BIOASSAYS OF [redacted] CORPORATION, [redacted] DIVISION

BREVARD COUNTY, FLORIDA

NPDES #FL0034690

SAMPLED 1/21/80

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Biological Section
Bureau of Water Analysis
April 7, 1980

INTRODUCTION

Harris Corporation, Semiconductor Division, is located on Palm Bay Road in Palm Bay, Brevard County (Fig. 1). The plant has been involved in the production of electronic components since 1970.

The Semiconductor Division of Harris Corporation discharges between 0.175 and 0.383MGD industrial wastewater to an unnamed drainage ditch. The drainage ditch flows into Turkey Creek which empties into the Indian River (Fig. 2). The wastewater discharge includes: semiconductor process rinse water, reverse osmosis reject water, regeneration wastes from the cationic/anionic resin exchange system, exhaust air scrubber water, cooling tower blowdown and once-through noncontact cooling water. Treatment prior to discharge consists of pH adjustment and two polishing ponds.

Potentially toxic substances in the plant effluent include: chromium, copper, lead, zinc, fluoride, hydrochloric acid, sodium hydroxide and ammonia (see appended chemical analysis data).

The following is a report of static bioassays, performed on effluent from this facility, to determine its possible effects on the biota of the receiving waters.

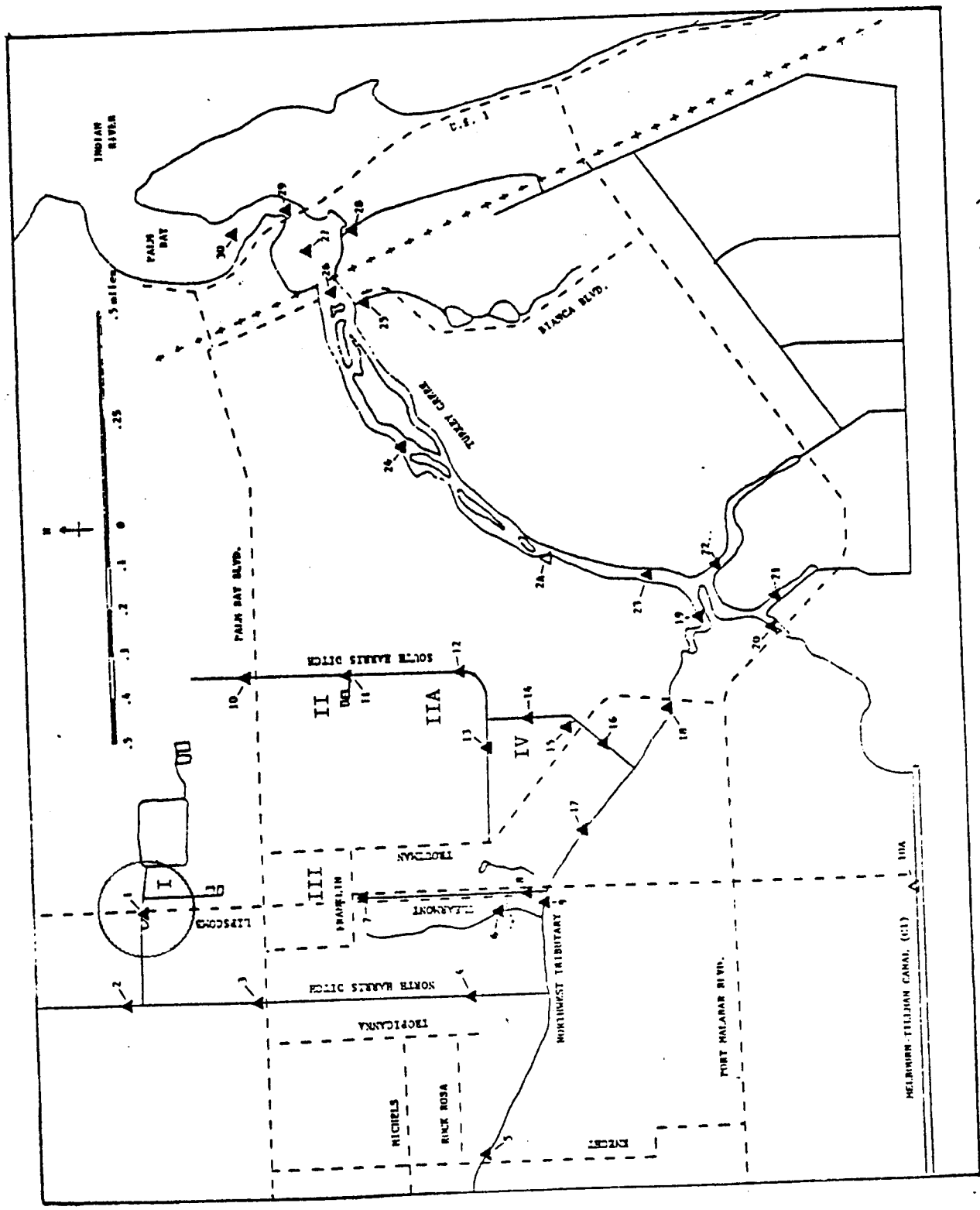


Figure 1. Station Location Map. Harris Corp., Semiconductor Division, Palm Bay, Brevard Co.

