

# **STREAM INVENTORY REPORT**

## **Hely Creek**

### INTRODUCTION

A stream inventory was conducted during June 5, 2006 to June 19, 2006 on Hely Creek. The survey began at the confluence with Van Duzen River and extended upstream 9,892 feet.

The Hely 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 Hely 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.

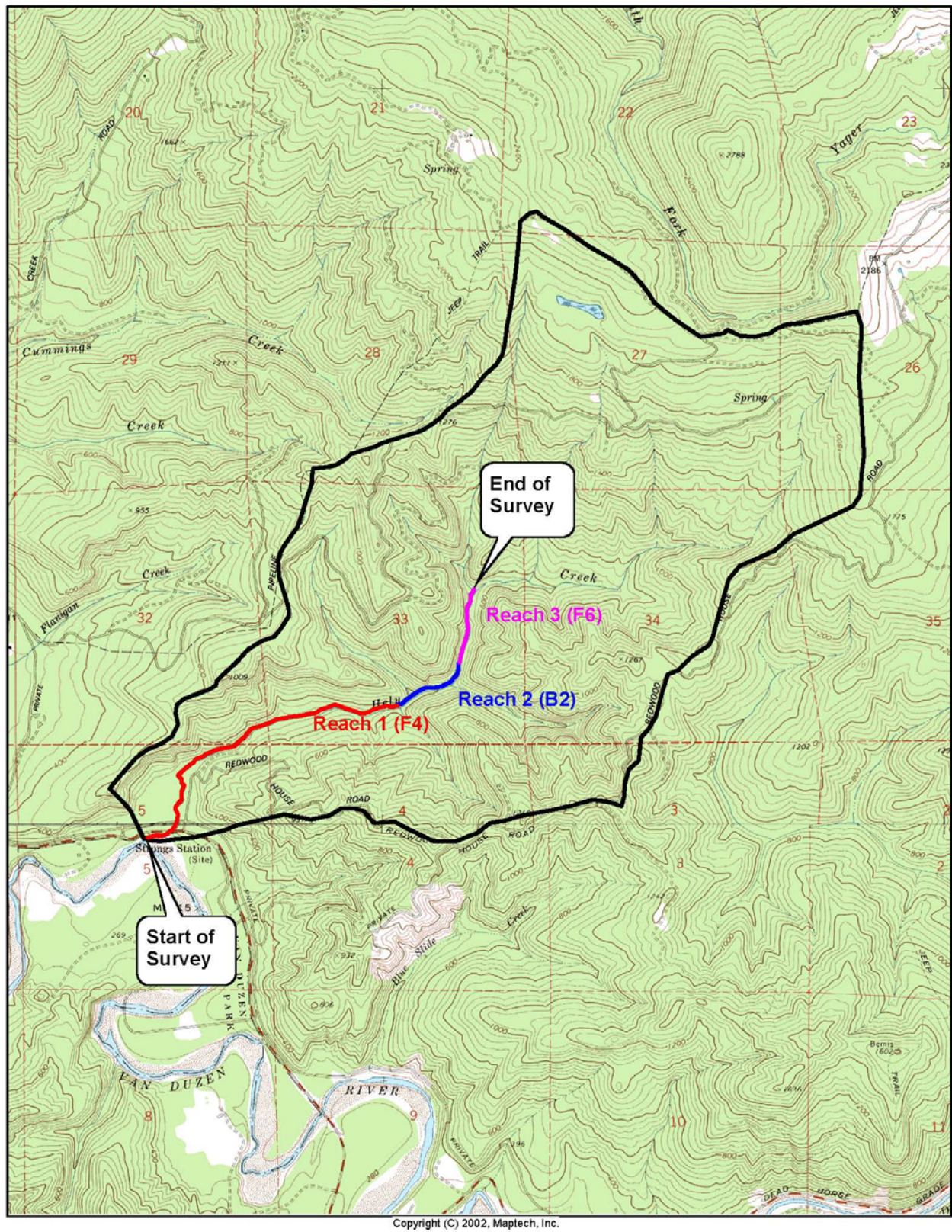
### WATERSHED OVERVIEW

Hely Creek is a tributary to the Van Duzen River, tributary to the Eel River, tributary to the Pacific Ocean, located in Humboldt County, California (Map 1). Hely Creek's legal description at the confluence with Van Duzen River is T01N R02E S05. Its location is 40°29'56.0" north latitude and 123°58'34.0" west longitude, LLID number 1239760404988. Hely Creek is a second order stream and has approximately 5.83 miles of blue line stream according to the USGS Owl Creek and Redcrest 7.5 minute quadrangle. Hely Creek drains a watershed of approximately 3.65 square miles. Elevations range from about 216 feet at the mouth of the creek to 1,850 feet in the headwater areas (average elevation of headwaters, not highest point). Redwood and Douglas fir forest dominates the watershed. The watershed is entirely privately owned and is managed for timber production. Vehicle access exists via Highway 101 south of Fortuna to Highway 36 east; proceed about 11.5 miles east and turn left onto Redwood House Road.

### METHODS

The habitat inventory conducted in Hely Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi et al, 1998). The California Conservation Corps (CCC) Technical Advisors and Watershed Stewards Project/AmeriCorps (WSP) Members that conducted the inventory were trained in standardized habitat inventory methods by the California Department of Fish and Game (DFG). 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 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 Hely 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". Hely Creek habitat typing used standard basin level measurement criteria. These parameters require that the minimum

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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 Hely 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 Hely 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 Hely 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

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withstand winter flows. In Hely 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 Hely Creek. In addition, twelve 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 2.0.19, 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

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- 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 Hely 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 June 5, 2006 to June 19, 2006 was conducted by B. Rahn and H. Sgalitzer (WSP) and T. Tollefson (DFG). The total length of the stream surveyed was 9,892 feet with an additional 402 feet of side channel.

Stream flow was measured near the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 2.145 cfs on June 12, 2006.

Hely Creek is an F4 channel type for 6,509 feet of the stream surveyed (Reach 1), a B2 channel type for 1,625 feet of the stream surveyed (Reach 2) and an F6 channel type for 1,758 feet of the stream surveyed (Reach 3).

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 with moderate gradients and riffle dominated channels with infrequently spaced pools. B2 channels have a very stable plan and profile with stable banks and boulder-dominant substrates. F6 channels are entrenched, meandering riffle/pool channels on low gradients with high width/depth ratios and silt/clay-dominant substrates.

Water temperatures taken during the survey period ranged from 53 to 58 degrees Fahrenheit. Air temperatures ranged from 53 to 64 degrees Fahrenheit.

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Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 34% riffle units, 34% flatwater units, 31% pool units and 1% dry units (Graph 1). Based on total length of Level II habitat types there were 37% riffle units, 37% flatwater units, 23% pool units and 3% dry units (Graph 2).

Thirteen Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were 31% run units, 19% mid-channel pool units, 18% low gradient riffle units (Graph 3). Based on percent total length, there were 33% run units, 22% low gradient riffle units, and 16% high gradient riffle units.

A total of 102 pools were identified (Table 3). Main channel pools were the most frequently encountered, at 63% (Graph 4), and comprised 66% 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. Thirty-four of the 101 pools (34%) had a residual depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 102 pool tail-outs measured, none had a value of 1, 14 had a value of 2 (13.7%); 45 had a value of 3 (44.1%); 17 had a value of 4 (16.7%) and 26 had a value of 5 (25.5%); (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 54, flatwater habitat types had a mean shelter rating of 36, and pool habitats had a mean shelter rating of 92 (Table 1). Of the pool types, the main-channel pools had a mean shelter rating of 84, Scour pools had a mean shelter rating of 104, backwater pools had a mean shelter rating of 150 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Large woody debris is the dominant cover types in Hely Creek. Graph 7 describes the pool cover in Hely Creek. Large woody debris 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 55% of pool tail-outs and small cobble observed in 16% of pool tail-outs.

The mean percent canopy density for the surveyed length of Hely Creek was 98%. Two percent of the canopy was open. Of the canopy present, the mean percentages of hardwood and coniferous trees were 86% and 14%, respectively. Graph 9 describes the mean percent canopy in Hely Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 92%. The mean percent left bank vegetated was 92%. The dominant elements composing the structure of the

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stream banks consisted of 75% sand/silt/clay, 19% cobble/gravel and 6% bedrock (Graph 10). Hardwood trees were the dominant vegetation type observed in 63% of the units surveyed. Additionally, 36% of the units surveyed had coniferous trees as the dominant vegetation type, and 1% had no vegetation (Graph 11).

### BIOLOGICAL INVENTORY RESULTS

Twelve sites were electrofished for species composition and distribution in Hely Creek on June 22, 2006. Water temperatures taken during the electrofishing period 11:20-16:00 ranged from 56 to 58 degrees Fahrenheit. Air temperature was 61 degrees Fahrenheit. The sites were sampled by B. Rahn and H. Sgalitzer (WSP) and T. Tollefson (DFG).

In reach one, which comprised the first 6,509 feet of stream, twelve sites were sampled. The reach sites yielded thirty-five young-of-the-year steelhead/rainbow trout (SH/RT), twenty-eight age 1+ SH/RT and one age 2+ SH/RT.

