THE BIG CYPRESS BASIN WATER QUALITY MONITORING NETWORK

ANNUAL REPORT FOR 1982

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Final Report to

Big Cypress Basin
South Florida Water Management District
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INTRODUCTION

In January 1979, the South Florida Water Management District established a water quality monitoring network in their Lower West Coast Planning Area. The primary objective of the network was to maintain a baseline data set for the area which would provide an accounting of materials discharged from the major drainage systems, depict areal and seasonal variability, and provide information for more comprehensive basin assessments (Dickson 1980). They sampled 19 stations throughout the planning area monthly from January 1979 to December 1980. The 1979 results were reported by Dickson (1980), and a report on the 1979 and 1980 data is currently in press.

In July 1981, the Big Cypress Basin resumed monthly sampling at 12 of the stations in western Collier County, and this monitoring continues to date. The purpose of this report is to present the results of the 1982 sampling. We have included the July-December 1981 data in Appendix A, although they are not discussed in our analyses.

METHODS

Locations of the 12 sites monitored since July 1981 and their relation to the canal system in the Big Cypress Basin are shown in Fig. 1. All sites are along canals except at East and West Cocohatchee River (ECOCORIV, WCOCORIV) and Gordon River (GORDONRV) (Table 1). These three sites are along remnants of natural drainages which have been surrounded and modified to various degrees by development. Samples were taken immediately above Amil Gate control structures at North Naples drainage canal (NNAPLES), WCOCORIV, and GORDONRV throughout the sampling period. An Amil gate was installed at the ECOCORIV site during April-May 1982 and our samples have been taken above this structure since June 1982. Samples were taken above fixed crest weirs at Faka Union canal(FAKA) and Golden Gate canal at C.R. 31 (GGCAT31) and above a removable riser board weir at Barron River (BARRON). All sites were within 6 km of the coast except Golden Gate canal at C.R. 951 (GGCAT951) and Cocohatchee canal at C.R. 951 (COCAT951) both of which are approximately 14 km inland.

Sites were sampled monthly, each generally at about the same time of day (Table 2). In situ measurements of temperature and dissolved oxygen were made with a YSI model 57 meter, specific conductance with a YSI model 33 meter, and pH with a Leeds Northrup 7417 pH meter. Samples from all sites were analyzed monthly for turbidity, color, alkalinity, organic nitrogen (TKN), nitrate (NO), nitrite

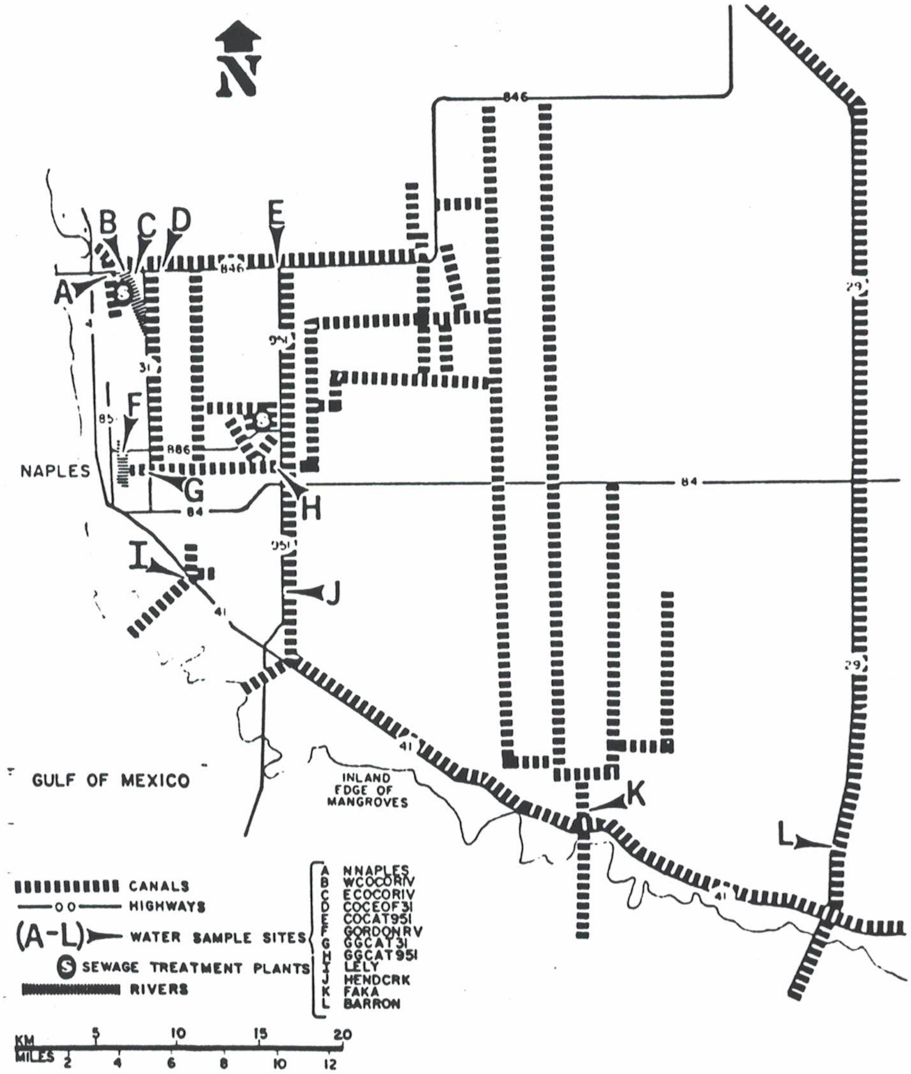

FIGURE I. WATER QUALITY MONITORING STATIONS WITHIN THE BIG CYPRESS BASIN

Table 2. Sampling times at Collier County canal sampling sites during 1982.

LOCATION	JAN. 14	FEB. 9	MAR. 8	APR. 13	MAY 17	JUNE 21	JULY 21	AUG. 10	SEP. 7	OCT. 9	NOV. 8	DEC. 4
BARRON	1430	1600	1715	1800	1725*	1728	1500	1055	1510	1728	1400	1715
COCAT951	-	-	-	-	-	0930	0830	0945*	1220	0935	0823	1435*
COCEOF31	0845	0950	0845	0945	1045	1015	0900	1035*	1200	1003	0840	1345*
ECOCORIV	1000	1130	1155	-	-	1230	1030	1130*	1150	1050	0945	1105*
FAKA	1340	1530	1645	1725	1640*	1653	1415	1010	1430	1650	1330	1640
GGCAT31	1100	1235	1410	1426	1430	1335	1130	0930	0920	1400	1140	0855
GGCAT951	1200	1330	1440	1500	1425*	1409	1200	1900	1250	1445	1115	1215
GORDONRV	1040	1205	1335	1353	1405	1300	1100	1935*	0945	1325	1020	1000
HENDCRK	1230	1410	1500	1516	1313*	1432	1230	1735	1400	1515	1200	1245
LELY	1300	1435	1530	1540	1200*	1455	1320	1235	1340	1540	1254	1330
NNAPLES	0920	1045	0450	1128	1215	1042	0945	1720*	1000	1132	0900	0805*
WCOCORIV	0945	1110	1055	1220	1255	1215	1015	1255*	1120	1110	0930	1030*

\- Site dry
* Done one day later

(NO_2), ammonia (NH_4), total phosphorus ($T-PO_4$), orthophosphate ($O-PO_4$), total suspended solids, total organic carbon, chloride (Cl), sulfate (SO_4), and total iron (Fe); and semiannually for hardness, sodium (Na), calcium (Ca) potassium (K), magnesium (Mg), arsenic (As), cadmium (Cd), chromium (Ch), copper (Cu), lead (Pb), mercury (Hg), nickel (Ni), and zinc (Zn). These analyses were performed by the South Florida Water Management District water chemistry division in West Palm Beach. Details of their analytical methods are given in Appendix B. All samples for laboratory analysis were refrigerated immediately following collection and some had preservatives added as noted in Appendix B. Two extra samples were taken at a different site each month as a check on within-sample variability and analytical precision. Total organic carbon determinations were terminated after the September 1982 sample.

ANALYSIS OF INDIVIDUAL WATER QUALITY PARAMETERS

Temperature

Water temperatures generally ranged from 17-24° C during January-March and November-December, and from 26-31° C during June-October (Table 3). All stations showed a similar seasonal fluctuation. The range of temperatures for all the sites on any sampling date was usually 3-5° C. This range of values was at least partially due to normal daily fluctuation since sites sampled in the afternoon generally had higher temperatures than those sampled in the

Table 3. Temperatures (^{o}C) at Collier County canal sampling sites during 1982.

LOCATION	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	$\bar{X}$	SD
BARRON	20.0	24.0	22.5	25.0	27.0	30.5	29.5	29.0	27.0	28.5	21.0	23.5	25.8	3.[illegible]
COCAT951	-	-	-	-	-	27.0	27.0	25.5	28.0	26.0	21.0	24.5		
COCEOF31	17.5	22.0	15.0	22.0	24.5	27.5	27.0	27.0	28.0	27.0	20.0	24.0	24.0	4.[illegible]
ECOCORIV	18.0	23.5	20.0	-	-	27.0	27.0	27.0	26.0	25.0	18.5	23.0	22.3	3.[illegible]
FAKA	18.0	25.5	23.5	28.0	28.0	29.5	31.0	28.5	27.0	27.5	21.0	24.0	25.4	4.[illegible]
GGCAT31	16.5	25.0	24.0	27.0	27.0	28.0	27.5	26.0	26.0	27.0	21.0	22.5	24.8	3.[illegible]
GGCAT951	19.0	26.0	23.5	28.0	26.0	27.0	26.0	26.0	27.0	26.5	21.0	23.0	24.9	2.[illegible]
GORDONRV	15.0	24.0	20.5	23.0	24.5	27.5	27.5	27.5	25.0	26.5	20.0	21.5	23.5	3.[illegible]
HENDCRK	18.5	25.0	21.5	22.5	25.0	30.0	28.0	28.0	26.0	27.5	21.0	23.0	25.1	3.[illegible]
LELY	18.5	25.0	22.0	29.5	25.5	30.0	31.0	28.0	28.0	28.5	21.0	24.0	26.6	4.[illegible]
NNAPLES	17.0	24.0	19.0	26.0	27.0	28.0	28.0	30.5	27.5	26.5	19.0	22.0	24.8	4.[illegible]
WCOCORIV	17.0	22.5	20.0	22.0	24.0	27.0	26.0	26.0	26.0	26.5	20.0	22.0	23.1	3.[illegible]
$\bar{X}$	17.7	24.2	21.1	25.3	25.9	28.3	28.0	27.4	26.8	26.9	20.4	23.1	24.7	
SD	1.4	1.2	2.6	2.8	1.4	1.4	1.7	1.5	1.0	1.0	0.9	1.0	1.3	

\- Site dry

morning. The range of mean annual temperatures for the morning sampling sites was 22.3-24.8° C, and for the afternoon sampling sites it was 25.1-26.6° C. Additional factors that may have influenced temperature were water volumes and flow rates and degree of shading. In general, stagnant and/or small water volumes will tend to heat and cool more rapidly than will large water volumes and/or flows. The higher water temperatures at the Lely canal (LELY) site were probably associated with shallowness, slow flows, and unshaded aspect, as well as a normal afternoon sampling time. The dense shade over the WCOCORIV, ECOCORIV, and GORDONRV sites could have contributed to their lower temperatures. The large water volumes at the GGCAT951 site probably moderated both winter and summer temperatures there. However, the more downstream GGCAT31 site on the same canal did not show a similar pattern. Three sites, GGCAT31, Henderson Creek canal (HENDCRK), and NNAPLES showed no consistent temperature patterns. Cocohatchee canal east of C.R. 31 (COCEOF31) and possibly COCAT951 showed an unexplained pattern of cooler temperatures from September through December compared to the other sampling sites on comparable dates.

Dissolved Oxygen

Oxygen enters surface water directly from the atmosphere and by the photosynthetic activity of aquatic plants. In South Florida, temperature is the most significant physical factor determining dissolved oxygen concentrations; they are inversely related. Water exposed to the air at sea level with a temperature of 25° C (the average temperature for our sampling sites) will be saturated at a dissolved oxygen concentration of 8.4 mg/l. Biological activity, however, also causes oxygen concentrations to fluctuate since plant and animal respiration consumes oxygen while photosynthesis produces it. Oxygen levels, therefore, are normally at a maximum during the afternoon when photosynthesis has been occurring for most of the day, and at a minimum early in the morning when increasing light allows resumption of photosynthesis.

Dissolved oxygen concentrations during this study typically ranged from 1.0-20.0 mg/l (Table 4), except for the WCOCORIV site which will be discussed separately below. In nearly all cases, dissolved oxygen values were highest during the sunny and relatively low flow winter-spring months when maximum concentrations were typically over 8 mg/l. Values over 10 mg/l occurred during this period at two canal sites, FAKA and LELY, both of which supported an abundance of submerged aquatic vegetation. During the summer, maximum concentrations rarely exceeded 6 mg/l. Minimum concentrations were also consistently lowest (1-2 mg/l) during the summer and highest (3-5 mg/l) during the winter. Monthly averages for all sites display this trend with the highest values during January-May, a sharp decline in June, and increasing values again in September. Others have also reported this seasonal fluctuation for the Big Cypress Basin (Duever et al. 1979). Factors causing higher

Table 4. Dissolved oxygen concentrations (mg/l) at Collier County canal sampling sites during 1982.

LOCATION	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	$\bar{X}$	SD
BARRON	4.6	3.8	6.5	9.8	8.9	3.0	3.8	3.0	3.1	5.5	5.3	3.4	5.6	2.5
COCAT951	-	-	-	-	-	2.0	1.7	3.0	4.4	2.7	2.6	7.1		
COCEOF31	3.8	4.2	5.3	7.4	8.2	3.4	4.5	5.5	7.2	4.0	5.1	8.9	5.4	1.8
ECOCORIV	6.3	4.5	6.6	-	-	2.1	3.0	4.8	3.1	1.3	1.8	2.1	3.7	2.1
FAKA	12.9	15.0	14.0	13.2	18.8	11.0	5.0	1.4	2.5	3.2	6.3	7.5	9.9	5.0
GGCAT31	8.0	7.7	9.7	8.0	8.7	4.2	4.7	2.6	4.0	2.7	4.7	4.0	5.8	2.5
GGCAT951	5.5	8.1	9.6	8.2	8.1	2.9	1.9	2.9	5.2	2.0	3.4	3.3	5.7	2.8
GORDONRV	8.0	5.7	6.0	0.6	2.2	1.8	1.1	3.2	4.1	2.7	2.4	2.7	3.4	2.2
HENDCRK	7.5	9.7	9.5	3.4	5.5	3.0	2.3	4.6	4.2	4.0	3.5	3.4	5.0	2.[illegible]
LELY	8.2	6.0	9.6	20.0	7.7	5.2	5.5	5.0	4.4	3.8	8.1	6.8	7.2	4.[illegible]
NNAPLES	4.4	7.8	5.3	7.7	8.0	3.7	3.8	6.2	5.1	1.6	7.0	6.2	5.9	2.[illegible]
WCOCORIV	1.0	0.2	0.2	0.3	0.3	2.2	0.7	2.1	1.1	0.6	0.4	0.5	0.8	0.[illegible]
$\bar{X}$	6.4	6.6	7.5	7.9	7.6	3.7	3.2	3.7	4.0	2.8	4.2	4.7	5.2	
SD	3.1	3.8	3.6	5.9	4.9	2.5	1.6	1.5	1.5	1.4	2.3	2.6	2.2	

\- Site dry

concentrations during winter and spring are probably varying combinations of cooler temperatures, higher light levels due to a reduced cloud cover during the dry season, and greater plant productivity associated with reduced flows and declining water tables during the dry season.

With the exception of WCOCORIV, no site had consistently above or below average dissolved oxygen values, although LELY most closely approached consistently above average values, and ECOCORIV most closely approached consistently below average values. Dickson (1980) reported a similar range of mean annual dissolved oxygen values for these same sites in 1979 and a nearly identical overall mean and standard deviation . However, a site by site comparison of annual means showed similar but slightly lower dissolved oxygen concentrations at most sites in 1979. Notable exceptions were substantially higher concentrations at ECOCORIV and WCOCORIV during 1979. With the exception of the WCOCORIV site, the dissolved oxygen concentrations we found were typical of levels reported for natural sites in this region by Duever et al. (1979).

Dissolved oxygen concentrations at WCOCORIV were often near zero in 1982 and had a much lower mean annual value than that reported by Dickson (1980). The mean value at WCOCORIV for 1982 is even lower than the minimum value for all of 1979. A floating mat of duckweed (Lemna minor) that completely covered the sampling site throughout 1982 was undoubtedly a major factor in the low dissolved oxygen values.

Percent saturation of dissolved oxygen values (Table 5) understandably showed the same trends for the same reasons as did dissolved oxygen. Highest percent saturations occurred in the winter and spring when all values in excess of 90% were recorded.

Specific Conductance

Specific conductance is a measure of the ability of water to conduct electricity. This is a function of the kinds and amounts of dissolved minerals in the water. Minerals vary in their ability to conduct electricity but generally the greater the concentration of dissolved minerals the greater the conductivity. Distilled water has a specific conductance of about 1 umho, while in Florida Bay it can be as high as 60,000 umho.

