ALLIANT TECHSYSTEMS

BENTHIC STUDY

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EXECUTIVE SUMMARY

According to the discharge permit issued to Alliant Techsystems 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 Alliant Techsystem's activities. By comparing this year's findings with those from 1988 through 1997, 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 Alliant Tech. The stream bed was similar to the 1997 study this year in that the water levels were low. CVLC was able to completely transect the river during sampling at about half of the sites this year. In comparing the data from the last ten years, the condition of the New River seems to have changed.

INTRODUCTION

Alliant Techsystems 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 Alliant Techsystems 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, B. Jeffries, T. Garnier and R. Foust all of CVLC, on August 24, 1998 through August 26, 1998. Samples were collected between 0830 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.

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 Alliant Tech's discharge zone. All other stations are located adjacent to or below Alliant Tech 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 Alliant Techsystem's 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 Alliant Tech's 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 a lot of trash and leaf litter. There was an oily sheen present in some spots of the water surface and also small amounts of floating foam. 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 separate access to both sides of the river). There is vegetation along the shoreline and frogs were heard at this site. There was no evidence of any Sphaerotilus growth.

Station descriptions (continued)

Station 2 is also upstream from Alliant Tech 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 years previous to 1997 left bank samples were taken from mid-stream. The complete transection of this site allowed for a thorough population study or organisms. The benthic population consisted of 24% Ephemeropterans this year which is consistent with the 22% found last year. Ephemeropterans are one of the three sensitive benthic macroinvertebrates, (Trichopterans and Plecopterans being the other two) their strong presence at this site suggests a healthy river environment. The Trichopterans were also present as 10% of the taxa found. Moss, algae, snails and small fish were abundant as in 1997. No floating foam or strong swampy odor were present on the left bank this year as was found last year. 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. Snails and bivalves (clams) were abundant again this year as in previous years. A boat with fishermen were observed as was a Kingfisher bird. No floating foam was observed as it had been the last three years. The shoreline was made up of small rocks, pebbles and grass. The left bank samples were taken midstream. No pollution was observed at this site as it was last year. 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 still muddy and silty as in previous years. Bivalves and their shells are abundant as are snails. Driftwood was observed with some of it caught on the bridge. Bedrock was exposed with moss clinging to it. Crayfish were seen as was evidence of birds, probably geese, on the shoreline. 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. More litter is present here than in previous years. An old tire, cans, rusted metal, pieces of lumber and railroad ties litter the river bed and banks of this site. Also a black oily substance was found on the Hess Stream sampler and its bottle. Benthic organisms, however, seem unchanged in terms of taxa richness. 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, water-striders and minnows were abundant. There is still evidence of previous flooding, from 1996, with vegetation still hanging on to the lower tree branches. The Power Plant Outfall was observed and again there was a treated water odor present. For the last two years the stream has been visually effected 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. The strong odor present last year at this site was not observed to be present this year. On the left bank side of the island the water is much deeper. Stream conditions appear normal; bivalves and snails were present. On the island there was evidence of ducks and a large habitation of geese. The River at this site is slower moving and very clear. There was no evidence of Sphaerotilus growth this year. 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. Different from last year, there was floating foam at the site as in years previous to 1997. The water coming from the outfall is more turbid and grey in color than the river. The shore was silty and the river bed was largely composed of moss covered rocks. Several large bass, water striders, small birds and two kingfishers were seen. The burning grounds are located downstream on the left bank. The river was transected three quarters of the way for sampling. There was no evidence of Sphaerotilus growth this year. There was again a noticeable difference in the conductivity between the outfall and the benthic site. The outfall exhibited a Conductivity of 482 umhos versus 160 umhos found at the benthic site. This difference in conductivity did not appear to pose any hazard to the benthic community.

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 stream bed was composed of various sized rocks, silt and some small pebbles. Water striders were present near shore as well as Kingfishers, a crane and mosquitos. There was no evidence of Sphaerotilus growth at this site. The current is swift here and this station was transected two-thirds 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 exposed bedrock with aquatic plants attached. The river is much lower here than last year, in fact the lower water levels make it possible to see the several cold springs which line the river bank. Deer tracks and raccoon tracks are found on the river bank. Also two ducks flew off upon our approach to this site. A crane was observed on the right bank. Left bank samples were taken from the island to midstream. 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. "10 up" serves as a reference point as it is above any Alliant Tech activities. This station was very narrow and was very easy to transect completely. At both sites up and down the streambed as in 1996, is silty and slick with algae. Crayfish and clams were present. At both sites some floating foam was noted to be present. The overall condition of this site was good and no differences can be found between the reference point and the downstream site. There was no evidence of Sphaerotilus growth at either sub-site.

