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Microhabitat Utilization and Fish Survey of the Guadalupe River

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Glenn Longley

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February 23, 1998

Edwards Aquifer Research & Data Center
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This project was supported by Texas Water Development Board
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1.0 EXECUTIVE SUMMARY

Studies in the West Central area of the Trans-Texas Program have considered possible alternatives for making more water available for San Antonio through diversions from the Guadalupe River near Gonzales (G-10) and at Lake Dunlap (G-14). The diversions and their implications are discussed in the West Central Study Area Phase I Interim Report (HDR, 1994). The objective of this study was to develop information on fish community habitat relationships that will be utilized in the Texas Water Development Board's (TWDB) Macrohabitat Assessment Technique (MAT) for flow assessment. Identification of fish species present in different habitats was conducted. Water analyses were conducted at each site during each sampling event. The findings of these studies are presented in the report.

2.0 INTRODUCTION

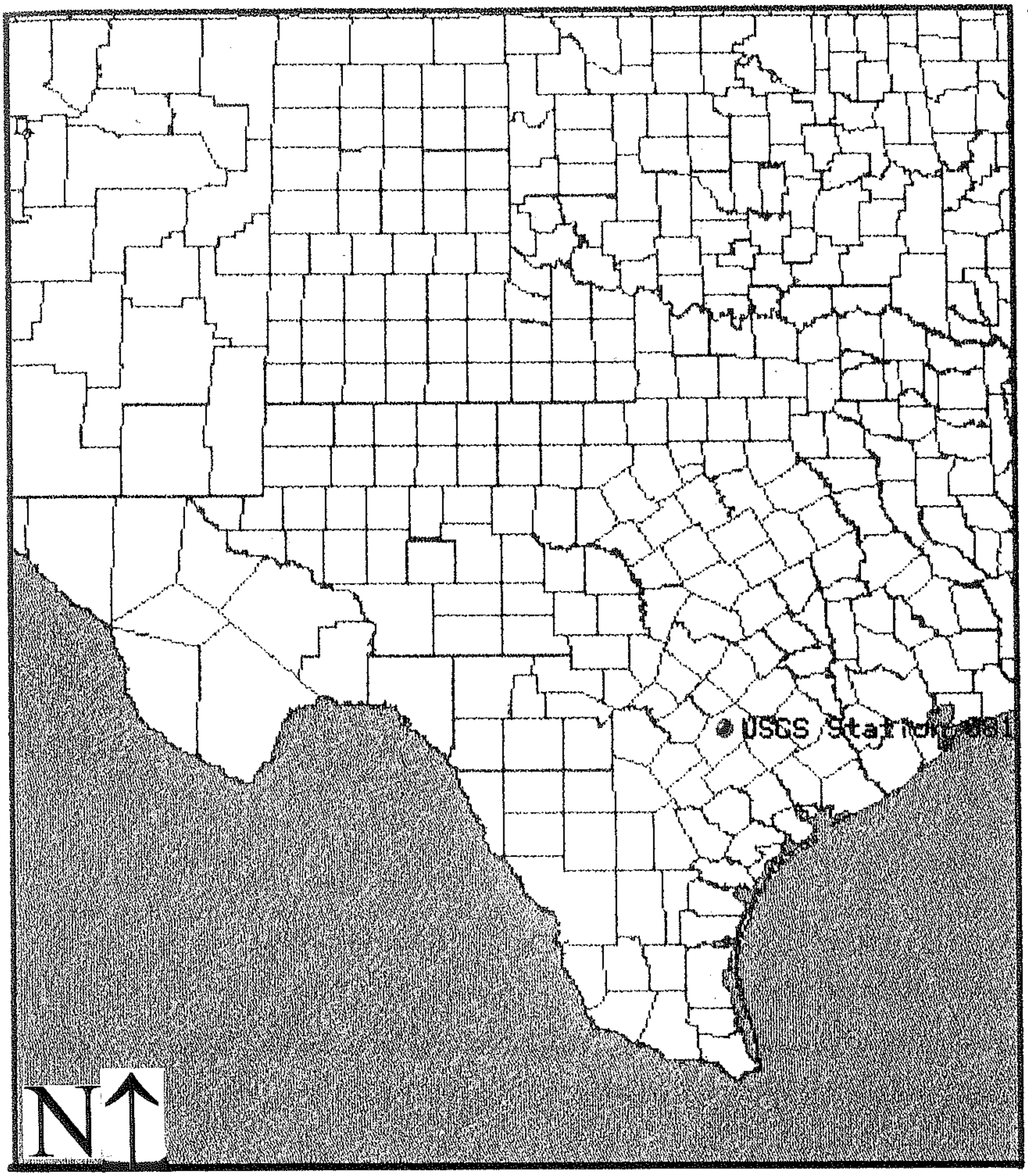
2.1 Study Area

The study area consisted of the Guadalupe River in Central Texas from Lake Dunlap (below the City of New Braunfels) to just below the City of Cuero. Two study sites (4 and 6) were selected from the original six and sampled during low, medium and high flows for both the summer and the winter. The other four sites were not chosen because of dynamic flow variations caused by dam released waters. These had flow range fluctuations that would have placed them within low, medium and high categories within a 24 hour period.

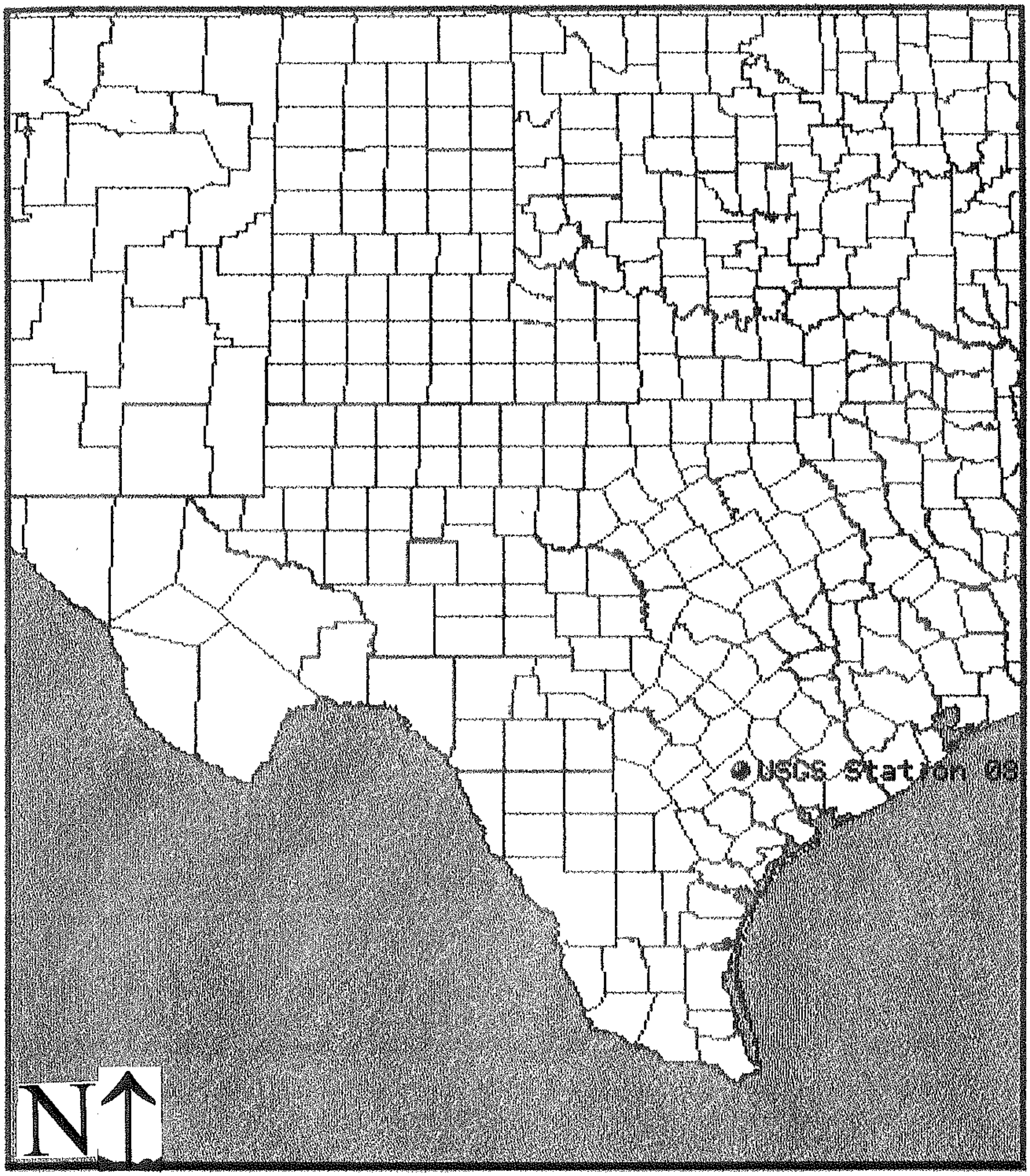
Site 4 was located on the Cannonade Ranch in Gonzales County, and Site 6 was located immediately upstream of Hwy. 72 bridge west of Cuero in DeWitt County.

Figures 1-4 describe the general study area. The area near Lake Dunlap to east of Seguin is in the Blackland Prairie. Through the study area the river lies in a broad, flat valley and is characterized by meanders. In the Blackland Prairie area there are three hydropower dams that have converted the river into a series of long riverine reservoirs. These are Lakes Dunlap, McQueeny, and Placid built in 1929 and 1930. They are narrow, moderately deep, usually murky, and have heavy bottom deposits of mud. East of Sequin the river enters the sandy Post Oak Belt near its western boundary. The stream appearance changes little. The valley remains broad, the water murky, and the pools long and separated by short, graveled riffles. Lake Gonzales (H-4) and Lake Wood (H-5) have converted much of the river into standing water. These lakes are similar to the three described for the area above. Near Gonzales the Guadalupe receives the San Marcos River, which increases the flow. Near Cuero the river traverses the Oak Savanna vegetative region and the river has heavily forested riparian areas. The segment of river between Canyon Dam and Wood Lake has a ratio of Pools : Runs : Riffles of 0.54 : 0.40 : 0.05 and the segment of river from Wood Lake to the Victoria County Line has a ratio of 0.51 : 0.46 : 0.02 (Longley, 1997).

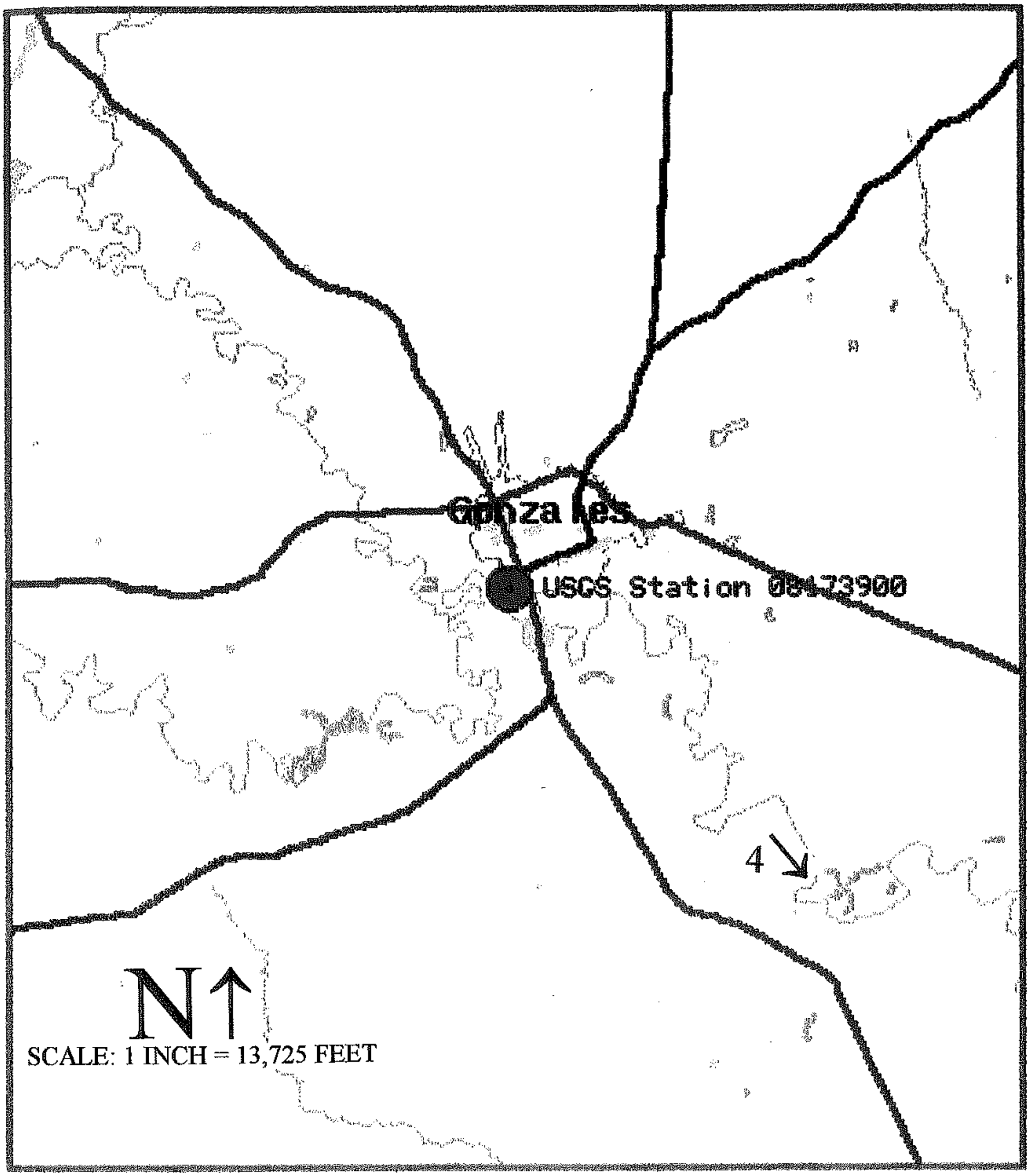
In the upper part of the study area primary land use in the watershed is farming dominated by corn, sorghum, and cotton production. From Gonzales down the primary use is rangeland for cattle production with many improved pastures containing Coastal Bermuda grass which may also be baled for hay production. In many areas cattle use the stream for watering.



