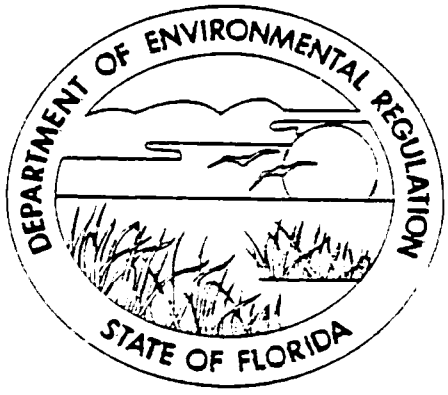


BIOASSAYS OF ROYSTER MULBERRY

POLK COUNTY, FLORIDA

NPDES #FL0000671

Biology Section
Bureau of Water Analysis
June 9, 1983

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EXECUTIVE SUMMARY

Royster Mulberry, Polk County, NPDES #FL0000671, on 17 to 19 May, 1983.

The sample of effluent from this phosphate fertilizer manufacturing facility was not toxic to the test organisms, Daphnia pulex and Heterandria formosa. Only one Daphnia pulex mortality was noted, in the 56% test concentration, while no Heterandria formosa died during the 48 hour static tests. Since the sample was not acutely toxic, chemical analyses were not performed.

INTRODUCTION

The Royster Mulberry facility is located on Hwy. 60, east of Mulberry, Polk County, Florida (Fig. 1). The facility produces phosphate fertilizers, such as diammonium phosphate and triple super phosphate, and related by-products, such as phosphoric and sulfuric acids. Production capacity (1974) has averaged 1692 metric tons of fertilizer per day, but may be considerably less at present. Process wastewater is contained on site. Non-process wastewater, consisting of non-contact cooling water, boiler and cooling tower blowdown, lost condensate, and plant area storm runoff is discharged through Outfall #002 to Skinned Sampling Creek, a tributary of the North Prong Alafia River. This 0.2 MGD effluent may be treated by neutralization and sedimentation prior to discharge.

To evaluate the effects that this effluent may have on the biota of the receiving waters, the FDER Biology Section performed two 48 hour static acute toxicity bioassays on a grab sample, on 17 to 19 May, 1983. The results of these tests are presented in this report. Those involved in performing these tests and in preparing this report were: C. W. Dye, M. L. Roll, and K. A. Study.

