Water Quality Assessment
Persimmon Creek
Greenville, Alabama
Butler County

June 1998

Environmental Indicators Section
Field Operations Division
Alabama Department of Environmental Management
Report Date: March 1999

Introduction

The city of Greenville, located in Butler County, has an NPDES permit (AL0020532) to discharge treated wastewater to an unnamed tributary to Persimmon Creek. Persimmon Creek flows into the Sepulga River, which is a part of the Conecuh River Basin. Persimmon Creek, in its entirety, is classified as Fish and Wildlife (F&W).

At the request of the Municipal Branch of the Water Division of the Alabama Department of Environmental Management (ADEM), staff members of the Environmental Indicators Section of Field Operations Division conducted a study to document the effects of the wastewater discharge on the in-stream macroinvertebrate community of Persimmon Creek. This effort included aquatic macroinvertebrate assessments, bioassay, and chemical analyses.

The collection of the water chemistry samples and the assessment of the stream habitat and aquatic macroinvertebrate community was conducted on June 24, 1998. The bioassay portion of the study was initiated on May 5, 1998.

Sampling Locations and Methodology

The following sampling locations were chosen for Persimmon Creek (see Figure 4). In addition, an established ecoregional reference stream with similar stream characteristics and habitat types was sampled to further assess the conditions of the stream.

PC-1	Persimmon Creek approximately 0.25 miles upstream of the confluence with the unnamed tributary into which the WWTP discharges. Lat 31° 47' 18.3"N Lon -86° 36' 20.0"W T9N, R14E, S1, SW1/4
PC-1A	Persimmon Creek approximately 25 feet downstream of confluence with unnamed tributary. Lat 31° 47' 13.7"N Lon -86° 36' 22.7"W T9N, R14E, S12, NW1/4
PC-3	Persimmon Creek approximately 0.75 miles downstream of confluence with the unnamed tributary. Lat 31° 47' 02.8"N Lon -86° 36' 28.2"W T9N, R14E, S12, NW1/4
PC-STP	The actual discharge point from the WWTP to the unnamed tributary to Persimmon Creek. Lat 31° 47' 23.0"N Lon -86° 36' 29.1"W T9N, R14E, S1, SW1/4

Aquatic macroinvertebrate samples were collected using the intensive Multihabitat Bioassessment method (MB-I) described in the *ADEM Standard Operating Procedures (SOP) and Quality Control Assurance (QCA) Manual*, Volume 2 (1996). The laboratory methods for this procedure were modified to include the identification of the three generally pollution sensitive orders Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies). Habitat quality was assessed using the modified Barbour & Stribling (1996) habitat assessment form. Table 1 provides the evaluation guidelines for the habitat assessment and the EPT Taxa Richness metric used to evaluate this stream.

Instream water samples for field parameters and chemical analyses were collected using the methodologies outlined in Volume 1 of the *ADEM Standard Operating Procedures (SOP) and Quality Control Assurance (QCA) Manual* (1994).

Samples collected from the WWTP discharge for toxicity testing were 24-hour composite samples taken at the permitted sampling point. The toxicity test was conducted as specified in NPDES permit number AL0020532 and per methodology outlined in *ADEM Standard Operating Procedures (SOP) and Quality Control Assurance (QCA) Manual*, Volume 4 (1994).

Sample handling techniques, physical data collection and chain-of-custody procedures utilized during this assessment were as described in the *ADEM Standard Operating Procedures and Quality Control Assurance Manual*, Volumes 1(1994), 2(1996) & 4(1994). Chain-of-custody was maintained by locking the samples in a Departmental vehicle when not in sight of a Field Operations employee.

Discussion and Results

A. Physical

The reaches sampled were estimated to have 80%–100% hardwood canopy cover with moderately unstable banks. Persimmon Creek is a slow moving stream comprised of sandy/clay substrate with run depths of approximately 1-1.5 feet and pool depths of approximately 2 feet. The ecoregional reference site PYW-1 was similar to the study stations in characteristics (bottom substrate) and habitat types. The habitat quality of the three study locations was suboptimal but comparable to the ecoregional reference chosen (97%-111% of Reference) (Figure 3a & Table 1).

The unnamed tributary station UNT-1 located upstream of the discharge could not be sampled because the channel was comprised of shallow, non-flowing intermittent pools. Due to the lack of flow above the discharge, the unnamed tributary was 100% effluent during the sampling period. The WWTP discharges into this unnamed tributary, which flows into Persimmon Creek.

B. Chemical

The field parameters measured at each station were pH, conductivity, dissolved oxygen, turbidity and water temperature. Results showed little change in the pH, dissolved oxygen or turbidity between stations (Table 2 & Figure 2). However, the conductivity did appear to be elevated at the WWTP discharge and at the farthermost downstream station PC-3 as compared to the reference site and control.

