'U S ENVIRONMENTAL PROTECTION AGENCY
REGION 4, SCIENCE and ECOSYSTEM SUPPORT DIVISION
ATHENS, GEORGIA 30605-2720

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MEMORANDUM

SUBJECT Biological Monitoring of Dredging Activities in Twelvemile Creek, Draft Report, SESD Project No 99-0436

FROM Bobby Lewis, Life Scientist
Hazardous Waste Section

THRU Archie Lee, Chief
Hazardous Waste Section

TO Craig Zeller, Remedial Project Manager
Waste Management Division

The attached draft report, Biological Monitoring of Dredging Activities in Twelvemile Creek, was developed to assess the potential environmental impacts of the selected remedial action of dredging and pumping sediments on Twelvemile Creek Please review and return comments at your earliest convenience

If you have any questions, please give me a call at (706) 355-8629

10115907

Biological Monitoring of Dredging Activities in Twelvemile Creek
Draft Report

The remedial action selected to address PCB contamination in sediments of the Twelvemile Creek arm of Lake Hartwell consists of passing sediment from two impoundments, located on Twelvemile Creek (Woodside I and Woodside II, Figure 1), downstream to cover contaminated sediments in Lake Hartwell The sediment will be passed over the dams by dredge and pump, and natural flow conditions of the stream will move the sediment to contaminated areas of Lake Hartwell

Concerns regarding environmental impacts of the dredging operation immediately downstream of the dredging activities have been raised The dredging activity unnaturally increases the sediment loading downstream of the Woodside dams This increased sediment load may potentially impact non-target areas immediately downstream of the dams before the sediment load moves naturally to the target areas It is unclear what the short and long term impacts of the remedial action will be

Methods

To evaluate short term impacts, biological and physical assessments outlined in EPA's Rapid Bioassessment Protocols for use in Streams and Rivers (1989) were utilized to assess the impacts immediately downstream of the dredging operations A baseline survey was conducted prior to the dredging operations for passing sediment in April of 1999 and a follow up survey was conducted in September of 1999 after dredging operations had ceased Rapid Bioassessment Protocol II (RBP II), family level macroinvertebrate index was used to assess the biological impacts of passing sediment and the habitat assessment outlined in the RBP document was conducted to assess physical changes in the study area

Benthic macroinvertebrates were sampled using a multi-habitat approach This consisted of collecting a representative sample of organisms from all habitats present at a site Targeted habitats included riffle/runs, undercut banks, pools, rocks, woody debris, and leaf packs Each multi-habitat sample was preserved in the field in 70% ethyl alcohol and then transported back to the laboratory for analysis In the laboratory the organisms in each sample were first "picked and sorted" into major taxonomic groups and then identified to the generic level using the most current taxonomic keys available

Benthic macro invertebrate data was analyzed based EPA's Rapid Bioassessment Protocol II (RBP II) found in Protocols for Use in Stream and Rivers (USEPA 1989) The RBP II is a family level analysis based on the calculation of the following eight metrics

1 Taxa Richness
2 Family Biotic Index
3 Ratio of Scrapers/Filter Collectors
4 Ratio of EPT and Chironomid Abundances
5 % Contribution of Dominant Family

6 EPT Index
7 Community Loss Index
8 Ratio of Shredders/Total

After listing the value for each metric, the value is "scored" using the scoring criteria outlined on p 6-12 in the RPB manual(USEPA 1989) and then a **Total Score** is calculated for each sampling station The total score for each sampling station is then compared to the total score of the background station (Station 1) and listed as a **% Comparison to Reference Score** The % Comparison to Reference Score provides a **Final Assessment** of stream condition at each sampling station

Five sampling locations were selected for this evaluation (see Figure 1) Station 1 was located upstream of both dams in location that appeared to have minimal impact and was is very similar to Station 4, an area of greatest concern Station 1 was used as a reference station for evaluating sediment impacts Stations 2 was located just downstream of the Woodside I dam, Station 3 was located just upstream of the Woodside II dam, and Station 4 was located just downstream of the sediment discharge point in an area appearing to have minimal impact and representing probable stream conditions if the two Woodside dams were not in place, Station 5 was located in a low gradient depositional area downstream of Station 4

Results and Discussion

Habitat Assessments

The habitat assessment utilized in this investigation is outlined in EPA's RBP (1989) document An example of the data sheet used in this assessment is presented in Appendix A Each location received a habitat score between 0 and 120 A score of 120 is considered perfect A summary of habitat scores is presented in Table 1

While the Habitat Score at the background station (Station 1) actually increased slightly between the April and September sampling events, the scores for the remaining four stream stations decreased The Habitat Assessment Field Data Sheets clearly indicate that the decrease in habitat quality at all four stations was due to an increase in sedimentation (see categories 1, 2, 5, and 6 of Table 1) with the sedimentation being most severe at Stations 2 and 5, less severe at Station 3 and slight at Station 4

Although there was increased amounts of sediment observed at Station 4, the area of most concern, it did not drastically effect the habitat score The habitat score at Station 4 went from 118 to 112 The base flow at Station 4 is probably significant enough to pass most of the sediment being discharged with out drastically effecting the available habitat Most of the sediment settles out near Station 5 just downstream of Station 4 in a lower gradient area Station 5 was already heavily impacted by sediment before the additional sediment was passed Its initial habitat score was only 42 But, what little habitat was available was further impacted by the increased sediment loading Station 5's habitat score after sediment passing dropped to 26

Station 3 was already heavily impacted by sediment and did not change considerably between the sampling events Station 2, which is located just downstream of the Woodside 1 dam, had the greatest decrease in habitat score between sampling events Its habitat score went from 112 to 92 Significant amounts of sediment was observed at Station 2 during the post sediment passing sampling event However, there was enough viable habitat remaining to achieve a score as high as 92 which is still supportive of a macroinvertebrate community Station 1 was a background area located upstream of the two Woodside dams

Benthic Community Assessment

A summary of the RBP II analysis along the habitat assessment is presented in Table 2 A list of macroinvertebrates collected and the RBP II analysis is presented in Appendix B

The results of the RBP II analysis (Total Score, % Comparison to Reference, and Final Assessment) show that Stations 2, 3 and 5 were already moderately impaired in April while Station 4 was non-impaired at that time However, the increase in sedimentation seen at Stations 2, 3 and 5 in September appears to have little effect on their respective benthic communities Their Final Assessments remained unchanged

Station 4 did show a change in the benthic community, its RBP Final Assessment, dropped from a non-impaired status to a moderately impaired status Of the eight metrics calculated in the RBP analysis, three of the metrics scores decreased between the April and September sampling events which resulted in the final assessment of moderately impaired These three metrics were the EPT Index, Taxa Richness and Community Similarity The EPT Index "score" went from a 6 to a 3 between the two sampling events However, the EPT Index at Station 4 (see Tables 2 and Appendix B) remained higher than any of the other stations, except Station 1 Although there was a decrease in the EPT Index value at Station 4, from 16 to 10, the EPT Index value also decreased at the Station 1 (reference station), from 16 to 12 This indicates that there was a shift in the EPT index between the sampling events, probably due to seasonal fluctuations If the EPT Index at Station 4 during the September sampling event had been 11 instead of 10, the EPT Index "score" would have remained unchanged Therefore, the decrease in score from 6 to 3 is considered to be minimal

There was an overall loss in taxa richness at Station 4 between the two sampling events which resulted in decreasing the scores for the Taxa Richness and Community Similarity metrics (see Tables 2 and Appendix B) The taxa richness at Station 1 increased between the sampling events, so seasonal fluctuations does not explain the decline in taxa richness a Station 4

Summary

The data indicates there is some minimal impact to the stream habitat on Twelvemile Creek from the sediment passing activities above the Woodside Dams The station with the greatest habitat impacts was Station 5 Station 5 was already heavily impacted by sediment prior to this investigation Station 5 is very close to the headwaters of the Twelvemile Creek arm of Lake Hartwell It is a low gradient area where flow from the creek dramatically begins to slow down

and suspended sediment begins to drop out Sediment deposition is already a problem for this area

Station 4, the area of most concern, was slightly impacted between sampling events There was a decrease in the RBP II score which resulted in a change of the final assessment from non-impaired to moderately impaired, but, the cause off this decrease does not appear to be all sediment related As indicated above, the habitat score at Station 4 was the least affected score between sampling events There was only a 5% reduction in habitat score between the pre and post sampling events (Table 2) This decrease in habitat score is not significant enough to account for the decrease in the RBP II score

There may be other factors that contributed to the decrease in the RBP II score at Station 4 The post sediment passing sampling event occurred in September during a very dry time of year, especially in 1999 There is small municipal sewage treatment plant just down stream of Station 2 Its possible that its discharge during a very dry time of year may of had some effect on the creek However, assessing other contributions of potential impacts to the Twelvemile Creek is beyond the scope of this investigation

Overall, if future sediment passing activities are restricted to high flow conditions during the year, any impacts to the stream habitat and benthic communities of Twelvemile Creek will be minimal and short lived

