ALLIANT TECHSYSTEMS INC.
Annual
Benthic Study
September 22, 1997

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

According to the discharge permit issued to the Radford Army Ammunition Plant (RAAP) by the Department of Environmental Quality, an annual benthic study must be performed to determine if any environmental impact has occurred within the New River as a result of the RAAP's activities. By comparing this year's findings with those from 1988 through 1996, potential long term impact can be determined.

In general, our findings this year indicate that no impairment to the New River is occurring as a result of the RAAP. The stream bed was different this year in that it was very dry. The water levels were very low and since the river bed did not experience any flood like conditions or extreme erosion as it had last year, there was not as much exposed bedrock as was reported last year. (The lower water levels allowed for more sedimentation to collect upon the bedrock, therefore, becoming much more conducive to benthic organisms.) CVLC was able to completely transect the river during sampling at several of the sites this year as opposed to only one or two last year. This change is being attributed to the dry summer and lower water levels. In comparing the data from the last nine years, the overall condition of the New River continues to be unaffected by the activities of the RAAP. In terms of taxa richness the river overall appears to be unchanged to improving.

INTRODUCTION

The Radford Army Ammunition Plant is located near Radford, Virginia; all of its outfalls discharging into the New River. The plant manufactures many types of explosives, ammunitions and rocket fuel. During the sampling event, there was no obvious activity which seemed to have any impact on the New River.

Due to the various river conditions at each station, some of the left bank samples were actually taken at midstream (this is further detailed in the Station Description section). The river bed of the New River generally is a mixture of sand and cobble with sheets of bedrock, as well as plentiful growths of elodea and other macrophytes. Several deep holes and large boulders periodically complicated sampling. Periodic changes in the water level of the New River due to the opening of Claytor Lake dam were possible, however, water level changes were not noted during our sampling period.

METHODS AND PROCEDURES

Central Virginia Laboratories and Consultants (CVLC) was contracted to perform a qualitative benthic survey during the delegated time frame and in accordance with requirements discussed in the RAAP NPDES Permit. The methods used in this study were approved by the Department of Environmental Quality before any analysis was performed. This study consisted mainly of benthic macroinvertebrate identification and general observations of each site in terms of bank erosion or other possible signs of impact.

Samples were collected by A. Sisson, T. White, T. Garnier and R. Foust all of CVLC, on August 18, 1997 through August 20, 1997. Samples were collected between 0815 and 1530 on each of these days. Eleven stations were studied, ten on the New River and one on Stroubles Creek, each with six subsites. The subsites have been broken down to reflect left and right bank samples. Each subsite has been sampled and analyzed in a separate manner, however, after analysis, data for each station was compiled in order to generate taxa richness and total number of organisms found as requested by the client.

At each station, water was tested for average depth, temperature, specific conductance, pH and Dissolved Oxygen.

As requested, the presence or absence of Sphaerotilus at each site has been noted. Sphaerotilus, or "Sewage Fungus" is a bacteria which uses organic carbon as a growth substrate can become over abundant in polluted waters.

Methods and Procedures (cont'd)

All comparisons and conclusions drawn from this study have been performed only against historical data which has been generated from the same sites.

Benthic sampling was performed using the Canton modification of the Hess Stream Bottom Sampler. The sampler is a stainless steel cylinder 33 cm in diameter and 51 cm high. Organisms were obtained by scrubbing and dislodging any and all organisms from rocks and debris contained within the sampler. Next, the substrate within the sampler was disturbed to 15 cm below packed surface or until bedrock was reached, allowing benthic organisms to be collected. All samples, once collected, were preserved in a 70% ethanol/Rose Bengal mixture for transport to the laboratory. At the laboratory, all organisms were classified to the lowest practical taxonomic level. Stations 1 and 2, and the upstream site at Station 10 represent reference controls since they are areas outside of RAAP's discharge zone. All other stations are located adjacent to or below RAAP and municipal point discharges.

Station descriptions

As mentioned earlier, samples were taken from both left and right banks of the New River. The right bank samples were taken to assess areas of direct impact from the RAAP discharges, the left bank samples serve as a comparison for the section of the river. The river is wide enough that the left bank is not directly affected by the RAAP discharges. In some cases, the river current was too swift to safely cross to obtain left bank samples, so in the instances pointed out below, left bank samples were taken from mid-stream.

Station 1 is located just downstream from the State Route 114 bridge, crossing the New River. This site serves as one of the reference sites to which other sites downstream can be compared. This site has continued to improve compared to previous years sampling. The number of organisms was still lower than any other site but in terms of taxa richness it was very much the same as other sites tested. The site itself is used as a public boat launch and swimming hole and appeared very polluted as in the previous years surveys. The river bed at this site was extremely muddy and silty with more vegetation found than last year. Both banks were sandy with leaf litter and trash. Due to stream conditions, right bank samples were taken directly off the right bank and left bank samples were taken directly off of the left bank (this is the only site where there is access to both sides of the river). Several birds were seen at this site including two Kingfishers. Minnows and crayfish were also observed at this site. There was no evidence of any Sphaerotilus growth.

Station descriptions (continued)

Station 2 is also upstream from RAAP activities and is used as a reference site to which downstream sites can be compared. Samples from this site were taken near the rapids and the entire stream was transected. In previous years left bank samples were taken from mid-stream. The complete transection of this site allowed for a thorough population study of organisms. The benthic population consisted of 56% Trichopterans this year as opposed to 29% last year. Trichopterans are one of the three sensitive benthic macroinvertebrates, (Ephemeropterans and Plecopterans being the other two) their strong presence at this site suggests a healthy river environment. The Ephemeropteran were also present as 22% of the taxa found. The water level was two or three feet below the observed water mark. Moss and algae were on rocks. Crayfish, snails, small birds and various fish were also observed. Floating foam and a strong swampy odor were present on the left bank. This could be a result of the low water level. There was no evidence of Sphaerotilus growth.

Station 3 is located below the Oleum plant discharge and also has a stormwater outfall which discharges nearby. The site is located directly under the power lines with steam pipes downstream. There is a small vegetated island in the middle of the stream. Floating foam was again present as it has been the last two years. The shoreline was made up of small rocks and some signs of erosion were noted with tree roots exposed along the right bank. The left bank samples were taken midstream at the island due to extreme current flow on the other side of the centrally located island. Fish snails and bivalves were abundant. Also birds and a doe with two fawns were seen. There was also pollution at this site. There was no evidence of Sphaerotilus growth.