Water samples were also collected for laboratory analysis and results are provided in Table 2. Chloride and Total Alkalinity levels downstream of the discharge PC-1a were elevated as compared to the control and reference site but decreased by the most downstream station PC-3. Nutrient levels downstream of the discharge were also elevated as compared to the control and reference site.

C. Aquatic Macroinvertebrate Assessment

Aquatic macroinvertebrate data were analyzed according to in-house draft ecoregional evaluation guidelines. The aquatic macroinvertebrate community at PC-1a and PC-1 were evaluated as fair and PC-3 was evaluated as poor (See Table 1b).

D. Bioassay

Short-term chronic toxicity tests conducted on the Greenville WWTP effluent indicated that there was not a significant difference to *Ceriodaphnia dubia* survival or reproduction or to *Pimephales promelas* survival or growth when exposed to a 66% effluent solution, the permitted in-stream waste concentration (Appendix A).

Effluent samples were also collected for laboratory analysis in conjunction with the toxicity test. Results summarized in Appendix B showed that pesticide and metal concentrations were all below detectable limits.

Conclusions

The results of this study indicate that at the time of sampling Persimmon Creek below the Greenville WWTP was not impaired by the WWTP effluent. The macroinvertebrate community below the discharge was similar to the control station for EPT Taxa Richness.

The Water Use Classification for Persimmon Creek is Fish & Wildlife, which specifies the best usage of waters to be suitable for fishing, propagation of fish, aquatic life, and wildlife, and any other usage except for swimming, and water-contact sports or as a source of water supply for drinking or food processing purposes (*Rules and Regulations: Water Quality Criteria and Use Classifications*, Water Division-Water Quality Program, ADEM, Ch.335-6-10). Based on the data available, Persimmon Creek at each of the sampling locations was meeting the chemical/physical parameters of the Fish & Wildlife Water Use Classification Criteria. Biological data collected during this study and Whole Effluent Toxicity tests confirm that Persimmon Creek at the study locations was meeting the General Conditions Applicable to All Water Quality Criteria (Ch. 335-6-10-.05 (1); …quality of any waters receiving sewage…will not cause the best usage(propagation of aquatic life)…to be adversely affected by such sewage…).

TABLE 1a

Aquatic Macroinvertebrate Data

	PC-1 (Control)	PC-1A	PC-3	PYW-1 (Reference)
Habitat Assessment Score	129	147	145	133
Habitat Quality (% comparability to Reference site)	97%	111%	109%	
EPT Taxa Richness	8	7	6	8
Stream Condition Category (based on EPT taxa richness)	Fair	Fair	Poor	Fair

