

BIOASSAYS OF MONSANTO TEXTILES COMPANY

ESCAMBIA COUNTY, FLORIDA

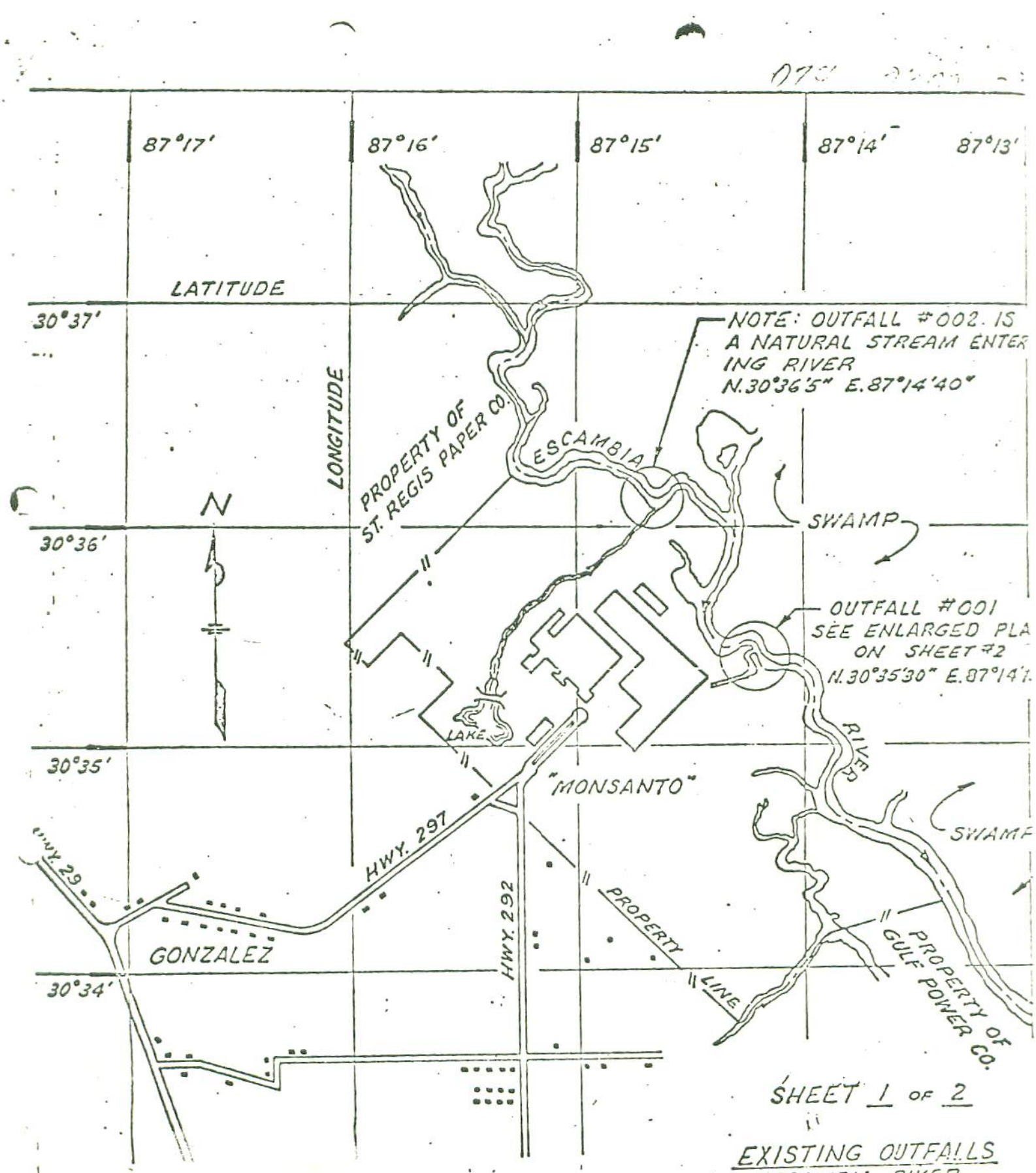
NPDES Permit #FL0002488

Biological Section
Bureau of Water Analysis
May 22, 1980

INTRODUCTION

Monsanto Textiles Company is located near Gonzalez in Escambia County, Florida (Fig. 1). This facility operates continuously producing nylon fibers and intermediate products. Process wastewater is generated by the production of adipic acid and nylon fibers. Additional sources of wastewater are cooling water and storm water. A schematic of wastewater sources and flow is outlined in Figure 2. Discharge is to the Escambia River thence to Escambia Bay.

