DRAFT REPORT - 8758

CALOOSAHATCHEE RIVER OXBOWS:

ENVIRONMENTAL INVENTORY

James F. Milleson

Assistance: Edward Terczak
Robert Martens
Michael Zaffke

Invertebrate Identification: Edward Terczak

April 12, 1979

INTRODUCTION

The Caloosahatchee river extends from the southwest shore of Lake Okeechobee, near Moore Haven, to the Gulf of Mexico near Ft. Myers. The Caloosahatchee River is the major waterway in southwest Florida, and serves multiple functions by providing for navigation, recreation, irrigation, drainage, and as a source for potable water.

Earliest attempts to "improve" the Caloosahatchee River for navigation were begun by Hamilton Disston during the 1880's. At present, the Caloosahatchee River, designated C-43, is an improved channel, about 50-130 meters wide and 6 to 9 meters deep. The Moore Haven Lock (HGS No. 1) and Structure 77 (S-77) mark the eastern end of C-43 at Lake Okeechobee. The Ortona Locks (S-78) are located 24 km to the west. Water stages upstream of S-78 are maintained at approximately 3.5 meters msl. The Franklin Locks (S-79), 66 km west of Lake Okeechobee, separates the fresh water river from the tidal influenced estuary. Water levels in the western reach of the Caloosahatchee River are maintained at approximately 1.0 meter msl.

Between the Franklin Locks and the City of LaBelle, 29 km to the east, are 35 oxbows extending from the canal. These oxbows are remnants of the original river channel which was severed during digging of the canal. C-43 is a very steep sided canal, whose banks are subjected to considerable erosion from wakes caused by large boat traffic. Consequently, the shallow water areas along the sides of C-43 are limited and not conducive to the establishment of aquatic plant communities in such an unstable environment. Therefore, some of the oxbows may provide shallow, vegetated areas which are more suitable for fish and wildlife than C-43.

For a variety of reasons, requests have been made to this District and other agencies to purchase, fill, dredge or otherwise alter some of the Caloosahatchee River oxbows. The purpose of this investigation is, therefore, to identify and catalogue the oxbows in C-43, and to conduct a cursory sampling program which would indicate the current environmental status of these areas, as well as document the ecological attributes of the oxbows compared to the canal habitats.

MATERIALS AND METHODS

Recent aerial photography was used to identify and locate oxbows along the Caloosahatchee River, for mapping purposes, and to estimate oxbow sizes. Aerial photographs obtained from Lee County were taken in 1975 and prepared by the Florida Dept. of Transportation (1:3600). United States Dept of Agriculture SCS photography of Hendry County was taken in 1974 (1:2400). Mark Hurd aerial photography (1972) of the entire Caloosahatchee River was also used. These photos were scale 1:24,000.

As each oxbow was located in the field, a preliminary inventory was conducted. This consisted of taking depth soundings across the oxbow in approximately three to five locations. An Ekman dredge was used to obtain a sample of bottom sediments from two to five locations in each oxbow. The sediments were examined in the field and described by the investigator. The sediment components are listed in this report in estimated order of abundance. Finally, areas in each oxbow occupied by aquatic vegetation were mapped, and the most common species were listed.

The thirty-five oxbows inventoried were classified according to general characteristics, such as average water depth, predominant nature of sediments, and whether the oxbow was open or closed. Seven oxbows were then selected which represented the range of conditions encountered in the preliminary

survey. The detailed sampling program of the seven representative oxbows included:

1. Benthic Fauna Sampling. Three transects were established across each oxbow. Four Ekman grabs (totaling 0.09 m^2) were combined from along each transect. The contents of the dredge were washed in a U.S. Standard Sieve No. 30, and the remaining organisms and debris preserved in 10% formalin with Rose bengal stain. In the laboratory the samples were rinsed with fresh water, organisms separated from debris, identified to genus and species by Edward Terczak, and counted.

The water depth and a description of the bottom sediments were recorded at the time of collection.

2. Benthic Sediment Analysis. Descriptions of benthic sediments, especially those which consist of various amounts of organic material, may not be consistent or accurate. Therefore, two samples of bottom substrate were obtained from each of the seven oxbows, including as wide of a range of bottom types as possible. Samples were placed into quart jars and frozen until analyzed. Chemical analysis consisted of percent organic material, percent inorganic material (marl) and percent insoluble ash (sand), and percentage of nitrogen and phosphorus. Physical measurements consisted of a particle size analysis (clay, silt, and sand) of the insoluble ash portion.

3. Associated Phytomacrofauna Sampling. Two methods were employed to sample invertebrate macrofauna and other organisms which inhabit the vegetated zones in the oxbow.

At one location in each oxbow, 5 replicate Hester Dendy samplers of the circular design (EPA, 1973), with an effective surface area of 0.13 m^2,

were suspended from 0.5 to 0.75 m underwater near the shore of the oxbow. The samples were incubated for 28 to 29 days. Upon retrieval, each sampler was disassembled, scraped clean and rinsed with fresh water. All organisms were collected by screening through a U.S. Standard No. 30 sieve and preserved with 10% formalin. In the laboratory all organisms were identified and enumerated.

A qualitative sample of free swimming organisms and those attached to floating vegetation were collected from each oxbow with a small mesh dip net.

4. Primary Productivity. Artificial substrates were used to document the growth of periphytic algae in the oxbows. One periphytometer(R) II, holding eight glass slides (24.5 x 75 mm) each was situated in each oxbow adjacent to the Hester Dendy samplers for a period of 28 to 29 days. Periphytometers were also placed along the edge of C-43 in several locations during this same interval. Upon retrieval glass slides were removed from the holders, placed individually into glass bottles and stored for 1 to 2 days on ice in the dark. In the laboratory the slides were scraped and washed, then the algae was filtered onto 0.45 micron pore size Gelman glass fiber filters. Photosynthetic pigments were extracted by grinding the filters in 90% acetone, and chlorophyll a concentrations were determined by the trichromatic method (Strickland and Parsons, 1972).

5. Fishes. The larger fish inhabiting selected oxbows and the edges of C-43 were sampled by electroshocking (240V). All individuals captured were identified, measured, and returned to the water. Species observed but not captured were noted.

6. Water Chemistry. An effort was made to compare water quality in the oxbows with water quality in C-43. Two or three samples were collected from each oxbow on July 14, 1978, one day after the routine water quality

sampling run was made on the Caloosahatchee River. Samples were taken from the surface and near the bottom of the water column where the water was sufficiently deep. A Hydrolab(R) Surveyor II was used to measure dissolved oxygen, temperature, specific conductivity and pH at 0.5 m intervals through the water column at each site. Water samples were filtered through 0.45 micron nucleopore filter and analyzed by Standard Methods or APHS methods for nitrogen and phosphorus species, silica, sulfate, chloride, alkalinity, sodium, potassium, calcium, magnesium, and color. Unfiltered samples were analyzed for total Kjeldahl nitrogen, total phosphorus and turbidity.

RESULTS

OXBOW INVENTORY

Figure 1 shows the Caloosahatchee River (C-43) from LaBelle to the Franklin Locks (S-79) and the location of the oxbows inventoried as a portion of this survey. All 35 oxbows are located west of the city of LaBelle. Appendix I provides an initial inventory of each oxbow, and includes a scale map, several water depth profiles, descriptions of bottom sediments, and depicts the distribution of the most abundant plant species.

These 35 oxbows range in area from less than one acre (number 23) to 11.6 acres (number 2), and in length from about 390 feet (number 14) to 2370 feet (number 10). Twenty of the oxbows are open, eleven are blocked either by floating vegetation mats or emergent aquatic vegetation, and four are completely blocked from the canal on one end by fill or sediment.

Water depths in the oxbows are variable, although the maximum depths recorded in most of the oxbows was between 5 and 10 feet. Only three oxbows (numbers 3, 11, and 15) were considered deeper than average, and nine oxbows (12, 16, 17, 21, 23, 24, 27, 34, and 35) had maximum depths less than 5 feet.

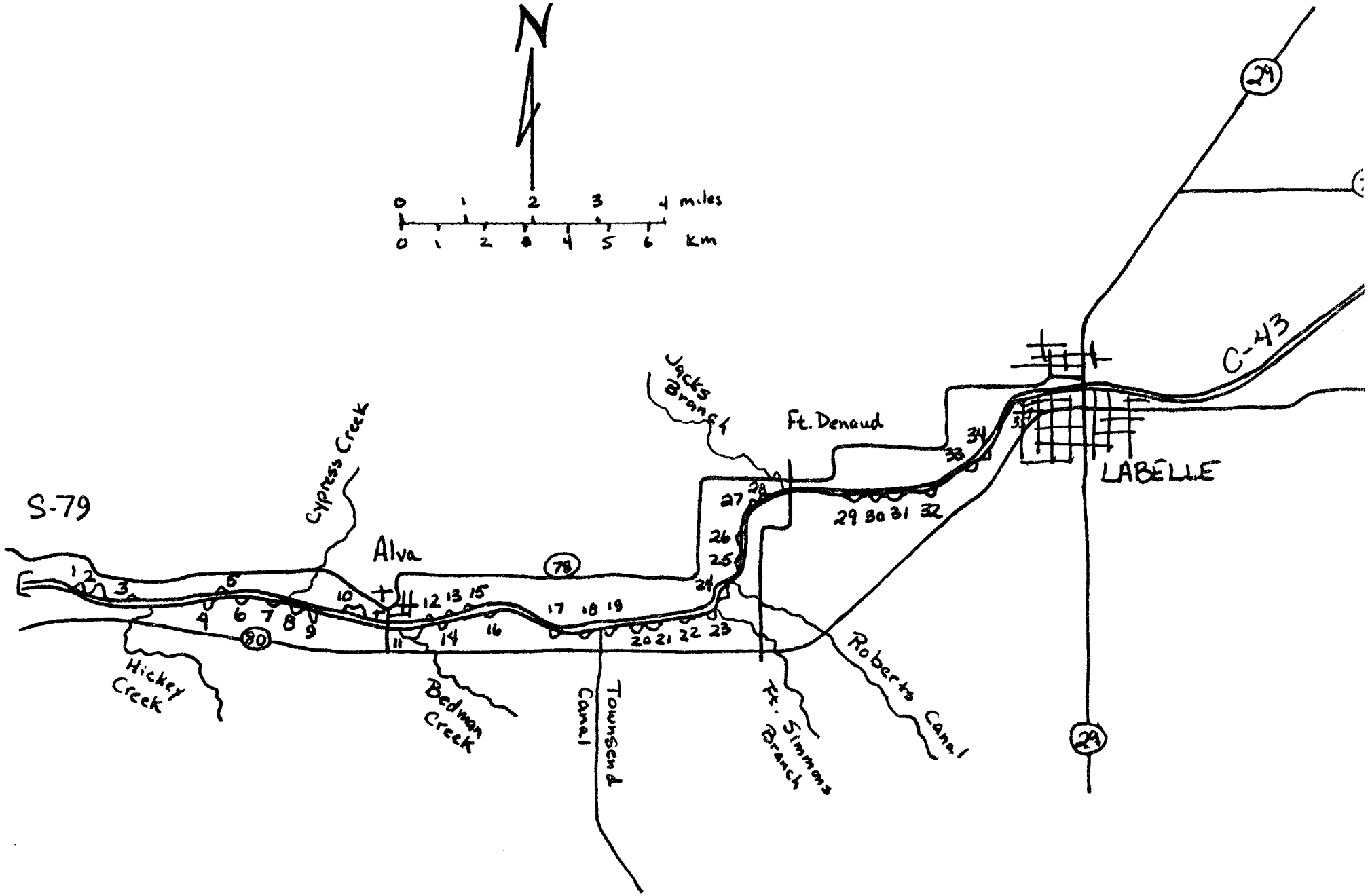


FIGURE 1: The Caloosahatchee River, C-43, Oxbows and Major Tributaries in the Western Reach

Sediments in the oxbows were predominantly organic ranging from well decomposed, very fine particulate matter described as mud or ooze, to a coarse peat with plant detritus fragments. These organic deposits were variable in thickness, ranging from only a few inches to several feet in depth. The bottom substrate in a few oxbows consisted of sand, shell fragments, or marl. Several types of benthic algae also colonized some of the oxbow substrates.

The sides of these oxbows generally drop steeply from the exposed river bank, and the anticipated, gently sloping vegetated, littoral zone did not occur regularly. Aquatic or semi-aquatic vegetation was generally of 3 types:

1) emergent vegetation growing in shallow water areas
2) floating mat vegetation communities
3) overhanging river bank vegetation

The most abundant emergent vegetation in the Caloosahatchee River oxbows was spatterdock (Nuphar advena), wild rice (Zizania aquatica), and cattail (Typha sp.). Floating mats of aquatic vegetation were usually dominated by alligator weed (Alternanthera philoxeroides) floating maidencane (Sacciolepis striata), water lettuce (Pistia stratoites) and primrose willow (Ludwigia peruviana). Overhanging riverbank vegetation consisted primarily of taro (Colocasia esculentum), leather fern (Acrosticum sp), coastal plain willow (Salix caroliniana), popash (Fraxinus caroliniana), and wax myrtle (Myrica cerifera). Table 1 provides a listing of the plant species encountered along the Caloosahatchee River oxbows and/or the islands, their common name, the two letter code used in Appendix I, and their distribution.

TABLE 1 : Plant Species in the Caloosahatchee River Oxbows

Species	Common name	Code	Distribution*
Acrosticum sp.	leather fern	ac	3,2
Alternanthera philoxeroides	alligator weed	al	2
Annona glabra	pond apple	an	3
Carya aquatica	water hickory	ca	3
Cicuta mexicana	water hemlock	cc	3
Cladium jamaicense	sawgrass	cl	1
Colocasia esculentum	taro	co	3
Eichhornia crassipes	water hyacinth	ei	2
Fraxinus caroliniana	pop ash	fx	3
Hibiscus grandiflorus	swamp hibiscus	hi	3
Hydrocotyle sp.	pennywort	hy	2
Ludwigia peruviana	primrose willow	lu	2
Myrica cerifera	wax myrtle	my	3,4
Nuphar advena	spatterdock	nu	1
Panicum hemitomon	maidencane	ph	1
Panicum paludivagum		pp	1
Panicum repens	torpedo grass	pr	1,2
Phrogmites australis	reed	pg	1
Pinus elliottii	slash pine	pn	4
Pistia stratoites	water lettuce	pi	2
Polygonum sp.	smartweed	po	1,2
Pontederia lanceolata	pickerelweed	pt	1
Psidium guajava	guava	ps	3,4
Quercus sp.	oaks	qu	3,4
Sabal palmetto	cabbage palm	sb	3,4
Sacciolepis striata	floating maidencane	ss	2
Sagittaria latifolia	arrowhead	sg	1
Salix caroliniana	coastal plain willow	sx	3
Sambucus simpsonii	florida elder	sa	3
Schinus terebinthifolius	brazilian pepper	st	3,4
Scirpus cubensis		sc	2
Taxadium distichum	cypress	tx	1,3,4
Typha sp.	cattail	ty	1
Zizania aquatica	wild rice	zi	1

* (1) emergent (2) floating (3) river bank (4) terrestrial

Because water levels in the Caloosahatchee River are generally stabilized, diversity of emergent vegetation is low. In contrast, the banks of the oxbows provide perhaps the most desirable habitat to support aquatic and water tolerant species of plants. These overhanging plants may be partially submerged in the water. They provide shade and shelter but also contribute considerable organic material into the water in the form of leaf litter and plant detritus. Floating mat communities are indicative of stabilized water levels, and also indicate that water flows through the oxbows are minimal. Nine of the eleven oxbows that were blocked by vegetation had extensive floating mats of vegetation. These mats block sunlight to the water beneath, reduce dissolved oxygen levels and contribute organic material.

DETAILED SAMPLING

The seven oxbows selected for more detailed environmental analysis were numbers 3, 10, 15, 20, 21, 24, and 28. Figures 2 to 4 show these oxbows and the locations of the various sampling sites. Oxbow 3 is open, has a maximum depth of 12 feet and organic sediments. Oxbow 10 is open with an average depth of about 5 feet and organic sediments. Oxbow 12 is open with maximum depth of 11 feet and sandy sediments. Oxbow 20 is open, about 5 feet deep, and has sand dominated sediments. Oxbow 21 is blocked on the east side by an extensive mat of floating vegetation, averages about 4 feet deep, and has sediments dominated by peat and detritus. Oxbow 24 is open but heavily vegetated by spatterdock, averages about 3 feet deep, and is dominated by organic sediments. Oxbow 28 is blocked on the east side by a sand bar, the water depth varies from 7 1/2 to 2 feet, but averages 5 feet, and has organic sediments.

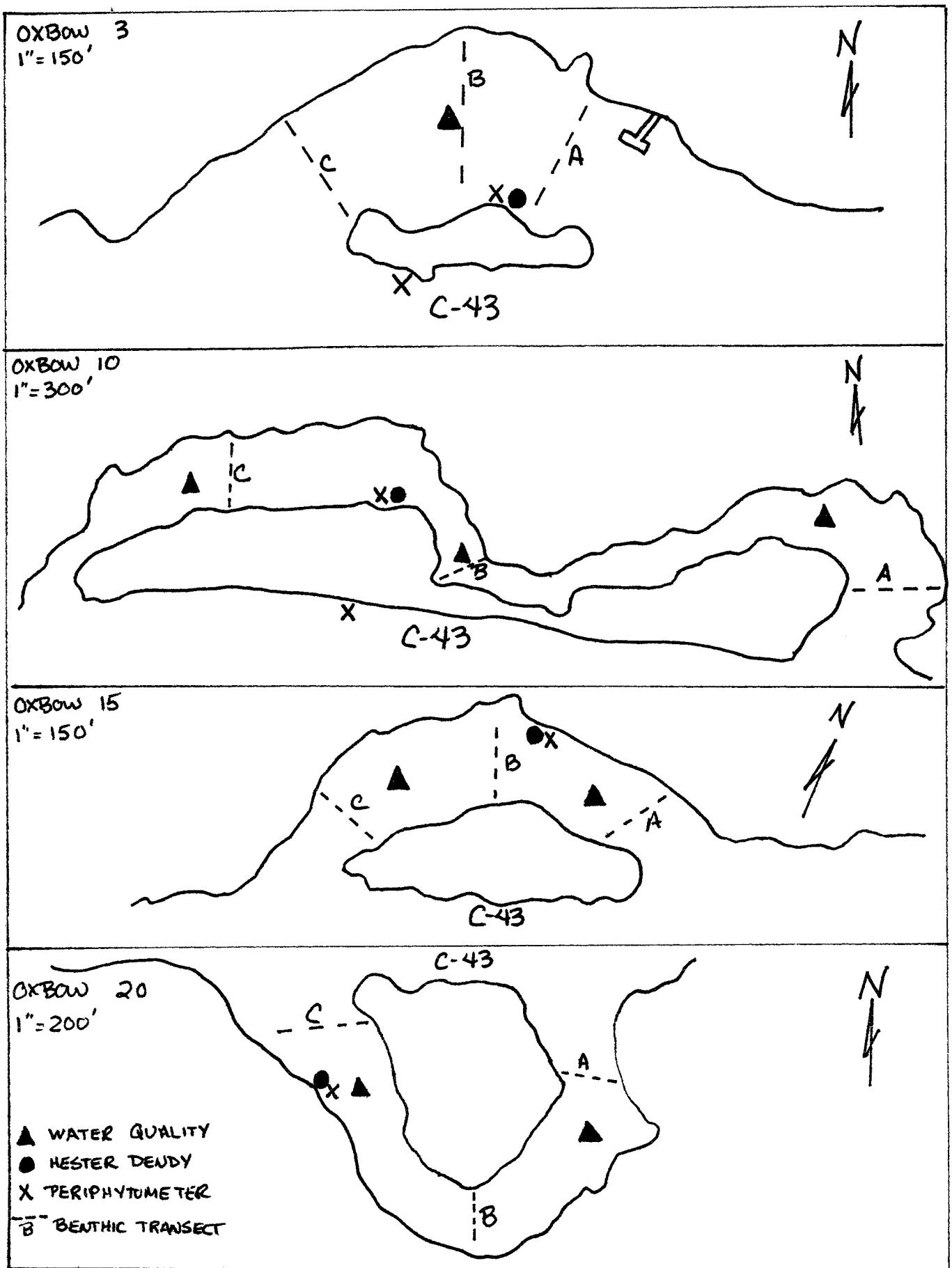


FIGURE CALOOSAHATCHEE RIVER OXBOWS SELECTED FOR DETAILED SAMPLING, AND SAMPLE LOCATIONS

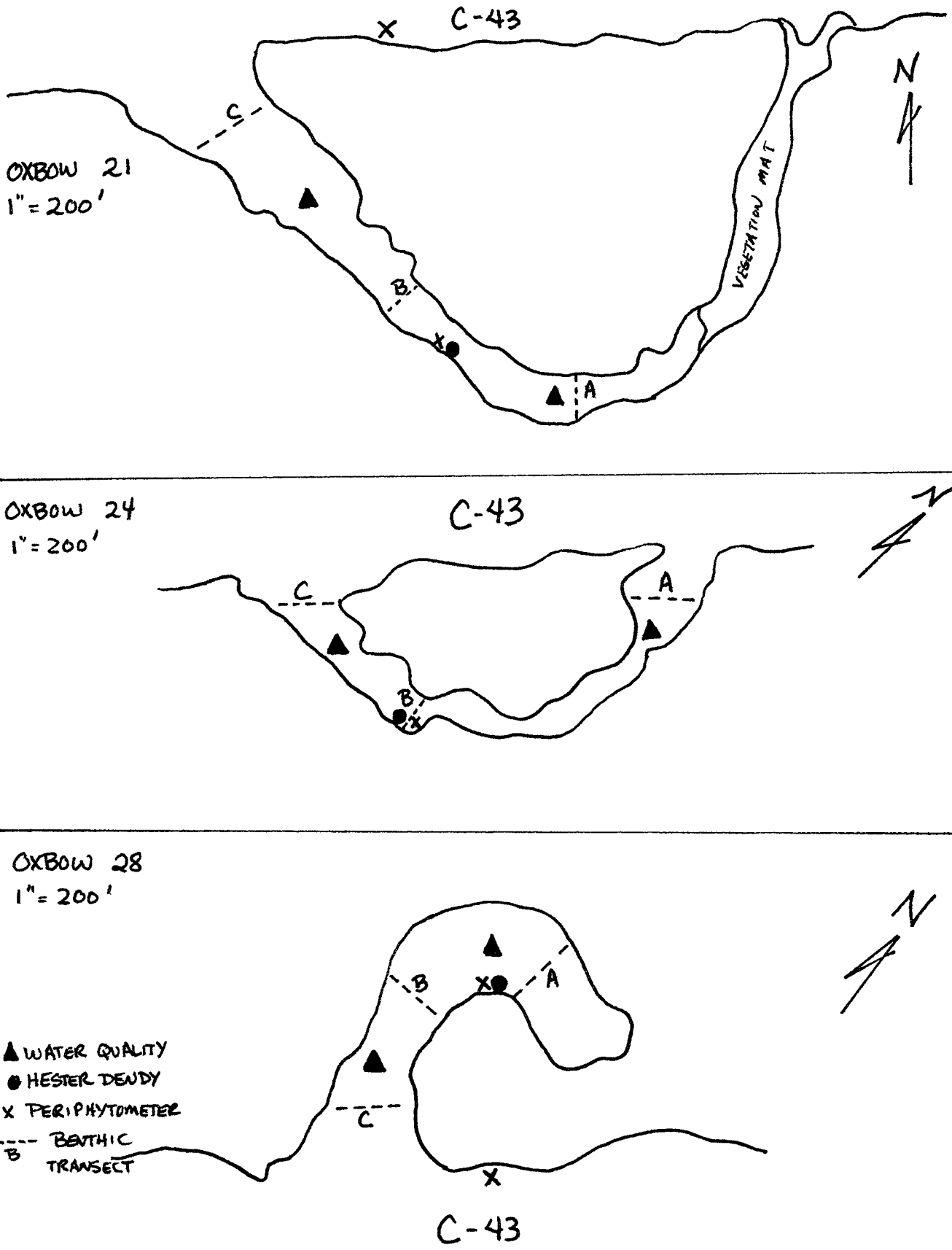


FIGURE CALOOSAHATCHEE RIVER OXBOWS SELECTED FOR DETAILED SAMPLING, AND SAMPLE LOCATIONS

Oxbow Benthos

Benthic macrofauna samples were taken from the seven Caloosahatchee River oxbows at water depths ranging from 0.5 to 4.0 meters, (1.5 to 12 feet), with an average depth of 1.5 meters (5 feet)(Table 2).

