CALIFORNIA DEPARTMENT OF FISH AND GAME
STREAM INVENTORY REPORT
McDowell Creek
Report Revised April 14, 2006
Report Completed 2005
Assessment Completed 1998

INTRODUCTION

A stream inventory was conducted during 6/25/1998 to 8/5/1998 on McDowell Creek. The survey began at the confluence with Dooley Creek and extended upstream 3.8 miles. Note – The habitat survey was conducted as the following: McDowell Creek begins at the confluence with Middle Fork McDowell Creek. Middle Fork McDowell Creek was surveyed as Middle Fork Dooley Creek. North Fork McDowell Creek was surveyed as North Fork Dooley Creek.

The McDowell 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 McDowell 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 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

McDowell Creek is a tributary to Dooley Creek which flows into the Russian River, located in Mendocino County, California (see McDowell Creek map, page 2). The legal description at the confluence with Dooley Creek is T13N, R11W, S21. Its location is 38°58'17.0" N. latitude and 123°04'42.0" W. longitude. Year round vehicle access exists from Highway 101 near Hopland, via un-improved roads south of Highway 175.

McDowell Creek and its tributaries drain a basin of approximately 13.27 square miles. McDowell Creek is a third order stream and has approximately 7.47 miles of blue line stream, according to the USGS Hopland, Highland Springs, Purdys Gardens, and Lakeport 7.5 minute quadrangles. McDowell Creek has two major tributaries which are included in this report in italics. Two minor tributaries were noted during the survey. The crew walked up each of these tributaries for approximately 500 feet. Both tributaries had little flow and were choked with vegetation. No fish were observed in either of the minor tributaries. Summer flow was measured as approximately 1.4 cfs at habitat unit #90 on June 26, 1998. Another flow was measured as approximately 1.4 cfs at habitat unit #321 on July 1, 1998. Elevations range from about 538 feet at the mouth of the creek to 2969 feet in the headwaters. Hardwood forest dominates the watershed. The watershed is primarily privately owned and is managed for agriculture. Vehicle access exists via Hwy 175. Sensitive plants and animals listed from the CNPS Inventory and CDFG's Natural Diversity Database within McDowell Creek watershed are: *Tracyina rostrata* (beaked tracyina), *Carex comosa* (bristly sedge), *Rana boylii* (foothill yellow-legged frog), *Cryptantha clevelandii var. dissita* (serpentine cryptantha), *Layia septentrionalis* (Colusa layia) and *Boschniakia hookeri* (small groundcone).

Salmonid fish species historically present in McDowell Creek include steelhead trout.

METHODS

The habitat inventory conducted in McDowell 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/AmeriCorps) Members that conducted the inventory were trained in standardized habitat inventory methods by the California Department of Fish and Game (DFG). 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 measured for maximum depth, depth of pool tail crest (measured in the thalweg), dominant substrate composing the pool tail crest, and embeddedness. Habitat unit types encountered for the first time are measured for all the parameters and characteristics on the field form. Additionally, from the ten habitat units on each field form page, one is randomly selected for complete measurement. All pools except step-pools are fully sampled

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 McDowell 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. Additionally, a recording thermograph was deployed in McDowell Creek from July 14 to October 29, 1998 to record temperatures every two hours on a 24 hour basis during warm summer months.

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". McDowell 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 McDowell 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 McDowell 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 McDowell 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 McDowell 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 McDowell Creek. In addition, three 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 2.0.16, a Visual Basic data entry program developed by Karen Wilson, Pacific States Marine Fisheries Commission in conjunction with the California Department of Fish and Game. 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 McDowell 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 6/25/1998 to 8/5/1998, was conducted by J. Lester and J. Jenkins (WSP). The total length of the stream surveyed was 20,071 feet with an additional 731 feet of side channel.

A flow of 1.4 cfs was measured June 26, 1998 at habitat unit #90, 7194' above survey start with a Marsh-McBirney Model 2000 flowmeter. Another flow was measured as 1.4 cfs on July 1, 1998 at habitat unit # 321, 18904' above survey start.

McDowell Creek is a B4 channel type for 6,929 feet of the stream surveyed (Reach 1), a F4 channel type for 1,478 feet of the stream surveyed (Reach 2), a B4 channel type for 5,447 feet of the stream surveyed (Reach 3), a F4 channel type for 4,064 feet of the stream surveyed (Reach 4), a B2 channel type for 2,153 feet of the stream surveyed (Reach 5.

B4 channels are moderately entrenched riffle dominated channels with infrequently spaced pools, very stable plan and profile, stable banks on moderate gradients with low width /depth

ratios and gravel dominant substrates.

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

B2 channels are moderately entrenched riffle dominated channels with infrequently spaced pools, very stable plan and profile, stable banks on moderate gradients with low width /depth ratios and boulder dominant substrates.

Water temperatures taken during the survey period ranged from 61 to 73 degrees Fahrenheit. Air temperatures ranged from 64 to 91 degrees Fahrenheit. Water temperatures taken with a recording thermograph deployed from July 14 to October 29, 1998, recording every two hours, ranged from 49.7 to73.2 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 35% pool units, 47% flatwater units, 18% riffle units, 1% culvert units, (Graph 1). Based on total length of Level II habitat types there were 17% pool units, 70% flatwater units, 12% riffle units, 1% culvert units, (Graph 2).

Seventeen Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were 23% Mid-Channel Pool units, 21% Run units, 15% Step Run units, 1% Lateral Scour Pool - Boulder Formed units, 11% Glide units, 11% Low Gradient Riffle units, 2% Corner Pool units, 1% Lateral Scour Pool - Log Enhanced units, 1% Secondary Channel Pool units, 6% High Gradient Riffle units, 4% Plunge Pool units, 1% Culvert units, 2% Step Pool units, 1% Cascade units, (Graph 3). Based on percent total length, 12% Mid-Channel Pool units, 28% Run units, 35% Step Run units, 6% Glide units, 6% Low Gradient Riffle units, 1% Corner Pool units, 1% Lateral Scour Pool - Log Enhanced units, 6% High Gradient Riffle units, 1% Plunge Pool units, 1% Culvert units, 2% Step Pool units.

A total of 124 pools were identified (Table 3). Main Channel pools were the most frequently encountered, at 73%, and comprised 78% 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. One of the 124 pools (1%) had a residual depth of three feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 120 pool tail-outs measured, eleven had a value of 1 (9.2%); twenty-seven had a value of 2 (22.5%); fifteen had a value of 3 (12.5%); fifty-three had a value of 4 (44.2%); fourteen had a value of 5 (11.7%); (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 like bedrock, log sills, or boulders.

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 11 , flatwater habitat types had a mean shelter rating of 11 , and pool habitats had a mean shelter rating of 14 (Table 1). Of the pool types, the Main Channel pools had a mean shelter rating of 13, Scour pools had a mean shelter rating of 15, Backwater pools had a mean

shelter rating of 22, (Table 3).

Table 5 summarizes mean percent cover by habitat type. Small Woody Debris is the dominant cover type in McDowell Creek. Graph 7 describes the pool cover in McDowell Creek. Root Mass 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. Gravel was observed in 70% of pool tail-outs, and small Cobble observed in 15% of pool tail-outs.

The mean percent canopy density for the surveyed length of McDowell Creek was 73%. The mean percentages of hardwood and coniferous trees were 100% and 0%, respectively. Twenty-seven percent of the canopy was open. Graph 9 describes the mean percent canopy in McDowell Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 66%. The mean percent left bank vegetated was 64%. The dominant elements composing the structure of the stream banks consisted of 4% bedrock, 3% boulder, 36% cobble/gravel, 57% sand/silt/clay, (Graph 10). Deciduous trees were the dominant vegetation type observed in 59% of the units surveyed. Additionally, there were no coniferous trees as a dominant vegetation type, (Graph 11).

BIOLOGICAL INVENTORY

JUVENILE SURVEYS:

The Department of Fish and Game conducted a survey in McDowell Creek on July 8, 1954 to look for fingerling steelhead holding pond sites. Several 0+ rainbow trout/steelhead were observed in the narrow ravine that begins at the foot of the Hopland Grade.

The Bureau of Land Management conducted a biological survey of McDowell Creek on August 14, 1975. The survey started at the confluence of the east fork and the north fork of McDowell Creek and continued for 900 feet. Intermittent pools were present, but no fish were observed during the survey.

The Department of Fish and Game conducted a biological survey upstream and downstream of a box culvert located at Post Marker 5.76 on Highway 175 on June 5, 1990. The water temperature was 57'F and the flow was estimated at 2 cfs during the electrofishing survey. Steelhead were observed upstream and downstream of the culvert. Approximately 50 0+ steelhead were observed along with a few California newts over a 75 yard section of stream.

On July 23, 1998 a recent biological inventory was conducted in McDowell Creek to document the fish species composition and distribution at several locations. Each site was single pass electrofished in McDowell Creek using one Smith Root Model 12 electrofisher. Fish from each site were counted by species, and returned to the stream. The air temperature was 87°F and the water temperature was 68°F. The observers were Jennifer Jenkins, Janet Lester (AmeriCorps), Steve Canata, and Bob Coey (DFG).

The inventory of Reach 3 started at habitat unit #219 and ended approximately 147 feet upstream. In pool, run, and riffle habitat types 48 0+, 7 1+, 3 2+, and 1 3+ steelhead were observed along with 10 bullfrog larvae.

The inventory of Reach 4 started at habitat unit #224 and was spot checked in various locations throughout the reach. In pool, run, and riffle habitat types 35 0+, 24 1+, 14 2+, and 2 3+ steelhead were observed along with 2 pacific giant salamanders and 1 bullfrog larvae.

The inventory of Reach 5 started 17,118 feet from the mouth and was spot checked in various locations throughout the reach. In pool, run, and riffle habitat types 70 0+ steelhead were observed.

