BIOASSAY OF [redacted] UTILITIES AUTHORITY WASTEWATER TREATMENT PLANT,

ST. LUCIE COUNTY, FLORIDA

(NPDES #FL0027278)

SAMPLED 1/29/80

Biological Section
Bureau of Water Analysis
30 January 1980

BIOASSAY OF FT. PIERCE UTILITIES AUTHORITY WASTEWATER TREATMENT PLANT,

ST. LUCIE COUNTY, FLORIDA

(NPDES #FL0027278)

Biological Section
Bureau of Water Analysis
30 January 1980

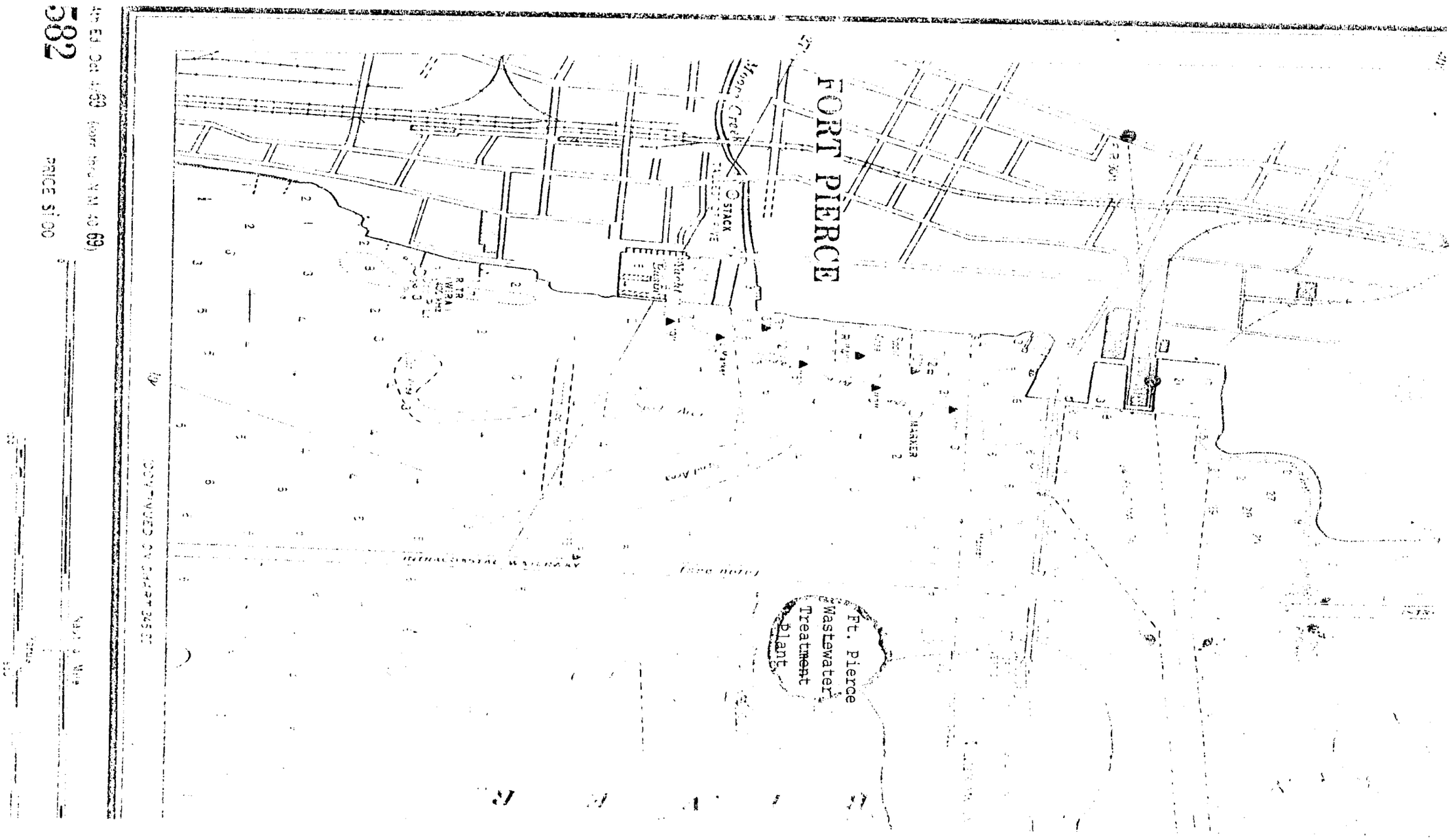
INTRODUCTION

The Ft. Pierce Utilities Authority Wastewater Treatment Plant receives sewage from approximately 33,000 residents of Ft. Pierce. Additionally, the plant provides secondary treatment for 0.274 MGD of industrial effluents. The total plant design capacity is currently 5.0 MGD with a scheduled increase to 9.0 MGD by 1981. It is located on Causeway Drive in Ft. Pierce and discharges to the Indian River (Fig. 1).