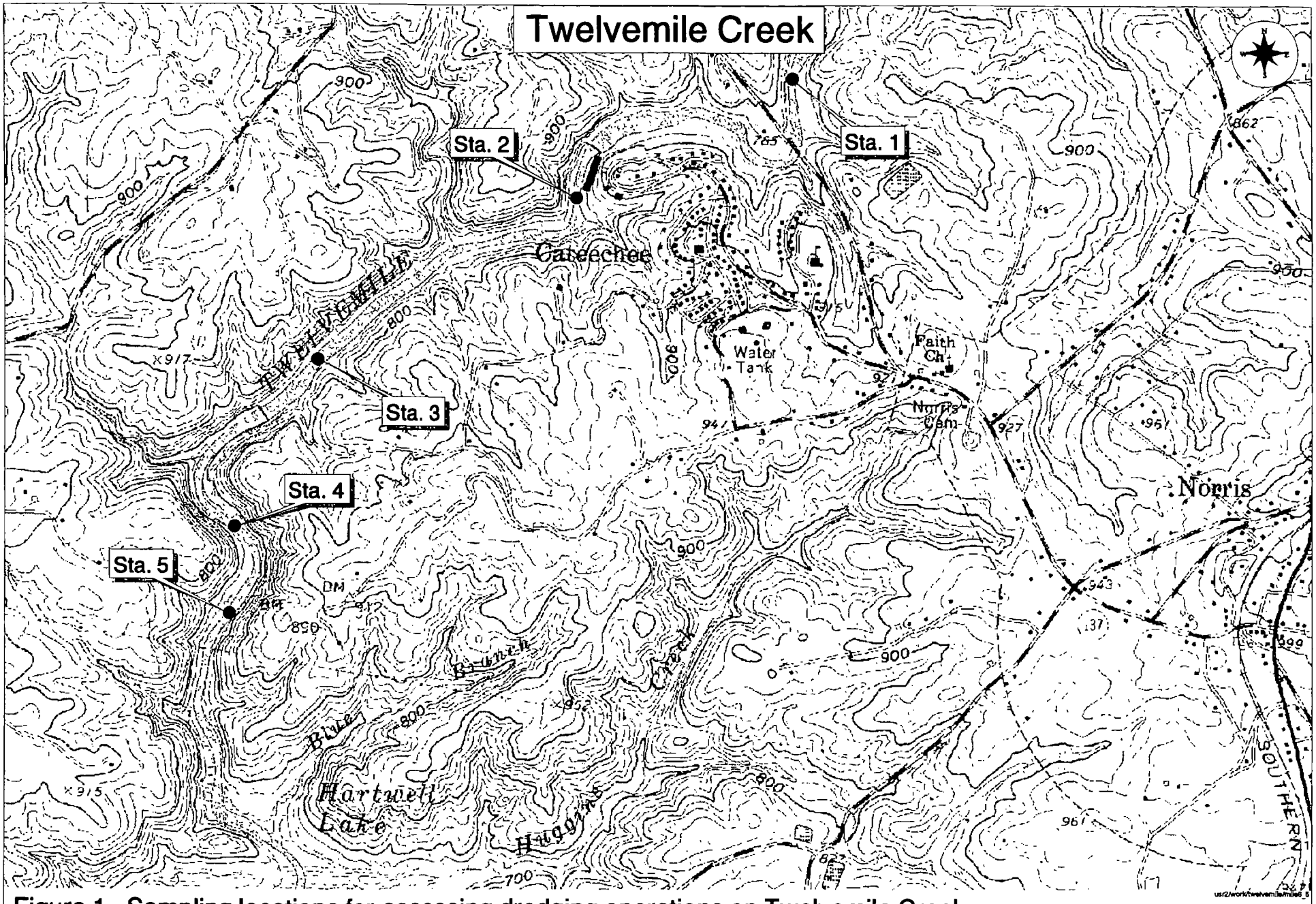

Figure 1. Sampling locations for assessing dredging operations on Twelvemile Creek.

● Sampling locations

0 0.5 1 Miles

Table 1 Habitat Assessment Summary Results for the April and September Sampling Events

Habitat Parameter	Sampling Station									
	1		2		3		4		5	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1 Bottom Substrate (score out of 20)	18	18	18	18	6	5	18	18	6	2
2 Embeddedness (score out of 20)	16	18	17	12	6	5	17	15	6	2
3 $\leq$ 0 15 cms flow or > 0 15 cms flow (score out of 20)	18	19	15	15	7	5	15	15	6	2
4 Channel Alteration (score out of 15)	11	12	17	12	2	2	13	13	3	1
5 Bottom Scouring and deposition (score out of 15)	10	11	13	3	2	2	13	9	2	1
6 Pool/riffle Ratio (score out of 15)	13	13	14	14	2	2	14	14	2	1
7 Bank Stability (score out of 10)	8	8	5	5	8	7	10	10	5	5
8 Bank Vegetative Stability (score out of 10)	9	9	7	7	9	9	10	10	5	5
9 Stream side Cover (score out of 10)	7	7	6	6	9	9	8	8	7	7
Total Score	110	115	112	92	51	46	118	112	42	26

Table 2 Comparison of Habitat Score with the RBP II Analysis, and EPT Index Calculated from Benthic Macro Invertebrate Data Collected in April and September on Twelvemile Creek, South Carolina for the Sangamo Weston/12 mile Study

Sampling Station	1		2		3	
Sampling Date	April 1999	September 1999	April 1999	September 1999	April 1999	September 1999
Habitat Score	110	115	106	88	54	46
EPT Index	16	12	9	7	12	6
Total (RBP II) Score	48	48	21	24	33	27
% Comparison to Reference Station*	100	100	44	50	69	56
Final Bioassessment	non-impaired	non-impared	moderately impaired	moderately impaired	moderately impaired	moderately impaired
Sampling Station	4		5			
Habitat Score	118	112	46	26		
EPT Index	16	10	10	6		
Total (RBP II) Score	39	30	27	24		
% Comparison to Reference Station*	81	62	56	50		
Final Assessment	non-impaired	moderately impaired	moderately impaired	moderately impaired		

* Station 1 scores from the April and September, 1999 sampling dates were used as the reference station values for percent comparison

Appendix A

Habitat Assessment Data Sheets

HABITAT ASSESSMENT FORM

HABITAT ASSESSMENT FIELD DATA SHEET

Name of Water Body Twelve Mile Cr Station # 001

Date 4-7-99 Investigator Lewis/Dorn SCORE 110

HABITAT PARAMETER	CATEGORIES: EXCELLENT	GOOD	FAIR	POOR	COMMT
1 BOTTOM SUBSTRATE/ AVAILABLE COVER	>50% rubble, gravel, submerged logs, undercut banks, or other stable habitat 18 20-16	50-30% rubble, gravel or other stable habitat Adequate habitat 15-11	30-10% rubble, gravel or other stable habitat. Habitat availability < desirable 10-6	<10% rubble, gravel or other stable habitat. Lack of habitat is obvious 5-0	
2. EMBEDDEDNESS (observe in "run" area)	Gravel, cobble, boulder, and logs are <25% surrounded by fine sediment or sand 16 20-16	Gravel, cobble, boulder, and logs are 25-50% surrounded by fine sediment or sand 15-11	Gravel, cobble, boulder, and logs are 50-75% surrounded by fine sediment or sand 10-6	Gravel, cobble, boulder, and logs are >75% surrounded by fine sediment or sand 5-0	
3 STREAM FLOW <= 5 CFS	Warm; 5 cfs ~~18~~ 20-16	5-2 cfs 15-11	2-1 cfs 10-6	1 cfs 5-0	
OR >5 CFS Slow < 1 ft/s Fast > 1 ft/s Deep >1 6 ft Shallow <1 6 ft	All habitats present Slow & deep, slow & shallow, fast & deep, fast & shallow. 18 20-16	3 of 4 habitats present. (Missing riffles or runs get lower score than missing pools) 15-11	2 of 4 habitats present (Missing riffles/runs get lower score.) 10-6	Dominated by one velocity/depth category (usually pool). 5-0	
4. CHANNEL ALTERATION (resulting in a loss of habitat)	Little / no enlargement of islands or point bars, and/or no channelization. 15-12	Some new increase in bar formation, mostly from coarse gravel; and/or some channelization present. 11 11-8	Moderate deposition of new gravel, coarse sand on old and new bars; pools partially filled w/silt; and/or embankments on both banks. 7-4	Heavy deposits of fine material, bar development increase Most pools filled w/ silt; and/or extensive channelization. 3-0	
5 BOTTOM SCOURING AND DEPOSITION	<5% of bottom affected. 15-12	5-30% affected. Scour at constrictions and steep grades Some deposition in pools. 10 11-8	30-50% affected. Deposit and scour at obstructions, bends, and constrictions. Some filling of pools 7-4	>50% bottom changing nearly year long. Pools absent due to deposition. Only large rocks exposed 3-0	
6 RUN/BEND, POOL/RIFFLE RATIO (distance between riffles or bends/ stream width).	If ratio is 5-7. 15-12 13	If ratio is 7-15. 11-8	If ratio is 15-25 7-4	If ratio is >25 3-0	
7 BANK STABILITY	Stable. No erosion or bank failure. 10-9	Moderately stable. Infrequent erosion mostly healed over. 8 8-6	Moderately unstable. Moderate erosion. High erosion during high flow. 5-3	Unstable. Many eroded areas. "Raw" areas frequent on straight and bends. 2-0	
8. BANK VEGETATIVE STABILITY	>80% of streambank covered by vegetation or boulders and cobbles. 9 10-9	79-50% covered by vegetation, gravel or larger material. 8-6	49-25% covered by vegetation, gravel or larger material. 5-3	<25% covered by vegetation, gravel or larger material. 2-0	
9. STREAMSIDE COVER	Dominant vegetation is shrub 10-9	Dominant vegetation is of tree form. 7 8-6	Dominant vegetation is grass or forbes. 5-3	>50% no vegetation Dominant material is soil, rock, bridge materials, culverts, or mine tailings. 2-0	
CATEGORY RANGE	135-104	103-71	70-35	34-0	