Station descriptions (continued)

Station 11 is the farthest away from the RAAP and is downstream from all of the above stations. This station is fairly new and had not been sampled before 1991. The river bed is silty with some smaller pebbles with a large amount of plant growth growing towards the water surface. The samples for this site were collected upstream from the riffle zone. Several ducks, clams, snails and water striders were observed at this station. The river was completely transected at this site for sampling. Old appliances and furniture on the left bank as well as a campsite with a shelter. 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 a Fisher AP-15 meter, the Dissolved Oxygen readings were performed using a YSI field meter and the conductivity readings were taken using an Orion Model 120 meter. All meters were calibrated and adjusted according to manufacturers recommendations 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. This sampling method has only been used for the last three sampling events. 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 1996 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 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 7.06 to 8.48 S.U. and Dissolved Oxygen readings were suitable for aquatic life, ranging from 5.1 to 8.4 mg/l. Temperatures were also constant throughout the river ranging from 22.0 degrees to 28.4 degrees Celsius. Chemical conditions at all of the sites were good although changed from previous years. The Dissolved Oxygen readings were lower than in previous years, however, the temperatures were notably higher than in previous years. The increased temperature is a result of the lower river levels and hot air temperatures which occurred the month before sampling. Dissolved Oxygen is directly affected by temperature. As water temperature increases, its ability to hold oxygen decreases, thus lower Dissolved Oxygen readings will occur in warmer water. The Percent Composition and Taxa Richness were no different between the reference sites and the sites downstream from Alliant Tech.

Biological Data

The number of organisms collected at each station ranged from 44 found at Station 1 to 615 organisms found at Station 9. Station 1 has continued to show a decrease in numbers of organisms compared with all previous samplings dating back to 1988. This could be attributed to the fact that station is now used as a boat launching area and is used by the public frequently. State Route 114 bridge has been widened and the increased surface area of the bridge could potentially cause more run-off and, therefore, more pollution to that site. These findings are the same as previous years.

The number of taxa found at the stations directly affected by Alliant Techsystems are the same with what was found in 1995. 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 previous years of data, the stream bed is continuing to thrive after the stress of recent flooding 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 Alliant Techsystems. Overall, taxa diversity showed no signs of impairment as a result of Alliant Techsystems discharges.

Biological Data (continued)

In the 1991 through 1997 surveys, the river was dominated by Mayflies and clams. This appears to be true for the 1998 survey as well. The 1998 survey also found the Trichopterans significantly present as in 1997. The fact that the Mayflies (Ephemeroptera) and Caddisflies (Trichoptera) are present, shows that the river is conducive to aquatic life. Mayflies and Caddisflies are two of the most pollutant sensitive insects 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 1997 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 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 Alliant Techsystems. In comparison with historical data, river conditions seem to have continued to change as a result of severe snow runoff and flooding which occurred in the winter of 1995-1996 and extreme hot and dry conditions for the month previous to the 1998 sampling. These changes have caused more bedrock to be exposed within the stream-bed, which can leave less area for benthic organisms to thrive. Overall organism numbers and taxa richness do not show that the increase of exposed bedrock has caused that to happen this year. The changes which have occurred to the stream-bed this year appear to have occurred as the result of natural ecological cycles, not because of any activities occurring at Alliant Tech. There was no Sphaerotilus found at any of the locations this year which would potentially effect benthic organisms. When comparing to historical data, there appears to be no current negative impacts on benthic macroinvertebrates of the New River as a result of the activities of Alliant Techsystems.

TABLE I

WATER CHEMISTRY FOR RAAP BENTHIC STUDY

August 1998 Study, CVLC

Station #	Water Depth (in)	Temp. °C	Specific conductance (umhos)	pH (S.U.)	Dissolved Oxygen (mg/l)
1	0 - 36	27.0	110	7.89	6.3
2	0 - 38	25.1	120	7.45	5.1
3	0 - 6	27.0	146	8.36	6.9
4	0 - 38	27.0	120	7.90	6.8
5	7 - 38	28.7	141	8.03	6.8
6	12 - 40	25.0	130	7.30	5.1
7	15 - 40	25.0	482	7.06	6.4
8	11 - 20	24.0	400	8.33	8.4
9	0 - 36	27.0	130	8.06	6.8
10 Up	0 - 8	23.0	390	8.48	7.2
10 Down	10 - 18	22.0	370	8.26	7.4
11	0 - 30	25.0	130	7.30	5.2

TABLE II

TOTAL TAXA, RIGHT BANK VS. LEFT BANK

August 1998 Study, CVLC

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

TABLE III

PERCENT COMPOSITION PER STATION

August 1997 Study, CVLC

Station #	1	2	3	4	5	6	7	8	9	10	11
Total # of Org.	44	261	415	218	162	319	325	393	615	196	531
TAXA	*	*	*	*	*	*	*	*	*	*	*
Ephemeroptera	16	24	5.5	22	59	48	15	14	14	12	7
Odonata	2	0	0	0.4	0	0.6	0.3	2	0.3	0.5	0
Trichoptera	5	10	8	5	2.4	6	29	7	12	0	10
Megaloptera	0	0	0	0	0	0	0	0	0	0	0
Diptera	14	0.7	0.4	0.9	0	0.3	0.3	0	0.8	1.5	0
Plecoptera	0	0	0	0	0	0	0	0	0	2	0
Neuroptera	2	0.7	0	1.8	0	1.9	0.9	0	0.2	3	2
Coleoptera	2	5	1.4	1.3	8	1.6	14	8	7	77	21
Annelida	50	1.5	4	0.4	2.4	1.9	0	1.5	0.2	4	0.8
Amphipoda	0	0.7	0.2	0	0	0.9	0.6	0	1.3	0	0
Decapoda	0	0	0	0.9	0	0.3	0	0.3	0	0	0
Pelecypoda	5	22	20	33	20	25	3	26	41	0	53
Turbellaria	0	0	0	0	0	0	0	0.3	0	0	0
Gastropoda	0	35	60	35	6.7	47	37	40	24	0	8

