



**California Department of Fish and Wildlife  
Sonoma County  
Russian River Watershed  
Stream Habitat Assessment Reports**

# **The North Fork of Mark West Creek**

*Surveyed 2012*

*Report Completed in 2013*



## North Fork Mark West Creek

### STREAM INVENTORY REPORT

#### North Fork Mark West Creek

#### INTRODUCTION

A stream inventory was conducted 9/4/2012 to 9/5/2012 on North Fork Mark West Creek. The survey began at the confluence with Mark West Creek and extended upstream 0.9 miles.

The objective of the habitat inventory was to document the habitat available to anadromous salmonids in North Fork Mark West Creek.

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

#### WATERSHED OVERVIEW

North Fork Mark West Creek is located in Sonoma County, California (Map 1). It is a tributary to Mark West Creek, which flows into Russian River, which flows into Pacific Ocean. North Fork Mark West Creek's legal description at the confluence with Mark West Creek is T08N R07W Sec.25. Its location is (38:31:13.0N) 38.5203 north latitude and (122:35:27.0W) 122.5909 west longitude, LLID number 1225909385203. North Fork Mark West Creek is a second order stream and has approximately 1.7 miles of blue line stream according to the USGS National Hydrology Dataset (NHD). North Fork Mark West Creek drains a watershed of approximately 1.4 square miles. Elevations range from about 1,224 feet at the mouth of the creek to 2,365 feet in the headwater areas (average elevation of headwaters, not highest point). Evergreen forest dominates the watershed. The watershed is primarily privately owned, which accounts for 86% of the land area. One hundred percent of the land is considered natural. Vehicle access exists via St Helena Rd in Santa Rosa, CA.

#### METHODS

The habitat inventory conducted in North Fork Mark West 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.

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### 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 North Fork Mark West 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". North Fork Mark West 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

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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 North Fork Mark West 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 such as 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 North Fork Mark West 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 North Fork Mark West 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 North Fork Mark West Creek, the dominant composition type and the

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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 North Fork Mark West Creek. In addition, 1 site was sampled for species composition and distribution using one-meter pole seine nets and hand-nets. These sampling techniques are not discussed in the *California Salmonid Stream Habitat Restoration Manual* but were adopted for the purpose of this specific sampling survey conducted on September 7, 2011.

The sampling period began at 13:22 and water temperature taken during this time was 62 degrees. Air temperature was recorded to be 84 degrees Fahrenheit. This site was sampled by D.Acomb (CDFW) and D. Dela Vega (WSP).

The sample site was located just upstream of the confluence of the North Fork of Mark West creek and Mark West Creek main stem, directly below the St. Helena Road culvert. The site yielded 0 young-of-the-year steelhead/rainbow trout (SH/RT), 3 age 1+ SH/RT, 0 age 2+ SH/RT, and 0 Non-salmonid aquatic species.

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### 2011 North Fork Mark West Creek Seine Sampling observations

Date	Site #	Reference Point	Distance From Reference Point (ft.)	Steelhead/Rainbow Trout			Non Salmonids Name species
				0+	1+	2+	
06/21/2011	1	St. Helena Road culvert	30	0	3	0	n/a

### 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 North Fork Mark West 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

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### HABITAT INVENTORY RESULTS

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

The habitat inventory of 9/4/2012 to 9/5/2012, was conducted by D. Dela Vega, C. Neill (WSP). The total length of the stream surveyed was 4,707 feet with an additional 0 feet of side channel.

Stream flow was not measured on North Fork Mark West Creek.

North Fork Mark West Creek is an A4 channel type for 4,707 feet of the stream surveyed (Reach 1). A4 channels are steep, narrow, cascading, step-pool, high energy debris transporting channels with depositional soils, and gravel-dominant substrates.

Water temperatures taken during the survey period ranged from 53 to 58 degrees Fahrenheit. Air temperatures ranged from 61 to 78 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 44% dry units, 41% pool units, 10% flatwater units, 3% riffle units, and 3% culvert units (Graph 1). Based on total length of Level II habitat types, there were 75% dry units, 14% flatwater units, 7% pool units, 2% riffle units, and 1% culvert units (Graph 2).

Eight- Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were 44% dry units, 36% mid-channel pool units, and 8% step run units (Graph 3). Based on percent total length, 75% dry units, 14% step run units, and 5% mid-channel pool units.

A total of 16 pools were identified (Table 3). Main channel pools were the most frequently encountered at 100% (Graph 4), and comprised 100% of the total length of all pools (Table 3).

Table 4 is a summary of maximum residual pool depths by pool habitat types. Pool quality for salmonids increases with depth. Two of the 16 pools (12%) had a residual depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 16 pool tail-outs measured, 8 had a value of 1 (50%), 7 had a value of 2 (44%), 1 had a value of 5 (6%) (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 5, flatwater habitat types had a mean shelter rating of 5, and pool habitats had a mean shelter rating of 15 (Table 1). Of the pool types, the main channel pools had a mean shelter rating of 15 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover type in

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North Fork Mark West Creek. Graph 7 describes the pool cover in North Fork Mark West Creek. Boulders are 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. Gravel substrate was observed in 63% of pool tail-outs; and small cobble substrate was observed in 19% of pool tail-outs.

The mean percent canopy density for the surveyed length of North Fork Mark West Creek was 93%. Of the canopy present, the mean percentages of hardwood and coniferous trees were 62% and 38%, respectively. Seven percent of the canopy was open. Graph 9 describes the mean percent canopy in North Fork Mark West Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 72%. The mean percent left bank vegetated was 72% (Table 7). The dominant elements composing the structure of the stream banks consisted of 39% bedrock, 26% cobble/gravel, 24% sand/silt/clay, and 11% boulder (Graph 10). Deciduous trees were the dominant vegetation type observed in 50% of the units surveyed. Additionally, 26% of the units surveyed had coniferous trees as the dominant vegetation type, and 16% had brush as the dominant vegetation type (Graph 11).

