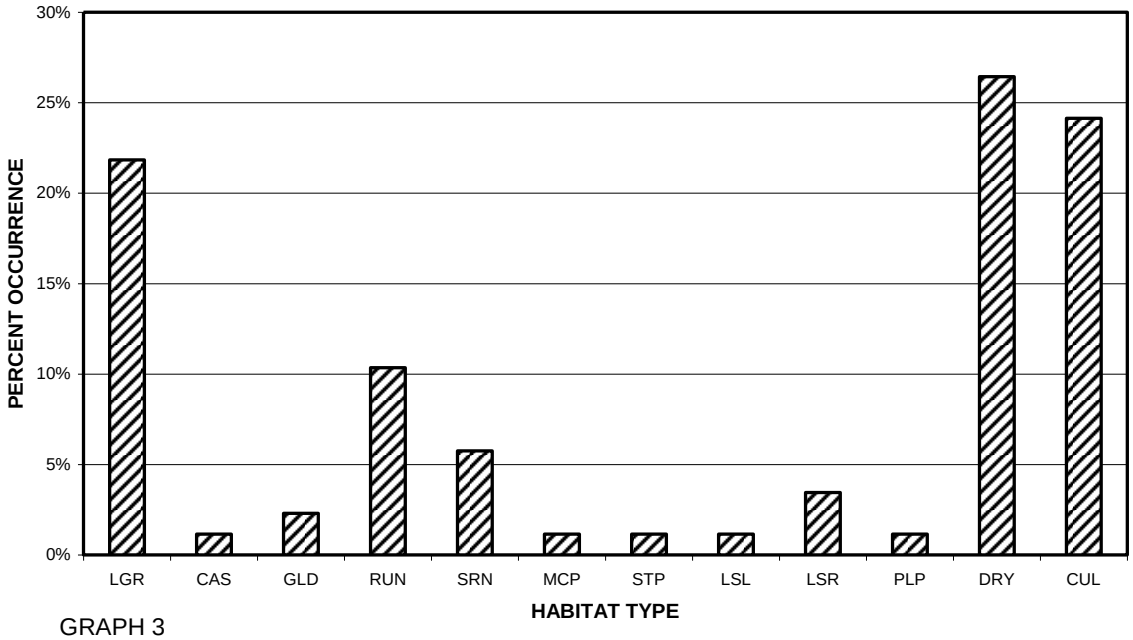
GRAPH 1

LARKSPUR CREEK 2009
HABITAT TYPES BY PERCENT TOTAL LENGTH



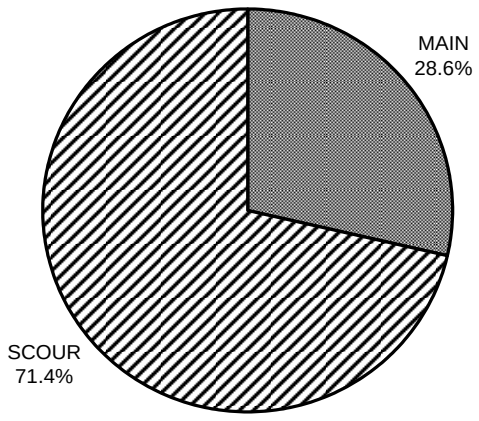
GRAPH 2

LARKSPUR CREEK 2009
HABITAT TYPES BY PERCENT OCCURRENCE



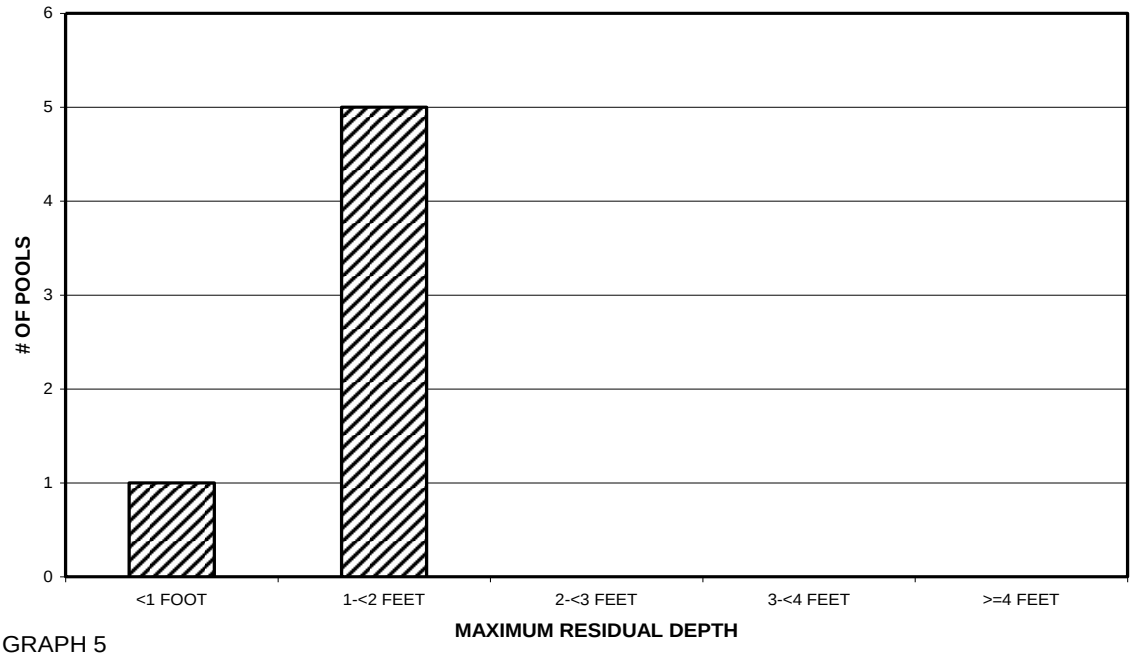
GRAPH 3

LARKSPUR CREEK 2009
POOL TYPES BY PERCENT OCCURRENCE



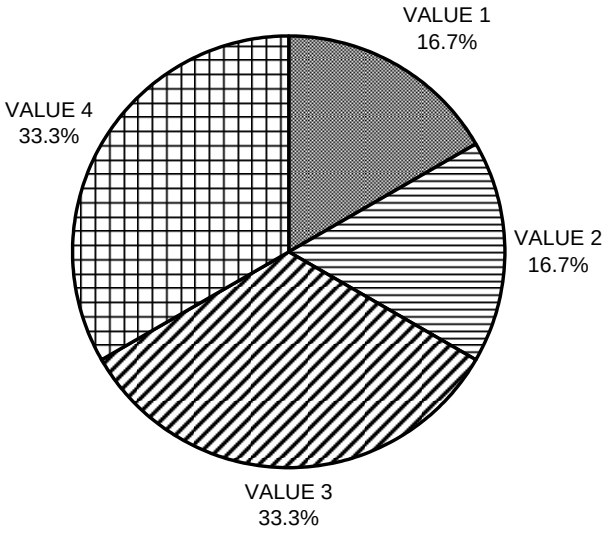
