

STREAM INVENTORY REPORT

Houston Creek

INTRODUCTION

A stream inventory was conducted during the summer of 2002 on Houston Creek. The survey began one mile above the confluence with the East Fork Scott River and continued upstream 0.7 miles.

The Houston 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 Houston 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 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

Houston Creek is a tributary to the East Fork Scott River, a tributary to the Scott River, a tributary to the Klamath River, which drains to the Pacific Ocean. It is located in Siskiyou County, California (Map 1). Houston Creek's legal description at the confluence with the East Fork Scott River is T41N R7W S15. Its location is 41.4020 degrees north latitude and 122.6476 degrees west longitude. Houston Creek is a second order stream and has approximately five miles of blue line stream according to the USGS Gazelle Mountain and China Mountain 7.5 minute quadrangles. Houston Creek drains a watershed of approximately 9.4 square miles. Elevations range from about 4,200 feet at the mouth of the creek to about 7,500 feet in the headwater areas. Douglas fir/grass/oak/mixed hardwood/mixed conifer forest dominates the watershed. The watershed is primarily privately owned and national forest land and is managed for timber production, rangeland, and recreation. Vehicle access exists via Gazelle - Callahan Road to Forest Service road 41N03.

METHODS

The habitat inventory conducted in Houston 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.

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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 Houston 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) at 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 (1985 rev. 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 (1988). 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". Houston 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

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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 Houston 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 not suitable for spawning due to inappropriate substrate particle size, bedrock, or other considerations.

6. Shelter Rating:

Instream shelter is composed of those elements within a stream channel that provide 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. 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 Houston Creek, a standard qualitative shelter value of 0 (none), 1 (low), 2 (medium), or 3 (high) was assigned according to the complexity of the cover. Thus, shelter ratings can range from 0-300 and are expressed as mean values by habitat types within a stream.

7. Substrate Composition:

Substrate composition ranges from silt/clay sized particles to boulders and bedrock elements. In all fully-described habitat units, dominant and sub-dominant substrate elements were ocularly estimated using a list of seven size classes and recorded as a one and two, respectively. In addition, the dominant substrate composing the pool tail-outs is recorded for each pool.

8. Canopy:

Stream canopy density was estimated using modified handheld spherical densimeters as described in the *California Salmonid Stream Habitat Restoration Manual*. Canopy density relates to the amount of stream shaded from the sun. In Houston 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 deciduous 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 Houston 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

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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'.

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 Houston Creek. In addition, eighteen sites were snorkel dived. These sampling techniques are discussed in the *California Salmonid Stream Habitat Restoration Manual*.

DATA ANALYSIS

Data from the habitat inventory form are entered into Habitat 8.4, a dBASE 4.2 data entry program developed by Tim Curtis, Inland Fisheries Division, 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 Pool Depths by Habitat Types
- Dominant Substrates by Habitat Types
- Mean Percent Shelter by Habitat Types
- Mean Percent Vegetative Cover
- Fish Habitat Elements by Stream Reach
- Dominant Vegetation Type for Entire Stream
- Mean Percent Cover Types for Entire Stream

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Graphics are produced from the tables using Microsoft Excel. Graphics developed for Houston Creek include:

- Riffle, Flatwater, Pool Habitats by Percent Occurrence
- Riffle, Flatwater, Pool Habitats by Total Length
- Total Habitat Types by Percent Occurrence
- Pool Types by Percent Occurrence
- Total Pools by Maximum Depths
- Embeddedness
- Pool Cover by Cover Type
- Dominant Substrate in Low Gradient Riffles
- Mean Percent Canopy
- Bank Composition by Composition Type
- Bank Vegetation by Vegetation Type

HABITAT INVENTORY RESULTS

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

The habitat inventory of September 11, 12, and 17, 2002 was conducted by T. Behm and S. Maurer (DFG). The total length of stream surveyed was 3,797 feet.

A stream flow measurement of Houston Creek on September 11, 2002 showed a stream flow of 1.33 cubic feet per second (cfs).

Houston Creek is an A2 channel type with an average bankfull width of 16.2 feet for the 3,797 feet of the stream surveyed. A2 channels are steep, narrow, cascading step-pool streams with high energy/debris transport associated with depositional soils and boulder channels.

Water temperatures taken during the survey period ranged from 51 to 60 degrees Fahrenheit. Air temperatures ranged from 56 to 88 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 49% riffle units, 34% flatwater units, and 17% pool units (Graph 1). Based on total length of Level II habitat types there were 54% riffle units, 34% flatwater units, and 11% pool units (Graph 2).

Twelve Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were high gradient riffle units, 23%; step run units, 22%; and cascade units, 16% (Graph 3). Based on percent total length, high gradient riffle units made up 29%, step run units 27%, and cascade units 19%.

A total of 18 pools were identified (Table 3). Main channel pools were the most frequently encountered, at 67%, (Graph 4) and comprised 76% of the total length of all pools.

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Table 4 is a summary of maximum pool depths by pool habitat types. Pool quality for salmonids increases with depth. Thirteen of the 18 pools (72%) had a depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 18 pool tail-outs measured, five had a value of 1 (28%); five had a value of 2 (28%); and eight had a value of 5 (44%); (Graph 6). On this scale, a value of 1 indicates the highest quality of spawning substrate.

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 41, flatwater habitat types had a mean shelter rating of 31, and pool habitats had a mean shelter rating of 38 (Table 1). Of the pool types, the main channel pools had the highest mean shelter rating at 43. Scour pools had a mean shelter rating of 30 (Table 3).

Reach 1 was not surveyed due to lack of landowner permission. In Reach 2, Houston Creek had a total of 23 pieces of LWD. This is an average of 1.37 pieces of LWD per 100'. Reach 3 was not surveyed due to lack of landowner permission. In Reach 4, Houston Creek had a total of 82 pieces of LWD. This is an average of 3.86 pieces of LWD per 100'.

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover type in Houston Creek. Graph 7 describes the pool cover in Houston Creek. Boulders are the dominant pool cover type followed by bedrock ledges and whitewater.

Table 6 summarizes the dominant substrate by habitat type. Graph 8 depicts the dominant substrate observed in pool tail-outs. Boulders were the dominant substrate observed in 39 % of pool tail-outs while gravel was the next most frequently observed substrate type, at 28%.

The mean percent canopy density for the surveyed length of Houston Creek was 51%. The mean percentages of deciduous and coniferous trees were 5% and 46%, respectively. Forty-nine percent of the canopy was open. Graph 9 describes the mean percent canopy in Houston Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 39%. The mean percent left bank vegetated was 41%. The dominant elements composing the structure of the stream banks consisted of 46% cobble/gravel, 27% boulder, 19% bedrock, and 7% sand/silt/clay (Graph 10). Coniferous trees were the dominant vegetation type observed in 55% of the units surveyed. Additionally, 32% of the units surveyed had brush as the dominant vegetation type, and 10% had deciduous trees as the dominant vegetation (Graph 11).

BIOLOGICAL INVENTORY RESULTS

Eleven sites were snorkeled for species composition and distribution in Houston Creek on October 2 and October 10, 2002. Water temperatures taken during the dive period ranged from 42 to 50 degrees Fahrenheit. Air temperatures ranged from 52 to 58 degrees Fahrenheit. The sites were sampled by S. Maurer (DFG).