TABLE 1b

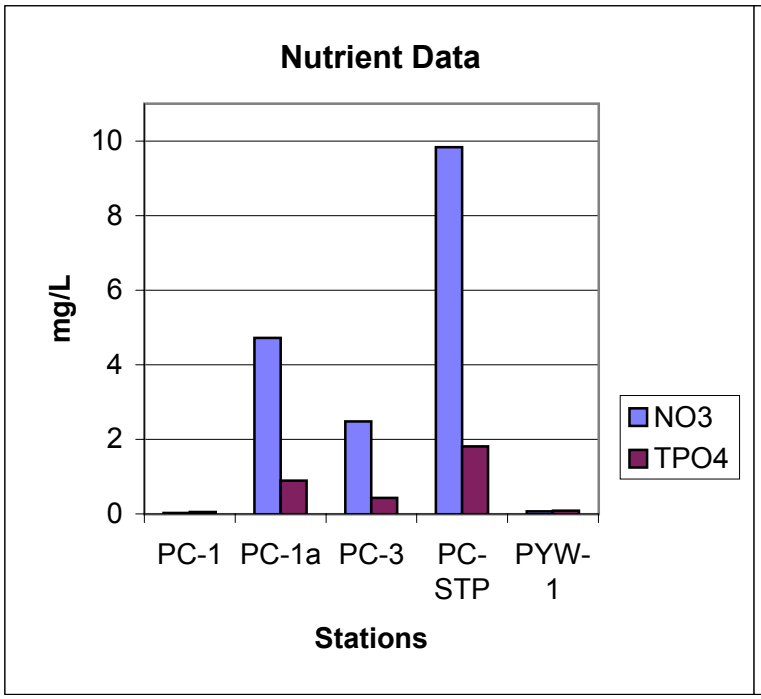
Biometric Interpretation

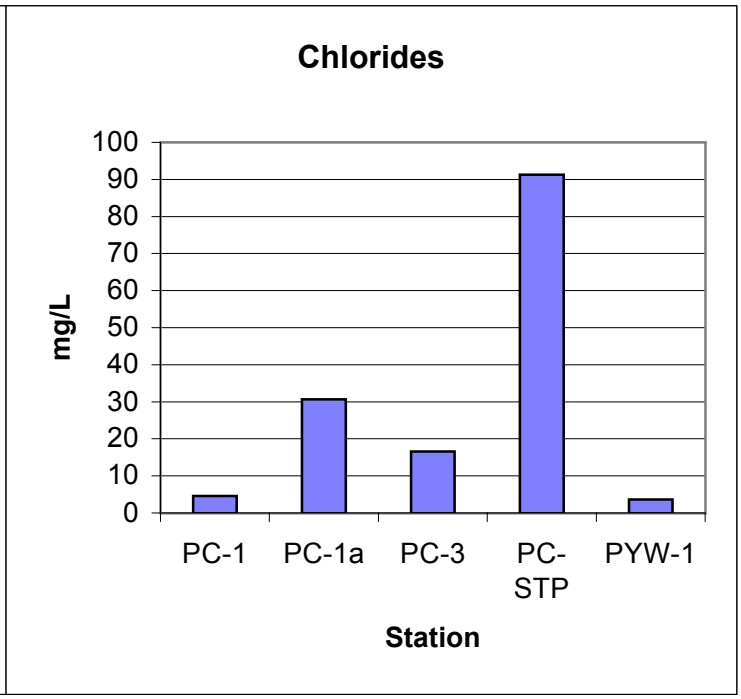
METRIC	RANGE	INTERPRETATION
Habitat Assessment	170-220 118-169 60-117 0-59	Optimal Sub-optimal Marginal Poor
EPT Taxa Richness	>18 18-12 11-7 <7	Excellent Good Fair Poor

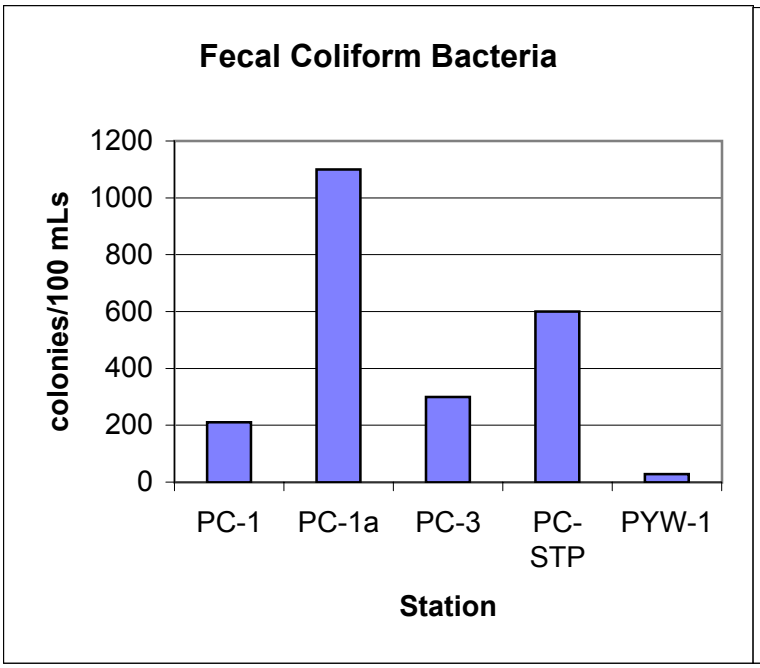
TABLE 2
Chemical Analyses & Field Parameters

