SURVEY OF JONES CREEK, UPSTREAM AND DOWNSTREAM OF JONES CREEK WASTEWATER TREATMENT PLANT DICKSON COUNTY, TENNESSEE AND BIG TURNBULL CREEK DICKSON AND WILLIAMSON COUNTY SEPTEMBER 1993

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ABSTRACT

Jones Creek at RM 21.5, Dickson County, Tennessee receives treated wastewater from one of the treatment plants serving the city of Dickson. An assimilative capacity study (ACAP) was conducted during low flow conditions of 1993. In conjunction with the ACAP, a benthological study was performed of six study sites within Jones Creek using RM 24.4 as the upstream comparison. Big Turnbull Creek, Dickson and Williamson County, was sampled at three points and used as the watershed reference comparison .

The study sites located 0.1 RM and 1.3 RM downstream of the discharge were the most severely impacted. The aquatic invertebrate community sampled from the site just below the sewage treatment plant was 28% comparable to the upstream reference station and 33% comparable to the watershed reference station. River mile 20.2, 1.3 RM downstream of the effluent discharge point, was determined during the ACAP study as the point of the dissolved oxygen sag. It was biologically 33% comparable to the upstream reference station and 38% comparable to watershed reference station. At RM 19.1, the stream had recovered biologically to the slightly impaired category.

Chemical analyses found no permit violations or water quality criteria violations. Fecal coliform levels were elevated from RM 21.9 to 18.4. The Jones Creek WWTP's self-monitoring data indicated chronic violations of ammonia and chlorine. The Division's grabbed samples did not find violations of permit limits, however, the aquatic community indicated a substantial impact downstream of the WWTP discharge (RM 21.5) to RM 19.7 where a tributary dilutes the effluent. The streambed below the WWTP discharge was covered in a thick layer of dark solids indicating a problem with solids release. A study conducted by the Division in 1991 found the same problem.

Jones Creek below the WWTP from RM 21.5 to 19.7 is not supporting its use classification for fish and aquatic life. Comparing RM 24.4 to Big Turnbull Creek, the upstream comparison was slightly impaired probably due to nonpoint source pollution.

INTRODUCTION

Jones Creek at river mile 21.5, in Dickson County, Tennessee, receives treated wastewater from the Jones Creek Wastewater Treatment plant (WWTP) serving the city of Dickson. The WWTP is a secondary treatment system and is permitted (NPDES: TN0021016) to discharge 0.9 MGD to Jones Creek which has a 3Q20 of 0.60 CFS at river mile (RM) 21.5. Jones Creek at this permitted discharge rate of 0.9 MGD would be 70% treated wastewater downstream of the outfall during times of low flow. Prior to this study the plant has recorded discharges of up to 7.0 MGD and has an average discharge of 1.2 MGD. The plant has had many problems in the years prior to this study. Self-monitoring data yields many violations of permit limits in 1992 and 1993 including 46 daily ammonia violations, and 56 daily chlorine violations (Jones Creek Permit File).

The city is presently building a WWTP which will treat and discharge 3.0 MGD to Jones Creek which at low flow will be 88% effluent after mixing. Due to the need to understand the streams ability to assimilate waste an assimilative capacity (ACAP) study or total maximum daily load (TMDL) study was conducted by the Division in 1993. A report prepared by Sheri Duren (1994) of the Division entitled "Jones Creek, Total Maximum Daily Load Study, Summer 1993" presents the extensive physical data that was acquired during the study. In conjunction with the ACAP, a benthological study was conducted at the same locations as the ACAP with several more points added. A watershed reference stream, Big Turnbull Creek, was used as an overall comparison to Jones Creek. This report provides the results of that study.

SITE DESCRIPTION Jones Creek (WBID TN05130204002) and Big Turnbull Creek (WBID TN05130204006) are tributaries of the Harpeth River at RM 10.6 and RM 35.1, respectively, (U.S.G.S. 35NW and 305SW) of the lower Cumberland River. Jones Creek has a drainage area of 107 square miles near its mouth with a 3Q20 of 7.2 CFS and Big Turnbull Creek has a drainage area of 115 square miles near its mouth and a 3Q20 of 12.2 CFS. Jones Creek includes approximately 32 tributaries. Sulphur Fork Creek is the

largest of the second order streams at RM 12.7. Four third order streams are included in the Jones Creek drainage area: Town Branch at RM 12.4 which drains 9.34 sq. miles; Little Jones Creek at RM 18.4, 18.7 sq. miles; Will Hall Creek, RM 19.7, 10.4 sq. miles; and Spicer Branch at RM 23.8. Big Turnbull Creek includes approximately 28 tributaries with four third order streams: Beaverdam Creek at RM 10.7, Nails Creek at RM 13.2, Parker Creek at RM 18.8, and Barren Fork at RM 20.3.

Jones Creek's headwaters begin in the town of Dickson. One of the tributaries that form the headwaters of Jones Creek is impounded to form Luther Lake located near Highway 70. Besides the WWTP, another point source discharge is located at RM 24.0 Burns Stone Quarry, which is regulated by the Division of Water Pollution Control, Surface Mining Section. In September of 1992, heavy deposits of fine sediments were found within the creek which were washed in from the production area during rain events and discharged from an overflowing settling pond which was not adequately retaining the silt. The quarry also has an intake which removes a substantial amount of water from the creek at times of processing. Eubank Asphalt located upstream of Burns Stone Quarry also removes water from Jones Creek for processing.

Big Turnbull Creek has a point source discharge at RM 11.0 of filter backwash from the Turnbull utility district water treatment plant (NPDES TN0004855). The filtration plant draws approximately 1.2 million gallons of water from the stream/day. Burns Elementary School (NPDES TN0063878) discharges 0.016 MGD to Beaverdam Creek at RM 3.7 which enters Big Turnbull Creek at RM 10.7. Bethany Hills Camp (NPDES TN0028991) discharges 0.0075 MGD of domestic wastewater to RM 1.8 of Sullivan Branch which enters Big Turnbull Creek at RM 0.2 (U.S.G.S. 305SW). All of these discharges within Big Turnbull Creek were downstream of the study sites and therefore not influencing this study.

Jones Creek and Big Turnbull Creek are within the Western Highland Rim ecoregion and are found within the St Louis/Warsaw geologic formation of Mississipian age (Hardeman 1966). The streams are typically flatrock with some cobble and gravel.