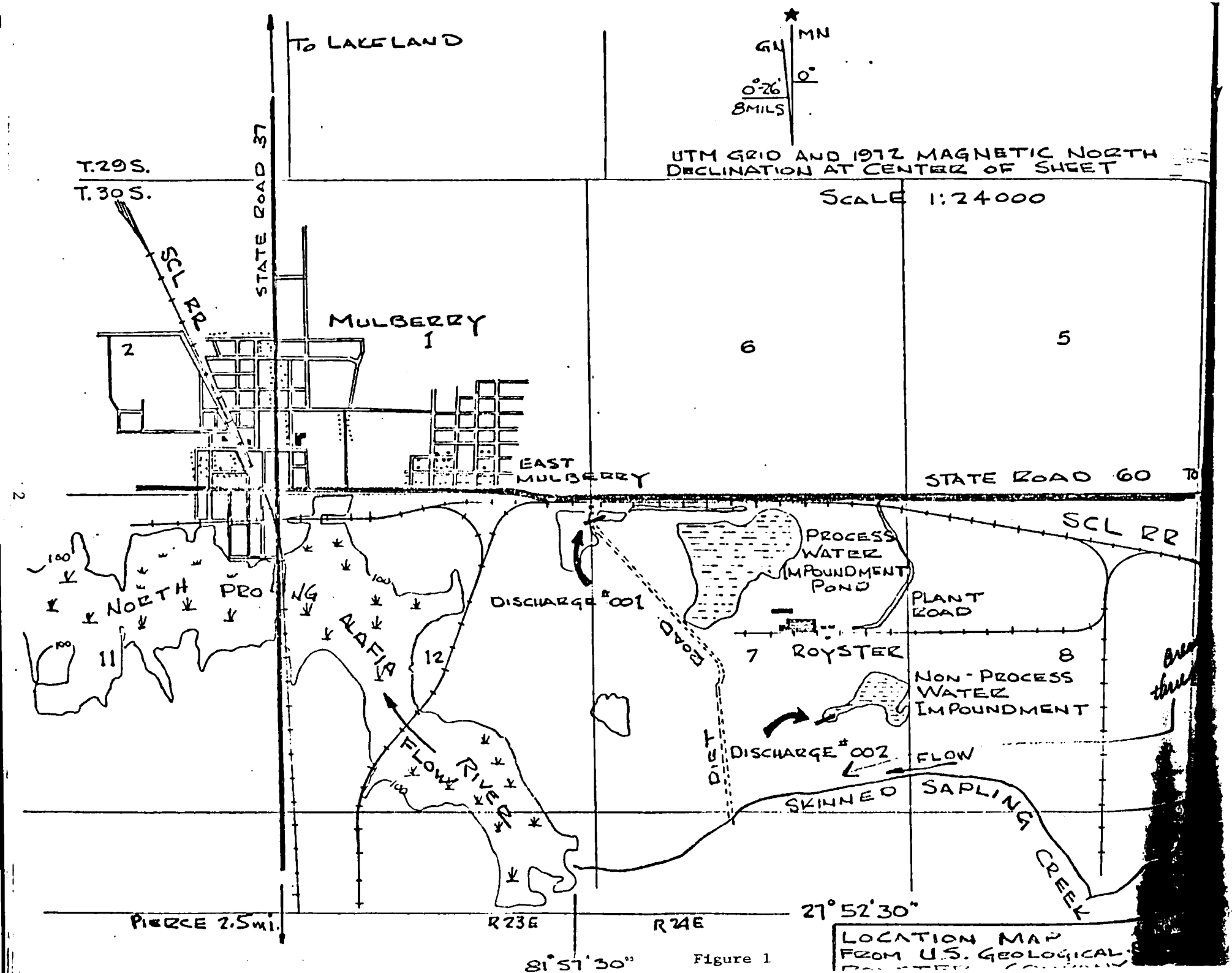


Figure 1

LOCATION MAP FROM U.S. GEOLOGICAL

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. One of these indigenous species was 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 3 to 15 days old.

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

Two separate 48 hour static acute toxicity bioassays were performed on a grab sample of effluent from Royster Mulberry's Outfall #002. The tests were performed from 0910 hours on 17 May to 0930 hours on 19 May, 1983. The sample was collected by Mr. Matt McCann of DER's Tampa office at 0925 hours on 16 May, 1983, using standard wastewater sampling procedures. Separate samples were obtained for chemical and biological testing. Samples for metal analyses were preserved with HNO_3. Samples for organic chemical analyses and for the bioassays were unpreserved. The samples were iced and transported to the DER laboratory in Tallahassee for analyses within 24 hours of collection.

Freshwater for dilution of the effluent sample 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 that recommended by APHA (1980).

Two replicates, each with six randomly arranged concentrations 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 this test.

Two replicates, of six randomly arranged concentrations and a control, were used for the Heterandria formosa (least killifish) bioassay. 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 5 per chamber, resulting in 10 per concentration. Fish were not fed during this test.

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. Total alkalinity and total hardness (measured as $CaCO_3$ using HACH Chemical Company reagents) were recorded at the beginning of the test for the controls and the 100% effluent concentration. 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. Ammonia concentrations, including the total and unionized fraction (expressed in mg/l as N and as NH_3, respectively), were recorded in the controls and the 100% effluent test concentration at the beginning of the test. Total ammonia concentrations were determined using an Orion® specific ion probe and an Orion Ionalyzer®. The unionized fraction was then calculated based on the total ammonia concentration, and the pH, temperature, and salinity of the sample. These values were recorded on the bioassay data forms and are presented in Tables 2 and 3.

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

Daphnia pulex (water flea)

Concentration	Dilution Water	Effluent	Total Volume
Control	200.0 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%	136.0 ml	64.0 ml	200 ml
56.0%	88.0 ml	112.0 ml	200 ml
100.0%	———	200.0 ml	200 ml

Heterandria formosa (least killifish)

Concentration	Dilution Water	Effluent	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%	340 ml	160 ml	500 ml
56.0%	220 ml	280 ml	500 ml
100.0%	———	500 ml	500 ml

Table 2. Data recorded during 48 hour, *Daphnia pulex*, static acute toxicity bioassay of Royster Mulberry, Polk County, Florida, NPDES #FL0000671, on 17 to 19 May, 1983.