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The following chart displays the information yielded from these sites:

Date	Site #	Approx. Dist. from start (ft.)	Hab. Unit #	Hab. Type	Reach #	Channel type	Steelhead			Coho		
							YOY	1+	2+	YOY	1+	2+
10/2/02	1	0	2	4.2	2	A2	13	2	1	0	0	0
10/2/02	2	43	3	1.1	2	A2	1	0	0	0	0	0
10/2/02	3	55	4	3.3	2	A2	7	1	0	0	0	0
10/2/02	4	1252	31	1.2	2	A2	0	1	0	0	0	0
10/2/02	5	1281	32	3.3	2	A2	2	2	0	0	0	0
10/2/02	6	1378	35	5.6	2	A2	2	2	4	0	0	0
10/2/02	7	7115	50	4.2	2	A2	0	0	0	0	0	0
10/2/02	8	7131	51	3.4	2	A2	1	0	0	0	0	0
10/10/02	9	8021	72	1.1	2	A2	0	0	0	0	0	0
10/10/02	10	8767	94	3.3	2	A2	0	0	0	0	0	0
10/10/02	11	8797	96	5.6	2	A2	0	0	0	0	0	0

DISCUSSION

Houston Creek is an A2 channel type for the entire survey length of 3,797 feet. A2 channel types are generally not suitable for fish habitat improvement structures.

The water temperatures recorded on the survey days of September 10, 11, and 17, 2002 ranged from 51 to 60 degrees Fahrenheit. Air temperatures ranged from 56 to 88 degrees Fahrenheit. To make any further conclusions, temperatures need to be monitored throughout the warm summer months, and more extensive biological sampling needs to be conducted.

Flatwater habitat types comprised 54% of the total length of this survey, riffles 34%, and pools 17%. The pools are relatively deep, with 13 of the 18 (72%) pools having a maximum 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 depth of at least two feet, occupy at least half the width of the low flow channel, and be as long as the low flow channel width. Installing structures that will increase or deepen pool habitat is recommended for locations where their installation will not be threatened by high stream energy, or where their installation will not conflict with the modification of the numerous log debris accumulations (LDA's) in the stream.

Ten of the 18 pool tail-outs measured had embeddedness ratings of 1 or 2. 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 Houston Creek should be

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mapped and rated according to their potential sediment yields, and control measures should be taken.

Six of the 18 pool tail-outs measured had gravel or small cobble as the dominant substrate. This is generally considered poor for spawning salmonids.

The mean shelter rating for pools was 38. The shelter rating in the flatwater habitats was 31. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by boulders in all habitat types. Additionally, bedrock ledges and whitewater contribute a small amount. 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 51%. Reach 1 was not surveyed while Reach 2 had a canopy density of 51%. 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 39% and 41%, respectively. In areas of stream bank erosion or where bank vegetation is not at acceptable levels, planting endemic species of coniferous and deciduous trees, in conjunction with bank stabilization, is recommended.

RECOMMENDATIONS

1. Houston Creek should be managed as an anadromous, natural production stream. Based on available information, favorable water temperatures, gradient and flow regimes exist in the stream to support various life history stages of salmonids.
2. Spawning and rearing distribution within Houston Creek for the various species of salmonids utilizing the stream should be determined.
3. There are several log debris accumulations on Houston Creek that may limit or impede access for anadromous fish. These should be evaluated and treated as necessary to allow access to upstream rearing and spawning areas.
4. Active and potential sediment sources related to streambank erosion, the road system, mining activities and landslides should be identified, mapped, and treated according to their potential for sediment yield to the stream and its tributaries.
5. 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.
6. Increase woody cover in pools and flatwater habitat units.

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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):	Comments:
0'	Start of survey 5,229 feet (0.99 mile) above confluence with East Fork Scott River at USFS property line. The channel type is an A2. Dive site #1.
43'	Dive site #2.
55'	Dive site #3.
301'	Little Houston Creek enters on the right bank; the water temperature was 51 degrees Fahrenheit.
1252'	Dive site #4.
1281'	Dive site #5. Left bank eroding.
1,378'	Dive site #6. Six foot high plunge.
1,560'	Left bank tributary; the water temperature is 54 degrees Fahrenheit.
1,620'	Left bank seep.
7,115'	Dive site #7.
7,131'	Dive site #8.
7,350'	Houston Mine on right bank.
8,021'	Dive site #9.
8,313'	Right bank tributary.
8,389'	Five foot high plunge over debris accumulation.
8,767'	Dive site #10.
8797'	Dive site #11. Five foot high plunge over debris accumulation.
9,035'	End of Survey at USFS property line.

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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.

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LEVEL III and LEVEL IV HABITAT TYPES

RIFFLE

Low Gradient Riffle	(LGR)	[1.1]	{ 1 }
High Gradient Riffle	(HGR)	[1.2]	{ 2 }

CASCADE

Cascade	(CAS)	[2.1]	{ 3 }
Bedrock Sheet	(BRS)	[2.2]	{24}

FLAT WATER

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]	

Houston Creek

Drainage: East Fork Scott River

Table 1 - SUMMARY OF RIFFLE, FLATWATER, AND POOL HABITAT TYPES

Survey Dates: 09/11/02 to 09/17/02

Confluence Location: QUAD: Gazelle Mt LEGAL DESCRIPTION: T41NR07WS15 LATITUDE:41°24'7" LONGITUDE:122°38'55"

HABITAT UNITS	UNITS FULLY MEASURED	HABITAT TYPE	HABITAT PERCENT OCCURRENCE	MEAN LENGTH (ft.)	MEAN LENGTH (ft.)	TOTAL LENGTH (ft.)	PERCENT TOTAL	MEAN WIDTH (ft.)	MEAN DEPTH (ft.)	MEAN AREA (sq.ft.)	MEAN ESTIMATED TOTAL AREA (sq.ft.)	MEAN VOLUME (cu.ft.)	MEAN ESTIMATED TOTAL VOLUME (cu.ft.)	MEAN RESIDUAL POOL VOL (cu.ft.)	MEAN SHELTER RATING
51	17	RIFFLE	49	41	41	2056	54	9.1	0.5	291	14833	168	8590	0	41
35	8	FLATWATER	34	37	37	1295	34	8.3	0.7	304	10646	229	8027	0	31
18	18	POOL	17	24	24	436	11	10.8	1.1	240	4315	276	4976	190	38
TOTAL UNITS	TOTAL UNITS			TOTAL LENGTH (ft.)				TOTAL LENGTH (ft.)		TOTAL AREA (sq. ft.)		TOTAL VOL. (cu. ft.)			
104	43			3797				3797		29793		21594			

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Drainage: East Fork Scott River

Table 2 - SUMMARY OF HABITAT TYPES AND MEASURED PARAMETERS

Survey Dates: 09/11/02 to 09/17/02

Confluence Location: QUAD: Gazelle Mt LEGAL DESCRIPTION: T41NR07WS15 LATITUDE:41°24'7" LONGITUDE:122°38'55"

