ANNUAL REPORT
OF THE
CONTINUING SURFACE WATER QUALITY
MONITORING PROGRAM
FOR THE PALMER RANCH
APRIL, 1985 - MARCH, 1986
SARASOTA COUNTY, FLORIDA

December, 1986

Prepared For:

PALMER VENTURE
7184 Beneva Road
Sarasota, Florida 33583

Prepared By:

CONSERVATION CONSULTANTS, INC.
P. O. Box 35
5010 U.S. Highway 19 North
Palmetto, Florida 33561

H. Lee Davis, Ph.D.
Principal Investigator

Richard W. Odell
Staff Scientist

PRINCIPAL PROJECT PARTICIPANTS

CONSERVATION CONSULTANTS, INC.

William W. Hamilton	Project Director
H. Lee Davis, Ph.D.	Principal Investigator
Richard W. Odell	Data Acquisition and Management
Dorothy S. Morse	Laboratory Services

TABLE OF CONTENTS

TABLE OF CONTENTS
(Continued)

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDIX A TABLES

ANNUAL REPORT OF THE
CONTINUING SURFACE WATER QUALITY MONITORING PROGRAM
THE PALMER RANCH
SARASOTA COUNTY, FLORIDA

1.0 INTRODUCTION

A master development plan for the North Tract of the Palmer Ranch is being implemented pursuant to the terms and conditions of the Master Development Order (MDO) which was adopted on December 24, 1984, by the Board of County Commissioners of Sarasota County. The MDO calls for planning and developing the 5,119-acre North Tract of the Palmer Ranch in incremental developments. Construction of the first incremental development (Prestancia) was initiated in January, 1986. As shown in Figure 1.1, the North Tract of the Palmer Ranch is located in west-central Sarasota County.

Pursuant to the conditions of the MDO, a "Continuing Surface Water Quality Monitoring Program" is required to be performed prior to and during construction of the North Tract. Additionally, annual reports of the monitoring program are required to be provided to the Sarasota County Planning Department, the Southwest Florida Regional Planning Council, the Florida Bureau of Land and Water Management, and all affected permitting agencies pursuant to the requirements of Chapter 380.06(14) and (16), Florida Statutes, Chapter 9B-16.25, Florida Administrative Code, and procedures established by the Southwest Florida Regional Planning Council. Each annual report is required to be submitted on the anniversary of the effective date

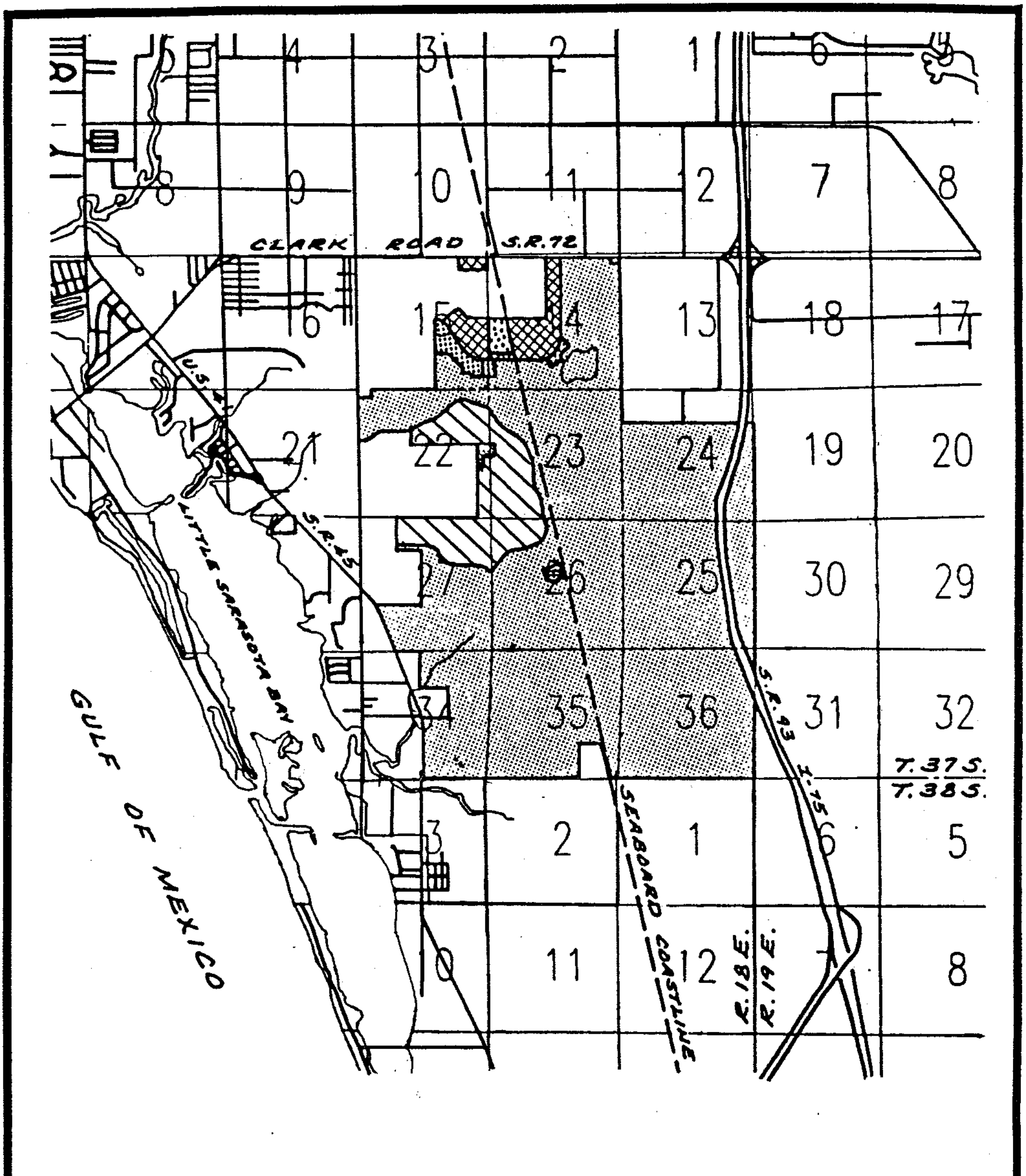


FIGURE 1.1

GENERAL SITE LOCATION

of the MDO, for each following year until, and including, such time as all terms and conditions of the MDO are satisfied.

The primary purpose of the required "Continuing Surface Water Quality Monitoring Program" is to provide a continual assessment of the surface water quality conditions prior to and during the construction activities on the North Tract of the Palmer Ranch.

The monitoring program which was initiated in May, 1984 employed a bimonthly sampling frequency as required for the first year of monitoring (May, 1984 - March, 1985). Subsequently, the scope of the monitoring program for the following two-year period (April, 1985 - March, 1987) was revised during an agency review meeting in June, 1985. The meeting involved the developer's representative, Mr. T. W. Goodell, P.E. of Palmer Venture, and Mr. Russell P. Klier, P.E., Director of Sarasota County Environmental Services Department (personal communication with Mr. T. W. Goodell). The revised workscope entailed a 13 station network with a quarterly sampling frequency for the parameters monitored during the first year except trace elements and organochlorine pesticide scans which would receive annual audits (refer to correspondence of Mr. T. W. Goodell to Mr. R. P. Klier of July 24, 1986).

Palmer Venture contracted Conservation Consultants, Inc. (CCI) to carry out the continuing surface water quality monitoring program during the second year of the monitoring program. CCI began monitoring on September 16, 1985, pursuant to the instructions provided by Mr. T. W. Goodell.

Water quality conditions recorded during the second year of monitoring, April, 1985 - March, 1986, are reported herein. The report includes an assessment of the results with respect to applicable water quality criteria, spatial and temporal trends, and the results of the first year of monitoring.

2.0 GENERAL ENVIRONMENTAL SETTING

2.1 Climate

Prevailing climatic conditions in west-central Florida are subtropical, characterized by abundant rainfall and moderate temperatures. Average monthly temperatures derived from two separate 30-year periods of record are provided in Table 2.1 below :

Table 2.1 Monthly Average Temperatures
(National Weather Service - Tampa, Florida)

Month	Air Temperature 1941-1970[a] °C	°F	1931-1960[b] °C	°F
January	16.4	61.6	16.9	62.4
February	17.2	62.9	17.7	63.8
March	19.4	66.9	19.4	67.0
April	22.3	72.1	22.1	71.8
May	24.8	76.7	24.9	76.8
June	26.8	80.3	26.9	80.4
July	27.6	81.6	27.6	81.6
August	27.7	81.9	27.8	82.0
September	26.9	80.5	27.0	80.6
October	23.9	75.0	23.9	75.1
November	19.8	67.7	19.9	67.9
December	17.1	62.8	17.4	63.4
Annual	22.5	72.5	22.6	72.7

[a]Thompson, 1976
[b]Bradley, 1974

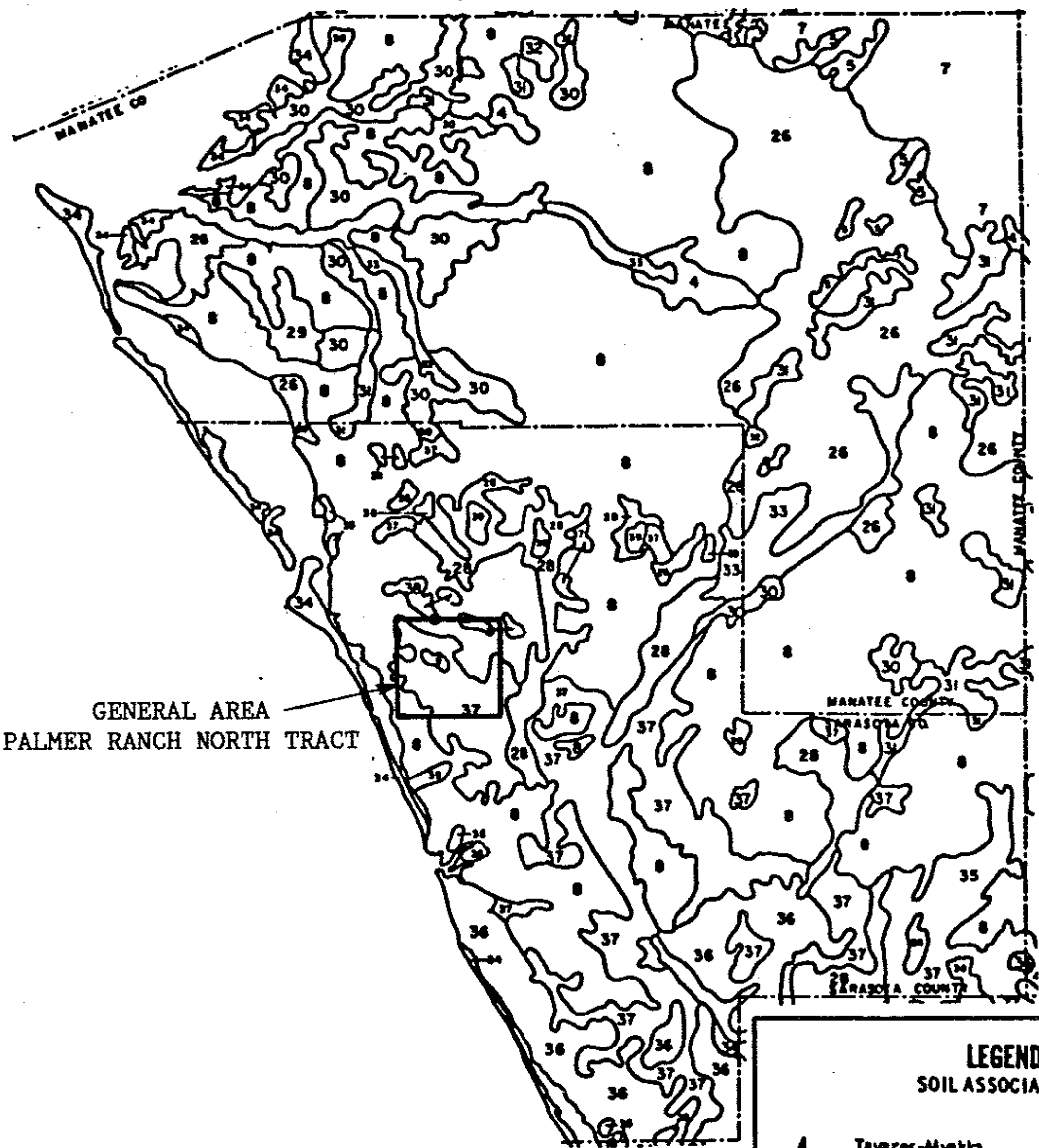
Based on a 30-year record of rainfall at Bradenton, Florida (NOAA, 1977) precipitation averages 56 inches per year. Minimum annual rainfall during that 30-year period was 29 inches while the maximum observed was 93 inches. Historical rainfall trends for this area of Florida indicate a wet season during the summer months (June - September) followed by a dry season during the fall and early winter months (October - January). On the average 62 percent (35 inches) of the annual rainfall occurs during the wet season as compared with only 13 percent (7 inches) during the dry season. The dry season is followed by a secondary winter wet season and subsequently a secondary spring dry season.

2.2 Soils

Soils in the area of the Palmer Ranch are generally sandy except in areas of low relief and poor drainage where peaty mucks are common. Upland soils found throughout the Palmer Ranch are predominately of the Myakka-Immokalee-Basinger Association. This soil association is defined as being nearly level with poorly drained sandy soils. Figure 2.1 and Table 2.2 provide the locations and descriptions of the soil associations that occur in the area of the Palmer Ranch.

2.3 Land Use and Vegetation

Historically, the primary land use within the Palmer Ranch has been cattle ranching. However, recent changes in land uses on the Palmer Ranch have included land disposal of sewage sludge wastes, wastewater treatment facilities, and associated effluent disposal spray fields. Although the effluent disposal spray fields were not actively used during the second year of monitoring, sewage sludge-wastes were applied to various areas of the ranch. Additionally, the construction of the Central County



LEGEND
SOIL ASSOCIATIONS

4	Tavares-Myakka
5	Pomello-St. Lucie
7	Myakka-Pomello-Basinger
8	Myakka-Immokalee-Basinger
26	Immokalee-Pomello
28	Pompano-Charlotte-Delray
30	Wabasso-Bradenton-Myakka
31	Placid-Basinger
32	Delray-Manatee-Pompano
33	Fresh Water Swamp & Marsh
34	Tidal Marsh & Swamp-Coastal Beach Ridges
35	Pomello-Paola-St. Lucie
36	Immokalee-Myakka-Pompano
37	Adamsville-Pompano
38	Scranton, var.-Ona-Placid
39	Terra Ceia

Source: The Florida General Soils Atlas, Florida Division of State Planning (1975)

FIGURE 2.1

SOIL ASSOCIATIONS IN REGION

Table 2.2 Descriptions of Soil Associations.

Area Definition	Map Unit No.	Soil Association Description
Areas dominated by moderately well to poorly drained soils not subject to flooding	4	Tavares-Myakka association: Nearly level to gently sloping, moderately well-drained soils sandy throughout and poorly drained sandy soils with a weakly cemented sub soils.
	5	Pomello-St. Lucie association:Nearly level to sloping, moderately well drained, sandy soils with weakly cemented sandy subsoil and excessively drained soils sandy throughout.
	7	Myakka-Pomello-Basinger association: Nearly level, poorly and moderately well drained, sandy soils with weakly cemented sandy subsoil and poorly drained sandy soils throughout.
	8	Myakka-Immokalee-Basinger association: Nearly level, poorly drained, sandy soils with weakly cemented sandy subsoil and poorly drained sandy soils throughout.
	26	Imokalee-Pomello association: Nearly level to gently sloping, poorly and moderately well drained, sandy soils with weakly cemented sandy subsoil.
	30	Wabasso-Bradenton-Myakka association: Nearly level, poorly drained, sandy soils with a weakly cemented sandy subsoil layer underlain by loamy subsoil; poorly drained soils with thin, sandy layers over loamy subsoil and poorly drained soils with weakly cemented sand subsoil.

Table 2.2 (continued) Descriptions of Soil Associations.

Area Definition	Map Unit No.	Soil Association Description
Areas dominated by moderately well to poorly drained soils not subject to flooding (continued)	35	Pomello-Paola-St. Lucie association: Nearly level to sloping, moderately well drained sandy soils with weakly cemented sandy subsoil and excessively drained soils, sandy throughout.
	36	Imokalee-Myakka-Pompany association: Nearly level, poorly drained, sandy soils with weakly cemented sandy subsoil and poorly drained soils, sandy throughout.
	37	Adamsville-Pompany association: Nearly level, somewhat poorly and poorly drained, soils, sandy throughout.
	38	Scranton, var.-Ona-Placid association: Nearly level, somewhat poorly drained, dark surface soils, sandy throughout; poorly drained soils with thin, sandy layers over weakly cemented sandy subsoil and very poorly drained soils, sandy throughout.
Areas dominated by poorly and very poorly drained soils subject to flooding	28	Pompano-Charlotte-Delray association: Nearly level, poorly drained soils, sandy throughout,and very poorly drained soils with thick sandy layers over loamy subsoil.
	31	Placid-Bassinger association: Nearly level, very poorly and poorly drained soils, sandy throughout.

Table 2.2 (continued) Descriptions of Soil Associations.

Area Definition	Map Unit No.	Soil Association Description
Areas dominated by poorly and very poorly drained soils subject to flooding (continued)	32	Delray-Manatee-Pompano association: Nearly level, very poorly drained soils with thick, sandy layers over loamy subsoil; very poorly drained sandy soils, with loamy subsoil and poorly drained soils, sandy throughout.
	33	Fresh Water Swamp and Marsh association: Nearly level, very poorly drained soils subject to prolonged flooding.
	34	Tidal Marsh and Swamp-Coastal Beach Ridges/Dune association: Nearly level, very poorly drained soils subject to frequent tidal flooding, high-lying coastal dune-like ridges and deep, droughty sands.
	39	Terra Ceia association: Nearly level, very poorly drained, well-decomposed, organic soils 40-91 cm (16-36 inches) thick over loamy material.

Utilities Regional Treatment Plant was completed and construction of Prestancia began during the fourth quarter of the second year of the monitoring program. Land uses adjacent to the ranch which are located upstream in the drainage basins of the ranch include golf courses, roads and highways, residential developments, commercial businesses, a dairy farm, and light industry.

The primary vegetation associations found on the ranch include pine flatwoods, improved and semi-improved pasture, wet prairies, marsh and sloughs, swamps, and wetland fringing hammocks.

2.4 Drainage

The North Tract of the Palmer Ranch is divided into six drainage basins which ultimately discharge into Little Sarasota Bay. Two basins, the Catfish Creek-Trunk Ditch Basin and the South Creek Basin, drain the majority of the North Tract. As shown in Figure 2.2, approximately 2,590 acres of the Catfish Creek - Trunk Ditch Basin which has a total drainage area of 3,700 acres and approximately 1,770 acres of the South Creek Basin which has a total drainage area of 12,000 acres are located on the North Tract. Four minor basins also drain portions of the property. These include Matheny Creek Basin (40 acres), Elligraw Bayou Basin (180 acres), North Creek Basin (460 acres), and Clower Creek Basin (80 acres). The primary streams of these basins are generally described in the following sections.

2.4.1 Catfish Creek

Catfish Creek is a meandering stream that flows southwest to the southern boundary of the property, intersecting Trunk Ditch at

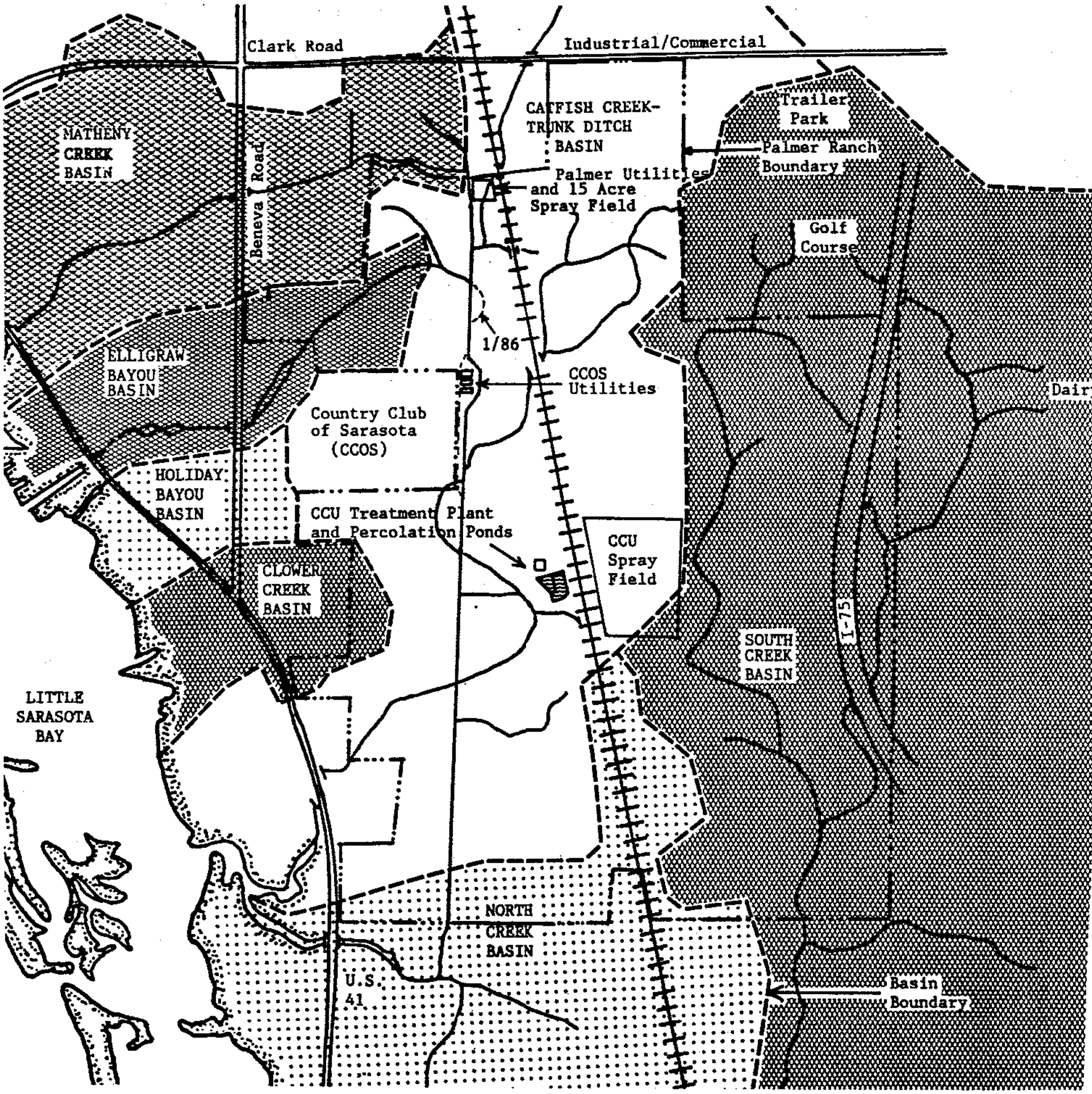


FIGURE 2.2
PALMER RANCH DRAINAGE BASINS

five locations. The upper reach of Catfish Creek receives off-site drainage from Clark Road and the adjacent commercial/industrial areas. Many of these commercial/industrial areas lack stormwater management systems.

On the Palmer Ranch, Catfish Creek receives drainage from an effluent disposal spray field operated by Palmer Utilities and a recently completed spray field which will be operated by the Central County Utilities Wastewater Treatment Facilities. However, neither of these two spray fields were actively used during the second year of the monitoring program. The remainder of the drainage into Catfish Creek originates in wetlands, pine flatwoods, and improved pasture.

Downstream of the Palmer Ranch, Catfish Creek receives drainage from residential areas including a mobile home park and runoff from U.S. Highway 41. Further downstream, Catfish Creek is subject to the tidal influences of Little Sarasota Bay.

2.4.2 Trunk Ditch

Trunk Ditch is a straight canal that was constructed by Sarasota County to improve drainage. During the fourth quarter of the second year of monitoring, Trunk Ditch underwent realignment in association with Prestancia construction. Trunk Ditch exhibits steep banks which are sparsely vegetated. However, its channel supports a large standing crop of Hydrilla, Elodea, cattail, and other aquatic weeds.

Trunk Ditch originates near the northern end of the property and flows south intersecting Catfish Creek at five locations. At the southern end of Trunk Ditch, it becomes contiguous with a dredged tributary of the North Creek Basin.