The following chart displays the information yielded from these sites:

2006 Hely Creek E-fish observations:

Date	Site #	Hab. Unit #	Hab. Type	Approx. Dist. from mouth (ft.)	Coho		SH/RT		
					YOY	1+	YOY	1+	2+
Reach 1 F4 Channel Type									
06/22/06	1	008	4.2	350	0	0	3	1	0
06/22/06	2	010	3.3	412	0	0	5	3	0
06/22/06	3	013	4.2	502	0	0	5	0	0
06/22/06	4	021	4.2	708	0	0	2	4	0
06/22/06	5	074	3.3	2116	0	0	1	1	0
06/22/06	6	076	4.2	2154	0	0	3	2	0
06/22/06	7	083	3.3	2298	0	0	7	4	1
06/22/06	8	096	4.2	2668	0	0	8	0	0
06/22/06	9	100	4.2	2747	0	0	0	0	0
06/22/06	10	106	3.3	2889	0	0	0	4	0

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2006 Hely Creek E-fish observations:

Date	Site #	Hab. Unit #	Hab. Type	Approx. Dist. from mouth (ft.)	Coho		SH/RT		
					YOY	1+	YOY	1+	2+
06/22/06	11	131	3.3	3529	0	0	1	5	0
06/22/06	12	150	4.4	4056	0	0	0	4	0

## DISCUSSION

Hely Creek is an F4 channel type for the first 6,509 feet of stream surveyed and a B2 channel type for the next 1,625 feet and an F6 channel type for the remaining 1,758 feet. The suitability of F4, B2 and F6 channel types for fish habitat improvement structures are as follows: F4 channel types are good for bank-placed boulders and fair for plunge weirs, single and opposing wing-deflectors, channel constrictors and log cover. B2 channel types are excellent for plunge weirs, single and opposing wing deflectors and log cover. F6 channel types are good for bank-placed boulders and fair for plunge weirs, boulder clusters, single and opposing wing deflectors and log cover.

The water temperatures recorded on the survey days June 5, 2006 to June 19, 2006, ranged from 53 to 58 degrees Fahrenheit. Air temperatures ranged from 53 to 64 degrees Fahrenheit. To make any 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 37% of the total length of this survey; riffles 37%, pools 23% and 3% dry units. The pools are relatively shallow, with only 34 of the 101 (34%) pools having a maximum residual depth greater than 2 feet. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat. In first and second order streams, a primary pool is defined to have a maximum residual depth of at least two feet, occupy at least half the width of the low flow channel, and be as long as the low flow channel width. Installing structures that will increase or deepen pool habitat is recommended.

Fourteen of the 102 pool tail-outs measured had embeddedness ratings of 1 or 2. Sixty-two of the pool tail-outs had embeddedness ratings of 3 or 4. Twenty-six 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 Hely Creek should be mapped and rated according to their potential sediment yields, and control measures should be taken.

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Seventy-two of the 102 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 92. The shelter rating in the flatwater habitats was 36. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by large woody debris in Hely Creek. Large woody debris is the dominant cover type in pools followed by small woody debris. Log and root wad cover structures in the pool and flatwater habitats would enhance both summer and winter salmonid habitat. Log cover structure provides rearing fry with protection from predation, rest from water velocity, and also divides territorial units to reduce density related competition.

The mean percent canopy density for the stream was 98%. Reach 1 had a canopy density of 97.7%, Reach 2 had a canopy density of 99.1% and Reach 3 had a canopy density of 99.4%. The percentage of right and left bank covered with vegetation was 92% and 92%, respectively. In areas of stream bank erosion planting endemic species of coniferous and hardwood trees, is recommended.

## **RECOMMENDATIONS**

- 1) Hely Creek should be managed as an anadromous, natural production stream.
- 2) The limited water temperature data available suggest that maximum temperatures are within the acceptable range for juvenile salmonids. To establish more complete and meaningful temperature regime information, 24-hour monitoring during the July and August temperature extreme period should be performed for 3 to 5 years.
- 3) Where feasible, design and engineer pool enhancement structures to increase the number of pools. This must be done where the banks are stable or in conjunction with stream bank armor to prevent erosion.
- 4) There are several log debris accumulations present on Hely 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.
- 5) Inventory and map sources of stream bank erosion and prioritize them according to present and potential sediment yield. Identified sites should then be treated to reduce the amount of fine sediments entering the stream.
- 6) 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.

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### COMMENTS AND LANDMARKS

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

Position (ft.):	Habitat Unit #:	Comments:
0	0001.00	Begin survey at confluence with Van Duzen River. High gradient riffle with 3 foot elevation change at the confluence. Log structure
182	0004.00	Out of influence of Van Duzen River.
292	0006.00	Presence of young-of-the-year (YOY) salmonids in pool.
323	0007.00	Highway 36 Bridge. Concrete abutments of bridge make up left and right banks. Access to Hely Creek via trail from Highway 36 Bridge on left bank.
376	0009.00	Flow taken (2.145 cfs).
468	0012.00	Swale on left bank.
569	0015.00	Log debris accumulation (LDA); composed of 10+ pieces of large woody debris (LWD) 15' high x 35' wide x 60' long. Substrate of sand to cobble retained 30' wide x 100' long x 6' deep. LDA spans entire width of channel. Blowout on left bank caused by former blockage of main channel. Fish observed above LDA.
582	0016.00	LDA ends
980	0035.00	Log structure
1170	0041.00	Channel type taken; F4
1496	0055.00	Left bank erosion 49' wide x 6' tall
1936	0068.00	Left bank erosion 25' wide x 12' high x 10' deep
2116	0074.00	LDA; 7' high x 35' wide x 50' long; composed of 12+ pieces of LWD; water flows through with visible gaps. Substrate of sand to cobble sediment retained 20' wide x 100' long x 5' deep. YOY salmonids seen above LDA.
2178	0078.00	End of LDA

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2474	0087.00	Presence of YOY salmonid at pool tail out
2555	0090.00	Log structure
2577	0091.00	Log structure
2590	0092.00	Log structure
2608	0093.00	Log structure
2624	0094.00	LDA starts and ends at HU 98; 11' high x 58' wide x 80' long; composed of 25+ pieces of LWD. Water flows with visible gaps. Silt to cobble sediment retained 25' wide x 80' long x 8' deep. YOY seen within and above LDA.
2703	0098.00	LDA ends. YOY observed. Log structure
2747	0100.00	LDA; 8' high x 35' wide x 21' long composed of 8+ pieces LWD. Water flows with visible gaps. Silt to cobble sediment retained 30' wide x 60' long x 4' deep. YOY seen above LDA
2844	0103.00	Log structure across pool Left bank erosion; 40' high x 30' wide x 30' deep due to failed road. Old culvert in bank
2859	0104.00	Erosion due to failed road with old culvert on left bank LDA; 8' high x 38' wide x 30' long composed of 15+ pieces LWD; silt to cobble sediment retained 25' wide x 150' long x 8' deep. No fish seen above LDA. Eight foot high waterfall on main channel. Side channel travels under LDA.
2889	0106.00	LDA ends
3021	0108.01	Left bank erosion due to skid road failure; 50' high x 70' long x 20' deep. High sediment load to creek.
3388	0125.00	Left bank erosion due to failed skid road.
3406	0126.00	Left bank erosion.
3422	0127.00	LDA; 9' high x 35' wide x 86' long composed of 18+ pieces of LWD. Water flows through with visible gaps. Silt to cobble sediment retained 25' wide x 200' long x 5' deep; associated left bank erosion.
3484	0130.00	LDA ends

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3664	0135.00	Left bank erosion 15' high x 20' deep
3684	0136.00	Left bank erosion 66' long x 15' high x 10' deep
3972	0144.00	LDA; 10' high x 35' wide x 44' long composed of 8+ pieces LWD. Water flows through with visible gaps. Silt to gravel sediment retained 35' wide x 30' long x 5' deep. Associated erosion on right bank 40' long x 20' deep x 30' high. No fish seen above LDA.
4087	0151.00	Tributary #1; water temperature in the tributary was 52° F. Not accessible to fish due to 25% slope.
4169	0153.00	Left bank erosion 10' deep x 15' wide x 30' high
4374	0157.00	Right bank erosion 10' wide x 10' high x 5' deep Access trail on left bank to Redwood House Road
4475	0160.00	First YOY salmonid observed since LDA #5 at habitat unit 104.
4825	0167.00	LDA; 12' high x 65' wide x 35' long composed of 12+ pieces LWD; water flows with visible gaps. Silt to cobble sediment retained 25' wide x 35' long x 10' deep; associated left bank erosion.
4837	0168.00	Left bank erosion; 20' high x 40' long x 10' deep
4853	0169.00	LDA ends
4885	0170.00	Juvenile salmonid fish seen, about 4" long. Log structure
5280	0182.00	LDA; 10' high x 50' wide x 35' long with 7+ pieces LWD; water flows through with visible gaps. Silt to cobble sediment retained 40' wide x 50' long x 5' deep. Right bank erosion; 10' high x 3' wide x 1' deep. Left bank erosion; 30' high x 15' wide x 30' deep.
5344	0184.00	Left bank erosion 30' high x 20' wide x 30' deep
5382	0185.00	LDA; 5' high x 20' wide x 21' long composed of 6+ pieces of LWD; water flows through with visible gaps. Silt to gravel sediment retained 8' wide x 30' long x 2' deep. Left bank erosion
5724	0194.00	Log structure
5945	0200.00	Left bank erosion; 15' wide x 8' high x 2' deep