On 13 February 1980 the Biological Section received effluent samples from outfall #001 of this facility and conducted static bioassays to determine the existence and the extent of toxicity to the biota of the receiving waters.



SHEET 1 OF 2

FIGURE 1.

LOCATION MAP

SCALE IN MILES

1 3/4 1/2 1/4 0 1 2

EXISTING OUTFALLS

In ESCAMBIA RIVER
at MONSANTO COMPANY
County of ESCAMBIA
State of FLORIDA
Date 5-28-71

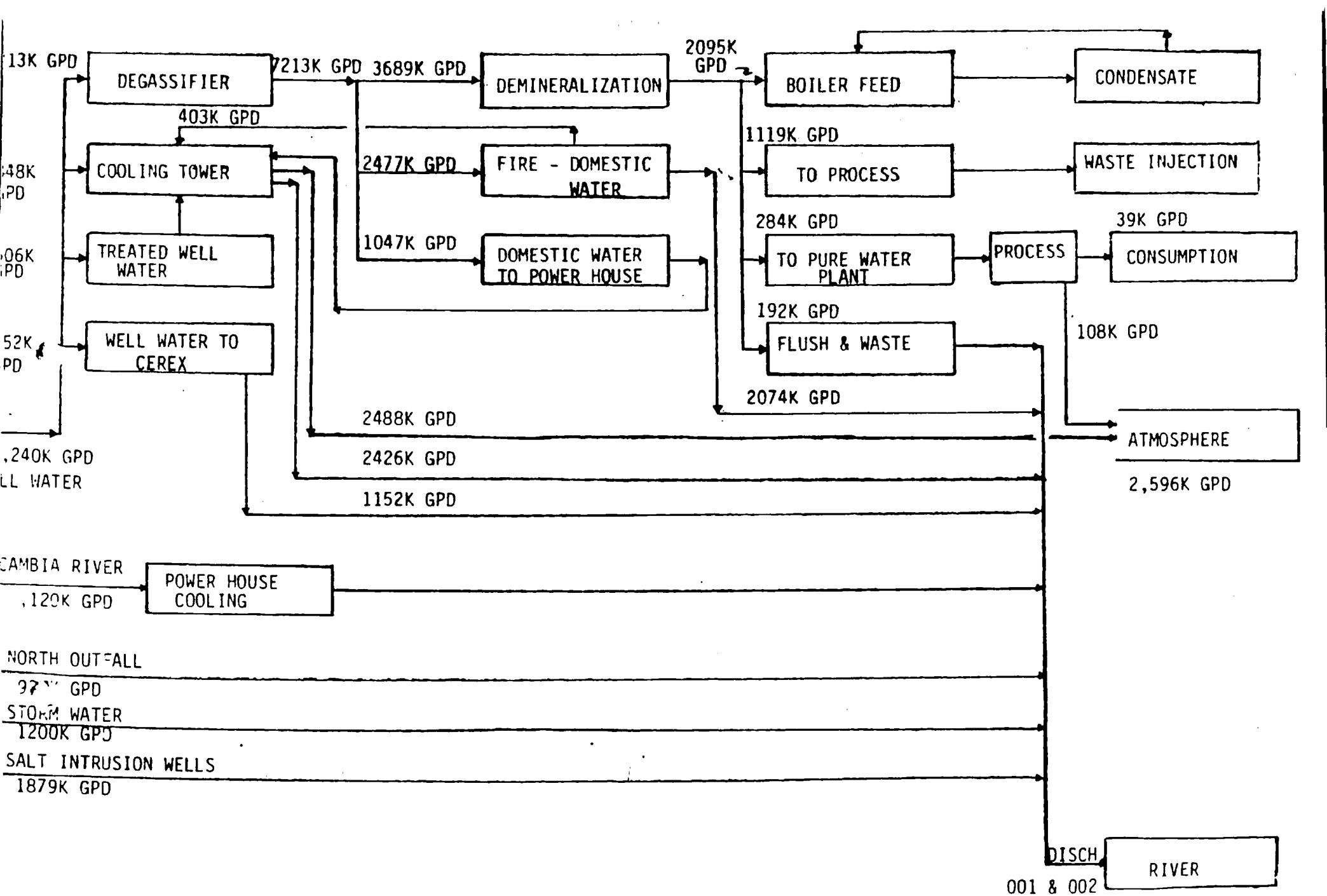


FIGURE 2

SCHEMATIC OF WATER FLOW
MONSANTO TEXTILES COMPANY
GONZALEZ, ESCAMBIA, FLORIDA
JULY 12, 1978

METHODS AND MATERIALS

Test methods used for conducting these static bioassays are extensively described by Peltier (1978). The organisms selected for this study are among those recommended by Peltier (1978) and the U.S. EPA (1978). 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 on March 9, 1979. This culture has been maintained continually since their 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. 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). These neonates were then pipetted individually from the culture dish and placed randomly into the test chambers at the beginning of the test.

Pimephales promelas (fathead minnow)

A breeding culture of approximately 100 adult fathead minnows were obtained from the EPA laboratory in Cincinnati, Ohio on 12 May 1979. The fish were transferred to three 125 gallon aquaria filled with unchlorinated City of Tallahassee well water and reared at 24-25°C under 16:8 hour light-dark cycle. Water circulation, aeration and purification were accomplished with heavy-duty outside motor filters. These fish were fed Purina Trout Chow® at a rate of 0.75g/30 fish twice daily. Breeding was encouraged by placing several halved clay pots in each tank to serve as a substrate for eggs and to provide cover for the fish. Tanks were examined twice daily (at feeding time) for egg production. Clay pots containing egg clusters were immediately transferred to 15 gallon aerated aquarium for hatching. A new aquarium was prepared for each week's production of eggs thereby segregating fish into even age groups to be used for testing. After hatching fathead fry were fed twice daily with freshly hatched Artemia (brine shrimp). The fish used in this test were all 3 months old at the time of the test.

Test Methods

Two separate 48 hour static bioassays were conducted 13 February 1980 on a 24 hour composite sample of effluent from outfall #001. The sample was collected on 12 February by Mr. Rick Bradburn of DER's Northwest District Office using standard wastewater sampling procedures. Separate samples were obtained for