Number of Organisms (% Taxa)

TABLE IV

Organism density per Site and Station

Station # 1

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

Organism density per Site and Station

Station #____1____

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	3	2		5	8			8
Naididae	4			4	5			5
(Hirudinea) Hirudinidae (Leeches)								
Amphipoda								
Gammaridae Gammarus								
Turbellaria								
(Tricladida) Planariidae Dugesia								
Decapoda (Crayfish, Shrimp)								
Astacidae Cambarus								
Pelecypoda (Clams)								
Corbiculidae Corbicula (Clams)	1			1	1			1
Gastropoda (Snails)								

Table IV

Organism density per Site and Station

Station # 2

Insecta	Right Bank				Left Bank			
Ephemeroptera	1	2	3	Total	1	2	3	Total
Heptageniidae Stenonema	1	12	11	24	4		1	5
Arthoplea								
Siphlonuridae Isonychia		1	8	9				
Baetidae Beatis	3			3	4	5	2	11
Pseudocloeon								
Ephemeridae Ephemera		8	1	9		1		1
Odonata			1	1				
(Zygoptera) Coenagrionidae Argia								
(Anisoptera) Gomphidae Gomphus								
Trichoptera		1	1	2				
Hydroptilidae spp.	1			1		3	2	5
Hydropsychidae Hydropsyche		3		3	4		1	5
Brachycentridae Brachycentrus						3		3
Helicopsychidae Helicopsyche		6		6				
Megaloptera								
Sialidae Sialis								
Corydalidae Corydalus								
Diptera								
Chironimidae		2		2				
Simulidae								
Plecoptera								
Perlidae Perlinella								
Neuroptera					2			2

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	3	3	7		6	1	7
Psephenidae Psephenus								
Non-Insecta								
Annelida		2		2				
(Oligochaeta) Tubificidae						2		2
Naididae								
(Hirudinea) Hirudinidae								
Amphipoda								
Gammaridae Gammarus	1	1		2				
Turbellaria								
(Tricladida) Planariidae Dugesia								
Decapoda								
Astacidae Cambarus								
Pelecypoda								
Corbiculidae Corbicula	1	3	4	8	2	22	26	50
Gastropoda	1	11	5	17	55	12	7	74

Table IV

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				
Arthoplea								
Siphlonuridae Isonychia	1			1			1	1
Baetidae Beatis	5	4	3	12	2		3	5
Pseudocloeon								
Ephemeridae Ephemera			3	3				
Odonata								
(Zygoptera) Coenagrionidae Argia								
(Anisoptera) Gomphidae Gomphus								
Trichoptera	2		1	3		1	1	2
Hydroptilidae spp.					1	1		2
Hydropsychidae Hydropsyche		2	2	4	1			1
Brachycentridae Brachycentrus	2	4	6	12	2	5	3	10
Helicopsychidae Helicopsyche								
Megaloptera								
Sialidae Sialis								
Corydalidae Corydalus								
Diptera	1			1				
Chironimidae							1	1
Simulidae								
Plecoptera								
Perlidae Perlinella								
Neuroptera								

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					2	3		5
Psephenidae Psephenus			1	1				
Non-Insecta								
Annelida		9	6	15				
(Oligochaeta) Tubificidae					1			1
Naididae								
(Hirudinea) Hirudinidae (Leeches)								
Amphipoda								
Gammaridae Gammarus						1		1
Turbellaria								
(Tricladida) Planariidae Dugesia								
Decapoda								
Astacidae Cambarus								
Pelecypoda								
Corbiculidae Corbicula (Clams)		3	22	25		17	41	58
Gastropoda (Snails)	9	123	110	142	9	32	66	108

Table IV

Organism density per Site and Station

Station # 4

Insecta	Right Bank				Left Bank			
Ephemeroptera	1	2	3	Total	1	2	3	Total
Heptageniidae Stenonema	4	8	1	13		2	2	4
Arthoplea	6			6				
Siphlonuridae Isonychia	6		3	9		2	2	4
Baetidae Beatis		1		1				
Pseudocloeon	3			3				
Ephemeridae Ephemera		1		1		3	3	6
Odonata								
(Zygoptera) Coenagrionidae Argia	1			1				
(Anisoptera) Gomphidae Gomphus								
Trichoptera					1			1
Hydroptilidae spp.								
Hydropsychidae Hydropsyche								
Brachycentridae Brachycentrus		1		1	1	3	5	9
Helicopsychidae Helicopsyche								
Megaloptera								
Sialidae Sialis								
Corydalidae Corydalus								
Diptera								
Chironimidae								
Simulidae	2			2				
Plecoptera								
Perlidae Perlinella								
Neuroptera	2			2		1	1	2

