

BIOASSAYS OF MRI CORPORATION

TAMPA, HILLSBOROUGH COUNTY, FLORIDA

NPDES # FL0001775

Biological Section
Bureau of Water Analysis
February 4, 1981

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INTRODUCTION

The MRI Corporation is a tin electrowinning (recovery of metals from solution using electrolysis) plant located at 9220 Stannum St., Tampa, Hillsborough County, Florida (Figure 1). The NPDES designated outfall (#001) is to an unnamed ditch, thence to Six Mile Creek, and ultimately to Tampa Bay. Toxic substances in the discharge may include heavy metals, (mercury, chromium, copper, lead, iron, aluminum, cadmium, zinc, and nickel), cyanide and oil and grease. Treatment prior to discharge of 0.044 MGD wastewater includes a calcium hypochlorite rinse, acidification with sulfuric acid, rotating drum vacuum filtration, neutralization, and final dilution with non-contact cooling water.

At the request of DER's Southwest District , as well as MRI Corporation, the Biological Section performed static bioassays on 4 November 1980, to determine the existence and extent of toxicity to the biota of the receiving waters. These tests were performed to confirm the toxicity of this effluent which was noted in an earlier DER Bioassay (1 July 1980). At the request of the company and the DER District Office, the Biological Section split bioassay samples with a consulting firm (Environmental Science and Engineering, Inc.) employed by MRI Corporation. Additionally, on 16 December 1980, the Biological Section performed further static bioassays on effluent from MRI Corporation. This third series of bioassays was requested by personnel from DER's Southwest District since there was some confusion regarding the sample site location for the tests conducted on 4 November 1980.

The results of these tests (conducted on 4 November and 16 December 1980) are presented here.

Mysidopsis bahia (mysid shrimp) - In September, 1978, approximately 300 adult mysid shrimp were obtained from the Gulf Breeze EPA Laboratory in Pensacola, Florida. The mysids have been cultured under continuous lighting in 10 and 15 gallon all glass aquaria equipped with undergravel filtration and aeration. The mysid shrimp are cultured over a wide range of salinities (10-30 0/00) to minimize acclimation periods to low or high salinity effluents. Sea water is obtained from the FSU Marine Laboratory located at Turkey Point, Florida (salinity range 17-31 0/00) and partial water changes are performed weekly. Fresh water, for dilution of the sea water as necessary, is obtained from a deep well near the DER laboratory. The mysids are fed twice daily with freshly hatched Artemia (brine shrimp) and are kept at a constant temperature of $22^{o} \pm 1^{o}C$. Immediately prior to the bioassay, a suitable number of mysids were transferred by net to a culture dish for observation and selection of individuals for the test. Fifteen day old (three-quarter adult size) mysids were used in this test. Organisms selected for testing were transferred individually by glass tube and randomly placed in the test chambers.

To ensure the uniform sensitivity of these test organisms to toxic substances, the Biological Section conducts monthly Standard Reference Toxicant Bioassays using sodium lauryl sulfate as the reference toxicant.

Test Methods

Four separate 48 hour static bioassays were conducted from 1000 hours on 4 November to 1000 hours on 6 November 1980. Two additional static bioassays were performed from 1000 hours on 16 December to 1000 hours on 18 December 1980. The respective grab samples were collected by Mr. David Demmi at 1200 hours on 3 November 1980, and Mr. Don Moores at 1015 hours on 15 December 1980. Both are from DER's Southwest District Office and used standard wastewater sampling procedures. In each case separate samples were obtained for chemical and biological analyses. Samples for heavy metal analysis were preserved with HNO_3. Samples for the bioassays were unpreserved. The samples were iced and transported to the DER laboratory in Tallahassee within 24 hours of their collection. The following table lists the test organisms used for these toxicity tests:

Test Date	Test Organism
4 to 6 November 1980	Daphnia pulex
	Simocephalus serrulatus
	Pimephales promelas
	Mysidopsis bahia
16 to 18 December 1980	Daphnia pulex
	Mysidopsis bahia

Diluent for the freshwater bioassays was obtained from the same DER well that is used to culture the test organisms. The concentration series selected for this study (Table 1a and b) is that recommended by APHA (1976).

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

Two replicates of six concentrations and a control, were used for the Pimephales promelas 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. Fathead minnows were loaded 5 per chamber resulting in 10 per 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, 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 forms (Tables 2, 3 and 4 for the November tests and Table 6 for the December test). These organisms were not fed during the course of the tests.

