TENTH ANNUAL REPORT OF THE CONTINUING SURFACE WATER QUALITY MONITORING PROGRAM FOR THE CATFISH AND NORTH CREEKS OF THE PALMER RANCH JANUARY - DECEMBER, 1994 SARASOTA COUNTY, FLORIDA

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1.0 INTRODUCTION

A master development plan for the Palmer Ranch is being implemented pursuant to the terms and conditions of the **Amended and Restated Master Development Order** (Amended MDO) for the Palmer Ranch Development of Regional Impact (DRI) which was adopted on July 12, 1991, by the Board of County Commissioners of Sarasota County. The amended and original MDO's call for planning and developing the 5,119-acre Palmer Ranch DRI in incremental developments. Construction of the first incremental development (Prestancia) was initiated in 1986. The Palmer Ranch is located in west-central Sarasota County as shown in **Figure 1.1**.

Pursuant to the conditions of the original MDO, a "Continuing Surface Water Quality Monitoring Program" was required to be performed prior to and during construction, except during the period in which a "Pollutant Loading Monitoring Program" was to be performed as specified in the Agreement of Understanding between Sarasota County and Palmer Venture established during August 1987.

The original monitoring program, which was initiated in May 1984 by GeoScience, Inc., employed a bimonthly sampling frequency as required for the first year of monitoring. Subsequently, the scope of the monitoring program for the following two-year period was revised during an agency review meeting in June 1985. The meeting involved the developer's representative, Mr. T. W. Goodell, and Mr. Russ Klier of

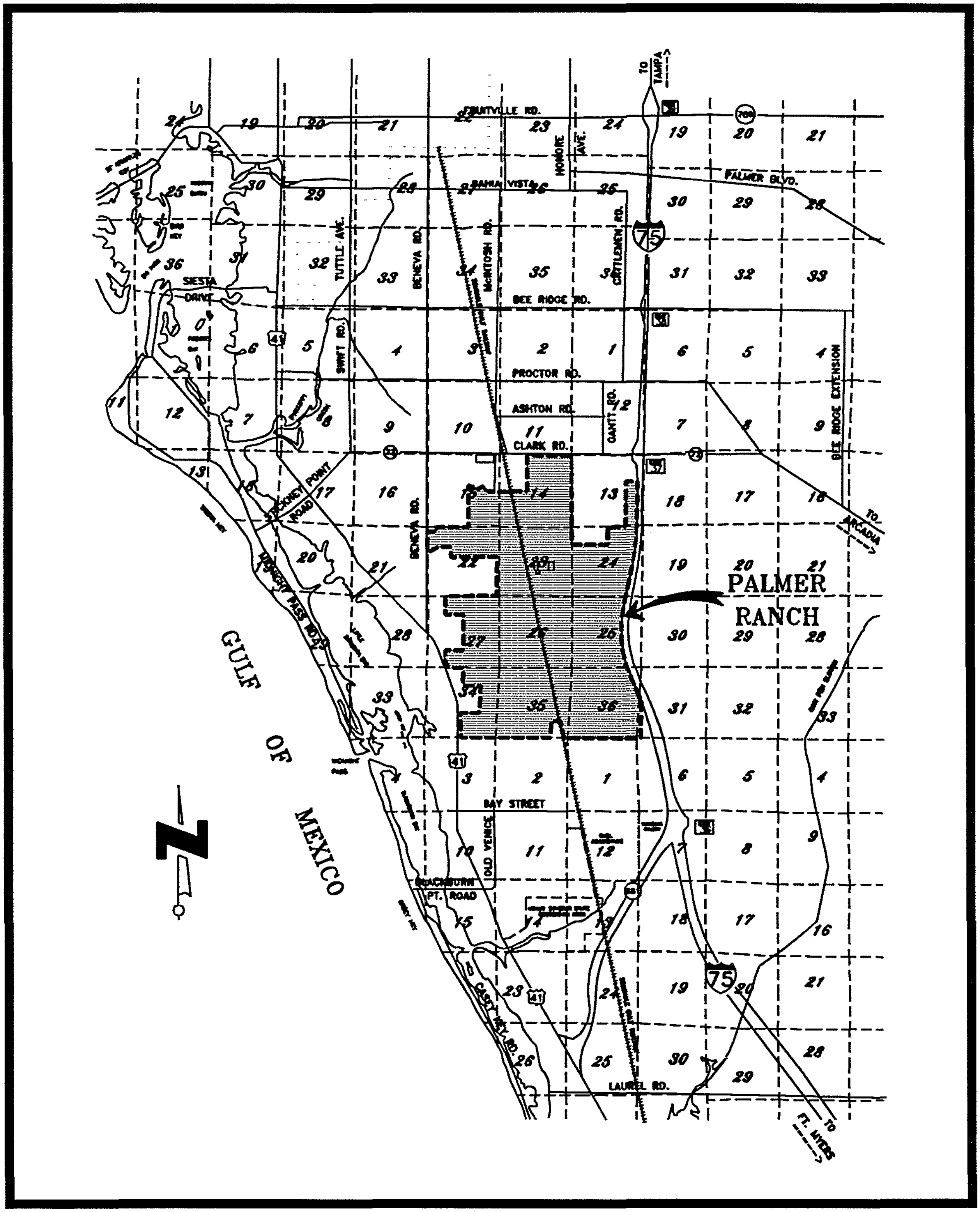


Figure 1.1 General Site Location.

Sarasota County Pollution Control Division (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 pesticides which would receive annual audits (refer to July 24, 1986 correspondence of Mr. T. W. Goodell to Mr. Russ Klier).

Palmer Venture contracted CCI Environmental Services, Inc. (*f.k.a.* Conservation Consultants, Inc.) to implement the "Continuing Surface Water Quality Monitoring Program" during the second year of the monitoring program. CCI Environmental Services, Inc. (CCI) began monitoring on September 16, 1985, pursuant to the instructions provided by Palmer Venture. Except for an annual sampling event conducted in September 1988, the "Continuing Surface Water Quality Monitoring Program" was suspended in June 1988, due to the initiation of the "Pollutant Loading Monitoring Program". The Stormwater Pollutant Loading Monitoring Program was performed between June 1988 and December 1989 and a report submitted to Sarasota County on May 29, 1992. Subsequent to an agreement between the Sarasota County Pollution Control Division and Palmer Venture, the "Continuing Surface Water Quality Monitoring Program" was resumed in December 1989 with a single annual sampling event conducted during the fifth monitoring year. After resumption of monitoring in December 1989, the surface water quality monitoring was performed on a quarterly basis at all stations until December 10, 1991.

With adoption of **Exhibit "E" to the Amended and Restated Master Development Order for the Palmer Ranch Development of Regional Impact (Appendix A)**, a revised water quality monitoring program was implemented in 1992. This revised monitoring program consists of quarterly water quality measurements and grab sample collection in Catfish Creek, North Creek and South Creek at a total of 10 monitoring stations. In accordance with Exhibit "E", monitoring in the South Creek Basin was suspended until one month prior to any development activity occurring in the basin. Upon intent to re-initiate monitoring of the South Creek Basin, Sarasota County Pollution Control Division is to be notified of dates of sampling and stations to be sampled. As specified in Exhibit "E", this pre-development monitoring event will include water quality grab sampling and *in situ* measurements at four (4) monitoring stations along South Creek. Following this initial monitoring event, all subsequent monitoring shall be performed on a quarterly basis during the development phase. During development, all stations located downstream of an area under development shall be monitored. Additionally, one sampling site located upstream of a development area shall also be monitored in order to determine baseline water quality conditions. Once an area is substantially developed as agreed to by the Sarasota County Pollution Control Division and the Palmer Ranch, a modification of the monitoring program shall be subject to discussion for change in water quality monitoring frequency from quarterly to semi-annually or to be discontinued.

Under the amended and approved monitoring plan as stated in Exhibit "E", monitoring of Catfish Creek and North Creek is to continue on a quarterly basis for a maximum of two years or until substantial development occurs. Once substantial development or a two-year period occurs and is agreed to by both Sarasota County Pollution Control Division and the Palmer Ranch, the monitoring frequency for sites located in

Catfish Creek and North Creek shall be subject to change from quarterly to semi-annually depending on results obtained up to that time. On April 29, 1994, Mr. Kent Kimes of the Sarasota County Pollution Control Division approved a reduction in sampling frequency for the Catfish Creek and North Creek monitoring stations from quarterly to semi-annually.

Monitoring of the South Creek Basin was re-initiated with the first quarterly sampling occurring on January 13, 1994. Results of the water quality monitoring performed in the South Creek Basin are presented in a separate narrative report (CCI, 1995).

The water quality conditions recorded during semi-annual sampling events for the period from January through December 1994 in the Catfish Creek and North Creek basins are reported herein. This report includes a discussion of the results with respect to applicable water quality criteria, observed spatial and temporal trends, and comparisons with results obtained during previous monitoring events.

2.0 GENERAL ENVIRONMENTAL SETTING

2.1 Climate

Prevailing climatic conditions in west-central Florida are sub-tropical, 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 AVERAGE MONTHLY AIR TEMPERATURES (NATIONAL WEATHER SERVICE, TAMPA, FL.).

	AIR TEMPERATURE			
	1941-1970[a]		1931-1960[b]	
MONTH	°C	°F	°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 Average	22.5	72.5	22.6	72.7

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

Based on a 30-year period of record, rainfall in Bradenton, Florida (NOAA, 1977) averages 56 inches per year. The minimum annual rainfall recorded during the 30-year period was 29 inches while the maximum was 93 inches. Historical rainfall trends for this area show that a wet season occurs during the period of June through September followed by a dry season during the period of October through January. On the average 62 percent (35 inches) of the annual rainfall occurs during the summer with only 13 percent (7 inches) during the fall. The dry season is followed by a short wet period during February and March and subsequently a short dry period during April and May.

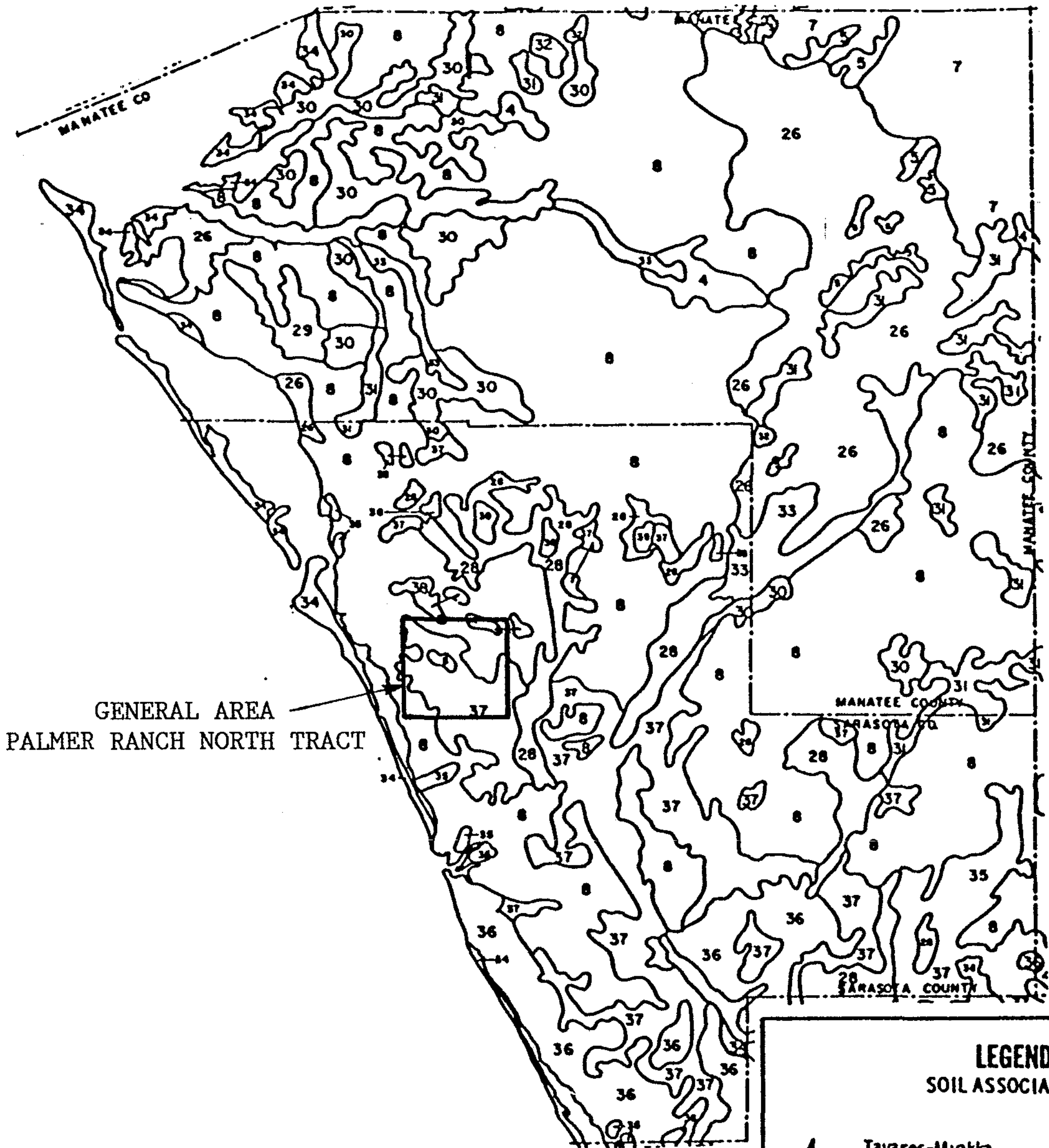
2.2 Soils

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 (Florida Division of State Planning, 1975). 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 (Florida Division of State Planning, 1975).

Along the well-incised banks of several drainage ditches traversing the Palmer Ranch (*e.g.* lower reach of Catfish Creek), it is evident that a natural marine deposit exists a few feet below the ground surface. This marine deposit contains a thin layer of shells and shell fragments. **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 the following: construction of a surface water management system; construction of roads, golf courses, homes and wastewater treatment facilities and associated domestic wastewater spray effluent fields; and, land disposal of sludge. During the second monitoring year (April 1985 - March 1986), the land application of sludge wastes on



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 Céia

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 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 DESCRIPTIONS OF SOIL ASSOCIATIONS (Continued).

Area Definition	Map Unit No.	Soil Association Description
Areas dominated by moderately well to poorly drained soils subject to flooding (continued)	35	Pomello-Paola-St. Lucie association: Nearly level to sloping, moderately well drained sandy soils with weakly cemented sandy not subsoil and excessively drained soils, sandy throughout.
	36	Imokalee-Myakka-Pompano association: Nearly level, poorly drained, sandy soils with weakly cemented sandy subsoil and poorly drained soils, sandy throughout.
	37	Adamsville-Pompano 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 sub-soil.
	31	Placid-Bassinger association: Nearly level, very poorly and poorly drained soils, sandy throughout.

TABLE 2.2 DESCRIPTIONS OF SOIL ASSOCIATIONS (Continued).

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, draughty sands.
	39	Terra Ceia association: Nearly level, very poorly drained, well-decomposed, organic soils 40-91 cm (16-36 inches) thick over loamy material.

the Palmer Ranch was discontinued and construction of the Central County Utilities Regional Treatment Plant and an adjacent golf course was completed. Subsequently, construction of a residential development was initiated during the third monitoring year.

Land uses adjacent to the ranch which are located upstream in several drainage basins covering portions of the ranch include golf courses, roads and highways, residential developments, a mobile home park, commercial businesses, a dairy farm which was changed to a sod farm (effective August 1, 1987), light industry, and a metal salvage operation.

The primary vegetation associations found on the undeveloped areas of the ranch include pine flatwoods, improved and semi-improved pastures, wet prairies, marshes and sloughs, swamps, and wetland fringing hammocks.

2.4 Drainage

The Palmer Ranch DRI is divided into six primary drainage basins which ultimately discharge into Drymond Bay. Two basins, the Catfish Creek\Trunk Ditch Basin and the South Creek Basin, drain the majority of the North Tract. 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 approximately 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). A general description of the major streams in these basins is provided in the following sections.

2.4.1 *Catfish Creek*

Catfish Creek within the limits of the Palmer Ranch DRI was a man-made ditch/channel system which flowed southwest to the southern boundary of the property, intersecting Trunk Ditch, a straight man-made canal, at five locations. The upper portion of Catfish Creek receives off-site drainage from commercial and industrial areas near Clark Road. Many of these commercial and industrial areas lack stormwater management systems. The lower portion of the Catfish Creek drainage system receives stormwater run-off from various stormwater management systems located throughout the Palmer Ranch residential development.

Immediately downstream of the Palmer Ranch, the Catfish Creek drainage system receives drainage and at times "overflow" from the wastewater treatment ponds associated with a mobile home park. Farther downstream, drainage from residential areas and run-off from U.S. Highway 41 enter the creek. Beyond U.S. Highway 41, Catfish Creek is affected by tidal changes from Little Sarasota Bay.

2.4.2 *Trunk Ditch*

Trunk Ditch was originally constructed to improve drainage. Initially, it extended from the northern boundary of the Palmer Ranch property to North Creek and resulted in scouring velocities during major storm events. These high velocities resulted in out-of-bank flooding and sediment transport. During early 1986, a segment of Trunk Ditch was re-constructed in association with the Development of Prestancia. This reconstruction resulted in an improved channel and the placement of two water level control weirs. As a result of these two weirs, lentic conditions occur during the dry season. Vegetation in Trunk Ditch is dominated by Hydrilla, Elodea, cattail, and other aquatic weeds. As mentioned earlier, Catfish Creek intersects Trunk Ditch at five locations.

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

Subsequently, three (3) additional weirs were added in the re-constructed portion of the Trunk Ditch during 1988 to 1991. Also, a drainage-basin divide between Catfish Creek and North Creek was created at that time with the construction of Central Sarasota Parkway.

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 and trees resulting in a partially overhanging canopy. Most of the drainage into this dredged tributary originates from improved pasture, idle agricultural land, a marsh/slough system, and an off-site metal salvage operation. Downstream of the North Tract, Trunk Ditch enters the main channel of North Creek, which subsequently flows into Little Sarasota Bay. Residential areas, U. S. Highway 41, and pine flatwoods drain into the downstream reach of North Creek.

2.4.4 *South Creek*

South Creek within the Palmer Ranch is largely a shallow ditch system constructed through historic, broad sloughs or interconnecting previously isolated marshes. The banks of South Creek are vegetated with grasses and occasional pines, while its channel is generally void of aquatic vegetation. Upstream of the Palmer Ranch, South Creek receives drainage in its western tributary from a golf course and a mobile home park. At its eastern boundary, it receives drainage from agricultural and recreational land uses as well as Interstate I-75. Before mid-1987, much of the area upstream of I-75 was used as a dairy farm.

Within the Palmer Ranch, South Creek receives drainage primarily from improved pastures and pine flatwoods. Downstream of the ranch, South Creek flows through the Oscar Scherer State Recreational Area and subsequently into the tidal waters of Drymond Bay.

2.4.5 *Elligraw Bayou*

Elligraw Bayou is a channelized stream that flows southwesterly to Drymond Bay. The banks of Elligraw Bayou are sloped and vegetated with grasses and trees. On the ranch, Elligraw Bayou receives drainage from Increment II development areas and Prestancia (Increment I). Downstream of the Palmer Ranch, Elligraw Bayou flows through Ballantrae and several other residential areas before entering Drymond 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 Drymond Bay. The banks of Matheny Creek are steep and vegetated with grasses and some trees. Drainage enters Matheny Creek from residential developments, commercial and industrial areas, and golf courses.

2.4.7 *Clower Creek*

Clower Creek forms the south border of the 70-acre Sarasota Square Mall. A 1.6 acre wet prairie located east of the mall on the Palmer Ranch most likely represents the headwaters of Clower Creek during the wet season. Drainage conveyed by Clower Creek flows westerly for 1,350 feet, and subsequently, through an underground pipeline along the north and west borders of a trailer park adjacent to the Sarasota Square Mall. After flowing underground for about 650 feet, drainage enters the mall's stormwater management system. Subsequently, discharge from the mall's stormwater management system drains through swales into culverts and underneath U.S. 41 to Drymond Bay.

2.5 <u>Water Quality Classification</u>

The segments of the streams traversing the North Tract of the Palmer Ranch are non-tidal freshwater systems which have been designated by the State as Class III waters pursuant to Sub-section 17-302.400(1) of the Florida Administrative Code (FAC). Downstream, these streams flow into an estuarine system (Drymond Bay) which is classified as an Outstanding Florida Water (OFW). In addition, the segment of South

Creek which flows through the Oscar Scherer State Recreational Area is classified as an OFW. State and Sarasota County water quality standards applicable to the "Continuing Water Quality Monitoring Program" (*i.e.*, those applicable to Class III, predominantly fresh surface waters) are listed in **Table 2.3.**

TABLE 2.3 APPLICABLE STATE AND COUNTY WATER QUALITY CRITERIA FOR CLASS III, PREDOMINATELY FRESH WATERS.

Parameter	State of Florida FAC 62-302	Sarasota County Ord. No. 72-37
Arsenic	Not >50 μg/L	Not >100 μg/L
Biochemical Oxygen Demand	Not to be increased in a manner that would depress Dissolved Oxygen levels below criteria.	Same as FAC 62-302
Coliform, Fecal	Not >800/100 mL	----
Coliform, Total	Not >2,400/100 mL	Not >2,400/100 mL
Specific Conductance	Shall not be increased more than 50% above background or to 1,275 μmhos/cm, whichever is greater, in predominantly fresh waters.	+100% above background, or to max. of 500 μmhos/cm in fresh water streams.
Copper	Not >12.8 μg/L at a Total Hardness of 110 mg/L	Not >10 μg/L
Dissolved Oxygen	Not <5 mg/L	Not <4 mg/L
Lead	Not >3.6 μg/L at a Total Hardness of 110 mg/L	Not >10 μg/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.	-----
Nitrogen, Ammonia (ionic plus non-ionic)	See Nutrients	Only applies to non-ionic Ammonia
Nitrogen, Nitrite	See Nutrients	-----
Nitrogen, Nitrate	See Nutrients	-----
Nitrogen, Total	See Nutrients	-----

TABLE 2.3 APPLICABLE STATE AND COUNTY WATER QUALITY CRITERIA FOR CLASS III, PREDOMINATELY FRESH WATERS (Continued).

Parameter	State of Florida FAC 62-302	Sarasota County Ord. No. 72-37
Nitrogen, Organic	See Nutrients	-----
Oil and Greases	Not >5 mg/L	Not >15 mg/L
Phosphate, Ortho	See Nutrients	-----
Phosphorus, 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	Not >115 μg/L at a Total Hardness of 110 mg/L	Not >10 μg/L

3.0 FIELD AND LABORATORY PROCEDURES

3.1 Station Locations and General Descriptions

The "Continuing Surface Water Quality Monitoring Program" employs a network of 10 sampling stations located at various sites along South Creek, Catfish Creek, North Creek, and Trunk Ditch (**Figure 3.1**). A general description of the characteristics of the 10 sampling stations is provided in **Table 3.1**.

As stated previously, monitoring in South Creek was re-initiated in January 1994, approximately one month prior to development activity in the basin. Results of the 1994 water quality monitoring performed at stations located in the South Creek are presented in a separate report (CCI, 1995).

In Catfish Creek, inflow into the Palmer Ranch was monitored at Station CC-1 while outflow was monitored at Station CC-5. Station CC-1 receives drainage from Clark Road, McIntosh Road, and various commercial/industrial developments. Two tributaries of Catfish Creek were also monitored near their confluences with Trunk Ditch (Stations CC-2 and CC-3). These two stations represent stream segments which receive drainage from Prestancia and backwater effects of Trunk Ditch.

Trunk Ditch was monitored within its realigned segment within the Catfish Creek-Trunk Ditch Drainage Basin at Station CC-4. This site lies adjacent to and receives drainage from both the Country Club of Sarasota and Prestancia and sources farther upstream, as well as pine flatwoods, improved pastures, and wetlands of the Palmer Ranch. Farther to the South, Trunk Ditch was monitored at a location within the North Creek Basin, *i.e.*, Station NC-6.

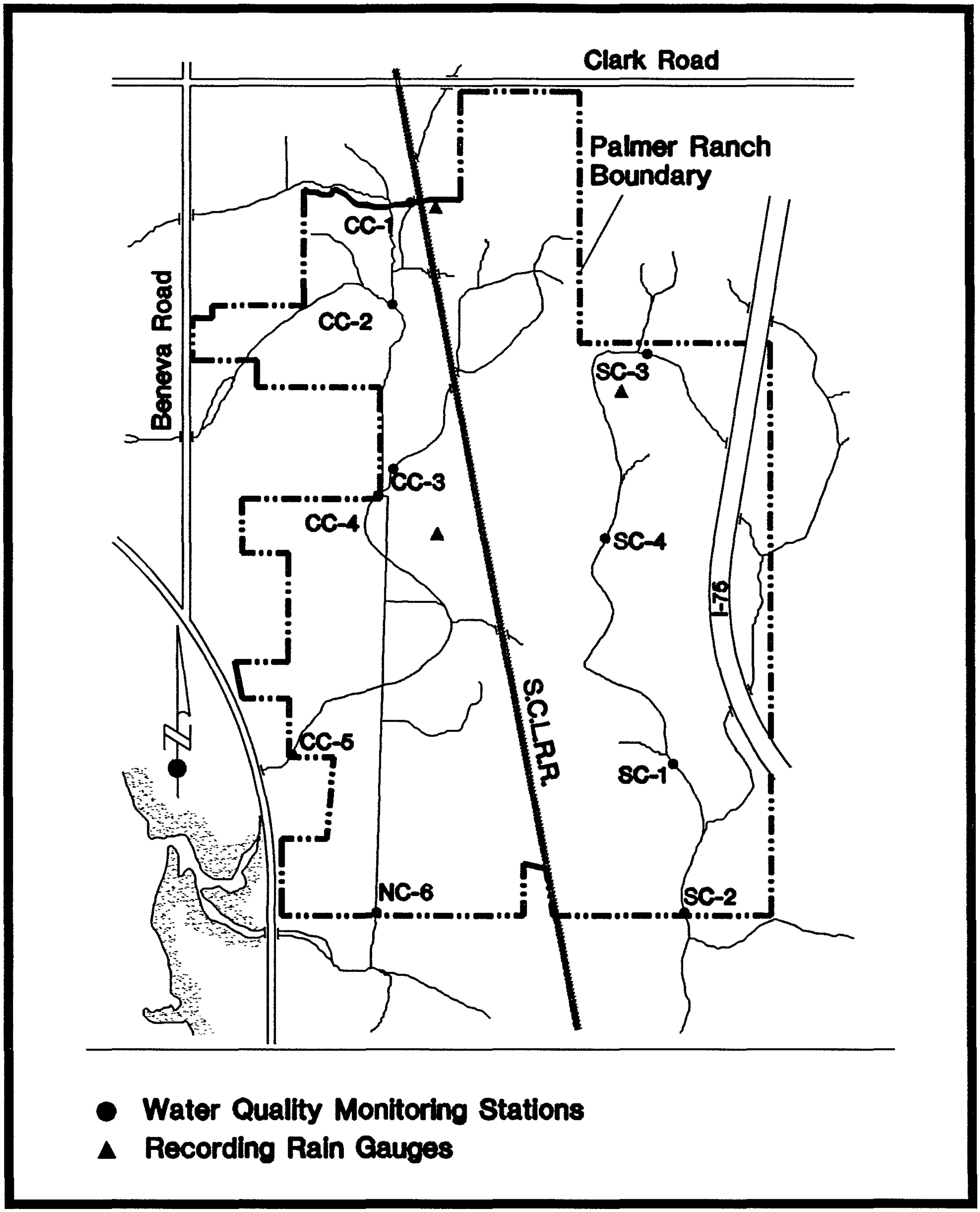


Figure 3.1 Locations of Surface Water Monitoring Stations.

TABLE 3.1 GENERAL DESCRIPTIVE CHARACTERISTICS OF SURFACE WATER QUALITY SAMPLING STATIONS.

	General	Water Depth	Channel Width	
CC-1	Catfish Creek Site Entry	1.0-1.6	10	75-100% Canopy of *Salix*, Rooted Emergents, Incised Banks.
CC-2	Catfish Creek Upstream of Trunk Ditch	0.0-0.45	12	Aquatic Vegetation, Shallow Sloped Banks.
CC-3	Catfish Creek Upstream of Trunk Ditch	0.3-0.6	6	Aquatic Vegetation, Incised Banks.
CC-4[b]	Trunk Ditch Downstream of Catfish Creek Confluence	0.6-2.2	50	Sodded Banks, Rooted Emergents.
CC-5	Catfish Creek Outfall from Site	0.3-0.8	50	Shading in by Oaks, Willows, and Wax Myrtle, Sodded Banks.
NC-6	Trunk Ditch Downstream of Catfish Creek	1.7-2.7	12	Aquatic Vegetation.
SC-1	South Creek Mid-property	0.6-0.7	12	Sand covered with Organic Matter.
SC-2	South Creek at Site Exit	0.5-1.2	17	Rooted Emergents, Floating Aquatics, Palm Trees Shade Channel in A.M.
SC-3	South Creek Outfall from Large Wetland	0.0-0.7	10	Shallow banks, Aquatic Vegetation.
SC-4	South Creek near Honore Avenue	0.7-1.2	8	Rooted Emergents Cover 33% of Channel, Canopy of Pine.

[a]Range in Depth recorded during monitoring period of April, 1987 - March, 1988.
[b]Depths reported are depths at sampling location - total depth at site averages 8.0 feet.

3.2 Parameters and Sampling Frequency

Semi-annual sampling was performed during March and September 1994. The analysis of the annual parameters was performed for samples collected during the September 1994 monitoring event. The dates and times of all sample collections are provided in **Table 3.2.**

Surface water quality monitoring from January through December 1994 was performed by: (1) the use of field instrumentation and *in situ* measurements; and (2) the collection of grab samples for subsequent laboratory analyses. A digital readout Hydrolab or Grant/YSI multi-parameter water quality meter was used for *in situ* measurements of dissolved oxygen, pH, specific conductance, and water temperature. Prior to deployment in the field, all instrumentation was calibrated according to the manufacturer's recommended procedures. All *in situ* measurements were taken at approximate mid-stream and mid-depth at each station. Grab samples were collected at each station during the four quarterly events, preserved, and analyzed in the laboratory within the recommended hold times for the following parameters:

- Ammonia Nitrogen
- Nitrate Nitrogen
- Nitrite Nitrogen
- Organic Nitrogen[1]
- Total Nitrogen
- Orthophosphate
- Total Phosphorus
- Oil and Grease
- Total Suspended Solids
- Turbidity
- Biochemical Oxygen Demand
- Fecal Coliform Bacteria
- Total Coliform Bacteria

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[1]Organic Nitrogen = Total Kjeldahl Nitrogen - Ammoniacal Nitrogen.