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						2		2
Psephenidae Psephenus							1	1
Non-Insecta								
Annelida								
(Oligochaeta) Tubificidae								
Naididae	1			1				
(Hirudinea) Hirudinidae								
Amphipoda								
Gammaridae Gammarus								
Turbellaria								
(Tricladida) Planariidae Dugesia								
Decapoda								
Astacidae Cambarus					2			2
Pelecypoda								
Corbiculidae Corbicula	20	10	12	42	4	15	10	29
Gastropoda	2	2	15	19	6	28	23	57

Table IV

Organism density per Site and Station

Station # 5

Insecta	Right Bank				Left Bank			
Ephemeroptera	1	2	3	Total	1	2	3	Total
Heptageniidae Stenonema		1	5	6	1		2	3
SPP					2			2
Siphlonuridae Isonychia	1	15	31	47	2	4		6
Baetidae Beatis		5	4	9		3	2	5
Pseudocloeon						6	8	14
Ephemeridae Ephemera		1	2	3			1	1
Odonata								
(Zygoptera) Coenagrionidae Argia								
(Anisoptera) Gomphidae Gomphus								
Trichoptera								
Hydroptilidae spp.								
Hydropsychidae Hydropsyche								
Brachycentridae Brachycentrus					2	1	1	4
Helicopsychidae Helicopsyche								
Megaloptera								
Sialidae Sialis								
Corydalidae Corydalus								
Diptera								
Chironimidae								
Simulidae								
Plecoptera								
Perlidae Perlinella								
Neuroptera								

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		2	3	1	1	5
Psephenidae Psephenus		5		5		1		1
Non-Insecta								
Annelida								
(Oligochaeta) Tubificidae								
Naididae	2	1		3				
(Hirudinea) Hirudinidae	1			1				
Amphipoda								
Gammaridae Gammarus								
Turbellaria								
(Tricladida) Planariidae Dugesia								
Decapoda								
Astacidae Cambarus								
Pelecypoda								
Corbiculidae Corbicula	5	7	5	17	4	7	5	16
Gastropoda	5			5	4	2		6

Table IV

Organism density per Site and Station

Station # 6

Insecta	Right Bank				Left Bank			
Ephemeroptera	1	2	3	Total	1	2	3	Total
Heptageniidae Stenonema	10	22		32	15	16	4	35
Arthoplea		1		1				
Siphlonuridae Isonychia	22	19		41				
Baetidae Beatis		12	3	15		5	21	26
Pseudocloeon								
Ephemeridae Ephemera	1	2		3				
Odonata								
(Zygoptera) Coenagrionidae Argia		2		2				
(Anisoptera) Gomphidae Gomphus								
Trichoptera								
Hydroptilidae spp.		6		6	1	3	2	6
Hydropsychidae Hydropsyche								
Brachycentridae Brachycentrus	1		3	4		2		2
Helicopsychidae Helicopsyche						1		1
Megaloptera								
Sialidae Sialis								
Corydalidae Corydalus								
Diptera			1	1				
Chironimidae								
Simulidae								
Plecoptera								
Perlidae Perlinella								
Neuroptera		2	1	3	2		1	3

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						3	1	4
Psephenidae Psephenus			1	1				
Non-Insecta								
Annelida								
(Oligochaeta) Tubificidae							1	1
Naididae			3	3			2	2
(Hirudinea) Hirudinidae								
Amphipoda								
Gammaridae Gammarus	2			2				
Turbellaria								
(Tricladida) Planariidae Dugesia								
Decapoda								
Astacidae Cambarus						1		1
Pelecypoda								
Corbiculidae Corbicula	16		5	21	30	8	22	60
Gastropoda	17		55	72	7	12	60	79

Table IV

Organism density per Site and Station

Station #____7____

Insecta	Right Bank				Left Bank			
Ephemeroptera	1	2	3	Total	1	2	3	Total
Heptageniidae Stenonema		5	2	7	2		1	3
Arthoplea								
Siphlonuridae Isonychia	6	2		8		2	6	8
Baetidae Beatis					3	9	3	15
Pseudocloeon			1	1	1			1
Ephemeridae Ephemera	4		1	5				
Odonata								
(Zygoptera) Coenagrionidae Argia	1			1				
(Anisoptera) Gomphidae Gomphus								
Trichoptera								
Hydroptilidae spp.	4			4	5	48		53
Hydropsychidae Hydropsyche	16		9	25		4		4
Brachycentridae Brachycentrus	1	2		3	2	1	2	5
Helicopsychidae Helicopsyche							1	1
Megaloptera								
Sialidae Sialis								
Corydalidae Corydalus								
Diptera								
Chironimidae		1		1				
Simulidae								
Plecoptera								
Perlidae Perlinella								
Neuroptera	2			2			1	1