SAMPLING LOCATIONS In September 1993, a stream survey was conducted of Jones Creek and Big Turnbull Creek at several locations. These locations can be found in Table I along with the river mile, latitude/longitude, elevation and stream order. Figure 1 and 2 provides a map of these locations. Within Jones Creek, JC01 was upstream (U/S) of both the Jones Creek WWTP and the Burn's Rock Quarry discharge. JC02 was downstream (D/S) of the Burn's Stone Quarry discharge but upstream of the city's WWTP. There were five sites downstream of the WWTP: JC02A, JC03, JC04, JC05 and JC06. Sites JC02A and JC03 were located at sites which did not have significant dilution from tributaries. Sites JC04, JC05 and JC06 were located downstream of second and third order streams which provided significant dilution. Big Turnbull Creek, Sites B1, B2, B3 were used as reference stream comparisons. B1 was used as a comparison to JC01, JC02, and JC02A. B2 was a comparison to JC03, JC04 and JC05. B3 was a comparison to JC06.

BACKGROUND INFORMATION A survey of the benthological community was conducted in March of 1991 by the Division. The sites were 200 feet downstream of the WWTP outfall, 0.3 miles downstream of the outfall and 1.9 miles downstream. Biometrics yielded an excessively impacted stream 1.9 miles downstream and a substantially impaired stream 0.3 miles downstream of the outfall. Notable was the heavy accumulations of sludge along the right bank just below the outfall indicating that solids were released from the WWTP.