Station descriptions (continued)

Station 4 is located directly upstream from the RAAP bridge which crosses the New River. The shore the stream-bed were muddy and silty as in previous years. The current was very slow this year. Bivalves and their shells were abundant as were snails. A large grey Heron and some smaller birds were also seen. The water at this site was very clear, probably due to the extremely slow current. There was still trash and vegetation hanging on trees on the shoreline. This is probably remaining from the 1996 flooding. Left bank samples were taken from mid-stream. There was no evidence of Sphaerotilus growth.

Station 5 is located at the Power Plant effluent discharge point. Conditions of the river bank and stream-bed were the same as the last two years. The river bank and shore were muddy with various sized rocks and boulders. The river-bed consisted mostly of bedrock and various sized rocks and some silt. Again, snails and bivalves were abundant. A Heron, minnows and smaller birds were present. There was also evidence of raccoons. A small amount of floating foam was seen in the flow of the river but none was collecting on shore. There was still evidence of previous erosion at this site. Slick algae and water striders present as well as driftwood and aquatic plants exposed in the middle of the river. The Power Plant Outfall was observed and toilet paper was observed in the river by the outfall. Some green fungal-like algae is growing near the outfall in its flow. Last year there was no environmental impact observed, this year there seems to be some small changes as a result of the outfall. The left bank samples were taken mid-stream. There was no evidence of Sphaerotilus growth.

Station Descriptions (continued)

Station 6 is located below the combined effluent discharge. The river bed consisted of rocks of various sizes and exposed bedrock. A slick algae covered the rocks near shore. Floating foam and evidence of erosion were also observed. There was also a strong odor present at this site. On the left bank side of the island the water is much deeper. Stream conditions appear normal; water striders, bivalves, minnows and snails were present. On the island there was evidence of aquatic birds either ducks or geese. and a Crane was observed. There was no evidence of Sphaerotilus growth this year. Sphaerotilus was spotted at this site in 1995 which was the first time it had been present in five years. At this site, left bank samples were taken midstream.

Station 7 is located downstream of the Blacksburg-Virginia Polytechnic Institute sewage treatment plant. A distinct "treated" odor were present at the outfall which is the same as previous years, however, this year there was no floating foam at the site. The shore was silty and the river bed was largely composed of small rocks, sand and exposed bedrock. Two large fish a goose and two kingfishers were seen. Two deer were observed on the left bank. There was no evidence of Sphaerotilus growth this year as was found in 1994 and 1995. The water coming from the outfall is slightly more turbid and grey in color than the river. There was again a noticeable difference in the conductivity between the outfall and the benthic site. The outfall exhibited a Conductivity of 560 umhos versus 220 umhos found at the benthic site. This difference in conductivity did not appear to pose any hazard to the benthic community. At this site, sampling completely transected the stream width.

Station descriptions (continued)

Station 8 is located downstream from the Stroubles Creek-New River confluence. This site is also across from the waste-fuel burning area. The river itself was very shallow and swift with two islands in the center. The water this year was very turbid due to heavy rains which occurred overnight. A strong treated water odor was present mid-river. The stream bed was composed of various sized rocks, silt and some exposed bedrock. Water beetles were present near shore as well as several species of birds. The presence of Sphaerotilus growth could not be determined due to the turbidity of the water. This station was transected three quarters of the way across when sampled.

Station 9 is located near the lower magazine area. The river bed consisted of small rocks and sand with some leaf litter and aquatic plants. There were many snails observed at this site. In fact the snail and clam population made up 94% of the population of organisms found. As there was last year, a small springs was on the right bank of this site which was bubbling and fed into the river. Left bank samples were taken from the island to midstream. Wildlife such as a blue heron and a white heron were seen as well as many geese and water striders. There was no evidence of Sphaerotilus growth.

Station 10 is divided into two sections, the upstream and the downstream of the TNT plant on Stroubles Creek. This station was very narrow and was very easy to transect completely. The creek was very turbid and had flooded its banks this year due to the heavy rain the night before. At both "10 up" and "10 down" floating foam was noted to be present as it was last year. The substrate at both "10 up" and "10 down" was not visible this year due to the turbidity and flow. There was no evidence of Sphaerotilus growth.

Station descriptions (continued)

Station 11 is the farthest away from the RAAP and is downstream from all of the above stations. This site serves as a reference site. This station is fairly new and had not been sampled before 1991. The conditions at this station were the same as last year. The river bed had a large amount of plant growth. The bank was quite muddy with the stream-bed consisting of various sized rocks and some exposed bedrock. The samples for this site were collected upstream from the riffle zone. Several small fish, bivalves, snails and water beetles were observed at this station. There was no evidence of Sphaerotilus growth at this station.

Chemical and Physical Measurements

Measurements performed in the field included pH, Dissolved Oxygen, temperature and conductivity. The pH and temperature readings were taken using an Orion 250A meter, the Dissolved Oxygen readings were performed using a YSI field meter and the conductivity readings were taken using an Orion meter. All meters were calibrated before measurement at each site.

Biological Sampling

As requested by the contract proposal, biological samples were collected using the Canton Modification of the Hess Stream Bottom Sampler. All sampling events performed before 1991 were performed using a "D" frame kick net. It is important to note, however, when comparing data from 1991 through 1997 to all other historical data, due to different techniques, discrepancies in organism numbers could be noted. For example when sampling with a Hess Bottom sampler a defined area is all that is sampled, when sampling with a "D" frame kick net an undetermined area is sampled due to the size of the individuals foot, stride or the angle of the foot when kicking. As mentioned earlier, this may not affect the total number of taxa found, however it can affect the actual numbers and condition of each of those taxa found.

Biological Sampling (continued)

At each station, six samples were taken, three representing the right bank transection and three representing the left bank transection. Each of the subsites were kept separate and were preserved in 70% ethanol for transport to the laboratory. Once at the laboratory, the organisms were sorted by station and subsite into order classifications. From the order classifications, the organisms were further sorted into the lowest practical taxonomic classification (Family, Genus and species). Using the findings of the laboratory enumeration, data was compiled to determine taxa richness.

RESULTS

Chemical Data

On the days of sample collection, all of the analyses were normal in comparison with historical data. As in the past, the test sites had basic pH readings ranging from 7.34 to 8.51 S.U. and Dissolved Oxygen readings were suitable for aquatic life, ranging from 7.5 to 9.6 mg/l. Temperatures were also constant throughout the river ranging from 21.0 degrees to 25.5 degrees Celsius. These temperatures were slightly higher than in previous years, however due to the lower water levels this would be justified. Overall chemical conditions at all of the sites were very good.