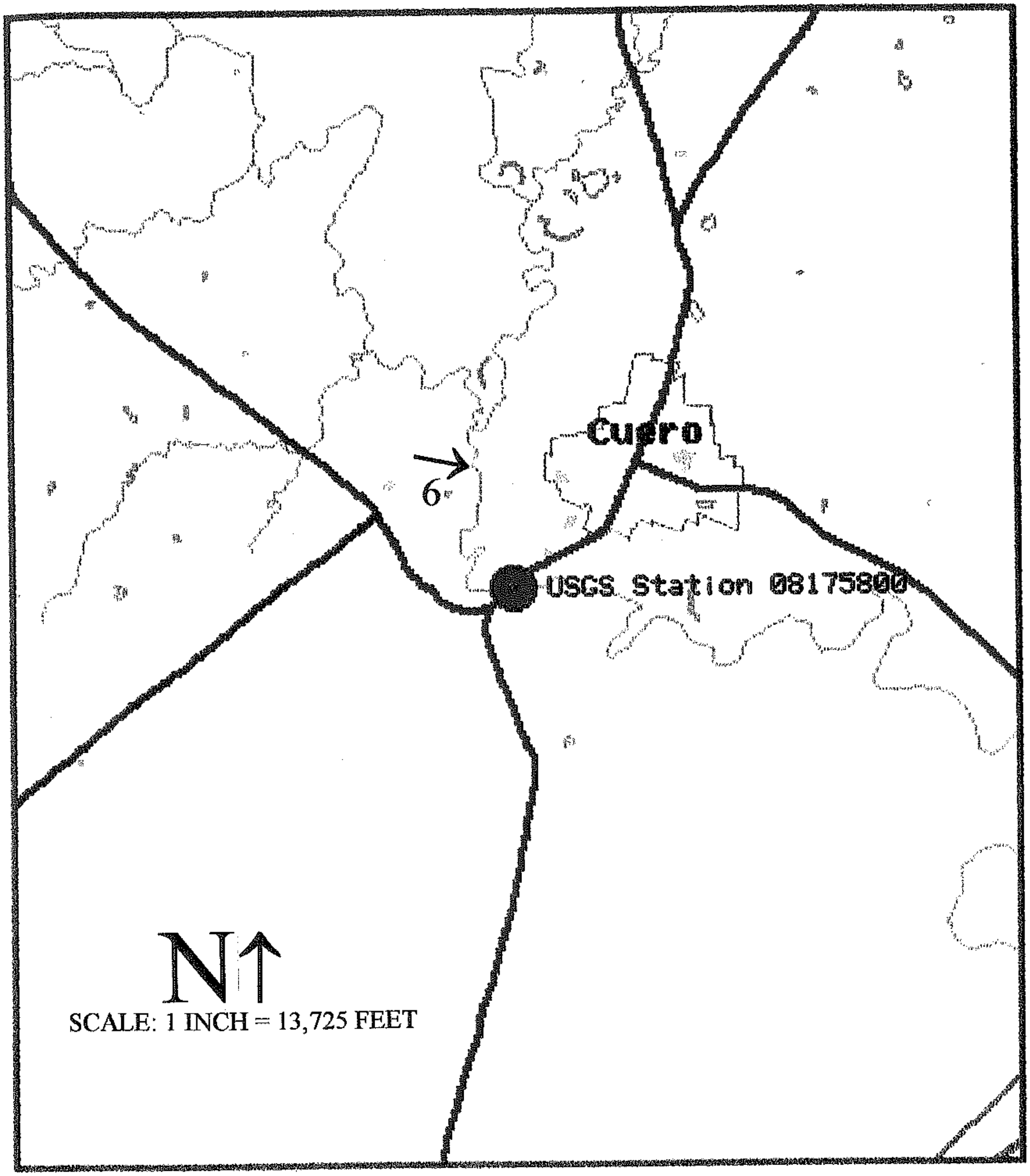
General study area (Site 4). *Source: USGS.*
Figure 1.



General study area (Site 6). *Source: USGS.*
Figure 2.



General study area (Site 4). *Source: USGS.*
Figure 3.



General study area (Site 6). *Source: USGS.*
Figure 4.

2.2 Water Quality

The methods utilized to determine the existing water quality were physicochemical and biological. Physicochemical methods indicate that the stream meets the standards set by the TNRCC at the times sampled. The biological methods used followed the Index of Biotic Integrity (IBI) tests found in Karr et al. (1986).

2.3 Protected Species

The fish surveys conducted indicated that the Guadalupe Bass occurred in the area. Texas Parks and Wildlife Department (TPWD) has indicated the possible presence of the Blue Sucker in the area (Bauer and Spain 1991), but none were found during this study. Cagle's Map turtle, a federally listed reptile in category II is found in the study area (Killebrew 1991). No effort was made in this study to collect species other than fish.

2.4 Climate

The study area is humid subtropical with hot summers. Rainfall averages 33 inches annually and is heaviest in May and September (Mathews and Tallent 1996). The prevailing winds are southeasterly, often pushing warm, moist air from the Gulf of Mexico during spring, summer and fall. This leads to very sporadic rainfall from thunderstorms during these months. In the winter some Polar air gets into the area and is often stopped by warmer air off the Gulf. This results in mild winters most of the time. Rainfall during the winter is usually distributed along frontal boundaries, giving a more uniform coverage of rain than the thunderstorms that predominate during the rest of the year (Mathews and Tallent 1996).

2.5 Geology

In the upper part of the study area the surface deposits are from the Eocene. The surface deposits become progressively younger as you go down stream. In the Cuero area the surface deposits are from the Pliocene (Arbingast et al., 1976). The Guadalupe and its tributaries have cut into these deposits and have redeposited alluvium along the floodplain. This has resulted in various deposits of clay, silt, sand and gravel often carried from far upstream.

3.0 SITE SELECTION

3.1 Basic Strategy

An important step in environmental assessment of the aquatic communities is the selection of the study sites (Figures 5 and 6). Additionally staff of the TWDB wanted sites that had representative habitat and hydrological conditions that would allow them to obtain information in their MAT protocol. The sites were selected from the 1996 Guadalupe River Report (GRP). In that study, Natural Resource Conservation Service (NRCS) employees were contacted in the various counties within the study area. They assisted in finding cooperative landowners that would make sites available to study. They were also generally familiar with where riffles occurred along the river, from their work with farmers and ranchers. TWDB staff participated in the selection of sites. Once sites were chosen, the actual sampling began. Photos were made of the sites during the summer of 1996, used in the GRP and will be used again in this study (Appendix 3).

3.2 Soil Associations

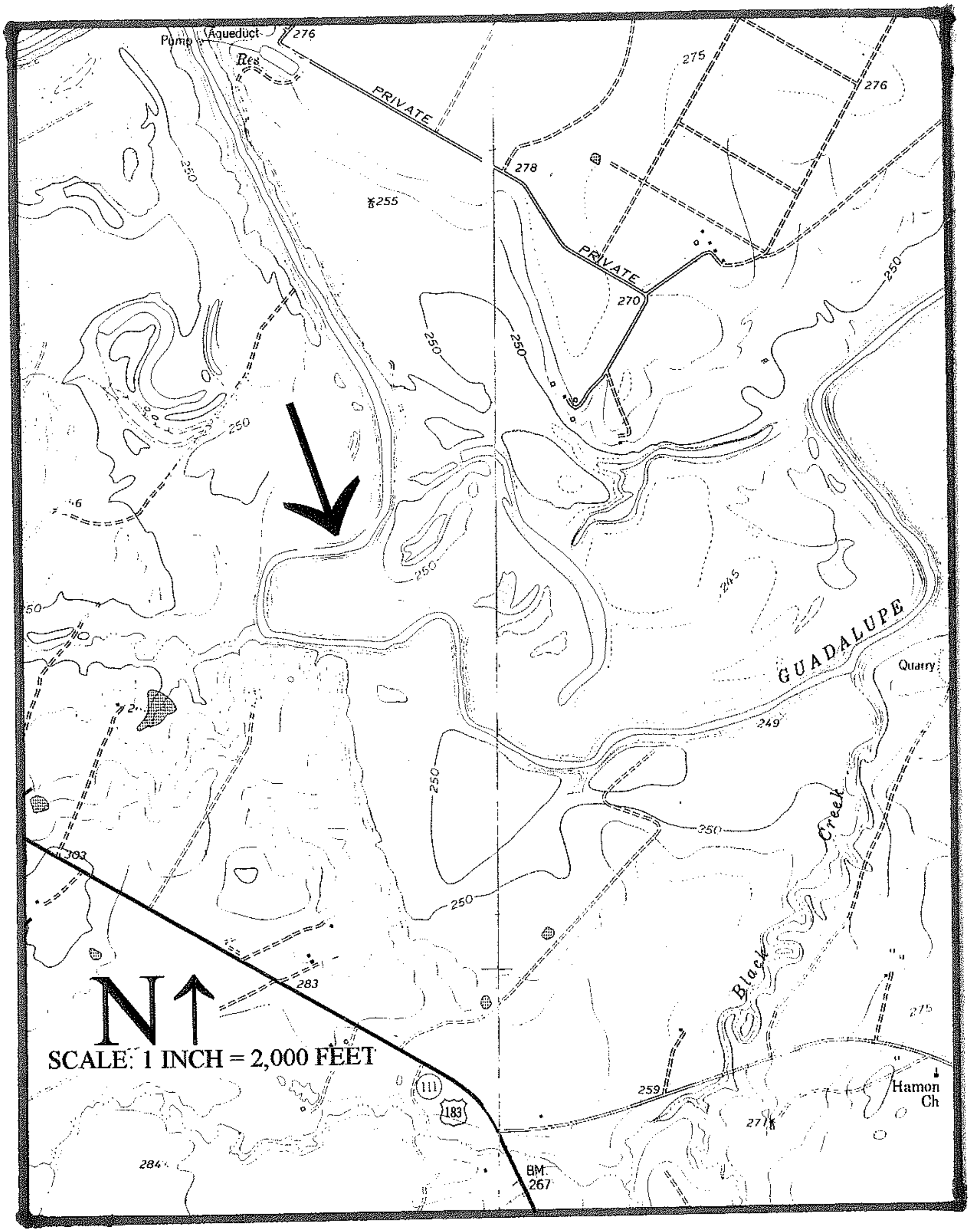
The upper study area was primarily Blackland Prairie. Next to the river dark gray to reddish brown calcareous clay loams and clays were prevalent. The soils along the river changed to light brown to dark gray sandy loams, clay loams and some clays where sandy soils were dominant away from the river (Arbingast et al. 1976).

3.3 Hydrological and Geomorphic Criteria

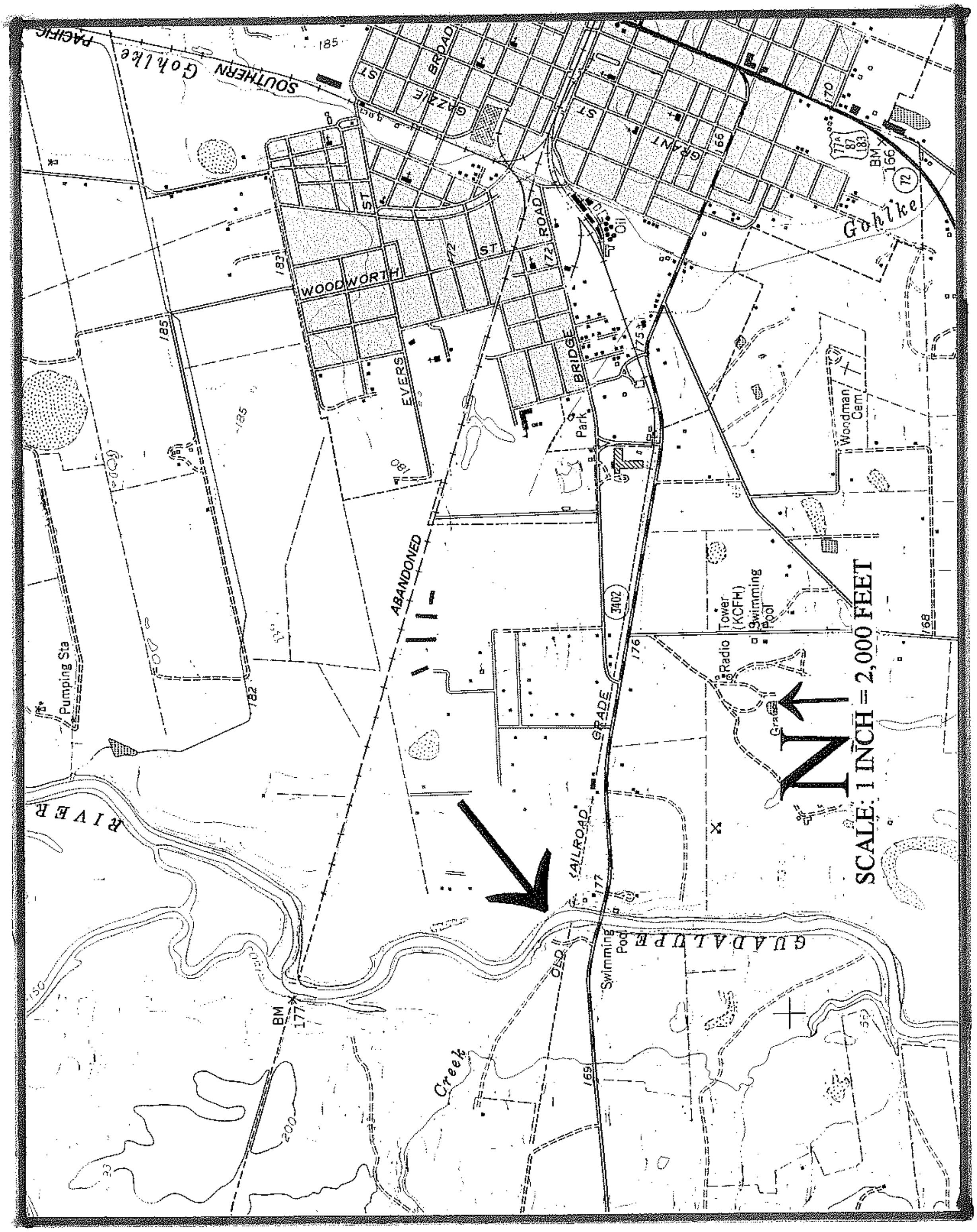
The intent of the study was to sample during the warm season (May - October) and the cool season (November - April) at three different flow regimes: 50%, 30% and 20% below median annual flow, provided the flows were available during the allotted time for the study. The USGS gauge at Gonzales (#08173900) and the Cuero gage (#08175800) were used to determine times for sampling at each site. The TWDB staff monitored the sites at different flows to determine if channel morphometry, hydraulics, and habitat conditions occurred at each study site.

3.4 Field Reconnaissance

As indicated under 3.1, in 1996, local NRCS staff were utilized to help locate suitable sites for study. Participating in this phase were Dr. Glenn Longley, Director of the Edwards Aquifer Research & Data Center (EARDC) at Southwest Texas State University, two graduate students John Burch and Keith Cox. Participating TWDB staff included Raymond Mathews Jr., fisheries biologist/ecologist (Contract Manager), Greg Malstaff, geomorphologist; and James Tallent, civil engineer and hydrologist. The hydrologist and geomorphologist looked at the sites to determine their suitability for hydrological modeling. The interdisciplinary approach assures that all aspects of the study were considered during this phase.



Specific study area (Site 4). *Source USGS.*
Figure 5.



Specific study area (Site 6). *Source USGS.*
Figure 6.

4.0 DATA COLLECTION

4.1 Bathymetric

This work is to be done by the TWDB.

4.2 Hydrological

Additional work is to be done by the TWDB staff. The stream flow Information from the USGS gages at Cuero and Gonzales were used to select sampling times for all sites. It was noted during the study that flows at all sites varied considerably during each day. It was discovered, by talking with Guadalupe Blanco River Authority staff, that these daily wide fluctuations in flow were the result of filling reservoirs of the hydroelectric dams upstream and then releasing flows at levels that allowed for more efficient generation of electricity. It is likely that these daily fluctuations have far more effect on the stream communities than any other factor. One reason is that during low flows considerable amounts of the habitat are dewatered. This would be expected to have considerable effects on reproductive activities of fish and other aquatic organisms. A group that has declined in numbers is the freshwater mussels including: *Quadrula aurea* (Golden orb), *Quadrula petrina* (Texas pimpleback) and *Quincucina mitchelli* (False spike). Probable cause for this decline has been attributed to large scouring floods, flow regimes, temperature regimes and possible transient toxicity in the Guadalupe River (Longley, 1997).

4.3 Habitat assessment

US Environmental Protection Agency (EPA), Texas Natural Resource Conservation Commission (TNRCC) and TPWD have been using RBA Protocols II and V all across the state for setting stream classifications (Bayer et al., 1992). TWDB staff have developed their own system, known as the Macrohabitat Assessment Technique (MAT), for describing instream flow needs (Mathews and Bao, 1991). Other techniques have been used for similar purposes, especially prominent is the Instream Flow Incremental Methodology (IFIM) that has been use extensively below dams (Stalnaker, Lamb, Henriksen, Bovee and Bartholow, 1995). This study utilizes the combination of RBA protocols and MAT.

4.31 Site Descriptions and Flows Sampled

The flows sampled for each of the site is given in Table 1 and flows for the individual microhabitats are given in Table 2 and 3. The individual sketch sites are shown in Figures 7 and 8. Figures 9, 10, and 11 show daily maximum, minimum and mean discharge at the Gonzales gage, and Figure 12 shows the daily mean discharge at the Cuero gage.

4.32 Habitat Mapping and Photodocumentation

Limited data was collected by the biologists. Figures 1-4 show the study sites. The photos of the different habitats at each site are found in the Appendices.

4.33 Microhydraulic Effect of Habitat

This work is to be completed by TWDB staff.

4.34 Instream Habitat Classification

Habitat is basically a locality, site or particular type of environment on a microscale that is occupied by an organism or population of organisms.