Runoff entering the upper reaches of Trunk Ditch originates along Clark Road and the adjacent commercial and industrial areas. Downstream, runoff enters Trunk Ditch from the Country Club of Sarasota including the golf course and contiguous residential area, as well as pine flatwoods, improved pastures, and wetlands of the Palmer Ranch.

Of significance, a sill (elevated streambed) exists in Trunk Ditch downstream of the last confluence with Catfish Creek. Consequently, its southernmost segment is subject to stagnation during dry periods when water levels and flows are minimal. During periods of low water, the flow in Trunk Ditch normally discharges into Catfish Creek. However, during periods of high water, Trunk Ditch discharges into both Catfish Creek and North Creek.

2.4.3 North Creek

North Creek is connected to Trunk Ditch by a dredged tributary located near the southern boundary of the North Tract. The banks of this tributary are vegetated with grasses, weeds, and trees resulting in a partially overhanging canopy. Most of the drainage into the tributary of North Creek originates in improved pasture, idle agricultural land, and a marsh/slough. Downstream of the North Tract, it enters the main channel of North Creek and subsequently discharges into Little Sarasota Bay. Residential areas, U. S. Highway 41, and pine flatwoods drain into the downstream reach of the North Creek Basin.

2.4.4 South Creek

South Creek is a meandering stream that has been partially channelized. The banks of South Creek are vegetated with grasses and occasional pines while its channel is generally void of aquatic vegetation as a result of county maintenance operations during 1984 (T. W. Goodell, personal communication). Upstream of the Palmer Ranch, South Creek receives drainage from a golf course, residential areas, I-75, and a large dairy. On the ranch, drainage enters South Creek primarily from improved pastures and pine flatwoods. Downstream of the North Tract, South Creek flows through the Oscar Scherer State Recreational Area and subsequently into the tidal waters of Little Sarasota Bay.

2.4.5 Elligraw Bayou

Elligraw Bayou is a channelized, minor stream that flows south-westerly to Little Sarasota Bay. The banks of Elligraw Bayou are moderately to steeply sloped and vegetated with grasses and trees. Some segments of Elligraw Bayou receive drainage from marshes, sloughs, and improved pasture. Downstream of the Palmer Ranch, Elligraw Bayou flows through Ballantrae and several other residential areas before entering Little Sarasota Bay.

2.4.6 Matheny Creek

Matheny Creek is a channelized stream that originates in the marshes and sloughs northwest of the Palmer Ranch. It flows southwest and eventually discharges into Little Sarasota Bay. The banks of Matheny Creek are steep and primarily vegetated with grasses. Drainage enters Matheny Creek from residential developments, commercial and industrial areas, and golf courses.

2.5 Water Quality Classification

The streams traversing the Palmer Ranch are freshwater and are designated by the State as Class III waters. Little Sarasota Bay is the receiving waters of these streams and is classified by the State as an Outstanding Florida Water (OFW). In addition, the segment of South Creek which flows through the Oscar Scherer Recreational Area is classified by the State as an OFW. Water quality standards applicable to the parameters of the surface water quality monitoring program are listed in Table 2.3.

Table 2.3 Applicable Water Quality Criteria

Parameter	State of Florida FAC 17-3	Sarasota County Ord. No. 72-37
Arsenic	Not > 50 ug/l	Not > 0.01 mg/l
BOD-5	Not to be increased in a manner that would depress Dissolved Oxygen levels below criteria.	Same as FAC 17-3
Cadmium	Not >0.8 ug/l in predominantly fresh waters with a hardness of less than 150 mg/l of $CaCO_3$. Not to exceed 1.2 ug/l in harder waters.	Not >0.01 mg/l
Chromium	Not > 50 ug/l	Not > 0.02 mg/l
Coliform, Fecal	Not > 800/100 ml	----
Coliform, Total	Not > 2,400/100 ml	Not > 2,400/100 ml
Conductivity	Shall not be increased 100% above background or to a maximum level of 500 uhmos/cm if the surface water is less than or equal to 500 umhos/cm. Shall not be increased more than 50% above background or to a maximum of 5,000 umhos/cm if the surface waters are equal to or greater than 500 umhos/cm yet less than 5,000 umhos/cm.	+100% above background, or to max. of 500 umhos/cm
Copper	Not > 30 ug/l	Not > 0.01 mg/l
Dissolved Oxygen	Not < 5 mg/l	Not < 4 mg/l
Lead	Not > 30 ug/l	Not > 0.01 mg/l
Mercury	Not > 0.2 ug/l	Not > 0.01 mg/l
Nickel	Not > 100 ug/l	Not > 0.1 mg/l
Nutrients	Concentrations in a body of water shall not be altered in such a manner as to cause an imbalance in natural populations of aquatic flora or fauna.	-----

Table 2.3 (continued) Applicable Water Quality Criteria

Parameter	State of Florida FAC 17-3	Sarasota County Ord. No. 72-37
Nitrogen, Ammonia (ionic plus non-ionic)	See Nutrients	Only applies to non-ionic Ammonia
Nitrogen, Nitrite	See Nutrients	-----
Nitrogen, Total	See Nutrients	-----
Nitrogen, Organic	See Nutrients	-----
Oil and Greases	Not > 5 mg/l	Not > 15 mg/l
Aldrin plus Dieldrin	Not > 0.003 ug/l	-----
alpha - BHC	-----	-----
beta - BHC	-----	-----
delta - BHC	-----	-----
gamma - BHC (Lindane)	Not > 0.01 ug/l	-----
Chlordane	Not > 0.01 ug/l	-----
4,4' DDD	-----	-----
4,4'-DDE	-----	-----
4,4'-DDT	Not > 0.001 ug/l	-----
Endosulfan	Not > 0.003 ug/l	-----
Endrin	Not > 0.004 ug/l	-----
Heptachlor	Not > 0.001 ug/l	-----
Toxaphene	Not > 0.005 ug/l	-----
Polychlorinated Biphenyls	Not > 0.001 ug/l	-----

Table 2.3 (continued) Applicable Water Quality Criteria

Parameter	State of Florida FAC 17-3	Sarasota County Ord. No. 72-37
Phosphate, Ortho	See Nutrients	-----
Phosphate, Total	See Nutrients	-----
pH	6 - 8.5	6 - 8.5
Solids, Total Suspended	-----	-----
Turbidity	Not > 29 NTU above background	Not > 25 JTU above background
Zinc, as Zn	Not > 30 ug/l	Not > 0.01 mg/l

3.0 FIELD AND LABORATORY PROCEDURES

3.1 Station Locations and General Descriptions

The Continuing Surface Water Quality Monitoring Program employed a network of 13 sampling stations located at various sites along South Creek, Catfish Creek, Elligraw Bayou, Trunk Ditch, and North Creek during the second annual monitoring period of April, 1985 - March, 1986 (Figure 3.1). Table 3.1 describes the general characteristics of the 13 sampling stations.

South Creek was monitored at five locations. These included two points of inflow (SC-3 and SC-7) as well as one point of outflow (SC-2) from the North Tract. South Creek was also monitored within the North Tract (Stations SC-4 and SC-1) and at a point downstream of the development site (Station SC-8).

In Catfish Creek, inflow into the North Tract was monitored at Station CC-1 while outflow was monitored at Station CC-5. Two tributaries of Catfish Creek were also monitored near their confluences with the main channel of Catfish Creek (Stations CC-2 and CC-3).

Trunk Ditch was monitored at a point immediately downstream of Prestancia which began construction during the fourth quarter, i.e. Station CC-4, and further downstream at the juncture with the North Creek Basin, i.e. Station NC-6.

Elligraw Bayou was monitored near its point of outflow from the North Tract at Station EL-1. However, there was no monitoring of Matheny Creek during the second year of the program.

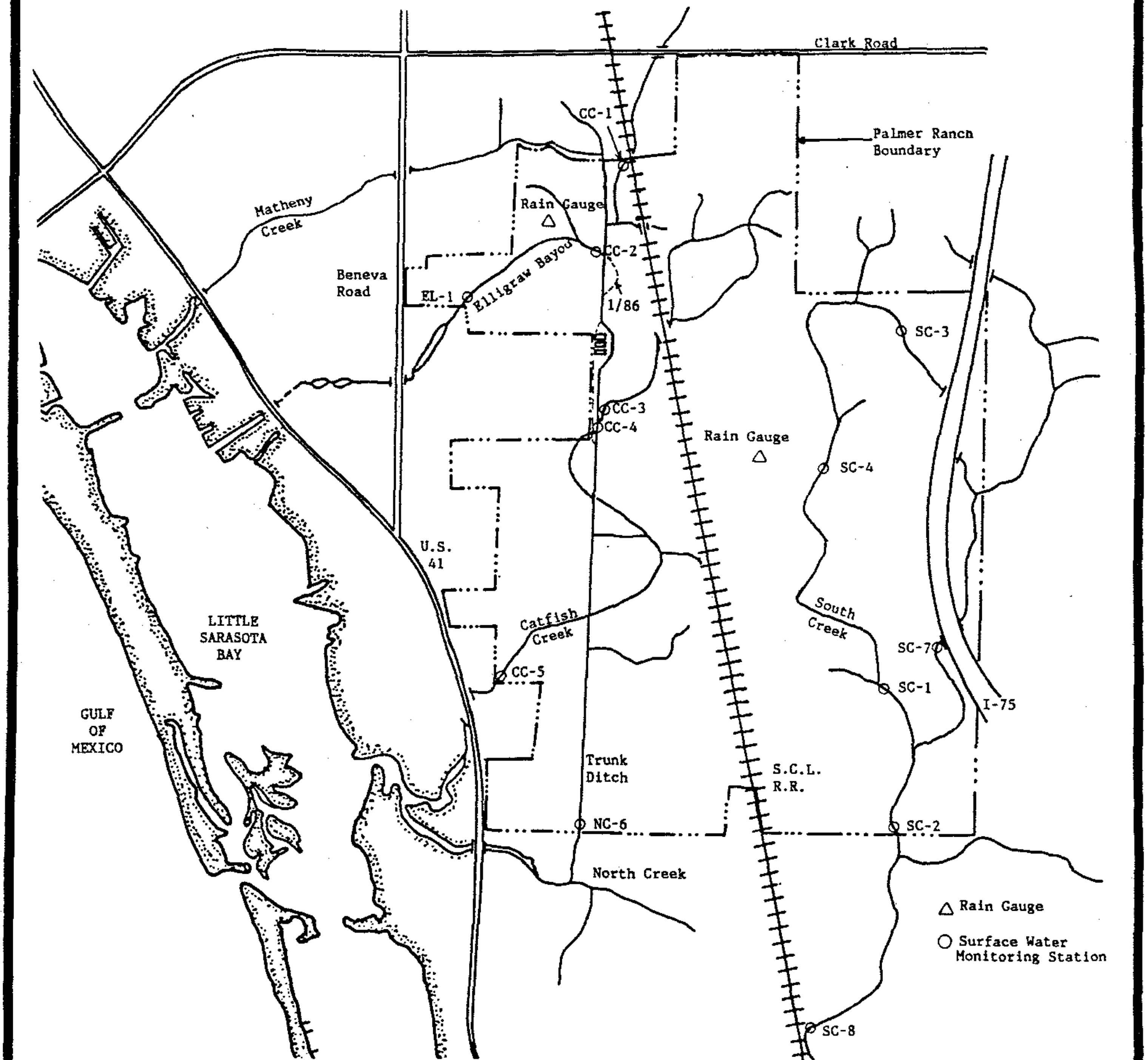


FIGURE 3.1
LOCATIONS OF MONITORING STATIONS AND RAIN GAUGES

Table 3.1. General Descriptive Characteristics of Each Surface Water Quality Sampling Station.

Station	General Location	Water Depth (ft)[a]	Channel Width (ft)	Habitat
CC-1	Catfish Creek Site entry	0.6-1.6	4	Aquatic Vegetation Incised Banks
CC-2	Catfish Creek near Elligraw Confluence	0.8-1.2	12	Aquatic Vegetation Shallow sloped Banks
CC-3	Catfish Creek Upstream of Trunk Ditch	0.8-1.5	6	Aquatic Vegetation Incised Banks
CC-4[b]	Trunk Ditch Downstream of Catfish Creek confluence	0.8-0.9	4/ 12	Filled with Vegetation/ No Vegetation
CC-5	Catfish Creek Outfall from Site	0.4-0.9	8	Aquatic Vegetation
NC-6	Trunk Ditch Downstream of Catfish Creek	1.5-1.9	12	Aquatic Vegetation
El-1	Elligraw Bayou near Site exit	0.0-0.6	6	Aquatic Vegetation
SC-1	South Creek mid-property	0.6	12	Sand covered with organic matter
SC-2	South Creek at Site exit	0.4-1.0	8	Sand bottom some vegetation
SC-3	South Creek outfall from large wetland	0.0-1.2	6	Shallow banks Aquatic Vegetation

Table 3.1.(continued)

General Descriptive Characteristics of Each Surface Water Quality Sampling Station.

Station	General Location	Water Depth (ft)[a]	Channel Width (ft)	Habitat
SC-4	South Creek near Honore Avenue	0.4-0.5	5	Pine straw debris
SC-7	South Creek near I-75 downstream of Dairy	0.3-0.5	4	Sand bottom Organic matter
SC-8	South Creek upstream of Oscar-Scherer Recreational Area	2.0-2.8	10	Aquatic Vegetation Incised Banks

[a]Range in Depth recorded during monitoring period of September, 1985 - March, 1986.
[b]Conditions before/after Trunk Ditch reconstruction

3.2 Parameters and Sampling Frequency

Sampling was attempted at all 13 stations on a quarterly basis during the second annual monitoring period of April, 1985 - March, 1986. During the first quarter (April-June) the effects of the extended drought precluded several attempts to acquire water quality samples (Goodell, 1985). However, successful sampling events were performed during the remainder of the second year of monitoring. With the exception of dry conditions during December, 1985, in the upper reaches of Elligraw Bayou (at Station EL-1) and in the upper reaches of South Creek (at Station SC-3), all 13 stations were successfully sampled at the end of the second, third, and fourth quarters. The dates and times of all sample collections are given in Table 3.2.

The monitoring program acquired water quality data by: (1) *in situ* measurements and (2) grab sampling and laboratory analyses. Stream flow was also measured as a supplementary parameter during the third and fourth quarterly events. A digital readout Hydrolab Series 4000 was used for *in situ* measurements of dissolved oxygen, pH, specific conductance, and water temperature. Prior to deployment in the field, the Hydrolab was calibrated according to the manufacturer's recommended procedures. All *in situ* measurements were taken at approximate mid-depth at each station.

Surface water quality samples were collected as grab samples at approximate mid-depth and returned to the laboratory for analyses. With the exception of the aforementioned dry conditions,

Table 3.2 Date and Time of Sampling for Second Annual Monitoring Period of April, 1985 - March, 1986.

Event No.	Date of Sampling	EL-1	CC-1	CC-2	CC-3	CC-4	CC-5	NC-6	SC-1	SC-2	SC-3	SC-4	SC-7	SC-8
1	April-June[a]	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
2	09/16/85	0825	0908	0848	0753	0735	1007	0938	1146	1130	1250	1230	1205	1051
3	12/11/85	dry	1303	1249	1231	1212	1140	0935						
	12/12/85								0948	0857	dry	1053	1008	0810
4	03/26/86	1152	1248	1234	1104	1114	1012	0948						
	03/27/86								1142	1054	1312	1245	1214	1002

[a]Refer to first quarter report prepared by T.W. Goodell (December, 1985)

water samples were collected at all stations, i.e., whenever water was present. Following quarterly collections, water samples were preserved, as specified by the analytical procedures, and returned to the laboratory for analyses of the required parameters as listed in Table 3.3. In addition, an annual audit of the organochlorine pesticides and the trace metals listed in Table 3.3 was performed during September, 1985.

All laboratory analyses were performed in accordance with the procedures described in the sixteenth edition of Standard Methods (APHA, 1985), Methods for Chemical Analysis of Water and Wastes (USEPA, 1983) or the Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater (USEPA, 1982). Laboratory analyses were performed by the CCI laboratory except for pesticide scans, oils and greases, arsenic, and mercury which were performed by a contract laboratory. Copies of the data reports provided by the contract laboratory are given in Appendix B.

In association with water quality measurements and grab sampling, measurements of stream stage and stream flow were taken at each station as an aid in evaluating the water quality data. Stream flow was measured beginning in December, 1985, by the use of the salt dilution method described by the USGS (1982). Measurements of water depth were initiated in September, 1985, using a fiberglass tape positioned at the deepest cross-sectional point of the stream where all water quality measurements and samples were taken.

Table 3.3 Collection and Analytical Methods

Parameter	Collection	Field Handling	Hold Time	Laboratory Handling	Analytical Method	Method Reference
Bacteria, Fecal Coliform	Grab	Stored on Ice	8 Hours	Immediate Analysis	Membrane Filter	APHA 909C
Bacteria, Total Coliform	Grab	Stored on Ice	8 Hours	Immediate Analysis	Membrane Filter	APHA 909A
Biochemical Oxygen Demand (BOD-5 Day)	Grab	Stored on Ice	6 Hours	Immediate Analysis	Titration - Modified Winkler	APHA 507
Conductivity	In situ	---	---	---	Hydrolab	Manufacturer's Specifications
Oxygen, Dissolved	In situ	---	---	---	Hydrolab	Manufacturer's Specifications
Nitrogen, Ammonia (ionized + non-ionized)	Grab	Acidified to pH <2, Stored on Ice	7 Days	Stored at 4°C	Distillation, Colorimetric - Nesslerization	APHA 417A,B
Nitrogen, Nitrate	Grab	Stored on Ice	48 Hours	Immediate Analysis	Colorimetric - Brucine	EPA 352.1
Nitrogen, Nitrite	Grab	Stored on Ice	48 Hours	Immediate Analysis	Colorimetric - Diazotization	EPA 354.1
Nitrogen, Total Kjeldahl[a]	Grab	Acidified to pH <2, Stored on Ice	7 Days	Stored at 4°C	Digestion/ Distillation, Colorimetric - Nesslerization	APHA 420A
Nitrogen, Total	Grab	Acidified to pH <2, Stored on Ice	7 Days	Stored at 4°C	Calculation	APHA 416
Oil And Grease	Grab	Acidified to pH <2, Stored On Ice	28 Days	Stored at 4°C	Gravimetric	EPA 413.1

Table 3.3 (continued) Collection and Analytical Methods

Parameter	Collection	Field Handling	Hold Time	Laboratory Handling	Analytical Method	Method Reference
pH	In situ	---	---	---	Hydrolab	Manufacturer's Specifications
Phosphate, Ortho, Dissolved	Grab	Stored on Ice	48 Hours	Immediate Analysis	0.45u Filtration, Colorimetric - Ascorbic Acid	EPA 365.2
Phosphate, Total	Grab	Acidified to pH <2, Stored on Ice	28 Days	Stored at 4°C	Persulfate Digestion, Colorimetric - Ascorbic Acid	EPA 365.2
Solids, Total Suspended (TSS)	Grab	Stored on Ice	7 Days	Stored at 4°C	Glass Fiber Filtration, Dried at 105°C	APHA 209C
Temperature	In situ	---	---	---	Hydrolab	Manufacturer's Specifications
Turbidity (NTU)	Grab	Stored on Ice	24 Hours	Immediate	Nephelometric	APHA 214A
Arsenic, Total	Grab	Acidified to pH <2, Stored on ice	6 Months	Stored at 4°C	Digestion, Furnace Technique Atomic Absorption	EPA 206.2
Cadmium, Total	Grab	Acidified to pH <2, Stored on Ice	6 Months	Stored at 4°C	Digestion/ PDCA Extraction, Atomic Absorption	EPA 213.1
Chromium, Total	Grab	Acidified to pH <2, Stored on Ice	6 Months	Stored at 4°C	Digestion/ PDCA Extraction, Atomic Absorption	EPA 218.1

Table 3.3 (continued) Collection and Analytical Methods

Parameter	Collection	Field Handling	Hold Time	Laboratory Handling	Analytical Method	Method Reference
Copper, Total	Grab	Acidified to pH <2, Stored on Ice	6 Months	Stored at $4^{\circ}C$	Digestion, Atomic Absorption	EPA 220.1
Lead, Total	Grab	Acidified to pH <2, Stored on Ice	6 Months	Stored at $4^{\circ}C$	Digestion/ PDCA Extraction, Atomic Absorption	EPA 239.1
Mercury, Total	Grab	Acidified to pH <2, Stored On Ice	28 Days	Stored at $4^{\circ}C$	Digestion, Cold Vapor Method	EPA 245.1
Nickel, Total	Grab	Acidified to pH <2, Stored on Ice	6 Months	Stored at $4^{\circ}C$	Digestion, Atomic Absorption	EPA 249.1
Zinc, Total	Grab	Acidified to pH <2, Stored on Ice	6 Months	Stored at $4^{\circ}C$	Digestion, Atomic Absorption	EPA 289.1
Pesticides, Organochlorine	Grab	Stored On Ice	7 Days	Stored at $4^{\circ}C$	Gas Chromatograph	EPA 608

[a]Total Kjeldahl Nitrogen is comprised of ammonia-nitrogen plus organic nitrogen

4.0 RESULTS AND DISCUSSION

The results of the Continuing Surface Water Quality Monitoring Program for the second year of monitoring (April, 1985 - March, 1986) are tabulated in Appendix A. The acquired data are organized by parameter according to sampling location, sampling episode, mean, range, standard deviation, and number of observations (N).

4.1 Rainfall and Hydrology

4.1.1 Rainfall

The second year of monitoring occurred during a dry period in which only 33 inches of rainfall was recorded on the North Tract of the Palmer Ranch. As discussed in Section 2.1 Climate, the average amount of rainfall expected is 56 inches/year based on a 30-year period of record (NOAA, 1977). Figure 4.1 provides a comparison of the monthly distribution of rainfall measured on the Palmer Ranch during the second year of monitoring to the distribution of historical rainfall for the 30-year period of record.

As given in Table 4.1, the seasonal amounts of rainfall recorded on-site during the first and second quarters were 6.44 and 15.60 inches, respectively. During the third and fourth quarters, 3.54 and 7.87 inches were recorded, respectively. This temporal trend follows the normal occurrence of the wet season which typically occurs during June, July, August, and September and the normal occurrence of the dry season which typically occurs during October, November, and December. Coincidentally, the second

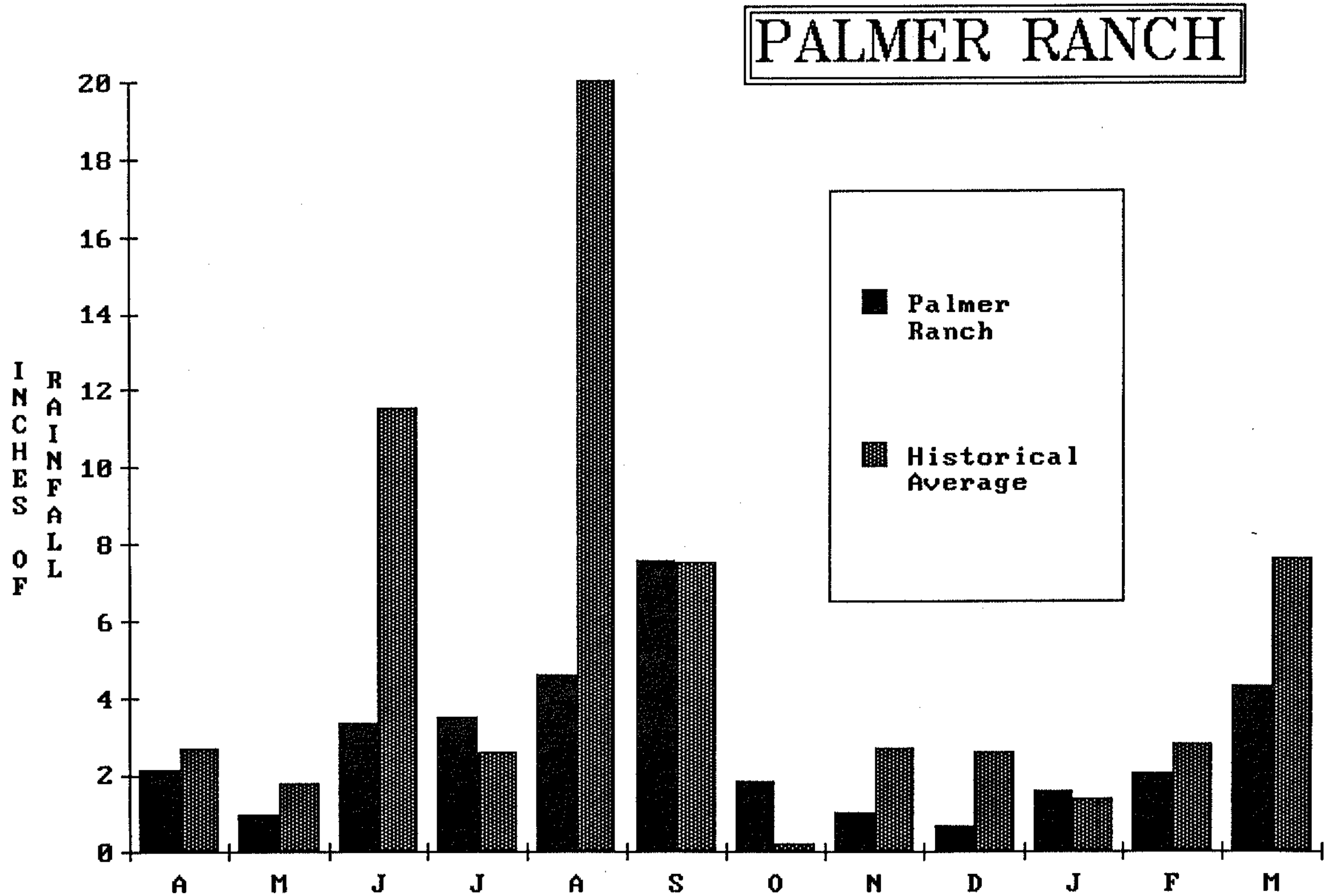


Figure 4.1 Historical vs. Rainfall Recorded on the Palmer Ranch 1985–1986

Table 4.1 Rainfall Recorded on the Palmer Ranch during the Period of April, 1985 through March, 1986.

