

Biological Assessment of

Arvah B. Hopkins Generating Station: A Gradient Approach

Leon County

NPDES #FL0025518

Sampled June 2002

February 2003

Biology Section

Bureau of Laboratories

Division of Resource Assessment and Management

Quality Manual No. 870346G
NELAC Certification No. E31780

Florida Department of Environmental Protection

Fifth Year Inspection Summary

Discharger:	Arvah B. Hopkins Generating Station
County:	Leon
NPDES Number:	FL0025518
Permit Expiration:	11/06/2002

Toxics Sampling Inspection **(XSI)**

Date Sampled: June 25, 2002

Results: Metals were detected in the effluent, control, and test site samples at levels that complied with Class III Water Quality Standards (Table 1). No organic constituents were detected in the effluent.

Compliance Biomonitoring Inspection **(CBI)**

Date Sampled: June 25, 2002

Results: The effluent sample was not toxic to the fish, *Cyprinella leedsi,* or to the invertebrate, *Ceriodaphnia dubia,* during the 48-hour acute screening bioassay.

Impact Bioassessment Inspection **(IBI)**

Date Sampled: June 25, 2002

Results: In the qualitative macroinvertebrate samples, all study sites received either "good" or "excellent" ratings on the Stream Condition Index. There was some alteration of the communities nearer the outfall, however. Test Site 1 received a SCI score of 21 placing it in the lower range of the "good" category while Test Site 2 received 27 points placing it in the lower end of the "excellent" category. Control Sites 1 and 2 received 29 and 33 points, respectively, placing them in the mid and upper ends of the "excellent" category. The force of the effluent entering Beaver Creek has altered the physical structure of the system and may explain the differences in community structure near the outfall.

Water Quality Inspection **(WQI)**

Date Sampled: June 25, 2002

Results: Physical-chemical parameters were similar among the study sites and complied with Class III water quality criteria. Nutrients were similar among the study sites. Algal Growth Potential (AGP) values in the effluent sample and at the control and test sites were below the 5.0 mg dry wt/L "problem threshold" established for freshwaters.

Biological assessments are prepared by FDEP staff to provide information for review of NPDES permit renewal applications. Biological assessments, in conjunction with other information concerning the subject facility and its receiving-water body, are used to determine appropriate permit conditions.

Introduction

The Arvah B. Hopkins Generating Station is located west of Tallahassee, on State Road 260, Leon County Florida (Appendix 1). This facility is an oil/natural gas powered electric generating facility owned and operated by the City of Tallahassee. The wastewater from the plant consists of cooling-tower blowdown, turbine-cooling water, and treatment-pond effluent that is treated by mixing, flocculation, sedimentation, and in the case of the cooling tower blowdown, pH adjustment prior to being discharged. Effluent is discharged at outfall D001 through an onsite man-made drainage ditch to Beaver Creek. The discharge enters Beaver Creek at its headwaters, flows through the Lake Talquin Wildlife Management Area, and feeds into Lake Talquin near the confluence with the Ochlockonee River (see Facility Summary in Appendix 2). The design flow of the wastewater system is 3.3 million gallons per day (MGD). The actual flow during this survey was 2.1 MGD (see Facility Summary in Appendix 2).

Class III Freshwater Water Quality Criteria and facility permit limits are listed in Table 1. Values that exceed water quality or permit limits are highlighted in bold text. Bioassessments conducted in 1995 and 1996 demonstrated adverse effects to the macroinvertebrate and the periphyton communities of Beaver Creek were due to elevated copper and conductivity (FDEP 1995, 1996) and resulted in violations of the biological integrity criterion (Rule 62-302.530(11) FAC). The facility's Discharge Monitoring Reports indicate that copper concentrations in the discharge have been decreasing over the last two years. In 2001 there were three minor pH excursions.

Background

The purpose of this investigation was to determine the discharger's effects on the receiving water's biological communities. In previous biological assessments, the facility has negatively altered the invertebrate community, has discharged high levels of copper, and increased the specific conductance downstream of the outfall (FDEP 1995,1996). The facility's discharge enters Beaver Creek at its headwaters, essentially dominating the stream. The force of the effluent entering the creek has caused scouring and habitat reduction in approximately the first 100 meters downstream of the outfall and may have contributed to impacts to the invertebrate communities seen in previous biological assessments (FDEP 1995, 1996). In addition to habitat alterations, previously elevated levels of copper and common ground water ions (read as specific conductance) appear to have contributed to impacts to the invertebrate communities in Beaver Creek when compared to a near-by Control Site (Three Pole Creek).

In 1996, Three Pole Creek received an "excellent" Stream Condition Index (SCI) rating compared to a "poor" rating in Beaver Creek. Previous effluent specific conductance values have ranged from

890 to1040 μmhos substantially higher than levels measured in Three Pole Creek. Effluent copper values ranged from 43 to 81 μg/L, levels high enough to be chronically toxic to some invertebrates (ACQUIRE 1994). Toxicity has not been measured in previous studies in part due to elevated hardness values (approximately 400 mg/L $CaCO_3$). Metal toxicity decreases with increased water hardness and copper toxicity would have been difficult to detect for this reason (per Steve Wolfe, former Biology Section Administrator). The facility currently has an 800m copper mixing zone and is applying for an extension to address the copper in Beaver Creek.

Due to a significant drought, the historical control site in Three Pole Creek was not an appropriate control site for this study. Instead, a concentration gradient was used to determine if impacts to the biological communities decreased with decreasing effluent concentration. Four sites, two test sites and two control sites, were located at increasing distances from the outfall in Beaver Creek. The two test sites were within the facility's mixing zone and the control sites were downstream of the mixing zone. Test Site 1 began 30m below the point of discharge to 130m and Test Site 2, from approximately 130-230m. The control sites were located roughly 1000m downstream of the point of discharge; control Site 1 was upstream of Control Site 2 (see map in Appendix).

Previous biological assessments have shown significant elevations in conductivity associated with the effluent (FDEP 1995, 1996) and for this reason it was chosen as the parameter upon which the concentration gradient would be based. On June 14, 2002, replicate conductivity measures were taken along with other field parameters (pH, dissolved oxygen, and temperature) beginning at Test Site 1 and moving downstream to Control Site 2 (Table 2). These measurements showed that without input from tributaries flowing into Beaver Creek, there is essentially no dilution of the effluent at the control sites. As a result of this, any changes seen at the biological communities among the study sites will not be attributed to differences in water chemistry but to other physical alterations the discharge may be having on the in-stream habitat

A habitat assessment was performed *in situ* to compare all sites. Supplemental physical and chemical data were collected on the effluent and study sites. Data for this report were collected on June 25, 2002. Due to low water levels, periphytometers and Hester-Dendy samplers were not deployed for this study.

All field and laboratory biological methods followed Biology Section Standard Operating Procedures (SOPs, see< www.dep.state.fl.us/labs/sops/index.htm> for details) and met DEP quality assurance/quality control standards (see <www.dep.state.fl.us/labs/nelap/index.htm >).

The DEP Central Laboratory in Tallahassee conducted this investigation. The report was reviewed by District representatives and the Point Source Studies Review Committee (Wayne Magley, Chuck Ziegmont and Michael Tanski).

Results and Discussion

- Chemical results are reported in Table 1 and Appendix 4. A complete listing of all analytes measured can be found in Appendix 4. Copper was detected in the effluent sample at a level that complied with Class III Water Quality Criteria and permit limits. Aluminum, arsenic, copper, iron, and lead were detected in the study site samples at levels that complied with Class III Water Quality Criteria (FAC 62-302). No organic pollutants were detected in the effluent.
- The conductivity gradient demonstrated Beaver Creek to be effluent dominated throughout the study area with only minor reductions in conductivity at Control Sites 1 and 2 (Table 2).
- Dissolved oxygen, water temperature, and pH at test and control sites complied with Class III Water Quality Criteria (Table 1, FAC 62-302). Effluent conductivity was not in violation of Class III Water Quality Criteria (FAC 62-302) or facility permit limits. Conductivity levels were elevated at all study sites ranging from 734 μhmos/cm at Control Site 2 to 819 μhmos/cm at Test Site 1 (Table 2). A tributary flowing into Control Site 2 had an average conductivity level of 24 μhmos/cm (Table 2).
- The effluent sample was not toxic to the fish, *Cyprinella leedsi,* or to the water flea, *Ceriodaphnia dubia,* during 48-hour acute screening bioassays (Table 1, Appendix 7), complying with FAC 62-302 and the facility's permit limits.
- Fecal and total coliform samples were not collected for this study.
- With the exception of total phosphorus, the effluent does not appear to be contributing to increases in nutrients at the study sites where values were 80-90% of typical values at all study sites and comparable to the effluent level. Ortho-phosphate was somewhat higher at the control sites (70-80%) compared to the test sites (50-60%) (Appendix 6). All other nutrients were less than 50% of values measured in other typical Florida Streams.
- Algal growth potential (AGP) is a measure of nutrients available for algal growth (Miller *et al.* 1978). Raschke and Shultz (1987) found that AGP above 5.0 mg dry weight/L represents a "problem threshold" for fresh receiving waters, implying nutrient enrichment. AGP values in the effluent and at all study sites were estimated to be below the "problem threshold" (Table 1). AGP values were estimated due to a temperature excursion of six hours during the AGP test. These data suggest no problematic nutrient enrichment related to the discharge in this portion of Beaver Creek. There was no evidence of growth inhibition in AGP data (Table 3).

- Habitat assessment scores placed Test Site 1 and 2 in the "sub-optimal" category with 102 points each. Control Sites 1 and 2 scored 126 and 130 points, respectively, which placed them in the "optimal" category (see Appendix 8).
- Qualitative measures of benthic macroinvertebrate assemblages from dipnet samples are summarized in Table 4 and 5 and in Appendix 9. Control Sites 1 and 2 had SCI scores of 29 and 33, respectively, placing each site in the "excellent" category. Test Sites 1 and 2 had SCI scores of 21 and 27, respectively, placing Test Site 1 in the "good" category and Test Site 2 in the "excellent".
- Dipnet samples were subsampled to a targeted 100-organism count. Habitat reductions by effluent scouring at Beaver Creek are indicated by the amount of the dipnet sample that was sorted to reach the 100-organism target. At the control sites, 9-10% of the sample was sorted, while at the test sites 22-33% of the sample was sorted.

Summary

The facility appears to be in compliance with its permit limits and Class III water quality standards. Copper was detected in the effluent at a level below Class III Water Quality Criteria and levels known to be chronically toxic to invertebrates. Total phosphorus levels were elevated at all study sites and appear attributable to the effluent.

Removal of the physical habitat at Test Site 1 due to force of the effluent entering Beaver Creek appears to have caused reductions in the macroinvertebrate communities near the outfall. These alterations are seen in the lower Habitat Assessment scores, a reduction in the Stream Condition Index score at Test Site 1, and in the higher proportion of the dipnet samples that were sorted to reach the targeted number of individuals at the test sites when compared to the control sites.

Literature Cited

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Table 1. Effluent limits and summary of chemistry data.

Arvah B. Hopkins Generating Station	Effluent Limits	Effluent Samples	Control Site 1	Control Site 2	Test Site 1	Test Site 2
Organic Constituents (µg/L)						
None Detected						
Metals (µg/L)						
Aluminum	1500 **	50 U	470	360	50 U	230
Arsenic	50 **	3.0 U	3.3 I	3.0 U	3.4 I	3.0 U
Cadmium	3.041 b**	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U
Calcium	-	93.3	86.3	79.9	27.9	27.7
Chromium	579.0 b*	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Copper	34.6 b*	11.9	9.7	8.1	12.4	14.5
Iron	1000 *	25 U	426	341	25 U	98 I
Lead	15.74 b**	0.25 U	0.58 I	0.45 I	0.25 U	0.31 I
Magnesium	-	28.7	26.4	24.5	27.9	27.7
Nickel	456.3 b**	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Selenium	5.0 **	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Silver	0.07 **	0.02 U	0.02 U	0. 02 U	0.02 U	0.02 U
Zinc	2.0 a *	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U
Nutrients (mg/L)						
Ortho-phosphate	-	0.084	0.21	0.20	0.088	0.092
Total phosphorus	-	0.55 J	0.53	0.47 A	0.56	0.58
Ammonia	-	0.010 U	0.014 I	0.020 I	0.010 U	0.010 U
Nitrate+Nitrite	-	0.050	0.031	0.031	0.056	0.054
TKN	-	0.18 I	0.43	0.36 A	0.18 I	0.18 I
Organic Nitrogen	-	0.18	0.42	034	0.18	0.18
Total Nitrogen	-	0.23	0.46	0.39	0.23	0.23
Un-ionized ammonia	0.02 *	< 0.00	-	-	-	-
General Physical-Chemical Parameters						
Habitat Assessment	-	-	126	130	102	102
DO (mg/L)	≤ 5.0 **	9.5	7.9	8.0	8.3	8.5
pH (SU)	6.0-8.5 *	7.3	7.9	7.9	7.8	7.9
Conductivity (µmhos/cm)	**	823	776	734	819	818
Sulfate (mg/SO_4/L)	-	160 A	150	140	160	150
Temperature (°C)	≤ 26.67 *	23.6	24.1	23.8	23.1	23.3
Total Dissolved Solids (mg/L)	-	523 A	495	451	529	509
Total Suspended Solids (mg/L)	–	4 U	29	19	4	6
Flow (MGD)	report	2.1	-	-	-	-
Hardness (mg $CaCO_3$)	report	351.16	324.21	300.40	342.62	339.55
AGP (mg dry wt/L)	-	3.9 J	3.9 J	3.6 J	3.6 J	3.5 J
Toxicity (48-hour static, screening bioassay)						
Bioassay - Fish	NOEC	no mortality	-	-	-	-
Bioassay - Invertebrate	NOEC	no mortality	-	-	-	-

* Permit limit

** Class III water quality standard

a - Daily maximum

b - Value is calculated based on hardness

A - Value reported is the mean of two or more determinations

I - Value reported is between the minimum quantitation limit, and the laboratory pratical quantitation limit

J - Estimated value

K - Actual value is known to be less than value given

L - Actual value is known to be greater than value given

N - Presumptive evidence of presence of material

U - Material analyzed for but not detected; value reported is the minimum detection limit

NOEC - A no observed effect concentration less than 100% effluent will constitute a violation of this permi

Table 2. Arvah Hopkins data showing conductivity gradient from June 14, 2002.