Specific conductance measurements within the study area showed extreme variability at some sites while remaining relatively constant at others (Table 6). All sites had highest values in late winter and spring which were a result of drying conditions and associated concentration of minerals. Sporadic extremely high values recorded at LELY, GORDONRV, ECOCORIV, and BARRON were undoubtedly influenced by saltwater inputs during the dry season. ECOCORIV and WCOCORIV showed relatively high, although not extreme, specific conductance values which were quite consistent throughout the year. Values from ECOCORIV did show occasional indications of flushing by freshwater, while those for WCOCORIV never decreased to natural freshwater

Table 5. Percent saturation of dissolved oxygen at Collier County canal sampling sites during 1982.

LOCATION	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	$\bar{X}$	SD
BARRON	50	44	74	116	109	39	48	38	39	69	59	39	67	31
COCAT951	-	-	-	-	-	24	21	36	55	33	29	83		
COCEOF31	39	47	52	83	96	42	55	67	90	49	56	103	65	22
ECOCORIV	56	52	72	-	-	26	37	59	37	16	19	24	41	20
FAKA	135	179	162	164	234	140	65	18	31	39	70	87	117	60
GGCAT31	81	91	113	98	106	52	58	31	48	33	52	45	67	29
GGCAT951	59	98	111	102	98	35	23	35	64	24	38	38	68	34
GORDONRV	79	66	66	7	26	22	14	39	49	33	26	30	38	22
HENDCRK	79	115	105	38	65	38	29	57	51	49	39	39	58	25
LELY	87	71	108	255	92	67	71	62	55	48	90	79	88	51
NNAPLES	45	91	56	93	98	46	47	80	63	19	75	69	65	24
WCOCORIV	10	2	2	3	3	27	8	25	13	7	4	56	13	16
$\bar{X}$	66	78	84	96	93	47	40	46	50	35	46	58	61	
SD	32	46	42	75	61	32	21	19	19	17	25	26	26	

\- Site dry

Table 6. Specific conductance (umho) at Collier County canal sampling sites during 1982.

LOCATION	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	$\bar{X}$	SD
BARRON	590	600	600	610	5300	285	310	330	380	320	335	410	839	1410
COCAT951	-	-	-	-	-	425	520	550	580	200	383	355		
COCEOF31	520	620	510	700	630	510	600	375	500	245	320	610	474	159
ECOCORIV	960	8500	4100	-	-	1500	1830	490	1300	450	1000	1150	2249	2234
FAKA	600	620	650	600	700	400	375	400	464	410	650	700	536	122
GGCAT31	520	610	600	710	700	600	690	600	640	580	570	600	618	57
GGCAT951	580	610	600	700	670	610	550	600	700	460	470	590	604	7[illegible]
GORDONRV	1050	1720	1090	25500	4100	650	870	700	610	880	1340	2700	3434	7024
HENDCRK	1100	1300	1080	1150	1200	170	690	355	900	630	900	1010	800	372
LELY	1400	5100	16000	30800	1480	315	900	340	620	500	840	910	4358	8655
NNAPLES	1180	1150	1000	1400	1200	1000	500	710	700	460	590	700	956	34[illegible]
WCOCORIV	1420	1400	1300	1450	1620	1330	1280	1200	1180	1080	1100	1200	1283	14[illegible]
$\bar{X}$	902	2021	2503	3590	1760	650	768	554	715	518	708	911	1385	
SD	352	2512	4590	7735	1614	418	423	245	279	253	328	625	1287	

\- Site dry

levels. Significant saline water inputs must be occurring at these two sites to maintain this year-round condition. NNAPLES and HENDCRK also had some relatively high dry season values (>900 umho). They may possibly have been more affected by drydown and concentration of minerals than were other sites which maintained specific conductance values representative of normal Big Cypress fresh waters (COCAT951, COCEOF31, FAKA, GGCAT31, GGCAT951). These latter sites are either farthest inland and/or have significant year-round freshwater inputs because of their location on major drainage canals.

The specific conductance values were comparable to those summarized by Duever et al. (1979) for similar situations in the Big Cypress. Specific conductance values reported by Dickson (1980) show similar relationships among the sites and similar annual means at most sites compared to the 1982 values. Two saltwater influenced sites with the highest annual means and greatest variability in 1982, LELY and GORDONRV, had much lower values in 1979. The BARRON site also showed some higher values indicative of saltwater influence in 1982. Mean annual specific conductance at WCOCORIV was somewhat lower and the monthly values were much more stable in 1982. Installation of fencing which prevented unauthorized tampering with the Amil gate is responsible for this stabilization (Vidzes, pers. comm.).

pH

The pH of a substance is a measure of its degree of acidity or alkalinity. The pH scale ranges from 0 to 14 with values below 7.0 being acid, exactly 7.0 neutral, and above 7.0 alkaline. Precipitation is usually acid. The pH was measured in precipitation that had accumulated during each week of 1982 from January 1-September 14 at Corkscrew Swamp Sanctuary, which is located in the north-central portion of the Big Cypress Basin. The pH values ranged from 3.0-5.9 and averaged 4.4. Once rainfall becomes runoff its pH is influenced by substrate characteristics and biological activity. The limestone substrates found throughout the Big Cypress region tend to increase the pH of precipitation. In addition, photosynthetic activity causes a daily fluctuation in pH by removing carbon dioxide from the water which results in higher daytime values.

In general, pH was higher in spring (March-April) and fall (November) and lower during the summer (June-July). All measurements made during 1982 at all sampling stations had a pH of 7.0 or above (Table 7). FAKA generally had the highest pH values and the highest value recorded for the year, 9.8 in April. The influence of photosynthesis on pH is reflected in the generally higher average annual values for stations sampled later in the day (7.7-8.1) compared to those sampled in the morning (7.4-7.7). This contrast is further enhanced by the large amounts of vegetation at the FAKA and LELY stations which were normally sampled in the afternoon. The only other site-specific pattern was the

Table 7. pH at Collier County canal sampling sites during 1982.

LOCATION	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	$\bar{X}$	SD
BARRON	7.5	7.4	7.8	7.9	7.9	7.3	7.7	9.0	7.7	7.7	8.2	7.7	7.8	.4
COCAT951	-	-	-	-	-	7.2	7.0	7.4	7.8	7.0	7.3	7.7		
COCEOF31	7.2	7.0	7.3	7.3	7.2	7.5	7.3	7.5	7.9	7.2	7.7	7.8	7.4	.3
ECOCORIV	7.8	7.6	7.7	-	-	7.2	7.3	7.4	7.8	7.0	7.8	7.6	7.6	.3
FAKA	8.0	8.3	8.6	9.8	8.3	8.0	7.6	8.1	7.7	7.4	8.1	7.8	8.1	.5
GGCAT31	7.9	8.0	8.1	7.8	7.8	7.4	7.4	7.0	7.1	7.4	7.8	7.5	7.6	.4
GGCAT951	7.6	7.6	7.9	7.7	7.8	7.3	7.2	7.3	7.6	7.3	7.7	7.5	7.6	.2
GORDONRV	7.9	7.8	7.8	7.1	7.4	7.4	7.4	7.6	7.6	7.5	7.7	7.5	7.6	.2
HENDCRK	7.5	7.6	7.9	7.8	7.6	7.3	7.5	7.3	7.5	7.3	7.7	7.5	7.5	.2
LELY	7.7	7.6	7.8	8.4	7.5	7.4	7.5	7.6	7.9	7.8	7.9	7.8	7.7	.3
NNAPLES	7.5	7.7	7.7	7.8	7.9	7.4	7.4	7.6	7.7	7.3	7.8	7.8	7.7	.2
WCOCORIV	7.5	7.4	7.6	7.4	7.4	7.4	7.5	7.4	8.0	7.3	7.8	7.6	7.5	.2
$\bar{X}$	7.7	7.6	7.8	7.9	7.7	7.4	7.4	7.6	7.7	7.4	7.8	7.7	7.6	
SD	0.2	0.3	0.3	0.8	0.3	0.2	0.2	0.5	0.2	0.2	0.2	0.1	0.2	

\- Site dry

consistently low values at COCEOF31 during January-May, which thereafter were within the normal range found at other stations. The more upstream station on this canal, COCAT951, was dry from January-May. However, when flow was reestablished in June, this station frequently had relatively low pH values compared to other sites on the same sampling dates. All other sites had pH values which were generally similar to one another.

Duever et al. (1979) reported a comparable range of pH values for the Big Cypress, although values below 7.0 were missing from our data. Dickson (1980) reported lower (by 0.2-0.8 units) mean annual pH values at all sites during 1979 compared to 1982. All sites had minimum values less than or equal to 7.0 during 1979. Minima ranged from 6.0 at COCAT951 to 7.0 at FAKA. Maxima ranged from 7.2 at GGCAT951 to 8.1 at COCAT951. While annual means were consistently lower in 1979, these differences are not large and could be attributable to differences in sampling techniques.

Turbidity

Turbidity is a measure of the degree to which suspended particles reduce the light transmissivity of water. Turbidity was formerly measured in Jackson Turbidity Units (JTU), but is now reported in Nephelometric Turbidity Units (NTU). These units are not identical, but they are similar. Nephelometers allow measurement of lower turbidities than do Jackson turbidimeters.

Most sampling sites had very low turbidities throughout the year with monthly measurements and mean annual values of generally less than 5.0 NTU (Table 8). Lowest values were consistently found at BARRON, FAKA, GORDONRV, and HENDCRK. Sites with only slightly higher values (about half of their monthly samples were between 5-10 NTU and their annual means were slightly over 5 NTU) were COCEOF31, ECOCORIV, and GGCAT951. These are still generally low turbidities. At the latter two sites, the higher values occur erratically and cannot be correlated with any special disturbance. However, the high values at COCEOF31 were concentrated during January-May and suggest a specific disturbance. The NNAPLES and WCOCORIV sites had the highest recorded values of 21.0-22.0 NTU. NNAPLES had relatively high turbidities during the summer from May-August, while WCOCORIV had higher values from June-December.

Duever et al. (1979) reported that turbidities for natural Big Cypress waters were normally less than 5 JTU and higher values were usually associated with construction activities. Dickson (1980) reported mean annual turbidity values below 5.0 JTU at all but one site with a range of values from 0.4 to 12.0 JTU. COCAT951, however, averaged 34.3 JTU for 1979 with values ranging from 0.5 to 140.0 JTU. Construction activity must have been responsible for this tremendous variability.

Table 8. Turbidity (NTU) at Collier County canal sampling sites during 1982.

LOCATION	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	$\bar{X}$	SD
BARRON	1.9	3.2	2.5	1.3	1.9	0.6	1.4	0.8	1.6	1.0	1.0	4.5	1.8	1.
COCAT951	-	-	-	-	-	1.6	4.7	3.6	2.2	1.2	4.7	3.8		
COCEOF31	8.8	9.1	9.2	7.4	13.1	2.9	3.0	1.5	1.4	2.3	3.5	7.9	5.8	3.
ECOCORIV	3.8	2.1	4.5	-	-	8.1	8.4	3.0	4.9	5.3	4.1	9.1	5.3	2.
FAKA	1.0	1.6	0.4	1.8	1.3	0.4	1.2	2.0	1.0	1.9	1.1	2.2	1.3	0.
GGCAT31	3.2	2.9	2.1	1.3	2.4	3.6	4.5	3.4	6.1	3.3	3.6	8.2	3.7	1.
GGCAT951	4.8	6.6	7.3	6.2	4.6	3.3	8.7	4.1	4.3	4.0	6.5	7.7	5.7	1.
GORDONRV	1.9	2.6	2.8	2.5	1.7	1.2	1.0	2.1	2.1	2.1	1.1	1.9	1.9	0.
HENDCRK	1.2	1.6	1.2	1.0	2.7	0.8	4.7	1.4	1.8	1.3	1.0	2.1	1.7	1.
LELY	4.5	3.6	3.3	3.9	5.0	1.2	2.1	2.7	1.2	1.6	4.1	4.9	3.2	1
NNAPLES	4.9	3.4	3.2	6.0	8.4	21.0	9.1	9.1	4.7	6.5	4.3	4.9	7.1	4
WCOCORIV	6.4	2.4	7.3	3.3	3.0	22.0	17.2	9.3	11.9	19.0	9.4	22.0	11.1	7
$\bar{X}$	3.9	3.6	4.0	3.5	4.4	5.6	5.5	3.6	3.6	4.1	3.7	6.6	4.3	
SD	2.4	2.3	2.8	2.3	3.7	7.7	4.7	2.8	3.1	5.0	2.5	5.5	2.9	

\- Site dry

Color

When light passes through water, dissolved substances absorb some wavelengths of light but not others. The unabsorbed wavelengths determine the color of water. Dissolved organics are responsible for the brown stain that is the predominant color in surface water within the Big Cypress, although Little et al. (1970) found some high values that were associated with construction activity. Color is measured relative to a platinum-cobalt standard.

The higher values for each site tended to occur during the summer wet season, and monthly means for all sites illustrate this overall trend (Table 9). Higher summer values probably result from the flushing of dark stained surface water from wetlands. Color values were regularly lowest at the FAKA site and highest at the GGCAT951 site. The GORDONRV site tended to have among the highest values from January-April and among the lowest values from May-December. ECOCORIV values were among the lowest January-March and consistently highest from June-December following installation of the new Amil gate.

Duever et al. (1979) reported a general range of 7-70 with an occasional 100+ value for the Big Cypress region in a survey of available data. Most values in our study were consistently in the upper portion of this range or higher. Mean annual color values reported by Dickson (1980) were equal to or less than our 1982 values for the same sites. FAKA had essentially the same low value during both years. BARRON and LELY also had low values in 1979, but much higher

Table 9. Color at Collier County canal sampling sites during 1982.

LOCATION	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	$\bar{X}$	SD
BARRON	19	32	44	14	25	88	102	115	92	46	52	84	59	35
COCAT951	-	-	-	-	-	108	69	109	63	74	67	+		
COCEOF31	61	69	67	45	62	92	88	125	64	54	138	77	79	28
ECOCORIV	39	57	42	-	-	151	160	147	181	195	129	132	123	57
FAKA	40	36	23	9	17	62	82	102	23	48	15	33	41	28
GGCAT31	80	91	107	47	73	84	76	124	71	88	70	93	84	20
GGCAT951	109	97	138	67	100	105	122	135	104	103	96	97	99	34
GORDONRV	70	94	82	84	54	88	72	108	36	57	30	+	71	24
HENDCRK	49	63	74	35	55	119	129	120	61	95	64	47	67	34
LELY	40	71	58	56	45	111	33	100	34	47	17	16	52	30
NNAPLES	71	53	76	66	53	69	111	138	74	113	52	+	80	29
WCOCORIV	40	51	57	62	59	76	58	96	56	64	53	60	61	14
$\bar{X}$	56	64	69	49	54	96	91	118	71	82	65	71	74	
SD	25	22	31	23	23	24	34	16	41	42	39	35	23	

- Site dry

values in 1982. All other sites, except ECOCORIV, had 1979 values that were very similar to the 1982 data. The ECOCORIV site had similar 1979 and 1982 values before installation of the Amil gate but much higher values thereafter.

Alkalinity

Alkalinity is the ability of water to accept protons (neutralize acids). Bicarbonate, carbonate, and hydroxide are the bases which usually determine alkalinity. Alkalinity values are reported in mg/l as $CaCO_3$ equivalents.

At most sites, alkalinities were higher during the winter-spring dry season and lower during the summer-fall wet season (Table 10). This pattern was probably related to the greater influence of limestone substrates when water levels were lower and flows slower during the dry season. GGCAT31 and GGCAT951 both had relatively high alkalinities during the wet season compared to other sites on similar dates and WCOCORIV had relatively low dry season values. FAKA almost invariably had the lowest alkalinities. BARRON, COCEOF31, and ECOCORIV exhibited a general pattern of relatively high values during late winter and early spring, and relatively low values during late summer and fall compared to other sites on similar dates. The alkalinity values for all sites throughout the sampling period are comparable to values reported by Duever et al. (1979).

Table 10. Alkalinity (mg/l) at Collier County canal sampling sites during 1982.

LOCATION	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	$\bar{X}$	SD
BARRON	271	291	257	294	249	131	105	129	151	126	149	173	194	72
COCAT951	-	-	-	-	-	150	191	223	183	56	169	+	162	57
COCEOF31	242	256	233	266	257	157	202	115	182	65	125	223	194	65
ECOCORIV	259	216	239	-	-	109	177	115	194	73	206	199	179	61
FAKA	202	129	100	34	93	123	109	142	152	145	223	153	134	50
GGCAT31	228	228	206	207	250	184	220	216	240	186	222	237	220	21
GGCAT951	237	237	226	245	251	223	243	217	242	170	214	235	228	22
GORDONRV	248	210	182	147	277	130	207	169	133	184	271	+	196	52
HENDCRK	268	275	227	159	266	47	168	94	262	161	264	275	206	78
LELY	225	212	207	186	245	75	243	96	161	124	260	248	190	63
NNAPLES	214	162	181	226	214	205	132	169	183	100	183	+	179	38
WCOCORIV	209	152	142	140	144	165	154	172	157	159	170	158	160	18
$\bar{X}$	237	215	200	191	225	142	179	155	187	129	205	211	187	
SD	24	51	46	75	60	51	48	47	97	47	47	43	26	

\- Site dry

\+ Sample lost

Nitrogen

Nitrogen is an essential plant nutrient. In natural waters, it is found in many forms which can be lumped into two major groups, organic and inorganic. Organic nitrogen is in the form of relatively complex compounds that result from animal metabolism or the decomposition of living things. Organic nitrogen consists of proteins, peptides, nucleic acids, and urea. The inorganic forms are produced largely by the oxidation of organic forms or fixation of atmospheric nitrogen by microbial activity. The inorganic forms of nitrogen in increasing order of their oxidation state and availability to plants are nitrate (NO_3), nitrite (NO_2), and ammonia (NH_4). Major sources of nitrogen associated with man's activities include domestic sewage effluents and agricultural fertilizers. These sources can contribute both organic and inorganic forms.