## DISCUSSION

North Fork Mark West Creek is a A4 channel type for the entire 4,707 feet of the stream survey.. The suitability of A4 channel types for fish habitat improvement structures is/are as follows: A4 channel types are good for bank-placed boulders and fair for plunge weirs, opposing wing-deflectors and log cover.

The water temperatures recorded on the survey days 9/4/2012 to 9/5/2012, ranged from 53 to 58 degrees Fahrenheit. Air temperatures ranged from 61 to 78 degrees Fahrenheit. This is a good water temperature range for salmonids. 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 14% of the total length of this survey, riffles 2%, and pools 7% (44% dry units, 41% pool units, 10% flatwater units, 3% riffle units, 3% culvert units). The pools are relatively shallow, with 2 of the 16 (12%) pools having a maximum residual depth greater than two 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 the numerous log debris accumulations (LDA's) in the stream.

Fifteen of the 16 pool tail-outs measured had embeddedness ratings of 1 or 2. Zero of the pool tail-outs had embeddedness ratings of 3 or 4. One of the pool tail-outs had a rating of 5, which is



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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 North Fork Mark West Creek should be mapped and rated according to their potential sediment yields, and control measures should be taken.

Thirteen of the 16 pool tail-outs measured had gravel and small cobble as the dominant substrate. This is generally considered good for spawning salmonids.

The mean shelter rating for pools is 15. The shelter rating in the flatwater habitats is 5. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by boulders in North Fork Mark West Creek. Boulders are 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 93%. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was 72% and 72%, 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

North Fork Mark West 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. The only limiting identified barrier throughout the watershed is the St. Helena Road in-stream Culvert located just upstream of the confluence of the North Fork with Mark West Creek. It has been identified by multiple sources as a limiting fish barrier denying upstream access to more spawning and rearing habitat, and should be 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.

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- 2) 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.
- 3) Due to the natural high gradient of the stream throughout Reach 1, access for migrating salmonids is an ongoing potential problem. Good water temperature and flow regimes exist in the stream and it offers good conditions for rearing fish. Fish passage should be monitored and improved where possible.
- 4) There are several log debris accumulations present on the North Fork of Mark West Creek that are retaining large quantities of fine sediment. The modification of these debris accumulations is desirable, but must be done carefully, over time, to avoid excessive sediment loading in downstream reaches.

### 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.

<b>Position</b>	<b>Habitat Unit #</b>	<b>Memo</b>
0	0001.00	Start of Survey at the St. Helena Rd. culvert due to lack of landowner access at the confluence of the North Fork of Mark West and Mark West Creek. WP 39 38.5209 122.5913
0	0001.00	Culvert 1 is under St. Helena Rd. The culvert is made of Corrugated Metal Piping with length = 53', height = 6', width = 6', diameter = 6', plunge height = 7.5', and an estimated slope = 1-2%. The culvert is rusted on the bottom, slightly dented, and has a concrete bottom for 1/3 of the length of the culvert from the upstream end. It is a possible barrier to adults and juveniles. Rip rap is placed at the outlet of the culvert. WP # 39 N38.52092 W122.59133
53	0002.00	At the bottom of the unit is a downed tree, which is cabled to the culvert on the right bank.
53	0002.00	Right bank tributary # 1 is 52' into the unit. The tributary is dry with flow= 0 cfs. Water temperatures = N/A and the slope measured with the clinometer = 4-8%, within the first 100' = 2-4%, and after the slope = 8-6%. The tributary was checked 200' up by the survey crew and it is accessible to fish. The dominant substrate is bedrock and boulder. WP #40

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<b>Position</b>	<b>Habitat Unit #</b>	<b>Memo</b>
		N38.52116,W122.59103 Left bank tributary #2 is 93' into the unit. The tributary is dry, water temperatures = N/A, and slope measured with the clinometer = 1-2%. The crew checked 200' up the tributary and found it is accessible to fish, with excellent spawning gravel available. WP #40 N38.52116 W122.59103
430	0004.00	At the bottom of the habitat unit are boulder roughs, which are a potential barrier. Picture 211 taken. 20 feet into the unit is a left bank drainage off the mountain side. 98' into the unit is the NOAA stream gauge in a dried pool/depression. 200' into the unit is another boulder rough with a 7' plunge, which could be a potential barrier. Pictures 214 and 215 taken. After the first 420' the channel become constricted by bedrock, creating a narrow canyon. Pictures 212 and 213 taken.
970	0005.00	The water quality/clarity appears to be good. The plunge into the pool is 6' in high flows. Pictures 216 and 217 taken.
1,191	0009.00	3' Plunge into the Habitat Unit
1,297	0014.00	Right bank tributary #3 is 175' into the unit. It is dry with flow = 0 cfs. The water temperatures = N/A, the slope measured with a clinometer = 45%. The crew checked 125 feet up and found the tributary is not accessible to fish. The dominant substrate is bedrock and boulder. WP #43 N38.52430 W122.59003
1,840	0015.00	The step pool is separated by multiple dry units.
1,906	0016.00	Left bank tributary # 4 is at the bottom of the unit. It is dry with flow = 0 cfs. Water temperatures = N/A and the slope measured with a clinometer = 3-5%. The crew checked 150 up and found the tributary is accessible to fish. The tributary is at the toe of a remnant landslide. The substrate is gravel for the first 100', and then becomes boulder. WP # 44 N38.52581 W122.58904  Right bank tributary # 5 is at the bottom of the unit. It is dry with flow= 0 cfs. The water temperatures = N/A and the slope measured with a clinometer = 5-8%. The crew checked 175' up and found that the tributary is accessible to fish. The tributary is at the toe of a remnant landslide. The substrate is gravel and boulder, and there is a 3' plunge from the