A total of 28 different species of organisms were collected in these samples. The average density of individuals recovered from the samples was 79/ft^2 (848/m^2). This figure is misleading, however, since 53% of all individuals collected were Chaoborus punctipennis at oxbow 28. Benthic macrofauna density in the other six oxbows was low, ranged from 19/ft^2 (201/m^2) in oxbow 15 to 64/ft^2 (692/m^2) in oxbow 10, and averaged 34/ft^2 (365/m^2).

Three species, Tubifex tubifex, Gammarus fasciatus, and Chaoborus punctipennis, were collected from each of the oxbows and collectively accounted for 88% of the total numbers of individuals. Cyathura polita, Corbicula leana, Ablabesmyia cinctipes, and Polypedilum halteri, were the four next most abundant species.

Tubifex tubifex, Gammaris fasciatus and Cyathura polita are scavangers and feed on algae, vegetation and plant detritus. Ablabesmyia cinctipes, Polypedilum halterali and Chaoborus punctipennis are primarily predators which feed on rotifers and microcrustacea. C. punctipennis often feeds extensively on Tubifex tubifex. Corbicula is a filter feeding pelecypod that would not be expected in great abundance in fine, organic sediments that dominant the oxbow bottoms, since it usually prefers sandy bottoms and moving water.

The oxbows with sandy sediments (15 and 20) had lower density of organisms, 201 and 273/m^2, respectively and higher diversity indices than

TABLE : BENTHIC FAUNA RECOVERED FROM SELECTED CALOOSAHATCHEE RIVER OXBOWS, JANUARY 1978, NUMBER OF INDIVIDUALS PER METER^2

		Oxbow #	3	10	15	20	21	24	28		
		Depth in meters	1.5-3.0	1.0-2.0	0.9-4.0	0.6-1.8	0.8-1.3	0.5-0.8	0.6-2.5		
		Open/Closed	O	O	O	O	C	O	C		
		Substrate type *	O	O	S	S	O	O	O	Total	Relative
		Deep/Moderate/Shallow	D	M	D	S	S	S	M	Number	Abundance
Annelida	Tubificidae	Tubifex tubifex	143	136	54	122	108	122	466	1151	19.4
		Limnodrilus hoffmeisteri			22	11		14		47	0.8
	Hirudinea			11					7	18	0.3
Amphipoda	Gammaridae	Gammarus fasciatus	4	366	18	54	22	104	7	574	9.7
	Cerophiidae	Corophium lacustre		4						4	0.1
Decapoda	Palaemonidae	Palaemonetes paludosus				7				7	0.1
Isopoda	Anthuridae	Cyathura polita	32		22		4	11	7	75	1.3
	Sphaeromatidae	Cassidinidae lunifrons				4	7			11	0.2
Pelecypoda	Corbiculidae	Corbicula leana	11	11	36	32		32	50	172	2.9
	Unionidae	Anodonta imbecilus		11	4					14	0.2
Diptera	Chironomidae	Ablabesmyia cinctipes	14	36	22	4		14	4	93	1.6
		Chironomus sp.	14	11						25	0.4
		Chironomus carus							32	32	0.5
		Chironomus crassicaudatus							4	4	0.1
		Chironomus stigmaterus		22		7			4	32	0.5
		Cryptochironomus fulvus							4	4	0.1
		Glyptotendipes paripes							25	25	0.4
		Orthocladius sp.							4	4	0.1
		Pentaneurini sp.			7		11			18	0.3
		Polypedilum halteri	14		7	14		4	7	47	0.8
		Procladius sp.	22			4	4	14		43	0.7
		Tribelos sp.				4				4	0.1
	Culicidae	Chaoborus punctipennis	43	82	4	7	230	11	3128	3505	59.0
	Ceratopogonidae	Bezzia sp.							4	4	0.1
Ephemeroptera	Baetidae	Callibaetis floridanus		4						4	0.1
	Caenidae	Caenis diminuta			4			4		7	0.1
Odonata	Libellulidae	Perithemis seminole					4			4	0.1
Pisces	Percidae	Etheostoma fusiforme	4		4			7		14	0.2
Total # Species			10	11	12	12	8	11	15	28	
# Individuals/m^2			301	692	201	273	384	337	3752	5940	100.2
Shannon Weaver $\bar{d}$			2.46	2.14	3.07	2.55	1.62	2.52	0.91		

* O = organic

the other five oxbows with organic sediments. Oxbow 28 had the highest number of species collected, probably due to the wide range of depths and substrate types sampled. Five chironomid species were collected only from oxbow 28. Otherwise, the oxbows with sandy sediments also had a greater number of species than those oxbows with organic sediments.

Comparison With Canal (C-43) Benthos

The three species of benthic invertebrates which dominated the fauna of the canal bottom were Tubifex tubifex, Chaoborus punctipennis, and Ablabesmyia cinctipes. Each of these species were among the most abundant invertebrates collected from the oxbow benthic region. Only the amphipod, Gammarus fasciatus, which was abundant in the oxbows, was relatively scarce in C-43. However, this amphipod was extremely common in the artificial substrate samplers suspended in C-43 near the water surface.

Oxbow Sediment Analysis

Chemical and physical analyses of sediment samples from the seven oxbows (Table 3) showed no consistent correlation with the field description made at the time of collection. Whereas most sediments were described as mud with varying amounts of detritus, sand and shell, the chemical analysis indicated that these sediments were primarily composed of insoluble ash (sand) and calcium carbonate (marl) materials. A particle size analysis indicated that most of the sediments were clay loams or sandy clay loams.

All of the samples which described sand as a major component, (24a, 21b, 20 a+b, 15 a+b) had the highest percentage of insoluble ash (59-77%).

TABLE 3. SEDIMENT ANALYSIS, CALOOSAHATCHEE RIVER OXBOWS

Oxbow	Field Description	% Organic	% Marl	% Insoluble ash (sand)	Description based on particle size distribution	% Nitrogen	% Phosphorus
28 a	det, pt	33	13	54	sandy clay loam	1.07	.174
b	md, det	14	28	58	clay loam	.71	.175
24 a	sa, sh, md, det	13	17	70	loam	.55	.178
b	md, det	20	38	42	clay loam	.81	.168
21 a	md, det, sh	17	29	54	clay loam	.78	.181
b	sa, md, det	9	16	75	sandy clay loam	.27	.184
20 a	md, sa, det, al	7	17	77	sandy clay loam	.16	.143
b	md, sa, sh, det	5	36	59	clay loam	.21	.137
15 a	md, sh, sa	3	19	77	sandy clay loam	.10	.119
b	det, sh, md, sa	7	26	68	sandy clay	.36	.138
10 a	al, md, sh	17	31	52	clay loam	.73	.228
b	md, det, sh	22	39	39	clay loam	.48	.234
3 a	md, det, sh	16	34	51	clay	.57	.281
b	md, det, sh, mr	12	42	47	clay	.43	.309

al = algae, det = detritus, md = mud, mr = marl, pt = peat, sa = sand, sh = shell

The percentage of nitrogen in particular, and to a lesser extent phosphorus, also tend to group the more sandy sediments from the organic sediments. The average nitrogen content in oxbows 15 and 20 was 0.21% compared to 0.64% for the other oxbows. Oxbows 15 and 20 averaged .134% phosphorus in the sediments, compared to .211% phosphorus for the others.

In contrast, canal bottom sediments were sandy at the eastern portion of C-43, upstream of Ortona Lock, and had more organic and marl constituents downstream of Ortona. Average percent nitrogen and phosphorus in the canal downstream of Ortona was similar to the percentages reported for the oxbows - all of which were located downstream of Ortona.

Associated Phytomacrofauna

Table 4 summarizes the average density of organisms recovered in Hester Dendy samplers from six of the seven oxbows subjected to 4 week incubation periods. The samplers from oxbow 24 were not recovered. A total of 30 species of aquatic organisms were recovered from the six oxbows, with five additional species present in samplers which were allowed to incubate for six weeks. No species was present in samplers from each of the six oxbows, although six species (Gammarus fasciatus, 2 snails, Pomatropsis sp., Pomatopyragus sp. and three chironomids, Ablabesmyia cinctipes, Goldchironomus holoprasinus and Polypedilum halteralii) were present in five of the six oxbow samples. These six species, plus the mayfly larvae, Caenus diminuta, were the most abundant organisms accounting for 96.9% of all organisms collected. The snail, Pomatropsis sp., which readily colonized the samplers, alone comprised 55% of all individuals organisms.

TABLE : AQUATIC MACROFAUNA RECOVERED FROM CALOOSAHATCHEE RIVER OXBOWS

			Benthic	Shallow Water	Vegetated	Comments
Pisces	Centrarchidae	Enneacanthus gloriosus			X	
		Leponis sp.			X	
	Cyprinodentidae	Fundulus chrysotus			X	
		Lucaria goodei			X	
	Percidae	Etheostoma fusiforme	X	X	X	Wide distribution
	Poeciliidae	Gambusia affinis			X	
		Heterandia formosa			X	
		Poecilia latipinna		X	X	
Annelida	Hirulinea		X	X		
	Tubificidae	Limnodrilus hoffmeisteri	X			
		Tubifex tubifex	X	X		
Amphipoda	Corophiidae	Corophium lacustre	X	X		
	Gammaridae	Gammarus fasciatus	X	X	X	Wide distribution
Decapoda	Palaemonidae	Palaemonetes paludosus	X		X	
Gastropoda	Ancylidae	Ferrissia sp.		X		
	Bythiniidae	Pomatiopsis sp.		X		
		Pomatopyragus sp.		X		
	Physidae	Physa pomila		X	X	
	Pilidae	Pomacea paludosus		X		
	Planorbidae	Gyralus jenfensi			X	
		Helisoma sp.		X		
		Helisoma scalare		X		
	Thiaridae	Melanoides tuberculata		X	X	
Pelecypoda	Corbiculidae	Corbicula leana	X			
	Unionidae	Anodonta imbecilus	X			
Isopoda	Anthuridae	Cyathura polita	X	X		
	Aphaeromidae	Cassidinidea lunifrons	X	X	X	Wide distribution
Coleoptera	Chrysomelidae	Donacia sp.		X		
	Gyrinidae	Dineutes sp.		X		
		Dineutes carolinus			X	
		Gyrinus elevatus		X		
Diptera	Ceratopogonidae	Bezzia sp.	X			
		Probezzia sp.		X	X	
	Chironomidae	Ablabesmyia cinctipes	X	X		
		Chironomus sp.	X			
		Chironomus carus	X			
		Chironomus crassicaudatus	X			
		Chironomus stignaterus	X	X		
		Cryptochironomus sp.			X	
		Cryptochironomus fulvus	X			
		Geoldchironomus holoprasinus		X		
		Glyptotendipes paripes	X			
		Orthocladius sp.	X			
		Parachironomus sp.			X	
		Ponteneurini sp.	X		X	
		Polypedilum halterali	X	X	X	Wide distribution
		Procladius sp.	X			
		Rheotanytarsus		X		
		Tribelos sp.	X			
	Culicidae	Chaoborus punctipennis	X			
		Culex territans		X		
		Culiseta inornata		X		
	Stratiomyiidae	Odontomyia sp.			X	
Ephemeroptera	Baetidae	Callibaetis floridanus	X	X		
	Caenidae	Caenis diminata	X	X		
Hemiptera	Belastomatidae	Belastoma sp.			X	
Lepidoptera	Pyralilidae	Nymphula sp.			X	
Odonata	Libellulidae	Celithemis eponina		X		
		Pachydiplax longipennis		X	X	
		Perithemis seminole	X			
		Somatochlora filosa		X		
	Coenigrionidae	Ischnura polita		X		
Tricoptera	Hydropsychidae	Hydropsyches sp.		X		
	Psychomyiidae	Polycentropus sp.		X		

Organism density on the samplers showed considerable variability, but the average was similar to that occurring naturally on the oxbow benthic substrate. Of the total 35 species collected, only 11 were also collected from the benthic substrate and 24 species were unique to the Hester Dendy samplers.

Additional organisms were collected from each oxbow by qualititively dipping a small mesh net in and amongst floating and emergent vegetation in each oxbow. A total of 24 species were collected by this method, including 8 species of small fishes, 3 species of snail and 6 species of dipterans. Again, this technique recovered 17 species that were not found on the benthic substrate, 15 species that were not recovered from the Hester Dendy artificial substrates, and 13 species that were unique altogether.

Table 5 summarizes the small fish and aquatic invertebrate organisms recovered from the Caloosahatchee River oxbows, and the type of habitats from which they were recovered. Altogether 64 species of aquatic macrofauna were recovered from Caloosahatchee River oxbows using a variety of sampling techniques. Only four of these species were recovered from all three of the habitats. Fifteen species were recovered by two of the sampling methods, and 45 species were recovered by only one of the techniques.

This sampling was cursory, and additional species could have likely been obtained by a more intensive sampling program. However, the data clearly shows the diversity of aquatic organisms which occupy the various niches unique to the oxbows associated with various types of vegetation, substrates, and water depths.

TABLE : AQUATIC MACROFAUNA COLONIZING HESTER DENDY SAMPLERS IN CALOOSAHATCHEE RIVER OXBOWS FOR 4 WEEK INCUBATION PERIOD, JULY-AUGUST, 1978. NUMBER ORGANISMS PER SQUARE METER.

Species		3	10	15	20	21**	28	Total	% Abundance
Pisces	Percidae Etheostoma fusiforme	4					3	7	.1
	Poeciliidae Poecilia latipinna						*	-	
Annelida	Hirulinea		6					6	.1
	Tubificidae Tubifex tubifex					2		2	-
Amphipoda	Corophiidae Corophium lacustre	*		3				3	-
	Gammaridae Gammarus fasciatus	15	38	3	6	3		65	1.0
Gastropoda	Ancylidae Ferrissia sp.					3		3	-
	Bythiniidae Pomatropsis sp.	415	3020		56	3	59	3553	55.0
	Pomatopyragus sp.	192	252		56	3	56	562	8.7
	Physidae Physa piula		6					6	.1
	Pilidae Pomacea paludosus		2					2	-
	Planorbidae Helisoma sp.		2					2	-
	Helisoma scalare						8	8	.1
	Thiaridae Melanoides tuberculata	42	8				5	55	.8
Isopoda	Anthuridae Cyathura polita			3				3	-
	Sphaeronidae Cassidinidea lunifrons	4		38			*	42	.7
Coleoptera	Chrysomelidae Donacia sp.						*	-	-
	Gyrinidae Dineutes sp.			*			3	3	-
	Gyrinaus elevatus					2		2	-
Diptera	Ceratopogonidae Probezzia sp.	*						-	-
	Chironomidae Ablabesmyia cinctipes	54	4	74	2		13	147	2.3
	Geoldchironomus holoprasinnus	54	12	394	6		602	1068	16.8
	Polypedilum halterali	84	6	84	23		23	220	3.4
	Chironomus stigmaterus					8		8	.1
	Rheotanytarsus sp.						3	3	-
	Culicidae Culiseta inornata					2		2	-
	Culex territans						*	-	
Ephemeroptera	Caenidae Caenis diminuta	614		10		2	18	644	10.0
	Baetidae Callibaetis floridanus		6					6	.1
Odonata	Libellulidae Celithemis eponina		2		2		8	12	.2
	Pachydiplax longipennis	*			2	2	3	7	.1
	Somatochlora filosa		8		2	2	*	12	.2
	Coenagrionidae Ischura polita	*		3			3	6	.1
Tricoptera	Hydropsychidae Hydropsyches sp.	*						-	-
	Psychomyiidae Polycentropus sp.			5				5	.1
Total Number Individuals		1478	3372	617	155	32	807	$\bar{x}$=1076	99.5
Total Number Species		10	14	10	9	11	14	Totl. No. Species = 30	
		(15)		(11)			(19)	(35)	

* = organisms collected in six week incubation
**= samples inundated with Pistia

Primary Production

The growth of periphytic algae on submersed artificial substrates in Caloosahatchee River oxbows is dependent on many factors including the presence of periphytic algae in the water, availability of dissolved nutrients, water color and clarity, temperature and sunlight. Periphytometers placed in the seven oxbows showed a considerable variability in the amount of chlorophyll a attached during the incubation period. For instance oxbows 3, 20 and 28 produced over 10 times the amount of chlorophyll a as oxbows 21 and 24 (Table 6). In comparison, chlorophyll a accumulation in C-43 near oxbow 10 was similar to the high oxbow values, but accumulation in C-43 near oxbow 21 was extremely high, 3 to 4 times greater than all other measurements.

Water quality samples taken during the incubation period indicated little difference between oxbows, with the exception of excess inorganic nitrogen concentrations in oxbows 3 and 20 (nitrate and nitrite concentrations in all other oxbows were below the limits of analytical detection). However, it is not discernible with such limited data what the causes for the vast differences in primary production were. This is an area of study that could be further investigated.

Fishes

A cursory inventory of fish inhabiting the Caloosahatchee River oxbows and canal was made by electroshocking. Although the Caloosahatchee River is a freshwater habitat, several estuarine species pass through the Franklin Locks into the river. These sampling efforts revealed a much more diverse composition of species in the oxbow environments than in C-43.

TABLE 6. ACCUMULATION OF CHLOROPHYLL A ON PERIPHYTOMETERS INCUBATED IN C-43 AND OXBOWS, JULY - AUGUST, 1978.

Oxbow #	Number of Sites	Incubation Period (days)	x chl a mg/m^2	s.d.
3	8	29	32.8	10.0
10	4	29	16.2	3.5
15	8	28	16.1	2.2
20	8	28	28.2	11.2
21	8	28	3.0	1.3
24	8	28	3.0	2.4
28	8	28	38.0	6.7
C-43 by Oxbow 10	5	29	29.6	4.0
C-43 by Oxbow 21	8	28	112.0	27.4

Common Name	Scientific Name	Oxbow	Canal
Largemouth bass	Micropterus salmoides	X	
Bluegill	Lepomis microlophus		X
Catfish	Ictalurus sp.		X
Lake chubsucker	Erimyzon sucetta	X	
Florida gar	Lepisosteus platyrhincus	X	
Bowfin	Amia calva	X	
Gizzard shad	Dorosoma cepedranum	X	
Mullet	Mugil sp.	X	X
Snook	Centropomus undecimalis	X	
Atlantic needlefish	Strongylura marina	X	
Other Species Observed			
Tarpon	Megalops atlantica		X

The above list, although obviously incomplete, indicates that the shallow water, protected habitats within the oxbows does provide food, shelter, and other conditions that may be more favorable to many species of fishes than C-43. Intensive sampling programs were previously undertaken by the Florida Game and Freshwater Fish Commission (Horel, 1960; Ogilvie, 1965). These studies identified a larger number of species inhabiting this area, but concluded that salt water fish, primarily mullet, were the dominant species (Ogilvie, 1965). Both studies considered the importance of oxbows to the fishes of the Caloosahatchee River.

Observations made during this study, the two Game Commission studies (Horel, 1960; Ogilive, 1965) and by the U.S. Fish and Wildlife Service (1957) all come to the conclusion that the Caloosahatchee River provides a limited resource for fresh or salt water sportfishing. The most likely location to encounter good sportfishing conditions is downstream of the Franklin Locks during discharge periods.

Water Quality

The Caloosahatchee River oxbows are relatively narrow and shallow in comparison with C-43, and may have little or no exchange of water with the canal. Water quality samples were taken in each of these oxbows concurrent with sampling in the canal during July 1978 to ascertain if detectable differences occurred.

Table 7 compares the surface water quality values from seven oxbows with the seven C-43 sample sites located in the river between LaBelle and Franklin Locks. Temperature, pH, total phosphrous and sulfate were higher in C-43 than in the oxbows, although temperature and pH can vary with the time of day, amount of sunlight, etc. Sodium and magnesium concentrations were significantly higher in the oxbow waters than in C-43, which may suggest a lack of water exchange between oxbows and canals. Overall, the data collected on this date shows similar quality between oxbow and canal waters.

Table 8 compares surface water quality parameters from the seven oxbows sampled. These data indicate little variability in water quality between the oxbows, with the exception of high nitrate values in oxbows 3 and 20, and low TKN values in oxbows 3, 10, 15, and 28. There were no discernible trends in water quality data evident when oxbows were grouped according to type (open, closed) or distance from Franklin Locks. Since water quality varies in the Caloosahatchee River with season, rainfall, and discharge, a more rigorous sampling schedule would have to be undertaken to investigate possible changes throughout the year.