HABITAT ASSESSMENT FORM

HABITAT ASSESSMENT FIELD DATA SHEET

Name of Water Body Twelve Mile Cr. Station # 002

Date 4-7-99 Investigator Lewis / Dorn SCORE 106

CATEGORIES

HABITAT PARAMETER	EXCELLENT	GOOD	FAIR	POOR	COMMT
1 BOTTOM SUBSTRATE/ AVAILABLE COVER	>50% rubble,gravel, submerged logs, undercut banks,or other stable habitat 18 20-16	50-30% rubble gravel or other stable habitat Adequate habitat 15-11	30-10% rubble,gravel or other stable habitat Habitat availability < desirable 10-6	<10% rubble,gravel or other stable habitat Lack of habitat is obvious 5-0	
2 EMBEDDEDNESS (observe in "run" area)	Gravel,cobble, boulder, and logs are <25% surrounded by fine sediment or sand. 17 20-16	Gravel,cobble, boulder, and logs are 25-50% surrounded by fine sediment or sand 15-11	Gravel,cobble, boulder, and logs are 50-75% surrounded by fine sediment or sand 10-6	Gravel,cobble, boulder, and logs are >75% surrounded by fine sediment or sand 5-0	
3 STREAM FLOW <= 5 CFS	Warm; 5 cfs ~~20-17~~ 20-16	5-2 cfs 15-11	2-1 cfs 10-6	1 cfs 5-0	
OR >5 CFS Slow. < 1 ft/s Fast > 1 ft/s Deep >1.6 ft Shallow <1 6 ft	All habitats present Slow & deep, slow & shallow, fast & deep, fast & shallow 20-16	3 of 4 habitats present (Missing riffles or runs get lower score than missing pools) 15 15-11	2 of 4 habitats present (Missing riffles/runs get lower score.) 10-6	Dominated by one velocity/depth category (usually pool). 5-0	
4. CHANNEL ALTERATION (resulting in a loss of habitat)	Little / no enlargement of islands or point bars, and/or no channelization. 15-12	Some new increase in bar formation,mostly from coarse gravel; and/or some channelization present 11 11-8	Moderate deposition of new gravel,coarse sand on old and new bars;pools partially filled w/silt;and/or embankments on both banks 7-4	Heavy deposits of fine material, bar development increase Most pools filled w/ silt;and/or extensive channelization. 3-0	
5 BOTTOM SCOURING AND DEPOSITION	<5% of bottom affected. 13 15-12	5-30% affected.Scour at constrictions and steep grades Some deposition in pools 11-8	30-50% affected. Deposit and scour at obstructions, bends, and constrictions. Some filling of pools 7-4	>50% bottom changing nearly year long. Pools absent due to deposition. Only large rocks exposed 3-0	
6. RUN/BEND, POOL/RIFFLE RATIO (distance between riffles or bends/ stream width).	If ratio is 5-7. 15-12 14	If ratio is 7-15 11-8	If ratio is 15-25 7-4	If ratio is >25. 3-0	
7. BANK STABILITY	Stable. No erosion or bank failure. 10-9	Moderately stable. Infrequent erosion mostly healed over 8-6	Moderately unstable. Moderate erosion. High erosion during high flow. 5 5-3	Unstable. Many eroded areas. "Raw" areas frequent on straight and bends. 2-0	
8. BANK VEGETATIVE STABILITY	>80% of streambank covered by vegetation or boulders and cobbles. 10-9	79-50% covered by vegetation, gravel or larger material. 7 8-6	49-25% covered by vegetation,gravel or larger material. 5-3	<25% covered by vegetation,gravel or larger material. 2-0	
9. STREAMSIDE COVER	Dominant vegetation is shrub 10-9	Dominant vegetation is of tree form. 6 8-6	Dominant vegetation is grass or forbes. 5-3	>50% no vegetation Dominant material is soil,rock, bridge materials,culverts,or mine tailings 2-0	
CATEGORY RANGE	135-104	103-71	70-35	34-0	

* right bank relatively stable
left bank unstable

right bank = bedrock/shrub
left bank mostly rock/tree

HABITAT ASSESSMENT FORM

HABITAT ASSESSMENT FIELD DATA SHEET

Name of Water Body Twelve Mile Cr. Station # 003

Date 4-7-99 Investigator Lewis/Dorn SCORE 52

HABITAT PARAMETER	CATEGORIES: EXCELLENT	GOOD	FAIR	POOR	COMME
1 BOTTOM SUBSTRATE/ AVAILABLE COVER	>50% rubble, gravel, submerged logs, undercut banks, or other stable habitat 20-16	50-30% rubble, gravel or other stable habitat Adequate habitat. 15-11	30-10% rubble, gravel or other stable habitat Habitat availability < desirable. 6 10-6	<10% rubble, gravel or other stable habitat Lack of habitat is obvious. 5-0	
2. EMBEDDEDNESS (observe in "run" area)	Gravel, cobble, boulder, and logs are <25% surrounded by fine sediment or sand. 20-16	Gravel, cobble, boulder, and logs are 25-50% surrounded by fine sediment or sand 15-11	Gravel, cobble, boulder, and logs are 50-75% surrounded by fine sediment or sand 6 10-6	Gravel, cobble, boulder, and logs are >75% surrounded by fine sediment or sand 5-0	
3 STREAM FLOW <= 5 CFS	Warm; 5 cfs 20-16	5-2 cfs ~~10~~ 12 15-11	2-1 cfs 10 10-6	1 cfs 5-0	
OR >5 CFS Slow < 1 ft/s Fast > 1 ft/s Deep: >1.6 ft Shallow: <1.6 ft	All habitats present Slow & deep, slow & shallow, fast & deep, fast & shallow. 20-16	3 of 4 habitats present. (Missing riffles or runs get lower score than missing pools) 15-11	2 of 4 habitats present. (Missing riffles/runs get lower score.) 10 ~~7~~ 10-6	Dominated by one velocity/depth category (usually pool). 0 5-0	
4. CHANNEL ALTERATION (resulting in a loss of habitat)	Little / no enlargement of islands or point bars, and/or no channelization. 15-12	Some new increase in bar formation, mostly from coarse gravel; and/or some channelization present. 11-8	Moderate deposition of new gravel, coarse sand on old and new bars; pools partially filled w/silt; and/or embankments on both banks. 7-4	Heavy deposits of fine material, bar development increase Most pools filled w/ silt; and/or extensive channelization. 2 3-0	
5 BOTTOM SCOURING AND DEPOSITION	<5% of bottom affected. 15-12	5-30% affected. Scour at constrictions and steep grades. Some deposition in pools. 11-8	30-50% affected. Deposit and scour at obstructions, bends, and constrictions. Some filling of pools 7-4	>50% bottom changing nearly year long. Pools absent due to deposition. Only large rocks exposed. 2 3-0	
6 RUN/BEND, POOL/RIFFLE RATIO (distance between riffles or bends/ stream width).	If ratio is 5-7. 15-12	If ratio is 7-15. 11-8	If ratio is 15-25. 7-4	If ratio is >25 2 3-0	
7. BANK STABILITY	Stable. No erosion or bank failure. 10-9	Moderately stable. Infrequent erosion mostly healed over 8 8-6	Moderately unstable. Moderate erosion. High erosion during high flow. 5-3	Unstable. Many eroded areas. "Raw" areas frequent on straight and bends. 2-0	
8. BANK VEGETATIVE STABILITY	>80% of streambank covered by vegetation or boulders and cobbles. 9 10-9	79-50% covered by vegetation, gravel or larger material. 8-6	49-25% covered by vegetation, gravel or larger material. 5-3	<25% covered by vegetation, gravel or larger material. 2-0	
9. STREAMSIDE COVER	Dominant vegetation is shrub . 9 10-9	Dominant vegetation is of tree form. 8-6	Dominant vegetation is grass or forbes. 5-3	>50% no vegetation Dominant material is soil, rock, bridge materials, culverts, or mine tailings 2-0	
CATEGORY RANGE	135-104	103-71	70-35	34-0	