Total nitrogen concentrations of our samples ranged from 0.22 mg/l to 3.18 mg/l at all sites, except WCOCORIV which was consistently higher and will be discussed separately (Table 11). There were no seasonal trends in total nitrogen concentrations. Values were generally lowest at FAKA and frequently low at BARRON and HENDCRK. They were frequently high at ECOCORIV, GORDONRV, and NNAPLES. Monthly values were very similar to those reported by Dickson (1980) and most fall within the range reported for the Big Cypress region (Duever et al. 1979). Concentrations over approximately 2.00 mg/l can be naturally associated with low water levels during the dry season. The

Table 11. Total nitrogen concentrations (mg/l) at Collier County canal sampling sites during 1982.

LOCATION	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	$\bar{X}$	SD
BARRON	.60	.95	.22	.34	.93	.96	.86	1.23	1.43	1.09	.88	1.58	.92	.40
COCAT951	-	-	-	-	-	1.02	.56	1.85	.98	.82	.76	+		
COCEOF31	.98	1.85	1.00	1.03	1.37	1.33	1.34	1.78	1.05	.88	.92	1.17	1.23	.32
ECOCORIV	.92	1.15	1.69	-	-	1.29	1.76	1.88	1.66	1.51	1.63	1.14	1.46	.32
FAKA	.54	.36	.96	.63	.81	.92	1.12	.93	1.19	.86	.68	.50	.79	.25
GGCAT31	1.86	1.03	1.19	.85	1.26	.97	.62	.88	1.23	.67	.87	.92	1.03	.33
GGCAT951	.95	1.32	1.16	.37	.93	1.10	.76	.97	1.42	.94	.90	.95	.98	.27
GORDONRV	1.21	2.10	1.54	2.51	1.45	.95	.66	1.89	1.30	2.12	1.06	+	1.53	.57
HENDCRK	1.51	.57	.85	.40	1.27	.93	1.38	.97	1.21	1.00	.73	.69	.96	.34
LELY	1.27	1.88	2.56	3.18	1.64	.81	.61	.71	.91	1.77	.74	.69	1.40	.83
NNAPLES	1.14	.66	1.35	1.20	1.52	2.26	1.99	2.12	1.59	1.26	.71	+	1.44	.53
WCOCORIV	3.76	3.55	5.54	3.37	3.58	3.58	2.97	3.65	2.74	4.42	2.91	4.18	3.69	.76
$\bar{X}$	1.10	1.19	1.25	1.17	1.24	1.14	1.06	1.38	1.27	1.17	.90	.96	1.16	
SD	.40	.60	.61	1.02	.29	.40	.50	.52	.24	.45	.27	.34	.26	

\- Site dry

\+ Sample lost

WCOCORIV site always had the highest total nitrogen concentrations. On the average they were three times higher than any of the other sites, and its monthly values were nearly twice those reported by Dickson (1980) for the same site in 1979.

Organic nitrogen concentrations ranged from 0.10-3.63 mg/l (Table 12). FAKA and NNAPLES had higher concentrations during the wet season, but otherwise there were no consistent seasonal trends at our sites during 1982. Concentrations were generally low at FAKA and HENDCRK, and frequently low at BARRON, COCAT951, GGCAT31, and LELY compared to other sites. They were frequently high at NNAPLES and during the spring at LELY. The WCOCORIV site had the highest organic nitrogen concentrations except from February-March. Concentrations found in this study were comparable to those reported by Duever et al. (1979). Mean annual organic nitrogen concentrations during 1979 (Dickson 1980) were similar to our 1982 values at most sites. Notable exceptions were a substantially higher mean annual value at HENDCRK and a much lower value for WCOCORIV in 1979. Again, except for WCOCORIV, values above approximately 2.00 mg/l were associated with low dry season water levels.

Inorganic nitrogen concentrations at all but WCOCORIV ranged from <0.01 mg/l at most sites sometime during the year to 0.11-0.37 mg/l (Table 13). Inorganic nitrogen concentrations in 1982 were generally similar to the 1979 values reported by Dickson (1980), except for the

Table 12. Organic nitrogen concentrations (mg/1) at Collier County canal sampling sites during 1982.

LOCATION	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	$\bar{X}$	SD
BARRON	.56	.93	.10	.33	.86	.95	.84	1.21	1.30	1.07	.81	1.29	.85	.37
COCAT951	-	-	-	-	-	.94	.44	1.63	.97	.81	.64	+		
COCEOF31	.82	1.70	.87	1.01	1.36	1.16	1.24	1.70	1.01	.86	.81	.94	1.12	.32
ECOCORIV	.87	1.03	1.63	-	-	1.09	1.59	1.78	1.60	1.46	1.55	1.12	1.37	.31
FAKA	.53	.35	.94	.61	.79	.91	1.10	.90	1.11	79	.57	.47	.76	.25
GGCAT31	1.77	.92	1.17	.84	1.25	.87	.53	.75	1.12	.58	.66	.75	.93	.35
GGCAT951	.92	1.31	1.15	.36	.91	.99	.64	.87	1.34	.88	.77	.81	.91	.27
GORDONRV	1.14	1.88	1.46	2.23	1.31	.89	.53	1.82	1.20	2.00	.78	+	1.39	.55
HENDCRK	1.49	.56	.84	.37	1.26	.90	1.17	.76	.99	.80	.60	.62	.86	.32
LELY	1.23	1.85	2.40	3.17	1.63	.79	.57	.66	.88	1.75	.61	.63	1.35	.83
NNAPLES	.97	.64	1.14	1.15	1.51	1.89	1.90	1.99	1.58	1.22	.70	+	1.34	.48
WCOCORIV	2.06	1.06	1.15	1.58	2.13	2.83	2.08	2.75	2.08	3.63	1.47	2.80	2.14	.76
$\bar{X}$	1.12	1.11	1.17	1.17	1.30	1.18	1.05	1.35	1.27	1.32	.82	1.05	1.16	
SD	.48	.52	.57	.93	.40	.59	.56	.65	.34	.84	.33	.71	.39	

- Site dry

+ Sample lost

Table 13. Inorganic nitrogen ($NO_2 + NO_3 + NH_4$) concentrations (mg/l) at Collier County canal sampling sites during 1982.

LOCATION	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	$\bar{X}$	SD
BARRON	.04	.02	.03	<	<	.01	.02	.03	.13	.02	.07	.29	< .06	>
COCAT951	-	-	-	-	-	.08	.12	.22	<	<	.12	+		
COCEOF31	.16	.15	.13	.02	<	.17	.10	.08	.04	.02	.11	.23	< .11	>
ECOCORIV	.05	.12	.06	-	-	.20	.17	.10	.06	.05	.07	.02	.09	
FAKA	.01	<	.02	.02	.02	<	.02	.03	.08	.07	.11	.03	< .04	>
GGCAT31	.09	.11	.02	<	<	.10	.09	.14	.11	.09	.21	.17	< .11	>
GGCAT951	.03	<	.01	<	.02	.11	.12	.10	.08	.06	.13	.14	< .08	>
GORDONRV	.07	.22	.08	.28	.14	.06	.13	.07	.10	.12	.28	+	.14	
HENDCRK	.01	<	<	.03	<	.03	.21	.21	.22	.20	.14	.07	< .12	>
LELY	.04	.03	.16	.01	<	.02	.04	.05	.03	.02	.13	.06	< .05	>
NNAPLES	.17	.02	.21	.05	<	.37	.09	.13	<	.04	<	+	< .14	>
WCOCORIV	1.70	2.49	4.39	1.79	1.45	.75	.89	.90	.66	.79	1.44	1.38	1.55	1
$\bar{X}$	.22	< .29	< .47	< .22	< .33	< .16	.17	.17	< .13	< .12	< .24	< .27	< .23	
SD	.50	> .73	>1.30	> .56	> .63	> .21	.23	.24	> .18	> .22	> .39	.43	> .44	

\- Site dry

\+ Sample lost

< Less than .01 detection limit

February-March 1982 measurements at WCOCORIV.

Nitrate concentrations were below detection levels at all but one site during April and May (Table 14). This is the end of the dry season when water levels are characteristically lowest. HENDCRK had undetectable levels from January-May, but relatively high concentrations from July-October. Most sites had maximum nitrate values sometime during the period of October-March. This coincides with the peak of agricultural activity in the area, and may be associated with chemical fertilizers in runoff waters. Even these maxima, however, are not excessive. BARRON, COCAT951, FAKA, LELY, and NNAPLES had generally low concentrations while WCOCORIV had generally high concentrations. Dickson (1980) reported similar, relatively low mean annual nitrate concentrations at most sites in 1979. Only two sites showed significantly higher values in 1982: HENDCRK due to the high summer and fall values mentioned above, and WCOCORIV with its frequently high levels. Except for WCOCORIV during the winter dry season, concentrations were within the normal range reported for the Big Cypress (Duever et al. 1979).

Nitrite concentrations were below the detection level at the majority of sites during most months (Table 15). However, WCOCORIV had relatively high levels during most months. Other sites with detectable nitrite concentrations for at least six months included COCEOF31, ECOCORIV, GORDONRV, and NNAPLES, although all of these normally had only marginally detectable concentrations. Highest

Table 14. Nitrate concentrations (mg/l) at Collier County canal sampling sites during 1982.

LOCATION	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	$\bar{X}$	SD
BARRON	.023	.010	.013	<	<	<	<	.009	.042	.007	.031	.219	< .044	>.072
COCAT951	-	-	-	-	-	.037	<	.076	<	<	<	.055		
COCEOF31	.104	.113	.066	<	<	.126	.078	.053	.026	.010	.087	.213	< .088	>.057
ECOCORIV	.031	.081	.017	-	-	.059	.047	.045	<	<	<	<	< .047	>.022
FAKA	<	<	<	<	<	<	<	<	.068	.039	.101	.014	< .056	>.038
GGCAT31	.072	.087	.009	<	<	.049	.045	.071	.066	.055	.094	.127	< .068	>.032
GGCAT951	.017	<	<	<	<	.060	.049	.049	.033	.037	.085	.097	< .053	> .02
GORDONRV	.054	.173	.042	<	.076	.023	.050	-	.070	.079	.201	+	< .085	>.06
HENDCRK	<	<	<	<	<	.006	.163	.156	.146	.165	.111	.042	< .113	>.06
LELY	.007	.025	<	<	<	<	<	.007	.006	<	.053	.028	< .021	>.01
NNAPLES	<	.008	.056	<	<	.049	.015	.046	<	.017	<	+	< .032	>.02
WOCORIV	1.071	.749	1.162	<	<	.229	.272	.145	.084	<	.683	<	< .549	>.42
$\bar{X}$	< .172	<.156	< .195	< .004	< .011	<.071	< .090	< .066	< .060	<.051	< .161	< .085	< .101	
SD	> .365	>.246	> .427	-	> .023	>.068	> .086	> .050	> .041	>.052	> .201	> .085	> .143	

\- Site dry

\+ Sample lost

< Less than .004 mg/l detection limit

Table 15. Nitrite concentrations (mg/l) at Collier County sampling sites during 1982.

LOCATION	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	$\bar{X}$	SD
BARRON	<	<	<	<	<	<	<	<	.004	<	<	.028	< .016	>.01
COCAT951	-	-	-	-	-	<	<	<	<	.009	<	+	- -	
COCEOF31	.008	.009	.004	.004	<	.006	<	<	<	<	.007	.006	< .006	> .00
ECOCORIV	.007	.008	.004	-	-	.007	.010	.005	.005	.006	<	.005	< .006	> .00
FAKA	<	<	<	<	<	<	<	<	.006	.006	<	<	< .006	> .00
GGCAT31	<	<	<	<	<	.005	<	<	<	.005	.004	.007	< .005	> .00
GGCAT951	<	<	<	<	<	<	<	<	<	.005	.005	.008	< .006	>.0
GORDONRV	<	.008	.006	.008	.008	.005	.006	.006	.007	<	.020	+	< .008	>.0
HENDCRK	<	<	<	<	<	.005	.006	.006	.008	.011	<	<	< .007	>.0
LELY	<	<	<	.004	<	<	<	<	<	<	<	<	< .004	>.0
NNAPLES	<	<	.048	.004	<	.009	.006	.008	<	.005	<	+	< .013	>.0
WCOCORIV	.128	.249	.232	.004	<	.064	.089	.058	.055	<	.114	<	< .110	>.0
$\bar{X}$	<.048	<.069	<.059	<.005	<.008	<.014	<.023	<.017	<.014	<.007	<.030	<.011	≤ .016	
SD	>.070	>.120	>.099	>.002	>.001	>.022	>.037	>.023	>.020	>.002	>.047	>.010	≥ .030	

\- Site dry
\+ Sample lost

< Less than .004 mg/l detection limit

concentrations (> 0.020 mg/l) occurred during the winter. Only winter WCOCORIV samples exceeded the normal range of Big Cypress nitrite concentrations reported by Duever et al. (1979). Dickson (1980) reported very low mean annual nitrite concentrations at all sites except WCOCORIV in 1979. Most sites maintained these low values in 1982, although several were increased slightly by unusually large values during a single month: BARRON in December and NNAPLES in March. Frequently high values at WCOCORIV, however, resulted in a substantially higher 1982 annual mean.

Ammonia concentrations were generally low and exhibited no obvious seasonal patterns (Table 16). WCOCORIV consistently had the highest values, particularly during the winter. The annual mean for 1982 at this site was almost five times higher than it was in 1979 (Dickson 1980). Sites with generally low concentrations included FAKA, BARRON, COCEOF31, GGCAT951, GGCAT31, HENDCRK, and LELY. The four sites (WCOCORIV, ECOCORIV, NNAPLES, LELY) where ammonia tended to dominate the inorganic nitrogen fraction are all relatively small slow-flowing bodies of water. They are also located in relatively developed areas and may be affected by wastewater inputs. However, ammonia levels even at these sites were still comparable to those reported by Duever et al. (1979) for the Big Cypress region. Mean annual ammonia concentrations in 1979 (Dickson 1980) were similar to our 1982 values. While 1979 ammonia concentrations at WCOCORIV were higher than levels at other sites, there was an even greater disparity in 1982.

Table 16. Ammonia concentrations (mg/l) at Collier County canal sampling sites during 1982.

LOCATION	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	$\bar{X}$	SD
BARRON	<	<	<	<	<	<	<	.01	.08	<	.03	.04	< .04	> .03
COCAT951	-	-	-	-	-	.04	.11	.14	<	<	.06	+		
COCEOF31	.05	.03	.06	<	<	.04	.02	.02	.01	<	.02	<	< .03	> .02
ECOCORIV	<	.03	.04	-	-	.13	.11	.05	.05	.05	.07	<	< .07	> .04
FAKA	<	<	.02	.02	.02	<	.02	.02	.01	.03	.01	.01	< .02	> .01
GGCAT31	<	.02	<	<	<	.05	.04	.06	.04	.03	.11	.04	< .05	> .03
GGCAT951	<	<	<	<	.01	.04	.07	.05	.04	.02	.04	.03	< .04	> .02
GORDONRV	.01	.04	.03	.27	.06	.03	.07	.07	.02	.04	.06	+	.06	.07
HENDCRK	<	<	<	.03	<	.02	.04	.05	.07	.02	.02	.02	< .03	> .02
LELY	.03	<	.13	<	<	.02	.03	.04	.02	<	.07	.03	< .05	> .04
NNAPLES	.17	<	.11	.04	<	.31	.07	.08	<	.02	<	+	< .11	> .10
WCOCORIV	.50	1.49	3.00	1.79	1.44	.46	.53	.70	.52	.79	.64	1.38	1.10	.76
$\bar{X}$	< .07	< .15	< .31	< .22	< .16	< .10	< .09	.11	< .07	< .09	< .10	< .17	< .14	
SD	> .15	> .44	> .89	> .56	> .45	> .14	> .14	.19	> .14	> .22	> .17	> .45	> .30	

- Site dry

\+ Sample lost

< Less than .01 mg/l detection limit

More than 90% of the average annual total nitrogen concentrations measured at all but the WCOCORIV site were organic nitrogen. Dickson (1980) found a similar percentage for all of his study sites in 1979. Klein et al. (1970) reported that organic nitrogen is normally the dominant form in natural systems and made up 81% of the total nitrogen in samples from the Big Cypress region. At WCOCORIV organic nitrogen made up only 58% of the average annual total nitrogen concentration.

Phosphorus

Phosphorus is an essential plant nutrient whose concentration in natural waters is often the key factor limiting biological productivity. Total phosphorus, like nitrogen, occurs in both organic and inorganic forms. The soluble inorganic, orthophosphate, is the form most available to plants.