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6346	0212.00	Log structure on right bank creating plunge pool
6383	0214.00	Log structure with stored sediment about 5' high behind log
6470	0217.00	Channel type change; B2
6649	0222.00	Left bank tributary #2. Water temperature of tributary was 51°F. Accessible to fish at high flows; 11% (6 degree) slope at mouth of tributary.
6859	0229.00	Left bank erosion; 50' high x 20' wide x 30'deep
6924	0231.00	Juvenile fish seen, about 4" long. Left bank erosion; 8' high x 10' wide x 2' deep
6967	0232.00	Right bank tributary #3. Water temperature of the tributary was 53°F. Accessible to salmonids with a 4% slope. No fish seen. Small LDA and sediment buildup 50' up the tributary.
7175	0238.00	LDA; 10' high x 30' wide x 45' long with 10+ pieces LWD; water flows with visible gaps. Silt to gravel sediment retained 20' wide x 60' long x 8' deep. Right bank erosion; 50' wide x 40' high x 20' deep
7456	0248.00	LDA on right bank
7494	0249.00	Right bank tributary #4. Not accessible to fish, gradient 65%
7606	0254.00	LDA; 11' high x 25' wide x 50' long with 10+ pieces LWD; water flows with visible gaps. Silt to cobble sediment retained 20' wide x 90' long x 7' deep.
7678	0256.00	Seep on right bank hillside.
7713	0257.00	Left bank tributary #5. Water temperature of the tributary was 53°F. Accessible to fish, 4% gradient. No fish seen.
7951	0259.00	Four juvenile fish seen in pool, ranging in size from 2 - 5"
8001	0261.00	LDA; 8' high x 40' wide x 10' long with 5+ pieces of LWD; water flows through with visible gaps. Silt to gravel sediment retained 40' wide x 20' long x 2' deep.
8123	0264.00	LDA; 15' high x 30' wide x 15' long with 10+ pieces LWD; water flows, but no visible gaps. Water seeps through sediment. Silt to gravel sediment retained 20' wide x 20' long x 12' deep.

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8134	0265.00	Channel type changes to an F6
8182	0266.00	LDA; 7' high x 15' wide x 6' long with 4+ pieces of LWD; water flows, but no visible gaps. Silt to gravel sediment retained 15' wide x 25' long x 3' deep.
8234	0268.00	LDA; 7' high x 20' wide x 5' long with 5+ pieces of LWD; water flows, but no visible gaps. Silt to gravel sediment retained 15' wide x 35' long x 5' deep.
8302	0270.00	LDA; 10' high x 20' wide x 8' long with 8+ pieces LWD; water flows, but no visible gaps. Silt to gravel sediment retained 20' wide x 60' long x 8' deep.
8358	0272.00	LDA; 8' high x 15' wide x 20' long with 5+ pieces of LWD; water flows, but no visible gaps. Silt to gravel sediment retained 15' wide x 60' long x 7' deep.
8448	0274.00	YOY seen above and below LDA, many over 6" long. LDA 5' high x 20' wide x 25' long with 6+ pieces of LWD; water flows with visible gaps. Silt to gravel sediment retained 20' wide x 50' long x 3' deep. Fish seen above and below LDA.
8505	0277.00	LDA; 5' high x 20' wide x 10' long with 3+ pieces LWD; water flows through with visible gaps. Silt to gravel sediment retained 15' wide x 20' long x 1' deep.
8758	0285.00	LDA; 9' high x 30' wide x 5' long with 5+ pieces LWD; water flows through, visible gaps present, sediment retention; 20' wide x 50' long x 5' deep; sediment size range from silt to gravel.
9590	0310.00	Left bank tributary #6. Water temperature in the tributary 53° F. Not accessible to fish at low flow, 12% gradient.
9604	0311.00	LDA; 7' high x 15' wide x 5' long with 5+ pieces LWD; water flows with visible gaps. Silt to gravel sediment retained 10' wide x 25' long x 3' deep.
9631	0312.00	Juvenile fish seen about 4" long.
9865	0320.00	Tributary #7. Flows and contributes approximately 40% to the flow of receiving stream. Accessible to fish, 11% gradient. Checked up tributary 200 feet, no fish observed.

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9892	0320.00	End of survey at the confluence of Hely Creek and Tributary #7. Giant old growth logs span the creek overhead reaching bank to bank.
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## **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.

## Hely 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 a marsh	(MAR)	[9.1]	

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

Stream Name: Hely Creek

LLID: 1239760404988

Drainage: Van Duzen River

Survey Dates: 6/5/2006 to 6/19/2006

Confluence Location: Quad: OWL CREEK

Legal Description: T01NR02ES05

Latitude: 40:29:56.0N

Longitude: 123:58:34.0

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
4	0	DRY	1.2	89	357	3.5									
110	19	FLATWATER	33.7	34	3764	36.6	8.5	0.8	1.2	240	26444	183	20086		36
102	101	POOL	31.3	23	2321	22.5	12.2	1.0	1.8	279	28450	400	40809	289	92
110	16	RIFFLE	33.7	35	3852	37.4	8.9	0.4	0.7	234	25723	99	10923		54
Total Units	Total Units Fully Measured				Total Length (ft.)					Total Area (sq.ft.)			Total Volume (cu.ft.)		
326	136				10294					80617			71818		

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

Stream Name: Hely Creek

LLID: 1239760404988

Drainage: Van Duzen River

Survey Dates: 6/5/2006 to 6/19/2006

Confluence Location: Quad: OWL CREEK

Legal Description: T01NR02ES05

Latitude: 40:29:56.0N

Longitude: 123:58:34.0W

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 (%)
60	9	LGR	18.4	37	2236	21.7	9	0.4	0.9	248	14883	93	5572		15	98
50	7	HGR	15.3	32	1616	15.7	8	0.4	1.1	216	10779	108	5378		99	98
100	17	RUN	30.7	33	3349	32.5	9	0.8	2	232	23200	174	17440		31	99
10	2	SRN	3.1	42	415	4.0	8	0.9	1.2	312	3119	252	2523		83	100
61	60	MCP	18.7	24	1434	13.9	12	0.9	3.5	280	17073	374	22810	255	83	98
3	3	STP	0.9	33	99	1.0	11	1.1	2	357	1071	547	1641	371	90	99
3	3	CRP	0.9	30	90	0.9	13	0.8	2.3	379	1136	496	1488	343	160	97
4	4	LSL	1.2	23	91	0.9	11	1.1	2.8	245	978	317	1268	245	70	100
3	3	LSR	0.9	22	66	0.6	9	0.5	1.3	206	619	216	648	109	165	100
1	1	LSBk	0.3	27	27	0.3	7	1.3	2.1	189	189	284	284	246	5	95
26	26	PLP	8.0	19	490	4.8	14	1.2	6.4	271	7049	463	12040	368	100	98
1	1	DPL	0.3	24	24	0.2	14	1.8	2.6	336	336	605	605	605	150	95
4	0	DRY	1.2	89	357	3.5										98

Total Units  
326

Total Units Fully Measured  
136

Total Length (ft.)  
10294

Total Area (sq.ft.)  
80431

Total Volume (cu.ft.)  
71696

**Table 3 - Summary of Pool Types**

Stream Name: Hely Creek

LLID: 1239760404988

Drainage: Van Duzen River

Survey Dates: 6/5/2006 to 6/19/2006

Confluence Location: Quad: OWL CREEK

Legal Description: T01NR02ES05

Latitude: 40:29:56.0N

Longitude: 123:58:34.0W

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
64	63	MAIN	63	24	1533	66	11.9	0.9	284	18147	260	16653	84
37	37	SCOUR	36	21	764	33	12.8	1.1	269	9971	329	12157	104
1	1	BACKWATER	1	24	24	1	14.0	1.8	336	336	605	605	150

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
102	101	2321	28455	29415

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

Stream Name: Hely Creek

LLID: 1239760404988

Drainage: Van Duzen River

Survey Dates: 6/5/2006 to 6/19/2006

Confluence Location: Quad: OWL CREEK

Legal Description: T01NR02ES05

Latitude: 40:29:56.0N

Longitude: 123:58:34.0W

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
60	MCP	59	6	10	38	63	14	23	2	3	0	0
3	STP	3	0	0	2	67	1	33	0	0	0	0
3	CRP	3	0	0	2	67	1	33	0	0	0	0
4	LSL	4	0	0	2	50	2	50	0	0	0	0
3	LSR	3	1	33	2	67	0	0	0	0	0	0
1	LSBk	1	0	0	0	0	1	100	0	0	0	0
26	PLP	26	2	8	12	46	8	31	3	12	1	4
1	DPL	1	0	0	0	0	1	100	0	0	0	0

