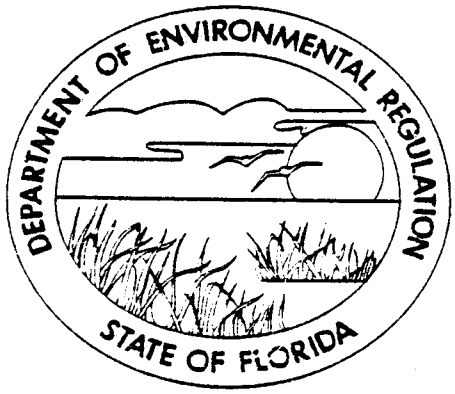
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BIOASSAYS OF THE JACKSONVILLE U.S. NAVAL AIR STATION

SEWAGE TREATMENT PLANT

JACKSONVILLE, DUVAL COUNTY, FLORIDA

NPDES #FL0000957

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Biology Section
Bureau of Water Analysis
September 9, 1982

BIOASSAYS OF THE JACKSONVILLE U.S. NAVAL AIR STATION

SEWAGE TREATMENT PLANT

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EXECUTIVE SUMMARY

Jacksonville U.S. Naval Air Station STP, NPDES #FL0000957, on 3 to 5 August, 1982

The sample of pre-chlorinated and chlorinated effluents from this facility were not toxic to the organisms tested. Only a few random Daphnia pulex and Simocephalus serrulatus mortalities were noted, while no Heterandria formosa died during the 48 hour static tests. The "chlorinated" effluent contained very little total residual chlorine, <0.05 mg/l.

INTRODUCTION

The Jacksonville U.S. Naval Air Station is a U.S. Government facility located in Jacksonville, Duval County, Florida (Figure 1). The associated sewage treatment plant treats waste from the air station, including domestic waste, water from industrial cooling systems, boiler wash, vehicle and equipment cleaning operations, and other miscellaneous sources. The plant has a design capacity of 3.0 MGD and is currently operating near this level, at 2.6 MGD. Discharge is to the St. Johns River (NPDES Outfall #001).

The NPDES permit for this facility contains discharge limits for many potentially toxic substances, including chromium, zinc, copper, cyanide and phenol. Additionally, this facility has received notices for exceeding its permit limitations and for the inadequate disposal of sludges and solids.

The Biological Section had previously performed bioassays on samples of pre-chlorinated, chlorinated and de-chlorinated effluents from this facility, in May, 1981. The results of those tests indicated that the pre-chlorinated and de-chlorinated effluents were not toxic to Daphnia pulex, while the chlorinated effluent was extremely toxic to Daphnia, with 24 and 48 hour LC_{50} values of <5.6% (FDER 1981). The toxicity was attributed to the presence of total residual chlorine.

To further evaluate the existence and extent of toxicity of this effluent to the biota of the receiving waters, the Biological Section performed additional static acute toxicity bioassays on grab samples, on 3 to 5 August, 1982. The results of these latest tests are presented in this report.

