

DEPARTMENT OF NATURAL RESOURCE PROTECTION

TECHNICAL REPORT SERIES

TR: 94-03

**SUMMARY OF BACTERIOLOGICAL TESTING**

**IN THE LAS OLAS ISLES**

**JULY 1993 THROUGH AUGUST 1994**

ENVIRONMENTAL MONITORING DIVISION

OCTOBER 6, 1994

## **EXECUTIVE SUMMARY**

An 18-month study of water quality problems in the New River Basin (Broward County, DNRP, 1993) concluded that elevated levels of fecal coliform bacteria adversely affect water quality within the Las Olas Isles. This report is a summary of data collected since the completion of the original New River Study. It discusses the influence of storm-water runoff, sanitary sewers, and inhabited moored vessels (IMV's) on water quality in the area.

In cooperation with the City of Fort Lauderdale Public Works Department, DNRP monitored a network of sampling stations to evaluate the various sources of bacteria to the surface waters of the area.

The fecal coliform group was the most useful indicator group for evaluating bacterial impacts because of its occurrence in the gut of warm-blooded animals, its limited viability in aquatic environments, and its ability to provide the most consistent station rankings with respect to water quality.

The contribution of stormwater runoff from roads and other land surfaces was exhibited by an elevated and generally uniform fecal coliform levels over the entire study area.

Many instances of sewer failures, malfunctions and complaints were recorded during the study. Concurrent with the period of this study, sewer repairs included replacement of the force main running down Las Olas Blvd., and the relining of several gravity sewers on the Isles. The City of Fort Lauderdale Public Service Department has verified the integrity of all gravity sewers by remote camera. Most ongoing service on the sewer system is a result of problems with the pneumatically-operated pumps that carry sewage from the center of each Isle to the Las Olas Blvd. sewer line.

Water quality monitoring in the area since the conclusion of the New River Study continues to show a chronic adverse impact from fecal coliform bacteria. It is suspected that the source of the bacteria is the discharge of sanitary waste from IMV's since the greatest levels of bacteria correspond to the areas where IMV density is high and tidal flushing is low. This relationship persists even after the data are filtered for rainfall and documented sewer problems.

In response to concerns raised by the Broward County Department of Natural Resource Protection, the City of Fort Lauderdale has passed regulations designed to reduce discharges from IMV's through regulation of the landowners who rent dock space to the IMV's.

To date no positive impact from these regulations has been found.

It is recommended that monitoring of a baseline network of water quality stations continues in order to evaluate the future effectiveness of the regulations in resolving these problems.

It is further recommended that the implications of the Florida Clean Vessel Act be reviewed in the context of the local ordinance and that the issue of enforcement of the local ordinance be reviewed.

## **1.0 INTRODUCTION**

### **1.1 BACKGROUND**

A program of monitoring the surface waters of Broward County has been conducted by the Department of Natural Resource Protection since 1971. The information collected under this program is used to provide a sound, scientific basis for environmental decisions. DNRP has refined the program with the goal of providing a more detailed analysis of water quality from a basin-by-basin viewpoint. As a result of this refinement, the New River Basin was identified as an area of special concern with respect to water quality. From June 1991 through January 1993, a baseline study was conducted to assess the nature and extent of water quality issues associated with the New River (Broward County DNRP, 1993). This study found the water quality of certain canals within the Las Olas Isles area to be negatively affected by bacteria suspected to originate from the discharge of sanitary wastes from inhabited moored vessels (IMV's).

It should be noted that the Florida legislature recognizes water quality impacts associated with vessel discharges. In 1994 it passed a more stringent Clean Vessel Act (Chapter 94-241 F.S.) which improves definitions of floating structures, houseboats, and marine sanitation devices. The act also tightens the discharge prohibitions and authorizes boarding of vessels to inspect marine sanitation devices. Specifically the act prohibits the discharge of raw sewage from any vessel, houseboat or floating structure and requires any direct discharge toilet or holding tank to be locked or secured to prevent direct discharge.

### **1.2 STUDY OBJECTIVES**

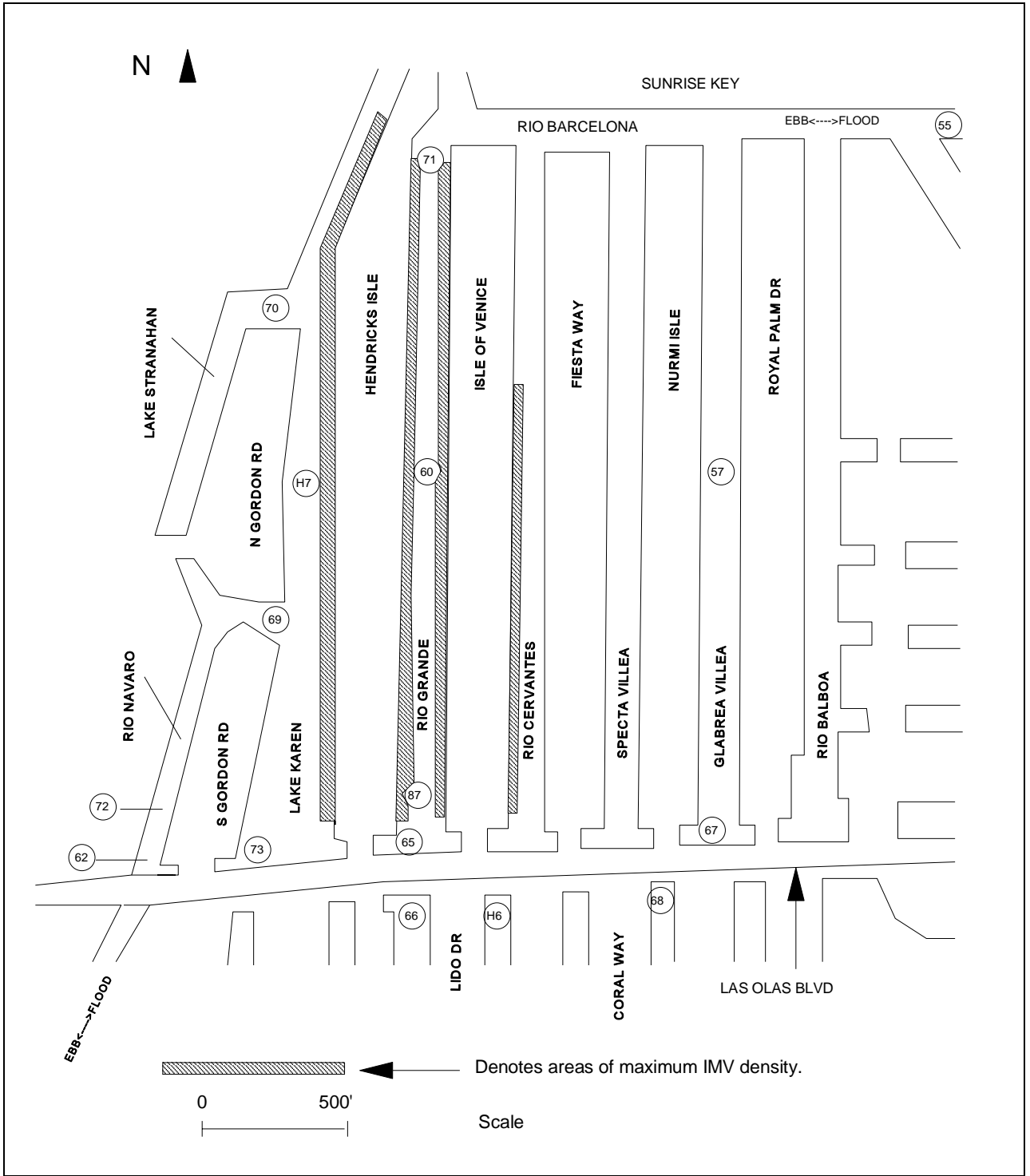
The subject of this report is a summary of data that have been collected July 1993 through August 1994 in the Las Olas Isles area following the original work in the New River basin. The report also incorporates data provided by the City of Fort Lauderdale Public Services Department. Bacteriological monitoring in the Las Olas Isles area has continued in order (1) to identify the sources of high bacterial levels in this area (2) to evaluate the effectiveness of regulations formulated to minimize the discharge of sanitary wastes from IMV's.

### **1.3 DESCRIPTION OF THE STUDY AREA**

Figure 1 identifies the study area with respect to the entire New River basin. Figure 2 illustrates the actual study area and identifies the sampling locations. The Las Olas Isles study area is defined on the north by Rio Barcelona, on the west by Rio Navaro and Lake Stranahan, on the south by Las Olas Blvd., and on the east by Rio Balboa (see Figure 2). Part of this area is zoned to allow IMV's. Such IMV's are particularly prevalent on the Isle of Venice and Hendricks Isle.

**Figure 1      MAP OF THE NEW RIVER BASIN**





**Figure 2** DIAGRAM OF LAS OLAS ISLES SAMPLING STATIONS.  
 (approx. scale; 1" equals 500')

## 2.0 METHODOLOGY

### 2.1 BACTERIOLOGICAL PARAMETERS

While no bacterial test can absolutely detect the origin of sewage in water, there are tests that help in identifying the presence of fecal material. Four different bacteriological indicator groups have been monitored in the Las Olas Isles area since the conclusion of the original New River study.

The **total coliform** test is best suited to identify contamination of potable water supplies since bacteria measured by this test may result from many sources. Chapter 27 of the Broward County Code of Regulations (DNRP Pollution Control Code) specifies a maximum total coliform density of 1,000 colonies per 100 milliliters (ml) in marine and fresh waters.

**Fecal coliform** represent the fecal component of the coliform group and are differentiated by their ability to colonize in the appropriate medium at an elevated incubation temperature. The fecal coliform test (membrane filter technique) gives a 93% accuracy in differentiating between coliform found in the feces of warm-blooded animals and those from other environmental sources (Standard Methods, 1992, p. 9-60). The fecal coliform group is also a useful indicator of remoteness of a source of bacteria because the non-fecal members of the coliform group may be expected to survive longer than the fecal members in the unfavorable environment provided by the water (Standard Methods, 1992, p. 9-1). DNRP code specifies a maximum fecal coliform density of 200 colonies per 100 ml for a monthly average, 400 colonies per 100 ml for 10% of samples, and 800 colonies per 100 ml in any sample.

The **fecal streptococcus** group consists of several species of the genus *Streptococcus*, such as *S. faecalis*, *S. faecium*, *S. avium*, *S. bovis* and *S. gallinarum*. They all give a positive reaction with Lancefield's Group D antisera and have been isolated from the feces of warm-blooded animals. *S. faecalis* and *S. faecium* once were thought to be more human-specific than other *Streptococcus* species. Other species have been observed in human feces but less frequently. (Watanabe, et. al., 1981). Similarly, *S. bovis*, *S. equinus*, and *S. avium* are not exclusive to animals, although they usually occur at higher densities in animal feces (Thomas, et. al., 1978). Certain streptococcal species predominate in some animal species and not in others, but it is not possible to differentiate the source of fecal contamination based on speciation of fecal streptococci (Standard Methods, 1992, p. 9-70). DNRP code does not provide a standard for fecal streptococcus.

