

BIOASSAYS OF GROUNDWATER SAMPLES

MIAMI INTERNATIONAL AIRPORT

DADE COUNTY, FLORIDA

Biology Section
Bureau of Water Analysis
May 3, 1984

BIOASSAYS OF GROUNDWATER SAMPLES

MIAMI INTERNATIONAL AIRPORT

DADE COUNTY, FLORIDA

Biology Section
Bureau of Water Analysis
May 3, 1984

EXECUTIVE SUMMARY

Miami International Airport Groundwater Samples, on 25 to 27 January, 1984.

The groundwater sample #001, from well #DCAD-25, was not acutely toxic to the test organisms, Daphnia pulex and Notropis leedsi. No mortality of D. pulex and only a few random mortalities of N. leedsi were noted during the 48 hour definitive and screening bioassays. The groundwater sample #002, from well #EAL 7, also was not acutely toxic during the definitive bioassays using the test organisms, Daphnia pulex and Heterandria formosa. An insufficient number of D. pulex died to calculate a LC_{50}, while no H. formosa mortality was noted. However, in the screening test (100% sample) of this groundwater, complete mortality of Notropis leedsi was noted in less than 24 hours. This suggests that the EAL-7 Groundwater was indeed acutely toxic to fish, at least at higher concentrations. The groundwater sample #003 from well #Con. E-23, proved to be extremely toxic to Daphnia pulex, producing a 48 hour LC_{50} value of 3.9%. In the Notropis leedsi bioassay of this sample, insufficient mortality was noted in the highest test concentration (18%) to calculate a LC_{50}. Unfortunately, a shortage of fish precluded the use of higher test concentrations, where greater mortality would have been most likely observed.

The results of organic chemical analyses of these samples, performed by Enviropact. Inc., indicated the presence of various concentrations of toluene, chlorobenzene, benzene and ethyl benzene in the Well #Con. E-23 sample and the #EAL-7 sample. These contaminants were not found in the DCAD-25 sample. Although the concentrations of these chemicals individually are significantly below toxic levels, they may have acted synergistically to have caused the observed toxicity, since toxicity was noted only in the samples containing the chemicals.

INTRODUCTION

The Miami International Airport is located just west of the city of Miami, Dade County, Florida (Fig. 1). Apparently, for several years there has been chronic spillage of jet fuel, gasoline, cleaning solvents and other organic materials which have accumulated in and on top of the shallow groundwater in the area.

To determine if this groundwater is acutely toxic to aquatic organisms, personnel from the Southeast District's groundwater and enforcement staffs requested that acute toxicity bioassays be performed. Groundwater samples from three monitoring wells (#DCAD-25, #EAL-7 and #Con. E-23) were collected on January 24, 1984, on which a total of 10 definitive and screening acute toxicity bioassays were performed. Locations and descriptions of these wells are presented in Figure 2. Those involved in performing these tests and in preparation of this report were C. W. Dye and M. L. Roll.