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Position	Habitat Unit #	Memo
		confluence with the North Fork of Mark West Creek. The same WP and flag was used for left bank tributary # 4 and right bank tributary # 5. WP # 44 N38.52581 W122.58904
2,039	0019.00	Upstream of the pool large and small wood are retaining gravel.
2,224	0022.00	120 feet into the unit is an old landslide scarp on the left bank, approximately 75' x 70' x 15', with a drainage along the side.
2,573	0024.00	There is a small trail on the left bank of the tributary.
2,573	0024.00	Right bank tributary # 6 is at the bottom of the unit. It is dry. The water temperatures = N/A and the slope measured with the clinometer = 10-12%. The crew checked 200' up and found that the tributary is not accessible to fish. The tributary is extremely entrenched with a high erosion potential. The dominant substrate is gravel, silt, and sand. WP # 46 N38.52690 W 122.58812
2,676	0025.00	Left bank tributary # 7 is 27' into the unit. It is dry. The water temperatures = N/A and the slope measured with a clinometer = 25%. The crew checked 75' up and found that the tributary is not accessible to fish. The channel is entrenched and the dominant substrate is gravel and silt. WP # 47 N38.52741 W122. 58833
3,100	0028.00	Right bank tributary # 8 is at the bottom of the unit. The tributary is wet, with an estimated flow = 0.001-0.01 cfs, contributing 100% of the flow to the North Fork of Mark West Creek. The water temperature upstream = dry, downstream = 58 F, and in the tributary = 60 F. The slope measured with the clinometer = 4-6 %. The crew checked 200' up and found the tributary is accessible to fish. The dominant substrate is cobble and gravel. The tributary has deep pools with flowing water and 1-2 foot plunges between the pools. The North Fork of Mark West Creek is dry above the tributary and the tributary appears to be the only source of water the North Fork. WP # 48 N38.52852 W122.58749
3,200	0029.00	There are numerous short dry units between the areas with water throughout the unit.
3,553	0032.00	There is a 4' plunge at the top of the unit from a piece

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Position	Habitat Unit #	Memo
		of large wood spanning the creek. The wood is retaining gravel for at least 30' upstream.
3,715	0036.00	There is a spring near the top of the unit on the right bank, which has an approximate flow = 0.01 cfs.
3,823	0039.00	315' into the unit is a right bank drainage, which is not accessible to fish. 350' into the unit is a cluster of 5 pieces of large wood, with associated small wood. It is not retaining gravel and fish can easily pass underneath the accumulation. 684' into the unit is a right bank drainage, which is not accessible to fish.
3,823	0039.00	Left bank tributary #9 is 884' into the unit. It is dry with flow = 0 cfs. The water temperatures = N/A and the slope measured with a clinometer = 25-30%. The crew checked up 125' and found that it is not accessible to fish. The channel is overgrown, looks inactive, and the substrate can't be seen through the debris. WP # 51 N 38.52973 W122.58286
4,707	0039.00	End of survey due to lack of landowner 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.

## North Fork Mark West Creek

### 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 }

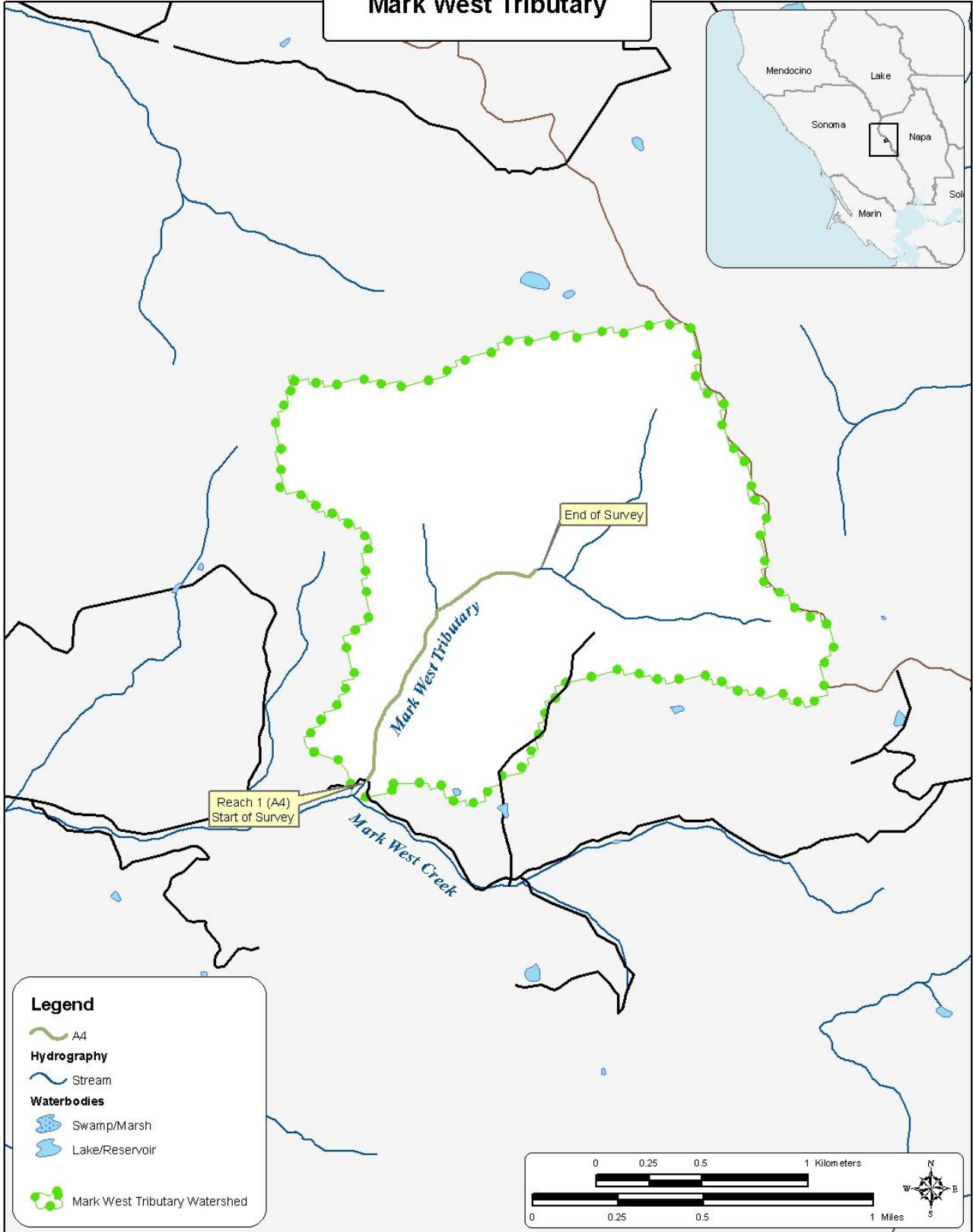
#### BACKWATER POOLS

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 marsh	(MAR)	[9.1]	