The **enterococcus** group is a subset of the fecal streptococci that includes *S. faecalis*, *S. faecium*, *S. gallinarum* and *S. avium* and are differentiated from fecal streptococcus by their ability to grow under different incubation conditions. In marine waters, the EPA has established a water quality guideline of 35 colonies/100 ml based upon the association of gastroenteritis with poor water quality as indicated by the enterococcus test. The Florida Administrative Code and the Broward County Code of Ordinances do not provide a standard for enterococci.



## 2.2 SAMPLING LOCATIONS

Beyond a baseline network of stations, several sampling locations in the Isles have been tested during the period covered by this report in order to refine our understanding of water quality problems in the Las Olas Isles area. Figure 2 identifies the stations sampled during the period July 1993 to August 1994.

During the three-month period July through September 1993, a baseline network consisting of Stations 55, 57, 60, and 62 was monitored. Station 55 monitors water quality entering the Isles from the east during the outgoing tide and the outflow from the Isles during the incoming tide. Station 62 represents water entering the Isles from the New River proper during the incoming tide and the outflow during the ebb tide. Station 60 was selected for its proximity to the maximum density of IMV's. The number and concentration of IMV's in the study area were determined by examining aerial photographs taken in December 1991. Station 57 provides a comparison to a nearby isle where IMV's are less prevalent. A count of moored vessels from the aerial photographs showed 220 equally distributed on either side of the Rio Grande and another 167, primarily on the east side of Lake Karen.

In October 1993, four additional stations were tested to detect any leakage at those points from the force main running down Las Olas Blvd. These stations are identified as 65, 66, 67, & 68. Leakage from the force main here would be expected to affect water quality on one or both sides of Las Olas Blvd. Water bodies on the north and south sides of Las Olas are not directly connected at these points.

From November 1993 to August 1994, the network consisted of Stations 55, 57, 60, 62, 66, 69, 70, 71, 72, 73, & 87. Stations 69 & 70 were added to determine if water from Rio Navaro and Lake Stranahan carried any fecal contamination from faulty sewers to the west. Stations 71 & 87 were added to evaluate whether any gradient in bacteria concentrations might be evident along the length of the Rio Grande canal. Stations 72 & 73 evaluate water quality flowing out of Rio Navaro and Lake Karen respectively during an outgoing tide.

The City of Fort Lauderdale Public Service Department also began regular water quality testing in the Las Olas Isles area beginning in November 1993. Sampling of the baseline network, Stations 55, 57, 60, & 62 (Fort Lauderdale designations H1, H2, H3, & H4 respectively) was done by both agencies. An effort was made to coordinate sampling to provide the maximum amount of temporal coverage. Beyond the four baseline stations, the City has established a station, designated H7, to monitor IMV's moored on Lake Karen and two stations, designated H5 & H6, to provide additional data on the S side of Las Olas where IMV's are prohibited.

Descriptions of sampling stations monitored during this study appear in Table 1.

**TABLE I  
SAMPLING LOCATIONS**

DNRP SITE #	FT. L. SITE #	STATION DESCRIPTION	*VESSELS WITHIN 300 FT.
55	H1	INTERSECTION OF RIO BARCELONA & MIDDLE RIVER	3
57	H2	MID-POINT, GLABREA VILLEA	4
60	H3	MID-POINT, RIO GRANDE	61
62	H4	N SIDE OF LAS OLAS BRIDGE OVER RIO NAVARO	3
65	NO EQUIV.	E SIDE OF HENDRICKS ISLE BRIDGE OVER RIO GRANDE	13
66	H5	N END OF CANAL E OF LIDO DR.	4
67	NO EQUIV.	N END OF CANAL W OF ROYAL PLAZA DR.	0
68	NO EQUIV.	N END OF CANAL E OF CORAL WAY	2
69	NO EQUIV.	CENTER OF N PASSAGE BETWEEN LAKE KAREN & RIO NAVARO	35
70	NO EQUIV.	CENTER OF N PASSAGE BETWEEN LAKE KAREN AND LAKE STRANAHAN	36
71	NO EQUIV.	N END OF RIO GRANDE AT RIO BARCELONA	31
72	NO EQUIV.	RIO NAVARO, 50 YD. N OF LAS OLAS BLVD.	3
73	NO EQUIV.	E SIDE OF S. GORDON RD. BRIDGE AT LAS OLAS	2
87	NO EQUIV.	S END OF RIO GRANDE, 50 YD. N OF LAS OLAS BLVD.	35
NO EQUIV.	H6	N END OF CANAL W OF LIDO DR.	4
NO EQUIV.	H7	MID-POINT LAKE KAREN	37

\* From aerial photography, December 1991

## 2.3 SAMPLING TECHNIQUES

All samples were collected by hand from a small boat at the water surface. A 250 ml sterile glass bottle was lowered into the water while the boat was held into the current. Sample collection was conducted mornings without regard to tidal phase. Immediately after collection, samples were cooled to 4 degrees Celsius in ice. The samples were taken to the laboratory and analyzed within six hours using EPA-approved membrane filter techniques.

## 2.4 STATISTICAL TECHNIQUES

Statistical manipulation of the data was limited to calculation of median values. Median values are used for analysis of the data because significant variability can occur in measurements from one day to the next due to such factors as meteorological conditions and tidal phase. The median value of a set of data was found by ranking the data from highest to lowest. In data sets with an odd number of members, the data point with the rank at the center of the data set is the median. In data sets with an even number of members, the two centrally-ranked data points are averaged to find the median. Medians were not calculated for data sets with less than five members.

## 3.0 RESULTS AND DISCUSSION

### 3.1 USE OF FECAL COLIFORM TO DESCRIBE WATER QUALITY

As it was noted in Section 2.1, several bacteriological indicators were monitored during this project. However, to simplify presentation and interpretation of the data from this study, only fecal coliform results will be discussed. The rationale for this approach is as follows:

- o **Total coliform** are not very useful for detecting fecal contamination since they can originate from sources other than the gut of warm-blooded animals.
- o **Enterococci**, although showing good correlation with gastroenteritis in marine waters used for recreational purposes, are too long-lived to be useful for identifying nearby sources of sewage. The median time for 90% die-off has been estimated at 2.4 days (Hanes & Fragala, 1967). In addition, there are no accepted state or local water quality standards adopted for enterococci.
- o **Fecal coliform** are very sensitive to environmental conditions and do not survive for extended periods outside the gut. They are therefore good indicators of the proximity of a source of sewage. Median time for 90% die-off has been estimated at 2.2 hours (Chamberlin & Mitchell, 1978).
- o **Fecal streptococci** generally persist longer in water than similarly exposed fecal coliform and are thus less useful indicators of source proximity than fecal coliform (Geldrich, E., 1976).

### 3.2 TEST FOR RANKING CONSISTENCY USING FECAL COLIFORM

If water quality at a particular station is being degraded by a continuous source of bacteria, its ranking, compared with other stations should be consistent. To find out whether the fecal coliform test data show any consistent ranking of stations, a simple test was devised. In this test, fecal coliform data from the four baseline stations monitored over the entire 13-month period were examined. For each sampling event, the stations were ranked one through four (highest to lowest) with respect to fecal coliform levels. Then the number of times a station achieved a certain ranking was totaled and overall percentages were computed. The data from this test appear in Table II.

	<b>* NUMBER OF TIMES IN RANK</b>			
	<b>1ST HIGHEST</b>	<b>2ND HIGHEST</b>	<b>3RD HIGHEST</b>	<b>4TH HIGHEST</b>
STATION 55	0	4	7	3
STATION 57	1	1	4	8
STATION 60	11	2	1	0
STATION 62	2	8	3	1

\* (Four stations x 14 events = 56 data points)

**TABLE II: STATION RANKINGS, USING FECAL COLIFORM**

From the above data, it is shown that, using fecal coliform values, Station 60 is ranked 1st highest a majority of the time (79%); Station 62 is ranked 2nd highest a majority of the time (57%); Station 55 is ranked 3rd highest a majority of the time (50%); and Station 57 is ranked 4th highest a majority of the time (57%).

Thus, fecal coliform values can provide a good means of showing which stations are consistently better or worse than others.

### 3.3 TIDAL FLUSHING WITHIN THE LAS OLAS ISLES

Tidal flushing within the central north-south finger canals of the Isles is very slight. However, due to the large area being drained, flows under Las Olas Blvd. at Station 62 can be very high. In general, water flows to the west and south on the outgoing tide and to the east and north on the incoming tide.

### 3.4 SOURCES OF BACTERIA

There are three potential sources of fecal coliform bacteria found in the Las Olas Isles: stormwater runoff, inhabited moored vessels, and sanitary sewers.

Figure 3 illustrates the median fecal coliform levels from all data collected during the study period within the Las Olas Isles area.

The highest bacterial levels clearly correspond to the proximity of the station to areas of greatest IMV density.