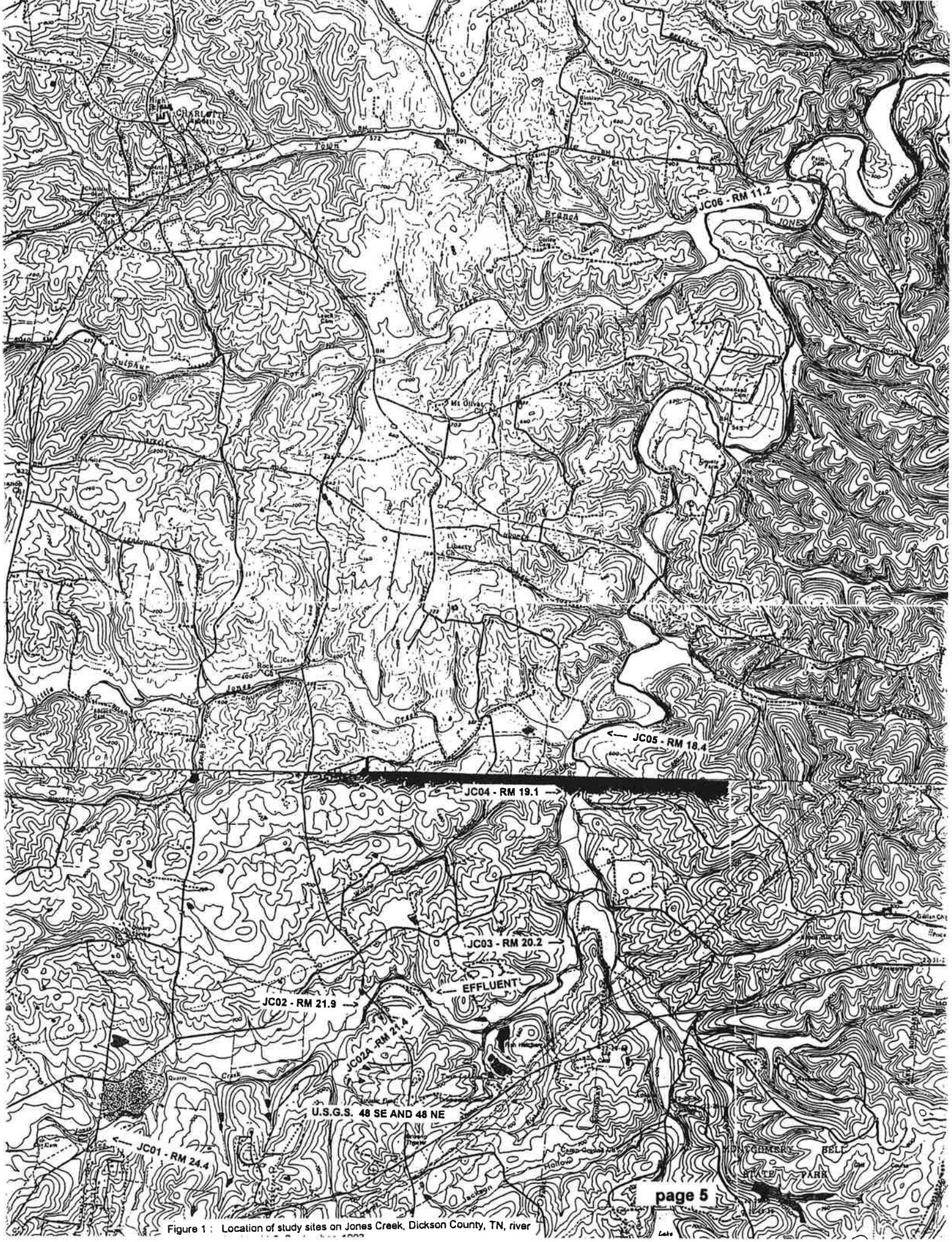

Figure 1 : Location of study sites on Jones Creek, Dickson County, TN, river

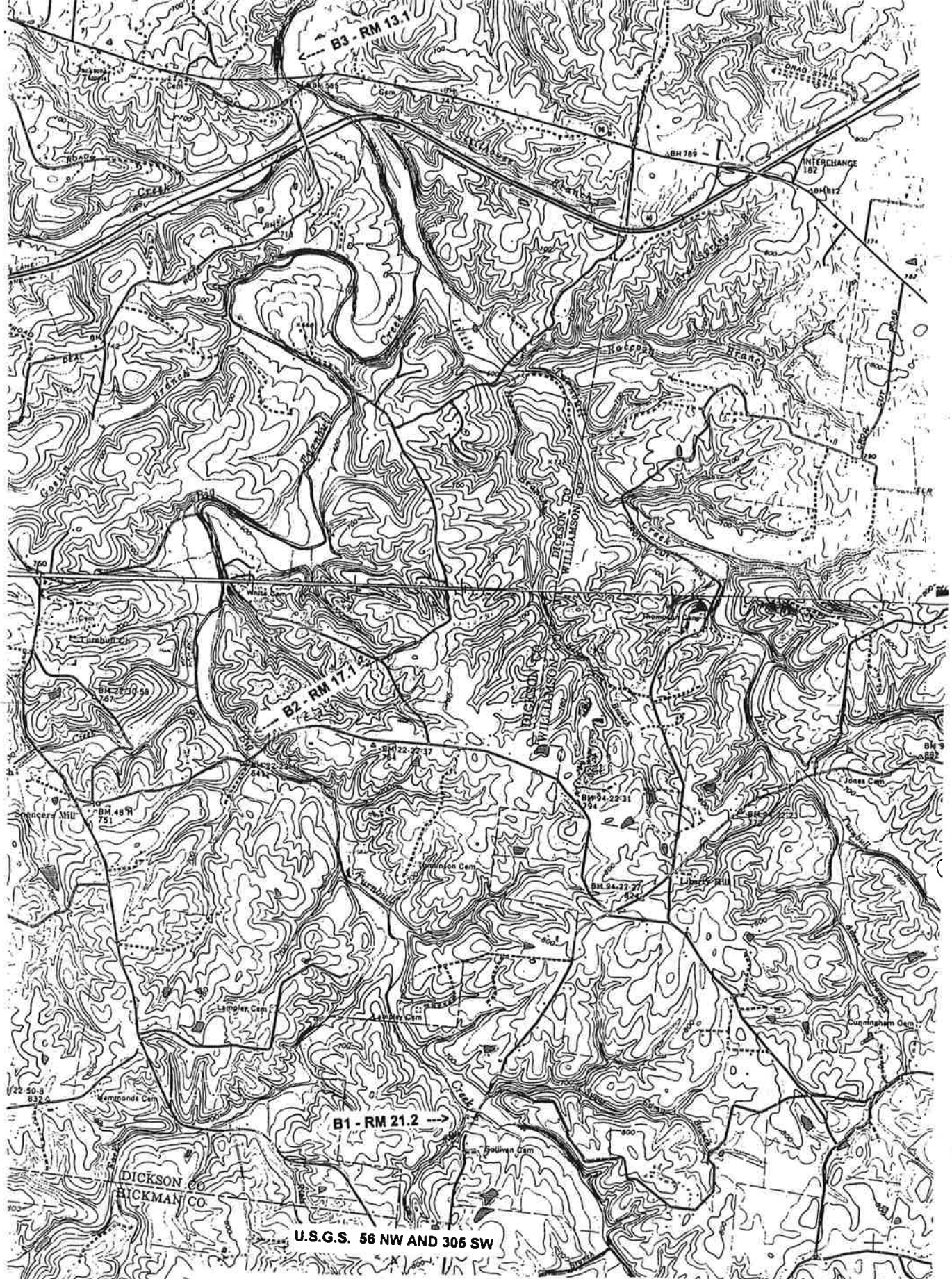

Figure 2 Location of study sites on Big Turnbull Creek, Dickson and Williamson County, TN, river mile 21.2 to 13.1, September 1993.

TABLE I
SAMPLING LOCATIONS FOR
JONES CREEK STUDY
SEPTEMBER 2, 1993

SITE NO.	LOCATION	RM	U.S.G.S QUAD	LATITUDE	LONGITUDE	STREAM ORDER AND ELEVATION IN FEET
JC01	JONES CREEK AT HUMMINGBIRD LANE UPSTREAM OF ROCK QUARRY	24.4	48 SE BURNS	36°05'28"N	87°20'05"W	3 660 FT
JC02	JONES CREEK AT ROCK CHURCH ROAD UPSTREAM WWTP	21.9	48 SE BURNS	36°06'15"N	87°19'06"W	3 660 FT
EFFL UENT	WWTP DISCHARGE	21.5	48 SE BURNS			
JC02A	JONES CREEK AT 0.1 MILES D/S WWTP	21.4	48 SE BURNS	36°06'13"N	87°18'47"W	3 600 FT
JC03	JONES CREEK AT DO SAG, DUKE FARM	20.2	48 SE BURNS	36°06'35"N	87°17'50"W	3 560 FT
JC04	JONES CREEK AT RICHARDSON CEMETERY ROAD, D/S WILL HALL BRANCH	19.1	48 SE BURNS	36°07'17"N	87°17'45"W	4 560 FT
JC05	JONES CREEK AT MATIAS ROAD, D/S LITTLE JONES CREEK	18.4	48 NE CHARLOTTE	36°07'40"N	87°17'45"W	4 540 FT
JC06	JONES CREEK AT PETTY ROAD D/S TOWN BRANCH AND SULPHUR FORK CREEK	11.2	48 NE CHARLOTTE	36°10'42"N	87°16'25"W	4 480 FT
B1	BIG TURNBULL CREEK AT OLD COX PIKE	21.2	56NW CRAIGFIELD	35°57'52"	87°11'52"W	3 660 FT
B2	BIG TURNBULL CREEK AT WHITE ROAD	17.1	305SW WHITE BLUFF	36°00'15"N	87°13'15"W	4 600 FT
B3	BIG TURNBULL CREEK AT HWY 96	13.1	305SW WHITE BLUFF	36°01'58"N	87°12'54"W	4 560 FT

METHODS

At each site water quality, chemical, and bacteriological parameters were sampled. Chemical analyses was performed on grab samples and consisted of permit limits and standard instream analysis. Water quality parameters (dissolved oxygen, pH, conductivity

and temperature) were also taken at the time of chemical sample collection using a Hydrolab Surveyor II meter.

Benthic macroinvertebrate samples were collected within riffle areas at each site using EPA protocols (Plafkin et. al 1989) and standard operating procedures. Benthic samples were collected using a semi-quantitative traveling kick method within the riffle areas. Habitat was analyzed at each site over a 300 foot section of stream and the immediate sampling area.

Organisms were returned to the field office and identified to the lowest practical taxon. The semi-quantitative macroinvertebrate riffle samples were analyzed using a modified version of the EPA's Rapid Bioassessment Protocol III methodology. This protocol utilizes a set of biological metrics to make determinations of the biological condition of a stream site through comparison with a reference site of similar habitat. The scores from the metrics are summed and divided by the total possible score, resulting in a final percentage of site comparability from which a Biological Condition Category can be determined.

For this study, Site JC01 within Jones Creek was used as the upstream reference comparison to all of the other sites within Jones Creek. Since the size of the stream changed between sampling points (JC06 much larger than JC01), Big Turnbull Creek was used as a reference comparison to Jones Creek comparing different locations on Big Turnbull to similar sized stream sites on Jones Creek. B1 was used as a comparison to JC01, JC02, and JC02A. B2 was a comparison to JC03, JC04 and JC05. B3 was a comparison to Jones Creek's JC06. Both the habitat scores and biotic data was compared.