TABLE 3.2 DATE AND TIME OF SAMPLING FOR THE TENTH ANNUAL MONITORING PERIOD OF JANUARY THROUGH DECEMBER, 1994

Event No.	Date of Sampling	Monitoring Stations CC-1	CC-2	CC-3	CC-4	CC-5	NC-6
1	14-Mar-94	13:20	13:00	11:15	11:30	10:50	10:20
2	13-Sep-94	10:10	10:35	11:00	11:20	11:50	12:20

Additional surface water grab samples were collected at each of the 6 monitoring stations during the September 1994 monitoring event for the laboratory analysis of the following parameters:

- Arsenic
- Copper
- Lead
- Zinc

All sampling was performed in accordance with CCI's Comprehensive Quality Assurance Plan (CompQAP No. 87201G) on file with the Florida Department of Environmental Protection. Laboratory analyses were performed in accordance with the procedures described in the 17th edition of *Standard Methods for the Examination of Water and Wastewater* (APHA, 1989), *Methods for Chemical Analysis of Water and Wastes* (USEPA, 1983) or other FDEP/USEPA approved methodology. The methods used in the collection, preservation, handling, storage, and analysis of all surface water samples are provided by parameter in **Table 3.3.**

Laboratory analyses were performed by CCI's laboratory which is certified by Florida Department of Health and Rehabilitative Services for the analyses of environmental and drinking water samples. Copies of the laboratory reports of results for the 1994 monitoring events are provided in **Appendix C.**

Two additional parameters, stream flow and stream depth, were monitored at each sampling point concurrently with water quality monitoring as an aid in evaluating the water quality data although not formally part of the "Continuing Surface Water Quality Monitoring Program." Water velocity was determined using a Marsh McBirney model 201D flow meter. Stream flows were subsequently determined in accordance with

TABLE 3.3 COLLECTION AND ANALYTICAL METHODS USED DURING THE CONTINUING SURFACE WATER QUALITY MONITORING PROGRAM.

Parameter	Sample Type	Field Handling	Hold Time	Laboratory Handling	Analytical Method	Method Reference
Total Arsenic	Grab	HNO_3 to pH <2, Stored on Ice	6 Months	Stored at Room Temperature	Digestion, Atomic Absorption - Furnace Technique	EPA 206.2
Fecal Coliform Bacteria	Grab	Stored on Ice	30 Hours	Immediate Analysis	Multiple Tube Fermentation	APHA 9221 C
Total Coliform Bacteria	Grab	Stored on Ice	30 Hours	Immediate Analysis	Multiple Tube Fermentation	APHA 9221 A
Biochemical Oxygen Demand (BOD-5 Day)	Grab	Stored on Ice	48 Hours	Immediate Analysis	Membrane Electrode	APHA 5210 B
Conductivity	*In situ*	----	----	----	Hydrolab - Wheatstone Bridge	APHA 2510 B
Total Copper	Grab	HNO_3 to pH <2, Stored on Ice	6 Months	Stored at Room Temperature	Digestion, Atomic Absorption	EPA 220.1
Total Lead	Grab	HNO_3 to pH <2, Stored on Ice	6 Months	Stored at Room Temperature	Digestion, Atomic Absorption	EPA 239.1
Ammonia Nitrogen	Grab	H_2SO_4 to pH <2, Stored on Ice	28 Days	Stored at 4 °C	Automated Phenate	EPA 350.1
Nitrate + Nitrite Nitrogen	Grab	H_2SO_4 to pH <2, Stored on Ice	28 Days	Stored at 4 °C	Automated Cadmium Reduction	EPA 353.2
Nitrite Nitrogen	Grab	Stored on Ice	48 Hours	Stored at 4 °C	Automated Autoanalyzer	EPA 353.2
Nitrate Nitrogen	Grab	----	----	----	Calculation	EPA 353.2
Total Kjeldahl Nitrogen	Grab	H_2SO_4 to pH <2, Stored on Ice	28 Days	Stored at 4 °C	Automated Block Digestion, Autoanalyzer	EPA 351.2
Total Nitrogen	Grab	----	----	----	Calculation	EPA 351.2
Oil and Grease	Grab	H_2SO_4 to pH <2, Stored on Ice	28 Days	Stored at 4 °C	Gravimetric	EPA 413.1

TABLE 3.3 COLLECTION AND ANALYTICAL METHODS USED DURING THE CONTINUING SURFACE WATER QUALITY MONITORING PROGRAM (Continued).

Parameter	Sample Type	Field Handling	Hold Time	Laboratory Handling	Analytical Method	Method Reference
Dissolved Oxygen	*In situ*	----	----	----	Hydrolab - Membrane Electrode	APHA 4500 G
pH	*In situ*	----	----	----	Hydrolab - Electrometric	APHA 4500-H^+
Orthophosphate	Grab	Stored on Ice	48 Hours	Immediate Analysis	Automated, Ascorbic Acid	EPA 365.1
Total Phosphorus	Grab	H_2SO_4 to pH <2, Stored on Ice	28 Days	Stored at 4 °C	Automated Block Digestion, Autoanalyzer	EPA 365.4
Total Suspended Solids (TSS)	Grab	Stored on Ice	7 Days	Stored at 4 °C	Glass Fiber Filtration, Dried at 105 °C	APHA 2540 C
Temperature	*In situ*	----	----	----	Hydrolab - Thermistor	APHA 2550 B
Turbidity (NTU)	Grab	Stored on Ice	48 Hours	Stored at 4 °C	Nephelometric	APHA 2130 B
Total Zinc	Grab	HNO_3 to pH <2, Stored on Ice	6 Months	Stored at Room Temperature	Digestion, Atomic Absorption	EPA 289.1
Flow/Direction	*In situ*	----	----	----	Marsh-McBirney Flow Meter - Electromagnetic Sensor	Manufacturer's Specifications

APHA - American Public Health Association, American Water Works Association and Water Pollution Control Federation, 1989. *Standard Methods for the Examination of Water and Wastewater*, 17th Edition. American Public Health Association.

EPA - U.S. Environmental Protection Agency, 1983. *Methods for Chemical Analysis of Water and Wastes*, EPA - 600/4-79-020, National Environmental Research Center, Cincinnati, Ohio.

the USGS two-point (*i.e.* area/velocity) method (USGS, 1982). Stream depth was measured with a weighted fiberglass tape at each point of water quality sampling.

4.0 RESULTS AND DISCUSSION

During the tenth year of the "Continuing Surface Water Quality Monitoring Program" (*i.e.*, January through December 1994) quarterly surface water quality monitoring was conducted by CCI. Sampling was conducted on March 14 and September 13, 1994, in compliance with the conditions of the Amended and Restated Master Development Order for the Palmer Ranch Development of Regional Impact (**Appendix A**).

Individual results for the two semi-annual events performed during the 1994 monitoring year for the "Continuing Surface Water Quality Monitoring Program" are tabulated by parameter in **Appendix B.** For each parameter, statistics (*i.e.*, mean, range, standard deviation, and number of observations) are calculated across sampling events and sampling locations. Also, applicable water quality criteria are footnoted below each table.

Copies of the laboratory reports of analytical results for the samples collected during the 1994 monitoring year are provided in **Appendix C.** Comparison of the data with previous results and general conclusions are included with the discussion for each parameter or group of related parameters.

4.1 Rainfall and Hydrology

4.1.1 *Rainfall*

Less than the normal amount of rainfall was recorded in the Catfish Creek and North Creek basins of the Palmer Ranch during the tenth year of the "Continuing Surface Water Quality Monitoring Program." The rainfall amount recorded during 1994 is approximately six inches less than the average annual rainfall of approximately 54 inches based on a 30-year period of record (NOAA, 1982). Approximately 48 inches of precipitation were recorded (**Table 4.1**) during 1994 in comparison to 38 to 56 inches recorded during previous monitoring years (CCI, 1988a, 1988b, 1991, 1992a, 1993, and 1994).

Figure 4.1 provides a comparison of the monthly distribution of rainfall measured in the Catfish Creek and North Creek Basins of the Palmer Ranch during the 1994 monitoring year with the monthly distribution of historical rainfall for the 30-year period of record (NOAA, 1982). Rainfall recorded during the 1994 monitoring year generally followed expected seasonal trends for this region of Florida as observed during previous monitoring years. During the 1994 monitoring year, below-normal rainfall was observed during five months (*i.e.*, February, May, June, August and November), whereas above-normal rainfall occurred during January, July, September, October and December. Normal rainfall amounts were recorded during both March and April (**Figure 4.1**). The highest monthly rainfall during 1994 was observed in September when 13.25 inches were recorded compared to a historical average for this month of approximately 8.47 inches.

As provided in **Table 4.1**, the seasonal amounts of rainfall recorded on-site during the spring and summer quarters totalled 3.86 and 28.64 inches, respectively. Rainfall recorded during the fall and winter quarters were 7.63 and 7.94 inches, respectively. In the four-month period from June through September, when the primary wet season normally occurs, 29.98 inches (or 62 percent of the total annual rainfall) was recorded on the Palmer Ranch. The total rainfall recorded during the primary wet season for higher than reported for previous monitoring years (CCI, 1986, 1988a, 1988b, 1990, 1991, 1992a, 1993 and 1994). These higher stream flows recorded during the 1994 monitoring year are a result of the wetter conditions reported for September 1994 and that no monitoring was performed during the months of June and December which typically have low rainfall.

Approximately 91 percent of the stream flow measurements collected in the Catfish Creek and North Creek Basins during the 1991 monitoring year showed positive flows. The relatively higher percentage of positive flows in these two basins reported in more recent monitoring years can be attributed to improved basin geometry and hydraulic residence time in the watershed resulting in a more efficient drainage system. In general, stream flows recorded in Catfish Creek and North Creek Basins for previous monitoring years were lower than for the 1994 monitoring year. The lower percentage of positive flows recorded in both Catfish Creek and North Creek Basins during previous monitoring years probably resulted from lower rainfall and drainage improvement operations in these basins.

During the tenth year of monitoring, stream flows in the Catfish Creek/Trunk Ditch Basin ranged from 233 to 2,792 gallons per minute (GPM) in its upper reaches (CC-1 and CC-2) and from 233 to 2,351 GPM in its mid-reach (CC-3 and CC-4). Overall, stream flows measured during the 1995 monitoring year for all six stations ranged from 27 to 6,183 GPM.

The highest steam flows during 1994 occurred during the September monitoring event with an average flow for Catfish Creek of 2,395 GPM. High stream flows measured in September coincide with the end of the wet season and the highest 2-week antecedent rainfall amount (**Table 4.1**). The higher rainfall amounts reported for this period resulted in an elevated groundwater table and a higher percentage of runoff, both of which increased stream flow. Stream flows recorded for the six monitoring stations during the 1994 monitoring year are illustrated in **Figure 4.2**.

As noted during the past four years of monitoring, it is apparent that low flow conditions have prevailed in various stream segments. During the tenth year of monitoring, low flow conditions were most frequently observed in the Catfish Creek/Trunk Ditch Basin at Station CC-3. During the 1990, 1991, 1992 monitoring years (CCI, 1991, 1992a and 1993), Station CC-2 exhibited low flow conditions most frequently. In general, stream flows measured during the two 1994 monitoring events in Catfish and North Creeks were greater than measured in previous years.

4.2 Physical Water Quality Parameters

4.2.1 *Water Temperature*

Appendix Table B-3 presents the surface water temperature measurements acquired during the 1994 monitoring year. Results indicate that the water temperature of the streams of the North Tract of the Palmer Ranch ranged from 18.2 to 30.0°C during the two monitoring events. This range is similar to those recorded during previous years of monitoring (Palmer Venture, 1986; and CCI, 1986, 1988a, 1988b, 1991, 1992a, 1993 and 1994).

As expected, the lowest water temperatures were recorded in the streams of the North Tract during the March 1994 event with the highest water temperatures

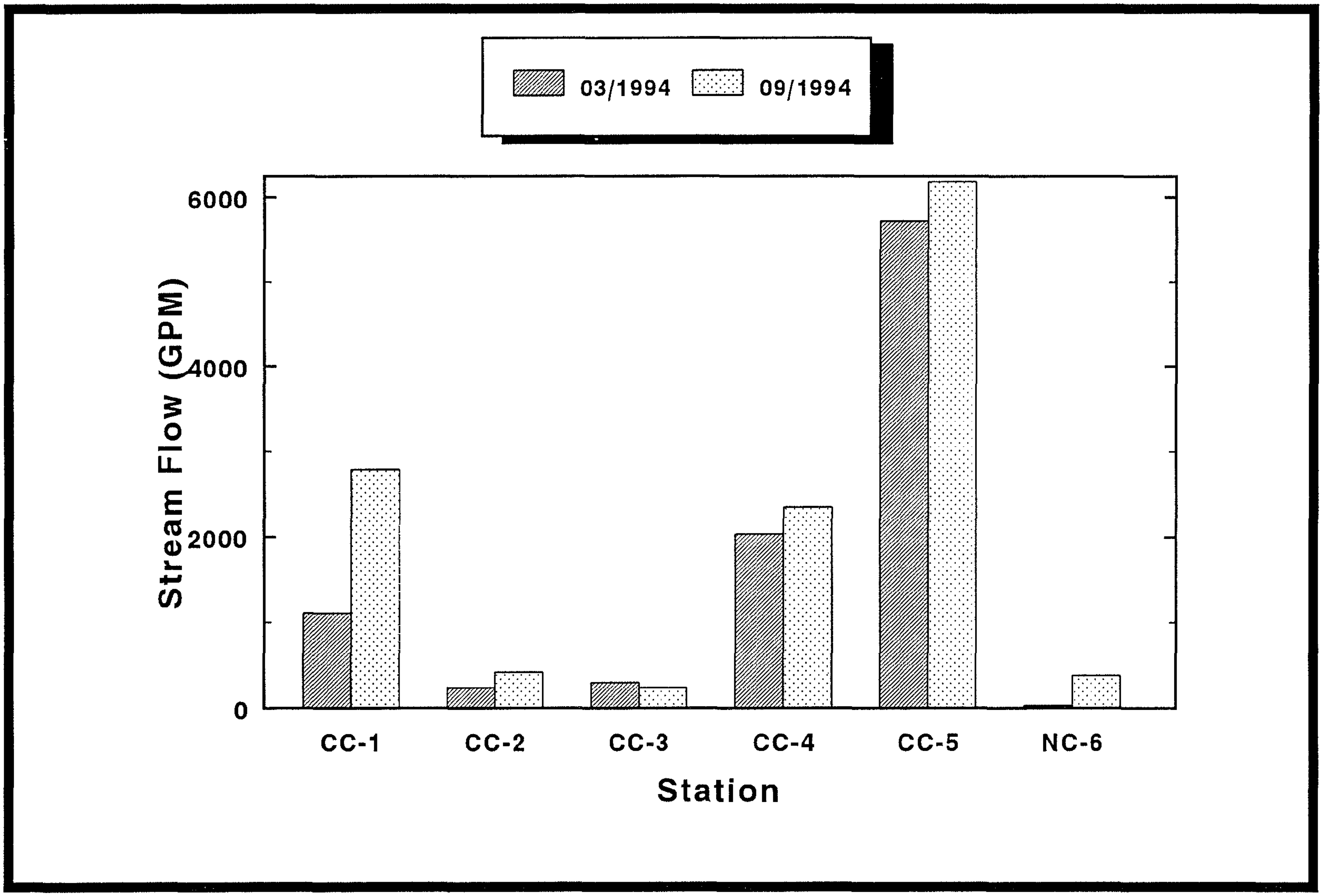

Figure 4.2 Stream Flows Measured During Each Semi-annual Sampling From January to December 1994 at the Palmer Ranch, Sarasota County.

recorded during the September monitoring event. Water temperatures averaged 26.9°C during the September 1994 event, while an average temperature of 21.3°C was observed during the March event. Average temperatures for Catfish Creek and North Creek for each event are very similar with differences among stations generally being 6°C or less.

An evaluation of diurnal variations in water temperature in the Catfish Creek and South Creek Basins was performed during the 1985 dry season and the 1986 wet season (CCI, 1987). Results of the diurnal evaluation showed increases in water temperature to maximum levels by mid-afternoon followed by declines during the evening to minimal levels by early morning. The results of the diurnal study are provided in the report prepared by CCI (CCI, 1987).

4.2.2 *Specific Conductance*

As evidenced in **Appendix Table B-4**, Catfish Creek and North Creek exhibited a range in specific conductance of 421 to 935 micromhos per centimeter (μmhos/cm) compared with ranges of 567 to 1,625, 626 to 1,332, 431 to 1,459, and 526 to 954 μmhos/cm during the sixth, seventh and eighth monitoring years, respectively (CCI, 1991, 1992a, 1993 and 1994). The higher range observed during the sixth monitoring year probably resulted from the relatively low amount of rainfall that occurred during 1990. As discussed in the previous annual reports (CCI 1988a, 1988b, and 1991), during times of drought, such as occurred during the second and sixth monitoring years, the lack of precipitation resulted in minimal runoff of low conductivity stormwater thereby allowing the conductivity in the streams of the ranch to increase due to evaporation. In addition, a larger portion of the streams' surface waters probably originated from groundwater exfiltration. Since groundwater normally has a higher conductivity than rainwater and surface runoff, an increase in the conductivity of the streams would be expected.

The lowest conductivities recorded during the 1994 monitoring year occurred during the September monitoring event with conductivities averaging 579 μmhos/cm. As described above, these lower conductivities most likely resulted from the cumulative effects of increased rainfall and subsequent increase in surface runoff of low conductivity stormwater during this period (refer to **Table 4.1**). Specific conductance levels measured at the six monitoring stations during the 1994 monitoring year are illustrated in **Figure 4.3**.

In a comparison of both streams monitored during 1994 within the Palmer Ranch, the overall annual mean conductivities for North Creek and Catfish Creek Basins were 684 and 682 μmhos/cm, respectively. Overall, both creeks exhibited similar conductivities during the two monitoring events in 1994 (**Appendix Table B-4**).

As observed during the previous years of monitoring (CCI 1988a, 1988b, 1991, 1992a, 1993 and 1994), no apparent spatial trends were observed in conductivity within the two monitored basins of the Palmer Ranch (**Appendix Table B-4** and **Figure 4.3**). In the Catfish Creek/Trunk Ditch Basin, conductivities in the upper reaches averaged 640 μmhos/cm, compared to an average of 734 μmhos/cm observed for the mid-reach.

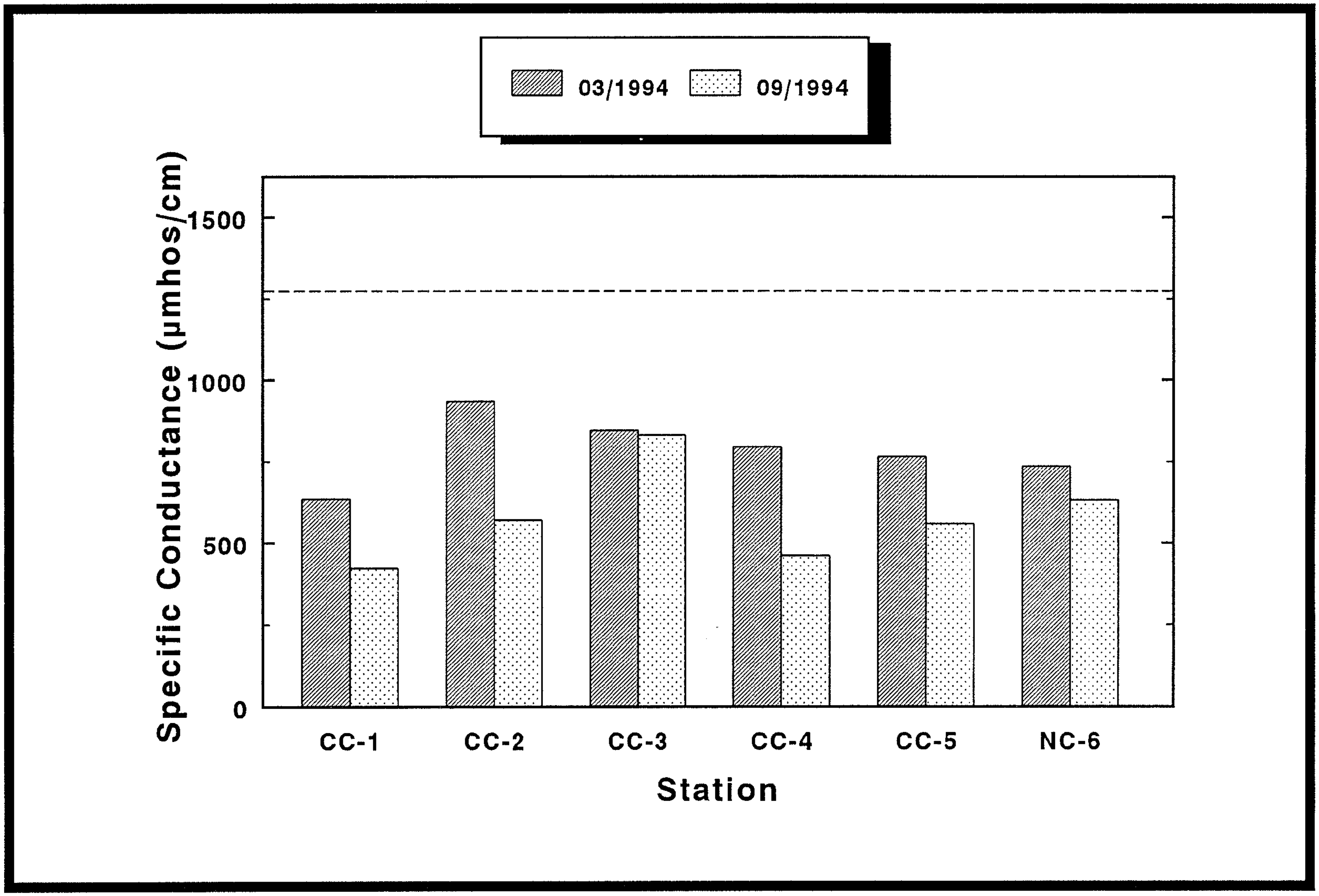

Figure 4.3 Specific Conductance Levels Measured During Semi-annual Sampling from January to December 1994 at the Palmer Ranch, Sarasota County. Dashed Line Depicts State Standard.

The State specific conductance criterion applicable to the streams of the Palmer Ranch allows an increase of not more than 50 percent above background levels or to a level of 1,275 μmhos/cm whichever is greater. All of the 12 conductivity measurements made during the 1994 monitoring year were below the 1,275 μmhos/cm threshold (**Figure 4.3**). Therefore, no violations of the State criteria for specific conductivity occurred during 1994.

The Sarasota County criterion for specific conductance (Ordinance No. 72-37) is similar to, but more stringent than, the State criteria. The County standard allows up to a 100 percent increase above background to a maximum level of 500 μmhos/cm in freshwater streams. Therefore, only two conductivity measurements made in the streams of the Palmer Ranch during 1994 were in compliance with the County criteria. Ubiquitous non-compliance conductivities were also observed during the past years of monitoring (CCI 1986, 1988a, 1988b, 1991, 1992a, 1993 and 1994).

4.2.3 *Total Suspended Solids*

During the tenth year of monitoring, Catfish Creek and North Creek in the Palmer Ranch exhibited a range of total suspended solids (TSS) from 2 to 32 mg/L with an annual average of approximately 8 mg/L (**Appendix Table B-5**). **Figure 4.4A** illustrates the distribution of TSS levels during the 1994 monitoring year for Catfish Creek and North Creek. In general, the TSS levels observed during this monitoring year are comparable to those recorded during previous monitoring years (Palmer Venture, 1986; CCI, 1986, 1987, 1988a, 1988b, 1991, 1992a, and 1993).

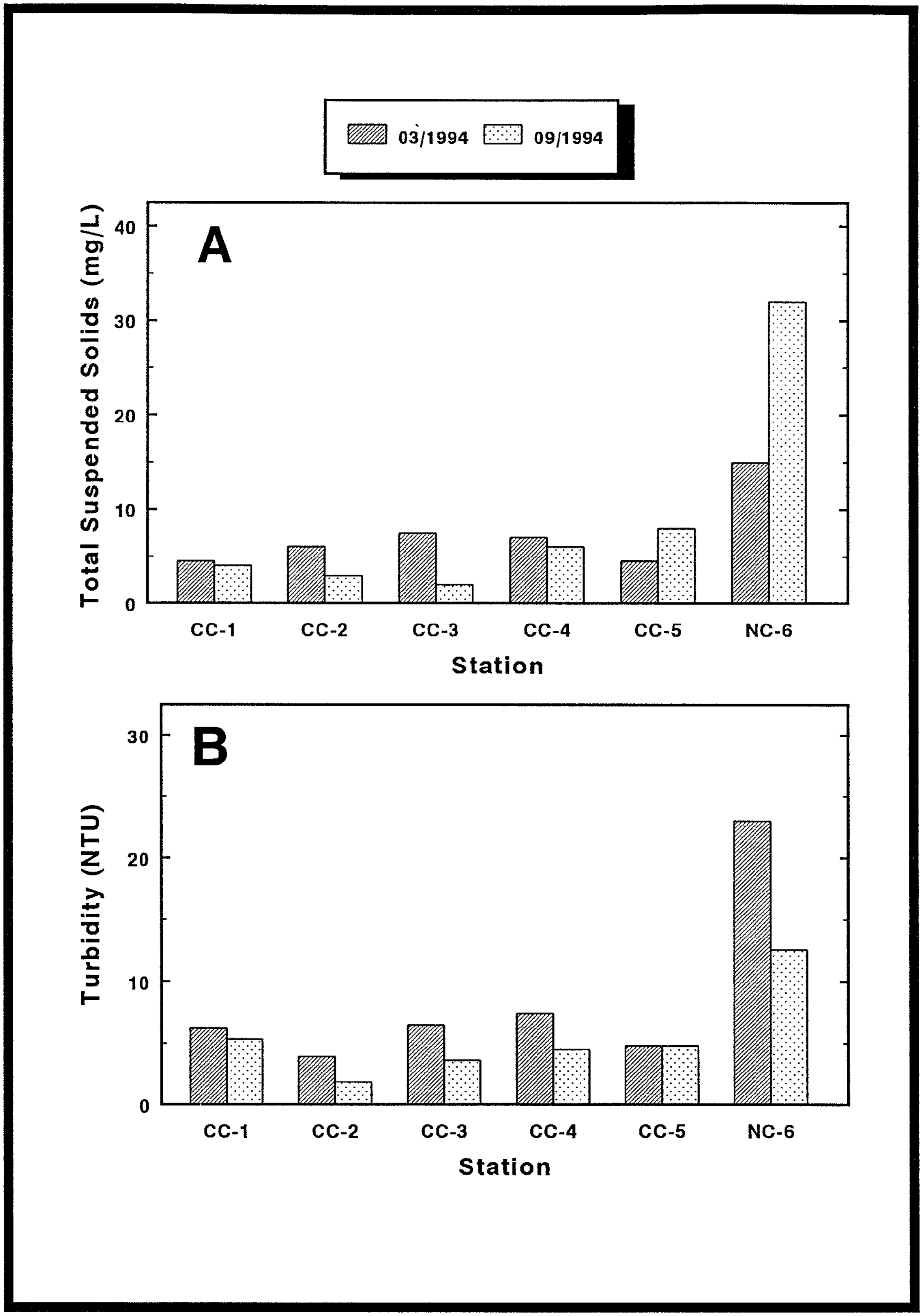

Figure 4.4 **(A) Total Suspended Solids and (B) Turbidity Levels Measured During Semi-annual Samplings from January to December 1994 at the Palmer Ranch, Sarasota County.**

The highest TSS levels during 1994 were recorded at the North Creek station (*i.e.*, NC-6). The lowest TSS levels were recorded in the upper reach of Catfish Creek (*i.e.*, CC-1 and CC-2). Interestingly, the highest average TSS level was recorded for the September monitoring event, probably due to high rainfall (*i.e.*, 13.25 inches) recorded during that month and the subsequent surface water runoff. Relatively lower TSS concentrations were recorded for the March sampling event with suspended materials averaging 7 mg/L for both Catfish Creek and North Creek. Overall, similar TSS levels were reported for all five sampling stations in the Catfish Creek during both the March and September monitoring events with the March event exhibiting slightly higher TSS levels. These similar mean concentrations of TSS recorded during 1994 monitoring event may be attributed to well-established littoral zones around the Catfish Creek, especially at CC-2, as well as the storm water management system in Prestancia.

During the 1993 monitoring year TSS levels reported for the six monitoring stations ranged from <1 to 14 mg/L and averaged 7 mg/L (CCI, 1994). Total suspended solids exhibited higher levels in the Catfish Creek and North Creek basins of the Palmer Ranch for the 1992 monitoring year with concentrations ranging from <1 to 31 mg/L and averaging 5 mg/L (CCI, 1993). A similar trend was observed during the 1991 monitoring year with TSS levels ranging from <1 to 87 mg/L with an annual average of 9 mg/L for the six monitoring stations in the Catfish Creek and North Creek basins (CCI, 1992a).

Lower TSS levels with a range from <1 to 13 mg/L were reported for these two Creeks during the 1990 monitoring year than for previous years (CCI, 1991). Total suspended solid levels reported for the third and fourth monitoring years ranged from 3 to 57 and from <1 to 46 mg/L, respectively, with a yearly average of approximately 13 mg/L during each of the two monitoring years (CCI, 1988a and 1988b). During the second year of monitoring, these two streams of the Palmer Ranch exhibited a much wider range in TSS (*i.e.*, 1 to 103 mg/L) and a higher yearly average (*i.e.*, 25 mg/L) (CCI, 1986). Moreover, high TSS levels were recorded in the vicinity of the Prestancia construction site in Catfish Creek (CC-3), and Trunk Ditch (CC-4). These elevated TSS levels observed near Prestancia were attributed to construction activities including the excavation of Trunk Ditch.

During the first year of monitoring, TSS was reported to be much lower than observed during the past four years of the monitoring program, perhaps as a result of low mass transport rates associated with drought conditions or differences in sampling and analytical procedures (Palmer Venture, 1986). Overall, the surface waters of the ranch showed a TSS range of approximately 1 to 12 mg/L during the first year of monitoring, similar to levels measured during the 1993 monitoring events.