# Mark West Tributary



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

**Stream Name:** North Fork Mark West Creek  
**Survey** 9/4/2012 to 9/5/2012

**LLID:** 1225909385203 **Drainage:** Russian River - Middle

**Confluence Location: Quad:** CALISTOGA **Legal Description:** T08NR07WS25 **Latitude:** 38:31:13.0N **Longitude:** 122:35:27.0W

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
1	0	CULVERT	2.6	53	53	1.1									
17	0	DRY	43.6	209	3550	75.4									
4	2	FLATWATER	10.3	170	682	14.5	2.0	0.2	0.4	67	268	13	54		5
16	16	POOL	41.0	22	350	7.4	5.1	0.4	0.9	93	1490	45	721	44	15
1	1	RIFFLE	2.6	72	72	1.5	3.0	0.2	0.4	184	184	37	37		5
<b>Total Units</b>	<b>Total Units Fully Measured</b>				<b>Total Length (ft.)</b>						<b>Total Area (sq.ft.)</b>		<b>Total Volume (cu.ft.)</b>		
39	19				4707						1941		811		



**Table 2 - Summary of Habitat Types and Measured Parameters**

**Stream Name:** North Fork Mark West Creek  
**Survey** 9/4/2012 to 9/5/2012

**LLID:** 1225909385203 **Drainage:** Russian River - Middle

**Confluence Location:** Quad: CALISTOGA **Legal Description:** T08NR07WS25 **Latitude:** 38:31:13.0N **Longitude:** 122:35:27.0W

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 (%)
1	1	LGR	2.6	72	72	1.5	3.0	0.2	0.4	184	184	37	37		5	88
1	1	RUN	2.6	31	31	0.7	2.0	0.2	0.4	56	56	11	11		5	84
3	1	SRN	7.7	217	651	13.8	2.0	0.2	0.4	78	234	16	47		5	95
14	14	MCP	35.9	18	246	5.2	5.0	0.4	2.0	82	1148	42	584	42	16	93
1	1	CCP	2.6	38	38	0.8	5.0	0.3	0.7	171	171	68	68	51	5	96
1	1	STP	2.6	66	66	1.4	4.0	0.4	1.4	172	172	69	69	69	5	93
17	0	DRY	43.6	209	3550	75.4										94
1	0	CUL	2.6	53	53	1.1										
<b>Total Units</b>	<b>Total Units Fully Measured</b>				<b>Total Length (ft.)</b>					<b>Total Area (sq.ft.)</b>			<b>Total Volume</b>			
39	19				4707					1964			816(cu.ft.)			

### Table 3 - Summary of Pool Habitat Types

**Stream Name:** North Fork Mark West Creek  
**Survey** 9/4/2012 to 9/5/2012

**LLID:** 1225909385203

**Drainage:** Russian River - Middle

**Confluence Location: Quad:** CALISTOGA

**Legal Description:** T08NR07WS25

**Latitude:** 38:31:13.0N

**Longitude:** 122:35:27.0W

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
16	16	MAIN	100	22	350	100	5.1	0.4	93	1490	44	704	15
Total Units	Total Units Fully Measured				Total Length (ft.)					Total Area (sq.ft.)		Total Volume (cu.ft.)	
16	16				350					1490		704	

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

**Stream Name:** North Fork Mark West Creek  
**Survey** 9/4/2012 to 9/5/2012

**LLID:** 1225909385203

**Drainage:** Russian River - Middle

**Confluence Location: Quad:** CALISTOGA

**Legal Description:** T08NR07WS25

**Latitude:** 38:31:13.0N

**Longitude:** 122:35:27.0W

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
14	MCP	88	10	71	2	14	2	14	0	0	0	0
1	CCP	6	1	100	0	0	0	0	0	0	0	0
1	STP	6	0	0	1	100	0	0	0	0	0	0
<b>Total Units</b>			<b>Total &lt; 1 Foot Max Resid. Depth</b>	<b>Total &lt; 1 Foot % Occurrence</b>	<b>Total 1 &lt; 2 Feet Max Resid. Depth</b>	<b>Total 1 &lt; 2 Feet % Occurrence</b>	<b>Total 2 &lt; 3 Feet Max Resid. Depth</b>	<b>Total 2 &lt; 3 Feet % Occurrence</b>	<b>Total 3 &lt; 4 Feet Max Resid. Depth</b>	<b>Total 3 &lt; 4 Feet % Occurrence</b>	<b>Total &gt;= 4 Feet Max Resid. Depth</b>	<b>Total &gt;= 4 Feet % Occurrence</b>
16			11	69	3	19	2	13	0	0	0	0
Mean Maximum Residual Pool Depth (ft.):			1									

**Table 5 - Summary of Mean Percent Cover By Habitat**

**Stream Name:** North Fork Mark West Creek      **Dry Units:** 17      **LLID:** 1225909385203      **Drainage:** Russian River - Middle  
**Survey** 9/4/2012 to 9/5/2012

**Confluence Location:** Quad: CALISTOGA      **Legal Description:** T08NR07WS25      **Latitude:** 38:31:13.0N      **Longitude:** 122:35:27.0W