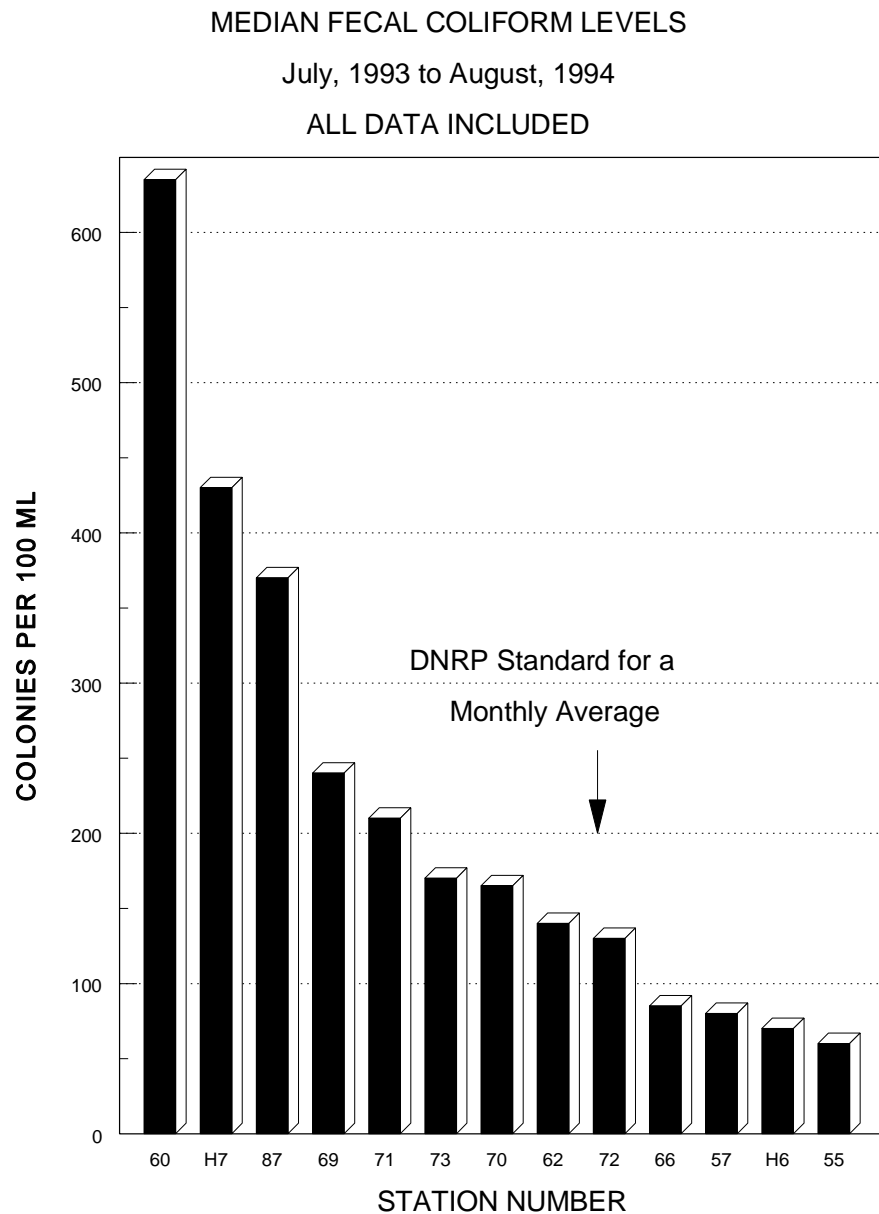
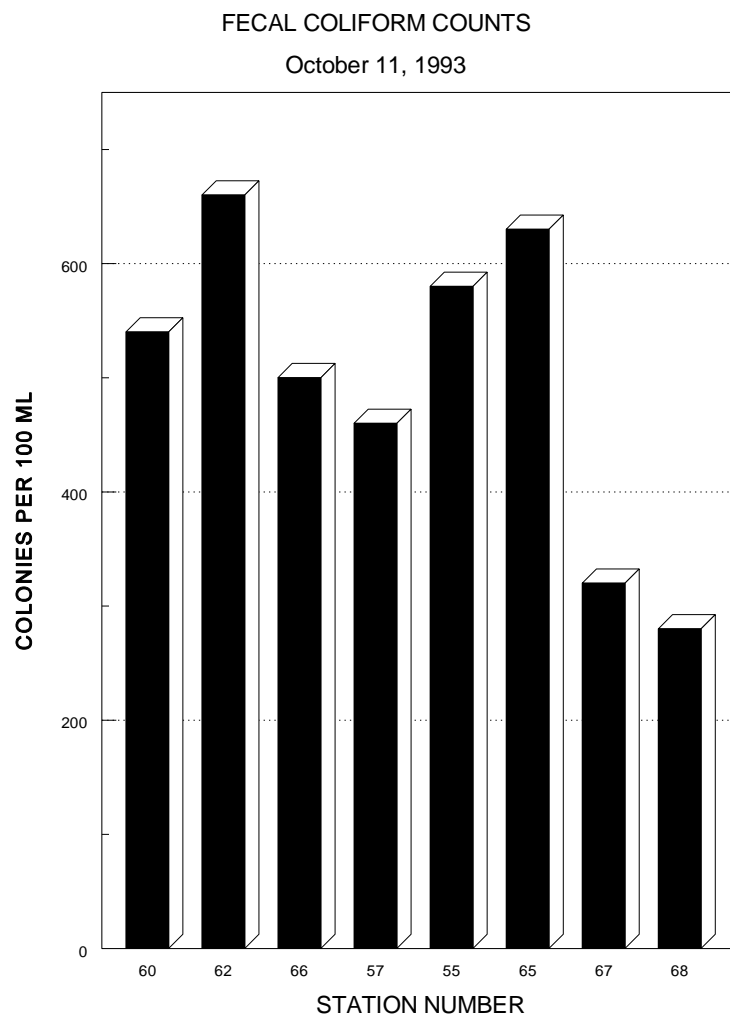


Figure 3 MEDIAN FECAL COLIFORM LEVELS - ALL DATA INCLUDED

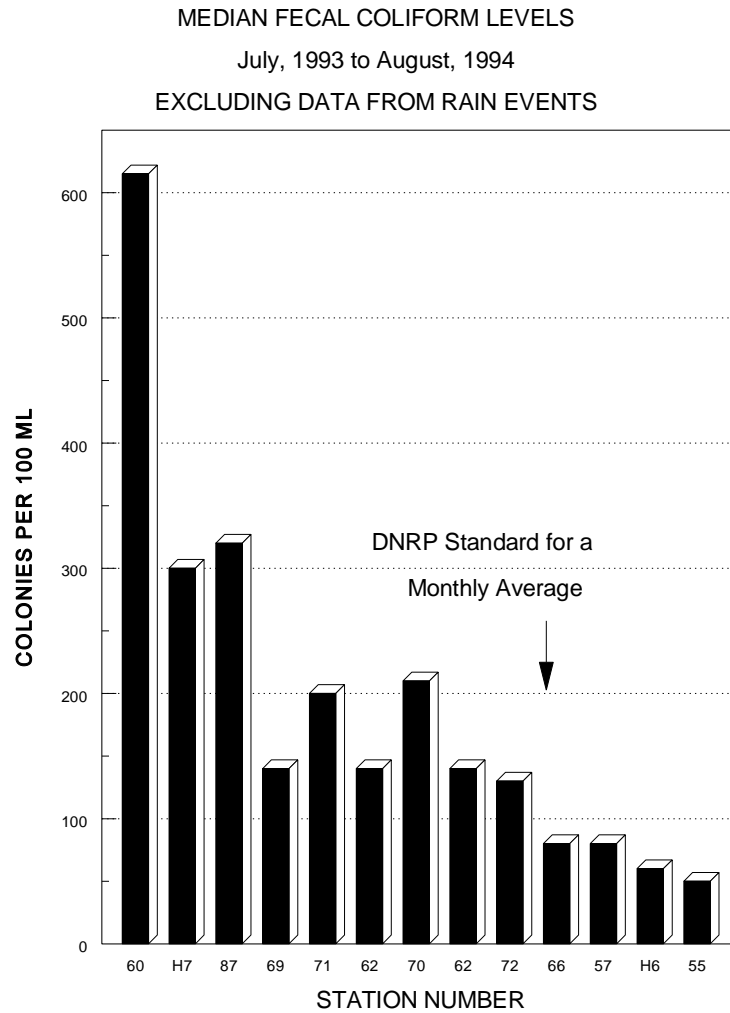
### 3.4.1 Storm-water Runoff

Storm-water runoff contributes to bacteria level elevations by depositing bacteria picked up from roadways and other land surfaces into surface waters. Total coliform elevations reflect contributions from both fecal and nonfecal matter while fecal coliform elevations generally reflect contributions from fecal matter. During dry weather periods, area-wide bacterial levels in surface waters are usually at their lowest levels. As is typical of other areas in the county, significant bacterial elevations were observed in the Las Olas Isles during or within 24 hours following heavy rainfall. Most of the sampling events during this study occurred during dry periods. However, the event of October 11, 1993 occurred following a significant rainfall (2.35" in the preceding 24 hr.). The impact of the rain can be clearly seen in the data as shown by the generally uniform and high levels of bacteria seen at all stations (see Figure 4). Despite an elevated fecal coliform value at Station #60 of 540 colonies/100 ml due to rainfall, this value is less than the median value of 610 colonies for this station.



**Figure 4** FECAL COLIFORM LEVELS ASSOCIATED WITH A RAIN EVENT

Figure 5 illustrates the distribution of fecal coliform levels after the data are filtered for rain events (arbitrarily defined as greater than 0.5" in the preceding 24 hr.). The correspondence between IMV density and fecal coliform levels persists.



**Figure 5 MEDIAN FECAL COLIFORM LEVELS - RAIN EVENTS EXCLUDED**

### 3.4.2 Sanitary Sewers

The second source of fecal bacteria is municipal sanitary sewers. Although all of the gravity sewers in the area have been televised and verified as leak-free, failures of the force main running down Las Olas Blvd. have been documented and led to the decision by the Fort Lauderdale Public Services Department to replace that force main ahead of schedule. It has also been documented that the pneumatically-operated pump stations at the center of each Isle have failed occasionally. This results in the possibility of the discharge of sewage to the street and ultimately to the surface waters.

To screen the data for sewer failures and malfunctions that may have occurred during the study period and isolate the impact of IMV's, extensive documentation provided by the Fort Lauderdale Public Services Department was reviewed by DNRP. The documentation included records of failures of the Las Olas force main, maintenance reports on the mid-Isle pump stations and complaints received by the Customer Service Department.

Table 3.1 lists the date and location of force main repairs during the study period.

**TABLE 3.1**  
**Force Main Failures**

DATE	LOCATION
08/18/93	Bridge crossing (west side, Sospiro Canal, west of S. Gordon Rd.)
10/19/93	Lido Dr. at E. Las Olas Blvd.
10/20/93	Hendricks at E. Las Olas Blvd. (100 fr. west of Hendricks Blvd.)
10/26/93	Hendricks at E. Las Olas Blvd. (80 ft. west of Hendricks Blvd.)
12/01/93	E. Las Olas Blvd. (at bridge over Sospiro Canal, west of S. Gordon Rd.)
12/03/93	E. Las Olas Blvd. (at bridge over Sospiro Canal, west of S. Gordon Rd.)

None of the force main failures took place within an interval (within 24 hours preceding a sampling event) that should have influenced the results.



Table 3.2 lists mid-Isle pneumatic pump station repairs that occurred during this study.

**TABLE 3.2**  
**Mid-Isle Pneumatic Pump Station Repairs**

DATE	LOCATION	DATE	LOCATION
07/05/93 to 07/11/93	Nurmi Drive	02/27/94 to 02/28/94	Nurmi Drive
07/13/93	Nurmi Drive	03/07/94	Nurmi Drive
07/16/93	Nurmi Drive	06/15/94	Nurmi Drive
08/08/93	Nurmi Drive	06/28/94	Isle of Venice
08/09/93	Nurmi Drive	06/30/94	Hendricks Isle
08/24/93	Nurmi Drive	07/01/94	Hendricks Isle
09/07/93	Nurmi Drive	07/04/94	Hendricks Isle
09/16/93	Nurmi Drive	07/06/94	Hendricks Isle
09/17/94	Nurmi Drive	07/07/94	Hendricks Isle
11/18/93	Isle of Venice	07/12/94	Hendricks Isle
11/22/93	Isle of Venice	07/14/94	Hendricks Isle
12/03/93	Royal Palm Drive	07/15/94	Hendricks Isle
12/09/93	Royal Palm Drive	07/19/94	Hendricks Isle
12/13/93 to 12/15/93	Royal Palm Drive	07/22/94	Hendricks Isle
01/07/94	All Stations Down	07/29/94	Hendricks Isle
01/24/94	Hendricks Isle	08/16/94	Hendricks Isle

Beyond the repairs noted in Table 3.2, Public Services personnel began precautionary daily inspections of the pump stations in January.