4.2.4 *Turbidity*

During the tenth year of the monitoring program, turbidity levels measured in Catfish Creek and North Creek ranged from 1.8 to 23.0 NTU with an overall average of 7.0 NTU (**Appendix Table B-6**). In comparison, similar turbidity ranges of 2.8 to 36 NTU, 1.0 to 27.0 NTU, 1.7 to 24 NTU, 0.8 to 29.0 NTU, 1.0 to 25.0 NTU, and 1.3 to 30.0 NTU were exhibited during the third, fourth, sixth, seventh, eighth and ninth monitoring years, respectively, with positive correlations with TSS during all years (CCI, 1988a, 1988b, 1991, 1992a, 1993 and 1994).

During the second year of monitoring, CCI (1986) reported high turbidities of 1.5 to 61 NTU in Catfish Creek and North Creek, while during the first year of monitoring much lower turbidities (*i.e.*, less than 6 NTU) were reported (Palmer Venture, 1986). Differences between the first and second year have been attributed to a combination of the droughty conditions in the first year resulting in lower pollutant loadings, and the initiation of construction including the reconstructed of Trunk Ditch during the second year of monitoring.

As in previous years, turbidity and TSS levels measured during the 1994 monitoring year were found to be positively correlated (*i.e.*, correlation coefficient (r) = 0.60). This relatively poor correlation between TSS and turbidity can be explained by the amount of organic matter and colloidal material present in the surface water. High organic content in surface waters will exhibit an increased turbidity reading even though the amount of filterable TSS is low. The large amount of vegetation around both Catfish and North Creeks contributes to the organic matter content of both creeks. Also, the presence of colloids in a water sample will result in a higher turbidity level. In slow moving creeks, such as those on the Palmer Ranch property, a greater mass of colloidal species is present. Because colloids readily pass through a filter with a pore size of 0.45 μm (such as on filters used for TSS measurements), a strong correlation between TSS and turbidity is difficult to attain.

Turbidity exhibited the opposite seasonal trend observed for TSS in Catfish Creek. The highest mean turbidity level (*i.e.*, 5.8 NTU) occurred March 1994 while the lowest mean level (*i.e.*, 4.0 NTU) was determined for the September event (**Appendix Table B-6**). Similar observations were made for the North Creek site with 23.0 NTU reported for the March 1994 monitoring event compared with 12.6 NTU in September. The overall distribution of stream turbidity levels measured during the 1994 monitoring year in Catfish Creek and North Creek is shown in **Figure 4.4B**.

The General Water Quality Criteria for all surface waters (FAC Chapter 62-302) specifies that turbidity shall not exceed 29 NTU above natural background. Based on turbidity measurements taken during previous years of monitoring, natural background turbidity levels are expected to be less than 25 NTU (mean plus one standard deviation), although higher background turbidities might occur because of natural processes, *e.g.*, organic decay and import of particulate matter via stormwater runoff. Therefore, all turbidity measurements performed during the 1994 monitoring year were in compliance with the applicable state water quality criteria.

Sarasota County Ordinance (No. 72-37) allows a maximum increase of 25 Jackson units above background. Analysis of turbidity samples, however, was performed in accordance with FAC Chapter 62-302 criteria that is based on the Nephelometric procedure. Therefore, a comparison of the turbidity results to the County criteria cannot be made.

4.3 Oxygen Demand and Related Parameters

4.3.1 *Biochemical Oxygen Demand*

As presented in **Appendix Table B-7**, the 5-day biochemical oxygen demand (BOD_5) recorded in the two streams of the North Tract averaged 3.5 mg/L and ranged from 1.5 to 5.6 mg/L during the 1994 monitoring year. Biochemical oxygen demand levels in Catfish Creek averaged 3.2 mg/L with a range of 1.5 to 4.7 mg/L with Stations CC-4 and CC-5 exhibiting the highest mean BOD_5 levels for Catfish Creek (**Appendix Table B-7**). Overall, the highest mean BOD_5 level was reported for Station NC-6. Additionally, a positive correlation between BOD_5 and TSS was noted (*i.e.*, correlation coefficient (r) = 0.66), and is attributed to decaying vegetation and other organic matter in the water column. The highest BOD_5 levels were recorded for the March event. **Figure 4.5** illustrates the distribution of BOD_5 concentrations measured in Catfish Creek and North Creek during the 1994 monitoring year.

Comparatively, BOD_5 averaged 1.7 mg/L during the 1993 monitoring period and had a range of 0.2 to 3.7 mg/L (CCI, 1994). Similar BOD_5 levels were observed during the 1992 monitoring year with concentrations averaging 1.8 mg/L and ranging from 0.2 to 5.3 mg/L (CCI, 1993). During the 1991 monitoring year, BOD_5 concentrations were lower than those measured in 1994 and averaged 1.3 mg/L (CCI, 1992a). During the 1990 monitoring year in Catfish Creek and North Creek an overall average BOD_5 concentration of 1.7 mg/L was observed (CCI, 1991). Results obtained during the third and fourth years of monitoring were more comparable to the 1994 results when BOD_5 in these streams of the Ranch averaged 3.0 and 2.6 mg/L, respectively (CCI, 1988a and 1988b). Similar trends were observed during the second year of

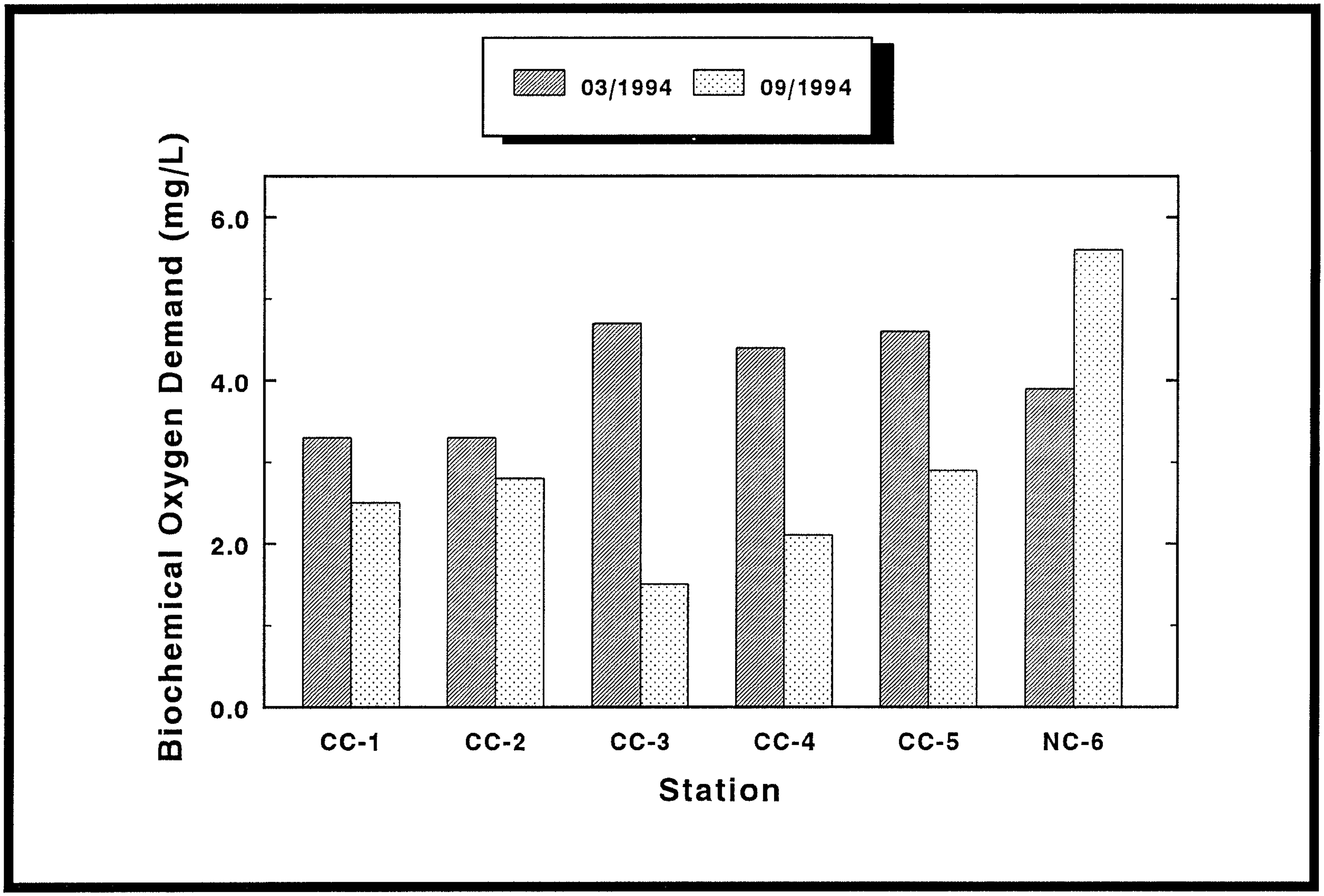

Figure 4.5 Biochemical Oxygen Demand Measured During Semi-annual Samplings from January to December 1994 at the Palmer Ranch, Sarasota County.

monitoring when a higher average BOD_5 concentration of 4.5 mg/L was recorded for these two Creeks (CCI, 1986).

During the first year of monitoring, Palmer Venture (1986) reported a range in BOD_5 of 1.2 to 6.5 mg/L in Catfish Creek/Trunk Ditch. At the Trunk Ditch-North Creek juncture, BOD_5 was reported to range from 2.0 to 6.0 mg/L.

According to Hynes (1966), a BOD_5 of 3 mg/L suggests "fairly clean" water while a BOD_5 of 5 mg/L suggests "doubtful" quality water. In addition, a BOD_5 screening level of greater than 3.3 mg/L has been established for Florida waters to indicate potential water quality problems (FDER, 1990). Measurements of BOD_5 in North Creek and Catfish Creek during the September 1994 monitoring event generally exhibited fairly clean water with only one of the six measurements being over the 3.3 mg/L screening level. However, all samples collected during the March monitoring event exceeded the 3.3 mg/L screening level for BOD_5. These higher BOD_5 levels observed during the March 1994 monitoring event probably resulted from a relatively large standing crop of aquatic vegetation in both creeks. This conclusion is supported by the higher TSS and turbidity levels reported during the March event. Overall, BOD_5 levels for this event averaged 4.0 mg/L and ranged from 3.3 to 4.7 mg/L (**Appendix Table B-7**).

Biochemical oxygen demand can be defines as: *the amount of oxygen required by bacteria while stabilizing organic matter under aerobic conditions* (Sawyer and McCarthy, 1978). The decomposable organic matter present in Catfish Creek is mostly attributed to decaying vegetation and hydrocarbon input (*i.e.*, automobile emission, oil leakage, *etc.*).

The General Criteria for BOD_5 in all surface waters as designated by FAC Chapter 62-302, "Rules and Regulations of the Department of Environmental Protection," as well as Sarasota County Ordinance No. 72-37, specifies that BOD_5 shall not be increased to levels that would result in violations of dissolved oxygen. The BOD_5 concentrations recorded in Catfish Creek and North Creek of the Palmer Ranch exceeded the 3.3 mg/L screening level that the FDER (1990) considers to suggest potential water quality problems during the March 1994 monitoring event. Also during the tenth year of monitoring, only one of the 24 BOD_5 measurements was greater than the 5 mg/L level which Hynes (1966) considered to be "doubtful" or between "fairly clean" and "bad" water quality.

4.3.2 *Dissolved Oxygen*

Appendix Table B-8 provides the results of dissolved oxygen measurements acquired during the tenth year of monitoring. Temporal and spatial distributions of dissolved oxygen concentrations measured at six monitoring stations within Catfish Creek and North Creek during the 1994 monitoring year are presented in **Figure 4.6A.** Overall, dissolved oxygen was found to average 6.3 mg/L, with a range of 0.8 to 10.0 mg/L. The highest dissolved oxygen concentrations were recorded in the Catfish Creek/Trunk Ditch Basin with dissolved oxygen concentrations averaging 6.7 mg/L. The lowest dissolved oxygen levels were recorded in the southern end of Trunk Ditch (North Creek-Trunk Ditch Basin at Station NC-6) where dissolved oxygen averaged 4.3 mg/L. Seasonally, the highest average dissolved oxygen levels were observed for the March monitoring event with concentrations averaging 7.3 mg/L. These higher dissolved oxygen levels are associated with cooler water temperatures, a higher standing crop

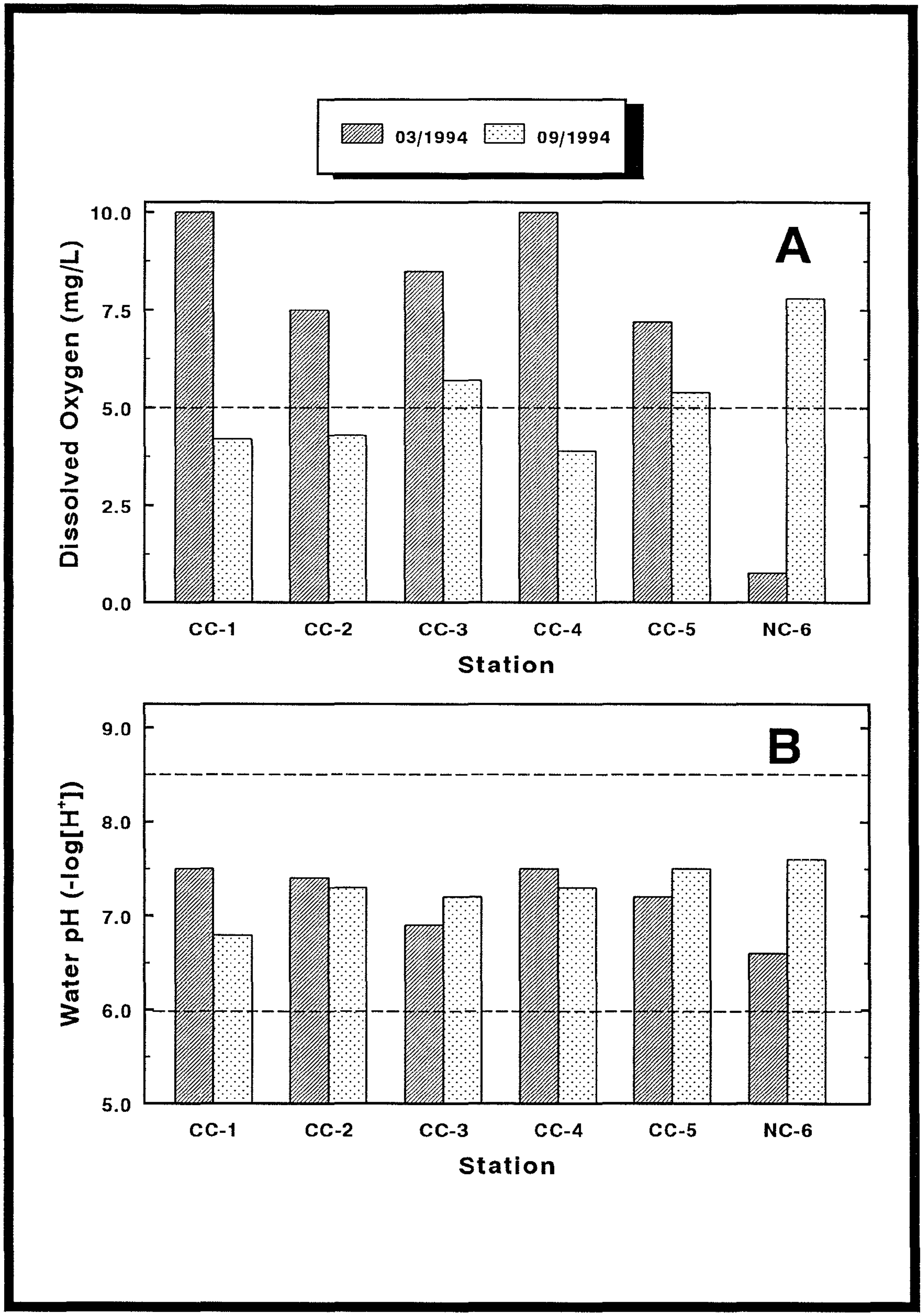

Figure 4.6 (A) Dissolved Oxygen and (B) Water pH Levels Measured During Semi-annual Samplings from January to December 1994 at the Palmer Ranch, Sarasota County. Dashed Lines Depict State Standards for both Dissolved Oxygen and Water pH.

of aquatic vegetation as suggested by higher BOD_5, TSS and turbidity levels observed during this event. In contrast, dissolved oxygen concentrations for the September monitoring event averaged 5.2 mg/L in conjunction with the highest average water temperatures. Similar seasonal trends have been observed during previous monitoring years (CCI, 1988a, 1988b, 1991, 1992a, 1993 and 1994) and reflect the changes in the solubility of dissolved oxygen in the water column with changes in water temperature.

The dissolved oxygen concentrations obtained during the 1994 monitoring year for Catfish and North Creeks are generally comparable to those measured during the third, fourth, sixth, seventh, eighth and ninth monitoring years (CCI, 1988a, 1988b, 1991, 1992a, 1993 and 1994) but slightly higher than the concentrations determined during the first two years of the monitoring program (Palmer Venture, 1986; and CCI, 1986). During the third, fourth, sixth, seventh and eighth monitoring years (CCI, 1988a, 1988b, 1991, 1992a, 1993 and 1994), dissolved oxygen was found to average 5.3, 7.7, 5.4, 4.5, 4.8 and 5.0 mg/L, respectively.

An evaluation of diurnal variations in dissolved oxygen in Catfish Creek and South Creek was performed during the dry season of 1985 and the wet season of 1986. The results of the diurnal evaluation showed typical increases in dissolved oxygen during the day to maximum levels by mid-afternoon and declines during the night to minimal levels by midmorning, as well as diurnal trends characteristic of the stream community. A summary of the results of the diurnal study is provided in the report prepared by CCI (1987).

During the tenth monitoring year, dissolved oxygen concentrations in the two streams of the North Tract frequently occurred at levels below the 5.0 mg/L criteria specified by FAC Chapter 62-302 and rarely below the 4.0 mg/L standard specified by Sarasota County Ordinance 72-37 for predominantly freshwater. Of the 12 dissolved oxygen measurements made during the 1994 monitoring year, four were below the 5.0 mg/L state criteria with only two of the measurements being below the 4.0 mg/L County Criteria.

4.3.3 *Water pH*

Results of pH monitoring in Catfish Creek and North Creek during 1994 are provided in **Appendix Table B-9** with temporal and spatial distributions shown in **Figure 4.6B.** During the 1994 monitoring year, pH levels in these two streams of the Palmer Ranch ranged from 6.6 to 7.6. Similar pH ranges were observed during the first through ninth monitoring years (Palmer Venture, 1986; and CCI, 1986, 1988a, 1988b, 1991, 1992a, 1993 and 1994).

During the tenth year, the lowest pH levels were observed at CC-3 and NC-6 with pH levels averaging 7.1 units at both stations. The highest pH levels were recorded at Stations CC-2, CC-4 and CC-5 all of which averaged 7.4. These differences are attributed primarily to spatial variations in community metabolism. Differences or changes in pH are indicative of the effects of net community metabolism on the level of carbon dioxide and pH. During periods of net community respiration, carbon dioxide (CO_2) is produced faster than it is assimilated. When CO_2 is dissolved in water, carbonic acid (H_2CO_3) is formed in the following reaction:

$$H_2O + CO_{2_{(g)}} \rightleftharpoons H_2CO_{3_{(aq)}} \rightleftharpoons H^+ + HCO_3^-$$

As a result of CO_2 production during respiration, water pH is depressed due to the release of hydrogen ions (H^+) as H_2CO_3 dissociates. In contrast, carbon dioxide is consumed faster than it is produced during periods of net community photosynthesis (primary production). Thus, the reaction will shift toward the left, thereby removing CO_2 and increasing pH.

Therefore, pH typically exhibits a diel trend of increases during the day and decreases during the night. The amplitude of the cycle normally depends on the rate of production and consumption and to a lesser extent on the buffering capacity, *i.e.*, alkalinity, of the water and atmospheric exchange of carbon dioxide.

In a diurnal evaluation of Catfish Creek and South Creek, which was conducted during the dry season of 1985 and the wet season of 1986, CCI (1987) reported changes in pH characteristic of the different biological communities. During the day, Catfish Creek and South Creek exhibited changes in pH ranging up to a 1 to 2 unit increase with maximum diurnal changes observed in the lower reach of Catfish Creek (*i.e.*, CC-5) where the greatest metabolic rates were encountered.

As specified in the General Criteria for all surface waters (FAC Chapter 62-302) and in the Sarasota County Ordinance No. 72-37, the allowable variation in pH is 1.0 units above or below the normal pH provided that the pH is not lowered or elevated outside the range of 6.0 to 8.5. Additionally, if natural background is less than 6.0, 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 tenth year of monitoring, all pH measurements in Catfish Creek and North Creek were within the allowable range of 6.0 to 8.5 (**Figure 4.6B**).

4.4 Macronutrients

4.4.1 *Total Nitrogen*

Appendix Table B-10 provides the results of total nitrogen measurements acquired during the 1994 monitoring year for Catfish Creek and North Creek. Spatial and temporal distributions of total nitrogen concentrations for the 1994 monitoring year are provided in **Figure 4.7**. Average total nitrogen concentrations measured during the 1994 monitoring year were slightly lower than measured during the 1993 monitoring year (CCI, 1994). Although total nitrogen levels measured in 1994 varied slightly from those observed during previous monitoring years, the spatial and compositional trends in total nitrogen were similar to the trends observed previously eventhough less frequent sampling events occurred in 1994. During the tenth monitoring year, the mid and lower reaches of Catfish Creek exhibited lower total nitrogen levels than observed in the other stream segments of the Palmer Ranch. The highest total nitrogen concentrations for 1994 were observed at Station NC-6 which exhibited an average total nitrogen concentration of 1.26 mg/L for the two monitoring events. Average concentrations of 0.79 and 0.89 mg/L were observed at the downstream property boundaries in Catfish Creek and Trunk Ditch, respectively.

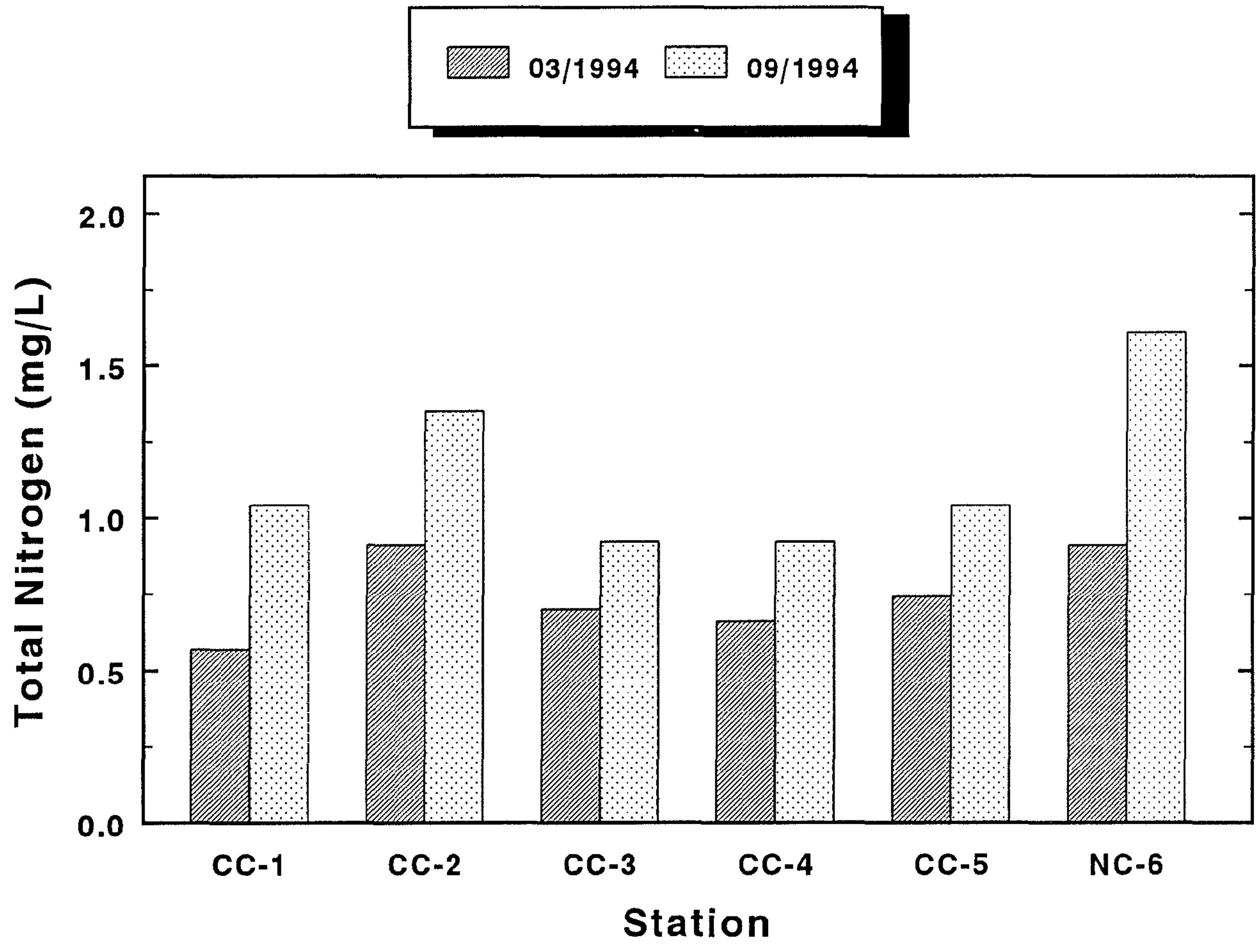

Figure 4.7 Total Nitrogen Levels Measured During Semi-annual Samplings from January to December 1994 at the Palmer Ranch, Sarasota County.

The highest total nitrogen concentrations were observed for the September monitoring event and correspond to the wettest conditions and period of the greatest runoff and stream flows. During the March 1994 monitoring event, the lower total nitrogen concentrations probably resulted from lower inputs of detritus in runoff and lower rate of primary productivity during this period of the year.

Overall, total nitrogen levels in Catfish Creek and North Creek averaged 0.97 mg/L during the 1994 monitoring year as compared to higher averages of 1.86, 1.42, 1.44, 1.36 and 1.31 mg/L observed for the second, third, fourth, eighth and ninth years of monitoring, respectively (CCI, 1986, 1988a, 1988b, 1993 and 1994). Average total nitrogen concentrations in Catfish Creek and North Creek during the sixth and seventh monitoring years (*i.e.*, 1.18 mg/L during both years) were slightly higher than observed for the tenth year (CCI, 1991 and 1992a). Overall, total nitrogen levels measured in Catfish Creek during the tenth monitoring year were comparable to or lower than levels measured in previous years.

Figure 4.8 provides the mean total nitrogen concentrations observed for the streams traversing the Palmer Ranch during the second, third, fourth, sixth, seventh, eighth, ninth and tenth monitoring years. Also included in **Figure 4.8** is the average total nitrogen concentration measured in Catfish Creek during the "Stormwater Pollutant Loading Monitoring Program" performed at the Palmer Ranch (CCI, 1992b). The mean concentrations for each component of total nitrogen (*i.e.*, ammonia, nitrate + nitrite, and organic nitrogen) are also depicted in **Figure 4.8** in order compare the relative importance of each nitrogen fraction. In general, average total nitrogen concentrations

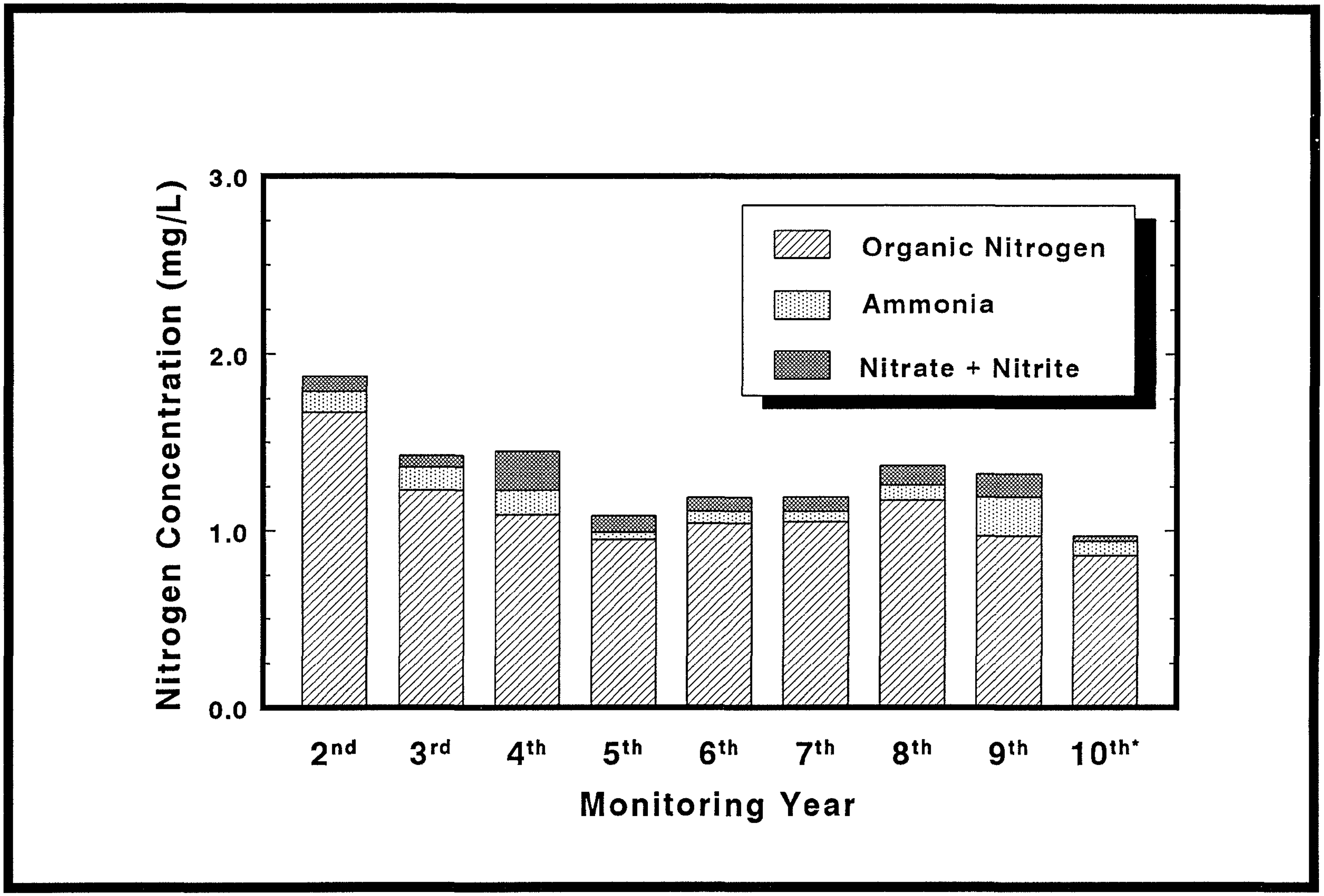

Figure 4.8 **Average Nitrogen Concentrations from the Second Through the Tenth Year of Monitoring at the Palmer Ranch, Sarasota County. *Tenth Year Monitoring Performed Semi-annually Rather than Quarterly.**

for the six monitoring stations has exhibited a decrease over the past several years and may be indicative of a general improvement in water quality in these two streams of the North Tract of the Palmer Ranch. Not only has total nitrogen decreased, the forms of nitrogen that are readily assimilated by algae and plants (*i.e.*, nitrate + nitrite) have also declined. Results of the 1994 monitoring year show the average total nitrogen concentration to be the lowest measured for the six monitoring sites over the past ten years. Although water quality was monitored semi-annually during the 1994 monitoring year, the lower total nitrogen concentrations are not believed to be a result of less frequent monitoring. Typically, the highest total nitrogen concentrations from previous monitoring years were measured during the September event (*i.e.*, end of the summer wet season). Because water quality samples were collected during the September event in 1994, the lower total nitrogen concentrations observed during this monitoring year may reflect the efficacy of the stormwater management system in place in these two streams.