Treatment at this facility consists of comminution, grit removal, aeration (a split proces including both activated sludge and contact stabilization), clarification, digestion, and sludge thickening and removal prior to effluent discharge.

On 29 January 1980, the Biological Section obtained effluent samples taken before chlorination from the Ft. Pierce Wastewater Treatment Plant outfall #001 and performed a static bioassay to determine the existence and extent of toxicity to the biota of the receiving waters.

Figure 1. Location map of Ft. Pierce Utilities Authority Wastewater Treatment Plant, Ft. Pierce, Florida.



METHODS AND MATERIALS

Test methods used for conducting this static bioassay are extensively described by Peltier (1978). The organism selected for this study is among those recommended by Peltier (1978) and the U.S. EPA (1978). The life history of this test organism and maintenance procedures used to culture it are detailed below.

History and Maintenance of Bioassay Organism

A breeding culture of Daphnia pulex (water flea) was obtained from the EPA laboratory in Athens, Georgia on March 9, 1979. This culture has been maintained in 2½ gallon all glass aquaria under a 16:8 hour light-dark cycle. Organisms have been fed a liquified blend of Purina Trout Chow® and Cerophyl® twice daily. Daphnia used in this bioassay were siphoned into a large culture dish through a series of nested stainless steel screens to isolate the proper size and age organisms (neonates). The selected neonates were pipetted individually from the culture dish and randomly placed into the test chambers at the beginning of the test.

Test Methods

A 48 hour static bioassay was conducted from 1130 hours on 30 January to 1130 hours 1 February 1980 on an effluent grab sample from outfall #001. The sample was collected by Mr. Greg Graves of the South Florida Subdistrict Branch Office of DER at 0800 hours on 29 January 1980, using standard wastewater sampling procedures. The sample was iced and transported to the DER laboratory in Tallahassee.

Freshwater for dilution of the effluent sample was obtained from the same City of Tallahassee well that is used to culture the test organisms. The concentration series selected for this study is that recommended by APHA (1976) (Table 1).

Two replicates, each with six concentrations and a control, were used to test with 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 transferred individually by glass pipette and were loaded 10 per chamber, resulting in 20 per test concentration.

Dissolved oxygen, pH, and the number of live organisms were recorded for each test chamber at 0 hours, 24 hours, and 48 hours. Total alkalinity, total hardness, and conductivity were recorded at the beginning of the test for the controls and the 100% effluent concentration. These values were recorded daily on the bioassay data forms and are presented in Table 2. Organisms were not fed during this test.

Table 1

Concentration Series and Volumes used for this Static Bioassay

Concentration	Dilution Water	Effluent	Total Vol.
Control	200 ml	-	200 ml
5.6%	189 ml	11 ml	200 ml
10.0%	180 ml	20 ml	200 ml
18.0%	164 ml	36 ml	200 ml
32.0%	136 ml	64 ml	200 ml
56.0%	88 ml	112 ml	200 ml
100 %	-	200 ml	200 ml

Table 2. Data recorded during 48-hour, *Daphnia pulex* static acute toxicity bioassay performed on the Ft. Pierce Authority Wastewater Treatment Plant, St. Lucie County, Florida. 30 January to 1 February 1980. NPDES Permit #FL0027278. Outfall #001.