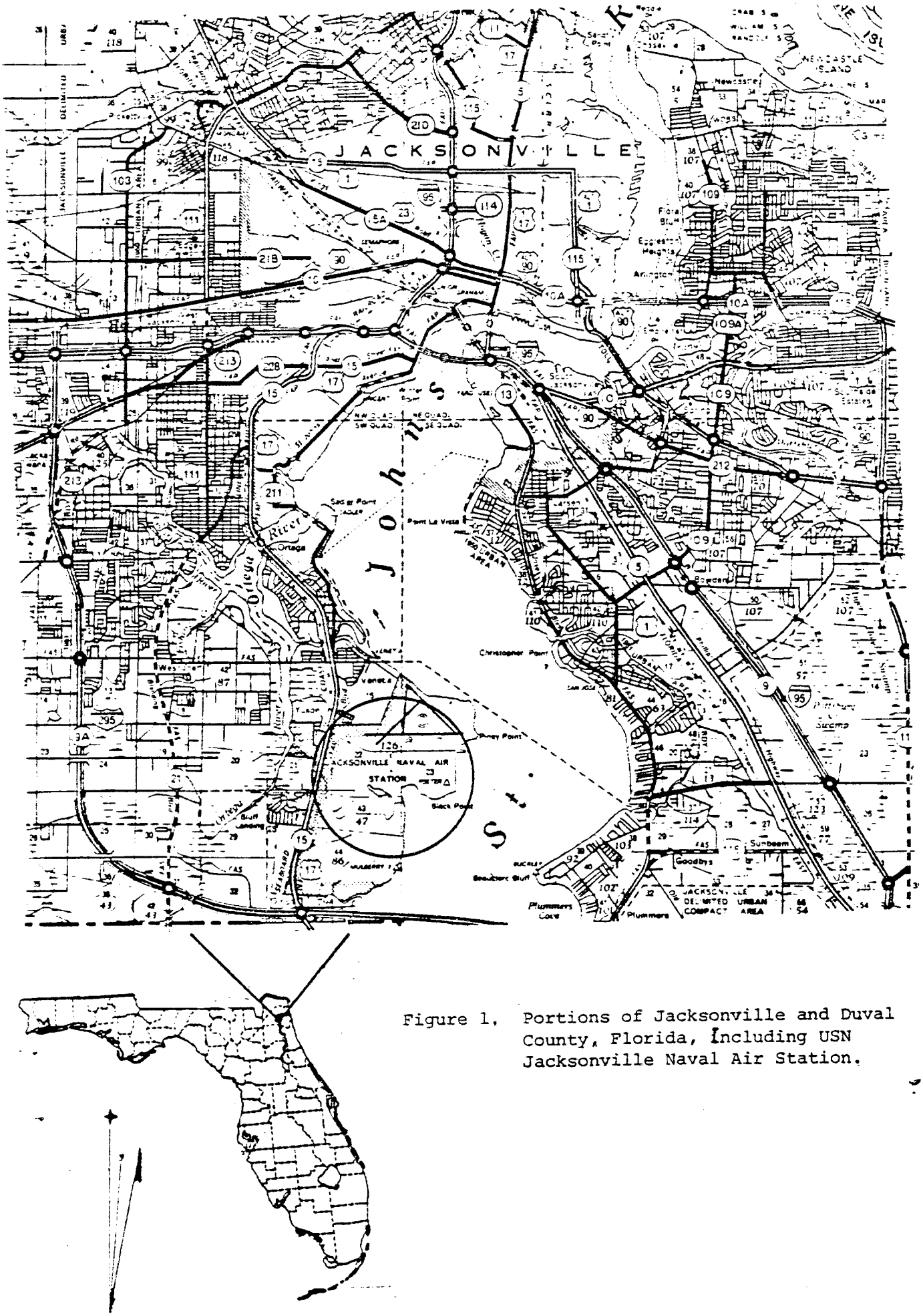


Figure 1. Portions of Jacksonville and Duval County, Florida, including USN Jacksonville Naval Air Station.

METHODS AND MATERIALS

Test methods used to conduct these static bioassays are extensively described by Peltier (1978). The organisms selected for this study include a species recommended by Peltier (1978) and the U.S. EPA (1978). Additionally, the Biological Section maintains cultures of several species of organisms indigenous to the State of Florida. Two of these indigenous species were 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 1°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.

Simocephalus serrulatus (water flea) - An indigenous breeding population of Simocephalus serrulatus was collected from Lake Jackson, Leon County, Florida, in March, 1980, by personnel from DER's Biological Section. Positive identification of the organisms was made by Mr. Jeff Foran of the University of Florida Department of Environmental Engineering Sciences. The cultures are maintained in two and one-half gallon all glass aquaria, filled with unchlorinated DER well water, under a 16:8 hour light-dark cycle. The 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 1°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) twice daily. New born fish are initially maintained in the adult tanks, but are removed at weekly intervals, thereby segregating fish into even age groups. The fish used in this test were 1 to 3 weeks old.

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

Five separate 48 hour static acute toxicity bioassays were performed on samples of pre-chlorinated and chlorinated effluents from the Jacksonville U.S. Naval Air Station STP. The tests were performed from 1130 hours on 3 August to 1200 hours on 5 August, 1982. The samples were collected by Mr. Martin Zenas of DER's Jacksonville Office at 1400 hours on 2 August, 1982, using standard wastewater sampling procedures. The samples were iced and transported to the DER laboratory in Tallahassee for analysis within 24 hours of collection.