Total phosphorus concentrations ranged from approximately 0.010 mg/l at most sites to approximately 0.200 mg/l at some sites (Table 17). There were no seasonal trends. Sites that were more remote and/or carry large flows from relatively undeveloped areas (BARRON, COCAT951, FAKA, GGCAT31, GGCAT951, HENDCRK) had consistently low phosphorus concentrations which were almost invariably below 0.050 mg/l. The remaining sampling sites were within urbanized areas and on bodies of water with more limited flows. WCOCORIV always had the highest concentrations, often one to two orders of magnitude higher than any other

Table 17. Total phosphorus concentrations (mg/l) at Collier County canal sampling sites during 1982.

LOCATION	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	$\bar{X}$	SD
BARRON	.013	.017	.014	.018	.017	.030	.023	.025	.027	.024	.013	.043	.022	.009
COCAT951	-	-	-	-	-	.050	.015	.013	.010	.012	.008	.114		
COCEOF31	.030	.028	.026	.049	.038	.053	.015	.048	.026	.061	.033	.041	.037	.01
ECOCORIV	.043	.138	.049	-	-	.109	.076	.089	.076	.195	.090	.148	.101	.04
FAKA	.016	.008	.010	.016	.010	.013	.043	.037	.020	.023	.017	.008	.018	.01
GGCAT31	.031	.026	.013	.014	.028	.061	.022	.028	.025	.034	.013	.024	.027	.01
GGCAT951	.024	.039	.014	.035	.014	.032	.032	.023	.020	.038	.025	.019	.026	.00
GORDONRV	.041	.054	.067	.179	.057	.131	.056	+	.117	.078	.045	.043	.079	.04
HENDCRK	.021	.017	.009	.020	.031	.026	.043	.015	.016	.017	.008	.012	.020	.01
LELY	.022	.036	.048	.227	.111	.045	.015	.031	.025	.079	.014	.020	.056	.06
NNAPLES	.070	.040	.036	.046	.063	.056	.859	.418	.095	.165	.037	+	.171	.25
WCOCORIV	2.397	3.636	2.359	1.872	1.728	1.086	.864	1.045	.842	1.322	1.321	1.578	1.671	.8
$\bar{X}$	.246	.367	.240	.248	.210	.141	.172	.161	.108	.171	.135	.186	.188	
SD	.714	1.085	.703	.576	.534	.300	.323	.316	.234	.367	.374	.464	.469	

\- Site dry

\+ Sample lost

site. ECOCORIV, GORDONRV, and NNAPLES also had relatively high values generally exceeding 0.040 mg/l. Our values were very similar to those reported for the same sites by Dickson (1980), except for somewhat higher April-May 1982 values at LELY. Other than the January-May and December 1982 values at WCOCORIV, total phosphorus concentrations found during this study were within the normal range reported for the region by Duever et al. (1979).

The majority of individual monthly orthophosphate concentrations were below the 0.004 mg/l detection limit (Table 18). There were no seasonal trends. Sites with low total phosphorus concentrations also tended to have minimal or undetectable orthophosphate levels. At these sites, orthophosphate made up 12 to 33 percent of the mean annual total phosphorus concentrations. At sites with higher orthophosphate levels, it made up a greater percentage of the mean annual total phosphorus concentration: 39% at ECOCORIV, 45% at NNAPLES, 58% at GORDONRV, and 87% at WCOCORIV. In general, orthophosphate concentrations for 1982 are comparable to the concentrations reported by Dickson (1980). These values, excluding the WCOCORIV data, are well within the range of concentrations reported for natural runoff in the Big Cypress region (Duever et al. 1979).

Total Suspended Solids

Total suspended solids are the materials retained on a standard glass-fiber filter after filtration of a well-mixed sample. Values ranged from less than the 1.0 mg/l detection

Table 18. Orthophosphate concentrations (mg/l) at Collier County canal sampling sites during 1982.

LOCATION	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	$\bar{X}$	SD
BARRON	<	<	<	<	.006	.005	<	<	<	<	<	.013	<.008	>.004
COCAT951	-	-	-	-	-	.018	<	<	<	<	<	+		
COCEOF31	<	<	<	<	<	.025	.004	.022	.011	.030	.013	<	<.018	>.010
ECOCORIV	.005	.086	.017	-	-	.044	.032	.041	.020	.098	.039	.024	.041	.030
FAKA	<	<	<	<	<	<	<	<	<	<	<	<	<.004	>.000
GGCAT31	.005	.006	<	<	<	.027	.008	.014	.008	.017	.007	.006	<.011	>.007
GGCAT951	.005	<	<	<	<	.010	.010	.012	<	.015	.068	<	<.010	>.003
GORDONRV	<	.016	.046	.128	.023	.084	.031	-	.072	.050	<	+	<.056	>.037
HENDCRK	.005	<	<	<	<	.004	<	<	<	<	<	<	<.005	>.001
LELY	.005	.006	<	.012	.004	.019	<	<	.004	<	<	<	<.008	>.006
NNAPLES	.030	<	<	<	<	<	.562	.155	.020	.090	.006	+	<.144	>.212
WCOCORIV	2.028	3.144	2.253	1.843	1.715	.895	.791	.939	.749	1.060	1.240	1.506	1.514	.721
$\bar{X}$	< .298	< .652	< .772	< .661	< .437	<.113	< .205	< .197	< .126	<.194	< .219	< .387	< .153	
SD	> .763	>1.394	>1.283	>1.025	> .852	>.276	> .329	> .367	> .276	>.383	> .501	> .746	> .430	

\- Site dry

\+ Sample lost

< Less than .004 mg/l detection limit

limit at many sites on the January and February sampling dates to 32 mg/l at WCOCORIV in June. Most values, however, were less than 10.0 mg/l. Maximum values occurred at the majority of sites in March and April. The monthly averages also suggest a seasonal trend with a winter minimum and a spring maximum. While no sites were consistently higher or lower than any others, COCEOF31 and WCOCORIV frequently had relatively high values and FAKA, GGCAT31, and GGCAT951 had relatively low values.

Total Organic Carbon

Sampling for total organic carbon was terminated after September 1982, so a full year of data is not available. Concentrations generally ranged from approximately 5.0-25.0 mg/l, with two higher values of 50.0 and 74.6 mg/l. There is a distinct seasonal trend of higher values during the summer wet season and lower values throughout the rest of the year. While there was relatively little variability among the sites on any one sampling date, the remote BARRON and FAKA sites tended to have the lowest total organic carbon concentrations on most sampling dates and GGCAT951 and NNAPLES tended to have relatively high concentrations. ECOCORIV had low values prior to installation of the Amil gate, but consistently had the highest values thereafter. The 1982 values were slightly higher than those found by Dickson (1980), but are still within the range reported for natural waters within the Big Cypress region (Duever et al. 1979).

Table 19. Total suspended solids concentrations (mg/l) at Collier County canal sampling sites during 1982.

LOCATION	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	$\bar{X}$	SD
BARRON	<	2.0	3.0	11.0	3.0	5.0	3.0	5.0	7.0	6.0	<	5.0	< 4.3	> 2.8
COCAT951	-	-	-	-	-	2.0	2.0	3.0	4.0	3.0	4.0	<		
COCEOF31	3.0	3.0	11.7	23.0	12.0	10.0	2.0	7.0	4.0	4.0	7.0	7.0	7.8	5.9
ECOCORIV	1.0	<	10.0	-	-	7.0	3.0	1.0	13.0	6.0	3.0	6.0	< 5.1	> 4.1
FAKA	<	1.0	5.0	+	3.0	4.0	2.0	2.0	1.0	3.0	3.0	5.0	< 2.7	> 1.5
GGCAT31	<	<	6.0	5.0	3.0	5.0	1.0	4.0	3.0	2.0	4.0	4.0	< 3.3	> 1.7
GGCAT951	1.0	2.0	8.0	8.0	5.0	3.0	5.0	2.0	2.0	4.0	3.0	5.6	4.1	2.3
GORDONRV	2.0	<	2.0	22.0	8.0	6.0	2.0	3.0	5.0	3.0	7.0	4.0	< 5.4	> 5.7
HENDCRK	4.0	3.0	9.0	7.0	6.0	1.0	7.0	5.0	1.0	2.0	1.0	1.2	4.0	2.8
LELY	7.0	<	20.0	<	5.0	5.0	1.0	1.0	4.0	9.0	6.0	6.0	< 5.5	> 5.3
NNAPLES	4.0	<	15.0	5.0	12.0	11.0	1.0	7.0	10.0	13.0	4.0	4.0	< 7.3	> 4.8
WCOCORIV	6.0	<	4.0	3.0	9.0	32.0	4.0	7.0	14.0	18.0	7.0	1.0	< 8.8	> 8.8
$\bar{X}$	< 2.8	< 1.6	8.5	< 9.4	6.6	7.6	2.8	3.9	5.7	6.1	< 4.2	< 4.2	< 5.3	
SD	> 2.2	> 0.8	5.5	> 7.9	3.5	8.2	1.8	2.3	4.4	4.9	> 2.2	> 2.1	> 1.9	

\- Site dry   < Less than 1.0 mg/l detection limit   + Sample lost

Table 20. Total organic carbon concentrations (mg/l) at Collier County canal sampling sites during 1982.

LOCATION	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	$\bar{X}$	SD
BARRON	50.1	6.5	6.3	5.0	7.1	10.1	14.1	16.5	12.9	*	*	*	14.3	14.0
COCAT951	-	-	-	-	-	15.8	14.3	17.0	10.7	*	*	*		
COCEOF31	10.3	13.2	13.8	12.9	19.0	14.3	18.6	20.4	13.3	*	*	*	15.1	3.4
ECOCORIV	11.2	13.3	12.8	-	-	20.0	23.5	21.5	19.9	*	*	*	17.5	4.9
FAKA	6.5	8.0	7.2	7.1	7.1	7.8	14.9	16.1	5.4	*	*	*	8.9	3.8
GGCAT31	13.9	17.1	15.9	16.6	21.9	14.4	14.8	17.2	11.5	*	*	*	15.9	2.9
GGCAT951	14.7	16.7	17.8	18.5	23.9	16.8	14.4	19.5	13.4	*	*	*	17.3	3.2
GORDONRV	17.5	18.4	15.0	17.4	19.7	14.6	14.4	16.1	10.4	*	*	*	16.5	2.9
HENDCRK	12.2	14.8	14.5	10.5	20.9	13.5	18.3	17.3	12.9	*	*	*	15.0	3.3
LELY	10.7	15.7	12.0	24.1	19.7	13.5	12.1	14.7	8.4	*	*	*	14.5	4.8
NNAPLES	12.6	14.1	17.5	17.6	74.6	15.9	20.8	21.3	13.4	*	*	*	23.1	19.6
WCOCORIV	12.2	15.5	15.6	16.0	14.4	16.4	16.1	19.0	13.6	*	*	*	15.4	1.9
$\bar{X}$	15.6	13.9	13.5	14.6	22.8	14.4	16.4	18.1	12.2				15.8	
SD	11.8	3.7	3.8	5.7	19.1	3.2	3.3	2.2	3.5				3.3	

\- Site dry

* Sampling terminated after September 1982

<u>Chloride</u>

Chloride concentrations showed large areal and seasonal variability among sites (Table 21). There is a distinct seasonal trend in chloride concentrations. Relatively high concentrations occurred during the dry season from January-May, with April generally having the highest values at most sites. Concentrations were lowest during the wet season from June-October. Sites farthest inland or those with the largest flows (BARRON, COCAT951, COCEOF31, GGCAT31, GGCAT951) had low values ranging from approximately 10-60 mg/l. FAKA was only slightly higher with a range of about 20-80 mg/l. ECOCORIV, GORDONRV, and WCOCORIV had the most consistently high values. Whereas most sites had a relatively consistent range of high, intermediate, or low chloride levels, compared to other sites LELY had high concentrations throughout the spring dry season and much lower concentrations during the rest of the year. The very high dry season chloride levels at ECOCORIV, GORDONRV, and LELY are best explained on the basis of saltwater inflows from the coast, while the high levels at other sites at this time of year are probably associated with concentration processes during low flow periods. The year-round relatively high values at ECOCORIV and WCOCORIV suggest saltwater inputs from a saline aquifer. These values are within the range of those reported for similar situations in the Big Cypress region (Duever et al. 1979).

Table 21. Chloride concentrations (mg/l) at Collier County canal sampling sites during 1982.

LOCATION	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	$\bar{X}$	SD
BARRON	24.6	32.0	31.4	26.7	1262.4	12.0	13.5	12.8	26.6	10.9	20.7	27.7	125.1	358.2
COCAT951	-	-	-	-	-	12.7	14.8	14.1	17.0	10.5	14.5	+		
COCEOF31	56.9	48.7	39.8	57.6	42.6	32.2	36.8	25.9	17.0	13.4	19.3	26.9	34.8	14.
ECOCORIV	153.8	2575.0	1285.1	-	-	275.4	336.8	58.9	192.6	50.3	172.3	164.8	526.5	804.
FAKA	75.9	57.7	74.5	77.0	76.9	26.9	20.9	18.7	35.1	19.7	42.9	39.1	47.1	24.
GGCAT31	46.3	30.7	40.9	60.7	37.0	31.8	35.1	25.0	36.8	18.0	25.1	23.4	34.2	11.
GGCAT951	25.8	19.1	34.6	49.8	27.9	20.1	18.6	13.0	29.5	11.1	16.0	18.2	23.6	10.
GORDONRV	191.0	405.9	202.8	8171.9	1034.1	57.3	75.0	68.7	75.5	87.6	192.7	+	960.2	2408
HENDCRK	160.4	175.4	165.6	184.3	127.2	7.8	45.3	21.8	76.6	37.7	87.4	93.2	98.6	63.
LELY	366.9	1476.3	4965.4	8906.3	236.1	25.4	65.0	23.9	57.2	41.1	87.4	97.4	1362.4	2765
NNAPLES	310.3	179.0	178.5	251.1	199.1	123.0	43.2	73.1	74.4	41.1	63.6	+	139.7	90
WCOCORIV	359.3	300.7	307.5	364.2	334.4	216.2	202.3	194.4	184.0	168.3	204.4	197.9	252.8	74
$\bar{X}$	161.0	482.0	666.0	1815.0	338.0	70.0	76.0	46.0	69.0	43.0	79.0	77.0	327.7	
SD	132.0	811.0	1471.0	3550.0	442.0	89.0	97.0	52.0	60.0	46.0	72.0	67.0	445:8	

\- Site dry

\+ Sample lost

Sulfate

Sulfate concentrations closely parallel the chloride data both in terms of general seasonal and areal trends and relative concentrations in individual samples. Dry season (January-May) concentrations were characteristically high, and wet season (June-December) values were relatively low (Table 22). Remote or well-flushed sites (BARRON, COCAT951, COCEOF31, GGCAT31, GGCAT951) had relatively low concentrations below 50 mg/l. Again, FAKA had slightly higher values up to approximately 85 mg/l. Higher values were also distributed among consistently higher sites (ECOCORIV, GORDONRV, WCOCORIV), and a seasonally higher site (LELY), and are likely to be associated with saltwater inputs as discussed for chloride. Duever et al. (1979) reported values in natural surface waters of the Big Cypress region as being below 3.0 mg/l, although higher concentrations around 20.0 mg/l were not unusual. They also noted that concentrations up to 3110 mg/l have been found in areas influenced by coastal saltwater inputs. Most values in this study were greater than 20 mg/l, which may reflect greater proximity to the coast, different soil types, or a difference in analytical techniques. Another possibility is that acid precipitation has become more significant in southwest Florida in recent years and has led to higher sulfate levels in our surface waters.

Table 22. Sulfate concentrations (mg/l) at Collier County canal sampling sites during 1982.

LOCATION	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	X̄	SD
BARRON	9.3	17.5	5.8	7.8	202.0	<	<	<	5.2	5.8	7.1	<	< 32.6	>58.6
COCAT951	-	-	-	-	-	30.5	40.5	26.0	42.4	10.3	21.1	+		
COCEOF31	24.0	40.1	50.3	13.4	31.7	41.2	24.9	14.5	16.6	11.5	14.3	16.7	24.9	13.0
ECOCORIV	49.8	468.7	194.7	-	-	97.4	135.3	27.0	85.4	37.3	65.2	62.8	122.4	131.6
FAKA	53.3	72.6	52.9	83.9	81.9	21.1	11.5	10.6	25.0	12.7	31.4	28.2	40.4	27.5
GGCAT31	46.0	34.4	32.5	50.1	44.3	33.9	40.5	37.1	39.1	27.0	32.4	25.2	36.9	7.5
GGCAT951	24.3	31.6	32.0	43.0	41.9	47.5	42.4	39.1	53.1	27.0	27.6	28.7	36.5	9.2
GORDONRV	57.7	88.1	56.9	1166.1	250.3	55.1	61.5	54.0	42.2	48.9	135.9	+	183.3	331.6
HENDCRK	85.6	97.7	85.7	107.3	86.0	9.5	39.5	17.8	68.2	33.1	89.3	52.5	64.4	32.9
LELY	57.7	205.3	799.1	1269.0	64.4	10.9	48.3	14.2	35.4	23.7	52.7	83.5	222.0	395.6
NNAPLES	85.6	102.5	88.0	75.4	79.3	66.0	14.2	20.2	29.4	17.0	19.1	+	54.2	34.2
WCOCORIV	98.9	73.4	71.5	76.3	<	85.7	77.4	76.9	77.3	54.9	66.2	65.3	< 74.9	>11.4
X̄	53.9	112.0	133.6	289.0	< 98.0	< 42.0	< 45.1	<28.5	43.3	25.8	46.9	< 40.9	< 81.1	
SD	28.1	129.0	226.1	490.8	> 76.1	> 29.8	> 35.2	>20.5	24.2	15.6	37.4	> 26.1	> 66.4	

\- Site dry

\+ Sample lost

< Less than 5.0 detection limit

Total Iron

Total iron concentrations exhibited some weak seasonal and areal trends. Low concentrations were more frequent during the dry season from February-May, and higher concentrations were more frequent from June-December (Table 23). This may have been related to the relatively low solubility of iron when dissolved oxygen concentrations were high and vice versa, and/or wet season flushing of shallow groundwaters which typically have high iron levels. FAKA and WCOCORIV had consistently low total iron values, and BARRON, GORDONRV, and HENDCRK frequently had relatively low values. GGCAT951 had consistently high values. Three other sites had consistently high values for short periods: COCEOF31 during the winter and spring months, NNAPLES during the summer wet season, and ECOCORIV after the Amil gate was installed. The characteristics of sites with consistently or seasonally high or low total iron concentrations do not appear to be related to any obvious environmental factors or conditions. The range of total iron concentrations found in this study are similar to those reported by Duever et al. (1979) for samples collected primarily from canals.