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	20	5	17	42		2		2
Psephenidae Psephenus								
Non-Insecta								
Annelida								
(Oligochaeta) Tubificidae								
Naididae								
(Hirudinea) Hirudinidae								
Amphipoda					1			1
Gammaridae Gammarus			1	1				
Turbellaria								
(Tricladida) Planariidae Dugesia								
Decapoda								
Astacidae Cambarus								
Pelecypoda								
Corbiculidae Corbicula		5	4	9	1			1
Gastropoda		46	19	65	15	17	24	56

Table IV

Organism density per Site and Station

Station # 8

Insecta	Right Bank				Left Bank			
Ephemeroptera	1	2	3	Total	1	2	3	Total
Heptageniidae Stenonema	3	7	3	13				
Arthoplea								
Siphlonuridae Isonychia	1	7		8	1			1
Baetidae Beatis					1		2	3
Pseudocloeon	12		5	17	4		7	11
Ephemeridae Ephemera		1		1				
Odonata								
(Zygoptera) Coenagrionidae Argia		2	1	3			1	1
(Anisoptera) Gomphidae Gomphus		2		2		3		3
Trichoptera					1	2		3
Hydroptilidae spp.			1	1		2		2
Hydropsychidae Hydropsyche	3		3	6	4		4	8
Brachycentridae Brachycentrus			2	2	1	4	3	8
Helicopsychidae Helicopsyche								
Megaloptera								
Sialidae Sialis								
Corydalidae Corydalus								
Diptera								
Chironimidae								
Simulidae								
Plecoptera								
Perlidae Perlinella								
Neuroptera								

Organism density per Site and Station

Station # 8

Insecta, Continued	Right Bank				Left Bank			
	1	2	3	Total	1	2	3	Total
Diptera								
Tipulidae								
Coleoptera								
Elmidae Stenelmis	5		8	13		3	7	10
Psephenidae Psephenus	4	5		9			1	1
Non-Insecta								
Annelida		1	1	2		2	2	4
(Oligochaeta) Tubificidae								
Naididae								
(Hirudinea) Hirudinidae								
Amphipoda								
Gammaridae Gammarus								
Turbellaria								
(Tricladida) Planariidae Dugesia	1			1				
Decapoda								
Astacidae Cambarus	1			1				
Pelecypoda								
Corbiculidae Corbicula		11	63	74		16	13	29
Gastropoda	2	16	5	23	45	49	39	133

Table IV

Organism density per Site and Station

Station # 9

Insecta	Right Bank				Left Bank			
Ephemeroptera	1	2	3	Total	1	2	3	Total
Heptageniidae Stenonema							3	3
Arthoplea								
Siphlonuridae Isonychia		3		3				
Baetidae Beatis	1			1		14	4	18
Pseudocloeon		12	21	33	3		22	25
Ephemeridae Ephemera		1		1			1	1
Odonata								
(Zygoptera) Coenagrionidae Argia								
(Anisoptera) Gomphidae Gomphus	1		1	2				
Trichoptera		1	1	2	2	26		28
Hydroptilidae spp.					1			1
Hydropsychidae Hydropsyche					10	6	9	25
Brachycentridae Brachycentrus		2	1	3		2	10	12
Helicopsychidae Helicopsyche								
Megaloptera								
Sialidae Sialis								
Corydalidae Corydalus								
Diptera								
Chironimidae			4	4	1			1
Simulidae								
Plecoptera								
Perlidae Perlinella								
Neuroptera						1		1

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	18	3	3	24	1	4	13	18
Psephenidae Psephenus					1			1
Non-Insecta								
Annelida	1			1				
(Oligochaeta) Tubificidae								
Naididae								
(Hirudinea) Hirudinidae								
Amphipoda								
Gammaridae Gammarus		2	6	8				
Turbellaria								
(Tricladida) Planariidae Dugesia								
Decapoda								
Astacidae Cambarus								
Pelecypoda								
Corbiculidae Corbicula	133	9		142	1	106	1	108
Gastropoda	20	14	10	44	10	73	22	105

Table IV

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	1	5	1	7		3		3
Arthoplea	2			2				
Siphlonuridae Isonychia								
Baetidae Beatis					2	2		4
Pseudocloeon			3	3		2	2	4
Ephemeridae Ephemera								
Odonata								
(Zygoptera) Coenagrionidae Argia								
(Anisoptera) Gomphidae Gomphus						1		1
Trichoptera					1			1
Hydroptilidae spp.								
Hydropsychidae Hydropsyche								
Brachycentridae Brachycentrus								
Helicopsychidae Helicopsyche								
Megaloptera								
Sialidae Sialis								
Corydalidae Corydalus								
Diptera								
Chironimidae		1		1	1			1
Simulidae						1		1
Plecoptera								
Perlidae		1		1		2	1	3
Neuroptera	1	3		4		1		1