Arvah B. Hopkins Generating Station	Dissolved Oxygen (mg/L)		pH (SU)		Temperature (C)		Conductance (umhos/cm)		
	a [1]	b	a	b	a	b	a	b	c
EFFLUENT	9.54	9.41	7.33	7.39	23.59	23.58	823	823	823
Test Site 1									
5m [2]	8.23	8.23	7.80	7.79	23.15	23.15	820	818	820
30m	8.22	8.21	7.81	7.80	23.13	23.13	819	819	819
75m	8.23	8.22	7.82	7.82	23.11	23.10	819	819	819
100m	8.25	8.24	7.82	7.83	23.10	23.10	819	819	816
Test Site 2									
10m	8.50	8.40	7.88	7.87	23.26	23.26	818	818	818
30m	8.31	8.29	7.89	7.88	23.27	23.27	817	818	818
60m	8.27	8.25	7.89	7.89	23.29	23.28	818	817	817
90m	8.24	8.24	7.90	7.90	23.30	23.30	813	812	816
Control Site 2									
2m	7.97	7.90	7.94	7.93	23.76	23.76	734	735	736
30m	7.65	7.66	7.94	7.92	23.85	23.80	746	709	765
70m	7.74	7.66	7.96	7.96	23.94	23.94	773	774	774
100m	7.71	7.65	7.96	7.95	23.96	23.95	774	773	775
Control Site 1									
1m	7.90	7.81	7.92	7.93	24.06	24.06	776	762	771
30m	7.76	7.72	7.94	7.95	24.07	24.07	777	772	776
80m	7.79	7.71	7.95	7.95	24.08	24.09	777	777	774
100m	7.83	7.70	7.96	7.95	24.10	24.10	778	777	----
Tributary @ Control Site 2	8.25	8.19	4.37	4.27	22.58	22.57	14	27	31

1 - a , b, and c represent replicates measures taken at each location

2 - distances were randomly selected along each 100m stream transect

Table 3. Measured and predicted algal growth potential (AGP) for total soluble inorganic nitrogen (TSIN) and ortho phosphate (OP) limitation.

Location	AGP (measured)	Predicted AGP (TSIN) ± 20%	N:P ratio
December-01			
Control Site 1	3.9	1.71+0.342	0.2
Control Site 2	3.6	1.9+0.38	0.3
Test Site 1	3.6	2.508+1.0944	0.8
Test Site 2	3.5	2.432+1.1096	0.7
Effluent	3.9	2.28+0.38	0.7

Table 4. Community structure of control and test sites.

Arvah B. Hopkins Generating Station	Control Site 1	Control Site 2	Test Site 1	Test Site 2
Macroinvertebrate Qualitative				
% Dominant Taxon	20.0	10.2	24.5	10.1
EPT Taxa	8	8	4	4
Florida Index	15	18	11	21
Number of Taxa	30	35	27	26
Total No. of Individuals	105	98	102	89
Stream Condition Index	29	33	21	27
Community Composition				
% Amphipoda	0.0	0.0	1.0	0.0
% Coleoptera	8.6	13.3	12.8	15.7
% Decapoda	1.9	3.1	6.9	5.6
% Diptera	19.0	31.6	22.6	48.3
% Ephemeroptera	28.6	24.5	24.5	4.5
% Megaloptera	0.0	1.0	0.0	2.2
% Nemertea	1.0	0.0	2.0	0.0
% Odonata	1.9	7.1	2.0	10.1
% Oligochaeta	8.6	2.0	8.8	0.0
% Pelecypoda	4.8	0.0	0.0	0.0
% Plecoptera	1.0	2.0	0.0	0.0
% Trichoptera	24.8	15.3	18.6	13.5
Functional Feeding Groups				
% Burrowing Deposit Feeders	7.6	2.0	5.9	0.0
% Predators	7.1	16.8	18.1	34.3
% Surface Deposit Feeders	35.2	34.7	38.7	30.3
% Suspension Feeders/Filterers	32.9	12.8	7.8	8.4
% Scrapers	10.5	16.8	17.7	14.6
% Shredders	2.4	6.1	2.5	7.3

Table 5. Stream Condition Index results for control and test sites.

Control Site 1

Macroinvertebrate Dip Net (20 sweeps of most productive substrates)	Value	5	3	1	Score
Total Number of Taxa	30	≥31	30-16	<16	3
EPT Taxa	8	≥7	6-4	<4	5
# Chironomid Taxa	9	≥9	8-5	<5	5
% Contribution of Dominant Taxon	20	≤22	23-61	>61	5
% Diptera	19	-	≤50	>50	3
Florida Index	15	≥16	15-8	<8	3
% Suspension feeders/Filterers	33	≥12	11-6	<6	5
Total Score		**Panhandle**			**29**
Interpretation of Scores		**Excellent**			**27-33**
		Good			21-26
		Poor			14-20
		Severely Degraded			7-13

Summer Index Period: Stream Condition Index (SCI) for Florida Panhandle (April1996)

Control Site 2

Macroinvertebrate Dip Net (20 sweeps of most productive substrates)	Value	5	3	1	Score
Total Number of Taxa	35	≥31	30-16	<16	5
EPT Taxa	8	≥7	6-4	<4	5
# Chironomid Taxa	14	≥9	8-5	<5	5
% Contribution of Dominant Taxon	10	≤22	23-61	>61	5
% Diptera	32	-	≤50	>50	3
Florida Index	18	≥16	15-8	<8	5
% Suspension feeders/Filterers	13	≥12	11-6	<6	5
Total Score		**Panhandle**			**33**
Interpretation of Scores		**Excellent**			**27-33**
		Good			21-26
		Poor			14-20
		Severely Degraded			7-13

Summer Index Period: Stream Condition Index (SCI) for Florida Panhandle (April1996)

Table 5. Stream Condition Index results for control and test sites. **Continued.**

Test Site 1

Macroinvertebrate Dip Net (20 sweeps of most productive substrates)	Value	5	3	1	Score
Total Number of Taxa	27	≥31	30-16	<16	3
EPT Taxa	4	≥7	6-4	<4	3
# Chironomid Taxa	6	≥9	8-5	<5	3
% Contribution of Dominant Taxon	24	≤22	23-61	>61	3
% Diptera	23	-	≤50	>50	3
Florida Index	11	≥16	15-8	<8	3
% Suspension feeders/Filterers	8	≥12	11-6	<6	3
Total Score		**Panhandle**			**21**
Interpretation of Scores		**Excellent**			27-33
		Good			**21-26**
		Poor			14-20
		Severely Degraded			7-13

Summer Index Period: Stream Condition Index (SCI) for Florida Panhandle (April1996)

Test Site 2

Macroinvertebrate Dip Net (20 sweeps of most productive substrates)	Value	5	3	1	Score
Total Number of Taxa	26	≥31	30-16	<16	3
EPT Taxa	4	≥7	6-4	<4	3
# Chironomid Taxa	11	≥9	8-5	<5	5
% Contribution of Dominant Taxon	10	≤22	23-61	>61	5
% Diptera	48	-	≤50	>50	3
Florida Index	21	≥16	15-8	<8	5
% Suspension feeders/Filterers	8	≥12	11-6	<6	3
Total Score		**Panhandle**			**27**
Interpretation of Scores		**Excellent**			**27-33**
		Good			21-26
		Poor			14-20
		Severely Degraded			7-13

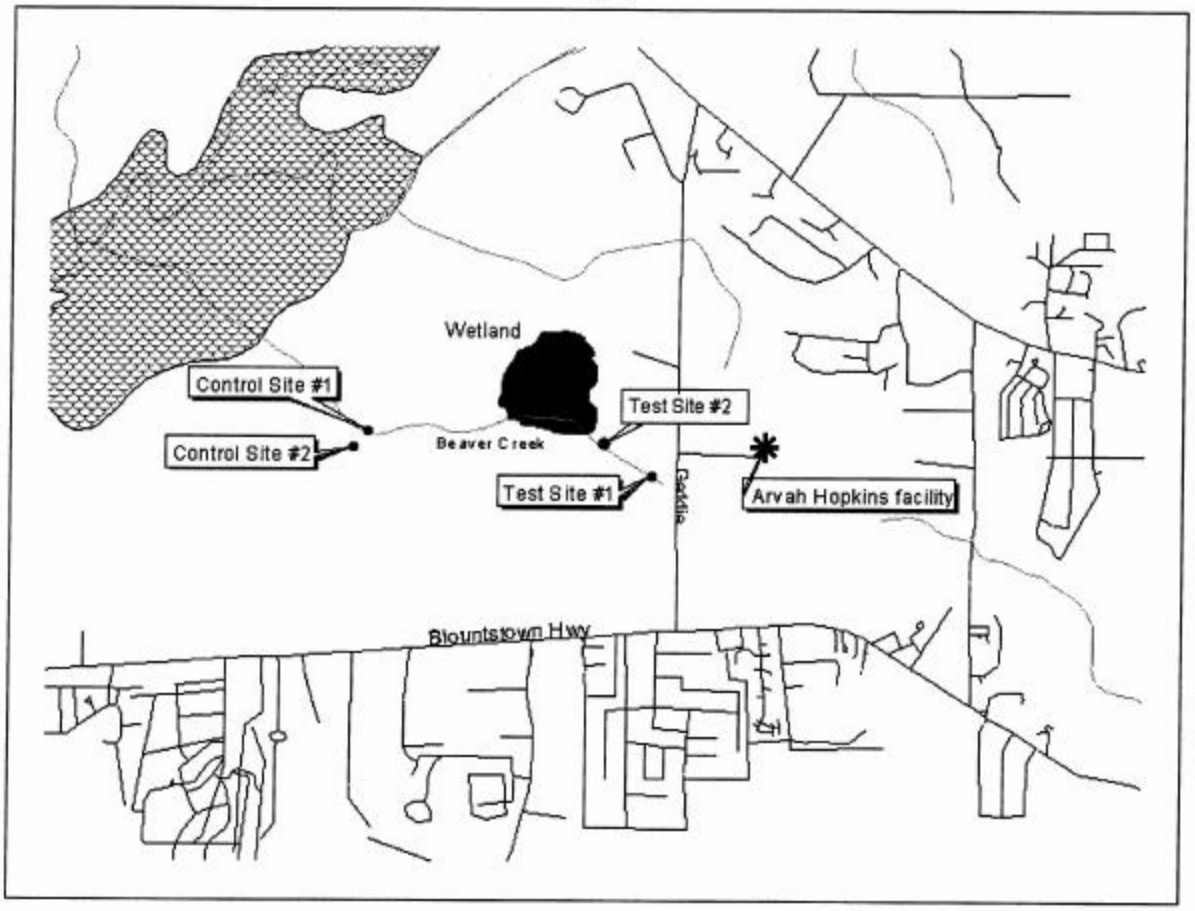
Summer Index Period: Stream Condition Index (SCI) for Florida Panhandle (April1996)

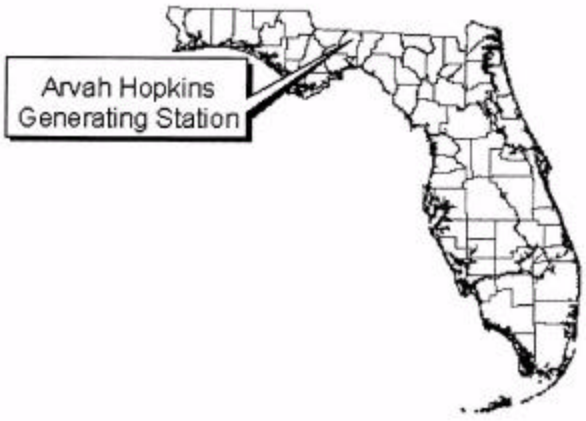
Appendices

- Appendix 1. Map of facility
- Appendix 2. Facility summary
- Appendix 3. Methods
- Appendix 4. Chemical analyses of effluent and receiving water.
- Appendix 5. Explanation of biological measurements
- Appendix 6. Typical values for selected parameters in Florida waters
- Appendix 7. Additional physical, chemical, and toxicological results
- Appendix 8. Habitat Assessment field sheets
- Appendix 9. Dipnet samples: macroinvertebrate counts and taxa lists

Appendix 1

Arvah Hopkins Generating Station





0 0.9 Miles

N
W E
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FDEP-Bureau of Laboratories
Fifth Year Inspections
Created by: Julie Riley
Created on : December 12, 2002

Appendix 2

State of Florida
Department of Environmental Protection
Facility Summary

Facility Name: Arvah B. Hopkins Generating Station		**Prepared By: Angela Schrift Amended by Eric Kitchen**
Location: County Rd. 1585 – Geddie Rd. Tallahassee, Florida 32304 Latitude: 30°27'4"N Longitude: 84°24'12"W	**County: Leon**	**District: Northwest District**
Federal Permit No.: FL0025518 Expiration Date: 10/01/2002	**State Permit No.: Expiration Date:**	**Facility Type: Industrial Wastewater Treatment and Disposal System**
Function of Facility: To provide a wastewater treatment and disposal system to serve a steam electric power generation plant. The industrial wastewater treatment and disposal system has a 3.3 MGD and consists of two fossil fuel-fired units; Unit #1 has a nominal rating of 75MW and Unit #2 has a nominal rating of 238 MW.		
Description of treatment process: Lime treatment consisting of mixing, flocculation, and sedimentation of the treatment pond effluent, auxiliary cooling water, boiler blowdown, and demineralizer waste. Also, pH adjustment of cooling tower blowdown. Effluent is discharged at D001 through an onsite man-made drainage ditch to Beaver Creek which eventually leads to Ochlockonee River.		
Receiving Waters: Beaver Creek to Lake Talquin		**Classification: Class III Waterbody**
Design Flow: 3.3 MGD	**Mean Flow: 1.8 MGD**	**Flow During Survey: 2.1 MGD**
Discharge is: x Continuous		
Facility Mixing Zone Details: There is an 800 meter mixing zone extending from the point of discharge; currently under permit renewal review for copper and temperature.		
List Effluent Limits:		

Parameter and Units	Limit	Describe special permit conditions and permit modifications:
Flow (MGD)	Report (daily avg. and daily maximum)	Authorized to discharge from outfall D0171 and D0172 – Cooling Tower Blowdown from Cooling Towers #1 and #2, respectively, to the on-site man-made drainage ditch through Outfall D001 to Beaver Creek
Free Available Chlorine (mg/l)	0.2 (daily average) 0.5 (daily maximum)	
Time of Chlorine Discharge minutes/tower/day	120 (daily maximum)	Neither free available chlorine (FAC) or total residual chlorine (TRC) or other Department approved biocide shall be discharged from any tower for more than two hours in any one day and not more than any one tower shall discharge FAC or TRC
Total Recoverable Zinc (mg/l)	1.0 (daily average) 2.0 (daily maximum)	

Appendix 3

Methods

The effluent was analyzed for nutrients, metals, organic constituents (base, neutral and acid extractables) and pesticides. The results from these analyses were compared with Water Quality Limits (FAC 62-302) and facility permit limits (Table 1, Appendix 2). A list of the analytes tested for, the minimum detection limit and the practical quantitation limit are given in Appendix 4. Methods used for all chemical analyses are on file at the FDEP Central Chemistry Laboratory in Tallahassee and may be viewed on the web at http://www.floridadep.org/labs/sop/index.htm.