During the habitat inventory, a 15' rock falls that appeared to impede further fish passage was observed at habitat unit #345. When the habitat inventory survey was ended the crew continued to observe the stream for the presence of fish for 0.5 miles above the rock falls. The stream continued to become steep and narrow and no salmonids or rainbow trout were observed.

A summary of historical and recent data collected appears in the table below.

Table 1. Species Observed in Historical and Recent Surveys

YEARS	SPECIES	SOURCE	Native/Introduced
1954, 1990, 1998	Steelhead	DFG	N
1998	Pacific Giant Salamander	DFG	N
1990	California Newt	DFG	N

Historical records reflect that no hatchery stocking or transfers have occurred into McDowell Creek. Records show that an unknown number of steelhead fingerlings were rescued from McDowell Creek in 1950.

No introduced species were observed and historical records reflect that no hatchery stocking has occurred in the watershed.

ADULT SURVEYS:

On June 5, 1990 the Department of Fish and Game met with Caltrans to review a proposal to repair undermining of the box culvert located at Post Marker 5.76 on Highway 175. The culvert was set at an estimated 3% slope and had an exposed sill which was approximately two feet above the downstream elevation of McDowell Creek. This caused flows in the culvert to be wide, shallow, and fast. Adult fish had to jump the two feet and swim up through the rapid and shallow flows coming out of the box culvert. A deep (2.5' to 3.0') pool was noted at the downstream end of the culvert. Caltrans plans consisted of filling the voids of the culvert with additional concrete and RSP. The plans also consisted of extending the wing-walls and sill down below current stream grade and

filling the pool with RSP. Since viable steelhead habitat existed upstream of the site, the Department of Fish and Game recommended that Caltrans improve fish passage conditions at the culvert.

No spawning/carcass survey was done in 1998/1999 due to inadequate staffing levels.

DISCUSSION

McDowell Creek is a B4 channel type for 6,929 feet of the stream surveyed (Reach 1), a F4 channel type for 1,478 feet of the stream surveyed (Reach 2), a B4 channel type for 5,447 feet of the stream surveyed (Reach 3), a F4 channel type for 4,064 feet of the stream surveyed (Reach 4), a B2 channel type for 2,153 feet of the stream surveyed (Reach 5).

There are 12376 feet of B4 channel type in Reaches 1 and 3. According to the DFG Salmonid Stream Habitat Restoration Manual, B4 channel types are excellent for low-stage plunge weirs, boulder clusters, bank placed boulders, single and opposing wing-deflectors and log cover. They are also good for medium-stage plunge weirs.

There are 5542 feet of F4 channel type in Reaches 2 and 4. F4 channel types are good for bank-placed boulders and fair for low-stage weirs, single and opposing wing-deflectors, channel constrictors and log cover.

There are 2153 feet of B2 channel type in Reach 5. B2 channel types are excellent for low and medium-stage plunge weirs, single and opposing wing deflectors and bank cover.

The water temperatures recorded on the survey days 6/25/1998 to 8/5/1998, ranged from 61 to 73 degrees Fahrenheit. Air temperatures ranged from 64 to 91 degrees Fahrenheit. These temperatures, if sustained, are above the threshold stress level (65°F) 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.

Summer temperatures measured using a remote temperature recorder placed in a pool ranged from 50° to 73°F in Reach 4. The Temperature Summary graph (Appendix E) shows that for much of the summer (July through August) the upper watershed exhibited temperatures above the optimal for salmonids.

Flatwater habitat types comprised 70% of the total length of this survey, riffles 12%, and pools 17%. The pools are shallow one of the 124 (1%) pools having a maximum residual depth greater than 3 feet. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat. In third and fourth order streams, a primary pool is defined to have a maximum residual depth of at least three 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.

Thirty-eight of the 120 pool tail-outs measured had embeddedness ratings of 1 or 2. Sixty-eight of the pool tail-outs had embeddedness ratings of 3 or 4. Fourteen 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 McDowell Creek should be mapped and rated according to their potential sediment yields, and control measures should be taken.

One-hundred five of the 124 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 14. The shelter rating in the flatwater habitats was 11. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by Small Woody Debris in McDowell Creek. Root Mass 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 73%. Reach 1 had a canopy density of 82.2%, Reach 2 had a canopy density of 90.6%, Reach 3 had a canopy density of 52.1%, Reach 4 had a canopy density of 77.4%, Reach 5 had a canopy density of 80.9%. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was moderate at 66% 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

McDowell 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. 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.

2. 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.

3. Increase the canopy on McDowell 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.

4. McDowell 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.

5. 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.

6. Increase woody cover in the pools and flatwater habitat units. Most of the existing cover is from root mass. Adding high quality complexity with woody cover is desirable.

7. The limited water temperature data available suggest that maximum temperatures are within/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.

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.

HABITAT UNIT#	STREAM LENGTH(FT)	COMMENTS
1.00	33	Begin survey at Highway 175 culvert. The beginning of survey was conducted 2 months after the other portions of the creek due to lack of access. The flags on the creek will not match the numbers in the creek.
5.00	245	At 28' right bank tributary.
6.00	850	At 28' wire fence across creek 7'H x 10'W.
12.00	1757	At 13' small debris accumulation across creek collecting due to boulders on left bank and right bank. The left bank has a small dry side channel and small pool below debris, 10'H x 8'W x 18'L. At 376' dry tributary enters right bank.
17.00	2043	Young of the year and 1+ salmonids observed.
29.00	3806	At 43' wire fence across creek 4'H x 20'W.
35.00	4114	Right bank failure at end of unit 15'H x 20'L x 5'W.
43.00	4589	Left bank active erosion 30'L x 35'H x 15'W.
43.10	4589	Pool completely separated from channel.
48.00	4731	At 8' large debris accumulation 4'H x 6'L x 15'W.
49.00	4774	Channel type taken here.
50.00	4803	Fish in pool
59.00	5275	At 48' large debris accumulation 25'W x 10'H x 73'L retaining sediment pinching wetted channel to 7'.

61.00	5381	At 40' barbed wire fence across creek and road crossing.
63.00	5496	At 20' left bank failure 15'H x 4'W x 78'L in very steep area.
67.00	5898	At 106' left bank failure 30'H x 40'L, active contributing clay.
68.00	5927	Fish observed. At 11' log crosses channel embedded in gravel.
70.00	5973	Small backwater pool being created less than 0.5' deep.
76.00	6453	At 125' side very small backwater pool less than 0.5'. At 130' right bank slide erosion site 64'L x 10'W x 100'H undercutting bank and contributing sediment. At 228' large debris accumulation 60'L x 8'H x 15'W retaining 4.5' of sand and gravel. At 295' left bank active erosion contributing sediment 50'H x 3'W x 45'L.
82.00	6621	Left bank active failure 40'H x 32'L x 7'W.
84.00	6696	Left bank erosion 45'H x 5'W x 36'L.
92.00	6951	Channel change to F4.
93.00	6975	Log weir.
97.00	7111	Left bank erosion 40'L x 25'H x 5' W.
102.00	7266	Large debris accumulation 44'L x 40'W x 10'H, not a barrier. At 11' left bank slide 100'H x 6'W contributing wood to large debris accumulation.
109.00	7550	At 64' screened 1' pipe with concrete walls and a 2' pool.
111.00	7773	Dirt road crosses at 24'.
113.00	7840	Left bank tributary enters.
117.00	8078	Right bank side channel at 10'.
120.00	8162	Left bank active hill side sliding 20' back from waters edge with 40' of fallen sediment at the bottom, 100'L x 110'H.
121.00	8236	At 64' dry side channel on right bank.
122.00	8370	At 85' left bank failure 70' L x 40'H with fallen trees and sediment depositing on left bank.
124.00	8472	Channel type taken B4.
129.00	8643	Side channel enters left bank.
129.20	8643	At 26' left bank slide begins filling in side channel with five fallen trees, 70'L x 100'H x 50' deep. It appears this was the original channel and a new channel was formed.
140.00	9199	At 28' side channel enters right bank.
143.00	9574	At 68' side channel enters.
144.00	9593	Very steep left bank eroding.
146.00	9623	Log weir creating plunge.
153.00	10181	Very steep left bank with no vegetation.
155.00	10223	Fish observed in pool.
162.00	10603	Three fallen trees collecting debris and a 1' jump.
166.00	10713	Willows choking channel.
167.00	10860	At 24' side channel right bank and large debris accumulation 111'L x 30'w x 4'H retaining 3' sediment and water passing through. Left bank erosion 180'L x 100'H causing accumulation.
167.10	10860	Passes through large debris accumulation described in unit 167.
171.00	10986	Seeping banks.
175.00	11504	At 63' left bank failure and concrete and metal debris throughout unit.
176.00	11536	Left bank slide 152'L x 15' deep x 100'H begins here.