Biological Data

The number of organisms collected at each station ranged from 90 found at Station 1 to 756 organisms found at Station 9. Station 1 has shown a slight increase this year in the number of organisms found (only 72 last year).

The number of taxa found at the stations directly affected by RAAP were about the same with what was found in 1996. This would suggest that there has been no new impact to the New River at least within the previous calendar year and in comparing with the last seven years of data, the stream bed is continuing to thrive after the stress of recent flooding, this years drought and severe impairment caused by the Sphaerotilus growth which occurred in the late 1980's.

In comparison with the historical data, the taxa richness is the same this year. Station 1 is a reference site and its impairment appears not to be related to the activities of Hercules RAAP. Overall, taxa diversity showed no signs of impairment as a result of Hercules RAAP discharges.

Biological Data (continued)

In the 1991 through 1995 surveys, the river was dominated by Mayflies and clams. This was also true for the 1996 survey as well except for the fact that the Caddisflies (Trichoptera) had also become more dominant. The 1997 survey shows that Caddisflies have become even more abundant and the presence of Stoneflies (Plecopterans) has also increased. The fact that the Mayflies (Ephemeroptera), Caddisflies (Trichoptera) and Stoneflies (Plecoptera) are present, shows that the river is conducive to aquatic life. Mayflies, Caddisflies and Stoneflies are considered to be the three most pollutant sensitive benthic macroinvertebrates and can therefore be very indicative of the quality of the water conditions in a river system. The fact that they have been thriving for the last several years shows that river conditions are favorable for aquatic life. In 1990 there was a noticeable drop in the number of clams found; in 1991 they were again dominant and the 1992 report does not have any reference to them. As mentioned earlier, they were another dominant species found during the 1993 through 1996 surveys; however, they are a very pollution tolerant species and their presence may or may not give any indication as to the water quality. CVLC feels that the presence of the Mayflies, Caddisflies, Stoneflies and other naturally occurring biological life indicates that river conditions continue to remain favorable.

CONCLUSIONS

This study was performed to determine if any impact has occurred to the New River as a result of activities performed by Hercules Radford Army Ammunition Plant. In comparison with historical data, river conditions seem to have changed slightly as a result of the dry summer of 1997. Even though the water levels were significantly lower the benthic community seems to be unchanged. Diversity of the river seems to have increased with as much as seventeen different taxa found as a couple of the sites. The overall average of taxa found for all eleven sites was 12, as opposed to 9.4 from last year. The changes which have occurred to the stream-bed again this year appear to have occurred as the result of natural ecological cycles, not because of any activities occurring at RAAP. There was no Sphaerotilus found at any of the locations this year which would potentially effect benthic organisms. There appears to be no current negative impacts on benthic macroinvertebrates of the New River as a result of the activities of Hercules RAAP.

TABLE I

WATER CHEMISTRY FOR RAAP BENTHIC STUDY

September 1997 Study, CVLC

Station #	Water Depth (cm)	Temp. °C	Specific conductance (umhos)	pH (S.U.)	Dissolved Oxygen (mg/l)
1	0 - 39	24	120	7.60	9.0
2	0 - 32	24.5	110	8.06	7.1
3	0 - 36	25.0	130	8.51	9.6
4	0 - 39	25.5	123	7.75	9.1
5	0 - 39	25.0	130	7.82	7.5
6	0 - 39	25.0	150	7.35	8.6
7	0 - 32	25.0	220	7.34	8.9
8	0 ->39	21.5	280	7.73	7.9
9	0 - 26	25.0	150	7.87	9.5
10 Up	0 - >39	21.0	280	7.67	8.1
10 Down	0 - 23	21.0	300	7.70	8.4
11	0 - 12	23.9	161	7.51	7.8

TABLE II

TOTAL TAXA, RIGHT BANK VS. LEFT BANK

September 1997 Study, CVLC

Station #	1	2	3	4	5	6	7	8	9	10	11
Right Bank (Up)	12	15	13	11	8	11	11	15	14	14	8
Left Bank (Down)	7	17	12	9	8	14	16	17	8	13	12

TABLE III

Organism density per Site and Station

Station #____1____

Insecta	Right Bank				Left Bank			
Ephemeroptera	1	2	3	Total	1	2	3	Total
Heptageniidae Stenonema		8		8			2	2
Arthoplea								
Siphlonuridae Isonychia		3		3				
Baetidae Beatis	3			3		1	1	2
Pseudocloeon								
Ephemeridae Ephemera	1			1				
Odonata								
(Zygoptera) Coenagrionidae Argia								
(Anisoptera) Gomphidae Gomphus								
Trichoptera								
Hydroptilidae spp.		1		1				
Hydropsychidae Hydropsyche								
Brachycentridae Brachycentrus								
Helicopsychidae Helicopsyche	1	3		4				
Megaloptera								
Sialidae Sialis								
Corydalidae Corydalus								
Diptera								
Chironimidae		4		4	1	1	1	3
Simulidae								
Plecoptera								
Perlidae Perlinella								
Neuroptera Sisrydae								

Organism density per Site and Station

Station # 1

Insecta, Continued	Right Bank				Left Bank			
	1	2	3	Total	1	2	3	Total
Diptera								
Tipulidae					4			4
Coleoptera								
Elmidae Stenelmis								
Psephenidae Psephenus								
Non-Insecta								
Annelida								
(Oligochaeta) Tubificidae	1		7	8		6		6
Naididae			1	1			1	1
(Hirudinea) Hirudinidae (Leeches)								
Amphipoda								
Gammaridae Gammarus	6	15		21				
Turbellaria								
(Tricladida) Planariidae Dugesia								
Decapoda (Crayfish, Shrimp)								
Astacidae Cambarus								
Pelecypoda (Clams)								
Corbiculidae Corbicula (Clams)		1		1	4	5		9
Gastropoda (Snails)	5	3		8				