Acute screening toxicity bioassays were performed on the effluent sample using the water flea, *Ceriodaphnia dubia,* and the fish, *Cyprinella leedsi* (Weber 1993). The effluent and water from control and test sites were analyzed for the presence and concentration of total and fecal coliform bacteria (APHA 1992, methods 9222 B, 9222 D).

An effluent sample and water samples from the control and test sites were autoclaved, filtered (0.45 μm), inoculated with the unicellular green alga, *Raphidocelis subcapitata* (formerly *Selanastrum capricornutum*), and incubated for 14 days (Miller et al. 1978). The algal growth potential (AGP) value is the peak growth of the alga within that 14-day period, recorded as mg dry weight/L (Miller et al. 1978). To measure possible inhibition of algal growth based on possible toxicants in effluent or site water, AGP results were compared to expected levels of dry weight production based on the nutrient content of the water (Miller et al. 1978, Appendix 5).

Benthic macroinvertebrates were collected from multiple substrates (*e.g.* snags, leaf packs, vegetation) using discrete dipnet sweeps (qualitative samples, method modified from Plafkin *et al.* 1989). Benthic macroinvertebrates were sorted and identified to the lowest practical taxonomic level, usually species. The Stream Condition Index and its component metrics were calculated from benthic macroinvertebrate data to determine the effects of the discharge on receiving waters. For a discussion of each biological measure and its potential relationship to Florida Administrative Code, see Appendix 5.

Appendix 4

Chemical analysis of effluent and receiving water. Continued.

Field ID	Analysis Group	Component	Result	Units	Remark	MDL	PQL
CONTROL SITE 1	Bio-AGP/LimNut	Algal Growth Potential	3.89	mg DryWt/L	J	0.1	0.3
CONTROL SITE 1	Bio-Invertebrates	Macroinvert-FW-Qual-Dipnet	30	# Taxa			
CONTROL SITE 1	Metals-Water	Aluminum_308	470	ug/L		50	200
CONTROL SITE 1	Metals-Water	Arsenic	3.3	ug/L	I	3	12
CONTROL SITE 1	Metals-Water	Cadmium	0.025	ug/L	U	0.025	0.1
CONTROL SITE 1	Metals-Water	Calcium	86.3	mg/L		0.1	0.4
CONTROL SITE 1	Metals-Water	Chromium	2	ug/L	U	2	8
CONTROL SITE 1	Metals-Water	Copper	2	ug/L	U	2	8
CONTROL SITE 1	Metals-Water	Copper	9.7	ug/L		0.75	3
CONTROL SITE 1	Metals-Water	Iron_271	426	ug/L		25	100
CONTROL SITE 1	Metals-Water	Lead	0.58	ug/L	I	0.25	1
CONTROL SITE 1	Metals-Water	Magnesium	26.4	mg/L		0.025	0.1
CONTROL SITE 1	Metals-Water	Nickel	2	ug/L	U	2	8
CONTROL SITE 1	Metals-Water	Selenium	0.5	ug/L	U	0.5	2
CONTROL SITE 1	Metals-Water	Silver	0.02	ug/L	U	0.02	0.08
CONTROL SITE 1	Metals-Water	Zinc	3	ug/L	U	3	12
CONTROL SITE 1	Nutrients-Liquid	Ammonia-N	0.014	mg N/L	I	0.01	0.02
CONTROL SITE 1	Nutrients-Liquid	Chloride	57	mg Cl/L		1	2.5
CONTROL SITE 1	Nutrients-Liquid	NO2NO3-N	0.031	mg N/L		0.004	0.01
CONTROL SITE 1	Nutrients-Liquid	N_KJEL_TOT	0.43	mg N/L		0.06	0.2
CONTROL SITE 1	Nutrients-Liquid	O-Phosphate-P	0.21	mg P/L		0.016	0.04
CONTROL SITE 1	Nutrients-Liquid	Sulfate	150	mg SO4/L		1	2.5
CONTROL SITE 1	Nutrients-Liquid	TDS	495	mg/L		15	60
CONTROL SITE 1	Nutrients-Liquid	TSS	29	mg/L		4	16
CONTROL SITE 1	Nutrients-Liquid	Total-P	0.53	mg P/L		0.02	0.05
CONTROL SITE 2	Bio-AGP/LimNut	Algal Growth Potential	3.58	mg DryWt/L	J	0.1	0.3
CONTROL SITE 2	Bio-Invertebrates	Macroinvert-FW-Qual-Dipnet	36	# Taxa			
CONTROL SITE 2	Metals-Water	Aluminum_308	360	ug/L		50	200
CONTROL SITE 2	Metals-Water	Arsenic	3	ug/L	U	3	12
CONTROL SITE 2	Metals-Water	Cadmium	0.025	ug/L	U	0.025	0.1
CONTROL SITE 2	Metals-Water	Calcium	79.9	mg/L		0.1	0.4
CONTROL SITE 2	Metals-Water	Chromium	2	ug/L	U	2	8
CONTROL SITE 2	Metals-Water	Copper	2	ug/L	U	2	8
CONTROL SITE 2	Metals-Water	Copper	8.1	ug/L		0.75	3
CONTROL SITE 2	Metals-Water	Iron_271	341	ug/L		25	100
CONTROL SITE 2	Metals-Water	Lead	0.45	ug/L	I	0.25	1
CONTROL SITE 2	Metals-Water	Magnesium	24.5	mg/L		0.025	0.1
CONTROL SITE 2	Metals-Water	Nickel	2	ug/L	U	2	8
CONTROL SITE 2	Metals-Water	Selenium	0.5	ug/L	U	0.5	2
CONTROL SITE 2	Metals-Water	Silver	0.02	ug/L	U	0.02	0.08
CONTROL SITE 2	Metals-Water	Zinc	3	ug/L	U	3	12
CONTROL SITE 2	Nutrients-Liquid	Ammonia-N	0.02	mg N/L	I	0.01	0.02
CONTROL SITE 2	Nutrients-Liquid	Chloride	55	mg Cl/L		1	2.5
CONTROL SITE 2	Nutrients-Liquid	NO2NO3-N	0.031	mg N/L		0.004	0.01
CONTROL SITE 2	Nutrients-Liquid	N_KJEL_TOT	0.36	mg N/L	A	0.06	0.2
CONTROL SITE 2	Nutrients-Liquid	O-Phosphate-P	0.2	mg P/L		0.008	0.02
CONTROL SITE 2	Nutrients-Liquid	Sulfate	140	mg SO4/L		1	2.5
CONTROL SITE 2	Nutrients-Liquid	TDS	451	mg/L		15	60
CONTROL SITE 2	Nutrients-Liquid	TSS	19	mg/L		4	16
CONTROL SITE 2	Nutrients-Liquid	Total-P	0.47	mg P/L	A	0.02	0.05

Appendix 4

Chemical analysis of effluent and receiving water. Continued.

Field ID	Analysis Group	Component	Result	Units	Remark	MDL	PQL
TEST SITE 1	Bio-AGP/LimNut	Algal Grow th Potential	3.59	mg DryWt/L	J	0.1	0.3
TEST SITE 1	Bio-Invertebrates	Macroinvert-FW-Qual-Dipnet	28	# Taxa			
TEST SITE 1	Metals-Water	Aluminum_308	50	ug/L	U	50	200
TEST SITE 1	Metals-Water	Arsenic	3.4	ug/L	I	3	12
TEST SITE 1	Metals-Water	Cadmium	0.025	ug/L	U	0.025	0.1
TEST SITE 1	Metals-Water	Calcium	91.2	mg/L		0.1	0.4
TEST SITE 1	Metals-Water	Chromium	2	ug/L	U	2	8
TEST SITE 1	Metals-Water	Copper	12.4	ug/L		0.75	3
TEST SITE 1	Metals-Water	Copper	2.2	ug/L	I	2	8
TEST SITE 1	Metals-Water	Iron_271	25	ug/L	U	25	100
TEST SITE 1	Metals-Water	Lead	0.25	ug/L	U	0.25	1
TEST SITE 1	Metals-Water	Magnesium	27.9	mg/L		0.025	0.1
TEST SITE 1	Metals-Water	Nickel	2	ug/L	U	2	8
TEST SITE 1	Metals-Water	Selenium	0.5	ug/L	U	0.5	2
TEST SITE 1	Metals-Water	Silver	0.02	ug/L	U	0.02	0.08
TEST SITE 1	Metals-Water	Zinc	3	ug/L	U	3	12
TEST SITE 1	Nutrients-Liquid	Ammonia-N	0.01	mg N/L	U	0.01	0.02
TEST SITE 1	Nutrients-Liquid	Chloride	58	mg Cl/L		1	2.5
TEST SITE 1	Nutrients-Liquid	NO2NO3-N	0.056	mg N/L		0.004	0.01
TEST SITE 1	Nutrients-Liquid	N_KJEL_TOT	0.18	mg N/L	I	0.06	0.2
TEST SITE 1	Nutrients-Liquid	O-Phosphate-P	0.088	mg P/L		0.004	0.01
TEST SITE 1	Nutrients-Liquid	Sulfate	160	mg SO4/L		1	2.5
TEST SITE 1	Nutrients-Liquid	TDS	529	mg/L		15	60
TEST SITE 1	Nutrients-Liquid	TSS	4	mg/L	U	4	16
TEST SITE 1	Nutrients-Liquid	Total-P	0.56	mg P/L		0.02	0.05
TEST SITE 2	Bio-AGP/LimNut	Algal Grow th Potential	3.54	mg DryWt/L	J	0.1	0.3
TEST SITE 2	Bio-Invertebrates	Macroinvert-FW-Qual-Dipnet	27	# Taxa			
TEST SITE 2	Metals-Water	Aluminum_308	230	ug/L		50	200
TEST SITE 2	Metals-Water	Arsenic	3	ug/L	U	3	12
TEST SITE 2	Metals-Water	Cadmium	0.025	ug/L	U	0.025	0.1
TEST SITE 2	Metals-Water	Calcium	90.3	mg/L		0.1	0.4
TEST SITE 2	Metals-Water	Chromium	2	ug/L	U	2	8
TEST SITE 2	Metals-Water	Copper	14.5	ug/L		0.75	3
TEST SITE 2	Metals-Water	Copper	3.6	ug/L	I	2	8
TEST SITE 2	Metals-Water	Iron_271	98	ug/L	I	25	100
TEST SITE 2	Metals-Water	Lead	0.31	ug/L	I	0.25	1
TEST SITE 2	Metals-Water	Magnesium	27.7	mg/L		0.025	0.1
TEST SITE 2	Metals-Water	Nickel	2	ug/L	U	2	8
TEST SITE 2	Metals-Water	Selenium	0.5	ug/L	U	0.5	2
TEST SITE 2	Metals-Water	Silver	0.02	ug/L	U	0.02	0.08
TEST SITE 2	Metals-Water	Zinc	3	ug/L	U	3	12
TEST SITE 2	Nutrients-Liquid	Ammonia-N	0.01	mg N/L	U	0.01	0.02
TEST SITE 2	Nutrients-Liquid	Chloride	58	mg Cl/L		1	2.5
TEST SITE 2	Nutrients-Liquid	NO2NO3-N	0.054	mg N/L		0.004	0.01
TEST SITE 2	Nutrients-Liquid	N_KJEL_TOT	0.18	mg N/L	I	0.06	0.2
TEST SITE 2	Nutrients-Liquid	O-Phosphate-P	0.092	mg P/L		0.004	0.01
TEST SITE 2	Nutrients-Liquid	Sulfate	150	mg SO4/L		1	2.5
TEST SITE 2	Nutrients-Liquid	TDS	509	mg/L		15	60
TEST SITE 2	Nutrients-Liquid	TSS	6	mg/L	I	4	16
TEST SITE 2	Nutrients-Liquid	Total-P	0.58	mg P/L		0.02	0.05

Appendix 4

Chemical analysis of effluent and receiving water. Continued.

Field ID	Analysis Group	Component	Result	Units	Remark	MDL	PQL
EFFLUENT	BNA-Water	1,2,4,5-Tetrachlorobenzene	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	1,2,4-Trichlorobenzene	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	1,2-Dichlorobenzene	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	1,3,5-Trinitrobenzene	3.9	ug/L	U	3.9	16
EFFLUENT	BNA-Water	1,3-Dichlorobenzene	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	1,3-Dinitrobenzene	1.9	ug/L	U	1.9	7.8
EFFLUENT	BNA-Water	1,4-Dichlorobenzene	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	1,4-Naphthoquinone	19	ug/L	U	19	78
EFFLUENT	BNA-Water	1-Naphthylamine	9.7	ug/L	U	9.7	39
EFFLUENT	BNA-Water	2,3,4,6-Tetrachlorophenol	1.9	ug/L	U	1.9	7.8
EFFLUENT	BNA-Water	2,4,5-Trichlorophenol	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	2,4,6-Trichlorophenol	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	2,4-Dichlorophenol	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	2,4-Dimethylphenol	49	ug/L	U	49	190
EFFLUENT	BNA-Water	2,4-Dinitrophenol	15	ug/L	U	15	58
EFFLUENT	BNA-Water	2,4-Dinitrotoluene	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	2,6-Dichlorophenol	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	2,6-Dinitrotoluene	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	2-Acetylaminofluorene	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	2-Chloronaphthalene	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	2-Chlorophenol	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	2-Methyl-4,6-dinitrophenol	2.9	ug/L	U	2.9	12
EFFLUENT	BNA-Water	2-Methylnaphthalene	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	2-Naphthylamine	9.7	ug/L	U	9.7	39
EFFLUENT	BNA-Water	2-Nitroaniline	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	2-Nitrophenol	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	2-Picoline	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	3,3'-Dichlorobenzidine	39	ug/L	U	39	160
EFFLUENT	BNA-Water	3,3'-Dimethylbenzidine	19	ug/L	U	19	78
EFFLUENT	BNA-Water	3-Methylcholanthrene	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	3-Nitroaniline	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	4,4'-DDD	1.5	ug/L	U	1.5	5.8
EFFLUENT	BNA-Water	4,4'-DDE	1.5	ug/L	U	1.5	5.8
EFFLUENT	BNA-Water	4,4'-DDT	1.5	ug/L	U	1.5	5.8
EFFLUENT	BNA-Water	4-Aminobiphenyl	3.9	ug/L	U	3.9	16
EFFLUENT	BNA-Water	4-Bromophenyl phenyl ether	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	4-Chloro-3-methylphenol	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	4-Chloroaniline	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	4-Chlorophenyl phenyl ether	1.9	ug/L	U	1.9	7.8
EFFLUENT	BNA-Water	4-Nitroaniline	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	4-Nitrophenol	15	ug/L	U	15	58
EFFLUENT	BNA-Water	5-Nitro-o-toluidine	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	7,12-Dimethylbenz(a)anthracene	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	Acenaphthene	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	Acenaphthylene	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	Acetophenone	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	Aldrin	1.5	ug/L	U	1.5	5.8
EFFLUENT	BNA-Water	Aniline	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	Anthracene	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	Azobenzene/1,2-Diphenylhydrazine	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	Benzidine	97	ug/L	U	97	390
EFFLUENT	BNA-Water	Benzo(a)anthracene	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	Benzo(a)pyrene	0.97	ug/L	U	0.97	3.9

Appendix 4

Chemical analysis of effluent and receiving water. Continued.