Records provided by the city utilities department indicate maintenance activities occurred within 24 hours preceding a sampling event on nine occasions:

**TABLE 3.3**  
**Pump Station Maintenance Activities Occurring During Sampling Events**

DATE OF MAINTENANCE	DATE OF SAMPLING	MAINTENANCE LOG ENTRY
11-22-93	11-23-93	"Air lines & valves", Isle of Venice
12-13-93	12-14-93	"Pot repairs", Royal Palm Drive
01-24-94	01-25-94	"Pot stat.ot", Hendricks Isle
03-07-94	03-08-94	"Unplugged dis/chr.line", Nurmi Drive
06-30-94	06-30-94	"Rebuilt slide valve", Hendricks Isle
07-04-94	07-05-94	"Pot out of service", Hendricks Isle
07-12-94	07-12-94	"Rebuilding sta", Hendricks Isle
07-19-94	07-19-94	"Removed pot and discharge chk/val", Hendricks Isle
08-16-94	08-16-94	"Put south pot back in sta/all valves", Hendricks Isle

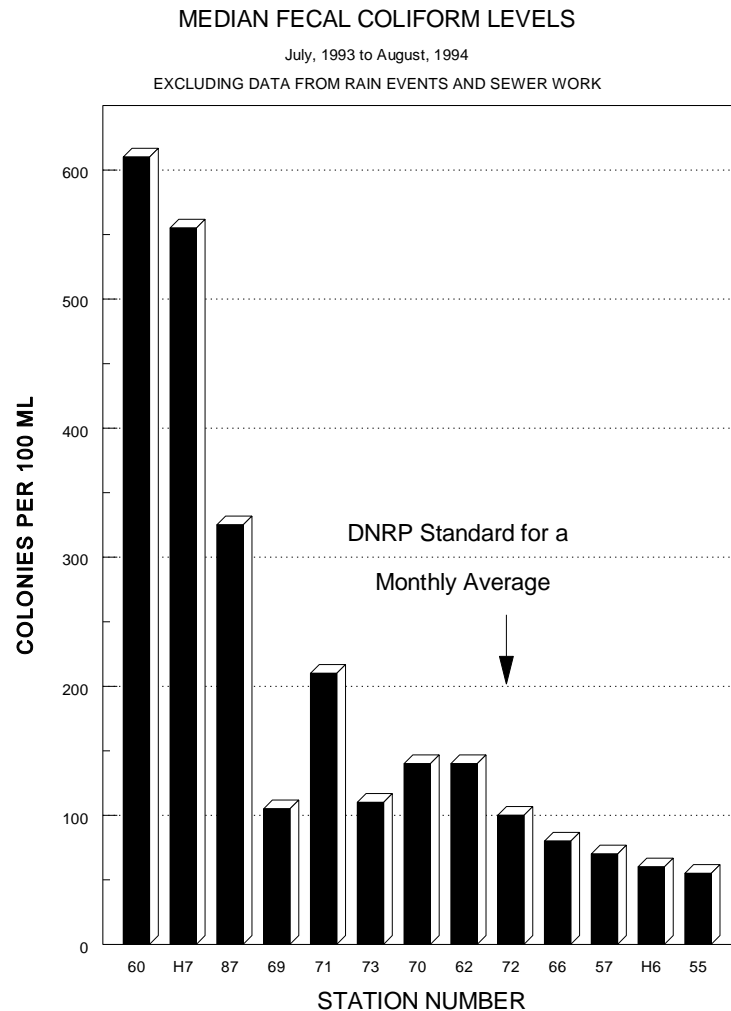
Vacuum trucks are provided to remove sewage during maintenance activities.

Table 3.4 lists complaints received by the Customer Service department from Isles residents during the study period.

**TABLE 3.4  
Complaints Received by Customer Service**

DATE		LOCATION
07/05/93	Sewer stoppage	Nurmi Drive
07/08/93	Manhole valve cover	Nurmi Drive
07/14/93	Manhole valve cover	Nurmi Drive
07/17/93	Sewer stoppage	Nurmi Drive
08/04/93	Sewage in street	Nurmi Drive
08/17/93	Sewer stoppage	Nurmi Drive
09/23/93	Sewage in street	Hendricks Isle
10/26/93	Broken sewer	Hendricks Isle
11/23/93	Sewage in street	Isle of Venice
12/03/93	Sewer stoppage	Royal Palm Drive
12/06/93	Sewer stoppage	Royal Palm Drive
12/20/93	Sewer stoppage	Royal Palm Drive
02/27/94	Sewer stoppage	Nurmi Drive
02/28/94	Sewer stoppage	Fiesta Way
03/02/94	Sewer stoppage	Isle of Venice
04/01/94	Sewer stoppage	Nurmi Drive
04/02/94	Sewer stoppage	Nurmi Drive
05/03/94	Sewer odor	Nurmi Drive
05/26/94	Sewer stoppage	Isle of Venice
06/15/94	Sewage in street	Nurmi Drive
06/24/94	Broken sewer	Nurmi Drive
06/29/94	Sewage in street	Hendricks Isle

The records do not indicate any sewage actually being discharged to surface waters because of the sanitary sewer failures, maintenance or complaints. However, the data from the dates corresponding to the problems can be excluded from the calculation of fecal coliform medians. Figure 6 illustrates the medians resulting from the exclusion of both storm events and documented sewer problems.



**Figure 6 MEDIAN FECAL COLIFORM LEVELS - RAIN & SEWER EVENTS EXCLUDED**

### 3.4.3 Inhabited Moored Vessels

The large number of IMV's concentrated in the area provides a source of fecal coliform from human sources. The lack of use of pump-out facilities was noted in the New River Report. Although some IMV's may have U.S. Coast Guard approved marine sanitation devices, federal regulations permit a properly-functioning Type II device to discharge fecal coliform bacteria at levels up to 200 colonies per 100 ml (Clean Water Notebook, 1994). The DNRP fecal coliform standard is 200 colonies per 100 ml as a monthly average and 800 colonies per 100 ml in any one sample.

The 1994 Clean Vessel Act (Chapter 94-241 F.S.) states that houseboats (defined as a vessel used primarily as a residence for a minimum of 21 days during any 30- day period) must be properly connected to a Type III marine sanitation device (33 CFR Part 159) by October 1, 1996, thus prohibiting direct discharge from this class of vessels. The Clean Vessel Act also specifically prohibits the discharge of raw sewage and gives the state the authority to board and inspect vessels for illegal discharge.

Figure 6 represents the distribution of fecal coliform after the data is filtered for storm and sewer effects. The association between elevated fecal coliform levels and high IMV density remains evident.

#### 4.0 CONCLUSIONS AND RECOMMENDATIONS

The fecal coliform group was identified as the most useful indicator water quality with respect to bacteria. Beyond its origin being restricted to the gut of warm-blooded animals, its short-term viability in aqueous environments makes it a useful indicator of source proximity. Of all the other bacteria groups employed, it also provides the most consistent ranking of stations with respect to water quality.

Heavy rainfall causes high levels of bacteria to appear throughout the Las Olas Isles area. This phenomenon is a county-wide observation. However, levels within the area of greatest IMV density during dry periods frequently exceeded levels that occurred during heavy rains. When data collected following a rain event are excluded from consideration, there is a clear relationship between IMV density and fecal coliform levels.

The sanitary sewer system in the area is old and under renovation. The pneumatically-operated pump stations at the center of each Isle seemed particularly subject to malfunction. However, representatives of the city's Public Services Department maintain that all sewer lines in the Las Olas Isles have been televised and repaired as necessary to insure that there are no active leaks. Extensive records were reviewed to identify any failures or malfunctions of the sanitary sewer system that occurred before a sampling event. When the data are filtered to exclude results produced concurrent with these events, the relationship between IMV density and relative fecal coliform levels persists.

It is consistently found that the greatest fecal coliform concentrations coincide with the greatest concentrations of IMV density, even when the data is corrected for the influence of stormwater and sewer system failures. This strongly suggests that the discharge of sewage from these vessels is the source of bacteria that are adversely affecting water quality.

Clearly even the use of Coast Guard-approved Type II MSD's would allow the release of material into inland surface waters violating county regulations and at levels far greater than permitted for sewage treatment plants.

The impact of vessels used for habitation has been widely recognized by the State of Florida and many other coastal states. Beyond amending the Florida litter law to prohibit the dumping of human waste on the waters of the state, the Florida legislature has recently passed the Clean Vessel Act in response to this issue. The act promulgates a five-year program to mitigate the impact of IMV's on the waters of the state. The elements of the act include the following:

- o Requirement that a vessel used primarily as a residence must be properly connected to a Type III marine sanitation device by October 1, 1996.
- o Prohibition of the discharge of raw sewage and authorization of boarding and inspection of vessels for illegal discharge.
- o Promotion of the use of existing pump-out facilities
- o Provision of funding for construction of new pump-out facilities in targeted areas.
- o Development of an education program aimed at changing attitudes and behaviors and providing information to the boating public and marine industry.
- o Development and implementation of evaluation methods to assess program problems, accomplishments and future needs.

It is recommended that regulations designed to minimize the impact of discharges from IMV's be actively enforced and that the regulation's effectiveness be monitored through continued sampling and testing for fecal coliform. The requirements of the state rule should be incorporated as necessary into city regulations. Should these regulations, once fully enforced, fail to reduce the impact of IMV's, further steps will be proposed.