Conc. 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)			$NH_3/NH_4OH/NH_4$ (mg/l)		Conductivity (µmhos)	
	0	24	48	0	24	48	0	24	48	0	48	0	48	0	24	48	0	48	0	48
Control	10	10	10	8.9	8.9	8.6	7.8	8.2	8.2	113		115		21.0	20.7	20.3	0/.02	--		
Control	10	10	10	8.9	8.9	8.6	7.8	8.2	8.3										201	210
5.6%	10	10	10	8.9	8.9	8.6	7.8	8.2	8.2					20.8	20.4	20.2				
5.6%	10	10	10	8.9	8.9	8.6	7.8	8.2	8.2										342	338
10.0%	10	10	10	8.9	8.8	8.6	7.8	8.2	8.2					20.8	20.5	20.3				
10.0%	10	10	10	8.9	8.8	8.6	7.8	8.2	8.2										445	575
18.0%	10	10	10	8.7	8.8	8.6	7.7	8.1	8.1					20.8	20.4	20.2				
18.0%	10	10	10	8.7	8.8	8.6	7.7	8.1	8.1										520	750
32.0%	10	10	10	8.7	8.7	8.7	7.6	8.0	8.0					20.7	20.5	20.2				
32.0%	10	10	10	8.7	8.7	8.7	7.6	8.0	8.0										780	1100
56.0%	10	10	10	8.7	8.5	8.7	7.4	7.8	7.8					20.5	20.5	20.1				
56.0%	10	10	9	8.7	8.5	8.7	7.4	7.8	7.8										1200	1700
100.0%	10	10	10	8.4	8.3	8.7	7.0	7.1	7.1	26		327		20.2	20.4	20.1	.005/.94	--		
100.0%	10	10	10	8.5	8.3	8.7	7.0	7.1	7.1										2650	2710

Remarks:

Table 3. Data recorded during 48 hour, Heterandria formosa,[a] static acute toxicity bioassay of Royster Mulberry, Polk County, Florida, NPDES #FL0000671, on 17 to 19 May, 1983.

Conc. 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/NH_3+NH_4 (mg/ℓ)		Conductivity (μmhos)	
	0	24	48	0	24	48	0	24	48	0	48	0	48	0	24	48	0	48	0	48
Control	5	5	5	8.8	8.4	8.2	7.8	8.1	8.1	113		115		20.8	20.2	20.2	0/.02	--		
Control	5	5	5	8.8	8.5	8.2	7.8	8.1	8.1										202	208
5.6%	5	5	5	8.8	8.4	8.2	7.8	8.0	8.0					20.9	20.3	20.0				
5.6%	5	5	5	8.8	8.3	8.2	7.8	8.0	8.0										340	340
10.0%	5	5	5	8.8	8.2	8.2	7.8	8.0	8.0					20.8	20.2	20.3				
10.0%	5	5	5	8.8	8.2	8.2	7.8	8.0	8.0										450	450
18.0%	5	5	5	8.8	8.2	8.3	7.7	7.9	8.0					20.7	20.1	20.1				
18.0%	5	5	5	8.8	8.2	8.3	7.7	7.9	8.0										750	730
32.0%	5	5	5	8.8	8.2	8.3	7.6	7.9	7.9					20.6	20.1	20.1				
32.0%	5	5	5	8.8	8.2	8.3	7.6	7.9	7.9										1100	1100
56.0%	5	5	5	8.8	8.1	8.3	7.4	7.6	7.7					20.4	20.1	20.3				
56.0%	5	5	5	8.8	8.1	8.3	7.4	7.6	7.7										1650	1650
100.0%	5	5	5	8.6	7.8	8.2	7.0	7.1	7.0	26		327		20.1	20.1	20.1	.005/.94	--		
100.0%	5	5	5	8.6	7.8	8.2	7.0	7.1	7.0										2640	2600

Remarks: [a] Weight of fish = 6.53 mg each, average of 10 fish.

RESULTS AND DISCUSSION

The sample of non-process wastewater from Royster Mulberry's Outfall #002 was not toxic to the test organisms, Daphnia pulex and Heterandria formosa. Only one D. pulex mortality was noted, in the 56% test concentration (Table 2), while no H. formosa died during the 48 hour static tests. Since the sample was not acutely toxic, chemical analyses were not performed.

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