Field ID	Analysis Group	Component	Result	Units	Remark	MDL	PQL
EFFLUENT	BNA-Water	Benzo(b)fluoranthene	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	Benzo(g,h,i)perylene	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	Benzo(k)fluoranthene	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	Benzyl alcohol	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	Bis(2-chloroethoxy)methane	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	Bis(2-chloroethyl)ether	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	Bis(2-chloroisopropyl)ether	2.9	ug/L	U	2.9	12
EFFLUENT	BNA-Water	Bis(2-ethylhexyl)phthalate	15	ug/L	U	15	58
EFFLUENT	BNA-Water	Butyl benzyl phthalate	4.9	ug/L	U	4.9	19
EFFLUENT	BNA-Water	Chrysene	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	Di-n-butyl phthalate	4.9	ug/L	U	4.9	19
EFFLUENT	BNA-Water	Di-n-octyl phthalate	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	Dibenzo(a,h)anthracene	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	Dibenzofuran	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	Dieldrin	1.5	ug/L	U	1.5	5.8
EFFLUENT	BNA-Water	Diethyl phthalate	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	Dimethyl phthalate	49	ug/L	U	49	190
EFFLUENT	BNA-Water	Dimethylaminoazobenzene	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	Dinoseb	3.9	ug/L	U	3.9	16
EFFLUENT	BNA-Water	Diphenylamine	2.9	ug/L	U	2.9	12
EFFLUENT	BNA-Water	Endosulfan I	3.9	ug/L	U	3.9	16
EFFLUENT	BNA-Water	Endosulfan II	3.9	ug/L	U	3.9	16
EFFLUENT	BNA-Water	Endosulfan sulfate	1.5	ug/L	U	1.5	5.8
EFFLUENT	BNA-Water	Endrin	1.5	ug/L	U	1.5	5.8
EFFLUENT	BNA-Water	Endrin aldehyde	3.9	ug/L	U	3.9	16
EFFLUENT	BNA-Water	Ethyl methanesulfonate	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	Fluoranthene	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	Fluorene	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	Heptachlor	1.5	ug/L	U	1.5	5.8
EFFLUENT	BNA-Water	Heptachlor epoxide	1.5	ug/L	U	1.5	5.8
EFFLUENT	BNA-Water	Hexachlorobenzene	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	Hexachlorobutadiene	2.9	ug/L	U	2.9	12
EFFLUENT	BNA-Water	Hexachlorocyclopentadiene	2.9	ug/L	U	2.9	12
EFFLUENT	BNA-Water	Hexachloroethane	2.9	ug/L	U	2.9	12
EFFLUENT	BNA-Water	Hexachloropropene	1.9	ug/L	U	1.9	7.8
EFFLUENT	BNA-Water	Indeno(1,2,3-cd)pyrene	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	Isophorone	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	Isosafrole	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	Methapyrilene	3.9	ug/L	U	3.9	16
EFFLUENT	BNA-Water	Methyl methanesulfonate	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	N-Nitrosodi-n-butylamine	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	N-Nitrosodi-n-propylamine	1.9	ug/L	U	1.9	7.8
EFFLUENT	BNA-Water	N-Nitrosodiethylamine	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	N-Nitrosodimethylamine	1.9	ug/L	U	1.9	7.8
EFFLUENT	BNA-Water	N-Nitrosodiphenylamine	2.9	ug/L	U	2.9	12
EFFLUENT	BNA-Water	N-Nitrosomethylethylamine	1.9	ug/L	U	1.9	7.8
EFFLUENT	BNA-Water	N-Nitrosomorpholine	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	N-Nitrosopiperidine	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	N-Nitrosopyrrolidine	1.9	ug/L	U	1.9	7.8
EFFLUENT	BNA-Water	Naphthalene	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	Nitrobenzene	1.9	ug/L	U	1.9	7.8

Appendix 4

Chemical analysis of effluent and receiving water. Continued.

Field ID	Analysis Group	Component	Result	Units	Remark	MDL	PQL
EFFLUENT	BNA-Water	Nitroquinoline-1-oxide	19	ug/L	U	19	78
EFFLUENT	BNA-Water	Pentachlorobenzene	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	Pentachloroethane	49	ug/L	U	49	190
EFFLUENT	BNA-Water	Pentachloronitrobenzene	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	Pentachlorophenol	2.9	ug/L	U	2.9	12
EFFLUENT	BNA-Water	Phenacetin	3.9	ug/L	U	3.9	12
EFFLUENT	BNA-Water	Phenanthrene	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	Phenol	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	Pyrene	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	Pyridine	3.9	ug/L	U	3.9	16
EFFLUENT	BNA-Water	Safrole	0.97	ug/L	U	0.97	3.9
EFFLUENT	BNA-Water	alpha-BHC	1.5	ug/L	U	1.5	5.8
EFFLUENT	BNA-Water	beta-BHC	1.5	ug/L	U	1.5	5.8
EFFLUENT	BNA-Water	delta-BHC	1.5	ug/L	U	1.5	5.8
EFFLUENT	BNA-Water	gamma-BHC	1.5	ug/L	U	1.5	5.8
EFFLUENT	BNA-Water	m,p-Cresols	1.9	ug/L	U	1.9	7.8
EFFLUENT	BNA-Water	o-Cresol	1.9	ug/L	U	1.9	7.8
EFFLUENT	BNA-Water	o-Toluidine	0.97	ug/L	U	0.97	3.9
EFFLUENT	Bio-AGP/LimNut	Algal Grow th Potential	3.92	mg DryWt/L	J	0.1	0.3
EFFLUENT	Bio-Toxicology	Bioassay-Acute-Screen-FW-C.dubia, LC50	100	LC50	L		
EFFLUENT	Bio-Toxicology	Bioassay-Acute-Screen-FW-Fish, LC50	100	LC50	L		
EFFLUENT	GC-Water	Alachlor	0.58	ug/L	U	0.58	2.32
EFFLUENT	GC-Water	Ametryn	0.049	ug/L	U	0.049	0.196
EFFLUENT	GC-Water	Atrazine	0.049	ug/L	U	0.049	0.196
EFFLUENT	GC-Water	Azinphos Methyl	0.049	ug/L	U	0.049	0.196
EFFLUENT	GC-Water	Bromacil	0.19	ug/L	U	0.19	0.76
EFFLUENT	GC-Water	Butylate	0.19	ug/L	U	0.19	0.76
EFFLUENT	GC-Water	Chlorpyrifos Ethyl	0.049	ug/L	U	0.049	0.196
EFFLUENT	GC-Water	Chlorpyrifos Methyl	0.097	ug/L	U	0.097	0.388
EFFLUENT	GC-Water	Diazinon	0.049	ug/L	U	0.049	0.196
EFFLUENT	GC-Water	Ethion	0.049	ug/L	U	0.049	0.196
EFFLUENT	GC-Water	Ethoprop	0.097	ug/L	U	0.097	0.388
EFFLUENT	GC-Water	Fenamiphos	0.19	ug/L	U	0.19	0.76
EFFLUENT	GC-Water	Fonofos	0.097	ug/L	U	0.097	0.388
EFFLUENT	GC-Water	Hexazinone	0.097	ug/L	U	0.097	0.388
EFFLUENT	GC-Water	Malathion	0.15	ug/L	U	0.15	0.6
EFFLUENT	GC-Water	Metalaxyl	0.24	ug/L	U	0.24	0.96
EFFLUENT	GC-Water	Metolachlor	0.49	ug/L	U	0.49	1.96
EFFLUENT	GC-Water	Metribuzin	0.097	ug/L	U	0.097	0.388
EFFLUENT	GC-Water	Mevinphos	0.19	ug/L	U	0.19	0.76
EFFLUENT	GC-Water	Naled	0.78	ug/L	U	0.78	3.12
EFFLUENT	GC-Water	Norflurazon	0.097	ug/L	U	0.097	0.388
EFFLUENT	GC-Water	Parathion Ethyl	0.15	ug/L	U	0.15	0.6
EFFLUENT	GC-Water	Parathion Methyl	0.097	ug/L	U	0.097	0.388
EFFLUENT	GC-Water	Phorate	0.049	ug/L	U	0.049	0.196
EFFLUENT	GC-Water	Prometryn	0.15	ug/L	U	0.15	0.6
EFFLUENT	GC-Water	Simazine	0.049	ug/L	U	0.049	0.196
EFFLUENT	Metals-Water	Aluminum_308	50	ug/L	U	50	200
EFFLUENT	Metals-Water	Arsenic	3	ug/L	U	3	12
EFFLUENT	Metals-Water	Cadmium	0.025	ug/L	U	0.025	0.1
EFFLUENT	Metals-Water	Calcium	93.3	mg/L		0.1	0.4

Appendix 4

Chemical analysis of effluent and receiving water. Continued.

Field ID	Analysis Group	Component	Result	Units	Remark	MDL	PQL
EFFLUENT	Metals-Water	Chromium	2	ug/L	U	2	8
EFFLUENT	Metals-Water	Copper	10.8	ug/L		0.75	3
EFFLUENT	Metals-Water	Copper	11.9	ug/L		2	8
EFFLUENT	Metals-Water	Iron_271	25	ug/L	U	25	100
EFFLUENT	Metals-Water	Lead	0.25	ug/L	U	0.25	1
EFFLUENT	Metals-Water	Magnesium	28.7	mg/L		0.025	0.1
EFFLUENT	Metals-Water	Nickel	2	ug/L	U	2	8
EFFLUENT	Metals-Water	Selenium	0.5	ug/L	U	0.5	2
EFFLUENT	Metals-Water	Silver	0.02	ug/L	U	0.02	0.08
EFFLUENT	Metals-Water	Zinc	3	ug/L	U	3	12
EFFLUENT	Nutrients-Liquid	Ammonia-N	0.01	mg N/L	U	0.01	0.02
EFFLUENT	Nutrients-Liquid	Chloride	56	mg Cl/L	A	2	5
EFFLUENT	Nutrients-Liquid	NO2NO3-N	0.05	mg N/L		0.004	0.01
EFFLUENT	Nutrients-Liquid	N_KJEL_TOT	0.18	mg N/L	I	0.06	0.2
EFFLUENT	Nutrients-Liquid	O-Phosphate-P	0.084	mg P/L		0.008	0.02
EFFLUENT	Nutrients-Liquid	Sulfate	160	mg SO4/L	A	2	5
EFFLUENT	Nutrients-Liquid	TDS	523	mg/L	A	15	60
EFFLUENT	Nutrients-Liquid	TSS	4	mg/L	U	4	16
EFFLUENT	Nutrients-Liquid	Total-P	0.55	mg P/L	J	0.02	0.05
EFFLUENT	Overflow	Oil and Grease		mg/L			

Appendix 5

Explanation of Biological Measures

(1) Habitat Assessment:

Eight aspects of the physical structure and extent of disturbance are ranked, with 20 possible points for each factor (FDEP SOP FT 3100, based on Plafkin *et al.*, 1989 and Barbour and Stribling, 1994). The Habitat Assessment score includes types and amounts of benthic substrates, water velocity, amount of sand or silt accumulation, extent of artificial channelization, bank stability, and riparian zone width and vegetation type. All scores are summed to yield an overall Habitat Assessment score. Habitat Assessment score ranges from 11-160 and overall habitat quality is assigned to one of four categories: Optimal (120-160 points), Suboptimal (80-119 points), Marginal (40-79 points), and Poor (11-39 points).

(2) Effluent and Water Samples from Control and Test Sites

Algal Growth Potential (AGP): The effluent and water from control and test sites are autoclaved, filtered (0.45µm), inoculated with the unicellular green alga, *Rhapidocelis subcapitata* (formerly *Selenastrum capricornutum),* and incubated for 14 days. The algal growth potential (AGP) value is the peak growth of the alga within that 14-day period, recorded as mg dry weight/L (Miller *et al.* 1978). Raschke and Shultz (1987) found that an AGP above 5.0 mg dry weight/L represents a "problem" threshold for fresh receiving waters, implying nutrient enrichment. High AGP values may constitute one line of evidence for violation of FAC 62-302.530(47), FAC 62-302.530(48)(a) and/or 62-302.530(48)(b).

The concentration of nutrients in a water sample may be used to calculate the expected yield of AGP under the assumption that other required nutrients (e.g. silicon, micronutrients) are present in excess (Miller *et al.* 1978). The expected amount of production is calculated as 38 times the total soluble inorganic nitrogen (nitrate and nitrite plus ammonia) under nitrogen limitation or 430 times the ortho-phosphate (OP) concentration under phosphorus limitation with an error of ± 20%. When the ratio of nitrogen to phosphorus (N:P) is less than 11:1, nitrogen limitation of algal production is likely. When the N:P ratio is above 11:1, phosphorus limitation is likely. Production of lower biomass than expected may be evidence of growth inhibition related to toxic compounds present in the water sample tested and may be a violation of FAC 62-302.530(62).

(3) Algal Phytoplankton and Periphyton Assemblages

Chlorophyll *a* Content: Chlorophyll *a* content is measured in both phytoplankton and periphyton samples to estimate algal biomass (APHA 1992, modified from *Standard Methods* 10200H). High algal biomass implies nutrient stress (Stevenson and Bahls 1999) and may be a violation of FAC 62-302.530(47), 62-302.530(48)(a) and/or 62-302.530(48)(b).