179.00	11917	Large debris accumulation ends at 16'. Bubbling springs through unit.
180.00	11949	Sulphur springs bubbling up and seeping through banks.
182.10	12018	Side channel possibly caused by springs, orange water.
188.00	12215	At 19' large debris accumulation 39'L x 30'W (into next unit).
194.00	12467	At 7' a failed erosion control structure made up of hundreds if tires, old side channel.
196.00	12542	Large debris accumulation 52'L x 7'H x 15'W with right and left bank collapse.
197.00	12558	Pool almost dammed by large debris accumulation.
201.00	12672	Willow and alder growing down into pool.
203.00	12725	Very bushy here.
205.00	12884	Plunge from driveway culvert.
206.00	12938	Concrete based un-baffled culvert 12'W. 10.4'H x 54'L with 15' long concrete lip with 4' drop from lip sill to water level.
210.00	13140	Fish observed above culvert.
215.00	13577	At 216', 11'H fence with questionable fish passage.
216.00	13622	Trees and grapes hanging in creek.
217.00	13682	At 2', Sanel Valley Road bridge and driveway; 14.5'H x 20'W x 11'L.
224.00	13893	Channel change to F4. Left bank failure with two fallen trees.
230.00	14068	Large debris accumulation 24'L x 30'W x 8'H.
236.00	14229	Great undercut banks.
240.00	14436	Right bank roots holding up bank failure.
242.00	14485	Trees growing across creek collecting debris (not currently in water).
248.00	14817	Downed trees and roots creating scour.
264.00	15621	Two tires in channel.
268.00	15749	Tires and trash in channel.
283.00	16457	At 12' side channel enters left bank.
286.00	16716	Left bank 80' L fence falling.
289.00	16802	1+ salmonid observed in pool.
291.00	16979	Dry channel right bank.
301.00	17508	At 12' flag on right bank "DFG Temp Station".
303.00	17587	Concrete culvert with no baffles 9'H x 11'W x 55'l. Distance from culvert to water level is 2". Hwy 175 crossing.
319.00	18738	Flow and channel type (from HU#277) taken.
320.00	18808	Three pools in a row.
324.00	19020	Eight pools in a row.
328.00	19200	Channel type taken.
331.00	19317	Seven foot jump.
333.00	19467	Four pools and 1+ salmonids observed.
334.00	19617	At 18' left bank cascade tributary.
337.00	19694	Jump 2.5' high.
339.00	19853	Two pools in a row.
340.00	19879	Pacific Giant Salamanders observed.
342.00	19954	Dry tributary right bank.
345.00	20071	END OF SURVEY; Plunge over boulders 15'H. Tadpoles, salamanders, frogs, 1+ and juvenile fish noted throughout survey but

0.5 miles above jump where stream steepens and narrows no fish observed. Three tributaries total in survey, one dry while the other two were walked up 500' with very little flow , choked by vegetation and no fish observed.

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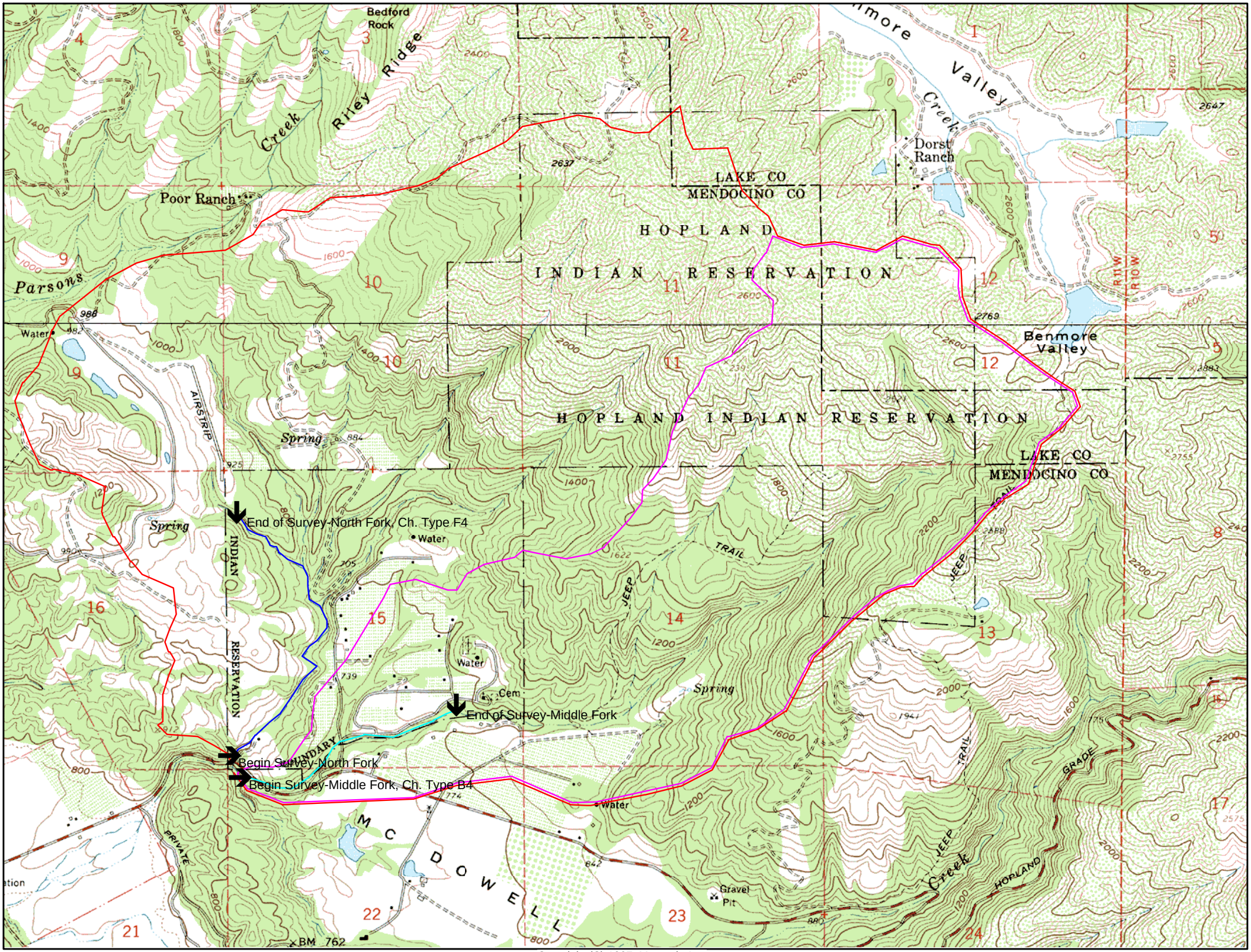


Table 1 - Summary of Riffle, Flatwater, and Pool Habitat Types

Stream Name: McDowell Creek

LLID: 1230783389715

Drainage: Russian River - Upper

Survey Dates: 6/25/1998 to 8/5/1998

Confluence Location: Quad: HOPLAND Legal Description: T000R000S00 Latitude: 38:58:17.0N Longitude: 123:04:42.0W

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
2	0	CULVERT	0.6	54	109	0.5									
166	22	FLATWATER	46.6	88	14548	69.9	7.4	0.5	0.8	589	97695	251	41744		11
124	124	POOL	34.8	29	3561	17.1	8.4	0.7	1.5	238	29487	261	32332	181	14
64	14	RIFFLE	18.0	40	2584	12.4	7.8	0.5	0.9	288	18412	183	11697		11

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
356	160	20802	145594	85773

Table 2 - Summary of Habitat Types and Measured Parameters

Stream Name: McDowell Creek

LLID: 1230783389715 Drainage: Russian River - Upper

Survey Dates: 6/25/1998 to 8/5/1998

Confluence Location: Quad: HOPLAND Legal Description: T000R000S00 Latitude: 38:58:17.0N Longitude: 123:04:42.0W

Habitat Units	Units Fully Measured	Habitat Type	Habitat Occurrence (%)	Mean Length (ft.)	Total Length (ft.)	Total Length (%)	Mean Width (ft.)	Mean Depth (ft.)	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 (%)
40	7	LGR	11.2	33	1339	6.4	8	0.3	0.5	227	9074	79	3141		5	60
22	6	HGR	6.2	53	1156	5.6	7	0.5	2	317	6970	155	3417		9	85
2	1	CAS	0.6	44	89	0.4	9	2.0	4	539	1077	1077	2155		45	95
38	5	GLD	10.7	34	1284	6.2	7	0.6	1.4	244	9264	141	5350		6	65
76	8	RUN	21.3	78	5908	28.4	7	0.4	1.1	421	31990	165	12513		7	75
52	9	SRN	14.6	141	7356	35.4	8	0.4	1.4	929	48309	390	20286		19	74
1	1	TRP	0.3	18	18	0.1	7	0.5	1.4	126	126	101	101	63		100
83	83	MCP	23.3	29	2425	11.7	8	0.7	2.8	230	19101	247	20483	169	13	75
6	6	STP	1.7	59	352	1.7	8	0.6	1.8	509	3057	558	3345	389	5	95
6	6	CRP	1.7	26	158	0.8	9	0.9	2.3	223	1337	265	1592	197	13	65
5	5	LSL	1.4	22	108	0.5	9	0.7	1.7	198	989	208	1040	145	9	90
1	1	LSR	0.3	24	24	0.1	8	0.4	1.1	192	192	173	173	77	5	100
1	1	LSBk	0.3	33	33	0.2	10	0.7	2.2	330	330	330	330	231	45	98
4	4	LSBo	1.1	23	92	0.4	11	0.9	2.1	209	834	259	1036	182	20	88
14	14	PLP	3.9	19	270	1.3	11	0.8	3.1	231	3230	284	3979	211	15	61
2	2	SCP	0.6	28	57	0.3	3	0.6	1.3	86	171	67	135	49	40	55
1	1	BPL	0.3	24	24	0.1	5	0.5	1.5	120	120	120	120	60	5	10
2	0	CUL	0.6	54	109	0.5										

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
356	160	20802	136172	79194

Table 3 - Summary of Pool Types

Stream Name: McDowell Creek

LLID: 1230783389715

Drainage: Russian River - Upper

Survey Dates: 6/25/1998 to 8/5/1998

Confluence Location: Quad: HOPLAND

Legal Description: T000R000S00

Latitude: 38:58:17.0N

Longitude: 123:04:42.0W

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
90	90	MAIN	73	31	2795	78	7.9	0.7	248	22284	182	16398	13
31	31	SCOUR	25	22	685	19	10.3	0.8	223	6912	190	5892	15
3	3	BACKWATER	2	27	81	2	3.7	0.5	97	291	53	158	23

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
124	124	3561	29487	22448

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

Stream Name: McDowell Creek LLID: 1230783389715 Drainage: Russian River - Upper

Survey Dates: 6/25/1998 to 8/5/1998

Confluence Location: Quad: HOPLAND Legal Description: T000R000S00 Latitude: 38:58:17.0N Longitude: 123:04:42.0W