HABITAT ASSESSMENT FORM

HABITAT ASSESSMENT FIELD DATA SHEET

Name of Water Body Twelve Mile Cr. Station # 004

Date 4-7-99 Investigator Lewis/Dorn SCORE 118

CATEGORIES

HABITAT PARAMETER	EXCELLENT	GOOD	FAIR	POOR	COMME
1. BOTTOM SUBSTRATE/ AVAILABLE COVER	>50% rubble, gravel, submerged logs, undercut banks, or other stable habitat 18 20-16	50-30% rubble, gravel or other stable habitat Adequate habitat 15-11	30-10% rubble, gravel or other stable habitat. Habitat availability < desirable 10-6	<10% rubble, gravel or other stable habitat Lack of habitat is obvious 5-0	
2 EMBEDDEDNESS (observe in "run" area)	Gravel, cobble, boulder, and logs are <25% surrounded by fine sediment or sand 17 20-16	Gravel, cobble, boulder, and logs are 25-50% surrounded by fine sediment or sand 15-11	Gravel, cobble, boulder, and logs are 50-75% surrounded by fine sediment or sand 10-6	Gravel, cobble, boulder, and logs are >75% surrounded by fine sediment or sand. 5-0	
3. STREAM FLOW <= 5 CFS	Warm/ 5 cfs ~~18~~ 20-16	5-2 cfs 15-11	2-1 cfs 10-6	1 cfs 5-0	
OR >5 CFS Slow < 1 ft/s Fast > 1 ft/s Deep >1 6 ft Shallow <1.6 ft	All habitats present Slow & deep, slow & shallow, fast & deep, fast & shallow 20-16	3 of 4 habitats present. (Missing riffles or runs get lower score than missing pools). 15 15-11	2 of 4 habitats present (Missing riffles/runs get lower score.) 10-6	Dominated by one velocity/depth category (usually pool) 5-0	
4. CHANNEL ALTERATION (resulting in a loss of habitat)	Little / no enlargement of islands or point bars, and/or no channelization. 13 15-12	Some new increase in bar formation, mostly from coarse gravel; and/or some channelization present. 11-8	Moderate deposition of new gravel, coarse sand on old and new bars; pools partially filled w/silt; and/or embankments on both banks 7-4	Heavy deposits of fine material, bar development increase Most pools filled w/ silt; and/or extensive channelization. 3-0	
5. BOTTOM SCOURING AND DEPOSITION	<5% of bottom affected. 13 15-12	5-30% affected. Scour at constrictions and steep grades Some deposition in pools. 11-8	30-50% affected. Deposit and scour at obstructions, bends, and constrictions. Some filling of pools 7-4	>50% bottom changing nearly year long. Pools absent due to deposition. Only large rocks exposed. 3-0	
6. RUN/BEND, POOL/RIFFLE RATIO (distance between riffles or bends/ stream width).	If ratio is 5-7. 15-12	If ratio is 7-15. 11-8	If ratio is 15-25 7-4	If ratio is >25. 3-0	
	14				
7. BANK STABILITY	Stable. No erosion or bank failure. 10 10-9	Moderately stable. Infrequent erosion mostly healed over. 8-6	Moderately unstable. Moderate erosion. High erosion during high flow. 5-3	Unstable. Many eroded areas "Raw" areas frequent on straight and bends. 2-0	
8. BANK VEGETATIVE STABILITY	>80% of streambank covered by vegetation or boulders and cobbles. 10 10-9	79-50% covered by vegetation, gravel or larger material. 8-6	49-25% covered by vegetation, gravel or larger material. 5-3	<25% covered by vegetation, gravel or larger material. 2-0	
9. STREAMSIDE COVER	Dominant vegetation is shrub 10-9	Dominant vegetation is of tree form. 8 8-6	Dominant vegetation is grass or forbes. 5-3	>50% no vegetation Dominant material is soil, rock, bridge materials, culverts, or mine tailings 2-0	
CATEGORY RANGE	135-104	103-71	70-35	34-0	

HABITAT ASSESSMENT FORM

HABITAT ASSESSMENT FIELD DATA SHEET

Name of Water Body Twelve Mile Cr. Station # 005

Date 4-7-99 Investigator Lewis/Dorn SCORE 46

HABITAT PARAMETER	CATEGORIES: EXCELLENT	GOOD	FAIR	POOR	COMME
1 BOTTOM SUBSTRATE/ AVAILABLE COVER	>50% rubble, gravel, submerged logs, undercut banks, or other stable habitat 20-16	50-30% rubble, gravel or other stable habitat. Adequate habitat 15-11	30-10% rubble, gravel or other stable habitat. Habitat availability < desirable 6 10-6	<10% rubble, gravel or other stable habitat. Lack of habitat is obvious 5-0	
2 EMBEDDEDNESS (observe in "run" area)	Gravel, cobble, boulder, and logs are <25% surrounded by fine sediment or sand 20-16	Gravel, cobble, boulder, and logs are 25-50% surrounded by fine sediment or sand 15-11	Gravel, cobble, boulder, and logs are 50-75% surrounded by fine sediment or sand 6 10-6	Gravel, cobble, boulder, and logs are >75% surrounded by fine sediment or sand 5-0	
3. STREAM FLOW <= 5 CFS	Warm; 5 cfs 20-16	5-2 cfs UD ~~12~~ ~~15~~-11	2-1 cfs 10 10-6	1 cfs 5-0	
OR >5 CFS Slow: < 1 ft/s Fast > 1 ft/s Deep: >1 6 ft Shallow <1.6 ft	All habitats present Slow & deep, slow & shallow, fast & deep, fast & shallow 20-16	3 of 4 habitats present (Missing riffles or runs get lower score than missing pools) 15-11	2 of 4 habitats present. (Missing riffles/runs get lower score.) UD ~~6~~ 10-6	Dominated by one velocity/depth category (usually pool). 5-0	
4. CHANNEL ALTERATION (resulting in a loss of habitat)	Little / no enlargement of islands or point bars, and/or no channelization. 15-12	Some new increase in bar formation, mostly from coarse gravel; and/or some channelization present. 11-8	Moderate deposition of new gravel, coarse sand on old and new bars; pools partially filled w/silt; and/or embankments on both banks 7-4	Heavy deposits of fine material, bar development increase Most pools filled w/ silt; and/or extensive channelization 3 3-0	
5 BOTTOM SCOURING AND DEPOSITION	<5% of bottom affected. 15-12	5-30% affected. Scour at constrictions and steep grades. Some deposition in pools. 11-8	30-50% affected. Deposit and scour at obstructions, bends, and constrictions. Some filling of pools 7-4	>50% bottom changing nearly year long. Pools absent due to deposition. Only large rocks exposed. 2 3-0	
6. RUN/BEND, POOL/RIFFLE RATIO (distance between riffles or bends/ stream width).	If ratio is 5-7. 15-12	If ratio is 7-15. 11-8	If ratio is 15-25. 7-4	If ratio is >25. 2 3-0	
7. BANK STABILITY	Stable. No erosion or bank failure. 10-9	Moderately stable. Infrequent erosion mostly healed over 8-6	Moderately unstable. Moderate erosion. High erosion during high flow. 5 5-3	Unstable. Many eroded areas. "Raw" areas frequent on straight and bends. 2-0	
8. BANK VEGETATIVE STABILITY	>80% of streambank covered by vegetation or boulders and cobbles. 10-9	79-50% covered by vegetation, gravel or larger material. 8-6	49-25% covered by vegetation, gravel or larger material 5 5-3	<25% covered by vegetation, gravel or larger material. 2-0	
9. STREAMSIDE COVER	Dominant vegetation is shrub . 10-9	Dominant vegetation is of tree form. 7 8-6	Dominant vegetation is grass or forbes. 5-3	>50% no vegetation Dominant material is soil, rock, bridge materials, culverts, or mine tailings 2-0	
CATEGORY RANGE	135-104	103-71	70-35	34-0	

* left bank stable
right bank unstable
raw areas

HABITAT ASSESSMENT FORM

HABITAT ASSESSMENT FIELD DATA SHEET

Name of Water Body Twelve Mile Creek Station# 001

Date 9-8-99 Investigator LD, PJL Score 115

CATEGORIES

HABITAT PARAMETER	EXCELLENT	GOOD	FAIR	POOR	COMMENTS
1 Bottom Substrate/ Available Cover	>50% rubble, gravel, submerged logs, undercut banks, or other stable habitat 18 20-16	50-30% rubble, gravel or other stable habitat. Adequate habitat 15-11	30-10% rubble, gravel or other stable habitat. Habitat availability < desirable 10-6	<10% rubble, gravel or other stable habitat Lack of habitat is obvious 5-0	
2 Embeddedness (observe in "run" area)	Gravel cobble, boulder, and logs are <25% surrounded by fine sediment or sand 18 20-16	Gravel cobble, boulder and logs are 25-50% surrounded by fine sediment or sand 15-11	Gravel cobble boulder and logs are 50-75% surrounded by fine sediment or sand 10-6	Gravel cobble boulder and logs are >75% surrounded by fine sediment or sand 5-0	
3 Stream Flow <= 5 CFS OR	Warm/ 5 cfs 20-16	5-2 cfs 15-11	2-1 cfs 10-6	1 cfs 5-0	
> 5 CFS Slow <1 ft/s Fast > 1 ft/s Deep > 1 6 ft Shallow <1 6 ft	All habitats present slow & deep, slow & shallow fast & deep, fast & shallow 19 20-16	3 of 4 habitats present (Missing riffles or runs get lower score than missing pools) 15-11	2 of 4 habitats present. (Missing riffles/runs get lower score) 10-6	Dominated by one velocity/depth category (Usually pool) 5-0	
4 Channel Alteration (resulting in a loss of habitat)	Little/no enlargement of islands or point bars and /or no channelization 12 15-12	Some new increase in bar formation, mostly from coarse gravel and/or some channelization present. 11-8	Moderate deposition of new gravel, coarse sand on old & new bars/pools partially filled w/ silt, and/or embankments on both banks 7-4	Heavy deposits of fine material, bar development increase Host pools filled w/ silt and/or extensive channelization 3-0	
5 Bottom Scouring and Deposition	<5% of bottom affected 15-12	5-30% affected Scour at constrictions and steep grades Some disposition in pools 11 11-8	30-50% affected Deposit and scour at obstructions bends and constrictions Some filling of pools 7-4	>50% bottom changing nearly year long Pools absent due to deposition Only large rocks exposed 3-0	
6 Run/Bend Pool/Riffle Ratio (Distance between riffles or bends/ stream width)	If the ratio is 5-7 13 15-12	If the ratio is 7-15 11-8	If the ratio is 15-25 7-4	If the ratio is >25 3-0	
7 Bank Stability	Stable No erosion or bank failure 10-9	Moderately stable Infrequent erosion mostly healed over 8 8-6	Moderately unstable Moderate erosion High erosion during high flow 5-3	Unstable Many eroded areas "Raw" areas frequent on straight and bends 2 0	
8 Bank Vegetative Stability	>80% of streambank covered by vegetation or boulders and cobbles 9 10-9	79-50% covered by vegetation, gravel or larger material 8-6	49-25% covered by vegetation gravel or larger material 5-3	<25% covered by vegetation gravel or larger material 2 0	
9 Streamside Cover	Dominant vegetation is shrub 10-9	Dominant vegetation is tree form 7 8-6	Dominant vegetation is grass forbes 5-3	>50% no vegetation Dominant material is soil rock, bridge materials, culverts or mine tailings 2 0	
CATEGORY RANGE	135-104	103-71	70-35	34-0	