Table III

Organism density per Site and Station

Station # 2

Insecta	Right Bank				Left Bank			
Ephemeroptera	1	2	3	Total	1	2	3	Total
Heptageniidae Stenonema								
Arthoplea	1	4	2	7	6	1	3	10
Siphlonuridae Isonychia		6	2	8	4	3	9	16
Baetidae Beatis	1			1		99	5	104
Pseudocloeon						3		3
Ephemeridae Ephemera		1		1	2			2
Odonata								
(Zygoptera) Coenagrionidae Argia								
(Anisoptera) Gomphidae Gomphus		1		1				
Trichoptera		1		1	1			1
Hydroptilidae spp.					5	11	4	20
Hydropsychidae Hydropsyche		1	4	5		32	3	35
Brachycentridae Brachycentrus		6	3	9	2	2	1	5
Helicopsychidae Helicopsyche		3	5	8	41	244	20	305
Megaloptera								
Sialidae Sialis								
Corydalidae Corydalus						1		1
Diptera								
Chironimidae	1			1	1		2	3
Simulidae								
Plecoptera	1			1				
Perlidae Perlinella								
Neuroptera Sisrydae						1		1

0

Organism density per Site and Station

Station # 2

Insecta, Continued	Right Bank				Left Bank			
	1	2	3	Total	1	2	3	Total
Diptera								
Tipulidae								
Coleoptera								
Elmidae Stenelmis	1	2	2	5	12	4	8	24
Psephenidae Psephenus								
Non-Insecta								
Annelida								
(Oligochaeta) Tubificidae								
Naididae								
(Hirudinea) Hirudinidae								
Amphipoda								
Gammaridae Gammarus	32			32	1	1		2
Turbellaria								
(Tricladida) Planariidae Dugesia								
Decapoda								
Astacidae Cambarus								
Pelecypoda								
Corbiculidae Corbicula	0	2	8	10	0	0	0	0
Gastropoda	10	10	1	21	26	0	8	34

Table III

Organism density per Site and Station

Station # 3

Insecta	Right Bank				Left Bank			
Ephemeroptera	1	2	3	Total	1	2	3	Total
Heptageniidae Stenonema						1	1	2
Arthoplea	1			1		2	4	6
Siphlonuridae Isonychia	1	4		5			1	1
Baetidae Beatis	1	2	17	20			2	1
Pseudocloeon								
Ephemeridae Ephemera								
Odonata								
(Zygoptera) Coenagrionidae Argia								
(Anisoptera) Gomphidae Gomphus					1			1
Trichoptera			2	2	1			1
Hydroptilidae spp.		1		1				
Hydropsychidae Hydropsyche							5	5
Brachycentridae Brachycentrus	1	11	8	20	2	8	23	33
Helicopsychidae Helicopsyche	6	20	15	41				
Megaloptera								
Sialidae Sialis								
Corydalidae Corydalus	1			1				
Diptera								
Chironimidae					1	1		2
Simulidae								
Plecoptera		1		1				
Perlidae Perlinella								
Neuroptera Sisrydae								

Organism density per Site and Station

Station # 3

Insecta, Continued	Right Bank				Left Bank			
	1	2	3	Total	1	2	3	Total
Diptera								
Tipulidae								
Coleoptera								
Elmidae Stenelmis		6	5	11		1		1
Psephenidae Psephenus			1	1				
Non-Insecta								
Annelida								
(Oligochaeta) Tubificidae								
Naididae								
(Hirudinea) Hirudinidae (Leeches)								
Amphipoda								
Gammaridae Gammarus								
Turbellaria								
(Tricladida) Planariidae Dugesia								
Decapoda								
Astacidae Cambarus								
Pelecypoda								
Corbiculidae Corbicula (Clams)	3	0	3	6	5	0	2	7
Gastropoda (Snails)	21	11	55	87	5	4	13	22

Table III

Organism density per Site and Station

Station # 4

Insecta	Right Bank				Left Bank			
Ephemeroptera	1	2	3	Total	1	2	3	Total
Heptageniidae Stenonema		1		1				
Arthoplea	3		4	7	1			1
Siphlonuridae Isonychia		1		1		2		2
Baetidae Beatis		1		1				
Pseudocloeon								
Ephemeridae Ephemera								
Odonata								
(Zygoptera) Coenagrionidae Argia					1			1
(Anisoptera) Gomphidae Gomphus								
Trichoptera			1	1				
Hydroptilidae spp.								
Hydropsychidae Hydropsyche		1		1				
Brachycentridae Brachycentrus					2		1	3
Helicopsychidae Helicopsyche								
Megaloptera								
Sialidae Sialis								
Corydalidae Corydalus								
Diptera								
Chironimidae	7	2	4	13	29	51	72	152
Simulidae								
Plecoptera								
Perlidae Perlinella								
Neuroptera Sisrydae								

Organism density per Site and Station

Station # 4

Insecta, Continued	Right Bank				Left Bank			
	1	2	3	Total	1	2	3	Total
Diptera								
Tipulidae								
Coleoptera								
Elmidae Stenelmis		1		1	2	1		3
Psephenidae Psephenus								
Non-Insecta								
Annelida								
(Oligochaeta) Tubificidae								
Naididae								
(Hirudinea) Hirudinidae								
Amphipoda								
Gammaridae Gammarus								
Turbellaria								
(Tricladida) Planariidae Dugesia								
Decapoda								
Astacidae Cambarus		1		1	2			2
Pelecypoda								
Corbiculidae Corbicula	7	20	41	68	6	20	16	42
Gastropoda	4	3	17	24	0	7	9	16

Table III

Organism density per Site and Station

Station #____5____

Insecta	Right Bank				Left Bank			
Ephemeroptera	1	2	3	Total	1	2	3	Total
Heptageniidae Stenonema						4	1	5
SPP	2	1	1	4			2	2
Siphlonuridae Isonychia								
Baetidae Beatis							1	1
Pseudocloeon								
Ephemeridae Ephemera	2			2		3		3
Odonata								
(Zygoptera) Coenagrionidae Argia								
(Anisoptera) Gomphidae Gomphus								
Trichoptera								
Hydroptilidae spp.								
Hydropsychidae Hydropsyche		1		1				
Brachycentridae Brachycentrus								
Helicopsychidae Helicopsyche								
Megaloptera								
Sialidae Sialis		1		1				
Corydalidae Corydalus								
Diptera								
Chironimidae						1		1
Simulidae								
Plecoptera								
Perlidae Perlinella								
Neuroptera Sisrydae	1			1				

Organism density per Site and Station

Station # 5

Insecta, Continued	Right Bank				Left Bank			
	1	2	3	Total	1	2	3	Total
Diptera								
Tipulidae								
Coleoptera								
Elmidae Stenelmis						1		1
Psephenidae Psephenus								
Non-Insecta								
Annelida								
(Oligochaeta) Tubificidae		1		1				
Naididae								
(Hirudinea) Hirudinidae								
Amphipoda								
Gammaridae Gammarus								
Turbellaria								
(Tricladida) Planariidae Dugesia								
Decapoda								
Astacidae Cambarus								
Pelecypoda								
Corbiculidae Corbicula	34	24	9	67	3	19	15	37
Gastropoda	10	7	9	26	0	9	8	17