Two 48 hour saltwater static bioassays (one in November and one in December) were also conducted on the effluent samples from MRI Corporation. Saltwater for dilution of the effluent samples was obtained from Turkey Point (salinity= 30.0 0/00 for the 4 November bioassay and 28.8 0/00 for the 16 December bioassay). To minimize salinity differences between the various concentrations, freshly autoclaved artificial sea salts (Ocean 50®) were added to the effluent samples and mixed with a magnetic stirrer until the dry salt mix dissolved. A salinity of 28.5 0/00 and 27.5 0/00 was achieved in two effluent samples on the respective test dates.

Two replicates, each of six concentrations of effluent and two controls were used in these tests. The first set of controls consisted of Turkey Point seawater and the second set consisted of DER well water adjusted to the approximate salinity of the diluent (i.e. 27 0/00)with artificial sea salts (Ocean 50®). Immediately prior to the bioassays a suitable number of mysids was transferred by net to a culture dish for observation and selection of individuals for the test. Individual mysid shrimp were siphoned or pipetted via glass tube, carefully examined for injury and transferred to wide mouth quart jars, each containing 500 ml of the appropriate concentration. The concentration series selected for these two studies (Table 1c) are those recommended by APHA (1976).

Five organisms were loaded per test chamber, giving ten per concentration. The pH, dissolved oxygen and the number of live organisms were recorded at 0, 24, and 48 hours (Table 4 and 6). According to U. S. EPA (1978), "Although it is generally undesirable to feed most fish and macroinvertebrates during static toxicity tests, an exception is necessary, for M. bahia". Therefore, mysids were fed brine shrimp nauplii (Artemia) daily at a rate of approximately 10 to 20 per mysid to minimize cannibalism.

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

a. Water fleas (Daphnia pulex and Simocephalus serrulatus)

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

b. 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

c. Mysid shrimp (Mysidopsis bahia)

Concentration	Seawater Diluent	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

Table 2 . Data recorded during 48 hour, Daphnia pulex, static acute toxicity bioassay of MRI Corporation, Tampa, Hillsborough County, Florida. NPDES #FL0001775, Outfall #003, 4 to 6 November 1980.

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 (µmhos)		
		0	24	48	0	24	48	0	24	48	0	24	48	0	24	48	0	24	48
Control	14	10	10	10	8.6	8.4	7.5	7.4	7.5	7.5	117			116					
Control	83	10	10	9	8.5	8.3	7.5	7.4	7.5	7.5							219		
5.6%	93	10	10	10	8.5	8.2	7.6	7.5	7.6	7.6									
5.6%	91	10	10	9	8.5	8.2	7.5	7.5	7.6	7.7							340		
10.0%	73	10	10	10	8.6	8.2	7.4	7.5	7.8	7.7									
10.0%	32	10	10	10	8.5	8.1	7.4	7.5	7.8	7.8							435		
18.0%	55	10	10	9	8.5	8.1	7.5	7.5	7.8	7.9									
18.0%	26	10	10	9	8.3	8.1	7.5	7.5	7.9	7.9							710		
32.0%	78	10	10	10	7.9	8.1	7.5	7.6	7.9	7.9									
32.0%	68	10	10	10	7.9	8.0	7.5	7.6	7.9	7.9							1020		
56.0%	48	10	10	10	8.4[c]	8.0	7.5	7.9	8.1	8.0									
56.0%	46	10	10	10	8.5[c]	7.9	7.4	7.9	8.1	8.0							1580		
100%	77	10	10	4[b]	8.3[c]	7.2	7.3	7.7	8.2	8.2									
100%	42	10	10	6[b]	8.4[c]	7.3	7.2	7.7	8.2	8.2	320			320			2510		

Remarks:

a. Test temperature range 20.0 to 21.2°C.
b. surviving organisms appear stressed.
c. Aerated to near saturation because of low dissolved oxygen content of effluent.

TABLE 5 .Data recorded during 48-hour, *Simocephalus serrulatus*, static acute toxicity bioassay of MRI Corporation, Tampa, Hillsborough County, Florida. NPDES #FL0001775, Outfall #003, 4 to 6 November 1980.