Cell Density: Cell density is estimated as number/ml for phytoplankton samples and number/cm^2 for periphyton samples (APHA 1992, modified from *Standard Methods* 10200F and 10900G).

Taxa richness: Taxa richness is the number of distinct algal taxa present in a sample. Stress tends to reduce the number of different types of algae present in a sample, but moderate nutrient enrichment of nutrient poor waters may sometimes be correlated with increased algal taxa richness (Stevenson and Bahls 1999).

Community Composition: Shifts in relative proportions of major groups of algae downstream of a point source, compared to upstream, control conditions, may indicate negative effects of a discharge (Stevenson and Bahls 1999) and may constitute violations of FAC 62-302.530(47), 62-302.530(48)(a) 62-302.530(48)(b) and/or 62-302.530(62).

Shannon-Weaver Diversity Index: This index is specified in the Florida Administrative Code 62-302 as a measure of biological integrity. Low diversity scores are undesirable. Where diversity is low, only a few taxa are abundant as compared to an area where many taxa are present with more equitable abundance among taxa (Magurran 1988). Low diversity scores related to a facility's effluent may constitute violations of FAC 62-302.530(47), 62-302.530(48)(a) 62-302.530(48)(b) and/or 62-302.530(62).

(4) Benthic Macroinvertebrate Assemblages

Taxa richness: Taxa richness is the number of distinct macroinvertebrate taxa present in a sample. Stress, habitat destruction and pollution tend to reduce the number of different types of organisms present (Karr and Chu 1998). Decreases in taxa richness related to a facility's effluent may constitute violations of FAC 62-302.530(47), 62-302.530(48)(a) 62-302.530(48)(b) and/or 62-302.530(62).

Percent Contribution of Dominant Taxon: Percent contribution of the dominant taxon is calculated by dividing the number of individuals in the most abundant taxa by the total number of individuals counted. Percent contribution of the dominant taxon tends to increase with increasing perturbation (Plafkin *et al.*, 1989). Increases in the percent contribution of the dominant taxon related to a facility's effluent may constitute violations of FAC 62-302.530(47), 62-302.530(48)(a) and/or 62-302.530(48)(b).

Shannon-Weaver Diversity Index: This index is specified in the Florida Administrative Code 62-302 as a measure of biological integrity. Low diversity scores are undesirable. Where diversity is low, only a few taxa are abundant as compared to an area where many taxa are present in equitable abundance among taxa (Magurran 1988). A difference of 25% in Shannon-Weaver diversity between results from Hester-Dendy multiplate samplers incubated for 28 days at test and control sites constitutes a violation of FAC 62-302.530(11).

The Florida Index: Some organisms become rare or absent as the intensity or duration of disturbance increases. The Florida Index assigns points to stream-dwelling macroinvertebrates based on their ranked sensitivity to pollution (Beck 1954). A site with a high Florida Index score is considered healthy (Ross 1990). Decreases in Florida Index points related to a facility's effluent may constitute violations of FAC 62-302.530(47), 62-302.530(48)(a) 62-302.530(48)(b) and/or 62-302.530(62).

Ephemeroptera/Plecoptera/Trichoptera (EPT) Taxa: This value is the number of EPT taxa present. More EPT taxa are usually present in unpolluted waters (Plafkin *et al.*, 1989, Wallace *et al.*, 1996). Decreases in the number of EPT taxa related to a facility's effluent may constitute violations of FAC 62-302.530(47), 62-302.530(48)(a) 62-302.530(48)(b) and/or 62-302.530(62).

Community Composition: Shifts in proportions of major groups of organisms downstream of a point source, compared to upstream, control conditions, may indicate negative effects of a discharge (Karr and Chu 1998). Shifts in community composition related to a facility's effluent may constitute violations of FAC 62-302.530(47), 62-302.530(48)(a) 62-302.530(48)(b) and/or 62-302.530(62).

Functional Feeding Groups: Environmental degradation may differentially affect groups of invertebrates based on how the group feeds (e.g. predators, deposit feeders, etc.). In Florida, pollution may be responsible for reducing the numbers of filter feeders (FDEP 1994) and shredders (EA Engineering 1994). Changes in the proportions of functional feeding groups related to a facility's effluent may constitute violations of FAC 62-302.530(47), 62-302.530(48)(a) 62-302.530(48)(b) and/or 62-302.530(62).

The Stream Condition Index (SCI): The SCI is a composite macroinvertebrate metric (Barbour *et al.* 1996a, b) developed for Florida. Using data from qualitative dipnet samples, the SCI assigns points to seven parameters, depending on how closely each parameter approaches an expected reference condition (Barbour *et al.* 1996a, b and FDEP SOP FS 7420, LT 7200). Points are summed to yield a final SCI score (range 7-33, depending on region and index period). Included in the calculation of SCI are taxa richness, number of EPT taxa, number of Chironomid taxa, percent contribution of the dominant taxon, the Florida Index, percent contribution of Diptera, and the percent contribution of suspension and filter feeders. Scores are broken into four ordinal groups: Excellent, Good, Poor and Very Poor. A decrease in ordinal SCI score from the Control to the Test site may be evidence of degradation related to a facility's effluent. An SCI score of "Poor" or "Very Poor" related to a facility's effluent may constitute violations of FAC 62-302.530(47), 62-302.530(48)(a) 62-302.530(48)(b) and/or 62-302.530(62).

Appendix 6

Typical Values for Selected Parameters in Florida Waters

Percentile Distribution (1617 stations)

CONTROL SITE 1

Parameter	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	95%	Measured
Periphyton Chlorophyll *a* (mg/m^2)	0.31	0.43	0.77	1.04	2.16	2.94	6.45	10.51	17.00	39.51	60.85	**NA**
Hester-Dendy Diversity	0.84	2.12	2.48	2.74	2.88	3.09	3.25	3.40	3.52	3.76	3.90	**NA**
Hester-Dendy Taxa Richness	6	6.5	9	11.5	13	15	17	21.5	26	29	32	**NA**
Dipnet Taxa Richness	9	12	17	20	22	24.5	26	**28**	**31**	37	53	**30**
Total Kjeldahl Nitrogen	0.30	**0.39**	**0.56**	0.73	0.87	1.00	1.11	1.26	1.49	1.93	2.80	**0.43**
Ammonia	**0.02**	0.02	0.04	0.05	0.06	0.08	0.11	0.14	0.20	0.34	0.60	**0.014**
Nitrate plus nitrite	0.01	0.01	**0.03**	0.05	0.07	0.10	0.14	0.20	0.32	0.64	1.05	**0.031**
Total Phosphorus	0.02	0.03	0.05	0.06	0.10	0.13	0.18	0.25	**0.39**	**0.74**	1.51	**0.53**
Orthophosphate	0.01	0.01	0.03	0.04	0.05	0.08	0.11	**0.17**	**0.27**	0.59	1.37	**0.21**
Turbidity (NTU)	0.60	0.90	1.20	1.45	2.10	2.80	3.60	4.50	6.65	10.45	16.30	**NA**

CONTROL SITE 2

Parameter	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	95%	Measured
Periphyton Chlorophyll *a* (mg/m^2)	0.31	0.43	0.77	1.04	2.16	2.94	6.45	10.51	17.00	39.51	60.85	**NA**
Hester-Dendy Diversity	0.84	2.12	2.48	2.74	2.88	3.09	3.25	3.40	3.52	3.76	3.90	**NA**
Hester-Dendy Taxa Richness	6	6.5	9	11.5	13	15	17	21.5	26	29	32	**NA**
Dipnet Taxa Richness	9	12	17	20	22	24.5	26	28	**31**	**37**	53	**35**
Total Kjeldahl Nitrogen	**0.30**	**0.39**	0.56	0.73	0.87	1.00	1.11	1.26	1.49	1.93	2.80	**0.36**
Ammonia	0.02	**0.02**	0.04	0.05	0.06	0.08	0.11	0.14	0.20	0.34	0.60	**0.02**
Nitrate plus nitrite	0.01	0.01	**0.03**	0.05	0.07	0.10	0.14	0.20	0.32	0.64	1.05	**0.031**
Total Phosphorus	0.02	0.03	0.05	0.06	0.10	0.13	0.18	0.25	**0.39**	**0.74**	1.51	**0.47**
Orthophosphate	0.01	0.01	0.03	0.04	0.05	0.08	0.11	**0.17**	**0.27**	0.59	1.37	**0.2**
Turbidity (NTU)	0.60	0.90	1.20	1.45	2.10	2.80	3.60	4.50	6.65	10.45	16.30	**NA**

Taxa richness and diversity values are for benthic macroinvertebrates. Hester-Dendy sample= benthic macroinvertebrates collected from a standardized multi-plate sampler. Dipnet taxa richness = number of taxa collected in standardized dipnet sweep samples. Diversity = Shannon-Weaver H'. NTU = Nephelometric turbidity units. Adapted from Joe Hand, FDER, personal communication, 1991 (data collected 1980-1989). NA = not available.

Appendix 6

Typical Values for Selected Parameters in Florida Waters

Percentile Distribution (1617 stations)

TEST SITE 1

Parameter	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	95%	Measured
Periphyton Chlorophyll *a* (mg/m^2)	0.31	0.43	0.77	1.04	2.16	2.94	6.45	10.51	17.00	39.51	60.85	**NA**
Hester-Dendy Diversity	0.84	2.12	2.48	2.74	2.88	3.09	3.25	3.40	3.52	3.76	3.90	**NA**
Hester-Dendy Taxa Richness	6	6.5	9	11.5	13	15	17	21.5	26	29	32	**NA**
Dipnet Taxa Richness	9	12	17	20	22	24.5	**26**	**28**	31	37	53	**27**
Total Kjeldahl Nitrogen	**0.30**	0.39	0.56	0.73	0.87	1.00	1.11	1.26	1.49	1.93	2.80	**0.18**
Ammonia	**0.02**	0.02	0.04	0.05	0.06	0.08	0.11	0.14	0.20	0.34	0.60	**0.01**
Nitrate plus nitrite	0.01	0.01	0.03	**0.05**	**0.07**	0.10	0.14	0.20	0.32	0.64	1.05	**0.056**
Total Phosphorus	0.02	0.03	0.05	0.06	0.10	0.13	0.18	0.25	**0.39**	**0.74**	1.51	**0.56**
Orthophosphate	0.01	0.01	0.03	0.04	0.05	**0.08**	**0.11**	0.17	0.27	0.59	1.37	**0.088**
Turbidity (NTU)	0.60	0.90	1.20	1.45	2.10	2.80	3.60	4.50	6.65	10.45	16.30	**NA**

TEST SITE 2

Parameter	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	95%	Measured
Periphyton Chlorophyll *a* (mg/m^2)	0.31	0.43	0.77	1.04	2.16	2.94	6.45	10.51	17.00	39.51	60.85	**NA**
Hester-Dendy Diversity	0.84	2.12	2.48	2.74	2.88	3.09	3.25	3.40	3.52	3.76	3.90	**NA**
Hester-Dendy Taxa Richness	6	6.5	9	11.5	13	15	17	21.5	26	29	32	**NA**
Dipnet Taxa Richness	9	12	17	20	22	24.5	26	28	31	37	53	**26**
Total Kjeldahl Nitrogen	**0.30**	0.39	0.56	0.73	0.87	1.00	1.11	1.26	1.49	1.93	2.80	**0.18**
Ammonia	**0.02**	0.02	0.04	0.05	0.06	0.08	0.11	0.14	0.20	0.34	0.60	**0.01**
Nitrate plus nitrite	0.01	0.01	0.03	**0.05**	**0.07**	0.10	0.14	0.20	0.32	0.64	1.05	**0.054**
Total Phosphorus	0.02	0.03	0.05	0.06	0.10	0.13	0.18	0.25	**0.39**	**0.74**	1.51	**0.58**
Orthophosphate	0.01	0.01	0.03	0.04	0.05	**0.08**	**0.11**	0.17	0.27	0.59	1.37	**0.092**
Turbidity (NTU)	0.60	0.90	1.20	1.45	2.10	2.80	3.60	4.50	6.65	10.45	16.30	**NA**

Taxa richness and diversity values are for benthic macroinvertebrates. Hester-Dendy sample= benthic macroinvertebrates collected from a standardized multi-plate sampler. Dipnet taxa richness = number of taxa collected in standardized dipnet sweep samples. Diversity = Shannon-Weaver H'. NTU = Nephelometric turbidity units. Adapted from Joe Hand, FDER, personal communication, 1991 (data collected 1980-1989). NA = not available.

Appendix 7

Additional physical, chemical, and toxicological results.

Data recorded during the 48-hour acute screening bioassays of a sample of effluent from the Arvah B. Hopkins Generating Station, County Rd. 1585-Geddie Rd., Tallahassee, Leon County, Florida, NPDES# FL0025518, performed from 25 to 27 June 2002.

Facility:	**Arvah B. Hopkins Generating Station**	**NPDES #:**	**FL0025518**	Facility Type:	**Electric Power Generator**	**Analysts:**	Jacquelyn Brynda
Location:	County Rd. 1585-Geddie Rd., Tallahassee	Contact/District:	Jackson/NW				Joshua Ayres
County:	Leon	Test type:	static acute screen				Gary Hardie
Sample Collection Date:	6/25/2002 Time: 1434	# tests:	2	Receiving Water:	Beaver Creek to Lake Talquin		Marshall Faircloth
Test Beginning Date:	6/25/2002 Time: 1555	Chlorination Type:	Non-chlorinated		Class III Fresh		
Test Ending Date:	6/27/2002 Time: 1430				**Page 1 of 1**	**Reviewer:**	David Whiting

Organism: ***Ceriodaphnia dubia*** Life stage: <24 hours

Concentrations	Sample/Diluent Volume(mL)	SURVIVAL # Alive 0 hr	24 hr	48 hr	pH 0 hour	24 hour	48 hour	Temperature[A] 0 hour	24 hour	48 hour	Dissolved Oxygen 0 hour	24 hour	48 hour	Conductivity Uncorrected µmhos/cm 0 hour	48 hour
Control A	0/20	5	5	5	8.1	-	8.4	26.0	-	24.5	7.5	-	7.6	190	205
Control B	0/20	5	5	5	-	-	8.4	-	-	24.4	-	-	7.5	-	200
Control C	0/20	5	5	5	-	-	8.4	-	-	24.4	-	-	7.7	-	215
Control D	0/20	5	5	5	-	-	8.4	-	-	24.5	-	-	7.7	-	210
100% A	20/0	5	5	5	7.9	-	8.6	25.6	-	24.4	7.0	-	7.7	820	855
100% B	20/0	5	5	5	-	-	8.6	-	-	24.4	-	-	7.7	-	895
100% C	20/0	5	5	5	-	-	8.6	-	-	24.4	-	-	7.7	-	890
100% D	20/0	5	5	5	-	-	8.6	-	-	24.4	-	-	7.7	-	910

[A] Temperatures of room and test incubator were continuously recorded on a strip chart recorder.
Room Temperature range for the test period was 24.5-26.5°C.
Incubator #3 temperature range for the test period was 24.0-25.0°C.

