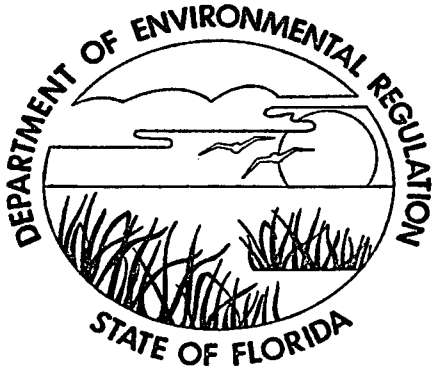


BIOASSAYS OF HOMESTEAD POWER PLANT

HOMESTEAD, DADE COUNTY, FLORIDA

NPDES #FL0002721

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NOVEMBER 14, 1986

Biology Section
Division of Environmental Programs

BIOASSAYS OF HOMESTEAD POWER PLANT

HOMESTEAD, DADE COUNTY, FLORIDA

NPDES #FL0002721

Biology Section
Bureau of Laboratories and
Special Programs
November 14, 1986

EXECUTIVE SUMMARY

Homestead Power Plant, Dade County, NPDES #FL0002721, on 23 to 25 September, 1986.

The sample of effluent collected from the Homestead Power Plant was apparently not acutely toxic to the test organisms, Notropis leedsi, Daphnia pulex, and Ceriodaphnia dubia. Only a few N. leedsi and C. dubia deaths were noted by 48 hours. However, the effluent did exhibit some toxicity to Daphnia pulex (20% mortality in the 100% concentration), which produced a calculated LC_{50} value of 280%. The confidence intervals associated with this LC_{50} calculation, however, are so large that, statistically, we cannot be assured that a violation of the acute toxicity standards has occurred. Therefore, we do not consider the sample to be acutely toxic.

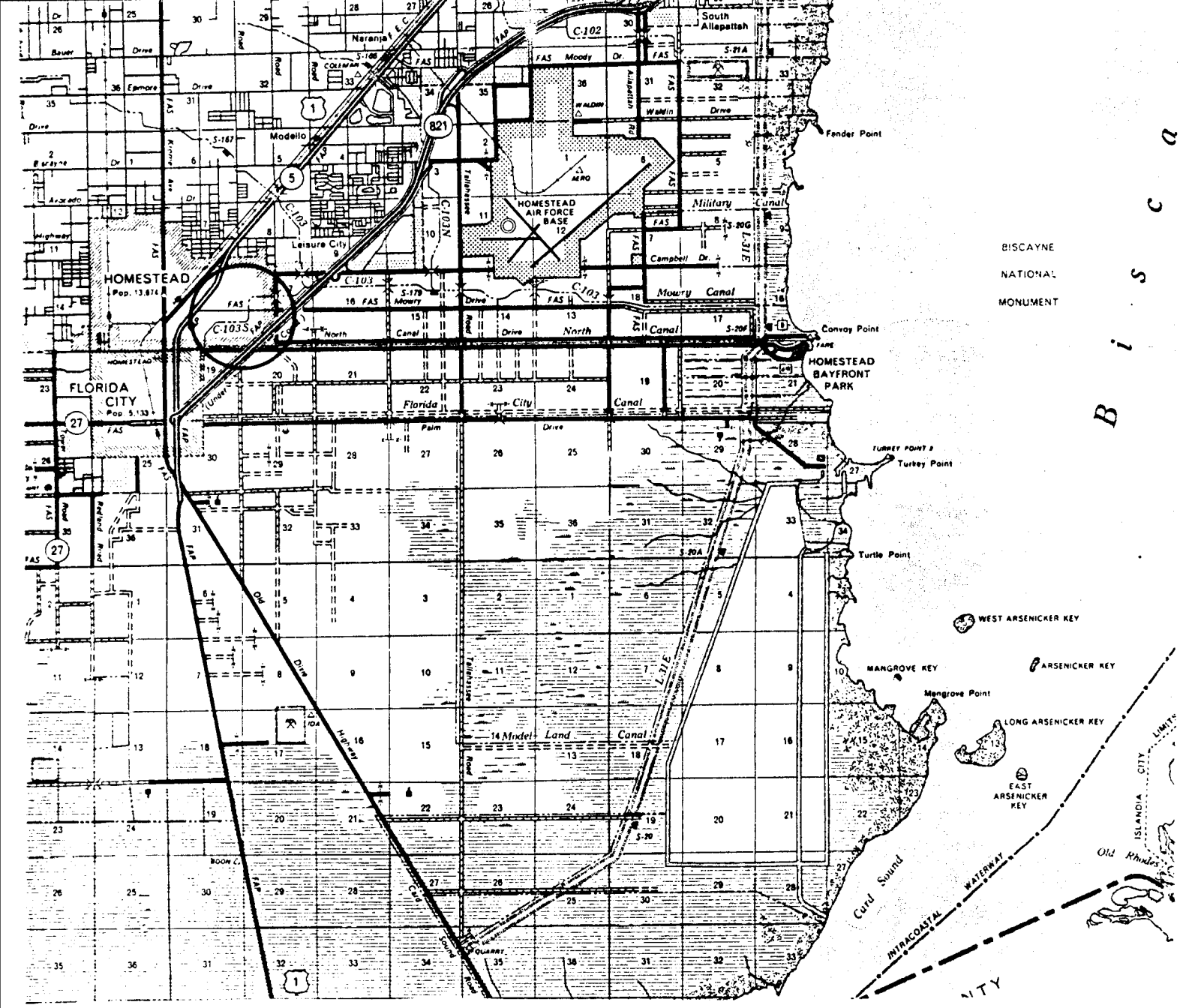
A cause of this slight toxicity was not readily apparent. No residual chlorine was detected in the sample and only a small amount of ammonia (0.3 mg/l total) was measured. Since the sample was not considered to be actuely toxic, further chemical analyses were not performed.