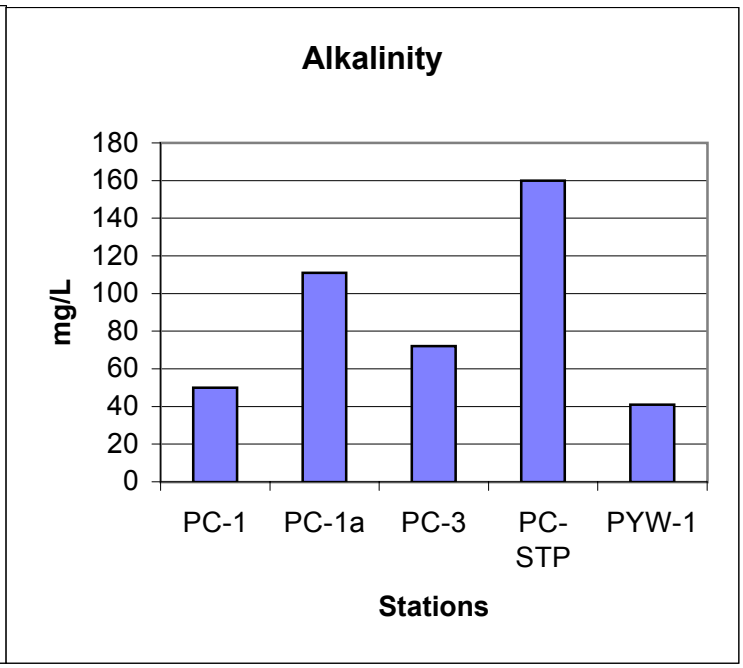
Parameter	PC-STP	PC-1	PC-1a	PC-3	PYW-1
Organics (μg/L)					
Diazinon (mdl=0.01)	<mdl	<mdl	<mdl	<mdl	<mdl
Miscellaneous Inorganics (mg/L)					
Total Alkalinity	160	50.0	111.0	72.0	41.0
Hardness	28	41.8	35.1	37.6	23.5
BOD	1.4	1.9	0.4	0.5	0.4
CBOD Ultimate	3.64	---	---	---	---
Hexavalent Chromium (mdl= 0.015)	<mdl	<mdl	<mdl	<mdl	<mdl
Total Dissolved Solids	546.0	99.0	322.0	227.0	97.0
Total Suspended Solids	6.0	7.0	10.0	10.0	8.0
Cyanide (mdl=0.004)	<mdl	<mdl	<mdl	<mdl	<mdl
Chloride	91.25	4.61	30.62	16.61	3.66
Nutrients (mg/L)					
Ammonia (mdl=0.3)	<mdl	0.04	<mdl	<mdl	<mdl
Nitrate (mdl=0.003)	9.83	0.026	4.72	2.48	0.069
Phosphate (mdl=0.004)	1.81	0.05	0.89	0.43	0.09
Total Kjeldahl Nitrogen (mdl=0.15)	0.55	<mdl	0.31	<mdl	0.51
Total Organic Nitrogen (mdl=0.2)	0.55	<mdl	0.31	<mdl	0.51
Trace Metals (mg/L except those noted)					
Arsenic (ug/L) (mdl=10.0)	<mdl	<mdl	<mdl	<mdl	<mdl
Cadmium (mdl=0.0030)	<mdl	<mdl	<mdl	<mdl	<mdl
Chromium (mdl=0.015)	<mdl	<mdl	<mdl	<mdl	<mdl
Copper (mdl=0.020)	<mdl	<mdl	<mdl	<mdl	<mdl
Lead (ug/L) (mdl=2.00)	<mdl	<mdl	<mdl	<mdl	<mdl
Mercury (ug/L) (mdl=0.500)	<mdl	<mdl	<mdl	<mdl	<mdl
Nickel (mdl=0.030)	<mdl	<mdl	<mdl	<mdl	<mdl
Silver (mdl=0.015)	<mdl	<mdl	<mdl	<mdl	<mdl
Zinc (mdl=0.030)	0.054	<mdl	<mdl	<mdl	<mdl
Dissolved Metals (all metals identified above)	<mdl	<mdl	<mdl	<mdl	<mdl
Fecal Coliform (colonies/100mL)					
Fecal Coliform Bacteria	>600	210	>1100	300	28
Field Parameters					
pH (standard units)	7.3	6.7	7.1	7.2	6.3
Conductivity (umhos/cm)	788	103	105	264	57
Dissolved Oxygen (mg/L)	7.8	6.7	6.8	6.8	4.5
Turbidity (NTU)	1.0	14.1	10.3	11.5	19.9
Water Temperature (C)	27	26	27	27	24
Air Temperature (C)	29	30	30	30	30
Flow (cfs)	2.2	8.6	10.8	13.0	0.9

Figure 1
Chemical and Biological Data









*Colonies graphed for PC-1a and PC-STP are estimated counts greater than the value shown.