Total Units	Total < 1 Foot Max Resid. Depth	Total < 1 Foot % Occurrence	Total 1< 2 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
101	9	9	58	57	28	28	5	5	1	1

Mean Maximum Residual Pool Depth (ft.): 1.8

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

Stream Name: Hely Creek

LLID: 1239760404988

Drainage: Van Duzen River

Survey Dates: 6/5/2006 to 6/19/2006

Dry Units: 4

Confluence Location: Quad: OWL CREEK

Legal Description: T01NR02ES05

Latitude: 40:29:56.0N

Longitude: 123:58:34.0W

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
60	8	LGR	0	6	0	0	11	1	13	30	1
50	7	HGR	4	20	24	6	17	0	16	13	0
110	15	TOTAL RIFFLE	2	13	11	3	14	0	14	22	1
100	17	RUN	9	23	23	12	15	2	0	5	0
10	2	SRN	5	15	25	0	0	0	25	30	0
110	19	TOTAL FLAT	8	22	23	11	13	2	3	8	0
61	60	MCP	5	28	35	6	9	0	7	6	2
3	3	STP	0	20	60	0	0	0	20	0	0
3	3	CRP	20	33	33	3	10	0	0	0	0
4	4	LSL	5	30	45	5	8	0	5	3	0
3	3	LSR	27	10	10	53	0	0	0	0	0
1	1	LSBk	90	10	0	0	0	0	0	0	0
26	26	PLP	7	19	35	1	5	2	26	3	1
1	1	DPL	0	30	60	0	10	0	0	0	0
102	101	TOTAL POOL	7	25	35	6	7	1	11	4	2
326	135	TOTAL	7	23	31	6	9	1	11	7	1

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

Stream Name: Hely Creek

LLID: 1239760404988

Drainage: Van Duzen River

Survey Dates: 6/5/2006 to 6/19/2006

Dry Units: 4

Confluence Location: Quad: OWL CREEK

Legal Description: T01NR02ES05

Latitude: 40:29:56.0N

Longitude: 123:58:34.0W

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
60	8	LGR	13	0	38	38	13	0	0
50	7	HGR	0	14	43	14	14	14	0
100	17	RUN	41	12	29	18	0	0	0
10	2	SRN	0	0	50	0	50	0	0
61	60	MCP	72	15	8	5	0	0	0
3	3	STP	67	33	0	0	0	0	0
3	3	CRP	33	67	0	0	0	0	0
4	4	LSL	75	0	25	0	0	0	0
3	3	LSR	100	0	0	0	0	0	0
1	1	LSBk	100	0	0	0	0	0	0
26	26	PLP	69	12	19	0	0	0	0
1	1	DPL	100	0	0	0	0	0	0

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

Stream Name: Hely Creek

LLID: 1239760404988

Drainage: Van Duzen River

Survey Dates: 6/5/2006 to 6/19/2006

Confluence Location: Quad: OWL CREEK

Legal Description: T01NR02ES05

Latitude: 40:29:56.0N

Longitude: 123:58:34.0W

Mean Percent Canopy	Mean Percent Conifer	Mean Percent Hardwood	Mean Percent Open Units	Mean Right Bank % Cover	Mean Left Bank % Cover
98	14	86	0	92	92

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.

Stream Name: Hely Creek	LLID: 1239760404988	Drainage: Van Duzen River
Survey Dates: 6/5/2006 to 6/19/2006	Survey Length (ft.): 10294	Main Channel (ft.): 9892
		Side Channel (ft.): 402
Confluence Location: Quad: OWL CREEK	Legal Description: T01NR02ES05	Latitude: 40:29:56.0N
		Longitude: 123:58:34.0W

STREAM REACH: 1									
Channel Type: F4			Canopy Density (%): 97.7				Pools by Stream Length (%): 23.6		
Reach Length (ft.): 6509			Coniferous Component (%): 16.0				Pool Frequency (%): 30.8		
Riffle/Flatwater Mean Width (ft.): 8.8			Hardwood Component (%): 84.0				Residual Pool Depth (%):		
BFW:			Dominant Bank Vegetation: Hardwood Trees				< 2 Feet Deep: 72		
Range (ft.): 15 to 37			Vegetative Cover (%): 91.2				2 to 2.9 Feet Deep: 24		
Mean (ft.): 24			Dominant Shelter: Large Woody Debris				3 to 3.9 Feet Deep: 4		
Std. Dev.: 5			Dominant Bank Substrate Type: Sand/Silt/Clay				>= 4 Feet Deep: 0		
Base Flow (cfs.): 2.1			Occurrence of LWD (%): 31				Mean Max Residual Pool Depth (ft.): 1.6		
Water (F): 53 - 58 Air (F): 53 - 64			LWD per 100 ft.:				Mean Pool Shelter Rating: 100		
Dry Channel (ft): 135			Riffles: 7						
			Pools: 18						
			Flat: 7						
Pool Tail Substrate (%): Silt/Clay: 7 Sand: 0 Gravel: 56 Sm Cobble: 19 Lg Cobble: 0 Boulder: 0 Bedrock: 18									
Embeddedness Values (%): 1. 0.0 2. 20.6 3. 48.5 4. 13.2 5. 17.6									

Channel Type:	B2	Canopy Density (%):	99.1	Pools by Stream Length (%):	19.1		
Reach Length (ft.):	1625	Coniferous Component (%):	12.3	Pool Frequency (%):	25.5		
Riffle/Flatwater Mean Width (ft.):	10.0	Hardwood Component (%):	87.7	Residual Pool Depth (%):			
BFW:		Dominant Bank Vegetation:	Hardwood Trees	< 2 Feet Deep:	75		
Range (ft.):	15 to 18	Vegetative Cover (%):	93.1	2 to 2.9 Feet Deep:	17		
Mean (ft.):	15	Dominant Shelter:	Boulders	3 to 3.9 Feet Deep:	8		
Std. Dev.:	1	Dominant Bank Substrate Type:	Sand/Silt/Clay	>= 4 Feet Deep:	0		
Base Flow (cfs.):	2.1	Occurrence of LWD (%):	25	Mean Max Residual Pool Depth (ft.):	1.9		
Water (F):	53 - 54	Air (F):	53 - 60	Mean Pool Shelter Rating:	66		
Dry Channel (ft):	0	Riffles:	7				
		Pools:	16				
		Flat:	4				
Pool Tail Substrate (%):	Silt/Clay: 17	Sand: 8	Gravel: 17	Sm Cobble: 25	Lg Cobble: 25	Boulder: 0	Bedrock: 8
Embeddedness Values (%):	1. 0.0	2. 0.0	3. 16.7	4. 8.3	5. 75.0		

## Summary of Fish Habitat Elements By Stream Reach

### STREAM REACH: 3

Channel Type: F6	Canopy Density (%): 99.4	Pools by Stream Length (%): 21.9
Reach Length (ft.): 1758	Coniferous Component (%): 7.6	Pool Frequency (%): 37.9
Riffle/Flatwater Mean Width (ft.): 6.5	Hardwood Component (%): 92.4	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation: Hardwood Trees	< 2 Feet Deep: 45
Range (ft.): 15 to 15	Vegetative Cover (%): 94.0	2 to 2.9 Feet Deep: 45
Mean (ft.): 15	Dominant Shelter: Large Woody Debris	3 to 3.9 Feet Deep: 5
Std. Dev.: 0	Dominant Bank Substrate Type: Sand/Silt/Clay	>= 4 Feet Deep: 5
Base Flow (cfs.): 2.1	Occurrence of LWD (%): 34	Mean Max Residual Pool Depth (ft.): 2.2
Water (F): 53 - 54 Air (F): 57 - 62	LWD per 100 ft.:	Mean Pool Shelter Rating: 82
Dry Channel (ft): 222	Riffles: 1	
	Pools: 19	
	Flat: 6	
Pool Tail Substrate (%): Silt/Clay: 14 Sand: 0 Gravel: 73 Sm Cobble: 0 Lg Cobble: 0 Boulder: 0 Bedrock: 14		
Embeddedness Values (%): 1. 0.0 2. 0.0 3. 45.5 4. 31.8 5. 22.7		

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

Stream Name: Hely Creek

LLID: 1239760404988

Drainage: Van Duzen River

Survey Dates: 6/5/2006 to 6/19/2006

Confluence Location: Quad: OWL CREEK

Legal Description: T01NR02ES05

Latitude: 40:29:56.0N

Longitude: 123:58:34.0W

**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	9	6	5.6
Boulder	0	1	0.4
Cobble / Gravel	22	29	18.9
Sand / Silt / Clay	104	99	75.2

**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	0	0	0.0
Brush	0	1	0.4
Hardwood Trees	80	90	63.0
Coniferous Trees	54	43	35.9
No Vegetation	1	1	0.7