We recommend continued routine inspection and biomonitoring of this facility.

INTRODUCTION

The Homestead Power Plant is located at 675 North Flagler Avenue, Homestead, Dade County, Florida (Fig. 1). This electric generating facility consists of nine small diesel-powered units which burn either natural gas or low-sulfur fuel oil. The 12 MGD wastewater discharge consists mostly of once-through cooling water, which flows into Card Sound (south of Biscayne Bay) via drainage ditches. The facility has a history of cooling water contamination due to oil from leaks in the cooling tubes (data from NPDES file).

At the request of DER's Southeast Florida District, the Biology Section performed three 48 hour static acute toxicity bioassays on 23 to 25 September, 1986, to evaluate the toxicity of the discharge from Homestead Power Plant. The results of these tests are presented in this report. Those involved in performing these tests and in the preparation of this report were: R. B. Frydenborg, M. L. Roll, and P. G. Weiland.



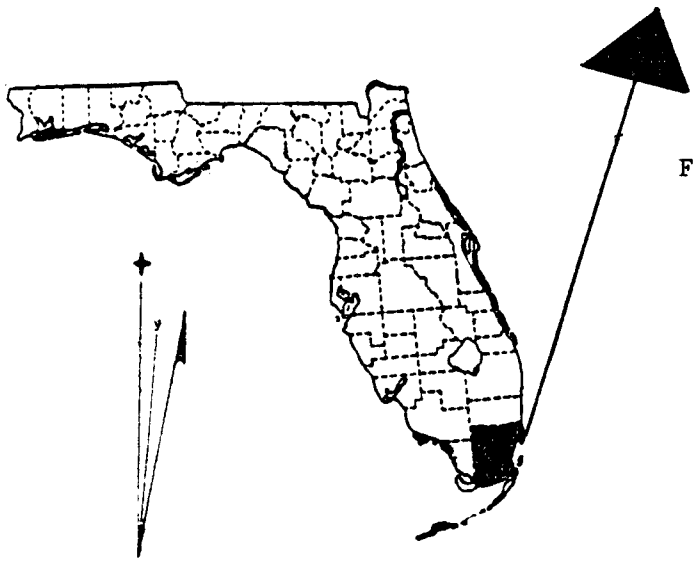


Figure 1. Portions of Dade County, Florida including Homestead and the approximate location of the Homestead Power Plant.