The largest fraction of total nitrogen observed during the entire monitoring program is organic nitrogen. During the tenth monitoring year, organic nitrogen represented approximately 88 percent of total nitrogen and averaged 0.86 mg/L. The second most abundant form of nitrogen was ammoniacal nitrogen (ionized plus un-ionized ammonia) which represented approximately 8 percent of the total nitrogen with an average concentration of 0.08 mg/L. Nitrate represented approximately 3 percent of the total nitrogen with an average level of 0.03 mg/L. As expected, the smallest fraction of total nitrogen was found to be nitrite with an average concentration of 0.01 mg/L which represented approximately 1 percent of the total nitrogen concentration.

Similarly, CCI (1986, 1988a, 1988b, 1991, 1992a, 1993 and 1994) reported comparable breakdowns of total nitrogen in Catfish Creek and North Creek during previous years of monitoring. The largest fraction of total nitrogen observed during the previous years of monitoring also occurred in the form of organic nitrogen. Organic nitrogen represented from 76 to 90 percent of the total and averaged from 1.04 to 1.67 mg/L during this period. Similarly, the second most abundant form of nitrogen was ammoniacal nitrogen that represented from 6 to 10 percent of the total with average levels of 0.06 to 0.14 mg/L over the same period. Nitrate represented approximately from 4 to 15 percent of the total with average levels ranging from 0.06 to 0.21 mg/L during the previous years of monitoring. As during the 1994 monitoring year, the smallest fraction of total nitrogen during previous years of monitoring was nitrite, which represented less than 1 percent of the total nitrogen present during all years.

During the first year monitoring, however, Palmer Venture (1986) reported a significantly different breakdown and a substantially lower total nitrogen concentration (*i.e.*, 0.8 mg/L) than during the following monitoring years. During the first year, total nitrogen averaged 69 percent organic nitrogen, 8 percent ammonia-nitrogen, 23 percent nitrate-nitrogen, and less than 1 percent nitrite-nitrogen. The lower total nitrogen during the first year versus the latter years cannot be explained based on the available information, but may be associated with the extremely droughty conditions experienced during the first monitoring year. Also, it is not completely understood why nitrate levels exceeded ammonia levels during the first year since nitrate is normally assimilated by denitrifying bacteria under conditions of depressed oxygen levels, a condition that prevailed throughout the first year.

As specified in FAC Chapter 62-302, nutrients, including total nitrogen, shall not be elevated to levels causing an imbalance in the natural flora and fauna, a condition characteristic of eutrophic or nutrient-rich streams. In this respect, there were some implications in the data acquired during the second, third, and fourth monitoring years that linked the observed total nitrogen levels to eutrophic conditions even though there appeared to be a general trend of decreasing nitrogen levels as previously discussed (CCI, 1986, 1988a, 1988b, 1991, 1992a, 1993 and 1994). Results obtained during the 1994 monitoring year indicate that all of the total nitrogen samples collected on the Palmer Ranch were below the screening level of 2.0 mg/L considered by the FDEP (FDER, 1990) to be characteristic of eutrophic conditions.

4.4.2 *Nitrite*

Nitrite levels observed in Catfish Creek and North Creek during the tenth year of monitoring are provided in **Appendix Table B-11**. Also, spatial and temporal distributions of nitrite concentrations measured during the 1994 monitoring year are presented in **Figure 4.9A**.

As expected, nitrite concentrations throughout these two streams traversing the North Tract were much lower than the other forms of nitrogen, and too low to be a significant nutrient source. Of the 12 samples collected during the 1994 monitoring year, only 4 samples contained nitrite concentrations above the 0.01 mg/L analytical detection limit. Overall, nitrite observations averaged 0.01 mg/L with a range of

<0.01 to 0.05 mg/L. The highest nitrite concentration was reported at Station CC-3 during the September 1994 monitoring event and corresponds to overall elevated nitrogen concentrations associated with the primary wet season. During the previous monitoring years, nitrite concentrations measured in Catfish Creek and North Creek averaged <0.01 to 0.03 mg/L and had a range from <0.01 to 0.20 mg/L (CCI, 1987, 1988a, 1988b, 1991, 1992a, 1993 and 1994).

As a nutrient, nitrite is considered to be covered by the general water quality standard (FAC Chapter 62-302). However, due to the observed low concentrations, nitrite was generally found to be of little importance as a nutrient in the streams of the Palmer Ranch. For all practical purposes, nitrite is considered to meet desired standards.

4.4.3 *Nitrate*

As shown in the results provided in **Appendix Table B-12** and **Figure 4.9B**, nitrate levels observed for Catfish Creek and North Creek in the Palmer Ranch during 1994 exhibited a yearly average of 0.03 mg/L with a range of <0.01 to 0.14 mg/L. These results are much lower than those determined during the fourth monitoring year for Catfish Creek and North Creek when nitrate averaged 0.21 mg/L and ranged from <0.01 to 1.30 mg/L (CCI, 1988b). More comparable nitrate concentrations were reported for the second, third, sixth, seventh and eighth monitoring years when nitrate exhibited yearly averages from 0.06 to 0.10 mg/L with a range from <0.01 to 0.57 mg/L (CCI, 1987, 1988a, 1991, 1992a, 1993 and 1994).

Unlike previous years, the highest mean nitrate level of 0.04 mg/L was recorded during the March monitoring event. The slightly higher average nitrate level recorded during the March monitoring event resulted from an elevated nitrate concentration at CC-1 of 0.14 mg/L. Nitrate concentrations at the remaining five stations ranged from 0.01 to 0.02 mg/L (**Appendix Table B-12**). Because CC-1 is located at the upstream most boundary of the Palmer Ranch, the reported nitrate level at this site is not believed to have been generated on the Ranch, but is believed to be associated with runoff from properties upstream of the Ranch.

Overall, the Catfish Creek/Trunk Ditch Basin exhibited the highest nitrate levels during the tenth monitoring year with an average of 0.04 mg/L. The highest average nitrate concentration of 0.06 mg/L was recorded in the upper reach (Stations CC-1 and CC-2) of Catfish Creek. Station CC-1 had the highest contribution to the average nitrate level during the tenth monitoring year with nitrate concentrations ranging from 0.03 to 0.14 mg/L and averaging 0.09 mg/L (**Figure 4.9B**). Nitrate concentrations for the 1994 monitoring year were observed to decrease from the upper reach (Stations CC-1 and CC-2) to the lower reach (Station CC-5) of Catfish Creek from an average concentration of 0.09 to 0.03 mg/L, respectively. This decrease probably results from nitrate assimilation by aquatic plants along the creek.

Very low nitrate levels were also recorded at the juncture of Trunk Ditch and the North Creek Basin as evidenced by the annual mean concentrations of 0.03 mg/L determined for Station NC-6. Low stream flow was also measured at this site indicating minimal runoff and nitrate import to the creek. Furthermore, the North Creek site exhibited anaerobic conditions, as evidenced by low dissolved oxygen concentrations, which are conducive to denitrification and minimal nitrate concentrations.

As a nutrient, nitrate is designated as a parameter covered by the general water quality criteria (FAC Chapter 62-302), and is an important limiting nutrient in the streams of the Palmer Ranch. Therefore, increases in nitrate availability from anthropogenic sources would accelerate production rates of aquatic plants resulting in an imbalance in the flora and fauna that would be considered a violation of the nutrient standard. However, the nitrate concentrations determined during the 1994 monitoring year were among the lowest recorded during the ten-year monitoring program and are not thought to represent an important source of nitrogen in the streams of the Palmer Ranch. Therefore, nitrate is considered to meet desired criteria.

4.4.4 *Ammoniacal Nitrogen*

Appendix Table B-13 provides the results of ammoniacal nitrogen measurements (ionized plus un-ionized ammonia) recorded during the tenth year of monitoring. Also, spatial and temporal distributions of ammoniacal nitrogen are illustrated in **Figure 4.9C.** As described previously, ammoniacal nitrogen represented 8 percent of the total nitrogen measured during the 1994 monitoring year. Overall, ammoniacal nitrogen exhibited an average of 0.08 mg/L with a range from <0.02 to 0.24 mg/L.

The highest ammoniacal nitrogen concentrations in Catfish Creek were recorded during the September 1994 averaging 0.10 mg/L. These higher ammoniacal nitrogen concentrations are believed to be associated with higher runoff during the wet season. An additional source of ammoniacal nitrogen into the Catfish Creek system may have been from a spray effluent field located in the eastern portion of the basin. Surface runoff from the effluent field may have entered the Catfish Creek system between CC-

4 and CC-5. This would explain the increased ammoniacal nitrogen concentration between these two stations.

Although ammoniacal nitrogen is a potentially important nutrient to the primary producers in the streams of the Palmer Ranch, the results suggest that nitrate might be the preferred nitrogen source. This indication is based on two annual trends observed during the 1994 monitoring year as well as previous monitoring years as related to normal plant production and decay. During the peak of the growing season (*i.e.*, September), the concentration of ammoniacal nitrogen was high at four monitoring stations in Catfish Creek (*i.e.*, CC-1, CC-3, CC-4 and CC-5) with concentrations ranging from 0.08 to 0.24 mg/L. In addition, during this same monitoring event, nitrate concentrations were relatively low ranging from <0.01 to 0.05 mg/L. The lower nitrate concentrations, relative to ammoniacal nitrogen, indicate a preferential uptake of nitrate as opposed to ammonia. Second, ammoniacal nitrogen were low during March (*i.e.*, 0.02 mg/L) at a time when nitrate levels were higher (*i.e.*, 0.04 mg/L). Since March is considered to be the end of the winter season when net (primary) production is minimal, assimilation of nutrients should also be minimal. Since nutrients should be more available when they are assimilated at minimal rates, and vice versa, their concentrations should be elevated during winter season and depressed during summer wet season. Furthermore, nitrification (biological oxidation of organic nitrogen to nitrate) is expected to increase in association with the die-off and decay of plant material under aerobic conditions. Moreover, die-off and decay of plant material are expected to increase immediately following the period in which its standing crop peaks. This can occur in the streams of the Palmer Ranch from October to December. Since it was evident that the streams of the Palmer Ranch followed these trends of primary production, decay, nitrification, and minimal levels of nitrate during the growing season, it is concluded that nitrate is the preferred nitrogen source. Other freshwater studies (Wetzel, 1975) have also concluded that aquatic vegetation, including algae, prefer nitrate to ammonia.

During the previous years of monitoring (Palmer Venture, 1986; and CCI, 1986, 1988a, 1991, 1992a, 1993 and 1994), ammonia concentrations were higher than those measured during the 1994 monitoring year. However, the ammoniacal nitrogen concentrations measured for the 1994 monitoring year were comparable to the eight monitoring year when ammonia ranged from <0.02 to 0.28 mg/L with an annual average of 0.09 mg/L (CCI, 1993). The largest range in ammoniacal nitrogen concentrations previously observed occurred during the 1991 monitoring year and was <0.02 to 0.65 mg/L (CCI, 1992a).

Although ammoniacal nitrogen is a nutrient and therefore has the potential to influence the growth of the primary producers (plants) and their balance with the consumers (bacteria and animals), FAC Chapter 62-302 does not provide a quantitative nutrient standard for ammoniacal nitrogen. Although it might be less preferred than nitrate, increases in ammonia have the potential to accelerate plant production, and, in turn, influence the balance between the flora and fauna of the streams traversing the Palmer Ranch. Although, the concentrations of ammoniacal nitrogen determined during the 1993 monitoring year were higher than previously recorded during the ten-year monitoring program, they are not thought to represent an important source of nitrogen in the streams of the Palmer Ranch. Therefore, ammonia is considered to meet desired criteria. Since the non-ionized fraction of ammoniacal nitrogen was not evaluated independently, comparisons to County and State criteria for non-ionized ammonia were not made.

4.4.5 *Organic Nitrogen*

Organic nitrogen[2] concentrations determined in Catfish Creek and North Creek within the Palmer Ranch during the 1994 monitoring year are provided in **Appendix Table B-14** and graphically depicted in **Figure 4.10**. Overall, an average organic nitrogen concentration of 0.86 mg/L was measured in these streams of the Palmer Ranch during the tenth year of monitoring with a range from 0.65 to 1.34 mg/L. Organic nitrogen concentrations reported for the 1992 and 1993 monitoring years were slightly elevated averaging 1.17 and 0.97 mg/L, respectfully (CCI, 1993 and 1994). Comparable average organic nitrogen concentrations (*i.e.*, 1.04 mg/L) were reported for the sixth and seventh monitoring years in Catfish and North Creeks (CCI, 1991 and 1992a). Higher average organic nitrogen concentrations of 1.10 and 1.23 mg/L were reported for the third and fourth monitoring years for stations located along Catfish and North Creeks within the Palmer Ranch, respectively (CCI, 1988a and 1988b). However, during the second year of monitoring (CCI, 1986 and 1988a), the organic nitrogen averaged 1.67 mg/L. Overall, the organic nitrogen data indicates a gradual improvement in water quality with respect to nitrogen over the past ten years. Also, channel maintenance in Trunk Ditch during the fourth monitoring year, as well as the aquatic community changes resulting from the "reconstruction" of a segment of the

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[2]Organic Nitrogen = Total Kjeldahl Nitrogen - Ammoniacal Nitrogen.

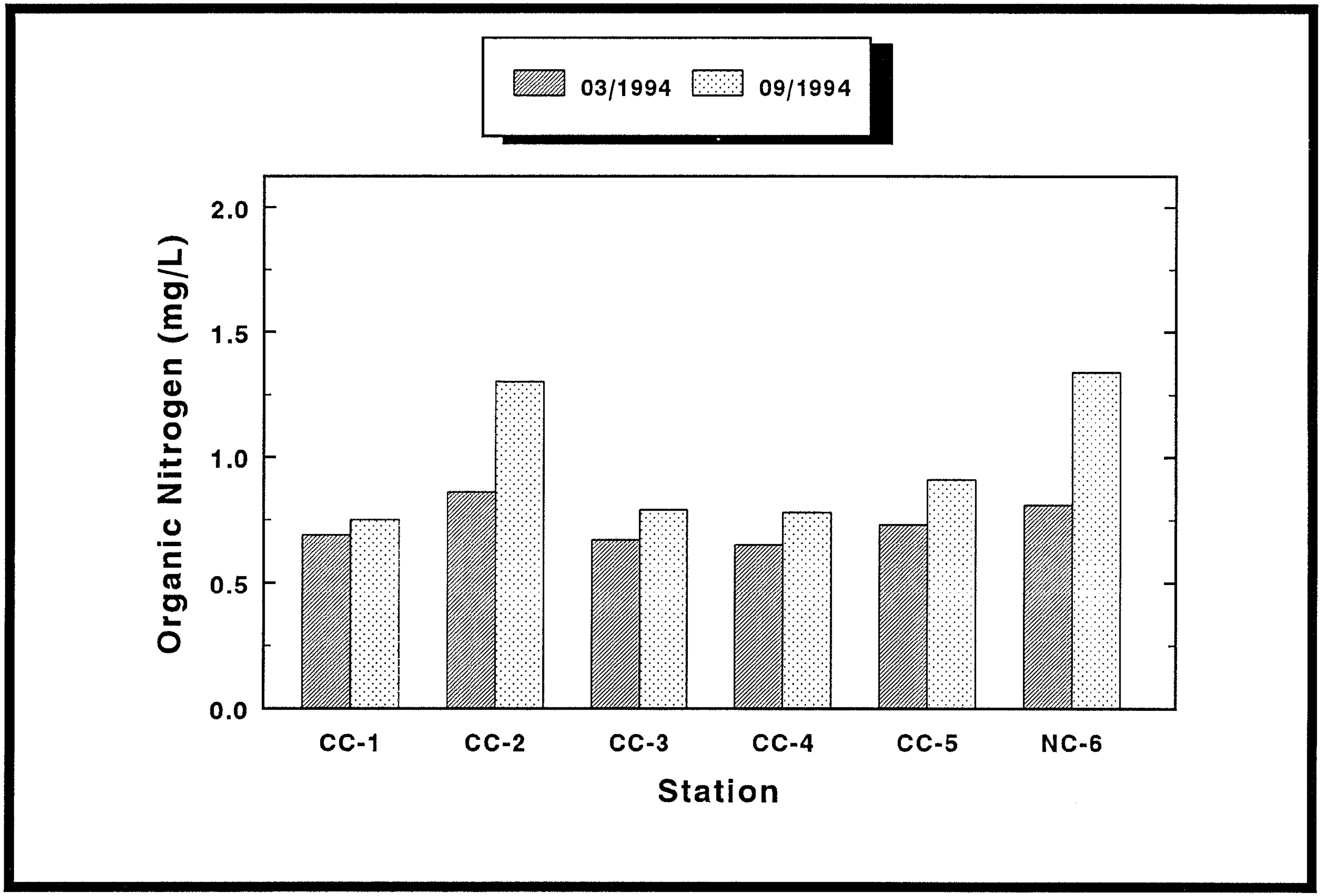


Figure 4.10 **Organic Nitrogen Concentrations Measured During Semi-annual Samplings from January to December 1994 at the Palmer Ranch, Sarasota County.**

Catfish Creek/Trunk Ditch Basin during the second year, may contribute to the declining trend in organic nitrogen.

The concentration of organic nitrogen followed a seasonal trend similar to that observed during previous monitoring years with the level of organic nitrogen increasing from the spring through the summer. A maximum organic nitrogen concentration was recorded during the late summer (*i.e.*, September) with lower organic nitrogen concentrations observed for March 1994 event. During the March and September 1994 monitoring events, organic nitrogen levels in Catfish and North Creeks averaged 0.74 and 0.98 mg/L, respectively.

Peaks in organic nitrogen during September are apparently associated with peaks in the standing crop of aquatic vegetation and stormwater loadings, since this month represents the primary wet season. During the fall and winter, the standing crop of vegetation declines in association with low production rates and the decay of plant material. During this period, organic nitrogen concentrations have exhibited a concomitant decline during previous studies as the plant material was depleted by the microbial heterotrophs. Additionally, stormwater loading rates most likely declined in association with minimal runoff during the relatively drier months of October through May.

4.4.6 *Total Phosphorus*

During the 1994 monitoring year, total phosphorus in the Catfish Creek/Trunk Ditch Basin of the Palmer Ranch averaged 0.21 mg/L and a range of 0.06 to 0.43 mg/L (**Appendix Table B-15**). The highest total phosphorus level (0.43 mg/L) was recorded at Station CC-2 during the September monitoring event (**Figure 4.11**). The lowest mean total phosphorus concentrations were observed at Stations CC-3 and CC-4. Overall, the average total phosphorus concentration in the Catfish Creek/Trunk Ditch Basin were observed to decrease in a downstream direction (**Appendix Table B-15**).

A similar total phosphorus distribution were observed during the previous monitoring year with concentrations ranging from 0.07 to 0.49 mg/L and averaging 0.09 mg/L (CCI, 1994). During the 1992 monitoring year, higher total phosphorus concentrations were observed with an average concentration of 0.38 mg/L and a range of 0.06 to 2.22 mg/L (CCI, 1993). Slightly lower total phosphorus concentrations were recorded for the 1991 monitoring year with an overall yearly average of 0.15 mg/L for the six monitoring stations in the Catfish Creek/Trunk Ditch and North Creek Basins (CCI, 1992a). Lower total phosphorus concentrations were also observed during the sixth monitoring year with concentrations in the Catfish Creek/Trunk Ditch and North Creek Basins averaging 0.12 mg/L (CCI, 1991). During the third and fourth monitoring years, total phosphorus levels averaged 0.26 mg/L for each year (CCI, 1988a and 1988b). The highest total phosphorus levels occurred during the second monitoring year with an average of 0.46 mg/L (CCI, 1986). The source of this phosphorus was attributed to cleared lands and construction activities associated with the development of Prestancia. Overall, the mean total phosphorus concentration recorded during the tenth year of monitoring in the Catfish Creek/Trunk Ditch and North Creek Basins were within the median value for the nine monitoring years on the Palmer Ranch property.

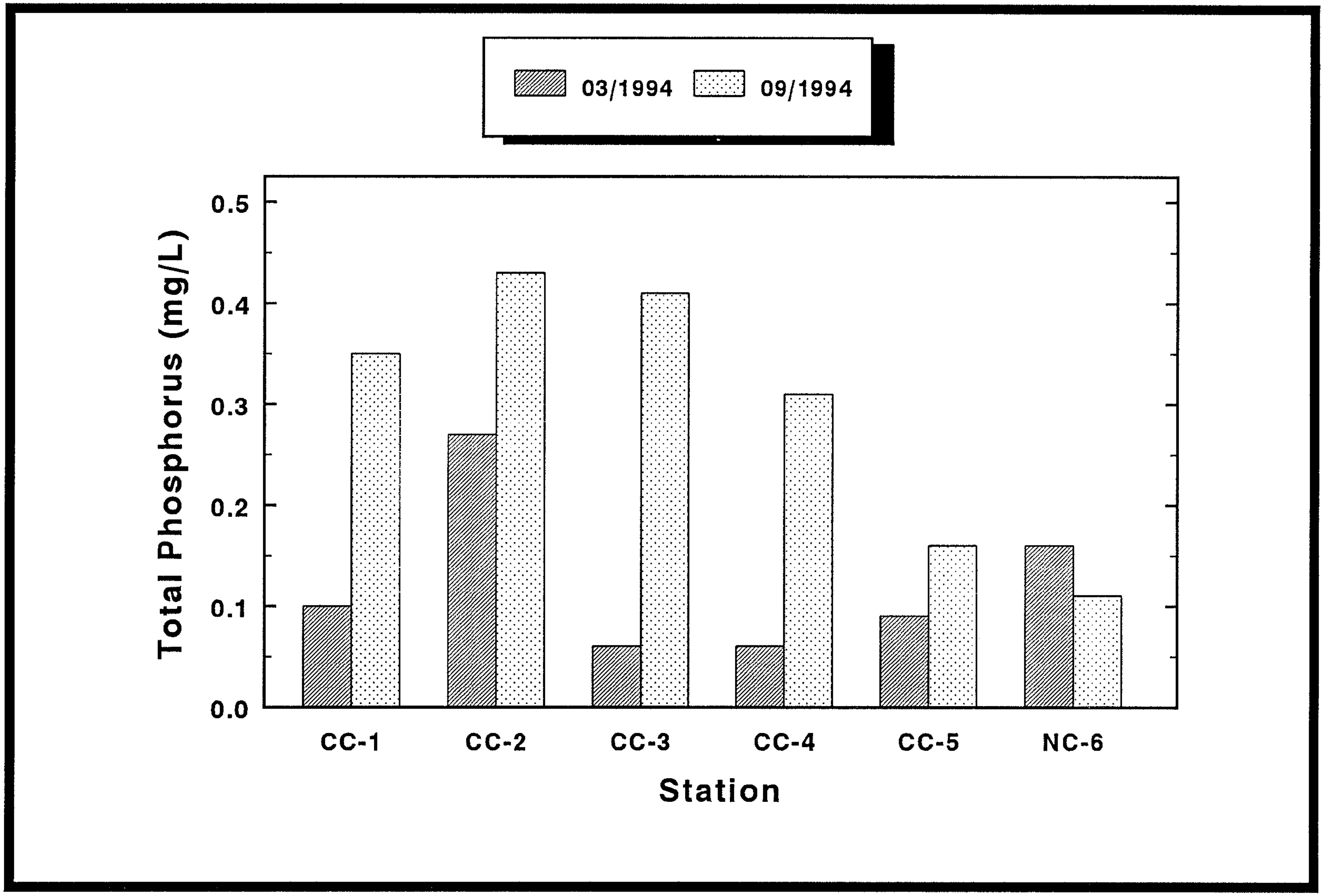


Figure 4.11 Total Phosphorus Concentrations Measured During Semi-annual Samplings from January to December 1994 at the Palmer Ranch, Sarasota County.

Average phosphorus concentrations in the Catfish Creek/Trunk Ditch and North Creek Basins declined during the second, third, fourth, fifth, sixth, seventh and ninth year of monitoring, as illustrated in **Figure 4.12.** However, average phosphorus levels recorded for the eighth year of monitoring were higher than recorded for previous years. This observed increase in phosphorus was attributed to a high rainfall amount of 38.33 inches recorded during the primary wet season. For comparison, the fractionation of orthophosphate and organic phosphorus levels is also provided in **Figure 4.12.**

As a nutrient, phosphorus is required by algae and other plants for the primary production of organic matter and, therefore, as specified in FAC Chapter 62-302, shall not be elevated to levels that will cause an imbalance in the natural flora and fauna. The results of the tenth year of monitoring indicate that the total phosphorus concentrations in the streams of the Palmer Ranch never exceeded the FDEP screening level of 0.46 mg/L (FDER, 1990) which is considered to be indicative of water quality problems. The total phosphorus concentrations were more often above the 0.09 mg/L level determined to be the median concentration for Florida streams (FDER, 1990).

Similar concentrations are normally found in west-central Florida because of the widespread deposits of naturally occurring phosphate (Sheldon, 1982). Interestingly, well drillers' logs show that phosphates exist in shallow deposits on the Palmer Ranch (Patton and Associates, 1984). As in the past years, a correlation between the total phosphorus concentrations and TSS concentrations suggests the controlling role of naturally occurring phosphate deposits on the phosphorus concentrations in the

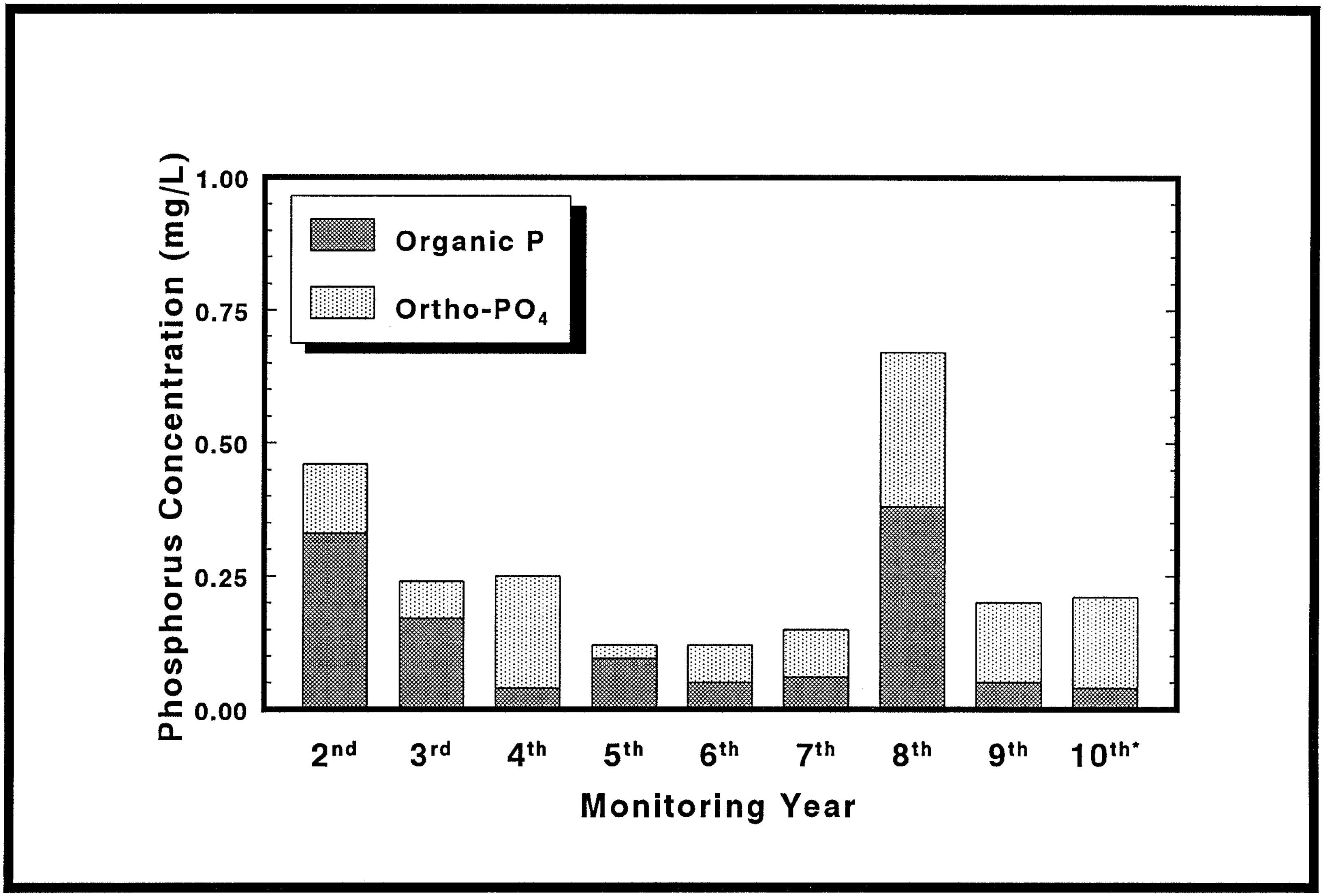


Figure 4.12 Average Phosphorus Concentrations from the Second through the Tenth Year of Monitoring at the Palmer Ranch, Sarasota County. *Tenth Year Monitoring Performed Semi-annually Rather than Quarterly.

streams of the Palmer Ranch. In addition, Palmer Venture (1986) noted that the phosphate levels in the streams of the Palmer Ranch were significantly influenced by groundwater during periods when stream flow was augmented by groundwater exfiltration (*i.e.*, low flow conditions). Consequently, phosphates originating from these naturally occurring deposits within, or upstream of, the Palmer Ranch should not be considered violations even though they exhibit the potential for contributing to high rates of primary production and a concomitant imbalance in the flora and fauna.