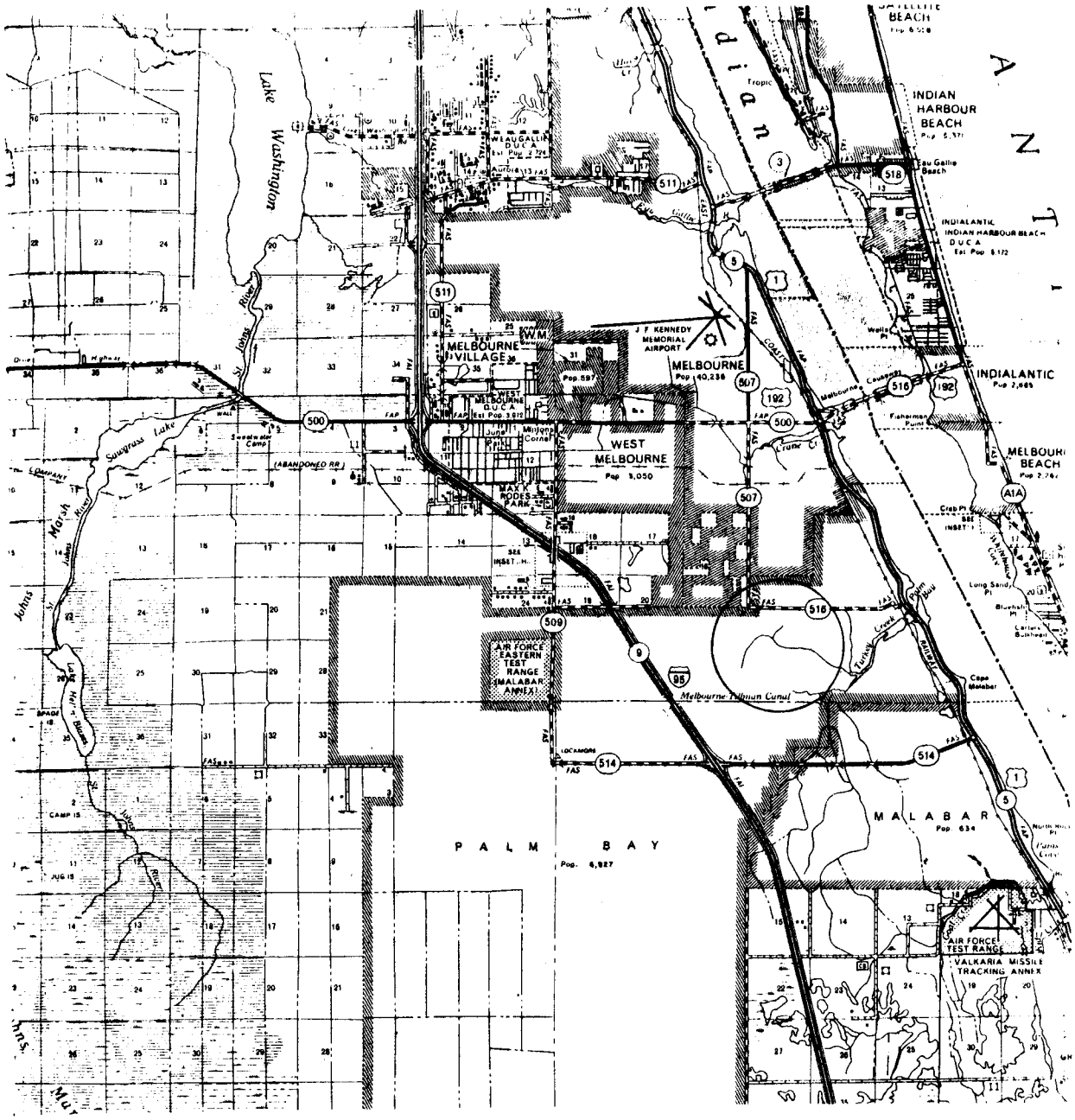


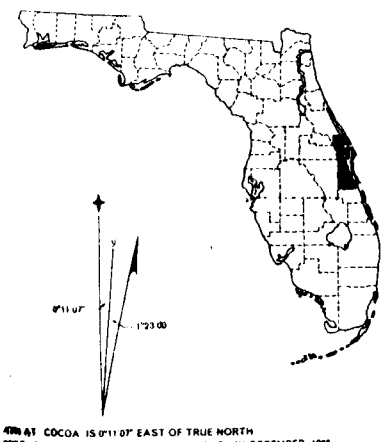
Figure 2. Portions of **BREVARD COUNTY** including study area **FLORIDA**

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FOR THE
TRAFFIC AND PLANNING DIVISION
FLORIDA STATE ROAD DEPARTMENT
IN COOPERATION WITH THE
U.S. DEPARTMENT OF COMMERCE
BUREAU OF PUBLIC ROADS

0 0.5 1 2 3 4 MILES
SCALE

0 0.1 0.2 0.3 0.4 0.5 MILE
SCALE FOR INSETS

MARCH, 1966



...61' COCOA IS 0°11'07" EAST OF TRUE NORTH
...IMATELY 1°23'00" EAST OF TRUE NORTH IN DECEMBER, 1966
...NETIC CHANGE IS APPROXIMATELY 7 WESTWARD

REVISIONS	
FEATURE	DATE
State Maintained Roads and City Limits	December 1968
SR 500, 514	March, 1969
MELBOURNE City Limits	Jan. 1971
US 192	Jan. 1971
I-95, SR 404	Jan., 1972

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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 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. 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 four 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 .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 aquaria 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

The Biological Section obtained samples of effluent from the Harris Corp., Semiconductor Division, to determine the existence and extent of toxicity to the biota of the receiving waters. Static bioassays were conducted on two

separate grab samples of effluent collected from outfall #001 (14 acre pond outfall at weir) of this facility. The initial sample of effluent was collected on 21 January 1980 by Mr. Mark Johnson and Mr. Steve Palmer of the Bureau of Water Analysis. A second sample of effluent from this outfall was collected by Mr. Johnson on 25 February 1980. Standard waste-water sampling procedures were used in each case. The initial sample was tested using both Daphnia pulex and fathead minnow (Pimephales promelas) in two separate bioassays (Tables 2 and 3). The second sample was tested with Daphnia pulex in a single bioassay (Table 4).