METHODS AND MATERIALS

Test methods used to conduct these static bioassays are extensively described by Peltier and Weber (1985) and the FDER Biology Section (1985). The organisms selected for this study include species recommended by Peltier and Weber (1985), the U.S. EPA (1978), and the FDER Biology Section (1985). 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, once daily on weekends, and are kept at a constant temperature of 22° ± 2°C. The aquaria are cleaned weekly by siphoning off half the water along with the detritus and excess organisms, and then refilling 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.

Ceriodaphnia dubia (water flea) - A breeding culture of Ceriodaphnia dubia was obtained from the EPA laboratory in Athens, Georgia, in June, 1985. The culture is maintained 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®, Cerophyl® and Fleischmann's® yeast twice daily, once daily on weekends, and are kept at a constant temperature of 26° ± 2°C. The aquaria are cleaned weekly by siphoning off half the water along with the detritus and excess organisms, and then refilling 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.

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° ± 2°C under a 16:8 hour light-dark cycle and are fed Tetra-Min® and frozen Artemia (brine shrimp) twice daily, and once daily on weekends. Breeding and egg hatching are encouraged at 25°C. The eggs are laid between stacked red ceramic tiles separated by a 3mm bead of silicone. Most of the eggs adhere to the tiles and are easily removed to heated, aerated hatching tanks. The narrow space between the tiles eliminates egg predation by

adult fish. New hatching tanks are started regularly 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 33 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

Methods used to perform acute toxicity bioassays are described by Peltier and Weber (1985) and the FDER Biology Section (1985). Some of the methods described below are more specific than those of Peltier and Weber. These will be noted in more detail.

Sampling Methods and Test Dates

Three static acute toxicity bioassays were performed on a sample of effluent (cooling water) collected from Homestead Power Plant. The tests were performed from 1000 hours on 23 September to 1000 hours on 25 September, 1986.

The sample was collected by Mr. William Thiel of DER's Southeast District at 1115 hours on 22 September, 1986, 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.

Test Temperature

Upon arrival of the iced (4°C) bioassay sample in the Tallahassee laboratory, the containers were placed in warm water and the temperature of the samples allowed to rise to 20° $\pm$ 2°C. Although this temperature may be different than the temperature of the sample during collection, it is the temperature range to which the test organisms are acclimatized and is the range recommended in the above referenced bioassay protocols. This avoids stressful effects caused by exposure to unusually cold or warm samples.

Freshwater Tests

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 an abbreviated version of that recommended by APHA (1980).

Two replicates, of each concentration and a control, were used to test with the water fleas, Ceriodaphnia dubia and Daphnia pulex. Flint glass jars of either 60 ml (for C. dubia) or 250 ml (for D. pulex) capacity were used as test chambers, and either 50 ml or 200 ml of the appropriate test concentration was placed in each chamber. Ceriodaphnia were siphoned into a large culture dish and neonates were transferred by glass pipette, and loaded 10 per chamber, resulting in 20 per test concentration. Daphnia were siphoned into a large culture dish to isolate the proper size and age organisms (neonates). To accomplish this, the Daphnia 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 Notropis leedsi (bannerfin shiner) 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.

Test Parameters

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 concentration 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 and end of the test. Total ammonia concentrations were determined using a HACH test kit. 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, 3, and 4.