Hardness

Hardness is the sum of calcium and magnesium ions and is expressed in mg/l as $CaCO_3$ equivalents. Hardness levels are increased by saltwater inputs, contact with bedrock in canals, and evaporative processes during the dry season. Semiannual hardness levels at most sites in 1982 were higher

Table 23. Total iron concentrations (mg/1) at Collier County canal sampling sites during 1982.

LOCATION	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	$\bar{X}$	SD
BARRON	.29	.35	.24	.10	.28	.16	.17	.19	.25	.10	.27	.45	.24	.10
COCAT951	-	-	-	-	-	.68	1.00	1.46	.62	.46	.48	.57		
COCEOE31	1.60	1.31	.94	1.04	1.12	.79	.86	.66	.43	.53	.61	1.37	.94	.36
ECOCORIV	.62	.23	.45	-	-	1.97	1.59	.89	.92	1.67	.62	1.29	1.03	.58
FAKA	.02	.10	.02	.04	.07	.30	.14	.17	.08	.32	.31	.28	.15	.1
GGCAT31	.55	.38	.30	.05	.41	.77	.83	1.13	.87	.61	.81	1.29	.67	.3
GGCAT951	1.23	1.53	1.13	.82	.81	1.02	1.49	1.17	1.05	.96	1.12	1.54	1.16	.2
GORDONRV	.21	.25	+	.32	.12	.25	.16	.29	.08	.29	.18	.30	.22	.0
HENDCRK	.13	.14	.09	.05	.28	.34	.97	.42	.44	.68	.31	1.07	.41	.3
LELY	.83	.57	.40	.96	.81	.41	.42	.29	.20	.57	.50	.50	.54	.2
NNAPLES	.81	.43	.32	.35	.42	2.56	1.41	2.40	.67	1.10	.48	.52	.96	.7
WCOCORIV	.02	.05	.07	.06	.08	.26	.22	.21	.19	.51	.25	.29	.18	[illegible]
$\bar{X}$	.57	.49	.40	.38	.44	.79	.77	.77	.48	.66	.50	.79	.59	
SD	.51	.49	.37	.41	.36	.75	.54	.68	.34	.42	.27	.48	.38	

\- Site dry

in February than July, probably because of dry season concentration processes (Table 24). Samples with high chloride levels also had substantially higher hardness values (ECOCORIV, LELY), suggesting the influence of saline groundwater or coastal inputs. In general, levels were within the range expected for canal and surface waters in the Big Cypress region (Duever et al. 1979).

Sodium

Since saltwater contains high concentrations of sodium, any inland site influenced by saltwater will either have consistently high or seasonally variable sodium concentrations. As would be expected, inland sites and those with strongest year-round flows (BARRON, COCAT951, COCEOF31, FAKA, GGCAT31, GGCAT951) had relatively low sodium concentrations on both semiannual sampling dates (Table 24). February values at these sites were usually higher than July values due to concentration processes associated with low dry season water levels. Their sodium concentrations, however, remained within the 3-35 mg/l range reported by Duever et al.(1979) for natural waters in the Big Cypress region. All of the other sites exhibited some evidence of coastal influences. They typically had sodium concentrations over 100 mg/l, and as high as 1350 mg/l during the dry season and from 25-200 mg/l during the wet season. ECOCORIV and WCOCORIV had relatively high values on both sampling dates. The temporo-spatial distribution of sodium values suggests a pattern quite similar to that

Table 24. Hardness values and calcium and sodium concentrations (mg/l) at Collier County canal sampling sites taken semiannually during 1982.

LOCATION	HARDNESS FEB	HARDNESS JULY	CALCIUM FEB	CALCIUM JULY	SODIUM FEB	SODIUM JULY
BARRON	292.5	130.7	108.4	46.9	15.2	9.3
COCAT951	-	240.5	-	90.7	-	10.0
COCEOF31	286.2	238.8	108.7	88.4	23.2	24.1
ECOCORIV	1055.2	399.7	144.0	115.4	1350.0	203.2
FAKA	213.0	148.2	75.1	53.4	33.1	14.1
GGCAT31	268.2	269.3	100.0	100.6	18.3	21.1
GGCAT951	273.1	288.2	102.6	109.3	14.2	12.3
GORDONRV	388.3	302.6	111.5	107.0	198.8	40.8
HENDCRK	398.8	238.2	120.5	81.7	110.6	29.4
LELY	701.9	308.8	125.5	110.3	755.0	39.7
NNAPLES	330.9	169.7	102.5	56.1	104.7	25.2
WCOCORIV	260.4	281.5	71.3	84.2	184.8	132.2
$\bar{X}$	406.2	251.4	106.4	87.0	255.3	46.8
SD	252.5	75.6	20.7	23.7	421.3	59.4

\- Site dry

observed for chloride and sulfate, both of which appeared to be primarily associated with saline water inputs.

<u>Calcium</u>

Calcium concentrations in surface waters of the Big Cypress are influenced by amount of contact with limestone substrates in canals, dry season concentration processes, and saltwater inputs. Calcium levels at all sites were similar or higher during the February dry season sampling period (Table 24). ECOCORIV had the highest values on both sampling dates, and FAKA was among the lowest on both dates. Concentrations were within the upper portion of the normal range for Big Cypress surface waters, which would be expected for canal sites or sites influenced by saltwater inputs (Duever et al. 1979).

<u>Potassium</u>

Potassium is another element whose concentration in fresh surface waters can be greatly increased as a result of saltwater inputs. Potassium concentrations were highly variable among the sites on the February sampling date (Table 25). All inland sites had concentrations of 0.4-1.3 mg/l, while most sites with more coastal influences generally ranged from 3.9 to 13.1 mg/l. LELY and ECOCORIV had values of 28.0 and 52.0 mg/l, respectively, which were probably due to saltwater inputs. July concentrations exhibited a similar pattern of "inland" and "coastal" sites, although several of the February "coastal" sites had values

Table 25. Potassium and magnesium concentrations (mg/l) at Collier County canal sampling sites during 1982.

LOCATION	POTASSIUM FEB	POTASSIUM JULY	MAGNESIUM FEB	MAGNESIUM JULY
BARRON	.60	1.75	5.30	3.30
COCAT951	-	1.40	-	3.40
COCEOF31	1.30	1.80	3.60	4.40
ECOCORIV	52.00	6.10	169.00	27.10
FAKA	.40	1.49	6.20	3.60
GGCAT31	1.00	1.36	4.50	4.40
GGCAT951	.70	.60	4.10	3.70
GORDONRV	9.30	3.53	26.70	8.60
HENDCRK	4.50	1.97	23.80	8.30
LELY	28.00	1.61	94.40	8.10
NNAPLES	3.90	5.61	18.20	7.20
NCOCORIV	13.10	9.33	20.00	17.30
$\bar{X}$	10.40	3.05	34.16	8.28
SD	16.10	2.63	51.73	7.13

- Site dry

more characteristic of inland concentrations. Continued relatively high concentrations at ECOCORIV, GORDONRV, NNAPLES, and WCOCORIV during the wet season suggest that saltwater inputs were affecting these sites year-round. All of the values we observed in the study were comparable to the normal range found in the Big Cypress region (Duever et al. 1979).

Magnesium

Magnesium can enter surface waters by contact with limestone substrates, but high concentrations are normally associated with saltwater inputs. Magnesium values also appeared to exhibit a lower inland-higher coastal distribution pattern similar to that just described for potassium. Inland concentrations were similar during both 1982 sampling periods while coastal values were much higher during February (Table 25). ECOCORIV on both sampling dates and LELY in February had particularly high values, although even these were not atypical for the Big Cypress region (Duever et al. 1979).

Trace Metals

Trace metals are normally found in natural surface waters in very small concentrations of 1 mg/l or less (Table 26). Higher concentrations can be indicative of a variety of human activities such as motorized vehicle use, agricultural use of herbicides, pesticides, and fertilizers, or construction. Cadmium and nickel were the only trace

Table 26. Trace metal concentrations ($\mu g/l$) at Collier County canal sampling sites taken semiannually during

LOCATION	ARSENIC FEB	ARSENIC JULY	CADMIUM FEB	CADMIUM JULY	CHROMIUM FEB	CHROMIUM JULY
BARRON	5.032	11.437	.312	<	+	1.251
COCAT951	-	17.849	-	<	-	3.163
COCEOF31	9.991	10.656	.207	<	1.703	3.641
ECOCORIV	21.498	13.001	21.689	1.754	1.703	6.150
FAKA	11.380	10.186	.127	<	+	1.490
GGCAT31	12.174	15.972	.670	<	1.925	3.999
GGCAT951	9.595	8.935	.186	<	+	6.317
GORDONRV	11.975	21.289	.860	<	2.259	2.924
HENDCRK	11.380	15.347	.680	<	+	8.898
LELY	19.911	5.964	13.852	<	+	3.282
NNAPLES	15.943	13.783	.801	.213	1.243	7.464
WCOCORIV	9.991	14.565	1.694	.515	2.608	1.968
$\bar{X}$	12.625	13.249	3.734	< .827	1.907	4.212
SD	4.767	4.164	7.171	> .817	.477	2.448

\- Site dry < Less than .040 ug/l detection limit + Sample lost

Table 26. (cont.)

LOCATION	COPPER FEB	COPPER JULY	LEAD FEB	LEAD JULY	MERCURY FEB	MERCURY JULY
BARRON	1.093	1.078	1.959	.530	.855	2.766
COCAT951	-	1.994	-	1.386	-	2.244
COCEOF31	1.413	8.223	1.605	1.434	.575	2.435
ECOCORIV	4.456	4.192	+	6.474	.907	2.200
FAKA	6.921	2.030	3.157	.390	.562	1.077
GGCAT31	9.900	5.108	1.959	2.194	1.116	2.406
GGCAT951	2.310	3.093	2.048	1.719	.875	.453
GORDONRV	5.480	4.119	5.418	3.193	.268	2.303
HENDCRK	3.591	2.763	6.039	2.432	.418	3.280
LELY	3.175	1.444	25.996	3.288	.836	.453
NNAPLES	5.256	4.119	5.684	.673	1.051	.306
WCOCORIV	3.815	2.910	<	3.858	1.377	1.620
$\bar{X}$	4.308	3.423	5.985	2.298	.804	1.795
SD	2.553	1.946	7.713	1.732	.325	.996

- Site dry   < Less than .400 µg/l detection limit   + Sample lost

Table 26. (cont.)

LOCATION	NICKEL FEB	NICKEL JULY	ZINC FEB	ZINC JULY
BARRON	5.350	.920	29.000	10.000
COCAT951	-	4.753	-	20.000
COCEOF31	7.096	3.782	24.000	20.000
ECOCORIV	71.746	13.023	28.000	70.000
FAKA	11.427	4.359	13.000	10.000
GGCAT31	7.431	3.966	25.000	30.000
GGCAT951	7.767	4.596	21.000	60.000
GORDONRV	17.269	5.646	27.000	20.000
HENDCRK	16.161	4.517	41.000	20.000
LELY	+	4.884	28.000	20.000
NNAPLES	16.027	3.178	23.000	20.000
WCOCORIV	13.374	9.006	40.000	30.000
$\bar{X}$	17.365	5.219	27.000	28.000
SD	19.586	3.070	8.000	19.000

- Site dry   + Sample lost

metals showing a seasonal trend at all sites. They were present in consistently higher concentrations in the February dry season samples. Copper and lead also frequently had higher values during this time of year. Chromium and mercury, however, were more abundant at most sites during the July sample. A few sites which had indicated saltwater influence on the basis of other parameters showed relatively high levels of some metals: ECOCORIV for arsenic, cadmium, and nickel and LELY for arsenic, cadmium, and lead in February, and GORDONRV for arsenic in July. All of the eight trace metals normally occurred at or below levels reported for natural surface waters of the Big Cypress region (Duever et al. 1979).

ANALYSIS OF INDIVIDUAL SITES

BARRON

The relatively undisturbed watershed and large flows in this canal tended to maintain low concentrations of all water quality parameters at our sampling site. Temperatures were relatively high because this site was normally sampled last and had more time to warm up than any of the other sites.

COCAT951

COCAT951 drains a somewhat smaller, but still sizeable, watershed that is largely undisturbed except for a nearby rock quarry. This resulted in low levels of most water quality parameters.

COCEOF31

COCEOF31 is located downstream of COCAT951, but is more influenced by agriculture and some nearby suburban development. Total suspended solids were generally higher at this site compared to the other sites. For some unknown reason, pH was relatively low, and turbidity, alkalinity, and total iron values were consistently high compared to other sites from January-May and compared to itself later in the year. Pumping of shallow groundwater into the canal could possibly account for these early 1982 values.

ECOCORIV

ECOCORIV had generally high nutrient (nitrogen, phosphorus) and saltwater-related (specific conductance, chloride, sulfate, hardness, sodium, calcium, potassium, magnesium) values. Alkalinity values were relatively low, and color, total organic carbon, and total iron values were relatively high following installation of the Amil gate in June. These results suggest saline groundwater inputs associated with coastal location and/or agricultural activity. ECOCORIV also had relatively high cadmium and nickel concentrations. The low dissolved oxygen values could be associated with any combination of eutrophication processes, shading by overhanging vegetation, and/or pumping of groundwater containing little or no oxygen.

FAKA

The large watershed area above the FAKA site is drained by the Faka-Union canal system but otherwise has been little affected by man. This and the large volumes of water involved result in very low levels of most water quality parameters. The only relatively high values were temperature, pH, and January-June dissolved oxygen. These were due to the fact that the site was normally sampled late in the day, which allowed time for the water to warm and for photosynthetic activity to raise pH and dissolved oxygen levels, particularly under low flow conditions during the dry season.

GGCAT31

This canal drains a large mostly undisturbed watershed, although suburban development is rapid in the vicinity of the sampling site. In general, water quality values are typically low or average compared to other sites. Chromium was the only parameter that was generally high, although it was only sampled semiannually. Alkalinities were generally high during the summer wet season.

GGCAT951

This sampling site is upstream of GGCAT31 and is less influenced by suburban development. It also had relatively low or average values for most water quality parameters, but high alkalinities during the summer wet season. However, it had relatively high turbidity, color, total organic carbon, and total iron values, suggesting drainage from wetlands and/or shallow groundwaters.

GORDONRV

This shallow tidal stream had relatively high nutrient (nitrogen, phosphorus) and saltwater-related (chloride, sulfate) values. Late dry season values for specific conductance, color, and organic nitrogen were also relatively high compared to other sites. There is significant suburban and agricultural development in the headwaters of this small watershed which could account for the high nutrient values and could contribute to high year-round saltwater inputs. The high dry season specific conductance is probably associated with tidal inflows of seawater.

HENDCRK

Samples from HENDCRK were typically low or average compared to other sites for all water quality parameters.

LELY

The only water quality parameters that were consistently high at LELY were temperature, dissolved oxygen, and pH. Like FAKA, this site was normally sampled in the afternoon, but in addition it is a shallow, slow-flowing canal with dense vegetation. As a result, there was time during the day for the water to warm and for photosynthetic activity to raise dissolved oxygen and pH values. The LELY site is on a small urbanized watershed, and it is possible that some combination of septic tank seepage and/or landscape fertilization and irrigation from saline aquifer wells may explain the high nutrient (nitrogen, phosphorus) and saltwater-related (specific conductance, chloride, sulfate) values found during the spring dry season. The high semiannual hardness and calcium values could also be a result of well pumping.

NNAPLES

The NNAPLES canal site generally had high turbidity, nutrients (organic nitrogen, phosphorus) and total organic carbon throughout the year, and high summer wet season total nitrogen and total iron concentrations. These data suggest effluents from a sewage treatment plant or farm fields, and possibly wet season pumping of shallow groundwater.

WCOCORIV

WCOCORIV had much higher nutrient (nitrogen, phosphorus) concentrations than any other site. It also had relatively high values typically associated with saltwater inputs (specific conductance, chloride, sulfate) and soil disturbance (turbidity, total suspended solids). All of these parameters could be associated with agricultural effluents resulting from fertilizer application, saline aquifer pumping, and soil disturbance. The consistently low dissolved oxygen concentrations could be associated with any combination of eutrophication processes, shading by overhanging vegetation, and/or pumping of groundwater containing little or no oxygen. There is a sewage treatment plant on this watershed which could also explain the high nutrient and low dissolved oxygen levels.