To differentiate between the toxicity resulting from chlorine and the toxicity associated with some other component of the effluent, the Biological Section adopted the following test procedure:

Test #1. Pre-Chlorinated Effluent using Daphnia pulex and Heterandria formosa (Tables 2 and 3). These tests were performed on an effluent sample collected at the end of the treatment process but prior to chlorination, and was intended to evaluate the toxicity of the effluent without the added toxic effects of chlorine.

Test #2. Chlorinated Effluent using Daphnia pulex, Simocephalus serrulatus and Heterandria formosa (Tables 4,5, and 6). These tests were performed on an effluent sample collected at the point of discharge.

Since the total residual chlorine measured in the chlorinated sample (<0.05 mg/l) was below toxic levels, a test using de-chlorinated effluent was not performed.

Freshwater for dilution of the effluent samples 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 concentrations and a control, were used to test with the water fleas, 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. Daphnia and Simocephalus were siphoned into large culture dishes 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. Simocephalus neonates were separated from the adults visually in the culture dish prior to loading. 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 six concentrations and a control, were used for the Heterandria formosa (least killifish) bioassays. 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 these tests.

Dissolved oxygen, pH, temperature, 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 were recorded at the beginning of the test for the controls and the 100% effluent concentrations. The specific conductance of each test concentration was recorded at the beginning and end of the test. Ammonia concentrations, including total and unionized fractions (expressed in mg/l as N and as NH_3, respectively), were recorded in the controls and the 100% effluent test concentrations 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 determined 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 through 6.

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

Daphnia pulex and *Simocephalus serrulatus* (water fleas)

Concentration	Dilution Water	Effluent	Total Volume
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
100.0%	--	200 ml	200 ml

Heterandria formosa (least killifish)

Concentration	Dilution Water	Effluent	Total Volume
Control	500 ml	---	500 ml
5.6%	472 ml	28 mlml	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 Jacksonville U.S. Naval Air Station STP, Duval County, Florida, NPDES #FL0000957, on 3 to 5 August, 1982.

Test #1 Pre-Chlorinated Sample

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	10	10	10	8.2	9.0	9.4	7.8	8.3	8.1	116		118		21.5	19.9	19.5	0/0	---		
Control	10	10	10	8.2	9.0	9.4	7.8	8.4	8.1										210	215
5.6%	10	10	10	8.3	9.1	9.4	7.8	8.4	8.2					21.4	19.8	19.5				
5.6%	10	10	9	8.3	9.0	9.4	7.8	8.4	8.2										230	225
10.0%	10	10	10	8.3	9.1	9.4	7.9	8.4	8.2					21.4	19.8	19.5				
10.0%	10	10	10	8.3	9.1	9.4	7.9	8.4	8.2										245	240
18.0%	10	10	9(10)[a]	8.3	8.9	9.4	7.9	8.4	8.2					21.4	19.9	19.6				
18.0%	10	10	10	8.3	8.9	9.4	7.9	8.4	8.2										270	270
32.0%	10	10	10	8.0	8.9	9.4	7.8	8.3	8.1					20.9	20.0	19.6				
32.0%	10	10	10	8.0	8.8	9.4	7.8	8.3	8.1										305	305
56.0%	10	10	10	7.7	8.7	9.3	7.7	8.2	8.1					20.5	20.1	19.6				
56.0%	10	10	10	7.7	8.7	9.3	7.7	8.2	8.1										375	375
100.0%	10	10	10	7.2	8.5	9.3	7.6	8.1	7.9	61		192		19.8	20.1	19.6	.01/.56	---		
100.0%	10	10	10	7.3	8.5	9.3	7.6	8.1	7.9										485	490

Remarks:

[a] Number in parentheses used for calculations since one organism was not found.

Table 3. Data recorded during 48 hour, Heterandria formosa[a], static acute toxicity bioassay of Jacksonville U.S. Naval Air Station STP, Duval County, Florida, NPDES #FL0000957, on 3 to 5 August, 1982.