SUMMARY

1. Since the 1880's the Caloosahatchee River has undergone substantial

TABLE COMPARISON OF WATER QUALITY PARAMETERS FROM CALOOSAHATCHEE RIVER CANAL (C-43) and OXBOWS, JULY 11-13, 1978[1]

Parameter[5]	C-43[2] $\bar{x}$	C-43[2] s.d.	Oxbows[3] $\bar{x}$	Oxbows[3] s.d.	Significance[4] 99%
Temp ^{o}C	31.01	0.59	29.0	0.93	X
Diss O_2	6.77	1.38	5.83	0.91	
Sp. cond µmho/cm	279.71	7.83	286.0	10.89	
pH	7.54	0.13	7.33	0.16	X
Secchi-m	1.21	0.15	1.07	0.25	
NO_3	0.009	0.011	0.015	0.023	
NO_2	0.010	0.009	0.004	0.000	
NH_4	<0.01	0.00	<0.01	0.00	
TKN	1.63	0.42	1.65	0.54	
oPO_4	0.097	0.009	0.088	0.011	
TPO_4	0.141	0.010	0.126	0.010	X
Tot diss. PO_4	0.121	0.017	0.107	0.013	
Na	34.82	1.26	39.31	1.38	X
K	3.97	0.14	4.27	1.12	
Ca	56.64	1.82	58.95	2.77	
Mg	9.56	0.17	10.88	0.61	X
Cl	57.01	1.11	59.95	3.00	
SO_4	33.83	1.42	24.84	2.64	X
SiO_2	7.94	0.08	7.76	0.24	
$CaCO_3$	161.79	4.91	162.07	9.12	

[1] surface samples only

[2] stations 26, 30, 32, 36, 37, 39, 41 n=7 values

[3] oxbows 3, 10, 15, 20, 21, 24, 28 n=15 values

[4] based on 2 tailed students t test, 20 df

[5] all units mg/l unless otherwise noted, except pH

TABLE COMPARISON OF WATER QUALITY PARAMETERS FROM SEVEN CALOOSAHATCHEE RIVER OXBOWS, JULY 13, 1978[1]

Parameter	28	24	21	20	15	10	3
Temp ^{o}C	28.5	27.8	28.0	29.0	30.0	29.7	30.0
Diss. O_2	4.6	5.1	5.0	6.4	6.5	5.8	6.4
Sp Cond µmho/cm	280	285	305	295	280	280	280
pH	7.35	7.15	7.05	7.40	7.45	7.32	7.50
Secchi-m	0.95	0.58	1.05	1.10	1.35	1.20	1.20
NO_3	<.004	<.004	<.004	.036	<.004	<.004	.057
NO_2	<.004	<.004	<.004	.004	<.004	<.004	.004
NH_4	<.01	<.01	<.01	<.01	<.01	<.01	<.01
TKN	1.53	2.13	2.02	2.32	1.12	1.29	1.33
oPO_4	.081	.098	.071	.092	.088	.092	.097
TPO_4	.122	.137	.129	.123	.118	.123	.136
$TdPO_4$	.098	.126	.087	.110	.106	.112	.116
Na	38.39	39.03	41.03	39.73	38.07	40.68	37.59
K	4.05	4.10	3.44	4.20	4.13	5.44	3.98
Ca	57.07	58.33	63.24	62.31	59.10	55.68	57.82
Mg	10.06	9.88	11.62	10.72	11.85	11.18	11.25
Cl	58.1	59.5	62.5	60.0	58.0	63.7	56.2
SO_4	21.4	21.9	27.5	25.1	26.4	25.8	22.8
SiO_2	8.0	7.7	8.1	7.8	7.8	7.4	7.7
$CaCO_3$	160.3	173.5	172.3	162.8	162.8	149.7	158.0

[1] surface sample only

alterations in an attempt to control water flows, provide for navigation, and to drain and irrigate the surrounding lands. The Caloosahatchee River has been replaced by C-43, 50 to 130 meters wide and 6-9 meters deep, with water control structures at three locations. The only remnants of the original Caloosahatchee River exist as 35 oxbows connected with C-43 between LaBelle and the Franklin Locks.

2. These 35 oxbows provide different habitats than C-43. Vascular vegetation in the oxbows occurs as emergent (Nuphar advena, Zizania aquatica, Typha sp.), floating (Alternanthera philoxeroides, Sacciolepis striata, Pistia stratoites) and riverbank (Colocasia esculentum, Acrosticum sp., Salix carolinana). Occasionally submerged vegetation as Najas guadalupensis or benthic algae are present. Vegetation along C-43 is primarily limited to riverbank species such as Colocasia esculentum, Myrica cerifera, Schinus terebinthifolius.

3. Stabilized water levels in the Caloosahatchee River since the completion of the control structures is not conducive to quality aquatic habitat. Consequently, only a few emergent species exist, and floating type species are quite abundant.

4. Oxbow benthos were dominated by three major species, Chaoborus punctipennis, the phantom midge, Tubifex tubifex, and the amphipod, Gammarus fasciatus. Tubifex and Gammarus are scavangers, feeding on algae and plant detritus, which is a major constituent of the oxbow bottom substrates. Chaoborus is a primary predator on Tubifex. The deep sediments in C-43, which are generally higher in marl content between LaBelle and Franklin Locks than were the oxbows, were inhabited primarily by Tubifex tubifex, Chaoborus punctipennis, and Ablabesmyia cinctipes.

5. Thirty species of aquatic organisms were recovered from artificial substrate samples in the oxbows. These were dominated by Pomatropsis sp., Geoldchironomus holoprasinus and Caenis dimnuta. Similarly incubated samplers in C-43 were colonized primarily by Cassidinidae lunifron, Gammarus fasciatus, Caenis diminuta and chironomids.

6. The growth of periphytic algae on artificial substrates in oxbows and C-43 exhibited considerable variability, but tended to be higher in the canal than in the oxbows.

7. Water quality analysis indicated similar chemical composition between C-43 and the oxbows. Higher sodium and magnesium concentrations in the oxbows suggest that there may not be complete exchange of water between oxbows and the canal. Temperature, pH, total phosphorus, and sulfate were significantly higher in C-43 than in the oxbows.

8. The Caloosahatchee River oxbows provide a sheltered, shallow water habitat with a substantial amount of aquatic and overhanging vegetation that is not available in C-43. These oxbows are inhabited by a variety of organisms not commonly found in the canal. The District should strive to keep these waters in state ownership and prevent any further filling or blocking of the oxbows. Any procedures which would reduce or eliminate floating vegetation species from the oxbows should be encouraged. Agencies involved in weed control activities should refrain from spraying beneficial emergent or riverbank vegetation.

APPENDIX I

INVENTORY OF 35 CALOOSAHATCHEE RIVER OXBOWS LOCATED BETWEEN LABELLE AND W.P. FRANKLIN LOCKS, FLORIDA

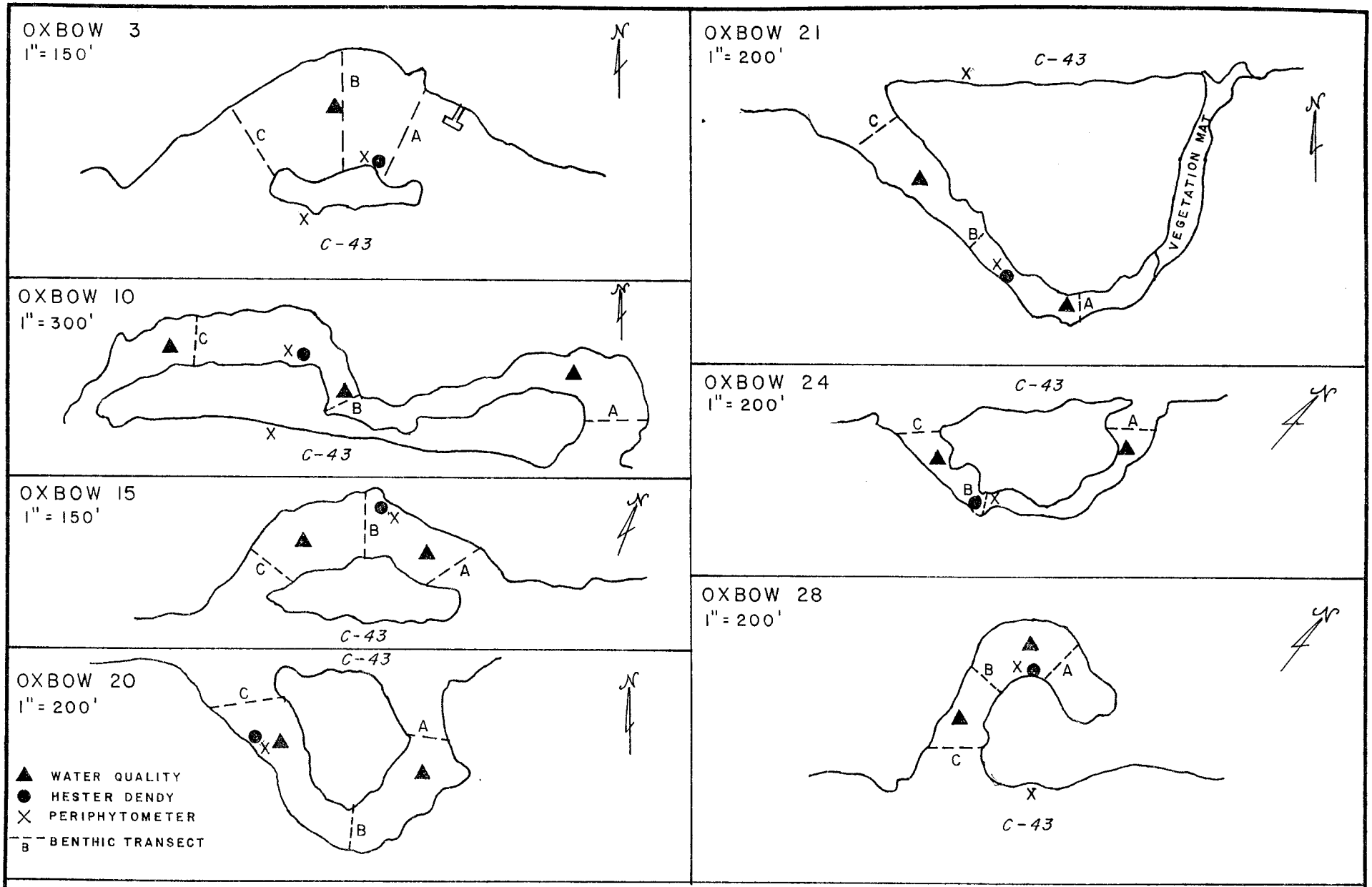
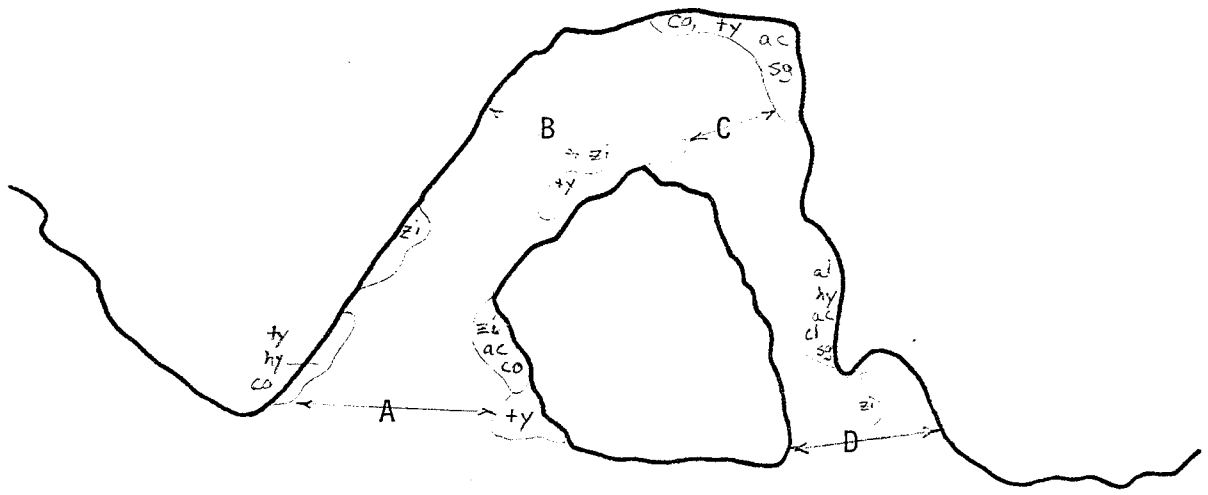
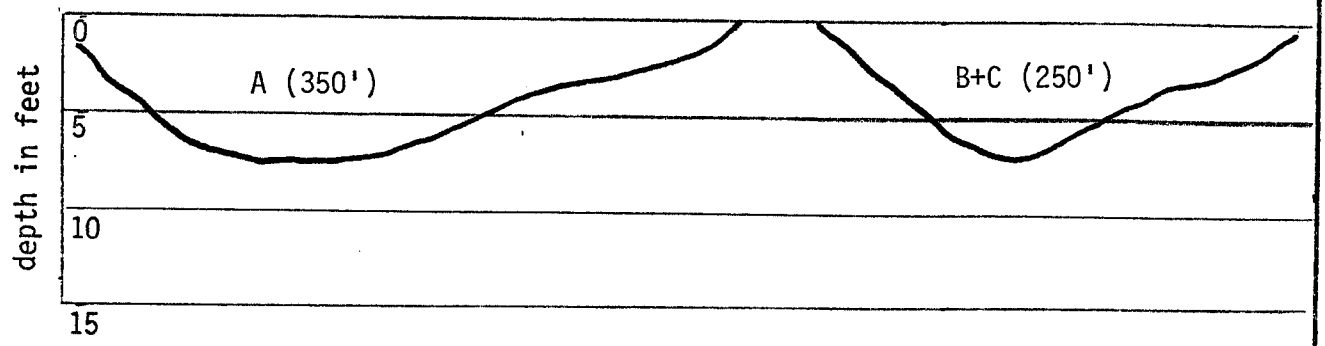


Figure CALOOSAHATCHEE RIVER OXBOWS SELECTED FOR DETAILED SAMPLING, AND SAMPLE LOCATIONS



C-43

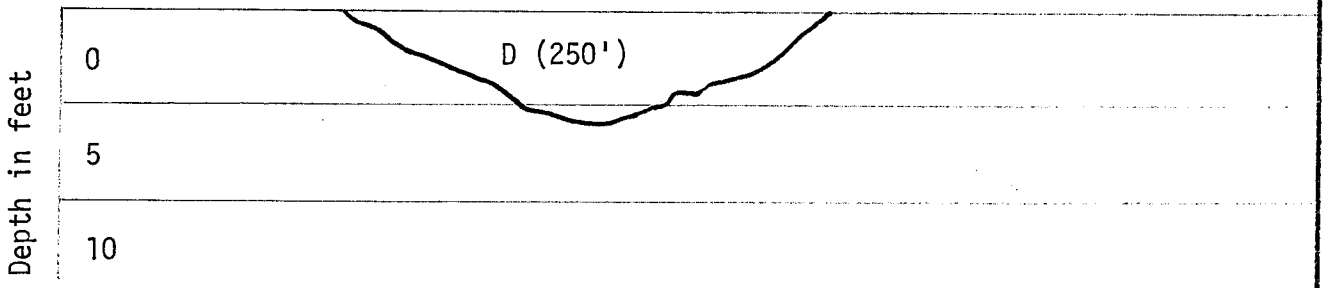
DEPTH PROFILES



COMMENTS

Bottom Substrates

A) Fine organic material, sand, live and dead Corbicula
B+C) Marl, sand, live and dead Corbicula
D) Marl, mud, live and dead Corbicula



OXBOW # 1

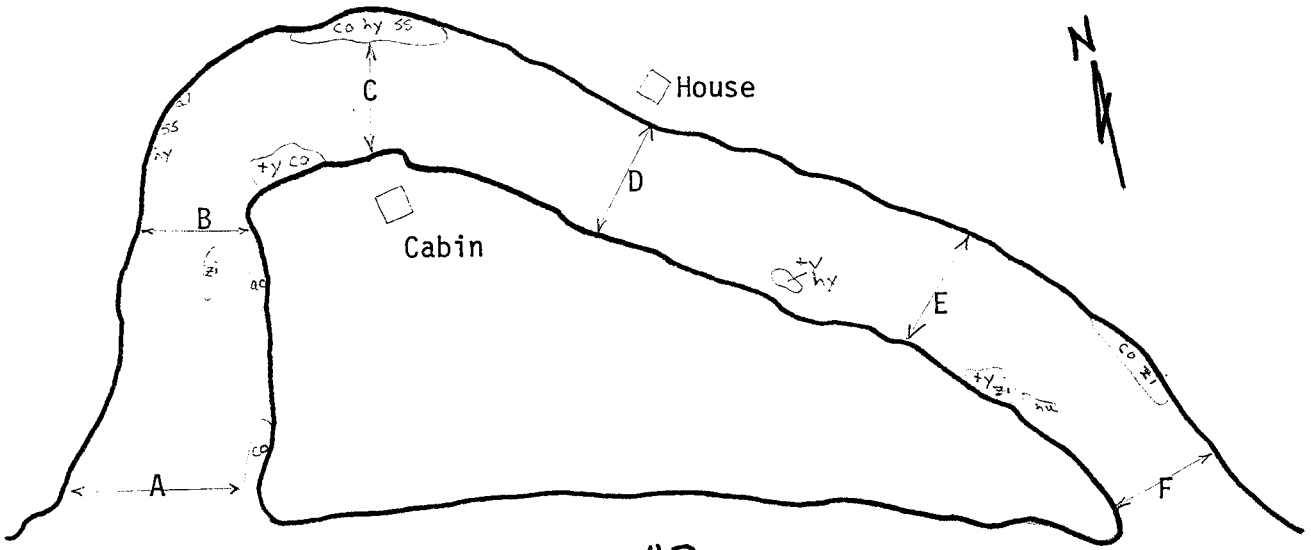
LOCATION R 26 E
T 43 S
SEC. 23

DATE INVENTORIED : 2/14/78

CENTER LINE LENGTH : 1395'

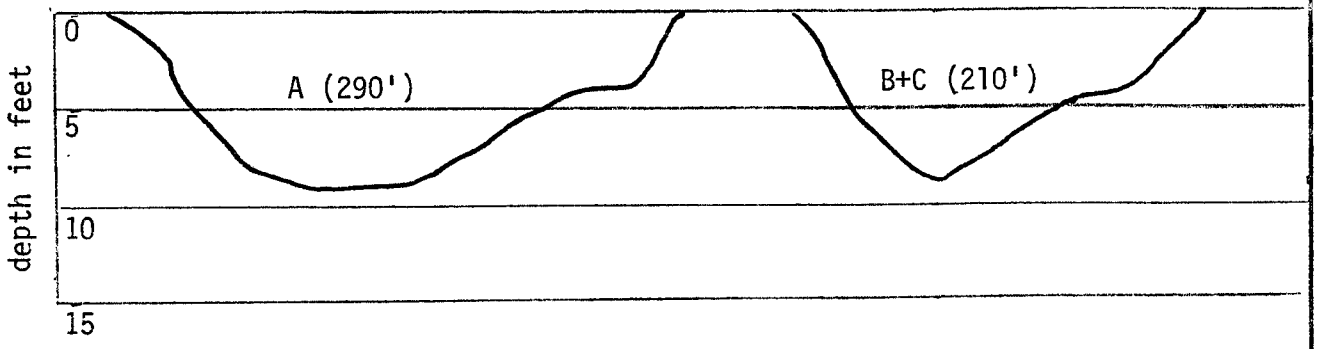
TOTAL AREA : 7.27 Acres

DRAWING SCALE 1" = 300 feet



C-43

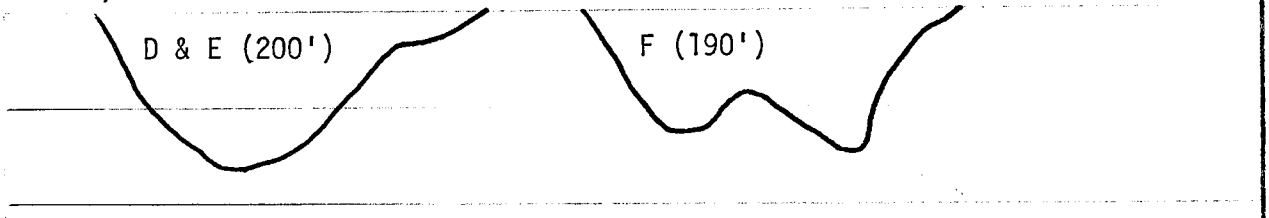
DEPTH PROFILES



COMMENTS

Bottom Substrates

A) Fine organic material
C) Fine organic material, dead Corbicula
F) Sand, marl, fine organic material, live and dead Corbicula



OXBOW # 2

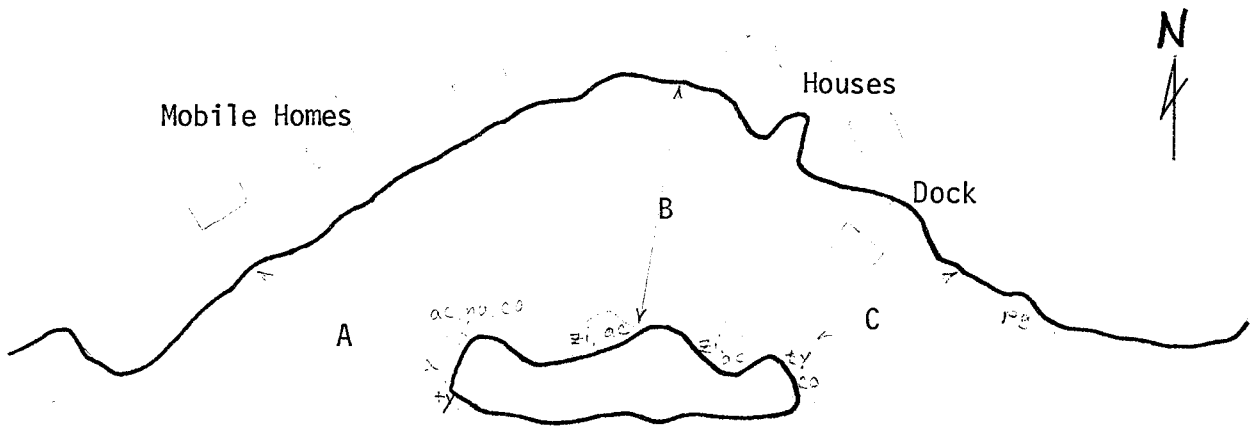
LOCATION R 26 E
T 43 S
SEC.23,24

DATE INVENTORIED : 2/14/78

CENTER LINE LENGTH : 2295'

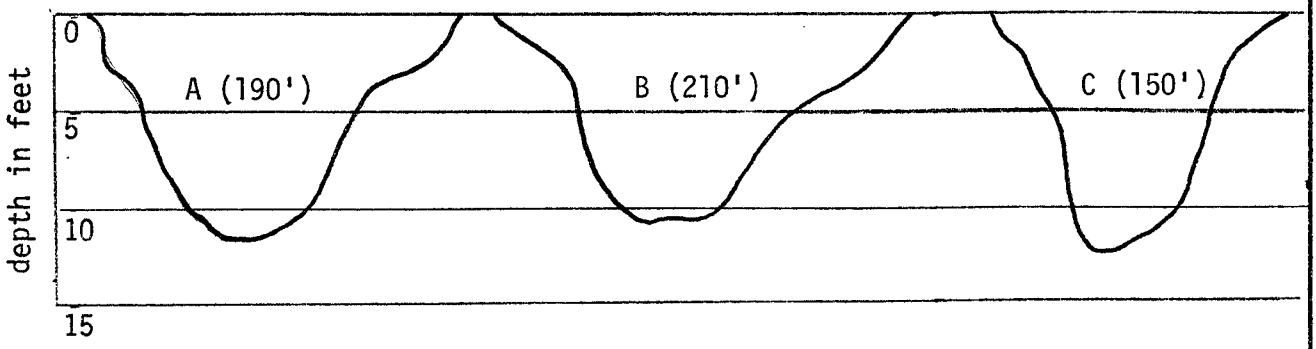
TOTAL AREA : 11.6 Acres

DRAWING SCALE 1" = 300 feet



C-43

DEPTH PROFILES



COMMENTS

Bottom Substrates

A) Black organic material, dead Corbicula
C) Black organic material, sand, dead Corbicula