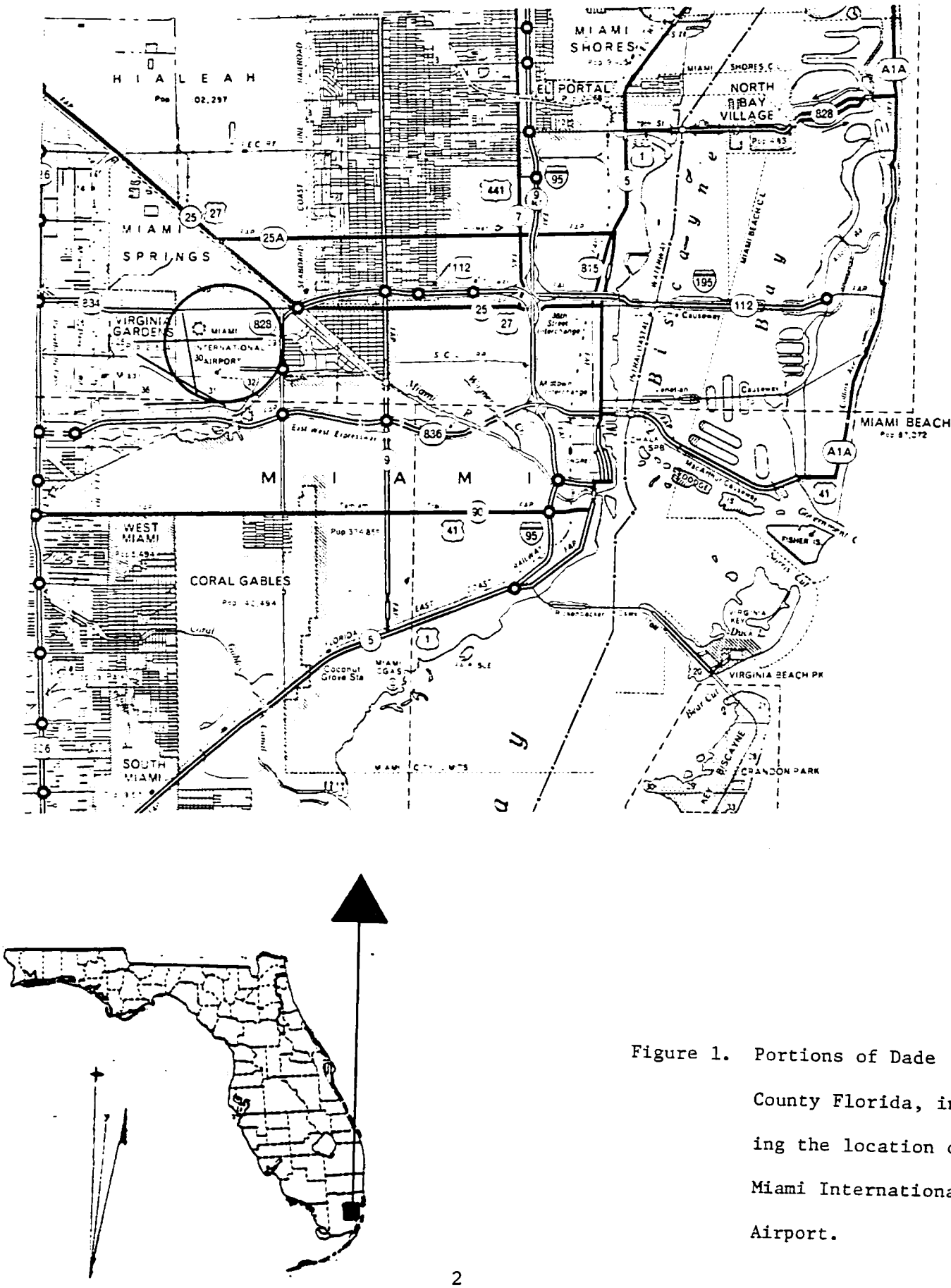


Figure 1. Portions of Dade County Florida, including the location of the Miami International Airport.