HABITAT ASSESSMENT FORM

HABITAT ASSESSMENT FIELD DATA SHEET

Name of Water Body Twelve Mile Creek Station# 002

Date 9-8-99 Investigator CD, RJL Score ~~[illegible]~~ 88 CD

CATEGORIES

HABITAT PARAMETER	EXCELLENT	GOOD	FAIR	POOR	COMMENTS
1 Bottom Substrate/ Available Cover	>50% rubble, gravel submerged logs undercut banks, or other stable habitat 18 20-16	50-30% rubble, gravel or other stable habitat. Adequate habitat 15-11	30-10% rubble, gravel or other stable habitat. Habitat availability < desirable 10-6	<10% rubble, gravel or other stable habitat. Lack of habitat is obvious 5-0	
2 Embeddedness (observe in run area)	Gravel cobble, boulder, and logs are <25% surrounded by fine sediment or sand 20-16	Gravel, cobble, boulder, and logs are 25-50% surrounded by fine sediment or sand 12 15-11	Gravel, cobble, boulder and logs are 50-75% surrounded by fine sediment or sand 10-6	Gravel, cobble, boulder, and logs are >75% surrounded by fine sediment or sand 5-0	
3 Stream Flow <= 5 CFS OR	Warm/ 5 cfs 20-16	5-2 cfs 15-11	2-1 cfs 10-6	1 cfs 5-0	
> 5 CFS Slow <1 ft/s Fast > 1 ft/s Deep > 1 6 ft Shallow <1 6 ft	All habitats present slow & deep slow & shallow fast & deep, fast & shallow 20-16	3 of 4 habitats present. (Missing riffles or runs get lower score than missing pools) 15 15-11	2 of 4 habitats present. (Missing riffles/runs get lower score) 10-6	Dominated by one velocity/depth category (Usually pool) 5-0	
4 Channel Alteration (resulting in a loss of habitat)	Little/no enlargement of islands or point bars, and /or no channelization 15-12	Some new increase in bar formation, mostly from coarse gravel and/or some channelization present. 8 11-8	Moderate deposition of new gravel, coarse sand on old & new bars/pools partially filled w/ silt, and/or embankments on both banks 7-4	Heavy deposits of fine material, bar development increase Host pools filled w/ silt and/or extensive channelization 3-0	
5 Bottom Scouring and Deposition	<5% of bottom affected 15-12	5-30% affected Scour at constrictions and steep grades Some disposition in pools 11-8	30-50% affected Deposit and scour at obstructions bends, and constrictions Some filling of pools 7-4	>50% bottom changing nearly year long Pools absent due to deposition Only large rocks exposed 3 3-0	
6 Run/Bend Pool/Riffle Ratio (Distance between riffles or bends/ stream width)	If the ratio is 5-7 14 15-12	If the ratio is 7-15 11-8	If the ratio is 15-25 7-4	If the ratio is >25 3-0	
7 Bank Stability	Stable No erosion or bank failure 10-9	Moderately stable Infrequent erosion mostly healed over 8-6	Moderately unstable Moderate erosion High erosion during high flow 5 5-3	Unstable Many eroded areas "Raw" areas frequent on straight and bends 2 0	
8 Bank Vegetative Stability	>80% of streambank covered by vegetation or boulders and cobbles 10-9	79-50% covered by vegetation gravel or larger material 7 8-6	49-25% covered by vegetation, gravel or larger material 5-3	<25% covered by vegetation gravel or larger material 2 0	
9 Streamside Cover	Dominant vegetation is shrub 10-9	Dominant vegetation is tree form 8-6	Dominant vegetation is grass forbes 6 5-3	>50% no vegetation Dominant material is soil rock, bridge materials, culverts or mine tailings 2 0	
CATEGORY RANGE	135-104	103-71	70-35	34-0	

Right bank stable, left bank unstable

ight bank s bedrock shrub
ft bank sly rock nd trees

HABITAT ASSESSMENT FORM

HABITAT ASSESSMENT FIELD DATA SHEET

Name of Water Body Twelve Mile Creek Station# 003

Date 9-8-99 Investigator LB, RJL Score 46

CATEGORIES

HABITAT PARAMETER	EXCELLENT	GOOD	FAIR	POOR	COMMENTS
1 Bottom Substrate/ Available Cover	>50% rubble, gravel, submerged logs, undercut banks, or other stable habitat. 20-16	50-30% rubble, gravel or other stable habitat. Adequate habitat. 15-11	30-10% rubble, gravel or other stable habitat. Habitat availability < desirable 10-6	<10% rubble, gravel or other stable habitat Lack of habitat is obvious 5 5-0	
2 Embeddedness (observe in 'run area)	Gravel cobble, boulder and logs are <25% surrounded by fine sediment or sand 20-16	Gravel cobble, boulder and logs are 25-50% surrounded by fine sediment or sand 15-11	Gravel cobble, boulder and logs are 50-75% surrounded by fine sediment or sand 10-6	Gravel cobble boulder and logs are >75% surrounded by fine sediment or sand 5 5-0	
3 Stream Flow <= 5 CFS OR	Warm/ 5 cfs 20-16	·5-2 cfs 15-11	2-1 cfs 10-6	1 cfs 5-0	
> 5 CFS Slow <1 ft/s Fast > 1 ft/s Deep > 1 6 ft Shallow <1 6 ft	All habitats present slow & deep slow & shallow fast & deep, fast & shallow 20-16	3 of 4 habitats present. (Missing riffles or runs get lower score than missing pools) 15-11	2 of 4 habitats present (Missing riffles/runs get lower score) 10-6	Dominated by one velocity/depth category (Usually pool) 5 5-0	
4 Channel Alteration (resulting in a loss of habitat)	Little/no enlargement of islands or point bars and /or no channelization 15-12	Some new increase in bar formation, mostly from coarse gravel and/or some channelization present. 11-8	Moderate deposition of new gravel coarse sand on old & new bars/pools partially filled w/ silt, and/or embankments on both banks 7-4	Heavy deposits of fine material, bar development increase Host pools filled w/ silt and/or extensive channelization 2 3-0	
5 Bottom Scouring and Deposition	<5% of bottom affected 15-12	5-30% affected Scour at constrictions and steep grades Some disposition in pools 11-8	30-50% affected Deposit and scour at obstructions bends and constrictions Some filling of pools 7-4	>50% bottom changing nearly year long Pools absent due to deposition Only large rocks exposed 2 3-0	
6 Run/Bend Pool/Riffle Ratio (Distance between riffles or bends/ stream width)	If the ratio is 5-7 15-12	If the ratio is 7-15 11-8	If the ratio is 15-25 7-4	If the ratio is >25 2 3-0	
7 Bank Stability	Stable No erosion or bank failure 10-9	Moderately stable Infrequent erosion mostly healed over 7 8-6	Moderately unstable Moderate erosion High erosion during high flow 5-3	Unstable Many eroded areas "Raw" areas frequent on straight and bends 2 0	
8 Bank Vegetative Stability	>80% of streambank covered by vegetation or boulders and cobbles 9 10-9	79-50% covered by vegetation gravel or larger material 8-6	49-25% covered by vegetation gravel or larger material 5-3	<25% covered by vegetation gravel or larger material 2 0	
9 Streamside Cover	Dominant vegetation is shrub 9 10-9	Dominant vegetation is tree form 8-6	Dominant vegetation is grass forbes 5-3	>50% no vegetation Dominant material is soil rock, bridge materials, culverts, or mine tailings 2 0	
CATEGORY RANGE	135-104	103-71	70-35	34-0	