Table III

Organism density per Site and Station

Station # 6

Insecta	Right Bank				Left Bank			
Ephemeroptera	1	2	3	Total	1	2	3	Total
Heptageniidae Stenonema								
Arthoplea	2	1		3		1		1
Siphlonuridae Isonychia	1			1				
Baetidae Beatis						19		19
Pseudocloeon								
Ephemeridae Ephemera						1	1	2
Odonata								
(Zygoptera) Coenagrionidae Argia								
(Anisoptera) Gomphidae Gomphus							1	1
Trichoptera	1		1	2				
Hydroptilidae spp.							1	1
Hydropsychidae Hydropsyche	9		2	11				
Brachycentridae Brachycentrus	2			2			1	1
Helicopsychidae Helicopsyche	1			1				
Megaloptera								
Sialidae Sialis								
Corydalidae Corydalus								
Diptera								
Chironimidae	2	4		6	2	113		115
Simulidae								
Plecoptera								
Perlidae Perlinella								
Neuroptera Sisrydae						1		1

Organism density per Site and Station

Station # 6

Insecta, Continued	Right Bank				Left Bank			
	1	2	3	Total	1	2	3	Total
Diptera								
Tipulidae								
Coleoptera								
Elmidae Stenelmis	1			1				
Psephenidae Psephenus						1		1
Non-Insecta								
Annelida								
(Oligochaeta) Tubificidae	1			1				
Naididae							1	1
(Hirudinea) Hirudinidae								
Amphipoda								
Gammaridae Gammarus						6		6
Turbellaria								
(Tricladida) Planariidae Dugesia								
Decapoda								
Astacidae Cambarus						1	1	2
Pelecypoda								
Corbiculidae Corbicula	2	2	6	10	19	28	42	89
Gastropoda	7	13	24	44	11	8	10	29

Table III

Organism density per Site and Station

Station # 7

Insecta	Right Bank				Left Bank			
Ephemeroptera	1	2	3	Total	1	2	3	Total
Heptageniidae Stenonema					1			1
Arthoplea	1			1	1	1	2	4
Siphlonuridae Isonychia	1			1		2	1	3
Baetidae Beatis							1	1
Pseudocloeon								
Ephemeridae Ephemera								
Odonata								
(Zygoptera) Coenagrionidae Argia								
(Anisoptera) Gomphidae Gomphus							1	1
Trichoptera								
Hydroptilidae spp.							2	2
Hydropsychidae Hydropsyche								
Brachycentridae Brachycentrus			1	1		1	1	
Helicopsychidae Helicopsyche	3		2	5	3	34	4	41
Megaloptera								
Sialidae Sialis								
Corydalidae Corydalus						2		2
Diptera								
Chironimidae	3		16	19			13	13
Simulidae								
Plecoptera			1	1				
Perlidae Perlinella						1		1
Neuroptera Sisrydae								

Organism density per Site and Station

Station #____7____

Insecta, Continued	Right Bank				Left Bank			
	1	2	3	Total	1	2	3	Total
Diptera								
Tipulidae								
Coleoptera								
Elmidae Stenelmis			3	3	1	6	4	11
Psephenidae Psephenus					1			1
Non-Insecta								
Annelida								
(Oligochaeta) Tubificidae								
Naididae	2			2				
(Hirudinea) Hirudinidae								
Amphipoda								
Gammaridae Gammarus					3	2		5
Turbellaria								
(Tricladida) Planariidae Dugesia								
Decapoda								
Astacidae Cambarus		1		1				
Pelecypoda								
Corbiculidae Corbicula	15	39	4	58	8	3	29	40
Gastropoda	4	10	5	19	9	5	18	32

Table III

Organism density per Site and Station

Station # 8

Insecta	Right Bank				Left Bank			
Ephemeroptera	1	2	3	Total	1	2	3	Total
Heptageniidae Stenonema								
Arthoplea			1	1		2	5	7
Siphlonuridae Isonychia			6	6		2		2
Baetidae Beatis	3	7	15	25			2	2
Pseudocloeon					4			4
Ephemeridae Ephemera								
Odonata								
(Zygoptera) Coenagrionidae Argia								
(Anisoptera) Gomphidae Gomphus								
Trichoptera								
Hydroptilidae spp.						1		1
Hydropsychidae Hydropsyche		7		7				
Brachycentridae Brachycentrus		9	2	11			8	8
Helicopsychidae Helicopsyche	8	12	32	52			2	2
Megaloptera								
Sialidae Sialis								
Corydalidae Corydalus			1	1				
Diptera								
Chironimidae	2	7	1	10			4	4
Simulidae								
Plecoptera								
Perlidae Perlinella								
Neuroptera Sisrydae			2	2	1			1

Organism density per Site and Station

Station # 8

Insecta, Continued	Right Bank				Left Bank			
	1	2	3	Total	1	2	3	Total
Diptera								
Tipulidae			1	1				
Coleoptera								
Elmidae Stenelmis		10	4	14			5	5
Psephenidae Psephenus			1	1	1	2	1	4
Non-Insecta								
Annelida								
(Oligochaeta) Tubificidae		72		72	3			3
Naididae					10			10
(Hirudinea) Hirudinidae								
Amphipoda								
Gammaridae Gammarus					2			2
Turbellaria								
(Tricladida) Planariidae Dugesia								
Decapoda								
Astacidae Cambarus						1		1
Pelecypoda								
Corbiculidae Corbicula	2	18	3	23	2	11	23	36
Gastropoda	20	4	51	75	0	1	4	5

Table III

Organism density per Site and Station

Station # 9

Insecta	Right Bank				Left Bank			
Ephemeroptera	1	2	3	Total	1	2	3	Total
Heptageniidae Stenonema								
Arthoplea	3			3	3	1		4
Siphlonuridae Isonychia		2		2				
Baetidae Beatis			3	3				
Pseudocloeon								
Ephemeridae Ephemera			1	1				
Odonata								
(Zygoptera) Coenagrionidae Argia								
(Anisoptera) Gomphidae Gomphus								
Trichoptera		1		1				
Hydroptilidae spp.								
Hydropsychidae Hydropsyche								
Brachycentridae Brachycentrus			1	1		1		1
Helicopsychidae Helicopsyche	2	1		3		1		1
Megaloptera								
Sialidae Sialis								
Corydalidae Corydalus			1	1				
Diptera		11	2	13		2		2
Chironimidae								
Simulidae								
Plecoptera		1		1				
Perlidae Perlinella								
Neuroptera Sisrydae								