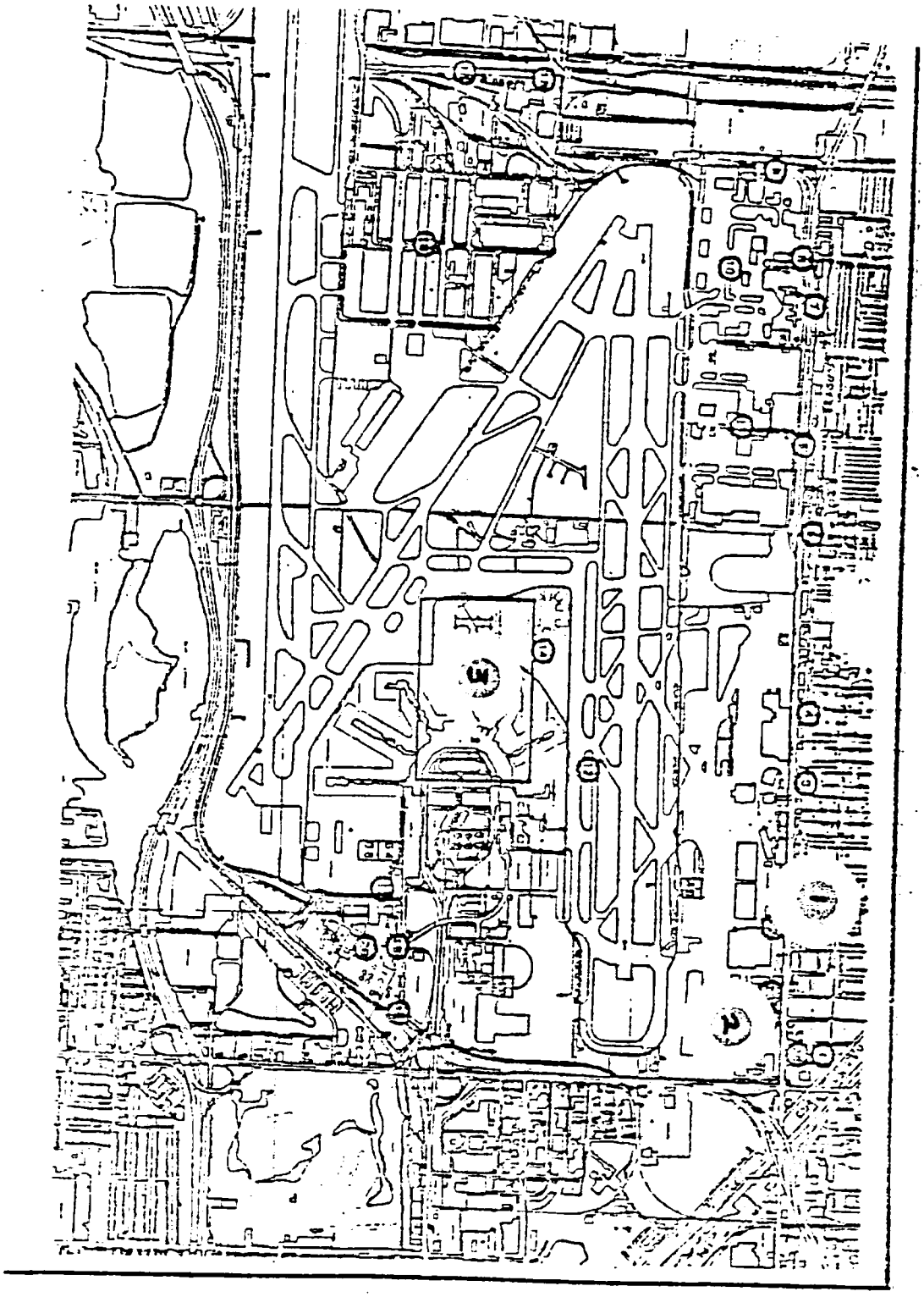


Figure 2. Locations and descriptions of groundwater monitoring wells:

1. #DCAD-25 - Off site, between Oakwood Drive and NW 36th Street.
2. #EAL-7 - Miami International Airport, storage and maintenance area.
3. #Con. E-23 - Miami International Airport, International Concourse E.

METHODS AND MATERIALS

Test methods used to conduct these static bioassays are extensively described by Peltier (1978) and the FDER Biology Section (1983). The organisms selected for this study include a species recommended by Peltier (1978), the U.S. EPA (1978), and the FDER Biology Section (1983). Additionally, the Biology Section maintains cultures of several species of organisms indigenous to the State of Florida. Two of these indigenous species were also selected for testing. Life histories of these test organisms and maintenance procedures used to culture them are detailed below.

History and Maintenance of Bioassay Organisms

Daphnia pulex (water flea) - A breeding culture of Daphnia pulex was obtained from the EPA laboratory in Athens, Georgia, in March, 1979. This culture has been maintained since its arrival in 2 1/2 gallon all-glass aquaria, filled with unchlorinated DER well water, under a 16:8 hour light-dark cycle. Organisms are fed a liquified blend of Purina Trout Chow® and Cerophyl® twice daily, and are kept at a constant temperature of 22° plus or minus 2°C. The aquaria are cleaned weekly by siphoning off half the water along with the detritus and excess organisms. They are then refilled with fresh aerated well water. Additional measures are taken and/or new cultures started in the event of abnormal circumstances such as: declining populations, ephippia formation, or excessive fungal or bacterial growth.

Heterandria formosa (least killifish) - Approximately 100 adult least killifish were obtained from a wild population in the St. Marks Wildlife Refuge (Wakulla County, Florida) during August, 1980. The fish are maintained in two and one-half to 15 gallon all-glass aquaria equipped with a flow-through water exchange system. Water for this system is unchlorinated and is pumped from a deep well near the DER laboratory. The least killifish are reared at 22° plus or minus 2°C under a 16:8 hour light-dark cycle and are fed freshly hatched Artemia (brine shrimp) and Tetra-Min® twice daily. New born fish are initially maintained in the adult tanks, but are transferred to separate aquaria at weekly intervals, thereby segregating fish into even age groups. The fish used in this test were 7 to 30 days old.