HABITAT UNITS	UNITS FULLY MEASURED	HABITAT TYPE	HABITAT OCCURRENCE	MEAN LENGTH	MEAN LENGTH	MEAN LENGTH	MEAN WIDTH	MEAN DEPTH	MEAN MAXIMUM DEPTH	MEAN AREA	TOTAL AREA	MEAN VOLUME	TOTAL VOLUME	MEAN RESIDUAL	MEAN SHELTER	MEAN CANOPY
#			%	ft.	ft.	ft.	ft.	ft.	ft.	sq.ft.	sq.ft.	cu.ft.	cu.ft.	cu.ft.		%
6	4	LGR	6	22	129	1	6	0.5	1.7	71	428	39	234	0	31	53
24	6	HGR	23	46	1101	8	11	0.5	1.3	350	8396	188	4519	0	56	49
17	5	CAS	16	43	739	5	9	0.6	2.3	444	7548	283	4813	0	45	54
4	2	BRS	4	24	97	1	9	0.4	2.0	170	680	81	324	0	8	56
12	4	RUN	11	23	272	2	9	0.8	1.4	169	2022	142	1706	0	19	50
23	4	SRN	22	44	1023	7	8	0.6	1.7	440	10116	317	7281	0	44	49
1	1	TRP	1	20	20	0	12	1.1	1.7	204	204	224	224	143	5	43
6	6	MCP	6	25	147	1	12	1.1	2.7	302	1811	348	2090	248	55	63
5	5	STP	5	33	164	1	9	0.9	3.0	246	1232	230	1151	132	37	55
1	1	LSBK	1	20	20	0	12	1.6	2.7	228	228	365	365	274	5	58
4	4	PLP	4	15	59	0	12	1.4	4.9	158	633	229	918	173	36	41
1	1	BPB	1	26	26	0	8	1.1	4.1	208	208	229	229	166	15	30
TOTAL UNITS	TOTAL UNITS			LENGTH (ft.)			AREA (sq.ft.)			TOTAL VOL. (cu.ft.)						
104	43			3797			33505			23853						

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Drainage: East Fork Scott River

Table 3 - SUMMARY OF POOL TYPES

Survey Dates: 09/11/02 to 09/17/02

Confluence Location: QUAD: Gazelle Mt LEGAL DESCRIPTION: T41NR07WS15 LATITUDE:41°24'7" LONGITUDE:122°38'55"

HABITAT UNITS	UNITS FULLY MEASURED	HABITAT TYPE	HABITAT PERCENT OCCURRENCE	MEAN LENGTH (ft.)	TOTAL LENGTH (ft.)	TOTAL PERCENT LENGTH	MEAN WIDTH (ft.)	MEAN DEPTH (ft.)	MEAN AREA (sq.ft.)	TOTAL AREA EST. (sq.ft.)	MEAN VOLUME (cu.ft.)	TOTAL VOLUME EST. (cu.ft.)	MEAN RESIDUAL POOL VOL. (cu.ft.)	MEAN SHELTER RATING
12	12	MAIN	67	28	331	76	10.4	1.0	271	3247	289	3465	191	43
5	5	SCOUR	28	16	79	18	12.2	1.4	172	861	256	1282	193	30
1	1	BACKWATER	6	26	26	6	8.0	1.1	208	208	229	229	166	15
TOTAL UNITS	TOTAL UNITS			TOTAL LENGTH (ft.)	436				TOTAL AREA (sq.ft.)	4315		TOTAL VOL. (cu.ft.)	4976	

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Drainage: East Fork Scott River

Table 4 - SUMMARY OF MAXIMUM POOL DEPTHS BY POOL HABITAT TYPES

Survey Dates: 09/11/02 to 09/17/02

Confluence Location: QUAD: Gazelle Mt LEGAL DESCRIPTION: T41NR07WS15 LATITUDE: 41°24'7" LONGITUDE: 122°38'55"

UNITS MEASURED	HABITAT TYPE	HABITAT PERCENT OCCURRENCE	<1 FOOT		1-2 FT.		1-2 FOOT		2-3 FT.		2-3 FOOT		3-4 FT.		3-4 FOOT		>=4 FT.		>=4 FOOT	
			MAXIMUM	DEPTH OCCURRENCE	MAXIMUM	DEPTH OCCURRENCE	MAXIMUM	DEPTH OCCURRENCE	MAXIMUM	DEPTH OCCURRENCE	MAXIMUM	DEPTH OCCURRENCE	MAXIMUM	DEPTH OCCURRENCE	MAXIMUM	DEPTH OCCURRENCE	MAXIMUM	DEPTH OCCURRENCE	MAXIMUM	DEPTH OCCURRENCE
1	TRP	6	0	0	0	1	100	0	0	0	0	0	0	0	0	0	0	0	0	0
6	MCP	33	0	0	0	2	33	4	67	0	0	0	0	0	0	0	0	0	0	0
5	STP	28	0	0	0	2	40	2	40	1	20	0	0	0	0	0	0	0	0	0
1	LSBK	6	0	0	0	0	0	1	100	0	0	0	0	0	0	0	0	0	0	0
4	PLP	22	0	0	0	0	0	3	75	0	0	0	0	0	0	1	25	1	25	25
1	BPB	6	0	0	0	0	0	0	0	0	0	0	0	0	0	1	100	1	100	100

TOTAL

UNITS

18

0 5 10 1 2

Drainage: East Fork Scott River

Survey Dates: 09/11/02 to 09/17/02

[illegible]

Houston Creek

Drainage: East Fork Scott River

Table 6 - SUMMARY OF DOMINANT SUBSTRATES BY HABITAT TYPE

Survey Dates: 09/11/02 to 09/17/02

Confluence Location: QUAD: Gazelle Mt LEGAL DESCRIPTION: T41NR07WS15 LATITUDE: 41°24'7" LONGITUDE: 122°38'55"

TOTAL HABITAT UNITS	UNITS FULLY MEASURED	HABITAT TYPE	% TOTAL SILT/CLAY DOMINANT	% TOTAL SAND DOMINANT	% TOTAL GRAVEL DOMINANT	% TOTAL SM COBBLE DOMINANT	% TOTAL LG COBBLE DOMINANT	% TOTAL BOULDER DOMINANT	% TOTAL BEDROCK DOMINANT
6	4	LGR	0	0	25	0	25	50	0
24	6	HGR	0	0	0	0	0	100	0
17	5	CAS	0	0	0	0	0	100	0
4	2	BRS	0	0	0	0	0	0	100
12	4	RUN	0	0	0	0	0	100	0
23	4	SRN	0	0	0	0	0	100	0
1	1	TRP	0	0	0	0	0	0	100
6	6	MCP	0	0	17	0	0	50	33
5	5	STP	0	0	0	0	0	100	0
1	1	LSBK	0	0	0	0	0	100	0
4	4	PLP	0	0	25	0	0	75	0
1	1	BPB	0	0	0	0	0	0	100

Summary of Mean Percent Vegetative Cover for Entire Stream

Mean Percent Canopy	Mean Percent Conifer	Mean Percent Deciduous	Mean Percent Open units	Mean Right bank % Cover	Mean Left Bank % Cover
51	91	9	0	39.3	40.5

Note: Mean percent conifer and deciduous 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.

$$91 \times .51 = 46\% \text{ coniferous}$$

$$9 \times .51 = 5\% \text{ deciduous}$$

$$100 - 51 = 49\% \text{ open canopy}$$

TABLE 8. FISH HABITAT INVENTORY DATA SUMMARY

STREAM NAME: Houston Creek
 SAMPLE DATES: 09/11/02 to 09/17/02
 STREAM LENGTH: 14306 ft.
 LOCATION OF STREAM MOUTH:

USGS Quad Map: Gazelle Mt
 Legal Description: T41NR07WS15

Latitude: 41°24'7"
 Longitude: 122°38'55"

SUMMARY OF FISH HABITAT ELEMENTS BY STREAM REACH

STREAM REACH 1

Channel Type: N/A
 Channel Length: 0 ft. (5,229 ft.)
 Riffle/flatwater Mean Width: *****
 Total Pool Mean Depth: **** ft.
 Base Flow: 0.0 cfs
 Water: - °F Air: - °F
 Dom. Bank Veg.: Coniferous Trees
 Vegetative Cover: *****%
 Dom. Bank Substrate: Cobble/Gravel

Canopy Density: *****%
 Coniferous Component: *****%
 Deciduous Component: *****%
 Pools by Stream Length: *****%
 Pools >=3 ft.deep: *****%
 Mean Pool Shelter Rtn: *****
 Dom. Shelter: Undercut Banks
 Occurrence of LOD: *****%
 Dry Channel: 0 ft.