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 bioassays were unpreserved. The samples were iced and transported to the DER laboratory in Tallahassee within 24 hours of collection.

Fresh water 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 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). Fatheads 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 2). 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% effluent concentration. These values were recorded daily on the Bioassay Data forms and are presented in Tables 2, 3 and 4. 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 Harris Corporation, Semiconductor Division, Palm Bay, Brevard Co., Florida. 22 January to 24 January 1980. NPDES Permit #FL0034690. 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			8.7	8.6	8.7			8.3	7.7	8.2			125					135					300				
Control	B	10	8	8			8.6	8.6	8.7			8.3	7.7	8.3																	
5.6	A	10	9	9			8.6	8.7	8.7			8.1	7.6	8.1																	
5.6	B	10	9	9			8.7	8.6	8.6			8.1	7.6	8.1																	
10.0	A	10	10	10			8.8	8.8	8.7			8.0	7.6	8.0																	
10.0	B	10	10	10			8.8	8.7	8.6			8.0	7.6	8.0																	
18.0	A	10	10	10			8.9	8.8	8.7			7.8	7.5	8.0																	
18.0	B	10	9	9			8.9	8.8	8.7			7.9	7.5	8.0																	
32.0	A	10	10	10			9.1	8.8	8.8			7.6	7.4	7.9																	
32.0	B	10	10	10			9.2	8.8	8.8			7.6	7.3	7.9																	
56.0	A	10	9	9			9.4	8.9	8.9			7.2	7.1	7.7																	
56.0	B	10	9	9			9.5	8.8	8.8			7.2	7.1	7.7																	
100	A	10	10	10			9.9	9.0	8.9			6.4	5.7	6.5																	
100	B	10	9	9			10.1	8.9	8.9			6.3	5.6	6.4			15					620					1600				

Remarks:

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

Copepods observed in effluent.