HABITAT ASSESSMENT FORM

HABITAT ASSESSMENT FIELD DATA SHEET

Name of Water Body Twelve Mile Creek Station# 004

Date 9-8-99 Investigator LD, RSL Score 112

CATEGORIES

HABITAT PARAMETER	EXCELLENT	GOOD	FAIR	POOR	COMMENTS
1 Bottom Substrate/ Available Cover	>50% rubble gravel submerged logs, undercut banks, or other stable habitat. 18 20-16	50-30% rubble, gravel or other stable habitat Adequate habitat 15-11	30-10% rubble, gravel or other stable habitat Habitat availability < desirable 10-6	<10% rubble gravel or other stable habitat. Lack of habitat is obvious 5-0	
2 Embeddedness (observe in "run" area)	Gravel cobble, boulder and logs are <25% surrounded by fine sediment or sand 20-16	Gravel cobble boulder and logs are 25-50% surrounded by fine sediment or sand 15 15-11	Gravel cobble, boulder and logs are 50-75% surrounded by fine sediment or sand 10-6	Gravel cobble boulder and logs are >75% surrounded by fine sediment or sand 5-0	
3 Stream Flow <= 5 CFS OR	Warm/ 5 cfs 20-16	5-2 cfs 15-11	2-1 cfs 10-6	1 cfs 5-0	
> 5 CFS Slow <1 ft/s Fast > 1 ft/s Deep > 1 6 ft Shallow <1 6 ft	All habitats present slow & deep, slow & shallow fast & deep fast & shallow 20-16	3 of 4 habitats present. (Missing riffles or runs get lower score than missing pools) 15 15-11	2 of 4 habitats present (Missing riffles/runs get lower score) 10-6	Dominated by one velocity/depth category (Usually pool) 5-0	
4 Channel Alteration (resulting in a loss of habitat)	Little/no enlargement of islands or point bars and /or no channelization 13 15-12	Some new increase in bar formation, mostly from coarse gravel and/or some channelization present 11-8	Moderate deposition of new gravel coarse sand on old & new bars/pools partially filled w/ silt, and/or embankments on both banks 7-4	Heavy deposits of fine material bar development increase Host pools filled w/ silt and/or extensive channelization 3-0	
5 Bottom Scouring and Deposition	<5% of bottom affected 15-12	5-30% affected Scour at constrictions and steep grades Some disposition in pools 9 11-8	30-50% affected Deposit and scour at obstructions bends and constrictions Some filling of pools 7-4	>50% bottom changing nearly year long Pools absent due to deposition Only large rocks exposed 3-0	
6 Run/Bend Pool/Riffle Ratio (Distance between riffles or bends/ stream width)	If the ratio is 5-7 14 15-12	If the ratio is 7-15 11-8	If the ratio is 15-25 7-4	If the ratio is >25 3-0	
7 Bank Stability	Stable No erosion or bank failure 10 10-9	Moderately stable Infrequent erosion mostly healed over 8-6	Moderately unstable Moderate erosion High erosion during high flow 5-3	Unstable Many eroded areas "Raw" areas frequent on straight and bends 2 0	
8 Bank Vegetative Stability	>80% of streambank covered by vegetation or boulders and cobbles 10-9 10	79-50% covered by vegetation gravel or larger material 8-6	49-25% covered by vegetation, gravel or larger material 5-3	<25% covered by vegetation gravel or larger material 2 0	
9 Streamside Cover	Dominant vegetation is shrub 10-9	Dominant vegetation is tree form 8 8-6	Dominant vegetation is grass forbes 5-3	>50% no vegetation Dominant material is soil, rock, bridge materials, culverts, or mine tailings 2 0	
CATEGORY RANGE	135-104	103-71	70-35	34-0	

HABITAT ASSESSMENT FORM

HABITAT ASSESSMENT FIELD DATA SHEET

Name of Water Body: Twelve Mile Creek Station#: 005

Date: 9-8-99 Investigator: LD, DJL Score: 26

CATEGORIES

HABITAT PARAMETER	EXCELLENT	GOOD	FAIR	POOR	COMMENTS
1 Bottom Substrate/ Available Cover	>50% rubble, gravel submerged logs, undercut banks, or other stable habitat. 20-16	50-30% rubble, gravel or other stable habitat Adequate habitat 15-11	30-10% rubble, gravel or other stable habitat. Habitat availability < desirable 10-6	<10% rubble gravel or other stable habitat. Lack of habitat is obvious 2 5-0	
2 Embeddedness (observe in "run" area)	Gravel cobble, boulder and logs are <25% surrounded by fine sediment or sand 20-16	Gravel cobble, boulder, and logs are 25-50% surrounded by fine sediment or sand 15-11	Gravel, cobble, boulder and logs are 50-75% surrounded by fine sediment or sand 10-6	Gravel, cobble, boulder and logs are >75% surrounded by fine sediment or sand 2 5-0	
3 Stream Flow <= 5 CFS OR	Warm/ 5 cfs 20-16	5-2 cfs 15-11	2-1 cfs 10-6	1 cfs 5-0	
> 5 CFS Slow <1 ft/s Fast > 1 ft/s Deep > 1 6 ft Shallow <1 6 ft	All habitats present slow & deep slow & shallow fast & deep, fast & shallow 20-16	3 of 4 habitats present (Missing riffles or runs get lower score than missing pools) 15-11	2 of 4 habitats present (Missing riffles/runs get lower score) 10-6	Dominated by one velocity/depth category (Usually pool) 2 5-0	
4 Channel Alteration (resulting in a loss of habitat)	Little/no enlargement of islands or point bars and /or no channelization 15-12	Some new increase in bar formation, mostly from coarse gravel and/or some channelization present 11-8	Moderate deposition of new gravel, coarse sand on old & new bars/pools partially filled w/ silt, and/or embankments on both banks 7-4	Heavy deposits of fine material, bar development increase Most pools filled w/ silt and/or extensive channelization 1 3-0	
5 Bottom Scouring and Deposition	<5% of bottom affected 15-12	5-30% affected Scour at constrictions and steep grades Some disposition in pools 11-8	30-50% affected Deposit and scour at obstructions, bends and constrictions Some filling of pools 7-4	>50% bottom changing nearly year long Pools absent due to deposition Only large rocks exposed 1 3-0	
6 Run/Bend Pool/Riffle Ratio (Distance between riffles or bends/ stream width)	If the ratio is 5-7 15-12	If the ratio is 7-15 11-8	If the ratio is 15-25 7-4	If the ratio is >25 1 3-0	
7 Bank Stability	Stable No erosion or bank failure 10-9	Moderately stable Infrequent erosion mostly healed over 8-6	Moderately unstable Moderate erosion High erosion during high flow 5 5-3	Unstable Many eroded areas 'Raw" areas frequent on straight and bends 2 0	
8 Bank Vegetative Stability	>80% of streambank covered by vegetation or boulders and cobbles 10-9	79-50% covered by vegetation, gravel or larger material 8-6	49-25% covered by vegetation gravel or larger material 5 5-3	<25% covered by vegetation gravel or larger material 2 0	
9 Streamside Cover	Dominant vegetation is shrub 10-9	Dominant vegetation is tree form 7 8-6	Dominant vegetation is grass forbes 5-3	>50% no vegetation Dominant material is soil, rock, bridge materials culverts or mine tailings 2 0	
CATEGORY RANGE	135-104	103-71	70-35	34-0	

-ft Bank
-able Right
ank usable
-aw areas

Appendix B

RBP Analysis and Macroinvertebrate Data

Results of the RBP II Analysis

Date	April	September	April	September	April	September	April	September	April	September
Station	1	1	2	2	3	3	4	4	5	5
Total # Individuals	**209**	**245**	**187**	**251**	**133**	**300**	**298**	**157**	**99**	**226**
Total # Taxa (Taxa Richness)	**31**	**41**	**32**	**29**	**42**	**44**	**48**	**29**	**24**	**27**
# Ephemeroptera Individuals	39	25	29	67	14	50	72	55	39	29
% Ephemeroptera Individuals	18 7	10 2	15 5	26 7	10 5	16 7	24 2	35 0	39 4	12 8
# Ephemeroptera Taxa	6	6	4	3	5	3	8	5	3	4
# Plecoptera Individuals	11	2	5	1	7	0	25	2	8	2
% Plectoptera Individuals	5 3	0 8	2 7	0 4	5 3	0 0	8 4	1 3	8 1	0 9
# Plecoptera Taxa	3	1	3	1	2	0	2	2	3	1
# Trichoptera Individuals	75	87	6	34	17	3	60	7	13	1
% Trichoptera Individuals	35 9	35 5	3 2	13 5	12 8	1 0	20 1	4 5	13 1	0 4
# Trichoptera Taxa	7	5	2	3	5	3	6	3	4	1
EPT INDEX	**16**	**12**	**9**	**7**	**12**	**6**	**16**	**10**	**10**	**6**
# Scraper Individuals	7	29	2	17	9	28	52	7	27	19
% Scraper Individuals	3 3	11 8	1 1	6 8	6 8	9 3	17 4	4 5	27 3	8 4
# Filtering Collector Individuals	121	125	37	34	28	31	112	27	13	10
% Filtering Collector Individuals	57 9	51 0	19 8	13 5	21 1	10 3	37 6	17 2	13 1	4 4
# Shredder Individuals	18	11	53	47	21	22	29	25	9	134
% Shredder Individuals	8 6	4 5	28 3	18 7	15 8	7 3	9 7	15 9	9 1	59 3
Ratio of Scrapers/Filtering Collecto	**0.05**	**0.23**	**0.05**	**0.50**	**0.32**	**0.90**	**0.46**	**0.26**	**2.08**	**1.90**
Ratio of Shredders/Total	**0.09**	**0.04**	**0.28**	**0.19**	**0.16**	**0.07**	**0.10**	**0.16**	**0.09**	**0.59**
# Chironomid Individuals	17	32	110	126	59	110	60	56	32	165
# Other Dipteran Individuals	50	1	13	2	5	4	40	7	0	3
Ratio EPT Individuals/Chironomid I	**7.35**	**3.56**	**0.36**	**0.81**	**0.64**	**0.48**	**2.62**	**1.14**	**1.88**	**0.19**
Dominant Family	Hydropsychii	Hydropsychida	Chironomida	Chironomidae	Chironomida	Chironomidae	Chironomida	Chironomidae	Chironomida	Chironomidae
% Contribution of Dominant Family	**32.1**	**34.7**	**58.8**	**50.2**	**36.8**	**36.7**	**20.1**	**35.7**	**32.3**	**73.0**
Family Biotic Index	**4.9**	**5.5**	**6.2**	**6**	**5.9**	**6.2**	**5.3**	**5.8**	**5**	**6.5**
# clinger taxa	21	29	15	15	18	18	28	18	14	14
#burrower taxa	6	6	10	9	12	15	9	6	3	4
# clinger individuals	186	167	110	173	73	118	245	123	73	200
# burrower individuals	15	65	63	84	30	105	29	20	6	8