LIMS	
Job number:	TLH-2002-06-25-70-01
sample number:	600363

Data Transcription Verification	
date:	12/16/2002
by:	Cathy Oaks
	Brad Ricardson

Total Residual CL2	mg/L	Method
Field:	-	-
Lab:	<0.03	Hach

Ammonia	Total (mg/L)	Unionized (mg/L)
Control water (fish):	<0.017	<0.017
Control water (water flea):	<0.017	<0.017
100% Sample:	<0.017	<0.504

Alk & Hardness	Alkalinity (mg/L)	Hardness (mg/L)
Control water (fish):	144	138
Control water (water flea):	80	81
100% Sample:	200	352

Organism: ***Cyprinella leedsi*** Life stage: 12 days

Concentrations	Sample/Diluent Volume(mL)	SURVIVAL # Alive 0 hr	24 hr	48 hr	pH 0 hour	24 hour	48 hour	Temperature[B] 0 hour	24 hour	48 hour	Dissolved Oxygen 0 hour	24 hour	48 hour	Conductivity Uncorrected µmhos/cm 0 hour	48 hour
Control A	0/500	5	5	5	7.8	8.1	8.4	25.6	25.3	24.7	7.0	7.0	7.7	290	290
Control B	0/500	5	5	5	7.8	8.2	8.4	25.6	25.3	24.3	7.2	7.0	7.6	295	280
Control C	0/500	5	5	5	7.8	8.2	8.4	25.6	25.7	24.4	7.3	7.2	7.7	280	285
Control D	0/500	5	5	5	7.8	8.2	8.4	25.6	25.8	24.3	7.3	7.2	7.6	285	285
100% A	500/0	5	5	5	8.0	8.3	8.4	25.4	25.9	24.6	7.6	7.1	7.5	835	830
100% B	500/0	5	5	5	8.0	8.3	8.4	25.3	25.6	24.2	7.6	7.1	7.5	825	825
100 % C	500/0	5	5	5	8.0	8.3	8.4	25.3	25.4	24.3	7.7	7.2	7.6	845	855
100% D	500/0	5	5	5	8.0	8.3	8.5	25.3	25.3	25.4	7.7	7.2	7.7	830	865

[B] Temperatures of room and test incubator were continuously recorded on a strip chart recorder.
Room Temperature range for the test period was 24.5-26.5°C.
Incubator #3 temperature range for the test period was 24.0-25.0°C.

Appendix 8

Habitat Assessment Field Sheets.

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL PROTECTION

PHYSICAL/CHEMICAL CHARACTERIZATION FIELD DATA SHEET (5-10-96)

SUBMITTING AGENCY CODE: / SUBMITTING AGENCY NAME:	STORET STATION NUMBER:	DATE (M/D/Y):	TIME	RECEIVING BODY OF WATER:
		6/25/02	9:25	

REMARKS:	COUNTY:	LOCATION:	FIELD ID/NAME:
	LEON	ARRAH HOPKINS	BEAVER CREEK - TEST SITE 1

RIPARIAN ZONE/INSTREAM FEATURES

Predominant Land-Use in Watershed (specify relative percent in each category):

Forest/Natural	Silviculture	Field/Pasture	Agricultural	Residential	Commercial	Industrial	Other (Specify)

Local Watershed Erosion (check box): None ☐ Slight ☐ Moderate ☒ Heavy ☐

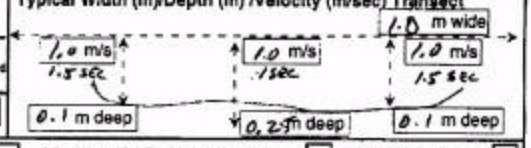
Local Watershed NPS Pollution (check box): No evidence ☐ Slight ☐ Moderate potential ☒ Obvious sources ☐

Width of riparian vegetation (m) on least buffered side: 718 m — *List & map dominant vegetation on back*

Artificially Channelized ☐ no ☐ recent, severe ☒ some recovery ☐ mostly recovered, more sinuous — Artificially Impounded ☐ yes

High Water Mark: 1.2 (m above present water level) + 0.25 (present depth in m) = 1.45 (m above bed)

Typical Width (m)/Depth (m) /Velocity (m/sec) Transect



Canopy Cover %: Open: ☐ Lightly Shaded (11-45%): ☐ Moderately Shaded (46-80%): ☐ Heavily Shaded: ☒

SEDIMENT/SUBSTRATE

Sediment Odors: Normal: ☒ Sewage: ☐ Petroleum: ☐ Chemical: ☐ Anaerobic: ☐ Other: ☐

Sediment Oils: Absent: ☒ Slight: ☐ Moderate: ☐ Profuse: ☐

Sediment Deposition: Sludge: ☐ Sand smothering: (none) slight moderate severe Silt smothering: (none) slight moderate severe Other:

Substrate Types	% coverage	# times sampled	method	Substrate Types	% coverage	# times sampled	method
Woody Debris (Snags)	1	1		Sand	7	2	
Leaf Packs or Mats				Mud/Muck/Silt			
Aquatic Vegetation				Other: PIPECLAY	80	3	
Rock or Shell Rubble				Other:			
Undercut banks/Roots	2	2		*Draw aerial view sketch of habitats found in 100 m section*			

WATER QUALITY	Depth (m):	Temp. (°C):	pH (SU):	D.O. (mg/l):	Cond. (umhos/cm) or Salinity (ppt):			Secchi (m):
Top	0.1	23.1	7.8	8.2	819			
Mid-depth								
Bottom								

System Type: Stream: ☒ (1st 2nd order, 3rd - 4th order, 5th - 6th order, 7th order or greater) Lake: ☐ Wetland: ☐ Estuary: ☐ Other: ☐

Water Odors (check box): Normal: ☒ Sewage: ☐ Petroleum: ☐ Chemical: ☐ Other: ☐

Water Surface Oils (check box): None: ☒ Sheen: ☐ Globs: ☐ Slick: ☐

Clarity (check box): Clear: ☐ Slightly turbid: ☒ Turbid: ☐ Opaque: ☐

Color (check box): Tannic: ☐ Green (algae): ☐ Clear: ☒ Other: ☐

Weather Conditions/Notes:
OVERCAST ; CALM ; 70's
WATER CHEMISTRY TAKEN AT 30M @ 9:20 AM
sampler preserved @ pH +/- 1 SU

Abundance:	Absent	Rare	Common	Abundant
Periphyton	☒	☐	☐	☐
Fish	☒	☐	☐	☐
Aquatic Macrophytes	☒	☐	☐	☐
Iron/sulfur Bacteria	☒	☐	☐	☐

SAMPLING TEAM: J. Jackson, M. Heyn, T. Richardson — SIGNATURE: — DATE: 6/25/02

FDEP-SOP-001/01: Form FD 9000-5 (June 1, 2001)

STREAM/RIVER HABITAT ASSESSMENT FIELD SHEET

SUBMITTING AGENCY CODE: / SUBMITTING AGENCY NAME:	STORET STATION NUMBER:	DATE (M/D/Y):	RECEIVING BODY OF WATER:
		6/25/02	

REMARKS:	COUNTY:	LOCATION:	FIELD ID/NAME:
	LEON	ARVAH HOPKINS	BEAVER CREEK - TEST SITE 1

Habitat Parameter	Optimal	Suboptimal	Marginal	Poor
Primary Habitat Components **Substrate Diversity** 7	Four or more productive habitats present (snags, tree roots/undercut banks, aquatic vegetation, leaf packs (partially decayed), rock). 20 19 18 17 16	Three productive habitats present. Adequate habitat. Some substrates may be new fall (fresh leaves or snags). 15 14 13 12 11	Two productive habitats present. Less than desirable habitat, frequently disturbed or removed. 10 9 8 7 6	One or less productive habitat. Lack of habitat is obvious, substrates unstable or smothered. 5 4 3 2 1
Substrate Availability 3	Greater than 30% productive habitat present at site. 20 19 18 17 16	16% to 30% productive habitat, by aerial extent. 15 14 13 12 11	6% to 15% productive habitat 10 9 8 7 6	Less than 5% productive habitat. 5 4 (3) 2 1
Water Velocity 3	Max. observed at typical transect: > 0.25 m/sec. But < 1 m/sec 20 19 18 17 16	Max. observed at typical transect: 0.1 to 0.25 m/sec 15 14 13 12 11	Max. observed at typical transect: 0.05 to 0.1 m/sec 10 9 8 7 6	Max. observed at typical transect: <0.05 m/sec. Or spate occurring: > 1 m/sec 5 4 3 2 1
Habitat Smothering 19 Primary Score 42	Less than 20% of habitats affected by sand or silt accumulation 20 19 18 17 16	20%-50% of habitats affected by sand or silt accumulation 15 14 13 12 11	Smothering of 50%-80% of the habitats with sand or silt, pools shallow, frequent sediment movement 10 9 8 7 6	Smothering of >80% of habitats with sand or silt, as severe problem, pools absent 5 4 3 2 1
Secondary Habitat Components **Artificial Channelization** 6	No artificial channelization or dredging. Stream with normal, sinuous pattern 20 19 18 17 16	Many have been channelized in the past (>20 yrs), but mostly recovered, fairly good sinuous pattern 15 14 13 12 11	Channelized, somewhat recovered, but > 80% of area affected 10 9 8 7 (6)	Artificially channelized, box-cut banks, straight, instream habitat highly altered 5 4 3 2 1
Bank Stability Right Bank 4 Left Bank 5	Stable. No evidence of erosion or bank failure. Little potential for future problems. 10 9	Moderately stable. Infrequent or small areas of erosion, mostly healed over. 8 7 6	Moderately unstable. Moderate areas of erosion, high erosion potential during floods. 5 4	Unstable. Many (60%-80%) raw, eroded areas. Obvious bank sloughing. 3 2 1
Riparian Buffer Zone Width Right Bank 10 Left Bank 4	Width of native vegetation (least buffered side) greater than 18 m 10 9	Width of native vegetation (least buffered side) 12m to 18 m 8 7 6	Width of native vegetation 6 to 12 m. human activities still close to system 5 4	Less than 6 m of native buffer zone due to intensive human activities 3 2 1
Riparian Zone Vegetation Quality Right Bank 10 Left Bank 10 Secondary Score 10	Over 80% of riparian surfaces consist of native plants, including trees, understory shrubs, or non-woody machrophytes. Normal, expected plant community for given sunlight & habitat conditions. 10 9	50% to 80% of riparian zone is vegetated, and/or one class of plants normally expected for the sunlight & habitat conditions is not represented. Some disruption in community evident. 8 7 6	25% to 50% of riparian ozone is vegetated, and/or one or two expected classes of plants are not represented. Patches of bare soil or closely cropped vegetation, disruption obvious. 5 4	Less than 25% of streambank surfaces are vegetated and/or poor plant community (e.g. grass monoculture or exotics) present. Vegetation removed to stubble height of 2 inches or less. 3 2 1
102	**TOTAL SCORE**			

ANALYSIS DATE:	ANALYST:	SIGNATURE:
6/25/02	JJACKSON	Jay A Jackson

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL PROTECTION

PHYSICAL/CHEMICAL CHARACTERIZATION FIELD DATA SHEET (5-10-96)

SUBMITTING AGENCY CODE: / SUBMITTING AGENCY NAME:	STORET STATION NUMBER:	DATE (M/D/Y):	TIME	RECEIVING BODY OF WATER:
		6/25/02	10:30	

REMARKS:	COUNTY:	LOCATION:	FIELD ID/NAME:
	LEON	ARVAH HOPKINS POWER PLANT FYI	BEAVER CREEK TEST SITE 2

RIPARIAN ZONE/INSTREAM FEATURES

Predominant Land-Use in Watershed (specify relative percent in each category):

Forest/Natural	Silviculture	Field/Pasture	Agricultural	Residential	Commercial	Industrial	Other (Specify)

Local Watershed Erosion (check box): None ☐ Slight ☐ Moderate ☐ Heavy ☒

Local Watershed NPS Pollution (check box): No evidence ☐ Slight ☒ Moderate potential ☐ Obvious sources ☐

Width of riparian vegetation (m) on least buffered side: 2 M

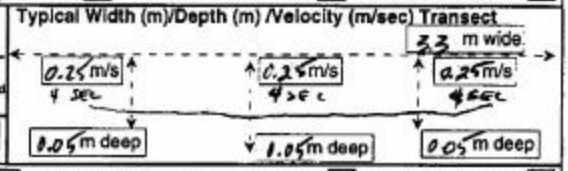
List & map dominant vegetation on back

Artificially Channelized ☐ no ☐ ☒ ☐ (recent, severe / some recovery / mostly recovered)

Artificially Impounded ☐ yes (more sinuous)

High Water Mark: 0.4 (m above present water level) + 0.05 (present depth in m) = 0.45 (m above bed)

Typical Width (m)/Depth (m) /Velocity (m/sec) Transect



Canopy Cover %: Open: ☐ Lightly Shaded (11-45%): ☐ Moderately Shaded (46-80%): ☒ Heavily Shaded: ☐

SEDIMENT/SUBSTRATE

Sediment Odors: Normal: ☒ Sewage: ☐ Petroleum: ☐ Chemical: ☐ Anaerobic: ☐ Other: ☐

Sediment Oils: Absent: ☒ Slight: ☐ Moderate: ☐ Profuse: ☐

Sediment Deposition: Sludge: ☐ Sand smothering: none / slight / moderate / severe — Silt smothering: none / slight / moderate / severe — Other:

Substrate Types	% coverage	# times sampled	method	Substrate Types	% coverage	# times sampled	method
Woody Debris (Snags)	3	5		Sand	94	5	
Leaf Packs or Mats	1	5		Mud/Muck/Silt			
Aquatic Vegetation				Other:			
Rock or Shell Rubble				Other:			
Undercut banks/Roots	2	5		*Draw aerial view sketch of habitats found in 100 m section*			