Temperature range for test period: 22.5° to 23.5°C.

Table 3. Data recorded during 48-hour, Pimephales promelas, static acute toxicity bioassay performed on Harris Corporation, Semiconductor Division, Palm Bay, Brevard Co., Florida. 22 January to 24 January 1980. NPDES Permit #FL0034690. 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			8.3	5.1	5.8			8.05	7.9	7.8			125					135					300				
Control	B	5	5	5			8.3	5.3	6.3			8.05	8.0	7.8																	
5.6	A	5	5	5			8.3	5.0	6.0			7.95	8.0	7.7																	
5.6	B	5	5	5			8.3	5.1	6.7			7.95	8.0	7.7																	
10.0	A	5	5	5			8.3	4.8	6.3			7.85	7.9	7.6																	
10.0	B	5	5	5			8.4	5.3	6.4			7.85	8.0	7.6																	
18.0	A	5	5	5			8.6	4.8	6.2			7.7	7.8	7.6																	
18.0	B	5	5	5			8.6	5.0	6.4			7.7	7.9	7.6																	
32.0	A	5	5	5			8.8	3.6	5.9			7.5	7.7	7.4																	
32.0	B	5	5	5			8.8	5.4	6.5			7.5	7.8	7.5																	
56.0	A	5	5	5			9.0	4.8	6.6			7.1	7.5	7.3																	
56.0	B	5	5	5			9.1	4.7	6.5			7.1	7.6	7.3																	
100	A	5	5	5			9.7	4.5	6.0			6.1	6.4	6.4																	
100	B	5	5	5			9.6	4.2	6.3			6.0	6.4	6.4			15					620					1600				

Remarks:

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

After 24 hours all chambers were aerated to near saturation.

Temperature range for test period: 22.5° to 23.5°C.

Table 4. Data recorded during 48-hour, Daphnia pulex, static acute toxicity bioassay performed on Harris Corporation, Semiconductor Division, Palm Bay, Brevard Co., Florida. 27 February to 29 February 1980. NPDES Permit #FL0034690. 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	8			7.9	8.8	8.6			8.3	8.2	8.1			125					125					230				
Control	B	10	10	9			7.9	8.8	8.6			8.2	8.2	8.1																	
5.6	A	10	10	9			8.0	8.8	8.7			8.2	8.3	8.2																	
5.6	B	10	10	10			8.0	8.8	8.7			8.2	8.3	8.2																	
10.0	A	10	10	10			8.0	8.9	8.9			8.1	8.3	8.3																	
10.0	B	10	10	10			8.1	8.9	8.9			8.1	8.3	8.3																	
18.0	A	10	9	7			8.2	9.0	9.1			8.1	8.3	8.3																	
18.0	B	10	10	10			8.2	9.0	9.1			8.1	8.3	8.3																	
32.0	A	10	10	9			8.5	9.2	9.5			8.0	8.2	8.3																	
32.0	B	10	10	10			8.5	9.2	9.5			8.0	8.2	8.3																	
56.0	A	10	10	7			8.9	9.6	9.9			7.8	8.2	8.2																	
56.0	B	10	10	9			8.9	9.6	9.9			7.7	8.2	8.2																	
100	A	10	10	10			9.6	9.6	9.9			7.2	7.3	7.4																	
100	B	10	9	9			9.6	9.6	9.9			7.1	7.3	7.4			15					580					1350				

Remarks:

Sample appears to contain substantial algae populations - note increase in DO with increasing effluent concentration.

Copepod observed in effluent.

Temperature range for test period: 22.0° to 23.0°C.

RESULTS AND DISCUSSION

Samples of effluent collected from the 14 acre pond outfall (#001) at the Harris Corporation, Semiconductor Division, exhibited no acute toxicity to either fathead minnows (Pimephales promelas) or Daphnia pulex. However, results of chemical analyses (Table 5) performed on samples of this effluent collected the same week, but not the same day as the bioassay samples, indicate that there were several components present in potentially toxic concentrations. Ammonia values of 5.91mg/l and 5.28mg/l were reported, respectively, for the January and February 24 hour composite samples.