chemical and biological testing. Samples for organic chemical analysis and the bioassays 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 City of Tallahassee well that is used to culture the test organisms. The concentration series selected for this study are those recommended by APHA (1976) (Table 1).

Two replicates of six concentrations and a control were implemented for the fathead minnow bioassay. The fish were transferred individually or by twos by net into wide mouth quart jars containing 500 ml each of the appropriate test concentration (Table 1). Fathead minnows were loaded 5 per chamber resulting in 10 per concentration.

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, 200 ml of the appropriate test concentration was placed in each chamber (Table 1). 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% concentration. These values were recorded daily on the bioassay data forms and are presented in Tables 2 and 3. Organisms were not fed during these tests.

Table 1.

CONCENTRATION SERIES AND VOLUMES USED FOR THESE STATIC BIOASSAYS

Fathead Minnow (Pimephales promelas)

Concentration	Dilution Water	Effluent	Total Vol.
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%	340 ml	160 ml	500 ml
56.0%	220 ml	280 ml	500 ml
100%	-	500 ml	500 ml

Water flea (Daphnia pulex)

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 Monsanto Textiles Company located in Escambia County, Florida. 13 February to 15 February 1980. NPDES Permit #FL0002488. 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			9.1	9.5	9.6			9.0	7.9	8.0			125					140					215				
Control	B	10	10	10			9.1	9.4	9.6			8.9	7.9	8.9													220				
5.6	A	10	10	10			9.2	9.6	9.7			8.8	7.9	8.0																	
5.6	B	10	10	10			9.2	9.6	9.7			8.8	7.9	8.0																	
10.0	A	10	10	10			9.2	9.5	9.7			8.7	7.9	8.0																	
10.0	B	10	10	10			9.3	9.4	9.6			8.7	7.9	8.0																	
18.0	A	10	10	10			9.4	9.5	9.6			8.6	7.8	8.9																	
18.0	B	10	10	10			9.3	9.5	9.6			8.6	7.9	8.0																	
32.0	A	10	9	9			9.2	9.5	9.5			8.6	7.8	7.9																	
32.0	B	10	10	10			9.4	9.4	9.5			8.5	7.8	7.9																	
56.0	A	10	9	3			9.5	9.5	9.6			8.4	7.7	7.8																	
56.0	B	10	9	4			9.6	9.3	9.5			8.4	7.7	7.8																	
100	A	10	7	3			9.7	9.4	9.5			8.3	7.5	7.6													300				
100	B	10	7	2			9.9	9.2	9.4			8.3	7.5	7.6			25					35					320				