Figure 2
Field Parameters

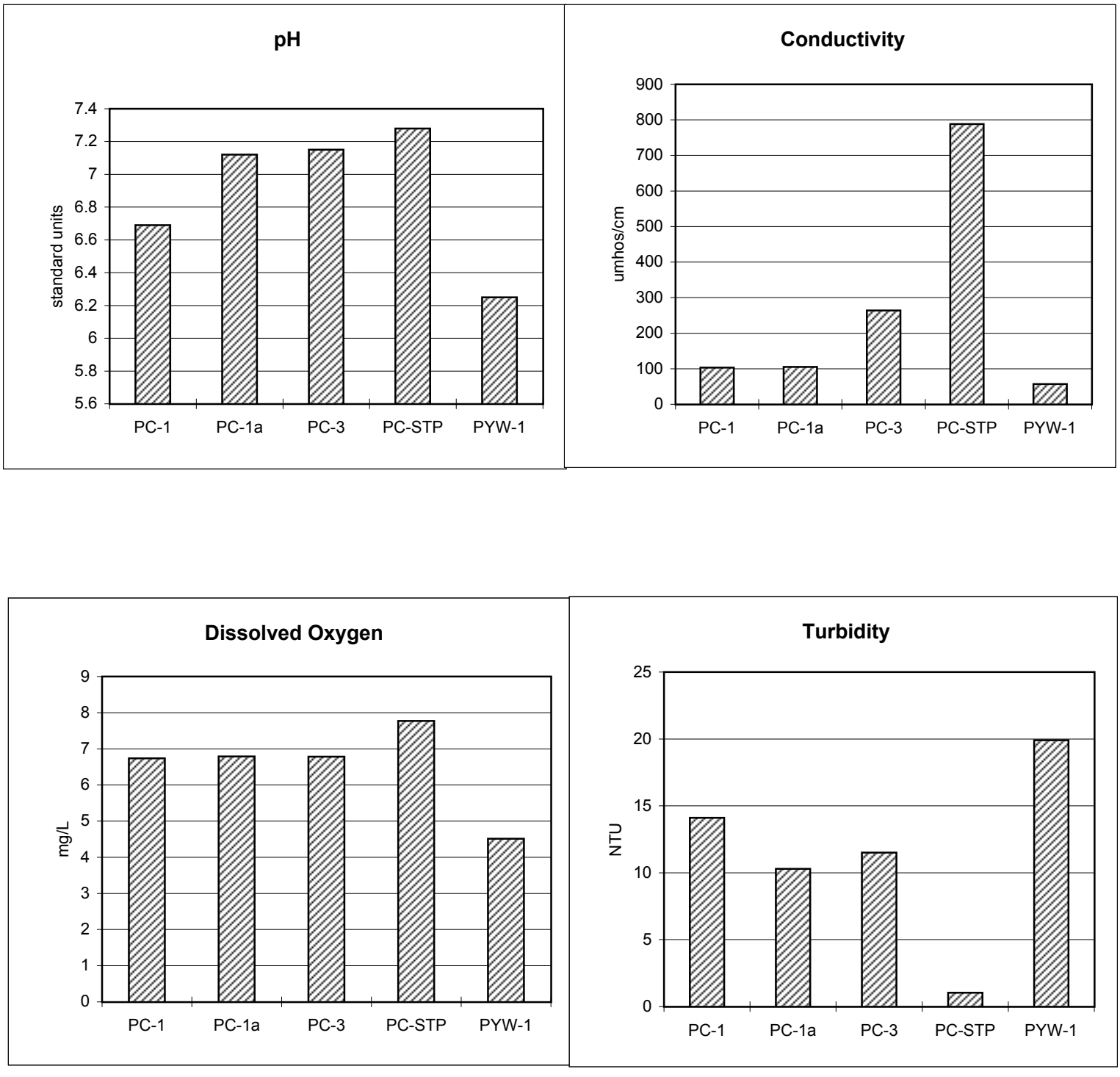


Figure 3a
Habitat Assessment

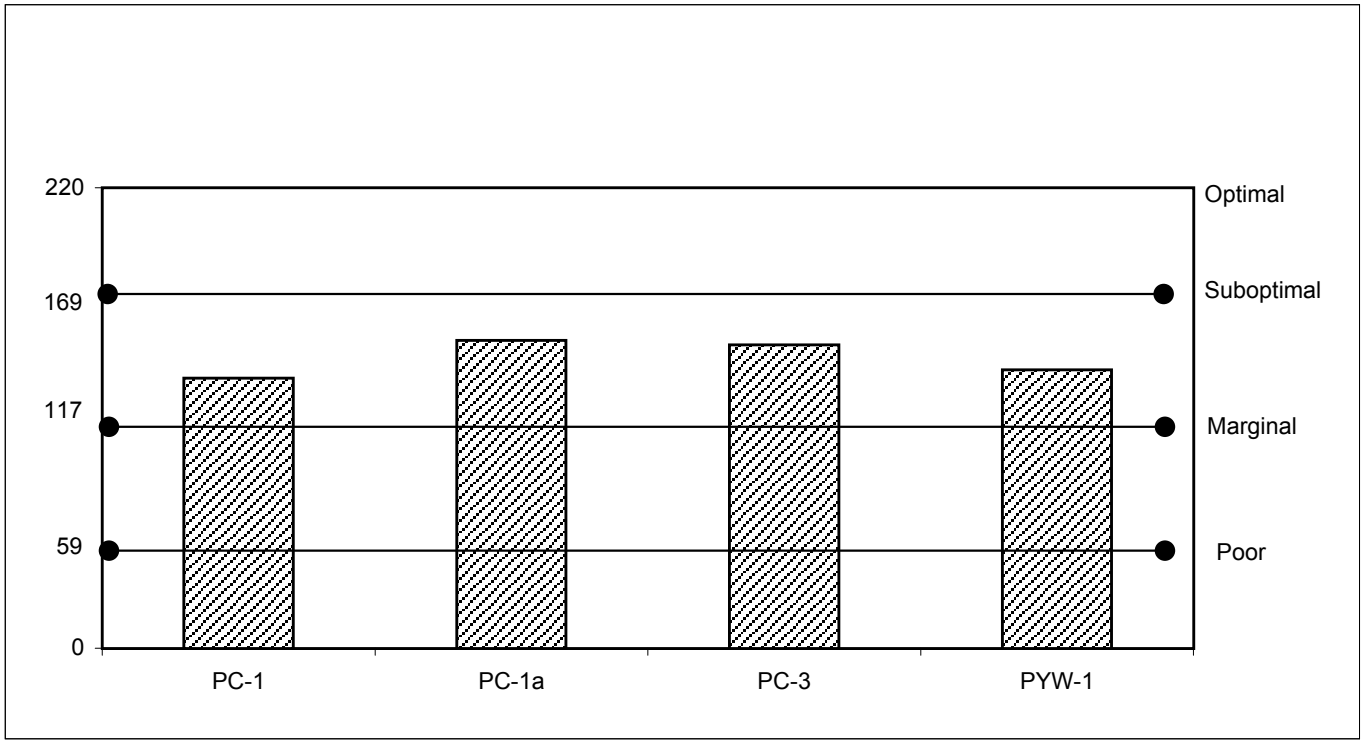
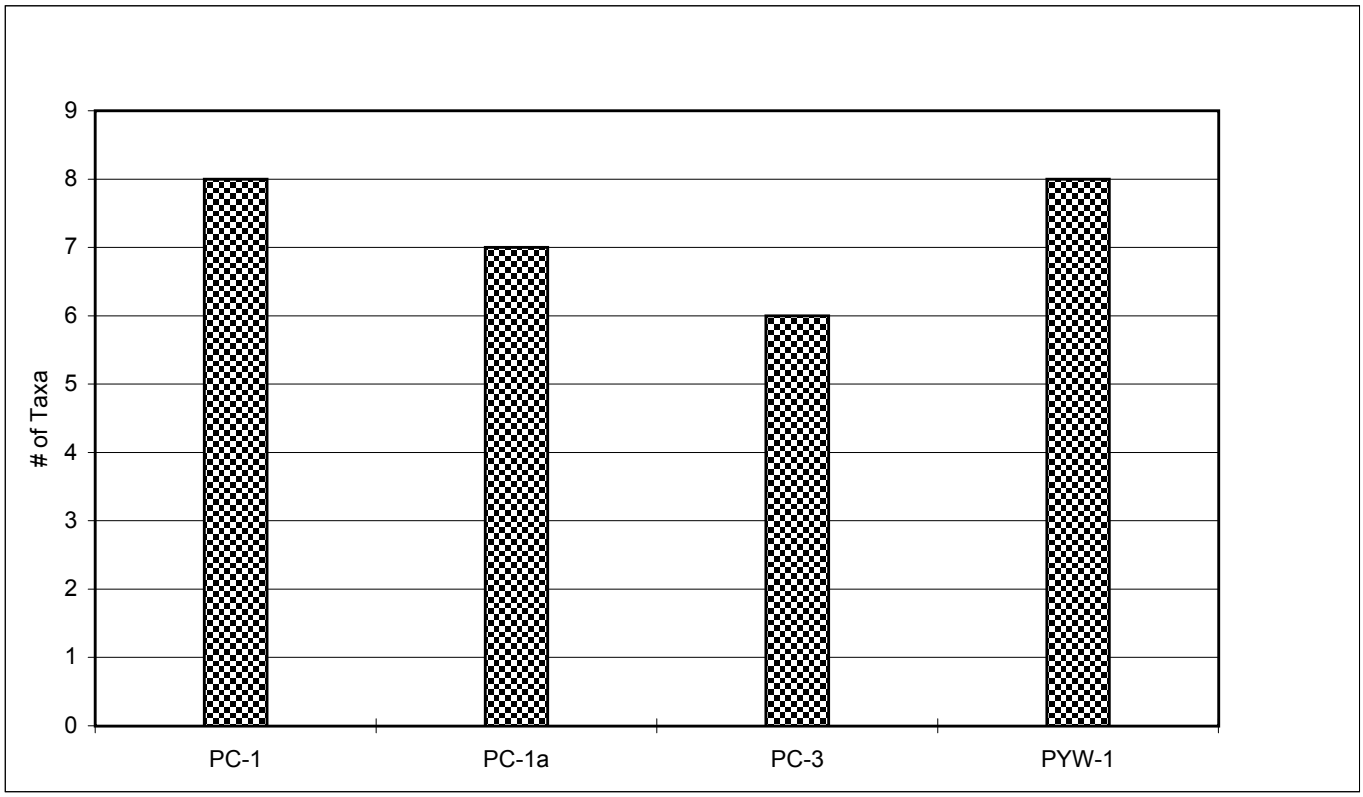


Figure 3b
EPT Taxa Richness



APPENDIX A

Toxicity Test Report

ALABAMA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
FIELD OPERATIONS DIVISION
ENVIRONMENTAL INDICATORS SECTION
BIOASSAY UNIT

TOXICITY TEST REPORT

1. GENERAL

NPDES PERMIT NO.: 0020532 DSN: 001 COUNTY: Butler
Facility Name: Greenville WWTP
Total 24-Hour Flow: (1) 2.21 MGD (2) 1.36 MGD (3) 1.56 MGD
Test Type: Short-term Chronic Screening
Test Id. #: 980505-01