	Rainfall (inches)		
Date	Monthly	Seasonal	Pre-event[a] Rainfall
April, 1985	2.14		
May, 1985	0.98		
June, 1985	3.32		----
Spring		6.44	
July, 1985	3.48		
August, 1985	4.59		
September, 1985	7.53		0.63
Summer (wet season)		15.60	
October, 1985	1.82		
November, 1985	1.04		
December, 1985	0.68		0.68
Fall (dry season)		3.54	
January, 1986	1.57		
February, 1986	2.03		
March, 1986	4.27		4.27
Winter		7.87	
Year		33.45	

[a]Antecedant rainfall during the 5-day period prior to each quarterly event

quarterly sampling event was performed at the end of the summer wet season and the third quarterly sampling event was performed at the end of the fall dry season.

Rainfall accumulations during the 5-day antecedent periods prior to each quarterly sampling event are given in Table 4.1. Prior to the second and third quarterly events (September, 1985, and December, 1985), only 0.63 and 0.68 inches of antecedent rainfall were recorded on the Palmer Ranch, respectively. However, 4.27 inches of rainfall were recorded during the 5-day period prior to the fourth quarterly event (March, 1986).

4.1.2 <u>Stream Stage</u>

Measurements of the maximum cross-sectional depth at each sampling station during the second, third, and fourth quarterly events are tabulated in Appendix Table A-1.

As previously mentioned, the first quarterly sampling event was not performed due to dry conditions resulting from the extended drought. During the second quarter which coincided with the normal occurrence of the wet season, the stream channels became inundated with water. As evidenced by the results given in Appendix Table A-1, stream stages ranged 0.3 - 2.75 feet on September 16, 1985. During the third quarter which coincided with the normal occurrence of the dry season, water levels declined as evidenced by the lower range in stream stage of 0.0 - 2.0 feet recorded on December 11 and 12, 1985. As previously noted, two upstream stations (EL-1 and SC-3) exhibited dry stream beds during the third quarterly survey. During the fourth quarter, stream water levels increased as a result of increased rainfall which was particularly heavy during the 5-day antecedent period prior to the sampling event. Water levels recorded on March 26 and 27, 1986, ranged 0.4 - 2.1 feet.

As expected, the lowest recorded water levels occurred during the dry third quarter although even lower unrecorded water levels probably occurred during the first quarter as a result of the drought which extended through June, 1985. The highest water levels occurred during the wet second quarter.

The shallowest stations were found in Elligraw Bayou (Station EL-1) and in South Creek (Station SC-7), whereas the deepest stations were found at the juncture of Trunk Ditch with the North Creek Basin (Station NC-6) and in South Creek downstream of the North Tract (Station SC-8). Stations EL-1 and SC-7 exhibited the shallowest average depths of 0.37 and 0.38 feet whereas Stations NC-6 and SC-8 exhibited the deepest average depths of 1.77 and 2.28 feet, respectively.

4.1.3 Stream Flow

As shown in Appendix Table A-2 measurable flows were only recorded in 12 of the 26 total observations during the third and fourth quarterly surveys. Although flow was not measured during the first and second quarters, it is assumed that there was no stream flow during the first quarter due to little or no incoming drainage during the drought but that intermittent stream flow occurred during the second quarter in response to increased stormwater runoff during the wet season. During the third and fourth quarterly surveys, no-flow conditions were noted in Catfish Creek at Stations CC-2 and CC-3 and in Trunk Ditch at its juncture with the North Creek Basin at Station NC-6. As previously discussed, Station SC-3 in South Creek exhibited a dry stream bed during the third quarterly survey (December, 1985) and a no-flow condition during the fourth quarterly survey (March, 1986). In comparison, flowing conditions were observed during both the third and fourth quarterly surveys at Station CC-5 in Catfish Creek and at Stations SC-2 and SC-4 in South Creek.

In Catfish Creek, recorded stream flows ranged 0 - 37 gpm in its upper reaches (CC-1 and CC-2), 0 - 39 gpm in its mid reach (CC-3 and CC-4), and 221 - 569 gpm at the point of outflow from the North Tract (CC-5) during the third and fourth quarters. During this same period, South Creek exhibited a range in recorded flow of 0 - 123 gpm in its upper reaches and 0 - 190 gpm in its mid reach. Less flow was observed in Elligraw Bayou (EL-1) as the observed flow ranged 0 - 15 gpm. Similar but no-flow conditions were observed at the juncture of Trunk Ditch with the North Creek Basin (NC-6).

As shown in Appendix Table A-2, stream flows during the third quarterly survey were generally lower than during the fourth quarterly survey. These differences are attributed to the effects of the dry fall season when rainfall and stream stage were minimal. As evidenced by the stage and stream flow data, it is apparent that some of the stream beds exhibit sills or bottom irregularities that caused no-flow conditions during periods of low water. Such conditions were prevalent at Station NC-6 where the southern-most end of Trunk Ditch joins the North Creek Basin.

4.2 Physical Water Quality Parameters

4.2.1 Water Temperature

Appendix Table A-3 presents the results of surface water temperature measurements recorded during the second, third, and fourth quarterly surveys. Although temperatures in the streams of the North Tract were found to range from 17.7 to 28.5°C it is likely that lower water temperatures occurred during the middle of the winter quarter and higher water temperatures occurred during the middle of the summer quarter. During the second year of monitoring, however, sampling events were performed at the end of each season (quarter) when temperature extremes are not expected (refer to Table 2.1).

During the fall dry season, CCI (1985) monitored water temperatures at 15-minute intervals for a period of 24 hours in Catfish Creek and South Creek to satisfy the diurnal monitoring requirements of the MDO. Results of the diurnal monitoring program showed that daily changes in water temperatures averaged 3 - 9°C and followed an expected pattern of morning lows and afternoon highs.

4.2.2 Specific Conductance

As evidenced in Appendix Table A-4, the streams of the North Tract exhibited a range in specific conductance of 413 - 1,809 micromhos per centimeter (umhos/cm). The lowest conductivities as noted in the range of 413 - 1,136 umhos/cm, were recorded during the second quarterly survey which was performed at the end of the summer wet season. These minimal conductivities most likely resulted from the cumulative effects of increased surface runoff of low conductivity stormwater during the summer wet season. In comparison, the highest conductivities of 740 - 1,809 umhos/cm were recorded during the third quarterly survey which was performed at the end of the fall dry season when there was little runoff of low conductivity stormwater. As a result, conductivities increased in association with net evaporation and the seepage of higher conductivity groundwater into the streams. During the fourth quarterly survey which was performed in March, 1986, the streams exhibited a range in conductivity of 726 - 1,298 umhos/cm, slightly lower than the range recorded during December, 1985. Perhaps the decrease in conductivities resulted from the approximately 4 inches of rainfall which occurred during the 5-day antecedent period prior to the fourth quarterly sampling event.

In a comparison of streams within the Palmer Ranch, South Creek exhibited higher conductivities than the other three streams during the second year of monitoring. Likewise, South Creek exhibited higher conductivities than the other streams during the first year of monitoring (Palmer Venture, 1986). During the second year, conductivities averaged 1,166 umhos/cm in South Creek while conductivities in Catfish Creek and Trunk Ditch averaged 791 umhos/cm. An average conductivity of 739 umhos/cm was recorded at the Trunk Ditch juncture with the North Creek Basin while conductivity in Elligraw Bayou averaged 873 umhos/cm.

Within the two major basins of the North Tract, there were no apparent spatial trends observed in conductivity although a declining trend might have occurred upstream of the North Tract (Appendix Table A-4). In Catfish Creek and Trunk Ditch, conductivities in the upper reaches averaged 720 umhos/cm, slightly less than in the mid and lower reaches which averaged 862 and 791 umhos/cm, respectively. In the South Creek Basin, upstream conductivities averaged 1,230 umhos/cm as compared to slightly lower mid-reach conductivities which averaged 1,043 umhos/cm.

During the first year of the monitoring program, Palmer Venture (1986) reported a wide range in conductivity of 463 - 1,250 umhos/cm although lower than the range observed during the second year of monitoring. The higher conductivities observed during the second year most likely culminated from the aftereffect of the extended drought.

In comparing and evaluating background levels with respect to the applicable State criteria, it is important to note that the 500 umhos/cm threshold which separates the double standard for specific conductance was frequently exceeded. The specific conductance criteria generally applicable to the streams of the Palmer Ranch allows an increase of not more than 50 percent above background levels to a maximum level of 5,000 umhos/cm. The criteria applicable to background levels below 500 umhos/cm allows a 100 percent increase in conductivity up to a maximum level of 500 umhos/cm. The latter criteria is expected to be more applicable during periods of sustained rainfall, e.g., wet years.

The Sarasota County criteria for specific conductance (Ordinance No. 72-37) is similar to the State criteria in that it allows a maximum of a 100 percent increase above background, or to a maximum level of 500 umhos/cm in freshwater streams. Therefore, the streams of the Palmer Ranch were generally out of compliance with the County criteria since they are considered to be freshwater.

4.2.3 <u>Total Suspended Solids</u>

During the second year of monitoring, the streams of the Palmer Ranch exhibited a wide range in total suspended solids (TSS) of 1 mg/l to 207 mg/l and a yearly average of approximately 24 mg/l (Appendix Table A-5). The highest TSS levels were recorded at various stations in Catfish Creek (CC-3), Trunk Ditch (CC-4), and Elligraw Bayou (EL-1). Construction activities associated with Prestancia including the realignment of Trunk Ditch occurred during the fourth quarter and apparently increased the TSS levels in a mid-reach segment of Trunk Ditch (CC-4).

During September, 1985, the highest levels of TSS occurred throughout the streams of the North Tract most likely as a result of high rates of runoff and transport of particulates. During September, 1985, TSS averaged 31 mg/l while quarterly rainfall peaked at 15.6 inches. In comparison, TSS declined to an average of approximately 17 mg/l during December, 1985, and 13 mg/l during March, 1986. Rainfall accumulations during the respective quarters were also low as 3.54 and 7.87 inches were recorded. Although 4.27 inches of rainfall were recorded during a 5-day period prior to the fourth quarterly survey, the effects of elevated mass loads of particulates were not evident except in Trunk Ditch which was undergoing realignment. The effects of the construction in Trunk Ditch and perhaps the adjacent construction of Prestancia were apparent at Station CC-4 where a high TSS level of 91 mg/l was recorded during March, 1986. Further downstream, however, the effects were not observed as a low TSS level of 1 mg/l was recorded at Station CC-5 during March, 1986.

TSS was reported to be lower during the first year of the monitoring program (Palmer Venture, 1986) as the streams exhibited a range of approximately 1 - 12 mg/l. The difference between the first and second year is not completely understood although it could be partly attributed to the effects of the extended drought during the first half of the first year and the effects of construction during the last quarter of the second year. The drought which occurred during six months of the first year as compared to only three months of the second year might have minimized stormwater loading rates of TSS to a greater extent during the first year than during the second year. In addition, construction activities which could have increased TSS loading rates only occurred during the second year of the monitoring program.

4.2.4 Turbidity

Stream turbidities were found to increase from an average level of 6 NTU during September, 1985, to an average level of 13 NTU during December, 1985, (Appendix Table A-6). In March, 1986, a similar average of 11 NTU was recorded. Although turbidity did not exhibit a direct correlation with the amount of seasonal rainfall as might be expected, there is evidence that turbidity increased in various segments of the streams during periods of no-flow or stagnation. Such conditions favor the decay of vegetation and most likely the accumulation of dissolved organic decay products which could affect turbidity. Palmer Venture (1986) noted a similar occurrence of decaying vegetation when flows declined during the first year of monitoring.

Overall, the streams traversing the North Tract exhibited a range in turbidity of approximately 1 to 61 NTU with an average of 10 NTU during the second year of the monitoring program (Appendix Table A-6). In comparison, Palmer Venture (1986) reported much lower turbidities (< 6 NTU) during the first year of monitoring although sampling was not performed when there was no apparent flow. Therefore, conditions which were found conducive to high turbidity during the second year of monitoring were not documented during the first year of monitoring. During the second year, samples were collected at all stations unless the streams were dry. Therefore, the difference in sampling procedures between the first and second years of monitoring might partly explain the difference in the turbidity results.

The General Criteria for all surface waters (F.A.C. 17-3) specifies that turbidity shall not exceed 29 NTU's above natural background. Based on turbidity measurements taken during the first and second year of the monitoring program, background turbidity levels are expected to be less than 10 NTU except during periods of no-flow when they are subject to higher levels. During March, 1986, however, a turbidity level of 61 NTU was recorded in Trunk Ditch at Station CC-4. As previously discussed (refer to Section 4.2.3), construction activities including the realignment of Trunk Ditch which began during the fourth quarter caused an increase in TSS and most likely the increase in turbidity. Therefore, the turbidity level of 61 NTU observed in Trunk Ditch during March, 1986, is considered a violation.

The turbidity criteria specified in the Sarasota County Ordinance (No. 72-37) allows a maximum increase of 25 Jackson units above background. Analysis of turbidity samples, however, were performed in accordance with F.A.C. 17-3 criteria which is based on the Nephelometric procedure. Therefore, a comparison to the County criteria was not performed.

4.3 Oxygen Demand and Related Parameters

4.3.1 <u>Biochemical Oxygen Demand</u>

As shown in Appendix Table A-7, the 5-day biochemical oxygen demand (BOD) recorded in the streams of the North Tract averaged approximately 4 mg/l during the second year of the monitoring program. The two largest streams, South Creek and Catfish Creek, exhibited similar BOD levels during September, 1985, December, 1985, and March, 1986. South Creek exhibited an average level of approximately 3.1 mg/l with a range of 1 - ~ 13 mg/l and Catfish Creek exhibited an average level of approximately 3.8 mg/l with a range of 0.4 - 9.3 mg/l. Higher BODs were observed in Elligraw Bayou and at the Trunk Ditch juncture with the North Creek Basin as both averaged approximately 8 mg/l. According to Hynes (1966), BODs of 3 mg/l are indicative of "fairly clean" water and BODs of 8 mg/l are indicative of poor quality water.

During the first year of monitoring, Palmer Venture (1986) reported an overall range in BOD of 1.2 - 8.9 mg/l. Catfish Creek and Trunk Ditch exhibited a range of 1.2 - 6.5 mg/l, and South Creek exhibited a range of 1.4 - 8.9 mg/l. In Elligraw Bayou and at the Trunk Ditch-North Creek juncture, BOD was reported to range 2 - 6 mg/l during the first year of monitoring.

The General Criteria for BOD in all surface waters as designated by the F.A.C. 17-3, Rules and Regulations of the Department of Environmental Regulation, as well as Sarasota County Ordinance No. 72-37, specifies that BOD shall not be increased to levels that would result in violations of dissolved oxygen. BODs recorded in the streams traversing the North Tract occasionally exceeded 5 mg/l, a threshold level which Hynes (1966) considered to be between "fairly clean" and "bad" water quality. During the second year of monitoring, 9 of the 37 BOD measurements exceeded 5 mg/l. Furthermore, it is possible that BODs in excess of 5 mg/l during periods of low flow and stagnation caused a significant lowering of dissolved oxygen levels, perhaps to non-compliance levels. Such conditions are suspected to have occurred in Elligraw Bayou (EL-1) and Trunk Ditch (CC-4 and NC-6) during the second year of monitoring and, therefore, might have been out of compliance with the General Criteria for BOD.

4.3.2 Dissolved Oxygen

Appendix Table A-8 gives the results of dissolved oxygen measurements acquired during the second year of monitoring. In general, the streams traversing the North Tract were found to be heterotrophic as evidenced by the low dissolved oxygen levels recorded during September, 1985, December, 1985, and March, 1986. Overall, dissolved oxygen was found to average 4.0 mg/l with a range of 0.4 - 12.4 mg/l. During September, 1985, dissolved oxygen averaged 2.4 mg/l as compared to averages of 4.3 and 5.4 mg/l during December, 1985, and March, 1986, respectively. The slight increase in dissolved oxygen observed during December, 1985, and March, 1986, is attributed to the seasonal cooling of fall and winter temperatures resulting in increased oxygen solubilities and possibly reduced rates of microbial heterotrophy, i.e., reduced rates of oxygen consumption.

During the fall dry season, CCI (1985) performed a diurnal dissolved oxygen survey of Catfish Creek and South Creek pursuant to the conditions of the MDO. Results of the diurnal survey showed that dissolved oxygen exhibited a wide diurnal variation in South Creek and Catfish Creek. In the lower reach of Catfish Creek and in the upper reach of South Creek, dissolved oxygen changes of 9.5 and 11.7 mg/l were recorded during a diurnal cycle. At the other four stations surveyed, diurnal variations were found to be less than 6 mg/l. As expected maximal dissolved oxygen levels were generally recorded late in the photoperiod while minimal dissolved oxygen levels were generally recorded at dawn. Such wide ranging diurnal trends are characteristic of high rates of community metabolism.

During the first year of monitoring (Palmer Venture, 1986), most of the streams of the North Tract exhibited low levels of dissolved oxygen as 22 of the 38 total measurements recorded were less than 4 mg/l. Furthermore, the yearly range of dissolved oxygen was reported to be 0.4 - 14 mg/l.

The oxygen regime in the streams of the North Tract ranged well below the 5 mg/l threshold specified by F.A.C. 17-3 and the 4 mg/l threshold specified by Sarasota County for predominantly freshwaters. Additionally, these criteria specify that normal daily and seasonal fluctuations be maintained as depicted by the diurnal surveys (CCI, 1985). Consequently, the North Tract streams were frequently out of compliance with both State and County criteria for dissolved oxygen.

4.3.3 pH

Results of pH monitoring are given in Appendix Table A-9. During the second year, the streams of the Palmer Ranch exhibited pH levels in the range of 6.0 - 8.1. As with dissolved oxygen, the average pH level during September, 1985, was less than observed during December, 1985, or during March, 1986. Similar to dissolved oxygen trends, the lowest pH levels (6.2) were recorded at the juncture of Trunk Ditch and the North Creek Basin, whereas the highest pH levels (7.5) were recorded in the lower reach of Catfish Creek at Station CC-5. These correlations of pH and dissolved oxygen are expected and are indicative of the effects of community metabolism on the level of carbon dioxide and consequently pH. During periods of net community respiration, carbon dioxide is produced faster than it is assimilated by the primary producers, thereby depressing pH as a result of its reaction with water to form carbonic acid. In contrast, carbon dioxide is consumed faster than it is produced during periods of net community primary production, thereby increasing pH.

In a diurnal survey of Catfish Creek and South Creek which was conducted during the fall dry season, CCI (1985) reported changes in pH similar to the diurnal trend observed in dissolved oxygen. During the day, Catfish Creek and South Creek exhibited changes in pH ranging up to a 1.8 unit increase. As observed with dissolved oxygen, maximal diurnal changes in pH were recorded in the lower reach of Catfish Creek and in an upper reach of South Creek.

During the first year of monitoring, Palmer Venture (1986) reported a range in pH of 6.3 - 8.4 for the streams of the Palmer Ranch. These results are similar to the results reported during the second year of monitoring.

As specified in the General Criteria for all surface waters (F.A.C. 17-3) and similarly in the Sarasota County Ordinance No. 72-37, the allowable variation in pH is 1.0 unit above or below the normal pH provided that the pH is not lowered or elevated outside the range of 6 to 8.5. Additionally, if natural background is less than 6, the pH shall not vary below the natural background or vary more than one unit above natural background. Similarly, if natural background is above 8.5, pH shall not vary above natural background or vary more than one unit below background. During the second year of monitoring, the observed range in pH (6.0 - 8.1) fell within the allowable range of 6 - 8.5 in the streams of the Palmer Ranch, and therefore, all measurements taken during the second year were in compliance with the applicable criteria for pH.

4.4 Macronutrients

4.4.1 Total Nitrogen

Appendix Table A-10 provides the results of total nitrogen measurements acquired during the second year of monitoring. As evidenced in the data, Elligraw Bayou exhibited higher total nitrogen levels than observed in the other streams of the North Tract. In Elligraw Bayou, total nitrogen levels averaged 7.5 mg/l (as N) while lower averages were observed in South Creek (2.8 mg/l), Catfish Creek (1.9 mg/l), and at the Trunk Ditch juncture with the North Creek Basin (1.7 mg/l). Overall, total nitrogen levels averaged 2.6 mg/l during the second year of monitoring.

A general declining trend in total nitrogen was noted throughout the streams of the Palmer Ranch during the period of September, 1985, to March, 1986, (Appendix Table A-10). During September, 1985, an average level of 3.2 mg/l was determined while during December, 1985, and March, 1986, total nitrogen gradually declined to average levels of 2.5 and 2.0 mg/l, respectively. This general decline in total nitrogen is attributed to the normal decay and export of organic matter following the peak of the summer growing season.

The largest fraction of total nitrogen observed during the second year of monitoring occurred in the form of organic nitrogen. Organic nitrogen represented approximately 85 percent of the total and averaged 2.2 mg/l (as N). The second most abundant form of nitrogen was ammonia (ionized plus non-ionized) which represented approximately 11.5 percent of the total with an average level of 0.3 mg/l (as N). Nitrate represented approximately 3 percent of the total with an average level of 0.06 mg/l (as N). As expected, the smallest fraction of total nitrogen was found to be nitrite which represented < 1 percent of the total.

In comparison, Palmer Venture (1986) reported a lower annual average in total nitrogen of 0.8 mg/l during the first year of monitoring. A fractional breakdown of the (annual average) total nitrogen level showed organic nitrogen to represent 69 percent, ammonia-nitrogen to represent 8 percent, nitrate-nitrogen to represent 23 percent, and nitrite-nitrogen to represent < 1 percent of the total. The difference in the total nitrogen levels observed during the first year versus those observed during the second year is not completely understood although some of the difference could be attributed to lower stormwater loadings during the first year as a result of the drought. Likewise, it is not completely understood why nitrate levels exceeded ammonia levels during the first year since nitrate is generally preferred by autotrophs during primary production and by various bacteria under conditions in which dissolved oxygen levels are depressed.

As specified in F.A.C. 17-3, nutrients including total nitrogen shall not be elevated to levels causing an imbalance in the natural flora and fauna. In this respect, there were some implications during the second year which linked the observed total nitrogen levels to non-compliance conditions. Results of the second year of monitoring showed that total nitrogen concentrations generally exceeded a threshold characteristic of eutrophic conditions, i.e. greater than 1.2 mg/l (FDER, 1983). As previously discussed, violations in dissolved oxygen resulted from the decay of excessive amounts of vegetation, perhaps due to prolific growths of vegetation associated with readily available nutrients.

4.4.2 Nitrite

Nitrite levels observed in the streams of the Palmer Ranch during the second year of monitoring are provided in Appendix Table A-11. As expected, nitrite concentrations throughout the streams traversing the North Tract were much lower than the other nitrogen constituents, and too low to be a significant nutrient source. Overall, nitrite observations averaged 0.02 mg/l (as N) with a range of $< 0.01 - 0.13$ mg/l (as N). Although there were no apparent temporal trends, South Creek exhibited a noteworthy trend as evidenced by its slightly higher nitrite levels as compared to other streams of the North Tract. This was particularly evident in the eastern tributary of South Creek (see Station SC-7) as nitrite averaged 0.06 mg/l. At the downstream property boundary, nitrite declined to an average level of 0.05 mg/l, and subsequently to 0.03 mg/l downstream of the North Tract.