Table 1.

Physicochemical data and flows for 1996 and 1997 sample times, Guadalupe River.

Site	Date	pH	S. Cond (μmhos/cm)	DO (mg/l)	Temperature (C)	Flows (cfs)
4 - summer high	10-18-97	6.5	20.0	8.0	20.7	1079-1283
4 - summer med	10-29-97	7.8	23	8.49	19.5	961-966
4 - summer low	*	*	*	*	*	*
4 - winter high	11-21-97	7.6	24	9.9	13.4	940
4 - winter med	X	X	X	X	X	X
4 - winter low	11-7-97	NA	26	9.5	18.6	591-644
6 - summer high	9-21-97	8.2	28.2	6.83	28.2	1007-1041
6 - summer med	10-25-97	7.6	230.0	7.58	22.7	830-844
6 - summer low	*	*	*	*	*	*
6 - winter high	*	*	*	*	*	*
6 - winter med	1-9-97	9.1	27.0	9.2	14.1	NA
6 - winter low	1-8-97	9.1	28.0	9.0	15.3	566-577

* - previous study

Table 2.

Winter depth and flows at sites 4 and 6.

	Site 4				Site 6			
	Low		High		Low		High	
Microhabitat	Depth	Flow	Depth	Flow	Depth	Flow	Depth	Flow
A	4.0	0.8	4.0	2.6	d	d	-	-
B	2.0	0.5	3.0	-0.5	d	d	-	-
C	0.5	0.3	5.0	2.15	3.0	2.0	-	-
D	6.0	0.0	7.0	0.10	d	d	-	-
E	4.0	0.2	3.0	0.25	d	d	-	-
F	2.0	1.8	3.0	1.25	d	d	-	-
G	4.5	1.2	5.0	3.4	5.0	4.0	-	-
H	6.5	0.0	7.0	-0.01	6.0	5.0	-	-
I	2.5	0.3	4.0	0.35	3.0	3.0	-	-
J	1.5	0.2	3.75	0.3	d	d	-	-
K	7.0	1.0	3.5	0.0	d	d	-	-
L	4.5	0.3	6.0	0.4	2.0	2.0	-	-
M	3.0	0.2	2.5	0.0	d	d	-	-
N	2.5	0.5	3.0	0.5	1.0	2.0	-	-
O	4.0	0.2	5.0	2.0	3.0	1.0	-	-
P	4.0	0.2	4.5	0.9	4.0	0.0	-	-
Q	4.0	0.2	4.5	0.2	d	d	-	-
R	3.5	0.1	4.0	0.3	1.0	1.0	-	-

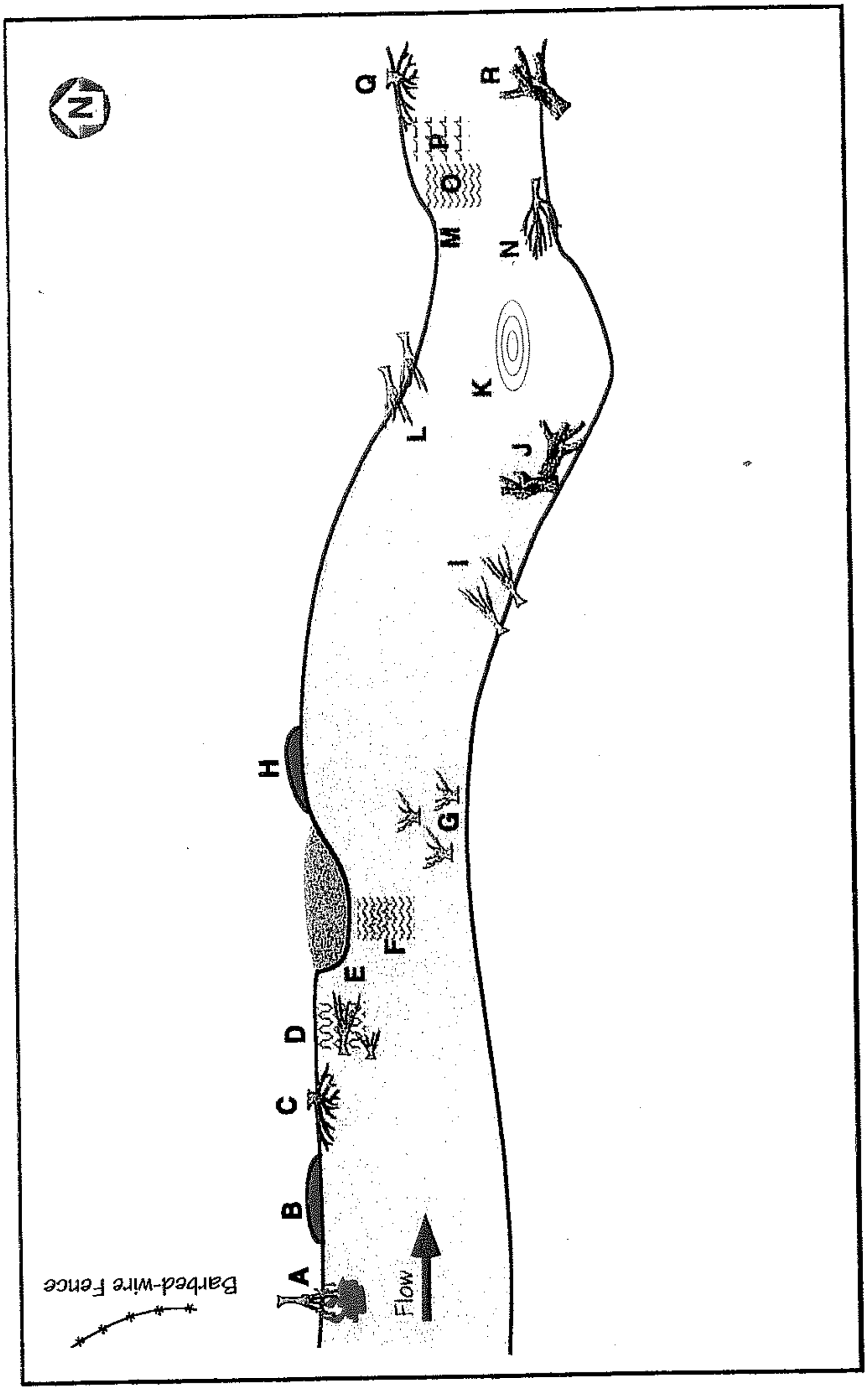
Depths are in ft. and flows are ft./sec.
d - too deep to measure.
"-" - not sampled.

Table 3.

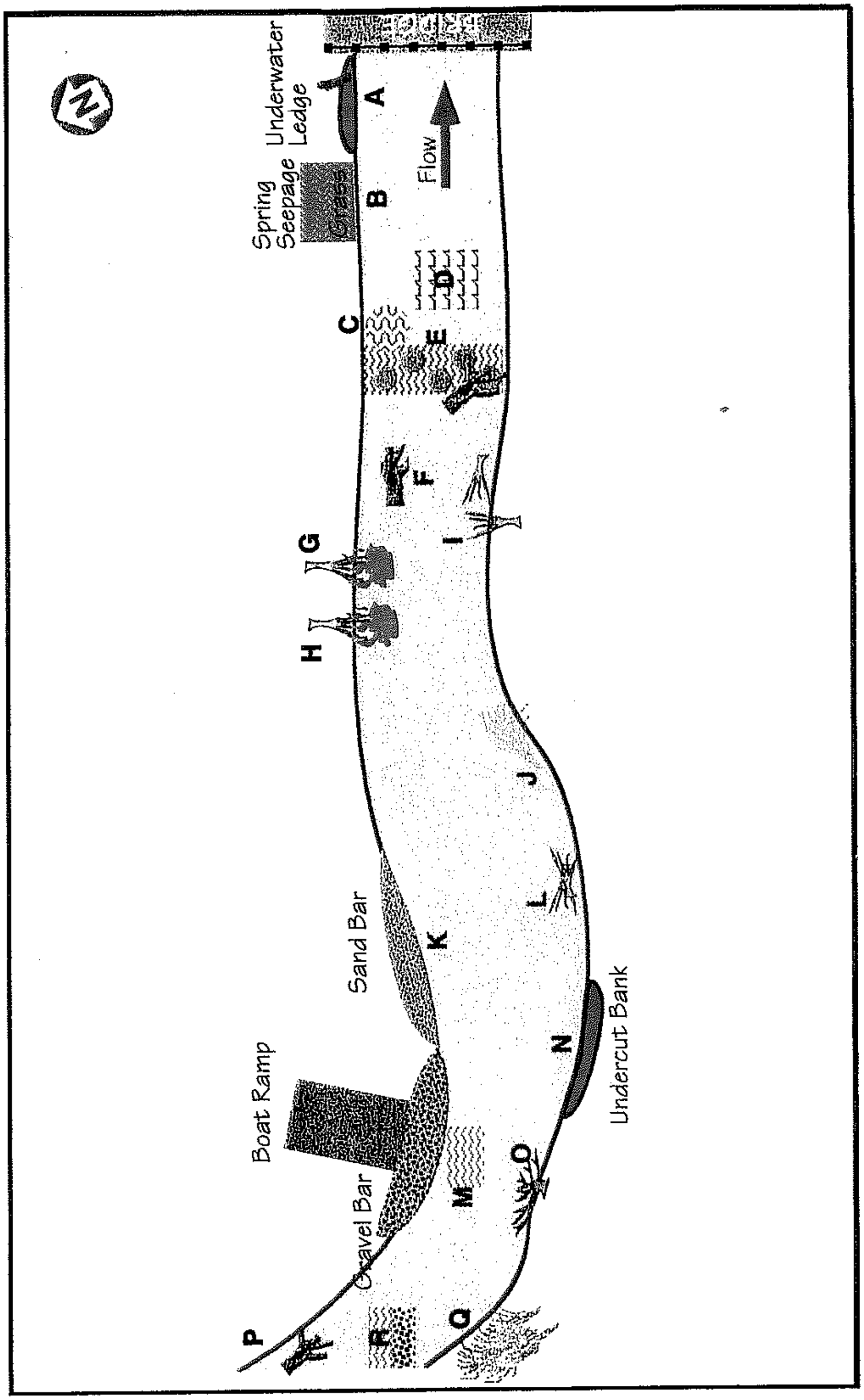
Summer depth and flows at sites 4 and 6.

	Site 4				Site 6			
	Med		High		Med		High	
Microhabitat	Depth	Flow	Depth	Flow	Depth	Flow	Depth	Flow
A	3.0	2.5	4.0	5.0	5.0	1.65	7.0	0.1
B	3.0	0.5	5.0	4.0	4.0	0.1	4.0	0.0
C	4.5	0.0	5.0	3.0	1.5	0.0	4.0	0.0
D	4.0	0.25	6.0	2.0	2.0	0.0	4.0	0.15
E	3.0	2.2	3.0	0.5	5.0	1.2	3.7	2.9
F	5.5	3.0	2.5	7.5	4.0	1.5	10.0	1.5
G	4.5	2.5	3.0	4.0	4.0	0.0	5.0	0.0
H	6.4	0.0	6.0	0.0	7.0	0.4	7.0	0.0
I	4.4	0.55	3.0	2.5	3.5	0.0	3.5	-0.8
J	2.2	0.9	4.0	4.5	5.0	0.0	4.0	0.8
K	2.4	1.0	3.0	3.0	3.0	0.0	1.0	0.0
L	4.2	0.1	5.5	0.5	6.0	0.0	4.0	1.3
M	3.2	1.65	2.0	0.1	1.0	0.0	1.2	1.4
N	3.9	0.6	3.5	2.0	3.0	2.3	3.5	2.5
O	3.5	1.85	3.0	5.7	5.0	2.2	4.0	1.3
P	4.3	1.25	5.0	6.0	2.0	1.4	4.5	0.6
Q	4.0	0.65	6.0	1.2	5.0	1.3	6.0	1.25
R	5.2	0.3	4.0	2.0	6.5	1.3	3.5	2.9

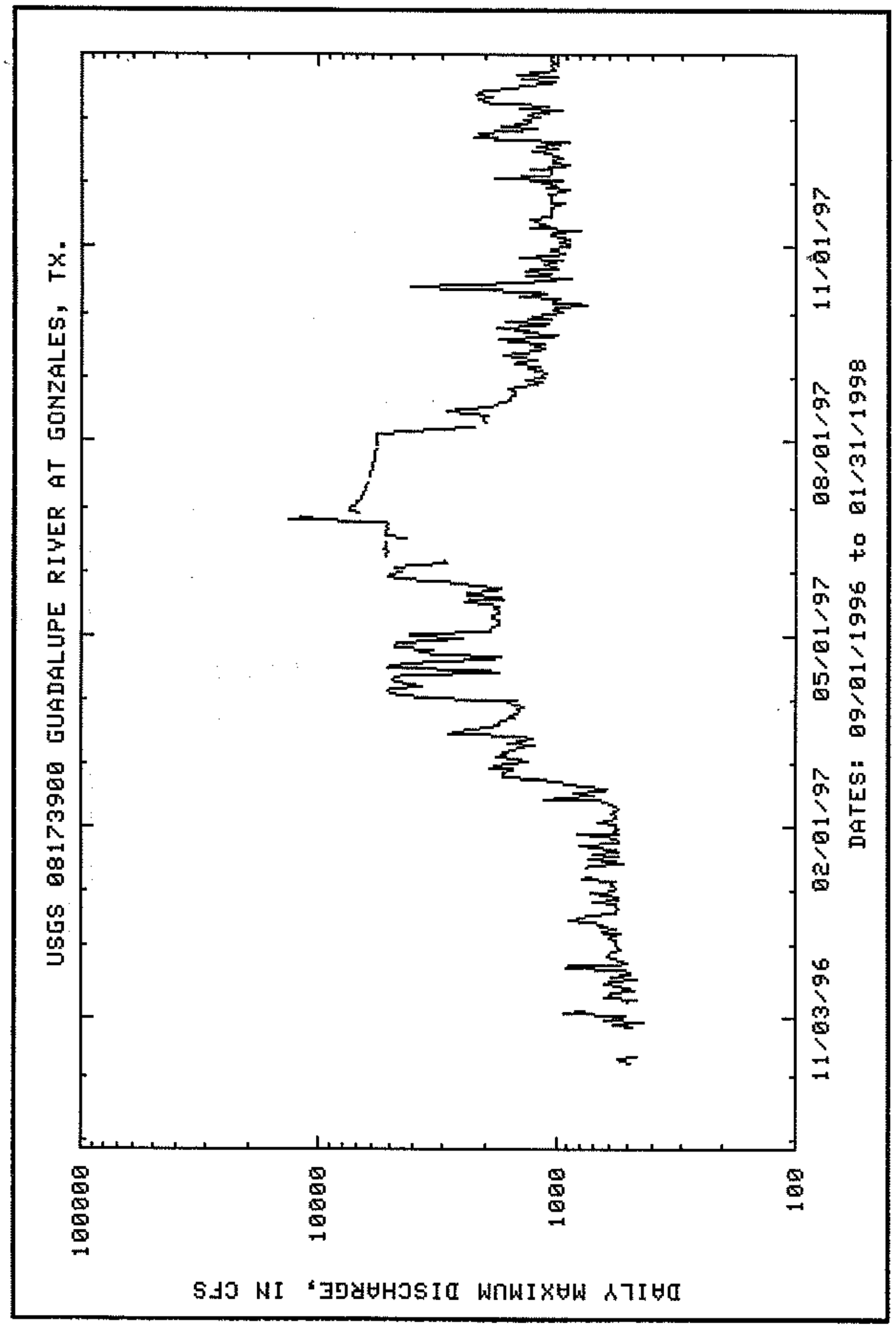
Depths are in ft. and flows are ft./sec.
d - too deep to measure.
"-" - not sampled.