Embeddness Value: 1. *****% 2. *****% 3. *****% 4. *****%
 *****% 5. *****%

Length of stream section not surveyed within survey reach
 and not included in above totals or calculations: 5229 ft.

STREAM REACH 2

Channel Type: A2
 Channel Length: 1675 ft.
 Riffle/flatwater Mean Width: 13 ft.
 Total Pool Mean Depth: 1.3 ft.
 Base Flow: 1.3 cfs
 Water: 55 - 60 °F Air: 64 - 88 °F
 Dom. Bank Veg.: Coniferous Trees
 Vegetative Cover: 31%
 Dom. Bank Substrate: Cobble/Gravel

Canopy Density: 47%
 Coniferous Component: 89%
 Deciduous Component: 11%
 Pools by Stream Length: 17%
 Pools >=3 ft.deep: 33%
 Mean Pool Shelter Rtn: 19
 Dom. Shelter: Boulders
 Occurrence of LOD: 1%
 Dry Channel: 0 ft.

Embeddness Value: 1. 33% 2. 22% 3. 0% 4. 0% 5. 44%

STREAM REACH 3

Channel Type:
 Channel Length: 0 ft. (5,280 ft.)
 Riffle/flatwater Mean Width: *****
 Total Pool Mean Depth: **** ft.
 Base Flow: 0.0 cfs
 Water: - °F Air: - °F
 Dom. Bank Veg.: Coniferous Trees
 Vegetative Cover: *****%
 Dom. Bank Substrate: Cobble/Gravel

Canopy Density: *****%
 Coniferous Component: *****%
 Deciduous Component: *****%
 Pools by Stream Length: *****%
 Pools >=3 ft.deep: *****%
 Mean Pool Shelter Rtn: *****
 Dom. Shelter: Undercut Banks
 Occurrence of LOD: *****%
 Dry Channel: 0 ft.

Embeddness Value: 1. *****% 2. *****% 3. *****% 4. *****%
 *****% 5. *****%

Length of stream section not surveyed within survey reach
 and not included in above totals or calculations: 5280 ft.

STREAM REACH 4

Channel Type: A2
Channel Length: 2122 ft.
Riffle/flatwater Mean Width: 7 ft.
Total Pool Mean Depth: 1.0 ft.
Base Flow: 1.3 cfs
Water: 51 - 54 °F Air: 56 - 86 °F
Dom. Bank Veg.: Coniferous Trees
Vegetative Cover: 49%
Dom. Bank Substrate: Cobble/Gravel

Canopy Density: 54%
Coniferous Component: 92%
Deciduous Component: 8%
Pools by Stream Length: 7%
Pools ≥ 3 ft. deep: 0%
Mean Pool Shelter Rtn: 57
Dom. Shelter: Boulders
Occurrence of LOD: 5%
Dry Channel: 0 ft.

Embeddness Value: 1. 22% 2. 33% 3. 0% 4. 0% 5. 44%

LWD

Reach 1 - Unsurveyed
Reach 2 - 1.37 pieces / 100 ft.
Reach 3 - Unsurveyed
Reach 4 - 3.91 pieces / 100 ft.

BFW

Reach 1 - Unsurveyed
Reach 2 - 21.6 ft.
Reach 3 - Unsurveyed
Reach 4 - 12.3 ft.

Mean Percentage of Dominant Substrate

Dominant Class of Substrate	Number Units Right Bank	Number Units Left Bank	Total Mean Percent
Bedrock	6	10	19.0
Boulder	10	13	27.4
Cobble/Gravel	21	18	46.4
Silt/clay	5	1	7.1

Mean Percentage of Dominant Vegetation

Dominant Class of Vegetation	Number Units Right Bank	Number Units Left Bank	Total Mean Percent
Grass	1	0	1.2
Brush	17	10	32.1
Decid. Trees	6	2	9.5
Conif. Trees	17	29	54.8
No Vegetation	1	1	2.4

Total stream average embeddedness value for pool 3.1

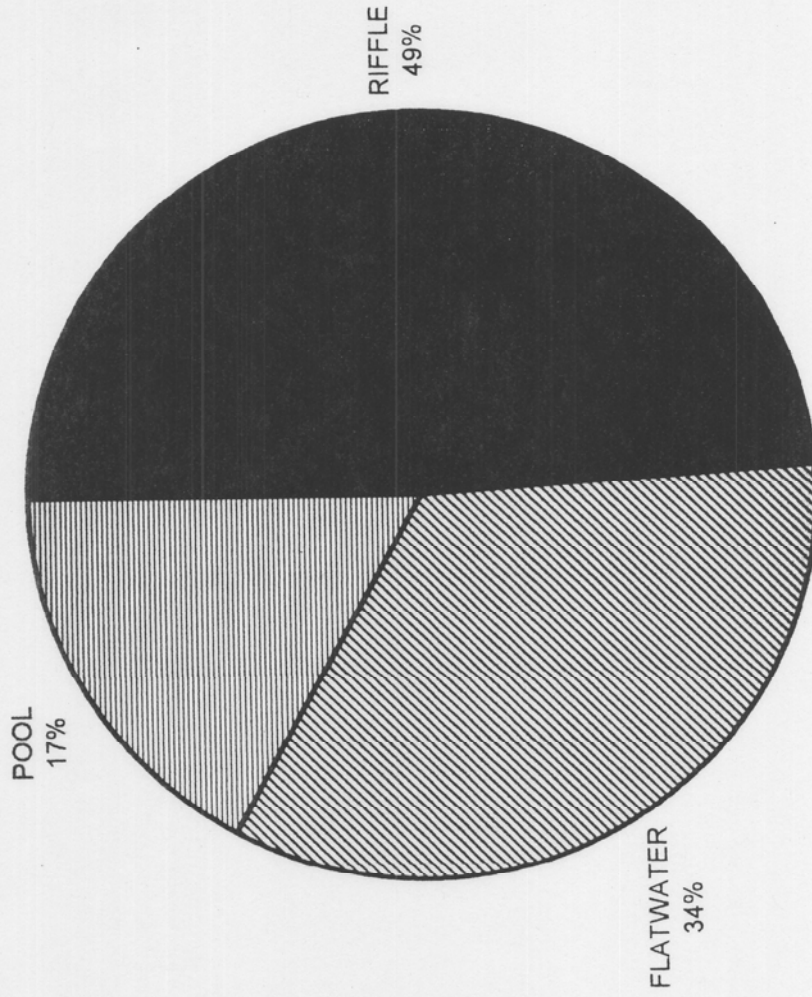
TABLE 10. MEAN PERCENT OF SHELTER COVER TYPES FOR ENTIRE STREAM

Stream: Houston Creek Drainage: East Fork Scott River

Survey Date: 09/11/02 to 09/17/02

	RIFFLES	FLATWATER	POOLS
UNDERCUT BANKS	2.0	2.5	3.1
SMALL WOODY DEBRIS	8.7	6.3	9.2
LARGE WOODY DEBRIS	3.5	1.9	3.6
ROOTS	0.3	1.3	0.3
TERRESTRIAL VEG	0.3	0	0.8
AQUATIC VEG	0	0	0
WHITewater	19.5	11.3	14.4
BOULDERS	56.0	74.4	50.3
BEDROCK LEDGES	9.5	2.5	18.3