Habitat Units	Habitat Type	Habitat Occurrence (%)	< 1 Foot Maximum Residual Depth	< 1 Foot Percent Occurrence	1 < 2 Feet Maximum Residual Depth	1 < 2 Feet Percent Occurrence	2 < 3 Feet Maximum Residual Depth	2 < 3 Feet Percent Occurrence	3 < 4 Feet Maximum Residual Depth	3 < 4 Feet Percent Occurrence	>= 4 Feet Maximum Residual Depth	>= 4 Feet Percent Occurrence
1	TRP	1	0	0	1	100	0	0	0	0	0	0
83	MCP	67	8	10	63	76	12	14	0	0	0	0
6	STP	5	0	0	6	100	0	0	0	0	0	0
6	CRP	5	0	0	4	67	2	33	0	0	0	0
5	LSL	4	0	0	5	100	0	0	0	0	0	0
1	LSR	1	0	0	1	100	0	0	0	0	0	0
1	LSBk	1	0	0	0	0	1	100	0	0	0	0
4	LSBo	3	0	0	3	75	1	25	0	0	0	0
14	PLP	11	2	14	9	64	2	14	1	7	0	0
2	SCP	2	0	0	2	100	0	0	0	0	0	0

Total Units	Total < 1 Foot Max Resid. Depth	Total < 1 Foot % Occurrence	Total 1< 2 Foot Max Resid. Depth	Total 1< 2 Foot % Occurrence	Total 2< 3 Foot Max Resid. Depth	Total 2< 3 Foot % Occurrence	Total 3< 4 Foot Max Resid. Depth	Total 3< 4 Foot % Occurrence	Total >= 4 Foot Max Resid. Depth	Total >= 4 Foot % Occurrence
124	10	8	95	77	18	15	1	1	0	0

Mean Maximum Residual Pool Depth (ft.): 1.5

Stream Name: McDowell Creek

LLID: 1230783389715 Drainage: Russian River - Upper

Survey Dates: 6/25/1998 to 8/5/1998

Confluence Location: Quad: HOPLAND Legal Description: T000R000S00 Latitude: 38:58:17.0N Longitude: 123:04:42.0W

Habitat Units	Habitat Type	Habitat Occurrence (%)	< 1 Foot Maximum Residual Depth	< 1 Foot Percent Occurrence	1 < 2 Feet Maximum Residual Depth	1 < 2 Feet Percent Occurrence	2 < 3 Feet Maximum Residual Depth	2 < 3 Feet Percent Occurrence	3 < 4 Feet Maximum Residual Depth	3 < 4 Feet Percent Occurrence	>= 4 Feet Maximum Residual Depth	>= 4 Feet Percent Occurrence
1	BPL	1	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 Foot Max Resid. Depth	Total 1< 2 Foot % Occurrence	Total 2< 3 Foot Max Resid. Depth	Total 2< 3 Foot % Occurrence	Total 3< 4 Foot Max Resid. Depth	Total 3< 4 Foot % Occurrence	Total >= 4 Foot Max Resid. Depth	Total >= 4 Foot % Occurrence
124	10	8	95	77	18	15	1	1	0	0

Mean Maximum Residual Pool Depth (ft.): 1.5

Table 5 - Summary of Mean Percent Cover By Habitat Type

Stream Name: McDowell Creek LLID: 1230783389715 Drainage: Russian River - Upper

Survey Dates: 6/25/1998 to 8/5/1998 Dry Units: 0

Confluence Location: Quad: HOPLAND Legal Description: T000R000S00 Latitude: 38:58:17.0N Longitude: 123:04:42.0W

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
40	4	LGR	0	63	0	13	0	0	0	0	25
22	5	HGR	0	0	0	0	16	0	24	20	0
2	1	CAS	0	0	30	0	0	0	30	70	0
64	10	TOTAL RIFFLE	0	25	3	5	8	0	15	17	10
38	4	GLD	4	25	0	28	25	0	0	13	6
76	7	RUN	2	41	7	11	10	0	3	20	6
52	6	SRN	1	21	0	13	9	0	10	44	2
166	17	TOTAL FLAT	2	30	3	16	13	0	5	27	4
1	0	TRP									
83	18	MCP	17	19	7	25	6	6	0	10	9
6	1	STP	0	0	0	50	0	0	0	50	0
6	2	CRP	10	10	0	30	0	0	0	0	50
5	4	LSL	13	13	75	0	0	0	0	0	0
1	1	LSR	20	0	0	70	0	0	0	0	10
1	1	LSBk	5	40	0	5	0	0	0	10	40
4	2	LSBo	0	8	0	45	8	0	0	40	0
14	2	PLP	0	13	13	13	5	0	33	25	0
2	1	SCP	10	75	0	15	0	0	0	0	0
1	1	BPL	0	0	0	0	0	0	0	0	0
124	33	TOTAL POOL	13	17	14	23	4	3	2	11	9
2	0	CUL									
356	60	TOTAL	8	22	9	18	7	2	5	17	8

Table 6 - Summary of Dominant Substrates By Habitat Type

Stream Name: McDowell Creek LLID: 1230783389715 Drainage: Russian River - Upper

Survey Dates: 6/25/1998 to 8/5/1998 Dry Units: 0

Confluence Location: Quad: HOPLAND Legal Description: T000R000S00 Latitude: 38:58:17.0N Longitude: 123:04:42.0W

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
40	7	LGR	0	0	86	14	0	0	0
22	5	HGR	0	0	40	40	20	0	0
2	1	CAS	0	0	0	0	0	100	0
38	5	GLD	0	0	100	0	0	0	0
76	8	RUN	0	0	50	38	13	0	0
52	9	SRN	0	0	33	67	0	0	0
1	0	TRP	0	0	0	0	0	0	0
83	19	MCP	16	21	32	26	0	0	5
6	1	STP	0	100	0	0	0	0	0
6	2	CRP	50	0	50	0	0	0	0
5	4	LSL	0	0	50	50	0	0	0
1	1	LSR	0	0	100	0	0	0	0
1	1	LSBk	0	0	0	0	0	100	0
4	2	LSBo	0	0	50	0	0	50	0
14	2	PLP	0	0	50	50	0	0	0
2	2	SCP	100	0	0	0	0	0	0
1	1	BPL	100	0	0	0	0	0	0

Table 7 - Summary of Mean Percent Canopy for Entire Stream

Stream Name: McDowell Creek LLID: 1230783389715 Drainage: Russian River - Upper

Survey Dates: 6/25/1998 to 8/5/1998

Confluence Location: Quad: HOPLAND Legal Description: T000R000S00 Latitude: 38:58:17.0N Longitude: 123:04:42.0W

Mean Percent Canopy	Mean Percent Conifer	Mean Percent Hardwood	Mean Percent Open Units	Mean Right Bank % Cover	Mean Left Bank % Cover
73	0	100	5	66	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.

Table 9 - Mean Percentage of Dominant Substrate and Vegetation

Stream Name: McDowell Creek LLID: 1230783389715 Drainage: Russian River - Upper

Survey Dates: 6/25/1998 to 8/5/1998

Confluence Location: Quad: HOPLAND Legal Description: T000R000S00 Latitude: 38:58:17.0N Longitude: 123:04:42.0W

Mean Percentage of Dominant Stream Bank Substrate

Dominant Class of Substrate	Number of Units Right Bank	Number of Units Left Bank	Total Mean Percent (%)
Bedrock	1	5	4.3
Boulder	3	1	2.9
Cobble / Gravel	24	26	35.7
Sand / Silt / Clay	42	38	57.1

Mean Percentage of Dominant Stream Bank Vegetation

Dominant Class of Vegetation	Number of Units Right Bank	Number of Units Left Bank	Total Mean Percent (%)
Grass	2	8	7.1
Brush	15	21	25.7
Hardwood Trees	49	33	58.6
Coniferous Trees	0	0	0.0
No Vegetation	4	8	8.6

Total Stream Cobble Embeddedness Values: 3

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

StreamName: McDowell Creek LLID: 1230783389715 Drainage: Russian River - Upper

Survey Dates: 6/25/1998 to 8/5/1998

Confluence Location: Quad: HOPLAND Legal Description: T000R000S00 Latitude: 38:58:17.0N Longitude: 123:04:42.0W

	Riffles	Flatwater	Pools
UNDERCUT BANKS (%)	0	2	13
SMALL WOODY DEBRIS (%)	25	30	17
LARGE WOODY DEBRIS (%)	3	3	14
ROOT MASS (%)	5	16	23
TERRESTRIAL VEGETATION (%)	8	13	4
AQUATIC VEGETATION (%)	0	0	3
WHITEWATER (%)	15	5	2
BOULDERS (%)	17	27	11
BEDROCK LEDGES (%)	10	4	9

Table 8 - Fish Habitat Inventory Data Summary

Stream Name: McDowell Creek LLID: 1230783389715 Drainage: Russian River -
Survey Dates: 6/25/1998 to 8/5/1998 Survey Length (ft.): 20802 Main Channel (ft.): 20071 Side Channel (ft.): 731
Confluence Location: Quad: HOPLAND Legal Description: T000R000S00 Latitude: 38:58:17.0N Longitude: 123:04:42.0W

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 1

Channel Type: B4
Reach Length (ft.): 6929
Riffle/Flatwater Mean Width (ft.): 10.3
BFW:
Range (ft.): to
Mean (ft.):
Std. Dev.:
Base Flow (cfs): 1.4
Water (F): 62 - 73 Air (F): 72 - 89
Dry Channel (ft.): 0

Canopy Density (%): 82.2
Coniferous Component (%): 0.0
Hardwood Component (%): 100.0
Dominant Bank Vegetation: Hardwood Trees
Vegetative Cover (%): 67.8
Dominant Shelter: Small Woody Debris
Dominant Bank Substrate Type: Sand/Silt/Clay
Occurrence of LWD (%): 5.6
LWD per 100 ft.:
Riffles:
Pools:
Flat:

Pools by Stream Length (%): 15.0
Pool Frequency (%): 44.0
Residual Pool Depth (%):
< 2 Feet Deep: 82.5
2 to 2.9 Feet Deep: 17.5
3 to 3.9 Feet Deep: 0.0
>= 4 Feet Deep: 0.0
Mean Max Residual Pool Depth (ft.): 1.51
Mean Pool Shelter Rating: 13

Pool Tail Substrate (%): Silt/Clay: 0.0 Sand: 0.0 Gravel: 90.0 Sm Cobble: 7.5 Lg Cobble: 0.0 Boulder: 2.5 Bedrock: 0.0
Embeddedness Values (%): 1. 15.0 2. 22.5 3. 7.5 4. 52.5 5. 2.5

STREAM REACH: 2

Channel Type: F4
Reach Length (ft.): 1478
Riffle/Flatwater Mean Width (ft.): 8.2
BFW:
Range (ft.): to
Mean (ft.):
Std. Dev.:
Base Flow (cfs): 1.4
Water (F): 63 - 67 Air (F): 69 - 85
Dry Channel (ft.): 0

Canopy Density (%): 90.6
Coniferous Component (%): 0.0
Hardwood Component (%): 100.0
Dominant Bank Vegetation: Hardwood Trees
Vegetative Cover (%): 68.6
Dominant Shelter: Small Woody Debris
Dominant Bank Substrate Type: Sand/Silt/Clay
Occurrence of LWD (%): 11.4
LWD per 100 ft.:
Riffles:
Pools:
Flat:

Pools by Stream Length (%): 21.0
Pool Frequency (%): 32.3
Residual Pool Depth (%):
< 2 Feet Deep: 80.0
2 to 2.9 Feet Deep: 20.0
3 to 3.9 Feet Deep: 0.0
>= 4 Feet Deep: 0.0
Mean Max Residual Pool Depth (ft.): 1.53
Mean Pool Shelter Rating: 10

Pool Tail Substrate (%): Silt/Clay: 0.0 Sand: 0.0 Gravel: 80.0 Sm Cobble: 20.0 Lg Cobble: 0.0 Boulder: 0.0 Bedrock: 0.0
Embeddedness Values (%): 1. 40.0 2. 30.0 3. 0.0 4. 30.0 5. 0.0

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 3

Channel Type: B4
Reach Length (ft.): 5447
Riffle/Flatwater Mean Width (ft.): 6.8
BFW:
Range (ft.): to
Mean (ft.):
Std. Dev.:
Base Flow (cfs): 1.4
Water (F): 61 - 72 Air (F): 69 - 91
Dry Channel (ft.): 0

Canopy Density (%): 52.1
Coniferous Component (%): 0.0
Hardwood Component (%): 100.0
Dominant Bank Vegetation: Hardwood Trees
Vegetative Cover (%): 72.3
Dominant Shelter: Small Woody Debris
Dominant Bank Substrate Type: Sand/Silt/Clay
Occurrence of LWD (%): 10.0
LWD per 100 ft.:
Riffles:
Pools:
Flat:

Pools by Stream Length (%): 12.2
Pool Frequency (%): 25.0
Residual Pool Depth (%):
< 2 Feet Deep: 84.0
2 to 2.9 Feet Deep: 16.0
3 to 3.9 Feet Deep: 0.0
>= 4 Feet Deep: 0.0
Mean Max Residual Pool Depth (ft.): 1.38
Mean Pool Shelter Rating: 20

Pool Tail Substrate (%): Silt/Clay: 4.0 Sand: 0.0 Gravel: 64.0 Sm Cobble: 28.0 Lg Cobble: 0.0 Boulder: 0.0 Bedrock: 4.0
Embeddedness Values (%): 1. 4.0 2. 8.0 3. 20.0 4. 60.0 5. 8.0

STREAM REACH: 4

Channel Type: F4
Reach Length (ft.): 4064
Riffle/Flatwater Mean Width (ft.): 5.6
BFW:
Range (ft.): to
Mean (ft.):
Std. Dev.:
Base Flow (cfs): 1.4
Water (F): 61 - 71 Air (F): 64 - 91
Dry Channel (ft.): 0

Canopy Density (%): 77.4
Coniferous Component (%): 0.0
Hardwood Component (%): 100.0
Dominant Bank Vegetation: Brush
Vegetative Cover (%): 58.9
Dominant Shelter: Boulders
Dominant Bank Substrate Type: Sand/Silt/Clay
Occurrence of LWD (%): 0.0
LWD per 100 ft.:
Riffles:
Pools:
Flat:

Pools by Stream Length (%): 22.9
Pool Frequency (%): 34.1
Residual Pool Depth (%):
< 2 Feet Deep: 82.8
2 to 2.9 Feet Deep: 17.2
3 to 3.9 Feet Deep: 0.0
>= 4 Feet Deep: 0.0
Mean Max Residual Pool Depth (ft.): 1.56
Mean Pool Shelter Rating: 16

Pool Tail Substrate (%): Silt/Clay: 0.0 Sand: 0.0 Gravel: 69.0 Sm Cobble: 17.2 Lg Cobble: 3.4 Boulder: 10.3 Bedrock: 0.0
Embeddedness Values (%): 1. 0.0 2. 24.1 3. 20.7 4. 41.4 5. 13.8

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 5

Channel Type: B2
Reach Length (ft.): 2153
Riffle/Flatwater Mean Width (ft.): 7.8
BFW:
Range (ft.): to
Mean (ft.):
Std. Dev.:
Base Flow (cfs): 1.4
Water (F): 65 - 68 Air (F): 77 - 84
Dry Channel (ft.): 0

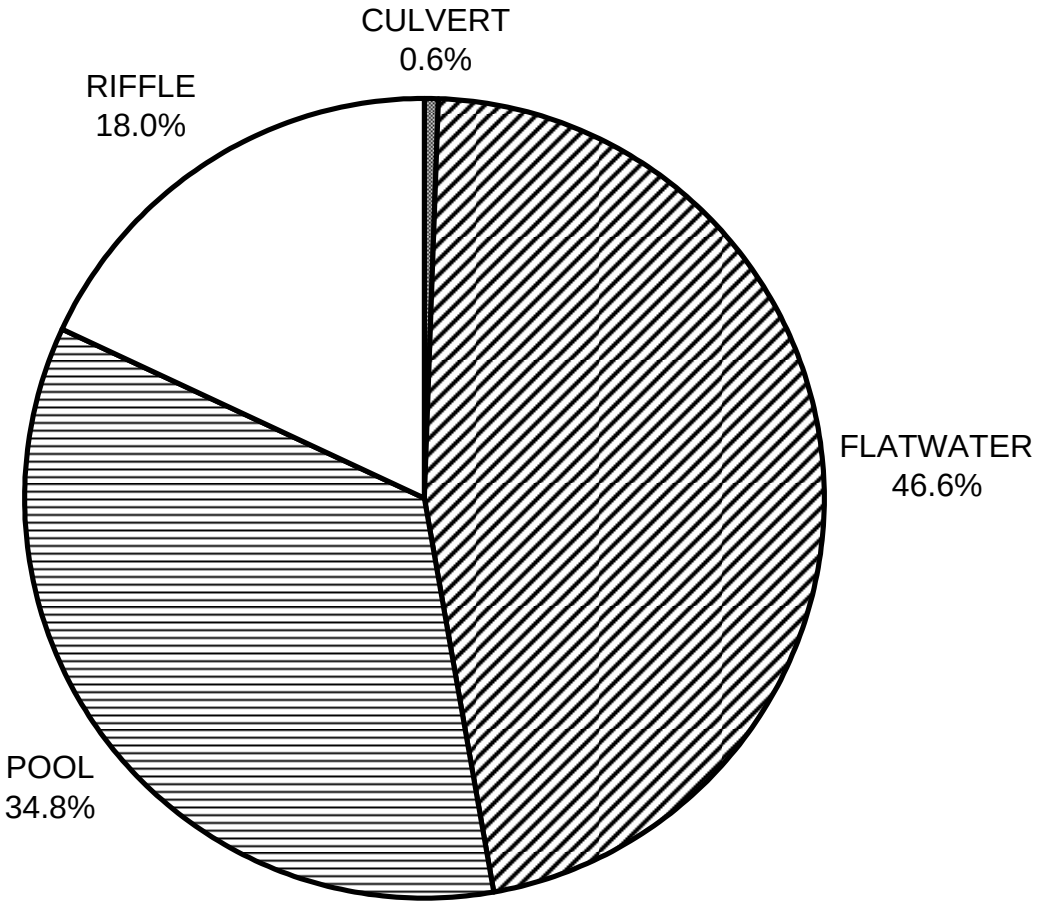
Canopy Density (%): 80.9
Coniferous Component (%): 0.0
Hardwood Component (%): 100.0
Dominant Bank Vegetation: Hardwood Trees
Vegetative Cover (%): 51.9
Dominant Shelter: Boulders
Dominant Bank Substrate Type: Sand/Silt/Clay
Occurrence of LWD (%): 16.3
LWD per 100 ft.:
Riffles:
Pools:
Flat:

Pools by Stream Length (%): 24.9
Pool Frequency (%): 43.2
Residual Pool Depth (%):
< 2 Feet Deep: 93.8
2 to 2.9 Feet Deep: 0.0
3 to 3.9 Feet Deep: 6.3
>= 4 Feet Deep: 0.0
Mean Max Residual Pool Depth (ft.): 1.38
Mean Pool Shelter Rating: 7

Pool Tail Substrate (%): Silt/Clay: 6.3 Sand: 0.0 Gravel: 37.5 Sm Cobble: 6.3 Lg Cobble: 12.5 Boulder: 37.5 Bedrock: 0.0