UNUSUAL WATER QUALITY CONDITIONS

Two sets of standards were used to evaluate our water quality data. The first was the legal standards of the Florida Department of Environmental Regulation (DER) as contained in the Florida Administrative Code chapter 17-3 (February 1983), and the second was the recent literature survey on quality of natural surface waters in the Big Cypress region (Duever et al. 1979).

Comparison with Florida D.E.R Standards

The relatively limited list of water quality parameters included in the DER standards for Class III waters (defined as suitable for recreation and healthy fish and wildlife populations) and their general criteria for surface waters are shown in Table 27. Table 28 shows the percentages of monthly measurements at each monitoring site that did not meet the DER standards. Only those parameters for which we found values not meeting these standards are discussed below.

Dissolved Oxygen

The DER standard does not take into account that natural aquatic and wetland habitats in South Florida regularly or periodically have dissolved oxygen concentrations well below 5.0 mg/l. This is why so many of our measurements were below the DER standard, but virtually all were within the natural background range reported by Duever et al. (1979). Only ECOCORIV and WCOCORIV had consistently low levels, but even these were not unnaturally low for South Florida.

pH

Some pH values exceeded the DER recommended criteria, but in all cases these were probably associated with intense

Table 27. Water quality standards of the Florida Department of Environmental Regulation.

	Class III Water (1)	General Criteria For Any Surface Water (2)
Dissolved Oxygen	≥5.0 mg/l	-
Turbidity	-	≤Background + 29 NTU
pH	-	≤Background ± one unit (within 6.0-8.5 range)
Alkalinity	≥20 mg/l	-
Specific Conductance	-	≤Background + 100% (if background < 500 umhos) ≤Background + 50% (if background > 500 umhos)
Ammonia (unionized)	≤0.02 mg/l	-
Chloride	≤250 mg/l	-
Arsenic	-	≤50 μg/l
Cadmium	≤1.2 μg/l	-
Chromium	-	≤50 μg/l
Copper	≤30 μg/l	≤50 μg/l
Iron	≤1.0 mg/l	-
Lead	≤30 μg/l	≤50 μg/l
Mercury	≤200 μg/l	-
Nickel	≤100 μg/l	-
Zinc	≤30 μg/l	≤100 μg/l

1 Class III waters are defined as suitable for recreation, propagation, and maintenance of healthy well-balanced populations of fish and wildlife.

2 Any violation of these criteria constitutes pollution.

Table 28. Percent of 1982 monthly measurements exceeding Florida Department of Environmental Regulation
Class III (1) water.

LOCATION	DISSOLVED OXYGEN(4)	AMMONIA	CHLORIDE	IRON	CADMIUM(5)	ZINC(5)	
BARRON	58	0	0	0	0	0	
COCAT951 (2)	86	0	0	29	0	0	
COCEOF31	42	0	0	42	100	0	
ECOCORIV (3)	80	0	40	40	0	50	
FAKA	25	0	0	0	0	0	
GGCAT31	58	0	27	17	0	0	
GGCAT951	50	0	0	75	0	50	
GORDONRV	67	0	33	0	0	0	
HENDCRK	67	0	0	8	0	50	
LELY	17	0	33		50	0	
NNAPLES	33	0	18	33	0	0	
WCOCORIV	100	50	42	0	50	50	

(1) Water suitable for recreation, propagation and maintenance of healthy, well-balanced populations of fish and wildlife.

(2) Percent of seven samples, site dry January to May.

(3) Percent of ten samples, site dry April and May

(4) Percent of samples below the dissolved oxygen standard.

(5) Percent of two semi-annual samples, February and July.

photosynthetic activity during the dry season at sites with large concentrations of submerged aquatic vegetation.

Ammonia

DER standards for ammonia are based on the unionized form (NH_3) which usually comprises less than 5% of the total ammonia within the normal ranges of temperature and pH in the Big Cypress region. Unionized ammonia levels exceeded DER standards at the WCOCORIV site only. Above standard levels were recorded here on half of the sampling dates.

Chloride

Chlorides exceeded DER standards for at least a few months at a number of sites near the coast, probably as a result of saltwater encroachment and/or seepage from saline groundwater wells.

Trace Metals

Iron is a common component of shallow groundwaters in the Big Cypress region. It exceeded DER standards at a number of sites, and probably originated from pumping or seepage from shallow groundwaters. The only other trace metals to exceed standards were cadmium and zinc, which happened generally only once in a semiannual sample at scattered sites.

Comparison With Natural Big Cypress Surface Waters

The ranges of values for the extensive list of water quality parameters summarized by Duever et al. (1979) appear in Table 29. Table 30 shows the percentages of monthly measurements at each monitoring site that were not within

Table 29. Water quality summary for surface freshwaters of the Big Cypress Swamp region from Duever et al. (1979).

	Range of Values*	Sources
General Parameters		
Dissolved Oxygen (mg/l)	0.0-11.6	2,4,6,8,12,13,14
Color units	7-70 (120)	2,4,7b,9,10
Turbity (JTU)	< 5.0	2,10
pH	6.8-8.2 (9.2)	2,3,6,7c,9,12,19,20
Alkalinity (mg/l)	110-260 (35)	2,4,6,10
Hardness (mg/l)	70-300	4,9,10
Specific Conductance (umhos)	80-900	2,4,9,10,14,17,18,19,20
Nutrients		
Total Phosphorus (mg/l)	0.00-1.34 (4.1)	1,2,4,5,9,10,11,12,13, 14,15,16,18
Orthophosphate (mg/l)	.000-.715 (1.68)	1,4,7a,12,14
Total Nitrogen (mg/l)	0.19-1.85 (8.96)	5,8,14,15,18
Organic Nitrogen (mg/l)	0.15-2.50 (8.05)	1,2,4,5,8,10,12,13,14,15
Nitrate (mg/l)	.00-.36 (10.00)	1,2,4,5,11,12,13,14,15
Nitrite (mg/l)	.00-.03 (.10)	1,5,8,11,12,13,14,15
Ammonia (mg/l)	.00-.60 (8.6)	4,5,8,10,11,12,13,15
Total Organic Carbon (μg/l)	1-37 (120)	2,4,5,8,10,12,15,19,20
Major Constituents		
Calcium (mg/l)	35-110	4,9,12,13,14
Chloride (mg/l)	5-50 (150)	2,4,9,10,12,19,20
Magnesium (mg/l)	1-10	4,9,12,13,14
Potassium (mg/l)	0.1-3.0 (9)	4,9,12,13,14
Sodium (mg/l)	3-35 (77)	4,9,12,13,14
Sulfate (mg/l)	< 3 (20)	2,4,9,10,12,13,14

Table 29. (cont.)

	Range of Values*	Sources
Trace Metals		
Arsenic (μg/l)	0-20 (50)	2,5,10,12,13,14,15
Cadmium (μg/l)	0-14 (50)	2,4,5,10,15
Chromium (μg/l)	0-20 (60)	2,4,5,10,12,13,14
Copper (μg/l)	0-10 (60)	1,2,5,10,12,13,14,15
Iron (mg/l)	.01-1.0 (8.0)	1,2,4,5,9,10,12,13,14,15
Lead (μg/l)	0-26 (50)	5,12,13,14,15
Manganese (μg/l)	0-80 (200)	2,5,10,12,13,14,15
Mercury (μg/l)	0-13	2,4,5,15
Nickel (μg/l)	0-24	2,4,5,10
Zinc (μg/l)	0-100 (250)	2,4,5,10

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1 Black, Crow and Eidsness 1975
2 Carter et al. 1973
3 Duever et al. 1974
4 EPA 1971
5 Freiberger and McPherson 1973
6 Hunt 1961
7a Kaufman 1975
7b Kaufman 1975
7c Kaufman 1975
8 Klein et al. 1970
9 Kolipinski and Higer 1969
10 Little et al. 1970
11 Miller 1975
12 McPherson 1969
13 McPherson 1970a
14 McPherson 1971
15 McPherson 1972
16 Odum 1953
17 Slack and Kaufman 1973
18 Waller and Earle 1975
19 Wimberly 1973
20 Wimberly 1974

* Numbers in parentheses are naturally occurring but unusual values outside the normal freshwater range.

Table 30. Percent of 1982 monthly measurements above the range of values for natural Big Cypress surface
Duever et al.(1979).

LOCATION		DISSOLVED OXYGEN	SPECIFIC CONDUCITIVITY	pH	TURBIDITY	COLOR	ALKALINITY	HARDNESS
BARRON		0	8	8	0	50	25	0
COCAT951	(1)	0	0	0	0	43	0	0
COCEOF31		0	0	0	50	42	8	0
ECOCORIV	(2)	0	58	0	40	50	0	50
FAKA		42	0	33	0	17	0	0
GGCAT31		0	0	0	17	83	0	0
GGCAT951		0	0	0	42	83	0	0
GORDONRV		0	58	0	0	58	0	100
HENDCRK		0	50	0	0	42	50	50
LELY		8	50	8	0	25	0	100
NNAPLES		0	50	0	50	33	0	50
WCOCORIV		0	100	0	75	17	0	0

Table 30. (cont.)

LOCATION	CHLORIDE	SULFATE	SODIUM (3)	CALCIUM (3)	POTASSIUM (3)	MAGNESIUM (3)
BARRON	0	67	0	0	0	0
COCAT951 (1)	0	86	0	0	0	0
COCEOF31	17	100	0	0	0	0
ECOCORIV (2)	100	100	100	100	100	100
FAKA	42	100	0	0	0	0
GGCAT31	8	100	0	0	0	0
GGCAT951	0	100	0	0	0	0
GORDONRV	100	100	100	50	100	50
HENDCRK	67	100	50	50	50	50
LELY	75	100	100	50	50	50
NNAPLES	75	100	50	0	100	50
WCOCORIV	100	100	100	0	100	100

Table 30. (cont.)

LOCATION	TOTAL NITROGEN	ORGANIC NITROGEN	NITRATE	NITRITE	AMMONIA	TOTAL PHOSPHORUS	ORTHO-PHOSPHATE	TOTAL ORGANIC CARBON (4)
BARRON	0	0	0	0	0	0	0	11
COCAT951 (1)	0	0	0	0	0	0	0	0
COCEOF31	0	0	0	0	0	0	0	0
ECOCORIV (2)	10	0	0	0	0	0	0	0
FAKA	0	0	0	0	0	0	0	0
GGCAT31	8	0	0	0	0	0	0	0
GGCAT951	0	0	0	0	0	0	0	0
GORDONRV	33	0	0	0	0	0	0	0
HENDCRK	0	0	0	0	0	0	0	0
LELY	25	8	0	0	0	0	0	0
NNAPLES	25	0	0	0	0	0	0	11
WCOCORIV	100	33	33	67	67	50	100	0

Table 30. (cont.)

LOCATION	IRON	ARSENIC (3)	CADMIUM (3)	NICKEL (3)			
BARRON	0	0	0	0			
COCAT951 (1)	14	0	0	0			
COCEOF31	42	0	0	0			
ECOCORIV (2)	40	50	50	50			
FAKA	0	0	0	0			
GGCAT31	17	0	0	0			
GGCAT951	75	0	0	0			
GORDONRV	0	50	0	0			
HENDCRK	8	0	0	0			
LELY	0	0	0	0			
NNAPLES	33	0	0	0			
WCOCORIV	0	0	0	0			

(1) Percent of seven monthly samples, site dry January to May.

(2) Percent of ten monthly samples, site dry April and May.

(3) Percent of two semi-annual samples

(4) Percent of nine samples, TOC measurements made January to September only.

the normal range for the Big Cypress region. Only those parameters for which we found values beyond the normal range for natural fresh surface waters are discussed below.

Dissolved oxygen concentrations differed significantly from natural Big Cypress surface waters at only two sites. During the spring dry season, FAKA and LELY had some unusually high values as a result of photosynthetic activity by submerged vegetation. The pH values were also high at these sites for the same reason. Color and sulfate values exceeded those in natural surface waters at all sites during 2-12 months for unknown reasons. Excessive values for turbidity occurred erratically and probably varied from site to site largely because of local site conditions, possibly mechanical cleaning of the canals, general construction activities, or shallow groundwater pumping. Excessive hardness, calcium, chloride, magnesium, potassium, sodium, and specific conductance values all appear to be primarily associated with saltwater inputs either from seawater or saline groundwaters. Most nutrient concentrations were above background levels for at least portions of the year only at WCOCORIV, although all coastal sites had unusually high total nitrogen concentrations during some months. The trace metals arsenic, cadmium, and nickel exceeded values for natural surface waters at only a few scattered sites.

CONCLUSIONS

Only WCOCORIV had consistently unusual values for a number of water quality parameters. These values were probably a result of sewage treatment plant effluents, although agricultural runoff could contribute to them. A number of other small canals and streams near the coast had some high values that could be associated with domestic wastes, saline groundwater seepage, and/or saltwater intrusion during the dry season. ECOCORIV, GORDONRV, and NNAPLES exhibited these characteristics fairly regularly, while LELY did primarily during the dry season.

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APPENDIX A

1981 Data Collected at Collier County Canal Sampling Sites

Table 1. Sampling times at Collier County canal sampling sites during 1981.

LOCATION	JULY 7	AUG. 8	SEP. 9	OCT. 7	NOV. 10	DEC. 4
BARRON	1315	1825	1430	1500	1450	1320
COCEOF951	0830	0910	0820	0920	0900	0730
COCEOF31	0900	1105	1030	1100	1100	1945
ECOCORIV	0940	1310	1015	1040	1040	0915
FAKA	1251	1745	1400	1430	1420	1245
GGCAT31	1043	1425	1145	1200	1200	1050
GGCAT951	1120	1520	1210	1330	1315	1110
GORDONRV	1025	1350	1120	1130	1145	1030
HENDCRK	1219	1620	1230	1315	1345	1125
LELY	1157	1655	1310	1230	1220	1200
NNAPLES	0954	1205	0920	0955	1000	0820
WCOCORIV	0925	1235	0945	1015	1020	0845

Table 2. Temperature (°C) at Collier County canal sampling sites during 1981.

LOCATION	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	$\bar{X}$	SD
BARRON	27.1	26.5	29.0	27.0	23.0	23.0	26.0	2.4
COCAT951	28.0	29.0	29.0	26.5	21.0	-	26.7	3.3
COCEOF31	27.2	28.0	29.0	27.0	23.0	22.0	26.0	2.8
ECOCORIV	28.2	28.0	29.0	26.0	23.0	23.0	26.2	2.7
FAKA	31.5	30.0	27.0	28.0	23.0	22.0	26.9	3.8
GGCAT31	28.5	29.5	28.0	26.5	23.0	22.0	26.3	3.1
GGCAT951	28.0	29.0	27.0	26.5	23.0	23.0	26.1	2.5
GORDONRV	28.0	29.0	29.0	26.0	22.5	21.0	25.9	3.4
HENDCRK	26.8	29.0	29.0	27.0	23.0	23.0	27.0	2.6
LELY	30.5	31.0	30.0	27.0	23.0	23.0	27.4	3.7
NNAPLES	31.5	31.5	28.5	27.0	23.5	23.0	27.5	3.7
WCOCORIV	27.8	29.0	27.0	25.0	22.5	23.0	25.7	2.6
$\bar{X}$	28.6	29.1	28.5	26.6	22.8	22.6	26.5	
SD	1.7	1.3	1.0	0.7	0.6	0.7	0.6	

\- Site dry

Table 3. Dissolved oxygen concentrations (mg/l) at Collier County canal sampling sites during 1981.

LOCATION	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	$\bar{X}$	SD
BARRON	2.9	7.1	2.2	3.0	4.5	4.6	3.8	1.6
COCAT951	2.9	4.1	0.9	0.5	2.6	-	2.3	1.2
COCEOF31	3.7	4.3	2.5	4.9	6.4	2.8	3.8	1.4
ECOCORIV	3.4	1.3	2.5	3.1	4.3	4.7	3.2	1.2
FAKA	4.4	5.6	1.9	5.8	8.2	10.5	6.1	3.0
GGCAT31	4.1	4.1	3.1	3.3	3.8	4.2	3.7	0.4
GGCAT951	2.1	2.7	1.3	1.3	2.2	2.4	2.2	0.6
GORDONRV	1.3	1.6	1.5	3.6	1.3	2.8	2.0	1.0
HENDCRK	1.7	4.1	2.1	2.3	3.5	1.2	2.4	0.9
LELY	3.7	8.4	2.5	2.0	4.6	6.1	4.6	2.4
NNAPLES	5.4	5.7	4.4	5.8	2.8	3.9	4.7	1.2
WCOCORIV	0.8	0.1	1.2	0.1	0.3	0.3	0.5	0.4
$\bar{X}$	3.0	4.1	2.2	3.0	3.7	4.0	3.3	
SD	1.4	2.4	1.0	1.9	2.2	2.7	1.5	

\- Site dry

Table 4. Specific conductance (umhos/cm) at Collier County canal sampling sites during 1981.