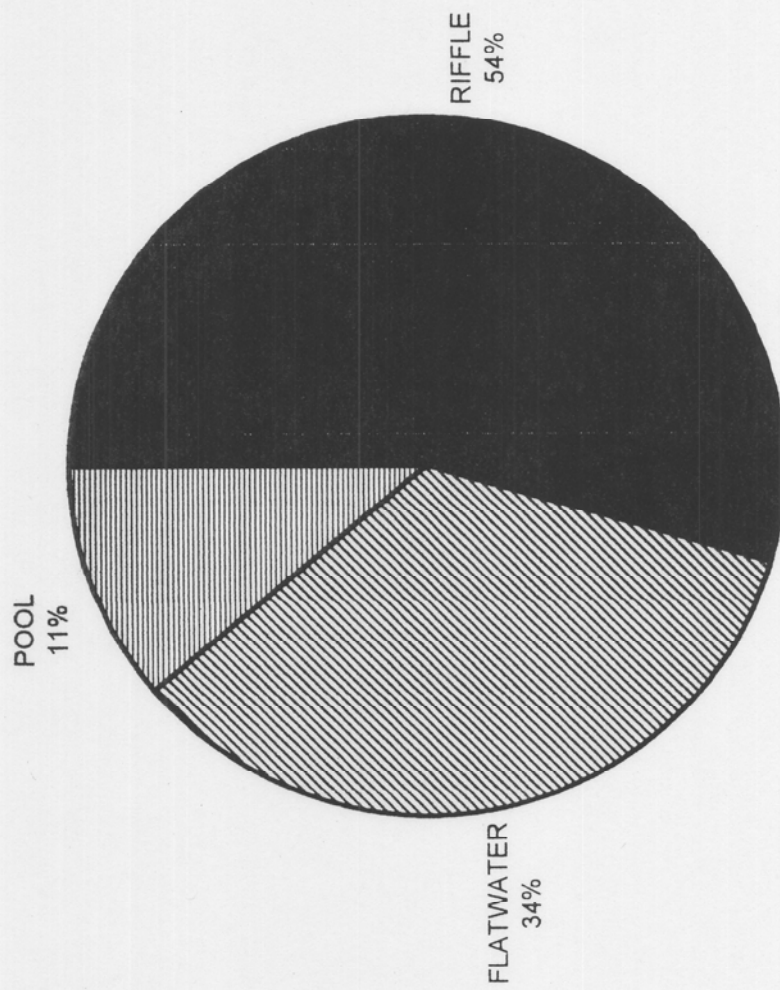
HOUSTON CREEK 2002 HABITAT TYPES BY PERCENT OCCURENCE