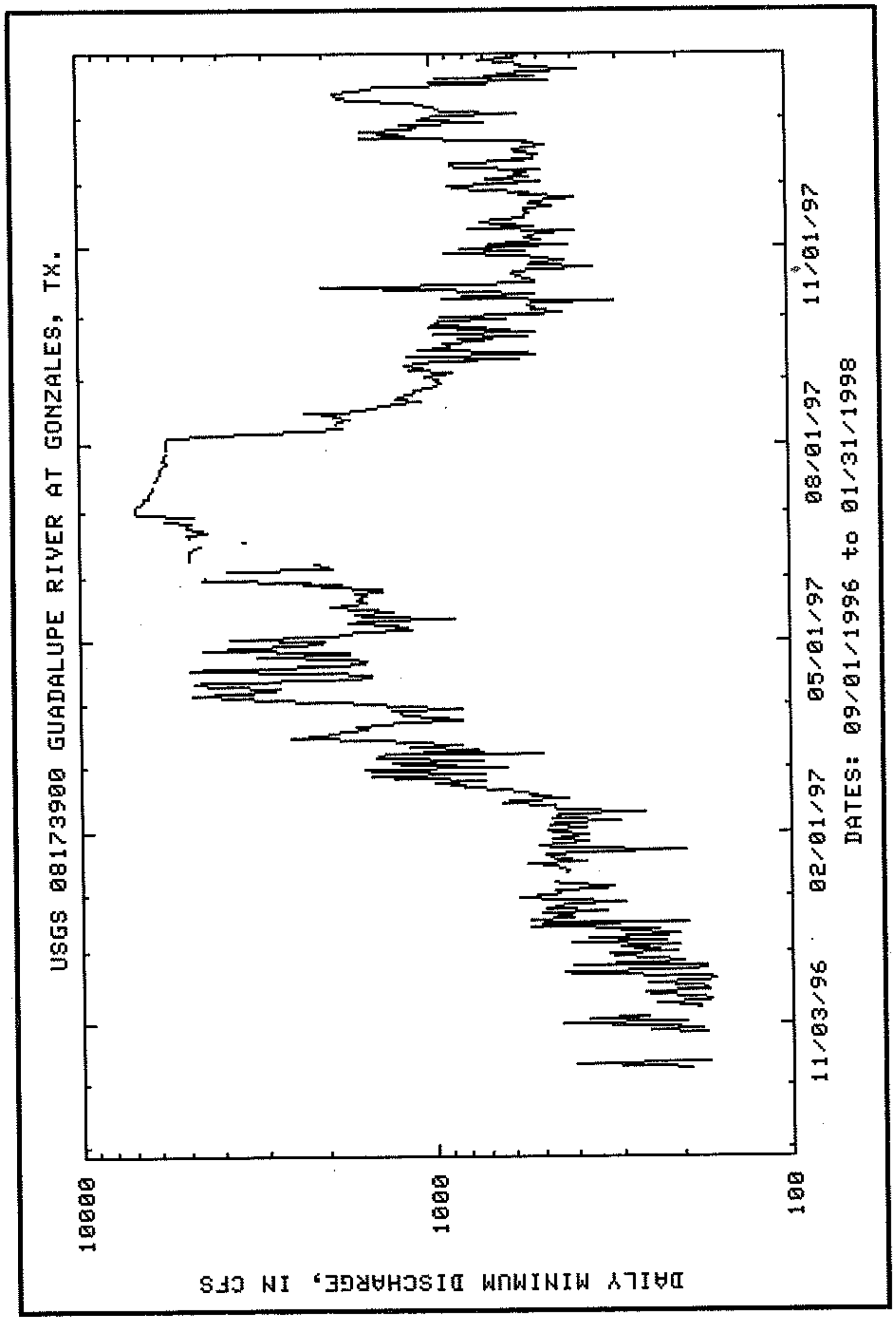
Sketch map of Site 4.
Figure 7.



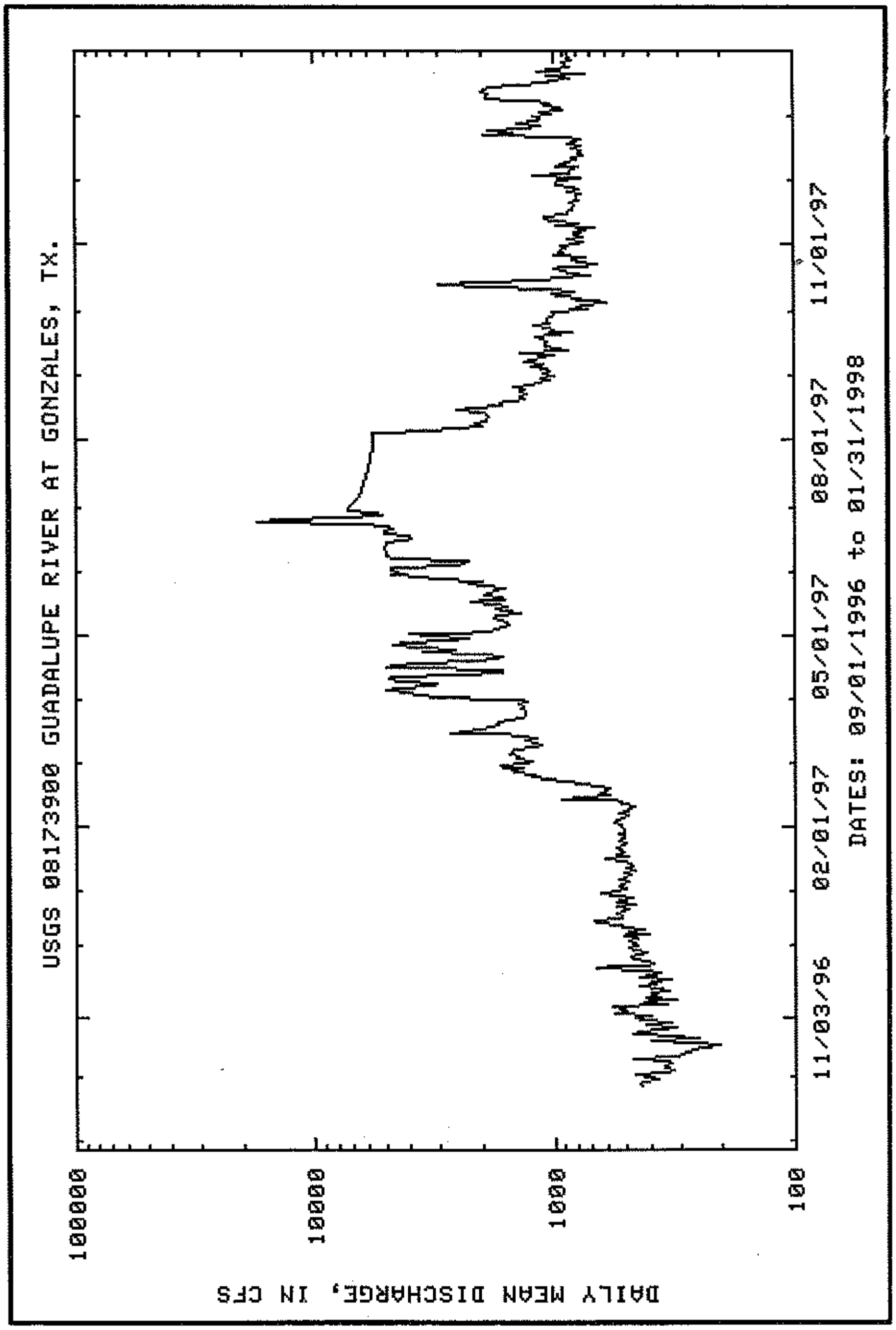
Sketch map of Site 6.
Figure 8.



Daily maximum flows at USGS Gonzales gage during the study period. *Source USGS.*
Figure 9.



Daily minimum flows at USGS Gonzales gage during the study period. *Source USGS.*
Figure 10.



Daily mean flows at USGS Gonzales gage during the study period. *Source USGS.*
Figure 11.

4.4 Biological Assessment

Water development projects such as the ones proposed alter the natural flow of a stream. It is important to know what the impact of the altered flows will be on the biological community. This information is important since it may be necessary to mitigate the effects of the altered flows by various management options.

4.41 Biological Indices

The indices used in this study have been developed by EPA and modified by TPWD for the purpose of categorizing stream segments. Additionally the MAT methodology developed by TWDB has been considered by gathering data in such a way that it will be useful for this technique.

4.42 Biological Sampling Techniques

In addition, effort was made to collect fish in the different types of habitats found at each of the study sites. The information resulting from this sampling is found in the following locations: Lists of all fish collected are given in Appendix 1, bubble diagrams of fish located in the different habitats at each collecting site at each sampling date (Appendix 2), and IBI's in (Appendix 4).

4.5 Chemical - Physical - Microbiological Assessment

Stream quality was also assessed utilizing grab samples taken at the same time the fish sampling was done. The following parameters were measured in the field: temperature, pH, dissolved oxygen, specific conductance. All analyses were done in accordance with EPA standards for testing (Table 1).

4.6 Biological Assessment of Habitat Utilization and Availability Conditions

The TWDB staff will complete this portion of the study utilizing MAT methods.

5.0 RECOMMENDATIONS AND CONCLUSIONS

A better method for determining when to sample for the different flow rates needs to be developed. To try and utilize gages far removed from sampling sites is not reasonable, particularly when there are reservoirs in between the gage and the site to be sampled. Since the flow in the Guadalupe through the study area is so variable and using one afternoon's flow to predict a sampling time for the next day is not reliable, some reasonable method needs to be developed that will yield the information sought by the TWDB.

It is often not possible to put together a sampling trip on such short notice, especially when using graduate students that have classes during the week days.

The biological and chemical-physical information developed during this study is more than adequate to evaluate the present environmental conditions of the study areas. To try to further develop detailed flow information for each study site will require much greater costs, because to do it right should involve the flows being taken at the sites at the times of sampling. I recommend that a beginning and ending flow be measured and that the flows available on regular sampling dates be used instead of trying to sample narrow flow ranges. Practicality has to be an important part of any field study and I feel that under the circumstances found in this river area, a modification of the usual methods must be employed.

The conditions mentioned in 4.2 would suggest that if future projects are forthcoming, one way to mitigate their effect would be to modify the operation for the hydroelectric generation operations to allow a more stable flow regime. The improvement from this action would likely be greater than the detrimental effect of removing water provided there is coordination so that stable minimum flows, seasonally adjusted could be assured.

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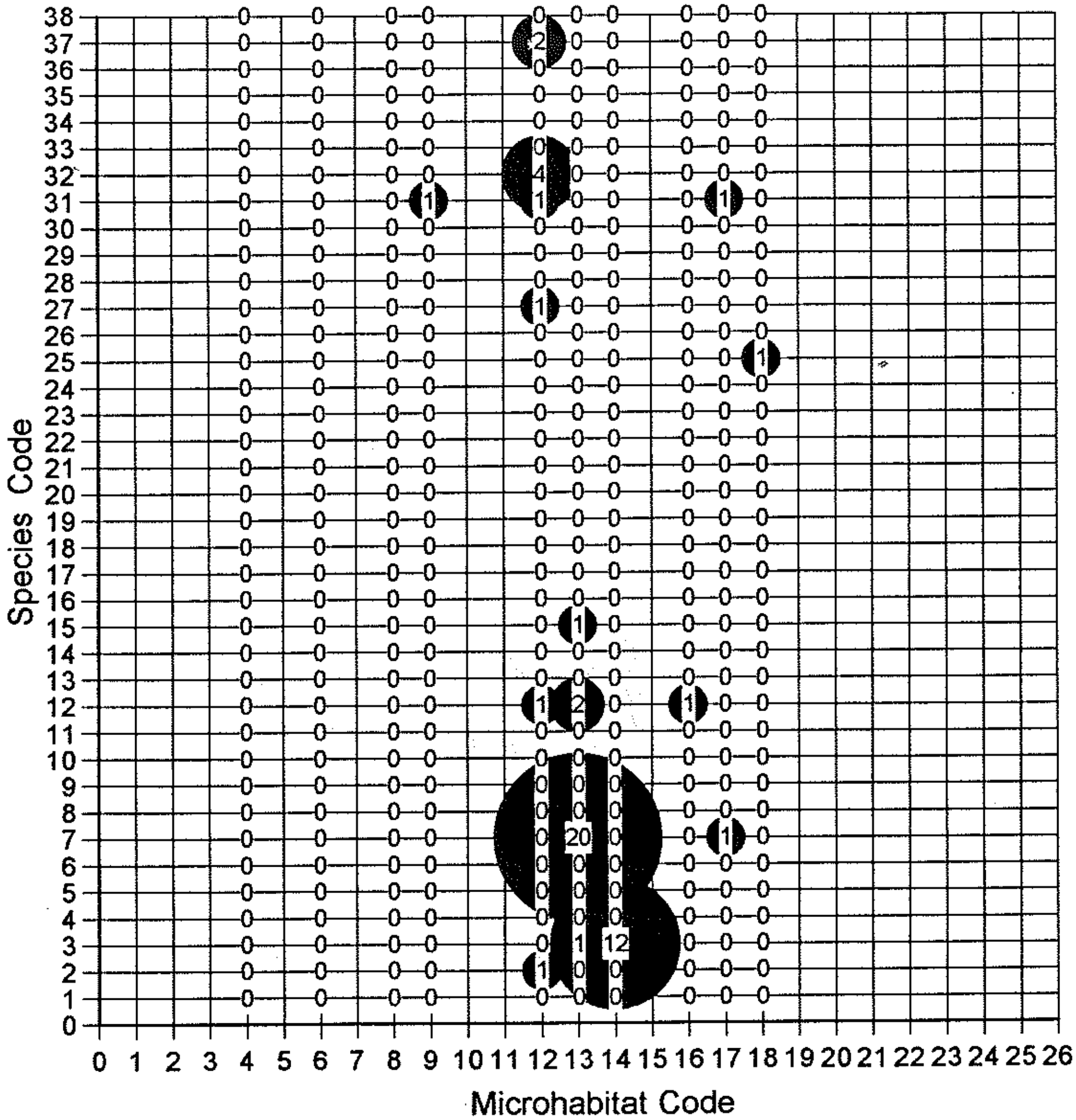
APPENDICES 7.0

Appendix 1.
Fish species code for bubble graphs.