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 (µmhos)		
		0	24	48	0	24	48	0	24	48	0	24	48	0	24	48	0	24	48
Control	29	10	10	9	8.4	8.6	7.3	7.5	7.7	7.8	117			116					
Control	66	10	10	7	8.5	8.6	7.4	7.5	7.7	7.8							219		
5.6%	82	10	10	8	8.5	8.5	7.4	7.5	7.8	7.8									
5.6%	02	10	10	10	8.5	8.5	7.4	7.5	7.8	7.8							340		
10.0%	88	10	10	10	8.6	8.5	7.3	7.6	7.8	7.9									
10.0%	95	10	10	9[b]	8.5	8.4	7.3	7.6	7.8	7.9							435		
18.0%	17	10	10	9	8.5	8.4	7.3	7.6	7.9	7.9									
18.0%	20	10	10	9	8.4	8.3	7.3	7.6	7.9	7.9							710		
32.0%	19	10	10	7	7.9	8.2	7.3	7.6	7.9	8.0									
32.0%	21	10	10	7[b]	7.9	8.1	7.3	7.6	7.9	8.0							1000		
56.0%	75	10	10	8[b]	8.3[c]	8.0	7.3	7.9	8.0	8.1									
56.0%	31	10	10	6[b]	8.6[c]	8.0	7.3	7.9	8.1	8.1							1500		
100%	53	10	10	3[b]	8.6[c]	7.6	7.1	7.7	8.1	8.2									
100%	60	10	10	4[b]	8.6[c]	7.5	7.0	7.7	8.1	8.2	320			320			2410		

Remarks:
a. Test temperature range 20.0 to 21.2 °C
b. Several organisms appear stressed.
c. Aerated to near saturation because of low dissolved oxygen content of effluent.

Table 4 . Data recorded during 48-hour, Pimephales promelas, static acute toxicity bioassay of MRI Corporation, Tampa, Hillsborough County, Florida. NPDES #FL0001775, Outfall #003, 4 to 6 November 1980

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 (µmhos)		
		0	24	48	0	24	48	0	24	48	0	24	48	0	24	48	0	24	48
Control	05[b]	5	5	5	8.3	7.5	8.4	7.5	7.7	7.8	117			116					
Control	57[c]	5	5	5	8.4	7.5	7.8	7.5	7.7	7.7							225		
5.6%	06[b]	5	5	5	8.4	7.6	8.2	7.6	7.7	7.7									
5.6%	28[c]	5	5	5	8.4	6.8	7.3	7.6	7.7	7.7							350		
10.0%	33[b]	5	5	5	8.4	7.4	8.2	7.6	7.8	7.8									
10.0%	30[c]	5	5	5	8.3	6.7	7.3	7.6	7.7	7.7							445		
18.0%	37[b]	5	5	5	8.2	7.4	8.2	7.6	7.8	7.9									
18.0%	46[c]	5	5	5	8.3	6.8	7.5	7.6	7.8	7.8							730		
32.0%	16[b]	5	5	5	7.6	7.4	8.1	7.6	7.8	8.0									
32.0%	50[c]	5	5	5	7.6	6.4	7.4	7.6	7.8	7.9							1060		
56.0%	49b	5	5	5	8.5[d]	7.3	8.1	7.7	8.0	8.0									
56.0%	11[c]	5	5	5	8.5[d]	6.7	7.4	7.8	8.0	8.0							1590		
100%	32[b]	5	5	5	7.9[d]	7.2	7.9	7.7	8.0	8.2									
100%	21[c]	5	5	5	8.6[d]	6.4	6.7	7.7	8.0	8.1	320			320			2540		

Remarks:
a. Test temperature range 20.0 to 21.1°C.
b. Contains all 5 to 10 days old fish (0.004lg/fish).
c. Contains all 14 to 18 days fish (0.029g/fish).
d. Aerated to near saturation because of low dissolved oxygen content of effluent.

Table 5 . Data recorded during 48 hour, Mysidopsis bahia, static acute toxicity bioassay of NRI Corporation, Tampa, Hillsborough County, Florida. NPDES #FL0001775, Outfall = 003, 4 to 6 November 1980.

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 $CaCO_3$)					Salinity (0/00)				
		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	44	5	5	5			7.5	5.8	5.8	7.6	7.4	7.4															
Control	19	5	5	5			7.6	5.9	6.1	7.7	7.5	7.5											30.0				
Control	34[b]	5	5	4[d]			7.3	6.2	6.1	8.4[f]	8.1	7.9															
Control	42[b]	5	5	5			7.3	6.2	6.5	8.4[f]	8.1	7.9											27.0				
5.6%	29	5	5	5			7.5	5.6	6.1	8.0	7.7	7.6															
5.6%	35	5	5	5			7.5	5.7	6.1	8.0	7.7	7.6											30.0				
10.0%	54	5	5	4[e]			7.6	5.4	5.3	8.0	7.7	7.5															
10.0%	15	5	5	5			7.6	5.5	5.8	8.0	7.7	7.6											30.0				
18.0%	14	5	5	5			7.6	5.6	5.9	8.1	7.8	7.7															
18.0%	17	6	6	6			7.4	5.6	6.0	8.1	7.8	7.7											30.0				
32.0%	25	5	5	5			7.4	5.5	5.8	8.2	8.0	7.9															
32.0%	12	5	5	5			7.4	5.5	6.1	8.2	8.0	7.9											30.0				
56.0%	31	5	5	5			7.5[c]	5.3	5.6	8.2	8.0	8.0															
56.0%	01	5	5	5			7.5[c]	5.3	6.3	8.2	8.1	8.0											29.0				
100%	39	5	4[d]	4			7.5[c]	5.5	6.1	8.3	8.2	8.2															
100%	20	5	5	5			7.3[c]	5.7	6.2	8.3	8.2	8.2											28.5				