LOCATION	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	$\bar{x}$	SD
BARRON	680	725	350	590	600	600	613	117
COCAT951	550	595	350	410	410	-	448	89
COCEOF31	590	580	290	560	600	650	571	119
ECOCORIV	950	2685	318	610	1100	4770	1739	1697
FAKA	1490	940	670	710	690	610	852	333
GGCAT31	690	685	580	680	610	600	651	46
GGCAT951	650	600	500	620	590	600	595	43
GORDONRV	1500	1005	1000	1180	8500	7000	3364	3435
HENDCRK	1000	1005	188	790	900	920	647	386
LELY	750	900	430	880	800	800	760	171
NNAPLES	1210	910	700	900	1420	1200	1056	264
WCOCORIV	1450	1500	1200	1300	1700	1620	1462	189
$\bar{x}$	959	1011	516	769	1493	1761	1063	
SD	366	587	336	260	2239	2123	823	

\- Site dry

Table 5. pH at Collier County canal sampling sites during 1981.

LOCATION	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	$\bar{X}$	SD
BARRON	7.6	7.6	7.6	7.3	7.8	7.7	7.6	0.1
COCAT 951	7.2	7.2	6.8	6.9	7.1	-	7.1	0.2
COCEOF31	7.5	7.3	7.2	7.6	7.8	7.6	7.5	0.2
ECOCORIV	7.8	7.3	7.5	7.5	7.8	7.5	7.6	0.2
FAKA	7.8	7.6	7.3	7.6	8.0	7.9	7.7	0.3
GGCAT31	7.8	7.4	7.4	7.6	7.7	7.7	7.6	0.1
GGCAT951	7.5	7.4	7.3	7.5	7.9	7.5	7.5	0.2
GORDONRV	7.7	7.4	7.4	7.5	7.6	7.6	7.5	0.1
HENDCRK	7.5	7.3	7.5	7.3	7.5	7.4	7.4	0.1
LELY	7.6	7.7	7.5	7.5	7.7	7.7	7.6	0.1
NNAPLES	8.1	7.4	7.5	7.5	7.2	7.2	7.5	0.3
WCOCORIV	7.5	7.3	7.3	7.4	7.5	7.4	7.4	0.1
$\bar{X}$	7.6	7.4	7.4	7.4	7.6	7.6	7.5	
SD	0.2	0.2	0.2	0.2	0.3	0.2	0.2	

\- Site dry

Table 6. Turbidity (NTU) at Collier County canal sampling sites during 1981.

LOCATION	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	$\bar{X}$	SD
BARRON	1.5	1.6	2.8	3.4	2.2	1.8	2.2	0.8
COCAT951	3.2	2.2	3.0	3.4	5.6	-	3.5	1.3
COCEOF31	2.7	2.5	3.3	6.1	16.0	8.1	6.5	5.2
ECOCORIV	2.4	3.7	3.5	3.8	5.9	3.8	3.9	1.1
FAKA	0.8	1.1	2.0	2.2	2.4	1.6	1.7	0.6
GGCAT31	2.4	2.5	6.2	4.4	4.0	4.0	3.9	1.4
GGCAT951	2.8	3.1	7.0	7.2	5.4	5.5	5.2	1.9
GORDONRV	1.1	1.5	3.1	2.5	2.4	4.8	2.6	1.3
HENDCRK	7.7	0.9	3.6	2.8	1.9	1.5	3.1	2.5
LELY	1.8	1.6	3.1	2.3	5.2	5.3	3.2	1.7
NNAPLES	1.9	4.8	8.0	5.7	7.0	4.9	5.4	2.1
WCOCORIV	4.5	1.9	8.0	4.6	2.0	2.6	3.9	2.3
$\bar{X}$	2.7	2.3	4.5	4.0	5.0	4.0	3.8	
SD	1.9	1.1	2.2	1.6	3.9	2.0	1.4	

\- Site dry

Table 7. Color at Collier County canal sampling sites during 1981.

LOCATION	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	$\bar{X}$	SD
BARRON	19	18	108	117	97	31	65	47
COCAT 951	152	65	118	127	102	-	113	32
COCEOF 31	80	85	109	157	77	63	95	34
ECOCORIV	79	128	106	90	70	39	85	31
FAKA	27	29	100	58	71	19	51	31
GGCAT31	119	85	100	117	128	97	108	16
GGCAT951	118	110	127	138	140	102	123	15
GORDONRV	59	57	63	81	79	150	82	35
HENDCRK	70	83	161	107	100	60	97	36
LELY	40	33	74	50	65	40	50	16
NNAPLES	51	92	127	109	110	92	97	26
WCOCORIV	80	103	72	90	55	25	71	28
$\bar{X}$	75	74	105	103	91	65	86	
SD	40	34	27	31	26	41	24	

\- Site dry

Table 8. Alkalinity (mg/l) at Collier County canal sampling sites

LOCATION	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	$\bar{X}$	SD
BARRON	5.43	5.61	2.78	4.75	5.32	3.81	4.62	1.11
COCAT951	4.45	3.89	2.59	3.55	3.70	-	3.64	.68
COCEOF31	4.92	3.94	1.79	4.27	4.90	4.83	4.11	1.20
ECOCORIV	4.87	3.60	1.87	4.19	5.32	4.81	4.11	1.25
FAKA	4.70	5.01	4.06	4.78	4.87	4.48	4.65	.34
GGCAT31	4.87	3.94	3.70	4.66	4.93	4.67	4.46	.51
GGCAT951	5.15	3.91	3.53	4.69	4.84	4.73	4.48	.62
GORDONRV	4.67	3.63	4.11	5.45	5.65	4.13	4.61	.80
HENDCRK	5.34	6.12	1.01	4.66	6.10	4.03	4.54	1.91
LELY	4.64	4.22	2.15	4.72	4.51	4.40	4.11	.97
NNAPLES	2.01	3.40	3.22	4.41	4.31	4.29	3.61	.93
WCOCORIV	3.13	3.66	2.95	3.49	4.82	4.16	3.70	.69
$\bar{X}$	4.52	4.24	2.81	4.47	4.94	4.39	4.22	
SD	.98	.87	.97	.54	.62	.34	.40	

- Site dry

Table 9. Total nitrogen concentrations (mg/l) at Collier County canal sampling sites during 1981.

LOCATION	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	$\bar{X}$	SD
BARRON	.62	.52	.96	1.35	1.08	1.17	.95	.32
COCAT951	1.41	1.17	1.22	1.58	1.47	-	1.37	.17
COCEOF31	.99	1.15	.88	1.88	1.17	1.21	1.21	.35
ECOCORIV	.99	2.12	1.00	1.36	1.04	1.04	1.26	.44
FAKA	.77	.62	1.02	.96	.64	.69	.78	.17
GGCAT31	1.22	1.45	.99	1.67	1.89	1.36	1.43	.32
GGCAT951	1.28	1.37	.91	1.31	1.24	1.50	1.27	.20
GORDONRV	1.17	1.42	1.07	1.63	1.49	2.26	1.51	.42
HENDCRK	1.16	.94	1.28	1.46	1.81	1.24	1.32	.30
LELY	.82	.74	1.52	1.09	.99	1.31	1.08	.30
NNAPLES	1.41	2.23	1.18	1.82	1.48	1.63	1.63	.37
WCOCORIV	3.95	3.33	2.78	3.85	2.25	2.62	3.13	.69
$\bar{X}$	1.32	1.42	1.23	1.66	1.40	1.46	1.41	
SD	.87	.80	.52	.74	.45	.55	.59	

\- Site dry

Table 10. Organic nitrogen concentrations (mg/l) at Collier County canal sampling sites during 1981.

LOCATION	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	$\bar{X}$	SD
BARRON	.60	.50	.93	1.22	.97	1.07	.88	.28
COCAT951	1.39	1.04	1.21	1.56	1.37	-	1.31	.20
COCEOF31	.97	1.07	.82	1.74	1.08	1.07	1.13	.32
ECOCORIV	.97	1.78	.93	1.28	.97	1.01	1.16	.33
FAKA	.76	.54	.92	.91	.63	.68	.74	.15
GGCAT31	1.18	1.33	.92	1.53	1.74	1.29	1.33	.28
GGCAT951	1.23	1.29	.83	1.17	1.10	1.45	1.18	.21
GORDONRV	1.10	1.30	.90	1.40	1.36	1.83	1.32	.31
HENDCRK	.99	.83	1.27	1.22	1.74	1.23	1.21	.31
LELY	.81	.71	1.50	1.01	.97	1.27	1.05	.29
NNAPLES	1.39	1.83	1.16	1.79	1.33	1.62	1.52	.27
WCOCORIV	2.83	1.89	1.04	2.45	1.52	1.80	1.92	.64
$\bar{X}$	1.19	1.18	1.04	1.44	1.23	1.30	1.23	
SD	.57	.49	.21	.42	.34	.35	.30	

\- Site dry

Table 11. Inorganic nitrogen concentrations (mg/l) at Collier County canal sampling sites during 1981.

LOCATION	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	$\bar{X}$	SD
BARRON	<	.02	.03	.13	.11	.09	< .05	> .05
COCAT951	.02	.13	<	.02	.10	-	< .07	> .05
COCEOF31	.02	.08	.06	.14	.09	.14	.09	.05
ECOCORIV	.02	.34	.07	.08	.07	.03	.10	.12
FAKA	<	.08	.10	.05	<	<	< .04	> .04
GGCAT31	.04	.11	.07	.14	.15	.07	.10	.04
GGCAT951	.05	.08	.08	.14	.14	.06	.09	.04
GORDONRV	.07	.13	.17	.23	.13	.43	.19	.13
HENDCRK	.17	.11	.01	.24	.07	.01	.10	.09
LELY	.01	.03	.02	.09	.02	.04	.04	.03
NNAPLES	.02	.40	.02	.03	.15	.01	.11	.15
WCOCORIV	1.12	1.44	1.74	1.40	.73	.82	1.21	.39
$\bar{X}$	<.13	.25	< .20	.22	< .15	< .16	< .18	
SD	>.31	.39	> .49	.38	> .19	> .25	> .43	

- Site dry

< Less than .01 mg/l detection limit

Table 12. Nitrate concentrations (mg/l) at Collier County canal sampling sites during 1981.

LOCATION	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	$\bar{X}$	SD
BARRON	<	.007	.014	.112	.095	.081	<.062	>.048
COCAT951	<	.017	<	<	.046	-	<.032	>.021
COCEOF31	.006	.059	.041	.124	.079	.077	.064	.040
ECOCORIV	.011	.015	.052	.064	.058	.020	.037	.024
FAKA	<	<	.014	.018	<	<	<.008	>.006
GGCAT31	.023	.079	.043	.093	.123	.053	.069	.036
GGCAT951	.037	.057	.022	.069	.094	.041	.053	.026
GORDONRV	.024	.047	.115	.096	.060	.394	.123	.137
HENDCRK	.012	.057	<	.090	.044	<	<.051	>.032
LELY	<	.019	<	.026	.008	<	<.011	>.009
NNAPLES	<	.058	<	.012	<	<	<.014	>.022
WCOCORIV	<	<	.472	.081	.360	.007	<.155	>.208
$\bar{X}$	<.019	<.042	<.097	<.071	<.097	<.096	<.057	
SD	>.011	>.025	>.155	>.038	>.098	>.134	≥.044	

\- Site dry

< Less than .004 detection limit

Table 13. Nitrite concentrations (mg/l) at Collier County canal sampling sites during 1981.

LOCATION	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	$\bar{X}$	SD
BARRON	<	<	.004	.009	<	<	<.007	≥.004
COCAT951	<	<	<	.005	<	-	<.005	≥.000
COCEOF31	<	.005	.004	.006	<	.004	<.005	≥.001
ECOCORIV	<	.008	.004	.006	<	.004	<.005	≥.002
FAKA	<	.005	.004	.005	<	<	<.004	≥.001
GGCAT31	<	.006	.004	.007	<	<	<.006	≥.002
GGCAT951	<	.006	.004	.007	<	<	<.006	≥.002
GORDONRV	.007	.018	.013	.011	.009	.019	.013	.005
HENDCRK	<	.008	.004	.024	<	<	<.012	≥.011
LELY	<	.005	.004	.009	<	<	<.005	≥.002
NNAPLES	<	.016	<	.006	<	<	<.006	≥.005
WCOCORIV	<	.005	.064	.070	.082	.089	<.052	≥.038
$\bar{X}$	<.007	<.007	<.011	.014	<.046	<.029	<.011	
SD	>.001	>.003	>.019	.018	>.052	>.041	>.013	

\- Site dry

< Less than .004 mg/l detection limit

Table 14. Ammonia concentrations (mg/l) at Collier County canal sampling sites during 1981.

LOCATION	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	$\bar{X}$	SD
BARRON	<	<	<	.01	<	<	< .01	≥.00
COCAT951	<	.11	<	.05	.05	-	< .07	≥.04
COCEOF31	<	.02	<	<	<	.06	< .04	≥.03
ECOCORIV	<	.32	<	.01	<	<	< .06	≥.13
FAKA	<	.07	.08	.03	<	<	< .04	≥.03
GGCAT31	<	.03	.02	.04	.02	.01	< .02	≥.01
GGCAT951	<	.02	.05	.06	.04	<	< .04	≥.02
GORDONRV	.04	.06	.04	.12	.06	.02	.06	.03
HENDCRK	.15	.05	<	.13	.02	<	< .09	≥.06
LELY	<	<	<	.05	.01	.03	< .02	≥.02
NNAPLES	<	.33	<	<	.15	.01	< .09	≥.13
WCOCORIV	1.12	1.44	1.20	1.25	.29	.72	1.00	.42
$\bar{X}$	<.44	< .25	< .28	< .18	< .08	< .14	< .13	
SD	>.59	> .44	> .52	> .38	> .10	> .28	≥.28	

\- Site dry

< Less than .004 mg/l detection limit

Table 15. Total phosphorus concentrations (mg/l) at Collier County canal sampling sites during 1981.

LOCATION	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	$\bar{X}$	SD
BARRON	.007	.006	.035	.085	.032	.021	.031	.029
COCAT951	.008	.007	.008	.043	.047	-	.023	.021
COCEOF31	.012	.009	.088	.022	.032	.030	.032	.029
ECOCORIV	.029	.156	.091	.036	.041	.064	.070	.048
FAKA	.009	.005	.016	.016	.012	.011	.012	.004
GGCAT31	.080	.015	.038	.020	.039	.053	.041	.024
GGCAT951	.005	.011	.041	.021	.021	.025	.021	.012
GORDONRV	.022	.052	.060	.047	.071	.336	.098	.118
HENDCRK	.009	.007	.016	.015	.014	.017	.013	.004
LELY	.009	.005	.018	.018	.043	.034	.021	.015
NNAPLES	.029	.057	.069	.057	.129	.106	.075	.037
WCOCORIV	1.229	1.232	1.354	1.422	.755	1.789	1.297	.337
$\bar{X}$	.121	.130	.153	.150	.103	.226	.145	
SD	.350	.350	.379	.401	.208	.527	.364	

\- Site dry

Table 16. Orthophosphate concentrations (mg/l) at Collier County canal sampling sites during 1981.

LOCATION	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	$\bar{X}$	SD
BARRON	<	.002	.015	.051	<	.009	<.019	>.022
COCAT951	<	<	<	.027	.005	-	<.016	>.016
COCEOF31	<	.003	.077	.013	<	.007	<.025	>.035
ECOCORIV	.021	.069	.062	.017	.019	.024	.035	.024
FAKA	<	<	.005	<	<	<	<.003	>.001
GGCAT31	<	.011	.020	.010	.013	.023	<.015	>.006
GGCAT951	<	.004	.020	.005	.005	.006	<.008	>.007
GORDONRV	<	.035	.041	.024	.023	.018	<.024	>.014
HENDCRK	<	.003	<	.007	.002	.008	<.005	>.003
LELY	<	<	.005	<	<	<	<.003	>.001
NNAPLES	<	.005	.042	.023	.036	.023	<.022	>.016
WCOCORIV	1.064	.854	1.438	1.329	.562	1.554	1.134	.379
$\bar{X}$	<.543	<.110	<.173	<.151	<.083	<.186	<.109	
SD	>.738	>.280	>.445	>.414	>.194	>.513	>.323	

\- Site dry

< Less than .002 detection limit

Table 17. Total suspended solids concentrations (mg/l) at Collier County canal sampling sites during 1981.