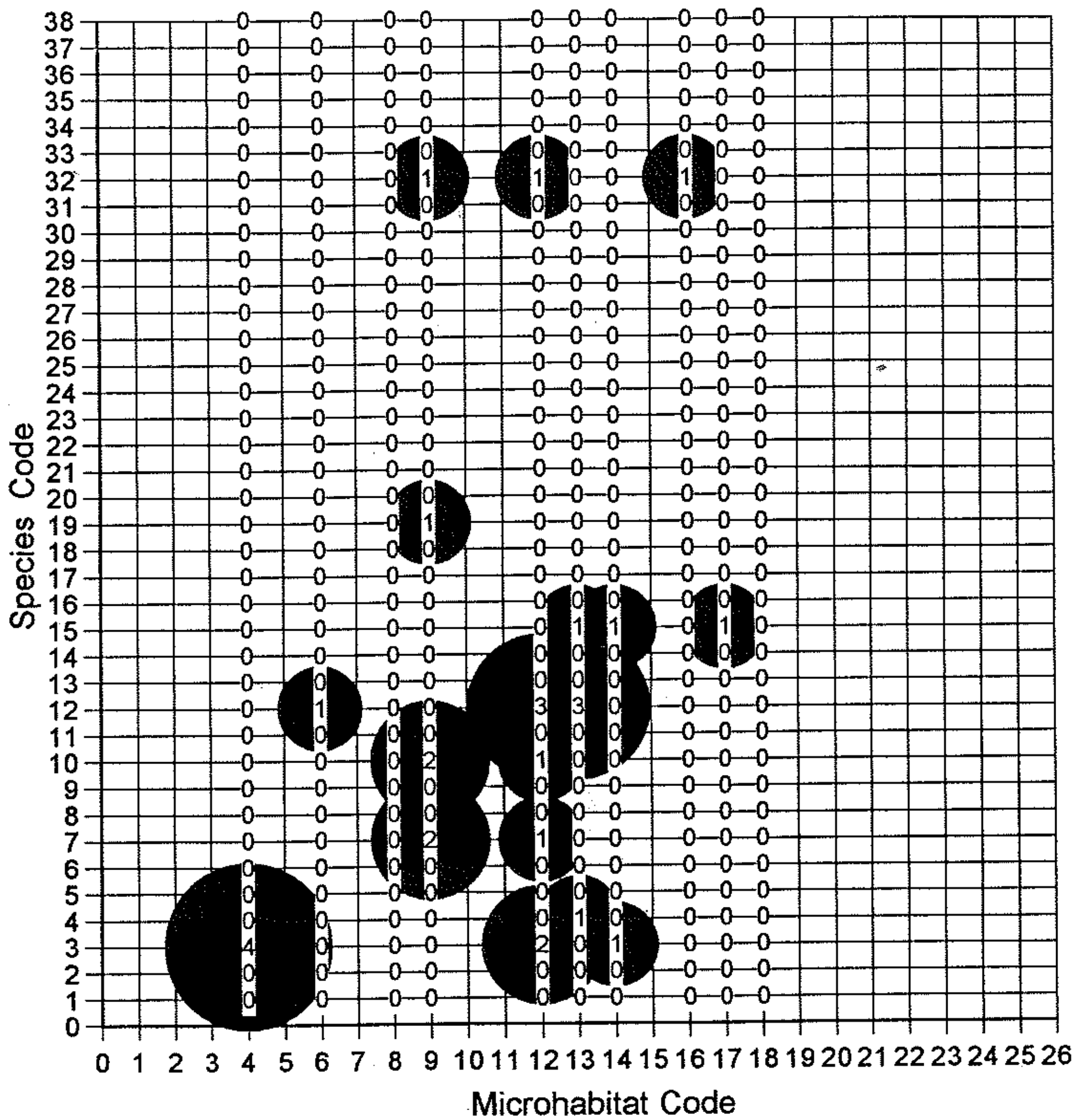
Code	Scientific Name	Common Name
1	*Anguilla rostrata*	American eel
2	*Lepisosteus oculatus*	Spotted gar
3	*Dorosoma cepedianum*	Gizzard shad
4	*Astyanax mexicanus*	Mexican tetra
5	*Hybopsis aestivalis*	Speckled chub
6	*Cyprinella venusta*	Blacktail shiner
7	*Cyprinella lutrensis*	Red shiner
8	*Notropis stramineus*	Sand shiner
9	*Notropis volucellus*	Mimic shiner
10	*Pimephales vigilax*	Bullhead minnow
11	*Campostoma anomalum*	Central stoneroller
12	*Ictiobus bubalus*	Smallmouth buffalo
13	*Moxostoma congestum*	Gray redhorse
14	*Minytrema melanops*	Spotted sucker
15	*Ictiobus bubalus*	Channel catfish
16	*Pylodictis olivaris*	Flathead catfish
17	*Ameirus natalis*	Yellow bullhead
18	*Fundulus notatus*	Blackstripe topminnow
19	*Gambusia affinis*	Western mosquitofish
20	*Poecilia latipinna*	Sailfin molly
21	*Menidia beryllina*	Inland silverside
22	*Micropterus punctulatus*	Spotted bass
23	*Erimyzin oblongus*	Creek chubsucker
24	*Micropterus treculi*	Guadalupe bass
25	*Micropterus salmoides*	Largemouth bass
26	*Lepomis gulosus*	Warmouth
27	*Lepomis cyanellus*	Green sunfish
28	*Lepomis auritus*	Redbreast sunfish
29	*Lepomis punctatus*	Spotted sunfish
30	*Lepomis microlophus*	Redear sunfish
31	*Lepomis macrochirus*	Bluegill
32	*Lepomis megalotis*	Longear sunfish
33	*Pomoxis annularis*	White crappie
34	*Pomoxis nigromaculatus*	Black crappie
35	*Percina macrolepida*	Bigscale logperch
36	*Etheostoma spectabile*	Orangethroat darter
37	*Cichlasoma cyanoguttatum*	Rio Grande cichlid
38	*Mugil cephalus*	Striped mullet

Appendix 1.
Microhabitat code for bubble graphs.

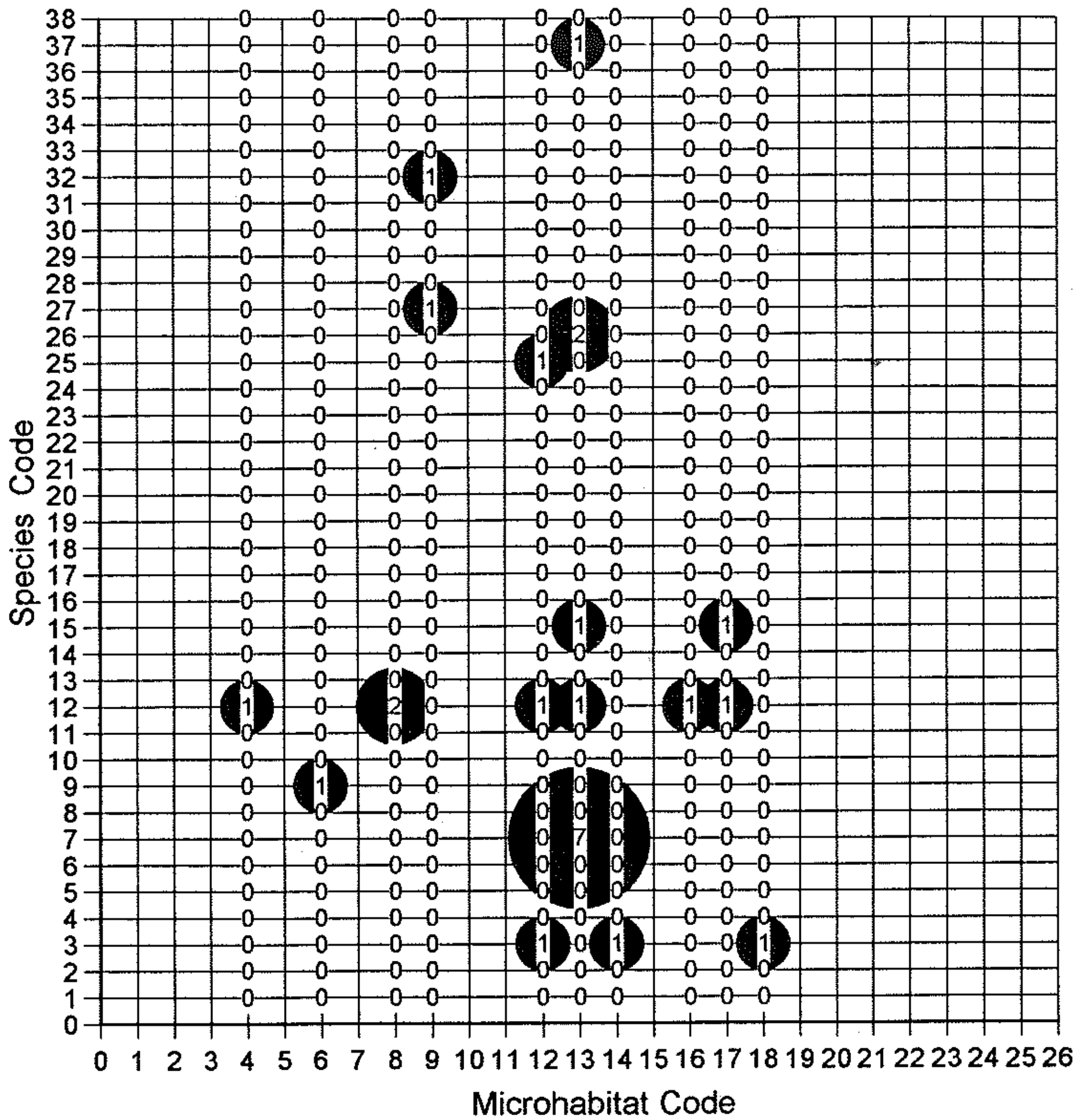
Graphs Code	Microhabitat
1	Pool
2	Chute
3	Rapid
4	Pool - Root Wad
5	Edgewater
6	Run
7	Run - Undercut Bank
8	Riffle - Bank Snag
9	Backwater
10	Riffle
11	Riffle - Debris dam
12	Riffle - Snag complex
13	Riffle - Channel snag
14	Eddy pool
15	Glide
16	Run - Root Wad
17	Pool - Bank Snag
18	Pool - Undercut Bank
19	Pool - Snag Complex
20	Pool - Channel Snag
21	Pool - Debris Dam
22	Run - Debris Dam
23	Run - Bank Snag
24	Run - Channel Snag
25	Backwater - Channel Snag



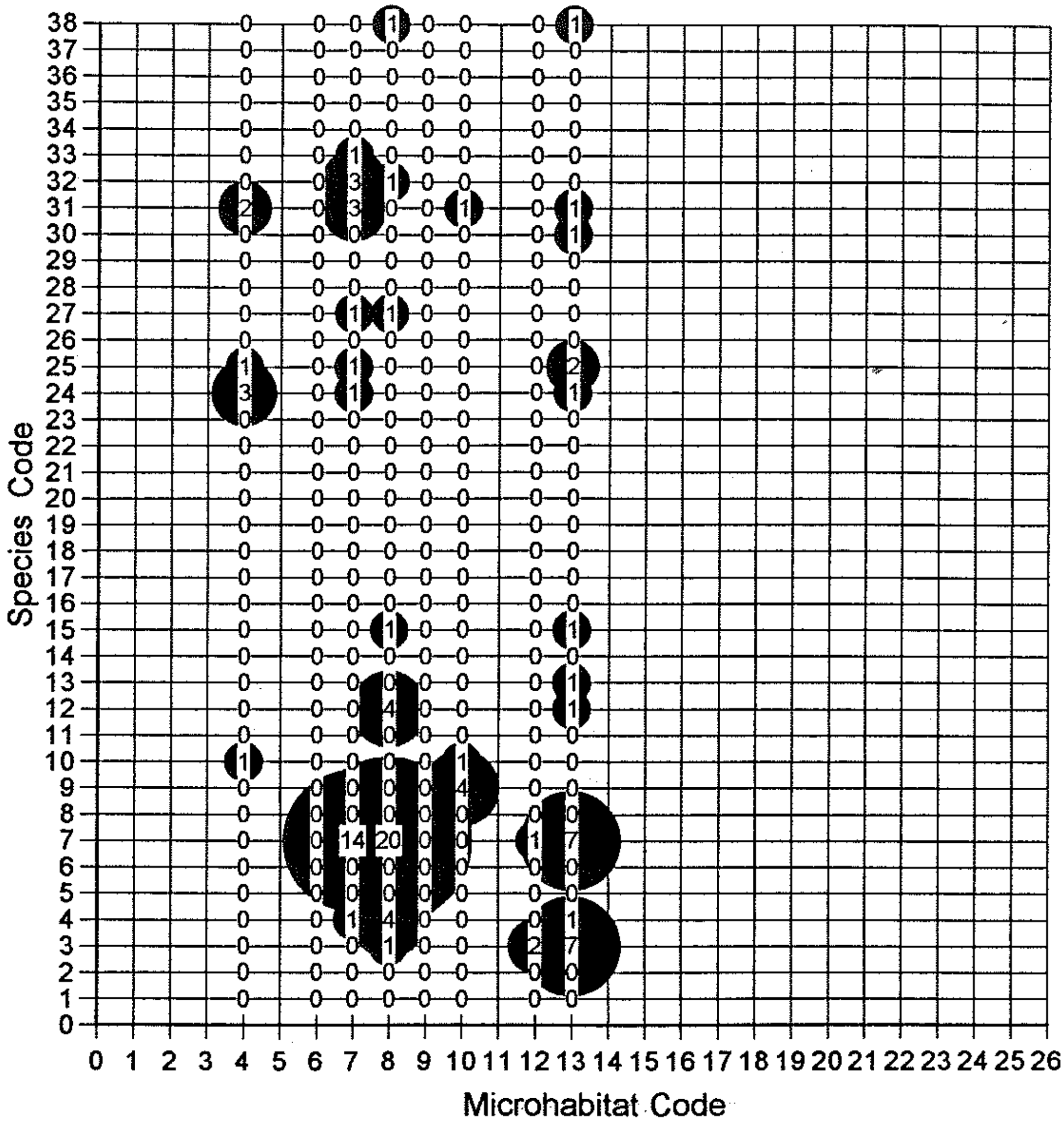
Appendix 2. Site 4 at winter low flow,
Nov. 7, 1997.



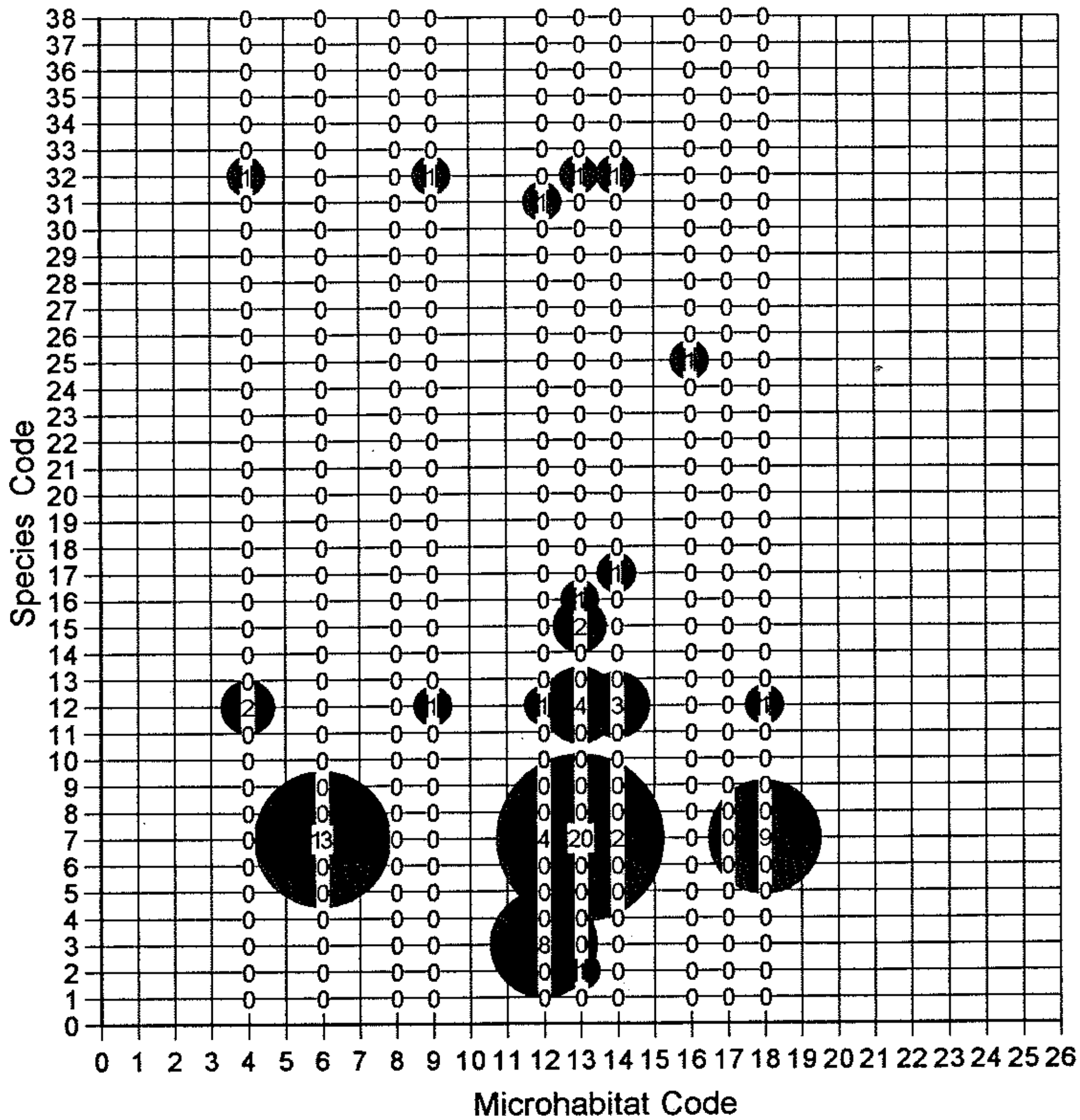
Appendix 2. Site 4 at winter high flow,
Nov. 21, 1997.