**Total Stream Cobble Embeddedness Values:**

4

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

StreamName: Hely Creek

LLID: 1239760404988

Drainage: Van Duzen River

Survey Dates: 6/5/2006 to 6/19/2006

Confluence Location: Quad: OWL CREEK

Legal Description: T01NR02ES05

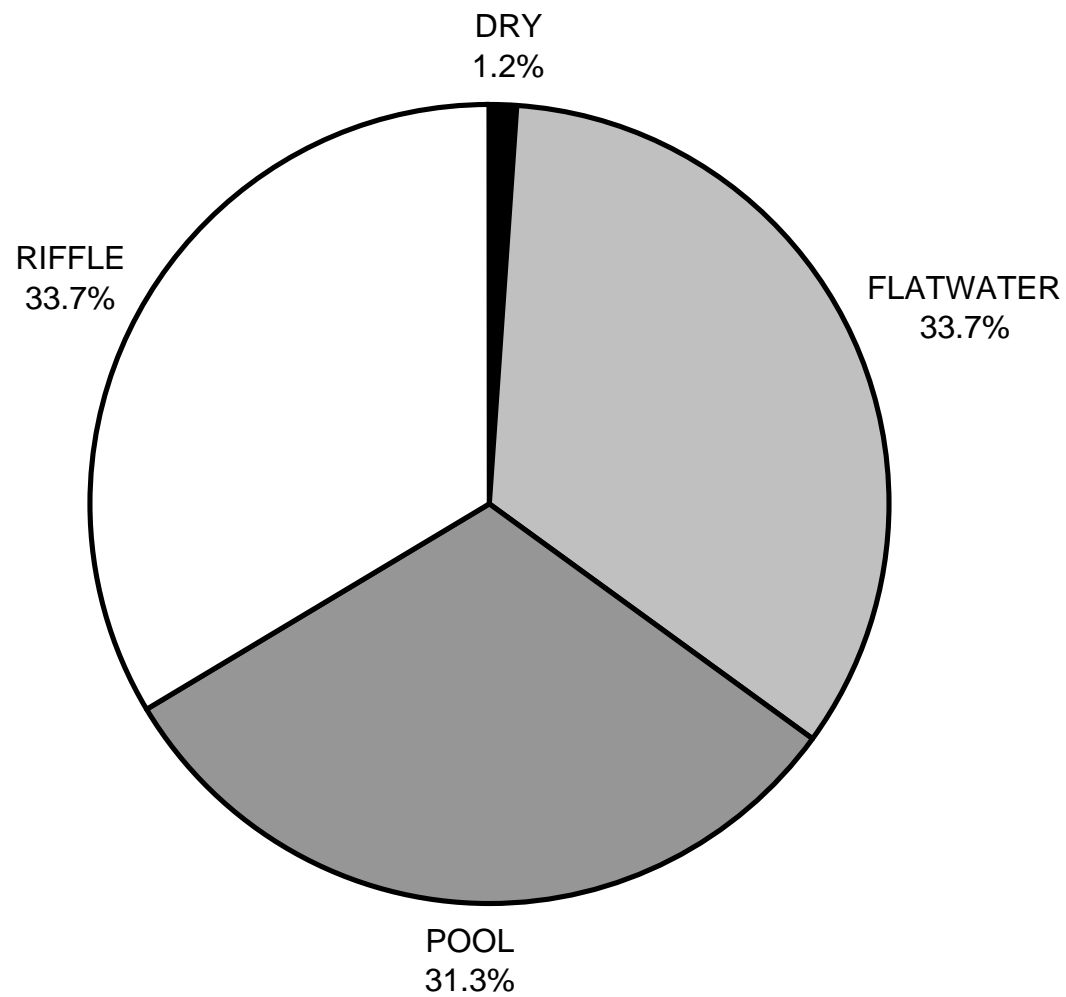
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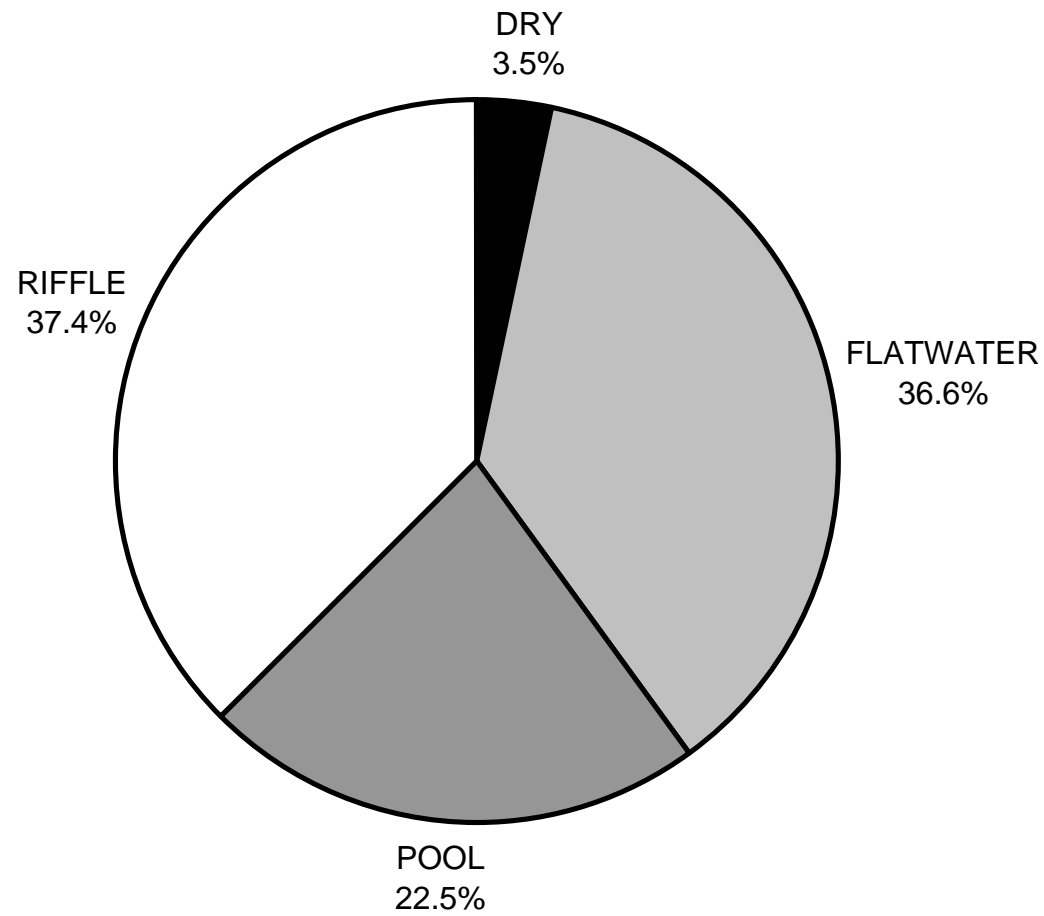
	Riffles	Flatwater	Pools
<hr/>			
UNDERCUT BANKS (%)	2	8	7
SMALL WOODY DEBRIS (%)	13	22	25
LARGE WOODY DEBRIS (%)	11	23	35
ROOT MASS (%)	3	11	6
TERRESTRIAL VEGETATION (%)	14	13	7
AQUATIC VEGETATION (%)	0	2	1
WHITEWATER (%)	14	3	11
BOULDERS (%)	22	8	4
BEDROCK LEDGES (%)	1	0	2