Results of the RBP II Analysis

Date	April	September	April	September	April	September	April	September	April	September
Station	1	1	2	2	3	3	4	4	5	5
proportion of clinger individuals	0 89	0 68	0 59	0 69	0 55	0 39	0 82	0 78	0 74	0 88
proportion of burrower individuals	0 07	0 27	0 34	0 33	0 23	0 35	0 10	0 13	0 06	0 04
clinger/burrower ratio	**12.40**	**2.57**	**1.75**	**2.06**	**2.43**	**1.12**	**8.45**	**6.15**	**12.17**	**25.00**
# intolerant taxa	**1**	**1**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**
# tolerant individuals	203	243	187	251	133	300	296	157	98	226
# intolerant individuals	6	2	0	0	0	0	2	0	1	0
% tolerant individuals	**97.1**	**99.2**	**100.0**	**100.0**	**100.0**	**100.0**	**99.3**	**100.0**	**99.0**	**100.0**
Community Loss Index	**0**	**0**	**0.5**	**0.9**	**0.3**	**0.5**	**0.1**	**0.9**	**0.8**	**0.9**
SCORING										
Taxa Richness	6	6	6	3	6	6	6	3	3	3
Family Biotic Index	6	6	6	6	6	6	6	6	6	6
Ratio of Scrapers/Filtering Collectors	6	6	0	6	6	6	6	6	6	6
Ratio EPT/Chironomids	6	6	0	0	0	0	3	3	3	0
%Contribution to Dominant Family	6	6	0	0	0	0	0	0	0	0
EPT Index	6	6	0	0	3	0	6	3	0	0
Community Loss Index	6	6	3	3	6	3	6	3	3	3
Ratio of Shredder/Total	6	6	6	6	6	6	6	6	6	6
TOTAL SCORE	**48**	**48**	**21**	**24**	**33**	**27**	**39**	**30**	**27**	**24**
% Comparison to Reference Score	**100**	**100**	**43.75**	**50**	**68.75**	**56.25**	**81.25**	**62.5**	**56.25**	**50**

Macroinvertebrate species list for the April, 1999 sampling event, Twelvemile Creek, Cateechee, SC.

	Functional Feeding Group	Habitat	Tolerance	Stations 1	2	3	4	5
Diptera								
Ceratopogonidae	predator	burrowers	7 (tol)					
Culicoides	predator	burrowers			1	1		
Empididae	predator	sprawlers/burrowers	8 (tol)					
Chelifera	predator	sprawlers/burrowers				1	1	
Hemerodromia	predator	sprawlers/burrowers					3	
Tipulidae	shredder	burrowers	6 (tol)					
Limonia	shredder	burrowers					1	
Antocha	collector/gatherer	clingers		1			2	
Simuliidae	collector/filterers	clingers	5 (tol)					
Simulium	collector/filterers	clingers		49	12	3	33	
Chironomidae	gatherer/collectors	burrowers	7 (tol)					
Tvetenia	collector/gatherer	sprawlers		3	2		7	
Cricotopus	shredder	clingers		1	21	3	6	1
Rheocricotopus	collectors	sprawlers		1	1	2	3	
Eukiefferiella	collectors	sprawlers		1			1	
Nilotanypus	predator	sprawlers			1		1	
Potthastia	collectors	sprawlers			2	1	4	1
Cardiocladius	predator	burrowers			1		1	
Corynoneura	collectors	sprawlers			6	5		
Smittia	collectors	burrowers			1			
Phaenopsectra	scrapers	clingers			2			
Saetheria	collectors	burrowers			5			
Robackia	collectors	burrowers			1			
Parametriocnemus	collectors	sprawlers			1	3	2	3
Cryptochironomus	predator	sprawlers/burrowers			4			
Polypedilum	shredder	climbers/clingers		8	31	17	15	6
Tanytarsus	collectors	climbers/clingers			3	8	4	1
Cladotanytarsus	collectors	burrowers				1		
Orthocladius	collectors/gatherers	sprawlers/burrowers		3	28	2	3	
Parakiefferiella	collectors/gatherers	sprawlers					2	1
Ablabesmyia	predator	sprawlers				2	1	
Meropelopia	predator	sprawlers				6	1	3

Macroinvertebrate species list for the April, 1999 sampling event, Twelvemile Creek, Cateechee, SC.

	Functional Feeding Group	Habitat	Tolerance	Stations 1	2	3	4	5
Rheopelopia	predator	sprawlers				1		
Brillia	shredder	burrowers				1	2	1
Rheotanytarsus	collectors	clingers				2	6	5
Nanocladius	collectors	sprawlers					1	
Odontomesa	collectors	sprawlers						10
Thienemanniella	predator	sprawlers				5		
Trichoptera								
Lepidostonatidae	shredder	climbers	1 (intol)					
Lepidostoma	shredder	climbers,sprawlers,clingers		6			2	1
Leptoceridae	collectors/filterers	climbers,sprawlers,clingers	4 (tol)					
Nectopsyche	shredder	climbers						1
Ceraclea	collectors/filterers	sprawlers		1				
Brachycentridae	filterers/collectors	clingers, climbers	2 (tol)					
Micrasema	shredder	clingers		1			3	
Hydropsychiidae	filterers/collectors	clingers	5 (tol)					
Hydropsyche	filterers/collectors	clingers		24		1	29	
Ceratopsyche	filterers/collectors	clingers		33	2	1	10	1
Cheumatopsyche	filterers/collectors	clingers		9	4	7	15	10
Macrostemum	filterers/collectors	clingers		1			1	
Polycentropodidae	filterers/collectors	clingers	3 (tol)					
Neureclipsis	filterers/collectors	clingers				7		
Polycentropus	predator	clingers				1		
Plecoptera								
Perlidae	predator	clingers	3 (tol)					
Perlesta	predator	clingers		8	2	6	24	4
Paragnetina	predator	clingers						1
Perlodidae	predator	clingers	2 (tol)					
Isoperla	predator	clingers		1	2	1	1	3
Nemouriidae	shredder	sprawlers/clingers	4 (tol)		1			
Zapada	shredder	sprawlers/clingers		2				

Macroinvertebrate species list for the April, 1999 sampling event, Twelvemile Creek, Cateechee, SC.

	Functional Feeding Group	Habitat	Tolerance	Stations 1	2	3	4	5
		Table 1 continued						
Ephemeroptera								
Ephemerellidae	gatherer/collector	clingers	3 (tol)					
Dannella	scrapers	clingers			1			
Serratella	gatherer/collector	clingers		1			3	
Ephemerella	gatherer/collector	clingers		10	1	4	6	10
Eurylophella	gatherer/collector	clingers		1			3	
Heptageniidae	scrapers	clingers	4 (tol)					
Stenonema	scrapers	clingers		6	1	7	41	27
Stenacron	gatherer/collector	clingers					1	
Heptagenia	scrapers	clingers		1			1	
Ephemeridae	gatherer/collector	burrowers	4 (tol)					
Hexagenia	gatherer/collector	burrowers				1		
Baetidae	gatherer/collector	swimmers/clingers	5 (tol)	20	26	1	9	
Isonychiidae	filterer/collector	swimmers/clingers	4 (tol)					
Isonychia	filterer/collector	swimmers/clingers				1	8	2
Odonata								
Corduliidae	predator	sprawlers/climbers	7 (tol)					
Macromia	predator	sprawlers/climbers				1	1	
Caenagrionidae	predator	climbers	9 (tol)			1		
Aeschnidae	predator	climbers	6 (tol)					
Boyeria	predator	climbers				1		
Gomphidae	predator	burrowers	6 (tol)					
Gomphus	predator	burrowers		3		2	1	4
Progomphus	predator	burrowers			1	2	1	1
Calopterygidae	predator	climbers	8 (tol)					
Calopteryx	predator	climbers			1	1		1
		Table 1 continued						
Coleoptera								
Elmidae	gatherer/collector	clingers	5 (tol)				1	
Stenelmis	scrapers	clingers					10	
Microcylloepus	gatherer/collector	clingers					1	

Macroinvertebrate species list for the April, 1999 sampling event, Twelvemile Creek, Cateechee, SC.