REMARKS:
a. Test temperature range 19.5 to 21.5°C.
b. Salinity adjusted well water control.
c. Aerated to near saturation because of the low dissolved oxygen content of the effluent.
d. Dead mysid was cannibalized.
e. Mysid jumped out of test container.
f. pH lowered from 9.3 to 8.4 with 2N HCL.

Table 6 . Data recorded during 48 hour, Daphnia pulex, static acute toxicity bioassay of MRI Corporation, Tampa, Hillsborough County, Florida. NPDES #FL0001775, Outfall #001, 16 to 18 December 1980.

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 (µmhos)		
		0	24	48	0	24 [c]	48	0	24	48	0	24	48	0	24	48	0	24	48
Control	19	10	10	10	8.2	8.6	8.7	7.8	7.8	8.0	120			117			220		
Control	111	10	10	10	8.2	8.6	8.7	7.8	7.8	8.0									
5.6%	17	10	10	10	8.0	7.9	8.1	7.7	7.9	8.0									
5.6%	2	10	10	10	8.0	7.9	7.9	7.7	7.9	8.0									
10.0%	121	10	10	10	8.0	7.5	7.4	7.7	7.9	7.9									
10.0%	125	10	10	10	8.0	7.5	7.3	7.7	7.9	7.9									
18.0%	143	10	10	10[b]	8.0	6.6	7.5	7.7	8.0	8.1									
18.0%	114	10	10	9[b]	7.9	6.5	7.6	7.7	8.0	8.1									
32.0%	134	10	10	10[b]	7.6	5.0	7.5	7.7	8.0	8.1									
32.0%	136	10	10	10[b]	7.6	5.0	7.3	7.7	8.0	8.1									
56.0%	22	10	10	8[b]	7.0	2.6	6.8	7.7	8.0	8.2									
56.0%	47	10	8[b]	7[b]	7.0	2.6	6.5	7.7	8.0	8.2									
100%	130	10	7[b]	2[b]	6.1	2.3	4.4	7.7	8.1	8.3									
100%	115	10	7[b]	2[b]	6.0	2.2	4.2	7.6	8.1	8.3	215			380			5200		

Remarks:
a. Test temperature range 19.3 to 21.9°C.
b. Several organisms in stress: trapped in precipitate, abnormal swimming or lethargic behavior.
c. Test containers gently aerated to at least 6.0 mg/l dissolved oxygen.

Table 7. Data recorded during 48 hour, Mysidopsis bahia, static acute toxicity bioassay of MRI Corporation, Tampa, Hillsborough County, Florida. NPDES #FL0001775, Outfall #001, 16 to 18 December 1980.

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 $CaCO_3$)			Salinity (o/oo)		
		0	24	48	0	24	48	0	24	48	0	24	48	0	24	48	0	24	48
						c													
Control	A	5	5	5	7.3	7.3	6.4	7.8	7.6	7.5							28.8		
Control	B	5	5	5	7.5	7.4	6.4	7.8	7.6	7.5									
Control	C [b]	5	5	5	7.0	5.5	6.3	8.6[e]	7.6	7.9							27.5		
Control	D [b]	5	5	5	6.9	5.5	6.4	8.6[e]	7.6	7.8									
5.6%	A	5	5	5	7.4	4.4	5.8	7.9	7.7	7.6							28.8		
5.6%	B	5	5	5	7.5	4.3	5.9	7.9	7.7	7.6									
10.0%	A	5	5	5	7.5	3.5	5.6	7.9	7.7	7.6							29.0		
10.0%	B	5	5	5	7.5	3.6	5.0	7.9	7.7	7.5									
18.0%	A	5	5	5	7.5	2.3	6.5[d]	8.0	7.8	7.7							28.75		
18.0%	B	5	5	5	7.5	2.3	6.7[d]	8.0	7.8	7.7									
32.0%	A	5	1	0	7.3	1.3	6.2[d]	8.0	7.8	7.7							28.5		
32.0%	B	5	4	1	7.3	1.6	6.1[d]	8.0	7.8	7.8									
56.0%	A	5	0	0	7.0	0.8	---	8.1[e]	7.8	---							28.0		
56.0%	B	5	0	0	7.0	0.8	---	8.1[e]	7.8	---									
100%	A	5	0	0	6.6	0.6	---	8.2[e]	8.0	---							27.5		
100%	B	5	0	0	6.6	0.5	---	8.2[e]	7.9	---									