Test Organism	Date/Time Started YYMMDD HHMM	Date/Time Ended YYMMDD HHMM	Control Validity (Acceptable/Unacceptable)
Ceriodaphnia dubia	980506 1545	980513 1420	Acceptable
Pimephales promelas	980506 1545	980513 1540	Acceptable

2A. SUMMARY OF RESULTS FOR SCREENING TEST

Test Org.	Effluent Conc.	Test Number (1) Surv	(1) Repro	(1) Grow	(2) Surv	(2) Repro	(2) Grow	(3) Surv	(3) Repro	(3) Grow	(4) Surv	(4) Repro	(4) Grow
C. d.	66%	PASS	PASS	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
P. p.	66%	PASS	-----	PASS	-----	-----	-----	-----	-----	-----	-----	-----	-----

3. LABORATORY ANALYSES OF UNDILUTED SAMPLES(S)

Sample Id.	pH su	Alkalinity mg/L as CaCO3	Hardness mg/L as CaCO3	Conductivity umhos/cm @ °C	TRC mg/L
980505-01	7.4	84	32	372 at 25.1	0.11
980507-01	7.4	103	37	445 at 25.7	0.09
980509-01	7.5	110	35	518 at 24.4	0.07

4. SAMPLE COLLECTION:

Were split samples collected?: no
Were samples collected as specified in NPDES Permit (Location and/or Type)? no - the samples were collected prior to the cascade aeration.

Sample Id.	Sample(s) Collected YYMMDD HHMM to YYMMDD HHMM	Arrival Temp (°C)	Used in Test(s) YYMMDD to YYMMDD
980505-01	980504 0920 to 980505 0905	2	980506 to 980507
980507-01	980506 0800 to 980507 0745	3	980508 to 980509
980509-01	980508 0800 to 980509 0745	3	980510 to 980512

5.CONTROL/DILUTION WATER

Carboy #	Preparation YYMMDD	Begin Use YYMMDD	Initial Water Chemistries pH (su)	Alkalinity (mg/L)	Hardness (mg/L)	Conductivity @ °C (umhos/cm)
C-4	980430	980506	8.3	66	80	290 at 24.7
C-2	980504	980508	8.2	68	72	273 at 23.7
C-3	980504	980510	8.2	66	74	285 at 23.5

PERMITTEE: Greenville WWTP NPDES #: 0020532 DSN: 001 TEST Id #: 980505-01

6. TOXICITY TEST INFORMATION

Test Organism	Organism Age	Organism Source	Org./Test Vessel	Replicates/Conc.
C.d.	7h	ADEM In-house cultures	1	10
P.p.	<24h	ADEM In-house cultures	12	4

Test Organism	Temperature Range (°C)	D.O. Range (mg/L)	pH Range (su)	Light Intensity Average (ft-c)
C.d.	24.0 - 25.5	7.4 - 8.4	7.5 - 8.6	69
P.p.	24.0 - 25.3	3.2 - 8.1	7.4 - 7.9	72

7. FEEDING: Fed Daily

Brine Shrimp Fed 0.15 mL Suspension of Newly Hatched Larvae 2 Times Daily.
YCT Fed 0.15 mL Suspension Containing 1800 mg/L TSS Daily.
Algae Fed 0.15 mL Suspension Containing 3.4×10^7 Algal Cells/mL Daily.

8. REFERENCE TOXICANT TESTS

TOXICANT - Sodium Chloride (NaCl)

Test Organism	Test Date YYMMDD	Results LC50 (mg/L)	95% Confidence Interval (mg/L)
C.d.	980507	1410.60	1265.09/1572.84
P.p.	980506	6558.61	6337.93/6786.99

9. TEST CONDITION VARIABILITY

A. Deviations From Standard Test Conditions: none

B. Test Solution Manipulations or Test Modifications

- ☒ Dechlorination
- ☐ Aeration during the test
- ☐ Aeration prior to test initiation or sample renewal
- ☐ Filtration
- ☐ pH adjustment
- ☐ NO sample modifications

On 980508 the 980507-01 sample was dechlorinated with 1mL 0.0375N Sodium Thiosulfate per 1/2 gallon of effluent. On 980509 the 980509-01 sample was dechlorinated with 0.8mL 0.0375N Sodium Thiosulfate per 1/2 gallon of effluent. The samples were dechlorinated because the sampler had been set up prior the the cascade aeration.