Organism density per Site and Station

Station # 9

Insecta, Continued	Right Bank				Left Bank			
	1	2	3	Total	1	2	3	Total
Diptera								
Tipulidae								
Coleoptera								
Elmidae Stenelmis		1		1			1	1
Psephenidae Psephenus								
Non-Insecta								
Annelida								
(Oligochaeta) Tubificidae								
Naididae								
(Hirudinea) Hirudinidae								
Amphipoda								
Gammaridae Gammarus		1		1	1			1
Turbellaria								
(Tricladida) Planariidae Dugesia								
Decapoda								
Astacidae Cambarus								
Pelecypoda								
Corbiculidae Corbicula	142	66	34	242	85	142	69	296
Gastropoda	28	66	36	130	17	12	18	47

Table III

Organism density per Site and Station

Station #____10____

Insecta	Right Bank (Up)				Left Bank (Down)			
Ephemeroptera	1	2	3	Total	1	2	3	Total
Heptageniidae Stenonema	3			3	1			1
Arthoplea	3			3				
Siphlonuridae Isonychia								
Baetidae Beatis			1	1	3		1	4
Pseudocloeon								
Ephemeridae Ephemera		2		2				
Odonata								
(Zygoptera) Coenagrionidae Argia								
(Anisoptera) Gomphidae Gomphus	1			1	1	1	1	3
Trichoptera								
Hydroptilidae spp.								
Hydropsychidae Hydropsyche					9	3	1	13
Brachycentridae Brachycentrus								
Helicopsychidae Helicopsyche								
Megaloptera								
Sialidae Sialis								
Corydalidae Corydalus		1		1	1	1		2
Diptera								
Chironimidae		1		1				
Simulidae					1		1	2
Plecoptera								
Perlidae Perlinella			1	1	4		5	9
Neuroptera Sisrydae		1		1	1	1		2

Organism density per Site and Station

Station # 10

Insecta, Continued	Right Bank (Up)				Left Bank (Down)			
	1	2	3	Total	1	2	3	Total
Diptera								
Tipulidae								
Coleoptera								
Elmidae Stenelmis	24	16	5	45	15	8	42	65
Psephenidae Psephenus	12	10	5	27	8	15	16	39
Acneus								
Non-Insecta								
Annelida								
(Oligochaeta) Tubificidae								
Naididae			30	30			1	1
(Hirudinea) Hirudinidae						1		1
Amphipoda								
Gammaridae Gammarus								
Turbellaria								
(Tricladida) Planariidae Dugesia	1			1				
Decapoda								
Astacidae Cambarus								
Pelecypoda								
Corbiculidae Corbicula	12	2	1	15		2	1	3
Gastropoda								

Table III

Organism density per Site and Station

Station # 11

Insecta	Right Bank				Left Bank			
Ephemeroptera	1	2	3	Total	1	2	3	Total
Heptageniidae Stenonema								
Arthoplea	4		1	5	1	12		13
Siphlonuridae Isonychia					3	56	4	63
Baetidae Beatis	2	2	1	5	2	4		6
Pseudocloeon								
Ephemeridae Ephemera								
Odonata								
(Zygoptera) Coenagrionidae Argia								
(Anisoptera) Gomphidae Gomphus					1			1
Trichoptera								
Hydroptilidae spp.								
Hydropsychidae Hydropsyche	12	3		15	2	10		12
Brachycentridae Brachycentrus						3		3
Helicopsychidae Helicopsyche			2	2	12	63	84	159
Megaloptera								
Sialidae Sialis								
Corydalidae Corydalus							1	1
Diptera								
Chironimidae							2	2
Simulidae								
Plecoptera								
Perlidae Perlinella								
Neuroptera Sisrydae								

Organism density per Site and Station

Station # 11

Insecta, Continued	Right Bank				Left Bank			
	1	2	3	Total	1	2	3	Total
Diptera								
Tipulidae								
Coleoptera								
Elmidae Stenelmis	17	1	3	21		1	1	2
Psephenidae Psephenus	1			1				
Non-Insecta								
Annelida								
(Oligochaeta) Tubificidae								
Naididae								
(Hirudinea) Hirudinidae								
Amphipoda								
Gammaridae Gammarus								
Turbellaria								
(Tricladida) Planariidae Dugesia								
Decapoda								
Astacidae Cambarus								
Pelecypoda								
Corbiculidae Corbicula	26	69	15	110	25	19	1	45
Gastropoda	6	2	0	8	0	4	0	4

TABLE IV

PERCENT COMPOSITION PER STATION

August 1997 Study, CVLC

Station #	1	2	3	4	5	6	7	8	9	10	11
Total # of Org.	90	677	279	341	170	351	271	398	756	277	478
TAXA	*	*	*	*	*	*	*	*	*	*	*
Ephemeroptera	21	22	13	4	10	7.4	4	12	2	5	19
Odonata	0	0.1	0.4	0.3	0	0.3	0.4	0	0	1.4	0.2
Trichoptera	6	56	37	1.5	0.6	5	19	20	0.9	5	40
Megaloptera	0	0.1	0.4	0	0.6	0	0.7	0.3	0.1	1	0.2
Diptera	12	8	0.7	48	0.6	5	12	4	2	1	0.4
Plecoptera	0	0.1	0.4	0	0	0	0.7	0	0.1	3.6	0
Neuroptera	0	0.1	0	0	0.6	0.3	0	0.8	0	1	0
Coleoptera	0	4	5	1.2	0.6	0.4	6	6	0.2	64	5
Annelida	18	0	0	0	0.6	0.6	0.7	21	0	12	0
Amphipoda	23	5	0	0	0	1.7	1.8	0.5	0.2	0	0
Decapoda	0	0	0	0.9	0	0.6	0.4	0.3	0	0	0
Pelecypoda	11	1	5	32	61	28	36	15	71	7	32
Turbellaria	0	0	0	0	0	0	0	0	0	0.4	0
Gastropoda	9	2	39	12	25	21	19	20	23	0	3

Number of Organisms (% Taxa)