Remarks:
a. Test temperature range 19.6 to 22.8°C.
b. Salinity adjusted well water control.
c. Test containers aerated to near saturation.
d. Test containers gently aerated overnight due to rapid decrease in dissolved oxygen.
e. pH adjusted with 1 to 5 drops of 2N HCL as follows: Control C and D - pH 8.6 adjusted to 7.8, 56% A and B - pH 8.1 adjusted to 7.9, 100% A and B - pH 8.2 adjusted to 8.0

RESULTS AND DISCUSSION

The sample from MRI Corporation collected on 3 November 1980 was not toxic to Pimephales promelas (a freshwater fish) or Mysidopsis bahia (a saltwater invertebrate). However, the sample was toxic to Daphnia pulex (a freshwater invertebrate) and Simocephalus serrulatus (a freshwater invertebrate indigenous to Florida) after 48 hours of exposure. The 48 hour LC_{50}'s for these two test organisms were 100% and 78 to 82% respectively (Table 8). The 96 hour LC_{50} would therefore be less than or equal to the values reported after 48 hours.

The effluent samples collected on 15 December 1980 were toxic to both Daphnia pulex and Mysidopsis bahia although Daphnia were less sensitive (24 hour LC_{50} >100%; 48 hour LC_{50} = 72 to 73% (Table 9)). Mysid shrimp LC_{50}'s were 32% and 30% at 24 hours and 48 hours respectively. Ninety-six hour LC_{50}'s for these two test organisms are less than or equal to the 48 hour values reported above.

The two bioassays conducted from 16 to 18 December 1980 exhibited substantial dissolved oxygen depletion in the higher test concentrations after both 24 and 48 hours (Tables 6 and 7). Although aeration may alter the results ot toxicity tests and generally should not be used (Peltier, 1978), several intermittent and continuous aeration methods were employed. Despite these efforts dissolved oxygen levels fell below the 40% saturation limit discussed by Peltier (1978). This low dissolved oxygen may have stressed the Daphnia and contributed to the mortality noted in the mysid shrimp test.

The reasons for the excessive oxygen demand of this effluent are currently unknown. However, chemical analyses performed by the DER Chemistry Section in Tallahassee may explain the oxygen demand as well as characterize the toxic components of the MRI Corporation discharge. Results of the chemical analyses were not completed at the time of this report.

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 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 8. LC_{50} Data for Bioassay of MRI Corporation on 4 to 6 November 1980.

Organism	Method of Data Analysis	24 hour LC_{50} and 95% confidence intervals	48 hour LC_{50} and 95% confidence intervals
Daphnia pulex	Binomial	No mortality	100% (56-∞),B
	Moving average		A,B
	Probit		>100% (56-∞),B,C
Simocephalus serrulatus	Binomial	No mortality	78.1% (18-∞),B
	Moving average		78.1% (50-175),B
	Probit		82.1% (52-208),B
Pimephales promelas		No mortality	No Mortality
Mysidopsis bahia		Mortality not attributed to toxicity.	Mortality not attributed to toxicity.

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, the LC_{50} value calculated by this method of statistical analysis does not meet the criteria established by the Committee on Methods for Toxicity Tests with Aquatic Organisms.

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

Table 9. LC_{50} Data for Bioassay of MRI Corporation on 16 to 18 Decmeber 1980.

Organism	Method of Data Analysis	24 hour LC_{50} and 95% confidence intervals	48 hour LC_{50} and 95% confidence intervals
Daphnia pulex	Binomial	A, B	72.6% (56-100)
	Moving Average	A, B	72.4% (62-89)
	Probit	>100% (97-629), B	72.1% (39-4300),C
Mysidopsis bahia	Binomial	32% (18-56)	29.7% (18-56)
	Moving Average	A	A
	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.

B. Due to the distribution of mortality, the LC_{50} value calculated by the method of statistical analysis does not meet the criteria established by the Committee on Methods for Toxicity Tests with Aquatic Organisms.

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

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