Notropis leedsi (bannerfin shiner) - Approximately 40 adult bannerfin shiners were obtained from an indigenous population in the upper Suwannee River during October, 1981. The breeding stock is maintained in 30 and 125 gallon all-glass aquaria equipped with a flow-through water exchange system. Water for this system is unchlorinated and is pumped from the DER deep well. The bannerfin shiners are reared at 22° plus or minus 2°C under a 16:8 hour light cycle and are

fed Tetra-Min® and frozen Artemia (brine shrimp) twice daily. Breeding and egg hatching are encouraged at 25°C. The eggs are laid under a 1" thick slab of marble raised 3 mm above a removable horizontal pane of glass. Most of the eggs adhere to the glass and are easily removed to an aerated hatching tank. The narrow space between the marble slab and glass eliminates egg predation by adult fish. New hatching tanks are started weekly to segregate fry into even age groups. Newly hatched fry are fed a liquefied blend of Purina Trout Chow® and Cerophyl® twice daily. After one week, feeding is augmented with newly hatched Artemia nauplii and finely crushed Tetra Min®. The fish used in this test were 7 to 30 days old at the time of the test.

To ensure the uniform sensitivity of these test organisms to toxic substances, the Biology Section conducts monthly standard reference toxicant bioassays using sodium lauryl sulfate as the reference toxicant.

Test Methods

A total of 10 definitive and screening acute toxicity bioassays were performed on the three groundwater samples from the monitoring wells #DCAD-25, #EAL-7 and #Con. E-23. The tests were performed from 1030 hours on 25 January to 1140 hours on 27 January, 1984. The samples were collected by Mr. Brad Rieck of the Southeast District at 1352 to 1530 hours on 24 January, 1984, using standard wastewater sampling procedures. The samples were iced and transported to the DER laboratory in Tallahassee for analyses within 24 hours of collection.

Freshwater for dilution of the groundwater samples was obtained from the same DER deep well that is used to culture the test organisms. The concentration series selected for this study (Table 1) is an abbreviated version of that recommended by APHA (1980).

Two replicates of each concentration and a control, were used to test with the water flea, Daphnia pulex. Flint glass jars of 250 ml capacity were used as test chambers, and 200 ml of the appropriate test concentration was placed in each chamber. Daphnia were siphoned into a large culture dish to isolate the proper size and age organisms (neonates). To accomplish this, the water fleas were siphoned through a stainless steel screen. The trapped adults were then discarded. These neonates were then transferred by glass pipette, examined for injury, and were loaded 10 per chamber, resulting in 20 per test concentration. Water fleas were not fed during these tests.

Two replicates of each concentration and a control, were used for the Heterandria formosa (least killifish) and the Notropis leedsi (bannerfin shiner) bioassays. The fish were transferred individually or by twos, into wide mouth quart jars containing 500 ml each of the appropriate test concentration, and were loaded approximately 5 per chamber, resulting in approximately 10 per concentration. Fish were not fed during these tests.

Dissolved oxygen (YSI Model 57 oxygen meter), pH (Corning Model 7 pH meter with Orion Ross® combination electrode), temperature (NBS calibrated glass thermometer), and the number of live organisms were recorded for each test chamber at 0 hours, 24 hours, and 48 hours. The specific conductance (YSI Model 33 S-C-T meter) of each test concentration was recorded at the beginning and end of the test. All instruments were calibrated daily according to manufacturer's recommendations. These values were recorded on the bioassay data forms and are presented in Tables 2 through 7.

Table 1. Concentration Series and Volumes Used for These Static Bioassays

1. Definitive Tests

Daphnia pulex (water flea)

Concentration	Dilution Water	Sample	Total Volume
Control	200.0 ml	-------	200 ml
1.0%	198.0 ml	2.0 ml	200 ml
5.6%	188.8 ml	11.2 ml	200 ml
10.0%	180.0 ml	20.0 ml	200 ml
18.0%	164.0 ml	36.0 ml	200 ml
32.0%[a]	136.0 ml	64.0 ml	200 ml

Heterandria formosa (least killifish)

Notropis leedsi (bannerfin shiner)

Concentration	Dilution Water	Sample	Total Volume
Control	500 ml	------	500 ml
5.6%	472 ml	28 ml	500 ml
10.0%	450 ml	50 ml	500 ml
18.0%	410 ml	90 ml	500 ml
32.0%[a]	340 ml	160 ml	500 ml

2. Screening Tests[b]

Daphnia pulex

Concentration	Dilution Water	Sample	Total Value
100.0%	-------	200 ml	200 ml

Notropis leedsi

Concentration	Dilution Water	Sample	Total Value
100.0%	-------	500 ml	500 ml

[a] The 32.0% concentration was used only in the bioassay of well #DCAD-25

[b] Screening tests were only performed on the samples from Well #DCAB-25 and Well #EAL-7.