OXBOW # 3

LOCATION R 26 E
T 43 S
SEC. 24

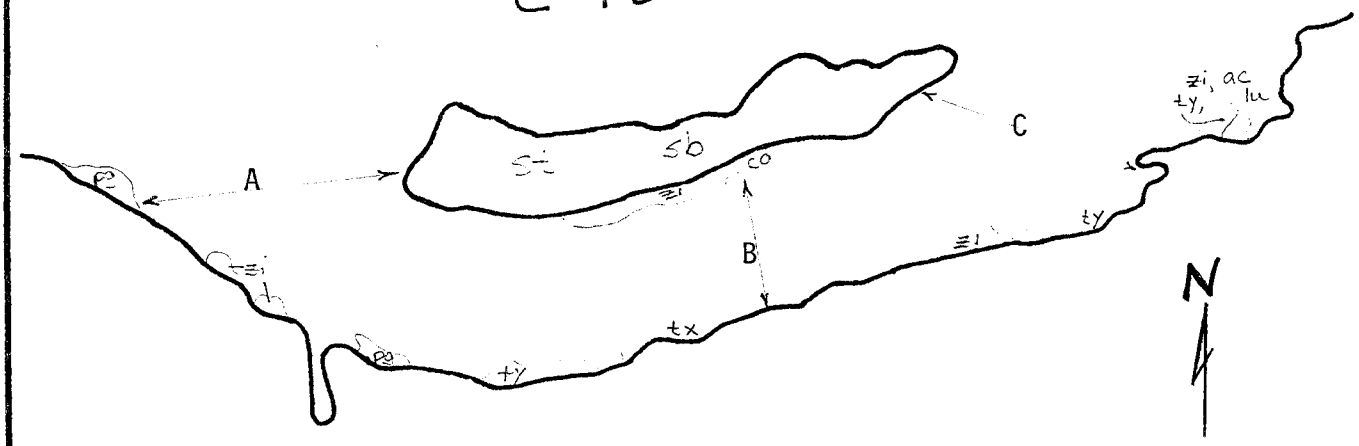
DATE INVENTORIED : 2/14/78

CENTER LINE LENGTH : 600'

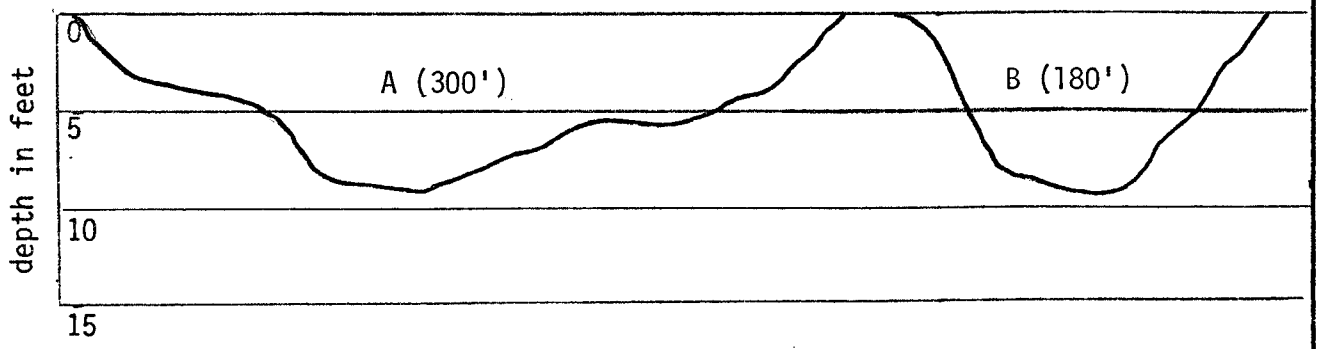
TOTAL AREA : 4.7 Acres

DRAWING SCALE 1" = 150 feet

C-43



DEPTH PROFILES



COMMENTS

Bottom Substrates

A) Fine organic material, sand, dead Corbicula
B) Fine organic material, mud, marl, live and dead Corbicula
C) Fine organic material, live Corbicula

OXBOW # 4

LOCATION R 27 E
T 43 S
SEC.19

DATE INVENTORIED : 2/14/78

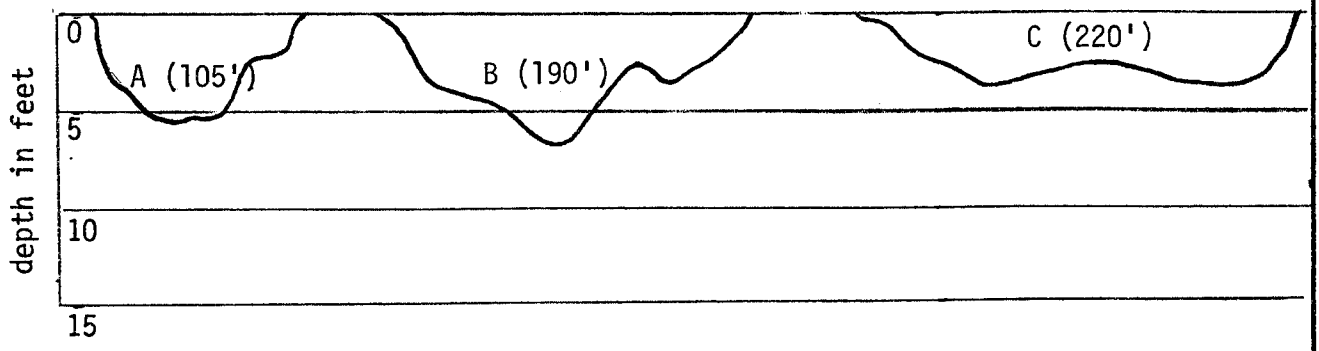
CENTER LINE LENGTH : 1500'

TOTAL AREA : 10.9 Acres

DRAWING SCALE 1" = 300 feet

C-43

DEPTH PROFILES



COMMENTS

Bottom Substrates

A) Sand, detritus, marl, dead Corbicula
B) Fine organic material, detritus, filamentous algae
C) Sand, live and dead Corbicula

OXBOW # 5

LOCATION R 27 E
T 43 S
SEC. 19

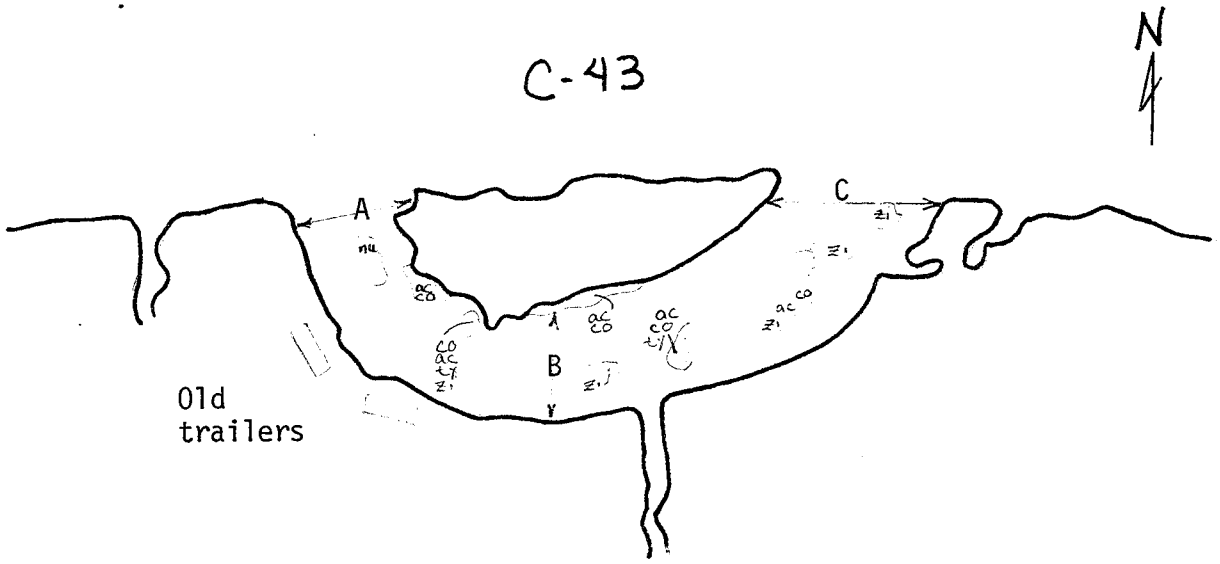
DATE INVENTORIED : 2/14/78

CENTER LINE LENGTH : 550'

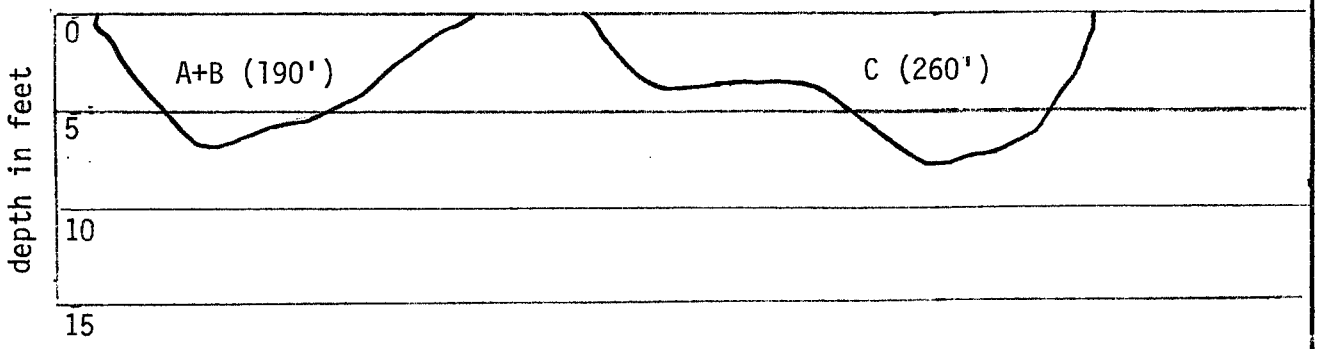
TOTAL AREA : 3.4 Acres

DRAWING SCALE 1" = 150 feet

C-43



DEPTH PROFILES



COMMENTS

Bottom Substrates

A) Fine organic material, sand, dead Corbicula
C) Fine organic material, sand, marl, live and dead Corbicula

OXBOW # 6

LOCATION R 27 E
T 43 S
SEC. 19

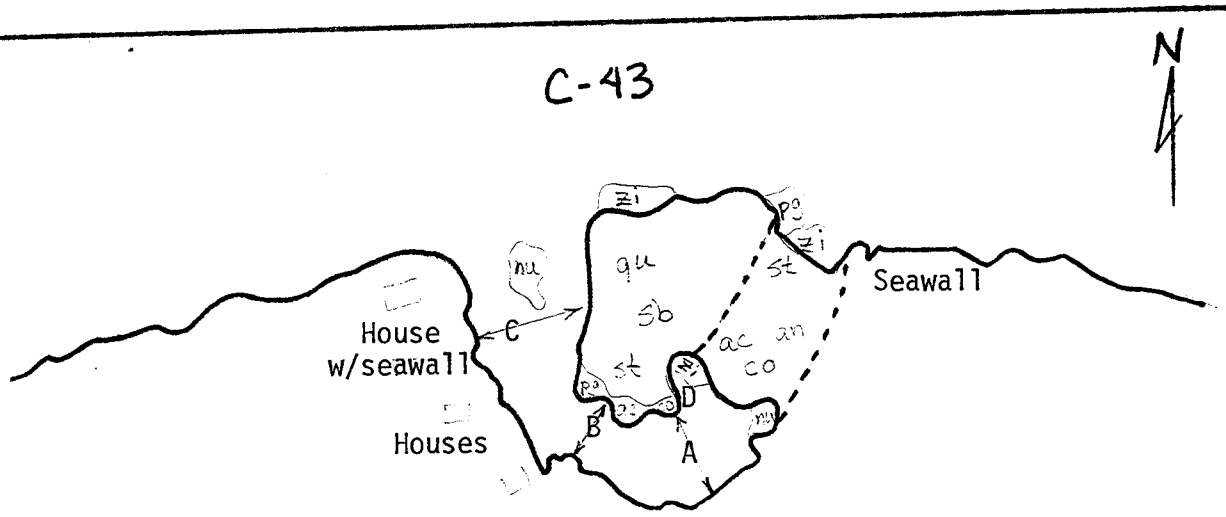
DATE INVENTORIED : 2/14/78

CENTER LINE LENGTH : 1080'

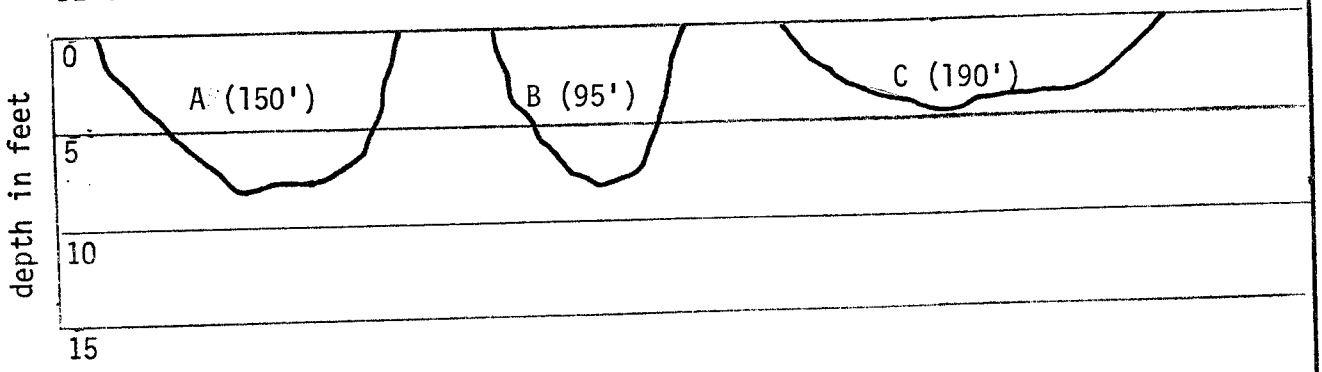
TOTAL AREA : 4.6 Acres

DRAWING SCALE 1" = 300 feet

C-43



DEPTH PROFILES



COMMENTS

Bottom Substrates

A) Fine organic material, leaf detritus
B) Fine organic material, leaf detritus
C) Fine organic material, sand, dead Corbicula

OXBOW # 7

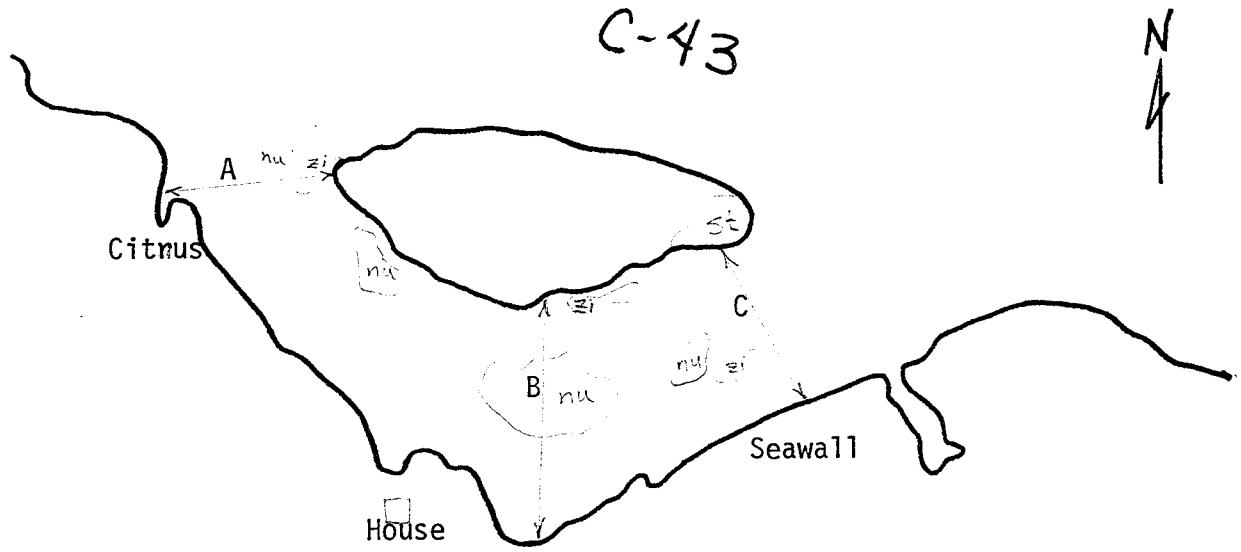
LOCATION R 17 E
T 43 S
SEC. 20

DATE INVENTORIED : 2/14/78

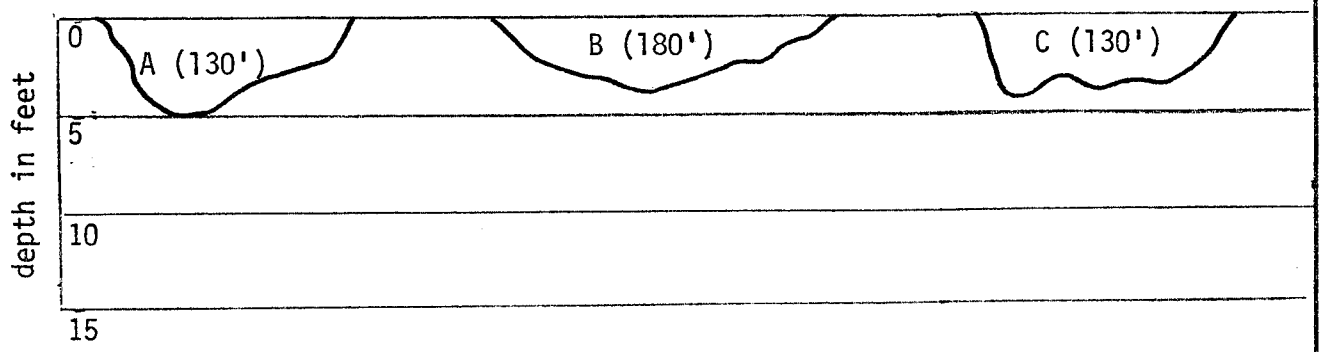
CENTER LINE LENGTH : 600'

TOTAL AREA : 2.2 Acres

DRAWING SCALE 1" = 300 feet



DEPTH PROFILES



COMMENTS

Bottom Substrates

A) Light brown sand
B) Mud, detritus, filamentous algae
C) Dark brown sand, dead Corbicula

OXBOW # 8

DATE INVENTORIED : 2/14/78

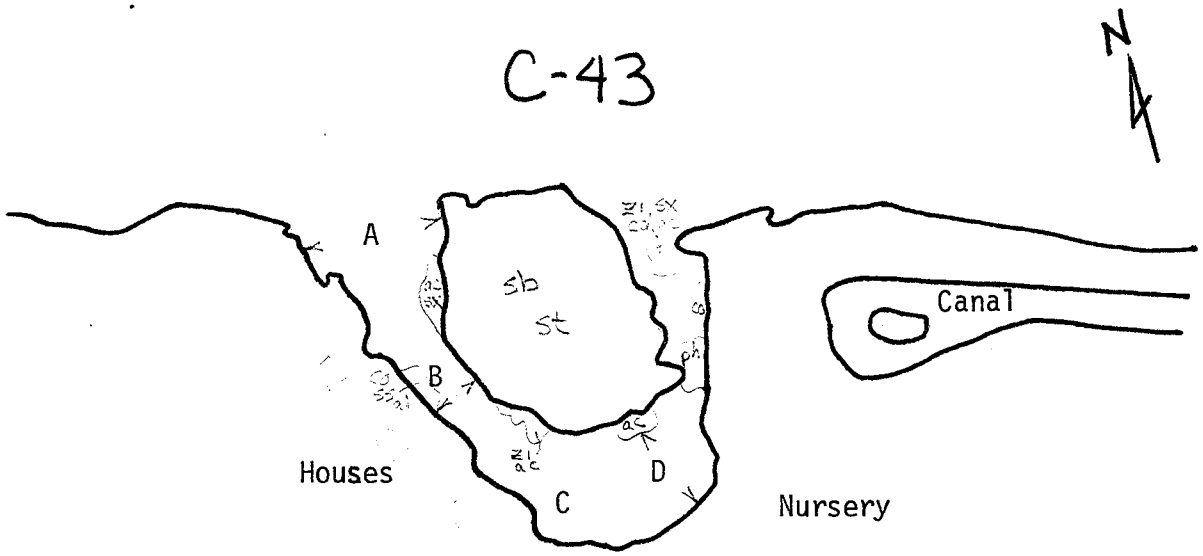
LOCATION R27 E
T43 S
SEC. 20,21

CENTER LINE LENGTH : 600'

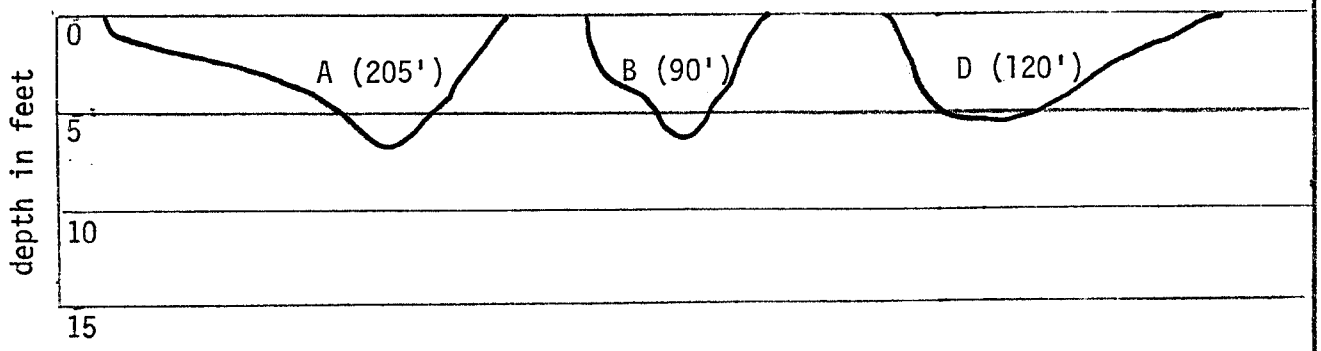
TOTAL AREA : 2.16 Acres

DRAWING SCALE 1" = 150 feet

C-43



DEPTH PROFILES



COMMENTS

Bottom Substrates

A) Organic mud, detritus, Chara sp.
B) Organic mud, detritus, Chara sp.
C) Very shallow area, water depth less than 1.5 feet, flocculent, undecomposed detritus
D) Organic mud, detritus