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					1			1
Elmidae Stenelmis	2	3	4	9	17	28	8	63
Psephenidae Psephenus	5	30	7	42	7	17	12	36
Acneus								
Non-Insecta								
Annelida								
(Oligochaeta) Tubificidae					6			6
Naididae								
(Hirudinea) Hirudinidae			2	2				
Amphipoda								
Gammaridae Gammarus								
Turbellaria								
(Tricladida) Planariidae Dugesia								
Decapoda								
Astacidae Cambarus								
Pelecypoda								
Corbiculidae Corbicula								
Gastropoda								

Table IV

Organism density per Site and Station

Station # 11

Insecta	Right Bank				Left Bank			
Ephemeroptera	1	2	3	Total	1	2	3	Total
Heptageniidae Stenonema	3	2		5	9			9
Arthoplea								
Siphlonuridae Isonychia		1	1	2				
Baetidae Beatis		8		8		1	4	5
Pseudocloeon		1		1	4			4
Ephemeridae Ephemera		1		1	4			4
Odonata								
(Zygoptera) Coenagrionidae Argia								
(Anisoptera) Gomphidae Gomphus								
Trichoptera			1	1				
Hydroptilidae spp.		9		9	2		1	3
Hydropsychidae Hydropsyche	9	24		33	2	2	1	5
Brachycentridae Brachycentrus						1		1
Helicopsychidae Helicopsyche								
Megaloptera								
Sialidae Sialis								
Corydalidae Corydalus								
Diptera								
Chironimidae								
Simulidae								
Plecoptera								
Perlidae Perlinella								
Neuroptera		4		4				

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	38	10	44	92		3	12	15
Psephenidae Psephenus	2			2	1			1
Non-Insecta								
Annelida					1	1	2	4
(Oligochaeta) Tubificidae								
Naididae								
(Hirudinea) Hirudinidae								
Amphipoda								
Gammaridae Gammarus								
Turbellaria								
(Tricladida) Planariidae Dugesia								
Decapoda								
Astacidae Cambarus								
Pelecypoda								
Corbiculidae Corbicula	93	103	47	243	12	8	18	38
Gastropoda	12	7	2	21	2	2	16	20