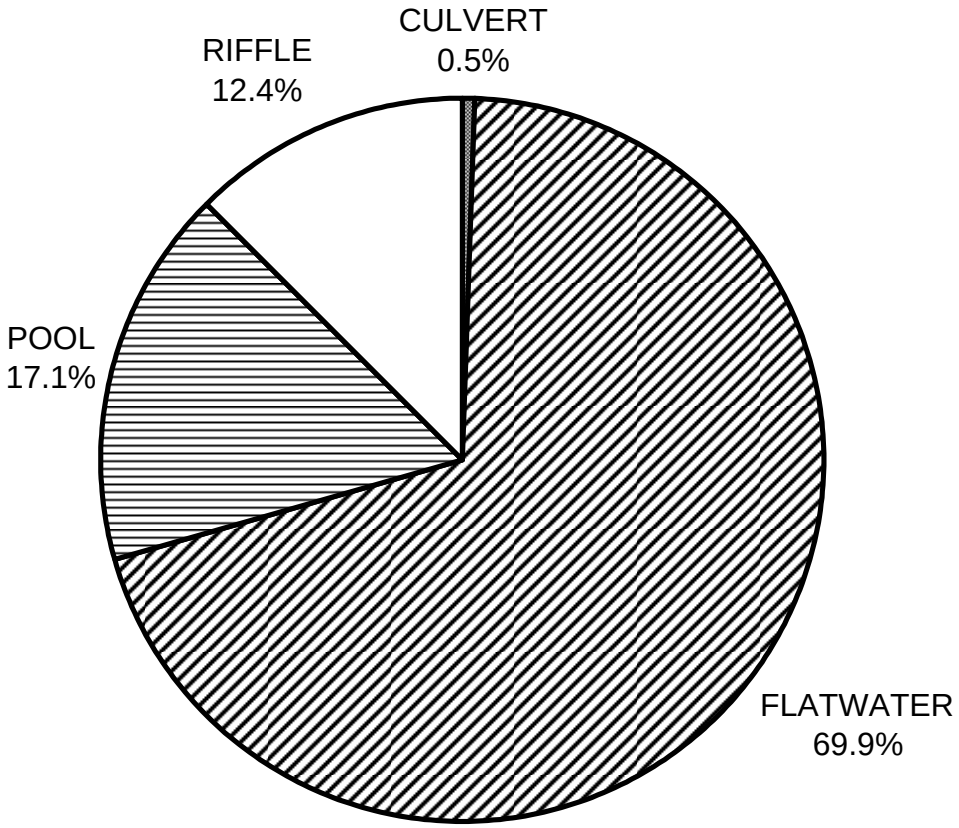
Embeddedness Values (%): 1. 0.0 2. 37.5 3. 6.3 4. 12.5 5. 43.8