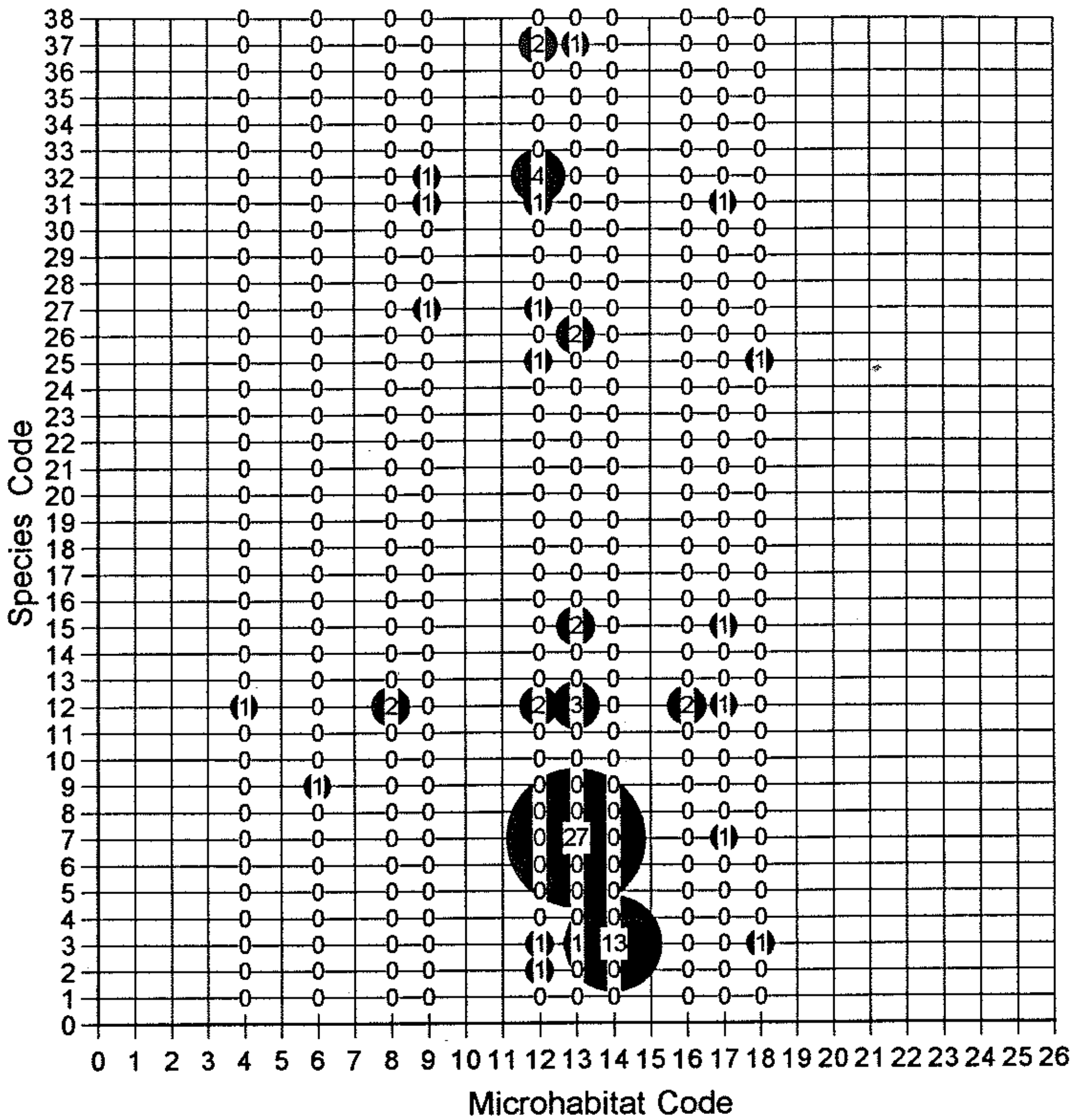
Appendix 2. Site 4 at summer low flow,
Oct. 29, 1997.



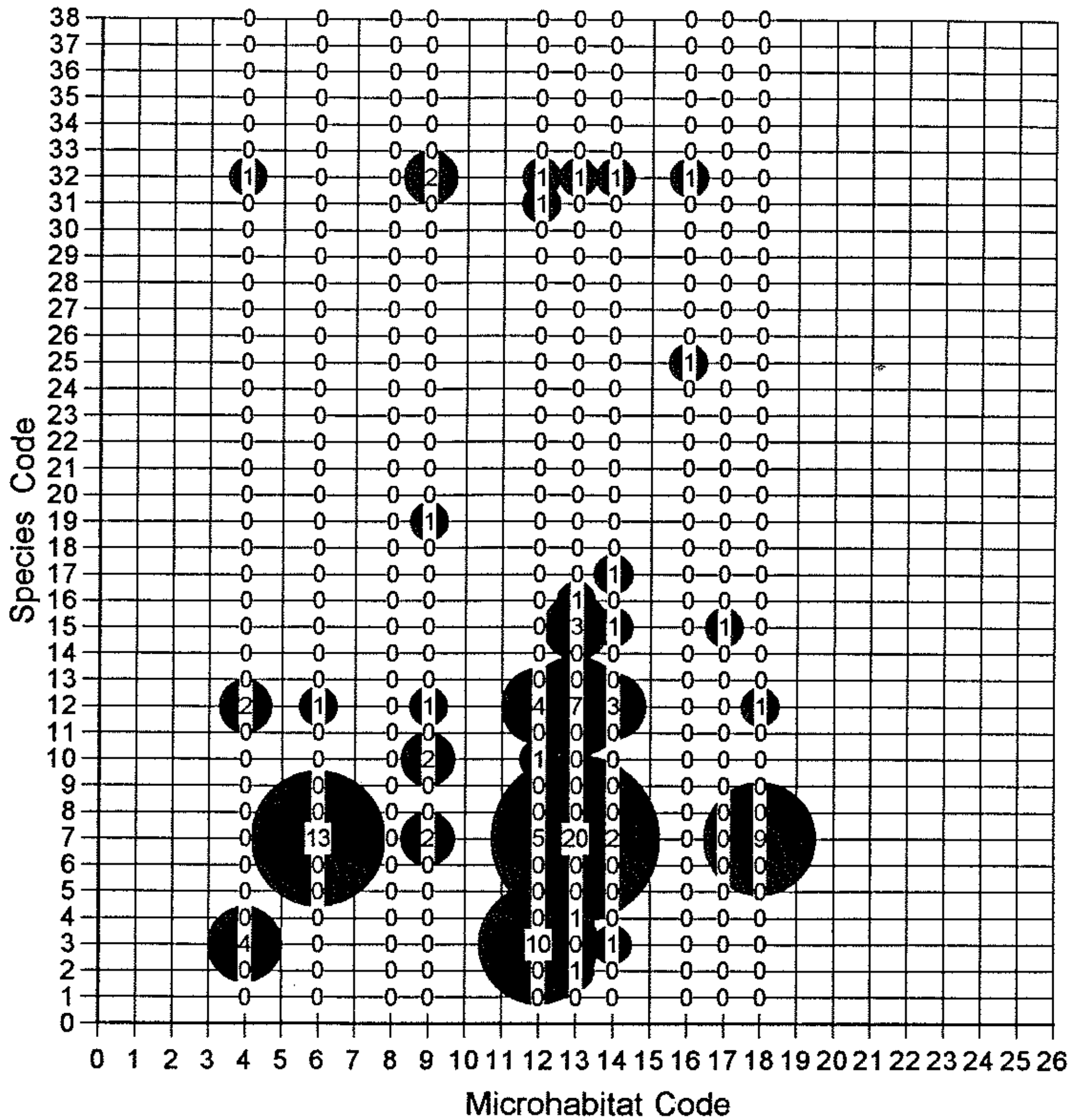
Appendix 2. Site 6 at medium flows, Jan. 9, 1997 and Oct. 25, 1997.



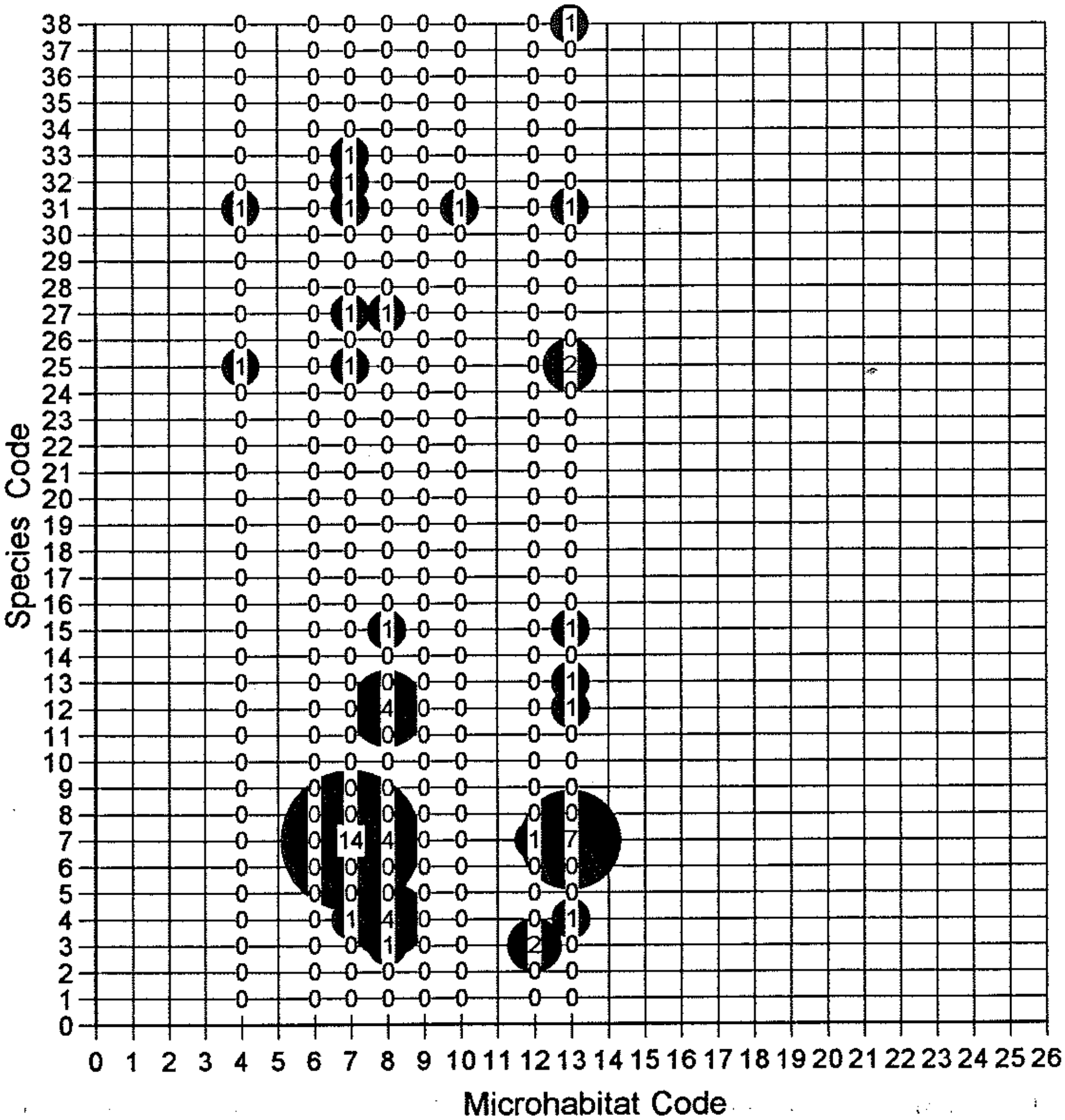
Appendix 2. Site 4 at summer high flow,
Oct. 18, 1997.



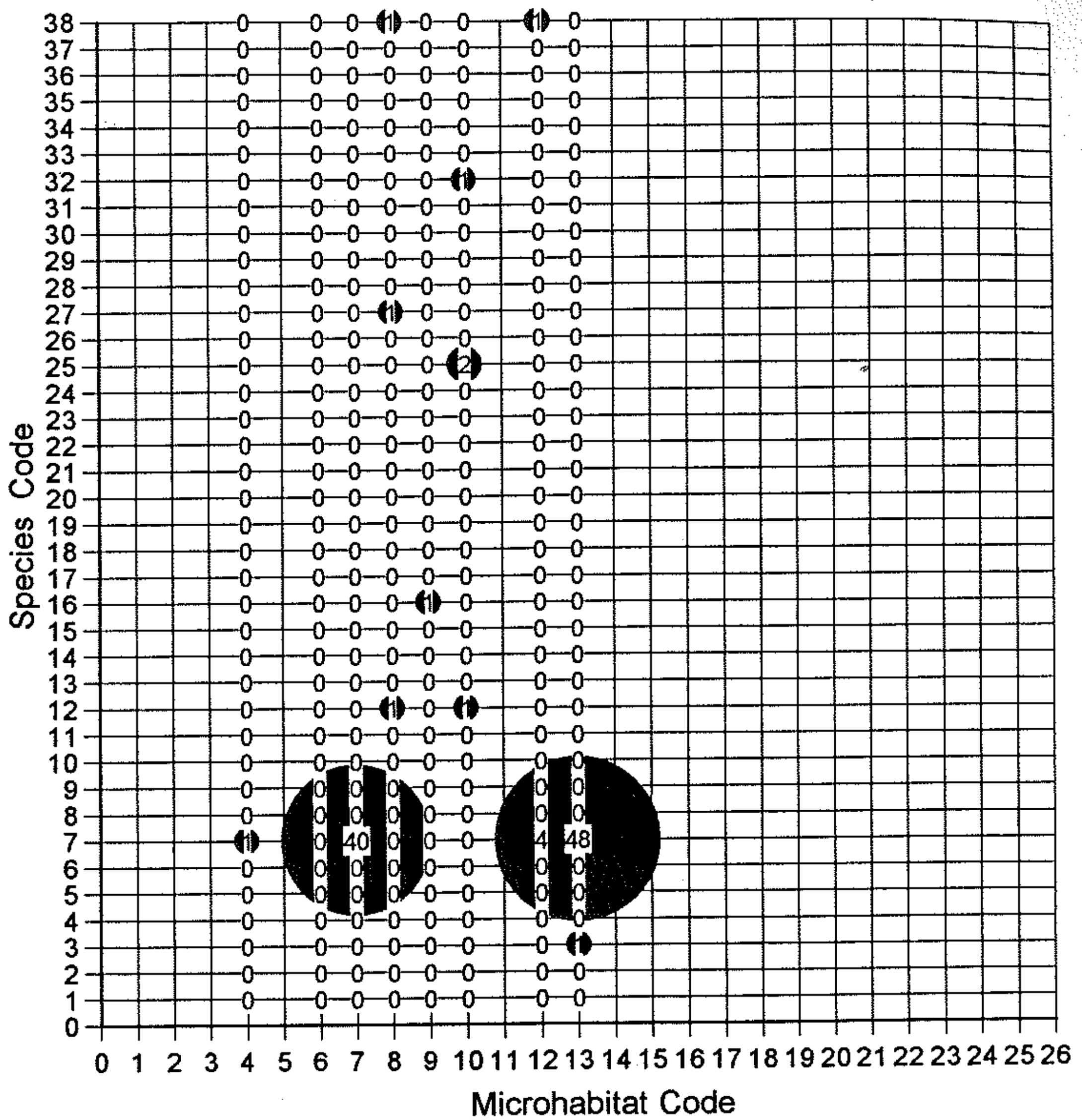
Appendix 2. Site 4 at low flows, Oct. 29, 1997 and Nov. 7, 1997.