APPENDIX I  
DNRP - CITY OF FORT LAUDERDALE COMBINED WATER QUALITY DATA  
LAS OLAS ISLES, JULY, 1993 TO AUGUST, 1994

DATA SOURCE	FT LAUD STA #	DNRP STA #	SAMPLE DATE	RAINFALL <24 HR	HIGH TIDE	LOW TIDE	SAMPLE TIME	LAB ID	BACTERIA, COLONIES\100 MLS				FLOW DIR.
									FECAL COLIF.	TOTAL COLIF.	FECAL STREP	ENTERO-COCCUS	
DNRP	H1	55	930727	0.0"	1628	1019	1150	51014	15	120	0	0	E
DNRP	H2	57	930727	0.0"	1628	1019	1202	51020	10	0	0	0	NA
DNRP	H3	60	930727	0.0"	1628	1019	1223	51045	700	5500	140	0	N
DNRP	H4	62	930727	0.0"	1628	1019	1213	51046	100	400	10	200	N
DNRP	H1	55	930824	0.65"	1500	0852	1030	51211	40	230	33	20	NA
DNRP	H2	57	930824	0.65"	1500	0852	1045	51212	10	67	33	0	NA
DNRP	H3	60	930824	0.65"	1500	0852	1100	51213	730	3800	300	70	N
DNRP	H4	62	930824	0.65"	1500	0852	1107	51214	140	1000	82	20	NA
DNRP	H1	55	930921	0.1"	1334	0726	1015	51371	40	400	33	10	NA
DNRP	H2	57	930921	0.1"	1334	0726	1030	51372	10	33	ND	20	N
DNRP	H3	60	930921	0.1"	1334	0726	1100	51373	190	700	100	20	N
DNRP	H4	62	930921	0.1"	1334	0726	1050	51388	180	430	170	40	N
DNRP	H1	55	931011	2.35"	1739	1146	1255	51501	580	1100	230	70	NA
DNRP	H2	57	931011	2.35"	1739	1146	1305	51502	460	1100	33	40	NA
DNRP	H3	60	931011	2.35"	1739	1146	1325	51505	540	1900	33	40	N
DNRP	H4	62	931011	2.35"	1739	1146	1335	51506	660	1600	430	200	N
DNRP	NA	65	931011	2.35"	1739	1146	1320	51504	630	1900	33	20	NA
DNRP	H5	66	931011	2.35"	1739	1146	1215	51508	500	1100	270	100	NA
DNRP	NA	67	931011	2.35"	1739	1146	1315	51503	320	1300	67	10	NA
DNRP	NA	68	931011	2.35"	1739	1146	1159	51507	280	770	67	0	NA



APPENDIX I  
DNRP - CITY OF FORT LAUDERDALE COMBINED WATER QUALITY DATA  
LAS OLAS ISLES, JULY, 1993 TO AUGUST, 1994

DATA SOURCE	FT LAUD STA #	DNRP STA #	SAMPLE DATE	RAINFALL <24 HR	HIGH TIDE	LOW TIDE	SAMPLE TIME	LAB ID	BACTERIA, COLONIES\100 MLS				FLOW DIR.
									FECAL COLIF.	TOTAL COLIF.	FECAL STREP	ENTERO-COCCUS	
DNRP	H1	55	931108	0.0"	1507	914	945	51763	20	100	67	20	E
DNRP	H2	57	931108	0.0"	1507	914	950	51764	1700	40000	34000	2000	S
DNRP	H3	60	931108	0.0"	1507	914	1005	51766	330	2400	130	200	S
DNRP	H4	62	931108	0.0"	1507	914	1030	51769	140	1300	100	40	N
DNRP	H5	66	931108	0.0"	1507	914	945	51773	80	3800	330	20	NA
DNRP	NA	69	931108	0.0"	1507	914	1025	51771	140	1500	67	130	E
DNRP	NA	70	931108	0.0"	1507	914	1020	51772	210	1200	130	90	E
DNRP	NA	71	931108	0.0"	1507	914	1000	51765	220	1500	100	80	S
DNRP	NA	72	931108	0.0"	1507	914	1026	51770	160	1400	130	40	N
DNRP	NA	73	931108	0.0"	1507	914	958	51768	200	1200	170	100	E
DNRP	NA	87	931108	0.0"	1507	914	1005	51767	230	1700	600	290	S
FT LAUD	H6	NA	931109	0.57"	0447	1119	NA	NA	NA	NA	NA	NA	NA
FT LAUD	H7	NA	931109	0.57"	0447	1119	NA	NA	NA	NA	NA	NA	NA
FT LAUD	H1	55	931109	0.57"	0447	1119	NA	NA	260	>4000	80	20	NA
FT LAUD	H2	57	931109	0.57"	0447	1119	NA	NA	470	>4000	1380	520	NA
FT LAUD	H3	60	931109	0.57"	0447	1119	NA	NA	1620	>4000	700	360	NA
FT LAUD	H4	62	931109	0.57"	0447	1119	NA	NA	450	>4000	320	320	NA
FT LAUD	H5	66	931109	0.57"	0447	1119	NA	NA	NA	NA	NA	NA	NA
FT LAUD	H7	NA	931116	0.12"	1105	0455	NA	NA	NA	NA	NA	NA	NA
FT LAUD	H6	NA	931116	0.12"	1105	0455	NA	NA	NA	NA	NA	NA	NA
FT LAUD	H1	55	931116	0.12"	1105	0455	NA	NA	250	1700	100	40	NA
FT LAUD	H2	57	931116	0.12"	1105	0455	NA	NA	50	1900	40	0	NA
FT LAUD	H3	60	931116	0.12"	1105	0455	NA	NA	910	4500	180	160	NA
FT LAUD	H4	62	931116	0.12"	1105	0455	NA	NA	140	1800	40	40	NA
FT LAUD	H5	66	931116	0.12"	1105	0455	NA	NA	NA	NA	NA	NA	NA

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 DNRP - CITY OF FORT LAUDERDALE COMBINED WATER QUALITY DATA  
 LAS OLAS ISLES, JULY, 1993 TO AUGUST, 1994

DATA SOURCE	FT LAUD STA #	DNRP STA #	SAMPLE DATE	RAINFALL <24 HR	HIGH TIDE	LOW TIDE	SAMPLE TIME	BACTERIA, COLONIES\100 MLS					FLOW DIR.
								LAB ID	FECAL COLIF.	TOTAL COLIF.	FECAL STREP	ENTERO-COCCUS	
FT LAUD	H6	NA	931123	0.0"	0504	1129	NA	NA	NA	NA	NA	NA	NA
FT LAUD	H7	NA	931123	0.0"	0504	1129	NA	NA	NA	NA	NA	NA	NA
FT LAUD	H1	55	931123	0.0"	0504	1129	NA	NA	40	100	0	0	NA
FT LAUD	H2	57	931123	0.0"	0504	1129	NA	NA	230	1700	0	0	NA
FT LAUD	H3	60	931123	0.0"	0504	1129	NA	NA	>2000	6500	200	80	NA
FT LAUD	H4	62	931123	0.0"	0504	1129	NA	NA	160	700	60	20	NA
FT LAUD	H5	66	931123	0.0"	0504	1129	NA	NA	NA	NA	NA	NA	NA
FT LAUD	H6	NA	931130	0.0"	0959	0350	NA	NA	10	200	40	0	NA
FT LAUD	H7	NA	931130	0.0"	0959	0350	NA	NA	NA	NA	NA	NA	NA
FT LAUD	H1	55	931130	0.0"	0959	0350	NA	NA	320	1600	40	40	NA
FT LAUD	H2	57	931130	0.0"	0959	0350	NA	NA	170	600	60	40	NA
FT LAUD	H3	60	931130	0.0"	0959	0350	NA	NA	350	1800	60	180	NA
FT LAUD	H4	62	931130	0.0"	0959	0350	NA	NA	160	1100	20	20	NA
FT LAUD	H5	66	931130	0.0"	0959	0350	NA	NA	70	300	40	120	NA
FT LAUD	H6	NA	931207	0.0"	0320	0949	NA	NA	50	700	0	20	NA
FT LAUD	H7	NA	931207	0.0"	0320	0949	NA	NA	NA	NA	NA	NA	NA
FT LAUD	H1	55	931207	0.0"	0320	0949	NA	NA	40	100	0	20	NA
FT LAUD	H2	57	931207	0.0"	0320	0949	NA	NA	140	1100	0	20	NA
FT LAUD	H3	60	931207	0.0"	0320	0949	NA	NA	610	3000	140	60	NA
FT LAUD	H4	62	931207	0.0"	0320	0949	NA	NA	110	300	20	20	NA
FT LAUD	H5	66	931207	0.0"	0320	0949	NA	NA	130	500	0	20	NA

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 DNRP - CITY OF FORT LAUDERDALE COMBINED WATER QUALITY DATA  
 LAS OLAS ISLES, JULY, 1993 TO AUGUST, 1994

DATA SOURCE	FT LAUD STA #	DNRP STA #	SAMPLE DATE	RAINFALL <24 HR	HIGH TIDE	LOW TIDE	SAMPLE TIME	BACTERIA, COLONIES\100 MLS					FLOW DIR.
								LAB ID	FECAL COLIF.	TOTAL COLIF.	FECAL STREP	ENTERO-COCCUS	
DNRP	H1	55	931208	0.0"	0437	1055	759	51979	220	830	170	40	E
DNRP	H2	57	931208	0.0"	0437	1055	807	51980	250	800	200	50	NA
DNRP	H3	60	931208	0.0"	0437	1055	826	51982	480	215	470	100	NA
DNRP	H4	62	931208	0.0"	0437	1055	839	51985	20	470	33	30	S
DNRP	H5	66	931208	0.0"	0437	1055	830	51989	100	200	130	50	S
DNRP	NA	69	931208	0.0"	0437	1055	845	51987	490	2600	370	110	NA
DNRP	NA	70	931208	0.0"	0437	1055	850	51988	210	300	33	50	NA
DNRP	NA	71	931208	0.0"	0437	1055	822	51981	490	1600	230	150	NA
DNRP	NA	72	931208	0.0"	0437	1055	841	51986	100	830	170	100	S
DNRP	NA	73	931208	0.0"	0437	1055	834	51984	140	270	100	80	NA
DNRP	NA	87	931208	0.0"	0437	1055	831	51983	420	1700	240	70	NA
FT LAUD	H7	NA	931214	.03"	1000	0349	NA	NA	NA	NA	NA	NA	NA
FT LAUD	H6	NA	931214	.03"	1000	0349	NA	NA	70	300	20	40	NA
FT LAUD	H1	55	931214	.03"	1000	0349	NA	NA	350	900	140	40	NA
FT LAUD	H2	57	931214	.03"	1000	0349	NA	NA	800	3400	40	20	NA
FT LAUD	H3	60	931214	.03"	1000	0349	NA	NA	>2000	9700	880	460	NA
FT LAUD	H4	62	931214	.03"	1000	0349	NA	NA	140	900	40	20	NA
FT LAUD	H5	66	931214	.03"	1000	0349	NA	NA	100	900	40	0	NA
FT LAUD	H7	NA	931221	0.0"	0314	0944	NA	NA	NA	NA	NA	NA	NA
FT LAUD	H6	NA	931221	0.0"	0314	0944	NA	NA	30	1100	0	20	NA
FT LAUD	H1	55	931221	0.0"	0314	0944	NA	NA	160	1000	100	40	NA
FT LAUD	H2	57	931221	0.0"	0314	0944	NA	NA	70	100	40	0	NA
FT LAUD	H3	60	931221	0.0"	0314	0944	NA	NA	620	11300	460	40	NA
FT LAUD	H4	62	931221	0.0"	0314	0944	NA	NA	110	1200	40	80	NA
FT LAUD	H5	66	931221	0.0"	0314	0944	NA	NA	70	700	260	220	NA

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DNRP - CITY OF FORT LAUDERDALE COMBINED WATER QUALITY DATA  
LAS OLAS ISLES, JULY, 1993 TO AUGUST, 1994