OXBOW # 9

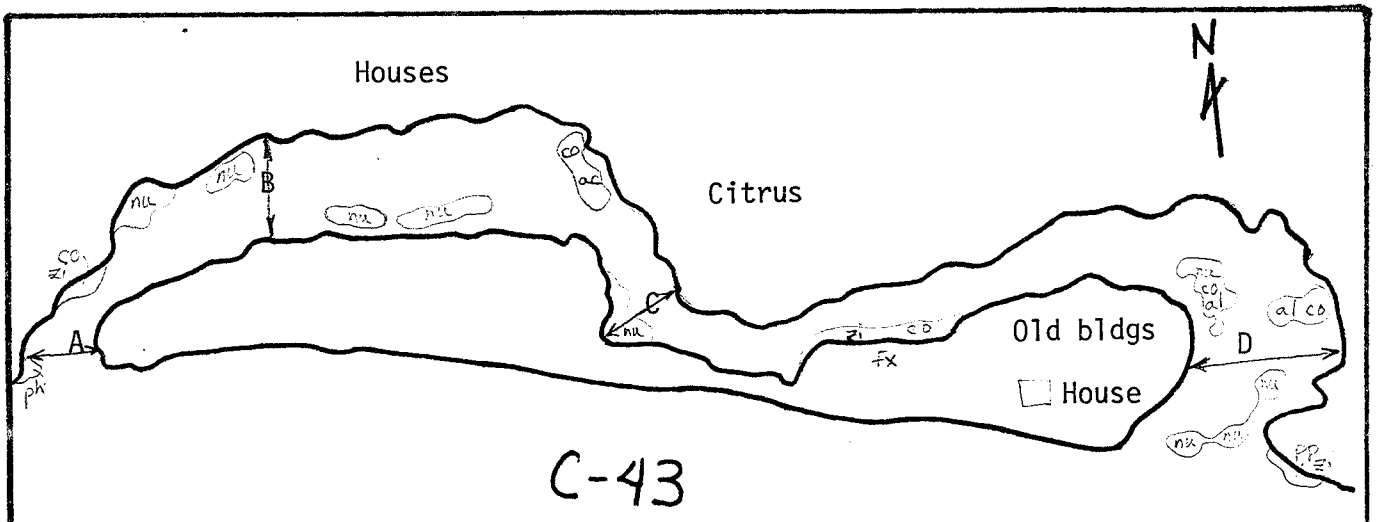
LOCATION R 27 E
T 43 S
SEC. 21,28

DATE INVENTORIED : 2/14/78

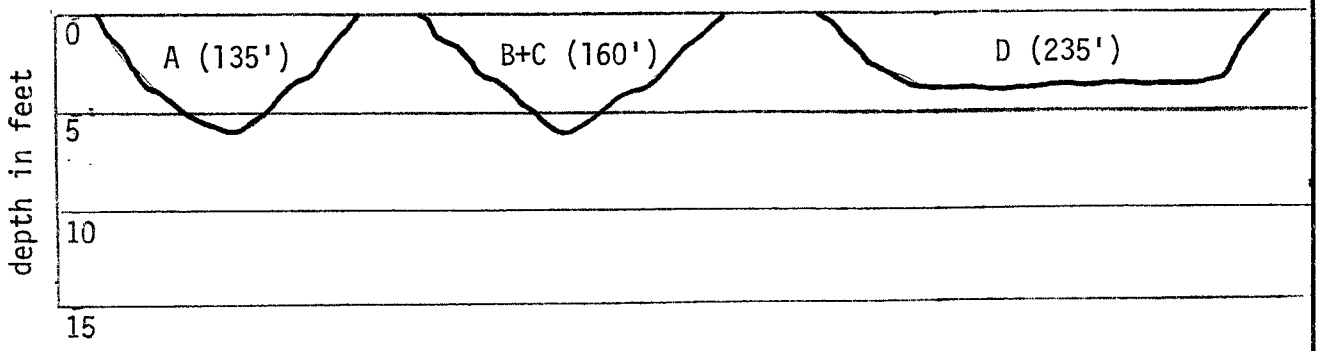
CENTER LINE LENGTH : 1110'

TOTAL AREA : 3.2 Acres

DRAWING SCALE 1" = 300 feet



DEPTH PROFILES



COMMENTS

Bottom Substrates

A) Fine organic material, sand, dead Corbicula
B) Fine organic material, sand, dead Corbicula
C) Fine organic material, sand, detritus
D) Fine organic material, sand, dead Corbicula

OXBOW # 10

LOCATION R 27 E
T 43 S
SEC. 21

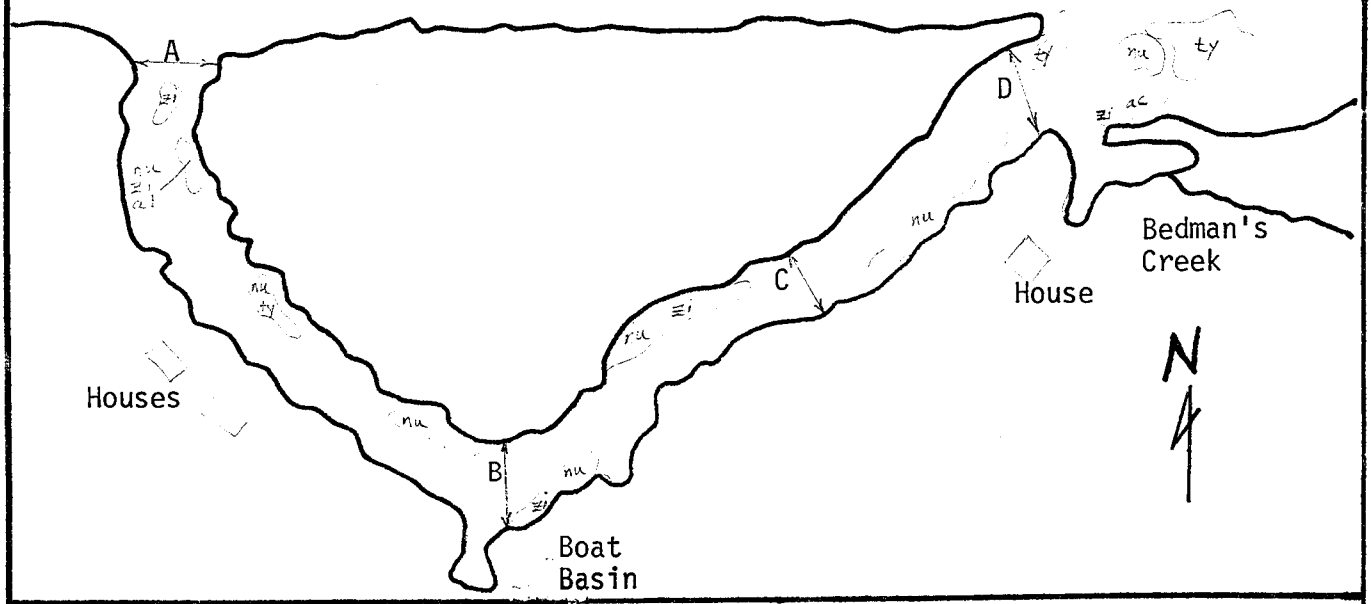
DATE INVENTORIED : 2/14/78

CENTER LINE LENGTH : 2370'

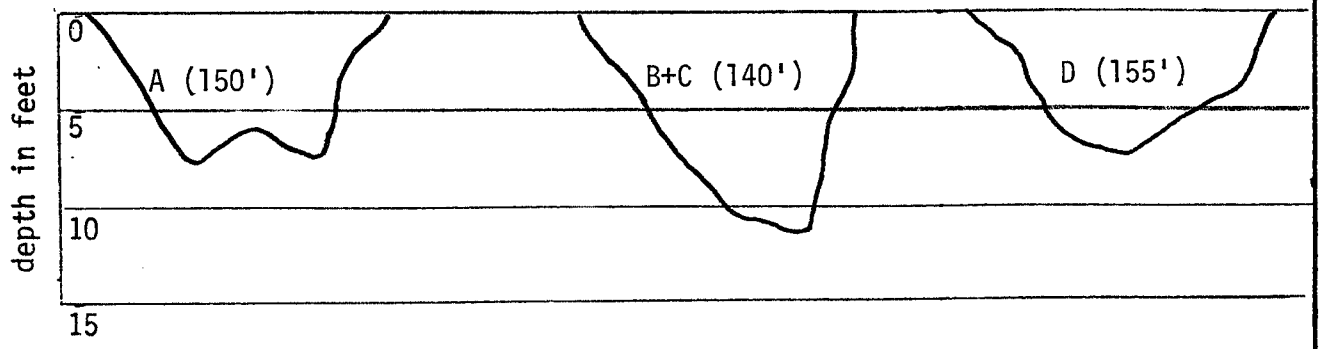
TOTAL AREA : 7.6 Acres

DRAWING SCALE 1" = 300 feet

C-43



DEPTH PROFILES



COMMENTS

Bottom Substrates

A) Fine organic material, sand, marl, dead Corbicula
B) Fine organic material, dead Corbicula
D) Fine organic material, sand, mud

OXBOW # 11

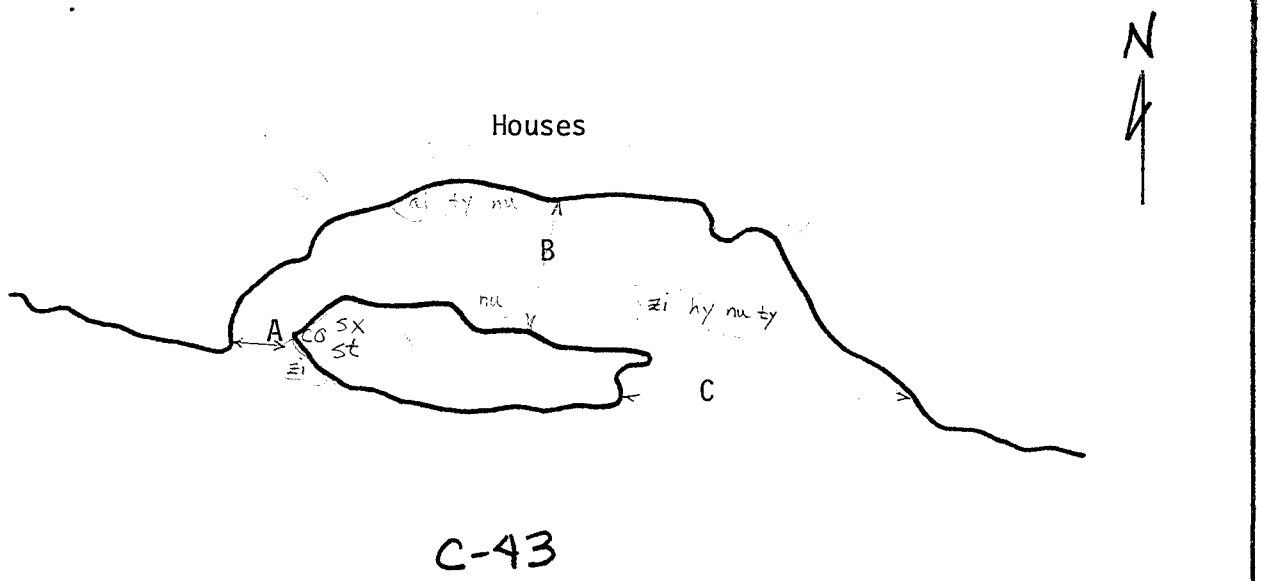
LOCATION R 27 E
T 43 S
SEC. 27

DATE INVENTORIED : 2/14/78

CENTER LINE LENGTH : 2160'

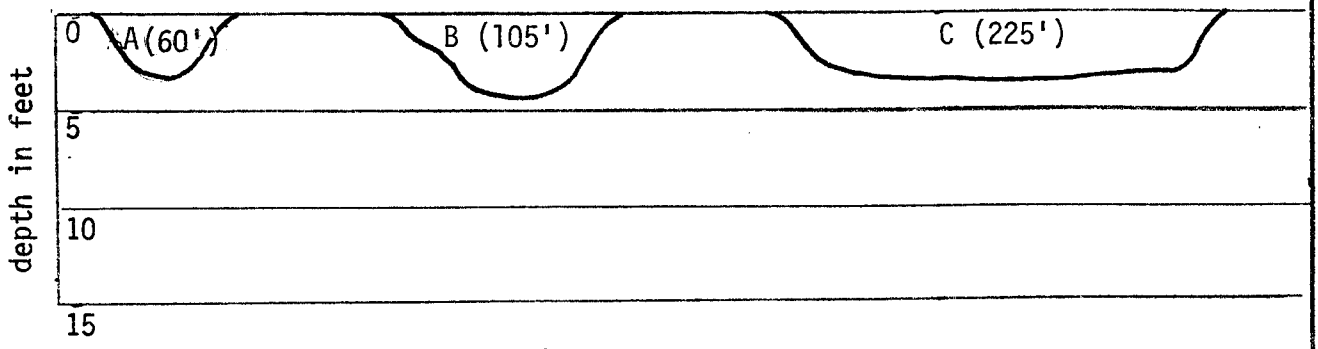
TOTAL AREA : 7.9 Acres

DRAWING SCALE 1" = 300 feet



C-43

DEPTH PROFILES



COMMENTS

Bottom Substrates

B) Organic material, sand, detritus, dead Corbicula

OXBOW # 12

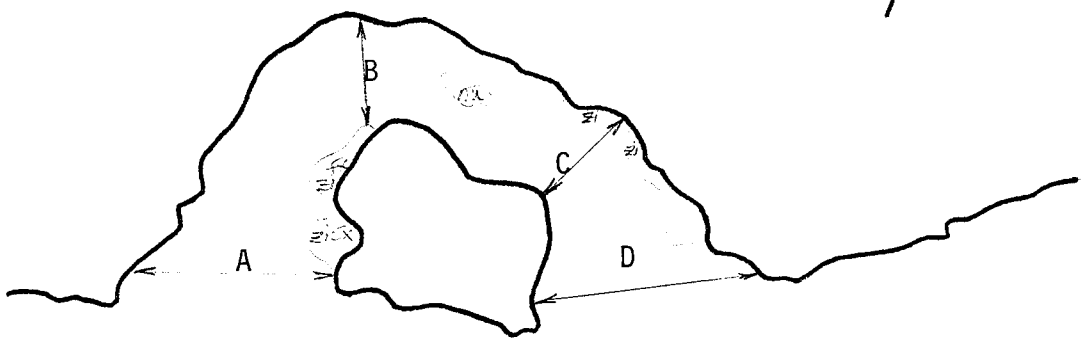
LOCATION R 27 E
T 43 S
SEC. 22

DATE INVENTORIED : 3/1/78

CENTER LINE LENGTH : 525'

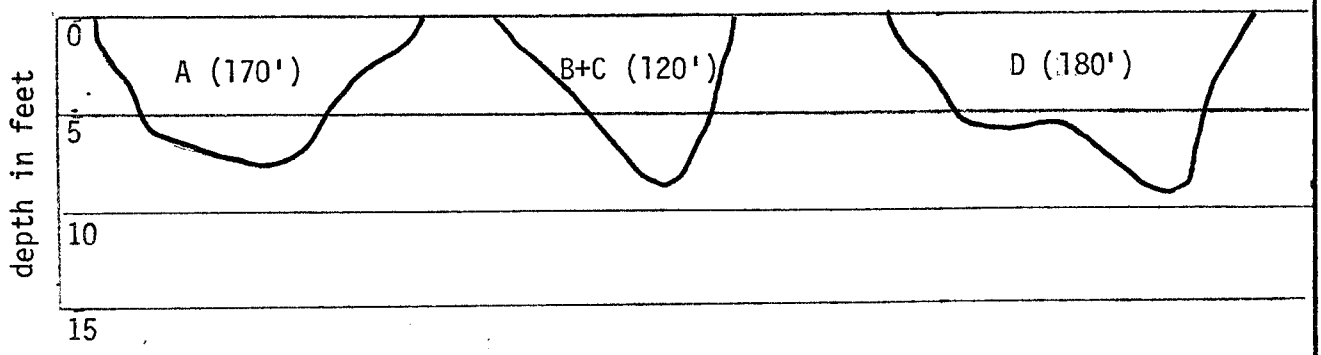
TOTAL AREA : 2.5 Acres

DRAWING SCALE 1" = 150 feet



C-43

DEPTH PROFILES



COMMENTS

Bottom Substrates

A) Fine organic material, sand, detritus
B) Fine organic material, sand, detritus
C) Fine organic material, dead Corbicula
D) Fine organic material, dead Corbicula

OXBOW #13

LOCATION R 27 E
T 43 S
SEC. 23

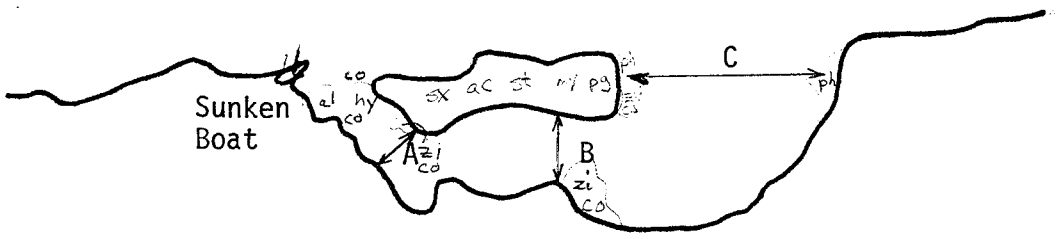
DATE INVENTORIED : 3/11/78

CENTER LINE LENGTH : 560'

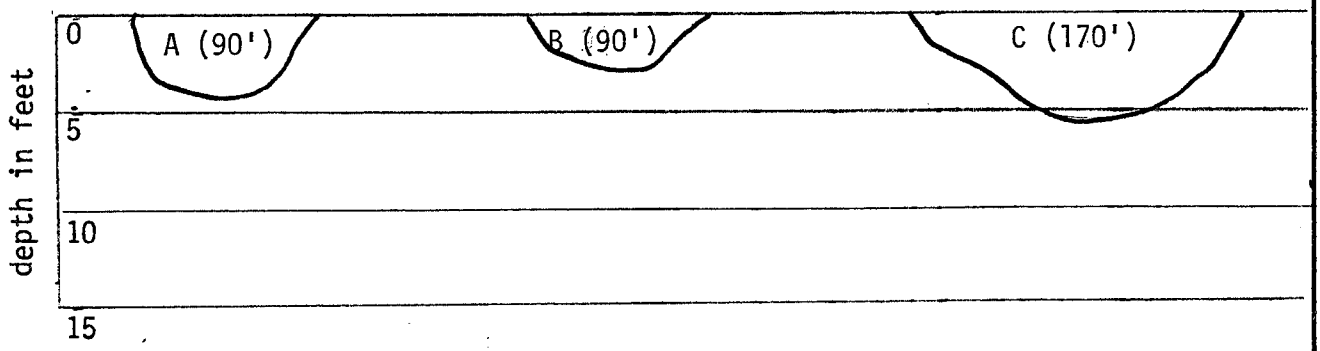
TOTAL AREA : 2.7 Acres

DRAWING SCALE 1" = 150 feet

C-43



DEPTH PROFILES



COMMENTS

Bottom Substrates

A) Fine organic material, leaf detritus
B) Fine organic material, leaf detritus
C) Sand, mud, detritus, dead Corbicula

OXBOW # 14

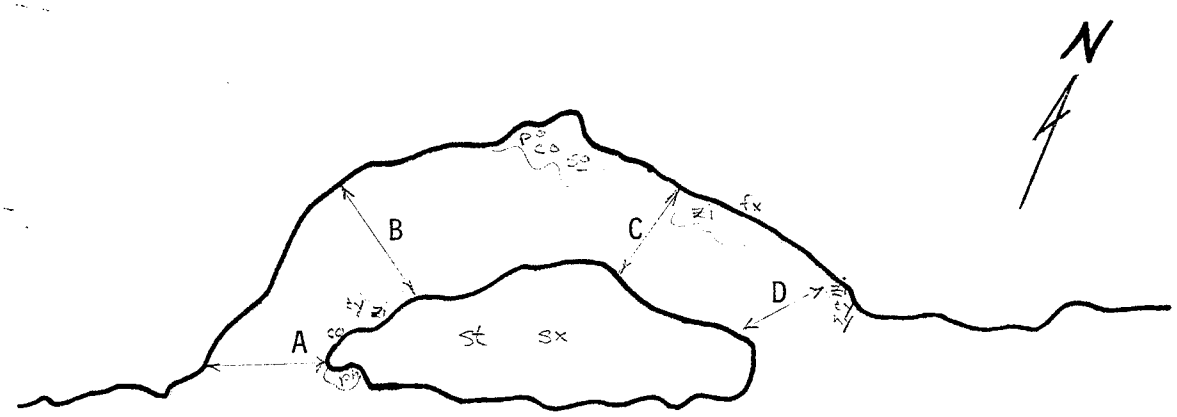
LOCATION R 27 E
T 43 S
SEC.23,26

DATE INVENTORIED : 3/1/78

CENTER LINE LENGTH : 390'

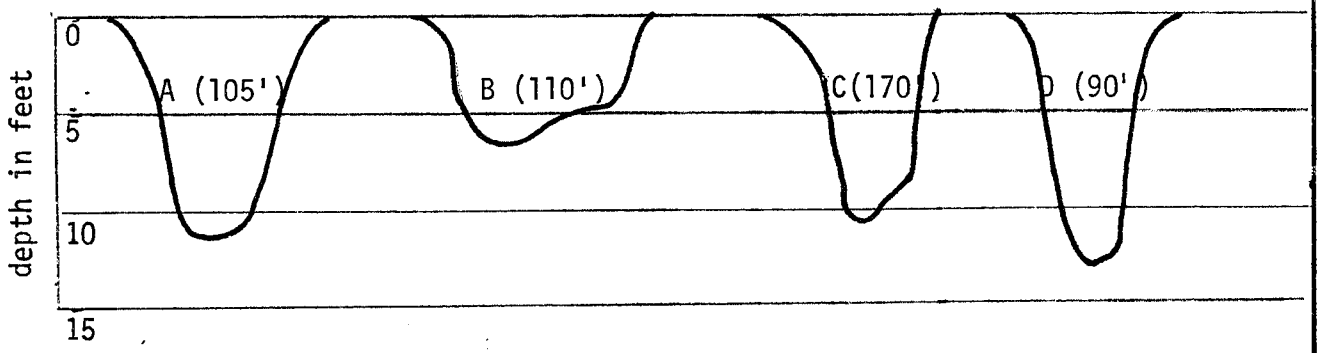
TOTAL AREA : 1.7 Acres

DRAWING SCALE 1" = 150 feet



C-43

DEPTH PROFILES



COMMENTS

Bottom Substrates

A) Yellow sand, live and dead Corbicula
B) Yellow sand, live and dead Corbicula
C) Yellow sand, live and dead Corbicula
D) Yellow sand, live and dead Corbicula