GRAPH 1

HOUSTON CREEK 2002

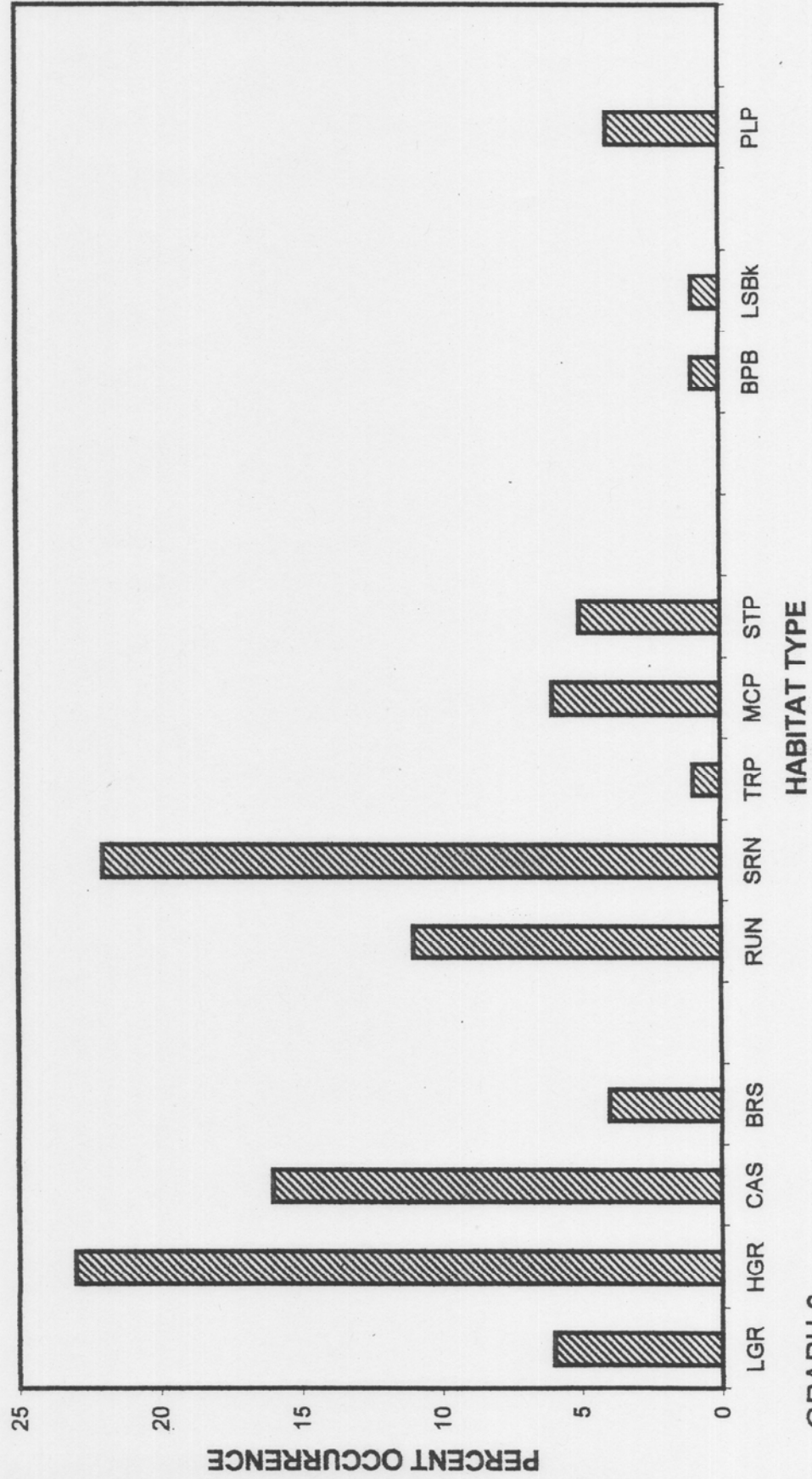
HABITAT TYPES BY PERCENT TOTAL LENGTH



GRAPH 2

HOUSTON CREEK 2002

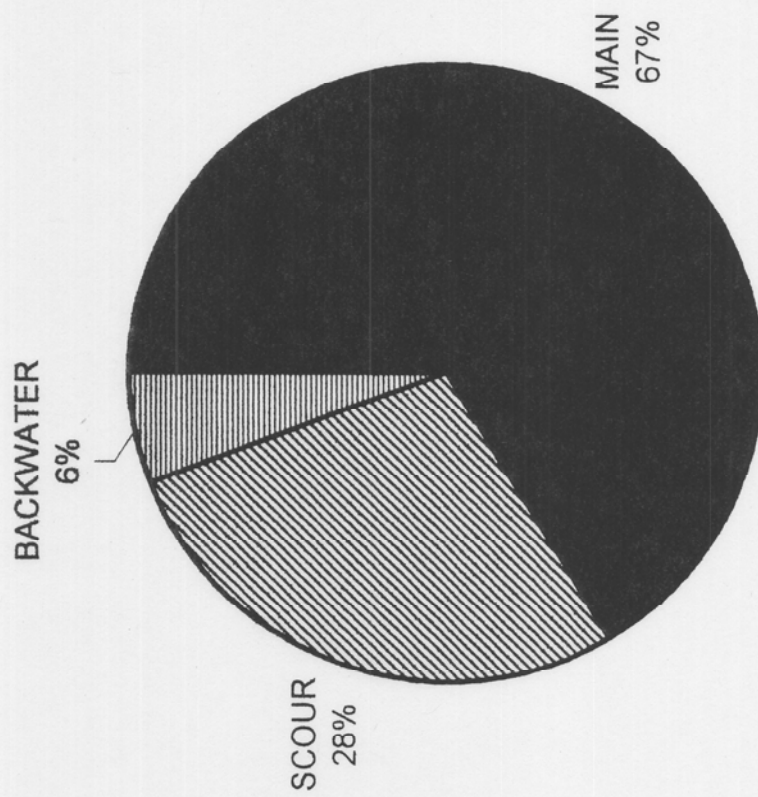
HABITAT TYPES BY PERCENT OCCURRENCE



GRAPH 3

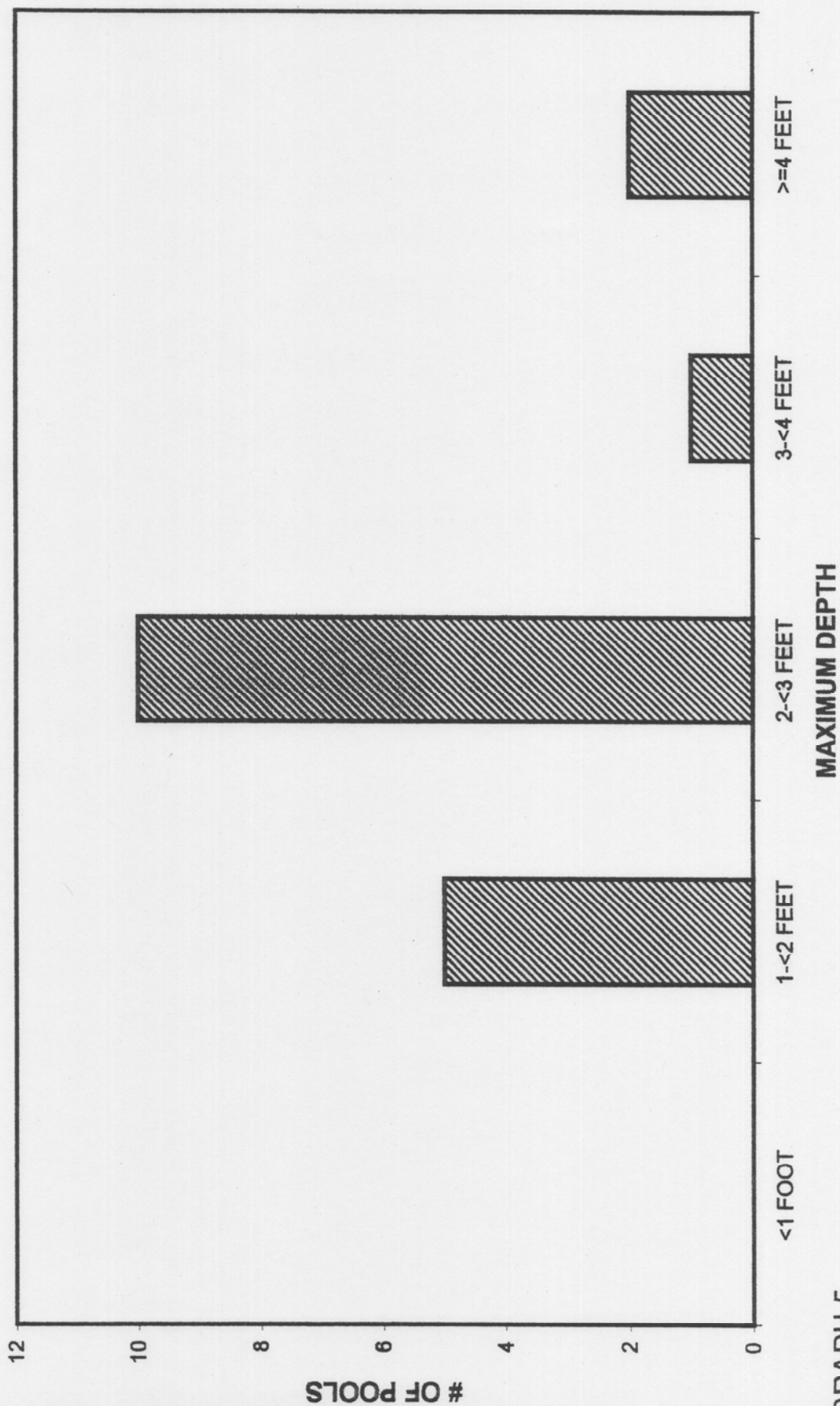
HOUSTON CREEK 2002

POOL HABITAT TYPES BY PERCENT OCCURRENCE



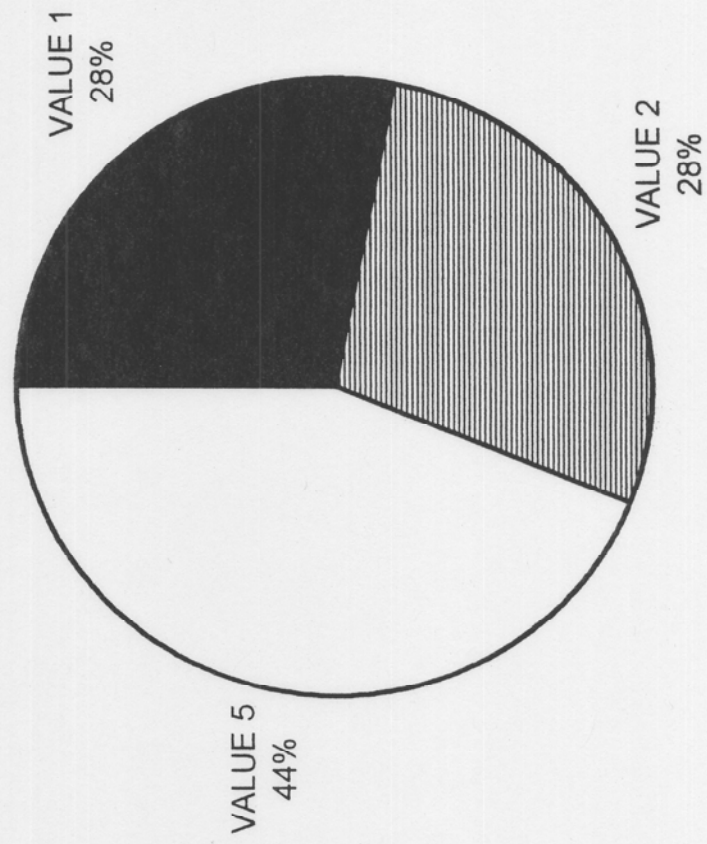