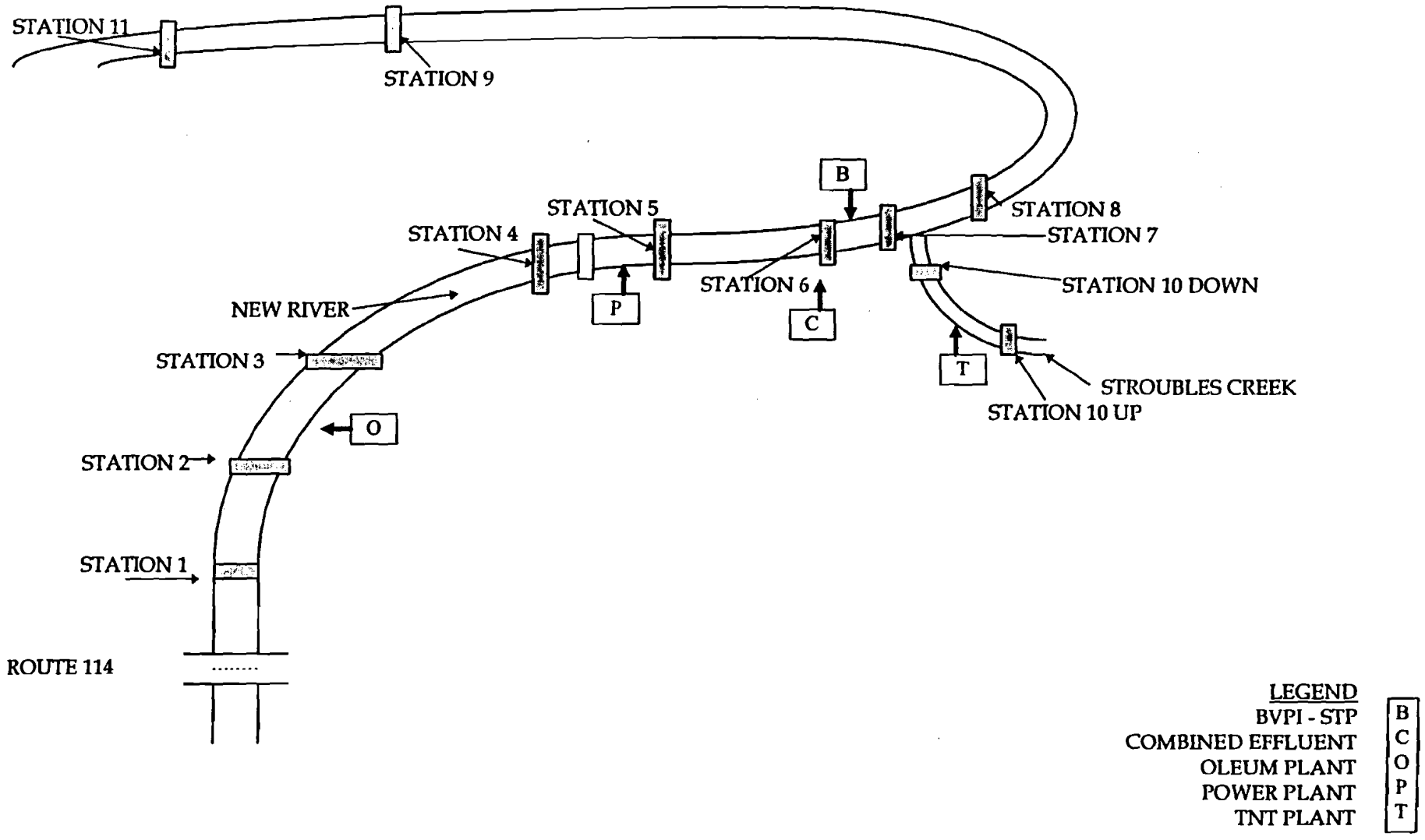

FIGURE 1: Sample stations on the New River and Stroubles Creek near RAAP.

Site #1 date - 08-20-97 0815

date: 8-19-97 1710

L. Bank	Rt. Bank
pH - 7.60	7.56
temp - 24°C	24
DO - 9.0	~~DO~~ 6.6
Depth range - 0 - 100+cm	0 - 100+ cm
Conductivity - 120	120

Observations - left bank is under bridge. Several swimmers & fisherman. Litter, fires, gravel on shore. Very silty w/few plants or rocks. several flocks of birds on wires. Some driftwood, river rocks on shore. Drops off rather suddenly from bank. Only got about 10 feet out from shore

Right bank is by B-C-VPI water authority building. Saw 2 kingfishers & other birds. Shore is sandy w/ leaf litter, driftwood trash. Some Aquatic plants are visible. few rocks, water deep here. Got about 10' out. Saw minnows, crayfish.

site: 2 date: 05-15-17 1030

pH – 8.06
temp – 24.5°C
DO – ~~10.3~~ AS 7.1
Depth – 0-81 cm
Conductivity – 110

Sphaerodites – absent

observations – this site is upstream from a bridge and downstream from RR trestle - there is a concrete ruin of a dam or channel on the right bank. current is swift here and small rapid goes all the way across. were able to collect all the way across river. water level looks to be about 2 or 3 feet below water mark. some vegetation is evident – moss & algae on rocks. crayfish spotted. many snails are evident. Also small birds, minnows & larger fish. some floating foam collecting on left bank. strong swampy odor on left bank.

rapid appears to be caused by manmade structure that has pipes & once crossed the width of river

Site #3 08.18.97 1400

pH: 8.51
temp: 25.0°C
DO: 9.6
depth: 0-91 cm
Conductivity: 130

sphaerotilus: absent

observations: site is downstream from rapids & directly under power lines. Steam pipes are downstream. Small vegetated island in center. many minnows & snails apparent. Saw one long narrow yellowish fish w/ spots. Shoreline is made up of smaller rocks. there is some erosion of bank w/ tree roots exposed. Saw birds and a doe w/ 2 fawns. Several caves in rock face across river. Got about ½ way across. some floating foam after rapids. a dry creek enters on right bank. Current splits at right bank and moves back across river. Saw some

dead fish (2) and trash.

Site #4 08/18/97 1530

pH: 7.75
temp: 25.5
DO: 9.1
Depth: 0-100 cm
conductivity: 123

Sphaerotilus: absent

observations: Site is upstream from a bridge and very silty onshore current is slow. very few rocks. Got 2/3 way across (to 2nd lamppost). Saw large grey orange and some (heron) smaller birds. Driftwood shows evidence of flooding. minnows & snails were sighted. some sections of vegetation and small rocks w/ bedrock showing. water is very clear. Some trash and vegetation hanging on trees on shoreline.