MCDOWELL CREEK 1998
HABITAT TYPES BY PERCENT OCCURRENCE



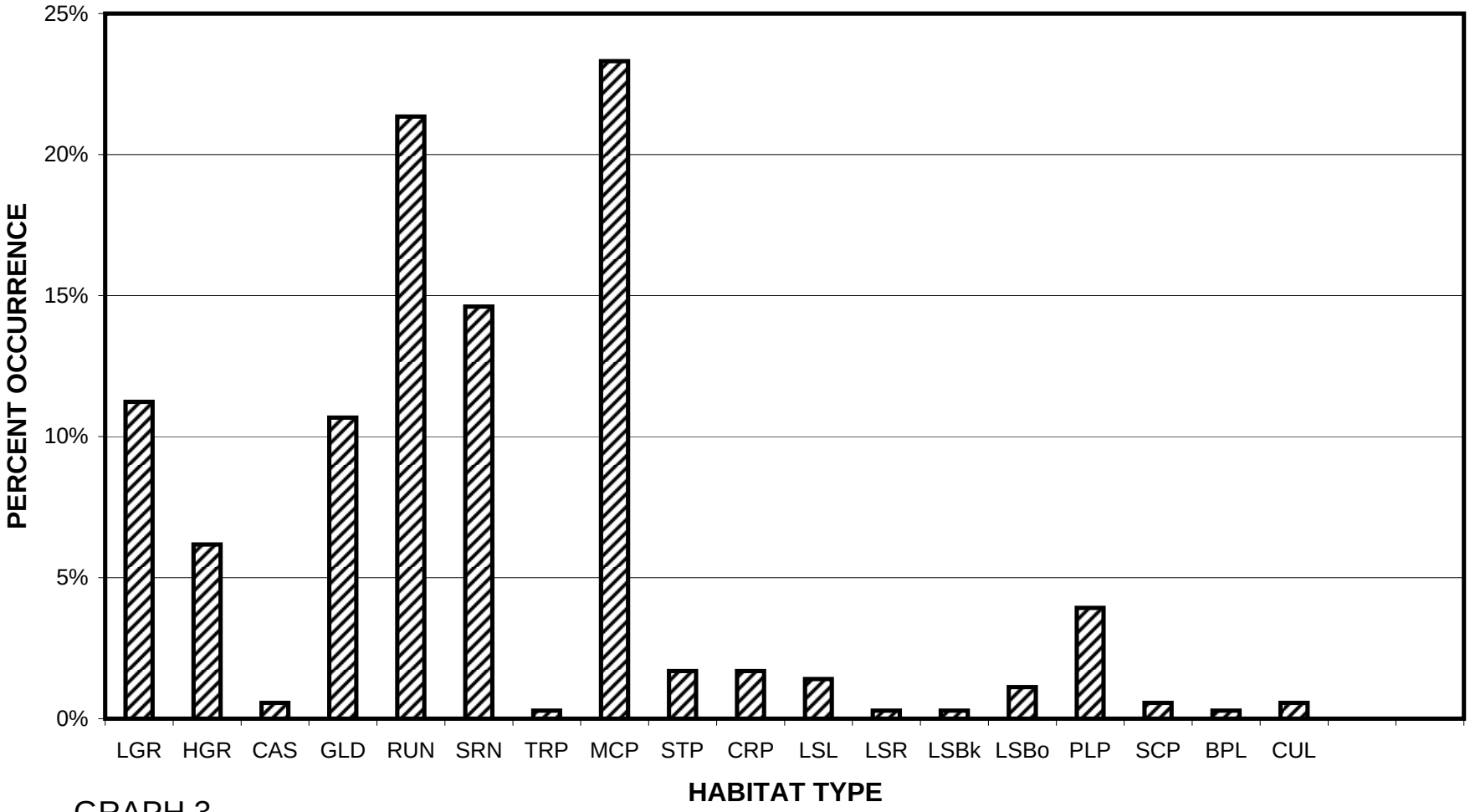
GRAPH 1

MCDOWELL CREEK 1998
HABITAT TYPES BY PERCENT TOTAL LENGTH



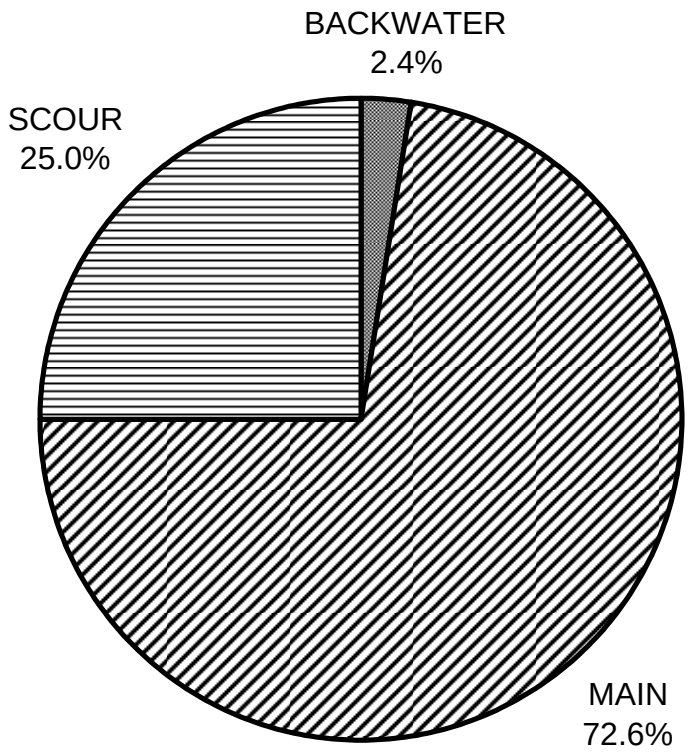
GRAPH 2

MCDOWELL CREEK 1998
HABITAT TYPES BY PERCENT OCCURRENCE



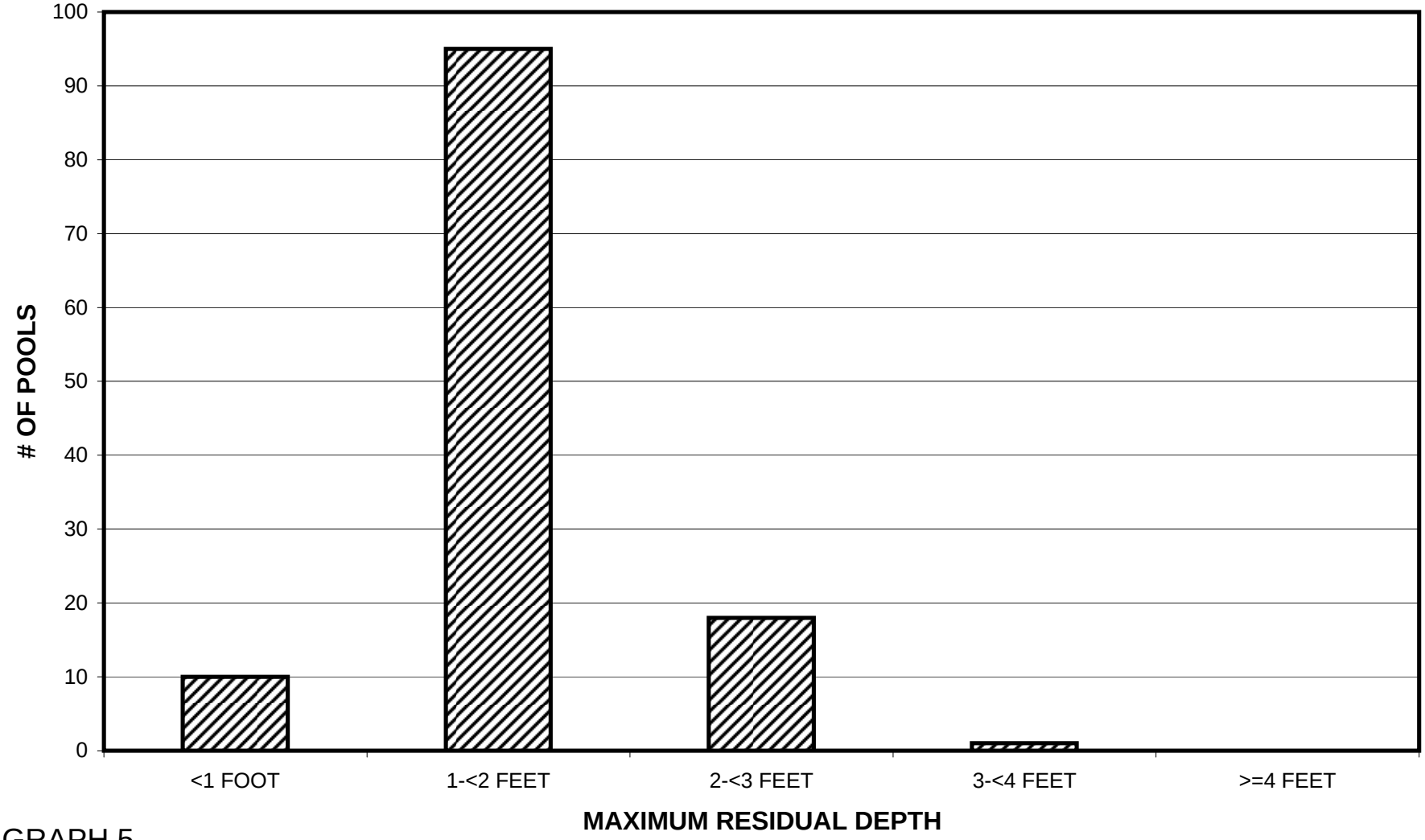
GRAPH 3

MCDOWELL CREEK 1998
POOL TYPES BY PERCENT OCCURRENCE



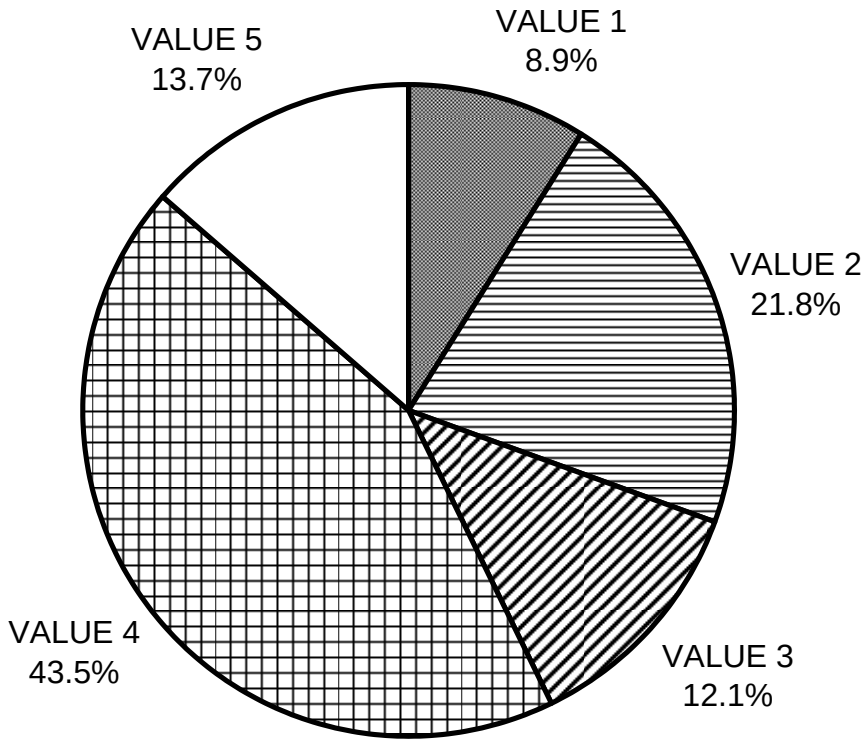
GRAPH 4

MCDOWELL CREEK 1998
MAXIMUM DEPTH IN POOLS



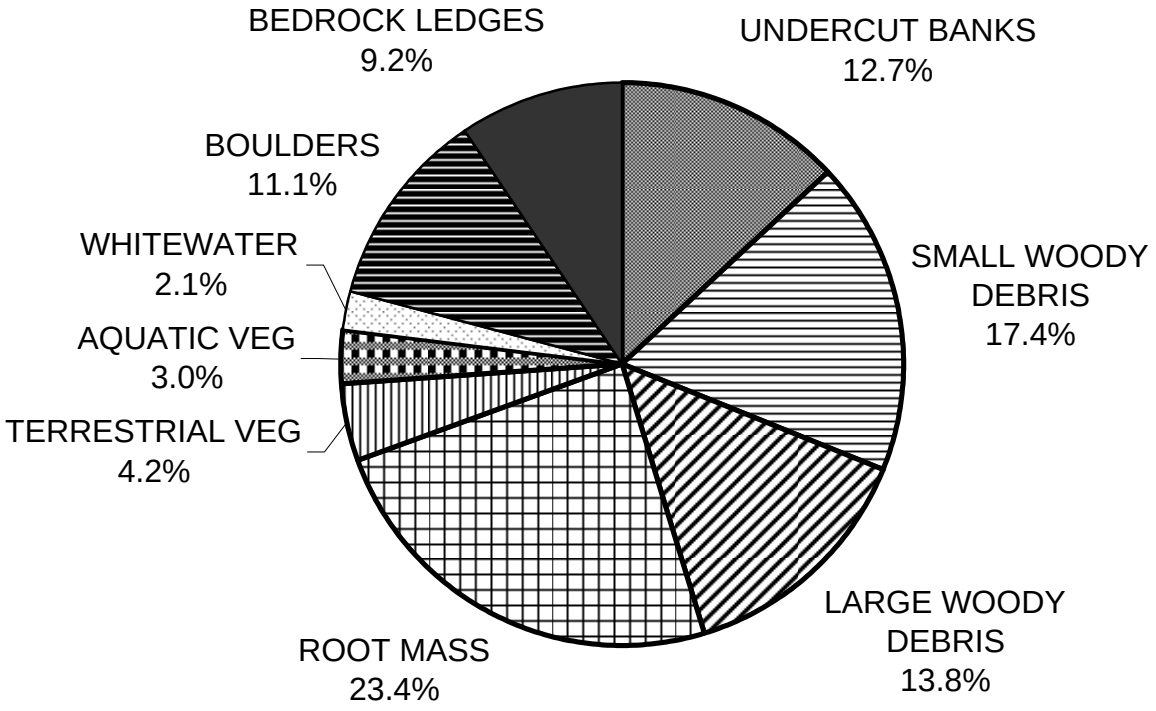
GRAPH 5

MCDOWELL CREEK 1998