RESULTS AND DISCUSSION

Appendix I and III provides the results of the water quality parameters and chemical analyses. The dissolved oxygen level was significantly lower below the WWTP than upstream of the WWTP especially at JC02A just downstream of the discharge. The assimilative capacity study, which occurred during this same time period, determined the dissolved oxygen sag as JC03 (RM 20.2 which is 1.3 RM downstream of the discharge).

The listed chemical results are those in which levels were measured above the detectable limit. The other chemical analyses: suspended residue, cadmium, copper, lead, mercury, nickel, and silver were all under the detectable limit. The chemical analyses were below Tennessee Water Quality Criteria. Fecal coliform was elevated at JC02, JC02A, JC03 and JC04. The effluent was within permit limits. Within the two years prior to this study, self-monitoring data lists many violations of Jones Creek WWTP's permit limits including ammonia violations, BOD, total residual chlorine and fecal coliform violations. While the chemical analyses did not show any pollutants present, an evaluation of the aquatic biological community allows the inspector to discern if pollutants have been chronically released either in continuous low amounts or large doses.

Each of the sites compared were very similar in their habitat availability (Table II). All of the sites within Jones Creek and Big Turnbull Creek were similar in the type of substrate availability. Sections of flatrock or bedrock were present as well as areas where the substrate consisted of boulder, cobble, gravel and fine particles.

JC01 located downstream of the city of Dickson was noted for the silt deposits which were found in many parts of the stream. The banks were severely eroded probably from extreme increases in flow during storms. The high water mark was over 6 feet high. Most of the stations within Jones Creek had signs of nonpoint source pollution.

TABLE II
COMPARISON OF HABITAT
JONES CREEK STUDY
SEPTEMBER 2, 1993

SITE NO.	RM	HABITAT SCORE	% COMPARISON TO REFERENCE	RIFFLE WIDTH	DEPTH IN RIFFLE	DEPTH IN RUN	WIDTH IN RUN
JC01	24.4	116	91%	16'	1"	3"	16'
JC02	21.9	NO SCORE		16'	3-4"	12-18"	20'
JC02A	21.4	121	94	24'	3-5"	12-18"	24'
JC03	20.2	123	100%	13-16'	4-7"	18-30"	30'
JC04	19.1	118	100%	20'	3-6"	20-24"	30'
JC05	18.4	119	100%	25-30'	5-6"	18"	55'
JC06	11.2	113	93%	20'	7-8"	18-22"	60'
B1	21.2	128		10'	1-3"	3-15"	20'
B2	17.1	116		18'	3-7"	18-20"	44'
B3	13.1	121		15-16'	8-10"	18-24"	60'

JC02A 0.1 RM downstream of the wastewater treatment plant was impacted with sludge and slime. This site was downstream of a large pool which had dark black sludge coating the bottom. There was a strong odor of sewage present.

Appendix III provides a list of the macroinvertebrate taxa. Table III provides the results of comparing the biotic data from JC02-JC06 to the upstream reference, JC01. It also provides the results of comparing the Jones Creek sites to Big Turnbull Creek.

Both the comparisons to JC01 and the comparisons to Big Turnbull Creek produced very similar results at all locations. JC02A, which was approximately 0.1 miles d/s the WWTP discharge was substantially impaired with only 28% comparability to the upstream reference stream and 33% comparability to the watershed reference. JC03, at the dissolved oxygen sag at the Duke Farm (RM 20.2 and 1.3 RM downstream of the discharge), was only 33% comparable to the upstream reference and 38% comparable to the watershed reference station. JC04-06 downstream of several tributaries improved in its overall rating and were slightly impaired. Figure 3 graphs the results of the biological comparisons.

TABLE III

% COMPARISON TO REFERENCE AND CONDITION CATEGORY

JONES CREEK STUDY - SEPTEMBER 1993

SITE	% COMPARISON TO REFERENCE JC01/B1	CONDITION CATEGORY
JC01 - U/S OF THE ROCK QUARRY, U/S WWTP	/78	SLIGHTLY IMPAIRED
JC02 - U/S WWTP, 2.1 RM D/S BURNS STONE QUARRY	72/83	SLIGHTLY IMPAIRED, NON IMPAIRED
JC02A - 0.1 RM D/S WWTP	28/33	SUBSTANTIALLY IMPAIRED
SITE	**% COMPARISON TO REFERENCE JC01/B2**	**CONDITION CATEGORY**
JC03 - AT DISSOLVED OXYGEN SAG, 1.3 RM D/S WWTP	33/38	SUBSTANTIALLY IMPAIRED
JC04 - 2.4 RM D/S WWTP	78/72	SLIGHTLY IMPAIRED
JC05 - 3.2 RM D/S WWTP	67/72	SLIGHTLY IMPAIRED
SITE	**% COMPARISON TO REFERENCE JC01/B3**	**CONDITION CATEGORY**
JC06 - 10.3 RM D/S WWTP	72/78	SLIGHTLY IMPAIRED