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
1	1	LGR	0	20	0	0	0	0	0	80	0
1	1	TOTAL RIFFLE	0	20	0	0	0	0	0	80	0
1	1	RUN	0	20	0	0	0	0	0	80	0
3	1	SRN	0	0	0	0	0	0	0	100	0
4	2	TOTAL FLAT	0	10	0	0	0	0	0	90	0
14	14	MCP	4	14	1	4	0	0	0	71	5
1	1	CCP	0	0	0	0	0	0	0	100	0
1	1	STP	0	0	0	0	0	0	0	100	0
16	16	TOTAL POOL	3	13	1	3	0	0	0	75	4
1	0	CUL									
39	19	TOTAL	3	13	1	3	0	0	0	77	4

**Table 6 - Summary of Dominant Substrates By Habitat Type**

**Stream Name:** North Fork Mark West Creek      **Dry Units:** 17      **LLID:** 1225909385203      **Drainage:** Russian River - Middle  
**Survey** 9/4/2012 to 9/5/2012

**Confluence Location: Quad:** CALISTOGA      **Legal Description:** T08NR07WS25      **Latitude:** 38:31:13.0N      **Longitude:** 122:35:27.0W

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
1	1	LGR	0	0	0	0	100	0	0
1	1	RUN	0	0	100	0	0	0	0
3	1	SRN	0	0	0	0	100	0	0
14	14	MCP	0	0	57	7	7	14	14
1	1	CCP	0	0	100	0	0	0	0
1	1	STP	0	0	0	100	0	0	0
1	0	CUL	0	0	0	0	0	0	0

### Table 7 - Summary of Mean Percent Canopy for Entire Stream

**Stream Name:** North Fork Mark West Creek  
**Survey** 9/4/2012 to 9/5/2012

**LLID:** 1225909385203 **Drainage:** Russian River - Middle

**Confluence Location:** **Quad:** CALISTOGA **Legal Description:** T08NR07WS25 **Latitude:** 38:31:13.0N **Longitude:** 122:35:27.0W

Mean Percent Canopy	Mean Percent Conifer	Mean Percent Hardwood	Mean Percent Open Units	Mean Right Bank % Cover	Mean Left Bank % Cover
93	38	62	0	72	72

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 North Fork Mark West Creek LLID: 1225909385203 Drainage Russian River - Middle  
 Survey Dates: 9/4/2012 to 9/5/2012 Survey Length (ft.): 4707 Main Channel (ft.): 4707 Side Channel (ft.): 0  
 Confluence Location: Quad CALISTOGA Legal Description: T08NR07WS25 Latitude: 38:31:13.0N Longitude: 122:35:27.0W

**Summary of Fish Habitat Elements By Stream Reach**

**STREAM REACH: 1**

Channel Type: A4	Canopy Density (%): 93.1	Pools by Stream Length: 7.4
Reach Length (ft.): 4707	Coniferous Component (%): 38.3	Pool Frequency (%): 41.0
Riffle/Flatwater Mean Width (ft.): 2.3	Hardwood Component: 61.7	Residual Pool Depth (%):
BFW:	Dominant Bank: Hardwood Trees	< 2 Feet Deep: 87.5
Range (ft.): 15.00 to 29.00	Vegetative Cover (%): 72.1	2 to 2.9 Feet Deep: 12.5
Mean (ft.): 19.77	Dominant: Boulders	3 to 3.9 Feet Deep: 0.0
Std. Dev.: 5.61	Dominant Bank Substrate: Bedrock	>= 4 Feet Deep: 0.0
Base Flow (cfs):	Occurrence of LWD (%): 1.1	Mean Max Residual Pool Depth: 0.88
Water (F): 0 - 58 Air (F): 61 - 78	LWD per 100 ft.:	Mean Pool Shelter: 15
Dry Channel (ft.): 3550	Riffles: 1	
	Pools: 1	
	Flat: 1	
Pool Tail Substrate (%): Silt/Clay: 0.0 Sand: 0.0 Gravel: 62.5 Sm Cobble: 18.8 Lg Cobble: 0.0 Boulder: 12.5 Bedrock: 6.3		
Embeddedness Values (%): 1. 50.0 2. 43.8 3. 0.0 4. 0.0 5. 6.3		

**Table 9 -Mean Percentage of Dominant Substrate and Vegetation**

**Stream Name:** North Fork Mark West Creek **LLID:** 1225909385203 **Drainage:** Russian River - Middle  
**Survey** 9/4/2012 to 9/5/2012  
**Confluence Location:** **Quad:** CALISTOGA **Legal Description:** T08NR07WS25 **Latitude:** 38:31:13.0N **Longitude:** 122:35:27.0W

**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	7	8	39.5
Boulder	2	2	10.5
Cobble/Gravel	6	4	26.3
Sand/Silt/Clay	4	5	23.7

**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	3	0	7.9
Brush	2	4	15.8
Hardwood	10	9	50.0
Coniferous	4	6	26.3
No Vegetation	0	0	0.0