Conc. or %	Test Container Number	Number of Live Organisms					Dissolved Oxygen (mg/l)					pH					Total Alkalinity (mg/l as $CaCO_3$)					Total Hardness (mg/l as $CaCO_3$)					Conductivity (Umhos)				
		0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96
Control	A	10	10	10			8.3	8.9	8.9			8.15	8.1	8.1			123					125					232				
Control	B	10	10	10			8.3	8.9	8.9			8.08	8.1	8.1																	
5.6	A	10	10	10			8.2	8.9	8.3			8.01	8.0	8.1																	
5.6	B	10	10	10			8.3	8.8	8.7			8.04	8.0	8.1																	
10.0	A	10	10	10			8.4	8.8	8.7			7.99	8.1	8.0																	
10.0	B	10	10	10			8.4	8.8	8.6			8.00	8.1	8.0																	
18.0	A	10	10	10			8.2	8.7	8.5			7.91	8.0	8.0																	
18.0	B	10	10	10			8.2	8.7	8.4			7.91	8.0	8.0																	
32.0	A	10	10	10			8.3	8.7	8.3			7.79	8.0	8.0																	
32.0	B	10	10	10			8.2	8.7	8.3			7.79	8.0	8.0																	
56.0	A	10	10	8			8.3	8.4	8.2			7.58	7.9	7.9																	
56.0	B	10	10	7			8.3	8.4	8.1			7.57	7.9	7.9																	
100.0	A	10	3	1			8.6	8.2	7.9			7.32	7.7	7.8			87					135					730				
100.0	B	10	5	3			8.7	8.2	7.8			7.30	7.7	7.8																	

Remarks: Temperature range during test 20.0 to 21.0°C.

RESULTS AND DISCUSSION

Effluent taken before chlorination from the Ft. Pierce municipal wastewater treatment plant demonstrated measurable toxicity to Daphnia pulex (Table 3). The LC_{50} at 24 hours exposure was found to be 93% and the 48 hour LC_{50} was calculated to be 73%. The 96 hour LC_{50} would therefore be $\leq$ 73%.

Chemical analysis of the effluent was not available at the time of this bioassay, however, the NPDES permit file suggests that flouride, sulfide, iron, oil and grease, pesticides and algicides may be present in the treated discharge water. Additionally, over 5% of the wastewater flow originates from uncharacterized industrial sources. Therefore, the origin of the toxicity found in this bioassay cannot, at present, be attributed to a single source or chemical compound.

Chapter 17-3.051, Florida Administrative Code, indicates that "all waters of the State shall at all places and at all times by free from...components of discharges which...are acutely toxic." "Acute toxicity" is defined in Chapter 17-3.021(1) to mean "the presence of one or more substances...in amounts which are greater than one-third (1/3) of the amount lethal to 50% of the test organisms in 96 hours (96 hour LC_{50})...". In the absence of a mixing zone, this 1/3 of the 96 hour LC_{50} applies at the point of discharge. Chapter 17-4.244(4) states that "in no event shall the maximum concentration of wastes in the mixing zone exceed the amount lethal to 50% of the test organisms in 96 hours (96 hour LC_{50}) for a species significant to the indigenous aquatic community..." This criterion applies at the point of discharge if there is a mixing zone. The distinction between presence or absence of a mixing zone is not relevant here, however, since the testing procedure used does not involve effluent concentration. The 1/3 of the 96 hour LC_{50} criterion is three times as stringent as the 96 hour LC_{50} criterion, and therefore, in the absence of a mixing zone, the procedure used is very lenient. The procedure followed is also lenient in that testing is only done for 48 hours. The 96 hours LC_{50} derived from this testing is therefore reported as "less than or equal to" the 48 hour measurement. The value found after 48 hours can never be more restrictive than the value found after 96 hours. It must be noted that all organisms used in these tests are significant to the indigenous aquatic community since they are sensitive to toxic substances which may be expected to impact the indigenous community.

The toxicity reported here is in excess of allowable limits.

Table 3

Values Obtained from Bioassay of
Ft. Pierce Authority Wastewater Treatment Plant

Organism	Method of Data Analysis	24 Hour LC_{50} and 95% Confidence Intervals	48 Hour LC_{50} and 95% Confidence Intervals
Daphnia pulex	Binomial	93.04% (56-∞)	72.7% (56-100)
	Moving Average	*	72.4% (62- 89)
	Probit	*	73.2% (63- 87)

* These data do not meet the criteria established by the Committee on Methods for Toxicity Tests with Aquatic Organisms because no "percent dead" is greater than 65 percent.

LITERATURE CITED

American Public Health Association. 1976. Standard Methods for the Examination of Water and Wastewater. 14th ed. pp. 1193.

Peltier, William. 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) 51p.

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.