WATER QUALITY	Depth (m):	Temp. (°C):	pH (SU):	D.O. (mg/l):	Cond. (µmhos/cm) or Salinity (ppt):			Secchi (m):
Top	0.1	23.3	7.9	8.3	817			
Mid-depth								
Bottom								

System Type: Stream: ☒ (1st - 2nd order / 3rd - 4th order / 5th - 6th order / 7th order or greater) Lake: ☐ Wetland: ☐ Estuary: ☐ Other: ☐

Water Odors (check box): Normal: ☒ Sewage: ☐ Petroleum: ☐ Chemical: ☐ Other: ☐

Water Surface Oils (check box): None: ☒ Sheen: ☐ Globs: ☐ Slick: ☐

Clarity (check box): Clear: ☒ Slightly turbid: ☐ Turbid: ☐ Opaque: ☐

Color (check box): Tannic: ☐ Green (algae): ☐ Clear: ☒ Other: ☐

Weather Conditions/Notes:
CM-M; 80's; WATER CHEMISTRY TAKEN AT 30 M
Samples preserved w/ pot I SM

Abundance:	Absent	Rare	Common	Abundant
Periphyton	☐	☒	☐	☐
Fish	☐	☒	☐	☐
Aquatic Macrophytes	☒	☐	☐	☐
Iron/sulfur Bacteria	☒	☐	☐	☐

SAMPLING TEAM:	SIGNATURE:	DATE:
JJACKSON, JRICHARDSON, M. HEYN		6/25/02

FDEP-SOP-001/01: Form FD 9000-5 (June 1, 2001)

STREAM/RIVER HABITAT ASSESSMENT FIELD SHEET

SUBMITTING AGENCY CODE: / SUBMITTING AGENCY NAME:	STORET STATION NUMBER:	DATE (M/D/Y):	RECEIVING BODY OF WATER:
		6/25/02	

REMARKS:	COUNTY:	LOCATION:	FIELD ID/NAME:
	LEON	ARVAH HOPKINS	BEAVER CREEK - TEST SITE 2

Habitat Parameter	Optimal	Suboptimal	Marginal	Poor
Primary Habitat Components **Substrate Diversity** 11	Four or more productive habitats present (snags, tree roots/undercut banks, aquatic vegetation, leaf packs (partially decayed), rock). 20 19 18 17 16	Three productive habitats present. Adequate habitat. Some substrates may be new fall (fresh leaves or snags). 15 14 13 12 (11)	Two productive habitats present. Less than desirable habitat, frequently disturbed or removed. 10 9 8 7 6	One or less productive habitat. Lack of habitat is obvious, substrates unstable or smothered. 5 4 3 2 1
Substrate Availability 6	Greater than 30% productive habitat present at site. 20 19 18 17 16	16% to 30% productive habitat, by aerial extent. 15 14 13 12 11	6% to 15% productive habitat 10 9 8 7 (6)	Less than 5% productive habitat. 5 4 3 2 1
Water Velocity 16	Max. observed at typical transect: > 0.25 m/sec. But < 1 m/sec 20 19 18 17 (16)	Max. observed at typical transect: 0.1 to 0.25 m/sec 15 14 13 12 11	Max. observed at typical transect: 0.05 to 0.1 m/sec 10 9 8 7 6	Max. observed at typical transect: <0.05 m/sec. Or spate occurring: > 1 m/sec 5 4 3 2 1
Habitat Smothering 12 Primary Score 45	Less than 20% of habitats affected by sand or silt accumulation 20 19 18 17 16	20%-50% of habitats affected by sand or silt accumulation 15 14 13 (12) 11	Smothering of 50%-80% of the habitats with sand or silt, pools shallow, frequent sediment movement 10 9 8 7 6	Smothering of >80% of habitats with sand or silt, as severe problem, pools absent 5 4 3 2 1
Secondary Habitat Components **Artificial Channelization** 14	No artificial channelization or dredging. Stream with normal, sinuous pattern 20 19 18 17 16	Many have been channelized in the past (>20 yrs), but mostly recovered, fairly good sinuous pattern 15 (14) 13 12 11	Channelized, somewhat recovered, but > 80% of area affected 10 9 8 7 6	Artificially channelized, box-cut banks, straight, instream habitat highly altered 5 4 3 2 1
Bank Stability Right Bank 8 Left Bank X	Stable. No evidence of erosion or bank failure. Little potential for future problems. 10 9	Moderately stable. Infrequent or small areas of erosion, mostly healed over. 8 7 6	Moderately unstable. Moderate areas of erosion, high erosion potential during floods. 5 4	Unstable. Many (60%-80%) raw, eroded areas. Obvious bank sloughing. 3 2 1
Riparian Buffer Zone Width Right Bank 10 Left Bank 2	Width of native vegetation (least buffered side) greater than 18 m (10) 9	Width of native vegetation (least buffered side) 12m to 18 m 8 7 6	Width of native vegetation 6 to 12 m. human activities still close to system 5 4	Less than 6 m of native buffer zone due to intensive human activities 3 (2) 1
Riparian Zone Vegetation Quality Right Bank 10 Left Bank 5 Secondary Score 51	Over 80% of riparian surfaces consist of native plants, including trees, understory shrubs, or non-woody machrophytes. Normal, expected plant community for given sunlight & habitat conditions. 10 9	50% to 80% of riparian zone is vegetated, and/or one class of plants normally expected for the sunlight & habitat conditions is not represented. Some disruption in community evident. 8 7 6	25% to 50% of riparian ozone is vegetated, and/or one or two expected classes of plants are not represented. Patches of bare soil or closely cropped vegetation, disruption obvious. (5) 4	Less than 25% of streambank surfaces are vegetated and/or poor plant community (e.g. grass monoculture or exotics) present. Vegetation removed to stubble height of 2 inches or less. 3 2 1

102 **TOTAL SCORE**

ANALYSIS DATE:	ANALYST:	SIGNATURE:
6/25/02	Joy Jackson	Joy Jackson

DEP-SOP-001/01: Form FD 9000-3 (June 20 2001)

PHYSICAL/CHEMICAL CHARACTERIZATION FIELD SHEET

SUBMITTING AGENCY CODE: / SUBMITTING AGENCY NAME:	STORET STATION NUMBER:	DATE (M/D/Y):	TIME	RECEIVING BODY OF WATER:
		6/25/02	1:50	

REMARKS:	COUNTY:	LOCATION:	FIELD ID/NAME:
	LEON	ARVAH HOPKINS	CONTROL BEAVER CREEK - SITE 1

RIPARIAN ZONE/STREAM FEATURES

PREDOMINANT LAND-USE IN WATERSHED (specify relative percent in each category):

FOREST/NATURAL	SILVICULTURE	FIELD/PASTURE	AGRICULTURAL	RESIDENTIAL	COMMERCIAL	INDUSTRIAL	OTHER (SPECIFY)

LOCAL WATERSHED EROSION (check box): None ☒ Slight ☐ Moderate ☐ Heavy ☐

LOCAL WATERSHED NPS POLLUTION (check box): No evidence ☐ Slight ☐ Moderate potential ☐ Obvious sources ☒ ARVAH HOPKINS

WIDTH OF RIPARIAN VEGETATION (m) On least buffered side: 7/8 m

LIST & MAP DOMINANT VEGETATION ON BACK

ARTIFICIALLY CHANNELIZED ☒ no ☐ recent, severe ☐ some recovery ☐ mostly recovered more sinuous

ARTIFICIALLY IMPOUNDED ☐ yes

HIGH WATER MARK: 0.4 (m above present water level) + 0.1 (present depth in m) = 0.5 (m above bed)

TYPICAL WIDTH (M) DEPTH (M)/VELOCITY (M/SEC) TRANSECT — 3.3 m wide

0.25 m/s	0.25 m/s	0.25 m/s
0.1 m deep	0.1 m deep	0.1 m deep

CANOPY COVER %: OPEN: ☐ LIGHTLY SHADED (11-45%): ☐ MODERATELY SHADED (46-80%): ☒ HEAVILY SHADED: ☐

SEDIMENT/SUBSTRATE

SEDIMENT ODORS: NORMAL: ☒ SEWAGE: ☐ PETROLEUM: ☐ CHEMICAL: ☐ ANAEROBIC: ☐ OTHER: ☐

SEDIMENT OILS: ABSENT: ☒ SLIGHT: ☐ MODERATE: ☐ PROFUSE: ☐

SEDIMENT DEPOSITION: SLUDGE: ☐ SAND SMOTHERING: NONE (LIGHT) MODERATE SEVERE SILT SMOTHERING: NONE SLIGHT MODERATE SEVERE OTHER: ☐

SUBSTRATE TYPE	% COVERAGE	# TIMES SAMPLED	METHOD	SUBSTRATE TYPES	% COVERAGE	# TIMES SAMPLED	METHOD
WOODY DEBRIS (SNAGS)	1	5		SAND	87	5	
LEAF PACKS OF MATS	4	5		MUD/MUCK/SILT			
AQUATIC VEGETATION				OTHER:			
ROCK OR SHELL RUBBLE				OTHER:			
UNDERCUT BANKS/ROOTS	8	5		DRAW AERIAL VIEW SKETCH OF HABITATS FOUND IN 100 M SECTION			

WATER QUALITY	DEPTH (M):	TEMP. (°C):	PH (SU):	D.O. (MG/L):	COND. (UMHO/CM) OR SALINITY (PPT):			SECCHI (M):
TOP	0.1	24.1	7.9	7.8	777			
MID-DEPTH								
BOTTOM								

SYSTEM TYPE: STREAM: (1ST-2ND ORDER) 3RD-4TH ORDER 5TH – 6TH ORDER 7TH ORDER OR GREATER LAKE: ☐ WETLAND: ☐ ESTUARY: ☐ OTHER: ☐

WATER ODORS (CHECK BOX): NORMAL: ☒ SEWAGE: ☐ PETROLEUM: ☐ CHEMICAL: ☐ OTHER: ☐

WATER SURFACE OILS (CHECK BOX): NONE: ☒ SHEEN: ☐ GLOBS: ☐ SLICK: ☐

CLARITY (CHECK BOX): CLEAR: ☒ SLIGHTLY TURBID: ☐ TURBID: ☐ OPAQUE: ☐

COLOR (CHECK BOX): SLIGHTLY TANNIC: ☒ GREEN (ALGAE): ☐ CLEAR: ☐ OTHER: ☐

WEATHER CONDITIONS/NOTES:
COOL ; 80's

ABUNDANCE:	ABSENT	RARE	COMMON	ABUNDANT
PERIPHYTON	☐	☒	☐	☐
FISH	☐	☒	☐	☐
AQUATIC MACROPHYTES	☒	☐	☐	☐
IRON/SULFUR BACTERIA	☒	☐	☐	☐

SAMPLING TEAM: JJACKSON, JRICHARDSON, MHEHN

SIGNATURE: Jay Jackson

DATE: 6/25/02

FDEP-SOP-001/01: Form FD 9000-5 (June 1, 2001)

STREAM/RIVER HABITAT ASSESSMENT FIELD SHEET

SUBMITTING AGENCY CODE: / SUBMITTING AGENCY NAME:	STORET STATION NUMBER:	DATE (M/D/Y):	RECEIVING BODY OF WATER:
		6/25/02	

REMARKS:	COUNTY:	LOCATION:	FIELD ID/NAME:
	LEON	ALYAH HOPKINS	BEAVER CREEK - CONTROL SITE 1

Habitat Parameter	Optimal	Suboptimal	Marginal	Poor
Primary Habitat Components **Substrate Diversity** 13	Four or more productive habitats present (snags, tree roots/undercut banks, aquatic vegetation, leaf packs (partially decayed), rock). 20 19 18 17 16	Three productive habitats present. Adequate habitat. Some substrates may be new fall (fresh leaves or snags). 15 14 (13) 12 11	Two productive habitats present. Less than desirable habitat, frequently disturbed or removed. 10 9 8 7 6	One or less productive habitat. Lack of habitat is obvious, substrates unstable or smothered. 5 4 3 2 1
Substrate Availability 9	Greater than 30% productive habitat present at site. 20 19 18 17 16	16% to 30% productive habitat, by aerial extent. 15 14 13 12 11	6% to 15% productive habitat 10 (9) 8 7 6	Less than 5% productive habitat. 5 4 3 2 1
Water Velocity 11	Max. observed at typical transect: > 0.25 m/sec. But < 1 m/sec 20 19 18 17 16	Max. observed at typical transect: 0.1 to 0.25 m/sec 15 14 13 12 (11)	Max. observed at typical transect: 0.05 to 0.1 m/sec 10 9 8 7 6	Max. observed at typical transect: <0.05 m/sec. Or spate occurring: > 1 m/sec 5 4 3 2 1
Habitat Smothering 13 Primary Score 46	Less than 20% of habitats affected by sand or silt accumulation 20 19 18 17 16	20%-50% of habitats affected by sand or silt accumulation 15 14 (13) 12 11	Smothering of 50%-80% of the habitats with sand or silt, pools shallow, frequent sediment movement 10 9 8 7 6	Smothering of >80% of habitats with sand or silt, as severe problem, pools absent 5 4 3 2 1
Secondary Habitat Components **Artificial Channelization** 20	No artificial channelization or dredging. Stream with normal, sinuous pattern (20) 19 18 17 16	Many have been channelized in the past (>20 yrs), but mostly recovered, fairly good sinuous pattern 15 14 13 12 11	Channelized, somewhat recovered, but > 80% of area affected 10 9 8 7 6	Artificially channelized, box-cut banks, straight, instream habitat highly altered 5 4 3 2 1
Bank Stability Right Bank 10 Left Bank 10	Stable. No evidence of erosion or bank failure. Little potential for future problems. (10) 9	Moderately stable. Infrequent or small areas of erosion, mostly healed over. 8 7 6	Moderately unstable. Moderate areas of erosion, high erosion potential during floods. 5 4	Unstable. Many (60%-80%) raw, eroded areas. Obvious bank sloughing. 3 2 1
Riparian Buffer Zone Width Right Bank 10 Left Bank 10	Width of native vegetation (least buffered side) greater than 18 m (10) 9	Width of native vegetation (least buffered side) 12m to 18 m 8 7 6	Width of native vegetation 6 to 12 m. human activities still close to system 5 4	Less than 6 m of native buffer zone due to intensive human activities 3 2 1
Riparian Zone Vegetation Quality Right Bank 10 Left Bank 10 Secondary Score 80	Over 80% of riparian surfaces consist of native plants, including trees, understory shrubs, or non-woody machrophytes. Normal, expected plant community for given sunlight & habitat conditions. (10) 9	50% to 80% of riparian zone is vegetated, and/or one class of plants normally expected for the sunlight & habitat conditions is not represented. Some disruption in community evident. 8 7 6	25% to 50% of riparian ozone is vegetated, and/or one or two expected classes of plants are not represented. Patches of bare soil or closely cropped vegetation, disruption obvious. 5 4	Less than 25% of streambank surfaces are vegetated and/or poor plant community (e.g. grass monoculture or exotics) present. Vegetation removed to stubble height of 2 inches or less. 3 2 1