4.4.7 *Orthophosphate*

Orthophosphate concentrations determined in the streams traversing the Palmer Ranch during the 1994 monitoring year are provided in **Appendix Table B-16**. Overall, the Catfish Creek/Trunk Ditch and North Creek Basins of the Palmer Ranch exhibited an average orthophosphate concentration of 0.17 mg/L during the tenth year of monitoring with a range from 0.03 to 0.42 mg/L (**Figure 4.13**). As with total phosphorus, the highest orthophosphate concentrations observed during the 1994 monitoring year occurred in September, at the end of the primary wet season (**Figure 4.13**).

Orthophosphate concentrations reported during the 1993 monitoring year were the most comparable with data collected during the tenth year of monitoring. Overall, orthophosphate concentrations averaged 0.15 mg/L during 1993 and ranged from <0.01 to 0.41 mg/L (CCI, 1994). During the eighth monitoring year, orthophosphate concentrations averaged 0.29 mg/L and ranged from 0.01 to 2.04 mg/L (CCI, 1993). Average orthophosphate levels recorded for the Catfish Creek/Trunk Ditch and North

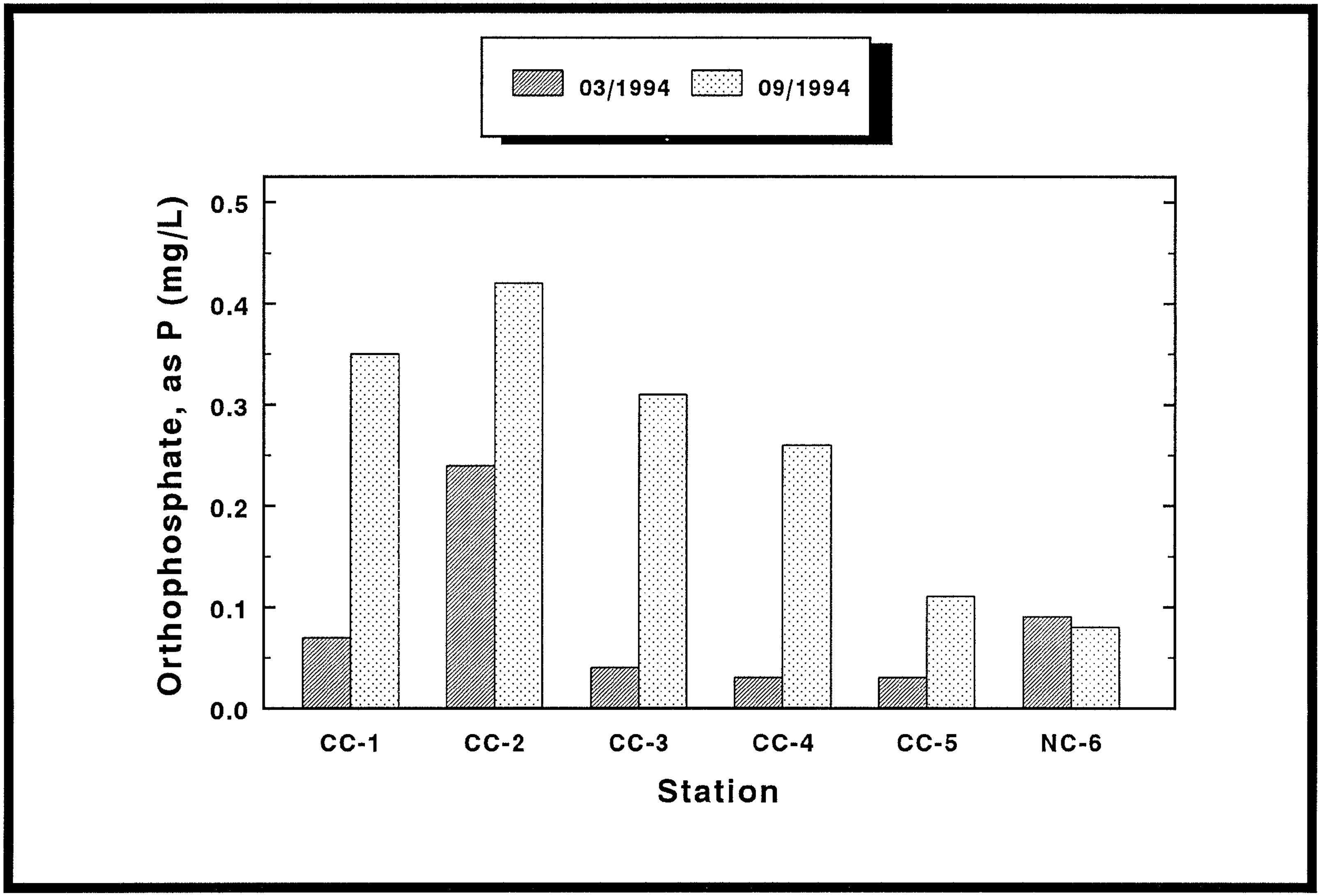


Figure 4.13 Orthophosphate Concentrations Measured During Semi-annual Samplings from January to December 1994 at the Palmer Ranch, Sarasota County.

Creek Basins during the 1990 and 1991 monitoring years were lower than recorded during the tenth year of monitoring. The annual mean orthophosphate concentrations determined during 1990 and 1991 were 0.07 and 0.09 mg/L, respectively (CCI, 1991 and 1992a). However, during the fourth year orthophosphate averaged 0.20 mg/L with a range of from 0.02 to 0.88 mg/L (CCI, 1988b). An annual mean orthophosphate concentration of 0.07 mg/L and range of <0.01 to 0.15 mg/L were recorded during the third year of monitoring (CCI, 1988b). The orthophosphate concentrations recorded during the second monitoring year ranged from 0.04 to 0.36 mg/L with an annual mean concentration of 0.13 mg/L (CCI, 1986).

Although the phosphorus concentrations have varied considerably over the last four years, the percentage of total phosphorus consisting of orthophosphate has remained relatively constant. During the 1994 monitoring year, orthophosphate represented approximately 81 percent of the total phosphorus in the two streams. In general, orthophosphate represented approximately 70 and 75 percent of the total phosphorus during 1992 and 1993, respectively, compared to 58 to 77 percent recorded for previous four years of monitoring.

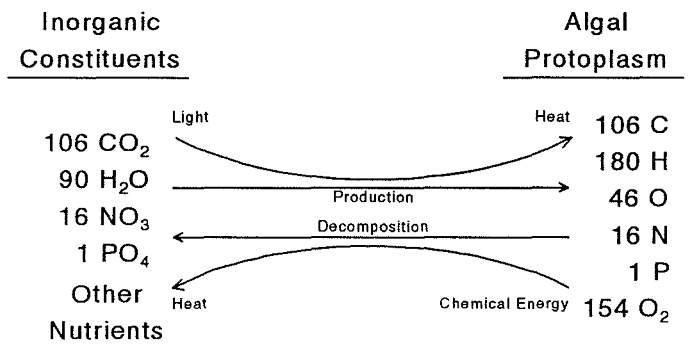
During the tenth year of monitoring, an apparent spatial and temporal trend in orthophosphate suggests that orthophosphate levels in the Catfish Creek/Trunk Ditch and North Creek Basins generally decrease in a downstream direction (**Figure 4.13**). Higher orthophosphate concentrations were observed during the September monitoring event (*i.e.*, end of the primary wet season), as expected (**Figure 4.13**). Similar trends were observed during the previous years of monitoring for the Catfish/North Creek

Basins. The spatial decline is attributed to the following: (1) downstream dilution of the runoff within the Catfish Creek/Trunk Ditch and North Creek Basins; and (2) phosphate uptake by biological and physicochemical processes. The temporal increase in orthophosphate concentrations recorded at the end of the primary wet season is attributed to increased runoff during the primary wet season.

As a nutrient, orthophosphate is designated by FAC Chapter 62-302 as a general water quality parameter. This criterion 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 occasionally above the threshold considered to indicate eutrophic conditions as defined by FDEP (FDER, 1983), orthophosphate has been found to occur naturally on the North Tract. Consequently, other factors, such as nitrogen availability, are probably more growth limiting than orthophosphate. Therefore, the phosphate levels found during the 1994 monitoring year is not likely to have caused an imbalance in the aquatic flora and fauna.

4.4.8 *Nutrient Ratios*

Nitrate and phosphate are required by aquatic plants in proportions of approximately 6.8:1 on a weight basis (or 16:1 N:P on a molar basis) (Odum, 1959 and GESAMP, 1987). Nitrogen and phosphorus are assimilated in this proportion by the primary producers (rooted aquatic plants and algae) and converted into protoplasm during the process of photosynthesis. Conversely, the (unresistant or digestible) 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. This relationship can be illustrated as:



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.

Importantly, other limiting factors such as low light and low dissolved oxygen could play as important, if not more important, roles in limiting the rate of primary production and decomposition in the streams of the Palmer Ranch, respectively. For example, if the availability of inorganic nitrogen is high and the N_i:P_i ratio is low, *e.g.*, 2:1, it would indicate that some factor other than inorganic nitrogen is the real limiting factor. Even so, determinations and the use of nutrient ratios in light of other important and potentially limiting factors is helpful in evaluating the results of long-term monitoring programs when nutrient loading and its consequences are major concerns, such as for the "Continuing Surface Water Quality Monitoring Program."

Results of the tenth year of monitoring were used to determine the weight ratios of nitrogen to phosphorus in the streams of the Palmer Ranch (**Figures 4.14A** and **4.14B**). Total nitrogen to total phosphorus ratios (N_t:P_t) are provided in **Appendix Table B-17** with ratios of inorganic nitrogen (ammonia, nitrite, and nitrate) to orthophosphate (N_i:P_i) being given in **Appendix Table B-18**.

The most meaningful ratio in assessing 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 even the unresistant organic forms must be chemically transformed into the inorganic forms prior to photosynthesis. The N_i:P_i ratios are consistently low and found to average approximately 1.1:1 for both semi-annual sampling events. The low N_i:P_i ratios are indicative of conditions in which fixed inorganic nitrogen would limit plant growth before orthophosphate (**Figure 4.14B**). In contrast, N_t:P_t ratios were found to average 6.8:1 indicating a balanced system (**Figure 4.14A**). In a nutrient-balanced system, neither nitrogen nor phosphorus limit plant growth because both are present in the proper proportions for plant growth. The low N_i:P_i ratios calculated from the 1994 data are attributed to the naturally high levels of orthophosphate, as well as the high percentage of total phosphorus represented by orthophosphate (81 percent of total phosphorus) while only 11 percent of the total nitrogen is comprised of inorganic nitrogen.

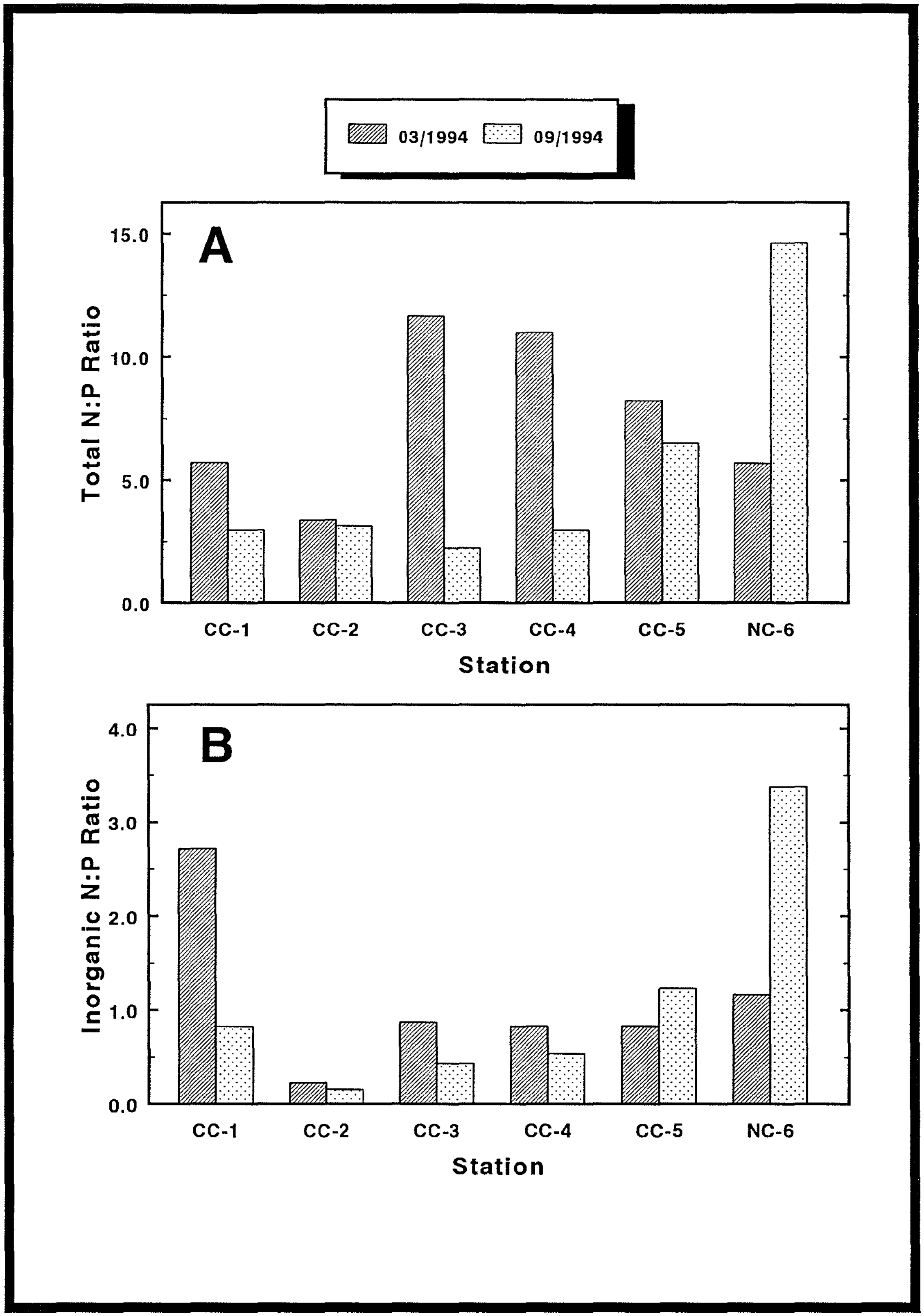


Figure 4.14 (A) Total Nitrogen to Phosphorus Ratios and (B) Inorganic Nitrogen to Phosphorus Ratios determined from Semi-annual Data Collected from January to December 1994 at the Palmer Ranch, Sarasota County.

4.5 Oils and Greases

As provided in **Appendix Table B-19**, the concentration of oil and grease in the streams of the Palmer Ranch ranged from <1 to 2 mg/L during the tenth year of monitoring. Two of the 12 measurements made for oil and grease during the past year of monitoring were above the analytical detection limit. However, all oil and grease measurements made during 1994 were below the State standard of 5 mg/L specified in FAC Chapter 62-302. In addition, all 12 measurements were also in compliance with the Sarasota County standard of 15 mg/L.

The concentrations of oils and greases reported in the streams of the Palmer Ranch during the previous years of the monitoring program (Palmer Venture, 1986; and CCI, 1986, 1988a, 1988b, 1991, 1992a, 1993 and 1994), ranged from less than 1 mg/L to 17 mg/L. Most of the observations (122 of 148) were found to be less than the maximum allowable State criteria of 5 mg/L and only one was found greater than the maximum allowable County criteria of 15 mg/L.

4.6 Bacteriological Parameters

4.6.1 *Total Coliform*

As indicated in **Appendix Table B-20**, the streams traversing the Palmer Ranch were found to exhibit violations of the State and County standards for total coliform bacteria during the 1994 monitoring year. Both the State and County standards, which allow up to 2,400 colonies/100 mL, were exceeded in 2 of the 12 samples collected during the 1994 monitoring year (**Figure 4.15A**). The highest bacteria concentrations were observed in the upper reach of the Catfish Creek/Trunk Ditch

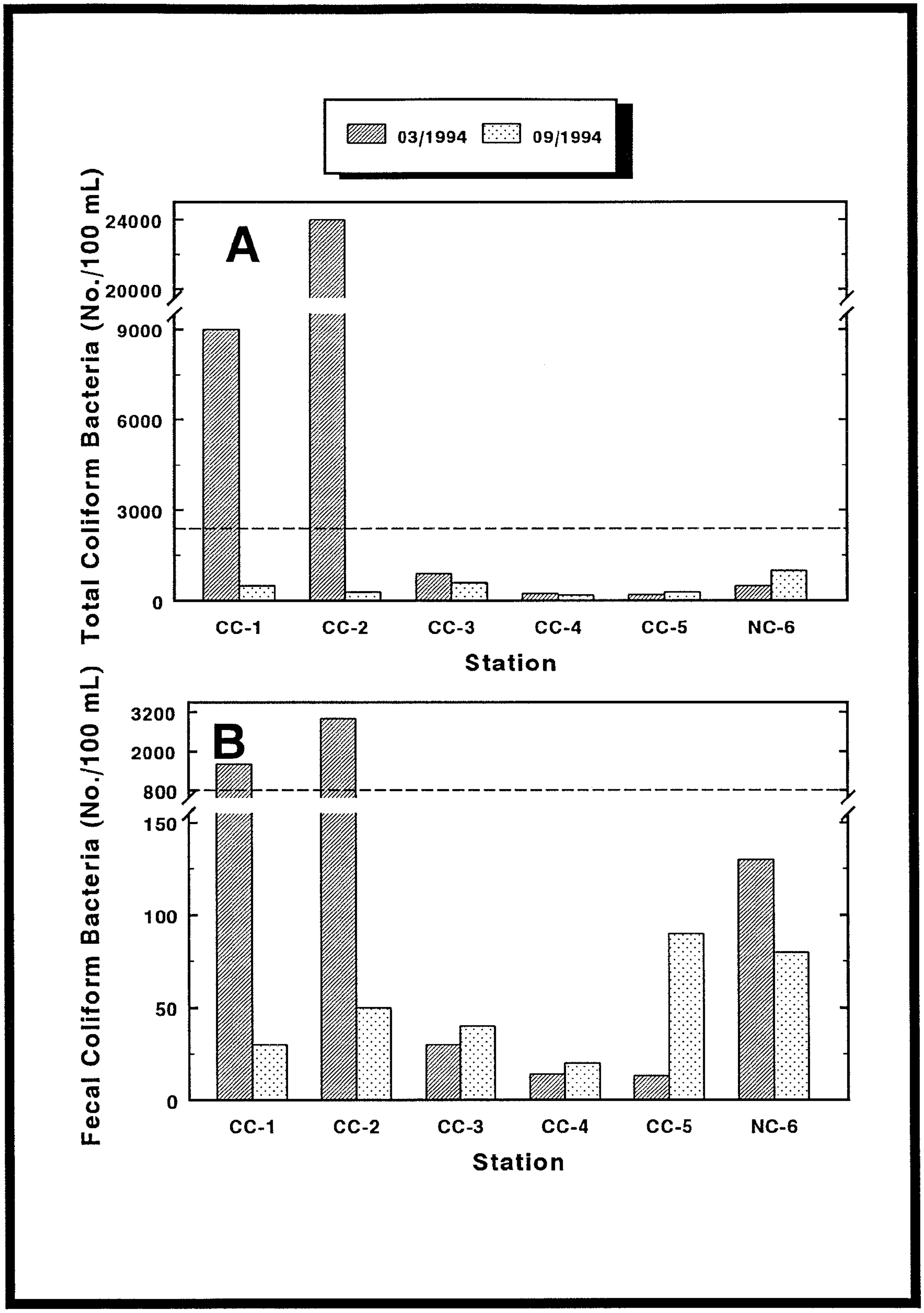


Figure 4.15 (A) Total Coliform Bacteria and (B) Fecal Coliform Bacteria Counts Measured During Semi-annual Samplings from January to December 1994 at the Palmer Ranch, Sarasota County. Dashed Lines Depict State Standards.

Basin at Stations CC-1 and CC-2 (**Figure 4.15A**) as was also observed during 1990, 1991, 1992 and 1993 monitoring years. During the second, third, fourth, sixth and seventh monitoring years (CCI, 1986, 1988a, 1988b, 1991, and 1992a), the total coliform concentrations in the Catfish Creek/Trunk Ditch Basin were also found to commonly exceed the State and County standards with 67, 52, 53, 43, 78 and 32 percent of the results being higher than the 2,400 colonies/100 mL criteria, respectively.

Unlike the previous years, the highest number of total coliform bacteria colonies were observed during the 1994 dry season with a mean level of 4,083 colonies/100 mL being observed for the March 1994 monitoring event. This may have resulted from the lack of flushing and the relatively high water temperatures. These conditions are conducive to bacterial accumulation and growth in surface waters.

As noted in previous years (CCI, 1988a, 1988b, 1991, 1992a, 1993 and 1994), these data show that several sources of coliform bacteria exist on and upstream of the Palmer Ranch. A primary source is expected to be the naturally occurring coliform bacteria of the soils and vegetation on and upstream of the ranch. During periods of land clearing coupled with significant runoff, this source is expected to be exacerbated. Such a condition probably occurred during the second and third monitoring years in the Catfish Creek/Trunk Ditch Basin as the construction of Prestancia was initiated. Another source of coliform bacteria is represented by the warm-blooded animals inhabiting the watershed, including dogs, cats, cattle, birds, feral hogs, deer, and rodents.

4.6.2 *Fecal Coliform*

During the tenth year of monitoring, the streams of the Palmer Ranch exhibited fecal coliform densities that ranged from 13 to 3,000 colonies/100 mL (**Appendix Table B-21**) as compared to a range of 17 to 5,000 colonies/100 mL during the ninth year (CCI, 1994). Of the 12 samples that were collected during the tenth year of monitoring, two (*i.e.*, 17 percent) exceeded the Class III State and County Standard of 800 colonies/100 mL (**Figure 4.15B**). The percentage of exceedances recorded during the third, fourth, sixth, and seventh monitoring years ranged from 26 to 43 percent. However, it is important to note that fewer samples were collected during the fourth year than during other years of monitoring.

The highest number of fecal coliform colonies and all of exceedances during the 1994 monitoring year generally occurred in the upper reach of the Catfish Creek/Trunk Ditch Basin (**Figure 4.15B**) probably due to a greater number of warm blooded animals in the stream communities associated with the developed portion of the Palmer Ranch. The high fecal coliform bacteria levels which were observed both upstream and internal to the Palmer Ranch, indicate significant sources of fecal coliform bacteria originating both upstream and within the ranch, with dogs, cats, birds, cattle, and other warm-blooded wild animals considered the primary sources.

4.7 Trace Elements

During the September 1994 monitoring event, samples were collected for the analyses of trace elements (*i.e.*, arsenic, copper, lead, mercury, nickel, and zinc). The results of these analyses are provided in **Appendix Table B-22** along with the applicable State and County Standards for each element.

Concentrations for all four trace elements measured in samples collected from the six monitoring stations located in the Catfish Creek and North Creek basins were below analytical detection limits. Therefore, all trace metal concentrations were found to be in compliance with both State and County standards.

5.0 SUMMARY

During the tenth year of the "Continuing Surface Water Quality Monitoring Program", sampling was performed at six stations located in the Catfish Creek/Trunk Ditch Basin of the Palmer Ranch over the period from January through December 1994. The sampling frequency during the 1994 monitoring year was changed from quarterly to semi-annual and approved by the Sarasota County Pollution Control Division. Semi-annual monitoring events were performed during March and September, 1994. Water quality monitoring has been performed at approximately the same six locations in the Catfish Creek/Trunk Ditch Basin during the previous nine years. However, monitoring was performed bimonthly during the first year and subsequently changed to a quarterly frequency at the beginning of the second year of monitoring. The results of the first eight years of monitoring may be reviewed in the annual reports prepared by Palmer Venture (1986) and CCI (1986, 1988a, 1988b, 1990, 1991, 1992a, and 1993). In addition, results from the "Stormwater Pollutant Loading Monitoring Program" for the Palmer Ranch performed from August 1988 to April 1990 can be reviewed in a final report prepared by CCI (1992b).

The continuing Surface Water Quality Monitoring Program conducted for the Palmer Ranch streams entailed measurements of specific conductance, water temperature, suspended solids, turbidity, dissolved oxygen, pH, biochemical oxygen demand, macronutrients, oil and greases, and bacteriological quality during each semi-annual sampling event. In addition, samples for the determination of trace elements were collected at all six sites on the Palmer Ranch on an annual basis during the September monitoring event. These results of the tenth year of monitoring are summarized in **Table 5.1**. A complete tabulation of results by parameter is provided in **Appendix B**.

The tenth year of monitoring exhibited less than normal amounts of rainfall with a total of approximately 48 inches of precipitation occurring on the Palmer Ranch. During the sixth and seventh monitoring years only 38 and 44 inches of rainfall were record, respectively. Meanwhile, 51, 52 and 50 inches of rainfall were reported during the third, fourth and ninth years of monitoring, respectively. A drought was experienced during much of the second year resulting in only 33 inches of rainfall being recorded. The historical amount of rainfall for the region based on a 30-year record is 54 inches per year (NOAA, 1982). Although rainfall during 1994 was less than normal, rainfall recorded during the month of September was the highest reported during the ten year monitoring period. Consequently, the streams of the Palmer Ranch exhibited above normal stream flows during much of the tenth monitoring year.

The specific conductance measured in the Catfish Creek/Trunk Ditch Basin ranged from 421 to 935 μmhos/cm, as compared with ranges of 567 to 1,625 μmhos/cm, 626 to 1,332 μmhos/cm, 431 to 1,459 μmhos/cm, and 526 to 954 μmhos/cm during the sixth, seventh, eighth and ninth monitoring years, respectively. The lower range in specific conductance measured during the tenth year may have been associated to the slightly wetter conditions and the subsequent increase of low conductivity rainfall and stormwater runoff entering the streams.

Seasonally, lower conductivities were recorded during the September 1994 semi-annual sampling event. These lower conductivities most likely resulted from the

TABLE 5.1 SUMMARY OF RESULTS FOR THE PALMER RANCH WATER QUALITY MONITORING PROGRAM FOR THE PERIOD FROM JANUARY THROUGH DECEMBER, 1994

Parameter	CC-1 Mean	CC-2 Mean	CC-3 Mean	CC-4 Mean	CC-5 Mean	Catfish Creek Basin Mean	N	Min	Max	Applicable Criteria[a]
PHYSICAL										
Depth (ft)	1.3	0.9	0.5	0.4	0.6	0.7	10	0.1	2.4	-------
Flow (GPM	1,952	325	265	2,191	5,953	2,137	10	233	6,183	-------
Temperature (°C)	23.7	25.0	23.6	24.2	24.2	24.1	10	20.8	27.4	-------
Conductivity (μmhos/cm)[b]	528	752	840	628	663	682	10	421	935	+50%, +100%
Total Suspended Solids (mg/L)	4	5	5	7	6	5	10	2	8	-------
Turbidity (NTU)[c]	5.8	2.9	5.1	6.0	4.8	4.9	10	1.8	7.4	+29, +25
OXYGEN DEMAND AND RELATED PARAMETERS										
Biochemical Oxygen Demand, 5-day (mg/L)	2.9	3.1	3.1	3.3	3.8	3.2	10	1.5	4.7	-------
Dissolved Oxygen (mg/L)	7.1	5.9	7.1	7.0	6.3	6.7	10	3.9	10.0	≥5.0, ≥4.0
pH (-log[H^+])	7.2	7.4	7.1	7.4	7.4	7.3	10	6.8	7.5	6.0 - 8.5
MACRONUTRIENTS (mg/L)										
Nitrite Nitrogen	0.02	<0.01	0.03	<0.01	<0.01	0.01	10	<0.01	0.05	-------
Nitrate Nitrogen	0.09	0.04	0.01	0.03	0.03	0.04	10	<0.01	0.14	-------
Ammonia Nitrogen[d]	0.14	0.02	0.05	0.05	0.05	0.06	10	<0.02	0.24	-------[e]
Organic Nitrogen	0.72	1.08	0.73	0.72	0.82	0.81	10	0.65	1.30	-------
Total Nitrogen	0.96	1.13	0.81	0.79	0.89	0.92	10	0.66	1.35	-------
Orthophosphate	0.21	0.33	0.18	0.15	0.07	0.19	10	0.03	0.42	-------
Total Phosphorus	0.23	0.35	0.24	0.19	0.13	0.22	10	0.06	0.43	-------
ORGANIC COPNSTITUENTS										
Oil and Grease (mg/L)	1.1	<1	1.1	<1	<1	0.8	10	<1	1.6	≤5, ≤15
BIOLOGICAL (count/100 mL)										
Total Coliform Bacteria	4,750	12,150	750	220	260	3,626	10	200	24,000	≤2,400
Fecal Coliform Bacteria	815	1,525	35	17	52	489	10	13	3,000	≤800

[a] State and County Criteria, respectively.
[b] State Criteria allows 50% increase above background to 1275 μmhos/cm and County Ordinance No. 72-37 allows 100% increase above background to 500 μmhos/cm.
[c] State Criteria allows a maximum increase of 29 NTU above background and County Ordinancce 72-37 allows a maximum increase of 25 JTU above background.
[d] Ionized plus un-ionized ammonia.
[e] State Criteria allows a maximum of 0.02 mg/L unionized ammonia, County ordinance allows a maximum un-ionized ammonia concentration of 0.2 to 2.0 mg/L depending on pH.

TABLE 5.1 SUMMARY OF RESULTS FOR THE PALMER RANCH WATER QUALITY MONITORING PROGRAM FOR THE PERIOD FROM JANUARY THROUGH DECEMBER, 1994(Continued).