	Functional Feeding Group	Habitat	Tolerance	Stations 1	2	3	4	5
Promoresia	gatherer/collector	clingers		3			4	1
Macronychus	collectors	clingers			1	1	3	
Ancyronyx	collectors/scrapers	clingers				2		
Oligochaeta								
Tubificidae	predator	burrower	7 (tol)	1		5		
Limnodrilus hoffmeisteni	predator	burrower		1		6		
Lumbriculidae	predator	burrower		3	2	1		
Bivalvia								
Corbiculidae	filterer/collector	burrower	6 (tol)	4	19	8	16	
Megaloptera								
Corydalidae	predator	clingers	6 (tol)					
Corydalus	predator	clingers		2			3	
Total # Individuals				**209**	**187**	**133**	**298**	**99**
Total # Taxa (Taxa Richness)				**31**	**32**	**42**	**48**	**24**

Macroinvertebrate species list for the September, 1999 sampling event, Twelvemile Creek, Cateechee, SC.

	Functional Feeding Group	Habitat	Tolerance	Stations 1	2	3	4	5
Diptera								
Culicidae	gatherer/collectors	swimmers	9 (tol)					
Anopheles	filterer/collectors	swimmers				1		
Muscidae	predators	sprawlers	6 (tol)					1
Ceratopogonidae	predator	burrowers	7 (tol)					
Dasyhelea	gatherer/collectors	sprawlers						1
Probezzia	predator	burrowers				3		
Culicoides	predator	burrowers						
Empididae	predator	sprawlers/burrowers	8 (tol)					
Chelifera	predator	sprawlers/burrowers						
Hemerodromia	predator	sprawlers/burrowers			2			1
Tipulidae	shredder	burrowers	6 (tol)					
Limonia	shredder	burrowers						
Antocha	collector/gatherer	clingers		1				
Simuliidae	collector/filterers	clingers	5 (tol)					
Simulium	collector/filterers	clingers					7	
Chironomidae	gatherer/collectors	burrowers	7 (tol)		2	2	2	
Tvetenia	collector/gatherer	sprawlers		1	1			
Cricotopus	shredder	clingers		2	13	8		1
Rheocricotopus	collectors	sprawlers		1			1	2
Eukiefferiella	collectors	sprawlers						
Nilotanypus	predator	sprawlers						
Potthastia	collectors	sprawlers						
Cardiocladius	predator	burrowers			21	3	3	
Corynoneura	collectors	sprawlers			2		1	1
Smittia	collectors	burrowers						
Phaenopsectra	scrapers	clingers		1	2			
Saetheria	collectors	burrowers			3	1		
Robackia	collectors	burrowers						
Parametriocnemus	collectors	sprawlers						1
Cryptochironomus	predator	sprawlers/burrowers			1			
Polypedilum	shredder	climbers/clingers		7	34	14	22	133

Macroinvertebrate species list for the September, 1999 sampling event, Twelvemile Creek, Cateechee, SC.

	Functional Feeding Group	Habitat	Tolerance	Stations 1	2	3	4	5
Tanytarsus	collectors	climbers/clingers		2	2	9	3	5
Cladotanytarsus	collectors	burrowers		5	7			
Orthocladius	collectors/gatherers	sprawlers/burrowers			31	6		
Parakiefferiella	collectors/gatherers	sprawlers						
Ablabesmyia	predator	sprawlers		3	2	6		6
Meropelopia	predator	sprawlers		3			3	1
Rheopelopia	predator	sprawlers						
Brillia	shredder	burrowers					1	
Rheotanytarsus	collectors	clingers		2	2	5	10	14
Stenochironomus	gatherer/collectors	burrowers		2		1		1
Nanocladius	collectors	sprawlers						
Odontomesa	collectors	sprawlers						
Thienemanniella	predator	sprawlers			1	2	9	
Dicrotendipes	gatherer/collectors	burrowers		3	2	23		
Pseudochironomus	gatherer/collectors	burrowers				29	1	
Cryptotendipes	gatherer/collectors	sprawlers				1		
		Table 3 continued						
Trichoptera								
Lepidostomatidae	shredder	climbers	1 (intol)					
Lepidostoma	shredder	climbers,sprawlers,clingers		2				
Leptoceridae	collectors/filterers	climbers,sprawlers,clingers	4 (tol)					
Nectopsyche	shredder	climbers						
Ceraclea	collectors/filterers	sprawlers						
Brachycentridae	filterers/collectors	clingers, climbers	2 (tol)					
Micrasema	shredder	clingers						
Hydropsychiidae	filterers/collectors	clingers	5 (tol)	7		1	2	1
Hydropsyche	filterers/collectors	clingers		74	31	1	4	
Ceratopsyche	filterers/collectors	clingers			2			
Cheumatopsyche	filterers/collectors	clingers		1	1		1	
Macrostemum	filterers/collectors	clingers		3				
Polycentropodidae	filterers/collectors	clingers	3 (tol)					
Neureclipsis	filterers/collectors	clingers						
Polycentropus	predator	clingers				1		

Macroinvertebrate species list for the September, 1999 sampling event, Twelvemile Creek, Cateechee, SC.

	Functional Feeding Group	Habitat	Tolerance	Stations 1	2	3	4	5
Plecoptera								
Perlidae	predator	clingers	3 (tol)					
Perlesta	predator	clingers						
Paragnetina	predator	clingers			1		1	2
Acroneuria	predator	clingers		2			1	
Perlodidae	predator	clingers	2 (tol)					
Isoperla	predator	clingers						
Nemouriidae	shredder	sprawlers/clingers	4 (tol)					
Zapada	shredder	sprawlers/clingers						
Ephemeroptera								
Ephemerellidae	gatherer/collector	clingers	3 (tol)	2				
Dannella	scrapers	clingers						
Serratella	gatherer/collector	clingers		1				
Ephemerella	gatherer/collector	clingers		1				
Eurylophella	gatherer/collector	clingers						
Heptageniidae	scrapers	clingers	4 (tol)		1			
Stenonema	scrapers	clingers		12	14	19	6	19
Stenacron	gatherer/collector	clingers						
Heptagenia	scrapers	clingers		4			1	
Ephemeridae	gatherer/collector	burrowers	4 (tol)					
Hexagenia	gatherer/collector	burrowers				20		
Baetidae	gatherer/collector	swimmers/clingers	5 (tol)	5	52	11	46	4
Isonychiidae	filterer/collector	swimmers/clingers	4 (tol)					
Isonychia	filterer/collector	swimmers/clingers					1	4
Tricorythidae	gatherer/collector	clingers/sprawlers	5 (tol)					
Tricorythodes	gatherer/collector	clingers/sprawlers					1	2
		Table 3 continuted						
Odonata								
Corduliidae	predator	sprawlers/climbers	7 (tol)					
Macromia	predator	sprawlers/climbers		2		9		
Caenagrionidae	predator	climbers	9 (tol)					

Macroinvertebrate species list for the September, 1999 sampling event, Twelvemile Creek, Cateechee, SC.

	Functional Feeding Group	Habitat	Tolerance	Stations 1	2	3	4	5
Argia	predator	clingers/climbers		2		21		1
Aeschnidae	predator	climbers	6 (tol)					
Boyeria	predator	climbers				1		2
Basiaeschna	predator	clingers/climbers				1		
Gomphidae	predator	burrowers	6 (tol)					
Gomphus	predator	burrowers		2		5		
Progomphus	predator	burrowers		13	2		1	1
Calopterygidae	predator	climbers	8 (tol)					
Calopteryx	predator	climbers				1		
Libellulidae	predator	sprawlers/climbers	7 (tol)					
Libellula	predator	sprawlers/climbers				1		
Coleoptera								
Elmidae	gatherer/collector	clingers	5 (tol)			1	1	
Stenelmis	scrapers	clingers		5		2		
Microcylloepus	gatherer/collector	clingers		1				
Promoresia	gatherer/collector	clingers		9				
Macronychus	collectors	clingers		4	2	15	2	7
Ancyronyx	collectors/scrapers	clingers		2		3		
Optioservus	collectors/scrapers	clingers		1				
Gyrinidae	predator	swimmers	6 (tol)					
Dineutus	predator	swimmers		1				
Gyrinus	predator	swimmers				5		
Dryopidae	shredders	clingers	5 (tol)					
Helichus	shredders	clingers					2	
		Table 3 continued						
Oligochaeta								
Tubificidae	predator	burrower	7 (tol)			7		
Limnodrilus hoffmeisteri	predator	burrower				4		
Lumbriculidae	predator	burrower				1		

Macroinvertebrate species list for the September, 1999 sampling event, Twelvemile Creek, Cateechee, SC.

	Functional Feeding Group	Habitat	Tolerance	Stations 1	2	3	4	5
Bivalvia								
Corbiculidae	filterer/collector	burrower	6 (tol)	40		28	12	5
Megaloptera								
Corydalidae	predator	clingers	6 (tol)		1			
Corydalus	predator	clingers		10	15		11	6
Neohermes	predator	clingers/climbers		1		1		3
Nigronia	predator	clingers/climbers		1		1		
Sialidae	predator	burrowers	8 (tol)					
Sialis	predator	burrowers				1		
Hemiptera								
Corixidae	predator	swimmers	9 (tol)			1		
Gerridae	predator	skater	5 (tol)					
Metrobates	predator	skater			1	20		1
Veliidae	predator	skater	5 (tol)					
Rhagovelia	predator	skater					1	
Gastropoda								
Physidae	scrapers	clingers	7 (tol)					
Physella	scrapers	clingers		4		4		
Table 4								
Total # Individuals				**245**	**251**	**300**	**157**	**226**
Total # Taxa (Taxa Richness)				**41**	**29**	**44**	**29**	**27**