**Total Stream Cobble Embeddedness Values:** 2



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

**Stream Name:** North Fork Mark West Creek  
**Survey** 9/4/2012 to 9/5/2012

**LLID:** 1225909385203 **Drainage:** Russian River - Middle

**Confluence Location: Quad:** CALISTOGA

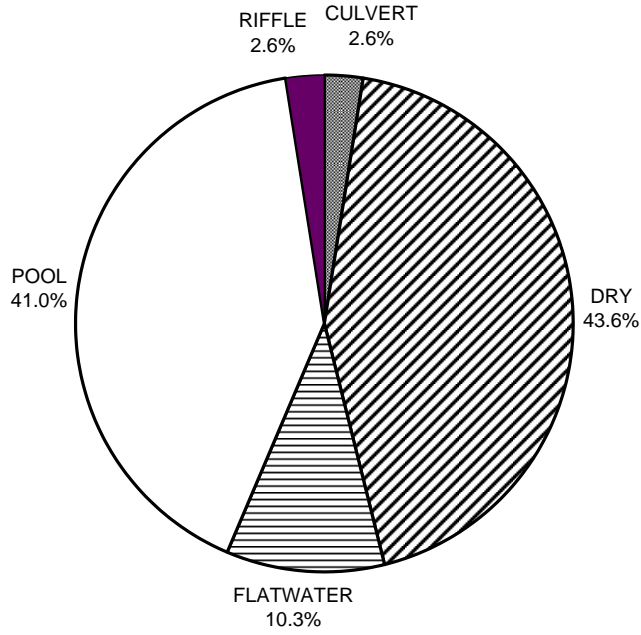
**Legal Description:** T08NR07WS25

**Latitude:** 38:31:13.0N

**Longitude:** 122:35:27.0W

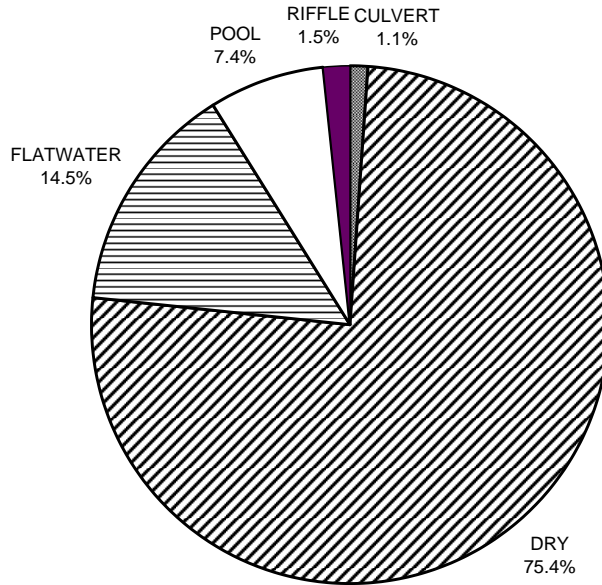
	Riffles	Flatwater	Pools
UNDERCUT BANKS (%)	0	0	3
SMALL WOODY DEBRIS (%)	20	10	13
LARGE WOODY DEBRIS (%)	0	0	1
ROOT MASS (%)	0	0	3
TERRESTRIAL VEGETATION	0	0	0
AQUATIC VEGETATION (%)	0	0	0
WHITEWATER (%)	0	0	0
BOULDERS (%)	80	90	75
BEDROCK LEDGES (%)	0	0	4

**North Fork Mark West Creek 2012  
HABITAT TYPES BY PERCENT OCCURRENCE**



GRAPH 1

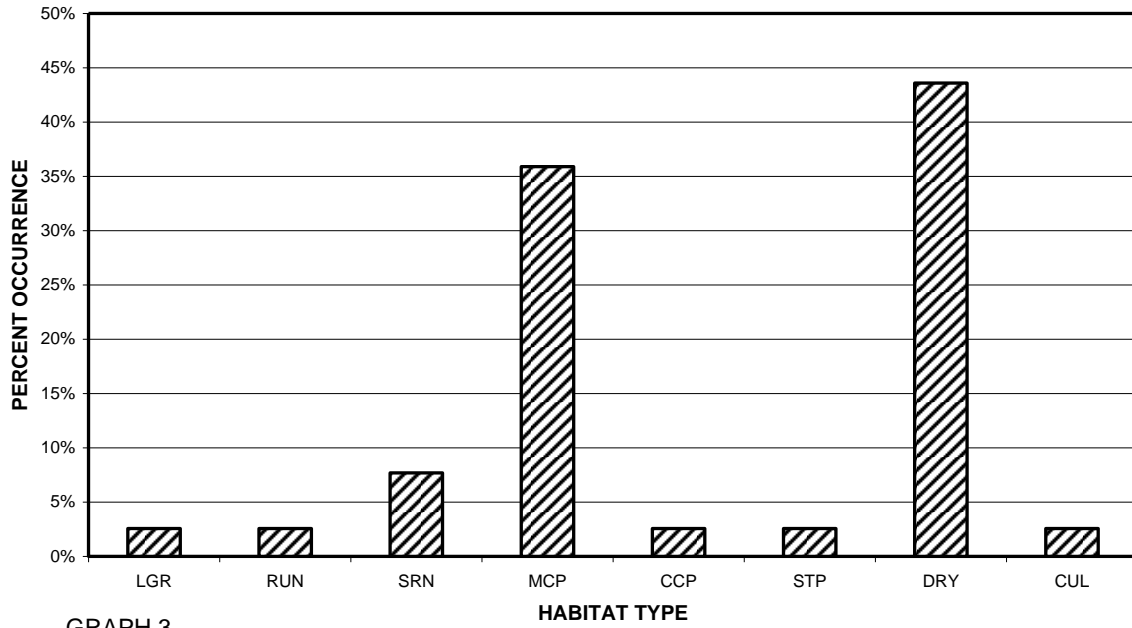
**North Fork Mark West Creek 2012  
HABITAT TYPES BY PERCENT TOTAL LENGTH**



