

BIOASSAY OF SAND LAKE ROAD
SEWAGE TREATMENT PLANT
ORANGE COUNTY, FLORIDA
NPDES #FL0022110

Biological Section
Bureau of Water Analysis
November 20, 1980

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INTRODUCTION

The Sand Lake Road Sewage Treatment Plant is located in southwest Orange County, Florida (Fig. 1). The facility serves a population of approximately 58,000 including a large part of the City of Orlando plus 20% of unincorporated Orange County. The plant has a design capacity of 6.0 MGD, and an average flow of 5.76 MGD. Secondary sewage treatment consists of contact stabiliation, secondary clarification and retention in a polishing pond prior to discharge. The major industrial contributor of the Sand Lake Road Plant is the Martin-Marietta Corporation, producers of guided missile systems and the space shuttle. Effluent discharge is to Shingle Creek, a major tributary to West Lake Tohopekaliga.

The Sand Lake Plant has reveived numerous notifications of violations, dating back to 1975, usually for exceeding NPDES permit limitations for total suspended solids and fecal coliforms.

On June 10, 1980 the Biological Section obtained samples from outfall #001 of the Sand Lake Road Sewage Treatment Plant and conducted bioassays to determine the existance and extent of toxicity to the biota of Shingle Creek. The results of these tests are reported here.

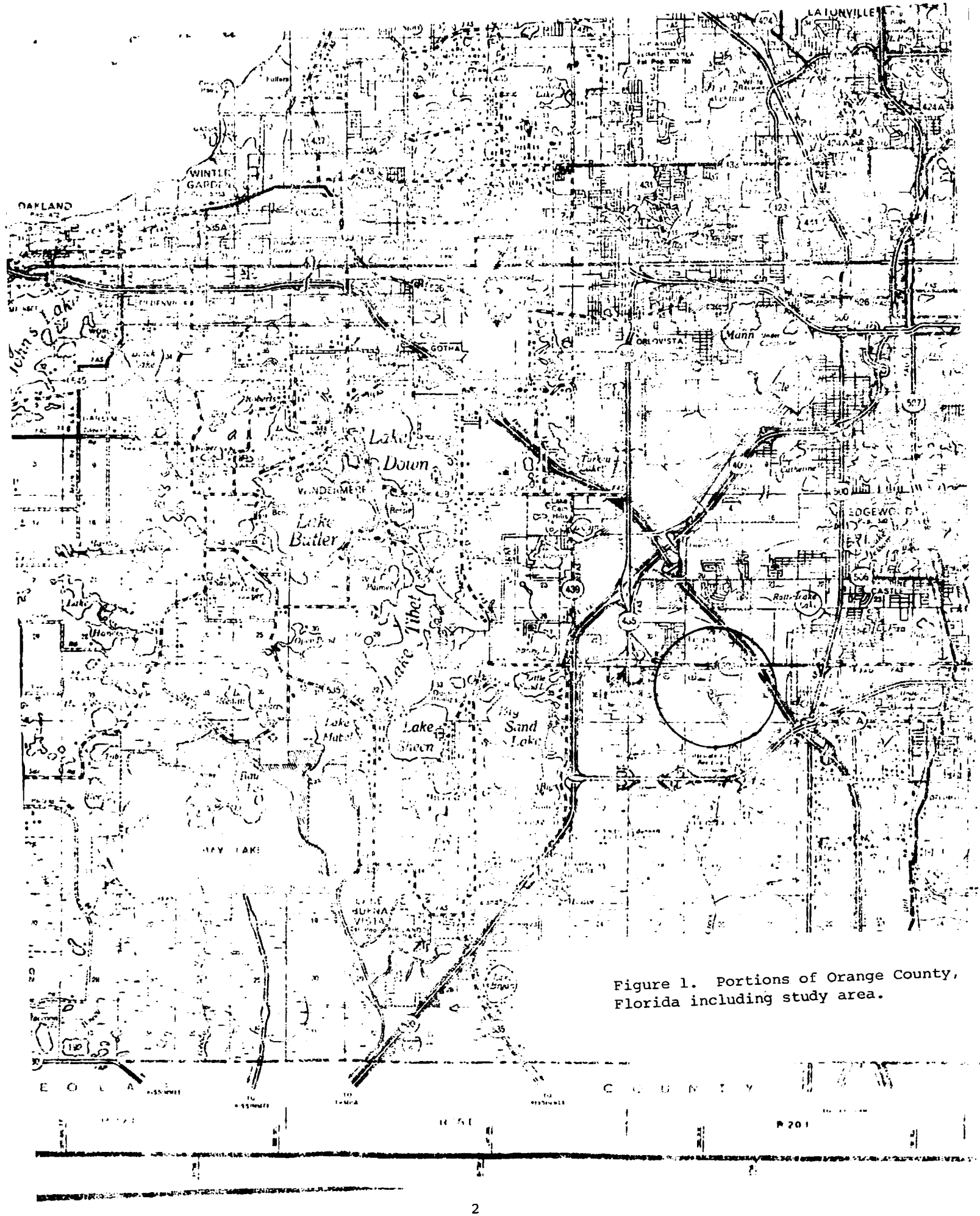


Figure 1. Portions of Orange County, Florida including study area.