OXBOW # 15

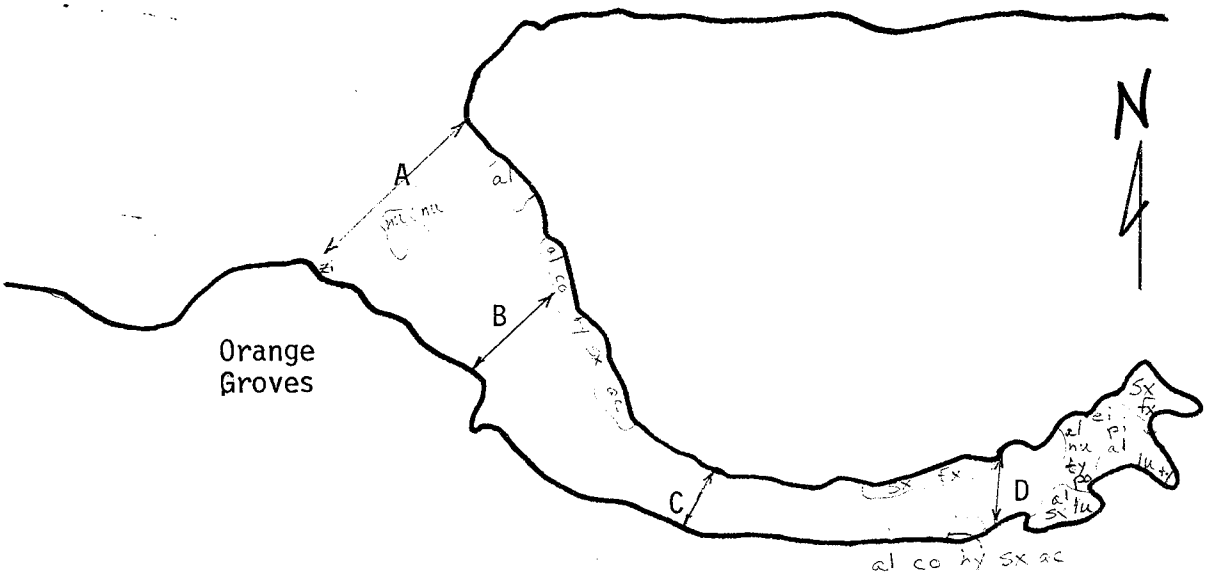
LOCATION R 27 E
T 43 S
SEC. 23

DATE INVENTORIED : 3/1/78

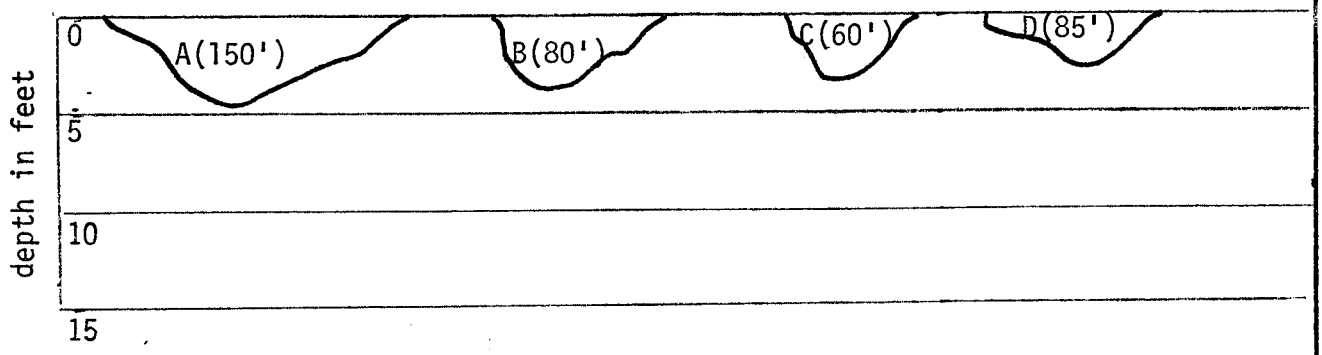
CENTER LINE LENGTH : 540'

TOTAL AREA : 2.3 Acres

DRAWING SCALE 1" = 150 feet



DEPTH PROFILES



COMMENTS

Bottom Substrates

A) Sand, marl, mud, dead Corbicula
B) Sand, marl, mud, dead Corbicula
C) Mud, detritus
D) Mud, detritus

OXBOW # 16

LOCATION R27 E
T43 S
SEC. 23

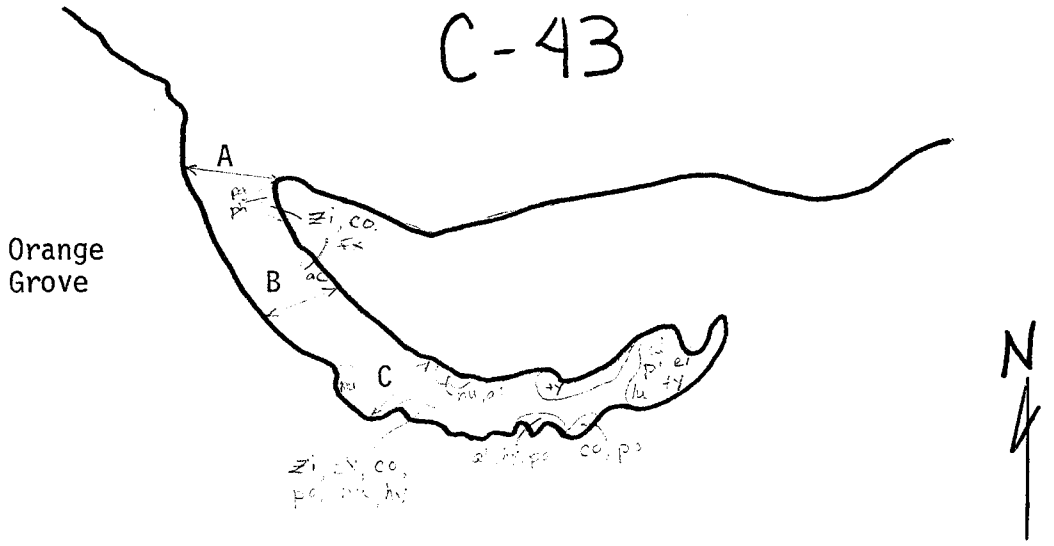
DATE INVENTORIED : 3/1/78

CENTER LINE LENGTH :750'

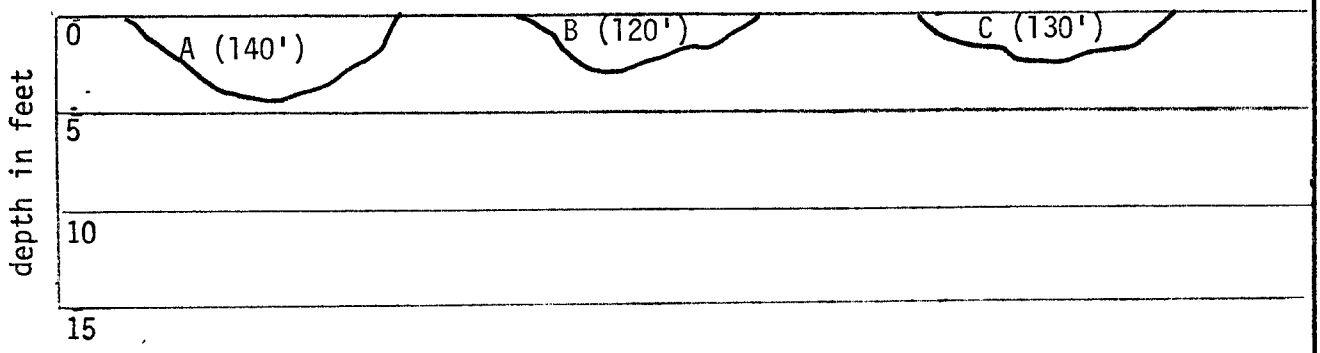
TOTAL AREA : 2.7 Acres

DRAWING SCALE 1" = 150 feet

C-43



DEPTH PROFILES



COMMENTS

Bottom Substrates

A) Peat, detritus, fine organic material
B) Peat, detritus, fine organic material
C) Peat, detritus

OXBOW # 17

LOCATION R 27 E
T 43 S
SEC. 25

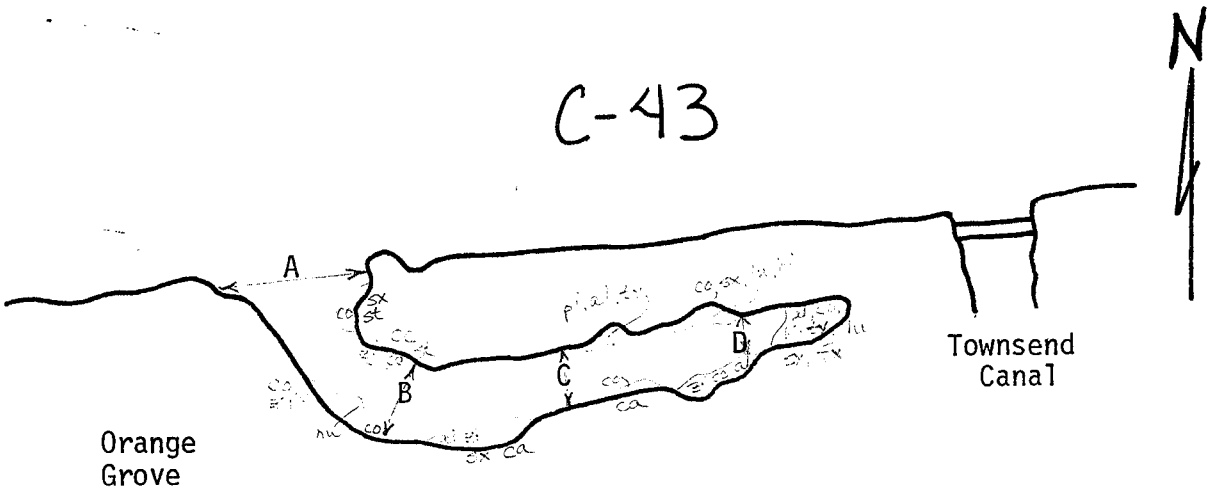
DATE INVENTORIED : 3/1/78

CENTER LINE LENGTH : 1020'

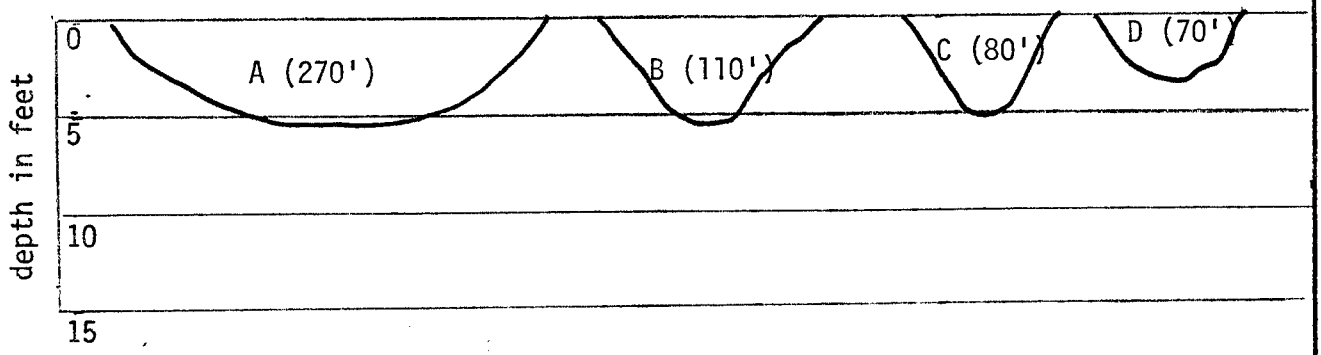
TOTAL AREA : 2.2 Acres

DRAWING SCALE 1" = 300 feet

C-43



DEPTH PROFILES



COMMENTS

Bottom Substrates

A) Marl, sand, live Corbicula
B) Sand, fine organic material, filamentous algae
C) Sand, fine organic material, filamentous algae
D) Fine organic material, sand, filamentous algae

OXBOW # 18

LOCATION R 28 E
T 43 S
SEC. 30

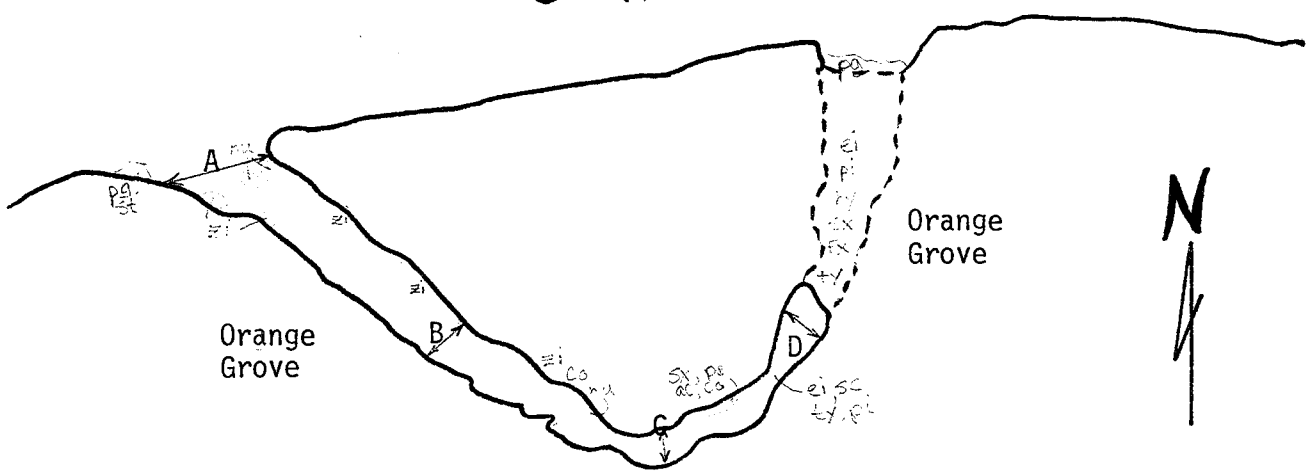
DATE INVENTORIED : 5/23/78

CENTER LINE LENGTH : 960'

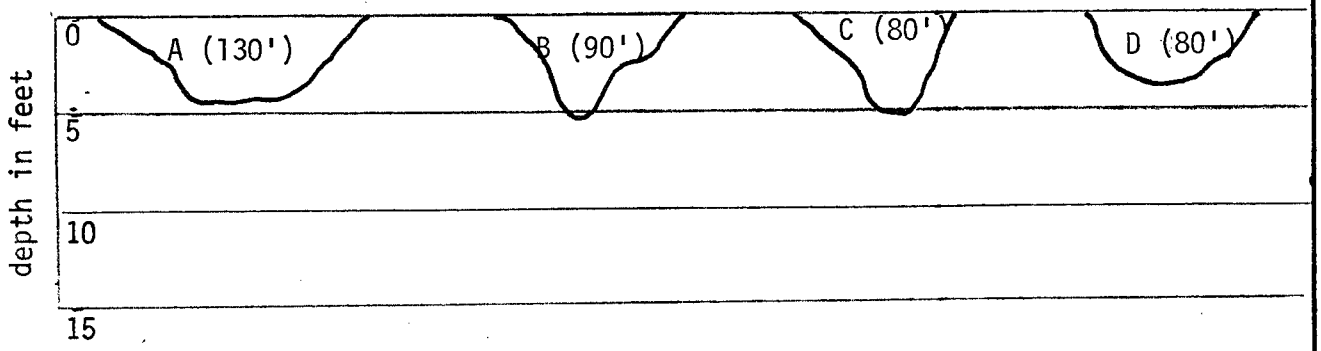
TOTAL AREA : 2.5 Acres

DRAWING SCALE 1" = 300 feet

C-43



DEPTH PROFILES



COMMENTS

Bottom Substrates

A) Fine organic material, detritus
B) Fine organic material, detritus
C) Flocculent fibrous peat, detritus
D) Flocculent fibrous peat, detritus

OXBOW # 19

LOCATION R 28 E
T 43 S
SEC. 30

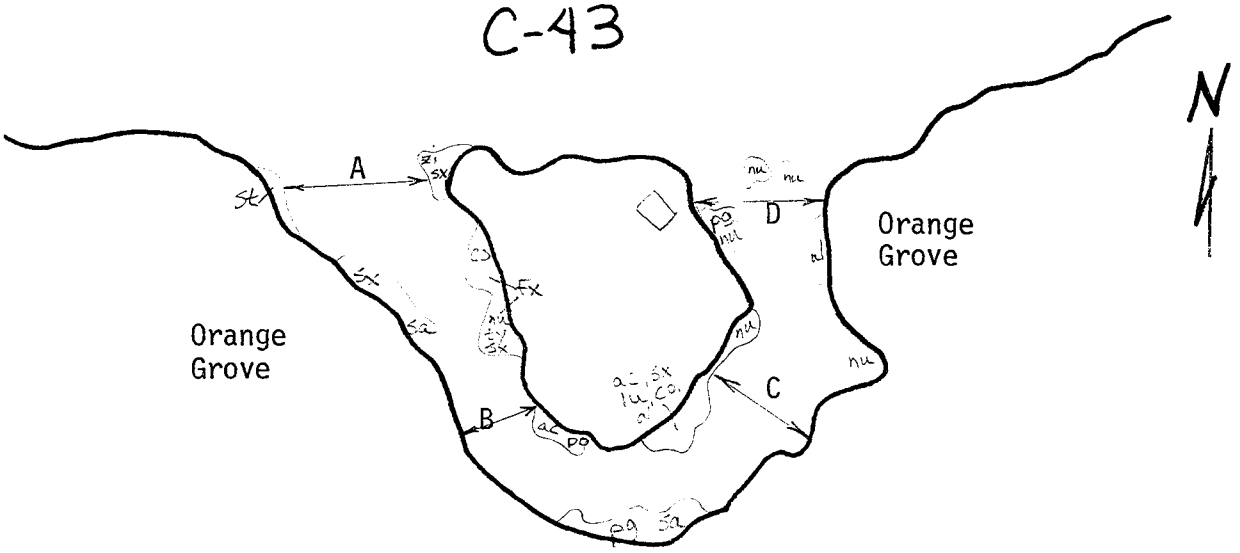
DATE INVENTORIED : 3/1/78

CENTER LINE LENGTH : 1600'

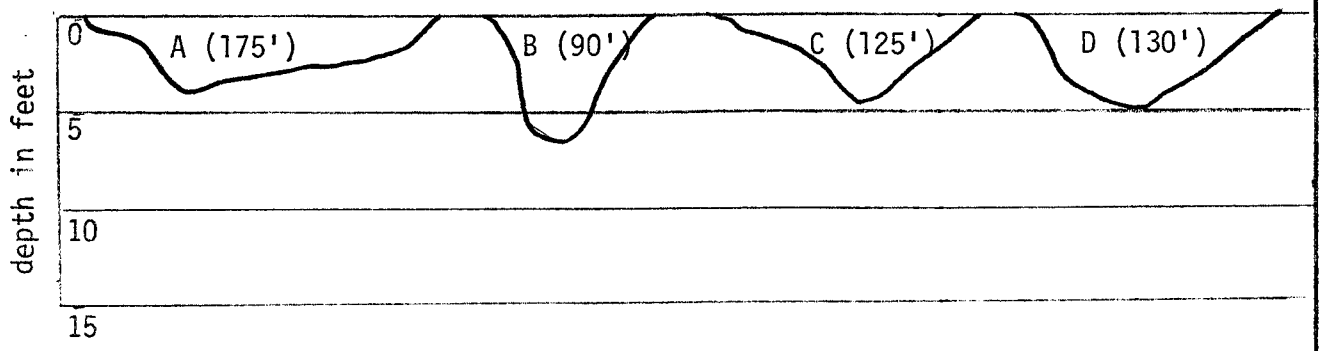
TOTAL AREA : 2.88 Acres

DRAWING SCALE 1" = 400 feet

C-43



DEPTH PROFILES



COMMENTS

Bottom Substrates

A) Brown sand, live and dead Corbicula
B) Sand, mud, dead Corbicula
C) Sand, mud, dead Corbicula
D) Brown sand, dead Corbicula

OXBOW # 20

LOCATION R 28 E
T 43 S
SEC. 29

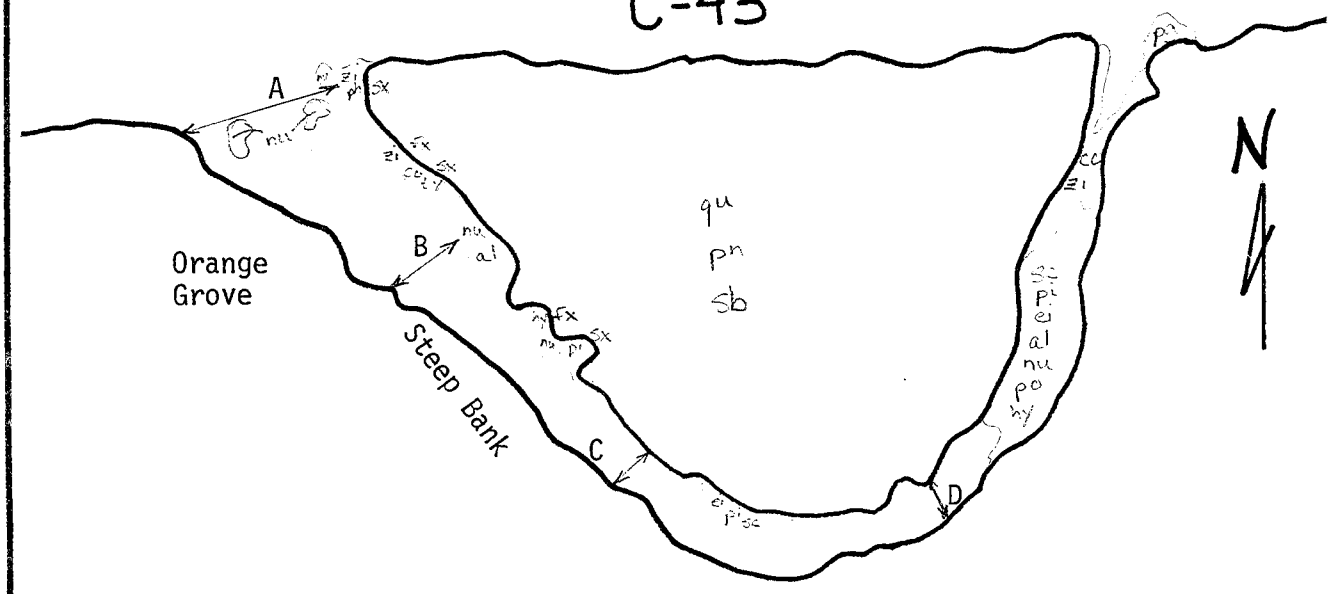
DATE INVENTORIED : 3/1/78

CENTER LINE LENGTH : 900'

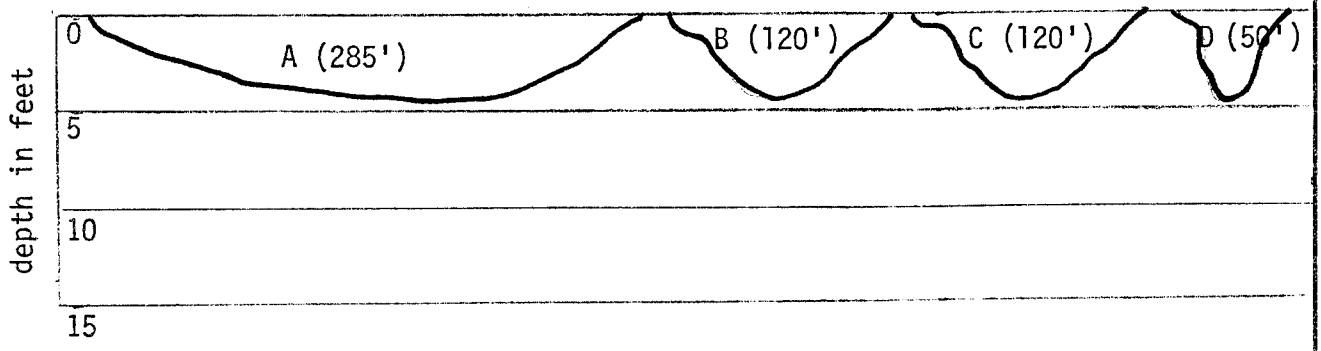
TOTAL AREA : 3.6 Acres

DRAWING SCALE 1" = 200 feet

C-43



DEPTH PROFILES



COMMENTS

Bottom Substrates

A) Sand, mud, live and dead Corbicula
B) Fibrous peat, detritus, fine organic material
C) Fibrous peat, detritus
D) Fibrous peat, detritus