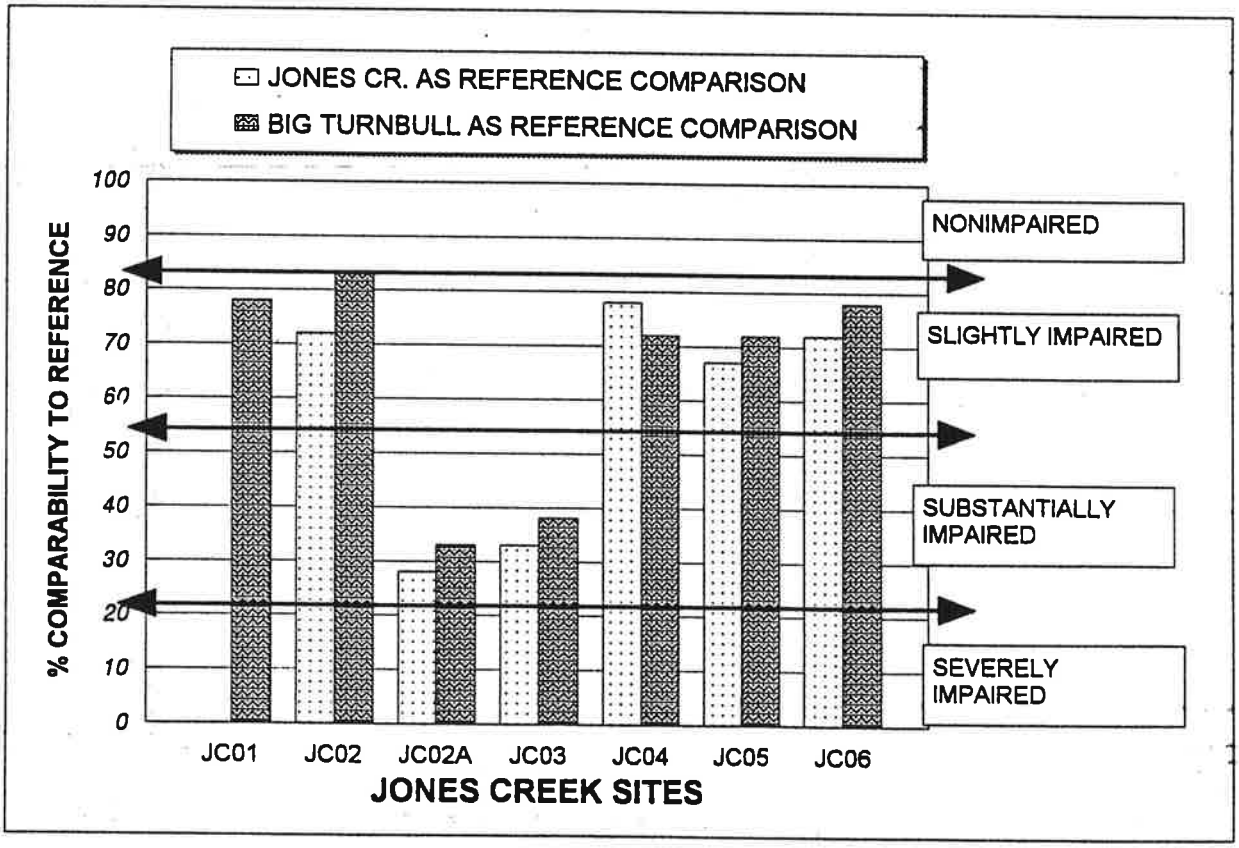

Figure 3 Plot of % comparability to reference sites and overall condition category of 6 sites within Jones Creek, Dickson County, Tennessee, September, 1993.

Also significant is the number of intolerant taxa at the upstream stations compared to the stations downstream of the WWTP especially at JC02A and JC03. Intolerant taxa are defined as those taxa sensitive to pollution, tolerant taxa are not sensitive to pollution, and facultative taxa fall in between these two categories. Figure 4 and 5 graphs those percentages. Jones Creek upstream of the WWTP had 32% intolerant taxa while downstream of the WWTP at JC02A, intolerant taxa comprised only 4% of the population, and at JC03, 14% of the taxa. There was a significant increase of tolerant taxa below the sewage treatment plant JC02A and JC03.

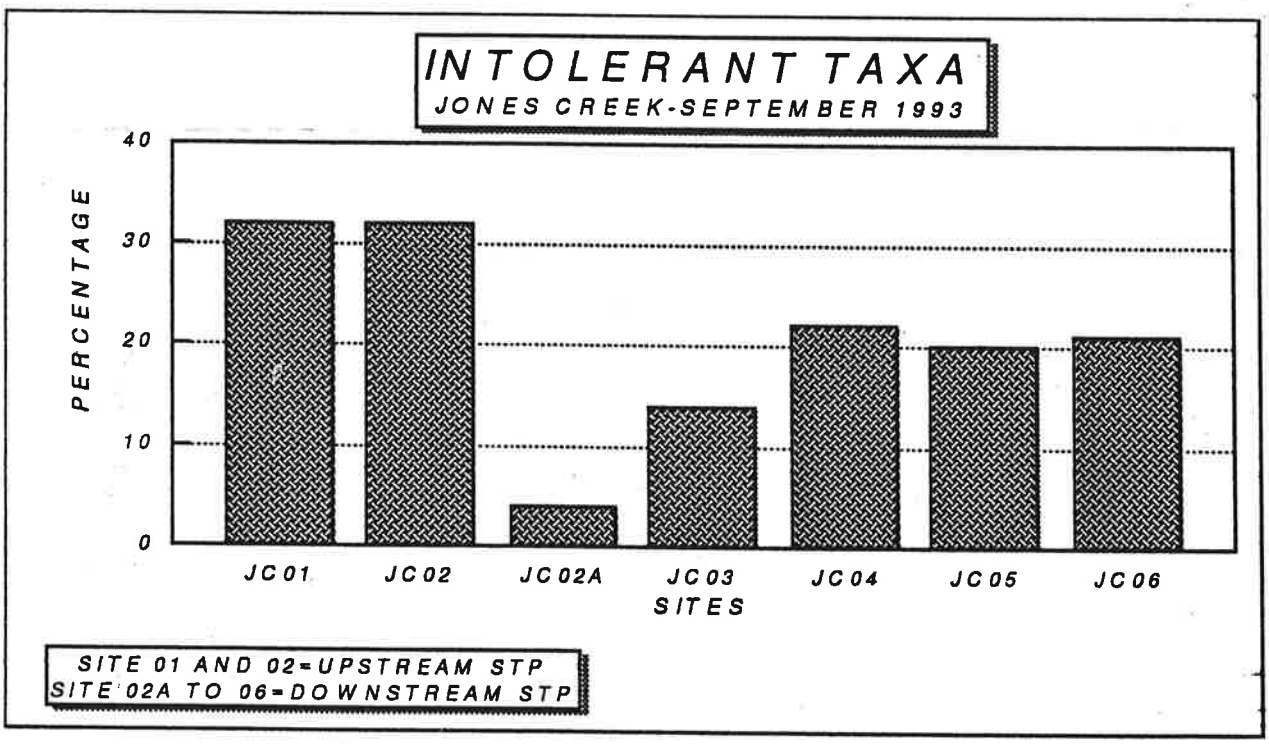

Figure 4: Percent intolerant taxa at each site, Jones Creek study, September, 1993.