DATA SOURCE	FT LAUD STA #	DNRP STA #	SAMPLE DATE	RAINFALL <24 HR	HIGH TIDE	LOW TIDE	SAMPLE TIME	BACTERIA, COLONIES\100 MLS					FLOW DIR.
								LAB ID	FECAL COLIF.	TOTAL COLIF.	FECAL STREP	ENTERO-COCCUS	
FT LAUD	H7	NA	931228	0.0"	0856	0249	NA	NA	NA	NA	NA	NA	NA
FT LAUD	H6	NA	931228	0.0"	0856	0249	NA	NA	60	800	60	0	NA
FT LAUD	H1	55	931228	0.0"	0856	0249	NA	NA	110	1100	60	40	NA
FT LAUD	H2	57	931228	0.0"	0856	0249	NA	NA	110	1000	40	0	NA
FT LAUD	H3	60	931228	0.0"	0856	0249	NA	NA	840	5700	160	140	NA
FT LAUD	H4	62	931228	0.0"	0856	0249	NA	NA	200	1400	140	140	NA
FT LAUD	H5	66	931228	0.0"	0856	0249	NA	NA	70	800	60	60	NA
FT LAUD	H6	NA	940104	0.02"	0156	0822	NA	NA	430	3200	280	100	NA
FT LAUD	H7	NA	940104	0.02"	0156	0822	NA	NA	NA	NA	NA	NA	NA
FT LAUD	H1	55	940104	0.02"	0156	0822	NA	NA	320	2200	120	180	NA
FT LAUD	H2	57	940104	0.02"	0156	0822	NA	NA	0	800	80	60	NA
FT LAUD	H3	60	940104	0.02"	0156	0822	NA	NA	580	3300	220	240	NA
FT LAUD	H4	62	940104	0.02"	0156	0822	NA	NA	480	2100	240	340	NA
FT LAUD	H5	66	940104	0.02"	0156	0822	NA	NA	350	3100	220	160	NA
DNRP	H1	55	940111	0.04"	0755	1425	1158	52163	40	33	67	60	W
DNRP	H2	57	940111	0.04"	0755	1425	1210	52164	150	900	67	110	S
DNRP	H3	60	940111	0.04"	0755	1425	1230	52166	1200	7100	400	170	S
DNRP	H4	62	940111	0.04"	0755	1425	1240	52169	270	2100	230	90	S
DNRP	H5	66	940111	0.04"	0755	1425	1200	52173	200	810	1400	1400	S
DNRP	NA	69	940111	0.04"	0755	1425	1246	52171	350	830	500	200	S
DNRP	NA	70	940111	0.04"	0755	1425	1250	52172	280	1000	330	160	W
DNRP	NA	71	940111	0.04"	0755	1425	1225	52165	200	1500	167	90	S
DNRP	NA	72	940111	0.04"	0755	1425	1243	52170	240	1000	130	140	S
DNRP	NA	73	940111	0.04"	0755	1425	1240	52168	930	3500	630	200	W
DNRP	NA	87	940111	0.04"	0755	1425	1234	52167	5600	6200	900	230	S

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 DNRP - CITY OF FORT LAUDERDALE COMBINED WATER QUALITY DATA  
 LAS OLAS ISLES, JULY, 1993 TO AUGUST, 1994

DATA SOURCE	FT LAUD STA #	DNRP STA #	SAMPLE DATE	RAINFALL <24 HR	HIGH TIDE	LOW TIDE	SAMPLE TIME	BACTERIA, COLONIES\100 MLS					FLOW DIR.
								LAB ID	FECAL COLIF.	TOTAL COLIF.	FECAL STREP	ENTERO-COCCUS	
FT LAUD	H6	NA	940112	0.34"	0943	0335	NA	NA	360	2600	660	620	NA
FT LAUD	H7	NA	940112	0.34"	0943	0335	NA	NA	NA	NA	NA	NA	NA
FT LAUD	H1	55	940112	0.34"	0943	0335	NA	NA	1320	4700	540	420	NA
FT LAUD	H2	57	940112	0.34"	0943	0335	NA	NA	530	2700	700	540	NA
FT LAUD	H3	60	940112	0.34"	0943	0335	NA	NA	1040	5700	640	520	NA
FT LAUD	H4	62	940112	0.34"	0943	0335	NA	NA	400	2900	540	320	NA
FT LAUD	H5	66	940112	0.34"	0943	0335	NA	NA	440	1700	420	540	NA
FT LAUD	H6	NA	940118	0.19"	0133	0800	NA	NA	>2000	1100	100	140	NA
FT LAUD	H7	NA	940118	0.19"	0133	0800	NA	NA	NA	NA	NA	NA	NA
FT LAUD	H1	55	940118	0.19"	0133	0800	NA	NA	200	2100	60	20	NA
FT LAUD	H2	57	940118	0.19"	0133	0800	NA	NA	LOS	1400	60	60	NA
FT LAUD	H3	60	940118	0.19"	0133	0800	NA	NA	960	8700	560	300	NA
FT LAUD	H4	62	940118	0.19"	0133	0800	NA	NA	430	2000	200	140	NA
FT LAUD	H5	66	940118	0.19"	0133	0800	NA	NA	80	2100	380	40	NA
FT LAUD	H6	NA	940125	0.05"	0746	1412	NA	NA	80	1000	20	20	NA
FT LAUD	H7	NA	940125	0.05"	0746	1412	NA	NA	NA	NA	NA	NA	NA
FT LAUD	H1	55	940125	0.05"	0746	1412	NA	NA	110	500	40	40	NA
FT LAUD	H2	57	940125	0.05"	0746	1412	NA	NA	230	1100	0	60	NA
FT LAUD	H3	60	940125	0.05"	0746	1412	NA	NA	860	4900	720	740	NA
FT LAUD	H4	62	940125	0.05"	0746	1412	NA	NA	630	3400	40	40	NA
FT LAUD	H5	66	940125	0.05"	0746	1412	NA	NA	280	2700	60	0	NA
FT LAUD	H6	NA	940201	0.46"	1259	0705	NA	NA	80	600	80	40	NA
FT LAUD	H7	NA	940201	0.46"	1259	0705	NA	NA	NA	NA	NA	NA	NA
FT LAUD	H1	55	940201	0.46"	1259	0705	NA	NA	70	600	40	40	NA
FT LAUD	H2	57	940201	0.46"	1259	0705	NA	NA	120	600	60	20	NA
FT LAUD	H3	60	940201	0.46"	1259	0705	NA	NA	200	1400	280	260	NA

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 DNRP - CITY OF FORT LAUDERDALE COMBINED WATER QUALITY DATA  
 LAS OLAS ISLES, JULY, 1993 TO AUGUST, 1994

DATA SOURCE	FT LAUD STA #	DNRP STA #	SAMPLE DATE	RAINFALL <24 HR	HIGH TIDE	LOW TIDE	SAMPLE TIME	BACTERIA, COLONIES\100 MLS					FLOW DIR.
								LAB ID	FECAL COLIF.	TOTAL COLIF.	FECAL STREP	ENTERO-COCCUS	
FT LAUD	H4	62	940201	0.46"	1259	0705	NA	NA	130	1400	40	40	NA
FT LAUD	H5	66	940201	0.46"	1259	0705	NA	NA	80	1800	60	20	NA
DNRP	H1	55	940208	0.0"	0757	1416	1130	52396	10	130	33	20	W
DNRP	H2	57	940208	0.0"	0757	1416	1140	52397	10	170	33	ND	NA
DNRP	H3	60	940208	0.0"	0757	1416	1200	52399	1600	5000	600	450	NA
DNRP	H4	62	940208	0.0"	0757	1416	1210	52402	130	770	ND	20	S
DNRP	H5	66	940208	0.0"	0757	1416	1130	52406	60	370	ND	10	N
DNRP	NA	69	940208	0.0"	0757	1416	1217	52404	45	430	42	15	NA
DNRP	NA	70	940208	0.0"	0757	1416	1222	52405	50	330	ND	20	NA
DNRP	NA	71	940208	0.0"	0757	1416	1155	52398	340	1400	100	130	NA
DNRP	NA	72	940208	0.0"	0757	1416	1212	52403	100	530	67	40	NA
DNRP	NA	73	940208	0.0"	0757	1416	1207	52401	60	730	67	10	W
DNRP	NA	87	940208	0.0"	0757	1416	1203	52400	1500	3300	200	80	NA
FT LAUD	H7	NA	940208	0.0"	0757	1416	NA	NA	NA	NA	NA	NA	NA
FT LAUD	H6	NA	940208	0.0"	0757	1416	NA	NA	60	600	200	80	NA
FT LAUD	H1	55	940208	0.0"	0757	1416	NA	NA	30	100	0	20	NA
FT LAUD	H2	57	940208	0.0"	0757	1416	NA	NA	20	200	20	0	NA
FT LAUD	H3	60	940208	0.0"	0757	1416	NA	NA	500	4200	80	100	NA
FT LAUD	H4	62	940208	0.0"	0757	1416	NA	NA	220	1300	180	40	NA
FT LAUD	H5	66	940208	0.0"	0757	1416	NA	NA	60	700	0	0	NA
FT LAUD	H6	NA	940215	0.0"	1212	0636	NA	NA	170	700	0	0	NA
FT LAUD	H7	NA	940215	0.0"	1212	0636	NA	NA	NA	NA	NA	NA	NA
FT LAUD	H1	55	940215	0.0"	1212	0636	NA	NA	60	300	40	0	NA
FT LAUD	H2	57	940215	0.0"	1212	0636	NA	NA	130	400	0	20	NA
FT LAUD	H3	60	940215	0.0"	1212	0636	NA	NA	330	1300	180	80	NA
FT LAUD	H4	62	940215	0.0"	1212	0636	NA	NA	130	1000	0	60	NA

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 DNRP - CITY OF FORT LAUDERDALE COMBINED WATER QUALITY DATA  
 LAS OLAS ISLES, JULY, 1993 TO AUGUST, 1994

DATA SOURCE	FT LAUD STA #	DNRP STA #	SAMPLE DATE	RAINFALL <24 HR	HIGH TIDE	LOW TIDE	SAMPLE TIME	BACTERIA, COLONIES\100 MLS					FLOW DIR.
								LAB ID	FECAL COLIF.	TOTAL COLIF.	FECAL STREP	ENTERO-COCCUS	
FT LAUD	H5	66	940215	0.0"	1212	0636	NA	NA	10	500	0	0	NA