During the first year of monitoring (Palmer Venture, 1986), nitrite was reported to range < 0.01 - 0.05 mg/l (as N), similar to the results observed during the second year of monitoring.

As a nutrient, nitrite is considered to be a water quality standard (F.A.C. 17-3). Due to the observed low concentrations, however, nitrite was found to be of little importance as a nutrient in the streams of the Palmer Ranch. For all practical purposes, therefore, nitrite is considered to meet desired standards.

4.4.3 Nitrate

As shown in the results provided in Appendix Table A-12, nitrate levels observed in the streams traversing the North Tract exhibited a yearly average of 0.06 mg/l with a range of < 0.01 - 0.42 mg/l (as N). During September, 1985, higher nitrate levels were recorded than during the following two quarterly surveys. In September, 1985, nitrate averaged 0.10 mg/l (as N) as compared to 0.07 mg/l (as N) during December, 1985, and 0.02 mg/l (as N) during March, 1986. This temporal trend could be partly attributed to nitrate contributions in rainfall and runoff as the observed levels were highest during the summer wet season, i.e., during September, 1985, and lowest during the fall dry season, i.e. during December, 1985.

In a comparison of streams, Catfish Creek exhibited the highest nitrate levels which averaged 0.09 mg/l (as N). The lowest nitrate levels which averaged 0.02 mg/l (as N) were recorded at the juncture of Trunk Ditch and the North Creek Basin. This juncture is normally stagnant and anaerobic, consequently, nitrate import is expected to be low. Furthermore, nitrate reduction and denitrification are expected to prevail under the observed conditions of depressed oxygen levels, thereby reducing nitrate concentrations to minimal levels. Catfish Creek, on the other hand, receives drainage from potential nitrate sources within its watershed. Potential nitrate sources in Catfish Creek include treated sewage disposal operations, a golf course and residential area (Country Club of Sarasota), commercial/ industrial land uses, and improved pastures on the North Tract.

The effect of a potential nitrate source was also observed in the upper reaches of the South Creek Basin (Appendix Table A-12). During the survey in December, 1985, a nitrate level of 0.38 mg/l (as N) was recorded in the east tributary of South Creek at the point of inflow into the North Tract (at Station SC-7). One potential upstream source of nitrate is a dairy farm.

During the first year of monitoring (Palmer Venture, 1986), the reported nitrate levels averaged 0.18 mg/l (as N) and ranged

< 0.01 - 0.7 mg/l (as N). As previously discussed, the reported nitrate levels represented a much larger fraction of the total nitrogen during the first year than during the second year of monitoring, i.e., 23 percent vs 3 percent.

As a nutrient, nitrate is designated as a general water quality standard, and is a potentially limiting nutrient in the streams of the Palmer Ranch. Therefore, increases in the availability of nitrate are subject to accelerate production rates of aquatic weeds and, in turn, cause an imbalance in the flora and fauna.

4.4.4 Ammonia

Appendix Table A-13 provides the results of ammonia measurements (ionized plus non-ionized) recorded during the second year of monitoring. Relative to the observed concentrations of nitrate, ammonia concentrations were higher indicating that ammonia is a potentially important nutrient source of nitrogen (although, perhaps, less preferred than nitrate) in the streams of the Palmer Ranch. This is evidenced by the higher ammonia average of 0.3 mg/l (as N) as compared to the nitrate average of 0.06 mg/l (as N). Overall, ammonia exhibited a wider range of < 0.01 - 2.75 mg/l (as N) as compared to nitrate which ranged < 0.01 - 0.42 mg/l (as N).

Ammonia levels recorded in the streams of the North Tract were similar except for those recorded in the eastern tributary of South Creek (Appendix Table A-13). Catfish Creek, the juncture of Trunk Ditch and the North Creek Basin, and Elligraw Bayou all exhibited similar averages of 0.11, 0.15, and 0.18 mg/l (as N), respectively. In South Creek, however, a much higher average of 0.52 mg/l (as N) was found primarily as a result of the higher ammonia levels observed in the eastern tributary. The eastern tributary of South Creek, as previously discussed, receives dairy farm drainage which is a potential source of ammonia. At its point of inflow into the North Tract, a high ammonia level of 2.75 mg/l (as N) was recorded during September, 1985. The effect of the ammonia source was observed downstream as a level of 1.04 mg/l (as N) was recorded at the downstream boundary of the North Tract and a level of 0.45 mg/l (as N) was observed further downstream at Station SC-8. During the following two quarterly surveys, the eastern tributary of the South Creek Basin was found to have the highest ammonia levels in all of the streams traversing the Palmer Ranch. Furthermore, the source of ammonia as evidenced by the spatial trend is located upstream of the North Tract.

Although lower ammonia levels were reported during the first year of the monitoring program (Palmer Venture, 1986), maximal levels were also reported in the eastern tributary of the South Creek Basin. Overall, ammonia levels averaged 0.07 mg/l (as N) and ranged < 0.01 - 0.44 mg/l (as N) during the first year. In the eastern tributary of the South Creek Basin (at the point of inflow into the North Tract), the highest levels of ammonia were recorded as evident in the recorded range of 0.13 - 0.44 mg/l (as N). The downstream effects, however, were not as apparent as during September, 1985, of the following year, perhaps due to the combined effects of the wet season following the extended drought.

Ammonia is a nutrient, and therefore, considered by F.A.C. 17-3 as a criteria of surface water quality. As in the case of nitrate, increases in ammonia have the potential to accelerate eutrophication, and, in turn, result in an imbalance in the flora and fauna of the streams traversing the Palmer Ranch. The non-ionized fraction of ammonia was not evaluated separate from the ionized fraction and, therefore, comparisons to County and State criteria for non-ionized ammonia were not performed.

4.4.5 Organic Nitrogen

Concentrations of organic nitrogen (total Kjeldahl nitrogen less ammonia nitrogen) in the streams traversing the Palmer Ranch (Appendix Table A-14) declined steadily during the fall and winter seasons. During September, 1985, organic nitrogen levels averaged 2.7 mg/l. In December, 1985, they declined to an average of 2.3 mg/l and eventually to 1.7 mg/l during March, 1986. It is probable that the concentration of organic matter peaked during the summer wet season in association with peaks in the standing crop of aquatic vegetation as well as maximal stormwater loadings of organic detritus. During the fall and winter, stormwater loadings and standing crops of vegetation declined possibly resulting in concomitant declines in organic nitrogen. Overall, organic nitrogen exhibited an annual average of 2.2 mg/l representing 85 percent of total nitrogen.

During the first year of monitoring, organic nitrogen was reported to average 0.6 mg/l and represented 69 percent of total nitrogen, somewhat less than observed during the second year of monitoring (Palmer Venture, 1986).

Organic nitrogen may be considered a nutrient standard (F.A.C. 17-3) since it is assimilated by microbial heterotrophs, used as an energy source as well as a source of nitrogen, and potentially recycled as an inorganic nutrient to be assimilated by vegetation and other autotrophs. In comparison of the average levels observed during the second year of monitoring to the aforementioned eutrophication threshold (1.2 mg/l) defined by FDER (1983), it is apparent that the levels of organic nitrogen in the streams of the Palmer Ranch (which averaged 2.2 mg/l) are indicative of eutrophic conditions and an imbalance in the flora and fauna.

4.4.6 Total Phosphate

The streams of the Palmer Ranch exhibited an average level in total phosphate of 1.0 mg/l (as P) and a range of 0.08 - 6.4 mg/l (as P) during the second year of the monitoring program (Appendix Table A-15). During September, 1985, total phosphate averaged 0.9 mg/l (as P) followed by average levels of 1.6 mg/l (as P) during December, 1985, and 0.6 mg/l (as P) during March, 1986.

The maximum total phosphate level that was recorded during September, 1985, was measured in Elligraw Bayou, i.e., 3.1 mg/l (as P), when maximal levels of total nitrogen, organic nitrogen, BOD, turbidity, and total suspended solids were also observed.

These high levels are attributed to the combined effects of peak stormwater loadings and the decay of vegetation. As previously noted, Elligraw Bayou also exhibited stagnant conditions during September, 1985, which facilitated the accumulation of nutrients and organic matter.

High total phosphate levels were also recorded in South Creek during the second year of monitoring, particularly in the eastern tributary which receives drainage from a dairy farm. At Station SC-7, which is located at the point of inflow into the North Tract, total phosphate averaged 3.6 mg/l (as P). Downstream, total phosphate averaged 2.4 mg/l (as P) at the point of outflow from the North Tract, and 0.7 mg/l (as P) further downstream of the North Tract. The effects of the upstream phosphate source were most pronounced during December, 1985, as the inflowing concentration was 6.4 mg/l (as P).

During the first year of monitoring, Palmer Venture (1986) reported a range in total phosphate of 0.1 - 4.7 mg/l (as P). Similar to the results of the second year of monitoring, the eastern tributary of South Creek was also found to exhibit the highest total phosphate levels in the streams of the Palmer Ranch, i.e. 1.6 - 4.7 mg/l (as P). Effects of this nutrient source were observed as far downstream as Station SC-8.

As a nutrient, phosphate is required by algae and other autotrophic organisms for the primary production of organic matter and, therefore, as specified in F.A.C. 17-3, shall not be elevated to levels which will cause an imbalance in the natural flora and fauna. By definition, the results of the second year of monitoring shows that the observed total phosphate levels in the streams of the Palmer Ranch exceeded the FDER threshold of 0.05 mg/l and, therefore, are indicative of eutrophic conditions and an imbalance in the flora and fauna (FDER, 1983).

In many cases such levels are normal in west-central Florida because of the widespread deposits of naturally occurring phosphate. Of significance, well drillers logs show that phosphates exist in shallow deposits on the Palmer Ranch (Patton and Associates, 1984). In addition, Palmer Venture (1986) noted that the phosphate levels in the streams of the Palmer Ranch were significantly influenced by phosphate enriched groundwater during periods when stream flow was significantly augmented by groundwater exfiltration, i.e., low flow conditions. Consequently, the high levels of phosphate which have resulted from the naturally occurring deposits within the Palmer Ranch should not be considered violations.

4.4.7 Orthophosphate

As evidenced in Appendix Table A-16, orthophosphate was found to average 0.7 mg/l (as P), representing approximately 66 percent of the total phosphate during the second year of monitoring. Overall, orthophosphate exhibited a range of < 0.02 - 5.5 mg/l (as P) as compared to a range of 0.1 - 4.3 mg/l (as P) during the first year of monitoring (Palmer Venture, 1986).

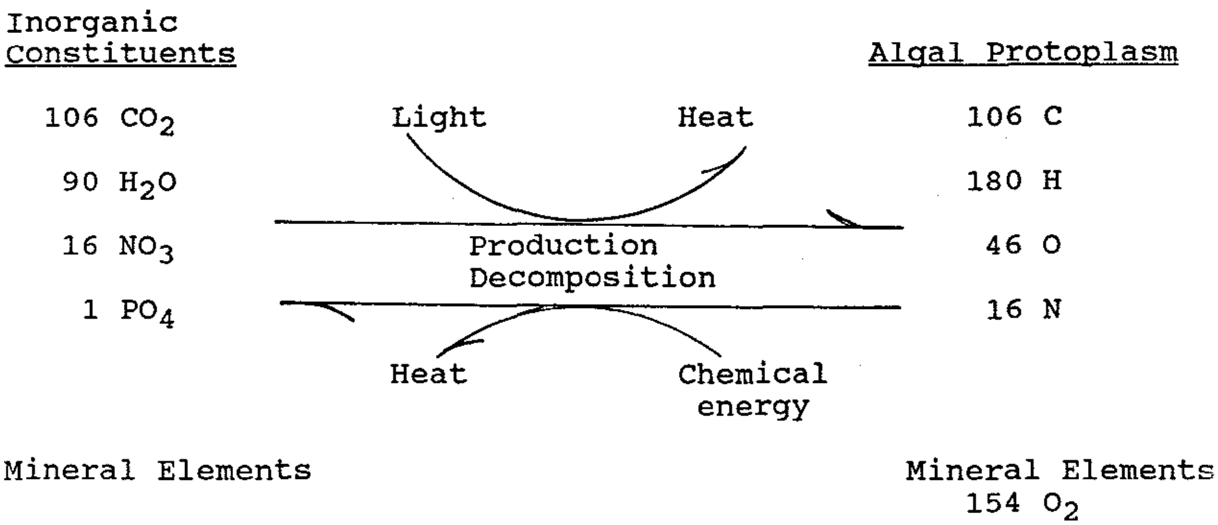
As with total phosphate and several other nutrients, orthophosphate results showed that there is a significant source of nutrients in the upper reaches of the South Creek Basin. This upstream nutrient source was particularly evident in the eastern tributary of South Creek as orthophosphate was found to average 3.0 mg/l (as P) at the point of inflow into the North Tract. Downstream of the North Tract, South Creek exhibited a lower average of 0.3 mg/l (as P). This general decline in orthophosphate is attributed to a combination of dilution and phosphate uptake by biological and physicochemical processes. During the first year of monitoring, Palmer Venture (1986) also evidenced this upstream nutrient source in South Creek.

During the second year of monitoring, the lowest orthophosphate levels were observed in the Catfish Creek Basin and at the juncture of Trunk Ditch and the North Creek Basin as orthophosphate averaged 0.1 mg/l (as P). In Elligraw Bayou, orthophosphate averaged 0.4 mg/l (as P).

As a nutrient, orthophosphate is designated by F.A.C. 17-3 as a general water quality criteria. This criteria specifies that the discharge of nutrients, such as orthophosphate, shall be limited to prevent an imbalance in the natural populations of aquatic flora and fauna. Although the observed levels are indicative of eutrophic conditions as defined by FDER (1983), orthophosphate has been found to occur naturally on the North Tract. Consequently, other factors are probably more growth limiting than phosphate and further increases in its availability is less likely to cause an imbalance in the aquatic flora and fauna.

4.4.8 Nutrient Ratios

Nitrate and phosphate are required in proportions of approximately 16:1 (N:P) as illustrated (Odum, 1959) in the following equation:



In these proportions, they are assimilated by the primary producers and converted into protoplasm during the process of photosynthesis. Conversely, the (unresistant) organic forms of nitrogen and phosphate are oxidized back into their biogenic salts during the process of aerobic respiration, e.g., organic decomposition, heterotrophic activity.

The primary forms of these biogenic salts are nitrate and orthophosphate. However, nitrate may be substituted by some plants for other forms of nitrogen, such as ammonia. Also of importance, orthophosphate may be accumulated and stored as polyphosphates by some algae, thereby alleviating a potential future phosphate limiting condition.

Results of the second year of monitoring were used to determine the atomic ratios of nitrogen to phosphorus in the streams of the Palmer Ranch. Total nitrogen to total phosphorus ratios (N_t:P_t) are provided in Appendix Table A-17 and ratios of inorganic nitrogen (ammonia, nitrite, and nitrate as N) to orthophosphorus (N_i:P_i) are provided in Appendix Table A-18. Estimates of the N_i:P_i ratios were generally low and found to average 4:1, indicative of nitrogen limiting conditions. In comparison, N_t:P_t ratios were found to average 11:1, closer to the balanced ratio of 16:1. The lower N_i:P_i ratios are attributed to the naturally high levels of orthophosphate, as well as its high percentage of total phosphorus (66 percent of total phosphorus). The higher N_t:P_t ratios are expected under conditions in which organic nitrogen is the predominant form of total nitrogen. As previously noted, organic nitrogen was found to average 85 percent of the total nitrogen in the streams of the Palmer Ranch. The more meaningful ratio in determining nutrient limiting conditions is based on the inorganic forms (biogenic salts as previously discussed) since these constituents are immediately available to the primary producers whereas the organic forms must be chemically transformed into the inorganic forms prior to photosynthesis.

An increase in the N_i:P_i ratio was recorded in Trunk Ditch at Station CC-4 during the fourth quarter when construction of Prestancia began and Trunk Ditch underwent realignment. During September, 1985, and December, 1985, the N_i:P_i ratio at Station

CC-4 remained fairly constant with an average of approximately 1:1. However, after construction was initiated during the fourth quarter, the $N_i:P_i$ ratio increased to 19:1. This elevated $N_i:P_i$ ratio is attributed to increased ammonia levels and decreased orthophosphate levels associated with construction and excavation activities during the fourth quarter.

4.5 Trace Elements

4.5.1 Arsenic

Arsenic levels in the streams traversing the Palmer Ranch (Appendix Table A-19) occurred at concentrations in the range of < 0.005 - 0.012 mg/l during September, 1985. These results indicate that the Palmer Ranch streams were in compliance with the applicable F.A.C. 17-3 General Criteria which allows a maximum of 0.05 mg/l. However, one observation of 0.012 mg/l which was recorded in Trunk Ditch (Station CC-4) was found to be out of compliance with the County criteria of 0.01 mg/l.

4.5.2 Cadmium

Cadmium was found to range < 0.0008 mg/l - 0.0034 mg/l in the streams of the Palmer Ranch during September, 1985, (Appendix Table A-19). Non-compliance levels with respect to State criteria, i.e., greater than 0.0012 mg/l, were recorded in the headwaters of the South Creek Basin near two points of inflow into the North Tract. The higher level of 0.0034 mg/l was recorded at Station SC-7 which receives upstream drainage from I-75 and a dairy farm. The other non-compliance observation of 0.0025 mg/l was recorded at Station SC-3 which receives upstream drainage from a golf course and residential area. With respect to the less stringent County criteria, all cadmium observations were found to be in compliance with the maximum allowable level of 0.01 mg/l.

4.5.3 Chromium

The applicable State water quality criteria for total chromium (F.A.C. 17-3) allows a maximum concentration of 0.05 mg/l while Sarasota County Ordinance No. 72-37 allows a maximum of 0.02 mg/l. As evidenced in Appendix Table A-19, the North Tract streams were not found to be out of compliance with either criteria during September, 1985, as all observations of total chromium were less than the detection limit of the analytical procedure, i.e., 0.05 mg/l.

4.5.4 Copper

As shown in Appendix Table A-19, the streams of the Palmer Ranch exhibited concentrations of copper which averaged 0.018 mg/l and ranged 0.011 - 0.067 mg/l during September, 1985. The only sample found to exceed the State criteria of 0.03 mg/l (F.A.C. 17-3) exhibited a level of 0.067 mg/l and was collected in a tributary of Trunk Ditch (Station CC-2) located at the northern end of the ranch. The sources of drainage in this tributary include back-flow from Trunk Ditch and drainage from the surrounding pastures and wetlands. The surrounding pastures and wetlands, however, are not expected to be significant sources of copper unless they were once used as a site for sewage-sludge disposal. On the other hand, some of the drainage into the upper reach of Trunk Ditch originates along Clark Road and its adjacent commercial and light industrial areas. Additionally, drainage from a relatively inactive spray field used by the Palmer Utilities sewage treatment plant is subject to enter Trunk Ditch. These land uses are all potential sources of copper and, therefore, might have contributed to the excess copper observed at Station CC-2 during September, 1985.

In a comparison of the observed copper levels in the streams of the Palmer Ranch to the County criteria which allows a maximum level of 0.01 mg/l, all 13 sampling sites were out of compliance during September, 1985.

4.5.5 Lead

Lead measurements in the streams of the Palmer Ranch were found to be in compliance with the applicable State criteria during September, 1985, except in the headwaters of the South Creek Basin where a lead concentration of 0.05 mg/l was recorded (see Station SC-3 in Appendix Table A-19). The residential area and golf course which are located upstream of the North Tract are potential sources of lead and might have contributed to the excess lead concentration recorded at Station SC-3. The other 12 lead measurements acquired during September, 1985, were found to be less than the State criteria of 0.03 mg/l.

In comparison to the more stringent County criteria of 0.01 mg/l, the Elligraw Bayou Station EL-1 (0.02 mg/l) and the South Creek Station SC-3 (0.05 mg/l) were found to be out of compliance.

During the first year of the monitoring program, lead was monitored bimonthly in the streams traversing the Palmer Ranch (Palmer Venture, 1986). A total of 38 measurements were reported. Of these, 12 measurements exceeded the State criteria of 0.03 mg/l. Overall, lead was reported to range < 0.01 - 0.09 mg/l during the first year of the monitoring program and generally exceeded the County criteria of 0.01 mg/l.

4.5.6 Mercury

As shown in Appendix Table A-19, the streams of the Palmer Ranch were found to exhibit mercury concentrations below the detection limit of 0.0002 mg/l, except at 3 of the 13 sampling sites. At Station EL-1, Station NC-6, and Station CC-1, mercury observations were found to range 0.0003 - 0.0004 mg/l thereby exceeding the State criteria of 0.0002 mg/l (F.A.C. 17-3). All 13 sampling sites, however, were found to meet the less stringent County criteria of 0.01 mg/l.

Potential sources of mercury on and adjacent to the Palmer Ranch include rain and dust fallout, commercial and industrial drainage along Clark Road, golf course drainage, and drainage sites on the Palmer Ranch which were used to dispose sludge wastes and to irrigate with treated wastewater effluent.

4.5.7 Nickel

The streams of the Palmer Ranch exhibited nickel levels of 0.02 mg/l or less during September, 1985, as compared to the maximum allowable limit of 0.1 mg/l (Appendix Table A-19).

Therefore, all 13 observations were found to be in compliance with both State and County standards for nickel.

4.5.8 Zinc

The streams of the Palmer Ranch exhibited a range in zinc of less than 0.005 mg/l to 0.036 mg/l during September, 1985, (Appendix Table A-19). As shown in the results, one of the 13 measurements exceeded the State standard of 0.03 mg/l. This observation (0.036 mg/l) was recorded in Elligraw Bayou at Station EL-1. In comparison to the more stringent County standard of 0.01 mg/l, however, five of the 13 measurements were found to be out of compliance.

Potential sources of zinc in Elligraw Bayou, as well as the other streams of the ranch, include rain and dust fallout and possibly drainage from areas once used as sewage sludge disposal sites.

4.6 Organic Constituents

4.6.1 Oils and Greases

As given in Appendix Table A-20, oils and greases in the streams of the Palmer Ranch were found to range from below the analytical detection limit of 1.0 mg/l up to a maximum of 15 mg/l during the second year of monitoring. During September, 1985, two of the 13 observations were found to exceed the State water quality standard of 5.0 mg/l although there were no observations which were found to exceed the less stringent County standard of 15 mg/l. These two exceedences of State standards were observed in

Elligraw Bayou at Station EL-1 and in South Creek at Station SC-1 where levels of 15 and 9 mg/l, respectively, were recorded. During December, 1985, and March, 1986, the streams traversing the Palmer Ranch were found to be in compliance as exhibited in their range of < 1.0 - 4.0 mg/l.

The two exceedences of State standards observed during the second year of monitoring are attributed to the production of natural oils and greases during the growth and decomposition of upland vegetation during the summer growing season. In addition, it is probable that stormwater runoff associated with the frequent wet season rains transported greater loads of these oils and greases from the surrounding watersheds to the streams of the Palmer Ranch.

The concentrations of oils and greases reported in the streams of the Palmer Ranch during the first year of the monitoring program (Palmer Venture, 1986), ranged from less than 1.0 mg/l to 8.8 mg/l. Most of the observations (36 of 38) were found to be less than the maximum allowable State criteria of 5.0 mg/l and all were found to be less than the maximum allowable County criteria of 15.0 mg/l. Two exceedences of the State criteria, however, were observed in Catfish Creek at Station CC-3 during July, 1984, and in South Creek at Station SC-8 during March, 1986. The results of the first year of monitoring, therefore, are similar to the results of the second year of monitoring.

4.6.2 Organochlorine Pesticides

Results of the 13 organochlorine pesticide scans (including polychlorinated biphenyls, i.e., PCBs) which were performed during September, 1985, are provided in Appendix Table A-21. These results show that the streams traversing the Palmer Ranch were in compliance with the applicable criteria for aldrin, dieldrin, lindane, chlordane, DDT, endosulfan, endrin, heptachlor, toxaphene, and PCBs.

4.7 Bacteriological Parameters

4.7.1 Total Coliform

As evidenced in Appendix Table A-21, the streams traversing the Palmer Ranch were found to exhibit high total coliform counts throughout the second year of the monitoring program. During September, 1985, total coliform counts were particularly high as they ranged 33,000 - ~ 1,000,000 counts/100 ml, consequently exceeding the allowable limit of 2,400/100 ml at all 13 stations. During December, 1985, bacterial counts declined to a range of 300 - 50,000 counts/100 ml as 8 of the 11 stations sampled were out of compliance. Although total coliform counts continued to decline during March, 1986, as evidenced by the lower range of 300 - 4,000 counts/100 ml, 4 of the 13 stations sampled exhibited non-compliance conditions.