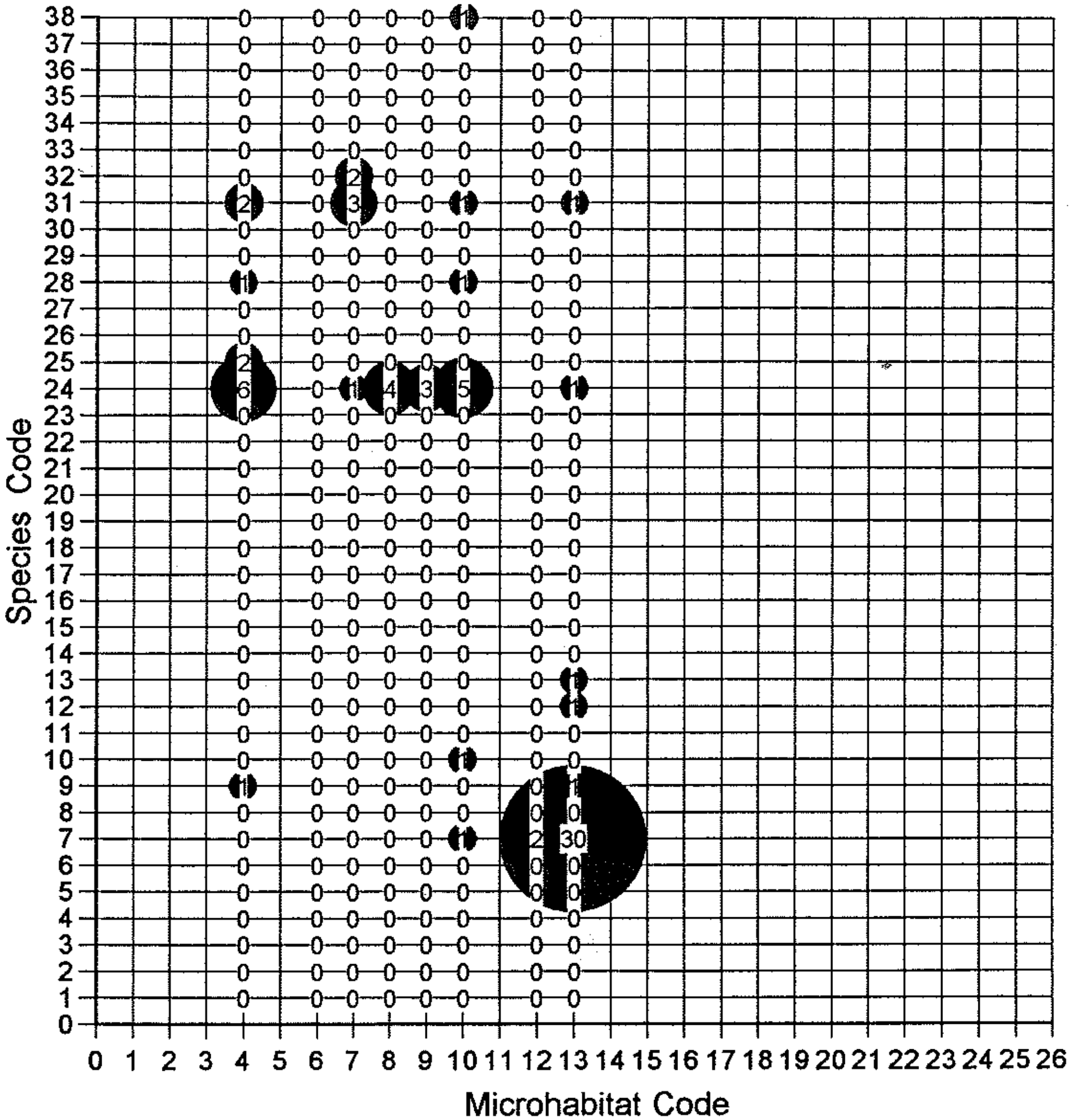
Appendix 2. Site 4 at high flows, Oct. 18, 1997 and Nov. 21, 1997.



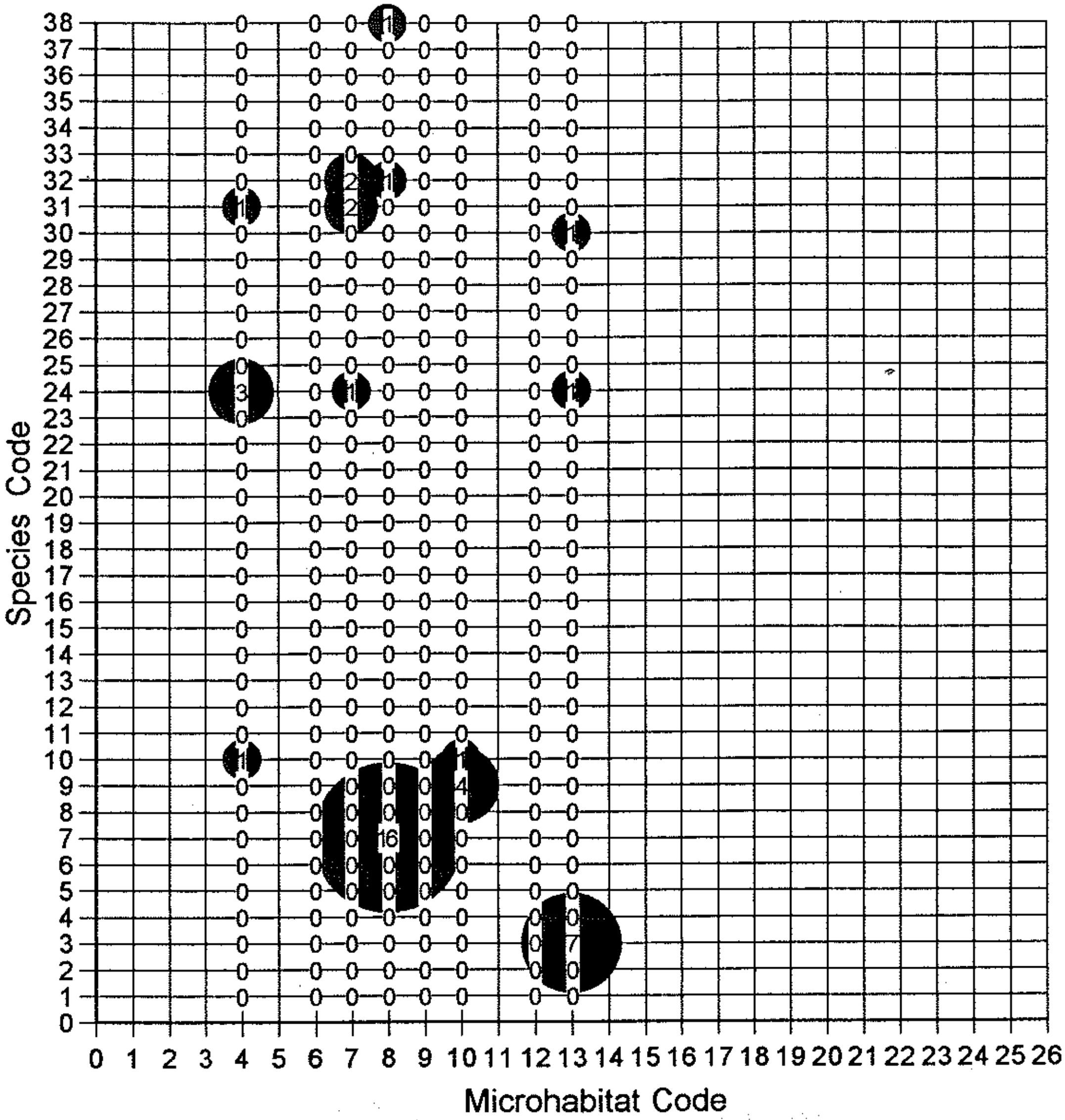
Appendix 2. Site 6 at summer medium flow, Oct. 25, 1997.



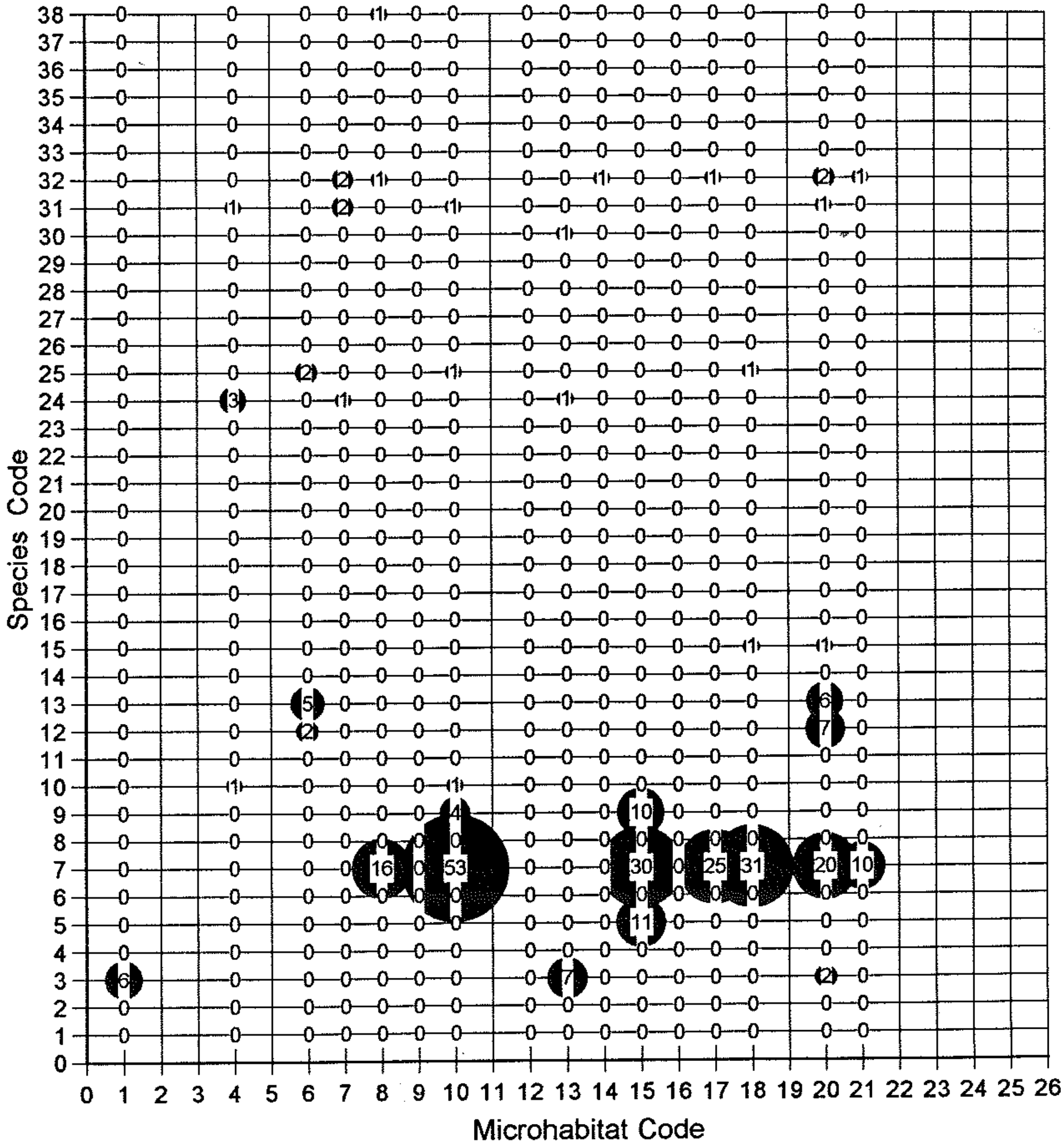
Appendix 2. Site 6 at summer high flow,
Sept. 21, 1997.



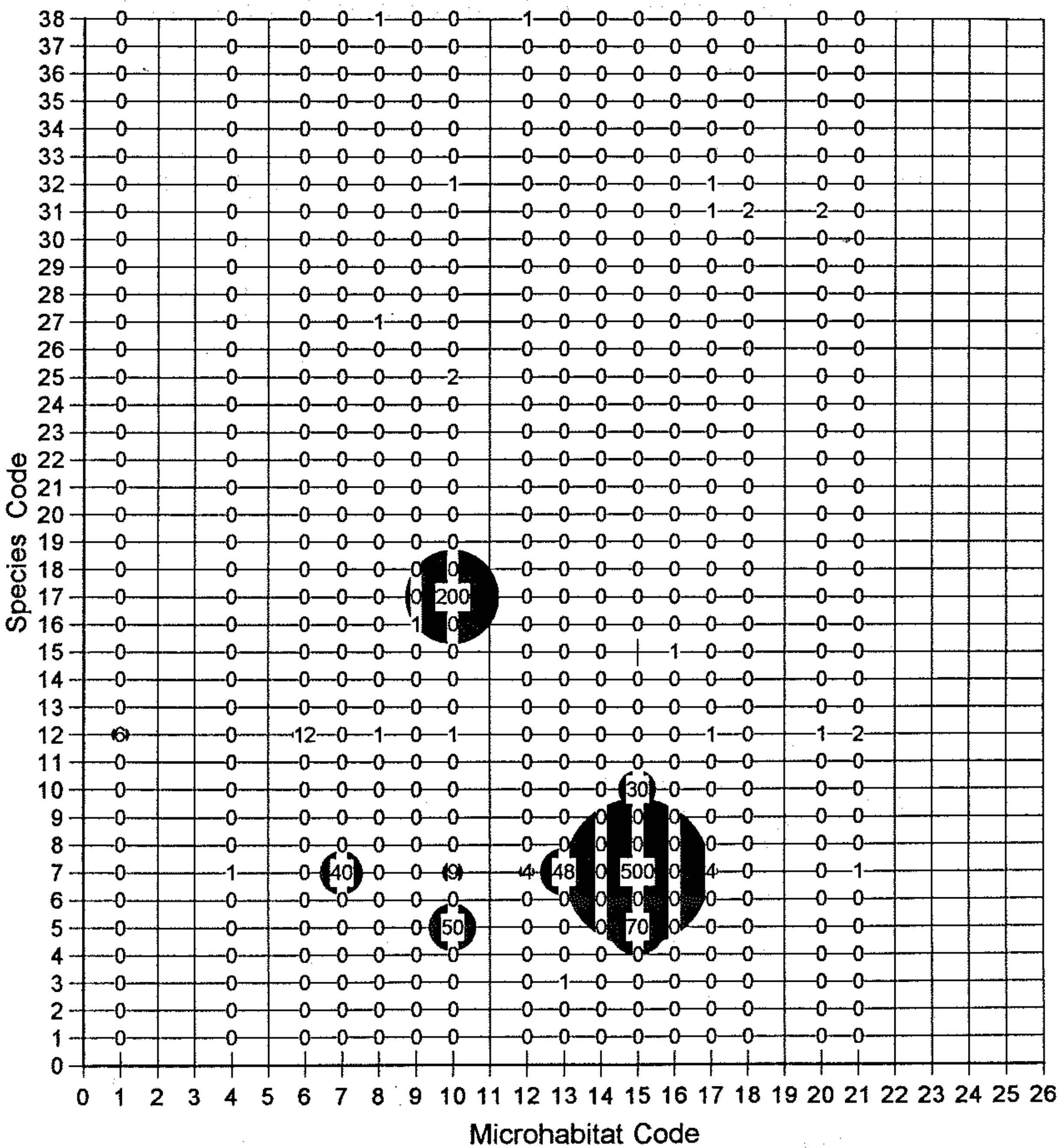
Appendix 2. Site 6 at winter low flow,
Jan. 8, 1997.



Appendix 2. Site 6 at winter medium flow, Jan. 9, 1997.



Appendix 2. Site 6 at low flows, Jan. 8, 1997 and May 8, 1996.