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DATA SOURCE	FT LAUD STA #	DNRP STA #	SAMPLE DATE	RAINFALL <24 HR	HIGH TIDE	LOW TIDE	SAMPLE TIME	BACTERIA, COLONIES\100 MLS					FLOW DIR.
								LAB ID	FECAL COLIF.	TOTAL COLIF.	FECAL STREP	ENTERO-COCCUS	
FT LAUD	H6	NA	940222	0.0"	0623	1253	NA	NA	120	300	20	20	NA
FT LAUD	H7	NA	940222	0.0"	0623	1253	NA	NA	NA	NA	NA	NA	NA
FT LAUD	H1	55	940222	0.0"	0623	1253	NA	NA	200	1800	20	0	NA
FT LAUD	H2	57	940222	0.0"	0623	1253	NA	NA	160	300	40	0	NA
FT LAUD	H3	60	940222	0.0"	0623	1253	NA	NA	630	1400	380	120	NA
FT LAUD	H4	62	940222	0.0"	0623	1253	NA	NA	740	1700	0	40	NA
FT LAUD	H5	66	940222	0.0"	0623	1253	NA	NA	150	600	100	20	NA
FT LAUD	H6	NA	940301	0.0"	0623	1253	NA	NA	150	600	20	20	NA
FT LAUD	H7	NA	940301	0.0"	0623	1253	NA	NA	NA	NA	NA	NA	NA
FT LAUD	H1	55	940301	0.0"	0623	1253	NA	NA	10	200	20	0	NA
FT LAUD	H2	57	940301	0.0"	0623	1253	NA	NA	190	800	100	40	NA
FT LAUD	H3	60	940301	0.0"	0623	1253	NA	NA	160	1900	200	160	NA
FT LAUD	H4	62	940301	0.0"	0623	1253	NA	NA	130	500	60	80	NA
FT LAUD	H5	66	940301	0.0"	0623	1253	NA	NA	100	600	200	180	NA
FT LAUD	H6	NA	940308	0.0"	0648	1309	NA	NA	20	100	20	20	NA
FT LAUD	H7	NA	940308	0.0"	0648	1309	NA	NA	NA	NA	NA	NA	NA
FT LAUD	H1	55	940308	0.0"	0648	1309	NA	NA	50	200	0	0	NA
FT LAUD	H2	57	940308	0.0"	0648	1309	NA	NA	230	200	80	0	NA
FT LAUD	H3	60	940308	0.0"	0648	1309	NA	NA	1070	5800	160	60	NA
FT LAUD	H4	62	940308	0.0"	0648	1309	NA	NA	300	2600	160	0	NA
FT LAUD	H5	66	940308	0.0"	0648	1309	NA	NA	20	200	20	0	NA
FT LAUD	H7	NA	940315	0.0"	1110	0557	NA	NA	640	1600	20	40	NA
FT LAUD	H6	NA	940315	0.0"	1110	0557	NA	NA	0	100	20	0	NA
FT LAUD	H1	55	940315	0.0"	1110	0557	NA	NA	50	600	60	0	NA
FT LAUD	H2	57	940315	0.0"	1110	0557	NA	NA	30	100	0	0	NA
FT LAUD	H3	60	940315	0.0"	1110	0557	NA	NA	90	1900	20	0	NA



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DATA SOURCE	FT LAUD STA #	DNRP STA #	SAMPLE DATE	RAINFALL <24 HR	HIGH TIDE	LOW TIDE	SAMPLE TIME	BACTERIA, COLONIES\100 MLS					FLOW DIR.
								LAB ID	FECAL COLIF.	TOTAL COLIF.	FECAL STREP	ENTERO-COCCUS	
FT LAUD	H4	62	940315	0.0"	1110	0557	NA	NA	60	1000	40	20	NA
FT LAUD	H5	66	940315	0.0"	1110	0557	NA	NA	20	200	0	0	NA
DNRP	H1	55	940316	0.0"	1043	1720	920	52686	60	200	33	10	E
DNRP	H2	57	940316	0.0"	1043	1720	920	52687	30	67	ND	10	S
DNRP	H3	60	940316	0.0"	1043	1720	940	52689	180	1000	200	20	N
DNRP	H4	62	940316	0.0"	1043	1720	955	52692	50	330	67	120	N
DNRP	H5	66	940316	0.0"	1043	1720	1000	52696	20	230	ND	ND	NA
DNRP	NA	69	940316	0.0"	1043	1720	1000	52694	20	270	ND	30	E
DNRP	NA	70	940316	0.0"	1043	1720	1005	52695	20	170	130	30	E
DNRP	NA	71	940316	0.0"	1043	1720	935	52688	40	5500	270	120	N
DNRP	NA	72	940316	0.0"	1043	1720	958	52693	ND	400	67	10	N
DNRP	NA	73	940316	0.0"	1043	1720	950	52691	80	130	33	67	N
DNRP	NA	87	940316	0.0"	1043	1720	945	52690	80	830	67	40	N
FT LAUD	H7	NA	940323	TRACE	0544	1217	NA	NA	470	1400	60	20	NA
FT LAUD	H6	NA	940323	TRACE	0544	1217	NA	NA	7	82	20	7	NA
FT LAUD	H1	55	940323	TRACE	0544	1217	NA	NA	2	109	7	7	NA
FT LAUD	H2	57	940323	TRACE	0544	1217	NA	NA	12	82	7	7	NA
FT LAUD	H3	60	940323	TRACE	0544	1217	NA	NA	212	3200	120	113	NA
FT LAUD	H4	62	940323	TRACE	0544	1217	NA	NA	72	1200	40	33	NA
FT LAUD	H5	66	940323	TRACE	0544	1217	NA	NA	28	100	7	7	NA
FT LAUD	H7	NA	940329	TRACE	1040	0448	NA	NA	1970	2400	210	150	NA
FT LAUD	H6	NA	940329	TRACE	1040	0448	NA	NA	80	500	40	0	NA
FT LAUD	H1	55	940329	TRACE	1040	0448	NA	NA	240	600	70	170	NA
FT LAUD	H2	57	940329	TRACE	1040	0448	NA	NA	0	100	0	10	NA
FT LAUD	H3	60	940329	TRACE	1040	0448	NA	NA	820	2100	60	20	NA
FT LAUD	H4	62	940329	TRACE	1040	0448	NA	NA	150	1200	0	20	NA

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DATA SOURCE	FT LAUD STA #	DNRP STA #	SAMPLE DATE	RAINFALL <24 HR	HIGH TIDE	LOW TIDE	SAMPLE TIME	LAB ID	BACTERIA, COLONIES\100 MLS				FLOW DIR.
									FECAL COLIF.	TOTAL COLIF.	FECAL STREP	ENTERO-COCCUS	
FT LAUD	H5	66	940329	TRACE	1040	0448	NA	NA	90	700	20	10	NA

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DATA SOURCE	FT LAUD STA #	DNRP STA #	SAMPLE DATE	RAINFALL <24 HR	HIGH TIDE	LOW TIDE	SAMPLE TIME	BACTERIA, COLONIES\100 MLS					FLOW DIR.
								LAB ID	FECAL COLIF.	TOTAL COLIF.	FECAL STREP	ENTERO-COCCUS	
FT LAUD	H7	NA	940405	0.0"	0523	1151	NA	NA	1310	5700	1060	780	NA
FT LAUD	H6	NA	940405	0.0"	0523	1151	NA	NA	40	200	30	0	NA
FT LAUD	H1	55	940405	0.0"	0523	1151	NA	NA	50	400	20	0	NA
FT LAUD	H2	57	940405	0.0"	0523	1151	NA	NA	50	200	30	10	NA
FT LAUD	H3	60	940405	0.0"	0523	1151	NA	NA	480	3700	340	110	NA
FT LAUD	H4	62	940405	0.0"	0523	1151	NA	NA	130	400	0	0	NA
FT LAUD	H5	66	940405	0.0"	0523	1151	NA	NA	30	100	0	0	NA
FT LAUD	H7	NA	940412	0.0"	1004	0424	NA	NA	260	2400	140	50	NA
FT LAUD	H6	NA	940412	0.0"	1004	0424	NA	NA	60	300	40	0	NA
FT LAUD	H1	55	940412	0.0"	1004	0424	NA	NA	50	500	30	20	NA
FT LAUD	H2	57	940412	0.0"	1004	0424	NA	NA	130	900	60	30	NA
FT LAUD	H3	60	940412	0.0"	1004	0424	NA	NA	740	4800	40	20	NA
FT LAUD	H4	62	940412	0.0"	1004	0424	NA	NA	250	800	30	40	NA
FT LAUD	H5	66	940412	0.0"	1004	0424	NA	NA	230	500	0	10	NA
FT LAUD	H6	NA	940419	0.0"	0306	0942	NA	NA	200	2000	350	50	NA
FT LAUD	H7	NA	940419	0.0"	0306	0942	NA	NA	290	700	10	10	NA
FT LAUD	H1	55	940419	0.0"	0306	0942	NA	NA	110	700	10	10	NA
FT LAUD	H2	57	940419	0.0"	0306	0942	NA	NA	0	0	0	0	NA
FT LAUD	H3	60	940419	0.0"	0306	0942	NA	NA	1670	1700	780	790	NA
FT LAUD	H4	62	940419	0.0"	0306	0942	NA	NA	1370	2300	30	30	NA
FT LAUD	H5	66	940419	0.0"	0306	0942	NA	NA	80	300	30	20	NA

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DATA SOURCE	FT LAUD STA #	DNRP STA #	SAMPLE DATE	RAINFALL <24 HR	HIGH TIDE	LOW TIDE	SAMPLE TIME	LAB ID	BACTERIA, COLONIES\100 MLS				FLOW DIR.
									FECAL COLIF.	TOTAL COLIF.	FECAL STREP	ENTERO-COCCUS	
DNRP	H1	55	940426	0.63"	0929	0340	1055	53073	90	370	33	40	W
DNRP	H2	57	940426	0.63"	0929	0340	1100	53074	30	300	67	ND	NA
DNRP	H3	60	940426	0.63"	0929	0340	1110	53076	1100	4200	1600	1400	NA
DNRP	H4	62	940426	0.63"	0929	0340	1131	53079	100	530	470	ND	S
DNRP	H5	66	940426	0.63"	0929	0340	1022	53083	200	700	67	60	NA
DNRP	NA	69	940426	0.63"	0929	0340	1137	53081	1000	3800	130	20	W
DNRP	NA	70	940426	0.63"	0929	0340	1141	53082	120	630	230	60	W
DNRP	NA	71	940426	0.63"	0929	0340	1105	53075	260	4300	500	320	N
DNRP	NA	72	940426	0.63"	0929	0340	1134	53080	410	1000	100	20	S
DNRP	NA	73	940426	0.63"	0929	0340	1129	53078	330	1400	33	10	W
DNRP	NA	87	940426	0.63"	0929	0340	1120	53077	560	1800	760	280	N
FT LAUD	H6	NA	940426	0.63"	0929	0340	NA	NA	90	600	60	20	NA
FT LAUD	H7	NA	940426	0.63"	0929	0340	NA	NA	1170	4600	70	30	NA
FT LAUD	H1	55	940426	0.63"	0929	0340	NA	NA	220	800	110	40	NA
FT LAUD	H2	57	940426	0.63"	0929	0340	NA	NA	70	1000	60	30	NA
FT LAUD	H3	60	940426	0.63"	0929	0340	NA	NA	1040	4000	1780	1370	NA
FT LAUD	H4	62	940426	0.63"	0929	0340	NA	NA	340	1200	60	40	NA
FT LAUD	H5	66	940426	0.63"	0929	0340	NA	NA	210	1200	230	100	NA
FT LAUD	H7	NA	940503	0.0"	0345	1021	NA	NA	1140	4600	60	10	NA
FT LAUD	H6	NA	940503	0.0"	0345	1021	NA	NA	40	600	20	30	NA
FT LAUD	H1	55	940503	0.0"	0345	1021	NA	NA	40	400	10	10	NA
FT LAUD	H2	57	940503	0.0"	0345	1021	NA	NA	80	400	10	0	NA
FT LAUD	H3	60	940503	0.0"	0345	1021	NA	NA	1160	3800	1270	20	NA
FT LAUD	H4	62	940503	0.0"	0345	1021	NA	NA	280	1000	20	0	NA
FT LAUD	H5	66	940503	0.0"	0345	1021	NA	NA	130	800	130	20	NA