PERMITTEE: Greenville WWTP NPDES #: 0020532 DSN: 001 TEST Id #: 980505-01

11. CHRONIC SCREENING TOXICITY TESTS RESULTS **TEST ORGANISM: Ceriodaphnia dubia**

Test Validity:
Is survival in the CONTROL ≥ 80%? Yes
Are Average Neonates/Surviving Female in the CONTROL ≥ 15.0? Yes
Did 60% of the CONTROL Females Produce Their Third Brood? Yes

MORTALITY **CHRONIC TOXICITY INDICATED? PASS**

Solution Concentration (%)	% Survival at 7 days
Control (0%)	80
66	90

STATISTICAL ANALYSES (Using proportion surviving):	COMMENTS:
☒ No Statistical Analysis Necessary	none

REPRODUCTION **CHRONIC TOXICITY INDICATED? PASS**

Solution Concentration (%)	Reproduction (Average # young /female)
Control (0%)	26.4
66	26

STATISTICAL ANALYSES (Using number of neonates):	COMMENTS:
Shapiro Wilk's Test (Normality) Test Statistic: 0.8923 Critical Value: 0.8680 (Parametric) Normally Distributed ☒ Yes (if test stat is > critical value) GOTO VARIANCE F-TEST ☐ No (if test stat is < critical value) GOTO WILCOXON RANK SUM TEST F-TEST F Statistic: 2.1964 Critical F: 6.5411 Variance ☒ Equal (if f stat is < critical f) GOTO T-TEST ☐ Unequal (if f stat is > critical f) GOTO MODIFIED T-TEST T-TEST t Statistic: 0.0757 Critical t value: 1.7341 Significant Difference ☐ YES (if t stat is > critical t) FAIL ☒ NO (if t stat is < critical t) PASS	none

PERMITTEE: Greenville WWTP NPDES #: 0020532 DSN: 001 TEST Id #: 980505-01

11. CHRONIC SCREENING TOXICITY TESTS RESULTS **TEST ORGANISM: Pimephales promelas**

Test Validity: Is survival in the CONTROL ≥ 80%? Yes
Is mean dry weight of surviving CONTROL fish ≥ 0.25mg? Yes

MORTALITY **CHRONIC TOXICITY INDICATED?** **PASS**

Solution Concentration (%)	% Survival at 7 days
Control (0%)	100
66	100

STATISTICAL ANALYSES (Using Survival data as proportion surviving that is arc sine transformed):	COMMENTS:
☒ No Statistical Analysis Necessary	none

GROWTH **CHRONIC TOXICITY INDICATED?** **PASS**

Solution Concentration (%)	Mean dry weight (mg)
Control (0%)	0.749
66	0.713

STATISTICAL ANALYSES (Using mean dry weights):	COMMENTS:
Shapiro Wilk's Test (Normality) Test Statistic: 0.9776 Critical Value: 0.7490 (Parametric) Normally Distributed ☒ Yes (if test stat is > critical value) GOTO VARIANCE F-TEST ☐ No (if test stat is < critical value) GOTO WILCOXON RANK SUM TEST F-TEST F Statistic: 6.7313 Critical F: 47.47 Variance ☒ Equal (if f stat is < critical f) GOTO T-TEST ☐ Unequal (if f stat is > critical f) GOTO MODIFIED T-TEST T-TEST t Statistic: 1.0654 Critical t value: 1.943 Significant Difference ☐ YES (if t stat is > critical t) FAIL ☒ NO (if t stat is < critical t) PASS	none

Signature: _____ Date: _____

APPENDIX B

Chemical Analyses of Samples Collected for Toxicity Testing

Chemical Analysis of Samples Collected for Toxicity Testing

Facility Name: Greenville WWTP
Location: Bulter
NPDES #: 0020532 DSN: 001
Collection Date: 5/5/98

PARAMETER	Result	
Diazinon	U 0.01	µg/l
Ethion	U 0.01	µg/l
Malathion	U 0.03	µg/l
Methyl Parathion	U 0.012	µg/l
Parathion	U 0.015	µg/l
Phosdrin	U 0.050	µg/l

PARAMETER	Result	
Arsenic by Graphite Furnace	U 0.0100	µg/l
Cadmium by ICP	U 0.0030	mg/l
Chromium by ICP	U 0.015	mg/l
Copper by ICP	U 0.020	mg/l
Hexavalent Chromium	U 0.020	mg/l
Lead by Graphite Furnace	U 0.002	µg/l
Mercury-FIMS	U 0.500	µg/l
Nickel by ICP	U 0.030	mg/l
Silver using ICP	U 0.015	mg/l
Zinc by ICP	U 0.030	mg/l
Dissolved Arsenic	U 0.0100	mg/l
Dissolved Cadmium	U 0.0030	mg/l
Dissolved Chromium	U 0.015	mg/l
Dissolved Copper	U 0.020	mg/l
Dissolved Lead	U 0.0020	µg/l
Dissolved Mercury	U 0.500	µg/l
Dissolved Nickel	U 0.030	mg/l
Dissolved Silver	U 0.015	mg/l
Dissolved Zinc	U 0.030	mg/l

BOD	4.0	mg/l
TSS	1.0	mg/l
Ammonia	U 0.3	mg/l
CN	U 0.004	mg/l

U denotes results less than instrument detection limit.

Figure 4

Station Location Map