During the first year of monitoring, Palmer Venture (1986) reported a similarly high frequency of non-compliance conditions in the streams traversing the Palmer Ranch as 27 of 38 total coliform counts exceeded 2,400/100 ml. They attributed the high frequency of violations to bacterial sources within the ranch.

4.7.2 Fecal Coliform

During the second year of monitoring, the streams of the Palmer Ranch exhibited fecal coliform densities in the range of < 20 - 33,000 counts/100 ml as given in Appendix Table A-22. Of the 37 samples which were collected, 10 exceeded the Class III standard of 800/100 ml. Although no exceedences were recorded during March, 1986, 3 of the 13 samples collected during September, 1985, and 7 of the 11 samples collected during December, 1985 were found to be out of compliance. Of significance, compliance conditions were observed in most of the inflows to the Palmer Ranch suggesting that exceedences resulted from sources within the ranch such as cattle and birds.

During the first year of monitoring, Palmer Venture (1986) reported a higher frequency of exceedences than during the second year of monitoring. Of the 38 observations, 22 exceeded the allowable limit of 800/100 ml. Only two of these 22 exceedences were recorded at points of inflow into the ranch, consequently, they attributed the high frequency of exceedences to sources within the ranch, e.g., cattle and birds.

5.0 SUMMARY

The second year of the "Continuing Surface Water Quality Monitoring Program" was performed during the period of April, 1985, through March, 1986. Sampling was conducted quarterly at 13 stations located in the streams of the Palmer Ranch. Although the first quarterly event was not performed due to the effects of the drought, successful sampling events were performed during the second, third, and fourth quarters.

Monitoring of the Palmer Ranch streams entailed quarterly measurements of conductivity, water temperature, suspended solids, turbidity, dissolved oxygen, pH, biochemical oxygen demand, macronutrients, and bacteriological quality. Also, organochlorine pesticide scans and measurements of trace elements including arsenic, cadmium, copper, chromium, lead, mercury, nickel, and zinc were performed during the second quarter. The results of the second year of monitoring are summarized in Table 5.1 with a complete tabulation of the results provided in Appendix A.

As evident in the results, the second year of monitoring was an abnormally dry year as only 33 inches of rainfall was recorded on the Palmer Ranch. The normal amount of rainfall for the region based on a 30-year record is 56 inches per year (NOAA, 1977). Consequently, the streams of the Palmer Ranch received little runoff and exhibited minimal flow. As a result, the water quality of the streams was affected by reduced stormwater loading rates as well as minimal flows.

Table 5.1
Palmer Ranch - Surface Quality Monitoring Program

April, 1985 - March, 1986

Parameter[a]	CC-1 Mean	CC-2 Mean	CC-3 Mean	CC-4 Mean	CC-5 Mean	El-1 Mean	NC-6 Mean	SC-1 Mean	FAC 17-3 Criteria	County Ordinance No. 72-37
PHYSICAL										
Depth (ft.)	0.93	0.93	1.11	0.87	0.60	0.37	1.77	0.59	------	------
Flow (GPM)	19	0	0	20	395	8	0	14	------	------
Temperature (C) (Field)	21.9	21.9	20.0	21.8	23.3	22.9	19.7	23.5	------	------
Conductivity (umhos/cm, Field)	676	763	841	882	790	873	739	1,291	+50%[b] +100%	+100% or to 500 umhos/cm
Solids, Total Suspended	4	28	47	52	7	108	10	28	------	------
Turbidity (NTU)	4.2	8.6	21.0	25.7	4.8	19.0	3.6	16.0	+29	+25 JTU
OXYGEN DEMAND and RELATED PARAMETERS										
BOD, 5-day	3.9	4.8	2.6	5.6	1.9	8.2	8.0	3.4	------	------
Dissolved Oxygen (mg/l, Field)	5.4	3.2	1.3	2.2	9.8	2.7	1.0	5.4	>5	>4
pH (-log[H+], Field)	7.4	7.1	7.2	7.1	7.5	6.9	6.2	7.3	6.0-8.5	6.0-8.5
MACRONUTRIENTS										
Nitrogen, Total	1.23	1.89	2.47	2.06	1.85	7.48	1.70	2.26	------	------
Nitrogen, Nitrite	0.03	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	------	------
Nitrogen, Nitrate	0.26	0.03	0.02	0.01	0.11	0.06	0.02	0.07	------	------
Nitrogen, Ammonia	0.11	0.11	0.11	0.12	0.07	0.18	0.15	0.15	------	------
Nitrogen, Organic	0.82	1.74	2.34	1.93	1.67	7.23	1.54	2.03	------	------
Phosphate, Total	0.20	0.56	0.72	0.60	0.45	1.93	0.18	0.92	------	------
Phosphate, Dissolved Ortho	0.10	0.23	0.06	0.16	0.15	0.41	0.10	0.76	------	------
TRACE ELEMENTS										
Arsenic, Total	<0.005	<0.005	<0.005	0.01	0.01	<0.005	<0.005	<0.005	0.05	0.01
Cadmium, Total	<0.0008	0.0008	<0.0008	0.0011	<0.0008	<0.0008	0.0009	<0.0008	0.0008[c] or 0.0012	0.01
Chromium, Total	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	0.02
Copper, Total	0.012	0.067	0.016	0.013	0.011	0.011	0.015	0.013	0.03	0.01
Lead, Total	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	0.03	0.01
Mercury, Total	0.0004	<0.0002	<0.0002	<0.0002	<0.0002	0.0003	0.0004	<0.0002	0.0002	0.01
Nickel, Total	<0.01	0.02	0.02	0.02	0.02	0.02	0.01	<0.01	0.1	0.1
Zinc, Total	0.015	0.018	0.006	0.012	0.005	0.036	0.012	0.006	0.03	0.01
ORGANIC CONSTITUENTS										
Oils and Greases	1	1	1.7	<1	1.3	8.5	<1	3	5.0	15
Aldrin (ug/l)	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	0.003[d]	------
alpha - BHC (ug/l)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	------	------
beta - BHC (ug/l)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	------	------
delta - BHC (ug/l)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	------	------
gamma - BHC (ug/l) (Lindane)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.01	------
Chlordane (ug/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	------
4 - 4' DDD (ug/l)	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	------	------
4 - 4' DDE (ug/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	------	------
4 - 4' DDT (ug/l)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	------
Dieldrin (ug/l)	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	0.003[d]	------
Endosulfan Alpha (ug/l)	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	0.003[e]	------
Endosulfan Beta (ug/l)	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	0.003[e]	------
Endosulfan Sulfate (ug/l)	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	------	------
Endrin (ug/l)	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	0.004	------
Endrin Aldehyde (ug/l)	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	------	------
Heptachlor (ug/l)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	------
Heptachlor Epoxide (ug/l)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	------	------
Toxaphene (ug/l)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.005	------
Polychlorinated Biphenyls (ug/l)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	------
BACTERIOLOGICAL										
Coliform, Total (per 100 ml)	54,167	131,867	34,000	22,000	13,667	500,400	16,100	21,247	2,400	2,400
Coliform, Fecal (per 100 ml)	480	837	11,110	5,687	373	1,605	573	240	800	------

Table 5.1

(Continued)

Parameter[a]	SC-2 Mean	SC-3 Mean	SC-4 Mean	SC-7 Mean	SC-8 Mean	All Stations Mean	All Stations N	All Stations Min	All Stations Max	FAC 17-3 Criteria	County Ordinance No. 72-37
PHYSICAL											
Depth (ft.)	0.73	0.59	0.46	0.38	2.28	0.94	37	0.30	2.75	------	------
Flow (GPM)	96	0	46	62	31	53	26	0	569	------	------
Temperature (C) (Field)	21.8	27.5	24.2	21.5	21.9	22.3	37	17.7	28.5	------	------
Conductivity (umhos/cm, Field)	1,270	913	1,237	1,386	816	964	37	413	1,809	+50%[b] +100%	+100% or to 500 umhos/cm
Solids, Total Suspended	11	7	7	13	8	24	37	1	207	------	------
Turbidity (NTU)	5.8	1.7	7.4	5.3	6.1	9.9	37	0.9	61	+29	+25 JTU
OXYGEN DEMAND and RELATED PARAMETERS											
BOD, 5-day	2.9	2.5	2.1	5.6	2.1	3.8	37	0.4	14.8	------	------
Dissolved Oxygen (mg/l, Field)	3.1	3.7	6.2	3.9	4.1	4.0	37	0.4	12.4	>5	>4
pH (-log[H+], Field)	7.0	6.8	7.2	7.2	6.9	7.1	37	6.0	8.1	6.0-8.5	6.0-8.5
MACRONUTRIENTS											
Nitrogen, Total	3.31	2.36	1.52	5.15	1.93	2.59	37	0.94	11.98	------	------
Nitrogen, Nitrite	0.05	<0.01	<0.01	0.06	0.03	0.02	37	<0.01	0.13	------	------
Nitrogen, Nitrate	0.01	0.02	0.02	0.14	0.02	0.06	37	<0.01	0.42	------	------
Nitrogen, Ammonia	0.59	0.17	0.09	1.80	0.19	0.30	37	<0.01	2.75	------	------
Nitrogen, Organic	2.62	2.17	1.97	2.63	1.69	2.21	37	0.57	11.70	------	------
Phosphate, Total	2.39	1.03	0.15	3.57	0.68	1.01	37	0.08	6.40	------	------
Phosphate, Dissolved Ortho	2.27	0.91	0.05	2.98	0.35	0.66	37	0.02	5.52	------	------
TRACE ELEMENTS											
Arsenic, Total	<0.005	0.01	0.006	<0.005	<0.005	0.003	13	<0.005	0.012	0.05	0.01
Cadmium, Total	<0.0002	0.0025	<0.0008	0.0034	<0.0008	0.0007	13	<0.0002	0.0034	0.0008[c] or 0.0012	0.01
Chromium, Total	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	13	<0.05	<0.05	0.05	0.02
Copper, Total	0.011	0.015	0.013	0.014	0.022	0.018	13	0.011	0.067	0.03	0.01
Lead, Total	<0.01	0.05	<0.01	<0.01	0.01	<0.01	13	<0.01	0.05	0.03	0.01
Mercury, Total	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	13	<0.0002	0.0004	0.0002	0.01
Nickel, Total	0.02	<0.01	0.01	0.02	<0.01	0.01	13	<0.01	0.02	0.1	0.1
Zinc, Total	0.01	<0.005	0.007	0.007	<0.005	0.01	13	<0.005	0.036	0.03	0.01
ORGANIC CONSTITUENTS											
Oils and Greases	<1	<1	<1	<1	1.67	1.35	37	<1	15	5.0	15
Aldrin (ug/l)	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	13	<0.003	<0.003	0.003[d]	------
alpha - BHC (ug/l)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	13	<0.005	<0.005	------	------
beta - BHC (ug/l)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	13	<0.005	<0.005	------	------
delta - BHC (ug/l)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	13	<0.005	<0.005	------	------
gamma - BHC (ug/l) (Lindane)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	13	<0.005	<0.005	0.01	------
Chlordane (ug/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	13	<0.01	<0.01	0.01	------
4 - 4' DDD (ug/l)	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	13	<0.03	<0.03	------	------
4 - 4' DDE (ug/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	13	<0.01	<0.01	------	------
4 - 4' DDT (ug/l)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	13	<0.001	<0.001	0.001	------
Dieldrin (ug/l)	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	13	<0.003	<0.003	0.003[d]	------
Endosulfan Alpha (ug/l)	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	13	<0.003	<0.003	0.003[e]	------
Endosulfan Beta (ug/l)	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	13	<0.003	<0.003	0.003[e]	------
Endosulfan Sulfate (ug/l)	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	13	<0.3	<0.3	------	------
Endrin (ug/l)	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	13	<0.004	<0.004	0.004	------
Endrin Aldehyde (ug/l)	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	13	<0.03	<0.03	------	------
Heptachlor (ug/l)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	13	<0.001	<0.001	0.001	------
Heptachlor Epoxide (ug/l)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	13	<0.005	<0.005	------	------
Toxaphene (ug/l)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	13	<0.005	<0.005	0.005	------
Polychlorinated Biphenyls (ug/l)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	13	<0.005	<0.005	0.001	------
BACTERIOLOGICAL											
Coliform, Total (per 100 ml)	15,433	23,500	22,000	34,467	13,067	84,374	37	300	1,000,000[f]	2,400	2,400
Coliform, Fecal (per 100 ml)	460	75	5,687	190	1,163	2,135	37	<20	33,000	800	------

[a] Results expressed as mg/l unless otherwise indicated

[b] +100% up to 500 umhos/cm
+50% in the range of 500 to 5,000 umhos/cm

[c] Cadmium criteria is 0.0008 for soft waters (less than 150 mg/l) and 0.0012 for harder waters (greater than 150 mg/l)

[d] Aldrin + Dieldrin

[e] Endosulfan a+b

[f] Reported value in excess of 1,000,000

A general water quality effect of the dry year of monitoring was evident in the high conductivities observed in the streams of the Palmer Ranch as shown in the annual range of 413 - 1,809 umhos/cm (Appendix Table A-4). Groundwater seepage effects were more pronounced than normal since groundwater exfiltration represented a larger percentage of the annual water budgets relative to surface runoff contributions. As a result, dissolved constituents including electrolytes transported into the streams via groundwater exfiltration exhibited greater affects on conductivity and the concentration of dissolved solids. Normally, stormwater exhibits lower conductivities than groundwater. Therefore, it tends to dilute the concentration of dissolved constituents and depress conductivities in the receiving waters. During the second year of monitoring, this diluting effect was found to be minimal due to the abnormally low rainfall and little surface runoff.

Similarly, the streams of the Palmer Ranch followed seasonal trends in conductivity which were also influenced by the amount of rainfall. This was evident in the inverse relationship of seasonal rainfall and conductivity. By the end of the summer wet season, i.e. during September, 1985, conductivities averaged 807 umhos/cm; however, by the end of the fall dry season, i.e. during December, 1985, conductivities increased to an average level of 1,077 umhos/cm. Conductivities remained at a comparatively high average of 1,024 umhos/cm during the winter quarter in association with minor amounts of rainfall.

In contrast, the streams exhibited a direct correlation between seasonal rainfall and total suspended solids as total suspended solids averaged 31 mg/l at the end of the summer wet season and declined to an average level of 17 mg/l by the end of the fall dry season. Total suspended solids remained low through the end of the winter season as reflected in its average of 13 mg/l. Although turbidity might be expected to be related to total suspended solids and rainfall, there was no apparent correlation. An exception was observed in Catfish Creek, however, as both turbidity and total suspended solids increased in association with construction activities during the fourth quarter.

Biochemical oxygen demands (BOD) were found to average 3.1 mg/l in South Creek and 3.8 mg/l in Catfish Creek, both of which are indicative of marginal water quality (Hynes, 1966). Higher BOD levels indicative of poor water quality were recorded in Elligraw Bayou and at the southern end of Trunk Ditch where stagnant conditions prevailed. Although pH was found to average 7.1, depressed levels of dissolved oxygen which averaged 4.1 mg/l were recorded throughout the year. Overall, the streams of the Palmer Ranch were found to exhibit heterotrophic conditions as evidenced by low levels of dissolved oxygen and marginal to high levels of BOD.

High levels of nutrients occurred in the streams of the Palmer Ranch during the second year of monitoring as total nitrogen and total phosphorus were found to exceed threshold levels characteristic of eutrophic conditions (FDER, 1983). The streams of the

Palmer Ranch exhibited annual averages in total nitrogen and total phosphorus of 2.6 mg/l and 1.0 mg/l, respectively. These averages exceed the FDER nutrient thresholds for total nitrogen and total phosphorus by factors of approximately 2X and 20X, respectively.

The inorganic fractions which are required by plants during the process of photosynthesis were also found to be readily available as orthophosphorus represented 66 percent of total phosphorus and inorganic nitrogen represented 15 percent of total nitrogen. Although the availability of inorganic nitrogen was found to be substantial, its low molecular ratio to orthophosphate implies that nitrogen should be more limiting to primary production in the streams of the ranch. Ratios of inorganic nitrogen to inorganic phosphorus were found to average 4:1 as compared to algal protoplasm which has a ratio of 16:1 (Odum, 1959).

Potential sources of nutrients upstream of the Palmer Ranch include a dairy farm, golf course, and residential development located in the South Creek Basin, the commercial-industrial strip development along Clark Road in the northern part of the Catfish Creek-Trunk Ditch Basin, and the country club development located in the western part of the Catfish Creek-Trunk Ditch Basin. Within the ranch, potential nutrient sources include active pastures, naturally occurring phosphate deposits which are subject to leach enriched seepage into the well incised streams of the ranch, and sewage-sludge disposal operations. Additionally, rainfall is a potentially ubiquitous source of nitrate.

The streams of the Palmer Ranch were found to be in compliance with the State water quality criteria for arsenic, chromium, and nickel during September, 1985. However, cadmium was found to be out of compliance with State criteria at two inflowing stations in the South Creek Basin and mercury was found to be out of compliance with State criteria at three stations located within the ranch. Copper, lead, and zinc were found to exceed State water quality standards at only one of the 13 stations sampled during September, 1985.

Several potential sources of trace elements exist within the basins. These include the commercial-industrial strip development upstream of the ranch in the Catfish Creek-Trunk Ditch Basin, the residential area and golf course upstream of the ranch in the South Creek Basin, and drainage within the ranch from once used sludge disposal sites and an inactive spray irrigation field (Palmer Utilities). Additionally, rain and dust fallout are potential sources of selected trace metals.

Organochlorine pesticide scans performed during September, 1985, showed no evidence of any measurable amounts or exceedences of the State Class III standards for aldrin, dieldrin, lindane, chlordane, DDT, endosulfan, endrin, heptachlor, toxaphene, or PCBs in the streams of the Palmer Ranch. Oils and greases which were monitored quarterly, however, exceeded the maximum allowed by the State, i.e., 5.0 mg/l, in Elligraw Bayou and in South Creek during September, 1985, but not during December, 1985 or March, 1986. A candidate source of the excess oils and greases are the vegetation associations within the ranch where oils and greases occur naturally as products of organic production and decay. Another source of oils and greases is the equipment used during construction; however, construction was not initiated until the fourth quarter when compliance conditions were found.

The bacteriological quality of the streams of the Palmer Ranch was found to be poor as total coliform and fecal coliform counts were frequently out of compliance with applicable standards. Of the 37 total coliform counts taken during the second year, 25 exceeded the maximum allowable limit of 2,400/100 ml. Similarly, 10 of the 37 fecal coliform counts were found to exceed the maximum allowable limit of 800/100 ml. The frequency of exceedences as well as bacterial densities were found to be directly related to the amount of rainfall. The primary sources of coliform bacteria within the Palmer Ranch include the fecal bacteria of cattle and birds as well as the naturally occurring soil bacteria. During storm events which frequently occur during the summer wet season, it is likely that more of these bacteria are transported by surface runoff to the streams of the Palmer Ranch than at other times of the year.

6.0 REFERENCES

American Public Health Association 1985. Standard Methods for the Examination of Water and Wastewater, 16th Edition. American Public Health Association.

Bradley, J. T. 1974. The Climate of Florida. In: Climates of the States. Vol. I - Eastern States. Water Information Center, Port Washington, New York.

Conservation Consultants, Inc. 1985. Diurnal Monitoring Program. Fall 1985. Palmer Ranch, Sarasota County, Florida. Prepared for Palmer Venture.

Florida Department of Environmental Regulation. 1983. Rule No.: Chapter 17 - 3, Water Quality Standards, Amended February 1, 1983.

Florida Department of Environmental Regulation. 1983. Discharge of Nutrients to Freshwater Lakes, Workshop, March 1983.

Florida Division of State Planning. 1975. The Florida General Soils Atlas.

Goodell, T.W. 1985. Quarterly Report. First Quarter of the Continuing Surface Water Quality Monitoring Program. April 1985 - March 1986.

Goodell, T.W. 1986. Correspondence to Mr. Russell Klier on July 24, 1986, regarding Stormwater Monitoring Event.

Goodell, T.W. 1985. Personal Communication with Conservation Consultants, Inc. regarding sampling sites, frequency, and parameters to be monitored for the Continuing Surface Water Quality Monitoring Program.

Hynes, H. B. N. 1966. The Biology of Polluted Waters. Liverpool University Press, Liverpool.

N.O.A.A. 1977. Local Climatological Data. Annual Summary.

Odum, E. P. 1959. Fundamentals of Ecology. W. B. Saunders Company, Philadelphia and London.

Palmer Venture. 1986. Surface Water Quality Monitoring and Assessment of the Palmer Ranch, Sarasota County Florida.

Patton and Associates. 1984. Surface Water Management Plan. Appendix B. Ground Water Management Plan, Palmer Ranch.

6.0 REFERENCES (Continued)

Sarasota County. 1972. Ordinance No. 72-37.

Thompson, R. B. 1976. Florida Statistical Abstract. University Presses, University of Florida, Gainesville, Florida.

United States Environmental Protection Agency. 1983. Methods for the Chemical Analysis of Water and Wastes, EPA - 600/4-79-0210, National Environmental Research Center, Cincinnati, Ohio.

United States Environmental Protection Agency. 1982. Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater, EPA-600/4-82-057. Environmental Monitoring and Support Laboratory, Cincinnati, Ohio.

United States Geological Survey. 1982. Measurement and Computation of Stream Flow. Vol. I Measurement of Stage and Discharge. Water Supply Paper 2175.