LOCATION	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	$\bar{X}$	SD
BARRON	+	5.0	<	<	<	<	< 5.0	>1.8
COCAT951	+	2.0	28.0	<	1.0	-	<10.3	>15.3
COCEOF31	+	2.0	22.0	<	6.0	<	<10.0	>10.6
ECOCORIV	+	6.0	240.0	<	<	<	<49.8	>106.3
FAKA	+	3.0	4.0	<	<	3.0	< 2.4	> 1.3
GGCAT31	+	2.0	30.0	<	<	<	<16.0	>19.8
GGCAT951	+	2.0	276.0	10.0	<	<	<96.0	>155.9
GORDONRV	+	6.0	28.0	<	5.0	12.0	<10.4	>10.6
HENDCRK	+	9.0	2.0	<	2.0	1.0	< 3.5	> 3.7
LELY	+	4.0	4.0	2.0	<	3.0	< 2.8	> 1.3
NNAPLES	+	3.0	32.0	<	12.0	<	< 9.8	>13.2
WCOCORIV	+	2.0	30.0	<	<	<	< 7.0	>12.9
$\bar{X}$	+	3.8	<63.3	<6.0	<5.2	<5.0	<18.6	
SD	+	2.3	>97.3	>5.7	>4.3	>4.3	>27.5	

\- Site dry

\+ Sample lost

Table 18.. Total organic carbon concentrations (mg/l) at Collier County canal sampling sites during 1981

LOCATION	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	$\bar{X}$	SD
BARRON	5.1	4.2	10.6	17.0	11.8	8.9	9.6	4.7
COCAT951	24.8	21.5	22.9	20.9	20.4	-	22.1	1.8
COCEOF31	17.5	13.3	17.3	14.3	15.6	13.0	15.2	2.0
ECOCORIV	16.4	17.6	15.6	14.9	15.6	12.4	15.4	1.7
FAKA	9.1	6.3	19.3	12.5	10.1	8.0	10.9	4.6
GGCAT31	16.4	12.4	20.2	16.1	18.3	15.9	16.6	2.6
GGCAT951	20.7	14.8	22.2	18.2	18.9	17.7	18.8	2.6
GORDONRV	15.5	13.9	18.6	15.8	13.4	33.2	18.4	7.5
HENDCRK	16.7	18.5	23.6	19.7	17.5	15.9	18.7	2.8
LELY	10.6	8.2	20.2	18.8	13.5	12.1	13.9	4.7
NNAPLES	16.7	15.2	14.2	17.6	17.4	15.3	16.1	1.4
WCOCORIV	17.8	18.2	11.1	16.1	14.0	12.4	14.9	2.9
$\bar{X}$	15.6	13.7	18.0	16.8	15.5	15.0	15.9	
SD	5.2	5.2	4.3	2.4	3.1	6.7	3.5	

\- Site dry

Table 19. Chloride concentrations (mg/l) at Collier County sampling sites during 1981.

LOCATION	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	$\bar{X}$	SD
BARRON	45.7	36.4	12.9	22.4	21.5	15.4	25.7	12.8
COCAT951	22.2	18.6	10.5	20.8	<	-	< 18.0	> 5.2
COCEOF31	25.5	22.0	10.5	24.4	30.0	30.3	23.8	7.3
ECOCORIV	168.1	519.7	12.9	42.3	161.2	1318.4	370.4	498.2
FAKA	199.0	68.3	25.7	36.0	48.1	39.8	69.5	65.0
GGCAT31	34.5	30.1	15.2	31.5	67.5	37.9	36.2	17.2
GGCAT951	21.0	19.2	9.4	16.7	20.4	15.4	17.0	4.3
GORDONRV	236.9	91.2	85.0	136.6	3201.0	1948.4	949.8	1320.6
HENDCRK	72.7	64.9	8.2	42.9	78.0	83.4	58.4	28.3
LELY	86.2	69.5	22.2	70.2	92.9	82.3	70.5	25.4
NNAPLES	223.4	91.0	52.4	105.6	283.4	201.3	159.5	89.7
WCOCORIV	281.8	214.0	190.9	211.5	337.6	420.6	276.1	89.4
$\bar{X}$	118.1	103.7	38.0	63.4	< 394.7	381.2	<172.9	
SD	97.0	141.6	53.3	59.5	>936.8	645.9	>269.4	

\- Site dry

< Less than 1.0 detection limit

Table 20. Sulfate concentrations (mg/l) at Collier County canal sampling sites during 1981.

LOCATION	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	$\bar{X}$	SD
BARRON	11.3	7.5	14.7	18.9	15.7	15.1	13.9	4.0
COCAT951	23.8	41.0	14.7	13.6	21.0	-	22.8	11.0
COCEOF31	17.1	22.6	16.1	17.6	23.6	27.4	20.7	4.5
ECOCORIV	42.3	144.8	18.7	20.2	44.6	223.5	82.4	83.4
FAKA	61.6	56.0	30.7	41.5	36.7	42.5	44.8	11.7
GGCAT31	41.0	30.5	36.0	37.5	41.9	37.0	37.3	4.1
GGCAT951	39.6	30.7	34.7	22.9	34.1	15.1	29.5	9.0
GORDONRV	140.2	94.9	78.6	72.2	492.5	312.7	198.5	169.7
HENDCRK	76.7	85.4	17.4	29.5	70.7	74.1	59.0	28.2
LELY	47.6	56.0	24.1	32.2	53.7	46.6	43.4	12.6
NNAPLES	46.3	37.1	30.7	33.5	82.5	70.0	50.0	21.4
WCOCORIV	119.0	87.0	70.6	46.9	104.8	100.1	88.1	26.0
$\bar{X}$	55.5	57.8	32.3	32.2	85.2	87.7	57.5	
SD	39.2	38.8	21.3	16.3	131.0	95.0	50.0	

\- Site dry

Table 21. Total iron concentrations (mg/l) at Collier County canal sampling sites during 1981.

LOCATION	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	$\bar{x}$	SD
BARRON	.22	.33	.35	.73	.79	.24	.44	.25
COCAT951	1.27	.60	.54	.55	1.15	-	.80	.38
COCEOF31	.57	.79	.56	.45	1.48	1.17	.84	.41
ECOCORIV	.50	1.21	.54	.62	.80	.29	.66	.32
FAKA	.04	.20	.44	.30	.33	<	<.22	>.17
GGCAT31	.50	.73	1.06	.73	.93	.79	.79	.19
GGCAT951	.69	1.11	1.58	1.35	1.01	.91	1.11	.32
GORDONRV	.17	<	.17	.16	.14	.17	<.14	>.06
HENDCRK	.59	.55	.42	.37	.28	.25	.41	.14
LELY	.25	.42	.33	.24	.66	.71	.44	.20
NNAPLES	.32	1.59	1.71	.08	3.39	1.02	1.35	1.19
WCOCORIV	.10	.11	.20	.42	.03	<	<.15	>.15
$\bar{x}$	.44	<.70	.66	.50	.92	<.62	<.61	
SD	.34	>.46	.51	.34	.89	>.38	>.38	

< Less than .02 mg/l detection limit

\- Site dry

Table 22. Hardness values and calcium and sodium concent[illegible]
sites during 1981.

LOCATION	HARDNESS AUG	CALCIUM AUG	SODIUM AUG
BARRON	290.2	105.3	25.5
COCAT951	261.4	99.5	10.3
COCEOF31	228.7	86.	17.1
ECOCORIV	466.5	120.8	334.3
FAKA	331.2	119.2	44.9
GGCAT31	254.8	95.5	17.9
GGCAT951	252.3	96.3	8.7
GORDONRV	312.3	106.9	53.3
HENDCRK	409:9	141.3	45.7
LELY	298.3	105.3	42.4
NNAPLES	255.0	86.5	57.5
WCOCORIV	308.6	90.5	148.5
$\bar{X}$	305.8	104.5	67.2
SD	69.8	16.1	92.0

Table 23. Potassium and magnesium concentrations (mg/l) at Collier County canal sampling sites during 1981.

LOCATION	POTASSIUM AUG	MAGNESIUM AUG
BARRON	0.9	6.6
COCAT951	0.5	3.1
COCEOF31	1.4	3.1
ECOCORIV	10.3	40.1
FAKA	1.4	8.2
GGCAT31	1.3	4.0
GGCAT951	0.4	2.9
GORDONRV	3.3	11.0
HENDCRK	2.0	13.9
LELY	1.1	8.6
NNAPLES	3.9	9.5
WCOCORIV	12.3	20.0
$\bar{X}$	3.2	10.9
SD	3.9	10.5

Table 24. Trace metal concentrations (µg/l) at Collier County canal sampling sites during 1981.

LOCATION	ARSENIC AUG	CADMIUM AUG	CHROMIUM AUG
BARRON	12.9	0.3	0.3
COCAT951	14.6	0.7	1.5
COCEOF31	8.4	2.4	1.2
ECOCORIV	19.5	3.0	1.9
FAKA	10.2	0.3	0.5
GGCAT31	4.6	1.3	1.2
GGCAT951	6.2	1.6	1.3
GORDONRV	8.0	1.1	0.8
HENDCRK	6.6	0.2	1.6
LELY	6.6	0.4	0.6
NNAPLES	10.0	1.4	1.0
WCOCORIV	10.0	2.0	1.8
$\bar{X}$	9.8	1.2	1.1
SD	4.2	0.9	0.5

Table 24. (cont.)

LOCATION	COPPER AUG	LEAD AUG	MERCURY AUG
BARRON	2.0	0.5	1.6
COCAT951	3.5	<	2.3
COCEOF31	3.4	<	0.4
ECOCORIV	1.8	1.0	0.3
FAKA	1.3	0.8	0.2
GGCAT31	2.4	<	0.5
GGCAT951	2.1	<	4.7
GORDONRV	2.5	1.0	2.2
HENDCRK	1.7	0.6	0.4
LELY	2.0	1.0	4.6
NNAPLES	3.2	1.2	3.1
WCOCORIV	2.6	0.6	0.5
$\bar{X}$	2.4	<0.8	1.7
SD	0.7	>0.3	1.7

Table 24. (cont.)

LOCATION	NICKEL AUG	ZINC AUG
BARRON	9.5	80.0
COCAT951	12.0	105.0
COCEOF31	8.2	62.0
ECOCORIV	21.9	85.0
FAKA	14.8	13.0
GGCAT31	10.9	61.0
GGCAT951	12.9	34.0
GORDONRV	20.7	45.0
HENDCRK	19.5	60.0
LELY	13.6	17.0
NNAPLES	15.2	57.0
WCOCORIV	21.4	297.0
$\bar{X}$	15.1	76.0
SD	4.8	74.0

APPENDIX B

South Florida Water Management District

Laboratory Procedures Used For Water Quality

Analyses Of Western Collier County Canal Samples

Table 1. Laboratory procedures used by the South Florida Water Management District for water quality analyses of samples from western Collier County canals.

Determination	Method	Range	Sensitivity	Detection Limit
Alkalinity	Colorimetric Automated Methyl Orange, Technicon AA II Method #111-71W, modified EPA Method #310.2	0-250 mg/l	5.0 mg/l	5.0 mg/l
Ammonia	Colorimetric Automated Phenate, Technicon AA II method #154-71W, modified EPA Method #350.1	0-50 mg/l	0.01 mg/l	0.01 mg/l
Chloride	Colorimetric Automated Ferricyanide, Technicon AA II Method #99-70W, modified EPA Method #325.2	0-200 mg/l	2.0 mg/l	4.0 mg/l
Nitrite	Colorimetric Automated Diazotization with Sulfanilamide and coupling with N-(1 naphthyl) ethylenediamine Dihydrochloride, Technicon colorimetric, automated AA II Method #120-70W, modified EPA Method #353.2	0-0.200 mg/l	0.002 mg/l	0.004 mg/l
Nitrate	Same as nitrite with Cadmium Reduction Column. Technicon AA II Method #100-70W, modified EPA Method #353.2	0.0.200 mg/l	0.002 mg/l	0.004 mg/l
Total Kjeldahl Nitrogen	Colorimetric, Semi-automated Block Digestor, Technicon AA II Method #376-75W, 334-74A, modified EPA Method #351.2	0-0.10 mg/l	0.001 mg/l	0.002 mg/l
Orthophosphate	Colorimetric, Automated, Phosphomolybdenum Blue Complex with Ascorbic Acid Reduction, Technicon AA II Method #155-71W, modified EPA Method #365.1	0-0.10 mg/l	0.001 mg/l	0.002 mg/l
Total Phosphate	Colorimetric, Semi-automated Persulfate Digestion followed by same method as orthophosphate Technicon AA II Method #155-71W, modified EPA Method #365.1.	0-0.10 mg/l	0.001 mg/l	0.002 mg/l
Sulfate	Colorimetric, Automated Methylthymol Blue, Technicon AA II Method #118-71W, modified EPA Method #375.2	0-250.0 mg/l	5.0 mg/l	5.0 mg/l

Table 2. Laboratory procedures used by the South Florida Water Management District for water quality analyses of samples from western Collier County.

Determination	Method	Range	Detection Limit
Sodium	Atomic Absorption Direct Aspiration with Dual Capillary System (DCS), EPA Method #273.1	0-150 mg/l	As calculated from absorbance
Potassium	Atomic Absorption Direct Aspiration with Dual Capillary System (DCS), EPA Method #258.1	0-10 mg/l	As calculated from absorbance
Calcium	Atomic Absorption Direct Aspiration with Dual Capillary System (DCS), Samples are treated with La_2O_3/HCl with DCS, EPA Method #215.1	0-150 mg/l	As calculated from absorbance
Magnesium	Atomic Absorption Direct Aspiration with Dual Capillary System (DCS), Same treatment as calcium, EPA Method #242.1	0-40 mg/l	As calculated from absorbance
Iron	Industrial method # 109-71W/B	0.02-1.0 mg/l	n/a
Arsenic (1)	Atomic Absorption, furnace technique, EPA method #206.2	5-100 µg/l	1 µg/l
Cadmium (1)	Atomic Absorption, furnace technique, EPA method #213.2	0.5-10 µg/l	0.1 µg/l
Chromium (1)	Atomic Absorption, furnace technique, EPA method #218.2	5-100 µg/l	1 µg/l
Copper (1)	Atomic Absorption, furnace technique, EPA method #220.2	5-100 µg/l	1 µg/l
Lead (1)	Atomic Absorption, furnace technique, EPA method #239.2	5-100 µg/l	1 µg 1
Mercury (1)	Manual Cold, vapor technique, EPA method #245.1	n/a	0.2 µg/l
Nickel (1)	Atomic Absorption, furnace technique, EPA method #249.2	5-100 µg/l	1 µg/l
Zinc (1)	Atomic Absorption, furnace technique, EPA method #289.2	0.2-4 µg/l	0.05 µg/l
Color	Colorimetric - Platinum-cobalt, measured at 465 nm, Reference to APHA color standard, EPA method #110.2	n/a	n/a
Turbidity	Nephelometric method, Standard methods 15th edition	n/a	n/a

Table 2. (cont.)

Determination	Method	Range	Detection Limit
Total Suspended Solids	Nonfiltrable Residue dried at 103-105°C, Standard methods 15th edition	n/a	n/a
Hardness	Calculated from calcium and magnesium determinations, Standard methods 15th edition	n/a	n/a
Total Organic Carbon (2)	Combustion-Infrared method, Standard methods 15th edition	n/a	n/a

1. Preserved with 2 drops concentrated HNO_3 per 60 ml sample

2. Preserved with 2 drops concentrated HCl per 60 ml sample.

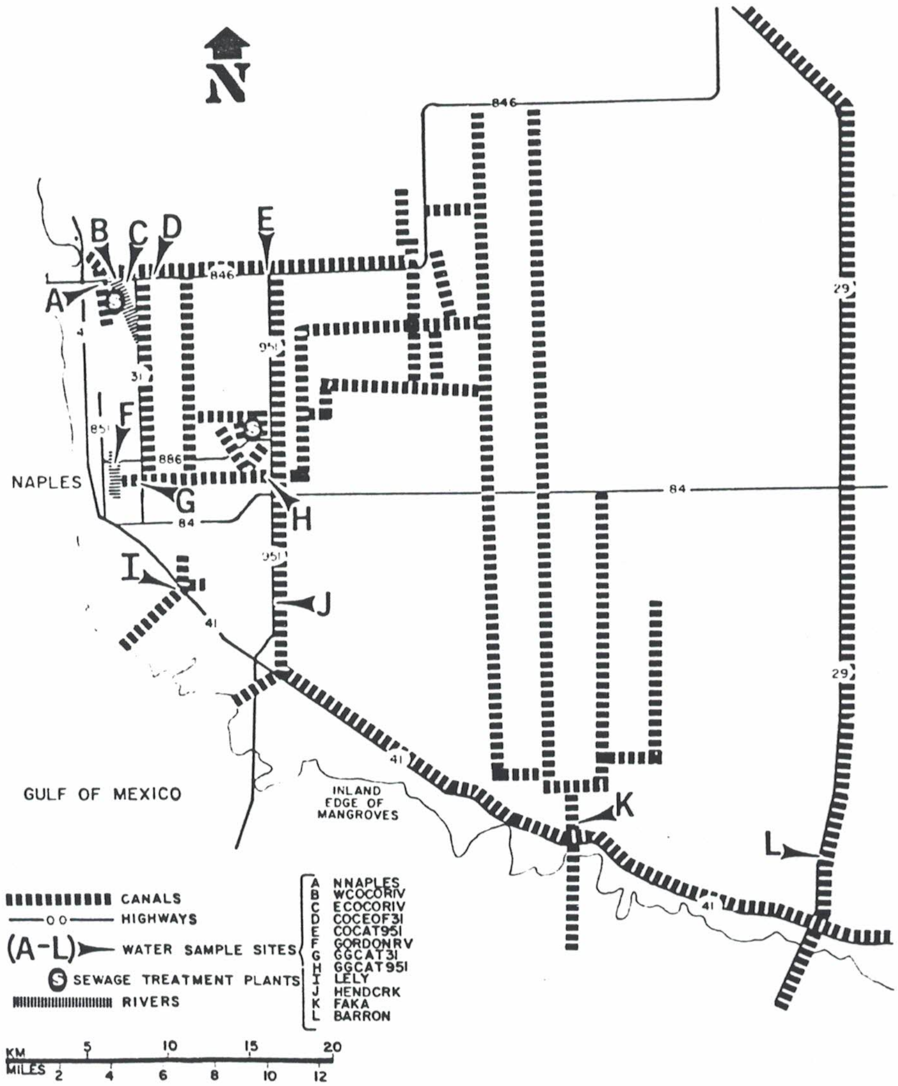

FIGURE I. WATER QUALITY MONITORING STATIONS WITHIN THE BIG CYPRESS BASIN