Parameter	NC-6 Mean	All Stations Mean	All Stations N	All Stations Min	All Stations Max	Applicable Criteria[a]
PHYSICAL						
Depth (ft)	0.8	0.7	12	0.1	2.4	-------
Flow (GPM)	206	1,815	12	27	6,183	-------
Temperature (°C)	24.1	24.1	12	18.2	30.0	-------
Conductivity (μmhos/cm)[b]	684	682	12	421	935	+50% +100%
Total Suspended Solids (mg/L)	24	8	12	2	32	-------
Turbidity (NTU)[c]	17.8	7.0	12	1.8	23.0	+29, +25
OXYGEN DEMAND AND RELATED PARAMETERS						
Biochemical Oxygen Demand, 5-day (mg/L)	4.8	3.5	12	1.5	5.6	-------
Dissolved Oxygen (mg/L)	4.3	6.3	12	0.8	10.0	≥5.0, ≥4.0
pH (-log[H^+])	7.1	7.2	12	6.6	7.6	6.0 - 8.5
MACRONUTRIENTS (mg/L)						
Nitrite Nitrogen	0.01	0.01	12	<0.01	0.05	-------
Nitrate Nitrogen	0.03	0.03	12	<0.01	0.14	-------
Ammonia Nitrogen[d]	0.15	0.08	12	<0.02	0.24	-------[e]
Organic Nitrogen	1.08	0.86	12	0.65	1.34	-------
Total Nitrogen	1.26	0.97	12	0.66	1.61	-------
Orthophosphate	0.09	0.17	12	0.03	0.42	-------
Total Phosphorus	0.14	0.21	12	0.06	0.43	-------
ORGANIC CONSTITUENTS						
Oil and Grease (mg/L)	<1	0.7	12	<1	1.6	≤5, ≤15
BIOLOGICAL (count/100 mL)						
Total Coliform Bacteria	750	3,147	12	200	24,000	≤2,400
Fecal Coliform Bacteria	105	425	12	13	3,000	≤800

[a] State and County Criteria, respectively.
[b] State Criteria allows 50% increase above background to 1275 μmhos/cm and County Ordinance No. 72-37 allows 100% increase above background to 500 μmhos/cm.
[c] State Criteria allows a maximum increase of 29 NTU above background and County Ordinancce 72-37 allows a maximum increase of 25 JTU above background.
[d] Ionized plus un-ionized ammonia.
[e] State Criteria allows a maximum of 0.02 mg/L unionized ammonia, County ordinance allows a maximum un-ionized ammonia concentration of 0.2 to 2.0 mg/L depending on pH.

cumulative effects of increased surface runoff of low conductivity stormwater during the primary wet season.

Total suspended solids levels in the Catfish Creek/Trunk Ditch Basin averaged 8 mg/L during the 1994 monitoring year. Seasonally, a slightly higher mean TSS level (*i.e.*, 9 mg/L) was observed during the September 1994 monitoring event probably resulting from high rainfall and subsequent surface water runoff. The March event exhibited a mean TSS level of 7 mg/L. These relatively similar TSS concentrations recorded during the 1994 monitoring year may be attributable to a well-established littoral zone around the Catfish Creek and the stormwater management system in place at Prestancia.

Because of the well-established littoral zone, less erosion of stream banks occurs during storm events resulting in lower TSS levels during the primary growing season (*i.e.*, primary wet season). In addition, the stormwater management system at Prestancia helped to improve water quality during storm periods by removing suspended solids from the storm generated runoff. For example, during the past years of monitoring, quarterly sampling was performed at stations along South Creek. Because the banks along South Creek are barren of dense vegetation, greater suspended solid loads are expected during periods of high runoff. In addition, no stormwater management system is presently in place along South Creek.

Higher TSS concentrations were measured in the Catfish Creek/Trunk Ditch and North Creek Basins during the 1991 monitoring year than during 1994. During the 1990 monitoring year, total suspended solid concentrations were lower and probably associated to the lower rainfall amounts recorded for that year.

Turbidity levels followed the same seasonal trends as TSS. As in previous years, turbidity and TSS levels measured during 1994 were found to be positively correlated (*i.e.*, $r = 0.60$).

Five-day biochemical oxygen demand was found to average 3.5 mg/L for the two streams of the North Tract. The BOD_5 levels measured in the Catfish Creek/Trunk Ditch and North Creek Basins during 1994 averaged higher than during the 1991, 1992 and 1993 monitoring years. More comparable BOD_5 results to those observed during the 1994 monitoring year were observed for the third and fourth monitoring years. As observed during prior monitoring years, a positive correlation was found between BOD_5 and TSS (*i.e.*, $r = 0.66$) indicating the contribution of decaying vegetation and other organic matter to TSS levels in the water column.

Dissolved oxygen levels were found to average 6.3 mg/L with a range from 0.8 to 10.0 mg/L. The results obtained for dissolved oxygen concentrations during the 1994 monitoring year for Catfish and North Creeks are generally comparable to those reported during the third, fourth, sixth, seventh, eighth and ninth monitoring years. Of the 12 dissolved oxygen measurements made during 1994, four were below the $\geq$5.0 mg/L State standard with two measurements below the less stringent County standard of $\geq$4.0 mg/L.

A steady decline of nutrients during the previous monitoring years has been observed in the surface waters of the Palmer Ranch. Nutrient concentrations during the 1994 monitoring year never exceeded the threshold levels characteristic of eutrophic conditions. During the tenth year of monitoring, Catfish and North Creeks exhibited annual average total nitrogen and total phosphorus concentrations of 0.97 and 0.21 mg/L, respectively. Total nitrogen concentrations measured during the 1993 monitoring period were slightly higher than those reported for 1994 monitoring year. However, total phosphorus concentrations reported during the 1993 monitoring year were similar to those recorded during the tenth monitoring year. In addition, total nitrogen and total phosphorus levels reported for the sixth and seventh years of monitoring were comparable to levels measured in 1994. Total nitrogen and phosphorus levels recorded during the second, third, and fourth monitoring years were generally higher than those measured in 1994.

Inorganic nitrogen and phosphorus fractions that are required by plants during the process of photosynthesis were also found to be readily available. Orthophosphate comprised 81 percent of the total phosphorus concentration while inorganic nitrogen represented 11 percent of the total nitrogen content. Although the availability of inorganic nitrogen was found to be substantial, its low ratio to orthophosphate implies that inorganic nitrogen should become limiting to primary producers in the streams on the Palmer Ranch before orthophosphate. Ratios of inorganic nitrogen to inorganic phosphorus (*i.e.*, orthophosphate) were found to average 1.1:1 (by weight), as compared to algal protoplasm which has a ratio of 6.8:1 (by weight). Interestingly, the average ratio of total nitrogen to total phosphorus determined from 1994 nutrient concentrations was 6.8:1 indicative of a balanced system with respect to nutrient limitation.

During prior years of monitoring, inorganic phosphorus comprised 58 to 77 percent of the total phosphorus. In addition, the inorganic nitrogen fraction constituted 10 to 23 percent of the total nitrogen content for during the first eight years. The ratios of inorganic nitrogen and inorganic phosphorus averaged 1:1 to 4.6:1 during the previous years of monitoring.

Potential sources of nutrients to Catfish Creek upstream of the Palmer Ranch are surface runoff originating in the commercial-industrial strip development along Clark Road and from the country club and development located in the western part of the Catfish Creek/Trunk Ditch Basin. Within the ranch, potential sources of nutrients include Prestancia (golf course and residential development), active pastures, and a effluent spray field. Additionally, rainfall and surficial phosphate deposits represent two ubiquitous sources of phosphate and fixed nitrogen throughout the ranch.

During the tenth year of monitoring, only two oils and greases concentrations measured for stations located in Catfish Creek and North Creek were greater than the analytical detection limit. However, all oil and grease levels were below the State standard of 5.0 mg/L. Potential sources of oils and greases into the Catfish and North Creeks include runoff from the golf course, roads, and natural vegetation. During previous years of monitoring in the Catfish and North Creeks, oils and greases ranged from <1 to 17 mg/L with five of the 160 observations (*i.e.*, less than 4 percent) exceeding the State standard, and only one measurement exceeding the 15 mg/L County standard.

The bacteriological quality of the streams on the Palmer Ranch was found to be improving. However, total coliform and fecal coliform levels in excess of the applicable standards were observed during 1994. Of the 12 coliform analyses, only two exceeded the maximum allowable limit of 2,400 colonies/100 mL for total coliform bacteria. Similarly, two of the 12 fecal coliform counts were found to exceed the maximum allowable limit of 800 colonies/100 mL. During the previous studies, 90 of 189 total coliform bacteria measurements (or approximately 48 percent) exceeded the 2,400 colonies/100 mL as specified in the State standard. In addition, approximately 47 percent of the fecal coliform bacteria measurements in the streams of the North Tract exceeded the 800 colonies/100 mL State standard. The primary sources of coliform bacteria on within the Palmer Ranch are expected to include warm-blooded animals as well as naturally occurring soil bacteria.

During storm events that frequently occur in the early spring through late summer, it is likely that more fecal and non-fecal coliform bacteria are transported by surface runoff to the streams of the Palmer Ranch than at other times of the year. However, during drier periods of the year, it is likely that birds, cattle, and other warm-blooded animals, which are sources of fecal coliform bacteria, are attracted to the streams to water and feed, thereby resulting in an increase in fecal coliform counts.

Annual samples for the analyses of trace elements (*i.e.*, arsenic, copper, lead, and zinc) were collected during the September 1994 sampling event. Concentrations of all four trace elements measured during the September 1994 monitoring event were below analytical detection limits. Therefore, trace element levels in the two streams of the North Tract of Palmer Ranch were assumed to be in compliance of both State and County standards during the 1994 monitoring year.

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APPENDIX A:

EXHIBIT "E"

0380-084

Exhibit "E" to the Amended and Restated
Master Development Order for the Palmer Ranch
Development of Regional Impact

(An Exhibit Containing Surface
Water Monitoring Program and
Consisting of Pages E-1 through E-5)

<u>SURFACE WATER MONITORING PROGRAM</u>

Locations

Water quality measurements and grab samples shall be performed in Catfish Creek, North Creek and South Creek. Sampling and measurements shall be made at a total of 10 monitoring stations (refer to FIGURE 5). Five stations are located in Catfish Creek (CC-1, CC-2, CC-3, CC-4 and CC-5); one station is located in North Creek (NC-6); and four stations are located in South Creek (SC-1, SC-2, SC-3 and SC-4)

Procedures

Monitoring shall be accomplished within a two-day period. At the time of grab sampling, simultaneous in situ measurements of dissolved oxygen, pH, temperature and specific conductance shall be made and flow rates shall be determined using velocity-area measurements. Additionally, water depths and pre- and post-event weather conditions shall be recorded. All sample collections and in situ measurements shall be made at approximate mid-depth and mid-stream at each of the ten stations.

Frequency

Due to the wealth of baseline monitoring data which currently exists, baseline monitoring of all South Creek sites shall be suspended until one month before development begins. One month prior to the commencement of sampling the Palmer Ranch will notify the Sarasota County Pollution Control Division the dates of sampling and stations to be sampled. At the time of sampling, water quality grab samples will be collected and in situ measurements made at all monitoring stations along South Creek. Following this initial monitoring event, all subsequent monitoring shall be performed on a quarterly basis during the development phase. During development, all stations located downstream of an area under development shall be monitored. In addition, one sampling site upstream of a development area shall be maintained for baseline determination. Once an area is substantially developed as agreed to by the Sarasota County Pollution Control Division and Palmer Ranch, a modification of the monitoring program shall be subject to discussion at any time to change the frequency of water quality monitoring from quarterly to semi-annual or to discontinue the monitoring.

Monitoring of Catfish and North Creeks shall continue on a quarterly basis for a maximum of two years or until substantial development takes place. Once substantial development or a two-year period occurs as agreed to by the Sarasota County Pollution Control Division and Palmer Ranch, monitoring frequency for sites located in Catfish and North Creeks shall be subject to change from quarterly to a semi-annual depending on the monitoring results obtained up to that time. Semi-annual sampling, for both basins, shall be performed during a dry and wet season allowing for monitoring of low and high flow conditions.

Parameters

All water quality grab samples shall be analyzed for the following parameters:

- Biochemical Oxygen Demand, 5-day
- Nitrite
- Ortho-phosphate
- Total Suspended Solids
- Ammonia Nitrogen
- Fecal Coliform
- pH
- Conductivity
- Total Kjeldahl Nitrogen
- Nitrate
- Total Nitrogen
- Total Phosphorus
- Turbidity
- Oils and Greases
- Total Coliform
- Dissolved Oxygen

Additionally, analysis shall be done for the following parameters on an annual basis (the first analysis done for South Creek sites will be in conjunction with the initial monitoring event):

- o Copper
- o Arsenic
- o Lead
- o Zinc

No pesticide or mercury, chromium, cadmium and nickel analysis shall be performed because results obtained from the Palmer Ranch Continuous Water Quality Monitoring Program during April 1985 through June 1990 on sites along Catfish Creek indicate that these parameters have consistently been below detection limits and/or state and county standards. Therefore, it may be more important to monitor those parameters which have exhibited higher concentrations than those set by the state.

<u>Methods</u>

All laboratory analyses and in situ measurements shall be performed in accordance with procedures described in the 17th edition of Standard Methods (APHA, 1989) or the Methods for Chemical Analysis of water and Wastes (USEPA, 1993). Methods used for in situ measurements, sample collection, sample preservation and storage and sample analysis are provided in Table A. As changes in technology advance, the methods used in laboratory analysis may be modified to reflect these state-of-the-art procedures. The surface water monitoring program for Catfish Creek, North Creek and South Creek shall be performed on a continuous basis.

<u>Additional Studies</u>

In considering the water quality of lakes on the Palmer Ranch, the Aquatic Center of the University of Florida has expressed interest in conducting limnological research on the Palmer Ranch. One of the objectives of the research would be to develop state-of-the-art strategies in the control of hydrilla and water hyacinth that can be applied on a nation-wide basis.

Since the borrow pit lake in Parcel C has an overabundance of hydrilla, this area has been selected for research. The borrow pit lake was conditioned in the MDO to undergo limnological study as a result of a previous commitment by the Palmer Ranch. Its characters are similar to other borrow pit lakes located on the Palmer Ranch, as well as other borrow pit lakes in Sarasota County. Management of the lake will comply with the newly adopted earth-moving ordinance (Ordinance No. 89-112) which became effective March 13, 1990. This ordinance has provisions to deal with borrow pit lakes uniformly throughout the County. This lake will be used for stormwater management purposes which will be enhanced by the creation of a littoral shelf. The creation of a littoral shelf would promote improved water quality as desirable vegetation would utilize nutrients and lower BOD and TSS levels. Additionally, the Palmer Ranch has made application for a permit from the Florida Game and Fresh Water Fish Commission for the introduction of Triploid Grass Carp. These measures, along with other biological or chemical controls that may be implemented as part of the University of Florida research project for control of hydrilla and lake rehabilitation, would indicate that a further limnological study is unwarranted. Consequently, it is recommended that the future limnological study of the borrow pit as conditioned in the MDO be deleted.

Further, the MDO required the monitoring of an off-site dairy farm to determine the source and significance of water quality problems contributed to surface water. As a result of the water quality data collected from Station SC-7, which is the site used to monitor this off-site contribution, pollutants have significantly decreased. This is no doubt a result of the elimination of the dairy farm which has been converted to residential development (Serenoa). Therefore, it is recommended that monitoring of the site be terminated.

Reporting

A data report shall be submitted to the Sarasota County Pollution Control Division following each sampling event. The report will include: (1) a map of the monitoring stations; (2) narrative and/or tabulation of methods used in collecting, handling, storing and analyzing all samples; (3) a tabulation of all measurement and results of analyses; and (4) the signature(s) of the individual(s) responsible for the authenticity, precision and accuracy of t he data presented. Brief summaries of the responsibility an credentials of the project team members shall be included. In addition, an annual report of the interpretation of the data shall be prepared following each year of monitoring. The annual report will include hydrological information derived from in situ measurements as well as interpretation of the chemical parameters measured over the year. Also included in the annual report shall be tabular representations of all the data collected over the previous year for all of the sites and graphical representation of some of the chemical trends discovered over the year of monitoring.

TABLE 4.1 RAINFALL RECORDED ON THE PALMER RANCH DURING THE PERIOD OF JANUARY THROUGH DECEMBER, 1994.

Date	Monthly Rainfall	Seasonal Rainfall[a]	Pre-event Rainfall (inches)		
			2 Month	2 Week	2 Day
January, 1994	3.56				
February, 1994	0.88				
March, 1994	3.50		5.25	2.79	0.00
Winter		7.94			
April, 1994	2.40				
May, 1994	0.12				
June, 1994	1.34				
Spring		3.86			
July, 1994	9.43				
August, 1994	5.96				
September, 1994	13.25		15.72	4.98	2.47
Summer (wet season)		28.64			
October, 1994	3.87				
November, 1994	0.77				
December, 1994	2.99				
Fall (dry season)		7.63			
Yearly Total		48.07			

[a] **Seasonal Rainfall (inches):**

Primary Wet Season (June - September) - 29.98
Primary Dry Season (October - January) - 11.19
Secondary Wet Season (February - March) - 4.38
Secondary Dry Season (April - May) - 2.52

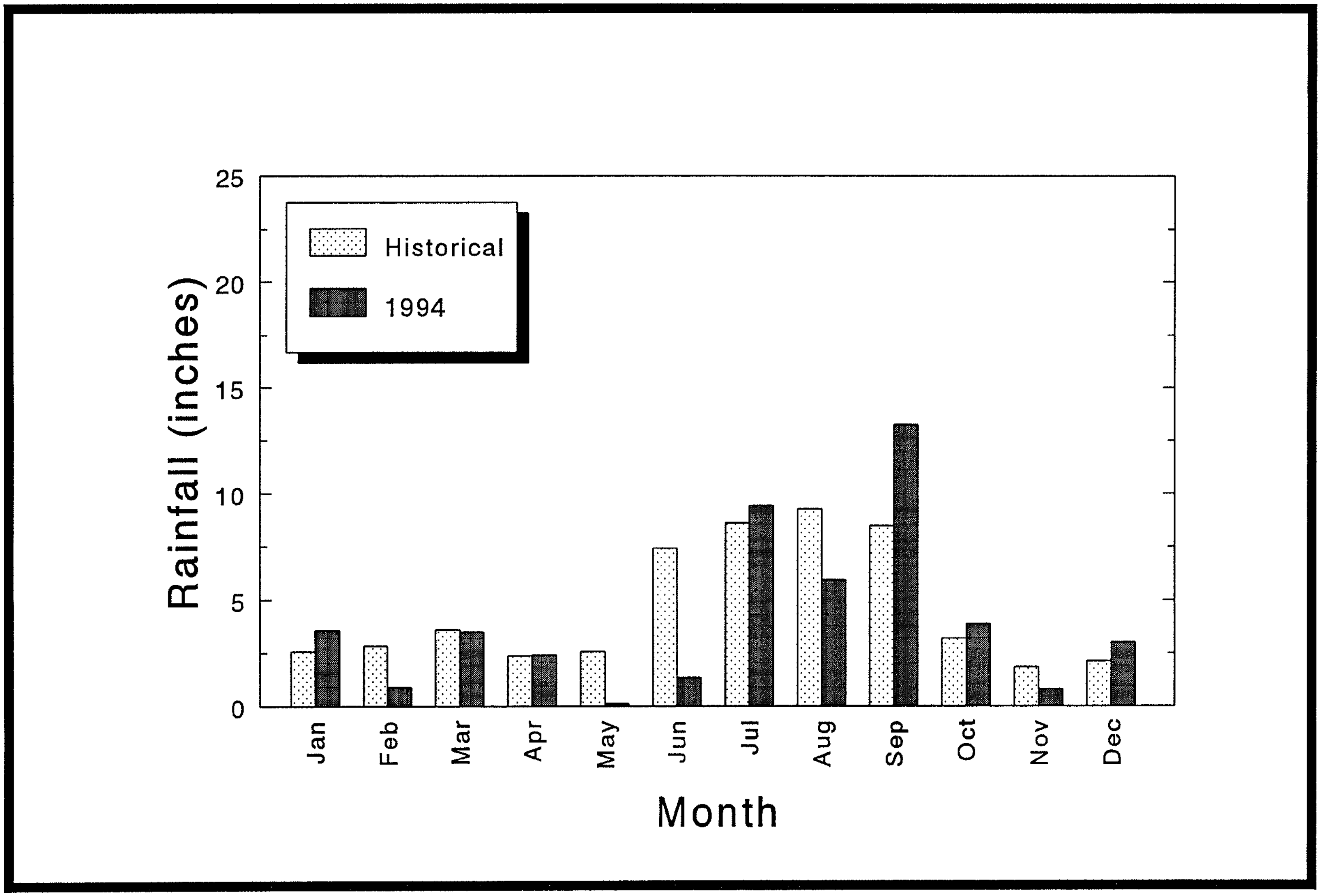

Figure 4.1 Historic Rainfall for Sarasota County Versus Actual Rainfall Recorded on the Palmer Ranch During January Through December 1994.

1994 was the highest observed on the Palmer Ranch property during the ten year monitoring period. Only 11.19 inches (*i.e.*, 23 percent of the annual rainfall) was recorded during the four-month period in which the primary dry season normally occurs (*i.e.*, October through January).

Antecedent rainfall accumulations during 2-day, 2-week and 2-month periods before each semi-annual monitoring event are given in **Table 4.1**. As evident in the table, no rainfall was recorded during the 2-day antecedent period for the March 1994 monitoring event. Rainfall was recorded during the 2-week antecedent periods for both events performed during the 1994 monitoring year. Before the March 1994 event, approximately 2.79 inches were recorded during the 2-week antecedent period. In contrast, 4.98 inches of rainfall were recorded during the 2-week period before the September event.

4.1.2 *Stream Stage*

Water depths measured at each station during the semi-annul sampling events performed during 1994 are tabulated in **Appendix Table B-1**. Stream stages determined during 1994 are lower than those measured during the 1993 monitoring year, especially during the March event. In March 1993, stream stage in the Catfish Creek and North Creek basins averaged 1.1 feet compared to an average stream stage 0.4 feet during 1994. The lower stream stages reported during the 1994 monitoring year are not unexpected considering that less rainfall was recorded than during 1993. In general, stream stage for all six monitoring stations averaged 0.7 feet with a range of 0.1 to 2.4 feet compared to an average of 1.2 feet recorded during the previous monitoring year (CCI, 1993).

In general, the Trunk Ditch exhibits the deepest waters of the streams traversing the North Tract of the Palmer Ranch with a depth of approximately 8 feet near the center of its reconstructed segment. This segment of Trunk Ditch runs adjacent to the Country Club of Sarasota and Prestancia. Although Station CC-4 is located on the reconstructed segment of Trunk Ditch, it exhibited an average depth of 0.4 feet because the depth measurements are taken in the littoral zone of the ditch. Therefore, stream stage(s) measured at Station CC-4 was comparable to other stations. The highest average stream stage in 1994 was observed at Station CC-1 (which is located in Trunk Ditch) with 2.4 feet.

The lowest stream levels in Catfish Creek were observed during the March 1994 monitoring event and reflect the dry conditions and the lack of rainfall in the 2-day period preceding the event. Average stream stages for stations CC-1, CC-2, CC-3, CC-4 and CC-5 were all under 1.0 feet during the March sampling event (**Appendix Table B-1**). The lowest stream stage recorded in North Creek occurred during the September 1994 event although 2.47 and 4.98 inches of rainfall was recorded during the 2-day and 2-week antecedent periods.

4.1.3 *Stream Flow*

As evident in **Appendix Table B-2**, positive stream flows (*i.e.*, measurable flows) were recorded for all 12 measurements (*i.e.*, 100 percent) taken during the tenth year of monitoring. As expected, the percentage of positive flows measured during 1994 is

APPENDIX B:
WATER QUALITY DATA

Appendix Table B-1
Continuing Surface Water Quality Monitoring Program
Stream Stage (ft)[a]
January - December, 1994

Sampling Date	Catfish Creek/Trunk Ditch							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	NC-6	Mean	STD	Min	Max	N
14-Mar-94	0.1	0.3	0.3	0.2	0.2	0.2	1.2	0.4	0.4	0.1	1.2	6
13-Sep-94	2.4	1.5	0.6	0.5	1.0	1.2	0.4	1.1	0.8	0.4	2.4	6
Mean	1.3	0.9	0.5	0.4	0.6		0.8					
Minimum	0.1	0.3	0.3	0.2	0.2		0.4					
Maximum	2.4	1.5	0.6	0.5	1.0		1.2					
Std. Deviation	1.6	0.8	0.2	0.2	0.6		0.6					
N	2	2	2	2	2		2					

Stations	Mean	STD	Min	Max	N
CC-1, CC-2 (upper reach)	1.1	1.1	0.1	2.4	4
CC-3, CC-4 (mid reach)	0.4	0.2	0.2	0.6	4
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	0.7	0.7	0.1	2.4	10
All six stations	0.7	0.7	0.1	2.4	12

[a] Stream Stage measured at sampling site for each station. 0.00 = Station dry.
STD - Standard deviation
N - Number of observations

Appendix Table B-2
Continuing Surface Water Quality Monitoring Program
Stream Flow (GPM)
January - December, 1994

	Catfish Creek/Trunk Ditch							All Stations				
Sampling Date	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	NC-6	Mean	STD	Min	Max	N
14-Mar-94	1,112	233	296	2,031	5,722	1,879	27	1,570	2,166	27	5,722	6
13-Sep-94	2,792	417	233	2,351	6,183	2,395	385	2,060	2,301	233	6,183	6
Mean	1,952	325	265	2,191	5,953		206					
Minimum	1,112	233	233	2,031	5,722		27					
Maximum	2,792	417	296	2,351	6,183		385					
Std. Deviation	1,188	130	44	226	326		253					
N	2	2	2	2	2		2					

Stations	Mean	STD	Min	Max	N
CC-1, CC-2 (upper reach)	1,139	1,165	233	2,792	4
CC-3, CC-4 (mid reach)	1,228	1,120	233	2,351	4
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	2,137	2,220	233	6,183	10
All six stations	1,815	2,145	27	6,183	12

STD - Standard deviation
N - Number of observations

Appendix Table B-3
Continuing Surface Water Quality Monitoring Program
Water Temperature (°C)
January - December, 1994

	Catfish Creek/Trunk Ditch							All Stations				
Sampling Date	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	NC-6	Mean	STD	Min	Max	N
14-Mar-94	21.9	24.1	20.8	21.9	20.9	21.9	18.2	21.3	1.9	18.2	24.1	6
13-Sep-94	25.4	25.8	26.3	26.4	27.4	26.3	30.0	26.9	1.7	25.4	30.0	6
Mean	23.7	25.0	23.6	24.2	24.2		24.1					
Minimum	21.9	24.1	20.8	21.9	20.9		18.2					
Maximum	25.4	25.8	26.3	26.4	27.4		30.0					
Std. Deviation	2.5	1.2	3.9	3.2	4.6		8.3					
N	2	2	2	2	2		2					

Stations	Mean	STD	Min	Max	N
CC-1, CC-2 (upper reach)	24.3	1.8	21.9	25.8	4
CC-3, CC-4 (mid reach)	23.9	2.9	20.8	26.4	4
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	24.1	2.5	20.8	27.4	10
All six stations	24.1	3.4	18.2	30.0	12

STD - Standard deviation
N - Number of observations

Appendix Table B-4
Continuing Surface Water Quality Monitoring Program
Specific Conductance (μmhos/cm)[a]
January - December, 1994

	Catfish Creek/Trunk Ditch							All Stations				
Sampling Date	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	NC-6	Mean	STD	Min	Max	N
14-Mar-94	635	935	847	795	766	796	736	786	102	635	935	6
13-Sep-94	421	569	832	461	559	568	632	579	146	421	832	6
Mean	528	752	840	628	663		684					
Minimum	421	569	832	461	559		632					
Maximum	635	935	847	795	766		736					
Std. Deviation	151	259	11	236	146		74					
N	2	2	2	2	2		2					

Stations	Mean	STD	Min	Max	N
CC-1, CC-2 (upper reach)	640	216	421	935	4
CC-3, CC-4 (mid reach)	734	183	461	847	4
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	682	177	421	935	10
All six stations	682	161	421	935	12

[a] Applicable surface water quality criteria:

State - Maximum allowable increase of 50% above background or to 1,275 μmhos/cm which ever is greater;

Sarasota County - Maximum allowable increase of 100% above background to a maximum of 500 μmhos/cm.