Table 2. Data recorded during 48 hour, Daphnia pulex, static acute toxicity bioassay of groundwater samples from the Miami International Airport Dade County on 25 to 27 January, 1984.

Sample #001- Well DCAD-25, Definitive and Screening Tests.

Concentration or %	Number of Live Organisms			Dissolved Oxygen (mg/l)			pH			Total Alakalinity (mg/l as $CaCO_3$)		Total Hardness (mg/l as $CaCO_3$)		Temperature (°c)			NH_3/N (mg/l)		Conductivity (umhos/cm)	
	0	24	48	0	24	48	0	24	48	0	48	0	48	0	24	48	0	48	0	48
Control	10	10	10	8.6	8.9	8.7	7.7	8.1	8.2					21.1	18.7	20.3				
Control	10	10	10	8.7	8.9	8.7	7.7	8.1	8.2										198	205
1.0%	10	10	10	8.7	8.9	8.7	7.7	8.1	8.2					21.0	18.8	20.4				
1.0%	10	10	10	8.7	8.9	8.7	7.7	8.1	8.2										200	210
5.6%	10	10	10	8.6	8.9	8.7	7.8	8.2	8.2					20.8	19.1	21.2				
5.6%	10	10	10	8.6	8.9	8.7	7.8	8.2	8.2										213	228
10.0%	10	10	10	8.6	8.9	8.7	7.7	8.2	8.2					20.7	19.3	22.3				
10.0%	10	10	10	8.5	8.9	8.7	7.7	8.2	8.2										225	245
18.0%	10	10	10	8.4	8.9	8.7	7.7	8.2	8.2					20.7	19.5	23.6				
18.0%	10	10	10	8.4	8.7	8.7	7.7	8.2	8.2										248	270
32.0%	10	10	10	8.1	8.7	8.6	7.6	8.2	8.3					20.7	19.6	23.5				
32.0%	10	10	10	8.2	8.7	8.6	7.6	8.2	8.3										285	305
SCREEN TEST																				
100.0%	10	10	10	6.7	8.4	8.5	7.3	8.0	8.2					21.4	19.8	22.3				
100.0%	10	10	10	6.7	8.4	8.5	7.3	8.0	8.2										463	410

Table 3. Data recorded during 48 hour, Notropis leedsi[a], static acute toxicity bioassay of groundwater samples from the Miami International Airport, Dade County, on 25 to 27 January, 1984.

Sample #001-Well #DCAD-25, Definitive and Screening Tests

Concentration or %	Number of Live Organisms			Dissolved Oxygen (mg/l)			pH			Total Alkalinity (mg/l as $CaCO_3$)		Total Hardness (mg/l as $CaCO_3$)		Temperature (°c)			NH_3/N (mg/l)		Conductivity (umhos)	
	0	24	48	0	24	48	0	24	48	0	48	0	48	0	24	48	0	48	0	48
Control	5	5	5	8.5	8.5	8.5	7.7	8.0	8.1					21.0	19.5	20.4				
Control	5	5	5	8.5	8.5	8.5	7.7	8.0	8.1										200	205
5.6%	5	4	4	8.6	8.5	8.5	7.7	8.0	8.1					21.0	19.0	20.0				
5.6%	5	5	5	8.6	8.5	8.5	7.7	8.0	8.1										217	219
10.0%	5	4	4	8.6	8.5	8.5	7.7	8.0	8.1					21.0	18.9	19.8				
10.0%	5	4	4	8.6	8.5	8.5	7.7	8.0	8.1										230	231
18.0%	5	3	3	8.6	8.5	8.5	7.7	8.0	8.1					20.9	18.9	19.8				
18.0%	5	5	5	8.5	8.5	8.5	7.7	8.0	8.1										252	252
32.0%	5	5	5	8.3	8.4	8.5	7.6	8.1	8.2					20.8	19.0	19.9				
32.0%	5	5	5	8.3	8.4	8.5	7.6	8.1	8.2										290	292
Screen Test[b]																				
100.0%	6	6	6[c]	6.5	7.9	8.5	7.3	7.8	8.0					21.7	19.7	20.2			470	468

REMARKS: [a]Weight of fish = 5.7mg each, average of 7 fish
[b]Due to a shortage of fish, only one chamber containing six fish was used for this screening test.
[c]Fish were observed to be swimming erratically, obviously stressed.