**HELY CREEK 2006**  
**HABITAT TYPES BY PERCENT OCCURRENCE**



GRAPH 1

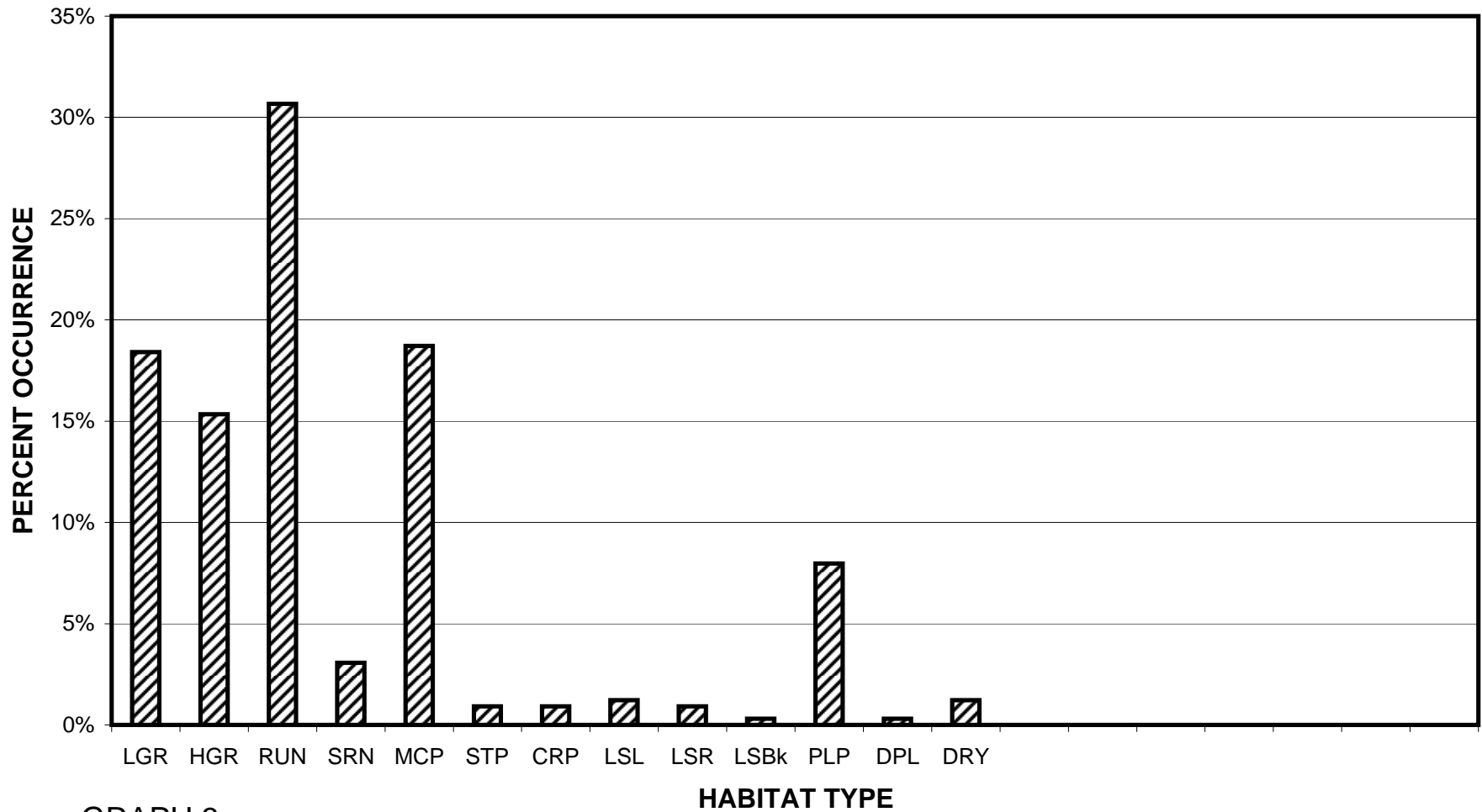
**HELY CREEK 2006**  
**HABITAT TYPES BY PERCENT TOTAL LENGTH**