GRAPH 2

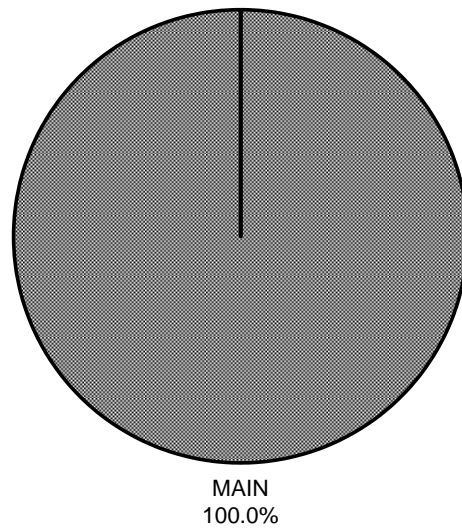
North Fork Mark West Creek

North Fork Mark West Creek 2012  
HABITAT TYPES BY PERCENT OCCURRENCE



GRAPH 3

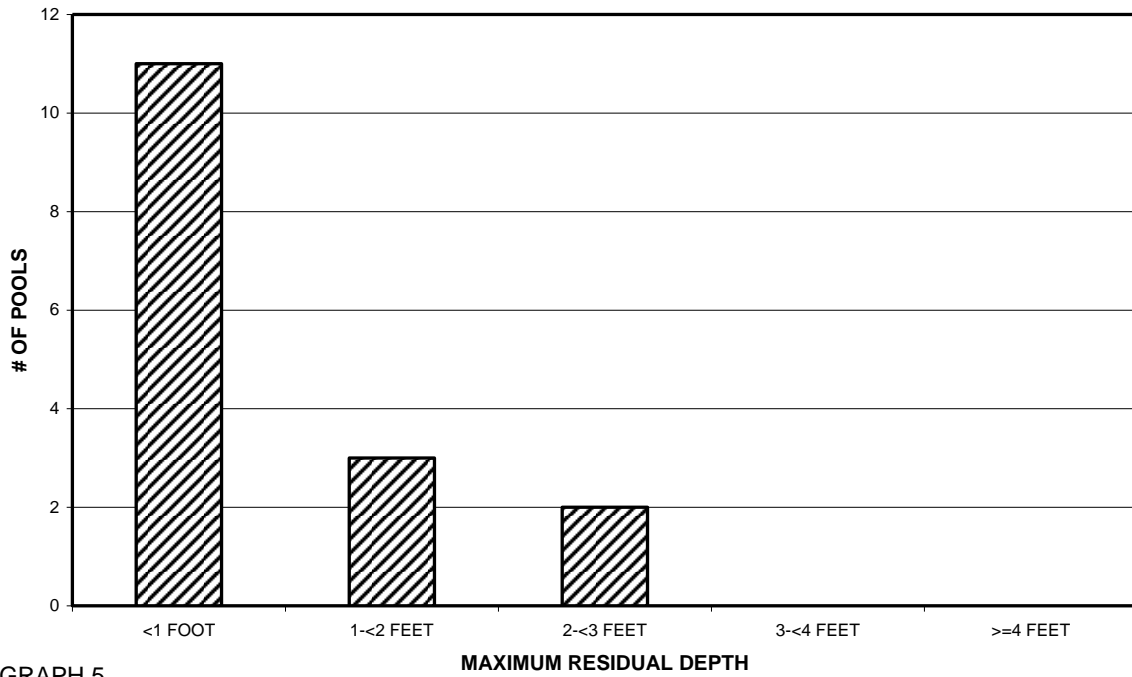
North Fork Mark West Creek 2012  
POOL TYPES BY PERCENT OCCURRENCE