Table 4. Data recorded during 48 hour, Daphnia pulex, static acute toxicity bioassay of groundwater samples from the Miami International Airport, Dade County on 25 to 27 January, 1984.

Sample #002- Well #EAL-7, Definitive and Screening Tests

Concentration or %	Number of Live Organisms			Dissolved Oxygen (mg/l)			pH			Total Alakalinity (mg/l as $CaCO_3$)		Total Hardness (mg/l as $CaCO_3$)		Temperature (°c)			NH_3/N (mg/l)		Conductivity (umhos)	
	0	24	48	0	24	48	0	24	48	0	48	0	48	0	24	48	0	48	0	48
Control	10	10	10	8.6	8.8	8.5	7.8	8.2	8.2					20.8	19.5	21.1				
Control	10	10	10	8.6	8.8	8.5	7.8	8.2	8.2										198	210
1.0%	10	10	10	8.7	8.8	8.5	7.8	8.2	8.2					20.7	19.3	20.6				
1.0%	10	10	10	8.7	8.8	8.5	7.8	8.2	8.2										203	215
5.6%	10	10	9	8.6	8.8	8.5	7.7	8.2	8.2					20.8	19.3	20.4				
5.6%	10	10	9	8.7	8.8	8.5	7.7	8.2	8.2										225	233
10.0%	10	9	8	8.4	8.8	8.4	7.6	8.2	8.2					20.8	19.5	20.3				
10.0%	10	10	9	8.4	8.8	8.4	7.6	8.2	8.2										250	255
18.0%	10	10	8	8.2	8.4	8.4	7.5	8.2	8.2					20.8	19.7	20.5				
18.0%	10	10	9	8.2	8.4	8.4	7.5	8.2	8.2										289	298
Screen Test																				
100.0%	10	10	7	4.4	7.6	7.7	7.2	7.7	8.1					21.6	20.2	21.2				
100.0%	10	10	9	4.4	7.6	7.7	7.2	7.7	8.1										760	750

Table 5. Data recorded during 48 hour, Heterandria formosa[a], static acute toxicity bioassay of groundwater samples from the Miami International Airport, Dade County, on 25 to 27 January, 1984.

Sample #002-Well WEAL-7, definitive and Screening Tests

Concentration or %	Number of Live Organisms			Dissolved Oxygen (mg/l)			pH			Total Alakalinity (mg/l as $CaCO_3$)		Total Hardness (mg/l as $CaCO_3$)		Temperature (°c)			NH_3/N (mg/l)		Conductivity (umhos)	
	0	24	48	0	24	48	0	24	48	0	48	0	48	0	24	48	0	48	0	48
Control	5	5	5	8.5	8.3	8.2	7.7	8.0	8.0					21.3	19.0	19.8				
Control	5	5	5	8.5	8.3	8.2	7.7	8.0	8.0										200	203
5.6%	5	5	5	8.6	8.3	8.2	7.7	8.0	8.0					21.1	18.8	19.8				
5.6%	5	5	5	8.6	8.3	8.2	7.6	8.0	8.0										230	232
10.0%	5	5	5	8.5	8.3	8.2	7.6	8.0	8.0					21.0	18.8	19.6				
10.0%	5	5	5	8.5	8.3	8.2	7.6	8.0	8.0										253	253
18.0%	4[b]	4	4	8.2	8.3	8.2	7.5	8.0	8.1					21.0	19.0	19.7				
18.0%	4[b]	4	4	8.2	8.3	8.2	7.5	8.0	8.1										295	295
Screen Test																				
Using N. leedsi																				
100.0%	6[c]	0	0	4.2	7.0	7.1	7.2	7.7	8.1					21.4	19.7	20.1			780	750

Remarks: [a]Weight of fish = 15.76mg each, average of 10 fish.
[b]Due to a shortage of fish, only four were loaded into these chambers.
[c]Due to a shortage of fish, only one chamber containing six fish was used for this screening test.

Table 6. Data recorded during 48 hour, Daphnia pulex, static acute toxicity bioassay of groundwater samples from the Miami International Airport, Dade County, on 25 to 27 January, 1984.