80

Site: 5 06-19-97 0855

pH: 7.82
Temp: 25.0°C
DO: 7.5
Depth: 0-100cm
Conductivity: 130

Sphaerotilus: absent

Observations: site is just down from bridge and opposite the outfall. Substrate is silty w/some small pebbles & bedrock showing. bivalves & snails abundant. Saw a heron, minnows, smaller birds. Evidence of raccoons. Small amount of floating foam but more collecting on shore. Some erosion is evident. Slick algae & water striders here. driftwood & aquatic plants exposed near middle of river. Got about 1/2 ~~2/3~~ across. Saw toilet paper in river by outfall. Some type of green fungal-like algae growing near outfall in flow. Very spongy. many holes in banks of river

Site #6 08-19-97 1045

	at outfall
pH: 7.35	7.8
temp: 25°C	22
DO: 8.6	7.6
conductivity: 150	180
depth: 99 cm	

sphaerotilus:

observations: Strong fishy odor here. Site is opposite Alliant outfalls A & B. There is a small island of pebbles, plants & trees, some larger rocks exposed in center of river. Many crayfish, minnows, larger fish. Evidence of aquatic birds (geese or ducks) on island. A crane was ~~sited~~ sighted. Some floating foam, slick algae, hair algae, water striders. Evidence of erosion caterpillar nests in trees near outfalls. Also slime-like clusters of filament gathered in sacks on rocks & driftwood just downstream. Got 1/2 way across. Some exposed bedrock & many smaller pebbles

Site #7 08-19-97 1215

	VPI Outfall	Site:
pH:	7.20	7.34
Temp°	23	25
DO:	8.4	8.9
Conductivity:	560	220

depth rg - 0 – 81cm

Sphaerotilus:

Observations: Site is at VPI outfall and across from burning grounds. There is abundant vegetation midstream. shore is silty and substrate is made up of gravel, larger stones. There is a strong treated odor coming from outfall. 2 Large fish were seen and a goose & 2 Kingfishers. Also 2 deer on left bank. Were able to cross entire river here. Water from outfall is slightly more turbid & grey in color. Some bedrock showing.

~~#8 site~~ #9 Site 08-19-97 1530

pH: 7.87
temp: 25
DO: 9.5
Conductivity: 150
depth: 0 - 67 cm

see next page for site #8

sphaerotilus: absent

observations: this site is across from a large island w/ trees, which is considered the right bank. ~~E~~ down river is a park. Many geese were sited here as well as a blue heron & white heron. River is much lower than in past years with substrate exposed. many water insects. striders. were able to cross to island. Bottom is silty w/ leaf litter, gravel, some aquatic plants. there is a bubbling spring exposed. 2 nesting boxes on left ~~bank~~ bank. Bedrock, silt & small pebbles make up river bottom. Many, many snails.

Site 8 08-20-97 0915

pH: ~~7.9~~ 7.73
temp: 21.5
DO: 7.9
conductivity: 280
depth range: 0-100+ cm

Sphaerotilus: not detected (too turbid)

Observations: Site is downstream from where Strubles creek meets river. Heavy rains overnight have caused the creek to be higher & very turbid. It is quite wide where it meets the river. There are a few small islands w/ trees. There are some rocks of various sizes in creek & river. Geese & heron sighted. Also Kildeer and other birds. Across river on left bank are the running grounds. Many water beetles. Current is quite swift. readings were taken in turbid water. moss & aquatic plants on rocks. Got 3/4 across; drop off sudden. Strong treated water odor about mid river.

10 site (down) 1130

08-20-97

pH: 7.70
temp: 21.0
DO: 8.4
conductivity: 300
depth: ~~730~~ 58 cm

Observations: this is the downstream site on Stroubles Creek. There is a bridge and pipes overhead. The creek is very turbid & rapid due to heavy rain, and has flooded its banks. There is some foam. Grass & large rocks on shoreline. Substrate not visible.

#10 Site (upstrm) 08-20-97 1145

pH: 7.67
temp: 21.0°C
DO: 8.1
Conductivity: 280
depth: 0-100+cm

observations: this site is near (RDAISA) building (turn by baseball field outside of secured area). It is the upstream site of Stroubles Creek. very woody area w/ steep banks & rocks of various sizes. Once again, creek is quite flooded, rapid & turbid. Substrate can't be seen. There are some rapids. Branches & leaves have fallen into creek, Hemlocks, maples, beeches, and hickories populate the forest here. moss and plants on shore rocks. water beetles and some foam on surface. Water level has dropped 2 feet since earlier.

#11 Site 08-20-97 1240

pH: 7.51
Temp: 23.9
DO: 7.80
Conductivity: 161
depth: 30" (0- cm)

observations: River is quite wide here and current is slow moving. Shore is sand & silt & quite soft, driftwood & leaf litter, a few larger rocks on river bottom. Saw several white herons & some smaller birds. Like site 9 the river turns here so that the left bank is closest to the gate. River appears quite deep here DO sampling was done a little (1/4 mile) away downstream at a rock shelf that runs the river's width. There is a campsite w/ fire debris & a shelter where a small creek feeds the river. The shelf is sandy w/ small pebbles & some

larger rocks. Many aquatic plants. 2 canoes passed. Water is only knee deep most of the way across on shelf.

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An Introduction to the Study of Insects, by Borror, Triplehorn and Johnson.

Freshwater Invertebrates of the United States, by Pennak.

Radford Army Ammunition Plant
Route 114, P.O. Box 1
Radford, VA 24141
USA

January 28, 2002

US Army Corps of Engineers
ATTN: CENAB-EN-HM
10 South Howard Street
Baltimore, MD 21201

Attention: Mr. John Tesner

Subject: Benthic Surveys, Radford Army Ammunition Plant

Dear Sir:

Enclosed please find copies of our Benthic Studies conducted in the years 1994 thru 1998, in accordance with the requirements of our Virginia Pollution Discharge Elimination System Permit.

If additional information is needed, please contact Mr. J. J. Redder (540) 639-7536.

Very truly yours,

C. A. Jake, Environmental Manager
Alliant Ammunition and Powder Company LLC

Enclosures

Coordination: J. McKenna

bc: Administrative File
J. J. Redder
J. McKenna
Env File – Enclosures located in the Water Cabinet (Env. Library)

02-815-21
LG Martin