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LAS OLAS ISLES, JULY, 1993 TO AUGUST, 1994

DATA SOURCE	FT LAUD STA #	DNRP STA #	SAMPLE DATE	RAINFALL <24 HR	HIGH TIDE	LOW TIDE	SAMPLE TIME	LAB ID	BACTERIA, COLONIES\100 MLS				FLOW DIR.
									FECAL COLIF.	TOTAL COLIF.	FECAL STREP	ENTERO-COCCUS	
DNRP	H1	55	940517	0.0"	0137	0814	1110	53254	30	300	33	ND	E
DNRP	H2	57	940517	0.0"	0137	0814	1117	53255	20	130	ND	ND	ND
DNRP	H3	60	940517	0.0"	0137	0814	1128	53257	150	1200	100	20	ND
DNRP	H4	62	940517	0.0"	0137	0814	1146	53260	30	130	67	ND	N
DNRP	H5	66	940517	0.0"	0137	0814	915	53264	80	100	230	40	NA
DNRP	NA	69	940517	0.0"	0137	0814	1142	53262	70	230	33	20	E
DNRP	NA	70	940517	0.0"	0137	0814	1139	53263	70	130	33	10	NA
DNRP	NA	71	940517	0.0"	0137	0814	1132	53256	180	1300	ND	40	ND
DNRP	NA	72	940517	0.0"	0137	0814	1144	53261	60	170	67	30	N
DNRP	NA	73	940517	0.0"	0137	0814	1147	53259	50	170	33	ND	E
DNRP	NA	87	940517	0.0"	0137	0814	1125	53258	60	460	25	10	ND
FT LAUD	H7	NA	940524	0.0"	0817	0230	NA	NA	80	300	20	20	NA
FT LAUD	H6	NA	940524	0.0"	0817	0230	NA	NA	0	0	0	10	NA
FT LAUD	H1	55	940524	0.0"	0817	0230	NA	NA	30	200	30	0	NA
FT LAUD	H2	57	940524	0.0"	0817	0230	NA	NA	20	300	0	0	NA
FT LAUD	H3	60	940524	0.0"	0817	0230	NA	NA	440	1300	20	0	NA
FT LAUD	H4	62	940524	0.0"	0817	0230	NA	NA	50	100	30	0	NA
FT LAUD	H5	66	940524	0.0"	0817	0230	NA	NA	40	300	50	40	NA
FT LAUD	H6	NA	940607	0.53"	0746	0214	NA	NA	190	1200	160	130	NA
FT LAUD	H7	NA	940607	0.53"	0746	0214	NA	NA	430	1500	30	20	NA
FT LAUD	H1	55	940607	0.53"	0746	0214	NA	NA	270	1600	30	0	NA
FT LAUD	H2	57	940607	0.53"	0746	0214	NA	NA	80	600	50	10	NA
FT LAUD	H3	60	940607	0.53"	0746	0214	NA	NA	790	7400	80	50	NA
FT LAUD	H4	62	940607	0.53"	0746	0214	NA	NA	290	1300	30	60	NA
FT LAUD	H5	66	940607	0.53"	0746	0214	NA	NA	240	2500	140	40	NA

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DATA SOURCE	FT LAUD STA #	DNRP STA #	SAMPLE DATE	RAINFALL <24 HR	HIGH TIDE	LOW TIDE	SAMPLE TIME	LAB ID	BACTERIA, COLONIES\100 MLS				FLOW DIR.
									FECAL COLIF.	TOTAL COLIF.	FECAL STREP	ENTERO-COCCUS	
DNRP	H1	55	940615	0.0"	0141	0751	1158	53512	10	67	33	10	W
DNRP	H2	57	940615	0.0"	0141	0751	1106	53513	30	33	ND	20	N
DNRP	H3	60	940615	0.0"	0141	0751	1119	53515	320	1000	ND	10	N
DNRP	H4	62	940615	0.0"	0141	0751	1140	53518	1500	1700	100	30	N
DNRP	H5	66	940615	0.0"	0141	0751	1059	53522	930	500	33	10	ND
DNRP	NA	69	940615	0.0"	0141	0751	1147	53520	570	1200	33	20	E
DNRP	NA	70	940615	0.0"	0141	0751	1151	53521	510	830	ND	20	E
DNRP	NA	71	940615	0.0"	0141	0751	1114	53514	110	170	33	ND	N
DNRP	NA	72	940615	0.0"	0141	0751	1143	53519	580	1500	33	10	N
DNRP	NA	73	940615	0.0"	0141	0751	1255	53517	600	1100	ND	10	W
DNRP	NA	87	940615	0.0"	0141	0751	1250	53516	320	830	ND	ND	N
FT LAUD	H7	NA	940630	TRACE	0219	0903	NA	NA	300	6600	10	10	NA
FT LAUD	H6	NA	940630	TRACE	0219	0903	NA	NA	150	>4000	90	10	NA
FT LAUD	H1	55	940630	TRACE	0219	0903	NA	NA	10	4400	0	10	NA
FT LAUD	H2	57	940630	TRACE	0219	0903	NA	NA	100	5700	20	30	NA
FT LAUD	H3	60	940630	TRACE	0219	0903	NA	NA	1270	>4000	60	0	NA
FT LAUD	H4	62	940630	TRACE	0219	0903	NA	NA	140	>4000	20	40	NA
FT LAUD	H5	66	940630	TRACE	0219	0903	NA	NA	50	>4000	110	0	NA
FT LAUD	H6	NA	940705	0.18"	0627	1310	NA	NA	170	>4000	10	0	NA
FT LAUD	H7	NA	940705	0.18"	0627	1310	NA	NA	40	>4000	0	10	NA
FT LAUD	H1	55	940705	0.18"	0627	1310	NA	NA	100	600	10	0	NA
FT LAUD	H2	57	940705	0.18"	0627	1310	NA	NA	0	200	20	0	NA
FT LAUD	H3	60	940705	0.18"	0627	1310	NA	NA	>2000	>4000	10	0	NA
FT LAUD	H4	62	940705	0.18"	0627	1310	NA	NA	110	200	10	0	NA
FT LAUD	H5	66	940705	0.18"	0627	1310	NA	NA	200	>4000	10	0	NA

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DATA SOURCE	FT LAUD STA #	DNRP STA #	SAMPLE DATE	RAINFALL <24 HR	HIGH TIDE	LOW TIDE	SAMPLE TIME	LAB ID	BACTERIA, COLONIES\100 MLS				FLOW DIR.
									FECAL COLIF.	TOTAL COLIF.	FECAL STREP	ENTERO-COCCUS	
DNRP	H1	55	940712	0.0"	1141	548	1033	53699	40	33	33	ND	ND
DNRP	H2	57	940712	0.0"	1141	548	1041	53700	ND	ND	ND	ND	ND
DNRP	H3	60	940712	0.0"	1141	548	1057	53702	60	170	33	ND	N
DNRP	H4	62	940712	0.0"	1141	548	1118	53705	10	67	33	30	N
DNRP	H5	66	940712	0.0"	1141	548	1010	53709	50	200	1100	90	ND
DNRP	NA	69	940712	0.0"	1141	548	1111	53707	40	230	33	20	E
DNRP	NA	70	940712	0.0"	1141	548	1127	53708	70	300	200	150	ND
DNRP	NA	71	940712	0.0"	1141	548	1052	53701	40	530	ND	30	N
DNRP	NA	72	940712	0.0"	1141	548	1116	53706	30	170	33	20	N
DNRP	NA	73	940712	0.0"	1141	548	1106	53704	30	100	67	10	ND
DNRP	NA	87	940712	0.0"	1141	548	1101	53703	30	200	33	ND	ND
FT LAUD	H7	NA	940719	0.0"	0548	1230	NA	NA	40	1800	NA	NA	NA
FT LAUD	H6	NA	940719	0.0"	0548	1230	NA	NA	10	0	NA	NA	NA
FT LAUD	H1	55	940719	0.0"	0548	1230	NA	NA	0	100	NA	NA	NA
FT LAUD	H2	57	940719	0.0"	0548	1230	NA	NA	0	100	NA	NA	NA
FT LAUD	H3	60	940719	0.0"	0548	1230	NA	NA	220	>4000	NA	NA	NA
FT LAUD	H4	62	940719	0.0"	0548	1230	NA	NA	0	500	NA	NA	NA
FT LAUD	H5	66	940719	0.0"	0548	1230	NA	NA	10	>4000	NA	NA	NA
DNRP	H1	55	940816	0.0"	0431	1116	920	53943	160	230	67	ND	E
DNRP	H2	57	940816	0.0"	0431	1116	932	53944	120	170	130	10	N
DNRP	H3	60	940816	0.0"	0431	1116	946	53946	530	4100	370	330	ND
DNRP	H4	62	940816	0.0"	0431	1116	958	53949	190	170	67	80	S
DNRP	H5	66	940816	0.0"	0431	1116	945	53953	220	5400	260	160	ND
DNRP	NA	69	940816	0.0"	0431	1116	1005	53951	340	500	33	30	W
DNRP	NA	70	940816	0.0"	0431	1116	1011	53952	270	700	130	20	ND
DNRP	NA	71	940816	0.0"	0431	1116	940	53945	320	1500	130	40	ND
DNRP	NA	72	940816	0.0"	0431	1116	1002	53950	250	630	300	180	S

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DATA SOURCE	FT LAUD STA #	DNRP STA #	SAMPLE DATE	RAINFALL <24 HR	HIGH TIDE	LOW TIDE	SAMPLE TIME	LAB ID	BACTERIA, COLONIES\100 MLS				FLOW DIR.
									FECAL COLIF.	TOTAL COLIF.	FECAL STREP	ENTERO-COCCUS	
DNRP	NA	73	940816	0.0"	0431	1116	955	53948	320	900	67	30	W
DNRP	NA	87	940816	0.0"	0431	1116	953	53947	540	1600	2000	1800	ND



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