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

Ceriodaphnia dubia (water flea)

Concentration	Dilution Water	Effluent	Total Volume
Control	50.0 ml	--------	50 ml
10.0%	45.0 ml	5.0 ml	50 ml
32.0%	34.0 ml	16.0 ml	50 ml
56.0%	22.0 ml	28.0 ml	50 ml
100.0%	-------	50.0 ml	50 ml

Daphnia pulex (water flea)

Concentration	Dilution Water	Effluent	Total Volume
Control	200.0 ml	--------	200 ml
10.0%	180.0 ml	20.0 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

Notropis leedsi (bannerfin shiner)

Concentration	Dilution Water	Effluent	Total Volume
Control	500 ml	--------	500 ml
50.0%	250 ml	250 ml	500 ml
100.0%	------	500 ml	500 ml

Table 2. Data recorded during 48 hour, Ceriodaphnia dubia, static acute toxicity bioassay of Homestead Power Plant, NPDES #FL0002721, Homestead, Dade County, from 23 to 25 September, 1986.

Concentration or %	Number of Live Organisms			Dissolved Oxygen (mg/l)			pH			Temperature (°C)			Conductivity[a] (umhos)	
	0	24	48	0	24	48	0	24	48	0	24	48	0	48
Control	10	10	10	8.6	8.4	8.5	8.0	7.8	7.9	21.5	20.0	20.0		
Control	10	10	10	8.6	8.4	8.5	8.0	7.8	7.9					
10.0%	10	10	10	8.7	8.5	8.5	8.0	7.9	8.0	21.5	19.9	19.5		
10.0%	10	10	10	8.7	8.5	8.5	8.0	7.9	8.0					
32.0%	10	10	10	8.7	8.7	8.7	7.9	7.9	8.1	21.5	19.9	19.5		
32.0%	10	10	10	8.7	8.7	8.7	7.9	7.9	8.1					
56.0%	10	10	10	8.7	8.7	8.7	7.8	7.9	8.1	21.5	19.8	19.5		
56.0%	10	10	10	8.7	8.7	8.7	7.8	7.9	8.1					
100.0%	10	10	9	8.7	8.8	8.6	7.6	8.0	8.2	21.5	19.8	19.7		
100.0%	10	10	10	8.7	8.8	8.6	7.6	8.0	8.2					

Control Water

NH_3(as NH_3)(mg/l): 0

Total ammonia (as N)(mg/l): 0

Total Alkalinity (mg/l $CaCO_3$): 120

Total Hardness (mg/l $CaCO_3$): 121

100% Effluent

NH_3(as NH_3)(mg/l): .006

Total ammonia (as N)(mg/l): 0.3

Total Alkalinity (mg/l $CaCO_3$): 210

Total Hardness (mg/l $CaCO_3$): 242

[a] Chambers too small for conductivity probe; not measured.

Table 3. Data recorded during 48 hour, Daphnia pulex, static acute toxicity bioassay of Homestead Power Plant, NPDES #FL0002721, Homestead, Dade County, from 23 to 25 September, 1986.

Concentration or %	Number of Live Organisms			Dissolved Oxygen (mg/l)			pH			Temperature (°C)			Conductivity (umhos)	
	0	24	48	0	24	48	0	24	48	0	24	48	0	48
Control	10	10	10	8.8	8.5	8.5	8.0	8.0	8.0	21.5	19.8	19.5		
Control	10	10	10	8.8	8.5	8.5	8.0	8.0	8.0				205	215
10.0%	10	10	10	8.8	8.6	8.6	8.0	8.0	8.0	21.5	19.9	19.4		
10.0%	10	10	10	8.8	8.6	8.6	8.0	8.0	8.0				235	230
32.0%	10	9	9	8.9	8.7	8.7	7.9	8.0	8.1	21.6	19.9	19.5		
32.0%	10	10	10	8.9	8.7	8.7	7.9	8.0	8.1				295	285
56.0%	10	10	10	8.9	8.8	8.7	7.8	8.0	8.1	21.5	19.9	19.5		
56.0%	10	10	10	8.9	8.8	8.7	7.8	8.0	8.1				360	350
100.0%	10	10	8	8.7	8.8	8.5	7.6	8.0	8.2	21.5	19.9	19.7		
100.0%	10	10	8	8.7	8.8	8.5	7.6	8.0	8.2				480	450