Test #1 Pre-chlorinated Sample

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	4[b]	4	4	8.1	8.9	9.2	7.7	8.3	8.0	116		118		21.5	19.8	19.4	0/0	---		
Control	4[b]	4	4	8.2	8.9	9.2	7.7	8.3	8.0										220	218
5.6%	4[b]	4	4	8.3	8.9	9.2	7.8	8.3	8.1					21.5	19.7	19.4				
5.6%	5	5	5	8.3	8.7	9.2	7.8	8.3	8.1										235	230
10.0%	5	5	5	8.2	8.5	9.1	7.8	8.2	8.0					21.4	19.7	19.3				
10.0%	5	5	5	8.3	8.5	9.1	7.8	8.2	8.0										250	240
18.0%	5	5	5	8.0	8.4	9.0	7.8	8.2	8.0					21.1	19.7	19.3				
18.0%	5	5	5	8.1	8.4	9.0	7.8	8.2	8.0										270	265
32.0%	5	5	5	7.9	8.3	8.8	7.8	8.1	7.9					20.8	19.8	19.5				
32.0%	5	5	5	8.0	8.3	8.8	7.8	8.1	7.9										310	310
56.0%	5	5	5	7.8	8.2	8.6	7.7	8.0	7.9					20.0	19.8	19.4				
56.0%	5	5	5	7.8	8.1	8.6	7.7	8.0	7.9										378	370
100.0%	5	5	5	7.3	7.4	8.3	7.6	7.8	7.7	61		192		19.5	19.9	19.4	.01/.56	---		
100.0%	5	5	5	7.3	7.3	8.3	7.6	7.8	7.7										490	490

Remarks:

[a] Weight of fish; 7.56 mg each, average of 10 fish.

[b] Due to a shortage of fish, only 4 were used in these chambers.

Table 4. Data recorded during 48 hour, Daphnia pulex, static acute toxicity bioassay of Jacksonville U.S. Naval Air Station STP, Duval County, Florida, NPDES #FL0000957, on 3 to 5 August, 1982.

Test #2 Chlorinated Sample[a]

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	10	10	10	8.3	9.0	9.5	7.8	8.4	8.1	116		118		21.7	19.8	19.7	0/0	---		
Control	10	10	9	8.3	9.1	9.5	7.8	8.4	8.1										210	215
5.6%	10	10	10	8.3	9.3	9.5	7.9	8.4	8.1					21.4	19.6	19.5				
5.6%	10	10	10	8.3	9.3	9.5	7.9	8.4	8.1										225	225
10.0%	10	10	10	8.3	9.2	9.5	7.9	8.4	8.1					21.4	19.6	19.5				
10.0%	11[b]	11	11	8.3	9.2	9.5	7.9	8.4	8.1										240	245
18.0%	10	10	10	8.1	9.2	9.4	7.9	8.4	8.1					21.3	19.6	19.4				
18.0%	11[b]	11	11	8.1	9.2	9.4	7.9	8.4	8.1										265	260
32.0%	11[b]	11	11	7.9	9.1	9.4	7.9	8.4	8.1					21.0	19.6	19.4				
32.0%	10	10	10	8.0	9.1	9.4	7.9	8.4	8.1										305	300
56.0%	10	10	10	7.8	9.0	9.3	7.8	8.3	8.0					20.6	19.6	19.4				
56.0%	10	10	10	7.8	9.0	9.3	7.8	8.3	8.0	70		202							370	370
100.0%	10	10	10	7.3	8.8	9.3	7.6	8.2	7.9					20.0	19.7	19.5	.02/1.0	---		
100.0%	11[b]	11	11	7.4	8.8	9.3	7.6	8.1	7.9										482	485

Remarks:

[a] Total Residual Chlorine: <0.05 mg/1 (HACH DPD Method)

[b] Extra organisms loaded by mistake, allowed to remain.

Table 5 . Data recorded during 48 hour, Simocephalus serrulatus, static acute toxicity bioassay of Jacksonville U.S. Naval Air Station STP, Duval County, Florida, NPDES #FL0000957, on 3 to 5 August, 1982.