METHODS AND MATERIALS

Test methods used to conduct 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 Organisms

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 since its arrival, in 2½ gallon all glass aquaria using a 16:8 hour light-dark cycle. Organisms have been fed a liquified blend of Purina Trout Chow ® and Cerophyl ® twice daily.

Test Methods

A 48 hour static bioassay was conducted from 1245 hours, June 10 to 1245 hours June 12, 1980, on a grab sample of effluent from outfall #001. The sample was collected at 1500 hours June 9 by Mr. Guy Hadley of DER's, St. Johns River District Office using standard wastewater sampling procedures. Separate samples were obtained for chemical and biological testing. Samples for metal analysis were preserved with HNO_3 (2ml/liter). Samples for organic chemical analysis and the bioassay were unpreserved. The samples were iced and transported to the DER laboratory in Tallahassee within 24 hours of collection.

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

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 siphoned into a large culture dish through a series of nested stainless steel screens to isolate the proper size and age organisms (neonates). These neonates were than 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 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 on the bioassay data form and are presented in Table 2. The 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%	188.8 ml	11.2 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 of Sand Lake Road Sewage Treatment Plant, Southwest Orange County, Florida. June 10-12, 1980. NPDES Permit #FL0022110 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/cm)				
		0	24	48	72	96	0	24	48	0	24	48	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96
Control	A	10	10	10			9.5	8.8	8.3	8.0	7.8	8.0	117					117					260				
Control	B	10	10	10			9.5	8.9	8.8	8.0	8.0	8.1															
5.6%	A	10	10	10			9.5	8.8	8.6	8.1	8.0	8.0															
5.6%	B	10	10	10			9.6	8.8	8.8	8.1	8.0	8.0															
10.0%	A	10	10	10			9.7	8.9	8.8	8.1	8.0	8.0															
10.0%	B	10	10	10			9.7	8.4	8.7	8.1	8.0	8.0															
18.0%	A	10	10	10			9.8	8.9	8.7	8.0	8.0	8.0															
18.0%	B	10	10	10			9.8	8.8	8.8	8.0	8.0	8.0															
32.0%	A	10	10	9			9.8	8.8	8.8	7.9	7.9	7.9															
32.0%	B	10	10	10			9.8	8.8	8.8	7.9	7.9	7.9															
56.0%	A	10	10	10			9.4	8.8	8.7	7.6	7.9	7.9															
56.0%	B	10	10	8			9.4	8.8	8.8	7.6	7.9	7.9															
100%	A	10	0	0			8.7	8.9	---	7.3	7.8	---															
100%	B	10	0	0			8.6	8.8	---	7.3	7.8	---	100					110					460				

Remarks: 1. Test temperature range : 22.0-24.5°C.
2. Total residual chlorine not detectable (<0.05 ppm).

RESULTS AND DISCUSSIONS

Effluent from the Sand Lake Road S.T.P. demonstrated a measurable toxicity to the organism tested (Daphnia pulex). The LC_{50} at 24 hours exposure was determined to be 75% while 48 hour LC_{50} values ranged from 66.4-70.3% (Table 3). The 96 hour LC_{50} value would therefore be $\leq$ 70.3%. Chemical analyses (Tables 4 and 5) failed to indicate a possible cause for the observed toxicity since none of the parameters tested for were present in sufficient quantities to result in mortality to Daphnia pulex (U.S. EPA 1977). Because of the limited chemical characterization of the effluent and the large number of contributors to a municipal sewage plant, it's impossible to attribute toxicity to a single source.

Chapter 17-3.051, Florida Administrative Code, indicates that "all waters of the State shall at all places and at all times be 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 hour LC_{50}...". In the absence of a mixing zone, this 1/3 of the 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 hour 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 . LC_{50} Data for Bioassay of Sand Lake Road Sewage 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	74.8% (56-100)	70.3% (56-100)
	Moving average	A	66.7% (59-78)
	Probit	A	66.4% (0-∞)B

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

Table 4. Field Parameters of Sand Lake Road STP Effluent at Outfall #001.

Temperature:	28.5 C^{o}
Conductivity:	650 µmhos
pH:	7.4
Dissolved Oxygen:	6.7 mg/l
Total Residue Chlorine:	0.3 mg/l*
Time:	1500 hours 9 June 1980
Observations:	minnows (Gambusia) at outfall

*Total Residue Chlorine at time of bioassay <0.05 ppm. (Hach DPD)

Table 5: Summary of Chemical Results of Sand Lake Road Sewage Treatment Plant Effluent at Outfall #001.

Metals:

Cadmium	< 1 µg/l
Lead	<10 µg/l
Copper	5 µg/l
Zinc	43 µg/l
Silver	< 1 µg/l
Nickel	< 10 µg/l

Nonmetals:

Fluorides:	0.62 mg/l
Chlorinated Hydrocarbons:	none detectable
Phenols:	none detectable

LITERATURE CITED

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