APPENDIX A. WATER QUALITY DATA

Appendix Table A-1

Continuing Surface Water Quality Monitoring Program

Stream Stage (ft)

April 1985 - March 1986

Sampling Date	Catfish Creek/ Trunk Ditch						Elligraw	North	South Creek							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	EL-1	NC-6	SC-1	SC-2	SC-3	SC-4	SC-7	SC-8	Mean	Mean	SD	Min	Max	N
June	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
September	1.60	0.75	1.50	0.75	0.60	1.04	0.50	1.50	0.60	1.00	0.60	0.40	0.30	2.75	0.94	0.99	0.66	0.30	2.75	13
December	0.58	1.20	0.79	0.95	0.35	0.77	0.00	1.92	0.58	0.80	0.00	0.47	0.35	2.00	0.70	0.77	0.60	0.00	2.00	13
March	0.60	0.85	1.05	0.92	0.85	0.86	0.61	1.90	0.60	0.40	1.18	0.50	0.50	2.10	0.88	0.93	0.51	0.40	2.10	13
Mean	0.93	0.93	1.11	0.87	0.60		0.37	1.77	0.59	0.73	0.59	0.46	0.38	2.28						
Minimum	0.58	0.75	0.79	0.75	0.35		0.00	1.50	0.58	0.40	0.00	0.40	0.30	2.00						
Maximum	1.60	1.20	1.50	0.95	0.85		0.61	1.92	0.60	1.00	1.18	0.50	0.50	2.75						
Std. Deviation	0.48	0.19	0.29	0.09	0.20		0.26	0.19	0.01	0.25	0.48	0.04	0.08	0.33						
N	3	3	3	3	3		3	3	3	3	3	3	3	3						

Stations	Mean	SD	Min	Max	N
CC-1, CC-2 (upper reach)	0.93	0.36	0.58	1.60	6
CC-3, CC-4 (mid reach)	0.99	0.25	0.75	1.50	6
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	0.89	0.33	0.35	1.60	15
SC-4, SC-1 (upper reach - west)	0.53	0.07	0.40	0.60	6
SC-3, SC-7 (upper reach - east)	0.49	0.36	0.00	1.18	6
SC-2, SC-8 (mid reach)	1.51	0.83	0.40	2.75	6
SC-1, SC-2, SC-3, SC-4, SC-7, SC-8 (entire basin)	0.89	0.69	0.30	2.75	17
All 13 Stations	0.94	0.58	0.30	2.75	37

SD - standard deviation

N - number of observations

Appendix Table A-2

Continuing Surface Water Quality Monitoring Program

Stream Flow (GPM)

April 1985 - March 1986

Sampling Date	Catfish Creek/ Trunk Ditch						Elligraw	North	South Creek							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	EL-1	NC-6	SC-1	SC-2	SC-3	SC-4	SC-7	SC-8	Mean	Mean	SD	Min	Max	N
June	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
September	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
December	0	0	0	0	221	44	0	0	0	2	0	2	0	0	1	17	59	0	221	13
March	37	0	0	39	569	129	15	0	28	190	0	91	123	62	82	89	149	0	569	13
Mean	19	0	0	20	395		8	0	14	96	0	46	62	31						
Minimum	0	0	0	0	221		0	0	0	2	0	2	0	0						
Maximum	37	0	0	39	569		15	0	28	190	0	91	123	62						
Std. Deviation	19	0	0	20	174		8	0	14	94	0	45	62	31						
N	2	2	2	2	2		2	2	2	2	2	2	2	2						

Stations	Mean	SD	Min	Max	N
CC-1, CC-2 (upper reach)	9	16	0	37	4
CC-3, CC-4 (mid reach)	10	17	0	39	4
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	87	173	0	569	10
SC-4, SC-1 (upper reach - west)	30	37	0	91	4
SC-3, SC-7 (upper reach - east)	31	53	0	123	4
SC-2, SC-8 (mid reach)	64	77	0	190	4
SC-1, SC-2, SC-3, SC-4, SC-7, SC-8 (entire basin)	28	53	0	190	12
All 13 Stations	53	119	0	569	26

SD - standard deviation

N - number of observations

Appendix Table A-3

Continuing Surface Water Quality Monitoring Program

Water Temperature (°C)

April 1985 - March 1986

Sampling Date	Catfish Creek/ Trunk Ditch						Elligraw	North	South Creek							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	EL-1	NC-6	SC-1	SC-2	SC-3	SC-4	SC-7	SC-8	Mean	Mean	SD	Min	Max	N
June	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
September	23.6	24.3	23.7	25.2	25.3	24.4	24.1	23.4	27.8	26.1	28.5	27.1	25.5	25.2	26.7	25.4	1.6	23.4	28.5	13
December	20.6	19.6	18.2	19.2	24.6	20.4	Dry	18.0	20.6	17.7	Dry	19.9	18.6	19.9	19.3	19.7	1.8	17.7	24.6	11
March	21.4	21.8	18.1	21.0	20.1	20.5	21.6	17.8	22.1	21.7	26.4	25.5	20.4	20.6	22.8	21.4	2.3	17.8	26.4	13
Mean	21.9	21.9	20.0	21.8	23.3		22.9	19.7	23.5	21.8	27.5	24.2	21.5	21.9						
Minimum	20.6	19.6	18.1	19.2	20.1		21.6	17.8	20.6	17.7	26.4	19.9	18.6	19.9						
Maximum	23.6	24.3	23.7	25.2	25.3		24.1	23.4	27.8	26.1	28.5	27.1	25.5	25.2						
Std. Deviation	1.3	1.9	2.6	2.5	2.3		1.2	2.6	3.1	3.4	1.1	3.1	2.9	2.4						
N	3	3	3	3	3		2	3	3	3	2	3	3	3						

Stations	Mean	SD	Min	Max	N
CC-1, CC-2 (upper reach)	21.9	1.6	19.6	24.3	6
CC-3, CC-4 (mid reach)	20.9	2.7	18.1	25.2	6
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	21.8	2.4	18.1	25.3	15
SC-4, SC-1 (upper reach - west)	23.8	3.1	19.9	27.8	6
SC-3, SC-7 (upper reach - east)	23.9	3.7	18.6	28.5	5
SC-2, SC-8 (mid reach)	21.9	2.9	17.7	26.1	6
SC-1, SC-2, SC-3, SC-4, SC-7, SC-8 (entire basin)	23.2	3.4	17.7	28.5	17
All 13 Stations	22.3	3.0	17.7	28.5	37

SD - standard deviation

N - number of observations

Appendix Table A-4

Continuing Surface Water Quality Monitoring Program

Specific Conductance (umhos/cm)

April 1985 - March 1986

Sampling Date	Catfish Creek/ Trunk Ditch						Elligraw	North	South Creek							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	EL-1	NC-6	SC-1	SC-2	SC-3	SC-4	SC-7	SC-8	Mean	Mean	SD	Min	Max	N
June	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
September	413	644	892	903	839	738	645	741	1,053	992	696	924	1,136	612	902	807	196	413	1,136	13
December	765	740	833	819	740	799	Dry	751	1,527	1,537	Dry	1,490	1,809	841	1,441	1,077	397	740	1,809	11
March	851	905	799	925	791	854	1,100	726	1,294	1,281	1,129	1,298	1,213	996	1,202	1,024	199	726	1,298	13
Mean	676	763	841	882	790		873	739	1,291	1,270	913	1,237	1,386	816						
Minimum	413	644	799	819	740		645	726	1,053	992	696	924	1,136	612						
Maximum	851	905	892	925	839		1,100	751	1,527	1,537	1,129	1,490	1,809	996						
Std. Deviation	189	108	38	46	40		228	10	194	223	217	235	301	158						
N	3	3	3	3	3		2	3	3	3	2	3	3	3						

Stations	Mean	SD	Min	Max	N
CC-1, CC-2 (upper reach)	720	160	413	905	6
CC-3, CC-4 (mid reach)	862	47	799	925	6
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	791	125	413	925	15
SC-4, SC-1 (upper reach - west)	1,264	217	924	1,527	6
SC-3, SC-7 (upper reach - east)	1,197	356	696	1,809	5
SC-2, SC-8 (mid reach)	1,043	298	612	1,537	6
SC-1, SC-2, SC-3, SC-4, SC-7, SC-8 (entire basin)	1,166	307	612	1,809	17
All 13 Stations	964	297	413	1809	37

SD - standard deviation

N - number of observations

Appendix Table A-5

Continuing Surface Water Quality Monitoring Program

Total Suspended Solids (mg/l)

April 1985 - March 1986

Sampling Date	Catfish Creek/ Trunk Ditch						Elligraw	North	South Creek							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	EL-1	NC-6	SC-1	SC-2	SC-3	SC-4	SC-7	SC-8	Mean	Mean	SD	Min	Max	N
June	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
September	5	35	25	29	7	20	207	19	19	12	12	10	16	13	14	31	51	5	207	13
December	5	43	103	37	13	40	Dry	8	36	17	Dry	6	20	6	17	17	14	1	43	11
March	2	5	12	91	1	22	8	3	29	3	1	4	4	6	8	13	24	1	91	13
Mean	4	28	47	52	7		108	10	28	11	7	7	13	8						
Minimum	2	5	12	29	1		8	3	19	3	1	4	4	6						
Maximum	5	43	103	91	13		207	19	36	17	12	10	20	13						
Std. Deviation	1	16	40	28	5		100	7	7	6	6	2	7	3						
N	3	3	3	3	3		2	3	3	3	2	3	3	3						

Stations	Mean	SD	Min	Max	N
CC-1, CC-2 (upper reach)	16	17	2	43	6
CC-3, CC-4 (mid reach)	50	35	12	103	6
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	28	30	1	103	15
SC-4, SC-1 (upper reach - west)	17	12	4	36	6
SC-3, SC-7 (upper reach - east)	11	7	1	20	5
SC-2, SC-8 (mid reach)	10	5	3	17	6
SC-1, SC-2, SC-3, SC-4, SC-7, SC-8 (entire basin)	13	9	1	36	17
All 13 Stations	24	38	1	207	37

SD - standard deviation

N - number of observations

Appendix Table A-6

Continuing Surface Water Quality Monitoring Program

Turbidity (NTU)

April 1985 - March 1986

Sampling Date	Catfish Creek/ Trunk Ditch						Elligraw	North	South Creek							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	EL-1	NC-6	SC-1	SC-2	SC-3	SC-4	SC-7	SC-8	Mean	Mean	SD	Min	Max	N
June	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
September	3.6	8.0	16.0	2.0	1.6	6.2	24.0	4.9	5.1	3.1	2.4	3.9	4.8	2.2	3.6	6.3	6.3	1.6	24.0	13
December	3.3	13.0	40.0	14.0	7.7	15.6	Dry	4.5	26.0	11.0	Dry	6.4	7.6	9.4	12.1	13.0	10.4	3.3	40.0	11
March	5.8	4.7	7.0	61.0	5.2	16.7	14.0	1.5	17.0	3.4	0.9	12.0	3.6	6.6	7.3	11.0	15.2	0.9	61.0	13
Mean	4.2	8.6	21.0	25.7	4.8		19.0	3.6	16.0	5.8	1.7	7.4	5.3	6.1						
Minimum	3.3	4.7	7.0	2.0	1.6		14.0	1.5	5.1	3.1	0.9	3.9	3.6	2.2						
Maximum	5.8	13.0	40.0	61.0	7.7		24.0	4.9	26.0	11.0	2.4	12.0	7.6	9.4						
Std. Deviation	1.1	3.4	13.9	25.5	2.5		5.0	1.5	8.6	3.7	0.8	3.4	1.7	3.0						
N	3	3	3	3	3		2	3	3	3	2	3	3	3						

Stations	Mean	SD	Min	Max	N
CC-1, CC-2 (upper reach)	6.4	3.3	3.3	13.0	6
CC-3, CC-4 (mid reach)	23.3	20.7	2.0	41.0	6
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	12.9	15.8	1.6	61.0	15
SC-4, SC-1 (upper reach - west)	11.7	7.8	3.9	26.0	6
SC-3, SC-7 (upper reach - east)	3.9	2.3	0.9	7.6	5
SC-2, SC-8 (mid reach)	6.0	3.3	2.2	11.0	6
SC-1, SC-2, SC-3, SC-4, SC-7, SC-8 (entire basin)	7.4	6.2	0.9	26.0	17
All 13 Stations	9.9	11.6	0.9	61.0	37

SD - standard deviation

N - number of observations

Appendix Table A-7

Continuing Surface Water Quality Monitoring Program

5 - Day Biochemical Oxygen Demand (mg/l)

April 1985 - March 1986

Sampling Date	Catfish Creek/ Trunk Ditch						Killgrew	North	South Creek							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	KL-1	NC-6	SC-1	SC-2	SC-3	SC-4	SC-7	SC-8	Mean	Mean	SD	Min	Max	N
June	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
September	2.4	2.5	0.8	9.3	0.9	3.2	14.8	2.8	3.5	2.2	3.6	1.0	1.9	2.2	2.4	3.7	3.8	0.8	14.8	13
December	2.2	4.8	6.6	6.0	2.9	4.5	Dry	7.5	5.6	4.3	Dry	3.9	>12.5	2.7	5.8	5.4	2.8	2.2	>12.5	11
March	7.1	7.1	0.4	1.6	2.0	3.6	1.6	13.8	1.1	2.2	1.4	1.3	2.5	1.3	1.6	3.3	3.7	0.4	13.8	13
Mean	3.9	4.8	2.6	5.6	1.9		8.2	8.0	3.4	2.9	2.5	2.1	5.6	2.1						
Minimum	2.2	2.5	0.4	1.6	0.9		1.6	2.8	1.1	2.2	1.4	1.0	1.9	1.3						
Maximum	7.1	7.1	6.6	9.3	2.9		14.8	13.8	5.6	4.3	3.6	3.9	>12.5	2.7						
Std. Deviation	2.3	1.9	2.8	3.2	0.8		6.6	4.5	4.5	1.0	1.1	1.3	4.9	0.6						
N	3.0	3.0	3.0	3.0	3.0		2.0	3.0	3.0	3.0	2.0	3.0	3.0	3.0						

Stations	Mean	SD	Min	Max	N
CC-1, CC-2 (upper reach)	4.4	2.1	2.2	7.1	6
CC-3, CC-4 (mid reach)	4.1	3.4	0.4	9.3	6
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	3.8	2.7	0.4	9.3	15
SC-4, SC-1 (upper reach - west)	2.7	1.7	1.1	5.6	6
SC-3, SC-7 (upper reach - east)	4.4	4.1	1.4	>12.5	5
SC-2, SC-8 (mid reach)	2.5	0.9	1.3	4.3	6
SC-1, SC-2, SC-3, SC-4, SC-7, SC-8 (entire basin)	3.1	2.6	1.0	>12.5	17
All 13 Stations	3.8	3.3	0.4	14.8	37

SD - standard deviation

N - number of observations

Appendix Table A-8

Continuing Surface Water Quality Monitoring Program

Dissolved Oxygen (mg/l)

April 1985 - March 1986

Sampling Date	Catfish Creek/ Trunk Ditch						Elligraw	North	South Creek							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	EL-1	NC-6	SC-1	SC-2	SC-3	SC-4	SC-7	SC-8	Mean	Mean	SD	Min	Max	N
June	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
September	0.8	0.7	0.9	0.4	7.7	2.1	0.7	0.6	4.5	2.3	2.0	6.3	1.9	2.9	3.3	2.4	2.3	0.4	7.7	13
December	6.3	2.7	1.1	1.6	12.4	4.8	Dry	1.1	4.7	1.6	Dry	4.5	7.3	4.2	4.5	4.3	3.3	1.1	12.4	11
March	9.0	6.3	1.8	4.7	9.3	6.2	4.7	1.4	6.9	5.3	5.3	7.9	2.4	5.3	5.5	5.4	2.4	1.4	9.3	13
Mean	5.4	3.2	1.3	2.2	9.8		2.7	1.0	5.4	3.1	3.7	6.2	3.9	4.1						
Minimum	0.8	0.7	0.9	0.4	7.7		0.7	0.6	4.5	1.6	2.0	4.5	1.9	2.9						
Maximum	9.0	6.3	1.8	4.7	12.4		4.7	1.4	6.9	5.3	5.3	7.9	7.3	5.3						
Std. Deviation	3.4	2.3	0.4	1.8	2.0		2.0	0.3	1.1	1.6	1.7	1.4	2.4	1.0						
N	3	3	3	3	3		2	3	3	3	2	3	3	3						

Stations	Mean	SD	Min	Max	N
CC-1, CC-2 (upper reach)	4.3	3.1	0.7	9.0	6
CC-3, CC-4 (mid reach)	1.8	1.4	0.4	4.7	6
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	4.4	3.7	0.4	12.4	15
SC-4, SC-1 (upper reach - west)	5.8	1.3	4.5	7.9	6
SC-3, SC-7 (upper reach - east)	3.8	2.2	1.9	7.3	5
SC-2, SC-8 (mid reach)	3.6	1.4	1.6	5.3	6
SC-1, SC-2, SC-3, SC-4, SC-7, SC-8 (entire basin)	4.4	1.9	1.6	7.9	17
All 13 Stations	4.0	2.9	0.4	12.4	37

SD - standard deviation

N - number of observations

Appendix Table A-9

Continuing Surface Water Quality Monitoring Program

pH (-log[H+])

April 1985 - March 1986

Sampling Date	Catfish Creek/ Trunk Ditch						Elligraw	North	South Creek							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	EL-1	NC-6	SC-1	SC-2	SC-3	SC-4	SC-7	SC-8	Mean	Mean	SD	Min	Max	N
June	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
September	7.0	6.8	7.0	6.9	7.5	7.0	6.8	6.4	6.9	6.8	6.5	6.7	6.6	6.7	6.7	6.8	0.3	6.4	7.5	13
December	7.6	7.3	7.5	7.5	7.6	7.5	Dry	6.2	7.8	7.3	Dry	7.7	8.1	7.3	7.6	7.4	0.5	6.2	8.1	11
March	7.5	7.3	7.0	7.0	7.3	7.2	7.0	6.0	7.3	7.0	7.0	7.1	7.3	6.8	7.0	7.0	0.3	6.0	7.5	13
Mean	7.4	7.1	7.2	7.1	7.5		6.9	6.2	7.3	7.0	6.8	7.2	7.2	6.9						
Minimum	7.0	6.8	7.0	6.9	7.3		6.8	6.0	6.9	6.8	6.5	6.7	6.6	6.7						
Maximum	7.6	7.3	7.5	7.5	7.6		7.0	6.4	7.8	7.3	7.0	7.7	8.1	7.3						
Std. Deviation	0.3	0.2	0.2	0.3	0.1		0.1	0.2	0.4	0.2	0.3	0.4	0.6	0.3						
N	3	3	3	3	3		2	3	3	3	2	3	3	3						

Stations	Mean	SD	Min	Max	N
CC-1, CC-2 (upper reach)	7.3	0.3	6.8	7.6	6
CC-3, CC-4 (mid reach)	7.2	0.3	6.9	7.5	6
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	7.3	0.3	6.8	7.6	15
SC-4, SC-1 (upper reach - west)	7.3	0.4	6.7	7.8	6
SC-3, SC-7 (upper reach - east)	7.0	0.6	6.5	8.1	5
SC-2, SC-8 (mid reach)	7.0	0.2	6.7	7.3	6
SC-1, SC-2, SC-3, SC-4, SC-7, SC-8 (entire basin)	7.1	0.4	6.5	8.1	17
All 13 Stations	7.1	0.4	6.0	8.1	37

SD - standard deviation

N - number of observations

Appendix Table A-10

Continuing Surface Water Quality Monitoring Program

Total Nitrogen (mg/l)

April 1985 - March 1986

Sampling Date	Catfish Creek/ Trunk Ditch						Elligraw	North	South Creek							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	EL-1	NC-6	SC-1	SC-2	SC-3	SC-4	SC-7	SC-8	Mean	Mean	SD	Min	Max	N
June	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
September	1.75	1.80	1.75	2.85	1.92	2.01	11.98	2.10	1.99	4.06	2.19	1.39	5.61	2.56	2.97	3.23	2.76	1.39	11.98	13
December	1.00	2.38	4.43	1.89	1.43	2.23	Dry	1.49	3.23	3.23	Dry	1.58	6.00	0.97	3.00	2.51	1.51	0.97	6.00	11
March	0.94	1.48	1.23	1.45	2.21	1.46	2.97	1.51	1.55	2.63	2.52	1.60	3.83	2.26	2.40	2.01	0.78	0.94	3.83	13
Mean	1.23	1.89	2.47	2.06	1.85		7.48	1.70	2.26	3.31	2.36	1.52	5.15	1.93						
Minimum	0.94	1.48	1.23	1.45	1.43		2.97	1.49	1.55	2.63	2.19	1.39	3.83	0.97						
Maximum	1.75	2.38	4.43	2.85	2.21		11.98	2.10	3.23	4.06	2.52	1.60	6.00	2.56						
Std. Deviation	0.37	0.37	1.40	0.58	0.32		4.51	0.28	0.71	0.59	0.16	0.09	0.94	0.69						
N	3	3	3	3	3		2	3	3	3	2	3	3	3						

Stations	Mean	SD	Min	Max	N
CC-1, CC-2 (upper reach)	1.56	0.50	0.94	2.38	6
CC-3, CC-4 (mid reach)	2.27	1.09	1.23	4.43	6
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	1.90	0.84	0.94	4.43	15
SC-4, SC-1 (upper reach - west)	1.89	0.63	1.39	3.23	6
SC-3, SC-7 (upper reach - east)	4.03	1.55	2.19	6.00	5
SC-2, SC-8 (mid reach)	2.62	0.94	0.97	4.06	6
SC-1, SC-2, SC-3, SC-4, SC-7, SC-8 (entire basin)	2.78	1.38	0.97	6.00	17
All 13 Stations	2.59	1.96	0.94	11.98	37

SD - standard deviation

N - number of observations

Appendix Table A-11

Continuing Surface Water Quality Monitoring Program

Nitrite (mg/l as N)

April 1985 - March 1986

Sampling Date	Catfish Creek/ Trunk Ditch						Elligraw	North	South Creek							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	EL-1	NC-6	SC-1	SC-2	SC-3	SC-4	SC-7	SC-8	Mean	Mean	SD	Min	Max	N
June	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
September	0.10	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.07	<0.01	<0.01	0.02	0.02	0.02	0.02	0.03	<0.01	0.10	13
December	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	Dry	<0.01	<0.01	<0.01	Dry	<0.01	0.13	<0.01	0.03	0.02	0.04	<0.01	0.13	11
March	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.07	<0.01	<0.01	0.03	0.08	0.03	0.02	0.02	<0.01	0.07	13
Mean	0.03	<0.01	<0.01	<0.01	<0.01		<0.01	<0.01	<0.01	0.05	<0.01	<0.01	0.06	0.03						
Minimum	<0.01	<0.01	<0.01	<0.01	<0.01		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01						
Maximum	0.10	<0.01	<0.01	<0.01	<0.01		<0.01	<0.01	0.01	0.07	<0.01	<0.01	0.13	0.08						
Std. Deviation	0.05	NA	NA	NA	NA		NA	NA	NA	0.03	NA	NA	0.05	0.03						
N	3	3	3	3	3		2	3	3	3	2	3	3	3						

Stations	Mean	SD	Min	Max	N
CC-1, CC-2 (upper reach)	0.02	0.04	<0.01	0.10	6
CC-3, CC-4 (mid reach)	<0.01	NA	<0.01	<0.01	6
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	<0.01	0.03	<0.01	0.10	15
SC-4, SC-1 (upper reach - west)	<0.01	NA	<0.01	0.01	6
SC-3, SC-7 (upper reach - east)	0.04	0.05	<0.01	0.13	5
SC-2, SC-8 (mid reach)	0.04	0.03	<0.01	0.08	6
SC-1, SC-2, SC-3, SC-4, SC-7, SC-8 (entire basin)	0.03	0.04	<0.01	0.13	17
All 13 Stations	0.02	0.03	<0.01	0.13	37

SD - standard deviation

N - number of observations

Appendix Table A-12

Continuing Surface Water Quality Monitoring Program

Nitrate (mg/l as N)

April 1985 - March 1986

Sampling Date	Catfish Creek/ Trunk Ditch						Elligraw	North	South Creek							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	EL-1	NC-6	SC-1	SC-2	SC-3	SC-4	SC-7	SC-8	Mean	Mean	SD	Min	Max	N
June	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
September	0.28	0.09	0.07	0.04	0.28	0.15	0.06	0.02	0.22	0.02	0.03	0.07	0.04	0.02	0.07	0.10	0.09	0.02	0.28	13
December	0.42	<0.01	<0.01	<0.01	<0.01	0.08	Dry	<0.01	<0.01	<0.01	Dry	<0.01	0.38	<0.01	0.06	0.07	0.15	0.01	0.42	11
March	0.09	<0.01	<0.01	<0.01	0.06	0.02	0.06	0.03	<0.01	<0.01	<0.01	<0.01	<0.01	0.04	0.01	0.02	0.03	0.01	0.09	13
Mean	0.26	0.03	0.02	0.01	0.11		0.06	0.02	0.07	0.01	0.02	0.02	0.14	0.02						
Minimum	0.09	<0.01	<0.01	<0.01	<0.01		0.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01						
Maximum	0.42	0.09	0.07	0.04	0.28		0.06	0.03	0.22	0.02	0.03	0.07	0.38	0.04						
Std. Deviation	0.14	0.04	0.03	0.02	0.12		0.00	0.01	0.10	0.03	0.02	0.03	0.17	0.02						
N	3	3	3	3	3		2	3	3	3	2	3	3	3						

Stations	Mean	SD	Min	Max	N
CC-1, CC-2 (upper reach)	0.15	0.15	<0.01	0.42	6
CC-3, CC-4 (mid reach)	0.02	0.03	<0.01	0.07	6
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	0.09	0.13	<0.01	0.42	15
SC-4, SC-1 (upper reach - west)	0.05	0.08	<0.01	0.22	6
SC-3, SC-7 (upper reach - east)	0.09	0.14	<0.01	0.38	5
SC-2, SC-8 (mid reach)	0.01	0.02	<0.01	0.04	6
SC-1, SC-2, SC-3, SC-4, SC-7, SC-8 (entire basin)	0.05	0.10	<0.01	0.38	17
All 13 Stations	0.06	0.11	<0.01	0.42	37

SD - standard deviation

N - number of observations

Appendix Table A-13

Continuing Surface Water Quality Monitoring Program

Ammonia (mg/l as N)

April 1985 - March 1986

Sampling Date	Catfish Creek/ Trunk Ditch						Elligraw	North	South Creek							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	EL-1	NC-6	SC-1	SC-2	SC-3	SC-4	SC-7	SC-8	Mean	Mean	SD	Min	Max	N
June	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
September	0.20	0.09	0.09	0.07	0.07	0.10	0.21	0.24	0.15	1.04	0.15	0.09	2.75	0.45	0.77	0.43	0.72	0.07	2.75	13
December	0.01	0.02	0.08	0.04	0.03	0.04	Dry	0.12	0.1	0.18	Dry	<0.01	1.03	0.01	0.26	0.15	0.28	<0.01	1.03	11
March	0.12	0.23	0.15	0.26	0.12	0.18	0.15	0.08	0.21	0.56	0.19	0.19	1.61	0.1	0.48	0.31	0.39	0.08	1.61	13
Mean	0.11	0.11	0.11	0.12	0.07		0.18	0.15	0.15	0.59	0.17	0.09	1.80	0.19						
Minimum	0.01	0.02	0.08	0.04	0.03		0.15	0.08	0.1	0.18	0.15	<0.01	1.03	0.01						
Maximum	0.20	0.23	0.15	0.26	0.12		0.21	0.24	0.21	1.04	0.19	0.19	2.75	0.45						
Std. Deviation	0.08	0.09	0.03	0.10	0.04		0.03	0.07	0.04	0.35	0.02	0.08	0.71	0.19						
N	3	3	3	3	3		2	3	3	3	2	3	3	3						