Control Water

NH_3(as NH_3)(mg/l): 0

Total ammonia (as N)(mg/l): 0

Total Alkalinity (mg/l $CaCO_3$): 120

Total Hardness (mg/l $CaCO_3$): 121

100% Effluent

NH_3(as NH_3)(mg/l): .006

Total ammonia (as N)(mg/l): 0.3

Total Alkalinity (mg/l $CaCO_3$): 210

Total Hardness (mg/l $CaCO_3$): 242

Table 4. Data recorded during 48 hour, Notropis leedsi, static acute toxicity bioassay of Homestead Power Plant, NPDES #FL0002721, from 23 to 25 September, 1986.

Concentration or %	Number of Live Organisms			Dissolved Oxygen (mg/l)			pH			Temperature (°C)			Conductivity (umhos)	
	0	24	48	0	24	48	0	24	48	0	24	48	0	48
Control	5	5	5	8.3	7.8	7.5	7.6	7.8	7.9	22.0	19.8	19.6		
Control	5	5	5	8.3	7.7	7.5	7.6	7.9	7.9				215	195
50.0%	5	5	5	8.4	7.7	7.5	7.5	7.8	7.9	22.0	19.8	19.6		
50.0%	5	5	5	8.5	7.7	7.5	7.5	7.8	7.9				356	315
100.0%	5	5	5	8.5	7.8	7.6	7.5	7.8	8.0	21.5	19.8	19.6		
100.0%	5	4	4	8.5	7.9	7.6	7.5	7.8	8.0				480	440

Control Water

NH_3(as NH_3)(mg/l): 0

Total ammonia (as N)(mg/l): 0

Total Alkalinity (mg/l $CaCO_3$): 120

Total Hardness (mg/l $CaCO_3$): 121

100% Effluent

NH_3(as NH_3)(mg/l): .005

Total ammonia (as N)(mg/l): 0.3

Total Alkalinity (mg/l $CaCO_3$): 210

Total Hardness (mg/l $CaCO_3$): 242

Table 5. LC_{50} Data for Bioassays of the Homestead Power Plant, NPDES #FL0002721, on 23 to 25 September, 1986.

Organism	Method of Data Analysis	24 Hour LC_{50} and 95% Confidence Intervals	48 Hour LC_{50} and 95% Confidence Intervals
Daphnia pulex	Binomial Moving Average Probit	Random Mortality	a a 280.0% (123.9 and ∞)
Ceriodaphnia dubia	Binomial Moving Average Probit	No Mortality	a
Notropis leedsi	Binomial Moving Average 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.

RESULTS AND DISCUSSION

The sample of cooling water discharge from the Homestead Power Plant was not considered to be acutely toxic to the test organisms, Ceriodaphnia dubia, Notropis leedsi, and Daphnia pulex. Only a few C. dubia and N. leedsi deaths were noted by the end of the 48 hour tests. However, a significant number of D. pulex (20% mortality in the 100% concentration) had died, producing a calculated LC_{50} value of 280.0% (Table 5). The 95% confidence intervals associated with this LC_{50} are so large that, statistically, we cannot be assured of the exactness of the calculation. Therefore, we do not consider the dishcarge to be acutely toxic or in violation of the acute toxicity standards.

A cause of the slight toxicity noted above was not readily apparent. No residual chlorine and only a small amount of ammonia (0.3 mg/l total and 0.006 mg/l unionized) was measured in the sample. Since the sample was not considered acutely toxic, further chemical analyses were not performed.

Recommendation

We recommend continued routine inspection and biomonitoring of the discharges from this facility.

LITERATURE CITED

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