GRAPH 4

HOUSTON CREEK 2002 MAXIMUM DEPTH IN POOLS



GRAPH 5

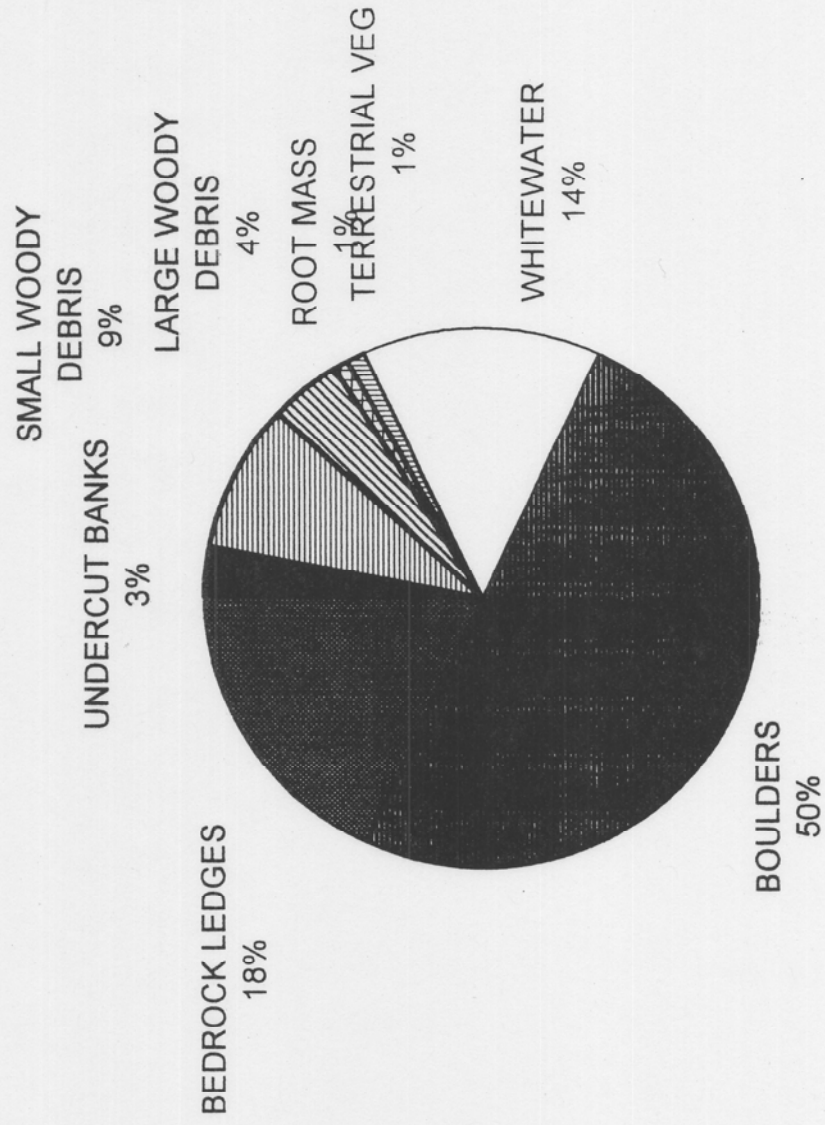
HOUSTON CREEK 2002 PERCENT EMBEDDEDNESS



GRAPH 6

HOUSTON CREEK 2002

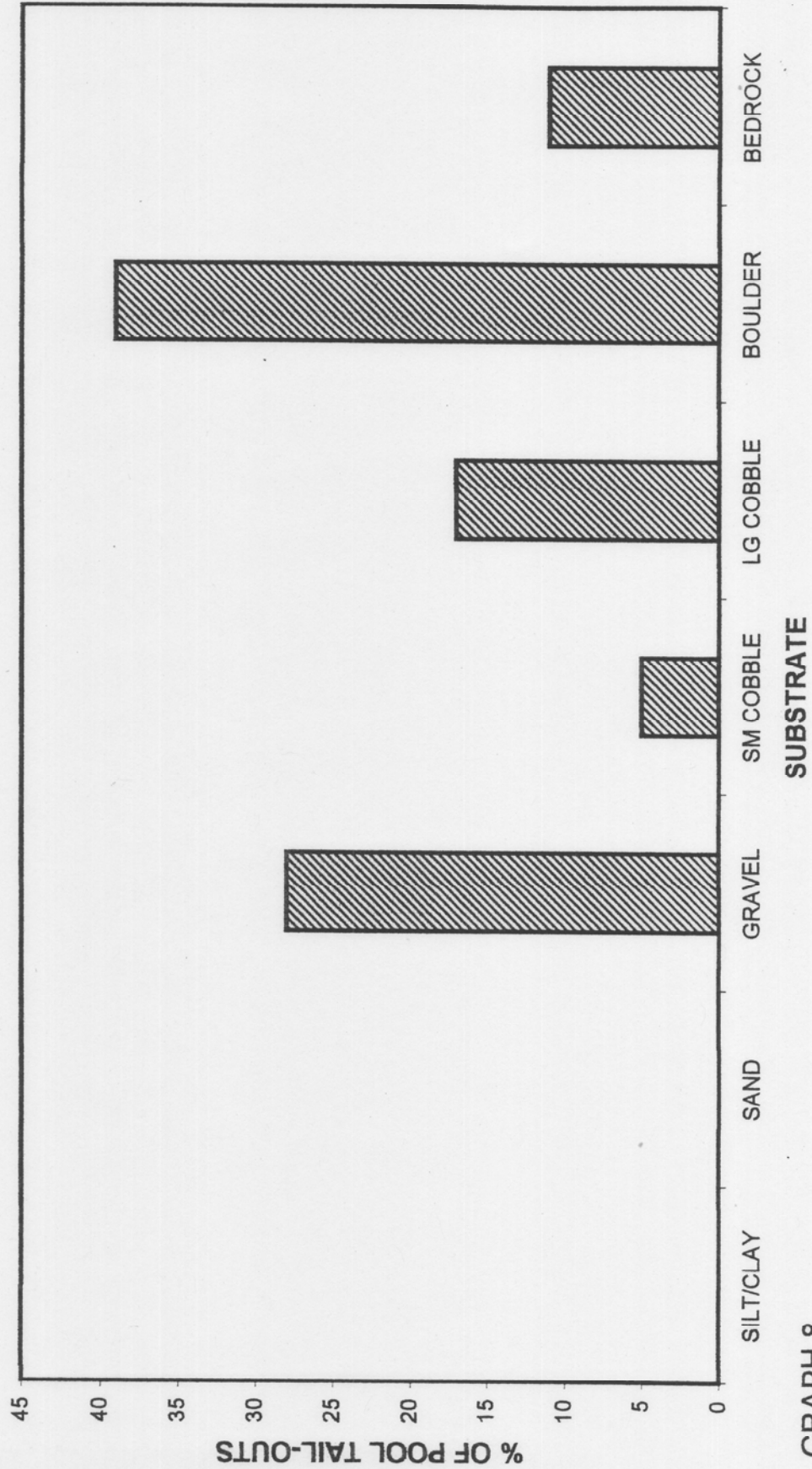
MEAN PERCENT COVER TYPES IN POOLS



GRAPH 7

HOUSTON CREEK 2002

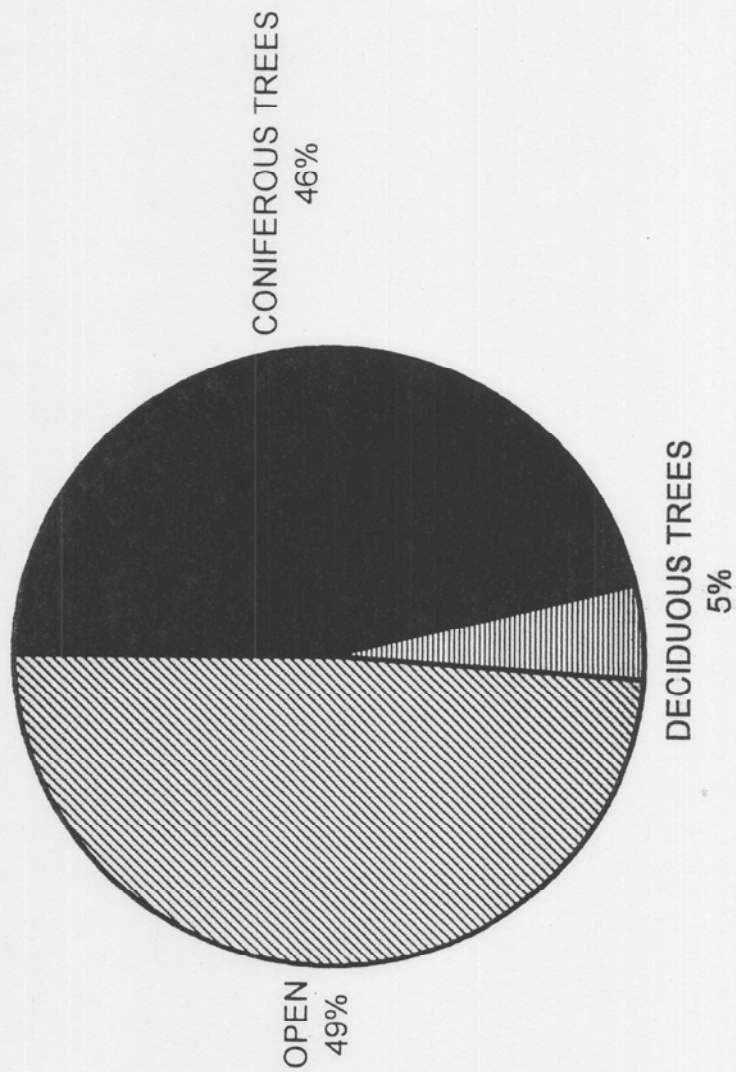
SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