Test #2 Chlorinated Sample[a]

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	10	10	10	8.6	9.2	9.5	7.8	8.1	8.0	116		118		21.4	20.0	19.7	0/0	---		
Control	10	10	9	8.6	9.2	9.5	7.8	8.2	8.0										198	205
5.6%	10	10	9	8.6	9.2	9.5	7.8	8.3	8.0					21.3	19.9	19.6				
5.6%	10	9	9	8.6	9.2	9.5	7.9	8.4	8.0										215	205
10.0%	10	10	10	8.5	9.1	9.5	7.9	8.4	8.0					21.3	19.9	19.5				
10.0%	10	10	10	8.5	9.1	9.5	7.9	8.4	8.0										230	225
18.0%	10	10	10	8.2	9.0	9.4	7.9	8.4	8.1					21.3	19.9	19.5				
18.0%	10	10	10	8.2	9.0	9.4	7.9	8.4	8.1										252	250
32.0%	10	10	10	8.0	8.9	9.4	7.9	8.4	8.1					21.2	19.9	19.6				
32.0%	10	10	10	8.1	8.9	9.4	7.9	8.4	8.1										295	295
56.0%	10	10	10	7.7	8.8	9.3	7.8	8.3	8.0					20.7	19.9	19.7				
56.0%	10	10	9(10)[b]	7.7	8.8	9.3	7.8	8.3	8.0										360	365
100.0%	10	10	10	7.2	8.5	9.3	7.6	8.2	7.9	70		202		20.0	20.0	19.8	.02/1.0	---		
100.0%	10	10	9	7.2	8.5	9.3	7.6	8.1	7.9										475	485

Remarks:

[a] Total Residual Chlorine: <0.05 mg/l (HACH DPD Method).

[b] Number in parentheses used for calculations since one organism was not found.

Table 6. Data recorded during 48 hour, Heterandria formosa[a], static acute toxicity bioassay of Jacksonville U.S. Naval Air Station STP, Duval County, Florida, NPDES #FL0000957, on 3 to 5 August, 1982.

Test #2 Chlorinated Sample[b]

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	8.2	8.9	9.4	7.7	8.2	8.1	116		118		21.7	20.0	19.7	0/0	---		
Control	5	5	5	8.3	8.9	9.4	7.7	8.2	8.1										215	215
5.6%	5	5	5	8.3	8.8	9.1	7.7	8.2	8.1					21.6	19.9	19.5				
5.6%	5	5	5	8.3	8.8	9.1	7.8	8.2	8.1										232	225
10.0%	5	5	5	8.2	8.8	9.0	7.8	8.2	8.0					21.5	19.8	19.4				
10.0%	5	5	5	8.2	8.8	9.0	7.8	8.2	8.0										247	240
18.0%	5	5	5	8.1	8.6	9.0	7.8	8.2	8.0					21.3	19.7	19.4				
18.0%	5	5	5	8.1	8.6	9.0	7.8	8.2	8.0										270	260
32.0%	5	5	5	8.1	8.4	8.9	7.8	8.2	7.9					21.0	19.6	19.4				
32.0%	5	5	5	8.1	8.5	8.9	7.8	8.1	7.9										310	305
56.0%	5	5	5	7.8	8.2	8.7	7.7	8.1	7.9					20.5	19.6	19.4				
56.0%	5	5	5	7.8	8.2	8.7	7.7	8.1	7.9										380	370
100.0%	5	5	5	7.2	8.1	8.7	7.6	7.9	7.8	70		202		19.9	19.7	19.5	.02/1.0	---		
100.0%	5	5	5	7.2	8.1	8.7	7.6	7.9	7.7										490	490

Remarks:

[a] Weight of fish: 7.56 mg each, average of 10 fish.

[b] Total Residual Chlorine: <0.05 mg/l (HACH DPD Method).

RESULTS AND DISCUSSION

The sample of pre-chlorinated and chlorinated effluents from the Jacksonville U.S. Naval Air Station STP were not toxic to the organisms tested. Only a few random Daphnia pulex and Simocephalus serrulatus mortalities were noted, while no Heterandria formosa died during the 48 hour static tests. The chlorinated sample contained very little total residual chlorine (<0.05 mg/1).

LITERATURE CITED

American Public Health Association. 1980. Standard Methods for the Examination of Water and Wastewater. 15th ed. 1134 p.

Florida Department of Environmental Regulation. Biological Section. 1981. Bioassays of USN Jacksonville Naval Air Station Sewage Treatment Plant and Landfill Leachate, Jacksonville, Duval County, Florida. NPDES #FL0000957. FDER. 13 p.

Peltier, W. 1978. Methods for measuring the acute toxicity of effluents to aquatic organisms. Environmental Research Laboratory. Athens, Georgia. EPA-600/4-78-012 (Revised July 1978). 51 p.

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. 121 p.