Sample #003- Well # Con. E 23, Definitive Test

Concentration or %	Number of Live Organisms			Dissolved Oxygen (mg/l)			pH			Total Alakalinity (mg/l as $CaCO_3$)		Total Hardness (mg/l as $CaCO_3$)		Temperature (°c)			NH_3/N (mg/l)		Conductivity (umhos)	
	0	24	48	0	24	48	0	24	48	0	48	0	48	0	24	48	0	48	0	48
Control	10	10	10	8.7	8.7	8.5	7.8	8.1	8.2					20.8	19.5	20.4				
Control	10	10	10	8.7	8.7	8.5	7.8	8.1	8.2										198	203
1.0%	10	9	9	8.7	8.7	8.5	7.7	8.1	8.2					20.9	19.4	20.2				
1.0%	10	9	8	8.7	8.7	8.5	7.7	8.1	8.2										202	209
5.6%	10	8	6	8.6	8.7	8.5	7.5	8.1	8.2					20.9	19.4	20.3				
5.6%	10	7	4	8.6	8.7	8.5	7.5	8.1	8.2										217	221
10.0%	10	4	1	8.5	8.7	8.6	7.4	8.1	8.2					20.8	19.6	20.3				
10.0%	10	7	3	8.5	8.7	8.6	7.4	8.1	8.2										233	238
18.0%	10	0	0	8.4	8.7	8.7	7.3	8.1	8.3					20.8	19.4	20.4				
18.0%	10	2	0	8.4	8.7	8.7	7.3	8.1	8.3										260	267

Table 7. Data recorded during 48 hour, Notropis leedsi[a], static acute toxicity bioassay of groundwater samples from the Miami International Airport, Dade County, on 25 to 27 January, 1984.

Sample #003-Well #Con, E-23, Definitive Test

Concentration or %	Number of Live Organisms			Dissolved Oxygen (mg/l)			pH			Total Alakalinity (mg/l as $CaCO_3$)		Total Hardness (mg/l as $CaCO_3$)		Temperature (°c)			NH_3/N (mg/l)		Conductivity (umhos)	
	0	24	48	0	24	48	0	24	48	0	48	0	48	0	24	48	0	48	0	48
Control	5	5	5	8.5	8.3	8.2	7.7	8.0	8.1					21.0	19.1	19.9				
Control	5	5	5	8.5	8.3	8.2	7.7	8.0	8.1										200	202
5.6%	5	5	5	8.5	8.3	8.2	7.5	8.0	8.1					21.0	19.0	19.8				
5.6%	5	5	5	8.6	8.3	8.2	7.5	8.0	8.1										220	221
10.0%	7	7	7	8.6	8.3	8.2	7.4	8.0	8.1					20.9	19.1	20.0				
10.0%	6	6	6	8.6	8.3	8.2	7.4	8.0	8.1										237	238
18.0%	6	4	4	8.5	8.2	8.2	7.3	7.9	8.1					20.8	19.3	20.1				
18.0%	5	5	5	8.5	8.2	8.2	7.3	7.9	8.1										275	270

Remarks: [a]Weight of fish: 5.7mg each, Average of 7 fish
[b]Extra organisms loaded by mistake, allowed to remain.

Table 8. LC_{50} Data for Bioassays (Definitive Tests) of Groundwater Samples from the Miami International Airport, Dade County, On 25 to 27 January, 1984.

Organism	Method of Data Analysis	24 Hour LC_{50} and 95% Confidence Intervals	48 Hour LC_{50} and 95% Confidence Intervals
Well #DCAD-25			
D. pulex	Binomial	No Mortality	No Mortality
	Moving Average		
	Probit		
N. leedsi	Binomial	Random Mortality	Random Mortality
	Moving Average		
	Probit		
Well #EAL-7			
D. pulex	Binomial	a	a
	Moving Average	a	a
	Probit	a	a
H. formosa	Binomial	No Mortality[b]	No Mortality[b]
	Moving Average		
	Probit		
Well #CON. E-23			
D. pulex	Binomial	10.6% (5.6 and 18)	5.6% (1 and 10)
	Moving Average	8.9% (6.5 and 13),d	4.4% (2.7 and 7.5)
	Probit	8.2% (0 and ∞),c	3.9% (2.4 and 5.5),d
N. leedsi	Binomial	a	a
	Moving Average	a	a
	Probit	a	a

[a] Due to an insufficient number of dead organisms, or to the irregular distribution of mortality, an LC_{50} value cannot be calculated using this method of statistical analysis.

[b] In the screening test of this sample, using N. leedsi, complete mortality was observed.

[c] Due to the distribution of mortality, results calculated using the probit method are not statistically sound.

[d] This LC_{50} value is reported in the text since it is the most statistically conservative value of the data set.