GRAPH 4

LARKSPUR CREEK 2009
MAXIMUM DEPTH IN POOLS



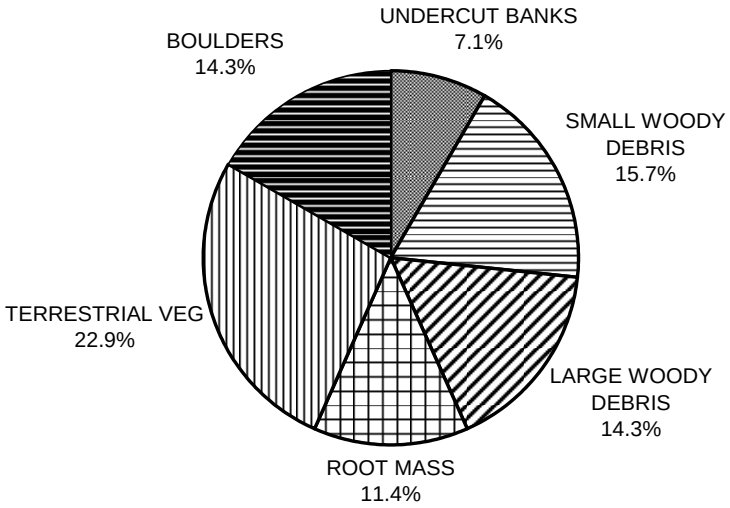
GRAPH 5

LARKSPUR CREEK 2009
PERCENT EMBEDDEDNESS



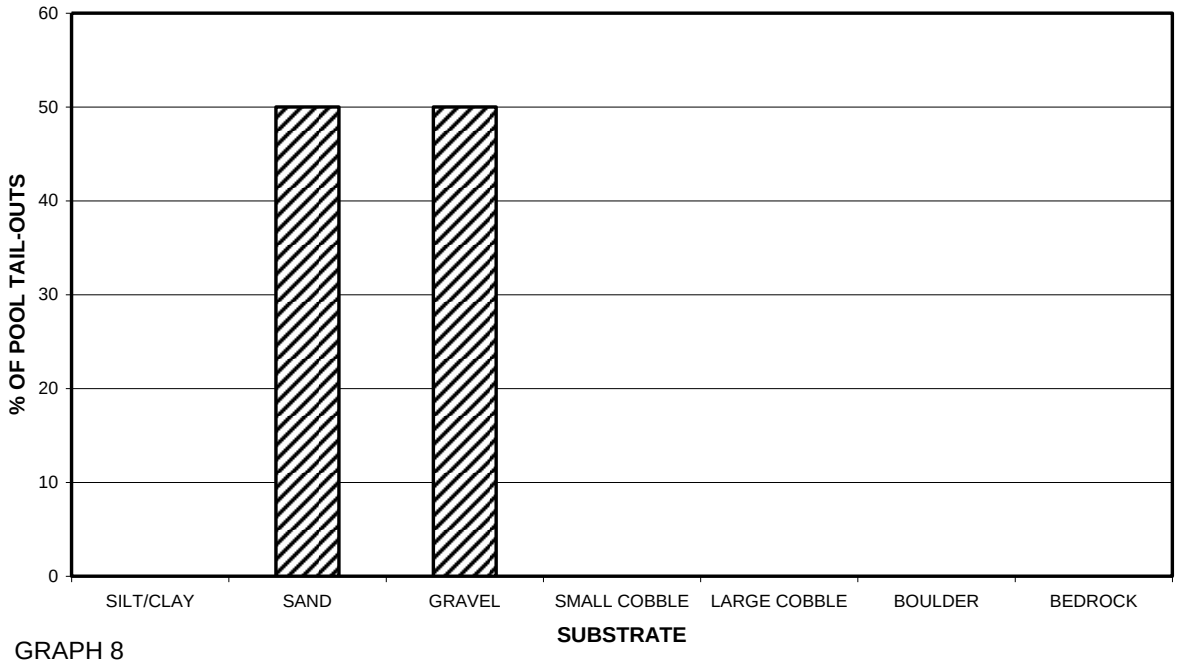
GRAPH 6

LARKSPUR CREEK 2009
MEAN PERCENT COVER TYPES IN POOLS



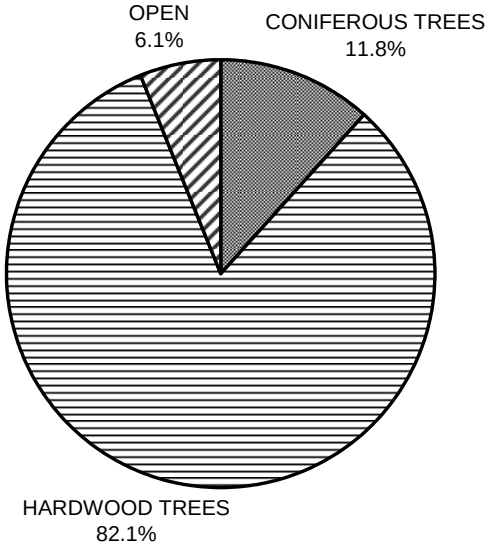
GRAPH 7

LARKSPUR CREEK 2009
SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



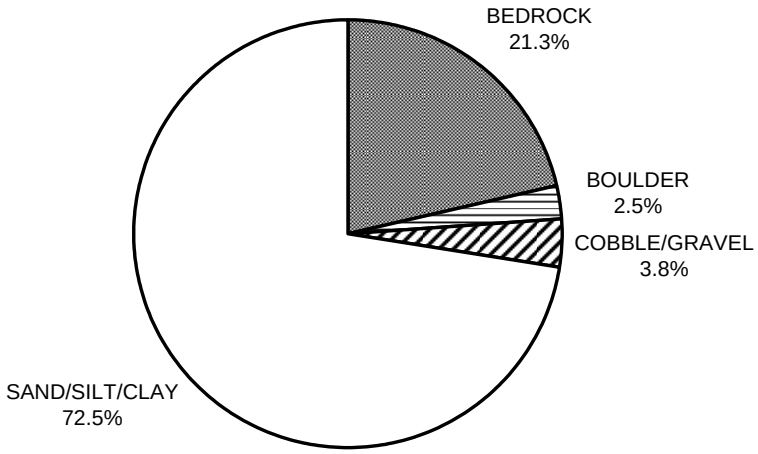
GRAPH 8

LARKSPUR CREEK 2009
MEAN PERCENT CANOPY



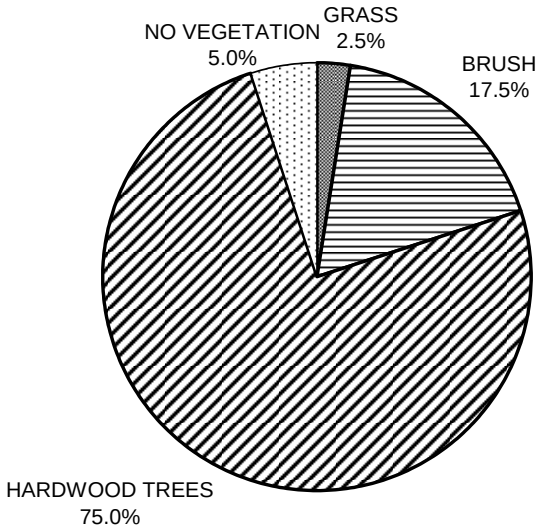
GRAPH 9

LARKSPUR CREEK 2009
DOMINANT BANK COMPOSITION IN SURVEY REACH



GRAPH 10

LARKSPUR CREEK 2009
DOMINANT BANK VEGETATION IN SURVEY REACH



GRAPH 11