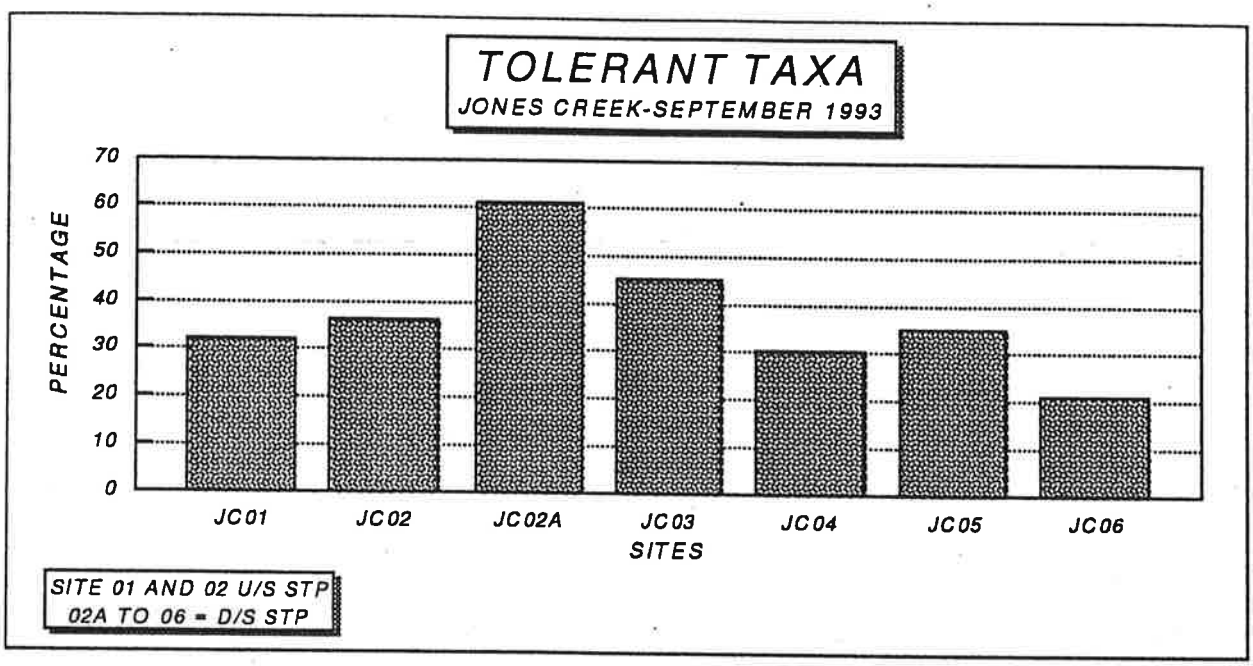

Figure 5: Percent tolerant taxa at each site, Jones Creek study, September, 1993

In 1991, the Division conducted a benthic macroinvertebrate survey of Jones Creek and found excessive impact at the stations just downstream of the WWTP (100 feet and 0.3 RM) and at Jones Creek Road Bridge (at RM 19.7, 1.8 RM D/S of the WWTP). This 1993 study found substantial impact at similar locations (0.1 RM downstream of the discharge and RM 20.2). Both the 1991 and 1993 study found large accumulations of dark black sludge below the WWTP. This indicates that the plant has a consistent problem with solids release. The high levels of discharged ammonia probably contributes to the extreme change in biota.

CONCLUSIONS

Jones Creek has suitable habitat to support a diverse benthic fauna. The marked changes in the fauna below the outfall are caused by the Jones Creek discharge. Burns Stone Quarry appears to have minimal effect on Jones Creek. However, several

parameters increase downstream of the quarry discharge including conductivity, hardness, sulfate and fecal coliform. The impact from the WWTP continues at least to the area of the Jones Creek Road Bridge (RM 19.7, 1.8 rm d/s of the WWTP) where Will Hall Branch enters, providing dilution. Therefore, Jones Creek does not support its use classifications for fish and aquatic life below the WWTP to RM 19.7. If improvements occur at the waste water treatment plant which will prevent the release of ammonia and solids, Jones Creek has a chance of recovering from this biological degradation. Jones Creek downstream of RM 19.6 is partially supporting of fish and aquatic life. Some of the impact can be attributed to nonpoint source pollution. Big Turnbull Creek is a healthy stream, supporting all of its stream classification uses. The stream appears to be in its best attainable condition at RM 17.1 and should be considered a suitable ecoreference stream at this point.

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APPENDIX I
JONES CREEK CHEMICAL ANALYSES
SEPTEMBER 3, 1993

PARAMETER	JC01	JC02	EFFLUENT (Permit limit)	JC02A	JC03	JC04	JC05	JC06
TEMPERATURE (oC)	24.78	23.99		23.75	23.31	23.08	25.33	25.08
DISSOLVED O^2 (ppm)	8.11	8.59		5.84	7.66	5.92	7.27	6.76
pH (s.u.)	7.78	7.8		7.4	7.7	7.31	7.5	7.5
CONDUCTIVITY (µmhos)	372	474		546	479	366	378	318
FECAL COL. (col/100 ml)	93	230	(200) 17	270	190	210	83	49
SETT. SOLIDS (ML/L)	<0.1	<0.1	<0.1	0.1	0.1	<0.1	<0.1	0.1
BOD (mg/L)	<2	<2	3.9	<2	<2	<2	<2	<2
TOTAL HARDNESS (MG/L)	189	268	177	251	205	177	165	165
NH3 (mg/L)	<0.02	<0.02	(3.0) 0.23	0.06	<0.02	<0.02	<0.02	<0.02
NO3 & NO2 (mg/L)	1.14	0.22	0.23	0.24	0.4	0.55	0.37	0.14
TOT. PHOSPHATE (MG/L)	<0.01	<0.01	0.82	0.15	0.06	0.09	0.07	0.09
SULFATE (MG/L)	10.8	111	9.87	87.8	64	27.7	6.93	27.3
IRON (µg/L)	100	80	120	260	170	190	140	160
MANGANESE (µg/L)	20	10	100	<10	70	70	20	40
ZINC (µg/L)	<20	<20	30	<20	<20	<20	<20	<20

APPENDIX II
BIG TURNBULL CREEK CHEMICAL ANALYSES
SEPTEMBER 3, 1993

PARAMETER	B1	B2	B3
TEMPERATURE (oC)	25.31	26.70	27.40
DISSOLVED O^2 (ppm)	6.74	7.37	7.68
pH (s.u.)	7.69	7.67	7.68
CONDUCTIVITY (µmhos)	246	232	248
FECAL COL. (col/100 ml)	140	93	135
SETT. SOLIDS (ML/L)	<0.1	<0.1	0.1
BOD (mg/L)	<2	<2	<2
TOTAL HARDNESS (MG/L)	135	132	135
NH3 (mg/L)	<0.02	<0.02	<0.02
NO3 & NO2 (mg/L)	0.21	0.20	0.12
TOT. PHOSPHATE (MG/L)	<0.01	<0.01	<0.01
SULFATE (MG/L)	9.05	9.73	7.94
IRON (µg/L)	<50	<50	115
MANGANESE (µg/L)	<10	<10	25
ZINC (µg/L)	<20	<20	20