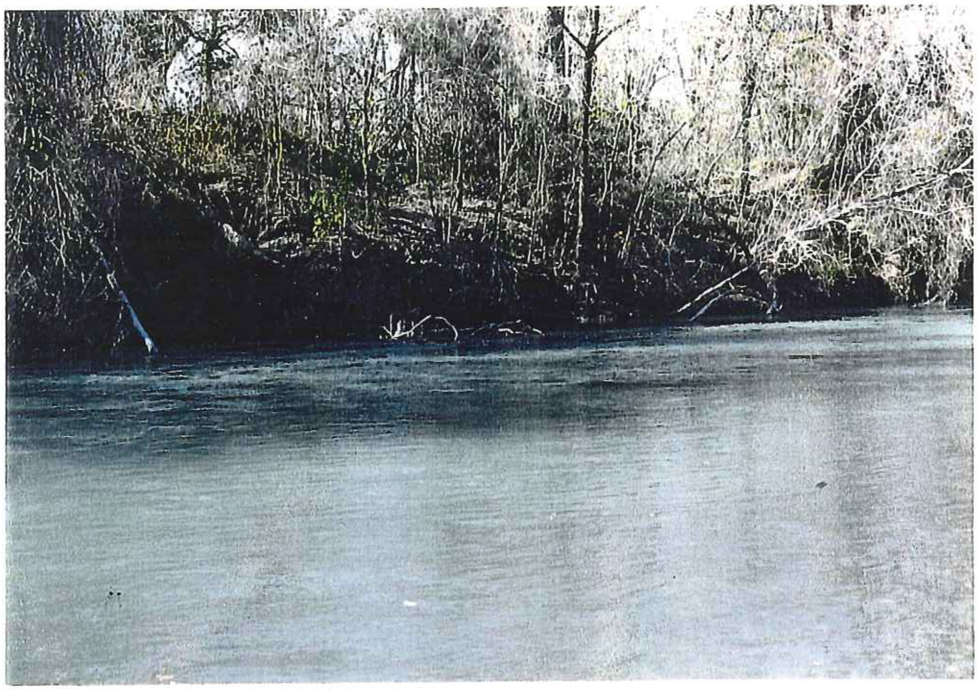


Appendix 2. Site 6 at high flows, April 2, 1996 and Sept. 21, 1997.

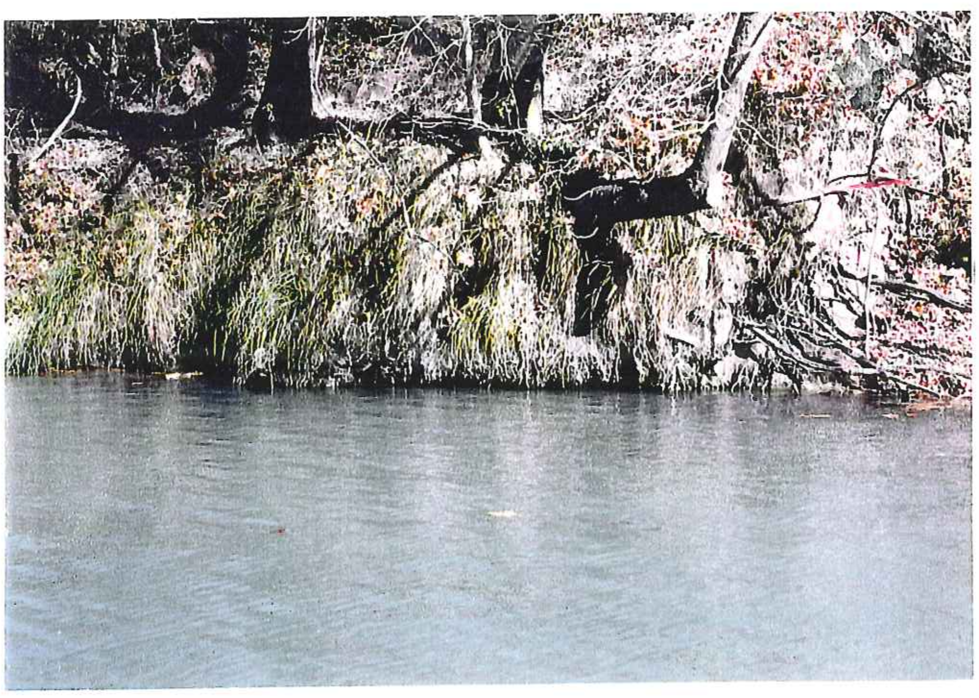
Site 4-D

Site 4-E,F,&G

Appendix 3. Microhabitats at Sample Sites.

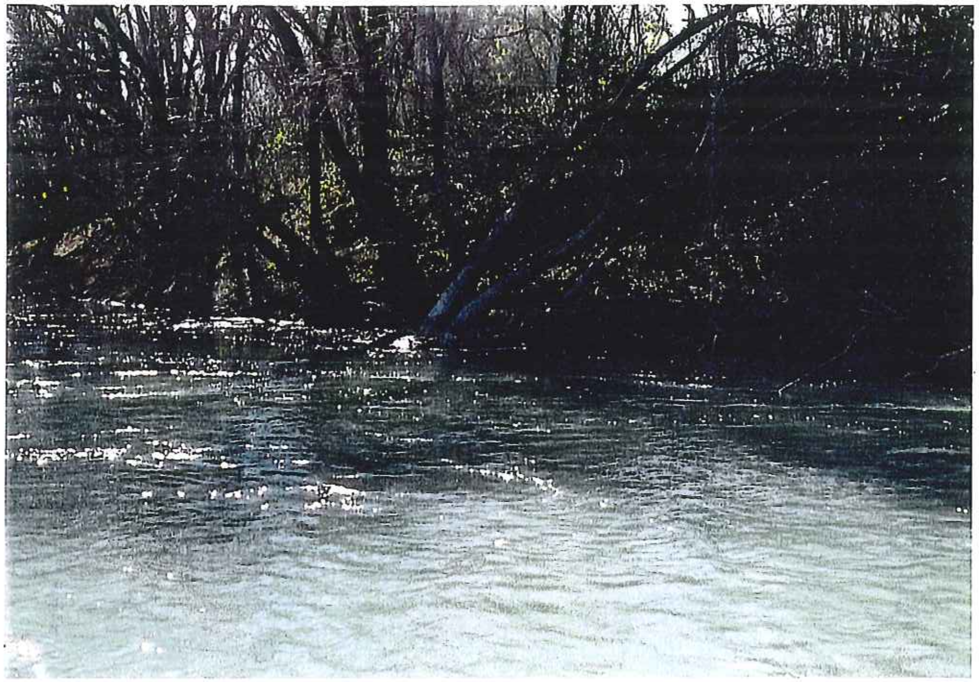


Site 4-G (close-up)



Site 4-H

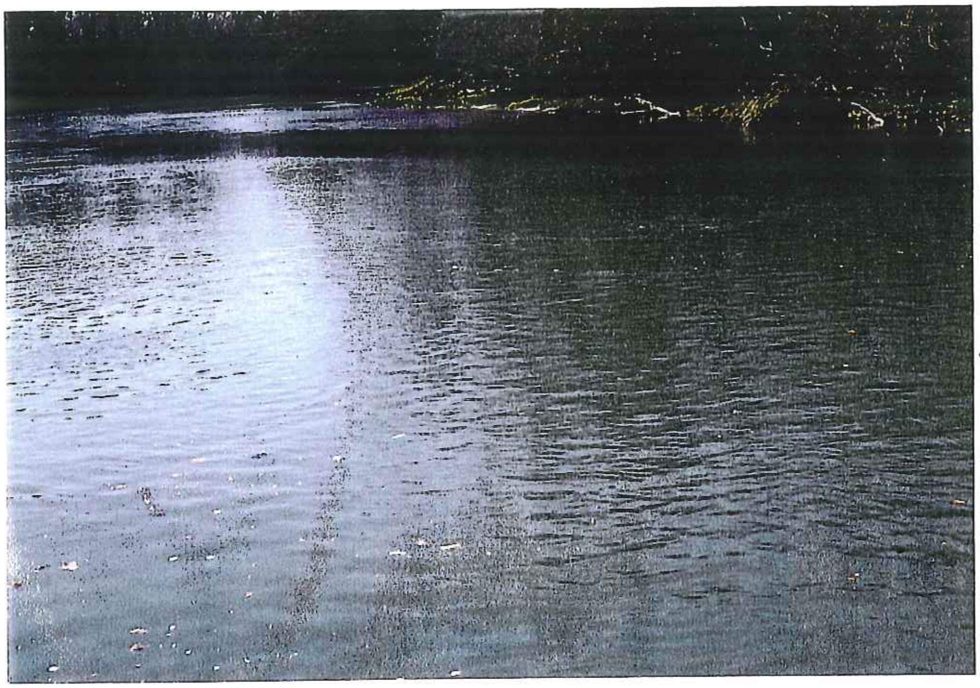
Appendix 3. Microhabitats at Sample Sites.



Site 4-I

Site 4-J

Appendix 3. Microhabitats at Sample Sites.



Site 4-K

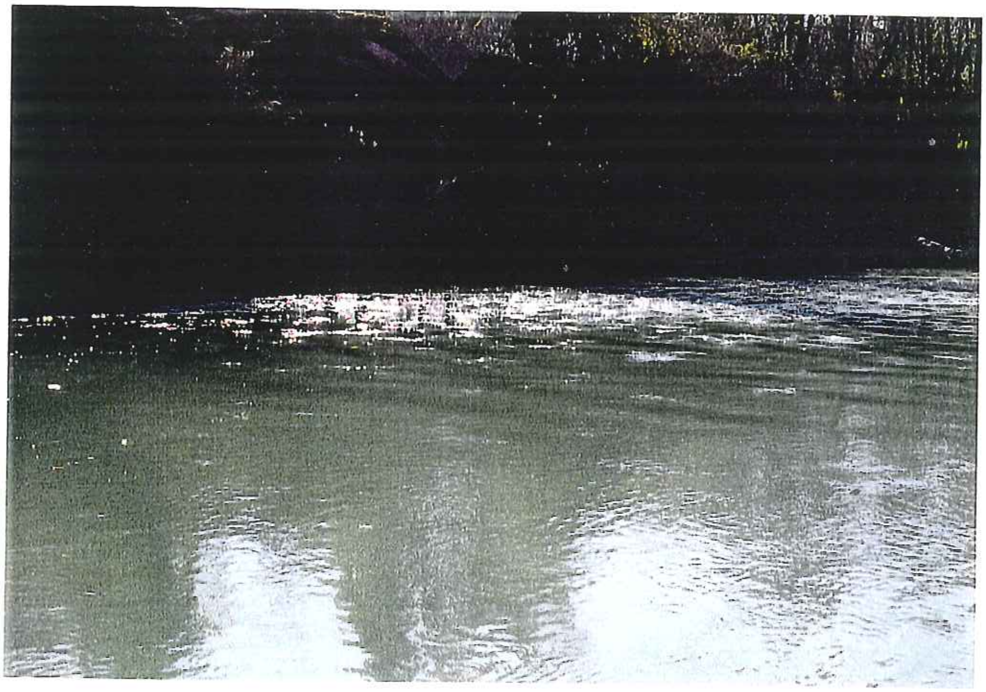
Site 4-L

Appendix 3. Microhabitats at Sample Sites.

Site 4-M

Site 4-N

Appendix 3. Microhabitats at Sample Sites.



Site 4-O

Site 4-P

Appendix 3. Microhabitats at Sample Sites.

Site 6-A

Site 6-B

Appendix 3. Microhabitats at Sample Sites.

Site 6-C

Site 6-D

Appendix 3. Microhabitats at Sample Sites.

Site 6-E

Site 6-F

Appendix 3. Microhabitats at Sample Sites.

Site 6-G

Site 6-H

Appendix 3. Microhabitats at Sample Sites.

Site 6-I

Site 6-J

Appendix 3. Microhabitats at Sample Sites.

Site 6-K

Site 6-L

Appendix 3. Microhabitats at Sample Sites.

Site 6-M

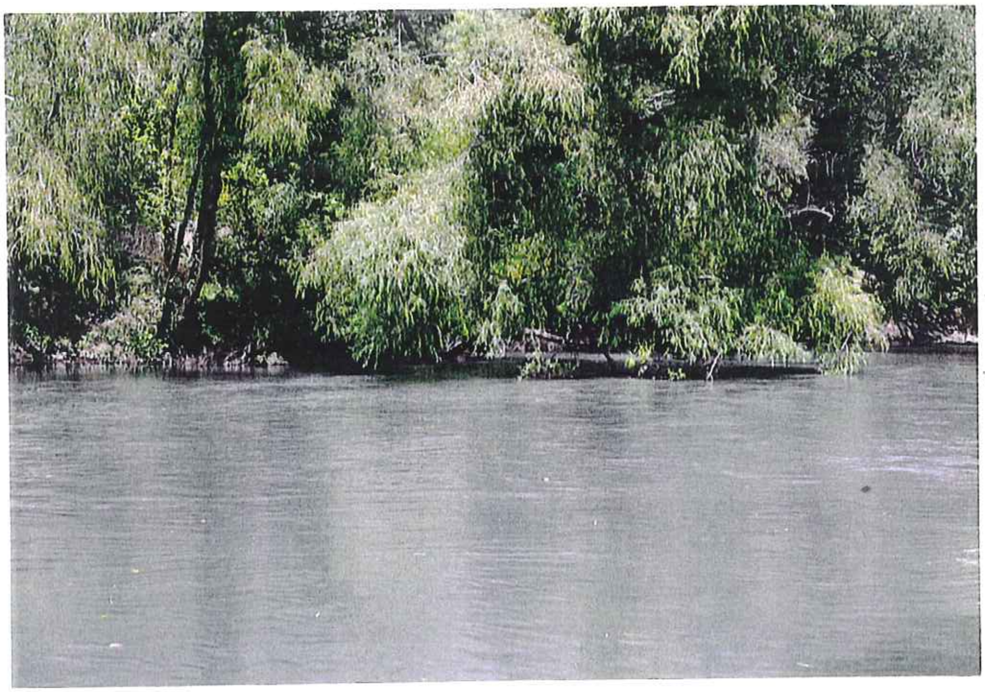
Site 6-N

Appendix 3. Microhabitats at Sample Sites.

Site 6-O

Site 6-P

Appendix 3. Microhabitats at Sample Sites.



Site 6-Q

Site 6-R

Appendix 3. Microhabitats at Sample Sites.

Appendix 4. Index of Biotic Integrity (IBI) for the study period.

	Site 4							
Sample Date:	18-Oct-97		29-Oct-97		7-Nov-97		21-Nov-97	
Metrics Used:	Raw Score	Metric Score	Raw Score	Metric Score	Raw Score	Metric Score	Raw Score	Metric Score
Total # of Species	10	5	10	5	10	5	8	5
# of Cyprinid Species	1	1	2	3	1	1	2	3
# of Benthic Invertivores	0	1	0	1	0	1	0	1
# of Sunfish Species	3	3	4	5	4	5	1	1
% Tolerant	76%	1	58%	1	78%	1	50%	3
% Omnivores	29%	1	46%	1	35%	1	61%	1
% Insectivores	67%	5	38%	3	59%	3	39%	3
% Piscivores	4%	3	15%	5	6%	3	0%	1
Total # of Indiv. per sein	79	3	26	1	51	3	28	1
% Hybrids	0%	5	0%	5	0%	5	0%	5
% Non-native species	4%	1	4%	1	8%	1	4%	1
% Diseased/Anomalies	0%	5	0%	5	0%	5	0%	5
IBI Score		34		36		34		30
Score Interpretation		SI		SI		SI		SI

SI = Slightly impaired
MI = Moderately impaired
NI = Non - impaired

Appendix 4. Index of Biotic Integrity (IBI) for the study period.

	Site 6							
Sample Date:	8-Jan-97		9-Jan-97		21-Sep-97		25-Oct-97	
Metrics Used:	Raw Score	Metric Score	Raw Score	Metric Score	Raw Score	Metric Score	Raw Score	Metric Score
Total # of Species	11	5	9	5	8	3	12	3
# of Cyprinid Species	3	3	3	3	1	1	1	1
# of Benthic Invertivores	1	3	0	1	0	1	1	3
# of Sunfish Species	5	5	4	5	3	3	4	5
% Tolerant	56%	1	62%	1	92%	1	66%	1
% Omnivores	3%	5	19%	1	5%	5	20%	1
% Insectivores	67%	5	69%	5	91%	5	68%	5
% Piscivores	31%	5	12%	5	4%	3	13%	5
Total # of Indiv. per sein	72	3	42	3	103	5	56	3
% Hybrids	0%	5	0%	5	0%	5	0%	5
% Non-native species	15%	1	7%	1	2%	3	16%	1
% Diseased/Anomalies	0%	5	0%	5	0%	5	0%	5
IBI Score		46		40		40		38
Score Interpretation		NI		NI		NI		SI

SI = Slightly impaired

MI = Moderately impaired

NI = Non - impaired