GRAPH 2

# HELY CREEK 2006

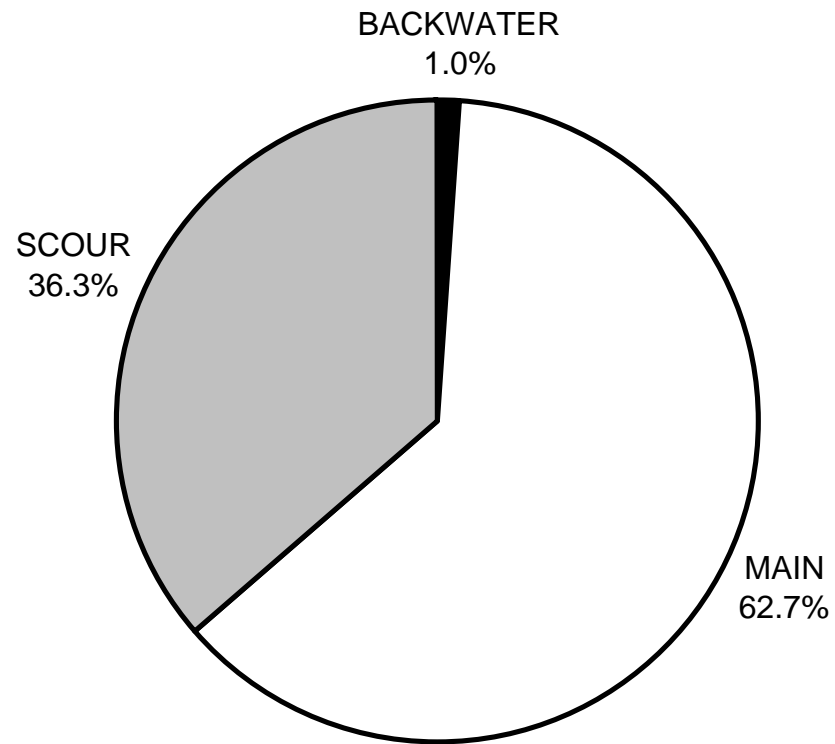
## HABITAT TYPES BY PERCENT OCCURRENCE



GRAPH 3

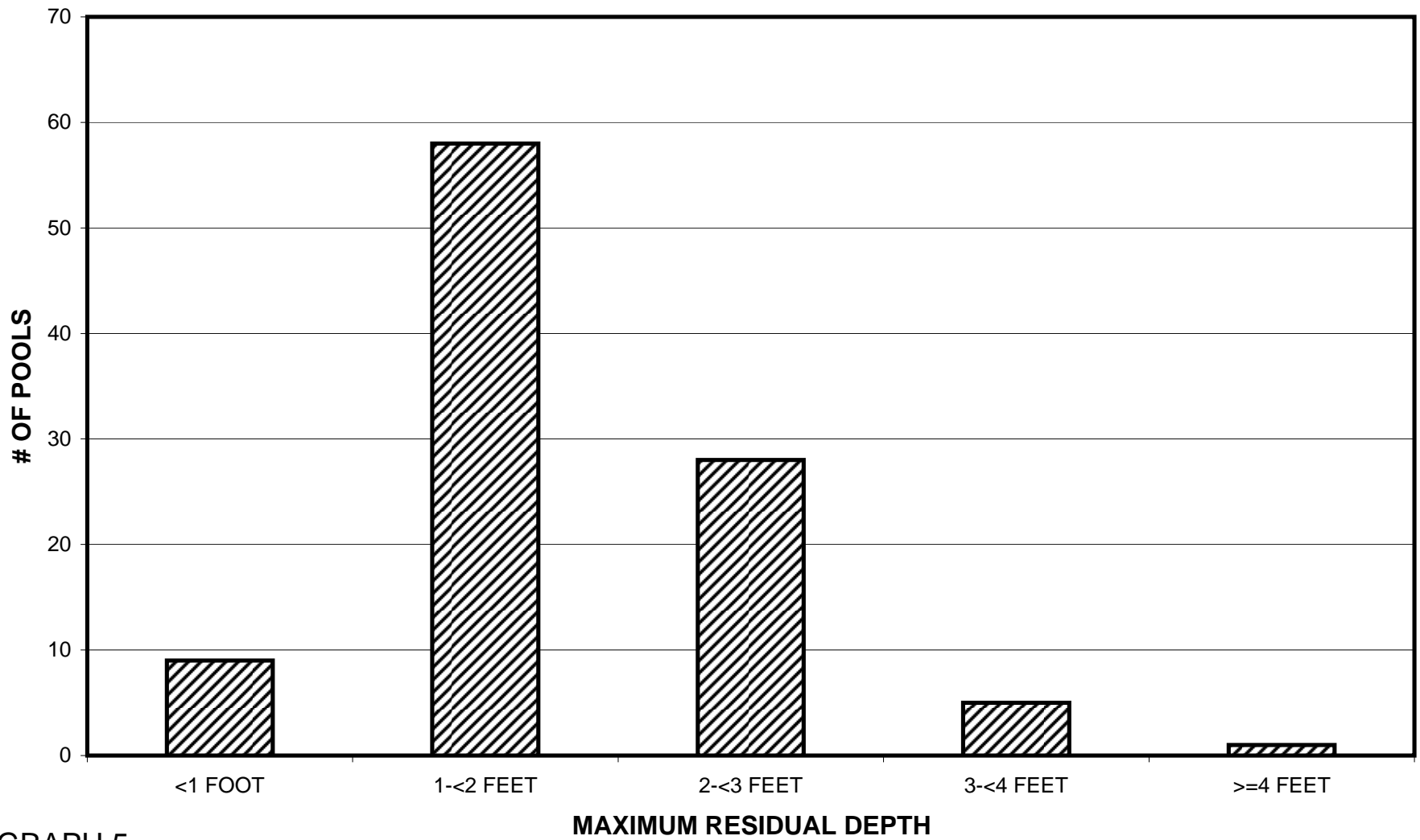
# HELY CREEK 2006

## POOL TYPES BY PERCENT OCCURRENCE



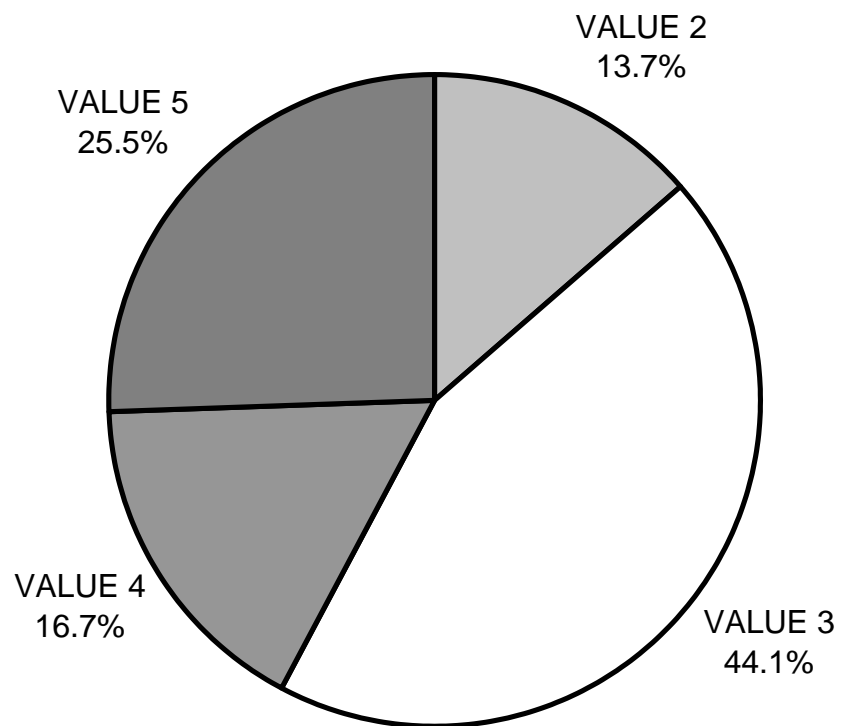
GRAPH 4

# HELY CREEK 2006 MAXIMUM DEPTH IN POOLS



GRAPH 5

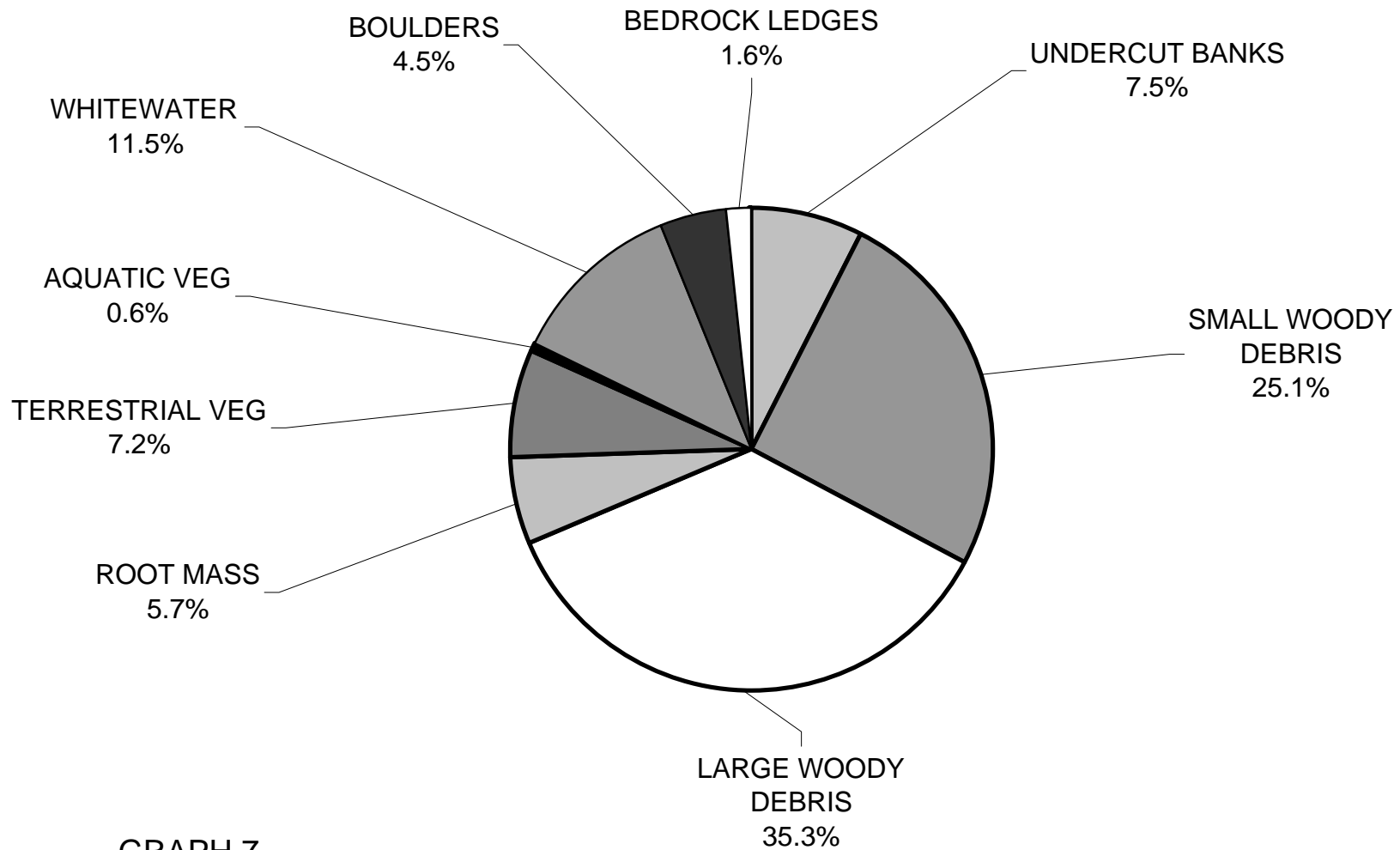
# HELY CREEK 2006 PERCENT EMBEDDEDNESS



GRAPH 6

# HELY CREEK 2006

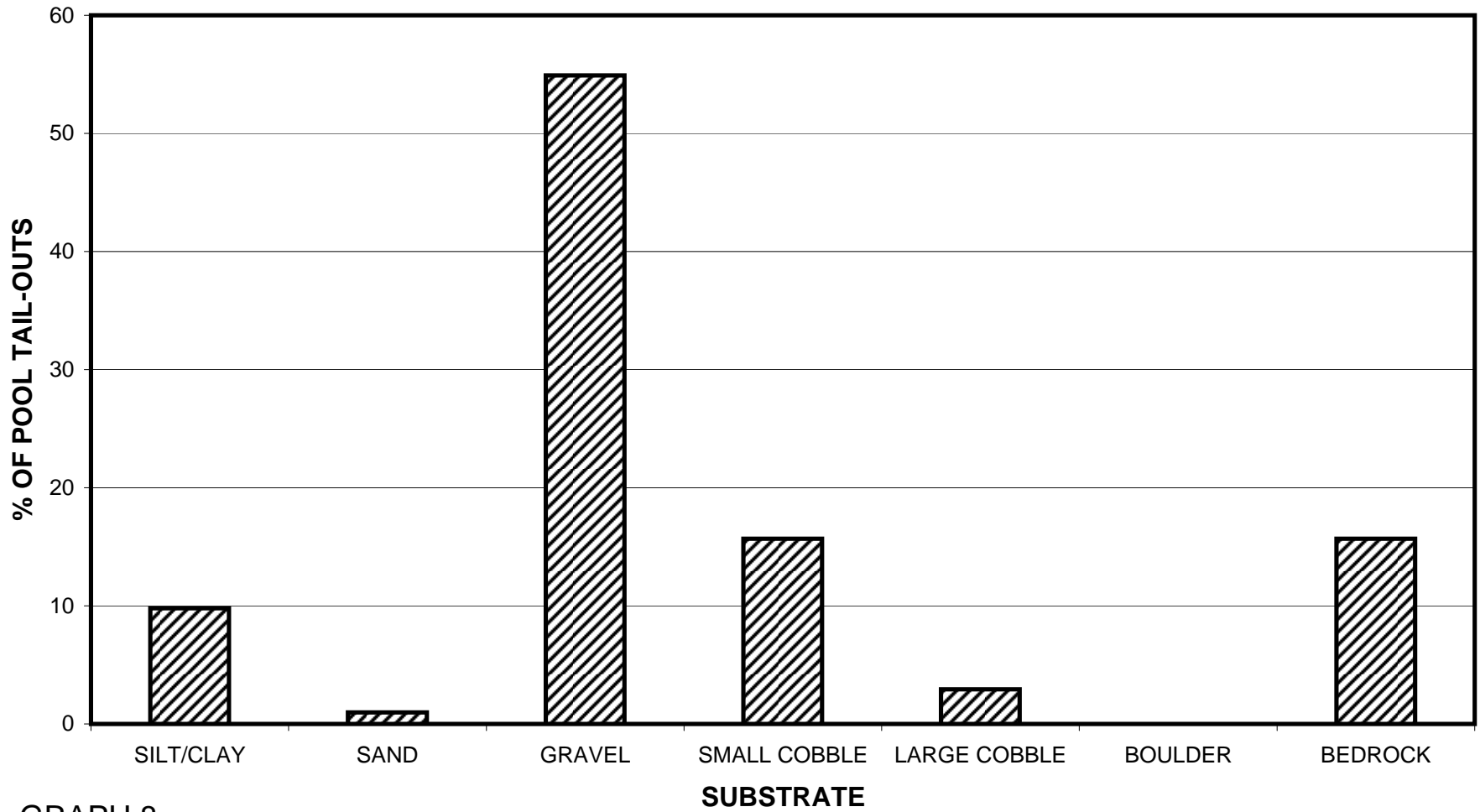