126 **TOTAL SCORE**

ANALYSIS DATE:	ANALYST:	SIGNATURE:
6/25/02	Johnny Richardson	

DEP-SOP-001/01: Form FD 9000-3 (June 20 2001)

PHYSICAL/CHEMICAL CHARACTERIZATION FIELD SHEET

SUBMITTING AGENCY CODE: / SUBMITTING AGENCY NAME:	STORET STATION NUMBER:	DATE (M/D/Y):	TIME	RECEIVING BODY OF WATER:
		6/25/02		

REMARKS:	COUNTY:	LOCATION:	FIELD ID/NAME:
	LEON	ARVAH HOPKINS	BEAVER CREEK – CONTROL SITE 2

RIPARIAN ZONE/STREAM FEATURES

PREDOMINANT LAND-USE IN WATERSHED (specify relative percent in each category):

FOREST/NATURAL	SILVICULTURE	FIELD/PASTURE	AGRICULTURAL	RESIDENTIAL	COMMERCIAL	INDUSTRIAL	OTHER (SPECIFY)

LOCAL WATERSHED EROSION (check box): None ☒ Slight ☐ Moderate ☐ Heavy ☐

LOCAL WATERSHED NPS POLLUTION (check box): No evidence ☐ Slight ☐ Moderate potential ☐ Obvious sources ☒ ARVAH EFFLUENT

WIDTH OF RIPARIAN VEGETATION (m) On least buffered side: 718m

LIST & MAP DOMINANT VEGETATION ON BACK

ARTIFICIALLY CHANNELIZED ☒ no ☐ recent, severe ☐ some recovery ☐ mostly recovered more sinuous

ARTIFICIALLY IMPOUNDED ☐ yes

HIGH WATER MARK 0.6 + 0.1 = 0.7
(m above present water level) (present depth in m) (m above bed)

TYPICAL WIDTH (M) DEPTH (M)/VELOCITY (M/SEC) TRANSECT — 3.0 m wide

0.25 m/s	0.25 m/s	0.25 m/s
4 SEC	4 SEC	4 SEC
0.1 m deep	0.05 m deep	0.1 m deep

CANOPY COVER %: OPEN: ☐ LIGHTLY SHADED (11-45%): ☐ MODERATELY SHADED (46-80%): ☒ HEAVILY SHADED: ☐

SEDIMENT/SUBSTRATE

SEDIMENT ODORS: NORMAL: ☒ SEWAGE: ☐ PETROLEUM: ☐ CHEMICAL: ☐ ANAEROBIC: ☐ OTHER: ☐

SEDIMENT OILS: ABSENT: ☒ SLIGHT: ☐ MODERATE: ☐ PROFUSE: ☐

SEDIMENT DEPOSITION: SLUDGE: ☐ SAND SMOTHERING: NONE (SLIGHT) MODERATE SEVERE SILT SMOTHERING: (NONE) SLIGHT MODERATE SEVERE OTHER:

SUBSTRATE TYPE	% COVERAGE	# TIMES SAMPLED	METHOD	SUBSTRATE TYPES	% COVERAGE	# TIMES SAMPLED	METHOD
WOODY DEBRIS (SNAGS)	3	5		SAND	5		
LEAF PACKS OF MATS	4	5		MUD/MUCK/SILT			
AQUATIC VEGETATION				OTHER:			
ROCK OR SHELL RUBBLE				OTHER:			
UNDERCUT BANKS/ROOTS	6	5		DRAW AERIAL VIEW SKETCH OF HABITATS FOUND IN 100 M SECTION			

WATER QUALITY	DEPTH (M):	TEMP. (°C):	PH (SU):	D.O. (MG/L):	COND. (UMHO/CM) OR SALINITY (PPT):			SECCHI (M):
TOP	0.1	23.9	7.9	7.7	746			
MID-DEPTH								
BOTTOM								

SYSTEM TYPE: STREAM (1ST) 2ND ORDER 3RD-4TH ORDER 5TH – 6TH ORDER 7TH ORDER OR GREATER LAKE: ☐ WETLAND: ☐ ESTUARY: ☐ OTHER: ☐

WATER ODORS (CHECK BOX): NORMAL: ☒ SEWAGE: ☐ PETROLEUM: ☐ CHEMICAL: ☐ OTHER: ☐

WATER SURFACE OILS (CHECK BOX): NONE: ☒ SHEEN: ☐ GLOBS: ☐ SLICK: ☐

CLARITY (CHECK BOX): CLEAR: ☒ SLIGHTLY TURBID: ☐ TURBID: ☐ OPAQUE: ☐

COLOR (CHECK BOX): SLIGHTLY TANNIC: ☒ GREEN (ALGAE): ☐ CLEAR: ☐ OTHER: ☐

WEATHER CONDITIONS/NOTES:
CALM; OVERCAST; ~50°F
pH preserved to 2.0 SU

ABUNDANCE:	ABSENT	RARE	COMMON	ABUNDANT
PERIPHYTON	☒	☐	☐	☐
FISH	☐	☒	☐	☐
AQUATIC MACROPHYTES	☒	☐	☐	☐
IRON/SULFUR BACTERIA	☒	☐	☐	☐

SAMPLING TEAM: JACKSON, J. RICHARDSON, M. HEYN

SIGNATURE: Jay A Jackson

DATE: 6/25/02

FDEP-SOP-001/01: Form FD 9000-5 (June 1, 2001)

STREAM/RIVER HABITAT ASSESSMENT FIELD SHEET

SUBMITTING AGENCY CODE: / SUBMITTING AGENCY NAME:	STORET STATION NUMBER:	DATE (M/D/Y): 6/25/02	RECEIVING BODY OF WATER:

REMARKS:	COUNTY: Leon	LOCATION: Arvah Hawkins Control Site2	FIELD ID/NAME:

Habitat Parameter	Optimal	Suboptimal	Marginal	Poor
Primary Habitat Components **Substrate Diversity** 13	Four or more productive habitats present (snags, tree roots/undercut banks, aquatic vegetation, leaf packs (partially decayed), rock). 20 19 18 17 16	Three productive habitats present. Adequate habitat. Some substrates may be new fall (fresh leaves or snags). 15 14 (13) 12 11	Two productive habitats present. Less than desirable habitat, frequently disturbed or removed. 10 9 8 7 6	One or less productive habitat. Lack of habitat is obvious, substrates unstable or smothered. 5 4 3 2 1
Substrate Availability 9	Greater than 30% productive habitat present at site. 20 19 18 17 16	16% to 30% productive habitat, by aerial extent. 15 14 13 12 11	6% to 15% productive habitat 10 (9) 8 7 6	Less than 5% productive habitat. 5 4 3 2 1
Water Velocity 15	Max. observed at typical transect: > 0.25 m/sec. But < 1 m/sec 20 19 18 17 16	Max. observed at typical transect: 0.1 to 0.25 m/sec (15) 14 13 12 11	Max. observed at typical transect: 0.05 to 0.1 m/sec 10 9 8 7 6	Max. observed at typical transect: <0.05 m/sec. Or spate occurring: > 1 m/sec 5 4 3 2 1
Habitat Smothering 13 Primary Score 50	Less than 20% of habitats affected by sand or silt accumulation 20 19 18 17 16	20%-50% of habitats affected by sand or silt accumulation 15 14 13 12 11	Smothering of 50%-80% of the habitats with sand or silt, pools shallow, frequent sediment movement 10 9 8 7 6	Smothering of >80% of habitats with sand or silt, as severe problem, pools absent 5 4 3 2 1
Secondary Habitat Components **Artificial Channelization** 20	No artificial channelization or dredging. Stream with normal, sinuous pattern 20 19 18 17 16	Many have been channelized in the past (>20 yrs), but mostly recovered, fairly good sinuous pattern 15 14 13 12 11	Channelized, somewhat recovered, but > 80% of area affected 10 9 8 7 6	Artificially channelized, box-cut banks, straight, instream habitat highly altered 5 4 3 2 1
Bank Stability Right Bank 10 Left Bank 10	Stable. No evidence of erosion or bank failure. Little potential for future problems. 10 9	Moderately stable. Infrequent or small areas of erosion, mostly healed over. 8 7 6	Moderately unstable. Moderate areas of erosion, high erosion potential during floods. 5 4	Unstable. Many (60%-80%) raw, eroded areas. Obvious bank sloughing. 3 2 1
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130 **TOTAL SCORE**

ANALYSIS DATE:	ANALYST:	SIGNATURE:

Appendix 9

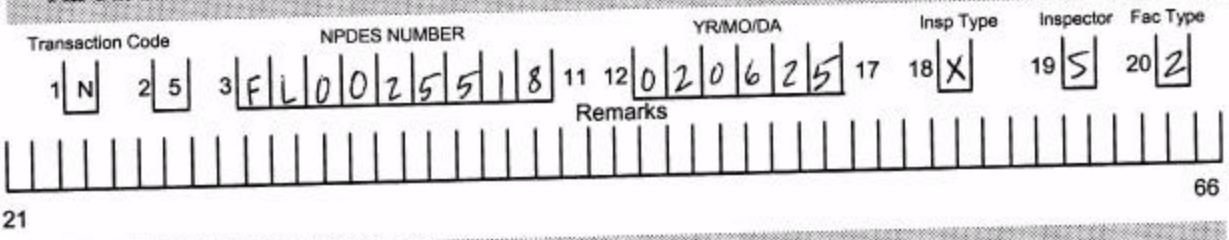
Qualitative benthic macroinvertebrate collections (n = 20 discrete dipnet sweeps) upstream and downstream of Arvah Hopkins Power Plant (June 25, 2002). Taxa lists and number of individuals counted.

	Control Site 1	Control Site 2	Test Site 1	Test Site 2
Amphipoda				
Undetermined Amphipoda	–	–	1	–
Coleoptera				
Dubiraphia vittata	–	2	3	9
Elmidae	–	3	1	–
Microcylloepus pusillus	6	3	1	–
Stenelmis sp.	1	2	6	3
Dineutus sp.	1	2	–	2
Hydrophilidae	–	1	–	–
Phaenonotum sp.	–	–	2	–
Ectopria sp.	1	–	–	–
Decapoda				
Cambaridae	–	3	7	4
Procambarus sp.	–	–	–	1
Palaemonetes sp.	2	–	–	–
Diptera				
Atrichopogon sp.	–	–	–	4
Ablabesmyia mallochi	–	–	1	3
Chironomidae	–	–	1	2
Corynoneura sp.	1	1	–	–
Corynoneura sp. B Epler	–	4	–	1
Hemerodromia sp.	5	5	9	9
Larsia decolorata	–	–	2	–
Limnophyes sp.	–	1	–	–
Paramerina sp.	1	–	–	–
Parametriocnemus sp.	1	–	–	–
Paraphaenocladius sp.	1	–	–	–
Pentaneura inconspicua	–	1	–	1
Phaenopsectra punctipes grp.	–	1	3	2
Polypedilum fallax	–	–	1	6
Polypedilum halterale grp.	1	–	–	–
Polypedilum illinoense grp.	–	1	–	5
Rheocricotopus robacki	1	1	–	–
Rheosmittia sp.	1	1	–	–
Rheotanytarsus exiguus grp.	–	1	–	1
Rheotanytarsus pellucidus	–	3	–	–
Simulium sp.	6	1	–	–
Stenochironomus sp.	–	3	–	–
Tabanidae	–	–	–	1
Tanytarsus sp. A Epler	1	2	–	–
Tanytarsus sp. M Epler	–	1	–	–
Tanytarsus sp. U Epler	–	–	–	3
Thienemanniella lobapodema	–	1	–	–
Thienemanniella xena	–	–	–	1
Thienemannimyia grp.	–	–	2	2
Tipula sp.	–	–	3	–
Xestochironomus sp.	1	3	1	2

Qualitative benthic macroinvertebrate collections (n = 20 discrete dipnet sweeps) upstream and downstream of Arvah Hopkins Power Plant (June 25, 2002). Taxa lists and number of individuals counted. Continued.

	Control Site 1	Control Site 2	Test Site 1	Test Site 2
Ephemeroptera				
Baetis intercalaris	21	10	25	4
Pseudocloeon sp.	8	8	–	–
Caenis sp.	1	6	–	–
Megaloptera				
Corydalus cornutus	–	–	–	2
Undetermined Megaloptera	–	1	–	–
Odonata				
Aeshnidae	–	–	–	1
Argia sedula	–	–	–	1
Argia sp.	–	–	–	5
Calopterygidae	–	1	–	–
Calopteryx sp.	1	2	1	–
Coenagrionidae	–	–	–	1
Gomphidae	–	4	–	–
Gomphus sp.	1	–	1	1
Oligochaeta				
Enchytraeidae	–	–	3	–
Allonais paraguayensis	–	–	2	–
Dero digitata complex	–	–	1	–
Nais communis complex	1	–	–	–
Pristina leidyi	–	–	1	–
Aulodrilus pigueti	–	1	–	–
Haber speciosus	–	–	1	–
Limnodrilus sp.	8	1	–	–
Tubificidae	–	–	1	–
Rhagovelia sp.	–	–	1	–
Prostoma sp.	1	–	2	–
Peleycpoda				
Corbicula fluminea	5	–	–	–
Plecoptera				
Perlesta sp.	1	–	–	–
Perlesta placida complex	–	2	–	–
Trichoptera				
Anisocentropus pyraloides	1	–	–	–
Cheumatopsyche sp.	16	8	5	5
Chimarra sp.	6	–	–	–
Hydropsyche sp.	–	–	3	–
Hydropsychidae	–	1	–	–
Hydroptilidae	–	2	–	–
Lype diversa	–	1	–	–
Neotrichia sp.	2	1	10	6
Oxyethira sp.	–	–	–	1
Triaenodes ignitus	–	1	–	–
Triaenodes sp.	–	1	–	–
Undetermined Trichoptera	1	–	1	–

Fill Out This Section For All Surface Water Discharger Inspections (CEI, CSI, CBI, PAI, XSI - RI Optional)



Fill Out This Section For All Surface Water Discharger Inspections (CEI, CSI, CBI, PAI, XSI - RI Optional)