OXBOW # 21

LOCATION R 28 E
T 43 S
SEC. 29

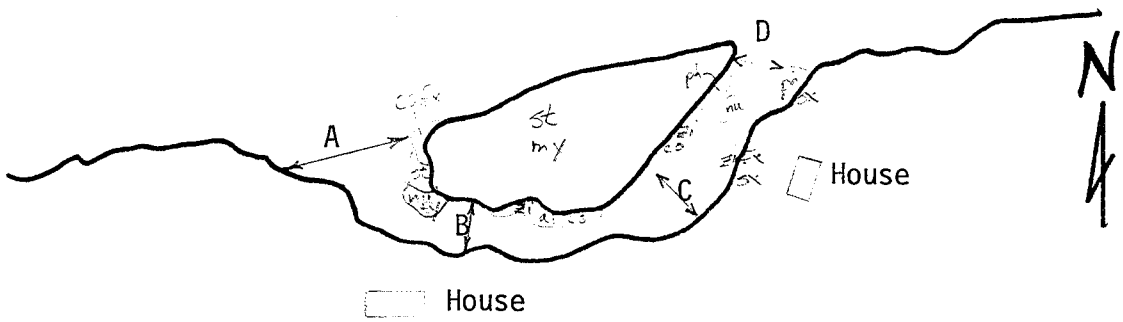
DATE INVENTORIED : 3/1/78

CENTER LINE LENGTH : 1320'

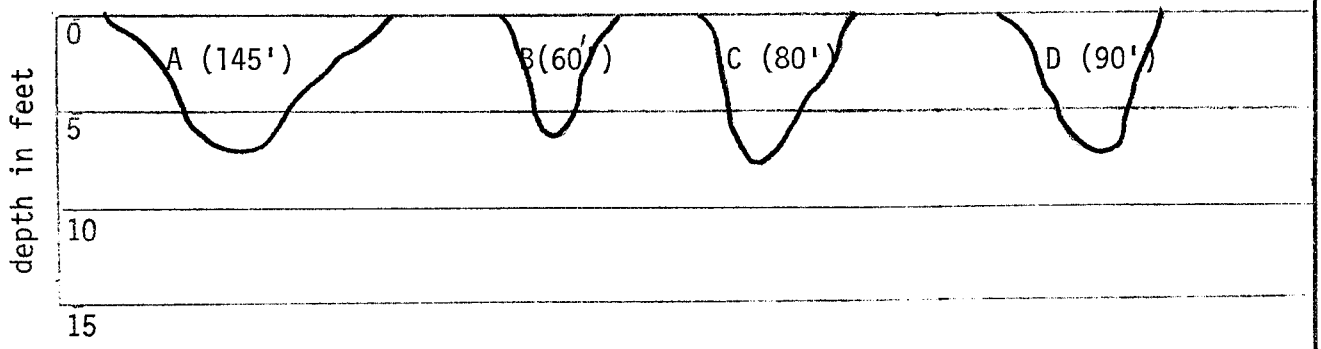
TOTAL AREA : 3.4 Acres

DRAWING SCALE 1" = 200 feet

C-43



DEPTH PROFILES



COMMENTS

Bottom Substrates

A) Brown sand, live and dead Corbicula
B) Fine organic material, sand
C) Fine organic material, sand

OXBOW # 22

LOCATION R 28 E
T 43 S
SEC. 20,29

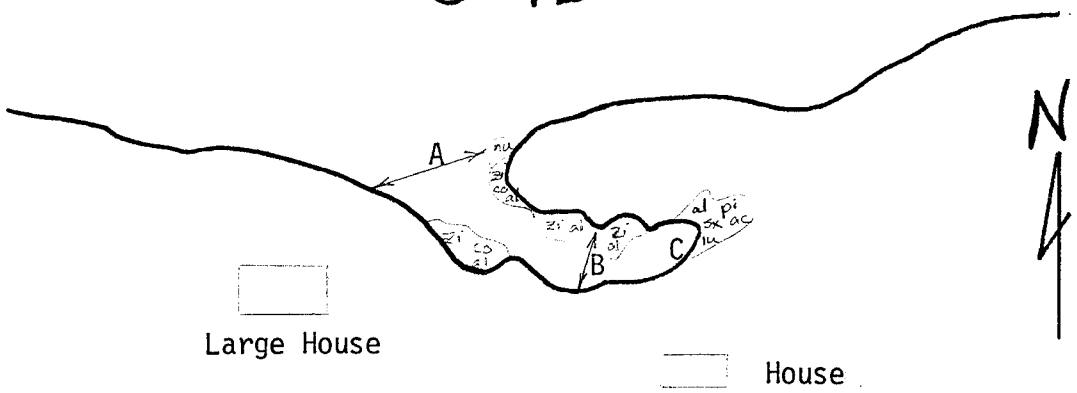
DATE INVENTORIED : 3/1/78

CENTER LINE LENGTH : 580'

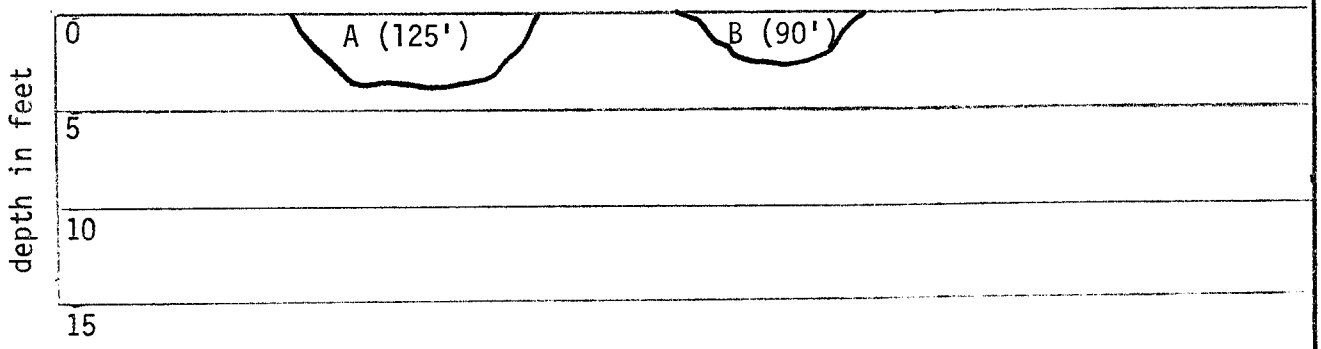
TOTAL AREA : 1.4 Acres

DRAWING SCALE 1" = 200 feet

C-43



DEPTH PROFILES



COMMENTS

Bottom Substrates

A) Gray sand, detritus, dead Corbicula
B) Gray sand, marl, detritus
C) Flocculent peat, detritus

OXBOW # 23

LOCATION R 28 E
T 43 S
SEC. 20,21,28,29

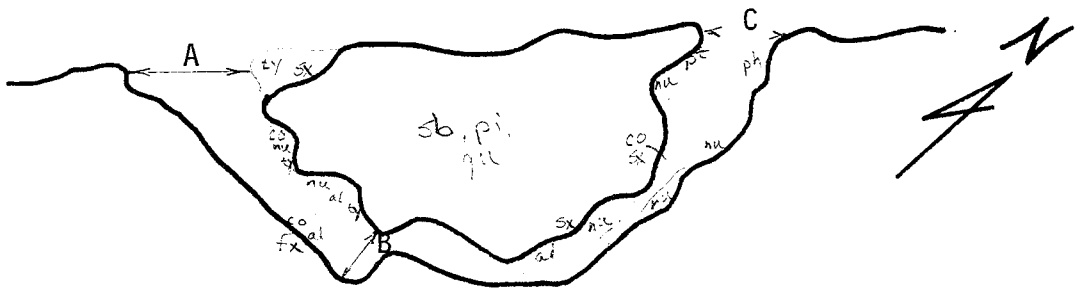
DATE INVENTORIED : 3/1/78

CENTER LINE LENGTH : 400'

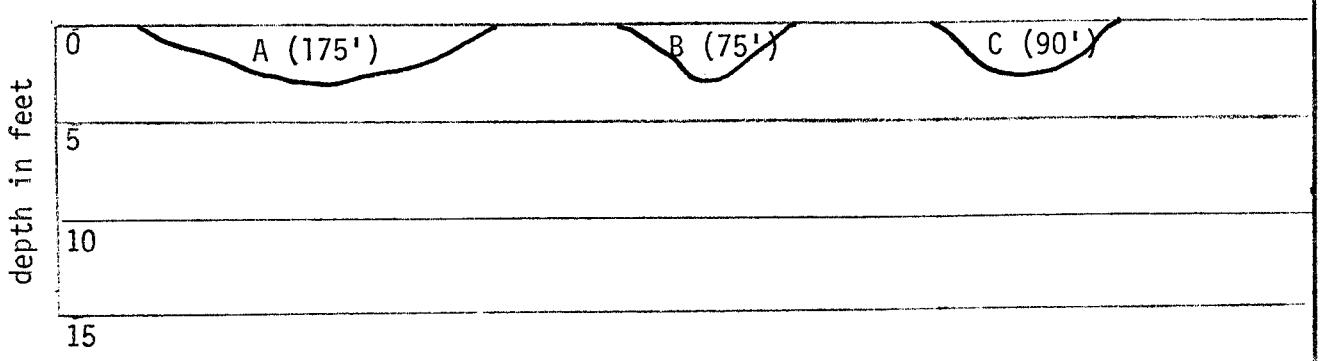
TOTAL AREA : 0.94 Acres

DRAWING SCALE 1" = 200 feet

C-43



DEPTH PROFILES



COMMENTS

Bottom Substrates

A) Fine organic material, detritus
B) Fine organic material, fibrous peat, detritus
C) Fine organic material, sand, dead Corbicula

OXBOW # 24

LOCATION R 28 E
T 43 S
SEC. 21

DATE INVENTORIED : 3/29/78

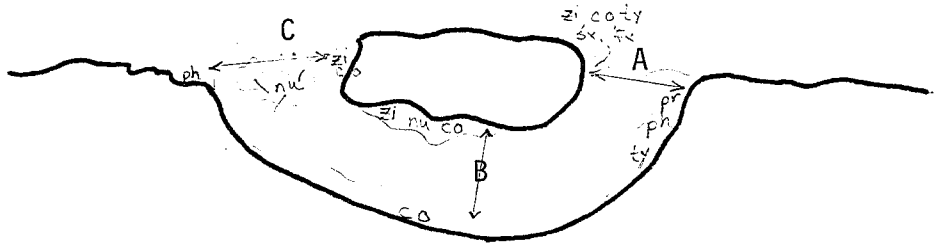
CENTER LINE LENGTH : 800'

TOTAL AREA : 1.7 Acres

DRAWING SCALE 1" = 200 feet

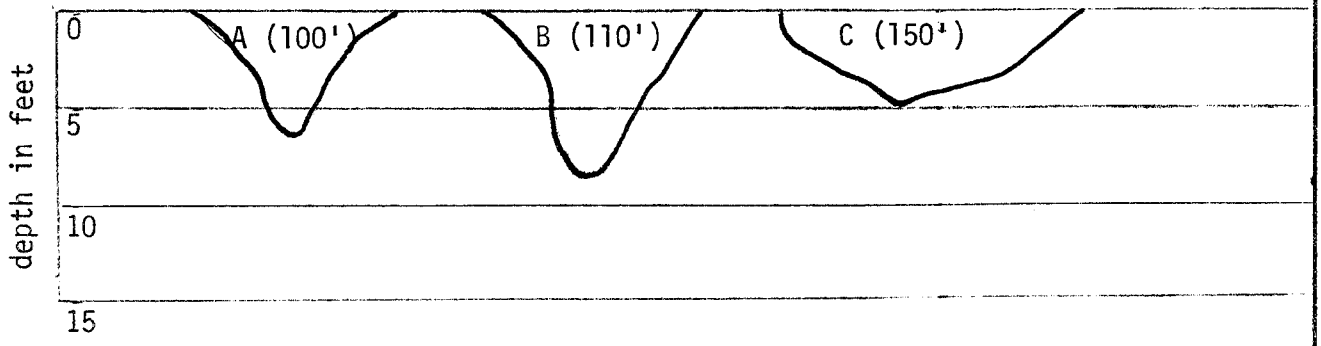
C-43

N



Orange Grove

DEPTH PROFILES



COMMENTS

Bottom Substrates

A) Brown sand, dead Corbicula
B) Fine organic material, dead Corbicula
C) Fine organic material, marl

OXBOW # 25

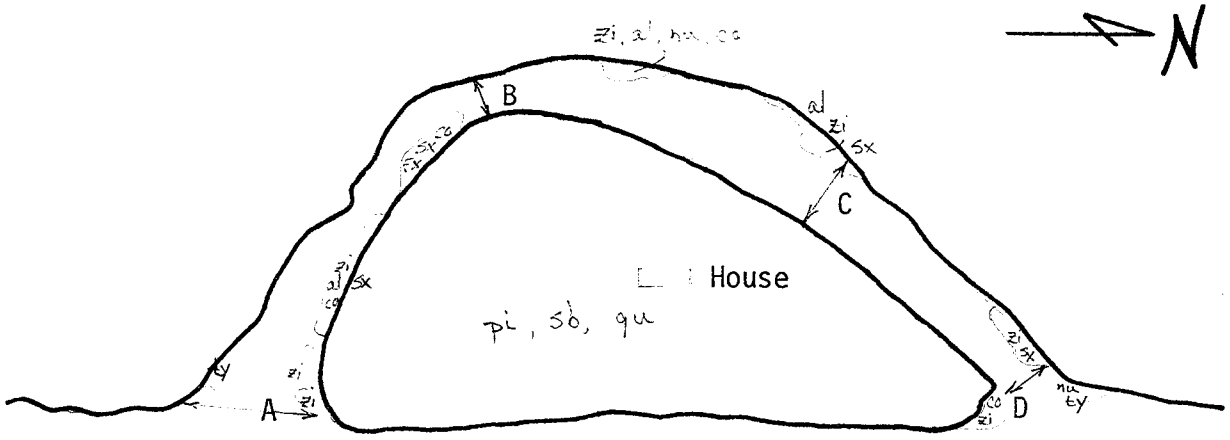
LOCATION R 28 E
T 43 S
SEC. 16

DATE INVENTORIED : 3/29/78

CENTER LINE LENGTH : 500'

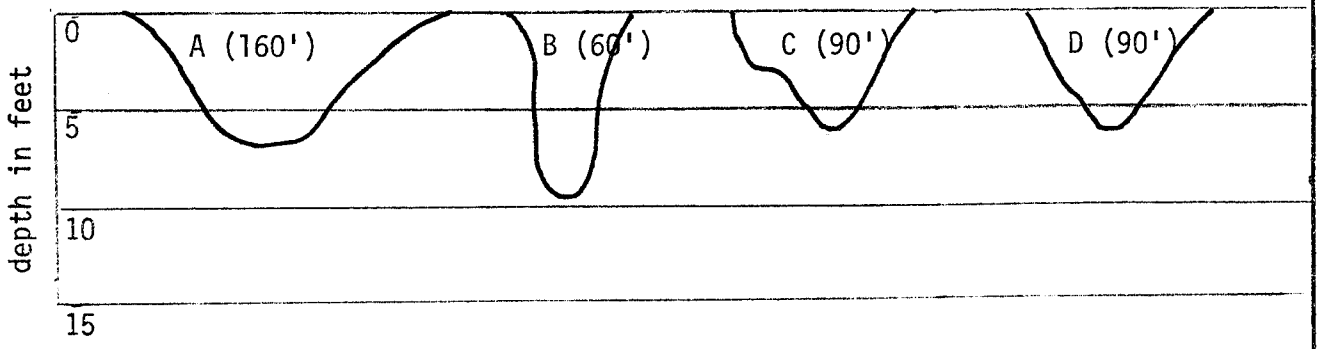
TOTAL AREA : 1.9 Acres

DRAWING SCALE 1" = 200 feet



C-43

DEPTH PROFILES



COMMENTS

Bottom Substrates

A) Fine organic material, dead Corbicula
B) Fine organic material, dead Corbicula
C) Fine organic material, dead Corbicula
D) Fine organic material

OXBOW # 26

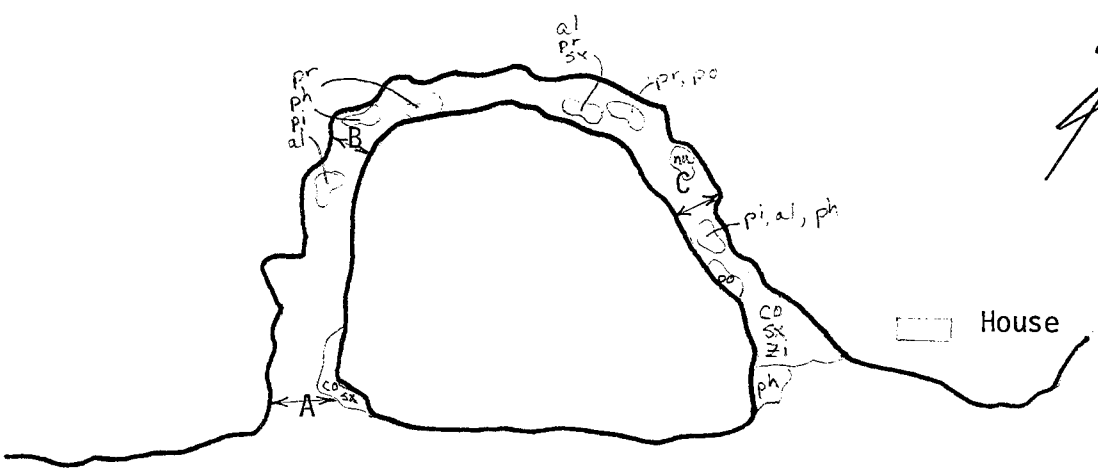
LOCATION R 28 E
T 43 S
SEC. 16

DATE INVENTORIED : 3/29/78

CENTER LINE LENGTH : 1180'

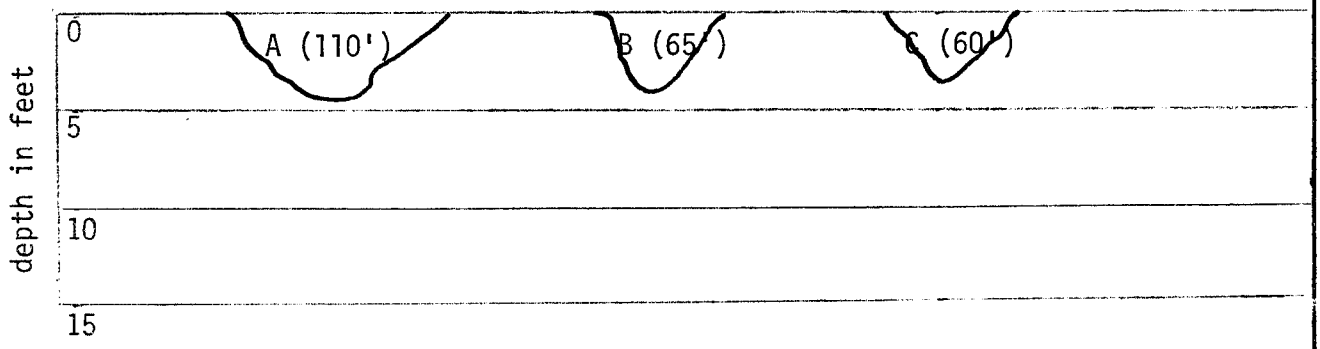
TOTAL AREA : 2.7 Acres

DRAWING SCALE 1" = 200 feet



C-43

DEPTH PROFILES



COMMENTS

Bottom Substrates

A) Sand, mud, fibrous peat, dead Corbicula
B) Fine organic material, fibrous peat
C) Fine organic material, fibrous peat

OXBOW # 27

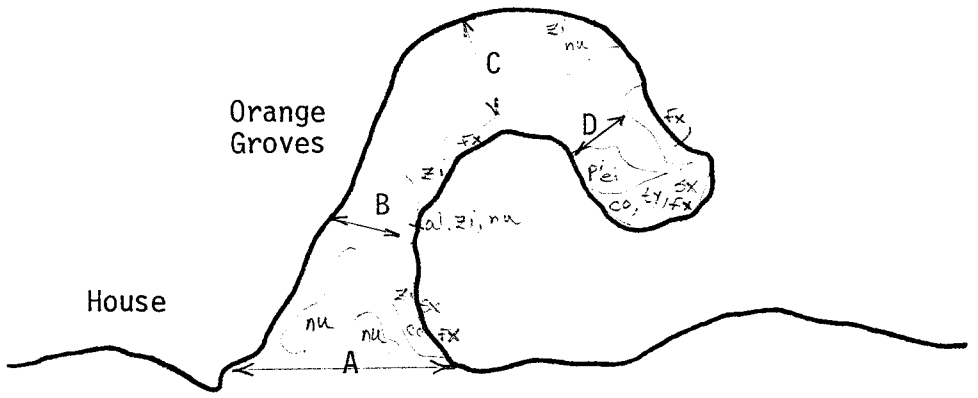
DATE INVENTORIED : 3/29/78

LOCATION R 28 E
T 43 S
SEC. 9

CENTER LINE LENGTH : 1000'

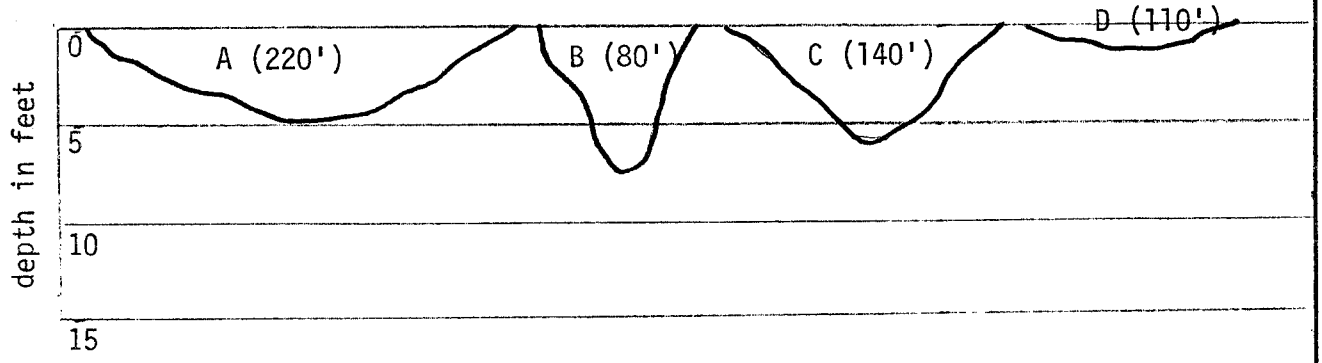
TOTAL AREA : 2.1 Acres

DRAWING SCALE 1" = 200 feet



C-43

DEPTH PROFILES



COMMENTS

Bottom Substrates

A) Fine organic material, detritus, benthic algae
B) Fine organic material, detritus, benthic algae
C) Fibrous peat, flocculent organic material
D) Fibrous peat, flocculent organic material