APPENDIX III
BENTHIC MACROINVERTEBRATE DATA
JONES CREEK AND BIG TURNBULL CREEK
DICKSON COUNTY
SEPTEMBER 1993

Order Family *Genus species*	TOLERANCE VALUE (TV)	FUNCT. FEEDING GROUP (FFG)	QUANTITAT ABUND. (QA1)										TV * QUANTIT. ABUNDANCE (TV * QA 1) JONES CR.							TV * QUANTIT. ABUNDANCE (TV * QA 1) BIG TURNBULL		
TAXA	TV	FFG	JC01	JC02	JC02A	JC03	JC04	JC05	JC06	B1	B2	B3	JC01	JC02	JC02A	JC03	JC04	JC06	JC06	B1	B2	B3
PLATYHELMINTHES																						
Tubellarian																						
Undet. genus	6.10	PRED			68								0.0	0.0	414.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ANNELIDA																						
Oligochaeta																						
Lumbriculidae																						
Undet. genus	7.03	SCAV		3	35				5				0.0	21.1	246.1	0.0	0.0	0.0	35.2	0.0	0.0	0.0
Naididae																						
Chaetogaster sp.	8.47	PRED			1																	
Nais sp.	8.88	SCAV							1													
Undet. genus	8.47	SCAV			4								0.0	0.0	33.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tubificidae																						
Branchiura sowerbyi	8.28	SCAV																				
Undet. genus	7.11	SCAV			15								0.0	0.0	106.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MOLLUSCA																						
Gastropoda																						
Ancylidae																						
Ferrisia sp.	6.55	SCRA			1	28	2	3					0.0	0.0	6.6	183.4	13.1	19.7	0.0	0.0	0.0	0.0
Hydrobiidae																						
Undet. genus	5.65	SCRA							14				0.0	0.0	0.0	0.0	0.0	0.0	79.1	0.0	0.0	0.0
Physidae																						
Physella sp.	8.84	SCRA			1								0.0	0.0	8.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pleuroceridae																						
Pleurocera sp.	6.00	SCRA			3	2	57	4	18	28	3		0.0	0.0	18.0	12.0	342.0	24.0	108.0	168.0	18.0	0.0
Pelecypoda																						
Corbiculidae																						
Corbicula fluminea	6.30	FF					6	4	4				0.0	0.0	0.0	0.0	37.8	25.2	25.2	0.0	0.0	0.0
Sphaeriidae																						
Sphaerium sp.	7.58	FF		2		10	7	2				1	0.0	15.2	0.0	75.8	53.1	15.2	0.0	0.0	0.0	7.6
Unionidae																						
Undet. genus	3.45	FF				1							0.0	0.0	0.0	3.5	0.0	0.0	0.0	0.0	0.0	0.0
ARTHROPODA																						
Crustacea																						
Decapoda																						
Cambaridae																						
Orconectes sp.	2.60	OMNIV	3			2	3		2	2			7.8	0.0	0.0	5.2	7.8	0.0	5.2	5.2	0.0	0.0
Isopoda																						
Asellidae																						
Lirceus lineatus	7.85	SH/COLL		2	2			1					0.0	15.7	15.7	0.0	0.0	7.9	0.0	0.0	0.0	0.0
Arachnida																						
Hydracarina	5.53	PRED	1										5.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Insecta																						
Ephemeroptera																						
Baetidae																						
Acentrella amplus	3.61	HERB									1	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.6	18.1
Baetis sp.	4.94	SCRA	36	18	1	19	43	20	7	25	26	31	177.8	88.9	4.9	93.9	212.4	98.8	34.6	123.5	128.4	153.1
Caenidae																						
Caenis sp.	7.41	COLL	12	100	1	20	111	96	49	95	57	16	88.9	741.0	7.4	148.2	822.6	711.4	363.1	704.0	422.4	118.6

APPENDIX III - PAGE 2
BENTHIC MACROINVERTEBRATE DATA
JONES CREEK AND BIG TURNBULL CREEK
DICKSON COUNTY
SEPTEMBER 1993

TAXA	TV	FFG	JC01	JC02	JC02A	JC03	JC04	JC05	JC06	B1	B2	B3	JC01	JC02	JC02A	JC03	JC04	JC05	JC06	B1	B2	B3
Heptageniidae																						
Stenacron sp.	3.57	SCRA	10										35.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Stenonema sp.	3.45	COLL	17	10		3	23	12	36	25	21	21	58.7	34.5	0.0	10.4	79.4	41.4	124.2	86.3	72.5	72.5
Stenonema femoratum	7.18	COLL	13			2							93.3	0.0	0.0	14.4	0.0	0.0	0.0	0.0	0.0	0.0
Stenonema mediopunctatum	3.77	COLL	18	13		6	18	10	16	10	11	8	67.9	49.0	0.0	22.6	67.9	37.7	60.3	37.7	41.5	30.2
Oligoneuriidae																						
Isonychia sp.	3.45	FF	19	12			19	9	54	18	21	32	65.6	41.4	0.0	0.0	65.6	31.1	186.3	62.1	72.5	110.4
Tricorythidae																						
Tricorythodes sp.	5.06	HERB				10	9	16	1	7	41	24	0.0	0.0	0.0	50.6	45.5	81.0	5.1	35.4	207.5	121.4
Odonata																						
Anisoptera																						
Gomphidae																						
Undet. genus	4.46	PRED	1										4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zygoptera																						
Calopterygidae																						
Calopteryx sp.	7.78	PRED			1								0.0	0.0	7.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Coenagrionidae																						
Argia sp.	8.17	PRED	4	1	1	1	6	3	2				32.7	8.2	8.2	8.2	49.0	24.5	16.3	0.0	0.0	0.0
Enallagma sp.	8.91	PRED								1	3		0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.9	26.7	0.0
Plecoptera																						
Leuctridae																						
Leuctra sp.	0.67	SHRED	2	1							1		1.3	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0
Hemiptera																						
Veliidae																						
Rhagovelia sp.	6.00	SCRA	3	3	1	1	2						18.0	18.0	6.0	6.0	12.0	0.0	0.0	0.0	0.0	0.0
Megaloptera																						
Corydalidae																						
Corydalus cornutus	5.16	PRED		1	2		11	6	6	3	6	3	0.0	5.2	10.3	0.0	56.8	26.8	26.8	15.5	31.0	15.5
Nigronia sp.	5.25	PRED																				
Nigronia fasciatus	5.55	PRED								1			0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.6	0.0	0.0
Nigronia serricornis	4.95	PRED	1							1	1		5.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	5.0	0.0
Sialidae																						
Sialis sp.	7.17	PRED	1										7.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Coleoptera																						
Dryopidae																						
Helichus sp.	4.63	SCRA					1						0.0	0.0	0.0	0.0	4.6	0.0	0.0	0.0	0.0	0.0
Elmidae																						
Microcylloepus sp.	2.11	SCRA	1				1		1				2.1	0.0	0.0	0.0	2.1	0.0	2.1	0.0	0.0	0.0
Optioservus sp.	2.36	SCRA								1		1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	0.0	2.4
Stenelmis sp.	5.10	SCRA	10	9	2	32	18	8	17	3	6	2	51.0	45.9	10.2	163.2	91.8	40.8	86.7	15.3	30.6	10.2
Stenelmis spp. #2	5.10	SCRA					13	4	14	1		1	0.0	0.0	0.0	0.0	66.3	20.4	71.4	5.1	0.0	5.1
Psephenidae																						
Ectopria nervosa	4.16	SCRA	1										4.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Psephenus herricki	2.35	SCRA	1	9			3	1	8	9	2		2.4	21.2	0.0	0.0	7.1	2.4	18.8	21.2	4.7	0.0
Trichoptera																						
Hydropsychidae																						
Ceratopsyche sp.	1.33	HERB		1				1					0.0	1.3	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0
Ceratopsyche bifida	2.18	HERB							6		21	3	0.0	0.0	0.0	0.0	0.0	0.0	13.1	0.0	45.8	6.5
Cheumatopsyche sp.	6.22	OMNIV	4	4		18	13	1	5	7	76	29	24.9	24.9	0.0	112.0	80.9	6.2	31.1	43.5	472.7	180.4
Hydropsyche sp.	4.29	FF			2						5		0.0	0.0	8.6	0.0	0.0	0.0	0.0	0.0	21.5	0.0
Limnephilidae																						
Neophylax sp.	2.20	SCRA								2			0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.4	0.0	0.0
Pycnopsyche sp.	2.52	SHRED		1									0.0	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Philopotamidae																						
Chimarra sp.	2.76	FF	3										8.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lepidoptera																						
Pyralidae																						
Petrophila sp.	2.09	SCRA	2								1		4.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1	0.0