Table 9. Results of Chemical Analyses (Volatile Organics)[a] of Groundwater Samples from Miami International Airport, performed by Enviropact, Inc.

	DCAD-25	EAL-7	Con. E-23
Toluene	------[b]	64.7 µg/l	124 ug/l
Chlorobenzene	------[b]	200 µg/l	361 ug/l
Benezene	------[b]	6.3 µg/l	27.0 µg/l
Ethyl Benzene	------[b]	306 µg/l	317 µg/l

[a] Only the compounds detected out of the analyses for 32 volatile compounds are reported here.

[b] Below detection limit.

RESULTS AND DISCUSSION

The groundwater sample #001, collected from monitoring well #DCAD-25 outside the perimeter of the Miami International Airport, was not acutely toxic to the test organisms, Daphnia pulex and Notropis leedsi. No mortality of D. pulex and only a few random mortalities of N. leedsi were noted during the 48 hour definitive and screening bioassays. However, in the N. leedsi screening test (100% sample) of this groundwater, the fish were observed to be swimming erratically and were obviously stressed at the end of the test (Table 3). A faint kerosene-like odor was detected in this sample.

The groundwater sample #002, collected from monitoring well #EAL-7 near a storage and maintenance area of the Airport, also was not acutely toxic to the test organisms, D. pulex and Heterandria formosa during the definitive bioassays. An insufficent number of D. pulex died to calculate an LC_{50}, while no H. formosa mortality was noted. However, in the screening test (100% sample) of this groundwater, using N. leedsi as the test organism, complete mortality of fish was noted in less than 24 hours (Table 5). Stronger kerosene like odor was noticeable in this sample than was detected in the sample from well #DCAD-25.

The groundwater sample #003, collected from monitoring well #Con. E-23 near Concourse E of the airport, proved to be extremely toxic to Daphnia pulex, producing 24 and 48 hour LC_{50} values of 8.2% and 3.9%, respectively (Table 8). In the definitive N. leedsi bioassay of this sample, insufficient mortality was noted in the highest test concentration(18%) to calculate an LC_{50}. Unfortunately, a shortage of fish precluded the use of higher test concentrations or a screening test, where greater mortality would most likely have been observed. A distinct kerosene odor and fine white sediment were noted in this sample.

The results of volatile organic analyses of these samples, performed by Enviropact, Inc. of Miami, are presented in Table 9. Present were various g/l concentrations of toluene, chlorobenzene, benzene and ethyl benzene in the samples from well #EAL-7 and well #CON. E-23, with higer concentrations found in the Con. E-23 sample. These compounds were not found in the well #DCAD-25 sample. The concentrations of these compounds reported to be acutely toxic to organisms such as Daphnia magna and Lepomis macrochirus (bluegill) are significantly higher than were found here. For example, LeBlanc (1980) reported D. magna 48 hours LC_{50}'s of 310mg/l, 86mg/l, 200mg/l and 75mg/l for toluene, chlorobenzene, benzene and ethyl benzene, respectively. Buccafusco et al. (1981) reported L. macrochirus 96 hour LC_{50}'s of 13mg/l, 16mg/l and 150mg/l

for, toluene, chlorobenzene and ethyl benzene, respectively. However, since toxicity was noted only in the samples containing these organic chemicals, it is suggested that this toxicity may have been due to synergistic effects between these chemicals and with other unknown components of the samples.

LITERATURE CITED

American Public Health Association. 1980. Standard Methods for the Examination of Water and Wastewater. 15th ed. 1134 p.

Buccafusco, R. J., Ells, S. J. and G. A. LeBlanc. 1981. Acute toxicity of priority pollutants to bluegill (Lepomis macrochirus). Bull. Environm. Contam. Toxicol. 26, 446-452.

Florida Department of Environmental Regulation, Biology Section. 1983. Quality Assurance Manual for Performing Acute Toxicity Tests. FDER. 22 p.

Leblanc, G. A. 1980. Acute toxicity of priority pollutants to water flea (Daphnia magna). Bull. Environm. Contam. Toxicol. 24, 684-691.

Peltier, W. 1978. Methods for measuring the acute toxicity of effluents to aquatic organisms. Environmental Research Laboratory. Athens, Georgia. EPA-600/4-78-012 (Revised July 1978). 51 p.

U.S. Environmental Protection Agency. 1978. Bioassay procedures for the Ocean Disposal Permit Program. Environmental Research Laboratory. Gulf Breeze, Florida. EPA-600/9-78-010. 121 p.