## MEAN PERCENT COVER TYPES IN POOLS



GRAPH 7

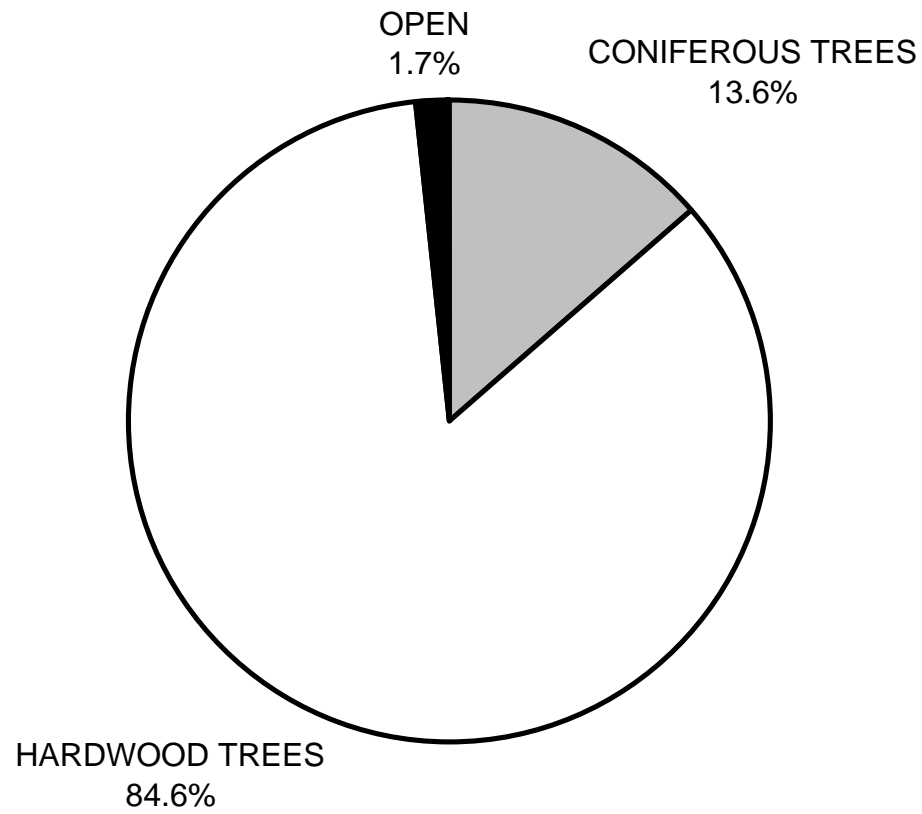
# HELY CREEK 2006

## SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



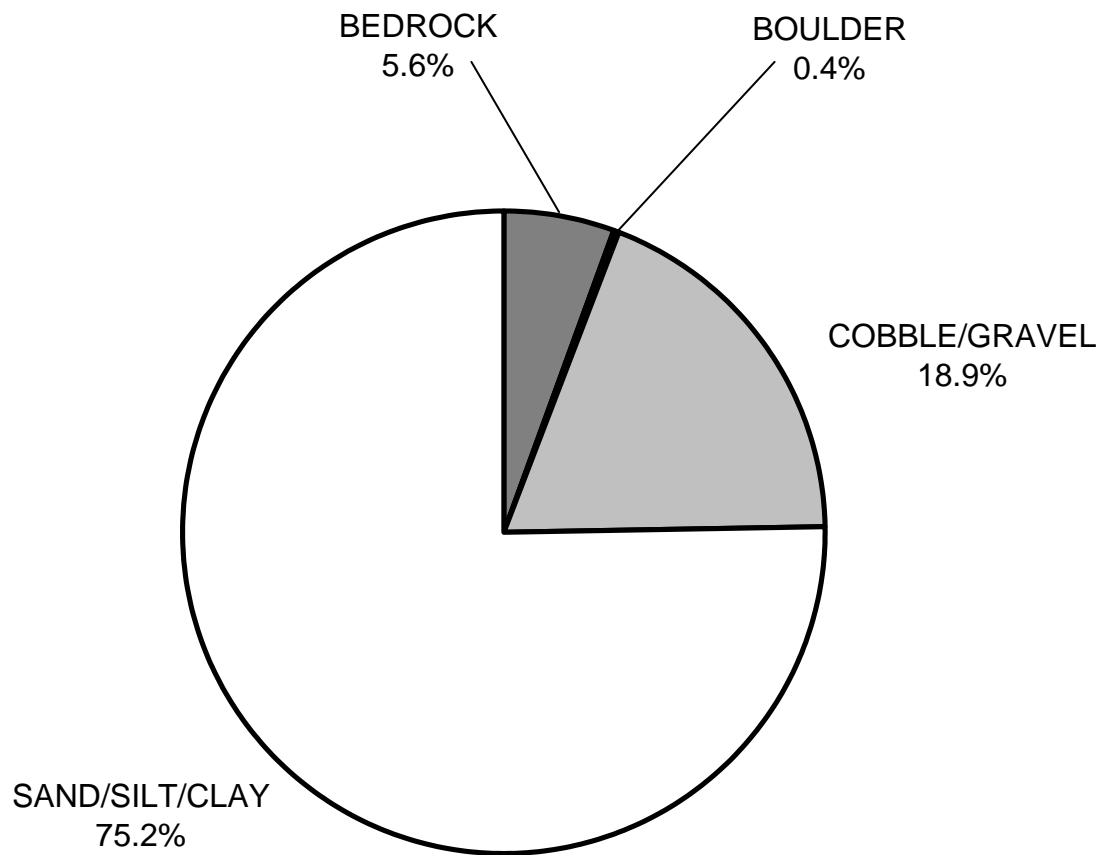
GRAPH 8

**HELY CREEK 2006  
MEAN PERCENT CANOPY**



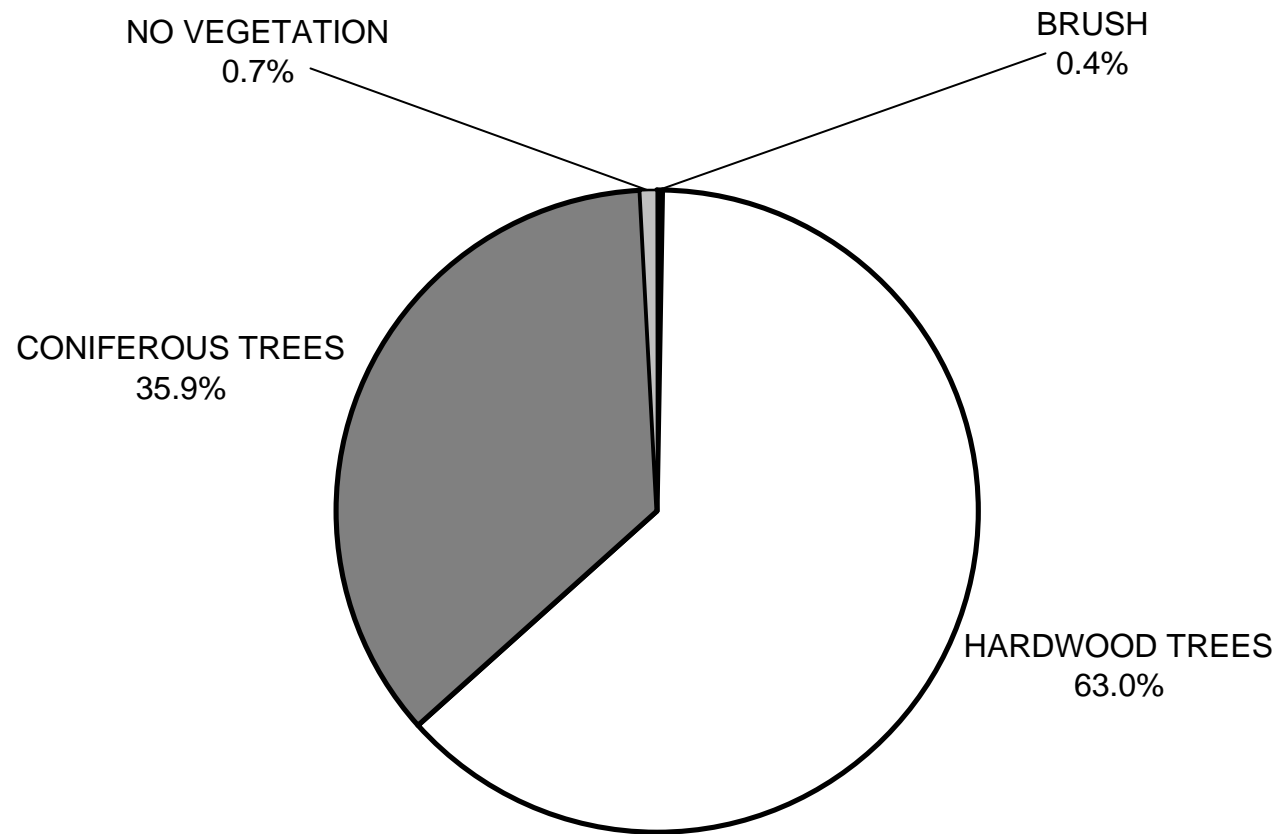
GRAPH 9

**HELY CREEK 2006**  
**DOMINANT BANK COMPOSITION IN SURVEY REACH**



GRAPH 10

# HELY CREEK 2006 DOMINANT BANK VEGETATION IN SURVEY REACH



GRAPH 11