APPENDIX III - PAGE 3
BENTHIC MACROINVERTEBRATE DATA
JONES CREEK AND BIG TURNBULL CREEK
DICKSON COUNTY
SEPTEMBER 1993

TAXA	TV	FFG	JC01	JC02	JC02A	JC03	JC04	JC05	JC06	B1	B2	B3	JC01	JC02	JC02A	JC03	JC04	JC05	JC06	B1	B2	B3
Diptera																						
Athericidae																						
Atherix lantha	2.10	PRED							1				0.0	0.0	0.0	0.0	0.0	0.0	2.1	0.0	0.0	0.0
Ceratopogonidae																						
Atrichopogon sp.	6.49	SCRA	2			1							13.0	0.0	0.0	6.5	0.0	0.0	0.0	0.0	0.0	0.0
Chironomidae																						
Undet. pupae	6.70		3		1	1			3		1	3	17.1	0.0	5.7	5.7	0.0	0.0	17.1	0.0	5.7	17.1
Chironominae																						
Demicryptochironomus sp.	2.12	PRED			1								0.0	0.0	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dicrotendipes sp.	8.10	COLL			1						1											
Polypedilum sp.	6.70	COLL	3	11	39	25	3	5	27	4	1	8	20.1	73.7	261.3	167.5	20.1	33.5	180.9	26.8	6.7	53.6
Rheotanytarsus sp.	5.89	FF	1		1	6	6		6	2	4	17	5.9	0.0	5.9	35.3	35.3	0.0	35.3	11.8	23.6	100.1
Tanytarsus sp.	6.76	OMNIV							1			1	0.0	0.0	0.0	0.0	0.0	0.0	6.8	0.0	0.0	6.8
Diamesinae																						
Diamesa sp.	8.12	SCRA								2			0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.2	0.0	0.0
Orthocladiinae																						
Corynoneura sp.	6.01	COLL							1	1	1		0.0	0.0	0.0	0.0	0.0	0.0	6.0	6.0	6.0	0.0
Eukiefferiella sp.	3.36	SCRA							2		1		0.0	0.0	0.0	0.0	0.0	0.0	6.7	0.0	3.4	0.0
Orthocladius sp.	5.94	SCRA									2	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.9	23.8
Parametriocnemus sp.	3.65	COLL				1							0.0	0.0	0.0	3.7	0.0	0.0	0.0	0.0	0.0	0.0
Psectrocladius sp.	3.59	COLL			3								0.0	0.0	10.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Paratrichocladius sp.	5.00	COLL			1								0.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tanypodinae																						
Ablabesmyia sp.	7.20	PRED										1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.2
Conchapelopia complex	8.42	PRED	11	6	19	5	1					1	92.6	50.5	160.0	42.1	8.4	0.0	0.0	0.0	0.0	8.4
Emphididae																						
Hemerodromia sp.	7.57	PRED	1			2							7.6	0.0	0.0	15.1	0.0	0.0	0.0	0.0	0.0	0.0
Simuliidae																						
Simulium sp.	4.00	FF							2		1		0.0	0.0	0.0	0.0	0.0	0.0	8.0	0.0	4.0	0.0
Tabanidae																						
Tabanus sp.	9.22	PRED						1					0.0	0.0	0.0	0.0	0.0	9.2	0.0	0.0	0.0	0.0
Tipulidae																						
Antocha sp.	4.26	SCRA			1								0.0	0.0	4.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	JONES CREEK							BIG TURNBULL CR.			JONES CREEK							BIG TURNBULL CR.		
	JC01	JC02	JC02A	JC03	JC04	JC05	JC06	B1	B2	B3	JC01	JC02	JC02A	JC03	JC04	JC05	JC06	B1	B2	B3
TOTAL ABUNDANCE =	184	207	208	196	376	206	308	248	315	212	923	1259	1369	1185	2181	1257	1554	1410	1668	1069
BIOTIC INDEX=											5.0	6.1	6.6	6.0	5.8	6.1	5.0	5.7	5.3	5.0
TOTAL TAXA=	28	19	26	22	23	20	28	22	26	21										
% INTOLERANT TAXA =	32	32	4	14	22	20	21	27	27	19										
% FACULTATIVE TAXA =	36	32	35	41	48	45	50	50	54	52										
% TOLERANT TAXA =	32	36	61	45	30	35	21	23	19	29										