GRAPH 8

HOUSTON CREEK 2002

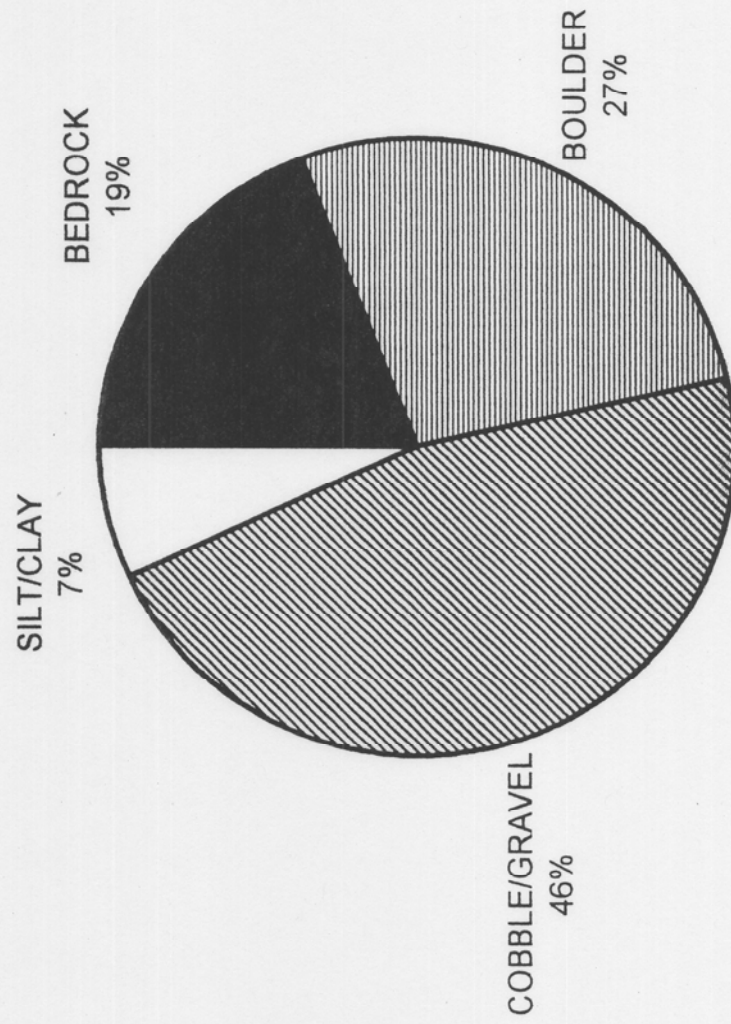
MEAN PERCENT CANOPY



GRAPH 9

HOUSTON CREEK 2002

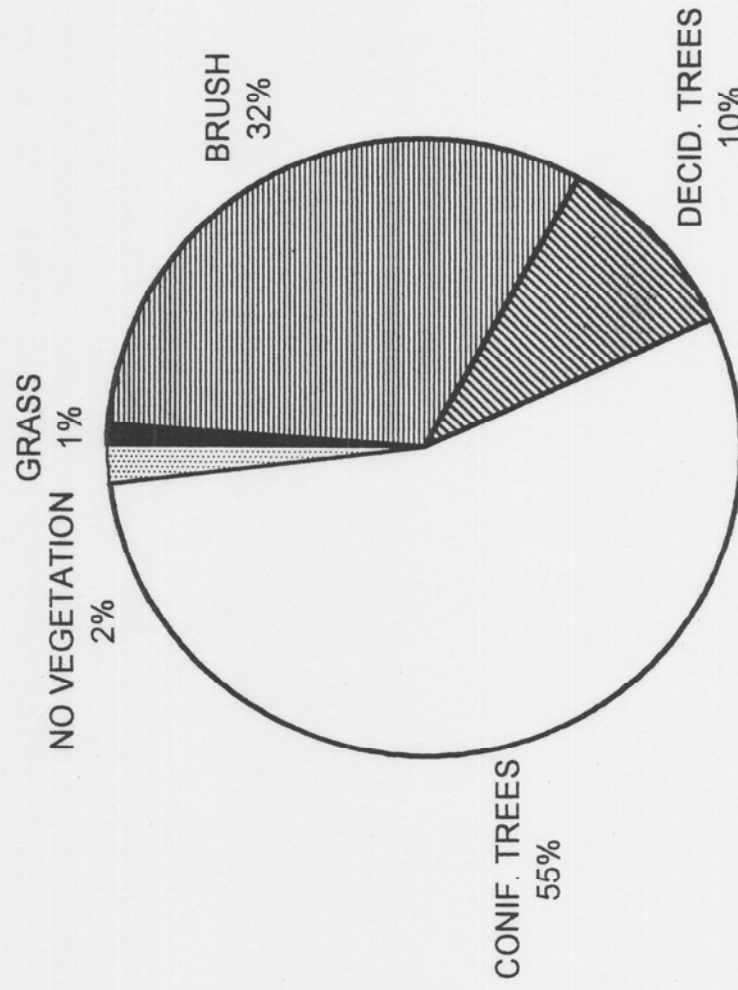
DOMINANT BANK COMPOSITION IN SURVEY REACH



GRAPH 10

HOUSTON CREEK 2002

DOMINANT BANK VEGETATION IN SURVEY REACH



GRAPH 11

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