Stations	Mean	SD	Min	Max	N
CC-1, CC-2 (upper reach)	0.11	0.08	0.01	0.23	6
CC-3, CC-4 (mid reach)	0.12	0.07	0.04	0.26	6
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	0.11	0.07	0.01	0.26	15
SC-4, SC-1 (upper reach - west)	0.12	0.07	<0.01	0.21	6
SC-3, SC-7 (upper reach - east)	1.15	0.97	0.15	2.75	5
SC-2, SC-8 (mid reach)	0.39	0.35	0.01	1.04	6
SC-1, SC-2, SC-3, SC-4, SC-7, SC-8 (entire basin)	0.52	0.71	<0.01	2.75	17
All 13 Stations	0.30	0.52	<0.01	2.75	37

SD - standard deviation

N - number of observations

Appendix Table A-14

Continuing Surface Water Quality Monitoring Program

Organic Nitrogen (mg/l)[a]

April 1985 - March 1986

Sampling Date	Catfish Creek/ Trunk Ditch						Elligraw	North	South Creek							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	EL-1	NC-6	SC-1	SC-2	SC-3	SC-4	SC-7	SC-8	Mean	Mean	SD	Min	Max	N
June	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
September	1.17	1.62	1.59	2.74	1.57	1.74	11.70	1.84	1.62	2.80	2.01	2.93	1.23	2.07	2.11	2.68	2.66	1.17	11.70	13
December	0.57	2.36	4.35	1.85	1.40	2.11	Dry	1.37	3.13	3.05	Dry	1.58	4.46	0.96	2.64	2.28	1.25	0.57	4.46	11
March	0.73	1.25	1.08	1.19	2.03	1.26	2.76	1.40	1.34	2.00	2.33	1.41	2.19	2.04	1.89	1.67	0.57	0.73	2.76	13
Mean	0.82	1.74	2.34	1.93	1.67		7.23	1.54	2.03	2.62	2.17	1.97	2.63	1.69						
Minimum	0.57	1.25	1.08	1.19	1.40		2.76	1.37	1.34	2.00	2.01	1.41	1.23	0.96						
Maximum	1.17	2.36	4.35	2.74	2.03		11.70	1.84	3.13	3.05	2.33	2.93	4.46	2.07						
Std. Deviation	0.25	0.46	1.44	0.64	0.27		4.47	0.21	0.79	0.45	0.16	0.68	1.35	0.52						
N	3	3	3	3	3		2	3	3	3	2	3	3	3						

Stations	Mean	SD	Min	Max	N
CC-1, CC-2 (upper reach)	1.28	0.59	0.57	2.36	6
CC-3, CC-4 (mid reach)	2.13	1.13	1.08	4.35	6
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	1.70	0.90	0.57	4.35	15
SC-4, SC-1 (upper reach - west)	2.00	0.74	1.34	3.13	6
SC-3, SC-7 (upper reach - east)	2.44	1.07	1.23	4.46	5
SC-2, SC-8 (mid reach)	2.15	0.67	0.96	3.05	6
SC-1, SC-2, SC-3, SC-4, SC-7, SC-8 (entire basin)	2.19	0.85	0.96	4.46	17
All 13 Stations	2.21	1.80	0.57	11.70	37

[a]Organic Nitrogen = Total Kjeldahl Nitrogen - Ammonia (as Nitrogen)

SD - standard deviation

N - number of observations

Appendix Table A-15

Continuing Surface Water Quality Monitoring Program

Total Phosphate (mg/l as P)

April 1985 - March 1986

Sampling Date	Catfish Creek/ Trunk Ditch						Elligraw	North	South Creek							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	EL-1	NC-6	SC-1	SC-2	SC-3	SC-4	SC-7	SC-8	Mean	Mean	SD	Min	Max	N
June	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
September	0.24	0.69	0.44	0.41	0.28	0.41	3.14	0.23	0.28	1.50	1.29	0.14	2.31	0.78	1.05	0.90	0.89	0.14	3.14	13
December	0.19	0.62	1.53	0.81	0.68	0.77	Dry	0.24	2.18	4.31	Dry	0.09	6.40	0.64	2.72	1.61	1.91	0.09	6.40	11
March	0.16	0.36	0.20	0.58	0.40	0.34	0.72	0.08	0.29	1.37	0.77	0.22	2.00	0.63	0.88	0.60	0.52	0.08	2.00	13
Mean	0.20	0.56	0.72	0.60	0.45		1.93	0.18	0.92	2.39	1.03	0.15	3.57	0.68						
Minimum	0.16	0.36	0.20	0.41	0.28		0.72	0.08	0.28	1.37	0.77	0.09	2.00	0.63						
Maximum	0.24	0.69	1.53	0.81	0.68		3.14	0.24	2.18	4.31	1.29	0.22	6.40	0.78						
Std. Deviation	0.03	0.14	0.58	0.16	0.17		1.21	0.07	0.89	1.36	0.26	0.05	2.01	0.07						
N	3	3	3	3	3		2	3	3	3	2	3	3	3						

Stations	Mean	SD	Min	Max	N
CC-1, CC-2 (upper reach)	0.38	0.21	0.16	0.69	6
CC-3, CC-4 (mid reach)	0.66	0.43	0.20	1.53	6
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	0.51	0.34	0.16	1.53	15
SC-4, SC-1 (upper reach - west)	0.53	0.74	0.09	2.18	6
SC-3, SC-7 (upper reach - east)	2.55	2.00	0.77	6.40	5
SC-2, SC-8 (mid reach)	1.54	1.29	0.63	4.31	6
SC-1, SC-2, SC-3, SC-4, SC-7, SC-8 (entire basin)	1.48	1.61	0.09	6.40	17
All 13 Stations	1.01	1.28	0.08	6.40	37

SD - standard deviation

N - number of observations

Appendix Table A-16

Continuing Surface Water Quality Monitoring Program

Orthophosphate (mg/l as P)

April 1985 - March 1986

Sampling Date	Catfish Creek/ Trunk Ditch						Elligraw	North	South Creek							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	EL-1	NC-6	SC-1	SC-2	SC-3	SC-4	SC-7	SC-8	Mean	Mean	SD	Min	Max	N
June	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
September	0.13	0.36	0.04	0.20	0.23	0.19	0.51	0.12	0.19	1.32	1.17	0.07	1.79	0.65	0.87	0.52	0.54	0.04	1.79	13
December	0.11	0.15	0.09	0.24	0.06	0.13	Dry	0.12	1.93	4.23	Dry	0.02	5.52	0.12	2.36	1.14	1.85	0.02	5.52	11
March	0.07	0.18	0.06	0.04	0.16	0.10	0.30	0.06	0.17	1.25	0.65	0.05	1.63	0.27	0.67	0.38	0.49	0.04	1.63	13
Mean	0.10	0.23	0.06	0.16	0.15		0.41	0.10	0.76	2.27	0.91	0.05	2.98	0.35						
Minimum	0.07	0.15	0.04	0.04	0.06		0.30	0.06	0.17	1.25	0.65	0.02	1.63	0.12						
Maximum	0.13	0.36	0.09	0.24	0.23		0.51	0.12	1.93	4.23	1.17	0.07	5.52	0.65						
Std. Deviation	0.02	0.09	0.02	0.09	0.07		0.10	0.03	0.82	1.39	0.26	0.02	1.80	0.22						
N	3	3	3	3	3		2	3	3	3	2	3	3	3						

Stations	Mean	SD	Min	Max	N
CC-1, CC-2 (upper reach)	0.17	0.09	0.07	0.36	6
CC-3, CC-4 (mid reach)	0.11	0.08	0.04	0.24	6
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	0.14	0.09	0.04	0.36	15
SC-4, SC-1 (upper reach - west)	0.41	0.68	0.02	1.93	6
SC-3, SC-7 (upper reach - east)	2.15	1.73	0.65	5.52	5
SC-2, SC-8 (mid reach)	1.31	1.38	0.12	4.23	6
SC-1, SC-2, SC-3, SC-4, SC-7, SC-8 (entire basin)	1.24	1.49	0.02	5.52	17
All 13 Stations	0.66	1.15	0.02	5.52	37

SD - standard deviation

N - number of observations

Appendix Table A-17

Continuing Surface Water Quality Monitoring Program

Total N to Total P Ratios (N_t:P_t)

April 1985 - March 1986

Sampling Date	Catfish Creek/ Trunk Ditch					Elligraw	North	South Creek						All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	EL-1	NC-6	SC-1	SC-2	SC-3	SC-4	SC-7	SC-8	Mean	SD	Min	Max	N
June	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
September	13	7	13	16	15	9	21	16	6	4	20	5	6	12	6	4	21	13
December	7	9	6	5	5	Dry	13	3	2	Dry	38	2	4	9	10	2	38	11
March	7	11	13	18	12	10	36	12	5	7	16	4	8	12	8	4	36	13
Mean	9	9	11	13	11	10	23	10	4	6	25	4	6					
Minimum	7	7	6	5	5	9	13	3	2	4	16	2	4					
Maximum	13	11	13	18	15	10	36	16	6	7	38	5	8					
Std. Deviation	0	2	3	6	4	1	10	5	2	2	11	1	2					
N	3	3	3	3	3	2	3	3	3	2	3	3	3					

Stations	Mean	SD	Min	Max	N
CC-1, CC-2 (upper reach)	9	2	7	13	6
CC-3, CC-4 (mid reach)	12	5	5	18	6
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	10	4	5	18	15
SC-4, SC-1 (upper reach - west)	18	11	3	38	6
SC-3, SC-7 (upper reach - east)	4	2	2	7	5
SC-2, SC-8 (mid reach)	5	2	2	8	6
SC-1, SC-2, SC-3, SC-4, SC-7, SC-8 (entire basin)	9	9	2	38	17

SD - standard deviation

N - number of observations

Appendix Table A-18

Continuing Surface Water Quality Monitoring Program

Inorganic N to Inorganic P Ratios ($N_i:P_i$)

April 1985 - March 1986

Sampling Date	Catfish Creek/ Trunk Ditch					Elligraw	North	South Creek						All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	EL-1	NC-6	SC-1	SC-2	SC-3	SC-4	SC-7	SC-8	Mean	SD	Min	Max	N
June	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
September	10	1	10	1	4	1	5	5	2	0.3	6	3	2	4	3	0	10	13
December	10	0.5	6	0.5	3	Dry	2	0.1	0.1	Dry	2	0.1	0.2	2	3	0	10	11
March	10	3	6	19	3	2	4	3	1	0.7	7	2	2	5	5	1	19	13
Mean	10	2	7	7	3	2	4	3	1	1	5	2	1					
Minimum	10	0.5	6	0.5	3	1	2	0.1	0.1	0.3	2	0.1	0.2					
Maximum	10	3	10	19	4	2	5	5	2	1	7	3	2					
Std. Deviation	0.00	1.08	1.89	8.61	0.47	0.50	1.25	2.01	0.78	0.20	4.93	1.20	0.85					
N		3	3	3	3	2	3	3	3	2	3	3	3					

Stations	Mean	SD	Min	Max	N
CC-1, CC-2 (upper reach)	6	4	1	10	6
CC-3, CC-4 (mid reach)	7	6	1	19	6
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	6	5	1	19	15
SC-4, SC-1 (upper reach - west)	4	2	0.1	7	6
SC-3, SC-7 (upper reach - east)	1	1	0.1	3	5
SC-2, SC-8 (mid reach)	1	1	0.1	2	6
SC-1, SC-2, SC-3, SC-4, SC-7, SC-8 (entire basin)	2	2	0.1	7	17

SD - standard deviation

N - number of observations

Appendix Table A-19

Continuing Surface Water Quality Monitoring Program

Trace Elements (mg/l)

April 1985 - March 1986

Sampling Date	Catfish Creek/ Trunk Ditch						Elligraw	North	South Creek							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	EL-1	NC-6	SC-1	SC-2	SC-3	SC-4	SC-7	SC-8	Mean	Mean	SD	Min	Max	N
Arsenic, Total, as As	<0.005	<0.005	<0.005	0.012	0.007	0.004	<0.005	<0.005	<0.005	<0.005	0.010	0.006	<0.005	<0.005	0.003	0.003	0.004	<0.005	0.012	13
Cadmium, Total, as Cd	<0.0008	0.0008	<0.0008	0.0011	<0.0008	0.0004	<0.0008	0.0009	<0.0008	<0.0002	0.0025	<0.0008	0.0034	<0.0008	0.001	0.0007	0.001	<0.0002	0.0034	13
Copper, Total, as Cu	0.012	0.067	0.016	0.013	0.011	0.024	0.011	0.015	0.013	0.011	0.015	0.013	0.014	0.022	0.014	0.018	0.014	0.011	0.067	13
Chromium, Total, as Cr	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NA	<0.05	<0.05	13
Lead, Total, as Pb	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.05	<0.01	<0.01	0.01	0.01	<0.01	0.014	<0.01	0.05	13
Mercury, Total, as Hg	0.0004	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0003	0.0004	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0002	<0.0002	0.0004	13
Nickel, Total, as Ni	<0.01	0.02	0.02	0.02	0.02	<0.01	0.02	0.01	<0.01	0.02	<0.01	0.01	0.02	<0.01	0.01	0.01	0.008	<0.01	0.02	13
Zinc, Total, as Zn	0.015	0.018	0.006	0.012	0.005	0.01	0.036	0.012	0.006	0.010	<0.005	0.007	0.007	<0.005	0.007	0.01	0.009	<0.005	0.036	13

SD - standard deviation

N - number of observations

Appendix Table A-20

Continuing Surface Water Quality Monitoring Program

Oils and Greases (mg/l)

April 1985 - March 1986

Sampling Date	Catfish Creek/ Trunk Ditch						Elligraw	North	South Creek							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	EL-1	NC-6	SC-1	SC-2	SC-3	SC-4	SC-7	SC-8	Mean	Mean	SD	Min	Max	N
June	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
September	1	1	2	<1	<1	<1	15	<1	9	<1	<1	<1	<1	2	1.94	2.38	4.32	<1	15	13
December	<1	2	<1	<1	<1	<1	Dry	<1	<1	1	Dry	<1	<1	<1	0.42	<1	0.62	<1	2	11
March	2	<1	3	<1	4	1.8	2	<1	<1	<1	2	<1	<1	3	1.17	1.23	0.42	<1	4	13
Mean	1	1	1.67	<1	1.33		8.50	<1	3	<1	1	<1	<1	1.67						
Minimum	<1	<1	<1	<1	<1		2	<1	<1	<1	<1	<1	<1	<1						
Maximum	2	2	3	<1	4		15.0	1	9	1	2	<1	<1	3						
Std. Deviation	0.8	0.8	1.3	NA	1.9		6.5	0.5	4.2	0.5	1	NA	NA	1.3						
N	3	3	3	3	3		2	3	3	3	2	3	3	3						

Stations	Mean	SD	Min	Max	N
CC-1, CC-2 (upper reach)	1	0.8	<1	2	6
CC-3, CC-4 (mid reach)	<1	1.21	<1	3	6
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	1	1.26	<1	4	15
SC-4, SC-1 (upper reach - west)	1.5	3.35	<1	9	6
SC-3, SC-7 (upper reach - east)	<1	0.8	<1	2	5
SC-2, SC-8 (mid reach)	<1	1.21	<1	3	6
SC-1, SC-2, SC-3, SC-4, SC-7, SC-8 (entire basin)	1	2.2	<1	9	17
All 13 Stations	1.35	2.85	<1	15	37

SD - standard deviation

N - number of observations

Appendix Table A-21
Continuing Surface Water Quality Monitoring Program
Organochlorine Pesticides (ug/l)
April 1985 - March 1986

Sampling Date	Catfish Creek/ Trunk Ditch					Elligraw	North	South Creek					
	CC-1	CC-2	CC-3	CC-4	CC-5	EL-1	NC-6	SC-1	SC-2	SC-3	SC-4	SC-7	SC-8
Aldrin	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
alpha - BHC	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
beta - BHC	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
delta - BHC	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
gamma - BHC (Lindane)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chlordane	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
4 - 4' DDD	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
4 - 4' DDE	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
4 - 4' DDT	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Dieldrin	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Endosulfan Alpha	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Endosulfan Beta	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Endosulfan Sulfate	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Endrin	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Endrin Aldehyde	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Heptachlor	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Heptachlor Epoxide	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Toxaphene	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Polychlorinated Biphenyls	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Appendix Table A-22

Continuing Surface Water Quality Monitoring Program

Total Coliform (count / 100 ml)

April 1985 - March 1986

Sampling Date	Catfish Creek/ Trunk Ditch					Elligraw	North	South Creek						All Stations		
	CC-1	CC-2	CC-3	CC-4	CC-5	EL-1	NC-6	SC-1	SC-2	SC-3	SC-4	SC-7	SC-8	Min	Max	N
June	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
September	160,000	390,000	51,000	>1,000,000	34,000	>1,000,000	44,000	62,000	40,000	43,000	44,000	102,000	33,000	33,000	>1,000,000	13
December	2,000	5,000	50,000	3,000	3,000	Dry	4,000	340	5,000	Dry	20,000	300	3,200	300	50,000	11
March	500	600	1,000	3,000	4,000	800	300	1,400	1,300	4,000	2,000	1,100	3,000	300	4,000	13
Minimum	500	600	1,000	3,000	3,000	800	300	340	1,300	4,000	2,000	300	3,000			
Maximum	160,000	390,000	51,000	>1,000,000	34,000	>1,000,000	44,000	62,000	40,000	43,000	44,000	102,000	33,000			
N	3	3	3	3	3	2	3	3	3	2	3	3	3			

Stations	Min	Max	N
CC-1, CC-2 (upper reach)	500	390,000	6
CC-3, CC-4 (mid reach)	1,000	>1,000,000	6
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	500	>1,000,000	15
SC-4, SC-1 (upper reach - west)	340	62,000	6
SC-3, SC-7 (upper reach - east)	300	102,000	5
SC-2, SC-8 (mid reach)	1,300	40,000	6
SC-1, SC-2, SC-3, SC-4, SC-7, SC-8 (entire basin)	300	102,000	17
All 13 Stations	300	>1,000,000	37

N - number of observations

Appendix Table A-23

Continuing Surface Water Quality Monitoring Program

Fecal Coliform (count / 100 ml)

April 1985 - March 1986

Sampling Date	Catfish Creek/ Trunk Ditch					Elligraw	North	South Creek						All Stations		
	CC-1	CC-2	CC-3	CC-4	CC-5	EL-1	NC-6	SC-1	SC-2	SC-3	SC-4	SC-7	SC-8	Min	Max	N
June	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
September	180	900	320	12,000	500	3,200	500	200	100	80	500	200	180	80	12,000	13
December	1,200	1,600	33,000	300	420	Dry	1,100	340	1,200	Dry	16,000	200	3,200	200	33,000	11
March	60	<20	<20	20	200	<20	120	180	80	70	560	170	110	10	560	13
Minimum	60	<20	<20	20	200	<20	120	180	80	70	500	170	110			
Maximum	1,200	1,600	33,000	12,000	500	3,200	1,100	340	1,200	80	16,000	200	3,200			
N	3	3	3	3	3	2	3	3	3	2	3	3	3			

Stations	Min	Max	N
CC-1, CC-2 (upper reach)	<20	1,600	6
CC-3, CC-4 (mid reach)	<20	33,000	6
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	<20	33,000	15
SC-4, SC-1 (upper reach - west)	180	16,000	6
SC-3, SC-7 (upper reach - east)	70	200	5
SC-2, SC-8 (mid reach)	80	3,200	6
SC-1, SC-2, SC-3, SC-4, SC-7, SC-8 (entire basin)	70	16,000	16
All 13 Stations	<20	33,000	37

N - number of observations

APPENDIX B. CONTRACT LABORATORY REPORTS

Enviropact of Tampa Bay, Inc.
Environmental Consulting and Analysis

11181 43 Street North
Clearwater, Florida 33520

Telephone (813) 223 5804
Telephone (813) 577 9663
Fla. Watts (800) 432 9706

Conservation Consultants, Inc.
726 8th Ave. W.
Palmetto, Fl. 33561

September 30,1985
Report T-2349

Sample Received: 9-17-85
Sample Designation: CCI Project #0380-001
Collected By: Your Rep

REPORT OF ANALYSIS	SC 1	SC 2	SC 3	UNITS
METALS				
Arsenic	<0.005	<0.005	0.010	mg/l
Mercury	<0.0002	<0.0002	<0.0002	mg/l
ORGANICS				
Oil and Grease	9*	<1	<1	mg/l
ORGANOCHLORINE PESTICIDES				
Aldrin	<0.003	<0.003	<0.003	ug/l
alpha- BHC	<0.005	<0.005	<0.005	ug/l
beta- BHC	<0.005	<0.005	<0.005	ug/l
delta- BHC	<0.005	<0.005	<0.005	ug/l
gamma- BHC	<0.005	<0.005	<0.005	ug/l
Chlordane	<0.01	<0.01	<0.01	ug/l
4,4'-DDD	<0.03	<0.03	<0.03	ug/l
4,4'-DDE	<0.01	<0.01	<0.01	ug/l
4,4'-DDT	<0.001	<0.001	<0.001	ug/l
Dieldrin	<0.003	<0.003	<0.003	ug/l
Endosulfan Alpha	<0.003	<0.003	<0.003	ug/l
Endosulfan Beta	<0.003	<0.003	<0.003	ug/l
Endosulfan Sulfate	<0.3	<0.3	<0.3	ug/l
Endrin	<0.004	<0.004	<0.004	ug/l
Endrin Aldehyde	<0.03	<0.03	<0.03	ug/l
Heptachlor	<0.001	<0.001	<0.001	ug/l
Heptachlor Epoxide	<0.005	<0.005	<0.005	ug/l
Toxaphene	<0.005	<0.005	<0.005	ug/l
Polychlorinated Biphenyls	<0.001	<0.001	<0.001	ug/l

* 233ml extracted

Enviropact, Inc.

Environmental Consulting and Analysis

Conservation Consultants, Inc.
726 8th Ave. W.
Palmetto, Fl. 33561

September 30,1985
Report T-2349

Sample Received: 9-17-85
Sample Designation:CCI Project #0380-001
Collected By: Your Rep.

REPORT OF ANALYSIS	SC 4	SC 7	SC 8	UNITS
METALS				
Arsenic	0.006	<0.005	<0.005	mg/l
Mercury	<0.0002	<0.0002	<0.0002	mg/l
ORGANICS				
Oil and Grease	<1	<1	2	mg/l
ORGANOCHLORINE PESTICIDES				
Aldrin	<0.003	<0.003	<0.003	ug/l
alpha- BHC	<0.005	<0.005	<0.005	ug/l
beta- BHC	<0.005	<0.005	<0.005	ug/l
delta- BHC	<0.005	<0.005	<0.005	ug/l
gamma- BHC	<0.005	<0.005	<0.005	ug/l
Chlordane	<0.01	<0.01	<0.01	ug/l
4,4'- DDD	<0.03	<0.03	<0.03	ug/l
4,4'- DDE	<0.01	<0.01	<0.01	ug/l
4,4'- DDT	<0.001	<0.001	<0.001	ug/l
Dieldrin	<0.003	<0.003	<0.003	ug/l
Endosulfan Alpha	<0.003	<0.003	<0.003	ug/l
Endosulfan Beta	<0.003	<0.003	<0.003	ug/l
Endosulfan Sulfate	<0.3	<0.3	<0.3	ug/l
Endrin	<0.004	<0.004	<0.004	ug/l
Endrin Aldehyde	<0.03	<0.03	<0.03	ug/l
Heptachlor	<0.001	<0.001	<0.001	ug/l
Heptachlor Epoxide	<0.005	<0.005	<0.005	ug/l
Toxaphene	<0.005	<0.005	<0.005	ug/l
Polychlorinated Biphenyls	<0.001	<0.001	<0.001	ug/l

Enviropact, Inc.

Environmental Consulting and Analysis

Conservation Consultants, Inc.
726 8th Ave. W.
Palmetto, Fl. 33561

September 30,1985
Report T-2349

Sample Received: 9-17-85
Sample Designation: CCI Project #0380-001
Collected By: Your Rep.