PERCENT EMBEDDEDNESS



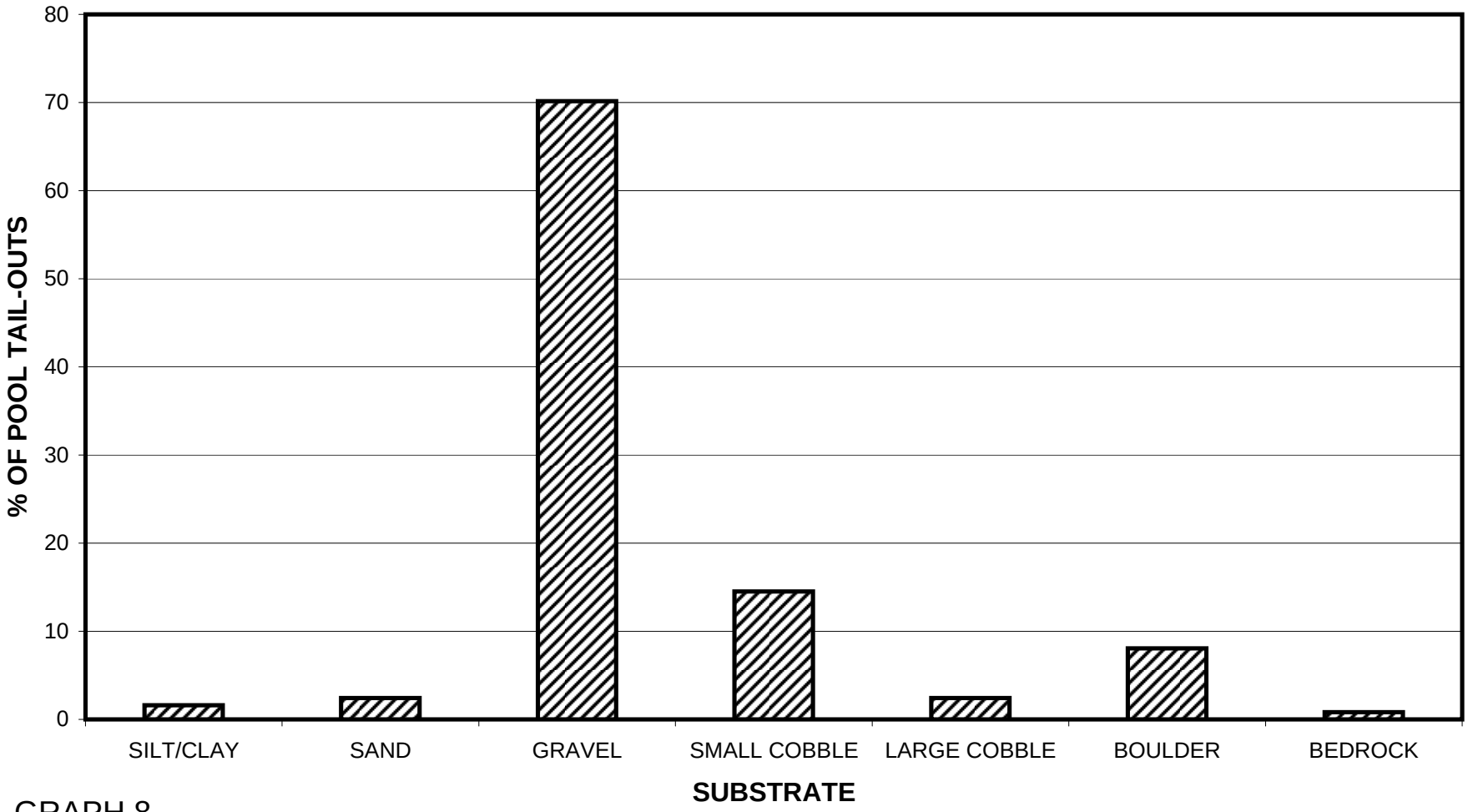
GRAPH 6

MCDOWELL CREEK 1998
MEAN PERCENT COVER TYPES IN POOLS



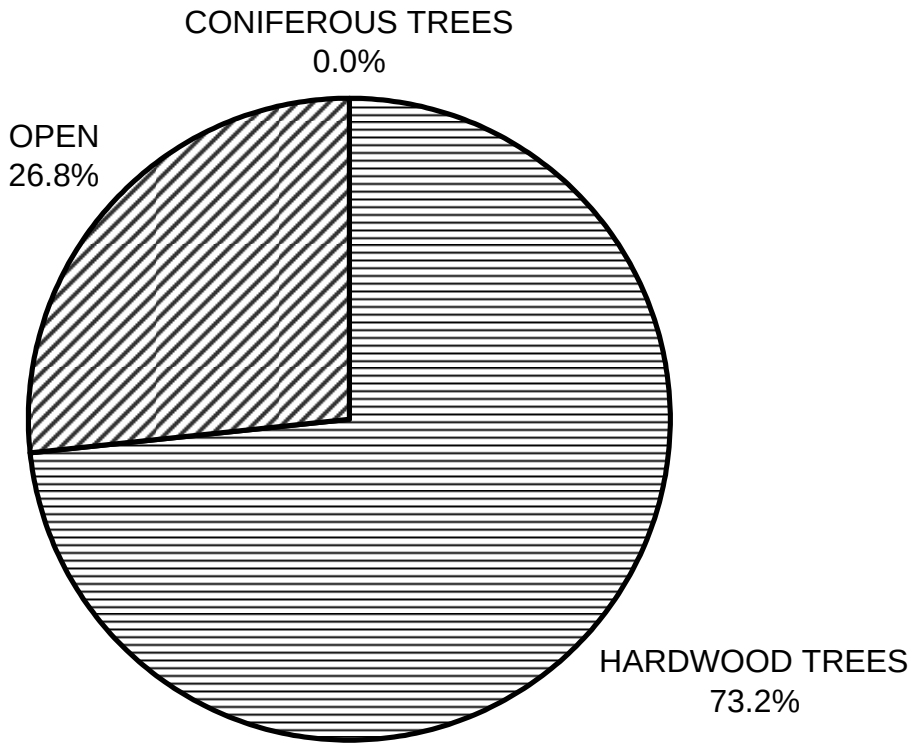
GRAPH 7

MCDOWELL CREEK 1998
SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



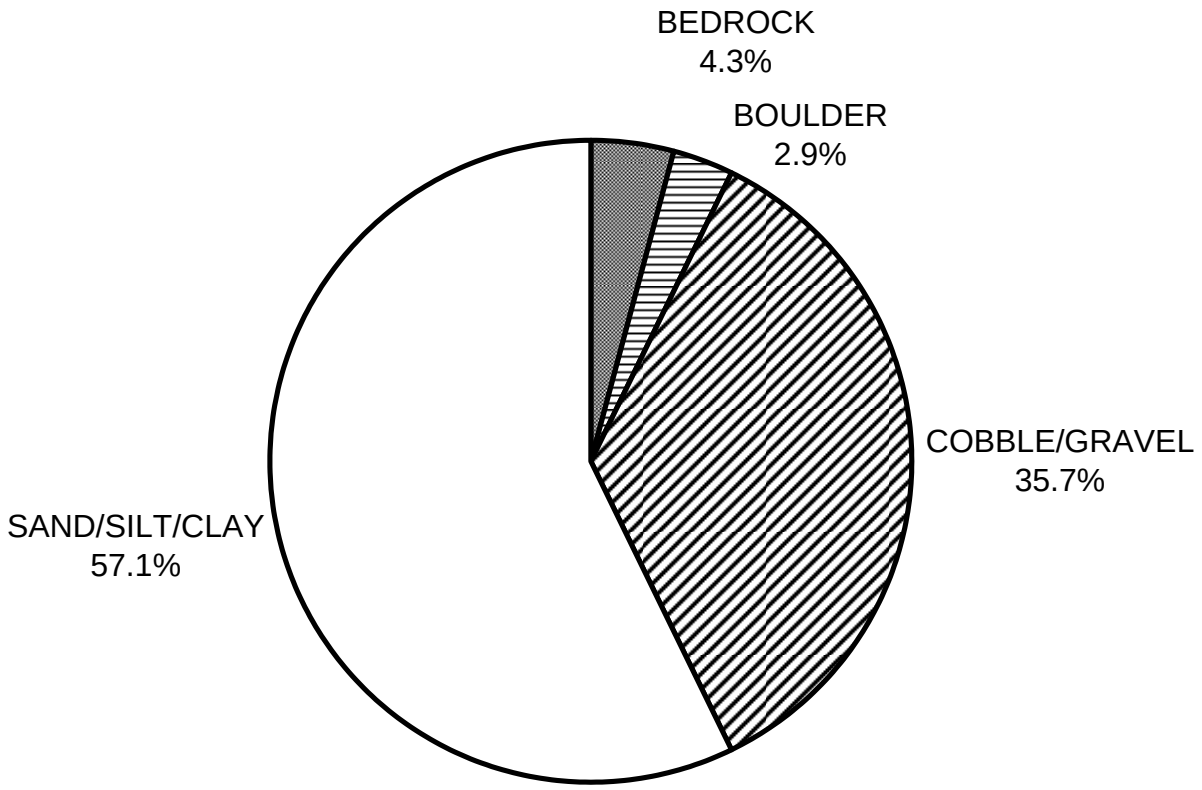
GRAPH 8

MCDOWELL CREEK 1998
MEAN PERCENT CANOPY



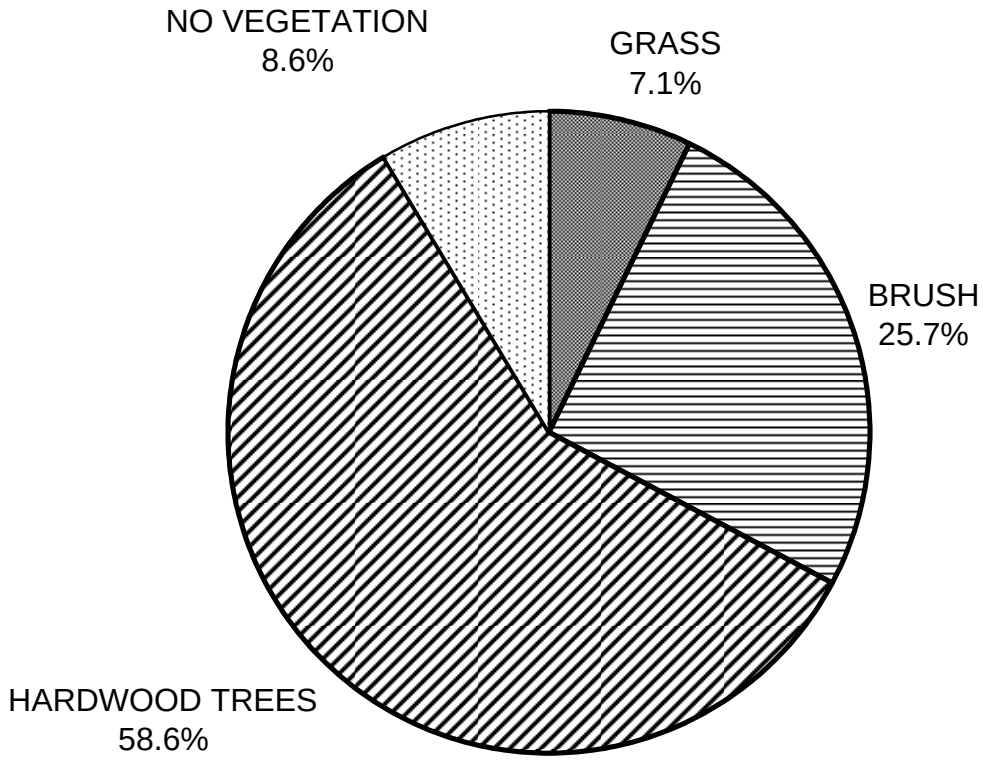
GRAPH 9

MCDOWELL CREEK 1998
DOMINANT BANK COMPOSITION IN SURVEY REACH



GRAPH 10

MCDOWELL CREEK 1998
DOMINANT BANK VEGETATION IN SURVEY REACH



GRAPH 11