STD - Standard deviation
N - Number of observations

Appendix Table B-5
Continuing Surface Water Quality Monitoring Program
Total Suspended Solids (mg/L)
January - December, 1994

	Catfish Creek/Trunk Ditch							All Stations				
Sampling Date	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	NC-6	Mean	STD	Min	Max	N
14-Mar-94	5	6	8	7	5	6	15	7	4	5	15	6
13-Sep-94	4	3	2	6	8	5	32	9	11	2	32	6
Mean			4	5	5	7	6	24				
Minimum			4	3	2	6	5	15				
Maximum			5	6	8	7	8	32				
Std. Deviation			0	2	4	1	2	12				
N			2	2	2	2	2	2				

Stations	Mean	STD	Min	Max	N
CC-1, CC-2 (upper reach)	4	1	3	6	4
CC-3, CC-4 (mid reach)	6	2	2	8	4
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	5	2	2	8	10
All six stations	8	8	2	32	12

STD - Standard deviation
N - Number of observations

Appendix Table B-6
Continuing Surface Water Quality Monitoring Program
Turbidity (NTU)[a]
January - December, 1994

Sampling Date	Catfish Creek/Trunk Ditch							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	NC-6	Mean	STD	Min	Max	N
14-Mar-94	6.2	3.9	6.5	7.4	4.8	5.8	23.0	8.6	7.1	3.9	23.0	6
13-Sep-94	5.3	1.8	3.6	4.5	4.8	4.0	12.6	5.4	3.7	1.8	12.6	6
Mean	5.8	2.9	5.1	6.0	4.8		17.8					
Minimum	5.3	1.8	3.6	4.5	4.8		12.6					
Maximum	6.2	3.9	6.5	7.4	4.8		23.0					
Std. Deviation	0.6	1.5	2.1	2.1	0.0		7.4					
N	2	2	2	2	2		2					

Stations	Mean	STD	Min	Max	N
CC-1, CC-2 (upper reach)	4.3	1.9	1.8	6.2	4
CC-3, CC-4 (mid reach)	5.5	1.8	3.6	7.4	4
CC-1 to CC-5 (entire basin)	4.9	1.6	1.8	7.4	10
All six stations	7.0	5.7	1.8	23.0	12

[a] Applicable surface water quality criteria:
State - Allows a maximum increase of 29 NTU
Sarasota County - Allows a maximum increase of 25 JTU above background

STD - Standard deviation
N - Number of observations

Appendix Table B-7
Continuing Surface Water Quality Monitoring Program
5-Day Biochemical Oxygen Demand (mg/L)
January - December, 1994

Sampling Date	Catfish Creek/Trunk Ditch CC-1	CC-2	CC-3	CC-4	CC-5	Mean	NC-6	All Stations Mean	STD	Min	Max	N
14-Mar-94	3.3	3.3	4.7	4.4	4.6	4.1	3.9	4.0	0.6	3.3	4.7	6
13-Sep-94	2.5	2.8	1.5	2.1	2.9	2.4	5.6	2.9	1.4	1.5	5.6	6
Mean	2.9	3.1	3.1	3.3	3.8		4.8					
Minimum	2.5	2.8	1.5	2.1	2.9		3.9					
Maximum	3.3	3.3	4.7	4.4	4.6		5.6					
Std. Deviation	0.6	0.4	2.3	1.6	1.2		1.2					
N	2	2	2	2	2		2					

Stations	Mean	STD	Min	Max	N
CC-1, CC-2 (upper reach)	3.0	0.4	2.5	3.3	4
CC-3, CC-4 (mid reach)	3.2	1.6	1.5	4.7	4
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	3.2	1.1	1.5	4.7	10
All six stations	3.5	1.2	1.5	5.6	12

STD - Standard deviation
N - Number of observations

Appendix Table B-8
Continuing Surface Water Quality Monitoring Program
Dissolved Oxygen (mg/L)[a]
January - December, 1994

	Catfish Creek/Trunk Ditch							All Stations				
Sampling Date	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	NC-6	Mean	STD	Min	Max	N
14-Mar-94	10.0	7.5	8.5	10.0	7.2	8.6	0.8	7.3	3.4	0.8	10.0	6
13-Sep-94	4.2	4.3	5.7	3.9	5.4	4.7	7.8	5.2	1.5	3.9	7.8	6
Mean	7.1	5.9	7.1	7.0	6.3		4.3					
Minimum	4.2	4.3	5.7	3.9	5.4		0.8					
Maximum	10.0	7.5	8.5	10.0	7.2		7.8					
Std. Deviation	4.1	2.3	2.0	4.3	1.3		5.0					
N	2	2	2	2	2		2					

Stations	Mean	STD	Min	Max	N
CC-1, CC-2 (upper reach)	6.5	2.8	4.2	10.0	4
CC-3, CC-4 (mid reach)	7.0	2.7	3.9	10.0	4
CC-1 to CC-5 (entire basin)	6.7	2.3	3.9	10.0	10
All six stations	6.3	2.7	0.8	10.0	12

[a] Applicable surface water quality criteria: State - Minimum allowable concentration of 5.0 mg/L; Sarasota County - Minimum allowable concentration of 4.0 mg/L

STD - Standard deviation
N - Number of observations

Appendix Table B-9
Continuing Surface Water Quality Monitoring Program
Water pH ($-\log[H^+]$)[a]
January - December, 1994

Sampling Date	Catfish Creek/Trunk Ditch CC-1	CC-2	CC-3	CC-4	CC-5	Mean	NC-6	All Stations Mean	STD	Min	Max	N
14-Mar-94	7.5	7.4	6.9	7.5	7.2	7.3	6.6	7.2	0.4	6.6	7.5	6
13-Sep-94	6.8	7.3	7.2	7.3	7.5	7.2	7.6	7.3	0.3	6.8	7.6	6
Mean	7.2	7.4	7.1	7.4	7.4		7.1					
Minimum	6.8	7.3	6.9	7.3	7.2		6.6					
Maximum	7.5	7.4	7.2	7.5	7.5		7.6					
Std. Deviation	0.5	0.1	0.2	0.1	0.2		0.7					
N	2	2	2	2	2		2					

Stations	Mean	STD	Min	Max	N
CC-1, CC-2 (upper reach)	7.3	0.3	6.8	7.5	4
CC-3, CC-4 (mid reach)	7.2	0.3	6.9	7.5	4
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	7.3	0.2	6.8	7.5	10
All six stations	7.2	0.3	6.6	7.6	12

[a] Applicable surface water quality criteria: State and Sarasota County - Allowable range of 6.0 - 8.5
STD - Standard deviation
N - Number of observations

Appendix Table B-10
Continuing Surface Water Quality Monitoring Program
Total Nitrogen (mg/L)
January - December, 1994

	Catfish Creek/Trunk Ditch							All Stations				
Sampling Date	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	NC-6	Mean	STD	Min	Max	N
14-Mar-94	0.88	0.91	0.70	0.66	0.74	0.78	0.91	0.80	0.11	0.66	0.91	6
13-Sep-94	1.04	1.35	0.92	0.92	1.04	1.05	1.61	1.15	0.28	0.92	1.61	6
Mean	0.96	1.13	0.81	0.79	0.89		1.26					
Minimum	0.88	0.91	0.70	0.66	0.74		0.91					
Maximum	1.04	1.35	0.92	0.92	1.04		1.61					
Std. Deviation	0.11	0.31	0.16	0.18	0.21		0.49					
N	2	2	2	2	2		2					

Stations	Mean	STD	Min	Max	N
CC-1, CC-2 (upper reach)	1.05	0.21	0.88	1.35	4
CC-3, CC-4 (mid reach)	0.80	0.14	0.66	0.92	4
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	0.92	0.20	0.66	1.35	10
All six stations	0.97	0.27	0.66	1.61	12

STD - Standard deviation
N - Number of observations

Appendix Table B-11
Continuing Surface Water Quality Monitoring Program
Nitrite (mg/L as N)
January - December, 1994

	Catfish Creek/Trunk Ditch							All Stations				
Sampling Date	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	NC-6	Mean	STD	Min	Max	N
14-Mar-94	0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01		<0.01	0.01	6
13-Sep-94	0.02	<0.01	0.05	0.01	<0.01	0.02	0.02	0.02	0.02	<0.01	0.05	6
Mean	0.02	<0.01	0.03	<0.01	<0.01		0.01					
Minimum	0.01	<0.01	<0.01	<0.01	<0.01		<0.01					
Maximum	0.02	<0.01	0.05	0.01	<0.01		0.02					
Std. Deviation	0.01		0.03				0.01					
N	2	2	2	2	2		2					

Stations	Mean	STD	Min	Max	N
CC-1, CC-2 (upper reach)	0.01	0.01	<0.01	0.02	4
CC-3, CC-4 (mid reach)	0.02	0.02	<0.01	0.05	4
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	0.01	0.01	<0.01	0.05	10
All six stations	0.01	0.01	<0.01	0.05	12

STD - Standard deviation
N - Number of observations

Appendix Table B-12
Continuing Surface Water Quality Monitoring Program
Nitrate (mg/L as N)
January - December, 1994

	Catfish Creek/Trunk Ditch							All Stations				
Sampling Date	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	NC-6	Mean	STD	Min	Max	N
14-Mar-94	0.14	0.02	0.01	0.01	0.01	0.04	0.02	0.04	0.05	0.01	0.14	6
13-Sep-94	0.03	0.05	<0.01	0.04	0.05	0.04	0.03	0.03	0.02	<0.01	0.05	6
Mean	0.09	0.04	0.01	0.03	0.03		0.03					
Minimum	0.03	0.02	<0.01	0.01	0.01		0.02					
Maximum	0.14	0.05	0.01	0.04	0.05		0.03					
Std. Deviation	0.08	0.02	0.00	0.02	0.03		0.01					
N	2	2	2	2	2		2					

Stations	Mean	STD	Min	Max	N
CC-1, CC-2 (upper reach)	0.06	0.05	0.02	0.14	4
CC-3, CC-4 (mid reach)	0.02	0.02	<0.01	0.04	4
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	0.04	0.04	<0.01	0.14	10
All six stations	0.03	0.04	<0.01	0.14	12

STD - Standard deviation
N - Number of observations

Appendix Table B-13
Continuing Surface Water Quality Monitoring Program
Ammoniacal Nitrogen (mg/L as N)
January - December, 1994

	Catfish Creek/Trunk Ditch							All Stations				
Sampling Date	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	NC-6	Mean	STD	Min	Max	N
14-Mar-94	0.04	0.03	0.02	<0.02	<0.02	0.02	0.08	0.03	0.03	<0.02	0.08	6
13-Sep-94	0.24	<0.02	0.08	0.09	0.08	0.10	0.22	0.12	0.09	<0.02	0.24	6
Mean	0.14	0.02	0.05	0.05	0.05		0.15					
Minimum	0.04	<0.02	0.02	<0.02	<0.02		0.08					
Maximum	0.24	0.03	0.08	0.09	0.08		0.22					
Std. Deviation	0.14	0.01	0.04	0.06	0.05		0.10					
N	2	2	2	2	2		2					

Stations	Mean	STD	Min	Max	N
CC-1, CC-2 (upper reach)	0.08	0.11	<0.02	0.24	4
CC-3, CC-4 (mid reach)	0.05	0.04	<0.02	0.09	4
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	0.06	0.07	<0.02	0.24	10
All six stations	0.08	0.08	<0.02	0.24	12

STD - Standard deviation
N - Number of observations

Appendix Table B-14
Continuing Surface Water Quality Monitoring Program
Organic Nitrogen (mg/L)[a]
January - December, 1994

Sampling Date	Catfish Creek/Trunk Ditch							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	NC-6	Mean	STD	Min	Max	N
14-Mar-94	0.69	0.86	0.67	0.65	0.73	0.72	0.81	0.74	0.08	0.65	0.86	6
13-Sep-94	0.75	1.30	0.79	0.78	0.91	0.91	1.34	0.98	0.27	0.75	1.34	6
Mean	0.72	1.08	0.73	0.72	0.82		1.08					
Minimum	0.69	0.86	0.67	0.65	0.73		0.81					
Maximum	0.75	1.30	0.79	0.78	0.91		1.34					
Std. Deviation	0.04	0.31	0.08	0.09	0.13		0.37					
N	2	2	2	2	2		2					

Stations	Mean	STD	Min	Max	N
CC-1, CC-2 (upper reach)	0.90	0.28	0.69	1.30	4
CC-3, CC-4 (mid reach)	0.72	0.07	0.65	0.79	4
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	0.81	0.19	0.65	1.30	10
All six stations	0.86	0.23	0.65	1.34	12

[a] Organic Nitrogen = Total Kjeldahl Nitrogen - Ammoniacal Nitrogen
STD - Standard deviation
N - Number of observations

Appendix Table B-15
Continuing Surface Water Quality Monitoring Program
Total Phosphorus (mg/L)
January - December, 1994

	Catfish Creek/Trunk Ditch							All Stations				
Sampling Date	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	NC-6	Mean	STD	Min	Max	N
14-Mar-94	0.10	0.27	0.06	0.06	0.09	0.12	0.16	0.12	0.08	0.06	0.27	6
13-Sep-94	0.35	0.43	0.41	0.31	0.16	0.33	0.11	0.30	0.13	0.11	0.43	6
Mean	0.23	0.35	0.24	0.19	0.13		0.14					
Minimum	0.10	0.27	0.06	0.06	0.09		0.11					
Maximum	0.35	0.43	0.41	0.31	0.16		0.16					
Std. Deviation	0.18	0.11	0.25	0.18	0.05		0.04					
N	2	2	2	2	2		2					

Stations	Mean	STD	Min	Max	N
CC-1, CC-2 (upper reach)	0.29	0.14	0.10	0.43	4
CC-3, CC-4 (mid reach)	0.21	0.18	0.06	0.41	4
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	0.22	0.15	0.06	0.43	10
All six stations	0.21	0.14	0.06	0.43	12

STD - Standard deviation
N - Number of observations

Appendix Table B-16
Continuing Surface Water Quality Monitoring Program
Orthophosphate (mg/L as P)
January - December, 1994

	Catfish Creek/Trunk Ditch							All Stations				
Sampling Date	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	NC-6	Mean	STD	Min	Max	N
14-Mar-94	0.07	0.24	0.04	0.03	0.03	0.08	0.09	0.08	0.08	0.03	0.24	6
13-Sep-94	0.35	0.42	0.31	0.26	0.11	0.29	0.08	0.26	0.13	0.08	0.42	6
Mean	0.21	0.33	0.18	0.15	0.07		0.09					
Minimum	0.07	0.24	0.04	0.03	0.03		0.08					
Maximum	0.35	0.42	0.31	0.26	0.11		0.09					
Std. Deviation	0.20	0.13	0.19	0.16	0.06		0.01					
N	2	2	2	2	2		2					

Stations	Mean	STD	Min	Max	N
CC-1, CC-2 (upper reach)	0.27	0.15	0.07	0.42	4
CC-3, CC-4 (mid reach)	0.16	0.15	0.03	0.31	4
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	0.19	0.15	0.03	0.42	10
All six stations	0.17	0.14	0.03	0.42	12

STD - Standard deviation
N - Number of observations

Appendix Table B-17
Continuing Surface Water Quality Monitoring Program
Total Nitrogen to Total Phophorus Ratios (N_t:P_t)
January - December, 1994

Sampling Date	Catfish Creek/Trunk Ditch CC-1	CC-2	CC-3	CC-4	CC-5	Mean	NC-6	All Stations Mean	STD	Min	Max	N
14-Mar-94	8.8	3.4	11.7	11.0	8.2	8.6	5.7	8.1	3.2	3.4	11.7	6
13-Sep-94	3.0	3.1	2.2	3.0	6.5	3.6	14.6	5.4	4.8	2.2	14.6	6
Mean	5.9	3.3	7.0	7.0	7.4		10.2					
Minimum	3.0	3.1	2.2	3.0	6.5		5.7					
Maximum	8.8	3.4	11.7	11.0	8.2		14.6					
Std. Deviation	4.1	0.2	6.7	5.7	1.2		6.3					
N	2	2	2	2	2		2					

Stations	Mean	STD	Min	Max	N
CC-1, CC-2 (upper reach)	4.6	2.8	3.0	8.8	4
CC-3, CC-4 (mid reach)	7.0	5.1	2.2	11.7	4
CC-1 to CC-5 (entire basin)	6.1	3.6	2.2	11.7	10
All six stations	6.8	4.1	2.2	14.6	12

STD - Standard deviation
N - Number of observations

Appendix Table B-18
Continuing Surface Water Quality Monitoring Program
Inorganic Nitrogen to Inorganic Phosphorus Ratios (N_i:P_i)
January - December, 1994

	Catfish Creek/Trunk Ditch							All Stations				
Sampling Date	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	NC-6	Mean	STD	Min	Max	N
14-Mar-94	2.7	0.2	0.9	0.8	0.8	1.1	1.2	1.1	0.8	0.2	2.7	6
13-Sep-94	0.8	0.2	0.4	0.5	1.2	0.6	3.4	1.1	1.2	0.2	3.4	6
Mean	1.8	0.2	0.7	0.7	1.0		2.3					
Minimum	0.8	0.2	0.4	0.5	0.8		1.2					
Maximum	2.7	0.2	0.9	0.8	1.2		3.4					
Std. Deviation	1.3	0.1	0.3	0.2	0.3		1.6					
N	2	2	2	2	2		2					

Stations	Mean	STD	Min	Max	N
CC-1, CC-2 (upper reach)	1.0	1.2	0.2	2.7	4
CC-3, CC-4 (mid reach)	0.7	0.2	0.4	0.9	4
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	0.9	0.7	0.2	2.7	10
All six stations	1.1	1.0	0.2	3.4	12

STD - Standard deviation
N - Number of observations

Appendix Table B-19
Continuing Surface Water Quality Monitoring Program
Oil and Greases (mg/L)
January - December, 1994

	Catfish Creek/Trunk Ditch							All Stations				
Sampling Date	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	NC-6	Mean	STD	Min	Max	N
14-Mar-94	2	1	2	<1	<1	1	<1	<1	1	<1	2	6
13-Sep-94	<1	<1	<1	<1	<1	<1	<1	<1		<1	<1	6
Mean	1	<1	1	<1	<1		<1					
Minimum	<1	<1	<1	<1	<1		<1					
Maximum	2	1	2	<1	<1		<1					
Std. Deviation	0.8	0.4	0.8									
N	2	2	2	2	2		2					

Stations	Mean	STD	Min	Max	N
CC-1, CC-2 (upper reach)	<1	0.5	<1	2	4
CC-3, CC-4 (mid reach)	1	0.6	<1	2	4
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	1	0.5	<1	2	10
All six stations	1	0.4	<1	2	12

[a] Applicable surface water criteria: State - Maximum allowable concentration of 5.0 mg/L
Sarasota County - Maximum allowable concentration of 15.0 mg/L

STD - Standard deviation
N - Number of observations

Appendix Table B-20
Continuing Surface Water Quality Monitoring Program
Total Coliform Bacteria (count/100 mL)[a]
January - December, 1994

	Catfish Creek/Trunk Ditch							All Stations				
Sampling Date	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	NC-6	Mean	STD	Min	Max	N
14-Mar-94	9,000	24,000	900	240	220	6,872	500	5,810	9,546	220	24,000	6
13-Sep-94	500	300	600	200	300	380	1,000	483	293	200	1,000	6
Mean	4,750	12,150	750	220	260		750					
Minimum	500	300	600	200	220		500					
Maximum	9,000	24,000	900	240	300		1,000					
Std. Deviation	6,010	16,758	212	28	57		354					
N	2	2	2	2	2		2					

Stations	Mean	STD	Min	Max	N
CC-1, CC-2 (upper reach)	8,450	11,131	300	24,000	4
CC-3, CC-4 (mid reach)	485	330	200	900	4
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	3,626	7,654	200	24,000	10
All six stations	3,147	7,014	200	24,000	12

[a] Applicable surface water criteria: State and Sarasota County - Maximum of 2400/100 mL

STD - Standard deviation
N - Number of observations

Appendix Table B-21
Continuing Surface Water Quality Monitoring Program
Fecal Coliform Bacteria (count/100 mL)[a]
January - December, 1994

	Catfish Creek/Trunk Ditch							All Stations				
Sampling Date	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	NC-6	Mean	STD	Min	Max	N
14-Mar-94	1,600	3,000	30	14	13	931	130	798	1,246	13	3,000	6
13-Sep-94	30	50	40	20	90	46	80	52	28	20	90	6
Mean	815	1,525	35	17	52		105					
Minimum	30	50	30	14	13		80					
Maximum	1,600	3,000	40	20	90		130					
Std. Deviation	1,110	2,086	7	4	54		35					
N	2	2	2	2	2		2					

Stations	Mean	STD	Min	Max	N
CC-1, CC-2 (upper reach)	1,170	1,425	30	3,000	4
CC-3, CC-4 (mid reach)	26	11	14	40	4
CC-1, CC-2, CC-3, CC-4, CC-5 (entire basin)	489	1,010	13	3,000	10
All six stations	425	926	13	3,000	12

[a] Applicable surface water criteria: State and Sarasota County - Maximum of 800/100 mL
STD - Standard deviation
N - Number of observations

Appendix Table B-22
Continuing Surface Water Quality Monitoring Program
Trace Metals (μg/L)[a]
September 13, 1994

Parameter	Catfish Creek/Trunk Ditch							All Stations				
	CC-1	CC-2	CC-3	CC-4	CC-5	Mean	NC-6	Mean	STD	Min	Max	N
Arsenic, Total	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01		<0.01	<0.01	6
Copper, Total	<1	<1	<1	<1	<1	<1	<1	<1		<1	<1	6
Lead, Total	<1	<1	<1	<1	<1	<1	<1	<1		<1	<1	6
Zinc, Total	<20	<20	<20	<20	<20	<20	<20	<20		<20	<20	6

[a] Applicable surface water criteria:

State - Maximum allowable concentrations of 50 μg/L for arsenic, 12.8 μg/L for copper, 3.6 μg/L for lead, and 115 μg/L for zinc

Sarasota County - Maximum allowable concentrations of 100 μg/L for arsenic, 10 μg/L for copper, 10 μg/L for lead, and 15 μg/L for zinc

STD - Standard deviation
N - Number of observations

APPENDIX C:
LABORATORY REPORTS

5010 U.S 19 North
Post Office Box 35
Palmetto, Florida 34220-0035

Palmetto (813) 722-6667
Bradenton (813) 747-0006
Tampa (813) 229-3516
Fax (813) 722-8384

CCI ENVIRONMENTAL SERVICES, INC.

LABORATORY REPORT

REPORT FOR: Mr. Jim Paulmann
PALMER VENTURE
7184 Beneva Road
Sarasota, Florida 34238

Report Number: 812/APR1594
Project Number: 0380-084
Sampling Date: 03-14-94
Sample Source: Surface Water
Sampled By: Schindehette

RESULTS OF ANALYSIS:	CC-1	CC-2	CC-3	Units
Laboratory Number	10962	10963	10964	-----
Sample Time	13:20	13:00	11:15	24 hours
ANALYSIS PERFORMED BY CCI				
Oil and Grease	1.6	1.0	1.6	mg/l
Biochemical Oxygen Demand	3.3	3.3	4.7	mg/l
Fecal Coliform Bacteria	1600	3000*	30	Col./100ml
Total Coliform Bacteria	9000*	≥16,000*	900	Col./100ml
Ammonia Nitrogen	0.04	0.03	0.02	mg/l
Nitrate Nitrogen	0.14	0.02	0.01	mg/l
Nitrite Nitrogen	0.01	<0.01	<0.01	mg/l
Total Kjeldahl Nitrogen	0.43	0.89	0.69	mg/l
Total Nitrogen	0.57	0.91	0.70	mg/l
Total Phosphorus	0.10	0.27	0.06	mg/l
Total Reactive Phosphate	0.07	0.24	0.04	mg/l
Total Suspended Solids	4.5	6	7.5	mg/l
Turbidity	6.2	3.9	6.5	NTU
Dissolved Oxygen (field)	10	7.5	8.5	mg/l
pH (field)	7.5	7.4	6.9	pH units
Specific Conductivity, (field)	635*	935*	847*	µmhos/cm
Temperature (field)	21.9	24.1	20.8	°C

*Noncompliance with Florida Administrative Code 17-302 and/or Sarasota County Ordinance 72-37, Class III surface waters.

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CCI ENVIRONMENTAL SERVICES, INC.

LABORATORY REPORT

REPORT FOR: Mr. Jim Paulmann
PALMER VENTURE
7184 Beneva Road
Sarasota, Florida 34238

Report Number: 812/APR1594
Project Number: 0380-084
Sampling Date: 03-14-94
Sample Source: Surface Water
Sampled By: Schindehette

RESULTS OF ANALYSIS:	CC-4	CC-5	NC-6	Units
Laboratory Number	10965	10966	10967	-----
Sample Time	11:30	10:55	10:30	24 hours
ANALYSIS PERFORMED BY CCI				
Oil and Grease	<1.0	<1.0	<1.0	mg/l
Biochemical Oxygen Demand	4.4	4.6	3.9	mg/l
Fecal Coliform Bacteria	14	13	130	Col./100ml
Total Coliform Bacteria	240	220	500	Col./100ml
Ammonia Nitrogen	<0.02	<0.02	0.08	mg/l
Nitrate Nitrogen	0.01	0.01	0.02	mg/l
Nitrite Nitrogen	<0.01	<0.01	<0.01	mg/l
Total Kjeldahl Nitrogen	0.65	0.73	0.89	mg/l
Total Nitrogen	0.66	0.74	0.91	mg/l
Total Phosphorus	0.06	0.09	0.16	mg/l
Total Reactive Phosphate	0.03	0.03	0.09	mg/l
Total Suspended Solids	7	4.5	15	mg/l
Turbidity	7.4	4.8	23	NTU
Dissolved Oxygen (field)	10	7.2	0.77*	mg/l
pH (field)	7.5	7.2	6.6	pH units
Specific Conductivity, (field)	795*	766*	736*	µmhos/cm
Temperature (field)	21.9	20.9	18.2	°C

*Noncompliance with Florida Administrative Code 17-302 and/or Sarasota County Ordinance 72-37, Class III surface waters.

Garry Payne

G. Garry Payne, Ph.D./Laboratory Director

FDHRS Drinking Water Certification #84243
FDHRS Environmental Certification #E84017

Analysis performed in accordance with E P A , Standard Methods or other FDHRS approved methodology

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Fax (813) 722-8384

LABORATORY REPORT

REPORT FOR:	Mr. Jim Paulmann PALMER VENTURE 7184 Beneva Road Sarasota, Florida 34238
Report Number:	162/NOV2394
Project Number:	0380-084
Sampling Date:	09-13-94
Sample Source:	Surface Water
Sampled By:	Iricanin

RESULTS OF ANALYSIS:	CC-1	CC-2	CC-3	Units
Laboratory Number	12135	12136	12137	-----
Sample Time	10:10	10:35	11:00	24 hours
ANALYSIS PERFORMED BY CCI				
Oil and Grease	<1.0	<1.0	<1.0	mg/l
Biochemical Oxygen Demand	2.5	2.8	1.5	mg/l
Fecal Coliform Bacteria	30	50	40	Col./100 ml
Total Coliform Bacteria	500	300	600	Col./100 ml
Ammonia Nitrogen	0.24	<0.02	0.08	mg/l
Nitrate Nitrogen	0.03	0.05	<0.01	mg/l
Nitrite Nitrogen	0.02	<0.01	0.05	mg/l
Total Kjeldahl Nitrogen	0.99	1.30	0.87	mg/l
Total Nitrogen	1.04	1.35	0.92	mg/l
Total Phosphorus	0.35	0.43	0.41	mg/l
Total Reactive Phosphate	0.35	0.42	0.31	mg/l
Total Suspended Solids	4	3	2	mg/l
Turbidity	5.3	1.8	3.6	NTU
Lead	<1	<1	<1	µg/l
Copper	<1	<1	<1	µg/l
Zinc	<20	<20	<20	µg/l
Dissolved Oxygen (field)	4.2	4.3	5.7	mg/l
pH (field)	6.8	7.3	7.2	pH units
Specific Conductivity, (field)	421	569	832	µmhos/cm
Temperature (field)	25.4	25.8	26.3	°C

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LABORATORY REPORT

REPORT FOR:	Mr. Jim Paulmann PALMER VENTURE 7184 Beneva Road Sarasota, Florida 34238
Report Number:	162/NOV2394
Project Number:	0380-084
Sampling Date:	09-13-94
Sample Source:	Surface Water
Sampled By:	Iricanin

RESULTS OF ANALYSIS:	CC-1	CC-2	CC-3	Units
Laboratory Number	12135	12136	12137	-----
ANALYSIS PERFORMED BY SUBCONTRACT LABORATORY[a]				
Arsenic	<0.01	<0.01	<0.01	μg/l

FDHRS Drinking Water Certification #84243
FDHRS Environmental Certification #E84017

Analysis performed in accordance with E.P.A. Standard Methods or other FDHRS approved methodology.

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LABORATORY REPORT

REPORT FOR: Mr. Jim Paulmann
PALMER VENTURE
7184 Beneva Road
Sarasota, Florida 34238

Report Number: 162/NOV2394
Project Number: 0380-084
Sampling Date: 09-13-94
Sample Source: Surface Water
Sampled By: Iricanin

RESULTS OF ANALYSIS:	CC-4	CC-5	NC-6	Units
Laboratory Number	12138	12139	12140	-----
Sample Time	11:20	11:50	12:20	24 hours

ANALYSIS PERFORMED BY CCI

Oil and Grease	<1.0	<1.0	<1.0	mg/l
Biochemical Oxygen Demand	2.1	2.9	5.6	mg/l
Fecal Coliform Bacteria	20	90	80	Col./100 ml
Total Coliform Bacteria	200	300	1,000	Col./100 ml
Ammonia Nitrogen	0.09	0.08	0.22	mg/l
Nitrate Nitrogen	0.04	0.05	0.03	mg/l
Nitrite Nitrogen	0.01	<0.01	0.02	mg/l
Total Kjeldahl Nitrogen	0.87	0.99	1.56	mg/l
Total Nitrogen	0.92	1.04	1.61	mg/l
Total Phosphorus	0.31	0.16	0.11	mg/l
Total Reactive Phosphate	0.26	0.11	0.08	mg/l
Total Suspended Solids	6	8	32	mg/l
Turbidity	4.5	4.8	12.6	NTU
Lead	<1	<1	<1	µg/l
Copper	<1	<1	<1	µg/l
Zinc	<20	<20	<20	µg/l
Dissolved Oxygen (field)	3.9	5.4	7.8	mg/l
pH (field)	7.3	7.5	7.6	pH units
Specific Conductivity, (field)	461	559	632	µmhos/cm
Temperature (field)	26.4	27.4	30.0	°C

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LABORATORY REPORT

REPORT FOR:	Mr. Jim Paulmann PALMER VENTURE 7184 Beneva Road Sarasota, Florida 34238
Report Number:	162/NOV2394
Project Number:	0380-084
Sampling Date:	09-13-94
Sample Source:	Surface Water
Sampled By:	Iricanin

RESULTS OF ANALYSIS:	CC-4	CC-5	NC-6	Units
Laboratory Number	12138	12139	12140	-----
ANALYSIS PERFORMED BY SUBCONTRACT LABORATORY[a]				
Arsenic	<0.01	<0.01	<0.01	μg/l

G. Garry Payne, Ph.D.
Laboratory Director

FDHRS Drinking Water Certification #84243
FDHRS Environmental Certification #E84017

Analysis performed in accordance with E P A . Standard Methods or other FDHRS approved methodology.

APPENDIX D:

MONITORING TEAM

WILLIAM W. HAMILTON — Principal Scientist

Fields of Competence

Environmental Assessment and Permitting; Project Management; Natural Systems Identification and Mapping; Habitat Mitigation Design; Wildlife Ecology and Wildlife Habitat Management Plans.

Experience Summary

William W. Hamilton has over twenty-three years of varied, practical environmental consulting experience. He has gained this experience by direct technical participation and/or management of a wide variety of environmental impact assessment and permitting projects. His more recent work has included design and management of environmental investigations to serve as a basis for surface water management permitting, dredge and fill permitting and listed species management plans. Additionally, Mr. Hamilton has frequently served to coordinate permit application processing on behalf of an Applicant and/or their design professionals. He has also provided design of mitigative efforts related to permit issuance. He has served as an expert witness on environmental matters in U.S. District Court, State of Florida Administrative Proceedings and numerous local government proceedings.

Mr. Hamilton's experience record also includes participation in several professional associations and related activities. He has served as a faculty member of the Florida Chamber's Environmental Permitting Summer School and is a past General Chairman of the Florida Association for Water Quality Control. He has also served as Chairman of the Technical Advisory Committee to the Board of County Commissioners for the identification and acquisition of conservation/passive recreation lands in Manatee County and was a member of the work group appointed to assist the Southwest Florida Water Management District in establishing the Eastern Tampa Bay Water Use Caution Area Management Plan.