REPORT OF ANALYSIS	NC 6	EL 1	CC 1	UNITS
METALS				
Arsenic	<0.005	<0.005	<0.005	mg/l
Mercury	0.0004	0.0003	0.0004	mg/l
ORGANICS				
Oil and Grease	<1	14.7	1	mg/l
ORGANOCHLORINE PESTICIDES				
Aldrin	<0.003	<0.003	<0.003	ug/l
alpha- BHC	<0.005	<0.005	<0.005	ug/l
beta- BHC	<0.005	<0.005	<0.005	ug/l
delta- BHC	<0.005	<0.005	<0.005	ug/l
gamma- BHC	<0.005	<0.005	<0.005	ug/l
Chlordane	<0.01	<0.01	<0.01	ug/l
4,4'- DDD	<0.03	<0.03	<0.03	ug/l
4,4'- DDE	<0.01	<0.01	<0.01	ug/l
4,4'- DDT	<0.001	<0.001	<0.001	ug/l
Dieldrin	<0.003	<0.003	<0.003	ug/l
Endosulfan Alpha	<0.003	<0.003	<0.003	ug/l
Endosulfan Beta	<0.003	<0.003	<0.003	ug/l
Endosulfan Sulfate	<0.3	<0.3	<0.3	ug/l
Endrin	<0.004	<0.004	<0.004	ug/l
Endrin Aldehyde	<0.03	<0.03	<0.03	ug/l
Heptachlor	<0.001	<0.001	<0.001	ug/l
Heptachlor Epoxide	<0.005	<0.005	<0.005	ug/l
Toxaphene	<0.005	<0.005	<0.005	ug/l
Polychlorinated Biphenyls	<0.001	<0.001	<0.001	ug/l

Enviropact, Inc.

Environmental Consulting and Analysis

Conservation Consultants, Inc.
726 8th Ave. W.
Palmetto, Fl. 33561

September 30,1985
Report T-2349

Sample Received: 9-17-85
Sample Designation: CCI Project #0380-001
Collected By: Your Rep.

REPORT OF ANALYSIS	CC 2	CC 3	CC 4	UNITS
METALS				
Arsenic	<0.005	<0.005	0.012	mg/l
Mercury	<0.0002	<0.0002	<0.0002	mg/l
ORGANICS				
Oil and Grease	1	2	<1	mg/l
ORGANOCHLORINE PESTICIDES				
Aldrin	<0.003	<0.003	<0.003	ug/l
alpha- BHC	<0.005	<0.005	<0.005	ug/l
beta- BHC	<0.005	<0.005	<0.005	ug/l
delta- BHC	<0.005	<0.005	<0.005	ug/l
gamma- BHC	<0.005	<0.005	<0.005	ug/l
Chlordane	<0.01	<0.01	<0.01	ug/l
4,4'- DDD	<0.03	<0.03	<0.03	ug/l
4,4'- DDE	<0.01	<0.01	<0.01	ug/l
4,4'- DDT	<0.001	<0.001	<0.001	ug/l
Dieldrin	<0.003	<0.003	<0.003	ug/l
Endosulfan Alpha	<0.003	<0.003	<0.003	ug/l
Endosulfan Beta	<0.003	<0.003	<0.003	ug/l
Endosulfan Sulfate	<0.3	<0.3	<0.3	ug/l
Endrin	<0.004	<0.004	<0.004	ug/l
Endrin Aldehyde	<0.03	<0.03	<0.03	ug/l
Heptachlor	<0.001	<0.001	<0.001	ug/l
Heptachlor Epoxide	<0.005	<0.005	<0.005	ug/l
Toxaphene	<0.005	<0.005	<0.005	ug/l
Polychlorinated Biphenyls	<0.001	<0.001	<0.001	ug/l

Enviropact, Inc.
Environmental Consulting and Analysis

Conservation Consultants, Inc.
726 8th Ave. W.
Palmetto, Fl. 33561

September 30,1985
Report T-2349

Sample Received: 9-17-85
Sample Designation: CCI Project #0380-001
Collected By: Your Rep.

REPORT OF ANALYSIS	CC 5	UNITS
METALS		
Arsenic	0.007	mg/l
Mercury	<0.0002	mg/l
ORGANICS		
Oil and Grease	<1	mg/l
ORGANOCHLORINE PESTICIDES		
Aldrin	<0.003	ug/l
alpha- BHC	<0.005	ug/l
beta- BHC	<0.005	ug/l
delta- BHC	<0.005	ug/l
gamma- BHC	<0.005	ug/l
Chlordane	<0.01	ug/l
4,4'- DDD	<0.03	ug/l
4,4'- DDE	<0.01	ug/l
4,4'- DDT	<0.001	ug/l
Dieldrin	<0.003	ug/l
Endosulfan Alpha	<0.003	ug/l
Endosulfan Beta	<0.003	ug/l
Endosulfan Sulfate	<0.3	ug/l
Endrin	<0.004	ug/l
Endrin Aldehyde	<0.03	ug/l
Heptachlor	<0.001	ug/l
Heptachlor Epoxide	<0.005	ug/l
Toxaphene	<0.005	ug/l
Polychlorinated Biphenyls	<0.001	ug/l

Analysis made in accordance with E.P.A.,A.S.T.M., Standard Methods or other approved methods.

Respectfully submitted,

Andrew R. Tintle
Laboratory Supervisor

Enviropact of Tampa Bay, Inc.
Environmental Consulting and Analysis

11181 43 Street North
Clearwater, Florida 33520

Telephone (813) 223-5804
Telephone (813) 577-9663
Fla. Watts: (800) 432-9706

Conservation Consultants, Inc.
726 8th Ave. W.
Palmetto, FL. 33561

December 20, 1985
Report T-2582
page 1 of 1
Lab ID #84271

Sample Received: 12-12-85
Sample Designation: CCI Project #0380-502
Collected By: Your Rep.

REPORT OF ANALYSIS	OIL AND GREASE	UNITS
NC-6	<1	mg/1
SC-1	<1	mg/1
SC-2	1	mg/1
SC-4	<1	mg/1
SC-7	<1	mg/1
CC-2	2	mg/1
CC-3	<1	mg/1
CC-4	<1	mg/1
CC-1	<1	mg/1
CC-5	<1	mg/1
SC-8	<1	mg/1

Analysis made in accordance with E.P.A., A.S.T.M., Standard Methods or other approved methods.

Respectfully submitted,

Andrew R. Tintle
Laboratory Supervisor

Jacksonville • Sebring • Melbourne • Key Largo • Tampa

Enviropact of Tampa Bay, Inc.
Environmental Consulting and Analysis

11181 43 Street North
Clearwater, Florida 33520

Telephone (813) 223-5804
Telephone (813) 577-9663

Conservation Consultants, Inc.
5010 N. Hwy. 19
Palmetto, Fl. 33561

April 17, 1986
Report T-2848
Lab I.D. #84271

Sample Received: 3/27/86
Sample Designation: CCI Project #0380-502; Quarterly Analysis
Collected By: Your Rep.

REPORT OF ANALYSIS	OIL & GREASE	UNITS
CC - 1	2	mg/l
CC - 2	<1	mg/l
CC - 3	3	mg/l
CC - 4	<1	mg/l
CC - 5	4	mg/l
SC - 1	<1	mg/l
SC - 2	<1	mg/l
SC - 3	2	mg/l
SC - 4	<1	mg/l
SC - 7	<1	mg/l
SC - 8	3	mg/l
EL - 1	2	mg/l
NC - 6	<1	mg/l

Analysis made in accordance with E.P.A., A.S.T.M., Standard Methods or other approved methods.

Respectfully submitted,

Andrew R. Tintle
Laboratory Supervisor

Jacksonville • Sebring • Melbourne • Key Largo • Miami

APPENDIX C. MONITORING TEAM

H. LEE DAVIS, Ph.D.
Principal Scientist

FIELDS OF COMPETENCE

Water Resource Planning and Mitigation Concepts, Design and Restoration, Toxicology and Water Chemistry, Limnology and Oceanography.

EXPERIENCE SUMMARY

Dr. H. Lee Davis has gained 20 years of applied research and environmental consulting experience in the field of water resources. Much of his applied research experience has been with evaluations of physical, chemical, and biological changes in natural systems resulting from watershed development and drainage, mining and cooling tower blowdown, point-sources and toxic waste effects, eutrophication, and dredge spoil disposal. In serving both the private and public sectors since 1971, he has employed this experience in planning and permitting studies for industry, utilities, municipalities, land developers and water management authorities. Many of these projects have involved stormwater management, wetland and stream restoration, expansion and protection of potable water supplies, harbor maintenance, and development of impoundments and marinas.

In addition, Dr. Davis has been responsible for the technical supervision and management of professional staffs of water resource scientists, engineers and chemists since 1968. Prior to joining CCI, Dr. Davis held the position of Water Resource Supervisor with Envirosphere Company, the environmental department of Ebasco Services, Inc. His experience from 1971 to 1978 was gained at Environmental Science and Engineering, Inc. where he was the Manager of the Environmental Sciences Division. During the first six years of his career, Dr. Davis was a research assistant at North Carolina State University and a research associate at the University of North Carolina. In these early positions, he supervised field and laboratory operations for studies related to phosphate mining and barrier island development.

EDUCATION

YEAR	SCHOOL
1971	North Carolina State University Ph.D., Marine Science (Marine Chemistry)
1968	North Carolina State University M.S., Zoology (Limnology)
1965	Wilmington College (University of North Carolina - Wilmington, N.C.) B.A., Chemistry and Biology

H. LEE DAVIS, Ph.D.
Principal Scientist

EMPLOYMENT HISTORY

1981 - Present	Conservation Consultants, Inc. Principal Scientist
1978 - 1981	Ebasco Services, Inc. Supervisor, Water Resources/ Envirosphere - Atlanta, Georgia
1971 - 1978	Environmental Science & Engineering, Inc. Director, Environmental Sciences Division ('75-'78) Director, Tampa Regional Office ('77-'78) Project Manager ('73-'78) Leader, Aquatic Sciences Group ('73-'75)
1970 - 1971	University of North Carolina Biology Department Wilmington, North Carolina Research Associate
1965 - 1970	North Carolina State University Pamlico Marina Laboratory Aurora, North Carolina Research Assistant

KEY PROJECTS

City of Bradenton: Principal Investigator for Water Quality Impact Assessment and Monitoring of Reservoir Expansion and Improvement Project; Bill Evers Reservoir, Manatee County, Florida.

Ramar Group Companies, Inc.: Project Manager for Water Quality Impact Assessment related to Stormwater Management Plan for 500-acre, planned residential community on the Caloosahatchee River; Lee County, Florida. Project scope included background monitoring, literature review to determine probable pollutant loadings for undeveloped and developed site, projection of mass loading impacts on water quality, and technical report.

Tara, Ltd.: Principal Investigator to prepare report characterizing background water quality on a 1,100-acre tract; performed statistical analysis of data from one-year water quality/water flow program (11 sites, monthly sampling); performed literature review and was primary author of report.

KEY PROJECTS (Continued)

Palmer Venture: Principal Investigator to monitor and to determine the stormwater pollutant loads and to evaluate the lake management plans for several incremental developments on the 5,000-acre north tract of the Palmer Ranch. Sarasota County, Florida.

Farmland Industries: Principal Investigator for an ecological assessment of the effects of high conductivity levels in the upper reaches of the North Prong Alafia River watershed. Polk County, Florida.

Southwest Florida Water Management District: Principal Investigator to characterize surface water quality of the Delaney Creek Watershed and to evaluate the proposed Stormwater Management Plan including a comprehensive evaluation of alternatives and the development of mitigative measures. Hillsborough County, Florida.

City of Bradenton: Principal Scientist to prepare a report of the existing and anticipated aquatic weed problems of the Bill Evers Reservoir and an analysis of the weed control programs. Submitted to the Evers Reservoir Management Committee, Bradenton, Florida.

Fowler, White, Gillen, Boggs, Villareal & Banker, P.A.: Principal Scientist to perform a data search, review, and analysis of annual cycles and spatial trends in dissolved oxygen and related parameters reported by past and ongoing studies performed in the tidal reach of the Manatee River. Manatee County, Florida.

American Cyanamid Company: Principal Investigator to perform a water quality impact assessment of six dragline and utility line crossings of the South Prong Alafia River during construction, operation, and reclamation phases. Subsequently served as the Senior Advisor on the construction and reclamation water quality monitoring program for the actual crossings. Hillsborough County, Florida.

American Cyanamid Company: Principal Scientist to perform a water quality baseline characterization of significant temporal and spatial trends in nutrient loads, dissolved oxygen, pH, fluoride, and other water quality parameters, for a 42-mile stretch of the South Prong Alafia River from Hookers Prairie to its confluence with the North Prong Alafia River during the period of 1965-1984. Hillsborough County, Florida.

American Cyanamid Company: Project Manager of the Supplement to the Development of Regional Impact Application related to various significant deviations from the original approved mine plan including floodplain crossings, mine expansion, and additional clay settling areas. Four Corners Mine, Hillsborough County, Florida.

KEY PROJECTS (Continued)

American Cyanamid Company: Project Manager for the baseline characterization of surface and ground water quality of three sub-basins of the South Prong Alafia River Basin as related to permit applications to mine within jurisdictional wetlands. Subsequently served as a Principal Scientist on the reclamation monitoring programs of the mined streams. Hillsborough County, Florida.

Holland and Knight: Principal Scientist for the assessment of potential adverse water quality impacts of proposed mining operations in selected wetlands and streams of the Alafia River Basin and an assessment of the feasibility to successfully reclaim mined watersheds. Hillsborough County, Florida.

AMAX Chemical Corporation: Principal Scientist for an evaluation of spatial and temporal trends of the saltwater - freshwater interface in Bishop Harbor and a contiguous tributary as related to permit renewal. Manatee County, Florida.

Agrico Chemical Company: Principal Investigator to evaluate the cause of an extreme range in pH in a chemical plant, wastewater holding pond. Subsequently developed and evaluated conceptual alternatives to control pH and related non-compliance parameters. Polk County, Florida.

Honeycomb Company of America: Project Manager to evaluate the quality of industrial wastewater from an aluminum honeycomb manufacturing facility as related to its suitability for discharge into a public sewer system. Manatee County, Florida.

Manatee County Planning and Development Department: Principal Scientist to evaluate the proposed Cooper Creek Development with respect to the possible impacts it could have on the quality of the drinking water supply of the Bill Evers Reservoir as well as its source waters. Manatee County, Florida.

Knepper & Willard, Inc.: Principal Scientist to characterize baseline water quality conditions for a 2,500-acre residential, commercial, and industrial development site and to evaluate the anticipated level of mitigation expected to be achieved through the implementation of a stormwater management plan. Saddlebrook Ranch, Pasco County, Florida.

Beker Phosphate Corporation: Principal investigator for An Evaluation of Environmental Significance of Phosphorus Levels in the discharge of clay settling pond effluent into Wingate Creek, Manatee County, Florida.

KEY PROJECTS (Continued)

Pan American Plant: Project Manager to conceptually design a source of low conductivity irrigation water for a plant nursery in lieu of high conductivity ground water sources. Manatee County, Florida.

Jacksonville Electric Authority: Project Scientist for the Evaluation of, Construction and Operation of an Ocean Going Barge Unloading Facility on Blount Island on the Water Quality and Aquatic Biology of the St. Johns River.

Carolina Power and Light: Project Investigator for the Evaluation of Cooling Water Design Alternatives including an Ocean Intake Five (5) Mile Long Pipeline Alternative to Mitigate Ecological Impacts on the Cape Fear River, 1200 MW Nuclear Power Plant. Southport, North Carolina.

Jacksonville Electric Authority: Co-principal Investigator for the preparation of a Site Certification Application and Environmental Impact Draft - Impact on Water Resources. Proposed 2-600 MW Unit Coal Fired Power Plant, Jacksonville, Florida.

Smith-Douglass Division of Borden Chemical: Project Manager for the preparation of Development of Regional Impact Application - Impact on Environment and Natural Resources. Wastewater discharge permits and baseline water quality monitoring program. Big Four Mine, Hillsborough County, Florida.

Offshore Power Systems: Principal Investigator for the pre-operational and operational assessment of a Dredge-Spoiling Operation in the St. Johns River; determination of reduced sulfur gas emissions from estuarine sediments. Jacksonville, Florida.

Mobile District, Corps of Engineers: Principal Investigator for the Development of a water quality and fishery assessment in the tailrace waters of West Point Dam, Georgia.

Texasgulf Company: Assistance in a long-term assessment of the nitrogen and phosphate budgets of the Pamlico River Estuary. Phosphate mine and fertilizer plant, Lee Creek, North Carolina.

Jacksonville Electric Authority: Principal Investigator for a two-year assessment of entrainment and impingement rates, fish return system effectiveness and thermal loading at the Northside Generating Station, a once-through cooled 1200 MW plant. St. Johns River, Jacksonville, Florida.

KEY PROJECTS (Continued)

New Orleans District, Corps of Engineers: Project Advisor for preparation of the Draft Environmental Report to perform maintenance dredging in the Gulf Intracoastal Waterway. Louisiana.

Southern States Energy Board: Co-principal Investigator; feasibility and impact assessment of a 16 Unit Nuclear Energy Park - Impact on water resources. Lake Hartwell, South Carolina.

SELECTED REPORTS

Davis, H. L. 1968. The net exchanges of phosphate by estuarine sediment in flowing waters. M.S. Thesis. North Carolina State University. 41 pages.

Davis, H. L. 1971. Evaluation and use of pCO_2 in studying community metabolism in heated experimental ecosystems. Ph.D. Dissertation. North Carolina State University. 90 pages.

Copeland, B. J. and H. L. Davis. 1972. Estuarine ecosystems and high temperatures. North Carolina State University. State College of Agriculture and Engineering. Raleigh. Water Resources Research Institute. Report No. 68. 101 pages.

Davis, H. L. and K. D. Wilson. 1975. Analysis of pollution from marine engines and effects on the environment - southern lakes. U.S.E.P.A., Report No. 71-060-003. 226 pages.

Davis, H. L. 1982. Pre-development surface water quality monitoring report. Tara Planned Unit Development Site, Manatee County, Florida. Prepared for TARA, LTD., Bradenton, Florida. 146 pages.

Davis, H. L. 1983. Bradenton reservoir improvements pre-construction water quality monitoring and water quality impact assessment report. Manatee County, Florida. Prepared for Smith and Gillespie Engineers, Inc. Jacksonville, Florida. 287 pages.

Davis, H. L. 1984. A review of dissolved oxygen and related water quality conditions for the lower Manatee River, Manatee County, Florida. Prepared for Fowler, White, et al., P.A. Tampa, Florida. 57 pages.

Davis, H. L. and W. W. Hamilton. 1984. Aquatic weeds in the Bill Evers Reservoir. Prepared for Evers Reservoir Management Committee. Bradenton, Florida. 13 pages.

SELECTED REPORTS (Continued)

Davis, H. L., J. M. Emery and L. J. Swanson. 1985. Systems characterization, Delaney Creek stormwater management master plan, Hillsborough County, Florida. Prepared for Ghioto, Singhofen and Associates, Orlando, Florida. 234 pages.

MEMBERSHIPS

American Society of Limnology and Oceanography
Southeastern Estuarine Research Society
Ecological Society of America

RICHARD W. ODELL
Staff Scientist

FIELDS OF COMPETENCE

Water Quality Monitoring, Biological Sample Collection/Processing, Automatic Instrumentation, Data Acquisition, Field Methodology/ Quality Assurance, Marine Biology, Air Quality Sampling, Visible Emissions

EXPERIENCE SUMMARY

Mr. Odell has six years of experience in environmental technical services. He has worked directly in the areas of water resources, aquatic biology, and wetlands. He has served as a coordinator, field team member, and quality assurance officer for numerous field sampling projects. He has completed all phases of surface water quality investigations including in situ measure-ments, grab samples, flow determinations, solar irradiance and light attenuation, automatic data acquisition, and composite sampling. He has monitored groundwater via well installations, water level measurements, and grab samples. He has collected and processed aquatic biological samples, participated in wetland jurisdiction determinations, and revegetated wetlands for mitigative purposes. Additionally, Mr. Odell has been active in data management and report preparation.

EDUCATION

YEAR	SCHOOL
1975	Delta State University Cleveland, Mississippi B.S. - Biology
1978	University of Southern Mississippi Hattiesburg, Mississippi 60 credit hours in Graduate Level Marine Biology, Environmental Physiology

RICHARD W. ODELL
Staff Scientist

EMPLOYMENT HISTORY

1980 - Present Conservation Consultants, Inc.

KEY PROJECTS

American Cyanamid Co.: Field Services Coordinator for background and post-reclamation monitoring of three wetland streams. Duties included project mobilization, grab and biological sample collection, automatic water quality data acquisition, data management, and report preparation.

American Cyanamid Co.: Field Technician for background assessment of wetland sources in the Little Manatee River drainage basin. Duties included stream flow measurements and grab sample collection.

American Cyanamid Co.: Field Team Leader for revegetation of wetland with native plant species. Duties included mobilization, site survey, and planting.

Applied Optics, Inc.: Field Technician for beryllium emissions evaluations during two-year period. Duties included equipment calibration and installation, in stack sampling, sample recovery, and data management.

CF Mining Corp.: Field Team Leader for background aquatic biological assessment of freshwater stream. Duties included installation and recovery of artificial substrate sampling devices and sample processing.

City of Bradenton: Field Team Leader for pre-construction and construction phase water quality monitoring of Bill Evers Reservoir. Duties included project mobilization, grab sample collection, *in situ* measurements, flow measurements, light attenuation and solar irradiance measurements, data management, and report preparation.

Florida Power and Light Co.: Field Technician and Field Team Leader for particulate emissions evaluations during three-year period. Duties included equipment installation, in stack sampling, and data management.

Honeycomb Co. of America: Field Technician for investigation of industrial wastewater discharge. Duties included mobilization, flow measurements, *in situ* water quality measurements, and preparation of flow-proportional composite sample.

KEY PROJECTS (Continued)

Loral American Beryllium: Field Technician for beryllium emissions evaluations during two-year period. Duties included equipment calibration and installation, in stack sampling, sample recovery, and data management.

Lynnette, Inc.: Field Team Leader for background biological and water quality assessment in Little Sarasota Bay. Duties included benthic biological sampling, water quality profile measurements, grab sample collection, and data management.

Manatee Canvest Corp.: Project Manager and Field Services Coordinator for post-construction water quality monitoring of a marina. Duties included automatic water quality data acquisition, grab sample collection, data management, and report preparation.

Marcove Venture: Field Technician for revegetation of mangrove ecosystem. Duties included mobilization, site survey, and planting.

Miller Trailers, Inc.: Field Technician for compliance visible emissions evaluations of industrial plant during two-year period.

Tara, Ltd.: Field Team Leader for background assessment of water quality and stream flow on 1,100-acre planned residential development site. Duties included grab sample collection, flow measurements, time-series composite sampling, data retrieval from continuous rainfall recorder, and data management.

U.S. Army, Corps of Engineers: Field Services Coordinator of daily monitoring project in association with dredge and dredge material disposal operations of the Tampa Harbor Deepening project. Served as Project Field Technician initially and as Field Services Coordinator for one year of three-year program. Participated in grab sample collection, scheduling, training, and data management.

DOROTHY S. MORSE
Staff Chemist

FIELDS OF COMPETENCE

Chemical Analysis of Surface and Ground Water, Wastewater, Soil, Marine Water, Air, Vegetation, and Animal Tissue; Bacteriological Analysis of Water; Analytical Quality Control and Assurance Procedures; Statistical Analysis of Data.

EXPERIENCE SUMMARY

Mrs. Morse joined Conservation Consultants, Inc. in 1979 and has been in charge of the daily operation of the water chemistry lab since that time. Her work includes both supervision and performance of analytical testing on surface, ground, and marine waters; Project Management; management of quality control functions for laboratory procedures and equipment, including preparation of Quality Assurance plan; and preparation of laboratory and project reports.

Prior to joining Conservation Consultants, Inc. in 1979, Mrs. Morse worked at the Manatee County Health Department Pollution Control Laboratory. From 1974-1978 she was in charge of a commercial laboratory in Manatee County which included positions with the University of Florida Soil Chemistry Research Laboratory and the Upstate Medical Center Biochemistry Research Laboratory in Syracuse, New York.

EDUCATION

YEAR	SCHOOL
1964-1968	Indiana University Bloomington, Indiana Bachelor Degree - Physiology & Chemistry
1972	University of Florida Gainesville, Florida Correspondence Course - Soil Chemistry

DOROTHY S. MORSE
Staff Chemist

EMPLOYMENT HISTORY

1979 - present	Conservation Consultants, Inc. Chief Chemist Environmental Engineering Division
1979	Manatee County Health Department Pollution Control Laboratory Technician
1974-1978	Utility Service Associates, Inc. Laboratory Supervisor Bradenton, Florida
1972-1974	Bradenton Research Center University of Florida Agricultural Center Soil Chemistry technician II
1968	Upstate Medical Center Technical Specialist II Syracuse, New York

SOCIETY MEMBERSHIPS

American Society for Testing and Materials (ASTM)