GRAPH 4

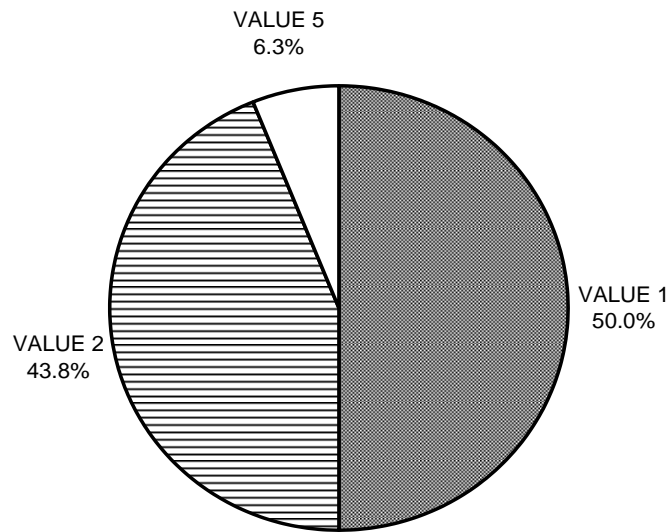
North Fork Mark West Creek

North Fork Mark West Creek 2012  
MAXIMUM DEPTH IN POOLS



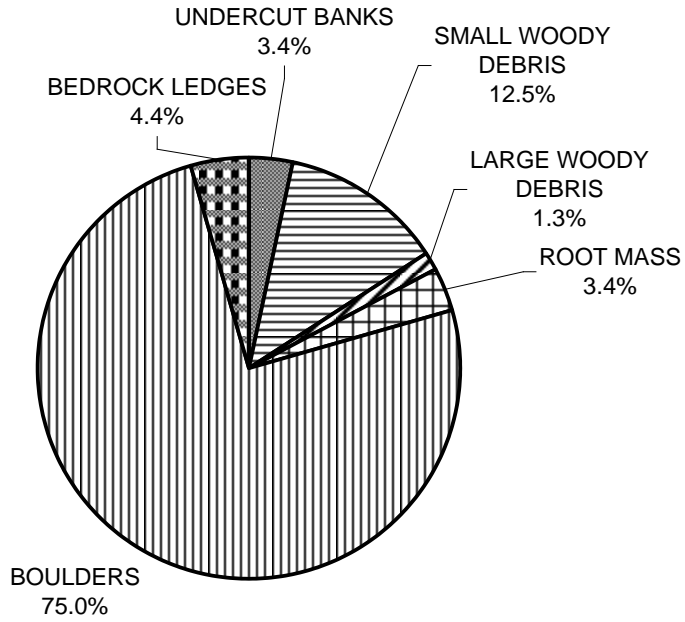
GRAPH 5

North Fork Mark West Creek 2012  
PERCENT EMBEDDEDNESS



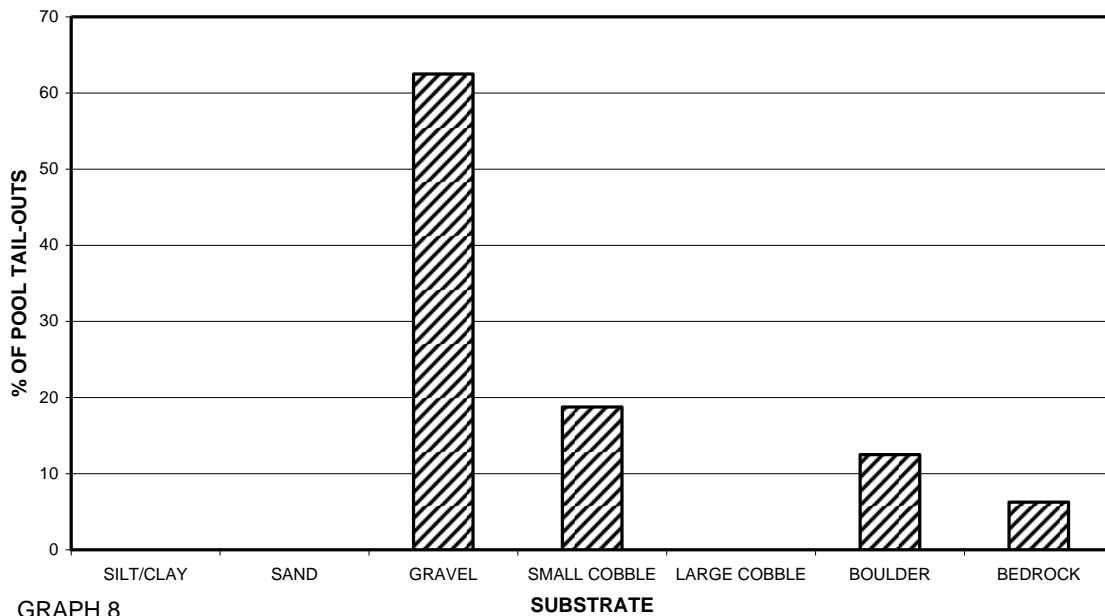
GRAPH 6

**North Fork Mark West Creek 2012  
MEAN PERCENT COVER TYPES IN POOLS**



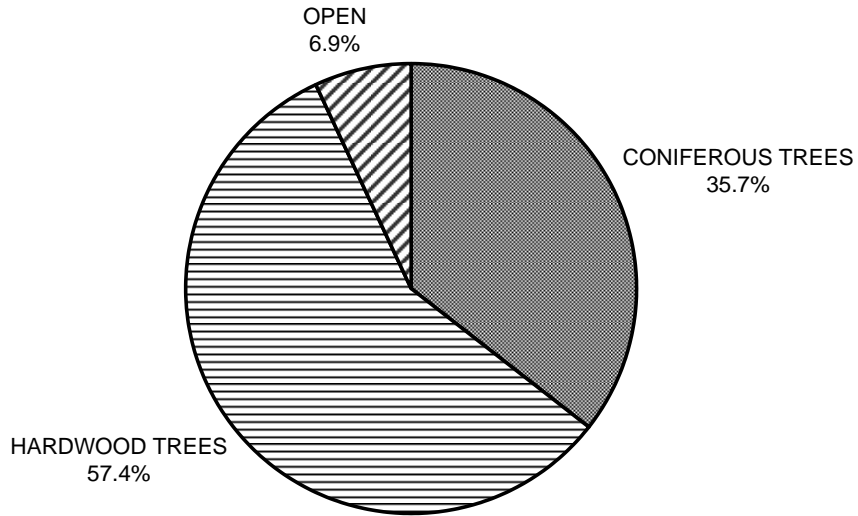
GRAPH 7

**North Fork Mark West Creek 2012  
SUBSTRATE COMPOSITION IN POOL TAIL-OUTS**



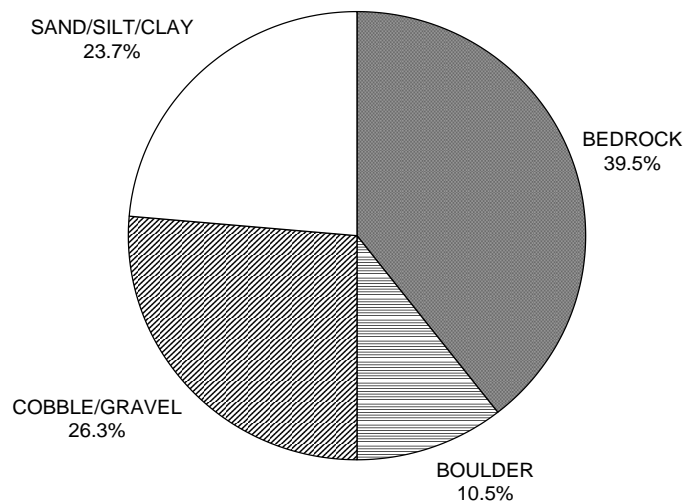
GRAPH 8

**North Fork Mark West Creek 2012  
MEAN PERCENT CANOPY**



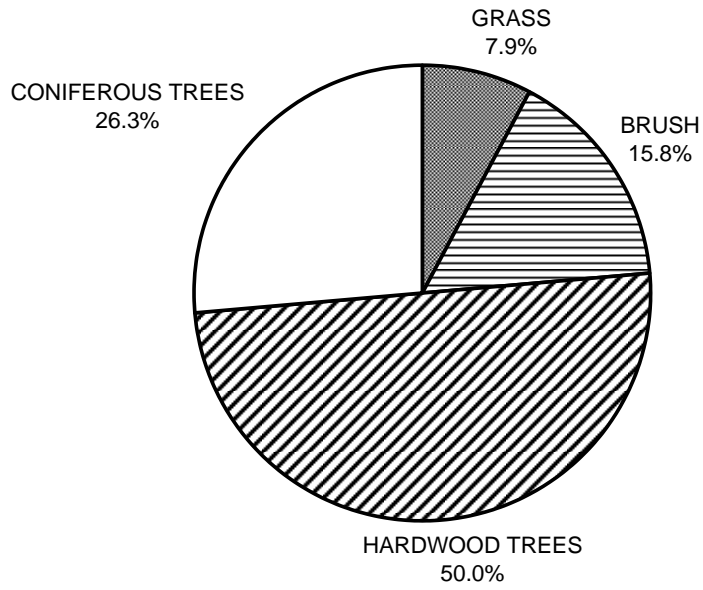
GRAPH 9

**North Fork Mark West Creek 2012  
DOMINANT BANK COMPOSITION IN SURVEY REACH**



GRAPH 10

**North Fork Mark West Creek 2012  
DOMINANT BANK VEGETATION IN SURVEY REACH**



GRAPH 11