Remarks: Total residual chlorine of 100% effluent = 0.0mg/l.

Table 3. Data recorded during 48-hour, Pimephales promelas, static, acute, toxicity bioassay performed on Monsanto Textiles Company located in Escambia County, Florida. 13 Feb. to 15 Feb. 1980. NPDES Permit #FL0002488. 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	5	5	5			9.2	5.3	5.4			7.8	7.3	7.2			125					140					205				
Control	B	5	5	5			9.1	4.8	5.4			7.9	7.3	7.3													210				
5.6	A	5	5	5			9.2	4.7	5.2			7.9	7.3	7.3																	
5.6	B	5	5	5			9.1	4.7	4.1			7.9	7.3	7.2																	
10.0	A	5	5	5			9.3	4.7	4.7			7.9	7.2	7.2																	
10.0	B	5	5	5			9.2	3.4	3.6			7.9	7.2	7.2																	
18.0	A	5	5	5			9.4	4.5	4.2			7.8	7.2	7.2																	
18.0	B	5	5	5			9.4	3.6	3.7			7.8	7.2	7.2																	
32.0	A	5	5	5			9.5	4.5	4.7			7.8	7.1	7.2																	
32.0	B	5	5	5			9.5	3.9	4.7			7.8	7.1	7.2																	
56.0	A	5	5	5			9.8	4.3	4.5			7.7	7.1	7.1																	
56.0	B	5	5	5			9.8	2.8	3.5			7.7	7.1	7.1																	
100	A	5	5	5			9.7	4.2	4.4			7.6	6.9	7.0													320				
100	B	5	5	5			10.4	3.2	3.1			7.6	6.9	6.9			25					35					315				

Remarks: After parameters (D.O. & pH) were recorded at 24 and 48 hours, all chambers were aerated for 7 minutes because of depleted D.O.

Fish age at time of test - 3 months (Hatch of 13 November).

Total Residual chlorine of 100% effluent = 0.0mg/l.

RESULTS AND DISCUSSION

Results from 48 hour static bioassays (Tables 2 & 3) conducted on a 24 hour composite sample of effluent from outfall #001 at this facility, indicate that this sample of wastewater was not acutely toxic to the fathead minnow (Pimephales promelas), however it was toxic to Daphnia pulex. The 48 hour LC_{50} for Daphnia was 55% (see Table 4). All fish survived 48 hours of exposure to all concentrations of this effluent (Table 3). Daphnia mortality occurred at both 100% and 56% concentrations (Table 2). Chemical analysis of this effluent consisted of only one parameter, which was PCB's and none were detected.

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 hours (96 hr LC_{50})...". Mixing zones are not relevant to this criterion, and the restriction on acute toxicity, therefore, applies at the point of discharge. Essentially this provision means that an effluent at the point of discharge can not cause 50% mortality in the test organisms even if the effluent is concentrated three-fold. Since the testing procedure used here does not involve any concentrating of the effluent, and since mortality is only measured for 48 hours, any toxicity reported here may be considered to be substantially in excess of allowable limits.

Table 4. LC_{50} Data

Type of Sample	Organism	Type of Test	Method of Data Analysis	24 hour LC_{50}	48 hour LC_{50}
24 hour comp.	Daphnia pulex	48 hour Static	Binomial test	>100%	49.5%
			Moving Average Method	>100%	55.9%
			Probit Method	>100%	59.6%
24 hour comp.	Pimephales promelas	48 hour static	- - -	No mortality	No mortality

LITERATURE CITED

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

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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.