Education

Year	School
1970	University of North Carolina Charlotte, North Carolina B.S. - Biology

Employment History

1972 - Present	CCI Environmental Services, Inc. (f.k.a. Conservation Consultants, Inc.)
1970 - 1972	Consultant to Conservation Consultants, Inc.
1969 - 1970	University of North Carolina Zoological Museum Charlotte, North Carolina Assistant Curator of Fishes

Key Projects

Palmer Venture: Project Manager for Eastside Environmental Systems Analysis. Supervised site assessments of vegetation communities and threatened/ endangered species occurrence. Prepared impact prediction/mitigation report. Assisted in development of master drainage plan for purposes of maintaining wetland hydroperiod. 2200± acres, Palmer Ranch, Sarasota County, Florida.

Del North Associates: Project Manager for design of Red-cockaded woodpecker monitoring plan to identify preferred habitat and foraging range. Prepared with others a report documenting extent of significant habitat. Prepared management plan identifying habitat preserve and maintenance procedures. Negotiated plan approval by Florida Game and Fresh Water Fish Commission. 1135 acre Del Vera Development, Lee County, Florida.

Miller Sellen & Associates, Inc: Project Manager for environmental constraints analysis of 30,000 acre tract. Responsible for site studies and literature reviews to identify protected and/or regulated habitats, and presence or likely occurrence of endangered/threatened species. Assisted in alternative land use evaluations and formulation of a conceptual development plan for the 30,000 acre site. Clay County, Florida.

Flag Development Company, Inc.: Project Manager for preparation of on-site management plan for Florida Scrub jay, Gopher tortoise and Florida sandhill crane, including identification of minimum area required for habitat preservation and long-term maintenance and monitoring programs. Negotiated plan approval by Florida Game and Fresh Water Fish Commission. 1800 acre New River Planned Development, Pasco County, Florida.

Key Projects (Continued)

Flag Avalon Associates, Ltd.: Project Manager responsible for preparation of vegetation, wetland and threatened/endangered species components of a Development of Regional Impact/Application of Development Approval for the 5,575 acre Avalon Park Development. Supervised all ecological field surveys and assisted in site design to minimize impacts to the Econ River which bisects the site. Also was primary author of a wildlife management plan to protect Red-cockaded woodpecker colonies, Florida scrub jay and Gopher tortoise on-site. Negotiated plan approval with the Florida Game and Fresh Water Fish Commission. Avalon Park, Orange County, Florida.

Palmer Venture: Sr. Project Advisor for a Study of Wetland Characteristics and Hydroperiod Simulation. Responsible for study design and report preparation. Program involved literature assessment of wetland hydroperiod and field appraisals of vegetative characterization of wetlands, wetland topography, soil borings and extended water level measurements in wetlands and in adjacent shallow wells. A mathematical model to simulate annual hydroperiod was constructed and validated with on-site data and literature. 5000 acres, Palmer Ranch, Sarasota County, Florida.

Seminole Farms Trust: Project Manager for habitat mapping and wetland assessment of two adjacent tracts totalling about 128 acres. Advised the client and counsel on regulatory requirements and exemptions for agricultural improvements to allow increased cattle carrying capacity on the tracts. City of Sanford, Florida.

Volusia County Government: Sr. Environmental Consultant. Reviewed habitat mapping and field inspected on-site wetlands. Advised project planning consultants on site use alternatives and "permitability". Provided a deposition regarding same in condemnation proceedings related to a County Solid Waste Transfer Facility. 60± acre site. Volusia County, Florida.

S.W. Johnson Development, Inc.: Project Manager for environmental components of surface water management and wetland resource permitting. Assisted in project layout to minimize adverse impacts on wetlands and developed approach to integrate preserved wetlands into the surface water management plan for hydroperiod maintenance. Assisted the Project Engineer in the preparation and processing of local, state and federal permits including wetland mitigation approval. 300 acre Deer Creek Subdivision, Sarasota County, Florida.

South Brevard Water Authority: Environmental Project Manager serving to coordinate and review preparation of habitat mapping and performance of wildlife surveys on a proposed regional wellfield site. Prepared wetland and wildlife impact analysis associated with various groundwater level drawdown scenarios. Provided expert testimony during Administrative Proceedings related to water use permitting. 22,000 acre Bull Creek site. Osceola County, Florida.

Key Projects (Continued)

Schroeder-Manatee, Inc.: Project Manager for ecological site assessments of a 1,500± acre site proposed as a major employment center. Reviewed habitat mapping and wildlife surveys as a basis for assisting on alternative site design evaluations. Coordinated staff preparation of responses to DRI Application questions concerning water quality, wetlands and wildlife. Prepared a wildlife habitat management plan and negotiated acceptance of same by the Florida Game and Freshwater Fish Commission. Provided expert testimony at local and regional government proceedings concerning project approval. University Place Development of Regional Impact, Sarasota County, Florida.

U.S. Home Corp.: Project Manager to develop habitat enhancement and management plan for Florida scrub jay. Supervised design of field study methodology to define range of scrub jay pair found nesting in uncharacteristic habitat, *i.e.*, a slash pine on a wetland fringe. Negotiated approval of a habitat enhancement and management plan with the U.S. Fish & Wildlife Service. Stoneybrook Golf and Country Club, Sarasota County, Florida.

Smith & Gillespie Engineers: Project Manager for a one-year baseline study of the six mile tidal segment of the Braden River below the Evers Reservoir dam. Responsibilities included field sampling design and general supervision of habitat mapping, bathymetric mapping, seasonal benthic community analyses, tidal amplitude monitoring and monthly water quality/salinity monitoring. Also reviewed and edited CCI staff reports of findings. Braden River, Manatee County, Florida.

W. F. Bishop & Associates: Project Environmental Consultant for design of a 1.5 acre tidal pond, mangrove swamp and salt marsh restoration program. The Barclay, Little Sarasota Bay, Sarasota County, Florida.

Manatee Gateway: Environmental Project Manager for Design and Permitting of 80-acre Boat Basin, Navigation Channel and Tidal Circulation Channel. Manatee Gateway Development on the Manatee River, Palmetto, Florida.

Lansbrook Development Corp.: Environmental Project Manager for design and Permitting Coordinator to acquire Federal, State and County permits for three docks (59 total slips), nature boardwalks and two boat ramps on Lake Tarpon (OFW), Pinellas County, Florida.

Bay Venture Corp.: Environmental Project Manager for stormwater system design assistance/wetland mitigation and Coordinator for dredge/fill and stormwater permitting. Five hundred acre Prestancia Development and TPC Golf Course, Sarasota County, Florida.

NENAD IRICANIN, Ph.D. — Environmental Scientist

Fields of Competence

Water Quality Based Effluent Limitation Studies, Pollutant Loading Analyses, Sediment Geochemistry, Aquatic Chemistry, Nutrient Exchange Rates and Nutrient Budgets, Data Acquisition and Interpretation, Computer Programming.

Experience Summary

Dr. Nenad Iricanin has nine years of applied research and consulting experience in the field of water resource science. His applied research experience includes particulate nutrient investigations in Florida waters, pollutant loading evaluations for both fresh water and marine systems, bulk sediment analyses for trace metals and nutrients, interstitial water analyses for trace metals and nutrients, water column analyses fro trace metals and nutrients, and *in situ* measurements of trace metals fluxes, sediment oxygen demand and nutrient regeneration from sediments using cores and chambers.

At CCI Environmental Services, Inc., Dr. Iricanin's responsibilities include implementation of Water Quality Based Effluent Limitations studies, evaluation of urban and industrial discharges, pollutant loading evaluations, conceptual stormwater management plans, sediment geochemistry and water/sediment interactions, waste load allocations, nutrient exchange rates, and nutrient budget determinations. Additionally, he performs statistical analyses and data interpretations of water resources and ecological assessments.

Dr. Iricanin is also a member of the American Society of Limnology and Oceanography, the American Geophysical Union, and the Oceanography Society

Education

Year	School
1990	Florida Institute of Technology Ph.D. - Chemical Oceanography
1984	Florida Institute of Technology M.S. - Chemical Oceanography
1982	Florida Institute of Technology B.S. - Chemical Oceanography

Employment History

1990 - Present	CCI Environmental Services, Inc. (*f.k.a.* Conservation Consultants, Inc.) Environmental Scientist

Key Projects

Royster Phosphates, Inc.: Project Scientist responsible for synthesizing water quality data from a Water Quality Based Limitation study and preparation of the "Intensive Survey" document for submittal to the Florida Department of Environmental Regulations. Manatee County, Florida.

IMC Fertilizer, Inc.: Project Scientist responsible for data collection and interpretation, and preparation of narrative report for submittal to the Florida Department of Environmental Regulation regarding a Water Quality Based Effluent Limitations study performed at the Hopewell facility. Hillsborough County, Florida.

IMC Fertilizer, Inc.: Project Scientist responsible for data collection and interpretation, and preparation of narrative report for submission to the Florida Department of Environmental Regulation regarding a Water Quality Based Effluent Limitations study performed at the Lonesome, Kingsford, Noralyn/Phosphoria, Four Corners, Clear Springs, and Haynsworth mines. Hillsborough, Manatee, and Polk counties, Florida.

Florida Department of Environmental Regulation: Project Scientist responsible for the collection of water samples during bi-weekly and storm event sampling in the Turkey Creek watershed and data management including performing statistical analysis of particulate nutrient loading and preparation of final report for submittal to the Florida Department of Environmental Regulation. Turkey Creek, Brevard County, Florida.

Department of Interior/U.S. Fish and Wildlife Service: Project Scientist during the second joint U.S.A.-U.S.S.R. ecosystem investigation of the Bering Sea responsible for the collection of sediment cores from 26 locations in the Bering Sea and subsequent analysis of trace metals in the upper sediment layer. Other responsibilities included data management, graphics generation, and report preparations for submittal to the U.S. Department of Interior. Bering Sea.

National Oceanic and Atmospheric Administration (NOAA): Project Scientist on the P-Prime (Pollutant-particle relationships in the marine environment) project responsible for the collection of interstitial water samples and subsequent analyses for nutrients and trace metals. Other responsibilities included data management, report preparation and submittal to the National Oceanic and Atmospheric Administration. Mississippi River delta.

Key Projects (Continued)

St. Johns River Water Management District: Project Scientist responsible for the investigation of the quantity, composition, and sources of suspended matter loading to Turkey Creek. Other responsibilities included data management and pollutant loading analyses from urban and rural watersheds. Turkey Creek, Brevard County, Florida.

Walt Disney EPCOT: Project Scientist responsible for the monthly collection of trace metal and major cation samples in an artificial seawater aquarium. Also responsible for analyses of water quality samples, data management, and monthly report submittal to Walt Disney World EPCOT. The Living Seas, Orange County, Florida.

King Engineering Associates: Project Scientist for the evaluation of stormwater quality and pollutant loading for the Lake Tarpon watershed. Responsibilities included a bathymetric survey of the lake, sediment nutrient exchange rates, sediment oxygen demand, and evaluation of a nutrient budget for Lake Tarpon. Also, responsible for data management and preparation of final report for submittal to Pinellas County. Lake Tarpon, Pinellas County, Florida.

Palmer Venture: Project Scientist responsible for pollutant loading analysis for pre- and post-development conditions for the 2,200-acre Palmer Eastside Planned Community and preparation of the final report for submittal to Sarasota County Pollution Control Division. Palmer Ranch, Sarasota County, Florida.

Schroeder-Manatee, Inc.: Project Scientist responsible for pollutant loading analysis for pre- and post-development, conceptual stormwater management plan and report preparation for the University Place Development of Regional Impact. Sarasota County, Florida.

Palmer Venture: Project Manager responsible for data management and statistical analysis of water quality data collected during various storm events at stations located in Catfish and South Creeks. In addition, responsible for preparation of interpretative water quality report for submittal to the Sarasota County Pollution Control Division. Palmer Ranch, Sarasota County, Florida.

Gulf Coast Pinellas Development: Project Scientist responsible for implementation and evaluation of a hydrographic and water quality study performed at the proposed Bay Pines Station Marina. Also, performed a biological and a geochemical study of sediments within the proposed marina basin and prepared an interpretative report of results for submittal to the Florida Department of Environmental Regulation and Pinellas County. Bay Pines, Pinellas County, Florida

Key Projects (Continued)

Kimley-Horn & Assoc.: Project Manager for the Sarasota County Interstate Business Center Development of Regional Impact. Responsible for pollutant loading analyses for pre- and post-development land uses. In addition, responsible for summarization of existing water quality at the development site and preparation of report. Sarasota County, Florida.

Palmer Venture: Project Manager for the Continuing Surface Water Monitoring Program at the Palmer Ranch. Responsible for surface water data collection, data interpretation and preparation of annual narrative report for submittal to the Sarasota County Pollution Control Division. Sarasota County, Florida.

Kimley-Horn & Assoc.: Project Manager responsible for the implementation of a surface water quality and sediment quality survey in the Matheny Creek watershed. Other responsibilities included performing a pollutant loading evaluation for the watershed for various land use scenarios utilizing a spreadsheet mathematical model and preparation of interpretative report for existing water and sediment quality and pollutant loading assessments for submittal to the Sarasota County Stormwater Division as part of the NPDES permitting process. Matheny Creek, Sarasota County, Florida.

Smith & Gillespie Engineering: Project Manager responsible for the implementation hydrographic and water quality data collection program in the tidal Braden River. In addition, responsible for management of collected data and utilization of hydrographic and water quality data in a statistical or mathematical model to determine the effects various freshwater flow scenarios on the salt regime of the tidal Braden River. Braden River, Manatee County, Florida.

Kimley-Horn & Assoc.: Project Manager responsible for performing a pollutant loading evaluation for the watershed for various land use scenarios utilizing a spreadsheet mathematical model and preparation of interpretative report for submittal to the Sarasota County Stormwater Division as part of the NPDES permitting process. Matheny Creek, Sarasota County, Florida.

Pasadena Yacht and Country Club: Project Manager responsible for the implementation of a post-construction compliance monitoring program. Other responsibilities included collection of hydrographic measurements and water and sediment quality samples within the marina basin and surrounding waters. In addition, responsible for data management and preparation of monitoring reports for submittal to the Florida Department of Environmental Protection. Boca Ciega, Pinellas County, Florida.

Key Projects (Continued)

Lansbrook Development Corporation: Project Scientist for the evaluation of water quality in existing stormwater lakes at the Carlyle Subdivision and their effects on receiving waters. Other responsibilities included data management and report preparation for submittal to Pinellas County.

Pinellas County, Florida.City of Gulfport: Project Manager for hydrographic and water and sediment quality monitoring of a municipal marina applying for a dredge and fill permit. Other responsibilities included data management, statistical evaluations, and report preparation for submittal to the Florida Department of Environmental Protection. Gulfport, Pinellas County, Florida.

Selected Publications

Iricanin, N., Seasonal trends and benthic fluxes of interstitial manganese. (1984). M.S. Thesis.

Gu, D., N. Iricanin, and J.H. Trefry (1987), The geochemistry of interstitial water for a sediment core from the Indian River Lagoon, Florida, *Florida Scient.*, 50, 99 - 110.

Iricanin, N., J.H. Trefry, R.P. Trocine, T.W. Vetter, and S. Metz, Seasonal and spatial variations of interstitial Mn and Fe in Mississippi Delta Sediments, *Geochimica Cosmochimica Acta* (in preparation).

Iricanin, N., The role of storms in the transport and composition of particles in a Florida creek. Ph.D. Dissertation.

Iricanin, N. and J.H. Trefry (1990). Trace metal distribution in sediments from the Bering Sea. In: P.F. Rosigno (ed.), *Results from the second joint U.S.-U.S.S.R. Bering Sea expedition, summer 1984.* U.S. Fish. Wildl. Serv. Biol. Rep. 90(13).x + 317 pp.

Fields of Competence

Chemical Analysis of Water and Sediment Samples, Design and Implementation of WQBEL Studies, Stormwater Quality and Drainage Impact Assessments, Pollutant Loading Evaluations, and Groundwater Quality Monitoring, Data Acquisition and Interpretation, Statistical Analysis of Data, and Computer Programming.

Experience Summary

Dr. G. Garry Payne has thirteen years of applied research and environmental chemistry experience. Applied research has included effects of common land use practices on water quality and environmental quality in general. He has supervised an analytical laboratory conducting analyses of plant, soil and water samples. Experience includes teaching applied chemistry procedures at the college level, and supervision of lab and field personnel.

Before joining CCI, Dr. Payne worked with research teams from 1981 to 1989, where he investigated nutrient chemistry from field research sites and was responsible for quality control and maintenance of modern analytical equipment. He has investigated the effects of metal-rich wastes on soil chemistry. He has considerable experience in the experimental design of field and laboratory studies, including effects of acidity and nutrients on plants. After obtaining his doctorate in agronomy with an emphasis in soil chemistry, Dr. Payne's work has centered on applied chemical research and methods of minimizing detrimental environmental impacts resulting from nutrient losses, in Florida.

At CCI, Dr. Payne serves as Director of the Water Resource Management Division and oversees professional staff involved with surface and groundwater quality monitoring, data management and laboratory services. He is directly involved with planning, monitoring, and permitting studies for industries, utilities, municipalities, land developers and water management authorities. Many of these projects involve groundwater monitoring programs, pollutant loading evaluations and stormwater impact assessment and management, monitoring of potable water supplies, FDEP and NPDES permitting, development of nutrient and hydrologic budgets, and diagnostic studies of freshwater and estuarine water bodies.

Education

Year	School
1986	Virginia Polytechnic Institute & State University Ph.D. - Agronomy (Soil Chemistry)
1983	University of Georgia M.S. - Agronomy (Soil Fertility)
1981	Christopher Newport College B.S. - Biology

Employment History

1989 - Present	CCI Environmental Services, Inc. (f.k.a., Conservation Consultants, Inc.) Senior Scientist
1987 - 1989	University of Florida Agricultural Research Center: Postdoctoral Fellow
1983 - 1987	Virginia Polytechnic Institute & State University Research & Teaching Assistant
1981 - 1983	University of Georgia: Research Assistant

Key Projects

City of Sarasota: Project Manager for the design and implementation of a FDER-approved Plan of Study for a Water Quality Based Effluent Limitation Study (WQBEL) for the City's discharge from the Reverse Osmosis Plant and Ion Exchange Facility. Also responsible of data collection, statistical analysis, and preparation of an interpretative report of results. Sarasota, Florida.

City of Palmetto: Project Scientist for the design and implementation of a FDER-approved Plan of Study for a Minimal Impact Assessment for the surface water discharge to Terra Ceia Bay from City of Palmetto's Advanced Waste Water Treatment Plant. Palmetto, Florida.

IMC Fertilizer: Project Manager for the design and implementation of a FDER-approved Plan of Study for a Level I Water Quality Based Effluent Limitation (WQBEL) study for the surface water discharge from the Hopewell Phosphate Mining Facility. Responsibilities included data analysis, and preparation of an interpretative report of results. Study was performed in support of FDER permit renewal. Hillsborough County, Florida.

IMC-Agrico Company: Project Manager for the design and implementation of a FDEP-approved Plan of Study for a Level I Water Quality Based Effluent Limitation (WQBEL) study for six Phosphate Mining and Washer/Beneficiation Facilities covering three major river systems. The study was performed to support applications for the renewal of FDEP discharge permits. Hillsborough, Manatee, and Polk Counties, Florida.

Havens & Emerson: Project Manager for the design and implementation of a FDEP-approved Plan of Study for a Minimal Impact Assessment for Hillsborough County's proposed surface water discharge from the South County AWT Plant at Port Redwing. Hillsborough County, Florida.

Palmer Venture: Project Scientist for design and implementation of a Storm Event Pollutant Loading Monitoring Program in Catfish and South Creeks on Palmer Ranch. Responsible for data collection, data analysis, and preparation of an interpretative report of results. Sarasota County, Florida.

Key Projects (Continued)

Pasadena Yacht and Country Club: Project Manager for the design and implementation of agency approved workscopes for water and sediment quality and hydrographic monitoring in Boca Ciega Bay for the Pasadena Yacht and Country Club Marina. Monitoring is performed to comply with FDER Permit requirements. Gulfport, Pinellas County, Florida.

Lake Tarpon Swim Study: Task manager for the assessment of the impacts of groundwater inputs on the quality of Lake Tarpon and the analyses and mapping of sediments to determine their impact on lake quality. Also evaluated stormwater quality and pollutant loadings, sediment nutrient exchange rates, sediment oxygen demand, and nutrient budgets. Pinellas County, Florida.

Palmer Venture: Project Scientist for an Assessment of Post-Development Pollutant Loading Rates including predictions of stormwater loadings from planned residential, transportation, and other land uses and predictions of pollutant removal rates for planned grassed swales, extended detention basins with long-term residence times and biological filters. Palmer Ranch. Increment VI and East Side. Sarasota County, Florida.

Gulfstream Development Corporation: Project Manager responsible for the implementation of agency approved workscopes for various water resource assessments and construction monitoring programs required by the DRI Development Orders prior to initiating construction of Woodmere Community Center and Woodmere Village. Venice, Florida.

Palmer Venture: Project Scientist for an Assessment of Post-Development Pollutant Loading Rates including predictions of stormwater loadings from planned residential, transportation, and other land uses and predictions of pollutant removal rates for planned grassed swales, extended detention basins with long-term residence times and biological filters. Palmer Ranch. Increment VI and East Side. Sarasota County, Florida.

Power Corporation: Project Manager responsible for the implementation of agency approved workscopes for various water resource assessments specified by the DRI Development Order during construction of the Tara Development. Responsible for data collection and preparation of reports of results. Manatee County, Florida.

SOS Associates, LTD.: Project Manager responsible for the design and implementation of agency approved workscopes for various surface water resource assessments and monitoring programs specified by the DRI Development Order during construction of the Cooper Creek Square Development. Bradenton, Florida.

Wilma Southeast: Project Manager responsible for the implementation of agency approved workscopes for various surface and groundwater quality and hydrographic monitoring programs required by the DRI Development Order during construction of the Creekwood Development. Bradenton, Florida.

Key Projects (Continued)

Pursley Communities, Inc.,: Project Manager responsible for the implementation of agency approved workscopes for various surface and ground water resource monitoring programs required by the DRI Development Order during construction of the River Club Development. Manatee County, Florida.

Terra Ceia Isles: Project Manager responsible for the design and implementation of agency approved workscopes for various surface water quality monitoring programs required by the DRI Development Order during construction of the Terra Ceia Isles Development. Manatee County, Florida.

Kimley-Horn & Assoc.: Project Scientist on the Sarasota County Interstate Business Center Development of Regional Impact. Responsible for pollutant loading analyses for pre- and post-development land uses. In addition, responsible for summarization of existing water quality at the development site and preparation of report. Sarasota County, Florida.

Kimley-Horn & Assoc.: Project Scientist responsible for the implementation of a surface water quality and sediment quality survey in the Matheny Creek watershed. Other responsibilities included performing a pollutant loading evaluation for the watershed for various land use scenarios utilizing a spreadsheet mathematical model and preparation of interpretative report for existing water and sediment quality and pollutant loading assessments for submittal to the Sarasota County Stormwater Division as part of the NPDES permitting process. Matheny Creek, Sarasota County, Florida.

Smith & Gillespie Engineers: Project Scientist responsible for the implementation hydrographic and water quality data collection program in the tidal Braden River. In addition, responsible for management of collected data and utilization of hydrographic and water quality data in statistical and mathematical model to determine the effects various freshwater flow scenarios on the salt regime of the tidal Braden River. Braden River, Manatee County, Florida.

Kimley-Horn & Assoc.: Project Scientist responsible for performing a pollutant loading evaluation for the watershed for various land use scenarios utilizing a spreadsheet mathematical model and preparation of interpretative report for submittal to the Sarasota County Stormwater Division as part of the NPDES permitting process. Matheny Creek, Sarasota County, Florida.

Van Der Noord Enterprises: Project Manager for the design and implementation of agency approved workscopes for water quality, hydrographic, and micro-faunal assessments in the Manatee River for the Regatta Pointe Marina. Studies were performed in support of an application for agency permits required for the expansion of the marina. Palmetto, Florida.

Key Projects (Continued)

Lombardo & Skipper: Project Manager responsible for the design and implementation of agency approved workscopes for water and sediment quality and hydrographic assessments in Sarasota Bay for the Sarabay Marina. Studies were performed in support of an application for a Wetland Resource Management Permit relative to the expansion of the marina. Cortez, Florida.

Larson Communities: Project Manager responsible for the design and implementation of agency approved workscopes for water quality and hydrographic assessments in Tampa Bay for the Placido Bayou Development. Studies were performed in support of an application for a FDER Dredge and Fill Permit relative to the construction of a proposed docking facilities at the Placido Bayou Development. St. Petersburg, Florida.

Selected Publications

Payne, G.G. and J.E. Rechcigl. 1989. Influence of various drying techniques on the extractability of plant nutrients from selected soils. Soils Science.

Payne, G.G. and M.E. Sumner. 1986. Yield and composition of soybeans as influenced by soil pH, phosphorus, zinc and copper. Communications in Soil Science and Plant Analysis 17:257-273.

Payne, G.G. and D.C. Martens. 1988. Form and availability of Cu and Zn following long-term $CuSO_4$ and $ZnSO_4$ applications to a Rhodic Paleudult. Journal of Environmental Quality 17:707-711.

Payne, G.G. and D.C. Martens. 1986. Lead in soils. p. 78-89. In Soils. Brooklyn Botanic Garden, Inc., Brooklyn, NY.

Martens, D.C., G.G. Payne, C. Winarko, E.T. Kornegay and M.D. Lindemann. 1985. Crop response to high levels of copper application. Internat. Copper Research Association, Research Report 292(F). 38 p.

Payne, G.G., J.E. Rechcigl and A.B. Bottcher. 1988. Development of fertilization practices for beef cattle pastures to minimize nutrient loss in runoff. Annual Report. South Florida Water Management District. 125 p.

Payne, G.G., J.E. Rechcigl and R.J. Stephenson. 1990. Development of DRIS norms for bahiagrass. Agronomy Journal 82:711-715.

KEVIN P. GUETTLER — Environmental Scientist

Fields of Competence

Implementation of Surface Water, Groundwater, Hydrologic, and Sediment Monitoring Programs; Maintenance of Field and Laboratory Instrumentation and Equipment; SCUBA Certified; Proficient in the use of Outboard and Inboard Boats; Water Quality Data Analysis; and Computer Programming.

Experience Summary

Mr. Guettler has two years experience in environmental technical services. He is experienced with various aspects of surface water investigations including in-situ measurements, surface water level instrumentation, flow determination, and grab/composite sampling techniques. He has also monitored groundwater quality via water level measurements and grab samples.

Mr. Guettler serves as an Environmental Scientist in the Water Resources Division and is responsible for the implementation of surface and ground water monitoring programs. He is knowledgeable in the operation and maintenance of water quality sampling equipment and instrumentation. He serves as Project Manager for various projects involving surface water, water level and groundwater investigations. In addition, he assists in the day-to-day operations of CCI's analytical laboratory, including routine analyses of surface and groundwaters. Prior to joining CCI, Mr. Guettler worked for the Florida Department of Environmental Protection/Florida Marine Research Institute where he was involved in research on hatchery production of marine/estuarine fish and population dynamics of local stocks.

Education

Year	School
1992	University of Florida B.S. - Wildlife Ecology

Employment History

1994 - Present	CCI Environmental Services, Inc. (*f.k.a.* Conservation Consultants, Inc.) Environmental Scientist
1993 - 1994	Florida Department of Environmental Protection Biological Scientist I
1992 - 1993	University of Florida Whitney Marine Laboratory Research Assistant

Key Projects

Power Corporation: Project Manager responsible for the implementation of agency approved workscopes for various water resource assessments required by the DRI Development Order for the Tara Development. Responsibilities include a monthly sample collection, surface water level recording, analysis and reporting of water quality. Manatee County, Florida.

Palmer Venture: Project Scientist and Field Team Leader responsible for the implementation of a surface and groundwater quality and hydrographic monitoring program in Catfish Creek on Palmer Ranch. Sarasota County, Florida.

Palmer Venture: Project Scientist and Field Team Leader responsible for the implementation of a surface and groundwater quality and hydrographic monitoring program in South Creek on Palmer Ranch. Sarasota County, Florida.

SOS Associates, LTD.: Project Scientist and Field Team Leader responsible for the implementation of agency approved workscopes for various surface water resource assessments and monitoring programs specified by the DRI Development Order during construction of the Cooper Creek Square Development. Manatee County, Florida.

Wilma Southeast: Project Manager and Field Team Leader responsible for the implementation of agency approved workscopes for various surface and groundwater quality and hydrographic monitoring programs required by the DRI Development Order during construction of the Creekwood Development. Manatee County, Florida.

Pursley Communities, Inc.: Project Scientist and Field Team Leader responsible for the implementation of agency approved workscopes for various surface and groundwater resource monitoring programs required by the DRI Development Order during construction of the River Club Development. Manatee County, Florida.

Key Projects (Continued)

City of Bradenton: Project Scientist and Field Team Leader responsible for the implementation of a water quality monitoring program to assess the impact of the City of Bradenton's WWTP discharge on the Manatee River. Manatee County, Florida.

Smith & Gillespie Engineers: Project Scientist and Field Team Leader for a post-construction water quality monitoring program in the Evers Reservoir and Braden River. The source for the City of Bradenton's principal drinking water. Responsibilities include data collection, data interpretation, and preparation of reports of results. Manatee County, Florida.

Smith & Gillespie Engineers: Project Scientist and Field Team Leader for an ongoing surface water quality monitoring program in the Braden River downstream of the Evers Reservoir Dam. Responsibilities include data collection, data interpretation, and preparation of reports of results. Manatee County, Florida.

Smith & Gillespie Engineers: Project Scientist and Field Team Leader responsible for the mobilization and implementation of a hydrographic and surface water quality monitoring program in the Braden River downstream of the Evers Reservoir Dam. Designed to evaluate the impacts of fresh water flow over the dam on the estuarine waters of the Braden River. Manatee County, Florida.

SMR Communities, Inc.: Project Manager and Field Team Leader responsible for the implementation of agency approved workscopes for various surface water resource assessments and monitoring programs specified by the DRI Development Order during construction of the Lakewood Ranch Boulevard within the Cypress Banks Development. Manatee County, Florida.

Terra Ceia Isles: Project Scientist and Field Team Leader responsible for the implementation of a surface water quality monitoring program in and around Terra Ceia Isles. Manatee County, Florida.

Pasadena Yacht and Country Club: Project Scientist and Field Team Leader for the implementation of agency approved workscopes for various hydrographic, sediment and surface water quality monitoring programs required for FDEP permit compliance. Pinellas County, Florida.

Sarasota County: Project Scientist and Field Team Leader responsible for the mobilization and implementation of an ambient water quality monitoring program in Sarasota County Bays and the Lower Myakka River. The monitoring program was designed to allow the status and trends of environmental quality indicators to be determined in order to track the estuarine health. Sarasota County, Florida.