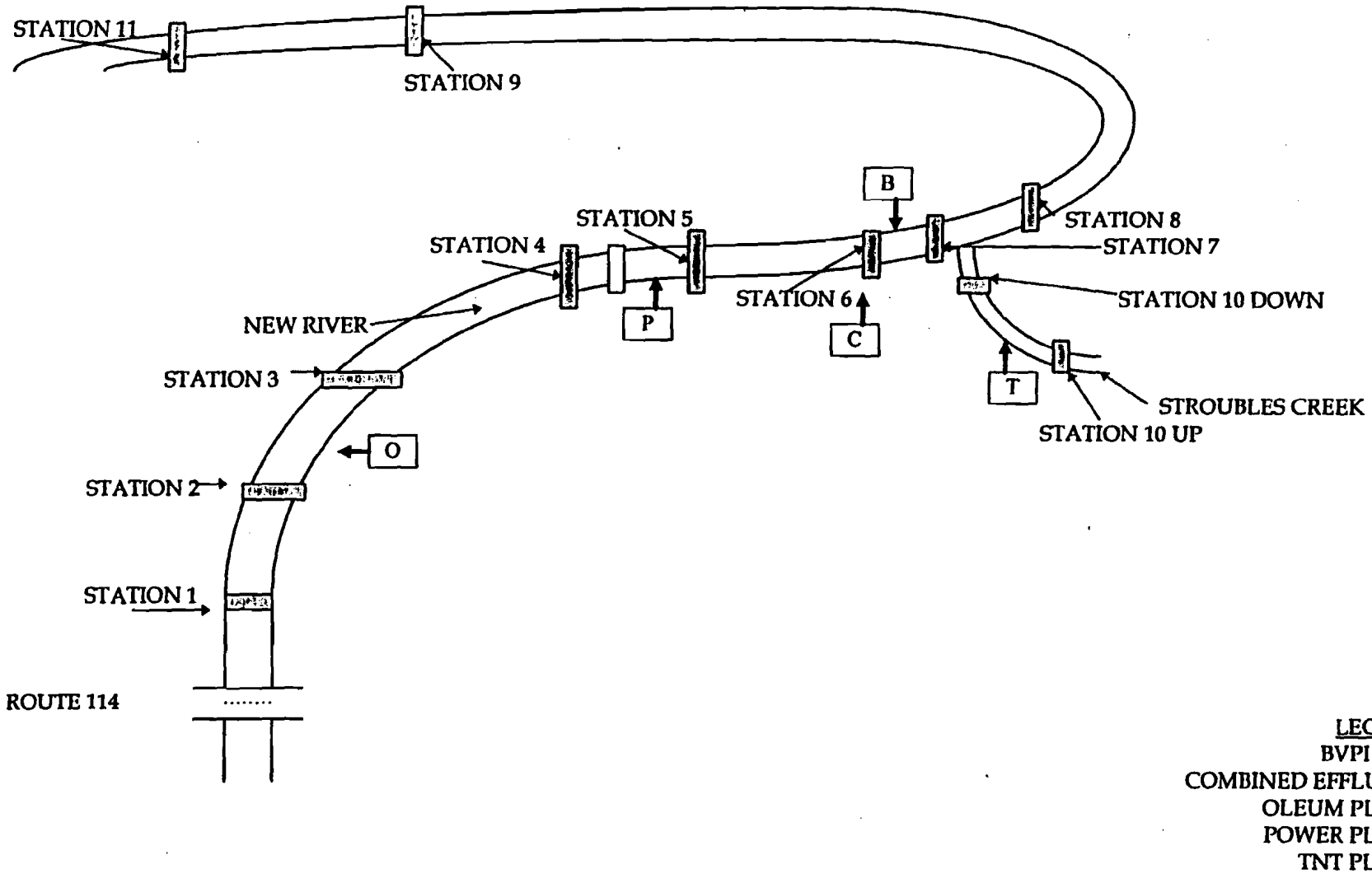

FIGURE 1: Sample stations on the New River and Stroubles Creek near RAAP.

REFERENCES

1993, 1994 and 1995 Surveys done for Alliant Tech (formerly RAAP) by Central Virginia Laboratories and Consultants.

1991 and 1992 Surveys done for Alliant Tech (formerly RAAP) by Freecol Labs.

1988 through 1990 Surveys done for Alliant Tech (formerly RAAP) by Dr. Ernest F. Benfield

Rapid Bioassessment Protocols for use in Streams and Rivers. EPA/444/4-89-001 May 1989.

Introduction to Aquatic Insects of North America, Second Edition, by R.W. Merrit and K.W. Cummins

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

Freshwater Invertebrates of the United States, by Pennak.

Limnology, by Charles R. Goldman and Alexander J. Horne.

Dr. James Carico, Lynchburg College, Lynchburg, Virginia

"Rite in the Rain"®

ALL-WEATHER

LINE RULE

Notebook No. 391

1998 Alliant Tech Benthic

6

Sphaerotilus growth last seen @ Sites #1e, 7 in 1995.

materials list:

waders x 4
pH meter w/ ATC. & temp
DO meter (field)
Cond. meter
yard/meter stick
DI bottle / Kimwipes
pH buffers, cond buffer, DO memb. & ECC
gloves
12 x 16 bottles (NPIC)
all alcohol w/ rose bengal
phone!
Sampler
ponchos?
pens/pencils
fire ext.

Site: #1

Left Bank	Rt Bank
Tues 8/25/98 1630	Wed 8/26/98 0820
pH - 7.89	7.04
temp - 27.0°C	24.0°C
DO - 6.3	4.2
cond - 110	110
depth - 36"+	36"+

Sphaeriidae: absent

observations: L bank is under bridge Scuba divers & fishermen, several vehicles & boats parked there. Very silty w/ slow moving H_2O and trash, leaf litter, driftwood. Water is deep & drops off about 20 feet out. Lots of pigeons here.

Rt. Bank - evidence of campfire. Strong fishy odor. Vegetation on shoreline, several large rocks, trash from fishermen, driftwood. There are some oily spots on water surface, also small amts. of floating foam. Can hear frogs peeping. Got about 10 feet from bank.

Site #2 Mon 8/24/98 1015

pH - 7.45
temp - 25.1
DO - 5.1
Cond - 120
Depth - 38"

Sphaerotilus: absent

Observations - Site is located next to power building. Power lines crossing river upstream from rapid that runs straight across. There is a concrete ruin of a bridge covered w/ vegetation.
Were able to get all the way across. Small fish (Bluegill?) and snails abundant. Many (15) buzzards circling. Also a boat w/ fishermen. moss and algae on rocks in rapids. Some fallen trees & evidence of flooding. Water is fairly clear & rapid here. Some bedrock showing

Site #3 Mon 08-24-98 1208

pH: 8.36
temp: 27.0°C
DO: 6.9
Cond: 146
depth: 0-6' in most of area we sampled

Sphaerotilus: absent

Observations: Site is downstream from rapids, under power lines. Upstrm from steam pipes. Small low island in center; minnows & snails sighted. Also dragonflies & water beetles. River gets deep fast towards center - get ½ way across. Shoreline is mostly smaller rocks, pebbles & grass. Some larger rocks exposed in rapids. Water is deep green in center where it drops off. One duck sighted also. There is a small creek feeding into the river from the rt. bank and small caves on left bank. 4 white herons is between sites 2 & 3. A boat w/ 2 fishermen is in the deeper water. Saw a Kingfisher @

Site 4 Mn 8/24/98 1500

pH - 7.90
temp - 27°C
DO - 6.8
cond - 120
Depth - 38"
Sphaerotilus - absent

Observations - Site is just upstream of a bridge. Same fishermen as site 3. Many clams & snails. Water tower on left bank has buzzards roosting. Much driftwood, some caught on bridge.

Substrate is much silt-ier here w/ small pebbles & gravel. Some bedrock showing & some moss. Got a little more than half way across.