OXBOW # 28

LOCATION R 28 E
T 43 S
SEC. 9

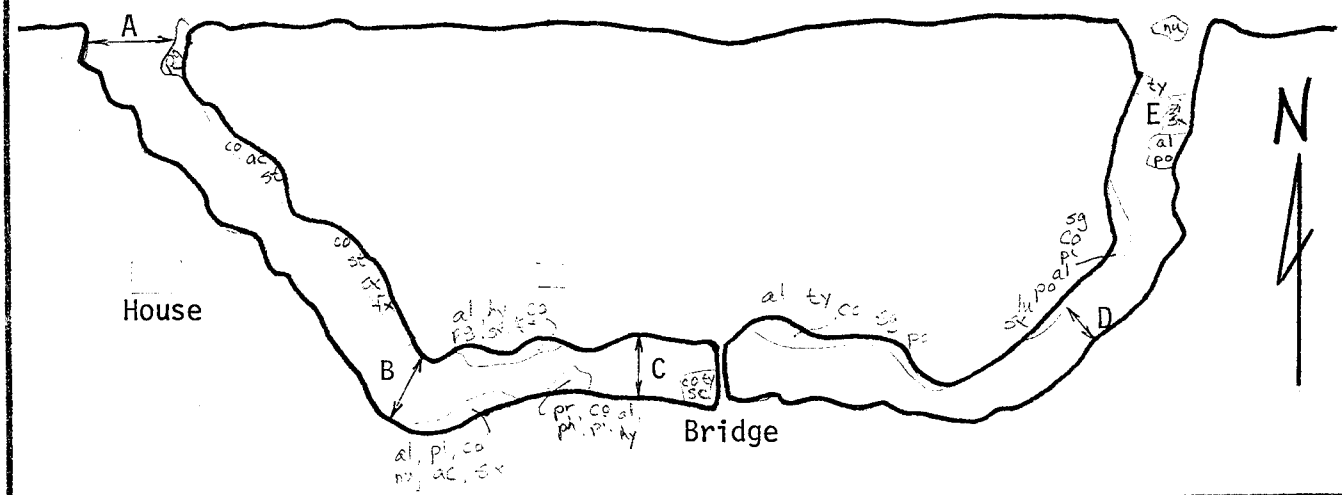
DATE INVENTORIED : 2/14/78

CENTER LINE LENGTH : 640'

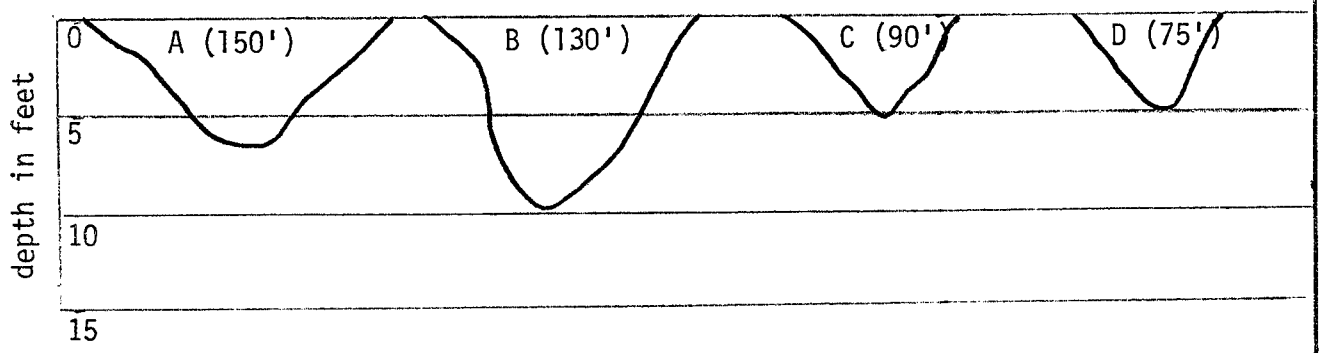
TOTAL AREA : 2.6 Acres

DRAWING SCALE 1" = 200 feet

C-43



DEPTH PROFILES



COMMENTS

Bottom Substrates

A) Marl, detritus, algae
B) Marl, detritus, algae
C) Fine organic material, leaf detritus, algae
D) Fine organic material, leaf detritus, algae
E) Fibrous peat, flocculent detritus, fine organic material, filamentous algae

OXBOW # 29

LOCATION R 28 E
T 43 S
SEC. 14

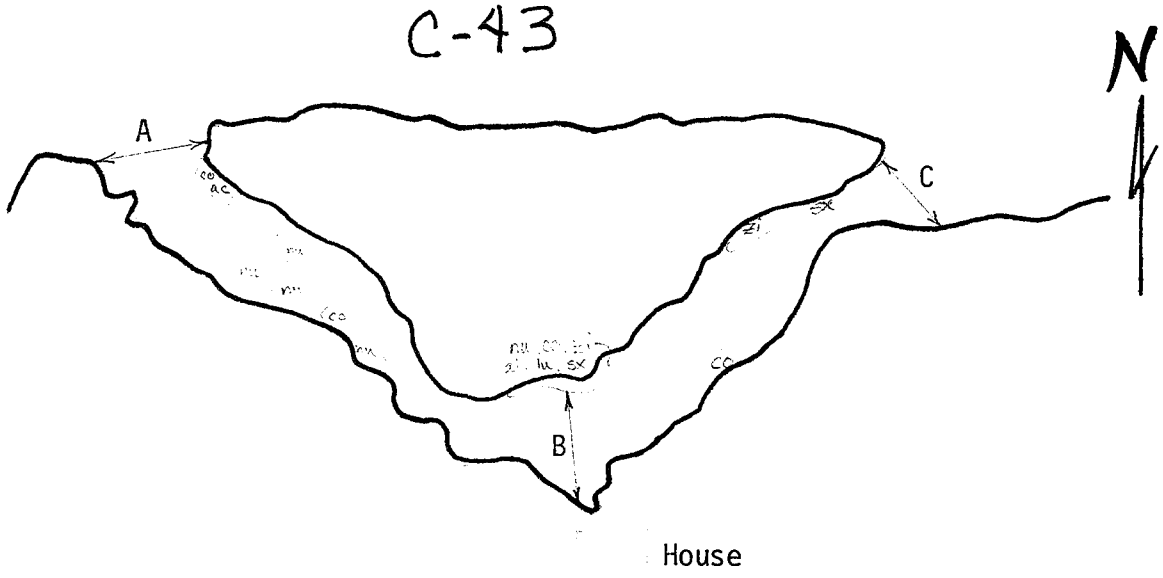
DATE INVENTORIED : 3/29/78

CENTER LINE LENGTH : 2340'

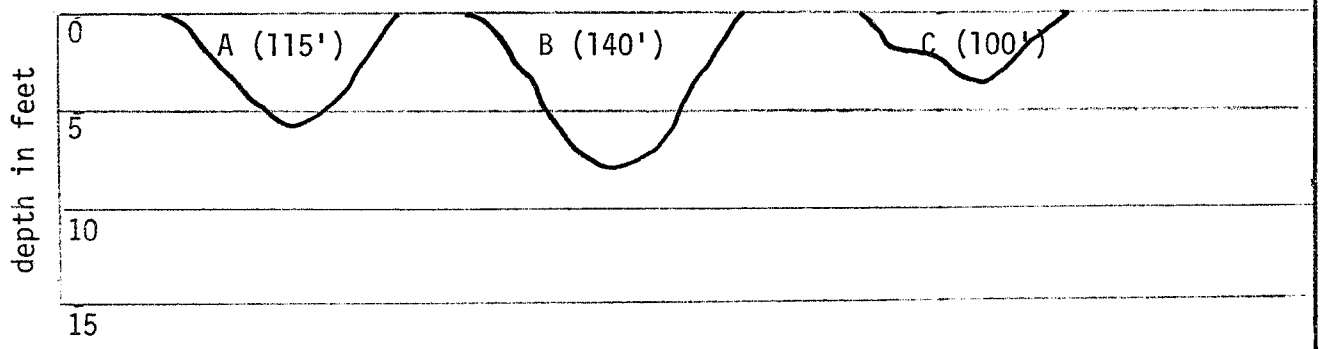
TOTAL AREA : 5.2 Acres

DRAWING SCALE 1" = 300 feet

C-43



DEPTH PROFILES



COMMENTS

Bottom Substrates

A) Marl, fine organic material, filamentous algae
B) Fine organic material, marl, filamentous algae
C) Fine organic material, marl, filamentous algae

OXBOW # 30

DATE INVENTORIED : 3/29/78

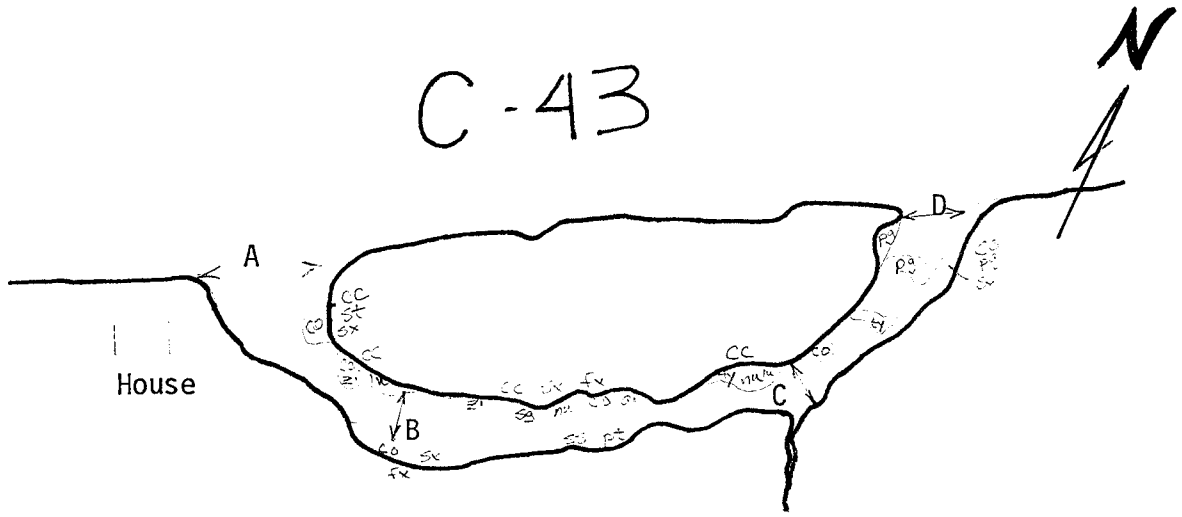
LOCATION R 28 E
T 43 S
SEC. 14

CENTER LINE LENGTH : 1100'

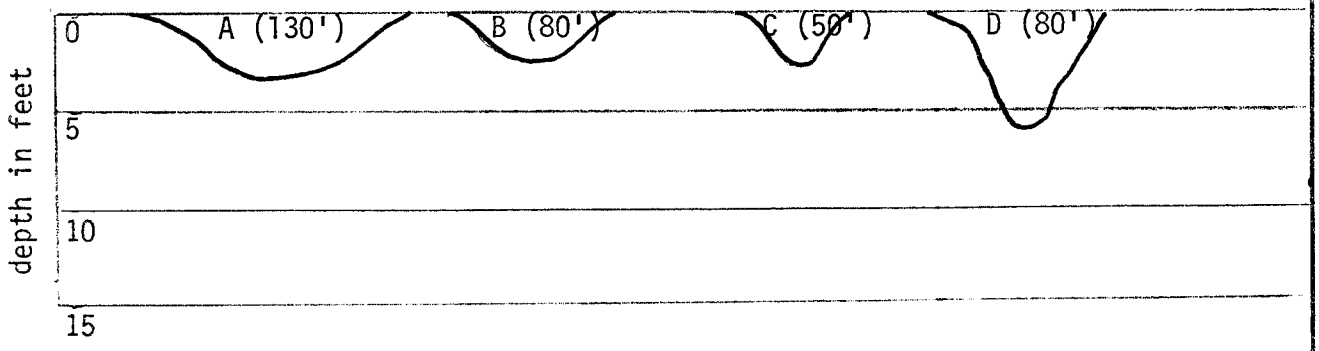
TOTAL AREA : 3.2 Acres

DRAWING SCALE 1" = 200 feet

C-43



DEPTH PROFILES



COMMENTS

Bottom Substrates

A) Detritus, fine organic material, fibrous peat
B) Fine organic material, detritus, fibrous peat
C) Fine organic material, detritus, fibrous peat
D) Sand, shell fragments

OXBOW # 32

LOCATION R 28 E
T 43 S
SEC. 13

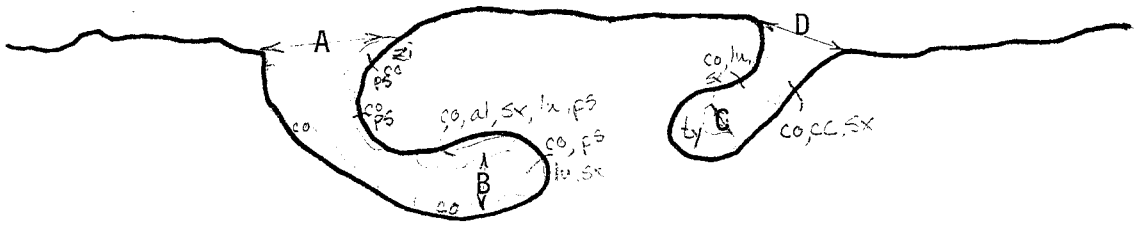
DATE INVENTORIED : 4/26/78

CENTER LINE LENGTH : 880'

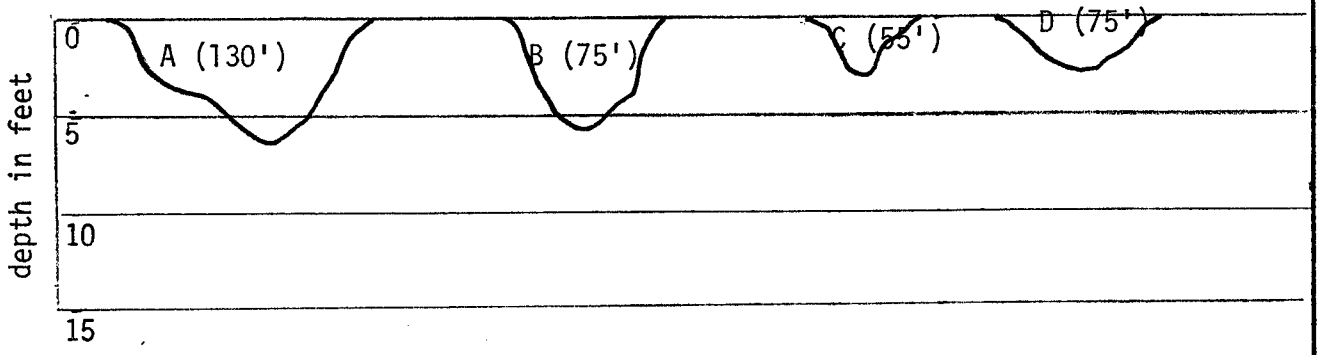
TOTAL AREA : 2.0 Acres

DRAWING SCALE 1" = 200 feet

C-43



DEPTH PROFILES



COMMENTS

Bottom Substrates

A) Sand, marl, shell fragments, live Corbicula
B) Fine organic material, marl, sand
C) Marl, fine organic material
D) Sand, shell fragments, marl

OXBOW # 33

LOCATION R 29 E
T 43 S
SEC. 7

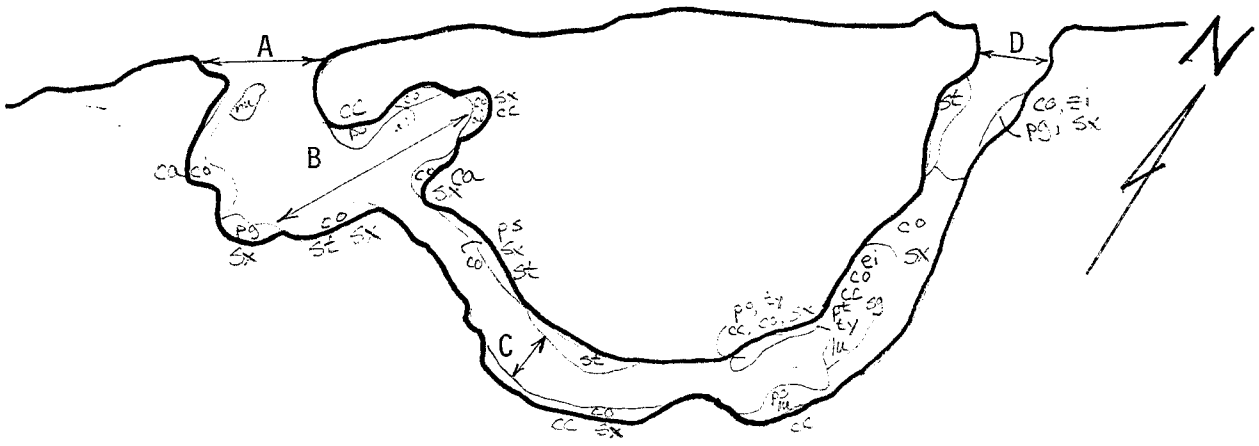
DATE INVENTORIED : 4/26/78

CENTER LINE LENGTH : 520'

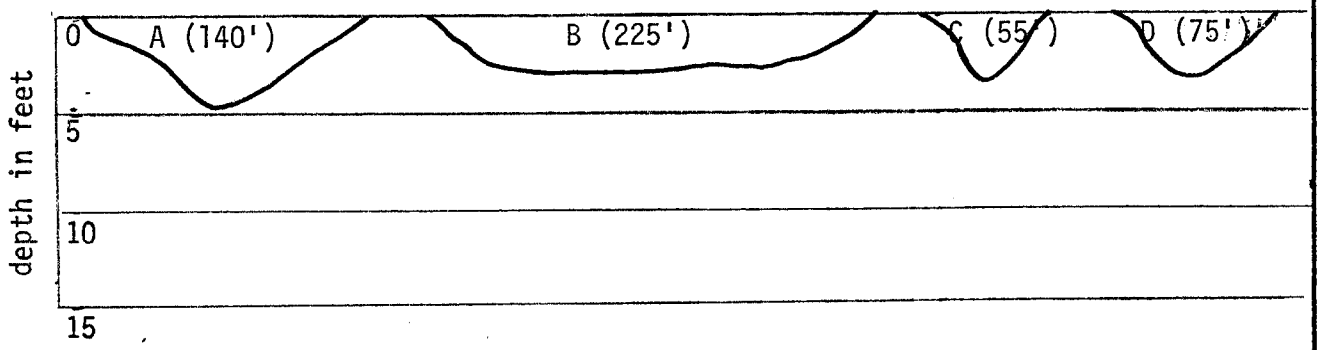
TOTAL AREA : 1.1 Acres

DRAWING SCALE 1" = 200 feet

C-43



DEPTH PROFILES



COMMENTS

Bottom Substrates

A) Marl, fine organic material
B) Marl, fine organic material
C) Flocculent detritus, fine organic material
D) Flocculent detritus, fine organic material
E) Sand, marl

OXBOW # 34

LOCATION R 29 E
T 43 S
SEC. 7

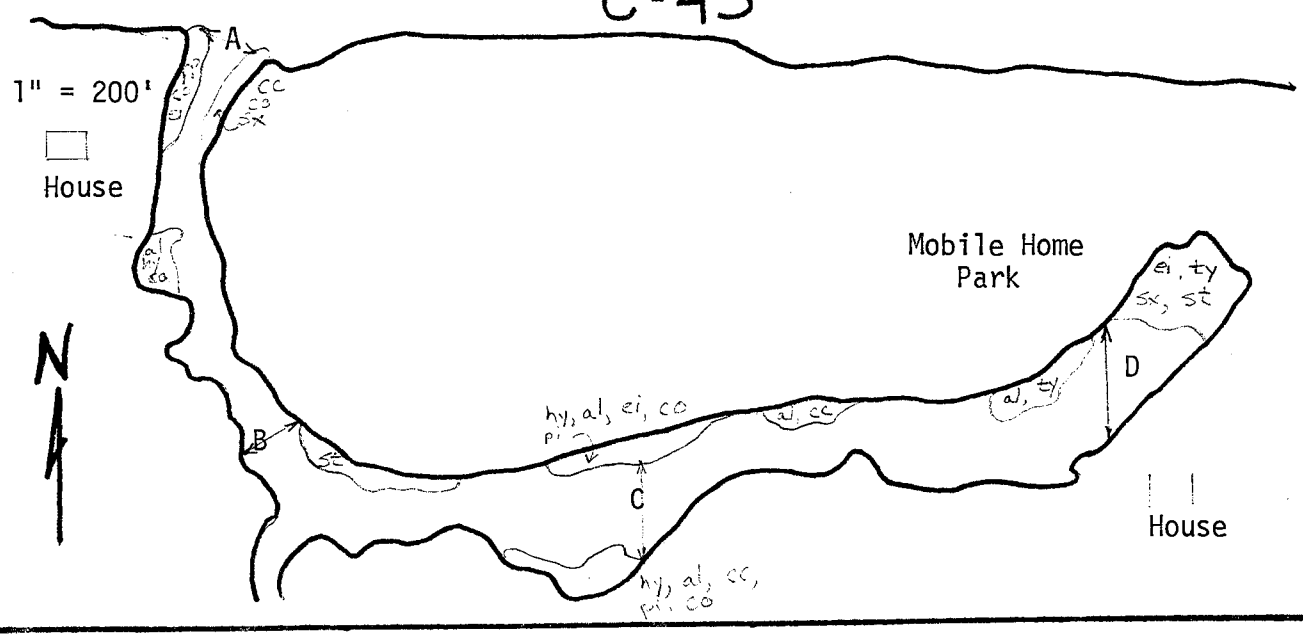
DATE INVENTORIED : 4/26/78

CENTER LINE LENGTH : 1200'

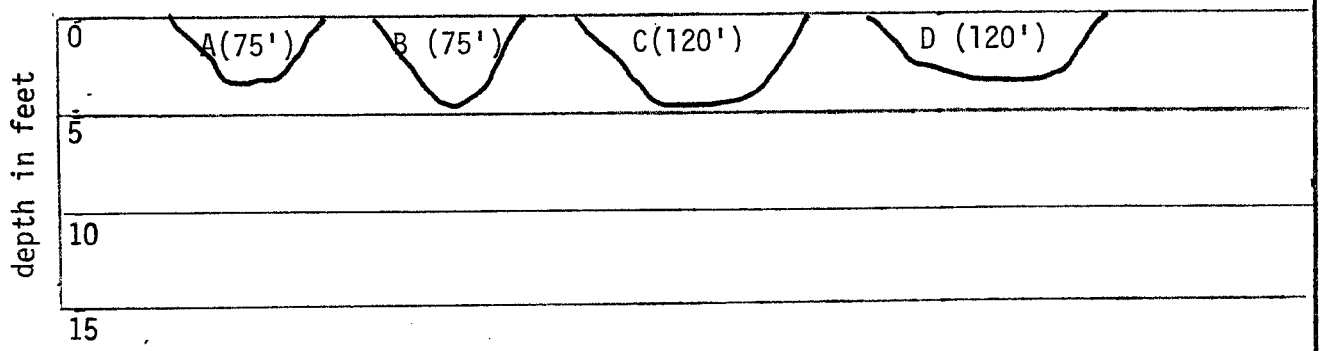
TOTAL AREA : 3.3 Acres

DRAWING SCALE 1" = 200 feet

C-43



DEPTH PROFILES



COMMENTS

Bottom Substrates

A & B) Marl, fine organic material, detritus, dead Corbicula
C) Fine organic material, marl
D) Submergent vegetation

OXBOW # 35

LOCATION R29 E
T43 S
SEC. 4

DATE INVENTORIED : 5/24/78

CENTER LINE LENGTH : 1540'

TOTAL AREA : 4.4 Acres

DRAWING SCALE 1" = 200 feet