This concentration of ammonia could be severely toxic to aquatic life if the pH of this effluent were to be increased above 7.5 for any reasonable time (EPA 1977). Because of the fugacity of NH_3, a flow-through assay would probably be more effective in detecting toxicity due to that compound. Additionally, it has been reported that fluoride concentrations as low as 1.5mg/l have affected hatching of fish eggs and 2.3mg/l, introduced as sodium fluoride, was lethal to rainbow trout (Salmo gairdneri) at 18°C (EPA 1977). Fluoride concentrations considerably in excess of those values were reported for each of the effluent samples analyzed (Table 5).

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 5. Results of chemical analyses performed on Harris Corporation, Semiconductor Division, Wastewater Discharge

	24 January 1980		28 February 1980	
Parameter	Grab Sample	Composite Sample	Grab Sample	Composite Sample
Total Organic Carbon	16mg/l	18mg/l	17mg/l	16mg/l
Arsenic	<10µg/l	<10µg/l	<10µg/l	<10µg/l
Cadmium	< 1µg/l	<1.4µg/l	< 1µg/l	< 1µg/l
Chromium	<10µg/l	<10µg/l	<10µg/l	<10µg/l
Copper	< 5µg/l	<5.9µg/l	< 5µg/l	< 5µg/l
Lead	< 5µg/l	< 5µg/l	< 5µg/l	< 5µg/l
Mercury	<0.2µg/l	<0.2µg/l	<0.2µg/l	<0.2µg/l
Nickel	<10µg/l	<10µg/l	<10µg/l	<10µg/l
Silver	< 1µg/l	< 1µg/l	< 1µg/l	< 1µg/l
Zinc	<25µg/l	<25µg/l	<25µg/l	<25µg/l
PCBs & Phthalates	N.D.	N.D.	N.D.	N.D.
Temperature	18°C	-	16°C	-
pH	5.8	6.2	6.6	-
Conductivity	1600 umhos	-	1400 umhos	-
Dissolved Oxygen	8.6mg/l	-	7.6mg/l	-
BOD_5	13.7mg/l	14.6mg/l	11.7mg/l	12.9mg/l
Ammonia (N)	6.17mg/l	5.91mg/l	5.26mg/l	5.28mg/l
Organic nitrogen	2.45mg/l	2.82mg/l	2.56mg/l	2.55mg/l
Nitrate & nitrite	1.46mg/l	1.21mg/l	1.93mg/l	1.84mg/l
Total nitrogen	10.1mg/l	9.94mg/l	9.75mg/l	9.67mg/l
Total phosphorus	8.48mg/l	8.33mg/l	6.25mg/l	6.19mg/l
Fluoride	13.8mg/l	13.8mg/l	15.6mg/l	15.6mg/l

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APPENDIX

HARRIS SEMICONDUCTOR CHEMICAL AND PHYSICAL

WASTE WATER ANALYSIS - 03/15/77

1. CHEMICAL PARAMETERS	INFLUENT	EFFLUENT
1. Total Solids		
Total	507 mg/l	773 mg/l
Volatile	432 mg/l	748 mg/l
Fixed	75 mg/l	25 mg/l
2. Suspended Solids		
Total	3 mg/l	12 mg/l
Volatile		
Fixed		
3. Chemical Oxygen Demand Index COD, HESD = 25 PPM	115 PPM	125 PPM
4. Nitrogen		
Amonia	5.0 mg/l	6.0 mg/l
$NO_3 - NO_2$	2.2 mg/l	6.6 mg/l
5. Phosphorous Total (P04)	12.5 mg/l	14.5 mg/l
6. Chlorides (Cl)	9.0 mg/l	14.3 mg/l
7. Fluorides (F)	6.75 mg/l	26.25 mg/l
8. Surface Active Agents	.037 mg/l	.110 mg/l
9. Copper	< 1 PPM	< 1 PPM
10. Chromium	NOT REGISTERED	NOT REGISTERED
11. Iron	NOT REGISTERED	NOT REGISTERED
12. Lead	< 1 PPM	< 1 PPM
13. Zinc	< 1 PPM	< 1 PPM

II. PHYSICAL PARAMETERS

1.	Flow (Estimates)		
	Minimum		
	Maximum		
	Average		
2.	PH		
	Minimum	6.8	4.8
	Maximum		
3.	Dissolved Oxygen (Effluent Only)		
	Minimum		
	Maximum		
4.	Turbinity	5	10
5.	Ditch Downstream of Outfall		
	PH	6.3	
	Flouride	3.5	
6.	Flow Over Wier		
	Minimum	50	
	Maximum	125	
	Average	100	

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