Crayfish spotted. Evidence of many geese here.

Site 5 Mon 8/24/98 153

pH - 8.03
Temp - 28.7
DO - 6.8
Cond - 141
Depth - 7" - 38"
Sphaerotilus absent

Observations: Some trash here, esp old tire. Signs of flooding also (vegetation on lower tree branches.) Site is opposite an outfall. Bedrock showing here w/silt and smaller rocks. Some aquatic vegetation. Many water striders and minnows. Got about 1/2 way across - rather shallow until sudden drop off. There is an odor like that of treated water directly upstream. Cans, rusted metal, pieces of lumber & railroad ties litter the riverbed & banks; lots of raccoon prints in bank. Small amts of a black oily substance were found on sampler & bottles at this site.

Site # 6 Tues 08/25/98 0830

	At outfall:
pH: 7.30	7.50
Temp: 25.0°C	25.0°C
DO: 5.11	5.4
Cond: 130	190
depth: 12"-10"	12"

sphaerotilus: absent

observations: Site is opposite 2 pipe outfalls; the smaller has flow, the larger does not. There is a small island of pebbles & plants w/ a fairly large goose habitation. Also a flock of ducks. Some larger fish spotted here, a blue heron. Got 2/3 across — river is slower moving & very clear. Pebbles near shore and more large rocks & bedrock towards center of river. Many snails and bivalves. There are signs of erosion on the bank and large gravel & rip-rap has been placed at the outfall. Some exposed bedrock on far bank.

V2

#7 Site Tues 8/25/98 1030

	VPI outfall	Site:
pH-	7.06	7.60
temp-	25.0	26.0
DO-	6.4	6.0
cond-	482	160
depth	18"	15"-40"

Sphaerotilus: absent

Observations: Outfall emits a noticeable oder of treated water. Several large bass were spotted, also water striders, small birds. Evidence of geese. Some floating foam coming from outfall water is more turbid & greyish at outfall. Many snails, pebbles on R. bank. Substrate is larger moss-covered rocks & plants. Burning grounds are across the river on left bank. Got 3/4 of the way across. Saw 2 Kingfishers, several crayfish.

3

#8 Site Tue 8-25-98 1145

pH - 8.33
temp - 24.0°C
DO - 8.4
cond - 402
depth — 11" to 20"
sphaerotilus - absent

Observations: Site is directly across from burning grounds and down stream of Stoubles creek, which is very low. Saw 2 very angry Kingfishers, a white crane water appears fairly shallow - water striders are evident. low islands w/ vegetation are in river here. there is a point of land w/ large sycamore trees and a maple. Current is swift here - got 2/3 across. there are biting insects (mosquitos) here. Substrate made up of small pebbles

#9 Site Tues 08/25/98 1450

pH - 8.06
temp - 27.0°C
DO - 6.8 ~~ppm~~ %s
cond - ~~140~~ 130
depth - 0-36"

sphaerotilus - absent

Observations - river here has a bend that causes up to 2' curve on the left bank. There are 2 woodduck nesting boxes. Also several cold springs which are visible due to low water - river is much lower than in past years. "Snake Island" is considered the right bank and there is a park across the river. Raccoons deer tracks on river banks. Also 2 ducks flew off. Some bedrock showing. Various aquatic plants attached to rock. One white crane on R bank.

#10 downstream JWood 8/26/98 1120

pH – 8.26
temp – 22.0°C
DO – 7.37
cond – 370
depth – 10" / 18"

Sphaerotilus absent

Observations – this site is the downstream position on Stoubles Creek. There are steampipes and RR tracks here, also a bridge crossing the creek. Creek is fairly low here, w/ pebbles & some larger rocks embedded, also some concrete. Crayfish & clams spotted. There are some trees and larger boulders on banks of creek but side is otherwise sunny. Bottom is slick w/ algae & silt on top of rocks. Some floating foam.

#10 upstream W8/26/98 1200

pH - 8.48
temp - 23.0°C
DO - 7.18
cond - 390
depth - .8"
sphaerotilus - absent

observations - this site is next to BOALS A underground building. Creek is in woods here w/ large boulders, gravel & pebbles. Moss on rocks, bottom slick w/ algae. Minnows & crayfish. Hemlocks, poplar, hickories grow here. Some evidence of erosion. Some deeper pools downstream of site. this is upstream site on Stoubles creek. Small amts of floating foam.

Site #11 Wed 8/26/98 0930

pH - 7.30
temp 25.0°C
DO - 5.2
cond - 130
depth - 30"
Sphaerotilus - absent

Observations: Tracks of a large bird on shoreline here (Heron?) there is a rocky ledge going across river at this site, driftwood, many animal tracks, water striders abundant. River is more silty here, w/ some smaller pebbles, there are at least 2 boats w/ fishermen. Lots of minnows, aquatic plants growing to water surface. Some ducks, clams, snails here. Got all the way across river. River runs wide here; current is quite strong in the center through shallows. Some old appliances + furniture on left bank, also campsite w/ a shelter.

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